A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

Project Information

1. **Proposal Title:**

   A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

2. **Proposal applicants:**

   David Vogel, Natural Resource Scientists, Inc.

3. **Corresponding Contact Person:**

   David Vogel
   Natural Resource Scientists, Inc.
   P.O. Box 1210 Red Bluff, CA 96080
   530 527-9587
   dvogel@resourcescientists.com

4. **Project Keywords:**

   Anadromous salmonids
   Fish Passage/Fish Screens
   Water Resource Management

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Fish Passage

8. **Type of applicant:**

   Private for profit

9. **Location - GIS coordinates:**

Latitude:	37.514
Longitude:	-120.370
Datum:	NAD27

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

Merced River between Crocker-Huffman Dam upstream to Merced Falls.

10. **Location - Ecozone:**

    13.3 Merced River

11. **Location - County:**

    Merced

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    18

15. **Location:**

    California State Senate District Number: 12

    California Assembly District Number: 26

16. **How many years of funding are you requesting?**

    1

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

       Single Overhead Rate: 40

       Total Requested Funds: $160,758

    b) Do you have cost share partners already identified?

Yes

If yes, list partners and amount contributed by each:

Merced Irrigation District $10,000

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CALFED program.

ERP-01-N48	**Juvenile Salmon Migratory Behavior Study in the North, Central, and South Delta**	**ERP**
Unknown	**Delta Cross Channel Studies**	**Unknown**

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

No

Have you previously received funding from CVPIA for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CVPIA program.

2001-K203	**Merced River Water Temperature Management Feasibility Study**	**AFRP**
	Report Title: Losses of young anadromous salmonids at water diversions on the Sacramento and Mokelumne Rivers	**AFRP**
	Report Title: Juvenile Chinook Salmon Radio-Telemetry Study in the Northern Sacramento-San Joaquin Delta, January-February 2000	**AFRP**
	Report Title: Juvenile Chinook Salmon Radio-Telemetry Study in the Southern Sacramento-San Joaquin Delta, December 2000-January 2001	**AFRP**
FWS Agreement #113320J027	**Merced River Wing Dam Monitoring, 2000-2002**	**AFRP**

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

    No

    Please list suggested reviewers for your proposal. (optional)

21. **Comments:**

    17a: Overhead is 40% of charge-out rate.

Environmental Compliance Checklist

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This is a feasibility only study.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

Land Use Checklist

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   Feasibility investigation only.

4. **Comments.**

Conflict of Interest Checklist

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

David Vogel, Natural Resource Scientists, Inc.

Subcontractor(s):

Are specific subcontractors identified in this proposal? No

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

David Vogel Natural Resource Scientists, Inc.

Keith Marine Natural Resource Scientists, Inc.

Comments:

Budget Summary

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Perform detail physical habitat inventories of the river reach between Crocker-Huffman Dam and Merced Falls Dam, defining interrelationships between quality and quantity of habitats available for potential chinook salmon and steelhead production and the opportunities and constraints of anadromous salmonid reintroduction	1440	41356	8270	21750	12406	0	0	23625	107407.0	33086	140493.00
2	Project Management	320	8811	1762	2643	0	0	0	0	13216.0	7049	20265.00
		1760	50167.00	10032.00	24393.00	12406.00	0.00	0.00	23625.00	120623.00	40135.00	160758.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=160758.00

Comments.

Budget Justification

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

Direct Labor Hours. Provide estimated hours proposed for each individual.

Principal Investigator: 480 hours Fishery Biologist: 480 hours Field Biologist: 480 hours Data Entry/Clerical: 320 hour

Salary. Provide estimated rate of compensation proposed for each individual.

Principal Investigator: $48.91/hour Fishery Biologist: $26.90/hour Field Biologist: $17.45/hour Data Entry/Clerical: $16.88/hour

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

Principal Investigator: 20% of salary Fishery Biologist: 20% of salary Field Biologist: 20% of salary Data Entry/Clerical: 20% of salary

Travel. Provide purpose and estimate costs for all non-local travel.

Travel entails field site visits and includes mileage, fuel, lodging and meals. Estimated cost: $21,750

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

All supplies & expendables pertain to field supplies. Estimated cost: $12,406.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

None.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

None.

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Project management tasks and associated costs (based on percentage of time) include: reporting requirements (4,053), report preparation ($6,080), project meetings ($3,040) and overall project oversight ($7,093).

Other Direct Costs. Provide any other direct costs not already covered.

Dredge Rental-$1,000; ADCP Rental-$3,000; Underwater Video Rental-$750; GPS Rental-$875; Jet Boat Rental & Fuel-$18,000.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Overhead rate is 40% of charge-out rate and includes workers compensation, office rent, phones, commercial general liability insurance, state disability insurance, utilities, computer hardware and software, furniture, office equipment and supplies, accounting payroll, and unbillable labor of support staff.

