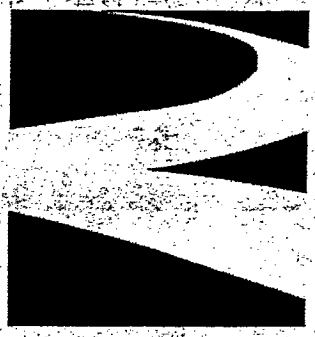

CALFED BAY-DELTA PROGRAM

PRELIMINARY WORKING DRAFT

CALFED BAY-DELTA PROGRAM
ECOSYSTEM RESTORATION PROGRAM PLAN

IMPLEMENTATION OBJECTIVES AND TARGETS

NOVEMBER 15, 1996

D-025908

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PRELIMINARY WORKING DRAFT

CALFED BAY-DELTA PROGRAM ECOSYSTEM RESTORATION PROGRAM PLAN IMPLEMENTATION OBJECTIVES AND TARGETS

INTRODUCTION

The mission of the CALFED Bay-Delta Program (CALFED) is to develop a long-term comprehensive plan to restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. CALFED's Ecosystem Restoration Program goal is to improve and increase aquatic and terrestrial habitats and improve ecosystem functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. A set of three objectives and 18 subobjectives have been created to be consistent with this goal (Table 1). From these objectives and subobjectives CALFED staff, the consultant team, and stakeholders have developed a preliminary draft set of implementation objectives and targets that are described in this report.

These draft implementation objectives and targets are the first piece of the CALFED Ecosystem Restoration Program Plan (ERPP). Portions of the plan yet to be developed include potential actions to meet the targets and visions of what we hope to accomplish for important resources and geographic zones of the Bay-Delta ecosystem. In addition, the plan will include an implementation strategy detailing phasing of actions and the adaptive management process, built around indicators of performance as measured in monitoring and focused research programs. These more detailed portions of the plan will be available toward the end of 1996, after we have more fully developed and reviewed the implementation objectives and targets within the CALFED agencies and stakeholders. Objectives are not expected to change with implementation of the program. Targets may change with results or with changes to storage and conveyance facilities.

The purpose of this report is to describe how CALFED is identifying its targets and to stimulate your thinking so that you can help us complete other portions of the Ecosystem Restoration Program Plan. Because portions of this task are incomplete and to keep this report brief, some important aspects of the targets are not included and will be presented later. These include the following:

- the basis or rationale for targets or groups of targets,
- indicators that can be used to measure progress toward the objectives,
- the appropriate means to monitor the results of the actions,

- the range of changes that might be undertaken through adaptive management,
- areas of uncertainty that may require focused research, and
- priorities for implementation and a schedule for phasing implementation that will support the goals and objectives of the program.

ECOSYSTEM RESTORATION PROGRAM

CALFED is working to achieve a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system. A healthy ecosystem will include a range of self-sustainable habitat types providing environmental, recreational, and aesthetic benefits. A healthy ecosystem will support an abundance of resident and anadromous fish sufficient to support viable recreational and commercial fisheries. It will also support sustainable plant and wildlife species and communities including resident species as well as migrants, such as waterfowl, that use the Pacific Flyway each winter.

The main theme of the restoration program is to protect, enhance, and restore natural processes that provide for self-sustainable ecosystem functions, habitats, and species and communities. In addition, the program will focus on reducing the effects of stressors that inhibit natural processes, ecosystem functions, habitats, and biological species and communities. If natural processes cannot be restored or effects of stressors cannot be reduced to the extent necessary, CALFED will proceed to protect, enhance, and restore important ecosystem functions, habitats, and fish and wildlife populations as needed to meet the program goal and objectives. Where ecosystem function and habitat restoration are inadequate to maintain species and communities, direct artificial support (e.g., hatcheries) might be necessary.

ECOSYSTEM RESTORATION PROGRAM PLANNING PROCESS

ERPP will be a comprehensive, whole-ecosystem plan for restoration and management of the Bay-Delta. ERPP will be a basinwide comprehensive management plan to restore the health of the Bay-Delta ecosystem. It will provide long-term protection, enhancement, and restoration actions to restore natural ecosystem processes, functions, habitats, and species or species groups in the system and will focus on reducing the effects of ecosystem stressors. ERPP will focus on specific implementation objectives, targets, and actions for ecosystem processes, functions, stressors, habitats, and species or species groups. These objectives, targets, and actions will be formulated into an overall vision for the ecosystem restoration of the Bay-Delta and its watershed. In addition, individual resource visions for what CALFED hopes to accomplish are included, as is an adaptive-management implementation strategy to accomplish these objectives, targets, actions, and visions.

ERPP is being developed by CALFED staff with the support of member agencies and stakeholders. The foundation for the plan was laid in a series of seven workshops conducted by CALFED staff during 1995 and early 1996 that led to program principles, objectives, draft actions, alternatives, and components. Efforts on ERPP began in July 1996 with the layout of concepts and content. Initial efforts focused on building on program objectives and the experiences of other comprehensive planning efforts in the basin, and soliciting information from agencies and stakeholder technical experts to design and craft the plan.

There are five basic tasks to developing ERPP:

- Define the ecosystem elements (processes, functions, habitats, stressors, and species) for which to set implementation objectives and targets.
- Develop implementation objectives and targets for restoration for each ecosystem element.
- Develop restoration actions and implementation levels to meet objectives and targets.
- Develop visions of what improvements in ecosystem health we hope to accomplish with the restoration program for ecosystem elements.
- Develop an implementation strategy for the program.

This report provides the results of tasks 1 and 2: defining ecosystem elements and setting implementation objectives and targets for each element.

TERMS

The basic features of ERPP are implementation objectives, targets, actions, and visions for ecosystem elements.

ECOSYSTEM ELEMENT

An ecosystem element is an ecosystem process or function, stressor, habitat, or species or species group.

IMPLEMENTATION OBJECTIVE

An implementation objective is the most specific and detailed description of what the program will strive to maintain or achieve for an ecosystem element. Implementation objectives are not intended to change over the life of the program.

TARGET

A target is a qualitative and quantitative statement of an implementation objective. Targets are something to strive for but may change over the life of the program with new information and progress. Targets may also vary with storage and conveyance alternatives. Targets can be set for the level of process or function to be achieved, the amount a stressor is to be reduced, the amount of a specific habitat to be restored, or the abundance or distribution of a species. Targets are typically oriented readily toward actions and can be measured to assess whether they are successfully achieved. Targets may include a range of values or a narrative description of the proposed future value of an ecosystem element. Targets are to be set based on realistic expectations, must be balanced against other resource needs, and must be reasonable, affordable, cost effective, and practicably achievable.

ACTION

An action represents a physical, operational, legal, or institutional change intended to maintain or achieve a desirable function or condition (target) of the Bay-Delta system.

VISION

A vision is what ERPP hopes to accomplish with the stated objectives, targets, and actions for a process, function, stressor, habitat, species or species group, or geographical unit.

APPROACH TO DEVELOPING A PRELIMINARY LIST OF ECOSYSTEM ELEMENTS

The first step in ERPP development was developing a preliminary list of ecosystem elements for which to set implementation objectives and targets. A program work team of resource experts was assembled from CALFED staff and staff consultants. The workteam sought information from technical experts from agencies and stakeholders to prepare the draft lists presented in this report. Primary physical processes that drive the ecosystem and species and species groups were used as a starting point for listing ecosystem elements. From this starting point, secondary ecosystem processes and functions, stressor, and habitat lists were developed. To be included, a primary

physical process had to have a strong independent effect on shaping the ecosystem. For a species to be included, it had to satisfy one of three primary criteria: (1) be threatened, endangered, or a species or group of species of concern that is dependent on the Delta, (2) be an economically important recreational or commercial species, or (3) be ecologically important as a major prey or foodweb species in the Delta. For stressors, secondary ecosystem processes and functions, or habitats to be included, they had to have a significant effect on either primary physical processes or Delta species, or on another stressor, secondary ecosystem process and function, or habitat that does have an effect.

APPROACH TO SETTING PRELIMINARY IMPLEMENTATION OBJECTIVES AND TARGETS

After listing ecosystem elements, the ERPP workteam sought information from technical experts on specific implementation objectives and targets for each of the ecosystem elements in the list. Many existing basinwide and local fish, wildlife, and habitat restoration "plans" were reviewed and considered. A list and summary of the contents of these plans is published in a companion CALFED report entitled Summary of Ecosystem Restoration Plans Pertaining to the Ecological Resources of the Bay-Delta and its Watershed. An initial list of implementation objectives and targets was developed for each ecosystem element. Because we set targets for each element, overlap and duplication of target occurs. In the final plan this overlap will be identified and duplication will be eliminated. CALFED staff welcomes agency, stakeholder, and public ideas and concerns in formulating, reviewing, and refining implementation objectives and targets. This information will be gathered later this fall and winter through technical working sessions, additional public workshops, and informal consultations on ERPP.

LIMITATIONS OF PRELIMINARY OBJECTIVES AND TARGETS

The objectives and targets presented in this report are offered as a preliminary working draft of implementation objectives and targets for discussions at public workshops in November and December 1996. They represent the broad views of many technical experts, but may not yet meet the two primary criteria stated by CALFED: 1) that objectives be acceptable to all stakeholders and fixed for the program, and 2) that targets need to be reasonable and practical and can be accomplished through the planned adaptive-management process of ERPP. Implementation objectives and targets meeting these criteria after further analysis will be included in the final ERPP. ERPP will then undergo extensive review at the programmatic level of the CALFED environmental review process. Targets will be tested and revised through the adaptive-management process of ERPP. The public workshop on November 19, comments submitted on this report from the stakeholders and agencies, and follow-up technical meetings will initiate the refinement process.

CALFED Ecosystem Restoration Planning Area

Consistent with CALFED geographic scope, the ecosystem restoration planning area has both a problem area and a solution area. The geographic area for defining ecosystem-quality problems consists of the legally defined Delta, Suisun Bay (extending to the Carquinez Strait), and Suisun Marsh (Figure 1). This is identical to the geographic scope defined as the problem area overall for CALFED. As with CALFED, the Ecosystem Restoration Common Program will address ecosystem-quality problems that are manifested in or closely linked to the Delta and to the Suisun Bay/Suisun Marsh areas.

The solution area delineated by the Ecosystem Restoration Common Program is the area in which most of the identified problems will be solved (Figure 2). The area includes the watershed of the Central Valley Basin and the San Francisco Bay. Although not specifically delineated on this map, solutions may also be found in the nearshore area of the Pacific Ocean. This solution area is smaller and a subset of the solution scope identified for CALFED.

Figure 3 depicts the ecological zones or units for managing the planning process. These 36 zones compose the focus study area for the ecosystem restoration planning effort and the area where actions would most likely result in an improvement in ecosystem health. The focus study area is the area where most of the direct impacts to ecosystem functions and processes have occurred and the area where species dependent on the Bay-Delta system spend an important part of their life cycles. There may also be opportunities to develop solutions outside of the focus study area, but still within the solution area. An example would be watershed improvements above dams. Watershed management could restore a more natural flow regime or improve water quality; therefore, the figures include a delineation of the watershed boundaries as part of the solution areas.

Ecosystem Elements

The initial task in developing the ERPP was to define the ecosystem elements for which implementation objectives and targets are set. For each of these elements, an indicator of ecosystem health will be prescribed that will be monitored to determine if the objectives and targets are met. Implementation objectives and targets will also be set for each ecosystem element by ecological zone or watershed, as appropriate. The full list of ecosystem elements is presented in Table 2. Ecosystem element categories, including primary physical processes, secondary ecosystem processes and functions, stressors, habitats, and species and species groups, are described below.

PRIMARY PHYSICAL PROCESSES

Primary physical processes are those physical processes that act to directly or indirectly, or in combination, to shape and form the ecosystem structure and function. The basic building blocks of the Bay-Delta and its watershed ecosystems are water, sediment, and geomorphologic structure, and the forces of tides and fire. Primary physical processes and the basis for inclusion in ERPP are presented in Table 3.

SECONDARY ECOSYSTEM PROCESSES AND FUNCTIONS

Secondary ecosystem processes and functions are those that occur in response to primary physical processes but that also exert important influence on the structure and function of the ecosystem. If primary physical processes are indirectly unable to produce the necessary responses in these secondary ecosystem processes and functions, then some form of direct action on these secondary ecosystem processes and functions might be necessary to achieve desired conditions. Secondary ecosystem processes and functions and the basis for inclusion in ERPP are presented in Table 4.

STRESSORS

Stressors are human-caused activities that affect ecosystem processes and functions, habitats, and species. Reducing the effects of ecosystem stressors is a primary focus of ERPP, together with maintaining, enhancing, and restoring primary physical processes. Stressors and the basis for inclusion in ERPP are presented in Table 5.

HABITATS

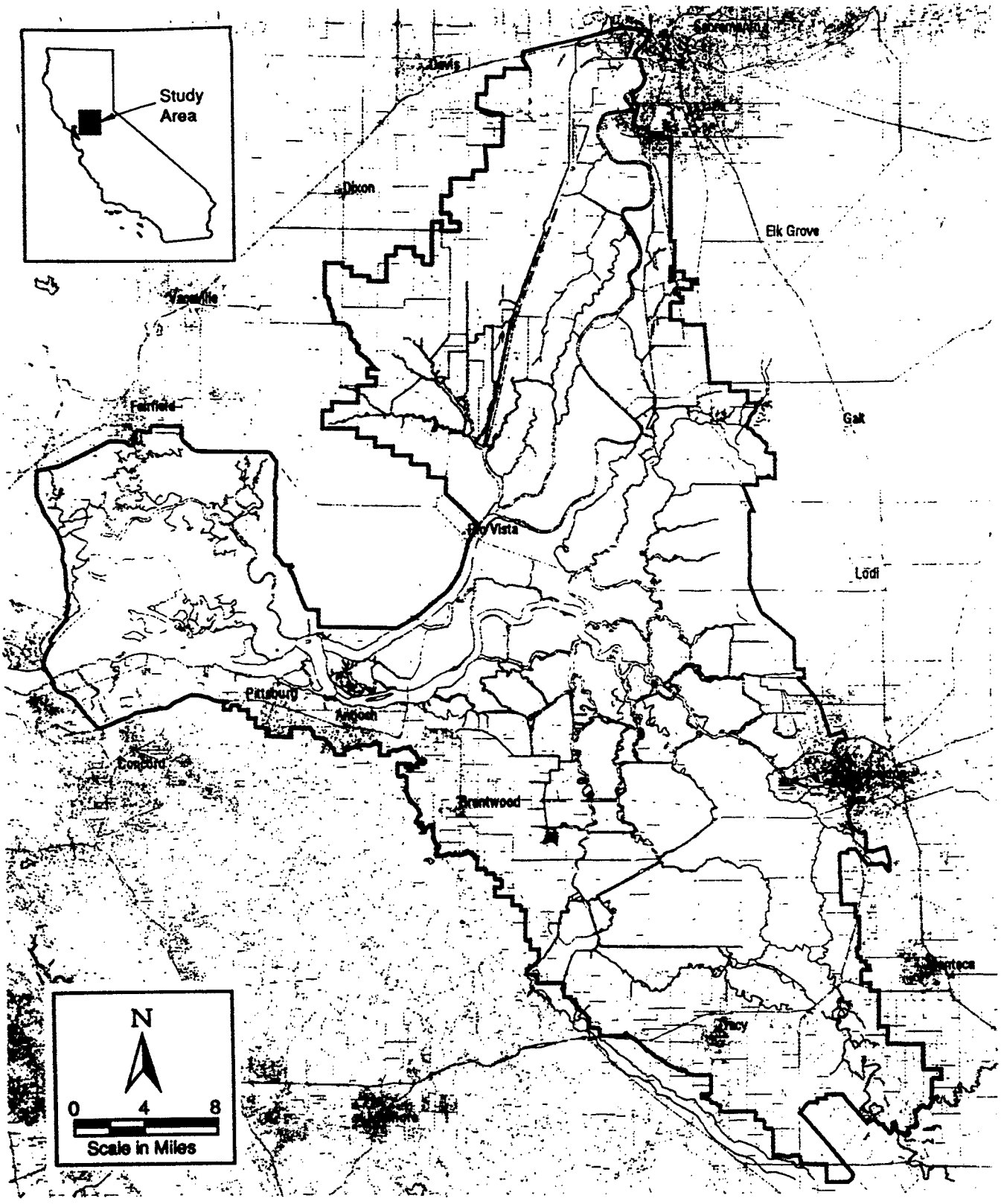
Habitats are areas occupied by plants, fish, and wildlife that have specific conditions responsive to the needs of plant and animal communities. Habitats will benefit markedly from restoration activities related to primary physical processes, secondary ecosystem processes and functions, and stressors. In some cases, direct action may be necessary to restore important habitats. Habitats and the basis for inclusion in ERPP are presented in Table 6.

