6 Monitoring Plan

California Department of Fish and Wildlife (CDFW) incidental take permit (ITP) regulations require a description of the proposed plan to monitor compliance with the avoidance, minimization, and mitigation measures and the effectiveness of the measures (14 CCR 783.2(a)(9)). This chapter is intended to fulfill this requirement.

Monitoring will be performed primarily to monitor the condition of a species' habitat and to detect and track occupancy by listed species. On protected and restored lands, monitoring will focus on describing the baseline condition of existing habitats, detecting presence and distribution of listed species, and identifying important threats to ongoing species persistence. Additional monitoring will be required at restoration sites, primarily in the months and years immediately following completion of the restoration work. Post-restoration monitoring will be focused on measuring variables associated with success criteria. For each restoration site, a comprehensive monitoring and management plan will be created to identify success criteria and an associated monitoring program. If an approved mitigation bank is used to provide credits for restoration and protection, monitoring will not be necessary on these lands as monitoring is included within the bank's negotiated terms. Monitoring will also be needed to verify performance of design take minimization measures, particularly relative to the performance and operating criteria for the conveyance facilities.

6.1 Collaborative Science and Adaptive Management Program

Considerable scientific uncertainty exists regarding the Delta ecosystem, including the needs of the species, the effects of CVP/SWP operations and the related operational criteria for the PA. To address this uncertainty, Reclamation, DWR, USFWS, NMFS, CDFW, and the public water agencies will establish a robust program of collaborative science, monitoring, and adaptive management. It is expected that this program will be based on the draft framework described in Appendix 6.A *Adaptive Management Framework for the California Water Fix (CWF) and 2008/2009 Biological Opinions on the combined operations of the Central Valley Project (CVP) and State Water Project (SWP)*. The draft adaptive management framework describes concepts to develop an adaptive management program for the CWF joint ESA Biological Opinion and 2081(b) Incidental Take Permit, and the CVP/SWP 2008/2009 BiOps and CESA authorizations.

DWR and Reclamation commit to implementing the Adaptive Management Program, consistent with the *Agreement For Implementation Of An Adaptive Management Program*

For Project Operations. The CWF AMP includes a cost estimate and DWR and Reclamation commit to implementing the categories of actions described in the cost estimate. Final determination of the specific actions, implementation plans, and costs associated with implementation of those actions will be determined through the IICG.

6.2 Monitoring and Research Program

Monitoring will be performed to measure a population's state and structure, to characterize the condition of a species' habitat and to detect and track presence or occupancy by listed species. Five general types of monitoring will occur:

- Continuation of existing monitoring required by the current BiOps (U.S. Fish and Wildlife Service 2008; National Marine Fisheries Service 2009), incidental take permit (CDFG 2009), and consistency determinations related to continuing operations of existing facilities and their effects on listed species.

- Monitoring required by permits and authorizations for construction of the proposed new facilities, including the MMRP that will be required under CEQA approvals, and any additional monitoring needed to assess effectiveness of AMMs and inform any necessary revision.

- Monitoring and studies related to operation of the proposed new facilities that must occur prior to operation of the new facilities, including those necessary to inform design and assess effects of the proposed NDD, HOR gate and modified CCF.

- Monitoring and studies related to operation of the proposed new facilities that must occur after operation of the new facilities has commenced (e.g., to support real-time operation of HOR gate), including those necessary to monitor the condition of both the species and the habitat conditions that may be influenced by the new facilities (e.g., upstream temperatures, potential for redd dewatering, Delta rearing conditions, water quality, etc.).

- Monitoring and studies related to evaluation of the effectiveness of proposed facilities (e.g., non-physical barrier at Georgiana Slough), habitat restoration and other mitigation measures after operation of the new facilities has commenced.

In addition to the monitoring commitments specified in the remainder of this section, monitoring under the PP is expected to also be initiated through the adaptive management framework described in Appendix 6.A *Adaptive Management Framework for the California Water Fix (CWF) and 2008/2009 Biological Opinions on the combined operations of the Central Valley Project (CVP) and State Water Project (SWP)*. Implementation of such monitoring actions would only occur if take authorization for the action were approved by the jurisdictional fish and wildlife agencies.

