Groundwater Sustainability Plan Chapter

for the

ROSEDALE-RIO BRAVO Management Area

Kern Groundwater Authority Groundwater Sustainability Agency

Kern County Sub-basin 5-22.14, California

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Abbreviations and Acronyms

AF	Acre-Feet
AFY	Acre-Feet per Year
APN	Assessor Parcel Number
B	Billion
BVWSD	Buena Vista Water Storage District
cfs	cubic ft per second
CASGEM	California Statewide Groundwater Elevation Monitoring
CIMIS	California Irrigation Management Information System
COC	Constituents of Concern
CVC	Cross Valley Canal
CVP	Central Valley Project
CWC	California Water Code
DWR	Department of Water Resources
EIR	Environmental Impact Report
ET	Evapotranspiration
ft	feet
ft/yr	feet per year
Grat	Groundwater Recharge Assessment Tool
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
I-5	Interstate Highway 5
ID4	Improvement District No. 4
IRWD	Irvine Ranch Water District
IRWMP	Integrated Regional Water Management Plant
ITRC	Irrigation Training and Research Center
JPA	Joint Powers Authority
JURP	Joint Use Recovery Project
KCWA	Kern County Water Agency
KGA	Kern Groundwater Authority
KRCWA	Kern River Coalition Authority
KWB	Kern Water Bank
KWBA	Kern Water Bank Authority
M	Million
MCL	Maximum Contaminant Level
mg/ℓ	milligram per liter
µg/ℓ	Microgram per liter
MMRP	Mitigation, Monitoring, and Reporting Plan
MOU	Memorandum of Understanding
O&M	Operations and Maintenance
ppm	parts per million
RRBDL	Rosedale-Rio Bravo District Land Sub-Management Area

RRBMA	Rosedale-Rio Bravo Management Area
RRBWL	Rosedale-Rio Bravo White Land Sub-Management Area
RRBWSD	Rosedale-Rio Bravo Water Storage District
SGMA	California Sustainable Groundwater Management Act
SOD	South of Delta
SWP	State Water Project
TDS	Total Dissolved Solids
USACE	U.S. Army Corps of Engineers
WRSP	Western Rosedale Specific Plan

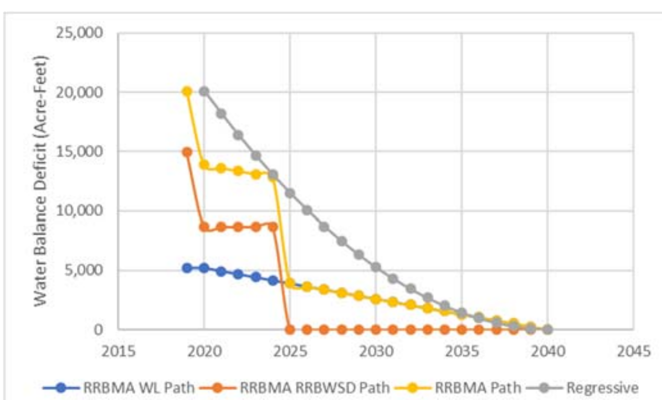
Executive Summary

The Rosedale-Rio Bravo Management Area (RRBMA) generally covers about 48,610 acres west of Bakersfield within the Kern County Sub-basin which has been categorized as severely over drafted and a high priority towards sustainability. This Groundwater Sustainability Plan (GSP), has a 20-year implementation schedule and a 50-year planning horizon, includes a physical description of the basin, including groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on historical and projected water demands and supplies, monitoring and management provisions.

The RRBMA relies heavily on groundwater and has approximately 350 extraction wells of which approximately half are agricultural and the other half banking, municipal, and domestic. In order to support the groundwater extraction, the Rosedale-Rio Bravo Water Storage District was formed in 1959 over most of the RRBMA area in order to import surface water supplies to reduce the rapid water level declines that were being experienced at the time. From the late 1970's to the late 2000's water levels stabilized, however, as a result of extreme drought conditions and regulatory restrictions on imported water supplies the decline has resumed at a rate of 3-6 ft/yr. As of 2018 the average depth to groundwater in the RRBMA was about 250 ft.

In order to protect the groundwater users in and proximate to the RRBMA, Minimum Thresholds are being set at the levels that were experienced during the last drought, which where historically low levels in the area. During that time many wells in the RRBMA were improved to accommodate the conditions but further lowering of water levels could cause further financial harm to the community in regard to well improvements, replacement, and water quality. The RRBMA has analyzed the costs associated with yet deeper Minimum Thresholds. Increasing the Minimum Thresholds by even 50 ft beyond the deepest historic levels could cause costs to RRBMA water users of approximately $640M. A large portion of these costs are based on anticipated treatment costs for municipal, domestic, and groundwater banking wells.

The RRBMA has a projected a potential long-term water supply deficiency of about 20,116 AFY. The RRBMA seeks to eliminate that shortage over the next 20 years in a regressive fashion (aggressive in first 10 years) by a combination of projects and water management actions. Projects include water supply transfers, construction of direct recharge projects, and demand reduction. Costs of these projects are estimated at $10M per year.



1. Administrative Information

1.1 General Information

1.1.1 Purpose of GSP

The purpose of this chapter is to describe the Rosedale-Rio Bravo Water Storage District Management Area (RRBMA) compliance with the requirements of the California Sustainable Groundwater Management Act (SGMA) developed in coordination of the Kern Groundwater Authority Groundwater Sustainability Agency (KGAGSA). This Groundwater Sustainability Plan (GSP) has a 20-year implementation schedule and a 50-year planning horizon, includes a physical description of the basin, including groundwater levels, groundwater quality, subsidence, information on groundwater-surface water interaction, data on historical and projected water demands and supplies, monitoring and management provisions.

The Rosedale-Rio Bravo Water Storage District (RRBWSD or District) operates primarily as a groundwater replenishment district similar to a traditional groundwater bank. Direct surface water deliveries to beneficial uses are minimal with most in-District deliveries via direct groundwater recharge. District landowners recover water for multiple beneficial uses via private and public groundwater extraction wells. The District, since its inception, has implemented several projects and acquired water supplies sufficient to provide for overlying demands. In spite of these efforts water levels have declined due to the existence of overdraft in other areas of the groundwater basin.

1.2 Agency Information

1.2.1 Chapter Agency

RRBWSD is a public agency organized in accordance with California Water Storage District Law (Division 14, commencing with §39000 of the California Water Code) for the purpose of acquiring, storing, distributing, and replenishing water supplies within its boundaries in Kern County, California. There is a board of five elected members that govern the District. It is operated by a General Manager, Eric Averett who is tasked with implementing the District's activities, including the District's activities under this plan; Mr. Averett is the District's Plan Manager for purposes of this chapter. Ultimately it is the elected Board of Directors of RRBWSD that is responsible for the RRBMA SGMA implementation. The elected board approves all final documents, updates, CEQA findings, procedures, and policies with respect to SGMA RRBMA activities

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1.3 GSP Implementation Costs

1.3.1 Costs Generated by GSP Implementation and Funding

As described in section 7. RRBWSD has been developing several projects in order to meet its measurable objectives by developing approximately **27,500 AFY** of new water supplies as summarized below at an estimated cost of **$10M per year**. In addition to these project costs are administrative and SGMA GSP management implementation and reporting costs of about $200,000/yr.

2020 Projects.

It is estimated that approximately **5,000 AFY** of additional supply could be developed by 2020 by the West Basin Improvements and Stockdale East projects. Total capital costs are approximately $13.2M and annual O&M costs are approximately $386,000. Total annualized cost is $1,341,000 or $268/AF (plus water cost).

2025 Projects.

It is estimated that approximately **11,500 AFY** could be on-line by 2025 through the implementation of Pilot Projects, James Groundwater Storage Project, and the Onyx Project. Total capital costs are approximately $38.8M and annual O&M costs are approximately $753,000. Total annualized cost is $3,223,000 or $280/AF (plus water cost for direct recharge projects).

2030 Projects.

It is estimated that another potential **10,000 AFY** is in development and could be on-line by 2030 through the implementation of the Kern Fan Project. Total capital costs are approximately $45M and annual O&M costs are approximately $1,350,000. Total annualized cost is $4,700,000 or $468/AF (plus water cost).

2035 Projects.

It is estimated that another potential **1,000 AFY** is in project development and could be on-line by 2035 (Western Rosedale In-Lieu Service Area). Total capital cost was approximately $5,100,000 and annual O&M costs are approximately $152,000. Total annualized cost is $526,000 or $467/AF (plus water cost).

RRBWSD estimates that full implementation and management of the groundwater management plan (GSP) could cost up to $10M per year. Costs may be recovered from several sources, including district assessments; charges to white lands via contract; a Water Charge for certain volumetric uses of water; and District water management program revenues. The proposed new water charge would be driven by the need to manage the underlying groundwater reservoir in a sustainable manner, which is something that has been hindered in the short term by hydrology, with the most recent period of drought, chronic overdraft within the basin, and in the long term by regulatory constraints which have been imposed on pumping from the Sacramento-San Joaquin River Delta, which have resulted in a declining yield of the District's contract for imported water from the State Water Project. Management of the area's water resources in a sustainable manner is not just a District initiative; it has been mandated by the State of California's passage of the Sustainable Groundwater Management Act.

Since the cost of a new water supply, assuming it could be found, is highly variable and speculative, it is proposed to initially base a Water Charge on a demand-management strategy. Under this approach, and assuming that long-term average water supply is less than long-term average water use, it would be intended that the Water Charge generate revenue to buy land(s) within the District for the purpose of retiring it from water-using purposes (and potentially for use as recharge facilities - a dual benefit that would both reduce demand and generate additional water supplies). Over time, it is intended that enough land be purchased and retired in this manner such that long-term water supply and water use are in relative balance. The unit Water Charge would be a function of the consumption which will be avoided for each acre retired; land cost; and the demand-management planning horizon. In particular, the land cost per acre is divided by the avoided consumption per acre, which yields a cost per AF of avoided water use. The initial unit Water Charge would be equal to this amount divided by the planning horizon in years. While this strategy is the basis for a proposed Water Charge, the District will place a high priority on and endeavor to develop additional water supply programs to minimize the amount of land retirement which may be required under SGMA.

The District has also entered into contractual arrangements with landowners whose lands are outside of the District to assist those landowners with SGMA compliance. Pursuant to these contracts, the District will recoup costs associated with assisting those landowners. These arrangements are included in Appendix I.

1.4 Description of Plan Area

1.4.1 Geographic Areas Covered

The RRBMA encompasses approximately 48,610 acres of lands (76 square miles) and is generally located at the western limit of Bakersfield between Stockdale Highway to the south and 7th Standard Road to the north, Interstate Highway 5 (I-5) near the west and the Santa Fe Railroad on the east as shown on Figure 1.

Within the RRBMA there are approximately 6,817 acres[1] of lands that are not within any district boundaries but have agreed, via agreement (Appendix I), to be included in the RRBMA along with District lands as illustrated in Figure 1. The lands which are not in the RRBWSD but in the RRBMA are referred to as the Rosedale-Rio Bravo White Lands (RRBWLs) which is a sub-management area of the RRBMA with its own water balance, projects, and management actions.

Within the RRBMA there are approximately 41,793 acres of land that are within the RRBWSD, which are referred to as the Rosedale-Rio Bravo Water Storage District Lands (RRBDL) within the RRBMA which is a sub-management area of the RRBMA with its own water balance, projects, and management actions.

There are 1,512 acres of lands within RRBWSD that are within the boundaries of the Kern River GSA. For purposes of developing and implementing a GSP, these lands will be covered by the Kern River GSA and are not in the RRBMA. These lands may receive certain water supply benefits from the RRBDL projects and management actions.

1.4.2 Plan Area Setting

The RRBMA is primarily rural in nature with the exception of urban development in the eastern portions of the management area as shown in Figure 2. There are approximately 41,000 acres of irrigated agriculture, 3,000 acres developed in residential, commercial and industrial. The areas not developed for typical land uses or undeveloped are mostly developed for water banking facilities, which include storage basin berms, water control structures, canals, groundwater wells, and power lines. The water banking areas total approximately 2,500 acres. There are also Scattered oil-field facilities present in some areas. There are 1,512 acres of lands developed to residential, commercial and industrial within RRBWSD but that are also within the boundaries of the Kern River GSA. There are NO federal or state properties other than road easements in the RRBMA, so no map was created.

The whole of the RRBMA is dependent on groundwater as the primary source of supply. There are approximately 350 wells in the RRBMA (4.7 wells/square mile). Approximately 135 of these wells are agricultural, 29 banking, 24 municipal, and 162 domestic. The M&I wells are predominately on the

[1] The precise amount of acreage is subject to change. The amount of acres in the text is a good faith estimate based upon those landowners who have agreed to participate in the RRBMA as of the date of this report.

eastern portion of the RRBMA and the agricultural and banking wells on the west. Well densities are shown on Figure 3.

The northern monitoring zone is a total of 8,072 acres and has 20 domestic and 32 agricultural wells (1.6 domestic well per square mile and 2.5 agricultural wells per square mile).

The central monitoring zone is a total of 13,377 acres and has 39 domestic and 26 agricultural wells (1.9 domestic well per square mile and 1.2 agricultural wells per square mile).

The southern monitoring zone is a total of 13,461 acres and has 14 domestic and 63 agricultural or banking wells (0.67 domestic well per square mile and 3 agricultural or banking wells per square mile).

The eastern monitoring zone is a total of 11,115 acres and has 86 domestic, 37 agricultural or banking wells, and 23 municipal wells (4.9 domestic well per square mile,2.1 agricultural or banking wells per square mile, and 1.3 municipal wells per square mile).

The south of river monitoring zone is a total of 2,596 acres and has 3 domestic, 6 agricultural or banking wells, and 1 municipal well (0.75 domestic well per square mile, 1.5 agricultural wells per square mile, and 0.25 municipal wells per square mile).

To support groundwater extraction and use, the RRBWSD imports surface water from various sources, including federal, state, and local supplies, through unbalanced exchange agreements, purchase or temporary transfers, or other means as available. Sources include the Central Valley Project (CVP), the State Water Project (SWP), Kern River, and appropriative (pre-1914 and post-1914) water rights. From 1962 through 2017, the District has taken delivery of approximately 3.8 million AF of imported surface water supplies.

1.4.2.1 Conjunctive Use Activity

The RRBWSD current boundary and recharge project facilities are shown on Figure 4. The District's groundwater recharge project was initially developed to take advantage of the Goose Lake channel, which traversed the District from east to west. The channel of the Goose Lake slough has been modified for use as a water conveyance and groundwater recharge canal. The District also participated in the initial construction and expansion of the Cross-Valley Canal (CVC), and has constructed a network of groundwater recharge basins and channels as a part of its project that as of the end of 2017 covers approximately 1,770 gross acres and 1,180 net wetted acres. In addition to the direct recharge facilities there are a number of diversion points off of the RRBWSD and neighboring BVWSD facilities that are capable of conjunctive use operations of up to 20,000 AFY, which would replace groundwater pumping demands with surface water deliveries.

In addition to groundwater recharge basins and channels, the District's facilities include recovery wells and pipelines for return of water as a part of its groundwater banking programs. Seven recovery wells, associated pipelines, and an outlet to the CVC were constructed at the east end of the District in 2006 as part of the RRB-ID4 Joint Use Recovery Project (JURP). The District constructed three recovery wells adjacent to the Enns Ponds and west intake canal in 2009 as a back stop to its groundwater banking programs. Three additional recovery wells were constructed adjacent to the West Basins during 2016 as a part of the District's Drought Relief Project.

The District also has the right to use groundwater recharge and recovery facilities in groundwater banking projects located to the south of the District as a part of agreements with the City of Bakersfield, Kern Water Bank, and the Kern County Water Agency (KCWA). The District has partnered with the Irvine

Ranch Water District (IRWD) in the development of the Stockdale Integrated Banking Project located along the south boundary of the District, which includes the District owned Stockdale East recharge and recovery area and the IRWD owned Strand Ranch and Stockdale West banking areas. All totaled, the District's average groundwater recharge rate is over 600 cfs.

1.4.2.2 Central Valley Project

The Central Valley Project (CVP) is a network of dams, power plants, and canals that provides water supply reliability to the Central Valley in periods of drought. The Bureau of Reclamation makes excess non-storable CVP Section 215 flood water available during wet years. If conveyance is available, this surplus CVP water could be delivered to the RRBWMA from the Friant-Kern Canal through the CVC. RRBWSD is a fourth priority non-CVP SOD Contractor that can take CVP water under certain conditions.

State Water Project

DWR delivers water to 29 State Water Contractors, including 21 south of the Sacramento River Delta, that are served from the California Aqueduct. State Water Contractors can order water up to their Table A allocation under a given allocation set by DWR, even if the water is not needed in that year, and this excess water can be stored outside the contractor's place of service for future use. RRBWSD currently receives SWP water through a water supply contract (Table 1 Entitlement 35,000 AF) with Kern County Water Agency (KCWA), one of the State Water Contractors.

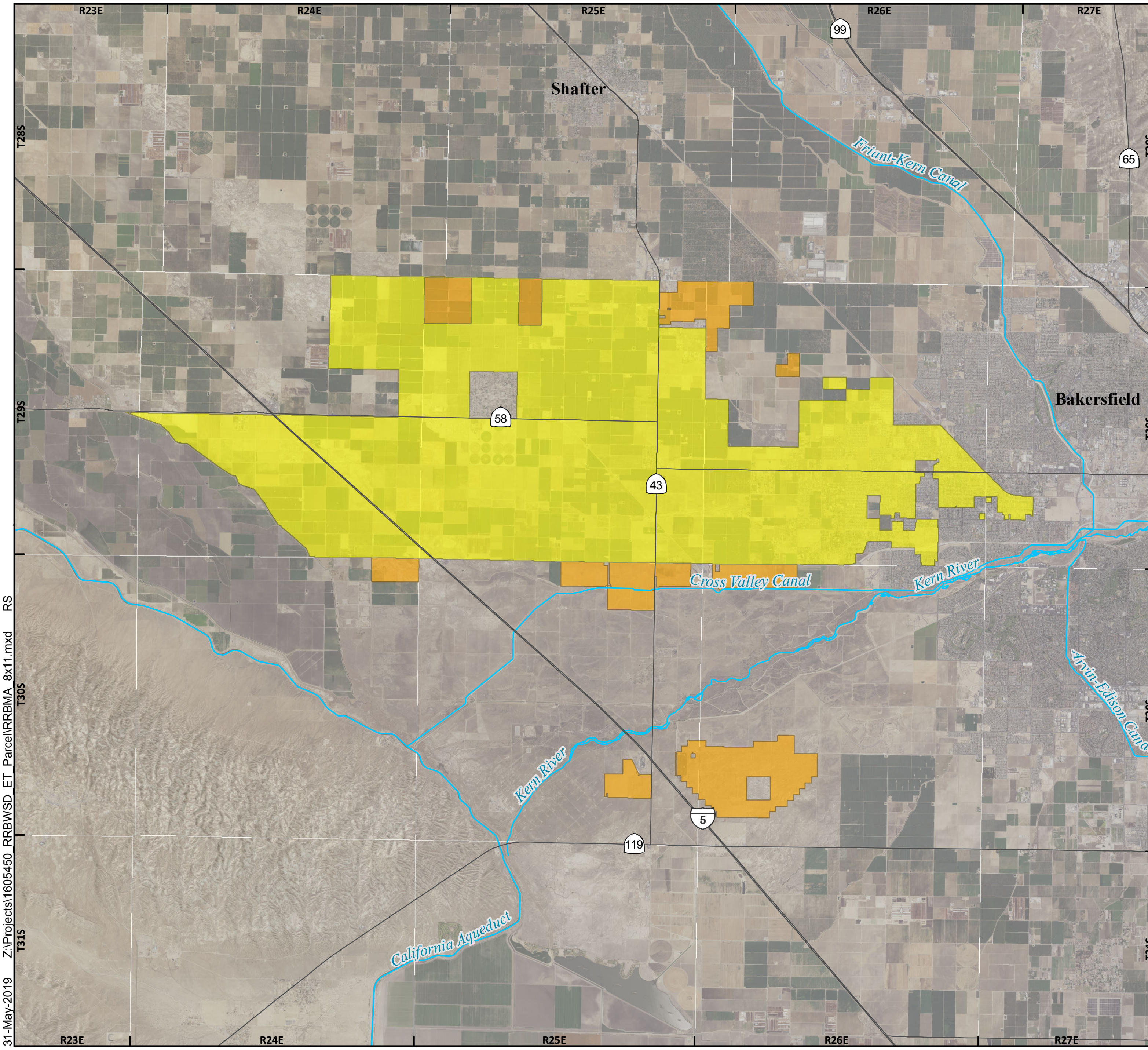
During wet hydrologic years, DWR may declare Article 21 water available, which is uncontrolled water that cannot be stored in State reservoirs. Article 21 supplies are available in short duration, and, if conveyance capacity exists, can be purchased and stored for future use. RRBWSD purchases excess Article 21 water through its State Water Contractor for delivery to existing project recharge facilities using the CVC when such water is available.

Appropriative Water Rights

Surface water rights, including pre-1914 and post-1914 water rights, are held by water districts and parties throughout California, including Kern River water rights. These water rights can be transferred to other parties as long as legal users of water are not injured (per Water Code Section 1706 and 1702). The SWRCB supervises changes to post-1914 water rights, but not pre-1914 water rights.

Unregulated Kern River flows are available during wet years when the U.S. Army Corps of Engineers (USACE) conducts mandatory releases of water from Isabella Reservoir for flood control purposes. The Kern River Watermaster records the amount of water released daily from the Isabella Reservoir into the Kern River. During these periods of flooding, releases from the Isabella Reservoir may be available for diversion.

RRBWSD currently receives Kern River water when it is available for groundwater recharge through water service agreements with the City of Bakersfield and other water right holders. Kern River "release" or "flood" water is also available to RRBWSD when water (1) is offered to all takers willing to sign a Notice/Order; or (2) is offered to the Kern River/California Aqueduct Intertie for disposal; or (3) is expected to flood farm acreage; or (4) is expected to be delivered into the Kern River Flood Channel for disposal out-of-county. RRBWSD also takes this release water from the Kern River for groundwater recharge if and when available.



ROSEDALE-RIO BRAVO MANAGEMENT AREA (RRBMA)

Rosedale-Rio Bravo W.S.D. in RRBMA (41,834 ac)

White Lands in RRBMA (6,828 ac)

All Other Features

Highway

Waterway

N

0 1.5 3 6
Miles

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

GEI Consultants

DECEMBER 2019 FIGURE 1

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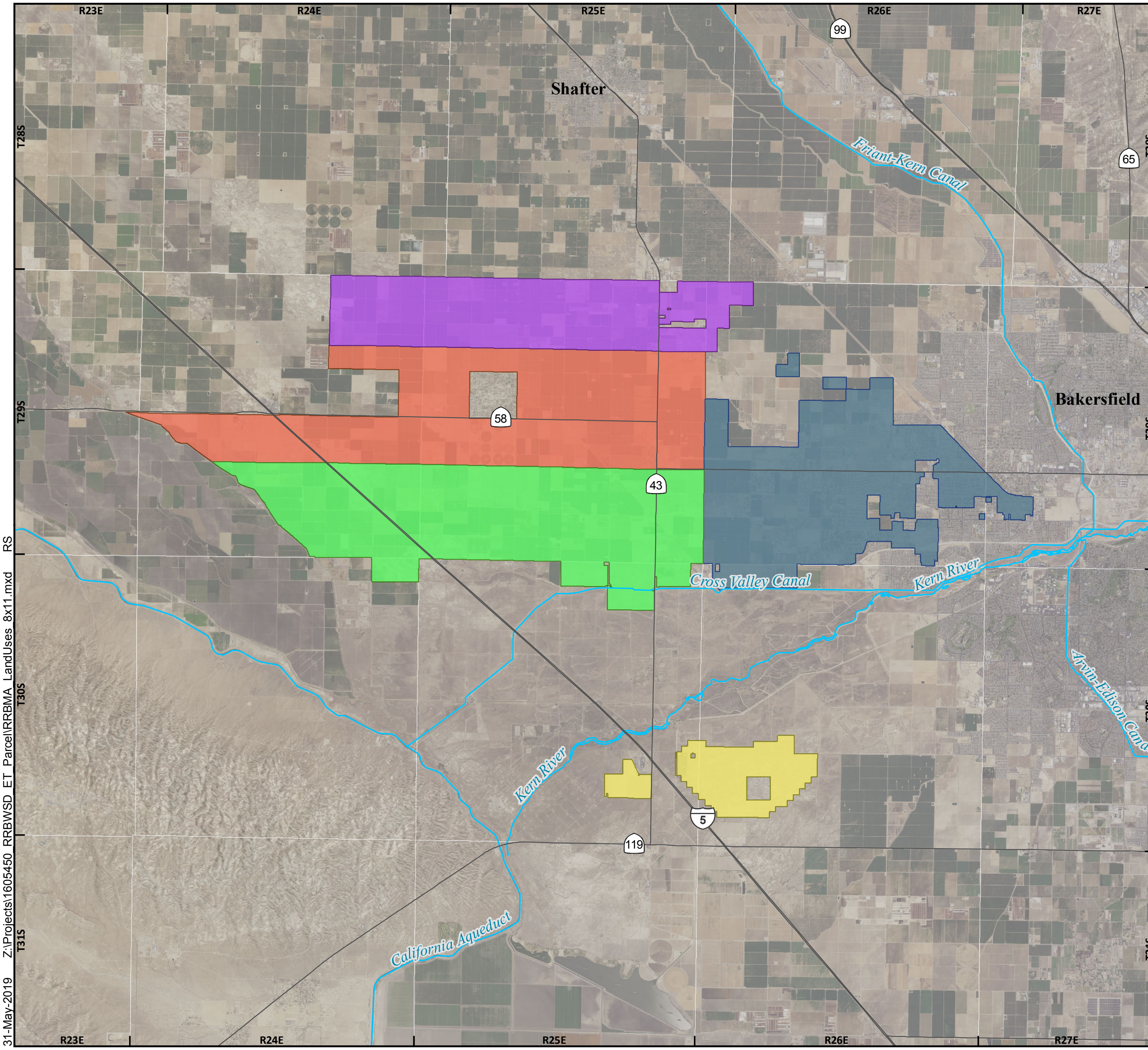

RRBMA LAND USES

Proposed Monitoring Zones

- East Zone - Agriculture, Urban and Groundwater Banking
- South Zone - Agriculture and Groundwater Banking
- Central Zone - Agriculture
- North Zone - Agriculture
- South of River Zone - Agriculture and Groundwater Banking

All Other Features

- Highway
- Waterway

N

0 1.5 3 6
Miles

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

GEI Consultants

DECEMBER 2019 FIGURE 2

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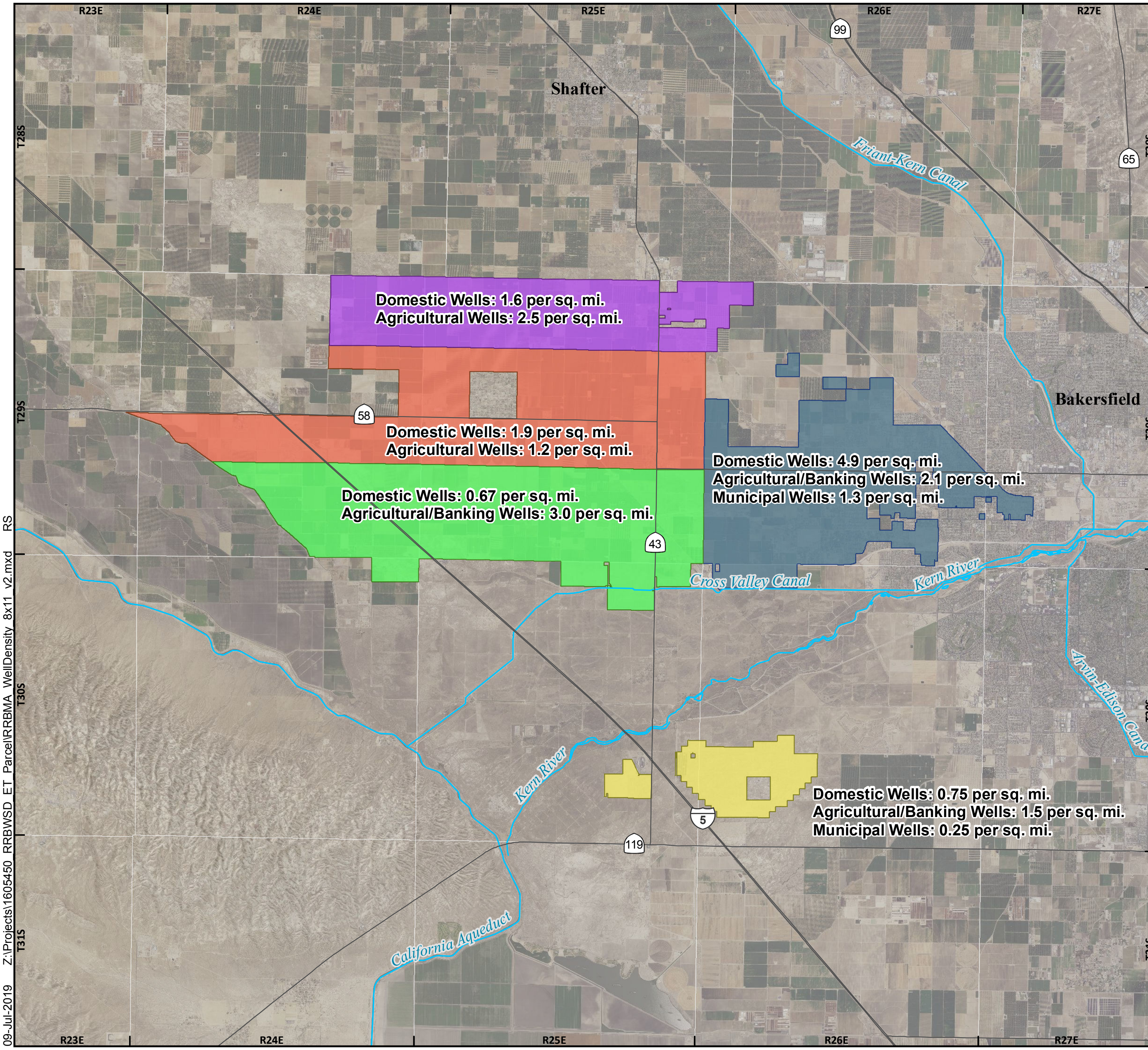
RRBMA WELL DENSITY



Proposed Monitoring Zones

- East Zone
- South Zone
- Central Zone
- North Zone
- South of River Zone

All Other Features

- Highway
- Waterway

N

0 1.5 3 6
Miles

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

GEI Consultants

DECEMBER 2019 FIGURE 3

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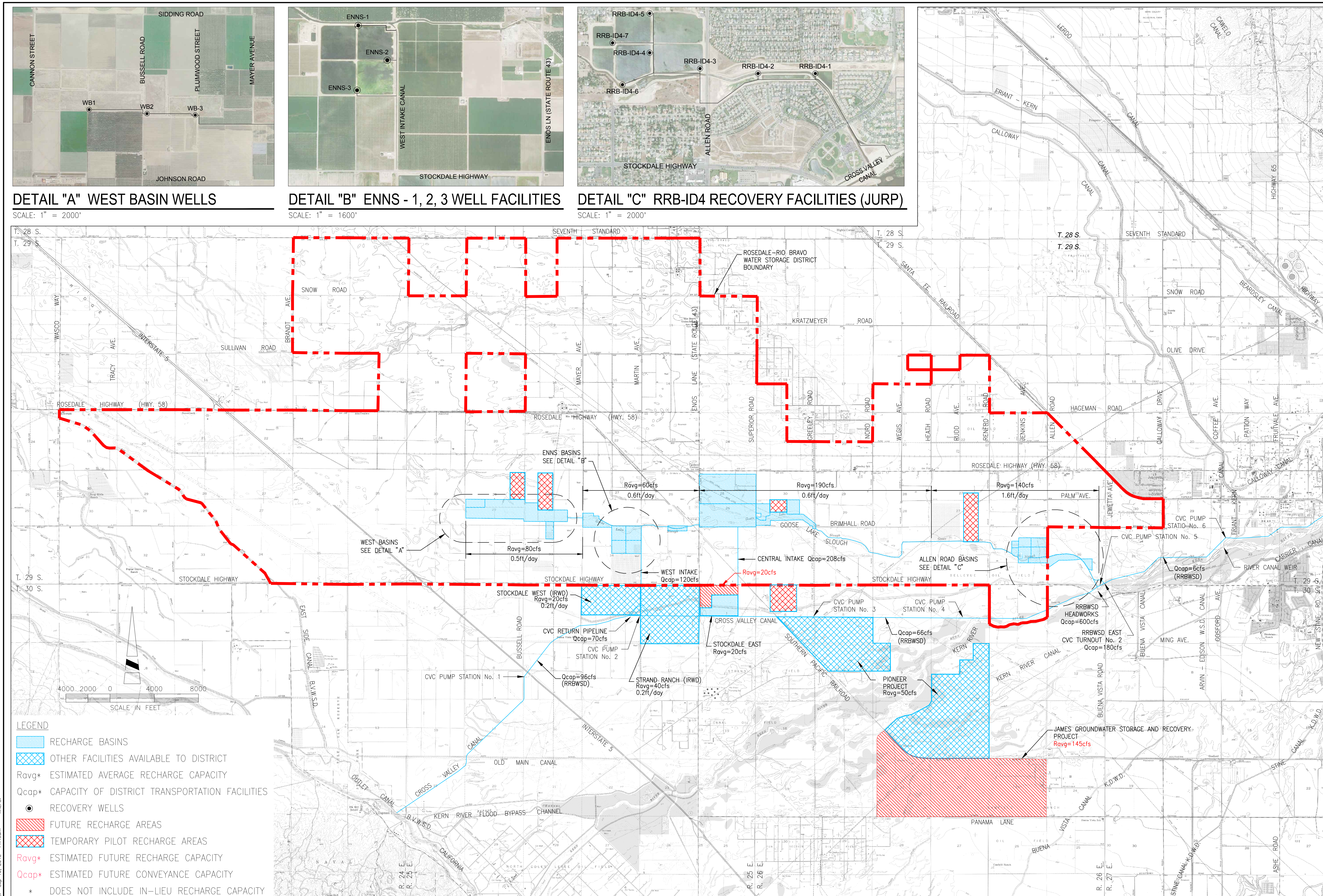


AECOM

FIGURE 4

2017 DISTRICT OPERATIONS REPORT
DISTRICT BOUNDARY AND FACILITIES
ROSEDALE-RIO BRAVO WATER STORAGE DISTRICT
Project No.: 60532551

1.4.3 General Plans in Plan Area

Most lands within the RRBMA also fall within the Kern County General Plan (Kern County Planning Department, 2009), which designates the majority of the lands as Intensive Agriculture as well as the Western Rosedale Specific Plan (WRSP) updated in 2007 as shown on the map in Appendix A-10. The Kern County General Plan is in the midst of a 2040 update which is expected to be adopted in 2019. The Western Rosedale Specific Plan (WRSP) was prepared in response to the concerns of the Rosedale community, landowners, and the Kern County Board of Supervisors. The General Goals of the WRSP is to:

1. Establish the role of Western Rosedale in the Bakersfield Metropolitan area
2. Improve the quality of air, land, water, and plant and animal life
3. Provide a range of housing alternatives
4. Diversify land uses and improve the economic opportunities
5. Provide public facilities and services existing and future development
6. Mange growth to conserve natural resources
7. Provide a mechanism for development of community identity
8. Protect public health and safety
9. Protect existing development from incompatible land uses

The WRSP area is largely served by a series of water districts and companies formed to serve specific housing tracts or areas. The western portion of the WRSP area is served by individual or small group wells, which are not always operated by a named district or company. Vaughn Water Company is the only water purveyor with an established service area within the area. The WRSP area obtains its water solely from underlying aquifers. Currently no treated surface water is delivered into the area aside from groundwater recharge. The existing infrastructure consists of well installations with storage facilities and delivery systems to the serve the developments. No backbone transmission or delivery systems exist within the WRSP area.

