3 Sustainable Management Criteria

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

Sustainable groundwater management is defined by SGMA as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results. Thus, the avoidance of undesirable results, defined later in this chapter, is vital to the success of this GSP. The purpose of this chapter is to define various Sustainable Management Criteria (SMC) by setting a sustainability goal, defining and quantifying undesirable results, and by setting minimum thresholds and measurable objectives. A thorough understanding of the historical and current state of the basin is necessary to properly define SMCs, therefore, development of the criteria is dependent on basin information developed and presented in the hydrogeologic conceptual model, groundwater conditions, and water budget sections of the EKGSA GSP (**Chapter 2**).

3.1 Sustainability Goal

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

SGMA requires GSAs to establish, within their GSP, a sustainability goal applicable for the entire basin that culminates in the absence of undesirable results within 20 years. The three Kaweah Subbasin GSPs developed the following sustainability goal collaboratively amongst the EKGSA, GKGSA, and MKGSA. The goal is also articulated within the Subbasin Coordination Agreement.

The broadly stated sustainability goal for the Kaweah Subbasin is for each GSA to manage groundwater resources to preserve the viability of existing agricultural enterprises of the region, domestic wells, and the smaller communities that provide much of their job base in the Sub-basin, including the school districts serving these communities. The goal will also strive to fulfill the water needs of existing and amended county and city general plans that commit to continued economic and population growth within Tulare County and portions of Kings County. The EKGSA intends to apply the larger Kaweah Subbasin sustainability goal to the additional unique groundwater needs of the EKGSA stakeholders such as unincorporated communities and schools, private domestic wells, and other local enterprises unique to the EKGSA not formally encompassed in the Subbasin wide sustainability goal.

The sustainability goal was derived from the basin setting, the Kaweah Subbasin Hydrologic Model (KSHM), historical and current groundwater conditions, and the water budget, as described in Chapter 2. To accomplish this sustainability goal, the Kaweah Subbasin's aquifer supply will be managed so that the Subbasin has achieved its sustainability goal. This goal will be achieved by the combined implementation of the EKGSA, GKGSA, and MKGSA GSPs. Specifically, all GSPs are designed to identify phased implementation of projects and management actions to reduce long-term groundwater overdraft. Individual GSPs will support the Subbasin-wide sustainability goal by implementing:

- The implementation of the EKGSA, GKGSA and MKGSA GSPs, each designed to identify phased implementation of measures (projects and management actions) targeted to ensure that the Kaweah Subbasin is managed to avoid undesirable results by 2040 or as may be otherwise extended by DWR.
- Collaboration with other agencies and entities to arrest chronic water-level and groundwater storage declines, reduce or minimize land subsidence where significant and unreasonable, decelerate ongoing water quality degradation where feasible, and sustain interconnected surface-waters where beneficial uses may be impacted.
- Application of the Kaweah Subbasin Hydrologic Model (KSHM) – incorporating the initial selection of projects and management actions by the Subbasin GSAs – and its simulation output is summarized in the Subbasin Coordination Agreement to help explain how the sustainability goal is to be achieved within 20 years of GSP implementation.
- Assessments at each interim milestone of those projects and management actions that were implemented and their achievements towards avoiding undesirable results as defined herein.
- Continuance of projects and management action implementation by the three GSAs as appropriate through the Planning and Implementation Horizon to maintain this sustainability goal.

In order to achieve the goals outlined in the EKGSA's GSP, a combination of projects and management actions will be implemented over the course of the next 20 years. There is currently estimated 28,000 AF/year of overdraft associated with the EKGSA. Understanding that projects take time and funding to construct, interim goals for 5, 10, and 15 years were set to create a glide path for reaching the sustainability goal by 2040. This "glide path" will mitigate groundwater level depletion by 5, 25, and 55 percent respectively. As much of the overdraft as possible will be mitigated by projects to improve water supply, overdraft not eliminated through these projects will be addressed via management actions. All planned projects and management actions are discussed in more detail in the Projects and Management Actions Chapter (**Chapter 5**), including a general timeline for project implementation.

The key to demonstrating that the Kaweah Subbasin is meeting its sustainability goal is by avoiding undesirable results. Further discussed in the next section, significant and unreasonable groundwater level depletion is the obvious cause of chronic lowering of groundwater levels. Within the EKGSA, significant correlation has also been developed between the lowering of groundwater levels and the undesirable results of significant and unreasonable surface water depletion and reduction of aquifer storage. Given the strong correlation between groundwater levels and the required sustainability indicators, eliminating long-term overdraft is the main method for achieving the Kaweah Subbasin's sustainability goal. Minimum thresholds, quantifiable values that represents the groundwater conditions at a representative monitoring site, were determined based on measured data from within the Agency's boundaries and will be discussed later in this chapter.

3.2 Sustainability Indicators

3.2.1 Sustainability Indicators Present in the Basin

Sustainability indicators are the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, become undesirable results. Within the Kaweah Subbasin, five sustainability indicators are present in the basin:

1. *Chronic lowering of groundwater levels resulting in a significant and unreasonable depletion of supply.*
2. *Significant and unreasonable reduction of groundwater storage.*
3. *Significant and unreasonable degraded water quality.*
4. *Significant and unreasonable land subsidence.*

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

For each of the five sustainability indicators applicable to the EKGSA, representative undesirable results, minimum thresholds, and measurable objectives are presented in later sections of this chapter.

3.2.2 Sustainability Indicators Not Present in the Basin

Legal Requirements:
§354.26 (d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Seawater intrusion can play an important role in groundwater quality for areas near the coast. However, the Kaweah Subbasin is located over 100 miles from the California Central Coast and no historical data to date has demonstrated any seawater intrusion impacts. Therefore, seawater intrusion will not be monitored or discussed throughout the rest of this GSP an indicator of sustainable management for the Kaweah Subbasin.

3.3 Management Areas

Legal Requirements:
§354.20. Management Areas
(a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin. (b) A basin that includes one or more management areas shall describe the following in the Plan: (1) The reason for the creation of each management area. (2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large. (3) The level of monitoring and analysis appropriate for each management area. (4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable. 19 (c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas. Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10733.2 and 10733.4, Water Code.

3.3.1 Rationale

To facilitate implementation of this GSP, it was necessary to look at both the political boundaries already in place and the natural hydrogeologic patterns present in the Subbasin and the EKGSA in particular. Historical boundaries of the member irrigation districts were used to separate the EKGSA into management areas. The district boundaries formed a helpful foundation for GSP implementation due to their status as longstanding public agencies in the community, their near-daily interaction with a majority of the heavily impacted EKGSA denizens, involvement with the GSP development process, ability to leverage surface water imports, and their critical role in future partnerships within the EKGSA on projects and management actions to achieve sustainability by 2040. The larger "urban" areas (City of Lindsay and Strathmore PUD) were grouped into nearby irrigation districts (Lindmore and Lindsay-Strathmore, respectively). The large non-districted areas in the primary intercardinal directions of the EKGSA made logical targets to also form their own management areas. These "non-districted area" management areas are within no other jurisdictional boundary other than Tulare County. These non-district areas will likely have oversight by both Tulare County and the EKGSA. This effectively divided the EKGSA into nine management areas. It is believed that forming these management areas based on existing jurisdictional boundaries will allow for effective implementation of EKGSA projects and management actions by leaning upon the existing governance structure of the irrigation districts. In addition, delineation based upon irrigation district service areas simplifies the water budget accounting for each management area as imported surface water supplies are allocated to the irrigation district responsible for its importation. For more information on imported surface water and its impacts on the water balance of the EKGSA, see **Chapter 2**. The management area boundaries are not intended to be restrictive of landowner's ability to transfer groundwater, should an allocation and transfer market be established, as groundwater is an overlying landowner right and not the management area.

The EKGSA recognizes that groundwater behavior is unlikely to mirror the pre-conceived political boundaries of irrigation districts. Therefore, to adequately account for differences in hydrogeologic behavior and pumping rates while forming minimum thresholds and measurable objectives, the EKGSA was further subdivided into threshold regions using the 2040 groundwater level projections based on a trend analysis of the current trajectory of groundwater levels. The methodology for this analysis is described further in **Appendix 3-A**. By incorporating the geographic location of threshold regions across the jurisdictional boundaries of the management areas allow for a comprehensive geologic and political lens to view minimum threshold and measurable objective tracking. In total, each overlying management area contains two to four threshold regions, **Figure 3-1** and **Figure 3-2** demonstrate which threshold regions fall within each management area.

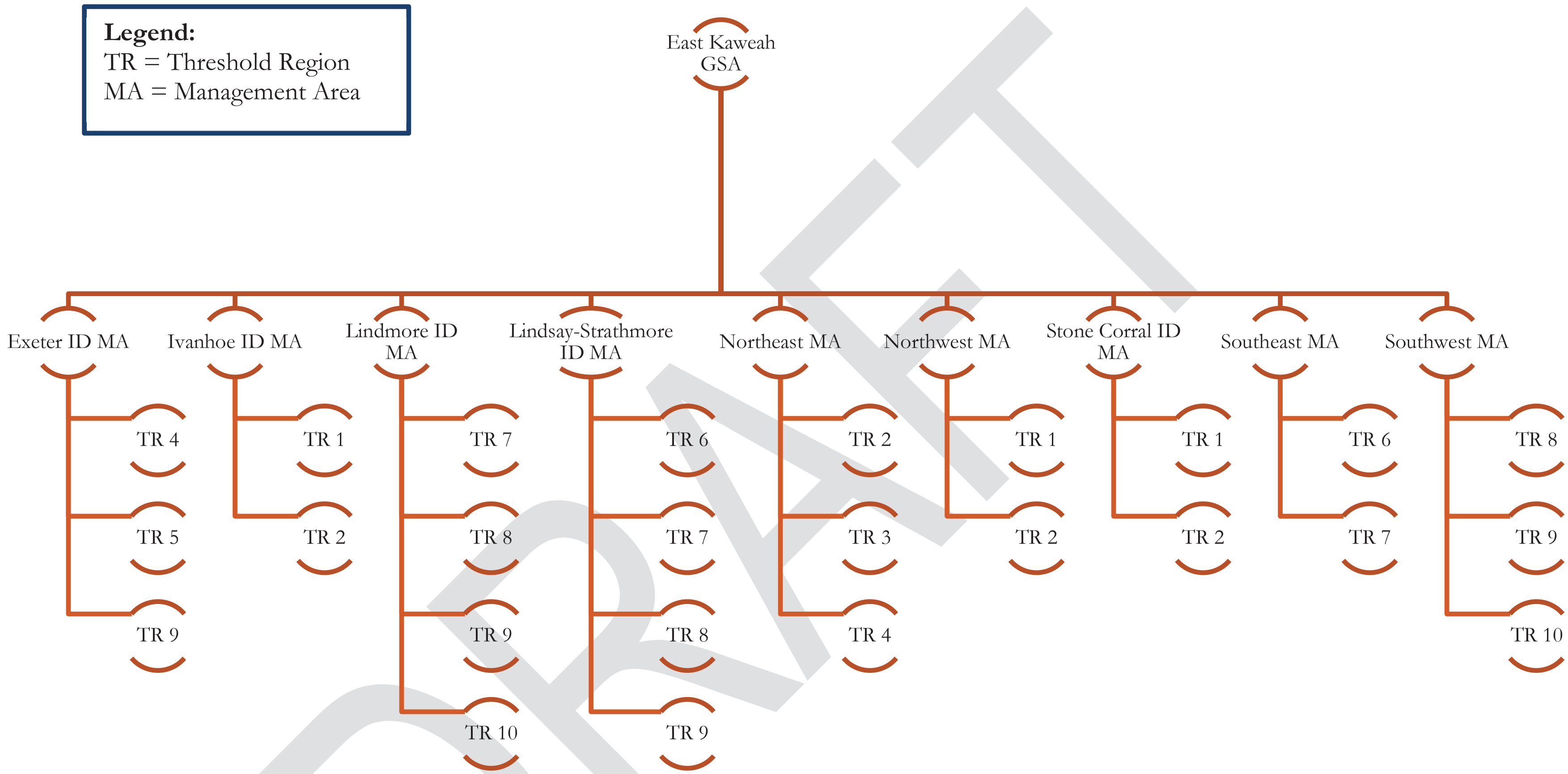

Figure 3-1 Organization Chart of EKGSA Management Areas and Overlapping Threshold Regions