6.2.1 Continuation of Existing Required Monitoring

Existing monitoring, which has been mandated under existing BiOps and authorizations (U.S. Fish and Wildlife Service 2008; California Department of Fish and Game 2009; National Marine Fisheries Service 2009), includes monitoring to track the status of each listed species of fish, and also monitoring to ascertain performance of minimization measures associated with operations of the south Delta export facilities and their fish salvage programs. Monitoring programs required under the existing NMFS (2009) BiOp includes the following items, called for under RPA Action 11.2.1.3 *Monitoring and Reporting Requirements*.

1. Reclamation and DWR shall participate in the design, implementation, and funding of the comprehensive CV steelhead monitoring program on CVP- and SWP-controlled streams.

2. Reclamation and DWR shall ensure that all monitoring programs regarding the effects of CVP and SWP operations and that result in the direct take of winter-run, spring-run, CV

steelhead, or Southern DPS of green sturgeon, are conducted by a person or entity that has been authorized by NMFS.

3. Reclamation and DWR shall submit weekly reports to the interagency Data Assessment Team (DAT) regarding the results of monitoring and incidental take of winter-run, spring-run, CV steelhead, and Southern DPS of green sturgeon associated with operations of project facilities.

4. Reclamation and DWR shall provide an annual written report to NMFS describing the results of real-time monitoring of winter-run, spring-run, CV steelhead, and Southern DPS of green sturgeon associated with operations of the DCC/CVP/SWP Delta pumping facilities, and other Division-level operations authorized through this RPA.

5. Reclamation and DWR shall continue the real-time monitoring between October 1 and June 30 each year of winter-run, spring-run, CV steelhead, and Southern DPS of green sturgeon in the lower Sacramento River, the lower San Joaquin River, and the Delta to establish presence and timing to serve as a basis for the management of Delta pumping operations consistent with actions in this RPA.

6. Reclamation and DWR shall submit weekly DAT reports and an annual written report to NMFS describing the results of real-time monitoring of winter-run, spring-run, CV steelhead, and Southern DPS of green sturgeon associated with operations of Delta pumping facilities and other Division level operations authorized through this RPA.

7. Reclamation shall coordinate with NMFS, USFWS, and DFW to continue implementing and funding fisheries monitoring of spring-run and CV steelhead in Clear Creek to aide in determining the benefits and effects of flow and temperature management.

8. Reclamation and DWR shall jointly fund these monitoring locations for the duration of the Opinion (through 2030) to ensure compliance with the RPA and assess the performance of the RPA actions.

9. Upstream: Adult escapement and juvenile monitoring for spring-run, winter-run, and steelhead on the Sacramento River, American River, Feather River, Clear Creek, Mill Creek, Deer Creek and Battle Creek.

10. Red Bluff Diversion Dam – completed.

11. Installed and operating at Tisdale Bypass.

12. Delta: Continuation of the following monitoring stations that are part of the IEP: Chipps Island Trawl, Sacramento Trawl, Knights Landings RST, and beach seining program. Additionally, assist in funding new studies to determine green sturgeon relative abundance and habitat use in the Delta.

13. San Joaquin River monitoring shall include: Adult escapement and juvenile monitoring for steelhead on the Stanislaus River; Mossdale Kodiak Trawling to determine steelhead smolt passage; steelhead survival studies associated with VAMP; monitoring at HORB to

determine steelhead movement in and around the barrier; predation studies in front of HORB and at the three agricultural barriers in the South Delta; and new studies to include the use of non-lethal fish guidance devices (e.g., sound, light, or air bubbles) instead of rock barriers to keep juveniles out of the area influenced by export pumping.

