M. Moe

SUMMARY OF CHANGES

(Supplement to the 2nd Administrative Draft)

for the

CALFED DRAFT PROGRAMMATIC EIS/EIR AND APPENDICES

March 2000

UNION LABEL

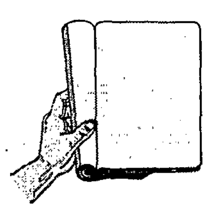
IMPACT ANALYSIS

Chapters 4 and 10

March 2000

Chapter 4. Guide to Impact Analyses and Description of Land Use Assumptions

This chapter provides a road map for the impact analyses. It also explains some of the approaches used in assembling the range of land use changes that may occur as a result of CALFED Bay-Delta Program implementation.



Revised 2-24-00

4. Guide to Impact Analyses and Description of Land Use Assumptions

4.1 GUIDE TO IMPACT ANALYSES

This chapter is included to help readers understand how the impact analyses are presented in Chapters 5, 6, and 7. Information on the environmental consequences of the alternatives presented in this document was derived primarily from technical reports. These technical reports were prepared for many of the resource categories and form the basis for the affected environment and environmental consequences descriptions in the March 1998 Draft Programmatic EIS/EIR and Chapters 5, 6, and 7 of this report. Since the CALFED Bay-Delta Program (Program) alternatives described in this report incorporate elements of the alternatives presented in the March 1998 Draft Programmatic EIS/EIR and the impacts are similar, information in the technical reports was verified and used in these analyses, along with additional modeling runs for the operations and water supply.

This chapter is included to help readers understand how the impact analyses are presented in Chapters 5, 6, and 7.

Because ~~a~~ the Preferred Program Alternative ~~has been~~ was identified ~~since~~ after the preparation of the March 1998 Draft Programmatic EIS/EIR, the Program decided to rewrite the draft Programmatic EIS/EIR rather than update or supplement the March 1998 version. Comments received on the March 1998 Draft Programmatic EIS/EIR were catalogued, and many of the issues noted in those comments were incorporated into the revised program plans. Where possible, they are also identified and addressed in the impact analyses.

Resources evaluated in this Draft Programmatic EIS/EIR have been grouped into three main categories, as illustrated in Table 4-1.

- Physical environment
- Biological environment
- Land use, social issues, and economics

To provide a quick visual reference for the reader, a topic illustration is included in the footer for each resource. For example, the reference illustration for the air quality resource impact analysis is a hot air balloon.

Table 4-1. Resource Categories Evaluated in the Draft Programmatic EIS/EIR

CHAPTER 5
PHYSICAL ENVIRONMENT

- Water Supply and Water Management
- Bay-Delta Hydrodynamics and Riverine Hydraulics
- Water Quality
- Groundwater Resources
- Geology and Soils
- Noise
- Transportation
- Air Quality

CHAPTER 6
BIOLOGICAL ENVIRONMENT

- Fisheries and Aquatic Ecosystems
- Vegetation and Wildlife

CHAPTER 7
LAND USE, SOCIAL ISSUES, AND ECONOMICS

- Agricultural Land and Water Use
- Agricultural Economics
- Agricultural Social Issues
- Urban Land Use
- Urban Water Supply Economics
- Utilities and Public Services
- Recreation Resources
- Flood Control
- Power Production and Energy
- Regional Economics
- Cultural Resources
- Public Health and Environmental Hazards
- Visual Resources
- Environmental Justice
- Indian Trust Assets

The Program currently consists of multiple **possible** actions that are diverse, geographically dispersed, and described in general terms. **Some or all of** these actions will be carried out over the course of many years. In addition, **the timing, location and magnitude of many of the actions is not yet known which results in** ~~there is~~ some uncertainty regarding the ~~eventual~~ **precise** outcome of Program actions. Consequently, the Program will be implemented in stages, using the information gained **in each stage** ~~by adaptive management~~ to modify and refine Program actions over time, within the framework of the Preferred Program Alternative. Given the uncertainties, the large scope of the Program area, and the conceptual nature of the proposed actions, the Program elected to prepare a Programmatic EIS/EIR.

This document provides a broad **and comprehensive** overview of the potential actions that could be taken by the Program. It describes, in a broad sense, the ~~potential~~ overall and long-term environmental consequences of all the **potential** proposed actions at the end of the program's **20-30 year time span.** ~~development (approximately 2020).~~ **This programmatic Eis/EIR is structured to be used as a tiering document. Individual, second-tier projects can use this analysis as a basis from which to supplement and refine the level of detail and can incorporate by reference relevant provisions in the Programmatic EIS/EIR, such as the cumulative impacts. Mitigation strategies are included to address potentially significant adverse environmental impacts, and will be applied to guide the formulation of project-level mitigation measures.** Any subsequent actions or facility construction stemming from the programmatic actions in the Preferred Program Alternative must be developed in compliance with NEPA, CEQA, and other applicable laws and regulatory processes.

The impact analysis for most resource categories is divided into several parts, including a summary, a description of the affected environment/existing conditions, and discussions of environmental consequences—including such topics as cumulative and growth-inducing impacts.

The organization of a typical resource discussion is depicted in Figure 4-1. The impact analysis for most resource categories is divided into several parts, including a summary, a description of the affected environment/existing conditions, and discussions of environmental consequences— including such topics as cumulative and growth-inducing impacts. Each of these divisions is explained more fully below.

Summary. The summary provides the conclusions of the detailed impact analysis. It gives an overview of the benefits and potentially significant adverse impacts that could result from implementing the Program, and lists possible mitigation strategies to lessen potentially significant impacts. Information presented in the summary for reach resource is the basis for the summary comparison of impacts presented in Chapter 3.

Areas of Controversy. As used in CEQA, areas of controversy include differences of opinion among technical experts or areas of uncertainty for which information is not available and cannot be readily obtained. Areas of controversy were identified by comments from CALFED agencies, public comments, and new information developed since the March 1998 Draft Programmatic EIS/EIR. For some resources, issues that do not meet ~~this CEQA definition for~~ areas of controversy as used in CEQA have been raised by a number of people. For recreation resources, for example, the effects on motorized boating in the Delta or of flooding free-flowing rivers by enlarging existing reservoirs are **controversial issues but do not represent disagreement among the technical experts.** ~~areas of concern that do not meet the CEQA definition for areas of controversy~~. These types of issues also are noted in the "Areas of Controversy" section. Although listing areas of concerns is not required by NEPA or CEQA, the Program decided to acknowledge concerns mentioned in the public review process. In most cases, the concerns are addressed in the impact analyses. In some cases, however, the concerns cannot be addressed at the programmatic level and will need to be addressed in second-tier documents.

Under CEQA, areas of controversy include differences of opinion among technical experts or areas of uncertainty for which information is not available and cannot be readily obtained.

Revised 2-24-00

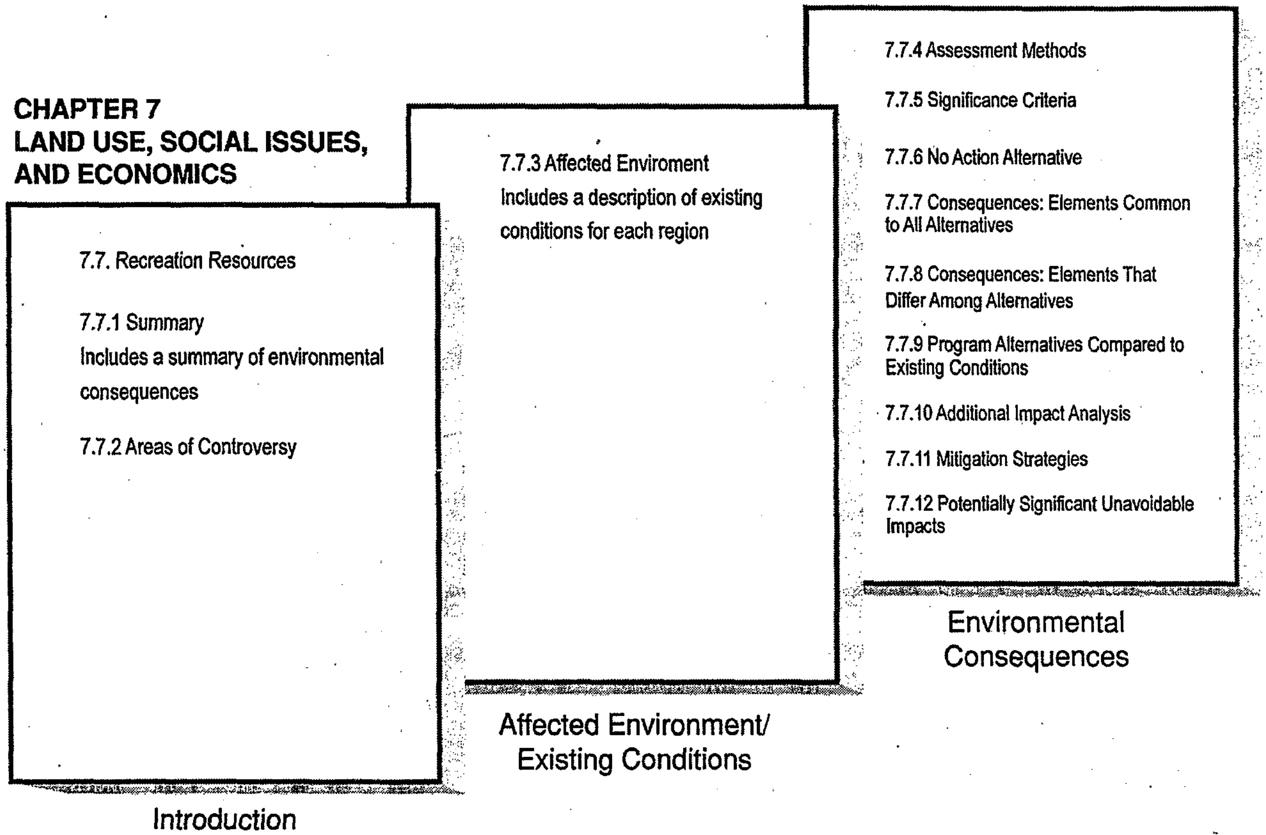


Figure 4-1. Organization of a Resource Discussion Using Recreation as the Example

Affected Environment/Existing Conditions. The "Affected Environment/Existing Conditions" section provides a historical perspective and an overview of the current conditions for each resource. The description of current conditions ~~uses the most recent~~ uses verified information. ~~available~~. The discussions are organized by region, in the following order:

- Delta Region
- Bay Region
- Sacramento River Region
- San Joaquin River Region
- Other SWP and CVP Service Areas

The regulatory framework that is part of the existing conditions can be found in Section 3 of Chapter 8, "Compliance with Applicable Laws, Policies, and Plans and Regulatory Framework."

Program regions are combined into a single discussion when their existing conditions/affected environment discussions are similar. Upper watershed descriptions for each resource are discussed, where **relevant** ~~appropriate~~, under the various regions.

Assessment Methods. Descriptions of assessment methods are resource specific, and provide the approach used to identify and assess the environmental consequences for the resource category. Analytical models used in the evaluation also are identified.

Significance Criteria. The threshold of significance for many of the environmental resources discussed in this impact analysis is described in qualitative terms and covers a broader spectrum of impacts than would be included in a site specific, project-level analysis. This is in part because the Program covers a wide variety of types of actions which will take place in many different physical settings over a 30 year period. As a consequence, the thresholds **for most resources** cannot be established with a precise, quantitative measurement. The measure of significance will vary depending on the nature and type of the proposed actions, the site characteristics where the actions take place and how they affect the existing conditions at the time of the proposed actions. The thresholds used in this PEIS/EIR are intended to identify potentially significant impacts at a programmatic level, and to provide guidance for developing significance criteria at the second tier. They also provide a tool to predict whether it is likely that the impacts identified as significant at the programmatic level can be avoided, reduced or mitigated to less than significant.
~~Because of the general nature of the planning process and the broad range of programmatic actions being considered, qualitative thresholds of significance generally are used.~~

~~These qualitative and general criteria provide the basis for establishing more specific or quantitative thresholds to be used in the project-specific, second-tier environmental documents. When specific actions are identified in Phase III, significance criteria will be expressed in quantitative terms or measurable performance criteria based on site-specific data.~~

No Action Alternative. This section presents the environmental consequences of the No Action Alternative compared to existing conditions. The No Action Alternative makes predictions about the future condition of environmental resources, taking into consideration recently constructed projects and projects ~~under~~ **proposed for** construction. For the No Action Alternative, assumptions **based on current expectations** are made about existing trends that may continue into the future and about **future** water project operations. For example, urbanization that is expected to continue would require additional land and water resources, with consequences on a variety of environmental resources. A list of projects included in the No Action Alternative impact analysis and water operation modeling assumptions are provided in Attachment A.

The Program has not selected a site-specific conveyance alignment or the location of any other structure or action mentioned in any discussions in this document. These selections will not occur until Phase III and would involve extensive study and interaction with all interested parties.

The impacts of each of the four Program alternatives are compared to both the No Action Alternative and the existing conditions/affected environment in Chapters 5, 6, and 7, ~~and 8~~ of the impact analysis section of this Programmatic EIS/EIR. Under the No Action Alternative, it is assumed that certain changes in the environment will occur regardless of whether any of the **Program** alternatives are implemented. For example, it is anticipated that trends in population growth and urbanization will continue, but the rate at which these trends will continue and the locations where they will occur cannot be projected except very generally. The same is true for any environmental impacts caused by growth and urbanization. It is likely that these changes would result in potentially significant impacts on the resources evaluated (land use, air quality, water quality, vegetation and wildlife, fisheries, and others), but there is no accurate way to predict how severe those impacts may be or where they will occur.

Because of the broad programmatic nature of the project, the 20- to 30-year planning horizon, and the imprecise **ability to predict** ~~understanding of~~ future conditions, it is difficult to distinguish in any meaningful way the differences between the conditions under the No Action Alternative and existing conditions. Consequently, the environmental impacts of the actions included in the Program alternatives when compared to existing conditions are described as being very similar to the impacts of those alternatives when compared to what is expected to happen under a future no-action scenario.

Program Alternatives. This section presents the consequences of the four Program alternatives, the reasons why social and economic effects are treated differently than physical impacts to the environment ~~are not considered a significant impact on the environment~~, and deviations from the format outlined in this chapter.

Social and economic changes resulting from a project are treated somewhat differently under CEQA and NEPA. CEQA does not treat economic or social changes resulting from a project as significant effects on the environment. However, if a physical change in the environment is caused by economic or social effects, the physical change may be regarded as a significant effect using the same criteria for other physical changes from the project. In addition, economic and social effects of a project may be used to assess the significance of a physical effect. Under NEPA, economic or social effects must be discussed if they are interrelated to the natural or physical environmental effects of a project. Economic and social effects are presented and methods to avoid or reduce adverse social and economic effects are addressed, as applicable, in the text of each environmental consequences chapters in the Programmatic EIS/EIR.

~~Under CEQA, an economic or social change by itself is not considered a significant impact on the environment. If the analysis can trace a chain of cause and effect from a proposed project through anticipated economic or social changes resulting from the project to physical changes caused in turn by the economic or social changes, it may be considered a significant impact. The focus of the analysis is on the physical changes to the environment, and economic or social changes do not have to analyzed in any detail greater than necessary to trace a chain of cause and effect. However, economic or social effects of a project can be used to determine the significance of physical changes caused by a project, and should be considered (together with technological and environmental factors) in deciding whether changes in a project are feasible to reduce or avoid the significant effects on the environment identified in the EIR. In the interest of full disclosure, the Program presents an overview of the potential social and economic effects of Program implementation.~~

Under CEQA, an economic or social change by itself is not considered a significant impact on the environment.

For most resources, the Levee System Integrity Program actions would affect only the Delta and Bay Regions, and the program is not discussed for other Program regions. The Levee System Integrity Program impacts on Suisun Marsh are discussed under the "Bay Region."

For most resources, the Levee System Integrity Program actions would affect only the Delta and Bay Regions, and the program is not discussed for other Program regions. The Levee System Integrity Program impacts on Suisun Marsh are discussed under the "Bay Region."

Because of the system-wide nature of the resource, the power and energy section is presented in a system-wide format. The water supply and Bay-Delta hydrodynamics and riverine hydraulics sections modify the definition of the San Joaquin River Region and the Other SWP and CVP Service Areas to better describe consequences affecting water supplies and flows in those regions.

Program Elements with Consequences Common to All Alternatives. This section presents the environmental consequences of the Program elements that are similar to all alternatives. Generally, the environmental consequences of all Program elements are the same for each

Revised 2-24-00

alternative. This description of environmental consequences also is presented by Program region. For brevity, regions are combined when environmental consequences are similar.

Program Elements with Consequences That Differ Among Alternatives. The consequences of Program elements that differ among the alternatives primarily are associated with conveyance in the Delta Region; therefore, this section is presented by alternative rather than by region. Other regions are included as subsections, where applicable. For brevity, Program regions are combined where environmental consequences are similar.

Program Alternatives Compared to Existing Conditions. Under CEQA, ~~the Program is required to analyze the effects of the Program alternatives compared to~~ the existing conditions **are normally the baseline for comparison of the effects of the project and** ~~and compared to the No Action Alternative. The effect of using the existing conditions as the baseline for determining environmental consequences~~ is presented in this section. This discussion ensures that all potentially significant impacts are identified. In most cases, because of the programmatic nature of the environmental assessment and long planning horizon, the conditions present under the existing conditions baseline are similar to those under the No Action Alternative. In these situations, differences between existing conditions and No Action Alternative cannot be distinguished **in a meaningful way** at the programmatic level, and the results of comparison of each alternative to the No Action Alternative and to existing conditions are the same. Where potential meaningful differences exist between the comparison to existing conditions and the No Action Alternative, the differences are identified and discussed in the this section.

Additional Impact Analysis. Four other topics are included in the impact analysis: cumulative impacts, growth-inducing impacts, the relationship between short-term uses of the environment and maintaining and enhancing long-term productivity, and irreversible and irretrievable commitments of resources. A summary of each of these topics is included in Chapter 3, and they are described below.

Cumulative Impacts. Cumulative environmental impacts must be addressed in environmental impact reports and environmental impact statements under both CEQA and NEPA. NEPA defines cumulative impacts as those impacts which result from the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency...or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The definition of cumulative impacts under CEQA is similar: "Cumulative impacts refer to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." Attachment A, of this PEIS/EIR, contains a list of other projects and activities considered in the cumulative impact analysis.

The evaluation of the long-term environmental impacts of the CALFED Program should be distinguished from the analysis of cumulative impacts. Because the CALFED Program is projected to occur over a 20-30 year time period, and the CALFED actions will affect a large geographic area, for certain resource categories these long-term impacts on the environment are similar to CALFED's incremental contribution to cumulative effects. Long-term impacts are the impacts of the CALFED Program that may occur over the Program's 30-year horizon. Cumulative impacts **include** the incremental contribution of the CALFED Program together with the impacts from other projects, **and are addressed in this section.**

Revised 2-24-00

The CALFED Program involves the approval of a program to restore the ecological health and improve water management for beneficial uses of the Bay-Delta system. The Program is a general description of a range of actions that will be further refined, considered and analyzed for site specific environmental impacts as part of second and third tier environmental documents prior to making a decision to carry out these later actions. The PEIS/EIR focuses on a general overview of cumulative impacts and associated mitigation measures. Because this Programmatic EIS/EIR does not analyze the site specific impacts of any projects, a detailed analysis of the Program's incremental contributions to cumulative impacts and the methods to mitigate the cumulative impacts of second-tier projects within the scope of **tiering from** this PEIS/EIR is not possible for most resource categories.

Later EIRs and EISs will be able to incorporate the cumulative and long-term impact analyses of this programmatic document and add detail about specific projects and their contribution to cumulative impacts. Any new significant environmental impacts, including an incremental contribution to a cumulative impact, which this Programmatic EIS/EIR did not address must **will** be evaluated in subsequent environmental reviews.

In general, the analysis of cumulative impacts is qualitative. Impacts were identified based on: (1) information extracted from available **existing** environmental documents or studies for the resource categories potentially affected by each project, and (2) knowledge of expected effects of similar projects in the study area. Because of the preliminary phase of most of the projects considered (environmental reviews have **may** not **have** been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was sparse.

Chapter 3 contains a summary of cumulative impacts and narratives and a table that identifies, by region, the resource category where potentially significant cumulative adverse impacts resulting from the incremental impact of the Preferred Program Alternative, when added to the impacts of applicable projects and activities listed in Attachment A, are anticipated.

Cumulative impacts are defined as impacts on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions undertaken by the same or other agencies or persons. Program actions may be implemented in an interactive manner with other concurrent and subsequent projects. The non-Program actions implemented concurrently with the Program may affect the results of implementing the Program and may result in impacts different than those associated with implementing only Program actions. A description of the programs and projects considered in the cumulative impact analysis is provided in Attachment A.

In general, the analysis of cumulative impacts is qualitative. Impacts were identified based on: (1) information extracted from available environmental documents or studies for the resource categories potentially affected by each project, and (2) knowledge of expected effects of similar projects in the study area. Because of the preliminary phase of most of the projects considered (environmental reviews have not been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was sparse.

In general, the cumulative impact analysis is qualitative. Cumulative impacts were based on resources potentially affected by each project in concert with Program actions.

Growth-inducing Impacts. This section describes actions associated with the Program that could **stimulate growth and cause growth-inducing impacts.** foster economic or population growth, result in construction of additional housing, either directly or indirectly, or remove obstacles to population growth. How population growth could affect existing community services also is considered in this section. **There are differences of opinion as to whether**

additional water supplies and/or improvements in water supply reliability stimulates growth. Discussions of growth-inducing impacts often cause differences of opinion among technical experts and is considered an area of controversy as used in CEQA. For this programmatic level of analysis, the assumption was made that any increase in water supplies and/or improvements in water supply reliability, associated with the Program, would stimulate growth. This assumption assures that the document discloses the environmental consequences associated with growth in the event program actions ultimately lead to this type of change. ~~Further, this section addresses how growth could lead to disturbances of resources. For example, water supply reliability could lead to growth, and that additional growth could affect geology and soil. However, it is not clear that improvements in water supply reliability will necessarily induce additional growth, and a discussion of these impacts are included for purposes of disclosure because it is an issue that is difficult to forecast.~~ Additionally, this section discusses whether improvements in other resource categories expected from the CALFED Program could cause growth-inducing impacts. For example, certain CALFED actions could improve recreational resources, which in turn, could stimulate growth and cause growth-inducing impacts.

For the agricultural economics, agricultural social issues, urban water supply economics, regional economics, and environmental justice sections, the section has been titled "Growth-Inducing Effects" because social and economic changes from a project are treated somewhat differently under CEQA and NEPA.

~~For the following resources, the cumulative impacts and growth-inducing impacts are referred to as Cumulative Effects and Growth-Inducing Effects, and are not treated as significant direct environmental impacts: agricultural economics, agricultural social issues, urban water supply economics, regional economics, and environmental justice (see second paragraph under "Program Alternatives" on page 4-5).~~

Relationship Between Short-Term Uses and Long-Term Productivity. This section discusses the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. Resource-specific summaries of the short-term uses in the project areas and the maintenance and enhancement of long-term productivity in those areas are provided.

Irreversible and Irretrievable Commitments. This section fulfills the requirement to address irreversible and irretrievable commitments of resources. Irreversible impacts are those that cause, through direct or indirect effects, use or consumption of resources in such a way that they cannot be restored or returned to their original condition despite mitigation. If unavoidable, potentially irreversible impacts are documented in this report. An irretrievable impact or commitment of resources occurs when a resource is removed or consumed. These types of impacts are evaluated to ensure that consumption is justified.

Mitigation Strategies. Because this Draft Programmatic EIS/EIR does not evaluate site-specific actions, no specific mitigation measures ~~or monitoring plans~~ are presented. Instead, general mitigation strategies are identified as ways to avoid, minimize, restore, or compensate for potentially significant adverse impacts. For some resources, specific mitigation measures are provided to display the array of techniques available in order to carry out the strategy. For example, construction activities can cause erosion of soils that leads to adverse impacts on water quality. A mitigation strategy would be to avoid and minimize the impact. Mitigation measures

Because this draft Programmatic EIS/EIR does not evaluate site-specific actions, no specific mitigation measures ~~or monitoring plans~~ are presented. Instead, general mitigation strategies are identified **and a mitigation monitoring plan to apply these strategies is described.**.

Revised 2-24-00

H-001159

H-001159

available to carry out this strategy include conducting work during dry periods and using erosion-control fencing or straw bales, water detention basins, and so forth.

The economic and social information analyses (agricultural economics, agricultural social issues, urban water supply economics, regional economics, and environmental justice) do not contain a **separate** mitigation strategies section. However, the Program has presented possible methods to alleviate potential adverse effects on these resources in the discussion of potential effects.

Potentially Significant Unavoidable Impacts. The final section is a discussion of potentially significant unavoidable impacts for each resource category. This section identifies potentially significant adverse impacts that **are anticipated to** remain significant even after implementing mitigation strategies and measures. For the economic and social information analyses, this section is titled Adverse Effects.

4.2 CEQA DOCUMENT REQUIREMENTS

CEQA requires that certain subjects be documented in an environmental impact analysis. The following explanation is provided to assist the reader in locating these subjects. The locations of discussions about the subjects are noted following each subject.

- ~~Affected environment~~. **Environmental setting.** Descriptions of the affected environment **that are relevant to each resource area addressed are included in each resource chapter, in** ~~are in~~ Chapters 5, 6, and 7. This section includes discussions ~~about~~ **of** historical and existing conditions.

- The ~~potentially~~ significant environmental effects of the proposed project. Chapter 3 provides a table of all potentially significant environmental effects of the Preferred Program Alternative. The potentially significant environmental effects of each of the alternatives are discussed by resource category in Chapters 5, 6, and 7.

- Any potentially significant environmental effects that cannot be avoided if the proposal is implemented. Each **environmental** resource category begins with a summary. Potentially significant environmental effects that cannot be avoided are noted in these summaries.

- Cumulative impacts. Cumulative impacts are addressed in each **environmental** resource category in Chapters 5, 6, and 7. ~~Chapter 3 contains a table of all potentially significant environmental effects, including significant and unavoidable impacts. Similarly,~~ The potentially significant environmental effects that cannot be avoided are discussed by **environmental** resource category in Chapters 5, 6, and 7.

- Mitigation measures proposed to minimize the potentially significant effects. Since this is a programmatic EIS/EIR, site-specific actions are not evaluated. Accordingly, no specific mitigation measures ~~or monitoring plans~~ are presented, but general mitigation strategies and a general mitigation monitoring plan are provided. Mitigation strategies can be found in the summaries and text for each **environmental resource** in Chapters 5, 6, and 7. The ~~draft~~ **proposed** programmatic mitigation monitoring plan is included in Chapter 9.

H-001160

- Alternatives to the proposed action including the No Action (or "No Project") Alternative and the environmentally superior (or "environmentally preferable") alternative. Chapter 2 describes alternatives, and Section 2.3 discusses the environmentally superior alternative.

- Growth-inducing impacts of the proposed action. These impacts are discussed in Chapter 3 and addressed in the environmental **resource categories in** ~~consequences sections of~~ Chapters 5, 6, and 7.

- The relationship between local short-term uses of mankind's environment and the maintenance and enhancement of long-term productivity. This relationship is summarized in Chapter 3 and addressed in the environmental **resource categories in** ~~consequences sections of~~ Chapters 5, 6, and 7.

- Any significant irreversible environmental changes that would be involved in the proposed action should it be implemented. These changes are discussed in Chapter 3 and addressed in the environmental **resource categories in** ~~consequences sections of~~ Chapters 5, 6, and 7.

- Summary (with major conclusions, areas of controversy, and issues to be resolved). A summary is included in each impact analysis for all **environmental** resource categories.

- Project description. The project description is found in Chapter 1. This discussion includes the Program purpose and need, Program goals and objectives, Program solution principles, Program study area and geographic scope, and the next steps in the process.

4.3 ESTIMATED LAND USE CHANGES DUE TO THE PROGRAM

Because of the general and programmatic nature of this document, it is impossible to specifically define the land use changes that will result from implementing the Program. The extent and specific locations of the Program actions have yet to be decided. To evaluate the environmental consequences of Program actions at a programmatic level, it is necessary to estimate the amount of land that could be disturbed by Program actions. The Program identified the maximum ranges of acreage that could be affected by the various Program elements to give decision makers and the public a sense of the "worst-case" land use impact.

Although impacts in the range of these acreage estimates are **theoretically** possible, the affected acreage likely would be considerably less because these estimates do not include reductions in the land use changes that could take place based on measures that may be implemented in Phase III to avoid, minimize, or mitigate these changes.

Because the Ecosystem Restoration Program actions could affect the largest amount of land, particularly agricultural lands, information is offered to illustrate actions that could be taken during Phase III to minimize the extent of lands, particularly in the Delta, adversely affected by the Program. The environmental, economic, and social consequences of these proposed land use changes and other adverse and beneficial impacts associated with the Program can be found in Chapters 5, 6, and 7.

The Program identified the maximum ranges of acreage that could be affected by the various program elements to give decision makers and the public a sense of the "worst-case" land use impact. Although these acreage estimates are **theoretically** possible, the affected acreage likely would be considerably less, depending on measures to avoid, minimize, or mitigate these actions.

Estimated land use changes are presented here as well as in the various environmental consequences discussions to provide a system-wide perspective regarding potential land use conversions and to reduce repetition in the document.

Other Program elements most likely to influence land use changes are water quality, levee system integrity, storage, and conveyance. The Water Transfer Program may influence land use changes if transfers from agriculture to urban or environmental uses are facilitated by the program. The extent of these potential changes are not known at the present time. Water Use Efficiency and Watershed Program measures are not expected to directly affect current land uses; therefore, no estimates of land changes relating to these programs are presented.

4.3.1 ECOSYSTEM RESTORATION PROGRAM

Table 4-2 summarizes the actions currently contemplated, along with estimates of the acreage that could be affected by each action.

Table 4-2. Estimate of Land Area Affected by the Ecosystem Restoration Program (in acres)

HABITAT TYPE	BAY REGION	DELTA REGION	SACRAMENTO RIVER REGION	SAN JOAQUIN RIVER REGION
Tidal perennial aquatic	1,500	7,000	0	0
Tidal perennial aquatic (shoals)	0	500	0	0
Nontidal perennial aquatic	1,600	2,600	0	1,000
Tidal sloughs	280-420	600-1,200	0	0
Midchannel islands	0	200-800	0	0
Fresh emergent wetland (tidal)	0	30,000-45,000	0	0
Fresh emergent wetland (nontidal)	0	14,500-17,000	0	0
Seasonal wetland	0	30,000	0	0
Riparian	160-360	1,000-1,500	6,500-7,000	700-1,300
Saline emergent wetland (tidal)	7,500-12,000	0	0	0
Stream meander corridor	0	0	19,000-27,000	1,500-2,000
Perennial grassland	4,000	4,000-6,000	0	0
Total acres	**15,040-19,880**	**90,400-111,600**	**25,500-34,000**	**3,200-4,300**

The Ecosystem Restoration Program would coordinate and assist in restoration activities currently under way and future activities **outside the Ecosystem Restoration Program** that could lead to the habitat restoration goals identified in the program. For example, actions under the Central Valley Project Improvement Act and the Central Valley Habitat Joint Venture are designed to protect and restore significant areas of land in the Central Valley. To the extent that

The Ecosystem Restoration Program would coordinate and assist in restoration activities currently under way and future activities that could lead to the habitat restoration goals identified in the program.

these activities and programs establish habitat that is **also** proposed in the Ecosystem Restoration Program, the amount of land needed to achieve the Ecosystem Restoration Program goals would be reduced.

The Program would take a variety of steps to reduce effects on farmland, including:

- Implementation of the Ecosystem Restoration Program would occur over many years. The implementation process would include extensive local community, landowner, and stakeholder involvement.
- The Program would obtain easements on existing farmland that would allow for **continued farming with** minor changes in agricultural practices, thus increasing the value of the crops to wildlife.
- Habitat restoration efforts would focus first on developing habitat on public land where appropriate.
- If no public land is available, restoration efforts would focus next on land acquired from willing sellers and that provides substantial benefits for ecological processes, habitat, or species.
- Where small parcels of land are needed for waterside habitat, acquisition efforts would seek out points of land on islands where the ratio of levee miles to acres farmed is high.
- ~~The Program would obtain easements on existing farmland that would allow for minor changes in agricultural practices, thus increasing the value of the crops to wildlife.~~
- Where possible, floodplain restoration efforts would include provisions for continued agricultural practices, which would be renewed on an annual basis.

4.3.2 WATER QUALITY PROGRAM

Facilities to control and treat various discharge effluents would directly affect current land uses. The extent and locations of these facilities are unknown at this time; consequently, the acreage that could be affected cannot be forecast in a meaningful way. These facilities will need to be evaluated for environmental impacts when the facilities are being planned.