According to the WRSP, future reliance on groundwater will not adequately provide a safe, reliable water source for the future. As the water table is repeatedly drawn down, the opportunity is increased for contaminants from various levels of the aquifer to commingle. To alleviate the pressure on the groundwater basin, it will be necessary to increase utilization of surface water either through increased basin recharge or through treatment and direct use of surface water. Groundwater recharge systems will need financial support.

It is not anticipated that any county or city land use plans will be impacted by the implementation of this GSP or that those plans will impact the GSP's implementation. In White Land areas with limited water supplies, the city and county should evaluate impacts on SGMA implementation caused by future developments. As land use changes away from agricultural over the next 20-50 years in the eastern and southern monitoring zones, demands are expected to reduce and water quality considerations increase. As such, revised thresholds may be considered at the 5-year planning intervals.

1.4.4 Other Plan Elements from CWC § 10727.4

A groundwater sustainability plan shall include, where appropriate and in collaboration with the appropriate local agencies, all of the following:

- Control of saline water intrusion.
- Wellhead protection areas and recharge areas.
- Migration of contaminated groundwater.
- A well abandonment and well destruction program.
- Replenishment of groundwater extractions.
- Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.
- Well construction policies.
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects.
- Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use.
- Efforts to develop relationships with state and federal regulatory agencies.
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity.
- Impacts on groundwater dependent ecosystems.

RRBWSD currently participates and cooperates in several existing District, multi-agency and other governmental programs and policies that address applicable issues as follows and found in Appendix A:

1. Memorandum of Understanding Regarding Operation and Monitoring of the Rosedale-Rio Bravo Water Storage District Groundwater Banking Program 2009 Amended (RRBWSD Banking MOU) Appendix A-1);
2. Memorandum of Understanding Regarding Operation and Monitoring of the Rosedale-Rio Bravo Water Storage District Groundwater Banking and Sale Program 2004 (RRBWSD Banking and Sale MOU) (Appendix A-2);
3. Kern Fan Purge Pump Water Quality Sampling Procedures (Sampling Procedures Appendix A-3);
4. Department of Water Resources Water Quality Policy and Implementation Process for Acceptance of Non-Project Water into the State Water Project (Pump-in Policy) (Appendix A-4);
5. Project Recovery Operations Plan Regarding Pioneer Project, Rosedale-Rio Bravo Water Storage District, and Kern Water Bank Authority Projects (Joint Operations Plan) (Appendix A-5);
6. RRBWSD Long Term Operations Plan from Stockdale EIR (Appendix A-6);
7. Kern Groundwater Authority Joint Powers Agreement (KGA JPA) (Appendix A-7);
8. Rosedale-Rio Bravo Water Storage District Groundwater Management Plan 2011 and 2013 (Appendix A-8);
9. Rosedale-Rio Bravo Water Storage District Operations Report, 2017 (Appendix D);
10. Kern County Environmental Health Department Water Well Ordinance; and
11. Kern Fan Monitoring Committee Operations Report (Appendix A - 9)
12. Kern Integrated Regional Water Management Plan
13. Kern River Watershed Coalition Authority

14. California Statewide Groundwater Elevation Monitoring (CASGEM)
15. Kern County Environmental Health Water Wells Program

It is not anticipated that any of the above mentioned will significantly conflict or impact the flexibility of implementation of this Groundwater Sustainability Plan. Some agreements may require minor amendment. RRBWSD will continue to comply with these programs and policies and will coordinate with other agencies as necessary.

1.4.4.1 Kern County Well Ordinance

The Kern County Environmental Health Department issues permits for the construction and destruction of wells within the basin. The ordinance has a number of components related to seals, water quality testing, destruction standards, proximity, and inspections that serve to protect groundwater quality. The Kern County Public Health Department administers the regional Water Wells Program that ensures the public receives water that is safe to drink and the quantity supplied is adequate to meet the community's needs. The Program issues permits to construct, reconstruct and destroy water wells and evaluates the construction and water quality of existing water wells. In making decisions regarding the issuance of new well permits, the County should consider water supply conditions in the Kern Sub-basin and the impact new wells made have on SGMA implementation as described in this GSP.

1.4.4.2 RRBWSD MOU's

Within the RRBMA are lands used for groundwater banking operations that are subject to the conditions specified in the MOU's (Appendix A-1 and A-2). The MOU's recitals state, among other things, that the Adjoining Entities and Project Participants desire that the design, operation and monitoring of the Project be conducted and coordinated in a manner to insure that the beneficial effects of the Project to the Project Participants are maximized but that the Project does not result in significant adverse impacts to water levels, water quality or land subsidence within the boundaries of Adjoining Entities, or otherwise interfere with the existing and ongoing programs of Adjoining Entities. A Monitoring Committee, comprised of one representative of each of the Adjoining Entities and one representative of the RRBWSD, has numerous functions specified in the MOU's including, to Develop procedures, review data, and recommend Project operational criteria for the purpose of identifying, verifying, avoiding, eliminating or mitigating, to the extent practicable, the creation of significant imbalances or adverse impacts.

A primary purpose of the monitoring committee is to evaluate groundwater information and determine if impacts are likely to occur as a result of project operations. If the monitoring committee determines that impacts are likely, then mitigation strategies are developed. Measures to prevent significant adverse impacts from occurring may include: (1) spreading out recovery areas; (2) providing buffer areas between recovery wells and neighboring overlying users; (3) limiting the monthly, seasonal, and/or annual recovery rate; (4) providing sufficient recovery wells to allow rotation of recovery wells or the use of alternate wells; (5) providing adequate well spacing; (6) adjusting pumping rates or terminate pumping to reduce impacts; and (7) imposing time restrictions between storage and extraction to allow for downward percolation of water to the aquifer. The MOU's also stipulate that water quality is to be at least maintained and, where possible, enhanced. Some of the measures prescribed in the MOU's to protect water quality include: 1) giving storage priority to the best quality water available, 2) removing more salts than are stored, 3) controlling the migration of poor quality water, and 4) extracting poorer quality groundwater where practicable (and where blending with excellent quality water from elsewhere in the area results in the water quality objectives of downstream users being met).

1.4.4.3 Pump-in Policy
The delivery of recovered water into the California Aqueduct is subject to the DWR's Pump-in Policy (Appendix A-4). The policy establishes a Facilitation Group of affected stakeholders and describes the requirements to implement a program including necessary monitoring and reporting. In practice, a proposal is submitted to DWR which describes the project proponents, maps showing all water sources and delivery points, rates and volumes of inflow, detailed water quality data for all recovery wells, and the expected blend of water delivered to the aqueduct. Well-water quality data and recovery rates are modeled to determine resultant blends and anticipated water quality changes in the aqueduct, and this information is reported to the Facilitation Group daily during recovery programs.

1.4.4.4 MMRP and Joint Operations Plan
Recovery operations are subject to a Long-Term Operations Plan established in the MMRP and the Joint Operations Plan (Appendix A-5 and A-6). Consistent with the MOU's, both plans designate specific measures to be employed to "... prevent, eliminate or mitigate significant adverse impacts" resulting from project operations. The Joint Operations Plan designates mitigation measures similar to those contained in the Long-Term KWB Plan described in the MMRP. The Joint Operations Plan was developed to supersede the Long-Term Plan as it considers cumulative recovery operations of KWBA, Rosedale, and KCWA projects. Both plans designate a committee that regularly monitors potential groundwater level impacts of banking project recovery operations on neighboring agricultural and domestic wells based on groundwater modeling. Specific triggers are set for potential mitigation actions, with significant impacts being avoided, eliminated, or mitigated by implementing one or more corrective actions, including investigation of any claims and pump lowering, well replacement, and/or reduction or adjustment of banking project recovery operations, as appropriate.

1.4.4.5 KGA Joint Powers Agreement
The KGA GSP includes an umbrella document with chapters that provide specific information for districts/banks/etc.

With respect to water-banking projects, the JPA (Appendix A-7) provides that: "Such chapter or provisions may include operating conditions for groundwater banking projects that have previously been negotiated with other Members or agencies within the Basin and/or are contained within approved environmental documents. The Authority will recognize such operating conditions and/or environmental documents as meeting the requirements of consistency with the Authority's GSP and the requirements of SGMA."

With respect to Kern County Sub-basin coordination the KGA acts as the RRBMA representative with the other Sub-basin GSA's.

1.4.4.6 Groundwater Management Plan
The District adopted a Groundwater Management Plan in 1997 under the provisions of California Water Code (CWC), Division 6, Part 2.75, Sections 10750 et seq., otherwise known as AB 3030. The provisions of CWC Sections 10750 et seq. were amended through California Senate Bill 1938 (SB 1938). At its meeting on November 13, 2012, the District board adopted a Resolution of Intention to update its current Groundwater Management Plan in order to be consistent with the provisions of CWC Sections 10750 et seq. as amended by SB 1938.

The goal of the District, as identified in its 1997 Groundwater Management Plan, is to balance recharge with consumptive use while respecting adjacent landowners and other basin users. Objectives listed in that plan included:

- Formalizing the District's groundwater management practices to provide for the continuance of local management and to enhance existing monitoring activities, and
- Identifying and implementing modifications to ongoing practices in order to preserve and enhance groundwater resources.

The updated 2013 Groundwater Management Plan (Appendix A-8) described current conditions in the plan area and the status of the District's groundwater monitoring and management programs. Annually the District produces an updated operations plan in accordance with plan. In addition, Basin Management Objectives have been developed as a part of this Groundwater Management Plan, as required by CWC Section 10750 as follows:

- Maintaining a positive water supply balance for its landowners,
- Working cooperatively with landowners and other water agencies overlying the Sub-basin on groundwater issues,
- Protecting groundwater quality, and
- Maintaining groundwater levels.

The District updates the report annually and posts it for review on the District website.

1.4.4.7 Kern Integrated Regional Water Management Plan

The Tulare Lake Basin Portion of Kern County Integrated Regional Water Management Plan (Kern IRWMP) is a collaboration of water suppliers, community and government representatives, environmental groups, businesses and a variety of other interested parties. The Kern IRWMP seeks to preserve the economic and environmental health of Kern County communities through comprehensive and efficient management of its water resources. The RRBWSD expects to cooperate and encourage regional projects that seek to accomplish GSP goals.

1.4.4.8 Kern River Watershed Coalition Authority

The Kern River Watershed Coalition Authority (KRCWA) is a joint powers authority, established to serve as the coordinator and coalition (third-party) group under the Irrigated Lands Regulatory Program in the Kern River watershed portion of the Kern County. On February 4, 2014 the Central Valley Regional Water Quality Control Board issued a Notice of Applicability (NOA) to the KRWCA, approving the KRWCA to represent member owners/growers of irrigated agricultural lands within the KRWCA boundary under the ILRP. It is not anticipated the activities under this program will be impact RRBMA SGMA implementation flexibility.

1.4.4.9 California Statewide Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. The RRBWSD cooperates and provides data to said program as required. The program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under SGMA. It is not anticipated the activities under this program will be impact RRBMA SGMA implementation flexibility.

1.5 Notice and Communication

Prior to enactment of the SGMA, the Kern Groundwater Authority (Groundwater Authority) was established to provide a framework for the active, comprehensive management of the groundwater basin underlying the valley portion of Kern County, to preserve and maintain local control (self-determination) of groundwater resources and provide long term surety for all basin users.

With passage of the SGMA, the Groundwater Authority has sought to coordinate local groundwater management efforts and is working with its members to determine the most cost effective and efficient way of meeting the new requirements of the SGMA.

In May 2018 the KGA (of which the District is a member) adopted a Communication and Engagement Plan. Implementation of SGMA and outreach requirements are broken down into four phases:

> Phase 1: GSA Formation and Coordination – Phase 1 ranged from 2015 to 2017, and during this phase, local agencies created groundwater sustainability agencies (GSA). The responsibility of a GSA is to develop and implement a groundwater sustainability plan (GSP) that will consider all beneficial uses and groundwater users within the basin. GSAs were required to be formed by June 30, 2017.
>
> Phase 2: GSP Preparation and Submission – The second phase of SGMA implementation ranges from 2017 to 2020. During this phase, GSAs must develop GSPs with measurable objectives and milestones that ensure basin sustainability. A basin may be managed by a single GSP or multiple coordinated GSPs. The California Department of Water Resources (DWR) developed regulations for evaluating GSPs and alternatives to GSPs by June 1, 2016.
>
> Phase 3: GSP Review and Evaluation – For the Kern Groundwater Authority (KGA), Phase 3 will be held in 2019, and consists of a public review period. The public review period will be held 90 days prior to the adoption of the GSP. Once the GSP has been submitted to the DWR by January 31, 2020, DWR will hold another 60-day review and comment period for stakeholders.
>
> Phase 4: Implementation and Reporting – Following the submission of the GSP, the KGA will immediately begin the implementation of efforts described in the GSP to reach sustainability within the basin. This will be an ongoing effort, as the goal of SGMA is to reach sustainability by 2040.

1.5.1 Participating Agencies

The Kern Groundwater Authority (KGA) provides local policy makers, stakeholders, and the public a forum to monitor, report and/or discuss groundwater activities and identify and address any local groundwater issues.

On April 26, 2017 The KGA (JPA) elected to become a GSA and was formed for the purpose of:

1. Coordinating groundwater management programs and activities;
2. Identifying and addressing issues pertaining to sustainable groundwater management; and
3. Establishing a framework for local groundwater management.

The 16 participants in the KGA are:

Arvin Community Services District
Arvin-Edison Water Storage District
Cawelo Water District
City of Shafter
Kern County Water Agency
Kern-Tulare Water District
Kern Water Bank Authority
North Kern Water District
Rosedale-Rio Bravo Water Storage District
Semitropic Water Storage District
Shafter-Wasco Irrigation District
Southern San Joaquin Municipal Utility District
Tejon-Castaic Water District
West Kern Water District
Westside District Water Authority
Wheeler Ridge-Maricopa Water Storage District

SGMA requires all high- and medium-priority groundwater basins, as designated by the DWR Bulletin 118, to be managed by a GSA or multiple GSAs. Part of the Tulare Lake Basin, the Kern County Groundwater Sub-basin is a high-priority basin that is in critical groundwater overdraft. The Kern County Groundwater Sub-basin currently has 10 GSAs:

Kern Groundwater Authority GSA (KGA)
Buena Vista Water Storage District
Cawelo GSA
Greenfield County Water District
Henry Miller Water District Kern Groundwater Authority
Kern River GSA McFarland GSA
Olcese GSA – Olcese Water District
Pioneer GSA
Semitropic Water Storage District
West Kern Water District

1.5.2 Beneficial Uses

Known RRBMA groundwater beneficial uses include:

Municipal and Domestic Supply (MUN) - Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR) - Includes uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Service Supply (IND) - Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Groundwater Banking - groundwater banking is a critical water resource management tool in California, Kern County, and the RRBMA. The RRBWSD and its partner water agencies practice groundwater banking in the RRBMA to support the various beneficial uses above.

1.5.3 Public Meetings

KGA's Stakeholder meetings are held the first Monday of each month at 3:30 p.m., at the RRBWSD office. These meetings are noticed on the RRBWSD's website. Meeting handouts and draft documents have been made available on RRBWSD's website.

KGA's Board meetings are held at 8 a.m. on the fourth Wednesday of every month, at either the Kern County Supervisor's office or the Greater Bakersfield Chamber of Commerce.

The KGA has hosted numerous informational workshops and solicited comments in a variety of forums including on-line stakeholder surveys in both English and Spanish.

Informational Meeting on Sustainable Groundwater Plan, Compliance & State Intervention – September 20, 2018
Groundwater Workshops – April 26 & May 21, 2018
Stakeholder Workshop #1 – October 24, 2016
Stakeholder Workshop #2 – November 1, 2016
Stakeholder Workshop #3 – November 15, 2016
Stakeholder Workshop #4 – November 28, 2016
Stakeholder Workshop #5 – December 5, 2016
Stakeholder Workshop #6 – December 20, 2016
Stakeholder Meeting – January 7, 2019
Stakeholder Meeting – February 4, 2019
Stakeholder Meeting – January 7, 2019
Stakeholder Poster Session – May 14, 2019
Stakeholder Meeting – June 3, 2019
Stakeholder Meeting – July 1, 2019
Stakeholder Meeting – August 5, 2019
Stakeholder Meeting – September 9, 2019
Stakeholder Meeting – October 7, 2019
Stakeholder Meeting – November 4, 2019

Please see Appendix C of Umbrella GSP for KGA comprehensive outreach effort.

The RRBMA has actively sought to solicit public engagement by means of a its local stakeholder groups. While the RRBMA is governed by the RRBWSD, a RRBMA Stakeholder Advisory Group (Stakeholder Group) has been established to provide stakeholders within the RRBMA an opportunity to participate in the development of the GSP and to review and provide comment as the GSP is developed. This Stakeholder Group is made up of representatives from four key interests within the RRBMA: Agricultural, Urban, White Lands, and Groundwater Banking. Meetings are held the 4th Tuesday of each month or as needed and geared towards discussions surrounding the development and implementation of the RRBMA SGMA GSP. The RRBWSD has designated representatives from each group. Meetings are posted and open to all stakeholders within the RRBMA and key documents are posted on the District website. https://www.rrbwsd.com/rrbma

White Land Stakeholder Workshop - November 11, 2018
RRBMA Stakeholder Workshop #1 – January 29, 2019
RRBMA Stakeholder Workshop #2 – February 26, 2019
RRBMA Stakeholder Workshop #3 – March 26, 2019
RRBMA Stakeholder Workshop #4 – April 23, 2019
RRBMA Stakeholder Workshop #5 – May 28, 2019
RRBMA Stakeholder Workshop #6 – June 25, 2019
RRBMA Stakeholder Workshop #7 – July 23, 2019
RRBMA Stakeholder Workshop #8 – August 27, 2019
RRBMA Stakeholder Workshop #9 – September 24, 2019
RRBMA Stakeholder Workshop #10 – November 26, 2019

Please see RRBMA outreach documentation in Appendix B.

The District maintains a website (www.rrbwsd.com); the District regularly posts materials regarding SGMA and conducts outreach to all stakeholders using the website. The RRBWSD has extensively participated in an exchange of information with other members of the KGA. Informal comments on this information were received and discussed at Stakeholder workshops. In addition, the RRBWSD Board of Directors has discussed SGMA topics at many of its regular and special meetings during the past few years.

At the RRBMA Stakeholder meetings, scores of topics have been covered including but not limited to: decision making process, public engagement, schedule, process, thresholds, undesirable results, projects, management actions, CEQA, basin coordination, sustainable yield, water balance, and consumptive use.

1.5.4 Comments Received

KGA comments are found in Appendix C of Umbrella GSP. RRBWD solicited informal verbal and written comments on three administrative drafts (March 22, June 7, and July 23, 2019) and incorporated recommendations as appropriate. RRBWSD also received informal and formal comments on the December 10, 2019 draft. The one formal comment are included in Appendix B of this RRBMA Chapter. These comments were also received by the KGA and others. KGA provided responses in the Umbrella GSP matrix.

1.6 GSP Organization

See section 1.5 of Umbrella GSP.

2. Basin Setting

2.1 Hydrogeologic Conceptual Model

See section 2.2 of Umbrella GSP for Kern County Sub-basin conceptual model and basin setting.

2.1.1 Local Refinements

As part of the RRBWSD's efforts to manage groundwater and evaluate impacts of neighboring groundwater banking projects a numerical groundwater flow model was developed in 2011 and has been updated and refined each year since. Current model boundaries and calibration wells are shown on Figure 5. A more detailed description is found in Appendix C. Plates 1-6 of the Hydrogeological Impact Evaluation Related to Operations 2011 found in Appendix C includes geologic cross sections. Figures 5-40 of the same report depict maps, graphs and charts depicting numerous hydrogeologic conditions of the RRBMA. The tool has been essential in mitigating groundwater impacts from banking recovery as well as evaluating future groundwater levels relative to future projects and management actions. For the RRBMA this tool was used to evaluate the adequacy of projects and management actions to effect compliance with minimum thresholds and measurable objectives. Transmissivity from specific capacity data for the area generally range from 100,000 to 400,000 gpd/ft, likewise available data indicates storativity values ranging from 0.00006 to 0.002 (T.Harder, 2011). These values indicate confined to semi-confined aquifer conditions. Groundwater collected from nested monitoring wells perforated in the upper approximately 250 ft of aquifer is generally enriched in calcium relative to the other cations. In contrast, groundwater from nested monitoring wells perforated deeper than 250 ft below ground surface (bgs) is generally enriched in sodium/potassium relative to other cations (T.Harder, 2011). These and other local conceptual model findings are found in the Appendix C.

2.1.1.1 Regional Geologic Setting

The hydrogeology of the southern San Joaquin Valley, and in particular the Kern Fan area, has been the focus of several previous studies by the Department of Water Resources and/or the United States Geological Survey. Croft (1972) studied in detail the hydrogeology of the Kern Fan area and Dale (et.al., 1966), in a broader work, studied the subsurface geology of the water bearing deposits beneath the southern San Joaquin Valley. The Department of Water Resources investigated the geology of the Kern Water Bank in great detail during the completion of studies for the development of the Kern Fan Element and the Rosedale Local Element of the Kern Water Bank (DWR, 1990). These earlier studies were subsequently refined by the RRBWSD as more information regarding the aquifer became available (R.Crewdson, 2003 and T.Harder, 2011).

The RRBMA lies within the region of California referred to as the Great Valley geomorphic province. The Great Valley geomorphic province is a long alluvial plain that runs approximately 400 miles through central California (CGS, 2002). The Great Valley can be further divided into the northern Sacramento Valley and the southern San Joaquin Valley. The RRBMA is located within the San Joaquin Valley which is flanked by the Sierra Nevada Range to the east, and the Coast Range to the west. Sediments located within the project area range in age from the Jurassic to Holocene period. Granitic and metamorphic rocks outcrop along most of the eastern and southern flanks of the Great Valley and marine rocks of pre-Tertiary age outcrop along most of the western flank. Post-Eocene-aged continental rocks and deposits found in this area contain most of the fresh groundwater and are underlain by or contain saline water at depth.

The Coast Range is dominated by the northwest trending San Andreas fault. Large coalescing alluvial fans have developed along each side of the valley (CGS, 2002). The larger and more gently sloping fans on the east side consist of deposits derived from the massive intrusive igneous rock sources of the Sierra Nevada; whereas, the smaller and more steeply sloping fans on the west side are built up by sediments originating from predominantly sedimentary rocks of the Coast Range. As a result, the valley floor consists mainly of two kinds of alluvial materials that differ widely in provenance and their respective engineering properties (CGS, 2002).

The Sierra Nevada block has been tilted westward, caused by faulting and uplifting of the eastern edge. The western side is depressed and overlain by the sedimentary deposits of the valley. The southern boundary of the Sierra Nevada block is the east-west running Garlock fault. The site is located on alluvial deposits derived from the Sierra Nevada Range near the southern boundary of the San Joaquin Valley.

2.1.1.2 Geology of the Aquifer

The RRBMA is located within the Kern County Sub-basin of the San Joaquin Valley Groundwater Basin (DWR, 2006). The sub-basin covers the western third of Kern County and includes Kern River and Poso Creek. Geologically, San Joaquin Valley is a structural trough created by tectonic forces and filled with older marine and younger continental sediments that were eroded from the surrounding mountains. These continental sediments derived from the alluvial processes form a wedge of deposits that thicken toward the center of the valley.

The sedimentary deposits of the valley have been estimated to range in thickness from 175 to 2,900 ft with an average of approximately 600 ft (DWR, 2006). Specific yield, the amount of water in storage in the ground that will drain under the influence of gravity and a measurement of water available for man’s use, ranges from about 3 – 12% in silts, 15 – 27% in sands and as high as 31% for gravels in the interval from surface down to 300 to 600 ft deep (DWR, 2006). The highest specific yield measurements are associated with sediments of the Kern Fan west of Bakersfield, including those in RRBMA. The well-sorted, sandy sediments have higher specific yields than finer grained silts and clays. For most of the basin, excluding the area of the Kern Fan, there are two water bearing units that are separated by an aquitard known as the Corcoran Clay, which restricts vertical groundwater flow between the overlying unconfined aquifer and the underlying confined aquifer. The hydrogeology of the Kern Fan region is characterized by thick alluvial deposits with an upper unconfined aquifer and areas where there are semi-confined conditions. A semi-confined aquifer is also referred to as a leaky aquifer where the confining layer is not continuous and vertical flow occurs between the upper unconfined aquifer and the lower aquifer. Some estimates indicate a total water storage capacity of 40 million AF (DWR, 2006).

The upper aquifer is considered to be unconfined and extends down to a depth of approximately 200 to 400 ft. The upper unconfined aquifer consists of interbedded silts, sands, with some minor deposits of clay (Meillier, 2001). In the Kern Fan area west of Bakersfield, the Corcoran Clay is not generally present although there are numerous discontinuous clay layers that can locally restrict vertical flow creating a separation between a shallow unconfined aquifer and a deeper semi-confined aquifer. The lower semi-confined aquifer, on average, extends to a depth of approximately 600 ft though in some areas can be quite deeper.

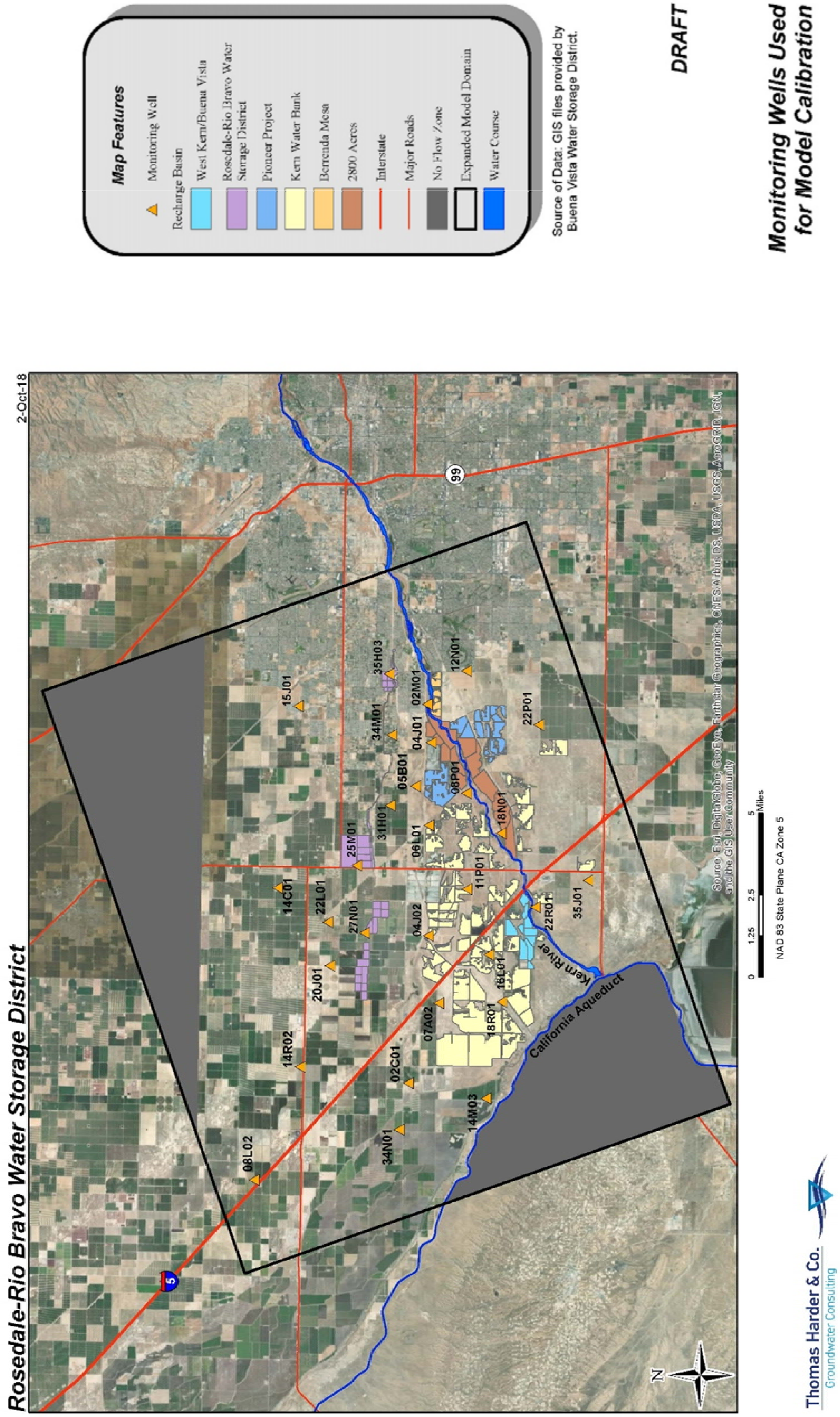


Figure 5. RRBWSD Numerical Model Boundary

2.1.1.3 Kern River Characteristics

The Kern River is a losing stream where it runs immediately south of the RRBMA, having only received flows in 6 of the last 22 years. The Kern River Reports prepared by the City of Bakersfield have recorded losses since at least 1987 throughout the lower reaches of the river from the 1st point of measurement several miles east of the RRBMA to the 2nd point of measurement just south of the RRBMA.

The RRBMA is in the central portion of the Kern County Sub-basin. Immediately south of the RRBMA is located the Kern River and is at the distal end of the Kern River Alluvial Fan.

2.2 Water Budget Allocation

2.2.1 Kern Sub-basin Water Budget

All GSAs in the Kern County subbasin (Subbasin) coordinated and collaborated on the development of a groundwater model (Model) to evaluate historical, baseline and projected groundwater conditions. The GSAs entered into a Cost Share Agreement with the Kern River GSA who took the lead and contracted with Todd Groundwater to develop the Model on behalf of the Subbasin. The contract required that Todd Groundwater use the C2VSim model provided by DWR. Considerable effort and resources were expended to update the C2VSim model with local data to better represent Subbasin conditions. The process Todd Groundwater used to update C2VSim is more fully described in the Historical and Projected Future Water Budget Development (see Attachment H in Umbrella GSP). Basin-wide water budget results from the Model are provided in Attachment H and show the Subbasin, as a whole, has a total storage deficit of approximately 324,326 AFY over the baseline period.

The Subbasin's dynamic conjunctive use programs, water banking operations, and water transfers/exchanges made it necessary to coordinate a GSA level water accounting system (Checkbook) using Subbasin specific values for supply, demand and net results. The Model results reflect Subbasin-wide conditions and do not allocate water shortages/surpluses, nor do the results allocate the "ownership" of water. As a result, the GSAs, through a coordinated effort, developed the Checkbook that estimates current conditions for each GSA that are generally consistent with the Model results under baseline condition. The Checkbook and Model budgets are based upon best available information, recognizing however, each estimate includes data gaps and has varying degrees of accuracy and/or reliability in the interest of developing a Subbasin coordinated approach.

To ensure the individual water budgets reflected actual conditions, the KGA members developed the Checkbook budget and coordinated water accounting methodology. The result of that effort indicates a current baseline shortage/deficit for KGA members of approximately -256,281 AFY.[2] This reflects the difference between a total demand for KGA members of 1,939,409 AFY, and a total supply of 1,683,128 AFY. Of the shortage/deficit of the KGA, Rosedale Rio-Bravo Management Area's portion of the KGA shortage/deficit is 20,116 AFY. Or a difference in demand of 118,860 AFY and a water supply of 98,744 AFY.

[2] The water supplies available to each KGA member from the Pioneer and Kern Water Bank banking programs are incorporated into the listed total available supplies. Note that both programs only store surface supplies, and do not have consumptive demands that contribute to the listed shortages. For more detail on the banking projects, please see the respective management area plans.

