Expert Witness Report of Peter J. Hradilek Ph.D.

Lower San Joaquin River Restoration Infrastructure Improvements Strategy

Supplemental Report

September 2005

Peter J. Hradilek

HDR

2365 Iron Point Road, Suite 300
Folsom, CA 95630

Contents

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Purpose and Assignment

The purpose of the following document is to provide comments on the expert report prepared by Dr. G. Mathius Kondolf and to develop appropriate and cost effective methods for the engineering implementation of an alternative for channel planform modifications and provisions for quality salmonid spawning and rearing habitat to accommodate the flow regime set forth in that document.

In addition, I have included errata for my previous expert report.

Proposed Alternative Plan

The proposed alternative plan differs from the plan presented in my original report in that instead of modifying Reach 4B for proposed flows of 4,500 cfs, the reach would be left as is. Flows in excess of the capacity of the reach would be routed through Sand Slough and re-enter the river via the Mariposa Bypass. For the cost estimate purposes it was assumed that the design capacity of Sand Slough would have to be increased to 4,200 cfs (i.e., the existing capacity of Reach 4B was taken as 300 cfs).

Development of Conceptual Opinions of Probable Construction Costs

I developed conceptual estimates of the scale and cost of the implementation measures for the alternative plan using the same methodology detailed in my original report. Costs associated bypass modifications include channel modifications to support outmigration of juvenile salmonids. These modifications include improved planform supporting hydraulic diversity, instream structures to provide for resting and hiding structure, and reestablishment of a native riparian vegetation community. Further, the hydraulic conveyance capacity of the channel reach from the Sand Slough Control Structure to the Mariposa Bypass will need to be increased from an existing capacity of 3,000 cfs to 4,500 cfs. These costs are included in Reach 4A.

Preliminary Costs for Alternative Alignment

Costs associated with the alternative Alignment are presented in Table 1.

Table 1. Conceptual Level Opinion of Probable Construction Costs

Reach	Estimated Cost
Reach 1	$ 6,918,000
Reach 2	$ 237,149,000
Reach 3	N/A
Reach 4	$ 53,040,000
Reach 5	N/A
Contractor Indirect Costs (8%)	$ 23,770,000
Subtotal Construction Costs	$ 320,877,000
Construction Contingency of 25%	$ 80,219,000
Total Estimated Construction Costs	$ 401,096,250

Other Project Costs		
Planning and Engineering Design (12%)	$	48,132,000
Construction Management (10%)	$	40,110,000
Environmental Documentation and Permitting	$	28,077,000
Subtotal Other Project Costs	$	116,319,000
Total Estimated Construction Costs	$	517,416,000

Errata for Original Report

Due to a formula error in the spread sheet used to develop the cost data, the total estimated project cost was under reported; it should have been $ 817,302,000 (rather than $792,125,000). The corrected spread sheet is provided in Appendix A.

The second paragraph on page 1 of the report should be corrected to read:

Summary of Opinions

It is my opinion that the measures recommended by Dr. Michael Harvey and Dr. Charles Hansen can be implemented via the engineering designs detailed below. My opinion of the total project cost is $ 817,302,000. It is furthermore my opinion that the levees to be implemented only provide minimal flood protection. Based on available information I estimate that the provided flood protection is at the four to eight year flood level; i.e., the levee design capacity will be exceeded once every four to eight years, on the average. This is far below the 100-year flood protection required for FEMA certification.

Table 5 should be corrected to read:

Reach		Estimated Cost
Reach 1	$	6,918,000
Reach 2	$	237,149,000
Reach 3		N/A
Reach 4	$	225,240,000
Reach 5		N/A
Contractor Indirect Costs (8%)	$	37,546,000
Subtotal Construction Costs	$	506,853,000
Construction Contingency of 25%	$	126,713,250
Total Estimated Construction Costs	$	633,566,250
Other Project Costs		
Planning and Engineering Design (12%)	$	76,028,000

Construction Management (10%)	$	63,357,000
Environmental Documentation and Permitting	$	44,350,000
Subtotal Other Project Costs	$	183,736,000
Total Estimated Construction Costs	$	817,302,000

Comments on Expert Report

The following are comments on the Expert Report of Professor G. Mathias Kondolf, Ph.D. the comments below are directly referenced to the numbered paragraph of the report.