Facilities to control and treat various discharge effluents would directly affect current land uses. The extent and locations of these facilities are unknown at this time; consequently, the acreage that could be affected cannot be forecast in a meaningful way.

Land retirement is not a specific objective of the CALFED Water Quality Program. However, it is a tool available to help meet the program's **water quality** objectives in the San Joaquin Valley, aimed at controlling degradation from selenium associated with agricultural drainage. Land retirement along the west side of the San Joaquin River watershed is included in the CALFED No Action Alternative to reflect actions planned by the federal government under the Central Valley Project Improvement Act (CVPIA). These actions would occur irrespective of the CALFED Program. As outlined in the Water Quality Control Plan, other water quality management tools will be used to their fullest extent before any land retirement is initiated under the CALFED Program.

Should land retirement still be deemed necessary, CALFED would consider implementing a program to retire lands in order to help meet water quality objectives for selenium under a tiered approach. Initially, up to 3,000 acres of land **in the San Joaquin Valley** with the greatest concentrations of selenium could be retried. If that is insufficient, land retirement would be expanded up to a total of 37,000 acres with high selenium concentrations. These values are based on the report titled "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley," a collaboratively published report coordinated by the U.S. Bureau of Reclamation and published in September 1990; it is commonly referred to as the "Rainbow Report."

The tiered approach to land retirement is intended to limit the need for land retirement to the least amount necessary in order to meet the water quality objectives.

~~The drainage management problem areas on the west side of the San Joaquin Valley are included in the No Action Alternative. This document assumes that land retirement in the area will take place even if the Program does not proceed. The Water Quality Program also has identified this drainage management problem as a water quality issue and intends to facilitate the retirement effort as part of the Water Quality Program element. This action could affect a maximum of 37,000 acres and be carried out in accordance with the September 1990 "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the West Side San Joaquin Valley."~~

4.3.3 LEVEE SYSTEM INTEGRITY PROGRAM

Levee restoration would cause both temporary and permanent land disturbance near existing levees. Land disturbed temporarily during construction would be restored through revegetation and likely would return to preconstruction conditions. These temporary losses are estimated at between 1,000 and 1,500 acres. Other land would be permanently affected by the larger footprint of the new levees. Levee reconstruction could require approximately 15,000 acres. About 625 of the 1,100 miles of Delta levees would be upgraded, and a 200-foot-wide piece of land is needed for each levee mile. The Program also projected that 100 miles of setback levees could be constructed, affecting an area 500 feet wide per levee mile. Subsidence control could affect about 14,000 acres. In total, an estimated range of 34,000-35,000 acres could be permanently affected by the Levee System Integrity Program. These estimates are the upper range of the possible acreage that could be affected. The Program will refine these estimates as the process continues.

Suisun Marsh levee restoration also would result in land disturbance. Assuming a similar footprint as the Delta levees, restoration of the Suisun Marsh levees could affect from 5,000 to 5,600 acres. Affected land uses are primarily wildlife habitat.

4.3.4 STORAGE

Several representative storage sites were examined to provide a better perspective on the potential magnitude of land use changes, as well as other storage-related consequences.

Acreage permanently affected by constructing or modifying storage facilities would be determined by the number, size, and location of sites eventually selected for those facilities. A range of additional groundwater storage also is included in the alternatives. Table 4-3 shows preliminary calculations of land that could be affected by the footprint of new storage facilities. Several representative storage sites were examined to provide a better perspective on the potential magnitude of land use changes, as well as other storage-related consequences. It is likely that land use impacts would extend beyond the reservoir site itself. The actual areas and land uses that would be affected depend on the siting, design, and operation of the reservoir. This information will be developed in subsequent project-specific environmental documents.

The following sites were investigated as examples for preliminary land use change analysis in this document:

- Sites/Colusa and Thomes-Newville Reservoir sites were selected to represent surface water storage on Sacramento River tributaries. Assuming a storage capacity of 3 MAF, the potential land affected by a new reservoir could range from 16,700 acres (Thomes-Newville) to 29,600 acres (Sites/Colusa). This range is included in the Sacramento River Region in Table 4-3.

- The Montgomery Reservoir site was the representative example for surface water storage on San Joaquin River tributaries. Assuming a storage capacity of 500 thousand acre-feet (TAF), the land that would be affected by a new reservoir at this site was estimated at 8,050 acres. This value is included in the San Joaquin River Region in Table 4-3.

- Groundwater storage was estimated at 1,500 acres in both the Sacramento River and San Joaquin River Regions. These values are included in the respective regional areas in Table 4-3.

- The Los Vaqueros Reservoir site was the example for the surface water storage off-aqueduct option. Assuming a storage capacity of 1 MAF, the potential land affected by enlarging the existing reservoir was estimated at 7,000 acres. This value is included in the San Joaquin River Region in Table 4-3.

- Victoria, Bacon, Holland, and Woodward Islands were the example sites for the in-Delta storage. The sites occupy an area of 18,000-19,500 acres. These values are included in the Delta Region in Table 4-3.

4.3.5 CONVEYANCE

The estimated amounts of land area (for example, agriculture, and fish and wildlife habitat) that would be affected by conveyance features are shown in Table 4-3.

Table 4-3. Estimates of Land Area Affected by Storage and Conveyance (in acres)

ALTERNATIVE	DELTA REGION STORAGE[1]	DELTA REGION CONVEYANCE	SACRAMENTO RIVER REGION STORAGE[1]	SAN JOAQUIN RIVER REGION STORAGE[1]	ALL REGIONS TOTAL
PPA[2]	0-15,000	100-4,500	0-32,000	0 to16,600	100-68,100
1	0-15,000	100-400	0-32,000	0 to16,600	100-64,000
2	0-15,000	4,000-4,500	0-32,000	0 to16,600	4,000-68,100
3	0-15,000	4,500-6,000	0-32,000	0 to16,600	4,500-69,600

Revised 2-24-00

Note:
PPA = Preferred Program Alternative.

* Estimates assume that channel capacity is enlarged by using setback levees; if dredging is used to enlarge channel capacity, less land would be required. For each configuration, the estimate of land area associated with conveyance changes is based on the following: operable Old River barrier—100 acres; channel enlargement along Old River—300 acres; screened intake near Hood and north Delta channel modifications—3,500-4,000 acres; and isolated open channel (45 miles long and 1,000 feet wide)—4,000-5,000 acres. Range of storage is the same for all alternatives. The upper end of the range reflects the variation possible, depending on which size reservoir is eventually selected.

[1] Estimates do not include lands that might be affected outside of the reservoir site.
[2] Preferred Program Alternative conveyance estimate ranges from without a pilot diversion facility to including a facility.

Program activities could affect lands designated as prime farmland, unique farmland, and farmland of state-wide importance. Table 4-4 summarizes the acreages by farmland type that could be affected by the Program. Except as noted, the acreage estimates assume that all Program activities would occur on these three types of farmland.

In addition to the long-term land use changes, the Program expects that construction activities will result in temporary conversion of additional agricultural land. Mitigation necessary to offset impacts on wildlife as a result of implementing the levee system integrity, water quality, conveyance, and storage elements may also affect ~~additional~~ agricultural lands. These additional acres of agricultural land are covered within the range of acres presented in Table 4-4.

The mitigation strategies presented in each resource category are guidelines for formulating measures that may be chosen by CALFED agencies other implementing agencies in second-tier environmental reviews, which will be completed before post-Record of Decision project actions occur. Specific mitigation measures will depend on project location, site impacts, size of the project, and other variables that cannot be determined at a programmatic level. Mitigation measures will be included, if a significant impact is identified, in these second-tier environmental documents. Implementing some mitigation measures could result in additional environmental effects, **as a result of the mitigation measures themselves**. However, until site-specific projects are analyzed and specific mitigation measures are selected, it is not possible to identify these additional effects at this time. Mitigation measures for these potential secondary effects will also be addressed in second-tier environmental documentation.

The mitigation strategies are designed to reduce and mitigate the programwide impacts on conversion of agricultural land as the Program is implemented through tiered, second-level projects. As the Program is implemented, project-level mitigation measures will be included to address the impacts of conversion of agricultural lands, as applicable to the site-specific conditions of each project. Until it is known which sites will be subject to specific Program projects, and what the proposals for specific locations are, it is difficult to identify the most appropriate and effective mitigation measures. Not all mitigation measures will be applicable to all projects because site-specific projects will vary in purpose, location, timing, **and scope.**

Table 4-4. Estimates of Area of Important Farmland ~~Affected~~ Potentially Converted by Program Elements (in acres)

ALTERNATIVE/REGION		ECOSYSTEM RESTORATION PROGRAM[2]			LEVEE SYSTEM INTEGRITY PROGRAM[2,5]			STORAGE[3]			CONVEYANCE[2,5,6]			WATER QUALITY PROGRAM[1,2,4]	TOTAL
		P	S	U	P	S	U	P	S	U	P	S	U	0	
PPA	Delta	85,800-101,600	3,200-6,500	1,400-3,500	31,000	2,500-3,000	500-1,000	0-14,000[2]	0-1,000[2]	0	100-3,800	0-200	0-500	0	124,500-166,100
	Sacramento River	21,700-28,800	3,300-3,900	600-1,300	0	0	0	0	0	0	0	0	0	0	25,600-34,000
	San Joaquin River	3,500-5,000	400-500	100-300	0	0	0	0	0	0	0	0	0	37,000	41,000-42,800
	Total	111,000-135,400	6,900-10,900	2,100-5,100	31,000	2,500-3,000	500-1,000	0-14,000	0-1,000	0	100-3,800	0-200	0-500	37,000	191,100-242,900
1	Delta	85,800-101,600	3,200-6,500	1,400-3,500	31,000	2,500-3,000	500-1,000	0-14,000[2,7]	0-1,000[2]	0	100-300	0-100	0	0	124,500-162,000
	Sacramento River	21,700-28,800	3,200-3,900	600-1,300	0	0	0	0	0	0	0	0	0	0	25,500-34,000
	San Joaquin River	3,500-5,000	400-500	100-300	0	0	0	0	0	0	0	0	0	37,000	41,000-42,800
	Total	111,000-135,400	6,900-10,900	2,100-5,100	31,000	2,500-3,000	500-1,000	0-14,000	0-1,000	0	100-300	0-100	0	37,000	191,100-238,800
2	Delta	85,800-101,600	3,200-6,500	1,400-3,500	31,000	2,500-3,000	500-1,000	0-14,000[2,7]	0-1,000[2]	0	3,500-3,800	100-200	400-500	0	128,400-166,100
	Sacramento River	21,700-28,800	3,200-3,900	600-1,300	0	0	0	0	0	0	0	0	0	0	25,500-34,000
	San Joaquin River	3,500-5,000	400-500	100-300	0	0	0	0	0	0	0	0	0	37,000	41,000-42,800
	Total	111,000-135,400	6,900-10,900	2,100-5,100	31,000	2,500-3,000	500-1,000	0-14,000	0-1,000	0	3,500-3,800	100-200	400-500	37,000	195,000-242,900
3	Delta	85,800-101,600	3,200-6,500	1,400-3,500	31,000	2,500-3,000	500-1,000	0-14,000[2,7]	0-1,000[2]	0	4,000-4,800	300-900	200-300	0	128,900-167,600
	Sacramento River	21,700-28,800	3,200-3,900	600-1,300	0	0	0	0	0	0	0	0	0	0	25,500-34,000
	San Joaquin River	3,500-5,000	400-500	100-300	0	0	0	0	0	0	0	0	0	37,000	41,000-42,800
	Total	111,000-135,400	6,900-10,900	2,100-5,100	31,000	2,500-3,000	500-1,000	0-14,000[7]	0-1,000	0	4,000-4,800	300-900	200-300	37,000	195,400-244,400

Notes:

Types of Farmland
- Prime (P) - Land with the best combination of physical and chemical features for the production of agricultural crops.
- State-wide importance (S) - Land with a good combination of physical and chemical features for the production of agricultural crops.
- Unique (U) - Land of lesser quality soils used for the production of the state's leading agricultural cash crops.

PPA = Preferred Program Alternative.

1 Acreages of farmland of state-wide importance cannot be accurately estimated at this time because mapping has not been completed in the San Joaquin River Region. It is possible that farmland of state-wide importance would be affected by the Water Quality Program in the Grasslands area of the San Joaquin River Region.
2 Estimates assume that all land conversion occurs on lands currently in use for agricultural purposes.
3 Outside the Delta, estimates assume that potential storage reservoirs sites are typically foothill grasslands and do not contain significant amounts of important farmland; small amounts of important farmland could be affected if reservoirs are sited in valleys containing alluvial deposits that support important agricultural farmland.
4 Total includes maximum acreage potentially affected by the Water Quality Program.
5 Estimates assume that all Delta channel capacity is enlarged by constructing setback levees; if dredging is used to enlarge channel capacity, less land would be required.
6 Preferred Program Alternative estimate ranges from without a pilot diversion facility to including a facility.
7 This figure, based on a conjectural project, could increase by 1,000 acres if the proposed Delta Wetlands Project, as currently configured, is approved and built.

H-001167

Summary of Changes for Chapter 10 of the Impact Analysis

Text was added or deleted to Chapter 10 in order to clarify the status of the work or existence of some of the panels or committees: the Bromide Panel, the Finance Work Group, the Governance Work Group (replacing text about the Assurances Work Group), and the Water Use Efficiency Work Group.

10.1.15 BROMIDE PANEL

Since analyses indicated that the Preferred Program Alternative could profoundly affect bromide concentration (a potential carcenogenic) in drinking water supplies from the Delta, the Program assembled a panel of independent, nationally recognized scientific experts to deliberate and provide relevant recommendations. Panelists were collaboratively chosen by members of the Water Quality Technical Group. The panelists areas of expertise included chemistry of DBP formation, source control, health effects of DPBs, water treatment, and drinking water regulation development. The panel met on September 8 and 9, 1998, and published its report in November 1998. The Bromide Panel's report is contained in full in the Water Quality Control Program Plan appendix to the Programmatic EIS/EIR.

The Program assembled a panel of independent, nationally recognized scientific experts to deliberate and provide relevant recommendations about bromide.

10.1.16 DIVERSION EFFECTS ON FISHERIES TEAM

The Diversion Effects on Fisheries Team (DEFT) was formed in February 1998 to evaluate the technical issues related to diversion impacts on fisheries. DEFT members include stakeholders and representatives from member agencies. Since it was formed, DEFT has met regularly to evaluate the likelihood of fisheries recovery under the three alternatives presented in March 1998, and to develop modified alternatives that would recover fish species. DEFT developed a list of seven entrainment losses or other effects that needed to be reduced, as well as eight programmatic actions to maximize the chances of a through-Delta conveyance meeting the Program purpose. These lists are summarized in the December 1998 Revised Phase II Report. DEFT continues to meet regularly to discuss the potential effects on fisheries from water project operations.

The Diversion Effects on Fisheries Team (DEFT) was formed in February 1998 to evaluate the technical issues related to diversion impacts on fisheries.

10.1.17 BAY-DELTA ADVISORY COUNCIL

The BDAC was established in May 1995 under the Federal Advisory Committee Act. Formed to assist Program leaders, the council consists of 31 stakeholder representatives appointed by then-Governor Wilson and President Clinton, through Secretary of the Interior Babbitt. BDAC members came from diverse backgrounds and represent water districts and utilities, environmental organizations, the California Farm Bureau, and sport fishing organizations from throughout the state. The group of citizen advisors initially were commissioned to help define problems in the Bay-Delta system, assure broad public participation, comment on environmental reports, and advise on proposed solutions.

The group of citizen advisors initially were commissioned to help define problems in the Bay-Delta system, assure broad public participation, comment on environmental reports, and advise on proposed solutions.

In October 1998, consultants conducted interviews of most BDAC members and some Program staff to evaluate the effectiveness of the council and its work groups. In all, 44 people were interviewed to assess the role and effectiveness of the council and its work groups in advising the Program on key policies and Program components. The results of the evaluation were presented to BDAC at its January 1999 meeting. Among the highlights of the consultant's report:

- BDAC should focus on three critical issues during 1999: (1) reaching agreement on the staged approach to the Preferred Program Alternative, (2) resolving the complex issues of Program governance, and (3) financing the Program.

- BDAC should continue a regular schedule of meetings through 1999, about half of which should be held outside Sacramento. BDAC deliberations should focus on a narrowed set of Program policy topics. To obtain the greatest benefit from these sessions, stakeholder and BDAC panels as well as facilitated break-out groups should be used.

- Certain BDAC work groups should be retired and others restructured to develop alternate, task-focused public venues for input on specific Program components. Some of these public meetings should be convened in conjunction with BDAC meetings.

- CALFED Policy Group members routinely should be included at BDAC meetings to strengthen communication and interchange between the groups.

- BDAC's role should be clarified vis a vis a public input process, such as the Ecosystem Roundtable. Participation guidelines for BDAC members in 1999 should be adopted to supplement those adopted in November 1996.

BDAC is scheduled to meet monthly through September 1999, at which time it is scheduled to meet monthly until the Final Programmatic EIS/EIR is released.

BDAC is scheduled to meet monthly through September 1999, at which time it is scheduled to meet monthly until the Final Programmatic EIS/EIR is released.

10.1.18 BDAC WORK GROUPS

Six subgroups to BDAC provided input into specialized areas of the Program. Each subgroup held regular public meetings to study specific Program areas. As a result of the BDAC consultant's findings, some of these work groups ~~will be~~ have been retired or restructured.

Water Use Efficiency Work Group. The seven-member Water Use Efficiency Work Group ~~addresses~~ addressed policy issues related to efficient water use and water demand management. Categories considered by the group include urban water conservation, agricultural water conservation, water recycling, and temporary or permanent land fallowing. ~~No changes were recommended for this work group.~~ This work group has been retired.

The seven-member Water Use Efficiency Work Group addresses policy issues related to efficient water use and water demand management.

Key questions of the work group include:

- What general approach is most appropriate to implement water use efficiency measures—regulatory, market, or a combination?

- How can water use efficiency be structured to complement the other water supply components of each alternative?

- What is the appropriate level of effort for water use efficiency measures in each alternative, and how should the level be set?

- Should water use efficiency measures be specified in alternatives, or should a target level of reduced demand be specified and the selection of measures left to water users?

The primary focus of the Ecosystem Restoration Work Group was to identify and develop options to address policy issues related to developing an effective ecosystem restoration strategy for the Program.

The work group produced summaries of each of these issues for BDAC to promote a better understanding and consideration by the full BDAC. Products developed by the group have been critical in Phase II development of the Preferred Program Alternative.

Ecosystem Restoration Work Group. This work group's primary focus was to identify and develop options to address policy issues related to developing an effective ecosystem restoration strategy for the Program. In light of the consultant's report, the work group's focus will change to:

- Prepare for the spring 1999 Scientific Review Panel, after which the work group's objective will be accomplished and the group will be retired.

- Provide further public discussion in 1999 about Ecosystem Restoration Program policy issues through focused workshops jointly sponsored with universities or other organizations. Policy areas could include Ecosystem Restoration Program management and oversight, including the public's role; integration of the Ecosystem Restoration Program, CMARP, Conservation Strategy, and Watershed and Levee System Integrity Programs; and review of final drafts of the Strategic Plan for Ecosystem Restoration and the Ecosystem Restoration Program, including Stage 1 actions.

The six-member Finance Work Group met regularly since April 1996 to identify key financial issues and problems that must be addressed for the Program to succeed.

Finance Work Group. This group was recommended for retirement. The six-member work group met regularly since April 1996 to identify key financial issues and problems that must be addressed for the Program to succeed. The work group also examined a range of alternative ways to address these issues and problems that could lead to building a workable consensus solution. Although retired, public discussions about overall finance issues will continue at BDAC meetings. These discussions should focus on applying the principle of "beneficiaries pay," and of allocating Program costs or investments between the state and federal governments and ~~the water users~~. **all users of the Bay-Delta system.**

The Governance Work Group. This work group, renamed the from the Assurances Work Group, was will be reconfigured to include a BDAC co-chair from the business community and to appoint additional BDAC members. Previously, the Assurances Work Group focused on identifying the assurance needs for each Program element and the ways in which these assurances can be provided. The objective of the Governance Workgroup is to focus on one of the assurances issues--the governance structure (institutional and decsion-making arrangements) to implement the CALFED Program over the long-term.

The Assurances Governance Work Group will meet on an as needed basis while the governance proposal is being developed. The Workgroup will report to BDAC on its recommendations and comments regarding CALFED governance.

~~**Assurances Work Group.** This work group was renamed the Governance Work Group and was will be reconfigured to include a BDAC co-chair from the business or agricultural community and to appoint or reappoint a maximum of 12 members. *NEED TEXT TO EXPLAIN THE NAME CHANGE, AND ANY CHANGES TO FOCUS OF THE GROUP* The Assurances Governance Work Group, which began meeting in August 1996, identified the assurance needs for each Program element and the ways in which these assurances can be provided. The objective of the group has been refined to now include making recommendations to BDAC and CALFED about the overall Program, the Ecosystem Restoration Program, and proposed legislative language concerning governance and oversight.~~

~~The Assurances Work Group identified the assurance needs for each Program element and the ways in which these assurances can be provided.~~

~~The Assurances Governance Work Group will continue to meet quarterly during 1999 and convene two of its meetings to coincide with regional BDAC meetings. The work group will try to coordinate its deliberations with those of the Irvine Foundation Focus Group.~~

The Water Transfers Work Group has been particularly helpful in developing the concept of a water transfer information clearinghouse.

Water Transfers Work Group. This work group has been instrumental in helping develop the Program's water transfer framework, including identifying issues and constraints, and developing potential solution options. The work group has been particularly helpful in developing the concept of a water transfer information clearinghouse.

In early 1999, this work group was retired, and a more focused group will be convened in its place. This new group will be comprised of agency representatives, water users, and environmental community representatives. The group will address quantifying and defining carriage water, reservoir refill criteria, third-party impacts, and the role of the public in overseeing a transfers clearinghouse.

Ecosystem Roundtable. The Ecosystem Roundtable is a stakeholder forum established as a subgroup of BDAC. Members of this group represent a cross section of stakeholders interested in and affected by habitat restoration activities in the Bay-Delta system.

Members of the Ecosystem Roundtable represent a cross section of stakeholders interested in and affected by habitat restoration activities in the Bay-Delta system.

Meeting on a quarterly or as-needed basis, the Ecosystem Roundtable has provided advice and recommendations to BDAC and the Program on coordinating existing and anticipated state and federal habitat restoration programs.

10.1.19 Groundwater Outreach Program

Appropriate and effective groundwater management will be essential to the success of the Program. As part of the Storage and Conveyance elements, the Program is looking to facilitate additional conjunctive use and groundwater banking opportunities; this could be one way to help maximize the overall water supply and protect groundwater resources. The Program initiated a groundwater outreach component to help identify and address stakeholder concerns about groundwater use and management, with special emphasis on conjunctive use projects.

The Program initiated a groundwater outreach component to help identify and address stakeholder concerns about groundwater use and management, with special emphasis on conjunctive use projects.

The Program contacted and met with dozens of individuals—including private citizens, water managers, water district board members, and elected officials—to learn about local

IMPLEMENTATION PLAN

March 2000

1.0 IMPLEMENTATION PLAN OVERVIEW

1.1 Introduction

Phase II of the CALFED Bay-Delta Program will culminate with the Federal Record of Decision (ROD) and the State Certification of the Final Programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (expected to be completed in mid-2000). At that time, Phase III of the CALFED Bay-Delta Program will begin implementation of the Preferred Program Alternative. Phase III is expected to extend thirty years or more. This Implementation Plan satisfies the requirement for the Final Programmatic EIS/EIR to include a schedule for funding and implementing all elements of the long-term CALFED Program (California Water Code section 78684.2).

CALFED's strategic approach for implementation includes staged implementation and staged decision making. The selection of a Preferred Program Alternative provides the broad resource framework and strategy for implementing a comprehensive Bay-Delta program. The programmatic decision sets in motion the implementation of some actions, as well as additional planning and investigation to refine other actions. Throughout the implementation period, monitoring will provide information about conditions in the Bay-Delta and results of our actions.

CALFED has decided to implement the Program through stages. The Preferred Program Alternative is composed of hundreds of individual actions that will be implemented and refined over time. The challenge in implementing the Program in stages is to allow actions that are ready to be taken immediately to go forward, while assuring that everyone has a stake in the successful completion of each stage. Linkages and assurance mechanisms will facilitate successful implementation. Project-level environmental documentation will be tiered off of the final Programmatic EIR/EIS. A full range of alternatives will be analyzed in the project environmental documentation. Impact evaluations of water supply availability, water quality, stages, circulation, sedimentation, fishery impacts, navigation, recreation, export water supplies will all be evaluated and made available for public review. The final decision on the project elements will be based on this full suite of analyses and public input.

Potential linkage and assurance mechanisms include contracts, legislation (including bond measures, authorizing and appropriations legislation, and other actions), interagency agreements, agency directives, and stakeholder driven decision processes such as the Ecosystem Roundtable project selection process. The various potential mechanisms will not all be in place at the beginning of ~~Stage~~ Phase III. It is anticipated that they will be negotiated and implemented based on ongoing coordination among CALFED agencies, stakeholders, the State Legislature, and Congress.

Another important part of CALFED's implementation strategy is adaptive management. There is a need to constantly monitor the Bay-Delta system and adapt the actions that are taken to restore

Action # 86: Streamline the Water Transfer Approval Process

1. General Description of the Action:

CALFED will work with the SWRCB, DWR, and USBR to refine and clarify the review and approval processes required for proposed water transfers. The intent is to identify agency policy issues that are problematic for some water transfer interests and to allow CALFED to focus attention on these areas for resolution. One desired outcome of the effort to streamline review and approval processes is publication of a unified set of rules, guidelines and procedures used by the agencies. As of July 1999, the SWRCB issued A Guide to Water Transfers in draft form. This document includes a description of the procedures to be followed and detailed information regarding the jurisdictional requirements for approving a specific transfer proposal (i.e., who has the authority to approve, disapprove or condition a proposed transfer). The current draft of this guidebook can be retrieved from the SWRCB web-site at *http://www.waterrights.ca.gov*. Eventually, these would be published in more refined detail through an online information clearinghouse ~~at a site on the Web for electronic access, maintained by the California Water Transfer Information Clearinghouse~~. The web-site would guide transfer proponents through a series of questions to help them understand the required approval procedures, the guidelines used by approving agencies, and would provide other information (i.e., broadly accepted impact analysis tools, useful data, etc.).

2. Cost Estimate:

Agency staff will be the primary developers of the initial application information on the web-site and development of subsequent iterations. CALFED staff will facilitate and coordinate agency activities. During FY 2000, an effort to develop a web-based navigational tool is anticipated to be contracted to consultants. This would be a one-time fee of about $350,000. Otherwise, costs are assumed based on part-time participation by a few agency staffers.

FY 2000 = $450,000 ($400,000 federal, $50,000 state, incl. contract for web site)
FY 2001 = $100,000 ($50,000 federal, $50,000 state)

3. Program Administration and Governance:

Since the state and federal agencies named above have the authority to review and approve many proposed water transfers, they will administer this action. CALFED staff will continue to facilitate activities between the agencies. No governance is needed.

4. Program Coordination:

No coordination with other CALFED programs is needed.

<u>Action # 88: Expedite the SWRCB Approval Process for Some Water Transfers</u>

1. <u>General Description of the Action:</u>

Certain types of water transfer proposals can already be expedited through the State Water Resources Control Board approval process. These are described in the draft "Guide to Water Transfers" circulated by the State Board staff in July 1999 (see Action #86). Additionally, SB 970, effective January 1, 2000, makes some changes in the State Board's approval process for certain types of transfers. For example, water code sections 1726 and 1727 have been repealed and replaced with a new section 1726 which shortens the amount of time allowed to the Board for evaluation of temporary transfers submitted under water code section.

During Stage 1 of Program implementation, additional mechanisms for expedited approvals of certain types of transfers will be discussed and evaluated by the CALFED agencies, including the State Board, in consultation with stakeholders. For example, in-basin transfers, transfers that have been previously approved and implemented without adverse impacts, instream flow transfers, and transfers within the CVP or SWP export service areas are the types of transfers which might be suitable for further modification and streamlining in the approval process.~~It is possible that new mechanisms could be adopted by the Board to improve the current process or to allow other types of transfers to be expedited (i.e., transfers that have occurred in the past with no impact, intra-basin transfers, instream flow transfers, etc.) This action is designed to evaluate what other types of transfers might be appropriate for expedited review and approval.~~ Because the Water Transfer Program is also designed to ensure protection for third-party interests, this action will not jeopardize necessary review and comment periods when and where they are appropriate. In addition, expedited process mechanisms will only be applicable to short-term transfers.

2. <u>Cost Estimate</u>:

This activity will require staff time from the SWRCB, DWR and USBR. Costs are based on nominal part-time effort of staff with authority to develop recommendations and CALFED staff support and facilitation. Ultimately, any costs are absorbed into the agency's operating budget.

FY 2000/01 = $40,000 ($20,000 federal, $20,000 state)

3. <u>Program Administration and Governance:</u>

This action would be administered jointly by USBR, DWR, and SWRCB with continued coordination efforts by CALFED staff over the next few years.

4. <u>Program Coordination:</u>

Conveyance Improvements and Water Quality **IP-2.8-3**

COMMENT: One reviewer supported evaluation of conveyance improvements which may be necessary to meet drinking water quality and fish recovery goals. The reviewer noted that a reduction in source water salinity improves the utility of a water supply for recycling and that evaluations of conveyance alternatives should be conducted through the Delta Drinking Water Council, coincident with federal decisions on future drinking water standards.

CALFED agrees with the reviewer's observations. The proposed approach to future decision making is reasonable, but will be subject to change as future events unfold.
Response to 1226.48

Coordinated Project Operations **IP-2.8-4**

COMMENT: A reviewer recommended that CALFED insist on coordinated management of Federal and State water systems in order to improve and optimize the efficiency of the existing infrastructure.

CALFED agrees with this recommendation, as reflected in the impact analysis operational assumptions and in the proposed Stage 1 actions for conveyance. Potential actions include implementation of Joint Point of Diversion, physical interties between the two systems at the intakes and between the aqueducts, consolidation of screened intakes, and better operational coordination. Such coordination needs to consider and respect existing water rights protections for all water users who might be affected by better coordination of export operations.
Response to 1272.9

*

Old River Barrier Location **IP-2.8-5**

COMMENT: One reviewer noted that the Old River tidal barrier is west of Paradise Cut, close to the CVP diversion point.

(ER) This is correct, and the ERP ~~will be~~ was corrected.
Response to 1350.40

Recirculation **IP-2.8-6**

Comment: Consider using recirculated water through the Delta Mendota Canal rather than water from the tributaries to provide spring pulse flows into the South Delta.

Response: CALFED Stage 1 actions provide for an evaluation of flow recirculation into the San Joaquin River using water from the Delta Mendota Canal (see South Delta Improvements under Section 4.1 of the Phase II Report). While it is possible for this recirculation to contribute to environmental pulse flows, it is unlikely that the recirculation could provide all the flows needed. To achieve the intended ecosystem benefit, pulse flows require a large volume of water over a relatively short duration. The rate of flows required are larger than the capacity of the Delta Mendota Canal. Due to the programmatic nature of the CALFED Program, no specific decisions

H-001179

have been made on the best way to provide the flows. However, it is likely that the flows will come from willing sellers or water developed by the CALFED Programmatic EIS/EIR. The pulse flows should have no negative effect on water rights or Delta statues. The Programmatic EIS/EIR discusses impacts on third parties and implementation strategies for implementation of the Program.

Response to 1070.7

2.9 Assurances and Institutional Arrangements

*

Regulatory Certainty **IP-2.9-1**

COMMENT: Some reviewers commented that regulatory certainty regarding Bay-Delta water supply is necessary so that users can meet constituents needs *or prior to implementation of additional diversions.*

(MS) As noted in Section 2.9 of the Implementation Plan, CALFED proposes implementation of a ~~Multi-Species Conservation Strategy~~ MSCS and notes the need for a final SWRCB decision on water rights allocations for the Water Quality Control Plan. These are the key elements for achieving a higher degree of regulatory certainty than current circumstances allow. In addition, one of the key goals of the ERP is to restore listed and sensitive aquatic species in order to reduce the conflict between those species needs and the needs of Delta water users. It should be noted that the SWRCB reserves the right to periodically reassess water rights allocations for the Delta, and thus no permanent, absolute regulatory certainty can be guaranteed.

Response to 1221.8, 1348.3
8T1.1, 13T25.1

2.10 Finance

2.11 Monitoring, Data Assessment, Research, and Adaptive Management

3.0 Near Term (Stage Ia) Actions

*

Assurance of Implementation Benefits **IP-3.0-1**

COMMENT: Some reviewers indicated that CALFED must include approval and early implementation of Stage 1 actions in the South Delta. Whereas, other reviewers were concerned that the Programmatic EIR/EIS lacked any firm commitments and that it did not provide assurances to continuously improve Delta water quality, and other Program elements.