SPECIES AND SPECIES GROUPS

The initial selection of species or species group ecosystem elements is based primarily on three criteria relevant to CALFED purposes. The species selected meet at least one of the following criteria: (1) it is threatened, endangered, or a species of special concern; (2) it is economically important by supporting a sport or commercial fishery; or (3) it is an important prey or habitat-producing species. Species and species groups and the basis for inclusion in ERPP are presented in Table 7.

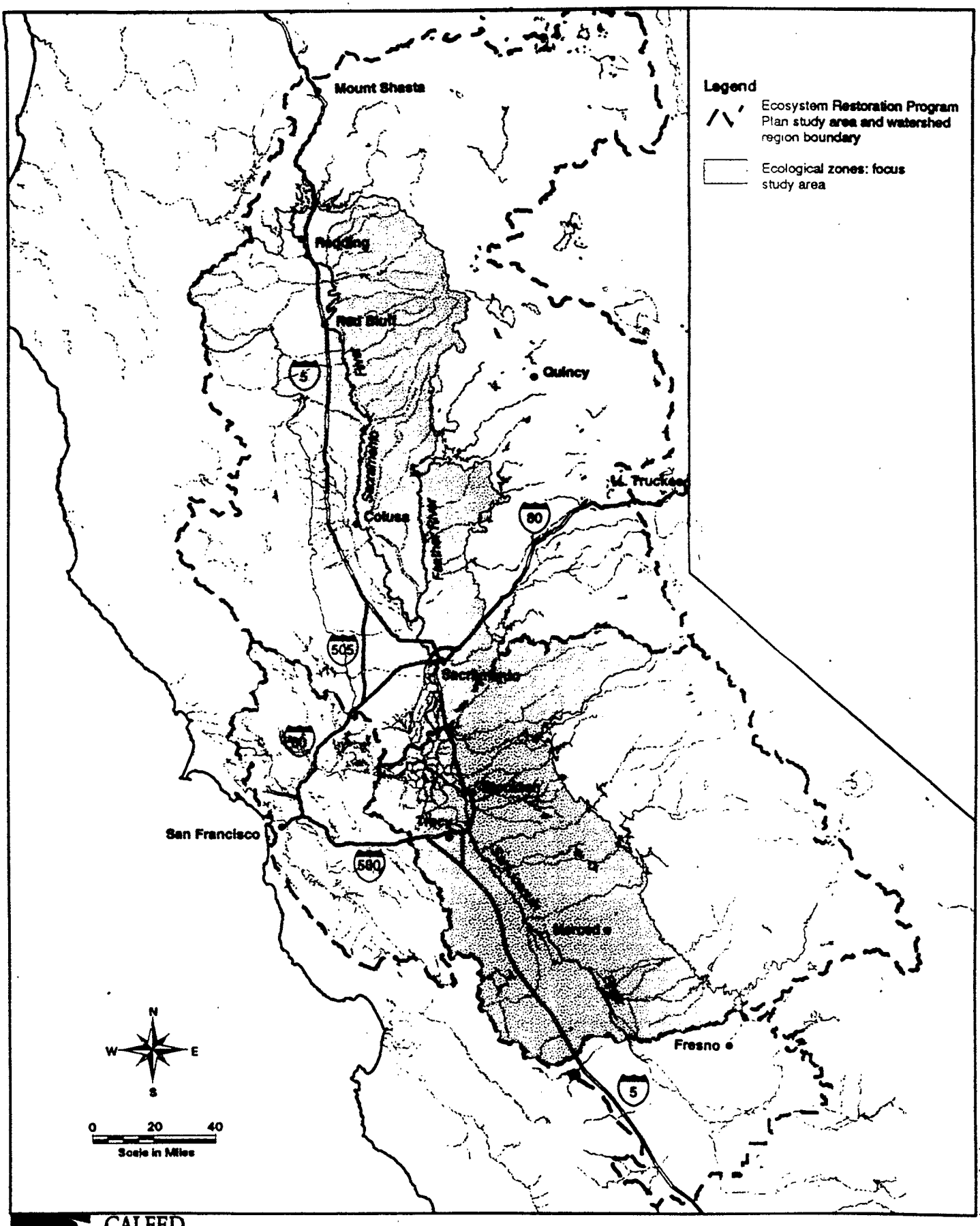
IMPLEMENTATION OBJECTIVES AND TARGETS

Implementation objectives provide a big-picture overview of what the restoration program is trying to achieve. Once the program is implemented, we do not plan to change implementation objectives. Targets provide a measure of what we hope to achieve. Targets may change at any time based on new information or policy direction. Targets must be balanced against other resource needs and be reasonable, feasible, cost-effective, and technically and practicably achievable. Achieving such targets will require a stepwise evaluation beginning with existing resource implementation objectives and targets. Using restoration objectives and targets identified in existing resource plans as a starting point, the CALFED consulting staff and agency and stakeholder experts have developed draft implementation objectives and targets for ERPP for each ecosystem element. These draft implementation objectives and targets will be reviewed and refined over the coming months. Implementation objectives and targets for primary physical processes, secondary ecosystem processes and functions, stressors, habitats, and species and species groups are presented in Tables 8-12.



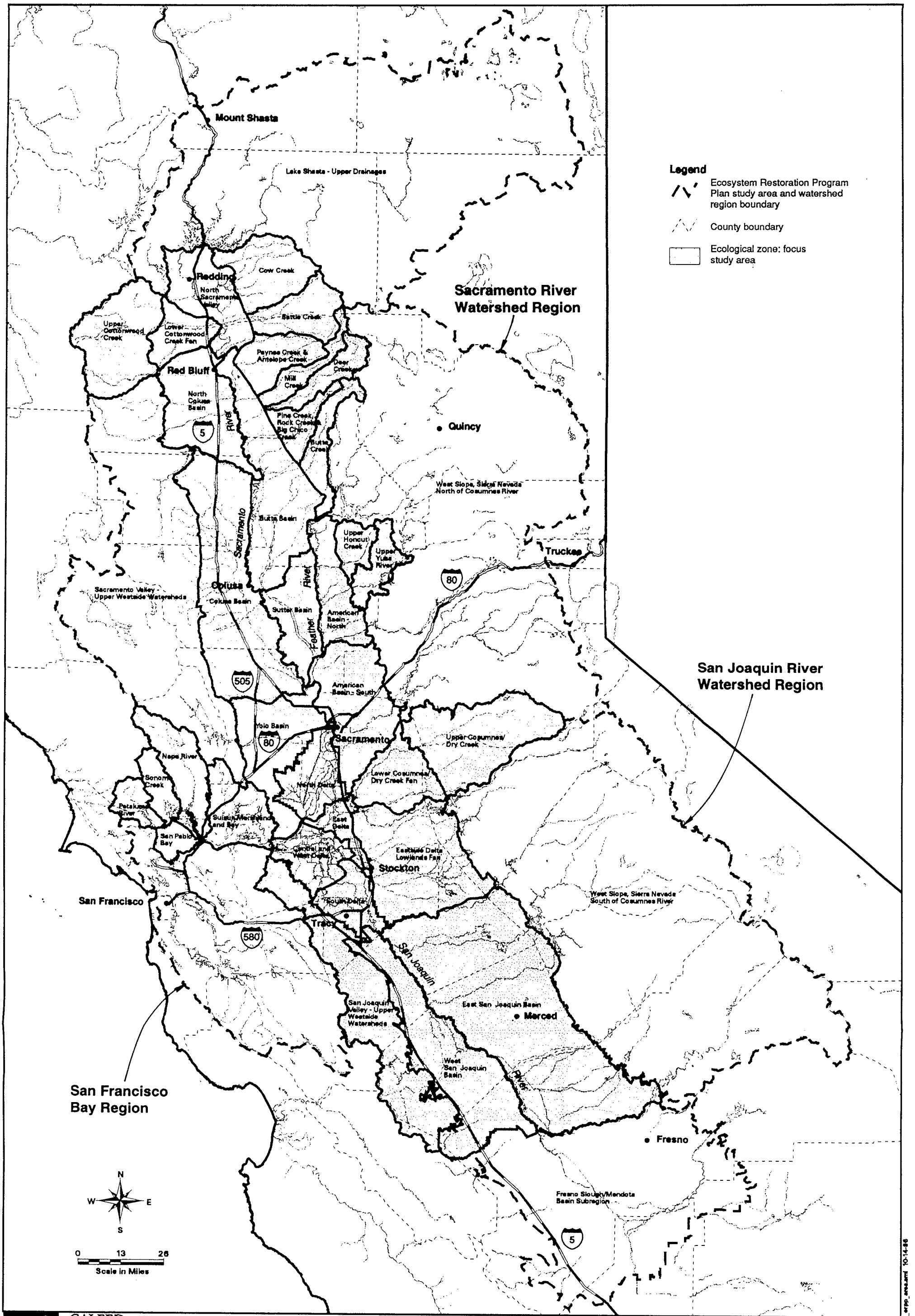
CALFED BAY-DELTA PROGRAM

Figure 1
Problem Scope



CALFED BAY-DELTA PROGRAM

Figure 2
Solution Scope



CALFED BAY-DELTA PROGRAM

Figure 3
Ecosystem Restoration Program Plan Study Area and Ecological Zones : Area Zones

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D-025923

A. **Improve and increase aquatic habitats** so that they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary.

1. **Increase amount of high-quality shallow riverine habitat** to allow sustainable fish spawning and early rearing.

   a. **Increase amount of quality riverine edge habitat** to allow spawning and rearing by sustainable populations of native fish species.

   b. **Increase amount of quality shallow shoal habitat** within the main channels of the Delta and upper Bay to allow shallow foraging by sustainable populations of juvenile estuarine fish.

2. **Increase amount of high-quality shaded riverine habitat** to allow the growth and survival of sustainable populations of estuarine resident and anadromous fish in the estuary.

   a. **Increase amount of quality riparian woodland habitat** to allow production of terrestrial food sufficient to support sustainable populations of resident and anadromous fish.

   b. **Increase amount of large, woody debris** along Delta levees to allow juvenile and adult feeding and refuge for sustainable populations of fish.

   c. **Increase amount of shaded riverine habitat** to provide localized temperature reduction.

3. **Increase amount of high-quality tidal slough habitat** containing emergent and submerged vegetation to support the fish production capacity of the Delta.

   a. **Increase amount of dead-end slough habitat** to allow spawning and rearing of sustainable populations of some resident species.

   b. **Reduce water hyacinth** populations in tidal slough habitats to improve habitat quality for sustainable populations of Delta fish.

   c. **Increase amount of high-quality tidal slough habitat** to allow increased primary biological production.

4. **Increase amount of high-quality estuary entrapment/null zone habitat** to support sustainable fish populations in the Bay-Delta system.

D-025924

a. **Reduce saltwater intrusion** into Suisun Bay to increase the nursery area for sustainable populations of plants and animals.

b. **Expand the geographic extent of low-salinity habitat** in Suisun Bay.

c. **Increase the occurrence of brackish water habitat** in San Pablo Bay during winter and spring to support sustainable populations of Bay species.

5. **Provide sufficient transport flows** at the proper times to move eggs, larvae, and juvenile fish from spawning habitats to nursery habitats in the Delta and Bay.

a. **Increase the transport of young fish from the Delta to Suisun Bay** nursery areas to support sustainable populations of important estuarine species.

b. **Increase the transport of young fish through the Delta** to the ocean to support sustainable populations of estuarine and anadromous fish species.

c. **Reduce the transport of young fish from north to south across the Delta** and the entrainment of fish in the Delta to increase the survival and abundance of estuarine and anadromous species.

d. **Reduce the blockage of and alterations to transport flows** by local structures.

6. **Reestablish appropriate upstream and downstream movement** of anadromous and estuarine fish.

a. **Enhance upstream migration of adult salmonids** through the Delta.

b. **Increase successful outmigration of juvenile fish** through the Delta.

c. **Enhance upstream migration of adult estuarine fish** into the Delta and river spawning areas.

7. **Improve the productivity of the Bay-Delta aquatic habitat foodweb** to support sustainable populations of desirable fish (and other) species.

a. **Reduce entrainment** of biological productivity throughout the aquatic foodweb.

b. **Reduce concentrations of toxicants** in the water column and in sediments.

c. **Reduce the effects of non-native species** on ecosystem productivity and competing with desirable species for habitat.

d. **Increase the residence time of water in Delta channels** to increase plankton productivity and reduce undesirable algal-mat growth in the Delta.

e. **Increase nutrients** from wetland and riparian habitats to aquatic habitats.

f. **Reduce salinity levels** in Delta aquatic habitats.

g. **Increase flows of freshwater** into the estuary.

8. **Reduce concentrations of toxic constituents and their bioaccumulation** to eliminate their adverse effects on populations of fish and wildlife species.

a. **Reduce the concentrations of pesticide residues** in Bay-Delta system water and sediments.

b. **Reduce the concentrations of hydrocarbons, heavy metals, and other pollutants** in Bay-Delta system water and sediments.

B. **Improve and increase important wetland habitats** so that they can support the sustainable production and survival of wildlife species.

1. **Increase the amount of high-quality brackish tidal marsh habitat** in the Bay-Delta system to better support sustainable populations of native wildlife species.

a. **Modify salinity levels in brackish tidal marshes** to improve their vegetation composition.

b. **Increase the areal extent** of brackish tidal marsh habitats.

c. **Improve the connectivity** between brackish tidal marsh habitats and their supporting habitats such as aquatic habitats and riparian woodlands and adjacent uplands.

2. **Increase the amount of high-quality freshwater marsh habitat** to better support sustainable populations of native wildlife species in the Delta.

a. **Restore appropriate salinity levels** in freshwater marsh habitat in the Delta to enhance forage and habitat suitability for some native species.

b. **Increase the areal extent** of freshwater marsh habitats.

c. **Improve the connectivity** among freshwater marsh habitats to provide corridors for population movement and genetic exchange for dependent species.

d. **Reduce the vulnerability** of existing freshwater marshes to levee failure.

3. **Increase the amount of high-quality riparian woodland habitat** in the Delta to better support sustainable populations of native wildlife populations.

   a. **Increase amounts of riparian habitat structure** for nesting near foraging areas for some native bird species.

   b. **Reduce fragmentation** of riparian woodland habitat patches to provide corridors for population movement and genetic exchange for dependent species.

   c. **Increase the areal extent** of riparian woodland habitats.

   d. **Improve the connectivity** between riparian woodlands and their supporting habitats such as aquatic habitats and brackish marsh habitats.