As is mentioned above, each estimate includes data gaps and has varying degrees of accuracy and/or reliability. The Checkbook is complimentary to the Model and reflects the allocation of water supply benefits and obligations independent of geographic constraints within the Subbasin. This was important to recognize and ensure the coordination of the various groundwater banking projects and water management programs amongst the various GSA's within the groundwater basin.

2.2.2 RRBDL - RRBWSD Sub-Management Area Water Budget

In 2017, the RRBWSD recharged into storage 323,000 AF of water net of losses, which is the highest on record for the District. Annual banking recovery volumes have reached 50,000 AF with an average overlying annual demand of about 105,000 AF in the RRBWSD. The overlaying demand includes an in-district consumptive use of about 87,000 AF of agricultural demand and 9,000 AF of urban demand as shown in Appendix E.

The Umbrella GSP groundwater model produced a basin-wide balance as described in section 2.3 of the Umbrella GSP. In its Operations Plan Update, the RRBWSD updates its numerical checkbook groundwater balance each year as shown in Appendix D and components described below. This is a valuable tool for the District to evaluate whether the District is balancing supplies and demands over time and whether management actions must be taken or projects implemented to meet the sustainability objectives.

2.2.2.1 Native Yield

There are many definitions of native yield, legal and otherwise; however, for the purposes of this chapter, it refers to groundwater benefits available to landowners that do not relate to Rosedale's efforts to import surface water supplies that are recharged into the groundwater aquifer and recovered in the RRBMA. Functionally, it is the proportionate share of local unadjudicated waters that enter the Kern County Sub-basin that are not a result of imported water supplies. The KGA, per its coordinated guidance document, has allocated a value of 0.15 AF per acre to all developed lands within each management area for water budget planning purposes. By definition, this unit value is intended to reflect a long-term average; the actual native yield in any given year is dependent upon hydrology, which is highly variable from year to year in the region. A non-precedent-setting approach of native yield unit value of 0.15 AF/acre for each APN in the RRBMA will be used in the balance calculations herein. It is understood that this number may not be the actual amount; native yield will be periodically reviewed by RRBWSD (and others) and will be refined as necessary as more definitive information is available. Native yield is only applied to offset groundwater extraction for overlying uses. No policy as to transferability of native yield should be assumed. There are 41,793 acres in the RRBWSD, thus resulting in a native yield of 6,269 AFY.

2.2.2.2 Precipitation

Precipitation amounts on the Kern Sub-basin surface are very limited and generally do not completely percolate to groundwater. The Shafter #5 CIMIS Station reported an annual range of 2.6 inches up to 13.05 inches for the 2005-2015 period with an average of 5.04 inches (0.42 ft). Because the water use calculation method described below accounts for all soil evaporation and crop ET, a gross precipitation number must be used across developed lands. Therefore, there was an average of 17,362 AFY (41,793 acres total – 996 acres undeveloped x .42 ft) of precipitation for the period.

2.2.2.3 Project Water

Project Water in RRBWSD is considered to be that which is recharged within or by the District for the benefit of its landowners, all of whom have access to the underlying groundwater reservoir for overlying use. The nature of the District's Project is such that recharge is highly variable from year to year, ranging from zero to about 275,000 AF within the District. The District also has access to recharge projects on the Kern River Fan, just south of the District, where it recharges water for the benefit of the District. During periods of drought there can be several consecutive years with little to no recharge. Accordingly, it is appropriate to consider an average annual recharge amount.

While the 20-year period extending from 1998 through 2017 will be used initially, a rolling 20-year average will be used going forward. It is intended that the annual average for the period be representative of the long-term average that can reasonably be anticipated going forward. If and when the prior 20-year period is not considered representative owing to changed conditions, adjustments may be required in the methodology. Water balance tables from the District's 2017 Operations Report are found in Appendix D and provide the basis for determining the average annual amount for 1998-2017, which is approximately 70,315 AFY. Based on the entirety of District Assessed Acres totaling 39,468, this results in Project Water amounting to 1.78 AF/acre/yr. Based on KGA baseline budget guidance the project water estimate of 69,479 AFY is made up of 22,811 AFY of SWP supplies, 9,438 AFY of CVP supplies, 29,003 AFY of Kern River supplies, and 8,227 AFY of other acquired supplies and banking program benefits. Long-term water supply forecasts (2015-2070) without climate change predictions is 70,616 AFY, which is extremely consistent with historic water supply amounts.

It is recognized that the sustainable yield calculation above is based on a 20-year historical period and may not represent future water supplies with respect to climate change and regulatory restrictions. According to DWR SWP Calsim, Friant-Kern and Kern River water supply forecasts it is expected that historical Project Water could be reduced by about 10,000 AFY (analysis in Appendix F) based on 2030 climate change predictions and the resultant water supply deficiency of 60,735 AFY as shown on Table 2.

2.2.2.4 Demand

As used herein, water use is defined as the total annual consumptive use of water (also referred to as total evapotranspiration or ET) and transfers under the District's water management programs. The total ET is intended to reflect the ET of applied water, as well as the ET of rainfall. In recent years, ET has been estimated by applying remote sensing techniques, and it is proposed that these techniques, or other functionally equivalent means, be used to estimate ET for the purposes described in this report, as opposed to using a metering device at each well. Though not the only provider, one such provider of these data is the Irrigation Training and Research Center (ITRC) located at Cal Poly San Luis Obispo. ITRC has been retained by the Kern Groundwater Authority to develop estimates of historical ET for several years. Data is found in Appendix E. By applying GIS techniques to the ET images generated by ITRC, the estimated ET corresponding to a specific area can be extracted on an annual (or more frequent) basis. In this manner, Assessor's parcel boundaries will be applied to the ET images for the purpose of developing an estimate of the total annual ET for each parcel for a given year, in addition to the total annual ET for the District as a whole. Average Water Use for the entire District, including the portion in the Kern River GSA,under existing conditions has been estimated by the ITRC to be 92,341 AFY (2005-2015). Based on review of ITRC ET estimation results the KGA decided that 5% should be added to account for potential methodology uncertainty which increases the 92,341 AFY up to 96,958 AFY. Annual water use on non-developed lands during 2017-2018 was 295 AFY. This includes ET of all vegetation as well as soil evaporation. In addition to the ET demand the District transfers about 9,500 outside the boundaries of RRBWSD to meet contractual program commitments. While the ITRC methodology includes urban development ET it does not account for internal usage that does not return to the groundwater basin within the RRBMA. While this number is unknown it is estimated to be 750 AFY (50% of the 7,500 acres of urban development times 2 AF/acre times 25% for internal use). Going forward, these estimates will be updated annually as the average of the last five years. This results in a total current annual demand of 108,038 AFY (96,958 AFY – 295 AFY + 9,500 AFY + 1,875 AFY). Projected future demands through 2070 may increase over time due to climate change affecting ET, decrease due to conversion of agricultural lands to urban, and decrease due to reduced District water sale commitments. It is expected that at least 2000 acres of agricultural land will convert to urban reducing demand by 2000 AFY (2.6 AF/acre ag – 1.6 AF/acre urban). ET on the remaining agricultural lands may increase by 3% (87,000 AFY x 3%) or 2,600 AFY. This results in a projected demand of 98,013 AFY.

2.2.2.5 Sustainable Yield (Water Balance)

Sustainable Yield is the sum of Native Yield, Precipitation and Project Water, all as described above. Table 1 shows historic average annual water supply surplus or deficiency by comparing water demand under existing conditions (2006-2015) with the average Sustainable Yield for the last 20 years (1998-2017). As shown, this amount is indicated to be on the order of 14,918 AFY of deficiency over the period. Table 2 depicts a forecasted balance considering regulatory and climate change stressors without the implementation of new projects and management actions (see section 7.3 and 7.4), to account for assumed changing conditions. This results in a potential deficiency of 13,647 AFY.

Native Yield	6,269 AFY
Precipitation	17,362 AFY
Project Water	69,479 AFY
Sustainable Yield	**93,111 AFY**
Demand	**108,038 AFY**
Deficiency	**14,918 AFY**

Table 1. Summary of Historical RRBWSD Water Supply, Water Use, and Implied Water Supply Balance

Native Yield	6,269 AFY
Precipitation	17,362 AFY
Project Water	60,735 AFY
Sustainable Yield	**84,366 AFY**
Demand	**98,013 AFY**
Deficiency	**13,647 AFY**

Table 2. Summary of Projected (2015-2070) RRBWSD Water Supply, Water Use, and Implied Water Supply Balance without Projects and Management Actions

2.2.3 RRBWL - White Land Sub-Management Area Water Budget

RRBWL lands are not included in the above RRBWSD balance. RRBWSD has no records of surface water deliveries for any of the RRBWL (other than for groundwater banking project operations - RRBWSD and IRWD owned – which are reflected below as Project Water to offset recharge losses (ET) of the banking operations). Demands for developed lands during the 2017-2018 period averaged 10,307 AFY (1.05 x 10,307 AFY = 10,822 AFY) as shown in Appendix E. Assuming the allocation of 0.15 AF/acre of native yield (6,817 acres x 0.15 AF/acre = 1,022 AFY) and an average of 0.44 AF/acre of precipitation (5,800 developed acres x 0.42 AF/acre = 2,436 AFY) the current deficit is 5,198 AFY as shown on Table 3.

Native Yield	1,022 AFY
Precipitation	2,436 AFY
Project Water	2,165 AFY
Sustainable Yield	**5,623 AFY**
Demand	**10,822 AFY**
Deficiency	**5,198 AFY**

Table 3. Summary of RRBWL Water Supply, Water Use, and Implied Water Supply Deficiency

2.3 Existing/Ongoing Water Resources Programs/Policies

See 1.4.4 Other Plan Elements from CWC § 10727.4

2.4 Existing Monitoring

For Basin-wide monitoring see section 2.3 of Umbrella GSP.

2.4.1 Groundwater Level Monitoring

Historic water levels in the RRBMA have varied through time in response to wet and dry cycles and water banking operations. The RRBMA measures 55 wells and the long term average water level hydrograph is shown in Figure 6. The hydrograph shows a steady decline in the average depth to groundwater from about 110 ft in the early 1960's down to 175 ft in the late 1970's and deliveries for RRBWSD purposes. From that period until the beginning of the most recent drought groundwater depths maintained from 150-200 ft (150 ft in recharge years and 200 ft in drought years). But during the last drought cycle (2012-2016) groundwater depths fell to below 250 ft for the first time. Since that time the average water level has recovered to about 200 ft. A chronic lowering of water levels was not indicated until the most recent drought when numerous pumps were lowered and many wells went dry, which occurred in the RRBMA in spite of the historical water management efforts within RRBWSD as demonstrated in the water budget on Table 1.

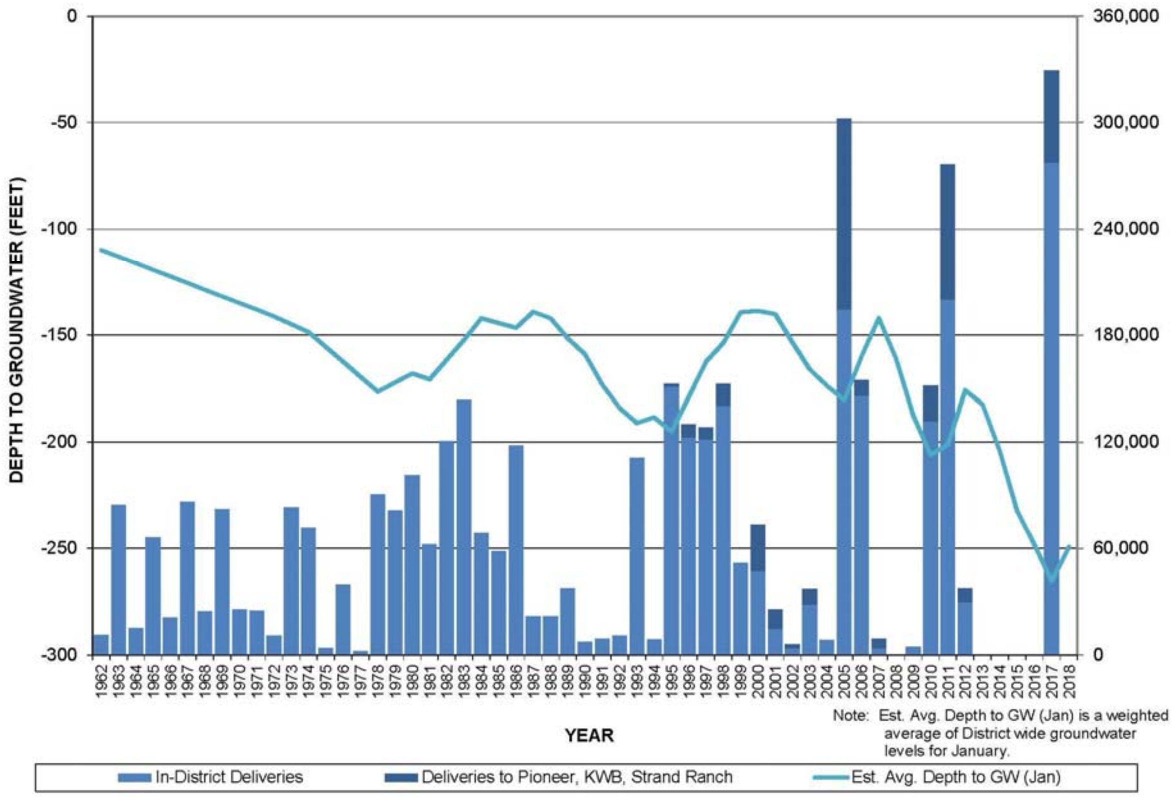
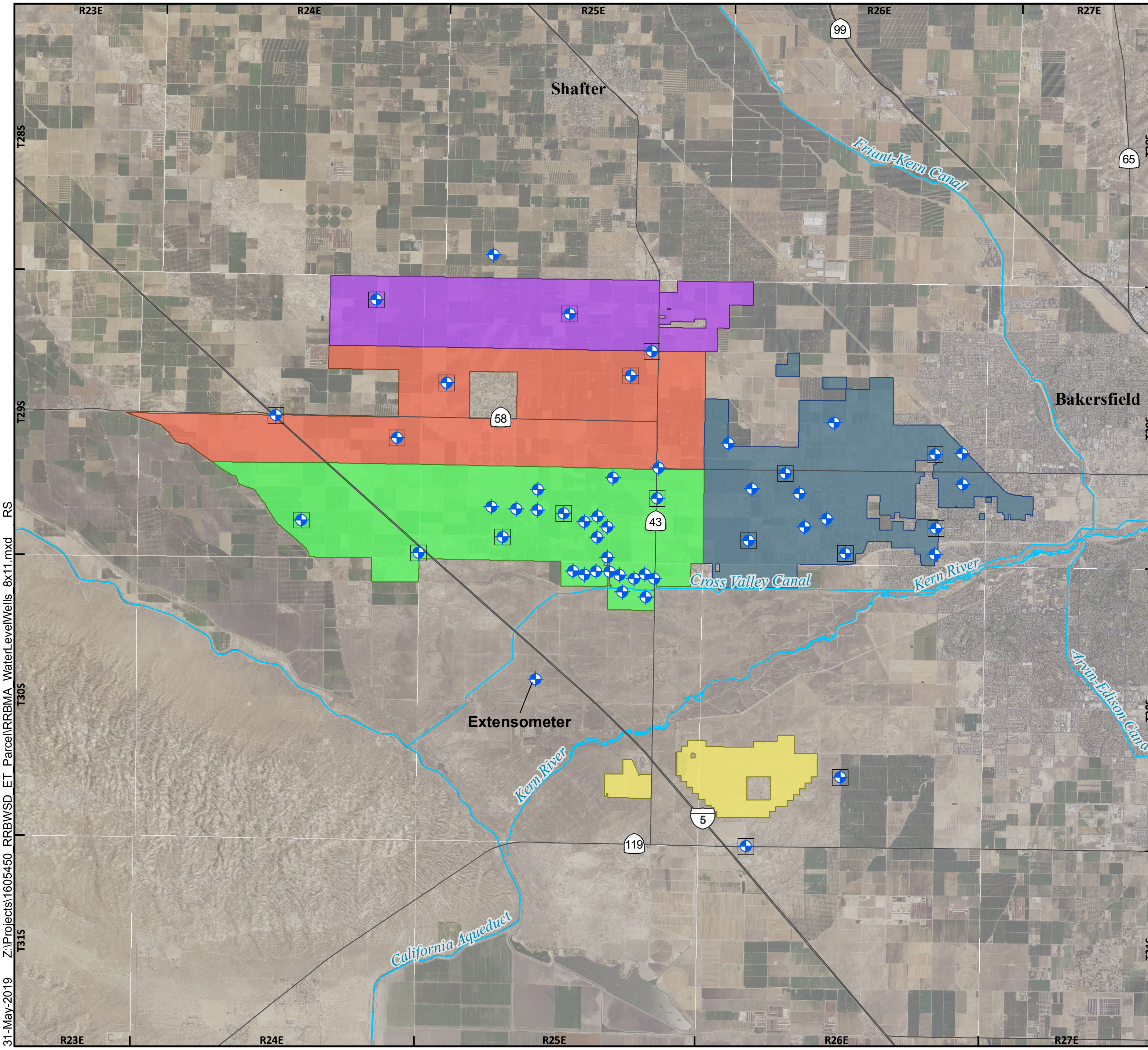


Figure 6. Average Depth to Groundwater

The average water level within the RRBMA is helpful as to long-term regional trends but is unable to identify more site-specific water level changes within the management area. The RRBMA is divided into four general zones of similar groundwater conditions with a hydrograph from a number of long-term monitoring wells within the zone. These Zones as shown in Figure 7 are the North, Central, South, East and South of River.

Long-term groundwater hydrograph plots of potentiometric surfaces are shown in Figures 8-12 for each of the zones (North, Central, South, East and South of River). It is noteworthy that the Northern and Central Zones show a muted impact of recharge and recovery operations from the banking projects to the south and indicate a steady decline from about 2001 to date of about 5-6 ft per year. The South and East Zones however depict large fluctuations consistent with large recharge and recovery cycles on the Kern River Fan and reflect similar groundwater level declines of about 3-4 ft per year over the 2001 to current period. The South of River Zone also depicts large fluctuations consistent with large recharge and recovery cycles on the Kern River Fan and reflect similar groundwater level declines of about 3-4 ft per year over the 2001 to current period.

Groundwater depths in the RRBMA generally get deeper with distance from the Kern River. Depths range from 100 ft to 240 ft immediately after the most recent recharge cycles and 240 ft to 300 ft during the most recent drought cycle, Figures 13-14. Seasonal fluctuations in the northern and central monitoring zones are limited (5-15 ft) due to the nature of an unconfined and semiconfined system. The zones closer to the Kern Fan banking area can experience seasonal swings of 5-75 ft.



RRBMA MONITORING ZONES FOR WATER LEVEL WELLS

Water Level Well

RRBMA Water Level Well

Proposed Monitoring Zones

East Zone

South Zone

Central Zone

North Zone

South of River Zone

All Other Features

Highway

Waterway

N

0 1.5 3 6

Miles

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

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FIGURE 7

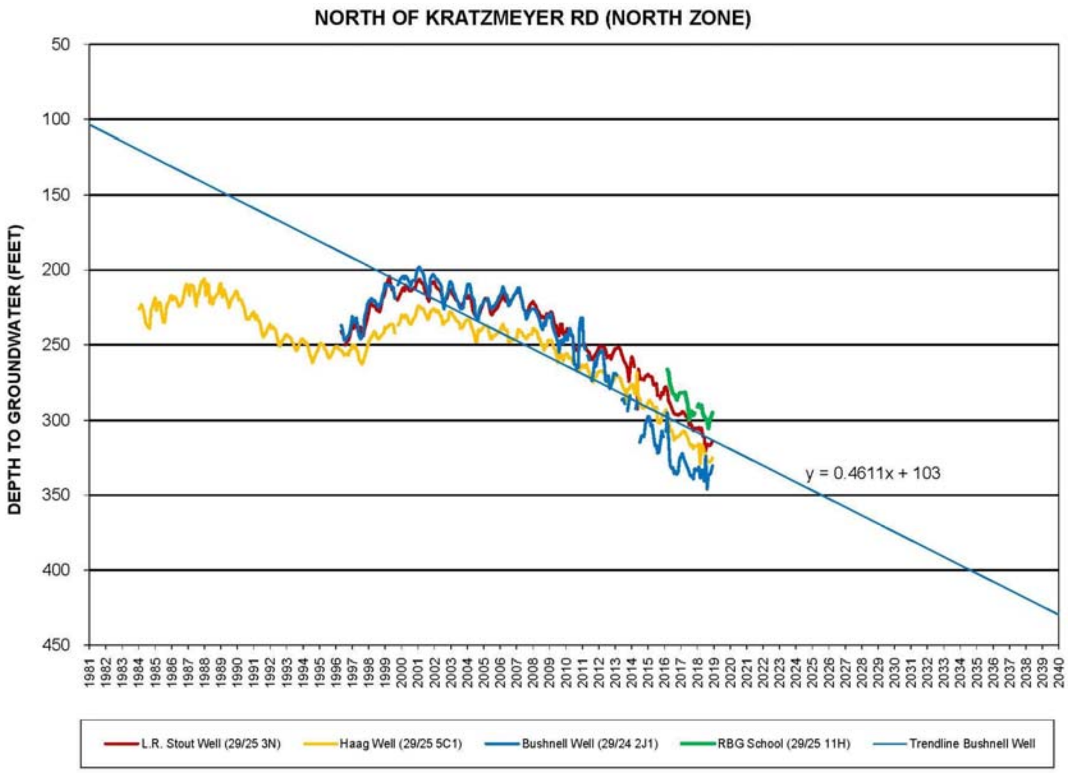


Figure 8. North Monitoring Zone Hydrograph

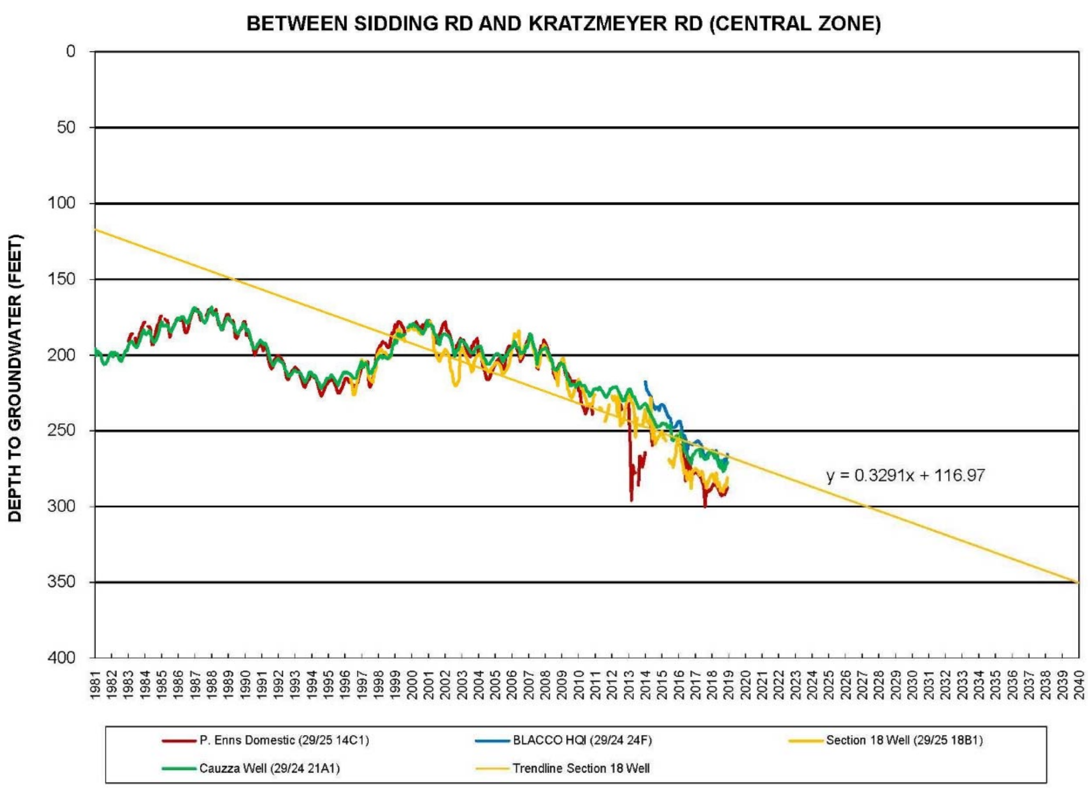


Figure 9. Central Monitoring Zone Hydrograph

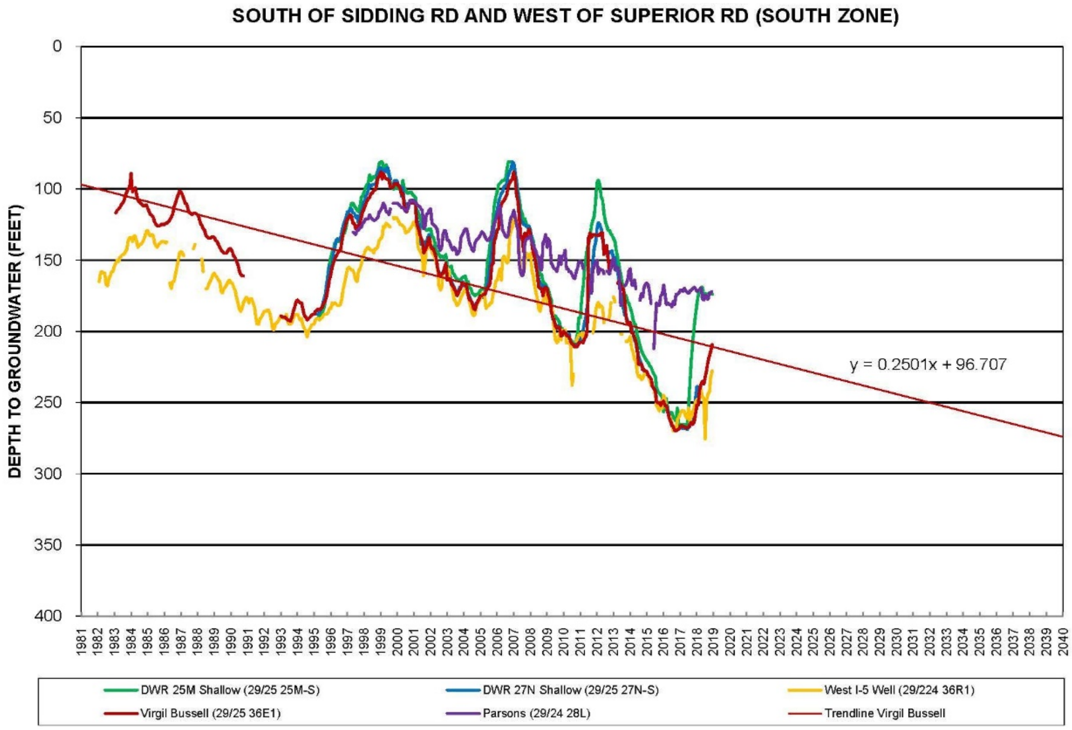


Figure 10. South Monitoring Zone Hydrograph

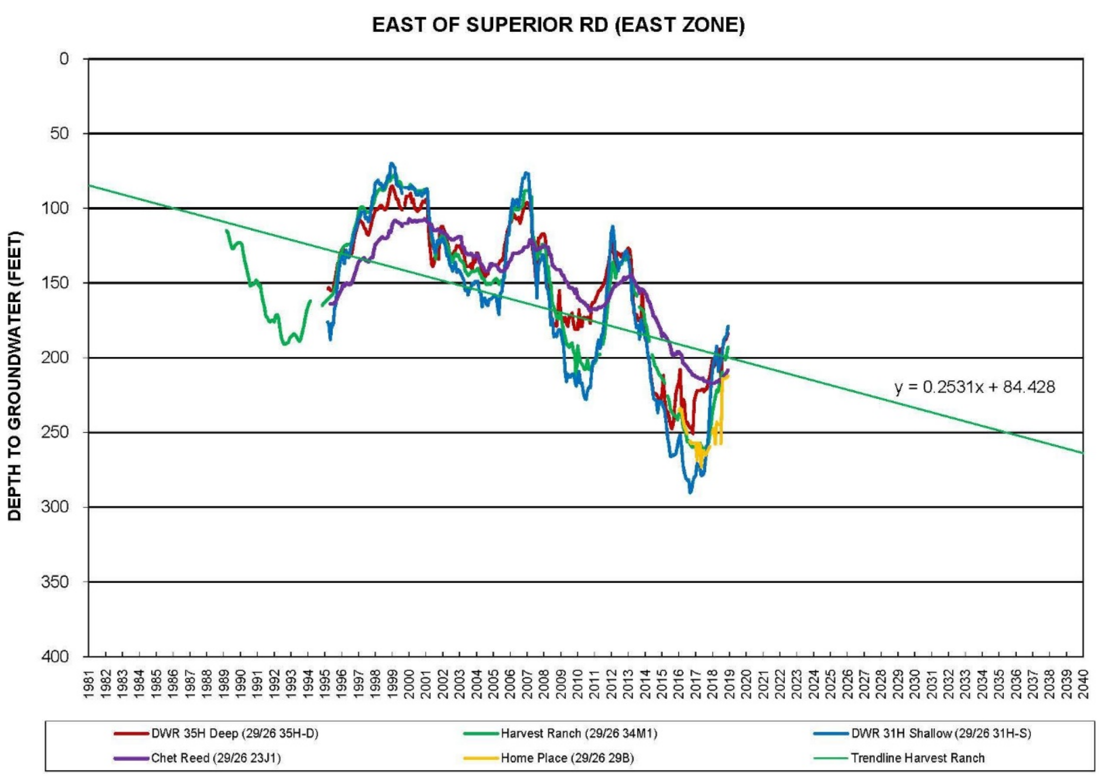


Figure 11. East Monitoring Zone Hydrograph

30S/R26E 28J (South of River Zone)

30S/R26E 32N (South of River Zone)

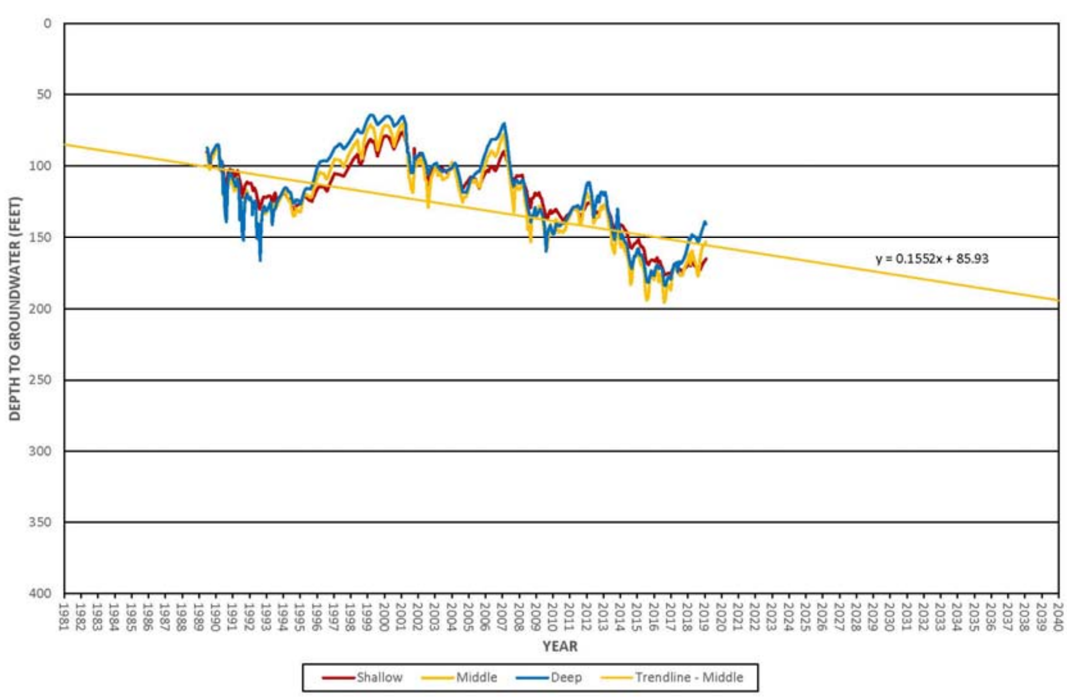


Figure 12. South of River Monitoring Zone Hydrographs

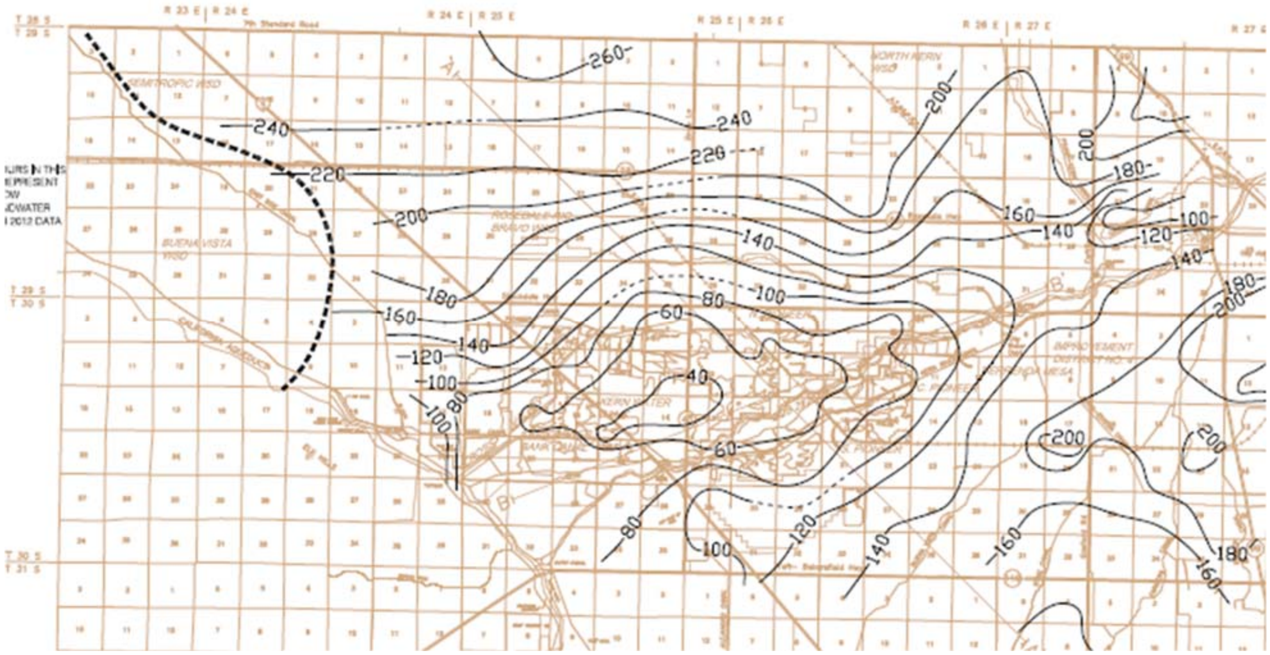


Figure 13. Groundwater Depths Spring 2012 - Immediately Post Recharge Cycle

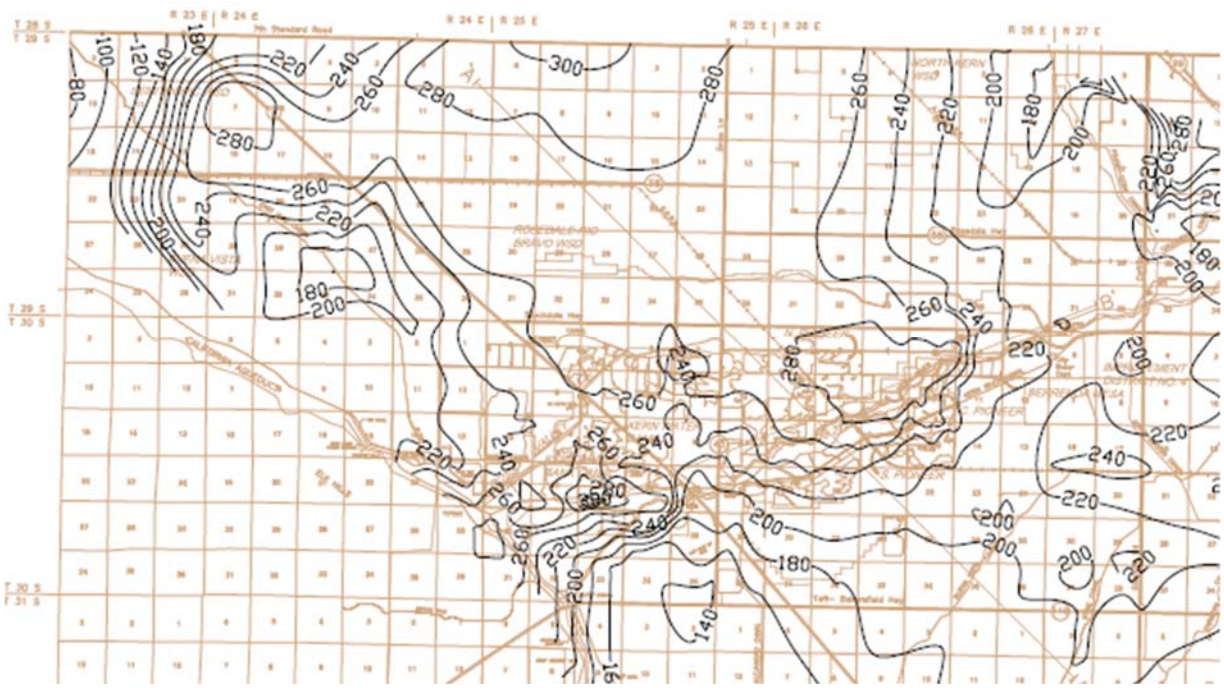


Figure 14. Groundwater Elevations Spring 2016 - Midst of Drought Cycle

Groundwater flow in the RRBMA is generally perpendicular to the Kern River. North of the River it flows northwest to the pumping depression north of RRBMA and south of the River it flows southeast as shown on elevation contour maps, Figures 15-16.