(ER) CALFED agrees that the various Stage 1 actions in the South Delta represent key actions which can provide immediate regional and statewide benefits in terms of water supply reliability,

LEVEE SYSTEM INTEGRITY PROGRAM PLAN

March 2000

Seismic loading threatens Delta levees. Some CALFED stakeholders are concerned that earthquakes may pose a catastrophic threat to Delta levees, that seismic forces could cause multiple levee failures in a short time, and that such a catastrophe could overwhelm the current emergency response system.

CALFED agrees that earthquakes pose a potential threat. In addition, Delta levees are at risk from floods, seepage, subsidence, and other threats. To address this concern, CALFED has begun a risk assessment to quantify these risks and develop a risk management strategy.

Over the past year, the Seismic Risk Assessment Subteam quantified the seismic risk to Delta levees. ~~The results indicate that "Significant seismic risk is present; however, improved preparedness can reduce the potential damage."~~ CALFED is continuing its risk assessment of floods, seepage, subsidence, and other threats.

Several risk management options have been developed for inclusion in the CALFED Preferred Program Alternative. The available risk management options include, but are not limited to:

- Improving emergency response capabilities,
- Reducing the fragility of the levees,
- Improving through-Delta conveyance,
- Constructing an isolated facility,
- Developing storage south of the Delta,
- Releasing more water stored north of the Delta,
- Restoring tidal wetlands,
- Controlling and reversing island subsidence,
- Curtailing Delta diversions, and
- Continuing to monitor and analyze total risk.

The final Risk Management Plan may include a combination of these options.

H-001182

2.4 DELTA LEVEE EMERGENCY MANAGEMENT AND RESPONSE PLAN

The goal of the Delta Levee Emergency Management and Response Plan (Emergency Management Plan) element is to enhance existing emergency management response capabilities in order to protect critical Delta resources and limit any interruption of services and supplies to six months or less in the event of a disaster. More focused analysis and documentation of specific targets and actions will occur in subsequent efforts.

The goal of the Delta Levee Emergency Management and Response Plan element is to enhance existing emergency management response capabilities in order to protect critical Delta resources in the event of a disaster.

2.4.1 INTRODUCTION

The existing emergency response capabilities need to be continuously refined, and funding needs to be increased. The Emergency Management Plan will build on existing state, federal, and local agency emergency management. It will propose specific actions that will improve response flexibility to ensure that appropriate resources are available and properly deployed, and provide for effective disaster recovery measures.

Table 7 lists implementation objectives, targets, and actions associated with the Emergency Management and Response Plan element.

2.4.2 BACKGROUND

The most recognizable threat to Delta islands and resources is inundation due to winter flood events. Other potential disasters that threaten these same resources include seismic events and levee failure during low-flow periods.

The most recognizable threat to Delta islands and resources is inundation due to winter flood events.

Current emergency response procedures could be streamlined to reduce delays in mobilizing resources. A quick response can prevent costly levee failures. In addition, the tendency to focus emergency response measures on those sites facing imminent failure can result in neglecting actions that could prevent threatened sites from escalating into emergencies.

2.4.3 CURRENT PROGRAM

The Governor's Office of Emergency Services (OES) coordinates state agency responses. When an incident appears to potentially exceed the resources of the local responsible agency, emergency personnel conduct on-site evaluations to determine what, if any, additional emergency support is warranted. Cities and counties can proclaim local disaster events and, in general, local or maintaining agencies are first in line for responsibility to address disaster events. Although certain agencies may have resources to provide initial emergency action, typically they cannot provide a sustained effort during a large disaster event. Most local agencies do not have the resources to address major disaster events, and existing agreements may provide a means for sharing additional resources from surrounding areas. The federal government provides financial assistance through FEMA under a presidential declaration of disaster; however, other federal agencies such as the Corps may provide assistance or resources under existing authorities.

Table 7. Implementation Objectives, Targets, and Actions Associated with the Delta Levee Emergency Management and Response Plan

Implementation Objective	Target	Action
Enhance emergency response capabilities and resource allocation	Develop the capability to efficiently respond to multiple concurrent levee breaks within the Delta Limit interruption of services to six months or less	Implement a comprehensive reconstruction, repair, and maintenance program for Delta levees Review, clarify, and refine command and control protocol; develop an Integrated Response Plan in conformance with SEMS/ICS Define agency responsibilities to ensure environmental compliance Purchase materials in advance and place in strategic locations Execute pre-negotiated contracts with contractors for forces and equipment to respond with short notice Clarify program eligibility, inspection, documentation, dispute resolution, auditing, and reimbursement procedures
Develop a stable funding source for emergency response	Provide funding for a well-defined Disaster Assistance Program	Prepare cost estimates Identify beneficiaries to provide equitable distribution of costs Develop funding sources

Notes:

ICS = Incident Command System.
SEMS = Standardized Emergency Management System.

The existing emergency management structure is designed to coordinate activities of multiple state, federal, and local agencies with varying responsibilities to provide emergency assistance in the event of a disaster. The Standardized Emergency Management System (SEMS) provides a framework for coordinating state and local government emergency response in California, using the Incident Command System (ICS) and mutual aid agreements. SEMS facilitates setting priorities, cooperation among agencies, and the efficient flow of resources and information.

2.4.4 PROPOSED PROGRAM

CALFED plans to build on the existing emergency response system. CALFED's Emergency Response Subteam determined that an effective Delta levee emergency response program should be concentrated in seven areas:

CALFED plans to build on the existing emergency response system.

- Funding;
- Response by state and federal agencies;

Research and demonstration projects are being conducted to quantify the effects of subsidence and determine how to reduce its threat to Delta levees.

In the late 1980s, DWR's Division of Engineering embarked on a long-term seismic stability evaluation of Delta levees. Strong-motion accelerometers were installed at several sites in the Delta. Field and laboratory testing is being done to better determine the static and dynamic properties of organic soils and to better determine their liquefaction potential. The potential activity of the Coast Ranges/Sierra Nevada Boundary Zone is being evaluated. In 1992, DWR published a report titled, "Seismic Stability Evaluation of the Sacramento-San Joaquin Delta Levees, Volume I." DWR's seismic investigation is being continued. DWR continues to collect data from their seismic monitoring instruments, and continues field and laboratory testing. These data will be published in future reports.

In 1998, a Seismic Vulnerability Subteam performed a seismic risk assessment of Delta levees. The sub-team was comprised of a group of experts in the fields of seismology and geotechnical engineering. The assessment identifies the risk to Delta resources during ~~a~~ catastrophic seismic events and comments on the general feasibility of various actions to reduce exposure to the risk. ~~The assessment determined that a significant seismic risk is present; however, improved preparedness can reduce the potential damage.~~ The Seismic Vulnerability Subteam's ~~December 1998~~ report, "Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees," is included in Appendix G of this document.

~~The Seismic Vulnerability Subteam determined that a significant seismic risk is present; however, improved preparedness can reduce the potential damage.~~

2.5.3 PROPOSED RISK ASSESSMENT

CALFED staff will work with stakeholders, the public, and state and federal agencies to develop and implement a Delta Levee Risk Assessment and Risk Management Strategy <u>to be completed during Stage I as listed in the CALFED implementation plan.</u> CALFED will incorporate the findings from the Seismic Vulnerability Subteam's assessment into an overall risk assessment. Once the risk to Delta levees is quantified and the consequences evaluated, CALFED will develop and implement an appropriate risk management strategy.

CALFED staff will work with stakeholders, the public, and state and federal agencies to develop and implement a Delta Levee Risk Assessment and Risk Management Strategy.

Several risk management options have been developed for inclusion in the CALFED Preferred Program Alternative. The available risk management options include, but are not limited to:

- Improving emergency response capabilities,
- Reducing the fragility of the levees,
- Improving through-Delta conveyance,
- Constructing an isolated facility,
- Developing storage south of the Delta,
- Releasing more water stored north of the Delta,
- Restoring tidal wetlands,
- Controlling and reversing island subsidence,
- Curtailing Delta diversions, and
- Continuing to monitor and analyze total risk.

The final Risk Management Plan will include a combination of these options and others identified as a result of the risk assessment.

Table 8 lists implementation objectives, targets, and actions associated with the Delta Levee Risk Assessment and Risk Management Strategy Element.

11. Stakeholder/Science Review

Implementation of the Levee Program will require regular input from stakeholders, the technical community, and the public. A Levee Program Coordination Group would be formed at the beginning of Stage Implementation to coordinate technical and non-technical issues with between the CALFED Advisory Council and the CALFED Policy Group. The Group would also will coordinate levee actions with all other CALFED actions. The composition of the Group is illustrated in Table 14.

Implementation of the Levee Program will require regular input from stakeholders, the technical community, and the public.

Table 14. Composition and Roles of the Levee Program Coordination Group

CALFED Staff/Agency/Stakeholder	Role
Staff	
Levee Program	Chair meetings, coordinate: funding, permits, policy, project priorities, conflict resolution, and project performance; report to Policy Group
Ecosystem Restoration Program	Coordinate Ecosystem Restoration Program actions with levee and conveyance actions
Conveyance	Coordinate conveyance actions with Levee and Ecosystem Restoration Program actions
Comprehensive Monitoring, Assessment, and Research Program (CMARP)	Coordinate CMARP levee actions with other CMARP actions
Agency	
California Department of Fish and Game (DFG)	Coordinate DFG permits and levee maintenance agreements
U.S. Fish and Wildlife Service (USFWS)	Coordinate USFWS permits and levee maintenance agreements

H-001186

13. Suisun Marsh Levee System

CALFED has added the Suisun Marsh levee system to the Levee Program ~~as an optional strategy~~ to achieve ~~its~~ ecosystem quality, water supply reliability, and water quality objectives. Efforts to clarify linkages of these actions to the CALFED objectives are ongoing and will be completed during early Stage I as listed in the CALFED implementation plan.

Ensuring the integrity of the exterior levees in the Suisun Marsh is critical to sustaining seasonal wetland values provided by the marsh's managed wetlands. Improved levees would ensure that conversion to tidal wetlands will not be due to levee failure but instead will be planned with consideration of landowner support Ecosystem Restoration Program targets, regional wetland goals, endangered species recovery plans, and Delta water quality objectives.

13.1 INTRODUCTION

Continued management of the Suisun Marsh for waterfowl and recreational activities is threatened by periodic flooding and the problem of maintaining a proper salt balance.

The Suisun Marsh consists of approximately 57,000 acres of marshland and 27,000 acres of bays and waterways. Waterways include a network of tidal sloughs, principally tributaries of Suisun and Montezuma Sloughs, together with many drainage sloughs. Major streams carrying runoff from surrounding hills and floodplains include Green Valley, Suisun, Ledgewood, Laurel, McCoy, Union, and Denverton Creeks.

The Suisun Marsh is one of the few major marshes remaining in California and furnishes habitat for a variety of plants and animals. The Suisun Marsh serves as a principal waterfowl wintering area and also is highly valued for fishing and recreation. Despite reclamation improvements in the late 1800s and early 1900s, agricultural development in the Suisun Marsh has been largely unsuccessful due to poor drainage and salt accumulation in the soil. Limited cattle production and dry farming of grain crops occurs today where suitable soils exist. For the most part, however, the marshlands have been converted to private duck clubs and state wildlife management areas. Continued management of the Suisun Marsh for waterfowl and recreational activities is threatened by periodic flooding and the problem of maintaining a proper salt balance.

The Suisun Marsh is an area of regional and national importance, providing a broad array of benefits that include recreation use and fish and wildlife habitat. The Suisun Marsh's approximately 229 miles of exterior levees are an integral part of its landscape and are key to preserving the Suisun Marsh's physical characteristics and processes.

The focus of the Suisun Marsh component of the Levee Program is to provide long-term protection for multiple Suisun Marsh resources by maintaining and improving the integrity of the Suisun Marsh levee system. The Suisun Marsh component of the Levee Program focuses on the legally defined Suisun Marsh.

DELTA LEVEE EMERGENCY MANAGEMENT AND RESPONSE PLAN

September 23, 1999

INTRODUCTION

Important local, statewide and national resources depend upon maintenance of an effective levee system in the Sacramento-San Joaquin Delta (Delta). A strong, on-going preventive levee repair, reconstruction, and maintenance program will reduce levee vulnerability, reduce (or in some cases, prevent) future emergencies and ensure the availability of the heavy marine construction equipment needed for effective emergency response. Notwithstanding increased efforts to upgrade and maintain Delta levees, the threats to levee system integrity cannot be totally eliminated. Thus an emergency management and response plan is required to protect Delta resources.

SCOPE

This report is intended to outline a major component of the CALFED Levee Program's Long-Term Levee Protection Plan and thereby supplement and suggest needed improvements in state and federal emergency response plans, while remaining consistent with their basic mandates and overall structure. It is focused on levee integrity. There are other types of emergency conditions, such as hazardous material spills, which could occur in Delta waterways and which, while not threatening levee integrity, could endanger water quality to the detriment of public water supplies and biological programs in which CALFED will have made substantial public investments. While such potential emergencies are recognized, they are presently excluded from the scope of this document. Similarly, the more widely recognized emergency response activities such as rescue, emergency medical services and evacuation are not addressed here.

BACKGROUND

The Delta is an area of farmland, waterways and communities. It includes approximately 740,000 acres and is roughly located between the cities of Sacramento, Stockton, Tracy and Antioch. There are about 700 miles of interlaced channels, rivers and sloughs that convey flood waters from the entire Central Valley to the ocean. Over 60 islands and tracts are protected by a network of approximately 1,100 miles of Local Flood Control Non-project Levees and Federal Flood Control Project Levees as shown in the California Department of Water Resources (DWR) Delta Atlas on pages 38 and 40. The Delta provides habitat for fish and wildlife, accommodates shipping, protects population centers and infrastructure including railroads, highways, and pipelines, provides for agriculture and a vast array of recreational activities, and conveys water to over 20 million Californians.

Most of the land in the central and western Delta is below sea level and rapid response to levee threats is unusually critical. A levee failure can endanger public safety, inundate thousands of acres of farmland and habitat, degrade in-Delta and export water quality, and disrupt the operations of the major State and Federal water delivery systems. Of course, multiple levee failures would substantially increase the scale of the emergency and the challenge of prompt response.

Delta levee integrity can be threatened several ways. Levee failure can occur from instability, overtopping and seepage. High water stages in the Delta can occur due to floods, unusually high tides, and atmospheric conditions involving high wind and low pressure. Levee performance during a seismic event is also a concern. Since original reclamation, each of the Delta islands or tracts has flooded at least once. With improved funding for preventive actions since 1986, disaster assistance spending has been reduced substantially.

FUTURE CONDITIONS

Implementation of CALFED's Levee System Integrity Program will not eliminate all threats to the levee system. Threatening circumstances, emergencies, and flooding should be anticipated. Embankments can be more vulnerable to failure during, or immediately after, construction. Thus, levee upgrades involving major earthwork may temporarily reduce levee stability. Commonly, combinations of high tributary flows, strong winds, high tides and low barometric pressure generate flood stage conditions in the Delta. Continued development and construction of upstream flood control features may increase flood water stages in the Delta. Rise in sea level, channel dredging, and subsidence near the levees may increase seepage through levees and their foundations and reduce levee integrity. Conversion of land near levees to habitat and other land use practices may increase problems related to burrowing animals, may reduce the probability that levee inspection will detect levee defects before the problem becomes a threat, and may hinder emergency flood fight efforts. Lastly, the seismic threat to Delta levees remains a major concern.

GOALS

The goal of the Delta Levee Emergency Management and Response Plan is to enhance existing emergency response programs and capabilities in order to protect the Public or restore critical Delta resources in the event of a levee emergency. A levee emergency is a condition of extreme peril to the safety of persons or property as a result of a threat of levee failure and island inundation. There are three critical components to emergency response.

1. Preparation The ability to respond effectively to a threat, emergency or actual levee failure depends heavily on advanced preparation. All agencies and people involved need to understand their respective roles and responsibilities. There must be emergency planning at all levels of responsibility, clear understanding, scripted procedures for the recognition and declaration of emergency conditions, and an established and rehearsed command and control system. Local, county, State, and federal responses must be better coordinated to enhance decision-making, communication and action protocols. Regulatory and environmental compliance must be incorporated into all response planning. Critical response resources must be immediately available at all levels. Resources include funding, equipment, materiel stockpiles, and appropriately trained personnel.

2. Quick and Effective Emergency Response Time is of the essence in response to any incident or threatening circumstance. An imminent threat of levee failure or a failure

requires immediate action that can only be the result of a thoroughly prepared and rehearsed emergency response plan with an identified funding base that ensures immediate, simultaneous, and integrated response by all levels of government. If failure can be prevented or addressed quickly, total losses and expenditures can be dramatically reduced and lives saved.

3. Completion of Post-Emergency Repairs In the event of an emergency, including breach closures, a smooth and quick transition to post emergency recovery work is needed to complete repairs and prepare for continued or new threats. Oftentimes one incident quickly follows another. It is important to facilitate resumption of normal economic activities, restore environmental resources damaged by the incident, prepare for subsequent emergency response, and expedite post-emergency repair efforts.

ANALYSIS OF THE CURRENT EMERGENCY RESPONSE PROGRAM

Significant improvements have been made to the existing emergency response system over the past several years. However, continuous improvements in the system must be made to reduce the risk to resources protected by Delta levees. Improving our emergency response capability is a very cost-effective method of reducing risk and preventing the huge losses, economic disruption, and human suffering resulting from levee failures.

Fluctuations in funding and the environmental regulations applicable to ongoing levee reconstruction, maintenance and repair work have impacted the capability of local, state and federal agencies to respond to imminent threats of levee failure in several ways.

The "work windows" established under biological opinions on endangered species (Chinook Salmon, Delta Smelt, and Swainsons Hawk) are especially important. These windows, combined with other environmental permitting practices, have severely constrained opportunities to perform the work in the Delta waterways, which is essential to proper levee reconstruction, repair and maintenance.

Without sufficient work opportunities, the specialized levee building equipment (especially side draft dredges, barge cranes and rock barges) and personnel experienced in operating conditions in the Delta have almost disappeared. These types of equipment and experienced operators are necessary during levee emergencies in those locations and under conditions where work often cannot be performed from the land.

Levee funding resources have been severely impacted by inconsistent and inadequate program funding. Local financial resources have been impacted by bank audit procedures which have reduced the availability of credit to local reclamation districts and by lengthy delays in reimbursement from state and federal disaster assistance programs because of often-unclear inspection, documentation, and audit procedures.

Some levee maintaining agencies do not generate the revenues needed to provide adequate maintenance and emergency response. The role of counties and cities in directly supporting floodfight operations by levee maintaining agencies has not been clearly defined in the past

H-001190

although these organizations can obviously provide rapid and important logistical support to these types of activities.

In some instances, direct State and federal emergency floodfight assistance has been delayed by the required showing that local resources have been exhausted and the lack of an operational plan providing the basis for an immediate, integrated, simultaneous response by all levels of government.

Although historically there has been confusion over the procedures for declaration of a state of emergency and the respective roles of the various local, State and federal interests, these areas have shown considerable improvement as a result of experience gained in the 1997 and 1998 flood emergencies. Three documents were completed in compliance with the Flood Emergency Action Team (FEAT) recommendations and have enhanced emergency operations: 1) Guidelines for Coordinating Flood Emergency Operations, 2) Flood Preparedness Guide for Levee Maintaining Agencies, and 3) Protocol for Closure of Delta Waterways. These guidelines have clarified the responsibilities of local agencies that maintain levees and flood control structures.

By law, State agencies must use the Standardized Emergency Management System (SEMS) when responding to emergencies involving multiple jurisdictions or multiple agencies. The basic framework of SEMS and the Incident Command System (ICS) incorporates multi-agency or inter-agency coordination, the State's master mutual aid agreement and mutual aid program, the operational area concept, and the Operational Area Satellite Information System (OASIS). SEMS has also enhanced the emergency response capability of local and State agencies.

The California Department of Water Resources approved Water Resources Engineering Memorandum No. 63 on January 29, 1999, which establishes the Department's policy and procedures for responding to emergency levee-endangering incidents in the Sacramento-San Joaquin Delta. Similar advance work is necessary relative to potential earthquake emergencies and in the regulatory arena to pre-define environmental regulations applicable to levee emergencies and recovery activities.

Although California Water Code Section 128 gives authority to the Department of Water Resources to flood fight during emergencies, it does not provide funds to support flood fighting. Consequently, the DWR response has generally been limited to technical assistance and coordination of work with the California Conservation Corps, and California Department of Forestry and Fire Protection for crews for placement of sandbags, plastic and other hand-labor-related work. On the other hand, the AB360 Program (Section 12994 of the California Water Code) has been a vehicle for providing funds for emergency response within the context of an emergency plan. These limited funds have historically been primarily used to reimburse local agency expenditures, to establish stockpiles of resources for use by levee maintaining agencies and to provide technical advice.

PROPOSED PROGRAM

CALFED's contribution to an effective Delta levee emergency response program should be concentrated in seven areas:

1. Funding for Ongoing Repair, Reconstruction and Maintenance The vulnerability of the levee system can be reduced by implementing an integrated and comprehensive reconstruction, repair and maintenance program for Delta levees and channels, as described and recommended under the Levee System Integrity Program. This can only be accomplished by supplementing local funding capability through State and federal cost-sharing at adequate and consistent levels, and by opening up existing "work windows" and environmental permitting so that a viable Delta levee building industry can be reestablished. From a levee emergency response viewpoint, the significant (even crucial) incidental benefit of a well-funded, on-going Delta levee program is to establish a continuous local presence of specialized equipment. Marine-based equipment required to perform levee rehabilitation on some central and western Delta islands will likely be more accessible during emergencies if there is sufficient ongoing work to maintain local operations.

2. Emergency Response (and Associated Funding) by State and Federal Agencies In accordance with the "Guidelines for Coordinating Flood Emergency Operations," if a flood fight exceeds the capability of the local levee-maintaining agency or if communities are threatened, the responsible city or county will assist with the flood fight with support from all other SEMS levels. Under SEMS, requests for flood fight assistance from the local LMA's are made to the county Operational Area's Emergency Operations Center, and, if necessary, are escalated to State OES' Regional Emergency Operations Center in Sacramento. The REOC will coordinate information and resources among OA' s and provide a liaison to federal agencies.

Lack of specific funding sources and obstacles within federal public assistance reimbursement rules have hindered direct involvement in flood fight activities by counties, cities, and State agencies. Creation of funding to support a delta levee emergency response plan would eliminate past hesitation and inefficiencies.

a. Federal Assistance The U. S. Army Corps of Engineers has primary federal authority for assisting states with flood fight efforts that meet the criteria established by Public Law 84-99. Under a Memorandum of Understanding with the Corps, DWR serves as the facilitator for all PL 84-99 flood-fighting efforts. DWR coordinates with the local agency, initiates the PL 84-99 request process, and assists the Corps in determining the applicability of PL 84-99.

Prior to making requests to the Corps, DWR reviews requests and information from the OA on the capability of the local agency. DWR ensures that local and State resources require supplementation and that an emergency situation exists. Once these determinations are made, DWR requests Corps assistance. DWR can also provide technical advice and assistance to local agencies concerning flood fighting and emergency flood control measures.

Every effort is made to expedite the Corps-DWR coordination on PL 84-99 requests consistent with the urgency of the situation. There have been some instances where the response was delayed, with a strong perception by local LMA's that the PL 84-99 decision process is hindered by a need to demonstrate that local and State resources "have been exhausted."

When the Corps does respond under the PL 84-99 emergency flood fight provisions, its efforts are 100 percent federally funded. Under the rehabilitation phase of PL 84-99, the Corps of Engineers repairs the flood-related damage to "federal project levees" and eligible non-project levees. The only non-federal costs are for lands, easements and rights-of-way, and local obligations to hold the government harmless and to operate and maintain the project, and to provide borrow material for repairs.

The role of the Corps should be clarified and confirmed through their participation in the preparation of and commitments to a delta levee emergency response plan so as to eliminate delay in response and avoid any dispute as to whether or not the local and State response is sufficient. This emergency response plan needs to address levee emergencies other than normal rain floods (e. g., earthquakes), and the Corps' role in any such emergencies. Special circumstances, such as multiple breaches within a short time frame, should be identified with criteria established for expedited response.

b. State Assistance For flood control projects sponsored by the Reclamation Board, DWR technical assistance may be requested directly. Existing State funding limits DWR's response to only providing technical assistance. The DWR financial capability to respond to flood emergencies in the Delta should be expanded to include all aspects of a flood fight where levees or other flood control structures are in danger of failure, regardless of whether or not the danger is due to storms, floods, earthquakes, rodents, vessel impacts or any other cause. The funding for support of DWR's efforts, either through expansion of existing programs or through creation of a new program should be ample and clearly committed for comprehensive emergency response[1].

Bond authorization might be particularly helpful to ensure the availability of State funds when needed. For example, authorization of $60 million in bonds to create and replenish a $10 million revolving fund specifically for financing implementation of a delta emergency response plan, as defined in California Water Code Section 12994(b)(2), would provide the assurance that pre-identified response commitments by DWR and other agencies would be funded, should help ensure that the local share requirement of federal disaster assistance programs will be available, and would provide the basis for seeking elimination of obstacles within federal reimbursement policies that hinder multi-jurisdictional flood fight responses.

3. Ensuring Availability of Levee Emergency Resources

---

[1] The $200,000 currently provided to DWR under the Delta Levee Subventions Program (Water Code § 12994) is not only inadequate, but will expire under the terms of its authorizing legislation.

a. Specialized equipment and operators: A revitalized levee rehabilitation industry under the Levee System Integrity Program will establish a fleet of specialized equipment essential to a rapid emergency response[2], but will not ensure its availability during emergencies which often extend to other areas. The Emergency Response Plan established under Assembly Bill 360 should establish pre-emergency contracting for specialized equipment to secure the availability of the equipment and experienced operators, and establish pricing for emergency services.

b. Materiel stockpiles: The State Department of Water Resources has established stockpiles for flood fight materiel (sandbags, plastic, stakes, light equipment, pumps, etc.) at locations in the northern, southern, and western Delta. This program needs to be expanded to include rock and sand stockpiles, and to key locations in the central and south Delta regions. Additionally, assurance of supply and/or stockpiling of drain rock and riprap should be included. Coordination between the stockpiling activities of other agencies would be desirable. Transportation of the materials to where they are most needed also needs to be addressed.

c. Labor: The Emergency Response Plan established under AB 360 should consider formal arrangements with the California Department of Forestry and Fire Protection as well as with the California Conservation Corps and with the State prison system for emergency assistance.

4. Integrated Response A detailed response plan should be developed for the Delta that would allow an immediate, simultaneous response to a serious incident (such as a major flood or an earthquake) by all levels of government within a single integrated organizational structure. The plan would identify common needs and functions of all agencies, e.g., housing, feeding, transportation, supplies (including rock and sand), equipment and contracted services and assign the most capable agency/jurisdiction to perform each on behalf of all agencies. The detailed floodfight/earthquake response plans for specific LMAs or areas of the Delta would provide the basis for pre-identifying and assigning specific responsibilities for each agency as well as the level of resources which the individual LMA would be expected to provide in response to the emergency. With detailed assignment of responsibilities, an organizational structure for the "area command" could be delineated so as to assure coordination with the "incident commands." The detailed

---

2

Ideally, the resident population of specialized equipment needs to be sufficient to operate in several locations at once, whether because of high flood stages threatening many sites, or because of a strong earthquake damaging several sites. A Delta-based dredging company estimates that it takes at least a $5 million annual levee program expenditure level to generate enough dredger work to justify operating one dredge, with a work window of 3 to 4 months. One barge crane/rock barge unit would be justified in a program of that size with a ten-month work window. By extrapolation, we might expect a $30 million annual program to support approximately 5 dredgers and 5 barge crane/rock barge units in the Delta given appropriate work windows.

response plan would serve as the basis for requesting modification to disaster assistance programs, including any needed legislation. The FEAT-produced documents, discussed earlier, may partially serve this purpose.

5. Clarifying Regulatory Procedures Although both State and federal laws suspend environmental regulation during emergencies, some clarifications are desirable.

a. The definitions of emergency for response and regulatory activities need to be consistent. It is especially important that the defined duration of the emergency be consistent for both purposes.

b. Mitigation measures which will be expected during post-emergency recovery work should be defined by a series of examples in order that emergency work will not unnecessarily exacerbate mitigation responsibilities, so that post-emergency recovery work will not be unnecessarily delayed, and so appropriate mitigation can be rapidly defined and implemented.

6. Clarifying Program Eligibility, Inspection, Documentation, Auditing, and Reimbursement Procedures In virtually all of the declared levee emergencies in the last twenty-five years there have been lengthy reimbursement delays, or outright denials which have adversely affected the financial condition and trade-credit and bank-credit opportunities of the local flood control agencies. The requirements of these programs need to be standardized to be consistent with one another, be well and timely communicated to the local agencies, and not be changed or re-interpreted during the completion of the reimbursement process. In addition, legal jurisdiction as a criterion for cost reimbursement needs to be clarified to eliminate obstacles to integrated, multi-jurisdictional emergency response.

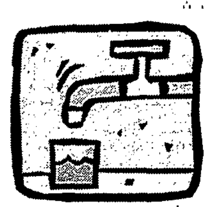
7. Dispute Resolution Because events move swiftly during emergency response, there should be a timely dispute resolution process. Currently, the "exhaustion of administrative remedies" followed by court system recourse is truly exhausting both in terms of energy and money. Reimbursement disputes have consumed more than fifteen years in many cases, with local resources being used, which should be going into levee work. A binding arbitration procedure conducted by knowledgeable but impartial arbiters should be established encompassing both the State and federal programs.

WATER QUALITY PROGRAM PLAN

March 2000

5.3 Water Quality

The CALFED Bay-Delta Program is expected to produce continuous overall improvements over the term of the Program to ensure that good-quality water is provided to serve all beneficial uses dependent on the water resources of the Bay-Delta system and its tributary watersheds.



5.3 Water Quality

5.3.1 SUMMARY

The Delta and its tributaries are key surface water sources of drinking water for the majority of Californians. These water resources also replenish reservoirs and groundwater basins that are relied on to maintain the continuity of water supplies throughout most of the state. The continued availability of good-quality water supplies from these sources is crucial to the maintenance of agriculture and other important water-dependent industries. The Sacramento-San Joaquin Delta and Bay (Bay-Delta) is the ecological hub of the Central Valley, and provides critical habitat for diverse fish and wildlife populations. Although individual criteria for beneficial uses vary, these beneficial uses require sustainable high-quality water for their maintenance and improvement. To be utilized effectively, source water supplies for municipal and industrial uses should be free of potentially harmful concentrations of contaminants that are infeasible, or unreasonably expensive, to remove. Population growth and future industrial development may increase waste loads to the Bay-Delta, which in turn would increase the burden on water resources, infrastructure, and drinking water treatment capabilities. Improved and increased measures will be needed to prevent or to reverse the potentially adverse effects of increased waste loads. Left unchecked, these pressures would lead to serious water quality degradation— potentially resulting in losses of agricultural, industrial, and biological productivity; increases in water treatment costs and associated secondary impacts; and increased risks to public health and welfare.

Preferred Program Alternative. The Water Quality and Watershed Programs would improve overall water quality by reducing the loadings of many constituents of concern that enter Delta tributaries from point and nonpoint sources. Actions under these program elements would reduce adverse concentrations of key contaminants contained in receiving waters, especially the Bay-Delta system. Principal targeted constituents include heavy metals, pesticide residues, salts, selenium, pathogens, suspended sediments, adverse temperatures, and disinfection byproduct precursors (DBPs) such as bromide and total organic carbon (TOC). Conversion of Delta islands from agriculture to wetlands could increase TOC loadings to the Delta channels, potentially contributing to the formation of ~~DPBs~~ DBPs in water treatment processes.

> The Water Quality and Watershed Programs would improve overall water quality by reducing the loadings of many constituents of concern that enter Delta tributaries from point and nonpoint sources.

The Water Use Efficiency Program could result in beneficial and adverse effects, depending on conditions. For example, program actions such as conservation would reduce diversions from channels and reduce loads of contaminants returned to the channels, resulting in general water quality benefits. However, some actions could result in increased releases of contaminants and produce localized increases in concentrations that in most cases would be limited to the mixing zone around the discharge. The Water Use Efficiency Program is focusing on achieving multiple benefits related to water quantity, quality, and timing; therefore, the adverse impacts from this program are expected to be minimal.

Improvements to the Delta levee system under the Levee System Integrity Program would greatly reduce the risk of rapid sea-water intrusion contaminating the Delta and disrupting water supplies following major levee failures, particularly seismically induced failures. All program actions (particularly channel dredging and construction of new levees and setback levees) could produce short-term adverse impacts during construction activities. Dredging may expose mercury-laden sediments, which could contribute to increased mercury availability to aquatic organisms and increased mercury concentrations in sediment; dredging also may mobilize other toxic elements. However, potentially significant impacts can be mitigated to less-than-significant levels.