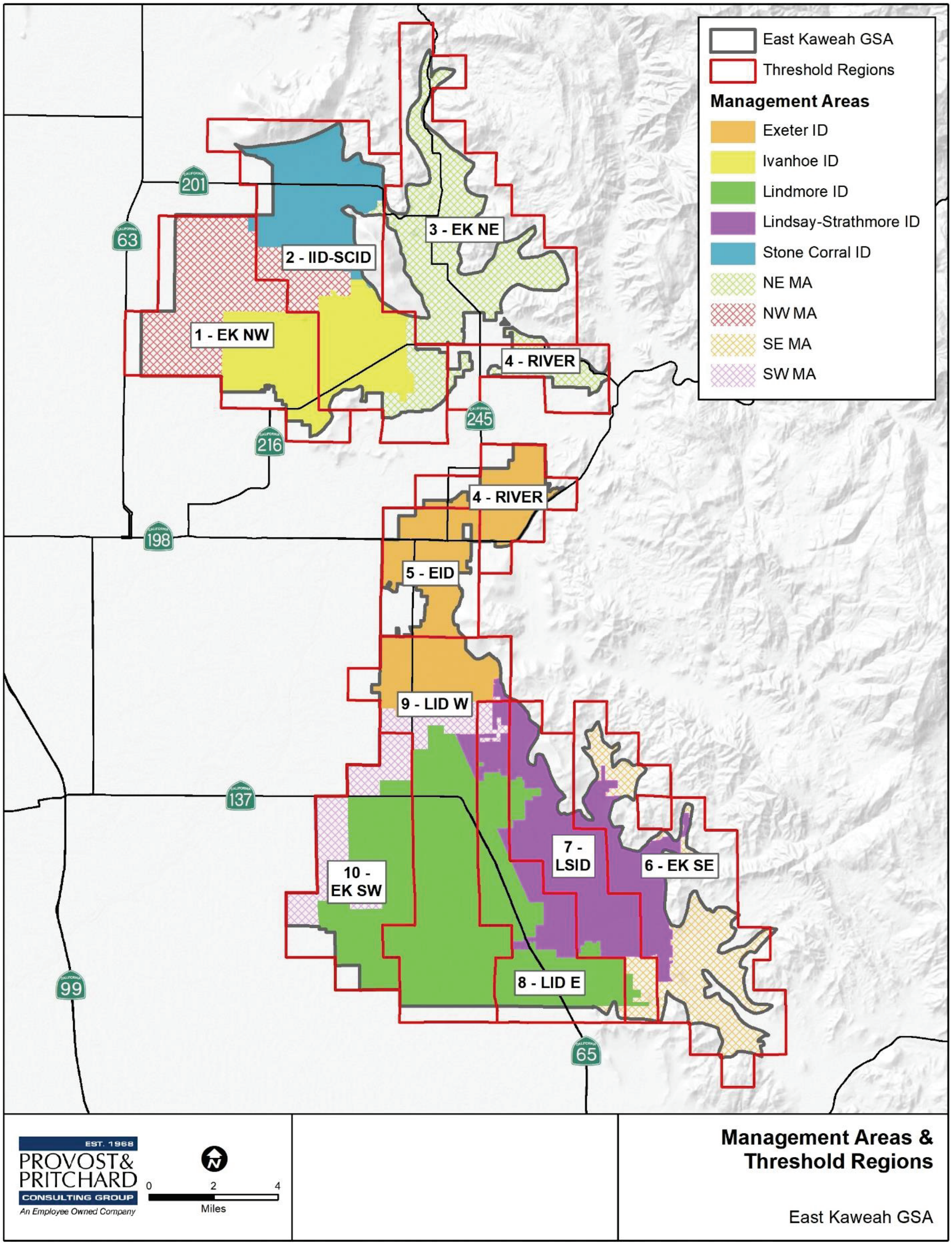

Figure 3-2. Map of EKGSA Management Areas and Overlapping Threshold Regions

3.3.2 Management Area Descriptions

3.3.2.1 Exeter ID Management Area

The Exeter ID Management Area primarily covers the existing area of the Exeter ID. The EKGSA will work closely with Exeter ID to implement projects and management actions within the District's jurisdiction. Formed in 1937, the district was formed to act as a civil and agricultural leader in the community that has the authorized and legal organization in place to consider the water needs of the Exeter area. Exeter ID also has the ability to negotiate and enter into contracts with the federal government for surface water supplies from the Central Valley Project (CVP). The District provides surface water to agricultural operations only. The District does not currently, nor has it historically, supplied water for municipal or industrial purposes. In addition to the agricultural land holdings, the communities of Lindcove, Yokohl, Rocky Hill, and Tooleville are located within the management area's boundary. These communities do not receive surface water deliveries from Exeter ID, but instead benefit from the in-lieu recharge provided by Exeter ID to agricultural acreage in close proximity to their communities.

Exeter ID Management Area is located within the Yokohl Creek portion of the Kaweah River Alluvial Fan and contains a mixture of older and younger alluvium soils (**Figure 3-3** and **Figure 3-4**). Surface water bodies of significance within the management area include two miles of the ephemeral Yokohl Creek in the northern portion and approximately eight miles of the Friant-Kern Canal (FKC). At this time, no significant groundwater dependent ecosystems have been identified along the ephemeral Yokohl Creek (**Figure 3-5**) in this management area. The Exeter ID Management Area's overlying land area encompasses hydrogeologic threshold regions four, five, and nine. As described in **Appendix 3-A**, threshold region four primarily consists of wells that, when projecting the 2040 water surface elevation (WSE) based on the current pumping regime, fall within the 301-400 feet WSE range. Per the same analysis, threshold region five primarily consists of wells that fall within the 201-300 feet WSE range. Wells located within threshold region nine would fall within the 101-200 feet WSE.

3.3.2.2 Ivanhoe ID Management Area

The Ivanhoe ID Management Area primarily corresponds with the existing service area of the Ivanhoe ID. The EKGSA will work closely with Ivanhoe ID to implement projects and management actions within the District's jurisdiction. Ivanhoe ID holds surface water rights to the Kaweah River and contracts with the federal government for CVP surface water supplies from the FKC.

The Ivanhoe ID Management Area is generally located between the St. Johns River to the south and Cottonwood Creek to the north. Approximately 90% of the District is situated on an old alluvial plain characterized by gently rolling terrain and strongly developed soils (**Figure 3-3** and **Figure 3-4**). The remainder of the District consists of small areas of foothill lands, recent stream deposits adjoining Cottonwood Creek, and adobe clay soils on the smooth valley plain near the foothills. At this time, no significant groundwater dependent ecosystems have been identified within the Ivanhoe ID Management Area (**Figure 3-5**). The Ivanhoe ID Management Area's overlying land area encompasses the hydrogeologic threshold regions one and two. Based on the trend analysis (**Appendix 3-A**), threshold region one projects to the 101-200 feet WSE range and threshold region 2 to the 201-300 feet WSE range.

3.3.2.3 Lindmore ID Management Area

The Lindmore ID Management Area primarily corresponds with the existing service area of the Lindmore ID, but also includes the City of Lindsay. The EKGSA will work closely with Lindmore ID and the City of Lindsay to implement projects and management actions within the management area. Lindmore ID organized for the purpose of securing a supplemental water supply from the Friant Division CVP in response to rapid expansion in the amount of irrigated agriculture. The City of Lindsay is also a Contractor for CVP supplies to meet its municipal demand. The City of Lindsay was included with Lindmore ID due to their proximity and location of some City wells being within the Lindmore ID boundary. The community of Plainview is also within this management area as it is located within the Lindmore ID boundary. Plainview does not receive surface water but will benefit from surface water deliveries within Lindmore ID maintaining groundwater levels.

The Lindmore ID Management Area lies at the base of the western foothills of the Sierra Nevada and extends from two miles north of Lindsay, southward to roughly 1 ½ miles south of Strathmore, a total distance of about nine miles. Running from east to west, the district is approximately 10 miles wide. Composed primarily of low alluvial plains and fans, this management area contains a mixture of both older and young alluvium soils (**Figure 3-3** and **Figure 3-4**). At this time, no significant groundwater dependent ecosystems have been identified within the Lindmore ID Management Area (**Figure 3-5**). Lindmore ID Management Area spans threshold regions seven, eight, nine, and ten. Per the trend analysis (**Appendix 3-A**), threshold region 7 primarily consists of wells that project to the 301-400 feet WSE range. Wells located within threshold region eight, nine, and ten projects to the 201-300 feet, 101-200 feet, and 1-100 feet WSE ranges, respectively.

3.3.2.4 Lindsay-Strathmore ID Management Area

The Lindsay-Strathmore ID Management Area covers the existing service area of the Lindsay-Strathmore ID and includes the communities of Strathmore and Tonyville. The EKGSA will work closely with Lindsay-Strathmore ID to implement projects and management actions within the management area. The District receives surface water supplies via the CVP and Kaweah River water through stock in the Wutchumna Water Company. The community of Strathmore, through Strathmore Public Utility District (PUD), also receives water through the CVP for its municipal demand. Strathmore and Tonyville were included with Lindsay-Strathmore ID due to connections each have with Lindsay-Strathmore ID where it be sharing a turnout on the FKC or Lindsay-Strathmore ID supplying water to the community.

The Lindsay-Strathmore ID Management Area overlays a combination of dissected upland, low alluvial plains, and Sierra Nevada geomorphology, and, depending on the location in the management area, geologic units vary between continental deposits, older alluvium, younger alluvium, and metamorphic rocks (**Figure 3-3** and **Figure 3-4**). Natural vegetation and wetlands along Lewis Creek in threshold regions six and seven have the potential to be identified as groundwater dependent ecosystems (**Figure 3-5**). However, the elevated groundwater surface is likely due to a perched surface that is more dependent on the surface and subsurface flows from the Sierra Nevada and independent of the pumping activities in the remainder of the aquifer.

Threshold regions six, seven, eight, and nine fall within the boundaries of the Lindsay-Strathmore ID management area. Based upon 2040 hydrograph projections, WSE in threshold region 6 project to the 401-500 feet range. Threshold region seven projects to the 301-400 feet WSE range and threshold region 8 projects to the 201-300 feet WSE range.

3.3.2.5 Northeast Management Area

The Northeast Management Area is composed primarily of non-districted areas located in the northeastern portion of the EKGSA. For the most part, this area does not receive surface water supply and relies primarily on groundwater pumping for any water needs. The Wutchumna Water Company and Sentinel Butte Mutual Water Company have service areas within this management area and deliver Kaweah River surface supplies to company stockholders. No irrigation district has oversight of the Northeast Management Area; therefore, the EKGSA in conjunction with Tulare County will likely provide oversight of this management area.

The Northeast Management Area is predominately located in the Cottonwood Creek Interfan area of the EKGSA but has highly diverse geologic units consisting of continental deposits, older and younger alluvium, diorite and granodiorite, gabbro, and metamorphic rocks (**Figure 3-3** and **Figure 3-4**). Potential groundwater dependent ecosystems exist along the Kaweah River in this management area (**Figure 3-5**).

The Northeast Management Area is primarily comprised of threshold region three but has some areas extending into region two. Threshold region three projects to the 301-400 feet WSE range, while threshold region two projects to the 201-300 feet WSE range.

3.3.2.6 Northwest Management Area

Similar to the Northeast Management Area, the Northwest Management Area is composed primarily of non-districted areas. Located in the Cottonwood Creek Interfan Area, the Northwest Management Area is composed primarily of older alluvium deposits, with some young alluvium deposits in the northern region of the management area (**Figure 3-3** and **Figure 3-4**). No natural vegetation and wetlands have been identified as groundwater dependent ecosystems within the management area (**Figure 3-5**). The Management Area encompasses threshold regions one and two. Per the trend analysis, threshold region one projects to the 101-200 feet WSE range and threshold region two projects to the 201-300 feet WSE range.

3.3.2.7 Stone Corral ID Management Area

The Stone Corral ID Management Area makes up the vast majority of the Stone Corral ID. The EKGSA will work closely with Stone Corral ID to implement projects and management actions within the management area. The District organized for the purpose of contracting for CVP surface supplies and for the construction of a distribution systems by the federal government. Stone Corral ID services agricultural demand and does not provide any municipal water deliveries.

The Stone Corral ID Management Area is situated on the ridge between the Kaweah and Kings River alluvial fans with dissected uplands dominating the geomorphology in the northeastern section of the management area. The area's geologic units range from continental deposits, to older and younger alluvium (**Figure 3-3** and **Figure 3-4**). At this time, no groundwater dependent ecosystems have been identified within the Stone Corral ID Management Area (**Figure 3-5**). The Stone Corral ID Management Area is almost entirely within threshold regions two, with a very small portion extending into threshold region one. Per the trend analysis, threshold region two projects to the 201-300 feet WSE range.

3.3.2.8 Southeast Management Area

The Southeast Management area is composed primarily of non-districted areas in the southeastern portion of the EKGSA. Consisting of the southeast border areas of the EKGSA, the management area encompasses portions of the Sierra Nevada, dissected uplands, and low alluvial plains. The geologic units in the management area consists of continental deposits, older and younger alluvium, diorite and granodiorite, gabbro, and metamorphic rocks (**Figure 3-3** and **Figure 3-4**). The Southeast Management Area contains significant potential for groundwater dependent ecosystems along Lewis and Frazier Creeks (**Figure 3-5**). However, these primarily occur higher in the foothills prior to influence of pumping. The Southeast Management Area contains threshold regions six and seven. Based upon the trend analysis projections, WSE in threshold region six projects to 401-500 feet range. Threshold region seven projects to the 301-400 feet WSE range.

3.3.2.9 Southwest Management Area

The Southwest Management Area includes non-districted areas west of Lindmore ID and includes the Lewis Creek Water District located between Lindmore and Exeter IDs. Lying on the Lewis Creek Interfan Area, the management area is mostly composed of older and younger alluvium deposits (**Figure 3-3** and **Figure 3-4**). No groundwater dependent ecosystems have been identified in this management area (**Figure 3-5**). The Southwest Management Area encompasses threshold regions eight, nine, and ten, which project to 201-300 feet, 101-200 feet, and 1-100 feet WSE ranges, respectively, per the trend analysis described in **Appendix 3-A**.

3.3.3 Monitoring and Analysis

The level of monitoring and analysis appropriate for each management area. (4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable. 19 (c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas. Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10733.2 and 10733.4, Water Code.

