COMPREHENSIVE REPORT
ACTIONS AND CATEGORIES

Prepared for:

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TABLE OF CONTENTS

RESTORATION OF BAY-DELTA SYSTEM SHALLOW WATER (TIDAL) HABITAT 1-1

General Actions for the Restoration of Delta Shallow Water Habitat 1-1

Actions for the Restoration of In-channel Delta Islands 1-2

Site Specific Actions for the Restoration of Delta Shallow Water Habitat 1-2

RESTORATION OF BAY-DELTA SYSTEM RIVERINE HABITAT 2-1

RESTORATION OF BAY-DELTA SYSTEM RIPARIAN HABITAT 3-1

General Actions for the Restoration of Delta Riparian Habitat 3-1

Actions for the Restoration of Delta Shaded Riverine Habitat 3-3

Site Specific Actions for the Restoration of Delta Riparian Habitat 3-3

RESTORATION OF BAY-DELTA SYSTEM WETLAND HABITAT 4-1

General Actions for Restoration of Wetland Habitat 4-1

Site Specific Actions for the Restoration of Delta Wetland 4-2

Actions to Acquire Additional Wetland Habitat 4-3

Actions for Funding Delta Wetland Restoration 4-3

Actions to Increase the Enforcement of Existing Wetland Regulations 4-4

Recommended Policy Changes for the Protection of Wetlands 4-4

Actions for the Development and Implementation of Wetland Programs 4-4

Actions for the Protection of Wetlands 4-4

Actions for Research and Further Study of Wetlands 4-5

Actions for Wetland Education and Public Out-Reach 4-5

RESTORATION OF BAY-DELTA SYSTEM TERRESTRIAL HABITAT 5-1

General Actions for the Management of Delta Terrestrial Habitat 5-1

Site Specific Actions for the Restoration of Delta Terrestrial Habitat 5-1

IMPLEMENTATION OF INTEGRATED HABITAT MANAGEMENT PROGRAMS 6-1

General Actions for the Management of Fish and Wildlife Habitat 6-1

General Actions for Habitat Planning 6-2

Actions to Develop and Implement Specific Habitat Management Plans 6-5

Actions for Recommended Changes in Policy 6-6

Actions for the Implementation of Habitat Management Programs 6-6

Actions for the Management of Water Quality Affecting Fish and Wildlife 6-7

Actions for Research and Further Study of Biological Resources 6-7

Actions for the Development of Habitat at Specific Sites within the Bay-Delta 6-9

Actions for Education and Public Out-Reach on Biological Resources 6-9

Actions for the Funding of Habitat Management Practices 6-10

Actions to Manage Special Status Fish Species 6-11

- General 6-11
- Delta Smelt 6-11
- Green Sturgeon 6-12
- Striped Bass 6-12
- Sacramento Splittail 6-12
- Winter-run Chinook Salmon 6-12

Actions to Manage Terrestrial Special Status Species 6-12

- General 6-12
- Invertebrates 6-13
- Aleutian Canada Goose 6-13
- California Black Rail 6-14