Executive Summary

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

The Merced River is the southernmost Central Valley stream presently inhabited by anadromous salmonids. The Merced River, its channel, watershed and riparian corridor, has been significantly altered by gold and gravel mining; dam construction for power production, irrigation, and flood control; agriculture; and urbanization. Compared to their historic access to spawning and rearing habitat in higher elevation river reaches, chinook salmon are restricted during all of their freshwater life stages to utilize the lower Merced River up to Crocker-Huffman Dam (River Mile 52), which is the upstream barrier for fish migration and the location of the Merced River Hatchery. Crocker-Huffman Dam along with three upstream dams (Merced Falls Dam [RM55], McSwain Dam [RM56], and New Exchequer Dam [RM62] proceeding in an upstream direction) regulate flows in the lower Merced River. As a result, natural salmon production is affected by limited accessible stream reach and alterations of stream channel, flow and water temperatures. Crocker-Huffman Dam forms a low-head, run-of-the-river diversion serving the Merced IDs Main Canal. The three mile tailwater river reach between the Crocker-Huffman and the Merced Falls dams is riverine in nature, benefits from cool temperature, hypolimnetic reservoir releases throughout its length, and supports a good sport fishery for trout indicating that habitat conditions may be suitable for anadromous salmonid spawning and rearing. However, this river reach is currently not accessible to anadromous salmonids since the existing fishway on Crocker-Huffman Dam is non-operational. Due to the proximity of the tailwater reach above Crocker-Huffman Dam to the deep reservoir releases, water temperatures are likely to be cooler and more suitable for salmonid spawning and rearing for longer periods of the year than in river reaches downstream of Crocker-Huffman Dam, particularly during drought years. Additionally, there are no fish screens on the diversions upstream of the dam. Re-establishing anadromous salmonid access to the river reach above Crocker-Huffman Dam has the potential to increase available spawning and rearing habitat and to enhance the natural salmon production of the Merced River. If suitable habitats are available, there is also the potential to re-establish steelhead in the Merced River. The primary objectives for our proposed one-year feasibility study are to examine the biological and physical technical issues associated with the potential for establishing migratory passage and fish protection at Crocker Huffman Dam and investigate the biological production potential of the riverine habitat between Crocker-Huffman and Merced Falls dams for anadromous salmonids. An additional and integral objective is to assess the implications for, and interactions of such a restoration action with, ongoing and future planned Merced River Hatchery operations. This investigation will examine the opportunities and constraints of anadromous salmonid reintroduction upstream of Crocker-Huffman Dam.

Proposal

Natural Resource Scientists, Inc.

A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River

David Vogel, Natural Resource Scientists, Inc.

A. Project Description: Project Goals and Scope of Work

1. Problem

The Merced River is the southernmost Central Valley stream presently inhabited by anadromous salmonids. The Merced River, its channel, watershed and riparian corridor, has been significantly altered by gold and gravel mining; dam construction for power production, irrigation, and flood control; agriculture; and urbanization (CDFG 1993, USFWS 1995, USBR 1997). Compared to their historic access to spawning and rearing habitat in higher elevation river reaches (USFWS 1995, Yoshiyama et al. 1996, Yoshiyama 1999), chinook salmon are restricted during all of their freshwater life stages to utilize the lower Merced River up to Crocker-Huffman Dam (River Mile 52), which is the upstream barrier for fish migration and the location of the Merced River Hatchery. Crocker-Huffman Dam along with three upstream dams (Merced Falls Dam [RM55], McSwain Dam [RM56], and New Exchequer Dam [RM62] proceeding in an upstream direction) regulate flows in the lower Merced River. As a result, natural salmon production is affected by limited accessible stream reach and alterations of stream channel, flow and water temperatures. Loss of habitat, and anadromous salmonid production potential, blocked by the construction of the dams is currently mitigated by Merced River Hatchery, funded by Merced Irrigation District (Merced ID) and operated by the California Department of Fish and Game (CDFG).

The three upstream-most dams Merced Falls Dam (Pacific Gas & Electric), McSwain Dam (Merced ID), and New Exchequer Dam (Merced ID) inundate the river channel to form moderately deep to very deep reservoirs for water storage or flow re-regulation and power generation. Crocker-Huffman Dam forms a low-head, run-of-the-river diversion serving the Merced ID's Main Canal. The three mile tailwater river reach between the Crocker-Huffman and the Merced Falls dams is riverine in nature, benefits from cool temperature, hypolimnetic reservoir releases throughout its length, and supports a good sport fishery for trout (Mike Bermingham, Merced ID Parks Manager, personal communication) indicating that habitat conditions may be suitable for anadromous salmonid spawning and rearing (Figure 1). However, this river reach is currently not accessible to anadromous salmonids since the existing fishway on Crocker-Huffman Dam is non-operational. Due to the proximity of the tailwater reach above Crocker-Huffman Dam to the deep reservoir releases, water temperatures are likely to be cooler and more suitable for salmonid spawning and rearing for longer periods of the year than in river reaches downstream of Crocker-Huffman Dam, particularly during drought years. Additionally, there are no fish screens on the diversions upstream of the dam. Re-establishing anadromous salmonid access to the river reach above Crocker-Huffman Dam has the potential to increase available spawning and rearing habitat and to enhance the natural salmon production of the Merced River. If suitable habitats are available, there is also the potential to re-establish steelhead in the Merced River.

The primary objectives for our proposed one-year feasibility study are to examine the biological and physical technical issues associated with the potential for establishing migratory passage and fish protection at Crocker Huffman Dam and investigate the biological production potential of the riverine habitat between Crocker-Huffman and Merced Falls dams for anadromous salmonids (Figure 1). An additional and integral objective is to assess the implications for, and interactions of such a restoration action with, ongoing and future planned Merced River Hatchery operations. This investigation will examine the opportunities and constraints of anadromous salmonid reintroduction upstream of Crocker-Huffman Dam.

Similar actions to improve or restore anadromous salmonid accessibility to stream habitat above impassible or marginally passable dams and weirs (due to inadequate or obsolete fishways) are currently taking place on other key salmon-producing Central Valley streams, namely Clear Creek, Battle Creek and Butte Creek, tributaries to the Sacramento River. All of these actions have been supported by CALFED, the CVPIA's Anadromous Fish Restoration Program (AFRP) and Anadromous Fish Screen Program (AFSP), and the CDFG's Salmon and Steelhead Restoration Program. Opportunities for restoring anadromous fish above existing dams on Central Valley streams are currently limited but are considered critical opportunities for alleviating several principal environmental stressors thought to contribute to the depressed population status of many at-risk species, including San Joaquin fall-run chinook salmon which inhabit the Merced River (Myers et al. 1998, NMFS 1998, CALFED 1999a, 1999b, 2001). Increasing, or restoring, utilization of spawning and rearing areas above natural and man-made migration barriers in streams is a sound management approach for restoring and enhancing fish runs which has met with considerable success when applied with appropriate ecological and engineering considerations (Calhoun 1966, Huntington et al. 1988, Flosi and Reynolds 1991).

