EXPERT REPORT OF SCOTT ENGLISH

I. Assignment

The Friant defendants in *NRDC v. Rodgers*, et al. have provided expert witnesses reports from Dr. Peter Hradilek and Mr. Edward Donahue setting forth cost estimates for various non-flow rehabilitation measures which were deemed necessary by one of more Friant expert to restore Chinook salmon to the San Joaquin River below Friant Dam. I was asked by the Natural Resources Defense Council (NRDC) to review the Friant cost estimates and develop my own cost estimates for non-flow rehabilitation measures relating to San Joaquin River salmon restoration.

II, Summary of Opinions

1. All of the rehabilitation treatments deemed necessary or potentially necessary by the NRDC experts can be constructed at a cost of approximately $50,055,934.00.
2. All of the rehabilitation treatments deemed not necessary but beneficial to San Joaquin River restoration by the NRDC experts can be constructed at an additional cost of approximately $51,463,066.00.
3. My estimate of the total cost to construct the various rehabilitation treatments identified by the NRDC experts as necessary, potentially necessary, or unnecessary but beneficial, is approximately $101 million. This compares with approximately $900 million in cost estimates provided by Friant experts Dr. Hradilek and Mr.Donahue (not counting land appraisal costs by Mr. Correia, which have yet to be received). The huge difference between my estimates and the Friant experts' estimates is due in large part to the fact that the NRDC experts recommend solutions that would either obviate several of the very expensive treatments called for by Dr. Hradilek and Mr. Donahue, or would meet the desired restoration objective in a more cost-effective manner.
4. Specific examples of very expensive rehabilitation treatments called for by Friant experts, which are either obviated or accomplished more cost-effectively under the recommendations of NRDC experts, include the Friant experts' recommendations for many miles of slurry walls which are assumed to be needed for seepage mitigation (including in

areas abutted by wildlife refuges), extensive construction of new levees, a Mendota bypass channel, multiple fishways, and numerous engineered fish screens. Based on the needs and strategies identified by the NRDC experts, many of these items are either unnecessary or can be accomplished at much less cost than what was estimated by Dr. Hradilek and Mr. Donahue. For example, a basic drainage system in areas where seeping levees may be a problem would be much more cost-effective than installing slurry walls throughout all reaches that may be affected by seepage. And instead of very expensive engineered fish screens, an inexpensive fish barrier system constructed from woven geotextile fabric could suffice to prevent adult and juvenile fish from entering canals in the Mendota Pool area and at other key diversion points. Utilizing this proven fish barrier system could potentially eliminate the need for a costly bypass channel at the Mendota Pool.

III. Discussion and Analysis

In developing this report, I reviewed several expert witness reports submitted in the *NRDC v. Rodgers* litigation relating to salmon habitat and stream rehabilitation treatments. I refreshed and expanded upon my knowledge of the relevant areas of the San Joaquin River by reviewing background materials and conducting field surveys. I then focused my cost analyses on the specific rehabilitation measures that Drs. Kondolf, Moyle, and/or Deverel identify -- either in their initial expert reports or their supplemental reports – as necessary or potentially necessary for achieving salmon restoration objectives, as well as other rehabilitation measures which they believe would be complimentary or beneficial to salmon restoration objectives, though not necessary. I developed conceptual level cost estimates based on these recommendations, prior studies and reports completed by others, and my own current and past field surveys.

My specific cost estimate conclusions are set forth, reach by reach, in Tables 1 through 6 at the end of this Report. In these Tables, I list the various rehabilitation treatments identified in expert reports submitted by NRDC and the Friant Defendants. I then assign one of four general "level of need" categories to each measure based on my understanding of the determinations made

by Drs. Kondolf, Moyle, and/or Deverel: 1) necessary; 2) potentially necessary, depending on other rehabilitation strategy decisions; 3) unnecessary but beneficial; and 4) unnecessary. In developing cost estimates for these measures, I found some of the Hradilek/Donahue cost estimates to be reasonable and in those instances I used them. In other instances, I found the Hradilek/Donahue cost estimates to be excessive and utilized my own estimates.

The following sections discuss how I arrived at the conclusions reflected in Tables 1 though 6. The types and locations of potential rehabilitation elements for which cost estimates are provided herein derives from my review of the Friant and NRDC expert reports; from my understanding of the determinations made by Drs. Kondolf, Moyle, and Deveral regarding particular rehabilitation issues, objectives and strategies; and from my own field surveys and research. The estimated costs for various types of rehabilitation treatments is also based on the specific type of treatment, site conditions, construction methods, materials, design, permit costs, construction supervision, other contingencies, and monitoring.

The San Joaquin River from Friant Dam to confluence with the Merced River spans 149.2 miles and has been divided into five reaches based on geomorphology and key infrastructure components. These reach descriptions are outlined in the Background Report (McBain and Trush 2002). The potential rehabilitation issues,[1] proposed treatment measures and costs are addressed in my report for each reach as follows:

[1] The characterizations of the various "potential issues" in the pages that follow are simply intended to summarize how Friant expert witnesses have characterized these issues, and not to provide my own judgments or characterizations about any given issue.

