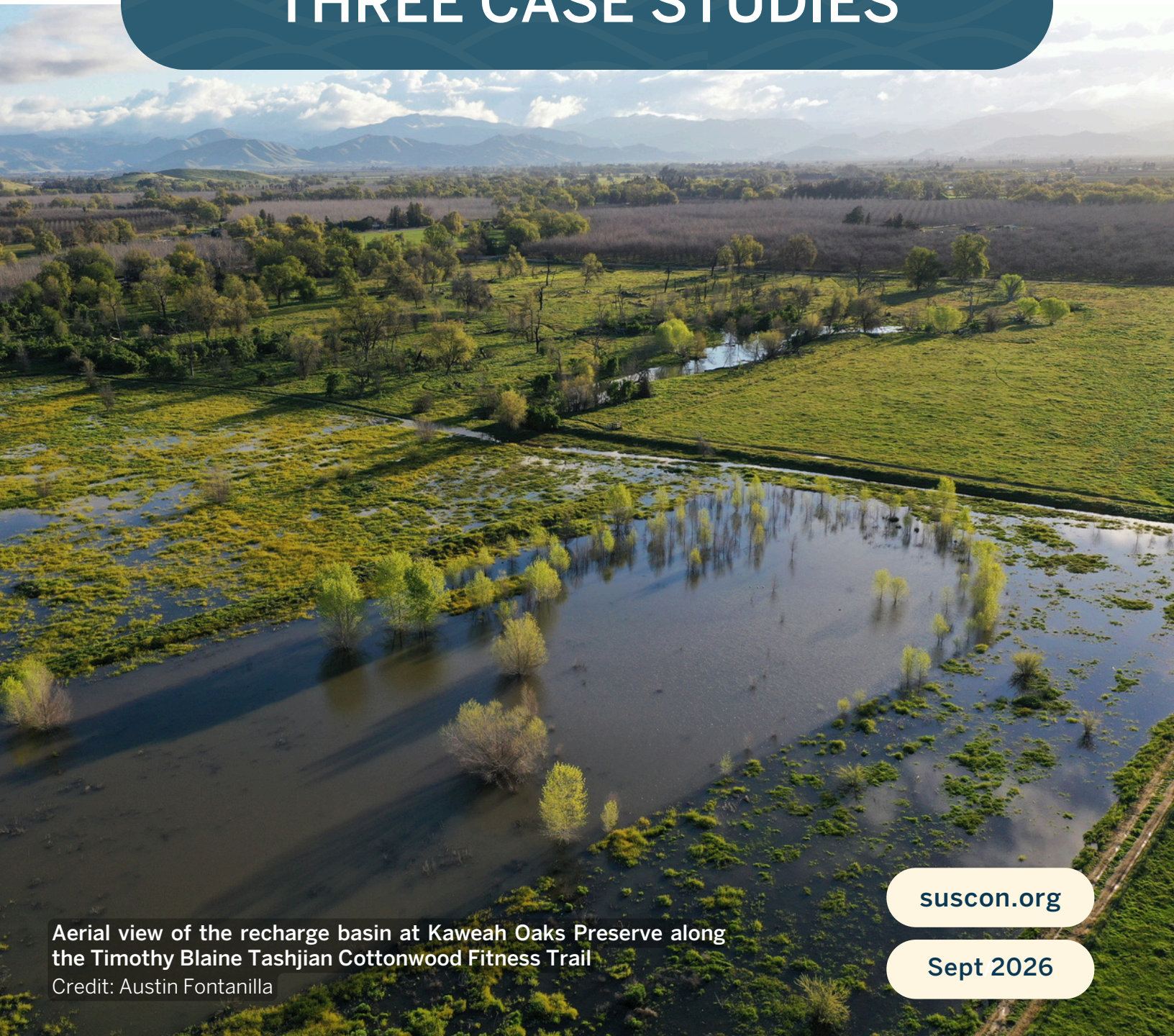




ECOLOGICAL RECHARGE BASINS

THREE CASE STUDIES



Aerial view of the recharge basin at Kaweah Oaks Preserve along the Timothy Blaine Tashjian Cottonwood Fitness Trail

