

3.7 ADAPTIVE MANAGEMENT PROGRAM

[*Note to Reviewers: The text of this section of Chapter 3 on adaptive management is subject to change and revision based on 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.”¹ 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.”²

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

¹ Fish and Game Code Section 2805(a)

² Five-Point Policy for HCPs, 65 FR 106, June 1, 2000

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

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

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

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

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

- 1 analyzing data, assimilating new knowledge, and making adjustments to the strategy
2 (Section 3.7.1);
- 3 • **Decision Making Process** – a decision making process that effectively uses new
4 information in a timely manner to make adaptive management changes and that allows
5 for sufficient input from various participants (Section 3.7.2; see also Chapter 7,
6 *Implementation Structure*) under the governance structure of the BDCP;
 - 7 • **Adaptive Ranges** – specifically established upper and lower boundaries and limits that
8 govern the scope of changes that can be made to conservation measures, including water
9 operations criteria, pursuant to the adaptive management program. These ranges are
10 reflected in the BDCP and its associated regulatory authorizations. (Section 3.7.3);
 - 11 • **Targeted Research** – experiments and pilot studies specifically designed to test
12 uncertainties and the hypotheses underlying conservation measures, and to rapidly gain
13 knowledge that could improve performance (Section 3.7.5);
 - 14 • **Status Reviews** – required regular reviews of the Conservation Strategy’s performance,
15 achievement of goals and objectives, and status of covered species (Section 3.7.6; see
16 also Section 6.2, *Compliance and Progress Reporting*).