Existing monitoring programs will continue, and information from these programs will facilitate tracking status of listed species of fish and evaluating effectiveness of minimization measures. This existing monitoring to track the status of listed species of fish is performed by the Interagency Ecological Program[1], and incidental take associated with this monitoring is authorized via ESA Section 10(a)(1)(A) Research and Enhancement Permits and state FGC Section 2081(a) permits. Monitoring to track performance of the south Delta export facilities and their fish salvage programs is authorized through the existing BiOps (National Marine Fisheries Service 2009, Section 13.4; U.S. Fish and Wildlife Service 2008, *Monitoring Requirements*). Use of scientific collection permits constitutes a conservative approach to take authorization associated with monitoring activities because such permits need periodic renewal, at which time methodology can be updated to ensure that incidental take is minimized consistent with available knowledge and techniques. Thus it is expected that continuation of existing monitoring would receive take authorization either through issuance of scientific collection permits, or through an alternative consultation pathway.

6.2.2 Required Compliance Monitoring

Monitoring required by permits and authorizations for construction, operation, and maintenance of the PP consists of compliance monitoring. Fulfillment of compliance monitoring and reporting requirements is solely the responsibility of Reclamation, DWR, and their contractors. Reclamation and DWR will track and ensure compliance monitoring is conducted in accordance with provisions of all permits and authorizations provided to the PP, and will provide results to CDFW at their request.

The principal permits and authorizations requiring monitoring are those related to ESA, CESA, NEPA and CEQA authorizations. Authorizations related to ESA include the terms and conditions of the BiOp for the proposed federal action, as well as the take limits identified in the incidental take statement within the BiOp. Authorizations related to CESA include the terms of the incidental take permit issued for the PP by the CDFW. That permit will be issued subsequent to the Notice of Decision and its terms are additional to those of the other authorizations issued to the PP. Authorizations related to NEPA and CEQA include, respectively, a Record of Decision and a Notice of Determination. Most notably, the CEQA authorization includes a requirement to implement all provisions of the Mitigation Monitoring and Reporting Program (MMRP), as required by CCC §18.04. At this time an MMRP has not been prepared for the PP, but it is a required component prior to issuance of a Notice of Determination; a draft MMRP will be provided to CDFW prior to issuance of the 2081(b) incidental take permit.

Although the terms and conditions of the 2081(b) incidental take permit are not known at this time, DWR, as the project applicant, will commit to track impacts of the PP on suitable habitat and the type and extent of habitat protection and restoration completed, and report the results to

[1] This program is described and data are archived at http://www.water.ca.gov/iep/activities/monitoring.cfm.

the jurisdictional fish and wildlife agencies (CDFW, NMFS, USFWS) on an annual basis. Additionally, DWR will assess impacts anticipated for the following year and determine the type, extent, and timing of future habitat protection and restoration needs. DWR will also perform monitoring to ascertain performance relative to the criteria identified in this PP. This monitoring will be achieved by performance, on an ongoing basis during the operational life of the facility, of the work specified in items 4, 5 and 10 in Table 6-3. Those items deal with monitoring of incidental take in the vicinity of the NDDs through the mechanisms of entrainment, impingement, and predation.

Furthermore, DWR commits to track impacts of the PP on habitat related issues associated with the modifications to Clifton Court Forebay and the HOR gate, and report the results to the jurisdictional fish and wildlife agencies (CDFW, NMFS, USFWS) on an annual basis. DWR will work closely with CDFW, USFWS and NMFS to ensure that these monitoring efforts support RTOs for the HOR gate; study drivers/predictors of loss, predation rates and survival; fish presence and movement around these structures and elsewhere in the south Delta; and water quality and circulation patterns in and around CCF.

The effects of the PP described in this application have been estimated conservatively to provide an analysis of the maximum potential adverse effects to the listed species. DWR, as the project applicant, has incorporated measures into the description of the PP to adequately offset the potential maximum adverse effects to the listed species.

DWR will ground-truth impact areas prior to initiating proposed actions to determine the extent of suitable habitat present. Suitable habitat is defined for each species in Chapter 2, *Covered Species.* After work is complete, DWR will field-verify the area and duration of impacts that have actually occurred. DWR will track predicted and actual impacts at each project site and provide that information in annual compliance reporting.

