provide flow to the SJR which continues through to the Delta. The east-side rivers, including the Merced River, Stanislaus River, and Tuolumne River, typically provide high quality Sierra water to the SJR. The west-side tributaries beginning at Mud and Salt Sloughs are dominated, especially during the summer, fall and winter, by agricultural tail water and subsurface drain flows that contain elevated concentrations of a variety of pollutants. Table 1 presents a summary of currently known and suspected contaminants of water quality concern in the SJR between Lander Ave. and the Delta.

Table 1. San Joaquin River Watershed TMDLs
Updated from Lee and Jones-Lee (2002)

Current (Active)
- Selenium
- Salinity at Vernalis, Total Dissolved Solids (TDS), Electrical Conductivity (EC)
- Boron
- Organophosphorus (OP) Pesticides (Diazinon, Chlorpyrifos)
- Oxygen-Demanding Substances (BOD/Algae, Ammonia, Organic N)

Pending (to be Developed)
- Organochlorine "Legacy" Pesticides (DDT, Chlordane, Dieldrin, Toxaphene, etc.)
- PCBs
- Dioxins/Furans
- Mercury
  - Sulfate (Bioaccumulation of Mercury)
- Pathogen-Indicator Organisms, *E. coli,* Fecal Coliforms
- Toxicity of Unknown Cause
- Salinity Upstream of Vernalis

Potential Future (to be Evaluated)
- Nutrients, Excessive Fertilization (Nitrogen and Phosphorus Compounds)
  - High pH, Low DO caused by Excessive Fertilization (Photosynthesis/Respiration)
- Alternative Pesticides to OP Pesticides including the Pyrethroid-Based Pesticides that are Causing Water Column and Sediment Toxicity
- PBDEs
- Total Organic Carbon, and other Chemicals such as Bromide that Develop into Disinfection Byproducts (Trihalomethanes) in Treated Domestic Water Supplies
- Excessive Sediment, Erosion, Turbidity
- Herbicides (toxicity to algae)
- Aquatic Sediment Toxicity (Pesticides, Nutrients/Algae/Sediment Ammonia, Heavy Metals, PAHs and other Chemicals)
- Unrecognized Pollutants
  - Pharmaceuticals and other Unregulated Chemicals Discharged by Confined Animal Facilities (dairies, feedlots, etc.) and Domestic Wastewaters

[updated from: Lee, G. F. and Jones-Lee, A., "An Integrated Approach for TMDL Development for Agricultural Stormwater Runoff, Tailwater Releases and Subsurface Drain Water," Proc. 2002 Water Management Conference, "Helping Irrigated Agriculture Adjust to TMDLs," pp. 161-172, US Committee on Irrigation and Drainage, Denver, CO, October (2002). http://www.gfredlee.com/tmdl_07.2002.pdf]

Increasing the flow of the SJR through Friant Dam releases as part of the SJR restoration will impact water quality in the SJR including the levels of the pollutants listed in Table 1. Lee and Jones-Lee (2006) reported,

> **"*Impact of Friant Dam Water Releases***
> *The Karlton (2004) court order states that the Department of Interior's failure to release sufficient water from Friant Dam to keep historic salmon fisheries in good condition violates California Fish and Game Code §5937. Judge Karlton established a February 2006 date for a hearing to consider the "remedy" for this violation, including the flows needed to restore the upper SJR fisheries and bring the operation of Friant Dam into compliance with the law. During the summer and early fall of most years, the SJR at the confluence with the Merced River largely consists of irrigation return (tailwater) flow. This results in the water in the SJR being of poor quality, with several known water quality objective (WQO) violations.*
>
> *"Since the magnitude of the corrective actions that will be needed to address these water quality problems will be dependent on the flow of the SJR, the releases of water from Friant Dam to restore fisheries will have ancillary effects on these water quality issues. Without increased flows from Friant Dam, a number of costly and arguably extreme control measures will be required to meet current and likely future WQOs. For the urban and agricultural interests affected by these measures, releases from Friant will be beneficial by helping to provide for less onerous pollutant control programs.*
>
> *"A key issue that will need to be addressed is the need, through permit conditions and/or other Water Rights mechanisms, for the Bureau of Reclamation to ensure that any new releases from Friant Dam to the SJR for the purpose of meeting instream flow needs for fisheries will be allowed to persist (i.e., not be diverted) throughout the SJR to at least Turner Cut in the Stockton Deep Water Ship Channel.*
>
> *"In accordance with Clean Water Act requirements, exceedance of a WQO means that action must be taken to eliminate the WQO violation. Since the quality of water in Millerton Lake is high, release of water from Friant Dam to the SJR channel that is allowed to pass all the way to the Delta and SJR Deep Water Ship Channel will dilute the concentrations of the pollutants in SJR water that are causing WQO violations. Reductions in the concentrations of pollutants by Friant releases to the SJR channel will reduce the cost of pollutant control programs that public agencies (including the USBR), municipalities and agricultural interests will have to fund to comply with Clean Water Act requirements. This is one of the substantial benefits of restoring releases of Friant Dam water to the SJR."*
>
> [Reference: Karlton, L. K., Order, No. Civ. S-88-1658 LKK, Natural Resources Defense Council, et al., Plaintiffs, vs. Roger Patterson, etc., et al., Defendants, US District Court, Eastern District of California, August 26 (2004).]

Scope of the SJR Restoration EIS/EIR

In previous writings,

> Lee, G., F., and Jones-Lee, A., "Need for Reliable Water Quality Monitoring/ Evaluation of the Impact of SWRCB Water Rights Decisions on Water Quality in the Delta and Its Tributaries," Submitted to CA Water Resources Control Board Workshop on D-1641 Water Rights, Sacramento, CA, March 22 (2005). http://www.members.aol.com/annejlee/DeltaWaterExportImpactsPaper.pdf
>
> Lee, G., F., and Jones-Lee, A., "Need for Reliable Water Quality Monitoring/Evaluation of the Impact of SWRCB Water Rights Decisions on Water Quality in the Delta & Its Tributaries," PowerPoint Slides Submitted to CA Water Resources Control Board Workshop on D-1641 Water Rights, Sacramento, CA, March 22, (2005). http://www.members.aol.com/annejlee/DeltaWaterExportImpactsPowerPoint.pdf

we have discussed the need for all water rights deliberations to include specific review of the impacts of altering water flow on water quality. The SJR Restoration Project EIS/EIR should include a comprehensive discussion of the impacts of Friant Dam releases that are made in accord with the Court order, as well as any other manipulations of flow in the SJR made as part of the Restoration Program, on water quality in the SJR and the Delta. Of particular concern will be any components of the SJR Restoration Program that would include or allow Friant Dam releases to be diverted from the SJR before they reach Turner Cut in the Delta Deep Water Ship Channel. Any such diversions would be adverse to improving the water quality in the SJR as a result of the restoration program releases of flows from Friant Dam.

The EIS/EIR should include an assessment of the impact of flow diversions that would be adverse to SJR water quality improvements that would otherwise occur if the diversions did not take place. Also needing discussion is the economic impact to SJR watershed NPDES dischargers, such as cities and industry as well as agricultural interests, that would be associated with diversions of Friant Dam released flow that would otherwise improve water quality in the SJR and thereby reduce the cost of wastewater treatment and stormwater runoff management. Further, the EIS/EIR should include a discussion of the follow-up monitoring/studies that will be needed to fully evaluate the impact of the Friant Dam flow releases and other flow alterations on all aspects of water quality, including the parameters listed in Table 1.

If there are questions about the background reports that we have developed or these comments please contact us.

G. Fred Lee
Anne Jones-Lee

To: Margaret Gidding
Bureau of Reclamation
2800 Cottage Way MP-140
Sacramento, CA 95825-1898

From: Jesse Limas Sr.
9090 Warren Rd
Valley Springs, CA 95252

Ms. Gidding, I am writing to comment in regards to the planning for the San Joaquin River Restoration. I am 59 years old and grew up accessing the river and the associated bottom lands hunting and fishing. I can remember as a boy seeing the banks of the river covered by anxious fisherman catching salmon and then a year or two latter going to the same location with no fisherman or salmon at the same fall time of the year. It has been a sad state of affairs with the rape of the San Joaquin and hopefully we will see her regain some of the beauty she used to have. I am an avid sportsman and have 4 sons and 2 daughters along with my wife who are all avid sportsman. We wish to see the San Joaquin be open with easy access points and open for multiple use including hunting and fishing. I and my boys are all waterfowlers and we often access the North Freitas Unit of the San Luis NWR Complex from the San Joaquin on down to Salt Slough and also access from the South Frietas Unit onto Salt Slough. This relatively small area still has some of the beauty of the old San Joaquin and we love it dearly and are very pleased that after years of litigation a change is on the way. Please do not lock hunters and fisherman who are extremely vested in the rebirth of this system out of this wonderful resource.

Sincerely,

Jesse Limas Sr.

faxed to Marvin
9/4

email from Karen to Morgan 9/24

State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
Central Region
1234 East Shaw Avenue
Fresno, California 93710
(559) 243-4005

September 21, 2007

Karen Dulik
Department of Water Resources
San Joaquin District
3374 East Shields Avenue
Fresno, California 93726

Dear Ms. Dulik:

Notice of Preparation (NOP) of a Draft Program Environmental Impact Statement/Environmental Impact Report (PEIS/EIR) for the San Joaquin River Restoration Program (SCH No. 2007081125)

The California Department of Fish and Game (Department) has reviewed the NOP for the Project referenced above. The San Joaquin River Restoration Program (SJRRP) is a result of the lawsuit, known as Natural Resources Defense Council, et al., v. Kirk Rodgers, et al., for which a settlement was reached on September 13, 2006 (hereafter referred to as "Settlement"). The SJRRP has two parallel goals of restoring fish populations in "good condition" and the reducing or avoiding adverse water supply impacts to all the Friant Division long-term contractors, resulting from flows provided for in the Settlement. The goals include improvements providing for channel capacity, fish habitat, flood protection, fish passage, fish screening, flows conducive to restoration, restoration and maintenance of fish populations in "good condition" from Friant Dam to the confluence of the Merced River, implementation of a water recirculation, recapture, reuse, exchange or transfer plan, and the creation of a Recovered Water Account to make water available at a reduced rate for contractors that experience a reduction in water supplies as a result of the Settlement. The Project area is defined as approximately 150 miles of the San Joaquin River from Friant Dam, near the town of Friant, to the confluence with the Merced River through Fresno, Madera and Merced Counties and the Friant Service Area. Program activities will be carried out in three stages including: 1) planning and environmental review; 2) initiation of interim flows, salmon reintroduction and river improvements; and 3) initiation of restoration flows. Physical and biological impacts to the environment may include cumulative impacts and impacts to the following resources: hydrology, water quality, water supply, flood control, land use, agricultural resources, mineral resources, noise, public utilities, power consumption, wetlands, rare and sensitive plant and animal species, geology, soils, socioeconomics, population, housing, transportation, traffic, air quality, cultural resources, aesthetics, flood protection and recreation. Our specific comments on the NOP follow.

Trustee Agency Authority: The Department is a Trustee Agency with the responsibility under the California Environmental Quality Act (CEQA) for commenting on projects that could impact plant and wildlife resources. Pursuant to Fish and Game Code Section 1802, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species. As a Trustee Agency for fish and wildlife resources, the Department is responsible for providing, as available, biological expertise to review and comment on environmental documents and impacts

arising from Project activities, as those terms are used under CEQA. The Department also has existing plans for restoring steelhead rainbow trout and salmon which are posted on our web page at www.dfg.ca.gov which may be useful in the preparation of the Draft PEIS/EIR.

Responsible Agency Authority: The Department has regulatory authority over projects that could result in the "take" of any species listed by the State as threatened or endangered, pursuant to Fish and Game Code Section 2081. If the Project could result in the "take" of any species listed as threatened or endangered under the California Endangered Species Act (CESA), the Department may need to issue an Incidental Take Permit for the Project. CEQA requires a Mandatory Finding of Significance, if a project is likely to substantially impact threatened or endangered species (Sections 21001{c}, 21083, Guidelines Sections 15380, 15064, 15065). Impacts must be avoided or mitigated to less than significant levels unless the CEQA Lead Agency makes and supports Findings of Overriding Consideration (FOC). The CEQA Lead Agency's FOC does not eliminate the Project proponent's obligation to comply with Fish and Game Code Section 2080. State-listed species known to occur or potentially occur in the Project area vicinity include, but are not limited to, the State threatened and Federally threatened spring-run Chinook salmon (*Oncorhynchus tshawytscha*); the State and Federally endangered and fully protected blunt-nosed leopard lizard (*Gambelia sila*); the State and Federally threatened giant garter snake (*Thamnophis couchi gigas*); the State threatened bank swallow (*Riparia riparia*); the State endangered yellow-billed cuckoo (*Coccyzus americanus occidentalis*); the State threatened Swainson's hawk (*Buteo swainsoni*); the State endangered, Federally delisted, and fully protected bald eagle (*Haliaeetus leucocephalus*); the State and Federally endangered least Bell's vireo (*Vireo bellii pusillus*); the State threatened and Federally endangered San Joaquin kit fox (*Vulpes macrotis mutica*); the State and Federally endangered Fresno kangaroo rat (*Dipodomys nitratoides exilis*); the State and Federally endangered riparian brush rabbit (*Sylvilagus bachmani riparius*); and the State endangered Delta button-celery (*Eryngium racemosum*). Additional State-listed plants are known to occur in the vernal pool habitat, adjacent to the San Joaquin River near Friant but, absent detailed Project-specific information, the Department is assuming at this time, that these areas would not be disturbed by Project-related activities or that they would be included in focused CEQA documents. We have some general comments on the potential for Project-related "take" which follows in subsequent portions of this letter. More specific comments will be provided once Project-specific details and Project-specific CEQA documents are available for review.

If it is determined that implementation of the proposed Project would result in "take" of State-listed species, the Department needs the Lead Agency's CEQA document to identify the Department as a Responsible Agency in this capacity, as well as the potential impacts to listed species; otherwise, preparation of a supplemental CEQA document may be necessary prior to Incidental Take Permit issuance. It is important to note that for State-listed species that are not also listed under the Federal Endangered Species Act (FESA), the Department cannot issue a Consistency Determination, pursuant to Fish and Game Code Section 2080.1. In order to obtain an Incidental Take Permit, the applicant will need to: 1) provide an analysis of the impact of the proposed taking; 2) provide an analysis of whether issuance of an Incidental Take Permit would jeopardize the continued existence of the covered species; 3) propose measures that minimize and fully mitigate the impacts of the proposed taking; 4) provide a proposed plan to monitor compliance with the minimization and mitigation measures; and 5) provide a description

of the funding source and level of funding available for implementation of the minimization and mitigation measures. The Department can provide a complete list of required Incidental Take Permit application components upon request.

The Department also has regulatory authority with regard to activities occurring in streams and/or lakes that could adversely affect any fish or wildlife resource, pursuant to Fish and Game Code Section 1600 et seq. For future construction activities that would involve work within the bed, bank or channel or would substantially divert or obstruct the natural flow of the San Joaquin River, its tributaries, or other drainages, a Stream Alteration Agreement (SAA) would be necessary, and the Project proponent would be required to submit a Stream Alteration Notification to the Department for the Project. The Department is required to comply with CEQA in the issuance or the renewal of an SAA. Therefore, for efficiency in environmental compliance, we recommend that the stream disturbance be described, and mitigation for the disturbance be developed as part of the environmental review process. This will reduce the need for the Department to require extensive additional environmental review for an SAA for this Project in the future. For additional information on notification requirements, please contact our staff for the Stream Alteration Program at (559) 243-4593.

Fully Protected Species: The Department has jurisdiction over fully protected species of birds, mammals, amphibians and reptiles, and fish, pursuant to Fish and Game Code Sections 3511, 4700, 5050, and 5515. "Take" of any fully protected species is prohibited, and the Department cannot authorize their "take." Four fully protected species, the blunt-nosed leopard lizard, bald eagle, golden eagle (*Aquila chrysaetos*), and the white-tailed kite (*Elanus leucurus*), are known to occur within all or portions of the Project area. In order to conduct Project-specific CEQA analysis and also to insure complete avoidance prior to implementation of any Project-specific actions, focused biological surveys would be needed to evaluate potential impacts and to develop appropriate avoidance and minimization measures.

Bird Protection: The Department has jurisdiction over actions which may result in the disturbance or destruction of active nest sites or the unauthorized "take" of birds. Sections of the Fish and Game Code that protect birds, their eggs and nests include Sections 3503 (regarding unlawful "take", possession or needless destruction of the nest or eggs of any bird), 3503.5 (regarding the "take", possession or destruction of any birds-of-prey or their nests or eggs), and 3513 (regarding unlawful "take" of any migratory non-game bird). This Fish and Game Code Section pertains to, but not exclusively, burrowing owls (*Athene cunicularia*), which are known to nest along various San Joaquin River system levees, such as, but not limited to, levees along the Eastside and Chowchilla Bypasses. In order to conduct Project-specific CEQA analysis and also to ensure complete avoidance of active nests and individuals, prior to implementation of any Project-specific actions, focused biological surveys would be needed to evaluate potential impacts and to develop appropriate avoidance and minimization measures.

Potential Project Impacts and Recommendations

Delta Button-Celery: This State endangered plant is known to be locally abundant in portions of the Eastside Bypass, and any major construction activities, as well as significantly modified hydrology within this area would likely result in "take." This species occurs in clay soils on sparsely vegetated margins of seasonally flooded floodplains and swales. About one-fourth of the approximately 27 historically known Delta button-celery occurrences have been extirpated

by flood control activities and conversion of lowlands to agriculture, and most of this species' remaining occurrences are in Merced County, along the historical floodplain of the San Joaquin River. Project-specific CEQA documents should evaluate the potential impacts to this species, not only direct impacts that could result from construction, but also from altered hydrology that could result in plant mortality or localized extirpation.

Fishery Resources: The Settlement specifically targets spring-run Chinook salmon (State threatened) and fall-run Chinook salmon for restoration. The Settlement also identifies other fish without specificity and states that the goal is to "restore and maintain fish populations in 'good condition'...including naturally-reproducing and self-sustaining populations of salmon and other fish." Presumably, this would include native anadromous and resident fish that may have occupied the Project area prior to construction of Friant Dam or may be expected to occupy the Project area as a result of Project restoration. Without more information, it is not possible to identify these "other fish." However, based upon limited information, other fish may include, but are not limited to, the State Species of Concern river lamprey (*Lampetra ayresii*), Kern brook lamprey (*Lampetra hubbsi*), green sturgeon (*Acipenser medirostris*), hardhead (*Mylopharodon conocephalus*), San Joaquin roach (*Lavinia symmetricus ssp.*), and Sacramento splittail (*Pogonichthys macrolepidotus*).

