

Case Study: Kern Water Bank

Incentivizing Groundwater Recharge

Case Study #5

Working Draft

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Center for Law, Energy, and the Environment
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This case study is part of a series focusing on incentives for Managed Aquifer Recharge, and the institutional context in which MAR projects are conducted. The series is being produced as part of a larger project examining this topic. A symposium on September 10, 2019 will highlight these and other projects. More information is available at law.berkeley.edu/recharge2019.

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Kern Water Bank

Incentivizing Groundwater Recharge – Case Study #5

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Overview

Location: Kern County, CA

Motivation for MAR: Inconsistent surface water deliveries

Project Goals: Provide drought reserve for agricultural operations

Key Actors: Kern County Water Agency (KCWA); Kern Water Bank Authority (KWBA)

Water Source: Imported water from State Water Project and Central Valley Project; Kern River

Start Date: 1995

Current Status: Fully operational

Project Results: Over the lifetime of the project, it has recharged 2.8MAF and recovered 1.6MAF; in 2017, the bank recharged a net of 556,000 AF

Cost: Recharge costs \$9.50-16/AF depending on recharge location; recovery costs depend on the season and range from \$98-153/AF

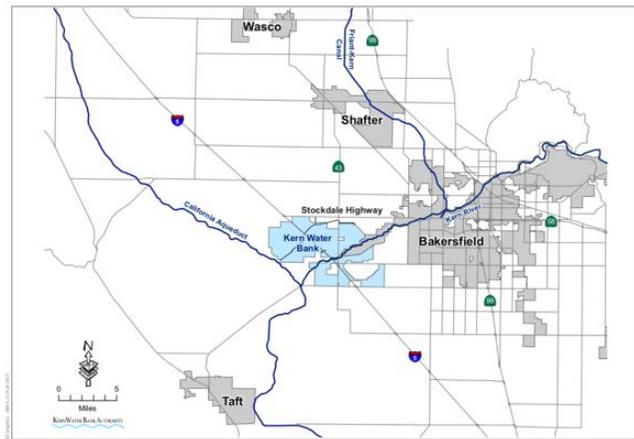


Figure ES-1
Kern Water Bank Location

1. Motivation and Goals

The Kern Water Bank (KWB, or the bank) acts as a drought reserve for its member entities, storing excess water in wet years to supplement inconsistent deliveries of surface water in dry years.¹ The bank was formed by a group of agricultural organizations and water districts in 1995 after a seven-year drought demonstrated the unreliability of imported surface water. Water stored in the bank comes from three surface water sources and enters the aquifer via infiltration ponds. The banked water is withdrawn at the request of participants and primarily goes to agricultural uses. The infiltration ponds used for recharge also provide environmental benefits by creating a wetland environment for migrating birds and protected species.

2. Geographic and Historical Context

The KWB is located 12 miles west of Bakersfield in Kern County, California. The county has an arid to semi-arid climate and receives only about 6.5 inches of rainfall on average.² The region relies on imported surface water from the State Water Project (SWP) and Central Valley Project to meet local water demand, 87% of which is agricultural.³ Agriculture accounts for 20% of exports from the county, totaling over \$7 billion in sales in 2017.⁴

The KWB is situated over the Kern River alluvial fan, a deposit of gravel and sand from ancient streambed channels.⁵ The alluvial fan is highly permeable and physically well suited for groundwater recharge operations. Due to the ease of recharge, and motivated by a lack of consistent surface water supply, the region is home to at least eleven other groundwater banking operations.⁶

California has a natural temporal and spatial mismatch between demand and supply of water, with the most demand in the south during the summer and supply in the north during the winter. In response, California's State Water Project (SWP) was constructed in the 1960s as a water storage and delivery system. Operated by the California Department of Water Resources (DWR), the SWP captures water in northern California and transports it throughout the state to 29 long-term contractors.⁷ DWR retains the rights to SWP water, while contractors hold entitlements to an amount of SWP water called their "Table A" amount, which is the maximum amount of water they can receive in a year. Most years, SWP contractors receive an allocation based on the current water conditions that is less than their full contract amount.