2. Justification

a. conceptual model

Dams can create environmental stress for anadromous fish by blocking migration and eliminating access to suitable habitat, by impeding upstream and downstream migration causing asynchrony between life history events and suitable environmental conditions such as delayed arrival to the spawning grounds for adults or to the estuary for smolts (Vogel et al. 1988), and by affecting stream flow and temperature regimes with consequent changes in many biological, ecological, and physical fluvial processes (Leopold et al. 1964, Hynes 1970). For most rivers with large dams and deep reservoirs, anadromous fish are completely blocked and habitat is lost due to inundation of the river channel by the reservoir. In some cases, local extinction of salmon and steelhead populations have occurred on streams where large dams blocked fish runs (Warner 1991, Mills et

al. 1996). Many moderately sized dams (e.g., Red Bluff Diversion Dam (Sacramento), Anderson-Cottonwood Diversion Dam (Sacramento), Woodbridge Diversion Dam (Mokelumne)) and small seasonal diversions are equipped with fishways to allow anadromous fish passage to suitable upstream habitats.

The CALFED Ecosystem Restoration Program Plan (ERPP) (CALFED 1998) set forth a vision for addressing the adverse effects of dams on fish passage and habitat loss to support the ERP's Strategic Plan Goals (CALFED 1999a). This vision proposed to improve habitat conditions below dams to enhance salmon and steelhead populations in lower river reaches. These improvements would include those that affect natural processes (e.g., sediment transport), habitat (e.g., riverine and riparian habitat features), and at-risk species requirements (e.g., water temperature, fish passage). The ERPP vision also proposed to address the feasibility of restoring fish above some dams where, consistent with other uses, opportunity and cooperation of local water districts and landowners exist.

Improvement of habitat condition downstream of dams will generally raise the quality of habitat (e.g., improved temperature regimes, restored flood-plain connectivity and channel configuration). Measures to actually increase the amount of physical habitat available for natural production of anadromous fish downstream of dams, such as when degraded channels are re-engineered to spawning riffles or when instream flows are manipulated to provide suitable spawning or rearing habitat, remain limited by the extent of the river reach below the dam. The only other means to increase habitat available to anadromous fish is to restore accessibility to stream reaches with suitable habitat.

Figure 2 depicts the core concept of our proposal which compares the relative relationships of present anadromous salmonid habitat use with that of the potential expansion of available habitat through re-establishing access above Crocker-Huffman Dam. Access to riverine habitat above Crocker-Huffman Dam would have the potential to expand the river reach distance by about 13% of that currently utilized for natural anadromous salmonid spawning and rearing in the Lower Merced River.

b. research project hypothesis and adaptive management implications

Our proposed investigation is ***targeted research*** to assess the technical biological and physical feasibility issues associated with establishing fish passage at an existing low-head, run-of-the-river diversion dam with a mitigation fish hatchery and reintroducing anadromous salmonids to potentially suitable habitat upstream of the dam, thus enhancing natural salmon production. In a large degree, our proposed project will be an opportunities and constraints analysis using site-

specific data on habitats available. The principal question to be addressed is whether habitat between Crocker-Huffman Dam and Merced Falls Dam is suitable for natural production of anadromous salmonids and the degree of natural production that could be expected. Formally, we hypothesize:

H_o: Habitat quality upstream of Crocker-Huffman Dam is not suitable for anadromous salmonid spawning and rearing.

H_{a1}: Habitat quality upstream of Crocker-Huffman Dam is marginally suitable for anadromous salmonid spawning and rearing and would be expected to have a lower smolt production capacity than downstream river reaches.

H_{a2}: Habitat quality is suitable for anadromous salmonid spawning and rearing and would be expected to produce smolts at a level similar to downstream river reaches.

H_{a3}: Habitat quality upstream of Crocker-Huffman Dam is very good and would be expected to have a high natural smolt production capacity.

Should this evaluation determine that it is feasible to reintroduce anadromous salmonid upstream of Crocker-Huffman Dam, stakeholder issues and detailed engineering design associated with providing fish passage and protection will be formulated in a subsequent phase of this project. In the subsequent phase, provisions for safe upstream and downstream fish passage will have to be evaluated as to technical feasibility, degree of dam and diversion intake modifications necessary to accommodate appropriate fishway and fish screening structures, and potential costs. Merced ID, the primary stakeholder on the issue of potential reintroduction of anadromous salmonids upstream of Crocker-Huffman Dam, will be a cooperator in this feasibility investigation. Information generated by our proposed investigations will advance knowledge and address current uncertainties regarding the technical biological and physical feasibility for reintroducing anadromous salmonids above Crocker-Huffman Dam. This will directly contribute to the information/learning feedback loop of the adaptive management model described in the ERP's Draft Stage 1 Implementation Plan (p.8). Our evaluation of the potential for reconnecting and restoring some of the historic geographic range of salmon spawning and rearing habitat on the Merced River will better define the scope of opportunities for improving habitat and increasing natural production of anadromous salmonids in the San Joaquin Basin.

3. Approach

Evaluation of the feasibility of re-establishing access and reintroducing anadromous fish to riverine habitat above Crocker-Huffman Dam will require assessing biological issues and habitat and ecological requirements for anadromous fish and, concurrently, impacts to and interactions with the Merced River Hatchery.