It will also be necessary to evaluate impacts to fishery resources outside the identified Project area. Potential Project-related impacts should be evaluated for, but not limited to, managed aquatic resources in the Lower San Joaquin River tributaries and the Sacramento-San Joaquin Delta, including fall/late-fall-run Chinook salmon (Central Valley ESU), a State and Federal Species of Concern. This includes current and ongoing Department management activities for fall-run Chinook salmon in the lower main stem San Joaquin River and its tributaries, Vernalis Adaptive Management Plan (VAMP) studies, and the broad array of mitigation efforts and studies in the lower San Joaquin River system. Furthermore, recreation impacts should be evaluated throughout the San Joaquin River system, including, but not limited to, potential impacts to the Millerton Lake fishery, which currently supports populations of fish popular with the sport fishing community, such as striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*) and spotted bass (*Micropterus punctulatus*).

Blunt-Nosed Leopard Lizard: This species is fully protected, and therefore, no "take," incidental or otherwise, can be authorized by the Department. There are upland habitat remnants scattered throughout the Project area that could support this species. While current observations of this species north of Fresno County are rare, there have been recent sightings of this species in remnant grasslands in Madera County, and potential habitat also exists in portions of the Chowchilla Bypass as well as the general vicinity of the proposed Mendota Pool Bypass. Protocol-level surveys should be conducted and results submitted to the Department, prior to any ground-disturbing activities in all areas of suitable habitat. Suitable habitat includes all grassland, shrub scrub, and potential riparian shrub scrub habitat that contains required habitat elements, such as small mammal burrows. This includes the area to be disturbed, as well as access points, travel routes, and an appropriate buffer. These surveys, the parameters of which were designed to optimize detectability, must be conducted to reasonably assure the Department that "take" of this fully protected species will not occur as a result of disturbance associated with Project implementation. In the event that this species is detected during protocol-level surveys, consultation with the Department is warranted to discuss how to implement the Project and avoid "take."

Swainson's Hawk: This State threatened species is known to nest in multiple locations throughout the Project area, and given the narrow strip of riparian habitat present along most of the San Joaquin River, it is likely that implementation of any Project-specific actions would result in impacts to known and/or potential nest trees. The Department considers removal of known raptor nest trees, even outside of the nesting season, to be a significant impact under CEQA and, in the case of Swainson's hawk, could also result in "take" under CESA. This is especially true with species such as Swainson's hawk that exhibit high site fidelity to their nest and nest trees year after year. If avoidance of a known nest tree is not feasible, consultation with the Department is warranted prior to taking any action, and a determination of "take" potential, under CESA or Fish and Game Code Sections 3503.5 and 3513, will be made.

To avoid or minimize impacts to Swainson's hawk, surveys for nesting raptors should be conducted following the survey methodology developed by the Swainson's Hawk Technical Advisory Committee (SWHA TAC, 2000) prior to any disturbance within 5 miles of a potential nest tree (DFG, 1994). These surveys, the parameters of which were designed to optimize detectability, should be conducted to reasonably assure the Department that "take" of this species will not occur as a result of disturbance associated with Project implementation. In the event that this species is detected during protocol-level surveys, consultation with the Department is warranted to discuss how to implement the Project and avoid "take."

Regardless of nesting status, trees that must be removed should be replaced with an appropriate native tree species planting at a ratio of 3:1 in an area that will be protected in perpetuity. This mitigation is needed to offset potential impacts to the loss of potential nesting habitat, which is a limited resource for this species throughout the Project area.

Should Project-related impacts to upland habitat within foraging distance (10 miles) of a nest occur, mitigation for upland habitat impacts is warranted. Mitigation should occur within 10 miles from nest trees. In addition to fee title acquisition of grassland habitat, mitigation could occur by the purchase of conservation or suitable agricultural easements. Suitable agricultural easements would include areas limited to production of crops such as alfalfa, dry land and irrigated pasture, and cereal grain crops. Vineyards, orchards, cotton fields, and other dense vegetation do not provide adequate foraging habitat.

Bald Eagle: This State endangered and fully protected species is known to nest along the Chowchilla Bypass and could nest at other locations within the Project area. It has also been routinely observed along the Merced River near Snelling, indicating that this species may also be present along the main stem of the San Joaquin River. It is important to note that the documented nest trees are not those "typically" used by this species. As noted above, in order to conduct Project-specific CEQA analysis and also to ensure complete avoidance prior to implementation of any Project-specific actions, focused biological surveys would be needed to evaluate potential impacts and to develop appropriate avoidance and minimization measures for this species.

Burrowing Owl: Burrowing owl burrows and burrowing owls are present in the Project area. The PEIR prepared for this Project should identify potential Project-specific actions that could impact burrowing owl populations, as well as portions of the Project area that are currently known to support burrowing owls. If any Project-specific ground-disturbing activities could occur

during the burrowing owl nesting season (approximately February 1 through August 31), implementation of avoidance measures would be required. The Department's Staff Report on Burrowing Owl Mitigation (CDFG 1995) recommends that impacts to occupied burrows be avoided by implementation of a no-construction buffer zone of a minimum distance of 250 feet, unless a qualified biologist, approved by the Department, verifies through noninvasive methods that either: 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival. Failure to implement this buffer zone could cause adult burrowing owls to abandon the nest, cause eggs or young to be directly impacted (crushed), and/or result in reproductive failure. Impacts of this nature are violations of Fish and Game Code Sections 3503, 3503.5, 3513 and the Federal Migratory Bird Treaty Act (MBTA).

The Department's Staff Report on Burrowing Owl Mitigation (CDFG 1995) also recommends that a minimum of 6.4 acres of foraging habitat per pair or unpaired resident burrowing owl should be acquired and permanently protected to offset the loss of foraging and burrow habitat.

Fresno Kangaroo Rat: The Fresno kangaroo rat (*Dipodomys nitratoides exilis*) has not been observed since 1992, when a single male was captured at the Department's Alkali Sink Ecological Reserve (ASER). Habitat for this species is described as sands and saline sandy soils in chenopod scrub and annual grassland communities on the valley floor. There are upland habitat remnants scattered throughout the Project area that could potentially support this species, such as the area north of Highway 180 near ASER. This appears to be the area proposed for the potential Mendota Pool Bypass. Because this potentially extinct subspecies could occur in specific portions of the Project area, the Department recommends that protocol-level surveys with all night trapping (with trap checks every 3 hours) be conducted on portions of the Project in specific areas where the Project footprint (construction and flooding) would impact kangaroo rat burrows. The Department will assist in identifying habitat areas that could support this species once Project-specific information is available. If this species is detected during trapping surveys, consultation with the Department is warranted. Any occupied habitat should be completely avoided to avoid the potential for a Jeopardy determination, and the occupied habitat should be permanently protected with conservation easements or fee title acquisition.

San Joaquin Kit Fox (SJKF): SJKF are known to occur in the Project area, including, but not limited to, areas within the Chowchilla and Eastside Bypasses. Kit fox readily forage in areas under agricultural production, but do not generally persist in these areas unless denning habitat is present nearby. Upland Habitat Recovery Action (a)(ix) of the Recovery Plan for Upland Species of the San Joaquin Valley (1998) is to "maintain and enhance movement of kit foxes between the Mendota Area, Fresno County, natural lands in western Madera County, and natural lands along Sandy Mush Road and in the Wildlife Refuges and easement lands of Merced County." Kit foxes in the Eastside Bypass area have been identified by the United States Fish and Wildlife Service (USFWS) as an important component to the east-west corridor thought to be used by kit fox in the Sandy Mush Road area. Given the tenuous nature of kit fox populations in and north of western Merced County, potential impacts to kit fox in this area could have population-level implications. Should the PEIR or focused Project-specific CEQA

documents consider structural modifications to the Eastside Bypass or use of the Eastside Bypass for fish passage, this issue would need to be evaluated carefully, and measures commensurate with the level of impact would need to be developed for avoidance, minimization, and mitigation.

Prior to any ground-disturbing activities associated with Project implementation, the Department recommends that the USFWS's "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance"(1999) be followed, prior to any ground-disturbing construction or maintenance activities occurring within the Project area, for the life of the Project. These surveys should also be conducted a maximum of 30 days prior to any ground-disturbing activities. In the event that active, known, or natal dens are detected during these or previous den surveys, consultation with the Department is warranted to discuss the potential for "take" under CESA. The Department also recommends that artificial dens be installed in areas that will be temporarily disturbed by construction and that would result in impacts to known kit fox dens and that periodic surveys are conducted for this species throughout the life of the Project.

In order to quantify potential impacts to SJKF under Project-specific CEQA analysis, there should be detailed surveys conducted in the Project area(s) to identify the number of natal, active, known, and potential kit fox dens that will be impacted as a result of Project implementation. Impacts to the kit fox prey base and movement corridors should also be quantified and disclosed.

Bats: Potential Project-related impacts to tree-roosting species of bats should be evaluated in the CEQA document prepared for this Project.

Special Status Habitat Types: There are several rare and declining habitat types within the Project area, including, but not limited to, wetlands, seasonal wetlands, vernal pools and associated uplands, elderberry savannah, riparian and riparian scrub habitat, non-native grassland (locally rare in Project area), Atriplex shrub scrub habitat, and alkali playa and grasslands. Potential Project-related impacts to these habitat types should be given special consideration in the CEQA document prepared for this Project.

Unlisted Species: Species of plants and animals need not be officially listed as Endangered, Rare, or Threatened (E, R, or T) on any State or Federal list to be considered E, R, or T under CEQA. If a species can be shown to meet the criteria for E, R, or T, as specified in the CEQA Guidelines (California Code of Regulations, Title 14, Chapter 3, Section 15380), it should be fully considered in the environmental analysis for the Project. Potential Project-related impacts to special status species potentially occurring in the Project area should be evaluated and discussed in the focused CEQA documents prepared for this Project.

Special Plants: In addition to plants listed as State and/or Federally threatened and endangered, the CEQA document prepared for this Project should evaluate and disclose the potential impacts to "special plant species," which include: plant species listed as candidates for State or Federal listing; taxa which meet the criteria for listing, even if not included on any list as

described in CEQA Guidelines Section 15380; taxa listed in the California Native Plant Society's *Inventory of Rare and Endangered Plants of California*; taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation; and taxa associated with a habitat that is declining in California at a significant rate.

If you have any questions on these issues, please contact Julie Vance, Senior Environmental Scientist, at the address provided on this letterhead or by telephone at (559) 243-4014, extension 222.

Sincerely,

for

W. E. Loudermilk
Regional Manager

cc: See Page Nine

cc: Susan Jones
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Jason Phillips
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Reclamation
Mid-Pacific Region
2800 Cottage Way
Sacramento, California 95825-1898

ec: Department of Fish and Game
Dale Mitchell, Gerald Hatler, John Battestoni

Literature Cited

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SAN JOAQUIN RIVER CONSERVANCY
STATE OF CALIFORNIA

5469 E. Olive Avenue
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September 10, 2007

Ms. Karen Dulik, Sr. Environmental Scientist
California Department of Water Resources
San Joaquin District
3374 E. Shields Ave.
Fresno, CA 93726

Dear Ms. Dulik:

Scoping Comments, San Joaquin River Restoration Program EIR/EIS

The San Joaquin River Conservancy and Department of Water Resources are involved in on-going activities to coordinate programs on the San Joaquin River to achieve mutually beneficial goals. This letter briefly summarizes opportunities for the Restoration Program to collaborate with the Conservancy, in order that those possibilities can be considered in the programmatic environmental document.

The San Joaquin River Conservancy is a regionally governed state agency formed to implement and manage the San Joaquin River Parkway, a planned 22-mile regional natural and recreation area in the river-bottom extending from Friant Dam to Highway 99. The Conservancy's mission includes acquiring approximately 5,900 acres from willing sellers, operating and managing those lands for public recreation and education, and protecting, enhancing, and restoring riparian and floodplain habitat.

The Conservancy governing board adopted the San Joaquin River Parkway Master Plan and certified its programmatic Environmental Impact Report in 1997. The Parkway Master Plan provides goals, objectives, and design standards for appropriate public recreational uses, trail corridors, buffers, fishing and boating access, etc. on public Parkway lands. The Recompiled San Joaquin River Parkway Master Plan, and the source documents if desired, will be provided to the Department under a separate cover.

The Parkway reach coincides with Reach 1 of the San Joaquin River Restoration Program. The Conservancy is the primary landowner within Reach 1 with fee title ownership of approximately 2,200 acres, and is actively negotiating to buy additional conservation lands. The Conservancy has provided maps of its lands to the Department. Many of these properties were acquired after they were mined for gravel, and therefore are targeted for channel restoration and gravel pond isolation.

The programmatic document should generally describe the areas within Conservancy and other Parkway lands that will be affected by significant restoration projects. It is understood that the projects and locations will be refined over time.

Restoration improvements in the Parkway reach, and in particular on Conservancy lands, should be designed to set the foundation for future Parkway projects consistent with the Parkway Master Plan. For example, the final configuration of restored lands should to the extent possible provide appropriate alignments, sites, and grades for future Parkway trails, fishing and boating access, and ancillary facilities such as staging areas and restrooms.

There might be channel reaches within the Parkway where the Restoration Program will plan to limit public access and/or recreational fishing. Similarly, additional fishing regulations might be planned. The Fisheries Management Plan element of the Restoration Program should evaluate how to effectively provide, control, and manage public access and recreational fishing on the river, while meeting Restoration Program objectives, so that the Parkway can support, and not interfere with fishery objectives.

Some Conservancy lands may contain gravel reserves important to the Restoration Program. The environmental documents should evaluate, on a programmatic level, the potential need for gravel and potential sources.

If habitat conservation or enhancement is required as mitigation for any Restoration Program projects, there may be opportunities to meet the requirements by supporting Conservancy habitat enhancement and restoration projects or contributing toward Conservancy conservation land acquisitions. These partnerships could meet regulatory mitigation obligations cost-effectively, directly benefit the community, maximize habitat improvements by creating larger scale protected areas, and help to accomplish regional resource conservation and management objectives.

We truly appreciate the Department's participation in the Conservancy's Jensen River Ranch Habitat Enhancement and Public Access Project. The Department and other Restoration Program representatives are encouraged to participate in an advisory capacity in the following Parkway projects currently underway:

- The Lost Lake Master Plan will be completed by the County of Fresno from summer 2007 through the end of 2008. The process will involve a great deal of interagency coordination, planning, advisory, and stakeholder involvement.
- Over 1,000 acres are owned by the Conservancy on both sides of the river immediately downstream of Highway 41. This Parkway area is called River West. The river channel in this reach is highly impacted by gravel mining. Reduced flows into the North Channel on the Conservancy's Sycamore Island property are affecting riparian habitat and ponds, and should be addressed along with channel restoration in the immediate area. A public access, recreation, and upland habitat enhancement project for River West will soon be in review pursuant to CEQA.

- Volunteer tree planting for educational and stewardship purposes is occurring throughout the Parkway. With guidance from the Department, the Conservancy can direct volunteer tree planting activities to areas outside those lands that will be graded or disturbed for river restoration. Close coordination can help ensure that the Restoration Program does not experience unnecessary mitigation requirements or costs to remove recently planted vegetation. Once restoration plans are completed, the Restoration Program can capitalize on volunteer efforts to assist with revegetation.

The Restoration Program in Reach 1 can be planned, designed, and implemented in cooperation with the Conservancy, its member agencies, and nonprofit partners in a manner that will enhance the benefits and reduce the costs that would be experienced if river restoration and the Parkway were developed in isolation of each other. We look forward to the opportunity to advance the San Joaquin River Parkway through partnership with the Restoration Program.

Please contact me at (559) 253-7324 or email Melinda.Marks@sjrc.ca.gov if you need additional information, maps, plans, or documents.

Respectfully,

Melinda S. Marks
Executive Officer

SAN JOAQUIN RIVER
RESTORATION PROGRAM

PUBLIC SCOPING COMMENTS
for the San Joaquin River Restoration Program Environmental Impact Statement/Environmental Impact Report

Please circle topic your comment relates to:

(Water)
Fish
Property
Environmental Issues
Other

Written comments can be submitted at the scoping meetings, mailed to the Bureau of Reclamation *(mailing address is on the back of this card)*, faxed 916-978-5114, emailed to mgidding@mp.usbr.gov or provided online at www.restoresjr.com by close of business on Friday, September 21, 2007. Thank you.

(Please print clearly)

Name Gary Martin

Organization and Address Pikaloki Farming
PO Box 549
Firebaugh Ca 93622

Phone ( ) _____ FAX ( ) _____ E-mail _____

Comment here: 8-30 07
Date

① Hopefully these studies can support the need for water storage. Storage funded early can be useful to fish & users of the water.

② As other landowners and farmers in these areas we can appreciate the publics desire to access river property. However keep in mind that this is still private property.

All comments become part of the public record.

RMC
San Joaquin River
Resource Management Coalition

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Los Banos, CA 93635
Phone: (209) 827-8616
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September 21, 2007

Ms. Margaret Gidding
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Ms. Karen Dulik
Senior Environmental Scientist
DWR-San Joaquin District
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RE: ***San Joaquin River Restoration Program***

Dear Ms. Gidding and Ms. Dulik:

The San Joaquin River Resource Management Coalition ("RMC") submits this letter in response to the Notice of Preparation (NOP) of a Draft Program Environmental Impact Statement/Environmental Impact Report (PEIS/EIR) for the San Joaquin River Restoration Program and the Notice of Intent to Prepare a Program Environmental Impact Statement/Environmental Impact Report and Notice of Scoping Meetings. We understand that comments on the scope of the PEIS/EIR are due September 21, 2007.

The RMC is a non-profit association whose members include landowners and farmers along the San Joaquin River and the San Joaquin River Exchange Contractors Water Authority ("Exchange Contractors"). Recently you were provided with a report prepared by the engineering firm of CH2M Hill that was prepared for the RMC, entitled "Draft Initial Appraisal Report, San Joaquin River Settlement Agreement and Legislation." The Appraisal Report is now finalized and is dated September 20, 2007 and in that report, the RMC identified a number of impacts that must be considered as part of the San Joaquin River Settlement Agreement and Legislation. The purpose of this letter is to submit the September 20, 2007 Appraisal Report as a formal comment to the PEIS/EIR

The NOP/NOI notes the following potential impacts: "Potential environmental impacts could affect the following resources: hydrology and water quality and water supply, flood control, land use and agricultural resources, mineral resources, noise, public utilities and power consumption,

biological resources including wetlands and rare and sensitive plant and animal species, geology and soils, socioeconomics and population and housing, transportation and traffic, air quality, cultural resources, aesthetics, flood protection, and recreation." Many of these impacts will effect members of the RMC. As such, the RMC has a direct and substantial interest in the development of the Restoration Program and the measures to mitigate the adverse impacts of the program. The Appraisal Report sets forth our initial concerns that need to be taken into account during the scoping process for the PEIS/EIR.