As discussed previously, management areas were designed based upon historical political boundaries. To fairly assess the level of monitoring and analysis required for each management area, the EKGSA was further broken into threshold regions. As described in **Appendix 3-A**, the threshold regions were determined using a trend analysis on several individual well hydrographs. The threshold region delineation process focused on combining areas mimicking similar hydrogeologic behavior (corroborated by historical data) in response to the climate and pumping regime experienced during the base period (1997 - 2017). Specifically, minimum thresholds and measurable objectives were set in a holistic manner that evaluated the potential impacts of each region's minimum thresholds on the whole basin. By determining minimum thresholds based from projecting hydrogeologic data over the base period, the EKGSA intended to capture the intricate relationships between threshold regions while setting minimum thresholds and measurable objectives.

Each threshold region will conduct a baseline amount of monitoring and analysis as set forth in the Monitoring Network Chapter (**Chapter 4**). If, based upon collected data, there is determined to be a need for different and/or additional monitoring and analysis for a sustainability indicator in a specific threshold region, that will be communicated in the required annual or five-year updates to this GSP.

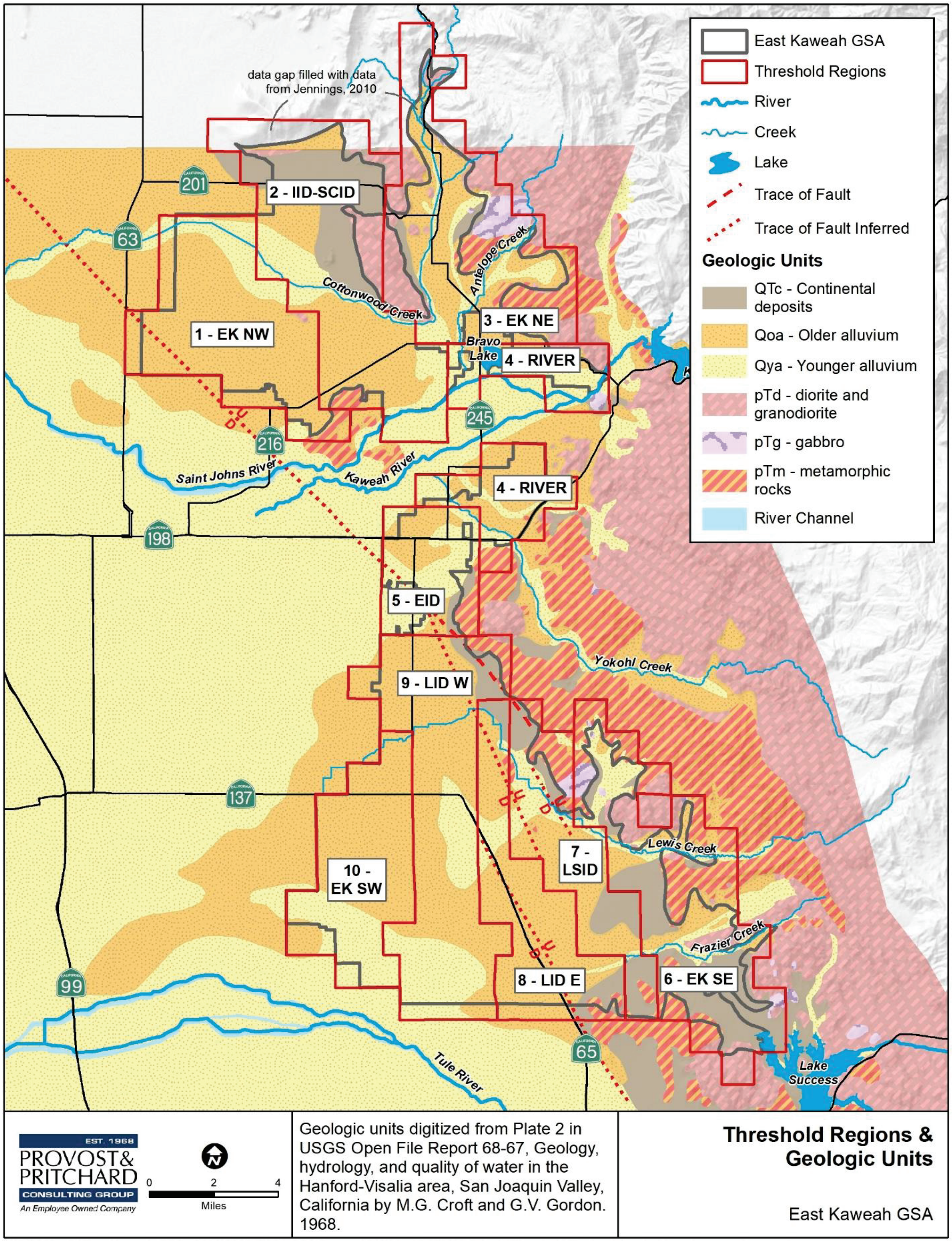

Figure 3-3. EKGSA Threshold Regions and Geologic Units

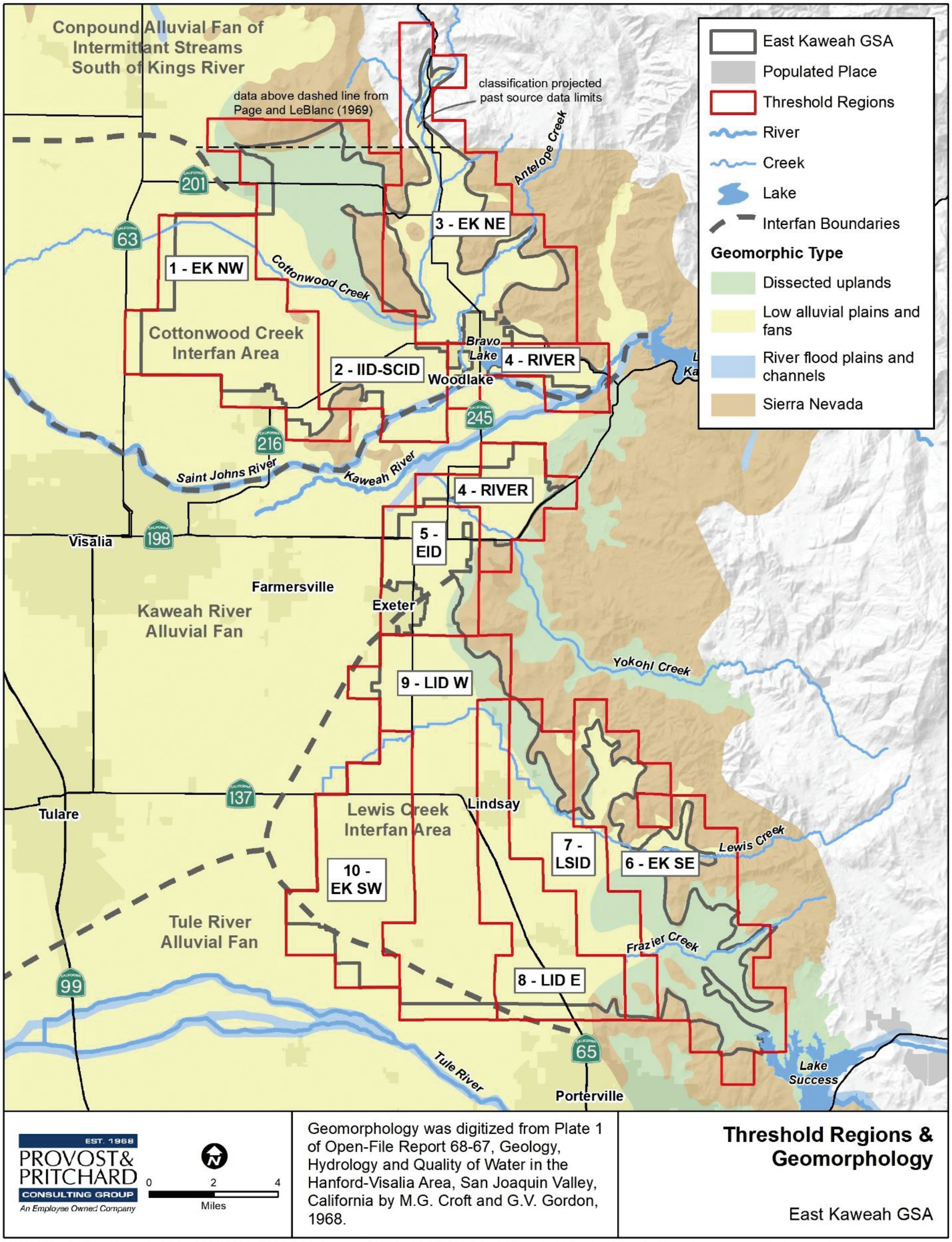

Figure 3-4. EKGSA Threshold Regions and Geomorphology

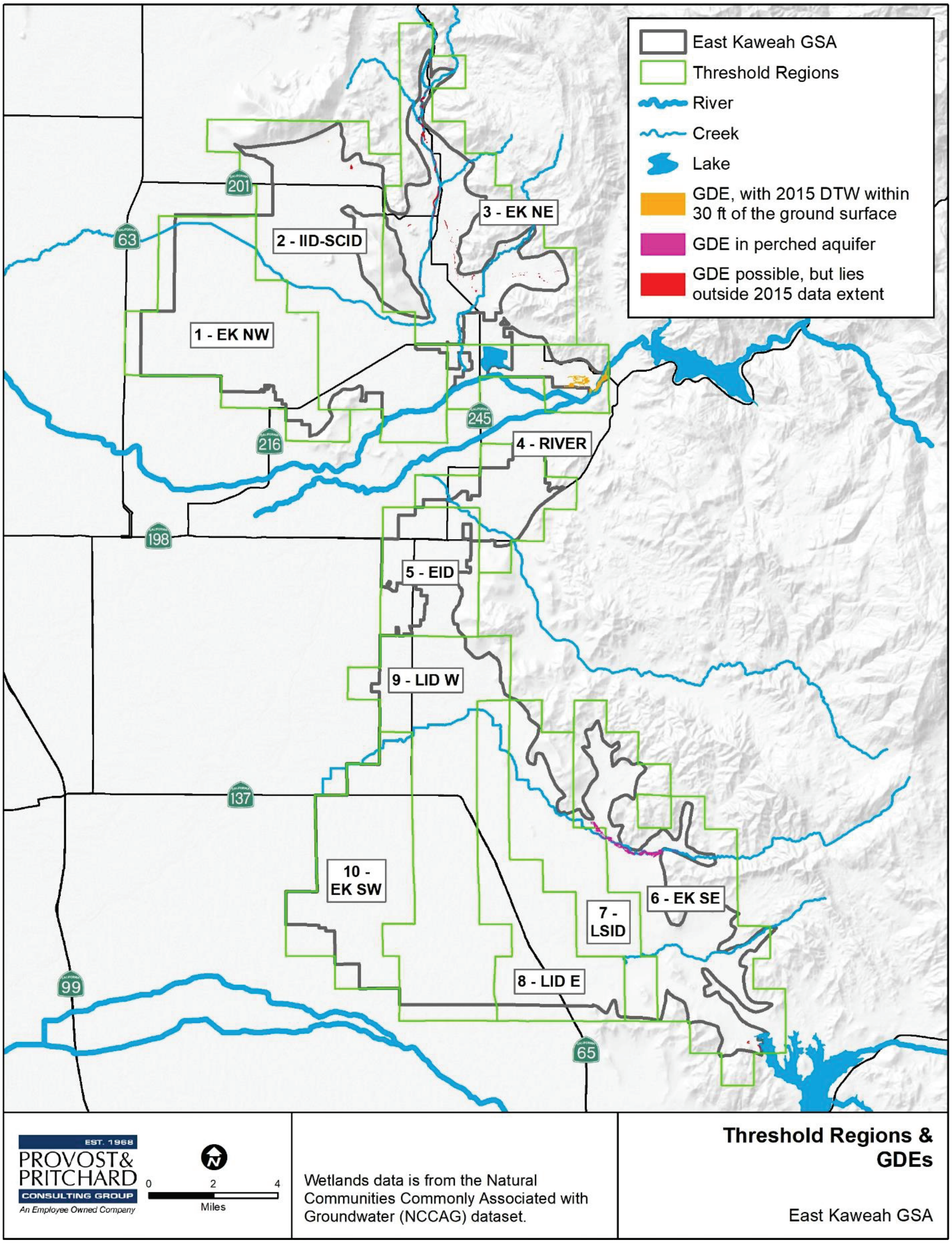

Figure 3-5. EKGSA Threshold Regions and Potential Groundwater Dependent Ecosystems

3.4 Undesirable Results, Minimum Thresholds, and Measurable Objectives by Sustainability Indicator

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

The goal of SGMA is to achieve sustainable management of groundwater basins. To meet this goal, the EKGSA has set undesirable results, minimum thresholds, and measurable objectives to provide quantitative support of the EKGSA's ability to reach sustainability by 2040. Demonstration of the absence of undesirable results supports a determination that a Subbasin is operating within its sustainable yield and, thus, that the sustainability goal has been achieved. However, the occurrence of one of more undesirable results within the initial 20-year implementation period does not by itself, indicate that the Subbasin is not being managed sustainably.

