A Briefing on the San Joaquin River Restoration Program

by Gary Pitzer, Water Education Foundation

Editor's Note:

This special publication was produced by the Water Education Foundation to provide the public with information on a major river restoration project underway in California – the San Joaquin River Restoration Program. The 2009 federal legislation authorizing this comprehensive program followed a 2006 settlement in a two-decade court fight over providing water downstream of Friant Dam to support a salmon fishery. The San Joaquin River settlement established two primary goals: restoring robust, self-sustaining populations of salmon and other fish below Friant Dam and minimizing the water supply impacts to farmers.

In 2009 the first restoration flows were released from Friant Dam down the San Joaquin River and in 2010 the river was reconnected to the Merced River. But restoration of this much-changed river must go beyond adding water – reshaping the San Joaquin is a substantial undertaking, involving significant structural changes. And federal officials and others involved in the program are striving to restore the river with as little adverse impact on local farms as possible – not an easy task. Bringing back the historic Chinook salmon fishery also is a complex task and will require the use of a fish hatchery in the early part of this program until a naturally producing population can take hold.

It is – and will continue to be – a fascinating program and we will continue to follow it in the years ahead through our publications, videos and other programs. We hope this online publication can help you understand the basics behind the restoration process. For more in-depth information, please visit the San Joaquin River Restoration Program website, www.restoresjr.net.

– Rita Schmidt Sudman, Executive Director, Water Education Foundation

The mission of the Water Education Foundation, an impartial, nonprofit organization, is to create a better understanding of water resources and foster public understanding and resolution of water resource issues through facilitation, education and outreach.

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Introduction

Once home to the nation's largest spring-run Chinook salmon population, the San Joaquin River was dammed in 1942 and most of its water was diverted north and south to farms and cities on the east side of the San Joaquin Valley. The region became one of the most productive agricultural regions in the world but the river's flow essentially ended 30 miles downstream of Friant Dam – drying up most of a 60-mile stretch of river and effectively cutting off the salmon from their historic spawning grounds.

In 1988, environmentalists filed suit to require some water to be released downstream to restore a salmon run. After nearly 20 years of litigation, a settlement was announced between a coalition of environmental and fishing groups, including the Natural Resources Defense Council (NRDC), the federal Bureau of Reclamation (Reclamation) and the Friant Water Users Authority (FWUA), a joint-powers authority consisting of 29 water districts, to restore the river. Congressional implementation of the settlement, including planning, environmental studies, and other activities, were authorized in the San Joaquin River Restoration Act (Act), approved in 2009 (Public Law 111-11.)

In October 2009, the first restoration flows were released from Friant Dam down the San Joaquin River and in 2010 the river was reconnected to the Merced River and, subsequently, the Sacramento-San Joaquin Delta. Past history was no longer prologue and restoration of the San Joaquin River – at an estimated cost approaching $1 billion – began in earnest.

But water alone won't do the job of restoring the altered river.

"The first major projects that we have to complete have to do with channel capacity," said Jason Phillips, former manager of the restoration program for Reclamation's Mid-Pacific Region. "We have sections of the river that have been encroached by farming, that have not conveyed water except during high flood events, that need to be rehabilitated, that need levees constructed and set back, that need the channel to be improved or cleared, and we have structures in the river that need to either be bypassed or rehabilitated so that they can pass flows and salmon."

The San Joaquin River settlement established two primary goals: restoring robust, self-sustaining populations of salmon and other fish below Friant Dam and minimizing the water supply impacts to farmers. After so many years in which most of the water went to agriculture, the restoration agreement will establish a new basis for releases from Friant Dam and Millerton Reservoir. Prior to the settlement, Friant Dam water releases dried up about below the dam at Gravelly Ford until water was reintroduced to the riverbed at the Mendota Pool.

(Located 40 miles downstream of Friant Dam, Mendota Pool is where water is returned to the San Joaquin riverbed from a distant source – the Sacramento River. The Sacramento River water is delivered south from the Delta via the 117-mile long Delta-Mendota

The San Joaquin River settlement established two primary goals: restoring robust, self-sustaining populations of salmon and other fish below Friant Dam and minimizing the water supply impacts to farmers

Canal to the pool, a historic diversion point for irrigation water used by the Miller and Lux Corp. Here the Delta-Mendota Canal's remaining water is released to replace San Joaquin flows that have been diverted by the Madera and Friant-Kern canals. The water is then delivered to the historic riparian diverters now known as the "exchange contractors.")

Initial studies indicated that restoring the river would result in the loss of 15 percent, on average, of the water that had been diverted to the Friant service area. Officials hope that will be less as the program is fully implemented. Supporters of the settlement believe the amount of the river flow dedicated for restoration is not a lot of water in the overall picture of the San Joaquin Valley. According to Reclamation, approximately 42,000 acre-feet of the interim flows was recaptured and stored in San Luis Reservoir in 2010 for recirculation back to the Friant contractors. Some 260,000 acre-feet of water was released.