California Clapper Rail 6-14

California Least Tern 6-14

Giant Garter Snake 6-15

Greater Sandhill Crane 6-15

Swainson's Hawk 6-16

Salt Marsh Harvest Mouse 6-16

Special Status Plants 6-17

ESTABLISHMENT OF FLOODWAYS AND MEANDER BELTS 7-1

CONTROL OF INTRODUCED SPECIES 8-1

DELTA WATERFOWL HABITAT MANAGEMENT 9-1

General Actions for the Management of Waterfowl Habitat 9-1

Actions for Waterfowl Habitat Planning 9-1

Actions to Provide Incentives for Waterfowl Habitat 9-1

Actions for Research and Further Study of Waterfowl and Waterfowl Habitat 9-3

Actions for Site Specific Waterfowl Habitat Planning 9-3

RESTORATION OF UPSTREAM ANADROMOUS FISH HABITAT 10-1

General Actions to Improve Upstream Anadromous Fish Habitat 10-1

Actions to Improve Anadromous Fish Habitat on Antelope Creek 10-4

Actions to Improve Anadromous Fish Habitat on the American River 10-5

Actions to Improve Anadromous Fish Habitat on Battle Creek 10-5

Actions to Improve Anadromous Fish Habitat on Bear Creek 10-6

Actions to Improve Anadromous Fish Habitat on the Bear River 10-6

Actions to Improve Anadromous Fish Habitat on Big Chico Creek 10-7

Actions to Improve Anadromous Fish Habitat on Butte Creek 10-7

Actions to Improve Anadromous Fish Habitat on the Calaveras River 10-8

Actions to Improve Anadromous Fish Habitat on Clear Creek 10-8

Actions to Improve Anadromous Fish Habitat in the Colusa Basin Drain 10-9

Actions to Improve Anadromous Fish Habitat on Cottonwood Creek 10-9

Actions to Improve Anadromous Fish Habitat on the Cosumnes River 10-9

Actions to Improve Anadromous Fish Habitat on Cow Creek 10-10

Actions to Improve Anadromous Fish Habitat on Deer Creek 10-10

Actions to Improve Anadromous Fish Habitat on Elder Creek 10-10

Actions to Improve Anadromous Fish Habitat on the Feather River 10-10

Actions to Improve Anadromous Fish Habitat on the Merced River 10-11

Actions to Improve Anadromous Fish Habitat on Mill Creek 10-12

Actions to Improve Anadromous Fish Habitat on the Mokelumne River 10-13

Actions to Improve Anadromous Fish Habitat on Mud Creek 10-14

Actions to Improve Anadromous Fish Habitat on Paynes Creek 10-14

Actions to Improve Anadromous Fish Habitat on the Sacramento River 10-14

Actions to Improve Anadromous Fish Habitat on the San Joaquin River 10-19

Actions to Improve Anadromous Fish Habitat on the Stanislaus River 10-21

Actions to Improve Anadromous Fish Habitat on Stony Creek 10-22

Actions to Improve Anadromous Fish Habitat on Thomes Creek 10-22

Actions to Improve Anadromous Fish Habitat on the Trinity River 10-23

Actions to Improve Anadromous Fish Habitat on the Tuolumne River 10-24

Actions to Improve Anadromous Fish Habitat on the Yuba River 10-25

IMPROVEMENT FOR UPSTREAM FISH PASSAGE 11-1

General Actions to Improve Upstream Fish Passage 11-1

Actions to Improve Anadromous Fish Passage on Antelope Creek 11-1

Actions to Improve Anadromous Fish Passage on Battle Creek 11-1

Actions to Improve Anadromous Fish Passage on Big Chico Creek..... 11-1

Actions to Improve Anadromous Fish Passage on Butte Creek 11-2

Actions to Improve Anadromous Fish Passage on the Calaveras River 11-3

Actions to Improve Anadromous Fish Passage on Clear Creek 11-3

Actions to Improve Anadromous Fish Passage on the Cosumnes River 11-3

Actions to Improve Anadromous Fish Passage on Cottonwood Creek 11-3

Actions to Improve Anadromous Fish Passage within the Delta..... 11-4

Actions to Improve Anadromous Fish Passage on Deer Creek..... 11-4

Actions to Improve Anadromous Fish Passage on Elder Creek 11-4

Actions to Improve Anadromous Fish Passage on the Feather River..... 11-4

Actions to Improve Anadromous Fish Passage on the Merced River..... 11-4

Actions to Improve Anadromous Fish Passage on Mill Creek..... 11-4

Actions to Improve Anadromous Fish Passage on the Mokelumne River..... 11-4

Actions to Improve Anadromous Fish Passage on the Sacramento River 11-5

Actions to Improve Anadromous Fish Passage on the San Joaquin River..... 11-11

Actions to Improve Anadromous Fish Passage on the Stanislaus River..... 11-11

Actions to Improve Anadromous Fish Passage on Stoney Creek..... 11-11

Actions to Improve Anadromous Fish Passage on Thomes Creek 11-11

Actions to Improve Anadromous Fish Passage on the Tuolumne River 11-11

Actions to Improve Anadromous Fish Passage on the Yuba River..... 11-11

RESTORATION OF UPSTREAM RIPARIAN HABITAT 12-1

General Actions for the Restoration of Upstream Riparian Habitat 12-1

Site Specific Actions for the Restoration of Upstream Riparian Habitat 12-2

RESTORATION OF UPSTREAM WETLANDS HABITAT 13-1

General Actions for the Restoration of Upstream Wetlands Habitat 13-1

Site Specific Actions for the Restoration of Upstream Wetland Habitat 13-2

DELTA INFLOW/OUTFLOW/EXPORT MANAGEMENT 14-1

Actions to Manage Delta Inflow and Outflow 14-1

Actions to Manage Delta Exports 14-2

Actions to Manage Outflow and Salinity 14-3

Actions to Manage In-Delta Circulation 14-5

Actions to Modify SWP and CVP Operations 14-6

Actions for Water Importation/Supplemental Water 14-9

MODIFICATION OF DIVERSION TIMING PATTERNS 15-1

INCREASED RATES OF DIVERSION CAPACITY 16-1

Actions to Increase the Rates of Diversion Capacity at the SWP 16-1

Actions to Increase the Rates of Diversion Capacity at Other Diversions 16-1

ACQUISITION OF LONG-TERM WATER SUPPLIES FOR FISH AND WILDLIFE 17-1

General Actions for the Acquisition of Long-Term Water Supplies for Fish and Wildlife 17-1

Actions for the Diversion and Conveyance of Fish and Wildlife Water Supplies 17-2

Actions to Manage Instream Flow for Fishery Resources 17-6

Actions to Mange Refuge Water Supplies 17-6

Actions for Long-Term Water Supply Planning for Fish and Wildlife 17-7

Action Strategies for the Long-Term Allocation of Water for Fish and Wildlife 17-8

INSTALLATION AND IMPROVEMENT OF FISH SCREENS 18-1

General Actions to Install or Improve Fish Screens 18-1

Actions to Install or Improve Fish Screens on the American River 18-1

Actions to Install or Improve Fish Screens on Battle Creek 18-1

Actions to Install or Improve Fish Screens on Bear Creek 18-2

Actions to Install or Improve Fish Screens on the Bear River 18-2

Actions to Install or Improve Fish Screens on Big Chico Creek 18-2

Actions to Install or Improve Fish Screens on Butte Creek 18-2

Actions to Install or Improve Fish Screens on the Calaveras River 18-3

Actions to Install or Improve Fish Screens on the Cosumnes River 18-3

Actions to Install or Improve Fish Screens on Cow Creek 18-3

Actions to Install or Improve Fish Screens on the Feather River 18-3

Actions to Install or Improve Fish Screens on the Merced River 18-3

Actions to Install or Improve Fish Screens within the Suisun Marsh 18-3

Actions to Install or Improve Fish Screens within the Sacramento-San Joaquin Delta 18-5

General Locations 18-5

Agricultural Diversions 18-6

Installation at Specific Locations within the Delta 18-6

Improvement of Existing Facilities 18-8

Actions to Install or Improve Fish Screens on Little Chico Creek 18-8

Actions to Install or Improve Fish Screens on the Merced River 18-8

Actions to Install or Improve Fish Screens on the Mokelumne River 18-8

Actions to Install or Improve Fish Screens on the Sacramento River 18-9

Actions to Install or Improve Fish Screens on the San Joaquin River 18-10

Actions to Install or Improve Fish Screens on the Stanislaus River 18-11

Actions to Install or Improve Fish Screens on the Tuolumne River 18-11

Actions to Install or Improve Fish Screens on the Yuba River 18-12

Actions to Install or Improve Fish Screens at Various Locations within the Bay Area 18-12

IMPROVEMENT OF BAY-DELTA SYSTEM FISH MIGRATION 19-1

General Actions for the Installation of Barriers to Guide Fish Movement 19-1

Installation of Barriers to Guide Fish Movement on Battle Creek 19-1

Installation of Barriers to Guide Fish Movement on Cottonwood Creek 19-1

Installation of Barriers to Guide Fish Movement within the Delta 19-1

Installation of Barriers to Guide Fish Movement on the Merced River 19-3

Installation of Barriers to Guide Fish Movement on the Mokelumne River 19-3

Installation of Barriers to Guide Fish Movement on the Sacramento River 19-3

Installation of Barriers to Guide Fish Movement on the San Joaquin River 19-3

IMPROVEMENT OF FISH SALVAGE OPERATIONS 20-1

General Actions for the Improvement of Fish Salvage Operations 20-1

Actions to Improve Fish Salvage Operations at the Delta Export Facilities 20-1

REMOVAL AND CONTROL OF AQUATIC PREDATORS 21-1

General Actions to Manage Predator Populations 21-1

Actions to Manage Predator Populations in the Delta 21-1

Actions to Manage Predator Populations in the Mokelumne River 21-1

Actions to Manage Predator Populations in the Sacramento River 21-1

Actions to Manage Predator Populations in the San Joaquin River 21-1

Actions to Manage Predator Populations in the Yuba River 21-1

FISH HATCHERY OPERATIONS 22-1

General Actions for Fish Hatchery Operation 22-1

Actions for Hatchery Management of Winter-run Salmon Populations 22-2

Actions for Fish Hatchery Operation on Big Creek 22-2

Actions for Fish Hatchery Operation on the Sacramento River and its Upper Tributaries 22-2

