*[**Note to Reviewers:** This table presents in-progress draft potential effectiveness monitoring actions for each BDCP conservation measure. This table will continue to be refined and populated to ensure that all of the effectiveness monitoring, including incorporation of metrics from the logic chain, are addressed.]*

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Ecosystem-Level Conservation Measures				
CM1: Water Facilities and Operation				
Monitoring Action CM1-1. Document the operation of the new water diversion facility in the north Delta with multiple intakes and fish screens and an isolated conveyance facility while maintaining sufficient bypass flows for covered fish species.				
Base condition: As-built construction drawings. **Approach**: Record amounts and timing of water diversion and conveyance, record bypass flows at automated monitoring stations downstream of the last intake. **Schedule:** real-time data compiled for daily summaries.	**Existing Programs:** 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) **Potential Program Additions:** add automatic water monitoring stations at each intake as needed.	1. Hourly Intake (cfs) 2. Bypass flow (cfs) downstream of last intake	This monitoring action will provide real-time data on the amount of water diverted by the north Delta diversion facility, and the amount of water that bypasses the facility. This information will be used by the Implementing Office to determine of water operations adhere to existing target levels. The monitoring schedule may be adjusted to better estimate diversion and bypass flows.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5 CHSA1.5 GRST1.1 RILA1.4 PALA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 1-2: Record and quantify the number of fish impinged at intakes of the new water diversion facility in the north Delta.				
Base condition: As-built construction drawings. **Approach**: Time stratified sampling; record number, size, species and life stage, reproductive status of impinged fish at intake screens; Install underwater monitoring cameras at fish screens to examine fish behavior at intake screens **Schedule:** Daily	**Existing Programs:** Protocols, equipment and skilled personnel working at CVP and SWP facilities (south Delta) **Potential Program Additions:** Equipment and staff to monitor north Delta diversion facility using identical protocols; protocols for analyzing video sequences of underwater cameras	1.Number of fish 2. Species 3. Life stage 4. Reproductive status	This monitoring action will provide data on impingement of covered fish species at the North Delta facilities. This information will be used by the Implementing Office to determine if the existing fish screens perform to meet target thresholds. It will also provide insights in fish behavior at intakes and will be used to evaluate and redesign fish screens if necessary. The monitoring schedule may be intensified if large numbers of fish are impinged at any given time/season.	CHSA1.6 STEE1.5 SASP1.4 GRST1.4 WHST1.4
Monitoring Action CM 1-3: Record and quantify the number of fish entrained at the south Delta SWP and CVP pumping facilities.				
Base Condition: Current levels of entrainment **Approach:** Use existing protocols and sampling procedures, continue to collect entrainment and salvage data at CVP and SWM pumping stations. **Schedule:** ongoing, daily	**Existing Programs:** Ongoing fish sampling at pumping facilities, IEP Monitoring (Fishery Improvements) coordinated with DWR, DFG, USBR, UCD, and other federal, state, and local agencies. **Potential Program Additions:** None	1. Monthly salvage density (fish/cubic foot per second [cfs] 2. Estimated entrainment (numbers) 3. Estimated impingement (numbers) 4. Species composition 5. Size distribution of individual species	This monitoring provides information about the seasonal distribution and amount of fish losses due to entrainment at pumping facilities The Implementation Office will use this information as input in population and life-cycle models of covered fish, and to determine if fish salvage and screening perform at expected target levels. This monitoring activity is already adaptively scheduled by adjusting sampling according to the number of fish entrained and by flow. Modification of this sampling is not expected.	CHSA1.6 GRST1.4 SASP1.4 STEE1.5 WHST1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM1-4: Document diversion operations to ensure target flows in Old and Middle Rivers.				
Base Condition: Pre-implementation flows of Old and Middle Rivers. **Approach:** Use existing network of fixed-site sampling stations to collect time-histories of water quality variables. Derive flux between regions in the Delta through these key channels. **Schedule:** Within 1 year of initiation of the South Delta Diversion Operational Limits, operate monitoring sites and track flow on a daily basis.	**Existing Programs:** 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) **Potential Program Additions:** **1.** If needed, add complementary stations to track water flows within Old and Middle River. see also Monitoring Action CM4-4 and Monitoring Action CM4-6.	1. Flow dynamics (velocity and volume of flows, direction) in Old and Middle River	This monitoring action will provide information regarding the effectiveness of adaptive operational changes of Old and Middle River flows (by modifications in export rates and reverse flows). The Implementing Office will use this information to determine if flow rates are within adaptive range limits. The schedule for monitoring may be changed if flow dynamics are found not to be within not adaptive range limits.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5 CHSA1.5 STEE1.3 PALA1.4 RILA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM1-5: Document fish migration and hydrodynamics (including hydraulic residence time) resulting from Delta Cross Channel operations (increasing the duration of Delta Cross Channel closure).				
Baseline Condition: Current knowledge of migration routes of covered fish species; if necessary determine proportion of covered juvenile fish (salmonids and sturgeon) migrating through the interior Delta and the mainstem of the Sacramento River. **Approach**: Conduct tracking (e.g., radio-telemetry, acoustic tracking, or other appropriate methods) of juvenile winter-run Chinook salmon, green and white sturgeon, and other species as appropriate to determine the proportion of fish migrating through the mainstem Sacramento River and tributaries and the interior of the delta and their survival. Compare water quality and organic food indices among migration routes and under different flow regimes and Cross Channel gate operation. **Schedule**: During migration track marked fish daily. Aggregate data by month and derive mortality estimates for fish in each migration route (mainstem vs interior).	**Existing Programs:** 1. Previous salmon survival and migration studies (e.g., USFWS, Perry et al. 2010), ultrasonic recorder stations (USGS & California Bay-Delta Authority). 2. Water quality monitoring sites within the Delta (see CM1-1). **Potential Program Additions:** Implement a routine juvenile fish migration and survival tracking program by experimentally releasing tagged fish to determine the effects of Cross Channel Closure on survival.	1. Migration routes (% individuals moving through the mainstem) by juvenile salmon and sturgeon 2. route- and species-specific survival estimates 3. Hydraulic residence time 4. Flows and downstream transport of fish eggs, larvae, juveniles, organic material, phytoplankton, and zooplankton, within the Sacramento River into the Delta.	This monitoring will provide information on the effectiveness of Delta Cross Channel closure to increase covered fish survival and by improving downstream transport of fish eggs, larvae, juveniles and organic food resources. Results of this monitoring will be used within the BDCP adaptive management framework to refine and modify seasonal operations of Delta Cross Channel gates. The schedule of monitoring may be adaptively altered if data resolution requirements are not met or when a clear relationship between Delta Cross channel operation, covered species survival and transport, and tidal flows is established and can be predicted robustly and with low uncertainty.	CHSA1.5 STEE1.3 RILA1.4 PALA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM1-6: Document achievement of minimum flow requirements at Rio Vista to support fishery and aquatic habitat in the reach of the Sacramento River between Sacramento and Rio Vista.				
Base Condition: Existing data and modeling results for flow statistics of the Sacramento river between Sacramento and Rio Vista **Approach:** Using the existing network of fixed-site sampling stations, collect time-histories of water quality variables. Derive flow rates. **Schedule:** Operate monitoring sites and track flow on a continuous basis for at least 5 years or until a robust predictive model can be derived from the monitoring data that allows forecasting of flow rates as a product of operational and other variables.	**Existing Programs:** 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) **Potential Program Additions:** 1. If needed, add complementary stations to track water flows within The Sacramento River between Sacramento and Rio Vista. see also Monitoring Action CM4-4 and Monitoring Action CM4-6.	1. Flow dynamics (cfs) of the Sacramento River reach between Sacramento and Rio Vista.	This monitoring action will provide information regarding the effectiveness of adaptive operational changes to ensure minimum flows at Rio Vista to support fishery and aquatic habitat in the reach of the Sacramento River between Sacramento and Rio Vista. The Implementing Office will use this information to determine if flow rates are within adaptive range limits. The schedule for monitoring may be changed if flow dynamics are found not to be within not adaptive range limits.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5 CHSA1.5 STEE1.3 GRST1.1 RILA1.4 PALA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM1-7: Monitor Delta outflows during the near-term implementation period for environmental benefits.				
Base Condition: Current Delta Outflows; seasonal position of 350 µS/cm EC isohaline (X2). **Approach**: Continue monitoring salinity via the fixed water quality stations throughout the Delta. Obtain Daily and seasonal dynamics to determine if and when Delta outflows are below target levels. **Schedule:** Daily monitoring via fixed station network.	**Existing Programs:** 1. IEP Monitoring Data– daily average surface salinity at fixed stations along the Sacramento River interpolated to determine the location of 350 µS/cm EC isohaline. 2. DSM2 Simulations – daily average, depth-averaged salinity at fixed locations (every DSM2 node) along the Sacramento River is interpolated to determine the location of 350 µS/cm EC isohaline. **Potential Program Additions:** none	1. Daily average surface salinity at fixed stations. 2. Interpolated position of the isohaline (X2), expressed in miles from the Golden Gate Bridge. 3. Net Delta Outflow Index	This monitoring action will provide information on the magnitude of Delta outflow and related parameters (salinity intrusion). It will track the position of the isohaline Based on results and analysis of monitoring data, adaptive modifications to management of Delta outflow under the BDCP adaptive management framework could occur by modifying operational criteria by season or water-year type (hydrology). The schedule of monitoring actions may be altered to improve precision and accuracy of estimating the position of the isohyaline.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5 CHSA1.5 STEE1.3 GRST1.1 RILA1.4 PALA1.4
Monitoring Action CM1-8: Record in-Delta agricultural, municipal, and industrial water quality.				
Base condition: Current water quality monitoring **Approach**: Continue current water quality monitoring as mandated by existing D-1641 North and Western Delta agricultural and municipal and industrial (M&I) standards and all water quality requirements contained in the North Delta Water Agency/DWR Contract and other DWR contractual obligations. **Schedule:** as currently implemented.	**Existing Programs:** 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc)	1. EC (salinity) 2. Water temperature (^{o}C) 3. mg/L dissolved oxygen 4. Turbidity (NTUs) 5. Concentration (µg/L) of ammonia, pyrethroids, copper, organophosphates 6. pH 7. mg methylmercury/L	This monitoring action is intended to collect data necessary to determine if salinity conditions are meeting contractual and legal requirements. This information will be used to address deviations from salinity target conditions, and design modifications and/ research studies to address uncertainty in salinity control. The monitoring schedule may be adjusted in response to monitoring results to better understand causal relationships between water management and salinity.	CHSA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 1-9: Document and quantify effects of modified/reduced operations the Montezuma Slough Salinity Control Gate for covered fish species passage and salinity				
Base Condition: current operation and flows (local current patterns and tidal hydrodynamics). **Approach**: continue to monitor and calculate water quality and flow parameters through Suisun March and at Chipps Island (Delta Net outflow index), continue IEP Suisun Marsh fish monitoring (otter trawls and beach seines) **Schedule**: instantaneous automatic 15 min interval recording of salinity data, Seasonal fish abundance as currently conducted by IEP.	**Existing Programs:** IEP coordinated programs: 1. Suisun Marsh Water Quality Monitoring and Compliance (five compliance stations); 2. Aquatic Monitoring by University of California Davis (UCD) and DFG in Suisun Marsh (otter trawls and beach seine) **Potential Program Additions:** none	1. Catch per unit effort (CPUE) and % change (over baseline conditions) of outmigrating juvenile salmonids and sturgeon in Suisun Marsh; 2. Catch per unit effort (CPUE) and % change (over baseline conditions) of splittail, salmonids, and sturgeon in existing and future restored intertidal marsh habitats in Suisun Marsh (see also CM 4-5). 3. Salinity levels within Suisun marsh and in adjacent Delta channels 4. Flow (cfs) in Montezuma Slough	This monitoring action provides information on the effects of changing or eliminating salinity control gate operations in Montezuma Slough on covered fish species and salinity levels within the Delta. In the event that the control structure remains in place and the gates are opened, results of monitoring could be used in the future to adaptively manage the control gates (resume gate operations) if unexpected undesirable consequences are detected. If the control structure is removed, adaptive management of salinity regimes will require modifications of Delta outflow to manage salinity within the marsh. The monitoring schedule may be adjusted to better inform management decisions if deemed necessary.	CHSA1.1 STEE1.1 STEE1.3 RILA1.4 PALA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM2: Yolo Bypass Fisheries Enhancements				
Monitoring Action CM2-1: Document the operation of the modified Fremont Weir (i.e., elevation reduction)				
Base Condition: As-built construction drawings. **Approach**: Document flow over the weir. Document the operation of inundation gates and deep channel fish passage gates. **Schedule:** real-time recording, during flooding of the weir.	**Existing Programs:** CA Dept of Water Resources/NCRO river stage monitoring gages **Potential Program Additions:** real-time recording of gate operations (open/closed)	1. River stage at Fremont weir 2. Flow (cfs) 3. Gate status (open/closed)	This monitoring action will provide information on the operation of the modified Fremont weir, particularly on the number of days and the amount of water that flows over the weir into Yolo bypass and the operation of the fish passage gates at below flood stage of the Sacramento River (11.5 – 17.5 ft) This information will be used by the Implementing Office to refine operation of the gates to provide for the inundation of the Yolo bypass according to target levels. The monitoring schedule may be adjusted if deemed necessary to provide higher resolution information for gate operations.	ECSY2.2 ECSY5.1 CHSA1.1 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.3 WHST1.3 RILA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-2: Document the effects of the fish passage gates at Fremont Weir (replacing fish ladder)				
Base conditions: As-built construction drawings. **Approach:** Install and operate underwater high resolution cameras and or automatic fish counters (using resistivity, infrared scanning technology or other appropriate methods) to characterize and quantify covered fish species passing through fish passage gates within the inundation channel during flooding of the Yolo Bypass. Compile and analyze fish passage data daily during operation of the passage gates. **Schedule:** real-time instantaneous fish counting when fish passage gates are open.	**Existing Programs:** none **Potential Program Additions:** Automated fish counting technology (automatic counter sensors, computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; See Monitoring Action CM2-7, CM2-10, CM2-11	1. Number of fish passing through the gates 2. Species 3. Size class 4. Origin (wild or hatchery for fin-clipped fish)	This monitoring action will provide information to quantify adult fish passage from the up- and downstream between the Sacramento River and the Yolo Bypass. This information will be used by the Implementing Office to estimate the population size of adult covered fish species using the Yolo bypass during inundation. The monitoring schedule will be adjusted during inundation events and status of fish passage gates.	CHSA1.1 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.3 WHST1.3 RILA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-3: Document the effects of the Yolo Bypass modifications to improve distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass.				
Base conditions: as-built construction drawings; current extent of Yolo bypass inundation and hydroperiod **Approach:** Document and quantify grading, removal of existing berms, levees, and water control structures, construction of berms or levees, re-working of agricultural delivery channels, and earthwork or structures by remote sensing data and field observations entered into GIS. Record and quantify the hydrodynamic characteristics of the Yolo basin by flood and spill gages and satellite imagery LANDSAT or similar to estimate extent of wetted area). Develop correlation between the extent wetted, hydrodynamic indicators and flood gage measurements. Update GIS database if lands are acquired in fee-title or through conservation or flood easements. **Schedule:** Daily monitoring of flood gauges, weekly acquisition of remote sensing data, until a correlation can be established between stage at various flood gauges and hydrodynamic measures.	**Existing Programs:** Yolo bypass inundation gauging stations at Fremont weir (USGS), Sacramento Weir (USGS) and Lisbon (DWR). Potential GIS capability with DWR IISS section within DWR-DES **Potential Program Additions:** Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)	1. Yolo bypass wetted area 2. Residence times 3. Flow ramping rate (change of water flow cmps/hr hour) 4. Recession timelines	This monitoring action will provide information on the relationships between the hydrological conditions within the Yolo bypass as they pertain to fish habitat, and flood gage information provided throughout the basin. This information will be used to determine the operational constraints and effectiveness of gate and spill operations of the Fremont weir and flow obstruction removals within the floodplain. It will also be used to assess if additional floodplain modifications are necessary to reduce flow and inundation impediments, and to address erosion and other issues. The monitoring schedule may modified once robust, statistically significant and precise correlations have been verified.	ECSY5.1 CHSA1.1 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.3 WHST1.3 RILA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-4: Document and quantify the effectiveness of Experimental Sturgeon Ramps for the upstream migration of sturgeon from the Yolo bypass to the Sacramento River.				
Base condition: as-built construction drawings **Approach**: Install and operate underwater high resolution cameras and automatic fish counters (using infrared scanning technology, resistivity sensors or other appropriate methods) to characterize and quantify covered fish species passing through sturgeon ramps when weir spills exceed 2 feet. **Schedule**: instantaneously count and record fish using ramps. Compile counts daily.	**Existing Programs:** none **Potential Program Additions:** Automated fish counting technology (automatic counter sensors, computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; live video feed to web-based application See CM 2-2	1. Number of fish passing 2. Species 3. Size class	This monitoring action will provide information on the effectiveness of experimental Sturgeon Ramps at the Fremont Weir to allow passage of adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir and into the Sacramento River. This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the sturgeon rams has been documented with low uncertainty.	GRST1.3 WHST1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-5: Document Stilling Basin Modification and assess risk of covered fish stranding.				
Base conditions: As-built construction drawings **Approach**: Document the physical changes in stilling basin topography. Estimate the number of fish stranding in the stilling basin as flows are receding by electro-fishing, beach seining or other appropriate method. **Schedule:** Sample if standing water remains within the basin after weir spills have ceased and floodplain drainage has begun.	**Existing Programs:** Intermittent and historical IEP and USFWS beach seine and trawling methods within the Yolo and Sutter bypasses **Potential Program Additions:** Fish sampling of stilling basin to verify stranding. See CM5-2	Number of fish Size species	This monitoring action will provide information to assess if the basin drains sufficiently into the deep fish passage channel and thus will prevent stranding of juvenile and adult fish. Information from this monitoring action will be used by the Implementing Office to assess the risk of stranding at the stilling basin, and to guide the redesign if necessary, if significant numbers of fish are found to be stranded in the basin after re-contouring. The monitoring schedule will be reduced to annual visits at the end of the inundation period once fish escape of from the basin has been verified with low uncertainty.	CHSA1.1 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.3 WHST1.3 RILA1.3 PALA1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-6: Document and evaluate Sacramento Weir improvements for fish passage and minimization of standing risk.				
Base condition: As-built construction drawings. **Approach:** Document modifications to the weir. Using fish sampling (seining, electro-fishing, traps), determine the number and species of juvenile and adult fish using the stilling basin and (if implemented) fish ladders. Install automatic fish scanners and underwater high-resolution cameras to assess passage of adult fish over the weir into the Sacramento River. **Schedule**: Weekly sampling of fish until a minimal stranding risk has been estimated and verified precisely. Instantaneous video monitoring of fish passing through fish ladder.	**Existing Programs:** none **Potential Program Additions:** Intermittent fish sampling during and after weir spills in Sacramento weir stilling basin; automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; See Monitoring Action CM2-2	Number, size and species of fish passing over fish ladder Number, species and life stage of juvenile fish sampled in the stilling basin	This monitoring action will provide information on the effectiveness of modifications of the Sacramento weir and its stilling basin to allow passage of adult and juvenile fish from the Yolo Bypass into the Sacramento River or downstream the Tule Canal/Toe Drain to escape stranding. This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.	CHSA1.3 CHSA1.1 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.3 WHST1.3 RILA1.3 PALA1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM2-7: Document the Tule Canal/Toe Drain Improvements to increase hydrologic connectivity.				
Base condition: As-built construction drawings. **Approach:** Document modifications to the Tule Canal /Toe drain. Measure flow within the channel with automatic gages. **Schedule**: Real-time continuous automatic flow measurements.	**Existing Programs:** none **Potential Program Additions:** Install automatic flow gage within the Tule Canal /Toe drain	1. flow (cfs)	This monitoring action will provide information on the effectiveness of modifications of the Tule Canal /Toe drain to allow passage of adult and juvenile fish downstream the Tule Canal/Toe Drain to escape stranding. This information will be used by the Implementing Office within the adaptive management experiment framework refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.	CHSA1.5 STEE1.3 GRST1.1 GRST1.3 WHST1.3 RILA1.3 RILA1.4 PALA1.4