1. **Para. 20, Infiltration Rates.** – The report makes the assumption that infiltration rates are strictly functions of flow rate. While it is true that infiltration rates are a function of the river water surface elevation (which is a function of flow), infiltration rates are also greatly affected by the location of the phreatic surface in the soil. In simple terms, the infiltration rate is a function of the difference between the water surface in the river and the water surface in the ground. Under most conditions, the latter is much more variable. Hence infiltration rates are greatly dependent on antecedent flow conditions. That means that the initial flows of the year, regardless of magnitude, will have higher infiltration rates than later ones. This is especially important if the first releases of the water year are low magnitude flows, since it that case a much greater percentage of the total river flow will infiltrate.

2. **Para. 68, Reservoir Re-Operation.** – The report states that since the reservoir operators from the Bureau of Reclamation are very skilled, the author "has no reason to doubt that they could successfully re-operate the reservoir to achieve ecological objectives along with traditional water supply and flood control objectives." Successful reservoir re-operation is not only a function of the skill of the reservoir operators but also of the availability of good data. The operators would have to have sufficient data early enough in the water year to decide in what kind of year (i.e., wet, normal-wet, normal-dry, etc.) they find themselves to make the appropriate releases necessary to achieve the stated objectives.

3. **Para. 71, Diversions.** – Note that according to the paragraph, no diversion of the spring pulse flow can be made at Mendota Dam; diversions can only be made at Sack Dam or further downstream. Also, to "preserve the continuity of summer, fall and winter base flows" diversions should be only made at Sand Slough or further downstream. It is difficult to see how this can be reconciled with the achievement of "traditional water supply objectives" (see comment above). In addition, the requirement of passing the spring pulse of 4,500 cfs through to Sack Dam (to preserve cooling effects) is inconsistent with the recommendation made in Paragraph 85 of only passing 2,500 cfs through Reach 2B and diverting the excess at the Chowchilla Bifurcation Structure.

4. **Para. 81, Modifications to Levees.** -- The text here (and in various other portions of the report) mentions "minor modifications to the levees." It needs to be pointed out that permitting agencies (California Department of Water Resources, U.S. Army Corps of Engineers, etc.) usually require that if any modifications are made to the levees, the levees be brought up to current standards. This means that, given the condition of the existing levees and current standards, realistically speaking, making only "minor modifications" is ruled out – bringing the levees up to current standards would, for all practical purposes, imply their complete (or at least near complete) reconstruction. In our cost analyses we did assume that the levees would be brought up to current USACE standards assuming the levee design capacities to be the restoration flows. Note that we did not assume that the levees were to be brought up to FEMA standards – that would require the levees to be raised to provide 100-year protection. (Sizing the levees for the restoration flows of 4,500 cfs and 8,000 cfs only provides flood protection in the 4-year to 8-year range.)

5. **Para. 82, Sand Slough.** – According to the text, "flows above 1,500 cfs, or the actual capacity of Reach 4B, would be diverted into Mariposa Slough/bypass (sic)." In order to reach the Mariposa Bypass the flows would have to be routed down Sand Slough. The stated capacity of Sand Slough is 3,000 cfs. Since the actual capacity of Reach 4B is of the order of 300 cfs to 400 cfs, the diversion would be around 4,100 cfs or 4,200 cfs, which is significantly above the stated capacity of the slough. (We understand that currently flows of around 4,500 cfs are at times being passed through the slough; this is accomplished by encroaching on the design freeboard and hence an unsafe practice.)

6. **Para. 84, Modifications to Levees.** -- See Comment #4 above. Also, levee setbacks could in no case be classified as minor modifications – setting back a levee implies complete new construction.