Actions for Fish Hatchery Operation within the Delta 22-3

Actions for Fish Hatchery Operation on the American River 22-3

Actions for Fish Hatchery Operation on the Feather River 22-3

Actions for Fish Hatchery Operation on the San Joaquin River 22-3

Actions for Fish Hatchery Operation on the Mokelumne River 22-4

FISH HARVEST MANAGEMENT 23-1

Actions for the Harvest Management and the Commercial Fishing Industry 23-1

Actions to Manage Fish Harvest and Modify Current Sportfishing Regulations 23-1

Actions to Increase Law Enforcement and Reduce Poaching 23-2

Actions for Research and Further Study 23-3

DESALINATION 24-1

General Actions for Desalination 24-1

Site Specific Actions for Desalinization 24-1

WATER CONSERVATION 25-1

General Actions for Water Conservation Planning 25-1

General Actions to Conserve Water in Agricultural Operations 25-4

Specific Actions to Conserve Water in Agricultural Operations 25-6

Actions to Reduce Industrial/Commercial Water Use 25-9

Actions to Reduce Urban Water Use 25-10
General 25-10
Landscaping 25-10
Metering 25-11
Specific Implementation Measures for Conservation 25-11
Financial Incentives for Water Conservation 25-12
Water Conservation Cost Sharing 25-12
Actions for Water Conservation Education and Public Out-Reach 25-13
WATER RECLAMATION 26-1
General Actions for the Use of Reclaimed Water 26-1
Actions for Agricultural Uses of Reclaimed Water 26-2
Actions to Manage Water Quality of Reclaimed Water 26-2
Actions for the Use of Reclaimed Water for Environmental Use 26-2
Actions for the Industrial Use of Reclaimed Water 26-2
Actions for the Treatment of Reclaimed Water 26-3
Actions for the Transport of Reclaimed Water 26-3
Actions for Water Reclamation Education and Public Out-Reach 26-3
Actions for the Research and Further Study of Water Reclamation 26-4
LAND RETIREMENT AND FALLOWING 27-1
General Actions for the Planning of Land Retirement and Fallowing 27-1
Site Specific Actions for Land Retirement and Fallowing 27-2
WATER PRICING 28-1
WATERSHED MANAGEMENT 29-1
General Watershed Management Actions 29-1

Actions to Improve Water Quality 29-3

Actions to Increase Water Yield 29-4

Actions for Managing in-Delta Water Quality 29-5

General Actions to Manage Point and Non-point Sources of Contamination 29-5

Actions to Change Water Quality Policy 29-18

Actions to Modify the Weather and Manage Snowpack 29-20

Actions for the Funding of Watershed Management Programs 29-22

NEW OR EXPANDED ON-STREAM STORAGE 30-1

General Action for On-Stream Storage Facilities and Projects 30-1

Actions for Increased Storage Down-Stream from the Delta 30-1

Actions for Increased Storage Upstream from the Delta 30-1

NEW OR EXPANDED OFF-STREAM STORAGE 31-1

General Actions for the Off Stream Storage Facilities and Projects 31-1

Actions for the Increased Storage Down-Stream of the Delta 31-1

Actions for the Increased Storage Upstream of the Delta 31-1

Actions to Increase Storage Within the Delta 31-2

GROUNDWATER BANKING CONJUNCTIVE USE 32-1

General Actions for the Management of Groundwater Resources 32-1

General Actions for Conjunctive Use Programs 32-2

Actions for the Management of Groundwater and Conjunctive Use in the Bay Area 32-2

Actions for the Storage of Groundwater in the San Joaquin Basin 32-3

Actions to Store Water in the Sacramento Basin 32-5

Actions to Store Water in the South Coast Region 32-6

IMPROVEMENT OF THROUGH DELTA CONVEYANCE 33-1

General Actions to Improve Through Delta Conveyance 33-1

Actions of the Construction of Channels and Conveyance Facilities 33-1

Actions for Channel Modification to Improve Through Delta Conveyance..... 33-2

Actions for New Diversion Strategies to Improve Delta Conveyance..... 33-4

Actions to Modify Existing Infrastructure to Improve Delta Conveyance 33-4

Actions for the Improvement of Through Delta Conveyance with Additional Pumping Plants..... 33-5

Plans for the Improvement of Through Delta Conveyance..... 33-5

Other Actions for the Improvement of Through Delta Conveyance 33-5

CONSTRUCTION AND IMPROVEMENT OF CONVEYANCE FACILITIES 34-1

CHANGES IN LOCATIONS OF DIVERSIONS..... 35-1

WATER TRANSFERS 36-1

LONG-TERM PLANNING FOR DROUGHT CONTINGENCIES 37-1

General Actions for Long-term Planning for Drought Contingencies..... 37-1

Actions to Acquire Long-Term Water Supplies for Drought Situations 37-1

WATER RESOURCES DATA AND INFORMATION MANAGEMENT..... 38-1

General Actions for Water Recourses Data and Information Management..... 38-1

Actions for Real-time Monitoring and Management 38-3

ESTABLISHMENT OF AN INSTITUTION FOR INTEGRATED LONG-TERM WATER MANAGEMENT..... 39-1

General Actions for the Establishment of an Institution for Integrated Long-Term Water Management 39-1

ESTABLISHMENT OF AN EXPORT CAPACITY MARKET..... 40-1

General Actions for the Establishment of an Export Capacity Market..... 40-1

INTEGRATION OF LAND-USE AND WATER SUPPLY PLANNING 41-1

General Actions for the Integration of Land-Use and Water Supply Planning 41-1

INSTALLATION AND OPERATION FLOW BARRIERS 42-1

General Actions for the Installation of Flow Barriers 42-1

Construct or Modify Barriers to Improve Water Quality 42-1

MANAGEMENT OF AGRICULTURAL DRAINAGE 43-1

General Actions to Manage Bacterial Contamination 43-1

General Actions to Control Contamination from Livestock Operations 43-1

General Actions to Control Contaminants from Fertilizer and Nutrient Application 43-4

General Actions to Control Erosion and the Movement and Discharge of Sediment 43-6

General Actions to Manage Contaminants form Pesticide, Herbicide, and Insecticide Use 43-7

General Actions to Control and Reduce Salt Accumulation and Salinity in Agricultural Drainage 43-13

General Actions to Control and Reduce Selenium and Other Trace Elements 43-15

General Actions to Reduce the Effects of Agricultural Drainage by Implementing Best Management Practices 43-16

Regulatory or Policy Changes designed to Ameliorate Problems related to Agricultural Drainage 43-16

General Actions Involving Crop Choice and Irrigation Practices 43-19

General Actions for the Disposal or Treatment of Agricultural Drainage 43-21

Site Specific Actions to Ameliorate Drainage Problems in the Grasslands Sub-Area 43-22

Site Specific Actions to Ameliorate Drainage Problems in the Kern Subarea 43-24

Site Specific Actions to Ameliorate Drainage Problems in the Northern Subarea 43-24

Site Specific Actions to Ameliorate Drainage Problems in the Tulare Subarea 43-24

Site Specific Actions to Ameliorate Drainage Problems in the Westlands Subarea 43-25

