Stockton East Water District
Calaveras River Habitat Conservation Plan

Appendix D

Compliance and Effectiveness Monitoring for the Calaveras River Habitat Conservation Plan

Fishery investigations have been ongoing in the lower Calaveras River downstream of New Hogan Dam since 2001. Monitoring has been conducted by the Fishery Foundation of California (FFC) on behalf of the U.S. Fish and Wildlife Service, and by FISHBIO on behalf of Stockton East Water District (SEWD). Primary juvenile salmonid migration monitoring has been conducted at Shelton Road (RM 28), while adult salmonid migration monitoring has been conducted throughout the river.

The overall goal of these studies has been to document baseline conditions and to collect information that will aid in the design and management of long-term conservation strategies and the Adaptive Management Plan's decision-making process (AMP process). Despite several years of monitoring, a few data gaps regarding salmonid populations within the Calaveras River still remain including:

(1) Steelhead/rainbow trout (*Oncorhynchus mykiss*) and Chinook salmon (*O. tshawytscha*) carrying capacity;
(2) Proportion of the *O. mykiss* population expressing different life-history patterns (i.e., resident, adfluvial, anadromous) and the factors influencing life-history expression (e.g., water temperature and migration delays);
(3) Susceptibility of individual salmonids to entrainment into individual private water diversions under varying conditions.

In general, Habitat Conservation Plan monitoring programs must provide information to: "(1) evaluate compliance; (2) determine if biological goals and objectives are being met; and (3) provide feedback information for an adaptive management strategy" (65 FR 35242). Under the Calaveras River Habitat Conservation Plan (CHCP), two categories of monitoring activities will be undertaken to fulfill these requirements: Compliance Monitoring and Effectiveness Monitoring. Compliance Monitoring Activities (CM) will be conducted to verify that conservation strategies pursuant to the CHCP are implemented according to the plan. Effectiveness Monitoring Activities (EM) will be implemented to evaluate whether the conservation strategies are achieving the CHCP biological goals and objectives and provide information for the AMP process.

A summary of conservation strategies, effects addressed, biological objectives and targets, and monitoring (compliance and effectiveness) is presented in Table D-1. A summary of data gaps that will also be directly or indirectly addressed through effectiveness monitoring is presented in Table D-2.

Details regarding conservation strategies, effects addressed, biological objectives and targets are presented in the main CHCP document, whereas, monitoring activities are detailed in this appendix under two sections: Compliance Monitoring Activities and Effectiveness Monitoring Activities. An annual CHCP implementation report that includes documentation of all CMs and EMs conducted that year will be prepared and submitted to the National Marine Fisheries Service (NMFS) within 120 days of the end of each year. Five-year reviews of EMs will also be prepared and submitted to NMFS within 120 days of the end of every five years.

COMPLIANCE MONITORING ACTIVITIES

A summary of CMs relative to biological objectives, targets, and conservation strategies is provided in Table D-1. CMs are *not* arranged in priority order, and descriptions consist of the biological objectives and associated targets addressed; the monitoring activity; and any related existing data (i.e., hydrology, water temperature, dissolved oxygen, physical habitat, benthic macroinvertebrates, and juvenile and adult salmonid monitoring).

CM-1. Maintain Daily Flow and Operation Records in an Operations Database

Biological Objectives and Targets Addressed: Biological Objectives include Flow, Fish Passage, and Avoid Entrainment; and associated Targets are F1-F3, FP3-FP4, FP7, AE2, and AE4 (Table D-1).

Action: SEWD will maintain daily flow and operation records in an operations database (see Attachment D-1) year-round to document compliance with biological objectives and associated targets identified above. Data will include USACE gaging station flow records for New Hogan Dam releases, Cosgrove Creek, and Mormon Slough; precipitation records for New Hogan; flow records from SEWD sensors located at Shelton Road and in Mormon Slough, Old Calaveras River channel, Mosher Slough/Creek, and Potter Creek (Figure D-1); daily diversion records at Bellota and the Old Calaveras River Headworks Facility; and the status of the Bellota ladder. Data sources include the California Data Exchange Center (CDEC) and United States Army Corps of Engineers (USACE) for gaging station flow and precipitation records, and SEWD for remaining data types. The operations database will be submitted to NMFS every two weeks and will provide verification that all relevant conservation strategies have been completed as expected and will identify any deviations.

CM-2. Document Implementation of Agriculture and Municipal Conservation Programs

Biological Objectives and Targets Addressed: Flow Biological Objective and associated F4 Target (Table D-1).

Action: SEWD will record implementation of its Agriculture and Municipal Conservation Programs to document compliance with the biological objective and associated target identified above. Annual documentation will provide verification that these programs, which are designed to help protect water resources in the basin, were implemented as described in their respective plans.

Table D-1. Summary of conservation strategies, effects addressed, biological objects and targets, monitoring, and uncertainties addressed by monitoring for Central Valley steelhead and multiple runs of Chinook salmon related to each covered activity. Asterisk indicates non-core monitoring that may be conducted if deemed necessary through the AMP process.

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM1. New Hogan Reservoir Water Impoundment and Non-flood Control Operations	Flow-related spawning, incubation, and rearing habitat	Flow	**F1.** Guaranteed minimum flow (20 cfs) maintained at Shelton Road	**CS1.** Minimum Instream Flow Commitment	**CM1.** Maintain daily flow and operation records in an operations database	**EM1.** Environmental conditions monitoring **EM2.** Adult salmonid monitoring **EM3.** Juvenile salmonid monitoring **EM12*.** Alternative fisheries monitoring
OM1	Flow-related migration opportunities	Flow	**F2.** Under high storage conditions (storage >152,000 AF on October 15), manage fall water storage to increase the frequency of migration opportunities into/out of the 18-mile spawning and rearing reach between Bellota and New Hogan Dam	**CS2.** Non-Dedicated Fall Storage Management Strategy	**CM-1**	**EM1, EM2, EM3, EM12***

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM1	Flow-related spawning, incubation, and rearing habitat and migration opportunities	Flow	**F3.** During flood control season periods not covered by F2 and CS2, coordinate flood control releases with USACE to optimize salmonid migration opportunities into/out of the 18-mile spawning and rearing reach between Bellota and New Hogan Dam	**CS3.** Flood Control Release Coordination with, and Advisory Support to, the U.S. Army Corps of Engineers (USACE)	**CM1**	**EM1, EM2, EM3, EM12***
OM1	Flow-related spawning, incubation, and rearing habitat and migration opportunities	Flow	**F4.** Promote water conservation in the basin to help reduce the potential for water storage levels to fall to critical levels	**CS4.** Agriculture and Municipal Conservation Programs	**CM2.** Document implementation of Agriculture and Municipal Conservation Programs	NA
OM2. SEWD Old Calaveras River Headworks Facility	Migration delays and blockage, and Entrainment	Fish Passage and Avoid Entrainment	**FP1 and AE1**. Avoid migration delays and blockage, and entrainment within the Old Calaveras River Channel by constructing a non-entraining barrier at the Old Calaveras River Headworks Facility and at the downstream end of the channel near the confluence with the SDC within the first ten years of the ITP.	**CS5.** Old Calaveras Headworks Facility Improvement	**CM3.** Document completion of the Old Calaveras Headworks Facility Improvement Project	**EM4:** Fish evaluation and salmonid relocation during fall flashboard dam removal operations **EM12***

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM2	Entrainment	Avoid Entrainment	**AE2.** Prior to a permanent solution (AE1), operate a temporary barrier to prevent downstream entrainment into the Old Calaveras River	**CS6.** Temporary Barrier at Old Calaveras Headworks Facility	**CM1**	**EM4, EM12***
OM3. SEWD Bellota Diversion Facility Operations	Migration delays and blockage, and Entrainment	Fish Passage and Avoid Entrainment	**FP2/AE3.** Construct and implement a combined crest gate/fishway/fish screen at the Bellota Diversion Facility to improve passage into/out of the 18-mile spawning and rearing reach between Bellota and New Hogan Dam and to prevent entrainment; target completion within the first five years, but no later than ten years of the ITP	**CS7.** Bellota Diversion Facility Improvement	**CM4.** Document completion of Bellota Diversion Facility Improvement Project	**EM1, EM2 EM12***
OM3	Migration delays and blockage	Fish Passage	**FP3.** Prior to a permanent solution, operate temporary fish ladders (typically November 1-March 31) to improve passage into/out of the 18-mile spawning and rearing reach between Bellota and New Hogan Dam at low flows	**CS8.** Temporary Fish Ladders at the Bellota Diversion Facility	**CM1**	**EM1,** **EM5:** Monitor pool downstream of Bellota for salmonids during interim fish ladder operations

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM3	Entrainment	Avoid Entrainment	**AE4.** Prior to a permanent solution (AE3), operate temporary fish screens at the Bellota Diversion Facility to reduce entrainment	**CS9.**Temporary Fish Screens at the Bellota Diversion Facility	**CM1**	**EM6:** Fish screen effectiveness monitoring, **EM12***
OM4. Artificial Instream Structures and SEWD Small Instream Dam Operations	Migration delays and blockage	Fish Passage	**FP4.** Implement improvements at artificial instream structures in Mormon Slough/SDC that block or impede fish passage (FISHBIO 2009) in order to increase passage opportunities into/out of the 18-mile spawning and rearing reach between Bellota and New Hogan Dam; at minimum, Tier 1 structures in Mormon Slough/SDC owned and operated by Stockton East Water District (i.e., 5) will be improved	**CS10.** Artificial Instream Structural Improvements	**CM1, CM5.** Document schedules and implementation status for artificial instream structure improvement projects and flow sensors	**EM1, EM2, EM7:** Structural improvement monitoring **EM8:** Stakeholder education efforts, **EM12***
OM4	Stranding	Fish Passage	**FP5.** Reduce potential stranding conditions during end-of-irrigation-season flashboard dam removal by sequential removal of dams in a downstream direction	**CS11.** Fall Flashboard Dam Removal Operations	**CM6.** Document annual fall flashboard dam removal operations and any associated salmonid relocation	**EM4, EM12***

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM4	Migration delays and blockage	Fish Passage	**FP6.** Improve juvenile downstream migration during the irrigation season by installing passage notches into otherwise impassable flashboard dams	**CS12.** Flashboard Dam Notches	**CM7.** Document annual installation of flashboard dam notches	**EM9:** Fyke net evaluation of flashboard dam notches, **EM12***
OM4	Migration opportunities	Fish Passage	**FP7.** Improve identification of fish passage opportunities and increase water use efficiency through use of flow sensors at 10 key flashboard dam locations	**CS13.** Supervisory Control and Flow Data Acquisition System	**CM-1**	**EM1, EM7, EM12***
OM5. Privately Owned Diversion Facilities Operated within the Districts' Service Areas	Entrainment	Avoid Entrainment	**AE5.** Through the AMP process, prioritize diversion structures within first two years of ITP and help implement fish screens at privately owned diversions until priority list is exhausted; thereby, preventing entrainment of salmonids into priority unscreened diversions	**CS14.** Fish Screens for Privately Owned Diversions	**CM8.** Document prioritization of fish screens for privately owned diversions	**EM8, EM12***
OM5	Entrainment	Avoid Entrainment	**AE6.** Educate stakeholders (workshop within first six months of ITP issuance; annual newsletters; regular website updates) regarding potential fish impacts from irrigation practices	**CS15.** Stakeholder Education Program	**CM9.** Document Stakeholder Education Program activities	**EM8, EM12***

Activity	Effects Addressed	Biological Objectives	Target	Conservation Strategy	Monitoring Compliance	Monitoring Effectiveness
OM6. SEWD Channel Maintenance for Instream Structures	Direct equipment related injury and mortality; Water quality (turbidity)	Avoid Direct Injury and Mortality; and Water Quality	**AD1/WQ1.** Avoid or minimize potential mortalities or injuries associated with heavy equipment and turbidity related impacts through implementation of approved Instream Structure Maintenance BMPs	**CS16.** Instream Structures Maintenance Timing and Actions	**CM10.** Document SEWD Instream Structures maintenance	**EM10.** SEWD Instream Structures maintenance operations water quality monitoring and/or visual assessment
OM7. Fisheries Monitoring Program	Direct handling related injury and mortality	Avoid Direct Injury and Mortality	**AD2.** Conduct approved handling protocols to minimize handling stress and reduce injuries and mortality	**CS17.** Fish Handling Protocols	**CM11.** Document take associated with SEWD fisheries monitoring	**EM11.** Fisheries Monitoring take assessment

Table D-2. Summary of data gaps regarding Central Valley steelhead and multiple runs of Chinook salmon (salmonids) that may be directly or indirectly addressed through several effectiveness monitoring activities (EM). Asterisk indicates non-core monitoring that may be conducted if deemed necessary through the AMP process.

Data Gaps	Effectiveness Monitoring Activity
DG-1: Salmonid population carrying capacities	**EM1:** Environmental conditions monitoring **EM2:** Adult salmonid monitoring **EM3:** Juvenile salmonid monitoring **EM12*:** Alternative fisheries monitoring
DG-2: Percent *O. mykiss* population expressing different life-history patterns and the factors influencing life-history expression	**EM1, EM2, EM3, EM12***
DG-3: Entrainment susceptibility of individual salmonids	**EM1, EM3, EM12*** **EM6:** Fish screen effectiveness monitoring **EM9:** Fish evaluation and salmonid relocation during fall flashboard dam removal operations

CM3. Document Completion of the Old Calaveras Headworks Facility Improvement Project

Biological Objectives and Targets Addressed: Biological Objectives include Fish Passage and Avoid Entrainment; and associated Targets are FP1 and AE1 (Table D-1).

Action: SEWD will record the AMP process during evaluation of possible entrainment and fish passage solutions at the Old Calaveras Headworks Facility (e.g., rock weir or decommissioning the facility), and will also prepare an action plan and a project completion report to document compliance with the biological objectives and associated targets identified above. The project is targeted for completion within the first 10 years of the Incidental Take Permit (ITP). Annual progress notes will be maintained and collated into a final action plan that identifies the permanent solution. An action plan will identify what needs to be done; what and why decisions have been made; intended actions and objectives; resources required to accomplish the action, and timeframe for completion. The final action plan will be completed within the first five years of the ITP.