In 1986, DWR began exploring the possibility of adding a storage component to SWP operations by creating a groundwater bank in Kern County.. Two year later, DWR purchased 20,000 acres of land in Kern County for \$31 million from Tenneco West, Inc. Tenneco West, in partnership with Wheeler Ridge-Maricopa Water Storage District, had already constructed 320 recharge ponds on the property in an attempt to establish a groundwater bank.⁸ After purchasing the land from Tenneco West, DWR continued work on the bank, including completing an environmental impact report, conducting over \$28 million in studies, and starting a water quality monitoring program on the site. However, in 1993, DWR halted progress on the bank due to high costs, Endangered Species Act habitat regulations, negotiations over local use of the bank, and uncertainty over the amount of water which would be available for storage in the bank.⁹ The estimated cost of banked water was also a factor, with most estimates evaluating the cost of stored water to bank users between \$400-450/AF, which local water users were unwilling to pay.¹⁰

At the same time that the DWR was struggling to develop the banking operation in Kern County, local agricultural SWP contractors were suffering from a lack of reliable surface water supplies. During the drought from 1987 to 1994, agricultural SWP allocations were sharply cut, and at one point eliminated altogether. To compensate for lack of surface water supplies, water users increased their reliance on local groundwater aquifers. In 1994, DWR and SWP contractors negotiated the Monterey Agreement, which revised several key SWP operating rules. The Agreement included a provision that transferred the KWB lands to several Kern County agricultural entities in exchange for the permanent retirement of 45,000 AF of those entities' contracted SWP water amount. Through this agreement and subsequent transfer and exchange agreement, the KWB was transferred to the Kern County Water Agency (KCWA), and then to a joint powers authority formed by the contractors whose SWP contracts were reduced, the Kern Water Bank Authority (KWBA).¹¹

Controversy over the transfer of the KWB from state to local control resulted in several lawsuits, including *Planning and Conservation League v. DWR*.¹² Despite legal disputes, the bank has been in operation since 1995 and continues today.

3. Regulatory Setting

The Kern Water Bank is mainly governed by a Memorandum of Understanding (KWB MOU) and its Operation Plan. Additional regulatory requirements for the bank, including water quality, are discussed in Part 4, below. However, both state water contracts and the Endangered Species Act (ESA) play an important part in the regulation of the bank.

3.1 DWR and State Water Contracts

As discussed above, the State Water Project is operated by DWR. Each year, DWR forecasts the amount of water that will be available in the SWP system. Allocations are then set by DWR based on each SWP contractor's Table A amount of water. Contractors rarely receive their entire Table A amount.

3.2 Endangered Species Regulations

Due to the presence of endangered species on the property, the KWBA must comply with the federal and state Endangered Species Acts (ESA). Under both laws, if actions taken by an entity have the potential to impact a threatened or endangered, that entity must obtain an incidental take permit from the U.S. Fish and Wildlife Service (USFWS). Incidental take permits are often contingent upon development and approval of a Habitat Conservation Plan (HCP), which indicates the steps that will be taken to reduce or mitigate harm to the species. The KWBA's HCP outlines how the KWB will operate to bank water while protecting environmental uses of the property. The KWBA also voluntarily created a Natural Community Conservation Plan under California's NCCP Act with the goal of contributing to the recovery of listed species. The KWBA submits reports annually to USFWS and the California Department of Fish and Wildlife (CDFW) to demonstrate its compliance with the stated plans.¹³

4. Managed Aquifer Recharge through the Kern Water Bank

The KWB uses infiltration ponds to recharge water from three sources: the SWP, the CVP, and the Kern River.

4.1 Recharge

4.1.1 Water Sources for Recharge

The majority (58.5%) of water banked in the KWB comes from the SWP.¹⁴ SWP water travels to Kern County through the 444-mile-long California Aqueduct, and is transported to the KWB's recharge ponds via local canals.¹⁵ The Kern County Water Authority (KCWA) is the local SWP contractor for the area and is responsible for distributing SWP water to thirteen local water districts, including Kern Water Bank Authority (KWBA) members Tejon-Castac Water District, Wheeler Ridge-Maricopa Water Storage District, Semitropic Water Storage District, and KCWA's Improvement District No. 4.¹⁶ All KWBA members have contracts for SWP water, either through the KCWA or directly from DWR.¹⁷

Approximately 27% of the water banked in the KWB comes from the Kern River.¹⁸ The Kern River is 164 miles long and fed by snowmelt from the southern Sierra Nevada mountain range.¹⁹ Most years, the river is dry downstream of Bakersfield due to diversions for irrigation and municipal water supply.²⁰ KWB has not received water from the Kern River for over half of the years that the bank has been in operation.²¹ Kern River water can be diverted to the KWB through several diversion facilities, including the KWB Canal.²² During wet years, flood flows from the Kern River may be diverted to the bank at the request of the Army Corps of Engineers. Kern River flood water is free to members of the Kern Water Bank, other than the cost of conveyance.