Credit: Austin Fontanilla

suscon.org

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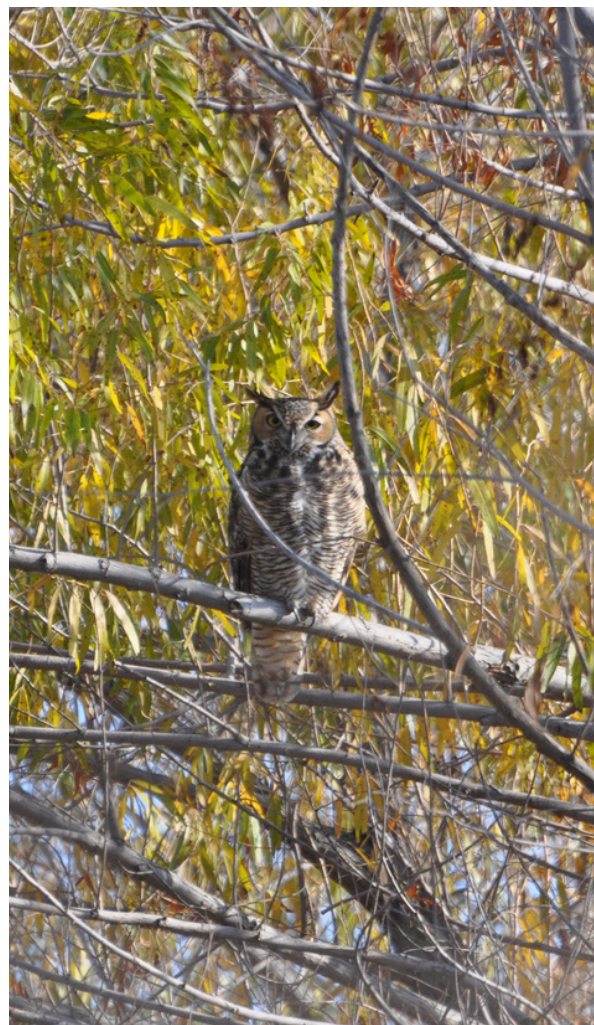
Jon Parker, Kern Water Bank

INTRODUCTION

Recharge basins are used by irrigation districts, water managers, and sometimes private landowners to **capture surface water during wet periods to augment groundwater for use in dry periods**.

Basin managers have observed migrating birds and other wildlife when these basins have water. Even during dry times, recharge basins can provide valuable habitat.

To further understand how recharge basins can enhance habitat, this document presents three case studies of ecologically beneficial recharge basins in the San Joaquin Valley – one large water bank that has been in operation for 30 years, one recently-built small recharge basin managed by a land trust, and one privately-owned recharge basin that is still in the planning stages.



Great horned owl
Jon Parker, Kern Water Bank

CASE STUDY 1

Kern Water Bank

Interviewee

Jonathan Parker, Geologist, Kern Water Bank

Project Description

The Kern Water Bank (KWB) encompasses over 20,000 acres of former farmland in the southern San Joaquin Valley. Established by the Kern Water Bank Authority in 1995, the KWB is well known for providing valuable upland habitat for raptors, terrestrial wildlife, and rare and endangered plants, in addition to over 139 identified species of birds. When water is present in the basins, it also provides valuable intermittent wetland habitat. Ornithological studies over the years indicate over 91 species of migratory water birds visit the wetlands, with populations of up to 35,000 individuals. KWB is an important wildlife resource in the San Joaquin Valley, especially when compared to surrounding agricultural lands.