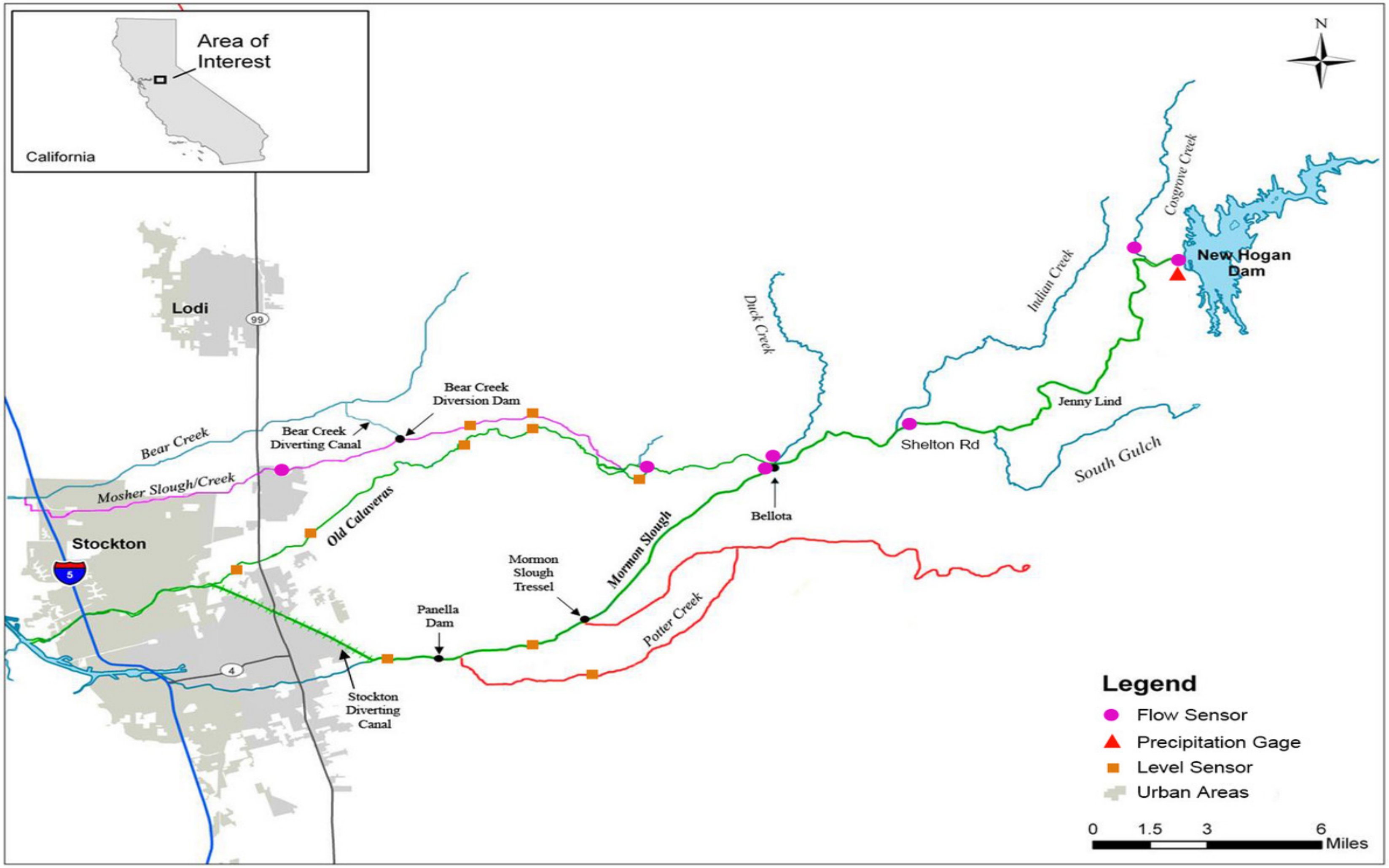

Figure D-1. Flow sensors in the lower Calaveras River.

Once the permanent solution is identified, construction is expected to take up to five years to complete; annual progress notes will be maintained and collated into a final project completion report that will provide verification that all work has been completed as expected and will identify any modifications to the original project concept or completion timeframe. The final report will be completed no later than 120 days after project completion.

CM4. Document Completion of the Bellota Diversion Facility Improvement Project

Biological Objectives and Targets Addressed: Biological Objectives include Fish Passage and Avoid Entrainment; and associated Targets include FP2 and AE3 (Table D-1).

Action: SEWD will record the progress during implementation of a permanent fish passage and entrainment solution for the Bellota Diversion Facility, as described in a final mitigated negative declaration (SEWD 2009), to document compliance with the biological objectives and associated targets identified above. The project is targeted for completion within the first five years of the ITP; however, scheduling uncertainties associated with permitting may result in a longer timeframe so the project will be completed no later than 10 years of issuance of the ITP. Annual progress notes will be maintained and collated into a final project completion report that will provide verification that all work has been completed as expected and will identify any modifications to the original project concept or completion timeframe. The final report will be completed no later than 120 days after project completion.

CM5. Document Schedules and Implementation Status for Artificial Instream Structure Improvement Projects and Flow Sensors

Biological Objectives and Targets Addressed: Biological Objectives include Fish Passage and associated Target FP4 (Table D-1).

Action: SEWD will document the schedules and implementation status for artificial instream structure improvement projects and flow sensors.

CM6. Document Annual Fall Flashboard Dam Removal Operations and Any Associated Salmonid Relocation

Biological Objectives and Targets Addressed: Fish Passage Biological Objective and associated FP5 Target (Table D-1).

Action: Near the end of each irrigation season, SEWD will notify NMFS, CDFW, and its fishery biologist (currently FISHBIO) a minimum of three days prior to initiation of the dewatering process for fall flashboard dam removal operations. SEWD will record implementation of the flashboard dam removal process and any associated salmonid relocation efforts to document compliance with the biological objective and associated target identified above. Documentation will provide verification that flashboard dams were

removed in accordance with project objectives, identify any deviations, and document whether any salmonids were present and were relocated.

CM7. Document Annual Installation of Flashboard Dam Notches

Biological Objectives and Targets Addressed: Fish Passage Biological Objective and associated FP6 Target (Table D-1).

Action: Each irrigation season, SEWD will notify NMFS, CDFW, and its fishery biologist (currently FISHBIO) a minimum of three days prior to installing or removing passage notches into/from flashboard dams. SEWD will record implementation of the flashboard dam notches to document compliance with the biological objective and associated target identified above. Documentation will provide verification that flashboard dam notches were installed and removed in accordance with project objectives and will identify any deviations.

CM8. Document Prioritization of Fish Screens for Privately Owned Diversions

Biological Objectives and Targets Addressed: Avoid Entrainment Biological Objective and associated AE5 Target (Table D-1).

Action: SEWD will record the AMP process during an evaluation that considers whether fish screens are necessary at individual, privately-owned, unscreened diversion facilities to document compliance with the biological objective and associated target identified above. Due to the large number of diversions, the AMP process for establishing screening priorities is expected to take up to two years to complete; annual progress notes will be maintained and collated into a final action plan that identifies the permanent solution. An action plan will provide an accounting of all screened and unscreened privately-owned diversions and will identify a fish screening priority list; what and why decisions have been made; intended objectives; resources required to accomplish the action, and an implementation schedule. The final action plan will be completed no later than 120 days after the first five years of the ITP.

Results of the action plan will be shared with individual landowners through the stakeholder education program. The District does not guarantee funding of privately-owned diversion screening but will provide assistance to landowners to locate and submit an application for funding opportunities that will allow cost-effective placement of screens at their facility. As fish screens are installed, SEWD will update the action plan’s list of existing unscreened and screened diversions and will prepare project completion reports that will provide verification that all work at individual diversions has been completed as expected and will identify any modifications to the original project concept or completion timeframe.

CM9. Document Stakeholder Education Program Activities

Biological Objectives and Targets Addressed: Biological Objectives include Fish Passage and Avoid Entrainment; and associated Targets FP4 and AE6 (Table D-1).

Action: SEWD will record the completion of periodic workshops, annual newsletters, and website updates to document compliance with the biological objectives and associated targets identified above. Documentation will provide verification that all educational activities have been completed as expected and will identify any deviations.

CM10. Document SEWD Instream Structures Maintenance

Biological Objectives and Targets Addressed: Biological Objectives include Avoid Direct Injury and Water Quality and associated Targets are AD1 and WQ1 (Table D-1).

Action: SEWD will record implementation of BMPs (including water quality measurements taken if flowing water is present) during instream maintenance operations to document compliance with the biological objective and associated target identified above. BMPs are designed to reduce potential impacts to water quality (e.g., turbidity), and water quality measurements will ensure that levels do not exceed CDFW approved criteria. Documentation will provide verification that BMPs were implemented and any water quality parameters measured were within criteria as prescribed by CDFW during instream maintenance operations.

CM11. Document Take Associated with Fisheries Monitoring

Biological Objectives and Targets Addressed: Avoid Direct Injury Biological Objective and associated AD2 Target (Table D-1).

Action: SEWD's fishery biologists (currently FISHBIO) will maintain daily salmonid take records to document compliance with the biological objective and associated target identified above. NMFS has previously identified the most protective fish handling protocols possible for minimizing potential impacts to fisheries associated with research and monitoring activities. Implementation of these protocols will ensure that there are minimal opportunities for salmonids to be injured or killed during monitoring activities. Monthly data summaries of take will be provided to CDFW and/or NMFS to ensure that take does not exceed expected values.

Effectiveness Monitoring

A summary of EMs relative to biological objectives, targets, and conservation strategies is provided in Table D-1; while a summary of EMs relative to data gaps is provided in Table D-2. EMs are *not* arranged in priority order and descriptions consist of the biological objectives and associated targets, as well as any data gaps addressed; the monitoring activity; and any related existing data (i.e., hydrology, water temperature, dissolved

oxygen, physical habitat, benthic macroinvertebrates, and juvenile and adult salmonid monitoring).

EM1. Environmental Conditions Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Biological Objectives include Flow, Fish Passage, and Avoid Entrainment; and associated Targets are F1, F2, F3, FP2-FP4, FP7, AE2-AE4 (Table D-1). Data Gaps include DG-1 through DG-3.

Action: SEWD will record environmental conditions monitoring data, in conjunction with data from other EMs (e.g., EM2 and EM3), to address whether measures designed to meet biological objectives and associated targets identified above are functioning as expected, as well as to provide information for addressing data gaps identified above to assist the AMP process. Various environmental factors are known to influence salmonid growth and survival (e.g., flow, water temperature, turbidity, and invasive species); therefore, it is important to monitor these parameters to determine whether one or more are affecting salmonid populations within the Calaveras River and whether one or more of the District's activities influences these effects.

Data recorded will include flow, water temperature, turbidity, dissolved oxygen, and benthic macroinvertebrates (BMI). Details regarding flow monitoring are addressed under CM1 above. Water temperatures will be recorded year-round at up to 11 potential thermograph locations (Figure D-2) that automatically record temperatures at hourly intervals. Thermograph data are downloaded approximately every month and water temperature data are summarized into a daily temperature database. Instantaneous handheld water temperatures are also recorded, along with instantaneous turbidity, during fisheries monitoring activities. Benthic macroinvertebrates and dissolved oxygen will also be monitored according to a study plan provided in Attachment D-2.

Existing Data:

<u>Hydrology</u>

- Due to its relatively small drainage area and limited snowpack, the hydrology of the Calaveras River is characteristic of rain-driven systems in California, whereby unimpaired flows range from very low to non-existent during the dry season (summer and early fall) to moderately high with sporadic peaks during the wet season (late fall through spring).
- Average annual run-off in the basin is 157,000 AF (years 1907 to 1980).
- Highest unimpaired flows typically occur from December through April.
- Natural unimpaired and post-dam instream flow conditions in the lower river exhibit high seasonal and inter-annual variability, which reflect patterns of seasonal precipitation and storm water runoff.
- Tributaries to the Calaveras River downstream of New Hogan Dam contribute to the high variability observed in the lower river. Peak seasonal flows within the only gauged tributary (Cosgrove Creek) have ranged from 68 to 1,267 cfs. Many of the tributaries are characterized by intermittent flows during the winter and spring

(December-May), having no measurable surface flow from at least July through September, and occasionally through mid-November.
- Prior to the District's operations, the lower river would frequently dry up during the late summer (CDFG 1963; USFWS 1960). Now, water stored in New Hogan Reservoir during wet seasons is released year-round for diversion, which results in sustained year-round flows between at least New Hogan Dam and Bellota Weir in all but drought years.
- Controlled reservoir releases during summer typically are greater than 150 cfs compared to a historical median of 0 cfs (range 0-64 cfs).
- Seasonal and inter-annual flow variability, both historical and present, represents a major factor influencing habitat quality and availability for salmonids.

Water Temperature

- New Hogan Reservoir experiences a slight to moderate thermal stratification during the late spring and summer months (April-August), but temperatures within the reservoir can be relatively uniform and cool by early fall at lowest pool elevations (USACE 2001).
- New Hogan Dam outlets are near the bottom of the reservoir; therefore, water released is the coldest possible.
- Water temperature below New Hogan Dam follows a general seasonal pattern with increasing temperatures during the spring and summer months and decreasing temperatures during the fall and winter.
- Water temperature is lowest near New Hogan Dam with a longitudinal gradient of increasing temperatures moving downstream.
- Daily fluctuations between minimum and maximum water temperatures were small to moderate throughout the year at New Hogan Dam (ranging from 0 to 5.4°C difference, greatest fluctuation range in January and smallest in June-August). At other locations, fluctuations increased and were more variable throughout the season traveling in a generally downstream direction. Largest daily difference was recorded as 11.3°C in May at Gotelli. Gotelli also had the greatest average differences in October through March (range 2.7 to 5.4°C) while Shelton had the greatest average differences in April through September (4.7 to 5.9°C).
- Water temperatures downstream of New Hogan Dam are influenced by ambient air temperatures. For example, water temperatures from April through September can be relatively high at Gotelli and Shelton Road with the 7-day average of daily maximum (7DADM) rising above 61°F and approaching 65°F in some years even though flows are greater than 150 cfs. However, temperatures drop below 61°F by mid-October to early November at flows ranging from 20 to 50 cfs.