Reach 1 (Friant Dam, RM 267.5 to Gravelly Ford, RM 227.5

POTENTIAL REACH 1 ISSUES	PROPOSED TREATMENT MEASURE AND RATIONALE
1. Culvert and gravel mine access road restricts fish passage at RM 253 per Dr. Hansen should be removed.	Although Dr. Hanson recommends removal of this culvert and access road at RM 253, Dr. Kondolf points out in his report that this culvert was recently washed out and there is an agreement with the landowner providing that not only will the road/culvert not be rebuilt, the channel in this location will also be restored to the satisfaction of the State Lands Commission and the Department of Fish and Game. The measures called for by Dr. Hanson are therefore unnecessary.
2. Remnant side channels and alcoves providing potential spawning and rearing areas are hydraulically isolated from the river except during high flow events. These should be re-connected with the main channel, per Drs. Hanson and Harvey.	Drs. Hansen and Harvey recommend channel reconstruction to reconnect the isolated side channels with the main channel. Drs. Moyle and Kondolf do not believe this is necessary, but believe that it would be beneficial. Dr. Hradilek's locations and cost estimates were utilized in this instance (see Table 1) because, based on my initial research and experience with similar projects, his locations and estimates seemed appropriate.
3. The availability of suitable spawning gravels is limited in areas of Reach 1, due to recruitment problems and gravel mining, and therefore gravel augmentation is needed per Drs. Hanson and Harvey.	Drs. Hanson and Harvey call for gravel augmentation for spawning habitat. Dr. Kondolf believes that it is not necessary but would be beneficial. I utilized Dr. Hradilek's cost estimates in Table 1 because, based on my initial research and experience with similar projects, his estimates seemed reasonable.

4. Abandoned in-channel gravel mining pits cause river discontinuity and may increase predation on juvenile salmonid**s** by creating habitat favored by predatory warm water fish, per Drs. Harvey and Hanson.	Filling of in-channel dredger pits is called for by Drs. Harvey and Hanson. Dr. Kondolf believes that this could be beneficial, though it is not necessary. Again, I utilized Dr. Hradilek's cost estimates in Table 1 because my review indicated that they seemed reasonable.
5. Land uses next to the river have channelized the San Joaquin River, thus reducing the available floodplain and requiring construction of a multi-stage channel per Drs. Harvey and Hanson.	Drs. Harvey and Hanson call for constructing a multi-stage channel. Dr. Kondolf determined that this is not necessary but would be beneficial. I found that Dr. Hradilek's channel reconstruction location and cost estimates were reasonable and I utilized them in Table 1.
6. Remnant off-channel gravel mining pits introduce false -pathways for migrating fish, and creates warm water fish habitat which increases potential predation on salmonids by predatory fish per Dr. Hanson.	Dr. Hradilek calls for construction of isolation dikes to block remnant off-channel gravel mine pits. Dr. Kondolf and Dr. Moyle conclude that that it while this is not necessary, it would be beneficial. Dr.Hradilek's dike locations and cost estimates were used in Table 1 because I found them to be reasonable.
7. Approximately 113 unscreened pump diversions are present in this reach which can cause mortality in outmigrating juvenile salmonids that become entrained in the diversions, per Dr. Hanson.	Mr. Donahue and Dr. Hanson call for screening these pump diversions. Dr. Moyle believes that screening these small diversions is not necessary, but would be beneficial. The cost estimates in Table 1 are based on recent fish screening costs for pump diversions from the Washington Department of Fish and Wildlife, which I believe to be more reasonable and appropriate than the significantly higher costs presented by Mr. Donahue.

Issues in Reach 2A: Gravelly Ford (RM 229) to Mendota Dam (RM 205)

POTENTIAL REACH 2A ISSUES	PROPOSED TREATMENT MEASURE AND RATIONALE
1. Bifurcation structure at SJR/Chowchilla Bypass may impede fish passage per Dr. Hanson.	Dr. Hanson identifies this as a passage barrier that must be retrofitted with a fishway. However, Dr. Kondolf determined that the bypass structure is not a fish migration barrier and therefore a fishway is not needed.
2. Juvenile salmon may be stranded in the Chowchilla Bypass per Dr. Hanson.	Mr. Donahue calls for a very costly fish screen (> $20 million) to prevent juvenile fish from entering the Chowchilla Bypass. Drs. Moyle and Kondolf believe that flows can be managed such that fish screening at this location is not necessary.
3. Culvert at RM 227 impedes fish passage per Dr. Hanson.	Dr. Hanson calls for removal of the culvert and earthen dam at RM 227. However, this culvert no longer exists – it was washed out this year. Dr. Kondolf concludes that no action is necessary because there is no current passage barrier and it is unclear whether this structure will be rebuilt. However if this structure is rebuilt, then permits from the Army Corps of Engineers, State Lands Commission and CDFG will likely be necessary. No cost estimates are provided in Table 1 because it is not clear whether this culvert will be rebuilt.

4. In Reach 2A (RM 225-216), levee instability related to channel capacity was indicated by Dr.Harvey at unspecified high flows.	Dr. Harvey recommends construction of 20 miles of new levees on both sides of the river at RM 225-216 at an unrounded cost of $20 million to contain high flows and solve a levee stability problem. Dr. Kondolf does not believe this action is necessary given that the channel in this area has adequate capacity and stability and that new levees are not required to accommodate restoration flows. Thus, no cost estimates are provided in Table 2.
5. Levee seepage loss in Reach 2A RM 225-216 was indicated by Dr. Harvey at unspecified flows.	Dr. Hradilek recommends construction of 20 miles of very expensive (>$90 million) slurry walls to solve a levee seepage problem in RM 225-216. However, Dr. Deverel believes it is not at all clear whether seepage will be a problem in this area at the flows recommended by Dr. Kondolf and that slurry walls are not necessary. Thus, no cost estimates are provided in Table 2.
6. A number of unscreened pump diversions are present in this reach, according to the 2001 CDFG report. These unscreened diversions may cause entrainment mortality to out-migrating juvenile fish per Dr. Hanson.	Mr. Donahue suggests screening approximately 10 riparian pump diversions in this reach. Dr. Moyle believes that the screens are not necessary but would be beneficial. The cost estimate in Table 2 is based on recent fish screening costs for pump diversions from the Washington Department of Fish and Wildlife, which I believe to more reasonable and appropriate than the significantly higher costs presented by Mr. Donahue.