Task 1: Perform detail physical habitat inventories of the river reach between Crocker-Huffman Dam and Merced Falls Dam, defining interrelationships between quality and quantity of habitats available for potential chinook salmon and steelhead production and the opportunities and constraints of anadromous salmonid reintroduction.

This task will be composed of multiple work efforts to evaluate the quantity and quality of potential anadromous salmonid habitats in the reach between Crocker-Huffman Dam and Merced Falls Dam. Detailed spawning and rearing habitat inventories of the river reach between Crocker-Huffman and Merced Falls dams will be performed. Established channel and habitat classification, typing, and rating methods commonly used within the State of California (e.g., methods described in Flosi and Reynolds 1991, Rosgen 1996, Bain and Stevenson 1999) will be applied to this task. An assessment of habitat factors that might limit anadromous salmonid spawning and rearing, if reintroduced to the tailwater above Crocker-Huffman Dam, will be performed. The range of factors likely to be considered would include; stream flow regime, water temperature regime, physical habitat availability, habitat condition, riparian condition, ecological interactions with resident species, migration barriers, and land use activities.

The entire riverbed substrate will be mapped using an underwater video camera apparatus that NRS, Inc. has utilized elsewhere to examine riverbed substrate in deep, swift water (Vogel 2000; Vogel 2001). The underwater survey will be performed by using an underwater video camera mounted on an aluminum frame with two 30-pound river survey weights to position and orient the camera in an upstream direction. The camera and camera frame are adjusted vertically by using a battery-powered winch mounted on the bow of a 21-ft inboard jet boat. Images from the underwater camera are transmitted by cable to a video monitor in the boat and a VCR which records the images. A 12-inch wide, horizontal metal rod with two-inch markings is positioned 18 inches in front of the camera's field of view and wide-angle lens to provide an accurate size perspective and compensate for underwater and camera lens refraction. A GPS with extended boat antenna is used to determine Universal Transverse Mercator coordinates during the underwater survey. The coordinates are simultaneously recorded with the underwater video for accurate mapping of the substrate.

Water velocities (including near-bed water velocities) will be measured with an Acoustic Doppler Current Profiler (ADCP) under a range of low, medium, and high flows to determine potential

spawning and egg incubation velocities available in the reach between Crocker-Huffman Dam and Merced Falls Dam. Historical data on river flow in this reach will be analyzed to determine appropriate sampling periods. We will also relate the historical flow regime (magnitude and timing), including diversions into Merced ID's main canal, to the periods when chinook salmon and steelhead spawn and incubate to assess life cycle periodicities with the expected flow regimes. The velocities over the entire reach will be mapped and overlaid with the substrate map previously described to determine potential anadromous salmonid spawning and incubation habitats. In those areas where substrates appear to be suitable for salmonid spawning based on velocity and riverbed mapping, substrate samples will be taken with a suction dredge to quantify particle size distribution for material beneath the surface. Substrate samples will be sieved with ASTM sieves in gradations of sizes to determine suitability of river gravels for spawning and incubation and the levels of fines present that may affect egg survival. The available substrate and near-bed water velocities will be compared to the spawning habitat preferences for salmon (e.g., Vogel 1982, 1983, Vogel and Taylor 1987).

Data will be compiled from existing temperature records collected in ongoing river temperature monitoring programs as part of Merced ID and CDFG's fisheries monitoring program and Merced ID's Water Temperature Management Feasibility Study (the latter supported by CALFED in 2000 and funded by the CVPIA AFRP in 2001-2002). Data will be used to assess any temperature limitations based on the biological criteria for anadromous salmonid reproduction.

Included in this analysis will be an examination of the non-functional fishway on Crocker-Huffman Dam to determine the measures necessary to modify or replace the fishway should suitable anadromous salmonid habitats be found upstream of the dam. Also, the intake to Merced ID's main canal off the impoundment created by Crocker-Huffman Dam will be assessed to determine fish screening issues should the recommendation of reintroduction of anadromous salmonids above the dam be a result of this feasibility investigation. Any other diversions from the impoundment will also be examine to determine potential fish screening issues. If anadromous salmonid habitats between Crocker-Huffman Dam and Merced Falls Dam are found to be suitable as a result of the field investigation, recommendations on upstream fish passage at Crocker-Huffman Dam and fish screens at Merced ID's main canal (and other possible sites) will be formulated as part of this feasibility investigation. For example, if the study recommends reintroduction of anadromous salmonids above the dam, the study would recommend a second phase engineering design and funding for upstream and downstream fish protective facilities.

Because of the potential impacts on operations of the Merced River Hatchery, this feasibility study will also include an assessment of potential biological impacts, interactions, and integration

with Merced River Hatchery. We will compile and summarize pertinent biological, structural, and operational information about the Merced River Hatchery and all potential issues, impacts, and interactions with potentially reintroducing anadromous salmonids above Crocker-Huffman Dam, the hatchery's water source.

4. Feasibility

All aspects of the field measurements for this project can be performed using standardized field sampling and field survey techniques or methods that NRS, Inc. is thoroughly familiar with based on prior project experience. The project team has the expertise and support services necessary (see Qualifications) to perform the proposed tasks within the proposed time line.

5. Performance Measures

Performance measures for this project will be in the form of written technical documentation of the research project describing experimental design, study protocols, a quality assurance program plan, data collected, analyses performed, and final results and recommendations. A written technical report will be peer reviewed by CALFED staff. Additionally, a technical presentation to CALFED will be provided, if requested.