4. **Increase the amount of breeding-waterfowl habitat** to better support sustainable populations of dabbling ducks.

   a. **Increase the amount of high-quality brood habitat** near nesting habitat for dabbling ducks.

   b. **Increase the amount of high-quality nesting habitat** near brood habitat for dabbling ducks.

5. **Increase the amount of wintering-wildlife habitat** for foraging and resting to better support sustainable populations of wintering waterfowl.

   a. **Increase supplies of suitable forage** such as waste grain on agricultural lands.

   b. **Increase the amount of resting areas** near foraging areas for wintering wildlife.

   c. **Increase the amount of high-quality foraging areas** (e.g., freshwater marsh and brackish water marsh) for wintering wildlife.

   d. **Reduce the vulnerability** of some existing wintering wildlife habitats to levee failures.

6. **Increase the amount of managed, permanent pasture habitat** to better support wintering crane populations.

   a. **Increase the amount of foraging habitat** in proximity to roosting habitat.

   b. **Increase the amount of roosting habitat** in proximity to foraging habitat.

7. **Increase floodplains and associated riparian habitat** to improve diversity and sizes of fish and wildlife populations.

   a. **Increase suitable floodplains** to improve the availability of temporary flooded spawning habitat for fish.

   b. **Improve narrow, restricted channels** to reduce the risk of catastrophic losses of wildlife habitat from levee failure.

C. **Increase population health and population size** of Delta species to levels that ensure sustained survival.

1. **Contribute to the recovery** of threatened or endangered species or species of special concern.

2. **Increase populations** of economically important species.

3. **Increase populations** of prey or food species.

D-025928

Table 2. ERPP Ecosystem Elements

A. Primary Physical Processes

1. Hydrograph
2. Hydraulic regime
3. Sediment supply
4. Geomorphology
5. Tides
6. Fire

B. Secondary Ecosystem Processes and Functions

1. Stream meander belts
2. Gravel recruitment
3. Gravel transport and cleansing
4. Estuarine mixing
5. Water temperature
6. Current velocities
7. Floodwater and sediment detention and retention
8 Vegetation succession, overbank flooding, and floodplain inundation
9. Nutrient inputs
10. Primary production
11. Secondary production
12. Nutrient cycling

C. Stressors

1. Levees, bridges, and bank protection
2. Dredging
3. Land use
4. Wildfire
5. Exotic species
6 Dams, reservoirs, and other human-made structures
7. Water management
8. Gravel mining
9. Contaminants
10. Human disturbance
11. Harvest of fish and wildlife
12. Predation and competition
13. Artificial production of fish

D. Habitats

1. Tidal perennial aquatic
2. Nontidal perennial aquatic
3. Dead-end sloughs
4. Open-ended sloughs
5. Seasonal wetland and aquatic
6. Shaded riverine aquatic
7. Saline emergent wetland
8. Fresh emergent wetland
9. Midchannel islands and shoals
10. Riparian scrub, woodland, and forest
11. Coastal scrub
12. Valley-oak woodland
13. Perennial grassland
14. Agricultural wetland
15. Agricultural upland

E. Species and Species Groups

Fishes

1. Delta smelt
2. Sacramento splittail
3. Longfin smelt
4. Green sturgeon
5. Sacramento fall-run chinook salmon
6. Sacramento winter-run chinook salmon
7. Sacramento spring-run chinook salmon
8. Sacramento late-fall-run chinook salmon
9. San Joaquin fall-run chinook salmon
10. Steelhead trout
11. Striped bass
12. White sturgeon
13. American shad
14. Largemouth bass

Table 2. Continued

Fish Species Groups

15. Other native resident fishes
16. Other non-native resident fishes
17. Marine fishes

Amphibians and Reptiles

18. California red-legged frog
19. Giant garter snake
20. Western pond turtle
21. Other native amphibians and reptiles

Birds

22. Swainson's hawk
23. California clapper rail
24. California black rail
25. Greater sandhill crane
26. Western yellow-billed cuckoo
27. Suisun song sparrow

Mammals

28. Salt marsh harvest mouse
29. Riparian brush rabbit

Wildlife Habitat Guilds

30. Deepwater wildlife guild
31. Shallow-water and mudflat wildlife guild
32. Saline emergent wetland wildlife guild
33. Fresh emergent wetland wildlife guild
34. Riparian wildlife guild
35. Valley-oak woodland wildlife guild
36. Agricultural wetland wildlife guild
37. Agricultural upland wildlife guild

Wildlife Species Guilds

38. Shorebird and wading bird guild
39. Upland game guild
40. Waterfowl guild
41. Neotropical migratory bird guild

Other Groups

42. Estuarine foodweb organisms
43. Terrestrial invertebrates

Plants

44. Delta button-celery

Plant Species Associations

45. Saline emergent wetland plant association
46. Fresh emergent wetland plant association
47. Coastal scrub plant association

Table 3. Basis for Selection of Primary Physical Process Ecosystem Elements

Primary Physical Process	Basis for Selection as an Ecosystem Element
Hydrograph	Hydrograph refers to the total amount and seasonal distribution of water entering the ecosystem, including surface and groundwater, and includes episodic events such as floodflows and drought cycles. The total volume and distribution in time and location of water supports important ecological processes and functions that sustain habitats and many species of the Bay-Delta, the Sacramento and San Joaquin rivers, and their tributaries. Human activities have had a large influence on the natural hydrograph of the Bay-Delta and the Sacramento-San Joaquin basin. There are opportunities to restore or simulate, where appropriate, a more natural hydrograph that sustains ecological functions and meets the life requirements of plants and animals.
Hydraulic regime	Hydraulic regime refers to the direction and velocity of flows in the Bay-Delta channels on a temporal, tidal, and seasonal basis for a given hydrologic condition. The direction and velocity of flows and their distribution in time and location support important ecological processes and functions in the Bay-Delta that sustain the foodweb, influence the spawning, rearing, and feeding of estuarine and anadromous fish, and support migration of adult and juvenile fish. Human activities have had a large influence on the natural hydraulic regime of the Bay-Delta. There are opportunities to restore or simulate, where and when appropriate, a more natural hydraulic regime that sustains ecological functions and meets the life requirements of fish and wildlife in or dependent on the Bay-Delta.
Natural sediment supply	The natural sediment supply is composed of mineral and organic fines, sands, gravel, cobble, and woody debris that naturally enter, deposit, erode, and transport through the Sacramento-San Joaquin basin. Sediment, like water, is one of the natural building blocks of the ecosystem on which many other ecological processes, functions, habitats, and species depend. Gravel, for example, is important for maintaining spawning habitat of salmon and supports the many invertebrates on which young salmon prey. Finer sediments and fluvial processes create the conditions necessary to establish new riparian forests and wetlands. Human activities have had a large effect on natural sediment processes in the watershed. There are opportunities to restore natural sediment processes or to compensate for the loss of sediment supply from building levees, dams, and reservoirs to meet the life requirements of plants and animals.

D-025931

Table 3. Continued

Primary Physical Process	Basis for Selection as an Ecosystem Element
Geomorphology	Geomorphology refers to the ecosystem's natural landscape form that serves to influence the direct effects of water, sediment, and plants on the Sacramento-San Joaquin basin. Geomorphology, like water and sediment, is a key structural component of the ecosystem. Natural barriers, channel morphometry, basin configuration, watershed and channel erosion, and other geological features determine the landscape of the ecosystem. There are opportunities to restore or manipulate geomorphology to benefit ecosystem health.
Tides	Tides are daily and seasonal water-level changes exerted by the moon's gravitational effect on the earth. Daily, monthly, and seasonal (neap and spring tides) tides exert important influences on estuarine processes in the Bay-Delta. Human activities have altered the effects of tides primarily as a result of changing geomorphology and sediment and hydrological processes. More natural tidal force can be restored through manipulations of other physical processes to change tidal effects and produce secondary effects on sediments and nutrient supply, vegetation, currents, and water levels.
Fire	Natural fire events are important determinants of watershed processes by maintaining grassland, woodland, and forest health through fuels reduction and plant succession and reproduction. By suppressing fires, modern human activities have had a large effect on the ecological role of natural fires in grasslands, woodlands, and forests. There are potential opportunities to expand the use of prescribed fires for restoring and maintaining grassland, woodland, and forest health in the upper watersheds of the Sacramento-San Joaquin basin.

Table 4. Basis for Selection of Secondary Ecosystem Process and Function Ecosystem Elements

Secondary Ecosystem Processes and Functions	Basis for Selection as an Ecosystem Element
Stream meander belts	Stream meander belts are the area in which natural bank erosion and floodplain and sediment bar accretion occur along streamcourses. Natural stream meander belts in alluvial systems function dynamically to transport and deposit sediments and provide transient habitats important to algae, aquatic invertebrates, and fish, as well as surfaces that are colonized by natural vegetation that support wildlife.
Gravel recruitment	Gravel recruitment is the process of gravel entering into the fluvial systems of the Sacramento-San Joaquin basin. Gravel deposits in streams and rivers are essential to maintain spawning and rearing habitats of salmon and steelhead and other native fishes. Gravel deposits have been greatly altered by human activities. Opportunities to maintain and restore gravel recruitment are possible through manipulation of natural processes (e.g., the natural hydrograph and sediment supply) and control or management of environmental stressors that adversely affect gravel recruitment (e.g., instream gravel mining and riprapped banks).
Gravel transport and cleansing	Gravel transport is the process whereby flows carry away finer sediments that fill gravel interstices, and gravel cleansing is the process whereby flows transport, grade, and scour gravel. Gravel transport and cleansing through flushing the majority of fines and movement of bedload is important to maintain the amount and distribution of spawning habitat in the Sacramento-San Joaquin basin. Human activities have greatly reduced or altered these processes. Opportunities for maintenance and restoration are possible by changing waterflow, sediment supplies, geomorphology of the basin, removing stressors, or directly manipulating channel features and stream vegetation.
Estuarine mixing	Estuarine mixing controls the salinity gradient, vertical and horizontal stratification of the water column, the position of entrapment and null zones, and the X2 water quality standard in the Bay-Delta estuary. The estuarine mixing process is controlled by geomorphology, tides, and freshwater inflow. Freshwater flow contributes to estuarine mixing and its associated processes, and creates freshwater and low-salinity aquatic habitat essential to many estuarine fishes. The entrapment and null zones collect nutrients and many types of organisms, and thus are essential in the foodweb of many estuarine organisms.

Table 4. Continued

Secondary Ecosystem Processes and Functions	Basis for Selection as an Ecosystem Element
Water temperature	Water temperature is determined by the natural heating and cooling process of water bodies and flows in the Sacramento-San Joaquin basin. Water temperature in the Sacramento-San Joaquin basin is controlled by water source (i.e., dam releases; runoff; and agricultural, municipal, and industrial discharges); surface and groundwater flow; geomorphology; tides; riparian shading; and, most often, by air temperature. Water temperature is a key factor in habitat suitability for aquatic organisms. Unnaturally high water temperatures can become stressors to many aquatic organisms.
Current velocities	Current velocities are the speed at which water flows through the watercourses of the Sacramento-San Joaquin basin. Tidal and nontidal freshwater current velocities are important in the vertical, lateral, and longitudinal transport of materials and organisms in the Bay-Delta and rivers. Human activities that have altered channel configurations or flow rates have altered current velocities throughout the Sacramento-San Joaquin basin. Opportunities to restore more natural current velocities to channels are possible primarily through manipulation of channel cross sections, floodplain topography, and secondarily through changes in flow rates downstream of reservoirs.
Floodwater and sediment detention and retention	Floodwater and sediment detention and retention is the process whereby flows and sediment are retained within floodplains of the Sacramento-San Joaquin basin. Retention and detention of water and sediment within basin floodplains are a secondary process controlled primarily by flow patterns and channel geomorphology, and secondarily by soils and plant communities. Floodwater storage and retention reduces flood effects, soil erosion, peat oxidation, and nutrient loss. The process stores water and sediment either permanently or temporarily, reducing the peak loads of both downstream systems.

Secondary Ecosystem Processes and Functions	Basis for Selection as an Ecosystem Element
Vegetation succession, overbank flooding, and floodplain inundation	Vegetation succession, overbank flooding, and floodplain inundation refers to seasonal flooding of floodplain habitats and the response of vegetation to the flood cycles. Overbank flooding is a secondary process to water and sediment flow through the Sacramento-San Joaquin basin in combination with geomorphology. Flooding of lands provides important seasonal habitat for fish and wildlife and provides sediment and nutrients to both the flooded lands and aquatic habitats that receive the returning or abating floodwaters. The flooding also shapes the plant and animal communities in the riparian, wetland, and uplands habitat subject to flooding. Opportunities to restore or enhance this process are possible by changing landscape features, geomorphology, and seasonal distribution of flow volume through the system.
Nutrient inputs	Nutrient inputs refer to the creation of, input to, flow through, and storage within the Sacramento-San Joaquin basin of carbon, nitrogen, phosphorous, and other inorganic elements, as well as organic compounds, in the Bay-Delta ecosystem. Nutrients important to plant and animal communities in the basin are derived through many of the primary and secondary processes influencing the Bay-Delta ecosystem. Human activities have greatly altered the input, residence time, and flow of nutrients into the ecosystem.
Primary production	Primary production refers to the energy produced by algae and other plants through photosynthesis. Primary production of plants in the Sacramento-San Joaquin basin is the basic process that supports the biological system. Nearly all primary and secondary processes have some effect on primary production in the basin. Human activities have altered production in many ways and opportunities to enhance this process exist by manipulating waterflow, nutrients, and geomorphology, and alleviating environmental stressors such as the introduction of salts, herbicides, and other toxins in watercourses.
Secondary production	Secondary production refers to the production of energy not directly related to photosynthesis. Secondary production in the Sacramento-San Joaquin basin occurs primarily through the breakdown of plant materials by microorganisms, such as bacteria, fungi, protozoans, and zooplankton, and large-animal grazing. Organic carbon forms, including the microorganisms and the byproducts of their work, are the base of the aquatic foodweb of the Bay-Delta ecosystem.

Table 4. Continued

Secondary Ecosystem Processes and Functions	Basis for Selection as an Ecosystem Element
Nutrient cycling	Nutrient cycling is the process of basic nutrients, such as nitrogen, phosphorous, and carbon, moving through the ecosystem and being repeatedly used and made available through physical, chemical, and biological processes. Many of the physical, chemical, and biological processes operating in the Sacramento-San Joaquin basin affect the cycling of nutrients through the ecosystem temporally and spatially. The reuse or recycling of nutrients is important to overall primary and secondary productivity of the Bay-Delta ecosystem.

Table 5. Basis for Selection of Stressor Ecosystem Elements

Stressor	Basis for Selection as an Ecosystem Element
Levees, bridges, and bank protection	Levees, bridges, and bank-protection structures inhibit overland flow and erosion and depositional processes that develop and maintain floodplains, and allow stream channels to meander. Levees prevent floodflows from entering historic floodplains behind levees, stopping evolution of floodplain geomorphology, and eliminate or alter the character of floodplain habitats dependent on overbank flows. Confinement of floodflows to channels by levees and bank protection structures also increases the fluvial energy of flows that scour or incise channel beds and reduces or halts the rate of channel meander and oxbow formation. Bridges have a similar, though generally more localized effect, on channel morphology and sediment transport.
Dredging	Dredging in Bay-Delta waters may damage aquatic habitat, increase turbidity and sediment suspension above ambient levels, release toxic-laden sediments into the water column, or harm aquatic animals and plants. Channel dredging also contributes to levee instability by deepening channels, and steepens channelbanks causing progressive erosion of shoreline habitats.
Land use	Land use in the Bay-Delta watershed may stress ecosystem processes, functions, habitats, and aquatic and terrestrial organisms. Land use activities that may be harmful include urban and industrial development, land reclamation, water conveyance infrastructure, livestock grazing, and agricultural practices.
Wildfire	Wildfires caused from unnaturally high fuel levels in tributary watersheds of the Bay-Delta threaten water supply and fish and wildlife habitat through deforestation and resulting high levels of erosion and increased rates of surface runoff.
Non-native species	Introductions of non-native plants, wildlife, fish, and clams and other aquatic invertebrates have greatly altered ecosystem processes, functions, habitats, species diversity, and abundance of native plants, fish, and wildlife. The number of introduced non-native species in the ERPP focus area continues to increase.
Dams, reservoirs, and other human-made structures	Dams and their associated reservoirs block fish movement, alter water quality, remove fish and wildlife habitat, and alter hydrological and sediment processes. Other human-made structures may block fish movement or provide habitat or opportunities for predatory fish and wildlife, which could be detrimental to fish species of special concern.