Issues in Reach 2B, Chowchilla Bypass (RM 216) to Mendota Dam (RM 205)

POTENTIAL REACH 2B ISSUES	PROPOSED TREATMENT MEASURE AND RATIONALE
1. Sections of levees in this reach may not have the necessary capacity to contain flows up to 4,500 cfs per Dr. Harvey.	Dr. Harvey recommended raising and rebuilding 22 miles of levee system on both sides of the river to accommodate proposed restoration flows and insure stability. Dr. Hradilek's cost estimates exceeded $9 million dollars (not including other construction costs and contingencies). However, noting a report by Dr. Harvey (MEI 2000) which concluded that it would be necessary to rebuild only two miles to accommodate flows, Dr. Kondolf concluded that it would be unnecessary to build 22 miles of levees. The cost estimates for rebuilding two miles of levees would run approximately $2 million dollars utilizing Dr. Hradilek's numbers, which I found to be reasonable.
2. Sections of levees within this reach have some degree of seepage issues per Dr. Harvey.	Dr. Hradilek recommended constructing 22 miles of slurry walls to mitigate for flow loss due to seepage for a cost exceeding $97 million. However, Dr. Deverel determined that slurry walls are not necessary, (especially within the Mendota Pool backwater area), and that any seepage problems could be adequately addressed by constructing a standard agricultural drainage system. In Table 3, I assume a worst-case scenario requiring such a drainage system for the entire 22 miles. Such a system would cost about $7 million.

3. The existing fish ladder at Mendota Dam is in disrepair and could impede salmonid passage during migration per Dr. Hanson.	Dr. Kondolf agrees that repairing the fish ladder at Mendota Dam is necessary to facilitate salmonid passage. My cost estimate is provided in Table 3. I am informed that Central California Irrigation District (CCID) has proposed to rebuild Mendota Dam,. Presumably CCID could (and may be required to) ensure fish passage as part of the new dam.

4. Mendota Pool contains a number of unscreened canals that divert water to and from the pool. These canals include: Columbia Canal, Helm Ditch, Fresno Slough, Delta-Mendota Canal, FCWD Canal, Main Canal, and the Outside Canal. These diversions could create false pathways that could lead to mortality among migrating juvenile and adult salmonids as per Drs. Harvey and Hanson.	Dr. Hradilek and Dr. Harvey call for a 9,800 ft. fish bypass channel around Mendota Pool with additional hydraulic control structures for cost exceeding $20 million. This included clearing, grubbing, channel excavation, levees on each side of the channel, and slurry walls on each side of the new channel. Mr. Donahue calls for a series of structures to provide screened passage, fish barriers, siphons, and flow control devices, with rounded costs exceeding $31 million dollars. Total cost of the Hradilek/ Harvey/Donahue bypass and related facilities would exceed $51 million. Dr. Moyle concludes that such a system is unnecessary because other possible means for preventing fish entrainment could be employed at a fraction of the cost. One option is to install an inexpensive geotextile curtain at three locations within the Mendota Pool to provide necessary fish barriers. (See Figure 1). These woven barriers would be designed to be maintained and replaced as necessary. Such systems have been successfully deployed in other projects which required isolating fish from diversions and intakes. Table 3 shows that the installed costs would be less than $300,000.