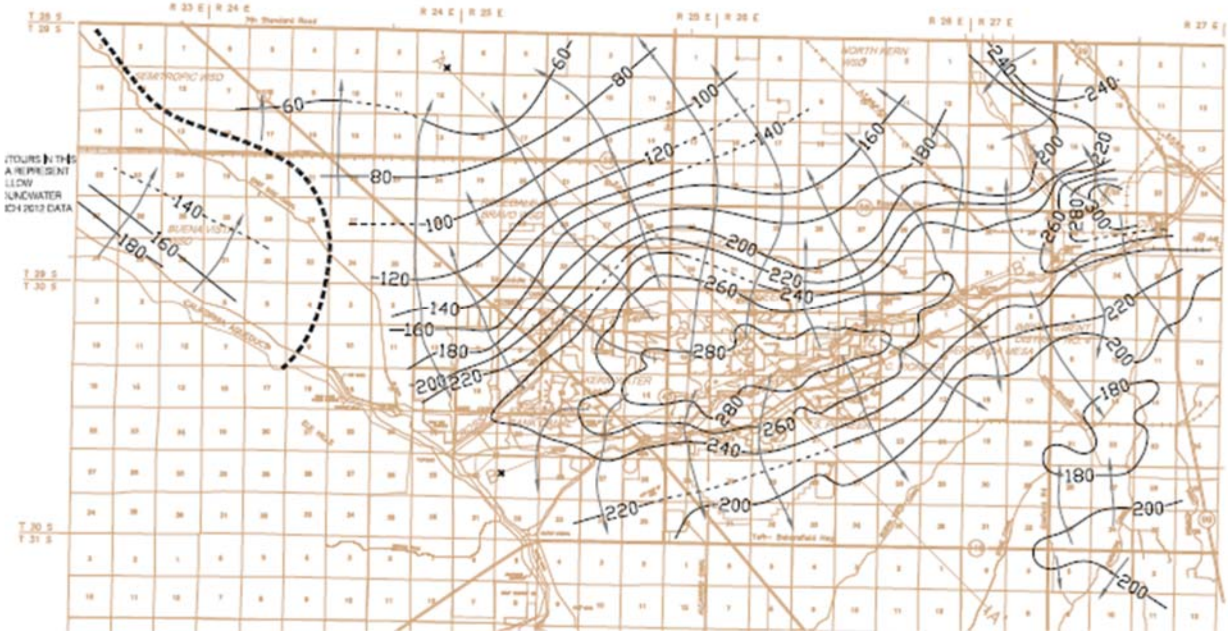


Figure 15. Groundwater Elevations Spring 2012 - Immediately Post Recharge Cycle

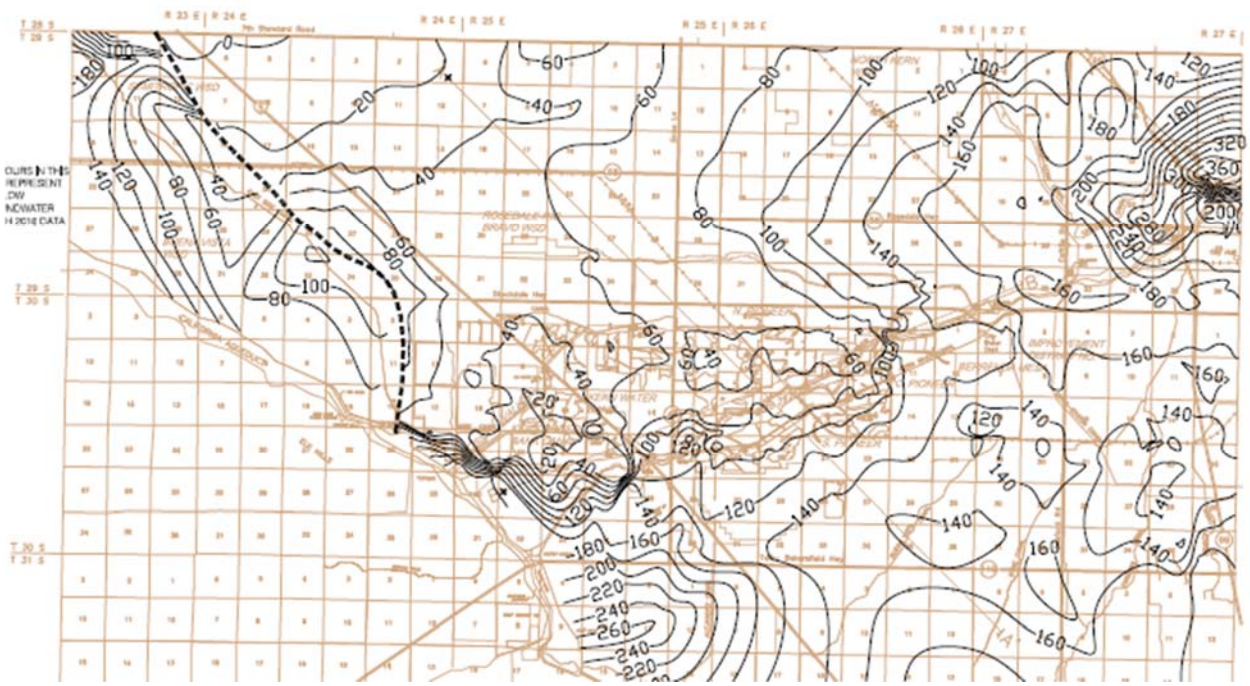


Figure 16. Groundwater Elevations Spring 2016 - Midst of Drought Cycle

2.4.2 Groundwater Quality Monitoring

Extensive monitoring has been used to establish baseline groundwater quality and ensure that groundwater quality problems are not developing. This monitoring consists of two elements: 1) the sampling of 6 dedicated monitoring wells twice a year for several potential constituents of concern, and 2) the sampling of 35 production wells every 3 years. The locations of the monitoring wells and production wells are shown on Figure 17.

The sampling of the monitoring wells is mandated by the MOU's. Under this program water samples are analyzed for several potential constituents of concern twice a year as described in the Kern Fan Monitoring Plan. The data is compiled and reported by the Kern Fan Monitoring Committee pursuant to the MOU's. Water quality hydrographs, statistical trend analysis, and salt balance calculations are included. Field procedures are as described in the Kern Fan Purge Pump Water Quality Sampling Procedures (Appendix A-3).

The second element of groundwater monitoring includes sampling the recovery wells according to the monitoring program and Cross Valley Canal (CVC) and Aqueduct pump-in guidelines. In addition to providing extensive information regarding groundwater quality, the results of this sampling are used to model expected changes in water quality in conveyance facilities receiving the recovered water. The model is updated daily and forwarded to DWR and the Facilitation Group as described in Appendix A-4.

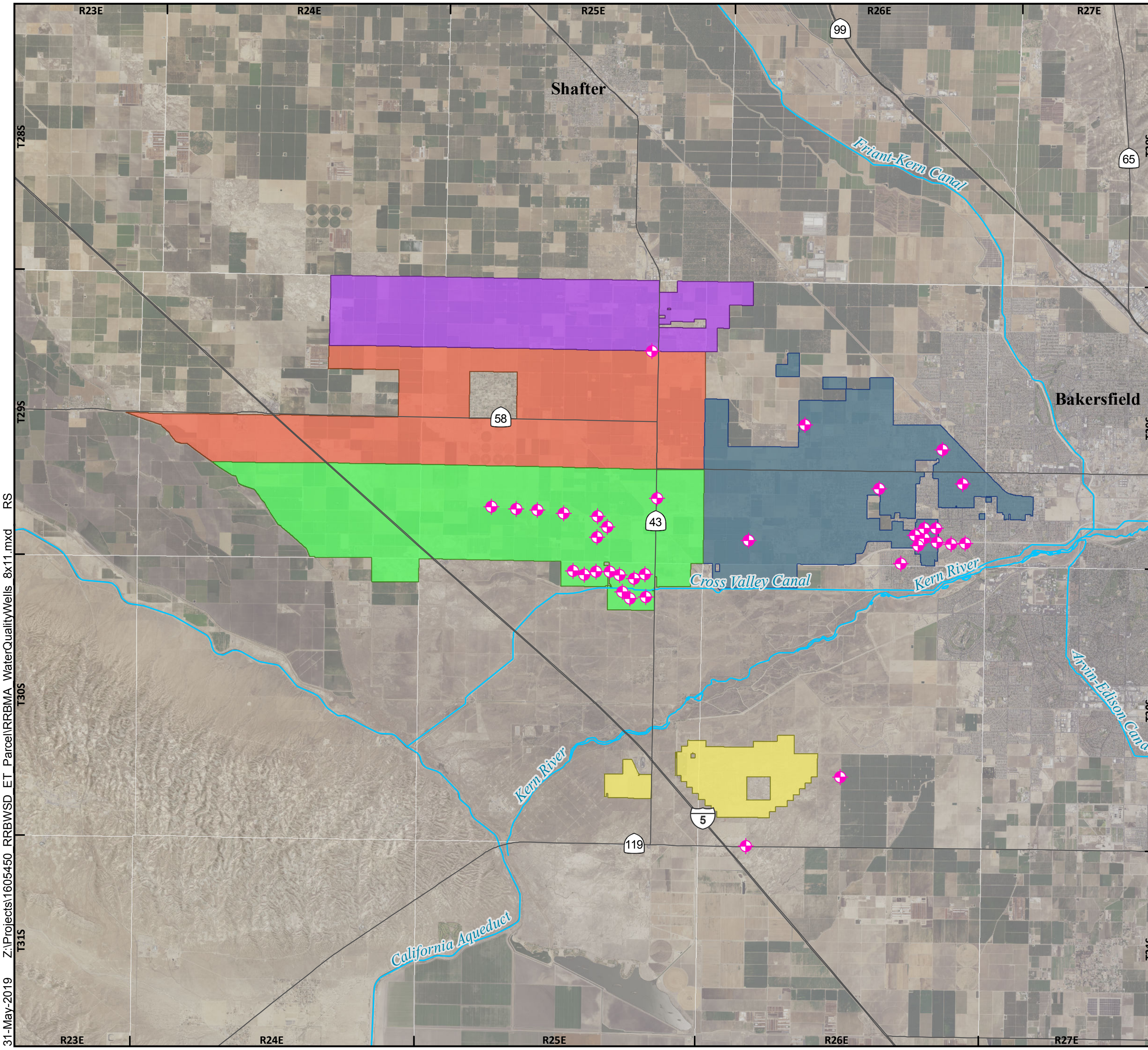
2.4.2.1 Groundwater Quality

Groundwater quality in the Kern Fan aquifer is generally excellent. In addition to testing each RRBWSD recovery well, six monitor wells are tested for the presence of several constituents semiannually. The water in each of RRBWSD Banking project and monitor wells are thoroughly and regularly tested in accordance with protocols developed by the California Department of Health Services for drinking water. Except for a few naturally occurring constituents in a few wells, the water quality of all the RRBWSD recovery wells meet the Department of Water Resources' Water Quality Policy for Acceptance of Non-Project Water into the State Water Project (See Section 2.8.5).

The concentration of total dissolved solids (TDS) ranges from about 100 mg/ℓ to about 350 mg/ℓ. The TDS in the California Aqueduct can range up to 325 mg/ℓ, and the secondary maximum contaminant level (MCL) for TDS in drinking water is 500 mg/ℓ. The concentration of nitrate ranges from about 1 mg/ℓ to about 10 mg/ℓ, and the MCL for drinking water is 10 mg/ℓ. The concentration of arsenic ranges from about 1 µg/ℓ to about 30 µg/ℓ, and the MCL for arsenic in drinking water is 10 µg/ℓ.

2.4.2.2 Spatial and Temporal Variations in Groundwater Quality

Although water quality across the Kern Fan is generally excellent, there are spatial variations in quality with both depth and locale. For example, arsenic concentrations are locally higher in the southern part of the aquifer; TDS concentrations generally increase to the west; and the concentrations of nitrate and TDS are typically higher in the shallow part of the aquifer and concentrations of arsenic are typically higher in the deeper part of the aquifer.



RRBMA MONITORING ZONES FOR WATER QUALITY WELLS

Water Quality Well

Proposed Monitoring Zones

- East Zone
- South Zone
- Central Zone
- North Zone
- South of River Zone

All Other Features

- Highway
- Waterway

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

GEI Consultants

DECEMBER 2019 FIGURE 17

Elevated arsenic concentrations appear to be, at least in part, related to the nature of the sediments in the aquifer. California State University, Bakersfield, has investigated the occurrence of arsenic in the vicinity of the Kern Water Bank (Negrini, et. al, 2008). Their studies suggest that the reducing geochemical environment more likely to be found in lacustrine rather than alluvial fan settings may favor the formation of arsenic-bearing pyrite, and these types of sediments have been identified in the southern part of the Kern Fan. A later change to more oxidizing geochemical conditions potentially dissolves the pyrite and releases the arsenic into the groundwater.

The increase in TDS to the west may be related to changes in the types of sediments in the aquifer and/or the influence of groundwater from the western part of the basin. The eastern part of the basin mostly consists of sediments derived from the Sierra Nevada, which are granitic. In the western part of the basin, sediments are increasingly derived from the Coast Ranges which include marine sedimentary rocks. Sediments derived from marine rocks can influence the salt content of groundwater.

The higher nitrate and TDS concentrations in the shallow part of the aquifer are believed to be in large part the result of years of agricultural use. Evapotranspiration of irrigation water adds salts and the addition of fertilizers adds excess nitrate to the root zone. If allowed to accumulate, the salts will inhibit crop growth, so they must be flushed from the root zone. In time, the salts and nitrate can reach groundwater.

Zone sampling while constructing wells reveals increased arsenic with depth. RRBWSD constructed banking recovery wells reveal arsenic levels increase with depth, which is the conventional thought in the area. Wells exceed the MCL at depths of about 500-700 ft as shown on Tables 3-6.

Aquifer Property/ Constituent	Units	850 - 870 ft bgs[1]	720 - 740 ft bgs	600 - 620 ft bgs	448 - 518 ft bgs	Drinking Water Standards / MCL[2]
Static Water Level	ft bgs	301	264	253	248	
Pumping Water Level	ft bgs	308	511	297	309	
Drawdown	ft	7	247	44	61	
Discharge Rate	gpm[3]	60	75	110	140	
Arsenic	µg/L[4]	30	14	2.5	0.63	10[A]
Fluoride	mg/L[6]	0.53	0.34	0.18	<0.05[6]	2[A]
Iron	µg/L	43	740	NA[8]	NA	300[C]
Manganese	µg/L	<10	19	7.6	8.4	50[B,C]
Nitrate as N	mg/L	<0.1	0.21	3	7.1	10[A]
Total Dissolved Solids	mg/L	130	100	200	340	500[B,C]
Turbidity	NTU[7]	37	10	20	10	5[C]

Table 3 - WB2 Zone Testing

Aquifer Property/ Constituent	Units	1,200 - 1,220 ft bgs[1]	940 - 960 ft bgs	820 - 840 ft bgs	700 - 720 ft bgs	580 - 600 ft bgs	420 - 440 ft bgs	Drinking Water Standards / MCL[2]
Static Water Level	ft bgs	310	317	315	284	277	253	
Pumping Water Level	ft bgs	557	357	537	489	329	276	
Drawdown	ft	247	40	222	205	52	23	
Discharge Rate	gpm[3]	20	40	70	90	230	100	
Specific Capacity	gpm/ft	0.1	1.0	0.3	0.4	4.4	4.3	
Arsenic	µg/L[4]	11	14	6.4	36	8.2	3.1	10[A]
Fluoride	mg/L[5]	0.88	0.76	0.79	0.83	0.19	N/A[7]	2[A]
Iron	µg/L	78	140	<50	<50	<50	110	300[C]
Manganese	µg/L	21	11	<10	<10	<10	15	50[B,C]
Nitrate as N	mg/L	<0.2[6]	<0.1	<0.1	<0.1	1.8	N/A	10[A]
Chloride	mg/L	480	200	90	11	9.9	N/A	250[C]
Total Dissolved Solids	mg/L	880	430	260	130	150	N/A	500[B,C]

Table 4 - SUP1 Zone Testing

Aquifer Property/ Constituent	Units	760 - 780 ft bgs[1]	685 - 705 ft bgs	580 - 600 ft bgs	380 - 400 ft bgs	Drinking Water Standards / MCL[2]
Static Water Level	ft bgs	282	279	277	268	
Pumping Water Level	ft bgs	310	298	362	331	
Drawdown	ft	29	19	85	64	
Discharge Rate	gpm[3]	180	140	140	180	
Specific Capacity	gpm/ft	6.31	7.3	1.6	2.8	
Arsenic	µg/L[4]	70	22	18	2.1	10[A]
Total Dissolved Solids	mg/L	160	110	130	150	500[B,C]

Table 5 - M1 Zone Testing

Aquifer Property/ Constituent	Units	920 - 940 ft bgs[1] Zone 1 8/26/2009	740 - 760 ft bgs Zone 4 9/14/2009	615 - 635 ft bgs Zone 2 8/27/2009	430 - 450 ft bgs Zone 5 9/16/2009	285 - 305 ft bgs Zone 3 8/28/2009	185 - 455 ft bgs Completed Well 10/27/2009	Drinking Water Standards / MCL
Arsenic	µg/L[2]	20	33	13	2	ND[4]	1.2	10
Fluoride	mg/L[3]	0.6	0.6	0.36	0.06	0.029	0.068	2
Iron	µg/L	180	310	600	66	ND	39	300[5]
Nitrate as N	mg/L	0.05[6]	0.17	0.32	1.5	6.3	0.52[6]	10
Total Dissolved Solids	mg/L	210	180	170	180	470	270	500[5]

Table 6 - Enns1 Zone Testing

As shown in Figures 18 there is an elevated TDS zone (1000-2500 ppm) just north of the RRBMA. With groundwater flow generally in the northwest direction this zone is not expected to migrate into the RRBMA.

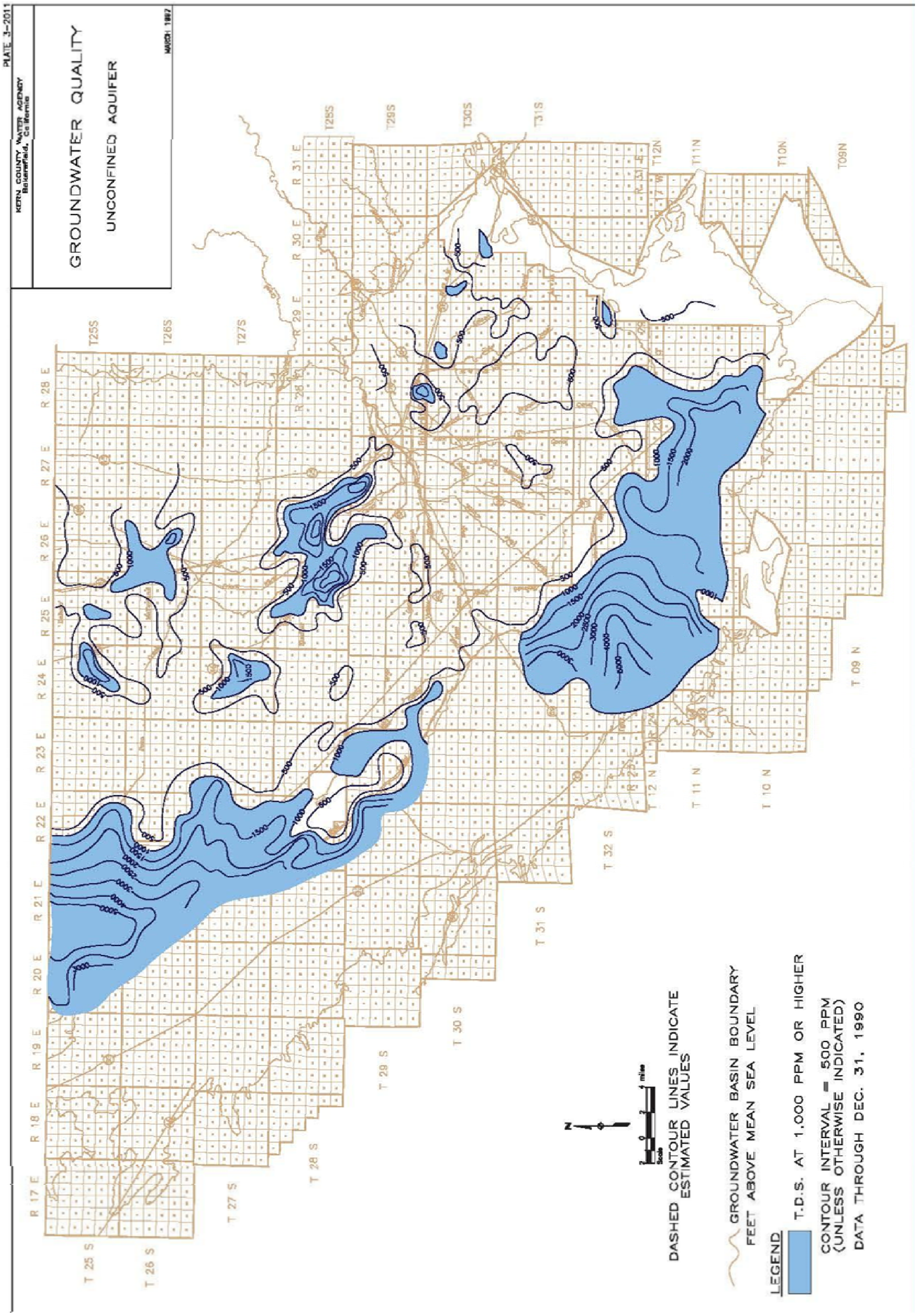


Figure 18. TDS in Unconfined Kern Sub-basin

2.4.2.3 Water Quality Changes

As shown in Figures 19-23 TDS has been stable over the last 20 years and generally below 400 mg/L. There is one elevated level from 300 to 600 mg/L in 29S/25E 27N2, which is a shallow monitoring well in the south monitoring zone.

As shown in Figures 24-28 arsenic levels over the last 20 years have been stable but many wells exceed the MCL of 10 micrograms/L.

As shown in Figures 24-28 nitrate levels over the last 20 years have been stable and generally below the MCL.   As groundwater levels in the northern monitoring zone has deepened the level has exceeded the 10 mg/L MCL.