KWB members bank their surplus surface water supplies in the Kern River Alluvial Fan aquifer in wet years and recover that stored surface water in dry years. The KWB can store up to 600,000 acre-feet each year, and at least 6% of the banked water is a leave-behind factored into KWB calculations. Groundwater modeling indicates that the recharged water does not move far in the groundwater system (only about 1-1.5 miles) and comes back when pumping is occurring. Before the

project began, the Kern Water Bank property was farmed and water levels were on average about 180 feet deep. Recharge operations in wet years can bring levels up to about 25 feet below ground surface (bgs), and during droughts, when the stored water is being recovered, levels can drop below 180 feet bgs. Overall, water levels have remained above pre-project levels for 23 of the 30 years of operations.

About 3,000 acres of the KWB are devoted to conservation banking, a market-based system where habitat is permanently protected and managed for threatened, endangered, or at-risk species in exchange for offsetting environmental damage caused by third-party construction projects elsewhere in the southern San Joaquin Valley.



Heermann's kangaroo rat.
Jon Parker, Kern Water Bank

Design

KWB is a group of large basins that are typically bermed on the downhill side and follow natural topography on the uphill side. When inundated, the average depth of water is around 2 feet and up to 4 feet near the downhill berms. The uphill sides are particularly valuable for shorebirds who need shallow water.

When KWB was formed, members did not want to engage in active restoration activities and instead let natural recruitment of wetland vegetation occur, which has led to positive outcomes. They note that wildlife came with the water, which is a common observation throughout the valley.

Management

The KWB applies adaptive management to control weeds, using cattle (and in the past, sheep) during dry times as a primary strategy to reduce undesirable vegetation like tumbleweeds and cattails. On occasion, KWB may burn small patches of vegetation. KWB does not use pesticides to reduce weeds except on access roads and near banking facilities. They do not disc vegetation in the basins, noting that discing allows fine sediments to settle into the basin bottom, which reduces recharge efficiency. Discing and disturbing the soil also encourages tumbleweed growth, which is a highly noxious weed in the area. They mow some areas and believe from experience that mowing dense stands of dead tumbleweeds opens up the ground to sunlight, which encourages native and non-noxious plant species to grow.

KWB avoids allowing turbid water into the basins to keep fine sediments out. KWB can receive water from the State Water Project and Friant Kern Canal (both of which are relatively free of sediment) and they wait for first flushes to occur from storm events before moving water from the Kern River.

During recharge events, mosquitoes are at times a concern for the KWB. Open, choppy water does not support mosquito larvae, but vegetation – especially dense stands of cattails – in and on the edges of the basins blocks wave action and can provide prime habitat for mosquito larvae. In addition to KWB's use of cattle to reduce cattail growth, the local mosquito abatement district controls mosquitos by spraying pesticides. Since 2006, KWB has been employing the services of mosquito fish to reduce the need for expensive pesticide applications. Mosquito fish cost about \$1,000 for 20,000 fish, making it a logical adaptive management approach for both financial and ecological reasons. As an example of the typical cost for this approach, KWB bought 140,000 fish in 2017 (\$7,000), 65,000 in 2019 (\$3,250), and 90,000 in 2023 (\$4,500). Spraying still occurs, but at lower rates due to using the mosquito fish.



Flame skimmer
Jon Parker, Kern Water Bank

Permitting

The KWB operates under a Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP), established with the US Fish and Wildlife Service and the California Department of Fish and Wildlife (CDFW). The plan includes adaptive management strategies, avoidance and mitigation measures, and monitoring and reporting requirements to protect special status species. The HCP/NCCP allows ongoing recharge, recovery, and maintenance activities (including incidental take) even if endangered species show up on the land. Obtaining the HCP/NCCP took a couple of years, was expensive, and is likely not feasible for smaller projects.