Table 5. Continued

Stressor	Basis for Selection as an Ecosystem Element
Water management	Diversion, storage, and release of water in Bay-Delta watershed directly affects fish, aquatic organisms, and nutrient levels in the system, and indirectly affects habitat, foodweb production, and species abundance and distribution. Diversions cause consumptive loss of water, nutrients, sediment, and organisms (entrainment). Seasonal and daily patterns of water released from storage may affect habitat, water quality, and aquatic organism survival (e.g., stranding). Flood control releases into bypasses also cause stranding of adult and juvenile fish. The transfer of water across the Delta through existing channels may also steer upstream migrating adult salmon and downstream migrating juvenile salmon from their primary migration routes. The rate of diversion from the Delta also contributes to reduced residence time of water, reducing primary and secondary production and standing biomass.
Gravel mining	Mining gravels from rivers and floodplains may affect gravel recruitment, fish and wildlife habitat, abundance of aquatic predators, water quality (primarily water temperature), and fish and wildlife populations. Instream mining removes riparian and marsh vegetation, alters channel sediment transport, and causes channel widening and incisions. Excessive instability of the riparian corridor could result.
Contaminants	Contaminants from point and nonpoint sources affect water quality and survival of fish, waterfowl, and the aquatic foodweb. Contaminant sources may cause severe toxicity and organism mortality or chronic low-level toxicity that affects species' health and reproduction.
Human disturbance	Human activities, including boating, habitat disturbance, and other activities, may affect wildlife habitat and species abundance and distributions.
Harvest of fish and wildlife	Legal and illegal harvest of fish and wildlife may affect abundance of species or viability of local populations.
Predation and competition	Unnatural levels of predation and competition may adversely affect populations of fish and wildlife.
Artificial production of fish	Fish hatcheries and other artificial rearing programs (e.g., pen-rearing salvaged striped bass) may adversely affect populations of "wild" fish. Direct effects might be predation on wild fish or competition from artificially reared fish. Indirect effects may occur from adverse changes in wild population genetics from interbreeding with hatchery fish. Disease may also be transferred from hatchery fish to wild fish.

Table 6. Basis for Selection of Habitat Ecosystem Element

Habitat	Basis for Selection as an Ecosystem Element
Tidal perennial aquatic	Tidal perennial aquatic habitats, particularly areas less than 9 feet deep from mean high tide, are important habitat use areas for many species of fish and wildlife in the Delta. The substantial loss of historic shallow-water areas, primarily as a result of reclamation of tidally influenced habitat and channel dredging has reduced the available habitat area for associated fish and wildlife. Loss of shallow-water areas has also caused a reduction in primary and secondary productivity, changing the historic foodweb of the Delta.
Nontidal perennial aquatic	Nontidal perennial aquatic habitats, particularly areas less than 6 feet deep, are important habitat use areas for many species of fish and wildlife in the ERPP focus area. The substantial loss or degradation of nontidal perennial aquatic habitats, primarily as a result of reclamation of wetlands and alteration of streamflows, has reduced the available habitat area for associated fish and wildlife.
Dead-end sloughs	Dead-end sloughs provide warmer, highly productive habitat for seasonal spawning, rearing, and foraging of important aquatic organisms, as well as important carbon production for other Bay- Delta habitats. Several smaller branches of tidal slough networks have been severed from the main slough channel by levees. For waterfowl and wildlife, dead-end sloughs have associated marsh and riparian corridors important for breeding, feeding, resting, and roosting.
Open-ended sloughs	Open-ended sloughs provide unique, generally low-velocity, habitats and important migratory pathways for many species and important habitat for wildlife and waterfowl along the riparian corridors of the sloughs. Levee construction and channel dredging over many years has converted the gradual sideslopes supporting marsh- and tideflat habitat along sloughs to steep-sided, high-velocity channels with narrow or nonexistent shoreline habitat.
Seasonal wetland and aquatic	Seasonal wetland and aquatic habitats are important habitat-use areas for many species of fish and wildlife in the ERPP focus area. Loss or degradation of historic seasonal wetlands, primarily as a result of urban development and reclamation of wetlands for agriculture, has substantially reduced the habitat area available for waterfowl, shorebirds, and other waterbirds. Loss of vernal pool habitat, in particular, has directly resulted in the listing of several species as threatened or endangered under the federal Endangered Species Act. The loss of seasonal aquatic floodplain habitat, primarily as a result of levee construction and alteration of riverflows has substantially reduced floodplain refuge habitat for fish and spawning habitat for the Sacramento splittail. Loss of this habitat has reduced water storage, nutrient cycling, and foodweb support functions in the ERPP focus area.

Table 6. Continued

Habitat	Basis for Selection as an Ecosystem Element
Shaded riverine aquatic	Shaded riverine aquatic habitats are important habitat areas for one or more life stages of most fishes that inhabit the ERPP focus area. The loss or degradation of historic riparian vegetation from river and stream channel banks and alteration of near shore aquatic habitat has primarily been caused by channelization, stabilization of channel banks with riprap, construction of levees and control of flows and diversion of water have altered the hydrologic conditions that historically supported riparian vegetation. The loss of shaded riverine aquatic habitat has directly contributed to declines in populations of associated native fishes and reduced an important source of nutrients and allochthonous material in streams and Delta sloughs.
Saline emergent wetland	Saline emergent wetland habitats, including brackish and saline wetlands, are important habitat use areas for fish and wildlife dependent on marshes and tidal shallows in the Bay-Delta and support several special-status plant species. The loss or degradation of historic saline emergent wetlands, primarily as a result of reclamation of tidally influenced wetlands for agriculture, has substantially reduced the habitat area available for associated fish and wildlife species. Several plant and animal species closely associated with tidal saline emergent wetlands have been listed as endangered under the State and federal Endangered Species Acts, primarily as a result of the extensive loss of this habitat type. Loss of this habitat has reduced nutrient cycling and foodweb support functions in the Bay-Delta.
Fresh emergent wetland	Tidal and nontidal fresh emergent wetland habitats are important habitat use areas for fish and wildlife dependent on marshes and tidal shallows in the ERPP focus area and support several special-status plant species. The loss or degradation of historic fresh emergent wetlands has substantially reduced the habitat area available for associated fish and wildlife species.
Midchannel islands and shoals	Midchannel islands and shoals provide unique remnant shallow-water edge habitat in many Delta channels. They typically support willow scrub, tule marsh, and tidal mudflat habitats and associated wildlife and fish. Midchannel islands and shoals have been shrinking or disappearing as a result of progressive erosion. Loss of this habitat has reduced nutrient cycling and foodweb support functions in the Bay-Delta.
Riparian scrub, woodland, and forest	Many species of wildlife, including several species listed as threatened or endangered under the State and federal Endangered Species Acts and several special-status plant species in the ERPP focus area are dependent on or closely associated with riparian habitats. Riparian habitats support the greatest diversity of wildlife species than all other habitat types in California. Degradation and loss of riparian habitat has substantially reduced the habitat area available for associated wildlife species. Loss of this habitat has reduced water storage, nutrient cycling, and foodweb support functions in the ERPP focus area.
Coastal scrub	Coastal scrub is associated with inland sand dunes and is limited in the ERPP focus area to the vicinity of the Antioch Dunes National Wildlife Refuge. This habitat area supports two plant and one butterfly species listed as endangered under the federal Endangered Species Act.

Table 6. Continued

Habitat	Basis for Selection as an Ecosystem Element
Valley oak woodland	Valley oak woodland habitats are important habitat use areas for many species of wildlife in the ERPP focus area. The loss or degradation of historic stands of valley oak woodland has substantially reduced the valley oak woodland habitat area available for associated wildlife.
Perennial grassland	Grasslands are important breeding and foraging habitat areas for many species of wildlife and support several special-status plant species. Most perennial grassland in the ERPP focus area, historically common throughout most of the Central Valley, has been lost or has been converted to annual grassland.
Agricultural wetland	Following extensive loss of native wetland habitats in the ERPP focus area, some wetland-associated wildlife species have adapted to the artificial wetland environment created by some agricultural practices and have become dependent on agricultural wetland areas to sustain their populations at current levels. Agriculturally created wetlands include rice lands; fields flooded for weed, salinity, and pest control; stubble management; and tailwater circulation ponds.
Agricultural upland	Following extensive loss of some native upland habitats, upland- associated wildlife species have adapted to the artificial upland environment created by some agricultural land uses and have become dependent on agricultural upland areas and field-border shelter belts to sustain their populations at current levels.

Table 7. Basis for Selection of Species and Species Group Ecosystem Elements

Species or Species Group	Basis for Selection as an Ecosystem Element
Fishes	
Delta smelt	The delta smelt is a native estuarine resident fish that has been listed as threatened under the State and federal Endangered Species Acts.
Sacramento splittail	The Sacramento splittail is a native resident fish that is proposed for listing under the federal Endangered Species Act and a candidate for listing under the State Endangered Species Act. The Sacramento splittail also supports a small winter sport fishery in the lower Sacramento River.
Longfin smelt	The longfin smelt is a native estuarine resident species and is designated as a species of special concern by the California Department of Fish and Game (DFG) and a species of concern by the U.S. Fish and Wildlife Service (USFWS).
Green sturgeon	The green sturgeon is designated as a species of special concern by DFG and a species of concern by USFWS.
Sacramento fall-run chinook salmon	The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The fall-run race is the largest population of chinook salmon on the Sacramento River.
Sacramento winter-run chinook salmon	The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The winter-run race is listed as endangered under the State and federal Endangered Species Acts.
Sacramento spring-run chinook salmon	The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The spring-run race on the Sacramento River is designated as a closely monitored species by DFG and a species of concern by USFWS.
Sacramento late-fall-run chinook salmon	The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The late-fall-run race on the Sacramento River is designated as a species of special concern by DFG and a species of concern by USFWS.
San Joaquin fall-run chinook salmon	The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The fall-run race on the San Joaquin River is designated as a species of special concern by DFG and a species of concern by USFWS.
Steelhead trout	The steelhead trout is an important native anadromous sport fish of high recreational and ecological value that is proposed for listing under the federal Endangered Species Act.

Table 7. Continued

Species or Species Group	Basis for Selection as an Ecosystem Element
Striped bass	The striped bass is an important non-native anadromous sport fish with high recreational value. It also plays an important role as a top predator in the aquatic system.
White Sturgeon	The white sturgeon is an important native anadromous sport fish with high recreational and ecological value.
American Shad	The American shad is an important non-native anadromous sport fish with high recreational value.
Largemouth bass	The largemouth bass is an important non-native resident sport fish with high recreational value.
Fish Species Groups	
Native resident fishes Representative species: • tule perch • hitch • hardhead • Sacramento blackfish • Sacramento sucker • Sacramento squawfish • threespine stickleback	Native resident fish species of the Delta are important ecologically and as indicators of ecosystem health. Some, such as the tule perch, Sacramento sucker, and threespine stickleback, are important elements of the foodweb. Others, such as the Sacramento squawfish, are important predators. Native resident fish have been in decline as a percent of total fish species abundance in tributaries of the Bay-Delta-Central Valley watershed.
Non-native resident fishes Representative species: • bluegill • white catfish • inland silverside • yellowfin goby • chameleon goby • threadfin shad • Wakasagi	Non-native resident fishes include many introduced species. Some of these species (e.g., threadfin shad) are considered beneficial as prey species for other fish or as sport fish (e.g., white catfish). Other species, such as the inland silverside and yellowfin goby, are considered undesirable because they compete with or are predators on native fish. Wakasagi is a close relative to the delta smelt and could threaten the delta smelt population through interbreeding or competition for habitat.
Marine fishes Representative species: • starry flounder • Pacific herring • northern anchovy • prickly sculpin • staghorn sculpin	Marine fishes include many species that are abundant and important ecologically in the Bay and coastal waters. Two ecologically important species are the Pacific herring and northern anchovy, whose young are important in the foodweb of key anadromous fishes including salmon and striped bass. These species are also important foodweb species for wildlife that forage for fish in the Bay-Delta (e.g., cormorants and terns).

Species or Species Group	Basis for Selection as an Ecosystem Element
Amphibians and Reptiles	
California red-legged frog	The California red-legged frog is associated with fresh emergent wetland and riparian habitat. The distribution and population of this species has declined substantially, primarily as a result of the loss or degradation of the species' habitat and introduction of non-native predators. The loss of habitat and declining condition of the species' population have warranted its listing as threatened under the federal Endangered Species Act.
Giant garter snake	The giant garter snake is associated with fresh emergent wetland habitat. The distribution and population of this species have declined substantially, primarily as a result of the loss or degradation of the species' habitat. The loss of habitat and declining condition of the species' population have warranted its listing as threatened under the State and federal Endangered Species Acts.
Other native amphibians and reptiles	Populations of many native amphibians and reptiles have declined primarily as a result of habitat loss or degradation and competition from introduced predators or competitors. Populations of several species, such as the California tiger salamander, have declined sufficiently to warrant their designation as special-status species by USFWS or DFG.
Western pond turtle	The western pond turtle is associated with fresh emergent wetland habitat. The distribution and population of this species have declined substantially, primarily as a result of the loss or degradation of wetland habitats and nearby uplands. The loss of habitat and declining condition of the species' population have warranted its designation as a species of concern by USFWS and a species of special concern by DFG.
Birds	
Swainson's hawk	The nesting population of the Swainson's hawk has declined substantially, primarily as a result of habitat loss and degradation, the adverse effects of toxic pesticides accumulated in the foodweb on reproduction, human-associated disturbances at nest sites, increased competition with other species for nest sites, and high rates of mortality during migration and on South American wintering areas. The loss of habitat and declining condition of the species' population have warranted its listing as threatened under the State Endangered Species Act.

Species or Species Group	Basis for Selection as an Ecosystem Element
California clapper rail	The California clapper rail is associated with saline emergent wetlands. The population and distribution of this species have declined substantially, primarily as a result of reclamation of tidal saltmarshes for agriculture and excessive predation on nests and individuals by introduced predators. The loss of habitat and declining condition of the species' population have warranted its listing as endangered under the State and federal Endangered Species Acts.
California black rail	The California black rail is associated with tidal and nontidal emergent wetlands. The population and distribution of this species have declined substantially, primarily as a result of the loss or degradation of salt- and freshwater marshes, and excessive mortality from non-native predators. The loss of habitat and declining condition of the species' population have warranted its listing as threatened under the State Endangered Species Act.
Greater sandhill crane	This subspecies of the sandhill crane primarily winters in the Delta and forages and roosts in agricultural fields and pastures. Because the winter range of the greater sandhill crane in the ERPP focus area overlaps the winter range of other sandhill crane subspecies, all subspecies are considered to be a key resource element. The greater sandhill crane population has declined primarily as a result of loss of suitable wetland nesting habitats. The loss of habitat and declining condition of the subspecies' population have warranted its listing as threatened under the State Endangered Species Act.
Western yellow-billed cuckoo	The western yellow-billed cuckoo is associated with mixed riparian and cottonwood forests. This species has been extirpated from the Delta. Elsewhere in the ERPP focus area, the population and range of this species have declined primarily as a result of the loss or degradation of extensive, mature and successional, riparian cottonwood forests. The loss of habitat and declining condition of the species' population have warranted its listing as endangered under the State Endangered Species Act.
Suisun song sparrow	This species is associated with saline emergent wetlands. The population and distribution of this species have declined substantially in the western Delta and Suisun Bay, primarily as a result of reclamation of tidal saltmarshes. The loss of habitat and declining condition of this species' population have warranted its consideration for listing under the State Endangered Species Act.