In conclusion, the RMC is pleased to be able to submit these comments and the attached Appraisal Report for your consideration.

Sincerely yours,

Mari Martin,
Chairperson

cc: RMC Board Members
San Joaquin River Exchange Contractors Water Authority
San Joaquin River Task Force

Appraisal Report

San Joaquin River Settlement Agreement and Legislation

Prepared for

San Joaquin River Resource Management Coalition

September 20, 2007

CH2MHILL

Contents

Appendixes

Tables

Figures

Acronyms

CAA	Clean Air Act
CDFG	California Department of Fish and Game
cfs	cubic feet per second
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CWA	Clean Water Act
DWR	California Department of Water Resources
ESA	Endangered Species Act
HEC	Hydrologic Engineering Center
LSJLD	Lower San Joaquin Levee District
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council
O&M	operations and maintenance
RMC	San Joaquin River Resource Management Coalition
SJRECWA	San Joaquin River Exchange Contractors Water Authority
USACE	U.S. Army Corps of Engineers

SECTION 1

Background and Purpose

This appraisal report was prepared by the San Joaquin River Resource Management Coalition (RMC) and is intended to provide an appraisal of the critical issues associated with the planned implementation of the San Joaquin River Settlement Agreement dated October 2006 (Settlement). Implementation of the Settlement has the potential to cause significant impacts to individuals and entities along the San Joaquin River that were not party to the Settlement (third parties) including RMC members. These potential impacts involve a wide range of issues related to:

- Water supply operations
- Land use
- Flood control operations/protection
- Agricultural crop production
- Seepage and shallow groundwater impacts
- Environmental and quality of life changes

The RMC members have the potential to bear substantial economic and environmental costs that could result from direct and indirect impacts if proposed restoration actions are not thoroughly evaluated, carefully implemented, and properly mitigated.

As described throughout this report, a comprehensive planning process must be undertaken to ensure successful implementation of the Settlement and to avoid or minimize direct and indirect impacts to third parties. To ensure that actions in one reach of the river do not create unintended impacts in other areas, this comprehensive planning process should consider all the restoration actions as part of a complete implementation effort, and avoid implementation or construction of partial actions before the comprehensive planning process is complete. Likewise, comprehensive funding for the restoration program is needed to ensure that implementation of all actions is fully funded prior to initiating any project construction activities.

This appraisal report provides a brief assessment of the issues associated with the potential restoration actions and physical system improvements described in the Settlement. This includes identification of potential impacts that could result from implementation of these actions, description of the evaluations needed, listing of approvals and permits needed, and description of any additional considerations that should be addressed. The proposed restoration actions and associated evaluations are grouped by those that are applicable to all or the majority of the river reaches (Section 2.1, River-wide Actions) and those that are specific to certain reaches (Section 2.2, Reach-specific Actions). This report also identifies an approach for landowner involvement and priorities for further technical analysis (Section 3, Conclusions and Recommendations).

While the RMC is not a party to the Settlement, it does support the legislation that was negotiated to address impacts to third parties and would like to work collaboratively with the U.S. Bureau of Reclamation (Reclamation), California Department of Resources (DWR),

and others in the planning process to allow for the successful implementation of the Settlement. The RMC brings local knowledge and understanding to the process, which can contribute substantially to the successful restoration of the San Joaquin River.

1.1 Background

1.1.1 San Joaquin River Resource Management Coalition

The RMC is an organization whose voting members include landowners, water and irrigation districts, the San Joaquin River Exchange Contractors Water Authority (SJRECWA), local government agencies, and farm bureaus within the RMC boundaries of Merced, Madera, Fresno, and a small portion of Stanislaus counties. Nonvoting members of the RMC include the Lower San Joaquin Levee District (LSJLD), various federal and state resource and regulatory agencies, local environmental interests, and interested members of the general public. Collectively, the RMC represents the interests of agencies and landowners along the San Joaquin River from Friant Dam to the confluence with the Merced River. The purpose of the RMC is to proactively address resource management challenges on the San Joaquin River, and to provide a voice in the planning process for all entities concerned with the river's future.

1.1.2 San Joaquin River Settlement Agreement

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit against Reclamation challenging the renewal of the long-term water service contracts for the Friant Division Contractors of Central Valley Project (NRDC, et al., v. Kirk Rodgers, et al., 1988). After more than 18 years of litigation, the parties to the lawsuit reached agreement on the terms and conditions of a Settlement and executed the Settlement in September 2006. The Settlement was approved by the U.S. District Court in October 2006. The Settlement is based on two parallel goals:

1. The 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.

2. The 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 the Settlement.

To accomplish these goals, the Settlement calls for a combination of channel and structural improvements along the San Joaquin River below Friant Dam and releases of additional water from Friant Dam to the confluence of the Merced River. Federal legislation has been introduced that includes specific language relative to some of the proposed improvements and if passed will supersede the existing language contained in the Settlement. The Settlement also calls for planning, implementation, mitigation, and funding measures to meet the goals. The improvements identified in the Settlement include the following (taken from paragraph 11 of the Settlement):

- Phase 1 Improvements (to be completed no later than December 31, 2013):

  - Creation of a bypass channel around Mendota Pool to convey at least 4,500 cubic feet per second (cfs) from Reach 2B to Reach 3 and construction of a structure capable of directing flow down the bypass and allowing the Secretary of the Interior (Secretary) to make deliveries of San Joaquin River water to the Mendota Pool.
  - Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool Bypass.
  - Modifications in channel capacity to the extent necessary to ensure conveyance of 475 cfs through Reach 4B. See the following discussion regarding Reach 4B and proposed federal legislation Section 9(g).
  - Modifications at the Reach 4B headgate to ensure fish passage and enable flow routing of between 500 cfs and 4,500 cfs in Reach 4B.
  - Modification of the Sand Slough Control Structure to ensure fish passage.
  - Screening the Arroyo Canal diversion structure to prevent entrainment.
  - Modifications to Sack Dam to ensure fish passage.
  - Modification of structures in the Eastside and Mariposa Bypass channels to the extent needed to provide fish passage on an interim basis until completion of Phase 2 improvements.
  - Modifications in the Eastside and Mariposa Bypass to establish a suitable low-flow channel.
  - Modifications to enable deployment of seasonal barriers to prevent adult fish from entering false migration pathways in the area of Salt and Mud sloughs.

- Phase 2 Improvements (to be completed no later than December 31, 2016):
  - Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 4B unless such modifications would not substantially enhance achievement of the Restoration Goal.
  - Modification of the Chowchilla Bifurcation Structure to provide fish passage and prevent entrainment.
  - Filling and/or isolating the highest-priority gravel pits in Reach 1.
  - Modification of the Sand Slough Control Structure to enable routing and conveyance of Restoration Flows of up to 4,500 cfs into Reach 4B.

Paragraph 12 of the Settlement further acknowledges that "there are likely additional channel or structural improvements... that may further enhance the success of achieving the Restoration Goal."

1.1.3 Federal Legislation

Federal legislation has been introduced in both the House of Representatives and the Senate that would provide the authorization necessary to implement the Settlement. The legislation generally parallels the Settlement, but includes a number of sections that supersede the Settlement and provide further clarification regarding implementation of the proposed actions and project phasing. As currently written, the legislation includes many protections and provisions supported by the various agencies and downstream landowners that have the potential to be significantly impacted by the Settlement. Among other things, the legislation provides authorization to conduct the following actions:

- Modify Friant Dam operations necessary to release Restoration and Interim Flows
- Enter into agreements with the state to facilitate or expedite implementation of the Settlement
- Enter into other appropriate agreements with state, tribal, local government agencies, and private parties, including agreements related to the construction, improvement, and operation and maintenance of facilities to achieve the purposes of the Settlement
- Conduct design or engineering studies necessary to implement the Settlement
- Initiate and expeditiously complete applicable environmental reviews and consultations as necessary to implement the Settlement
- Acquire property, interests in property, or options to acquire real property needed to implement the Settlement from willing sellers

Under the legislation, the Secretary is to identity the impacts associated with implementation of decisions or agreements to construct, improve, operate, or maintain facilities that are needed to implement the Settlement, and identify the measures that shall be implemented to mitigate impacts on adjacent and downstream water users and landowners. The impacts and mitigation measures are to be identified prior to the construction, improvement, operation, or maintenance of facilities that are needed to implement the Settlement. The legislation also specifies that "to the extent that costs incurred solely to implement this Settlement would not otherwise have been incurred by any entity or public or local agency or subdivision of the State of California, such costs shall not be borne by such entity, agency, or subdivision of the State of California, unless such costs are incurred on a voluntary basis."

Section 9(g) Reach 4B of the legislation requires that the Secretary conduct a study that specifies:

(i) the costs of undertaking any work required under paragraph 11(a)(3) of the Settlement to increase the capacity of Reach 4B prior to the reinitiation of Restoration Flows;

(ii) the impacts associated with the reinitiation of such flows; and

(iii) measures that shall be implemented to mitigate impacts.

The legislation states that the study shall be completed prior to restoration of any flows other than Interim Flows. Interim Flows must not exceed **existing** channel capacities and are defined in the Settlement as flows that will include releases of additional water from Friant Dam commencing no later than October 1, 2009, and continuing until full Restoration Flows begin. Interim Flow releases, per Paragraph 15 of the Settlement, have a specified timing and magnitude as defined in the appropriate year type hydrograph listed in Exhibit B of the Settlement. The requirements of this study supersede the Settlement paragraph 11 Phase 1 implementation improvements listed previously for Reach 4B.

Section 9(g) Reach 4B of the legislation also requires that the Secretary file a report with congress not later than 90 days after issuing a determination, as required in the Settlement, on whether to expand channel conveyance capacity to 4,500 cfs in Reach 4B; or use an alternate route for flows. This determination is to be made, **to the extent feasible**, before undertaking any **substantial** construction work to increase the capacity of Reach 4B.

The report shall identify the basis for the Secretary's determination and identify how different factors were assessed, such as comparative biological and habitat benefits, comparative costs and relative available state cost-sharing funds, and the comparative benefits and impacts on water temperature, water supply, private property, and local and downstream flood control. The report shall also include the Secretary's final cost estimate for expanding the capacity of Reach 4B to 4,500 cfs or any alternative route selected, as well as other alternative cost estimates provided by the state, the Restoration Administrator, and by other parties to the Settlement.

If the Secretary's estimated federal cost for expanding Reach 4B exceeds the remaining federal funding authorized by the legislation, then congress must increase the applicable authorization ceiling to at least cover the higher estimated federal costs before the Secretary commences actual construction work in Reach 4B to expand the capacity to 4,500 cfs to implement the Settlement.

1.2 Purpose of this Appraisal Report

The purpose of this appraisal report is as follows:

- Identify the critical issues associated with the planned implementation of the Settlement and associated legislation
- Provide a brief assessment of the potential issues and constraints associated with the proposed channel and structural improvements necessary to implement the Settlement
- Suggest priorities for conducting technical analyses to assess the constraints and impacts associated with the Settlement including:
  - Identify required future technical analyses
  - Identify priorities and process for conducting future analysis

1.3 Source Information

Technical information for this appraisal report has been gathered from existing documents, published studies, and court documents from NRDC, et al., v. Kirk Rodgers, et al., 1988. Additionally, information has been collected through personal communications with various RMC members and the LSJLD.

1.4 Project Area

The project area includes the Upper San Joaquin River from Friant Dam to the confluence of the Merced River. As shown in Figure 1-1, this area is divided into five reaches and seven subreaches. Detailed reach-by-reach maps are provided in Appendix A.

Maximum Flow Capacity
26,000 cfs

Salt and Mud
Slough Outlets

Maximum Flow Capacity
10,000 cfs

Maximum Flow Capacity
0 to 400 cfs

Maximum Flow Capacity
4,500 cfs

Maximum Flow Capacity
4,500 cfs

Maximum Flow Capacity
1,300 cfs

Maximum Flow Capacity
8,000 cfs

Maximum Flow Capacity
4,750 cfs

MERCED RIVER
MERCED
MERCED COUNTY
MARIPOSA COUNTY
MADERA COUNTY
FRESNO COUNTY
CHOWCHILLA
MADERA
FRESNO
LOS BANOS
FIREBAUGH
MENDOTA
FRIANT DAM
EASTMAN LAKE
HENSLEY LAKE
MADERA LAKE
MILLERTON LAKE
LOS BANOS RESERVOIR
LITTLE PANOCHE RESERVOIR
EAST SIDE CANAL
BEAR CREEK
OWENS CREEK
DUCK SLOUGH
MUD SLOUGH
SALT SLOUGH
LOS BANOS CREEK
MARIPOSA BYPASS
MARIPOSA BIFURCATION STRUCTURE
EAST SIDE BYPASS
4B Lower
4B Upper
4A
3
2B
2A
1
PICH ANDERSON BYPASS
SAND SLOUGH CONTROL STRUCTURE
SACK DAM
MENDOTA DIVERSION DAM
MENDOTA POOL
CHOWCHILLA BIFURCATION STRUCTURE
CHOWCHILLA RIVER
CHOWCHILLA BYPASS
ASH SLOUGH
BERENDA SLOUGH
DRY CREEK
FRESNO RIVER
COTTONWOOD CREEK
LONE WILLOW SLOUGH
GRAVELLY FORD CANAL
SAN JOAQUIN RIVER
FRESNO SLOUGH
ARROYO CANAL
MAIN CANAL
OUTSIDE CANAL
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
MADERA CANAL
FRIANT-KERN CANAL
99
140
165
152
33
5
59
41
145
168
180

LEGEND
- BARRIERS TO MIGRATION
- DAMS
- ROAD CROSSINGS AND CULVERTS
- NON-PROJECT LEVEES
- PROJECT LEVEES
- REACH DIVISION
- SAN JOAQUIN RIVER
- INTERSTATE HIGHWAY
- STATE-HIGHWAY
- US-HIGHWAY
- RAILROAD
- COUNTY BOUNDARY
- CITY
- REFUGES, WILDLIFE AREAS AND GRASSLAND
- CANALS

0 5 Miles

N

FIGURE 1-1
PROJECT AREA

CH2MHILL

\\GLACIER\PROJ\159813_SANJOAQUIN_RIVER\MAPFILES\FIGURES\FIGURE1_1.MXD FIGURE1-1.PDF 9/18/2007 13:33:12

SECTION 2

Appraisal of Proposed Restoration Actions

This section provides an overview of the proposed restoration actions, critical issues, and associated evaluations that need to be conducted as part of the planning process to implement the Settlement as specified in the associated federal legislation. The proposed restoration actions are based on the channel and structural improvements identified in paragraph 11 of the Settlement, and additional actions that may be necessary to further enhance the success of achieving the Restoration Goal, as described in paragraph 12 of the Settlement. The appraisal of the restoration actions and discussion of required evaluations are organized by those actions that are applicable to all or the majority of the river reaches (Section 2.1, River-wide Actions) and those that are specific to certain reaches (Section 2.2, Reach-specific Actions). For each proposed restoration action, the following are identified: potential impacts as a result of the action, evaluations needed, approvals and permits needed, and any additional considerations that should be addressed. Table 2-1 provides a summary of the proposed restoration actions.

2.1 River-wide Actions

This section addresses the following proposed restoration actions and evaluations that are applicable to all or the majority of the Upper San Joaquin River reaches:

- Levee and channel improvements
- Water supply operations
- Flood control operations
- Screen diversions
- Riparian habitat restoration

2.1.1 Levee and Channel Improvements

To achieve the Restoration Goal, the Settlement proposes to increase the frequency and magnitude of flows in the San Joaquin River below Friant Dam. Portions of the San Joaquin River are bounded by project levees, or levees constructed by the State of California as part of the Lower San Joaquin River Flood Control Project, and non-project levees, or levees constructed by local landowners. Under existing conditions, significant structural stability and seepage problems occur during flood-flow events in many areas throughout the existing project and non-project levee system. These structural stability and seepage problems will be exacerbated by the increased frequency and magnitude of flows in the San Joaquin River under the Settlement.

TABLE 2-1
Restoration Actions Proposed by Reach

Reach	Proposed Restoration Actions[a]
1	• Reconstruct channel/side channels and add gravel for spawning habitat • Fill and isolate gravel pits • Screen diversions • Remove or reconstruct barriers to migration (road crossings) • Restore riparian habitat • Gravelly Ford diversion protection[b]
2A	• Construct levee and channel improvements • Restore riparian habitat • Redesign or modify Chowchilla Bifurcation Structure for fish passage and prevent entrainment • Screen diversions
2B	• Construct levee and channel improvements • Restore riparian habitat • Remove or reconstruct San Mateo Road crossing • Screen diversions
Mendota Pool Bypass	• New bifurcation structure • Construct bypass channel • Fish screens and related fish bypass facilities • Create riparian habitat
3	• Construct levee and channel improvements • Replace or modify Sack Dam for fish passage • Screen Arroyo Canal • Screen other diversions • Restore riparian habitat
4A	• Construct levee and channel improvements • Screen diversions • Screen and modify Sand Slough Control Structure for fish passage
4B Upper	• Conduct Section 9(g) study and report required by federal legislation to assess potential costs, impacts, and mitigation before determining phasing and flow routing for Reach 4B (flows routed down the Mainstem or through the Flood Bypass System) Flows Routed Through Mainstem: • Construct levee improvements and associated river channel and floodplain • Restore riparian habitat • Reconstruct road crossings • Screen diversions • Screen and modify Mariposa Bifurcation Structure for fish passage Flows Routed Through Bypass System: • Construct levee and channel improvements • Create riparian habitat • Screen diversions • Screen and modify Mariposa Bifurcation Structure for fish passage

TABLE 2-1
Restoration Actions Proposed by Reach

Reach	Proposed Restoration Actions[a]
4B Lower	• Construct levee improvements • Restore riparian habitat
5	• Screen diversions • Screen Mud and Salt sloughs

[a] Proposed restoration actions are based on the channel and structural improvements identified in paragraph 11 of the Settlement as specified in the associated federal legislation. Additional actions may be necessary to further enhance the success of achieving the Restoration Goal, as described in paragraph 12 of the Settlement. Discussion of land acquisition needs is included in Section 2.2 Reach-specific Actions.

[b] Actions not called for in paragraph 11 but required as part of restoration program.

The structural stability of the existing levees must be improved first to safely pass the Restoration Flows. In addition, channel improvements, including the construction of a low-flow channel in reaches where a channel does not currently exist and construction of a new floodplain may be necessary to address the biological requirements of key stages of the salmonid life cycle. Some areas of the mainstem are not protected by project or non-project levees (primarily in Reach 4B Upper), and levees, floodplain, and a low-flow channel will be needed if this flow route is selected as part of the restoration program. Existing channel flow capacities must be assessed to determine appropriate Interim Flow release levels per federal legislation requirements. Existing levee constraints, proposed improvements, and associated evaluations are described below and summarized in Table 2-2.