Actions for the Funding of Urban and Industrial Discharge Programs 43-26

Actions for Education and Public Outreach on Agricultural Drainage Issues 43-27

Actions for the Monitoring of Agricultural Drainage 43-28

Actions to Protect Wetlands from Contaminants in Agricultural Drainage.... 43-28

Actions Involving the Use of Agricultural Drainage Water in Wetlands 43-28

Actions Involving Research and Studies 43-28

Actions to Fund Programs to Address Agricultural Drainage Problems 43-30

Actions for the Dilution of Agricultural Drainage 43-31

Actions for the Export of Drainage Water from the its Source 43-31

Actions for the Management of Groundwater and Agricultural Drainage..... 43-32

Actions for Land Retirement to Reduce Agricultural Drainage Problems..... 43-33

Actions for the Management of the San Joaquin River and Agricultural Drainage 43-33

MANAGEMENT OF URBAN/INDUSTRIAL DRAINAGE AND WASTEWATER DISCHARGE 44-1

General Measures to Reduce Contamination Associated with Construction Sites 44-1

General Actions to Reduce or Control Non-Point Source Discharge 44-2

General Actions to Control or Reduce Contaminants in Urban and Storm Water Runoff 44-3

Actions Involving the NPDES and Other Related Permits 44-4

Actions for the Establishment of Water Quality Criteria and Reduction of Priority or Targeted Pollutants 44-5

Actions for the Treatment of Urban and Industrial Discharge 44-5

Actions for Research and Further Studies on Urban and Industrial Discharge 44-6

Actions for Education and Public Outreach on Urban and Industrial Discharge 44-7

DREDGED MATERIAL MANAGEMENT 45-1

General Actions for the Management of Dredged Material 45-1

Actions for the Management of Delta Sediments 45-1

Actions for the Management of Dredging Operations 45-1

MANAGEMENT OF ABANDONED MINE DRAINAGE 46-1

General Actions for the Management of Mine Drainage 46-1

Site Specific Actions for the Management of Mine Drainage 46-2

Actions for Research and Further Study of Mine Drainage 46-3

Actions for Education and Public Out-Reach on Mine Drainage Issues 46-4

Actions for Funding Management of Mine Drainage 46-4

LEVEE MAINTENANCE AND STABILIZATION 47-1

General Actions for Delta Levee Maintenance and Stabilization 47-1

General Actions for the Management of Levee Vegetation 47-1

General Actions for Controlling Subsidence 47-2

Actions for the Coordinated Management of Delta Levees 47-2

Actions for Disaster Planning 47-3

Actions for the Funding of Levee Improvement Projects 47-3

Actions for the Improvement of Levee Maintenance Programs 47-4

Site Specific Actions to Control Subsidence and Improve Delta Levees 47-4

IMPROVEMENT OF FLOOD PROTECTION LEVELS AND SEISMIC STABILITIES 48-1

General Actions for Improvement of Levee Designs 48-1

General Actions for Planning Delta Levee Improvements 48-1

Actions of the Improvement of Flood Protection Levels 48-1

Actions to Improve Seismic Stabilities 48-2

REROUTING AND PROTECTION OF INFRASTRUCTURE FROM FLOODING AND SEISMIC RISK 49-1

ESTABLISHMENT OF LONG-TERM FUNDING MECHANISMS 50-1

General Actions for the Establishment of Long-Term Funding 50-1

Actions for the Development of an Emergency Funding Program 50-1

Actions for the Long-Term Funding of Levee Maintenance 50-1

REFERENCES 51-1

Restoration of Bay-Delta System Shallow Water (Tidal) Habitat

General Actions for the Restoration of Delta Shallow Water Habitat

Allow no net loss of shallow-water (less than 3 meter deep) habitat to dredging, and mitigate for all functions and values (172).

Protect existing shallow habitat from erosion (CALFED).

Restore tidal action to existing diked wetlands (CALFED).

Reconstruct levees to include shallow water habitat (CALFED).

Fill deep water to produce shallow habitat (CALFED).

Convert parts of the San Francisco Bay into fresh water embayments (7).

Coordination & management of studies on aquatic resources support functions of SF Estuary tidal marshlands (99).

Diked agricultural lands which were once part of the Estuary afford significant opportunities to restore or enhance wetland resources. Public and private entities should develop programs to acquire these lands and restore or enhance their wetland habitat values (1).

Evaluate fish use of shallow water habitats (99).

Identify and control sources and sinks of selenium and mercury where they are accumulating in aquatic populations in the Estuary (124).

Implement enhanced management of existing lands (shallow water habitat) to increase productivity so as to benefit a wider diversity of species (13, 12, 11).

Protect and maintain marshes, wetlands, shallow water areas, and tidal sloughs to protect fisheries values (124).

Reduce or eliminate unnecessary landfill projects to protect Bay and Delta tidelands (179).

Restore Delta islands as shallow water habitat (99).

Restore intertidal areas in San Francisco Bay system and adjacent upland buffer areas and drainage systems such as in Suisun Bay and Suisun Marsh, and salt ponds around the Bay (12).

Restore shallow water habitat (13, 12).

Restore shallow-water habitat in tidal areas (99).

Restore shallow-water spawning habitat in Delta upstream freshwater areas (99).

Restore tidal wetlands and shallow water habitat (13, 11).

Work with the dredging and flood control interests to reduce or eliminate practices that adversely affect fish habitat (124).

Reclamation districts should encourage the growth of tules along the water side

toe of the levees (6).

Restrict boating activities where necessary to decrease turbidity and physical destruction of shallow-water habitat (72).

Actions for the Restoration of In-channel Delta Islands

Department of Fish and Game and the State Lands Commission should develop a priority program for the evaluation, acquisition, management, and enhancement of channel islands to be administered as ecological reserves (28).

Promote the maintenance and development of tule island, tidal wetlands, and offshore berms to protect against erosion and provide detrital input and juvenile fish nursery habitat (124).

Stabilization of remnant Delta channel islands (99).

Undeveloped channel islands provide unique opportunities for permanent wildlife habitat in the Primary Zone. A strategy should be developed to encourage permanent protection and management of the channel islands. Protection may include: acquisition, conservation easements, or memoranda of understanding. Management may include: protection from erosion, controlling human access, or habitat management, such as planting native plants and removing exotic plants. Some larger, reclaimed channel islands may be suitable for mixed uses, such as recreation and habitat. Any development on channel islands must ensure long-term protection of the wildlife habitat (89).

Implement plans to preserve channel islands and enhance habitat on them (6).

Department of Fish and Game, in concert with other involved State agencies, should develop a program to preserve and enhance the wildlife habitat on channel islands (6).

Create channel islands in Delta backwater areas (13, 12).

Site Specific Actions for the Restoration of Delta Shallow Water Habitat

Little Mandeville Island tidal wetland project (99).

Restore berm island on San Joaquin River near confluence with False River (99).

Restore tidal marshes in San Francisco Bay (124).

Restoration of Bay-Delta System Riverine Habitat

Identify and protect remnant stream habitat containing indigenous and endemic fishes and other native aquatic species (124).

Reconstruct river banks and shallow areas (CALFED).

Restore and preserve channel islands (CALFED).

Restore natural channel configurations (CALFED).

Modify channel/levee construction practices to include riverine elements (CALFED).

Increase SF Estuary riverine habitat (99).

Protect existing SF Estuary riverine habitat (99).

