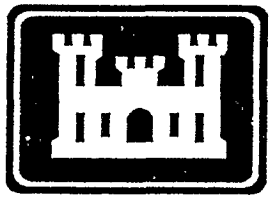
DESIGN MEMORANDUM NO. 6

LOWER SAN JOAQUIN RIVER, CALIFORNIA

CLEARING AND SNAGGING

DRAFT (REVISED)

GENERAL DESIGN MEMORANDUM AND ENVIRONMENTAL STATEMENT



US Army Corps of Engineers
Sacramento District

APRIL 1989

CONSPECTUS

This Draft General Design Memorandum and accompanying Draft Environmental Impact Statement/ Environmental Impact Report is a revision to previous draft documents of May 1985 and January 1987. This revision reflects additional scope and funding authorized by the Continuing Appropriations Act of 1988. This revision also reflects expanded environmental considerations, particularly mitigation, necessary to address comments on the previous documents. The scope of clearing work presented herein was developed for this and previous documents with the assistance of the local flood control associations to identify and correct known obstructions to the flood carrying capacity of the San Joaquin River. The mitigation identified was developed jointly by the Corps and the U.S. Fish and Wildlife Service using Habitat Evaluation Procedures. As the cost of the identified work and mitigation exceeds the Federal project monetary authority, some of the clearing and snagging work identified herein may have to be deferred or deleted depending upon resolution of concerns, local participation, or other aspects. The intent is to accomplish the maximum amount of clearing and snagging work consistent with the project authorization and public interests.

LOWER SAN JOAQUIN RIVER, CALIFORNIA

Clearing and Snagging

PART 1 - DRAFT DESIGN MEMORANDUM NO. 6

PART 2 - REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT/
DRAFT ENVIRONMENTAL IMPACT REPORT

APRIL 1989

PART 1

DRAFT GENERAL DESIGN MEMORANDUM NO. 6

LOWER SAN JOAQUIN RIVER, CALIFORNIA

PREVIOUS DESIGN MEMORANDA

No.	Date	Title	Approval Date
1	23 Dec 55	San Joaquin River Levees, General Design Memo	11 Jan 56
	30 Mar 59	Letter Supplement No. 1 to General Design Memo No. 1	14 Apr 59
2	15 Mar 57	San Joaquin River Levees Test Section for Bank Protection	5 Jun 57
	16 Apr 59	Supplement No. 1 Design Memo No. 2	17 Apr 59
	15 Jan 62	Supplement No. 2 to Design Memo No. 2 Test Sections for Bank Protection Construction Report	12 Apr 62
3	3 Aug 59	San Joaquin River Levees, Pumping Plant for Interior Drainage	6 Nov 59
4	1 Aug 60	Wetherbee Lake	Oct 60
5	27 Sep 84	Eastside Bypass at San Joaquin River	5 Oct 84

D-030536

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19 to 22	Project Plan - Kings River North

LOWER SAN JOAQUIN RIVER, CALIFORNIA
Clearing and Snagging
DESIGN MEMORANDUM NO. 6

PERTINENT DATA

1. General Data

Project Authorization Federal	Under Section 10 of Flood Control Act of 1944 (Public Law No. 534). Modified by Chapter 678 of Public Law 84-327 and by Title I, Chapter IV of the Supplemental Appropriations Act, 1983 (Public Law 98-63). Further modified by the Continuing Appropriations Act of 1988 (Public Law 100-202)
State	California Water Code Section 12688 (State Law AB 3397), 1984 Modified by State Law 3654, 1988
Streams	Lower San Joaquin River, and tributaries, including Tuolumne River, Stanislaus River and Kings River North
Purpose	Clearing and Snagging
Location	Counties of San Joaquin, Stanislaus, Merced, Madera and Fresno, California

2. Channels

Bamboo Removal	50 acres
Sediment Removal	1,250,000 cy
Rock Slope Protection	30,000 cy
Vegetation Clearing	135 acres

3. Mitigation

Revegetation	133 acres
Wetland Development	7 acres

4. Local Cooperation

Lands (Easements)	
Channel	265 acres
Disposal	35 acres
Wildlife Mitigation	300 acres
Temporary Disposal	80 acres
Acquisition	
Mitigation Easement	14 parcels
Channel and Disposal Easements	220 parcels

5. Costs * (1 October 1988 Price Level)

Federal First Cost	$ 11,500,000 **
Non-Federal First Cost	$ 4,100,000
Total Project First Cost	$ 15,600,000

* Includes prior expenditures for E&D and Eastside Bypass

** Congressional authorization is $8.0 million. $9.8 million inflated was working estimate contained in latest budget submittal.

CHAPTER 1 - INTRODUCTION

1-01. FEDERAL AUTHORIZATION. - This project was authorized by the Flood Control Act of 1944, Public Law No. 534, 1944 United States Code Congressional Service 887 for the Lower San Joaquin River and Tributaries project, as modified by Flood Protection - Lower San Joaquin River, California, Public Law No. 327, 1955 United States Code Congressional Service 703; the Supplemental Appropriations Act, 1983, Pub. L. No. 98-63, Section 205, U.S. Code Cong. & Ad News (97 Stat.) 301; and the Continuing Appropriations Act of 1988 (Energy and Water Development Appropriation Act of 1988), Public Law 100-202 (House Joint Resolution 395), December 22, 1987.

Section 10 of the 1944 Authorization Act states in part that:

> "... The plan of improvement for flood control and other purposes on the Lower San Joaquin River and tributaries, including Tuolumne and Stanislaus Rivers, in accordance with the recommendations of the Chief of Engineers in Flood Control Committee Document Numbered 2, Seventy-eighth Congress, second session, is approved and is hereby authorized for initiation and partial accomplishment of the plan ..."

Chapter 687 of Public Law 84-327 states that:

> "The project for construction of channel improvement works and levee construction and reconstruction on the San Joaquin River and tributary channels, authorized by the Flood Control Act approved December 22, 1944 is hereby modified to provide that in lieu of furnishing flowage easements along the San Joaquin River upstream of the mouth of the Merced River as set forth in the report of the Chief of Engineers, published as Flood Control Committee Document Numbered 2, Seventy-eighth Congress, responsible local interests may

construct levees and channel improvements, as required, to protect such lands against floods, subject to approval by the Chief of Engineers, United States Army: Provided, That the flood hazard to downstream areas is not materially increased thereby, and that due consideration be given to the timing and sequence of construction of the parts of the project to be accomplished by local interests in proper relation to the development of flood control storage on the tributaries of the San Joaquin River: And provided further, That construction and maintenance of such levees and channel improvements be undertaken at no cost to the United States."

Title I, Chapter IV of the 1983 Act states in part that:

"... The project for flood protection on the Lower San Joaquin River, California, authorized by the Flood Control Act approved December 22, 1944, as amended, is hereby further modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to perform clearing and snagging on the San Joaquin River from Stockton, California, to Friant Dam, at an estimated cost of $5,000,000. Prior to initiation of construction, a non-Federal entity shall provide adequate assurances for providing all lands, easements, rights-of-way and utility relocations at no expense to the Federal Government; execute a written agreement pursuant to Section 221 of Public Law 91-611; agree to operate and maintain the project works upon completion of construction in accordance with rules and regulations prescribed by the Department of the Army; and hold and save the United States free from damages due to construction, operation, and maintenance of the project, not including damages due to the fault or negligence of the United States or its contractors ..."

Section 101 of the Continuing Appropriations Act of 1988 states:

"...The project for flood protection on the Lower San Joaquin River, California, authorized by Section 10 of the Flood Control Act approved December 22, 1944 (58 Stat. 901), is modified -

(1) to authorize the Secretary of the Army, acting through the Chief of Engineers, to perform, in connection with the clearing and snagging authorized to be performed on such river from Stockton, California to Friant Dam as part of such project by the Supplemental Appropriations Act, 1983 (97 Stat. 310) -

(A) clearing and snagging in the area of the North Fork of the Kings River in Mendota Pool from the southerly boundary of the James Reclamation District Number 1606 to Mendota Dam;

(B) fish and wildlife mitigation; and

(C) such rip-rapping in the area of the clearing and snagging on such rivers as may be necessary to prevent erosion from such clearing and snagging; and

(2) to increase the estimated cost of the clearing and snagging on the Lower San Joaquin River, including the activities authorized by paragraph (1), from $5,000,000 to $8,000,000..".

1-02. PURPOSE AND SCOPE. - The purpose of this General Design Memorandum (GDM) is to describe clearing and snagging work authorized by Public Law 98-63 and Public Law 100-202 and mitigation measures proposed for the work. The extent of work may have to be further tailored to comply with the monetary limits of the authorized modification for channel clearing. This GDM provides the basis for preparation of plans and specifications. It should be noted that, even though the 1983 modification noted in the previous paragraph authorized the Corps to perform "clearing and snagging", no snagging is herein

proposed. It was recognized in the early studies for this project that there are few snags present, that the benefits of any snag removal are likely outweighed by the costs, and that the snags are a provider of fish and wildlife values. References in this document to "clearing and snagging" should be assumed to mean "clearing" with regard to the work proposed.

1-03. DESCRIPTION OF THE EXISTING PROJECT. -

a. The 1944 Flood Control Act authorized the Lower San Joaquin River and Tributaries project. The authorized project was for improvements by the Federal Government to the then existing channel and levee system along the San Joaquin River from Sacramento-San Joaquin Delta upstream to the mouth of the Merced River and on several tributaries and distributaries. The project also provided for flood protection along the San Joaquin River above the mouth of the Merced River by the State of California. These project elements are an integral part of the overall plan for flood control and other purposes in the San Joaquin River Basin. The project was designed to supplement upstream reservoirs by providing channel capacity along the San Joaquin River sufficient to safely pass flows.

1. Federal. - Federal construction of the Lower San Joaquin River and Tributaries project was initiated in 1956 and completed in 1968 except for the left (west) bank along the San Joaquin River from the Tuolumne River to the Merced River, which was completed in 1972. The Federally-constructed portion of the project consists of approximately 100 miles of intermittent levees along the San Joaquin River, Paradise Cut, Old River, and the lower reaches of the Stanislaus and Tuolumne Rivers. The levees vary in height from about 15 feet at the downstream end to an average of 6 to 8 feet over much of the project. Project levees, along with upstream river regulation, contain floods varying from about a 1 in 60 year event at the project's lower end, to about a 1 in 100 year event at its

upper limits. The California State Reclamation Board provided assurances to the Federal government for project operation and maintenance, including maintenance of the flood carrying capacity and the furnishing of flowage rights.

2. State. - Under the authorized plan of improvement for the portion of the project upstream of Merced River, the State of California was to provide flowage easements in areas subject to flooding. However, in lieu of flowage easements, the State chose to construct a bypass system consisting of levee and channel improvements. These improvements were coordinated with the Federal government to insure that Federal project standards were met and to insure the effectiveness of the Federal portion of the project. The Eastside and Chowchilla Bypass System consists primarily of man-made channels which divert and carry floodflows from the San Joaquin River at Gravelly Ford, along with inflows from other eastside tributaries, downstream to above the Merced River. The system consists of about 183 miles of new levees, several control structures and other appurtenant facilities, and approximately 80 miles of surfacing on existing levees. Construction of the system was initiated in 1959 and completed in 1966. Maintenance and operation of the completed State segments of the project are accomplished by the Lower San Joaquin Levee District (LSJLD). The Reclamation Board provided assurances to the Federal Government to operate and maintain the project in accordance with regulations prescribed by the Secretary of the Army.

3. Events Leading to the 1983 Appropriation. - The San Joaquin River Project, in combination with the upstream reservoir projects, has significantly reduced flood damages along the river. Even so, at times, when there is significant flood flow in the river system, overbank flooding, seepage adjacent to the active river channel and levee system, and erosion of riverbanks and levees cause damages primarily to agricultural lands. Because of the combination of development

within the floodplain and sediment deposition / vegetation growth which decreases the channel capacity, leading to increased flood problems, particularly in the high water years of 1982 and 1983, many local interests appealed to their elected representatives for assistance to improve the flood carrying characteristics of the channel by clearing the river. Subsequently, the original 1944 project was amended by Section 205 of the 1983 Supplemental Appropriations Act to provide for channel clearing and snagging.

4. Prior work under the 1983 project modification. - In the process of investigations for implementing the 1983 project modification, a serious potential flood problem was identified that required immediate alleviation in the Eastside Bypass at the confluence with the San Joaquin River. The design capacity of the bypass was found to have deteriorated. Should the west bypass levee at this location fail due to flow capacity exceedence, nearly 100 square miles of primarily agricultural lands would be inundated. Two primary causes for the capacity reduction were identified. One was a buildup of sand, beginning at the confluence and extending downstream in the bypass about 2 miles and amounting to about 1 million cubic yards. The other cause consisted of subsidence of the bypass west levee in about the same location as the deposited sand. An emergency plan was formulated to reduce the chances of levee failure through removal of the sand. The plan, which is described in DM No. 5, also called for restoration of the west State project levee. Removal of the sand by the Corps restored approximately 30 percent of the design capacity and reduced backwater effects which will lower the water surface upstream along the San Joaquin River. The work was accomplished between November 1984 and February 1985 at a cost of about $2.3 million. The LSJLD initiated and completed construction to raise the west levee in 1985.

a. The Reclamation Board is the local sponsor for this emergency work. In addition to operating and maintaining the completed work, the Board has agreed to insure restoration to grade, maintenance of the west project levee and removal of other flow obstructions in the bypass at or near the confluence location, thereby restoring much of the project flow capacity at this location.

b. Except for the emergency work described, further channel improvements in the bypass system to improve flow conditions are not considered as part of the authorized project modifications for channel clearing, unless the channel work would directly impact flow conditions in the historical San Joaquin River.

1-04. LOCAL COOPERATION. -

a. The authorized local cooperation requirements for the Lower San Joaquin River (Clearing and Snagging) project are:

1. provide all lands, easements, rights-of-way and utility relocations at no expense to the Federal Government.
2. execute a written assurance agreement pursuant to Section 221 of Public Law 91-611;
3. operate and maintain the project works upon completion of construction in accordance with rules and regulations prescribed by the Department of the Army; and
4. hold and save the United States free from damages due to construction, operation, and maintenance of the project, not including damages due to the fault or negligence of the United States.

b. Prior to initiation of construction, the local sponsor for the work must enter into a agreement for local cooperation. A draft of this agreement is included as Exhibit 1. By letter dated 24 April 1984, The Reclamation Board expressed its intent

to provide the necessary local cooperation for the project. On September 29, 1984, the State of California, by State Law AB 3397, becoming Section 12688 of the California Water Code, granted authority to The Reclamation Board to act as the non-Federal sponsor and otherwise authorized the project substantially in accordance with Public Law 98-63. State Assembly Bill 3654, passed by the State Legislature on September 28, 1988 authorizes The Reclamation Board to participate in the expanded $8 million clearing and snagging project.

1.05. COORDINATION. -

a. Primary participants from the project area have included the San Joaquin River Flood Control Association with principal member entities being the Central San Joaquin River Association, Lower San Joaquin Levee District, South Delta Water Agency, Kings River Water Association, and the Upper San Joaquin River Association; the Central California Irrigation District; the James and Tranquillity Irrigation Districts; the Union Irrigation District; various reclamation districts; the County of Fresno; and the City of Mendota. Various conservation groups included in coordination consisted of the San Joaquin River Committee (San Joaquin River Parkway), the Planning and Conservation League, the Audubon Society, Friends of the River, the Ecology Institute, the San Joaquin Wildlife Rescue Center, the United Anglers of California, the American Fisheries Society, the Native Plant Society, and the Sierra Club. Principal State and Federal Agency participants have included the following: The Reclamation Board, the California Department of Fish and Game, the State Lands Commission, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Environmental Protection Agency. Additionally, representatives of various Federal and State elected offices have participated in the development of the project. It is important to note that, even though the noted participants provided valuable information and

recommendations for the project, a listing as being coordinated with does not necessarily imply that a particular participant is a project proponent.

b. The accompanying revised draft environmental impact statement/ environmental impact report will describe impacts of the project and the proposed mitigation. It will be coordinated with all interested parties.

D-030550

CHAPTER 2 - PROJECT DESCRIPTION AND ACCOMPLISHMENTS

2-01. GENERAL. - The general layout of the proposed project modification is shown on Plate 1. Specific worksite locations are shown on Plates 2 thru 22. The physical features, including a brief statement on the proposed mitigation are described in the following paragraphs. Detailed information on impacts for the proposed project plan and mitigation measures is contained in the revised Draft Environmental Impact Statement (RDEIS/R).

2-02. GENERAL FLOOD AND RELATED PROBLEMS.- The Lower San Joaquin River study area has been the subject of numerous past flood investigations. Much has been accomplished to alleviate these problems; however, current land use changes and channel degradation have influenced surface water changes. As a result, both flooding on the riverside and landside, and seepage on the landside have resulted in agricultural damages. Damage due to high water occurs when adjacent ground is inundated, a levee fails, or seepage is present. Seepage flow saturates the land in a day or two in some places, and in other places may take up to two or three weeks. According to local interests, seepage drowns most planted crops rather quickly. Losses also occur on lands that are not planted at the time of seepage. These lands either have had or need expensive preparatory work for the next crop. Delays in such work caused by seepage typically either prevent timely planting of a crop or necessitate planting fast-growing, lower-yielding crop varieties. The upward flow of seepage water generally brings previously leached residual salts back up into the root zone. These salts stunt and reduce the yield of the next crop. Seeped lands can often not be economically farmed to any crop in the year that seepage occurs. For the purposes of this clearing and snagging analysis, flooding and seepage estimates

from 1982-83 were used to illustrate potential agricultural damages. It should be noted that 1982-83 was an abnormally wet year. Damage data was initially compiled in 1985 but has been updated and modified to correspond to this project's reach delineations.

2-03. ABBREVIATED DOCUMENT HISTORY. -

a. In May 1985 a Draft General Design Memorandum and Environmental Impact Statement for the project was circulated to interested agencies and individuals for review and comment. The draft report recommended a channel clearing plan which included provisions to mitigate adverse impacts on environmental resources. Generally, comments on the report indicated that it did not provide sufficient information to determine potential project impacts. In addition, some local flood control interests did not support the plan because the amount of mitigation identified in order to implement the project exceeded the amount they thought was warranted. In order to develop a channel clearing plan which could be supported by local interests and also adequately mitigate adverse project impacts, a "Cooperative Design Team (CDT)" was formed. The CDT consisted of local flood control interests and representatives of the Corps of Engineers, the State Reclamation Board, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. The Reclamation Board, as the non-Federal project sponsor, developed that portion of the CDT representing the local flood control interests along the river system.

b. An abbreviated habitat evaluation procedure (HEP) study was conducted jointly by the U.S. Fish and Wildlife Service and the Corps of Engineers in order to conceptually quantify aquatic and terrestrial habitat losses and to identify compensation needed to offset those losses. The study utilized random site transects and aerial photographs for identifying habitat values. Groundtruthing was minimal.

c. A revised channel clearing plan was developed utilizing the input of the worksite definitions, results from the informal HEP analysis and the opinions of the Design Team members. Local flood control interests in the reach of the San Joaquin River from the Old River to the Merced River requested deletion from the project because of the concept of the local provision of agricultural land for mitigation.

d. A revised Draft GDM/EIS deleting the reach of the San Joaquin River from the Old River to the Merced River was circulated for public review in January 1987. Comments on the document were generally unfavorable, particularly in regards to the lack of commitment on defining the mitigation lands, the location of the mitigation lands in disputed jurisdictions, the lack of a formal HEP analysis and associated mitigation improvement plan and the lack of clear project justification. The Environmental Protection Agency rated the document inadequate in its satisfaction of the National Environmental Policy Act requirements.

e. The Continuing Appropriations Act of 1988 was subsequently passed providing funds for fish and wildlife mitigation and to include the Kings River North and rip-rapping on the Middle River. Consequently, the Design Team approach was reestablished and members added representing Kings River North and those agencies and organizations most vocal in their opposition to the January 1987 Draft. With Federal funds available by the new legislation for mitigation development, the Old River to Merced River reach has requested to be added back into the project.

f. For input into this document, the previous worksites in the January 1987 Draft GDM/EIS have been modified to lessen environmental concerns, the new worksites added as a result of the new legislation have been defined and a formal draft HEP/

Coordination Act Report addressing the redefined and new worksites has been prepared. Additionally, The Reclamation Board has been actively resolving easement language on the mitigation lands to establish a firmer commitment and a resolution has been mostly completed on the disputed jurisdiction of the mitigation lands.

2.04. PROJECT LIMITATIONS. -

a. The clearing proposed herein was developed to provide the greatest flood protection within the general authorized language and funding by correcting identified obstructions that are a threat to the existing flood protection. It must be recognized that the proposed program is not a comprehensive evaluation of and solution to the flood control problems on the Lower San Joaquin River and Kings River North. Such a comprehensive plan identifying the needs and addressing the complete solutions would require a long term and costly study. Partial aspects of this larger study or program have been undertaken from time to time as evidenced by the documents referenced herein, but no new comprehensive plan has been developed, authorized or funded. A sedimentation investigation of the San Joaquin River system has been endorsed by The Reclamation Board and the California Water Commission. However, such a study would be of limited scope and not address the broad range of problems.

b. The proposed work herein, however, has taken into consideration the past partial studies. Professional knowledge and judgement of flood control problems has directed the course of the designs proposed as being complementary to any future flood control solutions. In this regard, the work proposed could be viewed as a part of an ultimate solution. It must be emphasized, however, that the work proposed is not the first phase of anticipated additional clearing and snagging work. Such future clearing and snagging work is neither currently authorized nor anticipated.

c. In consideration of the limitations, the work proposed is scoped to achieve the maximum flood control benefit with the least environmental damage. Worksites were chosen at identifiable problem areas and on lands previously non-existent or historically damaged. In this manner, any relationship of the proposed work to a more comprehensive flood control solution takes on less importance.

d. Using available data and some newly developed data, a hydraulic analysis and geotechnical investigation were performed of the worksites to assist in determining the scope and effects of the proposed work. Additionally, a water quality study was performed. More comprehensive studies or analyses are neither warranted nor justified.