Species or Species Group	Basis for Selection as an Ecosystem Element
Mammals	
Salt marsh harvest mouse	The salt marsh harvest mouse is associated with saline emergent wetlands. The population and distribution of this species have declined substantially, primarily as a result of reclamation of tidal saltmarshes for agriculture. The loss of habitat and declining condition of this species' population have warranted its listing as endangered under the State and federal ESAs.
Riparian brush rabbit	The riparian brush rabbit is associated with riparian habitats and has been extirpated from the Delta. Elsewhere in the ERPP focus area, the population and distribution of this species have declined substantially, primarily as a result of the loss or degradation of its habitat. The loss of habitat and declining condition of this species' population have warranted its listing as endangered under the State Endangered Species Act.
Wildlife Habitat Guilds	
Deepwater wildlife guild Representative species: • grebes and diving ducks • pelicans and cormorants • phalaropes • gulls and terns • river otter	Deepwater habitats used by associated wildlife species have been lost or degraded in the Delta. Channelization of rivers, reclamation of historic water bodies, and the alteration of the natural ecological processes that maintain productivity in deepwater habitats have resulted in the substantial loss, degradation, and fragmentation of historic deepwater habitats used by aquatic birds and mammals.
Shallow-water and mudflat wildlife guild Representative species: • wading birds and shorebirds • dabbling ducks, geese, and swans • peregrine falcon • gulls and terns	Shallow-water and mudflat habitats used by associated wildlife species have been lost or degraded in the Delta. Reclamation of tidal and nontidal wetlands, pollution, and the loss of seasonal overbank flooding have resulted in the substantial loss, degradation, and fragmentation of historic shallow-water habitats used by migratory and resident wildlife.

Species or Species Group	Basis for Selection as an Ecosystem Element
Saline emergent wetland wildlife guild Representative species: • shorebirds and wading birds • rails, ducks, and coots • wrens, yellowthroats, and blackbirds • deer mouse	Tidal and nontidal saline emergent wetland habitats, including brackish and saline wetlands, used by associated wildlife species have been lost or degraded in the Suisun Bay, Suisun Marsh, San Pablo Bay, and central- and south-Bay regions. Reclamation of tidal wetlands, pollution, and alteration of the supporting hydrology, and other human activities have resulted in the substantial loss, degradation, and fragmentation of historic saline emergent wetlands used by migratory and resident wildlife.
Fresh emergent wetland wildlife guild Representative species: • garter snakes • shorebirds and wading birds • rails, dabbling ducks, and coots • short-eared owl • wrens, yellowthroats, and blackbirds • beaver, muskrat, and river otter • gray fox and coyote	Tidal and nontidal freshwater emergent wetland habitats used by associated wildlife species have been lost or degraded in the Delta. Reclamation of wetlands, pollution, the loss of seasonal overbank flooding, and other human activities have resulted in the substantial loss, degradation, and fragmentation of historic fresh emergent wetlands used by migratory and resident wildlife.
Riparian wildlife guild Representative species: • salamanders and frogs • pond turtles, lizards, and garter snakes • hawks and owls • hummingbirds and woodpeckers • flycatchers and swallows • wrens, kinglets, and thrushes • vireos and warblers • towhees, sparrows, and finches • bats, gophers, and mice • skunks, bobcat, and mule deer	Riparian habitats used by associated wildlife species have been lost or degraded throughout the ERPP focus area. Development of floodplains, channelization of streams, stabilization of streambanks, construction and maintenance of levees, changes in stream hydrology, and other human activities have resulted in the substantial loss, degradation, and fragmentation of historic riparian habitats used by migratory and resident wildlife.

Species or Species Group	Basis for Selection as an Ecosystem Element
Valley-oak woodland wildlife guild Representative species: • hawks and owls • upland game birds • nuthatches and woodpeckers • flycatchers and swallows • wrens, kinglets, and thrushes • vireos and warblers • towhees, sparrows, and finches • bats, gophers, voles, and mice • skunks, bobcat, and mule deer	Valley-oak woodland habitats used by associated wildlife species have been lost or degraded throughout the ERPP focus area. Removal of valley-oak trees, displacement of native understory plant species by introduced species, and alteration of historic floodplain hydrology have resulted in the substantial loss, degradation, and fragmentation of historic valley-oak woodlands used by migratory and resident wildlife.
Agricultural wetland wildlife guild Representative species: • frogs and garter snakes • shorebirds and wading birds • waterfowl and gulls • blackbirds, hawks and owls	Many species of wetland associated wildlife are now dependent on agricultural wetlands (i.e., rice- and croplands flooded to control weeds, soil salinity, agricultural pests, or to attract wildlife) to maintain their populations and distribution. As a result of the loss or degradation of large areas of native aquatic and wetland habitats, many wildlife species associated with those native habitats now depend on agricultural wetlands for their forage, reproduction, and resting requirements. The potential value of agricultural wetlands to wildlife is reduced by some agricultural practices.
Agricultural upland wildlife guild Representative species: • waterfowl and upland game • hawks and owls • woodpeckers and flycatchers • sparrows, blackbirds, and finches	Many species of upland-habitat-associated wildlife are now dependent on agricultural uplands to maintain their populations and distribution. As a result of the loss or degradation of large areas of native upland habitats, many wildlife species associated with those native habitats now depend on agricultural uplands (i.e., all nonflooded agricultural cover types) for their forage, reproduction, and resting requirements. The potential value of agricultural wetlands to wildlife is reduced by some agricultural practices.
Wildlife Species Guilds	
Shorebird and wading-bird guild Representative species: • great blue heron • great egret • western sandpiper • long-billed dowitcher	Many species of shorebirds and wading birds migrate through, winter or breed in the Bay-Delta. These species are a significant component of the ecosystem, are of high interest to recreational bird watchers, and contribute to California's economy through sales of equipment and other bird-watching-related expenditures. There have been substantial losses of historic habitat used by these species and available information suggests that population levels for many of these species is declining.

Species or Species Group	Basis for Selection as an Ecosystem Element
Upland game guild Representative species: • California quail • mourning dove • common snipe • desert cottontail	Upland game species are of high interest to recreational hunters in the Bay-Delta and contribute to California's economy through the sale of hunting-related equipment and hunting-related expenditures.
Waterfowl guild Representative species: • canvasback • ring-necked duck • hooded merganser • northern pintail • mallard • greater white-fronted goose • snow goose • Canada goose • tundra swan	Many species of waterfowl migrate through, winter, or breed in the Bay-Delta. Waterfowl are a significant component of the ecosystem, are of high interest to recreational hunters and bird watchers, and contribute to California's economy through the sale of hunting and related equipment. Historic waterfowl wintering habitat areas have declined by approximately 95% and as a result of substantial losses of historic wetland and grassland habitats, waterfowl breeding populations have declined from historic levels.
Neotropical migratory bird guild Representative species: • Western kingbird • Western wood-pewee • Tree swallow • Cliff swallow • Northern oriole • Wilson's warbler • Yellow-breasted chat	Many species of neotropical migratory birds migrate through or breed in the Bay-Delta. These species are a significant component of the ecosystem, are of high interest to recreational bird watchers, and contribute to California's economy through sales of equipment and other bird-watching-related expenditures. There have been substantial losses of historic habitat used by these species and available information suggests that population levels for many of these species is declining.
Estuarine Foodweb Organisms • algae • aquatic higher plants • bacteria • zooplankton • epibenthic invertebrates • benthic invertebrates	Foodweb organisms are essential for the survival and productivity of fish populations in the Bay-Delta estuary. Foodweb organisms include bacteria, algae, higher plants (e.g., bulrush and cattail), zooplankton (e.g., copepods and cladocerans), epibenthic invertebrates (e.g., crayfish, and *Neomysis* and *Crangon* shrimp), and benthic invertebrates (e.g., clams). Some organisms are exotic species (e.g., water hyacinth, certain zooplankton, and Asian clams) that may be detrimental to native organisms and the foodweb in general.

Table 7. Continued

Species or Species Group	Basis for Selection as an Ecosystem Element
Terrestrial Invertebrates	
• Conservancy fairy shrimp • vernal pool tadpole shrimp • vernal pool fairy shrimp • valley elderberry longhorn beetle • Delta green ground beetle • Lange's metalmark butterfly	These special-status invertebrate species are associated with vernal pool, riparian, or inland dune habitats in portions of the Central Valley, including the Delta and Suisun Marsh regions. The distribution and populations of these species have declined substantially, primarily as a result of the loss or degradation of these habitats within their range. The loss of habitat and declining condition of these species populations have warranted their listing as threatened or endangered under the federal Endangered Species Act.
Plants	
Delta button-celery	Delta button-celery is endemic to the Delta and occurs in the floodplain of the San Joaquin River. Most of its historic habitat has been lost primarily as a result of flood control activities and agricultural land conversion. The loss of habitat and declining condition of these species populations have warranted their listing as endangered under the State Endangered Species Act.
Plant Species Associations	
Saline emergent wetland plant association: • soft bird's-beak • marsh gumplant • Suisun thistle • small spikerush	These species are endemic to tidal marshes in the greater San Francisco Bay-Suisun Marsh area. The majority of these species' habitat has been lost as a result of diking and drainage of tidal marsh. Other threats include mosquito abatement activities, vehicle use, trampling, and invasion by non-native plants. The loss of habitat and declining condition of these species' populations have warranted their listing as special-status species by DFG, USFWS, and/or the California Native Plant Society (CNPS).
Fresh emergent wetland plant association: • Mason's lilaeopsis • Sanford's arrowhead • Delta mudwort • bristly sedge • Suisun marsh aster • mad-dog skullcap • rose mallow • delta tule pea	These species are endemic to tidal or nontidal fresh emergent wetlands. Tidal species have lost a majority of their habitat through direct loss from flood control structures and riprap and through erosion of remnant in-channel islands. Nontidal species are presently threatened by grazing, development, and channel alteration. The loss of habitat and declining condition of these species populations have warranted their listing as special-status species by DFG, USFWS, and/or CNPS.

Species or Species Group	Basis for Selection as an Ecosystem Element
Coastal scrub plant association: • Antioch Dunes evening primrose • Contra Costa wall flower	These species are endemic to loose sand and stabilized dunes near river margins in the vicinity of Antioch. Most remaining plants occur at the Antioch Dunes National Wildlife Refuge. Most dune habitat in the Delta has been lost to conversion to agriculture or sand mining. Present threats include competition from invasive non-native species and recreational activities. The loss of habitat and declining condition of these species' populations have warranted their listing as endangered under the State and federal Endangered Species Acts.

Table 8. Primary Physical Processes Implementation Objectives and Targets

Ecosystem-Quality Objective[a]	Primary Physical Process	Implementation Objective	Targets[b]
A1, A2, A3, A4, A5, A6, A7, B1, B2, B3, B7, C1, C2, C3	Hydrograph	A. Restore some of the basic features of the hydrograph by shifting flows seasonally to better represent natural seasonal flow patterns.	1. More closely emulate the pattern of the natural hydrograph in tributaries that have existing large storage reservoirs in most year types (with the exception of critical drought years) by providing an initial fall pulse and a natural late-winter or spring pulse of flow for anadromous fish attraction and transport, riparian vegetation succession, channel maintenance, and nutrient transport. 2. In the mainstems of the Sacramento, San Joaquin, Feather, Yuba, and American Rivers, below the major storage reservoirs, more closely emulate the natural hydrograph in most year types by providing an initial fall pulse and a natural late-winter or spring pulse of flow for channel maintenance, nutrient transport, and anadromous fish attraction and transport. 3. In tributaries with little or no storage capacity, the natural hydrograph exists but manage storage and diversions to improve the hydrograph.
		B. Restore some semblance of the natural hydrograph by improving base flows so that they are more like historical or unimpaired baseflows during critical periods for the ecosystem.	1. In mainstem rivers, tributaries, and the Bay-Delta, restore a portion of baseflows in critical periods and year types where existing baseflows are less than natural baseflows.
A1, A2, A3, A4, A5, A6, A7, B1, B2, C1, C2, C3	Natural hydraulic regime	A. Restore some semblance of the natural hydraulic regime in the Bay-Delta.	1. Manage the operation of physical barriers to more closely emulate hydraulic conditions conditions present in Bay-Delta channels under mid-1960s level of water supply development. 2. Modify diversions in the Bay-Delta channels to more closely emulate hydraulic conditions present in Bay-Delta channels under mid-1960s level of water supply development.
A1, A2, B1, B2, B3, B7, C1, C2, C3	Natural sediment supply	A. Restore some semblance of the natural supply of sediments to fluvial and estuarine systems.	1. In tributaries and mainstem rivers restore a desirable level of sediment to meet the needs of spawning fish, maintain natural streamchannel meanders and bar formation, and match existing rates of downstream displacement.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

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Ecosystem-Quality Objective[a]	Primary Physical Process	Implementation Objective	Targets[b]
			2. In the Bay-Delta, restore desirable levels of sediment inputs to maintain wetlands, shallow-water habitat, and nutrient transport.
A1, A2, A3, A5, A6, B1, B2, B3, B7, C1, C2	Geomorphology	A. Restore natural compound cross sections and channel configurations by supplementing natural sediment and erosion processes as necessary with human-made processes.	1 Working with available hydrologic and sediment regimes, in a manner consistent with flood control requirements, more closely emulate natural streamchannel configurations in mainstem rivers, tributary streams, and Bay-Delta.
			2. Modify cross sections and channel configurations in mainstem rivers, tributary streams, and Bay-Delta to provide a more natural configuration, while maintaining consistency with flood control requirements.
		B. Restore natural floodplain configurations associated with rivers and tributaries.	1. Reconfigure Sutter, Yolo, and Sacramento bypasses to restore a natural configuration within existing flood control constraints while protecting important land uses and infrastructure.
			2. Reconfigure natural floodplains along the margin of the Delta, using the Cosumnes River Preserve as a model.
			3. Create floodplain preserves where natural sedimentation and vegetation succession can occur unimpeded, and as a source of riverine and estuarine nutrients and allochthonous material.
		C. Maintain, enhance, or restore tule and willow channel islands in the Bay-Delta.	1. Restore flows, patterns, velocities, and sediment loads to create conditions necessary to reduce current erosion rates of channel islands and reestablish processes that will build channel islands and shallow shoals.
			2. Armor channel islands and reduce boating activity or intensity to desirable levels in areas where boat wakes are the primary cause of erosion of channel islands.
		D. Restore tidal sloughs in the Bay-Delta estuary.	1. Remove barriers to tidal flow into existing backwater sloughs to reestablish connectivity with major channels and river systems.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Primary Physical Process	Implementation Objective	Targets[b]
A3, A4, A6, A7, B1, B2, C1, C2, C3	Tides	A. Restore the tidal exchange volume (prism) in the Bay-Delta to desirable and more natural levels.	1. Increase the tidal volume of the Bay-Delta by [redacted]% by increasing the surface area of undiked margins of the Bay and Delta.
		B. Restore natural tidal directions to the Bay-Delta estuary.	1. Restore net downstream flow in the south and central Delta.
			2. Restore the natural tidal and estuarine mixing regimes in major portions of the Suisun Marsh, Montgomery Slough, and adjacent Grizzly and Honker's bays.
A2	Fire	A. Restore the role of natural fire in maintaining grassland, wetland, woodland, and forest health in the Sacramento-San Joaquin basin.	1. Restore a desirable level of fire management that more closely approximates historic natural conditions in basin and tributary watersheds.
			2. Use prescribed fire management to reduce unnatural fuel loads that cause excessive erosion following wildfire events.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Table 9. Secondary Ecosystem Processes and Functions Implementation Objectives and Targets