Water from the CVP accounts for the remaining 14.5% of water entering the KWB.²³ The CVP is a federal water storage and delivery system operated by the U.S. Bureau of Reclamation (BOR). CVP water enters the Kern River through the Friant-Kern Canal, moving through the river channel and a local canal to reach the bank.²⁴ The KWB acquires CVP water through short-term arrangements with BOR.²⁵

4.1.2 Recharge Infrastructure

The combination of natural setting and built infrastructure combine to make the location of the Kern Water Bank ideal for recharge and storage. The Kern Water Bank covers 20,480 acres, much of which is located over the highly permeable Kern River alluvial fan. The bank is also located at the intersection of several of important conveyance structures that were already in existence at the time the bank was created. The Kern River flows through the center of the bank, with the Friant-Kern Canal delivering water to the Kern River to the north and California Aqueduct passing through the west boundary of the bank. This allows the bank the flexibility to recharge water from a variety of sources, depending on where water is available.

The recharge facilities include 75 shallow recharge basins, 88 recovery wells, 36 miles of pipelines, the six mile KWB canal to the Kern River, and three pump stations.²⁶ Recharge basins makeup a total of 7,500 acres of the KWB property, and are arranged in rows with small canals managed by weir boxes connecting neighboring ponds.²⁷ The basins are constructed by erecting a low earthen berm on the downslope area to create ponds on the sloping alluvial fan. Water depth in the recharge basins averages 2 feet. Due to soil permeability, recharge is relatively quick - occurring at rates of between 0.15 and 0.4 feet per day, with slower recharge rates occurring towards the end of a long recharge cycle. Depending on the rate of recharge and water availability, the bank has the ability to recharge 40,000 – 60,000 AF per month.

4.2 Accounting and Monitoring

Water used for recharge is tracked by a variety of entities. DWR tracks and meters water diverted from the SWP. The Kern County Water Agency (KCWA) tracks the amount of water diverted from the SWP and regularly reconciles these numbers with DWR. The KCWA tracks water arriving to the bank from the Friant-Kern Canal and accounts for this water for KWB participants.

Sales of water from the bank and recharge accounting are governed by several provisions in the KWB Memorandum of Understanding (MOU), and its Operations Plan.²⁸ First, a loss factor of 10% is assumed for all water banked in the KWB. This lost factor encompasses two components – 6% of the loss factor is based on the assumption of a closed-basin hydrology and stems from a KWBA study that showed evapotranspiration losses from the recharge ponds are approximately 2 to 4%. The other portion of the loss factor - 4% - is automatically included on all water stored in the KWB. This water is then kept in the bank and made available for purchase by adjoining water districts for overdraft correction. In total, 90% of water diverted to and stored in the bank is put into the bank member's account and is available for recovery and withdrawal.

Bank participants can sell their stored water to third parties. If water is sold to a third party outside of Kern County, an additional 5% loss factor is included in the sale. The water left into the aquifer as a result of the calculated 5% loss factor on a sale is not available for recovery for other users.²⁹

All water going out of the bank is deposited into the California Aqueduct for transport. At this point, the KCWA and DWR track and reconcile the amount of water leaving the bank.

Water recharged and recovered by the KWBA must comply with federal and state water quality regulations. The state Porter-Cologne Water Control Act of 1969 provided for the development of basin plans that specify beneficial uses of rivers and groundwater basins, as well as establish water quality standards for these waters. The Central Valley Regional Water Quality Control Board implements the Tulare Lake Basin Plan, which covers the Kern County sub-basin. The basin plan specifies allowable levels of pollutants in surface water and groundwater. KWBA monitors groundwater quality through testing of both dedicated monitoring wells and the recovery wells themselves. The monitoring wells are sampled according to a schedule set by the Kern Fan Monitoring Committee, and results are reported to the committee. The recovery wells are monitored according to a schedule by the KWBA, who reports the recovery well monitoring results to DWR. DWR determines if the water meets the criteria needed to be discharged into the California Aqueduct for delivery to KWBA members.³⁰

4.3 Recovery

Recovery wells are located on the northern two-thirds of the property, spaced approximately one-third of a mile apart. These wells are typically 750 feet deep and can yield up to 5,000 gallons per minute.³¹

Water is recovered from the bank via pumping at the request of KWB member entities, subject to control measures set by the KWB MOU that are intended to protect water levels. Water may also be recovered by exchange. During recovery by exchange, a KWB member uses surface water intended for another nearby groundwater banking project in exchange for the accounting transfer of stored groundwater from the KWB to that other groundwater banking program.³² KWB members may sell their banked water to non-participant agencies, but they must first offer the opportunity to purchase their water to other KWB members before selling

to non-participants.³³ From 1995 to February of 2012, maximum annual recovery from the bank was 227,000 AF.³⁴ From 1995 to 2016, a total of 1.5 million AF was pumped, all during dry years.³⁵ Approximately 910,000 AF of water is currently stored in the KWB.^{36, 37}