2.05. MIDDLE RIVER. -

a. Problem Statement and Previous Work. - The Middle River, the minor of the three distributaries of the San Joaquin River near its confluence with the Sacramento/San Joaquin Delta, has historically experienced levee erosion during high flows, especially on the west or left bank levee which occupies a location immediately adjacent to the channel. In an attempt to prevent further erosion, the local reclamation district installed rock slope protection at some locations and, along the length of the levee and berm for seven miles downstream from Old River, undertook a program of planting false bamboo (Arundo donaxu) as a slope protection measure. While the bamboo apparently does offer some protection to the levee slope by blocking direct flows, it has proliferated on a grand scale where today it literally covers the entire waterside levee slope and berm, as well as having escaped in several locations to both the opposite bank and the landside of the west levee. Eradication efforts at several irrigation pump locations along the reach have proven unsuccessful, the adjacent bamboo quickly growing into the cleared areas. Growing more than twenty feet

tall at maturity, the bamboo is a monoculture which has choked out all native vegetation of significant wildlife value and, at the water's edge, falls into the channel, accumulating a significant amount of dead material. Additionally, in the farthermost upstream reach near Old River, where the river velocity slows significantly as the water from the Old River enters the slower Middle River (2.5 fps at 10,000 cfs flood), significant quantities of silt from the entire San Joaquin system upstream, not dropped out until this low velocity area is reached, are precipitated at this location. In particular, the sediments settle out where the water is further slowed and trapped by the bamboo. As a result, a significant buildup of silt sediment has occurred on the west berm and slope. The new sediment, in turn, provides additional medium for the aggressive underground runners of the bamboo, and the new areas are quickly colonized further out into the river, further reducing the hydraulic capacity of the channel. Today, it is estimated that the channel has, at several locations, been reduced in width by up to twenty feet by this cyclic deposition and bamboo colonization. This combination of vegetation and channel narrowing, with the accompanying reduction in the channel's hydraulic capacity, has resulted in a higher water elevation at high flows and resulting crop damage by seepage and loss of irrigation facilities by flooding.

b. Proposed Work (See Plate 2). - The work in this reach of the project consists of the removal of false bamboo from the waterside of the west levee and berm for about seven miles downstream from the Old River, the removal of approximately 95,000 cy of sediment accumulated in and supporting much of this bamboo in the upstream three miles of the river, and the placement of 30,000 cy of rock slope protection on the same levee or berm slope where the bamboo removal exposes previous erosion or the potential for erosion on the levee or berm.

1. Bamboo removal. - The seven miles, or approximately 50 acres of bamboo would be mechanically removed to ground level from the berm and levee slopes. In the majority of locations, tractor mounted circular brush blades on an hydraulic arm could be utilized. The cut bamboo would then be raked, including that which fell into the channel, to the top of the levee for collection and transport to burn piles or to a Contractor selected disposal area. In those locations where elderberry occurs within or immediately adjacent to the bamboo (generally in the middle third of the seven mile stretch of bamboo), hand methods of cutting would be required to insure retention of the elderberry. A proliferation of small elderberry regeneration at the edge of the bamboo, difficult to avoid in total due to its small size and intermingling with the bamboo, would be mostly removed with the bamboo and mitigated for as described in subparagraph e. Subsequent new bamboo growth from the roots would then be sprayed with a contact herbicide for use in aquatic environments. A second, and possibly third, application would be performed subsequently during an extended construction period with the intention that a maximum removal effort be completed before the project is turned over to The Reclamation Board for operation and maintenance. An erosion control/ wildlife grass and shrub seeding would be accomplished following the final herbicide application. A seed mixture/application rate that discourages, or smothers, bamboo regeneration would be specified. Bamboo growing on the sediment deposits in the upstream three miles of the river could be removed as part of the sediment removal. Mechanical cutting in this area would be difficult due to the erratic and irregular surface of the sediment on which the bamboo is growing. Access to accomplish the removal is excellent from the top of the levee, although the narrowness of the levee roadway will be a constraint to getting the large volumes of cut bamboo transported to central burn or disposal area(s).

2. Sediment removal. - Approximately 95,000 cy of sediment, mostly concentrated on the west levee berm in the upstream three miles of the river, are to be removed. The exact yardage is only a rough estimate due mainly to the extreme density of the bamboo covering. A more precise estimate of sediment location and depth will be accomplished for the Final GDM/EIS by cutting swaths of bamboo from the levee top to the water's edge at regular intervals and additional sediment borings obtained. Additionally, new cross sections will be made at the swaths for comparison with the design sections to further estimate the sediment depth and location. A sampling of sediment borings has been made and analyses have been performed to determine the engineering properties of the sediment (see Exhibit 2). Sample borings have also been made of the levee waterside and landside slopes to determine stability after bamboo and sediment removal and to determine landside disposal specifications. Removal of sediment would be done during periods of low flow in the channel. Removal would be likely accomplished by either clamshell or dragline from the levee top. The levee slopes appear of insufficient strength to support equipment on either the berm or slope. The channel is shallow for waterborne equipment. Disposal will be by spreading out the sediment on the landside levee slope in those locations where adequate right-of-way width is available and where only grasses presently occur. The completed disposal will be seeded with a combination erosion control/ wildlife mixture and maintained until coverage is assured. The levee slopes and berms where sediment was removed and where rock slope protection is not proposed, as described in the next subparagraph, will be seeded in a manner similar to the slopes where the bamboo was removed, with one exception. Only grasses and low and open-growing shrubs will be specified, high and dense vegetation being the major reason for the sediment accumulation in the first place. In cooperation with the local landowners and the local reclamation district, sediment may also be disposed in adjacent

agricultural areas where material is desired to level fields. Water quality testing of the sediments is currently being conducted to insure non-toxicity for disposal (see Exhibit 4). The sediments will be first compared to Environmental Protection Agency (EPA) criteria for heavy metal content of farm soil. Subsequent to the tests, results will be sent to the Regional Water Quality Control Board for coordination to obtain the required monitoring program.

3. Rock slope protection. - With the removal of the channel choking bamboo and sediment, it is anticipated that it will be evident that some of the original levee slopes and berms will reveal an existing erosion problem or the real potential for a problem during the next high flow. This potential was recognized in a engineering review of the previous Draft General Design Memorandum and was the motivator behind the most recent project Congressional modification which specifically added the authority for rock slope protection. The levees along Middle River were originally built on the bank close to the channel with little or no berm. The material of the levees is comprised of fine sand, silt and some clay. From a 1955 COE report, "San Joaquin River Levees, General Design Memorandum No. 1" and a 1977 U.S.G.S./ Reclamation Board report, "Channel Capacity of the San Joaquin River", information and data was obtained to assist in analyzing the flows within this reach and the associated velocities. During flows of 950 to 1500 cfs along Middle River, the mean average velocities in the channel will range from 2.2 to 2.8 ft/sec. During design flows of 52,000 cfs along the San Joaquin River above Paradise Dam, flows in Middle River approximate 4,000 cfs. The estimated maximum velocity at the bottom of the river is 3.4 ft/sec near the bank and 4.8 ft/sec 10 feet out from the bank. Because of the closeness of the levees to the channel and the velocities experienced in this reach, erosion occurs along the berm and levee. Portions of the levees where no berm exists have in some instances eroded back to the point where a

1V on 1H slope now exists. An initial site visit by geotechnical/ soils personnel in early 1988 provided a preliminary recommendation that rock slope protection be provided at locations where the original berm is now less than 10 feet wide and where the original levee slope has eroded to a 1V on 1H or steeper slope. A recent (November 1988) site visit by geotechnical/ soils personnel was performed to obtain soil samples to further analyze the condition of the existing material on the levees and berms. A more complete hydraulic analysis is currently being conducted to determine the rock size and filter blanket specifications as well as the height and thickness placement on the levee and berm. Rock will only be placed on slopes cleared of bamboo except where necessary to provide lateral and vertical support, including keying into the channel bottom below normal low water level. As the majority of the locations of these levee slope and narrow berm conditions are currently masked by the bamboo and sediment coverings, a precise estimate of the extent of work necessary will not be available until the sediment and bamboo is removed. For the 30,000 ton estimate in this document, the locations recommended by the local reclamation district were used. These locations generally occur at the outside bends of the most severe curves where the greatest erosive forces are usually experienced. A hydraulic analysis and, if needed, an additional soils investigation will be performed when the exact erosion conditions are revealed to identify the maximum use of alternate bank slope protection materials such as erosion control matting or netting just below the soil line, especially in marginally erosive areas. Placement of rock would most likely be accomplished by track and boom from the levee top, the channel being shallow, narrow and choked with water hyacinth, making it difficult to accommodate barge traffic.

c. Accomplishments. - The hydraulic analysis presented as Exhibit 3 and discussed below is based on a preliminary

analysis presented in the 1985 San Joaquin River, California Clearing and Snagging, Draft GDM # 6 and present Corps experience in this area. There was very limited data available to perform the analysis under existing conditions. In analyzing the effects of the proposed work on the Middle River reach, a flow of 17,200 cfs measured upstream along the San Joaquin River at Vernalis was used. The proposed clearing at the flow analyzed would provide a new flow of 950 cfs along Middle River, realizing an estimated 29.5 % increase in flow and a 0.1 foot reduction in stage at the bifurcation of Old River and Middle River. This reduction in stage would result in a corresponding reduction in the seepage problem. With the proposed clearing work, the Middle River will be able to carry more of the San Joaquin River flows and reduce the amount of flow downstream of Middle River along Old River where seepage and flooding have been a serious problem. Upstream of Middle River, along Old River to the San Joaquin River, flows will increase about 1 %. There will be a corresponding stage reduction along Old River from the San Joaquin River downstream to Salmon Slough. This stage reduction is estimated to be between 0.1 and 0.2 foot. The proposed clearing of bamboo along Middle River on the left bank, together with the removal of accumulated sediment, will improve the flow conveyance of the channel. The work will also reduce the stage along Middle River downstream to about 2 miles beyond Howard Road. This reduction is estimated at 0.1 to 0.5 foot. The seepage problems generally experienced during flows of 1,000 cfs along Middle River will be limited by this reduction in stage. The removal of bamboo will potentially uncover an existing erosion problem. The placement of rock on the levee and banks will help reduce the erosion problems and reduce the chance of levee failure during flows greater than 3,000 cfs along Middle River. The velocities in this reach during flows of 3,000 cfs to 4,000 cfs are between 3.4 ft/sec and 4.8 ft/sec near the bank. In those locations where rock is placed on currently exposed portions of the unbermed levee below the bamboo, the additional

benefit is achieved of protecting the levees from serious undercutting by the channel bottom velocities. If allowed to continue, this undercutting increases the possibility of levee failure during moderate to high flows. The changes in hydraulic behavior in the adjacent Delta channels are limited as the Middle River will continue as a relatively minor waterway even with the proposed clearing in place. The proposed work, in consonance with the subsequent and perpetual maintenance by the Reclamation Board, will have a real, tangible and significant benefit by curtailing further channel degradation by bamboo proliferation and sediment deposition.

d. Maintenance. - Maintenance of the proposed work would consist of periodic inspections of the seven mile stretch of river to identify regeneration of bamboo or other high growing shrubs and the presence of any sediment build up. Regeneration would be spottreated chemically or removed by mechanical means. Sediment build up, not anticipated to any significant degree even during high water events due to the absence of the bamboo, would be removed and disposed of in a manner similar to the original. Rock slope protection would require inspection of its integrity, with adjustment and/or new rock if required. Water quality monitoring of sediment removal and disposal would be required. See Chapter 4 for additional information on maintenance.

e. Proposed Mitigation. - (See Appendix A to the RDEIS/R for additional information). Mitigation is proposed to be accomplished at two sites; a 5.0 acre parcel on the right bank near Crocker Road and a 6.0 acre parcel on the right bank north of Undine Road. Mitigation at both sites will consist of riparian revegetation (50 % cover) and wildlife seeding. Some minor fencing will be installed at the road access points to the sites to prevent trespass. See paragraph 2-10 for additional information on mitigation.

2-06. SAN JOAQUIN RIVER (OLD RIVER TO MERCED RIVER). -

a. Problem Statement and Previous Work. - The Lower San Joaquin River, in the reach from Old River to the Merced River, has, mainly because of its more gentle gradient than upstream reaches and its receipt of irrigation return, experienced a significant amount of sediment accumulation. This has reduced the channel capacity of the river and increased the flooding and seepage problems. According to the local flood control association, the bottom elevation of the river in many locations has been raised significantly by the accumulated sediment. Damage due to high water occurs when adjacent ground is inundated, a levee failure occurs or seepage is present. Land inside project levees in some areas is being cultivated for crops. Of about 2,100 acres which lie within project levees in this reach, about 620 were in cultivated crops and 50 in residential development in 1985. Two levee failures occurred in 1983, resulting in flooding of about 8000 acres with damages estimated at $8,000,000. Failure was by a combination of boils and sloughing aggravated by prolonged soaking and extreme river pressure. An additional 4000 acres were damaged by seepage with damages estimated at $600,000. 1983 was a particularly bad year for seepage due to long periods of high water. Water levels at the San Joaquin River gage at Vernalis were above warning stage for about six months and above danger stage for most of a two month period. 1983 and other high water years have deposited sediment that has built up on the inside of the major river bends which has deflected the river current towards the opposite bank, resulting in severe bank erosion and jeopardizing project levees, prime agricultural land, public recreation areas and sensitive environmental areas. Eroded soil is then free to travel downstream where it is further accumulated, exacerbating the problem. In many locations, landowners of the eroded banks have attempted bank repair and slope protection measures to arrest this erosion with varying degrees of success. In some locations, prime agricultural lands and private levees

have been abandoned to the erosive waters and increasing flood stages. Sediment removal to help restore the channel capacity and arrest this erosion was proposed in the May, 1985 GDM/EIS under the 1983 Authorization, but subsequently deleted from the program due to the local flood control association's objection to the level of mitigation proposed and the need for the local provision of agricultural land for mitigation. As these issues have presumably been somewhat addressed by the 1988 Authorization, the proposed work has been restored to this document at the request of the local interests in this reach.

b. Proposed Work (See Plates 3 to 12). - The work in this reach of the project consists of the excavation of approximately 300,000 cy of sandy sediment deposited at the inside of the river bends at 32 sites. The work would include the removal of the mostly grass and shrub vegetation growing upon the sites (approximately 27 acres of vegetation). Some trees, typically small diameter, would have to be removed, others will be retained. Shrub vegetation is typically willow and buttonbush, the willow reaching a 15 foot height in some locations. Tree species occur on occasion and include mostly willow, cottonwood and alder. Sites were initially identified using aerial photos taken during both normal and high flow events and from the testimony of the local landowners and flood control association who identified the most severe problem areas. All sites were then field checked both by land access and by water access to confirm the active accumulation and resultant opposite bank erosion. Sites with minimal apparent benefits and/or observed difficult or environmentally damaging access were modified or eliminated. The vegetative covering could, in most cases, be removed as part of the sediment removal operations using tracked scrapers and loaders. Larger individual trees or shrubs would be mechanically removed to off site prior to sediment removal. In the smaller sites, front end loaders would probably be used for sediment removal. Sediment would be removed down to near the normal low water

level with no work being done in the water. A 2.5H on 1V backslope will be left on the excavated sediment for stability. Sediment free of most organic material will normally be disposed of on the landside of the project levees in areas void of vegetation. Preliminary locations, identified in coordination with the local flood control association, are shown on the plates. Final locations will be determined with the landowner's assistance to minimize cost and environmental damage. Water quality testing of the sediments is currently being conducted to insure non-toxicity for disposal (see Exhibit 4). The sediments will be first compared to EPA criteria for heavy metal content of farm soil. A monitoring program will be prepared in cooperation with the Regional Water Quality Control Board. Access for the excavation and the disposal, including access for the subsequent maintenance by The Reclamation Board, will utilize existing roadways wherever possible or otherwise be located in open areas to minimize the need for vegetative and ground disturbance. A listing of the individual worksites follows:

River Mile	C.Y. Sed.	Acres	River Mile	C.Y. Sed.	Acres
56.9 left	3,200	.33	83.8 right	13,500	.93
60.0 left	3,000	.21	84.5 right	18,000	1.86
60.8 right	9,000	.62	85.7 right	5,000	1.00
61.5 left	6,000	.62	87.5 left	6,000	.33
65.2 right	12,500	1.29	88.0 right	1,500	.33
67.0 left	1,700	.28	88.6 left	2,250	.33
68.9 right	4,000	.41	89.8 right	3,000	.33
71.4 left	6,000	1.24	92.4 right	12,000	1.20
77.5 right	12,500	1.03	93.4 right	1,500	.33
79.0 right	80,000	3.30	93.7 right	3,000	.33
79.5 left	12,000	1.55	95.0 right	15,000	3.00
80.0 left	12,000	1.65	95.6 left	4,550	.94
80.8 right	2,400	.24	97.3 left	2,000	.21
81.0 left	13,500	.93	99.6 left	3,250	.51
81.2 right	7,500	.52	105.1 left	2,600	.41
81.8 left	6,000	.62	109.2 left	4,500	.62

c. Accomplishments. - The discussion below and the preliminary hydraulic analysis presented in Exhibit 3 are based on the 1985 Draft GDM/EIS, a 1955 report titled "San Joaquin River Levees General Design Memo No. 1", and a 1977 report, "Determination of Channel Capacity of the San Joaquin River (from Merced River downstream to just upstream of Old River)". Data of existing channel conditions has been obtained and analysis performed to further evaluate the effects of the proposed work on the river system within this reach. The flows analyzed in the preliminary hydraulic analysis are typical of flows that occur on a 15 to 20 year frequency. The analysis indicates that for flows between 8,100 cfs and 17,200 cfs, a stage reduction of 0.1 to 0.5 foot would occur. This stage reduction will have a positive effect on reducing flood damage due to overbank flow for flows in the range of 20,000 cfs. Overbank flow began to occur at 20,000 cfs with a corresponding stage of 19.6 ft. at the downstream end of the reach and 62 ft. at the upstream end. In some locations due to the right or left bank height, flows that are normally contained in the channel overflow out of the channel. To examine the relationship of flow versus stage the following is provided;

Discharge (cf/s)	Stage (ft) / Channel bank height (feet)		
	1	2	3
20,000	19.6/22.5	19.7/15.0	19.9/22.5
25,000	21.1	21.2	21.4
30,000	22.0	22.2	22.5
35,000	23.0	23.2	23.5
40,000	24.0	24.2	24.5
45,000	25.0	25.2	25.5
50,000	25.8	26.0	26.3
52,000	26.1	26.3	26.5
55,000	26.5	26.7	27.0

The data listed above was taken from the 1977 report on Channel Capacity of the San Joaquin River (Old River to Merced River). Section 1 is located downstream of Stanislaus River at the head of the Banta Carbona Canal. Section 2 is located approximately 1,240 feet upstream of section 1 and section 3 is approximately 2,000 feet upstream from section 2. These locations are close to the most downstream portion of the project. Given the conditions listed above with the proposed work in place at sections 1 and 2, the water will be maintained within the channel for flows up to 30,000 cfs where now these flows are out of the channel. Flows greater than 30,000 cfs but less than 32,000 cfs are still believed to be maintained within the channel. During normal flow years (1,000 cfs to 17,200 cfs with maximum flows of 33,000 cfs), the lands within the levees will be prevented from being inundated as often compared to previous years. This does not, however, hold true for all of the sections within this reach (section 2). In these areas the stage is higher than the channel bank height, therefore allowing the lands to be flooded. There are not many locations along this section where this occurs and the land adjacent to the channel has a small spillway to offset this shortfall. The proposed work does little to prevent the amount of seepage that is occurring doing high flows. A significant amount of seepage is experienced when the stage on the levees is at and above 24.5 ft. (warning stage) at the downstream end near Vernalis. The flows associated with this stage are 40,000 cfs and above. Due to the large area within the levees along most of the reach, this small reduction in stage will have minimal effect. The stages along the San Joaquin River at the mouth and upstream of the Stanislaus River past the mouth of the Tuolumne River are affected by backwater from these two tributaries. Stages can well exceed stages for design flows based on inlet flows from the tributaries. The channel banks outside the river bends within this reach experience a severe amount of erosion. The velocities at each removal site and along the entire reach were analyzed. The mean velocities normally

experienced during low flows of 1,000 cfs to 10,000 cfs are 1 to 3 ft/sec. Maximum velocities are about 4.5 to 6.5 ft/sec. for flows of 17,200 cfs to 25,000 cfs. The maximum velocities occurred when flows were contained within the main channel. At high discharges, velocities were reduced because of the large increase in channel area due to overbank flow. The mean velocities on the convex side of the river bends, where erosion is severe, occur about 10 feet from the toe of the bank and are about equal to the maximum velocity in the entire channel. Velocities at the top of and about 10 feet from the bank are about 0.4 times the maximum velocity. With the proposed work, the velocities will be reduced by 20% in the area of the removal and about 5 to 10% in the entire channel. This reduction in velocity will have a positive effect on limiting the amount of erosion occurring on the channel banks outside the river bends. In areas where the levee is close to the channel this reduction helps prevent endangering the stability of the levees by limiting the rate at which the channel is being eroded towards the toe of the levee, eventually eroding the levee itself. The analysis of the effects of the proposed work presented above is only true for conditions of 1977 and will not have the same degree of results based on present conditions. As previously stated, final analysis and design will be based on supplemental data currently being assembled and developed. The proposed work, in conjunction with an active maintenance program, will limit and reduce the amount of flood related problems experienced during certain flows, but more importantly, prevent further buildup of sediment at the 32 worksites.

d. Maintenance. - Maintenance by The Reclamation Board would require inspection of sediment accumulation at each of the original worksites. Sediment accumulations identified in consonance with the O & M requirements would need to be removed to the level of the original excavation, depending on water levels in the river. The water quality monitoring program will

need to be followed. Access routes would also have to be maintained and kept open where applicable, including the removal of invading vegetation. Observations of sediment buildup would be easily accomplished by watercraft and would probably not be necessary until following a high water event. Disposal of sediment would be in a manner similar to the original excavation. See Chapter 4 for additional information on maintenance.

e. Proposed Mitigation. - (See Appendix A to the RDEIS/R for additional information). Mitigation is required for the 27 acres of habitat lost to access the sediment accumulation as well as the habitat to be removed for equipment access to each site. Mitigation is proposed to be accomplished at five sites; an 11 acre portion of a 26 acre parcel at river mile 63.5 right, an 11 acre portion of a 31 acre parcel at river mile 66.4 right, a 15 acre parcel at river mile 66.8 right, a 9 acre parcel at river mile 84.0 left and an 11 acre portion of a 40 acre parcel at river mile 108.5 left. The locations reflect the Draft HEP/Coordination Act Report in terms of replacing habitat in the proximity of that lost. Riparian revegetation will be accomplished on the proposed acreage to obtain a 50 % cover. Fencing will be constructed at strategic locations to deter unauthorized trespass. See paragraph 2-10 for additional information on mitigation.