6. Data Handling and Storage

Data sheets will be examined by investigators in the field prior to leaving a site to insure that all data are recorded and measurements look reasonable. Any deficiencies will be addressed at the site. All data will be subjected to double data entry verification. Graphical data plots will be used to examine data sets for aberrant data and outliers and corrective actions will be taken. Computed values will be calculated twice to insure accuracy. Time series data will be maintained in a data base, while physical data will be maintained in tables. All data will be available on electronic media both during the project, as data become available, as well as upon project completion. All figures, tables, and data sets generated during the study will be reviewed by the Principal Investigator prior to submission to CALFED. Computer files will be backed up weekly and redundant backup tapes will kept in fire proof safes at Natural Resource Scientists, Inc. offices. Copies of all final computer data files and hard copies of data submissions will be provided to CALFED if requested.

7. Expected Products/Outcomes

Quarterly fiscal and programmatic reports will be prepared and provided according to CALFED

guidelines. The Project Manager/Principal Investigator will submit a draft and final CALFED-approved Monitoring Plan/QAPP. At the end of the project, a technical, peer-reviewed draft and final report will be completed describing all work performed and study results, including methodologies, data acquired during the project, analyses of results, and conclusions. Reports and data will be submitted in electronic format for entry into the CALFED database. In addition to a written report, a formal technical presentation on the project may be given to CALFED, if requested.

8. Work Schedule

A draft and final CALFED-approved Monitoring Plan/QAPP will be submitted in January 2003. Preliminary field reconnaissance and preparations would be performed during February and March 2003. Field portions of the study would be conducted from April to November 2003. A draft report will be prepared describing the work and submitted for peer review by CALFED in November 2003. A final report, incorporating reviewer comments, will be completed and submitted within a month after receipt of comments (December 2003). A technical presentation will be given (on request) to CALFED.

B. Applicability to CALFED ERP And Science Program Goals And Implementation Plan and CVPIA Priorities

1. ERP, Science Program and CVPIA Priorities

The ERP's Strategic Goal #1 seeks to achieve recovery of state and federally listed endangered and threatened species and establish large, self-sustaining populations and reversing declining population trends for at-risk native species, including San Joaquin fall-run chinook salmon. Our proposed targeted research/evaluation project directly addresses ERP Strategic Goal #1 and the San Joaquin Region priority #3 in the Draft Stage 1 Implementation Plan. This priority specifically identifies the need for actions that focus on improving spawning and rearing habitat on tributary streams of the San Joaquin for anadromous salmonids. Our proposed evaluation of the feasibility of new fish passage and protection to provide for access to increased habitat area addresses this need. Our project will improve knowledge and reduce scientific technical uncertainties associated with restoring anadromous fish access to potential habitats above Crocker-Huffman Dam on the Merced River. An increased understanding of the potential benefits for natural salmon production and the constraints of providing anadromous fish access to habitat above Crocker-Huffman Dam will contribute to CALFED's Science Program objectives, namely improving overall ability to compare relative effectiveness of different restoration strategies. This project will specifically support actions directed at the AFRP goal to increase

natural reproduction levels of anadromous fish throughout the Central Valley, which has as a first priority measures that protect and restore natural channel and riparian habitat values. Assessing the opportunity and technical feasibility for re-establishing access to suitable anadromous salmonid habitat to increase natural production in the Merced River will directly contribute to this AFRP priority.

2. Relationship to Other Ecosystem Restoration Projects

Several restoration efforts are underway on the Merced River. CALFED and the CVPIA have supported and funded most of these actions which are working to reduce the adverse effects of past alterations and improve habitat form and function along the Merced River and its riparian corridor downstream from the dams that currently block fish passage (e.g., Robinson Ranch Channel Restoration Project, Merced River Corridor Restoration Planning Project, Merced River Water Temperature Management Feasibility Study). Improved habitat quality resulting from these actions will likely improve survival of Merced River juvenile salmon which is expected to contribute to sustaining and rebuilding population levels. Significant enhancement of this potential for increasing salmon populations may exist by expanding available habitat through re-establishing fish passage past Crocker-Huffman Dam and reintroducing anadromous salmonids upstream of this dam to spawn and rear. This action may have the potential to increase the Merced River's capacity for natural anadromous salmonid production by adding nearly 13% to the presently available spawning reach length and 6% to the presently available rearing reach length.

Our proposal addresses the AFRP's objective to reduce the adverse effects of dams and diversions on anadromous fishes and increase natural production (2001 CALFED PSP). If our studies demonstrate feasibility of re-establishing access to riverine habitat upstream of Crocker-Huffman Dam, then an opportunity would be clearly defined as to how to remedy an existing migratory blockage and expanded spawning and rearing habitat. Our proposal also directly addresses NMFS's concerns regarding factors limiting San Joaquin Basin fall-run chinook salmon production (NMFS 1998), specifically habitat limitations below dams in the San Joaquin Basin.

3. Request for Next-Phase Funding

Not applicable.

4. Previous Recipient of CALFED Program or CVPIA funding

Natural Resource Scientists, Inc. has received CALFED and CVPIA funding for Central Valley projects. In 1995, a final contract peer-reviewed report entitled: "*Losses of young anadromous*