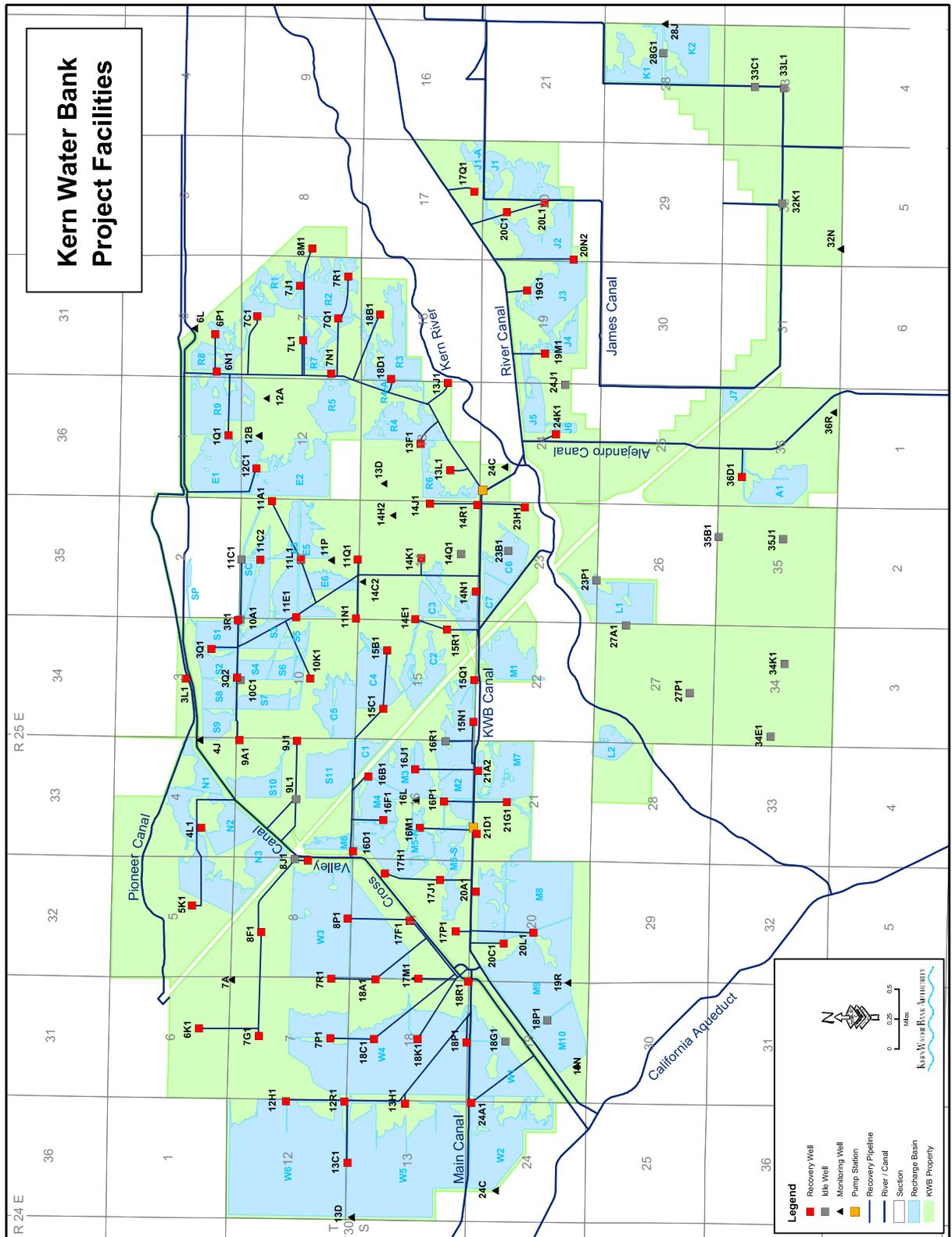


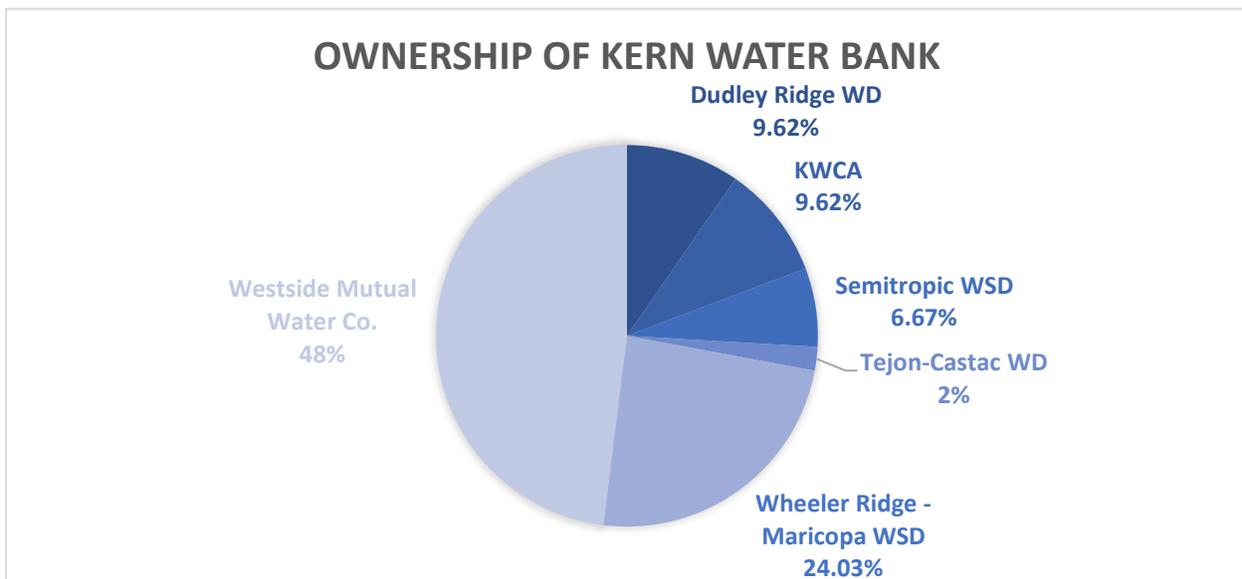
Figure 1 Map of Kern Water Bank facilities. Source: KWBA.

5. Project Management

5.1 KWBA Institutional Structure

The KWB is operated for the benefit of its member agencies. It does not hold water rights on its own. The bank is governed by the Kern Water Bank Authority (KWBA), a joint powers authority (JPA) consisting of six member agencies.³⁸ Two of the participants are California Water Districts (WDs),³⁹ two are California Water Storage Districts (WSDs),⁴⁰ and two are other water-related agencies. Both WDs and WSDs are special districts, a form of local government created to deliver a specific service to a defined geographic region.⁴¹ The four KWB member WDs and WSDs supply water for agricultural purposes. The two other members include the KCWA and the Westside Mutual Water Company. The KCWA participates on behalf of its Improvement District No.4, which provides treated water for urban uses.⁴² The Westside Mutual Water Company is a mutual water company, a corporation that delivers water to its shareholders.^{43,44, 45}

The JPA dictates that each KWBA member agency has rights to the project proportional to the amount of SWP water the member agency retired in the agreement that transferred the KWB from the DWR to the KWBA.⁴⁶ A total of 45,000 AF of the members' SWP water allocations were retired as part of this transfer. The chart below illustrates the ownership interest in the bank.^{47, 48, 49}



Each member of the KWBA has seat on the Board of Directors which governs the KWBA. The Westside Mutual Water Company currently holds two seats on the Board. The Board holds meetings monthly which include space for public comment in compliance with the Brown Act.⁵⁰

The KWB operates under the *Memorandum of Understanding Regarding Operation and Monitoring of the Kern Water Bank Groundwater Banking Program* (KWB MOU). The KWB MOU describes how the KWB will benefit project participants while having a limited negative impact

