San Joaquin River Restoration Settlement

-name redacted-, Coordinator
Specialist in Natural Resources Policy

-name redacted-, Coordinator
Analyst in Natural Resources Policy

November 9, 2007

Congressional Research Service
7-....
www.crs.gov
RL34237

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

Historically, Central California's San Joaquin River supported large Chinook salmon populations. Since the Bureau of Reclamation's Friant Dam on the San Joaquin River became fully operational in the 1940s, much of the river's water has been diverted for off-stream agricultural uses. As a result, approximately 60 miles of the river bed is dry in most years. Thus, the river no longer supports Chinook salmon populations in its upper reaches. In 1988, a coalition of conservation and fishing groups sued Reclamation (*Natural Resources Defense Council v. Rodgers*). A U.S. District Court judge has ruled that operation of Friant Dam violates state law because of its destruction of downstream fisheries. Faced with mounting legal fees, uncertainty, and the possibility of dramatic cuts to water diversions, parties negotiated a settlement instead of proceeding to trial. In September 2006, an agreement, commonly called the Settlement, was reached. It calls for new releases of water from Friant Dam to restore fisheries, as well as for efforts to mitigate reductions in off-stream deliveries lost to restoration flows.

Congressional authorization and appropriations are required for full Settlement implementation. Legislation based on the Settlement (H.R. 4074, H.R. 24 and S. 27) is pending. Related bills have also been introduced. A key legislative issue is how to finance the Settlement, specifically how to resolve congressional pay-as-you-go (PAYGO) issues. Other challenges are how to achieve the Settlement's dual goals of fisheries restoration and water management, and how to address concerns of stakeholders not party to the Settlement, without disrupting the negotiated agreement.

The amount of water projected for restoration flows and the volume of reduced Friant water deliveries are related, but the relationship would not necessarily be one-for-one. Available estimates for total annual Friant water supplies (including both contract and temporary water) are, *on average*, 15% to 16% less under the Settlement than under current operations; but such estimates do not account for improvements in water management that might reduce the impact on water users. For three-quarters of water contractors, the reduction would represent a reduction in one of their available sources of water. The impacts of such reductions will vary by contractor depending on the firmness of existing surface water supplies and the reliability of groundwater supplies. How to offset the decrease and who would pay for investments in other water sources and improved efficiency has not been determined.

Although the region may benefit from increased recreational expenditures and investment in river restoration activities under the Settlement, studies suggest its largest and mostly negative economic impact would be on the agriculture industry, at least in the short term. In addition, downsteam interests not party to the Settlement have been concerned about increased flooding, groundwater infiltration, and competition with existing federal financial commitments. Nearby communities fear harm to groundwater quantity and quality. Some of these concerns have been addressed in the legislation, but some remain. On the other hand, some communities and interests believe restoration will bring other benefits to the river, such as improved surface water quality in lower San Joaquin River reaches. Ultimate Settlement costs and benefits are very difficult to predict.

Contents

Figures

Tables

Appendixes

Contacts

Introduction

Historically, Central California's San Joaquin River supported large Chinook salmon populations. Since the Bureau of Reclamation's Friant Dam on the San Joaquin River became fully operational in the 1940s, much of the river's water has been diverted for agricultural uses. As a result, approximately 60 miles of the river is dry in most years, making it impossible to support Chinook salmon populations in the upper reaches of the river. In 1988, a coalition of conservation and fishing groups advocating for river restoration to support Chinook salmon recovery sued the Bureau of Reclamation (hereafter referred to as Reclamation), which owns and operates Friant Dam (*Natural Resources Defense Council v. Rodgers*).[1] Most long-term water service contractors who receive the diverted water were added to the case shortly thereafter as defendant intervenors. A U.S. District Court judge has since ruled that operation of Friant Dam violates state law because of its destruction of downstream fisheries. Faced with mounting legal fees, considerable uncertainty, and the possibility of dramatic cuts to water diversions, parties agreed to negotiate a settlement instead of proceeding to trial on a remedy regarding the court's ruling.

In September 2006, a Settlement Agreement was reached concerning operation of Friant Dam—one of the largest federal dams operated as part of Reclamation's Central Valley Project (CVP) in California. The Settlement calls for new releases of water from Friant Dam to restore fisheries in the San Joaquin River and for efforts to mitigate water supply losses due to the new releases. Full implementation of the Settlement would require congressional authorization and appropriations. Implementation legislation based on the Settlement (H.R. 4074, H.R. 24 and S. 27) is currently pending. Other San Joaquin water management bills have also been introduced (e.g., H.R. 3768 and H.R. 2498).

Under the Settlement, increased water flows for restoring fisheries would reduce diversions of water for off-stream purposes, such as irrigation, hydropower, and municipal and industrial uses. The quantity of water used for restoration flows and the quantity by which water deliveries would be reduced are related, but the relationship would not necessarily be one-for-one. For instance, in some of the wettest years, flood water releases could provide a significant amount of the restoration flows, thereby lowering the reduction in deliveries to agricultural and municipal users. Under the Settlement, no water would be released for restoration purposes in the driest of years; thus, no reductions in deliveries to Friant contractors would be made due to the Settlement in those years. Additionally, in some years, the restoration flows released in late winter and early spring may free up space for additional runoff in Millerton Lake, potentially minimizing reductions in deliveries later in the year—assuming Millerton Lake storage is replenished. Consequently, how deliveries to Friant water contractors might be reduced in any given year would depend on many factors.

Regardless of the specifics of how much water might be released for fisheries restoration vis-à-vis water diverted for off-stream purposes, there will be impacts to existing surface and groundwater supplies in and around the Friant Division Service Area and adjustments in local economies. Although some opposition to the Settlement and its implementing legislation remains, the largest and most directly affected stakeholders (i.e., the majority of Friant water contractors, their organizations, and environmental, fisheries, and community groups) support proceeding with the

[1] NRDC v. Patterson, 333 F. Supp. 2d 906, 925 (E.D. Cal. 2004).

Settlement Agreement, in lieu of going to trial. For some groups, going to trial risks considerable uncertainty and expense.

Congressional authorization and appropriations are required for full implementation of the Settlement. If Congress does not act on the legislation, some fear that the court will order a remedy, which may differ from the Settlement, and which may have more severe consequences for area water users and third parties. A key legislative issue is how to finance Settlement implementation, specifically how to resolve congressional Pay-As-You-Go (PAYGO) issues.[2] Other challenges are how to achieve the Settlement's dual goals of fisheries restoration and water management, and how to address concerns of stakeholders not party to the Settlement, without disrupting the negotiated agreement.

This report provides an overview of topics related to the Settlement that are relevant to congressional deliberations. The report includes a discussion of the San Joaquin River, the Settlement, its legal history, and pending legislation. It also provides a brief discussion of fisheries restoration, water management, funding, economic, and third party issues. The report concludes with a brief discussion of how the Settlement relates to other California water supply and resource management issues.

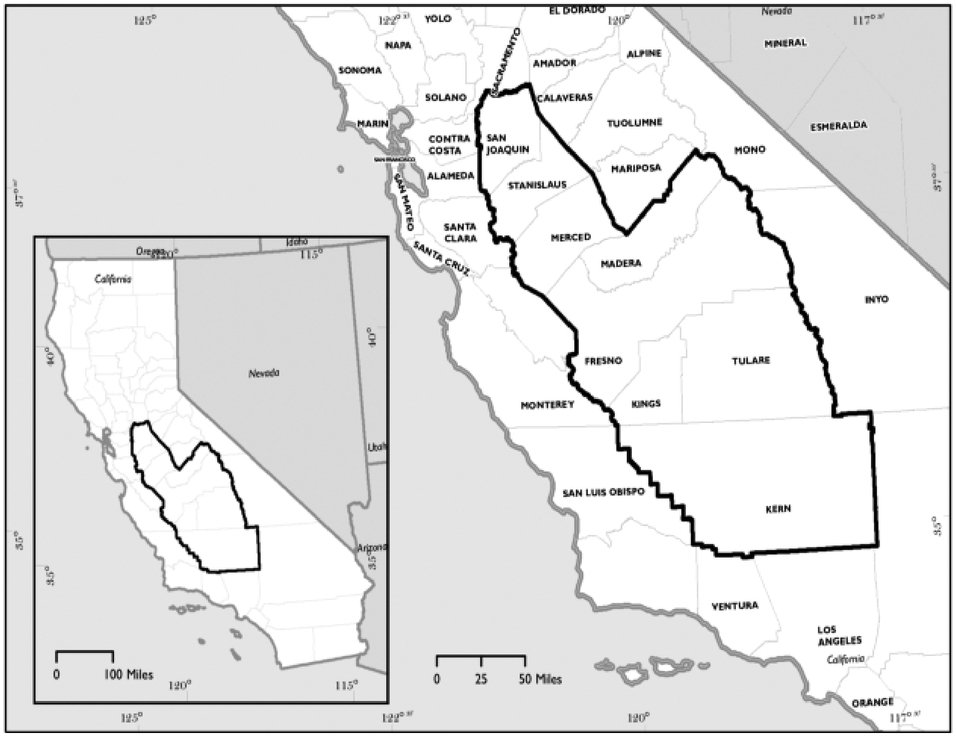
San Joaquin River Settlement and Impacts

Background

The Settlement in the lawsuit *Natural Resources Defense Council v. Rodgers*, involves operation of Friant Dam on the San Joaquin River—one of the largest federal dams of the Bureau of Reclamation's Central Valley Project (CVP) in California. As shown in **Figure 1**, Friant Dam and the Friant Division of the CVP are situated in the southern portion of the San Joaquin Valley (SJV); however, the San Joaquin River flows north to the San Joaquin and Sacramento Rivers Delta confluence with San Francisco Bay (Bay-Delta). Hydrologically, the Friant Division Service Area extends into the Tulare basin. Agriculture in these areas is highly dependent on irrigation; much of the irrigation water is surface water supplied by the Friant Division. Many growers also use groundwater, conjunctively managing their surface and groundwater supplies. This conjunctive management improves seasonal and multi-year water reliability for growers.

[2] House and Senate budget rules require offsets for certain spending measures, including those that include new mandatory (direct) spending. Finding an offset—that is, reducing spending elsewhere—to fund a new program, especially one for several hundred million dollars, is an often difficult task.

Figure 1. San Joaquin Valley



Source: Map prepared by The Congressional Cartography Program, Geography and Map Division, Library of Congress, 2007.

The SJV, an eight-county region extending 250 miles from Stockton in the north to Bakersfield in the south (**Figure 1**), is both rapidly growing and economically depressed. (For more information on challenges facing the SJV, see CRS Report RL33184, *California's San Joaquin Valley: A Region in Transition*, by (name redacted) et al.) Yet, the 27,280 square mile SJV is home to five of the nation's ten most agriculturally productive counties, as measured by value of total annual sales. The Friant Division Service Area includes four of these counties: Fresno, Tulare, Kern, and Merced. The SJV faces significant environmental and natural resource challenges, including the court-ordered restoration of the San Joaquin River discussed in this report.

Friant Division

The CVP is a multi-unit, multi-purpose reclamation project administered by the Bureau of Reclamation (Reclamation) under federal law, including the Reclamation Act of 1902 and amendatory acts (known as Reclamation Law), the federal Endangered Species Act (ESA), various other federal environmental and administrative laws, and various state laws. The Friant Dam was built on the San Joaquin River by Reclamation in the early 1940s. It stores the San Joaquin River's flow in Millerton Lake, the reservoir behind the dam, from which water for irrigation and other purposes is diverted into two canals. Reclamation delivers the impounded water to 28 irrigation and water districts in the Friant Division pursuant to various types of water service contracts, many of which originated in the 1940s. The Friant Division serves irrigation and water districts in the Fresno, Kern, Madera, Merced, and Tulare counties (**Figure 2**).

Unlike most Reclamation projects, the Friant Division (dam and distribution facilities) is operated in a way that diverts nearly all the San Joaquin River's flow away from the River.[3] By the late 1940s, Reclamation's operation of Friant Dam had caused long stretches of the river to dry up. Portions of the San Joaquin River upstream of its confluence with the Merced River remain mostly dry today, except during flood events. Reclamation's operation of Friant Dam largely destroyed numerous species of native fish from the Upper San Joaquin River, including spring- and fall-run Chinook salmon.[4] The diverted water helped develop and continues to support a diverse agricultural economy from north of Fresno to Bakersfield—the Friant Division Service Area.(see **Figure 2**).

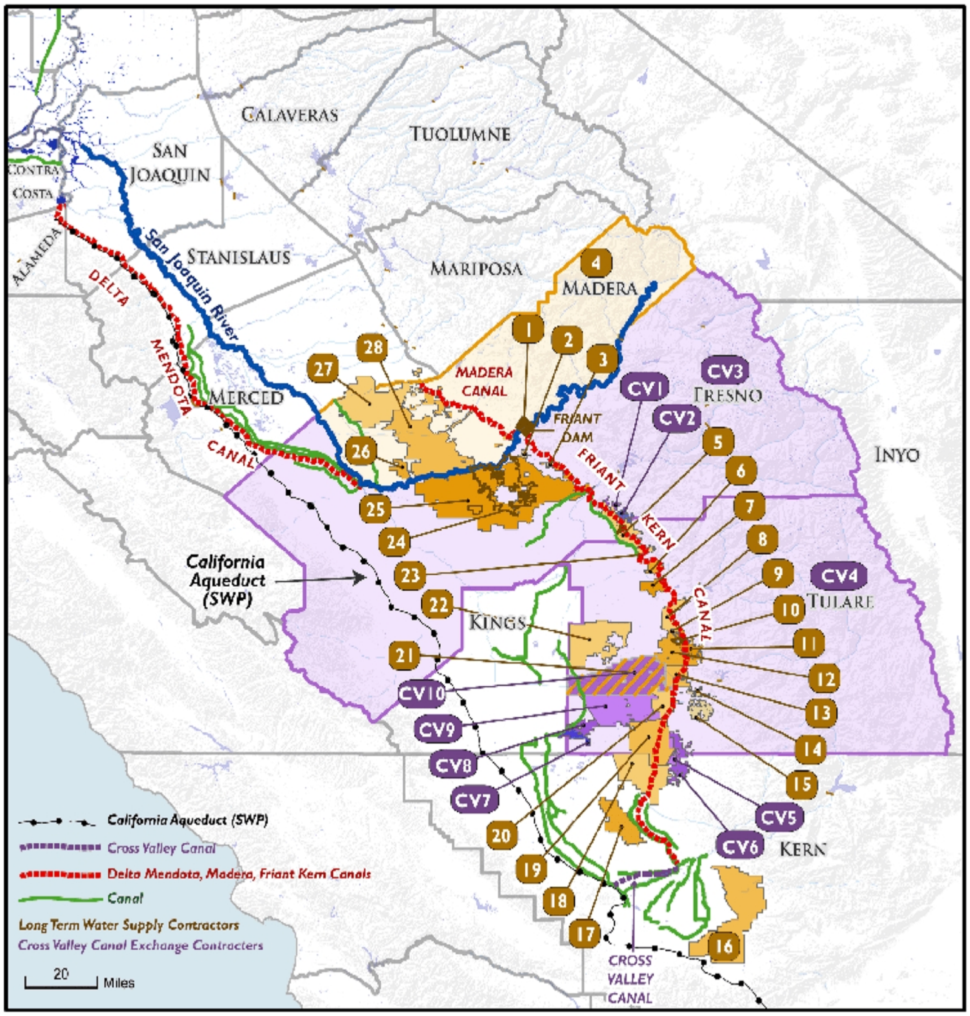
Chinook Salmon Runs

While water diverted from rivers helped establish California's vibrant and valuable agricultural economy, some California fisheries have declined since the 1940s—particularly commercial salmon fisheries—due to water diversions and other factors.

[3] A 1950 court ruling on the diversion of San Joaquin River flows noted that the court could find no other instance in which Reclamation was proposing to divert the entire flow of a river. The case involved rights of individuals downstream to continue to receive water from the river, as well as water for downstream fisheries and recreation. Eventually, water rights holders below the dam were granted water annually; however, no water was allocated to in-stream uses below the dam. Even though retaining water for in-stream uses (recreation, ecosystem health, fish and wildlife, and scenic values) is a relatively modern concept or value, there were local, and vocal, opponents of the proposed diversion of the river. By the court's count, there were some 1,000 farmers and ranchers below the dam who might be negatively affected. (Rank v. Krug, 90 F. Supp. 773 (S.D. Cal. 1950)). Some years later, Reclamation built the Trinity project, which diverted a significant portion of the Trinity River to other CVP water districts. Trinity River flows have also been very contentious and, per administrative actions recently upheld by a court ruling, are also to be increased to support and restore dwindling fisheries.

[4] San Joaquin River flows are needed to allow adult salmon to swim upstream to their spawning grounds, to provide habitat for juvenile salmon, to allow juvenile salmon to swim downstream in the spring through the lower river, and to dilute toxic and saline drainage to maintain a minimum level of water quality.