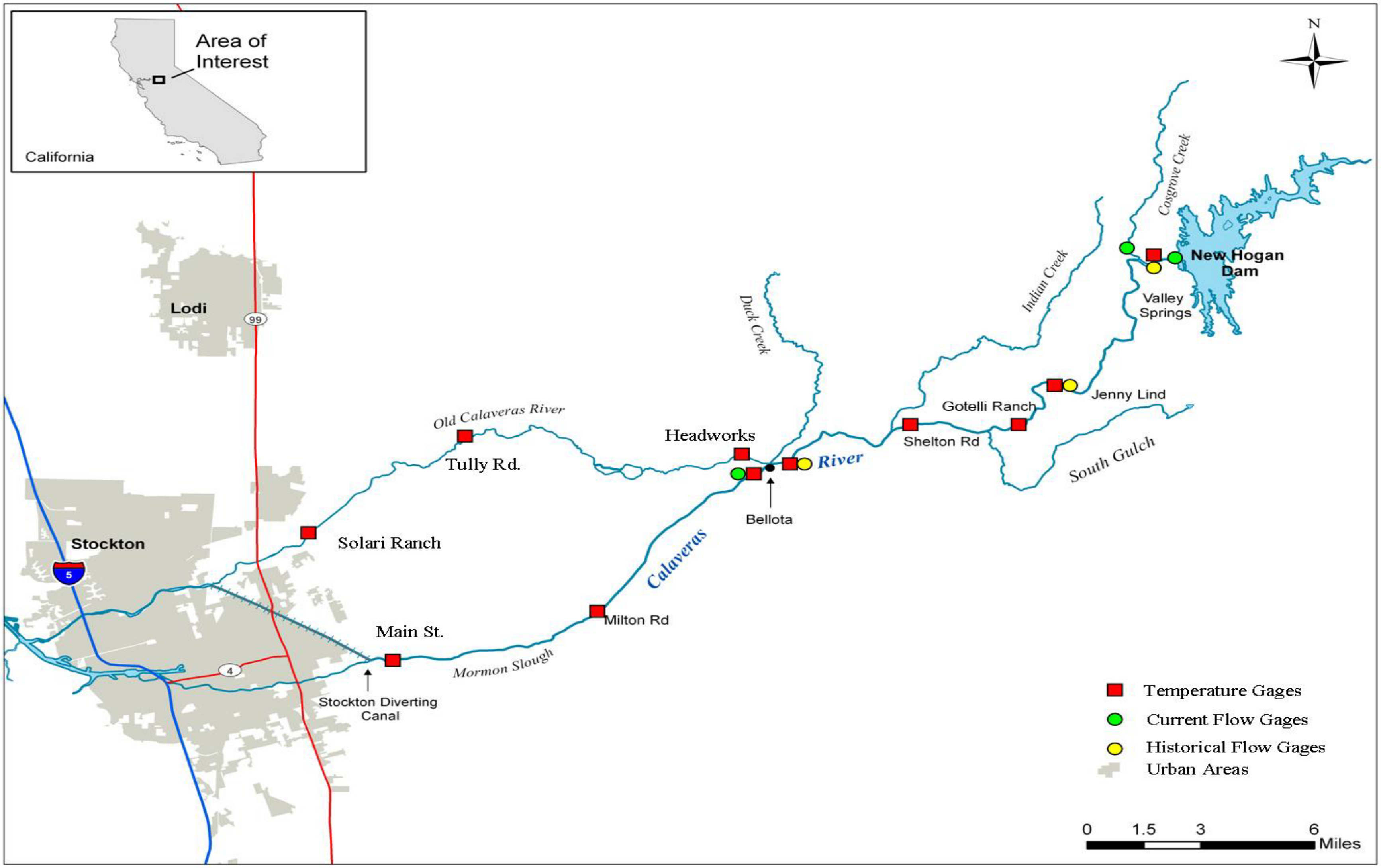

Figure D-2. Water temperature and USGS/USACE flow gaging stations in the lower Calaveras River.

- Evaluation of the 7DADM showed that water temperatures have the following characteristics:
    - are generally within the Environmental Protection Agency (EPA) Region 10's recommended spawning, incubation, and emergence range[1] from late November to early March between NHG and Shelton Road.
    - are generally within EPA Region 10's recommended "core" rearing range[1] year-round between New Hogan and Jenny Lind.
    - are generally within EPA Region 10's recommended "core" rearing range from late November to early March and "non-core" rearing range[1] from mid-March to mid-November between Gotelli and Shelton Road.
    - Based upon general EPA temperature guidelines, maximum temperatures observed below Shelton Road would be expected to result in physiological stress and/or mortality and make summer habitat conditions unacceptable. However, trout have been observed and appear to have over-summered in the Old Calaveras River in good health, which supports the idea that thermal criteria based on northern stocks may not apply to fish in the Calaveras River, or may indicate that there are localized areas of cool groundwater upwelling able to support fish.

Dissolved Oxygen

The CRWQCB Region 5 Basin Plan (1998) indicates dissolved oxygen (DO) levels for cold water fisheries "shall not be reduced below 7 mg/l." A small number of DO point measurements have been recorded which indicate:

- DO levels below 7mg/l were recorded during both the dry and wet seasons (mid May-October and November-mid May, respectively) at several locations between Bellota and the confluence during 2003 and 2004 (Tetra Tech 2005). In addition, low DO was recorded at Shelton Road during the dry season (Tetra Tech 2005). Sample sizes were small (n=1-2), but nonetheless indicate potential for impairment.
- DO levels below 7mg/l were recorded at Jenny Lind on October 7, 2000 (SAR 2003) and at Rock Quarry on October 31, 2005 (SEWD unpublished data). The October Jenny Lind measurement was taken in the morning, which may indicate high respiratory activity from algae populations during the night. However, the

[1] Little is known about the specific responses of Central Valley salmonid species to water temperatures (Williams and others 2007). In absence of Central Valley-specific data, criteria developed for more northern stocks are typically used as a conservative objective. For example, a Peer Review Panel on the nearby Stanislaus River recommended that EPA Region 10 criteria (developed based on laboratory studies of Pacific Northwest and Alaskan stocks) be used as objectives to evaluate potential benefits of various operating scenarios against one another (Deas and others 2004). These temperature criteria are believed to be conservative for Central Valley salmonids since water temperatures have always been naturally higher, particularly in the San Joaquin Basin, and regional salmonids have likely evolved to withstand higher temperatures. Therefore, it was assumed that as long as temperatures were within the EPA criteria which were developed based on the 7-day average of the daily maximum (DADM) values (i.e., <13°C [55°F] for salmonid spawning, egg incubation, and fry emergence; <16°C; 61°F for 'Core" rearing areas; and <18°C; 64°F for migration plus "non-core" rearing areas), the likelihood of temperature effects to salmonids would be minimized. These objectives can be applied in a similar approach to the Calaveras River.

Rock Quarry site was recorded at 2:30 PM and it is unknown what may have influenced this reading.

- DO levels in spring 2000 and 2001, ranging from 9.02 mg/L to 11.09 mg/L, indicate sufficient oxygen conditions to support aquatic life at all sample sites on the Calaveras River (SAR 2003).
- DO levels in fall 2000 and 2001 below Bellota Weir ranged from 9.65 mg/L to 11.27 mg/L.

Summer DO levels at two sites above Bellota were 11.03 mg/l and 9.75 mg/L and below Bellota were 7.21 mg/L to 8.76 mg/L. The latter measurements (i.e., below Bellota) were all taken in the late afternoon indicating the potential for lower DO conditions earlier in the day due to algal respiration at night.

<u>BMI Surveys</u>
Benthic macroinvertebrate (BMI) surveys conducted in 2004, 2005, 2007, and 2008 between NHG and Shelton Road (SEWD unpublished data) indicate:

- Spawning and rearing reach is subject to human and invasive species disturbances.
- Two lowermost survey sites, Shelton Road and Jenny Lind, are impaired:
    - Primarily due to the presence and high abundance of New Zealand mud snails (NZMS; *Potamopyrgus antipodarum*) (77 to 91.1% of invertebrate biomass for each site), which have displaced other native macroinvertebrates.
    - NZMS are believed to have colonized these locations sometime between fall 2002 and end of 2003 (first observed in January 2003).
- Uppermost Rock Quarry site ranges from unimpaired to marginally impaired, dependent on year and metrics applied.
- Degree of impairment cannot be accurately assessed at this time because adequate reference conditions are not available.

EM2. Adult Salmonid Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Biological Objectives include Flow and Fish Passage; and associated Targets are F1, F2, F3, FP2, and FP4 (Table D-1). Data Gaps include DG-1 and DG-2.

Action: SEWD's fisheries biologist will record adult monitoring data, which will be used in conjunction with EM1 data, to address whether measures designed to meet biological objectives and associated targets identified above are functioning as expected, as well as to provide information for addressing relevant data gaps to assist the AMP process. Adult salmonid counts in the spawning reach upstream of Bellota are important for establishing how many adults were able to access the spawning reach and to identify any relationships between spawner abundance and environmental or operational factors.

Once the preferred long-term solution for the Bellota Diversion Facility is implemented (within the first ten years of the ITP), an infrared scanner (i.e., Vaki Riverwatcher [Riverwatcher]), or similar passive video monitoring device, will be used to monitor fish

passage through the permanent fishway. In the interim, carcass surveys and/or redd counts may be conducted to provide escapement estimates. A detailed study plan will be developed, reviewed, and approved through the AMP process.

A Riverwatcher, or similar passive video monitoring device, would provide the most accurate count of adults migrating into the spawning grounds, while redd counts can provide estimates of escapement in years prior to video monitoring. The selected passive monitoring device would provide information related to migration timing, which may be correlated with streamflow and other environmental factors. Redd counts would also provide information regarding spawning distribution and timing; these data, coupled with environmental conditions, would shed light on suitability of various areas for salmonid spawning, relative productivity of each reach, and relationships between spawn timing and environmental or operational factors. Carcass surveys would only apply to Chinook salmon since steelhead sometimes survive spawning and are less likely to die on spawning grounds, making carcass counts ineffective for estimating the number of steelhead spawners.

Existing Data:
In 2002, spawning surveys were conducted from early January through late March 2002 to determine the temporal and spatial distribution of steelhead and resident rainbow trout spawning activity, as well as the size and potential superimposition of redds (Stillwater Sciences 2004).

- Number of rainbow trout redds documented in four reaches during first survey: New Hogan (45), upper Canyon (12), lower Canyon (5), and Jenny Lind (28).
- New redds appeared frequently and size varied substantially from approximately 1-7 ft^2 (0.09-0.65 m^2) with a median of 2-3 ft^2 (0.19-0.28 m^2).
- Estimated size of females, based on relationship of redd size to fish size developed in Keeley and Slaney (1996), ranged from 5-12.5 in. (13-32 cm) with a median of 7-9 in. (18-22 cm).
    - Size estimates suggest that most redds observed were constructed by resident rainbow trout.

In fall 2005, an adult redd/carcass count survey was conducted to determine spawning locations, mortality of fish that failed to enter spawning grounds, and total escapement of Chinook salmon (FFC 2007). Results included the following:

- Evidence of Chinook spawning documented both above and below Bellota.
    - Number of redds above Bellota was 159.
    - Number of redds below Bellota was 284.
- A total of 637 carcasses measured.
    - 93% of female carcasses above Bellota were fully spawned and 7% partially spawned.
    - 83% of female carcasses below Bellota were fully spawned, 9% partially spawned and 8% unspawned.

- Peterson population estimate was 868 (95% CI: 581-1,155). A second population estimate, based on multiplying the number of redds (n=443) by 2.5 adults, was 1,107, which falls within the 95% confidence limits of the Peterson estimate.

In fall 2011, an adult redd/carcass count survey was conducted to determine spawning locations, mortality of fish that failed to pass to spawning grounds, and total escapement of Chinook salmon (FFC 2012). Results including the following:

- Evidence of Chinook spawning documented both above and below Bellota.
    - Number of redds above Bellota was 48 (Jenny Lind-Shelton = 11; Shelton-Bellota = 37).
    - Number of redds below Bellota was 138 (Bellota-Flood = 89, Flood-Main Street = 49).
- A total of 68 carcasses measured.
    - 44% of the carcasses (n=30) were grilse and 56% were adults (n=38)
    - 59% were male, 34% were female and 7% were of unknown sex
    - 80% of males measured (32/40) were ad-clipped, and 91% of the females (21/23) were ad-clipped
- An initial population estimate based on multiplying the number of redds (n=186) by 2.5 adults was 465 spawners.

EM3. Juvenile Salmonid Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Flow Biological Objective and associated Targets F1, F2, and F3 (Table D-3). Data Gaps include DG-1 through DG-3.

Action: SEWD's fisheries biologist will record juvenile downstream migration monitoring data at the Shelton Road rotary screw trap (RST), which will be used in conjunction with EM1 data, to address whether measures designed to meet the biological objective and associated targets identified above are functioning as expected, as well as to provide information for addressing relevant data gaps to assist the AMP process. Juvenile salmonid counts at the lowermost boundary of quality spawning habitat (i.e., Shelton Road) are important for identifying population level attributes (e.g., abundance, timing of emergence and early emigration), individual level attributes (e.g., condition factors, life history expression), and associated influencing habitat attributes (water temperature, flow, etc.). It also allows the possibility to infer trends in habitat availability relative to environmental factors in the reach upstream of the trap, as well as to identify how many migrants may be susceptible to diversions downstream of Shelton Road.

Juvenile downstream migration will be monitored at Shelton Road with a rotary screw trap to estimate the annual abundance levels and migration characteristics of juvenile salmonids. A study plan is provided in Attachment D-3.

Existing Data:
Rotary screw trap sampling has been conducted annually at Shelton Road since 2002 to document the potential presence, relative abundance, and migration timing of juvenile *O. mykiss* and fall-run Chinook salmon within the lower Calaveras River (SEWD unpublished data). Data presented below ranges from the initiation of sampling in 2002 to the 2015 monitoring year.

Juvenile *O. mykiss*

- Juvenile *O. mykiss* have been observed every year and numbers have ranged from 319-3,134 with a median of 1,117. Rough population estimates indicate that juvenile *O. mykiss* outmigration abundance has ranged from 1,127 (80% CI: 1,101-2,073) to 13,670 (80% CI: 13,288-28,460), with a median of 5,739. Raw counts and estimated abundances are higher than for other Central Valley tributaries.
- Juvenile *O. mykiss* migration patterns are variable between years. Migrants have been observed as early as late October and as late as mid-July, but typically are observed between December and mid-May. They range in size from 20 mm to 450 mm, with fish larger than 300 mm (n=25) considered to be adults.
- Most juvenile *O. mykiss* migrated past Shelton Road (i.e., estimated passage) as young-of-year (YOY; ≤100 mm) in 2002, 2003, 2006, 2007, 2008, 2009, 2010, 2012, and 2013 (i.e., 84%, 87%, 77%, 83%, 81%, 75%, 86%, 76% and 62% of migrants, respectively) and as Age 1+ fish (> 100 mm) in 2004, 2005, 2011, and 2015 (i.e., 88%, 72%, 77%, and 92% of migrants, respectively). Juvenile outmigration of O. mykiss during 2014 was relatively split between YOY and Age 1+ fish (YOY=47.7% and Age 1+ = 52.3%).
- Most YOY migrated past Shelton Road during the spring and many Age 1+ fish migrated during the fall/winter (November-March).
- Steelhead smolts and silvery parr were captured in small numbers in years when YOY dominated the catch (approximately 15-30% of annual catch for each). However, in years when Age 1+ were dominant, silvery parr made up a high percentage of the catch (60% in 2004, 44% in 2005, 57% in 2011, and 59% in 2015). Smolts were primarily captured from November through March. Silvery parr were primarily captured from November through March and May to June (as Age 1+).
- Capture of juvenile *O. mykiss* exhibiting smoltification indicates presence of anadromous traits within the population. Unknown proportion of population is anadromous versus resident.
- Average *O. mykiss* K factors measured in the Calaveras during 2002-2015 have ranged from 1.19 to 1.64 (n=2,641), which indicates that fish are within good to excellent condition (K factor range ≥1.25) (Barnham and Baxter 1998; Baxter et al. 1991, as cited in Povslen 1993).