2-07. MENDOTA POOL. -

a. Problem Statement and Previous Work. - Mendota Dam was constructed across the San Joaquin River about one mile downstream from its confluence with the Kings River North to create a pool for the interchange of irrigation waters and to back up water for irrigation access. Sediment from the San Joaquin River, the Kings River and the several irrigation returns, particularly the Delta-Mendota Canal has accumulated in the pool, filling it almost to capacity. Sediment coming downriver, particularly during flood events, now travels over

the dam, rather than settling in the Pool, resulting in deposition downstream (see proposed work in Old River to Merced River reach). To date, it appears that there has been no attempt to remove any of the sediment as a flood control measure. A Preliminary Report for Flood Control on the San Joaquin River and Kings River North prepared in November 1983 for the Sacramento District by Stoddard and Associates recommended limited sediment removal as a means of reducing flood damages to the adjacent levee system.

b. Proposed Work (See Plate 13). - The work in Mendota Pool consists of the removal of approximately 170,000 cubic yards of sediment from an area of about 16.5 acres in the Pool. Work will consist of excavating a channel approximately 200 feet wide from the base of the dam extending 900 feet into the main body of the Pool. Excavation at a width of approximately 70 feet will continue another 600 feet to the confluence of the Kings River North and the San Joaquin River. The 70 foot width will continue another 1,500 feet into the northeast or San Joaquin River arm of the Pool and 2,000 feet into the south or Kings River North arm of the Pool. The excavation depth will vary, but on the average, it will be approximately 10 feet below the water surface elevation of 154.7 feet in the Pool. Removal of material will likely be by suction dredge with the use of floating pipelines. Temporary disposal of dredged material will be in a 75 acre diked settlement basin to the west of the pool (See Exhibit 2). The site will be prepared for the construction of the exterior dikes to form a settlement basin. The depth of the basin will be such that it provides adequate detention time to insure return effluent from the dredged slurry that meets all water quality criteria (see Exhibit 4). Ultimate disposal will consist of spreading the material on the surface of an uncapped sanitary landfill. This future work (transport to landfill) will be paid for and accomplished by Fresno County under an agreement with The Reclamation Board. The County has recently confirmed the

availability of the temporary disposal area and of their willingness to accomplish the final hauling to and spreading on the landfill.

c. Accomplishments. - The sediment removal in Mendota Pool has a direct and tangible flood protection benefit by providing an easily accessible sink to trap sediments that would otherwise continue downstream, reducing the downstream channel capacity and exacerbating erosion (see Old River to Merced River work accomplishments). This will reduce the sediment removal maintenance effort downstream required of The Reclamation Board in the Old River to Merced River reach as part of this project and of the Lower San Joaquin Levee District upstream of the Merced River as part of the State segment of the original flood control project. The preliminary hydraulic analysis attached as Exhibit 3 indicates that the removal of the sediment will reduce the stage 0.5 to 0.6 feet upstream along the San Joaquin River and Kings River North for approximately three miles. In the Kings River North arm, the velocity will be reduced to less damaging levels due to the increased area of flow. However, this work will have a very minor effect on increasing the channel conveyance within each arm. The water surface elevation in the Pool is regulated eleven months out of the year at 152-154 feet for irrigation purposes. This regulation of water surface elevation creates standing water within the pool and a backwater effect extends about three and one half miles upstream. The proposed work within each arm of the Pool is well within the backwater effect and there is very minor flow through the Pool. A preliminary report for flood control, San Joaquin River and Kings River North, by Stoddard & Associates, November 1983, for the Sacramento District, also indicates that removal of sediment from the pool bottom in the Kings River North arm will reduce velocity and erosion in this critical reach. The report analyzed excavating 78,000 cy of sediment and concluded there would be an average of 0.5 foot reduction in the water surface

elevation during high flows (4,000 cfs and greater further upstream). The plan analyzed in the Stoddard Report is very similar to the plan selected for the proposed work in this reach.

d. Maintenance. - Maintenance by the local sponsor would consist of inspections, probably yearly during the Mendota Pool de-watered period, of sediment accumulated within the Pool. A height gage set immediately after construction could readily reveal the extent of the accumulation. The sediment would need to be removed before it accumulates to the extent that sediment is no longer being trapped in the Pool area. Temporary disposal would be in a manner similar to the original, depending on future water quality problems documented with the sediment. Fresno County has previously indicated that it could utilize all sediment dredged from the Pool and disposed of in the temporary area. A letter has been solicited from them to confirm their previous abilities. Should Fresno County not be able to find a permanent disposal area for the sediment generated by maintenance, The Reclamation Board may need to locate a permanent disposal area. See Chapter 4 for additional information on maintenance.

e. Proposed Mitigation. - (Seē Appendix A to the RDEIS/R for additional information). Mitigation will take place on a 10 acre portion of the 47 acre parcel on the right bank of the San Joaquin River at river mile 205.5. This site borders Mendota Pool and is mostly at or below the water level of the Pool. A small levee keeps the Pool water out in the summer season. The mitigation will consist of the excavation of 7 acres of the site and breaching the levee to create an aquatic environment to replace that lost as part of the dredging. See paragraph 2-10 for additional information on mitigation.

2-08. SAN JOAQUIN RIVER (GRAVELLY FORD TO FRIANT DAM). -

a. Problem Statement and Previous Work. - This reach of the San Joaquin River, like the other reaches, has experienced increasing flood stages. Gage readings taken at 8,000 cfs at Skagg's Bridge were 203.4 in 1952, 204.8 in 1958 and 207.0 in 1967. In response to requests from the local Upper San Joaquin River Association, the Corps of Engineers, in 1968, 1969 and 1970, conducted channel clearing under authority of Section 208 of the 1954 Flood Control Act. The work included clearing vegetative growth and snags from about 8.5 miles of channel at critical locations from near Highway 41 to Gravelly Ford. Despite assurances to the Federal Government, maintenance of the cleared areas has not occurred. According to a subsequent Corps of Engineers/ State Reclamation Board 1972 Reconnaissance Appraisal of Flood and Related Problems and Solutions on the San Joaquin River Between Friant Dam and Gravelly Ford, "Flood damages ($265,000 in 1967) were due, in part, to higher than normal water surfaces resulting from a channel overgrown with vegetation and to development in the normal floodway required to pass 8,000 cfs". Further, in the report, as part of the analysis done on the Corps 1968-1970 vegetation clearing in the channel, it is stated "If the river is allowed to return to the condition that existed prior to the channel clearing work, it is estimated that these damages would increase to about $50,000/ year (from $30,000)". Additionally, the report compared the U.S.G.S. 1967 (preclearing) water profile at 8,000 cfs and the 1969 (post-clearing) profile also at 8,000 cfs and found that the water elevation of the 1969 flow was lower than in the 1967 flow. While there may be a number of reasons contributing to this, it is difficult to dismiss the vegetation clearing as a major factor. As indicated, no vegetation removal has taken place since the Corps' 1968 to 1970 work. Flood damages in the 1983 flood, at a flow of 10,000 cfs at Gravelly Ford, amounted to $125,000. These damages are mostly

from lost crop production, but also include flooding of recreation facilities, bank erosion and loss of some mature native vegetation.

b. Proposed Work (See Plates 14 to 18). - The proposed work consists of the removal of approximately 135 acres of vegetation and debris from 32 sites between Highway 41 and Gravelly Ford. Eight of the sites occur upstream of Highway 99 and 25 downstream. Sites are generally located at constricted areas of the reach and within the areas previously cleared by the Corps in 1968-1970 and not subsequently maintained and consist mostly of grass and scrub type material that has recolonized the sites. Willows and alders predominate with elderberry and cottonwood interspersed. These shrubs would be removed in total and disposed of by burning in a central location, chipped, or otherwise hauled off site by the contractor. Tree materials which do occur on the sites will be retained where diameters exceed six inches and otherwise do not occur in a dense stand that will capture flood debris. Trees retained will be trimmed to approximately an eight foot height to allow more unrestricted flood passage. Additionally, no vegetation will be removed in a strip approximately ten feet wide at the normal river edge. This will allow continued fisheries and wildlife benefits at the water's edge as well as provide a visual barrier to recreational water users without a serious compromise to flood stage reduction. Retention of the strip will also reduce the amount of mitigation required, particularly aquatic mitigation. A strip wider than ten feet would be left intact in certain sites where the floodway is wider than normal. The vegetation to be removed represents a loss of slightly less than 8% of the riparian vegetation presently occurring within the designated 8,000 cfs floodway between Highway 41 and Gravelly Ford as measured from April, 1984 aerial photos. The figures for upstream of Highway 99 and downstream are less than 3.5% and 10% respectively. A listing of the individual worksites follows:

River Mile	Acres	River Mile	Acres
227.4 right	1.87	235.1 right	4.71
227.5 right	1.25	235.5 left	6.40
228.0 left	8.54	235.5 right	1.78
229.0 left	12.28	236.8 right	4.00
229.4 right	5.25	237.1 right	2.58
230.0 left	19.57	237.3 left	4.45
230.7 right	4.80	237.8 left	2.31
231.4 right	7.20	237.9 right	1.95
231.4 left	4.27	248.9 right	4.89
232.0 left	4.45	249.5 right	3.55
233.6 right	2.67	249.8 right	.53
234.2 left	.35	250.0 left	4.71
234.3 right	1.51	250.7 left	1.60
234.3 left	3.20	255.1 right	1.60
234.4 right	2.13	255.2 left	3.20
234.8 right	5.34	255.3 right	.53

c. Accomplishments. - Removal of the proposed vegetation at the designated sites will have the immediate effect of reducing the flood stage several inches (see Hydraulic Analysis attached as Exhibit 3). This small reduction in stage will have a minor effect on reducing flooding near design flows of 7,000 to 8,000 cfs. However, vegetation clearing may create downstream flood problems as the sediment underlying the vegetation will be exposed for transportation and deposition downstream during the next high flow. The Chowchilla Bypass Structure downstream from Gravelly Ford, already experiencing sediment problems, could have those problems compounded by the additional sediment. Removal of the proposed vegetation will also have some very minor positive effect on reducing localized bank erosion by reducing stages and redirecting erosive currents. Most bank erosion in this reach occurs as the result of the gravel operations rather than vegetative growth in the flood plain and is therefore in locations unaffected by vegetative

clearing. The proposed vegetation clearing, in consonance with the associated maintenance by The Reclamation Board will arrest further stage increases possibly attributable to vegetative proliferation at the 32 sites to be cleared. Without the work and maintenance, the channel may continue to degrade in capacity as evidenced by the gage readings previously cited. The clearing will also provide a measure of the maintenance required of the 1968-1970 clearing.

d. Maintenance. - Maintenance of the vegetative removal sites by The Reclamation Board would consist of periodic removal of any substantial regrowth that occurs. Removal of contiguous vegetation adjacent to the river that has established itself since the original work or the last maintenance and now presents a compromise to the function of the original clearing will also need removal. Personnel familiar with vegetative species would have to be utilized to distinguish species with the potential for significant regrowth, such as willow, from the shorter shrub species, weeds and grasses. Disposal would also be by burning or removal from the site. See Chapter 4 for additional information on maintenance.

e. Proposed Mitigation. - (See Appendix A to the RDEIS/R for additional information). Mitigation is required for the 135 acres of vegetation removed less the trees retained within each site plus any vegetation removed to access the sites. Mitigation is proposed to be accomplished at six sites; on 37 acres of the 47 acre parcel near Mendota Pool at river mile 205.5 right, a 41 acre parcel at river mile 213.5 right, a 45 acre portion of a 65 acre parcel at river mile 215.0 right, an 18 acre parcel at river mile 231.0 right, an 11 acre parcel at river mile 238.0 right and a 70 acre parcel at river mile 246.5 left. The locations reflect the Draft HEP/Coordination Act Report analysis in terms of replacing habitat in the proximity of that lost. Revegetation with riparian plants will be

accomplished to achieve a goal of 50 % cover. Fencing will be erected to prevent unapproved encroachment. See paragraph 2-10 for additional information on mitigation.

2-09. KINGS RIVER NORTH. -

a. Problem Statement and Previous Work. - The Kings River North, from Mendota Pool 25 miles upstream to the southern boundary of the James Reclamation District 1606 (McMullin Grade) was added to the project specifically by the 1988 authorization. The James Bypass portion of the added river reach occurs from McMullin Grade downstream to the Southern Pacific Railroad tracks near river mile 12.5. This bypass was constructed within a 1200 foot right-of-way with the west levee constructed of material from within the right-of-way. The excavation left a deep channel parallel and immediately next to the levee and berm. During high water events, the channel velocities reach 4 to 5 feet per second. The high velocities, combined with localized turbulence caused by less eroded soil lenses and an occasional isolated tree protruding into the channel, has seriously eroded the levee berm and embankment in many locations. The local reclamation district has had to install rock slope protection and other repair measures to arrest the damage. The Stoddard Report recommends a substantial program of deepening of the channel and reconstruction of the levee system to alleviate the likelihood of levee failure. In addition, significant quantities of sediment have accumulated near the Southern Pacific Railroad tracks where the flood velocities are slowed and the water level raised by the constrictions imposed by the narrow railroad bridges. Much of the sediment accumulated originates from the erosion of the channel and berm/ levee upstream. The local reclamation district periodically removes some of the accumulations where it poses an immediate threat to the railroad or their irrigation facilities. In the high water of 1983, the Kings River North project reach experienced damages in the amount of $395,000, most of the damage occurring in the

James Bypass. The James Irrigation District, who normally spends $14,000 annually on maintenance of the Bypass, spent $28,000 in 1983 for erosion repair to the west levee.

b. Proposed Work (See Plates 19 to 22). - In Kings River North between river miles 12.5 and 25.0 (from Mendota Dam), the work will consist of the excavation of approximately 6,000 cy of hard soil lenses and three willow trees protruding into the James Bypass portion of the channel and the removal of approximately 25,000 cy of flood deposited sand, the majority of which is located immediately upstream of the Southern Pacific Railroad crossing. All excavation would be accomplished when the channel is dry and could be done easily by front end ripper/ loader and truck. Only the one sediment site near the railroad bridge contains any vegetation. Here, hand removal would be done around vegetation to be retained. Disposal would be either on the landside of the west levee or, where there is insufficient room adjacent to the levee, by removal to a County waste disposal area. Disposal areas on the levee slopes will be seeded with a wildlife/ erosion control mixture. Additional sediment removal from the channel bottom downstream of the Southern Pacific Railroad within the Mendota Wildlife Management area was proposed by the local James and Tranquillity Irrigation Districts. An analysis of the work revealed that the flood protection benefit derived from the additional work was minimal and the environmental costs high. The additional work is therefore herein not included. A listing of the proposed worksites follows:

River Mile	Proposed Work
12.5 left	Excavate 15,000 cy sand
14.6 right	Excavate 1,000 cy sand
15.0 right	Excavate 300 cy sand
15.2 right	Excavate 6,000 cy sand
15.8 right	Excavate 600 cy sand
22.2 right	Excavate 2,000 cy soil

22.8 right	Excavate 700 cy soil
22.9 right	Excavate 200 cy soil
23.1 right	Excavate 400 cy soil, remove one tree
24.4 right	Excavate 2,200 cy soil
24.7 left	Remove two trees

c. Accomplishments. - The removal of sediment and the hard soil lenses in the Kings River North provides a direct and tangible flood protection benefit within this reach and immediately downstream. Upstream of the Southern Pacific Railroad, removal of the sediment, which constricts the flow through the area and raises the stage during high flows, provides an easily accessible sink to trap sediments being displaced from upstream that would otherwise continue downstream, reducing the downstream channel capacity and exacerbating erosion (see Old River to Merced River work accomplishments). This will significantly reduce the maintenance effort downstream required of The Reclamation Board. The removal will also lower the water surface elevation during high flows and improve the flow conveyance through this reach. Likewise, the removal of the hard soil lenses intruding into the channel will have a minor effect on reducing the velocity. More importantly, the lens removal redirects flood flows away from the berm and levee, reducing the risk of erosion damage at each location and immediately downstream of each and preventing the associated downstream displacement of the eroded materials.

d. Maintenance. - Maintenance by the local sponsor would consist of inspections, probably yearly, of sediment accumulated upstream of the Southern Pacific Railroad. A height gage set immediately after construction could readily reveal the extent of the accumulation. The sediment would need to be removed when it accumulates to the extent of the original work. Disposal would be in a manner similar to the original. The removal of the hard soil lenses would require no subsequent

maintenance. See Chapter 4 for additional information on maintenance.

e. Proposed Mitigation. - (See Appendix A to the RDEIS/R for additional information). Mitigation is required for the habitat lost by the proposed work. No separate land acquisition is necessary to accomplish the mitigation because of the limited habitat to be lost. Mitigation consists of wildlife seeding at each worksite (2.8 acres total) and the planting of 10 rooted willow cuttings near the settling basin at the Southern Pacific Railroad crossing. See paragraph 2-10 for additional information on mitigation.

2-10. MITIGATION. -

a. Mitigation is provided to offset the environmental impacts of the proposed work. The new habitat replaces that lost and will generally be more usable for wildlife than that lost as it will not be submerged as often or for as long.

b. As indicated in the discussion on document history, the January 1987 Draft General Design Memorandum/ Environmental Impact Statement was unfavorably received partially because of the lack of a formal habitat evaluation analysis, the lack of a firm commitment on the mitigation lands and the lack of resolution on jurisdictional ownership of the identified mitigation sites. Additionally, local interests did not consider voluntary acquisition of agricultural land feasible.

c. The lack of a formal habitat evaluation analysis has been addressed by contracting with the U.S. Fish and Wildlife Service to prepare a HEP/ Coordination Act Report based on the proposed work. The Service submitted a draft HEP/ Coordination Act Report to the Corps for comment on November 30, 1988 identifying recommended mitigation sites and improvement programs thereon. The draft report was also transmitted by the U.S. Fish and Wildlife Service to the California Department of

Fish and Game, the State Lands Commission and several other agencies for comment. Comments were received from the Corps, the Environmental Protection Agency and the National Marine Fisheries Service and are currently being incorporated into the final report for transmittal to the Corps. Significant change from the draft report is not anticipated.

d. The lack of a firm commitment has been partially addressed by The Reclamation Board requesting a letter of intent from each of the landowners of the identified mitigation lands. The responses will indicate the landowner's awareness of the project and their general willingness to offer the lands as mitigation. Such responses will be an appendix to the Final General Design Memorandum.

e. The lack of firm commitment has also been addressed by requesting that The Reclamation Board complete an acceptable easement language for use in acquiring the lands. Currently, the language of the easements which the Board would use is being negotiated between the owners' representatives and fish and wildlife interests, particularly the California Department of Fish and Game to whom The Reclamation Board may turn over the mitigation lands for management. An agreed upon language is necessary to obtain commitments by the owners and be acceptable to the fish and wildlife requirements of the project. Attached to the EIS is the current (3/22/89) version of the easement language being negotiated. The two main current points of disagreement on the language wording are the acknowledgment of a possible public trust interest on the land and the right of public access. The landowners object to the inclusion of either in the language. For this document, a firm commitment rests with the stated intention to not initiate any clearing on a particular reach of river until the mitigation lands applicable to that reach are acquired and the wildlife

improvement program initiated. A firmer commitment via actual acquisition is not possible until after approval of the final document.

f. As part of resolving the question of public trust interest in the mitigation lands, the State Lands Commission staff has visited all the mitigation sites identified in this document. They have performed an analysis of each one to make a determination where the boundaries of State lands occur and whether there is land (usually agricultural or vacant and not likely to be colonized easily by vegetation) within the boundary that could be improved by this project for wildlife.

g. Two categories of mitigation lands are identified on the plates as part of this document. Those lands recommended by the U. S. Fish and Wildlife Service in the draft HEP/ Coordination Act Report are shown. The accompanying improvement program for each of these sites has been previously described. The improvement recommendations, consisting mostly of riparian revegetation and site access fencing, are in contrast to the concept in the previous document of natural revegetation in recognition of the unavailability of lands that could provide acceptable natural revegetation to meet the HEP requirements. The draft HEP/ Coordination Act Report was prepared utilizing the input of the State Lands Commission's determinations discussed above. It is anticipated that the recommended improvement programs on any lands claimed by the Commission will be approved by the Commission as contributing to the wildlife value of the land. Alternate mitigation sites are also shown on the plates. These sites will be utilized only in those situations where the recommended site(s) can not be obtained.

h. Subsequent to approval of the Final GDM/EIS and appropriation of funds by the California legislature, acquisition of the mitigation lands can be initiated by The

Reclamation Board. For those mitigation sites where the draft HEP/ Coordination Act Report recommends acquiring only a portion of a particular site, a design team of engineering, environmental and real estate personnel would be formed to determine the most appropriate portion conducive to successful mitigation. The State Lands Commission would be involved in the acquisition process to resolve conflicting ownership claims.

2-11. REAL ESTATE REQUIREMENTS. -

a. General.- Acquisition of lands, easements, and rights-of-way will be the responsibility of the non-Federal sponsor, The State Reclamation Board.

b. Land Rights. -

1. Channel Easements. - The Reclamation Board must obtain the right to construct, operate, and maintain the channel clearing and snagging works. This will include the right to clear, cut, fell, remove, and dispose of any and all timber, trees, underbrush and/or other obstructions, to excavate, dredge, cut away, and remove any or all of said land and to place upon it dredge or spoil material and for any other purposes required in connection with the project work.

2. Disposal Easements. - The Reclamation Board must obtain the right to dispose of all dredge and/or excavated material. All rights which do not interfere with the disposal activities may be retained by the owners.