Figure 2. Friant Division and Water Contractors



LONG TERM WATER SUPPLY CONTRACTORS

1 FRESNO CO. WATERWORKS NO. 18
2 GARFIELD WATER DISTRICT
3 INTERNATIONAL WATER DISTRICT
4 MADERA COUNTY
5 ORANGE COVE IRRIGATION DISTRICT
6 STONE CORRAL IRRIGATION DISTRICT
7 IVANHOE IRRIGATION DISTRICT
8 EXETER IRRIGATION DISTRICT
9 LEWIS CREEK WATER DISTRICT
10 CITY OF LINDSAY
11 LINDSAY-STRATHMORE IRRIGATION DISTRICT
12 LINDMORE IRRIGATION DISTRICT
13 PORTERVILLE IRRIGATION DISTRICT
14 TEA POT DOME WATER DISTRICT
15 TERRA BELLA IRRIGATION DISTRICT
16 ARVIN-EDISON W.S.D.
17 SHAFTER-WASCO IRRIGATION DISTRICT
18 SOUTHERN SAN JOAQUIN M.U.D.
19 DELANO-EARLIMART IRRIGATION DISTRICT
20 SAUCELITO IRRIGATION DISTRICT
21 LOWER TULE RIVER IRRIGATION DISTRICT
22 TULARE IRRIGATION DISTRICT
23 CITY OF ORANGE COVE
24 CITY OF FRESNO SERVICE AREA
25 FRESNO IRRIGATION DISTRICT
26 GRAVELLY FORD WATER DISTRICT
27 CHOWCHILLA WATER DISTRICT
28 MADERA IRRIGATION DISTRICT

CROSS VALLEY CANAL EXCHANGE CONTRACTORS

CV1 TRI-VALLEY WATER DISTRICT
CV2 HILLS VALLEY IRRIGATION DISTRICT
CV3 FRESNO COUNTY
CV4 TULARE COUNTY
CV5 RAG GULCH WATER DISTRICT
CV6 KERN-TULARE WATER DISTRICT
CV7 ATWELL ISLAND WATER DISTRICT
CV8 ALPAUGH IRRIGATION DISTRICT
CV9 PIXLEY IRRIGATION DISTRICT
CV10 LOWER TULE RIVER IRRIGATION DISTRICT

Source: Friant Water Authority. U.S. Bureau of Reclamation. Map: Congressional Cartography, Library of Congress, 2007

Historically, Central Valley spring-run Chinook were found throughout the Central Valley—from the northern Sacramento River drainage area to the southern portions of the San Joaquin drainage. The Middle and Upper San Joaquin River historically supported two or more independent populations of spring-run Chinook salmon. Most spawning by spring-run Chinook salmon in the San Joaquin River occurred upstream of the current location of Friant Dam. Historical spawning runs may have exceeded 200,000 fish annually, ascending the river as far as Mammoth Pool (about 1,000 meters elevation), which lies about 50 miles above Friant Dam. Today Central Valley spring-run Chinook salmon are listed as threatened under the ESA;[5] however, Central Valley spring-run Chinook salmon have been entirely extirpated from the San Joaquin River drainage, and currently inhabit only the Sacramento River drainage.[6]

Native fall and late-fall-run Chinook salmon continue to spawn in small numbers in the San Joaquin River tributaries such as the Mokelumne, Stanislaus, Tuolumne, and Merced Rivers. These fish spawn at lower elevations in these tributaries and have been less affected by dam construction than were spring-run Chinook salmon. In addition, there is significant artificial production of fall-run Chinook salmon by California Department of Fish and Game hatcheries on the Tuolumne, Mokelumne, and Merced Rivers.[7] Fall-run Chinook salmon are not listed under the ESA, but are identified as a species of concern.[8]

Recent Legal History

Litigation involving waters of the San Joaquin River spans several decades. Litigation resulting in the most recent Settlement, however, can be traced to a 1988 lawsuit. This lawsuit and the negotiated Settlement Agreement are discussed below.

NRDC v Rodgers

During the late 1980s the Friant Division water users sought renewal of their long-term water service contracts with Reclamation. Beginning in 1988, a coalition of environmental groups and anglers led by the Natural Resources Defense Council (NRDC) challenged the contract renewals in federal court on a number of environmental grounds. In addition to claims that the process under which Reclamation had begun contract renewals violated the National Environmental Policy Act (NEPA) (42 U.S.C. §§ 4321 et seq.) and that the lack of water in the river violated the ESA (16 U.S.C. §§ 1531-1544), the plaintiffs argued that Reclamation had violated Section 8 of the Reclamation Act of 1902 (43 U.S.C. § 383). That section provides that Reclamation will act in conformity with state laws "relating to the control, appropriation, use or distribution of water used in irrigation." The state law that is at issue here is California Fish and Game Code § 5937. Section 5937 provides as follows: "The owner of any dam shall allow ... sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam."

---

[5] 70 *Fed. Reg.* 37160, June 28, 2005.

[6] J. M. Myers, et al., *Status review of Chinook salmon from Washington, Idaho, Oregon, and California*, U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-35 (1998), pp. 119, 197-199.

[7] Ibid, pp. 120, 146, 194-195, 199-201.

[8] 69 *Fed. Reg.* 19975, Apr. 15, 2004.

The claims have been litigated in the U.S. District Court for the Eastern District of California. The district court has reviewed the application of § 5937 to the problem at hand on several occasions since 1988 and has issued several decisions. In 2004, the District Court issued another decision regarding the application of § 5937 to the San Joaquin River, finding that Reclamation had violated the state law. It stated: "There can be no genuine dispute that many miles of the San Joaquin River are now entirely dry, except during extremely wet periods, and that the historical fish populations have been destroyed."[9] The court did not declare what amount of water was necessary to satisfy the law or declare any other type of relief; rather, it set a 2006 trial date to determine a proper remedy.

The Settlement Agreement

Faced with the prospect of a court-imposed remedy, and mounting legal fees in preparation for trial, the parties (NRDC et al., Reclamation et al., and Friant long-term water service contractors) began a series of settlement negotiations in late 2005, and came to a tentative agreement in June 2006. The terms of the Settlement were then vetted with selected stakeholders, finalized, and presented to Congress in September 2006—the final Stipulation of Settlement was filed with the U.S. District Court, Eastern District of California, September 13, 2006. The Settlement Agreement was accepted by the District Court on October 23, 2006.

The stated goals of the Settlement are twofold: (1) to restore and maintain fish populations in "good condition"—the § 5937 standard—in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River; and (2) to reduce or avoid adverse water supply impacts to the Friant long-term water service contractors that may result from both interim flows and restorative flows provided in the Settlement. To accomplish these goals, the Settlement calls for numerous actions, some of which need congressional authorization and appropriations. Further, appropriations authorization is needed to finance settlement implementation as envisioned under the Settlement. The Settlement states that if legislation is not enacted by December 31, 2006, the Settlement may become void at the election of a party, at which point litigation might resume. While implementation legislation has been introduced (H.R. 4074, H.R. 24 and S. 27), it has not been enacted. To date, no party has elected to void the Settlement.

Legislative Context

In September 2006, the settling parties presented the Settlement, including its legislative proposal, to various Members of Congress. The parties hoped implementing legislation would be enacted prior to adjournment of the 109th Congress. However, numerous entities who were not party to the Settlement (i.e., *third parties*), objected to the legislative proposal included in the Settlement, as well as the swift time line imposed by the Settlement Agreement.[10] Shortly thereafter, many third parties met with the Settlement parties and certain Members of the California delegation. An agreement was reached to address certain third party interests; in exchange, these third parties agreed to support new legislation. Although many parties who had opposed the draft legislation in September 2006 supported the new legislation, other parties

[9] NRDC v. Patterson, 333 F. Supp. 2d 906, 925 (E.D. Cal. 2004).

[10] Testimony presented before the House Resources (renamed House Natural Resources in January 2007) Water and Power Subcommittee, Sept. 21, 2006, *Oversight Hearing on the San Joaquin Restoration Settlement Act*.

emerged that were not part of the new agreement, resulting in further opposition to Settlement legislation.[11]

San Joaquin River restoration Settlement legislation was introduced in early December 2006 (H.R. 6377 and S. 4084); however, no action was taken on the bills before adjournment of the 109th Congress. The Settlement bills were reintroduced in the 110th Congress as H.R. 24 and S. 27. Hearings were held in both houses of Congress (before the House Natural Resources Water and Power Subcommittee, March 1, 2007; and the Senate Energy and Natural Resources Water and Power Subcommittee, May 3, 2007). On November 5, 2007, H.R. 4074 was introduced as implementing legislation with provisions addressing congressional PAYGO rules. Implementation of the Settlement calls for construction of numerous projects and other activities that could cost between $250 million and $1.1 billion. Federal funding for these projects and activities is sought by the parties and is contemplated under the Settlement.

Federal budgetary and funding issues, as well as the viability of attaining the water management goal appear to be key points of contention at this stage. For example, funding mechanisms included in the current legislation would require a budgetary offset under congressional PAYGO rules—according to some, a difficult task in today's budget climate. An overall complication for Congress in considering San Joaquin Settlement legislation is that although the Settlement aims to end a 19-year lawsuit and comports with a court ruling, the Settlement would affect others outside the Friant Division Service Area. Another complication is the prospect that funding for the San Joaquin River Settlement may divert funds from salmon restoration projects in other river basins. Lastly, other recent events potentially limiting water exports from the Sacramento and San Joaquin Rivers Delta confluence could significantly affect implementation of the recirculation portion of the water management goal and has caused increased concern among some stakeholders. These issues, among others, are discussed below.

If Congress does not act on the legislation, some fear that the court will order a remedy, which may differ from the Settlement, and which may have more severe consequences for some area water users and third parties.

Settlement Goals and Implementing Legislation: Key Issues

As noted above, the settling parties agreed that it would have two goals: (1) a Restoration Goal: "... to restore and maintain fish populations in 'good condition' in the mainstem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally-reproducing and self-sustaining populations of salmon and other fish..."; and (2) a Water Management Goal: "... to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration flows provided for in this Settlement...".

In agreeing to these goals, parties acknowledged that the historical operation of Friant Dam resulted in significant portions of the San Joaquin River drying up in most years, with detrimental consequences for fisheries downstream from Friant Dam. They also agreed that achievement of the Restoration Goal by 2025 may not accomplish all desired results, but that efforts to achieve

[11] Testimony presented before the House Resources Water and Power Subcommittee, Sept. 21, 2006, *Oversight Hearing on the San Joaquin Restoration Settlement Act,* and testimony before the House Natural Resources Water and Power Subcommittee, March 1, 2007.

such results would result in public benefits (e.g., improved downstream water quality and increased recreational opportunities). They further acknowledged that the implementation of the Settlement would occur over many years and agreed to cooperate in good faith to achieve the dual goals of the Settlement. Some obligations are spelled out in the Settlement; moreover, the Settlement establishes a "framework" for accomplishing Settlement goals through activities such as environmental review, design, and construction.

Restoration Goal

Restoring San Joaquin River fisheries is the aim of the Restoration Goal and several details and obligations are included in the Settlement Agreement. Parties acknowledge that achievement of the Restoration Goal will require a combination of channel and structural improvements along the River below Friant Dam, as well as additional releases of water from the Dam. The Settlement lists several improvements to be implemented no later than December 13, 2013, with certain allowances for events beyond the control of the Secretary of the Interior. These "Phase I" improvements relate to modifying and improving the capacity of the San Joaquin River to accommodate new releases and range from creating a bypass channel around existing facilities to screening various canal entrances and modifying structures to provide fish passage. A second set of improvements—"Phase II"—would include further channel modifications, and/or isolation of certain gravel pits. This second set of improvements would be completed not later than December 31, 2016, also subject to appropriations and events beyond the control of the Secretary.

The Settlement also calls for specific "Restoration Flows"—additional releases of water from Friant Dam in accordance with certain hydrographs[12] included in the Settlement. The hydrographs establish certain "base flows" for each of six water year types (for a description of water year types see **Appendix A**); however the Secretary may also make "buffer flows" available up to an additional 10% of restoration flows, based on recommendations of a Restoration Administrator. The Secretary may purchase from willing sellers water to achieve the restoration goal and to mitigate unexpected seepage losses downstream. After commencement of restoration flows (following a period of interim flows), spring and fall-run Chinook salmon would be reintroduced by no later than spring of 2012.

Restoration Goal Issues

Although significant sums have already been spent on ecosystem restoration activities in the San Joaquin River watershed, there is no comprehensive (including the Upper San Joaquin River) program for specifically restoring San Joaquin Chinook salmon such as that contemplated under the Settlement. Many of the founding principles of the Settlement rely on existing salmon restoration studies conducted over the last decade or more. These studies have been carried out by a variety of sources, including the federal government, local entities, academics, consulting groups, and expert witnesses, some of which have been hired by different parties to the Settlement. Studies and expert reports that focused on water flows for salmon restoration ultimately led to the restoration flow levels established under the Settlement; however, some uncertainties remain. For example, while there has been much discussion and study of historical

[12] A hydrograph is a graph depicting the volume of river flow over various time periods. The hydrographs referred to in the Settlement include proposed restoration flow release schedules by month for each of 6 different water year types. For more information on water year types, their basis, and potential impacts of water supply reductions, see **Appendix A**.

spring-run Chinook salmon levels, and the potential for their reintroduction—some of which appears to be based on other relevant cases of salmon restoration in California—there appears to be still some uncertainty as to whether flows established under the Settlement and other Settlement efforts will be sufficient to successfully reestablish Chinook salmon populations in the Upper San Joaquin River.

Expert reports and rebuttals prepared during litigation have identified and evaluated numerous factors relevant to the successful reintroduction of Chinook salmon to the San Joaquin River. Given the complexity in the species' life cycle, and the complexity of the factors which influence its survival, restoration success cannot be predicted nor guaranteed with certainty. Among the more important factors are the quantity water flow and its timing, fish passage and diversion entrainment, water temperature and levels of dissolved oxygen, water quality, holding habitat, spawning habitat, and stock selection and genetics. Because Chinook salmon in the Upper San Joaquin River would be at the extreme southern extension of their historical range, all or many factors may need to be favorable to permit this species to complete its migratory life cycle. While some contend that all these factors indeed can be favorable, others point out that all these factors, many beyond human control, may not be favorable in any single year, leading to population stress and decline, if not total failure in some years. The question could reasonably be asked whether factors will be favorable in *enough* years to allow periodic migratory success sufficient to sustain a Chinook salmon population in the San Joaquin River above its confluence with the Merced River.

The San Joaquin River restoration will be complicated in several respects (e.g., size of area to be restored, southern limit of the species' range, potential lack of unique genetic stock,[13] extreme degradation of existing habitat, and potential climate change). Concerted attempts to restore salmon habitat in the Sacramento and San Joaquin River basins have produced encouraging results and success in some cases, but total success has been hard to claim in the short time these restoration efforts have been underway. As many of these projects have been conducted on small drainage areas, it would seem there is little precedent in California for the major restoration effort contemplated for the San Joaquin River. On the other hand, it could be argued that extensive restoration efforts in the Klamath River Basin have in all but one case at least maintained runs and avoided listing under the federal ESA, while many other nearby populations have been listed.

Water Management Goal

The water management goal as outlined in the Settlement includes two key parts: (1) an agreement to develop and implement a plan for the recirculation, recapture, reuse, and exchange or transfer of Restoration flows for the purpose of reducing or avoiding impacts to Friant long-term contractors; and (2) establishment of a "Recovered Water Account" to make up for water losses experienced by Friant long-term contractors. Water made available by the Secretary under the new account would be priced at a total cost of $10 per acre-foot. To implement the water management goal, the Settlement provides for a water accounting system, whereby the Secretary of the Interior is to monitor and record reductions in water deliveries to Friant Division long-term

[13] It is not clear if the runs of Chinook salmon which populated the Upper San Joaquin River were uniquely genetically structured to withstand warmer temperatures and whether existing Central Valley Chinook populations that might be used for re-introduction might contain that genetic capability. Given suitable habitat conditions, anadromous fish generally possess the capacity and capability to successfully adapt and colonize new habitat or re-colonize historical habitat.

contractors that have not been made up by recirculation, recapture, reuse, exchange or transfer of Restoration flows or replaced or offset by other water programs or projects undertaken or funded to mitigate water delivery impacts caused by the restoration flows.

Water Management Goal Issues

Some fear that water deliveries for off-stream purposes will be reduced directly, in a one-for-one fashion, to create restoration flows. However, as anticipated under the Settlement, the relationship of increased restoration flows and water delivery diversions would not necessarily result in a 1:1 trade-off. For example, in some years much of the restoration flows might be met with floodwaters. Also, under the Settlement, no water would be released for restoration purposes in the driest of years; thus, no reductions in Friant deliveries would be made due to the Settlement.