on adjacent water districts. It provides for the establishment of the Kern Fan Monitoring Committee (“Monitoring Committee”), which oversees water banking in the KWB to prevent adverse changes in water levels, water quality, or land subsidence. Members of the Monitoring Committee include KCWA and all water districts adjacent to the KWB: Buena Vista WSD, Rosedale-Rio Bravo WSD, Kern Delta WSD, Henry Miller WD, and West Kern WD.⁵¹ This Monitoring Committee is given the opportunity to review any activities that may result in adverse impacts and may make recommendations to the KWBA based on data.⁵² The Monitoring Committee is also responsible for suggesting resolutions to disputes regarding the operation of the KWB, before any legal action may be taken. If there is a dispute between the KWBA and the Monitoring Committee, it must be resolved through arbitration.⁵³

The KWBA also has two recovery operations plans that are intended to prevent pumping water from the KWB from having adverse impacts on nearby landowners. The *Long Term Project Recovery Operations Plan* (Long Term Plan) applies only to the KWB. It describes KWBA’s responsibility to monitor and report groundwater conditions, create a groundwater model to evaluate the impacts of project operations, and mitigate any negative impacts when necessary.⁵⁴ The *Joint Project Recovery Operations Plan Regarding Pioneer Project, Rosedale-Rio Bravo Water Storage District, and Kern Water Bank Authority Projects* is an agreement between the entities listed in the plan title. It establishes a Joint Operations Committee that includes representatives from each of the entities. This Committee meets during years when recovery operations are ongoing to evaluate groundwater conditions, landowner concerns, and consider mitigation actions.⁵⁵