3. Wildlife (Mitigation) Easements. - The Reclamation Board must obtain all land rights necessary to allow for project mitigation, including access and the implementation and maintenance of the wildlife improvement programs. The owners may retain all rights that do interfere with the improvement programs.

CHAPTER 3 - ENVIRONMENTAL CONSIDERATIONS

3.01. DESIGN CONSIDERATIONS. - The work was scoped to provide the greatest flood control benefit while incurring the least amount of environmental impact. On-going coordination with the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the Environmental Protection Agency and other Federal and State agencies has provided the Corps with information and recommendations that would reduce or eliminate potential environmental impacts caused by the project. Based on this information and recommendations, worksites were modified, eliminated and/or relocated. Methods of construction for clearing activities were also carefully determined taking into account environmental considerations. Furthermore, on-site mitigation measures such as avoidance techniques have been incorporated into the project design.

3.02. DRAFT ENVIRONMENTAL IMPACT STATEMENT. - The Draft Environmental Impact Statement/Report (DEIS/R) that is contained within this document provides detailed descriptions of the aforementioned impact assessment procedures and subsequent conclusions that were utilized by the impact assessment team.

CHAPTER 4 - OPERATION AND MAINTENANCE

4-01. GENERAL. - As noted in paragraph 1-04, the California Reclamation Board has been authorized by A.B. 3397 of 29 Sept 1984 and AB 3654 of 28 Sept 1988 to operate and maintain the project after completion of construction. It will be The Reclamation Board's responsibility to insure that all operation and maintenance is accomplished in compliance with Section 208.10, Title 33 of the Code of Federal Regulations.

4.02. MAINTENANCE REQUIREMENTS. -

a. Operation and maintenance (O&M) of the original worksites will consist of periodic inspection and removal as required of accumulated sediments and new vegetation, the extent thereof, of course, varying with river flows, hydrologic conditions and other variables affecting the rivers. Disposal of vegetation and sediment will generally be in a manner similar to and within the areas of original disposal where such easements will have been obtained by The Reclamation Board. By this project, The Reclamation Board is not taking on a comprehensive maintenance responsibility for the San Joaquin River. Responsibility generally is limited to that purpose for which each particular worksite was identified. It is recognized that the maintenance responsibilities will not necessarily be limited specifically to the exact physical limits of the original work. Limiting maintenance to the original boundaries of the sites would not fulfill the flood threat reduction purpose of the initial clearing. For example, the planned clearing of many of the point bar sediment sites (Old River to Merced River) is intended to shift river forces away from the active erosion on the opposite bank. Assuming future sediment deposition at the clearing site with physical limits larger than those of the original clearing, river forces would not be channeled away from the eroding bank by "scooping out" just the

sediment within the original limits. It should be noted that, except for the river reach from Gravelly Ford to Friant Dam, The Reclamation Board currently has the responsibility to maintain the Lower San Joaquin River and Tributaries project under the basic 1944 Federal authorization as clarified by the 1955 modification. For more reach specific O & M considerations, refer to the subparagraph on maintenance for each reach as described in Chapter 2.

b. Operation and maintenance of the mitigation areas will generally consist of preventing unauthorized encroachment through regular patrols and the maintenance of the property fences and gates. Maintenance of the wildlife facilities constructed by the Corps as part of the wildlife improvement program on the designated mitigation lands will also be required and will generally consist of activities such as eradication of invading species and sediment removal to keep waterways open in the aquatic mitigation areas. Some plantings in higher and drier parts of the mitigation areas or in poor soil moisture holding areas may require supplemental irrigation. A monitoring program for maintenance of the fish and wildlife facilities will need to be developed in conjunction with the Corps, the U.S. Fish and Wildlife Service and the California Department of Fish and Game to inspect and insure continued provision of the original fish and wildlife values.

c. Mitigation for O & M activities on the original worksites and disposal sites is not required as the mitigation proposed herein includes impacts anticipated for these normal activities, including maintenance of the accesses to the worksites. Additionally, future mitigation required of The Reclamation Board for subsidiary clearing outside the exact limits of the original worksites, as described in subparagraph a above, will not be necessary except in the Gravelly Ford to Friant Dam reach. In the other four reaches, the maintenance

responsibility by the Reclamation Board already exists under the 1944 authorization and 1955 modification. In the Gravelly Ford to Friant Dam reach, subsidiary clearing outside the original worksites would require The Reclamation Board to prepare supplemental environmental documentation. Supplemental environmental documentation and mitigation will also be required for any additional disposal sites if and when their need is necessitated by the initial sites exceeding their holding capacity.

d. Operation and maintenance considerations were an integral part of the work effort and siting for this project, including the development of a wildlife improvement program. Sites with hard to maintain access and minimal benefits were modified from previous documents in consideration thereof. Construction procedures insuring a minimal operation and maintenance program wherever possible are being developed such as mechanical removal of plant roots, recurring spraying of regrowth during an extended construction period, erection of substantial fencing at the appropriate mitigation areas and the care of any planted revegetation for a normal three-year establishment period. Additionally, some work items have been identified which will require little or no maintenance, such as the excavation of the protruding soil lenses in the Kings River North.

e. The Reclamation Board has developed a program for maintaining the pre-1988 modification project. It assumes no maintenance work of the worksites will be necessary for the first five years following completion of the work. After that time, the project would be maintained and the project worksites restored to their post-construction purpose during a 5-year maintenance program. It is estimated that reclearing would only take half the effort and half the cost of the original work. After the 5-year maintenance period, maintenance would be performed annually at a rate of 10 percent of the original

effort and cost. The Reclamation Board is currently updating the program notes to include the newly authorized additional work in the Kings River North, the rock stone protection in the Middle River, the recent site modifications of the original work and the proposed mitigation improvement program. Actual vegetative growth and sediment deposition are, of course, dependent upon volume and duration of streamflows as well as many other factors. Therefore, the actual frequency of maintenance will be adjusted accordingly.

4-03. OPERATION AND MAINTENANCE MANUAL. - An Operation and Maintenance Manual for the project reflecting the aforementioned considerations is currently being prepared by the Sacramento District in cooperation with The Reclamation Board outlining the operation and maintenance responsibilities of The Reclamation Board. The approved manual will form the basis for the subsequent operation and maintenance. Copies of this manual will be furnished to The Reclamation Board for implementation.

CHAPTER 5 - COSTS

5-01. BASIS OF FIRST COSTS. -

a. The detailed estimate of the first costs for the proposed Lower San Joaquin River clearing and snagging project is based on October 1988 price levels and is shown on Table 1. A cost summary is shown on Table 2. The estimated lands and damages costs were furnished by The Reclamation Board of the State of California. Land costs reflect the average price reasonably anticipated to be required to obtain the land from private landowners. Claims by the State Lands Commission are not considered, but would most likely lower the cost of each parcel in which the Commission claims jurisdiction. A 35% allowance for contingencies is added to the land costs to reflect the uncertainties in the price of lands, easements and rights-of-way. The unit prices for construction items were based on adjustments of average bid prices received on comparable work in the Sacramento District. For construction items, a 20-25 percent allowance was included for contingencies depending on the river reach and the engineering definition available for each reach. Suitable allowances were made for engineering and design, and supervision and administration based on costs experienced on comparable work within the Sacramento District and on costs already incurred.

b. The summary of first costs for clearing and snagging is shown below:

Summary of First Costs - Clearing and Snagging *	
Federal First Cost	$11,500,000 **
Non-Federal First Cost	$ 4,100,000
Total Project First Cost	$15,600,000

* Includes prior expenditures for E&D and Eastside Bypass.

** Congressional authorization is $8.0 million. $9.8 million inflated was working estimate contained in latest budget submittal.

5-02. MAINTENANCE COSTS. - The California Reclamation Board has developed a method for estimating the cost of operation and maintenance for this project based on their Flood Management staff's familiarity with the historical maintenance requirements of similar work. For a discussion of the operation and maintenance program, see Paragraph 4-02. They estimate that reclearing during the 5-year maintenance period would require half the effort and half the cost of the original construction cost. After the 5-year maintenance period, maintenance would be performed annually at a rate of 10 percent of the original cost in perpetuity. The average annual maintenance costs for channels will therefore be approximately $320,000 without adjustment for inflation. Actual costs, of course, will be dependent on many factors, particularly the hydrologic conditions each year and the efficiency of the maintenance effort.

CHAPTER 6 - PROJECT ECONOMIC FEASIBILITY

6-01. General. -

a. The overall Lower San Joaquin River project provides flood control primarily through levee and channel improvements as specified in Design Memorandum No. 1 dated 23 December 1955. The proposed clearing and snagging modifications as described herein were developed to help provide continued flood protection. The cost of the entire project, $33,576,000, includes levee work under the authorized plan of improvement, as well as the costs of the proposed clearing and snagging. A summary of first costs is shown below:

Summary of First Costs

1956 Authorization	
Federal	$12,976,000
Non-Federal *	5,000,000
Proposed Clearing and Snagging	
Federal	11,500,000
Non-Federal	4,100,000
TOTAL FIRST COSTS	$33,576,000

* Non-Federal costs are based on the costs of flowage easements and rights-of-way and do not include the cost of the Eastside Bypass.

b. The annual cost of the authorized levee work was updated to current price levels using the Construction Cost Index. On this basis, the annual costs are $3,440,000. The cost for the clearing and snagging modification was amortized over a 20-year period at the current interest rate of 8-7/8. The remaining useful life of the entire project is at least 20 years. The annual cost of the clearing and snagging is estimated at $1,690,000; therefore, the annual cost of the entire Lower San Joaquin River project amounts to $5,130,000.

c. Since the proposed clearing and snagging is included as a project modification, the average annual flood control benefits credited to the authorized levee and channel improvements were used to evaluate total project benefits. These updated average annual benefits, consisting of a reduction in flood damages to agriculture, are in excess of $5,700,000 and are attributable to the levee system. No benefits have been claimed for the Eastside Bypass.

d. A comparison of the annual flood control benefits of $5,700,000 with the estimated annual project costs of $5,130,000 yields a benefit-cost ratio for the Lower San Joaquin River project of 1.1 to 1.0.

CHAPTER 7 - DESIGN AND CONSTRUCTION SCHEDULE

7-01. GENERAL. - The preparation of plans and specifications for the proposed work on the Lower San Joaquin River Clearing and Snagging project will follow approval of the Final General Design Memorandum/ Environmental Impact Statement. Construction will not be initiated until the Assurance Agreement is signed by The Reclamation Board and the Corps of Engineers and a Record of Decision is filed. Separate contract packages will be prepared for each of the identified clearing situations corresponding to the specific reaches of the river. Clearing and mitigation will also be separate packages with the mitigation or fish and wildlife contracts for each reach being awarded prior to or concurrent with the clearing contract. It is anticipated that an award of the first contract packages for the clearing and mitigation at Mendota Pool and Middle River can be advertised in April of 1990, assuming the California legislature funds the necessary acquisitions by The Reclamation Board in a timely manner. Clearing at all the reaches would be completed by early 1992. Mitigation would continue into 1995 to provide the required maintenance of the riparian revegetation. A tentative project schedule is included in this document as Table 3.

7-02. WORK BY THE FEDERAL GOVERNMENT. - The Federal work will be responsible for the dredging, vegetation removal, excavation and initial implementation of the wildlife improvement program.

7-03. WORK BY OTHERS. - The Reclamation Board of the State of California will be responsible for furnishing all lands, easements, rights-of-way, and utility relocations necessary for this project. The Reclamation Board's participation is subject to funding by the California legislature. The Reclamation Board will also be responsible for all subsequent maintenance of the

project unless, as stated in the State's authorizing legislation, a local agency is formed to share or to take over the maintenance responsibility.

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CHAPTER 8 - CONCLUSIONS

8-01. CONCLUSIONS. - The work proposed in this General Design Memorandum and evaluated for environmental impact in the Revised Draft Environmental Impact Statement represents a scope refined from the previous document of January 1987 and updated to include the additional work and funding authorized by the Continuing Appropriations Act of 1988. With regard to the scope and cost of work identified, two significant items are apparent. First, all of the work identified and mitigation outlined is estimated to cost more than the monies authorized for the clearing and snagging work. Second, the estimated cost for mitigation associated with vegetative removal as is identified in the Gravelly Ford to Friant Dam reach is inordinate. Based on current estimates, some of the work presented herein will likely have to be reduced, deleted or deferred to remain within the project monetary authorization. The intent is to accomplish the work presented where necessary local cooperation is provided, up to the amount of the authorized Federal project cost. This report and the Revised Draft Environmental Impact Statement present the maximum scope of work and impacts associated with each clearing type or reach of work. Work will only be accomplished in reaches where The Reclamation Board, in cooperation with local interests, provides the necessary local cooperation, including providing lands for mitigation purposes. Actual work will be accomplished in the sequence determined by when the rights-of-way, easements and other acquisitions are provided by the sponsor. A tentative schedule is presented in Table 3 and is based partially on the estimated difficulty and length of the sponsor's acquisitions. Also with regard to priority for accomplishing work, the vegetation clearing in the Gravelly Ford to Friant Dam reach appears to be the least effective work because of the environmental considerations and high incremental costs. Additionally, the vegetation clearing in

this reach offers minimal reduction of flood damages and places the local sponsor in the position of possibly having to provide mitigation for future maintenance. However, the determining factors for where work will be accomplished will be (1) provision of local cooperation by the sponsor, and (2) not exceeding the authorized Federal cost. No work beyond that presented in this report is planned or anticipated. Further study, environmental compliance and authorization would be necessary before further Federal work would be undertaken.

8-02. FURTHER STUDIES. - To address concerns and interests beyond the identified clearing and snagging work, further investigation would be required. Numerous concerns for the many problems along the San Joaquin River have been voiced during public reviews and comments. The Reclamation Board and the California Water Commission are endorsing an investigation of sediment problems along the river to address how sediment affects flood problems. To address concerns and problems beyond sedimentation, a broader, more comprehensive investigation of all problems and beneficial uses would be necessary. To encompass the concerns of the wide variety of interests, an advisory council approach to the river's problems, including flood control, fish and wildlife, seepage, sedimentation, etc., similar to the current process on the Upper Sacramento River as authorized by California Senate Bill 1086, would be one means. Such a study could be pursued by private individuals or organizations or at various levels of government, although at the present time there are no plans for such a comprehensive review of the needs along the San Joaquin River.

8-03. RECOMMENDATIONS. - Recommendations will be prepared after public review and comment on this Draft General Design Memorandum/ Environmental Impact Statement and Report.

TABLE 1

LOWER SAN JOAQUIN RIVER, CALIFORNIA
(Clearing and Snagging)

MIDDLE RIVER

DETAILED ESTIMATE OF FIRST COST

1 October 1988 Price Level

COST ACCT. NO.	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
	FEDERAL				
06.	FISH AND WILDLIFE FACILITIES				
	Fencing (barbed wire)	200	LF	4.00	800
	Revegetation	5.5	AC	18,000.00	99,000
	Subtotal				99,800
	Contingencies (20%)				19,960
	TOTAL FISH AND WILDLIFE FACILITIES				120,000
09.	CHANNELS				
	Excavation	95,000	CY	2.50	237,500
	Bamboo Clearing	50	AC	5,000.00	250,000
	Rock Slope Prot.	30,000	TN	12.50	375,000
	Subtotal				862,500
	Contingencies (25%)				215,625
	TOTAL CHANNELS				1,100,000
30.	ENGINEERING AND DESIGN				210,000
31.	SUPERVISION AND ADMINISTRATION				100,000
TOTAL FEDERAL FIRST COST					1,530,000

NON-FEDERAL

LANDS AND DAMAGES				
Lands (Easements)				
Mitigation	11	AC	2,400.00	26,400
Channel	50	AC	200.00	10,000
Disposal	6	AC	2,500.00	15,000
Subtotal				51,400
Contingencies (35%)				18,000
Acquisition Cost				
Mitigation Easements	2	EA	15,000.00	30,000
Channel and Disposal Easements	48	EA	12,500.00	600,000
TOTAL LANDS AND DAMAGES				700,000
TOTAL NON-FEDERAL FIRST COST				700,000
TOTAL PROJECT FIRST COST (MIDDLE RIVER)				2,230,000

TABLE 1

LOWER SAN JOAQUIN RIVER, CALIFORNIA
(Clearing and Snagging)

LOWER SAN JOAQUIN RIVER FROM OLD RIVER TO MERCED RIVER

DETAILED ESTIMATE OF FIRST COST

1 October 1988 Price Level

COST ACCT. NO.	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
			FEDERAL		
06.	FISH AND WILDLIFE FACILITIES				
	Fencing (barbed wire)	12,400	LF	4.00	48,400
	Revegetation	26.2	AC	18,000.00	471,600
	Subtotal				520,000
	Contingencies (20%)				104,200
	TOTAL FISH AND WILDLIFE FACILITIES				625,000
09.	CHANNELS				
	Clear and Grub	27	AC	1,400.00	37,800
	Excavation	300,000	CY	3.00	900,000
	Subtotal				937,000
	Contingencies (20%)				187,000
	TOTAL CHANNELS				1,125,000
30.	ENGINEERING AND DESIGN				315,000
31.	SUPERVISION AND ADMINISTRATION				145,000
TOTAL FEDERAL FIRST COST					2,210,000

NON-FEDERAL

LANDS AND DAMAGES				
Lands (Easements)				
Mitigation	53	AC	2,400.00	127,200
Channel	27	AC	200.00	5,400
Disposal	25	AC	2,500.00	62,500
Subtotal				195,100
Contingencies (35%)				70,000
Acquisition Cost				
Mitigation Easements	5	EA	15,000.00	75,000
Channel and Disposal Easements	70	EA	12,500.00	875,000
TOTAL LANDS AND DAMAGES				1,215,000
TOTAL NON-FEDERAL FIRST COST				1,215,000
TOTAL PROJECT FIRST COST (OLD RIVER TO MERCED RIVER)				3,425,000

TABLE 1

LOWER SAN JOAQUIN RIVERS, CALIFORNIA
(Clearing and Snagging)

MENDOTA POOL

DETAILED ESTIMATE OF FIRST COST

1 October 1988 Price Level

COST ACCT. NO.	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
			FEDERAL		
06.	FISH AND WILDLIFE FACILITIES				
	Excavate 7 Acre Open Water Area	50,000	CY	4.00	200,000
	Channel Excavation	2,000	CY	4.00	8,000
	Canal Gate Installation	1	JOB	LS	1,500
	Subtotal				209,500
	Contingencies (20%)				41,900
	TOTAL FISH AND WILDLIFE FACILITIES				250,000
09.	CHANNELS				
	Mobilization/Demob	1	JOB	LS	250,000
	Excav.(Sediment)	170,000	CY	2.00	340,000
	Temporary Disposal Site Preparation	1	JOB	LS	45,000
	Subtotal				635,000
	Contingencies (20%)				127,000
	TOTAL CHANNELS				760,000
30.	ENGINEERING AND DESIGN				175,000

31. SUPERVISION AND ADMINISTRATION				85,000
TOTAL FEDERAL FIRST COST				1,270,000
	NON-FEDERAL			
LANDS AND DAMAGES				
Lands (Easements)				
Mitigation	10	AC	2,400.00	24,000
Channel	25	AC	200.00	5,000
Disposal (temporary)	80	AC	150.00	12,000
Subtotal				41,000
Contingencies (35%)				14,000
Acquisition Cost				
Mitigation Easements	1	EA	15,000.00	15,000
Channel and Disposal Easements	5	EA	12,500.00	62,500
TOTAL LANDS AND DAMAGES				130,000
TOTAL NON-FEDERAL FIRST COST				130,000
TOTAL PROJECT FIRST COST (MENDOTA POOL)				1,400,000

TABLE 1

LOWER SAN JOAQUIN RIVER, CALIFORNIA
(Clearing and Snagging)

LOWER SAN JOAQUIN RIVER FROM GRAVELLY FORD TO FRIANT DAM

DETAILED ESTIMATE OF FIRST COST

1 October 1988 Price Level

COST ACCT. NO.	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
	FEDERAL				
06.	FISH AND WILDLIFE FACILITIES				
	Fencing (barbed wire)	14,000	LF	4.00	56,000
	Revegetation	98	AC	18,000.00	1,764,000
	Subtotal				1,820,000
	Contingencies (20%)				364,000
	TOTAL FISH AND WILDLIFE FACILITIES				2,200,000
09.	CHANNELS				
	Vegetation Clearing	135	AC	700.00	94,500
	Subtotal				94,500
	Contingencies (20%)				18,900
	TOTAL CHANNELS				115,000
30.	ENGINEERING AND DESIGN				400,000
31.	SUPERVISION AND ADMINISTRATION				270,000
	TOTAL FEDERAL FIRST COST				2,985,000

NON-FEDERAL

LANDS AND DAMAGES				
Lands (Easements)				
Mitigation	222	AC	2,400.00	532,800
Channel	135	AC	200.00	27,000
Subtotal				559,800
Contingencies (35%)				195,200
Acquisition Cost				
Mitigation Easements	6	EA	15,000.00	90,000
Channel Easements	85	EA	12,500.00	1,065,000
TOTAL LANDS AND DAMAGES				1,910,000
TOTAL NON-FEDERAL FIRST COST				1,910,000
TOTAL PROJECT FIRST COST (GRAVELLY FORD TO FRIANT DAM)				4,895,000

TABLE 1

LOWER SAN JOAQUIN RIVER, CALIFORNIA
(CLearing and Snagging)

KINGS RIVER NORTH

DETAILED ESTIMATE OF FIRST COST

1 October 1988 Price Level

COST ACCT. NO.	ITEM	QUANTITY	UNIT	UNIT COST $	AMOUNT $
	FEDERAL				
06.	FISH AND WILDLIFE FACILITIES				
	Wildlife Seeding	2.8	AC	500.00	1,400
	Tree Planting	10	EA	150.00	1,500
	Subtotal				2,900
	Contingencies (20%)				580
	TOTAL FISH AND WILDLIFE FACILITIES				5,000
09.	CHANNELS				
	Excav. (Soil)	6,000	CY	4.00	24,000
	Excav. (Sand)	25,000	CY	3.00	75,000
	Subtotal				100,000
	Contingencies (20%)				20,800
	TOTAL CHANNELS				120,000
30.	ENGINEERING AND DESIGN				20,000
31.	SUPERVISION AND ADMINISTRATION				10,000
	TOTAL FEDERAL FIRST COST				155,000