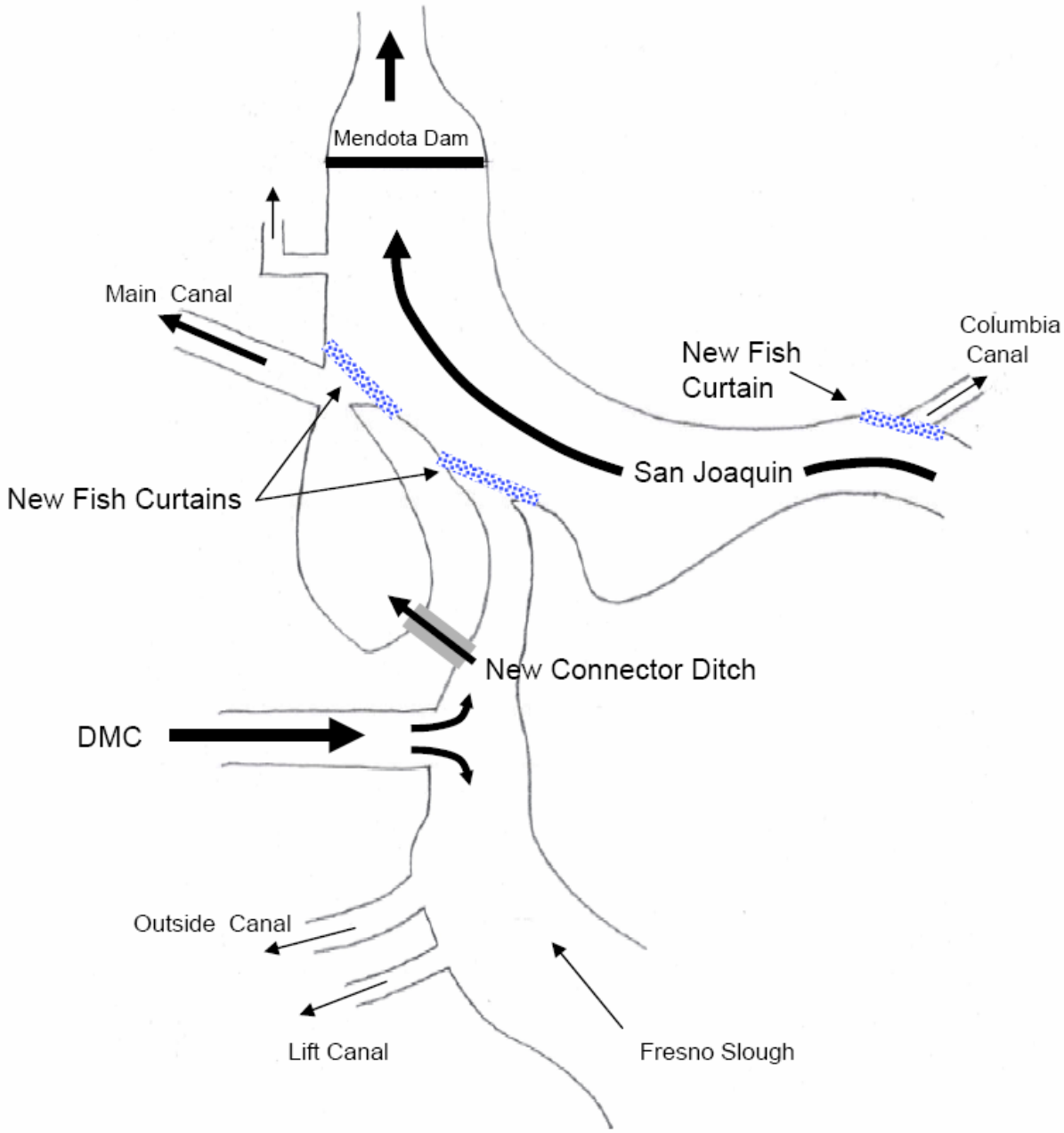

Figure 1: Mendota Pool Permeable Fish Curtain System

Issues in Reach 3, Mendota Dam (RM 205) to Sack Dam (RM 182)

POTENTIAL REACH 3 ISSUES	PROPOSED TREATMENT MEASURE AND RATIONALE
1. Four unscreened pump diversions are present in this reach which could entrain juvenile fish per Dr. Hanson.	Dr. Hanson calls for fish screens at these pump diversions. Dr. Moyle believes that while it is not necessary to screen these facilities, it would be beneficial. The cost estimate in Table 4 is based on recent fish screening costs for pump diversions from the Washington Department of Fish and Wildlife, which I believe to more reasonable and appropriate than the significantly higher costs presented by Mr. Donahue
2. Fish migration at Sack Dam could be a passage barrier problem per Dr. Hanson.	Mr. Donahue calls for installing a fishway. Dr. Kondolf's believes that this is not necessary, but that replacing the flash boards and doing minor repairs may be beneficial. Table 4 provides a cost estimate for these measures.
3. The Arroyo canal was identified by Dr. Hanson as a barrier and impediment to salmonid migration.	Dr. Hanson and Mr. Donahue call for a fish screen at the Arroyo canal. Drs. Moyle and Kondolf agree that screening this diversion is necessary. I used Mr. Donahue's estimate for this large fish screen in Table 4 because I found it to be reasonable.

Issues in Reach 4 Sack Dam (RM 182) to Merced River (RM 118)

POTENTIAL REACH 4 ISSUES	PROPOSED TREATMENT MEASURE AND RATIONALE
1A The Sand Slough control structure was identified by Dr. Hanson as barrier to fish migration.	Mr. Donahue calls for a fishway and screen facility for $29 million dollars to solve the passage problem. Dr. Kondolf's suggests that a fish screen is not necessary and sand bags placed in the notch of the weir or flash boards, would be sufficient to prevent fish and flow from entering the Eastside bypass at low flows. At high flows water and some fish will travel into and through the bypass. No cost estimate is necessary.

1B. Sand Slough control structure would need to be modified to allow 4500cfs of flow to enter the SJR, per Dr. Harvey.	Dr. Harvey calls for replacing the Reach 4B headgate structure and building a bifurcation structure at the Sand Slough control structure to allow 4500 cfs to enter the main river channel, but Friant expert reports provide no information on costs or design for this. Dr. Kondolf explains that such a headgate/ bifurcation system is potentially necessary depending on whether Reach 4B is modified to provide increased capacity (Dr. Kondolf characterized this related rehabilitation treatment as not necessary but beneficial). Due to time constraints, I was unable to develop a site-specific cost estimate for this measure. Therefore, in Table 5 I have used a surrogate cost -- the headgate/bifurcation cost estimate from Mr. Donahue for the Mendota Dam bypass channel which is roughly similar in purpose and size and which I found to be reasonable in that instance. Absent additional design information for the Sand Slough headgate/bifurcation measure, this surrogate estimate may or may not be appropriate.
2. The Mariposa bypass control structure could impede fish passage, per Dr. Hanson.	Mr. Donahue recommended building two fishways for a cost of $1.2 million dollars. Dr. Kondolf believes that this structure is not a passage barrier and thus no cost estimate is provided in Table 5.

3. A compound channel should be built to re-establish a planform that promotes improved habitat value per Dr. Harvey.	Dr. Hradilek recommends expanding the channel capacity and building set-back levees for a cost of around $20 million. He also recommends building a compound channel for a cost of $9 million. Dr. Kondolf believes that the proposed levee set-back is not necessary but would be beneficial. As for building an expensive compound channel, Dr. Kondolf believes this disturbance of existing riparian habitat is unnecessary and fluvial processes should gradually reclaim and create aquatic habitat. Table 5 provides my cost estimates consistent with these determinations by Dr. Kondolf.

4. Dr. Harvey reported that seepage beneath the levees is a problem in this reach.	For 21 miles on both sides of the river channel, Dr. Hradilek proposes building slurry walls at an approximate cost of $195 million to mitigate for seepage losses, while Dr. Harvey recommends building drains. Dr. Deverel does not believe that the assumption of widespread seepage requiring such extensive mitigation measures is justified by current information, but to the extent that seepage occurs and requires mitigation in certain areas, he recommends building a series of agricultural drains which are much more cost-effective than slurry walls. Dr. Deverel also points out that for approximately 6 of the 42 miles for which Friant experts assumed a seepage mitigation requirement, the river is abutted by wildlife refuge lands where mitigation presumably would not be necessary, and seepage could potentially be beneficial. Table 5 uses what I believe is a conservative assumption of building agricultural drains on both sides of the river for 36.3 miles.