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-8: Determine the effectiveness of Lower Putah Creek realignments to improve upstream and downstream passage of Chinook salmon and steelhead in Putah Creek and floodplain habitat restoration.				
Base condition: As-built construction drawings. **Approach:** Document modifications to Lower Putah Creek. Using automatic resistivity-based fish counters to detect and enumerate adult fish returning. **Schedule**: Continuous operation of the fish counter during spawning season.	**Existing Programs:** none **Potential Program Additions:** Install automatic fish counter within Lower Putah Creek. See Monitoring Action CM2-7	1. Number of fish returning 2. Species	This monitoring action will provide information on the effectiveness of modifications of Lower Putah Creek to allow passage of adult and juvenile covered fish along Lower Putah Creek. This information will be used by the Implementing Office within the adaptive management experiment framework refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.	CHSA1.3 STEE1.3 GRST1.3 WHST1.3 RILA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-9: Determine upstream migration success of salmonids, sturgeon, and lamprey through the Yolo Bypass.				
Base condition: existing knowledge of upstream migration and its correlation with flow (DFG data) Approach: Using a combination of mark-recapture and automatic resistivity-based fish counters and high-resolution underwater camera systems at Fremont weir, detect and enumerate adult fish returning (see Monitoring Action CM2-7). Schedule: Continuous operation of the fish monitoring system during migration season	**Existing Programs:** DFG fish tagging program **Potential Program Additions:** automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; See Monitoring Action CM2-2, CM2-6, CM2-10.	1. Number of fish passing 2. Species 3. Size class	This monitoring action will provide information on the effectiveness of adult covered fish species migrating from the Yolo Bypass over the Fremont Weir and into the Sacramento River. This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of permeability of the Yolo Bypass for upstream migration of adult fish has been documented with low uncertainty.	CHSA1.3 STEE1.3 GRST1.3 WHST1.3 RILA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-10: Determine passage rates of covered salmonids, sturgeon, Sacramento splittail, and lamprey from the Sacramento River into the Yolo Bypass during periods of Fremont Weir operation.				
Base condition: As-built construction drawings. **Approach:** Using a mark-recapture approach, determine the number and species of juvenile and fish out migrating over the Fremont weir. Install automatic fish scanners and underwater high-resolution cameras to assess passage of adult fish over the weir into the Sacramento River. **Schedule**: Weekly sampling of fish for the period of inundation. Instantaneous video monitoring of fish passing through fish ladder.	**Existing Programs:** none **Potential Program Additions:** Intermittent fish sampling during and after weir spills; automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; See Monitoring Action CM2-2, CM2-7, CM2-10	Number, size and species of fish passing over fish ladder Number, species and life stage of juvenile fish sampled in the stilling basin	This monitoring action will provide information on the effectiveness of modifications of the Sacramento weir and its stilling basin to allow passage of adult and juvenile fish from the Yolo Bypass into the Sacramento River or downstream the Tule Canal/Toe Drain to escape stranding. This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs. The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.	ECSY5.1 CHSA1.2 STEE1.2 SASP1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-11: Determine zooplankton and invertebrate production rates during periods the Fremont Weir is operated.				
Base Condition: existing data on Yolo Bypass zooplankton productivity **Approach:** Establish monitoring stations at inflow and outflow locations and within the inundated floodplain of the Yolo bypass. Take weekly grab samples and measurements of chlorophyll a and zooplankton. **Schedule:** Conduct sampling for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.	**Existing Programs:** Environmental Monitoring Program (EMP, under IEP) **Potential Program Additions:** **1.** Additional sampling stations in the Yolo Bypass floodplains t reflect the before-after-control-impact design. Locations of some added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added to account for different flow rates and inundation depth in dry vs wet years to track how food production develops over time. Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon) Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also: Monitoring Action CM4-4, CM4-6, and CM16-5	1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 3. Zooplankton species composition/relative abundance 4. Zooplankton density (number/1,000 m^3)	This monitoring action is intended to collect data necessary to determine and quantify the degree to which the Yolo bypass is producing and exporting phytoplankton and zooplankton into the Delta. This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for : 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (source-sink dynamics, variability and uncertainty in primary production response) 3. evaluating restoration design options to increase the production and export of primary production inundated floodplains 4. Implementing additional management actions to improve production and export of primary production from the floodplain. The monitoring schedule will be modified if uncertainty or variances do not support a clear causal relationship between floodplain inundation and food production and - exports.	ECSY5.1 ECSY5.2 CHSA1.2 STEE1.2 SASP1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-12: Determine growth rates of juvenile salmonids entering the Yolo Bypass during periods of Fremont Weir operation.				
Base condition: Current studies and knowledge about salmon growth and survival in the Delta and the Yolo bypass. **Approach**: Conduct routine mark-recapture and radio-telemetry tagging experiments by marking juvenile salmon within the Yolo bypass and measuring survival and growth rates at Chipps Island **Schedule**: annually mark and radio-tag individual Chinook for at least 5 years. Repeat mark-recapture monitoring every 5th year	**Existing Programs:** IEP mid-water trawl at Chipps Island, previous salmon survival studies (Perry et al 2009) **Potential Program Additions:** 1. routine radio-tracking and mark recapture program	1. survival rates 2. growth rates (mm/d)	This monitoring action provides information on the effectiveness of modifying the Fremont weir to benefit survival and growth rates of juvenile outmigrating Chinook salmon. The implementing Office will use this information to determine if operation of the Fremont weir is achieving target levels of survival and growth. The information will also ser as a basis to determine f additional research should be conducted, and if initial models and hypotheses are supported by monitoring data. The monitoring schedule may be extended if survival and growth data are inconclusive to determine that survival and growth has achieved target levels or of substantial environmental variability has increased the level of uncertainty associated with predicted outcomes.	CHSA1.2 STEE1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-13: Determine escapement success of juvenile covered salmonids, sturgeon, Sacramento splittail, and lamprey from the Yolo Bypass during periods of Fremont Weir operation.				
Base condition: Current studies and knowledge about survival of juvenile covered fish in the Delta and the Yolo bypass. **Approach**: Conduct routine mark-recapture and/ or radio-telemetry tagging experiments by marking juvenile covered species near the Fremont Weir within the Yolo bypass and measuring survival and growth rates at Chipps Island **Schedule**: annually mark and radio-tag individual covered species for at least 5 years. Repeat mark-recapture monitoring every 5th year	**Existing Programs:** IEP mid-water trawl at Chipps Island, previous salmon survival studies (Perry et al 2009) **Potential Program Additions:** 1. routine radio-tracking and/or mark recapture program	1. Survival rates 2. Species	This monitoring action provides information on the effectiveness of modifying the operations of Fremont weir to benefit survival and growth rates of juvenile outmigrating covered species. The implementing Office will use this information to determine if operation of the Fremont weir is achieving target levels of survival and growth. The information will also serve as a basis to determine if additional research should be conducted, and if initial models and hypotheses are supported by monitoring data. The monitoring schedule may be extended if survival and growth data are inconclusive to determine that survival and growth has achieved target levels or of substantial environmental variability has increased the level of uncertainty associated with predicted outcomes.	CHSA1.1 STEE1.1 GRST1.1 PALA1.2
Monitoring Action CM 2-15: Document Sacramento splittail spawning and spawning success in the Yolo Bypass during periods of Fremont Weir operation.				
	[Text to come.]	[Text to come.]	[Text to come.]	SASP1.1 SASP1.2 SASP1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 2-16: Determine the distribution and abundance of giant garter snake in the Yolo Bypass.				
Base Condition: none **Approach**: Using accepted survey protocols, conduct randomized, stratified surveys to detect presence of GGS in the Yolo Bypass, especially using known or historical locations as starting points and radiating outwards from there. **Schedule**: Annual surveys during periods of GGS activity. Continue for at least 5 inundation years. Repeat every 5 years, focusing on verifying presence in previously established occurrences.	**Existing Programs:** historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. Standardized surveys for Giants Garter Snake 3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand See Monitoring Action CM4-8 , 4-14	1. Presence and sex/age distribution of Giant Garter Snake 2. Estimated population trend Giant Garter Snakes in restored habitats (source or sink?)	This monitoring action is intended to collect data on the distribution and population trend of giant garter snake in the Yolo Bypass. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of giant garter snake in the Yolo Bypass This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of giant garter snake populations in the Yolo Bypass	TANC1.1 FMNC1.1 FMNC2.1 NANC2.1 NWNC2.1 ALNC1.2 ALNC1.5 ALNC1.7 ALNC1.8 GGSN1.1 GGSN2.1
Monitoring Action CM 2-17: Determine abundance of wintering waterfowl and shorebirds in the Yolo Bypass during years the Fremont Weir is operated.				
Base Condition: Current waterfowl monitoring as conducted by USFWS, CDFG and CWA **Approach**: Continue USFWS and CDFG special fall and midwinter aerial surveys. The midwinter survey, the longest running population assessment, focuses on all ducks, geese, swans, and coots. **Schedule**: Annual mid-winter surveys as currently implemented by USFWS.	**Existing Programs:** USFWS midwinter waterfowl surveys **Potential Program Additions:** none	1. Number 2. Species 3. sex/age composition (if possible)	This monitoring action provides information on the abundance of wintering waterfowl. The Implementation office will use this information to determine the effectiveness of inundation of the Yolo bypass ion providing wintering habitat for waterfowl. The Monitoring schedule may be changed if necessary to improve accuracy and/or precision of waterfowl estimates.	MWNC1.1 MWNC1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM3: Protect Natural Communities				
Action CM3-1 Record the acquisition or protection of parcels by conservation zone, natural community, and covered species habitat.				
Base Condition: Pre-acquisition parcel information. **Approach**: Document and record in a suitable database the characteristics of protected land as they are added to the conservation lands system **Schedule:** Update maps and database of conservation lands annually to reflect status of each parcel as they are added to the conservation land system.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)	Acres of land protected by Conservation Zone / ROA and natural community Linear miles of edge within tidal mudflat habitats as habitat for tidal-mudflat associated species (e.g., Delta tule pea, Suisun marsh aster)	This monitoring action will provide the means to track how the Implementing Office is adding conservation lands in each Conservation Acquisition zone. This information will be used to assess progress and determine if conservation targets in each CAZ and natural community have been met.	ECSY1.1 ECSY1.2 GRNC1.1 VPNC1.1 ALNC1.1-1.6
Monitoring Action CM 3-2: Record, quantify and delineate occurrences of covered plant species.				
Base Condition: Pre-acquisition parcel information. Baseline survey of parcels at acquisition **Approach**: Document and record in a suitable database the characteristics of rare species occurrences on BDCP protected lands **Schedule**: Survey once every 5 years to document presence and condition/abundance of special status plants	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Special status surveys and species verifications by a qualified botanist	Species occurrences: 1. Location 2. Species 3. Habitat 4. Number of individuals 5. Land use 6. Threats	This monitoring action will provide information on the presence and status of special-status plants on conservation lands within the BDCP Plan Area. This information will be used in the development of specific management plans for each parcel to ensure that management and protection activities are compatible with special-status plants and these plants are protected and maintained. The monitoring schedule will be altered for species that are dependent on specific climatic events or conditions (i.e. vernal pool plans require "wet" years to emerge)	ALMV1.1 AWNC1.1 CAGB1.1 CFTR1.1 DEBC1.1 HART/ BRIT1.1 HEPE1.1 SOBB1.1 SUTH1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 3-3: Document habitat connectivity among the various BDCP conservation land units in the conservation land system.				
Base Condition: Pre-acquisition parcel information. Baseline documentation **Approach**: Document and record in a suitable database evidence of connectivity and movement of animals and plants across conservation land habitats. **Schedule**: Update maps and database of conservation lands annually to reflect the conservation status of adjacent lands and the location of newly arriving species of interest.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)	Land status and changes in natural communities on adjacent parcels Species occurrence of newly arriving species Observed shifts in species distribution and use of the parcel.	This monitoring action will identify how well the protected lands are connected with adjacent habitats to enable species to move across the landscape. This information will be used to determine where uncertainties and knowledge gaps exists regarding the connectivity of habitats within the BDCP Plan Area, and where corridors for covered and invasive species exist. This information will be used to determine appropriate management strategies to support covered species and reduce the likelihood of dispersal of non-native invasive species. The monitoring schedule may be reduced to every 5 or even 10 years once conservation targets have been met within a Conservation Zone.	ECSY3.1 ECSY7.1 ALNC1.7 VRNC2.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Natural Community-Level Conservation Measures				
CM4: Tidal Habitat Restoration				
Monitoring Action CM4-1. Document the extent of tidal habitat restored.				
Base Condition: As-built construction drawings. **Approach:** Delineate the extent of subtidal aquatic, unvegetated mudflat, vegetated marsh plain by vegetation type, and transitional upland by vegetation type. **Schedule:** Annually delineate habitat components for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist) See Monitoring Action CM4-2, CM16-1	1. Extent, distribution, and channel order of tidal perennial aquatic natural community on restoration sites. 2. Percentage of subtidal aquatic habitat in areas of subsidence 3. Extent, distribution and persistence of high-functioning tidal mudflat community	This monitoring action provides information regarding the development of restored habitat components over time. Results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit. This information will also provide the basis for determining if there is a need to modify subsequent restoration designs to improve their ecosystem and habitat functions, or if it is necessary to alter management actions to support the development of desired habitat functions (e.g., control of non-native vegetation, planting of native emergent vegetation to improve development of marsh functions). The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	TANC1.1 BMNC1.1 FMNC1.1 MFNC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-2. Document the progress of vegetation community establishment and the extent of covered species habitat provided by restored tidal habitats.				
Base Condition: As-built construction drawings. **Approach:** For the first 5 years following completion of tidal marsh restoration projects, annually conduct aerial and/or field surveys in October to map the extent of tidal vegetation establishment. Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM4-1. **Schedule:** Annually quantify the extent of restored covered, species habitats for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel; see Monitoring Action CM4-1, CM16-1)	1. Extent, distribution and persistence of high-functioning tidal mudflat community 2. Linear extent of restored or created tidal mudflat substrate as part of the restored brackish and freshwater tidal habitat and channel margin enhancement. 3. Acres of covered species habitat 4. presence of key habitat correlates and requisites/attributes for covered species 5. Percent absolute and relative cover 6. Extent, distribution, cover, and species composition of non-native invasive species within establishing tidal mudflats on restoration sites	This monitoring action is intended to provide information regarding the development of habitat covered species in restored tidal habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	BMNC1.1 FMNC1.1 MFNC1.1 SOBB1.1 SUTH1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-3. Quantify the primary production exported from restored tidal marsh plain into adjacent restored subtidal aquatic habitat areas.				
Base Condition: Seasonal abundances of phytoplankton and zooplankton in channels adjacent to restoration sites. Sample restored subtidal prior to breaching of levees, measured for at least one year prior to restoring tidal habitat. **Approach:** Establish monitoring stations at inflow and outflow locations and within restored subtidal habitat. Take weekly grab samples and measurements of chlorophyll a and zooplankton. **Schedule:** Conduct sampling for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.	**Existing Programs:** Environmental Monitoring Program (EMP, under IEP) **Potential Program Additions:** **1.** Additional sampling stations in connection with restored tidal marsh plains to reflect the before-after-control-impact design. Locations of some added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites) Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon) Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also: Monitoring Action CM4-4, CM4-6, and CM16-5	1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 3. Zooplankton species composition/relative abundance 4. Zooplankton density (number/1,000 m^3)	This monitoring action is intended to collect data necessary to determine and quantify the degree to which restored tidal habitats are producing and exporting phytoplankton and zooplankton into restored subtidal habitats. This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for : 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (source-sink dynamics, variability and uncertainty in primary production response) 3. evaluating restoration design options to increase the production and export of primary production from restored tidal marsh plains 4. Implementing additional management actions to improve production and export of primary production from restored tidal marsh plains The monitoring schedule will be modified if uncertainty or variances do not support a clear causal relationship between tidal marsh restoration and food production and exports. The intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	ECSY5.1 ECSY5.2 TANC1.1 BMNC1.1 FMNC1.1 SASP1.2 CHIN1.1 STEE1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-4. Document the export of organic carbon produced in restored tidal marsh plain into existing Plan Area channels.				
Base Condition: Not applicable. **Approach:** Determine the extent of organic carbon produced in restored tidal marsh plains that is exported from restored tidal habitats to downstream locations either through modeling (e.g., particle tracking modeling) or direct observation (e.g., isotope marking). **Schedule:** To be determined based on an assessment of the sufficiency of phytoplankton and zooplankton production levels determined under CM4-3. Conduct once to establish the extent of organic carbon that is exported and repeat as needed if hydrodynamic conditions change sufficiently in the future such that export rates might be affected.	**Existing Programs:** Environmental Monitoring program (EMP, under IEP) **Potential Program Additions:** See Monitoring Action CM4-3. 1.Possible adaptive expansion of the monitoring program to include isotope particle marking and tracking to determine organic carbon exports downstream locations	1. Amount of organic carbon produced in restored tidal marsh 2. Proportion of total organic carbon produced in restored tidal marsh plain that is exported to specified downstream locations.	This monitoring action is intended to collect complimentary and additional data necessary to determine if and how much restored tidal habitats are producing and exporting phytoplankton and zooplankton to downstream locations. This monitoring is an adaptive contingency monitoring action in case actions under CM-4 suggest a high degree of uncertainty or suggest inadequacy of conceptual models. This monitoring action will be implemented as targeted research project to address uncertainty in food production pathways and the magnitude and dynamics of exports into Delta water ways. It will be adaptively applied to sites, seasons and identified portions of the Delta.	ECSY5.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-5. Determine the extent of covered fish species habitat restored by life stage.				
Base Condition: Not applicable. **Approach:** Based on the current understanding of life stage requirements of each covered fish species and key environmental correlates, delineate the extent of habitat restored for each covered species life stage based on bathymetry (determined from as-build drawings), substrate (assessed before levee breaching), and water quality parameters determined through CM-11. **Schedule:** Annually for the first 10 years and every 5 years thereafter.	**Existing Programs:** Current knowledge on life history and biology of covered fishes in the Delta, life history models. **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)	1. Extent of restored habitat 2. extent of spawning habitat 3. extent of rearing habitat 4. portion of restored habitat within migration routes/corridors	This monitoring action will provide information on the amount of habitat that is being restored through BDCP conservation measures and how it pertains to requirements for stage-specific life history events of covered species. The implementing Office will use this information to determine if restored habitat effectively addresses habitat limitations. The monitoring action will be intensified of modeling or field observations suggest that certain habitats are in short supply and that restoration and protection targets should be modified through the adaptive decision making process.	CHSA1.1 STEE1.1 SASP1.1 GRST1.2 WHST1.1 RILA1.1 PALA1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-6. Determine covered fish species use of restored subtidal aquatic habitat.				
Base Condition: Estimated existing seasonal abundances of relevant life stages of covered fish species in channels adjacent to restoration sites based on existing information (IEP fish sampling). **Approach:** Conduct surveys for each covered fish species using standardized existing or improved methods. **Schedule:** Conduct sampling for the first 5 years following reestablishment of tidal flow and at least every 5 years thereafter.	**Existing Programs:** IEP –coordinated fish surveys: 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl and "Supplemental Surveys", Mossdale trawl 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl **Potential Program Additions:** 1. Expanded sampling location array to reflect changed food availability, diversion and flow regimes (e.g., North delta and Ship Channel); additional sampling areas should be located near restored subtidal habitat to determine fish response to restored habitats. Stratify sampling by project and systemwide variables.	1. Seasonal distribution of covered fish species 2. Type of use (e.g., rearing, spawning) 3. Duration of use 4. species, age composition and sizes of covered fish species 5. CPUE	This monitoring action will provide information to determine and quantify use of restored subtidal aquatic habitat by covered fish species. This information in combination with evaluation of other covered fish species-related monitoring and research data, will be used to evaluate underlying models and hypotheses about the predicted benefits of restored subtidal aquatic habitat to covered fish species. This information will aid in identifying sources of uncertainty and will guide the design of further management experiments and/ research studies to address uncertainty. The Implementing Office will use this information to evaluate restoration design options and additional management actions to increase the benefits of restored tidal marsh plains to covered species. The monitoring schedule and methods may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	CHSA1.1 STEE1.1 SASP1.1 GRST1.2 WHST1.1 RILA1.1 PALA1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-7. Determine nonnative fish species use of restored subtidal aquatic habitat.				
Base Condition: Estimated existing seasonal abundances of relevant life stages of nonnative fish species in channels adjacent to restoration sites based on existing information (IEP fish sampling). **Approach:** Conduct surveys for nonnative fish species using standardized existing or improved methods. **Schedule:** Conduct sampling for the first 5 years following reestablishment of tidal flow and at least every 5 years thereafter.	**Existing Programs:** IEP –coordinated fish surveys: 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl and "Supplemental Surveys", Mossdale trawl 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl **Potential Program Additions:** 1. Expanded sampling location array to reflect changed food availability, diversion and flow regimes (e.g., North delta and Ship Channel); additional sampling areas should be located near restored subtidal habitat to determine fish response to restored habitats. Stratify sampling by project and systemwide variables.	1. Seasonal distribution of covered fish species 2. Type of use (e.g., rearing, spawning) 3. Duration of use 4. species, age composition and sizes of covered fish species 5. CPUE	This monitoring action will provide information to determine and quantify use of restored subtidal aquatic habitat by nonnative fish species. This information in combination with evaluation of other non-native fish species-related monitoring and research data, will be used to evaluate underlying models and hypotheses about the predicted use of restored subtidal aquatic habitat by nonnative fish species. This information will aid in identifying sources of uncertainty and will guide the design of further management experiments and/ research studies to address uncertainty. The Implementing Office will use this information to evaluate restoration design options and additional management actions to minimize the use of restored tidal marsh plains to nonnative species. The monitoring schedule and methods may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	ECSY6.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-8. Determine the extent of nonnative submerged (SAV) and floating aquatic vegetation (FAV) in subtidal aquatic habitats.				
Implemented through Monitoring Action CM13-1. *Also see Monitoring Action SY 5-2. Determine the abundance and species composition of non-native, submerged and floating aquatic vegetation (Table 3-20)*				ECSY6.1
Monitoring Action CM4-9. Determine the extent and patterns of establishment of nonnative clams in restored subtidal aquatic habitats.				
Base conditions: ongoing benthic monitoring by IEP throughout the Estuary. **Approach**: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site. Samples are analyzed by a contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler. **Schedule**: Quarterly	**Existing Programs:** Benthic monitoring component of IEP's Environmental Monitoring Program (EMP) **Potential Program Additions:** Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of the entire BDCP plan area. Database to track observation and incidental records of non-native bivalves to estimate their habitat use and range expansion in the Delta	1. Species of non-native bivalves 2. Total number of individuals counted 3. Size distribution of clams	This monitoring activity provides information on the non-native clams of the estuary, changes in their presence, abundance and distribution. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary. The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities. This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta. The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.	ECSY6.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-10. Determine the extent and patterns of establishment of Microcystis in restored subtidal aquatic habitats				
Base Condition: existing data on Delta microcystis abundance, productivity and correlations with water quality parameters **Approach:** Establish additional fixed monitoring stations as needed in areas where microcystis blooms are observed or likely to occur given water conditions. Take weekly grab samples and measurements of chlorophyll a. **Schedule:** Conduct sampling for the first 5 years following first detection and every 5 years thereafter.	**Existing Programs:** Environmental Monitoring Program (EMP, under IEP) **Potential Program Additions:** **1.** Locations of added stations will be fixed during the duration of the plan to detect increase on microcystis abundance and blooming activity in delta waterways Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon) *See Monitoring Actions CM 4-3, CM4-4 , CM4-6, and CM16-5* *See Monitoring Actions SY5-3 (Table 3-21)*	1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 3. microcystis colony structure 4. Water temperature 5. $NH4^+$ concentration 6. EC 7. presence of non-native clams (see SY5-3)	This monitoring action is intended to collect data necessary to determine and quantify the degree of microcystis spread and toxic blooms in the Delta. This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for : 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (e.g., excessive N loading . grazing effects by clams, salinity and temperature limiting factors) 3. evaluating restoration design options to increase the production and export of primary production inundated floodplains 4. Implementing additional management actions to improve production and export of primary production from the floodplain.	ECSY6.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-11. Determine water quality conditions for covered fish species in restored subtidal aquatic habitats.				
Base Condition: Existing seasonal water quality conditions in channels adjacent to restoration sites based on existing information (see Applicable IEP and other Resources). Upon breaching, establish base conditions by paired sampling within restored habitat and at outflow channel locations. **Approach:** Establish water quality sampling stations in restored subtidal habitat area. Monthly, collect and analyze water grab samples at representative depths for: 1) water temperature, 2) dissolved oxygen, 3) turbidity, 4) salinity, 5) ammonia and 6) methylmercury. **Schedule:** Sample monthly for 1) the first 2 years following reestablishment of tidal flow, 2) quarterly for the following 10 years, 3) and quarterly every 5 years thereafter.	**Existing Programs:** 1. Continuous Multiparameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) **Potential Program Additions:** **1.** There are over 100 water quality sampling sites within the Delta providing a baseline of water quality data. If needed, additional localized sampling stations may be added to reflect the before-after-control-impact design (grab samples in project locations). Locations of some stations will be added as levees are breached and sites are flooded to track water quality changes at restoration sites.	1. Water temperature (^{o}C) 2. mg/L dissolved oxygen 3. Turbidity (NTUs) 4. Salinity (EC) 5. pH 6. mg methylmercury/L	This monitoring action is intended to collect data necessary to determine if water quality conditions in restored tidal marshes are suitable for supporting covered fish species. It will also be used to determine the possible impact on water quality in adjacent channels and habitats. This information will be used to evaluate underlying models and hypotheses of water quality responses to tidal marsh restoration. This information will aid in identifying sources of uncertainty and will guide the design of further management experiments, design modifications and/ research studies to address uncertainty. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	CHSA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-12. Determine the response and status of salt marsh harvest mouse, Suisun shrew, Suisun song sparrow, and California clapper rail, California black rail to loss of existing Suisun Marsh habitats that are restored as tidal habitat.				
Base Condition: The existing distribution and abundance of Suisun Marsh covered mammal and bird species based on existing information and additional surveys if needed. **Approach:** Conduct surveys, transects, mark-recapture or other methods to evaluate the response and status of Suisun Marsh populations of covered mammal and bird species following the conversion of existing species habitat areas to tidal habitat. Map upland refugia during high tide events, survey for presence/use of salt marsh harvest mouse during high tide **Schedule:** Conduct at least annual sampling of covered species distribution and abundance for 5 years following each tidal habitat restoration project until use of restored tidal habitats by covered mammal and bird species is established.	**Existing Programs:** IEP's Suisun marsh program (triennial vegetation surveys, GIS map identifying 103 vegetation classifications, change detection analysis, Salt Marsh Harvest Mouse Monitoring program on Conservation Areas), Point Reyes Bird Observatory (PRBO) San Francisco Bay Tidal Marsh Project, some historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. Regular mark-recapture program for SMHM and Suisun shrew (trapping grids) in Suisun marsh 2. Standardized surveys for Clapper rail, Suisun song sparrow and black rail (using PRBO San Francisco Bay Tidal Marsh Project protocols as appropriate) 3. Establishment of new sampling points/grids/stations as habitat patches are restored See Monitoring Action CM4-9	1. Abundance (N) of each species in Suisun Marsh 2. Population trend (λ) of each species in Suisun Marsh 3. Distribution and range of each species in Suisun Marsh 4. Extent and distribution of upland refugia for salt marsh harvest mouse during high tide.	This monitoring action is intended to test the hypothesis that restoring tidal marshes will have no effect on the status and population size of covered species in Suisun Marsh. Monitoring results will be used to determine how much habitat restoration has affected the distribution and abundance of Suisun Marsh covered mammal and bird species. This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects in Suisun Marsh) are necessary to maintain viability of covered species populations in Suisun Marsh. Monitoring frequency and intensity may be adjusted to provide monitoring that addresses uncertainties effectively.	TANC1.1 BMNC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-13. Determine covered wildlife species use of restored tidal habitats in Suisun Marsh.				
Base Condition: The existing distribution and abundance of covered marsh-associated wildlife species in Suisun Marsh based on existing information and additional surveys if needed. Not applicable to restoration sites in the Delta. **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of marsh plain and transitional upland habitats by covered wildlife species. Conduct standard vegetation transects and monitoring of incidental reports of newly established clones of covered plants, tracking of growth, survival and cover of covered plant species. **Schedule:** Conduct surveys for each species during each species' active period for 5 years following the development of habitat functions for each species as determined through data collected under CM4-2 and every 5 years thereafter.	**Existing Programs:** IEP's Suisun marsh program, some historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. Intensive mark-recapture program for SMHM and Suisun shrew in Suisun marsh 2. Standardized surveys (breeding, winter) for Clapper rail, Suisun song sparrow and black rail 3. standard surveys of covered plant species 3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand See Monitoring Action CM4-8	1. Estimated abundance of each species in using restored habitat 2. estimated populations trend in restored habitats (source or sink?) 3. Presence and population size of covered plant species (e.g., bird's beak, Mason's lilaeopsis, Delta mudwort, Delta tule pea Slough thistle,and Suisun Marsh aster)	This monitoring action is intended to collect data on the distribution and population trend of covered species in Suisun Marsh restored habitats. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of Suisun Marsh covered mammal and bird species This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects in Suisun Marsh) are necessary to maintain populations of these covered species in Suisun Marsh and to increase the utility of restored habitats to covered species	ECSY1.5 TANC1.1 MFNC1.1 MFNC1.2 BMNC1.1 BMNC2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM4-14. Determine covered wildlife species use of restored tidal habitats in the Delta.				
Base Condition: The existing distribution and abundance of covered marsh-associated wildlife species, specifically giant garter snake (Conservation Zone 4 and 5), western pond turtles, and California least tern foraging sites. **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of marsh plain and transitional upland habitats by covered wildlife species. Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of Giant Garter snake (Conservation Zone 4 and 5), western pond turtles, and California least tern sites. **Schedule:** Conduct surveys for each species during each species' active period for 5 years following the development of habitat functions for each species as determined through data collected under CM4-2 and every 5 years thereafter.	**Existing Programs:** historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. Standardized surveys for Giants Garter Snake, western pond turtles and California least tern 3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand See Monitoring Action CM4-8	1. Presence and sex/age distribution of Giant Garter Snake 2. Presence and sex/age distribution of western pond turtles 3. Estimated populations trend of covered species in restored habitats (source or sink?)	This monitoring action is intended to collect data on the distribution and population trend of covered species in restored habitats. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of covered mammal and bird species. This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects) are necessary to maintain populations of these covered species and to increase the utility of restored habitats to covered species.	ECSY1.5 TANC1.1 MFNC1.1 MFNC1.2 BMNC1.1 BMNC2.1 FMNC1.1 FMNC2.1 GGSN1.1 GGSN2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM5: Seasonally Inundated Floodplain Restoration				
Monitoring Action CM 5-1: Develop inundation rating curves to quantify the relationship between discharge and inundation dynamics of floodplain habitat for covered species.				
Base condition: As-built restored habitat elevations and river stage elevations**.** **Approach:** The Implementing Office will develop inundation rating curves for inundation depth and extent of restored inundated floodplain habitat area and will record floodplain inundation events and period of inundation by automatic water depth monitoring gages and other appropriate methods. **Schedule**: monitoring of inundation depth and extent of inundated area will continue until a sufficient inundation rating curve can be established with reasonable uncertainty.	**Existing Programs:** California Bay Delta Authority Science Program - Integrated Regional Wetlands Monitoring (historical pilot program) **Potential Program Additions:** 1. Installation and monitoring of automated monitoring devices or other appropriate measures to determine inundation depth, stage and frequency.	1. Inundation frequency 2. Inundation duration	This monitoring element will provide information on the relationship between inundation depth and inundation period and extent to guide the design of floodplain projects and/or operation of flood control structures. This information will be used to guide and if necessary, change the design of floodplain restoration projects and if applicable, the operation of flood control structures to effectively control the period of inundation in seasonal floodplains under an variable flow regimes. The monitoring schedule may be adjusted in response to uncertainty of the established ratings curve.	CHSA1.1 STEE1.1 SASP1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-2: Record and quantify incidences and locations of stranded covered fish species at the end of the inundation period in restored floodplains.				
Base Condition: none **Approach**: Visual and other surveys (e.g., beach seining) immediately following inundation periods in restored floodplain habitats as flows are receding from the floodplain to document stranding locations and magnitude. **Schedule**: Annual surveys for the first five years after restoration. Once documented, monitoring will be discontinued and a more limited monitoring effort to be determined by the Implementing Office would be conducted every 5th year that restored floodplains are inundated to document any changes in stranding location and magnitude that may result from changes in floodplain topography (e.g., formation of scour holes or sedimentation that create isolated pools).	**Existing Programs:** Intermittent and historical IEP and USFWS beach seine and trawling methods within the Yolo and Sutter bypasses **Potential Program Additions:** **1.** Weekly surveys of restored floodplains to identify areas suddenly dewatered by lower river conditions which may contain stranded fish. 2. Follow-up on the ground, dip netting, beach seining or electro-shocking of remnant puddles to verify stranding. On-the-ground mapping of standing locations to guide re-contouring.	1. locations of covered fish species stranding 2. number, species, length, and age/sex distribution of stranded fish 3. type of stranding pool (i.e., erosion, topography, man-made, etc.)	This monitoring action will provide information on the extent and magnitude of fish strandings at the end of the inundation period in restored floodplains. This information will be used to determine the severity of fish stranding and their locations within the restored floodplain. Results of monitoring will be used to determine if modifications to floodplain surfaces are needed to reduce stranding risk (e.g., grading). The schedule of the monitoring action may be adjusted to reflect changes in management. In locations where floodplain topography was altered to reduce fish stranding, monitoring will continue for at least 3 years to document reduction in stranding incidences.	CHIN1.1 STEE1.1 SASP1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-3. Quantify presence and abundance of juvenile salmonids in restored floodplain habitats during inundation periods.				
Base Condition: Concurrent presence and abundance of juvenile salmonids in adjacent Delta waterways **Approach**: Visual and non-lethal fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections of restored floodplain habitats during the inundation period and in adjacent Delta waterways. **Schedule**: During the first 5 floodplain inundation events that coincide with rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling of the inundated floodplain as long as the floodplain is inundated. Subsequently monitor every fifth flood event over the term of the BDCP.	**Existing Programs:** Historical sampling, USFWS weekly beach seining survey of juvenile salmonids (49 permanent locations Delta wide) **Potential Program Additions:** 1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort	1. Abundance, size, and race of salmonid species in the inundated restored floodplain habitat and in adjacent Delta waterways.	This monitoring action will provide information on the presence and abundance and relative use of restored floodplains compared to adjacent delta waterways. Results of monitoring will be assessed to determine if floodplain habitats attract more salmonids than adjacent waterways and if fish abundance, age and size distributions differ among restored floodplains and adjacent waterways of the Delta. Results will be used to determine if subsequent design or locations of restored floodplains need to be adjusted to improve their function as juvenile salmonid habitat. The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish presence in inundated floodplains.	CHSA1.1 CHSA1.2 STEE1.1 STEE1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-4: Delineate and quantify Sacramento splittail spawning and rearing in relationship to restored seasonally inundated floodplain habitat.				
Base condition: Conduct surveys of splittail adults, larvae, and eggs in slow-moving sections of rivers and sloughs and dead-end sloughs adjacent to projected floodplains to determine the abundance of splittail larvae and early juveniles present during the reproductive period. **Approach:** Conduct fish sampling surveys in restored floodplain habitats and adjacent slow-moving sections of rivers and sloughs and dead-end sloughs during inundation periods to determine the change in densities of larvae and juveniles relative to base conditions and in-channel spawning. **Schedule:** Weekly fish sampling will be conducted in spawning habitat within restored habitats and in adjacent channel habitats during the first 5 floodplain inundation periods during the splittail spawning season. Subsequently monitor every fifth flood event over the term of the BDCP.	**Existing Programs:** USFWS rotary screw traps USFWS beach seine **Potential Program Additions:** 1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort	1. Production of Sacramento splittail (number of larval and early juvenile splittail/10,000 m^3) during floodplain inundation periods	This monitoring action will provide information on productivity of Sacramento splittail populations and the contribution of inundated restored floodplains on spawning and rearing of splittail. This information will be used by the Implementing Office to decide if the production of splittail during floodplain inundation periods has increased significantly from base conditions. If monitoring results do not support conceptual models and hypotheses predicting increasing splittail spawning, the Implementing Office will conduct additional studies to determine 1. uncertainties and competing hypotheses 2. other factors/stressors that affect splittail spawning and rearing in restored habitats, and 3. restoration design modifications to increase splittail productivity. If causes are related to inundation duration, experimental management of flood control structures and floodplain topography may used to address uncertainties. The monitoring schedule may be extended or intensified if uncertainties of causal relationships persist.	SASP1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-5: Quantify abundance of nonnative fish species in restored floodplain habitats during inundation periods.				
Base Condition: Concurrent abundance of nonnative fish species in adjacent Delta waterways **Approach**: Visual and non-lethal fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections of restored floodplain habitats during the inundation period and in adjacent Delta waterways. **Schedule**: During the first 5 floodplain inundation events that coincide with rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling of the inundated floodplain as long as the floodplain is inundated. Subsequently monitor every fifth flood event over the term of the BDCP.	**Existing Programs:** Historical sampling, USFWS weekly beach seining (49 locations Delta wide) **Potential Program Additions:** 1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort	1. Abundance, size, and race of salmonid species in the inundated restored floodplain habitat and in adjacent Delta waterways.	This monitoring action will provide information on the presence, abundance, and relative use of restored floodplains compared to adjacent delta waterways. Results of monitoring will be assessed to determine if floodplain habitats attract more salmonids than adjacent waterways and if fish abundance, age and size distributions differ among restored floodplains and adjacent waterways of the Delta. Results will be used to determine if subsequent design or locations of restored floodplains need to be adjusted to improve their function as juvenile salmonid habitat. The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish presence in inundated floodplains.	ECSY6.1 CHSA1.8 STEE1.7 SASP1.5