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

19 **3.7.1 Adaptive Management Process Framework**

20 The process framework for the BDCP adaptive management program is depicted in Figure 3.11.

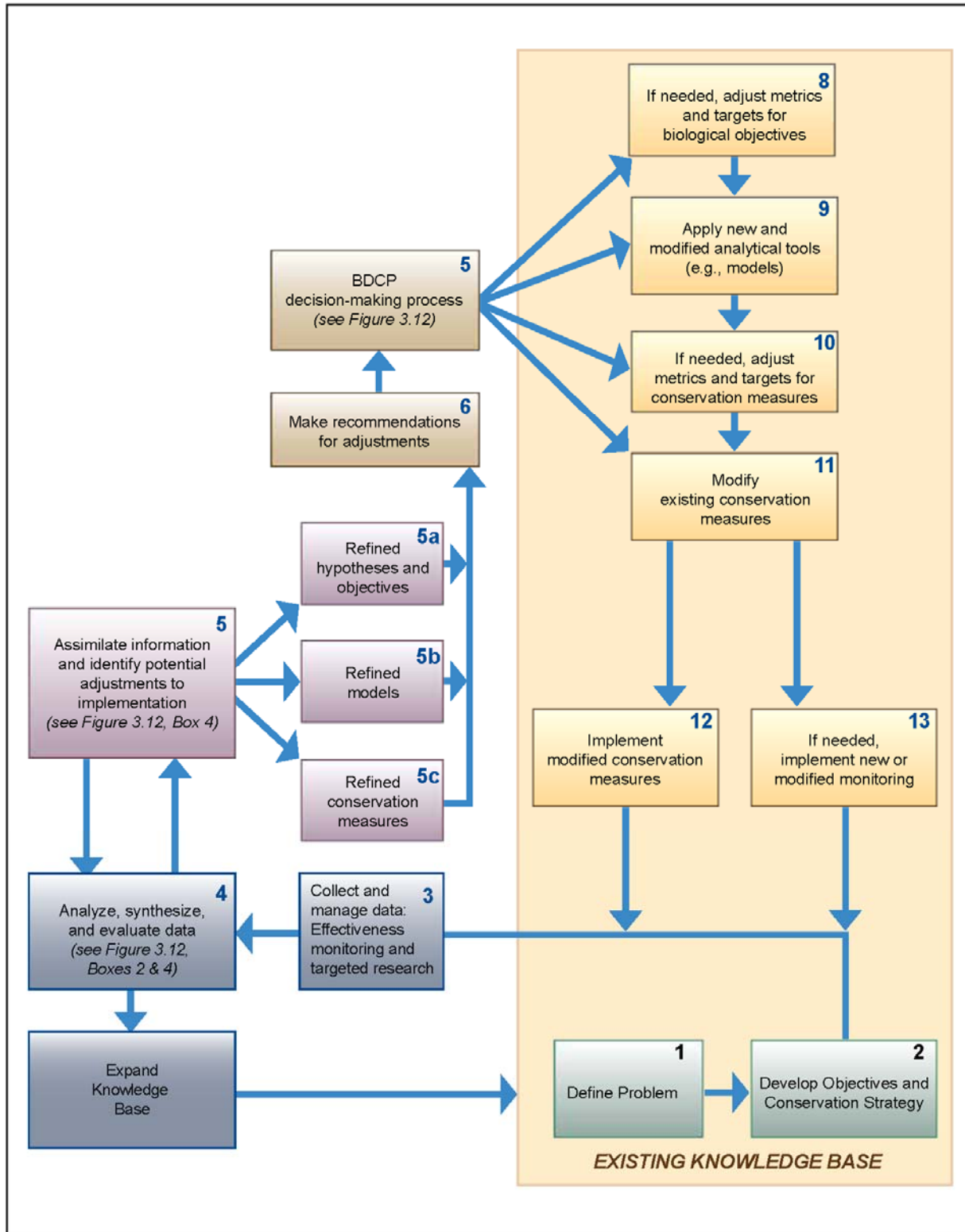


Figure 3-11. BDCP Adaptive Management Process Framework

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

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

30 The advisors report included an adaptive management process framework. The BDCP adaptive
31 management process depicted in the flow diagram in Figure 3.11 follows the recommendations
32 provided in the independent science advisors report.

3 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.

1 **3.7.1.1 Plan Objectives and the Knowledge Base**

2 The starting point for the BDCP adaptive management process is with the definition of global
3 problems and the identification of BDCP-specific, measurable and practical biological goals and
4 objectives (see Figure 3.11, Box 1, 2). BDCP objectives are based on the best available
5 information about covered species, natural communities, ecosystem function in the Delta, and
6 about the environmental stressors affecting these biological resources, and anticipated ecological
7 and species responses to the conservation measures. The current information about system
8 function and stressors comprises the existing “knowledge base” (see large shaded box underlying
9 the right side of Figure 3.11). The adaptive management process is designed to use new
10 information (i.e. contributions to the knowledge base) to inform a systematic and integrated
11 critical review, at regular intervals, of the entire Conservation Strategy, including BDCP
12 objectives, conservation measures, hypotheses relating to predicted outcomes and targets. As the
13 knowledge base is expanded, and biological models are revised, changes may be made to the
14 BDCP objectives and associated hypotheses, metrics, targets, and monitoring metrics (Figure
15 3.11, Box 5; see Section 3.7.1.3). The Science Manager, within the BDCP Implementation
16 Office, is responsible for ensuring that the adaptive management program is focused on the
17 achievement of BDCP biological goals and objectives and that the program draws from the best
18 scientific and commercial information available to support adaptive management decisions.