Monitoring

The KWB has a robust monitoring program under the HCP/NCCP and has amassed a trove of biological data. Under the HCP, monitoring is required for the endangered Tipton kangaroo rat and San Joaquin kit fox, and for rare and endangered plant species. Although monitoring for bird species is not required, KWB voluntarily enlists an ornithologist, who comes to KWB every two weeks to monitor bird populations. KWB has funded and supported several other activities and studies not required by the HCP/NCCP, including a lepidopterist survey (for butterflies and moths), an Observation Monitoring Site program (which tracks habitat changes with time), studies of the ecology and macroinvertebrate populations in the recharge basins, Kit Fox surveys by the

Endangered Species Recovery Program, native seed collection to support riverine restoration programs elsewhere, and several studies regarding the geology of the KWB. More data are in the KWB annual reports, available at kwb.org.

Funding

KWB maintenance, monitoring, and reporting activities are funded by six member organizations, including water districts, an improvement district, and a mutual water company, all of which place a high value on the water conservation benefits of the water bank.



White-tailed kite.
Jon Parker, Kern Water Bank

CASE STUDY 2

Kaweah Oaks Preserve



Aerial view of water being moved from the creek to the recharge basin.
Credit: Austin Fontanilla

Interviewee

Jonathan Vaughn, Land Stewardship Manager, Sequoia Riverlands Trust (SRT)

Project Description

This 22-acre recharge basin is located on the 347-acre Kaweah Oaks Preserve (KOP), just east of Visalia, CA.

Established in 1983, most KOP land was never farmed and supports large and healthy populations of oaks, elderberries, and other native plants. Historically, it received winter floodwater from Deep Creek, a tributary of the Kaweah River, thereby recruiting plants, nutrients, and sediment. However, in the 1960s, the Terminus Dam was constructed on the Kaweah River, which curtailed these natural flooding events. This left KOP managers wondering how to recreate the natural flood conditions to maintain the land's health.

In 2017, downstream water users near the Tulare lakebed experienced an almost emergency situation where flooding was occurring and needed to be lessened. The Kaweah Delta Water Conservation District (KDWCD) worked with them on creative solutions to retain water upstream during significant flood events to reduce disastrous flooding downstream while also recharging groundwater and improving ecosystem health.

In furtherance of this effort, KDWCD worked with KOP land managers to design, permit, and construct a recharge basin on a former 22-acre plum orchard that KOP acquired in 2014. KOP managers felt that construction on the former orchard site was more appropriate than

disturbing unfarmed land with native vegetation on the rest of the preserve. KDWCD worked quickly to move earth to create the basin using excavated soil to create berms on the sides and mounding soil within the basin itself, forming an “island” that now hosts duck nests. The district installed a temporary pump on Deep Creek to fill the basin during high flow events. At the same time, an existing “fitness path” was improved on the perimeter of the basin, which is linked to other trails on the preserve.

KOP and KDWCD were able to inundate the area in 2017. The area flooded again in 2023. There were very few trees at first, but after only a few years there are now large stands of willows, oaks, and other native trees. This area connects two woody riparian areas to the east and west of the basin that were formerly disconnected when the recharge basin was managed as a plum orchard.

KDWCD plans to install a permanent pump in Deep Creek on the northeast side of the KOP by the end of 2026, which will bring water into natural swales on the east side of the preserve before flowing into the constructed recharge basin. Water will then flow westward from the basin into more natural swales that spread out over the landscape and sink into the ground.

This project helps to recreate flooding conditions on the preserve, a long-held goal of the KOP managers, while also helping the KDWCD achieve its groundwater sustainability goals.

Management

KOP managers do not manage vegetation in the basin and instead allow natural processes to take place. Previously, they used discing and grazing to try to control Johnson grass, which proved ineffective. They might use grazing or mowing in the future to minimize thatch. They are loosely monitoring the recharge rates of the basin (estimated at about 1 acre-foot/acre/day based on the pump meter readings) and may adjust the management approach if recharge rates are significantly reduced over time. For now, they note that plants within the basin seem to improve infiltration because their roots create preferential pathways and build soil health, both of which help to infiltrate and absorb water underground.