Those additional flows in what was once a dry river have the potential to effect farms alongside the San Joaquin River. The irrigation districts that serve these areas are outside the FWUA and were not subject to the litigation; nor were they involved in the negotiations that led to the restoration plan.

Reshaping the San Joaquin is a substantial undertaking, involving significant structural changes. More than 10 miles of the existing river channel will be widened leading up to the Mendota Pool – where water from the Central Valley Project (CVP) is delivered. A bypass will be built around the pool or the dam will be moved upstream to allow salmon to migrate. The lower reaches of the river require substantial upgrading to ensure adequate flood protection.

Flood capacity in this area is a big concern, and Reclamation officials say improving the capacity of the stretch of the San Joaquin River from Gravelly Ford to Mendota Dam needs $100 million to $300 million in improvements. "This is a significant investment in flood capacity in the system and I don't think that should be lost," Phillips said. "This is a very degraded flood control system. It doesn't work very well."

Local flood control agencies believe the system functions as it was intended but issues such as levee foundation seepage and channel capacity degradation from sediment buildup and heavy vegetation encroachment need to be addressed. "These concerns are being exacerbated by the restoration program for which the program needs to address, but has not yet done so," said Reggie Hill, manager of the Lower San Joaquin Levee District.

Thus far, water has been released to the river for experimental and data collection efforts. The major river restoration efforts and full restoration flows are anticipated by 2013 with salmon introduced at that time. Riparian and aquatic restoration is targeted to be completed by 2016. The agreement runs through 2026 but may be extended indefinitely. Total cost for the implementation is $720 million, provided by a measure

carried by Sens. Dianne Feinstein and Barbara Boxer as part of an omnibus public lands bill.

After so many years in which most of the water went to agriculture, the restoration agreement will cause a new basis of releases from Millerton Reservoir. For "third parties" the settlement and subsequent legislation include provisions designed to address any third party impacts.

Third parties will not have to involuntarily pay to implement the terms of the settlement nor will state and local agencies be obligated to undertake restoration activities. The state has an agreement with the federal government that commits it to being a full partner in the restoration effort, including the use of funds from voter-approved ballot measures.

A measure of the success of the river's restoration will be the return of the spring run salmon, once the largest run of its kind in North America. Skeptics say the fish have been gone for too long to make a comeback, but others believe the run can be re-introduced and sustained provided the necessary preparations are undertaken. "I truly believe they will come back," said Peter Vorster, hydrologist with the Bay Institute.

Vorster acknowledged "it will take patience and letting the water flow," but said that other areas such as Putah Creek, Butte Creek and Clear Creek have demonstrated fish runs can be re-established and/or revitalized.

The preparation for salmon will include barriers in the river at Salt and Mud sloughs to prevent migrating fish from mistakenly turning up those waterways to spawn and a new hatchery.

Jeff McLain, fishery biologist with the National Marine Fisheries Service, said the goal of the restoration program is a self-sustaining salmon population. Re-locating the spring run to the San Joaquin will be a challenge, while establishing a fall run might work naturally. Fall run salmon already are found in several San Joaquin River tributaries. A fall run introduced in test areas in 2012 will enable researchers to evaluate factors such as predation and the suitability of rearing habitat.

This publication, produced by the Water Education Foundation, provides an overview of the issues associated with restoration of the San Joaquin River, along with some historical context of the river's prior development and some discussion on what the hopes for the future are.

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A Restored San Joaquin?

The unprecedented decision to restore a long-dead river understandably requires a scope of activity previously unseen. Scores of people, including engineering experts and fisheries biologists, are spending their days analyzing data in preparation for the expected return of salmon in a few short years. Re-establishing that population means reconfiguring a river channel that has been deprived of water for decades.

In March 2010, for the first time in a non-flood year in 60 years, San Joaquin River flows from Friant Dam reached the river's confluence with the Merced River and then on to the Delta. As the water migrates, it naturally seeks to refill available space underground, something restoration officials are keeping an eye on.