Juvenile Chinook salmon

- Juvenile Chinook salmon have been observed in eight out of 14 sampling years: 6 in 2002; 5,943 in 2006; 2,124 in 2007; 1 in 2008; 2,311 in 2012; 449 in 2013; 11 in 2014; and 21 in 2015.
- Rough population estimates indicate that juvenile Chinook abundance was 39,123 (80% CI: 32,936-74,100) in 2006; 20,805 (80% CI: 19,521-38,835) in 2007; 12,132 (80% CI: 12,132-13,682) in 2012; 4,082 (80% CI: 3,787-7,513) in 2013; and no estimates were done for 2002, 2008, 2014, and 2015 due to extremely low catch numbers.
- Juvenile Chinook migrants (all YOY) have been observed as early as December and as late as mid-July, but the majority migrated between February and May.
- Average Chinook K factors measured in 2006, 2007, 2012, and 2014 ranged from 1.42 to 1.62 (n=2,126), which indicates that fish are within good to excellent condition (K factor range ≥1.25) (Barnham and Baxter 1998; Baxter et. al 1991).

Comparison of *O. Mykiss* Migration between Calaveras River and Stanislaus River.

- *O. mykiss* juvenile migration timing and size ranges in the Calaveras River are similar to nearby Stanislaus River.
    - Age 1+ fish were captured migrating more often during the winter (December-March) while YOY were captured more frequently during spring (April-July).
- Number of *O. mykiss* captured (average = 1,117) and number of *O. mykiss* estimated (1,000-14,000 estimated each year) on the Calaveras River was at least 10-fold greater than on the Stanislaus River (i.e., about 50 fish captured and about 500-700 estimated each year). Large differences may not be as high as they appear and may not be entirely representative of actual conditions due to several factors:
    - It is highly likely that the relative catch rates between the two systems are different, particularly since the Stanislaus River rotary screw traps sample a significantly lower proportion of flow than on the Calaveras River.
    - Due to differences in trap efficiencies, the number of fish, and/or the number of fish per size class, that can be captured in each trap are disproportionate to each other.
    - Due to the limitations of sample size, few trap efficiency tests have been conducted on the Calaveras River with *O. mykiss*, so less precise estimates were calculated.
    - Stanislaus estimates are likely to be underestimated to some degree because so few fish are captured each day.
    - On the other hand, the Calaveras River estimates may be overestimated because the trap is only operated intermittently, resulting in a higher percentage of missing value estimates versus the Stanislaus River traps, which operate most days during the sampling season.

EM4. Fish Evaluation and Salmonid Relocation During Fall Flashboard Dam Removal Operations

Biological Objectives, Targets, and Data Gaps Addressed: Fish Passage and Avoid Entrainment Objectives and associated Targets FP1, FP5 and AE1. No data gaps addressed.

Action: SEWD's fisheries biologist will record fish evaluation and salmonid relocation data during fall flashboard dam removal operations, which will be used in conjunction with data from EM1, to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected.

Monitoring for presence/absence of fish in the Old Calaveras River channel during dewatering each year provides an indication of whether the interim or permanent barriers have been effective for preventing entrainment. In the event that salmonids do enter the channel and become stranded, relocation operations during dewatering will prevent or minimize mortality and will secondarily provide information (i.e., fish size, length, condition factor) regarding characteristics of entrained fish. SEWD will annually document whether salmonid relocation was necessary, which will provide an indication of the effectiveness of interim and permanent salmonid entrainment reduction measures (e.g., interim net and permanent non-entraining barrier).

Any salmonid relocation will be conducted according to a protocol developed and approved by CDFW and NMFS in 2004 (CDFG 2004; Attachment D-4) and will be implemented if authorized by CDFW.

Existing Data:
During fall flashboard dam removal operations, a small number of juvenile and adult *O. mykiss* have occasionally been stranded in the Old Calaveras River channel; live fish were either relocated or specimens were collected and submitted to California Department of Fish and Wildlife (CDFW; formerly known as California Department of Fish and Game) for genetic analyses (SEWD unpublished data).

- *O. mykiss* juveniles and adults have been observed surviving the summer in healthy condition within the Old Calaveras River channel despite water temperature conditions in excess of standard tolerance guidelines for the species. This ability to tolerate higher temperatures may be the result of local stock adaptations to warmer water conditions than the more northern stocks on which the tolerance criteria are based upon. Survival may have been influenced by one or more factors including presence of extensive riparian canopy, reduced algal mats, and lack of predatory fish.

EM5. Monitor Pool Downstream of Bellota for Salmonids During Interim Fish Ladder Operations

Biological Objectives, Targets, and Data Gaps Addressed: Fish Passage Biological Objective and associated Target FP3. No data gaps addressed.

Action: SEWD will record observations of salmonids in the pool downstream of Bellota during interim ladder operations, in conjunction with data from EM1, to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected. Prior to permanent improvements at the Bellota Diversion Facility, adult salmonids may enter the pool downstream of Bellota and become temporarily stranded under a declining hydrograph where the lower river becomes disconnected from the confluence. Under these circumstances, monitoring will identify whether salmonids are present in the pool and whether there are sufficient inflows to operate the upper ladder (i.e., ≥10 cfs). If these conditions exist, then the upstream ladder will be opened even though other ladder operating criteria are not met (i.e., there is no flow connectivity between the confluence and Bellota). Passage opportunities during the interim period are thus maximized by taking measures, whenever possible, to assist fish passage (e.g., board in the upper fish ladder will be removed).

EM6. Fish Screen Effectiveness Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Avoid Entrainment Biological Objective and associated AE4 Target (Table D-1). Data Gap includes DG-3.

Action: SEWD's fisheries biologist will record fish screening effectiveness monitoring data, which will be used in conjunction with data from EM1, to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected, as well as to provide information for addressing a relevant uncertainty to assist the AMP process. Monitoring will determine whether diversion screening design criteria were implemented and whether the screen provides salmonid protection from entrainment and impingement as expected.

Once the permanent fish passage and screening improvements are implemented at the Bellota Diversion Facility, fish screen effectiveness monitoring will be conducted according to the study plan provided in Attachment D-5.

No site-specific monitoring is planned at this time for evaluating the effectiveness of screening at individual privately owned diversions. As individual structures are proposed for screening improvements, a monitoring plan for representative projects will be prepared through the AMP process if deemed appropriate by NMFS.

EM7. Structural Improvement Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Fish Passage Biological Objective and associated target FP4. No data gaps addressed.

Action: Effectiveness of instream structure modifications in meeting passage design criteria will be evaluated using as-built surveys and streamflow records. This information will also be used to identify duration and frequency of passage opportunities. Supervisory Control and Flow Data Acquisition System (SCADA) data will also be used to provide an

indication of flow levels associated with juvenile migration, which will allow documentation and evaluation of fish passage opportunities.

EM8. Stakeholder Education Efforts

Biological Objectives, Targets, and Data Gaps Addressed: Biological Objectives include Fish Passage and Avoid Entrainment; and associated Targets are FP4**,** AE5, and AE6. Data Gap includes DG-3.

Action: SEWD will record stakeholder education efforts and maintain an updated list of screened/unscreened diversion to address whether measures designed to meet the biological objectives and associated targets identified above are functioning as expected, as well as to provide information for addressing uncertainties identified above to assist the AMP process. SEWD will document completion of stakeholder educational program activities (periodic workshops, annual newsletters, and a regularly updated website) including any stakeholder comments. Stakeholder education efforts will ensure that local landowners understand basin fishery issues and documentation of these efforts will confirm that landowners have received information to make informed choices regarding how they may contribute to maintaining adequate conditions for fish health. An updated fish screen status list for privately owned diversions will be maintained to document progress towards achieving fish screening goals to be established through the AMP process.

EM9. Fyke Net Evaluation of Flashboard Dam Notches

Biological Objectives, Targets, and Data Gaps Addressed: Fish Passage Biological Objective and associated target FP6. No data gaps addressed.

Action: SEWD will record fyke net evaluation data during operation of flashboard dam notches, which will be used in conjunction with data from EM1, to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected, as well as to provide information for addressing uncertainties identified above to assist the AMP process. Very little is known about the ability of salmonids to pass flashboard dams and any harm or injury that may be incurred during passage. Similarly, there are few examples of existing passage improvements at comparable structures to guide future improvements. Evaluating passage and potential injury of juvenile salmonids in the Old Calaveras River channel and Mormon Slough/SDC will provide information on the success of passage improvement measures and guide future passage improvement efforts.

A fyke net evaluation of flashboard dam notches will be conducted during at least one season according to the study plan provided in Attachment D-6.

EM10. SEWD Instream Structures Maintenance Operations Water Quality Monitoring and/or Visual Assessment

Biological Objectives, Targets, and Data Gaps Addressed: Biological Objectives include Water Quality and Avoid Direct Injury; and associated Targets are WQ1 and AD1. No data gaps addressed.

Action: SEWD will record water quality monitoring and/or visual assessment during instream structures maintenance operations to address whether measures designed to meet the biological objectives and associated targets identified above are functioning as expected.

If instream maintenance work will occur in flowing water, SEWD personnel will visually assess work areas for fish prior to and during activities and will disperse any fish observed. Any salmonids observed will be documented. Water quality measurements (water temperature, dissolved oxygen, electrical conductivity, and turbidity) will also be recorded. Visual assessments during work activities will reduce the likelihood that fish are injured or killed by equipment during maintenance operations.

EM11. Fisheries Monitoring Take Assessment

Biological Objectives, Targets, and Data Gaps Addressed: Avoid Direct Injury Biological Objective and associated Target AD2. No data gaps addressed.

Action: SEWD's fisheries biologists will maintain daily records of salmonid take (number and condition such as healthy, injured, or dead) to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected. These data will be used to determine whether sampling protocols offer sufficient salmonid protection or need to be modified.

EM12. Alternative Fisheries Monitoring

Biological Objectives, Targets, and Data Gaps Addressed: Biological Objectives include Flow, Fish Passage, and Avoid Entrainment; and associated Targets are F1-F3, FP1-FP2, FP4- FP7, AE1-AE3, AE5-AE6. Data Gaps include DG-1 through DG-3.

Action: Alternative monitoring activities such as seining, snorkel surveys, electrofishing, and telemetry will be conducted within funding constraints, if deemed necessary through the AMP process (i.e., an annual monitoring budget will be established and varying monitoring activities can be selected each year dependent on recommendations of the Governmental Resource Agencies and Science Advisors). A study plan is provided in Attachment D-5. If implemented, SEWD's fisheries biologists will maintain daily records of seining, snorkel survey, electrofishing and/or telemetry data, which can be used in conjunction with data from EM1 to address whether measures designed to meet biological objectives and associated targets identified above are functioning as expected, as well as to provide information for addressing uncertainties identified above to assist the AMP

process. One or more of these sampling methods can be used to evaluate fish assemblages between New Hogan Dam and the mouth of the river to determine: 1) what species are present and in what abundance, 2) how species assemblages change throughout the year in relation to environmental conditions, 3) residency rates and distribution of juvenile salmonids, 4) juvenile salmonid habitat use, and 5) if losses to juvenile salmonids are related to predation, water quality factors, entrainment, or a combination of these factors.

Existing Data:

Snorkel Surveys

Surveys have not been conducted in a way that allows quantitative comparison of population densities; however, qualitative characteristics have been documented as follows:

Snorkel surveys were conducted biweekly from March through October in 2002 to document salmonid distribution, abundance, and habitat use (Stillwater Sciences 2004). Surveys occurred in three reaches: (1) New Hogan Dam downstream to Cosgrove Creek, (2) Cosgrove Creek to Jenny Lind, and (3) Jenny Lind. These surveys indicate:

- Most *O. mykiss* (no salmon observed) reared within Reaches 1 and 2.
- Juvenile *O. mykiss* were initially most abundant in Reach 1 until mid-May, after which higher densities were observed in Reach 2 throughout the remainder of the study
    - Higher densities in Reach 2 were likely due to a combination of continued emergence within the reach and recruitment of juveniles from adjacent upstream and downstream reaches.
- Summer habitat conditions, especially water temperature, were more optimal in the upper two reaches and less optimal at Reach 3 and below.
- *O. mykiss* Age 1+ density during the winter was very low and was likely due to previous emigration from the river, downstream migration into the reach below Jenny Lind, or fish taking refuge in the stream substrate where they could not be observed.

Snorkel surveys were conducted twice in the fall of 2005 and once in fall of 2006. The two surveys conducted in 2005 were done to examine the potential change in fish density going from a low flow (25-47 cfs at NHG) to a high flow (540-727 cfs at NHG) period (SEWD unpublished data). The survey in 2006 was done to provide a comparison of fish density between years and it was conducted at a moderate flow (100-101 cfs at NHG). Three reaches were surveyed based on varying habitat types including Reaches 1, 3, and 4 identified above under Habitat Characteristics section. These surveys indicate:

- *O. mykiss* density decreased by an order of magnitude between Survey 1 and Survey 2 (i.e., low flow versus high flow conditions). This decline in density may have resulted from one or more factors including:
    - Increased habitat area during Survey 2. Since density is a function of the number of fish observed divided by habitat area, density would be expected to decline under conditions where the same number of fish occupy a habitat area that has become larger.

  - o Increased preferred habitat during Survey 2. Under low flow conditions, most locations within the reaches surveyed were shallow and fish may have sought out those few areas where depths were the greatest. This habitat selection behavior would concentrate fish in those areas where depths were sufficient for snorkeling. As depths increased under increasing flows, fish would likely disperse out of these restricted locations and spread out into previously shallow areas. Due to this redistribution of fish, in combination with the ability to snorkel more areas, densities would be reduced.
  - o Migration out of the study area. The increase in river flow between surveys may have swept *O. mykiss* downstream or stimulated downstream migration. If so, *O. mykiss* may have moved into areas where sampling was not conducted (i.e., Reach 2 or downstream of Reach 4).
  - o Observer bias. Under low flow conditions during Survey 1, divers were able to slowly move upstream and it is likely that counting accuracy was high. In contrast, divers had to float habitat units from top to bottom during the high flow conditions of Survey 2 and had no control over their speed; therefore, accuracy was reduced and numbers of fish may have been underestimated.
- *O. mykiss* densities in all three surveys were generally low compared to those documented by FFC in 2002 and were low compared to the average documented in other tributaries but were nonetheless within ranges observed elsewhere (Satterthwaite 2002).
- Low densities may be due to reduced susceptibility to observation during the day, and night counts may be warranted. Grost and Prendergast (1999) observed that substantial daytime hiding behavior may occur for rainbow trout >8 cm during the summer months.