Restoration of Bay-Delta System Riparian Habitat

General Actions for the Restoration of Delta Riparian Habitat

The SWRCB and Resources Agency, in consultation with other affected agencies, will establish a definition for riparian areas (73).

Improve and protect degraded riparian habitats (CALFED).

Modify levee maintenance practices (CALFED).

Protect existing riparian habitat (CALFED).

Establish priority for more mature communities (riparian forests) while recognizing the value of successional processes (73).

Provide special protection for riparian areas through State, local, and federal incentive and easements (e.g. tax reductions) (73).

The SWRCB/RWQCBs will use Porter Cologne and CWA Section 401 authorities actively and consistently to ensure that beneficial uses supported by wetlands and riparian areas are fully protected (73).

California shall increase its interaction with the federal agencies and CWA authorization to more fully protect wetlands and riparian areas (73).

The SWRCB and RWQCBs will use their existing authority under the current legislation to more effectively protect all beneficial uses supported by riparian areas (73).

Encourage consideration of riparian conservation in local and regional plans, in order to minimize the need for piecemeal regulatory protection (82).

Encourage State and federal agencies to develop internal riparian conservation policies and programs which are compatible with their programmatic goals (82).

Encourage replacement of riparian areas impacted by land use modifications with areas of equivalent habitat and value (82).

Encourage the development of riparian areas with habitat of equivalent value to areas likely to be impacted at some point in the future, then assign replacement value to these areas as compensation for habitat lost when impacts occur. Ensure that functions and values, including landscape and regional functions, are maintained by the replacement habitat areas (82).

SWRCB mitigation strategy shall ensure no net loss of riparian function and value will occur, particularly for riparian areas not regulated or protected by other State or federal agencies (73).

The Resources Agency will inventory riparian areas Statewide or, compile and disseminate if the inventory currently exists (73).

SWRCB will periodically retain university staff to conduct an independent scientific review of riparian-related activities (73).

The SWRCB/RWQCBs will initiate or strengthen local riparian corridor protection programs. Joint RWQCB/local programs will be developed, as with regulation of onsite disposal systems and storm water runoff using the following approach: a) The SWRCB will provide guidance to the RWQCBs for riparian corridor protection; b)The RWQCB will amend their Basin Plans, establishing standards for riparian corridor protection, delegating implementation to local governments, and establishing an implementation schedule. RWQCBs will recognize existing local programs and initiatives, and will consider cross-compliance with storm water requirements; c) The SWRCB/RWQCBs will provide technical assistance (e.g., best management practices, model ordinance provisions, methods of establishing setbacks) to local governments to help implement the standards through inclusion in local planning and regulatory programs; d) Local governments will adopt and implement the protective standards through land use plans, drainage and grading ordinances, etc.: e) The RWQCBs will directly enforce the Basin Plan standards where local governments fail to do so (73).

Restore or create additional riparian habitat (13, 12).

Develop and implement Best Management Practices (BMP's) for levee management so as to increase plant and wildlife habitat (13, 12).

Reduce channel velocities and erosions to protect channel and river vegetation (13, 12).

Obtain easements or acquire areas of existing natural vegetation along Delta rivers and channels (13, 12).

Provide protection to areas of existing natural vegetation along Delta rivers and channels to enhance migratory and resident fish as well as wildlife habitat (13, 12).

Protect and restore areas in the 100 year floodplain as plant and wildlife habitat (13, 12).

Identify and convert/restore non-wetland areas to wetland- or riparian oriented wildlife habitat. Purchase non-wetland areas to create wetlands. This action should be guided by and consistent with the regional wetlands management plan (124).

Department of Fish and Game/Fish and Wildlife Service should assist in developing an experimental program to create riparian forest (woodland) in the Delta, conducted on publicly owned land (28).

Open range live stock degrade water quality be destroying habitat along stream banks. Livestock managers need to include restoration and preservation of water quality, stream side vegetation, and protection of fish habitat in their management goals (79).

Actions for the Restoration of Delta Shaded Riverine Habitat

Protect existing shaded riverine aquatic habitats to ensure no net loss of acreage, linear coverage, and habitat value within the Estuary. Activities within the "legal Delta" should be conducted consistent with California's Delta Levees Flood Protection Act of 1988 (124).

Increase the quantity of shaded riverine aquatic habitat by 1,000 percent (124).

Restore shaded riverine habitat (13, 11).

Restore or create riparian and shaded riverine aquative habitat along the Delta river and channel system (13, 12).

Preserve and protect existing riparian habitat on Delta levees (25).

Site Specific Actions for the Restoration of Delta Riparian Habitat

Acquire the proposed Stone Lakes National Wildlife Refuge[1] (124).

Enhance levees for plant and wildlife resources along the Sacramento River and the San Joaquin River between Sacramento and Vernalis (13, 12).

Convert agricultural lands on Twitchell Island to four habitat types: permanent wetlands (14%), seasonal wetlands (27%), riparian woodland (6%), and grassland (53%) (133).

Implement the Sherman Island Wildlife Management Plan, including the restoration of riparian habitat (35).

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[1] Portions of the refuge remain unacquired.

Restoration of Bay-Delta System Wetland Habitat

General Actions for Restoration of Wetland Habitat

Increase the acreage of seasonal wetlands (13, 11).

Develop seasonal wetlands in the context of tidally influenced areas (13, 12).

Identify and convert or restore non-wetland areas to wetland-oriented wildlife habitat (124).

Encourage geographically focused cooperative efforts to protect wetlands (124).

Identify and convert/restore non-wetland areas to wetland- or riparian oriented wildlife habitat. Purchase non-wetland areas to create wetlands. This action should be guided by and consistent with the regional wetlands management plan (124).

Implement concerted efforts to acquire wetlands already dredged or destroyed and restore them so that wetlands in the Estuary are increased by 50 percent by 2000 (124).

Increase the area of seasonal wetlands and modify wetlands for use by water related wildlife (13, 12).

Increase the area of tidal wetlands (13, 12).

Protect and maintain marshes, wetlands, shallow water areas, and tidal sloughs to protect fisheries values (124).

Restore the elevation of some Delta lands in order to restore plant and wildlife functions lost through subsidence (13, 12).

California shall increase its interaction with the federal agencies and CWA authorization to more fully protect wetlands areas (73).

Encourage consideration of wetland conservation in local and regional plans, in order to minimize the need for piecemeal regulatory protection (82).

Encourage State and federal agencies to develop internal wetland conservation policies and programs which are compatible with their programmatic goals (82).

Encourage replacement of wetland areas impacted by land use modifications with areas of equivalent habitat and value (82).

Encourage the development of wetland areas with habitat of equivalent value to areas likely to be impacted at some point in the future, then assign replacement value to these areas as compensation for habitat lost when impacts occur. Ensure that functions and values, including landscape and regional functions, are maintained by the replacement habitat areas (82).