IV. Cost Estimate Tables

Table 1: Reach 1, Friant Dam, RM 266 to Gravelly Ford, RM 229

Treatment Type	*Level of Need*	*Quantity & Unit Cost*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimate*	*Comments*
1.Removal of culvert @ RM 253, as per Dr. Hanson	Not necessary, Not a passage barrier at this time, as per Dr. Kondolf	0	0	0	Culvert was recently washed out.
2. Reconnect side channel as per Dr. Hanson	Not necessary, but beneficial, as per Dr. Kondolf	14 acres@ $12K per acre	0	$168,000.00	Cost Estimates from Dr. Hradilek report
3. Gravel augmentation for spawning habitat as per Dr.Hanson	Not necessary, but beneficial as per Dr. Kondolf	103,704 cubic yards @$15 /yd	0	$1,556,000.00	Cost estimate provided by Dr. Hradilek Report
4. Fill in -channel dredger pits as per Dr's Hanson and Harvey	Not necessary, but beneficial as per Dr. Kondolf	507,421 cubic yards @ $6 / cu. yd.	0	$3,045,000.00	Cost estimate from Dr. Hradilek's Report
5. Construct multi-stage channel, as per Dr. Hradilek	Not necessary, but beneficial, as per Dr. Kondolf	54,476 cubic yards @ $6 per yd.	0	$327,000.00	Cost estimate from Dr. Hradilek Report
6. Construct isolation dikes As per Dr. Harvey	Not necessary, but beneficial, as per Dr. Kondolf	304,116 cubic yards @ $6 per yd.	0	$1,825,000.00	Cost estimate provided by Dr. Hradilek Report

Treatment Type	*Level of Need*	*Quantity & Unit Cost*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimate*	*Comments*
7. Construct fish screens for numerous riparian pump diversions which varied from 1 to 63 cu. ft. per second (cfs). 94% of the pumps diverted 1 to 10 cfs & the balance varied from 16 to 63 cfs. As per Donahue	Not necessary, but beneficial, as per Dr. Kondolf	113 pump stations, totaling 431 cfs (max. diversio ns @$4,300 per cfs	0	$485,900.00	Costs per cfs provided by WA Dept. of Fisheries. CDFG (2001)provided the number and locations of diversions.
Reach 1 Subtotal				$7,406,000.00	

Table 2: Reach 2A, Gravelly Ford to Chowchilla Bypass, RM 216

Treatment Type	*Level of Need*	*Quantity & Unit Price*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but BeneficialCost Estimates*	*Comment*
1. Construct Chowchilla By-Pass Structure as per Dr. Hanson	Not Necessary, Not a passage barrier, as per Dr. Kondolf	0.	0	0	
2. Construct fish screen at Chowchilla By-Pass as per Dr. Hanson Report.	Not Necessary, Not a fish passage barrier As per Dr. Kondolf	0	0	0	Management of the radial gates would eliminate the need for a fish screen

Treatment Type	*Level of Need*	*Quantity & Unit Price*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but BeneficialCost Estimates*	*Comment*
3. Remove earthen dam and culvert at RM 227 that provides access to gravel mine. Regrade this area to match natural river bed topography. Per Dr. Hanson	Not necessary. Not a passage barrier at this time.	0	0	0	
4. Construct 20 miles of new south and north bank levees, ~RM 225-216). Per Dr. Harvey	Not necessary because of adequate channel capacity & stability. As per Dr. Kondolf	0	0	0	
5. Construct 20 miles of slurry walls along the new south and north bank levees ~RM 225-216. to provide seepage loss and damage. As per Dr. Hradilek Report	Not necessary because of limited amounts of seepage. As per Dr. Deverel	. 0	0	0	
6. Construct fish screen for numerous riparian pump diversions, which vary between 3 and 16 cfs. As per Dr. Hanson Report.	Not necessary, but beneficial, as per Dr. Kondolf Report	10 pump diversions totaling ~53cfs max. diversions $4,300/cfs		$227,900.00	Costs per cfs provided by WA Dept. of Fisheries. CDFG (2001) provided the number and locations of diversion.
Reach 2A Subtotal				$227,900.00	

Table 3: Reach 2B, Chowchilla Bypass to Mendota Dam, RM 205

Treatment Type	*Level of Need*	*Quantity& unit Price*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimates*	*Comments*
1. Rebuild and raise levees on both sides of the river, about 22 miles. RM As per Dr.Hradilek Report.	Necessary only to a limited 2 mile section to provide greater channel capacity per Dr. Kondolf	234,000 cu yds. @ $9.00 per cu. yd.	$2,106,000.00	0	Cost figures per mile were extrapolated from Dr. Hradilek's Report
2. Construct slurry walls on both sides of the river, about 22 miles (RM 216-205) . As per Dr. Hradilek Report.	Not necessary because of other options for controlling levee seepage. As per Dr. Deverel.	0	0	0	
3. Construct a drainage system on both sides of the river, about 22 miles (~RM 216-205). As per Dr. Deverel Report	Potentially necessary to control seepage from the levee system in areas where mitigation is needed, per Dr. Deverel.	$320K per mile. O&M costs ~10k per year, to cover elect.etc.	$7,050,000.00	0	12 in perf. Pipe in 15 ft.x2 ft trench, filled with drain gravel & backfilled. Includes ~ 20 pumps and sump stations
4. Repair existing fish ladder at Mendota Dam. As per Dr. Kondolf Report	Potentially necessary (unless a new dam with fish passage is built) to provide fish passage, per Dr. Kondolf	Lump sum	$100,000.00	$0.00	I am informed that Central California Irrigation District (CCID) is proposing to rebuild the Mendota Dam. If so, CCID may be required to ensure fish passage for the new dam

Treatment Type	*Level of Need*	*Quantity& unit Price*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimates*	*Comments*
5. Construct fishway (bypass channel) around Mendota Pool and install fish screens at the upstream and downstream sections of the bypass channel. As per Dr. Hradilek Reports	Not necessary because of other fish barrier options that would replace the bypass channel and fish screen needs. As per Dr. Kondolf and Dr. Moyle	0	0	0	Even if the bypass channel strategy were selected, some of the expensive items included in the Hradilek/ Donahue estimate are not necessary. The bypass could be built at the same capacity as Reach 2B to allllow all SJR flow to be routed around Mendota Pool. This obviates the need for a fish screen at the upstream end. At the downstream end, a simple fish barrier (like the current DFG Hills Ferry barrier) could direct up-migrating adults into the bypass channel. There would be no need for additional screening. Per Dr. Moyle.