Snorkel surveys were conducted during late-summer or early fall in 2011–2013 to estimate the abundance and distribution of *O. mykiss* and to provide a point of comparison to investigate whether the population has shifted recently in response to changes in water temperature in the Calaveras River. Survey reaches included: (1) New Hogan Dam to Canyon, (2) Canyon to Jenny Lind, (3) Jenny Lind to Shelton Rd, and (4) Shelton Rd. to Bellota.

- The river-wide estimated abundance of *O. mykiss* averaged just over 7,200 fish between 2011 and 2013.
- Annual abundance estimates indicated that population of *O. mykiss* is relatively stable and increased in 2013.
- Densities of *O. mykiss* were highest (>1,000 *O. mykiss* per mile) in reaches in the Canyon reach of the Calaveras River.
- Long-term and river-wide densities were around 500 *O. mykiss* per mile.

<u>Telemetry (PIT tag, acoustic telemetry or radio-tracking)</u>
Pilot PIT tag studies were conducted in 2006 and 2009 according to a feasibility study plan provided in Attachment D-1.

In 2006, 114 *O. mykiss* were tagged and released between February 1 and March 9, and one was released on May 3. Forklengths of fish tagged ranged from 130 mm to 320 mm (avg. = 207 mm), and weights ranged from 23.9 g to 288.5 g (avg. = 93.7 g) (SEWD unpublished data).

- 19 fish (16.5%.) were detected post-release.
- 96 fish (83.5%) were not detected. Non-detections may have been due to one or more factors:
    - Downstream migration occurred during high flow events when the detection antennas were partially or completely non-operational (five of six antennas were completely non-operational after mid-March).
    - Detection efficiency of individual antennae may have fluctuated and may have been low so fish passed undetected.
    - Fish remained near release site to rear or migrated upstream.
    - Fish experienced mortality before being detected.
- Days until first detection at any site ranged from one to 105 days (mean = 11.7 days).
- Travel time to sites that were 2.2 to 5.8 miles downstream generally ranged from 0.12 to 1.10 miles/day (avg. = 0.44; n = 16), with exception of two fish that were calculated at 0.05 and 2.20 miles/day, respectively. Travel time to the lowermost site 24 miles downstream was 0.81 miles/day (n=1).
- Several fish stayed in an area approximately 2.5 miles downstream of release site for two to 13 days (n=5).
- Based on range of travel times (0.05 to 2.20 miles/day) and multiple detections of several fish at the same location over a range of days (2-13), it appears that some fish actively migrated after release while some continued to rear for a while before migrating downstream.
- Many logistical challenges occurred, as is typical during initial execution of any study, including hardware failure, software errors, vandalism, damaged antennas, and power supply reliability.

In 2009, *O. mykiss* were tagged and released (n = 63) between January 22 and February 20. Forklengths of fish tagged ranged from 133 mm to 310 mm (avg. = 168 mm), and weights ranged from 24.8 g to 336.5 g (avg. = 54.6 g) (SEWD unpublished data).

- 27 fish (43%) were detected.
- 36 fish (57%) were not detected. Non-detections may have been due to one or more factors:
    - Downstream migration occurred during or after high flow events when the detection antennas were completely non-operational (two antennas were damaged on February 17 and all antennas were completely non-operational after March 4).
    - Detection efficiency of individual antennae may have fluctuated and may have been low, so fish passed undetected.
    - Fish remained near release site to rear or migrated upstream.
    - Fish experienced mortality before being detected.
- Days until first detection at any site ranged from one to 23 days (avg. = 3.4 days).

- Travel time to sites that were 0.5 to 5.2 miles downstream generally ranged from 0.04 to 1.3 miles/day (avg. = 0.57; n = 25) with exception of two fish that were calculated at 2.6 and 5.2 miles/day, respectively.
- One fish that was first detected at the Bellota Intake (5.2 miles downstream) was subsequently detected at the Old Calaveras Headworks two days later.
- Unlike 2006, no fish were detected in Mormon Slough below the Bellota Intake station.
- Based on range of travel times (0.04 to 5.2 miles/day) and multiple detections of several fish at the same location over a range of days (2-10), it appears that some fish actively migrated after release while some continued to rear before migrating downstream.
    - One fish stayed in an area approximately 0.5 miles below release site for four days and several fish (n = 6) stayed in an area approximately 5.2 miles below release site for 2 to 10 days.
- Many logistic challenges continued in this second year including hardware failure, software errors, and antennas damaged by high flows.

<u>Visual Observations, Fyke Nets, or Electrofishing</u>

Beginning in fall 2001, adult and juvenile salmonid passage has been monitored periodically at the Bellota Weir, Mormon Slough/SDC, and Old Calaveras River primarily by visual observations, but also with fyke-nets and electrofishing (FFC 2007 and unpublished data).

- Surveys indicate that few adult Chinook attempt to migrate into the river during years when fall flows are low.
    - During low flow years, three to 17 adults were observed stranded primarily in the lower reaches of Mormon Slough/SDC and Old Calaveras River channel downstream of man-made structures, indicating that these structures represent barriers at low flows.
    - Location and timing of observations in low flow years indicates that adults may be falsely attracted into the river by localized run-off from storm drains in the lower Mormon Slough/SDC area. Storm run-off can occur in this lower area even when there are no corresponding freshets and/or flood control releases in the river above the point of discharge. This localized run-off likely occurs due to short rain events near Stockton where impervious surfaces concentrate precipitation into storm drains emptying into the lower channel. With no natural flow connection from the upper river, migration is prevented.
- During 2005, there were 21 out of 637 (3.3%) carcasses with clipped adipose fins indicating hatchery origin (FFC 2007). Analysis of coded wire tag information from 20 fish indicated that:
    - All were fall-run Chinook that had been released at Jersey Point in the San Joaquin River.
    - 12 fish (8 female; 4 male) were of Merced River hatchery origin (Merced hatchery marked 65% and 70% of smolts with coded wire tags in 2002 and 2003, respectively), and

- 8 fish (4 female; 4 male) were of Mokelumne River hatchery origin (Mokelumne River hatchery marked 7% and 3% of smolts with coded wire tags in 2002 and 2003, respectively).
- Given that only a small percentage of Mokelumne River, Feather River, Sacramento River, and American River hatchery salmon were marked, fish most likely originated from these hatcheries with a very small fraction of fish from other locations.

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Attachment D-1
Operations Database

Table D-1. Operations database to be filled out daily each year and submitted on a bi-weekly basis to NMFS and/or CDFW.

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			Comments
	Year-round					Irrigation Season																
	NHG	COS	TMT	MRS	OCH	FD	MSD	SD	CD	TD	EMD	SRD	MAD	MDS	TM	LD	LC		SHE* (cfs)	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	
1/1/12																						
12/31/12																						

Codes: NHG= New Hogan Dam; COS= Cosgrove Creek; TMT= To Treatment Plant; MRS= Mormon Slough at Bellota; OCH= Old Calaveras Headworks Facility; FD= Fujinaka Dam; MSD= ; SD= Sangunetti Dam; CD= Clements Dam; TD= Tully Dam; EMD= Eight Mile Dam; SRD= Solari Ranch Dam; MAD= McAllen Dam; MDS= Mosher Diversion Structure; TM= Tully-Mosher; LD= Lyons Dam; LC= Lefflers Crossing; SHE= Shelton Road. Asterisk indicates that Shelton Road measurements will be manually collected whenever New Hogan Dam releases are less than 35 cfs during the business week (Monday-Friday; no personnel available on Saturday and Sunday) to determine whether the minimum flow of 20 cfs is being maintained at Shelton Road.

Attachment D-2
Benthic Macroinvertebrates

This study includes bioassessment of aquatic benthic macroinvertebrates (BMIs) in the lower Calaveras River below New Hogan Dam (NHG) using protocols specified in the California Department of Fish and Game California Stream Bioassessment Procedure (CSBP) (CDFG 2003). The project is designed to establish baseline aquatic biological community structure in the primary salmonid rearing reach of the lower Calaveras River. A secondary purpose is to document the presence and distribution of New Zealand Mud Snails (NZMS) and BMI community response to this invasive species.

METHODS

Sampling Site Descriptions

Field data collection will occur at three sampling sites (Rock Quarry at river mile [RM] 41.3, Jenny Lind at 34.6, and Shelton Road at RM 29.3) (Table D-2.1, Figures D-2.1 and D-2.2). Sites were selected so that the biological communities within the primary spawning and rearing reach below New Hogan Dam could be evaluated. According to Harrington (1999), sampling BMIs once a year can adequately characterize biological condition as long as sampling occurs at the same time each year (either spring or fall). We chose to conduct sampling in the fall to coincide with NZMS reproduction, which most often occurs in summer and fall (IDNR 2005).

Table D-2.1. **Sampling locations and descriptions for three locations on the Calaveras River, sampled September 22, 2004, October 31, 2005, and September 10, 2007.**

Sta. Id.	RM	Latitude	Longitude	Elevation
Rock Quarry	41.3	N 38° 08.893’	W 120° 49.521’	529
Jenny Lind	34.6	N 38° 05.342’	W 120° 51.920’	229
Shelton Road	29.3	N 38° 04.367’	W 120° 55.887’	165

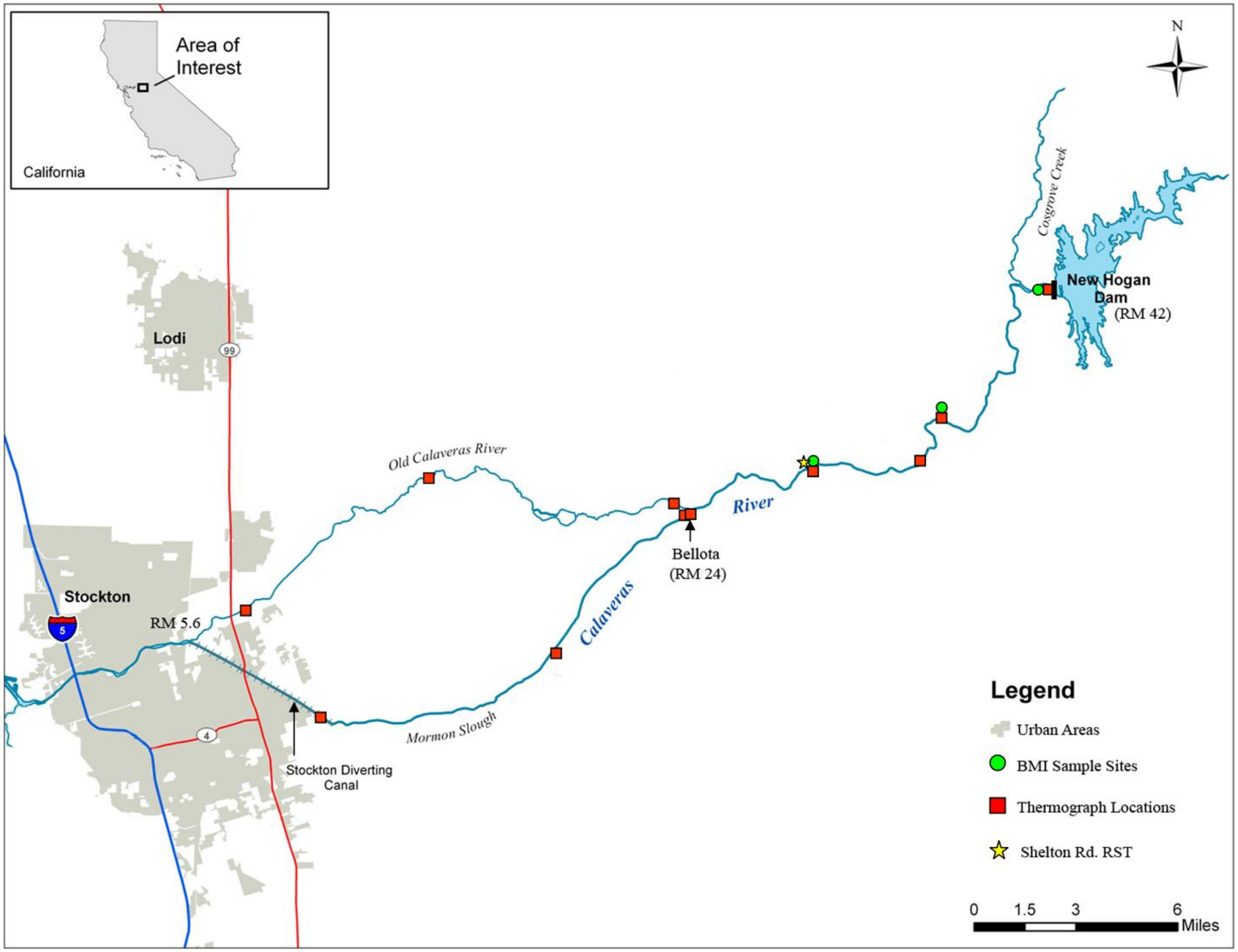

Figure D-2.1. Location of benthic macroinvertebrate (BMI) sampling sites in the lower Calaveras River.

Figure D-2.2. Photos looking up and downstream from each benthic macroinvertebrate (BMI) sampling site.

Collection of Benthic Macroinvertebrates

Sampling and laboratory procedures for this survey will follow the CSBP *Field Procedures for Collecting BMI Samples and Field Procedures for Measuring Chemical and Physical/Habitat Quality* (CDFG 2003). Our sampling approach includes the following:

1. At each sample site, BMI samples will be collected beginning at the most downstream riffle and proceeding upstream to avoid disrupting areas prior to sampling. Riffles are defined as areas in the reach where the velocity of flow is greatest due to shallow water coupled with a high relief bottom. At each site, the California Bioassessment Worksheet (CBW) will be used to collect all of the necessary station information.
2. At each sample location, the length of the riffle will be measured, and a random number table used to randomly establish three points along the riffle where transects will be established perpendicular to stream flow.
3. The benthos within a 2 ft^2 area will be sampled upstream of a 1 ft. wide, 0.5 mm mesh “D” frame kick-net. Sampling of the benthos will be performed manually by rubbing cobble and boulder substrates in front of the net, followed by “kicking” the upper layers of substrate to dislodge any remaining invertebrates. Substrate will be rubbed by hand for three minutes with the same amount of effort applied to each sample.
4. Three locations along each transect that are representative of habitat diversity will be sampled and combined into a composite sample. Each composite sample will be transferred into a 1 quart, wide-mouth plastic jar containing approximately 300 ml of 95% ethanol. This technique will be repeated for each of three riffles in each reach; thus, three composite samples will be collected for each site, for a total of 9 BMI samples.