The SWRCB will encourage temporary increases in wetland functions and values by encouraging the creation of temporary, "artificial" and "incidental" wetlands out of uplands or prior converted croplands. Efforts will be made to protect

sensitive or unique upland habitats from conversion to artificial wetlands. Allow flexibility in regulation only by establishing formal agreements between landowners and regulatory agencies, prior to creation of such wetlands (73).

SWRCB mitigation strategy shall ensure no net loss of wetland function and value will occur, particularly for riparian and wetland areas not regulated or protected by other State or federal agencies (73).

SWRCB will encourage advance compensation for loss of small wetlands, while providing adequate safeguards to ensure that values and functions, including landscape and regional functions, are replaced. Locate banks so that local functions and values are preserved. SWRCB will require: 1) success criteria for all mitigation; 2) monitoring for success; 3) guaranteed remediation for failure (e.g. performance bonds); and 4) the mitigation site to be dedicated in perpetuity (73).

Create wetlands in SF Estuary (99).

Where compatible with management objectives, design created wetlands with control features and structures to allow for rapid suppression of mosquito production (101).

Site Specific Actions for the Restoration of Delta Wetland

Acquire the proposed Stone Lakes National Wildlife Refuge[2] (124).

Adopt salinity standards, operate existing facilities, and construct additional facilities in Suisun Marsh to protect a wider array of species (13, 12).

Create wetland (20%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (33).

Create wetland (40%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (33).

Create wetland (60%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (33).

Employ a watermaster to direct the timing and volume of water diverted in the Suisun Marsh to maximize efficient and beneficial uses of the water (71).

Implement the Conceptual Habitat Plan for the Grizzly Sough Project Area (258).

Implement the Prospect Island Fish and Wildlife Habitat Restoration Plan (99, 132).

Little Mandeville Island tidal wetland project (99).

Restore up to 8,5000 acres of wetlands in the Yolo Bypass (101).

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[2] Portions of the refuge remain unacquired.

Within the Yolo Bypass, maintain existing seasonal and permanent wetlands (101).

Actions to Acquire Additional Wetland Habitat

Public and private entities should establish cooperative wetland creation, restoration and enhancement programs with landowners. These programs should employ strategies such as conservation easements, economic incentives and conjunctive use management, among others (1).

Expand wetlands acquisition program, or establish a new Estuary-specific wetland acquisition program (124).

Private, nonprofit trusts should be established for the specific purpose of acquiring and protecting wetland properties (1).

Public and private entities should increase their efforts to protect and increase the Delta's wetland resource base. For example, the State Coastal Conservancy should be given clear legislative authority to acquire, create, and restore or enhance wetlands in the Delta. Protection strategies could include fee and less than fee acquisition activities (1).

The Wildlife Conservation Board should make the acquisition of San Francisco Estuary wetlands a priority campaign (1).

Appropriations from existing State and federal sources should be significantly increased. Wetland habitat acquisition and restoration programs conducted by organizations such as the California Coastal Conservancy, the California Department of Fish and Game and the U.S. Fish and Wildlife Service should be accelerated and given increased funding from the appropriate sources. For example, the federal Land and Water Conservation Fund should be increased to expedite acquisition for the San Francisco Bay National Wildlife Refuge, and allow additional State and federal acquisitions of wetlands (1).

Implement concerted efforts to acquire wetlands already dredged or destroyed and restore them so that wetlands in the Estuary are increased by 50 percent by 2000 (124).

Actions for Funding Delta Wetland Restoration

All appropriate agencies allocated Proposition 70 monies should proceed aggressively with the acquisition of Estuary wetlands, giving priority to seasonal wetlands (1).

The State should aggressively pursue Section 306 Coastal Zone Management Act of 1972 grant monies (75).

The State Lands Commission should put increased priority on using its Kapiloff Land Trust monies for Estuary wetland acquisitions (1).

The State should make the "Wetland Element" of its Outdoor Recreation Plan (SCORP) its primary vehicle for spending its Land and Water Conservation Fund monies (1).

U.S. Department of Agriculture should immediately provide adequate funds for the Wetland Reserve Program (WRP) authorized by the Food, Agriculture Conservation and Trade Act of 1990. The WRP retains private ownership but requires a recorded 30 year or perpetual easement for restoration of wetlands on prior converted cropland and farmed wetlands and includes protection of adjoining wetlands (1).

Actions to Increase the Enforcement of Existing Wetland Regulations

Increase enforcement efforts to curtail illegal wetland alteration and to ensure compliance with permit conditions (124).

Recommended Policy Changes for the Protection of Wetlands

Encourage wetland protection by-laws (124).

Improve wetlands protection provided under the Clean Water Act (124).

Local governments should be compensated, whenever possible, for tax revenues lost when public agencies acquire wetlands (1).

The State and federal government should enact laws to create reliable, on-going new sources of funding for public agencies to acquire and expand the estuary's wetland resource base, such as additional bonds for the California Coastal Conservancy (1).

Actions for the Development and Implementation of Wetland Programs

Develop a Suisun Marsh ecological work group to evaluate beneficial uses and water quality objectives for Suisun Bay and Suisun Marsh ecosystems; assess effects of water quality objectives; identify and examine public interest and water quality needs to protect the Suisun Bay/Marsh; identify necessary studies to determine protective measures for the bay and marsh; evaluate effects of channel dredging on the marsh and channel water salinity; perform studies for evaluating urban effects on the marsh and bay ecosystems (71).

Innovative and experimental wetland establishment programs should be developed to expand the Estuary's wetland resource base. For example, the use of uncontaminated dredged materials as one method to restore wetlands should be explored (1).

Preserve existing Bay-Delta wetlands and develop programs to restore or expand wetland habitat (2).

Actions for the Protection of Wetlands

Preserve existing Bay-Delta wetlands and develop programs to restore or expand wetland habitat (2).

Protect existing SF Estuary wetlands (99).

Protect and maintain marshes, wetlands, shallow water areas, and tidal sloughs to protect fisheries values (124).

Reduce or eliminate unnecessary landfill projects to protect Bay and Delta tidelands (179).

Actions for Research and Further Study of Wetlands

Conduct studies to determine relationship between channel water salinity and soil water salinity under alternative management practices (Suisun Marsh) (71).

Federal and State agencies should formulate a coordinated Estuary-wide management system of classifying wetlands that distinguishes wetlands based on their values and functions including, but not limited to, their potential for: enhancement and restoration, protecting water quality, providing flood protection, trapping sediment, recharging groundwater supplies, sustaining endangered species, contributing to species diversity and/or wildlife habitat, and affording recreational opportunities. The ability of anyone wetland type to provide these values is a function of its physical characteristics, especially the source of its inflow waters, the ways in which water flows from wetlands, and the extent and type of its vegetation. As these factors vary for each type of wetlands, the wetland's values will also vary. Several federal agencies have completed studies to quantify habitat values, such as the USFWS" HEP and the Adamus technique (also known as the Wetland Evaluation Technique). A classification and ranking system should be developed which recognizes these different functions and provides standards to determine appropriate levels of protection, allowable impacts and uses and mitigation for each class of wetlands and acquisition priorities (1).