The EKGSA carefully considered and determined the conditions at which each of the five applicable sustainability indicators become significant and unreasonable. Undesirable results are considered to occur when any of the five sustainability indicators present in the Subbasin have exceeded minimum thresholds by a significant and unreasonable manner. All undesirable result descriptions presented in this chapter are consistent with those presented within the Kaweah Subbasin Coordination Agreement. Further sections of this chapter enumerate the data and rationale used as justification for determining "significant and unreasonable" undesirable result conditions for each particular sustainability indicator and provide the following rationales as required by §354.26:

- Investigation of the cause of groundwater conditions that will lead, or has led, to undesirable results;
- Criteria used to define when and where the effects of groundwater conditions cause undesirable results;
- Quantification of undesirable results via localized minimum threshold exceedances; and,
- Description of the potential effects of the undesirable result on beneficial uses or users.

In general, undesirable results for each sustainability indicator were determined using a lengthy, data informed, and stakeholder-inclusive progress. Specifically, the EKGSA Technical Advisory Committee (TAC) and Board of Directors (Board) carefully considered when the five sustainability indicators applicable to the EKGSA would reach levels that were "significant and unreasonable" based upon the quantitative data presented in the Basin Setting and Water Budget (**Chapter 2**). The Board, in combination with stakeholder input and TAC expert advice, ultimately determined undesirable results based upon the relative levels that would have a significant and unreasonable negative impact not only impact communities with the Kaweah Subbasin, historical and biological quality of life, but would also severely threaten regional agricultural economy and impact the world's food chain supply.

In addition to the quantitative description for each undesirable result, each undesirable result must also be substantiated using a quantitative minimum threshold. A minimum threshold is a quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin. When setting the minimum threshold for each sustainability indicator, the relevant beneficial uses and users of groundwater were considered. In addition, EKGSA minimum thresholds were set at levels that do not impede adjacent GSAs or subbasins from meeting their minimum thresholds or sustainability goals.

Based upon the hydrogeologic and institutional boundaries present, the EKGSA developed minimum thresholds for each of the sustainability indicators for each of the threshold regions as described in the previous sections. These geomorphic conditions, in addition to the jurisdictional boundaries of member agencies, made the creation of management zones with unique minimum thresholds. In total, the EKGSA consists of nine management areas and further sub-divided into ten threshold regions that exhibit unique hydrogeologic behavior (**Figure 3-2**).

For each minimum threshold, the following components will be presented in each indicators' relevant section:

1. *The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the Basin Setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the Basin Setting.*
2. *The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the EKGSA has determined that conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.*
3. *How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.*
4. *How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.*
5. *How state, federal, or local standards relate to the relevant sustainability indicator. If a minimum threshold differs from other regulatory standards, the EKGSA will explain the nature and basis for the difference.*
6. *How each minimum threshold will be quantitatively measured, consistent with monitoring network requirements.*
7. *In all management zones within the EKGSA, there is a significant correlation between groundwater levels and aquifer storage and interconnected surface water depletions. The EKGSA proposes to utilize groundwater levels as a proxy metric for these sustainability indicators). For land subsidence, the EKGSA will use a rate of land subsidence related to critical infrastructure (Friant-Kern Canal). The EKGSA will use constituents of concern concentration measurements as the quantitative metric to determine minimum threshold exceedances for water quality.*
8. *Each of the sustainability indicators must be monitored to watch for minimum threshold exceedances. However, based on the strong relationship between groundwater levels and changes in aquifer storage, land subsidence, and depletions of interconnected surface water, whichever indicator is the most sensitive to groundwater level reduction will be the limiting minimum threshold in that threshold region. Typically, given the specific hydrogeology of the EKGSA, groundwater levels have been determined to be the most sensitive to possible minimum threshold exceedances and therefore, causing undesirable results. In general, groundwater level minimum thresholds are the most sensitive to exceedances and would be triggered prior to undesirable results being experienced due to surface water depletions, aquifer storage reductions, or increasing levels of land subsidence. In addition to monitoring groundwater levels, water quality and land subsidence minimum thresholds will be monitored separately.*

Measurable objectives are quantitative goals that reflect the desired groundwater conditions and allow the EKGSA to achieve the sustainability goal within 20 years. Measurable objectives were set so that there is a reasonable margin of operational flexibility between the minimum threshold and measurable objective that provides accommodation for droughts, climate change, conjunctive use operations, and other groundwater management activities. Interim milestones for the EKGSA implementation timeline were designed to allow the EKGSA to make progress over time toward the sustainability goal and are presented for each sustainability indicator. A summary of the undesirable results, minimum thresholds, measurable objective, and interim milestone for each sustainability indicator is presented in **Table 3-1**.

Table 3-1. Sustainable management criteria overview for the EKGSA

Sustainability Indicator	GW Elevation	GW Storage	SW-GW Connection	GW Quality	Land Subsidence
Undesirable Result	Unreasonable lowering of groundwater levels resulting in significant impacts to supply	Unreasonable reduction in groundwater storage	Unreasonable depletion of interconnected surface water and groundwater, where present	Unreasonable long-term changes of water quality concentrations from baseline conditions to significantly impact users of groundwater	Unreasonable impacts to critical infrastructure (i.e. Friant-Kern Canal)
Measurement Methodology	Groundwater Levels	Groundwater Levels (Proxy)	Groundwater Levels (Proxy)	Sampling for 3 COCs at Ag wells in Monitoring Network; Utilize public system Title 22 quality monitoring	Annual survey of set Mile Posts along the FKC and InSAR data when available and Plainview well point
Minimum Threshold	2040 Projected GW elevation based on the baseline (1997-2017) trend analysis of GW levels at wells throughout the GSA (10 Threshold Regions)	2040 Projected GW elevation based on the baseline (1997-2017) trend analysis of GW levels at wells throughout the GSA (10 Threshold Regions)	2040 Projected GW elevation based on the baseline (1997-2017) trend analysis of GW levels at wells throughout the GSA (10 Threshold Regions)	No long-term (10-yr. running average) increase in concentration beyond recognized Ag or Urban standards for those wells under the threshold. For those wells over the recognized Ag or Urban standards, no long-term increases by 20% in concentration	9.5" of subsidence in a year and cumulative (relate to no more than 10% capacity reduction in current capacity of the FKC)
Measurable Objective	Spring 2017	Spring 2017	Spring 2017	No unreasonable increase in concentration caused by groundwater pumping and recharge efforts.	No subsidence/impacts to CVP deliveries along the FKC related to groundwater pumping within the EKGSA
Interim Milestones	Proportionate to % of overdraft to be corrected in 5-year intervals through implementation period	Proportionate to % of overdraft to be corrected in 5-year intervals through implementation period	Proportionate to % of overdraft to be corrected in 5-year intervals through implementation period	No change from current Objective (re-evaluate at the 5-year milestone pending data collection)	No change from current Objective

3.4.1 Chronic Lowering of Groundwater Levels, Reduction of Groundwater Storage, and Depletions of Interconnected Surface Water Bodies

3.4.1.1 Undesirable Results

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

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

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

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

Groundwater elevations shall serve as the sustainability indicator and metric for chronic lowering of groundwater levels, and by proxy, reductions in groundwater storage and of depletions of interconnected surface water bodies.

Based upon studies conducted by the USGS, water level data can be used to monitor short and long-term changes in groundwater storage. The USGS has also used groundwater level measurements as an appropriate proxy measurement for interconnected surface water depletions and aquifer storage losses due to groundwater pumping in places where there is connection (USGS 2017). A study, sponsored by USGS, depicts a variety of mathematical models that can be used to correlate groundwater depletion with interconnected surface water depletions. For example: an analytical model called the "Grover Solution" can be used to understand the effects of groundwater level on changes to streamflow (Barlow and Leake 2012).

$$Q_s = Q_w erfc(z)$$
$$Q_s = expression\ for\ the\ total\ rate\ of\ streamflow\ depletion\ as\ a\ function\ of\ time$$
$$Q_w = product\ of\ the\ pumping\ rate\ of\ a\ well\ (either\ directly\ measured\ or\ calculated$$
$$based\ on\ groundwater\ level\ change.$$
$$erfc(z) = complementary\ error\ function$$

Variable z in this equation is equal to $\sqrt{(d^2S)/(4Tt)}$ in which d is the shortest distance of the well to the stream, S is the storage coefficient of the aquifer (or specific yield, for water-table aquifers), T is the transmissivity of the aquifer, and t is the time. There is a lack of abundant streamflow data for all of the surface water bodies that run through the EKGSA. In the future, the EKGSA plans to install stream gauges to be able to collect accurate flow data and calculate the corresponding contributions of baseflow to overall stream flow.

With respect to groundwater level declines (as well as storage and surface water depletions by proxy), undesirable results occur when one third of the representative monitoring sites in all three GSA jurisdictions exceed their respective minimum threshold water level elevations. Should this occur, a determination shall be made of the then-current GSA water budgets and resulting indications on net reduction in storage. Similar determinations shall be made of adjacent GSA water budgets in neighboring subbasins to ascertain the causes for the occurrence of the undesirable result.

The Kaweah GSAs recognize that water levels will continue to decline until the overdraft within and surrounding the Subbasin has been corrected. It is also recognized that during this time, the water level may decline below the depth of some wells within the Subbasin. Well construction has varied over the years and wells have been constructed at varying depths, and the construction depth and perforation intervals are not known for all wells in the Subbasin at this time. Some wells, even recently constructed wells, may have been poorly constructed or constructed too shallow for long-term operation. SGMA does not require GSAs to maintain current water levels or prevent any wells from going dry. Rather, GSAs are required to stabilize and correct groundwater decline. The EKGSA does not view a well going dry as an undesirable result. However, the EKGSA intends to develop a Well Observation Program which will monitor, evaluate, and notify beneficial users of potential impacts and possible actions that may be taken to avoid or minimize undesirable results.

It is the preliminary determination that the percentages identified herein represent a sufficient number of monitoring sites in the Subbasin such that their exceedance would represent an undesirable result for groundwater level, reductions in groundwater storage, and depletions of interconnected surface water. Based on observed groundwater conditions in the future, no less frequently than at each five-year assessment, the EKGSA will evaluate if these percentages need to be adjusted.

3.4.1.1.1 Criteria to Define

Prior to defining any undesirable results in the Subbasin, the Subbasin GSAs reviewed the understanding of the Basin Setting, inventoried existing monitoring programs and available data, and actively engaged with interested parties. The reviewed information and stakeholder input were used by the TAC and EKGSA Board to determine when the conditions at which each of the sustainability indicators applicable to the EKGSA may become significant and unreasonable.

3.4.1.1.2 Causes of Groundwater Conditions that Could Lead to Undesirable Results

Lowering of groundwater levels, reduction in storage, and loss of interconnected surface water can all be caused by groundwater withdrawal in excess of recharge. Given assumed hydrogeologic parameters in the Subbasin, direct correlations exist between changes in water levels and estimated changes in groundwater storage. Causes of groundwater conditions that could lead to undesirable results include over-pumping or nominal groundwater recharge operations during drought periods such that groundwater levels fall and remain below minimum thresholds within each threshold region. Pumping beneath the EKGSA directly influences these sustainability indicators through the lowering of groundwater levels. Pumping beneath neighboring GSAs also influences groundwater levels beneath the EKGSA. With the EKGSA being at head of the Subbasin, groundwater will continue to flow down gradient and, in particular, towards depressions if pumping is not adequately curtailed, regardless of measures taken in the EKGSA to diminish overdraft.

Additional potential declines of the water table below minimum threshold levels could be caused by:

- *GSAs not correcting the overdraft at the incremental mitigation rates described later in this section.*
- *Hydrologic cycle significantly drier than historic average conditions.*
- *Extended or worse drought conditions than the historic 2012-2016 drought.*
- *Neighboring GSAs and Basins not correcting boundary flow losses.*
- *Increased demand and pumping beyond what are planned for in the water budget.*

3.4.1.1.3 Potential Impacts on Beneficial Uses and Users of Groundwater

The primary effect of the chronic lowering of the groundwater table has caused wells to be drilled deeper and deeper to maintain productivity. Without correcting the Subbasin's overdraft and stabilizing the water table, the decades long trend of drilling deeper and deeper wells would continue causing increased financial burden on stakeholders. Additionally, a significant portion of the eastern area of the EKGSA has shallow depth to bedrock and the availability of supply above the bedrock could be diminished such that productive wells could not be constructed if water levels are not stabilized above these levels. Long-term reductions in aquifer storage reduces the resilience of the Subbasin to withstand drought periods and reduced surface water imports.

3.4.1.2 Minimum Thresholds

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

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

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

3.4.1.2.1 Description of Minimum Thresholds

The minimum thresholds for groundwater elevation, groundwater storage, and interconnected surface water depletion were determined based on a hydrograph trend analysis that projected 2040 groundwater elevation based on the pumping and recharge regimes experienced during the base period (1997-2017). The primary data source for the hydrographs was the Water Data Library (WDL). The WDL was a sub-optimal resource due to a circumstance where most of the wells monitored by the groundwater agencies in the EKGSA ceased to have their well data entered into the WDL circa 2011. Fortunately, the member irrigation districts continued sampling as required by their federal contracts and provided any data records they had collected to the EKGSA that had not been entered into the WDL. Via this combination of data, the EKGSA was able create a robust set of hydrographs. **Appendix 3-A** contains the full methodology, data, and final hydrographs.