Additionally, it appears Friant managers may have considerable flexibility in managing supplies and balancing deliveries with other available sources. How much less water Friant contractors might receive will depend on several factors: how much is needed for restoration flows (based on specific water flow recommendations included in the Settlement); what type of water year is declared; what type of water contract water users have (i.e., how firm);[14] what mitigation or conservation efforts might be instituted; and how much water might be available to make up losses from the Recovered Water Account. Further, the overall impact on individual water users will depend, in part, on their access to other available water supply sources (other than deliveries from Friant Dam.)

Using two available data sources[15] (which do not account for improvements in water management that may dampen the Settlement's impact on agricultural and municipal users), it appears that annual water supplies for the Friant Division Service Area would be, *on average*, 15% to 16% less under the Settlement, than average supplies under current operating protocols. (See **Appendix A** for an analysis of available estimates of water supply reductions and a description of data sources.) Although the average reduction could be 15% to16%, water supply reductions could range from no reduction, to as high as 34% reduction in some years. The *total* average annual reduction in the volume of water delivered under the Settlement is estimated to be 204 thousand acre-feet (taf) or 225 taf, depending on the source (Steiner 2005, and BOR 2006, respectively); these estimates include cutbacks in temporary water that is made available in wetter years (i.e., water that is not contracted for on a long-term basis). In other words, this estimate includes reduction in both contract water and temporary water delivered by the Friant Division. These estimates can probably be viewed as an upper limit to average reductions that might occur under the Settlement. The average annual reduction in the *long-term water service contract*

---

[14] There are several different types of contracts used in the Friant Division. Some receive water on a higher priority basis than others, and therefore are considered more "firm" than others; some are for long-term deliveries, and some are temporary, one-year contracts. For more information on the variety of contracts and definitions of Class I, Class II, and § 215 water, see **Appendix A**.

[15] As part of its analysis of the Settlement Agreement, CRS collected and reviewed available information on the effects that proposed increased releases for fish restoration from Friant Dam could have on future deliveries by the Friant Division. The analysis largely relies on two available data sets on the estimated reductions to Friant water supplies under the Settlement: (1) Expert report of Daniel B. Steiner, *Effects to Water Supply and Friant Operations Resulting From Plaintiffs' Friant Release Requirements*, September 16, 2005 (hereafter referred to as Steiner 2005), prepared for Friant Water Users Authority; and, (2) U.S. Department of the Interior, Bureau of Reclamation, *Friant Division Allocations Based on SJR-Settlement Exhibit B Hydrographs for Restoration Releases*, table released December, 2006 (hereafter referred to as BOR 2006).

deliveries (i.e., not including temporary deliveries) under the Settlement, is estimated at 144 taf less than average annual long-term contract supplies without the Settlement.[16]

Almost half of the Friant contractors have access to other, non-Friant surface water supplies (mostly from local river and stream sources)[17] and 75% use groundwater supplies. Therefore, for three-quarters of the contractors, the reductions in Friant Division deliveries represent a reduction in one of multiple supplies. The level of reductions experienced by individual water districts would vary depending on their water service contracts. That is, the reduced delivery experienced in a given year by an individual water district would largely depend on how “firm” is the district’s Friant water supply contract.[18] Contracts with first priority delivery (known as Class I contracts) generally are held by the districts which serve municipalities and agricultural users without sources to other supplies—areas often in the foothills not underlain with adequate or reliable groundwater supplies.

Existing data assume Reclamation reduces “supplemental” water deliveries before first priority deliveries. These data estimate that average annual reductions in the Friant Division long-term water service contract water deliveries for individual Friant water districts would range between 5% and 27%—the low range being cutbacks to contractors with relatively firmer Friant Division contract supplies (46% of contractors) and the high range applicable to those with only supplemental Friant Division contract supplies (7% of contractors). All districts with supplemental Friant Division contracts (known as Class II contracts) have groundwater or other surface water supplies, so the reduction in Friant deliveries under the Settlement would represent a reduction in one of their supplies.

Regardless of the specifics of how much water might be released for fisheries restoration *vis-a-vis* water diverted for off-stream purposes, there will be impacts to existing surface and groundwater supplies in and around the Friant Division Service Area. Pertinent questions, to which there are no obvious answers, are how will water users adapt, how much water might be regained, and at what cost?

Possibilities exist to partially offset lower off-stream deliveries through water conservation, efficiency measures, water transfers and marketing, groundwater storage, and new infrastructure. However, at this time, it is unclear to what extent these measures could mitigate the lower deliveries, at what cost, and which measures might occur as part of the Settlement’s water management goal or as part of other state and local water development efforts (such as expanded groundwater banking and conjunctive use).

Federal Financing

The Settlement includes several new financing mechanisms. San Joaquin restoration legislation based on the Settlement (H.R. 24 and S. 27) would authorize and direct the Secretary of the Interior to implement terms and conditions of the Settlement in cooperation with the State of California, and authorize appropriations to carry out federal responsibilities. While the legislation includes an authorization of $250 million in appropriations, it also includes several provisions involving new funding mechanisms which, once established, would not be subject to annual

[16] Steiner 2005.

[17] U.S. Dept. of the Interior, Bureau of Reclamation, *Water Needs Assessment*, 2004.

[18] See **Appendix A** for a description of the different types of contracts and water supplies.

appropriations by Congress. Rather, funding via these mechanisms would provide sources of dedicated funding to implement the agreement. Although funding provision language, included in proposed legislation in Exhibit A of the Settlement, differs somewhat from the funding provisions in H.R. 24 and S. 27, it appears the funding mechanisms themselves are not substantively different.

Issues

Because the Settlement funding relies on redirecting existing federal revenues from the Friant Division into a new, permanent restoration account, among other financing mechanisms, the legislation has run into difficulties regarding its financing provisions. CBO has estimated the total federal share of the program as outlined in H.R. 24 to be $500 million; $430 million through 2017, and another $70 million through 2026. (See Congressional Budget Office, *H.R. 24, San Joaquin River Restoration Settlement Act*, CBO Cost Estimate, April 18, 2007.) Because the bill includes new direct spending, it would require an offset for such spending under congressional PAYGO rules. Restoration sponsors have been working to reduce the bill's budget score, and therefore reduce the potential offset needed. However, any change in the Settlement's financing formulas would require new agreement among the settling parties and may prove difficult.

Additional Issues

Water supply impacts may also have both positive and negative economic consequences. A review of other water supply reduction studies suggest the Settlement would have the largest, and mostly negative effect on the agriculture industry—at least in the short term—because most of the water diverted from the San Joaquin River is currently used to irrigate crops. However, it is not clear how much efforts to reduce water supply losses will also mitigate agricultural production losses. On the other hand, the region may benefit from increased recreational expenditures and investment in San Joaquin River restoration activities, as well as increased downstream water supply and water quality benefits.

The Settlement will also affect communities and interests not party to the Settlement. For example, Friant Division water users would likely experience reduced water deliveries, but the new water releases would affect downstream communities and landowners farther north who were not party to the lawsuit. The majority of the San Joaquin riverbed areas that would experience increased flows under the Settlement are not adjacent to, and are mostly distant from, the Friant Division Service Area. (See **Figure 2**.) Similarly, communities and landowners adjacent to lands served by Friant Division water might experience changes in groundwater quality and availability, and increased prices for substitute water. Another complication is the prospect that funding for the San Joaquin River Settlement may divert funds from salmon restoration projects in other river basins. In particular, Trinity River restoration proponents are concerned that San Joaquin River restoration as contemplated under the Settlement and implementing legislation might result in less funding for Trinity River restoration. These "third party" concerns, including possible groundwater supply impacts, are discussed below.

Agricultural Impacts

The San Joaquin Valley is among the nation's most productive farming regions. Ranked by value of production, four of eight San Joaquin counties—Fresno, Tulare, Kern, and Merced—are among the top five agricultural counties in the United States. These four counties, along with

Madera County, are the five SJV counties containing lands that directly receive water from the Friant Division. The value of crop and livestock products sold across these five counties totaled $9.3 billion in 2002, accounting for 36% of the value of California's total agriculture production and 5% of all U.S. agricultural production.[19]

At least eight studies have attempted to identify impacts to the agricultural sector due to temporary or permanent water losses.[20] However, there are substantial differences in reporting criteria and analytical approaches across each of the studies, making such estimates difficult to compare and/or validate. In addition, estimated economic, social, and environmental benefits are dispersed across broad segments of California's population; there is similarly a high degree of variability due to constraints related to methodology or data. As reported in the studies that use economic models to quantify the potential farm and regional economy effects, most studies agree that a reduction in available irrigation water supplies could lower gross farm revenue because of expected reductions in crop acreage and/or yield.

Studies that most closely approximate proposed reductions under the Settlement—those focusing on estimated effects for reductions of up to 200,000 acre-feet annually in the SJV—often employ a similar methodological approach, but with differing underlying assumptions and data, spanning a range of possible scenarios and outcomes, and often resulting in a wide range of estimated costs and benefits. Accordingly, these studies report a range of estimated farm impacts. Some studies further project lower farm profits and higher operating costs, as well as negative economic impacts to the broader regional economy and job markets. Some studies report that these economic costs will likely be offset by other economic and societal benefits, or other mitigating gains in the farm support services or non-farm sectors.

For example, estimates of the potential loss in gross farm revenue from reductions in acreage and/or yield range from about $40-$180 million per year, spanning possible outcomes during a full water year and a drought year (excluding one high-end drought year estimate under one of the studies examined). Only two of the studies reviewed by CRS provide estimates of changes in farm profits, but across very different scenarios: One study reports possible losses in farm profits reports ranging from 0.4% in a full water year to 6.7% in a drought year; another study reports profit losses of 2% with water trading compared to 3% without water trades between growing regions. Only two of the studies reviewed provide estimates of changes in farm costs, again across very different scenarios: One reports farm costs could increase by about $110 million

---

[19] Farm-level value. Does not include retail value markup or value added through food processing. Data taken from the U.S. Dept. of Agriculture, *Census of Agriculture* (Washington, DC: 2002).

[20] Citations for studies reviewed are: 1) C. Brown, G. Goldman, R. Howitt, and J. Siebert, *Impacts of Water Reallocations on the Eastern San Joaquin Valley*, University of California, December 1996; also C. Brown, G. Goldman, R. Howitt, and J. Siebert, "The Use of IMPLAN with a Water Allocation and Production Model," presented at the National IMPLAN Conference, Minneapolis, August 1996; 2) Northwest Economic Associates, *Analysis of the Impacts of Surface Water Reductions on the Eastern San Joaquin Valley of California*, August 1997; 3) Robert B. McKusick, *Economic Impact of Reduced Surface Water Deliveries in the Friant Division of the Central Valley Project* (including a supplemental September 2005 report), ENTRIX Inc., September 2005; 4) Michael Hanemann, *Rebuttal Expert Report*, University of California, Berkeley, 2006; 5) Northwest Economic Associates, *Economic Impacts of the 1992 California Drought and Regulatory Reductions on the San Joaquin Valley Agricultural Industry*, December, 1993; 6) L. Dale, and L. Dixon, *The Impact of Water Supply Reductions on San Joaquin Valley Agriculture During the 1986-1992 Drought*, RAND Corporation, 1998, accessed August 15, 2007 at http://www.rand.org/pubs/monograph_reports/2005/MR552.pdf; 7) Bazdarich, M., and C. Thornberg, "Benefits and Costs for California from Water Transfers," October 2006, accessed August 15 at http://www.beaconecon.com/products/White_Papers/water transfers.pdf; and 8) D. Villarejo, *Jobless After a Man-made Drought*, prepared for the Fresno County Economic Opportunities Commission and the Fresno County Workforce Investment Board, August 31, 2004.

during a drought year; another reports that additional costs to crop producers would be only $11 million, with other costs to dairies of $2 million (projected for the year 2025). A few of the studies reviewed by CRS estimate changes in regional economic conditions and employment, with varying results: One study estimates potential job losses ranging from 1,200 jobs in a full water year to 17,900 jobs in a drought year; two other studies estimate job losses ranging from 3,200 to 10,400. Finally, only two of the studies reviewed by CRS estimate the potential economic benefits or offsetting gains under the Settlement: One study reports substantial monetary benefits approaching $1.8 billion annually; another reports possible nonfarm gains that exceed estimated costs, with net gains to the broader economy of $12.6 million during a drought year. (See **Appendix B** for a summary of the studies.)

The substantial differences in reporting criteria and analytical approaches across these studies, make such estimates difficult to compare and/or validate. As a result, the estimated adverse economic effects and costs to the agricultural sectors under the Settlement based on these studies should be viewed with caution. These estimated changes in farm economic indicators based on these studies also should not be assumed to be cumulative each year, since these results do not take into account for the likelihood that farmers would take steps to adjust to a permanent water reallocation and such studies do not take into account potential recirculation, recapture and reuse or other water supply mitigation efforts contemplated under the Settlement.

Non-agricultural Economic Impacts

There may be positive and negative economic consequences of implementing the Settlement other than those immediately related to Friant contractors concerned with agriculture, and those of potential “third parties.” Possible economic effects include (1) potential costs to municipalities for replacing lost water supplies; (2) potential costs related to lost power generation; (3) potential benefits associated with enhanced recreational opportunities; (4) benefits associated with improvements in water quality; (5) public benefits associated with existence of environmental quality improvements; and (6) economic impacts related to restoration projects. There may also be positive or negative changes in land use values for land abutting the restored river.

While experts testifying prior to the Settlement noted potential municipal water costs of approximately $78,000 and power costs of approximately $1.2 million annually,[21] other experts have estimated increased recreational and scenic benefits ranging from $17.4 to $45.2 million annually.[22] Further, existence values—the value that some place on a restored river regardless of whether they actually use the resource—are estimated in at least one study to range from $1.6 billion to $1.7 billion.[23]

In general, significant costs and benefits are expected to result from implementation of the Settlement. Costs of the Settlement are concentrated in agriculture and several other sectors, while the benefits related to existence and recreation are dispersed over broad segments of the California population. Ideally, comparisons of costs and benefits across all affected sectors and parties should be assessed to inform policy options. Yet, expert reports reflected uncertainties related to data and modeling, unstated or uncertain underlying assumptions, and insufficient

---

[21] *Expert Report of Dr. Robert McKusick on the Economic Impact of Reduced Surface Water Deliveries in the Friant Division of the Central Valley Project.* Aug. 2005, p. 63.

[22] *Rebuttal Expert Report of Professor W. Michael Hanemann,* Case No. Civ-S-1658 LKK/GGH, 2006.

[23] Ibid.

information to replicate results. Costs and benefits cannot be readily compared because of the lack of standards and continuity in and among expert reports.

"Third Party" Impacts

Communities dependent on groundwater supplies are also concerned about potential effects on groundwater quantity and quality. While most communities in the area have adequate groundwater supplies, some do not. Similarly, downstream communities and water and power users outside the Friant Division Service Area are concerned about potential Settlement effects such as increased flooding, groundwater infiltration, competition with existing financial commitments, and management of threatened and endangered species and their effect on managing land and facilities.

The Settlement Agreement states that the parties do not intend to adversely affect others who were not party to the Settlement. However, changes in water use in the area served by the Friant Division may affect resources and their use in other areas. Actions directly affecting a specific group or interest are also likely to affect neighboring interests through legal, market, and institutional interactions.

When the Settlement was disseminated, some landowners and entities not party to the agreement expressed concern about the Settlement's potential effects on their interests. The House Resources Committee convened a hearing on September 21, 2006 in part to address many of the concerns brought forward by these "third parties."[24] A list of potential third party concerns regarding implementation of the Settlement identified during the hearing included:

- potential flooding and loss of crops and property in areas without adequate river channels;
- possible operational constraints related to the protection of reintroduced salmon under the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1543);
- potential impacts on existing salmon populations in San Joaquin tributaries and associated water uses;
- potential effects on surface and groundwater supplies, and water rights; and
- adequate program funding for Settlement implementation and other non-San Joaquin restoration projects (e.g., Trinity River restoration).

After the September 21, 2006 hearing, third parties were asked for suggestions to revise draft implementing legislation for the Settlement. Negotiations among the Settling Parties, the State of California, and several third parties resulted in an agreement to modify the draft legislation that had been included in the stipulated Settlement Agreement. At a subsequent hearing of the House Natural Resources Subcommittee on Water and Power on March 1, 2007, testimony of several third parties suggested that many of their previous concerns were resolved in the modified legislation, H.R. 24 and S. 27, introduced in the 110th Congress. While many third party issues appear to have been addressed, some others remain.

[24] *Oversight Hearing on The San Joaquin River Restoration Settlement Act,* before the Water and Power Subcommittee of the Committee on Resources, U.S. House of Representatives, (Sept. 21, 2006).

Groundwater Issues

For Friant Division contractors and nearby third parties who use groundwater, decreased Class II water supplies may be among the more important impacts from the Settlement. Class II supplies are often used by water users in lieu of groundwater pumping, or to recharge groundwater supplies. Some fear that increased groundwater pumping to replace the decreases in surface supplies may degrade groundwater quality, especially for water systems currently of marginal quality. Settlement participants anticipate that such impacts would be limited by the component of the Settlement that requires the development and implementation of a plan to recirculate, recapture, reuse, exchange, or transfer water released for restoration flows. Significant uncertainties exist, however, as key options—including some proposed projects to recapture and recirculate restoration flows—would be subject to regulatory limitations and existing water delivery commitments and priorities, as well as available funding.