Refine and coordinate existing monitoring programs to: (i) better evaluate ecosystem responses to immediate, phased, and long-term water quality and flow standards; (ii) more fully characterize ecosystem processes and properties; and (iii) enhance predictive capabilities of ecosystem models (124).

Existing federal and State funding should be more fully utilized to conduct research to fill key gaps in knowledge regarding the ecology of wetlands within the San Francisco Estuary (1).

Actions for Wetland Education and Public Out-Reach

SWRCB will periodically retain university staff to conduct an independent scientific review of riparian-related activities (73).

Federal and State resource agencies and academic institutions should fund the development and improvement of wetland education programs for schools and for interpretive centers and to enable schools with limited funding to participate in interpretive programs (1).

Additional wetland educational programs should be developed through the SFEP Public Advisory Committee (PAC) and where appropriate such programs should be integrated with other significant environmental and resource management issues related to the Estuary (1).

Restoration of Bay-Delta System Terrestrial Habitat

General Actions for the Management of Delta Terrestrial Habitat

Protect existing upland habitat (CALFED).

Establish upland habitat on levees (CALFED).

Establish upland habitat on fallowed croplands (CALFED).

Establish oak woodlands on suitable soils (CALFED).

Encourage wildlife-friendly agricultural practices (CALFED).

Preserve agricultural land uses providing habitat (CALFED).

Clean up sites contaminated with toxic substances (CALFED).

Time mowing of alfalfa and safflower on Sherman Island so it does not coincide with pheasant and quail hatching (35).

Site Specific Actions for the Restoration of Delta Terrestrial Habitat

Create wetland (20%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (35).

Create wetland (40%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (35).

Create wetland (60%), upland and riparian habitats on Sherman Island to benefit wildlife and control subsidence (35).

Convert agricultural lands on Twitchell Island to four habitat types: permanent wetlands (14%), seasonal wetlands (27%), riparian woodland (6%), and grassland (53%) (133).

Expand the SF Bay National Wildlife Refuge (99, 1, 124).

Medford Island multi-species protection and enhancement project (99).

Prospect Island Restoration (132, 99).

Little Holland Tract purchase (99).

Acquire the proposed Stone Lakes National Wildlife Refuge (124).

East Delta Fish and Wildlife Management Area near Beaver and Hog Sloughs (99).

Canal Ranch fish and wildlife management area (99).

Winter Island fish and wildlife management area (99).

Implementation of Integrated Habitat Management Programs

General Actions for the Management of Fish and Wildlife Habitat

Establish priorities for habitat improvement based on species (150).

Maximize habitat improvement (150).

Promote habitat improvement that promotes partnership with existing CVP (150).

Implement habitat improvements in balance with other beneficial uses ((i.e. decomposition of straw in rice field)) (CVPIA) (150).

SWRCB should consider historic habitat and restoration potential when establishing mitigation goals (73).

Control urban growth and wildlife damaging conversion of agricultural land use (13, 12).

Promote wildlife-friendly agricultural practices and implement enhance Delta farm-water management practices and farming practices that benefit fish and wildlife (13, 12).

Undeveloped channel islands provide unique opportunities for permanent wildlife habitat in the Primary Zone. A strategy should be developed to encourage permanent protection and management of the channel islands. Protection may include: acquisition, conservation easements, or memoranda of understanding. Management may include: protection from erosion, controlling human access, or habitat management, such as planting native plants and removing exotic plants. Some larger, reclaimed channel islands may be suitable for mixed uses, such as recreation and habitat. Any development on channel islands must ensure long-term protection of the wildlife habitat (89).

Identify and protect remnant stream habitat containing indigenous and endemic fishes and other native aquatic species (124).

Enhance the biodiversity within all publicly owned or managed wetlands and other wildlife habitats as appropriate (124).

Develop regulatory land use procedures to promote re-use of dredged material, wetland restoration and/or creation (124), and other beneficial uses (124).

Develop and implement the regional monitoring strategy, which will integrate and expand on existing efforts and eventually be part of a comprehensive regional monitoring program (124).

Wildlife habitat on the islands should be of adequate size and configuration to provide significant wildlife habitat for birds, small mammals, and other Delta wildlife (89).

Implement actions to improve habitat conditions for fish and wildlife in the Central Valley to minimize impacts of the CVP (173).

Implement provisions for disapproving projects having significant adverse effects on remaining habitat and requiring enhancement of disturbed habitat (71).

Perform habitat restoration in the Delta and upstream of the Delta as a condition of project approval (71).

Enhance biodiversity of SF Estuary (99).

Coordinate annual water management operations with SYMVCD (101).

Implement practices to discourage use, or modification to habitats to limit access, nesting, or feeding by wildlife at evaporation ponds, e.g., hazing, steepening side slopes (74).

Seasonal flooding should be carried out in a manner so as to minimize mosquito production. Delta-wide guidelines outlining "best management practices" should be prepared and distributed to land managers (89).

General Actions for Habitat Planning

Establish goals to direct efforts in fish and wildlife habitat development. Provide numerical goals by creating an inventory of plant and animal habitats and a documentation of their health (15).

Establish habitat corridors to interconnect existing wildlife preserves (13, 12).

Explore the utility of Habitat Conservation Plans (6).

Incorporate mitigation for development through mitigation banks and compensated acquisition of habitats into wildlife preserve expansion or creation (13, 12).

Provide guidance on a habitat mitigation plan (6).

The Resources Agency shall supervise the implementation of specified special flood control projects and certain levee projects. The Resources Agency, the Department of Water Resources, the Reclamation Board, and the Department of Fish and Game shall enter into a memorandum of understanding to coordinate the implementation of those projects. The agreement shall include a provision requiring the DFG to enforce mitigation requirements involving those specified projects (222).

Use mitigation "banks" to enhance overall habitat quality and diversity (6).

Coordinate with DFG to prevent or minimize impacts to fish and wildlife in the Delta (38).

Employ compensatory mitigation of habitat for species affected by sedimentation (74).

Establish priorities for habitat improvement (150).

Establish priorities for habitat improvement based on location and on value of potential animals/plants to the ecosystem (150).

Establish priorities for structures for fishery and habitat improvement (150).

Provide incentives to build structures without restoration fund money (150).

Structures for Fish and Wildlife (CVPIA). Establish facilities that allow for multiple uses of existing water supply ((discourage singular use of water supply)) (150).

SWRCB will establish a mitigation auditor, to evaluate mitigation project success and overall program success (73).

Coordinate proposed habitat projects through local governments to ensure compliance with local plans and policies (101).

SFEP should coordinate with and encourage the efforts of Statewide alliances, such as the California Wetland Policy Forum, that bring together divergent and competing interests on the wetland protection issue, to further the goals of the Estuary Project (1).

Coordinate proposed projects through agencies having flood control responsibilities to ensure compliance with flood control ordinances, regulations, and laws (101).

Ensure that habitat improvement projects are compatible with agriculture within the Yolo Bypass (101).