For a well's data to be utilized in the hydrographs it had to meet several criteria:

- *Data reported for the entire base period (1997-2017).*
  - *Wells that were drilled after 1997 were immediately disqualified.*
  - *Wells where data ceased to be reported were disqualified.*
  - *Wells with large temporal gaps were disqualified. However, a temporal gap of a year or two was not grounds for a removal from consideration.*
- *Baseline data quality.*
  - *Wells that exhibited a severe degree of erratic behavior (many measurements did not make sense) were immediately disqualified. This was a rare disqualification.*
  - *Wells that exhibited a mild degree of erratic behavior (e.g. one or two measurements that would place the WSE above ground level for a season) were curated. The majority of the data was left untouched, but the impossible measurements were removed. The wells that remained became hydrograph candidates.*
- *Confidence in well location.*
  - *Wells with data pulled from the WDL came with reliable location data. Unfortunately, by the time we had reached this step in the process almost all of the wells had been knocked out of the running by the personnel incident alluded to earlier.*
  - *Any district wells that could not be matched to the WDL and that did not have clear and defined spatial locations were disqualified.*
- *Hydrograph corroboration*
  - *Every well will behave as an individual according to local conditions. Slight variations between two nearby wells are completely natural and not a cause for concern. However, extreme variations in the conditions of adjacent wells should give pause.*

The trends of the hydrographs were projected out to 2040. These projections were used to create a groundwater surface in GIS via the method Spline with Barriers. This groundwater surface revealed locations where the local wells conflicted with one another. The wells in opposition were analyzed to determine consistency of data internally and with other adjacent wells. If data appeared consistent both wells were left alone. That the wells were being analyzed in this way suggests a lack of consistency, though, and so it was more likely that one of the wells would be found somewhat defective. The hydrograph for the lackluster well was excluded from the projection analyses.

3.4.1.2.2 Relationship to other Sustainability Indicators

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

The following provides an explanation of the relationship between the water level minimum thresholds and the other sustainability indicators and how the EKGSA determined that the minimum thresholds will avoid undesirable results for each Indicator:

- ***Depletion of surface water interconnections*** *occurs when there is direct influence between groundwater and surface water. High groundwater levels may seep into the streambed (a gaining reach) or water in the stream may directly provide recharge to the aquifer (a losing reach). Surface water and groundwater are not determined to interact if there are significant distances between groundwater and surface water. Surface water may continue to infiltrate and contribute to groundwater quantities, but this trip through the vadose zone acts as a barrier between the two bodies. They are not directly interacting and are therefore no longer interconnected. For most of the Kaweah Subbasin, there is not connected surface water due to the depths of groundwater and intermittent flows in many river or creek channels. However, there are some potential areas for interconnected surface water on the eastern side of the Subbasin. The Kaweah River, Cottonwood Creek, Lewis Creek, and Frazier Creek have potential for connection with the groundwater below. The most likely is the Kaweah River, which above a location known as McKays Point is locally known as a gaining portion of the River. Local observations suggest this portion of the Kaweah River always has water in the channel, except in 2015 when some portions became dry due to the historic drought. The other creeks have potential for interconnected surface water near the foothills, however due to the intermittent flows in these small watersheds the connection may not be very consistent. Lewis Creek is known to have a perched aquifer under it, but even in midst of the drought, groundwater dropped from 7 feet depth to water to 13 feet depth, most likely due to less inflow coming in from the mountains. Based on this understanding and limited impacts of groundwater pumping on interconnected surface water bodies streamflow, it was determined that focusing the minimum threshold on groundwater levels would be appropriate for evaluating any undesirable effects on surface water connection.*
- ***Groundwater storage*** *is the measure of how much groundwater is stored within the aquifer. Therefore, more groundwater storage will be available to the aquifer during periods with higher groundwater levels than to the same aquifer when groundwater levels are lower. The strength of this relationship varies according to the depth to the base of the aquifer. An equal volume of groundwater lost by an area with a very shallow depth to the base of the aquifer and an area with a very great depth to the base of the aquifer will have vastly different consequences for beneficial users. The remaining amount of storage within the aquifer was a limiting factor in several of the eastern threshold regions that have a shallower aquifer due to presence of bedrock. This limitation was incorporated into the setting of groundwater level minimum thresholds.*
- ***Groundwater Quality*** *in the EKGSA has not been directly correlated with groundwater levels (**Appendix 3-B**).*
- ***Land subsidence*** *is typically directly impacted by lowering of groundwater levels, if occurring within a susceptible soil layer (i.e. clay layer). Through review of available subsidence data he EKGSA has not experienced significant subsidence within its boundary, which also limits the impact and correlation that the lowering of groundwater levels has on land subsidence. Instead, the EKGSA is setting a separate minimum threshold for land subsidence based directly on land elevation measurements on or near critical infrastructure (Friant-Kern Canal).*

3.4.1.2.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Once the hydrographs for the 1997-2017 base period were developed, the EKGSA was able to critically analyze the projected 2040 groundwater levels and determine the magnitude of potential impacts likely to occur due to the current pumping and recharge regime. If overdraft conditions in the Subbasin continue at a pre-SGMA implementation rate (i.e. similar to the base period condition), groundwater levels in many of the EKGSA threshold regions by 2040 will be at groundwater levels that mirror the condition of the basin before the Central Valley Project brought in surface water supplies. **Appendix 2-B** contains historical information regarding the impacts to the basin and **Figure 2-20** shows the change in groundwater elevation pre- and post-CVP. Through this analysis, based on current data availability, it was determined that returning to groundwater conditions similar to that of pre-1950 is an Undesirable Result and thus marked a baseline minimum threshold for groundwater levels. After looking at 2040 projections, candidate water level minimum thresholds were investigated to determine if they were sufficiently protective of aquifer storage capacity and interconnected surface water areas. In the eastern threshold regions of the GSA, some candidate minimum threshold levels were increased due to the shallow depth to the bottom of the aquifer. Each baseline minimum threshold for groundwater levels was also evaluated by the TAC to determine if it was stringent enough by reviewing if the projected level would cause excessive strain to the health of local communities, the agrarian economy, or interconnected surface water areas. More stringent minimum thresholds were, and can continue to be, formed if deemed necessary by the EKGSA, its TAC, and relevant stakeholders.

3.4.1.2.4 Impact of Minimum Thresholds on Water Uses and Users

Minimum thresholds for groundwater levels, interconnected surface water depletions, and aquifer storage were determined for each threshold region after lengthy consideration of the potential impacts on stakeholders within the EKGSA. The minimum thresholds have been established based on historic rate of decline and enough operational flexibility to maintain delivery during a 10-yr drought. The minimum thresholds have been determined based on the plan to correct the existing overdraft with an incremental approach intended to result in stabilized groundwater levels by 2040.

Stabilizing the groundwater levels will provide more certainty of the long-term availability of groundwater supply for all beneficial uses and users. An analysis was performed evaluating the Well Completion Report data set on potential impacts to the wells of agricultural, domestic, and public users. The data set has challenges and gaps when evaluating in this manner. There is uncertainty with several completion components such as location and missing or uncertain values related to depth or perforation interval. With these gaps in mind, a preliminary analysis of wells going dry was performed by comparing well bottom perforation elevations and the proposed minimum threshold in each threshold region. The bottom perforation elevation was chosen for the analysis due to this being the point at which no water can be extracted from a well. Wells would be impacted sooner than reaching this elevation, however inherent challenges with the data plus additional challenges such as whether the well is still in use or the setting of the pump bowls directed the analysis to focus on bottom perforations. The results from this analysis are summarized in **Figure 3-6**. Across the EKGSA approximately one-third of all wells may go dry at the proposed minimum thresholds. Evaluating by well type, one-half of the domestic wells may go dry, while approximately one-quarter of the agricultural wells and one-eighth of public wells would suffer the same fate. Percentages vary by threshold region, and the EKGSA recognizes that some shallow wells will likely go dry until water levels have been stabilized. Without SGMA and the proposed incremental mitigation by the EKGSA, the shallow wells would have gone dry sooner, requiring communities and landowners to deepen these existing wells. The minimum thresholds have been established to allow for continued beneficial use within the EKGSA and provide improved long-term certainty of groundwater levels and corresponding supply. The EKGSA intends to bolster the well data set for future analyses in two ways, partnering with the Kaweah Subbasin GSAs and County of Tulare to develop a more complete well canvass of the area, and developing a Well Observation Program to monitor and evaluate potential impacts to drinking water wells.

3.4.1.2.5 Minimum Thresholds in Relation to Adjacent Basins

The minimum thresholds established are based on projections of incremental historic decline starting immediately and reaching stabilization by 2040. This approach is believed to be conservative and protective from undesirable results. The Kaweah Subbasin has met with their neighboring subbasins and GSAs outside of the Kaweah Basin to discuss the process for modeling and setting thresholds and potential impacts. Most criteria and numeric setting were not final during these meetings. However, it is understood amongst all parties that minimum threshold elevations along the boundaries will need to be coordinated during implementation once focus shifts from finalizing the initial GSP documents. The EKGSA will evaluate and coordinate the potential differences between boundary thresholds and work to coordinate needed resolutions and clarifications when GSPs are completed.

3.4.1.2.6 Measurement of Minimum Thresholds

Groundwater levels, storage, and interconnected surface water depletion minimum thresholds will be quantitatively measured using groundwater level measurements collected twice per year, to represent seasonal high and low groundwater conditions. The monitoring wells will be used by the EKGSA, described in the Monitoring Network Chapter (**Chapter 4**), to collect representative measurements to characterize the groundwater table. Groundwater level measurements will demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and/or surface water features. These measurements will also be used to estimate annual change in groundwater storage. Wells near potential interconnected surface water will be monitored to characterize the spatial and temporal changes to evaluate potential depletions of surface water caused by groundwater extractions.

3.4.1.2.7 Minimum Threshold Relationship to Federal, State, or Local Standards

There are currently no state, federal, or local regulatory standards applicable to groundwater levels. This GSP will become the basis for local regulatory standards.

3.4.1.2.8 Individual Minimum Thresholds by Threshold Region

The groundwater level minimum thresholds were established for each of the EKGSA threshold regions (**Figure 3-2**) and are summarized in the following table. For comparison, 2015 groundwater surface elevation (WSE) and depth to water (DTW) are included.

Table 3-2 Groundwater Level Minimum Thresholds

Threshold Region	Water Surface Elevation (ft.)	Depth to Water (ft.)	2015 WSE (ft.)	2015 DTW (ft.)
EKGSA NW	185	169	246	108
IID-SCID	292	102	325	68
EKGSA NE	394*	81*	430*	45*
River	365	76	392	49
Exeter	244	162	309	97
EKGSA SE	429*	89*	413*	105*
LSID	312	123	337	98
Lindmore - East	235	164	307	92
Lindmore - West	145	218	241	122
EKGSA SW	75	269	163	182

*Regions with data gaps. Values estimated based on current data available.

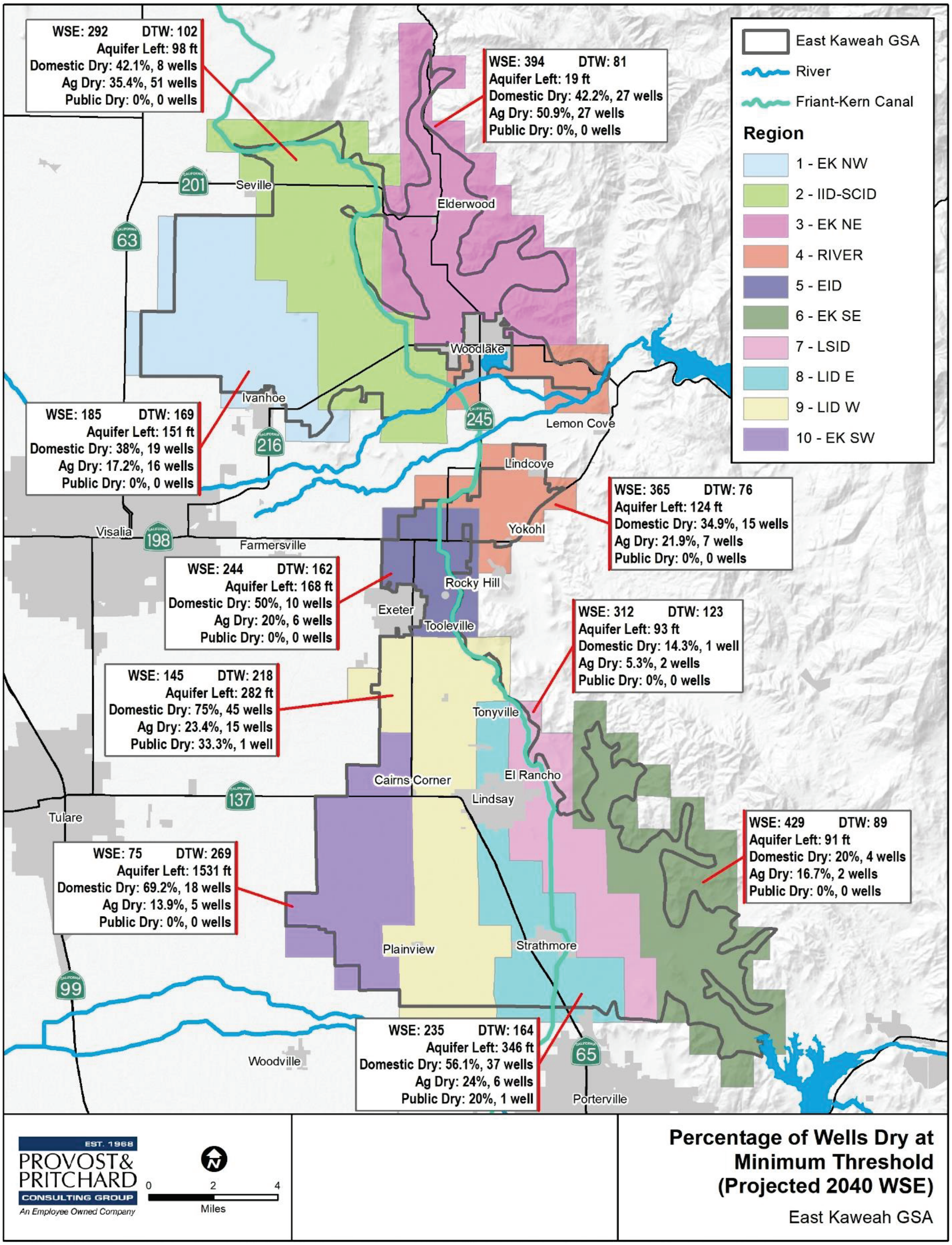

Figure 3-6 Groundwater Minimum Threshold and Well Impacts by Threshold Region

3.4.1.3 Measurable Objectives

Legal Requirements:

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

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

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

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

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

(f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.