NON-FEDERAL

LANDS AND DAMAGES				
Lands (Easements)				
Channel	26	AC	200.00	5,200
Disposal	4	AC	2500.00	10,000
Subtotal				15,200
Contingencies (35%)				5,320
Acquisition Cost				
Channel and Disposal Easements	10	EA	12,500.00	125,000
TOTAL LANDS AND DAMAGES				145,000
TOTAL NON-FEDERAL FIRST COST				145,000
TOTAL PROJECT FIRST COST (KINGS RIVER NORTH)				300,000

TABLE 2

LOWER SAN JOAQUIN RIVER, CALIFORNIA
(Clearing and Snagging)

COST SUMMARY

1 October 1988 Price Level

Activity	PROJECT FIRST COSTS Federal $	Non-Federal $	Total $
Middle River	1,530,000	700,000	2,230,000
San Joaquin River from Old River to Merced River	2,210,000	1,215,000	3,425,000
Mendota Pool	1,270,000	130,000	1,400,000
San Joaquin River from Gravelly Ford to Friant Dam	2,985,000	1,910,000	4,895,000
Kings River North	155,000	145,000	300,000
Costs to date for E&D and S&A and construction of Eastside Bypass	3,350,000	0	3,350,000
Total	11,500,000 *	4,100,000	15,600,000

* Congressional authorization is $8.0 million. $9.6 million inflated was working estimate contained in latest budget submittal

D—030608

TABLE 3

DESIGN AND CONSTRUCTION SCHEDULE

		FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95
		O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S
GDM/EIS		SUBMIT DRAFT; SUBMIT FINAL; SIGN ROD						
PLANS & SPECS	MENDOTA POOL	TO SPD; ADV; AWARD						
	MIDDLE RIVER	TO SPD; ADV; AWARD						
	KINGS RIVER NORTH	TO SPD; ADV; AWARD						
	OLD RIVER TO MERCED RIVER	TO SPD; ADV; AWARD						
	GRAVELLY FORD TO FRIANT DAM	TO SPD; ADV; AWARD						
CONSTRUCTION	MENDOTA POOL							
	MIDDLE RIVER							
	KINGS RIVER NORTH							
	OLD RIVER TO MERCED RIVER							
	GRAVELLY FORD TO FRIANT DAM							
FISH & WILDLIFE FACILITIES	MENDOTA POOL							
	MIDDLE RIVER							
	KINGS RIVER NORTH							
	OLD RIVER TO MERCED RIVER							
	GRAVELLY FORD TO FRIANT DAM							
O & M MANUAL								

Table 4

DESIGN FLOWS

Reach		Design Flows (cfs)
San Joaquin River		
Friant Dam to Chowchilla Bypass Structure		8,000
Chowchilla Bypass		5,500
Eastside Bypass		10,000 - 18,500
Mariposa Bypass		8,500
Kings River North		4,750
San Joaquin River		
Chowchilla Bypass Structure to Mendota Dam		2,500
Mendota Dam to Sand Slough		4,500
Sand Slough to Mariposa Bypass		1,500
Mariposa Bypass to Merced River		10,000 - 26,000
Merced River to Tuolumne River		45,000
Tuolumne River to Stanislaus River		46,000
Stanislaus River to Paradise Dam		52,000
Paradise Dam to Old River	(37,000)	52,000
Paradise Cut	(15,000)	
Middle River		4,000

Sources:
a. Report on flood control Operation and Maintenance, San Joaquin River, Friant Dam to Stockton, California Department of Water Resources, Jan. 1975
b. Report on the San Joaquin River Levees General Design Memorandum No.1 Dec 1955.

(DRAFT)

AGREEMENT BETWEEN

THE UNITED STATES OF AMERICA

AND

THE CALIFORNIA STATE RECLAMATION BOARD

FOR LOCAL COOPERATION AT

LOWER SAN JOAQUIN RIVER, CALIFORNIA

THIS AGREEMENT entered into this _____ day of _____, 1989 by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), represented by the Contracting Officer executing this agreement, and the CALIFORNIA STATE RECLAMATION BOARD (hereinafter called the "State"), WITNESSETH THAT:

WHEREAS, construction of the Lower San Joaquin River, California project (hereinafter called the "Project") was authorized by the Flood Control Act of December 1944 and modified by Public Law 84-327 and Section 205 of the 1983 Supplemental Appropriations Act (Public Law 98-63) and further modified by the Continuing Appropriations Act of 1988 (Public Law 100-202); and

WHEREAS, maintenance of the Project was authorized by State Law AB 3397 (Section 12688 of the California Water Code) and further modified by State Law AB 3564 (Sections 8610 and 8611 of

EXHIBIT 1

the California Water Code).

NOW, THEREFORE, the parties agree as follows:

1. OBLIGATIONS

The State agrees that, upon notification that the Government will commence construction of the Project substantially in accordance with Federal and State legislation as set forth above authorizing such project, and as described in Design Memorandum No. 6 for the Project, the State shall, in consideration of the Government commencing construction of such project, fulfill the requirements of non-Federal cooperation specified in such language, to wit:

a. provide all lands, easements, rights-of-way and utility relocations at no expense to the Federal Government;

b. operate and maintain the project works upon completion of construction in accordance with rules and regulations prescribed by the Department of the Army and in accordance with paragraph 2 of this Agreement.

c. hold and save the United States free from damages due to construction, operation, and maintenance of the project, not including damages due to the fault or negligence of the United States.

d. comply with the applicable requirements of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act" of 1970 (Public Law 91-646, 84 Stat, 1894), as published

in the Federal Register, Volume 52, # 247, 17 December 1987;

e. comply with Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352), that no person shall be excluded from participation in, denied the benefit of, or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin.

f. assume responsibility and pay damages, if necessary, in the event there is failure to perform in accordance with the terms of this Agreement and any other applicable provisions of section 221 of Public Law 91-611 and 99-662.

2. OPERATION AND MAINTENANCE

The State hereby gives the Government permission to enter, at reasonable times and in a reasonable manner, upon lands which it owns or controls, for access to the project for the purpose of inspection. If such inspection shows that the State for any reason is failing to repair and maintain the project in accordance with the assurances hereunder and has persisted in such failure for 30 days after a notice in writing has been delivered by the Government to the State, the Government shall have the further right, as stated above, to enter upon the land for the purpose of operating, repairing, and maintaining the modification reaches. Operation, repair, and maintenance by the Government in such event shall not operate to relieve the State of responsibility to meet its obligations as set forth in paragraph 1 of the Agreement, or to preclude the Government from

D-030612

pursuing any other remedy at law or equity.

3. MAINTENANCE OF RECORDS

a. The State shall maintain books, records, documents and other evidence pertaining to costs and expenses incurred in the performance of the work and acquisition of the required real estate interests to the extent and in such detail as will properly reflect all net costs of whatever nature involved therein. The State shall make available at their offices at reasonable times, the accounting records for inspection and audit by an authorized representative of the Division or District Engineer.

b. The Government shall credit the State for its participation upon receipt of properly certified invoices and upon approval by the Contracting Officer of the purchase and sufficiency of the real estate interests acquired.

4. REPRESENTATIVES

To provide for consistent and effective communication between the State and Government during the term of construction, the State and the Government will appoint representatives to coordinate on scheduling plans, specifications, contract costs and other matters relating to construction of the Project.

D-030613

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By:_____
Colonel, Corps of Engineers
District Engineer
Contracting Officer

THE CALIFORNIA STATE RECLAMATION BOARD

_____
President
The Reclamation Board

ATTEST:

By: _____
Counsel
State of California
Reclamation Board

FOR THE SECRETARY OF THE ARMY

Date:_____

GENERAL DESIGN MEMORANDUM NO. 6
LOWER SAN JOAQUIN RIVER, CALIFORNIA
Clearing and Snagging

Geotechnical Investigation for Vegetation and Sediment Removal

Prepared By:
Soil Design Section
Sacramento District
Corps of Engineers, U.S. Army
January 1989

EXHIBIT 2

D—030615

GENERAL DESIGN MEMORANDUM NO. 6
LOWER SAN JOAQUIN RIVER, CALIFORNIA
Clearing and Snagging

TABLE OF CONTENTS

LIST OF PLATES

1. Introduction. - This report contains geotechnical descriptions and design recommendations for project reaches on Middle River, San Joaquin River from Old River to Merced River, Mendota Pool, and Kings River North for vegetation and sediment removal. The report was developed from site reconnaissance data, existing soil reports, and laboratory index property testing. During the development of this report, hydraulic information on flow velocities were lacking on some project reaches. Consequently, in order to aid in the identification of reaches requiring slope protection maximum permissible flow velocities are presented.

2. References. -

a. "Foundation Investigation Undine Road Bridge # 1902 At Middle River", January 1974, Moore & Taber Northern California Consulting Engineers and Geologists

b. "Foundation Investigation Howard Road Bridge Across Middle River", May 1967, Moore & Taber Northern California Consulting Engineers and Geologists

c. Design Memorandum No. 1 - San Joaquin River Levees, Lower San Joaquin River and Tributaries Project, California, December 1955

d. "Soils of Madera County California", Soil Survey No. 12, January 1956, University of California, Berkeley

3. MIDDLE RIVER.

3-01. Site Conditions. From the site reconnaissance work, embankment sections were selectively surveyed. The embankments are typically 15 feet high with crown widths ranging from 18 to 25 feet. Embankment slopes range from 1.8 to 3 horizontal (H) on 1 vertical (V) on the landside and 2.2 to 3.5 H on 1 V on the waterside. The embankment materials consist primarily of sand, silts and mixtures thereof (references a. and b.). Based on standard penetration tests the sands range from loose to medium density and the silts range from soft to medium consistency. Throughout the project reach there is evidence of surface erosion, sloughing, and settlement on the embankments. Areas where irrigation pumps where installed through the embankments have experienced significant waterside and landside erosion. The toe of the waterside slope terminates along a berm in portions of the project reach. The near surface (0 - 4 feet)

soil consists primarily of silt with sand and silty sand and is typically loose. The landside toe of the embankment typically has both lined and unlined irrigation ditches running parallel to it.

3-02. Embankment Slopes and Stability. The proposed work affecting the levee stability consists of removing the false bamboo and the sediment accumulated along the waterside slope and berms. For the planned removal two conditions were investigated: (1) slopes with no berms, and (2) slopes with berms. For condition (1), the embankment waterside slope surface material was sampled and found to be primarily silty sand and sandy silt. For this type of soil with no vegetative cover, erosion will develop when the river velocities exceed 2 feet per second (fps). Where the removal of bamboo results in unprotected waterside slopes steeper than 3H on 1V, the slope should be reconstructed no steeper than to 3H on 1V. This also applies to existing unprotected slopes that are steeper than 3H on 1V. In areas where slope protection is used, the slope should not be steeper than 2.5H on 1V. For condition (2), where bamboo or sediment removal occurs along the slopes, the recommendations indicated for condition (1) should be followed. For removal along the berm, where the berm width exceeds 15 feet, it would be desirable to maintain at least a 15-foot berm to prevent removal of levee toe support and assure levee stability. The recommended excavation slope along the berm and in the channel is 2.5H on 1V. Berms less than 15 feet that have bamboo removal should be hydraulically evaluated for erosion potential to insure that the levee toe support is maintained. PLATE 3-1 presents the stability analysis upon which the sediment removal recommendation along berms is based. Although the minimum factor of safety (F.S.=1.3) is adequate, it is possible that localized minor sloughing may occur during a postulated worst case sudden drawdown condition. This is primarily due to the lack of cohesion in the soil. Landside slope stability was not analyzed, because landside improvements are outside of the project scope. Where fine grained soils are presently providing a riverward blanket, removal may result in an increase in landside seepage, mainly in the ditches, during high river stages.

3-03. Bank Protection. Reaches requiring bank protection such as matting, netting, and stone protection will be evaluated through hydraulic analysis utilizing soil information. If the selected method of slope protection consists of riprap, a bedding layer or geotextile filter fabric would be required to prevent the cohesionless fines and sands from migrating through the stone protection. Excavation for toe trenches for riprapping along slopes shall be at a slope not steeper than 2.5H on 1V. Unless

otherwise required for scour protection, the depth should not be greater than 4 feet to guard against toe instability during construction.

3-04. Sediment Disposal. Except for highly organic soil (i.e. OH, OL), sediment removed from the river and berms can be disposed of along the landside toe to form a berm. The berms shall not be closer than 6 feet from top of ditch edge and have side slopes not greater than 2.5H on 1V. The recommended maximum height of berm fill shall not exceed 8 feet. This height can be exceeded provided that the side slopes are not steeper than 3H on 1V. The berm size and location limits are shown on PLATE 3-2. The soil loose lifts should not exceed 8 inches and compacted to a minimum of 90 percent of ASTM D 698 maximum density.

4. SAN JOAQUIN RIVER - OLD RIVER TO MERCED RIVER.

4-01. Site Conditions. Reference c. describes the foundation soils of the project reach as alluvial deposits consisting primarily of fine sands, silts, and clays of varying thicknesses from a few inches to as much as 5 or 6 feet. The soils have slight cementation and are able to stand in near-vertical slopes where exposed in river bank cuts. The embankment material consists primarily of silt, sand, and fine gravel in levees close to the river channel. The embankment material for levees farther away from the river channel consists primarily of silt, sand, and clay. Levee slopes vary from 1H on 1V to 3H on 1V for both the landside and waterside. The sediment accumulated in the river channel consist of silts, sand, and fine gravel. Some portions of the project reach have experienced severe erosion along the waterside slope resulting in near-vertical faces. Other portions of the project reach have been reported to experience landside seepage along the levees during high river stages. Recent levee failures were reported to be caused by bank erosion and piping.

4-02. Sediment Removal. The planned removal of sediment for this project reach is of sufficient distance (over 30 feet) from the toe of the levees and will not impact stability. Where sediment removal is close to the levee, there may be an increase in seepage during high river stages where fine grained soils are presently providing a riverward blanket. Slopes excavated no steeper than 2.5H on 1V is considered adequate for stability.

4-03. Sediment Disposal. The disposal of excavated sediment that contains no organics can be placed along the landside levee toe to form a berm. The berm should not be placed in close proximity to any ditches or any cut slopes. For this reason, berm

location and limits shown on PLATE 3-1 should only be used for ditches or slopes less than 5 feet deep. Berms located near ditches or slopes that are deeper than 5 feet should be located at a minimum distance of 1.5 times the depth of the ditch or cut slope. The fill should have loose lifts not to exceed 8 inches and compacted to a minimum of 90 percent of ASTM D 698 maximum density.

5. MENDOTA POOL.

5-01. General. The dredge disposal dike design was based on site reconnaissance, nearby water well information, and soil survey maps (reference d.). Information from the site reconnaissance consisted of sampling surface material (0 to 3 feet) and performing in-situ shear tests using a portable torvane to estimate shear strength. Selected samples were laboratory tested for moisture, Atterberg limits, and gradation. The dike embankment was designed and analyzed with respect to slope stability. The approximate disposal dike location is shown on PLATE 5-1. The data used in the dredge excavation slope was obtained from soil samples taken in the pool by the Hydraulic Section.

5-02. Foundation Conditions. The foundation soils consist of highly plastic clays near the upper surface and underlying alluvium consisting of sand and gravel and layers of sand and gravel mixed with clay. The near surface material tested had shear strengths ranging from 188 to 270 pounds per square foot (psf). The upper 1 foot of the clay contains some organics such as small roots which is indicative of the previous agricultural use of the soil. The depth to groundwater is unknown. During the exploration, water was not encountered in the upper 3 feet. An existing sanitary landfill just north of the dredge disposal site has monitoring wells which could indicate possible high ground water conditions.

5-03. Dike Design. The proposed dike height of 9 feet was determined based on the volume of dredged material, containment area limits, and water quality considerations. The conditions typically analyzed for stability are (1) end of construction, (2) steady seepage, and (3) sudden drawdown. The dike embankment material borrowed from the site will be clay. Consequently the low permeability of this material and the low pool height (less than 3 feet) will not be significantly affected by the sudden drawdown condition. Steady seepage is not likely to develop due to the low permeability of the clay and the relatively short duration of the dredge operation. For steady seepage and sudden drawdown conditions, would have dredged material on the waterside (interior of the containment site) provides a stabilizing effect.

The most critical condition is therefore the end of construction. Based on information from the field sampling and testing, shear strengths were adopted and unit weights were estimated. Since the proposed embankment is only 9 feet high, the increase in vertical stress due to the embankment decreases significantly below 20 feet. This limits the depth of the potential failure surfaces. The dike analyzed was 9 feet high with a 10-foot crown and side slopes 1V on 2H for both landside and waterside slopes (See PLATE 5-2). The stability analysis resulted in a minimum factor of safety of 1.2, which is acceptable for temporary embankments in low populated areas. Because of the relatively weak foundation soils in this area, 10-foot high dikes are considered to be the maximum height that can be constructed in any one year. Stage construction would be necessary for any increased heights.

5-04. Construction Considerations. Site preparation for the surface of the borrow and foundation area should include clearing and stripping of 12 inches to remove the uppermost organic material. Excavation for the borrow materials should be no closer than 20 feet from the toe of the dikes. The borrow excavation depth is limited to the location of the groundwater. Drainage of the borrow area may be needed to achieve satisfactory moisture for the material. To provide a stable dike, the embankment must be placed on the stripped foundation surface. The embankment must be compacted to increase the shear strength and should have an average compacted density of at least 95% of ASTM D 698 maximum density. For estimating purposes, an 8-inch loose lift compacted with 6 passes of a tamping roller should be used. The dike embankment should not be within 20 feet of the toe of the existing levee along the Kings River North.

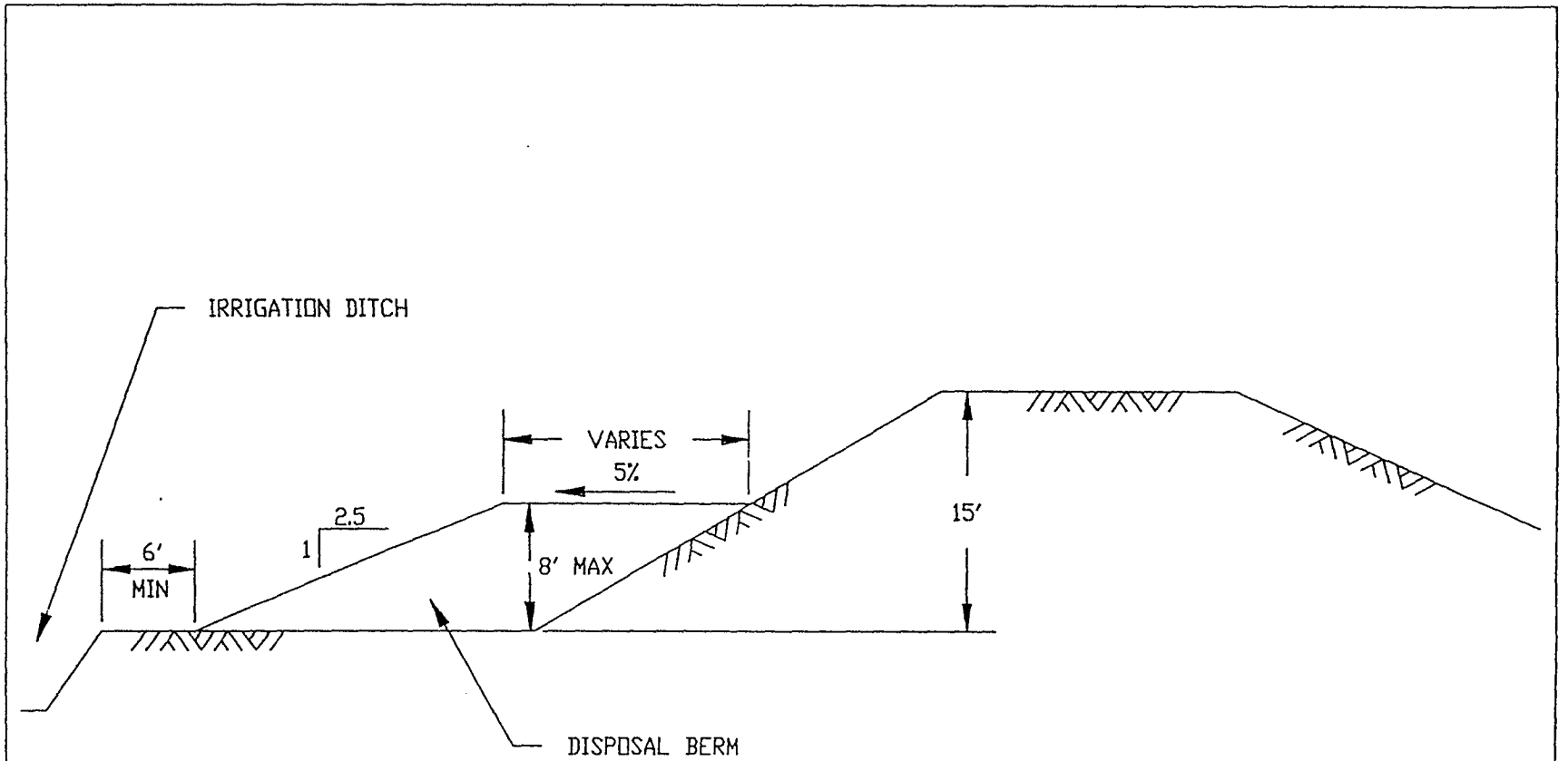
5-05. Dredge Excavation. The planned excavation is be performed by hydraulic suction dredges. For this type of dredging, a vertical or box cut, or sloped cut can be utilized. Vertical or box cuts would require making the required width of excavation larger by a distance equal to the depth of excavation. Based on soil samples taken in the pool, the sloped dredge excavation should not exceed a 2H on 1V for depths up to 10 feet.

6. KINGS RIVER NORTH.

6-01. Site Conditions. River channel material in the project reach consists primarily of sand and silt. The soil in some areas has slight cementation. The sediment deposited in the river channel bottom is primarily sand. The channel banks have been eroded in some locations and are cut to vertical faces up to 5 feet high. Portions of the reach have eroded to the extent where stability of the left embankment is being effected.