Ecosystem-Quality Objective[a]	Secondary Ecosystem Processes and Functions	Implementation Objective	Targets[b]
A6, A7, C1, C2, C3	Stream meander migration	A. Maintain, enhance, or restore natural stream meander processes.	1. Preserve the existing natural meander belts in the Sacramento River between Chico Landing and Red Bluff, and in the San Joaquin River between Mossdale and the mouth of the Merced River. 2. Establish nodes of floodplain expansion or levee setbacks where channel migration can occur in select reaches of the Sacramento River downstream of Chico Landing. 3. Restore natural meander processes to more closely approximate historic conditions in major tributaries of Sacramento and San Joaquin rivers. 4. Restore natural channel processes within portions of the San Joaquin River floodplain.
A1, A2, B1, B2, B3, B7, C1, C2, C3	Gravel recruitment	A. Maintain, enhance, or restore gravel recruitment processes that are important sources of gravel to riverine systems of the Sacramento-San Joaquin basin.	1. Maintain existing levels of erosion and gravel recruitment in tributaries and rivers that sustain an adequate level of gravel recruitment. 2. Enhance and restore natural erosion and gravel recruitment processes in mainstem rivers and tributaries. 3. Restore desirable levels of gravel recruitment through direct manipulation and input on all rivers and streams where the natural fluvial process has been interrupted by dams or other human-made features that retain the sediment supply.
A1, C1, C2, C3	Gravel transport and cleansing	A. Maintain, enhance, or restore the gravel transport and cleansing processes in riverine systems of the Sacramento-San Joaquin basin.	1. Increase the rate of gravel transport and cleansing in mainstem rivers and tributaries by restoring more natural hydrograph patterns. 2. Enhance or restore gravel transport and cleansing in rivers and tributaries to desirable levels through direct manipulation of channel and floodplain deposits.
A1, C1, C2, C3	Water temperature	A. Maintain, enhance, or restore natural water temperature regimes.	1. Establish desirable water temperatures during summer and fall base-flow periods and low-flow springs of drier years in tributaries and mainstem rivers.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Secondary Ecosystem Processes and Functions	Implementation Objective	Targets[b]
			2. Establish desirable water temperatures in mainstem rivers below major storage reservoirs from late spring through early fall for salmon and steelhead early life stages rearing.
A1, A2, A5, A6, B3, B7, C1, C2	Current velocities	A. Maintain, enhance, and restore natural current velocity patterns.	1. Establish desirable flow velocity patterns in mainstem rivers, tributaries, and Bay-Delta sloughs and channels by restoring overbank floodplains and more natural compound channel sections and planform.
A1, A2, A3, A5, A6, A7, C1, C2, C3	Floodwater and sediment detention and retention	A. Maintain, enhance, or restore natural patterns of floodwater and sediment detention and retention in the Sacramento-San Joaquin basin.	1. Establish a desirable level of floodwater retention potential by expanding, where feasible and consistent with flood protection, the floodplain area of tributaries, mainstem rivers, and Bay-Delta estuary that are flooded at higher flows and tides. 2. Establish a desirable level of sediment retention along tributaries, mainstem rivers, and in the Bay-Delta by increasing, where feasible and consistent with flood protection, the active floodplain area and increasing channel roughness from riparian vegetation.
A1, A2, A6, A7, B2, A3, B5, B7, E1, E2	Vegetation succession, overbank flooding, and floodplain inundation	A. Maintain, enhance, or restore natural overbank flooding, floodplain inundation, and vegetation succussion.	1. Increase overbank flooding potential to tributary and river floodplains, where feasible and consistent with flood protection, to support a desirable vegetation succession process. 2. Increase the area, frequency, and duration of flooding to existing tributary and river floodplains during the wet season, where feasible and consistent with flood protection,.
A4, A7, C1, C2, C3	Nutrient inputs and availability	A. Maintain, enhance, or restore the amounts of basic nutrients available to the foodweb of estuarine and riverine systems.	1. Restore nutrients in the Bay-Delta to levels consistent with the mid-1960s level of development to provide a desirable level of foodweb productivity. 2. Maintain existing or reestablish desirable levels of nutrient inflow to tributary streams and mainstem rivers.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Secondary Ecosystem Processes and Functions	Implementation Objective	Targets[b]
A4, A7, C1, C2, C3	Aquatic primary production	A. Maintain, enhance, or restore primary aquatic production (i.e., algae and phytoplankton) in the Sacramento-San Joaquin basin.	1. Restore levels of primary production in the Bay-Delta and mainstem rivers to levels occuring under the mid-1960s level of development by increasing nutrient levels and residence times of water in the system. 2. Maintain and enhance aquatic primary production in tributaries.
A4, A7, C1, C2, C3	Aquatic secondary production	A. Maintain, enhance, or restore secondary aquatic production (e.g., zooplankton) in the Sacramento-San Joaquin basin.	1. Restore secondary production to the Bay-Delta and mainstem rivers to levels consistent with the mid-1960s level of development by increasing nutrient level and residence time of water in the system. 2. Maintain and enhance aquatic secondary production in tributaries.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
A6, A7, C1, C2, C3	Levees, bridges, and bank protection	A. Reestablish natural geomorphological and fluvial processes in artificially confined channel reaches.	1. Set back [redacted] miles of levees along the Sacramento River and [redacted] miles of levees along the San Joaquin River in feasible and cost-effective areas to reestablish hydrologic connectivity between these channels and natural floodplains.
		B. Reestablish floodplain riparian vegetation along artificially confined channel reaches.	1. Modify vegetation maintenance practices in ways consistent with flood protection needs along levee berms and graded banks along [redacted] miles of the Sacramento River, [redacted] miles of the San Joaquin River, and [redacted] miles of their major tributaries where local practices inhibit establishment and maturation of riparian vegetation.
A1, A7, A8, C1, C2, C3	Dredging	A. Reduce the loss and degradation of habitat from dredging activities in the Bay-Delta.	1. Reduce the loss and degradation of important aquatic habitat to dredging activities that are not essential for flood conveyance or maintenance of industrial shipping pathways.
			2. Manage dredging during key periods and in sensitive areas for aquatic resources to reduce impacts to aquatic resources.
A1, B7, C1, C2	Land use	A. Establish internal buffer zones around important habitat areas to protect these habitats from incompatible adjacent land uses.	1. Manage land uses adjacent to important habitat areas occupied by special-status plant and animal species in the ERPP focus area to be compatible with maintaining or increasing special-status species populations.
			2. Manage land uses adjacent to enhanced or restored habitat areas in the ERPP focus area to provide buffer zones.
			3. Modify agricultural practices within 100 feet of occupied giant garter snakes and western pond turtle habitat to restore suitable nesting habitat areas.
		B. Preserve special-status wildlife nesting sites.	1. Manage land uses on lands supporting Swainson's hawk nest trees, including land development, agriculture, and fuel wood cutting, that could result in the removal or degradation of traditional nesting sites to increase nesting success and prevent nest site abandonment.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

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Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
		C. Promote rangeland management practices and livestock stocking levels that are consistent with maintaining high-quality habitat conditions.	1. Manage grazing levels and seasonal timing of grazing or defer grazing in habitats occupied by special-status plants in the ERPP focus area so that rangeland habitat conditions are compatible with maintaining or enhancing populations of these species.
			2. Adjust grazing levels and seasonal timing of grazing or eliminate grazing in active floodplains to encourage establishment of, or enhance the quality of existing, riparian vegetation, maintain or enhance shaded riverine aquatic habitat, and reduce the rate of channel bank erosion in the ERPP focus area.
		D. Reduce adverse impacts of water conveyance infrastructure maintenance on special-status species.	1. Reduce the annual loss of California red-legged frog habitat associated with maintenance of ditches and canals under state, federal, and local jurisdiction within the species range in the ERPP focus area by [redacted]% to maintain or increase the specie's population.
			2. Reduce the annual loss of giant garter snake habitat associated with maintenance of ditches and canals under state, federal, and local jurisdiction within the species range in the ERPP focus area by [redacted]% and limit maintenance activities to October 30-March 1 to maintain or increase the specie's population.
B7, C1	Wildfire	A. Reduce fuel load levels in upper watersheds to reduce potentially damaging wildfires.	1. Implement forest and rangeland practices that reduce the fuel loads in upper watersheds of the Bay-Delta-River system.
		B. Protect special-status plant populations from fuel load control practices that adversely affect these species.	1. Manage vegetation control for seasonal fire management in areas occupied by special-status plant species in the ERPP focus area that can be adversely affected by these practices to maintain or increase their populations.
		C. Prevent long-term loss of important habitat areas to catastrophic wild fires.	1. Reduce the potential for uncontrolled fires in mature riparian forests in the ERPP focus area to maintain these limited habitat areas.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
			2. Reduce the potential for uncontrolled fires in the upper watersheds of the Bay-Delta to protect water supply.
A1, A2, A3, A7, B1, B2, B3, B7, C1, C2, C3	Exotic species	A. Reduce populations of harmful introduced plants.	1. Reduce the surface area of channels and sloughs in the Delta covered by water hyacinth by 50% to increase the productivity of the aquatic food web and provide habitat areas for fish and wildlife.
			2. Reduce populations of exotic plants that compete with native plant species at the Antioch Dunes National Wildlife Refuge by 50% to increase populations of the host plant of the listed Lange's metalmark.
			3. Reduce populations of invasive exotic plant species that compete with the establishment and succession of native riparian vegetation in the Delta, along the Sacramento River, the San Joaquin River, and major tributaries to the Sacramento and San Joaquin Rivers by 10% to assist in the natural reestablishment of native riparian vegetation in floodplains, increase shaded riverine aquatic cover for fish, and increase habitat values for riparian associated wildlife.
			4. Reduce populations of invasive exotic plant species that compete with the establishment and succession of native saline and fresh emergent marsh vegetation in the Delta by 10% to assist in the natural reestablishment of these native habitats and increase habitat values for associated wildlife.
		B. Reduce populations of harmful introduced animals.	1. Reduce populations of bullfrogs and non-native fish species that prey on or compete with the listed California red-legged frog in historic red-legged frog habitat in the Delta by 10% to assist in the species recovery.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

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Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
			2. Reduce populations of bullfrogs and non-native fish species that prey on or compete with the listed California red-legged frog in areas adjacent to the Delta from which recruitment to the Delta could occur.
			3. Reduce introduced red fox and Norway rat populations in and adjacent to suitable California clapper rail, California black rail, and salt marsh harvest mouse habitat areas in the Delta by 10% to reduce predation levels on eggs, juveniles, and adults and assist in the recovery of these listed species.
		C. Control influx of exotic aquatic species into the Bay-Delta watershed from ship ballast water and border crossings.	1. Reduce or eliminate the influx of exotic aquatic species in ship ballast water.
			2. Reduce the potential for influx of exotic aquatic plant and animal species at border crossings.
A6, C1, C2	Dams, reservoirs, and other man-made structures	A. Reduce the potential to block movements of juvenile and adult fish at instream barriers within the Bay-Delta watershed.	1. Reduce hindrance of migrating fish at all instream structures that presently allow some form of passage in the Bay, Delta, mainstem rivers, and tributaries.
		B. Reduce the potential for instream, man-made structures to provide habitat or opportunities for predators.	1. Reduce habitat and opportunities for predators around instream structures.
A1, A2, A4, A5, A6, A7, A8, B1, B2, B3, B7, C1, C2, C3	Water management and diversions	A. Reduce entrainment of aquatic organisms and nutrients into water diversions.	1. Reduce entrainment of fish and nutrients into diversions by 50% in Bay, Delta, rivers, and tributaries.
			2. Reduce export loss rates of striped bass to that consistent with mid-1960s level of development.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
			3. Reduce entrainment losses of striped bass eggs, larvae, and juveniles at agricultural, power plant, and managed wetland diversions by 50%.
		B. Reduce the loss of adult and juvenile fish due to stranding (becoming lost, blocked, or stranded) in the Bay -Delta watershed.	1. Reduce loss of upstream migrating salmon or other anadromous or resident fishes to becoming lost on upstream or returning downstream migrations.
		C. Reduce the loss of juvenile anadromous and resident fish from being stranded in seasonal or managed wetlands, flood bypasses, or leveed lands.	1. Reduce stranding of fish in seasonal or managed wetlands, flood bypasses, or leveed lands.
		D. Manage flows to improve habitat conditions for all life stages of important fish species.	1. Improve flows on tributaries and mainstem rivers at important times of the year for spawning, rearing, foraging, and migration of important fishes.
			2. Provide appropriate Delta outflow at important times of the year, which together with other habitat improvements will support the recovery of fish species of special concern.
		E. Reduce effects on fish and their habitat from extreme daily or seasonal flow fluctuations below mainstem and tributary reservoirs.	1. Manage reservoirs to reduce flow fluctuations that dewater salmon and steelhead redds.
			2. Manage unnecessary high flows from reservoirs where possible considering flood control requirements so as not to mobilize spawning substrate during the spawning to emergence period of salmon and steelhead.
A1, A7, C1, C2, C3	Gravel mining	A. Reduce the effects of gravel mining on gravel recruitment in mainstem rivers and tributaries.	1. Protect, enhance, and restore natural gravel recruitment in areas of active and inactive gravel mining.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
			2. Reduce gravel mining operations in active floodplains of the Sacramento River, of the San Joaquin River, and their major tributaries to restore historic movement of gravels and other sediments necessary for restoration of fish spawning habitats.
A7, A8	Contaminants	A. Reduce concentrations and bioaccumulation of pollutants.	1. Reduce the input of herbicides, pesticides, fumigants, and other agents toxic to fish and wildlife in the Delta.
A2, B3, C1, C2	Human disturbance	A. Reduce human activities that adversely affect wildlife behavior or cause habitat destruction.	1. Reduce the level of human activity near active Swainson's hawk nest sites in the Delta during the breeding period that could cause nesting efforts to fail to assist in recovery of this listed species.
			2. Reduce boat wakes near California black rail nesting areas in the Delta from March to June to levels necessary to prevent destruction of nests to assist in recovery of this listed species.
			3. Reduce the level of access to California clapper rail and California black rail nesting areas in the Delta from during the nesting period to levels necessary to prevent nesting efforts from failing as a result of human disturbance to assist in the recovery of these listed species.
			4. Reduce the level of access to, and activity near, active greater sandhill crane roost sites in the Delta to levels sufficient to prevent abandonment of roost sites to assist in the recovery of this listed species.
			5. Reduce the level of access to areas supporting special-status plant species in the Delta to levels sufficient to maintain high-quality habitat condition and plant vigor to assist in the recovery of these species.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
		B. Reduce boat traffic and boat speeds in areas where levees or channel islands and their associated shallow water and riparian habitat are susceptible to wake damage.	1. Manage boat traffic in sensitive habitat areas to reduce boat wake erosion.
		C. Protect important Bay-Delta habitats from boat wakes.	1. Protect or buffer all remaining channel islands from boat wake erosion
C1, C2	Harvest of fish and wildlife	A. Reduce the level of illegal harvest of fish and wildlife.	1. Reduce illegal harvest of fish species in the Delta and in waters used by anadromous fish that migrate through the Delta by 90% to maintain or increase their populations.
			2. Reduce illegal harvest of special-status plants and animals, and waterfowl in the Delta by 90% to maintain or increase their populations.
		B. Reduce the legal harvest of fish species of special concern.	1. Manage and reduce the legal harvest of fish species of special concern until the species recovers.
C1, C2	Predation and competition	A. Reduce the loss of juvenile anadromous and resident fish and other aquatic organisms due to predation.	1. Reduce the level of predation to increase populations of desirable aquatic species.
		B. Increase the nesting success of ground-nesting birds.	1. Reduce predation and competition levels by introduced species on ground-nesting wildlife in the Delta by enhancing nesting habitat conditions for native species and increasing the size and connectivity among nesting habitat areas.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