Based on ranges of results obtained from model runs, the Preferred Program Alternative generally would improve in-Delta and export water quality, and dependent beneficial uses because of increased inflows of higher quality water from Sacramento River and the north Delta, and improved circulation in Delta channels. Electrical conductivity (EC, an index of salinity) would be reduced in the northeast Delta, central Delta, south Delta, and southwest Delta, and on the San Joaquin River in the west Delta. These improvements generally would occur from November through March of average, dry, and critical years, and in September of dry and critical years. Similar improvements in EC would occur at the CVP and SWP intakes, and at both of the Contra Costa Water District (CCWD) diversions from Old River. EC would increase at some times in the Lower Sacramento River.

The Preferred Program Alternative should result in increased cross-Delta flows, improved circulation, and resultant increases in dispersion and dilution of ocean salt. Given that sea-water intrusion is the major source of bromide in the Delta, bromide concentrations should decrease along Old and Middle Rivers, which would benefit the primary diversion and export facilities. This would depend on Delta Cross Channel (DCC) gate operation in coordination with the Hood to Mokelumne River channel operations.

Additional upstream storage would increase flexibility to provide additional fresh-water releases and Delta inflows that will improve water quality.

Although the effects of additional upstream storage may differ depending on its location and operations, additional upstream storage generally would increase the flexibility to provide for additional fresh-water releases and Delta inflows that will improve Delta water quality. These benefits would be most apparent in dry months and seasons when additional water would be needed to meet consumptive and environmental demands. Upstream storage releases also could benefit export water quality during dry years. Additional off-aqueduct south-of-Delta storage could relieve export pressures in the south Delta, thereby avoiding some of the potential for pumping-induced water quality degradation. Storage- and nonstorage-dependent operational changes being considered by the Program could significantly extend or magnify the ranges of water quality effects of the Preferred Program Alternative, depending on existing and antecedent hydrologic conditions. Releases from storage also could augment Delta outflows when needed to control sea-water intrusion and optimize estuarine conditions for the ecosystem and dependent fish species (as indicated by the position of the X2 [isohaline] index compared to standards). X2 refers to the mean tidal distance of the 2,000 milligrams per liter (mg/L) isohaline (a line of equal salinity) upstream from the Golden Gate Bridge. (Note that although this standard is based on temporal variations in salinity, it is used to regulate flow; therefore the topic is covered in Section 5.2, "Bay-Delta Hydrodynamics and Riverine Hydraulics".

Construction of Delta facilities could result in potentially significant impacts on water quality that are associated with earth moving and dredging. Impacts would consist primarily of increased sediment loads caused by erosion and sediment disturbance. Releases of nutrients, natural organic matter, and toxicants into the water column could increase to various degrees, depending on the types of construction methods, materials, and mitigation strategies used.

Disturbances to previously farmed soils could release residual agricultural pesticides, including organochlorinated pesticides, mercury, nutrients, and other chemicals that may adversely affect water quality. Most of these impacts would be relatively short term in duration. In general, potentially significant impacts that are associated with construction of Delta facilities can be mitigated to less-than-significant levels.

Alternatives 1, 2, and 3. Under Alternatives 1, 2, and 3, the water quality impacts of Program elements other than Conveyance would be similar to those described for the Preferred Program Alternative. In terms of the impacts of Conveyance on in-Delta and export water quality, Alternative 1 would cause water quality conditions in the Delta and export service areas to worsen. Alternative 2 generally would improve water quality compared to the No Action Alternative in the central Delta and at the export facilities. Alternative 3, compared to the No Action Alternative, would result in significant decreases in average salinities and bromides in the south Delta, along Old River, and at the two CCWD intakes, during all or most months of most years. Alternative 3 also would result in greatly improved export water quality at Clifton Court Forebay (CCFB) (and at the Delta-Mendota Canal [DMC] intake if an intertie is constructed), and in the SWP and CVP service areas to the south and west—particularly for the following parameters: EC, total dissolved solids (TDS), bromide, chloride, and dissolved organic carbon (DOC). Salinities are projected to increase compared to the No Action Alternative in the northeast Delta, the central Delta, and in the south Delta along Middle River.

Under Alternatives 1, 2, and 3, the water quality impacts of Program elements other than Conveyance would be similar to those described for the Preferred Program Alternative.

The following table presents the potentially significant adverse impacts associated with the Preferred Program Alternative. Mitigation strategies that correlate to each listed impact are noted in parentheses after the impact.

Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative

Potentially Significant Adverse Impacts

~~Potential~~ Releases of inorganic and organic suspended solids into the water column and turbidity resulting from increased erosion during construction, dredging, or drainage of flooded lands (7,8,9).

~~Potential~~ Releases of toxic substances, such as pesticide, selenium, and heavy metal residues, into the water column during construction and dredging (7,8,9,14,15).

~~Potential~~ Net increases in salinity, if evaporation increases from in-Delta storage or converting ~~after~~ irrigated croplands ~~are converted~~ to wetlands (2,3,13).

~~Although the Preferred Program Alternative would improve water quality at many locations in the Delta, it would cause water quality to deteriorate in local areas. Increased total dissolved solids (TDS) content of water in certain Delta channels would result in a potentially significant unavoidable impact on the local suitability of the water as a source for agricultural irrigation.~~

~~The Preferred Program Alternative would allow an increase in the total amount of water that could be diverted from the south Delta, with a concomitant reduction in the total volume of fresh water outflow from the Delta to San Francisco Bay. Consequently, the average salinity of Bay waters could increase very slightly, and South Bay flushing could be slightly reduced during high outflow periods.~~

~~Potential growth induced by the Preferred Program Alternative would result in an increase in discharge of point and nonpoint source pollutants to water bodies, with a consequent adverse effect on in-stream water quality. Nonpoint sources largely are unregulated, and mitigation depends on local voluntary efforts. The potentially significant impacts related to the increased discharge of nonpoint source pollutants from growth induced by the Preferred Program Alternative are likely to be unavoidable.~~

At this programmatic level, it is unknown where any increases in population growth or construction of additional housing would take place, or what level of growth might be associated with improved water supply reliability. When and if they occur, these changes will be subject to local land use decisions by individual cities and counties. Point and non-point source pollution associated with urban growth is experiencing increasing regulation to minimize impacts on surface water. While the location and magnitude of growth induced impacts are not definable, mitigation methods through regulation already exist. Additionally, the CALFED program proposes to reduce other existing non-point source pollution that is not currently regulated, thus reducing overall impacts of non-point source pollution.

~~Potential~~ Increases of TOC in river water caused by the increased contact between flowing or ponded water and vegetation or peat soils that would result from conversion of agricultural lands to wetlands and from actions in other program elements. (4,5,10,11,12).

Increased water temperatures and resultant decreased dissolved oxygen concentrations due to the increased residence time of water in channels that are widened or restored to meandering patterns (2,3,13).

~~Potential~~ Decreases in in-stream water quality if water use efficiency measures or water transfers reduce diluting flows (1,2,3).

~~Potential~~ Increases in concentrations of constituents of concern if water transfers reduce in-stream flows and deplete river assimilative capacities (1,2,3,6).

Mitigation Strategies

1. Improving treatment levels provided at municipal wastewater treatment plants to upgrade the quality of the constituents of concern ~~(other than dissolved inorganic solids)~~ discharged to receiving waters in order to compensate for the reduction in dilution caused by improved water use efficiency or water transfers. Salt concentrations in discharges could be reduced by improved salt management of wastewater inputs to treatment plants.

2. Releasing additional water from enlarged or additional off-stream surface storage, or from additional groundwater storage.

3. Releasing additional water from storage in existing reservoirs or groundwater basins.

4. ~~Improving water treatment facilities, either at the point of consumption or at the source, to remove TOC.~~ Treating water at the source

H—001201

H-001201

(such as Delta drains), upgrading water treatment processes at drinking water treatment plants and/or providing treatment at the point of use (consumer's tap).

5. Using innovative, cost-effective disinfection processes (for example, ~~ultra-filtration,~~ UV irradiation, and ozonation— in combination with other agents) that form fewer or less harmful DBPs.

6. Using existing river channels for water transfers and timing the transfers to avoid adverse water quality impacts.

7. Using best construction and drainage management practices to avoid transport of soils and sediments into waterways.

8. Using cofferdams to construct levees and channel modifications in isolation from existing waterways.

9. Using sediment curtains to contain turbidity plumes during dredging.

Potentially Significant Adverse Impacts and Mitigation Strategies Associated with the Preferred Program Alternative (Continued)

10. Separating water supply intakes from discharges of agricultural and urban runoff.

11. Applying agricultural and urban BMPs, and treating drainage from lands with concentrations of potentially harmful constituents to reduce contaminants. Treating drainage from agricultural lands underlain by peat soils to remove TOC.

12. Relocating diversion intakes to locations with better source water quality.

13. Restoring additional riparian vegetation to increase shading of channels.

14. Core sampling and analysis of proposed dredge areas and engineering solutions to avoid or prevent environmental exposure of toxic substances after dredging.

15. Capping exposed toxic sediments with clean clay/silt and protective gravel.

~~Bold indicates a~~ No potentially significant unavoidable impacts related to water quality are associated with the Preferred Program Alternative.

5.3.2 AREAS OF CONTROVERSY

Under CEQA, areas of controversy involve factors that are currently unknown or reflect differing opinions among technical experts. Unknown information includes data that are not available and cannot readily be obtained. The opinions of technical experts can differ, depending on which assumptions or methodology they use. Below is a brief description of the areas of controversy for this resource category. Given the programmatic nature of this document, many of these areas of controversy cannot be fully addressed; however, subsequent project-specific environmental analysis will evaluate these topics in more detail.

Water Quality Program actions are aimed at controlling organic carbon, a precursor to DBPs.

Total Organic Carbon Drinking Water Concerns. Water Quality Program actions are aimed at controlling organic carbon, a precursor to DBPs. Treatment of Delta island drainage is being studied as a potential means of reducing organic carbon loading. Source control may offer more cost-effective means than downstream treatment to meet regulatory requirements. There is inadequate knowledge of baseline conditions of TOC at key Delta locations and tributaries, including the intake to North Bay Aqueduct. There is also inadequate understanding of TOC loads in the system and of the extent to which CALFED actions will reduce or increase TOC at drinking water diversion points. Controversy exists concerning the contribution of natural or developed wetlands to TOC concentrations found in Delta waters at drinking water intakes. The proposed restoration of wetlands through the Ecosystem Restoration Program may increase the total amount of TOC and DOC at drinking water intakes, increasing the potential to form DBPs. This controversy is likely to exist until further studies determine the extent that restored wetlands may influence Delta drinking water quality and what levels of DBPs are considered safe. It is expected that the Preferred Program Alternative would have a net beneficial effect on DOC concentrations at the export pumps in the South Delta but it may not improve water qulaity sufficiently to avoid treatment to remove DOC.

Pathogens. The drinking water objective of the Water Quality Program is to sufficiently improve source water quality to allow production of drinking water that is safe, meets anticipated regulatory standards, and is acceptable to the consumers. Of primary importance is the reduction and maintenance of pathogen loadings in source waters to required levels. Pathogen levels in Delta waters are largely unknown at this time. ~~Based on limited data, levels for pathogens in routine sampling of Delta water appear to be lower than the national averages. However, the limited data, along with significant technical limitations in measuring techniques, do not enable a reliable impact analysis to be performed at this time.~~ Utilities using Delta water sources primarily disinfect with chlorine, which is effective for total coliform, viruses, and *Giardia lamblia*, at reasonably feasible concentrations and contact times. However, chlorine ~~chorine~~ is not able to inactivate some microorganisms, such as *Cryptosporidium parvum*, which may be present in source waters and may be regulated in the near future. An increasing number of utilities are using ozone or a combination of disinfectants that more effectively inactivates most pathogenic microorganisms, including *Cryptosporidium parvum*. Utilities are anticipating stricter requirements from the EPA for the control of pathogenic microorganisms. Since the Delta is a relatively unprotected and unknown source of pathogens, and treatment technology continues to be advanced, controversy exists on whether taking water from the Delta constitutes adequate source water protection.

~~Based on limited data, levels for pathogens in routine sampling of Delta water appear to be lower than the national averages.~~ Pathogen levels in Delta waters are largely unknown at this time.

Bromide. The Revised Phase II Report Appendix identifies bromide as a critical constituent concerning selection of the Preferred Program Alternative. Bromide is critical because the selection of storage and conveyance options can profoundly affect bromide concentrations in municipal water supplies diverted from the Delta. It is believed that the primary source of bromide in Delta waters is sea-water intrusion. Other possible sources of bromide have been hypothesized, as follows:

Bromide is critical because the selection of storage and conveyance options can profoundly affect bromide concentrations in municipal water supplies diverted from the Delta.

- Bromide loading in the San Joaquin River from agricultural application of the fumigant, methyl bromide.
- Bromide leached from the geological strata in the watershed of the San Luis Reservoir.
- Connate groundwater sources (sources of ancient sea-water origin) of bromide in or around Empire Tract in the Delta.

The limited available data suggest that none of these sources is a highly significant source of bromide when compared to sea water.

Although the following issue does not meet the CEQA criteria as an area of controversy, the subject is one of concern to CALFED agencies.

Good Samaritan Protection. Water Quality Program actions include remedial activities to clean up abandoned mine sites in order to reduce metals that enter water bodies. A step-wide approach would be conducted, leading to implementation of what are expected to be the cost effective remediation strategies. An agency or entity performing a clean-up of an abandoned mine, however, may be subject to liability for its efforts. A major concern, for example, is liability under the Clean Water Act. Some CALFED implementing agen-cies are unlikely to undertake abandoned mine remediation due to the risk of liability under the present law. Some people recommend that federal law provides additional "Good Samaritan" protections to reduce the liability risk and thus encourage mine remediation. Others object to such provisions, arguing that current law better balances the goals of encouraging clean-ups and avoiding unwarranted litigation with other goals, such as providing incentives to ensure that clean-ups are completed with proper care and providing citizens with appropriate relief if they are harmed.

Water Quality Program actions include remedial activities to clean up abandoned mine sites in order to reduce metals that enter water bodies.

Drinking Water Regulations The future of drinking water regulations and the ability of water purveyors to meet them by increasing treatment is a matter of controversy. It is difficult to predict what substances will be regulated in the future and their likely acceptable maximum contaminant levels in drinking water. Some believe that whatever the regulations are, treatment systems can be designed and built to remove them. Others believe that treatment may be technically infeasible, too costly, and not justified by the resulting benefits to public health.

5.3.3 AFFECTED ENVIRONMENT / EXISTING CONDITIONS

5.3.3.1 DELTA REGION

Activities and Sources That Affect Water Quality in the Delta

Hydraulic and hard-rock mining for gold in the late 1800s produced the first significant impacts on water quality in the Delta. Mercury, mined in the Coast Ranges, was used to separate gold in the Sierra Foothills. Hydraulic mining created large amounts of sediment that contained high levels of heavy metals (cadmium, copper, zinc, and mercury). This sediment was washed from the hillsides, carried downstream, and deposited in river beds, Delta tidal marshes, and mudflats. These metals still are considered contaminants of concern because of their continuing potential to adversely affect beneficial uses in the Delta. Sampling in the Sacramento River from 1987 to 1992 indicates that about 75% of the mass of these metals found in sediments can be traced to past mining activities.

Hydraulic mining created large amounts of sediment containing high levels of heavy metals (cadmium, copper, zinc, and mercury).

The growth of agriculture, enabled by the diversion of irrigation water from the rivers and Delta during this century, also has led to water quality concerns. The application of fertilizers and pesticides on 500,000 acres of farmland in the Delta and another 4.5 million acres in the San Joaquin and Sacramento Valleys has adversely affected the beneficial uses of water for drinking, fishery resources, recreation, and agricultural uses.

Water quality in the San Joaquin River and the south Delta has been affected by salts and natural deposits of selenium-rich soils. Salts and selenium that are concentrated in shallow groundwater on the west side of the San Joaquin Valley are mobilized when subsurface water must be

Salts and selenium are mobilized when subsurface water must be pumped to drain agricultural lands.

pumped to drain agricultural lands. The San Joaquin Valley Drainage Program (1990) includes plans to curtail discharges of drain water to the river, reduce the amount of applied irrigation, and retire some irrigated lands.

Compared to historical conditions, Delta salinity during low-flow periods is much lower since the construction of dams, which allow storage and fresh-water releases during dry and critical periods. Sea-water intrusion into the Delta can be intensified by diversion of fresh water and the corresponding decrease of fresh-water outflow from the Delta. As a result, the west Delta often experiences increased salinity during summer and fall, although to a substantially lessened extent since construction of the upstream dams. High salinity adversely affects the quality of drinking and irrigation water.

More recently, urban development and population growth in and around the Delta have contributed to adverse impacts on water quality, and simultaneously have increased demand for better water quality. ~~Disinfection to treat water for domestic consumption may produce DBPs,~~ When Delta water is disinfected for household consumption, unwanted byproducts are formed, some of which are suspected to be carcinogenic in humans.

Water quality in the Delta also is affected by various point and nonpoint pollutant sources— some of which are located in the Delta, most of which occur in the Sacramento and San Joaquin Valleys.

Industrial and municipal wastewater treatment plant discharges are strictly regulated to minimize adverse impacts on water quality; however, these discharges are not regulated for organic carbon and pathogenic protozoa, two important constituents of drinking water. ~~m~~Much of the runoff from urban and agricultural areas is unregulated and more difficult to control. Runoff, containing oil, grease, metals, pesticides, fertilizers, and many other pollutants, contributes to the pollution of Delta and Bay waters.

Much of the runoff from urban and agricultural areas is unregulated and more difficult to control.

Recreational uses also have contributed to deterioration of the water quality in the Bay-Delta. Key contaminants associated with recreational uses are pathogens caused by human and animal detritus; and oil, grease, fuel, and fuel additive discharges from recreational vehicles.

The principal sources of pollutants to the Delta include:

- Drainage from inactive and abandoned mines that contribute metals, such as cadmium, copper, zinc, and mercury.
- Stormwater inflows and urban runoff that contribute metals, sediment, pathogens, organic carbon, nutrients, pesticides, dissolved solids (salts), petroleum products, and other chemical residues.
- Municipal and industrial wastewater discharges that can contribute salts, metals, trace elements, nutrients, pathogens, pesticides, organic carbon, oil and grease, and turbidity.
- Surface agricultural irrigation return flows and nonpoint discharges that can contribute salts (including bromide), organic carbon, nutrients, pesticides, pathogens, and sediment.
- Subsurface agricultural drainage that can contribute salts (including bromide), selenium, nutrients, and some agricultural chemical residues.

- Large dairies and feedlots that can contribute nutrients, organic carbon and pathogenic organisms.

- Water-based recreational activities (such as boating) that can contribute hydrocarbon compounds, nutrients, turbidity, and pathogens.

- Atmospheric deposition that can contribute metals, pesticides, and other synthetic organic chemicals, and may lower pH.

- Sea-water intrusion that can contribute salts, including bromide.

In addition to these sources, natural processes, such as high flows, and anthropogenic activities, such as dredging, can mobilize constituents that originate from these sources.

Beneficial Uses, Water Quality Objectives, and Pollutants of Concern

Specific beneficial uses and water quality objectives for the Bay-Delta waters have been identified by the San Francisco Bay and Central Valley Regional Water Quality Control Boards. Similar lists of beneficial uses have been developed for surface water in other regions.

Drinking water standards are designed to protect human health and to maintain the aesthetic qualities of appearance, taste and odor, and color. Water quality objectives to protect environmental beneficial uses are often more stringent than drinking water standards. However, for TOC, TDS and pathogens which are of concern for drinking water, no environmental objectives are established. One of the most important distinctions between drinking water standards and environmental water quality objectives may be the point at which they apply. Environmental water quality objectives typically are applied to discharges and to receiving waters. For drinking water, some standards are designed to apply at the drinking water source, some at the treatment plants, and some at the customer's tap. There are no corresponding ecological protection standards for some substances that are regulated in drinking water.

Water quality objectives to protect environmental beneficial uses are often more stringent than drinking water standards.

Water treatment requires disinfection to kill pathogens and to guard against contamination in the supply system. However, disinfection of water containing TOC and bromide can result in the formation of DBPs, which are believed to cause cancer. As a result, TOC and bromide are undesirable in drinking water supplies. Some of the water quality parameters that are very important for agriculture or industry (for example, temperature, boron, and sodium adsorption ratio) are less important for drinking water.

Recreational beneficial uses include in-stream uses. Water quality standards may be designed to reduce the hazards that are associated with contacting contaminated water, to prevent bioconcentration of contaminants in fish and wildlife, or to prevent degradation of such qualities as water clarity.

Under Section 303(d), the Clean Water Act requires regulatory agencies to periodically evaluate the extent to which water bodies are supporting these beneficial uses, based on an evaluation of exceedances of water quality objectives. The result is a list of impaired water bodies and the constituents and sources that may be causing that impairment. A Section 303(d) list was compiled for the Program in the Water Quality Program Plan Appendix. Based on this and other sources of information, the stakeholders and CALFED staff developed the list of parameters of concern shown in Table 5.3-1.

Factors That Affect Variability of Water Quality in the Delta

Water quality in the Delta is continually changing over time and space in response to natural hydrologic conditions, operation of upstream reservoirs, agricultural and water supply diversions, and discharges into the system. Seasonal trends reflect the effects of higher spring/summer runoff and fall/winter low-flow periods. Yearly changes in water quality are associated with different water-year types, as defined in the SWRCB's D-1485.

Table 5.3-1. Water Quality Parameters of Concern to Beneficial Uses

Metals and Toxic Elements	Organics/ Pesticides	Disinfection By-Product Precursors	Other
Cadmium	Carbofuran	Bromide	~~Ammonia~~
Copper	Chlordane[a]	TOC	DO
Mercury	Chlorpyrifos		Salinity (TDS, EC)
Selenium	DDT[a]		Temperature
Zinc	Diazinon		Turbidity
	PCBs[a]		Toxicity of unknown origin[b]
	Toxaphene[a]		Pathogens
	Dioxins[d]		Nutrients[c]
	Dioxin like compounds[d]		pH (Alkalinity)
			Chloride
			Boron
			Sodium adsorption ratio

Notes: EC = Electrical conductivity.
TDS = Total dissolved solids.

[a] These compounds are no longer used in California. Toxicity from these compounds is remnant from past use.
[b] Toxicity of unknown origin refers to observed aquatic toxicity, the source of which is unknown.
[c] Nutrients includes nitrate, nitrite, ammonia, organic nitrogen, total phosphorus, and soluble reactive phosphorus.
[d] These compounds may be added after review by an appropriate group of stakeholders

Spatial trends of water quality in the Delta reflect the effects of inflows, exchange with the Bay, diversions, and pollutant releases within the Delta. The north Delta tends to have better water quality, in large part because of the inflow from the Sacramento River, which is fed by reservoirs containing high-quality water. The quality of water in the west Delta is strongly influenced by exchange with the Bay; during low-flow periods, sea-water intrusion causes poorer water quality. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, and the effects of diversions that can sometimes increase sea-water intrusion from the Bay.

The quality of water in the west Delta is strongly influenced by exchange with the Bay; during low-flow periods, sea-water intrusion causes poorer water quality.

Water Quality Issues in the Delta

Based on the above discussion, the significant water quality issues in the Delta Region are as follows:

- Discharges from Delta islands have elevated concentrations of TOC (a DBP precursor) and salts that affect industrial, municipal, and agricultural uses.

- High-salinity water from Suisun and San Francisco Bays intrudes into the Delta during periods of low Delta outflow. Salinity adversely affects most beneficial uses. Bromides associated with sea water leads to the formation of brominated DBPs in treated water.

Bromides associated with sea water leads to the formation of brominated DBPs in treated water.

- Synthetic chemicals (such as pesticides and herbicides) and natural contaminants (heavy metals) have accumulated in sediments in the Delta, and can accumulate in aquatic organisms. For example, mercury and DDT, which bioaccumulate through the food web in fish and shellfish, can exceed acceptable limits for human consumption. Disturbance of contaminated sediments can release these constituents into the water column.

- Agricultural drainage to the Delta can contain elevated levels of nutrients, suspended solids, organic carbon, salinity, selenium, and boron, in addition to chemical residues. All of these constituents may adversely affect the beneficial uses of Delta water.

- Heavy metals, including cadmium, copper, mercury, and zinc, continue to enter the Delta. Sources of these metals include runoff from abandoned mine sites, tailings deposits, downstream sediments where the metals have been deposited over the past 150 years, urban runoff, and industrial and municipal wastewater discharges.

- The estuarine salinity gradient and its associated entrapment zone (where biological productivity is relatively high because of the mixing dynamics and accumulation of suspended materials) affect the quality and extent of habitat for some estuarine species. The entrapment zone and adjacent habitats support fish food production in the Delta. The location of the entrapment zone and its extent are controlled by Delta outflow, and directly affect environmental and dependent recreational beneficial uses.

The location of the entrapment zone and its extent are controlled by Delta outflow, and directly affect environmental and dependent recreational beneficial uses.

- Oxygen depletion adversely affects aquatic organisms. It is caused by discharges of inadequately treated wastes, and discharges of nutrients that promote the growth and decay of natural vegetation. Sources of oxygen-demanding materials and nutrients include discharges from industrial and municipal treatment plants, and from agricultural and urban sources. Such problems are of particular concern in the lower San Joaquin River and in the south Delta.

Oxygen depletion is caused by discharges of inadequately treated wastes, and discharges of nutrients that promote the growth and decay of natural vegetation.

- The population of the Central Valley is expected to increase substantially by 2020. Increased discharge of municipal wastewater and urban runoff in the valley could degrade water quality.

Summary of Data for Key Water Quality Constituents

The following section describes the results of water quality sampling in the Delta for some key constituents. Except for salinity predictions, which are made possible by available mathematical modeling tools, there is currently little ability to predict levels of other water quality constituents that would be present in the Delta estuary, with or without CALFED actions. Even accurate qualitative assessments are generally not possible, due to the many changes that will be made in the system. CALFED is, however, investing in the development of modeling tools that may have the capability of assessing water quality constituents other than salinity. When these tools become available, they will be employed to prepare project-specific environmental documentation in conjunction with planning CALFED projects.

Bromide. The primary source of bromide in Delta waters is sea-water intrusion. Other sources include drainage returns in the San Joaquin River and within the Delta, connate water (saline water trapped in sediment when the sediment was deposited) beneath some Delta islands, and possibly agricultural applications of methyl bromide. The river and agricultural irrigations sources are primarily a "recycling" of bromide that originated from sea-water intrusion. Dissolved bromide concentrations at sampling stations for the Municipal Water Quality Investigation (MWQI) shown in Table 5.3-2 indicate a gradient in bromide such that mean concentrations range from about 0.46 mg/L at Rock Slough to 0.27 mg/L at CCFB. The effect of recycling bromide in the lower San Joaquin River is indicated by a mean concentration of about 0.27 mg/L at the DMC and 0.31 mg/L at Vernalis. In contrast, the mean bromide concentration on the Sacramento River at Greene's Landing is about 0.018 mg/L.

Table 5.3-2. Mean Concentration of Constituents

DELTA AREA	LOCATION	BROMIDE, DISSOLVED (mg/L)	CHLORIDE, DISSOLVED (mg/L)	DOC (mg/L)	SELENIUM, DISSOLVED (mg/L)	SPECIFIC CONDUCTANCE (µmhos/cm)	TDS (mg/L)
North	Sacramento River at Greene's Landing	0.018	6.8	2.5	0.000	160	100
	North Bay Aqueduct at Barker Slough	0.015	26	5.3	0.000	332	192
South	SWP Clifton Court Forebay	0.269	77	4.0	0.000	476	286
	CVP Banks Pumping Plant	0.269	81	3.7	0.000	482	258
	San Joaquin River at Vernalis	0.313	102	3.9	0.002	749	459
	Contra Costa Intake at Rock Slough	0.455	109	3.4	0.000	553	305

Notes:

mg/L = Milligram per liter.
µmhos/cm = *Micromhos per centimeter.*

Source:

DWR Municipal Water Quality Investigation (MWQI) data. Sampling period varies, depending on location and constituent, but generally is between 1990 and 1998.

Total and Dissolved Organic Carbon. The sources of organic carbon are primarily decayed vegetation. Important sources to the Delta include the Sacramento River, the San Joaquin River, and in-Delta island drainage return flows. Based on diversion estimates from DWR's Delta Island Consumptive Use Model (1995a), and DWR data on concentrations in the Delta and in

The sources of organic carbon are primarily decayed vegetation.

return flows (1995b), in-Delta sources are estimated to contribute about 40-50% of the TOC to the Delta.

Monitoring data show that most of the TOC in the Delta is in the dissolved form, called DOC. DOC concentrations in the Delta channels vary seasonally, showing a peak during the wet season (from January through March) when runoff occurs. Mean annual concentrations of DOC in the Delta channels ~~generally~~ range from ~~about 2-6 mg/L~~, 6-13 mg/L, however at the Barker Slough intake to the North Bay Aqueduct where local drainage predominates, the range is 6 to 20 mg/L ~~with the higher concentrations occurring in areas like Barker Slough where local drainage dominates water quality~~ (Table 5.3-2).

The contribution of DOC from agricultural drains varies, depending on conditions on the island and especially the peat (organic) content of the soils. Sampling data obtained through DWR's MWQI Program show that mean annual concentrations of DOC may range from 17 mg/L at Brannan Island to 44 mg/L at Empire Tract. A strong seasonal variation, with concentrations increasing by about a factor of 2 during the wet season, also is indicated in the data.

More monitoring data and research are needed to determine the quality and quantity of sources of TOC and DOC from various land use practices in the Delta. CALFED has funded research on amounts and types of organic carbon emanated from restored wetlands. Research on reactivity of different DOC chemicals to form harmful DBPs has also begun. The Drinking Water Quality section of CALFED has formed a workgroup to help guide CALFED in proposals to protect public health through the reduction of DBPs. The Department of Water Resources, Municipal Water Quality Investigations Program, has convened a scientific advisory panel to address DBP reduction, and will coordinate with CALFED activities. These groups and studies will help refine the CALFED actions to reduce TOC to applicable levels. The types of CALFED actions would not significantly differ from what is already discussed in the Water Quality Program Plan.

Salinity, Total Dissolved Solids, and Electrical Conductivity. These parameters are measures of dissolved salts in water. Salinity is a measure of the mass fraction of salts (measured in parts per thousand [ppt]), whereas TDS is a measure of the concentration of salts (measured in mg/L). Since EC of water generally changes proportionately to changes in dissolved salt concentrations, EC is a convenient surrogate measure for TDS. Based on DWR's MWQI data for Delta channels, TDS is approximately equal to EC times 0.58.

Excess salinity in Delta waters affects agricultural, industrial, and municipal water supply beneficial uses, as well as habitat quality for aquatic biota in the Delta. For example, the monthly average TDS objective in the SWP water service contract is 440 mg/L. Sources of salinity include sea-water intrusion, agricultural drainage, municipal wastewater, urban runoff, connate groundwater, and evapotranspiration of plants. Sea-water intrusion is the major source of salinity in the Delta. Agricultural drainage, particularly from the San Joaquin Valley also is an important source, especially in the South Delta; however, much of the San Joaquin River salt load reflects ~~recycling~~ recirculation of salts from the agricultural irrigation water that is obtained from the DMC.

Much of the San Joaquin River salt load reflects ~~recycling~~ recirculation of salts from the agricultural irrigation water that is obtained from the Delta-Mendota Canal.

TDS concentrations, as indicated in Table 5.3-2 are highest in the west Delta and the south Delta channels affected by the San Joaquin River. The mean concentration at CCFB is about 286 mg/L; at the Contra Costa intake at Rock Slough, the mean concentration is about 305 mg/L. The high concentrations in the San Joaquin River at Vernalis (459 mg/L) reflect the accumulation of salts in agricultural soils and the effects of recycling salts via the DMC. At

Barker Slough in the north Delta, which is not substantially affected by sea-water intrusion, the mean TDS concentration is about 192 mg/L. Mean TDS in the Sacramento River at Greene's Landing is relatively low, around 100 mg/L.

Pathogens. The term "pathogens" refers to viruses, bacteria, and protozoa that are a potential threat to human health. Of particular concern, from the point of view of water supply, are protozoa such as *Giardia lamblia* and *Cryptosporidium parvum*, which are resistant to traditional disinfection methods. The frequency of detection of *Giardia lamblia* and *Cryptosporidium parvum* in samples obtained by DWR's Coordinated Pathogen Monitoring Program (1998) at 14 stations located in the SWP or SWP service area indicated positive detection of *Giardia lamblia* cysts in about 26% of all the samples (wet and dry weather) and positive detection of *Cryptosporidium parvum* cysts in about 8% of all the samples. The frequency of detection increased in those samples obtained during runoff events (wet-weather events), which suggests sources such as urban and agricultural runoff, and wet-weather bypass flows from wastewater treatment plants. However, the limited data and significant technical limitations in analysis techniques do not enable reliable conclusions to be drawn at this time.