7. **Para. 85, Flow Control.** – The detailed flow control implicit in the stated routing requirements would require complex and near constant manipulation of the gates at the Chowchilla Bifurcation Structure.

8. **Para. 87, Minor Changes, Small Actions.** -- The text refers to "minor changes" and "small actions" in Reaches 2B and 4B. Since this would involve modifying the levees in the reaches, the changes are not minor and the actions are not small; see Comment #4 above.

Professional Experience

Dr. Peter Hradilek is the National Technical Director of Dams and Hydraulic Structures for HDR Engineering. He works out of the Folsom, California office.

Dr. Hradilek has over 36 years of experience providing project management, planning, design, and construction services for flood control, irrigation, dam safety, and infrastructure rehabilitation projects. His experience also includes flood hydrology and hydraulics, institution building, and earthquake engineering and seismology. He has evaluated damages resulting from major natural disasters (floods and earthquakes) in the United States, Chile, and Ecuador. He has BS, MS and PhD degrees in engineering from UCLA and holds P.E. and G.E. registrations in California. Prior to joining HDR he was with the US Army Corps of Engineers (USACE) and the US Bureau of Reclamation (USBR). While at the USBR, he headed up the Analysis Branch of the Safety Evaluation of Existing Dams (SEED) program and was, while assigned to the International Affairs Division, the Team Leader of the Technical Assistance Program to the Republic of Brazil.

He has extensive experience in the design and analysis of all types of dams and hydraulic structures throughout North and South America. He is a long-time member of USSD and sits on the Earthquake Committee.

Dr. Hradilek has also lectured at universities, and held seminars and workshops. Additionally, he has published numerous technical articles and reports in the fields of irrigation, civil, structural, geotechnical, and earthquake engineering.

Project Experience

Dam Safety

Contra Loma Dam Improvements –Contra Costa Water District, Antioch, California. Provided Hydraulic, hydrologic, civil, and structural engineering as well as ecosystem restoration services for the Contra Loma Dam improvements.

Federal Energy Regulatory Commission (FERC) Dam Safety Reviews. Dr. Hradilek has been certified as an independent consultant for FERC part 12 safety reviews and is a FERC-trained FMA facilitator. He participated in the safety reviews of the following dams:

- Hunters Dam – Utica Power Authority, California
- Murphys Afterbay Dam – Utica Power Authority, California
- Murphys Forebay Dam – Utica Power Authority, California
- Loup River Project – Loup Power District, Nebraska
- Ford Hydroelectric Project – Ford Motor Company, Minnesota
- Oroville Dam – Department of Water Resources, California
- Thermalito Diversion Dam – Department of Water Resources, California
- Fish Barrier Dam – Department of Water Resources, California
- Thermalito Forebay Dam – Department of Water Resources, California
- Thermalito Afterbay Dam – Department of Water Resources, California

The last six listed were PFMA studies.

Dam Safety Program- U.S. Department of Interior, Bureau of Reclamation, Denver, Colorado. Served as technical specialist and head of the Analysis Branch in the Engineering and Research Center. Provided support of the Safety Evaluation of Existing Dams (SEED) program, which involved safety evaluation of all U.S. Department of Interior dams nationwide. Analyzed the safety of the dams with regards to stability under static (i.e., flood) and dynamic (i.e., earthquake) loading. Analyses were conducted for hydrologic/hydraulic issues (flood routing; reservoir evacuation; and spillway and outlet works performance), seismotectonic and geologic issues (earthquake accelerations; fault offsets; seiche, and landslides and fault displacement waves), geotechnical issues (static and dynamic stability, deformation, liquefaction, and seepage), and structural issues (static and dynamic stresses and deformations). More than 90 dams were evaluated, including the following:

- Alcova Dam
- Altus Dam
- Anderson Ranch Dam
- Big Sandy Dam
- Blue Mesa Dam
- Boca Dam
- Box Butte Dam
- Bottle Hollow Dam
- Bully Creek Dam
- Bumping Lake Dam
- Caballo Dam
- Cachuma (Bradbury) Dam
- Cascade Dam
- Casitas Dam
- Clark Canyon Dam
- Cold Springs Dam
- Contra Loma Dam
- Crane Prairie Dam
- Crawford Dam
- Currant Creek Dam
- Deer Creek Dam
- Deerfield Dam
- Elephant Butte Dam
- Emigrant Dam
- Fish Lake Dam
- Folsom Dam
- Fontanelle Dam
- Foss Dam
- Fruitgrowers Dam
- Glen Anne Dam
- Guernsey Dam
- Heart Butte Dam
- Huntington North Dam
- Hyrum Dam
- Island Park Dam
- Jackson Gulch Dam
- Jackson Lake Dam
- Joes Valley Dam
- Lahontan Dam
- Lake Alice Dam
- Lake Sherburne Dam
- Lauro Dam
- Little Panoche Dam
- Los Banos Dam
- Marshall Ford Dam
- Martinez Dam
- McKay Dam
- Medicine Creek Dam
- Meeks Cabin Dam
- Merritt Dam
- Minitare Dam
- Minidoka Dam
- Navajo Dam
- Newton Dam
- Ochoco Dam
- Olympus Dam
- O'Neill Forebay Dam
- Ortega Dam
- O'Sullivan Dam
- Pactola Dam
- Palisades Dam
- Picacho North Dam
- Prineville (Arthur A. Bowman) Dam
- Rye Patch Dam
- Salmon Lake Dam
- Sanford Dam
- San Luis Dam
- Scofield Dam
- Senator Wash Dam
- Sherman Dam
- Sly Park Dam
- Soldiers Meadow Dam
- Squaw Lake Dam
- Stampede Dam
- Starvation Dam
- Tieton Dam
- Trinity Dam
- Twin Buttes Dam
- Twitchell (Vaquero) Dam
- Whiskeytown Dam
- Wickiup Dam
- Willow Creek Dam

Dam Safety Projects in Brazil - U.S. Department of Interior, Bureau of Reclamation/Federal Government of Brazil, Brasilia and Fortaleza, Brazil. Team leader of the U.S. Department of Interior, Bureau of Reclamation, technical assistance team as part of the U.S.-Brazil Technical Cooperation Agreement. Served the dam safety specialist for the World Bank Safety of Dams Panels. Provided consulting services on safety-related issues for a number of major existing and new dams in Brazil, including:

- Armando Ribeira Gonçlves (Açu) Dam - DNOCS
- Atalho Dam - DNOCS
- Canoas Dam – State of Pernambuco
- Cachoerinha Dam - DNOCS
- Ceraíma Dam - CODEVASF
- Curral Velho Dam - DNOCS
- Estreito IV Dam - CODEVASF
- Frios Dam - DNOCS
- Itaipu Dam – Itaipu Binacional
- Jerimum Dam - DNOCS
- Parelhas Dam - DNOCS
- Pedra Redonda Dam - DNOCS
- Pedrinhas Dam - DNOCS
- Piracuruca Dam - COMDEPI
- Poço Comprido Dam - DNOCS
- Sem Nome [sic] Dam - DNOCS
- Taquara Dam - DNOCS
- Tricí Dam - DNOCS

Salinas Dam Seismic Safety Evaluation - U.S. Army Corps of Engineers, Los Angeles, California. Project manager for the earthquake safety evaluation of existing concrete dams. Also provided dynamic time history analysis for Salinas Dam, a concrete arch dam.

Brazilian Federal Safety of Dams Manual - Federal Government of Brazil. Member of an interagency panel that developed the Brazilian Federal Safety of Dams Manual.