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Ecosystem-Quality Objective[a]	Stressor	Implementation Objective	Targets[b]
C1, C2	Artificial production of fish	A. Reduce the negative effects of stocking hatchery reared and pen-reared striped bass, salmon, and steelhead in the Bay-Delta, rivers, and tributaries.	1. Limit hatchery supplementation to watersheds with limited natural spawning capacity. 2. Limit hatchery supplementation to populations that cannot be sustained through natural production. 3. Utilize methods to limit straying and loss of genetic integrity of wild and hatchery supported stocks. 4. Reduce the present threat of hatchery fish contaminating "wild" stocks of salmon and steelhead.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
A2, B1, B2, B5, C2	Tidal perennial aquatic	A. Increase the area of shallow-water and mudflat habitat.	1. Create 10,000 acres of tidally influenced shallow-water and mudflat habitat areas in the Delta, 2,000 acres in Suisun Bay, and 1,000 acres in San Pablo Bay to provide foraging and resting habitat for waterbirds and rearing, foraging, and escape cover for fish.
			2. Restore [redacted] miles of shallow water in the Bay-Delta and [redacted] acres adjacent to channel islands to provide rearing, foraging, and escape cover for fish, and foraging habitat for associated wildlife.
B2	Nontidal perennial aquatic	A. Increase the area of deep, open- water habitats in the Delta.	1. Include creation of deep, open-water areas within restored fresh emergent wetland habitats in the Delta to provide resting habitat for waterbirds and foraging habitat for diving ducks and other waterbirds that feed in deep water, and habitat for associated fish species.
		B. Increase the area of shallow, (depths less than 3 feet) open-water habitat in the Delta.	1. Include creation of shallow, open-water areas in restored saline and fresh emergent wetland habitat areas in the Delta to provide resting, foraging, and brood habitat for waterbirds and habitat for fish and aquatic plants and animals.
			2. Restore [redacted] miles of shallow water in leveed portions of mainstem rivers to provide rearing, foraging, and escape cover for fish, and foraging habitat for associated wildlife.
		C. Restore shoal habitat areas.	1. Restore the area of shoals in the Delta to level of the mid-1960s.
		D. Provide flows necessary for successful reproduction of striped bass.	1. Maintain and enhance striped bass spawning habitat by maintaining flows of [redacted] cubic feet/second (cfs) from April 1-June 15 at Sacramento for the Sacramento River spawning population and [redacted] cfs at Jersey Island for the San Joaquin River population.

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Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			2. Provide transport flows of [redacted] cfs at Rio Vista in the lower Sacramento River from April 25-June 15 to transport eggs and larval striped bass to downstream nursery areas in the Bay and Delta.
	Dead-end sloughs	A. Protect and enhance existing dead-end slough habitat in the Bay-Delta.	1. Protect and enhance habitats associated with all existing dead-end sloughs in the Bay-Delta to provide habitat high-quality habitat areas for the giant garter snake to assist in the recovery of the species, and associated fish and wildlife.
		B. Restore historical natural dead-end slough habitats in the Bay-Delta.	1. In the near term, recreate 50 miles, and in the long-term 100 miles, of natural dead-end slough habitat in the Bay-Delta to replace lost slough habitat to provide habitat high-quality habitat areas for fish, the giant garter snake to assist in the recovery of the species, and associated wildlife.
	Open-end sloughs	A. Protect and enhance existing open-end slough habitat in the Bay-Delta.	1. Protect and enhance all existing open-end sloughs in the Bay-Delta to provide habitat high-quality habitat areas for the giant garter snake to assist in the recovery of the species, and associated fish and wildlife.
		B. Restore historical natural open-end slough habitats in the Bay-Delta.	1. Recreate 10 miles of historical natural open-end slough habitat in the Bay-Delta, [redacted] miles along mainstem rivers, and [redacted] miles in bypass floodplains to replace lost slough habitat to provide habitat high-quality habitat areas for fish, the giant garter snake to assist in the recovery of the species, and associated wildlife.
B2, C1	Aquatic seasonal	A. Increase the area of seasonal wetlands and associated mudflats.	1. Restore and manage to a total of 20,000 acres of seasonal wetland habitat in the Delta and 4,000 acres in Suisun Marsh to provide high-quality foraging and resting habitat for wintering waterfowl and migrant and wintering shorebirds.

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Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
		B. Increase wildlife habitat values associated with existing seasonal wetlands.	1. Enhance 5,000 acres of low- to moderate-quality seasonal wetlands in the Delta to provide greater forage and resting habitat value for waterfowl, shorebirds, and other water birds.
		C. Increase the area of vernal pool habitats.	1. Restore 100 acres of vernal pools in the Delta region and associated watersheds that provide suitable habitat for each listed fairy shrimp species to assist in the recovery of these species by increasing the number and distribution of populations.
			2. Restore 500 acres of vernal pools in the Delta region and associated watersheds that provide suitable habitat for the Delta green ground beetle within its historic range to assist in its recovery by increasing the number and distribution of populations.
		D. Enhance degraded vernal pool habitats.	1. Enhance __ low- to moderate-quality vernal pools in the Delta within the historic range of, or in habitat currently occupied by, listed fairy shrimp species or the Delta green ground beetle.
A2, B3, B7, C1, C2	Shaded riverine aquatic	A. Increase the length of streamchannels bordered by riparian vegetation and reduce fragmentation of riparian corridors.	1. Restore [redacted] miles of riparian vegetation along largely unvegetated riprapped banks along Delta island levees to provide cover and other essential habitat requirements for anadromous and native resident fish species, and wildlife.
			2. Restore [redacted] miles of riparian vegetation along largely unvegetated riprapped banks along the Sacramento River and [redacted] miles along the San Joaquin River to provide cover and other essential habitat requirements for anadromous and native resident fish species, and wildlife.

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Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			3. Restore [redacted] miles of riparian vegetation along major tributaries to the Sacramento River and San Joaquin River to provide cover and other essential habitat requirements for anadromous and native resident fish species, and wildlife.
		B. Enhance degraded habitat areas.	1. Enhance [redacted] miles of existing low to moderate quality shaded riverine aquatic habitat in the Delta, [redacted] miles along the Sacramento River, [redacted] miles along the San Joaquin River, and [redacted] miles along major tributaries to the Sacramento River and San Joaquin River to provide high-quality habitat for anadromous and native fish species, and riparian associated wildlife.
		C. Preserve existing shaded riverine aquatic habitat areas.	1. Maintain [redacted] miles of existing streamside riparian vegetation in the Delta, __ miles along the Sacramento River, [redacted] miles along the San Joaquin River, and __ miles along major tributaries to the Sacramento River and San Joaquin River that provide high-quality shaded riverine aquatic habitat for anadromous and native resident fish species, and riparian associated wildlife in high-quality condition.
B1, C1, C2	Saline emergent wetland	A. Increase the area of saline emergent wetlands.	1. Restore 2,000 acres of tidally-influenced saline emergent wetland in the Suisun Bay area and 1,000 acres in San Pablo Bay within the historic and current range of associated special-status and listed plant and animal species to expand their populations and range to assist in their eventual recovery.
		B. Enhance degraded saline emergent wetlands.	1. Enhance 5,000 acres of existing low- to moderate-quality saline emergent wetlands in the Suisun Bay area and 2,000 acres in San Pablo Bay within the historic and current range of associated special-status and listed plant and animal species to expand their populations and range to assist in their eventual recovery.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			2. Enhance [redacted] acres of additional low- to moderate-quality saline emergent wetland in the Suisun Bay area and [redacted] acres in San Pablo Bay to provide high-quality habitat for waterfowl, shorebirds, and other associated wildlife.
		C. Preserve existing saline emergent wetland habitat areas.	1. Maintain __ acres of existing tidal and nontidal saline emergent wetland in the Suisun Bay area and __ acres in San Pablo Bay that provide high-quality habitat for saline emergent wetland associated plants and animals.
B2, C1, C2	Fresh emergent wetland	A. Increase the area of fresh emergent wetlands.	1. Restore 2,000 acres of tidally influenced fresh emergent wetland in the Delta within the historic and current range of associated special-status and listed plant and animal species to expand their populations and range to assist in their eventual recovery.
			2. Restore 10,000 acres of additional tidally influenced fresh emergent wetland in the Delta to provide high-quality habitat for waterfowl, shorebirds, and other associated wildlife, and rearing, foraging, and escape cover for fish.
			3. Restore 6,000 acres of nontidal fresh emergent wetland in the Delta to provide high-quality habitat for special-status plants and animals, waterfowl, shorebirds, and other associated wildlife.
		B. Enhance degraded fresh emergent wetlands.	1. Enhance 1,000 acres of low- to moderate-quality fresh emergent wetland in the Delta to provide high-quality habitat for special-status plants and animals, waterfowl, shorebirds, and other associated wildlife.
			2. Enhance 100 miles of canals and ditches in the ERPP focus area within the existing range of the giant garter snake to create higher quality habitat to assist in the recovery of the species.

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[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
		C. Protect existing fresh emergent wetlands.	1. Expand the area of existing preserves and wildlife refuges in the Delta to include __ acres of existing fresh emergent wetlands.
B3, B7, C1, C2	Riparian scrub, woodland, and forest	A. Increase the area of riparian habitat.	1. Restore 25 linear miles of riparian habitat along largely unvegetated riprapped banks along Delta island levees, 50 linear miles along the Sacramento River, 25 linear miles along the San Joaquin River, and 50 linear miles along major tributaries of the Sacramento River and San Joaquin River to create corridors of riparian vegetation no less than __ feet in width and __ miles in length to provide shaded riverine aquatic cover for anadromous and other fish species, and to create high-quality habitat for associated special-status plant and animal species, and other associated wildlife. 2. Restore 20 miles of riparian habitat on the water side of levees along the Sacramento River and San Joaquin River to create habitat corridors at least __ miles in length of which 75% is greater than 150 feet wide and at least 25% is greater than 300 feet wide to provide shaded riverine aquatic cover for anadromous and other fish species, and to create high-quality habitat for associated special-status plant and animal species, and other associated wildlife. 3. Restore 100 miles of riparian habitat on the land side of levees along the Sacramento River and San Joaquin River in the Delta at least __ miles in length to create high-quality habitat for associated special-status plant and animal species, and other associated wildlife.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			4. Restore 5,000 acres of the historic floodplain area of the Sacramento River, 2,000 acres of the San Joaquin River, and 1,000 acres along major tributaries of the Sacramento River and San Joaquin River in a manner consistent with flood control requirements create conditions suitable for the natural reestablishment of riparian vegetation to create high-quality habitat for associated special-status plant and animal species, and other associated wildlife.
		B. Enhance degraded riparian habitats.	1. Enhance 500 acres of low- to moderate-quality riparian habitat in the Delta, 1,000 acres in the Sacramento River floodplain, 500 acres in the San Joaquin River floodplain, and 500 acres in the floodplains of major tributaries of the Sacramento River and San Joaquin River to provide high-quality habitat for anadromous and native fish species, associated special-status plant and animal species, and other associated wildlife.
		C. Protect existing riparian habitats.	1. Expand existing preserves and wildlife refuges in the Delta to include 2,000 acres of existing valley foothill riparian habitat.
C1	Coastal scrub	A. Preserve existing Antioch inland dune habitat areas.	1. Maintain or increase existing Antioch inland dune habitat quality in the Delta to maintain special-status plant and animal, and other associated wildlife populations in all habitat areas.
		B. Enhance degraded inland dune habitats	1. Enhance 100 acres of low- to moderate-quality Antioch inland dune habitat in the Delta to provide high-quality habitat for special-status plant and animal, and other associated wildlife populations.
	Channel Islands	A. Protect and enhance existing channel islands in the Delta.	1. Protect and enhance all existing remnant channel islands in the Delta.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
		B. Restore natural channel islands in the Delta.	1. Restore __ acres of historic natural channel islands in the Delta.
B3, B7, C1	Valley-oak woodland	A. Increase the area of valley-oak woodland.	1. Restore 2,000 acres of valley-oak woodland within its historic range in the Delta, 5,000 acres in the historic Sacramento River floodplain upstream of the Delta, and 2,000 acres in the historic San Joaquin River floodplain to provide high-quality habitat for associated special-status plants and animals, and other associated wildlife.
		B. Enhance degraded valley-oak woodlands.	1. Enhance 500 acres of low- to moderate-quality valley-oak woodlands in the Delta, 1,000 acres in the Sacramento River floodplain, and 1,000 acres in the San Joaquin River floodplain to provide high-quality habitat for associated special-status plant and animal species, and other associated wildlife.
		C. Preserve existing valley-oak woodlands.	1. Expand the area of existing preserves and wildlife refuges in the ERPP focus area to include 2,000 acres of existing valley-oak woodland habitat.
B7, C1	Perennial grassland	A. Increase the area of perennial grasslands.	1. Restore 5,000 acres of perennial grasses in conjunction with restoration of floodplain riparian and valley-oak habitats to provide high-quality habitat conditions for associated special-status plant species.
B2, B4, B5, B6, C1	Agricultural wetland habitat	A. Comanage agricultural wetlands to provide high wildlife values for associated species and maintain or increase the economic viability of agricultural lands.	1. Improve management on 100,000 acres of rice field acreage in the historic Sacramento River floodplain to increase the wildlife forage and resting area habitat values of rice fields for wintering and migrating waterfowl and shorebirds, and other associated wildlife.

[a] CALFED ecosystem-quality objectives are described in Table 1.

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Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			2. Increase the area of winter and spring flooded cornfields by 25% and pastures by 10% in the Delta to provide high-quality foraging habitat for wintering and migrating waterfowl and shorebirds, and other associated wildlife. 3. Periodically flood 2,000 acres of pasture during spring and winter in the historic Sacramento River floodplain and 4,000 acres in the historic San Joaquin River floodplain to provide high-quality foraging habitat for wintering and migrating waterfowl and shorebirds, and other associated wildlife. 4. Periodically flood 2,000 acres of pasture each with a minimum flooded area of 200 acres from October-March in portions of the Delta relatively free of human disturbance to create suitable roosting habitat for wintering greater sandhill crane, and other wintering sandhill crane subspecies. 5. Create 500 permanent or semipermanent ponds each with a minimum size of 0.5 acre in farmed areas of the Delta, 500 ponds in farmed areas of the historic Sacramento River floodplain, and 300 ponds in farmed areas of the historic San Joaquin River floodplain that provide suitable waterfowl nesting habitat, but lack suitable brooding habitat, to increase resident dabbling duck production.
B2, B4, B5, B6, C1	Agricultural upland habitat	A. Comanage agricultural uplands to provide high wildlife values for associated species and maintain or increase the economic viability of agricultural lands.	1. Increase the acreage farmed for wheat and other crop types that provide suitable nesting habitat for waterfowl and other ground nesting species by 10% in the Delta, 5% in the historic Sacramento River floodplain, and 5% in the historic San Joaquin River floodplain.