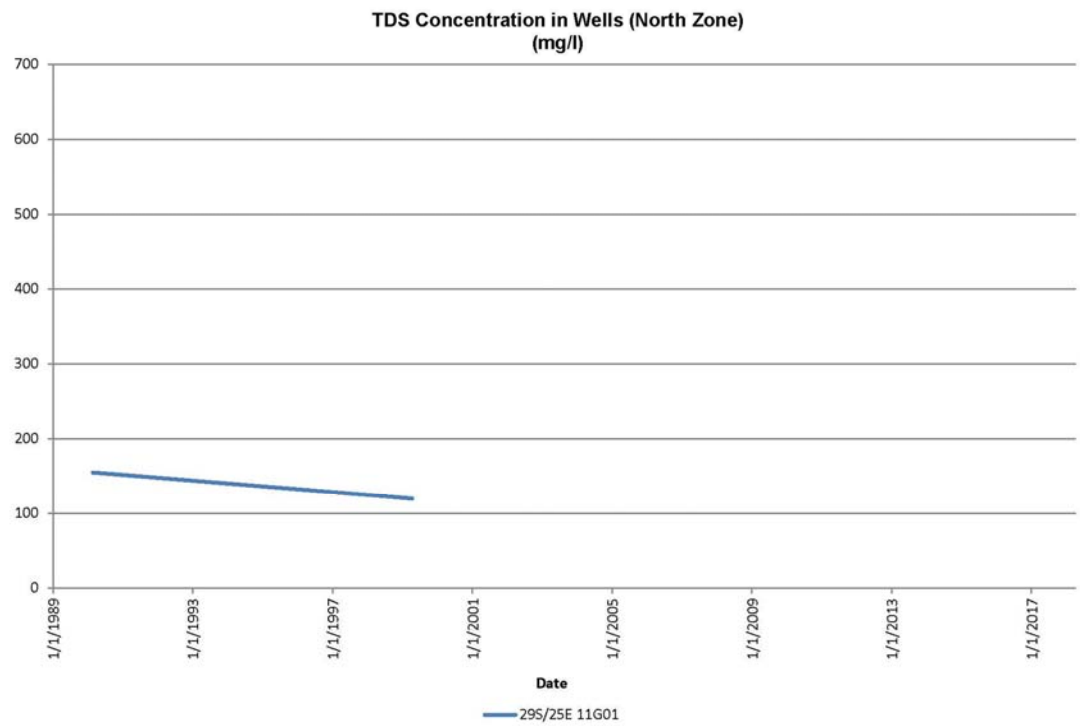


Figure 19. North Monitoring Zone - TDS

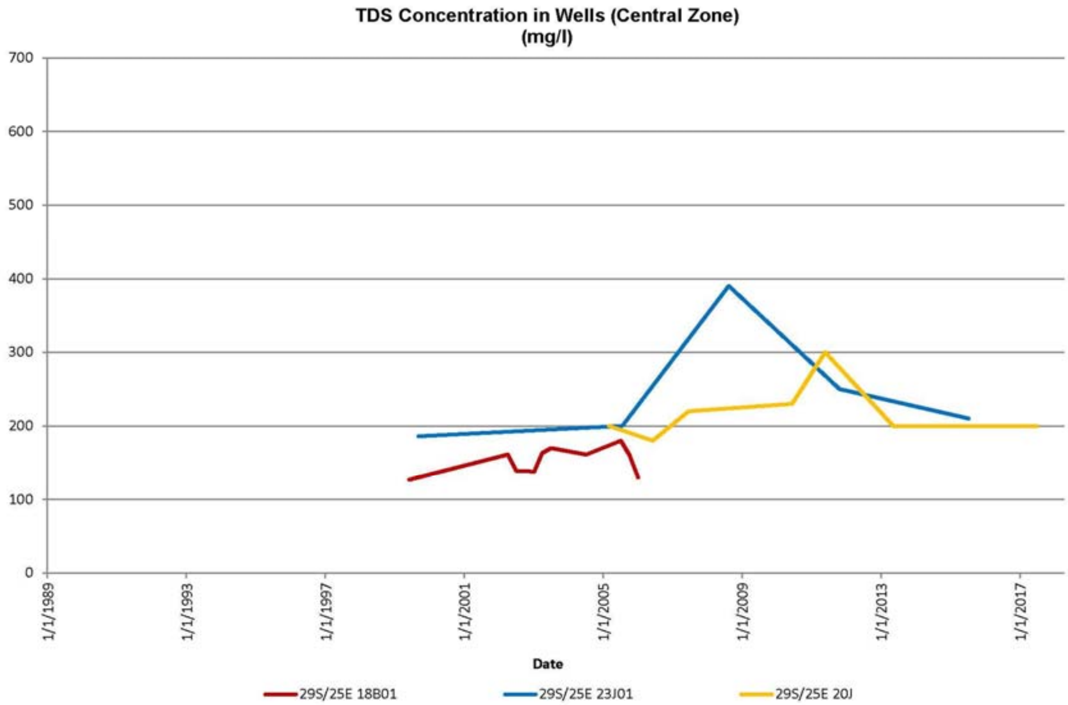


Figure 20. Central Monitoring Zone - TDS

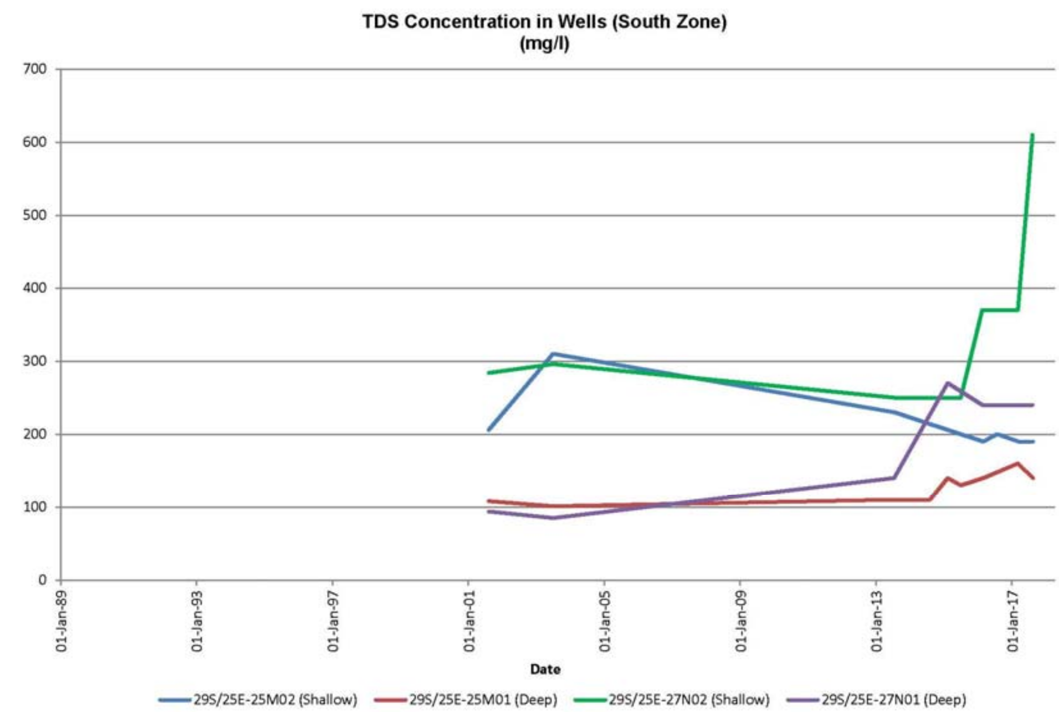


Figure 21. South Monitoring Zone - TDS

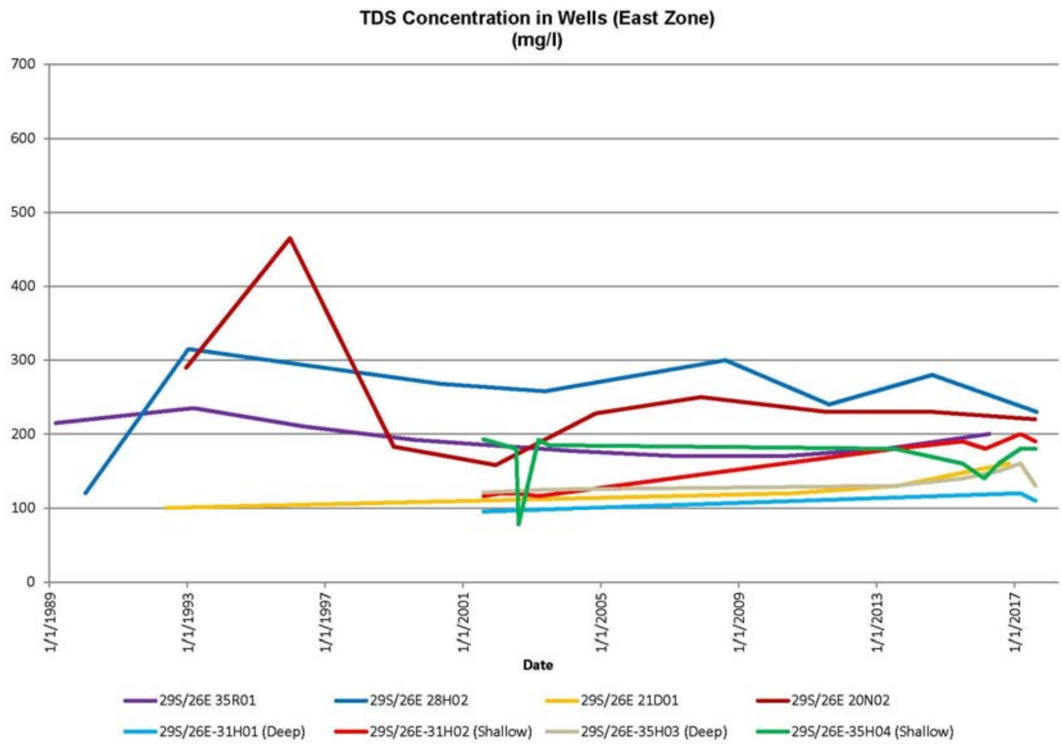
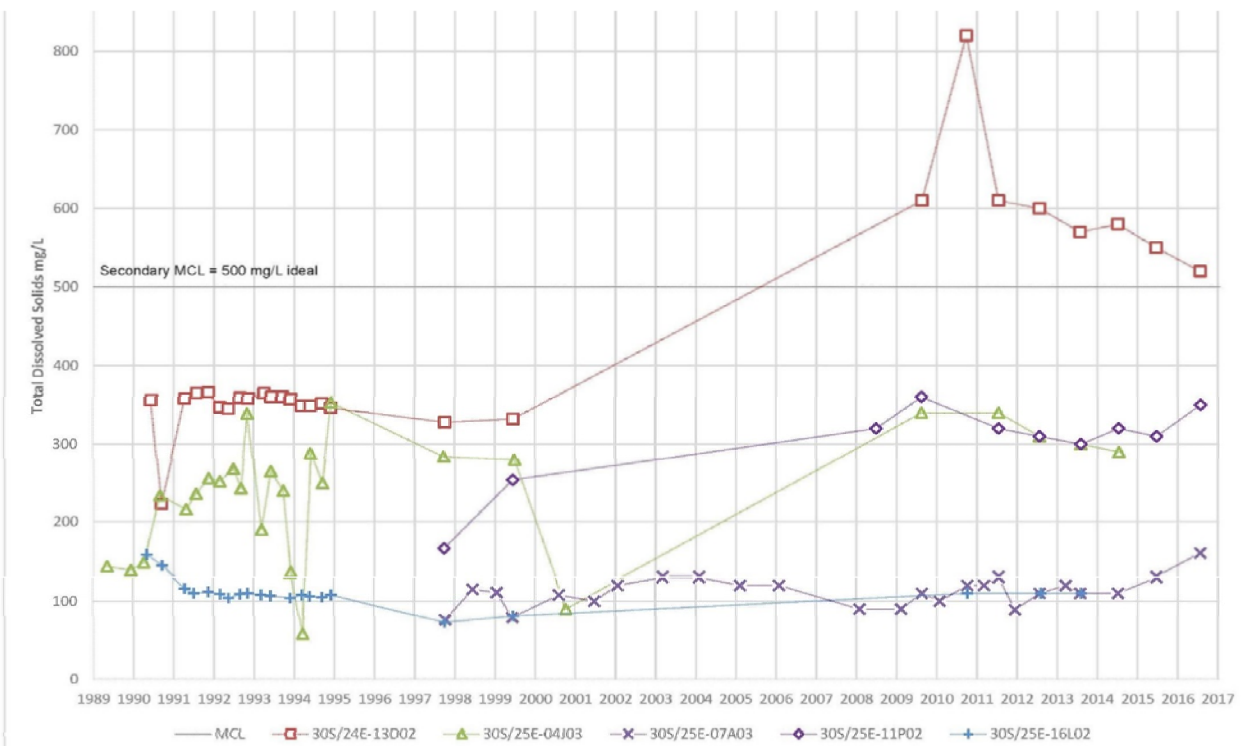


Figure 22. East Monitoring Zone - TDS

Figure 23. South of River Monitoring Zone - TDS



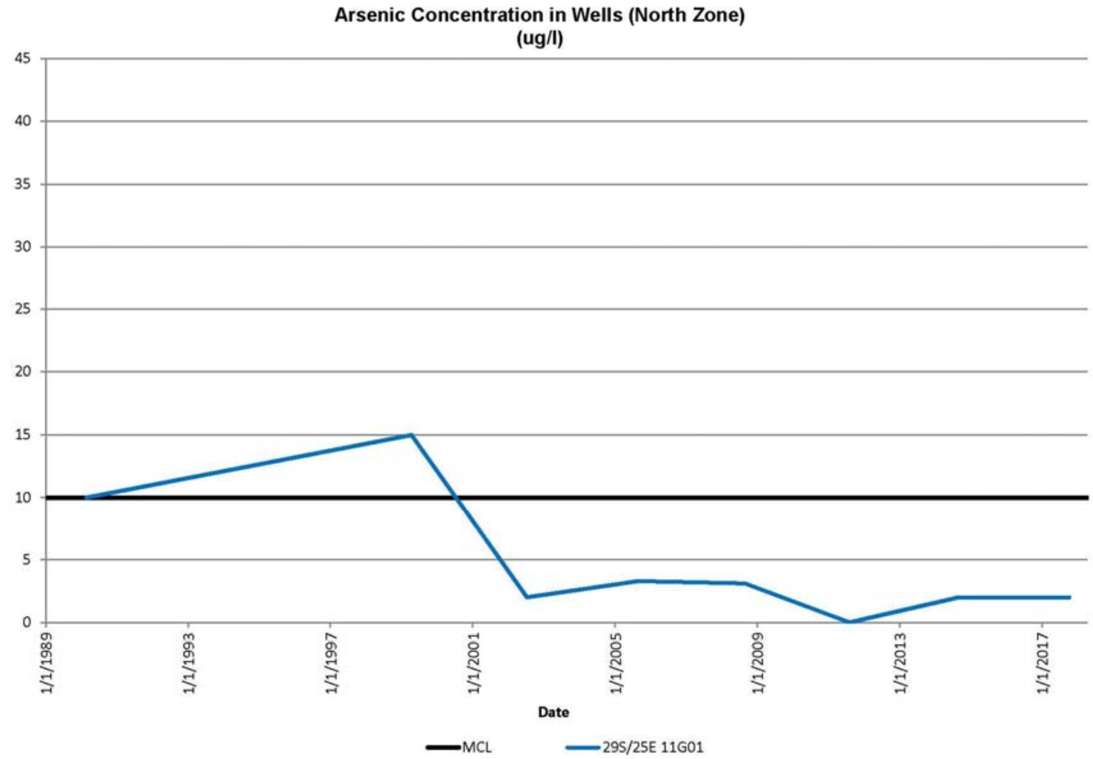


Figure 24 - North Monitoring Zone – Arsenic

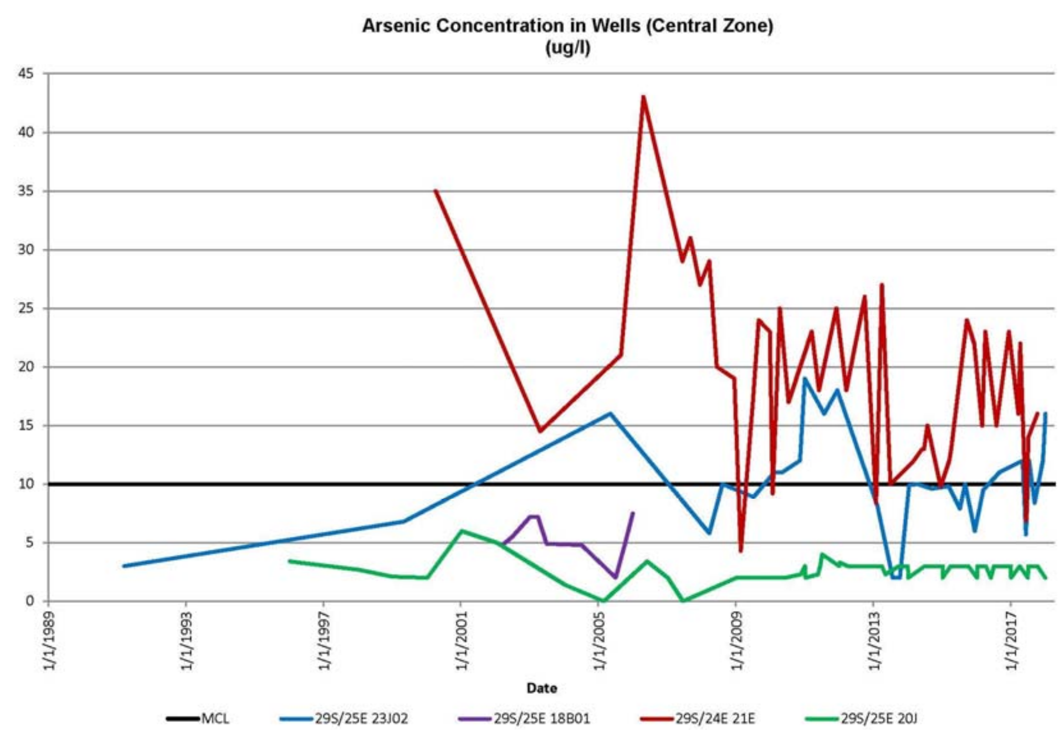


Figure 25 - Central Monitoring Zone - Arsenic

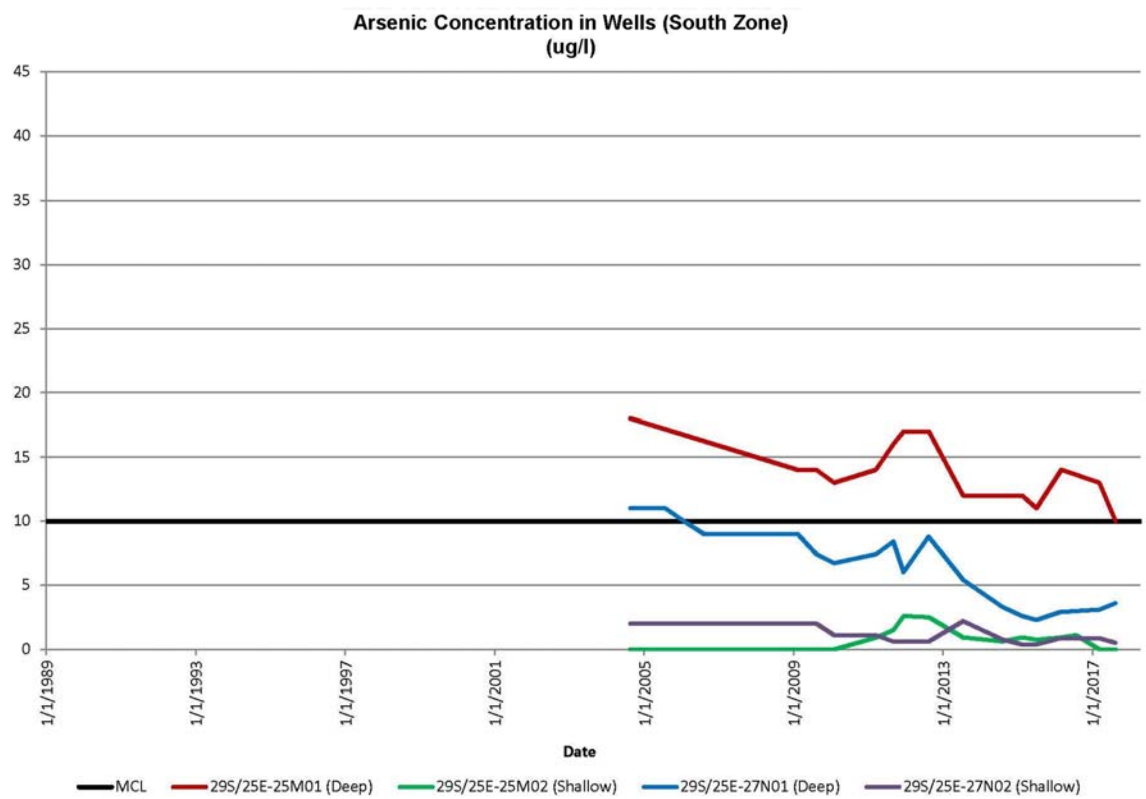


Figure 26 - South Monitoring Zone - Arsenic

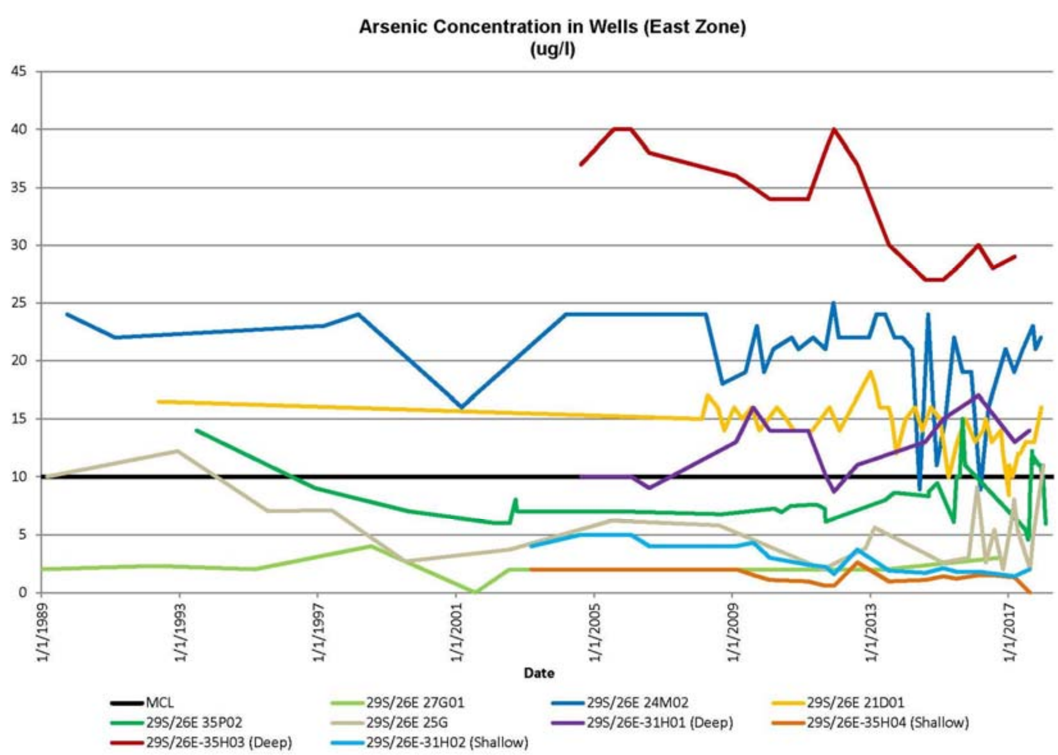


Figure 27 - East Monitoring Zone - Arsenic

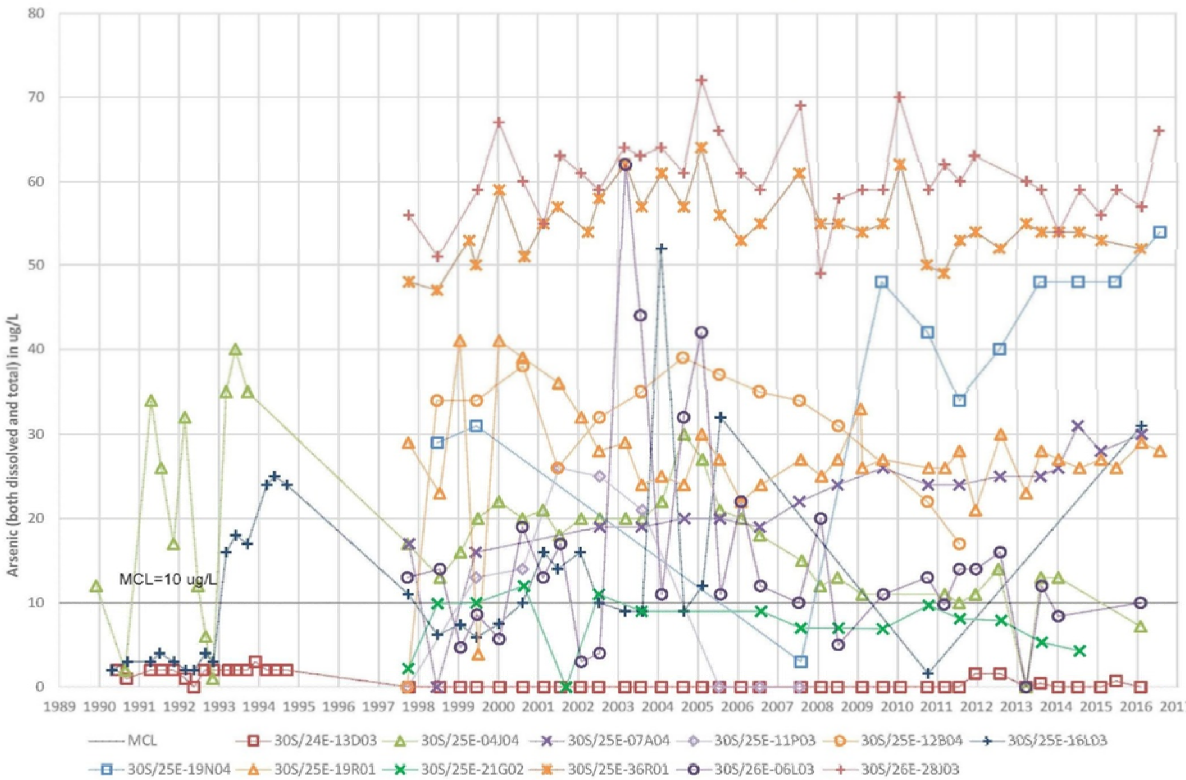


Figure 28 - South of River Monitoring Zone - Arsenic

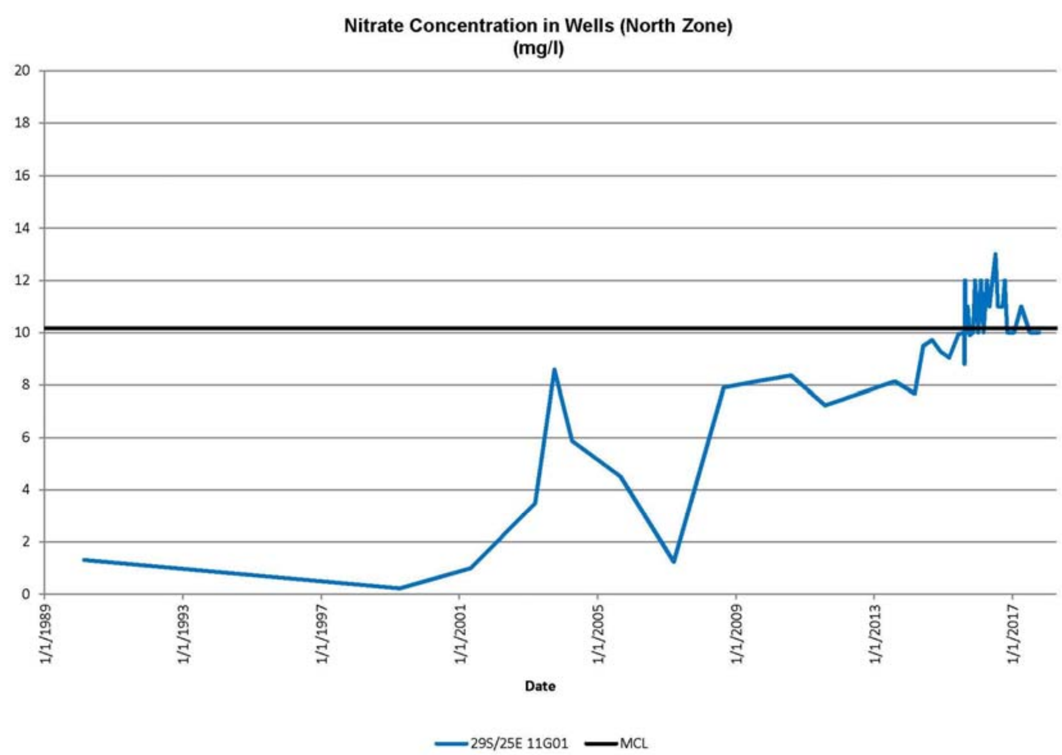


Figure 29 North Monitoring Zone - Nitrate

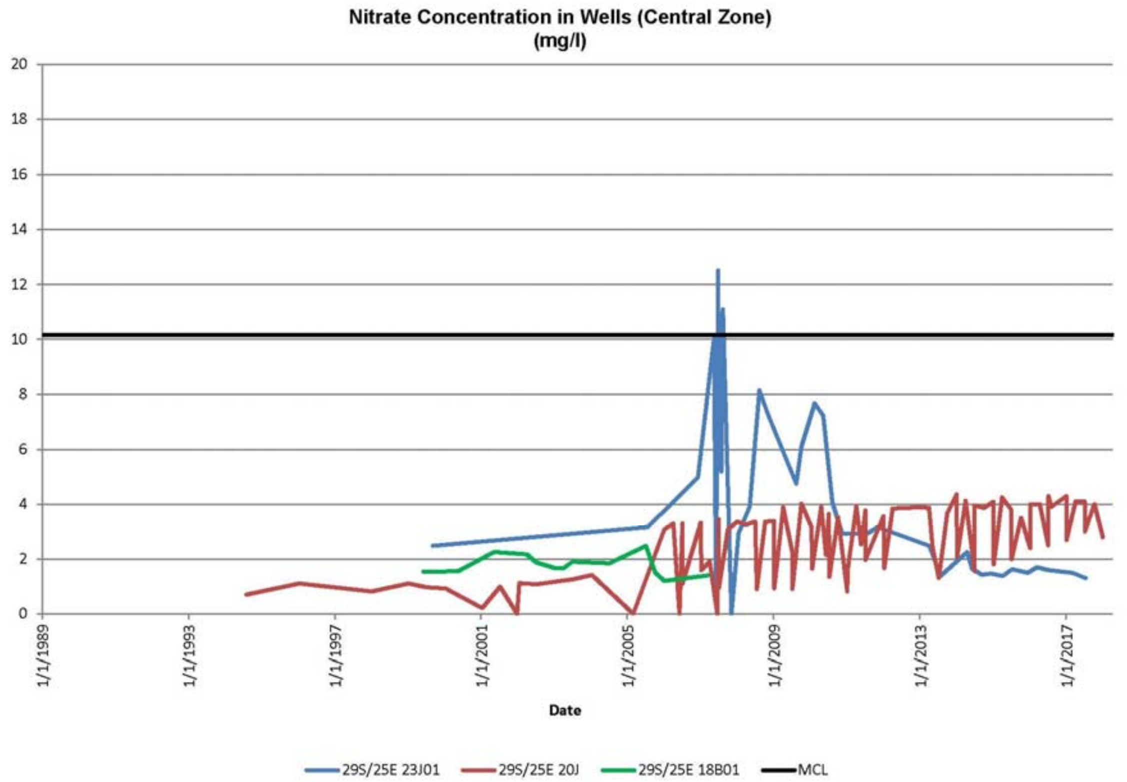


Figure 30 Central Monitoring Zone - Nitrate

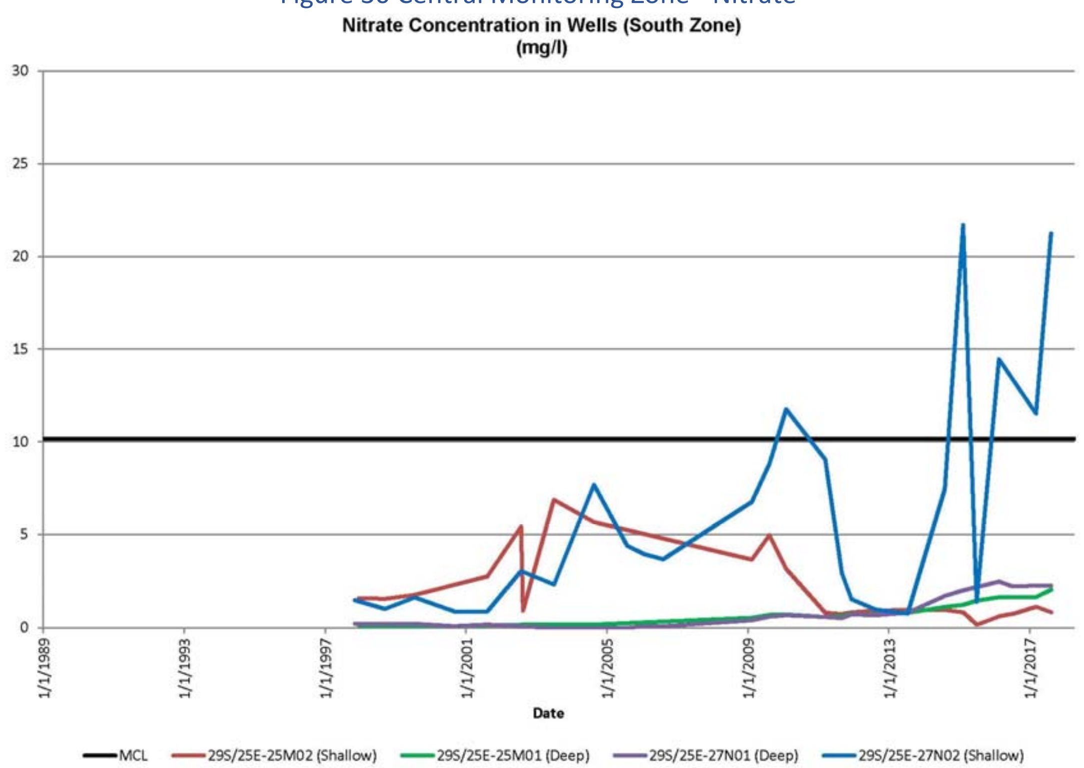


Figure 31 South Monitoring Zone - Nitrate

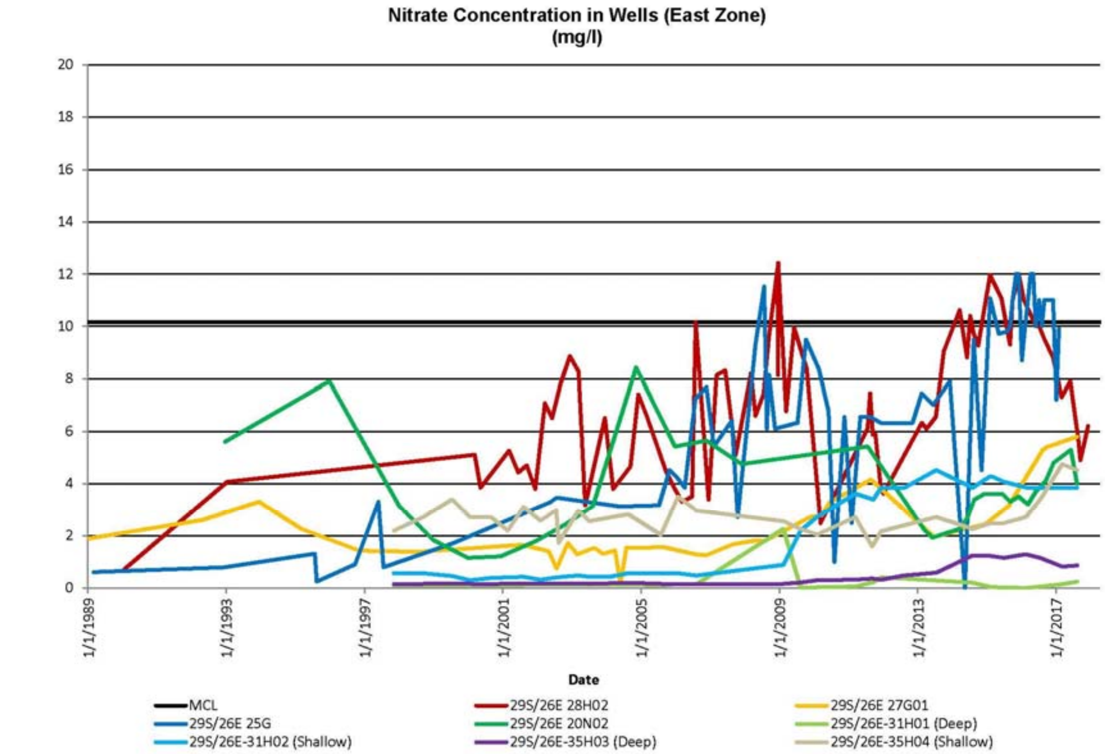


Figure 32 East Monitoring Zone - Nitrate

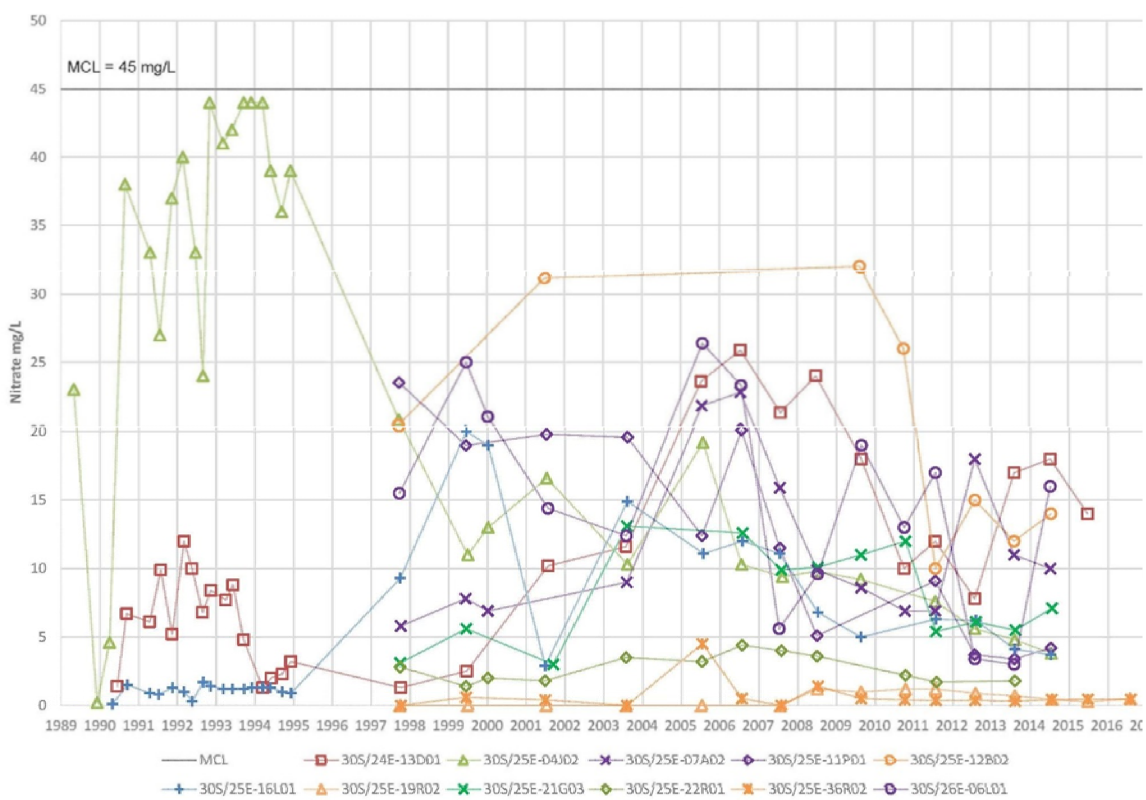


Figure 33 South of River Monitoring Zone - Nitrate

2.4.3 Subsidence Monitoring

Subsidence has occurred historically north and south of the RRBMA, but not in the management area itself, see Figure 34. See section 2.3.6 of Umbrella GSP for additional regional information. Subsidence has been continuously monitored by DWR since June 1994 with an extensometer located near the center of the KWB in Section 16, T30S/R25E which is between the South and the South of River monitoring zones as shown on Figure 7. The results of the monitoring indicate both upward and downward changes (of at most 0.1 ft/yr) have occurred within an overall upward trend of inflation as shown on Figure 35. As of June 2018, the land surface was 0.27 ft higher than the land surface in June 1994. The data indicates subsidence has not resulted from KWB recovery operations during extended droughts. DWR has developed, as part of their SGMA technical assistance a statewide InSAR subsidence dataset. InSAR is a satellite-based remote sensing technique that measures vertical surface displacement changes at high degrees of measurement resolution and spatial detail. Subsidence for 2016 and 2017 in the RRBMA was about upward by 0.01 ft per year. Using this platform displacements are shown on Table 7.