salmonids at water diversions on the Sacramento and Mokelumne Rivers" was completed by NRS, Inc. under a subcontract with CVPIA AFRP funding (prime contract number is unknown). In May 2000, a contract peer-reviewed report entitled: "*Juvenile Chinook Salmon Radio-Telemetry Study in the Northern Sacramento - San Joaquin Delta, January - February 2000*" was completed for the CVPIA AFRP (open contract, order no. 101810M102). In August 2001, a draft CVPIA AFRP contract report entitled: "*Juvenile Chinook Salmon Radio-Telemetry Study in the Southern Sacramento - San Joaquin Delta, December 2000 - January 2001*" was submitted to the IEP for peer review (Contract No. 101811D027). Results of a CALFED field study of juvenile salmon at the Delta Cross Channel (DCC) during November 2000 were presented at the IEP 2001 Asilomar conference and a written report is in progress (CALFED DCC study contract no. unknown). An expanded version of the DCC studies for 2001 was recently approved by the CALFED Science Panel and funding was approved in September 2001; no funds have been expended to date. Three research projects, "*Juvenile Salmon Migratory Behavior Study in the North, Central, and South Delta*" was recently approved by CALFED (CALFED Project No. ERP-01-N48) and a contract was executed with the National Fish and Wildlife Foundation in September 2001; no funds have been expended to date. A project on the initial phase of a "*Merced River Water Temperature Management Feasibility Study*" (2001-K203) was recently approved by CALFED and a USFWS CVPIA contract is being developed with the USFWS; no funds have been expended to date. NRS, Inc. is working on the AFRP project "*Merced River Wing-Dam Monitoring, 2000-2002"* on behalf of Merced ID (FWS Agreement #113320J027).

5. System-Wide Ecosystem Benefits

Our proposal supports an effort to contribute to the AFRP goal to double natural production of anadromous salmonids Central Valley-wide. Our proposal is the first step of a critical opportunity to provide habitat for increasing the self-sustaining natural production potential of an at-risk species, the San Joaquin fall-run chinook salmon in the Merced River and, possibly, steelhead thus increasing the overall anadromous salmonid production potential for the San Joaquin Basin (CALFED ERP Strategic Goal #1 for at-risk species). Other native species could benefit from access to habitat above Crocker-Huffman Dam, such as the native cyprinids Sacramento pikeminnow (*Ptychocheilus grandis*) and hardhead (*Mylopharodon conocephalus*) which have habitat requirements characteristic of foothill level Central Valley stream reaches (Moyle 1976). Reintroduction of anadromous salmonids to the Merced River above Crocker-Huffman Dam would also contribute to riparian nutrient cycles and benefit riparian-dwelling terrestrial animals which feed on salmon and salmon carcasses, such as the bald eagle, turkey vultures, raccoons, skunks, and river otter.

C. Qualifications

Natural Resource Scientists, Inc. has extensive expertise on water project operations interrelationships with aquatic resources. NRS, Inc. has performed numerous investigations of freshwater habitat requirements and factors limiting fish populations and the development of measures to improve river and stream conditions for fishery resources. Additionally, NRS, Inc. is thoroughly familiar with the Merced River and has been working on Merced River fishery and water resource issues for the past decade. NRS, Inc. has established and maintained an extensive network of water temperature monitoring stations in the upper and lower Merced River and its reservoirs over the past four years and has been monitoring juvenile salmon outmigration on the Merced River for the past three years. The CDFG, USFWS, and the National Marine Fisheries Service (NMFS) will provide technical assistance with data acquisition and resource guidance. Merced ID will collaborate and coordinate with the NRS, Inc. and the latter three agencies throughout the project. NRS, Inc. will perform the data acquisition, processing, and analyses, project oversight and coordination, and project reporting requirements, including technical report writing.

David A. Vogel, Project Manager
Natural Resource Scientists, Inc., Senior Scientist
M.S., 1979, Natural Resources (Fisheries), University of Michigan
B.S., 1974, Biology, Bowling Green State University

Mr. Vogel will serve as Project Manager for this project because of his expertise and knowledge of the interrelationships of Merced ID's water project operations and fishery resources over the past decade. Mr. Vogel specializes in aquatic resource assessments and resolution of fishery resource issues associated with land and water development. His 25 years of work experience in fisheries has included large-scale assessments in river systems, lakes and reservoirs, and estuaries. Most of his experience has been associated with restoration of western United States fishery resources. Mr. Vogel has worked as a biological consultant for the U.S. Bureau of Reclamation to define interrelationships of salmon resources and Central Valley Project water project operations. He was the Task Manager for the Biological Assessment of the 1992 operations of the Central Valley Project (CVP) and was the principal biologist in charge of developing the long-term Biological Assessment for the CVP. Mr. Vogel has been working on Central Valley fishery resource research and management projects and interrelationships with water project operations for 20 years.

Keith R. Marine, Project Ecologist
Natural Resource Scientists, Inc., Aquatic Ecologist
M.S., 1997, Ecology, University of California, Davis
B.S., 1983, Wildlife and Fisheries Biology, University of California, Davis

Mr. Marine will serve as Project Ecologist for this project because of his expertise in ecological requirements, reproductive physiology, and behavior of anadromous salmonids and other California native fishes. Mr. Marine specializes in the ecological sciences with emphasis on fisheries science, aquatic and marine biology, and physiological ecology. He has extensive experience in ecological and biological assessment and conducting research directed at resolving natural resource management problems. Mr. Marine has designed and conducted ecosystem-level investigations on fish migration and behavior associated with operation of large Central Valley Project facilities, including fish responses at fish passage and screening facilities. His expertise includes a comprehensive research background in physiological ecology of California's native fishes, including Pacific anadromous salmonids. He has participated in the design and evaluation of the biological performance of fishways and fish screens, including migrational behavior, entrainment, physical injury, predation, and physiological responses of juvenile salmonids to fish passage systems. Mr. Marine has performed evaluations of fish populations, fish habitat requirements, stream flow assessments and stream temperature modeling in support of fishery conservation and restoration programs.