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Ecosystem-Quality Objective[a]	Habitat	Implementation Objective	Targets[b]
			2. Convert 10% of agricultural lands in the Delta, 5% in the historic floodplain of the Sacramento River, and 5% in the historic floodplain of the San Joaquin River that are farmed from crop types that have relatively low forage value for wintering waterfowl, wintering sandhill cranes, and other wildlife to production of crop types that provide greater forage value. 3. Defer fall tillage on 75% of cornfields in the Delta, 10% in the historic floodplain of the Sacramento River, and 5% in the historic floodplain of the San Joaquin River to increase the available forage for wintering waterfowl, wintering sandhill cranes, and associated wildlife. 4. Improve management on 8,000 acres of corn and wheat fields in the Delta to leave 10-25% of crops in each field unharvested to provide forage for waterfowl, sandhill cranes, and other wildlife.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Table 12. Species and Species Group Implementation Objectives and Targets

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
Fishes			
C1, C2	Sacramento winter-run chinook salmon	A. Restore abundance to levels that represent recovery.	1. Restore the run size in the mainstem Sacramento River to the number identified in the recovery plan for this stock (approximately 40,000 adults on a sustained basis). 2. Restore runs to selected tributaries and maintain a minimum spawning population of 200 adult fish for each individual stock to sustain genetic diversity.
C1, C2	Sacramento spring-run chinook salmon	A. Restore and maintain abundance at levels that will fully utilize existing and restored habitat.	1. Restore the run size in the mainstem Sacramento River to the number adults identified in the recovery plan for this stock. 2. Maintain a minimum spawning population of 200 adult fish for each individual stock to sustain genetic diversity.
C1, C2	Sacramento late fall-run chinook salmon	A. Restore and maintain abundance at levels that will fully utilize existing and restored habitat.	1. Maintain a long-term average cohort replacement rate of greater than or equal to 1.
C1, C2	Sacramento fall-run chinook salmon	A. Restore and maintain abundance at levels that will fully utilize existing and restored habitat.	1. Maintain a long-term average cohort replacement rate of greater than or equal to 1.0.
C1, C2	San Joaquin fall-run chinook salmon	A. Restore and maintain abundance at levels that will fully utilize existing and restored habitat.	1. Restore the run size in the San Joaquin River tributaries to levels consistent with the recovery plan for these stocks. 2. Maintain a long-term average cohort replacement rate of greater than or equal to 1.0.

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
C1, C2	Steelhead trout	A. Restore and maintain steelhead at levels that will fully utilize existing and restored habitat.	1. Maintain a cohort replacement rate of greater than 1. 2. Maintain a minimum spawning population of 200 adult fish for each individual stock to sustain genetic diversity.
C1	Delta smelt	A. Restore delta smelt abundance to levels that represent recovery.	1. Restore and maintain population abundance in the Bay-Delta similar to the abundance represented by the 1967-1981 fall mid-water trawl catch for September and October. 2. The fall mid-water trawl catch in September and October must exceed 239 for 2 out of 5 years and not fall below 84 for more than 2 consecutive years. 3. The targets identified for the 2 preceding implementation objectives must be met and, in addition, the 5 consecutive years must include 2 sequential extreme outflow years (i.e., at least one critical or dry year followed by a critical, dry, or wet year).
		B. Restore delta smelt distribution in the Bay-Delta to historic patterns.	1. The fall mid-water trawl survey in September and October must capture delta smelt in all zones in 2 out of 5 consecutive years, in at least 2 zones in 3 out of the 5 consecutive years, and in at least 1 zone in all years.
C1	Longfin smelt	A. Restore longfin smelt abundance to levels that represent recovery	1. In 5 out of 10 consecutive years, maintain the population abundance (as represented by the number captured in the September and October fall mid-water trawl survey) greater than the number calculated by the equation $10^{(1.64 \times \log(\text{average February-May outflow}))-10.6}$

[a] CALFED ecosystem-quality objectives are described in Table 1.

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
		B. Restore longfin smelt distribution to historic patterns	1. The fall mid-water trawl survey in September and October must capture longfin smelt in all zones in 5 out of 10 consecutive years, in at least 2 zones in 6 out of the 10 consecutive years, and in at least 1 zone in 9 out of the 10 consecutive years.
C1	Green sturgeon	A. Restore self-sustaining green sturgeon population	1. Maintain a 50-year median population of 1,000 fish over 1 m in total length. The population abundance must not fall below 1,000 fish over 1 m in total length for more than 3 consecutive years. The 1,000 fish over 1 m in length must include 500 females over 1.3 m in total length.
			2. Reduce the annual harvest rate to less than 5% of the population.
C1, C2	Starry flounder	A. Restore self-sustaining starry flounder population to historical levels, including historic fishery component	1. Maintain an index of population abundance (fall mid-water trawl index) equal to the 1967-1974 fall mid-water trawl index. Maintain commercial catch levels equivalent to 1970 to present.
C1, C2	White sturgeon	A. Restore self-sustaining white sturgeon population to historical levels.	1. Double the abundance of the average 1967-1991 population estimates of fish older than 15 years.
		B. Restore and maintain a quality fishery	1. Maintain a population that contains at least 100,000 fish that are greater than 102 cm in length.
C1, C2	Sacramento splittail	A. Maintain Sacramento splittail abundance at levels that ensure protection from extinction	1. Maintain an index of population abundance (fall mid-water trawl index) equal to the 1967-1983 fall mid-water trawl index.
		B. Reduce harvest of Sacramento splittail.	1. Reduce the annual harvest rate until the population recovers.

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
C1, C2	Striped bass	A. Maintain a self-sustaining population and a quality fishery for striped bass.	1. Increase the population to 2.5 to 3.0 million adult fish.
C1, C2	Largemouth bass	Maintain existing population distribution	1. Maintain the distribution reflected by present electrofishing catch in the Delta.
		B. Maintain existing size structure for population	1. Maintain existing percentage of population greater than 30 cm in length.
C1, C2	White catfish	A. Restore a self-sustaining population abundance.	1. Restore the index of white catfish abundance in the Delta to the 1980 population level.
		B. Restore population distribution.	1. Restore the distribution of white catfish in the Delta as reflected by the 1980 population.
		C. Restore the population size and age structure.	1. Restore the size and age structure to that observed in 1980.
C1, C3	Threadfin shad	A. Maintain threadfin shad abundance at levels that provide adequate forage base for predatory fishes and support commercial fishing	1. Maintain an index of population abundance (fall mid-water trawl index) equal to the 1967-1976 fall mid-water trawl index.
C1, C2	American shad	A. Maintain a self-sustaining American shad population and a quality fishery	1. The 25-year average fall mid-water trawl index must exceed the 1967-1995 average fall mid-water trawl index.

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
Fish Species Groups			
C3	Other native resident fishes Representative species: • tule perch • hitch • hardhead • Sacramento blackfish • Sacramento sucker • Sacramento squawfish • threespine stickleback	A. Maintain, enhance, and restore resident fish diversity, populations, and natural distributions of this group of fish that will fully utilize existing and future habitat in the Bay-Delta and associated tributaries.	1. Maintain and enhance existing species diversity, age structure, populations, distributions, and abundance levels. 2. Maintain population growth rates of greater than 1.0 for each species in the group.
C1, C3	Other non-native resident fishes Representative species: • bluegill • inland silverside • yellowfin goby • chameleon goby • threadfin shad • Wakasagi	A. Maintain non-native fish populations and their present distribution in the Bay-Delta of species that do not compete with anadromous fish and other native fish species.	1. Maintain existing species diversity, distributions, and abundance levels of species. 2. Maintain population growth rates at 1.0 for each species in the group.

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
		B. Reduce non-native fish populations and their present distribution in the Bay-Delta of species that compete with anadromous fish and other native fish species.	1. Reduce existing species diversity, distributions, and abundance levels. 2. Reduce population growth rates below 1.0 for each species in the group.
Amphibians and Reptiles			
B2, B3, C1	California red-legged frog	A. Increase populations sufficiently to contribute to the recovery of the species and its eventual delisting.	1. Preserve at least five core habitat areas composed of suitable habitat of at least 50 acres, with each area in each of the known occupied habitat areas in the Delta region. 2. Increase the population by ___% by enhancing degraded wetland and riparian habitats within the species' historic range in the Delta region.
B2, C1	Giant Garter snake	A. Increase populations sufficiently to contribute to the recovery of the species and its eventual delisting.	1. Achieve a 1:1 sex ratio in existing Delta populations and increase the population size to at least 2,000 individuals. 2. Restore and preserve at least five core suitable habitat areas for this species each area at least 100 acres in each of the known occupied habitat areas in the Delta region. 3. Increase the population fivefold by enhancing degraded wetland habitat, canals, and ditches within the species' historic range in the Delta region.
Birds			

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
B3, B7, C1, C3	Swainson's hawk	A. Increase populations sufficiently to contribute to the recovery of the species and its eventual delisting.	1. Restore a minimum estimated historical nesting density of nine nesting pairs per 100 square miles in the Delta region to assist in recovery of the species. 2. Increase prey populations and availability on 10,000 acres of suitable Swainson's hawk foraging habitat in the Delta region to provide the prey base necessary to support an expanding population.
B1, C1, C3	California clapper rail	A. Increase populations sufficiently to allow for recovery of the species and its eventual delisting.	1. Restore sufficient saltmarsh in the Delta region necessary to connect and combine disjunct saltmarsh habitat areas that support California clapper rail populations to enlarge current protected areas and reduce intermarsh distances. 2. Increase the population by restoring __ acres of historically occupied but currently unsuitable habitat areas in the Delta region to connect fragmented habitat areas, and provide unrestricted tidal circulation, healthy invertebrate populations, and suitable nesting habitat.
		B. Protect existing populations.	1. Manage__ acres of existing occupied saltmarsh and associated habitat in the Delta region to ensure existing populations and habitat conditions are maintained or increased.
B2, C1, C3	California black rail	A. Increase populations sufficiently to allow for recovery of the species and its eventual delisting.	1. Restore and enhance 1,000 acres of vegetated wetland and upland habitat adjacent to occupied tidal sloughs in the Delta region to increase population size by providing cover and refugia from predators during high tides and flood waters. 2. Protect 1,000 acres of existing unoccupied, but suitable, tidal slough habitats near occupied habitat areas in the Delta region from degradation to ensure suitable habitat for future natural expansion of the population.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
		B. Protect existing populations.	1. Manage 500 acres of existing occupied tidal slough and associated habitat in the Delta region to ensure existing populations and habitat conditions are maintained or increased.
B2, B5, B6, C1,	Sandhill cranes (all subspecies)	A. Provide sufficient roosting habitat to sustain the wintering population.	1. Create five suitable roosting habitat areas with a minimum size of 200 acres each within the species' existing winter range within the Delta region.
		B. Provide foraging habitat of sufficient quality and quantity to support the wintering population.	1. Increase the amount of available sandhill crane food in existing foraging habitat by 10,000 in the Delta region to ensure adequate forage availability for wintering populations.

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[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
Mammals			
B1, C1	Salt marsh harvest mouse	A. Increase populations sufficiently to allow for recovery of the species and its eventual delisting.	1. Increase the population by 100% by restoring existing tidal saltmarsh within the species' historic range in the Delta region. 2. Reintroduce and establish viable populations at 10 suitable habitat areas within unoccupied portions of the species' historic range in the Delta region.
B3, C1	Riparian brush rabbit	A. Increase populations sufficiently to allow for recovery of the species and its eventual delisting.	1. Restore __ acres of suitable riparian habitat to connect historic occupied habitat areas in the Delta region with occupied habitat areas along the Stanislaus River to reestablish habitat connectivity and allow for reestablishment of historic Delta populations. 2. Restore __ acres of suitable riparian habitat in the Delta region within the species' historic range and reintroduce animals into restored habitat to reestablish five additional self-sustaining populations. 3. Restore 500 acres of riparian habitat to connect fragmented habitat areas along occupied drainages to reestablish connectivity among disjunct populations within the ERPP focus area.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
B3	Neotropical migratory bird guild Representative species: • western kingbird • western wood-pewee • tree swallow • clift swallow • warbling vines • Wilson's warbler • yellow-breasted chat	A. Increase abundance and breeding success of neotropical migratory birds in the Delta region.	1. Reduce competition from other species and nest site predation levels by 25% in the Delta region by restoring 500 acres of climax riparian forest and 1,000 acres of valley oak woodland in stands that are at least 300 feet in width.
Estuarine Food Web Organisms			
A7, C3	Foodweb organisms	A. Increase organic carbon production (i.e., algae, bacteria, protozoa, zooplankton, and epibenthic invertebrates) in the Delta.	1. Restore to levels consistent with the mid-1960s level of development.
		B. Increase carbon inputs to the Delta and the Bay from new sources.	1. Restore to levels consistent with the mid-1960s level of development.
		C. Retain natural variation and diversity of lower trophic level species and resources.	1. Restore to levels consistent with the mid-1960s level of development.
Terrestrial Invertebrates			

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Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
C1	Fairy shrimp	A. Increase habitat areas in the Delta occupied by federally listed fairy shrimp species.	1. Increase the number of vernal pools occupied by fairy shrimp by __% within the historic range of these species in the Delta region.
C1	Lange's metalmark	A. Maintain existing populations in the Delta.	1. Protect the only known population and associated habitat in the Delta region from disturbance or degradation.
Plants			
C1	Delta button-celery	A. Increase the population size sufficiently to ensure the long-term viability of existing populations.	1. Increase the area of occupied habitat by 300 acres by restoring suitable unoccupied habitat areas within the historic range of these species in the ERPP focus area. 2. Enhance existing occupied habitat areas within the ERPP focus area to increase population size tenfold to ensure long-term viability of existing populations and provide seed or propagule sources for natural expansion of populations.
Plant Species Associations			
B1, C2	Saline emergent wetland plant association • soft bird's-beak • marsh gumplant • Suisun thistle • small spikerush	A. Increase populations of special-status plant populations associated with saline emergent wetlands sufficiently to contribute to the recovery of these species.	1. Increase the area of habitat occupied by these species to 1,000 acres by restoring suitable unoccupied habitat areas within the historic range of these species in the ERPP focus area. 2. Enhance existing occupied habitat areas in the ERPP focus area to increase population size tenfold and to ensure long-term viability of existing populations, and provide seed or propagule sources for natural expansion of populations.

[a] CALFED ecosystem-quality objectives are described in Table 1.

[b] Proposed land use changes will occur with participation and cooperation of agricultural stakeholders, including farmers, ranchers, and other landowners and lessees. Land use change implementation should be accomplished by conservation easements and acquisitions through various payment programs.

Ecosystem-Quality Objective[a]	Species or Species Group	Implementation Objective	Targets[b]
B2, C1	Fresh emergent wetland plant association • Mason's lilaeopsis • Sanford's arrowhead • Delta mudwort • bristly sedge • Suisun marsh aster • mad-dog skullcap • rose mallow • delta tule pea	A. Increase populations of special-status plant populations associated with fresh emergent wetlands in the Delta sufficiently to contribute to the recovery of these species.	1. Increase the area of habitat occupied by these species by 500 acres by restoring suitable unoccupied habitat areas within the historic range of these species in the Delta. 2. Enhance existing occupied habitat areas in the Delta to increase population size fivefold and to ensure long-term viability of existing populations and provide seed or propagule sources for natural expansion of populations.
C1	Coastal scrub plant association • Antioch Dunes evening primrose • Contra Costa wall flower	A. Increase the size of special-status plant populations associated with inland dune habitat in the Delta sufficiently to ensure the long-term viability of existing populations.	1. Increase the area of habitat occupied by these species by 100% by restoring suitable unoccupied habitat areas in the vicinity of Antioch Dunes National Wildlife Refuge.

[a] CALFED ecosystem-quality objectives are described in Table 1.

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