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-6: Identify types and quantities of aquatic food production for covered fish species.				
Base Condition: Aquatic food production in adjacent channel habitat prior to restoration activities. Take weekly samples and measurements during inundation period for zooplankton and pelagic macroinvertebrates in Delta waterways adjacent to floodplain restoration sites for a least one year before habitat is restored to establish base conditions. **Approach:** Sample and measure zooplankton and pelagic macroinvertebrates abundance weekly at inflow, outflow and interior sampling points/transects within restored floodplains during inundation periods, and compare these with in-channel samples of zooplankton and pelagic macroinvertebrates taken in adjacent waterways. Assess measurements of zooplankton and pelagic macroinvertebrates to establish relationships between restored floodplain habitat during inundation periods and production of zooplankton and and pelagic macroinvertebrate forage species for covered fish. **Schedule** : Once these relationships have been established, annual monitoring of aquatic food production may be discontinued and a more limited monitoring effort to be determined by the Implementing Office may be conducted every 5th year to document any changes in zooplankton and macroinvertebrates production during floodplain inundation periods over the term of the BDCP.	**Existing Programs:** Zooplankton monitoring conducted by Environmental Monitoring Program (EMP under IEP umbrella) also includes monitoring of water quality, benthos, phytoplankton and exotic species **Potential Program Additions:** 1. Additional sampling stations to reflect the before-after-control-impact design. Locations of some added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites) Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon) Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also Monitoring Action CM4-4 and Monitoring Action CM4-6.	1. Zooplankton species composition/relative abundance 2. Zooplankton density (number/1,000 m^3) 3. Pelagic macroinvertebrate species composition / relative abundance 4. Pelagic macroinvertebrate density (number/1,000 m^3)	The monitoring action will provide information to test hypotheses on the role that the restored floodplain plays in providing additional aquatic food resources for covered fish in and outside the restoration areas. The monitoring will provide quantitative assessments to determine how much of this food enters the aquatic system through outflows from the floodplain. This information will be used by the Implementing Office to determine if and how much restored floodplains contribute to increased food availability for covered fish species. This information will be used to guide the development of alternative models, hypotheses, management strategies and additional research studies to resolve uncertainties about hypotheses or models. For example, if production of zooplankton and macroinvertebrates does not exceed production relative to base conditions or is not trending towards achieving those production levels, the Implementing Office may conduct investigations to determine causes for insufficient production of zooplankton and macroinvertebrates. Depending on the causes, potential actions could include the experimental modification of floodplain surfaces to increase inundation duration or vegetation structure, or installing water control structures at inflow and outflow locations.	ECSY5.1 ECSY5.2 CHSA1.2 STEE1.2 SASP1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM5-7: Document occurrences and abundances of delta button-celery and slough thistle.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	MFNC1.1 MFNC1.2
CM6: Channel Margin Habitat Restoration				
Monitoring Action CM6-1 Extent of channel margin enhanced to provide habitat for covered fish species.				
Base Condition: As-built restoration designs. Baseline documentation for acquired parcels **Approach:** Extent of enhanced habitat following restoration actions will be delineated, including habitat type (e.g., submerged bench, channel margin emergent vegetation, overhead shaded riverine cover) and vegetation communities. **Schedule**: Annually delineate habitat components for the first 5 years following restoration actions.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel) See Monitoring Action CM4-1, CM4-2, CM6-2)	1. Linear feet of enhanced habitat by habitat type	This monitoring action will provide information about the progress and spatial extent of channel habitat enhancement. This information will be used to determine if subsequent restoration designs can or should be modified to improve habitat conditions for covered fish species. It will also serve to guide and design management actions to increase or maintain enhancement results (see Monitoring Action CM16-2). The monitoring schedule may be adjusted for a particular project in response to monitoring results. The intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	MFNC1.1 MFNC1.2 CHSA1.1 STEE1.1 SASP1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM6-2: Quantify the extent and dynamics of establishment of emergent vegetation .				
Base Condition: As-built restoration designs. Targets for the establishment of emergent vegetation as identified in habitat enhancement design specifications for each channel margin enhancement site. Baseline documentation for acquired parcels. **Approach:** Percent absolute vegetative cover and extent of vegetated channel will be determined in years 1, 2, and 5 following enhancement. Enhancement sites will be monitored at least every 5 years to assess the extent of established non-native invasive vegetation.	**Existing Programs:** DWR IISS section within DWR-DES **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel) See Monitoring Action CM4-1, CM4-2, CM6-1)	1. Percent absolute vegetation cover over time 2. Linear extent of vegetated channel margin 3. Presence and extent of non-native invasive vegetation	This monitoring action is intended to provide information regarding the development of habitat structure and vegetation community structure in enhanced channel margin habitats over time. This information will provide the basis for determining if there is a need to modify subsequent enhancement designs to improve the development of emergent vegetation over time. It also may guide development of management actions to improve the establishment of emergent plant communities in enhanced channel margin habitats, including additional studies to identify such actions. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	FMNC1.1 FMNC2.1 MFNC1.1 MFNC1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM6-3: Quantify the presence and abundance of covered and nonnative fish species using enhanced channel margin habitats.				
Base condition: If sufficient existing information is not available, conduct monthly fish sampling surveys along existing channel margin habitats to be enhanced for a least one year before enhancement is implemented using appropriate survey methods to be determined by the Implementing Office to establish base conditions. **Approach:** Following enhancement, initiate comparable surveys within enhanced channel margin habitats and continue surveys **Schedule**: Continue surveys until a relationship between the abundance of each covered fish species/non-native predatory fish species and the extent and function of enhanced habitat is established (at least 5 years). Subsequently, surveys will be conducted at least every 5 years to document any changes that may occur in use of enhanced channel margin habitats over the term of the BDCP.	**Existing Programs:** fish surveys 1. CDFG 20 mm Survey 2. CDFG delta smelt larva study 3. USFWS Spring Kodiak Trawl and 'Supplemental Surveys", Mossdale trawl 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl **Potential Program Additions:** Expanded sampling location array to sampling locations along channel margin and within channel margin habitats. Beach seining to reflect micro-habitats and shallow areas not sampled by trawls. Trawl or townet surveys if channel margin extends too deep for beach seine sampling.	1. Presence of covered fish species by life stage in enhanced channel margin habitats 2. Abundance and length of covered fish species per unit area of habitat 3. Abundance of nonnative fish per unit area of habitat 4. Ratio of nonnative predatory fish to native fish	This monitoring action will provide quantitative information about the effectiveness of the enhanced channel margins to provide habitat for different life stages of covered fish species and their spatial response (presence and density) to these enhancements. Monitoring results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit. The information provided will also support decisions on potential modification of enhancement design and techniques. It will guide management actions to maintain enhanced habitats. It will also be used to determine if additional research activities or special survey technology should be developed. The monitoring schedule may be adjusted if the relationship between the abundance of each covered fish species/non-native predatory fish species and the extent and function of enhanced habitat cannot be established with acceptable certainty over the first 5 years, especially in cases where designs and enhancement techniques are changed through the adaptive management process. In these cases, annual monitoring will continue for 10 years post enhancement, and then be repeated every 5 years.	ECSY6.1 CHSA1.8 STEE1.7 SASP1.5 CHSA1.1 STEE1.1 SASP1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM6-4: Document occurrences and abundances of intertidal covered plant species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	FMNC1.1 FMNC2.1 MFNC1.1 MFNC1.2 SOBB1.1 SOBB1.2 SUTH1.1 SUTH1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM7: Riparian Habitat Restoration				
Monitoring Action CM7-1. Document the extent of riparian natural communities restored.				
Base Condition: As-built construction drawings. **Approach:** Delineate the extent of restored riparian habitat by vegetation community type, vegetation structure type, and seral stage; to characterize vegetation structure, measure vegetation attributes such as canopy height, canopy closure, and percent midstory cover. Also measure percent native trees and percent native shrubs **Schedule:** Annually delineate habitat components for the first 5 years following the implementation of individual riparian restoration projects and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2)	1. Acres of each component of restored riparian habitat. 2. patch length, width 3. % absolute vegetation cover. 4. % relative cover of native plant species. 5. Canopy height 6. Canopy closure 7. % midstory cover 8. % native trees 9. % native shrubs	This monitoring action is intended to provide information regarding the development of restored riparian habitat components over time. This information will provide the basis for determining if there is a need to: Modify subsequent restoration designs to improve their ecosystem and habitat functions, Undertake management actions to improve development of desired habitat functions (e.g., control of non-native vegetation, planting of native vegetation, improve local hydrology to enhance development of riparian functions and diversify native vegetation types, habitat structure, and seral stage). The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	VRNC1.1 VRNC2.3 RIBR1.1 RIWR1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM7-2. Document the extent of covered species habitat supported by restored riparian natural communities.				
Base Condition: As-built construction drawings. **Approach:** Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM7-1. **Schedule:** Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every riparian restoration project and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2)	1. Acres of each covered species habitat restored.	This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored riparian habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	VRNC1.1
Monitoring Action CM7-3. Document the extent of restored riparian brush rabbit and riparian woodrat habitat.				
Base Condition: As built construction drawings. **Approach**: Annual stratified randomized surveys of Riparian brush rabbit for 10 consecutive days **Schedule**: Every 5 years in suitable riparian habitat followed by surveys every 5 years	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data **2.** field survey crews for riparian wildlife surveys	1. Acreage and net gain or loss (%) of suitable habitat with adjacent upland flood refugia 2. Number and size of largest patches of suitable riparian habitat with upland refugia 3. Connectivity between suitable riparian habitat in the Plan Area and occupied habitat outside the Plan Area 5. Presence/abundance of riparian woodrats in Conservation Zone 7		RIBR1.1 RIWR1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM7-4. Document the self-sustainability of restored riparian habitats and their functioning over time.				
Base Condition: As-built construction drawings. **Approach:** Evaluate and quantify the extent of restored riparian habitat exhibiting ecological succession, characteristic attributes and regeneration based on evaluation of data collected under Monitoring Action CM7-1. **Schedule:** Quantify the extent of restored riparian habitat exhibiting regeneration and/or ecological succession by spatially tracking changes in seral stage every 5 years beginning with the implementation of every riparian restoration project.	**Existing Programs:** None **Potential Program Additions:** 1. Habitat structural monitoring/inventory using standard forestry and/or botanical protocols 2. randomized sampling of riparian habitat structure	1. Percent relative cover of restored riparian habitat exhibiting succession 2. Percent relative cover of restored riparian habitat exhibiting regeneration. 3. Connectivity with existing riparian corridors	This monitoring action is intended to provide information regarding the self-sustainability of restored riparian habitats and their functioning over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	ECSY1.5 VRNC2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM7-5. Determine covered wildlife species use of restored riparian habitats.				
Base Condition: The existing distribution and abundance of covered wildlife species in restored riparian patches based on existing information and additional surveys if/where needed. **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of riparian habitats by covered wildlife species. **Schedule:** Conduct surveys for each species during each species' active period for 5 years following the implementation of each restoration project as determined through data collected under CM4-2 and every 5 years thereafter.	**Existing Programs:** 1. Breeding bird survey routes (partial) 2. historical and intermittent research results (e.g., Point Reyes Bird Observatory bird monitoring database from over 250 sites in riparian habitats throughout California, much of it in the Central Valley) 3. CALFED science program bird monitoring element of project plans **Potential Program Additions:** 1. Breeding bird surveys (USGS protocol) at additional locations in restored riparian habitats, surveys should be consistent with the Riparian Habitat Joint Venture's "Riparian Bird Conservation Plan" 2. Randomized amphibian an reptile surveys during peak activity times in restored riparian habitats and adjacent remnant riparian habitats (control sites).	1. Estimated abundance of each species using restored riparian habitat 2. Estimated extent of occupied covered species habitat	This monitoring action is intended to provide information regarding the type and extent of use of restored habitats by riparian-associated covered wildlife species. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	VRNC1.1 VRNC2.1 RIBR1.1 RIWR1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM8: Grassland Community Restoration				
Monitoring Action CM8-1. Document the extent of grassland habitat restored.				
Base Condition: As-built construction drawings. **Approach:** Delineate the extent of grassland habitat by vegetation type, vegetation structure, and dominant species composition. **Schedule:** Annually delineate habitat components for the first 5 years following the implementation of individual grassland restoration projects.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2)	1. Acres of each component of restored grassland habitat. 2. Percent absolute vegetation cover. 3. Percent relative cover of native plant species.	This monitoring action is intended to provide information about the development of grassland attributes in restored grassland habitat parcels over time. Monitoring results will be used to determine if subsequent restoration designs should be modified to improve their ecosystem and habitat functions. It will also guide adaptive management actions to improve development of desired habitat attributes (e.g., re-seeding, planting of native vegetation, control of non-native vegetation). The monitoring schedule may be adjusted for a particular project in response to monitoring results, especial the rangeland health assessment. The intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and grassland community responses are established.	ECSY1.3 ECSY1.5 ECSY3.2 GRNC1.2 GRNC2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM8-2. Document the ecosystem functions of restored grassland habitat in comparison with site potential.				
Base Condition: Post-restoration conditions determined under CM8-1). Reference sheet for ecological site(s) – to be developed if necessary. **Approach:** Apply the "Interpreting Indicators of Rangeland Health" protocol to conduct rapid, qualitative assessment of soil/site stability, hydrologic function, and biotic integrity of restored grassland sites against a reference condition (ecological site; see Appendix I-xx, "Interpreting Indicators of Rangeland Health- version 3.0"). **Schedule:** Conduct rangeland health assessment in year 5 and every 10 years thereafter	**Existing Programs:** 1. NRCS National Grazing Lands Team, 2. County RCDs 3. NRCS local and regional offices **Potential Program Additions:** 1. ESD reference sheets for all restored grassland sites 2. Rangeland health assessment capabilities (terrestrial botanist, collaboration with NRCS soil specialists)	Rangeland health indicators: 1. Rills 2. Water Flow Patterns 3. Pedestals and/or Terracettes 4. Bare Ground 5. Gullies 6. Wind Scour or deposition 7. Litter Movement 8. Soil Surface Resistance to Erosion 9. Soil Surface Loss & Degradation 10. Plant Community Composition and Distribution Relative to Infiltration and Runoff 11. Compaction 12. Functional/Structural Groups 13. Plant Mortality and Decadence 14. Litter Amount 15. Annual Production 16. Invasive Plants 17. Reproductive Capability of Perennial Plants	This monitoring action is intended to provide information about the development of ecosystem functions in restored grassland habitat components over time. This information will provide the basis for addressing whether subsequent restoration designs should be modified to improve their ecosystem and habitat functions. It also will establish if adaptive management actions or interventions are required to halt deteriorative processes (erosion, invasive weeds). Furthermore, the information may provide reasons for additional research studies to address and resolve uncertainties in understanding ecosystem processes in restored grassland habitats. The monitoring schedule may be adjusted for a particular project in response to monitoring results. The intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and grassland community responses are established.	GRNC1.2 GRNC2.1 GRNC2.2 GRNC2.3 GRNC2.4 GRNC2.5