Physical/Habitat Quality Assessment and Chemical Measurements

Physical habitat quality will be assessed for the monitoring reaches using U.S. Environmental Protection Agency (EPA) Rapid Bioassessment Protocols (RBP) (Barbour et al. 1999). Physical/habitat measurements will be collected at each site and the information will be recorded on the CBW. These measurements are summarized as follows:

1. Water temperature (°F) and dissolved oxygen (mg/L) will be measured. Specific conductance (e.g., electroconductivity; μS/cm) and pH may be recorded.
2. Riffle length, width, and depth (in meters) will be recorded. Width measures will be taken either at a transect representative of the stream width in the reach or, in the case of variable widths, each transect will be measured and an average generated. Depth measures will be taken at a representative depth.
3. Surface velocity will be measured in the thalweg of a representative run area.
4. Percent canopy cover and stream gradient will be visually estimated.
5. Substrate complexity, embeddedness, consolidation and their categories (i.e., fines, gravel, cobble, boulder, and bedrock) will be estimated using CSBP Physical/Habitat Quality Form.

Taxonomic Identification of Benthic Macroinvertebrates

Professional level identification of freshwater organisms will be conducted in adherence with Taxonomic Effort Level 2 specified in the CSBP. Taxonomic identification of specimens will be conducted by an approved California Bioassessment Laboratory (e.g., ECORP Consulting, Inc.). Raw data will be provided in an appendix.

Analysis of Benthic Macroinvertebrate Samples

Multi-metric. The RBP uses a multi-metric approach to bioassessment data analysis. Metrics are numerical measures that attempt to characterize the macroinvertebrate community sampled. All BMI data will be used to calculate the CSBP bioassessment metrics specified in the manual and their responses to impaired conditions are listed in Table D-2.2. Metric groups include Richness Measures, Composition Measures, Tolerance/Intolerance Measures, Functional Feeding Group, and Abundance Measures, which are defined according to Harrington and Born (2000), as follows:

- ***Richness Measures*** **-** These metrics reflect the diversity of the aquatic assemblage where increasing diversity correlates with increasing health of the assemblage and suggests that niche space, habitat, and food sources are adequate to support survival and propagation of a variety of species.
- ***Composition Measures*** **-** These metrics reflect the relative contribution of the population of individual taxa to the total fauna. Choice of a relevant taxon is based on the knowledge of the individual taxa and their associated ecological patterns and environmental requirements such as those that are environmentally sensitive or a nuisance species.

Table D-2.2. Bioassessment metrics used to describe characteristics of the benthic macroinvertebrate (BMI) community in the lower Calaveras River. Harrington and Born 2000.

BMI Metric	Description	Response to Impairment
Richness Measures		
Taxa Richness	Number of individual taxs collected from each sample	Decrease
EPT taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) orders	Decrease
Ephemeroptera taxa	Number of mayfly families	Decrease
Plecoptera taxa	Number of stonefly families	Decrease
Trichoptera taxa	Number of caddisfly families	Decrease
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae	Decrease
Sensitive EPT index	Percent composition of mayfly, stonefly, and caddisfly larvae with tolerance values between 0 and 3	Decrease
Percent Hydropsychidae	Percent composition of the caddisflies in the more tolerant family Hydropsychidae	Increase
Percent Baetidae	Percent composition of the mayflies in the more tolerant family Baetidae	Increase
Shannon Diversity	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	Decrease
Tolerance/Intolerance Measures		
Tolerance Value	Weighted tolerance value for whole sample (number of organisms per taxa times t-value for taxa; sum this value for all taxa in sample; divide by total number of organisms in sample)	Increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a CTV of 0, 1, or 2	Decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a CTV of 8,9, or 10	Increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	Increase
Functional Feeding Groups (FFG)		
Percent Collectors	Percent of macrobenthos that collect/gather fine particulates	Increase
Percent Filterers	Percent of macrobenthos that filter fine particulates	Increase
Percent Scrapers	Percent of macrobenthos that graze upon periphyton	Variable
Percent Predators	Percent of macrobenthos that feed on other organisms	Variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulates	Decrease
Abundance		
Estimated Abundance	Estimated number of macroinvertebrates in sample calculated by extrapolations from the proportion of organisms in each sample	Variable

- ***Tolerance/Intolerance Measures* -** These metrics reflect the relative sensitivity of the benthic community to aquatic perturbations. The taxa used are usually pollution tolerant and intolerant taxa but are generally nonspecific to the type of stressors. Percent Hydropsychidae and Baetidae (tolerant families) are regional metrics that have evolved to be particularly useful in California. The metric values usually

increase as the effects of pollution in the form of organics and sedimentation increases.

- ***Functional Feeding Groups* -** These metrics provide information on the balance of feeding strategies in the aquatic assemblage. The FFG composition is a surrogate for complex processes of trophic interaction, production, and food source availability. An imbalance of the composition of FFG reflects unstable food dynamics and indicates a stressed condition.
- ***Abundance* -** This metric provides information about the overall abundance of macroinvertebrates.

Deliverable: Annual summary report with data sheets.

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Attachment D-3
Calaveras River Juvenile Salmonid
Migration Monitoring Program

The information collected during the Calaveras River salmonid migration monitoring program (Juvenile Salmonid Monitoring Program) will document juvenile salmonid presence, abundance, and migration behavior, as well as identify the environmental and/or water management conditions that affect juvenile salmonids' ability to migrate successfully out of the river and susceptibility to entrainment into unscreened diversions. Fishery information is vital for resource managers to be able to ascertain the effectiveness of conservation strategies in order to successfully maintain salmonid populations within the Calaveras River. In addition, the Juvenile Salmonid Monitoring Program will provide resource managers of the Calaveras River with data regarding fish populations to assist in making informed adaptive management decisions for sustainable native fishery management.

SEWD's biologists hypothesize that annual abundance of juvenile salmonids will increase over the term of the CHCP relative to pre-conservation measure levels. The ability to detect a statistically significant difference between pre- and post-project abundance is based on the assumption that the biologists can obtain a representative sample of biological information. Production levels of fish populations are naturally subject to annual variations regardless of the quality of the habitat. Production level variations can be caused by changes in environmental (climate, fire, etc.) and/or biological (primary production, disease, etc.) conditions. Therefore, we expect that future fish populations will fluctuate widely in annual abundance, but we also expect to observe higher mean levels of abundance than those prior to implementation of conservation strategies.

The goal of the Juvenile Salmonid Monitoring Program is to be able to estimate annual abundance levels and migration characteristics of juvenile salmonids in order to assess the effectiveness of conservation strategies and to provide information for adaptive management. Objectives are to: (1) monitor passage of *O. mykiss* with a rotary screw trap in the lower Calaveras River, (2) monitor environmental variables in the lower Calaveras River, and (3) determine the influence of environmental and biological variables on *O. mykiss* migration characteristics and life-history preferences.

Null Hypotheses include:

1. Null hypothesis: There is no significant difference between average abundance prior to structural improvements and post-structural improvements.

2. Null hypothesis: There is no significant relationship between migration patterns and environmental variables (e.g., flow, temperature, and turbidity).

3. Null hypothesis: There is no significant correlation between level of smoltification (i.e., parr, silvery-parr, smolt life-stages) and environmental variables (e.g., flow, temperature, and turbidity).

4. Null hypothesis: There is no significant correlation between condition factor and environmental variables (e.g., flow, temperature, and turbidity).

GENERAL PLAN OF WORK

An evaluation of juvenile salmonid downstream migration will be conducted each year at Shelton Road using a rotary screw trap (RST). The primary purpose of the RST monitoring is to characterize juvenile salmonid downstream migration within the lower Calaveras River, including (1) temporal patterns during migration; (2) annual estimated number of migrants by lifestage; (3) condition factor; (3) effects of environmental factors on migration timing, migration rate, and survival; and (4) effects of water management operations on migration timing, migration rate, and survival.

Objective 1: Monitor Juvenile Salmonid Downstream Migration with a Rotary Screw Trap in the Lower Calaveras River

In order to evaluate salmonid relative abundance, migration timing, and life-history preferences, migrating juvenile salmonids will be sampled with a rotary screw trap in the Calaveras River at Shelton Road (RM 28), which is downstream of the quality spawning and rearing reach. The channel morphology at the site allows the trap to operate most effectively.

Task 1.1 Monitor juvenile salmonid downstream migration with a rotary screw trap near Bellota during intermittent periods between November 1 and July 15 each year.

Migration characteristics (e.g., timing, age composition, etc.) and abundance of juvenile Chinook and *O. mykiss* will be monitored as they migrate downstream in the Calaveras River during intermittent periods between November 1 and July 15 using a rotary screw trap. The trap will sample 24 hours per day for three to five days per week, dependent on flow conditions and personnel availability. During sampling, the trap will be monitored a minimum of once per day, which includes processing all fish captured and clearing the live box of debris to ensure that (1) fish do not experience mortality or stress as a result of debris accumulation, and (2) the trap is not hampered by debris and is operating properly. All fish captured will be identified to species, enumerated, and a sub-sample of salmon and *O. mykiss* will be measured (see Task 1.2).

All data will be collected on data sheets in the format used by the U.S. Fish and Wildlife Service (USFWS) throughout the Central Valley and will be collected in compliance with standards established in the CVPIA Comprehensive Assessment and Monitoring Program protocol.

<u>Abundance Estimates</u>

In past years (i.e., 2002-2015), trap efficiency tests could not be conducted so precise estimates of the total number of juvenile salmonid migrants could not be calculated.

Nonetheless, an estimate of *O. mykiss* relative abundance for the sampling season was calculated by first expanding the daily number of fish captured by the percentage of daily flow sampled through the trap:

$$N_e = \frac{V_d\left(3.14 * \frac{r^2}{2}\right)}{F_d}$$

where, N_e is the expanded daily number of fish, V_d is the daily velocity, r is the radius of the trap, and F_d is the daily flow measured at New Hogan Dam.

Then, with these expanded numbers, we used a predictive regression equation and 80% confidence intervals to estimate the number of fish that would have been captured on those days that were not sampled (i.e., missing data) as follows:

Daily Missing Value = $\hat{y}$

where, $\hat{y} = \alpha + \beta X_h$ and X_h =missing day number

and, $CI_{(80\%)} = t_{\alpha/2;df}\sqrt{MSE\left(1 + \frac{1}{n} + \frac{(X_h - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right)}$

where, X_i =sampled day number

The values for α and β for each block of missing values will be derived by using the daily estimated numbers for the three days prior to and immediately following the period of no sampling days. Missing data estimates will not be calculated for non-sampling periods extending greater than seven days. The total estimated number of fish migrating for a sampling season will then be calculated by adding all of the daily expanded numbers and daily missing value estimates.

In order to calculate more accurate abundance estimates, mark-recapture trap efficiency tests need to be performed and will be conducted throughout the study period (see Task 1.3). Because fish lengths may affect the efficiency of collection, the number of *O. mykiss* captured will be separated into two size (fork length) classes prior to analyses: size class 1 (≤ 100 mm) and size class 2 (>100 mm). Daily abundance estimates for each size class will be calculated using Peterson's unbiased estimator equation:

$$N = \frac{M(C+1)}{(R+1)}$$

where N = estimated number of migrants migrating downstream in the river.
M = number of migrants marked and released above the rotary-screw trap.
C = total number of migrants captured at the rotary-screw trap, and
R = number of marked migrants recaptured at the rotary-screw trap.

For days not sampled, we will use a predictive regression equation and 80% confidence intervals to estimate the number of fish that would have been captured on those days that were not sampled (i.e., missing data) as follows:

Daily Missing Value $= \hat{y}$
where, $\hat{y} = \alpha + \beta X_h$

and X_h =missing day number; and $CI_{(80\%)} = t_{\alpha/2;df}\sqrt{MSE\left(1 + \frac{1}{n} + \frac{(X_h - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right)}$

where, X_i =sampled day number

The values for α and β for each block of missing values were derived by using the daily expanded numbers (N_e) for the three days prior to and immediately following the period of no sampling days. Missing data estimates were not calculated for non-sampling periods extending greater than 7 days. The total estimated number of fish migrating for a sampling season was then calculated by adding all of the daily expanded numbers and daily missing value estimates ($\sum Ne_i + \hat{y}_i$).

For statistical analyses, fish were separated into two different lifestage categories based on fork lengths: young-of-year (YOY; ≤100 mm) and Age 1 + fish (> 100 mm). Linear regression was used to evaluate relationships between the daily expanded numbers (N_e) of each lifestage and daily environmental parameters (flow, water temperature, and turbidity).

Condition Factor

The overall condition of *O. mykiss* captured will be calculated using Fulton's Condition Factor:

$$K = \left(\frac{W}{SL^3}\right) * 10^5$$

where W is weight (g) and SL is standard length (mm).

Task 1.2. Biosampling of salmonids and non-salmonids.

All fish captured will be identified to species and enumerated. All salmonids will be inspected for marks (e.g., adipose clips, fin clips, dye) and any adipose clipped salmonid(s) will be sacrificed for coded-wire tag retrieval. In addition, sub-samples of salmonids and non-salmonids will be measured and evaluated as follows:

<u>Biosampling Salmonids</u>. Forklengths (mm) will be measured for up to 50 randomly selected fish from each species within each size class and any additional Chinook or *O. mykiss* will be counted in respective size classes. Measured salmonids will also be weighed, inspected for overall physical condition, and evaluated for degree of smolting based on a scale ranging from 1 to 3 for Chinook (1 having no physical signs of smolting and 3 having obvious signs) and from 1 to 5 for *O. mykiss* (as described in the *O. mykiss* life-stage assessment protocol developed by the IEP Steelhead Project Work Team in 1998). Salmonids will be anesthetized with a solution of fresh river water and aspirin-free Alka-Seltzer prior to being measured. After processing, fish will be placed into buckets of fresh water to recover fully (at least 5 minutes) before being returned to the Calaveras River.

<u>Biosampling Non-salmonids</u>. After all salmonids have been processed, forklengths (mm) will be measured from up to 25 randomly selected individuals per non-salmonid fish species and any additional individuals will be counted. Measured non-salmonids will also be inspected for overall physical condition. Smaller non-salmonids (under 150 mm) to be measured will be anesthetized with a solution of fresh river water and aspirin-free Alka-Seltzer and will be placed into buckets of fresh water to recover fully after processing, before being returned to the Calaveras River. Larger non-salmonids will be kept in separate containers, measured without anesthetic, and then released back into the river.