2.1.1.1 Potential Impacts

Restoration Flows will increase the magnitude and frequency of flows in the San Joaquin River system, and possibly, in the bypass system. Some reaches do not have sufficient capacity to convey the Restoration Flows and new levees or setback levees will be needed. Additionally, increasing the magnitude and frequency of flows has the potential to increase the amount of time and height of water on the toe of the existing levees, which will result in additional seepage and piping. This seepage and piping may cause crop damage, exacerbate high groundwater levels in some reaches of the river, and increase the potential for levee failure. Increasing the frequency, amount of time, and height of water on the toe of the levees may also cause additional erosion of the levee banks, requiring additional measures to prevent degradation of the levee slope.

The potential impacts of the increased magnitude and frequency of flows in the San Joaquin River under the Settlement on the existing levee and channel system can be mitigated using various methods, including the following.

- Rebuild existing levees to improve structural stability
- Redesign existing channel to increase capacity
- Install slurry walls to reduce seepage and improve structural stability
- Construct setback levees for areas with limited capacity
- Construct a low-flow channel in reaches where a channel does not currently exist
- Construct new floodplains to provide for flood flow routing

TABLE 2-2
Existing Levee and Channel Constraints and Potential System Improvements by Reach

Reach	Levee	Approx Current Maximum Capacity	Minimum Restoration and Water Right Flow	Existing Levee Stability or Piping Problems	Potential Impacts	Potential River System Improvements
1	None	8,000 cfs	7,000 cfs	Not Applicable	None identified	No improvements needed
2A	Project	8,000 cfs	7,000 cfs	Piping and seepage observed well below flow capacity and historical levee failure	Increased frequency and magnitude of flows can increase the amount of seepage, resulting in crop damage and exacerbating levee stability problems	Rebuild levees and install slurry walls; construct setback levees and new floodplain; construct low-flow channel
2B	Non-project	1,300 cfs	7,000 cfs	Significant seepage and stability problems with higher flows (greater than 1,300 cfs)	Inadequate capacity for Restoration Flows; increased frequency and magnitude flows will increase the amount of seepage, resulting in crop damage and levee stability problems	Rebuild levees and install slurry walls; construct setback levees and new floodplain; construct low-flow channel
3	Non-project	4,500 cfs	5,300 cfs	Seepage problems with higher flows	Increased frequency and magnitude of flows will increase the amount of seepage, resulting in crop damage and levee stability problems; potential flooding of urban areas with levee failure	Rebuild levees and install slurry walls
4A	Non-project	4,500 cfs	4,500 cfs	Seepage and levee stability problems	Increased frequency and magnitude of flows will increase the amount of seepage, resulting in crop damage and levee stability problems	Rebuild levees and install slurry walls
4B Upper Mainstem	None / Non-project	0 cfs	4,500 cfs	Lack of levees throughout much of the reach; lack of defined river channel	Inadequate capacity for Restoration Flows; lack of comprehensive levee system, low-flow channel, and floodplain; potential seepage-induced high groundwater and resulting crop damage	Construct levees with slurry walls; construct setback levees and new floodplain; construct low-flow channel
4B Upper Bypass System	Project	13,500 cfs	4,500 cfs	Piping and seepage observed at flows well below design capacity	Increased frequency and magnitude of flows will increase the amount of seepage, resulting in crop damage and levee stability problems	Rebuild levees and install slurry walls in some areas; construct low-flow channel
4B Lower	Project	10,000 cfs	4,500 cfs	Seepage and high groundwater results in crop damage during high flows	Increased frequency and magnitude of flows will increase the amount of seepage, resulting in crop damage and levee stability problems	Install slurry walls
5	Project	26,000 cfs	4,500 cfs	None identified at this time	None identified at this time	None identified at this time

- Install subsurface drainage systems to reduce seepage impacts and mitigate for interruption of drainage from adjacent lands

Mitigation measures will vary by reach with a combination of measures possibly occurring in each reach.

2.1.1.2 Evaluation Needed

Because of the high costs of levee and channel improvements and the potential for property damage and loss of life, an extensive evaluation of the existing project and non-project levees and associated channel capacity constraints should be conducted as part of the restoration planning process. This evaluation should include the following:

- Engineering analysis and design including:
  - Topographic and channel surveys
  - Hydrologic Engineering Center (HEC) computer modeling
  - Final channel design and land acquisition plan
  - Sediment management plan and long-term monitoring
  - Groundwater surveys and long-term monitoring
  - Geotechnical studies to determine structural stability of existing levees
- Mitigation and monitoring program

These evaluations are described in more detail as follows.

Engineering Analysis and Design. Engineering analyses should be conducted for all proposed levee and channel improvements. The analyses should consist of two major components: (1) determine the existing levee and channel constraints within each reach; and (2) conduct an analysis of possible alternatives for levee and channel improvements. Alternatives should consider various methods to improve problem levees and channel areas including structural improvements, such as rebuilding levees, installing slurry walls, installing tile drains, and different construction methods. The alternatives analysis should also incorporate historical knowledge and local understanding and be coordinated closely with local agencies and landowner representatives. Additionally, agreement on the appropriate assumptions for the analyses should be obtained early in the process with local agencies and landowners. These analyses should be based on the best available information, include field studies and data collection as needed, and be conducted to professional standards using established engineering practices. All engineering design should be conducted to Reclamation, California DWR, and/or U.S. Army Corps of Engineers (USACE) design standards and guidelines, as appropriate.

Topographic and Channel Surveys. A common set of topographic and channel survey information for the entire Upper San Joaquin River should be established and serve as the basis for future analysis. Detailed topographic and channel surveys were previously prepared for the San Joaquin River by Ayres Associates and Mussetter Engineering, Inc., respectively. The survey results should be reviewed for technical accuracy, completeness, and area of coverage to determine their applicability for future analysis.

Topographic surveys should include aerial photography, ground control, and extend a sufficient width to include areas of potential setback levees. Topographic data should be

sufficient for all anticipated engineering and design analysis and should be conducted, at a minimum, to the nearest foot with an accuracy of plus or minus 6 inches. To the extent possible, this effort could build upon the topographic survey effort previously completed by Ayres Associates.

Channel surveys should include sufficient cross section lengths to include areas of potential setback levees. Survey data should be sufficient for all anticipated engineering and design analysis and cross sections should be conducted, at a minimum, at 1,000-foot intervals along the river with shorter intervals where structures are located or where focused studies are proposed. To the extent possible, this effort should build upon the previous channel survey effort conducted by Mussetter Engineering, Inc.

HEC Computer Modeling. A HEC-RAS analysis for predicting water surface elevations downstream should be conducted with the model calibrated using historical high-flow and water level data. The analysis should be conducted using appropriate roughness coefficients based on established engineering practice to accurately model water surface elevations. The overall ultimate growth landscape design for riparian habitat should be considered in the roughness coefficient assumptions to better characterize roughness and determine future channel characteristics (see discussion under Section 2.1.5).

Final Channel Design and Land Acquisition Plan. All levee and channel improvements must be designed for ultimate future riparian habitat conditions to ensure that adequate design flood flow capacity is maintained and there is no increase in the water surface elevation, as compared to the existing "baseline conditions" (see discussion under Section 2.1.5).

Levee and channel improvements must be designed per U.S Army Corps of Engineers (USACE) and state levee standards. USACE standards are specified in Levee Design Manual, EM 1110-2-1913 and Design Guidance for Levee Underseepage, ETL 1110-2-569. State design criteria are specified in the California Code of Regulations, Title 23 Waters, Div. 1 Reclamation Board. These documents are currently under review and important design criteria revisions are anticipated that will be critical to the planning and design of levee and channel improvements along the San Joaquin River.

Channel reconstruction must be designed to safely convey the estimated 4,500 cfs Restoration Flows plus water right flows in Reaches 2B and 3. In Reach 2B, a total capacity of at least 7,000 cfs is needed (4,500 cfs Restoration Flow and 2,500 cfs for water right flows). In Reach 3, total capacity of at least 5,300 cfs is needed (4,500 cfs Restoration Flow and 800 cfs for water right flows). For additional information on reach-specific improvements and evaluations, refer to the reach-by-reach discussions in Section 2.2.

A comprehensive land acquisition plan must be developed that specifically identifies, on a parcel-by-parcel basis, all the acreage that will need to be purchased from **willing sellers** or for which easements will be required for facilities construction, channel improvements and levee setbacks, and full restoration project implementation. The plan must clearly describe all valuation procedures and conform with Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice.

Sediment Management Plan and Long-term Monitoring. A sediment transport monitoring and management plan should be developed for all reaches of the San Joaquin River. The

sediment management plan should be developed based on analyses of sediment transport characteristics in the project area and field surveys of channel and floodplain conditions. The management plan should identify reaches with the potential for significant aggradation or degradation, and the likely processes (e.g., bank erosion, bed scour, backwater deposition, etc.) contributing to aggradation or degradation in each reach. The management plan should also identify appropriate frequencies of sediment transport monitoring (ideally tied to existing data on sediment incipient motion and sediment transport) for each reach. Finally, the plan should describe methods for sediment transport monitoring appropriate for expected conditions in each reach. Monitoring will depend on reach-specific conditions but should include some combination of permanently monumented monitoring cross sections, erosion pins, scour chains, bedload transport monitoring, and suspended load transport monitoring. Specific monitoring methods must be conducted prior to release of Interim or Restoration Flows to establish baseline conditions, and on a regular basis after implementation, to detect ongoing change. The management plan should also describe permit requirements and best management practices to apply if and when changes are detected.

Groundwater Surveys and Long-term Monitoring. Groundwater surveys and monitoring should be conducted for areas of the San Joaquin River with known seepage problems and areas of high groundwater. The survey and monitoring effort should be initiated prior to any levee improvements or Interim or Restoration Flow releases to determine baseline conditions. Groundwater monitoring wells with data loggers to continuously record water levels should be appropriately placed to record shallow groundwater levels and potential effects on groundwater from increased Restoration Flows in the river. Groundwater quality monitoring should be regularly conducted at selected wells where known poor groundwater conditions exist, including the lower reaches of the river. Piezometers and shallow groundwater monitoring wells should be installed in adjacent agricultural lands to monitor salts in the root zone as increases in groundwater elevations can bring leached salts into the root zone and affect the long-term productivity of agricultural lands.

Geotechnical Studies to Determine Structural Stability of Existing Levees. An extensive evaluation should be conducted to determine the structural stability of the existing levee system and assess the potential impacts of releasing Restoration Flows. This effort should be conducted on a subreach basis as factors that can affect levee stability (such as native soils and materials used in constructing the levees) can vary substantially over relatively small sections of the project and non-project levees. This evaluation should be conducted throughout the mainstem and for reaches of the bypass system where Restoration Flows may be routed. This evaluation should consist of the following:

- Conduct geotechnical borings at least every mile on both sides of the river both through the project or non-project levee and outside the levee in the adjacent agricultural lands to evaluate subsurface conditions.
- Conduct field tests in borings for permeability, density, and to obtain samples for lab tests of compaction, permeability, strength, and grain size. Utilize the field and lab data to establish seepage and strength parameters for design.
- Determine the potential for seepage through the levees under Restoration Flows using the material properties from the geotechnical investigation and laboratory testing.

Permeability values for vertical and horizontal directions should be used, along with two-dimensional cross sections to estimate seepage rates and exit gradients under a variety of flows and durations.

- Determine slope stability under short-term rapid drawdown from peak flows and long-term steady-state seepage using conventional two-dimensional stability computer methods. This should be completed for both sides of the river at all sections where borings have been made. Determine the likely levee stability between boring locations using established engineering practices.
- Where exit gradients may cause erosion or low slope stability factors of safety, rerun the analysis utilizing slurry cutoff walls or sheetpiling set to a range of depths below the crest of the levees. Perform cost analysis to estimate what depth and type of seepage cutoff method is most cost effective. Perform this analysis along the entire reach where poor slope stability or seepage conditions exist.
- Evaluate liquefaction potential under design earthquake shaking with and without flow in the river. Estimate amount of seismically induced Settlement.
- Conduct a sensitivity analysis, to ensure adequate protection, using a range of permeability values to estimate the effect of seepage with and without a slurry cutoff wall made to different depths.
- Evaluate the feasibility of using setback levees with and without slurry walls and with imported embankment material to determine if seepage into the agricultural fields can be reduced under ultimate restoration conditions.
- Estimate potential water surface elevations within the levees and adjacent fields under ultimate (full riparian growth) restoration conditions along all reaches studied.
- Determine the need for levees to be set back to accommodate Restoration Flows, water-right flows, and an increment of flood flows using appropriate roughness coefficients to account for additional future riparian vegetation.
- Determine appropriate construction materials and techniques for rebuilt levees.
- Determine appropriate construction materials and techniques for slurry wall installation.
- Identify potential borrow material sources.

The geotechnical studies should determine the need for slurry walls to mitigate seepage-induced impacts to agricultural lands and improve levee stability. Slurry walls are needed if the stability analysis indicates that seepage through the embankment or the foundation under the embankment results in: (1) a low safety factor, (2) exit gradients outside the levee that have the potential to cause sand boils, or (3) water table rise that could cause crop damage. Sheet pile walls may also be used to prevent seepage under and through levees and embankments. If the embankment is made out of sand but the foundation under the embankment is silty or silty sand, the embankment may be rebuilt or a very short slurry wall can be used. If the foundation is sand but the embankment is silt, a slurry wall down into the foundation is needed for seepage reduction.

Mitigation and Monitoring Program. Construction of levee and channel improvements will cause a variety of construction and operations-related environmental impacts. Impacts would be expected to a variety of resource areas including air quality, biological resources, cultural resources, traffic and transportation, and water resources. Although many of these impacts would be expected to be temporary, some long-term impacts may occur. Many of the impacts have the potential to be significant. In addition, because of the aggressive schedule outlined in the Settlement, it is likely that numerous Settlement-related construction projects would occur at the same time, potentially resulting in significant cumulative impacts. A comprehensive analysis of potential environmental impacts should be conducted. This analysis should include a comprehensive mitigation and monitoring program to reduce or eliminate, to the extent feasible, construction and operational impacts.

2.1.1.3 Approvals and Permits Needed

A variety of approvals and permits would be needed for levee and channel improvement activities including the following:

- Land acquisition (because of the nature of this action, easements do not appear viable)
- Access agreements from adjacent landowners
- Compliance with the following federal and state laws: National Environmental Policy Act (NEPA); California Environmental Quality Act (CEQA); Endangered Species Act (ESA); California Endangered Species Act (CESA); Clean Water Act (CWA); Clean Air Act (CAA); CDFG Code Section 1600; DWR floodway permits; and a variety of federal and state laws, policies, and regulations and federal Executive Orders
- Reclamation Board and LSJLD Encroachment Permit(s)
- Operations and maintenance permits/agreements with a local maintaining agency that has yet to be determined
- State Lands Lease and Land Transfer

2.1.1.4 Additional Considerations

Any proposed levee improvements would need to consider the extent of future riparian vegetation and include setback levees or other measures to increase channel capacity as needed to maintain design flow capacities (see discussion under Section 2.1.5, Riparian Habitat Restoration).

It is assumed that re-built or otherwise improved levees would be owned by the state. Operations and maintenance (O&M) of these structures and associated flood channel would be conducted by a local maintaining agency that has yet to be determined, under agreement with the state. Funding for the O&M activities would be needed. Additionally, long-term assurances and ESA and CESA compliance for O&M activities, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, would be necessary. This long-term ESA and CESA compliance for O&M activities must be completed concurrent with ESA and CESA compliance for construction activities. Long-term O&M activities would include vegetation maintenance and removal

and sediment removal (including dredging) in portions of the mainstem San Joaquin River to maintain channel capacity.

Long-term establishment of a low-flow channel may not be possible in some reaches because of the sand-bedded character of these reaches. As flows increase, the sand-bedded channel will likely mobilize and become unstable.

2.1.2 Water Supply Operations

Reaches 2B and 3 of the San Joaquin River provide critical water supply conveyance for delivery of water under existing water rights. Water delivered via the Delta-Mendota Canal is diverted by agricultural users at Mendota Pool, along Fresno Slough, and downstream on the San Joaquin River at Sack Dam. Implementation of the Settlement has the potential to significantly impact the operational flexibility needed to provide water to agricultural diverters along Fresno Slough and at the Columbia Canal headworks in Reach 2B. Water supply operations associated with Mendota Pool, including potential impacts, evaluations, approvals and permits, and additional considerations, are described in Section 2.2.4.

2.1.3 Flood Control Operations

Flood control operations on the San Joaquin River include conveyance of flood flows from the Kings River and operation of the Lower San Joaquin River Flood Control Project, described as follows.

2.1.3.1 Coordination with Kings River Flood Flows

Currently, per the flood control manual operations, flood flows from the Kings River are diverted into the San Joaquin River via the Fresno Slough at Mendota Pool during flood flow releases from Pine Flat Reservoir The Kings River conveys up to the first 4,750 cfs of flow into the San Joaquin River and then up to the next 4,750 cfs is diverted to the Tulare Lake Bed. Above a Kings River flood flow of 9,500 cfs, the remaining flow is split 50/50 between the San Joaquin River and the Tulare Lake Bed. Kings River flood flows have priority over Restoration Flows released from Friant Dam into the San Joaquin River. The operation of the Chowchilla Bifurcation Structure is coordinated with the amount of Kings River flood flows entering the San Joaquin River system via Fresno Slough, if San Joaquin River flood flows are being released from Friant Dam. The volume of San Joaquin River flow routed into the bypass system is increased as the amount of Kings River flood flows entering the San Joaquin River increases. Under high Kings River flow conditions, all flows in the San Joaquin River may be routed into the bypass system at the Chowchilla Bifurcation Structure.

2.1.3.2 Lower San Joaquin River Flood Control Project

The Lower San Joaquin River Flood Control Project consists of project levees and a number of bifurcation structures, control structures, and bypass channels that route high flows out of the San Joaquin River into the bypass system, moderating flows in Reaches 2B, 3, 4, and 5. Major facilities in the San Joaquin River Flood Control Project include the Chowchilla Bifurcation Structure, Chowchilla Bypass, Eastside Bypass Control Structure, Eastside Bypass, Mariposa Bypass Structure, and Mariposa Bypass.

The LSJLD was created in 1955 and is responsible for the maintenance and operation of the project flood control facilities. LSJLD, in accordance with its agreement with the state

Reclamation Board, is obligated to maintain not only the bypasses, but the channel of the San Joaquin River in the project area, in a condition where the channel will carry specified flood flows in accordance with the maximum benefits for flood protection. This obligation may be in direct conflict with some of the proposed restoration actions, including those that encourage vegetation growth in and along the river or bypass channels.