19 **3.7.1.2 Collect and Manage Data**

20 Critical to the adaptive management process is the collection and management of existing and
21 new data (see Figure 3.11, Box 3) to assess conservation measure performance and the
22 achievement of biological goals and objectives. Monitoring and targeted research data collection
23 and management will be the responsibility of the Science Manager within the BDCP
24 Implementation Office with assistance from the Interagency Ecological Program (IEP), and in
25 coordination with the Delta Science Program and other science and monitoring programs (see
26 Section 3.6, *Monitoring and Research Program*). Monitoring actions and metrics are described
27 in section 3.6, *Monitoring and Research Program*. In addition, results of targeted research and
28 scientific modeling conducted by programs other than the BDCP will contribute to the
29 knowledge base to support understanding of ecological cause and effect relationships.
30 Monitoring data and research results will provide the BDCP Implementation Office with
31 information to help determine the effectiveness of conservation measures in providing benefits to
32 species and habitats, the effectiveness of adjusting or modifying approaches to the
33 implementation of the measures, and the effectiveness of combinations of measures to achieve
34 desired objectives. Because new data provide the foundation for making effective adjustments to
35 plan implementation over time through the adaptive management process, collected data will
36 undergo quality assurance reviews. Recommendations to modify implementation of conservation
37 measures will be guided by information gathered through the monitoring and research program
38 and other research sources (Figure 3.11, Box 3, see also Figure 3.12 Box 3). The BDCP
39 monitoring and research program is designed to establish cause and effect relationships between
40 implementation of specific conservation measures and the type and magnitude of ecosystem and

1 species responses to those measures, as well as responses to the implementation of combinations
2 of conservation measures.

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

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

14 **3.7.1.3 Analyze Data, Assimilate Information, and Develop and Recommend** 15 **Adjustments to Implementation.**

16 The science advisors report on adaptive management (Appendix G) pointed out that the weakest
17 aspect of most adaptive management plans is in the sequence of steps required to link the
18 knowledge gained from implementation monitoring and research and other sources to decisions
19 about whether to continue, modify, or stop actions, refine objectives, or alter monitoring (Figure
20 3.11, Box 5 and Box 6; Figure 3.13). See the discussion of internal and external science review
21 in the 3.7.2, *Adaptive Management Decision Making*.

22 Collected data will be analyzed and synthesized at appropriate intervals by the Implementation
23 Office, in coordination with Delta Science Program and IEP, and these results will be evaluated
24 by the Adaptive Management Team. The BDCP Science Manager may utilize IEP, the Delta
25 Science Program, and other expertise to support the evaluation of monitoring and research data.
26 Results will include information related to cause and effect relationships between conservation
27 measures and ecological processes, covered species, and natural communities; the status of
28 ecosystem conditions and covered species; and the effectiveness of the conservation measures
29 and the monitoring program (Figure 3.11, Box 5). The results will also clearly identify the
30 inferential reliability of this knowledge (sensu Romesburg 1981), statistical performance
31 measures (e.g. power accuracy, precision) and, if appropriate, alternative hypotheses generated
32 from the results. Information gained through this process may indicate the need to redefine
33 hypotheses underlying biological objectives and conservation measures; refine, discontinue, or
34 expand conservation measures; or develop and implement new conservation measures within
35 limits set by the plan and its associated regulatory authorizations.

1 The science advisors also emphasized the need to integrate the evaluation of the efficacy of
2 conservation measures across suites of measures that are inter-related, and to use and expand
3 upon the existing (and new) modeling capabilities to assist in that integrated evaluation. New
4 data will therefore also be used to update models (e.g., conceptual, statistical, and process
5 models) and other analytical tools that are useful in assessing the performance of both individual
6 conservation measures and suites of interrelated measures in helping to achieve the goals and
7 objectives of the plan as the magnitude of stressors are better understood and uncertainties are
8 resolved. New data and modeling work will also help predict the magnitude and trajectory of
9 ecosystem and covered species responses to conservation measures and identify the need for new
10 models and tools (Figure 3.11, Box 5 which corresponds to Box 4 of decision making process
11 illustrated in Figure 3.12). Ecological models (either conceptual or mathematical) are extremely
12 valuable for formalizing the link between objectives and proposed conservation measures to
13 clarify how and why each conservation measure is expected to contribute to objectives and are a
14 key element of adaptive management. Models will be used to formalize knowledge about the
15 system and to predict the outcomes of and design modifications to conservation measures.