Task 1.3. Conduct mark-recapture trap efficiency tests for use in calculating abundance estimates

A photonic system will be used for marking trap efficiency release groups because of the high quality of marks and the ability to use the marking equipment in rapid succession. Juvenile *O. mykiss* (>30mm) will be tagged photonically using either a MadaJet (MADA Equipment Co., Inc., Carlstadt, NJ) or a Pow'r-ject injector (NewWest Technologies, Santa Rosa, CA) and Day-Glo Color Corporation (Cleveland, OH) tag solution. This solution was recommended by CDFW staff at the Merced River Hatchery and has been used to tag juvenile Chinook salmon for their studies since 1999.

For photonic dye efficiency marking at the screw trap, we will conduct the following procedures. Upon removal from the livebox, *O. mykiss* will be roughly sorted by size and temporarily placed in five-gallon buckets equipped with battery operated aerators. All *O. mykiss* will be anesthetized; checked for marks and overall health; and up to 50 young-of-year (≤100 mm) and up to 50 Age 1+ (>100 mm) will be measured (forklengths and weights) and scale samples collected. Any previously marked fish will be placed in a five-gallon bucket(s) containing fresh river water. A portion of unmarked *O. mykiss* (>30 mm) will receive a photonic dye mark. With the photonic dye marking method, a marker tip is placed against the caudal (top or bottom lobe), dorsal or anal fin and dye is injected into the fin rays. One mark will be applied to each fish and all fish in a group will receive the same mark, but the mark location will vary between groups so each group can be uniquely identified. Several different photonic dye colors can be used to differentiate the groups including blue, orange, yellow, and green. The color used will be coordinated with the regional CDFW biologist on an annual basis. According to the manufacturer, the

photonic mark is visible for up to six months. Upon marking, marked fish will be placed immediately in an aerated cooler(s) containing fresh river water.

Immediately after all fish are processed and have recovered from anesthesia, the unmarked or previously marked fish in the bucket(s) will be released downstream of the trap, and newly marked fish in the aerated cooler(s) will be transported to the trap efficiency release site a small distance upstream (approximately a half-mile above the trap). At release sites, fish are held in livecars constructed of 15-inch diameter PVC pipe cut into 34-inch lengths. The ends of the tube are fitted with a fine mesh, with one end being removed to access fish. Livecars are tethered to vegetation or other structures and kept in areas of low water velocity to reduce fish stress.

Prior to release, marked fish are sampled for length and mark retention. Fifty fish (or the entire release group if fewer than 50 fish) are randomly selected from each release group, anesthetized, and examined for mark retention; the remaining fish in each group are enumerated. Mark retention is rated as present or absent. All marked fish are released approximately one hour after sunset. Livecars are located several feet away from the specific release points and fish are poured from the live cars into buckets for release. Releases will be made by using a dip net to scoop up to 10 fish at a time and place them in the river so they can swim away. After releasing a “net-full” of fish, we will wait 30 seconds to three minutes before releasing another “net-full” of up to 10 fish. This is the same release procedure used on the Stanislaus and Tuolumne rivers since 1995. Due to the confined channel morphology at the release site, marked fish are essentially evenly distributed across the stream width during release.

The traps are then checked at one-hour intervals following the efficiency releases to determine the proportion of recaptured individuals. The number of times the trap is checked following an efficiency release is dependent upon the number of marked fish recovered from the livebox during a trap check. Generally, the traps are checked a minimum of two times or until the recovery of marked fish equals zero during a trap check.

Objective 2. Monitor Environmental Variables that may Influence Timing, Size, and Number of Migrants

Both environmental and biological factors may influence the timing, size, and number of juvenile Chinook and steelhead trout migrating downstream in the Calaveras River. We will monitor environmental variables (e.g., flow, temperature, and turbidity) and use regression analysis to determine their potential influence on juvenile Chinook and *O. mykiss* migration.

We will record hourly water temperatures using thermographs placed in the lower Calaveras River approximately every five miles between New Hogan Dam and Mormon Slough. Thermograph data will be downloaded approximately once per month. We will also record instantaneous water temperature and dissolved oxygen concentration (YSI ODO Meter), instantaneous turbidity (turbidimeter), instantaneous conductivity (Extech

EC400 meter), and weather conditions each day at the trapping site. In addition, we will assemble relevant data on daily river flow and water quality collected by the USGS at stations downstream of New Hogan Dam and by the USACE at New Hogan Dam and Mormon Slough.

Objective 3. Determine the Influence of Environmental and Biological Factors on Migration Characteristics of Juvenile Chinook Salmon and *O. mykiss* in the Calaveras River

Data pertaining to number and size/age (at release) of salmonids along with environmental parameters will be summarized in charts, graphs, and tables. Depending on the form of the hypothesis and distributional properties of the data, an appropriate statistical test will be applied to determine potential relationships or correlations between environmental (e.g., flow, temperature, turbidity), structural (e.g., flashboards installed or not installed, particularly at Bellota; combined crest gate/fishway/fish screen installed at Bellota), and biological (e.g., size/age at release, estimated size at detection based on growth curves) parameters and migration activity. The suite of likely candidate tests includes least squares regression, Student's *t*-test, Kolmogorov-Smirnov test, ANOVA, and the chi-squared test.

Deliverables:
Copies of data sheets, summaries, and electronic computer files will be supplied to the National Marine Fisheries Service, California Department of Fish and Wildlife, and other interested resource agencies on a monthly basis during sampling, or as requested by the Regional NMFS/CDFW biologist.

Attachment D-4
Flashboard Dam Removal Fish Relocation Protocol

Annually in October, Stockton East Water District (SEWD) will remove the flashboard dams within, and drain, the Old Calaveras River channel. SEWD will notify their fisheries biologists (currently FISHBIO), the National Marine Fisheries Service (NMFS; currently Monica Gutierrez), and California Department of Fish and Wildlife (CDFW; currently Chris McKibbin) a minimum of three days prior to the initiation of the dewatering process. The dam removal process itself will begin at the upstream end of the channel and proceed downstream which should allow fish to voluntarily travel downstream over a two- to three-day period as the water recedes, alleviating the need to be rescued. SEWD personnel will monitor the drainage of water from each dam and its movement downstream in an attempt to 1) maximize the likelihood that fish are able to travel downstream with the flow, and 2) to identify if fish become stranded behind each dam as water drains. During the de-watering period, SEWD's fisheries biologists will conduct seining surveys in the Old Calaveras River channel to evaluate the effectiveness of the barrier net that has been installed at the Headworks to block downstream migrating salmonids. Staff will be prepared to rescue fish if needed.

Immediately following the de-watering at each structure, SEWD's fisheries biologists will seine any ponded areas upstream or downstream to document fish presence. Block nets will be deployed at the upstream and downstream ends of each "unit" prior to seining to ensure that fish do not move out of the sample area. Seining will continue until a pass results in no catch. Any fish collected will be identified to species, lengths and weights will be measured, and smolt index will be obtained from a subsample of up to 25 *O. mykiss* or Chinook salmon. If mortalities are collected by SEWD personnel, or by SEWD's fisheries biologists, biological data will be collected from each fish, and NMFS and CDFW will be notified.

Any dead Central Valley steelhead trout (*O. mykiss*) encountered will be placed in plastic bags (one fish per bag), which will be placed on ice in the field and transferred to a freezer at the end of the day. Labels containing species, date, capture location (GPS), length (mm), weight (0.1 grams), and body of water shall be placed in the bag along with the sample. The specimens shall be sent to CDFW for research purposes. The current Department contact is:

Mrs. Lea Koerber
California Department of Fish and Wildlife
Central Valley Tissue Archive
980 Riverside Parkway, Suite 110
West Sacramento, CA 95605
(916) 375-6092

If mortality of salmonids is believed to be imminent, rescue operations will occur according to the following protocol. Non-salmonids will not be transported. Rescued

salmonids will be placed into a 250-gallon aerated transport tank containing relatively clean water (as compared to the stranding location) obtained from the Calaveras River downstream from the stranding location, to provide similar water quality parameters such as temperature. Young-of-the-year *O. mykiss* (<100 mm) and adult *O. mykiss* (>300 mm) will be released upstream at Shelton Road, taking precaution to acclimate the fish to the cooler water. Age 1+ *O. mykiss* (100-300 mm) and all juvenile Chinook salmon will be released in the San Joaquin Delta near Stockton, again taking precaution to acclimate the fish to the temperature at the release site, as it is expected to differ from the temperature at the collection site.

Introducing fish to drastic changes in water temperature with no acclimation period can create stress or thermal shock. To safeguard against any potential behavioral changes or physiological shock, the following acclimation protocol was developed. First, temperature will be measured at both the collection and release sites. If the release site water temperature is within five degrees of the collection site temperature, fish will be released immediately. However, differences in temperatures above the five-degree range will warrant an acclimation period of 10 minutes per 1°F. Acclimation will be accomplished by slowly introducing release site water into the transport tank until the water temperature in the tank is equal to the release site temperature. If at any time during the acclimation period individual fish appear lethargic or are not able to maintain their equilibrium, the acclimation period will be extended as needed. During acclimation, fish will be held no longer than one hour to limit accumulated stress resulting from long holding periods with wild fish.

A project leader will be responsible for overall compliance with the proposed field protocol and the terms and conditions of all collection permits including a Scientific Collectors Permit provided by CDFW. A lead field person will be responsible on any given day to assure compliance with all terms and conditions.

Field data (including raw data sheets) shall be provided to NMFS on a monthly basis by electronic or regular mail as requested by the NMFS/CDFW Regional biologist (currently Mike Healey and Chris McKibbin).

New Zealand Mudsnail (*Potamopyrgus antipodarum*) general protocols established by CDFW will also be followed.

Should a deviation from the above occur, NMFS and CDFW shall be notified immediately.

Attachment D-5

Data Collection and Monitoring Plan for the Bellota Weir and Diversion Facility Fish Protection Project

The Bellota Diversion Facility (RM 24) is an unscreened, gravity-fed diversion with an associated flashboard weir (Figure D-4.1). On or about April 15 each year, an 8-foot high weir is installed which allows up to 75 cfs to be diverted throughout the irrigation season (approximately April 15-October 15). On or about October 15, the 8-foot high weir is removed and replaced with a temporary 2-foot weir which allows up to 59 cfs to be diverted for M&I purposes during the non-irrigation season (approximately October 15-April 15).

From mid-October to mid-April, water released from New Hogan reservoir is diverted at Bellota to the Dr. Joe Waidhofer Water Treatment Plant (WTP) for M&I use. Flows do not continue past the 2-foot flashboard dam structure at Bellota Weir until freshet events or flood control releases occur. From mid-April through mid-October, a portion of water released from the reservoir is diverted at Bellota for delivery to Potter Creek for irrigation and for M&I use. Water is also delivered for irrigation in Mormon Slough and the Old Calaveras channel through the Bellota Weir slide gates and Calaveras River Headworks Facility, respectively. During the irrigation season, flows are provided to maintain pools behind flashboard dams for agricultural diversions in these channels and typically do not reach the confluence with the San Joaquin River.

Figure D-4.1. Bellota Weir (foreground) and Bellota Diversion intake (top center).

Dependent on a variety of factors (e.g., time of year, proportion of water diverted, weir configuration, species, and lifestage), salmonids may experience entrainment into the Bellota Diversion; temporary migration delays or blockage at the Bellota Weir, which may then lead to impacts such as thermal stress; increased susceptibility to predation; reduced spawning success; or stranding and associated mortality.

A fish passage and screening improvement project ("Project") will be implemented at the Bellota Diversion Facility. Although the Project will improve instream conditions at Bellota, the fishery agencies and SEWD have recognized that it will take several years before the Project is completed due to the time required to create final designs, carry out permitting processes, and implement the construction phase. In the interim, two temporary fish ladders and a temporary screen have been operated to help improve fish passage and reduce entrainment.

As in previous years, the two temporary ladders will be installed during the non-irrigation season to assist fish passage at low flows. One ladder will be installed at the upstream edge of the Bellota Weir to provide upstream fish passage opportunities from the pool on the apron of Bellota Weir to the pool upstream of the Bellota Weir (Figure D-4.2). The second ladder is installed on the downstream side of the Bellota Weir apron in order to create a deeper pool on the weir's apron for more effective fish passage into the upper ladder.

Figure D-4.2. Photograph looking upstream at the configuration of Bellota Weir during the non-irrigation season when two denil fish ladders are installed.

A temporary screen was installed in December 2005. The temporary screen has a mesh size of 3/16 inches (4.76 mm) in diameter, which will provide complete protection for fingerlings (i.e., NMFS and CDFW criteria for fingerlings is <1/4 inch [6.35 mm] diameter mesh) but does not meet criteria for fry (i.e., NMFS and CDFW criteria for fry is < 3/32 inches [2.38 mm] in diameter).

Data Collection and Monitoring Methods
The effectiveness of the reconfigured inflatable crest-gate weir at the Bellota Weir and fish passage structure will be determined through biological monitoring (Juvenile and Adult Salmonid Monitoring Programs), whereas the effectiveness of the fish screen at the Bellota Diversion Facility will primarily be determined by monitoring compliance with NMFS and CDFW fish screening criteria (NMFS 1997, CDFG 2000). Fish screening criteria define several conditions concerning velocity and general operation as follows:

- Maintaining a uniform flow distribution over the screen surface to minimize approach velocity.
- Keeping approach velocities ≤0.33 feet per second.
- Screen submergence area required during irrigation season (833 ft^2 for 275 cfs) and during non-irrigation season (227 ft^2 for 75 cfs).

Although NMFS and CDFW also generally have a sweeping velocity criterion, it was determined during the preliminary design development that a screen could not be designed for this location that would meet this criterion under all conditions. This issue was discussed with the agencies and they agreed that the typical sweeping velocity criterion will not be required.

Types of Data

Pre- and post-Project biological data will be collected through two different monitoring programs: Juvenile and Adult Salmonid Monitoring Programs. Ideally, juvenile entrainment monitoring would be conducted directly behind the entrance of the diversion facility. However, due to the diversion intake's configuration (i.e., intake is a 54-inch diameter pipe with a concrete forebay; Figure D-4.4), this is not possible. It is also not possible to sample at the pipeline's terminus into the Water Treatment Plant reservoir due to its location near the bottom of the reservoir. Instead, results of the Juvenile Salmonid Monitoring Program will provide an indirect indication of the effectiveness of measures implemented to reduce potential entrainment losses and improve passage conditions. Adult Salmonid Passage Monitoring will be conducted to document passage conditions at the Bellota Weir fish ladder.