2.1.3.3 Potential Impacts

Conveyance of Kings River Flood Flows. Restoration actions including riparian vegetation enhancement, levee and channel, improvements, the Mendota Pool Bypass, and revised operating criteria for the Chowchilla Bifurcation Structure, have the potential to conflict with the routing of Kings River flood flows.

Lower San Joaquin River Flood Control Project. Existing channel capacity in the bypass system is sufficient to handle the Interim and Restoration Flows, however, these flows do not comply with the original mandated purpose of the bypass system and do not comply with the conditions of the flood easements for the bypass system (i.e., Interim and Restoration Flows are not flood flows). Expanded easements, land acquisition, and new legislation will be needed to route non-flood flows through the bypass system. In addition, new O&M agreements and increased funding for maintenance operations will be required.

The LSJLD is funded by property tax assessments on lands within the LSJLD boundaries that receive flood control benefits. As a result of conversion of lands to state and federal ownership (primarily for wildlife areas), the LSJLD is facing a disappearing tax base at a time when O&M costs are rising. The additional costs to maintain the channel, levee, and related flood control facilities that would be constructed under the Settlement will far exceed the LSJLD's current operating budget. These additional costs would result from additional vegetation management activities, additional sediment management and removal activities, cleaning of screens and trash racks on facilities, staff time to open and close gates and flap gates (in the bypass system), and staff time for flood watch (24-hour staffing needed when flows abut the toe of the levees). Additionally, the presence of water in the river channel year-round or for extended times during the year will change the LSJLD maintenance activities including the timing, tools, and techniques used. Under existing conditions, most maintenance activities are conducted when the river is dry, allowing for easy access to the river, reducing the potential for safety hazards, and allowing for the use of tools (including certain herbicides) and techniques that cannot be used in wet conditions. A local maintaining agency would need to be identified, and funds will be needed to cover O&M cost and maintain the channels, levees, and related flood control facilities that would be constructed under the Settlement. It is assumed that these funds would come from the state or federal government rather than from local funding sources, as these costs are a direct result of the restoration program.

As described previously, the LSJLD is obligated to maintain the bypasses and the channel of the San Joaquin River in a condition where the channel will carry flood flows in accordance with the maximum benefits for flood protection. This obligation may be in direct conflict with some of the proposed restoration actions, including those that encourage vegetation growth in and along the river or bypass channels. The Settlement should not conflict with or reduce the channel capacity or its overall ability to convey flood flows in any way. Existing channel capacities must be maintained or enhanced.

2.1.3.4 Evaluation Needed

Conveyance of Kings River Flood Flows. Routing of Kings River flood flows should be considered in the evaluation of levee, channel, and vegetation improvements and the Mendota Pool Bypass. Facilities and operating criteria, including new operating criteria for the Chowchilla Bifurcation Structure must be developed to allow for continued routing (including priority) of Kings River flood flows.

Lower San Joaquin River Flood Control Project. As part of the Reach 4B study, an evaluation should be conducted to determine the feasibility and cost of expanded easements or land acquisition in the bypass system to allow construction of a larger/wider channel to account for riparian vegetation growth and allow for routing of non-flood flows.

A process must be developed to work with a local maintaining agency to determine O&M costs and determine future funding sources.

2.1.3.5 Approvals and Permits Needed

Legislation and/or LSJLD authorization to route flows other than flood flows through the bypass system.

2.1.3.6 Additional Considerations

Changes in the current flood control operations will require development of an updated flood control plan for the Upper San Joaquin River and Kings River.

2.1.4 Screen Diversions

Based on an inventory conducted by the CDFG in 2001, there are more than 150 diversions along the San Joaquin River between Friant Dam and the confluence with the Merced River. Table 2-3 lists the number of diversions inventoried by reach and Appendix B provides a listing of the diversions by River Mile. While some of the inventoried diversions are not currently in use and some may already be screened, it is believed that the vast majority of these diversions are unscreened. Unscreened diversions can result in entrainment of juvenile salmon leading to direct mortality or stranding of juveniles in canals and related irrigation facilities. These diversions would need to be screened prior to reintroduction of salmon to the San Joaquin River system. Responsibility and funding for future operations and maintenance of the screens and associated facilities will need to be determined and necessary agreements achieved.

2.1.4.1 Potential Impacts

Screening diversions could cause changes in diversion hydraulics and increase required maintenance activities.

2.1.4.2 Evaluation Needed

Screens must be designed in accordance with National Marine Fisheries Service (NMFS) Fish Screening Criteria for Anadromous Salmonids (NMFS, 1997), criteria established by the CDFG, or other applicable criteria at the time of construction. Engineering analyses and design should be conducted for each diversion to reduce the potential for changes in diversion hydraulics, determine fish behavior response to hydraulic conditions, identify and

address potential sediment and debris problems, and identify the potential for creating predation opportunities. For larger diversions, engineering analyses and design should include computer modeling to determine appropriate hydraulics and screen design, and should consider ways to minimize maintenance activities. Depending on screen size and location, a thorough analysis of environmental impacts from construction and operation of the screen may also be needed. All screens should be designed assuming fry-sized spring and fall run salmonids could be present at the diversion.

TABLE 2-3
Number of Diversions on the Mainstem San Joaquin River by Reach

Reach	Number of Diversions
1	117
2A	5
2B	15
3	3
4A	2
4B Upper	8
4B Lower	2
5	2
Total	**154**

Source: CDFG, 2001

Note: Does not include diversions in the Mendota Pool area or in the bypass system. Bypass system includes 380 local drainage flap gates, 20 which are located in the Reach 4B area being considered as an alternative flow route. See Appendix B for a listing of diversions by river mile.

2.1.4.3 Approvals and Permits Needed

The following approvals and permits would likely be needed:

- Cooperation from the owner/operator of the diversion structure or pump
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, and CAA)
- O&M agreements

The level of effort for environmental analysis would depend on the size and location of the diversion. Larger screens may necessitate a much more extensive environmental review and compliance with state, federal, and local laws in addition to those listed previously.

2.1.4.4 Additional Considerations

As noted previously, environmental review and compliance will depend on the size and location of the diversion.

2.1.5 Riparian Habitat

Riparian habitat is proposed in all reaches of the San Joaquin River to provide cover for rearing and outmigrating juvenile salmon, provide habitat diversity and complexity for prey sources for juvenile salmon, to shade the channel and reduce overall water temperatures, and provide cover for juvenile salmon and reduce opportunities for predation by avian species.

2.1.5.1 Potential Impacts

Growth of riparian habitat will increase the "roughness coefficient" or amount of friction (drag) on flows in the river corridor and result in additional debris being trapped along the river or at structures or road crossings (between bridge pillars). This increase in roughness raises the water surface elevation of the river as flows are slowed by vegetation. Depending on the area and design channel capacity, an increase in the water surface elevation of the river will increase the frequency of flows at the levee toe, causing additional seepage and levee stability problems. Planning for the restoration of riparian habitat must account for these potential consequences and newly constructed or redesigned channel configurations (setback levees, and so forth) should allow for additional vegetation (increased roughness) in the river channel to maintain design flood flow capacity and maintain original design water surface elevations (stage).

2.1.5.2 Evaluation Needed

An overall "landscape" design is needed to determine the long-term extent, composition, and structure (size, location, and related criteria) of riparian vegetation restoration. This design should be conducted on a reach-by-reach basis and should include detailed information, including the vegetation composition (including desirable and undesirable species) and specific locations/areas for large woody riparian vegetation. Agreement with local agencies and landowners on critical assumptions for the analyses should be sought early in the process. This detailed design information should be used in the engineering and hydraulic analysis conducted for levee and channel improvements (see Section 2.1.1) to determine appropriate channel characteristics (such as widths, depths, and locations of setback levees). This detailed design information should be used as a guide for long-term management and increased maintenance of riparian vegetation by a local maintaining agency.

2.1.5.3 Approvals and Permits Needed

The extent of approvals and permits needed would depend on the actions taken. Larger planting efforts may require NEPA, CEQA, ESA, CESA, CWA, and CAA compliance. Natural revegetation may not require federal, state, or local approvals or permits. Under all circumstances, coordination with the LSJLD and the Reclamation Board would be needed, and depending on the extent of activities, an Encroachment Permit from the Reclamation Board may be needed.

2.1.5.4 Additional Considerations

A clearly defined set of goals for vegetation area and structure is needed to manage potential conflicts with channel capacities and flood operations. Additionally, revegetated areas would need to be managed for exotic species.

As described in Section 2.1.3, the LSJLD maintains the majority of the Upper San Joaquin River channel and the bypass system for flood conveyance. Additional vegetation in the channel would necessitate additional management activities by LSJLD or a local maintaining agency. An O&M agreement and funding for these activities would be needed. Additionally, long-term assurances and ESA and CESA compliance for O&M activities,

including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, would be necessary.

2.2 Reach-specific Actions

This section addresses proposed restoration actions, critical issues, and technical evaluations needed by reach. A tabular summary of the following information is provided in Appendix C. See Table 2-1 for a summary of the restoration actions proposed by reach.

2.2.1 Reach 1

Reach 1 is approximately 38.5 miles long. It begins at Friant Dam, where the San Joaquin River exits the Sierra Nevada foothills, and ends at Gravelly Ford, where the River transitions from a predominantly gravel-bed system to a predominantly sand-bed system. In this reach, the river is confined within natural terraces and bluffs. Water is present year-round in Reach 1, and the river is flanked by riparian vegetation through most of the reach. Adjacent land uses include gravel mining, rural residential areas, and agricultural lands. Reach 1 is anticipated to serve as the primary holding and spawning habitat for salmon because of its proximity to Friant Dam and availability of cold water, availability of larger pools, and gravel-to-cobble bedded channel. A variety of channel improvements are needed in Reach 1 to address the biological requirements of key stages of the salmonid life cycle. The following restoration actions are proposed for Reach 1:

- Reconstruct channel/side channels and add gravel for spawning habitat
- Fill and isolate gravel pits
- Reconstruct barriers to migration (road crossings)

Following is a more detailed description of each of these actions, along with a discussion of improvements needed to maintain adequate water levels at diversions near the Gravelly Ford Gaging Station. In addition to these actions, existing diversions in Reach 1 would need to be screened and riparian habitat restoration would be needed as described in Section 2.1.

2.2.1.1 Reconstruct Channel/Side Channels and Add Gravel for Spawning Habitat

Gravel augmentation is needed in Reach 1 because the construction of Friant Dam effectively cut off the main sediment supply for the San Joaquin River. The quantity and quality of suitable spawning habitat is insufficient to support the biological requirements of salmon, and the addition of gravel to specific areas of the river is needed to improve spawning habitat and the likelihood of successful fry emergence. Reconstruction of the side channels in Reach 1 is important, as these side channels could provide additional juvenile rearing habitat. These channel improvements in Reach 1 are necessary to establish the biological requirements for key stages of the salmonid life cycle.

Potential Impacts. Reconstruction of the mainstem and side channels and the addition of gravel for spawning habitat would result in changes in localized river hydraulics.

Evaluation Needed. Detailed engineering designs would be needed for reconstruction of the mainstem and side channels and more generalized designs would be needed for gravel addition areas. As part of this analysis and design effort, pre- and post-channel surveys, flow and sediment transport monitoring and studies, and computer modeling should be

conducted to estimate and monitor changes in localized river hydraulics and sediment transport. If sensitive biological or cultural resources may be located in the project area, pre-construction surveys should be conducted and sensitive resources should be avoided or mitigated. Mitigation measures should be developed to minimize impacts to water quality and air quality.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Land easements or acquisition
- Access agreements from adjacent landowners
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, CAA, and CDFG Code Section 1600 Agreement)
- State Lands Lease and possible land transfer

Additional Considerations. Need agreement with existing local responsible agencies for long-term maintenance of gravel beds.

2.2.1.2 Fill and Isolate Gravel Pits

Historical sand and gravel mining activities immediately adjacent to the river have resulted in large remnant gravel pits within the floodplain. During high flows, the river has "captured" or flowed into some of these pits, and many of the gravel pits are now connected to the river. These captured pits hinder the natural downstream transport of sediment from upstream areas and adversely affect the quantity of appropriately sized spawning gravels. In addition, water temperatures in captured pits are generally higher than in the mainstem, and thus, the pits provide warm-water habitat for non-native predators that prey on juvenile salmon. Many of the captured pits should be isolated from the mainstem or filled to improve sediment transport and reduce habitat for non-native predators.

The potential impacts, evaluations, approvals and permits, and additional considerations for filling and isolating gravel pits are the same as those identified in Section 2.2.1 for reconstructing channel/side channels and adding gravel for spawning habitat.

2.2.1.3 Reconstruct Barriers to Migration

Barriers to migration in Reach 1 consist of the Vulcan culverts located at River Mile 258.5 and the Stuart/Nuss Road culverts located at River Mile 229.0. The Vulcan culverts consist of 10 round culverts that span the width of the San Joaquin River. The Stuart/Ness Road culverts consist of two round culverts that also span the width of the San Joaquin River. Both culverts present barriers to migration at different flows and would need to be removed or reconstructed. Potential impacts, evaluations, and approvals and permits would differ, depending on whether or not the road crossings are only removed or removed and reconstructed.

Potential Impacts. If the road crossings are removed, the potential impacts to hydrology and flooding would likely be minimal and would generally improve (lessen) flow constructions within the channel.

If the road crossings are reconstructed, new road crossings or possibly bridges have the potential to cause changes in localized river hydraulics. These changes include additional structures in the channel that have the potential to: (1) redirect flows resulting in additional erosion or sedimentation and (2) increase the potential for flooding due to increased roughness (including the potential to serve as a debris trap).

Evaluation Needed. If the road crossings are removed, localized topographic and channel surveys would be needed to determine locations and amount of sediment removal. Pre-construction biological surveys should be conducted and mitigation measures should be developed to minimize impacts to water quality, air quality, and biological resources.

If the road crossings are reconstructed, detailed engineering designs would be needed. The analysis and design effort should include pre- and post-channel surveys, flow and sediment transport monitoring and studies, and computer modeling to estimate and monitor changes in localized river hydraulics and sediment transport. If sensitive biological resources may be located in the project area, pre-construction surveys should be conducted and take of sensitive species should be avoided or mitigated. Mitigation measures should be developed to minimize impacts to water quality, air quality, cultural resources, and biological resources.

Approvals and Permits Needed. The following approvals and permits would likely be needed.

- Cooperative agreement with owners (for private roads) or counties (for public roads)
- Access agreements from adjacent landowners
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CAA, CDFG Code Section 1600 Agreement, and CWA including a dredging permit from the USACE)
- State Lands Lease

Additional Considerations. As described previously, impacts and associated evaluations and mitigations would be reduced if the road crossings are not reconstructed. However, this could impact local gravel mining operations that frequently use these crossings.

2.2.1.4 Pump Diversion at Gravelly Ford

The Gravelly Ford Gaging Station is located at the downstream end of Reach 1. Reclamation generally targets a flow of approximately 5 cfs past Gravelly Ford to maintain upstream water levels for riparian diversions. Channel scour and channel incision in the area near the gaging station have reduced the accuracy of the gaging station and the ability to reliably pump water from the river for irrigation purposes

Potential Impacts. Channel scour upstream of the Gravelly Ford Gaging Station has affected the ability of some water right holders to divert water in this reach of the river. A small sand barrier is periodically constructed upstream of the Gravelly Ford Gaging Station to back water up for diversion at local pumping facilities. Increasing the frequency and magnitude of flows in this area under the Settlement would cause additional scour, channel incision, and further exacerbate pumping problems.

Evaluation Needed. Engineering analysis and design for changes to the river channel and gaging station will be needed. Channel improvements, including the construction of a small diversion weir with fish passage capability, may be necessary for continued operations of these diversion facilities. This effort should include pre- and post-channel surveys, flow and sediment transport monitoring and studies, and computer modeling to estimate and monitor changes in localized sediment transport and river hydraulics. If sensitive biological resources may be located in the project area, pre-construction surveys should be conducted and sensitive areas should be avoided or mitigated.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Coordination with the U.S. Geological Survey
- Access agreements from adjacent landowners
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, CAA, and CDFG Code Section 1600 Agreement)
- State Lands Lease
- Future O&M agreements

Additional Considerations. None identified at this time.

2.2.2 Reach 2A

Reach 2A is approximately 13 miles long. It begins at Gravelly Ford and extends downstream to the Chowchilla Bifurcation Structure. The river in this reach is entirely sand-bedded and maintained for flood control purposes by the LSJLD. No low-flow channel exists throughout much of the reach and lower flows tend to spread out over large areas, resulting in shallow water depths and high water temperatures. These water depths and high water temperatures are likely to be lethal to upmigrating adult salmon and outmigrating juvenile salmon. Typically, there are no flows in Reach 2A except under flood flow conditions. Adjacent land uses are primarily agricultural. Current published channel design capacity for Reach 2A is approximately 8,000 cfs.

Reach 2A would provide habitat for upmigrating adult salmon and outmigrating juvenile salmon. However, both levee and fish passage improvements are needed to pass the Restoration Flows, promote riparian vegetation, allow for fish passage through the reach, and prevent fish stranding in the bypass system. The proposed restoration actions in Reach 2A are as follows:

- Improve levees and enlarge channels
- Restore riparian habitat
- Redesign or modify Chowchilla Bifurcation Structure for fish passage
- Screen diversions

A summary of some of these actions including levee and channel improvements, riparian habitat creation, and screening diversions is provided in Section 2.1. Levee and channel improvements specific to Reach 2A and the modification of the Chowchilla Bifurcation Structure for fish passage and to prevent entrainment are described as follows.

2.2.2.1 Levee and Channel Improvements

Most of Reach 2A is bounded by project levees and piping and seepage have been observed at flows well below the maximum capacity. Historically, levee failures have occurred during high-flow events. These problems will be exacerbated by the growth of new riparian vegetation and the increased frequency of peak flows that would occur under the Settlement, causing increased water surface elevations, additional seepage, and potential levee failures. The structural stability of the existing levees must be improved to safely pass Restoration Flows. In addition, slurry walls may be needed to reduce seepage and seepage-induced crop damage, and to improve levee structural stability. Setback levees and a new floodplain may also be needed in Reach 2A to provide additional capacity necessary to restore riparian vegetation in this reach.

A low-flow channel may be needed to provide depths necessary for fish passage and reduce water temperatures. It has been suggested that restoration of riparian vegetation alone will result in a defined low-flow channel. However, this action is unproven on the sand-bedded San Joaquin River and should be tested extensively under a variety of flow conditions (including high-flow conditions) before being seriously considered as a method to establish a low-flow channel.