The geographic area for restoration stretches 153 miles from Friant Dam to the confluence of the Merced River. The region includes Fresno, Madera, Merced and Stanislaus counties. Reclamation divides the river into five reaches:

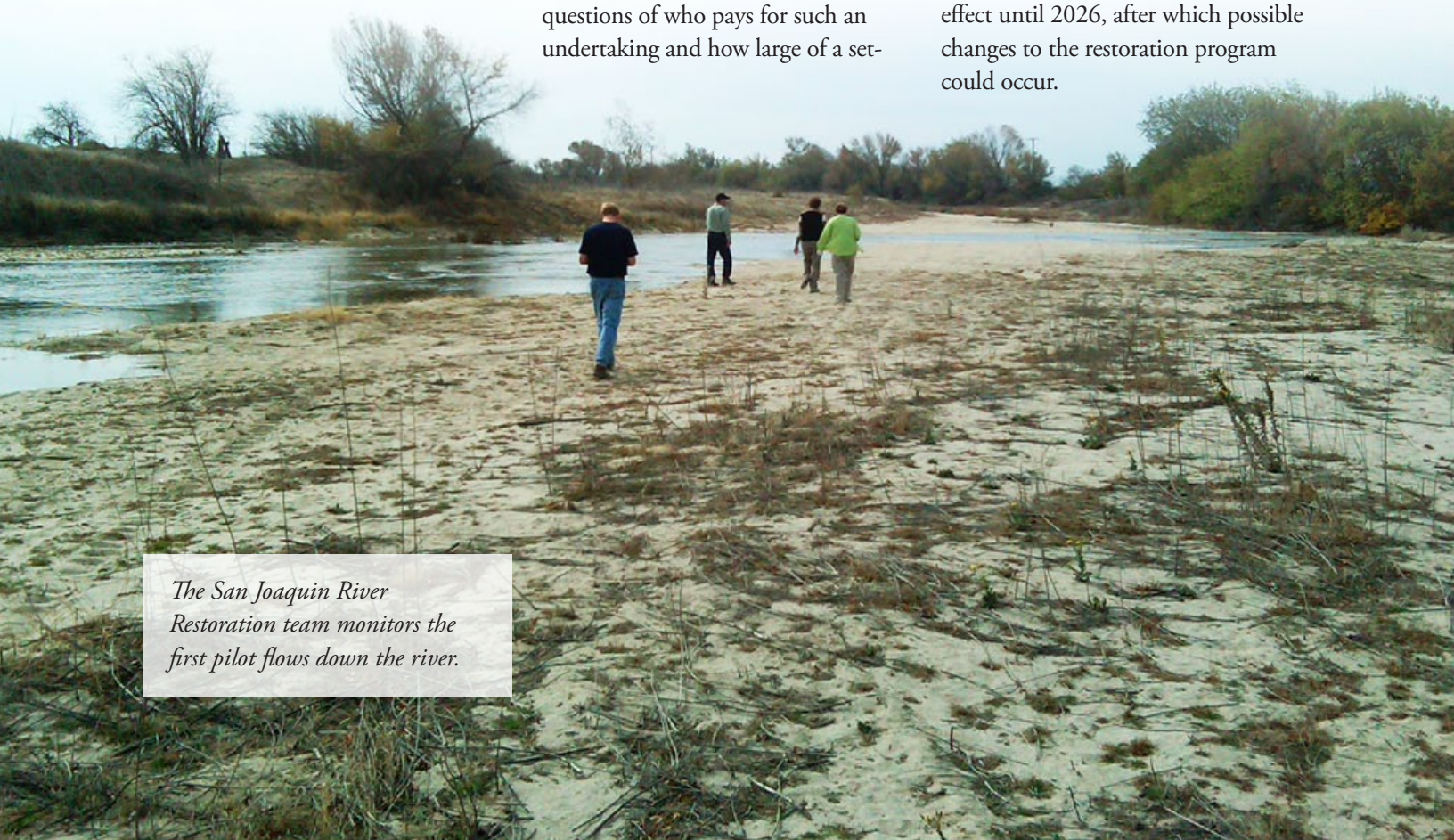
- Reach 1 – Friant Dam to Gravelly Ford
- Reach 2 – Gravelly Ford to Mendota Dam
- Reach 3 – Mendota Dam to Sack Dam
  Reach 4 – Sack Dam to the confluence of Bear Creek and the Eastside Bypass
- Reach 5 – Eastside Bypass/Bear Creek confluence to the Merced River confluence

The area known as Reach 4B is a controversial part of the restoration program because of the work needed to convey flows of at least 475 cubic feet per second.

Mendota Pool – where CVP water is sent to San Joaquin Exchange Contractors – may be moved upstream or bypassed to accommodate fish passage. The proposition invites questions of who pays for such an undertaking and how large of a setback for the new river channel would be needed. Likewise, replacement of the antiquated Sack Dam with newer technology is being contemplated.

The settlement notes that changes and modifications to the San Joaquin River system should be undertaken to the extent that they are consistent with applicable law and operational criteria such as flood control, dam safety and operation and maintenance.

Naturally, such a large undertaking requires a phased approach, and planners announced a schedule that would gradually increase flows toward the expected reintroduction of salmon by the end of 2012. Restoration takes different forms, from expansion of the river channel to levee improvements and to providing suitable habitat for fish passage. Funds for the project come from water users, state bond initiatives and federal authorizations. The settlement continues in effect until 2026, after which possible changes to the restoration program could occur.