Compliance monitoring would also occur to ensure that each mitigation site met performance commitments specific to that site and its protected species. Since the locations of mitigation sites have not yet been determined and the construction and operation of those sites will be subject to provisions of separate incidental take permits, site-specific compliance monitoring needs are not here described.

6.2.3 Monitoring After Operations Commence

Monitoring and studies related to CVP and SWP Delta operations, that must occur after operation of the new facilities has commenced, broadly consists of three types of monitoring, performed to assess system state and effects on listed species: monitoring addressing the operation of the proposed new facilities, monitoring related to species condition and habitat that may be influenced by operations of the new facilities, and monitoring addressing the habitat protection and restoration sites.

6.2.3.1 Monitoring Addressing Conveyance Facilities Operations

Monitoring and studies related to operation of the proposed new facilities, that must occur after operation of the new facilities has commenced, is focused on potential effects on listed fish species.

Specific monitoring studies focused on the effects of operating the north Delta diversions will be developed in collaboration with USFWS, CDFW, and NMFS. The Fish Facilities Technical Team (2011) also identified monitoring associated with the north Delta intakes and their post-construction effects. Some of this work was focused on specific key questions rather than general monitoring and is described in Section 3.4.11, *Research Program*, while the monitoring studies include items 1-6 and 8-10 as listed in Table 6-3. Items 6-10 in Table 6-3 are studies focused on NDD performance, which were developed after the Fish Facilities Technical Team work during the BDCP process. For Delta Smelt, no specific monitoring plan is proposed, however, a future CDFW- or USFWS-approved monitoring plan may be developed once operations commence.

Monitoring and studies will also be developed for the new South Delta facilities, including specifically the modified CCF and HOR gate, as part of the respective tech teams for these components of the PP. These will focus on entrainment and salvage; drivers/predictors of fish loss, predation rates and survival; fish presence and movement around these structures; and water quality and circulation patterns.

6.2.3.2 Monitoring Addressing Habitat Affected by Operations of the New Facilities

Overall operational monitoring will also be needed in areas upstream and downstream of the new facilities. The specific monitoring studies will be developed in collaboration with USFWS, CDFW, and NMFS and focus on entrainment into the interior delta, outflow, temperature, redd dewatering, fish presence and movement, downstream habitat effects, and through-delta survival.

6.2.3.3 Monitoring Addressing Habitat Protection and Restoration Sites

Metrics and protocols for wildlife species effectiveness monitoring will be developed after land acquisition but before restoration actions or enhancement and management activities are begun. Table 6-1 details the proposed effectiveness monitoring actions and success criteria relevant to listed species of wildlife. Effectiveness monitoring actions listed in Table 6-1 would be implemented for the duration of the 2081(b) incidental take permit issued for the PP.

Research under the PP could also be initiated through the adaptive management framework (Appendix 6.A *Adaptive Management Framework for the California Water Fix (CWF) and 2008/2009 Biological Opinions on the combined operations of the Central Valley Project (CVP) and State Water Project (SWP)*). Implementation of such research actions would only occur if take authorization for the action were approved by the jurisdictional fish and wildlife agencies.