A summary of the potential impacts, evaluations, approvals and permits, and additional considerations associated with river-wide levee and channel improvements is provided in Section 2.1.1.

2.2.2.2 Redesign or Modify Chowchilla Bifurcation Structure for Fish Passage and Prevent Entrainment

In addition to the levee improvements identified previously, modifications would need to be made to the Chowchilla Bifurcation Structure to allow for fish passage into Reach 2B. An evaluation is needed to determine whether or not the Chowchilla Bifurcation Structure should be screened to prevent outmigrating juvenile salmon from entering the bypass system or if individual flap gates and turnouts within the bypass system could be screened. In the event that the Chowchilla Bifurcation Structure is screened at the head of the bypass system, then the potential backwater effects that could cause trash and debris build-up during high-flow events would need to be evaluated. In the event that the Chowchilla Bifurcation Structure is not screened at the head of the bypass system and juvenile salmon are allowed to enter the bypass system, then the individual flap gates and turnouts within the bypass system would need to be screened to prevent fish entrainment.

Potential Impacts. Modifications to the Chowchilla Bifurcation Structure would cause changes in localized river hydraulics and flood flow characteristics. Additionally, modifications may cause excessive sand deposition in the area, necessitating additional sand removal (dredging) activities. Screening of the individual flap gates and turnouts within the bypass system has the potential to substantially increase O&M costs.

Evaluation Needed. Detailed engineering design of the modified Chowchilla Bifurcation Structure would be needed. The analysis and design should include pre- and post-topographic and channel surveys, long-term flow and sediment transport monitoring and studies, and computer modeling to estimate and monitor changes in localized river hydraulics and sediment transport. Impacts on adjacent levees, such as increased backwater

effect during high-flow events, should be considered during design. A sediment management plan should be prepared and long-term sediment monitoring should be conducted (see Section 2.1.1).

If sensitive biological resources may be located in the project area, pre-construction surveys should be conducted and take of sensitive species should be avoided or mitigated. Mitigation measures should be developed to minimize impacts to water quality and air quality.

Fish passage facilities should be designed in coordination with NMFS and CDFG and applicable engineering design criteria at the time of construction. Analyses should be conducted to reduce the potential for changes in river hydraulics, determine fish behavior response to hydraulic conditions, identify and address potential sediment and debris problems, and identify the potential for creating predation opportunities. These analyses should also include technical analyses to determine appropriate hydraulics and passage design, and should consider ways to minimize maintenance activities. An analysis of environmental impacts from construction and operation of the passage facilities would be needed.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, CAA, and CDFG Code Section 1600 Agreement)
- Reclamation Board and LSJLD Encroachment Permit

Additional Considerations. New fish screen and passage facilities should be under federal or state ownership with O&M conducted by a local maintaining agency. An O&M agreement and funding to cover O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

As described in Section 2.1.3, an updated flood control plan, which includes changes to the operation of the Chowchilla Bifurcation Structure, may be needed. Any modifications to the Chowchilla Bifurcation Structure must maintain or improve the upstream and downstream design flow capacities.

2.2.3 Reach 2B

Reach 2B is approximately 11 miles long. It begins at the Chowchilla Bifurcation Structure and ends at Mendota Dam. No river flows exist in Reach 2B Upper, above the Mendota Pool backwater formed by Mendota Dam, except under flood flow conditions. However, some riparian vegetation occurs in Reach 2B, likely due to localized high groundwater conditions as a result of the Mendota Pool. Similar to Reach 2A, Reach 2B is entirely sand-bedded and there is no low-flow channel throughout much of the reach. Lower flows tend to spread out over large areas, resulting in shallow water depths and high water temperatures. Adjacent land uses are primarily agricultural and most of Reach 2B is bounded by non-project levees.

Reach 2B would provide habitat for upmigrating adult salmon and outmigrating juvenile salmon. However, both levee and fish passage improvements are needed to pass the Restoration Flows and allow for fish passage through the reach. The proposed restoration actions for Reach 2B are as follows:

- Construct levee and channel improvements
- Restore riparian habitat
- Reconstruct San Mateo Road crossing
- Screen diversions

A summary of some of the river-wide issues associated with these actions is provided in Section 2.1. Issues associated with levee and channel improvements specific to Reach 2B are described as follows.

2.2.3.1 Levee and Channel Improvements

Reach 2B does not have sufficient capacity to convey the Restoration Flows, and the structural stability of the existing private levees would need to be improved. Improvements could include setting back and rebuilding existing levees and potentially installing slurry walls to reduce seepage and improve the structural stability. Similar to Reach 2A, Reach 2B is entirely sand-bedded and there is no low-flow channel throughout much of the reach. Shallow water depths and high water temperatures are likely to be lethal to upmigrating adult salmon and outmigrating juvenile salmon. A low-flow channel would be needed to provide depths necessary for fish passage and reduce water temperatures.

Mendota Dam, at the downstream end of Reach 2B, raises the water surface level in the Mendota Pool and backs water up the San Joaquin River and Fresno Slough. When there are flood flows at the Chowchilla Bifurcation Structure, only 1,300 cfs are routed through Reach 2B and flows in excess of this amount are routed into the Chowchilla Bypass. Flows higher than 1,300 cfs result in significant seepage and levee stability problems. This condition only occurs if there are no Kings River flows entering the San Joaquin River through Fresno Slough. As identified in Section 2.1.2, Reach 2B provides critical water supply conveyance for delivery of water under existing water rights. The ability to convey flows for delivery under existing water rights must be maintained. A total capacity of up to 7,000 cfs is needed in this reach to convey up to 4,500 cfs of Restoration Flow and up to 2,500 cfs of water right flows.

2.2.3.2 Reconstruct San Mateo Road Crossing

The San Mateo Road Crossing is located upstream of Mendota Pool at River Mile 211.8. The road crossing consists of a round, corrugated metal pipe with an unpaved, low-water crossing, and provides access across the river for existing agricultural operations. The road crossing is believed to be a barrier to migration and must be reconstructed.

Potential impacts, evaluations needed, approvals and permits needed, and additional considerations are the same as those described for removal or reconstruction of road crossings in Reach 1 (see Section 2.2.1).

2.2.4 Mendota Pool Bypass

The Settlement proposes the construction of a bypass to route upmigrating adults and outmigrating juvenile salmon around the Mendota Pool. Construction of the Mendota Pool Bypass would eliminate a number of concerns with routing fish though Mendota Pool, including the need to provide fish passage at Mendota Dam, screening of the numerous diversions in the pool, and reducing the potential for warm-water predation in the pool. Any San Joaquin River flow that is in excess of the specified restoration flow through the bypass must be allowed flow into Mendota Pool to meet water rights demands. Figure 2-1 provides a schematic plan view of the proposed bypass channel, related facilities, and design flow rates. The proposed restoration actions for the new Mendota Pool Bypass are as follows.

- Construct bypass channel
- Construct upstream bifurcation structure
- Install fish screens and passage facilities

Riparian habitat restoration will also be needed in the new bypass channel to reduce water temperatures and provide cover for upmigrating and outmigrating salmon. This action is described in Section 2.1.5.

In addition to the actions identified previously, the Columbia Canal Company's water intake and related facilities must be reconfigured as a result of the construction of the Mendota Pool Bypass; this action is described as follows.

2.2.4.1 Construct Bypass Channel

The Mendota Pool Bypass will require the construction of a new channel with setback levees and a low-flow channel. As proposed in the expert report of Dr. Michael D. Harvey (2005), the new channel would be approximately 9,800 feet long, with a low-flow channel that would convey 200 cfs, a main channel that would convey up to 4,000 cfs, and an overbank area to convey an additional 500 cfs. The overall channel capacity would be designed to convey up to the Restoration Flow of 4,500 cfs. A series of drop structures may be needed in the downstream extent of the bypass channel to maintain design slopes.

Potential Impacts. The Mendota Pool Bypass would cause substantial changes to the geomorphology of the river. These changes could alter sediment transport and river hydraulics, potentially changing erosion and sedimentation characteristics, changing flow routing and 'stress' points on adjacent levees and other infrastructure, and changing overall flooding characteristics. The bypass could also cause increased seepage in the area, exacerbating already high groundwater levels around the Mendota Pool. Long-term impacts to agricultural lands are expected as a result of high groundwater levels that are likely to affect production on adjacent agricultural lands. Substantial flood easements, mitigation, or acquisition of these lands will be necessary.

Evaluation Needed. Evaluations needed are the same as those identified in Section 2.1.1 for levee and channel improvements.

Approvals and Permits Needed. Approvals and permits needed are the same as those identified in Section 2.1.1 for levee and channel improvements.

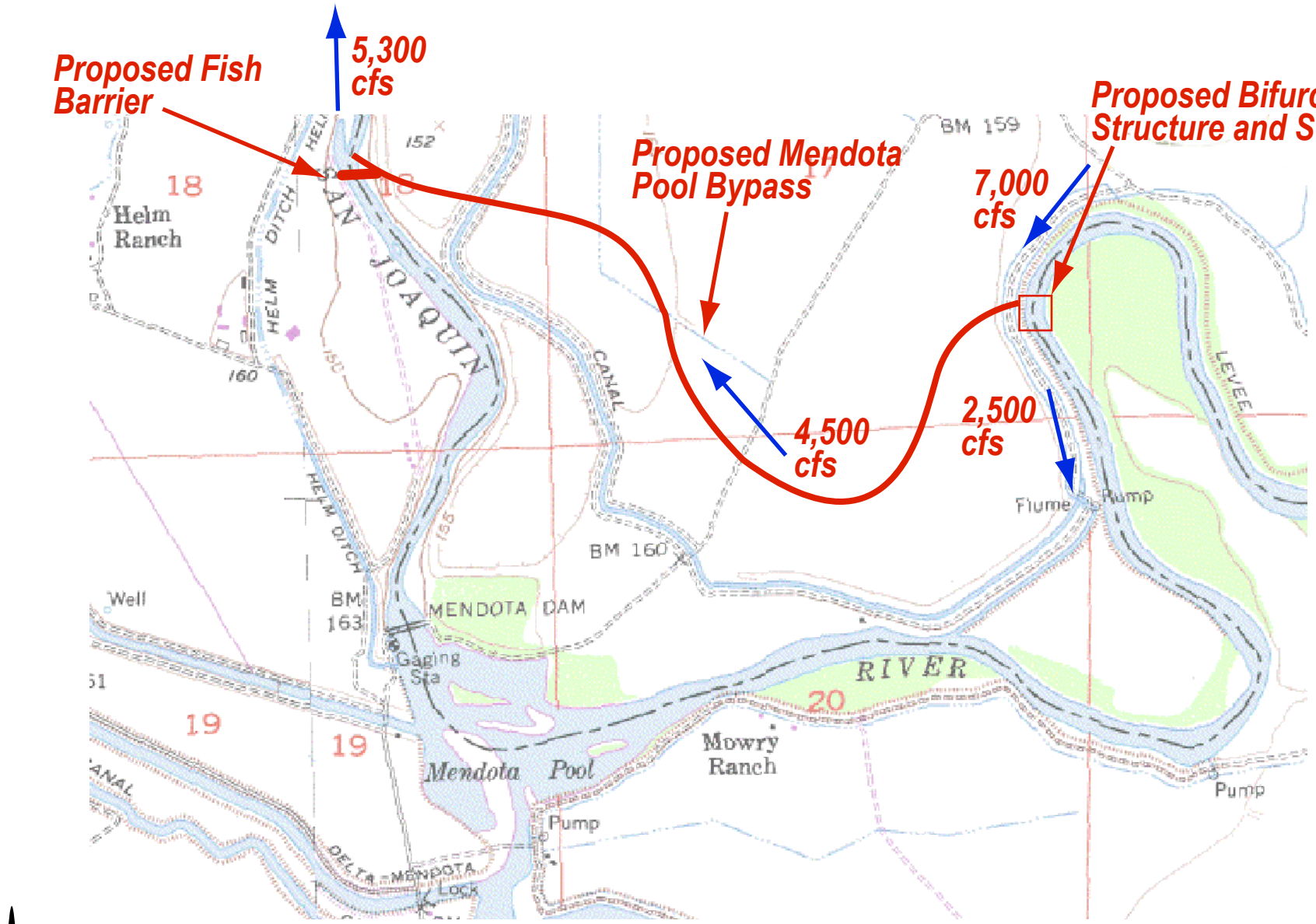

FIGURE 2-1
PROPOSED MENDOTA POOL BYPASS
REQUIRED DESIGN FLOWS

Additional Considerations. Conveyance of flows in the San Joaquin River above 2,500 cfs downstream of the Chowchilla Bifurcation Structure will require changes to the flood bypass operating criteria.

Similar to levee and channel improvements identified in Section 2.1.1, it is assumed that Mendota Pool Bypass facilities would be owned by the state and/or Reclamation and O&M activities would be conducted by a local maintaining agency that has yet to be determined. An O&M agreement and funding for O&M activities would be needed. Additionally, long-term assurances and ESA and CESA compliance for O&M activities, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, would be necessary.

2.2.4.2 Construct New Bifurcation Structure

The new bifurcation structure will be located just downstream of the head of the proposed Mendota Pool Bypass Channel and control the amount of flow entering Mendota Pool, diverting remaining flows into the bypass channel. The structure must have variable gate position controls and be sized to allow a maximum flow of 2,500 cfs to reach the pool. The structure and gates must be designed to provide control for multiple flow split scenarios between the pool and the bypass channel.

Under irrigation season operations, the backwater behind Mendota Dam extends up Fresno Slough (flows south) and conveys Delta-Mendota Canal water 12 miles upstream to irrigators located along the slough including Tranquility, James Irrigation District, Westlands Water District, and the Mendota State Wildlife Area. This backwater behind Mendota Dam will extend up the San Joaquin River to the new bifurcation structure. Therefore, the design must account for back pressure on the downstream side of the structure caused by this backwater, thus preventing flows from the Mendota Pool from entering the Mendota Pool Bypass Channel.

Potential Impacts. Construction of the new bifurcation structure may cause changes in localized river hydraulics and flood flow characteristics causing excessive sand deposition in the area, necessitating additional sand removal (dredging) activities.

Evaluation Needed. Detailed engineering design of the proposed bifurcation structure will be needed. The analysis and design should include pre- and post-topographic and channel surveys, long-term flow and sediment transport monitoring and studies, and computer modeling to estimate and monitor changes in localized river hydraulics and sediment transport. Impacts on adjacent levees, such as increased backwater effect during high-flow events, should be considered during design. A sediment management plan should be prepared and long-term sediment monitoring should be conducted (see Section 2.1.1).

If sensitive biological resources may be located in the project area, pre-construction surveys should be conducted and take of sensitive species should be avoided or mitigated. Mitigation measures should be developed to minimize impacts to water quality and air quality.

Analyses should be conducted to reduce the potential for changes in river hydraulics, determine fish behavior response to hydraulic conditions, identify and address potential

sediment and debris problems, and identify the potential for creating predation opportunities. These analyses should also include technical analyses to determine appropriate hydraulics and passage design, and should consider ways to minimize maintenance activities. An analysis of environmental impacts from construction and operation of the passage facilities would be needed.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, CAA, and CDFG Code Section 1600 Agreement)
- Reclamation Board and LSJLD Encroachment Permit

Additional Considerations. The new bifurcation facility should be under federal or state ownership with O&M conducted by the existing local responsible agencies. An O&M agreement and funding to cover O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

As described in Section 2.1.3, an updated flood control plan, which includes operation of the new bifurcation structure, will be needed. The new structure must maintain or improve upstream and downstream design flow capacities and not cause any increase in flood flow water surface elevations.

2.2.4.3 Fish Screens and Passage Facilities

Fish screens and passage facilities would be needed for the new Mendota Pool Bypass. These facilities are expected to consist of a fish screen at the new bifurcation structure at the upstream end of the bypass channel and a barrier to migration for upmigrating adult salmon between the downstream end of the bypass channel and Mendota Dam. The bypass drop structures will also require fish passage facilities.

Potential Impacts. Potential impacts are generally the same as those identified previously for constructing the Mendota Pool Bypass Channel.

Evaluation Needed. The evaluations needed for screen design and installation are described in Section 2.1.4.

Approvals and Permits Needed. Approvals and permits needed are the same as those identified in Section 2.1.4.

Additional Considerations. Any new fish screen and bypass facilities should be under federal or state ownership with O&M conducted by a local maintaining agency that has yet to be determined. An O&M agreement and funding to cover increased O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

2.2.4.4 Reconfigure the Columbia Canal Company's Water Intake and Related Facilities

The Columbia Canal Company diversion headworks is located on the mainstem of the San Joaquin River upstream of Mendota Dam, but downstream of the proposed Mendota Pool Bypass Bifurcation Structure.

Potential Impacts. The Mendota Pool Bypass Channel will need to cross the Columbia Canal. If the Columbia Canal headworks are to remain in place, the construction of a siphon and related facilities on the canal would be required. The Columbia Canal Company would need to be compensated for any additional O&M activities that result from new facilities and any additional pumping. If the canal headworks are to be moved, new diversion facilities would be needed. Depending on the location of the new diversion facilities, the majority of the Canal Company's delivery system may need to be reconstructed to allow for continued gravity-flow water delivery.

Evaluation Needed. To ensure the continued water supply operations of the Mendota Pool, an alternatives analysis should be conducted to determine engineering designs and locations of structures for the Mendota Pool Bypass and related facilities. The alternatives analysis should incorporate local knowledge and be coordinated closely with local agencies, including the Central California Irrigation District owner and operator of Mendota Dam and the Columbia Canal Company owner and operator of the Columbia Canal. Overall, these analyses should be conducted in a similar manner as the engineering analysis and design for levee and channel improvements described in Section 2.1.1. As part of this analysis and design effort, pre- and post-channel surveys, flow and sediment transport monitoring and studies, and computer modeling should be conducted to estimate and monitor changes in localized river hydraulics and sediment transport. The analyses should be based on the most recently available information, include field studies and data collection as needed, and be conducted to professional standards using established engineering practices. All engineering design should be conducted to Reclamation, DWR, and/or USACE design standards and guidelines, as appropriate.

Approvals and Permits Needed. Depending on the action taken, a variety of approvals and permits may be needed including the following.

- Land acquisition and/or easements
- Access agreements from adjacent landowners
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CWA, CAA, and CDFG Code Section 1600 Agreement)
- Reclamation Board and LSJLD Encroachment Permit(s)
- State Lands Lease and Land Transfer

Additional Considerations. None identified at this time.

2.2.5 Reach 3

Reach 3 is approximately 23 miles long and conveys up to 800 cfs of water from the Mendota Pool to Sack Dam for irrigation diversion into the Arroyo Canal. The river in this reach is flanked by large woody riparian vegetation. Adjacent land uses consist of urban

lands in the City of Firebaugh and agricultural lands throughout the remainder of the reach. The current published channel design flood flow capacity for Reach 3 is 4,500 cfs.