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM8-3. Document the extent of covered species habitat supported by restored grassland natural communities.				
Base Condition: Post-restoration conditions determined under CM8-1). **Approach:** Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM8-1. **Schedule:** Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every grassland restoration project and every 5 years thereafter.	**Existing Programs:** 1. USGS Breeding bird survey routes (partial) 2. historical and intermittent research studies **Potential Program Additions:** 1. Breeding bird surveys (USGS protocol) at additional locations in restored grassland habitats 2. randomized camera trap, track, scat or spotlight surveys for mammals 3. Randomized amphibian an reptile surveys during peak activity times in restored habitats and adjacent remnant riparian habitats (control sites).	1. Acres of each covered species habitat restored.	This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored grassland habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The information will also be used to determine what management actions (e.g., prescribed burning, controlled livestock grazing, weed control) are appropriate and indicated to advance progress towards achieving conservation targets. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and outcomes are established.	GRNC1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM8-4: Determine covered wildlife and plant covered species use of restored grassland.				
Base Condition: Post-restoration conditions determined under CM8-1). **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, breeding) of vernal pool complex by covered wildlife species. **Schedule:** Conduct surveys during each species' active period for 5 years following implementation of each restoration project as determined through data collected under CM8-3 and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** See CM 8-3	1. Estimated abundance of each species using restored grassland 2. Estimated extent of grassland habitat occupied by each covered species (or number of occurrences for covered plant species) 3. Occurrence of breeding activity	This monitoring action is intended to provide information regarding the degree of apparent response by covered species to grassland restoration and the habitat functions provided. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established	GRNC1.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM9: Vernal Pool Complex Restoration				
Monitoring Action CM9-1. Document the extent of vernal pool complex restored.				
Base Condition: As-built construction drawings. **Approach:** Delineate the extent of restored vernal pool complex by type (e.g., vernal pools, vernal pool margins, and swales) and in relation to the local moisture gradient and dominant, associated plant communities. **Schedule:** Annually delineate habitat components for the first 5 years following the implementation of individual vernal pool complex restoration projects and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) Various vernal pool monitoring and sampling plans (e.g., **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist)	1. Acres of each component of restored vernal pool complex habitat. 2. Percent absolute vegetation cover. 3. Percent relative cover of native plant species.	This monitoring action is intended to provide information regarding the development of restored habitat components over time. This information will provide the basis for determining if restoration targets (acres) are met, if existing restoration designs and methods are adequate in providing the desired results, and if uncertainties exist that may require additional experimentation or research. Monitoring information will also provide information necessary to determine if habitat management actions are necessary to improve habitat functions (e.g., the need to implementing nonnative species control actions). The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	VPNC2.1 VPNC2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM9-2. Quantify the extent of covered species habitat and functions supported by restored vernal pool complex.				
Base Condition: As-built construction drawings. **Approach:** Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM9-1 and based on inventory of key environmental correlates or habitat requisites of covered species. **Schedule:** Annually quantify the extent of restored, covered species habitats for the first 5 years with sufficient hydrology following the implementation of every vernal pool complex restoration project and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy 3. Delineation and mapping of species occurrences and special habitat features (key ecological correlates) that are pre-requisite for covered species using the site (e.g., small mammal burrows for burrowing owls) 4. Hydrological monitoring program (remote or on the ground tracking of inundation of vernal pool habitats 5. Survey team for vernal pool species (botanist, aquatic ecologist)	1. Acres of each covered species habitat restored. 2. Presence and abundance of habitat elements required by covered species for breeding, resting, foraging etc. Source of water feeding the restored vernal pool complex 3. Seasonal timing and duration of the inundation and water-logged soil phase 4. Estimated species diversity 5. Presence/abundance of non-native species 6. Presence/abundance of non-native predators	This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored vernal pool complex habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	VPNC2.1 VPNC2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM9-3: Determine covered wildlife and plant covered species use of restored vernal pool complex.				
Base Condition: The existing distribution and abundance of covered wildlife species in restored vernal pool complex patches based on existing information and additional surveys if/where needed. **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, breeding) of vernal pool complex by covered wildlife species. **Schedule:** Conduct surveys for each species during each species' active period for 5 years for which sufficient hydrology is present following the implementation of each restoration project as determined through data collected under CM9-2 and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** See CM 9-2	1. Estimated abundance of each species using restored vernal pool complex 2. Estimated extent of vernal pool complex habitat occupied by each covered species (or number of occurrences for covered plant species 3. Occurrence of breeding or regeneration at restored vernal pool complex	This monitoring action is intended to provide information regarding the degree of apparent response by covered species to vernal pool complex restoration and the habitat functions provided. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established	VPNC2.1 VPNC2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM10: Nontidal Freshwater Marsh Restoration				
Monitoring Action CM10-1. Document the extent of nontidal marsh habitat restored.				
Base Condition: As-built construction drawings, comprehensive ecological baseline documentation. **Approach:** Delineate the extent of nontidal freshwater marsh by vegetation type, vegetation structure, and plant species composition. **Schedule:** Annually delineate habitat components for the first 5 years following the implementation of individual non-tidal marsh restoration projects and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel) See Monitoring Action CM4-2, CM16-1	1. Acres of each component of restored nontidal marsh habitat. 2. Acres restored or created in Conservation Zones, 1,2,4,5, and 7, respectively) 2. Percent absolute upland, emergent and floating vegetation cover. 3. Percent relative cover of native plant species.	This monitoring action is intended to provide information regarding the progress of development of restored habitat components over time. This information will provide the basis for determining if future nontidal freshwater marsh restoration projects should be modified to improve ecosystem and habitat functions. It will also identify potential needs for management actions, such as hydroperiod modifications, non-native species control and vegetation management (controlled livestock grazing, prescribed burning). The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	NANC2.1 NWNC2.1 GGSN1.1 GGSN2.1 GGSN2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM10-2. Document the extent, attributes and functions of giant garter snake and other covered species habitat supported by restored non-tidal marsh communities.				
Base Condition: Baseline documentation, as-build construction drawings and maps **Approach:** Evaluate and quantify the extent of giant garter snake and other covered species habitats based on evaluation of data collected under Monitoring Action CM10-1 and from field surveys of specific key environmental correlates and habitat requisites for covered species. **Schedule:** Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every riparian restoration project and every 5 years thereafter.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel; see Monitoring Action CM4-1, CM16-1)	1. Acres of each covered species habitat restored. 2. Extent and dispersion/ connectivity of upland refugia for target covered species such as giant garter snake in areas prone to flooding 3. habitat attributes and habitat function (e.g., foraging, breeding, resting, etc) for Giant garter snake and western pond turtle.	This monitoring action is intended to provide information regarding the development of habitat functions for giant garter snake and other covered species over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for giant garter snake. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	NANC2.1 NWNC2.1 GGSN1.1 GGSN2.1 GGSN2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM 10-3. Document the functionality and condition of restored nontidal marsh habitats over time.				
Base Condition: As-built construction drawings. Comprehensive ecological baseline documentation **Approach:** Conduct a California Rapid Assessment Method for Wetlands (CRAM, Appendix I-X "California Rapid Assessment Method for Wetlands version 5.0.2") to (a) evaluate wetland conditions and stressors and determine the need for intensive monitoring; (2) evaluate performance of restored nontidal marsh; and (3) assess progress of restoration relative to ambient conditions, reference conditions, and expected ecological trajectories. **Schedule:** Conduct a CRAM assessment 5 years after project implementation and every 5 years thereafter.	**Existing Programs:** none **Potential Program Additions:** **1.** develop CRAM capability either per contract with consultant or by training botanical staff.	1. Buffer and Connectivity Metrics 2. Water Source, Hydroperiod, Hydrologic Connectivity 3. Physical Patch Richness 4. Topographic Complexity 5. Organic Matter Accumulation 6. Biotic Patch Richness 7. Vertical Structure 8. Interspersion and zonation 9. Percent Invasive Plant Species 10. Native Plant Species Richness	This monitoring action is intended to provide information regarding the functionality, condition and self-sustainability of restored non-tidal marsh habitats and their ecological dynamics over time. The use of CRAM for ambient monitoring will, over time, help the Implementing Office to quantify the relative influence of anthropogenic stress, management actions, and natural disturbance on the spatial and temporal variability in reference conditions. This information can then be used in the design, management, and assessment of similar wetland projects. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established. If the causes are not readily apparent, then research might be recommended to determine the causes and to what extent they can be managed. If the causes are deemed natural, then management actions may not be warranted.	NANC2.1 NANC2.2 NWNC2.1 NWNC2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM10-4. Determine covered wildlife species use of restored non-tidal marsh habitats.				
Base Condition: The existing distribution and abundance of covered wildlife species, especially giant garter snake, in restored and existing nontidal marsh habitats patches based on existing information and additional surveys if/where needed. **Approach:** Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, resting) of giant garter snake; reconnaissance level surveys and incidental records of other covered species (primarily tricolored blackbird, western pond turtle) and non-native predators or competitors **Schedule:** Conduct surveys for each species during each species' active period for 5 years following the implementation of each restoration project as determined through data collected under CM4-2 and every 5 years thereafter.	**Existing Programs:** USGS studies of Giant Garter Snakes at four sites in the Sacramento Valley (1996–2006), USGS Natomas HCP Monitoring. **Potential Program Additions:** 1. Add the USGS Giant Garter Snake monitoring team under the IEP program for routine GGS effectiveness monitoring. Conduct, possibly localized mark-recapture /and radio-telemetry studies to determine habitat use patterns within proposed 1,000-acre giant garter snake conservation lands designed to enhance the Caldoni Marsh/White Slough and the Yolo Basin/Willow Slough giant garter snake populations. 2. Annual wildlife surveys for covered species.	1. Estimated abundance of each covered target species in created non-tidal, freshwater perennial emergent wetlands 2. Estimated extent of occupied covered species habitat in each created non-tidal, freshwater perennial emergent wetland 3. Acreage of created nontidal marsh that functions as habitat for the giant garter snake within or adjacent to habitat occupied by the Caldoni Marsh/White Slough and Yolo/Willow Slough giant garter snake subpopulations in Conservation Zones 2 and 4 3. Connectivity of water conveyance and habitat for giant garter snake 4. Acreage of created nontidal marsh that functions as habitat for the tricolored blackbird 4 5. Acreage of created nontidal marsh that functions as habitat for the western pond turtle 6. Abundance of feral pigs, cats and other non-native predators (non-native centrarchid fish and bullfrog) or competitors (non-native turtles), abundance of nest predators and parasites (brown-headed cowbirds)	This monitoring action is intended to provide information regarding the use and functionality of restored habitats for covered species, particularly the giant garter snake. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. It will also determine if additional research studies are needed to assess the contribution of restored non-tidal marsh habitats to the viability of covered species. The monitoring schedule may be adjusted annually for a particular project in response to variable water levels and habitat conditions, marsh maintenance and enhancement activities, grazing or other circumstances that necessitate changes in the sampling schedule and/or protocol. Sampling intensity may take into account garter snake activity (and therefore detectability), unfavorable habitat conditions (i.e., lack of water), maintenance activities, trap theft and/or tampering, or other circumstances. Monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	NANC2.1 NANC2.2 NWNC2.1 NWNC2.2

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM11 Enhance and Manage Preserved Natural Communities				
Monitoring Action CM11-1. Document the planning and implementing progress for the development of Site-Specific Management Plans				
Base Condition: N/A **Approach**: Document completion of site-specific management plans for conservation lands in annual plans **Schedule**: Within 1 year of each conservation land acquisition.	**Existing Programs:** None **Potential Program Additions:** Project management database	Management plans	This monitoring action is intended to provide information to assess the progress the Implementing Office is making towards developing long-term guidance for site-specific management of each acquired BDCP conservation lands. The information in each management plan will provide the menu of actions to be undertaken and related implementation schedules.	

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM11-2 Quantify covered species habitat availability, function, and suitability of conservation lands				
Base Condition: Baseline condition reports, existing conditions (see Chapter 2, *Existing Ecological Conditions* and Appendix A, *Covered Species Accounts*). **Approach**: Inventory key habitat correlates and requisites for each covered species associated with natural communities to determine the extent and suitability of covered species habitat on conservation lands over time (e.g., percent of riparian with suitable structure and vegetation associations to support riparian brush rabbit; percent of agricultural habitat suitable for Swainson's hawk or greater sandhill crane foraging). Conduct comprehensive field surveys, map extent, and document conditions. **Schedule**: Conduct complete baseline survey the first year following implementation of Site-Specific Management Plan, then repeat biannually for 10 years, followed by 5-year interval surveys.	**Existing Programs:** DWR IISS section within DWR-DES (potentially) **Potential Program Additions:** 2. Vegetation and habitat sampling (on-the ground) for field verification to increase mapping accuracy (botanist) 3. Capabilities to determine habitat quality and presence of key habitat correlates for covered species (terrestrial ecologist) See also CM 7-1, CM 8-1, CM 10-1	1. Extent, distribution, age structure, size structure, canopy structure, vegetation associations, and species composition of each natural community on restoration sites 2. Presence of species-specific requisites (e.g., basking sites, roost and nest trees, foraging sites, burrows, cover) 3. Estimated abundance of suitable habitat for each targeted covered species. 4. occurrences of Suisun Thistle 5. proximity of non-rice agricultural lands to occupied Swainson's hawk nesting habitat 6. relative cover of native grasses and forbs in Alkali seasonal wetlands and grasslands 5. acres of greater sandhill foraging habitat within its winter use area and within 2 miles of known roosting sites in CZ 3,4,5, and/or 6 6. Prey abundance for grassland foraging species, especially insects, small mammals 7. Extent and severity of detrimental agricultural practices and disturbance from adjacent sites 7. extent of seasonal buffers around riparian habitats	This action is intended to provide information on the abundance of suitable habitat and habitat functions that addresses any or all life requisites for each covered species on all BDCP protected lands. The information will provide the basis of tracking specific habitat elements and habitat function throughout the Plan Area that is essential for Covered Species occurrence, including riparian structure and composition, functionality of water conveyance canals and associated wetlands, woodlots, tree and hedge rows, vegetation and winter water depth of created managed wetland, and the proportion of agricultural lands with suitable cover types that meet foraging habitat objectives for agriculture-associated covered species. . This monitoring is subject to modification if acquisition proceeds more slowly than expected and the periodicity can be extended.	ALNC1.2 ALNC1.4 AWNC2.1 FMNC1.1 FMNC2.1 TANC 2.1 GRNC1.1 GRNC2.2 GRNC2.1 IDSC1.1 NANC2.1 VRNC2.1 VRNC2.2 VRNC2.3 VPNC2.1 MWNC1.2 BMNC1.1 ONSW1.1 SUTH1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM11-3. Quantify abundance, locations and distribution of Invasive Plants on conservation lands				
Base Condition: Percent cover at the time of acquisition. **Approach**: Develop survey and control protocols and include in Site-Specific Management Plans. Implement periodic inventory of invasive plant populations on conservation lands. Establish thresholds for control actions and implement before thresholds are reached. **Schedule**: Conduct complete baseline survey the first year following implementation of the Site-Specific Management Plan; continue in 5-year intervals. Implement control actions as needed based on management thresholds.	**Existing Programs:** previous landowner's knowledge, agricultural agency (RCD, NRCS) weed abatement records **Potential Program Additions:** 1. Non-native invasive species survey protocols and identification skills 2. Weed control team (trained staff, equipment, GPS, etc).	1. Estimated percent cover of invasive species 2. Location 3. Species 4. Previous control measures	This Monitoring Action is intended to provide information on the extent of invasive plant infestations on BDCP protected lands, and to establish and implement a process of control of invasive species populations. This information will provide the basis for determining the extent of infestation, control triggers, and longterm monitoring to estimate the success of control actions. This monitoring action is subject to modification based on the response of nonnative invasive species to control measures.	ALNC1.1 AWNC2.1 BMNC2.1 CAGB1.1 CAGB1.2 CALT1.1 CCWF/ADEP1.1 CFTR1.1 CFTR1.2 CFTR1.3 DEBC1.1 DEBC1.2 ECSY1.5 ECSY4.1 ECSY3.1 GGNS2.2 GGSN1.1 GGSN2.1 GSHC1.1 GRNC2.1 GRNC2.2 HART/BRIT1.1 HART/BRIT1.2 HART/BRIT1.3 HART/BRIT1.4 HEPE1.1 HEPE1.2 IDSC1.1 MFNC1.2 MWNC2.1 NANC2.1 NWNC2.1 ONSW1.1 SOBB1.1 SOBB1.2 RIBR1.1 RIWR1.1 CRLF1.1 SUTH1.1 SUTH1.2 TANC1.1 TANC2.1 TCBB1.1 VPNC2.1 VRNC2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM11-4. Fund Research				
Base Condition: N/A **Approach**: Provide funding to support the USFWS captive breeding and reintroduction program for Lange's metalmark butterfly and for implementation of the propagation and out-planting program for Contra Costa wallflower and Antioch Dunes evening primrose; and **Schedule**: As requested.	Existing Programs: Program Additions	Receipt of funds.	This Monitoring Action is intended to assist with established and ongoing research programs to benefit target species. This monitoring action is subject to modification based on continuing research activities and the need for additional funding.	IDSC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM11-5. Increase habitat function for covered species				
Base Condition: Pre-acquisition condition. **Approach**: Each Site-Specific Management Plan will include specific enhancement objectives to increase habitat function by supporting or increasing specific key environmental correlates and habitat requisites for covered species depending on the location, existing habitat function, and opportunities for enhancement. For example, in grassland habitats where burrowing animals are determined to be limited based on results from implementation of Monitoring Action CM11.3, actions will be undertaken (e.g., manipulation of topography, reduction in rodent control programs, non-native predator control, etc.) to increase ground squirrel and small mammal populations. Another example is postponing tilling of harvested corn fields to increase available forage for wintering greater sandhill cranes. **Schedule**: Variable and ongoing.	**Existing Programs:** None **Potential Program Additions:** 1. Survey methodology to inventory habitat functions and stressors for individual covered species on conservation land 2. Database on non-native predator records on conservation lands (observations, surveys, control measures)	1. Burrowing owl occupancy of artificial burrows. 2. Swainson's hawk and white-tailed occupancy of planted trees. 3. Ground squirrel and rodent activity (burrows per acre). 4. Greater sandhill crane occupancy of created roosts. 5. Activity and reproductive performance of tricolored blackbird colonies. 6. Estimated abundance of California red-legged frogs in enhanced stockponds. 7. Extent of grazing activity in vernal pools 8. Condition of rangeland (cover and composition). 9. Percent cover of native grasses 10. Number of created riparian brush rabbit "bunny mounds" 11. Activity , reproductive success and percent of parasitized nests of tricolored blackbird and yellow-breasted chat breeding colonies, and least Bell's vireo and yellow-billed cuckoo nests. 12. Extent of upland refugia in restored marshes. 13. Documented predation events at nesting colonies. 14. Trend in predator populations. 15. Estimated abundance of feral pigs in Suisun Marsh and other conservation lands. 16. presence /abundance of black rats in suitable riparian woodrat habitat in Conservation Zone 7 17. Acres of each agricultural cover type. 18. Forage value of greater sandhill crane winter foraging habitat (lbs per acre). 19. Covered aquatic invertebrate occupancy of vernal pools. 20. Estimated abundance of giant garter snake	This action is intended to enhance the function of BDCP protected lands to meet specific covered species requirements. This information will provide the basis for determining the functioning of conservation lands with respect to meeting covered species objectives. Management actions are undertaken based on the guidance in the Site-Specific Monitoring Plan, which is subject to modification based on site-specific conditions, opportunities unforeseen at the onset of implementation, or to adjust to the progress of other site specific management plans and the need to meet overall Plan Area-wide goals.	ALNC1.1 ALNC1.1 AWNC2.1 BMNC2.1 CAGB1.1 CAGB1.2 CALT1.1 CCWF/ADEP1.1 CFTR1.1 CFTR1.2 CFTR1.3 DEBC1.1 DEBC1.2 ECSY1.5 ECSY4.1 ECSY3.1 GGNS2.2 GGSN1.1 GGSN2.1 GSHC1.1 GRNC2.1 GRNC2.2 HART/BRIT1.1 HART/BRIT1.2 HART/BRIT1.3 HART/BRIT1.4 HEPE1.1 HEPE1.2 IDSC1.1 MFNC1.2 MWNC2.1 NANC2.1 NWNC2.1 ONSW1.1 SOBB1.1 SOBB1.2 RIBR1.1 RIWR1.1 CRLF1.1 SUTH1.1 SUTH1.2 TANC1.1 TANC2.1 TCBB1.1 VPNC2.1 VRNC2.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM12: Methylmercury Management				
Monitoring Action CM12-1: Determine the trend in load of methylmercury or precursors discharged from treated sources				
Base conditions: Mercury concentrations in soils to be restored as tidal habitat before levees are breached based on survey information collected under Conservation Measure *CM4, Tidal Habitat Restoration*. **Approach**: Testing of monthly water and sediment samples in restored subtidal habitat areas for methylmercury concentrations. **Schedule**: Monitor monthly for five years or until relationships between restoration of tidal habitats at different locations in the Plan Area and methylmercury concentrations are understood. After the initial five year monitoring period, every 10 years monitor methylmercury concentrations bimonthly for one year.	**Existing**: 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program 3.Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 5. other (DWR, SFEI, etc) 6. UC Davis Biosentinel Hg Monitoring Program **Potential Program Additions:** 1. Establishment and monitoring of methylmercury monitoring stations in restored subtidal habitat areas. See also Monitoring Action CM4-4 and Monitoring Action CM4-6. 2. Expand UC Davis Biosentinel Hg Monitoring Program to include entire Delta and restored floodplain and tidal habitats.	Concentration of methylmercury and precursors	This monitoring is designed to determine the effectiveness of tidal habitat restoration designs in avoiding or reducing methylmercury concentrations in restored subtidal habitats. This information will be used by the Implementing Office to determine if adjustments in tidal habitat restoration designs are necessary to further reduce methylation of mercury. The monitoring schedule may be adjusted based on assessments of initial monitoring results at each restoration site.	TANC1.1 BMNC1.1 FMNC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM12-2: Determine the extent of methylmercury exported into Delta channels.				
Base conditions: 1) Methylmercury concentrations in the water column and sediments in channels adjacent tidal marsh restoration sites before levees are breach based on existing data or survey data collected for this purpose. 2) Methylmercury concentrations in restored subtidal habitats from data collected under CM12-2. **Approach**: Testing of monthly water and sediment samples in channels adjacent to restored subtidal habitat areas for methylmercury concentrations in conjunction with sampling implemented under CM12-1. **Schedule**: Monitor monthly for five years or until relationships between restoration of tidal habitats at different locations in the Plan Area and export of methylmercury into adjacent channels are understood. After the initial five year monitoring period, every 10 years monitor methylmercury concentrations bimonthly for one year.	**Existing**: 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program 3. Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 5. Other (DWR, SFEI, etc) 6. UC Davis Biosentinel Hg Monitoring Program **Potential Program Additions:** 1. Establishment and monitoring of sampling stations in channels adjacent to restored subtidal habitats	Concentration of methylmercury and precursors	This monitoring is designed to determine the effectiveness of tidal habitat restoration designs in avoiding or reducing export of methylmercury into existing Plan Area tidal aquatic habitats. This information will be used by the Implementing Office to determine if adjustments in tidal habitat restoration designs are necessary to further reduce methylation of mercury. The monitoring schedule may be adjusted based on assessments of initial monitoring results.	TANC1.1 BMNC1.1 FMNC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM13: Nonnative Aquatic Vegetation Control				
Monitoring Action CM13-1: Detect and document the establishment of non-native submerged (SAV) and floating aquatic vegetation (FAV) in subtidal aquatic habitats in restored tidal habitat areas.				
Base Condition: The current extent of SAV and FAV present in channels adjacent to tidal habitat restoration sites before breaching of levees based on existing information or field surveys. **Approach**: Monthly monitoring to detect and delineate the extent of SAV and FAV in newly restored tidal habitat areas to detect SAV and FAV establishment, conditions under which it establishes, and patterns of establishment. Monitoring data will be evaluated relative to water quality, hydrodynamic, and other physical parameters collected under other monitoring actions or by others to establish relationships between SAV/FAV establishment and restoration design and site conditions. **Schedule:** Monitoring will occur for five years at each site until relationships between tidal habitat restoration designs and SAV/FAV establishment are well understood.	**Existing Programs:** Department of Boating and Waterways is the lead agency for controlling aquatic weeds in the Delta **Potential Program Additions:** 1. SAV/FAV surveys of restored subtidal habitats	Temporal progress of SAV/FAV establishment Spatial extent of SAV/FAV within a restored subtidal habitat project area	This monitoring is designed to determine the SAV/FAV establishment process relative restoration design and parameters related to Plan Area location (e.g., water quality constituents, hydrodynamic conditions, wind patterns). This information will be used to determine if subsequent restoration designs should be adjusted to reduce the likelihood of establishment and extent of SAV/FAV in restored subtidal habitats and to help guide development of more effective SAV/FAV control methods. The duration of monitoring may be increased or decreased as indicated from evaluation of monitoring results.	ECSY6.1 TANC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM13-2: Determine the need for implementation of SAV/FAV control actions and the effectiveness of SAV/FAV control actions.				
Base condition: the extent and distribution of SAV/FAV in restored subtidal habitat areas before implementation of control actions. **Approach**: Monthly surveys of restored subtidal habitats from [month] to [month] to assess the extent of SAV/FAV for use in determining need to implement control actions. Weekly surveys to document changes in extent and distribution of SAV/FAV relative to base conditions following implementation of control actions. **Schedule:** Monthly surveys to determine the need to implement control actions over the term of BDCP. Monitoring following control actions continues until monitoring indicates that the response of SAV/FAV has stabilized or SAV/FAV is determined to be spreading.	**Existing Programs:** Department of Boating and Waterways is the lead agency for controlling aquatic weeds in the Delta **Potential Program Additions:** 1. SAV/FAV surveys of restored subtidal habitats in conjunction with control actions	Areal extent of SAV/FAV or other appropriate measure (e.g., biovolume) Distribution of SAV/FAV in restored habitat	This monitoring action is designed to provide the information necessary to determine the need to implement control actions, the effectiveness of SAV/FAV control techniques over time, and to help determine the frequency with which control actions will need to be implemented in future years. Monitoring frequency and duration to determine the need to implement control actions may be adjusted if relationships between SAV/FAV establishment and need for control actions is established.	ECSY6.1 TANC1.1