Three types of post-Project physical data (i.e., water velocity measurements, underwater video, and general operational and maintenance data) will be collected at the Bellota diversion fish screen to determine whether screening criteria for anadromous salmonids are being met. Although screening criteria were originally developed to guide the design and construction of screen facilities, these criteria have also been used to evaluate whether facilities are meeting their intended fish protection functions (McMichael et al. 2004). For instance, McMichael et al. (2004) found good agreement between biological and physical results in field tests, which were also consistent with laboratory study results (Abernethy et al. 1989, 1990).

Juvenile Salmonid Monitoring Program

The Juvenile Salmonid Monitoring Program was started in 2002 and will continue through the term of the ITP to document salmonid presence, relative abundance, and migration behavior, as well as environmental and/or anthropomorphic conditions that affect juvenile salmonid susceptibility to entrainment into unscreened diversions. The primary monitoring activity under this program includes the operation of a rotary screw trap (RST) at Shelton Road (RM 28) to document juvenile salmonid abundance and migration characteristics (Figure D-4.3).

Data collected through rotary screw trapping will be used to assess the benefits of any fish screens or passage improvements that are constructed on the Calaveras River as conservation strategies.

Figure D-4.3. Rotary screw trap operated during juvenile salmonid migration season at Shelton Road.

Adult Salmonid Passage Monitoring

The abundance and seasonal timing of adult Chinook salmon and steelhead trout migrating upstream above Bellota will be determined by using a Vaki Riverwatcher (Riverwatcher) or similar passive video monitoring device. The Riverwatcher uses an infrared scanner to detect fish movement and document passage. It is able to record the length and height of each fish that passes upstream or downstream, as well as the date and time of passage. A video monitoring similar would require a biologist to review recorded passages and identify the species that have utilized the ladder to pass upstream.

The Riverwatcher or similar passive video monitoring device would be operated in the permanent fish ladder under post-Project conditions to evaluate passage improvements.

Data will be gathered during the adult migration season, generally between November and March.

Juvenile Entrainment Monitoring

Figure D-4.4. Bellota Diversion concrete forebay.

Water Velocity Measurements

Water velocity will be measured across the screen face to evaluate if conditions meet NMFS and CDFW approach velocity criteria and to identify whether “hotspots” of high approach velocity exist that may impinge juvenile salmonids. Velocity surveys will occur three times during the first year. Velocity data will be taken using a calibrated Acoustic Doppler Velocimeter (ADV), which can simultaneously measure approach and sweeping velocities. The ADV will be mounted 3 inches in front of the screen and a minimum of three replicate velocity measurements will be taken at each of six, evenly spaced points along each screen panel. Analog signals of velocity measurements will be output to a portable computer. Average sweep and approach velocities will be calculated for each survey.

Water velocity will also be measured in the vicinity of the intake structure to identify if undesirable flow patterns exist (e.g., eddies, stagnant flow zones) that may cause migration delays or provide predator opportunities. Velocity data will be collected within the Bellota pool in the immediate vicinity of the Bellota intake structure and screen. Measurements will be taken according to U.S. Geological Survey (USGS) protocols using a USGS Type AA current meter.

Underwater Video

In conjunction with velocity surveys, digital underwater video and/or an ARIS sonar camera will be used to monitor screen integrity and debris accumulation, and document fish presence and behavior. Poor screen or seal conditions could injure small fish or allow them to become impinged or entrained; therefore, screen integrity will be monitored by visually inspecting for any gaps between screens and seals.

Debris build-up can severely decrease seal life and provide cover for predators. Additionally, debris accumulation on the screen face can effectively reduce the cross-sectional area resulting in head loss across the screen face and associated "hotspots" of high approach velocity that may impinge juveniles. Although a pole can be placed in the water to gauge depth of accumulated sediments, a determination regarding the exact type of debris present and how it affects water flow through or past the screen cannot be made without a video survey.

Miscellaneous General Operational and Maintenance Data

General data collected during each screen inspection survey includes the following:

- general site descriptions and photographs
- screen submergence levels
- cleaning system operation and incidence of head loss across the face of the screen
- bypass flow conditions

Data Interpretation and Evaluation

Biological Data

Juvenile Salmonid Migration Monitoring

Baseline rotary screw trap data collected during the years prior to screen construction will be compared to post-Project data to determine whether there is a statistically significant increase in juvenile salmonid migration post-Project and whether an increase in salmonid production associated with improved passage conditions might be inferred.

Adult Salmonid Passage Monitoring

Riverwatcher data collected will be used to determine the extent that adult passage occurs as a result of improved passage conditions.

Physical Data

Water Velocity Measurements

Velocity data from individual measurement points will be averaged and then all values plotted to illustrate the distribution of velocities across the screen structure. Due to anticipated variation of point measurements across a site, the screen will be considered within criteria if 90% of the approach velocity measurements are ≤0.33 feet per second.

Underwater Video

Digital video recorded from underwater screen inspections will be viewed in the laboratory following the evaluation. Still images from screen captures will be made of any potential problems. For example, any gaps between the screen and the rubber seal can be documented based on the amount of visible light underneath the screen and debris problems can be documented based on the amount of debris build-up. Fish impingement may also be documented. Although the video work will not have a major bearing on whether the screen meets the screening criteria or not, it will provide a means for early detection of potential problems that can be addressed through timely maintenance.

Miscellaneous General Data

Screen submergence levels will be considered within criteria if the area submerged is equal to the maximum flow diverted divided by the approach velocity during the irrigation season and during the non-irrigation season (i.e., 833 ft^2 at 275 cfs and 227 ft^2 at 75 cfs), respectively.

The screen cleaning system will be determined to be functioning properly if it removes most of the debris and prevents head loss across the screen. Visual inspections and underwater video will provide the documentation to determine whether the cleaning system is functioning properly.

Bypass flow conditions through the fishway attraction water system (AWS) and through the irrigation bypass system will be maintained by SEWD in an operations database. Bypass flow conditions will be considered within criteria if the first 60 cfs of irrigation flows are routed through the AWS and up to another 140 cfs are routed through the irrigation bypass system. In addition, up to 60 cfs will be bypassed through the AWS during the non-irrigation season when flow is available.

REFERENCES

Abernethy, C. S., D. A. Neitzel, and E. W. Lusty. 1989. Velocity measurements at six fish screening facilities in the Yakima River Basin, Washington, Summer 1988. Prepared by the Pacific Northwest Laboratory for the Division of Fish and Wildlife, Bonneville Power Administration, Portland, Oregon.

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CDFG [California Department of Fish and Game]. 2000. Fish screening criteria. Native Anadromous Fish and Watershed Branch, Department of Fish and Game, Resources Agency, State of California. Internet report available at http://www.dfg.ca.gov/nafwb/fishscreencriteria.html

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NMFS [National Marine Fisheries Service]. 1997. Fish Screening Criteria for Anadromous Salmonids. National Marine Fisheries Service, Southwest Region, Santa Rosa, CA. 12pp. Internet report available at http://swr.ucsd.edu/hcd/fishscrn.pdf#search='fish%20screen%20criteria'

Attachment D-6

Fish Community Distribution and Composition in the Calaveras River below New Hogan Dam Study

This multi-year assessment will evaluate fish assemblages between New Hogan Dam and the mouth of the river to determine, 1) which species are present and in what abundance, 2) how species assemblages change throughout the year in relation to environmental conditions, 3) residency rates and distribution of juvenile salmonids, and 4) whether losses to juvenile salmonids are related to predation, water quality factors, entrainment, or a combination of these factors. The study will document data regarding juvenile salmonid presence, abundance, and rearing/migration behavior, as well as identify the environmental and/or water management conditions that effect juvenile salmonids ability to migrate successfully out of the river and susceptibility to entrainment into unscreened diversions. Fishery information is vital for resource managers to be able to develop appropriate conservation strategies in order to successfully maintain salmonid populations within the Calaveras River. Data collected during this monitoring program can be used to assess the effectiveness of applied conservation strategies, particularly the effectiveness of long-term solutions implemented at Bellota and the Old Calaveras River Headworks as part of a Calaveras River Habitat Conservation Plan (CHCP). In addition, the monitoring program will provide resource managers on the Calaveras River with data regarding fish populations to assist in making informed adaptive management decisions for sustained native fishery management.

We hypothesize that annual abundance of juvenile salmonids will increase relative to pre-conservation measure levels. The ability to detect a statistically significant difference between pre- and post-project abundance is based on the assumption that we can obtain a representative sample of biological information. Production levels of fish populations are naturally subject to annual variations regardless of the quality of the habitat. Production level variations can be caused by changes in environmental (climate, fire, etc.) and/or biological (primary production, disease, etc.) conditions. Therefore, we expect that future fish populations will fluctuate widely in annual abundance levels, but we also expect to observe higher mean levels of abundance than those prior to conservation strategies being implemented.

1. Null hypothesis: There is no significant difference between average abundance pre-structural improvements and post-structural improvements.

2. Null hypothesis: There is no significant relationship between spatial distribution patterns and environmental variables (e.g., flow, temperature, and turbidity).

GENERAL PLAN OF WORK

Species composition, abundance, and distribution will be determined throughout the study period by direct sampling throughout the study reach. The primary sampling

technique to capture juvenile salmon will be seining, but backpack electrofishing will also be used to target non-salmonid species that can typically avoid a seine. In addition, fyke nets may be used at the outfall of some flashboard dams.

Objective 1. Direct Sampling throughout Study Reach

Specific sampling locations will be selected at the beginning of the study period, located at frequent and regular intervals throughout the lower river. Based on the objectives of the study and past sampling experience, we anticipate that approximately 10 locations will be selected in the 42-mile study reach. Both electrofishing and seining will be conducted at each location, with each gear used in the respectively separate microhabitat areas in which they are effective. The same general areas will be sampled each time, but sample areas may vary somewhat as a result of changes in flow. Sampling frequency may occur up to once every two weeks during the primary steelhead outmigration period (December-May) and up to once per month June-November. Electrofishing will not be conducted during November-December and April-May based on expected adult fall-run Chinook and CVC steelhead spawn timing. Seining will occur year-round.

Three seine hauls will be made at each sampling location using 6-ft high, 1/8-inch mesh nylon seine nets in lengths of 20 or 30 feet. Backpack electrofishing will be conducted using a battery powered Smith-Root unit. Settings will vary depending upon water quality conditions. All fish captured by either method will be placed in buckets and will be segregated according to size class to avoid stress and predation.

Once the target area has been sampled, all fish collected will be anesthetized using a solution of fresh river water and aspirin-free Alka-Seltzer tablets, identified to species, a sub-sample of up to 50 of each species will be measured, and individuals in excess of the sub-sample will be enumerated. For fish species with a forked tail, fork length will be measured; for other species, standard length will be taken. Reasonable efforts will be made to process salmonids first to minimize stress. Smolt indices will be recorded for sub-sampled salmonids according to standard IEP protocol. All fish will be allowed to recover before being released.

Environmental Data. In addition to biological data, other data recorded at each seining and electrofishing site will include the maximum depth, area sampled (determined from estimating average length and width sampled), minutes sampled, electrofisher settings, time of day, weather conditions, habitat type, substrate type, water temperature, turbidity, conductivity, and dissolved oxygen. Non-biological parameters such as water temperature and flow will also be monitored continuously at permanent gauging stations and suspended particulate matter and toxins will be monitored at regular intervals to assess how these variables may influence juvenile salmonid rearing and survival.

Photonic Tag. After processing, all juvenile *O. mykiss* and Chinook salmon (>30mm) will be tagged photonically using either a MadaJet (MADA Equipment Co., Inc., Carlstadt, NJ) or a Pow’r-ject injector (NewWest Technologies, Santa Rosa, CA) and Day-Glo Color Corporation (Cleveland, OH) tag solution. This solution was

recommended by CDFW staff at the Merced River Hatchery and has been used to tag juvenile Chinook salmon for their studies since 1999.

A photonic system will be used for marking the study fish because of the high quality of marks and the ability to use the marking equipment in rapid succession. All fish will be anesthetized using a solution of fresh river water and aspirin-free Alka-Seltzer before the appropriate mark is applied. With this method, a marker tip is placed against the caudal (top or bottom lobe), dorsal or anal fin and dye is injected into the fin rays. One mark will be applied to each fish and all fish in a group will receive the same mark, but the mark location will vary between groups so each group can be uniquely identified. Several different photonic dye colors can be used to differentiate the groups including blue, orange, yellow, and green. According to the manufacturer, the photonic mark is visible for up to six months.

PIT tag. After processing, a portion of untagged O. mykiss (>100 mm) may be surgically implanted with a PIT tag. PIT tags from Texas Instruments (23mm x 4mm) will be surgically inserted into fish according to Zydlewski et al. (2003) techniques, with the exception that the incision will be closed with a bio-adhesive. During a PIT Tag feasibility study, the benefit of reduced surgery times and excellent tag retention with bio-adhesive sutures versus silk sutures was identified. Other researchers have found that adhesive sutures were up to 35% faster (Petering and Johnson 1991), with silk sutures taking between 2 to 4.5 minutes (Moore et al. 1990; Jepsen et al. 2002). Ombredane et al. (1998) suggested that handling time was a greater factor to overall mortality rates than the presence of the transmitter itself.

Surgery will entail making a 4-mm-long incision on the mid-ventral line starting 15-20 mm anterior to the pelvic girdle (Roussel et al. 2000). A sterilized tag will be slowly pushed through the incision into the peritoneal cavity and then closed with an adhesive compound. During surgery, water will be flushed over the gills to minimize stress. After the suture is complete, an antibiotic ointment will be applied to the wound to promote healing and avoid infection (Martinelli et al. 1998, Carr 2000). Tags will remain within the fish indefinitely.

Objective 2. Fyke Net Sampling at Flashboard Dam Outfalls

Dependent on flow conditions, flow conveyance openings (i.e., notches measuring one square foot square) may be installed about 3-4 ft above the base of up to 20 individual flashboard dams (Figure 1) during April-October. These notches are designed to move additional water as well as potentially assist fish downstream migration. As in 2006, all of the outlets would be made as “fish friendly” as possible in that they will spill into pool areas and not onto exposed riprap or concrete. In order to monitor fish movement through these openings, a fyke net would be mounted on the flashboard dam across the opening. Fish processing and environmental measurements would be conducted and recorded as above.

Figure 1. Water spilling through new opening located in between braces of a flashboard dam.

Deliverables:

Copies of data sheets, summaries, and electronic computer files will be supplied to the National Marine Fisheries Service, California Department of Fish and Wildlife, and other interested resource agencies on a monthly basis during sampling.