Others are concerned that restoration flows down the San Joaquin River may degrade shallow groundwater quality beneath the river, particularly in the lower reaches. Waterlogging of soils and leaching of salt already present in the soil are some key concerns. In addition, infiltration of restoration flows—especially in the upper reaches of the river—seems likely to be substantial. Underground diversions—groundwater pumping from wells near the river—of the infiltrated water may increase infiltration rates above the estimates in the Settlement. This potential was explicitly addressed by the Parties in the Settlement (Article 13(c)); however, it is unclear how it may progress in practice. Any actions taken to curtail increased infiltration from groundwater pumping may introduce conflict between groundwater users and parties to the Settlement charged with redressing underground diversions. This potential conflict, while beyond the scope of this report, may also raise legal questions regarding how the State of California views surface water and groundwater interactions.

In sum, the possible impacts that Settlement implementation may have on groundwater quality and quantity are difficult to assess, as such effects will depend on a substantial set of variables and uncertainties. While it is certain that the restoration of flows from Friant Dam (Millerton Lake) to the San Joaquin River will lead to changes in the way water is managed in the region, what is not known is what specific water management changes might result and how water users might adapt to reductions in water deliveries. Increased dependence on groundwater as a water source in southern SJV potentially could worsen the quality of groundwater as shallow irrigation wells recirculate groundwater and further concentrate dissolved solids and other contaminants. This could degrade water quality in local drinking water wells and irrigation wells, many of which are already of marginal quality. There is expectation, however, that reduced surface water flows to the Friant Division ultimately will lead to more efficient use of water through continuing improvements in operations, infrastructure, and water management practices. At the same time, increased river flows could raise the groundwater table and improve groundwater quality outside the Friant Division Service Area beneath reaches of the river where groundwater quality is currently impaired.

Concluding Remarks and the Larger Policy Context

The Settlement Agreement and subsequent implementing legislation are the culmination of nearly two decades of discussion, argument, and study on whether and how to restore fisheries below Friant Dam, a federally owned and operated facility on the San Joaquin River. The most recent actions relate to a court decision that Reclamation is operating the dam in violation of California state fish and game code. The implications of this decision are far reaching for California water management and for both the directly affected water users and the indirectly affected communities, landowners, and water users. Several broad policy issues are raised by the Settlement. These issues partially derive from constraints imposed by the pressure to react to a settlement responding to a judicial ruling, as opposed to managing or legislating on an issue prior to, or absent, such a settlement.

Another overarching issue is how San Joaquin River management ties into other CVP management decisions, as well as state and local water systems. Both the CVP and State Water Project (SWP)—a largely parallel state water supply system south of the Bay-Delta—are operating under regulations that limit the amount (and timing) of water that can be exported south out of the Bay-Delta. Recent court decisions regarding the health of threatened Delta Smelt may constrain such future exports. The degree to which some of the water management goals identified in the Settlement might rely on moving water in and out of the Bay-Delta could affect the ultimate ability to recapture, recirculate, and/or reuse San Joaquin River restoration flows. At minimum, it appears the restoration effort will necessitate multi-year water planning and investments, including having the funding on hand and infrastructure in place to buy and put to use surplus water (e.g., for groundwater recharge), and to buy water in dry years for those without sufficient access to groundwater, those with primarily Class II supplies, or in the driest of years. Therefore, the future of water resource management in the Central Valley is not just conjunctive water management, but multi-year conjunctive management with the financial resources to make it happen, in addition to integration of federal, state, local, and private infrastructure projects. Whether Congress addresses this issue—in California and elsewhere—given current water resource authorization and appropriations practices and a restrictive budgetary climate remains to be seen.

While the issues discussed here have confronted prior Administrations and Congresses, a Settlement Agreement was not reached until the U.S. District Court acted, ultimately resulting in the difficult choices facing Congress today (e.g., budgetary, water delivery, and ecosystem health trade-offs). This is a common dilemma for resource agencies implementing projects and programs which are based on societal and political trade-offs made decades ago (e.g., agricultural industry over commercial and sport fishing industries, or timber harvest over species habitat). It is hard to say what is fair or just when such significant trade-offs were made decades ago, causing harm to some, but providing benefit to others who then made financial and livelihood decisions based on those policies. In the eyes of many, the San Joaquin river restoration is an effort to respond to fisheries economic and ecological damage begun 60 years ago; for others the potential of reduced water supplies for off-stream use is a breach of promises made 60 years ago. For the court, it is a matter of Friant Dam operations comporting with state law.

Appendix A. Analysis of Existing Water Supply Impacts Data

Introduction to the Analysis and Summary of Results

The Settlement would use San Joaquin River water, which in recent history has been diverted and delivered to Friant Division contractors for off-stream uses, to maintain in-stream flows in the San Joaquin River for fish restoration. The Settlement would reduce Friant water deliveries to water districts absent offsetting measures. That is, the Settlement would redistribute a portion of the annual water supply away from agricultural and municipal water districts to achieve the restoration flows (based on hydrographs) agreed to under the Settlement. In a given year, how much less water would be available for off-stream uses in the Friant Division Service Area would depend largely on how much water would be released for fish restoration. Following a protocol established in the Settlement, the restoration flows would be determined annually based on the basin's estimated runoff for the year. Under the Settlement, restoration flows would be higher in wetter years and lower in drier years. The quantity of water used for restoration flows and the quantity by which water deliveries would be reduced are related, but the relationship would not necessarily be one-for-one. For instance, in some of the wettest years, flood water releases could provide a significant amount of the restoration flows, thereby lowering the reduction in deliveries to agricultural and municipal users. Under the Settlement, no water would be released for restoration purposes in the driest of years; thus in those years, no reductions in Friant deliveries would be made due to the Settlement.

As part of its analysis of the Settlement Agreement, CRS collected and reviewed available information on the effects that proposed increased releases for fish restoration from Friant Dam could have on future deliveries by the Friant Division. Few data are available on what actions Reclamation or water users might take to mitigate reduced Friant water deliveries. Guidelines and other specifics regarding Settlement implementation remain to be determined. Although broad conceptual papers are available, decisions on one or more courses of action have not been made.

Therefore, the analysis in this appendix is limited to existing data and estimates of water supplies, which do not account for water supply management measures that could reduce the effects of the Settlement on agricultural and municipal water users. The analysis largely relies on two available data sets on the estimated reductions to Friant water supplies under the Settlement:

- Expert report of Daniel B. Steiner, *Effects to Water Supply and Friant Operations Resulting From Plaintiffs' Friant Release Requirements*, September 16, 2005 (hereafter referred to as Steiner 2005), prepared for Friant Water Users Authority; and
- U.S. Department of the Interior, Bureau of Reclamation, *Friant Division Allocations Based on SJR-Settlement Exhibit B Hydrographs for Restoration Releases*, table released December, 2006 (hereafter referred to as BOR 2006).

The two data sets are not identical, and both have some limitations for purposes of this analysis. CRS used the most comparable elements of the data sets for the analysis presented herein.[25] The

[25] Both sources use the Millerton Lake drainage area's past runoff conditions to illustrate the impact that the Settlement (continued...)

analysis herein was performed using both data sets when possible. However, many of the figures in this appendix present information from only one data set. Even though the data are imperfect—the estimates were made assuming no changes in Friant Dam or other Central Valley Project (CVP) operations, no changes in water use efficiency, and no other actions that might mitigate reduced Friant water supplies—they give some idea of the range of changes that water users might experience under the Settlement.

Using available data (which does not account for any improvements in water management that may reduce the Settlement's impact on agricultural and municipal users), it appears that annual water supplies for the Friant Division Service Area would be, *on average*, 15% to 16% less under the Settlement, than average supplies under current operating protocols. Although the average reduction could be 15 to 16%, water supply reductions could range from no reduction, to as high as a 34% reduction in some years. The *total* average annual reduction in the volume of water delivered (i.e., reduction in both contract water and temporary water delivered by the Friant Division) under the Settlement is estimated to be 204 thousand acre-feet (taf) or 225 taf, depending on the source (Steiner 2005, or BOR 2006, respectively) less than average annual supplies without the Settlement. These average estimates include cutbacks in temporary water that is made available in wetter years (but that is not contracted for on a long-term basis), and thus these estimates can be viewed as an upper limit to average reductions that might occur under the Settlement. The average annual reduction in *long-term water service contract* water deliveries (i.e., not including temporary deliveries) under the Settlement, is estimated at 144 taf less than average annual long-term contract supplies without the Settlement (Steiner 2006).

Almost half of the Friant contractors have access to other, non-Friant surface water supplies (mostly from local river and stream sources)[26] and 75% use groundwater supplies. Therefore, for at least three-quarters of the contractors, the reductions in Friant Division deliveries represents a reduction in one of multiple supplies. However, because it is difficult to get reliable data on all non-federal water supply source, the extent of other supplies and their accessability and reliability is unclear. In some cases both other surface and groundwater supplies appear to be substantial, in

(...continued)

might have on contract water supplies. Using actual historic *allocations* as a starting point, BOR 2006 recalculates what contract water supplies (i.e., supplies to Class I contractors, Class II contractors, and for § 215 contracts) might have been in the past if restoration releases under the Settlement had been in place for 1957 through 2005. The analysis in BOR 2006 combines Class II and § 215 water supplies. By using historic allocations as a starting point, the BOR 2006 data set does not necessarily reflect current Reclamation procedures for deciding allocations, and it reflects anomalies and changes in operating protocols that would not necessarily be replicated in the future. For example, 1958 was a year with high runoff in the basin; current operations would result in some Class II and § 215 allocations. BOR 2006 does not show any such deliveries because in 1958 these types of contracts were not in use. Class II contracts were not active until 1962, and § 215 water was first available mid-1995. Another example is from 1998; the relatively low allocations in 1998 partially resulted from Kings River water being pumped into the Friant Kern Canal to reduce flood potential in the Kings River basin. The BOR 2006 estimate includes data on the contract water supplies under the Settlement both with and without the 10% buffer flows. In contrast, Steiner 2005 uses historic *runoff* data for 1922 through 2003 to *model* water diversion and delivery under the Settlement. The modeling applies current water management regimes and contracts with and without the Settlement to the historic runoff data; in other words, Steiner 2005 applies the current Class II and § 215 contracts to the entire 1922 to 2003 time period. Unlike BOR 2006, the analysis in Steiner 2005 distinguishes between Class II and § 215 contracts. Although some data for 2004 are available in Steiner 2005, the last year for which Steiner 2005 presents a complete analysis is 2003. The model used in Steiner 2005 accounts for the distinction between runoff water year (Oct. to Sept.), the restoration flow year (Feb. to Jan.), and the contract year (March to Feb.); BOR 2006 simplified its analysis by not differentiating between the various kinds of timeframes, instead basing the entire analysis on the runoff water year (Oct. to Sept.).

[26] U.S. Dept. of the Interior, Bureau of Reclamation, *Water Needs Assessment*, 2004.

other cases not. **Table A-1** shows the diversity of water supplies; however, non-federal supplies are not quantified.

The level of reductions experienced by individual water districts would likely vary depending on their water service contracts. That is, the reduced delivery experienced in a given year by an individual water district would largely depend on how "firm" is the district's Friant water supply contract. Contracts with first priority delivery (known as Class I contracts) generally are held by the districts which serve municipalities and agricultural users without sources to other supplies—areas often in the foothills not underlain with adequate or reliable groundwater supplies. Existing data assumes Reclamation would reduce "supplemental" water deliveries (known as Class II water) before first priority deliveries. These data estimate average annual reductions in Friant Division long-term water service contract deliveries for individual Friant water districts would range between 5% and 27%—the low range being cutbacks to contractors with relatively firmer Friant Division contract supplies (46% of contractors) and the high range applicable to those with only supplemental Friant Division contract supplies (7% of contractors). All districts with supplemental Friant Division contracts have access to groundwater or other surface water supplies.

Possible actions that may partially offset reduced off-stream deliveries include water conservation, efficiency measures, water transfers and marketing, groundwater storage and banking, water pricing (e.g., the Recovered Water Account), and new infrastructure. However, at this time, it is unclear to what extent these measures could mitigate the lower deliveries, at what cost, and which measures might occur as part of the Settlement's water management goal or as part of other state or local water development efforts. Further, some Class II supplies are used in lieu of pumping groundwater, to recharge groundwater, and to conjunctively manage seasonal or yearly water supplies. Because of this complexity, it is unclear what effect water conservation and efficiency measures (which could reduce inflows to groundwater) might have on long-term water demands and supply management.

The first part of this appendix provides an overview of water supplies in the Friant Division Service Area, including not only releases from Friant Dam but also other surface water and groundwater supplies. The next part of this appendix discusses how water needs for restoration flows under the Settlement might affect Friant Division water supplies. It addresses potential effects of the Settlement on *aggregate* Friant Division contract water supplies; it then analyzes estimates of the reduction in supplies for *individual* water districts (contractors). This appendix attempts to present data that illustrate not only the average annual water supply reductions under the Settlement, but also the variation that might be experienced annually. This appendix does not discuss specific effects of the Settlement on groundwater supplies and potential economic impacts of water reductions and increased restoration flow. Where reductions in water supply are discussed, they are relative to long-term average water deliveries, not the full amount of water supply contracts.

Water Supplies in the Friant Division Service Area

The Friant Division Service Area of the CVP extends from just north of the Merced/Madera County line north of the San Joaquin River, southeast to Bakersfield, CA. (See **Figure 2**.) Much of the area is naturally well-endowed with both surface and groundwater supplies, and has benefitted from extensive federal investment in the development of surface water supplies, as well as investment in private and public groundwater recharge projects. The waters of the service area support a substantial farm and food processing economy, as well as a growing population.

The area is bisected by several large rivers and streams; the largest surface water source for the Friant Division Service Area is the San Joaquin River, which lies in the northern part of the service area. San Joaquin River water is stored behind Reclamation's Friant Dam in Millerton Lake and is delivered to long-term contractors (also referred to as water users or water districts) via the Madera Canal and Friant-Kern Canal. Friant Dam and the two canals are managed as part of the federal CVP. Even though the area is relatively rich in water resources compared to much of the West, groundwater overdraft has been a perennial problem since the area was intensely developed for agriculture early in the 20th Century.

Runoff entering Millerton Lake (i.e., the Millerton Lake drainage area) averages 1,700 taf, but can vary widely; from 1922 through 2004, runoff has varied from a low of 362 taf in 1977, to a high of 4,642 taf in 1983 (Steiner 2005). This large variation can lead to management difficulties, particularly in extremely dry and extremely wet years. Millerton Lake has a capacity of approximately 500 taf,[27] which is insufficient to provide multi-year storage. As a consequence of its capacity, the reservoir is operated on an annual basis and may refill multiple times in a wet year. Because the lake does not have multi-year storage, the quantity of water available for delivery in a given year is largely a function of that year's runoff.

In non-flood years, all but sufficient flows to satisfy water right holders below the dam (i.e., riparian releases representing approximately 117 taf annually in recent years) is diverted away from the San Joaquin riverbed into the Friant-Kern Canal and Madera Canal just below the dam. These canals transport the water for delivery to Friant water users. Once the riparian water rights holders (Reach 1) remove their water, the river generally runs dry or with little flow for most of the year in the 24-mile stretch between Gravelley Ford and Mendota Pool (Reach 2). (See **Figure A-1** for a map of the river reaches.) Except when there are flood releases, the water in the San Joaquin River between Mendota Pool and Sack Dam (Reach 3) is not San Joaquin River water; it is CVP water imported from northern California through the Bay-Delta. A group of CVP contractors known as the San Joaquin River Exchange Contractors removes this imported Delta water from the river over the course of Reach 3.[28] After this stretch, the river is generally dry again for 46 miles from Sack Dam to Bear Creek (Reach 4) except for inflows from groundwater and agricultural runoff.

Reclamation historically has operated Friant dam to maximize water deliveries in the Friant Division while first meeting water right obligations downstream—i.e., releasing water to the river only as necessary to meet downstream water right obligations—and to manage flood waters. Because water deliveries to the Friant Division (after downstream water right obligations are met) are maximized each year, some reaches of the riverbed remain dry during portions of many years. According to the 2004 ruling of the U.S. District Court, Eastern District, California,[29] this management regime has resulted in untenable effects on downstream resources, particularly anadromous fish, under California state law.