5.2 Costs and Financing

The KWB was established by an exchange through which KWBA member agencies voluntarily retired rights to 45,000 AFY of water from the SWP in return for a transfer of the land where the bank is currently located from DWR to KWBA members. Eighteen entities had the opportunity to participate in the bank by giving up Table A allocations – however, only six chose to do so. While in retrospect the value of participation in the KWB has proven significant for its members, at the time the project was perceived as a risky investment because it was unclear whether permitting could be negotiated. Further, at the time of the exchange, water sales of \$1,000/AF for Table A water were reported in the area. Assuming this reflects the market value of larger quantities of Table A water at the time, the retired water entitlement exchanged by bank members had significant market value. However, in retrospect, SWP contract deliveries have since been much less reliable, and are projected to decrease in reliability given climate change and other factors.⁵⁶

Major infrastructure developments on the property, including construction of the KWB Canal, have been paid for with \$27 million in private loans, a \$5 million Proposition 204 loan,⁵⁷ and a \$3.4 million Proposition 13 grant.⁵⁸ KWBA member agencies must repay most of these loans, but some have been publicly funded.

The KWB itself does not profit from water bank operations. Member agencies pay the cost of recharge, which is \$9.50 to \$16 an acre-foot, and recovery, which is \$98-153 per acre-foot.⁵⁹

They also pay for operation and maintenance of the banking facilities through assessments levied based on their share in the project. At the end of each year, the bank reconciles its actual operating costs with what it charged members; members receive a refund on any overpaid funds. Costs of the Monitoring Committee are split between project participants and the adjacent non-member entities on the committee.⁶⁰

However, a relatively small number of landowners control the member agencies, which in turn, collectively influence KWB operations. These landowners are ultimately the direct beneficiaries of the water deliveries made by the KWB and of the resulting profits from beneficial use of that water for agricultural purposes or from the sale of any stored water.

Over 3,000 acres of the KWB land function as a conservation bank. Companies and organizations whose projects have been determined to impact threatened or endangered species found in the Kern County area can apply to purchase offsite mitigation credits from the KWB. USFWS and CDFW determine whether applicants are eligible for offsite mitigation based on the species present at both locations.⁶¹ The KWB charges \$5,000 per transaction and \$15,000 per mitigation credit, plus another \$375 per credit that goes into an endowment fund managed by CDFG for the restoration and conservation of listed species living on lands owned by the bank.⁶² As of 2016, 1,321 credits have been sold.⁶³

One additional source of income to the KWB was the Environmental Water Account (EWA), available to the bank from 2000 to 2007. The EWA was designed to reduce conflicts between environmental needs and other uses of water in the Sacramento-San Joaquin Delta. The EWA allows fishery managers to purchase from contractors water that otherwise would have flowed out of the Delta. This action protects endangered fish species in the Delta and ensures compliance with the Endangered Species Act. Up to \$50 million per year from federal and state taxes was available to the EWA.⁶⁴ From 2000 to 2005, the KWB sold 317,174 acre-feet of water to the EWA.⁶⁵

6. Analysis

6.1 Key Elements

Several factors were key to the creation and success of the Kern Water Bank. The State Water Project is crucial in a number of ways. The availability of Table A water among project participants and the willingness of the state to trade the physical assets of the nascent Kern site for those contract water assets were crucial for moving the project from a stalled state controlled groundwater storage project to a locally controlled water bank. The temporal relationship between local demands and available conveyance through the SWP is also important to the banks success. The SWP has a conveyance bottleneck during the times of peak demand and thus south of Delta storage, such as that provided by the KWB, is highly valuable for increasing supply reliability.

The KWB also benefits from its location at the confluence of multiple surface water sources and the presence of conveyance infrastructure that can help transport that water. During wet periods it can choose between purchasing excess Kern River water, CVP water, or SWP water.

Existing infrastructure, including the California Aqueduct and the Friant-Kern Canal, serve to convey water to the bank. The bank's location over overlying a highly permeable part of the local aquifer is also makes the bank ideally sited for recharge.