The San Joaquin River Restoration team monitors the first pilot flows down the river.

Lower San Joaquin River Flood Control Project

The geography of the San Joaquin River and its tributaries has contributed to periodic flooding. Despite the engineering efforts by federal, state and local authorities, flooding problems continue to threaten lives and property.

Since completion of Friant Dam there have been reduced flow volumes and a major accumulation of sediment in the riverbed. The loss of peak flows prevented sediment from moving downstream and inhibited the channel from conveying high flood flows. Sediment buildup has led to vegetation encroachment within the channel, exacerbating the problem. Consequently, when future floods arrive, the level of inundation increases.

The federal Flood Control Act of Dec. 22, 1944 authorized a flood control project on the lower San Joaquin River which would have required the state to obtain flowage easements upstream of the mouth of the Merced River. The State Reclamation Board adopted a substitute plan called the Lower San Joaquin River Flood Control Project that required bypasses, levees and channel improvements. The federal government authorized the plan on Aug. 9, 1955. The Lower San Joaquin Levee District was created by the Legislature to ensure the benefits of the project would not be lost and to provide protection to the people and the property for which the project was designed.

Reach 2B of the San Joaquin River includes the Chowchilla Bifurcation Structure.

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Salmon: Life History and Reproduction

Chinook salmon are anadromous, which means that they spend part of their life in the ocean and the other part in freshwater rivers and streams. Chinook salmon are born in freshwater streams and then travel to the open ocean to grow into adulthood. Chinook salmon may spend between one to eight years in the ocean before returning to their natal streams to spawn, though the average is 3 to 4 years. At reproductive maturity, they will swim back to their birth stream to lay eggs. After so many years, some salmon can be hundreds of miles away from their birth stream. The time of the breeding depends on the river and population of salmon. Typically, they breed in the summer and autumn.

At their birth stream, male and female salmon pair up to breed. The female digs a nesting hole, known as a redd. She deposits thousands of eggs in the redd before the male releases his sperm. After mating, the male and females stand guard over the eggs to protect them from predators. Chinook salmon burn a lot of energy migrating to the nesting grounds, breeding and protecting the eggs. Both parents will die before the eggs even hatch.

Restoring the river means bringing the salmon habitat back to optimum conditions. "You have to have the right proportions of the gravel sizes for salmon, you also have to have cool water, water flowing through the gravel, typically we call those riffles, where they spawn, good water quality in general," McClain said. "They also need structure and habitat, they need plants that are both in-stream as well as habitat along the edges of the river, what we call riparian habitat."

Despite skepticism concerning the practicality of returning salmon to the San Joaquin River, biologists say the river may in fact serve as a refuge for the fish because its source drains high-elevation snowmelt that remains ice-cold in spring. With the assistance of a hatchery rearing program that will be fully operational in 2014, projections are for 30,000 spring run and 10,000 fall run fish.

Re-introducing the spring-run salmon population involves bringing as many as 100 breeding pairs of fish to the San Joaquin River from other managed areas such as Butte Creek and the Feather River Hatchery in late 2011. Other possible contributing waterways are the Mokelumne, Stanislaus and Yuba rivers.

The National Marine Fisheries Service is expected to approve a permit for the salmon re-introduction in April 2012.

The Science of Salmon Restoration

Returning salmon to the San Joaquin River is not as simple as merely returning flows to the river's dry reaches, although that is certainly part of the equation. Scientists have examined the river's fishery conditions and the water supply needed to enhance habitat, but a definitive answer remains elusive.

Challenges are numerous, including the lack of available spawning ground as well as the fact that the river's relatively flat slope hinders movement of cold water and "bed mobilization," the process by which fine silts are scoured downstream. Environmentalists say the San Joaquin can be brought back to function as it did before Friant Dam was built.

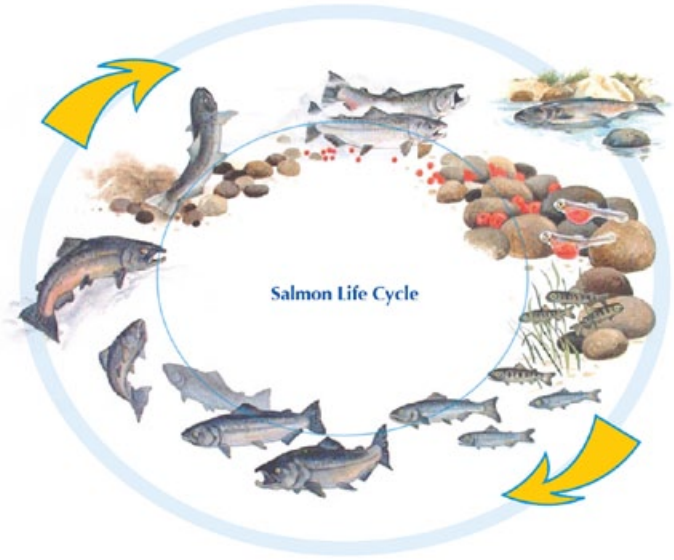
"Restoring the San Joaquin River and the channel capacity is not impossible. We clearly can do it," said Monty Schmitt, senior scientist with NRDC and the San Joaquin River Project Manager. "Yes, it costs a lot of money but since this is for perpetuity, let's do it right."