Table 3-3. Groundwater Level Measurable Objectives

Threshold Region	Water Surface Elevation (ft.)	Depth to Water (ft.)	2015 WSE (ft.)	2015 DTW (ft.)
EKGSA NW	227	127	246	108
IID-SCID	326	68	325	68
EKGSA NE	440*	35*	430*	45*
River	397	44	392	49
Exeter	303	103	309	97
EKGSA SE	441*	77*	413*	105*
LSID	357	78	337	98
Lindmore - East	300	99	307	92
Lindmore - West	229	134	241	122
EKGSA SW	160	184	163	182

**Regions with data gaps. Values estimated based on current data available.*

The analysis evaluating Well Completion Report data set for the minimum thresholds was performed at the measurable objective elevations. With the data gaps previously described in mind, a preliminary analysis of wells going dry was performed by comparing well bottom perforation elevations and the proposed measurable objectives in each threshold region. The results from this analysis are summarized in **Figure 3-7**. Across the EKGSA approximately 2% of all wells may go dry at the proposed measurable objectives. Evaluating by well type, 12% of the domestic wells may go dry, while 9% of the agricultural wells and no public wells would become dry. The percentages do vary by threshold region, as shown in the figure.

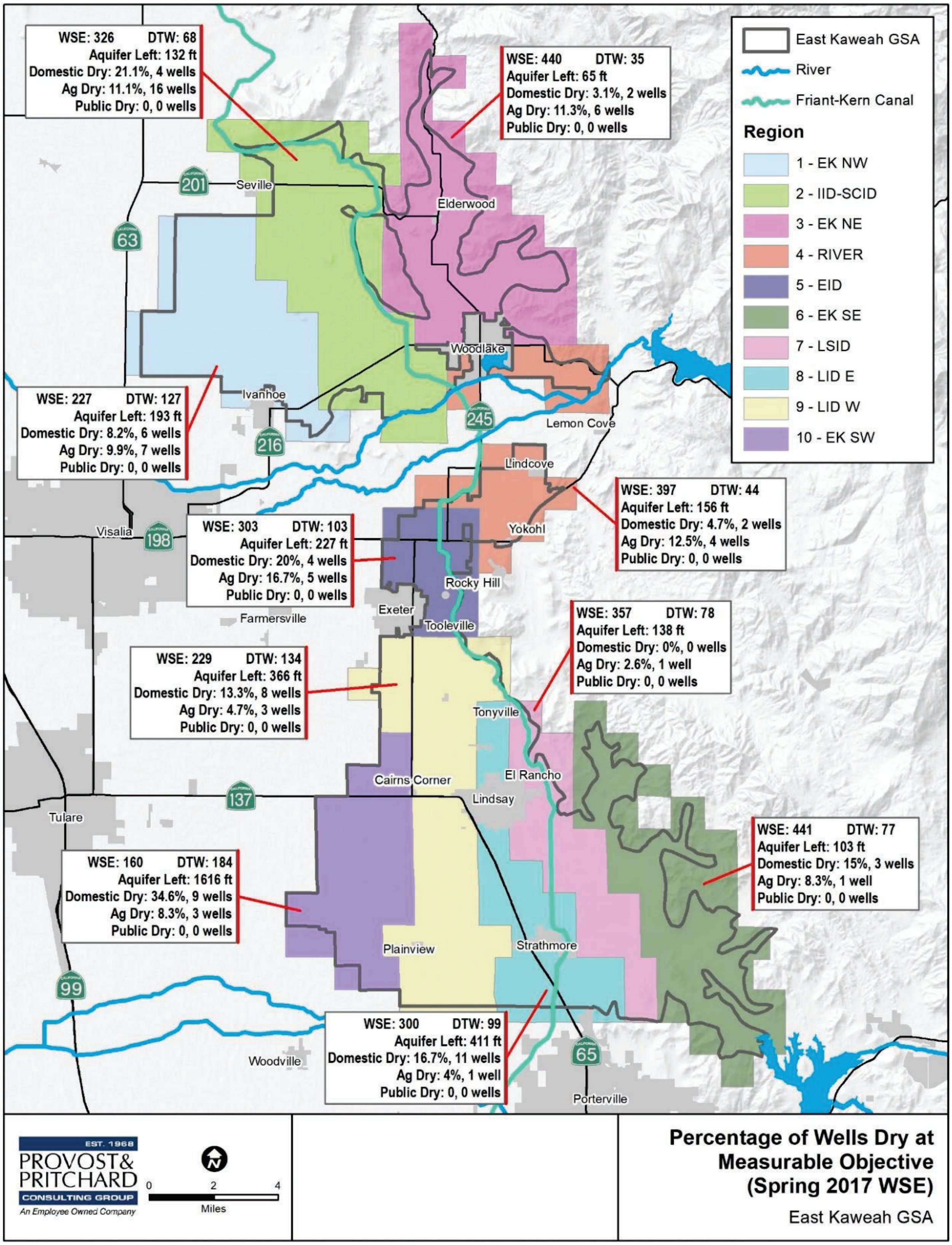

Figure 3-7 Groundwater Measurable Objective and Well Impacts by Threshold Region

A margin of operational flexibility, or margin of safety, allows for variation in groundwater levels due to seasonal, annual and/or drought variations, and also takes into consideration levels of uncertainty. Drought years may cause pumping to increase, but wet years may provide enough opportunity for surface water recharge to offset drought years. This operational flexibility is the difference in groundwater levels between the Measurable Objective and Minimum Threshold and is depicted in **Table 3-4**.

Table 3-4 Margin of Operation Flexibility by Threshold Region

Threshold Region	2040 MT (ft.)	2040 MO (ft.)	Operational Flexibility (ft)
EKGSA NW	185	227	42
IID-SCID	292	326	34
EKGSA NE	394	440	46
River	365	397	32
Exeter	244	303	59
EKGSA SE	429	441	12
LSID	312	357	45
Lindmore - East	235	300	65
Lindmore - West	145	229	84
EKGSA SW	75	160	85

3.4.1.3.1 Path to Achieve Measurable Objective

The EKGSA and Kaweah Subbasin will implement projects and management actions to correct the declining groundwater levels and reach sustainability. The EKGSA-specific projects and potential management actions are described in **Chapter 5**. Implementation timeline and approximate costs are discussed in **Chapter 6**. The interim milestones for water level correction are unique to each threshold region but follow the same incremental mitigation rate for correction of 5%, 25%, 55%, 100% by 2025, 2030, 2035, and 2040, respectively. Measurable objective water levels have been determined based from the estimated overdraft correction timeline proposed within the EKGSA. **Table 3-5** summarizes the interim milestones by threshold region and **Figure 3-8** and depicts graphically using the EKGSA Northwest threshold region as an example.

Table 3-5 Groundwater Level Interim Milestones by Threshold Region

Threshold Region	Minimum Threshold (ft.)	2020 WSE (ft.)	5% Correction		25% Correction		55% Correction		100% Correction	
			2025 Δ (ft.)	2025 WSE (ft.)	2030 Δ (ft.)	2030 WSE (ft.)	2035 Δ (ft.)	2035 WSE (ft.)	2040 Δ (ft.)	2040 WSE (ft.)
EKGSA NW	185	222	-7	214	-1	214	3	217	10	227
IID-SCID	292	322	-6	316	-1	315	3	318	8	326
EKGSA NE	394	434	-8	426	-1	425	4	429	11	440
River	365	393	-6	387	-1	386	4	390	7	397
Exeter	244	295	-10	285	-1	284	5	289	14	303
EKGSA SE	429	439	-2	437	0	437	1	438	3	441
LSID	312	351	-8	344	-1	343	4	347	10	357
Lindmore - East	235	292	-11	281	-1	280	5	285	15	300
Lindmore - West	145	218	-14	204	-1	203	7	209	20	229
EKGSA SW	75	149	-14	135	-1	133	7	140	20	160

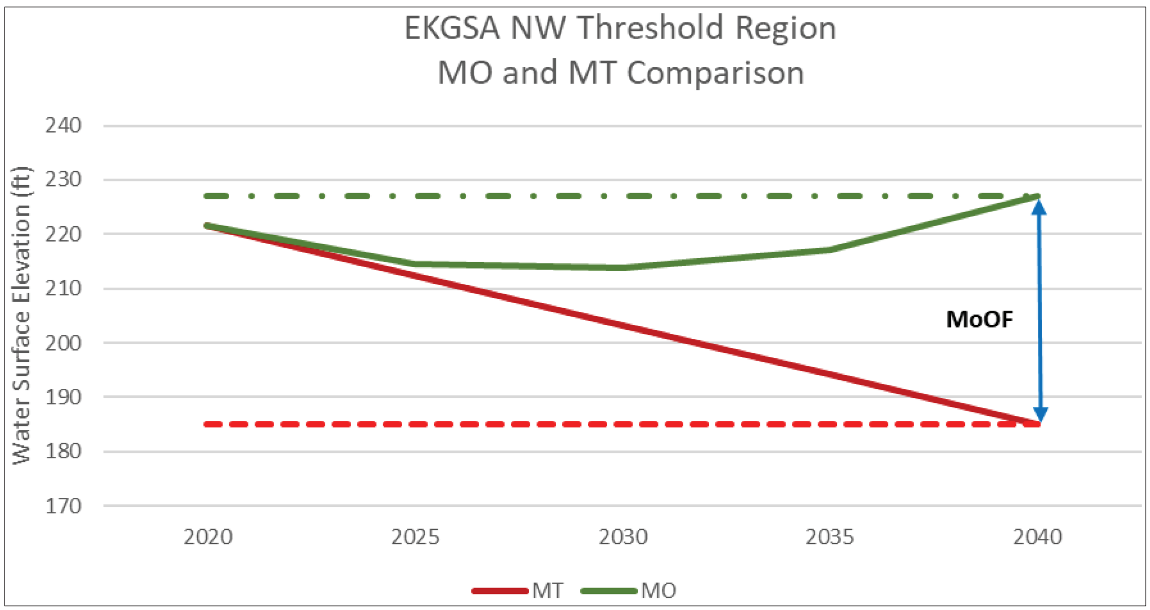

Figure 3-8 Example MO vs. MT Groundwater Level Comparison

3.4.2 Degraded Water Quality

3.4.2.1 Undesirable Results

Water quality degradation will be considered an undesirable result if, due to the impacts of EKGSA's projects or management actions on groundwater flow, concentrations of constituents of concern increase beyond the baseline concentration to significantly impact the beneficial uses and users of Kaweah Subbasin groundwater.

3.4.2.1.1 Criteria to Define

California's Porter-Cologne Water Quality Control Act (Porter-Cologne) is the overarching legislation determining the state standards applied to water quality within the boundaries of the EKGSA. Porter-Cologne extends the responsibilities of the federal Clean Water Act (CWA) from surface water to also include protecting groundwater quality. Implementation and compliance with the federal CWA and Porter-Cologne within California is maintained by the State and Regional Water Quality Control Boards. Each of California's nine regional water quality control boards must formulate and adopt basin plans for all areas of its region. Basin plans must conform with statewide policy set by the legislature and SWRCB (State Board 2015). Basin plans consists of designated beneficial uses to be protected, water quality objectives to protect those uses, and program implementation needed for achieving the objectives (California Water Code §13050(j)).

In the Kaweah Subbasin, the "Water Quality Control Plan for the Tulare Lake Basin" (Basin Plan), contains the administrative policies and procedures for protecting the surface and groundwater quality in the Tulare Lake Basin and its implementation is overseen by the Central Valley Regional Water Quality Control Board (Regional Board). Basin plans are adopted and amended by Regional Boards under a structured process involving full public participation and state environmental review. Basin plans and amendments must be approved by the State Water Board, Office of Administrative Law, and, if applicable, the U.S. Environmental Protection Agency. Due to the comprehensive scientific studies and stakeholder input used to develop, and the rigorous regulatory process required to approve the Basin Plan, the Kaweah Subbasin is leaning on this and other agencies directed with water quality regulation for assisting in defining "significant and unreasonable" water quality degradation.