Russell L. Liebig, Fishery Biologist
Natural Resource Scientists, Inc., Fishery Biologist
B.S., 1998, Wildlife, Fisheries, and Conservation Biology, University of California, Davis

Mr. Liebig is employed by Natural Resource Scientists, Inc. as a Fishery Biologist working on multiple anadromous fishery resource monitoring projects. These intensive field projects included monitoring of juvenile and adult salmon and steelhead migration on the Mokelumne River, juvenile salmonid downstream migration on Merced River, sonic and radio-tracking of salmon in the Delta, and fish experiments at the Glenn-Colusa Irrigation District on the Sacramento River. These projects required tagging of salmonids using several types of fish marking techniques. His duties also included fish trap calibration and maintenance. Mr. Liebig is very knowledgeable and experienced in the methods and equipment used in fishery resource field surveys.

D. Cost

1. Budget

Total budget for this project is given in the 2002 PSP web forms.

2. Cost-Sharing

It is anticipated that Merced Irrigation District will contribute up to $10,000 as in-kind contributions to this project. The contributions will be in the form of technical and support staff for information and evaluation of their facilities and operations.

E. Local Involvement

Merced ID and CDFG have jointly developed and agreed upon a 10-year study program to determine the potential factors that may limit salmon production in the Merced River. This program is designed to evaluate the habitats necessary for increased salmon production by assessing the needs for each freshwater salmon life stage (i.e., upstream migration, spawning, egg incubation, fry and juvenile rearing, and outmigration). The joint study program defines the objectives, basic experimental design, and the responsibilities for study implementation. The studies and instream flow scheduling will be coordinated with other studies throughout the San Joaquin basin and the Delta. Components of this program are presently underway. The completion of the 10-year program is intended to identify the long-term instream flow and other needs of salmon in the Merced River. To facilitate the studies, CDFG and Merced ID have established the Merced Management and Technical Advisory Committees (TAC); the latter committee establishes and coordinates study protocols, study amendments, funding issues, and information sharing and exchange. USFWS and NMFS staff also participate in the TAC meetings. Natural Resource Scientists, Inc. serves on this committee and this project will be closely coordinated with the Merced TAC.

With funding from the USFWS AFRP and the CALFED Bay-Delta Program, the Merced County Planning and Community Development Department, with cooperation from Merced ID, have embarked on a collaborative effort to develop a restoration strategy for the Merced River corridor. This program will seek to join input from community stakeholders with a scientifically-based understanding of current river conditions and processes to identify a feasible corridor restoration strategy. Public involvement will play a key role in the restoration planning process, and public coordination will continue through the life of the project. To establish this role, the County, with Merced ID's assistance, convened a Merced River Stakeholder Group. The Stakeholder Group represents a broad array of public and private interests, including local business and property owners; state, local, and federal agencies; fish and environmental groups; and other groups or individuals. In addition to working with his Stakeholder Group, the County also conducted regular workshops to keep the public informed of the project's progress. These groups will be kept informed and involved in this project.

No third-party impacts are anticipated. Because this project is a feasibility study, land use changes will not occur as a result of this project. Merced ID, the entity that would ultimately be most affected if anadromous salmonids are reintroduced above Crocker-Huffman Dam, is a

cooperator in this feasibility investigation. Those parties who support restoration of San Joaquin anadromous salmonids that would benefit from the proposed project would also benefit.

F. Compliance with Standard Terms and Conditions

Natural Resource Scientists, Inc. will comply with the standard State and Federal contract terms described in Attachments D and E of the CALFED 2002 Proposal Solicitation Package.

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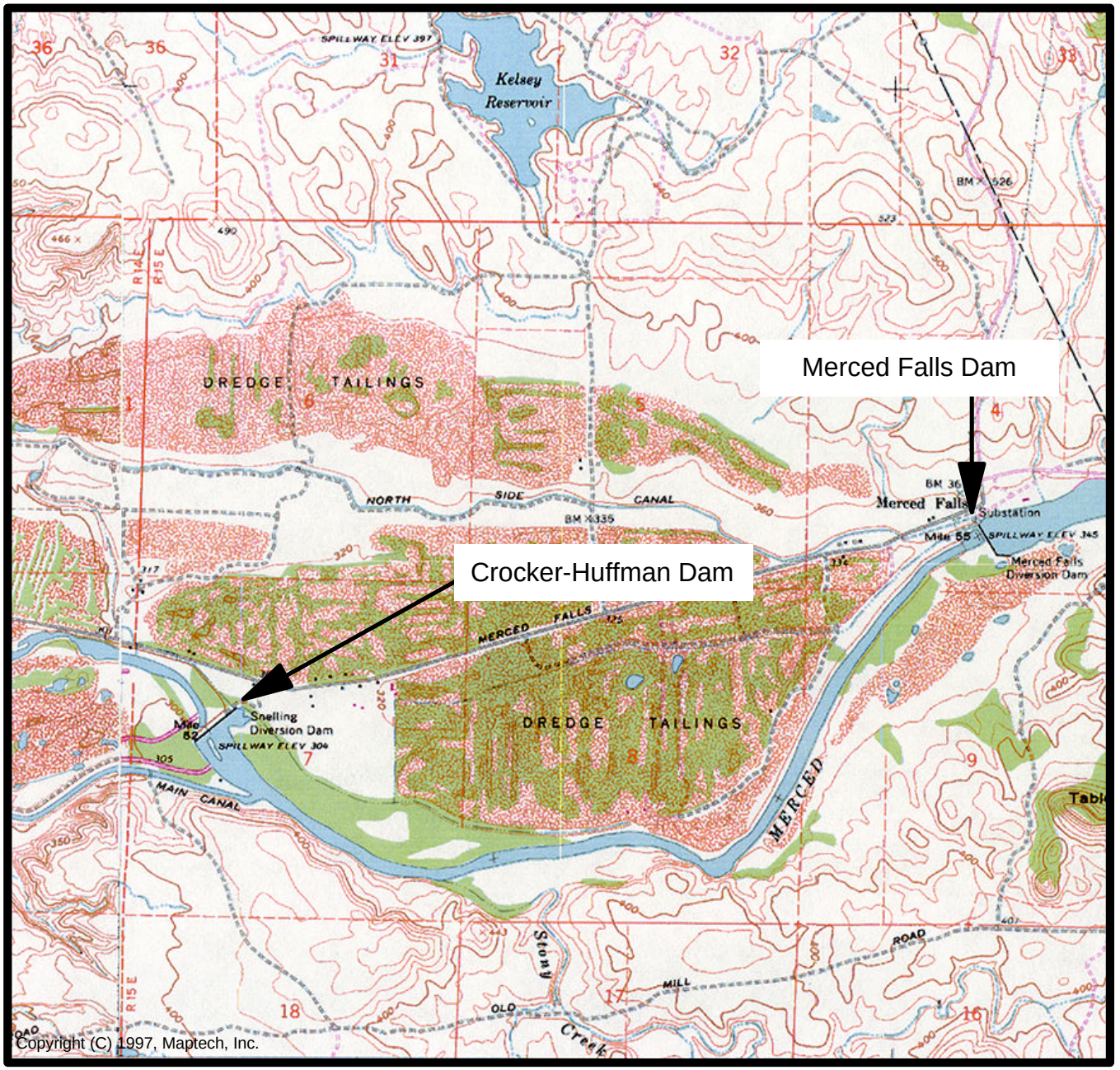