Restoration of the salmon will not only benefit commercial fishermen but could be a step toward de-listing the spring run salmon, benefiting water users throughout the state. The Central Valley spring run is listed as "threatened" under the federal Endangered Species Act.

At Putah Creek in Solano County, which had dried because of drought conditions, water was reintroduced through alterations to Solano Dam releases. The result was a remarkable success with the return of about 70 salmon and sparked a subsequent investment to restore spawning beds.

Salmon are returned to rivers by various means, in many cases well before river restoration is fully completed. Eggs can be incubated in waters to establish the homing base that enables the majority of salmon to return to their original nursery. The homing instinct for San Joaquin River salmon has been eradicated, with fish instead venturing up the Merced River or other tributaries.

Several changes are needed to facilitate salmon restoration, such as re-establishing the historic channel, possibly isolating or filling hundreds of acres of large pits left from gravel mining, modifying numerous fish



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– Monty Schmitt, NRDC

With adequate funding, a reason able amount of water and removal of the multiple barriers to fish passage on the river, an aggressive restoration program could return as many as 15,000 salmon.

passage barriers and ensuring proper water temperature. Estimates are that 385,000 acre-feet of water in a dry year to 1.8 million acre-feet in a wet year are needed for the fish. One of the key functions for development is the relationship between flow magnitude and water temperatures.

With adequate funding, a reasonable amount of water and removal of the multiple barriers to fish passage on the river, an aggressive restoration program could return as many as 15,000 salmon. Still, scientists say the San Joaquin is not a functional river because there is no connection and there is no river channel anymore in certain reaches. A number of places will require reconfiguration of the river channel, particularly in the lower river.

How water quality is affected by irrigation drainage is of concern because of the possible impacts to fish restoration. The matter will ultimately be decided by the State Water Resources Control Board (State Water Board) as it considers regulation of discharges from agricultural lands. Selenium, a natural element in the valley soil, could have deleterious effects on restored salmon runs. Selenium is essential for life, but in high concentrations, it will kill or cause deformities in animals.

Irrigation drainage collects selenium in high concentrations. The river also gets big doses of selenium during storms, when uncontrolled runoff drains into the San Joaquin. While runoff has decreased, the concern is the cleanup has not progressed far enough to protect salmon, including a 5-mile stretch from Mud Slough to the confluence of the Merced River.

Farmers say they need the extra time to develop a treatment plant to eliminate the rest of the bad water. They must submit a plan on the treatment plant by 2013 and reduce selenium levels by 40 percent from the current levels over the next five years. Furthermore, they say their studies show that increased freshwater during salmon migration will dilute contamination and move it out, especially during the higher flows that the restoration must have to help the salmon move.

A River Diverted

Powered by the snowpack and springs of the Sierra Nevada, the San Joaquin River flows from the mountains, swings north and crosses the expanse of the Central Valley before mingling with the Sacramento River and the brackish waters of the Bay-Delta estuary. Prior to its alteration, which began in the 19th century, the river supported both fall and spring runs of Chinook salmon, with populations estimated in the hundreds of thousands.

Farming expanded as the century turned, but growers became painfully aware that the capricious climate could often rob them of the precious precipitation they needed to fill canals and refill underground aquifers.

Severe drought in the 1920s and 1930s dried up thousands of acres of land, strained groundwater supplies and germinated the idea that would eventually see the light of day as the CVP. After plans for a state-built system dissolved because of the inability to sell bonds during the Depression, the federal government in 1935 authorized the CVP.