	2016	2017	2-Year
I5 and Stockdale Hwy	-.018	-.006	-.024 ft
Stockdale Hwy and 43	-.021	-.020	-.041 ft
Allen and 58	-.011	-.011	-.022 ft
58 and 43 (north)	-.008	-.003	-.011 ft
43 and 7th Standard	-.003	-.004	-.007 ft
Average	**-.012**	**-.009**	**-.021 ft**

Table 7. Subsidence

Figure 34 - USGS 1926-1970 Historical Subsidence Areas

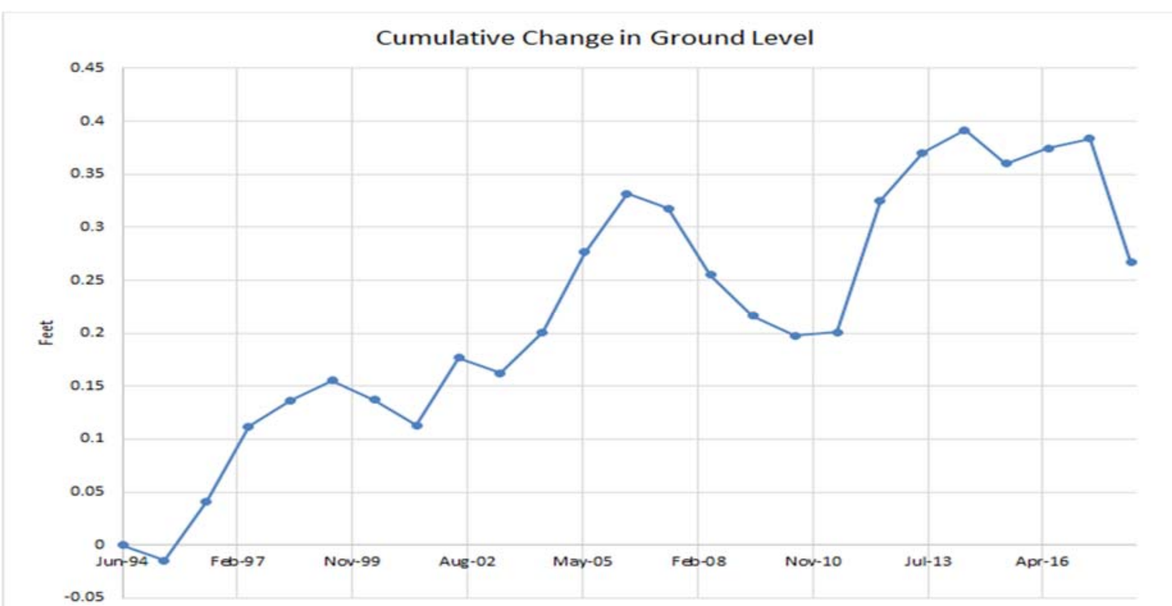


Figure 35 - KWB Extensometer Data

2.4.4 Surface Water Monitoring

The volumes of water delivered to the RRBWSD for storage purposes are measured and reconciled by several agencies, including DWR, KCWA, the City of Bakersfield, Buena Vista Water Storage District, and the Army Corps of Engineers, depending on the source of the water. The results are then tabulated by the RRBWSD and documented in an annual Operations Report by the Kern Fan Monitoring Committee and RRBWSD (see latest Kern Fan Operations report in Appendix A-9) and summarized on Table 8.

RRBWSD does not monitor the quality of water delivered for storage purposes, rather monitoring by others is relied upon. Kern River and CVP (Friant-Kern) water is monitored by Improvement District 4 of the KCWA and reported in annual reports (i.e. http://www.kcwa.com/wp-content/uploads/2018/07/ROWC2016.pdf), and SWP water in the California Aqueduct is monitored by DWR (https://water.ca.gov/Programs/State-Water-Project/Water-Quality).

KCWA and DWR monitor the quality of water delivered to the California Aqueduct during recovery operations by collecting samples in delivery conveyances (e.g. the KWB Canal) and at locations upstream and downstream of delivery points at least quarterly as required by the Pump-in Policy (See Appendix A-4). The results are distributed to the Facilitation Group and summarized in annual reports prepared by DWR.

Supplies	
SWP 2016 Carryover (per KCWA)	530
SWP 2017 Entitlement	25,415
SWP Article 21	22,186
SWP Pools	341
Kern River Basic Contract	52,053
Kern River Miscellaneous Contract	49,921
BV Kern River Purchase	9,964
Lower River Purchase	10,323
Kern River COB/KCWA Purchases	10,165
Friant-Kern 215 Purchases	1,950
SJR Contractors Purchase	4,113
AEWSD Banking	10,904
BV/CLWA Banking	80,000
DEID Banking	27,905
KTWD Banking	35,805
IRWD Banking	19,391
Grimmway Program (RRB Share)	336
Homer Program (2:1 Exchange)	23,698
SJR Contractors (2:1 Exchange)	10,000
Westside Program (5:2 Exchange)	1,813
Westside Program (1:1 Exchange)	3,150
Total	**399,963**

Deliveries To	
RRBWSD Kern River Intake	171,625
RRBWSD CVC Turnout No. 1	41,876
RRBWSD CVC Turnout No. 2	59,860
RRBWSD via BV Eastside Canal	6,237
Strand Project Facilities	51,714
Pioneer Project	48,388
Grimmway (RRB Share)	336
CLWA	9,360
CVWD	5,397
WKWD	6,008
Total	**399,691**

Table 8. RRBWSD 2017 Deliveries (AF)

2.5 Management Areas Within Chapter

2.5.1 Management Areas Within Chapter (RRBWSD)

The Chapter is divided into two sub-management areas. First is the portion of the RRBWSD within the RRBMA (abbreviated as RRBDL), and the second comprises the white lands (non-districted lands) within the RRBMA (abbreviated as RRBWL). The RRBWL are the non-districted lands that have contracted with the RRBWSD to be included in the RRBMA as shown on Figure 1. Note that these areas do not include a portion of the eastern portion of the RRBWSD that is in the Kern River GSA and within the City of Bakersfield.

2.5.1.1 Reason for Creation

Because of water supply differences and the differences in the District's authority between the district and non-district lands, two distinct management areas were created. The District's authority to fund and implement management actions and projects is also different in each area.

2.5.1.2 Management Areas Conditions

Conditions are very similar between the two management areas. Each area relies on groundwater. The RRBWSD portion of the RRBMA has developed groundwater banking infrastructure, conveyance and surface water supplies. Both IRWD and RRBWSD has established groundwater banking infrastructure in the White Lands portion of the RRBMA. The other portions of the White Lands of the RRBMA has not developed any projects or water supplies to date. Because authority, projects and management actions will vary between the two different areas they were split into sub-management areas.

2.5.1.3 Minimum Thresholds and Measurable Objectives Differentiation

Minimum Threshold and Measurable Objectives in each management area were developed with the same methodology.

2.5.1.4 Monitoring Differentiation

Monitoring plans in each management area were developed with the same methodology.

3. Sustainable Goal and Undesirable Results

3.1 Reference Umbrella GSP

See section 3. of Umbrella GSP.

3.2 Undesirable Results, Preliminary Monitoring, and Threshold Evaluation

As described in SGMA, undesirable results are one or more of the following effects:

1. **Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon;**
2. **Significant and unreasonable reduction of groundwater storage;**
3. Significant and unreasonable seawater intrusion;
4. **Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies;**
5. **Significant and unreasonable land subsidence that substantially interferes with surface land uses; and/or**
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

As discussed below, seawater intrusion and depletion of interconnected surface waters are conditions that do not exist in the RRBMA.

With respect to the remaining undesirable results discussed in SGMA, extensive monitoring of the operations and operational constraints demonstrate that the RRBMA:

1. Does not cause a chronic lowering of groundwater levels;
2. Does not create a significant or unreasonable depletion of supply or reduction in groundwater storage;
4. May degrade water quality; and
5. May cause land subsidence.

RRBWSD groundwater banking operations may cause a temporary lowering of groundwater levels toward the end of extended recovery periods. However, potential impacts that may result from this temporary lowering of groundwater levels are mitigated pursuant to the requirements described in the MMRP and Joint Operations Plan, which are incorporated into this GSP as potential management actions (see Section 1.4.4; and Appendix A). RRBWSD banking operations do not create a significant or unreasonable depletion of supply or reduction in groundwater storage because only previously stored supplies can be recovered after the deduction of appropriate losses.

As to RRBMA operations, four scenarios were considered from least to most aggressive to a sustainable RRBMA groundwater supply and demand:

- Delayed Sustainability at 2040 (status quo till 2035)
- Progressive Sustainability by 2040 (limited action 2020-2025)
- Linear Sustainability by 2040 (straight line)
- Regressive Sustainability by 2040 (aggressive 2020-2030)

These four sustainability paths are then analyzed to see which path is required to meet minimum thresholds, measurable objectives, and interim milestones as shown on Figure 36. The RRBMA has committed to the path to sustainability shown on Figure 37 which resembles a Regressive strategy which is the only path to enable the possibility to meeting minimum thresholds, measurable objectives, and interim milestones.

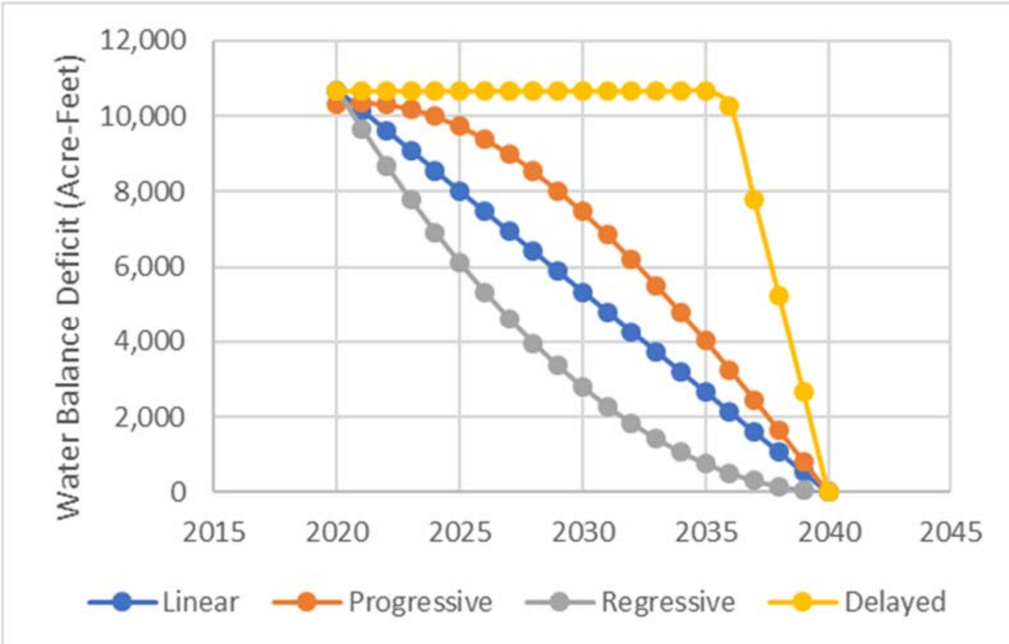


Figure 36. Considered Paths to Sustainability

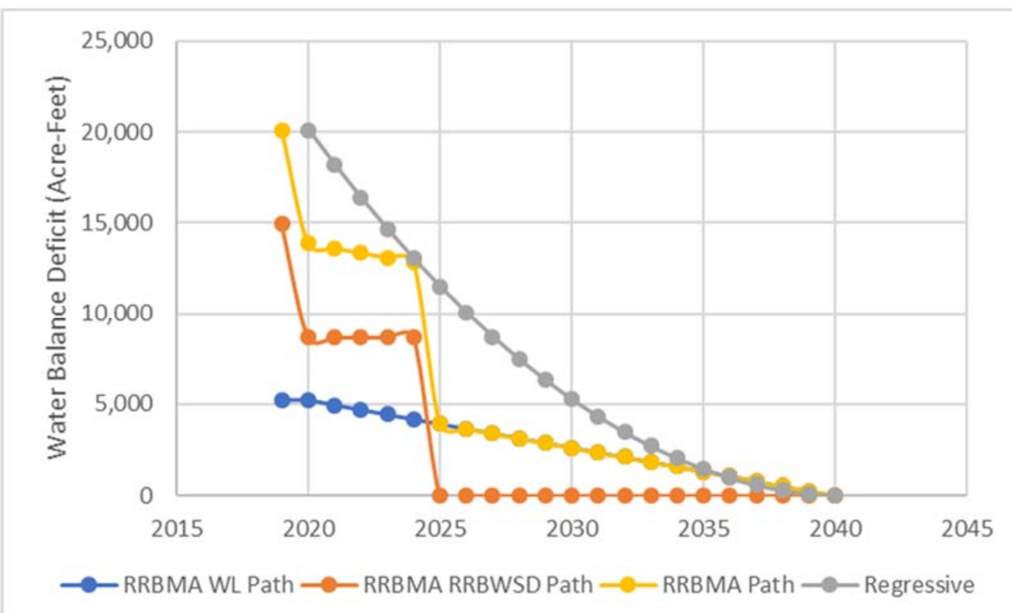


Figure 37. Selected Path to Sustainability Includes Projects and Management Actions (water transfers, expanded recharge facilities, and demand reductions)

3.2.1 Groundwater Levels

Historical groundwater levels are presented in section 2.4.1. As to projected groundwater levels the RRBMA has cooperated and partially funded a KGA effort to develop a basin wide model using C2VSim which will be incorporated into future plan updates. For purposes of this report, RRBWSD utilized its annually updated and calibrated MODFLOW numerical model (hereafter referred to as the Harder Model) originally constructed in 2011. This model was constructed to evaluate the potential groundwater impacts of RRBWSD, KWB, and Pioneer project operations and is also capable of predicting water levels based on various projected RRBMA operations. The Harder Model, evaluated the historical operations from 1988 through 2010, with updates made from 2011 to 2019. Various projected operation, project implementation and management activities for the period 2020 through 2070 have been analyzed.

The RRBMA selected regressive sustainability strategy assumes that the District will make larger strides initially towards a fully sustainable goal by 2040. Under this strategy, with the RRBMA currently facing a potential water supply versus demand balance shortfall of 18,289 AFY, the RRBMA will seek water supply programs and demand reductions at an aggressive rate during the 2020-2030 period and slower rate during the 2030-2040 period. Figures 38-40 show projected water levels under this scenario at various well sites. Additional well sites forecasts and a location map is found in Appendix C. Under this scenario the projected average water depth would generally remain above the historic low point of the last drought (2012-2016) and rise as high as current 2019 levels. During the last drought (2012-2016) historically low groundwater levels in the RRBMA caused damages to overlying users; therefore, levels deeper than experienced during that period would be considered an undesirable result.

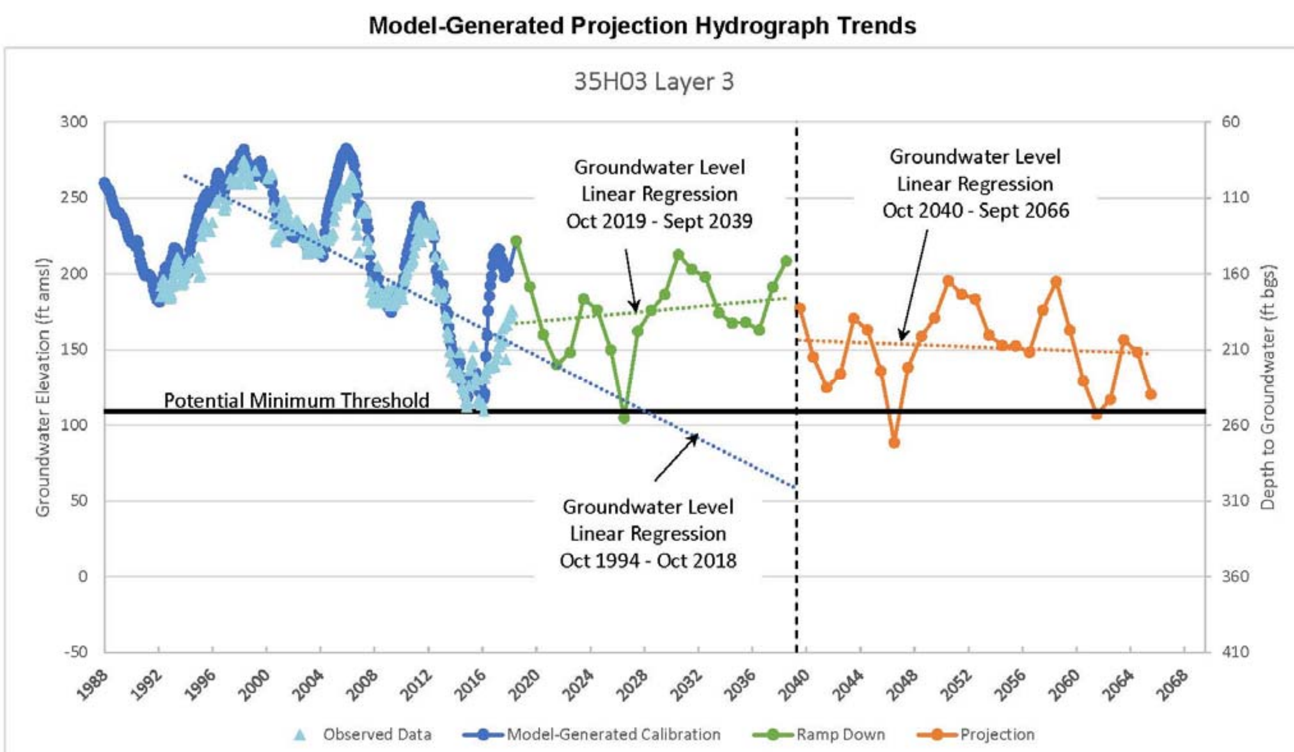


Figure 38. East Zone Regressive Path to Sustainability

Model-Generated Projection Hydrograph Trends

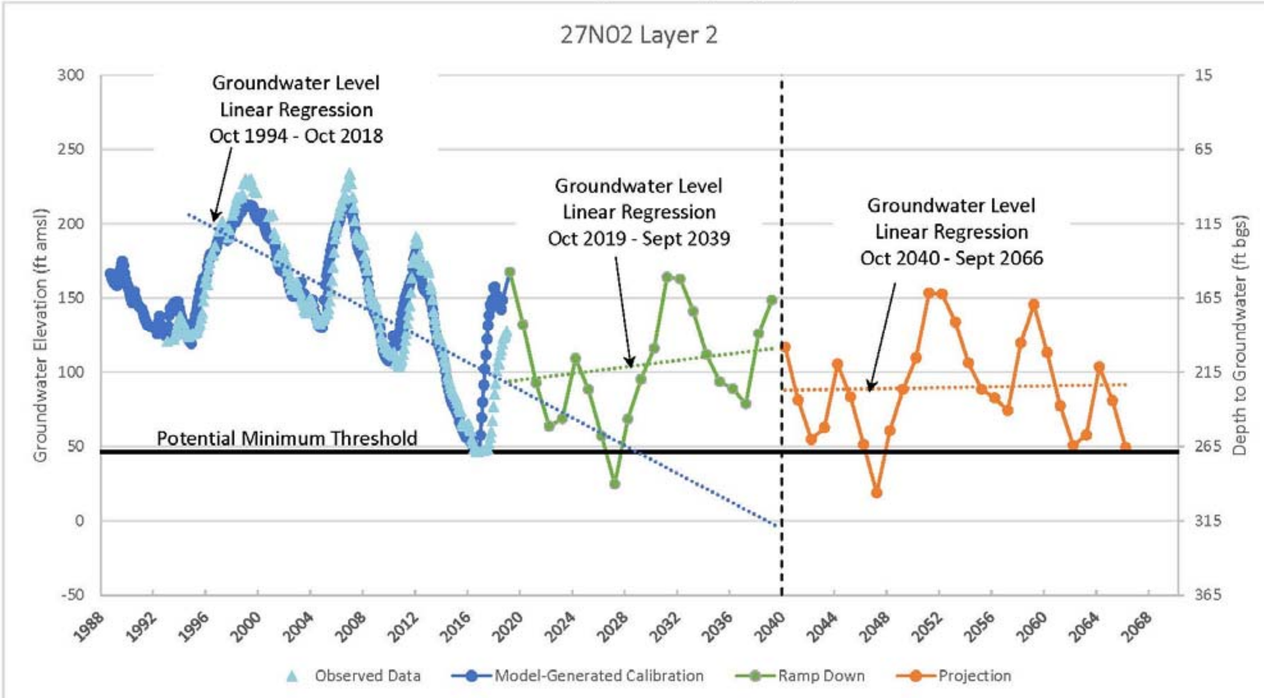


Figure 39. South Zone Regressive Path to Sustainability

Model-Generated Projection Hydrograph Trends

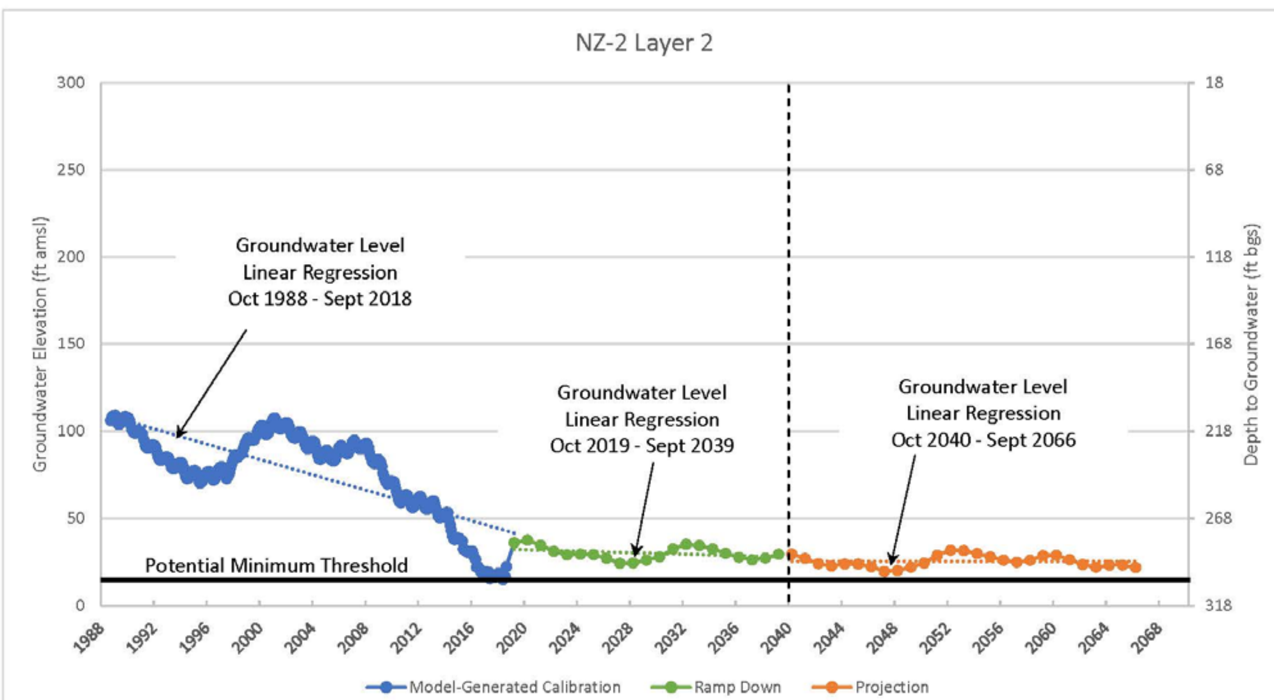


Figure 40. North Zone Regressive Path to Sustainability

3.2.2 Groundwater Storage

The RRBMA seeks a balanced water supply and positive groundwater storage (surplus) by 2040. The RRBDL could have positive groundwater storage by 2025 and the RRBWL by 2040. It is expected that prolonged drought periods (3-6 years, i.e. 2012-2016) could impact the RRBMA areas ability to have a balanced supply. That being said the RRBMA could draw down as much as 223,000 AF during such a period as shown on the balance sheet in the Operations Report found in Appendix D. Per the District Operations Report the balance went from 344,461 AF at the end of 2011 down to 121,496 AF at the end of 2016. A negative RRBMA groundwater storage balance post 2040 would be considered an undesirable result in that it would likely trigger water levels to drop below selected minimum thresholds.

3.2.3 Seawater Intrusion (N/A)

The Kern sub-basin is not adjacent to the Pacific Ocean, bays, deltas, or inlets and seawater intrusion is not an applicable sustainability indicator, because seawater intrusion does not exist and could not occur. As such, seawater intrusion is not further considered in this document.

3.2.4 Degraded Water Quality

The RRBMA seeks to protect groundwater quality for both current and future beneficial uses. To the extent that water quality is degraded to a point where expected beneficial use is precluded due to management actions or lack thereof this is an undesirable result.

3.2.5 Subsidence

The potential for subsidence in the Kern Fan area is monitored with an extensometer operated by the Department of Water Resources, and no significant inelastic subsidence has been recorded. In fact, since the inception of KWB operations, there has been an overall net rise in the land surface elevation (See Section 2.9.4). The RRBMA seeks to protect critical infrastructure (such as: roadways, railways, fluid conveyance, etc.) from impacts from subsidence. Specific critical infrastructure to or in the RRBMA are: Westside Parkway that connects Highway 99 to Interstate 5, Cross Valley Canal, California Aqueduct, Friant-Kern Canal, various RRBWSD and purveyor water laterals and pipelines, high pressure transmission gas pipelines, oil transmission pipelines, San Joaquin Valley Railroad, Burlington Northern Santa Fe Railroad. To the extent that subsidence does have an impact on these elements that would be considered an undesirable result (see 5.5 below).

3.2.6 Depletions of Interconnected Surface Water (N/A)

The Kern River is a losing stream where it parallels the RRBMA (see Section 2.2), having only received flows in 6 of the last 22 years, and depletions of interconnected surface water are not an applicable sustainability indicator because depletions do not exist and could not occur. As such, depletions of interconnected surface water are not further considered in this document. Likewise, there are no groundwater-dependent ecosystems identified in the RRBMA.

3.2.6 Groundwater Dependent Ecosystems

There are no identified groundwater dependent ecosystems within the RRBMA.

4. Monitoring Networks

4.1 Monitoring Networks Objectives

The objective of the monitoring network is to track whether the various Minimum Thresholds and Undesirable Results are occurring and how the plan is progressing towards meeting Measurable Objectives and Interim Milestones. Collected information will be analyzed and submitted consistent with SGMA regulations in conjunction and coordinated with KGA submittal processes. The RRBMA will also compare conditions against Minimum Thresholds to understand if undesirable results are occurring.

4.2 Groundwater Rationales

The RRBWSD has historically employed a robust groundwater monitoring network based on its desire to effectively manage groundwater. It has bolstered such efforts in relation to its operation of groundwater banking projects on behalf of itself and program partners. This monitoring network has demonstrated, by decades of data, to be representative of the monitoring zones in which the specific wells are located. The RRBWSD has also cooperated with previous legislative programs such as CASGEM, SB1938, and AB3030. The RRBMA seeks to develop a groundwater monitoring network that is consistent with these above-mentioned programs so as not to create duplicative efforts. Well owner access monitoring agreements are found in Appendix J.

The groundwater monitoring network is designed to:

- record level and quality trends by monitoring zone;
- depict groundwater surface, flow directions, and hydraulic gradients;
- monitor annual groundwater storage changes;
- evaluate groundwater depletion; and
- determine the rate of subsidence.

4.3 Groundwater Level Monitoring Network

The RRBMA seeks a robust water level monitoring network given that this is an important method to measuring groundwater sustainability in the area. Groundwater levels are monitored monthly in 20 locations, six of these locations are multi completion monitor wells at various depth intervals so that water level information is also available vertically within the aquifer. The wells are a combination of agricultural, domestic and dedicated monitor wells of known well construction. The current wells offer reliable long-term data.

4.3.1 Management Areas

The RRBMA has two sub-management areas that include five monitoring zones (North, Central, South, East, and South of River). Each monitoring zone was selected based on similar groundwater conditions and land use patterns. See Figure 7. The various selected wells have a long monitoring history and have proven to be representative of the monitoring zones that are each somewhat different in terms of conditions and beneficial uses. The wells and data used has been incorporated into the District numerical groundwater model (Appendix C) and have served to assist with calibrating the model in many circumstances. None of the selected wells provide data that are outliers to the nature of groundwater in any of the monitoring zones.

4.3.2 Monitoring Frequency

The RRBWSD currently measures wells monthly which provides abundant data to determine groundwater elevation trends.

4.3.3 Spatial Density

Groundwater levels are monitored monthly in 20 locations, an areal density of 1 well per 3.6 square miles or 28 wells per 100 square miles (Figure 7) across the entire RRBMA. Six of these locations are nested multi completion monitor wells at various depth intervals so that water level information is also available vertically within the aquifer. Each Monitoring Zone has 3-5 monitoring locations within to further provide ample well density. The data is compiled and reported by the Kern Fan Monitoring Committee pursuant to the MOU's (Kern Fan Operations Report - Appendix A) and the RRBWSD annual Operations Report (Appendix D). Groundwater depth and elevation maps, as well as hydrographs for the wells are included. Data is also posted at the RRBWSD website at www.RRBWSD.com.

4.3.4 Maps of Grid for Each Management Area

See Figure 7.

4.3.5 Monitoring Protocols

See section 3.3.7. of Umbrella GSP

4.4 Groundwater Storage Monitoring Network

The RRBMA seeks to have a robust groundwater storage monitoring network. The RRBMA will update its groundwater checkbook balance and as well as do a spring to spring water surface storage calculation using the RRBWSD groundwater model as described in section 2.1.

4.4.1 Management Areas

The RRBMA has two sub-management areas which include five monitoring zones (North, Central, South, East, and South of River). Each monitoring zone was selected based on similar groundwater conditions and land use patterns. See Figure 7. Each management area will be analyzed for groundwater storage as described above.

4.4.2 Monitoring Frequency

The RRBMA will update its groundwater checkbook balance and as well as do a spring to spring water surface storage calculation using the RRBWSD groundwater model as described in section 2.1. each year.

4.5 Seawater Intrusion Level Monitoring Network (N/A)

The RRBMA is not in proximity to seawater.

4.6 Degraded Water Quality Monitoring Network

The RRBMA seeks to have a robust water quality monitoring network. Groundwater quality is monitored annually in 35 locations, six of these locations are multi completion monitor wells at various depth intervals so that water level information is also available vertically within the aquifer. The wells are a combination of agricultural, domestic and dedicated monitor wells of known well construction. The current wells offer reliable long-term data. The following constituents of concern will be sampled and tested for:

COCs	Beneficial Uses by Monitoring Zone
Arsenic	Drinking Water/Banking
Chromium (Total Chromium)	Drinking Water/Banking
Hexavalent Chromium	Drinking Water/Banking
Nickel	Drinking Water/Banking
pH	Ag/Drinking Water/Banking
TDS	Ag/Drinking Water/Banking
Specific Conductance	Ag/Drinking Water/Banking
Chloride	Ag/Drinking Water/Banking
Sulfate	Drinking Water/Banking
Uranium	Drinking Water/Banking
Low Level Bromide	Drinking Water/Banking
Low Level 1,2,3-TCP	Drinking Water/Banking
Dissolved Organic Carbon (DOC)	Drinking Water/Banking
Nitrate as NO3	Drinking Water/Banking

4.6.1 Management Areas

The RRBMA has two sub-management areas which include five monitoring zones (North, Central, South, East, and South of River). Each monitoring zone was selected based on similar groundwater conditions and land use patterns. See Figure 17. Each management area will be analyzed for groundwater quality as described above.

4.6.2 Monitoring Frequency

The RRBWSD currently samples wells annually for constituents of concern which provides abundant data to determine groundwater quality trends.

4.6.3 Spatial Density

Groundwater quality is monitored at 35 locations, an areal density of 0.45 wells per square mile, or 1 well per 2.2 square miles, or 45 wells per 100 square miles (Figure 17) across the entire RRBMA. Six of these locations are nested multi completion monitor wells at various depth intervals so that water level information is also available vertically within the aquifer. The data is compiled and reported by the Kern Fan Monitoring Committee pursuant to the MOUs (Kern Fan Operations Report - Appendix A) and the RRBWSD annual Operation Report (Appendix D). Groundwater quality hydrographs are included. The District Operations Report is also posted at the RRBWSD website at www.RRBWSD.com.

4.6.4 Maps of Grid for Each Management Area

See Figure 17.

4.6.5 Monitoring Protocols

See section 3.3.7. of Umbrella GSP and Appendix A-3.

4.7 Land Subsidence Monitoring Network

See section 3.3.7. of Umbrella GSP.

4.8 Depletions of Interconnected Surface Water Monitoring Networks (N/A)

There are no interconnected surface waters in the RRBMA.

4.9 Monitoring Improvement Plan

The RRBMA will annually review and evaluate data with respect to the adequacy of the monitoring plan. It will identify data gaps, quality of data, adequacy of frequency and density. Adjustments will be made accordingly and documented.

4.9.1 Groundwater Level Monitoring Improvements

By 2030 the RRBMA will make efforts to have all sites as dedicated monitor wells.

4.9.2 Groundwater Storage Monitoring Improvements

The RRBMA and RRBWSD will seek to make improvements to the District model and participate in the regional model updates to better estimate groundwater storage. See section 4 of Umbrella GSP.

4.9.3 Seawater Intrusion Monitoring Improvements (N/A)

4.9.4 Degraded Water Quality Monitoring Improvements

By 2030 the RRBMA will make efforts to have all sites converted to dedicated monitor wells. The RRBMA have identified that there are water quality data gaps in both the North and Central monitoring zones. As the water level wells transition to dedicated monitoring wells by 2030 the RRBMA will seek to have 2-3 water quality monitoring wells in each monitoring zone.