Table 6-1. Proposed Effectiveness Monitoring Actions and Success Criteria

Monitoring Type	Action Description	Metric	Success Criteria	Protected Lands Timing and Duration	Restoration Site Timing and Duration
California Tiger Salamander	Dip netting and visual surveys.	Number of individuals per site.	Maintain population at or above baseline.	One year of surveys at each site; 50% in the second year, and 50% in the third year; two of the four sites randomly sampled for presence every three years for 10 years and then every five years thereafter.	One year of surveys at each site; 50% in the second year, and 50% in the third year; two of the four sites randomly sampled for presence every three years for 10 years and then every five years thereafter.
Giant Garter Snakes	Surveys to detect presence of individuals; measure giant garter snake habitat connectivity.	Number of individuals at each site; acreage of connected habitat	Maintain population at or above baseline; no loss in habitat connectivity from baseline.	One year of trapping at each site; 50% of sites sampled in the second year, and 50% of sites sampled in the third year; two of the four sites randomly sampled for presence every three years for 10 years and then every five years thereafter.	One year of trapping at each site; 50% of sites sampled in the second year, and 50% of sites sampled in the third year; two of the four sites randomly sampled for presence every three years for 10 years and then every five years thereafter.
Swainson's Hawk – Nesting habitat	Nesting surveys during Swainson's hawk breeding season.	Number of nesting/breeding pairs in protected and restored habitat.	Maintain population at or above baseline.	One nesting survey a year for the first three years during optimal breeding time; then every five years thereafter until end of permit term.	One survey a year during optimal breeding time for three years; then every five years thereafter until end of permit term.
Swainson's Hawk – Foraging habitat	Swainson's hawk nesting surveys; crop type during nesting surveys on cultivated lands.	Number of activate nest sites; habitat value of crop types on cultivated lands, as determined consistent with Table 2.4 *Swainson's Hawk Agricultural Foraging Habitat Value Classes.*	Maintain population at or above baseline.	One nesting survey per year for the first three years; then every 5 years thereafter until end of permit term.	One nesting survey per year for the first three years; then every 5 years thereafter until end of permit term.
Tricolored Blackbird	Tricolored blackbird nesting surveys; crop type during nesting survey.	Number and size of colonies; habitat value of crop types as determined consistent with Table 5.4.8-1 *Tricolored Blackbird Foraging Habitat Value Classes.*	Maintain population at or above baseline	One nesting survey per year for the first three years; then every 5 years thereafter until end of permit term.	One nesting survey per year for the first 3 years; then every 5 years thereafter until end of permit term.

Monitoring Type	Action Description	Metric	Success Criteria	Protected Lands Timing and Duration	Restoration Site Timing and Duration
Mason's Lilaeopsis	Mason's lilaeopsis population surveys.	Number and distribution of plants.	Establishment of Mason's lilaeopsis in mitigation areas and persistence in those locations.	Not applicable; protection is not proposed.	One survey per year for the first 3 years; then every 5 years thereafter until end of permit term

6.2.4 Monitoring Prior to Operations

Monitoring and studies related to operation of the proposed new facilities, that must occur prior to operation of the new facilities, is focused on the conveyance facilities and their potential effects on listed fish species. This monitoring begins with gathering baseline data to compare with post-construction monitoring and studies. While a more detailed effort has already been made regarding monitoring for the NDD, monitoring prior to operations will be required throughout the action area, including CCF, the HOR gate, and key habitat areas downstream and upstream of the new facilities. DWR will commit to working with the fish agencies to develop the specifics of that monitoring, which will be a key charge of both the Clifton Court Forebay Technical Team (Section 3.2.5.1.3 *Clifton Court Forebay Technical Team*) and HOR gate (Section 3.2.8.1.1 *HOR Gate Technical Team*).

For the NDD, specific monitoring studies will be also developed in collaboration with USFWS, CDFW, and NMFS that are focused on preconstruction conditions and on design of the diversions. These monitoring efforts prior to operations will build off the work done by the Fish Facilities Technical Team (2011), which identified monitoring associated with the north Delta intakes and their effects. The pre-construction studies identified by this group were focused on specific key questions rather than general monitoring needs and are listed in Table 6-2. Monitoring studies focused on the NDDs were developed during the BDCP process and include items 7 and 8 as listed in Table 6-3. These studies and their projected timeframes will be revisited as the final monitoring plan is developed.