16 Based on assimilation of new information, the Adaptive Management Team (see Section 3.7.2.1,
17 *Roles and Responsibilities*) working with the IEP, Real Time Operations Response Team (see
18 Chapter 7, *Implementation Structure*) and the Implementation Facilitation Team (see Chapter 7,
19 *Implementation Structure*), as appropriate, will formulate recommended new approaches for
20 BDCP implementation intended to increase the effectiveness of conservation measures, the
21 monitoring program, analytical tools, and metrics in meeting the biological goals and objectives
22 of the BDCP (see Figure 3.11, Box 6). The BDCP Program Manager may include such
23 recommendation in the Annual Workplan and Budget (see Section 6.2, *Compliance and Progress*
24 *Reporting*). Recommended new approaches to conservation actions would be considered, and
25 potentially adopted, through the BDCP adaptive management decision making process (Figure
26 3.12).

27 **3.7.1.4 Implement Modified Conservation Measures, Tools, Metrics, and** 28 **Targets**

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

- 33 • **Adjustments to metrics and targets for biological objectives** (Figure 3.11, Box 8) –
34 Metrics and targets for BDCP biological objectives were developed based on the existing
35 knowledge base. New information developed during the BDCP implementation could
36 result in the need to revise metrics and targets for these objectives (as allowable under the
37 authorizing permits).
- 38 • **Development and application of new analytical tools** (Figure 3.11, Box 9) – As
39 knowledge grows over time, new analytical tools are expected to be developed including

1 monitoring technologies and techniques, physical and biological models, statistical
2 relationships, etc. These new tools would be applied to the monitoring and evaluation of
3 implementation of the BDCP Conservation Strategy as they become available.

- 4 • **Adjustments to metrics and targets for conservation measures** (Figure 3.11, Box 10)
5 – Specific metrics and targets have been identified for BDCP conservation measures
6 based on existing knowledge. As understanding of the Delta ecosystem improves,
7 revisions would be made to these metrics and targets to reflect this new knowledge, as
8 appropriate.
- 9 • **Modification of conservation measures** (Figure 3.11, Box 11) – The adaptive
10 management program guides the modification of BDCP conservation measures to
11 improve effectiveness in meeting BDCP goals and objectives. The adaptive management
12 program can also modify priorities and timetables for implementing conservation
13 measures based on new knowledge.
- 14 • **Discontinuance of ineffective conservation measures** (Figure 3.11, Box 11) – The
15 adaptive management program allows for the elimination of unsuccessful conservation
16 measures. The funds allocated to these measures may be reallocated to expand successful
17 measures.
- 18 • **Identification of new conservation measures** (Figure 3.11, Box 11) – As a result of
19 BDCP monitoring and research and new knowledge, new stressors may be identified
20 which are drivers of ecosystem change and species response. The adaptive management
21 program may be used, subject to the limits established in the Plan, to incorporate new
22 conservation measure to address these stressors in the Conservation Strategy. [*Note to*
23 *Reviewers: Could refer to section 3.5 Potential CMs for Other Stressors depending on the*
24 *approach decided for those potential conservation measures.*]
- 25 • **Implementation of new or modified monitoring methods** (Figure 3.11, Box 13) – The
26 adaptive management program will inform and guide the subjects of monitoring,
27 monitoring metrics, and the duration and scope of monitoring. Monitoring technology
28 and techniques improve through time and as new methods are developed they will be
29 incorporated into the BDCP monitoring program. The adaptive management program
30 would also identify and implement modifications to the research program and adaptive
31 management experiments to address new uncertainties and fill knowledge gaps.

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

1 **3.7.2 Adaptive Management Decision Making Process**

2 This section describes the process by which adaptive management decisions will be made,
3 including those that result in adjustments to conservation measures, operational criteria,
4 biological objectives, metrics and targets, the monitoring program including monitoring
5 methods, and analytical tools, as warranted by new information. This section describes the
6 relationships among, and coordination between, the entities that comprise the governance
7 structure (Chapter 7, *Implementation Structure*) in the context of the adaptive management
8 decision-making process (Figure 3.12).