6-02. Sediment Removal. The planned sediment removal is primarily along the bottom and right sides of the river channel. The right side of the river channel has primarily setback levees (over 100 feet away) and sections of no levees. Consequently, removal of sediment along the right side should not impact on the left side levees. Any deepening along the bottom of the channel should be limited to 6 feet in order not to impact on levee toe stability. The recommended slope excavation should not be steeper than 2.5H on 1V. Deepening along levee toes where the berms have been eroded to less than 15 feet should be avoided. If deepening is necessary in these areas, integrity of the berms must be insured by placement of bank protection.

6-03. Sediment Disposal. The sediment removed can be place along the landside toe to form a berm. Berms should be located not less than 6 feet from the edges of ditches or cut slopes less than 5 feet deep. Berms located near ditches or slopes that are deeper than 5 feet should be located at a minimum distance of 1.5 times the depth of the ditch or cut slope. The soil should be compacted to insure stability to a minimum of 90 percent of ASTM D 698 maximum density.



SCALE: 1' = 10'

NOTE:

1. MAXIMUM BERM HEIGHT MAY BE EXCEEDED PROVIDED THAT THE SIDE SLOPE IS 3H:1V.

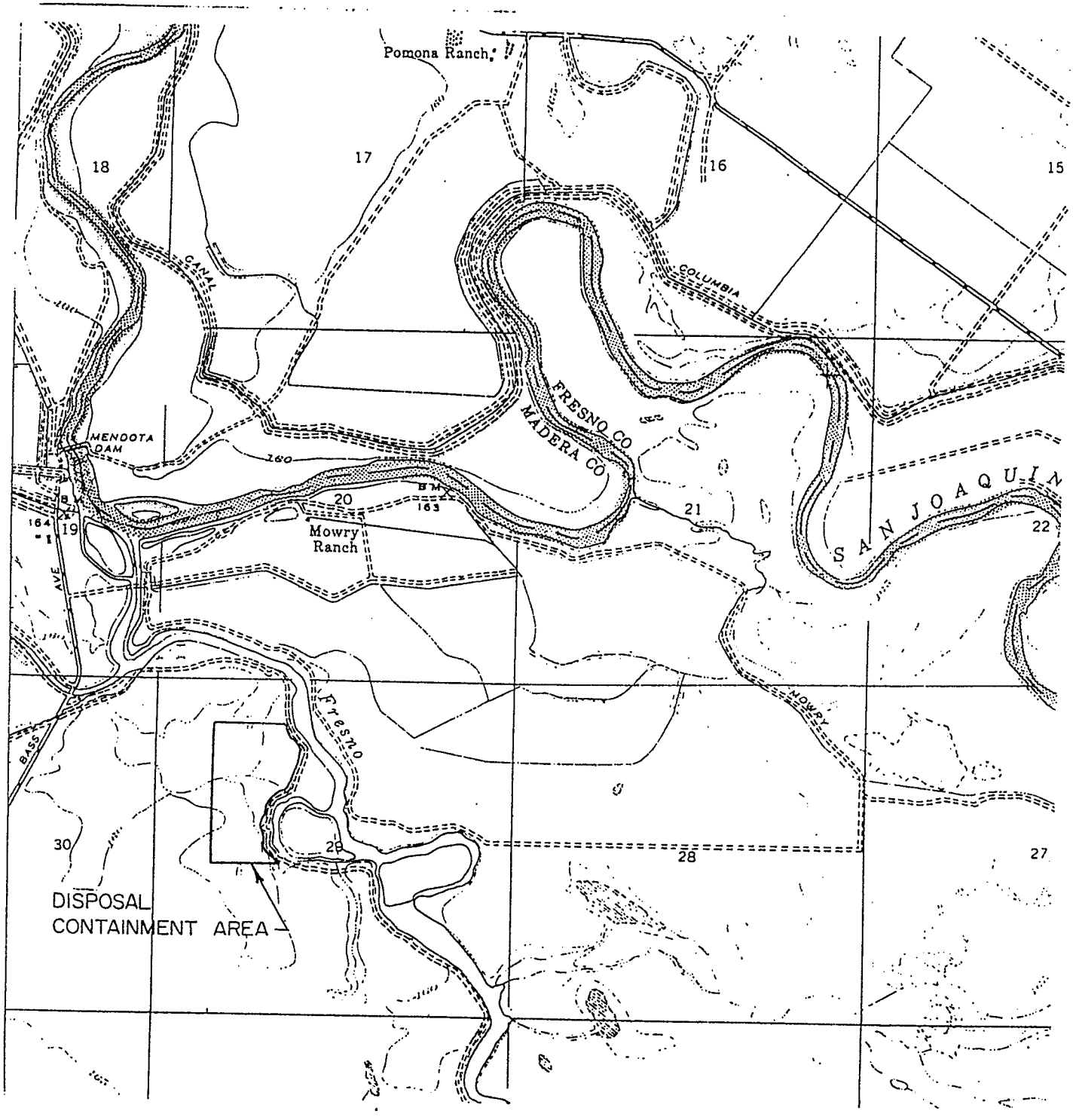
SAN JOAQUIN COUNTY CALIFORNIA

LOWER SAN JOAQUIN RIVER CLEARING AND SNAGGING

DISPOSAL BERM
MIDDLE RIVER

U.S. ARMY ENGINEER DIST., SACRAMENTO
GEOTECHNICAL BRANCH - SOIL DESIGN SECTION
JANUARY 1989

PLATE 3-2



APPROXIMATE LOCATION OF DREDGE DISPOSAL SITE

SCALE: 1" = 200'

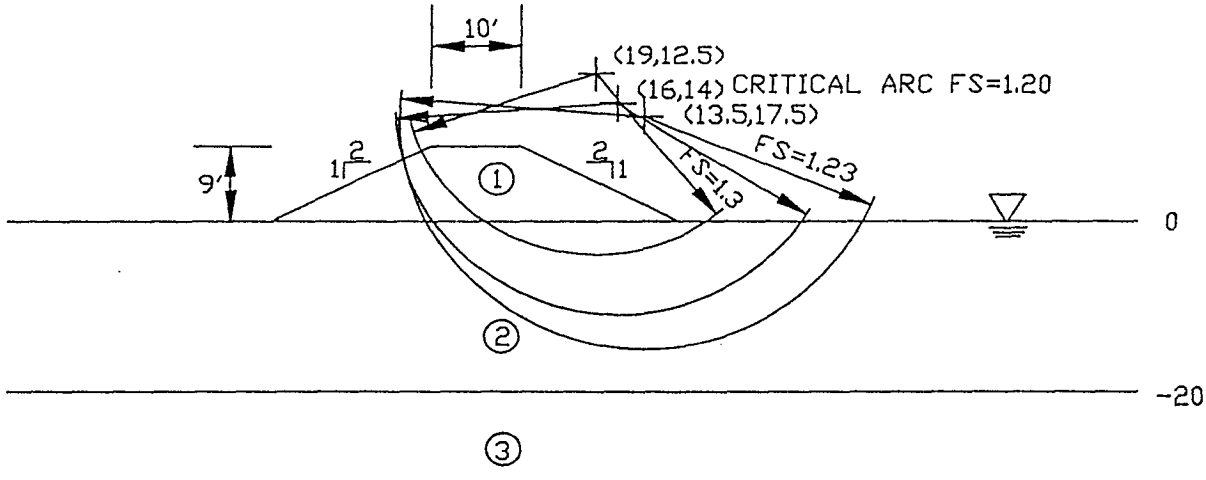
PLATE 5-1

D—030624

D-030624

ADOPTED DESIGN PARAMETERS

MATERIAL	UNIT WEIGHTS (pcf)		UNCONSOLIDATTED UNDRAINED SHEAR STRENGTH	
	MOIST	SATURATED	ø , (deg.)	c , (psf)
① Embankment Clay	100	–	–	200
② Foundation Clay	–	90	–	180
③ Foundation Sand & Gravel	–	115	0	30



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NOTE:

1. Circular arc slope stability analysis using the Simplified Bishop Procedure was performed by computer analysis utilizing the UTEXAS2 Slope Stability Program, U.S. Army Corps of Engineers, Waterways Experiment Station.

SCALE: 1" = 20'

FRESNO COUNTY CALIFORNIA

LOWER SAN JOAQUIN RIVER CLEARING AND SNAGGING

SLOPE STABILITY ANALYSIS

END OF CONSTRUCTION

MENDOTA POOL DREDGE CONTAINMENT DIKES

U.S. ARMY ENGINEER DIST., SACRAMENTO

GEOTECHNICAL BRANCH - SOIL DESIGN SECTION

PLATE 5-2

D-030625

HYDRAULIC ANALYSIS

Table of Contents

TABLES

PLATES

EXHIBIT 3

CHAPTER I - INTRODUCTION

Introduction. - This appendix describes the methods, assumptions, and limitations of a preliminary hydraulic analysis to describe the effects of the Lower San Joaquin River and Tributaries Project for snagging and clearing.

A link-node hydrodynamic computer model was used for the analysis of potential work in the Middle River. The Middle River is part of the Sacramento-San Joaquin Delta network, an interconnected system of channels subject to tidal influences. The link node hydrodynamic model was chosen since it allows the effects of tides and changes in the flow distribution between the channels to be analyzed. The model describes the Sacramento-San Joaquin Delta network as a number of nodes, (discrete volume units of water body) connected by links (channels which carry flow between nodes). The model operates by solving the basic equations of continuity and motion for each node and channel at discrete steps in time. The result is a simulation of the flows and stages through out the system at discrete time intervals for a tidal cycle.

The remainder of the hydraulic analysis was performed using the Corps of Engineers HEC-2 Computer model. This model determines the water surface profile in a natural channel using the standard step method. The model was chosen since the rest of the San Joaquin River is outside tidal influences and the water surface profile is controlled by backwater effects.

All reasonable efforts were made to make the analysis as accurate as possible using the available data. The purpose of these hydraulic analyses was to define the relationship between the potential lowering of the water surface stage by various channel measures. The analysis were not performed to determine absolute water surface elevations. Given this study goal the results of the hydraulic analysis were considered acceptable as a preliminary analysis only. Additional data is presently being collected to perform a thorough analysis based on present conditions.

CHAPTER II - MIDDLE RIVER

(Old River to 2 Miles downstream of Howard Road)

The hydraulic analysis of potential work in the Middle River was performed using a hydrodynamic link-node model of the San Francisco Bay Region. This model was chosen to account for tidal effects and flow distribution changes, both important in the Middle River analysis.

The Sacramento District hydrodynamic model of the San Francisco Bay and Delta was used to accomplish the analysis. Channel cross-section data along the Middle River obtained in February 1984 was used to modify the existing model. New cross-section data is being obtained and will be utilized to more accurately represent existing conditions in the Middle River compared to 1984. Tidal data and flow rates of rivers which empty into the San Francisco Bay were chosen to represent "typical" spring conditions when the flow in the San Joaquin River is usually near the desired flow of 17,200 cfs at Vernalis. The model was calibrated and run to establish the baseline conditions.

The plans analyzed were:

Plan 1 - Remove the bamboo only.

Plan 2 - Open constricted channel reaches to mean channel area except do not disturb riparian vegetation on the east bank.

Plan 3 - Open channel to mean channel area at all constricted reaches and throughout the entire reach of Middle River.

Plan 4 - Open channel to the largest cross-section possible without disturbing the existing levees (90 feet wide at elevation 0.0).

Plan 5 - Open channel to mean channel area except leave first 1 mile downstream of bifurcation with Old River in existing condition.

Plan 6 - Open first mile downstream of bifurcation with Old River to 90 feet wide at elevation 0.0.

The effect of removing the bamboo was analyzed by changing the roughness coefficient along Middle River from 0.045 to 0.030. The effect of sediment removal was evaluated by enlarging channel cross-section for each plan and computing the appropriate geometric parameters to represent the modified channel. The sediment will only be removed down to the normal summer low water stage (2 ft.) without going in the water.

In general, the model runs show that decreasing the hydraulic resistance to flow along the Middle River would result in:

- Little or no change in stage in the San Joaquin River.

- A general decrease in stage in the southern most or project reach of the Middle River.

- An increase in stage in the northern most or unmodified portion of the Middle River.

- An increase in flow through Middle River which affects the flow distribution throughout a number of South Delta Channels.

- A decrease in stage along the Old River.

Specific results of the analysis for each project are summarized in Tables A and B. Table A is a summary of with and without project stages at selected points throughout the South Delta. Table B is a similar summary except for flows in selected channels. Plate B-1 shows the locations of these points and channels as well as the direction of flow in the channel.

The analysis shows that opening up the Middle River results in a lowering of the water surface primarily along Old River and a general increase in water surface along Middle River with the largest increase in those effects associated with the largest amount of clearing. Middle River flows in a northwesterly direction from the bifurcation with Old River. Referring to Table A, both Plan 2 and Plan 5 would produce a greater lowering of the water surface in Middle River than Plan 3 and Plan 4 with less excavation. On the other hand, the decrease in water surface lowering

along Old River would be less. When Middle River is opened, as in Plans 3 or 4, the flow is significantly increased. Since the downstream reach of the channel would not be modified under any of the plans as the flow rate is increased, the water surface stage would be higher than under without-project conditions. This higher downstream stage results in a backwater effect which would increase stages along the modified section of the river.

Under Plans 2 and 5 the reach of Middle River about 1 mile downstream of the bifurcation with Old River would be left constricted compared to the remaining 6 miles of project reach. This portion of the reach would act like a value limiting the flow into Middle River. The limited increase in flows under these plans would reduce the downstream stages in the unmodified channels and reduce the backwater effect.

Plan 3 and 4 would produce the greatest lowering of stage at the mouth of the Middle River and along the Old River. These two plans would also result in the greatest increase in flows carried by the Middle River and increase in stage along the Middle River.

Plan 2 was chosen for inclusion in the proposed Project Modification. Although Plan 3 appears to be the best method to lower stages in Old River, Plan 2 was selected because it provided a lesser impact on native vegetation. Plan 2 will lower stages in Old River and in most of the reach in Middle River. Plan 2 assumes that any Middle River cross-section

constricted to less than the mean cross-sectional area along the river would be opened to equal the mean cross-sectional area, except for the first one mile downstream from the bifurcation with Old River. The mean cross-section area was computed as 540 square feet from the existing channel cross-sections. The cross-sections with less than 540 square feet of area were all in the first 3 miles from the bifurcation with Old River. Plate B-2 shows the with and without project water surface profiles along Old and Middle Rivers.

The estimated extent of channel modifications was derived considering the following guidelines:

- Historical data shows that elevation of the thalweg of the Middle River has remained relatively constant since the 1930's. The bottom of excavation was set at the waters normal summer low stage (2 ft.).

- Most of the riparian vegetation along the Middle River is on the right bank. Excavation would be from the left bank to avoid impacts on native vegetation as much as possible.

- Trapezoidal excavation with 1V on 2.5H side slopes.

The with-project geometric model parameters were computed from the modified cross-sections and used in the hydraulic analysis. Volume of material to be removed was estimated using the average end area method.

Referring to Tables 1 and 2, Plan 2 results, with flows in San Joaquin River at Vernalis of about 17,200 cfs, in an approximate 0.1 foot reduction in stage at the Old and Middle River bifurcation. Flows in the Middle River would be increased from 720 cfs to 934 cfs, an increase of about 25 percent. The stage will decrease for about 5 to 6 miles downstream and then taper off to zero. This reduction would be between 0.2 and 0.5 feet. Further downstream the stage would increase about 0.1 foot for about three miles. The plan would cause an estimated 0.1 to 0.2 foot stage decrease along the Old River from the San Joaquin River to Salmon Slough and a stage decrease of about 0.1 foot or less in the San Joaquin River.

CHAPTER III - SAN JOAQUIN RIVER:

(OLD RIVER TO MERCED RIVER)

The hydraulic analysis along San Joaquin River from Old River to Merced River was performed using the HEC-2 computer model.

During January 1985, flows in the San Joaquin River through this reach were at or near the design level of 17,000 cfs at Vernalis. While the flows were in this range high water marks were taken and channel cross-sections obtained at approximately 0.5 mile intervals. The HEC-2 model was built and calibrated to this data. Flows used in the model were 15,700 cfs from Mossdale to Paradise Cut, 17,200 cfs from Paradise Cut to Stanislaus River, 13,200 cfs from Stanislaus to Toulumne Rivers and 8,100 cfs from Toulumne to Merced Rivers.

The potential project works in this reach have been limited primarily to sand or point bar removal at pertinent locations. The selection of sand bars for removal were chosen based on the potential to reduce, (1) erosion primarily on the opposite bank of the river in the river bends, (2) the upstream water stage and (3) the velocity in the river bends.

Constricted reaches were identified by using the HEC-2 model to compute the energy slope at each cross-section for the measured water surface

profile. The accumulated energy slope at the cross-sections were then plotted. Constricted reaches were identified by evaluation of changes in the slope of this plot. A steep portion of the plot was assumed to be located downstream of a constricted reach and a flat portion to be upstream of a constricted reach.

The number of locations of potential point bar removal (32) precluded a detailed analysis of each site. A point bar at river mile 60.0 with a measured cross-section through it was chosen to analyze the probable impact on the local river hydraulics of its removal. The hydraulic effect of removal of these point bars was evaluated by assigning dummy cross-sections at the upstream and downstream limits of potential work and running the model. The cross-section through the point bar was then modified to reflect the potential changes and the model executed. The flow rate and downstream water surface elevation from the measured profile were used for the analysis.

The analysis indicates that at flows of 8,100 to 13,000, point bar removal would typically yield about a 0.1 - 0.3 foot reduction in water surface stage upstream of the removal site decreasing to zero within 2 or 3 miles. Plate B-3 shows with and without-project water surface profiles for typical point and sand bar removal. The magnitude of the stage decrease would be somewhat proportional to the flow rate. That is, at higher flows, but still with the majority of flow within the low flow channel, the impact would likely be a larger stage decrease (about 0.5 ft.). The analysis also showed that the flow velocity at the point bar sites would decrease by about

20 percent for flow rates in the 10,000 to 25,000 cfs range recorded at the gaging station approximately 5 miles upstream from the confluence of the Stanislaus and the San Joaquin River near Vernalis. This reduction would have a tendency to reduce local erosion. The point bar removal may also decrease the cross channel flows caused by meanders which also may reduce erosion. New channel data is being collected to analysis this reduction in cross channel flow and its effects on erosion on the opposite bank. A further analysis on sediment transport will also be conducted to look at the effects of sand bar removals on upstream and downstream reaches and emphasize the importance of an active maintenance program within this reach.

CHAPTER IV -SAN JOAQUIN RIVER: MENDOTA POOL

A preliminary hydraulic analysis of potential work in Mendota Pool area was performed using the HEC-2 computer model.

There were no recent cross-section data available for Mendota Pool and San Joaquin River in this reach; however stereo aerial photography (1" = 500') taken during a very low flow condition were used to estimate general river bottom conditions. Since the flow through the pool would have been very low at that time, the pool surface in the photography was assumed flat and assigned an elevation of +100 feet. The assumptions made within this analysis will not be used for a final basis of work in this reach due to lack of data. Cross-sections have been taken of the Pool area and additional cross-sections for upstream reaches are being taken (Kings River North and The San Joaquin River from the Pool to Gravelly Ford) and an analysis will be performed to address the effects of clearing the pool.

The cross-section geometry above the water surface was developed from these photographs using photogrammetric methods. An initial estimate of the under water channel configuration was made to complete the cross-section. Observed water surface profiles from Mendota Dam upstream along both the Kings and San Joaquin River at near design flows of 7500 cfs were used with the HEC-2 program to compute the roughness coefficients required to

reproduce the measured water surface profile with the initial cross-section data. The under water channel cross-section along the northern arm of the Kings River North and the westerly end of the San Joaquin River was then adjusted until the computed roughness coefficients appeared to reasonably represent what could be expected in the both reaches (channel 0.03-0.04, overbank 0.04-0.07). These final roughness coefficients were then put into the HEC-2 model and new water surface profiles computed. This was considered the baseline or the without-project condition. All plans were then evaluated and compared to this without-project condition.

Mendota Pool is primarily used for gravity diversion into irrigation canals, therefore the pool elevation is held constant at 154 ft.- 155 ft. during most of the year (January through November) regardless of the inflow rates of the San Joaquin and Kings River North. The downstream water surface elevation under design flows was assumed to be near the same elevation as shown in the aerial photographs. A dummy cross-section was put into the model to represent Mendota Dam as an overflow weir with a water surface elevation of 155.5 feet. An HEC-2 model was also built for the Mendota Pool-Kings River North reach using the same techniques. Flows used in the analysis were design flows of 8,500 cfs in the San Joaquin River, 5,000 cfs in the Kings River North and 7,500 cfs through Mendota Pool.

Six plans were analyzed with the HEC-2 model using the channel improvement option to compute the new water surface profiles and quantities of excavated material. The plans consisted of various widths of channel clearing in Mendota Pool and the San Joaquin River and are based on a

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trapezoidal excavation with 1V on 2.5H side slopes. The invert elevation of excavation was set as the estimated bottom of the low flow channel near Mendota Dam. The upstream bottom elevation was chosen at 10 feet below the still water surface. At interim locations, the depth was extrapolated between the upstream and downstream depths. The bottom widths considered are as following tabulation:

Plan	Downstream End Width (ft)	Upstream End Width(ft) SJR	Kings River North
1	350	100	150
2	300	100	150
3	300	300	100
4	250	75	100
5	200	70	70
6	375	0	0

Upstream limits of work along both rivers were determined by trial and error based on a goal of excavating between about 150,000 and 200,000 cys of sediment.

The results of the analysis indicate there would be very little difference in the water surface reduction between the plans studied. Each plan would result in a minor (0.1 foot) increase in stage immediately upstream of Mendota Dam and a 0.5-0.6 foot reduction in stage further upstream. This stage reduction would extend upstream Of Mendota Pool tapering off to zero in about 3.5 miles along San Joaquin River and about 3 miles along Kings River North.