Reach 3 would provide passage for upmigrating adult salmon and outmigrating juvenile salmon. However, both levee and fish passage improvements are needed to pass the Restoration Flows, allow for fish passage past Sack Dam, and prevent fish stranding and entrainment in the Arroyo Canal. The proposed restoration actions for Reach 3 are as follows.

- Levee and channel improvements
- Replace or modify Sack Dam for fish passage
- Screen Arroyo Canal
- Screen other diversions
- Restore riparian habitat

A summary of the common river-wide issues associated with these proposed actions is provided in Section 2.1. The following describes the levee and channel improvements specific to Reach 3, modification of Sack Dam for fish passage, and the screening of the Arroyo Canal.

2.2.5.1 Levee and Channel Improvements

Most of Reach 3 is bounded by non-project levees and irrigation canals. The existing channel capacity is approximately 4,500 cfs, but flows of less than this magnitude can cause seepage and levee stability problems. Irrigation canals closest to the river are typically filled with water during high-flow events to improve canal wall stability and prevent collapse. Seepage and stability problems in Reach 3 are of concern because levee failure would likely cause flooding of both agricultural lands and urban areas in the City of Firebaugh. The effects of conveying the Restoration Flows through Reach 3 are uncertain at this time, however, seepage problems have been identified with past high flows. Levee stability studies should be conducted to determine whether improvements are needed.

Reach 3 provides critical water supply conveyance for delivery of water under existing water rights. The ability to convey flows for delivery under existing water rights must be maintained. A total flow capacity of up to 5,300 cfs is needed in this reach to convey a combination of up to 4,500 cfs of Restoration Flow and up to 800 cfs of water right flows. Hydraulic analyses must be conducted to determine the combination of levee setbacks, levee reconstruction, or slurry walls needed to provide an increase in flow capacity while still maintaining existing water surface elevations under future conditions with a mature growth of riparian vegetation and necessary seepage protection.

A summary of the potential impacts, evaluations, approvals and permits, and additional considerations associated with levee and channel improvements is provided in Section 2.1.1.

2.2.5.2 Replace or Modify Sack Dam for Fish Passage

A portion of the flows from the Delta-Mendota Canal are allowed to continue down the San Joaquin River to Sack Dam for diversion at the Arroyo Canal. Sack Dam is owned and operated by the San Luis Canal Company and backs up water for diversion into the Arroyo Canal. Sack Dam spans only a portion of the San Joaquin River, and increasing the frequency and magnitude of flows in the San Joaquin River at Sack Dam may affect the

structural stability of the dam. Additionally, Sack Dam would need to be modified to allow for fish passage around the structure.

Potential Impacts. Replacement or modification to Sack Dam has the potential to cause localized changes to sediment transport and river hydraulics due to modifications to the river channel.

Evaluation Needed. Engineering analyses of changes to the river channel would be needed. The analysis and design effort should include pre- and post-channel surveys, flow and sediment transport monitoring and studies, and computer modeling to estimate and monitor changes in localized sediment transport and river hydraulics. If sensitive biological resources may be located in the project area, pre-construction surveys should be conducted and sensitive areas should be avoided or mitigated.

Fish passage facilities should be designed in coordination with NMFS and CDFG and applicable engineering design criteria at the time of construction. Analyses should be conducted to reduce the potential for changes in river hydraulics, determine fish behavior response to hydraulic conditions, identify and address potential sediment and debris problems, and identify the potential for creating predation opportunities. These analyses should also consider ways to minimize maintenance activities. An analysis of environmental impacts from construction and operation of the passage facilities would be needed.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Approval from San Luis Canal Company and access agreements from adjacent landowners
- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CDFG Code Section 1600 Agreement, CWA, and CAA)
- Reclamation Board and LSJLD Encroachment Permit
- State Lands Lease

Additional Considerations. A newly constructed diversion facility would be under federal or state ownership with O&M conducted by the San Luis Canal Company. An O&M agreement and funding to cover increased O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

Construction scheduling of channel and dam improvements will be critical, as Reach 3 is used year-round for conveyance of various flows including irrigation, refuge, and flood flows. Alternative means to convey and divert water at the San Luis Canal Company headworks will be needed during periods of restoration construction.

2.2.5.3 Screen Arroyo Canal

Flows diverted into the Arroyo Canal are used for irrigation and wildlife refuge areas. A screen would be needed on the Arroyo Canal to prevent entrainment of upmigrating adult

salmon and outmigrating juvenile and direct mortality or stranding of spring and fall run salmon in the canal and related irrigation facilities.

Potential Impacts. Screening the Arroyo Canal may cause localized changes in sediment transport and river hydraulics and may also change diversion hydraulics. Screening the Arroyo Canal may increase required maintenance activities and increase overall O&M costs.

Evaluation Needed. The evaluations needed for screen design and installation are described in Section 2.1.4.

Approvals and Permits Needed. Approvals and permits needed are the same as those identified in Section 2.1.4. In addition, cooperation and coordination with the San Luis Canal Company would be needed.

Additional Considerations. Any new fish screen should be under federal or state ownership with O&M conducted by the San Luis Canal Company. An O&M agreement and funding to cover increased O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

2.2.6 Reach 4A

Reach 4A is approximately 13.5 miles long. It begins at Sack Dam and ends at the Sand Slough Control Structure. Flows in this reach are usually negligible except for flood flows. Adjacent land uses are primarily agricultural.

Similar to Reach 3, Reach 4A would provide passage for upmigrating adult salmon and outmigrating juvenile salmon. Levee and fish passage improvements are also needed on Reach 4A to pass the Restoration Flows, allow for fish passage through the reach, and prevent fish stranding and entrainment. The proposed restoration actions for Reach 4A are as follows:

- Construct levee and channel improvements
- Screen diversions
- Screen and modify Sand Slough Control Structure for fish passage

A summary of the issues associated with levee and channel improvements and screening diversions is provided in Section 2.1. Issues associated with levee and channel improvements and the Sand Slough Control Structure specific to Reach 4A are described as follows.

2.2.6.1 Levee and Channel Improvements

Most of Reach 4A is bounded by non-project levees and canals. The existing design channel capacity is 4,500 cfs, but flows of this magnitude cause significant seepage and levee stability problems. To safely convey the Restoration Flows and prevent seepage damage to adjacent crops, the structural stability of the existing levees would need to be improved. These improvements could include rebuilding the existing levees and/or installing slurry walls to prevent seepage and improve structural stability.

A summary of the potential impacts, evaluations, approvals and permits, and additional considerations associated with levee and channel improvements is provided in Section 2.1.1.

2.2.6.2 Screen and Modify Sand Slough Control Structure

The Sand Slough Control Structure is located at the downstream end of Reach 4A. The structure was constructed as part of the Lower San Joaquin River Flood Control Project, and currently diverts all flows from the San Joaquin River into the Eastside Bypass. Improvements to the structure for fish passage would depend on the routing of Restoration Flows (i.e., through the mainstem San Joaquin or the bypass system). Use of the mainstem San Joaquin River in Reach 4B for Restoration Flows would require the construction of fish passage facilities on the portion of the Sand Slough Control Structure on the mainstem San Joaquin River and a fish screen on the headworks for the Eastside Bypass. Conversely, bypassing Reach 4B of the mainstem San Joaquin River and using the bypass system for Restoration Flows would require the construction of fish passage facilities on the headworks for the Eastside Bypass and a fish screen on the portion of the structure on the mainstem San Joaquin River.

Potential Impacts. Similar to screening and fish passage activities in other reaches, modifications to the Sand Slough Control Structure could cause localized changes in sediment transport and river hydrology, changes in diversion hydraulics, and increase maintenance activities.

Evaluation Needed. The evaluations needed for screen and fish passage design and installation are described in Section 2.1.4 and Section 2.2.2, respectively.

Approvals and Permits Needed. The following approvals and permits would likely be needed:

- Environmental compliance (likely NEPA, CEQA, ESA, CESA, CDFG Code Section 1600 Agreement, CWA, and CAA)
- Reclamation Board and LSJLD Encroachment Permit (will necessitate access agreements from adjacent landowners)

Additional Considerations. New fish screen and passage facilities should be under federal or state ownership with O&M conducted by a local maintaining agency that has yet to be determined. An O&M agreement and funding to cover increased O&M costs would be needed. Additionally, long-term assurance and ESA and CESA compliance, including assurances and compliance for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect, are needed for O&M activities. This long-term ESA and CESA compliance for O&M activities should be completed concurrent with ESA and CESA compliance for construction activities.

2.2.7 Reach 4B (Upper)

Reach 4B Upper is approximately 21.3 miles long and extends from the Sand Slough Control Structure to the Mariposa Bifurcation Structure. Because of the very limited channel capacity in Reach 4B Upper, all flood flows in Reach 3 are currently diverted into the bypass system at the Sand Slough Control Structure. The channel in Reach 4B is filled with dense vegetation, clogged with sediment, and poorly defined. However, portions of the Reach 4B

channel are used for local water supply operations, including surface water storage and conveyance. Adjacent land uses are primarily agricultural and rely on a complex irrigation and drainage network to provide water supply, control shallow groundwater levels, and provide drainage.

The Settlement calls for modifications to Reach 4B to convey Interim Flows of 475 cfs and ultimately Restoration Flows of at least 4,500 cfs. Interim Flows must not exceed existing channel capacity and, as defined in the Settlement, are restoration releases of water from Friant Dam commencing no later than October 1, 2009, and continuing until full Restoration Flows begin. Interim Flow releases, per Paragraph 15 of the Settlement, have a specified timing and magnitude as defined in the appropriate year type hydrograph listed in Exhibit B of the Settlement.

The federal legislation states that a study shall be completed prior to restoration of any flows other than Interim Flows. The requirements of the legislation supersede the Settlement paragraph 11 Phase 1 implementation improvements, including the modification of Reach 4B to convey Interim Flows of 475 cfs.

The federal Legislation, as currently proposed, directs the Secretary to conduct a study that evaluates the following items:

- The costs of undertaking any work required under paragraph 11(a)(3) of the Settlement to increase the capacity of Reach 4B prior to the reinitiation of Restoration Flows;
- Impacts associated with the reinitiation of such flows; and
- Measures that shall be implemented to mitigate any impacts.

This study will require extensive surveying, field work, and hydraulic analyses to establish the existing channel capacity, potential impacts of the reinitiation of flows, monitoring requirements, and potential mitigation measures. This field work and analyses must be conducted prior to the release of any Interim Flows into Reach 4B Upper.

The legislation also requires that the Secretary file a report with Congress not later than 90 days after issuing a determination, as required in the Settlement, on whether to expand channel conveyance capacity to 4,500 cfs in Reach 4B; or use an alternate route for pulse flows. This determination is to be made, **to the extent feasible**, before undertaking any **substantial** construction work to increase the capacity of Reach 4B.

The report shall identify the basis for the Secretary's determination and identify how different factors were assessed such as comparative biological and habitat benefits, comparative costs and relative available state cost-sharing funds, and the comparative benefits and impacts on water temperature, water supply, private property, and local and downstream flood control. The report shall also include the Secretary's final cost estimate for expanding the capacity of Reach 4B to 4,500 cfs or any alternative route selected, as well as other alternative cost estimates provided by the state, the Restoration Administrator, and by other parties to the Settlement.

The two flow routes being considered are the mainstem San Joaquin River and the use of the bypass system. Either flow routing scenario would need to provide passage for upmigrating adult salmon and outmigrating juvenile salmon. Additionally, modifications would need to be made to the Mariposa Bifurcation Structure.

2.2.7.1 Screen and Modify Mariposa Bifurcation Structure

The Mariposa Bifurcation Structure is located at the downstream end of Reach 4B Upper. The structure was constructed as part of the Lower San Joaquin River Flood Control Project, and diverts flows from the bypass system back into the San Joaquin River. Improvements to the structure for fish passage would depend on the routing of Restoration Flows (i.e., through the mainstem San Joaquin or the bypass system). Use of the mainstem San Joaquin River for Restoration Flows would require the construction of fish passage facilities on the Mariposa Bifurcation Structure and a fish screen on the headworks for the Eastside Bypass to prevent stranding of upmigrating adult in the bypass system. Conversely, using the bypass system for Restoration Flows would require the construction of fish passage facilities on the bypass headworks and a fish screen on the headworks for the mainstem San Joaquin River.

The potential impacts, evaluations, approvals and permits, and additional considerations for screening and modifying the Mariposa Bifurcation Structure for fish passage are the same as those identified in Section 2.2.6 for screening and modifying the Sand Slough Control Structure.

2.2.7.2 Flows Routed Through Mainstem

In the event that flows are routed through the mainstem, the following improvements are proposed:

- Construct levees and associated river channel and floodplain
- Restore riparian habitat
- Reconstruct road crossings
- Screen diversions
- Reconstruct adjacent irrigation and drainage network
- Implement monitoring and mitigation program

A summary of the issues associated with levees and river channel construction, riparian habitat restoration, and screening diversions is provided in Section 2.1.1. A description of the actions specific to Reach 4B are described as follows.

Construct Levees and Associated River Channel and Floodplain. Reach 4B Upper is bounded in some areas by non-project levees. The existing channel capacity is likely less than 200 cfs, with the capacity in some areas near zero. Substantial levee and channel improvements are needed to convey the Interim and Restoration Flows through this reach. These improvements would probably include the construction of setback levees on both banks, installation of slurry walls to reduce seepage and improve levee stability, and installation of tile drain systems. The entire existing channel would need to be excavated to construct a new continuous river channel, adjacent floodplain, and low-flow channel. This extensive construction would result in the destruction of existing riparian habitat and potential endangered species issues along the Reach 4B corridor.

A summary of the potential impacts, evaluations, approvals and permits, and additional considerations associated with levee and channel improvements is provided in Section 2.1.1. In addition to the considerations identified in Section 2.1.1, the following must be addressed:

- The long-term establishment of a low-flow channel may be challenging in Reach 4B because of high groundwater levels and possible infill during flood events

- Use of Reach 4B for water supply operations must be maintained or mitigated
- A substantial amount of land acquisition will be required along the mainstem corridor of the river.

A variety of infrastructure exists within the area of the Reach 4B mainstem river channel, including homes, farm buildings, groundwater wells, tile drains, and other agricultural-related infrastructure. These structures would need to be moved, reconstructed, redesigned, or protected, as appropriate, and the owners would need to be compensated accordingly. Landowners along Reach 4B have carefully reviewed the restoration plan actions within this reach and the RMC supports a process to ensure that landowner-proposed mitigation measures are fully considered in the implementation process, such that landowner issues are satisfactorily addressed or mitigated.

Additionally, portions of the existing Reach 4B channel are used for local water supply operations, including surface water storage and conveyance. These operations would be impacted by the new channel under the Settlement. Coordination with the landowners is needed to determine appropriate mitigation measures.

Reconstruct Road Crossings. Four road crossings that would be barriers to migration are located on the San Joaquin River in Reach 4B Upper. The road crossings consist of three private roads and the Turner Island Road crossing. The crossings provide access across the river for existing agricultural operations and would need to be reconstructed as part of the channel improvements.

The potential impacts, evaluations, approvals and permits, and additional considerations associated with reconstructing these road crossings are the same as those identified in Section 2.2.1 for reconstructing road crossings in Reach 1.

Reconstruct Adjacent Irrigation and Drainage Network. Reach 4B Upper includes an extensive water distribution and drainage network that supports agricultural operations in the area. Dredging and construction of a new river channel to convey Restoration Flows will significantly affect these operations and require major reconfiguration of the distribution and drainage network. This reconstruction will require extensive surveying and mapping, field work, monitoring, and hydraulic analyses to ensure that the irrigation and drainage network is reconstructed to maintain its original function and allows continued agriculture operation in the area.

Implement Monitoring and Mitigation Program. A monitoring and mitigating program must be designed to identify and eliminate potential impacts to agricultural lands for both Interim and full Restoration Flow conditions. A shallow groundwater investigation and monitoring will be required prior to the release of Restoration Flows to establish "baseline" conditions for assessment of potential impacts. A near-term monitoring and mitigation plan must be developed in coordination with local landowners to address potential mitigation issues and identify appropriate mitigation responses to impacts caused by Interim Flows. Adequate funding and resources for long-term groundwater monitoring of adjacent agricultural lands must be included in the Secretary's report on expanding the capacity of Reach 4B to 4,500 cfs.

2.2.7.3 Flows Routed Through Bypass System

In the event that Restoration Flows are routed through the bypass system the following restoration actions are proposed.

- Construct levee and channel improvements
- Restore riparian habitat
- Screen diversions
- Modify drop structures for fish passage
- Provide drainage for adjacent agricultural lands

A summary of the issues associated with levee and channel improvements, riparian habitat restoration, and screening diversions is provided in Section 2.1. A description of the actions specific to the bypass system follows.

Construct Levee and Channel Improvements. The bypass system is bounded by project levees and has a published channel design capacity of approximately 13,500 cfs, but flood flows of this magnitude cause significant seepage and levee stability problems. To maintain the existing design flow capacity of the bypass under restoration conditions, the bypass must be enlarged to account for growth of riparian vegetation in the channel. O&M costs will increase as vegetation becomes established in the channel and requires more intensive and costly maintenance.

To safely convey the Restoration Flows and prevent seepage damage to adjacent crops, the structural stability of the existing levees must be improved in some areas. These improvements could include rebuilding portions of the existing levees and installing slurry walls to reduce seepage and improve levee structural stability.

In addition, as described in Section 2.1.3, the bypass system was constructed to convey flood flows. Routing Restoration Flows through the bypass system does not comply with the purpose of the bypass system and does not comply with the conditions of the flood easements for the bypass system (i.e., Interim and Restoration Flows are not flood flows). Expanded easements or land acquisition would be needed to route non-flood flows down the bypass system. As described in the discussion of additional considerations in Section 2.1.1, the LSJLD is responsible for both the levees and the channel bottom in the bypass system. Regular Restoration Flows in the bypass would increase the LSJLD's overall O&M efforts and should be considered in the design of future facilities. In addition, flows in the bypass system may create localized high groundwater effects and prevent adjacent agricultural lands from draining properly. While slurry walls may reduce seepage impacts to adjacent agricultural lands, they may trap water in the bypass, delaying efforts to drain adjacent agricultural lands into the bypass through flap gates throughout the system.

Modify Drop Structures for Fish Passage. Three drop structures exist in the Eastside Bypass system; one is located at the confluence of the Eastside Bypass and the San Joaquin River near Salt Slough and the other two are located upstream of Road 9. All three structures are barriers to fish migration, and would need to be modified for fish passage. Two additional structures used for water supply operations at the Merced Wildlife Refuge are also located in this area of the bypass system (personal communication, R. Hill, 2007). Whether or not these structures are barriers to migration is unknown and additional analysis is needed.