9 **3.7.2.1 Roles and Responsibilities**

10 3.7.2.1.1 *Science Manager*

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

16 3.7.2.1.2 *Adaptive Management Team*

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

- 22 • BDCP Science Manager (chair);
- 23 • IEP Lead Scientist;
- 24 • Senior scientists from IEP member agencies⁴;
- 25 • SFWCA scientists;
- 26 • Other scientists; and
- 27 • Scientists from the Stakeholder Committee, as appropriate.

⁴ 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).

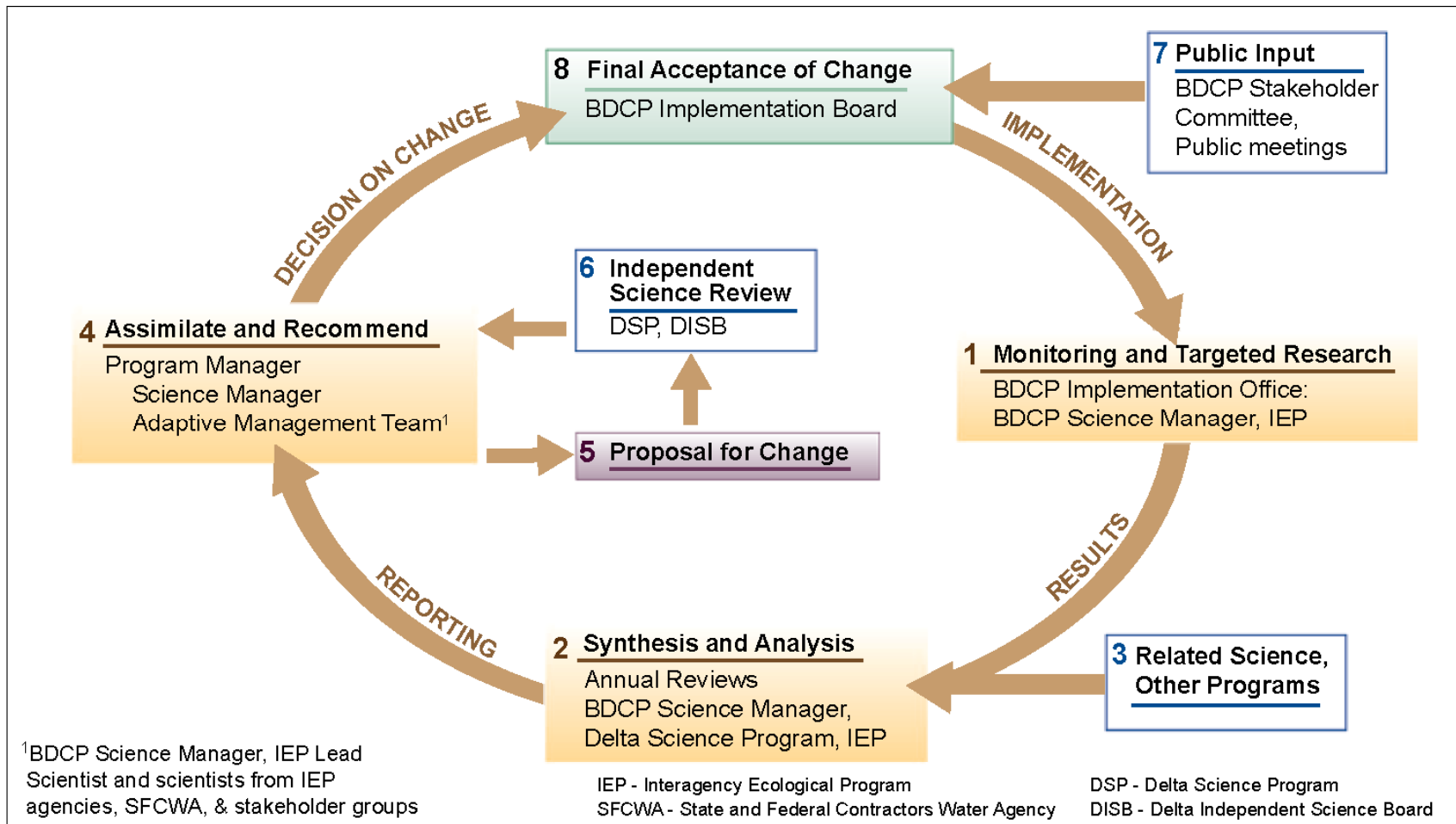


Figure 3-12. BDCP Adaptive Management Decision Making Process

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

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

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

14 **3.7.2.2 Adaptive Management Decisions and Responses (Not Related to** 15 **Water Operations)**

16 The Program Manager will manage the BDCP adaptive management program through the
17 Science Manager. The Program Manager will facilitate and coordinate discussion and
18 consideration of adaptive management issues among the various participating entities, including
19 the authorized entities, fish and wildlife agencies, and the Implementation Board to facilitate
20 decision-making regarding changes in the implementation of the Plan. Adaptive management
21 decisions to take new actions within the BDCP Plan Area will take into account and be
22 coordinated with changes that may be made to upstream operations, which may result from
23 changes made pursuant to existing or future biological opinions for the CVP/SWP project
24 operations outside the Delta. The decision-making process described in this section does not
25 apply to changes or modifications to water operations that may be made by DWR and USBR.
26 The process for adaptive management decisions affecting water operations is set out in Section
27 3.7.3.2, *Decision Process for Adjusting Water Operations within the Adaptive Range*. The
28 following approach (depicted in Figure 3.12) will be used to make adaptive management
29 decisions relating to BDCP actions that are not related to water operations.

- 30 1. Monitoring and targeted research (Figure 3.12, box 1) will be conducted under the
31 direction of the Science Manager, with support provided by the IEP.