4.9.5 Land Subsidence Monitoring Improvements

See section 3.3.8. of Umbrella GSP.

4.9.6 Interconnected Surface Water Monitoring Improvements (N/A)

5. Minimum Thresholds, Measurable Objectives, and Interim Milestones

As described in SGMA, undesirable results are one or more of the following effects:

1. **Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon;**
2. **Significant and unreasonable reduction of groundwater storage;**
3. Significant and unreasonable seawater intrusion;
4. **Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies;**
5. **Significant and unreasonable land subsidence that substantially interferes with surface land uses; and/or**
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The Kern sub-basin is not adjacent to the Pacific Ocean, bays, deltas, or inlets and seawater intrusion is not an applicable sustainability indicator, because seawater intrusion does not exist and could not occur. Likewise, the Kern River is a losing stream where it parallels the RRBMA, having only received flows in 6 of the last 22 years, and depletions of interconnected surface water is not an applicable sustainability indicator. Therefore, these undesirable results are not discussed in any detail in this chapter.

The RRBMA approach to sustainability is a Regressive Sustainability (see Figure 37) by 2040 which is an aggressive approach with more water supply projects and management actions implemented in the early years of the implementation period. Given the current conditions within the RRBMA, the large urban area and the concerns over degraded water quality within declining water levels, the RRBMA has implemented a proactive approach to ensuring sustainability. Accordingly, the interim milestone goals for all categories are to be between the Measurable Objectives and Minimum Thresholds throughout the period.

Minimum thresholds and/or their applicability for each of the remaining categories are described below.

5.1 Chronic Lowering of Groundwater Levels

For the past twenty five (25) years the RRBWSD has been in water supply balance (supplies have been equal to or greater than demand) as described in section 2.2.2; RRBWSDs operations have not contributed to the chronic lowering of groundwater levels, nor are the projected future operations of the RRBWSD expected to cause or contribute to the chronic lowering of groundwater levels within the RRBMA as the District seeks to always have a balance water supply with its demand. The RRBMA does include RRBWLs (White Lands) and is bordered on two sides by lands without surface water supplies and almost completely dependent on groundwater pumping. These factors, combined with being located within a critically overdrafted basin, have caused groundwater levels to decline 3-5 ft per year on average over time despite RRBWSD's balanced condition. The RRBWSD anticipates that adjacent groundwater sustainability plans will contain projects and management actions that reach a sustainable level over the next 20 years, thereby lessening their impacts within the RRBMA.

Despite RRBWSD's expanding water management efforts, average groundwater depths dropped from 175 ft down to 250 ft below ground surface during the 2012-2016 drought cycle. The RRBWSDs ability to maintain groundwater levels are drastically diminished by deep and persistent groundwater pumping depression existing northwest of RRBMA, which results in a steep groundwater gradient across the RRBMA from southeast to northwest of about 15 ft per mile. This dewatering coupled with banking project extractions, occurring during the peak period of drought, resulted in significant expense to landowners in the RRBMA in terms of pump lowering, well replacement, well-head treatment, and increased energy costs. That reinvestment now allows most RRBMA landowners to tolerate average groundwater depths of about 256-329 ft (range of the monitoring zones) below ground surface, which was the depth at the end of the 2012-2016 drought. To the extent that further water level declines are experienced, additional reinvestment in groundwater facilities would be required and additional energy costs would be incurred, which would be deemed an undesirable result. Table 9 depicts the financial impact of a threshold scenarios of 0, 25, 50, 75, and 100 ft deeper that 2016 levels ($0M, $372M, $640M, $661M, $675M respectively) as found in Appendix H. The financial impacts include typical well infrastructure improvement costs and extra energy lift costs for domestic, agricultural and municipal wells. The impacts also include arsenic treatment costs for domestic, municipal and groundwater banking wells. A secondary threshold of arsenic impact was evaluated in order to understand at what depth to groundwater arsenic treatment would be required (report found in Appendix H). As was discussed in section 2.4.2.2, arsenic increases with depth. At the deepest levels experienced during the last drought arsenic levels were reaching the MCL.

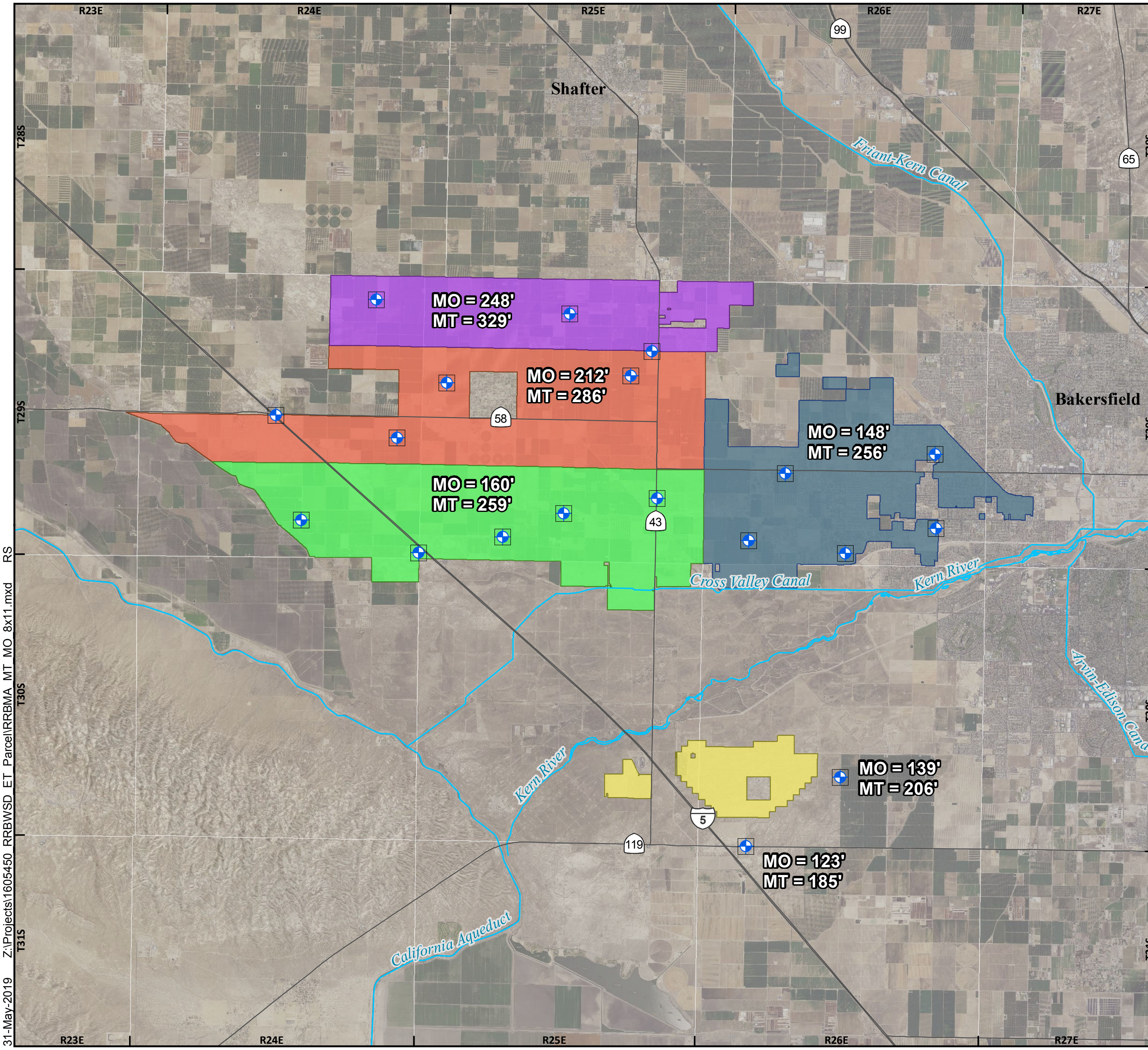
The RRBMA will seek to maintain at least two water level monitoring points for each monitoring zone. To the extent that average water levels in of designated monitoring points has exceeded the minimum threshold of the monitoring zone, it will be considered an undesirable result. To the extent that two of the North, Central, and South of River zones exceed this criterion, the RRBMA will consider it an undesirable result. To the extent that either the South or East zones exceed this criterion, the RRBMA will consider it an undesirable result.

	Scenario #0	Scenario #1	Scenario #2	Scenario #3	Scenario #4
Reference GW Depth					
Domestic					
Pumps Lowered	0	0	0	136	136
Pump Lowering	$0	$0	$0	$1,090,667	$1,636,000
Wells Rehabilitated	0	19	34	42	45
Well Rehabilitation	$ -	$ 185,000	$ 335,000	$ 420,000	$ 450,000
Wells Replaced	0	15	21	38	54
Well Replacement	$ -	$ 666,368	$ 975,085	$ 1,944,075	$ 2,927,478
Extra Lift	$ -	$ 35,438	$ 70,877	$ 106,316	$ 141,755
Elec. Upgrades	0	0	0	0	0
Elec. Upgrading	$ -	$ -	$ -	$ -	$ -
As Treats	0	0	0	283	283
As Treating	$ -	$ -	$ -	$ 3,390,000	$ 3,390,000
Total Cost	$ -	$ 886,806	$ 1,380,962	$ 6,951,057	$ 8,545,234
Agricultural					
Pumps Lowered	0	0	0	138	138
Pump Lowering	$ -	$ -	$ -	$ 5,526,667	$ 8,290,000
Wells Rehabilitated	0	8	20	27	31
Well Rehabilitation	$ -	$ 562,500	$ 1,462,500	$ 2,025,000	$ 2,325,000
Wells Replaced	0	0	0	0	1
Well Replacement	$ -	$ -	$ -	$ -	$ 194,400
Extra Lift	$ -	$ 6,247,729	$ 12,511,498	$ 18,792,608	$ 25,092,504
Elec. Upgrades	0	0	21	21	38
Elec. Upgrading	$ -	$ -	$ 317,500	$ 317,500	$ 565,000
As Treats	0	29	29	29	29
As Treating	$ -	$ 362,500,000	$ 362,500,000	$ 362,500,000	$ 362,500,000
Total Cost	$ -	$ 369,310,229	$ 376,791,498	$ 389,161,775	$ 398,966,904
Municipal/Public					
Pumps Lowered	0	0	0	22	22
Pump Lowering	$ -	$ -	$ -	$ 1,320,000	$ 1,980,000
Wells Rehabilitated	0	0	1	2	5
Well Rehabilitation	$ -	$ -	$ 200,000	$ 400,000	$ 1,000,000
Wells Replaced	0	2	2	4	4
Well Replacement	$ -	$ 457,200	$ 487,200	$ 905,100	$ 957,600
Extra Lift	$ -	$ 1,198,022	$ 2,396,842	$ 3,596,525	$ 4,797,143
Elec. Upgrades	0	0	0	0	0
Elec. Upgrading	$ -	$ -	$ -	$ -	$ -
As Treats	0	0	28	28	28
As Treating	$ -	$ -	$ 259,000,000	$ 259,000,000	$ 259,000,000
Total Cost	$ -	$ 1,655,222	$ 262,084,042	$ 265,221,625	$ 267,734,743
Total	$ -	$ 371,852,256	$ 640,256,502	$ 661,334,458	$ 675,246,881

Table 9. Financial Impacts at various Threshold Levels - #0 Selected, +25' deeper each scenario

Recognizing that even an increase in groundwater depth of 50 ft can create a $13,000/acre impact, the RRBMA has set its minimum threshold at recent historic drought levels (2012-2016) as shown in Figures 41-46 below. The RRBMA will seek to maintain water levels above the minimum thresholds with a goal of meeting the measurable objectives (Figures 41-46), which are levels that maintain recovery capacity and efficiency and minimize water costs. Reasonable management actions and projects will be implemented in an effort to meet these goals, recognizing that adjacent management area projects and management actions must also be adequate and enacted in order for these goals to be achieved. Because water levels are already near the minimum thresholds, meaning further permanent dewatering of the aquifer is not envisioned in the RRBMA plan, interim milestones were not assigned.

RRBMA MINIMUM THRESHOLDS AND MEASURABLE OBJECTIVES



MO - Measurable Objective
MT - Minimum Threshold
Depth to Groundwater

RRBMA Water Level Well

Proposed Monitoring Zones

- East Zone
- South Zone
- Central Zone
- North Zone
- South of River Zone

All Other Features

- Highway
- Waterway

N

0 1.5 3 6
Miles

Rosedale-Rio Bravo Management Area
Kern County, California

Rosedale-Rio Bravo WSD

GEI Consultants

DECEMBER 2019 FIGURE 33

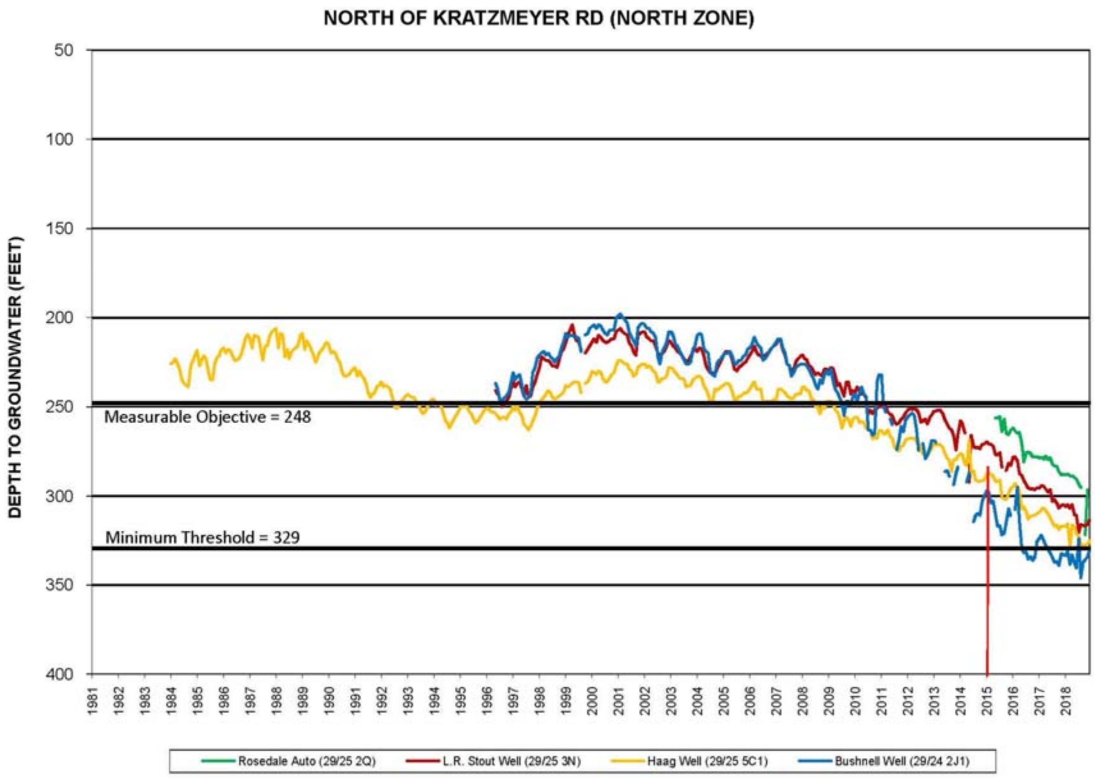


Figure 42. North Monitoring Zone Minimum Thresholds and Measurable Objectives

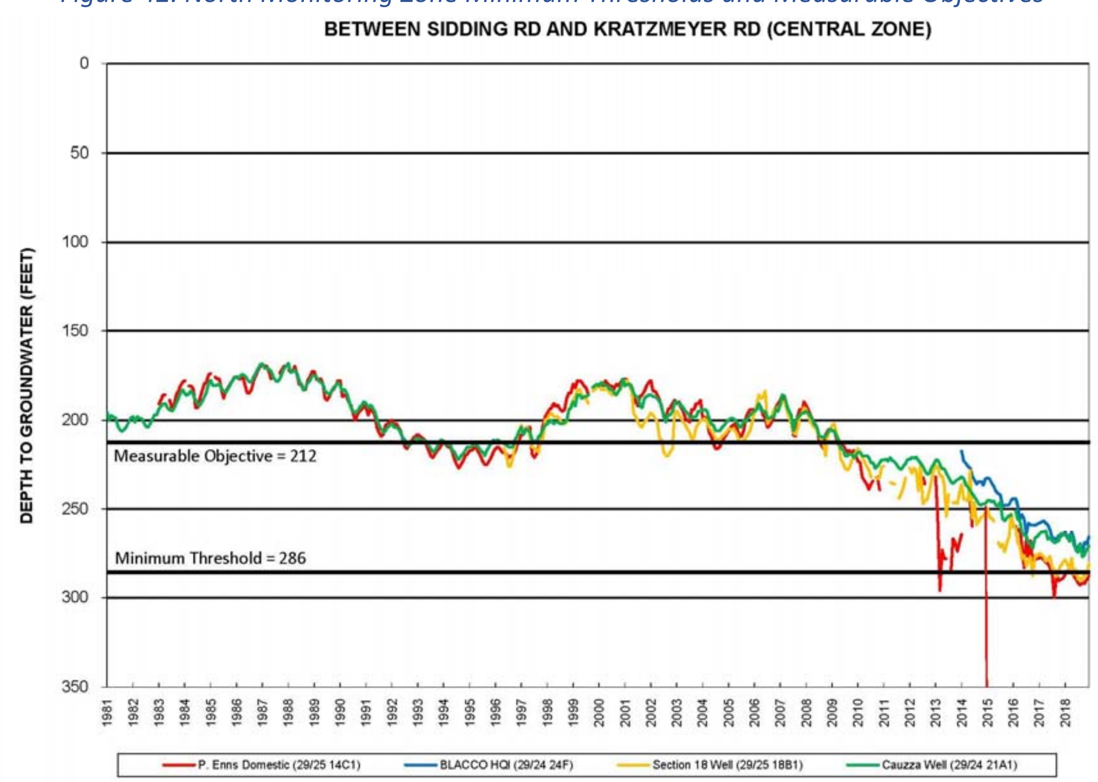


Figure 43. Central Monitoring Zone Minimum Thresholds and Measurable Objectives

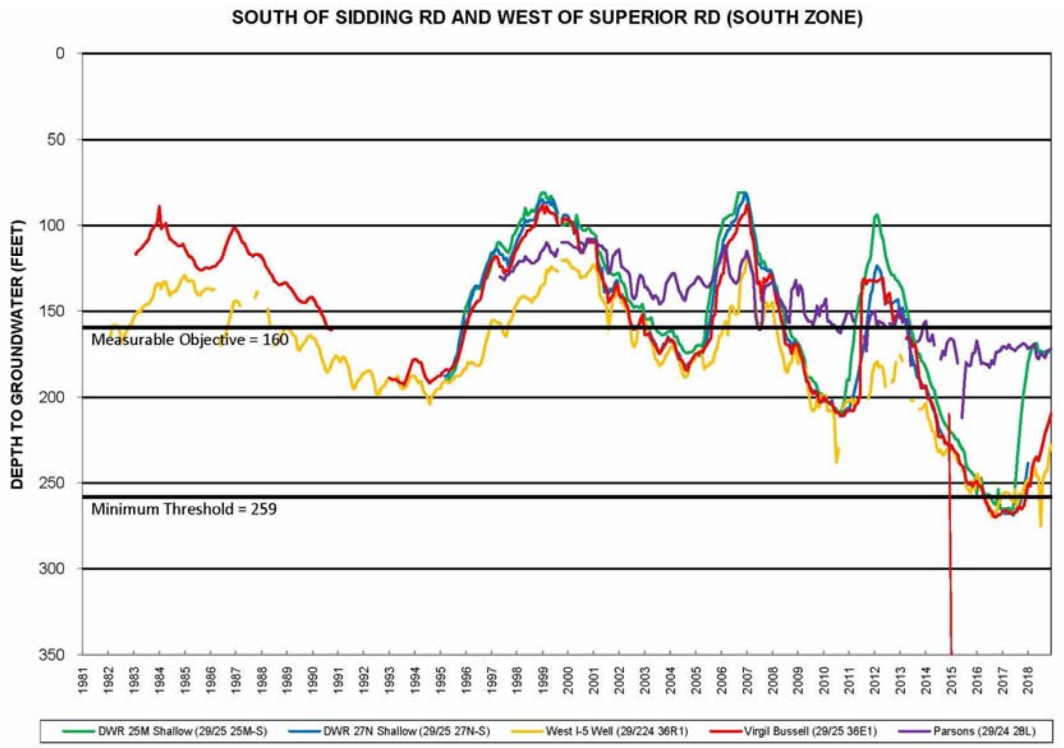


Figure 44. South Monitoring Zone Minimum Thresholds and Measurable Objectives

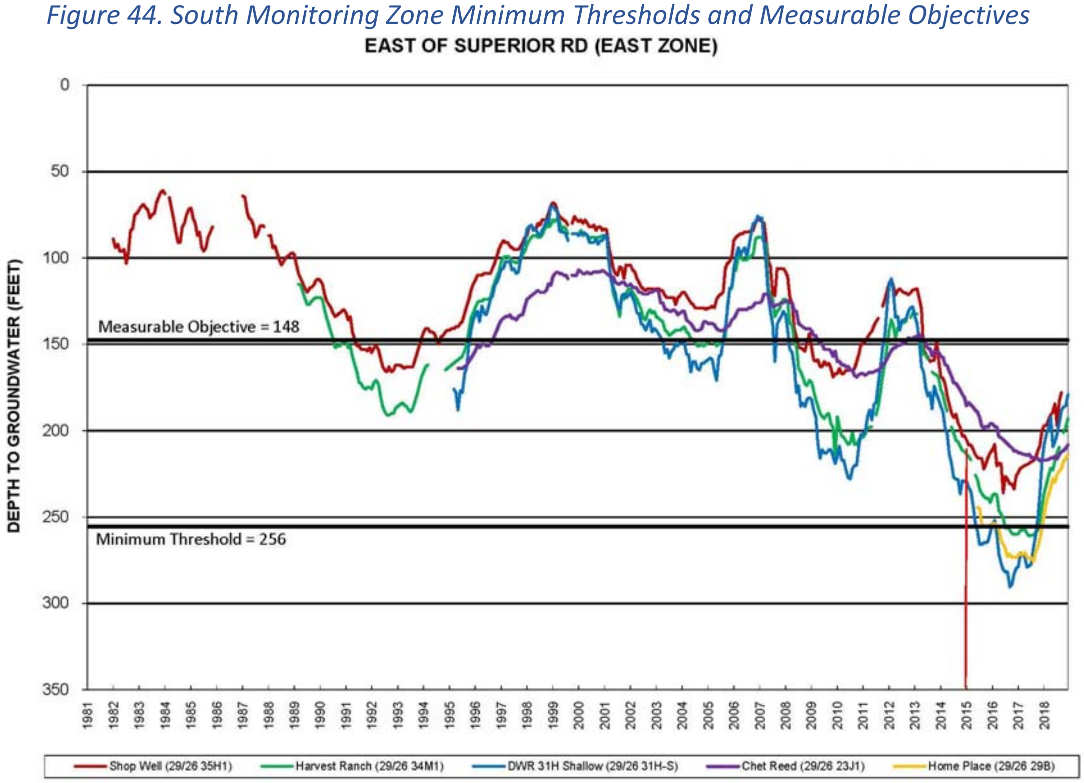
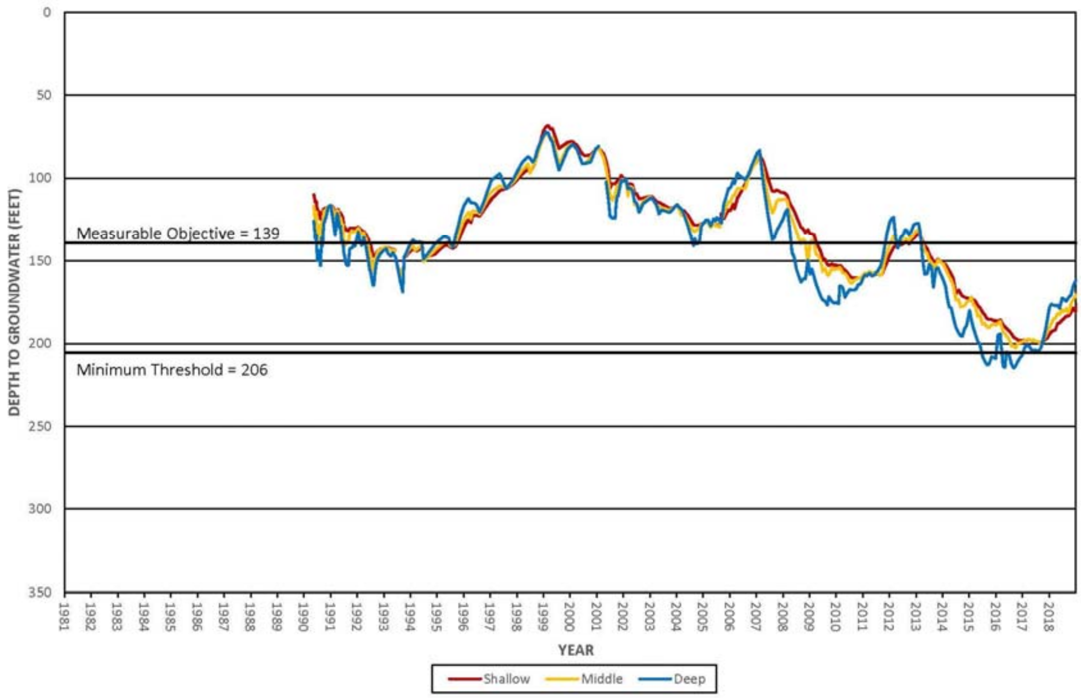


Figure 45. East Monitoring Zone Minimum Thresholds and Measurable Objectives

30S/R26E 28J (South of River Zone)



30S/R26E 32N (South of River Zone)

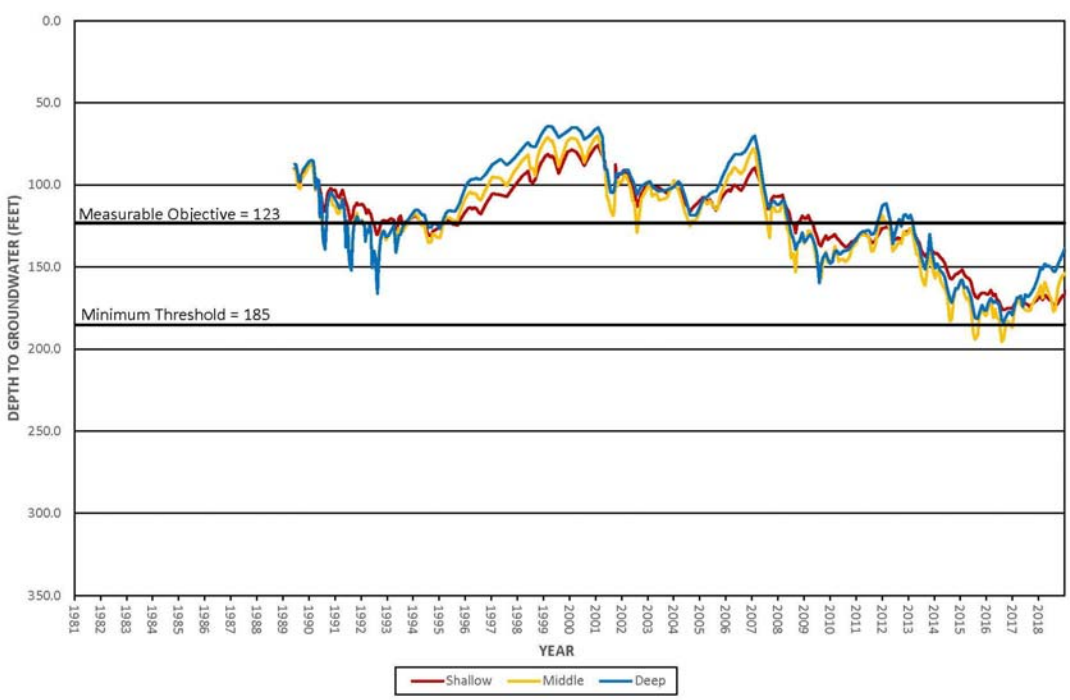


Figure 46. South of River Monitoring Zone Minimum Thresholds and Measurable Objectives

5.2 Reduction of Groundwater Storage

The RRBMA seeks to have a balanced water supply and has accomplished this goal to date (as documented in its annual Operations Report - shown on Table 2 of Appendix D with an end of 2017 balance of 195,784 AF). Despite a historical positive balance, water levels in the RRBMA have declined. The RRBMA has calculated the amount of groundwater storage between the groundwater level Minimum Threshold and the Measurable Objective in the RRBMA to be 663,000 AF (Appendix C). The Minimum Threshold for the RRBMA groundwater storage as calculated by its cumulative checkbook balance (Appendix D) will be 0 AF and its Measurable Objective is 663,000 AF. The storage level with respect to the calculated water surface calculations will assume the level Minimum Threshold to be 0. Water surface elevations and calculated storage will be compared to the checkbook balance and reported in plan updates. Differences between the two would likely point to adjoining Management Area actions or inactions impacting water levels within the RRBMA.

5.3 Seawater Intrusion (N/A)

5.4 Degraded Water Quality

Groundwater quality in the RRBMA is monitored annually 35 locations; six of these locations are multi completion monitor wells at various depth intervals so that water level information is also available vertically within the aquifer as shown on Figure 17. These wells are sampled and analyzed for constituents of concerns (COCs) including:

COCs	Beneficial Uses by Monitoring Zone
Arsenic	Drinking Water/Banking
Chromium (Total Chromium)	Drinking Water/Banking
Hexavalent Chromium	Drinking Water/Banking
Nickel	Drinking Water/Banking
pH	Ag/Drinking Water/Banking
TDS	Ag/Drinking Water/Banking
Specific Conductance	Ag/Drinking Water/Banking
Chloride	Ag/Drinking Water/Banking
Sulfate	Drinking Water/Banking
Uranium	Drinking Water/Banking
Low Level Bromide	Drinking Water/Banking
Low Level 1,2,3-TCP	Drinking Water/Banking
Dissolved Organic Carbon (DOC)	Drinking Water/Banking
Nitrate as NO3	Drinking Water/Banking

The measurable objective will be any applicable beneficial use COC value that is less than the MCL and a value increase less than 10% of the 2015-2020 value. An Undesirable Result will exist if any applicable beneficial use COC value that is greater than the current MCL and value increase of greater than 10% from the 2015-2020 value. [3]

With respect to arsenic (which is addressed in the water section 5.1) the following was considered in developing minimum thresholds:

- Beneficial Use of the water – Agriculture vs. Municipal
- Arsenic concentrations with depth in the aquifer
- The impact of lowering groundwater levels in the shallow and deep aquifers on arsenic concentrations in the water produced

Arsenic concentrations have been shown to increase with depth; therefore, it may be beneficial to manage groundwater levels at a certain elevation in some areas to avoid conditions that would result in arsenic concentrations above the MCL, particularly for wells that produce water for projects and municipal supply.

North and Central Monitoring Zone – In this area, it appears that when groundwater levels go down, the arsenic concentration in Well 11G01 goes down. At present, the arsenic concentration in this well is below the 10 μg/L MCL, but groundwater levels have also been at historical lows during the last few years. The beneficial use of the water in this area is primarily agriculture. In the future, if groundwater levels stabilize or even rise, then arsenic concentrations in this area could rise again. The exact depth interval of 11G01 is unknown but assuming it is an ag well, it is likely perforated at least partially in the deep aquifer. Given the beneficial uses of the water in this area and based on historical concentrations in 11G01, an Arsenic Minimum Threshold of 50 μg/L for the shallow and deep aquifers in the North Zone will be observed as it relates to ag beneficial uses, noting that this will not be protective of domestic beneficial uses of the water.

South Monitoring Zone - Based on nested monitoring wells 27N01/02 and 25/M01/02, arsenic concentrations in this zone tend to decrease as groundwater levels drop. It has been observed that the arsenic concentration in the deep aquifer increases with depth and, thus, as groundwater levels rise, arsenic concentrations in the discharge from the wells should drop. In addition to ag, beneficial use of the water includes groundwater storage projects, which require producing water that meets regulatory standards for drinking water. Maintaining groundwater levels above historical low levels observed in 2015 through 2017 should allow the RRBWSD to maintain arsenic concentrations below the MCL. An Arsenic Minimum Threshold of 80% of the MCL or 8 μg/L for both the shallow and deep aquifers in this zone will be observed. Based on observations and data to date, this should be protective of both municipal and project-related beneficial uses.

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[3] Jurisdiction over water quality is generally within the purview of other agencies, including the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, the Kern County Public Health department, and the like. RRBWSD does not determine which constituents constitute COC's, nor does it determine applicable MCL's for COC's. Nothing in this GSP chapter, including the determination of Measurable Objectives and Minimum Thresholds for water quality, shall constitute a representation or warranty by RRBWSD as to the quality of any water recovered from the groundwater basin underlying RRBMA for overlying uses, including but not limited to agricultural, domestic or industrial uses.

East Monitoring Zone – Arsenic concentrations in the shallow and deep aquifers in this zone show a clear correlation with depth: arsenic concentrations in shallow wells are generally below 10 μg/L and arsenic concentrations in deep wells are generally above 10 μg/L. An arsenic Minimum Threshold of 8 μg/L for the shallow aquifer (in recognition of municipal and project beneficial uses in the area) and a MT of 50 μg/L for the deep aquifer in the east zone.

South of River Zone – Arsenic concentrations in samples from wells in this zone have typically been well below the MCL. An arsenic Minimum Threshold of 8 μg/L for both shallow and deep aquifers in this area will be observed. Nitrate, on the other hand, has been detected above its MCL of 10 mg/L (as N) in some wells in this area.