Table 6-2. Preconstruction Studies at the North Delta Diversions

Potential Research Action[1]	Key Uncertainty Addressed	Timeframe
1. This action includes preconstruction study 1, *Site Locations Lab Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to develop physical hydraulic models to optimize hydraulics and sediment transport at the selected diversion sites.	What is the relationship between proposed north Delta intake design features and expected intake performance relative to minimization of entrainment and impingement risks?	Ten months to perform study; must be complete prior to final intake design.
2. This action includes preconstruction study 2, *Site Locations Numerical Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to develop site-specific numerical studies (mathematical models) to characterize the tidal and river hydraulics and the interaction with the intakes under all proposed design operating conditions.	How do tides and diversion rates affect flow conditions at the north Delta intake screens and at the Georgiana Slough junction?	Eight months to perform study; must be complete prior to final intake design.
3. This action includes preconstruction study 3, *Refugia Lab Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to test and optimize the final recommendations for fish refugia that will be incorporated in the design of the north Delta intakes.	How should north Delta intake refugia be designed in principle to achieve desired biological function?	Nine months to perform study; must be complete prior to final intake design.

Potential Research Action[1]	Key Uncertainty Addressed	Timeframe
4. This action includes preconstruction study 4, *Refugia Field Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to evaluate the effectiveness of using refugia as part of north Delta intake design for the purpose of providing areas for juvenile fish passing the screen to hold and recover from swimming fatigue and to avoid exposure to predatory fish.	How do alternative north Delta intake refugia designs perform with regard to desired biological function?	Two years to perform study; must be complete prior to final intake design.
5. This action includes preconstruction study 5, *Predator Habitat Locations* as described by the Fish Facilities Working Team (2013). The purpose of this study is to perform field evaluation of similar facilities (e.g., Freeport, RD108, Sutter Mutual, Patterson Irrigation District, and Glenn Colusa Irrigation District) and identify predator habitat areas at those facilities.	Where is predation likely to occur near the new North Delta intakes?	One to two years to perform study; must be complete prior to final intake design.
6. This action includes preconstruction study 6, *Baseline Fish Surveys* as described by the Fish Facilities Working Team (2013), somewhat modified based on discussions with NMFS during 2014. The purpose of this study is to perform literature search and potentially field evaluations at similar facilities (e.g., Freeport, RD108, Sutter Mutual, Patterson Irrigation District, and Glenn Colusa Irrigation District), to determine if these techniques also take listed species of fish, and to assess ways to reduce such by-catch, if necessary.	What are the best predator reduction techniques, i.e., which techniques are feasible, most effective, and best minimize potential impacts on listed species?	Two years to perform study; must be complete prior to final intake design.
7. This action includes preconstruction study 7, *Flow Profiling Field Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to characterize the water velocity distribution at river transects within the proposed diversion reaches for differing flow conditions. Water velocity distributions in intake reaches will identify how hydraulics change with flow rate and tidal cycle, and this information will be used in fish screen final design and in model-based testing of fish screen performance (preconstruction study 8, below).	What is the water velocity distribution at river transects within the proposed intake reaches, for differing river flow conditions?	One year to perform study; must be complete prior to final intake design.
8. This action includes preconstruction study 8, *Deep Water Screens Study* as described by the Fish Facilities Working Team (2013). The purpose of this study is to use a computational fluid dynamics model to identify the hydraulic characteristics of deep fish screen panels.	What are the effects of fish screens on hydraulic performance?	Nine months to perform study; must be complete prior to final intake design.