Dam Design and Construction

Folsom Dam Outlet Modification (Stilling Basin) - U.S. Army Corps of Engineers, Sacramento District, California. Technical lead for the analysis and retrofit design of the stilling basin, comprising the floor and two types of sidewalls. The stilling basin floor is 242 ft wide and approximately 350 ft long. The sidewalls are up to xx ft high. Analysis was performed based on expected loads during the construction of the outlet modifications, and on the increased hydrodynamic loads due to the outlet modifications. Selected the critical stations of L-wall and anchored wall to check the existing resultant location, sliding stability, bearing capacity and concrete compression stresses. Selected the controlling hydrodynamic and hydrostatic conditions to check slab flotation. Designed post tensioned tie-backs and tie-downs for the sidewalls and invert of the stilling basin to resist hydrostatic, hydrodynamic, seismic and construction loads in accordance with current USACE criteria and ACI 318-99.

Folsom Dam Outlet Modification (Bulkhead Systems) - U.S. Army Corps of Engineers, Sacramento District, California. Provided quality assurance/quality control (QA/QC) for the design of the construction bulkhead system.

Folsom Dam Modification, Conceptual Structural Design for Surcharge Storage (Task Order 10) - U.S. Army Corps of Engineers, Sacramento District, Folsom, California. Provided quality assurance/quality control (QA/QC) for the conceptual structural design of the surcharge storage component of the Folsom Dam modification project, which will allow dam operators to maintain objective releases or releases that would not exceed the downstream levee system's capacity while surcharging to elevation 474 feet. Use of this surcharge operation allows an additional 48,000 acre-feet of space to be credited for flood control.

Folsom Dam Raise, American River Watershed - U.S. Army Corps of Engineers, Sacramento District, California. Project engineer for the development of the Project Management Plan and Schedule for the American River Watershed Folsom Dam Raise Project.

Brazil Dam Designs and Construction - Federal and Various State Governments of Brazil. Consultant for the design and construction of numerous embankment (soil and rock) and gravity (RCC and conventional concrete) dams in Brazil, including the following:

- Castanhão Dam - DNOCS
- Covas de Mandioca Dam - CODEVASF
- Curral Velho Dam - DNOCS
- Jequitaí I Dam - CODEVASF
- Jequitaí II Dam - CODEVASF
- Piracuruca Dam - COMDEPI
- Ponto Novo Dam – Sate of Bahia
- Santa Rosa Dam - DNOCS

Oros Dam Raising - Federal Government of Brazil. Provided design services for the proposed raising of Oros Dam, a large curved embankment dam.

Sweetwater Dam Raising - U.S. Army Corps of Engineers, Los Angeles, California. Consultant for the proposed raising of Sweetwater Dam, a gravity-arch dam of masonry construction.

Flood Control and INFRASTRUCTURE Repair

Indian Bend Wash Flood Control - U.S. Army Corps of Engineers, Los Angeles District, Scottsdale, Arizona. Hydraulic, civil, structural, and research engineer, responsible for providing planning, design, and construction of various flood control projects, including the award winning Indian Bend Wash project in Scottsdale, Arizona.

Sweetwater River Flood Control - U.S. Army Corps of Engineers, Los Angeles, California. Project manager for the Sweetwater River flood control project.

Earthquake Investigation for USACE Flood Control Structures - U.S. Army Corps of Engineers (USACE), Los Angeles District, California. Investigated the effects of the 1971 San Fernando earthquake on USACE flood control structures.

Ecuador Flood Rehabilitation - U.S. Agency of International Development (USAID), Guayaquil, Ecuador. Technical coordinator for the emergency rehabilitation project that mitigated the damages caused by the 1982/83 "El Niño" floods in Ecuador. Responsible for all engineering aspects of the rehabilitation and reconstruction work, which included flood control (levee and flood wall repair and construction, river control structures, etc.) and damaged irrigation, transportation, electrical and sanitary infrastructures. Project also included the construction of new schools.

Irrigation

Irrigation Infrastructure Projects in Brazil - U.S. Department of Interior, Bureau of Reclamation/Federal Government of Brazil, Brasilia and Fortaleza, Brazil. Team leader of the U.S. Department of Interior, Bureau of Reclamation, technical assistance team as part of the U.S.-Brazil Technical Cooperation Agreement. Provided technical assistance under a series of World Bank loans financing water resources development projects (principally irrigation) in Brazil, which included all project phases, from planning and basic design, through construction, and into operation and maintenance. Projects included irrigation infrastructures, including dams, canals, pipelines, pumping plants, tunnels, and other related structures. Was also involved with the restructuring of the federal water resources sector, dealing with such aspects as institution building, water law, and federal policy on water resources management.