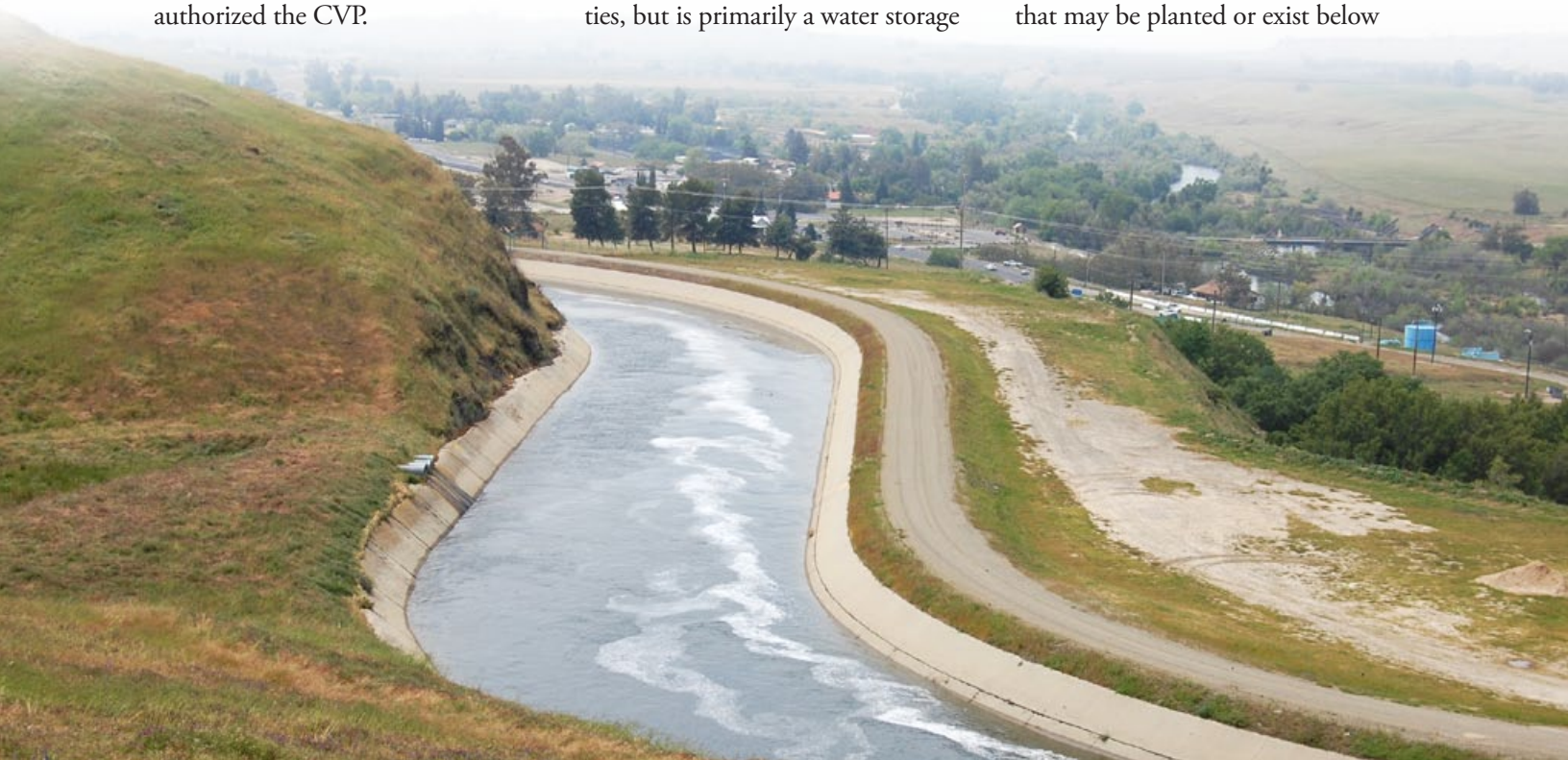
Within a decade, Friant Dam was completed and except for releases to manage floods and meet the needs of riparian water-rights holders immediately below the dam, the upper San Joaquin's entire flow was impounded by the dam and diverted into Madera and Friant-Kern canals and delivered to farms to the north and south, respectively. Prior to construction, historic San Joaquin water rights holders agreed to exchange their rights for water from the Sacramento-San Joaquin Delta. The river ran in fits and starts but Reclamation always released about 100,000 acre-feet of water each year to meet its water rights commitments and to support the trout hatchery below the dam.

Today, the Friant Division's 1 million acres of farmland support a $4.5 billion economy and the livelihood of many large and small communities. Relatively small at 520,000 acre-feet of storage, water from Millerton Lake is allocated to water districts north and south via the Madera and Friant-Kern canals. The dam provides flood protection and recreation opportunities, but is primarily a water storage facility for the Friant Project.

Throughout the early years of Friant Dam's operation, and prior to the completion and full operation of the Madera and Friant-Kern canals, water releases enabled salmon to spawn in the river, with an estimated 56,000 salmon returning as part of the 1945 spring run. Historically, spring run Chinook salmon were one of the largest runs on the Pacific Coast. In 1885, commercial fisheries harvested more than 600,000 fish in the Central Valley.

Even though Friant releases reached about 40 miles downstream, eventually increased diversions caused two long stretches of the river to dry up. By 1949, the fall run salmon had disappeared and the spring run shortly thereafter.