Certain protozoa such as *Giardia lamblia* and *Cryptosporidium parvum* are resistant to traditional disinfection methods.

Mercury. Mining-related activities are known to be a significant source of mercury in the Delta. The Coast Ranges, on the west side of the Sacramento Valley, contain a large deposit of cinnabar (mercury ore). At one time, mines in the area supplied the majority of mined mercury in the United States. The majority of the mercury mines in the Coast Ranges are abandoned and remain unclaimed. During the late 1800s and early 1900s, mercury was intensively mined and refined in the Coast Ranges, and transported across the Central Valley to the Sierra Nevada for use in placer gold mining operations. The Central Valley Regional Water Quality Control Board (CVRWQCB) (1998) has estimated that approximately 7,600 tons of refined mercury (commonly called quicksilver) were deposited in the Mother Lode region during the Gold Rush mining era. Studies by UC Davis and, more recently, by Bouse et al. (1996) and Harnberger et al. (1999) at the U.S. Geological Survey (USGS) show that the sediments mobilized by hydraulic mining ultimately were transported to the Bay-Delta, where they formed marshes and islands or were deposited in shallow water. USGS studies show that mercury concentrations in Bay sediments containing hydraulic mining debris range from 0.3 to 1 microgram per gram ($\mu g/g$). More importantly, certain conditions in these sediments can cause the formation of methyl mercury, the most bioavailable form of mercury.

Mining-related activities are known to be a significant source of mercury in the Delta.

Pesticides (Diazinon and Chlorpyrifos). Organophosphate pesticides, such as diazinon and chlorpyrifos, are used in the Central Valley on orchard crops (about half a million acres), including almonds, peaches, and prunes. The pesticides are applied during the dormant spray season from December through February. In 1993, Domagalski (1996) at the USGS estimated that over 45,000 kilograms (kg) of diazinon and 300 kg of chlorpyrifos were used predominantly in the Central Valley during the dormant spray season. Diazinon and chlorpyrifos also are used by commercial applicators and home owners to control common pests.

Diazinon and chlorpyrifos have been detected in surface water during winter and early spring from applications to orchards, in irrigation return water during summer, and in urban runoff samples during both winter and summer. Concentrations of diazinon measured in the Sacramento River in Sacramento during a January 1994 runoff event peaked at around 350 nanograms per liter (ng/L). In the Sacramento Slough north of the Delta, concentrations exceeded 1,000 ng/L. Toxicity identification evaluations (TIEs) were conducted by Foe (1995) from the CVRWQCB on samples to determine the presence of toxics in *Ceriodaphnia* bioassays from the Sacramento and San Joaquin Rivers. The results confirmed that diazinon was a primary toxicant.

H-001211

Organochlorine Pesticides. Organochlorine pesticides (DDT, toxaphene, dieldrin, and chlordane) were widely used in the Central Valley until the 1970s and remain very persistent. Residues of these agents are still widespread in the Central Valley and are mobilized during winter storms, by irrigation and dredging and by construction activities. Fish tissue analyses indicate that levels of these pesticides can exceed recommended safe levels for human consumption. According to Fox and Archibald (1996), concentrations of organochlorine pesticides are generally much lower in bed sediment and biota in the Sacramento River basin compared to the San Joaquin River basin. Dioxin and Dioxin like compounds have been identified by the US EPA as substances that impair beneficial uses in the San Francisco Bay and portions of the Delta. The impacts of these compounds will be reviewed by an appropriate stakeholder group to determine if these compounds should be added to the list of Parameters of Concern. If listed, a CALFED stakeholder team will be assembled to develop a list of actions CALFED might take to address these compounds. Appropriate environmental documentation will be prepared as necessary.

Concentrations of organochlorine pesticides are generally much lower in bed sediment and biota in the Sacramento River basin compared to the San Joaquin River basin.

Selenium. Selenium is naturally abundant in the marine sedimentary rocks and soils weathered from the rocks of the Coast Ranges west of the San Joaquin Valley. Mobilization and transport of selenium occurs during large runoff events or by land uses, such as road building, overgrazing, mining, and irrigated agriculture. Between 1986 and 1995, annual selenium loads in the San Joaquin River near Vernalis averaged 4,040 kg (8,906 pounds [lbs]), with a range of from 1,615 to 7,819 kg (from 3,558 to 17,238 lbs). Wastewater discharges from the refineries in the San Francisco Bay Area are another important source of selenium. Alpers and others from the USGS indicate that in 1991, the average riverine selenium loads that reached the San Francisco Bay Estuary was around 2 kg per day (730 kg per year), while refinery loads averaged 7.1 kg per day (2,592 kg per year) and municipal loads averaged 2.2 kg per day (803 kg per year). (Alpers et al. 1999a, 1999b.)

Selenium is naturally abundant in the marine sedimentary rocks and soils weathered from the rocks of the Coast Ranges west of the San Joaquin Valley.

Trace Metals. Heavy metal loading in the watershed has been suspected as a possible source of aquatic toxicity throughout the Bay-Delta and its tributaries. The major sources of metals are abandoned mines, agriculture, and urban runoff. For example, data collected by Alpers et al. (1999a, 1999b) from USGS indicate copper loads from the Colusa Basin Drain were 39.7 lbs per day, based on sampling conducted in June 1997; whereas the loads from Iron Mountain in Spring Creek were about 26 lbs per day, based on measurements conducted in May 28, 1997. In May and September, DWR measured concentrations of 9 trace metals at 11 stations in the Bay-Delta and Suisun Bay from 1975 to 1993. Trace metals frequently exceeded the guidelines for marine and fresh-water toxicity. Trace metals (most frequently copper) exceeded the guidelines for fresh-water acute and chronic toxicity on 34 occasions. Marine acute and chronic toxicity guidelines were exceeded 181 times; copper accounted for 160 of these exceedances. In a USGS study conducted by Alpers et al., (1999a) to determine the role of Iron Mountain as a source of toxicity in the Sacramento River, lead-isotope data in suspended colloidal material and sediments were analyzed, indicating that the effects of Iron Mountain were relatively minor downstream of Red Bluff.

Heavy metal loading in the watershed has been suspected as a possible source of aquatic toxicity throughout the Bay-Delta and its tributaries.

5.3.3.2 BAY REGION

Water quality in San Francisco Bay is affected by flows from the Delta, runoff from the surrounding urban areas, municipal and industrial wastewater discharges, and drainage from abandoned mines. Water quality monitoring has been conducted in the Bay by the San Francisco Estuary Institute as part of its Regional Monitoring Program (RMP), as well as by industrial and sanitary dischargers. The contaminants of concern identified by the RMP include diazinon and chlorpyrifos in water; DDTs, chlordanes, polycyclic aromatic hydrocarbons (PAHs) in sediment; and PCBs, cadmium, mercury, selenium, PAHs, chlordanes, dieldrin, and DDTs in bivalve and fish tissue. Copper and nickel in the South Bay are currently the subject of a total maximum daily load (TMDL) evaluation. TMDLs identify the maximum amount of contaminant allowed in a water body that would not harm any beneficial uses of the water body. Selenium discharges from refineries and other sources in the Bay Area also are of concern. Dioxin discharges, especially from combustion sources, typify chemicals whose origin in part is atmospheric but may adversely affect water quality. Methyl tert-butyl ether (MTBE) has been found in a number of drinking water reservoirs in the Bay Area, which has prompted restrictions on certain types of water recreation.

Copper and nickel in the South Bay are currently the subject of a total maximum daily load evaluation.

5.3.3.3 SACRAMENTO RIVER REGION

Past mining practices, particularly hydraulic mining, have resulted in the discharge of huge quantities of sediment into major tributaries in gold-producing areas. Areas where mining operations were conducted continue to be a major source of toxic chemical loading to streams in some areas, including the Clear Creek watershed and local watersheds of the Sierra Nevada. Logging operations increased erosion and discharge of sediments into streams and rivers over widespread areas in upper watersheds of the Sierra Nevada and Cascade Ranges. Other water quality issues in the Sacramento River Region are similar to those described for the Delta Region.

In general, water quality in the Sacramento River is good, although the possible adverse effects associated with metals contamination from abandoned mercury and other hard-rock mining activities are of concern. Mercury is likely to be found in sediments and aquatic tissue rather than in the water column. In 1986, the CVRWQCB surveyed mercury contamination in fish and sediment in the Sacramento River watershed. The CVRWQCB detected elevated mercury levels in sediment in the Yuba and Bear Rivers and in Cache, Putah, and Stony Creeks. Recent sampling by the USGS National Water Quality Assessment (NAWQA) Program and reported by Domalgalski (1999) has confirmed the continued presence of elevated concentrations of mercury in the sediments of the Yuba River, Bear River, and Cache Creek, as well as in the sediments of other streams and rivers in the Sacramento River basin.

Data collected by researchers at UC Davis (Slotten et al. 1997) and as part of the Sacramento River Watershed Program Mercury Control Planning Project (Larry Walker and Associates 1997) also indicates that mercury in a bioavailable form is affecting the aquatic food chain. Survey results of bioavailable mercury throughout the northwestern Sierra Nevada (from the Feather River south to the Cosumnes River) found the most highly elevated mercury in the aquatic food webs of the South and Middle Forks of the Yuba River, the North Fork of the Cosumnes River, tributaries throughout the Bear River drainage, the mid-section of the Middle Fork of the Feather River, and Deer Creek.

Evidence indicates that mercury in a bioavailable form is affecting the aquatic food chain.

Other metals, such as copper, cadmium, lead, and zinc, are of concern in the Sacramento River Region. The influence of metal-laden acidic drainage from the Iron Mountain Mine site (via Spring Creek and the Spring Creek arm of Keswick Reservoir) is apparent in water samples from the site below Keswick Dam, where occasional exceedances of water quality standards for copper have been noted. Sample analysis using very small filtrates (0.005-micrometer-equivalent pore size) indicated that much of the copper and, to a lesser extent, zinc were in the colloidal form. Available data from agricultural drain samples indicate that trace-metal loading from agricultural drainage may be significant during certain flow conditions.

5.3.3.4 SAN JOAQUIN RIVER REGION

Water quality conditions in the San Joaquin River Region are influenced by agricultural activities that are associated with irrigation and agricultural chemical applications. Selenium in the lower San Joaquin River comes primarily from subsurface agricultural drainage discharged from the Grasslands area on the west side of the San Joaquin Valley through Mud Slough. Selenium also is conveyed to the San Joaquin River in natural storm runoff during wet years, primarily from Panoche and Silver Creeks. Annual selenium loads in the San Joaquin River near Vernalis between 1986 and 1995 averaged 4,040 kg (8,906 lbs) per year. The riverine load seldom reaches the estuary, as flows are generally insufficient and south Delta diversions draw most of the San Joaquin River water from the Delta. A report by Alpers et al. (1999a, 1999b) indicated that in 1991, for example, the average San Joaquin River selenium load that reached the estuary was around 2 kg per day (730 kg), compared to an average load from Bay Area refineries of 7.1 kg per day (2,592 kg) and municipal loads that averaged 2.2 kg per day (803 kg).

Water quality conditions in the San Joaquin River Region are influenced by agricultural activities that are associated with irrigation and agricultural chemical applications.

Salt loading can lead to impairment of water quality in the lower San Joaquin River, in the south Delta, and at diversion facilities. Surface and subsurface agricultural drainage waters are the major source of salts in the San Joaquin River. The mean annual salt load exported out of the basin was approximately 770,000 tons per year from 1985 to 1994. ~~Recycling~~ Recirculation of salt from the Delta, via the DMC to the west side of the San Joaquin Valley and through accumulation of salts in the soils and shallow groundwater in the west side of the Valley, are the major sources of salts in the San Joaquin River. Data reported by Grober (1999) at the CVRWQCB indicate that concentrations in the San Joaquin River at Vernalis, expressed in terms of specific conductance (μmhos/centimeter [cm]) exceeded the 700-μmhos/cm 30-day running average objective for April through August in about 54% of the time from 1986 to 1997. These concentrations exceed desirable levels for agricultural irrigation and cause problems for south Delta farmers and for export water.

Salt loading can lead to impairment of water quality in the lower San Joaquin River, in the south Delta, and at diversion facilities.

Low dissolved oxygen conditions occur in the Stockton reach of the San Joaquin River and in urban waterways around the City of Stockton. After storms, dissolved oxygen concentrations as low as 0.34 mg/L have been recorded in Smith Canal, Mosher Slough, 5-Mile Slough, and the Calaveras River. These conditions also occur during late summer and fall because of a combination of high water temperature, nutrients, algal blooms, and discharge. Effluent from the Stockton Regional Wastewater Control Facility is considered to be a relatively large source of oxygen-depleting substances, as is water from the Stockton Turning Basin. Although the data are not conclusive, other sources such as urban runoff, runoff from confined animal facilities, and sediment demand also may contribute significantly to lowering dissolved oxygen.

5.3.3.5 OTHER SWP AND CVP SERVICE AREAS

Two distinct, noncontiguous areas are included in the Other SWP and CVP Service Areas: in the north are the CVP's San Felipe Division and the SWP's South Bay service areas, and to the south are the other SWP service areas. The northern section of this region encompasses parts of the central coast counties of Santa Clara, San Benito, Santa Cruz, and Monterey. The southern portion includes parts of Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.

The quality of water from the Delta delivered to the Other SWP and CVP Service Areas is of major concern, particularly with respect to salinity and drinking water quality. Salinity is an issue because excessive salinity may adversely affect crop yields and require more water for salt

Salinity is the primary water quality constraint to recycling wastewater. The lack of alternate sources of low-salinity water reduces opportunities to stretch water supplies by blending.

leaching, may require additional municipal and industrial treatment, may increase salinity levels in agricultural soils and groundwater, and is the primary water quality constraint to recycling wastewater. Also, according to a Salinity Management Study, conducted by The Metropolitan Water District of Southern California (MWD) (1997), alternative sources for MWD's service area generally have quite high levels of salinity. The TDS of Colorado River water averages about 700 mg/L, whereas the TDS average at the SWP terminal reservoirs is about 300 mg/L. The lack of alternate sources of low-salinity water reduces opportunities to stretch water supplies by blending.

Constituents that affect drinking water quality include bromide, natural organic matter, microbial pathogens, nutrients, TDS, hardness, alkalinity, pH, and turbidity. Of particular concern to water purveyors are anticipated drinking water regulations that may require reductions in the levels of DBPs that are formed during water treatment disinfection and oxidation while also implementing more stringent disinfection regulations. The problem of formation of brominated DBPs is specific to the Delta as a drinking water source. Brominated DBPs are formed by the reaction of bromide and TOC with the disinfectant chemicals used in water treatment. Brominated DBPs are of concern because of their link to miscarriages and cancer. Elevated levels of bromide (primarily from sea-water intrusion) and elevated levels of TOC that are associated in large part with Delta island drainage contribute to the formation of brominated DBPs. The Delta has higher average levels of bromide than 95% of the source waters in the rest of the country, making the water more difficult to treat.

> The problem of formation of brominated DBPs is specific to the Delta as a drinking water source. The Delta has higher average levels of bromide than 95% of the rest of the country, making the water more difficult to treat.

5.3.4 ASSESSMENT METHODS

Qualitative and quantitative methods were used to assess the impacts of the Preferred Program Alternative and the Program alternatives on water quality. Primarily qualitative methods were used to determine water quality impacts from implementation of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Programs. Quantitative analysis is not available because there is insufficient research to support reliable mathematical models of the effectiveness of individual program actions on water quality parameters. The effects of constructing surface water and groundwater storage were assessed qualitatively, but the effects of storage (nonconstruction) and conveyance of each option under the alternatives were quantitatively assessed based on modeling results.

> The effects of constructing surface water and groundwater storage were assessed qualitatively, but the effects of storage (nonconstruction) and conveyance of each option under the alternatives were quantitatively assessed based on modeling results.

Quantitative methods were used to predict changes in the concentrations of constituents of concern from implementing the Storage and Conveyance elements. Specifically, the impacts of the Program alternatives on water quality were analyzed with DWR's Delta Simulation Models (DSM1 and DSM2).

The generation of modeling results, which help to predict impacts, evolved in response to decisions on the Preferred Program Alternative and Alternatives 1, 2, and 3. Since spring 1997, there have been several DSM2 model runs; and assumptions for these runs have not been uniform. Work in progress includes the generation of a set of modeling runs which predict the ranges of impacts of each Program Alternative under a reasonable range of water management scenarios, referred to as "bookends." The set of assumptions for the bookends include a range of water demands and regulatory requirements. The assumed ranges also were included in the No Action Alternative. A more detailed description of the bookends are in Sections 5.1.4.1 and 5.1.4.2. ~~These relatively new modeling results, although available at the time of this water quality impact analysis, are considered preliminary.~~ Modeling used in this Impact Analysis was conducted using modeling assumptions that match the assumptions made in modeling the CALFED Preferred Program Alternative, to describe the bookends of what was considered.

The initial study (dated March 1997) uses DWRDSM1 and simulates five alternatives, including Existing Delta Geometry, Interim South Delta Program (ISDP), North Delta Program, North Delta Program with Hood Diversion, and California Urban Water Agency (CUWA) Alternative C Geometry. Similarly, the next study (dated August 1997) uses DWRDSM1 to simulate Program Alternatives 1A, 1C, 2B, 2D, and 3E. The January 1998 study uses DWRDSM2 to simulate Program Alternatives 1A, 1C, 2B, 3E, and 3X. Finally, the June 1998 study also uses DWRDSM2 to simulate Program Alternatives 1C, 2B, and 3X (DWR 1998). The difference between the January and June studies, however, is a variation in the DWRSIM studies that was incorporated into the simulations. Further descriptions of the Delta hydrology and operating assumptions for each alternative for each run are presented in each of the above-referenced documents.

In February 1998, Delta modeling studies were performed for the Diversion Effects on Fisheries Team (DEFT) and were completed using DWRDSM2. These modeling results were used to predict the performance of the Preferred Program Alternative for a range of assumptions that would affect water operations.

Delta modeling of flow, EC, and water levels in the south Delta were used to predict water quality impacts of the Program alternatives. Additionally, the simulations were used to describe Delta inflows and exports under various alternatives over an extended period of time.

Delta modeling of flow, EC, and water levels in the south Delta were used to predict water quality impacts of the alternatives.

During the past year, the Delta Modeling Section has been conducting EC-based water quality model runs for the Program. EC is a convenient water quality indicator because it is a good index for salinity. EC is easily measured in the field, and therefore provides good records for model calibration and verification. In evaluating the overall environmental consequences of alternatives, model predictions of mean annual EC values for a 16-year hydrologic sequence were used to compare the predicted long-term performance of each alternative against the No Action Alternative or existing conditions. In evaluating the performance of each alternative for "worst-case" conditions, model predictions of mean monthly EC during dry and critical years were used. However, the results of these runs may not predict the concentrations of other water quality constituents that are not directly related to salinity.

A different approach was introduced, called "fingerprinting," to help facilitate predictions of constituents other than salinity. The idea behind fingerprinting is to track the water coming from each source separately. It was assumed that six major sources of water enter the Delta: the Sacramento River, San Joaquin River, east side streams, Yolo Bypass, water from Martinez, and in-Delta agricultural drainage returns. Tracking these inflows to the Delta is called "source tracking." In addition, the water entering the Delta at different times is tracked separately, called "time tracking." For most model runs, the hydrology is assumed to change monthly; therefore, time tracking was performed in a monthly mode. For example, the water that enters the Delta in February is monitored separately from the water that enters the Delta in January. In the fingerprinting mode, DSM2 is simulating a total of 72 constituents (from 6 sources and for 12 months in the year). The results can be applied to any conservative constituent. A conservative water quality constituent is a relatively stable constituent that does not change chemical composition in an aquatic environment. The analysis was verified by comparing the results of the fingerprinting analyses with the EC modeling, using DWRDSM2.

The output from a fingerprinting run consists of 72 numbers at any given location and time.

The output from a fingerprinting run consists of 72 numbers at any given location and time. In essence, these numbers represent the "source blending ratios" that depend on location and time.

H-001216

H-001216

Once these blending ratios are known, they can be applied to any conservative water quality constituent, provided the concentration for that constituent is known for all the sources of water in the Delta at all times.

To verify this approach, the Delta Modeling Section applied the fingerprinting approach to predict EC concentrations and compared their results to actual EC predictions by DSM2 in standard water quality runs. The results are quite consistent.

The modeling effort is a valuable tool developed to predict the effects of the proposed storage and conveyance facilities. Models are subject to continued refinement and improvement, and cannot provide all of the information needed to analyze the impacts of the Program alternatives. A more complete description of modeling assessment methods is given in Attachment A. Where the modeling results are incomplete or not applicable, impacts were estimated based on other available information and professional judgement.

5.3.5 SIGNIFICANCE CRITERIA

The significance of both adverse and beneficial effects on water quality was assessed based on modeling studies described above and in Attachment A and programmatic analyses. Impacts on water quality are considered potentially significant if implementing the Preferred Program Alternative has the potential to result in any of the following conditions:

- Beneficial uses of the water are adversely affected.
- Existing regulatory standards are exceeded.
- An undesirable effect on public health or environmental receptors is produced.

Program effects are considered beneficial if implementing the Preferred Program Alternative would result in the reverse of one or more conditions listed above. Given that model predictions are subject to error, potentially significant water quality changes are defined as those that exceed the probable uncertainty in the modeling results. Predicted effects that fell within the probable uncertainty in the modeling results could not be interpreted and were considered less than significant. The uncertainty in the modeling results is estimated at approximately ±10%.

The uncertainty in the modeling results is estimated at approximately ±10%.

5.3.6 NO ACTION ALTERNATIVE

By 2020, state-wide water use is projected to increase from 79.49 MAF (based on 1995 demands) to 80.50 MAF during near-normal years, and from 64.79 to 65.96 MAF during drought years. Although water use is projected to decrease slightly in agricultural regions, reductions in alternative supplies and proportionately larger increases in urban area demands would result in increased overall demands for Delta exports. As a result, total annual demands for Delta exports could increase from the current range of 5.9-6.9 MAF, to a range of 7.1-7.6 MAF in 2020, depending on the annual hydrology.

Although water use is projected to decrease slightly in agricultural regions, reductions in alternative supplies and proportionately larger increases in urban area demands would result in increased overall demands for Delta exports.

The No Action Alternative supplements the existing conditions with some reoperation of system facilities to accommodate changes in flow timing resulting from 2020 demands. Under the No Action Alternative, future SWP and CVP operations, and resultant controlled flow conditions in the Bay-Delta system and its tributaries are assumed to be managed essentially as they are today, with one exception. Increased Delta export demands are projected to be satisfied largely by increased south Delta pumping during August through March in near-normal and wet years, and December through February in dry and critical years.

The following elements of the No Action Alternative are particularly pertinent to water quality:

- Water storage and conveyance facilities currently under construction would be completed. These facilities include the Eastside Reservoir and Inland Feeder; interim reoperation of Folsom Reservoir; levee restoration along selected reaches of the Sacramento River, its tributaries, and flood bypasses; and Stone Lakes NWR.

- Wastewater and water treatment facilities would be expanded to meet the needs of growing populations.

- Treatment levels would remain at current levels, increase if source water becomes more degraded, or improve in response to new regulations.

> Under the No Action Alternative, water storage and conveyance facilities currently under construction would be completed.

Other operations and factors that would affect Bay-Delta channel and export water quality conditions include hydrologic and environmental conditions in the watersheds, population and land use, the quality of point and nonpoint source discharges, upstream reservoir releases and diversions, Delta outflows and sea-water intrusion, the provisions of the CVPIA and Bay-Delta Accord, and compliance with the State and Regional Water Quality Control Boards' Basin Plans and the State Board and Delta Water Quality Control Plan standards. Future changes in the Bay-Delta Accord, flow requirements, water quality standards, and water rights decisions could impose additional regulatory controls over SWP and CVP operations and Delta inflows controlled by upstream users. Changes in such regulatory controls could result in proportionately larger effects on water quality during dry and critically dry water-year types.

~~Tables 5.3-3a and 5.3-3b summarize the results of model predictions of salinity changes (expressed as EC) throughout the Delta for the No Action Alternative compared toexisting conditions for the long term hydrologic sequence and the dry and critical water-year types, respectively. Separate predictions are shown for the water management Criterion A without storage and for water management Criterion B with storage. For each criterion, changes are shown for the annual average value and for the month during which the higher salinities are projected.~~
Tables 5.3.3a and 5.3.3b show predicted changes in salinity that would occur in the Delta under the No Action Alternative compared to existing conditions. Table 5.3.3a shows average changes over a long period that includes a full range of hydrologic conditions (wet, normal, dry and critically dry years). Tables 5.3.3b shows changes for dry and critically-dry years only. Positive values in the tables indicate an increase in salinity relative to the existing condition; negative values indicate a decrease.

> No Action Alternative conditions are projected to result in less-than-significant increases in salinity concentrations.

Separate predictions are shown for Water Management Criteria A and B. ~~Criterion B assumes that water is available from new surface or subsurface storage reservoirs; Criterion B does not.~~ For each criterion, changes are shown for average monthly values and for the month during which the highest salinity concentrations are predicted to occur.

Tables 5.3-3a and 5.3-3b indicate that the No Action Alternative is projected to result in less-than-significant changes throughout the Delta Region when compared to modeled existing conditions. For example, during the long-term hydrologic sequence at CCFB, the annual average salinity is projected to increase by 10-40 μmhos/cm (2-8%), and the mean monthly salinity for December is projected to increase by about 40-70 μmhos/cm (4-8%). (A ~~percentage~~ change between ±10 ~~μmhos/cm~~ percent is considered within the margin of error of the model analysis and is defined as less than significant.) During dry and critical years, Table 5.3-3b shows that these ranges increase by 0-60 μmhos/cm (0-10%) for the annual average and by 10-70 μmhos/cm (1-6%) on average for December.

Water quality for other constituents (other than salinity that has been addressed above) would change under the No Action Alternative in response to the effects of population and land use changes, increased export demand, and the effects of future regulatory controls. According to modeling conducted by DWR (1998 DSM model run) the predicted frequency distribution of bromide at the Contra Costa Canal Intake on Rock Slough has a median concentration of about 250 ug/l under existing conditions which would increase to about 300 ug/l under the No Action Alternative. At Clifton Court the modeling indicated a median bromide concentration of 150 ug/l under existing conditions and about 200 ug/l under the No Action Alternative. These changes are primarily the result of increased export demand and associated increased salinity intrusion into the Delta.

Organic carbon concentration in the Delta are assumed to remain essentially unchanged under the No Action Alternative. According to MWD estimates the median organic carbon concentration at the Harvey O. Banks Pumping Plant would be about 3.2 mg/l, and the 90th percentile concentration would be about 3.8 mg/l (WQPP, Section 3.7.2). Under existing conditions the mean concentration of DOC at the Banks Pumping Plant is about 3.7 mg/l (Table 5.3-2).

Project levee maintenance is assumed to continue in accordance with current requirements and practices, but no major rehabilitation efforts would be undertaken. Despite maintenance actions, levees could continue to deteriorate, increasing the risk of their failure due to seismic events, erosion, and overtopping. Such levee failures could threaten water quality at the CVP and SWP pumps, and at other water supply intake locations. The severity and extent of any degradation caused by the potential influx of ocean salinity (including bromide), TOC, soils, and sediment, and by the potential release of a variety of chemicals and wastes used or stored in areas protected by levees would depend on many factors. These factors include the season, hydrology, available reservoir storage, location of the breaks and storage, and extent of any flooding. In the worst case (foreseeable only in the event of a series of earthquake-induced west Delta levee failures that occurred during summer to late fall or during drought periods), water could become temporarily unusable for municipal and agricultural supplies for extended periods until the contam-inants could be flushed from the system. The resultant pooling of ocean salts, including bromide, in the Delta would cause potentially significant adverse impacts on water users and could cause a prolonged interruption of supply from the state's predominant water source.

The growing imbalance between Delta-dependent water demands and the available supplies of good-quality water could be exacerbated in some regions. This could occur in the service areas if providers were required to replace good-quality Delta water with poorer quality water obtained from less desirable alternative sources. Regardless of the source of the degradation, resultant water quality impacts also could produce potentially significant adverse impacts on dependent water treatment costs, economic productivity, fish and wildlife habitats, public health, and social well-being.

In some regions, providers would be required to replace good-quality Delta water with poorer quality water obtained from less desirable alternative sources.

H—001219

H-001219

5.3.7 CONSEQUENCES: PROGRAM ELEMENTS COMMON TO ALL ALTERNATIVES

For water quality, the environmental consequences of the Ecosystem Restoration, Water Quality, Levee System Integrity, Water Use Efficiency, Water Transfer, and Watershed Program elements are similar under all Program alternatives, as described below. This section also discusses the environmental consequences of the Storage and Conveyance elements that are common to all alternatives— those related to construction. The environmental consequences of actions in the Storage and Conveyance elements that are not related to construction of facilities vary among Program alternatives, as described in Section 5.3.8.

The discussions below relate to all Program regions.

5.3.7.1 ECOSYSTEM RESTORATION PROGRAM

The Ecosystem Restoration Program involves expanding floodplains and creating wetland habitat in the Bay-Delta system, and altering the management of storage reservoirs to provide more water for environmental purposes. The program would result in both short- and long-term effects on water quality. The short-term effects would occur during and in the years immediately following construction.

Construction activities necessary to implement the Ecosystem Restoration Program would include breaching and demolishing existing levees, and constructing new setback levees. Most of the construction activities would occur in dry conditions, but some construction in waterways would be necessary. Total suspended solids (TSS) is the primary contaminant of concern that would be affected by construction activities. Quantities of soil would be released into the water column during in-water construction, and flowing water would dislodge soil particles from new levees and wetlands during the initial water-soil contact period. Soil particles would increase the TSS content of Delta waters in the vicinity of construction activities. Nutrients and organic matter also are likely to be released during construction. Because some of the older levees may have been built with dredge spoils when environmental regulations were less stringent, there is a possibility that toxic substances could be released during their demolition. Before construction occurs, soils will be tested to determine potentially toxic substances. Such substances may be avoided or mitigated, depending on the type and concentration. In some cases core sampling and testing will lead to engineered solutions to prevent toxic material exposure to the environment. If toxic sediments are to be exposed, an engineered cap could be placed that would prevent environmental exposure of that material. It is expected that impacts of the Ecosystem Restoration Program that are associated with construction can be reduced to a less-than-significant level.

> **Quantities of soil would be released into the water column during in-water construction, and flowing water would dislodge soil particles from new levees and wetlands during the initial water-soil contact period.**

The long-term effects of the Ecosystem Restoration Program would include both beneficial and adverse changes in water quality. Expanding the floodplains and wetland areas in the Delta, in the northern portions of the Bay Region, and along the Sacramento and San Joaquin Rivers and their tributaries would restore some of the natural self-purification capacity of the waterways. Some contaminants are removed by various physical, chemical, and biological processes as river water flows through vegetated areas. The increased acreage of wetlands under the Ecosystem Restoration Program would increase the opportunity for these processes to occur. Also, most of the land that would be converted to wetlands or floodplain now is used for irrigated agriculture. Conversion of irrigated cropland or pasture to wetlands would reduce the discharge of nutrients and other agricultural chemicals into waterways, which also would benefit water quality in the Bay-Delta system.

Replacing irrigated cropland with wetlands could result in a net increase in water salinity because evaporation would increase. However, the conversion from irrigated crops to wetlands, also could reduce salinity due to the reduction or elimination of applied salts through fertilizer application. The concentration of TOC in river water also may change, but it is unknown whether concentrations would be increased or decreased. Wetlands have a demonstrated capacity to generate organic carbon. Inundation of soils could cause changes in the degree to which the organic content of organic (peat) soils is mobilized into Delta waters. Some theorize that the change from cropland to wetlands would extend the period in which water is in contact with peat soils, thus increasing TOC concentrations. Others theorize that opportunities for contact with peat soils would be reduced because sediment would be deposited in the wetlands, separating river water from direct contact with the underlying peat soils. Some studies currently are being conducted to evaluate how TOC is assimilated in the environment through microorganisms. Additional studies are needed to establish the relationship between management of riverside lands and TOC concentrations in river water.

Inundation of soils could cause changes in the degree to which the organic content of organic (peat) soils is mobilized into Delta waters.

If the Ecosystem Restoration Program causes a reduction in TOC concentrations, there could be an adverse effect on biological productivity in the Delta if carbon is the limiting ecological factor. The reduction in TOC concentration would improve the suitability of Delta waters as a drinking water source. If TOC concentration is increased by the Ecosystem Restoration Program then biological productivity may be increased and the suitability of water for drinking water supply decreased. ~~However, it should be noted that any adverse changes in TOC or salinity concentrations attributable to the Ecosystem Restoration Program are likely to be small compared to the beneficial changes in salinity and TOC concentration produced by the conveyance and storage elements of the Preferred Program Alternative. Thus, no mitigation measures are needed.~~ Until specific project plans are formulated, it will not be possible to answer all questions concerning mitigation measures for potential adverse changes in TOC. Mitigation measures fore TOC could include filling and draining the wetlands in manners that do not contribute to TOC at the diversion facilities. Mitigation could also include treatment systems for discharges from constructed wetlands during certain periods of the year. Notwithstanding, CALFED is committed to adequate investigation of potential negative impacts of ecosystem restoration measures, and to full mitigation of any such impacts as a condition of project implementation.