São Francisco River Diversion - Federal and Various State Governments of Brazil. Evaluated he proposed São Francisco River diversion, which is a major trans-basin diversion to bring water to the semi-arid Northeast.

Brazil Irrigation Projects - Federal and Various State Governments of Brazil. Project manager for the oversight of major irrigation projects, including:

- Baixo Acaraú
- Barreiras
- Formoso H
- Jaíba
- Platôs de Guadalupe
- Pontal
- Tabuleiros Litoráneos
- Tabuleiros de Russas

Peru Irrigation Projects - Ministry of Agriculture and Food, Lima, Peru. Design engineer and member of a U.S. Bureau of Reclamation Technical Assistance Team in Lima, Peru. Provided technical assistance to the National Program of Small and Medium Irrigations under an Interamerican Development Bank loan. Work included a number of projects scattered throughout Peru, and involved some complex technical issues and structures such as trans-basin water diversions, underwater lake taps, and various large dams.

Geotechnical

LNWI (Lower North West Interceptor) New Natomas and South River Pump Stations - Sacramento Regional District Sanitation District. Geotechnical engineer for the design of the two pump stations. Prepared the two Geotechnical Baseline Reports (GBR's) and specifications.

South Sacramento Streams - U.S. Army Corps of Engineers, Sacramento District, California. Provided quality assurance/quality control (QA/QC) for the evaluation of slope stability for short term, long term and rapid drawdown cases of critical sections of Morrison Creek, Elder Creek, Unionhouse Creek and Florin Creek.

Bear River and WP Interceptor Canal Levees – Reclamation District No. 784, Yuba County, California. Provided quality assurance/quality control (QA/QC) for the levee improvement project involving seepage mitigation through slurry walls and seepage berms.

Sacramento River East Bank Levee, Pocket Area - Sacramento Area Flood Control Agency, CA. Provided quality assurance/quality control (QA/QC) for alternative analysis, predesign, and final design of seepage mitigation improvements for the Sacramento River east bank levee, located in the Little Pocket Area and Pocket Area of the City of Sacramento. Alternatives included replacing the original slurry walls with deeper cutoff using either slurry trench or deep soil mixing techniques, and drainage relief using relief wells.

Education

Ph.D., Earthquake Engineering, Solid Mechanics, Geotechnical Engineering, University of California, Los Angeles (UCLA) 1978

M.S. Structural Engineering, Earthquake Engineering, Geotechnical Engineering, UCLA, 1970

B.S., Civil Engineering, Hydraulic Engineering, Structural Engineering, Geotechnical Engineering, UCLA, 1968

Professional Registrations

Professional Geotechnical Engineer #940, California 1985

Professional Civil Engineer, #24777, California 1975

Professional Affiliations

Association of State Dam Safety Officials

American Society of Civil Engineers

International Society for Soil Mechanics and Foundation Engineering

United States Society on Dams (formerly United States Committee on Large Dams) – member of the Earthquake Committee

Earthquake Engineering Research Institute;

Seismological Society of America

International Water Resources Association

United States Committee on Irrigation and Drainage

International Network on Participatory Irrigation Management

Publications and presentations authored by witness in the last 10 years

Publications

Rehabilitation of Folsom Dam Stilling Basin, Proceedings of the 25th Annual USSD Conference, Salt Lake City, UT June 2005; [with Rick L. Poeppelman and Yunjing (Vicky) Zhang.]

Editor and co-author of a series of manuals for the Brazilian Federal Government, published by the Brazilian Ministry of Regional Integration, 2002 (in Portuguese):

- General Planning for Irrigation Projects
- Classification of Lands for Irrigation
- Economic and Financial Evaluation of Irrigation Projects
- Operation and Maintenance of Irrigation Projects
- Technical Specifications for Irrigation Projects
- Evaluation of Small Dams
- Design of Irrigation Projects
- Construction of Irrigation Projects

Presentations

Dam Rehabilitation and Modernization and member of the panel on *Aging Infrastructure* at the National Water Resources Association's 2005 Western Water Seminar, Big Sky, MT, July 2005.