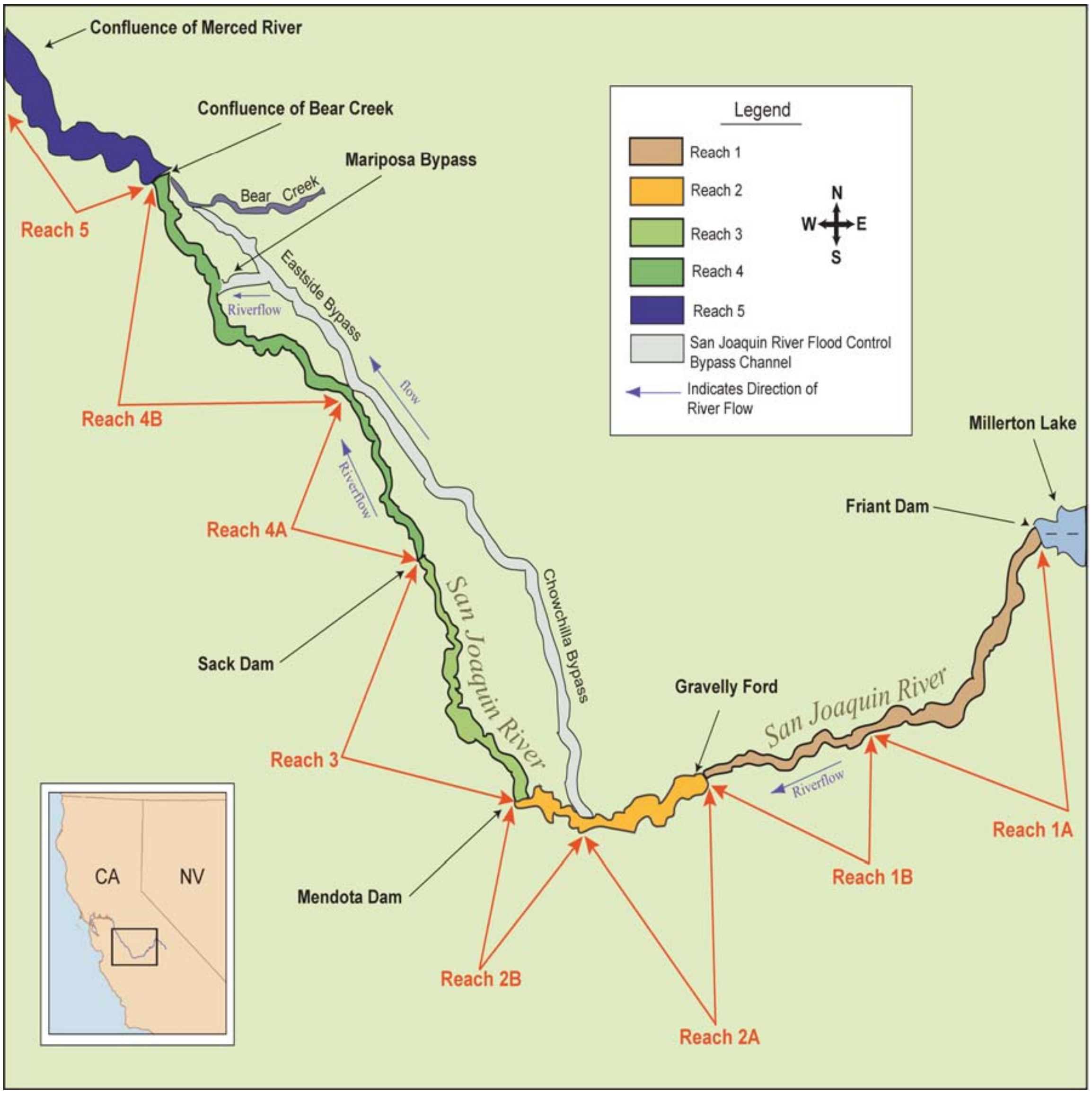
---

[27] http://www.usbr.gov/dataweb/html/friant.html#general, accessed July 27, 2007.

[28] San Joaquin River Exchange Contractors receive their water supplies via other CVP facilities, principally, the Delta-Mendota canal and Mendota pool. These contractors retain senior San Joaquin River water rights which predate construction of Friant Dam. These contractors agreed to receive non-Friant CVP supplies in lieu of taking water directly from the San Joaquin River, as they had done prior to construction of Friant Dam; however, if such supplies are not available, they may take their supplies from Friant releases. In essence these contractors entered into contracts "exchanging" their river diversion for a supply of water from other CVP facilities, yet their priority right to San Joaquin water remains.

[29] NRDC v. Patterson, 333 F. Supp. 2d 906, 925 (E.D. Cal. 2004).

Figure A-1. San Joaquin River Reaches



Surface Water Supplies: Friant Dam Releases

In January each year, Reclamation makes a preliminary projection of how much runoff is expected in the Millerton Lake drainage area. A formal estimate is made each February, and re-calculated monthly throughout the spring and summer. In most years, approximately 70% of the runoff occurs in spring and early summer (April - July). Using these projections, Reclamation decides how to "allocate" Friant water supplies. Water *releases* at Friant Dam fall into several categories:

- *Riparian flow releases* are made to supply water to water right holders below the dam who are not part of the Friant Division Service Area and are not party to the Settlement. These releases have been approximately 117 taf annually in recent years, and would not change under the Settlement Agreement or proposed implementing legislation.

- *Flood releases* may be necessary when forecast runoff is excessive or when water inflow exceeds the capacity of the reservoir. When additional releases above the minimum (riparian water rights releases) need to be made, portions of the flood releases may be used for temporary water contracts.
- *Releases for diversion* to canals that deliver project water to long-term water service contractors in the Friant Division Service Area of the CVP.

Surface Water Supplies: Friant Division Water Supplies

Twenty-eight water districts in the Friant Division Service Area have long-term water service contracts with Reclamation for the delivery of water stored behind Friant Dam (see **Table A-1**). This water supplies approximately 1 million acres of farmland and several cities and towns, including the City of Fresno. Water is delivered northwest via the 36-mile Madera Canal, and south via the 152-mile Friant-Kern Canal. (See **Figure 2**.) Annual deliveries are reported to average around 1,300 taf. In total, approximately 15,000 farms are served by Friant water supplies. Friant water supply deliveries and allocations fall into several categories:[30]

- *Class I* water, sometimes referred to as the "firm" supply,[31] is the first 800 taf of storable water (if available) in the Millerton Lake drainage area in excess of instream rights; it is allocated to Friant long-term water service contractors. It is delivered under contract to districts with limited or no access to groundwater supplies, and as a base supply to other districts. Class I supplies are insufficient to meet the base supplies of all districts.
- *Class II* supplies are "supplemental" supplies. Class II water is allocated and delivered only when Class I demands can be fully met. Class II water often is used for irrigation supplies. In wetter years, Class II water also is used to directly recharge groundwater supplies through various means or used in lieu of groundwater (i.e., contractors use Class II surface water instead of pumping groundwater when it is available), thereby meeting water demands and partially restoring groundwater supplies.
- *§ 215* "temporary" water may be made available when flood waters must be released from Friant Dam. Under § 215 of the Reclamation Reform Act of 1982 (P.L. 97-293), normal ownership and full cost pricing limitations of reclamation

[30] Adapted from Friant Water Users Authority Briefing Book, handout entitled, *About the Friant Division*, Sept. 2006, p. 2. For this appendix and to simplify comparison between the Steiner 2005 and BOR 2006 data sets, CRS generally does not differentiate between the allocations and deliveries. This appendix generally refers generically to *water supplies*. BOR 2006 presents data on reductions in *water allocations*, while much of the data on reductions presented in Steiner 2005 are in *water deliveries*. The differences between allocations and deliveries are: (1) the losses in the canals (e.g., evaporation and infiltration), and (2) not all allocated water is demanded by the water contractors (i.e., some water may be allocated by Reclamation but is not delivered because of the lack of contractor demand, especially in wetter years). Steiner 2005 calculated average canal losses at 63 taf (i.e., less than 5% of average annual deliveries or allocations) and assumes that the allocated water is demanded by the contractors. Because the allocations estimated by BOR 2006 represent the quantity allocated before the canal losses occur, and the deliveries estimated by Steiner 2005 represent the quantity delivered after canal losses occur, the reduction estimates from BOR 2006 may be systematically higher than the deliveries estimated in Steiner 2005, but on average by only 5%. CRS consulted with Reclamation and others in an effort to identify a systematic way to account for differences in Reclamation allocations and deliveries, but no approach was identified. However, it appears that the two sets are reasonably similar.

[31] Although Class I supplies are "firm" relative to other Friant supplies, they are subject to water availability; consequently, the full contract amount may not be delivered in some years.

law are waived for lands that receive only a temporary (not to exceed one year) water supply. Under § 215, the Secretary also is authorized to waive payments for such supplies.

Class II and § 215 demands and deliveries are highly variable depending on runoff quantity and timing and Reclamation operating and contracting procedures. For example, there exists considerable financial incentive to take § 215 water in lieu of Class II deliveries when § 215 fees are waived. When declaration of § 215 water availability is made early in the season, many contractors reduce or sometimes forego Class II deliveries. This complexity makes it difficult to estimate the impacts of water supply reductions under the Settlement on Class II contractors.

Table A-1 lists the average annual Class I and Class II water supplies for the 28 Friant water districts, and the average § 215 delivery for all districts. (See bottom of **Table A-1**.) Total Class I water supplies ranged from 200 taf to 800 taf between 1962 and 2003 (Steiner 2005); combined Class II and § 215 allocations ranged from zero to 1,401 taf (BOR 2006). Average annual Class I, II, and §215 water supplies in **Table A-1** total to 1,281 taf. **Table A-1** shows a Class I average of slightly less than the full contract amount of 800 taf largely because runoff was insufficient in drought years to allow Reclamation to fully meet Class I contracts.

Table A-1. Friant Contractor Annual Water Supply and Supply Diversity

Contractors	Avg. Est. Annual Friant Water Supply (acre-feet)		Non-Friant Water Supply	
	Class I	Class II	Surface Water	Ground Water
Friant-Kern Canal				
Arvin-Edison WSD	37,700	87,295	Kern River	yes
Delano-Earlimart ID	102,545	20,866	none	yes
Exeter ID	10,839	5,322	none	yes
Fresno ID		21,006	Kings River	yes
Garfield WD	3,299		none	no
International WD	1,131		none	no
Ivanhoe ID	7,257	2,213	Wutchumna River	yes
Lewis Creek WD	1,367		none	no
Lindmore ID	31,103	6,162	none	yes
Lindsay-Strathmore ID	25,919		Kaweah River	yes
Lower Tule River ID	57,681	66,660	Lower Tule River	yes
Orange Cove ID	36,946		none	yes
Porterville ID	15,080	8,403	Tule River and others	yes
Saucelito ID	19,981	9,187	none	yes
Shafter-Wasco ID	47,125	11,091	none	yes
Southern San Joaquin MUD	91,423	14,004	none	yes
Stone Corral ID	9,425		none	yes

Contractors	Avg. Est. Annual Friant Water Supply (acre-feet)		Non-Friant Water Supply	
	Class I	Class II	Surface Water	Ground Water
Tea Pot Dome WD	7,069		none	no
Terra Bella ID	27,333		none	no
Tulare ID	28,275	39,492	Kaweah River	yes
Madera Canal				
Chowchilla WD	51,831	44,813	Chowchilla River	yes
Madera ID	80,113	52,096	North Fork Willow Creek	yes
San Joaquin River				
Gravelly Ford WD		3,921	Cottonwood Creek	yes
Friant Division M&I				
City of Fresno	56,550		Kings River	yes
City of Orange Cove	1,320		none	yes[a]
City of Lindsay	2,356		none	no
Fresno County Water Works 18	141		none	no
Madera County	189		North Fork Willow Creek	yes
SUBTOTAL-Class I &II	***754,005***	***392,531***		
SUBTOTAL-§ 215		***134,303***		

Sources: Columns 2 and 3 show data for the 1922-2003 period, Steiner 2005. Columns 4 and 5, Department of the Interior, Bureau of Reclamation, *Water Needs Assessment*, 2004, provided to CRS by Reclamation, July 2007; and CRS phone interviews with staff of Friant contractors July 2007.

Note: Many Friant contractors have several sources of water supply, some of which are substantial. However, because it is difficult to get reliable information on non-federal supplies, quantities here are unspecified. Additionally, information in this table may not reflect the entire scope of supplies available to each district.

a. Groundwater supplies are available; however, the groundwater is of insufficient quantity and quality to contribute significantly to water supplies for municipal and industrial customers.

Other Surface Water Supplies

Many parts of the Friant Division Service Area, particularly the southeast areas, have access to non-Friant surface water supplies. Several other rivers and streams bisect the area, including the Kings River, Cottonwood Creek, Johns River, Kaweah River, Tule River, Deer Creek, White River, and Poso Creek. The Kern River terminates near the southernmost portion of the Friant Division Service Area.

As previously noted, according to Reclamation water needs assessment data, many (43%) of the Friant districts have access to other, non-Friant surface water supplies, mostly from local river and stream sources.[32] In most cases, local sources are a much smaller percentage of total supplies

[32] U.S. Dept. of the Interior, Bureau of Reclamation, *Water Needs Assessment*, 2004.

than Friant surface water or groundwater supplies; however, in a few cases (e.g., City of Fresno and Fresno Irrigation District), it appears that other surface sources may supply more than 50% of their water supply. Water imports into the service area have been relatively modest; however, these may increase if Friant water deliveries are reduced. At the same time, limited water availability, cost of alternate supplies, and regulatory constraints on water transfers may restrict efforts to import water into the service area.

Table A-1 (above) shows the diversity of water supply sources of the Friant long-term water contractors. Columns 2 and 3 show average water supplies for the Friant Division; columns 4 and 5 show other water supply indicators, such as whether a district has access to other surface or groundwater supplies.

Groundwater Supplies

Drawdown of groundwater levels in the Friant Division Service Area as a result of pumping in the early 20th Century motivated both Friant Dam construction in the early 1940s and efforts to reduce groundwater demand.[33] Deliveries from Friant Dam reduced demands on the aquifer as Friant water, in lieu of groundwater, was used for irrigation. Reduced pumping slowed the rate of water table decline, but water table levels in the southern San Joaquin Valley have not returned to pre-development elevations. Land subsidence, which occurred as a result of groundwater pumping, slowed considerably as additional surface water supplies became available and demand for groundwater dropped.

Facilities to pump groundwater are available throughout most of the Friant Division. (See **Table A-1**.) The limited estimates of groundwater pumping that are available indicate that water users in the Arvin-Edison Water Storage District, Fresno Irrigation District, Tulare Irrigation District, Madera Irrigation District, Lower Tule River Irrigation District, and Chowchilla Water District generally pump the largest volumes of groundwater in the Friant Division Service Area.[34] In contrast, water users in the Garfield Water District, International Water District, Lewis Creek Water District, Tea Pot Dome Water District, and Stone Corral Irrigation District typically pump the smallest amounts of groundwater annually.[35] Total volumes pumped in the Friant Division between 1987 and 2003 range from a peak of over 2,000 taf in 1990 to a low of 450 taf in 1998, nearly a five-fold difference.

Other groundwater resources have the potential to also be available for use by Friant contractors. Groundwater banking—using dewatered aquifer space to store water during wet years, so it can be pumped and used during dry years—is increasingly being discussed and pursued in California. The water transport system in the state increases the possibilities for beneficial use of groundwater banking. Those connected to the transport system potentially could use banked groundwater regardless of their own access to groundwater supplies. Groundwater banking, while an opportunity, also has its costs and constraints. In California, pumping and canal capacity and species-related operational issues may limit some groundwater banking opportunities; further, the

---

[33] Friant Water Users Authority, *Friant Division Cumulative Groundwater Storage USBR Water Supply Report & FWUA 2002 Update*, Appendix A, Section 1, April 9, 2002.

[34] *Expert Report of Charles M. Burt, Ph.D., P.E., on Friant Service Area, Reasonableness of Surface Water Use, Annual Gross Groundwater Pumping Requirement, and Estimated Increased Energy Use Under the Spring Run Scenario by 2025*, August 18, 2005.

[35] Ibid.

costs to bank and move water, or purchase banked water may be higher than some users are willing to pay.