~~An increase in TOC concentrations in Delta waters in the vicinity of municipal water intakes could significantly affect municipal water supplies.~~

~~Changing the TOC concentrations in Delta channels has the potential to affect ecosystem productivity, probably by increasing it. The increase in salinity would marginally reduce the suitability of Delta and Sacramento and San Joaquin River waters as sources of municipal and agricultural water supply. Potentially significant impacts can be mitigated to less-than-significant levels.~~

~~An increase in TOC concentrations in Delta waters in the vicinity of municipal water intakes could significantly affect municipal water supplies, in turn affecting water system customers in the Central Valley and in the Other SWP and CVP Service Areas. Some forms of TOC react with the chemicals used to disinfect water at the treatment plant and form chemical compounds believed to be hazardous to humans. The significance of the adverse impact would depend on the magnitude of the increase in TOC concentrations and its reactivity with disinfectants. Mitigation may not be available to reduce impacts to less-than-significant levels.~~

Under the Ecosystem Restoration Program, flow regimes in the Sacramento and San Joaquin Rivers, their tributaries, and the Delta would be established that emulate natural seasonal flows. These large flows would be allowed to pass through the Delta and on to San Francisco Bay. Their long-term effects would include lowering water salinity and temperature, and increasing dissolved oxygen concentrations in Delta waterways at certain times of the year. These effects would benefit water quality for ecosystem restoration.

Reestablishing natural flow regimes would help to lower water salinity and temperature, and increase dissolved oxygen concentrations in Delta waterways at certain times of the year.

5.3.7.2 WATER QUALITY PROGRAM

The Water Quality Program calls for a range of actions that would reduce the discharge to waterways of contaminants in municipal and industrial wastewater, urban and agricultural runoff, and drainage from abandoned mines. Water supply intakes would be relocated to areas with better water quality. Research and monitoring programs would be undertaken to improve understanding of the significance of various contaminants in water and the effectiveness of remedial actions. The actions are described in detail in the Water Quality Program Plan Appendix.

~~The long-term effect of the Water Quality Program would be to reduce the mass of some contaminants, metals, pesticides, total suspended solids and nutrients, for example, entering the Bay-Delta system and its tributaries relative to the No Action Alternative. This would, in turn, improve water quality in the Sacramento and San Joaquin Rivers and San Francisco Bay, relative to the No Action Alternative. It is not possible to make quantitative estimates of the reductions because the effectiveness of many of the actions in the Water Quality Program is unknown.~~

The long-term effect of the Water Quality Program would be to reduce the mass of some contaminants (e.g. metals, pesticides, total suspended solids and nutrients) entering San Francisco Bay, the Sacramento-San Joaquin Delta, the Sacramento and San Joaquin Rivers, and other Bay-Delta tributaries relative to the No Action Alternative. This would, in turn, improve water quality in the Bay-Delta system relative to the No Action Alternative. It is not possible to make quantitative estimates of the reductions because the effectiveness of many of the actions in the Water Quality Program is unknown.

It should be noted, however, because urban development is expected to proceed rapidly in the Sacramento and San Joaquin Valleys between now and 2020, the reductions in discharge of some contaminants attributable to the Water Quality Program may be offset by increases attributable to urbanization. For example, the reduction in discharged metals attributable to those elements of the Water Quality Control Program that address discharges from abandoned mines would likely be offset by an increase in the discharge of metals in urban runoff.

~~The cumulative and long-term effect of the Water Quality Program would be to reduce the mass of contaminants entering the Bay-Delta system and its tributaries which would, in turn, generally improve the water quality in the Sacramento and San Joaquin Rivers, the Delta, and San Francisco Bay. Improved water quality would more readily support designated beneficial uses, including the use of Delta and river water for ecosystem restoration and municipal water supply.~~ A specific action addresses reducing the discharge of oxygen-demanding substances in the vicinity of the City of Stockton. As a result, this action would improve the dissolved oxygen content of waters in the southeast Delta. Another action addresses reducing the discharge of selenium from oil refineries, which would reduce selenium concentrations in the waters of San Francisco Bay.

~~The cumulative and long-term effect of the Water Quality Program would be to reduce the mass of contaminants entering the Bay-Delta system and its tributaries.~~

Drinking water actions would benefit municipal water supply customers in the Central Valley and in the Other SWP and CVP Service Areas who obtain their water supplies from the Delta and its tributaries. Municipal and agricultural users of Delta water also would benefit from the water quality actions to relocate water supply intakes to areas with better water quality. The Water Quality Program would not result in any long-term adverse environmental impacts.

Some actions in the Water Quality Program involve construction (for example, increased treatment of municipal and industrial wastewater and urban runoff, and agricultural irrigation system improvements). Construction activities would occur in the Bay, Delta, Sacramento River, and San Joaquin River Regions. It is expected that the adverse impacts of construction on water quality, primarily the discharge of soil particles and consequent increase of TSS concentrations and the associated release of toxicants in the vicinity of construction sites, could be reduced to a less-than-significant level by the application of appropriate mitigation measures.

5.3.7.3 LEVEE SYSTEM INTEGRITY PROGRAM

The Levee System Integrity Program involves extensive construction to raise and strengthen levees in the Delta. The program would result in short-term adverse effects on water quality in the Delta. The program would result in long-term beneficial effects on water quality in the Delta and on the quality of water supplied to municipal and agricultural water users in the Central Valley and in the Other SWP and CVP Service Areas.

The Levee System Integrity Program involves extensive construction to raise and strengthen levees in the Delta.

Waterside construction activities for the Levee System Integrity Program would result in short-term effects on water quality similar to the levee modifications components of the Ecosystem Restoration Program, except that they would occur only in the Delta. Local increases in the TSS content of waters in Delta channels are expected. Some increase in nutrient and TOC concentrations also may occur. Toxic substances contained in old levees or in channel sediments could be released during waterside levee work or dredging. However, it is expected that short-term construction impacts can be reduced to a less-than-significant level.

If sediments for the purpose of levee system construction were to be obtained from non-local sources such as the Bay, careful consideration would be taken to ensure that there would be no adverse effects on water quality or natural resources. For example, Bay sediments may contain elevated levels of salts that would prevent their use without conducting additional monitoring and/or incorporating salinity control strategies.

If the levees are not improved, the risk of failure during earthquakes and floods or as a result of gradual structural deterioration is considerable. A catastrophic levee failure could cause saline waters from the Bay to penetrate deep into the Delta. This would be most pronounced in dry or critically dry years when the fresh-water flow from the Central Valley is insufficient to repel saline waters. Intrusion of sea water would result in a potentially significant adverse impact on beneficial uses of Delta waters, including municipal and agricultural water supply and possibly the protection of aquatic life. Water customers in the Central Valley and in the Other SWP and CVP Service Areas could be deprived of water from the Delta for months or years. The Levee System Integrity Program would reduce the risk of catastrophic levee failure and consequently the risk of a sudden deterioration in water quality. The Levee System Integrity Program would not result in any long-term adverse effects on water quality.

A catastrophic levee failure would cause saline waters from the Bay to penetrate deep into the Delta.

5.3.7.4 WATER USE EFFICIENCY PROGRAM

A number of measures in the Water Use Efficiency Program provide incentives for water conservation and reduce institutional barriers to water recycling. Because little construction would be involved, short-term adverse environmental impacts are considered less than significant.

The primary long-term effect of the Water Use Efficiency Program would be reducing the amount of water needed to support a given level of population and economic activity in California. Because diverting water from streams for human use generally results in adverse impacts on water quality (such as increased temperature and less dilution of contaminants), an increase in water use efficiency would result in an overall benefit to water quality. However, the beneficial effect would not be distributed evenly across all surface waters and may be partially offset by adverse impacts. Increased water use efficiency would adversely affect water quality when the volume of municipal wastewater or agricultural tailwater discharged to a stream is reduced but the mass load of salts and other contaminants in the discharge remains the same. However, since the Water Use Efficiency Program is also focusing on achieving benefits related to water quality and flow timing, it is expected that many of these potentially significant adverse effects would be offset by other water quality improvements. Any potentially significant adverse effect would be most pronounced in streams where municipal or agricultural discharges represent a substantial proportion of streamflow.

The primary long-term effect of the Water Use Efficiency Program would be reducing the amount of water needed to support a given level of population and economic activity in California.

The water quality benefits of the Water Use Efficiency Program primarily would occur in the Bay and Delta Regions, and in river reaches in the Central Valley downstream of municipal and agricultural water supply intakes. The quality of water diverted from the Delta could be improved, which could benefit municipal and agricultural water users in the Central Valley and in the Other SWP and CVP Service Areas. Any adverse effects of the Water Use Efficiency Program would occur most acutely in small streams in the Sacramento River and San Joaquin River Regions, downstream of municipal and agricultural wastewater discharges. In most cases, it is expected that the localized adverse water quality impacts of the Water Use Efficiency Program can be mitigated to a less-than-significant level by increasing treatment of wastewater before it is discharged to waterways, increasing fresh-water releases from reservoirs to provide more dilution water, or altering the timing of agricultural return flows to coincide with periods when receiving water bodies have greater assimilative capacity. Water efficiency measures would not be applied in small watersheds where adverse impacts, as determined by site specific review, on water quality are significant and mitigation measures are impractical.

5.3.7.5 WATER TRANSFER PROGRAM

The Water Transfer Program proposes a framework of actions, policies, and processes that, collectively, would facilitate water transfers and further development of a state-wide water transfers market. This could result in the transfer of water from areas of abundance to areas of scarcity. The program does not include specific water transfer proposals. These would occur between willing sellers and willing buyers as they do now. Little construction would be involved; consequently, short-term adverse impacts are considered less than significant.

Water transfers would delay or eliminate the need to develop new water supply sources, probably new storage reservoirs, which would result in the potential to improve water quality.

Unlike the Water Use Efficiency Program, the Water Transfer Program would not reduce the total amount of water needed to support a given level of population and economic activity. Rather, it would temporarily or permanently reallocate water supplies among various users, including the environment.

Water transfers could affect water quality primarily through changes to river flow and water temperatures. In addition, the source of water for a transfer, the timing, magnitude, and pathway of each transfer would affect the potential for potentially significant impacts. Potential beneficial water quality impacts are a function of the ability of a transfer to decrease the concentration of various contaminants through both increased streamflow and the potential for obtaining higher quality water from several sources. Because specific transfers can invoke both beneficial and adverse impacts, at times on the same resource, net effects must be considered on a case-by-case basis.

The Water Transfer Program could benefit the Other SWP and CVP Service Areas when water of higher quality than local sources is imported into the region through a water transfer. For example, water transferred into southern California from the Central Valley can be of better quality than existing sources imported from the Colorado River.

5.3.7.6 WATERSHED PROGRAM

The Watershed Program would provide technical and financial assistance to local watershed programs. It would support projects, including ecological restoration projects, that would reduce the discharge of contaminants from nonpoint sources to waterways. The contaminant most likely to be affected is TSS, but some reduction in the discharge of nutrients, pesticides, and pathogenic microorganisms also may occur. Because most of the nonpoint source control measures are likely to be nonstructural, little construction is expected. Consequently, short-term adverse impacts of the program on water quality are expected to be less than significant.

Long-term impacts of the Watershed Program on water quality are expected to be exclusively beneficial. By reducing the mass of pollutants reaching the Delta from tributary streams, the program would improve in-stream water quality and the quality of water diverted for municipal and agricultural use. In-stream water quality would be improved in the Sacramento River and San Joaquin River Regions, and the reduced contaminant load in Delta outflow would benefit the Bay Region. Improvements in the quality of water diverted from the Delta would benefit municipal and agricultural uses in the Central Valley and in the Other SWP and CVP Service Areas.

Long-term impacts of the Watershed Program on water quality are expected to be exclusively beneficial.

5.3.7.7 IMPACTS RELATED TO CONSTRUCTION FOR STORAGE AND CONVEYANCE ELEMENTS

The Program alternatives may include new storage projects. Water storage may occur in surface or groundwater reservoirs. The storage projects would result in short-term and long-term effects on water quality. The short-term effects on water quality from construction of surface water reservoirs primarily would result from ground disturbance and consequent increased soil erosion rates. Excess sediment could be discharged to streams from construction activities being performed in streams and from precipitation falling on exposed soils.

Groundwater storage projects could use injection wells or spreading basins to convey water to underground storage. Because construction of injection wells would involve little ground disturbance or increased soil erosion, minor adverse effects on water quality are expected.

Groundwater storage projects could use injection wells or spreading basins to convey water to underground storage.

Short-term impacts on water quality from surface water reservoir construction would affect the Delta, Sacramento River, and San Joaquin River Regions. Short-term adverse effects on water quality from groundwater storage construction would affect the Sacramento River and San Joaquin River Regions. Mitigation is available to reduce all potentially significant impacts to less-than-significant levels.

Storing water in surface reservoirs may affect water quality in a number of ways. The reservoir pool would inundate previously dry lands. Depending on geologic characteris-tics, trace elements may be mobilized, particularly in the deeper parts of the reservoirs where dissolved oxygen concentrations may become depressed. Mercury compounds are present in rocks in some parts of the Sacramento Valley. Under certain conditions, these compounds may be converted into biologically available methyl mercury. Reservoirs in California generally experience algal blooms in the first years of operation due to mobilization of nutrients. Periodic blooms can continue indefinitely.

Typically, surface water reservoirs would be used to store abundant spring flows for later release and use in dry months or years. Off-stream reservoirs would alter the hydrology of the intermittent or small perennial streams on which they are built. Spring flows would be reduced or eliminated compared to unimpaired flows, and flow in naturally dry periods would be increased. Because reservoirs trap sediment, the TSS content of water released into the downstream channel would be less than the TSS content of stream water prior to reservoir construction. The reduction in TSS content would be greatest during high-flow conditions. Nutrients and organic matter in particulate form also would be trapped in the reservoir, and their concentrations in stream water below the reservoir would be reduced. Depending on the design of the reservoir outlet, the dissolved oxygen content of released water could be less than that of the stream to which ~~is it~~ it is discharged, resulting in lowered oxygen in the stream. Conversely, when the reservoir is spilling, water may become supersaturated with oxygen and nitrogen.

Off-stream reservoirs would alter the hydrology of the intermittent or small perennial streams on which they are built. Spring flows would be reduced or eliminated compared to unimpaired flows, and flow in naturally dry periods would be increased.

During periods of low unimpaired streamflow, releasing water from reservoirs could substantially reduce water temperatures in the downstream river reaches. Water released from reservoirs initially would be cooler than unimpaired stream waters and would remain cooler due to the increased flow volume.

Groundwater storage would be used conjunctively with surface waters to meet various needs and demands for water. During periods of high streamflow, groundwater aquifers with available space would be artificially recharged with surface water, using spreading basins or injection wells. Water would be pumped from the aquifers to meet municipal and agricultural water demand when surface water supplies are limited. Pumped water may be used directly or returned to surface streams for diversion at a downstream location.

Groundwater storage would be used conjunctively with surface waters to meet various needs and demands for water.

The quality of water diverted from surface streams, temporarily stored in the ground, and then withdrawn for use would be altered. Water pumped from the ground would contain less suspended solids, more dissolved solids, and generally higher nitrates than the source water. If the water is used directly by municipalities or agricultural, its suitability for use would be reduced somewhat by its increased mineral concentrations. If the water is pumped into a surface stream during low-flow periods, it would result in similar effects to those described for releasing water from surface reservoirs, with the possible addition of increased biological productivity due to the presence of nitrate.

The quality of water diverted from surface streams, temporarily stored in the ground, and then withdrawn for use would be altered.

The diversion of water into storage from the Sacramento River, San Joaquin River, or other large streams tributary to the Delta during high-flow periods would reduce the magnitude and duration of high flows. Although the effects of the diversions on in-stream water quality in the rivers and in the Delta would be minor, they could be of greater consequence to San Francisco Bay. Periodic high flows from the Delta profoundly affect salinity concentrations in the Bay and may play an important role in initiating water circulation in the South Bay. Increased diversion of water from the Delta for transfer to storage reservoirs via the California Aqueduct or the DMC could reduce Delta outflow and adversely affect water quality in San Francisco Bay.

The potentially significant impacts of a reduction in the magnitude and frequency of high Delta outflows on water quality in San Francisco Bay would be unavoidable.

Release of water down the Sacramento River, the San Joaquin River, or other major streams during low-flow periods would improve water quaiity in the rivers and in the Delta. Contaminants discharged by cities, industries, and agriculture would be diluted; and in-stream contaminant concentrations would be reduced in the rivers and in the Delta. Improved water quality in the Delta would benefit municipal and agricultural water users in the Delta, Central Valley, and the Other SWP and CVP Service Areas.

Most of the long-term adverse effects of surface and groundwater storage on water quality can be reduced to a less-than-significant level by various mitigation measures.

5.3.8 CONSEQUENCES: PROGRAM ELEMENTS THAT DIFFER AMONG ALTERNATIVES

The generation of modeling results, which helps to predict impacts, evolved in response to decisions on the Preferred Program Alternative and Alternatives 1, 2, and 3. Since spring 1997, there have been several DSM2 model runs, and assumptions for these runs have not been uniform. Recent modeling work includes the generation of a set of modeling runs that predict the ranges of impacts of each Program Alternative under a reasonable range of water management scenarios, referred to as bookends. The set of assumptions for the bookends include a range of water demands and regulatory requirements. The assumed ranges also were included in the No Action Alternative. A more detailed description of the bookends are in Sections 5.1.4.1 and 5.1.4.2 of Chapter 5.1. These results, although available and incorporated in this analysis, are considered preliminary.

For water quality, the Storage and Conveyance element actions that are not related to construction are integrated and result in environmental consequences that differ among the alternatives, as described below.

H-001227

5.3.8.1 PREFERRED PROGRAM ALTERNATIVE

Delta Region

The Preferred Program Alternative is a phased process that does not approve the construction of the diversion facility unless certain criteria are met. The Preferred Program Alternative would function similarly to Alternative 1 if a diversion facility is not constructed. The remainder of this section, including tables and graphs describing the Preferred Program Alternative, assumes that a diversion facility is in place.

The Preferred Program Alternative is a phased process that does not approve the construction of the diversion facility unless certain criteria are met.

The four primary sources that transport contaminants into the Delta are San Francisco Bay, the Sacramento and San Joaquin Rivers, and waste discharges into the system. Other primary variables include high-quality inflows from tributaries, especially the Sacramento River and east side streams, and the timing and distribution of their flows throughout the Delta. The capacity of conveyance features and new storage facility capacities and locations (if any) will greatly influence the overall and localized water quality effects of the Preferred Program Alternative (and the other Program alternatives evaluated) on constituent sources and their circulation within the Delta, the Central Valley, and areas of use. The locations of key water quality simulation stations and the Delta subregions that they represent which are used to gauge the water quality effects of primary concern are shown in Figure 5.3-1. The subregions were delineated on the basis of common hydrodynamic and water quality characteristics that help to determine the water quality impacts of the Program alternatives.

Water quality conditions in the Delta would be best where and when good-quality water, primarily from the Sacramento River, flows in optimal patterns across the Delta to discharge to Suisun Bay and to the diversion pumps. During this process, whether the flows are natural or induced, they would continue to intermix with, dilute, and flush poorer quality water from the San Joaquin River and other channels containing constituents from point and nonpoint waste discharges. It is believed that to prevent increases in salinity from ocean salt intrusion, net tidal flow reversals (especially negative QWEST flows) should be minimized. The actual water quality improvements achieved would depend on the capacities and configurations selected for the pilot Hood diversion facility, and other north Delta and south Delta channel modifications. (Note that if the Hood diversion and other North Delta improvements were not constructed, the impacts would be similar to those for Alternative ~~2~~ 1.) Water quality also would be affected by the number and type of south Delta water quality control facilities; Delta facility and pump operations; local discharges, including island drainage; and the locations, timing, and magnitudes of any additional flow releases from upstream reservoirs.

Water quality conditions in the Delta would be best where and when good-quality water, primarily from the Sacramento River, flows in optimal patterns across the Delta to discharge to Suisun Bay and to the diversion pumps.

Table 5.3-4a summarizes the results of model predictions of average salinity changes (expressed as EC) throughout the Delta for the Preferred Program Alternative compared to the No Action Alternative for a representative long-term hydrologic sequence that includes all water-year types (See Section 5.2). Separate predictions are shown based on modeling assuming water management Criterion A without storage, and water management Criterion B with storage which define the bookends for the analysis of water quality. For both sets of criteria, changes are shown for the annual average value over the period of the simulation, and for the month of the year during which the salinity is the highest. Compared to the No Action Alternative, Table 5.3-4a shows that under the Preferred Program Alternative, salinity is projected to improve overall in the northeast Delta, in the central Delta, in the south and southwest Delta, and on the San Joaquin River in the west Delta (as indicated by Jersey Point). Salinity decreases of more than 10% are considered to be beneficial, as shown in the table. For example, at the intake to CCFB, the mean long-term salinity is projected to decrease by 10-110 μmhos/cm (2-21%), and the

Under the Preferred Program Alternative, salinity is projected to improve overall in the northeast Delta, in the central Delta, in the south and southwest Delta, and on the San Joaquin River in the west Delta.

mean monthly salinity for December, the month of highest projected salinity, is projected to decrease by about 200-370 μmhos/cm (20-39%). Changes during other months could be both significant and larger. At the North Bay Aqueduct (NBA) intake in the North Delta Sub-Region, Table 5.3-4a indicates negligible change in salinity.

During dry and critical years, Table 5.3-4b shows that the decreases in salinity become larger, ranging from 10 to 110 μmhos/cm (2-21%) for the long-term maximum salinity at CCFB, and from 200 to 370 μmhos/cm (20-39%) on average for the month of maximum salinity, December. Compared to the "all year" predictions, the only change in level of significance occurs at Grant Line Canal at Tracy Road where the change in EC is sufficiently large during September of dry and critical years to qualify as a beneficial effect. Significant improvements during months of maximum salinity are projected to occur during winter months from December through February, and most frequently during December and January. At the North Bay Aqueduct (NBA) intake in the North Delta Sub-Region, Table 5.3-4b indicates negligible change in salinity.

Overall (with the singular exception of the NBA), the Preferred Program Alternative is projected to improve in-Delta and export water quality and dependent beneficial uses because of the resultant increases in the flow of good-quality water from the north Delta (especially with new upstream storage). Other contributing factors include corresponding decreases in the quantities of sea-water intrusion and improved water circulation in affected Delta channels.

The Preferred Program Alternative is projected to improve in-Delta and export water quality and dependent beneficial uses because of the resultant increases in the flow of good-quality water from the north Delta.

Potential improvements in Delta water quality compared to the No Action Alternative would be greatest in the central and south Delta, especially in the reach of the San Joaquin River in the central Delta where flows would enter from the north, and in Old River and other southwest Delta channels that convey water directly toward the pumps. A shift in export water quality based on reduced San Joaquin River flows entering the pumps would allow selenium in the San Joaquin River to enter the Delta and Bay.

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta, depending on factors such as the mixtures of source waters attained at each location that result from variations in the pathways and timing of flows through Delta channels. The magnitude of the changes also would depend on variations in annual hydrology. In general, the improvements in water quality would increase during dry and critical years, and be attenuated during above-normal and wet years.

Average monthly salinities during the summer months would be slightly increased in the San Joaquin River, in the west Delta, and in Old River. Whereas the above-referenced tables show the salinity changes relative to the No Action Alternative, Figures 5.3-2 through 5.3-6 show the predicted ranges of mean annual and peak EC values for the Preferred Program Alternative and the No Action Alternative at the following five stations, respectively: Old River at CCFB, San Joaquin River at Prisoner's Point, San Joaquin River at Jersey Point, Middle River at Tracy Road, and Old River at Rock Slough. These locations were selected to be representative of locations in the central, south, and west Delta, including several key export locations.

At Old River at Rock Slough, the Preferred Program Alternative ranges for dry and critical years and the long term are distinctly lower and do not overlap with the No Action Alternative range.

The range of values for each alternative plotted in the figures are indicative of the range of uncertainty in potential outcomes considering variations in conveyance capacities, storage, hydrology, and water management and operations. At Old River at Rock Slough, the Preferred Program Alternative ranges for dry and critical years and the long term are distinctly lower and do not overlap with the No Action Alternative range. At the remaining selected stations, the ranges do overlap slightly; however, the Preferred Program Alternative ranges are still distinctly lower. This indicates that the EC values under the Preferred Program Alternative are definitively lower at all of the selected stations than those of the No Action Alternative. The distribution of the ranges (that is, increasing from Jersey Point to Middle River at Tracy Road and CCFB) can be explained by the increased effects of salinity intrusion associated with water management Criterion B with storage.

~~The increased cross-Delta flows and increased sea-water intrusion, coupled with increases in the concentrations of salts drawn from the San Joaquin River and interior Delta drain-age, could act in concert to increase the frequency of higher bromide concentrations at Old and Middle Rivers.~~

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of the PPA on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR for Alternatives 1 and 2 indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (WQPP, California DWR, 1998a, Unpublished data). South Delta improvements associated with the PPA should limit recirculation effects, and the extent to which the PPA includes a screened diversion at Hood along with channel modifications on the Mokelumne River would lead to improved bromide water quality at the export facilities.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. The PPA includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

Bay Region

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

With increased exports from the Delta, the Preferred Program Alternative could slightly reduce net Delta outflows, resulting in greater sea-water intrusion into the Bay and resultant increases in salinity, including bromide, in the San Francisco, San Pablo, and Suisun Bays (the Suisun Bay is contiguous with Delta channels and diversion points). However, these increases are projected to be less than significant.

With increased exports from the Delta, the Preferred Program Alternative could slightly reduce net Delta outflows, resulting in greater sea-water intrusion into the Bay and resultant increases in salinity.

Sacramento River Region

Without new storage, the Preferred Program Alternative is not expected to affect surface water flows in the Sacramento River Region or the resultant water quality conditions. Impacts on surface water quality in the Sacramento River Region would result from changes in streamflows due to releases from, and diversions to, storage; and from construction, operation, and maintenance of new off-stream storage facilities, if built.

With additional new storage, the Preferred Program Alternative could produce water quality benefits in the Sacramento River Region when reservoir releases are made. Releases of high-quality water from storage could result in increased flows during low-flow periods. These increases could result in dilution of constituents carried by the streams and could provide water quality benefits for municipal, agricultural, and ecosystem beneficial uses. The increased flows should not be sufficiently large to significantly accelerate channel scouring. Turbidities and suspended sediment deposition probably would be reduced overall.

With additional new storage, the Preferred Program Alternative could produce water quality benefits in the Sacramento River Region when reservoir releases are made.

Temperatures could increase or decrease in the Sacramento River if inflows of warmer or cooler waters occur from new off-stream reservoirs. For this reason, surface water releases from Sacramento tributary storage may be confined to those needed to meet consumptive uses in adjacent service areas in order to prevent temperature changes to the Sacramento River. For example, inflows of water 5 degrees warmer than the water in the trunk stream, at a rate equal to 10% of the flow in the trunk stream, could increase the average temperature of the trunk stream by about half a degree (Celsius or Fahrenheit). However, inflows to streams from off-tributary reservoirs would be uncommon. More frequently, stored water would be delivered to water users via canals, in exchange for reduced in-stream diversions. This would benefit in-stream conditions for indigenous aquatic life.

More frequently, stored water would be delivered to water users via canals, in exchange for reduced in-stream diversions. This would benefit in-stream conditions for

San Joaquin River Region

General impacts of storage and conveyance options on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region. However, the potential for significant changes in the quality (and quantity) of the water exported to the region as a result of decisions made during the term of this Program and other non-CALFED Programs mentioned under "Cumulative Impacts" in Section 5.3.10 is substantial. As indicated in Table 5.3-5a, the average annual improvement in the salinity of water exported to the San Joaquin Valley Region is projected to average from 2 to 39%, a small to potentially substantial benefit compared to the No Action Alternative.

The potential for sig-nificant changes in the quality (and quan-tity) of the water exported to the San Joaquin River Region as a result of deci-sions made during the term of this Program is substantial, and other programs also could produce poten-tially significant effects.

The range of potential long-term water supply variations (possibly in the realm of 800 TAF of gains with new storage to 500 TAF of losses without new storage) and source-dependent water quality characteristics are sufficiently large to significantly alter prevailing water quality and the resultant salt balance in the SWP and CVP service areas and throughout the San Joaquin Valley. The effects of the potential variations would be most pronounced in those areas that are already deficient in both quality and quantity of water. Resultant changes in land use in the service areas that could secondarily affect water quality, water supply, demands, and beneficial uses of water resources would in turn depend on the magnitude of the variations in the delivered water supplies and their quality. Despite the variability, overall improvements in water quality in the areas served by exports would benefit municipal, agricultural, and ecological uses of the water. Improvements would reduce the salt loads entering the basin and reduce the amount of salt recycling that occurs between the basin and the Delta.

Despite the variability, overall improvements in water quality in the areas served by exports would benefit municipal, agricul-tural, and ecological

Additional upstream storage capacity would produce additional beneficial impacts on export water quality. Releases of high-quality water from new upstream storage during periods when salinities and other constituents otherwise would be higher at the export pumps could reduce salinities in the SWP and CVP service areas in the valley further, depending on the locations and months of the releases— especially during dry and critical years. Additional off-aqueduct storage could afford opportunities for additional pumping to storage during high-outflow periods, when water quality is good and environmental constraints allow, for later use when Delta water quality or environmental conditions are less favorable.

Other SWP and CVP Service Areas

The Preferred Program Alternative could benefit export water quality outside the Central Valley. Benefits could result from the changes in flow and salinity patterns throughout the Delta, as described for the Delta Region. Benefits and potential impacts could be somewhat similar to those described above for the water service areas in the San Joaquin Valley, although more of these service areas are served by SWP exports from CCFB than from the CVP. However, increased fresh-water inflows from additional upstream releases from storage would be needed to produce optimal beneficial effects in these areas.

A variation of the Preferred Program Alternative would extend the Tehama-Colusa Canal to connect to the North Bay Aqueduct (NBA). Construction of such an extension would improve the quality of water exported through the NBA. Presently, organic carbon in NBA exports is the most significant source of water quality degradation for the North Bay municipalities using the water, as it promotes formation of harmful chemical byproducts in the drinking water disinfection process. Linkage of the Tehama-Colusa Canal to the NBA would significantly reduce organic carbon concentrations in the export water by avoiding local sources of organic carbon. Negative impacts of this action might include reduced supply available to other users of the Tehama-Colusa Canal. ~~and, possibly, less dilution of pollutants in Barker Slough and contiguous channels as a result of reduced flows caused by reduced NBA diversions.~~

Linkage of the Tehama-Colusa Canal to the North Bay Aqueduct would significantly reduce organic carbon concentrations in the export water by avoiding local sources of organic carbon.

~~Another variant of the Preferred Program Alternative would relocate the intake of the NBA to a source that is less subject to local contributions of organic carbon, such as the Sacramento River. The positive impacts of this action would be similar to those described for the Tehama-Colusa Canal extension variant with regard to reducing concentrations of organic carbon. Negative impacts of this action would include reduced downstream flows in the water body where the intake was relocated, and reduced dilution of pollutants in Barker Slough and contiguous channels as a result of reduced flow caused by reduced NBA diversions.~~

Additional upstream storage capacity would produce increased beneficial impacts on export water quality. Releases of high-quality water from new upstream storage during periods when salinities and other constituents would otherwise be higher at the export pumps could reduce salinities in the Other SWP and CVP Service Areas somewhat further, depending on the location and month of the releases— especially during dry and critical years. During these times, service areas such as the San Felipe Division of the CVP would benefit in two ways: (1) both agricultural and municipal supplies would benefit from lower salinities, while (2) the municipal supplies would also benefit from lower bromide levels. Additional off-aqueduct storage could afford opportunities for additional pumping for storage during high outflow periods when water quality is good and environmental constraints allow, for later use when Delta water quality or environmental conditions are less favorable.

Additional upstream storage capacity would produce increased beneficial impacts on export water quality.

Simulations of bromide concentrations at key Delta export facilities were calculated based on fingerprint modeling data for the alternatives completed in 1998. The data were analyzed for dry and critical years, the most critical times of high bromide concentrations. The data were updated for the most recent model results, using the bromide-to-EC ratios in the older modeling exercise and the EC values generated in the latest model exercise. Based on changes in EC, bromide concentrations would not differ significantly between Alternative 2 and the Preferred Program Alternative with the future diversion facility option in place. Without the proposed future diversion facility, bromide concentrations under the Preferred Program Alternative would be more comparable to Alternative 1. Bromide concentrations from the two alternatives should be referenced for an estimate of bromide concentrations anticipated in the Preferred Program Alternative.