Plan 5 was the selected plan for inclusion in the proposed Project modification due to the opportunity to extend the work farther upstream and still effect a significant reduction in water surface. Plates B-4 and B-5 shows the estimated with and without project water surface profiles along the San Joaquin River and Kings River North, respectively, at the flow rates previously mentioned. The work would involve removing 170,000 cys of sediment from a 200 X 900 and 70 X 600 foot channel from behind Mendota Dam upstream into the main body of the pool. Sediment would also be removed from about a 70 foot wide channel for an additional 1,500 feet into the San Joaquin River arm and 2,000 feet into the Kings River North arm.

CHAPTER V -SAN JOAQUIN RIVER: GRAVELLY FORD TO FRIANT DAM

The hydraulic analysis of potential work in the reach was performed using the HEC-2 computer program.

Cross-section data for this reach was obtained by photogrammetric methods from aerial photography. For the scale of photographs used (1" = 1,660 feet) this method yielded relative vertical accuracy of about 0.7 feet. The vertical control was obtained from U.S.G.S. 7-1/2 minute topographic quadrangle maps. This means that the error between any 2 elevations within a cross-section was less than about 0.7 feet but that the error in absolute elevations could be significantly larger. Since the cross-section data was to be used in a computer model to define changes in water surface stage and not absolute water elevations the data was assumed acceptable. Four field cross-sections were collected by the California Department of Water Resources. These cross-sections tended to confirm those used in the computer model.

Manning's roughness coefficients used on the model were estimated as 0.06 for over bank (dense growth of willow saplings and brush) and 0.03 for the channel (sand channel). A flow rate of 8,000 cfs was used in the analysis as this is the objective maximum flood control release from Friant Dam. The downstream boundary water surface elevation was determined by trial and error until the profile appeared reasonable.

Four plans were analyzed with the computer model, as described below.

- Plan 1 - Clear restrictive vegetation from a width of about 200 feet along the low flow channel.

- Plan 2 - Clear restrictive vegetation as above and remove encroaching embankments.

- Plan 3 - Clear restrictive vegetation, 200 foot width in the low flow channel and remove some restrictive sediment.

- Plan 4 - Clear restrictive vegetation for a width of about 400 feet along the low flow channel and remove encroaching embankments.

Actual site visits were taken to determine locations where vegetation and sediment deposits appeared to restrict the river flow through the channel. The effect of removing sediment deposits and levees associated with quarry operations, were analyzed by modifying the cross-section data to reflect the changes. The effect of vegetation removal was analyzed by changing the Manning's "n" value.

The results of the analysis are summarized as follows:

Plan	:	Mean Stage Reduction (ft)
1		0.4
2		0.4
3		1.4
4		0.4

In the lower section of this reach between Gravelly Ford and Highway 99 Plan 3 would provide a substantial decrease in stage over the other plans but would require a significant amount of sediment removal. The other plans would provide the same amount of stage reduction resulting in very little difference in impact between them.

In the upper section of this reach from Highway 99 to Friant Dam Plan 1 would result in a stage decrease of 0.2 to 0.3 feet due to limited amount of vegetation removal as compared to the downstream section (see DM). Plan 2 would result in a stage decrease of 0.2 to 0.5 feet. Aerial photographs taken of this section at a flow rate of 10,000 cfs show that the levee does

extend into the river and ponding upstream of the encroaching portion of the levee is visible.

Plan 1 was selected for inclusion in the proposed project. The Plan involves removing restrictive vegetation from selected sites in the channel only. Plate B-6 shows the estimated with and without project water surface profile for this reach of river. The plan would result in an estimated mean water surface stage decrease of 0.4 feet. This stage reduction would have a minor impact on reducing flooding near design flows of 7,000 and 8,000 cfs (release from Friant Dam). This 0.4 foot computed surface stage decrease is, however, not conclusive as the computed value is significantly smaller than the 0.7 foot margin of error.

Table A

Stage at selected points in the South Delta

LOCATION	NODE #	Base	Plan 1		Plan 2		Plan 3		Plan 4		Plan 5		Plan 6	
		Stage (ft)	Stage (ft)	Change (ft)	Stage (ft)	Change (ft)	Stage (ft)	Change (ft)	Stage (ft)	Change (ft)	Stage (ft)	Change (ft)	Stage (ft)	Change (ft)
Middle River @ Victoria Canal	142.00	1.64	1.65	0.01	1.65	0.01	1.65	0.01	1.66	0.02	1.65	0.01	1.65	0.01
Middle River @ Inland Canal	64.00	1.97	2.16	0.19	2.14	0.17	2.26	0.29	2.74	0.77	2.09	0.12	2.14	0.17
	65.00	2.17	2.36	0.19	2.28	0.11	2.44	0.27	3.07	0.90	2.22	0.05	2.28	0.11
Middle River @ Howard Road	66.00	3.36	3.38	0.02	3.20	-0.16	3.49	0.13	4.42	1.06	3.10	-0.26	3.20	-0.16
	67.00	3.83	3.81	-0.02	3.59	-0.24	3.94	0.11	4.90	1.07	3.45	-0.38	3.59	-0.24
Middle River @ Undine Road	68.00	4.75	4.68	-0.07	4.22	-0.53	4.68	-0.07	5.21	0.46	4.04	-0.71	4.22	-0.53
	69.00	5.23	5.13	-0.10	4.73	-0.50	5.27	0.04	5.45	0.22	4.52	-0.71	4.73	-0.50
Middle @ Old River	70.00	6.13	6.00	-0.13	6.02	-0.11	5.94	-0.19	5.66	-0.47	6.05	-0.08	6.02	-0.11
Old River @ San Joaquin River	79.00	8.93	8.88	-0.05	8.89	-0.04	8.86	-0.07	8.77	-0.16	8.90	-0.03	8.89	-0.04
Old River @ Salmon Slough	147.00	4.18	4.10	-0.08	4.11	-0.07	4.06	-0.12	3.90	-0.28	4.13	-0.05	4.11	-0.07
SJR @ I-5 Crossing	202.00	12.18	12.16	-0.02	12.16	-0.02	12.15	-0.03	12.11	-0.07	12.17	-0.01	12.16	-0.02
SJR @ Banta-Carbona Canal	207.00	16.04	16.03	-0.01	16.03	-0.01	16.03	-0.01	16.01	-0.03	16.04	0.00	16.03	-0.01
SJR @ Vernalis	216.00	23.50	23.50	0.00	23.50	0.00	23.50	0.00	23.49	-0.01	23.50	0.00	23.50	0.00

Table B

Flows in selected South Delta Channels

CHANNEL	CHAN #	Base	Plan 1		Plan 2		Plan 3		Plan 4		Plan 5		Plan 6	
		Q (ft3/s)	Q (ft3/s)	Change (ft3/s)	Q (ft3/s)	Change (ft3/s)	Q (ft3/s)	Change (ft3/s)	Q (ft3/s)	Change (ft3/s)	Q (ft3/s)	Change (ft3/s)	Q (ft3/s)	Change (ft3/s)
SJR above Paradise Cut	205.00	17192.00	17192.00	0.00	17192.00	0.00	17192.00	0.00	17193.00	1.00	17192.00	0.00	17192.00	0.00
SJR between Paradise Cut&Old River	201.00	15557.00	15557.00	0.00	15557.00	0.00	15557.00	0.00	15558.00	1.00	15557.00	0.00	15557.00	0.00
SJR below Old River	89.00	6670.00	6623.00	-47.00	6630.00	-40.00	6602.00	-68.00	6509.00	-161.00	6641.00	-29.00	6578.00	-92.00
SJR downstream Calaveras River	20.00	6297.00	6251.00	-46.00	6258.00	-39.00	6230.00	-67.00	6139.00	-158.00	6268.00	-29.00	6207.00	-90.00
SJR downstream Turner Cut	19.00	5251.00	5221.00	-30.00	5226.00	-25.00	5207.00	-44.00	5148.00	-103.00	5232.00	-19.00	5192.00	-59.00
Old River above Middle River	80.00	8847.00	8895.00	48.00	8888.00	41.00	8917.00	70.00	9010.00	163.00	8877.00	30.00	8940.00	93.00
Old River below Middle River	189.00	8097.00	7896.00	-201.00	7925.00	-172.00	7802.00	-295.00	7381.00	-716.00	7971.00	-126.00	7698.00	-399.00
Old River below Salmon Slough	182.00	2440.00	2381.00	-59.00	2390.00	-50.00	2354.00	-86.00	2233.00	-207.00	2403.00	-37.00	2324.00	-116.00
Old River below Italian Slough	178.00	3949.00	3882.00	-67.00	3891.00	-58.00	3852.00	-97.00	3718.00	-231.00	3905.00	-44.00	3819.00	-130.00
Old River below Woodward Canal	175.00	3441.00	3448.00	7.00	3447.00	6.00	3452.00	11.00	3468.00	27.00	3445.00	4.00	3456.00	15.00
Old River below Woodward Island	169.00	3473.00	3488.00	15.00	3486.00	13.00	3496.00	23.00	3525.00	52.00	3482.00	9.00	3503.00	30.00
Middle River below Old River	79.00	721.00	970.00	249.00	934.00	213.00	1086.00	365.00	1600.00	879.00	877.00	156.00	1213.00	492.00
Middle River below Victoria Canal	180.00	2503.00	2617.00	114.00	2600.00	97.00	2669.00	166.00	2900.00	397.00	2574.00	71.00	2727.00	224.00
Middle River below Woodward Canal	176.00	2822.00	2863.00	41.00	2857.00	35.00	2881.00	59.00	2962.00	140.00	2847.00	25.00	2902.00	80.00
Middle River below Woodward Island	168.00	2675.00	2707.00	32.00	2702.00	27.00	2723.00	48.00	2790.00	115.00	2694.00	19.00	2740.00	65.00
Middle River below Empire Cut	164.00	2628.00	2650.00	22.00	2646.00	18.00	2660.00	32.00	2705.00	77.00	2640.00	12.00	2671.00	43.00
Grant Line Canal	183.00	6829.00	6685.00	-144.00	6706.00	-123.00	6619.00	-210.00	6319.00	-510.00	6739.00	-90.00	6545.00	-284.00
Victoria North Canal	179.00	1956.00	1821.00	-135.00	1842.00	-114.00	1758.00	-198.00	1472.00	-484.00	1873.00	-83.00	1687.00	-269.00
Wo rd Canal	170.00	95.00	103.00	8.00	102.00	7.00	106.00	11.00	120.00	25.00	100.00	5.00	110.00	15.00

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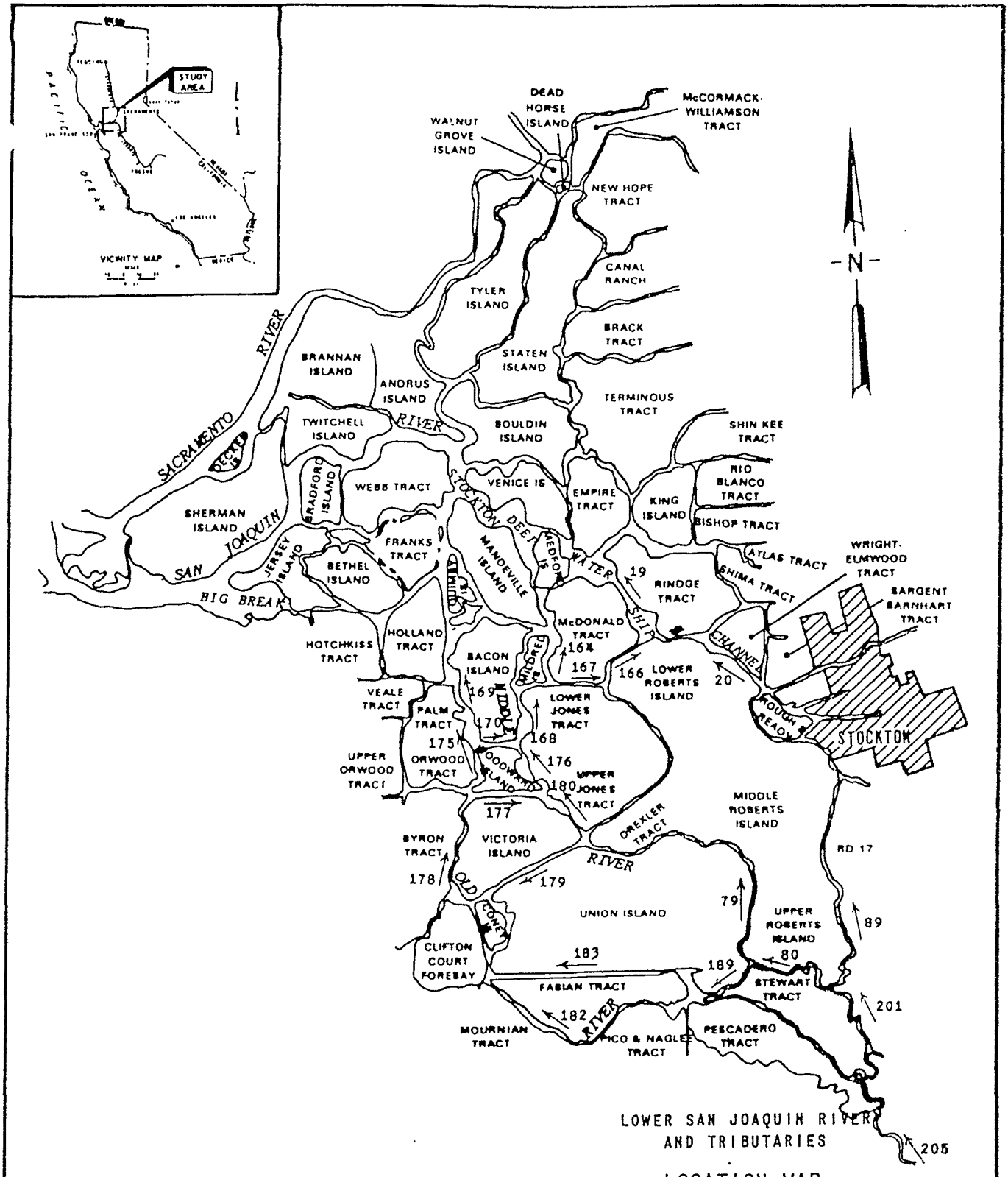

LOWER SAN JOAQUIN RIVER AND TRIBUTARIES

LOCATION MAP CHANNELS AND NODES IN THE SOUTH DELTA

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MAY 1985

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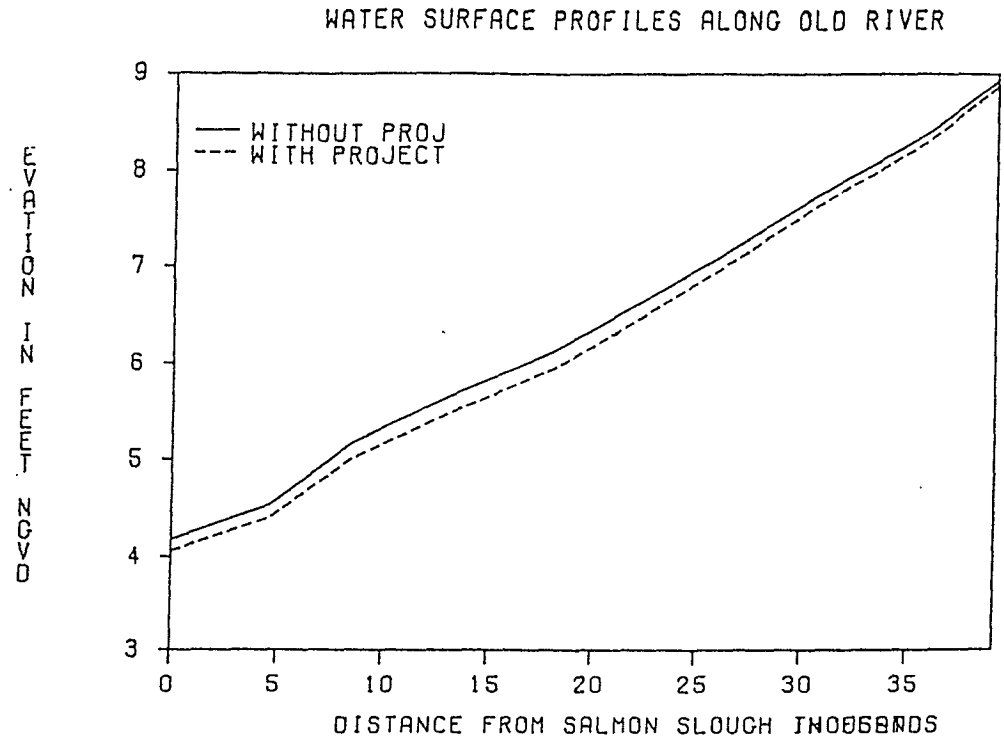
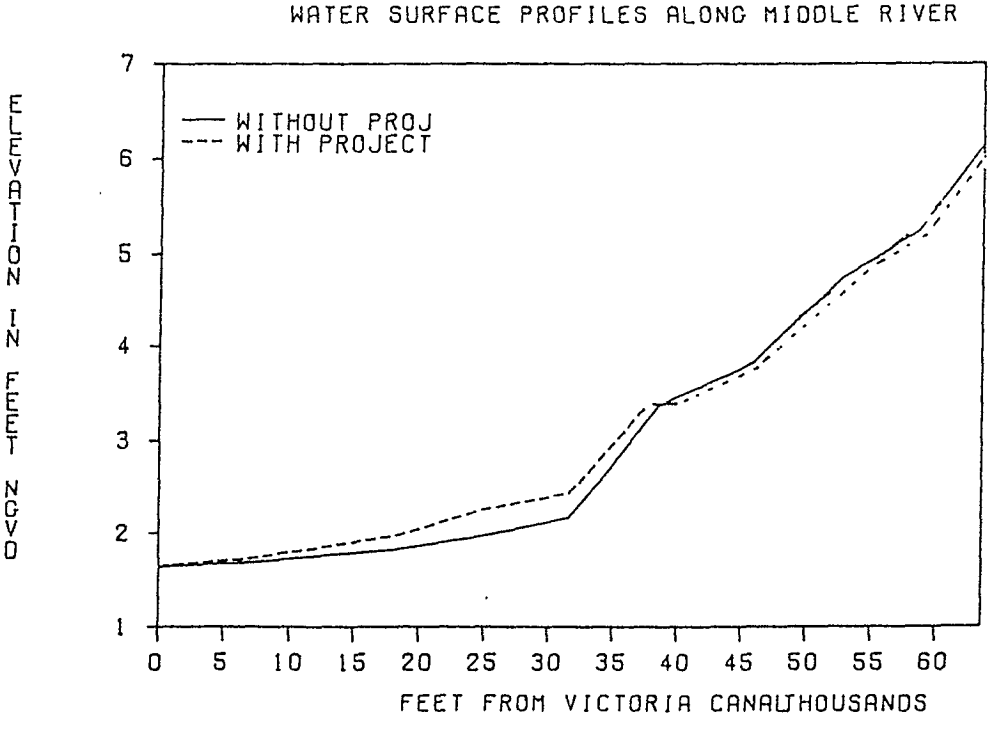
PLATE B-1

D-030647





LOWER SAN JOAQUIN RIVER
AND TRIBUTARIES.

WITH AND WITHOUT PROJECT
WATER SURFACE PROFILES
OLD AND MIDDLE RIVERS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MAY 1985

PLATE B-2

SAN JOAQUIN RIVER PROJECT

Clearing and Snagging

Water Quality & Land Quality Study

INTRODUCTION

1. The following paragraphs tell of work done in 1985, 1986, and to be done in early 1989 to determine how the project will affect water and land quality in the Mendota Pool area and along the San Joaquin River and Middle River. Some of the work, such as that for the Mendota Pool area, is already completed. When all work is completed, a final report will be written and submitted to the Regional Water Quality Control Board, seeking a waste discharge permit.

MENDOTA POOL INVESTIGATION

2. In this phase of the investigation the water and land quality resulting from the removal and subsequent use of the Pool sediment was determined. The design of a dredged material disposal pond whose return effluent would meet receiving water criteria was achieved. Uses to which the sediment could be put were determined. One use under investigation is as a cover for the town of Mendota sanitary landfill.

3. Specifically, the questions to be answered were as follows:

- o What is the background quality of water in the Pool?
- o What is the existing dry-weight concentration of toxic trace elements in the dredged material, and how will these relate to any solid-phase criteria regarding polluted sediments or soils?
- o What will be the dry-weight concentration of toxic trace elements in the dredged material, and how will these relate to any solid-phase criteria regarding polluted sediments or soils?
- o What will be the dry-weight concentration of organic chemicals in the dredged material, and how will these relate to the detectable limits of laboratory instrumentation?

EXHIBIT 4

- What is the horizontal distribution of any toxic trace elements in the sediment throughout the Pool, and what would be the best spatial sequence of dredging if such concentration variations exist?

- What will be the concentrations of toxic trace elements and organic chemicals in any plume stirred up by the dredging action?

- What size of disposal pond should be used such that its effluent will meet water quality criteria after dilution in the Pool?

- What mitigative measures could be done to the disposal pond design or operation in order to achieve a better effluent quality?

- Can the dredged material be used to cover an existing sanitary landfill, or stockpiled on adjacent land or plowed into farm soils, without causing contamination problems in emerging vegetation, in invertebrates, or in rainfall or leachate runoff, over the long-term?

These questions are summarized in the schematic of Figure 1.

4. In order to obtain answers to the above questions, the following tests were run on sediment core and river water samples in 1986:

a. Total acid digests and solvent extractions of sediments, for toxic trace elements and organic chemicals;
b. Standard and modified elutriate tests of sediments and river water, for toxic trace elements and organic chemicals;
c. Column settling tests.

The five sites from within the Pool where sediment cores were taken are shown in Figure 2. Results of the total acid digests for toxic trace elements, showing the total amounts present and how they compare to criteria, are shown in Figure 3.

5. Data from the modified elutriate test and column settling test were used to determine dissolved contaminant concentrations and the sediment-bound fraction of contaminants in the pond effluent returning to the receiving water from different sized ponds, and by this means the pond size needed to achieve receiving water quality criteria was determined. The pond detention time allows much of the incoming sediment load to settle out, thereby also removing much of the sediment-bound fraction of contaminants.