- 32 2. The BDCP Science Manager, in coordination with the IEP, Adaptive Management Team,
33 and the Delta Science Program, will assemble, synthesize, and analyze the results of
34 BDCP monitoring and targeted research (Figure 3.12, box 2) efforts and integrate the
35 results of new and relevant scientific research and studies conducted by other parties
36 (Figure 3.12, box 3).

- 1 3. Based on this information and the advice of independent scientists, as appropriate (Figure
2 3.12, boxes 5 and 6), the Adaptive Management Team, through the Science Manager,
3 will provide recommended program changes to the Program Manager (Figure 3.12, Box
4 4), either as part of the annual and five year workplan development process or on an *ad*
5 *hoc* basis, where an adaptive change should occur on a shorter than annual timeframe.

- 6 4. The Program Manager will recommend adaptive management changes to the
7 Implementation Board (Figure 3.12, Box 4). The Implementation Board will provide an
8 opportunity for stakeholder input (Figure 3.12, box 7). The Implementation Board will
9 review the Program Manager's recommendation and make final acceptance of the
10 proposed adaptive management changes (Figure 3.12, Box 8).

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

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

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

- 31 • Any change in the water operating criteria within the adaptive range;
- 32 • Discontinuation of a conservation measure;
- 33 • Expansion of a conservation measure;
- 34 • Addition of a new conservation measure;

- 1 • Decisions to reallocate available funding or resources away from ineffective conservation
2 measures and toward more promising ones; or
- 3 • Any change to BDCP goals and objectives.

4 The Program Manager will consult with the Implementation Facilitation Team, the Real Time
5 Operations Response Team and Adaptive Management Team regarding ongoing implementation
6 issues which may require changes to broad elements of the Plan or specific actions to determine
7 if such changes should be considered through the adaptive management process. Changes to the
8 Plan would be subject to the limits, boundaries, parameters and sideboards established for
9 adaptive management actions, including funding caps established to implement the BDCP
10 Conservation Strategy.