Only water quality factors related to "actions, conditions, or circumstances resulting from human activities" are subject to the authority of the State or Regional Boards (CVWRCB 2015). Once beneficial uses have been determined for the basin, requisite water quality objectives are set to protect the beneficial use. Objectives can be revised through the basin plan amendment process and are achieved primarily through the adoption of waste discharge requirements (including federal NPDES permits) and enforcement orders. In the Kaweah Subbasin, Detailed Analysis Unit (DAU) 242, several beneficial uses for groundwater have been identified in the Basin Plan. However, due to the size of DAUs, the listed beneficial uses may not exist throughout the entire DAU. Through stakeholder discussions and anecdotes, it became clear that the primary beneficial uses of groundwater that are realized within the EKGSA are AGR and MUN. Thus, minimum threshold criteria focus on protecting these beneficial uses, which are described as:

- *Agricultural Supply (AGR) – Uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.*
- *Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply*

3.4.2.1.2 Causes of Groundwater Conditions that Could Lead to Undesirable Results

The research conducted to date indicates that land use practices, natural geologic formations, point sources of contamination, and pumping localities and rates may all contribute to groundwater conditions with constituent of concern concentrations that may exceed recognized water quality standards. As extensively discussed in

Chapter 2, historical and current land use practices (i.e. agriculture, dairies, and septic systems) and natural geologic formations have led to the Subbasin's groundwater aquifer exceeding several contaminant thresholds for some time. Change in groundwater levels may or may not be a cause, depending on location, as some constituents improve with lowering water levels while others decrease, and vice versa.

3.4.2.1.3 Potential Impacts on Beneficial Uses and Users

Groundwater quality degradation has the potential to negatively impact drinking and irrigation water users. Quality degradation that impacts constituent concentrations with agronomic recommended thresholds can have a negative impact on crop health and yield. In extreme situations, it can permanently damage crops. Degraded groundwater quality with respect to drinking water users, could potentially lead to groundwater unfit to meet potable water standards which may lead to added costs for drilling new wells or new treatment needs.

3.4.2.2 Minimum Thresholds

3.4.2.2.1 Description of Minimum Thresholds

Unlike groundwater storage and surface water depletion, no statistically significant correlation has been found between groundwater levels and water quality in the EKGSA (**Appendix 3-B**). Therefore, groundwater levels are not to be used as a proxy for determining water quality minimum thresholds. Instead, the EKGSA evaluated individual constituents of concern (COC) and, when available, historical water quality data indicated the potential for that contaminant to negatively impact the municipal and agricultural uses in the area. The compiled COC list was formed using the recorded water quality data over the 1997-2017 base period from the State Water Board's GAMA GeoTracker database (GeoTracker). The GeoTracker database includes the following datasets:

- *Department of Pesticide Regulation (DPR);*
- *Department of Water Resources (DWR);*
- *Groundwater Ambient Monitoring Assessment (GAMA) domestic wells, special study sites, and priority basin projects;*
- *State Water Board regulated monitoring wells, including:*
  - *Irrigated Lands Regulatory Program (ILRP);*
  - *Dairy Order;*
- *Public Water System Wells; and,*
- *National Water Information System (NWIS).*

In addition to GeoTracker data, the EKGSA also investigated data presented by the CV-SALTS surveillance and monitoring program pilot studies. The EKGSA also discussed the COC list with its stakeholders to ensure quality concerns from different parties were met.

Well monitoring data from Geotracker, and other sources, is currently not available at a granular enough level to allow for the mapping of specific contaminant plumes. Given these data gaps, the current level of water quality monitoring for the identified COCs needs to be enhanced by a network to track regional trends and to serve as a warning system for changes in water quality. More details on the EKGSA's monitoring network is provided in **Chapter 4**.

Table 3-6. Constituents of Concern for the EKGSA with Respective Minimum Threshold

Constituent	*Threshold Level*		*Threshold Type*	*Municipal Minimum Threshold*	*Agricultural Minimum Threshold*
1,2,3-Trichloropropane (1,2,3 TCP)	*0.005 ug/L*	*5 ppt*	*Primary MCL*	*X*	
1,2-Dibromo-3-chloropropane (DBCP)	*0.2 ug/L*	*0.2 ppb*	*Primary MCL*	*X*	
Arsenic	*10 ug/L*	*10 ppb*	*Primary MCL*	*X*	
Chloride	*500 mg/L*	*500 ppm*	*Action Level*	*X*	
	106 mg/L	106 ppm	*Agricultural Water Quality Goal*		*X*
Hexavalent Chromium	*20 ug/L***	*20 ppb*	*Health-Based Screening Level**	*X*	
Nitrate (as N)	*10 mg/L*	*10 ppm*	*Primary MCL*	*X*	
Perchlorate	*6 ug/L*	*6 ppb*	*Primary MCL*	*X*	
Sodium	*50 mg/L*	*50 ppm*	*Action Level*	*X*	
	69 mg/L	69 ppm	*Agricultural Water Quality Goal*		*X*
Total Dissolved Solids (TDS)	*1000 mg/L*	*1000 ppm*	*Secondary MCL*	*X*	*X*

**In 2014, the SWRCB established an MCL for hexavalent chromium at 10 ug/L. Due to lawsuits, the MCL was withdrawn by the SWRCB in 2017. Until an MCL is legally established, the previous Health-Based Screening Level will be used as the applicable threshold. A health-based screening level is a non-enforceable water-quality benchmark used to supplement MCLs and may indicate a potential human-health concern. (USGS 2018).*

***Until a revised MCL is adopted by the SWRCB, the total chromium MCL (20 ug/L) will be used as the drinking water standard for enforcement of the Safe Drinking Water Quality Requirements.*

The EKGSA emphasizes that the development and monitoring schedule of the aforementioned water quality COC list will be an iterative process. Over time, COCs that were historically a cause for concern within the basin may dissipate, while other COCs may emerge. The SWRCB continually updates applicable drinking water MCLs to address emerging contaminants of concern via a scientific, peer-reviewed process. In addition, agricultural commodity groups and the UC Cooperative Extension frequently publish research regarding the agronomic impacts of water quality. The EKGSA plans to annually assess, based on updates to data and research made publicly available, the applicability of the COC list and add or remove COCs as needed to sufficiently protect beneficial uses in the area.

Minimum Threshold

The EKGSA minimum threshold for groundwater quality will be based on a 10-year running average for COCs at a monitoring location. Minimum thresholds will breakdown to two categories, as follows:

- *For wells with 10-year average COC concentrations less than the recognized standard, no increase in concentration beyond the standard*
- *For wells with 10-year average COC concentrations greater than the recognized standard, no increases beyond 20% to the initial average concentration at GSP implementation*

It should be noted that COC concentrations in the range of 75% to 125% of the recognized standard may have challenges in evaluating statistical trends as the allowable error from laboratory analyses may influence the percentage. COC with small recognized limits are especially susceptible.

These COC concentrations will be with respect to the beneficial use the groundwater well supplies. Thus, public drinking wells will be subject to the municipal minimum threshold standard, and irrigation wells will be subject to the agricultural minimum threshold standards. A compiled list of COCs relevant to the EKGSA and their respective threshold levels is presented in **Table 3-6**.

The EKGSA recognizes that improving groundwater quality is a critical issue for long-term sustainability. However, unlike other sustainability indicators, groundwater quality management is already a part of a large, robust regulatory structure in place under the authority of the State Water Board. Through the data collection for developing this GSP, there are historical groundwater exceedances for the identified COCs predating January 1, 2015. See the Basin Setting in **Chapter 2** (and **Appendix 2-E**) for historical water quality information. However, §10727.2(b)(4) expressly states that a GSP, "may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015." The EKGSA does not intend to take over regulatory roles assigned to other entities. Rather than duplicate these efforts, the EKGSA proposes to collaborate with other groundwater quality agencies and programs, when feasible, to sustain groundwater quality better than minimum thresholds. The EKGSA will also work to implement groundwater projects and management activities that support improved water quality while bringing the aquifer to a sustainable level.

3.4.2.2.2 Relationship for each Sustainability Indicator

As demonstrated in **Appendix 3-B**, water quality is uniquely independent from the other sustainability indicators within the EKGSA. At this time, given the data available, there does not appear to be a relationship between water quality and the other sustainability indicators in the Subbasin. Declining water levels, which relate directly with a reduction of groundwater storage, can potentially lead to increased concentrations of COC for those that reside in larger proportions in deeper aquifer zones. Conversely, rising water levels, which relate directly with an increase in groundwater storage, can also lead to increased concentrations of some COC that may reside in unsaturated soils at shallower depths. Groundwater quality cannot be used to predict responses of other sustainability indicators, and there is not a strong correlation by indicators that can potentially affect water quality such as change in groundwater levels and storage. Therefore, groundwater quality minimum thresholds should be established separately from other indicators.

3.4.2.2.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Under SGMA, GSAs were given limited powers related to the groundwater quality sustainable indicator. For this reason, the EKGSA will be leaning on and collaborating with regulatory agencies tasked with establishing water quality standards and resolving quality issues. Thus, setting groundwater quality minimum thresholds was based on established standards aimed at protecting beneficial uses and users. The EKGSA views water that exceeds the established standards for the designated beneficial use is an undesirable result.

3.4.2.2.4 Impact of Minimum Thresholds on Water Uses and Users

The minimum thresholds have been set consistent with recognized water quality standards with respect to the water uses and users of groundwater at a given well. Minimum thresholds for drinking water supply wells lean on the recognized standards that are intended to be protective of human health (i.e. MCLs and Title 22). Minimum thresholds for irrigation supply wells lean on standards that are intended to be protective of agricultural crop health. Maintaining concentrations below these levels and leaning on agencies with the authority to solve quality issues, beneficial uses and users should be protected within the EKGSA.

3.4.2.2.5 Measurement of Minimum Thresholds

Measurement of water quality for evaluation against minimum thresholds will occur in two ways. For public wells supplying drinking water, the quality data is made public. The EKGSA will evaluate the regularly collected data for specific municipal COCs and their 10-year running average concentration, trend over time, and relation to its recognized water quality standard. Water quality for agricultural COCs will be collected through the representative agricultural wells in the monitoring network. Sampling will occur concurrent with groundwater level monitoring (Spring and Fall) to evaluate the COC 10-year running average concentrations, trend over time, and relation to its recognized water quality standard. As data is collected for both municipal and agricultural COCs, the minimum threshold trends and percentages can be evaluated and changed, if deemed appropriate by the EKGSA and its stakeholders.

In addition, while the preparation of this GSP was exempt from the California Environmental Quality Act (CEQA) requirements, projects implemented by the GSA under this GSP that "require the construction of a facility" are not exempt from CEQA. During CEQA compliance for a project requiring the construction of a facility (recharge pond, additional surface water conveyance, etc.), the EKGSA will investigate potential negative impacts on water quality resulting directly from the project on the aquifer prior to construction.

3.4.2.2.6 Minimum Thresholds for Management Areas and Threshold Regions

The minimum thresholds established by the EKGSA are specific to the beneficial use at a well. Therefore, the same minimum threshold parameters for water quality will be applied throughout the entire EKGSA. During implementation if additional data indicates special areas of concern, this policy decision can be reassessed.

3.4.2.3 Measurable Objectives

3.4.2.3.1 Description of Measurable Objective

The measurable objective for groundwater quality in the EKGSA is to have no unreasonable increase in concentration caused by groundwater pumping and recharge efforts. This objective will likely be evaluated on a case-by-case basis. The reason for the objective being "no unreasonable increase" is there may be instances where an increased concentration for short period is acceptable. For example, a recharge basin may cause a spike in concentrations in groundwater quality initially as constituents are carried through the soil profile. However, over the long-term, recharging with high quality surface water will improve groundwater quality. An example would be to have a well that has consistently been increasing to 9 mg/L Nitrate as N. Through implementation of a recharge basin up-gradient of this well, the concentrations have begun to plateau and/or improve (i.e. concentration drops to 6 mg/L). This would be viewed as achieving the Measurable Objective as no unreasonable increase occurred and/or improvement occurred.

3.4.2.3.2 Margin of Safety for Measurable Objective

The EKGSA will establish policy where it will begin to take action as monitoring of the groundwater quality concentration averages shows increase towards recognized quality standards. Action will begin if a COC concentration 10-year average reaches 80% of the recognized standard. If a COC concentration has not yet reached 80% of the recognized standard, but a statistically significant rapid rate of degradation towards the recognized standard exists, that may also trigger first action steps. If the action steps are triggered, the first step will be to initiate an evaluation of potential causes and sources of the concentration increase. When a cause is known, projects, management actions, and appropriate education and outreach can be implemented to resolve an issue. Based upon the data presented in the source analysis, appropriate examples of follow-up management actions or projects may include, but are not limited to, reassessing pumping allocations, exploring alternative placement of recharge areas, water treatment projects, notification and outreach with impacted stakeholders, and/or conferring with the appropriate state or local agency to confirm a plan exists to address the water quality problem of concern. Beginning to act when concentrations are at 80% is common amongst other groundwater quality agencies (i.e. CV-SALTS), and the EKGSA is proposing to adopt this practice.