Treatment Type	*Level of Need*	*Quantity& unit Price*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimates*	*Comments*
6. Install fish barrier system at three locations in Mendota Pool to keep salmon within the SJR and isolate them from the DMC, Main Canal, Outside Canal, Columbia Canal, and Fresno Slough. As per Dr. Kondolf and DR. Moyle Reports	Potentially necessary (unless bypass channel is built) to keep salmon within SJR and prevent them from entering numerous canals, per Dr. Kondolf and Dr. Moyle	Estimated total length for 3 locations is 1000 ft. x 10 ft. depth.	$200K for 3 barriers. Installation cost $50K per barrier Estimated project cost is $350,000.00		Refer to attached product specs. and diagram of fish barrier locations. Also, refer to attached case studies of similar applications.
Reach 2B subtotals			$9,606,000.00		

Table 4: Reach 3, Mendota Dam to Sack Dam, RM 182

Treatment Type	*Level of Need*	*Quantity& Unit Costs*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimates*	*Comment*
1. Construct fish screens for numerous riparian pump diversions, which varied from 1 to 2 cfs. As per Dr. Hanson	Not necessary but beneficial, per Dr. Kondolf and Dr. Moyle	4 pumps totaling 5 cfs max. diversion. $4,300 /cfs	0	$21,500.00	Unit price from WA Dept. of Fisheries

Treatment Type	*Level of Need*	*Quantity& Unit Costs*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Estimates*	*Comment*
2. Repair existing fish ladder at Sack Dam . As per Dr. Hanson	Dr. Kondolf' suggests that this treatment is not necessary but would be beneficial	Lump sum	Lump sum	$50,000.00	Estimate is based on minor repairs and replacement o f flash boards
3. Construct fish screen at Arroyo Canal as per Dr. Hanson	Dr. Kondolf's' report suggests that this treatment is necessary	Lump Sum	$4,521,000.00		Estimate provided by HDR , Mr. Donahue
Reach 3 Subtotal			$4,521,000.00	$71,500.00	

Table 5: Reach 4, Sack Dam, to Eastside Bypass at RM 135

Treatment Type	*Level of Need*	*Quantity& Unit Cost*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Est.*	*Comments*
1A. Construction of Sand Slough fishway and screen to Eastside Bypass, per Dr. Hanson	Not necessary, Not a passage barrier. Minor modifications will suffice.As per Dr. Kondolf	Lump Sum	0	$50,000.00 To modify	Operation of the Sand Slough gates would help fish passage. No screen necessary
1B. Dr. Harvey recommended replacing the headgate structur and building a SJR bifurcation	Dr.Kondolf thinks this treatment is necessary.	Lump Sum	$3,000,000.00		Designs and cost estimates were utilized from the Donahue Report

Treatment Type	*Level of Need*	*Quantity& Unit Cost*	*Necessary or Potentially Necessary cost Estimate*	*Not Necessary but Beneficial Cost Est.*	*Comments*
2. Construction of Mariposa fishway per Dr. Hanson's Report.	Not necessary, as per Dr. Kondolf' Report	0	0	0	Not a fish passage problem
3. Construction of a total of 44 miles of set-back levees RM 168-RM 135.9. (includes both banks, as well as clearing grubbing). As per Dr. Harvey Report.	Not necessary, but beneficial, as per Dr. Kondolf Report	640 ac. @ $2.5k / ac. 2,106,368 cu. Yds. @ $9.00 per cu. yd.	0	$1,600,000 Clearing /Grubb $18,958,000Levee construction	Cost estimate provided by Dr. Hradilek Report
4. Channel excavation and reconfiguration of a total of 44 miles (includes both sides of SJR). (RM's 168-135.9). As per Dr. Hradilek's Report	Not necessary Riparian habitat would be damaged for no net gain in habitat quality. As per Dr.Kondolf's report.	0	0	0	Channel reconfiguration will occur naturally as higher flows change the SJR. Not necessary to over engineer.
5. Construct Slurry walls along both sides of the river for a total of 44 miles. RM's 168-135.9. As per Dr. Hradilek's Report	Not necessary to utilize slurry walls. Drainage systems better. As per Dr. Deverel's	0	0	0	No costs for slurry walls due to utilizing other methods for managing seepage
6. Construct a drainage system on both sides of the SJR, for about 36.3 miles. As per Dr. Deverels Report	May be necessary in some areas to control seepage beneath the levees, per Dr. Deverel	$320K per mile. Does not include O&M costs.	$11,616,000.00		Drains not necessary in refuge areas
Reach 4 Subtotal			$14,616,000.00	$20,608,000.00	