Evaluation of Stilling Basin Performance Due to Historic Flows, Tri-Service Infrastructure Conference, St. Louis, MO, August 2005.

Other cases in which witness has testified as expert at trial or by deposition within the last 4 years

None.

Additional Data and New Information Considered in this Supplemental Report

The only additional information reviewed in the preparation of this supplemental report includes Dr. G. Mathius Kondoff.

Compensation to be paid for this testimony

For the preparation of testimony deliverables, I will be paid at an hourly rate of $195.

When performing deposition and testimony, I will be paid at an hourly rate of $292.

Appendix A: Cost Data

PATH: P:\200157\22865.056\Reports\Infrastructure TM\[DRAFT_costs_Alternate.xls]Estimate

Job No.	200157-22865-056	Calc No.	
Project: Friant Dam/ San Joaquin River Project	Computed: KD	Date	8/21/2005
Subject: Alternative Referenced by Dr. G. Mathius Kondolf	Checked: MCG	Date	
Task: Quantities & Costs	Sheet: 1	Of	1

Computation

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	QUANTITY	UNITS	PRICE	ROUNDED COST
Reach 1				
1. Reconnect Side Channels	14	Acre	$12,000	$165,000
2. Gravel Augmentation for Spawning	103,704	CY	$15	$1,556,000
3. Fill Dredger Pits	507,421	CY	$6	$3,045,000
4. Reconstruct Multi-Stage Channel	54,476	CY	$6	$327,000
5. Construct Isolation Dikes	304,116	CY	$6	$1,825,000
Reach 2A				
1. Construction of 9 Miles of New South Bank Levee (~RM 225-216)	1,024,320	CY	$9	$9,219,000
2. Construction of 11 Miles of New North Bank Levee (~RM 227-216)	1,251,947	CY	$9	$11,268,000
3. South Bank Levee Foundation Seepage Problems (~RM 225-216) 9 Miles of Slurry Walls	2,851,200	SQFT	$14	$39,917,000
4. North Bank Levee Foundation Seepage Problems (~RM 227-216) 11 Miles of Slurry Walls	3,484,800	SQFT	$14	$48,788,000
5. Rock Slope Protection	667	Ton	$61	$41,000
Reach 2B (RM 216-205) (Bifurcation Structure to Mendota Dam)				
1. Rebuild and Raise Levees Each Side (About 22 Miles)	1,053,184	CY	$9	$9,479,000
2. Slurry Walls (About 22 Miles)	6,969,600	SQFT	$14	$97,575,000
Reach 2B Bypass Channel Around Mendota Dam				
1. Clearing and Grubbing	30.0	Acre	$2,500	$75,000
2. Channel Excavation	453,704	CY	$6	$2,723,000
3. Construct Levees Each Side (9800 ft)	177,707	CY	$9	$1,600,000
4. Slurry Walls Each Side (9800 ft)	1,176,000	SQFT	$14	$16,464,000
Reach 3 (RM 205-182) (Mendota Dam to Sack Dam)				
Reach 4A (RM 182-168.5) (Sack Dam to Sand Slough Control Structure)				
1. Constructi of 4,800 ft of Levee (for Left and Right)	87,040	CY	$9	$784,000
2. Construct 4,800 ft of Slurry Wall (Left and Right)	576,000	SQFT	$14	$8,064,000
Reach 4B (RM 168.5-135.9) (SS Control Structure to Bear Creek)				
1. Channel Reconstruction	5,377,778	CY	$6	$29,578,000
2. In-Stream Habitat and Grade Control	22	MI	$80,000	$1,760,000
3. Slope Stabilization	1,075,556	CY	$6	$6,454,000
4. Overbank Revegetation	640	AC	$10,000	$6,400,000
Mobilization/Demobiliation	5%			$14,856,000
Insurance and Bonds	3%			$8,914,000
Construction Subtotal				**$320,877,000**
Construction Contingencies (25%)				**$80,219,250**
Total Probable Construction Costs				**$401,096,250**
Other Project Costs				
Planning and Engineering Design Cost	12%			$48,132,000
Construction Management	10%			$40,110,000
Envirionmental Documentation and Permitting	7%			$28,077,000
Subtotal Other Project Costs				**$116,319,000**
TOTAL ESTIMATED PROJECT COST				**$517,416,000**