The potential impacts, evaluations, approvals and permits, and additional considerations associated with the modifications to drop structures in the bypass system are the same as those identified in Section 2.2.6. Additional analysis is needed to determine if the two structures used for water deliveries to the Merced Wildlife Refuge are barriers to migration.

Drainage of Adjacent Agricultural Lands. Approximately 20 flap gates are located in this area of the bypass system (personal communication, R. Hill, 2007). These flap gates are used to drain adjacent agricultural lands. The gates are checked by November 1 and after each flood-flow event. The gates are closed during flood-flow events to prevent flows in the bypass from flooding adjacent lands. Extended flows in the bypass system would make these flap gates inoperable for an extended time during the year, preventing drainage from adjacent agricultural lands. Pumps or other means of draining these lands may be needed.

The potential impacts, evaluations, approvals and permits, and additional considerations for installation of pumps or other means to drain adjacent agricultural lands would be minimal. If pumps are used, they should be electrical, and depending on pump locations, new power lines may be needed. Cooperation of the adjacent landowner would also be needed.

2.2.8 Reach 4B (Lower)

The lower portion of Reach 4B is 11.4 miles long and extends from the Mariposa Bifurcation structure to the confluence with the Bear Creek/Eastside Bypass. Reach 4B Lower receives periodic flood flows from the Eastside Bypass, but has limited riparian vegetation. Adjacent land use is primarily agricultural.

Reach 4B Lower would provide passage for upmigrating adult salmon and outmigrating juvenile salmon. Levee improvements may be needed to mitigate seepage problems. Additionally, riparian restoration actions will be needed to reduce water temperatures and provide cover for upmigrating and outmigrating salmon. This action is described in Section 2.1. No other actions are currently proposed for this reach.

Construct Levee and Channel Improvements. Reach 4B Lower is bounded by project levees and has a published channel design capacity of 10,000 cfs. However, levee seepage in combination with high groundwater and poor groundwater quality results in crop damage during high flows. These problems will be exacerbated by the increased magnitude and frequency of flows that would occur under the Settlement, increasing both the amount of seepage, resulting crop damage, and the potential for levee failure. The structural stability of the existing levees must be improved in some areas to safely pass the Restoration Flows.

A summary of the potential impacts, evaluations, approvals and permits, and additional considerations associated with levee and channel improvements is provided in Section 2.1.1.

2.2.9 Reach 5

Reach 5 is 17.8 miles long and extends from the confluence with Bear Creek/Eastside Bypass to the confluence with the Merced River. The river flows year-round in this reach because of agricultural return flows. Adjacent land uses consist of agricultural and refuge lands.

Reach 5 is bounded by project levees, and the published channel design capacity is approximately 26,000 cfs, which is sufficient to convey the Restoration Flows with no

channel or levee improvements. However, fish screens will be needed on currently unscreened diversions and migration barriers will be needed on Mud and Salt sloughs.

2.2.9.1 Screen Mud and Salt Sloughs

Mud and Salt sloughs convey agricultural return flows to the mainstem San Joaquin River. These flows may attract adult and juvenile salmon into false migration pathways. Modifications to deploy seasonal barriers to prevent adult fish from entering Salt and Mud sloughs are identified as a Phase 1 improvement in the Settlement (to be completed no later than December 31, 2013). To reduce O&M costs and maintenance requirements, permanent barriers to migration should be considered rather than seasonal barriers.

Potential impacts, evaluations needed, approvals and permits needed, and additional considerations are the same as those described for screening diversions in Section 2.1.4.

2.3 Landowner and Facility Owner Interaction

Requirements under this section are currently under negotiation between the RMC, Reclamation, DWR, and will be finalized and submitted under separate cover.

SECTION 3

Conclusions and Recommendations

While the RMC is not a party to the Settlement, it does support the legislation that was negotiated to address impacts to third parties and would like to work collaboratively with Reclamation, DWR, and others in the planning process to allow for the successful implementation of the Settlement. The RMC brings local knowledge and understanding to the process, which can contribute substantially to this process. Collectively, the RMC represents the interests of local agencies and landowners along the San Joaquin River in the planned restoration area from Friant Dam to the confluence with the Merced River. Thus, the RMC members have the potential to bear substantial economic and environmental costs that could result from direct and indirect impacts if Settlement actions are not thoroughly evaluated and carefully implemented.

3.1 Conclusions

The following summarizes the major conclusions and recommendations of this appraisal report.

- A comprehensive planning process must be undertaken to prevent and mitigate direct and indirect impacts of the Settlement to third parties. To ensure that actions in one reach of the river do not create unintended impacts in other areas, this comprehensive planning process should consider all the restoration actions as part of a complete implementation effort and avoid taking half measures. Likewise, comprehensive funding for the restoration program is required to ensure that all required restoration and mitigation actions are funded and implemented. The RMC members have a significant stake in the Settlement implementation and need a significant role in the Settlement planning and implementation process.

- The Settlement proposes to increase the frequency and magnitude of flows in the San Joaquin River below Friant Dam. This increase in flows will exacerbate existing levee stability and seepage problems and may exceed channel flow capacities in some reaches. Levee and channel improvements are needed in Reaches 2A, 2B, 3, 4A, 4B Upper (either the mainstem or the bypass), and 4B Lower to safely convey the Restoration Flows. Improvements to reduce or eliminate impacts to levee stability and adjacent lands from increased seepage must be coordinated throughout all reaches, with other improvements such as riparian habitat restoration, water supply, and flood control operations. Detailed engineering analysis and design must be conducted for all proposed levee and channel improvements.

- Reaches 2B and 3 of the San Joaquin River provide critical water supply conveyance for the delivery of water under existing water rights. Implementation of the Settlement has the potential to impact these water supply operations through insufficient channel capacities and operations of new structures, including the proposed Mendota Pool

Bypass. Settlement actions must be carefully planned and designed to maintain flexibility in water supply operations throughout the river system.

- Flood control operations on the San Joaquin River include conveyance of flood flows from the Kings River and operation of the Lower San Joaquin River Flood Control Project. Settlement actions, including levee and channel improvements, the Mendota Pool Bypass, and revised operating criteria for the Chowchilla Bifurcation Structure have the potential to conflict with the routing of flood flows. Proposed restoration actions should not reduce the channel design capacity or the system's overall ability to convey flood flows. Existing channel design capacities and flood operations must be the first priority and maintained or enhanced to protect public safety.

- Fish passage and screening facilities are needed in all river reaches. This includes facilities to allow fish passage around or over existing or proposed structures, screens on diversions to prevent entrainment, reconstruction of road crossings, and permanent barriers on sloughs. These facilities should be designed in accordance with NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS, 1997), criteria established by the CDFG, other applicable criteria at the time of construction, and in accordance with established professional engineering practices. Fish passage and screening facilities will require additional O&M to maintain, increasing O&M costs for the owner or operator. O&M agreements and funding to cover increased O&M costs would be needed.

- Creation of riparian habitat restoration is needed in all reaches of the San Joaquin River. However, this action may be in direct conflict with the LSJLD's channel and flood control obligations. An overall "landscape" design should be used in the engineering and hydraulic analysis conducted for levee and channel improvements, and agreement with local agencies and landowners on critical assumptions for the analyses should be sought early in the process. This landscape design should include sufficient detail to be used as a guide for long-term management of riparian vegetation by a local maintaining agency, and be the basis for the redesign of flood control channel cross sections to account for the establishment of future mature vegetation in the channel.

- Existing channel capacity in Reach 4B is extremely limited. Flows of any amount down this reach are likely to cause localized flooding and seepage impacts to adjacent agricultural lands. An extensive evaluation of the existing channel capacity, including topographic surveys, channel cross sections, and HEC-RAS computer modeling should be conducted to determine channel capacity and potential impacts before any flows are introduced to this reach. This information will also be critical to the planning and design of the new channel if Reach 4B is selected. Additionally, a thorough mitigation and monitoring plan should be developed to identify, evaluate, and mitigate all direct and indirect impacts.

- The additional O&M associated with channel, levee, and related flood control facilities improvements under the restoration program are likely to far exceed the operating budget of the LSJLD. These additional costs should be assumed by the Settlement parties or state or federal sources rather than local sources. A process should be developed to determine a local maintaining agency, identify additional maintenance costs, and establish a secure funding source.

- Long-term assurances and ESA and CESA compliance for O&M activities at new or expanded facilities are needed. This ESA and CESA compliance must include the potential for take of salmon after the ESA Section 10(j) experimental population status is no longer in effect and should be completed concurrent with ESA and CESA compliance for construction activities.
- A comprehensive land acquisition plan must be developed that specifically identifies, on a parcel-by-parcel basis, all the acreage that will need to be purchased from **willing sellers** or for which easements will be required for facilities construction, channel improvements and levee setbacks, and full restoration project implementation. The plan must clearly describe all valuation procedures and conform with Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice.

3.2 Recommendations

3.2.1 RMC Involvement

The RMC is unique in that it represents the interest of landowners, agencies and other stakeholders throughout the entire project area, all of which have the potential to bear substantial economic and environmental costs that could result from direct and indirect impacts from the implementation of the Settlement. Local landowner involvement brings local knowledge and historical understanding to the restoration planning process. This can contribute substantially to the successful implementation of the Settlement and enable legislation by identifying opportunities and constraints early in the process, and providing initial "on-the-ground" or "field expertise" with little time spent in the field. Additionally, local support and involvement will facilitate local acceptance of the project and will help to facilitate obtaining access agreements, and other similar documents.

3.2.1.1 Alternatives Development/Program Alternatives Report

The RMC should be involved in all aspects of development of the Program Alternatives. As described in the Program Management Plan (Reclamation, 2007), the Program Alternatives Report shall "identify the study area, describe existing conditions, compile existing data, identify data gaps, develop a problem statement, develop a purpose and needs statement, identify problems, needs, and opportunities, define planning objectives and constraints, and define evaluation criteria and performance measures." The RMC's local knowledge can contribute substantially to these efforts. Early stakeholder input, including input on analysis assumptions, engineering criteria, and facility operations, will be critical for the successful implementation of the Settlement by Reclamation and the Five Agency Team.

3.2.1.2 Technical Work Groups

The RMC should play a technical role in the planning, review, and implementation of the Settlement by Reclamation and the Five Agency Team, and should be a contributing member of the four Technical Work Groups. This will facilitate input of local knowledge early in the process for a more efficient process and contribute to the successful implementation of the Settlement. Input by the RMC at the Technical Work Group level will

also facilitate input by landowners and other third parties through the stakeholder subgroup process identified in the Program Management Plan (Reclamation, 2007).

3.2.1.3 Facilitation of Public Input

The RMC is willing to work with Reclamation to help facilitate the Technical Sub-group Participant process and input from other local landowners and the general public.

3.2.2 Priorities for Technical Analyses

The following actions and priorities are recommended for near-term technical analyses.

3.2.2.1 Priority Evaluations

Restoration actions in Reach 4B, Reach 2B, and the Mendota Pool Bypass constitute a substantial portion of infrastructure improvements necessary to safely convey Interim and Restoration Flows. These improvements will take many years to plan, design, permit, and construct. Thus, Reclamation should prioritize these actions and initiate the engineering analysis and design for these reaches as soon as possible. As described in Section 2.1.1, the engineering analysis and design should consist of two major components: (1) determine the existing levee and channel constraints by reach, and (2) conduct an analysis of possible alternatives for levee and channel improvements. Alternatives should consider various methods to improve problem levees and channel areas including structural improvements, such as rebuilding levees and installing slurry walls, and different construction methods. The alternatives analysis should also incorporate historical knowledge and local understanding and be coordinated closely with local agencies and landowner representatives. Additionally, agreement on the appropriate assumptions for the analyses with local agencies and landowners should be obtained early in the process. These analyses should be based on the best available information, include field studies and data collection as needed, and be conducted to professional standards using established engineering practices. All engineering design should be conducted to Reclamation, DWR, and/or USACE design standards and guidelines, as appropriate.

These focused efforts can be conducted concurrently with the Programmatic NEPA process currently underway by Reclamation.

3.2.2.2 Required Data Collection and Analysis

To support the priority analyses identified previously, the following data collection and analyses are needed.

1. **Detailed Topographic and Channel Surveys.** Existing topographic and channel survey information should be reviewed to determine if it meets the needs of the Settlement efforts. Additional data should be collected as needed. These data should be shared with all interested parties and should serve as a single common basis for topographic and channel information for all future Settlement actions.

2. **Groundwater Monitoring.** Install groundwater monitoring wells in areas of the San Joaquin River and bypass system with known seepage problems and areas of known high groundwater to establish "baseline" pre-project conditions. Groundwater monitoring wells should include data loggers to continuously record water levels and

should be appropriately placed to determine shallow regional groundwater flows and potential effects on groundwater from increased flow in the river.

3. **Levee and Channel Improvements-Work Plan and Data Collection.** Begin overall data collection and analysis efforts necessary to determine the extent and type of required levee and channel improvements. A Work Plan should be developed for this effort to outline: (1) data needs, (2) a process for reviewing existing data for adequacy, and (3) a process for filling data gaps, including conducting field and laboratory testing. Efforts on the Work Plan should begin as soon as possible, as the scale of the overall data collection and analysis effort is likely to be substantial.

4. **Levee and Channel Improvements—Technical Approach Development.** A process should be developed to identify and agree upon the overall technical approach for the analysis of levee and channel improvements, including the key engineering assumptions. This process should: (1) seek to identify the analysis tools (such as modeling tools) that would be used, data needs for these tools, and agreement on key engineering assumptions necessary to complete the analysis; and (2) include local input.

3.2.3 Implementation Phasing of Restoration Actions

- The comprehensive planning and design process must consider all the restoration actions as part of a complete implementation effort and ensure that the construction phasing of actions in one reach of the river does not create unintended impacts in other downstream areas.

- Construction activities should start upstream in Reach 1 and progress downstream on a reach-by-reach basis. Upstream restoration improvements to reconstruct the channel in Reaches 1 and 2A to safely convey restoration flows should be completed before initiating construction in the lower reaches that involve substantially increasing the capacity of the existing river channel. This approach will ensure that salmon are not introduced into the system from downstream prematurely before necessary restoration actions are achieved.

- Comprehensive funding for construction and future operation for any reach must be in place prior to initiating any project construction activities within that reach.

- All restoration improvements, O&M agreements, and mitigation measures must be constructed and fully functional before salmonids are re-introduced to the Upper San Joaquin River to ensure successful implementation of the settlement and to prevent unintended impacts to third parties.

SECTION 4

References

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NMFS (National Marine Fisheries Service). 1997. Fish Screening Criteria for Anadromous Salmonids. January.

Reclamation (U.S. Bureau of Reclamation). 2007. Program Management Plan for the San Joaquin River Restoration Program, Implementing the Stipulation of Settlement in Natural Resources Defense Council, et al., v. Kirk Rodgers, United States Bureau of Reclamation, et al. May.

APPENDIX A

Reach-by-Reach Maps

Maximum Flow Capacity
26,000 cfs
Restoration Flow
4,500 cfs

Maximum Flow Capacity
10,000 cfs
Restoration Flow
4,500 cfs

Maximum Flow Capacity
0 to 400 cfs
Restoration Flow
4,500 cfs

Maximum Flow Capacity
4,500 cfs
Restoration Flow
4,500 cfs

Maximum Flow Capacity
4,500 cfs
Restoration and Water Right Flows
5,300 cfs

Maximum Flow Capacity
1,300 cfs
Restoration and Water Right Flows
6,800 cfs

Maximum Flow Capacity
8,000 cfs
Restoration Flow
4,500 cfs

Maximum Flow Capacity
4,750 cfs

Restoration Flow
4,500 cfs

SCREEN SLOUGH OUTLETS

MARIPOSA BIFURCATION STRUCTURE
MODIFY FOR FISH PASSAGE

SCREEN DIVERSIONS AND DRAINS ALL REACHES

SAND SLOUGH CONTROL STRUCTURE
MODIFY FOR FISH PASSAGE

SACK DAM
MODIFY FOR FISH PASSAGE

ACQUIRE PROPERTY TO EXCAVATE CHANNEL AND SETBACK LEVEES

CONSTRUCT MENDOTA POOL BYPASS

MENDOTA DIVERSION DAM

MENDOTA POOL

DREDGE LOW FLOW CHANNEL REACH 2B

CHOWCHILLA BIFURCATION STRUCTURE
MODIFY FOR FISH PASSAGE

ACQUIRE PROPERTY FOR LEVEE SETBACKS AND MENDOTA POOL BYPASS

SCREEN ARROYO CANAL

DREDGE LOW FLOW CHANNEL REACH 2A

SCREEN DIVERSIONS

AUGMENT GRAVEL AND ISOLATE/FILL GRAVEL PITS

MERCED RIVER
MERCED
EAST SIDE CANAL
BEAR CREEK
DUCK SLOUGH
MARIPOSA BYPASS
SAND SLOUGH
BANKS CREEK
EAST SIDE BYPASS
FISH ANDERSON BYPASS
ARROYO CANAL
MADERA CO
ASH SLOUGH
BERENDA SLOUGH
BERY CREEK
CHOWCHILLA
MARIPOSA COUNTY
MERCED COUNTY
MADERA COUNTY
FRESNO COUNTY
EASTMAN LAKE
HENSLEY LAKE
MADERA CANAL
MADERA LAKE
MILLERTON LAKE
FRIANT DAM
FRIANT KERN CANAL
LOS BANOS
LOS BANOS RESERVOIR
MADERA
CHOWCHILLA BYPASS
FIREBAUGH
LONE WILLOW SLOUGH
CALIFORNIA AQUEDUCT
LITTLE PANOCHE RESERVOIR
MAIN CANAL
OUTSIDE CANAL
DELTA MENDOTA CANAL
SAN JOAQUIN RIVER
FRESNO
FRESNO SLOUGH
COLUMBIA CANAL

4B Lower
4B Upper
4A
3
2B
2A
1

99 140 165 33 152 5 59 41 145 168 180

LEGEND
- BARRIERS TO MIGRATION
- DAMS
- ROAD CROSSINGS AND CULVERTS
- EVALUATE FOR LEVEE AND CHANNEL IMPROVEMENTS
- MENDOTA POOL BYPASS CHANNEL
- REACH DIVISION
- SAN JOAQUIN RIVER
- INTERSTATE HIGHWAY
- STATE-HIGHWAY
- US-HIGHWAY
- RAILROAD
- COUNTY BOUNDARY
- CITY
- CANALS

0 5 Miles

N

FIGURE A-1
PROPOSED RESTORATION ACTIONS

CH2MHILL