Figure 1. Merced River between Crocker-Huffman Dam and Merced Falls Dam

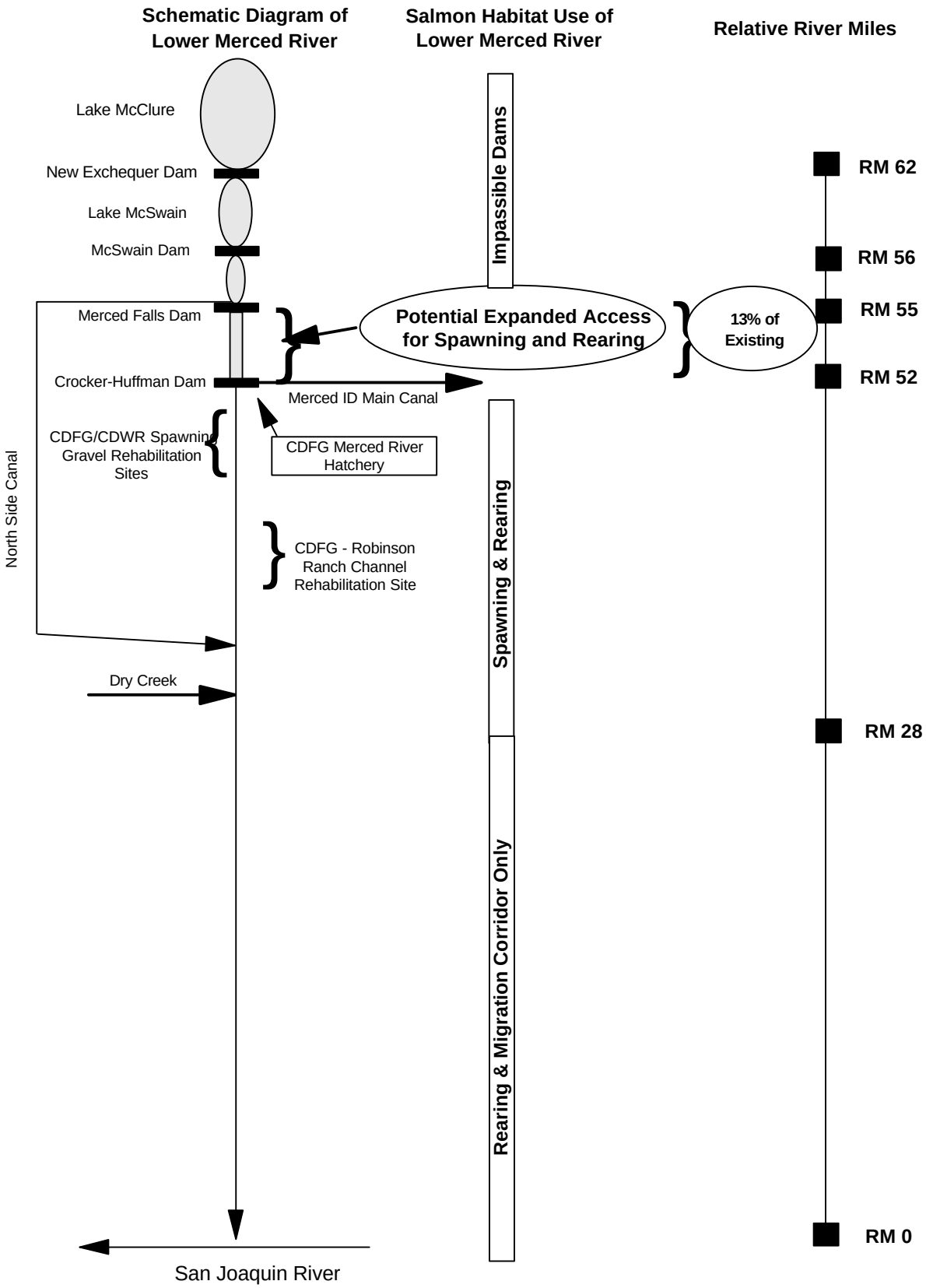

Figure 2. Conceptual Habitat Use Relationships of Re-establishing Anadromous Salmonid Access to Habitat Above Crocker-Huffman Dam on the Lower Merced River. (Spawning and rearing reach designations adapted from CDFG 1993, JSA 1995, USFWS 1995)