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM13-3: Determine the effectiveness of SAV/FAV control actions in reducing the risk for nonnative predatory fish predation on covered fish species.				
Base condition: Nonnative predatory fish abundance before implementation of control actions as determined through CM15 or surveys conducted specifically for this purpose. **Approach:** Bimonthly surveys of control areas following control actions to determine the abundance and distribution of non-native predatory fish. **Schedule:** Monitoring following control actions continues until monitoring indicates that the response of nonnative predatory fish has stabilized or there abundance and distribution increases.	**Existing Programs:** DFG, USFWS, and NMFS fish monitoring programs **Potential Program Additions:** 1. Non-predatory surveys of restored subtidal habitats	Number of nonnative predatory fish per unit area	This monitoring action is designed to provide the information necessary to determine the need to implement control actions, the effectiveness of SAV/FAV control techniques over time, and to help determine the frequency with which control actions will need to be implemented in future years.	ECSY6.1 TANC1.1 CHSA1.8 SASP1.5 STEE1.7
Monitoring Action CM13-4: Determine if non-native SAV/FAV control results in measurable increase in turbidity.				
Base condition: Turbidity of the water column at sampling locations within restored subtidal habitat areas before implementation of SAV/FAV control actions. **Approach**: Weekly turbidity measurements at sampling sites within restored subtidal habitat areas following implementation of control actions. Conducted in conjunction with monitoring under CM2 **Schedule**: see Monitoring Action CM13-1	**Existing:** 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program 3.Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 5. other (DWR, SFEI, etc) **Potential Program Additions:** **1.** Establishment sampling stations and monitoring of turbidity in restored subtidal habitat areas	Turbidity (NTU, TSS)	This monitoring approach will provide information necessary to determine if removal of nonnative aquatic vegetation will increase turbidity of the water column to improve habitat conditions for delta smelt.	ECSY6.1 TANC1.1 CHSA1.8 SASP1.5 STEE1.7

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Species-Level Measures				
CM14: Stockton Deep Water Ship Channel Dissolved Oxygen Levels				
Monitoring Action CM14-1 Operate and maintain an oxygen aeration facility in the Stockton Deep Water Ship Channel (DWSC) to increase dissolved oxygen concentrations between Turner Cut and Stockton to meet Total Maximum Daily Load (TMDL) objectives(above 6.0 mg/L from September 1 through November 30 and above 5.0 mg/L at all times).				
Base condition: Existing aeration operations **Approach:** Keep daily operational and maintenance records for the oxygen aeration facility, tracking hours of operation, amount of Oxygen (lbs) injected, sensor operations and system failures or shutdowns. **Schedule:** Daily operational logs and maintenance records, DWSC Demonstration Dissolved Oxygen Aeration Facility monthly reports.	**Existing Programs:** DWR's Stockton DWSC Demonstration Dissolved Oxygen Project, Bay-Delta Office. **Potential Program Additions:** None	Operational statistics 1. hours of operation 2. lbs of dissolved oxygen 3. failures & shutdowns 4. operational costs 5. maintenance and repair records	This monitoring activity ensures that the operation of the DWSC dissolved Oxygen aeration facility is recorded accurately and operational data are publicly available. The Implementing Office will use this information to determine if system modifications need to be implemented based on system performance and cost/benefit ratios. The monitoring schedule may be adjusted if the existing aeration facility will be modified or additional aerators and associated infrastructure are added to optimize DO delivery to the river.	CHSA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM14-2 Measure levels of dissolved oxygen (DO) delivered to the river within the 7.5 mile low dissolved oxygen area of the ship channel				
Base condition: As built construction drawings **Approach:** measure dissolved oxygen levels at various distances from the diffuser(s) and depths via remote monitoring stations. Current DO sensors are placed at a depth of about 10 ft (at low tide) and record 15-minute data. Additional sensors will be installed concurrent with addition of diffuser facilities. **Schedule:** Measure minimum DO levels per 15 min interval at each DO sensor station over a 25 hr tidal cycle. Compile Monthly Dissolved Oxygen Data Reports.	Existing Programs: **1.** Demonstration Dissolved Oxygen (DO) Aeration Facility remote monitoring stations (NA 40, 42, 43 and 48), handheld instrument data, California Data Exchange Center (CDEC) Rough and Ready Island (RRI) station data, and CDEC San Joaquin River at Garwood Bridge (SJG) station data Potential Program Additions: Possibly additional remote monitoring stations Possible additional diffusers	1. diffused oxygen (mg/L)	Results from this monitoring will be used to assess the performance of the facilities operations at achieving the water quality objective. The BDCP Implementing Office will use this information to determine whether aeration facility operations result in measurable benefits to water quality of the DWSC. Based on review of performance and effectiveness monitoring results, the BDCP Implementing Office will adjust funding levels, oxygen diffuser methods, or other related aspects that will improve the performance and/or biological effectiveness of the project through the BDCP adaptive management process as appropriate. Such changes will be effected through the BDCP adaptive management process and would be included in the subsequent annual work plans.	CHSA1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM14-3 Determine if aeration increases the use of the Stockton DWSC as a migration route for covered fish species.				
Baseline Condition: existing knowledge and study results on fish migration routes and channel-specific survival rates **Approach**: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine the proportion of tagged fish that successfully migrate through the DWSC. Determine the residence time within DWSC. **Schedule**: Implement covered fish species tracking until a precise (+- 5%) estimate of permeability can be established by species, location and season. Once permeability rates have been estimated, fish tracking can be discontinued for 5 years. Every 5 years thereafter, the Implementing Office will estimate permeation rates and residence times for covered fish species for at least 2 months.	**Existing Programs:** USFWS Delta Juvenile Fish monitoring program (DJFMP), various DFG fish survival and migration tracking studies. Potential Program Additions: Coordinate DJFMP with juvenile fish mortality tracking projects in coordination with operation of DWSC aeration facilities. Separate tracking of tagged adults	Permeation rates (% of tracked fish) Residence time of tracked fish within the DWSC Survival of tagged fish (see also CM 16-3)	This monitoring action is designed to provide information on the effects of DO aeration of the DWSC in enhancing migration of covered species through the DWSC. The Implementing Office will use this information to determine if oxygen diffusion is effective in the re-routing of migrating covered fish species. The monitoring action may be reduced if permeation rates are found to have minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies every 5 years will determine if increasing monitoring activities are necessary (i.e., if permeation rates fall below the initially determine value).	CHSA1.3 STEE1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM15: Predator Control				
Monitoring Action CM15-1: Document the extent and locations of fish predator hotspots within the Delta.				
Base Condition: Estimated existing locations and types of predator hotspots such as abandoned structures, boats, deep holes , etc. where predators have an above-average effect on sensitive life stages of covered fish species, based on existing information. **Approach:** Using a combination of existing knowledge (e.g., survey of fishermen about striped bass catch locations), aerial surveys (e.g., during mapping of nonnative FAV/SAV), and direct observations (IEP and agency staff on boats within the Delta waterways), inventory and map all known and suspected predator hotspots within Delta waterways where sensitive lifestages of covered fish species are present. **Schedule:** Within 3 years and prior to implementing any predator control measures at hotspots, conduct complete mapping of all major fish-rearing habitats within each waterway to identify and rank potential hotspots of predators. Continue adding new hotspots as they become known.	**Existing Programs:** Extant knowledge of hotspots by fishery biologists, game wardens and agency staff.: DWR IISS section within DWR-DES (potential data warehouse and GIS repository) **Potential Program Additions:** **1.** Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. tracking of incidental information of predator hotpots from agency staff	1.Location 2. Size 3. Type 4. Structural elements 5. Abundance and type of predatory fish present and relative threat to covered fish species	This monitoring action is designed to provide information on the location and extent of predator hotspots within Delta waterways. The Implementing Office will use this information to schedule removal/amelioration of structures and channel geometry to reduce favorable spots for predatory fish. It also will allow the Implementing Office to estimate costs and technical constraints in removing certain hotspots and adaptively prioritize these for removal. This information will be updated annually and the scheduling of removal/amelioration activities will be adjusted adaptively based on this information The schedule may be adjusted in response to unscheduled events that add significant hiding cover into the channel (floods, windthrow, etc), and to the removal and decelerating need of removals as the channels are being cleared.	ECSY6.1 CHSA1.8 SASP1.5 STEE1.7

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM15-2: Document the extent of predator hotspot removals/ameliorations.				
Base condition: Completed predator hotspot inventory and map (see CM15-1). **Approach**: Annually update the database by identifying removed hotspots. Track costs and disposal of removed materials. **Schedule**: Annual.	**Existing Programs:** none **Potential Program Additions:** **1.** Responsibility to track progress as predator hotspots are removed or ameliorated	Change in number of hotspots Type of hotspots removed/ ameliorated (abandoned structure, boat, etc.)	See CM 15-1	ECSY6.1 CHSA1.8 SASP1.5 STEE1.7
Monitoring Action CM15-3: Document the extent of predator removal activities within Delta hotspots				
Base condition: Existing knowledge of agency staff and experts pertaining to predator hotspots (see CM 15-1). Prior to predator control measures, the relative abundance (species, size and age composition) of predatory fish species must be sampled (non-lethally) at least twice per hotspot to establish baseline conditions. **Approach**: Implement localized predator control actions (e.g., electro-shocking, seining, gill netting or other appropriate methods) to remove targeted predators of covered fish species **Schedule**: Upon establishing baseline conditions and after implementing control measures, continue localized control measures each year at various locations throughout the Delta. Each hotspot will be treated several times (not more than 10 days apart) until predator numbers removed have declined and show a significant asymptotic trend (leveling off). Resample and retreat hotspots every 3-5 years.	**Existing Programs:** IEP fish predator control studies **Potential Program Additions:** Predatory fish control program to reduce localized predator densities and thus reduce covered fish mortality	Predators removed: Species number Size, age Location Diet (gut content)	This monitoring action will provide a estimate of the magnitude of the predator control efforts (Treatment size). This information will be used by the Implementing Office to estimate the effectiveness of controlling predators on sensitive lifestages of covered fish species in open systems (waterways of the delta). It will also provide insight in the life history of predatory fish and will allow addressing potential efficiency issues in an adaptive manner. The Implementing Office will also use these data to address cost effectiveness and to guide additional research, This schedule may be changed upon careful review of results to better encapsulate the response time of predator populations to control measures.	ECSY6.1 CHSA1.8 SASP1.5 STEE1.7

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM15-4: Determine the survival of covered fish species in response to predator control actions.				
Base condition: Baseline studies of predatory fish abundance and mortality levels of covered species due to predation prior to predator control measure implementation. **Approach**: Implement an adaptive experimental management program using a BACI approach to determine the existence and importance of compensatory predation mortality in sensitive lifestages of covered fish species. Specifically, this program investigates under which environmental conditions mortality of covered fish is additive and hence can be affected by localized predator control. Using a combination of fish tagging, sampling and radio- or acoustic telemetry tracking approaches, the Implementing Office will determine mortality rates due to predators at local predation hotspots in comparison to earlier (unmanaged) circumstances (before) and adjacent, randomly selected non-hotspot sites (control sites) **Schedule**: Annually, until uncertainty regarding predator management effectiveness (and density dependence) can be reduced and robust correlations between environmental conditions and predator control effectiveness can be established.	**Existing Programs:** USFWS Delta Juvenile Fish monitoring program (DJFMP), Delta smelt mortality monitoring, DFG hatchery fish radio tracking and acoustic tagging studies. **Potential Program Additions:** Coordinate DJFMP with fish mortality tracking projects in coordination with predator removal projects.	1. Survival rates of sensitive lifestages of covered fish species	This monitoring action is designed to provide information on the effects of predator removals on juvenile fish of covered species. The Implementing Office will use this information to determine if predator removal is effective in increasing the survival of juvenile covered fish species (i.e., mortality is not compensatory / juvenile fish are not regulated by density-dependent factors). To remove uncertainty regarding the role of varying habitat quality and spawning success, the Implementing Office will determine if targeted research or management experiments are needed to determine the conditions under which predator removal an effective management tool to support survival of sensitive lifestages of covered fish species.	ECSY6.1 CHSA1.8 SASP1.5 STEE1.7

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM16: Non-Physical Fish Barriers				
Monitoring Action CM16-1 Document the installation of non-physical fish barriers.				
Baseline Condition: As-built construction drawings. **Approach**: Document the installation and seasonal operation of non-physical fish barriers. **Schedule**: ongoing as barriers are installed.	**Existing Programs:** 2009 pilot study (Bowen et al. 2009), various research data. **Potential Program Additions:** 1. Fish barrier database that tracks seasonal operation, cost and incidental observations	Location Hours and dates of operations Performance/Failures and operational statistics of the three components (light, sound, bubbles) Other incidental observations Cost of operations	This monitoring action will provide information on the operation of non-physical fish barriers. This information will be used by the Implementing Office to schedule operations, redesign failing or faulty equipment, or implement other corrective measures as needed to ensure the continuous operation. The monitoring schedule will be adjusted to reflect additional data needs	CHSA1.5 STEE1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM16-2: Determine the permeability of non-physical barriers for outmigrating juvenile salmonids.				
Baseline Condition: existing knowledge and study results on fish migration routes and channel-specific survival artes **Approach**: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine the proportion of tagged fish that penetrate non-physical fish barriers. Determine the residence time at or near barriers. **Schedule**: Implement juvenile salmonid tracking prior or at least simultaneously with the initiation of operation of each physical barrier. Continue tracking fish until a precise (+- 5%) estimate of permeability can be established by species, location and season. Use occasional failures as "experiments" to determine "control" values. Once permeability rates have been estimated, fish tracking can be discontinued for 5 years. Every 5 years thereafter, the Implementing Office will randomly select 3 non-physical fish barriers and estimate permeation rates and residence times for outmigrating juvenile salmonids for at least 2 months.	**Existing Programs:** USFWS Delta Juvenile Fish monitoring program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies. **Potential Program Additions:** Coordinate DJFMP with fish mortality tracking projects in coordination with operation of non-physical fish barriers.	Permeation rates (% of tracked fish) Residence time of tracked fish within 500 ft of the barriers Lifestage of tracked fish Survival of tagged fish (see also CM16-3)	This monitoring action is designed to provide information on the effects of non-physical fish barriers in deterring juvenile fish of covered species to enter "low survival" channels. The Implementing Office will use this information to determine if non-physical fish barriers are effective in the re-routing of migrating juvenile covered fish species. This information will also be used to determine if outmigrating juvenile salmonids "pool" at the barriers. Intermittent replications of fish tracking will ensure that non-physical fish barriers are still functional and effective. The monitoring action may be reduced if permeation rates are found to have minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies at 3 randomly selected barriers every 5 years will determine if increasing monitoring activities are necessary (i.e., if permeation rates fall below the initially determined value).	CHSA1.5 STEE1.3

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM16-3 Determine the abundance of predators and their effect on the survival of outmigrating juvenile salmonids at non-physical fish barriers.				
Base condition: Baseline studies of predatory fish abundance and mortality levels of covered species due to predation.. **Approach**: Using a combination of fish tagging, sampling and radio- or acoustic telemetry tracking approaches, or visual sampling (underwater cameras) the Implementing Office will determine the abundance and composition of predator guilds at non-physical fish barriers in comparison to earlier (unmanaged) circumstances (before) and adjacent, randomly selected non-hotspots sites (control sites). In conjunction with CM16-3, estimate predation mortality to juvenile salmonids. Also, investigate if there are correlations between residence time of marked juvenile salmonids and predation risk and survival at barriers. **Schedule**: Annually, until uncertainty regarding predation rates can be reduced and robust correlations between residence time and survival of marked juvenile salmonids can be established	**Existing Programs:** USFWS Delta Juvenile Fish Monitoring Program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies. **Potential Program Additions:** Coordinate DJFMP with fish mortality tracking projects in coordination with operation of non-physical fish barriers.	Survival of tracked juvenile salmonids (a) within 500 feet of non-physical fish barriers, and (b) for the entire migration (by migration route)	This monitoring action is designed to provide information on the effects of non-physical fish barriers in increasing total survival of outmigrating juvenile fish of covered species. The Implementing Office will use this information to determine to what degree survival of migrating juvenile covered fish species increases as a function of non-physical fish barriers. It will also use these data to determine if predation in the immediate vicinity of barriers increases due to juvenile fish aggregations at the barriers, and to what extent predation at the barriers alters survival during the entire outmigration This information will also be used to determine if predator control activities (see CM15) may be indicated. Results from intermittent replications of fish tracking will determine if non-physical fish barriers are still functional and effective. The monitoring action may be reduced if predation rates are found to have estimable, minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies at 3 randomly selected barriers every 5 years will determine if increasing monitoring activities are necessary (i.e., if predation rates increase above the initially determined value).	CHSA1.5 CHSA1.8 STEE1.3 STEE1.7 SASP1.5

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM16-4: Determine change in survivorship of outmigrating juvenile salmonids redirected by non-physical barriers.				
Baseline Condition: existing survivorship of outmigrating salmonids using existing migration pathways **Approach**: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine change in outmigration success relative to existing conditions **Schedule**: Annually during peak outmigration periods of affected runs until relationships between barrier operations and outmigration success are understood	**Existing Programs:** USFWS Delta Juvenile Fish monitoring program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies. **Potential Program Additions:** Implementation of targeted studies to assess change in survivorship relative to barrier operations.	Change in proportion of outmigrating salmonids passing Chipps Island	This action is designed to provide the Implementing Office with information necessary to determine the effectiveness of non-physical barriers and barrier operations in improving juvenile salmonid survival by directing migration pathways.	CHSA1.5 CHSA1.8 STEE1.3 STEE1.7 SASP1.5
CM17: Hatchery and Genetic Management Plans				
Monitoring Action CM17-1 Document development and implementation of hatchery and genetic management plans for salmonid stocks.				
Base condition: Existing HGMPs and hatchery operations **Approach:** BDCP will evaluate progress towards HGMPs for each hatchery through annual accomplishment reports plans, fiscal accounting reports and interagency agreements and work plans. **Schedule:** within the first 5 years BDCP will have funded and achieved the development of HGMPs for each hatchery within the BDCP area. Updates of HGMPs are conducted every 10 years for the duration of the BDCP.	**Existing Programs:** Existing HGMPs and drafts (Nimbus Hatchery , Feather River Hatchery, Mokelumne River Hatchery) and Coleman National Fish Hatchery and Livingston Stone National Fish Hatchery 2001 Biological Assessment **Potential Program Additions:** none	Annual fiscal /accounting reports Interagency workplans HGMPs as they are developed	This monitoring action will provide information on the progress the BDCP Implementing Office is making towards the implementation of HGMPs for all salmonid hatcheries affected by BDCP. This information will be used by the Implementing Office to determine if modifications to targets or schedules are necessary, and how modifications will be implemented. Such changes will be effected through the BDCP adaptive management process and will be included in the subsequent annual work plans.	CHSA1.9 STEE1.8

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM17-2 Determine if HGMP development and implementation substantially and cost-effectively benefit covered salmonid stocks.				
Base condition: HGMPs as developed and implemented, research hypotheses and models. **Approach**: With funding from BDCP, the Implementing Office will collaborate in the Design and Evaluation of targeted studies, conducted by collaborating agencies that explicitly test the hypothesis that implemented HGMPs are reducing negative effects on wild Chinook salmon and steelhead. **Schedule:** 10 years after implementation of the BDCP, the Implementing Office will have completed a comprehensive meta-analysis and evaluation of the HGMP program.	**Existing Programs:** DFG and USFWS expert staff, UCD genetics lab, hatchery personnel and facilities **Potential Program Additions:** review and analysis capability (either in house or under contract) to comprehensively and rigorously evaluate studies and data on the impacts of hatchery fish on wild salmonid stocks.	Population viability of wild salmonid stocks Competition indices and models Genetic integrity of hatchery and wild stocks	This monitoring action will provide information on the cost-benefit relationship of implementing HGMPs to benefit wild salmonids. If results of review indicate that HGMP development and implementation does not substantially and cost-effectively benefit covered fish species, the BDCP Management Entity in coordination with Fishery Agencies may terminate this conservation measure. If terminated, remaining funding will be deobligated from this conservation measure and reallocated to augment funding for other more effective conservation measures identified in coordination with the Fishery Agencies through the BDCP adaptive management process. The monitoring schedule may be extended for up to 5 years if longer time series are needed to determine conclusively the effects of HGMPs on wild salmonid stocks.	CHSA1.10 STEE1.9

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM18: Illegal Harvest				
Monitoring Action CM18-1: Determine if hiring target of 17 additional game wardens for the BDCP Plan Area has been met				
Base Condition: Current staffing levels of CDFG enforcement officers within the BDCP Plan Area. **Approach:** Review annual employment reports provided by DFG to determine success in filling vacant game warden positions and to determined why positions were not filled (if applicable) **Schedule:** Annual monitoring until the 5-year deadline has been met	**Existing Programs:** none Potential Program Additions: 1. Collaborative data exchange with DFG enforcement and Human Resources	1. Hiring of 17 additional game wardens for the BDCP Plan Area	This monitoring action is intended to provide information regarding achieving enhanced enforcement of fishery regulations for covered species. This information will provide the basis for determining if there is a need to modify the hiring process. The monitoring schedule may be extended beyond the initial 5 year period if necessary.	CHSA1.7 STEE1.6 SASP1.3 GRST1.5 WHST1.5
Monitoring Action CM18-2: Determine the game warden's contact rate with the public				
Base Condition: Current 5-year average contact rate for Game wardens in the BDCP Plan Area **Approach:** The Implementing Office will review annual reports of enforcement statistics for the BDCP plan area, which details the number of contacts, warnings and citations issued per game warden **Schedule:** Annual monitoring of game warden contact rates	**Existing Programs:** Existing analytical methods for assessing effectiveness of contact rates **Potential Program Additions:** 1. Collaborative data exchange with DFG enforcement	1. Rates of contacts, warnings and citations by game warden	This monitoring action is intended to provide information regarding the achievement of enhanced enforcement of fishery regulations for covered species. This information will provide the basis for determining if there is a need provide additional training of game wardens. The monitoring schedule may be altered if necessary.	CHSA1.7 STEE1.6 SASP1.3 GRST1.5 WHST1.5

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
Monitoring Action CM18-3: Determine compliance ratios in routine enforcement activities				
Base Condition: 5-year average compliance ratios for Game wardens in the Bay Delta and similar areas **Approach:** The total number of contacts with the public and the total number of warnings and citations issued per year will be recorded annually, consistent with current game warden practices. **Schedule:** Annual monitoring of compliance ratios	**Existing Programs:** Existing analytical methods for assessing compliance effectiveness **Potential Program Additions:** 1. Collaborative data exchange with DFG enforcement	1. % change in compliance ratios (trend) 2. Annual deviation from the 5 year running average compliance ratio.	This monitoring action will provide an assessment of routine enforcement activity and effectiveness of enforcement to reduce illegal harvest This monitoring action will provide the basis for determining if enforcement actions and staffing levels are sufficient to reduce illegal harvest of covered fish in the BDCP Plan Area. The monitoring schedule may be reduced once compliance ratios have declined and are at satisfactory levels	
Monitoring Action CM18-4: Determine success of undercover and non-routine operations				
Base Condition: Current 5-year average arrest ratios for undercover and special enforcement actions in the BDCP Plan Area. **Approach:** The total number of contacts with the public and the total number of warnings and citations issued per year will be recorded annually, consistent with current game warden practices. **Schedule:** Annual monitoring of compliance ratios	**Existing Programs:** Existing analytical methods for assessing success of special enforcement operations **Potential Program Additions:** 1. Collaborative data exchange with DFG enforcement	1. Number of arrests in special undercover enforcement operations 2. Annual deviation (% change) from the 3 year running average of number of arrests per person-hour	This monitoring action will provide an assessment of undercover and non-routine enforcement activity and effectiveness of enforcement to reduce illegal harvest. This monitoring action will provide the basis for determining if undercover and special enforcement actions are sufficient to reduce illegal harvest of covered fish in the BDCP Plan Area. The monitoring schedule may be reduced once arrests/person-hour ratios have declined and are at satisfactory levels.	CHSA1.7 STEE1.6 SASP1.3 GRST1.5 WHST1.5

Table 3-20. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Objectives addressed*
CM19: Conservation Hatcheries				
Monitoring Action CM19-1: Support the development of a delta and longfin smelt conservation hatchery by USFWS to house a delta smelt refugial population and provide a source of delta and longfin smelt for supplementation or reintroduction, if deemed necessary by Fishery Agencies.				
Base condition: MOU **Approach**: IEP will 1) document the establishment of functional hatchery facilities and 2) track the funds expended towards implementing a collaborative development of conservation hatcheries by USFWS through its annual reports, financial and operational records. **Schedule**: Annually	**Resources:** 1. USFWS proposals **Potential Program Additions:** 1. Conservation hatchery program budget, 2. Conservation hatchery administration staff	1. Annual progress reports	This monitoring action will provide a detailed accounting of expenses and other support provided to USFWS to develop and operate Conservation hatcheries. This information will be used by the Implementing Office to determine if funding levels and expected benefits are within target levels. The annual reporting schedule is maintained for the duration of the conservation hatchery program.	
Monitoring Action CM19-2: Support the expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory to serve as a population safeguard in case of a catastrophic event in the wild.				
Base condition: MOU. **Approach**: IEP will 1) review annual reports to determine if hatchery operations are successful in establishing and maintaining sufficient refugial populations to meet BDCP objectives and 2) track the funds expended towards expanding refugial population of Delta smelt and longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory through its annual reports, financial and operational records. **Schedule**: Annually	Resources: 1. University of California, Davis Fish Conservation and Culture Laboratory Potential Program Additions: 1. Conservation hatchery program budget 2. Conservation hatchery administration staff	1. Annual progress reports	This monitoring action will provide a detailed accounting of expenses and other support provided to expanding refugial populations of Delta smelt and longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory. This information will be used by the Implementing Office to determine if funding levels and expected benefits are within target levels. The annual reporting schedule is maintained for the duration of the conservation hatchery program.	