Table 6: Summary, Estimated Rehabilitation Costs Per Reach

Comparison of Friant Expert Costs with NRDC Expert Costs

Reach	***HDR Estimates --Dr. Hradilek***	***HDR Estimates -- Mr. Donahue***	***NRDC Estimate – Necessary or Potentially Necessary***	***NRDC Estimate -- Unececessary But Beneficial***
Reach 1	$6,918,000.00	$11,130,000.00(Costs for all pump screens , 5 reaches)	0	$7,406,000.00
Reach 2A	$237,149,000.00	$30,166,000.00	0	$227,900.00
Reach 2B	Combined costs for 2A & 2B	$31,530,000.00	$9,606,000.00	$50,000.00
Reach 3	0	$4,521,000.00	$4,521,000.00	$75,000.00
Reach 4	$225,240,000.00	$30,329,000.00	$14,616,000.00	$21,793,000.00
Reach 5	0	0	0	0
Contractor 8% Indirect Costs	$21,933,000.00	Included in the rounded costs	$2,299,440.00	$2,364,080.00
Subtotal Construct. Cost	$491,240,000.00	N/A	$31,042,440.00	$31,915,080.00
Construction contingency 25%	$122,810,000.00	Included in rounded costs	$7,760,610.00	$7,978,770.00
Total Estimated Construction Costs	$614,050,000.00	N/A	$38,803,050.00	$39,893,850.00
Other Project Costs		Included in rounded costs		
Planning & Engr. Design 12%	$73,686,000.00	Included in rounded costs	$4,656,366.00	$4,787,262.00
Construction Man. 10 %	$61,405,000.00	Included in rounded costs	$3,880,305.00	$3,989,385.00

Reach	*HDR Estimates --Dr. Hradilek*	*HDR Estimates -- Mr. Donahue*	*NRDC Estimate – Necessary or Potentially Necessary*	*NRDC Estimate -- Unececessary But Beneficial*
Environmental Documentation and Permits 7%	$42,984,000.00	Included in rounded costs	$2,716,213.00	$2,792,569.00
Subtotal Other proj. costs	$178,075,000.00	N/A	$11,252,884.00	$11,569,216.00
Total Costs	$792,125,000.00	$107,676,000.00	$50,055,934.00	$51,463,066.00

V. Expert Qualifications:

I have over 25 years of experience in the areas of environmental/watershed planning, fisheries/stream restoration, wetland delineation/mitigation, and project management. As a licensed California Engineering Contractor, I am experienced in project design and construction and have applied this expertise on numerous stream rehabilitation projects which involved project supervision, construction management, permitting, and cost estimates. I have supervised the design and implementation of numerous stream restoration projects including projects involving fishways, fish bypass channels, small dam removal, historic channel rewatering, riparian revegetation, wetland construction, sediment removal, spawning bed construction, side channel construction, bank stability, irrigation structures, and in- channel enhancement of salmonid habitat. Many of the projects on which I have worked involved multi-million dollar budgets and complex, innovative restoration techniques. A great deal of my experience has been in the Mono Basin and Eastern Sierra where I participated in numerous restoration projects on Rush and Lee Vining Creeks, Walker River and other projects. This included extensive work in the early 1990's as the court-appointed Restoration Specialist overseeing restoration work on Parker and Walker Creeks for El Dorado County Superior Court Judge Terrance Finney.

Representative projects on which I have worked as a restoration specialist include:

Ashland Creek (Design and Construction of 2 Natural Fishways, and Dam Removal)
Bear Creek (Salmonid Enhancement, Design & Construction of Alcove, Sidechannel, & Instream Structures)
Bear Creek (Side Channel, Salmonid Habitat Impovement, Gravel Removal Mitigation)
Clear Springs Golf Resort (Wetlands/Riparian Enhancement)
Dead Indian Plateau (Wildlife Habitat Mapping, 70,000 Acres)
E. Fork Walker River (Sediment Removal, Monitoring)
Ecological Inventory (Soils, Geomorph & Veg., S. Cascades, 40,000 Acres)
English Pond Remediation (Sediment Removal Plan)
Evans Creek (Fish Bypass Channel Design)
Fort Creek (Remediation Design & Construction)
Geothermal EIS at Newberry Crater
Gazos and Pescadero Creeks (Aquatic Habitat Improvement, Design and Construction)
Hunter Creek (Intertidal Habitat Improvement)
Illinois Valley Golf Course (Wetland Mitigation & Design)
Instream Salmonid Habitat Restoration Design & Construction for Numerous Streams in S. OR & N. CA
Laurel Pond (Wetland Design for Waterfowl Habitat & Wastewater Treatment
Lazy Creek (Restoration, Design & Construction)
Lost River (Erosion Control Study, 120 mi.)
Mono Lake (Stream, Wetland & Riparian Restoration, Design & Construction)
Moss Landing (Salt Marsh Restoration Construction)
Mount Ashland Ski Resort (Wetland Assesment, & Ski Run Crossing Design)
N. Mountain Park Natural Area (Wetland Restoration/Enhancement Plan and Construction)
Oak Knoll Golf Course (Wetland/Pond Design & Construction)
Parker Creek (Stream Remediation & Construction)
Rio Puerco Basin (Range Vegetation Study, 180,000 acres)
Roca & Paridise Creeks (Stormwater/Stream Treatment, Design & Construction)
Rogue Valley Golf & Country Club (Stream Restoration, Design & Construction)
Snake River (Riparian & Wetland Habitat Mapping, 160 Miles of River)
South Fork Little Butte Creek (Stream Restoration)
Strawberry River (Stream Restoration Plan, 22 mi.)
Summers Meadow (Riparian Habitat Improvment)
Trout Creek (Riparian Restoration Plan, 170 mi.)
Tulana Farms (Klamath Lake Riparian & Wetland Restoration)
Tunitas Creek (Road Removal and Erosion Control)
Wagner Creek (Flood Damage Assesment & Restoration Plan)
Weber Creek (Stream Restoration from Dam Sediment Release)
Wetland Delineation and Mitigation for 35 Projects in Oregon and California
Valley of the Rogue State Park (Vegetation Mapping & Wetland Determination)

Relevant projects within the past three years include:

Participated in San Joaquin River Restoration Planning Effort as part of the Jones and Stokes Planning Team

Completed a recent preliminary rehabilitation survey and photographic log of the San Joaquin River from Friant Dam to the confluence with the Merced River.