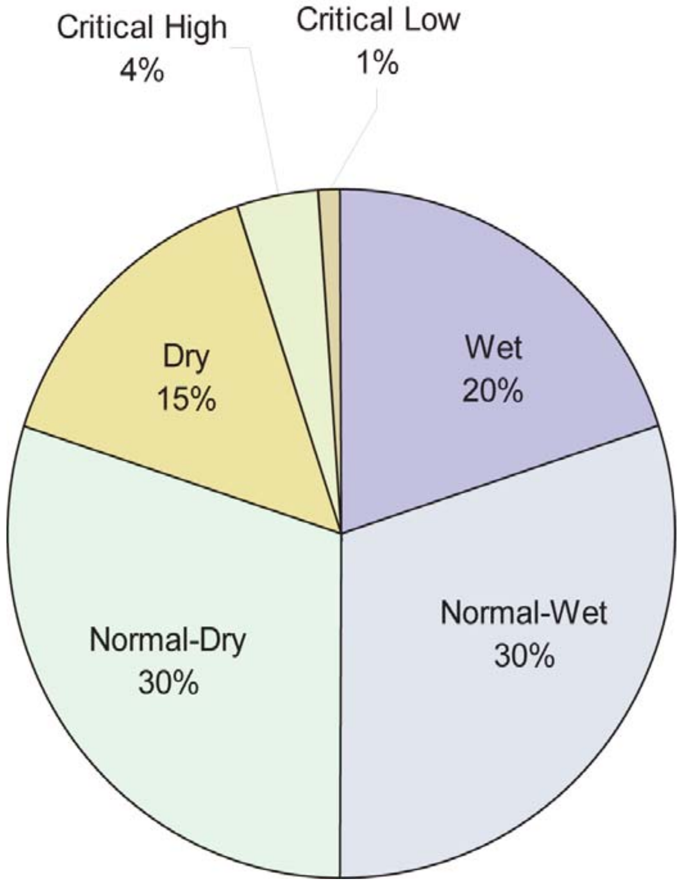
Contract Water Supplies Under the Settlement[36]

The Settlement establishes a framework for achieving both restoration and water management goals. The viability of attaining both goals is uncertain and will depend upon many factors. Currently, the annual volume of water diverted for off-stream uses by Friant water contractors is a function of water availability (which depends on precipitation, storage capacity, and flood flow management), minus the riparian releases for water right holders below the dam. Under the Settlement, the quantity of water available for diversion to Friant contractors would be a function of water availability, minus the riparian releases for downstream water right holders *and* releases for restoration flows.

Under the Settlement Agreement as specified in Exhibit B, paragraph 2, Reclamation would categorize runoff conditions for each year into one of six *water year types* based on runoff conditions. *Wet* (wettest 20% of years) and *Normal-Wet* (the next wettest 30% of years) are used to define the years with above average runoff. *Normal-Dry* (the next 30%) and *Dry* (the next 15%) capture the years with below average runoff, but not the years with the lowest runoff (i.e., the bottom 5%). The bottom 5% are classified into *Critical High* or *Critical Low*. Critical low are the driest of years; those years with less than 400 taf of runoff . Critical High are all other years with runoff in the bottom 5%. **Figure A-2** provides a graphical presentation of the relative frequency of each of the water year types. Because only one year had a runoff of less than 400 taf in the 1922 to 2004 data set, the frequency of a Critical Low runoff year is shown as 1% in **Figure A-2**.

[36] In the portion of this appendix analyzing aggregate reductions to Friant water supplies, CRS largely restricted analysis to the years 1962 to 2003, and does not distinguish between Class II water and § 215 water. These parameters were chosen in order to use data from both BOR 2006 and Steiner 2005, and to present the data and analysis in as consistent and simple a format as possible. The following points explain why these parameters were chosen. (1) 1962 is the lower time limit of the analysis because Class II water was not made available until 1962. The absence of Class II water allocations prior to 1962 makes the BOR 2006 data from 1957 through 1961 sufficiently different from the current water allocation protocols to warrant its exclusion. (2) 2003 was selected as the upper time limit of the analysis because that was the last complete year in Steiner 2005. (3) BOR 2006 grouped Class II and § 215 water; comparison of the data sets was facilitated by merging Class II and § 215 data from Steiner 2005. In the portions of this appendix analyzing estimated annual reductions for individual Friant water districts, CRS used Steiner 2005 data because no district-level data were available in BOR 2006. The longer period—1922 to 2003—available in Steiner 2005 was used, since it was not necessary to shorten the period to fit with the BOR 2006 data. Steiner 2005 contractor-level data are available for both Class I and Class II water, but not for § 215 water. Therefore, the contractor-level analysis is limited to Class I and Class II water.

Figure A-2. Frequency of Water Year Types



The water year type is determined by comparing the runoff predictions for the year to past annual runoff volumes in the Millerton Lake drainage area. These runoff categories are used to select the restoration hydrograph to be used for a given year, which forms the basis for monthly water releases. Paragraph 13, Section j, in the Settlement states that the Secretary of the Interior shall develop guidelines for "procedures for determining water year types..." which may affect how the designation of water year type is implemented.[37]

Each water year type is associated with an annual restoration flow regime (i.e., a hydrograph) in Exhibit B of the Settlement. In other words, each year the quantity of water to be released from Millerton Lake for restoration would be determined by the designation of the basin's runoff as one of the six water year types. Under the Settlement, Reclamation would release water to achieve the target restoration flows. Multiple hydrographs were considered during litigation; the Settlement's hydrographs are based on the expert testimony of G. Mathias Kondolf prepared on

[37] An illustration of the significance of water year classifications and the methodology for the classifications can be seen when comparing BOR 2006 with Steiner 2005. There exist four differences in the classification of water year types used by BOR 2006 and Steiner 2005 (for years in which the data sets overlap). As shown in **Table A-2**, Steiner 2005 classified four years in wetter water year types than BOR 2006. Classifying a year differently may have significant implications because generally, the wetter the classification, the more restoration releases are made. For example, in 1989 the runoff was 939 taf, Steiner 2005 classified this runoff as Normal Dry (see **Table A-2**) which would lead to restoration releases of 247 taf under the Settlement; for the same runoff, BOR 2006 classified 1989 as Dry which would lead to restoration releases of 184 taf under the Settlement.

behalf of the Natural Resources Defense Council (plaintiffs) and are often referred to as the Kondolf hydrographs.[38]

The restoration flows in the Settlement are higher in wetter years and lower in drier years. The quantity of water used for restoration flows and the quantity of water by which Friant water deliveries would be reduced are related, but the relationship is not necessarily one-for-one. Many of the tables and figures in this appendix depict *estimates* of lower Friant water deliveries under the Settlement. The data come from two sources that make estimates based on the water quantities required to create the flows in the six Kondolf hydrographs: Steiner 2005 and BOR 2006.

Limitations of Water Supply Estimates and Mitigation for Reductions

Figures A-3 and **A-4**[39] show graphically the estimated reduced annual Friant water supplies using the Steiner 2005 and the BOR 2006 data sets, respectively; **Table A-2** provides much of the same information in a tabular format. Both sources used historic conditions as proxies for estimating the future effect of the Settlement.[40] The two figures and the table are ordered according to annual runoff, with 1983 having the highest runoff and 1977 the lowest in the 1962 to 2003 period. There are limits to these data sets due to a number of factors, explained below. Thus, ultimate impact on Friant water contractors is anticipated to be different than the available estimates if the Settlement is implemented.

For example, the Settlement, in Paragraph 16, calls for measures to mitigate lower Friant water supplies as restoration releases are implemented; these include establishing a Recovered Water Account, and efforts to recirculate, recapture, and reuse the restoration releases. The Friant Water Users Authority in February 2007 developed a report, titled *San Joaquin River Restoration Program Water Management Goal: Potential Programs & Projects*, which briefly outlines numerous projects that could be undertaken to mitigate or offset reduced water supplies. However, no specific water management projects are identified as part of the Settlement, nor is it clear how funding under the Settlement would be divided between efforts to achieve the restoration goal and efforts to achieve the water management goal. Consequently, the analysis in this appendix cannot estimate potential savings and how these savings may reduce the magnitude of the reductions in water supplies of the Friant water contractors.

There are additional reasons why available estimates could differ from the future supplies of Friant water contractors operating under the Settlement. Guidelines on how the Settlement would be implemented remain to be established and numerous provisions in the Settlement provide for implementation flexibility. For example, Paragraph 13, Section j of the Settlement Agreement states that the Secretary of the Interior shall develop guidelines, including "procedures for determining and accounting for reductions in water deliveries to Friant Division long-term

[38] The option for a 10% buffer flow that could be used to augment the restoration base flow established in the hydrographs was added prior to finalizing the Settlement Agreement. The Steiner 2005 data set does not include estimates with the 10% buffer flows; the buffer flow was added to the Settlement after Steiner's report was completed. To take advantage of the comparable elements of the two data sets and because the implementation of the buffer flow remains to be determined, the analysis in this appendix does not address the 10% buffer flow option.

[39] See footnote 25 for an explanation of the 1998 data in BOR 2006.

[40] The potential impact of climate change on water supplies, particularly snow pack in California, has some observers questioning past runoff as a predictor of future runoff quantity and timing.

contractors...," which will affect how Reclamation makes operational decisions at Friant Dam, and thus allocation decisions. Both BOR 2006 and Steiner 2005 adopt a reduction protocol (similar to the current protocol) for how to reduce contractor water supplies to obtain water for the restoration flows. Both data sets presume eliminating deliveries to § 215 contracts and Class II water before reducing Class I water supplies. However, the guidelines to be established pursuant to the Settlement Agreement could differ from the reduction protocol used by BOR 2006 and Steiner 2005. Further, districts may try to negotiate a different allocation for water supply reductions.

Figure A-3. Estimated Friant Division Water Supply Under Settlement: Steiner 2005

(1962-2003, by decreasing runoff amount, not chronological order)

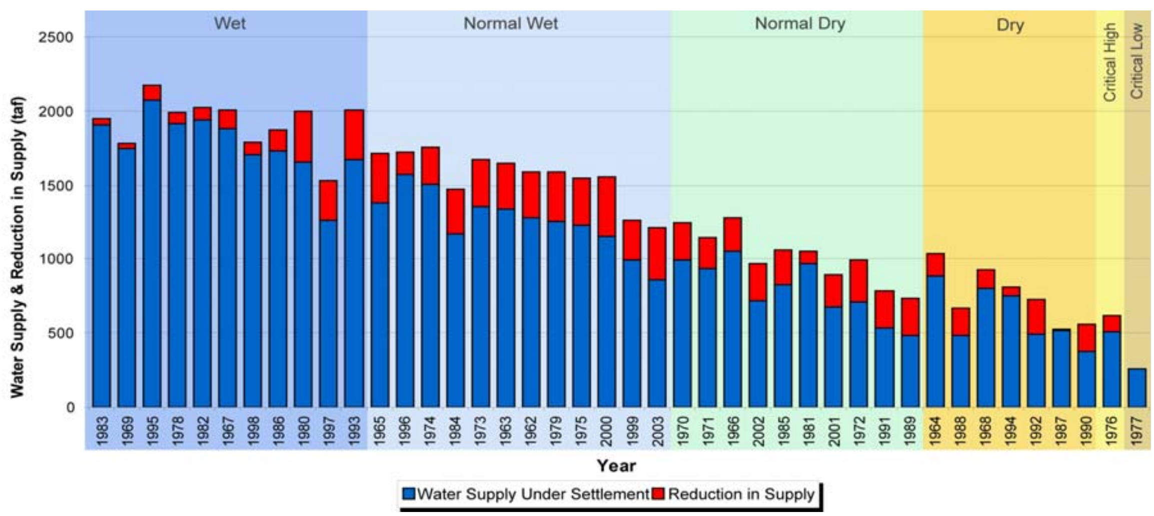


Figure A-4. Estimated Friant Division Water Supply Under Settlement: BOR 2006

(1962-2003, by decreasing runoff amount, not chronological order)

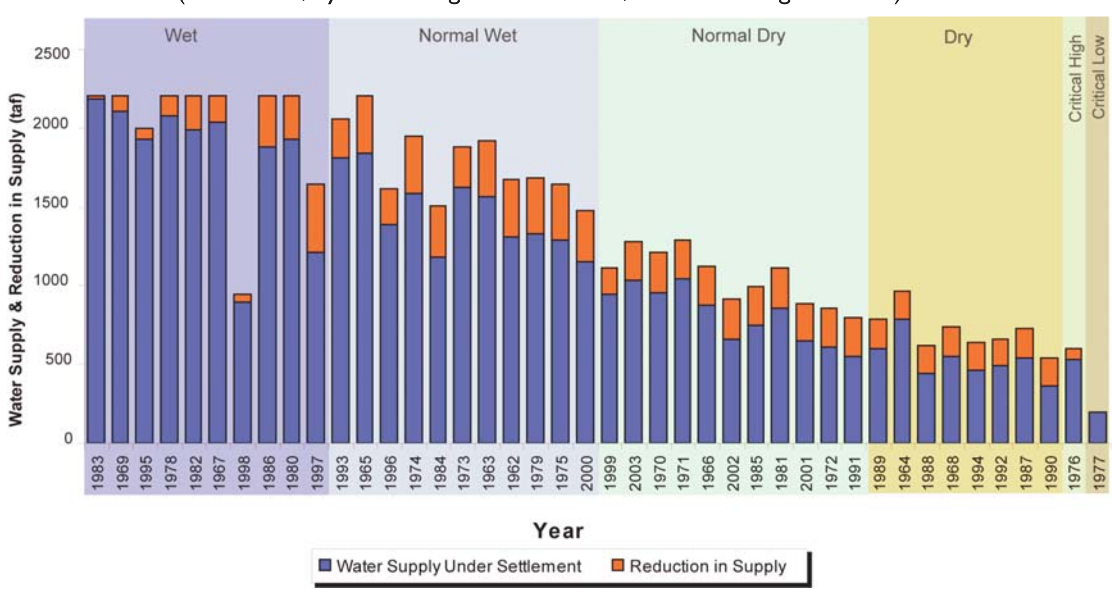


Table A-2. Annual Runoff, Year Type, Friant Water Supply, and Estimated Reductions from Average Friant Supply Under the Settlement, 1962-2003

Year	Water Year Type		Runoff (taf)	Friant Water Supply (taf)		Est. Annual Reduction (taf)		Reduction as % of Supply
	Steiner	BOR		Steiner	BOR	Steiner	BOR	Steiner
Wet								
1983	Wet	Wet	4642	1947	2201	37	18	2
1969	Wet	Wet	4040	1780	2201	35	98	2
1995	Wet	Wet	3878	2173	2001	98	75	5
1978	Wet	Wet	3402	1993	2201	76	124	4
1982	Wet	Wet	3316	2025	2201	83	216	4
1967	Wet	Wet	3232	2004	2201	125	163	6
1998	Wet	Wet	3160	1790	940	85	47	5
1986	Wet	Wet	3031	1876	2201	142	316	8
1980	Wet	Wet	2973	2000	2201	344	272	17
1997	Wet	Wet	2782	1534	1641	268	433	17
1993	*Wet*	*Normal Wet*	*2673*	2004	2061	331	250	17
Normal Wet								
1965	Normal Wet	Normal Wet	2272	1715	2201	335	356	20
1996	Normal Wet	Normal Wet	2203	1723	1613	154	225	9
1974	Normal Wet	Normal Wet	2191	1755	1949	247	363	14
1984	Normal Wet	Normal Wet	2049	1475	1501	302	322	20
1973	Normal Wet	Normal Wet	2047	1670	1879	317	257	19
1963	Normal Wet	Normal Wet	1945	1644	1921	303	356	18
1962	Normal Wet	Normal Wet	1924	1586	1669	309	356	19
1979	Normal Wet	Normal Wet	1830	1591	1683	338	356	21
1975	Normal Wet	Normal Wet	1796	1543	1641	312	356	20
2000	Normal Wet	Normal Wet	1742	1552	1477	397	323	26
1999	*Normal Wet*	*Normal Dry*	*1527*	1259	1108	264	168	21
2003	*Normal Wet*	*Normal Dry*	*1450*	1211	1277	352	244	29

Year	Water Year Type		Runoff (taf)	Friant Water Supply (taf)		Est. Annual Reduction (taf)		Reduction as % of Supply
	Steiner	BOR		Steiner	BOR	Steiner	BOR	Steiner
Normal Dry								
1970	Normal Dry	Normal Dry	1446	1244	1206	249	248	20
1971	Normal Dry	Normal Dry	1418	1146	1291	212	248	18
1966	Normal Dry	Normal Dry	1299	1282	1122	231	248	18
2002	Normal Dry	Normal Dry	1171	967	912	246	248	25
1985	Normal Dry	Normal Dry	1129	1064	996	239	248	22
1981	Normal Dry	Normal Dry	1068	1051	1108	85	248	8
2001	Normal Dry	Normal Dry	1065	892	885	217	235	24
1972	Normal Dry	Normal Dry	1039	993	856	279	248	28
1991	Normal Dry	Normal Dry	1034	782	800	245	248	31
1989	*Normal Dry*	*Dry*	939	734	784	246	184	34
Dry								
1964	Dry	Dry	922	1038	968	154	184	15
1988	Dry	Dry	862	669	624	184	184	28
1968	Dry	Dry	862	925	736	125	184	14
1994	Dry	Dry	826	815	640	59	174	7
1992	Dry	Dry	809	731	664	238	172	33
1987	Dry	Dry	758	526	728	9	184	2
1990	Dry	Dry	743	557	544	182	184	33
Critical High								
1976	Critical High	Critical High	629	621	600	108	71	17
Critical Low								
1977	Critical Low	Critical Low	362	259	200	2	0	1
	Average		**1869**	**1337**	**1372**	**204**	**225**	**15**

Source: Data adapted from Steiner 2005 and BOR 2006. *Italics* indicate inconsistent classifications.