5.3.8.2 ALTERNATIVE 1

Delta Region

Water quality conditions in the Delta would be best where and when good-quality water, primarily from the Sacramento River, flows in optimal patterns across the Delta to discharge to Suisun Bay and to the diversion pumps. The actual water quality improvements achieved would depend on the capacities and configurations selected for north Delta and south Delta channel modifications. Water quality also would be affected by the number and type of south Delta water quality control facilities; Delta facility and pump operations; local discharges, including island drainage; and the locations, timing, and magnitudes of any additional flow releases from upstream reservoirs.

Water quality would be affected by the number and type of south Delta water quality control facilities; Delta facility and pump operations; local discharges; and the locations, timing, and magnitudes of any additional flow releases from upstream reservoirs.

Table 5.3-5a summarizes the results of model predictions of salinity changes (expressed as EC) throughout the Delta for Alternative 1 compared to the No Action Alternative for a representative long-term hydrologic sequence that includes all water-year types (see Section 5.2). Separate predictions are shown based on modeling assuming water management Criterion A without storage, and water management Criterion B with storage which define the bookends for the analysis of water quality For both sets of criteria, changes are shown for the annual average value over the period of the simulation and for the month of the year when salinity is the highest.

Compared to the No Action Alternative, Table 5.3-5a shows that under Alternative 1, salinity is projected to be significantly affected in the central Delta, in the south Delta, and in the San Joaquin River in the west Delta (as indicated by Jersey Point). For example, at CCFB, the mean long-term salinity is projected to increase by 30-70 µmhos/cm (5-13%), and the mean monthly salinity for December , the month of highest projected salinities, is projected to increase by about 70-140 µmhos/cm (7-15%). During dry and critical years, Table 5.3-5b shows that these ranges increase to 40-100 µmhos/cm (6-16%) for the long term and to 90-270 µmhos/cm (8-25%) on average for the month of maximum salinity, January. Changes during other months could be both significant and larger. Alternative 1 would potentially degrade overall in-Delta and export water quality and dependent beneficial uses because of the resultant increases in sea-water intrusion (see Figures 5.2-36 and 37 in Section 5.2). This degradation is projected to occur despite the increased potential for reservoir releases and increased inflows of better quality water across the Delta from the Mokelumne and Sacramento Rivers southward, and the potentially improved water circulation in affected Delta channels.

Potential reductions in Delta water quality compared to the No Action Alternative would be greatest in the south Delta, especially in Old River and other southwest Delta channels that convey water directly toward the pumps.

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta, depending on factors such as the mixtures of source waters attained at each location that result from variations in the pathways and timing of flows through Delta channels. The magnitude of the changes also would depend on variations in annual hydrology.

In general, the magnitude of impacts would be increased in dry and critical years, and attenuated in above-normal and wet years.

Whereas the above tables show the salinity changes relative to the No Action Alternative, Figures 5.3-7 through 5.3-11 show the ranges of predicted mean annual and peak EC values (μs/cm) for Alternative 1 and the No Action Alternative at the following five stations respectively: Old River at CCFB, San Joaquin River at Prisoner's Point, San Joaquin River at Jersey Point, Middle River at Tracy Road, and Old River at Rock Slough. These locations were selected to be representative of locations in the central, south, and west Delta, including export locations.

Average monthly salinities would be increased in the central Delta, in the San Joaquin River in the west Delta, in Old River at Rock Slough, in Old River at SR 4, and at CCFB compared to the No Action Alternative.

The range of values for each alternative indicated in the figures are indicative of the range of uncertainty. In general, the ranges do not overlap, indicating that EC values under Alternative 1 are distinctly different (and higher) than under the No Action Alternative. The distribution of the ranges (that is, decreasing from Jersey Point to Middle River at Tracy Road and CCFB) can be explained by the increased effects of salinity intrusion associated with water management Criterion B with storage.

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of Alternative 1 on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (Figure 10, 11, page Appendix E, WQPP, California DWR, 1998a, Unpublished modeling). This modeling indicates that under Alternative 1 mean bromide concentrations at Clifton Court are predicted to be about 330 ug/l compared to about 300 ug/l under the No Action Alternative. Thus under Alternative 1, mean bromide concentrations at the export facilities in the south Delta are predicted to increase by about 10%.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. Alternative 1 includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

~~Increased cross-Delta flows and increased sea-water intrusion, coupled with increases in the concentrations of salts drawn from the San Joaquin River and interior Delta drainage, could act in concert to increase the frequency of higher bromide concentrations at Old and Middle Rivers.~~

The actual magnitudes of monthly variations in salinity, including bromide, from No Action Alternative conditions would depend on annual, seasonal, and geographically determined differences in the proportion of sea water present. Bromide is of particular concern to municipal water users because it is an inorganic precursor to several of the most potentially harmful known DBPs (for example, bromodichloromethane, bromate, and brominated halo-acetic acids— known for their roles as carcinogens and potential causes of increased birth defects).

Bay Region

With increased exports from the Delta, Alternative 1 could result in potentially significant impacts by reducing net Delta outflows, resulting in greater sea-water intrusion into the Bay. This could result in increases in salinity, including bromide, in San Francisco, San Pablo, and Suisun Bays.

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

Sacramento River Region

Impacts on water quality associated with Alternative 1 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

Impacts on water quality associated with Alternative 1 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

San Joaquin River Region

General impacts of storage and conveyance options on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region under the Preferred Program Alternative. However, the potential for significant changes in the quality (and quantity) of the water exported to the region as a result of decisions made during the term of this Program is great, and other non-CALFED programs also will produce effects (see "Cumulative Impacts" in Section 5.3.10). As indicated in Table 5.3-5a, the average annual increase in the salinity of water exported to the San Joaquin River Region via the DMC (assuming an intertie with CCFB) compared to the No Action Alternative is projected to range from -2 to 13% for long term averages. The resultant net change in salt loads delivered to the valley is more difficult to project because it also would depend on changes in water deliveries, the locations where the water is applied, and source control actions taken. However, the effect would be to increase salt loads and the resultant recycling of salts in the San Joaquin Valley.

The range of potential long-term water supply variations (possibly in the realm of 800 TAF of gains with new storage to 500 TAF of losses without new storage) and source-dependent water quality characteristics are sufficiently large to significantly degrade prevailing water quality and the resultant salt balance in the SWP and CVP service areas and throughout the San Joaquin Valley. The effects of the potential variations would be most pronounced in those areas that are already deficient in both quality and quantity of water. Resultant changes in land use in the service areas that could secondarily affect water quality, water supply, demands, and beneficial uses of water resources would in turn depend on the magnitude of the reductions in the quality of delivered water supplies. Despite the variability, overall degradation of water quality in the areas served by exports would adversely affect municipal, agricultural, and ecological uses of the water.

The range of potential long-term water supply variations and source-dependent water quality characteristics are sufficiently large to significantly degrade prevailing water quality and the resultant salt balance in the SWP and CVP service areas in the San Joaquin Valley and throughout the valley.

Other SWP and CVP Service Areas

Alternative 1 also could result in detrimental impacts on export water quality outside the Central Valley. Impacts on export water quality could result from the changes in flow and salinity patterns throughout the Delta as described above for the Delta Region. Potential impacts would be similar to but less than those described for the water service areas in the San Joaquin Valley. Increased fresh-water inflows from additional upstream releases from storage could reduce the magnitude of the effects in these areas.

Additional off-aqueduct storage could afford opportunities for additional pumping for storage during high-outflow periods when water quality is better and environmental constraints allow, for later use when Delta water quality or environmental conditions are less favorable.

Simulations of bromide concentrations at key Delta export facilities were calculated based on fingerprint modeling data for the alternatives completed in 1998. The data were analyzed for dry and critical years, the most critical times of high bromide concentrations. The data were updated for the most recent model results, using the bromide-to-EC ratios in the older modeling exercise and the EC values generated in the latest model exercise. Based on changes in EC, bromide concentrations would not differ significantly between the No Action Alternative and Alternative 1. The bromide concentrations at Contra Costa Canal under Alternative 1 are expected to be about 2.0 mμg/L under both Criterion A and Criterion B scenarios during December, the month of highest projected bromide levels. The annual average bromide concentrations are projected to range from 0.64 to 0.89 mμg/L under Criterion A and Criterion B, respectively.

At CCFB the peak bromide concentrations are projected to range from 1.2 to 1.3 mμg/L under Criterion A and Criterion B, respectively. The annual bromide concentrations are projected to be about 0.64 mμg/L for both Criterion A and Criterion B.

5.3.8.3 ALTERNATIVE 2

Delta Region

Based on the results of model runs, Alternative 2 generally would improve in-Delta and export water quality, and dependent beneficial uses because of the resultant increased inflows of higher quality water from the Sacramento River and north Delta, and the improved circulation in Delta channels. Potential improvements to Delta water quality would be greatest in the channels that convey water directly toward the pumps (primarily Old and Middle Rivers) and in the San Joaquin River in the central Delta. Potential improvements would be least in distant channels or areas that are isolated by constricted channels and reduced circulation. The magnitude of the changes would vary continuously throughout the Delta and would depend on the mixtures of source waters that result at each location, the pathways and timing of flows through Delta channels, and the locations and magnitudes of local discharges. Water quality improvements would be greatest where good-quality Sacramento River waters are drawn across the Delta (intermixing with San Joaquin River and other channel flows) to feed flows into the channels leading toward the diversion pumps. The amounts of improvement achieved would depend on the capacities of any north Delta and south Delta channel modifications and the locations, timing, and magnitude of any additional flow releases from upstream reservoirs. A shift in export water quality based on reduced San Joaquin River flows entering the pumps would allow selenium in the San Joaquin River to enter the Delta and Bay.

Table 5.3-6a summarizes the results of model predictions of salinity changes (expressed as EC) throughout the Delta for Alternative 2 compared to the No Action Alternative for a representative long-term hydrologic sequence that includes all water-year types (see Section 5.2). Separate predictions are shown based on modeling assuming water management Criterion A without storage, and water management Criterion B with storage, which define the bookends for the analysis of water quality. For both sets of criteria, changes are shown for the annual average value over the period of the simulation and for the month of the year when salinity is the highest.

Compared to the No Action Alternative, Table 5.3-6a shows that under Alternative 2, salinity is projected to improve throughout most of the Delta and at the export facilities. For example, at CCFB, the mean long-term salinity is projected to decrease by 140-180 μmhos/cm (25-34%), and the mean monthly salinity for December, the month of highest projected salinities, is projected to decrease by 470-560 μmhos/cm (48-59%). During dry and critical years, Table 5.3-6b shows that salinity is projected to decrease by 170-220 μmhos/cm (25-35%) for the long term, and to decrease by 560-660 μmhos/cm (48-60%) on average for the month of maximum salinity, December. The improvement in water quality is caused by increased flows of higher quality water across the Delta from the Mokelumne and Sacramento Rivers southward, and the improved water circulation in affected Delta channels. Based on these comparisons, potential benefits to Delta water quality compared to the No Action Alternative would be greatest in the south Delta, especially in Old River and in other southwest Delta channels that convey water directly toward the pumps. Salinities also would be substantially reduced in Middle River in the southeast Delta, and also in the south Delta channels where circulation could be further improved by the installation of optional tidal flow control facilities. Salinities would be reduced in the San Joaquin River in the west Delta, where the intrusion of ocean salts from the Bay would be lessened by reductions in net tidal flow reversals.

Potentially significant adverse impacts on average annual salinities would be restricted primarily to Vernalis and to the lower Sacramento River (for example, Emmaton) due to the diversion of upstream flows into the central and south Delta.

Potentially significant adverse impacts on average annual salinities would be restricted primarily to Vernalis and to the lower Sacramento River (for example, Emmaton) due to the diversion of upstream flows into the central and south Delta.

Whereas the above tables show the salinity changes relative to the No Action Alternative, Figures 5.3-12 through 5.3-16 show the range of predicted mean annual and peak EC values (μs/cm) for Alternative 2 and the No Action Alternative at the following five stations respectively: Old River at CCFB, San Joaquin River at Prisoner's Point, San Joaquin River at Jersey Point, Middle River at Tracy Road, and Old River at Rock Slough. These locations were selected to be representative of locations in the central, south, and west Delta, including export locations.

The range of values for each alternative indicated in the figures are indicative of the range of uncertainty. In general, the ranges do not overlap, indicating that EC values under Alternative 2 are distinctly different (and lower) than under the No Action Alternative. Although improvements are indicated at all five stations, the effects of improved conveyance are seen most dramatically at the San Joaquin River at Jersey Point. These figures also show that this alternative performs even better during dry and critical years.

In general, the ranges do not overlap, indicating that EC values under Alternative 2 are distinctly different (and lower) than under the No Action Alternative.

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of Alternative 2 on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (Figure 10, 11, page Appendix E, WQPP, California DWR, 1998a, Unpublished modeling). This modeling indicates that under Alternative 2 mean bromide concentrations at Clifton Court are predicted to be about 150 ug/l compared to about 300 ug/l under the No Action Alternative. Thus under Alternative 2, mean bromide concentrations at the export facilities in the south Delta are predicted to decrease by about 50%.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. Alternative 2 includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

~~The increased cross-Delta flows, reduced sea-water intrusion, improved circulation, and resultant increases in dispersion and dilution of smaller quantities of ocean salts would act in concert to decrease bromide concentrations at drinking water supply intakes in the Delta.~~

~~Increased cross-Delta flows, reduced sea-water intrusion, improved circulation, and resultant increases in dispersion and dilution of smaller quantities of ocean salts would act in concert to decrease bromide concentrations at drinking water supply intakes in the Delta. The actual magnitudes of monthly variations from No Action Alternative condi-tions would depend on hydrologic, seasonal, and geographically determined differences in the proportion of sea water present.~~

Bay Region

With increased exports from the Delta, Alternative 2 could result in potentially significant impacts by reducing net Delta outflows, resulting in greater sea-water intrusion into the Bay. This could result in increases in salinity in San Francisco, San Pablo, and Suisun Bays.

With increased exports from the Delta, Alternative 2 could result in potentially significant impacts by reducing net Delta outflows, resulting in greater sea-water intrusion into the Bay.

The addition of new storage could improve water quality in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

Sacramento River Region

Impacts of Alternative 2 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

San Joaquin River Region

General impacts of the Storage and Conveyance elements on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region. However, the potential for significant changes in the quality (and quantity) of the water exported to the region as a result of decisions made during the term of this Program is great, and other non-CALFED programs also will produce effects (see "Cumulative Impacts" in Section 5.3.10). As indicated in Table 5.3-6a, there is a significant projected decrease in salinity (ranging from 17 to 37%) of water exported to the San Joaquin River. The resultant net change in salt loads delivered to the San Joaquin Valley is difficult to project because it would depend on water delivery operations, and other factors; however, based on this analysis alone, long-term salinity loads to the Valley could be significantly reduced. Overall improvements in water quality in the areas served by exports would benefit municipal, agricultural, and ecological uses of the water. Improvements also would reduce salt loads entering the basin and reduce the amount of salt recycling that occurs between the basin and the Delta.

Alternative 2 could significantly reduce long-term salinity loads to the San Joaquin Valley.

Other SWP and CVP Service Areas

Alternative 2 also would result in beneficial impacts on export water quality outside the Central Valley. Benefits would result from the improved export water quality as described for the Delta Region. Benefits and potential impacts would be similar to those described earlier for the water service areas in the San Joaquin Valley. Overall water quality improvement benefits should be somewhat greater because more of these service areas are served by SWP exports from CCFB, which receives higher quality water than the CVP.

Under Alternative 2, benefits would result from the improved export water quality in the Other SWP and CVP Service Areas.

Simulations of bromide concentrations at key Delta export facilities were calculated based on fingerprint modeling data for the alternatives completed in 1998. The data were analyzed for dry and critical years, the most critical times of high bromide concentrations. The data were updated for the most recent model results, using the bromide-to-EC ratios in the older modeling exercise and the EC values generated in the latest model exercise. Based on changes in EC, bromide concentrations would not differ significantly between the No Action Alternative and Alternative 1. The bromide concentrations at Contra Costa Canal under Alternative 2 are expected to range from 0.59 to 0.44 µmg/L under Criterion A and Criterion B, respectively, during December, the month of highest projected bromide levels. These concentrations represent a 71% and 78% drop, respectively, from the bromide concentrations under Alternative 1. The annual average bromide concentrations are projected to range from 0.38 to 0.30 µmg/L under Criterion A and Criterion B, respectively. These concentrations represent a 39% and 66% drop, respectively, from concentrations in Alternative 1.

At CCFB the peak bromide concentrations are projected to range from 0.39 to 0.30 µmg/L under Criterion A and Criterion B, respectively. These concentrations represent a projected 68% and 76% drop, respectively, in bromide compared to Alternative 1. The annual bromide concentrations are projected to range from 0.36 to 0.27, respectively, for Criterion A and Criterion B. These concentrations represent a 43% and 58% drop, respectively, in bromide compared to Alternative 1.

5.3.8.4 ALTERNATIVE 3

Delta Region

Water quality would be affected by the capacity of the isolated facility, the number and type of south Delta water quality control facilities; Delta facility and pump operations; local discharges; and the locations, timing, and magnitudes of any additional flow releases from upstream reservoirs.

Water quality conditions in the Delta would be best where and when good-quality water, primarily from the Sacramento River, can be at least partially tapped to flow in optimal patterns through the Delta to discharge to Suisun Bay and toward the diversion pumps. The actual water quality improvements achieved would depend on the capacities and configurations selected for north Delta and south Delta channel modifications. A shift in export water quality based on reduced San Joaquin River flows entering the pumps would allow selenium in the San Joaquin River to enter the Delta and Bay.

Water quality conditions in the Delta would be best where and when good-quality water, primarily from the Sacramento River, can be at least partially tapped to flow in optimal patterns through the Delta to discharge to Suisun Bay and toward the diversion pumps.

Consistent with prior analysis, Table 5.3-7a summarizes the results of model predictions of average salinity changes (expressed as EC) throughout the Delta for Alternative 3 compared to the No Action Alternative for a representative long-term hydrologic sequence that includes all water-year types. Separate sets of predictions are shown based on modeling assuming water management Criterion A without storage, and water management Criterion B with storage, which define the bookends for the analysis of water quality. For both sets of criteria, changes are shown for the annual average value over the period of the simulation, and for the month of the year when salinity is the highest. Salinity increases or decreases of more than 10% are considered to be significantly adverse or beneficial, respectively, as shown in the table.

Compared to the No Action Alternative, Table 5.3-7a shows that under Alternative 3, salinities are projected to increase in the northeast Delta (especially in the lower Mokelumne River), at most stations in the central Delta, and in the south Delta in Middle River at Tracy Road. For example, on the San Joaquin River at Turner Cut, the mean long-term salinity is projected to increase by 110-130 μmhos/cm (25-29%); and the mean monthly salinity for January, the month of highest project salinities, is projected to increase by about 40-90 μmhos/cm (6-13%).

Salinities are projected to decrease and produce beneficial effects in the southwest Delta, all export locations, and throughout the west Delta most of the time. For example, on Old River at Rock Slough, the mean long term salinity is projected to decrease by 50-140 μmhos/cm (9-23%), and the mean monthly salinity for December, the month of highest projected salinities, is projected to decrease by about 320-610 μmhos/cm (27-50%).

Salinities are projected to decrease and produce beneficial effects in the southwest Delta, all export locations, and throughout the west Delta most of the time.

Through careful water management, Alternative 3 is projected to improve both in-Delta and export water quality and dependent beneficial uses because of the overall resultant increases in the flow and export of good-quality water from the north Delta (especially with new upstream storage).

During dry and critical years, Table 5.3-7b shows that the increases in salinity at Turner Cut and the decreases in salinity on Old River near the intake to the Contra Costa Canal off Rock Slough become even larger. They range from increases of 150 μmhos/cm (26-29%) for the long term and from 150-170 μmhos/cm (20-26%) on average for the month of February to decreases of 60-180 μmhos/cm (9-25%) for the long term and from 420-840 μmhos/cm (31-59%) on average for the month of December. The increases in salinity cause one impact assessment adjective in the table to change from less than significant to beneficial in Suisun Bay at Port Chicago in September. Significant improvements during months of maximum salinity are projected to occur during December, or from September through October. However, changes during other months may be both significant and larger.

Water quality is projected to improve most dramatically at CCFB due to the transfer of high-quality water from Hood both around and through the Delta to be blended with Old River water at ratios varying from 50:50 to 95:05. Long-term improvements are projected to range from 280-390 μmhos/cm (53-69%), and monthly improvements are projected to range from

640-830 µmhos/cm (67-85%) during December, the month of maximum salinity concentrations.

Through careful water management, Alternative 3 is projected to improve both in-Delta and export water quality and dependent beneficial uses because of the overall resultant increases in the flow and export of good-quality water from the north Delta (especially with new upstream storage). Other contributing factors include corresponding decreases in the quantities of sea-water intrusion caused by reverse flows in the west Delta, and improved water circulation in many affected Delta channels.

Potential improvements in Delta water quality compared to the No Action Alternative would be greatest in the southwest Delta, especially in the Old River and the other southwest Delta channels that convey water directly toward the export pumps.

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta, depending on factors such as the mixtures of source waters attained at each location that result from variations in the pathways and timing of flows through Delta channels. The magnitude of the changes also would depend on variations in annual hydrology. In general, the improvements in water quality would increase during dry and critical years, and be attenuated during above-normal and wet years.

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta.

Whereas the above tables show the salinity changes relative to the No Action Alternative, Figures 5.3-17 through 5.3-21 show the predicted ranges of mean annual and peak EC values (µs/cm) for Alternative 3 and the No Action Alternative at the following five stations respectively: Old River at CCFB, San Joaquin River at Prisoner's Point, San Joaquin River at Jersey Point, Middle River at Tracy Road, and Old River at Rock Slough. These locations were selected to be representative of locations in the central, south, and west Delta, including several key export locations.

The range of values for each alternative plotted in the figures are indicative of the range of uncertainty in potential outcomes considering variations in conveyance capacities, storage, hydrology, and water management and operations. At Middle River at Tracy Road Bridge, the Preferred Program Alternative ranges for the long term overlap with the No Action Alternative range and are somewhat higher. The monthly peak ranges at Middle River at Tracy Road Bridge and all ranges at the remaining selected stations do not overlap, and the Alternative 3 ranges (in the southwest Delta, west Delta, and San Joaquin in the central Delta) are distinctly lower than those of the No Action Alternative. This indicates that the EC values under Alternative 3 are definitively lower at these stations than those of the No Action Alternative. The distribution of the ranges (that is, decreasing from Jersey Point to Middle River at Tracy Road and CCFB) can be explained by the decreased effects of salinity intrusion associated with water management Criterion B with storage.

The range of values for each alternative plotted in the figures are indicative of the range of uncertainty in potential outcomes considering variations in conveyance capacities, storage, hydrology, and water management and operations.

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of Alternative 3 on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged

310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (Figure 10, 11, page Appendix E, WQPP, California DWR, 1998a, Unpublished modeling). This modeling indicates that under Alternative 3 mean bromide concentrations are predicted to be about 40 ug/l at Clifton Court compared to about 300 ug/l under the No Action Alternative (about 90% reduction); and about 350 ug/l at Contra Costa Canal Intake at Rock Slough compared to about 450 ug/l under the No Action Alternative (about 30% reduction);.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. Alternative 3 includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

Bay Region

With increased exports from the Delta, Alternative 3 could slightly reduce net Delta outflows, resulting in greater sea-water intrusion into the Bay and resultant increases in salinity in San Francisco, San Pablo, and Suisun Bays (Suisun Bay is contiguous with Delta channels and diversion points). However, these increases are projected to be less than significant because of the application of environmental and water quality standards would preclude any facility operations that could cause adverse impacts in the Bay Region.

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low outflow periods.

Sacramento River Region

Impacts on water quality associated with Alternative 3 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

Impacts on water quality associated with Alternative 3 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

San Joaquin River Region

General impacts of storage and conveyance options on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region under the Preferred Program Alternative. However, as indicated in Table 5.3-7a, the average annual decrease in the salinity of water exported to the San Joaquin River Region via the California Aqueduct and the DMC compared to the No Action Alternative is projected to range from 16 to 74% over the long term (see table for predicted ECs). The resultant net reduction in salt loads delivered to the valley is more difficult to project because it also would depend on changes in water deliveries, the locations where the water is applied, and source control actions taken. However, the overall effect would be to dramatically decrease salt loads and the resultant recycling of salts in the San Joaquin Valley and River.

The overall effect of Alternative 3 in the San Joaquin River Region would be to dramatically decrease salt load and the resultant recycling of salts in the San Joaquin Valley and River.

Use of the isolated facility would reduce the recirculation of contaminants contained in San Joaquin River flows by greatly reducing the return of river outflows to the vicinity of the export pumps. Instead, San Joaquin River flows would drain in a more natural pattern toward the Bay and the ocean. The resultant low salinity and associated constituent concentrations in the exported water would greatly reduce demands on treatment technologies; reduce costs; enable more efficient use to be made of existing supplies; and increase the potential for conjunctive use, source water blending, wastewater reuse, and recycling.

Additional upstream storage capacity could reduce adverse impacts and could even produce additional beneficial impacts on export water quality. Releases of high-quality water from new upstream storage during periods when salinities and other constituents otherwise would be higher at the export pumps could reduce salt loads in the SWP and CVP service areas in the valley further, depending on the locations and timing of the releases— and especially during dry and critical years. Additional off-aqueduct storage could afford opportunities for additional pumping to storage during high-outflow periods, when water quality is good and environmental constraints allow, for later use when Delta water quality or environmental conditions are less favorable.

Other SWP and CVP Service Areas

Potential impacts and benefits on water quality in the Other SWP and CVP Service Areas would be similar to those described for the water service areas in the San Joaquin Valley.

Additional off-aqueduct storage could afford opportunities for additional pumping for storage during high outflow periods when water quality is highest and environmental constraints allow, for later use when Delta water quality or environmental conditions are less favorable.

Alternative 3 has the potential to produce the best water quality for export to the Other SWP and CVP Service Areas of all the alternatives because much of the exported water would be diverted from the Sacramento River via the isolated facility and would not be subject to degradation in the Delta.

Alternative 3 has the potential to produce the best water quality for export to the service areas of all the alternatives because much of the exported water would be diverted from the Sacramento River via the isolated facility and would not be subject to degradation in the Delta. Tables 5.3-7a and 5.3-7b show the comparative mean annual salinities (expressed as EC) of each of the primary points for out-of-basin export diversion from the Delta for the Management Criterion. With the isolated system, water also could be pumped from the Delta when environmental constraints and water quality standards permit, and periods of poorer water quality could be largely avoided. Water quality benefits could be enhanced still further by releases from new or enlarged storage facilities. The low salinity and associated constituent concentrations that would be achievable would further reduce the demands on treatment technologies; reduce costs; enable more efficient use to be made of existing supplies; and further increase the potential for conjunctive use, source water blending, wastewater reuse and recycling.

Concentrations of bromide at CCFB under Alternative 3 would be roughly equivalent to concentrations of bromide in the Sacramento River, assuming very little mixing of Sacramento River water with Delta water near the fore-bay. Bromide concentrations in the Sacramento River are negligible.

Simulations of bromide concentrations at key Delta export facilities were calculated based on fingerprint modeling data for the alternatives completed in 1998. The data were analyzed for dry and critical years, the most critical times of high bromide concentrations. The data were updated for the most recent model results, using the bromide-to-EC ratios in the older modeling exercise and the EC values generated in the latest model exercise. Based on changes in EC, bromide concentrations would not differ significantly between the No Action Alternative and Alternative 1. The bromide concentrations at Contra Costa Canal under Alternative A are expected to range from 0.51 to 0.76 μmg/L under Criterion A and Criterion B, respectively, during December, the month of highest projected bromide levels. These concentrations represent a 75% and 63% drop, respectively, in bromide compared to Alternative 1. The annual average bromide concentrations are projected to range from 0.43 to 0.46 μmg/L under Criterion A and Criterion

H-001243

B, respectively. These concentrations represent a 48% and 52% drop, respectively, in bromide compared to Alternative 1.

Concentrations of bromide at CCFB under Alternative 3 would be roughly equivalent to concentrations of bromide in the Sacramento River, assuming very little mixing of Sacramento River water with Delta water near the forebay. Bromide concentrations in the Sacramento River are negligible.

5.3.9 PROGRAM ALTERNATIVES COMPARED TO EXISTING CONDITIONS

5.3.9.1 PREFERRED PROGRAM ALTERNATIVE

This programmatic analysis found that the potentially beneficial and adverse impacts from implementing any of the Program alternatives when compared to existing conditions were generally the same impacts as those identified in Sections 5.3.7 and 5.3.8, which compares the Program alternatives to the No Action Alternative. Additionally, the comparison of the Program alternatives to existing conditions did not identify any additional potentially significant environmental consequences that were not identified in the comparison of Program alternatives to the No Action Alternative.

Table 5.3-8a summarizes the results of model simulations of average annual salinity (expressed as EC) throughout the Delta for the Preferred Program Alternative compared to existing conditions. Table 5.3-8b summarizes the results of model simulations of average annual EC during dry and critical years throughout the Delta for the Preferred Program Alternative compared to existing conditions. ~~The impacts associated with the Preferred Program Alternative, when compared to existing conditions, generally would be similar to those compared to the No Action Alternative, except that the benefits would be less pronounced. In other words, the degree of water quality improvement that would be achieved in the future with the Preferred Program Alternative is projected to almost always be significantly greater than it would be if the facilities were constructed today.~~
The Preferred Program Alternative would lower salinity levels at most locations in the Delta and in most water years as compared to existing conditions.

~~The degree of water quality improvement achieved in the future under the Preferred Program Alternative is projected to almost always be significantly greater than it would be if the facilities were constructed today.~~

The effects of the Preferred Program Alternative were compared to both the existing condition and No Action Alternative. They are similar. However, the improvement in salinity concentrations is more pronounced when the comparison is made to the No Action Alternative. This is because under the No Action Alternative water quality will deteriorate relative to the existing condition and thus there is more room for improvement in salinity levels. In other words, the water quality benefits of the Preferred Program Alternative will be more apparent if it is built 20 years hence rather than today.

The overall geographic variations in the improvements and Delta locations where the changes were less than significant may be observed by comparing Table 5.3-8a with Table 5.3-4a. The differences between the comparisons of average annual ECs for the Preferred Program Alternative with average annual existing conditions, and annual ECs for the Preferred Program

Alternative during dry and critical years with existing conditions during dry and critical years generally were less than significant.

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of the PPA on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR for Alternatives 1 and 2 indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (WQPP, California DWR, 1998a, Unpublished data). South Delta improvements associated with the PPA should limit recirculation effects, and ~~the extent to which the PPA includes~~ if a screened diversion at Hood is constructed as part of the PPA along with channel modifications on the Mokelumne River, it would lead to improved bromide water quality at the export facilities.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. The PPA includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

5.3.9.2 ALTERNATIVE 1

Delta Region

Potentially beneficial and adverse impacts from implementing Alternative 1 when compared to existing conditions are generally the same as identified in Section 5.3.8.2, where Alternative 1 is compared to the No Action Alternative. Additionally, the comparison of Alternative 1 to existing conditions did not identify any additional potentially significant environmental consequences that were not identified in Section 5.3.8.2.

Table 5.3.9a summarizes the results of model predictions of salinity changes (expressed as EC) throughout the Delta for Alternative 1 compared to existing conditions for a representative long-term hydrologic sequence that includes all water-year types (see Section 5.2). Separate predictions are shown based on modeling assuming water management Criterion A (without storage) and water management Criterion B (with storage), which define the bookends for the analysis of water quality. For both sets of criteria, changes are shown for the annual average value over the period of the simulation and for the month of the year during which the higher salinities are projected.

Compared to existing conditions, Table 5.3.9a shows that under Alternative 1, salinity is projected to be significantly affected in the central Delta, in the south Delta, and in the San Joaquin River in the west Delta (as indicated by Jersey Point). For example, at CCFB, the mean long-term salinity is projected to increase by 70-80 μmhos/cm (13-15%), and the mean monthly salinity for December is projected to increase by about 140-180 μmhos/cm (15-20%). During dry and critical years, Table 5.3.9b shows that these ranges increase from 100 to 110 μmhos/cm (16-18%) for the long term and from 170 to 210 μmhos/cm (16-19%) on average for the month of December. Alternative 1 would potentially degrade overall in-Delta and export water quality and dependent beneficial uses because of the resultant increases in sea-water intrusion (see Figures 5.2-36 and 37 in Section 5.2). This degradation is projected to occur despite the increased potential for reservoir releases and increased inflows of better quality water across the Delta from the Mokelumne and Sacramento Rivers southward, and the potentially improved water circulation in affected Delta channels.

Compared to existing conditions, salinity is projected to be significantly affected under Alternative 1 in the central Delta, in the south Delta, and in the San Joaquin River in the west Delta (as indicated by Jersey Point).