Potential Research Action[1]	Key Uncertainty Addressed	Timeframe
9. This action includes preconstruction study 9, *Predator Density and Distribution* as described by the Fish Facilities Working Team (2013); and includes post-construction study 9, *Predator Density and Distribution*, as described by the Fish Facilities Technical Team (2011). The purpose of this study is to use an appropriate technology (to be identified in the detailed study plan) at two to three proposed screen locations; the study will also perform velocity evaluation of eddy zones, if needed. The study will also collect baseline predator density and location data prior to facility operations, compare that to density and location of predators near the operational facility; and identify ways to reduce predation at the facilities.	What are predator density and distribution in the north Delta intake reaches of the Sacramento river?	Start in 2016 to collect multiple annual datasets before construction begins. The post-construction study will cover at least 3 years, sampling during varied river flows and diversion rates.
10. This action includes preconstruction study 10, *Reach-Specific Baseline Juvenile Salmonid Survival Rates* as described by the Fish Facilities Working Team (2013); and includes post-construction study 10, *Post-Construction Juvenile Salmon Survival Rates* as described by the Fish Facilities Technical Team (2011). The purpose of this study is to determine baseline rates of survival for juvenile Chinook salmon and steelhead within the Sacramento River near proposed north Delta diversion sites for comparison to post-project survival in the same area, with sufficient statistical power to detect a 5% difference in survival. Following initiation of project operations, the study will continue, using the same methodology and same locations. The study will identify the change in survival rates due to construction/operation of the intakes.	How will the new north Delta intakes affect survival of juvenile salmonids in the affected reach of the Sacramento River?	The pre-construction study will cover at least 3 years and must be completed before construction begins. The post-construction study will cover at least 3 years, sampling during varied river flows and diversion rates.
11. This action includes preconstruction study 11, *Baseline Fish Surveys* as described by the Fish Facilities Working Team (2013) and includes post-construction study 11, *Post-Construction Fish Surveys* as described by the Fish Facilities Technical Team (2011). The purpose of this study is to determine baseline densities and seasonal and geographic distribution of all life stages of delta and longfin smelt inhabiting reaches of the lower Sacramento River where the north Delta intakes will be sited. Following initiation of diversion operations, the study will continue sampling using the same methods and at the same locations. The results will be compared to baseline catch data to identify potential changes due to intake operations.	How will the new north Delta intakes affect delta and longfin smelt density and distribution in the affected reach of the Sacramento River?	Pre-construction study will cover at least 3 years. Post-construction study will be performed for duration of project operations (or delisting of species), with timing and frequency to be determined.

Notes

1. All research actions listed in this table are part of the PA. For all proposed research actions, a detailed study design must be developed prior to implementation. The study design must be reviewed and approved by CDFW, NMFS, and USFWS prior to implementation.

Table 6-3. Monitoring Actions for Listed Species of Fish for the North Delta Intakes

Monitoring Action(s)	Action Description[1]	Timing and Duration
1. Fish screen hydraulic effectiveness	This action includes post-construction study 2, *Long-term Hydraulic Screen Evaluations*, combined with post-construction study 4, *Velocity Measurement Evaluations*, as described by the Fish Facilities Technical Team (2011). The purpose of this monitoring is to confirm screen operation produces approach and sweeping velocities consistent with design criteria, and to measure flow velocities within constructed refugia. Results of this monitoring will be used to "tune" baffles and other components of the screen system to consistently achieve compliance with design criteria.	Approximately 6 months beginning with initial facility operations.
2. Fish screen cleaning	This action includes post-construction study 3, *Periodic Visual Inspections* as described by the Fish Facilities Technical Team (2011). The purpose of this monitoring is to perform visual inspections to evaluate screen integrity and the effectiveness of the cleaning mechanism, and to determine whether cleaning mechanism is effective at protecting the structural integrity of the screen and maintaining uniform flow distribution through the screen. Results of this monitoring will be used to adjust cleaning intervals as needed to meet requirements.	Initial study to occur during first year of facility operation with periodic re-evaluation over life of project.
3. Refugia effectiveness	This action includes post-construction study 5, *Refugia Effectiveness* as described by the Fish Facilities Technical Team (2011). The purpose is to monitor refugia to evaluate their effectiveness relative to design expectations. This includes evaluating refugia operation at a range of river stages and with regard to effects on target species or agreed proxies. Results of this monitoring will be used to "tune" the screen system to consistently achieve compliance with design criteria.	Approximately 6 months beginning with initial facility operations.
4. Fish screen biological effectiveness	This action includes post-construction study 7, *Evaluation of Screen Impingement* as described by the Fish Facilities Technical Team (2011). The purpose of this monitoring is to observe fish activity at the screen face (using technology to be identified in the detailed study plan) and use an appropriate methodology (to be identified in the detailed study plan) to evaluate impingement injury rate. Results of this monitoring are to be used to assess facility performance relative to take allowances, and otherwise as deemed useful via the collaborative adaptive management process.	Study to be performed at varied river stages and diversion rates, during first 2 years of facility operation.
5. Fish screen entrainment	This action includes post-construction study 8, *Screen Entrainment* as described by the Fish Facilities Technical Team (2011). The purpose of this monitoring is to measure entrainment rates at screens using fyke nets located behind screens, and to identify the species and size of entrained organisms. Results of this monitoring are to be used to assess facility performance relative to take allowances, and otherwise as deemed useful via the collaborative adaptive management process.	Study to be performed at varied river stages and diversion rates, during first 2 years of facility operation.
6. Fish screen calibration	Perform hydraulic field evaluations to measure velocities over a designated grid in front of each screen panel. This monitoring will be conducted at diversion rates close to maximum diversion rate. Results of this monitoring will be used to set initial baffle positions and confirm compliance with design criteria.	Initial studies require approximately 3 months beginning with initial facility operations.