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Job No.	200157-22865-056	Calc No.	

Computation

HDR

Project	Friant Dam/ San Joaquin River Project	Computed	KD	Date	8/21/2005
Subject	Errata	Checked	MCG	Date	
Task	Quantities & Costs	Sheet	1	Of	1

	QUANTITY	UNITS	PRICE	ROUNDED COST
Reach 1				
1. Reconnect Side Channels	14	Acre	$12,000.00	$165,000
2. Gravel Augmentation for Spawning	103,704	CY	$15.00	$1,556,000
3. Fill Dredger Pits	507,421	CY	$6.00	$3,045,000
4. Reconstruct Multi-Stage Channel	54,476	CY	$6.00	$327,000
5. Construct Isolation Dikes	304,116	CY	$6.00	$1,825,000
Reach 2A				
1. Construction of 9 Miles of New South Bank Levee (~RM 225-216)	1,024,320	CY	$9.00	$9,219,000
2. Construction of 11 Miles of New North Bank Levee (~RM 227-216)	1,251,947	CY	$9.00	$11,268,000
3. South Bank Levee Foundation Seepage Problems (~RM 225-216) 9 Miles of Slurry Walls	2,851,200	SQFT	$14.00	$39,917,000
4. North Bank Levee Foundation Seepage Problems (~RM 227-216) 11 Miles of Slurry Walls	3,484,800	SQFT	$14.00	$48,788,000
5. Rock Slope Protection	667	Ton	$61.35	$41,000
Reach 2B (RM 216-205) (Bifurcation Structure to Mendota Dam)				
1. Rebuild and Raise Levees Each Side (About 22 Miles)	1,053,184	CY	$9.00	$9,479,000
2. Slurry Walls (About 22 Miles)	6,969,600	SQFT	$14.00	$97,575,000
Reach 2B Bypass Channel Around Mendota Dam				
1. Clearing and Grubbing	30.0	Acre	$2,500.00	$75,000
2. Channel Excavation	453,704	CY	$6.00	$2,723,000
3. Construct Levees Each Side (9800 ft)	177,707	CY	$9.00	$1,600,000
4. Slurry Walls Each Side (9800 ft)	1,176,000	SQFT	$14.00	$16,464,000
Reach 3 (RM 205-182) (Mendota Dam to Sack Dam)				
Reach 4A (RM 182-168.5) (Sack Dam to Sand Slough Control Structure)				
Reach 4B (RM 168.5-135.9) (SS Control Structure to Bear Creek)				
1. Clearing and Grubbing	640	Acre	$2,500.00	$1,600,000
2. 44 Miles of Levee Construction	2,106,368	CY	$9.00	$18,958,000
3. Channel Excavation	1,588,800	CY	$6.00	$9,533,000
4. Slurry Wall	13,939,200	SQFT	$14.00	$195,149,000
Mobilization/Demobiliation	5%			$23,466,000
Insurance and Bonds	3%			$14,080,000
Construction Subtotal				**$506,853,000**
Construction Contingencies (25%)				**$126,713,250**
Total Probable Construction Costs				**$633,566,250**
Other Project Costs				
Planning and Engineering Design Cost	12%			$76,028,000
Construction Management	10%			$63,357,000
Envirionmental Documentation and Permitting	7%			$44,350,000
Subtotal Other Project Costs				**$183,735,000**
TOTAL ESTIMATED PROJECT COST				**$817,302,000**