The California Department of Fish and Game (DFG) in 1950 inquired whether Reclamation was obligated to comply with Section 5937 of the Fish and Game Code, which required dam operators to "allow sufficient water at all times to pass … to keep in good condition any fish that may be planted or exist below



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the dam." Federal officials and Friant water users denied that releases from the dam were called for to preserve salmon, adding that legal opinion upheld Friant's primary purpose as a source of irrigation.

Into the fray stepped then-Attorney General Edmund G. "Pat" Brown, who in 1951 opined that the federal government did not have to comply with the Fish and Game Code, and that releases for the preservation of fish "would indeed constitute 'a waste of water' in view of the grave need for all available water for higher use elsewhere." DFG pressed on, pushing the matter to the agency then known as the State Water Rights Board.

Ultimately, in a finding known as Decision 935 (D-935), the Water Board dismissed DFG's claim as "not in the public interest" at that time, while recognizing that Friant should maintain a minimum release that waters the river to Gravelly Ford. Rebuked, DFG prepared to take the matter to court to force releases for salmon. Brown, who was elected governor in 1958, was working on his own water plan and halted the suit.

Deprived of its flow, the San Joaquin became a river in name only for certain reaches, where bypasses shunt flood flows while parts of the historical channel are choked with trees and vegetation. Some stretches were nothing more than irrigation drainage.

The loss of the San Joaquin Chinook salmon run "was really felt most strongly" by the commercial salmon fishermen along the coast, Schmitt said. The end of the San Joaquin salmon run was "the beginning of a slide in the salmon populations in the state of California that really has had a very large impact over time."

The early legal skirmishes intensified in the 1970s as the state sought certain water releases from New Melones Reservoir on the Stanislaus River, a tributary to the San Joaquin. Seeking to establish its pre-eminence over state law, the federal government filed suit to establish the rule of law once and for all. Eventually, a milestone 1978 U.S. Supreme Court ruling required federal agencies to comply with state water laws unless there was a clear congressional directive to the contrary.

Armed with the high court's ruling, NRDC, along with other environmental and fishery interests, sued Reclamation in 1988 to halt the renewal of long-term Friant water contracts, claiming the impacts to river habitat had not been adequately considered. Shortly after the initial filing, the state Court of Appeals affirmed the duty of the State Water Board to follow Section 5937 and the suit was amended to incorporate a 5937 cause of action.

The case's winding, 18-year course traversed three presidential administrations, numerous amendments and an attempted negotiated settlement. Along the way, the State Water Board, which had previously sided with Reclamation regarding the operation of the dam, changed its stance, filing "friend of the court" briefs on behalf of the plaintiffs. The brief acknowledged the conundrum with changing the course of the dam's operation.

"It is still feasible to compel the release of water from Friant Dam to restore the former salmon runs, and it would still impair the primary irrigation objective of the Friant Division to do so," the brief said. "There is still not enough water in the state's water bank to do both."

The Court Ruling

In 2004, a ruling in the San Joaquin case issued by Judge Lawrence Karlton described a complicated river system that supported not only salmon, but also rainbow trout, splittail and the water quality and habitat of the Delta. Karlton cited a 1994 U.S. Fish & Wildlife Service report, *The Relationship Between Instream Flow, Adult Immigration, and Spawning Habitat Availability for Fall-Run Chinook Salmon in the Upper San Joaquin River*, which called the dam's operation a "disaster" for Chinook salmon.

"There is no genuine dispute … as to whether [Reclamation] has released sufficient water to maintain historic fisheries, and the record … is clear [it] has not," Karlton wrote.

As legal basis for the plaintiffs' argument, Karlton pointed to a provision of the federal Reclamation Act that stipulates its purpose of not affecting or interfering with state laws regarding the control, appropriation, use or distribution of water. He chided the defendants for "continually relitigating" previously decided arguments, such as the applicability of Section 5937, the State Water Board's D-935 and whether the 1992 Central Valley Project Improvement Act (CVPIA) trumps the plaintiffs' argument.

The CVPIA required a comprehensive plan that is "reasonable, prudent and feasible" to re-establish and sustain anadromous fisheries from Friant to the San Joaquin River's confluence with the Delta, while allowing the project's operation to continue pending congressional authorization of additional releases. In lieu of water, FWUA members contribute to an environmental restoration fund, some $160 million between 1993 and 2003.

Karlton wrote "there is no apparent reason" why the CVPIA and Section 5937 "cannot be read" as complementary, and that "whatever the reasonableness component of the CVPIA ordains, it is clear that complete diversion of the river, with its concomitant destruction of the historical fisheries, is not reasonable." He did not, however, suggest that irrigated agriculture should suffer undue harm in the course of determining the remedy for the beleaguered river.

"Farmers throughout the valley have dedicated their lives and fortunes to making the desert bloom," he wrote. "They did so in reliance on the availability of CVP water. That reality most likely should be taken into account when the court comes to address a remedy."