*[**Note to Reviewers:** This table presents in-progress draft potential system-wide monitoring actions based on the five ecological characteristics described in Section 3.6.2, Monitoring Framework. This table will continue to be refined and populated to ensure that all of the system-wide monitoring actions, including incorporation of metrics from the logic chain, are addressed.]*

Table 3-21. Potential System-Wide Monitoring Actions

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Ecosystem Monitoring Element: Foodweb				
Element 1: Primary and Secondary Production				
Monitoring Action SY1-1: Determine the seasonal abundance, distribution, and composition of phytoplankton and zooplankton in Delta and Suisun Marsh/Bay waterways.				
Condition: Seasonal abundances of phytoplankton and zooplankton in Delta and Suisun Marsh channels and waterways as currently sampled. **Approach:** Establish monitoring stations that are representative of different reaches of the Delta and Suisun marsh Take monthly grab samples and measurements of chlorophyll a and zooplankton. Invertebrate sampling should be adaptively adjusted to changes in fish diets. Plankton monitoring tracks changes in phyto- and zooplankton diversity, abundance, and distribution associated with physical and other biological factors in the Delta. Salinity and other water quality variables are monitored at all plankton sites. **Schedule:** Conduct sampling monthly every year for the first 10 years, then randomly sample 30% of all sampling stations annually for the duration of the BDCP.	**Existing Programs:** Ongoing discrete sampling through Environmental Monitoring Program (EMP, under IEP) **Potential Program Additions:** **1.** Additional sampling stations to represent the entire system by individual reach or major channel system. Locations of added stations will be fixed during the duration of the plan to detect increase on food availability in delta waterways. Note that additional stations are added under Monitoring Actions CM 4-3, CM4-4 , CM4-6, and CM16-5 as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites) Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon.	1. Phytoplankton: -mg/L chlorophyll a - species composition - relative abundance 2. Zooplankton: - number/1,000 m^3 - species composition - relative abundance 3. variations in oxygen concentration 4. organic carbon-14 content 5. Stable isotopes of Oxygen (16O, 18O and 17O	This monitoring action is intended to collect data necessary to determine and quantify the overall production and export of phytoplankton and zooplankton throughout the Delta This information, in combination with evaluation of other project-specific foodweb-related monitoring and research data, will provide the basis for : 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (source-sink dynamics, variability and uncertainty in primary production response) 3. evaluating restoration design options to increase the production and export of primary production from restored tidal marsh plains 4. Implementing additional management actions to improve production and export of primary production within the Delta. The monitoring schedule will be modified if uncertainty or variances do not support current conceptual models and hypotheses	ECSY5.1 CHSA1.2 STEE1.2 SASP1.2 GRST1.2 WHST12

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY1-2: Determine the seasonal abundance, distribution, and composition of benthic invertebrates in Delta and Suisun Marsh/Bay waterways.				
Base conditions: ongoing benthic monitoring by IEP throughout the Estuary. **Approach**: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site. Samples are analyzed by a contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler. **Schedule**: Quarterly	**Existing Programs:** Benthic monitoring component of IEP's Environmental Monitoring Program (EMP) **Potential Program Additions:** Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of the entire BDCP plan area.	1. Species of macro-benthic organisms identified 2. Total number of individuals counted	This monitoring activity provides information on the benthic communities of the estuary, changes in benthic fauna presence, and abundance and distribution associated physical factors in the estuary. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary. The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities. This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta. The implementing office will use this information to address changes and modifications to conservation measures through the adaptive decision making process. The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.	ECSY5.1 ECSY5.2 CHSA1.2 STEE1.2 SASP1.2 GRST1.2 WHST12

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Ecosystem Monitoring Element: Physical/Chemical/Nutrient Processes				
Element 2: Water Quality				
Monitoring Action SY2-1: Determine the seasonal and spatial variability of water quality within the Plan Area.				
Condition: Existing seasonal water quality conditions based on existing information (see Applicable IEP and other Resources **Approach:** Continue current water quality monitoring as mandated by existing D-1641 North and Western Delta agricultural and municipal and industrial (M&I) standards and all water quality requirements contained in the North Delta Water Agency/DWR Contract and other DWR contractual obligations. **Schedule:** as currently implemented.	**Existing Programs:** 1. Continuous Multiparameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2.Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and USGS)National Water Quality Assessment Program (, Toxic Substances Hydrology Program 5.. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) **Potential Program Additions:** **1.** There are over 100 water quality sampling sites within the Delta providing a baseline of water quality data. If needed, additional sampling stations may be added to reflect system-wide representative sampling efforts. Additional water quality sampling stations will be added as levees are breached and sites are flooded to track water quality changes at restoration sites. 2. Expand UC Davis Biosentinel Hg Monitoring Program to include entire Delta. see also Monitoring Action CM4-4 and Monitoring Action CM4-6.	1. Water temperature (^{o}C) 2. mg/L dissolved oxygen 3. NTUs 4. EC 5. pH 6. mg methylmercury/L 7. other nutrients and/or toxicants (e.g., Ammonia, Major Cations (Na, K, Ca, Mg), Metals (Cd, Co, Cu, Fe, Mn, Pb, Zn), inorganic Nitrate, pyrethrins,) 8. Derived location of X2 (isohyaline)	This monitoring action is intended to collect data necessary to determine if salinity conditions are meeting contractual and legal requirements. It also provides data necessary to determine if water quality conditions in the different portions of the Delta remain suitable or improve for supporting covered fish species. This information will also used as a reference condition to determine the possible impact of restoration activities on water quality. This information will be used to address deviations from salinity target conditions, and design modifications and/ research studies to address uncertainty in salinity control. This information will be used to evaluate underlying models and hypotheses of water quality responses conservation measures. This information will aid in identifying sources of uncertainty and will guide the design of further management experiments, design modifications and/ research studies to address uncertainty. The monitoring schedule may be adjusted in response to monitoring results to better understand causal relationships between water management and water quality.	CHSA1.1 GRST1.2 PALA1.1 RILA1.1 SASP1.1 STEE1.1 WHST1.1

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Ecosystem Element 3: Hydrodynamics				
Monitoring action SY 3-1: Determine daily flow characteristics throughout the BDCP Plan area.				
Base Condition: Temporal and spatial patterns of flow throughout the Delta region; DAYFLOW, SI3D predictions. **Approach**: Continue monitoring Delta flow and hydrological dynamics through IEP's EMP,. Continue to monitor and calculate flow parameters through Suisun March and at Chipps Island (Delta Net outflow index), **Schedule**: as currently implemented	**Existing Programs:** 1. Delta Flows network (USGS) (21 continuously operating flow stations) 2. IEP EMP sampling station network (15 sites sampled monthly) 3. Flow models (e.g., DAYFLOW, SI3D) **Potential Program Additions:** Expand the USGS network to 29 stations as planned	1. Flow (CFS) 2. Salinity (EC) 3. Water temperature (C^o)	This monitoring action will provide data that will be used by water project operators to assess compliance with target flow levels. They provide a framework for understanding how the tidal currents, river inflows, water project exports, temporary barriers, and DCC gate operations impact transport within the upper estuary. These data are also used routinely for numerical model calibration and validation and are regularly leveraged into large interdisciplinary process-based studies.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5, ECSY0.1 CHSA1.5 GRST1.1, RILA1.4, PALA1.4
Ecosystem Element 4: Climate Change				
Monitoring action SY 4-1 Determine the long term dynamics of hydrological characteristics (water level, temperature, salinity) throughout the BDCP Plan area.				
Base Condition: Current monitoring conducted by the interagency network of recorder stations. **Approach**: Continue existing continuous USGS and other agency monitoring programs of Bay Delta water levels, salinity and water temperature; continue modeling of **Schedule**: as currently implemented	**Existing Programs:** Delta Flows network (USGS) comprised of 21 continuously operating flow stations **Potential Program Additions:** Expand the network to 29 stations as planned; See Monitoring Action SY4-1	1. Water level (m) 2. Salinity (EC) 3. Water temperature (C^o)	This monitoring action will provide the Implementing Office with information to determine the magnitude and direction of climate-driven environmental change within the Delta. This information will be used to (a) calibrate models and modify hypotheses as necessary, (b) determine if goals, objectives, or conservation measures are no longer linked with underlying models or hypotheses and thus should be adjusted, modified or eliminated, and (c) if and where changes to planned restoration activities should be considered and managed through the adaptive decision making framework.	ECSY2.1 ECSY2.2 ECSY2.3 ECSY2.4 ECSY2.5, ECSY0.1 CHSA1.5 GRST1.1, RILA1.4, PALA1.4

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Ecosystem Monitoring Element: Ecological Processes				
Element 5: Nonnative Species				
Monitoring Action SY 5-1: Determine the seasonal abundance, distribution, and composition of established nonnative fish predators and competitors with native fishes.				
Base condition: Existing fish surveys and harvest statistics for non-native fish predators/competitors. **Approach:** Annual surveys of non-native fish populations to detect long-term trends. Continue representative sampling of non-native predators in trawls and fish surveys. Estimate harvest rate, population size (CPUE) and age distribution of non-native predatory fish caught in sport fisheries (mark-recapture). **Schedule**: annual	**Existing Programs:** fish surveys 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl and 'Supplemental Surveys", (e.g., Mossdale trawl) 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl 8. DFG striped bass mark-recapture program 9. IEP fish predator control studies **Potential Program Additions:** Expanded sampling location array to create representative systemwide monitoring network of fish populations. Beach seining to reflect micro-habitats and shallow areas not sampled by trawls. Creel surveys or mandatory harvest reporting for non-native sport fish	1.Abundance, density and diet of non-native predatory centrarchids species (e.g., largemouth bass and sunfishes) in size classes that prey on covered fish species in Delta channels 2. Abundance of non-native predatory fish per unit area of habitat 4. Ratio of non-native fish to native fish 5. Change in harvest success and size of non-native fish caught in sport fisheries	This monitoring action will provide quantitative information about the effectiveness of the conservation measures to reduce predator and competitor populations for different life stages of covered fish species and their spatial response (presence and density) to these enhancements. Monitoring results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit. The information provided will also support decisions on potential modification to conservation measures, goals and objectives. It will also be used to determine if additional research activities or special survey technology should be developed.	ECSY6.1 TANC1.2 CHSA1.8 STEE1.7 SASP1.5

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY 5-2. Determine the abundance and species composition of non-native, submerged and floating aquatic vegetation.				
Base Condition: Existing knowledge/surveys/data by resource managers (DBW) will be used to delineate and estimate nonnative SAV and FAV extent in the Delta. **Approach**: This monitoring is implemented as a two-stage sampling: 1. determine the extent and locations of SAV/FAV by remote sensing or other appropriate methods; 2. Randomized stratified water column sampling. Once a close correlation has been established between actual vegetation samples and remote sensing, physical vegetation samples can be eliminated from the sampling protocol. **Schedule:** Every 3 years delineate areas of nonnative invasive aquatic vegetation and conduct Delta wide paired sampling.	**Existing Programs:** Department of Boating and Waterways (DBW) Aquatic Pest Control Program (DBW is the lead agency for controlling Water Hyacinth and Egeria in the Delta) **Potential Program Additions:** 1. Collaboration with DBW on delineation and inventory of aquatic weed extent 2. Remote sensing or aerial imagery acquisition multiple times throughout the growing season (additional delineation via GPS/GIS from vessels etc.) 3. Vessel-based subsampling to estimate composition of aquatic species See also Monitoring Actions CM 13-1, SY3.3	Extent (acres) of nonnative SAV and FAV Maps of the distribution of nonnative SAV and FAV Species composition of nonnative aquatic vegetation	This monitoring is designed to determine the extent of nonnative SAV and FAV in the waterways and floodplains of the BDCP. The BDCP Implementing Office will use results of plan-area wide monitoring to determine if and where controlling SAV and FAV is achievable and sustainable. This information will be used to determine if non-native aquatic vegetation control measures are sufficient to sustainably reduce their impact in important portions of the Delta. The results will also be used by the Implementing Office to determine if control activities should be adaptively adjusted to changing nonnative SAV/FAV extent. The Implementing Office will also use these results to address uncertainties with research studies and adaptive management experiments. The monitoring schedule may be adjusted to reflect changes in non-native aquatic control efforts.	ECSY6.1 TANC1.2 CHSA1.8, SASP1.5, STEE1.7

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY5-3. Determine the status and distribution of nonnative clams.				
Base conditions: ongoing benthic monitoring by IEP throughout the Estuary. **Approach**: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site. Samples are analyzed by a contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler. **Schedule**: Quarterly	**Existing Programs:** Benthic monitoring component of IEP's Environmental Monitoring Program (EMP) **Potential Program Additions:** Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of the entire BDCP plan area. Database to track observation and incidental records of non-native bivalves to estimate their habitat use and range expansion in the Delta	1. Species of non-native bivalves 2. Total number of individuals counted	This monitoring activity provides information on the non-native clams of the estuary, changes in their presence, abundance and distribution. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary. The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities. This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta. The implementing office will use this information to address changes and modifications to conservation measures through the adaptive decision making process. The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.	ECSY6.1 TANC1.2

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY5-3. Determine the status and distribution of Microcystis blooms.				
Base Condition: existing data on Delta microcystis abundance, productivity and correlations with water quality parameters **Approach:** Establish additional fixed monitoring stations as needed in areas where microcystis blooms are observed or likely to occur given water conditions. Take weekly grab samples and measurements of chlorophyll a. **Schedule:** Conduct sampling for the first 5 years following first detection and every 5 years thereafter.	**Existing Programs:** Environmental Monitoring Program (EMP, under IEP) **Potential Program Additions:** **1.** Locations of added stations will be fixed during the duration of the plan to detect increase on microcystis abundance and blooming activity in delta waterways Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon) *See Monitoring Actions CM 4-3, CM4-4 , CM4-6, and CM16-5*	1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 3. microcystis colony structure 4. Water temperature 5. $NH4^+$ concentration 6. EC 7. presence of non-native clams (see SY5-3)	This monitoring action is intended to collect data necessary to determine and quantify the degree of microcystis spread and toxic blooms in the Delta. This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for : 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (e.g., excessive N loading . grazing effects by clams, salinity and temperature limiting factors) 3. evaluating restoration design options to increase the production and export of primary production inundated floodplains 4. Implementing additional management actions to improve production and export of primary production from the floodplain.	ECSY6.1

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Natural Community Monitoring Element				
Element 6: Landscape change				
Monitoring SY6-1: Determine the long-term changes in the location, extent, distribution and juxtaposition of Natural Communities within the Plan Area.				
Base Condition: Current landscape composition (see Chapter 2, *Existing Ecological Conditions*). **Approach**: GIS coverages of natural communities will be updated by remote sensing or other appropriate methods to provide estimates of the change occurring within natural communities and landscapes of the BDCP Planning Area. Classification will be field-checked using BDCP conservation lands as verification sites. **Schedule**: Every five years	**Existing Programs:** GIS database (BDCP) Agency databases (CASIL) **Potential Program Additions:** GIS and spatial analysis capability	1. Extent (acres) 2. Location (boundaries) 3. Distribution (number of parcels, parcel size) 4. Neighborhood spatial statistics	This monitoring action will provide the Implementing Office with a Planning Area-wide assessment of how landscapes change over time. This provides an important framework for assessing the effectiveness of the conservation lands system and its functionality and role within the overall landscape. It also indicates to what degree landscape change follows anticipated shifts in the distributions of covered species and natural communities in response to climate change. The Implementing Office will use this information to determine if current models and hypotheses on landscape and climate change are supported or need to be modified. It further will use this information to examine the context of conservation measures and to address conservation targets through the adaptive decision making process. For example, if certain natural community types become unexpectedly rare, the Implementing Office can adaptively respond by increasing acquisition of conservation lands of the rarest community type. The monitoring schedule may be adjusted if landscape change accelerates.	ECSY1.1 ECSY1.2

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY6-2: Determine structural connectivity and identify corridors and landscape barriers of the BDCP Plan Area				
Base Condition: Current landscape composition (see Chapter 2, *Existing Ecological Conditions*). **Approach**: Connectivity will be evaluated from Planning Area - wide GIS mapping by calculating structural connectivity measures (e.g., mean inter-patch distance and other connectivity measures) and species specific functional connectivity assessments (e.g., least-cost corridor analyses, circuit theory). Connectivity maps will be produced to identify gaps and breaks in structural and functional connectivity throughout the BDCP Planning Area. **Schedule**: Every 10 years.	**Existing Programs:** GIS databases (BDCP) Agency databases (CASIL) **Potential Program Additions:** 1. GIS and spatial analysis capability 2. Connectivity assessment and analysis (including species modeling)	1. Landscape statistics (e.g., contagion, diversity, elevation, area-perimeter ratios)	This monitoring action will provide the Implementing Office with a Planning Area-wide assessment of structural and functional connectivity of habitats for covered species over time. This provides an important framework for assessing the effectiveness of the conservation lands system and its functionality in connecting habitats and improving covered species movement across the landscape. The Implementing Office will use this information to determine the locations where additional conservation land acquisitions are need to increase landscape connectivity. The monitoring schedule may be adjusted if landscape change accelerates or if major, landscape-altering events occur (floods, fire, seismic events).	ECSY3.1 ECSY3.2

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Element 7: Biodiversity				
Monitoring Action SY7-1: Determine the diversity of native species within the BDCP Area.				
Base Condition: Current species occurrence and predicted habitat (see Appendix 1, Covered Species and Chapter 2, *Existing Ecological Conditions*). **Approach**: Calculate the change in the number of present covered species, based on (a) updated maps of natural communities (see Monitoring Action SY6-1), (b) actual surveys of conservation lands, (c) species occurrence databases (e.g., CNDDB) and other agency records. **Schedule**: Every 10 years.	**Existing Programs:** 1. GIS databases 2. CNDDB	1. Number of species 2. Acres of habitat per species	This monitoring action will provide information to the Implementing Office whether the presence/occurrence and diversity of covered species may have changed for the Planning Area. The Implementing Office will use this information to evaluate if conservation lands acquisition should be redesigned or modified. It will also use this information to initiate targeted research to determine causal relationships for this change. This monitoring schedule may be intensified to a 5-year interval if rapid change in biodiversity is indicated or following a major, planning area – wide disturbance (flood, seismic event, etc).	ECSY1.1

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Fish, Wildlife, and Plant Monitoring Elements				
Element 8: Abundance and distribution of covered fish species.				
Monitoring Action SY8-1: Determine the distribution and abundance of juvenile salmonid abundance for each run.				
Base Condition: Current knowledge of presence and abundance of juvenile salmonids in Delta waterways **Approach**: Visual and non-lethal fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections in Delta rearing habitats during the. **Schedule**: Annually during rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling	**Existing Programs:** Historical sampling, USFWS weekly beach seining survey of juvenile salmonids (49 permanent locations Delta wide) **Potential Program Additions:** 1. Add sampling locations to ensure statistical representative sampling effort See also *Monitoring Action CM5-3.*	1. Abundance 2 . size 3. race 4. location	This monitoring action will provide information on the presence and abundance and relative use of delta waterways by juvenile salmonids. Results of monitoring will be assessed to determine if salmonid distribution and abundance is responding to increasing habitat and food availability as restoration progresses. The information will be used test and evaluate numerous models and hypotheses on stressors and limiting factors for salmonids in the Delta. The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish presence in inundated floodplains.	CHSA1.5 STEE1.3
Monitoring Action SY8-2: Determine the seasonal abundance and distribution of juvenile and adult delta smelt.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Monitoring Action SY8-3: Determine the location of delta smelt spawning habitats.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY8-4: Determine the seasonal abundance and distribution of juvenile and adult Sacramento splittail.				
Base condition: Conduct surveys of splittail adults, larvae, and eggs to determine the abundance of splittail larvae, juveniles and adult present during the reproductive period. **Approach:** Conduct fish sampling surveys to determine the change in densities of larvae and juveniles relative to base conditions and in-channel spawning. **Schedule:** Weekly fish sampling will be conducted in spawning habitat during the first 5 floodplain inundation periods during the splittail spawning season. Subsequently monitor every fifth flood event over the term of the BDCP.	**Existing Programs:** USFWS rotary screw traps USFWS beach seine **Potential Program Additions:** 1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort	1. Production of Sacramento splittail (number of larval and early juvenile splittail/10,000 m^3) during floodplain inundation periods	This monitoring action will provide information on productivity of Sacramento splittail populations and the contribution of inundated restored floodplains on spawning and rearing of splittail. This information will be used by the Implementing Office to decide if the production of splittail during floodplain inundation periods has increased significantly from base conditions. If monitoring results do not support conceptual models and hypotheses predicting increasing splittail spawning, the Implementing Office will conduct additional studies to determine 1. uncertainties and competing hypotheses 2. other factors/stressors that affect splittail spawning and rearing in restored habitats, and 3. restoration design modifications to increase splittail productivity. If causes are related to inundation duration, experimental management of flood control structures and floodplain topography may used to address uncertainties. The monitoring schedule may be extended or intensified if uncertainties of causal relationships persist.	SASP1.1 SASP1.3

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY8-5: Determine the seasonal abundance and distribution of juvenile and adult green sturgeon and white sturgeon.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	GRST1.2 WHST1.1
Element 9: Survival of covered fish species.				
Monitoring Action SY9-1: Determine nonnative predatory fish predation rates on each run of juvenile salmonids.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.5 CHSA1.8 STEE1.3 STEE1.7 SASP1.5
Monitoring Action SY8-2: Determine annual outmigration success of juvenile salmonids.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.5 CHSA1.8 STEE1.3 STEE1.7 SASP1.5
Monitoring Action SY8-3: Determine entrainment levels of covered fish species.				
Implemented through Monitoring Actions CM-2 and CM-3.				
Monitoring Action SY8-4: Determine tissue concentrations of selenium, mercury, pyrethroids, and endocrine disrupting compounds in covered fish species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
Monitoring Action SY8-5: Determine Pacific and river lamprey upstream and downstream migration success.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
Element 10: Growth rates of covered fish species.				
Monitoring Acton SY10-1: Determine the level of co-occurrence of juvenile fall-run Chinook salmon with preferred prey species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.1
Monitoring Acton SY10-2: Determine the level of co-occurrence of delta smelt with preferred prey species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Monitoring Acton SY10-3: Determine the extent of delta smelt rearing habitat.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Monitoring Acton SY10-4: Determine the spring abundance of preferred longfin smelt prey species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Acton SY10-5: Determine the seasonal abundance of preferred Sacramento splittail prey items.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	SASP1.2
Monitoring Acton SY10-6: Determine the size (weight, length) distribution of juvenile salmonids of each run outmigrating from the Delta.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.2 STEE1.2
Monitoring Acton SY10-6: Determine the seasonal size (weight, length) distribution of delta smelt and longfin smelt.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Element 11: Production of covered fish species.				
Monitoring Acton SY11-1: Determine the extent of longfin smelt spawning habitat.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Monitoring Acton SY11-2: Determine the upstream migration success of green and white sturgeon through the Delta .				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Monitoring Acton SY11-3: Determine adult recruitment of delta smelt and longfin smelt .				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	
Element 12: Genetic integrity of wild salmonid stocks.				
Monitoring Action SY12-1: Determine the degree of population genetic variability in each Chinook salmon run and Central Valley steelhead.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.9 STEE1.8

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Element 13: Distribution, status, trends of covered wildlife species populations.				
Monitoring Action SY12-1: Determine the number of occupied Swainson's hawk, least Bell's vireo, and western yellow-billed cuckoo nesting territories.				
Base Condition: Pre-acquisition condition, existing knowledge on presence of covered species habitat requirements. **Approach**: Review of agency records, research results, expert knowledge and other data on locations of observations of nesting Swainson's hawk, least Bell's vireo, and western yellow-billed cuckoo. **Schedule**: Annual.	**Existing Programs:** None **Potential Program Additions:** 1. Database of observation records *See CM 11-5*	1. location 2. species	This action is intended to provide the basis for comparing plan-area-wide species performance to the functioning of conservation lands. Management actions are undertaken based on the guidance in the Site-Specific Monitoring Plan, which is subject to modification based on site-specific conditions, opportunities unforeseen at the onset of implementation, or to adjust to the progress of other site specific management plans and the need to meet overall Plan Area-wide goals.	ALNC1.8 ECSY1.5 VRNC1.1 VRNC2.1
Monitoring Action SY12-2: Determine the abundance and distribution of riparian brush rabbit and riparian woodrat if found in the Plan Area.				
Base Condition: expert knowledge **Approach**: track agency records, studies and incidental observations of riparian brush rabbit and riparian woodrat within the BDCP plan Area. If necessary, conduct 10 day trapping grid sampling to verify suspected occurrences. **Schedule**: Annual compilation of Continue for at least 5 inundation years. Ten repeat every 5 years, focusing on verifying presence in previously established occurrences	**Existing Programs:** historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. database to track annual information on riparian brush rabbit and riparian woodrat distribution and status	1. Presence and sex/age distribution of riparian brush rabbit and riparian woodrat in the BDCP plan area.	This monitoring action is intended to collect data on the distribution and population trend of riparian brush rabbit and riparian woodrat. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of riparian brush rabbit and riparian woodrat. This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of of riparian brush rabbit and riparian woodrat populations.	RIBR1.1 RIWR1.1 VRNC1.1 VRNC2.1