The willingness of KWB members to take risk on development of the project was another factor in its success. The fact that most of the agencies that were eligible to participate in the formation of the bank chose not to participate may be a strong indicator of the historical risk of giving up Table A water (a known benefit) in exchange for developing the project at the time for which positive results were not guaranteed. However, it is crucial to note that the lack of transparency during the Monterey Agreement negotiations casts a shadow over that transaction, making it unclear to what extent the KWB, and ultimately the private landowners who enjoy its water deliveries, benefited from a state subsidy that is today possibly worth significantly more than the water entitlements exchanged to gain ownership of the bank.

6.2 Incentives and Benefits

The main benefit of the KWB is increased water supply reliability for its member agencies. The KWB provides water storage to member agencies when they have excess water, and recovery when they do not, increasing the reliability of each member's water supplies. During dry years, SWP allocations have been below 100%, for example, a low of 5% in 2014 and a high of 70% in 2002.⁶⁶ During these years, when KWB members could not meet irrigation demands with SWP water alone. Banked water allowed bank members to keep crops alive and maintain production and profit.

Aside from benefiting its members by providing water during shortages, the Kern Water Bank also benefits the local environment by providing increased habitat for sensitive wildlife. The KWB has reestablished 12,000 acres of grassland habitat and 7,500 acres of aquatic or semi-aquatic habitat, depending on how full recharge ponds are. Frequent wildlife surveys on the property monitor the diversity and abundance of plant and animal species. In 2011 and 2012, 35,000 individuals of 66 species of waterfowl were estimated to have utilized the KWB during their winter migration.⁶⁷ Endangered or threatened species found on the property include the Tipton kangaroo rat, San Joaquin kit fox, and Blunt-nosed leopard lizard. The fallowed land also provides benefits as a carbon sink. It is important to consider that 3,797 acres of the project are available for purchase for the mitigation of environmental damages caused by other projects.

6.3 Challenges and Future Considerations

The challenges KWB faces are mainly physical. One future challenge for the bank include routine maintenance, including the cost of replacing and rehabilitating wells. As the bank frequently operates year-round, wells naturally need regular rehabilitation and replacement. The biggest challenge to the bank, however, is water supply. Essential to the bank's future operations is the continued availability of surplus water in wet years for recharge. If California faces a particularly prolonged drought, water may not be available for storage and the bank may begin to see net outflows rather than net gains to water in storage.

Acknowledgements

Funding for this research project was provided by Nestlé Waters North America.

Endnotes

¹ ICF. p. 2-1.

² ICF. *Kern Water Bank Authority Conservation and Storage Project Environmental Impact Report*. Kern Water Bank Authority, 2018. p. 3.6-9.

³ Tiedeman et. al. "Recent Trends in Water Use and Production for California Oil Production." *Environmental Science and Technology*, 2016.

⁴ Hamilton. p. 9, 14. Baker. p. 24; Kern Crop Report 2017 - http://www.kernag.com/caap/crop-reports/crop10_19/crop2017.pdf

⁵ AECOM. "Appendix 7-1. Kern Water Bank Study Area Physical Data Collection Technical Report." *California Department of Water Resources*, 2016. p. 6, 7, 8.

⁶ California Department of Water Resources. "Appendix E. Study of the Transfer, Development, and Continued Use and Operation of the Kern Water Bank (Revised)." *CA Department of Water Resources*, 2014. p. E-5.

⁸ Thomas p.90.

⁹ Thomas p.90-92

¹⁰ Thomas, p. 90.

¹¹ Appendix E p.E-10, Thomas p.91

¹² *Planning and Conservation League v. Dep't of Water Res.*, 100 Cal. Rptr. 2d 173 (Cal. Ct. App. 2000)

¹³ 2016 Compliance Report, KWB HCP/NCCP, ICF p. 2-16

¹⁴ Between 1995 to 2016, 58.5% of water deposited in the Kern Water Bank came from the State Water Project. ICF. [*Kern Water Bank Authority Conservation and Storage Project Environmental Impact Report*](#). Kern Water Bank Authority, 2018. p. 3.6-20.

¹⁵ AECOM. "Appendix 7-1. Kern Water Bank Study Area Physical Data Collection Technical Report." *California Department of Water Resources*, 2016.

California Department of Water Resources. "[Appendix E. Study of the Transfer, Development, and Continued Use and Operation of the Kern Water Bank \(Revised\)](#)." *CA Department of Water Resources*, 2014.

¹⁶ <http://www.kcwa.com/agencyfunction/>.

¹⁷ ICF. p. 2-4

¹⁸ See 1.

¹⁹ AECOM. p.22.

²⁰ ICF. p. 3.6-10

²¹ See 1.

²² See 8 and 9.

²³ See 1.

²⁴ AECOM. p. 21.

²⁵ ICF. p. 2-4.

²⁶ ICF. p. 3-11.

²⁷ ICF. p. 2-11, DWR p. 30, 42.