11 In some instances, a significant change in population trends for a covered species may occur,
12 necessitating responsive actions (Figure 3.13). Efforts to respond to such circumstances would
13 be conducted within the framework of the adaptive management program, as appropriate.

14 **3.7.2.3 Internal Scientific Review**

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

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

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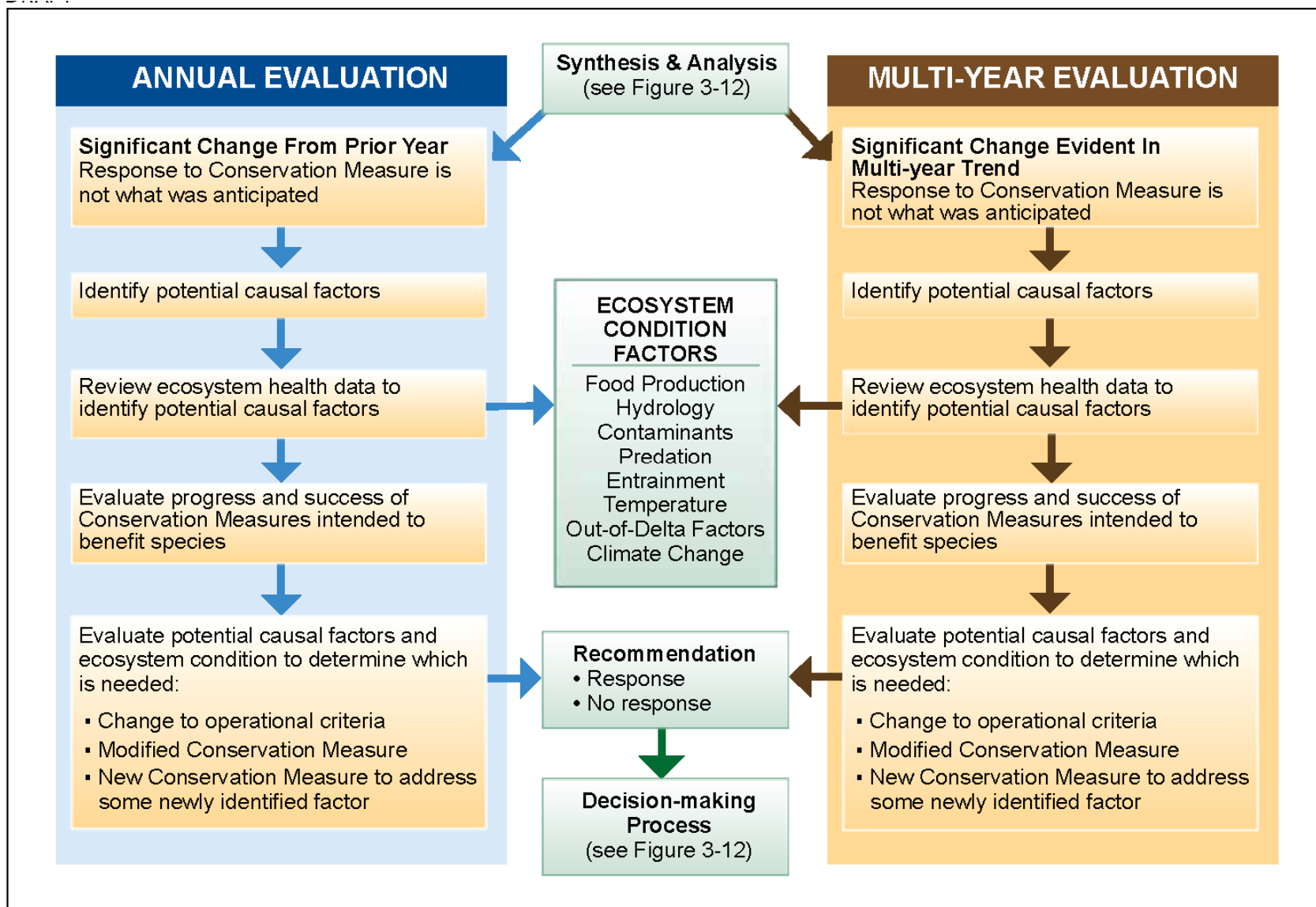