The ruling set the stage for all the parties – farmers, environmentalists, fishery organizations – to come together and forge an agreement for the release of water down river. The threat of further litigation and the uncertainty regarding how a judge might order a remedy for the river brought final agreement.

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Other Settlement Aspects

Under the terms of the agreement, wildlife habitat will be restored along the course of the river. Water releases will be keyed to the specific needs of spring run and fall run Chinook salmon, with the amount varying depending on how wet or dry conditions are in the region.

The settlement also allows Reclamation to sell water during wet spring periods at a reduced price of $10 per acre-feet. Water districts outside the Friant Division agreed to support the settlement after an agreement was reached to protect their water rights. These third parties included the San Luis & Delta-Mendota Water Authority, Merced Irrigation District, the San Joaquin River Exchange Contractors Authority, the Merced, Turlock, Modesto, Oakdale and South San Joaquin irrigation districts, and Westlands Water District.

The settlement stipulates an environmental fee of $7 per acre foot of water delivered to Friant contractors that is expected to average about $8 million per year. As much as $2 million annually of other CVPIA restoration fund payments made by Friant water users under the CVPIA would also be directed for implementation of the settlement.

Ongoing Monitoring

Reclamation is tracking how far the water spreads from the riverbed and how high the groundwater level rises. More than 90 monitoring wells have been established for this purpose. The amount of water released from Friant Dam may have to be reduced if water is accumulating too rapidly near the surface, something that could drown the root systems of crops.

Reclamation plans to use groundwater monitoring wells adjacent to the riverbed to track seepage.

"Water often finds the path of least resistance, and oftentimes in a system where we have no levees the river is just adjacent to all of our fields," said Cannon Michael, a Los Banos grower. "The hydraulic pressure is going to push the water out into sand lenses where you'll see water come out hundreds of yards out into the field."

Already, those downstream of Friant have issues with the restoration program. According to press reports, the Wolfsen Land and Cattle Co. in Los Banos filed a claim for damage from flooding and seepage. The effect of the discharge "was to flood, erode, seep under, and physically inundate and invade the Wolfsen properties, thereby taking their property for public use," the complaint said.

The problem illustrates the difficulty associated with reviving a river in which channel capacity has been severely degraded. As such, Reclamation must determine how much of the restoration flows are sent down the original river channel or flood bypasses. Whatever course is chosen must reconcile the fact that crop plantings now exist in the river's traditional floodplain. "Again, this is where the restoration program fails in addressing the flood management concerns and operations," Hill said. "[Reclamation] is not a flood management agency and they do not determine the route of flows in the bypass system. That responsibility lies with the [Lower San Joaquin] Levee District, which they acknowledge."

Concerned about the impacts on their constituents, Reps. Dennis Cardoza, D-Merced, and Jim Costa, D-Fresno, in September 2010 asked for "immediate attention" from Reclamation Commissioner Michael Connor regarding the downstream impacts of river restoration. "The long-term credibility of the [program] requires that Reclamation establish a good neighbor policy and immediately work with third party stakeholders to develop a process to review claims and … provide mitigation, including compensation," a letter says.

In For the Long-Term

There is still a lot to be learned about restoring the San Joaquin River, including the relative success of re-introducing salmon and the impacts to the farm economy. The initial stages of the restoration project are guiding officials as they steer the process. On one front, it may appear the projected loss of water to agriculture will be less than the original estimates. Because of the wet 2009-2010 winter, farmers also were able to cheaply buy back about another third of the water they lost. Even so, farmers say the water delivery system needs to be improved so more water can be sent back to farms in drier seasons.

"The settlement agreement really has two co-equal goals," Schmitt said. "One is to restore naturally occurring healthy populations of Chinook salmon. The other goal is the water management goal and this is to create a plan to re-circulate and recapture some of that restoration water that's put downstream and to bring it back to the Friant farmers."

Bringing water back to the farmers is important because of the projected loss from their water supply (with the associated loss acreage and jobs) and the challenge of restoring that water in the most environmentally acceptable way. Water contractors are working with Reclamation on several options, including exchanges with the districts on the Kings River system that also receive water from Millerton Reservoir and districts like Arvin-Edison Water Storage District in Kern County that can receive water from both the Cross Valley Canal and Millerton.

For Cardoza and Costa, self-proclaimed "supporters and advocates" of the restoration program, it is imperative that the plan go forward in a balanced fashion that takes care of downstream landowners as well as the interest of the longtime water rights holders affected by the settlement. The "worst possible scenario," they wrote, would be one in which introduced salmon quickly die off due to insufficient habitat while farmers see their livelihood destroyed.

Phillips stressed the need to take the long view of the restoration project. "It's going to take longer than 20 years to restore a naturally reproducing salmon fishery, it may take 40 or 60 years to really get to that phase ultimately," he said. "And there's a check in point at 2026 to see how we're progressing."

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