5.5 Land Subsidence

Historic operations during four significant storage cycles and two significant recovery cycles have resulted in a cumulative land surface rise of about 0.27 ft (see Section 2.7.3), indicating the Kern Fan Aquifer is not susceptible to land subsidence due to stored water recovery. Subsidence is not an applicable sustainability indicator in the RRBMA because subsidence has not occurred. Extensometer monitoring will continue. RRBMA will participate in a regional effort with the KGA and other GSAs overlying the basin.

Until a regional a program is developed, a threshold of 2 ft will be assigned given that there is not a history of subsidence in the RRBMA. A measurable objective of less than 1 foot will be assigned and a 2030 milestone of less than 1.5 ft will be assigned.

5.6 Interconnected Surface Water (N/A)

5.7 Potential Effects Beyond Management Area

The RRBWSD has sought for many years to be in balance as to water supplies and demands, and forecasts to operate in the same manner going forward. There should be no lasting effects from RRBWSDs operations outside the management area. The RRBWL agricultural land use operations do have an effect on the RRBMA and adjacent management areas because those lands rely solely on groundwater pumping and except for water banking lands have not historically recharged or obtained any additional water supplies.

The RRBMA is not expected to create any undesirable results on adjacent management areas as the small water supply deficiency is expected to be mostly eliminated by 2025 due to management actions and projects as depicted by Figure 37.

6. Water Supply Accounting

6.1 Allocation from Umbrella GSP

All GSAs in the Kern County subbasin (Subbasin) coordinated and collaborated on the development of a groundwater model (Model) to evaluate historical, baseline and projected groundwater conditions. The GSAs entered into a Cost Share Agreement with the Kern River GSA who took the lead and contracted with Todd Groundwater to develop the Model on behalf of the Subbasin. The contract required that Todd Groundwater use the C2VSim model provided by DWR. Considerable effort and resources were expended to update the C2VSim model with local data to better represent Subbasin conditions. The process Todd Groundwater used to update C2VSim is more fully described in the Historical and Projected Future Water Budget Development (see Attachment H in Umbrella GSP). Basin-wide water budget results from the Model are provided in Attachment H and show the Subbasin, as a whole, has a total storage deficit of approximately 324,326 AFY over the baseline period.

The Subbasin's dynamic conjunctive use programs, water banking operations, and water transfers/exchanges made it necessary to coordinate a GSA level water accounting system (Checkbook) using Subbasin specific values for supply, demand and net results. The Model results reflect Subbasin-wide conditions and do not allocate water shortages/surpluses, nor do the results allocate the "ownership" of water. As a result, the GSAs, through a coordinated effort, developed the Checkbook that estimates current conditions for each GSA that are generally consistent with the Model results under baseline condition. The Checkbook and Model budgets are based upon best available information, recognizing however, each estimate includes data gaps and has varying degrees of accuracy and/or reliability in the interest of developing a Subbasin coordinated approach.

To ensure the individual water budgets reflected actual conditions, the KGA members developed the Checkbook budget and coordinated water accounting methodology. The result of that effort indicates a current baseline shortage/deficit for KGA members of approximately -256,281 AFY.[4] This reflects the difference between a total demand for KGA members of 1,939,409 AFY, and a total supply of 1,683,128 AFY. Of the shortage/deficit of the KGA, Rosedale Rio-Bravo Management Area's portion of the KGA shortage/deficit is 20,116 AFY. Or a difference in demand of 118,860 AFY and a water supply of 98,744 AFY.

As is mentioned above, each estimate includes data gaps and has varying degrees of accuracy and/or reliability. The Checkbook is complimentary to the Model and reflects the allocation of water supply benefits and obligations independent of geographic constraints within the Subbasin. This was important to recognize and ensure the coordination of the various groundwater banking projects and water management programs amongst the various GSA's within the groundwater basin.

[4] The water supplies available to each KGA member from the Pioneer and Kern Water Bank banking programs are incorporated into the listed total available supplies. Note that both programs only store surface supplies, and do not have consumptive demands that contribute to the listed shortages. For more detail on the banking projects, please see the respective management area plans.

6.2 Water Accounting Framework

The RRBMA has developed a simple framework by which landowners may track their path to sustainability. The RRBMA will track net demand by means of METRIC satellite imagery techniques. To the extent that imported water supply allocated to the landowner, precipitation, and allocated portion of native yield are less than the net demand, a water supply imbalance will be calculated as follows:

Native Yield + Precipitation + Imported Supply = Sustainable Yield - Demand = <u>Balance</u>

6.2.1 Landowner Allocations

The RRBMA will allocate the same amount of native yield and precipitation to all developed lands.

6.2.2 Accounting Tools

The RRBMA is developing a web-based water supply accounting database system on an APN (assessor's parcel number) basis that will provide parcel allocation of Native Yield, Precipitation, and Project Water supply as compared to consumptive use on a monthly time step by the end of the following month. This will enable landowners to track water supply and usage to meet management action demand reduction objectives. Currently the RRBMA is working with the Environmental Defense Fund (EDF) to provide the RRBWSD with a water accounting platform.

6.2.2 Allocation Among Sub-Management Areas

The RRBMA will allocate Native Yield and Precipitation to both sub-management areas (White Land and RRBWSD) in the same manner. However, RRBWSD lands in the RRBMA will be allocated a proportionate share of Project Water to offset and even potentially eliminate imbalance. White Lands will not be allocated a portion of RRBWSD Project Water but will be able to access imported water supplies and projects that create water supplies on a mutually agreeable basis. RRBWSD's Board of Directors anticipates that Landowners will be able to aggregate their APNs and available water supplies within each sub-management area in order to maximize flexibility. It is also anticipated that transfers into the RRBDL sub-management areas will be considered but that transfers out of the RRBDL will not allowed.

Lands used for groundwater banking have historically used both a 3% and 6% estimate of recharge loss via agreement (e.g., the MOU's). By using a water balance instead of a flat loss estimate, the RRBMA will be able to more accurately calculate the recharge loss and help ensure sustainable operation of the banking operations in the future. To the extent that banking lands use groundwater for overlying beneficial uses, the Native Yield will be assigned to offset that use. To the extent that overlying beneficial use is not triggered, only actual precipitation and project water will be used to offset calculated demands (ET) as described in section 2.2.2.

6.2.3 Changes Over Time

The native yield allocation is expected to be revisited over time by the KGA and other Kern Sub-basin GSAs to evaluate its accuracy and sustainability.

7.0 Projects, Management Actions, and Adaptive Management

7.1 Sustainability Target

See Section 3.2.

7.2 Water Accounting Framework

See Section 6.

7.3 Projects

RRBWSD is developing several projects in order to meet its measurable objectives and achieve sustainability. All the considered projects and management actions help the RRBMA achieve its measurable objectives for chronic lowering of groundwater levels, reduction in groundwater storage, degraded water quality, and land subsidence. Project and management action implementation will be subject to CEQA requirements for implementation and the associated public noticing, regulatory, and permitting requirements. It is expected that RRBWSD will serve as the lead agency for these actions. RRBWSD is a public agency organized in accordance with California Water Storage District Law (Division 14, commencing with §39000 of the California Water Code) for the purpose of acquiring, storing, distributing, and replenishing water supplies within its boundaries in Kern County, California.

For each project conservative assumptions as to average annual yield are provided recognizing that there will be more competition for supplies moving forward than in the past. For direct recharge projects average annual yield is based expected recharge rates multiplied by the anticipated surface area multiplied by 150 days of usage, two years out of ten. This equals about 8% opportunity time; RRBWSD past operations are about 40%. Direct recharge projects also typically provide demand reduction benefits that are also considered in project supplies. A pre-project demand of 2.3 AF/Acre is assumed. See project evaluation matrix in Appendix K.

7.3.1 West Basin Improvements

The West Basins Improvement Project is the improvement of existing recharge ponds and development of an additional 50-acre project west of Bakersfield designed to recharge, store and recover water to provide a cost-effective and reliable water supply for landowners within the RRBWSD. RRBWSD purchased the properties in 2009-2015. This project has the potential to recharge up to 5,000 AF of water in wet years. This could provide the RRBWSD with up to 1000 AFY. Project construction was completed in 2016 at a total capital cost of approximately $1M; annual O&M costs are estimated to be $20,000. Total annualized cost is $81,000, or $61/AF (plus water cost). See Figure 47.

Figure 47. West Basin Improvements

7.3.2 Stockdale East Groundwater Storage and Recovery Project

The Stockdale East Groundwater Storage and Recovery Project is a developed 200-acre project west of Bakersfield designed to recharge, store and recover water to provide a cost-effective and reliable water supply for landowners within the RRBWSD. RRBWSD purchased the property in 2010. This project has the potential to recharge up to 25,000 AF of water in wet years. This could provide the RRBWSD with up to 4,000 AFY on average. Project status is 90% complete, it will be operational by 2020. Estimated total capital cost is $12.2M and annual O&M costs of $366,000. Total annualized cost is $1.26M or $330/AF (plus water cost). See Figure 48.

Figure 48. Stockdale East

7.3.3 Pilot Projects

In 2017 the RRBWSD developed four pilot recharge projects under which it leased properties for temporary recharge activities. During that year approximately 10,000 AF was recharged in these projects. Since that time the District has invested in a Groundwater Recharge Assessment Tool (Grat) in order to identify similar project sites in the future. These efforts could provide RRBWSD with up to 2,000 AFY. These projects could be on-line as early as 2025. Estimated total capital cost is $2M; annual O&M costs are estimated to be $100,000. Total annualized cost is $223,000, or $61/AF (plus water cost). See Figure 49.

Figure 49. Pilot Project

7.3.4 Onyx Ranch

The RRBWSD owns several parcels of land and the associated water rights for the Onyx Ranch and the Smith Ranch. These parcels are located along the South Fork of the Kern River in the Kern River Valley, in and around the communities of Weldon and Onyx, in an unincorporated area of northeastern Kern County. These parcels together comprise the 4,109.18-acre project site. The RRBWSD is currently conducting an analysis of a proposed change in the point of diversion and place of use of the water rights associated with these parcels so that the water can be delivered in the RRBWSD service area on the San Joaquin Valley floor and used for irrigation and groundwater recharge. The project would reduce the diversion of water on the project site and convert the irrigated fields to lower water use crops or allow the fields to return to their native vegetative state. With the proposed project, RRBWSD would allow the water that would have been diverted on the project site to remain in the South Fork of the Kern River and flow downstream. This could result in a net increase in flows within the South Fork of the Kern River, and the Isabella Reservoir where the water would be released through the Isabella Dam and flow downstream in the lower Kern River until the water is diverted at the RRBWSD diversion point. From there, the RRBWSD would deliver the water to recharge basins and channels within and near its service area west of the City of Bakersfield (City) in unincorporated Kern County within the San Joaquin Valley. The net increase in water supplies to the RRBWSD's service area as a result of the proposed project would help mitigate the shortages in RRBWSD's contracted State Water Project (SWP) water supply from the State of California, which has steadily reduced due to environmental constraints in the Sacramento/San Joaquin Delta. The proposed project would provide the RRBWSD with approximately 6,500 AFY. The project is currently undergoing a feasibility and environmental analysis. The project could be on-line as early as 2025. Estimated total capital cost is $30M; annual O&M costs are estimated to be $450,000. Annualized cost is $2.3M, or $356/AF. See Figure 50.

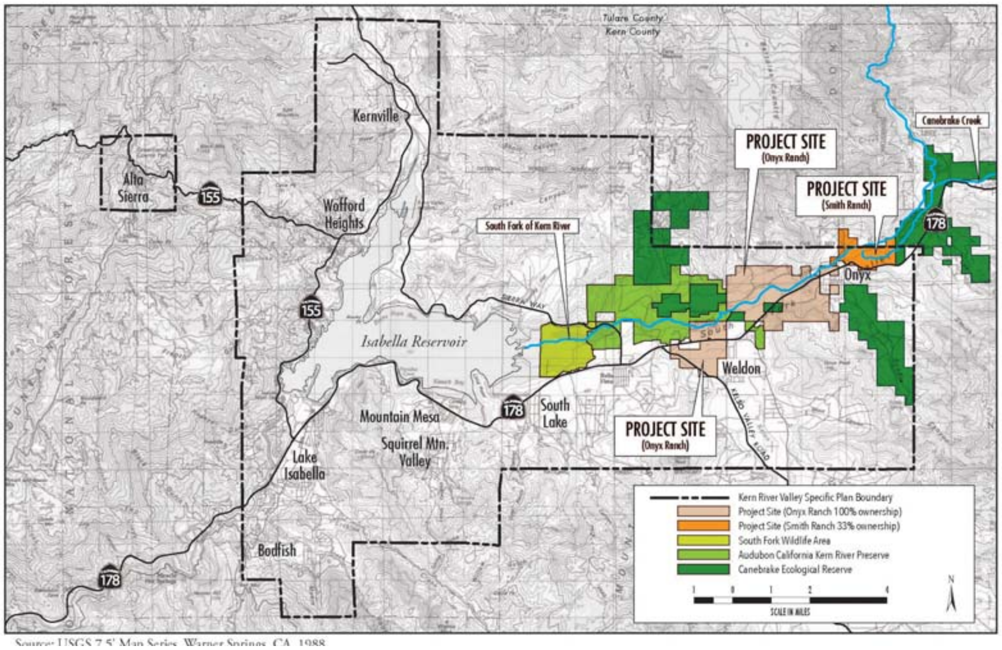

Figure 50. Onyx Ranch Project Site

7.3.5 James Groundwater Storage and Recovery Project

The James Groundwater Storage and Recovery Project is a proposed 2,070-acre project in southwest Bakersfield designed to recharge, store and recover water to provide a cost-effective and reliable water supply for landowners within the RRBWSD (and elsewhere). The project property, known locally as McAllister Ranch, was formerly a planned residential development that was in the early stages of construction. Due to the downturn in the real estate market and project financing issues, development was discontinued, and the property sat idle for several years until it was sold in a bankruptcy proceeding. Rosedale and Buena Vista Water Storage District jointly purchase the property in 2011. This project has the potential to recharge up to 150,000 AF of water in wet years. This could provide the RRBWSD with up to 3,000 AFY. Current project status is feasibility and environmental analysis. This project could be online as early as 2025. Estimated total capital cost is $6.8M; annual O&M costs are estimated to be $200,000. Annualized cost is $700,000, or $235/AF (plus water costs). See Figure 51.

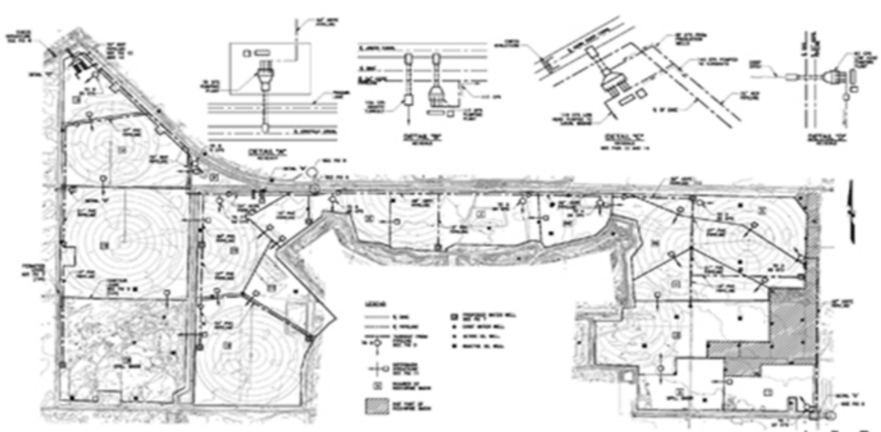

Figure 51. James Project

7.3.6 Kern Fan Groundwater Storage Project.

The District has evaluated a conceptual Kern Fan Groundwater Storage Project (Kern Fan Project). This project would serve to develop a regional water bank in the Kern Fan to capture and store Article 21 water via the State Water Project (SWP) during conditions when surface water is abundant. A two-phased approach would be taken to the development of the Kern Fan Project. The first phase would be to develop a project site, including the purchase of approximately 640 acres of land in the Kern Fan area. The first phase would also include constructing conveyance facilities, recharge facilities, and recovery facilities as necessary to develop a fully functioning water banking project. The second phase of the Kern Fan project would involve acquiring an additional 640 acres of land for expansion of the water banking facilities and developing the associated recharge and recovery facilities. On July 24, 2018 the California Water Commission approved $2.7B of Proposition 1 funding to eight water storage projects, including $67.5M towards the Districts sponsored Kern Fan Groundwater Storage Project. This could provide the RRBWSD with up to 10,000 AFY. Project status is feasibility analysis. This project could be on-line as early as 2030. Estimated total capital cost is $45M; annual O&M costs are estimated to be $1.35M. Annualized cost is $4.7M or $468/AF (plus water costs). See Figure 52.

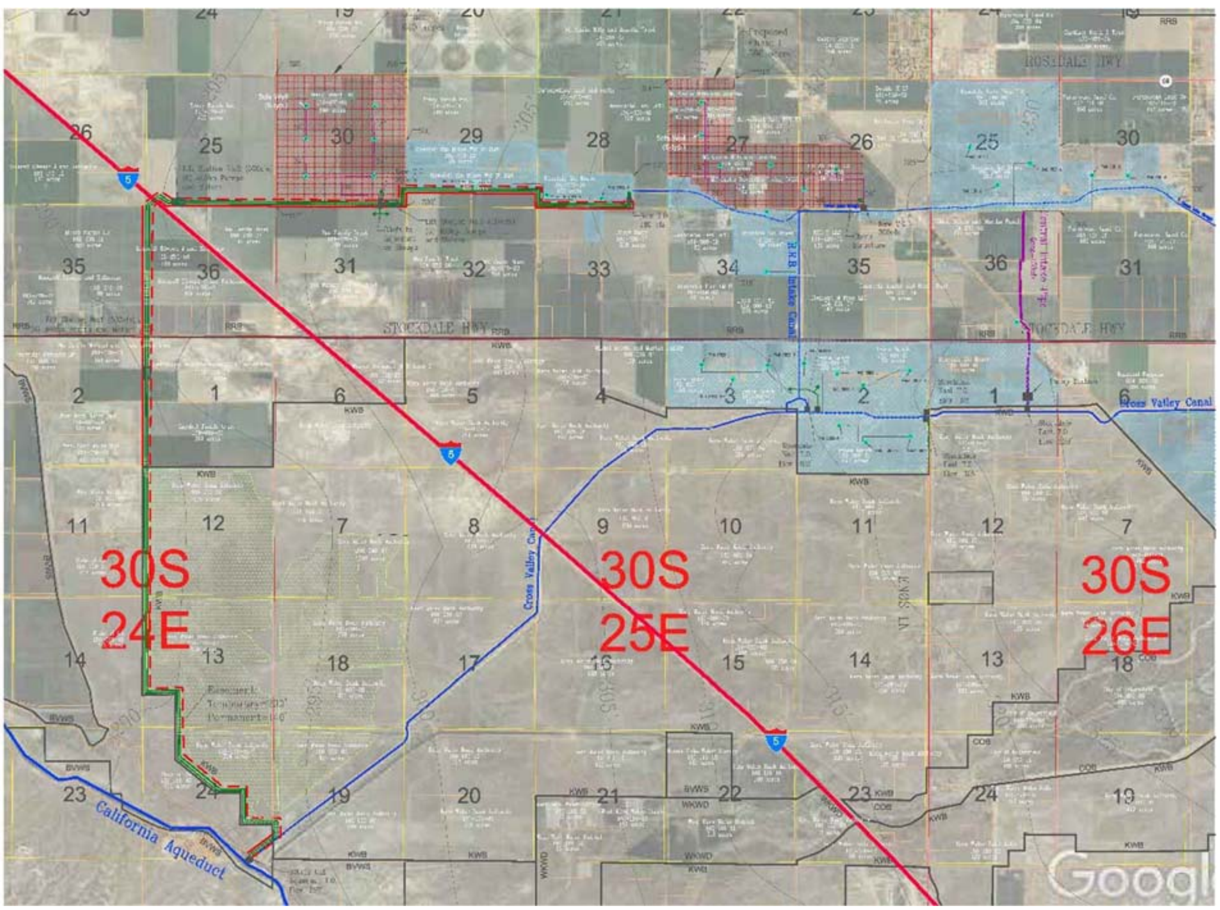

Figure 52. Kern Fan Project

7.3.7 Western Rosedale In-Lieu Service Area

The Western Rosedale Lands In-Lieu Service Area Project (the Project) includes construction and operation of up to ten miles of water conveyance pipelines, including appurtenant facilities (such as pumps and valves), and a joint service area agreement between RRBWSD and BVWSD in order to provide surface water to agricultural water users within the portion of RRBWSDs service area located westerly of Interstate 5 in close proximity to Buena Vista Water Storage Districts East Side Canal. This could provide the RRBWSD with up to 1,000 AFY. Project status is shovel ready; feasibility and environmental analysis is complete. This project could be on-line as early as 2035. Estimated total capital cost is $5.1M; annual O&M costs are estimated to be $152,000. Annualized cost is $526,000, or $467/AF (plus water costs). See Figure 53.

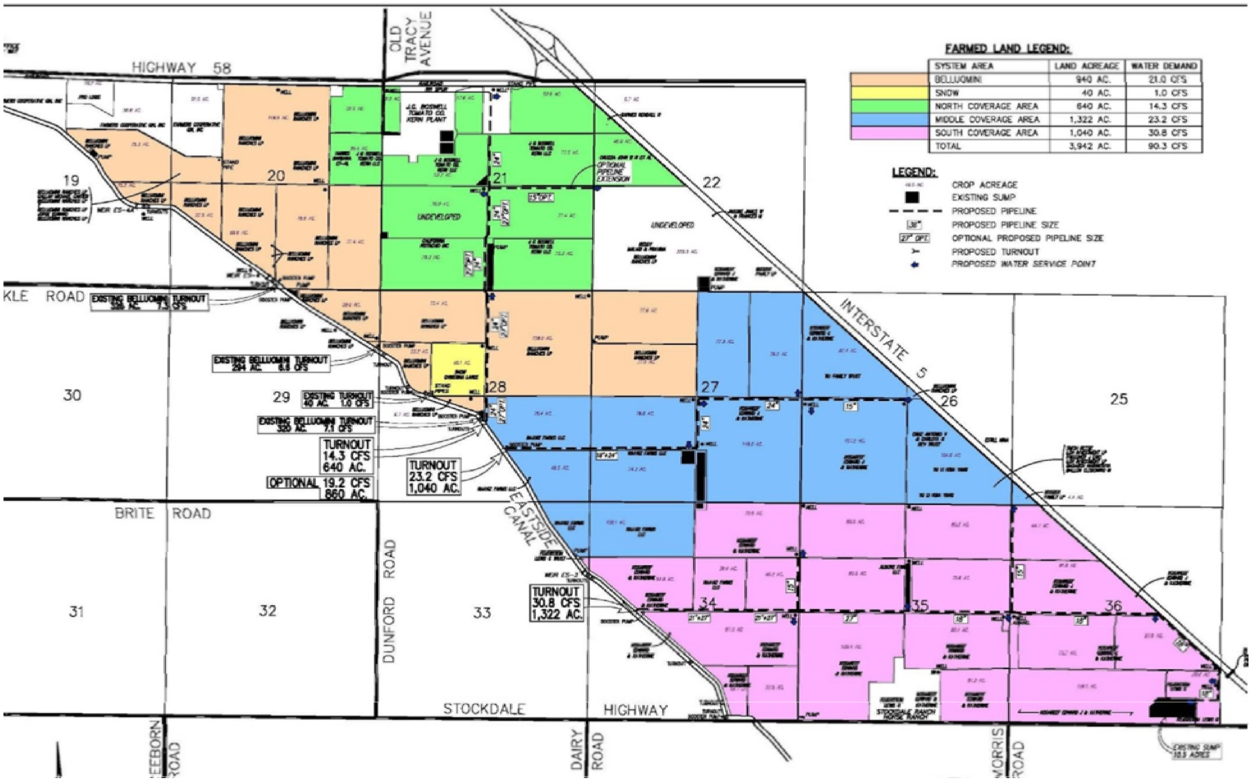

Figure 53. Western Rosedale In-Lieu Service Area

7.3.7 Ten Section Water Recharge Project

The owners of Ten Section located within the South of the River Monitoring Zone are currently studying the feasibility of a 200+ acre groundwater recharge, storage and recovery project. It is estimated that approximately 2,200 AF/month could be recharged into the aquifer. No implementation date is known at this time.

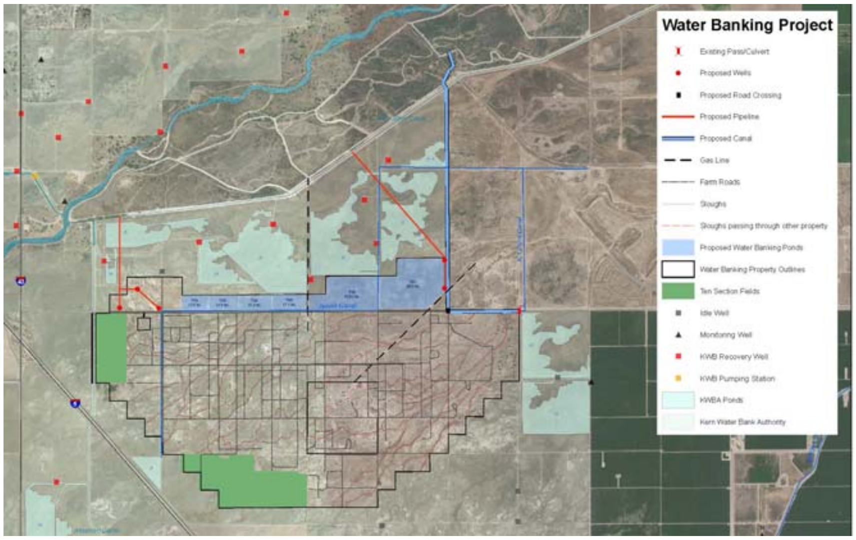

Figure 54. Ten Section Groundwater Recharge Project

7.4 Management Actions

7.4.1 Water Charge Demand Reduction

The Water Charge (as described in section 1.3.1) would be expected to result in demand reduction in the RRBWSD. For market reasons it is probable that landowners will opt to fallow ground in order to trade water supplies to other District landowners, as well as fallow lands (or limit double cropping) to avoid the Water Charge all together. With an agricultural water consumptive-use demand of about 84,000 AFY we conservatively expect a 5% demand reduction as a result of the water charge which results in about 4,000 AFY of reduced demand. This management action could be on-line as early as 2025. This management action also provides funding for projects described in section 7.3. The unit Water Charge is calculated as the estimated land cost per acre ($25,000) divided by the avoided water use per acre (2.6 AF/ac) divided by the planning horizon in years (20 yrs). Using these assumptions, a maximum initial unit Water Charge could be as much as $480 per AF; the basis for a potential water charge is described in more detail in the 2018 Engineers Report found in Appendix K.

7.4.2 RRBWL (White Land) Water Supplies and Demand Imbalance Reduction

White Lands (non-RRBWSD lands) within the RRBMA that are not used for groundwater banking will correct the water supply imbalance on a linear basis over the planning period of 2020-2040. Like RRBWSD lands, the white lands will start with the native yield of 0.15 AF/acre. The total annual demand for white lands in the RRBMA is about 10,822 AFY with a water supply imbalance (or deficit) of 5,198 AFY. The <u>average</u> agricultural demand is 2.6 AF/acre according to METRIC studies. While agricultural demands in the White Lands range from 1.4-4.9 AF/acre the initial allowable demand will be the average demand of 2.6 AF/acre. It is expected that white lands would seek to acquire water supplies for in-lieu and direct groundwater recharge via banking agreements with RRBWSD or others to offset demands. Demand reduction will occur as follows over the 2020-2040 period; the imbalance will be reduced by 1/20 of the current imbalance each year (5%) as shown on Table 10. To the extent the imbalance is not met during the current year it will be deducted from the subsequent. To the extent that white land landowners import water supplies their respective farming unit net demands are offset.

Native Yield + Precipitation + Imported Supply = Sustainable Yield - Demand = <u>Imbalance</u>

1,022 AFY	+ 2,436 AFY	+ 2,165 AFY	= 5,623 AFY	- 10,822 AF	= **5,199 AF**
0.15 AF/acre	+ .42 AF/acre	+ 0 AF/acre	= 0.57 AF/acre	- 2.6 AF/acre	= **2.03 AF/acre**

	Allowable Imbalance	Allowable Demand
Allowed 2020 Imbalance = 2.03 x 20/20	= 2.03 **AF/acre**	**2.6 AF/acre**
Allowed 2021 Imbalance = 2.03 x 19/20	= **1.92 AF/acre**	**2.5 AF/acre**
Allowed 2022 Imbalance = 2.03 x 18/20	= **1.82 AF/acre**	**2.4 AF/acre**
Allowed 2023 Imbalance = 2.03 x 17/20	= **1.72 AF/acre**	**2.3 AF/acre**
Allowed 2024 Imbalance = 2.03 x 16/20	= **1.62 AF/acre**	**2.2 AF/acre**
Allowed 2020-2024 Imbalance	**= 9.11 AF/acre**	**12.0 AF/acre**
Allowed 2040 Imbalance = 2.3 x 0/20	**= 0.0 AF/acre**	**0.57 AF/acre**

Table 10. Projected RRBWL Demand Reduction Milestones

This approach will result in about 260AF of imbalance reduction each year and 2,600 AFY by 2030 and a total of 5,199 AFY by the 2040 sustainability planning period. This management action could be on-line as early as 2020.

7.4.3 RRBWD 3rd Party Recharge and Storage Program

The RRBWSD will assist 3rd parties (white lands, districts, and private parties) in recharging water supplies for use in the RRBMA or other down gradient areas in the Kern Sub-basin. RRBWSD would offer existing conveyance and recharge facilities in exchange for a portion of the imported water supply and payments of yet-to-be developed costs and/or fees. This management action could be on-line as early as 2020. It is expected that the RRBWSD would provide this service in exchange for 20-33% of the imported water supply and that an average amount of 5000 AFY would be imported. This management action could bring an additional supply of 1,250 AFY to RRBDL lands.

7.5 Adaptive Management Actions

To the extent that projects and management actions described in sections 7.3 and 7.4 are unable to prevent undesirable effects that are caused by RRBMA activities, further actions will be evaluated and considered. For example, if either the projects or management actions are unable to produce the projected supplies, or other better options are found that prove more cost effective the RRBMA may deviate from the actions as described above. At each 5-year planning window each previously described project and action will be evaluated as well as new ones included. The RRBMA will enact projects and actions to accomplish at least a linear path to sustainability as described on Figure 36 in section 3.2.

RRBWLs Water Supplies and Demand Imbalance Reduction.

Because the White Lands are located outside of the political boundaries of the RRBWSD, assessment and water charges are not likely to be imposed unless voluntarily created by those landowners. Currently, there is a contractual relationship with the RRBWSD and the specific landowners that provides the landowners with a method to comply with SGMA. Compliance with demand reduction management action will initially be voluntary in nature. However, to the extent that a landowner refuses to comply, the RRBWSD may terminate the contractual relationship that provides the landowner with SGMA compliance and remove the landowner from the RRBMA. The RRBMA will be performing annual demand estimates as described in section 2.2.2, and will each year evaluate RRBWL compliance. The RRBWSD will in the future provide the RRBWLs with opportunities to participate in water supply programs that RRBWSD does not participate in; there will likely be opportunities for those lands and landowners to generate additional water supplies through these efforts.

7.6 Summary

2020 Projects.

It is estimated that approximately **5,000 AFY** of additional supply could be developed by 2020 by the West Basin Improvements and Stockdale East projects. Total capital cost are approximately $13.2M and annual O&M costs are approximately $386,000. Total annualized cost is $1,341,000 or $268/AF (plus water cost).

2020 Management Actions.

It is estimated that the RRBWL demand reductions described above will result in approximately 217 AFY of demand reduction starting in 2020. This approach would result in an imbalance reduction of **2,167 AFY** by 2030 and a total of **4,335 AFY** by the 2040 sustainability planning period.

It is estimated that the RRBMA 3rd party recharge and storage program will result in approximately **1,250 AFY** of new supplies for the RRBMA starting in 2020.

2025 Projects.

It is estimated that approximately **11,500 AFY** could be on-line by 2025 through the implementation of Pilot Projects, James Groundwater Storage Project, and the Onyx Project. Total capital cost are approximately $38.8M and annual O&M costs are approximately $753,000. Total annualized cost is $3,223,000 or $280/AF (plus water cost for direct recharge projects).

2025 Management Actions.

It is estimated that the District demand reduction Water Charge could result in approximately **4,000 AFY** starting by 2025.

2030 Projects.

It is estimated that another potential **10,000 AFY** is in development and could be on-line by 2030 through the implementation of the Kern Fan Project. Total capital cost are approximately $45M and annual O&M costs are approximately $1,350,000. Total annualized cost is $4,700,000 or $468/AF (plus water cost).

2030 Management Actions.

No Additional Envisioned at this time.

2035 Projects.

It is estimated that another potential **1,000 AFY** is in project development and could be on-line by 2035 (Western Rosedale In-Lieu Service Area). Total capital cost is estimated to be approximately $5,100,000; annual O&M costs are estimated to be $152,000. Total annualized cost is $526,000, or $467/AF (plus water cost).

2040 Projects.

No Additional Envisioned at this time.

2040 Management Actions.

No Additional Envisioned at this time.

See table 11. for 5-year milestones.

	Projects	Management Actions	Total
2020	5,000 AFY	1,250 AFY	6,250 AFY
2025	11,500 AFY	5,300 AFY	16,800 AFY
2030	10,000 AFY	1,300 AFY	11,300 AFY
2035	1000 AFY	1,300 AFY	2,300 AFY
2040	0 AFY	1,300 AFY	1,300 AFY
			37,950 AFY

Table 11. Projected Project and Management Action Milestones

References and Technical Studies

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