Figure 3-13. BDCP Adaptive Management Process: Response to a Significant Trend in a Covered Species

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

1 timetable. These changed criteria will become the new operational criteria for the
2 conservation measure within which the Real Time Operations Response Team may make
3 real time operational decisions.

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

7 **3.7.4 Concept of Adaptive Management Triggers**

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

17 **3.7.5 Adaptive Management Experiments**

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

27 **3.7.5.1 Targeted Research**

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

33 The Implementation Office may undertake or fund targeted research through the BDCP research
34 program to provide information necessary to adaptively implement the BDCP (see Section 3.6,
35 *Monitoring and Research Program*). This research should answer specific management-related

1 questions that arise based on results of monitoring and to address data gaps to provide
2 information necessary to successfully implement the conservation measures.

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

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

14 **3.7.5.2 Management-Oriented Conceptual Models**

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

34 The Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Conceptual Models
35 developed by the CALFED Ecosystem Restoration Program are a suite of process, habitat, and
36 species models incorporating the current scientific understanding of the Delta. These conceptual
37 models describe the relationship of life history components to known drivers or stressors, and
38 include categorical evaluations of the relative importance, predictability and level of

1 understanding of the linkages between these drivers/stressors and outcomes. The DRERIP
2 Evaluation Process was used to evaluate the relative magnitude and certainty of effects of
3 proposed BDCP conservation measures on aquatic covered species (i.e., fish and aquatic plants),
4 aquatic and estuarine natural communities, and related ecosystem processes using these DRERIP
5 models and other available data (see Section 10.4, *DRERIP Evaluation Process* and Appendix F,
6 *BDCP DRERIP Evaluation Results of Draft Conservation Measures*). The DRERIP process
7 was also used to explicitly identify key data gaps that should be filled through directed research
8 or other exploratory studies. In most cases these models consist of diagrams that show the
9 hypothesized relationships that characterize the ecosystem and are supplemented by written
10 materials. There is also a need to develop full life history model for all of the covered fish
11 species to facilitate plan implementation and guide adaptive management decision making
12 process. Additional models may be developed as needed during the development and refinement
13 of detailed monitoring plans. As new information becomes available, the DRERIP models will
14 be updated to improve confidence in model parameters.

15 Species-habitat models have been developed for terrestrial Covered Species and natural
16 communities; (see Appendix A, *Covered Species Accounts*). Species-habitat models, which can
17 also be considered conceptual models, are useful tools that make explicit the assumptions about
18 the relationship between species and habitat type. Species-habitat models were developed for the
19 BDCP to hypothesize a relationship between land cover type and other habitat components and
20 the distribution of covered species. These models have served as the basis for identifying current
21 habitat distribution, predicting habitat distribution after restoration-related conservation measures
22 are implemented, estimating impacts of conservation measure implementation, and prioritizing
23 land acquisition. Information from pre-acquisition surveys and the planning surveys for covered
24 activities will further refine these models such that they can be used to more accurately predict
25 distribution, occupancy, and assess population trends.

26 **3.7.6 Database Development and Reporting**

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

33 **3.7.7 Program Status Reviews**

34 Requirements for annual and five year reports and work plans by the Implementation Office that
35 include discussions of implementation results and adaptive management changes are described in
36 Section 6.2, *Compliance and Project Reporting*.
37

1 **3.7.8 Public Involvement**

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

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