Monitoring Action(s)	Action Description[1]	Timing and Duration
7. Fish screen construction	Document north Delta intake design and construction compliance with fish screen design criteria (note, this is simple compliance monitoring).	Prior to construction and as-built.
8. Operations independent measurement	Document north Delta intake compliance with operational criteria, with reference to existing environmental monitoring programs including (1) Interagency Ecological Program Environmental Monitoring Program: Continuous Multi-parameter Monitoring, Discrete Physical/ Chemical Water Quality Sampling; (2) DWR and Reclamation: Continuous Recorder Sites; (3) Central Valley RWQCB: NPDES Self- Monitoring Program; and (4) USGS Delta Flows Network and National Water Quality Assessment Program. The purpose of this monitoring is to ensure compliance and consistency with other relevant monitoring programs, and to ensure that this information is provided to CDFW, NMFS, and USFWS in association with other monitoring reporting.	Start prior to construction of water diversion facilities and continue for the duration of the PA.
9. Operations measurement and modeling	Document north Delta intake compliance with the operational criteria using flow monitoring and models implemented by DWR. The purpose of this monitoring is to ensure and demonstrate that the intakes are operated consistent with authorized flow criteria stated in Table 3-21 *New and Existing Water Operations Flow Criteria and Relationship to Assumptions in CALSIM II Modeling*, and with the stated commitment to manage operations at all times to avoid increasing the magnitude, frequency, or duration of flow reversals in the Sacramento River at the Georgiana Slough junction above pre-north Delta diversion intakes operations levels.	Start prior to completion of water diversion facilities and continue for the duration of the permit term.
10. North Delta intake reach salmonid survivorship	Determine the overall impact on survival of juvenile salmonids through the diversion reach, related to the operation of the new north Delta intakes. Use mark/recapture and acoustic telemetry studies (or other technology to be identified in the detailed study plan) to evaluate effects of facility operations on juvenile salmonids, under various pumping rates and flow conditions. Results of this monitoring are to be used to assess whether survival objectives for juvenile salmonids traversing the diversion reach are being met, to determine whether take allowances are exceeded, and otherwise as deemed useful via the collaborative adaptive management process. The screens will be operated to achieve the following performance standard: Maintain listed juvenile salmonid survival rates through the reach containing the NDD (0.25 mile upstream of the upstream-most intake to 0.25 mile downstream of the downstream-most intake) of 95% or more of the existing survival rate in this reach. The reduction in survival of up to 5% below the existing survival rate will be cumulative across all screens and will be measured on an average monthly basis.	Survivorship monitoring to be performed over the operational life of the facility.

Notes

1. All monitoring actions are part of the PA. For all proposed monitoring actions, a detailed study design must be developed prior to implementation. The study design must be reviewed and approved by CDFW, NMFS, and USFWS prior to implementation.

6.3 References

California Department of Fish and Game. 2009. California Endangered Species Act Incidental Take Permit No. 2081-2009-001-03.

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