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta, depending on factors such as the mixtures of source waters attained at each location that result from variations in the pathways and timing of flows through Delta channels. The magnitude of the changes also would vary from variations in annual hydrology. In general, the magnitude of impacts would be increased in dry and critical years, and attenuated in above-normal and wet years.

The actual magnitudes of the salinity changes would vary tidally, seasonally, and spatially throughout the Delta.

~~Increased cross-Delta flows and increased sea-water intrusion, coupled with increases in the concentrations of salts drawn from the San Joaquin River and interior Delta drainage, could act in concert to increase the frequency of higher bromide concentrations at Old and Middle Rivers.~~

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. ~~The effect of the PPA on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.~~

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR for Alternatives 1 and 2 indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (WQPP, California DWR, 1998a, Unpublished data). ~~South Delta improvements associated with the PPA should limit recirculation effects, and the extent to which the PPA includes if a screened diversion at Hood is constructed as part of the PPA along with channel modifications on the Mokelumne River, it would lead to improved bromide water quality at the export facilities.~~

~~Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. The PPA includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.~~

The actual magnitudes of monthly variations in salinity, including bromide, from existing conditions would depend on annual, seasonal, and geographically determined differences in the proportion of sea water present. Bromide is of particular concern to municipal water users because it is an inorganic precursor to several of the most potentially harmful known DBPs (for example, bromodichloromethane, bromate, and brominated halo-acetic acids— known for their roles as carcinogens and potential causes of increased birth defects).

Bay Region

With increased exports from the Delta, Alternative 1 could result in potentially significant impacts by reducing net Delta outflows, resulting in greater sea-water intrusion into the Bay. This could result in increases in salinity in San Francisco, San Pablo, and Suisun Bays.

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

The addition of new storage could improve water quality and dependent conditions for estuarine biological resources in the west Delta as a result of increased Delta outflows, especially during low-outflow periods.

Sacramento River Region

Impacts on water quality associated with Alternative 1 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

San Joaquin River Region

When comparing Alternative 1 to existing conditions, general impacts of storage and conveyance options on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region under the Preferred Program Alternative. However, the potential for significant changes in the quality (and quantity) of the water exported to the region as a result of decisions made during the term of this Program is great, and other non-CALFED programs also will produce effects (see "Cumulative Impacts" in Section 5.3.10). As indicated in Table 5.3-9a, the average annual increase in the salinity of water exported to the San Joaquin River Region via the DMC (assuming an intertie with CCFB) compared to existing conditions is projected to range from 2 to 20% for long-term averages. The resultant net change in salt loads delivered to the valley is more difficult to project because it also would depend on changes in water deliveries, the locations where the water is applied, and source control actions taken. However, the effect would be to increase salt loads and the resultant recycling of salts in the San Joaquin Valley.

The range of potential long-term water supply variations and source-dependent water quality characteristics are sufficiently large to significantly degrade prevailing water quality and the resultant salt balance in the SWP and CVP service areas in the San Joaquin Valley and throughout the valley.

The range of potential long-term water supply variations (possibly in the realm of 790 TAF of gains with new storage to 270 TAF without new storage) and source-dependent water quality characteristics are sufficiently large to significantly degrade prevailing water quality and the resultant salt balance in the SWP and CVP service areas and throughout the San Joaquin Valley. The effects of the potential variations would be most pronounced in those areas that are already deficient in both quality and quantity of water. Resultant changes in land use in the service areas that could secondarily affect water quality, water supply, demands, and beneficial uses of water resources would in turn depend on the magnitude of the reductions in the quality of delivered water supplies. Despite the variability, overall degradation of water quality in the areas served by exports would adversely affect municipal, agricultural, and ecological uses of the water.

Other SWP and CVP Service Areas

Alternative 1 also could result in detrimental impacts on export water quality outside the Central Valley. Impacts on export water quality could result from the changes in flow and salinity patterns throughout the Delta as described above for the Delta Region. Potential impacts would be similar to but less than those described for the water service areas in the San Joaquin Valley.

Impacts on export water quality could result from the changes in flow and salinity patterns throughout the Delta.

5.3.9.3 ALTERNATIVE 2

Delta Region

Potentially beneficial and adverse impacts from implementing Alternative 2 when compared to existing conditions are generally the same as identified in Section 5.3.8.3, where Alternative 2 is compared to the No Action Alternative. Except at Collinsville, the comparison of Alternative 2 to existing conditions did not identify any additional potentially significant environmental consequences that were not identified in Section 5.3.8.3.

Table 5.3-10a summarizes the results of model predictions of salinity changes (expressed as EC) throughout the Delta for Alternative 2 compared to the existing conditions for a representative long-term hydrologic sequence that includes all water-year types (see Section 5.2). Separate predictions are shown based on modeling assuming water management Criterion A(without storage), and water management Criterion B(with storage), which define the bookends for the analysis of water quality. For both sets of criteria, changes are shown for the annual average value over the period of the simulation and for the month of the year when salinity is the highest.

Compared to existing conditions, Table 5.3-10a shows that under Alternative 2, salinity is projected to improve throughout the Delta and at the export facilities. For example, at CCFB, the mean long-term salinity is projected to decrease by 90-190 μmhos/cm (17-39%), and the mean monthly salinity for December is projected to decrease by 400-510 μmhos/cm (44-56%). During dry and critical years, Table 5.3-10b shows that salinity is projected to decrease by 110-240 μmhos/cm (18-39%) for the long term, and to decrease by 490-630 μmhos/cm (45-58%) on average for the month of December. The improvement in water quality is caused by increased flows of higher quality water across the Delta from the Mokelumne and Sacramento Rivers southward, and the improved water circulation in affected Delta channels.

Under Alternative 2, compared to existing conditions, salinity is projected to improve throughout the Delta and at the export facilities.

~~Increased cross-Delta flows, reduced sea-water intrusion, improved circulation, and resultant increases in dispersion and dilution of smaller quantities of ocean salts would act in concert to decrease bromide concentrations at drinking water supply intakes in the Delta.~~

Potentially significant adverse impacts on average annual salinities would be restricted primarily to the lower Sacramento River (for example, Emmaton) due to the diversion of upstream flows into the central and south Delta.

~~Increased cross-Delta flows, reduced sea-water intrusion, improved circulation, and resultant increases in dispersion and dilution of smaller quantities of ocean salts would act in concert to decrease bromide concentrations at drinking water supply intakes in the Delta. The actual magnitudes of monthly variations from existing conditions would depend on hydrologic, seasonal, and geographically determined differences in the proportion of sea water present.~~

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. ~~The effect of the PPA on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.~~

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR for Alternatives 1 and 2 indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (WQPP, California DWR, 1998a, Unpublished data). ~~South Delta improvements associated with the PPA should limit recirculation effects, and the extent to which the PPA includes if a screened diversion at Hood is constructed as part of the PPA along with channel modifications on the Mokelumne River, it would lead to improved bromide water quality at the export facilities.~~

~~Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. The PPA includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.~~

Bay Region

With increased exports from the Delta, Alternative 2 could result in potentially significant impacts by reducing net Delta outflows, resulting in greater sea-water intrusion into the Bay. This could result in increases in salinity in San Francisco, San Pablo, and Suisun Bays.

Sacramento River Region

Impacts of Alternative 2 in the Sacramento River Region would be similar to those described for the Preferred Program Alternative.

San Joaquin River Region

General impacts of storage and conveyance options on upstream water quality in the San Joaquin River Region are expected to be similar to those described for the Sacramento River Region. However, the potential for significant changes in the quality (and quantity) of the water exported to the region as a result of decisions made during the term of this Program is great, and other non-CALFED programs also will produce effects (see "Cumulative Impacts" in Section 5.3.10).

As indicated in Table 5.3-10a, a significant long-term decrease in the salinity (ranging at the DMC from 11 to 36%) of water exported to the San Joaquin River Region is projected under Alternative 2. The resultant net change in salt loads delivered to the San Joaquin River Valley is difficult to project because it would depend on water delivery operations, and other factors; however, based on this analysis alone, long-term salinity loads to the Valley could be significantly reduced. Overall improvements in water quality in the areas served by exports would benefit municipal, agricultural, and ecological uses of the water. Improvements also would reduce the amount of salt recycling that occurs between the basin and the Delta.

A significant long-term decrease in the salinity of water exported to the San Joaquin River Region is projected under Alternative 2.

Other SWP and CVP Service Areas

Alternative 2 also would result in beneficial impacts on export water quality outside the Central Valley. Benefits would result from the improved export water quality as described for the Delta Region. Benefits and potential impacts would be similar to those described earlier for the water service areas in the San Joaquin Valley. Overall water quality improvement benefits should be somewhat greater because more of these service areas are served by SWP exports from CCFB, which receives higher quality water than the CVP.

Alternative 2 also would result in beneficial impacts on export water quality outside the Central Valley.

5.3.9.4 ALTERNATIVE 3

Table 5.3-11a summarizes the results of model simulations of average annual salinity (expressed as EC) throughout the Delta for Alternative 3 compared to existing conditions. Table 5.3-11b summarizes the results of model simulations of average annual EC during dry and critical years throughout the Delta for Alternative 3 compared to existing conditions. The impacts associated with Alternative 3, when compared to existing conditions, generally would be similar to those compared to the No Action Alternative, except in some cases ~~at Emmaton~~, in the Central Delta where the impacts compared to existing conditions would be significant. During dry and critical years, impacts in the Central Delta include a rise in annual EC at Turner Cut of 26% to 29% for Criterion A and Criterion B, respectively. Annual EC is projected to increase at Turner Cut 27% to 25% Criterion A and Criterion B, respectively, under the all-water year model results. The Mokulumne River at Terminous is projected to increase in EC 16% to 21% during dry and critical years, an average of 17% during all water years. Middle River at Tracy Road is expected to increase 16% to 19% under Criterion A (without storage) on the average for all water years and dry and critical years, respectively. ~~also would be similar to the comparison with the No Action Alternative.~~ In general, potentially significant impacts would be larger in magnitude where they occur, especially with Criterion A. Positive impacts for south Delta diversion facilities would experience significantly lower EC with this alternative. It is projected that Clifton Court Forebay would experience water up to 86% lower in EC under this alternative. ~~In other words, future water quality impacts with Alternative 3 are projected to almost always be somewhat larger in magnitude than they would be if the facilities were constructed today.~~

The overall geographic variations in the improvements, and Delta locations where the changes were significant and less than significant may be observed by comparing Table 5.3-11a with Table 5.3-7a. The differences between the comparisons of average annual ECs for Alternative 3 with average annual existing conditions, and annual ECs for Alternative 3 during dry and critical years with existing conditions during dry and critical years generally showed the differences to be more pronounced during the dry and critical years.

The quality of water in the Delta is dependent in large part on how circulation patterns in the Delta affects the movement and mixing of constituents originating from different sources, including in-Delta sources, Bay sources, and tributary sources. The effect of the PPA on constituents therefore will vary depending on how the alternative might alter the mixture of waters arriving at a given location.

The principal source of bromide in the Delta is San Francisco Bay. Although there is evidence that the current conditions in the Delta lead to significant recycling of bromide via the DMC and San Joaquin River, the origin of this bromide is also the Bay. To illustrate the extent of recycling, bromide concentrations from January 1990 to March 1998 in the San Joaquin River averaged 310 ug/l compared with 18 ug/l on the Sacramento River (WQPP, June 1999). Bromide modeling conducted by DWR for Alternatives 1 and 2 indicate that bromide concentrations are predicted to be significantly reduced depending on the extent to which the alternative limits recirculation of San Joaquin River water and preferentially conveys Sacramento River water to the export facilities (WQPP, California DWR, 1998a, Unpublished data). South Delta improvements associated with the PPA should limit recirculation effects, and the extent to which the PPA includes if a screened diversion at Hood is constructed as part of the PPA along with channel modifications on the Mokelumne River, it would lead to improved bromide water quality at the export facilities.

Data indicate that the major source of TOC at the export facilities is in-Delta drainage return (WQPP, Section 3.7.2). Therefore any conveyance alternative that relies on through-Delta conveyance will have limited effects on TOC concentrations. Control of organic carbon at the source, namely island drainage treatment, is therefore the primary option to consider. The PPA includes as an Early Implementation Action, pilot testing of treatment methods which, if proven to be technically and economically feasible, could lead to reductions in TOC at export facilities.

5.3.10 ADDITIONAL IMPACT ANALYSIS

Cumulative Impacts. The CALFED Program involves the approval of a program to restore the ecological health and improve water management for beneficial uses of the Bay-Delta system. The Program is a general description of a range of actions that will be further refined, considered and analyzed for site specific environmental impacts as part of second and third tier environmental documents prior to making a decision to carry out these later actions. The PEIS/EIR focuses on a general overview of cumulative impacts and associated mitigation measures. Because this Programmatic EIS/EIR does not analyze the site specific impacts of any projects, a detailed analysis of the Program's incremental contributions to cumulative impacts and the methods to mitigate the cumulative impacts of second-tier projects within the scope of this PEIS/EIR is not possible.

Later EIRs and EISs will be able to incorporate the cumulative and long-term impact analyses of this programmatic document and add detail about specific projects and their contribution to cumulative impacts. Subsequent project-level studies will also address the individual project's incremental contribution to cumulative impacts, and where appropriate, consider proposed strategies and mitigation measures to avoid, reduce or mitigate the project's contribution to cumulative impacts.

The incremental impact of the Preferred Program Alternative, when added to other past, present, and reasonably foreseeable future actions, could result in cumulative impacts on water quality resources.

This section identifies where Program actions could also contribute to significant adverse cumulative impacts on water quality. In doing so, those significant adverse cumulative impacts for which the Program's incremental contribution could be avoided or mitigated to less than cumulatively considerable are identified, as well as those impacts which, regardless of efforts to avoid, reduce or mitigate, will remain unavoidable. Refer to Chapter 3 for a summary of cumulative impacts. Refer to Attachment A for a list and description of the projects and programs considered in concert with the Preferred Program Alternative in this cumulative analysis.

For water quality, the analysis and conclusions regarding the significance of the Preferred Program Alternative's incremental contribution to cumulative impacts and the ability to avoid, reduce or mitigate those cumulative impacts, are the same as the analysis and conclusions regarding the Preferred Program Alternative's long-term impacts. This is in part because the long-term nature of Program and the wide range of actions that come within the scope of the Program's potential future actions. The potentially significant adverse long-term impacts and mitigation strategies that can be used to avoid, reduce or mitigate these impacts are listed in summary form in Section 5.3.1. The impact which cannot be avoided at the programmatic level is noted on the list in **bold type**. The long-term impacts are elaborated upon in Sections 5.3.7 and 5.3.8. Even though the Program's contribution to a cumulative impact is considered unavoidable at the programmatic level of analysis, it is possible that the individual project's contribution to cumulative impacts at the project-level of review, may be less than significant, or cumulatively considerable, through avoidance of these impacts, or through application of these mitigation strategies and the addition of new, site-specific mitigation measures.

The incremental impact of the Preferred Program Alternative when added to the potential impacts of the following projects would result in potentially significant adverse cumulative impacts on water quality in the Delta, Bay, Sacramento River, San Joaquin River and Other SWP and CVP Service Areas Regions: American River Water Resources Investigation, American River Watershed Project, Delta Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento Water Forum Process, EBMUD Supplemental Water Supply Project, Sacramento County Municipal and Industrial Water Supply Contracts and urbanization. The Trinity River Restoration Project and ISDP would cause water quality effects in the Program study area that were considered in the environmental impact analysis presented in Sections 5.3.7 and 5.3.8 of this chapter. At the programmatic level of analysis, the CALFED Program's incremental contribution to cumulative impacts resulting from environmental consequences listed in Section 5.3.1 are expected to be avoided, reduced or mitigated to a less than cumulatively considerable impact, with the exception of reduced freshwater outflow to the Bay causing a slight increase in average salinity and reduced flushing of the South Bay and potential growth related increases in discharge of nonpoint source pollutants to water bodies. These potentially unavoidable impacts could affect all Regions and are discussed in Section 5.3.12. It is not anticipated that the CALFED Program's contribution to this cumulative impact, at the programmatic level, can be avoided, reduced or mitigated to a less than cumulatively considerable impact.

~~Cumulative Impacts. The incremental impact of the Preferred Program Alternative, when added to other past, present, and reasonably foreseeable future actions, could result in cumulative impacts on water quality resources. For a summary of cumulative impacts for all resource categories, please refer to Chapter 3. For the list and a description of the projects and programs considered in this analysis of cumulative impacts, please see Attachment A.~~

~~Projects and actions that are assumed to be included under existing conditions and under the No Action Alternative were described earlier, along with the discussion of impacts of the No Action Alternative compared to the existing conditions. Related past, present, and probable future projects and actions have been evaluated for their potential to contribute to cumulative~~

effects. The cumulative impacts of all of these projects combined with the Preferred Program Alternative are listed below.

The following projects would result in negligible effects on water quality in the Bay-Delta system: the components of the CVPIA that are not included in the No Action Alternative, CCWD Multi-Purpose Pipeline Project, Hamilton City Pumping Plant Fish Screen Improvement Project, Montezuma Wetlands Project, Red Bluff Diversion Dam Fish Passage Program, Sacramento River Flood Control System Evaluation, West Delta Watershed Program, and the Sacramento River Conservation Area Program. The Trinity River Restoration Project and Interim South Delta Program (ISDP) cause water quality effects that were considered in the environmental impact analysis presented in Sections 5.3.7 and 5.3.8 of this chapter, and, therefore, would not cause additional cumulative effects. Consequently, these projects would not contribute to cumulative impacts on water quality and are not considered further in this cumulative impact analysis.

The American River Water Resources Investigation, American River Watershed Project, Delta Wetlands Project, Pardee Reservoir Enlargement Project, Sacramento Water Forum Process, EBMUD Supplemental Water Supply Project, Sacramento County Municipal and Industrial Water Supply Contracts and urbanization could cause environmental consequences that, when combined with Program actions, would result in cumulative impacts.

Changes in salinity due to lower flows and increased exports would result in a potentially significant cumulative impact in the Bay Region.

The water management projects listed in Attachment A and Program actions could lead to or involve increased storage and diversion of water. These projects cumulatively would reduce flows in tributary rivers and the Delta during high-flow periods and may increase flows in river reaches and Delta channels upstream of diversions during low-flow periods. The flow changes could result in cumulative effects on water quality. Changes in salinity due to lower flows and increased exports would result in a potentially significant cumulative impact in the Bay Region. Salinity increases in the Delta and lower Sacramento River could result in potentially significant adverse cumulative impacts on water quality of in-stream and consumptive use water resources. Mitigation measures have been identified that would reduce the impacts for Program actions and the projects included in Attachment A. Nevertheless, these cumulative effects in the Bay, Delta, and Other SWP and CVP Service Area Regions are considered potentially significant.

Projects listed in Attachment A and Program actions that involve construction, dredging, or drainage of flooded lands have the potential to release inorganic and organic suspended solids; and the potential for releases of toxic substances, such as pesticide, selenium, and heavy metal residues into the water column. These releases could result in potentially significant adverse cumulative impacts on the water quality of in-stream and consumptive use water resources. Mitigation measures have been identified that would reduce the impacts for Program actions and the projects included in Attachment A. Nevertheless, these cumulative effects are considered potentially significant in all Program regions.

To the extent that Program actions and projects listed in Attachment A lead to potential growth increases, this growth in combination with urbanization would result in a cumulative increase in discharge of nonpoint source pollutants to water bodies, with a consequent adverse effect on water quality of in-stream and consumptive use water resources. Nonpoint sources largely are unregulated, and mitigation depends on local voluntary efforts. This cumulative impact is considered potentially significant in all Program regions.

Cumulative impacts regarding bromide concentration increases are considered potentially significant.

Projects listed in Attachment A and Program actions could lead to increased bromide concentrations in certain Delta water areas. Program impacts are considered potentially significant adverse impacts regarding bromide concentration increases. The additional increases due to projects included in Attachment A would result in potentially significant adverse cumulative impacts on the water quality of in-stream and consumptive use water resources. Mitigation measures have been identified that would reduce the impacts for Program actions and for projects included in Attachment A. Nevertheless, these cumulative effects are considered potentially significant in the Delta Region and in the Other SWP and CVP Service Areas.

Projects listed in Attachment A and Program actions could lead to increased TDS content in certain Delta channels. The Program actions are considered potentially significant unavoidable impacts on the suitability of the water as a source for agricultural irrigation. The additional increases due to projects in Attachment A would result in potentially significant adverse cumulative impacts. Mitigation measures have been identified that would reduce the impacts for Program actions and the projects included in Attachment A. Nevertheless, these cumulative effects are considered potentially significant in the Delta Region.

Projects listed in Attachment A and Program actions could lead to increased TOC in river and Delta water areas. The Program actions are considered potentially significant adverse impacts regarding TOC increases. The additional increases due to projects in Attach-ment A would result in potentially significant adverse cumulative impact on the water quality of in-stream and consumptive use water resources. Mitigation measures have been identified that would reduce the impacts for Program actions and for projects included in Attachment A. Nevertheless, these cumulative effects are considered potentially significant in the Delta Region and in the Other SWP and CVP Service Areas.

Projects listed in Attachment A and Program actions could lead to increased water temperatures and resultant decreased dissolved oxygen concentrations due to the increased residence time of water in channels that are widened or restored to meandering patterns.

Projects listed in Attachment A and Program actions could lead to increased water temperatures and resultant decreased dissolved oxygen concentrations due to the increased residence time of water in channels that are widened or restored to meandering patterns. The Program actions are considered potentially significant adverse impacts regarding temperature increases and decreases in dissolved oxygen. The additional increases due to projects in Attachment A would result in cumulative impacts. Mitigation measures have been identified that would reduce the impacts for Program actions and for projects included in Attachment A. Nevertheless, these cumulative effects are considered potentially significant in all Program regions except in the Other SWP and CVP Service Areas.

Mitigation strategies have been identified that would reduce the impacts for Program actions and for projects included in Attachment A. Project-specific mitigation strategies that could be used are presented in Section 5.3.12. Other strategies could include operating the projects to minimize adverse effects on water quality. Effects on water quality will be addressed during project authorization or establishment of water rights. Nevertheless, the cumulative effects on water quality are considered potentially significant.

Cumulative effects on water quality are considered potentially significant.

Growth-Inducing Impacts. The Preferred Program Alternative would increase the reliability of water for municipal and agricultural use in the San Joaquin Valley, in central and southern coastal regions, and in southern California. Growth-inducing impacts could be caused by beneficial impacts on water quality associated with the Preferred Program Alternative. These impacts could include economic or population growth, or the construction of new housing stimulated by increased reliability of water supply. The degree of growth-inducing impact would depend on the locations of these activities and other factors dependent on the location. The significance of the growth-inducing impact cannot be determined at the programmatic level.

~~The potential growth induced by the Preferred Program Alternative could would result in indirect adverse impacts on water quality. Undeveloped lands converted to urban and agricultural uses could become a source of nonpoint pollutants. These pollutants, which would include TSS, pesticides, nutrients and toxic metals, would be delivered to waterways from urban and agricultural runoff. The volume of municipal wastewater and irrigation tailwater discharged to water bodies could would increase, and in-stream water quality could would be degraded.~~

~~The growth induced by the Preferred Program Alternative would could result in indirect adverse impacts on water quality.~~

~~Alternative 1 would induce less growth than the Preferred Program Alternative. Alternative 3 would induce more growth than the Preferred Program Alternative. The effects of Alternative 2 on growth would be similar to those described for the Preferred Program Alternative.~~

Short- and Long-Term Relationships. The Preferred Program Alternative generally would maintain and enhance long-term productivity of water quality but may cause adverse impacts on water quality resulting from short-term uses of the environment.

The Preferred Program Alternative would result in short-term adverse effects on water quality during the construction of facilities that are included in each alternative. The contaminant of concern most affected would be TSS. TSS concentrations are likely to be increased in the immediate vicinity of construction activities. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on these resources. The short-term impacts of the Preferred Program Alternative on water quality would be greater than, but similar to, those of Alternative 1, and less than those of Alternatives 2 and 3.

The short-term impacts on water quality of the Preferred Program Alternative would be offset by long-term improvements. The Ecosystem Restoration, Water Quality, and Watershed Program elements would result in long-term positive impacts on water quality for aquatic life and municipal and agricultural supply. The Levee System Integrity Program and the Storage and Conveyance elements of all Program alternatives would result in little effect on water quality for aquatic life but would improve the quality of water diverted from the Delta for municipal and agricultural use at some locations, with one exception. The reduction in total Delta outflow to San Francisco Bay could adversely affect water quality in the Bay.

The reduction in total Delta outflow to San Francisco Bay could adversely affect water quality in the Bay.

Irreversible and Irretrievable Commitments. The irreversible and irretrievable commitments of resources associated with the Preferred Program Alternative would not affect water quality.

5.3.11 MITIGATION STRATEGIES

These mitigation strategies will be considered during project planning and development. Specific mitigation measures will be adopted consistent with the Program goals and objectives and the purposes of site-specific projects. Not all mitigation strategies will be applicable to all projects because site-specific projects will vary in purpose, location and timing.

Specific mitigation measures will be adopted consistent with the Program goals and objectives and the purposes of site-specific projects.

TOC increases may be mitigated by locating created wetlands away from drinking water intakes, by treating wetland discharges, or by treating water to remove TOC before it is disinfected and supplied to water system customers.

Ecosystem Restoration Program. The Ecosystem Restoration Program element could increase the TOC content of Delta waters. If tests show that TOC increases would occur, wetland creation projects could be located away from the municipal water supply intakes or the diverted water could be treated to remove TOC. The Water Use Efficiency and Water Transfer Program elements of the alternatives, would result in some localized adverse impacts on water quality which could be mitigated, in most cases, by release of greater volumes of fresh water from upstream reservoirs.

TOC increases may be mitigated by locating created wetlands away from drinking water intakes, by treating wetland discharges, or by treating water to remove TOC before it is disinfected and supplied to water system customers. ~~Mitigation may not be available to reduce impacts to less-than-significant levels.~~

Construction activities for the Levee System Integrity Program would be similar to and integrated with those described for the Eco-system Restoration Program.

Levee System Integrity Program. Construction activities for the Levee System Integrity Program would be similar to and integrated with those described for the Ecosystem Restoration Program. Existing levees would be demolished, and new levees would be constructed— either at or close to the site of the original levees or set back some distance from the original levees if a channel is to be widened or a wetland created. Short-term effects on water quality would be similar to those described for the Ecosystem Restoration Program but would occur only in the Delta Region. Local increases in the TSS content of waters in Delta channels are expected. Some increase in nutrient and TOC concentrations also may occur. Toxic substances contained in old levees or in channel sediments could be released during demolition or dredging.

It is expected that short-term construction impacts can be reduced to a less-than-significant level by employing construction methods that minimize in-water construction and by applying appropriate mitigation measures.

It is expected that short-term construction impacts can be reduced to a less-than-significant level by employing construction methods that minimize in-water construction and by applying appropriate mitigation <u>strategies</u> ~~measures~~. Soils in the levees and channel sediments would be tested prior to commencement of construction so that the need for special mitigation measures can be determined.

Water Use Efficiency Program. Increased water use efficiency would adversely affect water quality when the volume of municipal wastewater or agricultural tailwater discharged to a stream is reduced but the mass load of salts and other contaminants in the discharge remains the same. The adverse effect would be most pronounced in streams where municipal or agricultural discharges represent a substantial proportion of streamflow. Adverse effects would occur most acutely in small streams in the Sacramento River and San Joaquin River Regions, downstream of municipal and agricultural wastewater discharges.

It is expected that, in most cases the localized adverse water quality impacts of the program can be mitigated to less-than-significant levels by increasing treatment of wastewater before it is discharged to waterways or increasing fresh-water releases from reservoirs to provide more dilution water.

Reduced streamflows in the Delta and in the Sacramento River and San Joaquin River Regions would adversely affect water quality.

Water Transfer Program. Reduced streamflows in the Delta and in the Sacramento River and San Joaquin River Regions would adversely affect water quality. Contaminant concentrations in streams would increase as the volume of dilution water decreased, and water temperatures may be elevated. The adverse effects of water transfers would be greatest if water is diverted at an upstream location in the Bay-Delta system and transferred in a pipeline or canal to the area of use.

The adverse impacts of water transfers on water quality could be lessened by requiring transferred water to be conveyed through natural channels to the area of use where feasible.

Most of the long-term adverse effects of surface and ground-water storage on water quality could be reduced to a less-than-significant level by various mitigation measures.

Storage. Most of the long-term adverse effects of surface and groundwater storage on water quality could be reduced to a less-than-significant level by various mitigation measures. Surface water reservoirs could be sited to avoid areas where rocks contain mercury or other potentially hazardous substances. If avoidance is impossible, rock outcrops could be covered with inert materials and vegetation cleared from the site to minimize the development of anaerobic conditions at the bottom of reservoirs. Outlet works at the reservoirs could be designed with multiple outlet portals to minimize depression of dissolved oxygen concentrations, to minimize the elevation of dissolved nitrogen concentrations, and to better control the temperature of released water. Water could be released from surface storage reservoirs to simulate natural flows in the small stream on which they are built. ~~The potentially significant impacts of a reduction in the magnitude and frequency of high Delta outflows on water quality in San Francisco Bay would be unavoidable.~~

Point and Nonpoint Source Loads Attributable to Growth. Growth induced by the Preferred Program Alternative in conjunction with other non-CALFED actions with growth-inducing impacts would result in indirect adverse effects on water quality. Water quality would be degraded by increased discharge of contaminants in municipal wastewater and urban runoff. Degradation of water quality from point sources of pollutants could be mitigated by increases in treatment. Degradation of water quality by nonpoint sources is more difficult to mitigate. The available mitigation strategies for nonpoint sources include implementing various BMPs but they are expected to largely fall short of fully offsetting the overall increase in nonpoint source loads attributable to growth.

Water quality would be degraded by increased discharge of contaminants in municipal wastewater and urban runoff.

The following mitigation strategies related to nonpoint source loads:

- Improving treatment levels provided at municipal wastewater treatment plants to upgrade the quality of the constituents (other than dissolved inorganic solids) discharged to receiving waters in order to compensate for the reduction in dilution caused by improved water use efficiency or water transfers.

- Releasing additional water from enlarged or additional off-stream surface storage, or from additional groundwater storage.

- Releasing additional water from storage in existing reservoirs or groundwater basins.

- Improving water treatment facilities, either at the point of consumption or at the source, to remove TOC. Using a mix of alternative source waters to reduce the influent bromide concentration.

- Using innovative, cost-effective disinfection processes (for example, ultra-filtration, UV irradiation, and ozonation— in combination with other agents) that form fewer or less harmful DBPs.

- Using existing river channels for water transfers and timing the transfers to avoid adverse water quality impacts.

- Using best construction and drainage management practices to avoid transport of soils and sediments into waterways.

- Using cofferdams to construct levees and channel modifications in isolation from existing waterways.

- Using sediment curtains to contain turbidity plumes during dredging.
- Relocating water supply intakes away from discharges of agricultural and urban runoff.
- Applying agricultural and urban BMPs, and treating drainage from lands to reduce contaminants (for example, treating drainage from agricultural lands underlain by peat soils to remove TOC).
- Relocating diversion intakes to locations with better source water quality.
- Restoring additional riparian vegetation to increase shading of channels.

5.3.12 POTENTIALLY SIGNIFICANT UNAVOIDABLE IMPACTS

Certain potentially significant adverse impacts on water quality that are associated with the Preferred Program Alternative cannot be reduced to a less-than-significant level by mitigation. These impacts are an unavoidable consequence of implementing the Preferred Program Alternative.

The Draft PEIS/EIR stated that salinity increases in isolated sections of the Delta, San Francisco Bay, San Pablo Bay, and Suisun Bay would be potentially significant and un avoidable. According to modeling results included in the Draft PEIS/EIR (Table 5.3-4) all salinity changes were projected to be less than significant. Therefore paragraphs referring to potentially significant changes in salinity were deleted.

~~Although the Preferred Program Alternative would improve water quality at many locations in the Delta, it would cause water quality to deteriorate in others. The increased TDS content of water in certain Delta channels would result in a potentially significant and unavoidable impact on the suitability of the water as a source for agricultural irrigation.~~

~~The Preferred Program Alternative could result in an increase in the total amount of water that could be diverted from the south Delta, with a concomitant reduction in the total volume of fresh water outflow from the Delta to San Francisco Bay. The resultant changes in salinity of Bay waters would be potentially significant and unavoidable.~~

~~The Preferred Program Alternative would allow an increase in the total amount of water that could be diverted from the south Delta, with a concomitant reduction in the total volume of fresh water outflow from the Delta to San Francisco Bay.~~

~~Potential growth induced by the Preferred Program Alternative would result in increased discharges of nonpoint source pollutants to water bodies, with a consequent potentially significant impact on in-stream water quality. Nonpoint sources are largely unregulated, and mitigation depends on local voluntary efforts. The potentially significant adverse impacts of increased discharges of nonpoint source pollutants from growth induced by the Preferred Program Alternative are unavoidable.~~