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Monitoring Action SY12-3: Determine the abundance and distribution of giant garter snake.				
Base Condition: expert knowledge **Approach**: track agency records, studies and incidental observations of Giant Garter Snakes within the BDCP plan Area. If necessary, conduct field trapping/sampling to verify suspected occurrences. **Schedule**: Annual compilation of Continue for at least 5 inundation years. Ten repeat every 5 years, focusing on verifying presence in previously established occurrences	**Existing Programs:** historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. database to track annual information o Garter snake distribution and status *See CM 2-16, CM10-4*	1. Presence and sex/age distribution of Giant Garter Snake	This monitoring action is intended to collect data on the distribution and population trend of giant garter snake. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of giant garter snakes. This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of giant garter snake populations.	ALNC1.1 ALNC1.2 ALNC1.5 ALNC1.6 TANC1.1 FMNC1.1 FMNC2.1 NANC2.1 NWNC1.1 NWNC2.1 ALNC1.7 ALNC1.8 GGSN1.1 GGSN2.1 GGSN2.2
Monitoring Action SY12-4: Determine the abundance of waterfowl wintering in the Plan Area.				
Base Condition: Current waterfowl monitoring as conducted by USFWS, CDFG and CWA **Approach**: Continue USFWS and CDFG special fall and midwinter aerial surveys. The midwinter survey, the longest running population assessment, focuses on all ducks, geese, swans, and coots. **Schedule**: Annual mid-winter surveys as currently implemented by USFWS.	**Existing Programs:** USFWS midwinter waterfowl surveys **Potential Program Additions:** none	1. Number 2. Species 3. sex/age composition (if possible)	This monitoring action provides information on the abundance of wintering waterfowl. The Implementation office will use this information to determine area-wide trends in waterfowl numbers and to compare these with waterfowl use of restored or created wetland wintering habitat for waterfowl. The Monitoring schedule may be changed if necessary to improve accuracy and/or precision of waterfowl estimates.	MWNC1.1
Monitoring Action SY12-5: Determine the abundance of shorebirds using the Plan Area during spring and fall migration periods.				
[Text to come.]	[Text to come.]	[Text to come.]		MWNC1.2

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Element 14: Reproductive success of covered wildlife species.				
Monitoring Action SY12-1: Determine Swainson's hawk, least Bell's vireo, and western yellow-billed cuckoo the nesting success.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
Monitoring Action SY12-1: Determine the recruitment rate for riparian brush rabbit and riparian woodrat if found in the Plan Area.				
Base Condition: expert knowledge **Approach**: If riparian brush rabbit or riparian woodrat are verified within the BDCP plan Area, conduct 10day capture-recapture (trapping grid) sampling at the beginning, middle and end of the reproductive period **Schedule**: 3 consecutive seasons every 10 years .	**Existing Programs:** historical surveys, research projects, approved sampling protocols. **Potential Program Additions:** 1. trapping survey team, equipment and methodology to conduct capture -recapure	1. sex/age distribution of riparian brush rabbit and riparian woodrat 2. Lactation rates	This monitoring action is intended to provide information on recruitment of juvenile riparian woodrats and brush rabbits into the adult population. This information will be used in parameterizing a population viability model for each species. Model output will predict the probability of population persistence and extinction. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of riparian brush rabbit and riparian woodrat. This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of of riparian brush rabbit and riparian woodrat populations.	

Table 3-21. Potential System-Wide Monitoring Actions (continued)

Base Conditions, Approach, and Schedule	*Applicable IEP and other Programs and Potential Additions to those Programs*	*Metrics*	*Adaptive Management Considerations*	*Biological Goals and Objectives Addressed*
Element 15: Distribution, status, and abundance of covered plant species.				
Monitoring Action SY12-1: Determine the abundance and distribution of intertidal covered plant species.				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	MFNC1.2 BMNC1.2 FMNC1.2 SUTH1.1 SUTH1.2 SOBB1.1 SOBB1.2

3.7 ADAPTIVE MANAGEMENT PROGRAM

[***Note to Reviewers**: The text of this section of Chapter 3 on adaptive management was revised based on comments by Steering Committee members following the October 21, 2010 meeting. This section is subject to change and revision based on further input from the BDCP Steering Committee.*]

The BDCP Adaptive management program is premised on the concept that, as new information and insight is gained during the implementation of a conservation plan, adjustments can be made to the conservation actions to further advance the goals and objectives of the plan. The Natural Community Conservation Planning Act (NCCPA) recognizes this function, defining adaptive management as a process whereby "the results of new information gathered through the monitoring program of the plan and from other sources [is applied] to adjust management strategies and practices to assist in providing for the conservation of covered species."[45] Similarly, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) describe adaptive management as a "method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned."[46]

Consistent with these definitions, the BDCP adaptive management program will provide the basis for: (1) key gaps in data and knowledge to be identified and steps to be taken to close such gaps; ; (2) alternative approaches to conservation actions to be developed that would enhance the effectiveness of conservation measures; (3) new information gathered through monitoring and targeted research programs to be evaluated; and (4) analytical processes and feedback loops to be instituted to better inform decisions regarding adaptive changes. Outcomes of the adaptive management decision making process could include changes in conservation measures, biological objectives and targets, monitoring actions and metrics, and analytical tools within the boundaries established by the BDCP.

The Program Manager, through the Science Manager, will be responsible for the administration and implementation of the BDCP adaptive management program. The BDCP Implementation Board will oversee the Implementation Office's implementation of the program. The roles and responsibilities of the Implementation Office, the Implementation Board, the fish and wildlife agencies, and the Authorized Entities in the adaptive management program are summarized in Section 3.7.2 *Adaptive Management Decision Making Process.*

The conservation measures described in Section 3.4, *Conservation Measures*, are based on the best scientific and commercial information and data available and have been designed to address the biological goals and objectives of the Plan. As the BDCP is being implemented, however, new data and information will be developed through the monitoring and research program described in Section 3.6, *Monitoring and Research Program*, as well as through other efforts, that

[45] Fish and Game Code Section 2805(a)

[46] Five-Point Policy for HCPs, 65 FR 106, June 1, 2000

will further inform the Implementation Office on a number of matters affecting plan implementation.

Information gained through monitoring and research will help inform investigations into such matters as: maximizing the efficacy of conservation measures and understanding the factors that may account for poorer than expected ecological responses to the implementation conservation measures; the synergistic and cumulative effects associated with multiple conservation measures; the influence of factors present outside the BDCP Plan Area, including those associated with other conservation planning efforts; and the effects of operational criteria on ecosystem conditions. Additionally, monitoring and research conducted under the BDCP and other programs produce information and data regarding the effects of climate change on Delta conditions (e.g., sea level rise, hydrology in the Delta watershed, and increased water temperatures), seismic events, projected large-scale changes in land use, and other circumstances that fall outside of the scope of the BDCP to address.

As more is understood about the Delta ecosystem, modifications to the BDCP conservation measures may be necessary. Conservation measures may initially prove to be less effective than expected, but as more is learned through the adaptive management process, certain adjustments may be possible to increase the effectiveness of measures. Alternatively, conservation measures may prove initially effective, but changing conditions in the Plan Area may necessitate changes in the manner in which conservation measure are implemented or require a shift to more effective measures. The adaptive management process will afford the Implementation Office, in coordination with the Implementation Board, the flexibility to address the shortcomings of conservation measures in meeting BDCP goals and objectives by making adjustments to these measures. Specifically, adaptive management changes may include modifications to the conservation measures, their elimination altogether, or the addition of new measures. The adaptive management program may also indicate refinements to the biological goals and objectives and targets; changes in the priorities for implementation of conservation measures, including the shifting of funds among measures; and changes to the monitoring program as indicated by new scientific information. Should strong cause and effect relationships be established, the adaptive management program will provide the mechanism to concentrate efforts on the implementation of conservation measures that have been demonstrated to be effective and to de-emphasize or discontinue implementation of conservation measures that have proven to be less effective at achieving desired outcomes.

To address uncertainty regarding Delta ecological processes and species biology, to provide for flexibility in the Conservation Strategy through time as ecological knowledge expands, and to ensure that the BDCP becomes increasingly more effective over time and responsive to changing ecological conditions in the Delta, the BDCP adaptive management program has been developed with the following elements:

- **Process Framework** – the process by which the BDCP adaptive management program will be implemented, including gathering data through monitoring and targeted research,

analyzing data, assimilating new knowledge, and making adjustments to the strategy (Section 3.7.1, *Adaptive Management Process Framework*);

- **Decision Making Process** – a decision making process that effectively uses new information in a timely manner to make adaptive management changes and that allows for sufficient input from various participants (Section 3.7.2, *Adaptive Management Decision Making Process*; see also Chapter 7, *Implementation Structure*) under the governance structure of the BDCP;
- **Adaptive Ranges** – specifically established upper and lower boundaries and limits that govern the scope of changes that can be made to conservation measures, including water operations criteria, pursuant to the adaptive management program. These ranges are reflected in the BDCP and its associated regulatory authorizations. (Section 3.7.3, *Concept of a "Defined Adaptive Range" and Water Operations Adaptive Management*);
- **Targeted Research** – experiments and pilot studies specifically designed to test uncertainties and the hypotheses underlying conservation measures, and to rapidly gain knowledge that could improve performance (Section 3.7.5, *Adaptive Management Experiments*);
- **Status Reviews** – required regular reviews of the Conservation Strategy's performance, achievement of goals and objectives, and status of covered species (Section 3.7.7, *Program Status Reviews*; see also Section 6.2, *Compliance and Progress Reporting*).

This adaptive program of knowledge expansion and implementation flexibility is central to the BDCP Conservation Strategy and the achievement of the BDCP biological goals and objectives.

3.7.1 Adaptive Management Process Framework

The process framework for the BDCP adaptive management program is depicted in Figure 3-63.

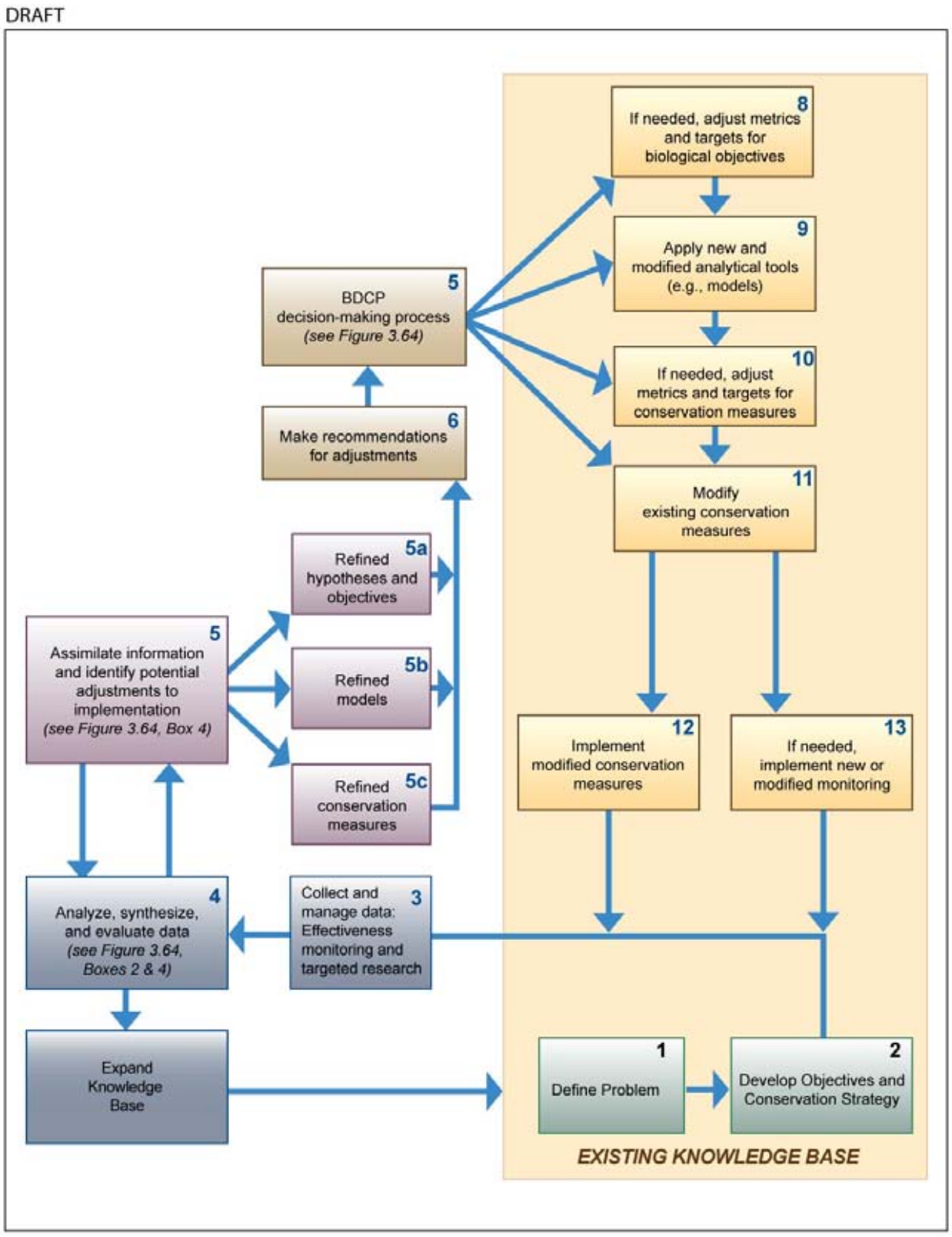

Figure 3-63. BDCP Adaptive Management Process Framework

To ensure development of a scientifically-based BDCP adaptive management program, independent science advisors were engaged to provide expert input on best approaches to adaptive management. The results of the deliberations of these scientists are reflected in the *BDCP Independent Science Advisors Report on Adaptive Management, February 2009* (Appendix G). The report set out the following principles for effective adaptive management:

1. The scope and degree of reversibility of each proposed action (i.e., conservation measure) determines the form of adaptive management that can be applied (e.g., "active" or versus "passive" adaptive management)[47].
2. The knowledge base about the ecosystem is key to decisions about what to do and what to monitor, and includes all relevant information, not just that derived from monitoring and analysis within the context of BDCP.
3. Program goals should relate directly to the problems being addressed and provide the intent behind the conservation measures; objectives should correspond to measurable, predicted outcomes.
4. Models should be used to formalize the knowledge base, develop expectations of future conditions and conservation outcomes that can be tested by monitoring and analysis, assess the likelihood of various outcomes, and identify tradeoffs among conservation measures.
5. Monitoring should be targeted at specific mechanisms thought to underlie the conservation measures, and must be integrated with an explicitly funded program for assessing the resulting data.
6. Prioritization and sequencing of conservation measures should be assessed at multiple steps in the adaptive management cycle.
7. Specifically targeted institutional arrangements are required to establish effective feedback mechanisms to inform decisions about whether to retain, modify, or replace conservation measures.
8. A dedicated, highly skilled agent (person, team, office) is essential to assimilate knowledge from monitoring and technical studies and make recommendations to senior decision makers regarding programmatic changes.

The advisors report included an adaptive management process framework. The BDCP adaptive management process depicted in the flow diagram in Figure 3-64 follows the recommendations provided in the independent science advisors report.

47 Active adaptive management is experimental, involving manipulations intended to achieve conservation goals but also to improve knowledge. Passive adaptive management is not experimental, but is nevertheless approached from a scientific perspective to improve knowledge and adapt strategies during project implementation.

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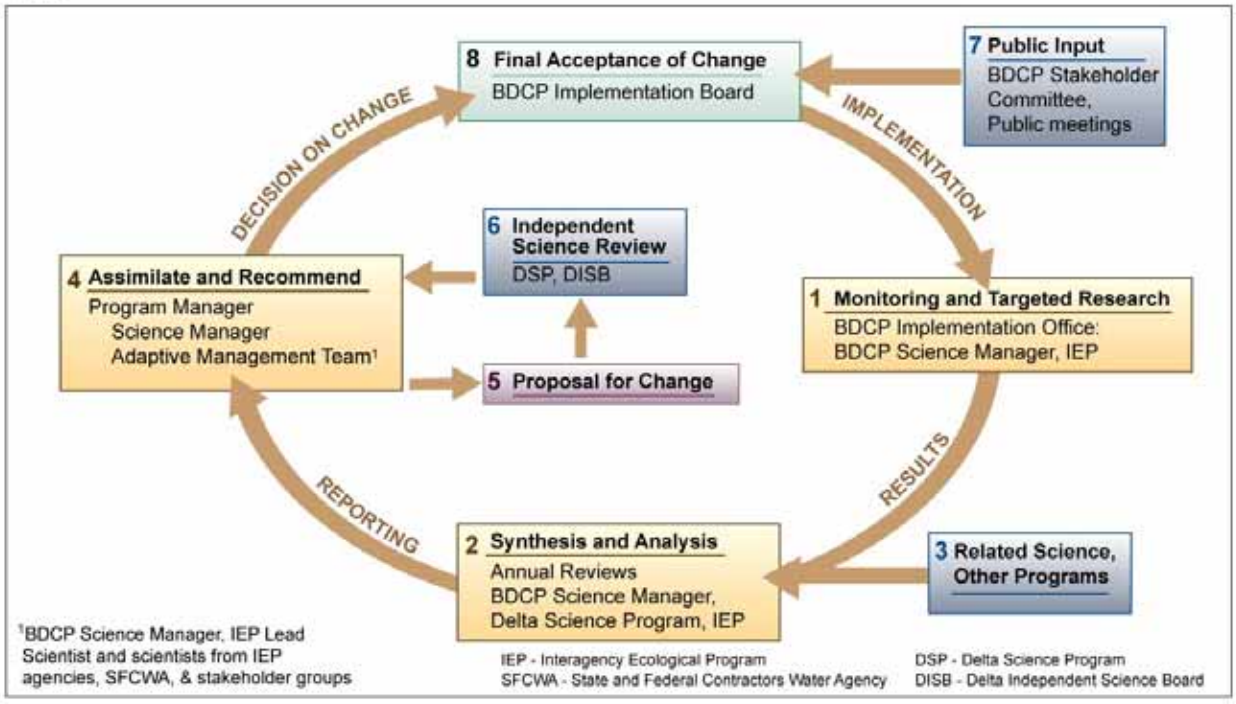

Figure 3-64. BDCP Adaptive Management – Decision-Making Process

3.7.1.1 Plan Objectives and the Knowledge Base

The starting point for the BDCP adaptive management process is with the definition of global problems and the identification of BDCP-specific, measurable and practical biological goals and objectives (see Figure 3-63, Boxes 1 and 2). BDCP objectives are based on the best available information about covered species, natural communities, ecosystem function in the Delta, and about the environmental stressors affecting these biological resources, and anticipated ecological and species responses to the conservation measures. The current information about system function and stressors comprises the existing "knowledge base" (see large shaded box underlying the right side of Figure 3-63). The adaptive management process is designed to use new information (i.e. contributions to the knowledge base) to inform a systematic and integrated critical review, at regular intervals, of the entire Conservation Strategy, including BDCP objectives, conservation measures, hypotheses relating to predicted outcomes and targets. As the knowledge base is expanded, and biological models are revised, changes may be made to the BDCP objectives and associated hypotheses, metrics, targets, and monitoring metrics (Figure 3-63, Box 5; see Section 3.7.1.3). The Science Manager, within the BDCP Implementation Office, is responsible for ensuring that the adaptive management program is focused on the achievement of BDCP biological goals and objectives and that the program draws from be best scientific and commercial information available to support adaptive management decisions.

3.7.1.2 Collect and Manage Data

Critical to the adaptive management process is the collection and management of existing and new data (see Figure 3-63, Box 3) to assess conservation measure performance and the achievement of biological goals and objectives. Monitoring and targeted research data collection and management will be the responsibility of the Science Manager within the BDCP Implementation Office with assistance from the Interagency Ecological Program (IEP), and in coordination with the Delta Science Program and other science and monitoring programs (see Section 3.6, *Monitoring and Research Program*). Monitoring actions and metrics are described in Section 3.6, *Monitoring and Research Program*. In addition, results of targeted research and scientific modeling conducted by programs other than the BDCP will contribute to the knowledge base to support understanding of ecological cause and effect relationships. Monitoring data and research results will provide the BDCP Implementation Office with information to help determine the effectiveness of conservation measures in providing benefits to species and habitats, the effectiveness of adjusting or modifying approaches to the implementation of the measures, and the effectiveness of combinations of measures to achieve desired objectives. Because new data provide the foundation for making effective adjustments to plan implementation over time through the adaptive management process, collected data will undergo quality assurance reviews. Recommendations to modify implementation of conservation measures will be guided by information gathered through the monitoring and research program and other research sources (Figure 3-63, Box 3, see also Figure 3-64, Box 3). The BDCP monitoring and research program is designed to establish cause and effect relationships between implementation of specific conservation measures and the type and

magnitude of ecosystem and species responses to those measures, as well as responses to the implementation of combinations of conservation measures.

The Implementation Office will establish processes and procedures to govern the systematic control and management of information obtained through BDCP monitoring and research. Specifically, the Implementation Office will ensure that all information is appropriately classified, stored, secured, and shared. This includes:

- Ensure that records of permanent value are preserved.
- Ensure the security and protection of regulatory, statutory or business importance from unauthorized access and/or modification.
- Ensure that all BDCP data is of the highest quality (accuracy and precision).
- Ensure responsive and transparent sharing of data across the widest-possible spectrum of users, including scientists, government agencies, non-governmental organizations and the public.

3.7.1.3 Analyze Data, Assimilate Information, and Develop and Recommend Adjustments to Implementation.

The science advisors report on adaptive management (Appendix G) pointed out that the weakest aspect of most adaptive management plans is in the sequence of steps required to link the knowledge gained from implementation monitoring and research and other sources to decisions about whether to continue, modify, or stop actions, refine objectives, or alter monitoring (Figure 3-63, Box 5 and Box 6; Figure 3-65). See the discussion of internal and external science review in the 3.7.2, *Adaptive Management Decision Making*.

Collected data will be analyzed and synthesized at appropriate intervals by the Implementation Office, in coordination with Delta Science Program and IEP, and these results will be evaluated by the Adaptive Management Team. The BDCP Science Manager may utilize IEP, the Delta Science Program, and other expertise to support the evaluation of monitoring and research data. Results will include information related to cause and effect relationships between conservation measures and ecological processes, covered species, and natural communities; the status of ecosystem conditions and covered species; and the effectiveness of the conservation measures and the monitoring program (Figure 3-63, Box 5). The results will also clearly identify the inferential reliability of this knowledge (sensu Romesburg 1981), statistical performance measures (e.g. power accuracy, precision) and, if appropriate, alternative hypotheses generated from the results. Information gained through this process may indicate the need to redefine hypotheses underlying biological objectives and conservation measures; refine, discontinue, or expand conservation measures; or develop and implement new conservation measures within limits set by the plan and its associated regulatory authorizations.