Another example of flexibility provided in the Settlement Agreement, which could result in contract water supplies varying from the BOR 2006 and Steiner 2005 estimates, is found in Paragraph 3 of Exhibit B of the Settlement. This paragraph states that:

> The Parties agree to transform the stair step hydrographs to more continuous hydrographs prior to December 31, 2008 to ensure completion before the initiation of Restoration Flows, provided that the Parties shall mutually-agree that transforming the hydrographs will not materially impact the Restoration or Water Management Goal.

This process may or may not materially impact Friant deliveries. The intent of the process is to provide smooth operation of dam releases and to avoid large fluctuations on a daily basis.

Table A-2 also illustrates the challenge of using estimates; it shows in *italics* that the two data sources—Steiner 2005 and BOR 2006—do not agree on how the water year type classifications would be applied to historic runoff conditions. Four discrepancies in their classifications are shown: 1989 (Dry/Normal Dry), 1993 (Normal Wet/Wet), 1999 (Normal Dry/Normal Wet), and 2003 (Normal Dry/Normal Wet). (Footnote 12 describes the potential significance of these discrepancies.)

In summary, numerous factors (e.g., operational changes, water transfers and acquisitions, recirculation, recapture, and reuse projects) would affect the ultimate change experienced in diversions, water deliveries, and water availability for the water districts in the Friant Division Service Area. Thus, estimates of water reductions contained herein are simply estimates of the *magnitude* of how contract supplies might be reduced based on best available information. Because of the lack of available information and specific plans on possible operational changes, efforts to mitigate reduced Friant deliveries, and the viability of offsetting reduced deliveries, these estimates assume no change in operations and no water supply mitigation projects.

Friant Contract Water Supplies—The Big Picture

Estimated Water Supply Reductions Under the Settlement

Table A-3 displays average district water supplies for Class I and Class II water. The table shows the water supply without the Settlement (which is also shown in **Table A-1**) and the Steiner 2005 and BOR 2006 estimates for how much, on average, the annual water supplies might be reduced under the Settlement. These figures are averages, however, and do not represent the full range of reductions that might be experienced in any given water year. The historical variation is depicted in **Figures A-3** and **A-4** (above). **Figure A-5** uses the BOR 2006 data to show the relationship between the volume of water released for restoration (in green) and the average annual reduction in water deliveries to contractors (in red). The figure illustrates that the restoration flows under the Settlement are higher in wetter years and lower in drier years. As one can see from the figure, the quantity of water for restoration flows and the quantity of water by which deliveries would be reduced are related, but the relationship is not necessarily one-for-one. For instance, in some of the wettest years, much of the restoration flows would be met by flood water releases, not reduced deliveries. Under the Settlement, no water would be released for restoration purposes in the driest of years.

The last column in **Table A-3** provides the estimates of the *average* reductions as a percentage of the *average* contractor's Friant water supply (not contract amount)—a range of 5% to 27%. These percentages represent reduction estimates only for Friant Dam releases, not reduction as a percentage of all the water supply sources (e.g., groundwater sources, other surface water supplies) that a district may have available. The two previous columns in **Table A-3** illustrate that a district's average annual reductions would largely be a function of its ratio of Class I and Class

II supplies. Districts with higher volumes of Class I water might experience less average reductions, *assuming* future guidelines developed by the Secretary of the Interior are based on the same or similar assumptions used in BOR 2006 and Steiner 2005 (i.e., eliminating Class II and §215 supplies before reducing Class I supplies).

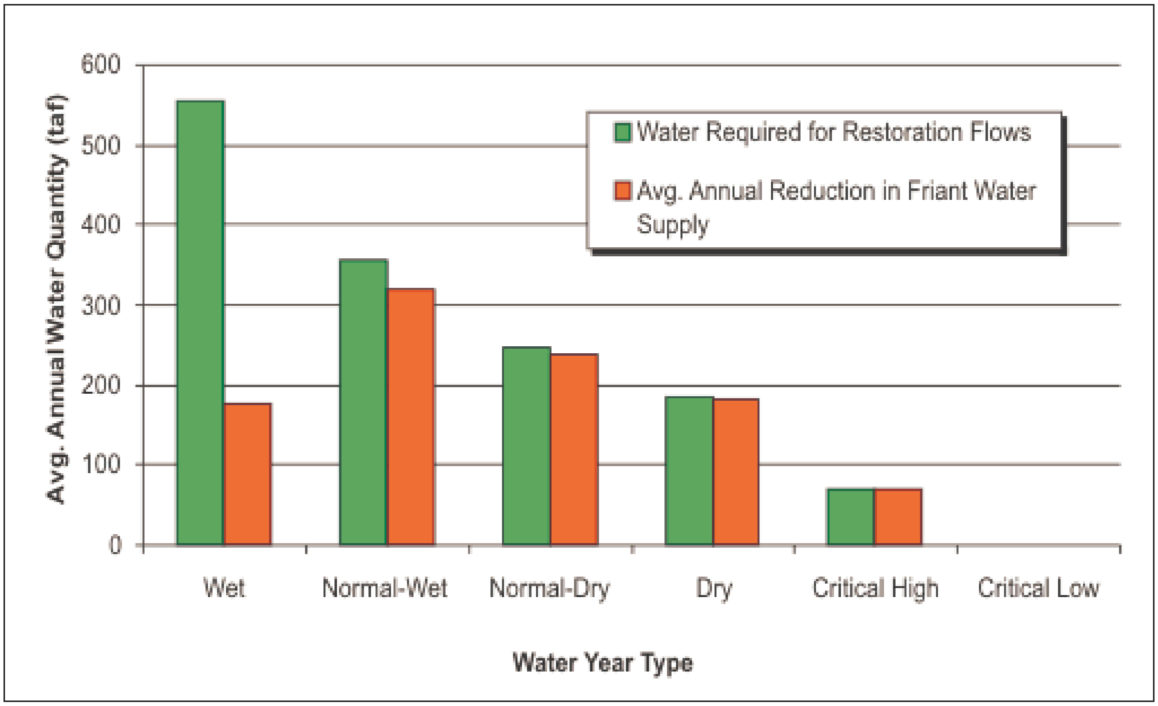
Table A-3. Estimated Average Annual Reductions Average in Friant Water Supplies

Contractors	Avg. Friant Supply w/o Settlement (af)		Avg. Reduction w/ Settlement (af)		Reduction as % of Avg. Supply		
	Class I	Class II	Class I	Class II	Class I	Class II	Total
Friant-Kern Canal							
Arvin-Edison WSD	37,700	87,295	1,915	23,655	5%	27%	20%
Delano-Earlimart ID	102,545	20,866	5,209	5,654	5%	27%	9%
Exeter ID	10,839	5,322	551	1,442	5%	27%	12%
Fresno ID		21,006		5,692		27%	27%
Garfield WD	3,299		168		5%		5%
International WD	1,131		57		5%		5%
Ivanhoe ID	7,257	2,213	369	600	5%	27%	10%
Lewis Creek WD	1,367		69		5%		5%
Lindmore ID	31,103	6,162	1,580	1,670	5%	27%	9%
Lindsay-Strathmore ID	25,919		1,317		5%		5%
Lower Tule River ID	57,681	66,660	2,930	18,063	5%	27%	17%
Orange Cove ID	36,946		1,877		5%		5%
Porterville ID	15,080	8,403	766	2,277	5%	27%	13%
Saucelito ID	19,981	9,187	1,015	2,489	5%	27%	12%
Shafter-Wasco ID	47,125	11,091	2,394	3,005	5%	27%	9%
Southern San Joaquin MUD	91,423	14,004	4,644	3,795	5%	27%	8%
Stone Corral ID	9,425		479		5%		5%
Tea Pot Dome WD	7,069		359		5%		5%
Terra Bella ID	27,333		1,388		5%		5%
Tulare ID	28,275	39,492	1,436	10,701	5%	27%	18%
Madera Canal							
Chowchilla WD	51,838	44,813	2,633	12,143	5%	27%	15%
Madera ID	80,113	52,096	4,070	14,117	5%	27%	14%
San Joaquin River							
Gravelly Ford WD		3,921		1,063		27%	27%
Friant Division M&I							
City of Fresno	56,550		2,873		5%		5%
City of Orange Cove	1,320		67		5%		5%
City of Lindsay	2,356		120		5%		5%

Contractors	Avg. Friant Supply w/o Settlement (af)		Avg. Reduction w/ Settlement (af)		Reduction as % of Avg. Supply		
	Class I	Class II	Class I	Class II	Class I	Class II	Total
Fresno County WWD 18	141		7		5%		5%
Madera County	189		10		5%		5%
SUBTOTALS - CLASS I & II	***754,005***	***392,531***	***38,301***	***106,366***	*5%*	*27%*	*13%*
SUBTOTAL - §215		***134,303***		***63,390***			*47%*
TOTAL - Class I , II & §215	***754,005***	***526,834***	***38,301***	***169,756***			*16%*

Source: Steiner 2005, 1922-2003 data.

Figure A-5. Estimated Restoration Flows and Estimated Reductions in Friant Water Supplies



Source: Restoration flow volumes from Settlement Exhibit B; reduction estimates for 1962-2003, BOR 2006.

Note: For clarity, this figure uses the BOR 2006 data instead of the Steiner 2005. Steiner accounts for the distinction between runoff water year (October to September), the restoration flow year (February to January), and the contract year (March to February). This realistic use of multiple timeframes in the modeling produces odd results when aggregating the information for this figure.

Steiner 2005 and BOR 2006 estimates of average percentage reductions by water year type, which are shown in **Table A-2** and **Figures A-3** and **A-4**, are more fully discussed below. As noted earlier, these figures represent estimates based on no changes in CVP operations or completion of other water management goals and objectives. As such, they are likely to represent the high end of what, *on average*, might be expected. As previously noted and as seen in **Figures A-3** and **A-4**, within each water year category, there exists substantial potential variation in the magnitude of the reduction in contract water supply.

Figures A-6 through **A-8** represent *average* estimated annual water supplies (in blue) and reductions (in red) using the Steiner 2005 data for the period 1962 to 2003. (See Footnotes 1 and 12 for an explanation of the selection of the 1962 to 2003 period.) **Figure A-6** shows in graphic form by water year type the estimated annual reduction in water deliveries under the Settlement, with the red representing the reduction from the water supply without the Settlement and the blue representing the quantity that would be available to contractors under the Settlement. For each water year type, one can see the proportion of water projected to be reduced. **Figure A-7** builds on **Figure A-6** by displaying the proportion of Class I, Class II, and §215 supplies. **Figure A-8** is a blowup of the red portion of **Figures A-6** and **A-7**, depicting the estimated reductions in the three types of supplies.

Figure A-6. Estimated Average Annual Friant Water Supply Under Settlement by Water Year Type

(1962-2003; Steiner 2005)

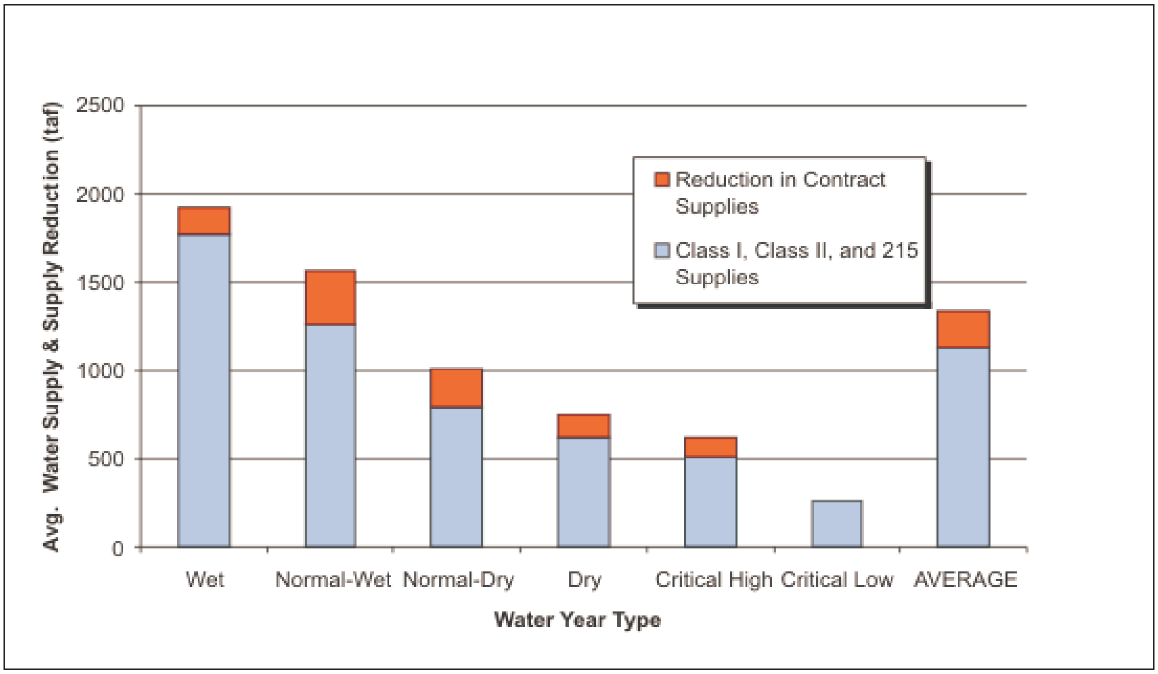


Figure A-7. Estimated Average Annual Water Supply Under Settlement by Water Year Type and Class

(1962-2003; Steiner 2005)

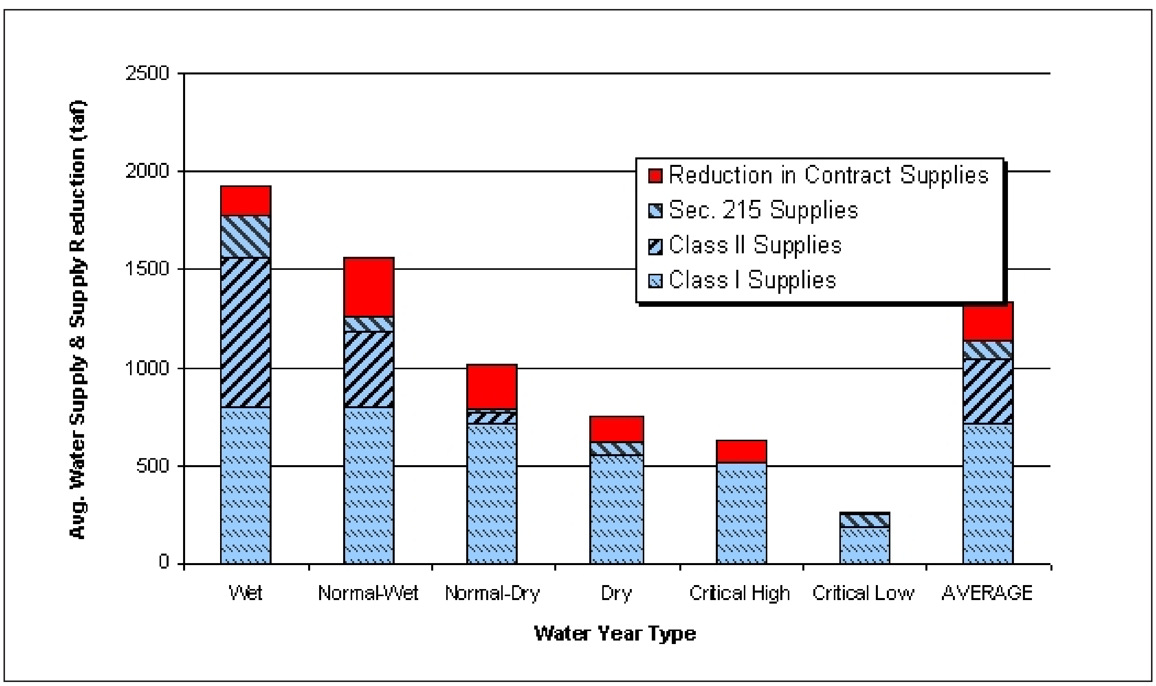
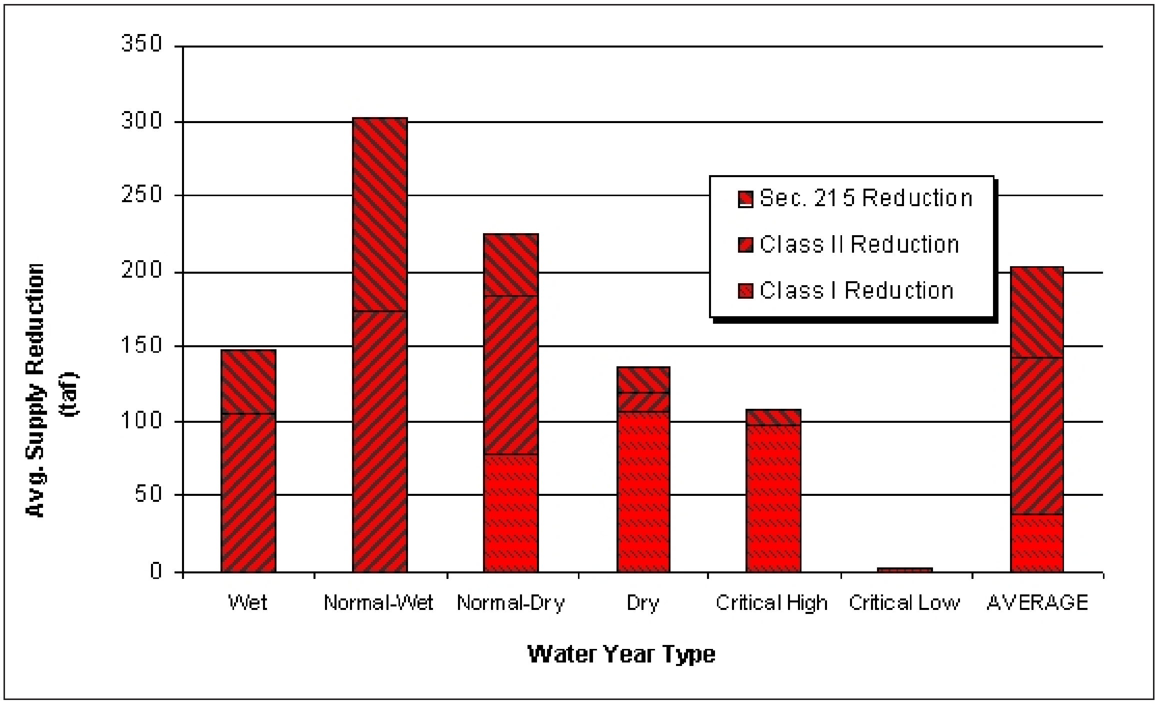


Figure A-8. Estimated Average Reduction in Water Supply by Water Year Type

(1962-2003; Steiner 2005)



Average Annual Impact on Friant Water Supplies

- According to available data for 1962 through 2003, annual water contractor supplies are estimated to be reduced, on average, 204 taf[41] (Steiner 2005) or 225 taf annually (BOR 2006) (see **Table A-2)**, which would represent between 15% and 16% of total average annual water supplies (i.e., including temporary deliveries) for Friant Division contractors.