Native elderberry fruit at the Kaweah Oaks Preserve

Permitting

All permitting for the original basin construction was done by KDWCD using its longstanding authority to maintain channels and areas adjacent to channels, which allowed the project to move quickly. The current expansion required the following permits:

- CDFW Lake and Streambed Alteration Agreement, under Fish and Game Code Section 1602
- Clean Water Act, Section 401 Water Quality Certification
- U.S. Army Corps of Engineers, Section 404 permit or Nationwide Permit authorization
- CEQA compliance

- Construction stormwater permit coverage or an applicable waiver
- San Joaquin Valley Air Pollution Control District construction notification or Dust Control Plan approval, as applicable

Funding

Mr. Vaughn believes that KDWCD paid for the original basin work themselves. The current expansion of the recharge footprint is funded by the Department of Water Resources through its Sustainable Groundwater Management grant program.



Aerial photograph of Kaweah Oaks Preserve showing Deep Creek and the recharge basin facing east. Credit: Austin Fontanilla

CASE STUDY 3

East Horizon Ranch

Interviewees

Justin Wylie (Tenant/Farmer) & Andrew Foraker (Vice President at SLM Partners)



Future recharge basin location, currently fallow. Courtesy of East Horizon Ranch, LLC.

Project Description

This proposed 50-acre project site is part of a larger organic citrus farm with regenerative agricultural practices called East Horizon Ranch. This farm is located in eastern Madera County and receives water from Madera Irrigation District.

Farm manager Justin Wylie and co-investor Andrew Foraker applied for a

Multibenefit Land Repurposing Program (MLRP) grant in Madera County to transition the land into an integrated water management basin with native habitat components. They hope to help the Madera subbasin achieve its groundwater sustainability goals, create valuable habitat, and improve groundwater levels of nearby domestic wells.

Design

This 50-acre project area is currently fallow and was prepared for a new mandarin orchard. The site is located on a gentle hill slope between the Madera Canal (uphill) and Dry Creek (at the bottom). The proposed design includes installing a series of terraced water management basins that are linked together. When Madera Irrigation District makes water available in Dry Creek, it would be pumped up to the highest basin using an existing pump in Dry Creek. Once full, water would spill over to the next basin downhill, and so on until water reaches the bottom basin near the creek. Water levels in the basins would be

monitored and pumping stopped when the bottom basin approaches capacity, to make sure no water spills back into the creek. Each basin is anticipated to be between 3 and 5 feet deep to maximize groundwater sustainability benefits when water is available (roughly one in every three years).

The basins will be planted with native annual and perennial plants. The farm managers envision a high-value habitat and area with groundwater sustainability infrastructure that local groups can visit, researchers can study, and water managers can observe to encourage this practice on private farms in their area and throughout the valley.



Map of recharge basin site and recharge water path. Courtesy of East Horizon Ranch, LLC.

Monitoring

Both managers are very interested in offering this project as a pilot site for others to study, and they already have some automatic monitoring set up, such as soil moisture sensors and a meter on the pump. They may be interested in hosting researchers who want to assess the habitat health, for example, by studying the evapotranspiration rates of native plants or by monitoring plant and animal species, as well as researchers interested in the effects this kind of water management basin infrastructure and avoided consumptive demand can have on nearby domestic wells.

Funding

Funding is provided by the Madera County Multibenefit Land Repurposing Program under a block grant from the California Department of Conservation. MLRP funding covers design, construction, planting, and water delivery costs over 10 years. The Madera MLRP also covers foregone income for the land area that would otherwise be farmed, which is an important incentive for landowners to participate in the program. A complementary contract with the U.S. Department of Agriculture's Natural Resources Conservation Service under the Environmental Quality Incentives Program will assist with seed and perennials costs.



Andrew Foraker (Vice President at SLM Partners) & Justin Wylie (Tenant/Farmer)



Looking southwest from the future recharge basin site at East Horizon Ranch