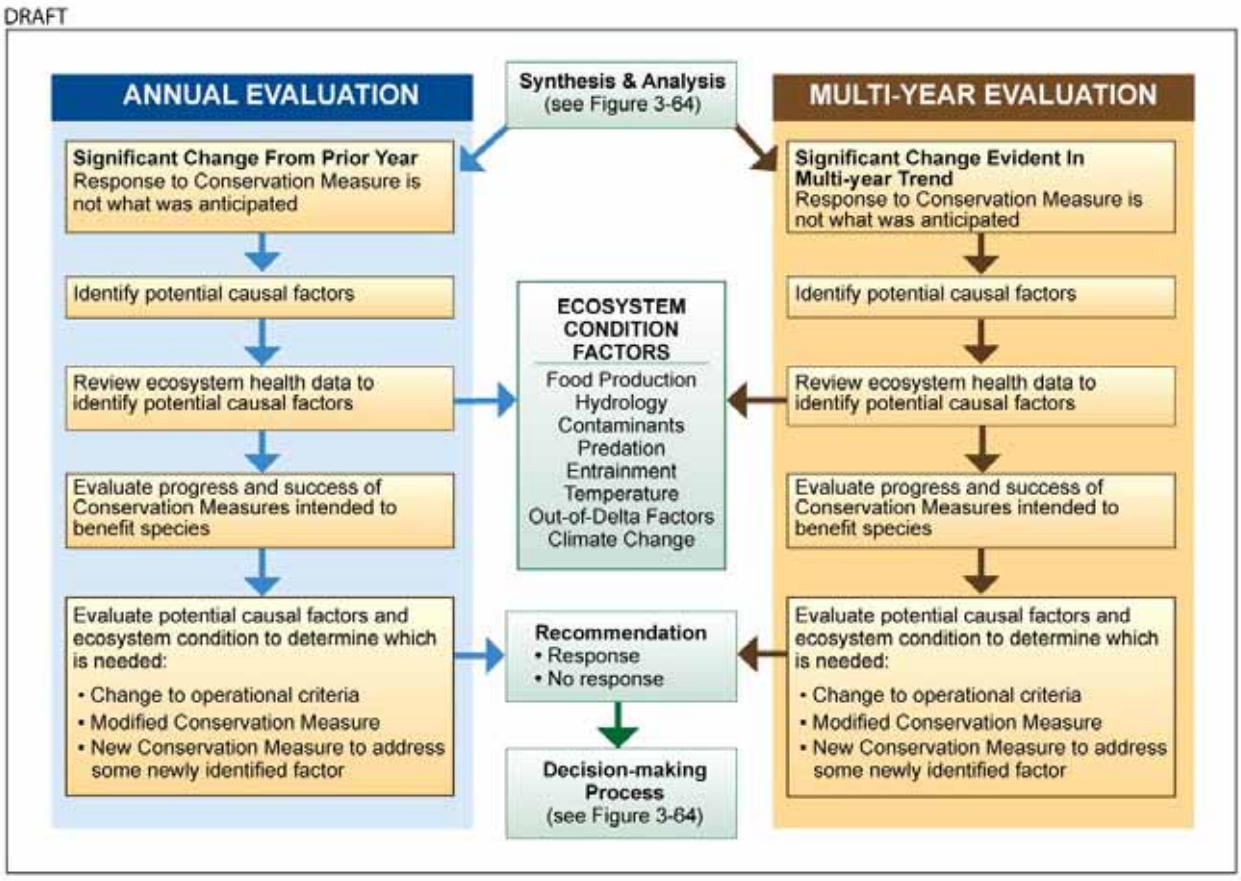

Figure 3-65. BDCP Adaptive Management Process: Response to a Significant Declining Trend in Covered Species

The science advisors also emphasized the need to integrate the evaluation of the efficacy of conservation measures across suites of measures that are inter-related, and to use and expand upon the existing (and new) modeling capabilities to assist in that integrated evaluation. New data will therefore also be used to update models (e.g., conceptual, statistical, and process models) and other analytical tools that are useful in assessing the performance of both individual conservation measures and suites of interrelated measures in helping to achieve the goals and objectives of the plan as the magnitude of stressors are better understood and uncertainties are resolved. New data and modeling work will also help predict the magnitude and trajectory of ecosystem and covered species responses to conservation measures and identify the need for new models and tools (Figure 3-63, Box 5 which corresponds to Box 4 of decision making process illustrated in Figure 3-64). Ecological models (either conceptual or mathematical) are extremely valuable for formalizing the link between objectives and proposed conservation measures to clarify how and why each conservation measure is expected to contribute to objectives and are a key element of adaptive management. Models will be used to formalize knowledge about the system and to predict the outcomes of and design modifications to conservation measures.

Based on assimilation of new information, the Adaptive Management Team (see Section 3.7.2.1, *Roles and Responsibilities*) working with the IEP, Real Time Operations Response Team (see Chapter 7, *Implementation Structure*) and the Implementation Facilitation Team (see Chapter 7, *Implementation Structure*), as appropriate, will formulate recommended new approaches for BDCP implementation intended to increase the effectiveness of conservation measures, the monitoring program, analytical tools, and metrics in meeting the biological goals and objectives of the BDCP (see Figure 3-63, Box 6). The BDCP Program Manager may include such recommendation in the Annual Workplan and Budget (see Section 6.2, *Compliance and Progress Reporting*). Recommended new approaches to conservation actions would be considered, and potentially adopted, through the BDCP adaptive management decision making process (Figure 3-64).

3.7.1.4 Implement Modified Conservation Measures, Tools, Metrics, and Targets

BDCP Implementation Office through the adaptive management program, and within the limits of the adaptive ranges set out in the BDCP and reflected in the associated regulatory authorizations, would implement adaptive changes to the BDCP Conservation Strategy that may include:

- **Adjustments to metrics and targets for biological objectives** (Figure 3-63, Box 8) – Metrics and targets for BDCP biological objectives were developed based on the existing knowledge base. New information developed during the BDCP implementation could result in the need to revise metrics and targets for these objectives (as allowable under the authorizing permits).
- **Development and application of new analytical tools** (Figure 3-63, Box 9) – As knowledge grows over time, new analytical tools are expected to be developed including monitoring technologies and techniques, physical and biological models, statistical

relationships, etc. These new tools would be applied to the monitoring and evaluation of implementation of the BDCP Conservation Strategy as they become available.

- **Adjustments to metrics and targets for conservation measures** (Figure 3-63, Box 10) – Specific metrics and targets have been identified for BDCP conservation measures based on existing knowledge. As understanding of the Delta ecosystem improves, revisions would be made to these metrics and targets to reflect this new knowledge, as appropriate.
- **Modification of conservation measures** (Figure 3-63, Box 11) – The adaptive management program guides the modification of BDCP conservation measures to improve effectiveness in meeting BDCP goals and objectives. The adaptive management program can also modify priorities and timetables for implementing conservation measures based on new knowledge.
- **Discontinuance of ineffective conservation measures** (Figure 3-63, Box 11) – The adaptive management program allows for the elimination of unsuccessful conservation measures. The funds allocated to these measures may be reallocated to expand successful measures.
- **Identification of new conservation measures** (Figure 3-63, Box 11) – As a result of BDCP monitoring and research and new knowledge, new stressors may be identified which are drivers of ecosystem change and species response. The adaptive management program may be used, subject to the limits established in the Plan, to incorporate new conservation measure to address these stressors in the Conservation Strategy. [***Note to Reviewers****: Could refer to Section 3.5, Potential Conservation Measures to Address Other Stressors, depending on the approach decided for those potential conservation measures.]*
- **Implementation of new or modified monitoring methods** (Figure 3-63, Box 13) – The adaptive management program will inform and guide the subjects of monitoring, monitoring metrics, and the duration and scope of monitoring. Monitoring technology and techniques improve through time and as new methods are developed they will be incorporated into the BDCP monitoring program. The adaptive management program would also identify and implement modifications to the research program and adaptive management experiments to address new uncertainties and fill knowledge gaps.

BDCP actions related to SWP and CVP water operations remain under the authority and are the responsibility of DWR and Reclamation, not the Implementation Office. Adjustments to the water operations criteria set out in the BDCP and reflected in its associated authorizations, and within the adaptive range for water operations described in CM1 *Water Facilities and Operations*, may only be conducted through the process identified in Section 3.7.3.2, *Decision Process for Adjusting Water Operations within the Adaptive Range.*

3.7.2 Adaptive Management Decision Making Process

This section describes the process by which adaptive management decisions will be made, including those that result in adjustments to conservation measures, operational criteria, biological objectives, metrics and targets, the monitoring program including monitoring methods, and analytical tools, as warranted by new information. This section describes the relationships among, and coordination between, the entities that comprise the governance structure (Chapter 7, *Implementation Structure*) in the context of the adaptive management decision-making process (Figure 3-64).

3.7.2.1 Roles and Responsibilities

3.7.2.1.1 Science Manager

The BDCP Implementation Office, under the direction of the BDCP Program Manager, is responsible for Plan implementation, including the monitoring, research, and adaptive management programs. The BDCP Science Manager, under the direction of the Program Manager, is the primary Implementation Office staff responsible for ensuring the proper implementation of these programs.

3.7.2.1.2 Adaptive Management Team

The Science Manager may create an "Adaptive Management Team" and will serve as the chair of and recommend membership for the BDCP Adaptive Management Team to the Program Manager. Membership of the Adaptive Management Team will be reviewed and approved by the BDCP Program Manager and the BDCP Implementation Board. The Adaptive Management Team may include:

- BDCP Science Manager (chair);
- IEP Lead Scientist;
- Senior scientists from IEP member agencies[48];
- SFWCA scientists;
- Other scientists; and
- Scientists from the Stakeholder Committee, as appropriate.

Adaptive Management Team members may change as necessary depending on specific the technical issues that need to be addressed (e.g., fisheries, terrestrial wildlife, habitat restoration, water operations).

[48] IEP has ten member agencies: three State (DWR, DFG, and State Water Resources Control Board); six Federal (USFWS, Reclamation, U.S. Geological Survey, USACE, NMFS, and U.S. Environmental Protection Agency), and one non-government organization (The San Francisco Estuarine Institute).

The Science Manager will utilize the Adaptive Management Team to support the conduct of annual and multi-year reviews, in coordination with the Delta Science Program, including efforts to identify issues that may benefit from independent science advice; consider potential adaptive management actions that may be indicated by the results of monitoring and research efforts; and identify research that may be useful to effectively address uncertainties. The Adaptive Management Team will make recommendations to the Program Manager for adaptive management changes to the BDCP Conservation Strategy.

The Science Manager may utilize the Adaptive Management Team to support the synthesis and presentation of current scientific knowledge on relevant Delta resources to the Program Manager and BDCP Implementation Board.

3.7.2.2 Adaptive Management Decisions and Responses (Not Related to Water Operations)

The Program Manager will manage the BDCP adaptive management program through the Science Manager. The Program Manager will facilitate and coordinate discussion and consideration of adaptive management issues among the various participating entities, including the authorized entities, fish and wildlife agencies, and the Implementation Board to facilitate decision-making regarding changes in the implementation of the Plan. Adaptive management decisions to take new actions within the BDCP Plan Area will take into account and be coordinated with changes that may be made to upstream operations, which may result from changes made pursuant to existing or future biological opinions for the CVP/SWP project operations outside the Delta. The decision-making process described in this section does not apply to changes or modifications to water operations that may be made by DWR and USBR. The process for adaptive management decisions affecting water operations is set out in Section 3.7.3.2, *Decision Process for Adjusting Water Operations within the Adaptive Range*. The approach depicted in Figure 3-64 will be used to make adaptive management decisions relating to BDCP actions that are not related to water operations.

1. Monitoring and targeted research (Figure 3-64, box 1) will be conducted under the direction of the Science Manager, with support provided by the IEP.

2. The BDCP Science Manager, in coordination with the IEP, Adaptive Management Team, and the Delta Science Program, will assemble, synthesize, and analyze the results of BDCP monitoring and targeted research (Figure 3-64, box 2) efforts and integrate the results of new and relevant scientific research and studies conducted by other parties (Figure 3-64, box 3).

3. Based on this information and the advice of independent scientists, as appropriate (Figure 3-64, boxes 5 and 6), the Adaptive Management Team, through the Science Manager, will provide recommended program changes to the Program Manager (Figure 3-64, Box 4), either as part of the annual and five year workplan development process or on an *ad hoc* basis, where an adaptive change should occur on a shorter than annual timeframe.

4. The Program Manager will recommend adaptive management changes to the Implementation Board (Figure 3-64, Box 4). The Implementation Board will provide an opportunity for stakeholder input (Figure 3-64, box 7). The Implementation Board will review the Program Manager's recommendation and make final acceptance of the proposed adaptive management changes (Figure 3-64, Box 8).

The BDCP Implementation Board will receive information on the implementation of the BDCP generally, and will review major aspects of the adaptive management program described in the Annual Workplan. Members of the Board will have the right to object to adaptive management proposals made by the Program Manager on the basis that the proposed change, a) will not adequately contribute to achievement of the goals and objectives of the BDCP, or, b) is inconsistent with the requirements of the Plan or the permits/authorizations. If changes are accepted by the Board, they will be implemented by the Implementation Office under the accepted timetable. If the Board cannot come to agreement on an adaptive management change, the dispute resolution process described in Chapter 7, *Implementation Structure*, will be used.

As the BDCP is being implemented, it is expected that some changes in implementation actions and some adaptive management decisions will be considered to be minor. These minor decisions will not be subject to the formal adaptive management decision process as described above. Once such a type or category of change is accepted as minor by the Implementation Board, the Program Manager will be able to undertake such minor adjustments to conservation measures, without the need for extensive coordination with the other entities, thereby encouraging efficiency and timeliness in the implementation process. Such changes to the manner in which actions are implemented under the Plan include, for example, refinements to techniques used to restore habitat or to remove invasive species.

Plan implementation and adaptive management responses that will require full review as part of the adaptive management process include:

- Any change in the water operating criteria within the adaptive range;
- Discontinuation of a conservation measure;
- Expansion of a conservation measure;
- Addition of a new conservation measure;
- Decisions to reallocate available funding or resources away from ineffective conservation measures and toward more promising ones; or
- Any change to BDCP goals and objectives.

The Program Manager will consult with the Implementation Facilitation Team, the Real Time Operations Response Team and Adaptive Management Team regarding ongoing implementation issues which may require changes to broad elements of the Plan or specific actions to determine if such changes should be considered through the adaptive management process. Changes to the

Plan would be subject to the limits, boundaries, parameters and sideboards established for adaptive management actions, including funding caps established to implement the BDCP Conservation Strategy.

In some instances, a significant change in population trends for a covered species may occur, necessitating responsive actions (Figure 3-65). Efforts to respond to such circumstances would be conducted within the framework of the adaptive management program, as appropriate.

3.7.2.3 Internal Scientific Review

The Program Manager will use the Adaptive Management Team to provide internal scientific review (internal to the Implementation Office) on specific technical issues of immediate importance to the success of the adaptive management program and the Conservation Strategy implementation. The Adaptive Management Team will also assess on a regular basis the overall efficacy of the adaptive management program, including the results of effectiveness monitoring, selection of research and adaptive management experiments, and relevance of new scientific information developed by others (e.g., universities, Delta Science Program) to determine whether changes in the implementation of the conservation measures and the monitoring program would improve the effectiveness of the BDCP in achieving its biological goals and objectives

Recommendations made by the Adaptive Management Team and by other scientists and experts will be memorialized in a standardized format and will include a description of the recommended change in implementation; a description of the justification for the recommended change; an assessment of effects the change may have on other elements of BDCP implementation, if any; and any other relevant information in support of the recommendation. The rationale for rejection of adaptive management recommendations made during the internal science review process will also be documented.

3.7.2.4 External Independent Scientific Review

Working in coordination with the Delta Science Program and the Adaptive Management Team, the Program Manager will from time to time seek additional science input on specific implementation and adaptive management-related issues. The Program Manager may convene, at its discretion, experts on selected topics that are not affiliated with the Implementation Office, permit holders, or fish and wildlife agencies. The Program Manager will consult with the Implementation Board regarding the selection of scientists to provide advice on specific matters.

3.7.3 Concept of a "Defined Adaptive Range" and Water Operations Adaptive Management

[***Note to Reviewers**: The process for making adjustments to water operations within the adaptive range needs to be consistent with the process in Section 3.7.2.2, with recognition that these kinds of changes will likely be made more frequently.*]

To allow for flexible and responsive implementation of the BDCP, several conservation measures include a defined "adaptive range" that establishes the parameters within which a conservation measure may be adjusted to improve its effectiveness or respond to changing biological conditions. For example CM6 *Channel Margin Habitat Enhancement* identifies a target of 20 linear miles of enhancement of channel margins in areas important to salmonid outmigration and identifies an adaptive range that allows for an additional 20 miles of margin enhancement through the adaptive management program should this measure prove to be highly effective.

3.7.3.1 Water Operations Adaptive Range

Defined adaptive ranges are included in the BDCP Conservation Strategy for a number of operational criteria established for water operations (see CM1 *Water Facilities and Operations* in Section 3.4 *Conservation Measures*). For example, initial operational criteria (to be implemented once new facilities become operational) are identified in CM1 for Sacramento River bypass flows at the north Delta diversions, along with a defined adaptive range. This adaptive range includes allowance for increasing the bypass flows, through the adaptive management process, should an initial flow criterion prove to be less effective than expected (as defined by the Plan; *e.g.*, objectives established to protect covered fish species). Similarly, a lower limit to the defined adaptive range includes an allowance for narrowing the bypass criteria (allowing increased diversions) should flows or other conservation measures prove more effective in meeting objectives than expected, as defined by a standard or measure set out in the biological objectives and monitoring program.

3.7.3.2 Decision Process for Adjusting Water Operations within the Adaptive Range

SWP and CVP water operations are under the authority and are the responsibility of DWR and Reclamation, not the Implementation Office. Accordingly, DWR and Reclamation will implement the BDCP water operations conservation measures, under CM1 *Water Facilities and Operations*. Adjustments of the water operations criteria within the adaptive range for water operations, established at the time of BDCP authorization and described in CM1 *Water Facilities and Operations*, may only be conducted through the following process.

1. **Proposal to change operating criteria within the adaptive range provided to Program Manager** - Proposals to change the criteria for water operations are likely to come primarily from the IO staff, but may come from an outside body. However, proposed changes may also be requested by member of the Stakeholder Committee. All proposals related to changes in the water operations criteria will be submitted to the Program Manager. A proposal to change the real time operational range within the adaptive range will be identified in the draft Annual Water Operations Strategy and the draft Annual Workplan and Budget. Out-of-cycle proposals for changes may be requested, if necessary, to address biological objectives in situations that are time sensitive.

2. **Review of proposed change** - The Program Manager, through the Science Manager, will solicit independent science input on the proposed change from the Delta Science Program, Independent Science Board, and other appropriate independent scientists with expertise in the resources and operational change proposed.

3. **Submittal of proposal for change by Program Manager to the "Decision Body"** – The Program Manager will submit the proposed change to the "Decision Body" for review as part of the draft Annual Workplan and Budget. Out-of-cycle proposals for changes may be submitted, if necessary to address biological objectives in situations that are time sensitive. [***Note to Reviewers****: The placeholder "Decision Body" is used here until the appropriate entity(ies) is/are identified to serve in the role.*]

4. **Review of proposal for change by "Decision Body" -** The program manager will facilitate a review by the "Decision Body." The "Decision Body" will review the proposed operational change and determine if it is acceptable.

5. **Resolutions of disputes among directors** – If the "Decision Body" cannot reach consensus, then the decision on the proposed change will be elevated to the "Higher Level Decision Body" for joint resolution.

6. **Establish the changed criteria** - Once changes are agreed to by the "Decision Body" or through the dispute resolution process, they will be incorporated into the Annual Water Operations Strategy by DWR and Reclamation and implemented under the accepted timetable. These changed criteria will become the new operational criteria for the conservation measure within which the Real Time Operations Response Team may make real time operational decisions.

The process described above applies only to changes in operational criteria that are within the bounds of the operational adaptive range established at the time of BDCP authorization and described in CM1 *Water Facilities and Operations.* .

3.7.4 Concept of Adaptive Management Triggers

The Program Manager, with Implementation Board concurrence, may elect to develop adaptive management triggers for specific parameters and metrics during Plan implementation as a tool to support the adaptive management program, should the development of such triggers prove valuable to the program. Adaptive management triggers are quantified thresholds established for objectives or conservation measures that, if exceeded, would identify the need for an analysis of cause and effect and development of alternative actions to improve effectiveness of the conservation measure. Adaptive management triggers related to effectiveness identify specific conditions in which targets are not likely to be achieved and therefore adaptive changes should be considered and undertaken.

3.7.5 Adaptive Management Experiments

Because the biological outcome of many management actions is uncertain, the adaptive management program is based on scientific principles that guide continual refinement of conservation efforts in order to achieve the biological goals of the plan. The adaptive management program will develop alternative management strategies and test the effectiveness of these strategies. To that end, there is a continuum of management actions that incorporate scientific principles of adaptive management to varying degrees. The simplest studies involve monitoring effects once a conservation action has been taken, without replication, controls, or comparison of management treatments. At the other end of the spectrum is targeted research that tests a hypothesis in a manner that can be validated through statistical inference.

3.7.5.1 Targeted Research

There are a number of key uncertainties surrounding covered species, ecological processes, and biotic/abiotic interactions, and regarding the effectiveness of the conservation measures (see discussions of hypothesized benefits for individual conservation measures in Section 3.4, *Conservation Measures).* Some of these key uncertainties are expected to be resolved using adaptive management targeted research and others may be resolved by studies outside BDCP.

The Implementation Office may undertake or fund targeted research through the BDCP research program to provide information necessary to adaptively implement the BDCP (see Section 3.6, *Monitoring and Research Program*). This research should answer specific management-related questions that arise based on results of monitoring and to address data gaps to provide information necessary to successfully implement the conservation measures.

Results of research will inform management decisions to and increase the effectiveness of conservation measures. It is expected that most or all targeted research will be conducted by or in partnership with outside scientists from academic institutions, consulting firms, and non-profit organizations. It is anticipated that funding provided by the Implementation Office for targeted research could be matched or supplemented by other entities to increase the level of research and to achieve results that integrate with broader issues in the research community. The amount of targeted research will be limited by funding available to the Implementation Office.

In addition to targeted research undertaken by the Implementation Office, it is also expected that scientists within the Implementation Office will develop partnerships with academic institutions to encourage academic research that could inform and improve management and monitoring techniques.

3.7.5.2 Management-Oriented Conceptual Models

Conceptual models describe our current understanding of a functioning ecosystem. They provide a framework for learning about a system and help formulate hypotheses about cause-and-effect relationships. Conceptual models are useful for management because they can help to identify

which factors may be important in a system, which of these factors may be influenced by management, and hence which attribute (component or condition) of the system should be assessed. Conceptual models can inform the research program in several important ways: by providing a basis from which to test assumptions about the relative importance of certain processes, by helping to identify threats or stressors, by identifying species or other attributes that function as ecosystem indicators, and by serving as a repository of our changing understanding of the system as more data become available. Conceptual models can also be used to communicate understanding of the system to other scientists and the public and to facilitate review. For a multi-species, ecosystem-process-based and habitat-based conservation plan such as the BDCP, models provide a useful framework for understanding how individual species react to the same management actions. Therefore, models must be sufficiently complex as to capture the relationships that drive the system and translate these relationships to covered species, but streamlined enough to be useful as management and monitoring tools. Models are only as good as the information used to develop them. Several types of conceptual models have been used in the development of the BDCP Conservation Strategy, and other models may be developed as more data become available, and as more efficient tools are developed.

The Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Conceptual Models developed by the CALFED Ecosystem Restoration Program are a suite of process, habitat, and species models incorporating the current scientific understanding of the Delta. These conceptual models describe the relationship of life history components to known drivers or stressors, and include categorical evaluations of the relative importance, predictability and level of understanding of the linkages between these drivers/stressors and outcomes. The DRERIP Evaluation Process was used to evaluate the relative magnitude and certainty of effects of proposed BDCP conservation measures on aquatic covered species (i.e., fish and aquatic plants), aquatic and estuarine natural communities, and related ecosystem processes using these DRERIP models and other available data (see Section 10.3.5, *DRERIP Evaluation Process* and Appendix F, *BDCP DRERIP Evaluation Results of Draft Conservation Measures.*). The DRERIP process was also used to explicitly identify key data gaps that should be filled through directed research or other exploratory studies. In most cases these models consist of diagrams that show the hypothesized relationships that characterize the ecosystem and are supplemented by written materials. There is also a need to develop full life history model for all of the covered fish species to facilitate plan implementation and guide adaptive management decision making process. Additional models may be developed as needed during the development and refinement of detailed monitoring plans. As new information becomes available, the DRERIP models will be updated to improve confidence in model parameters.

Species-habitat models have been developed for terrestrial Covered Species and natural communities; (see Appendix A, *Covered Species Accounts*). Species-habitat models, which can also be considered conceptual models, are useful tools that make explicit the assumptions about the relationship between species and habitat type. Species-habitat models were developed for the BDCP to hypothesize a relationship between land cover type and other habitat components and the distribution of covered species. These models have served as the basis for identifying current

habitat distribution, predicting habitat distribution after restoration-related conservation measures are implemented, estimating impacts of conservation measure implementation, and prioritizing land acquisition. Information from pre-acquisition surveys and the planning surveys for covered activities will further refine these models such that they can be used to more accurately predict distribution, occupancy, and assess population trends.

3.7.6 Database Development and Reporting

Proper data management, analysis, and reporting are critical to the success of the adaptive management program. Data on monitoring methods, results, and analysis must be managed, stored, and made available to Implementation Office staff, decision-makers, scientific advisors, and other appropriate persons. A database and clear reporting procedure is also required for permit compliance. See Section 3.6.8, *Database Development and Maintenance*, for a discussion of the proposed database structure.

3.7.7 Program Status Reviews

Requirements for annual and five year reports and work plans by the Implementation Office that include discussions of implementation results and adaptive management changes are described in Section 6.2, *Compliance and Progress Reporting*.

3.7.8 Public Involvement

Public involvement is an especially important component of successful adaptive management. The responsibility for public outreach by the Implementation Office is described in Section 7.5, *Public Outreach*.