Annual Impact on Friant Water Supplies by Water Year Type

- *Wet.* Based on data for Wet years between 1962 and 2003, estimated average annual reductions in contract water supplies could be 148 taf (Steiner 2005, **Figure A-8**) and 176 taf (BOR 2006), which could represent an average reduction of 8% or 9% of contractor annual water supplies. The 1962-2003 data in **Table A-2** shows that the variation in the volume of the reduction and the significance of the reduction as a percentage of water supply would vary for Wet years, from 35 taf to 344 taf and from 2% to 17%. In Wet years, Class I supplies generally would be unchanged.
- *Normal-Wet.* Based on data for Normal-Wet years (which have lower runoff than Wet years) between 1962 and 2003, estimated average annual reductions in contract water supplies could be 302 taf (Steiner 2005, see **Figure A-8**) or 320 taf (BOR 2006), which could represent an average reduction of 18% or 19% of annual contract water supplies. The Steiner 2005 data in **Table A-2** shows that

[41] Using a longer period from 1922 to 2003, Steiner 2005 estimated an average annual reduction of 208 taf.

the variation in the volume of the reduction and the significance of the reduction as a percentage of water supply would vary for Normal-Wet years, from 154 taf to 397 taf and from 9% to 29%. In Normal-Wet years, Class I supplies generally would be unchanged.

- *Normal-Dry.* Based on data for Normal-Dry years between 1962 and 2003, estimated average annual reductions in contract water supplies could be 225 taf (Steiner 2005, see **Figure A-8**) or 239 taf (BOR 2006)**,** which could represent an average reduction of 22% or 23% of annual contract water supplies. The Steiner 2005 data in **Table A-2** shows that the variation in the volume of the reduction and the significance of the reduction as a percentage of water supply would vary for Normal-Dry years, from 85 taf to 279 taf and from 8% to 34%.
- *Dry.* Based on data for Dry years between 1962 and 2003, estimated average annual reductions in contract water supplies for like years could be 136 taf (Steiner 2005, see **Figure A-8**) or 181 taf (BOR 2006), which could represent an average reduction of 18% or 25% of annual contract water supplies. The Steiner 2005 data in **Table A-2** shows that the variation in the volume of the reduction and the significance of the reduction as a percentage of water supply would vary for Dry years, from 9 taf to 238 taf and from 2% to 33%.
- *Critical High.* There was only one Critical High year between 1962 and 2003—1976; based on the limited available data, estimated contract water supplies reductions could be 71 taf (BOR 2006) or 108 taf (Steiner 2005, see **Figure A-8**)**,** which could represent 12% or 17% of annual water supplies. In Critical High years, Class I water might be reduced on average by 12% to 17%. Generally no Class II water is supplied in Critical High years with or without the restoration flows called for in the Settlement. Therefore, for Critical High years, generally there is no expected reduction in Class II water resulting from the Settlement. (See **Figure A-8**). Some Critical High years without the Settlement could have § 215 water according to Steiner 2005; these § 215 deliveries generally would not be made under the Settlement. Steiner 2005 modeled 1976 to have 11 taf of § 215 water without the Settlement, and no § 215 water with the Settlement.
- *Critical Low.* No restoration releases are to be made in Critical Low years, thus there generally would be no changes to Friant Division water supplies under the Settlement (see **Figures A-3**, **A-4**, and **A-8**).

To summarize, within each water year type, variation could exist in the quantity and percent reduction in Friant Division water supplies for different contract types (see **Table A-2** and **Figure A-8**). It is unknown whether Reclamation would try to (or could) limit this annual variation.

Friant Water Supplies: The Contractor-Level Picture

The analysis in this section is based on data from Steiner 2005. BOR 2006 provides no estimates of the impact of the Settlement on individual long-term contractors. The longer data set available in Steiner 2005 allows the contractor-level analysis to encompass a longer period—1922 to 2003—than much of the previous section's analysis. Steiner 2005 contractor-level data are available for both Class I and Class II water. Data for §215 water at the contractor-level are not included in Steiner 2005. Therefore, unlike the previous section, the analysis in this section is limited to Class I and Class II water.

As noted earlier, reductions of individual contractors' water supplies under the Settlement depend largely on the contractor's proportion of Class I to Class II contracts and the water year type, which depend on the runoff in a given year.

- The average reduction for Class I contract deliveries is estimated at 5%; the estimated average reduction for Class II deliveries is 27% (see **Table A-3**). The estimated average reduction for §215 deliveries is 47% (Steiner 2005).
- Many districts have both Class I and Class II contracts. Average annual reductions in average annual Class I and Class II water supplies are estimated at

  —5% for the districts with only Class I contracts, representing 46% of the contractors (i.e., 13 of the 28 districts);

  —6% to 15% for 36% of the districts (i.e., 10 of the 28);

  —16% to 20% for 11% of the districts (i.e., 3 of the 28); and

  —27% for the remaining 7% of districts (i.e., 2 of the 28, which are Fresno ID and Gravelley Ford WD) with only Class II contracts. (See **Table A-3**.)
- Under the Settlement, Class I water supplies would not be reduced in Wet and most Normal-Wet years (see **Figure A-8** for no Class I reduction on average); that is, 800 taf generally could be delivered to Class I contractors both currently and under the Settlement.
- Currently, Class I contracts often (but not always) are fully met in Normal-Dry years; with the Settlement, estimates are that Class I contracts would not be fully met in almost half (46%) of the Normal-Dry years (Steiner 2005).
- Currently, Class I contracts generally are not fully met in Dry, Critical High, and Critical Low years (see **Figure A-7** for average Class I deliveries below 800 taf). Under the Settlement, estimates are that Class I water supplies would be lower in Normal Dry, Dry, and Critical High years. (See **Figure A-8**.)
- The Class I deliveries in Critical Low years generally would be unchanged by the Settlement because no restoration releases are made.
- Under the Settlement, estimates are that Class II and §215 water supplies would be lower in Wet, Normal-Wet, and most Normal-Dry years, and somewhat lower in Dry years. (See **Figure A-8**.)
- Class II water generally is not supplied in most Dry and all Critical High and Critical Low years (Steiner 2005); under the Settlement, this would not change.

In Summary

The ultimate effect of increased releases for fish restoration efforts from Millerton Lake on Friant water deliveries is difficult to predict. Using available data (which does not account for any improvements in water management that may dampen the Settlement's impact on agricultural and municipal users), it appears that annual water supplies for the Friant Division Service Area would be, *on average*, 15% to 16% less under the Settlement, than average supplies under current operating protocols. Although the average reduction could be 15-16%, water supply reductions could be as little as no reduction, to as high as 34% reduction in some years.

For three-quarters of the Friant contractors, the reductions in Friant Division deliveries represents a reduction in one of multiple supplies. The level of reductions experienced by individual water districts would vary depending on their water service contracts. Existing data assumes Reclamation reduces "supplemental" water deliveries before first priority deliveries. These data estimate average annual reductions in the Friant Division long-term water service contract deliveries for individual Friant water districts range to vary between 5% and 27%—the low range being cutbacks to Class I contract supplies (46% of contractors) and the high range applicable to those with only Class II contract supplies (7% of contractors). All districts with supplemental Friant Division contracts (known as Class II contracts) have groundwater or other surface water supplies.

It remains unclear to what extent water reductions might be offset by projects and programs implemented pursuant to the Settlement, and at what cost. It is possible that a portion of the cutbacks could be mitigated via efficiency gains, water marketing (including voluntary sales and transfers), water pricing, groundwater storage and banking, or new infrastructure development. However, the viability of further improving efficiencies in the Friant Division, securing funding, and attaining both the restoration and water management goals is uncertain and would depend on many factors.

Appendix B.

Table B-1. Studies of the Negative Effects of Lower Water Deliveries to Agriculture in the San Joaquin Valley

	UC (1996)	NEA (1997)	McKusick (2005)	Hanemann (2005)
Purpose	Future effects of water cutbacks from eastside SJV (200 TAF annually).	Future effects of water cutbacks from eastside SJV (200 TAF annually).	Future effects of water cutbacks from Friant (avg. 142 TAF).	Future effects of water cutbacks from Friant (avg. 142 TAF).
Crops	12 crop categories (field crops, fruit, nuts, and vegetables).	12 crop categories (field crops, fruit, nuts, and vegetables).	10 crop categories (field crops, fruit, nuts, and vegetables) and dairies.	10 crop categories (field crops, fruit, nuts, and vegetables) and dairies.
General approach	Central Valley Production Model (CVPM), groundwater equations, input-output model.	Modified CVMP with other groundwater data and costs, with input-output multipliers.	Friant Division Production Model (FDMP), with input-output model.	Modified FDMP, with adjusted groundwater and other input data.
Acreage loss	67,200 acres (full water year) 733,600 acres (drought year)	172,900 acres (drought year)	51,320 acres (2025)	51,400 acres (no trading) 7,200 acres (w/trading)
Loss farm revenue	\$41.7 million (water year) \$578.4 million (drought year)	\$179.8 million (drought year)	\$159.3 million (2025)	n/a
Farm cost increase	n/a	\$109.8 million (drought year)	\$11.4 million (crops); \$2.3 million (dairies).	n/a
Profit loss	avg. -0.4% (water year); avg. -6.7% (drought yr)	n/a	n/a	avg. -3% (no trading) avg. -2% (w/ trading)
Other loss (regional)	\$6.2 million (water yr) \$99.8 million (drought)	n/a	\$85.1 million (personal income loss)	n/a
Affected crop acres	cotton, hay/pasture, grains, alfalfa, field crops	cotton, alfalfa hay, field crops, irrigated pasture	cotton, vegetables, hay/pasture, citrus	annual crops
Affected counties	Madera, Tulare, Kern	Fresno, Tulare, Kern	Kern (Arvin Edison), Tulare, Madera, Merced.	n/a

	UC (1996)	NEA (1997)	McKusick (2005)	Hanemann (2005)
Benefits	n/a	n/a	n/a	>1$billion
Job losses	1,229 jobs (full water year) 17,925 jobs (drought year)	10,420 jobs (drought year)	3,210 jobs (2025)	n/a

Source: Compiled by CRS. Citations for studies reviewed:

UC (1996)—C. Brown, G. Goldman, R. Howitt, and J. Siebert, *Impacts of Water Reallocations on the Eastern San Joaquin Valley*, University of California, December 1996; also C. Brown, G. Goldman, R. Howitt, and J. Siebert, "The Use of IMPLAN with a Water Allocation and Production Model," presented at the National IMPLAN Conference, Minneapolis, August 1996.

NEA (1997)—Northwest Economic Associates, *Analysis of the Impacts of Surface Water Reductions on the Eastern San Joaquin Valley of California*, August 1997.

McKusick (2005)—Robert B. McKusick, *Economic Impact of Reduced Surface Water Deliveries in the Friant Division of the Central Valley Project* (including a supplemental September 2005 report), ENTRIX Inc., September 2005.

Hanemann (2005)—Michael Hanemann, *Rebuttal Expert Report*, University of California, Berkeley, 2006.

Notes: n/a = not available (usually not computed by study under review).

"TAF" = thousand acre feet (1 acre foot equals approximately 325,900 gallons of water).

Table B-2. Comparison of Studies of the Negative Effects of Drought Conditions to SJV Agriculture

	NEA (1993)	RAND (1998)	Bazdarich and Thornberg (2006)	Villarejo (2004)
Purpose	Historical effects of 1987-89 drought in all SJV counties.	Historical effects of 1987-89 drought in Fresno and Kern counties.	Historical effects of 1987-91 drought in SJV (Fresno, Kern, Tulare).	Historical effects of reduced water supplies in 2001-2003 (westside SJV).
Crops	n/a	3 crop categories (field crops, fruit/nuts, vegetables).	Aggregate regional farm output in each county.	3 crop categories (field crops, fruit/nuts, vegetables).
General approach	Descriptive approach to assess farm revenue loss and increased farm costs	CVMP and "Rationing" models, comparing 1991 to 1987-1989 baseline.	Econometric model of aggregate farm output, isolating drought effects.	Analysis of acreage data, comparing reduction in 2001-2003 to 1998-2000 baseline.
Acreage loss	172,000 acres (idle) 33,300 acres (yield loss)	56,000 acres to 83,000 acres, compared to baseline.	n/a	42,500 fallow acres, compared to baseline.
Loss farm revenue	$157.1 million	$9.8-$53.8 million, compared to baseline.	$121 million (1991)	$58.7 million, compared to baseline; plus farm closures

	NEA (1993)	RAND (1998)	Bazdarich and Thornberg (2006)	Villarejo (2004)
Farm cost increase	about $259 million (ground and surface water costs)	n/a	n/a	n/a
Profit loss	n/a	n/a	n/a	n/a
Other loss (regional)	$144.6	n/a	$155.3 million (loss)	$83.2 million (including loss to agriculture service sector)
Affected crop acres	most field crops	most field crops	n/a	field crops, most bean crops, processing tomatoes, onions, beets, garlic, and melons
Affected counties	n/a	n/a	Fresno, Kern, Tulare (not all statistically significant)	n/a
Benefits	n/a	n/a	$167.9 million (offsets); net gain $12.6 million[a]	n/a
Job losses	3,900 jobs (farm and region)	n/a	n/a	750 jobs

Source: Compiled by CRS. Citations for studies reviewed:

NEA (1993)—Northwest *Economic Associates, Economic Impacts of the 1992 California Drought and Regulatory Reductions on the San Joaquin Valley Agricultural Industry*, December, 1993.

RAND (1998)—L. Dale, and L. Dixon, *The Impact of Water Supply Reductions on San Joaquin Valley Agriculture During the 1986-1992 Drought*, RAND Corporation, 1998, accessed August 15, 2007 at http://www.rand.org/pubs/monograph_reports/2005/MR552.pdf.

Bazdarich and Thornberg (2006)—Bazdarich, M., and C. Thornberg, "Benefits and Costs for California from Water Transfers," October 2006, accessed August 15 at http://www.beaconecon.com/products/White_Papers/watertransfers.pdf

Villarejo (2004)—D. Villarejo, *Jobless After a Man-made Drought*, prepared for the Fresno County Economic Opportunities Commission and the Fresno County Workforce Investment Board, August 31, 2004.

Notes: n/a = not available (usually not computed by study under review).

"TAF" = thousand acre feet (1 acre foot equals approximately 325,900 gallons of water).

a. Calculated by CRS based on reported farm sector losses and nonfarm sector gains for Fresno, Kern, and Tulare. 1991 estimates.

Author Contact Information

(name redacted), Coordinator
Specialist in Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

(name redacted), Coordinator
Analyst in Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Specialist in Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Specialist in Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Specialist in Energy and Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

Renee Johnson
Specialist in Agricultural Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Specialist in Environmental Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Analyst in Natural Resources Policy
#redacted#@crs.loc.gov, 7-....

(name redacted)
Legislative Attorney
#redacted#@crs.loc.gov, 7-....