6. The above chemical tests were conducted by a private laboratory that was selected because it had an established quality control program certified by the state of California Department of Health

Services. Data obtained from the above tests were compared to the following criteria or guidelines to determine project effects:

a. Water quality criteria for freshwater aquatic life (EPA, 1986:chronic criteria);
b. EPA criteria for sludge-amended farm soils used for growing edible crops;
c. USDA country-wide median data for uncontaminated farm soils.

7. The answers to the questions posed above, plus the results of the disposal pond design results, are presented below:

- The background toxic trace element concentrations (total) in the Mendota Pool water were either below freshwater aquatic life criteria or below instrumentation detection limits at the time of testing.

- The existing dry-weight concentrations of toxic trace elements in the sediment, including selenium, are either less than concentrations found in average U.S. farm soils by the USDA or than EPA-allowable concentrations in sludge-amended soils used for growing edible crops. (Ten elements tested.)

- The dry-weight concentrations of toxic trace elements in the dredged material will similarly be equal to or less than the concentrations described above, due to partitioning of any contaminants present between the solid and aqueous phases during the dredging operation.

- The dry-weight concentrations of organic chemicals in the dredged material will be less than the detectable limits of laboratory instrumentation, except for the chlorinated herbicide 2,4,5-T. (Forty-six chemicals tested.)

- There is little variation in the horizontal distribution of toxic trace elements within both arms of Mendota Pool, and thus there is no advantage to any special spatial sequence of dredging.

- If a substantial plume of suspended sediment is accidently stirred up by activity within the Pool itself, then dissolved zinc concentrations will exceed freshwater aquatic life criteria in the immediate vicinity of the dredge and the dissolved concentration of the organochlorine pesticide p,p'-DDE will exceed the detectable limit of laboratory instrumentation but still be below criteria.

- A 35-acre pond with a longitudinal baffle or a 70-acre pond without a baffle, both subjected to a 15 CFS dredging rate and a minimum water depth of 2 feet, will produce an effluent that will meet all freshwater aquatic life toxic trace element criteria in the Fresno Slough arm of Mendota Pool after complete mixing occurs between effluent and Slough water

(assumption: Slough flow rate is present at its normal summer southward flow of 330 CFS). (Arsenic, cadmium, chromium, and selenium require no dilution of the effluent; copper, lead, and nickel require some dilution water; and mercury, silver, and zinc require the full Slough flow for dilution.)

The above disposal pond size determinations were obtained using the following conservative assumptions: it was assumed that freshwater aquatic life criteria apply to total concentrations rather than just dissolved concentrations; a pond wind resuspension factor of 1.5 was used; a pond short-circuiting factor of 2.25 was used; and last-day-of-project pond water depth was used in determining hydraulic residence time in the pond for all calculations.

- o Mitigative measures that could be done to the above ponds to reduce the size of mixing zone needed in Fresno Slough would be to allow for a minimum pond water depth greater than 2 feet, or to slow the dredging rate to less than 15 CFS during the entire project or toward the end of the project as the hydraulic residence time decreases due to the filling of the pond.

- o The dredged material, after dewatering in the disposal pond, can be used to cap the Mendota sanitary landfill or disked into farmland soil. The toxic trace elements do not violate EPA or USDA solid-phase criteria for soils which grow plants that serve as edible crops or as animal feed, or in which invertebrates grow. Because the zinc content can violate freshwater aquatic life criteria if the zinc becomes waterborne, the dredged material landfill cover should be compacted and sloped to promote surface runoff and retard leachate production. Long-term geochemical changes are not expected to cause a lowering of pH that could increase the mobility of contaminants present.

- o The dredged material should not be stockpiled directly within the floodplain because of the potential for zinc contamination from rainfall runoff.

SAN JOAQUIN RIVER/MIDDLE RIVER INVESTIGATION

8. 1985 Work.

a. During preliminary investigations streamside soil cores were taken at the 3 sites shown in Figure 4. These cores were subjected only to the standard elutriate test. The results of these tests and their comparison to the freshwater aquatic life criteria are shown below:

Parameter	Site 4	Site 5	Site 6	EPA freshwater aquatic life criteria, ug/L (chronic)	EPA drinking water standard, MCL, ug/L
Arsenic	29.4	2.9	8.8	190.0	50
Cadmium	1.8	4.1	24.2	1.1*	10
Chromium(T)	13	34	195	210 *	50
Copper	7	23	46	12 *	-
Lead	1	32	60	3.2*	50
Mercury	4.8	1.2	1.2	0.012	2
Nickel	29	74	107	160 *	-
Selenium	2	3	30	35.0	10
Silver	28	11	15	0.12	50

(* based on hardness of 100 mg/L as CaCO3)

b. The procedure for the standard elutriate test calls for the supernatant to be filtered prior to testing, so only the dissolved fraction of any contaminants appears in the above data. The above data does indicate that a potential problem does exist for some parameters, especially in the Middle River area. More soil cores will be taken as described below and subjected to these and additional types of tests.

9. 1989 Work

a. In order to obtain additional information on this area and the expected project effects, additional work to be accomplished in early 1989 is described below. This work is being performed because of concerns over selenium and other toxic trace elements being found in San Joaquin River drainage waters and their potential for being adsorbed by suspended sediments, and because of the concern over trihalomethane-forming precursors in Delta waters.

b. The questions to be answered in this phase of the work are as follows:

(1)Middle River

- o Is the existing sediment contaminated, as regards EPA and USDA solid-phase criteria?
- o Will plumes and leakage from the sediment removal process (clam shell, drag line) pollute the river during the removal phase, as regards freshwater aquatic life criteria and drinking water standards? How long will any turbidity produced hang in suspension?
- o Will runoff from the dredged material, after placement on the landside of the levee, cause pollution to the river water, farmland soil or crops, or groundwater, as regards

freshwater aquatic criteria, drinking water standards, and leaf tissue content?

- o Will long-term geochemical changes to this material cause the release of additional contamination?

- o Will the sediment placed on the land side of the bank cause contaminant problems in vegetation that becomes established?

- o What mitigative measures will be needed to prevent pollution?

(2) San Joaquin River from Mendota Pool to Middle River.

- o Essentially the same as above, on a reduced scope.

c. The work to be done will consist of taking samples at the four sites shown in Figure 5. Streamside soil cores will be taken with a hand auger. The tests and parameters to be sampled are as follows:

Test #	
1	Bulk chemical analysis . total acid digest for toxic trace elements . solvent extraction for organic pesticides
2	Total extractable cations
3	Soil saturation extract cations and anions
4	Standard elutriate test (dissolved toxic trace elements and organic chemicals)
5	Modified elutriate test (total and dissolved toxic trace elements and organic chemicals)
6	Column settling test
7	DPTA test
8	Percent organic matter
9	Calcium carbonate equivalent
10	Wet and dry pH
11	Grain size distribution
12	Trihalomethane-forming potential
13	California waste extraction test (WET)

d. The sampling locations are to be as follows:

(1) San Joaquin River/Kings River above Mendota Pool: No sampling here, as material to be removed is above the summer water depth and is mostly sand.

(2) Mendota Pool: No additional testing needed. After the dredged material has dewatered and before placement on the Mendota sanitary landfill, two California WET tests should be done using deionized water.

(3) San Joaquin River below Mendota Pool:
2 sites (4 sites, composited to 2)

Site 1 Tests 1,4,11
Site 2 Tests 1,4,11

(4) Middle River:
2 sites (4 sites, composited to 2)
Site 3 Tests 1,2,3,4,5,6,7,8,9,10,11,12,16
Site 4 Tests Same, except no column settling test

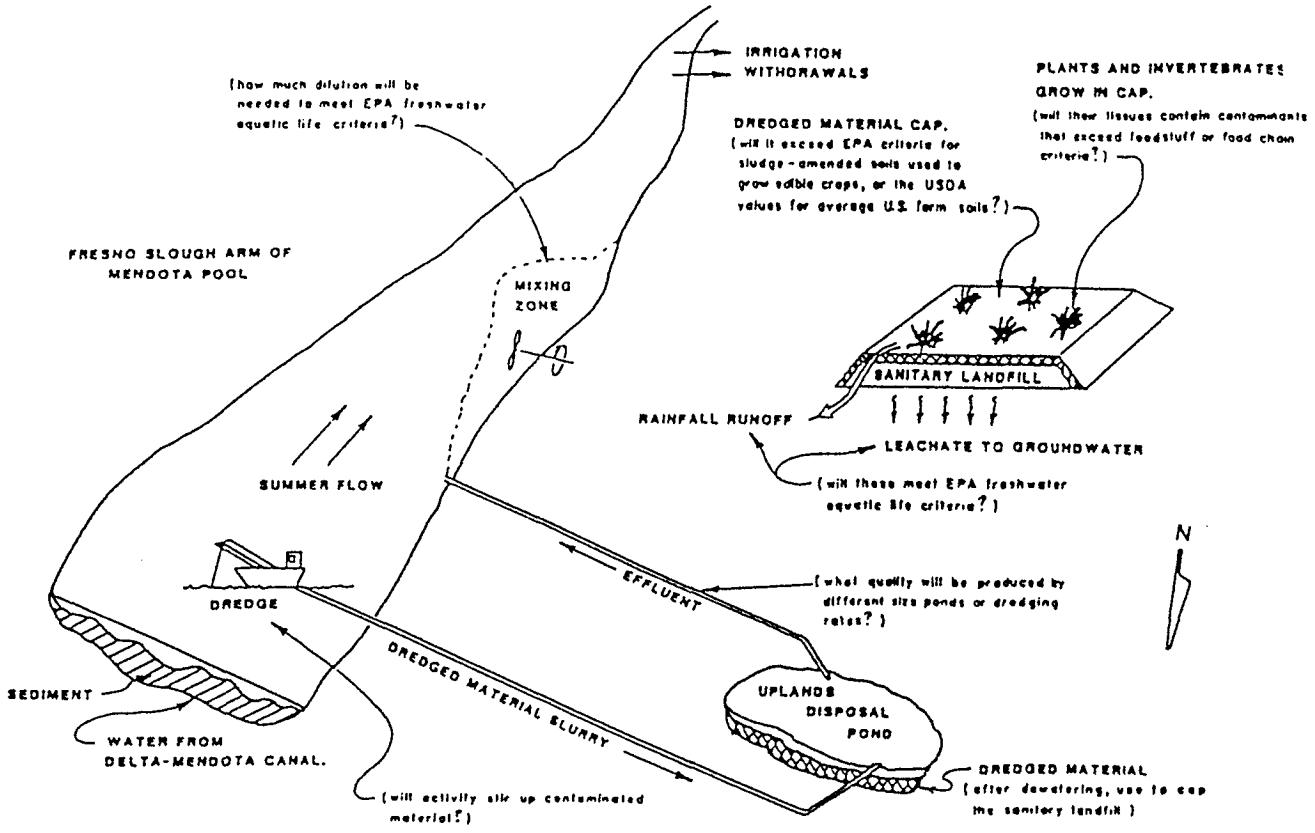


Figure 1. Schematic Showing Questions to be Answered in Dredging

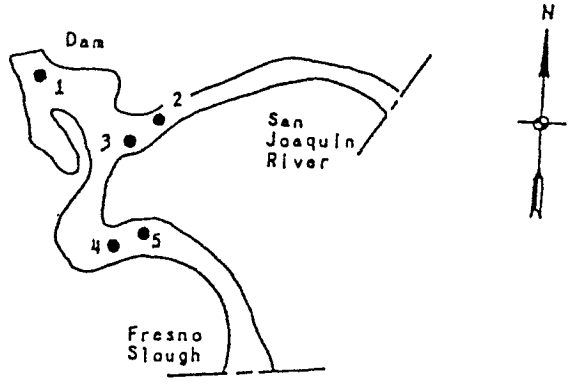
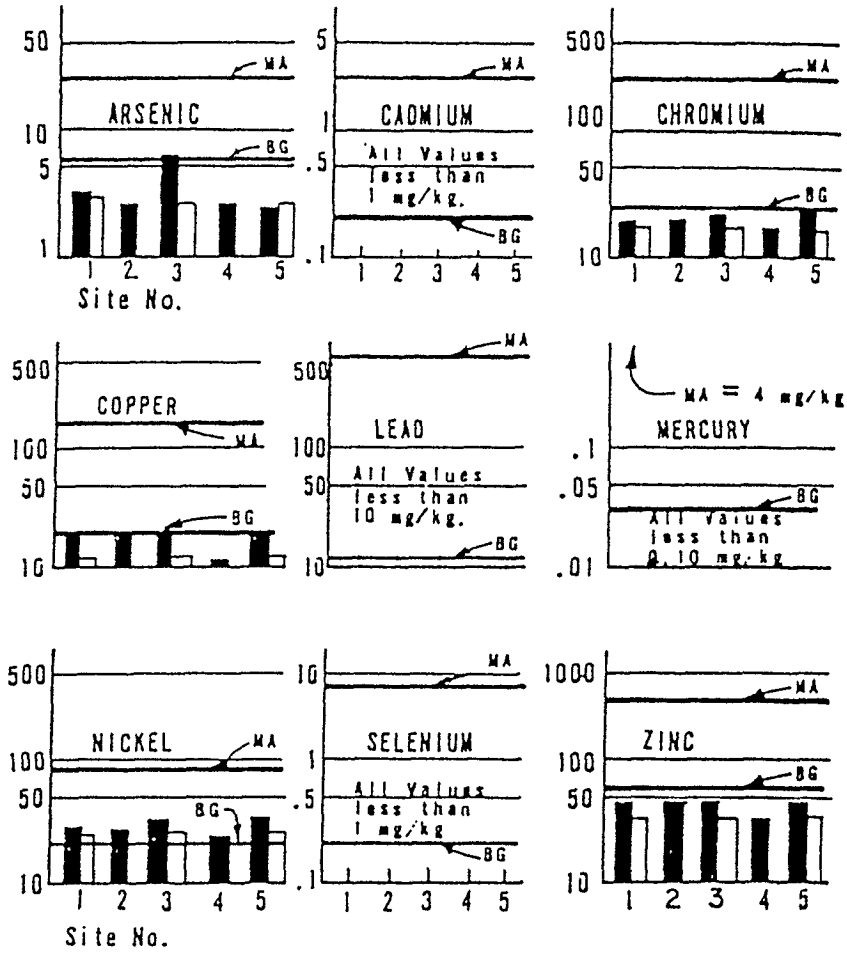


Figure 2. Mendota Pool Showing Location of Sediment Borings.



MA = Maximum allowable soil content.
BG = Background levels for Cropland Soil.

Figure 3. Toxic Trace Elements In Mendota Pool Sediments.

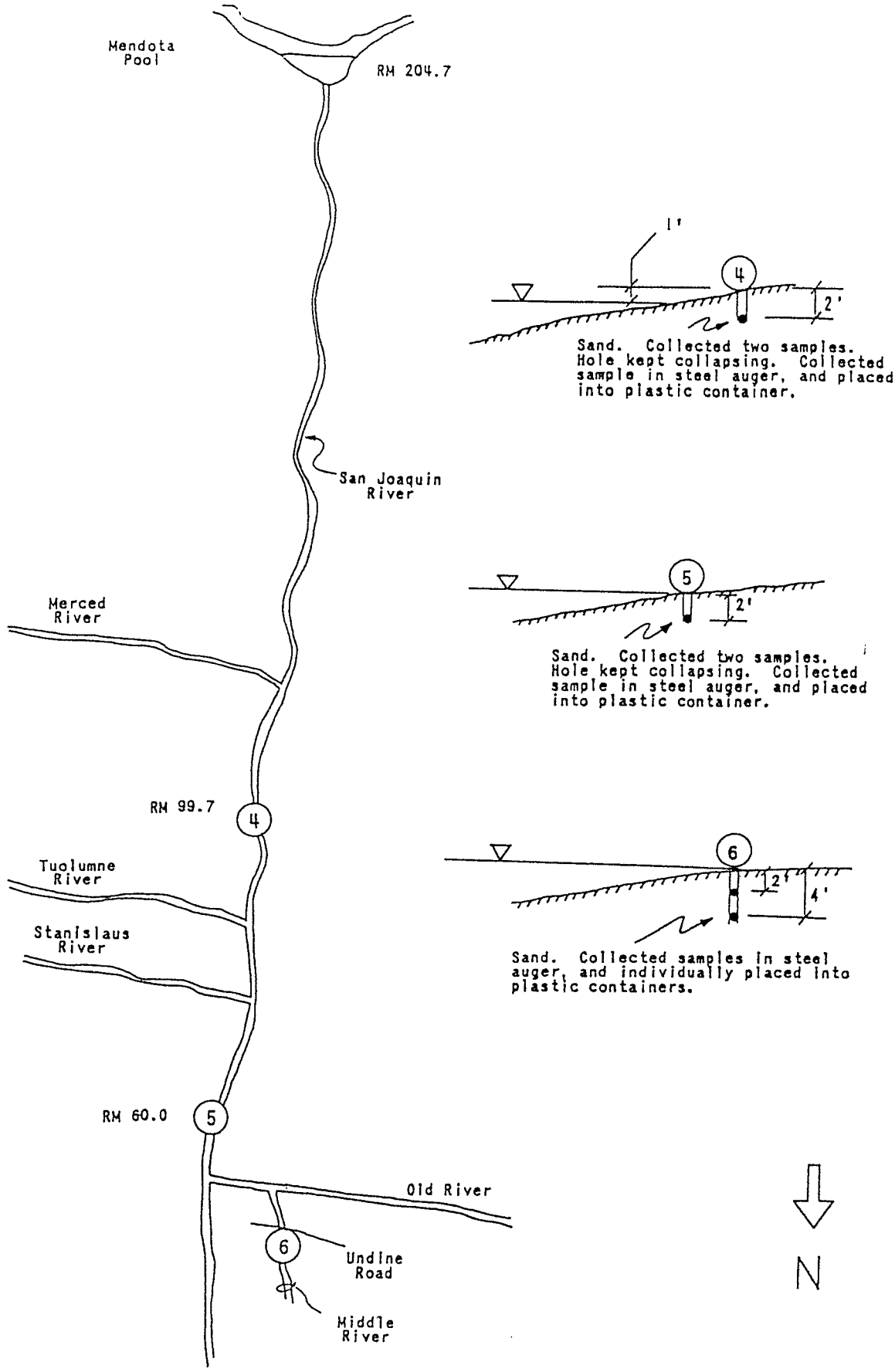


Figure 4. Sampling Sites

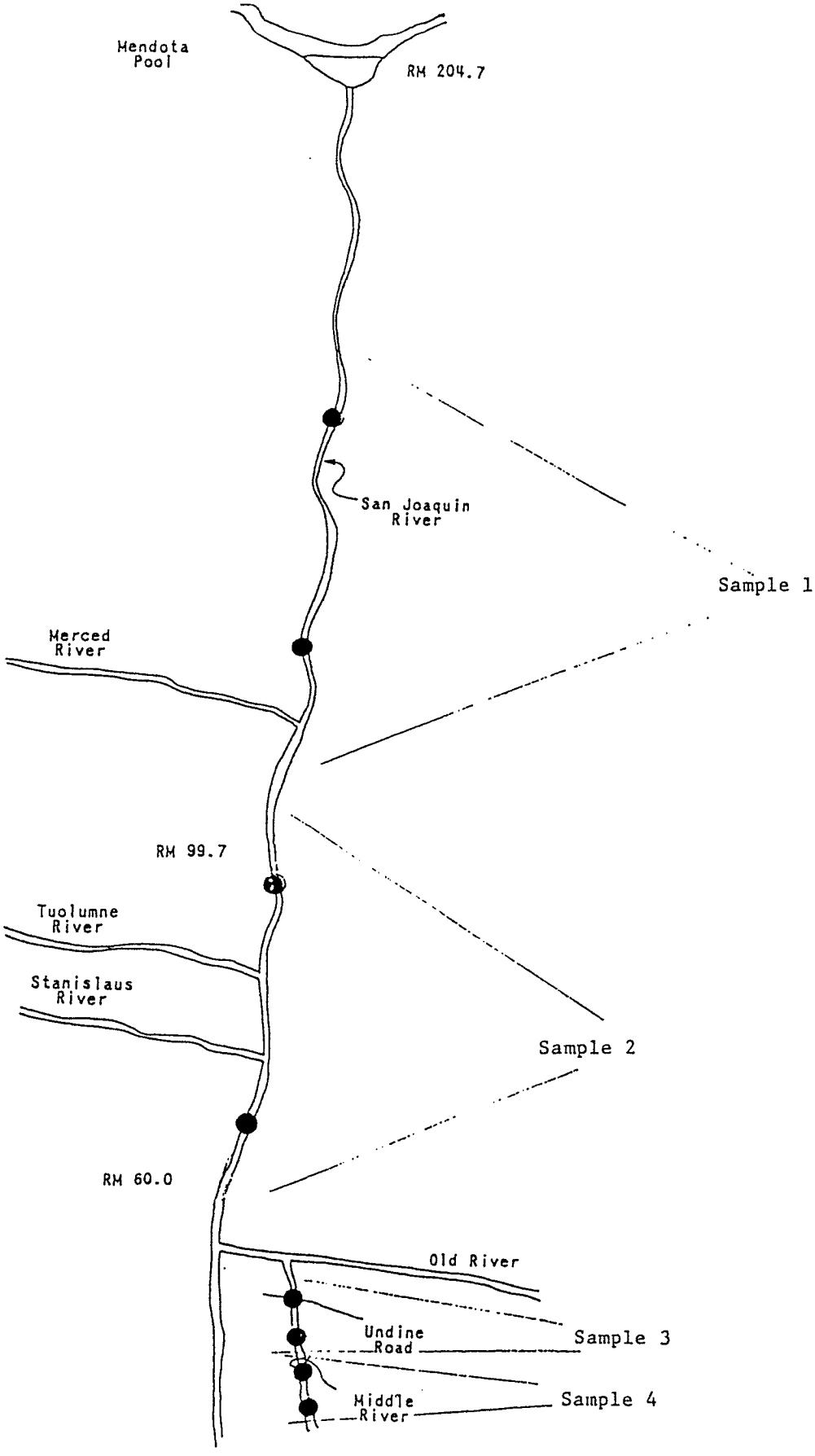


Figure 5. Sampling Sites

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