3.4.2.3.3 Path to Achieve Measurable Objective

The EKGSA and Kaweah Subbasin will be looking to partner with agencies tasked with mitigating water quality issues. Partnering with these entities is believed to allow the Subbasin to achieve sustainable management of the groundwater aquifer that is void of all undesirable results. Additionally, with the planned increase in groundwater recharge with high quality water sources (Friant CVP and/or Local Kaweah River supplies), groundwater quality is anticipated to improve during the implementation period.

3.4.3 Land Subsidence

3.4.3.1 Undesirable Results

Subsidence will be considered an undesirable result if there are unreasonable impacts on critical infrastructure.

3.4.3.1.1 Criteria to Define

The process used to develop the criteria for undesirable results began with the review of existing USGS, DWR, and USBR land subsidence data, and through discussions with stakeholders and landowners regarding locally observed conditions. The criteria for an undesirable result will be the significant loss of functionality of a structure or a facility to the point that, due to subsidence, the feature cannot be operated as designed requiring either retrofitting or replacement.

Based on the discussions with stakeholders and landowners, there have been no known undesirable results within the EKGSA. Water conveyance structures tend to be the most sensitive to subsidence. However, damage to roads, railways, bridges, pipelines, buildings, and wells can also occur. The EKGSA assessed critical infrastructure within the EKGSA that could be negatively impacted by significant subsidence. At this time, the EKGSA and its stakeholders have identified the Friant-Kern Canal (FKC) as the critical infrastructure within the EKGSA that could be negatively impacted by subsidence.

3.4.3.1.2 Causes of Groundwater Conditions that Could Lead to Undesirable Results

Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to movement of earth materials. It can be caused by compression of clay and silt layers in an aquifer system, drainage and oxidation of organic soils, and/or the dissolution and collapse of susceptible rocks (USGS 1999). Within the Kaweah Subbasin, causes of subsidence include over-pumping or nominal groundwater recharge operations during drought periods such that groundwater levels fall, dewatering susceptible layers and/or require wells to pull from deeper aquifers. When diminishing groundwater levels lead to aquifer compaction and subsidence, this negatively affects gravity-driven water conveyance structures by disrupting the natural grade line, reducing the facility's ability to convey water. Currently, subsidence in the EKGSA has not impacted the capacity of the FKC within the EKGSA boundary; however, chokepoints in the canal have been formed in neighboring GSAs due to land subsidence. These chokepoints cause reduced capacity of the FKC and limit the amount of surface water that can be delivered to Contractors.

3.4.3.1.3 Potential Impacts on Beneficial Uses and Users

In the San Joaquin Valley, the main problems related to land subsidence are the impacts to gravity driven water conveyance structures and increased flooding risk. Gravity conveyance facilities can be sensitive to minor changes in gradients can cause reductions in the designed capacity of the feature. Subsidence can also lead to increased flooding risk if a levee or surrounding area is lowered and overtopping of a water body occurs. Other facilities sensitive to subsidence include roads, railways, bridges, pipelines, buildings, and wells.

While more focus has been placed on the highly visible infrastructure damage from subsidence, which generally can be repaired, compaction of the aquifer system may permanently decrease its capacity to store water. Most aquifer compaction that occurs is generally irreversible. Any inelastic reduction in storage could be detrimental to the ability of groundwater users in the Subbasin to maintain a resilient groundwater supply.

Within the EKGSA, the beneficial uses and users are most impacted by decreased capacity in the FKC. Considered by many users to be the "lifeblood" of the EKGSA, maintaining integrity of the FKC will protect most beneficial users within the area. Although current data does not indicate a high likelihood within the EKGSA, beneficial users could also be impacted if subsidence caused damage to wells by collapsing casings.

3.4.3.2 Minimum Thresholds

3.4.3.2.1 Description of Minimum Threshold

Very few subsidence monuments are located within the EKGSA. Two subsidence monuments are located in the northern half of the GSA. One of these is by the FKC south of Colvin Mountain, while the other is located just east of Mud Spring Gap. Two monuments are located along Highway 198 in the Exeter ID.

DWR created a review of historical subsidence in the Valley entitled *Estimated Subsidence in the San Joaquin Valley between 1949 – 2005, most recently updated in April 2019.* This dataset only extends into the westernmost reaches of the EKGSA. All EKGSA subsidence indicated by the dataset was in the lowest vertical displacement group, with 0 to 5 feet of elevation lost. Over the time period, this equates to approximately 1 inch per year at the most. Based on the mild rates of subsidence, DWR did not choose to extend the dataset any further to the east.

DWR also reports InSAR subsidence data annually, showing the vertical displacement accrued since 2015. The change from 2015 to 2018 is the most recent set to be published and is presented in **Figure 3-9**. According to this data set, nearly two-thirds of the EKGSA falls within the 0 to 0.3 feet of change in elevation range during those three years, indicating either no subsidence or slight uplift. Much of the remaining third experienced 0.0 to 0.5 feet of subsidence. A small portion, approximately 5% of the EKGSA, experienced from 0.5 to 2.0 feet of subsidence in the area west of the Lindmore ID. In short, over 90% of the EKGSA experienced less than 0.5 feet of subsidence between June 2015 and June 2018. The small area of the EKGSA seeing higher subsidence rates may be consequence of actions outside of the EKGSA boundary.

Undesirable conditions resulting from subsidence in the EKGSA would be the diminishment of capacity of the FKC, and other harm inflicted on critical infrastructure. Diminished capacity is already documented and slated for repair further south of the EKGSA. Infrastructure within the Kaweah itself does not appear to be at risk.

No known significant clay layers exist within the EKGSA. Compaction due to dewatering and associated loss of storage are locally an issue of less concern. Should subsidence expand or accelerate within the EKGSA this position would be reevaluated.

3.4.3.2.2 Relationship for each Sustainability Indicator

Table 3-7 Relationship for Each Sustainability Indicator

Indicator	Relationship to Land Subsidence
Water Level	Land subsidence does not impact water levels, rather the water levels impact land subsidence. Land subsidence occurs due to a decline in water levels from confined groundwater pumping. It is assumed that the neighboring GSA's will reduce pumping to some extent from the confined aquifer to become sustainable. The reduction in confined groundwater pumping would lead to water levels stabilizing because of the water level sustainable management criteria, that would lead to land subsidence stabilizing.
Storage Change	There is loss of storage when land inelastic land subsidence occurs.
Groundwater Quality	No current nexus to land subsidence.
Interconnected Surface Water	No current nexus to land subsidence.

3.4.3.2.3 Selection of Minimum Thresholds to Avoid Undesirable Results

Based upon the surface water needs of stakeholders within the EKGSA, it was determined that no more than a 10% capacity reduction in the current capacity of the FKC due to subsidence would be acceptable. Using the maximum amount of capacity loss and the engineering specifications of the FKC, it was estimated that 9.5" of subsidence in one year in threshold regions near the FKC could result in up to a 10% capacity loss in the FKC. Therefore, the minimum threshold for land subsidence was set at no more than 9.5" of land subsidence in a year to protect the FKC. Additionally, since subsidence is tied to critical infrastructure capacity, the maximum cumulative subsidence for the implementation period is also set at 9.5" since that quantity relates to the 10% capacity reduction.

Table 3-8 Minimum Threshold for Land Subsidence

Minimum Threshold Parameter	Minimum Threshold Quantity
Annual Land Subsidence Rate	9.5 inches in a year; focus along the FKC
Maximum Cumulative Land Subsidence	9.5 inches

3.4.3.2.4 Impact of Minimum Thresholds on Water Uses and Users

At the minimum threshold, the impact on water uses and water users would likely be significant. Many within the EKGSA rely on surface water from the FKC, therefore, if the capacity of the FKC is restricted, the EKGSA will be impacted. If the land subsidence monitoring shows subsidence in the area that may impact the FKC, the EKGSA will assess the area and address accordingly. Since there are no known issues with subsidence historically within the EKGSA, it is not anticipated that land subsidence will cause issues with the minimum threshold criteria, particularly as groundwater levels are sustained.

Other beneficial users can be impacted by subsidence by impacts to infrastructure such as roads, bridges, foundations, pipelines, and well casings. At this time the EKGSA has not deemed impacts to these facilities as critical as to the FKC. However, to monitor potential impacts to well casings, a subsidence monitoring point will be established at a well in Plainview. This point will monitor potential impacts in an area of the EKGSA that may be more susceptible to subsidence, based on recent InSAR mapping (**Figure 3-9**).

3.4.3.2.5 Measurement of Minimum Thresholds

The rate and extent of land subsidence will be measured annually via a survey of set mile posts along the FKC and at one of the Plainview well points. InSAR data will be utilized as a backstop when available.

3.4.3.2.6 Minimum Thresholds for Threshold Regions

Given the EKGSA's focus for land subsidence is the impact on critical infrastructure, the minimum threshold is set independent of the established EKGSA threshold regions.

3.4.3.3 Measurable Objectives

3.4.3.3.1 Description of Measurable Objective

The measurable objective for the land subsidence sustainability indicator in the EKGSA is to have no subsidence impacts to CVP deliveries via the FKC.

3.4.3.3.2 Margin of Safety for Measurable Objective

Over a year, there is a 9.5" inch margin of safety that allows for at most a 10% decrease in the FKC capacity. Based upon study of the current FKC capacity, a 10% decrease in the FKC capacity is believed to be an allowable maximum impact based upon the historical rates of subsidence in other basins the FKC traverses.

3.4.3.3.3 Path to Achieve Measurable Objective

To date there is no evidence of impacts to the FKC's capacity related to subsidence within the EKGSA. Therefore, there is no need to develop milestones as the measurable objective is to maintain current conditions that are protective of the integrity of the FKC

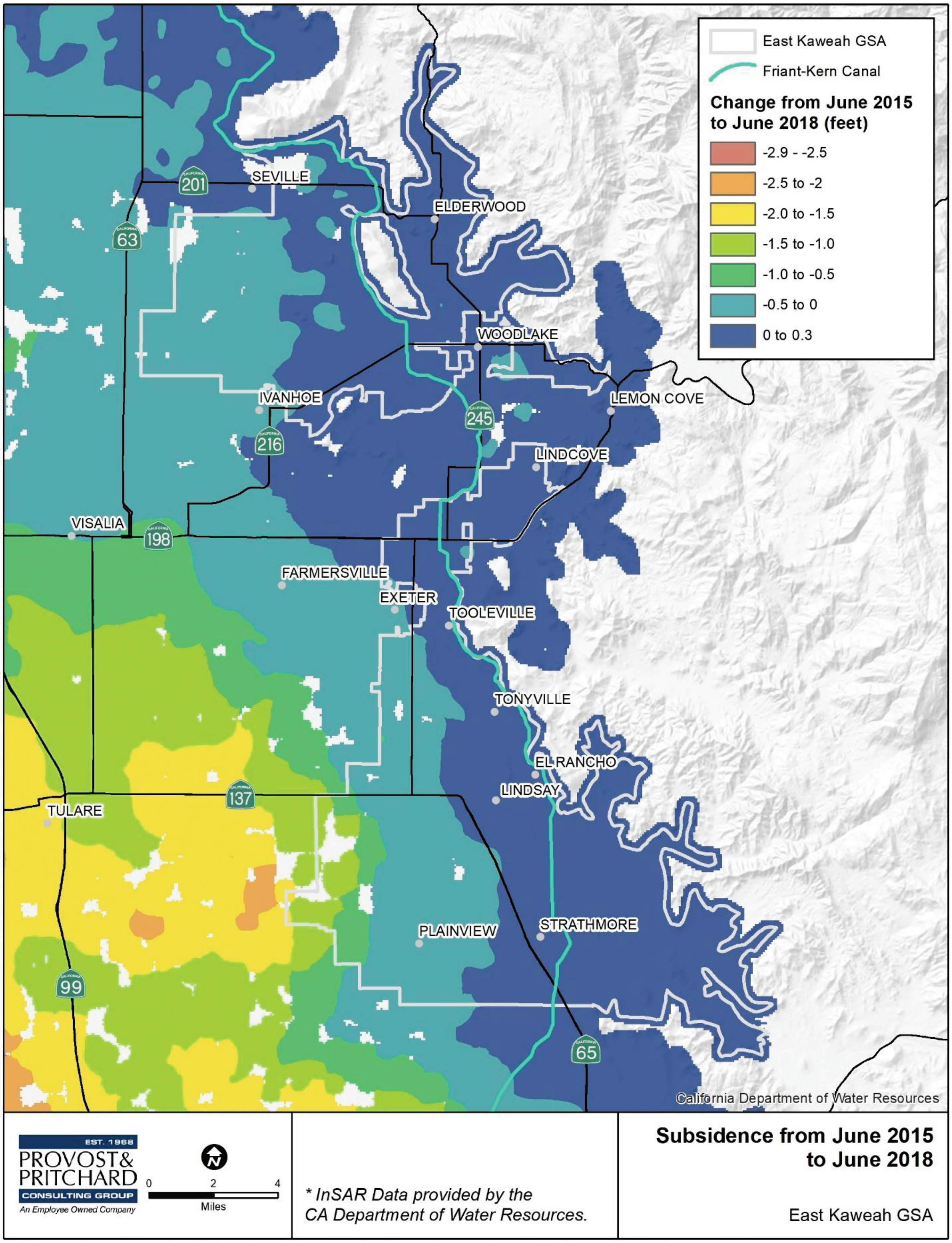

Figure 3-9. Subsidence NASA InSAR Data from 2015 to 2018 for the EKGSA