Rush Creek and Silver Lake, Delta Rehabilitation & Sediment Removal

North Mountain Park, Wetland Creation and Salmon Enhancement in Bear Creek

Riverwalk Park, Design and Construction of Treatment Wetlands and Creation of Side Channel and LWD Cover Elements for Salmonids

Omak Creek, 1300 Feet of Channel Reconfiguration to Provide Salmonid Habitat

Muddy Brook, Sediment Removal and Creek Restoration to Mitigate for Unlawful Sediment Release from Upstream Dam

Four Biological Assessments Regarding Impacts of Waste Water Treatment Plants and Infrastructure on Salmon Habitat in Yaquina Bay, & Ten-Mile Creek, Oregon

North Phoenix Road, Wetland Delineation, Mitigation, and Construction of Wetland System and Riparian Habitat Enhancement Using Irrigation Return H2O

Horn Creek, Realignment and Riparian Habitat Restoration

Clearwater River, Design and Construction of Wetland Restoration Project

My education, professional registrations, and basic professional history are as follows:

Education: B.S. University of Oregon, (Community Service and Public Affairs, in Biology & Geography); Graduate Work, Portland State University in Geography; Army Engineering School (4 mo.), Ft. Belvoir, Virginia.

Registrations: Engineering Contractors License, California License No. 599428; General Contractor, Oregon License No. 137378; Oregon Wetland Consultant.

Work Experience: The Nature Conservancy, Field Biologist (1975-1976); Army Corps of Engineers, Environmental Planner (1976-1977); U.S. Fish & Wildlife Service, Biologist/Program Manager (1977-1979); Principal, Northwest Biological Consulting (1979-Present).

VI. Prior Expert Testimony

I have not provided any expert trial or deposition testimony within the previous four years.

VII. Publications

My publications within the past ten years are:

English, Scott, M. 1978. Distribution and Ecology of Great Blue Heron Colonies on the Willamette River Oregon. National Audubon Society Research Report No. 7.

Holstein, Michael., and Scott English. 2003. "Golf for the Fun of It," Madrone Press Ashland, Oregon. 220 Pages.

VIII. Statement of Compensation

I am charging NRDC a discounted public interest rate of $75 per hour for work relating to the preparation of this report. My hourly rate for deposition testimony is $175 per hour.

IX. Information Considered, References, etc.

The information I considered in preparing this report is set forth in Attachmet A.

DATED: September 19, 2005

Scott English

ATTACHMENT A -- INFORMATION CONSIDERED

In developing my expert report, I considered the following information and materials:

Etcheverry. B.A. 1916, Irrigation Practices and Engineering . Volume III, Irrigation Structures and Distribution System . Mcgraw-Hill Book Company, London, UK.

Bell, Milo C., 1986. Fisheries Handbook of Engineering Requirements and Biological Criteria. U.S. Army Corps of Engineers. Portland District, Portland, Oregon.

Fisheries Restoration and Irrigation Mitigation Program. 2005. Montana Fish, Wildlife and Parks.

McBain and Trush, Inc., 2002. San Joaquin River Restoration Study Background Report. Prepared for the friant Water Users authority, Lindsay, CA and Natural Resources Defense Council, San Francisco, CA

Mussetter Engineering, Inc. 2005. Expert Report of Dr. Michael D. Harvey Regarding Geomorphic Requirements for Restoration of an Anadromous Fishery in the Upper San Joaquin River, California.

Expert witness reports (*NRDC v. Rodgers, et al*) of: Dr. Charles Hanson, Mr. Edward Donahue, Dr. Peter Hradilek, Dr. Michael Harvey, Tony Corriea, Dr. Robert McCusick, Dr. Kenneth Schmidt, Merlynn D. Bender, Joseph P. Kubitschek, Donald J. Smith, Dr. Clair B. Stalnaker, Tracy B. Vermeyen, Dr. Rodney J. Wittler, Ph.D, Dr. Matt Kondolf, Dr. Peter Moyle, Dr. Steve Deverel, Dr. Michael Deas.

Supplemental expert witness reports (*NRDC v. Rodgers, et al.*) of Dr. Peter Moyle, Dr. Matt Kondolf, and Dr. Steve Deverel.

Technical Materials, diagrams, and photographs from Gunderboom Company and Elastec Company regarding woven geotextile materials utilized in a fish barrier applications.

Case study from Elastec regarding the use of geotextile fish barriers in the Hudson river to prevent Shortnose and Atlantic Sturgeon from entering polluted water.

Fish screens and fish ladder specifications and requirement from the Washington Department of Fish and Game Screen Department and also from the Ducks Unlimited Office in California.

Levee Drainage information from the San Louis Drainage feature.

Vertical Barrier systems for mitigation of seeping levees from GSE Inc.

Fact Sheet from the BC Ministry of Agriculture regarding the economics of subsurface drainage.

Personal communications with the following individuals:

Jared Huffman,NRDC
Monty Schmitt,NRDC
John Cain,Natural Heritage Institute
Peter Vorster, Bay Institute
Dr. Mathew Kondolf, UC Berkeley
Dr. Peter Moyle, UC Davis
Dr. Steve Deverel, Hydrofocus
Carl McElvaney, Drain Systems Inc.
Bob Dove, Gunderboom Geotextile Products
Anthony Will, Cooper Crane company
Steve Day, Geosolutions
Terry Baker, GSE Company
Robert Marmaduke, Washington Department of Fish and Game
Bruce Dormandy, San Clemente Fish Barrier Project
Dr. Greg Pasternack UC Davis
Dr. Joe Merz, UC Davis
Mark Wilkie, ELASTEC Geotextile Products
Ed Rowe, United Pipe