²⁸ <http://www.kwb.org/store/files/109.pdf>; MOU (Appendix B); Operations Plan (Appendix C)

²⁹ DWR. p. 22.

³⁰ ICF. p. 2-15.

³¹ ICF. p. 2-12.

³² Multiple groundwater banks exist in the region, with several adjacent to the KWB. DWR. p. 47.

³³ Thomas p.94

³⁴ ICF. p. 3.1-7.

³⁵ ICF. p. 2-14.

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- ³⁶ ICF. p. 2-12.
- ³⁷ <http://www.kwb.org/store/files/5.pdf>
- ³⁸ KCWA, Semitropic Water Storage District, Tejon-Castac Water District, Wheeler Ridge-Maricopa Water Storage District, Dudley Ridge Water District, and Westside Mutual Water Company.
- ³⁹ Dudley Ridge and Tejon-Castac are Water Districts.
- ⁴⁰ Semitropic and Wheeler Ridge-Maricopa are Water Storage Districts.
- ⁴¹ https://calafco.org/sites/default/files/resources/Whats_So_Special.pdf p.2
- ⁴² <http://www.kcwa.com/agencyfunction/>
- ⁴³ <https://privatewaterlaw.com/2011/02/18/california-mutual-water-company-basics/>;
- ⁴⁴ Westside Mutual Water Company's shareholders consist only of the Wonderful Company, formerly Paramount Farms, a large agribusiness that was heavily involved in negotiating the transfer of KWB land to the KWBA. Thomas, Gregory A. "[Designing Successful Groundwater Banking Programs in the Central Valley: Lessons from Experience.](#)" *The Natural Heritage Institute*, 2001. p. 98.
- Keats, Adam and Chelsea Tu. "[Not All Water Stored Underground is Groundwater: Aquifer Privatization and California's 2014 Groundwater Sustainable Management Act.](#)" *Golden Gate University Environmental Law Journal*, vol. 9, 2016. p.96.
- ⁴⁵ The company is owned by Linda and Stewart Resnick, who through the Westside Mutual Water Company and Paramount Farming Company's holdings in Dudley Ridge WD, own or control a total of 59% of the KWBA.
- ⁴⁶ California Department of Water Resources. "[Appendix E. Study of the Transfer, Development, and Continued Use and Operation of the Kern Water Bank \(Revised\).](#)" *CA Department of Water Resources*, 2014. p. E-18.
- ⁴⁷ <http://www.semitropic.com/BoardOfDirectors.htm>
- ⁴⁸ [Tejon Ranch SEC Filings 10-k](#)
- ⁴⁹ <https://wrmwsd.com/>
- ⁵⁰ <http://www.kwb.org/index.cfm/fuseaction/pages.page/id/383>
- ⁵¹ ICF. p. 2-14.
- ⁵² DWR. p. 19-22.
- ⁵³ Kern Water Bank Authority. *Memorandum of Understanding Regarding Operation and Monitoring of the Kern Water Bank Groundwater Banking Program*. 1995. p.12. (In [Appendices](#) doc., p.86)
- ⁵⁴ Kern Water Bank Authority. *Long Term Project Recovery Operations Plan Regarding Kern Water Bank Authority Project*. (Appendices doc. p.96)
- ⁵⁵ Appendices doc. p.120.
- ⁵⁶ Null, S. E., and J. H. Viers (2013), In bad waters: Water year classification in nonstationary climates, *Water Resour. Res.*, 49, doi:10.1002/wrcr.20097
- ⁵⁷ California Proposition 204: [Bonds for Water Projects 1996](#)
- ⁵⁸ California Proposition 13: [2000 Water Bond](#)
- ⁵⁹ Personal Communication, KWBA.
- ⁶⁰ Thomas p.99 and ICF p. 2-2.
- ⁶¹ KWB Conservation Bank agreement
- ⁶² <http://www.kwb.org/index.cfm/fuseaction/pages.page/id/493>
- ⁶³ 2016 Compliance Report
- ⁶⁴ http://www.calwater.ca.gov/content/Documents/new_final_framework.pdf p. 5
- ⁶⁵ [Appendix E](#) p.53
- ⁶⁶ [http://www.mwdh2o.com/PDF%202016%20Background%20Materials/Chart%20-%20MWD%20Water%20Sales%20and%20SWP%20Conditions%20-%20All%20Years%20\(1990-2015\).pdf](http://www.mwdh2o.com/PDF%202016%20Background%20Materials/Chart%20-%20MWD%20Water%20Sales%20and%20SWP%20Conditions%20-%20All%20Years%20(1990-2015).pdf)
- ⁶⁷ ICF. 3.3-9