Coordinate habitat development programs among funding agencies to ensure that program requirements and funding levels continue to provide adequate incentives for private landowner participation in habitat projects (101).

Develop and adopt uniform compensatory mitigation policies (124).

Department of Fish and Game in cooperation with Office of Planning and Research (OPR) develop better guidelines for fish and wildlife habitat protection, maintenance and restoration policies and criteria to be included in local general plan; and develop methods for review of general plans (28).

Department of Fish and Game, with OPR, formulate and circulate a model zoning code for a resource conservation overlay district pertaining to development regulations in or adjacent to important habitat areas, and advocate their use by local governments (28).

Department of Fish and Game, with OPR, formulate and recommend a density transfer ordinance to protect the threatened environmental resources, and advocate their use by local governments (28).

Department of Fish and Game/Fish and Wildlife Service, develop detailed written and published policies and guidelines regarding mitigation and compensation and a consistent procedure to help in the evaluation of cumulative impacts (28).

Legislation should be enacted establishing a "land bank" in the Department of Fish and Game (or the State Coastal or Delta Conservancy), wherein a developer

could purchase an appropriate parcel of land, such as subsided land which has become marginally economic for agriculture or compensation and restoration of habitat lost to approved developments (28).

Legislation should be enacted requiring LAFCOs to evaluate the adequacy of wildlife protection policies in annexation proposals (28).

Legislation should be enacted to require local governments to adopt and map a significant resource areas inventory (at least including areas identified in this plan) as part of their open space/conservation elements, to protect them with an appropriate overlay zone and to require a Department of Fish and Game/Fish and Wildlife Service review of all development proposals and impact assessment documents affecting these sites (28).

Levee maintaining agencies and fish and wildlife agencies should continue to cooperate to establish appropriate vegetation guidelines. Continuation of the SB 34 Program with its incentive funding for mitigation should be supported as the best way to accomplish the goals of levee maintenance with no net long term loss of habitat (89).

Local subdivision ordinances should be revised to require: (a) habitat assessments, (b) open space dedication of habitat areas, (c) habitat impact mitigation measures, (d) performance bonds for development within wetland areas, and (e) denial of tentative and final maps for projects shown to have potential significant adverse impact on the environment and for which mitigation measures are not adequate (28).

Public agencies and non-profit groups have or propose to purchase thousands of acres of agricultural lands to restore to wildlife habitat. The amount, type, and location of land identified to be enhanced for wildlife habitat should be studied by wildlife experts to determine goals for future acquisition and restoration. Lands acquired for wildlife habitat should also be evaluated for recreation, access, research and other needed uses in the Delta. Habitat restoration projects should not adversely impact surrounding agricultural practices. Public-private partnerships in management of public lands should be encouraged. Public agencies shall provide funds to replace lost tax base when land is removed from private ownership (89).

Develop additional habitat and vegetation zones within the Delta (99).

State and federal agencies should require, to the extent of their authority, habitat restoration in the Delta and upstream of the Delta as a condition of approving projects (80).

Feasible steps to protect and enhance aquatic habitat should be implemented as may be determined by resource agencies consistent with balancing other beneficial uses of Delta resources (89).

Recreate various types of habitat, e.g., through provision of water and land for wetlands, levee setbacks, floodways, etc. (93).

Restore and preserve marsh, riparian, and upland habitat in the Delta (71).

Implement stream bank protection, stabilization, and revegetation (Department of Fish and Game) (84).

Actions to Develop and Implement Specific Habitat Management Plans

Develop, design, and implement a conservation management plan in the Estuary (13, 12, 99, 124).

Develop a comprehensive plan, which is reasonable, prudent, and feasible, to address fish, wildlife, and habitat concerns on the San Joaquin River, including but not limited to the streamflow, channel, riparian habitat, and water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fishes from Friant Dam to its confluence with the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (CVPIA, Section 3406 (c)(1)).

Develop and implement plans to reverse the decline in anadromous fisheries and "ensure a doubling" of anadromous fish in the Central Valley by the year 2002 (173).

Federal, State and local agencies should inventory their wetland holdings, develop specific management plans for these holdings and implement programs to maximize their habitat value. Degraded wetlands owned by these agencies should be restored to maximize their habitat value (1).

Federal, State and local agencies, in conjunction with universities and the public, should prepare a coordinated wetland management and restoration plan to protect and create wetland types and acreages in appropriate locations and amounts. Such a plan should include preservation of native species and maintenance of other functions and values of wetlands as management goals (1).

Develop and implement the San Joaquin River Management Plan to identify reservoir operational changes, habitat improvement measures, and other action items to improve habitat and health of the aquatic ecosystem in the San Joaquin River watershed (124).

Establish a plan to address fish, wildlife, and habitat concerns on the San Joaquin River downstream of Friant Dam (173).

Implement habitat conservation plan for SF Estuary (99).

Implement the Upper Sacramento River Plan (124).

Prepare a comprehensive management plan for the San Francisco Bay National Wildlife Refuge (124, 99).

Publicly-owned land should incorporate, to the maximum extent feasible, suitable and appropriated wildlife protection, restoration and enhancement as part of a Delta-wide plan for habitat management (89).

San Joaquin River Comprehensive Plan (Section 3406(c)(1), CVPIA Title 34) (99).

SF Estuary Wildlife Habitat Restoration and Management Plan (99).

Actions for Recommended Changes in Policy

Legislation be enacted to codify the "Delta Waterways Use Program" (28).

Sacramento and Stockton Port Districts, develop master plans reflecting a maximum feasible fish and wildlife habitat protection policy (28).

Actions for the Implementation of Habitat Management Programs

Establish, in cooperation with independent entities and the State of California, a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley and to assess the biological results and effectiveness of actions implemented under section 3406 (b) of the CVPIA (CVPIA, Section 3406 (b)(16)).

Develop and implement a program, within 3 years of enactment of CVPIA, which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991 (CVPIA, Section 3406 (b)(1)).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation and the Contra Costa Water District must develop and implement a program to monitor entrainment losses of winter-run chinook salmon at the Rock Slough intake on Contra Costa Canal (175).

Contact landowners and notify them of funding programs available, program funding limits, objectives, and eligibility requirements (101).

Department of Fish and Game. in cooperation with Fish and Wildlife Service, initiate a "Delta Wildlife Habitat Restoration Program," based on this plan, using funding from multiple sources, to identify appropriate "special restoration areas" for public investments and establishment of Ecological Reserves or Wildlife Management Areas (28).

A program by non-profit groups or other appropriate entities should be developed to promote acquisition of wildlife and agricultural conservation easements on private lands with the goal of protecting agriculture and wildlife habitat in the Delta (89).

Establish a comprehensive State wetlands program for the Estuary that, in addition, includes a coordinated regulatory and policy framework (124).

Comprehensive State wetlands program for SF Estuary (99).

Establish a comprehensive program for monitoring fish and wildlife to determine effectiveness of restoration efforts (173).

Expand existing private, State, and federal financial and technical assistance programs to individual landowners (124).

Implement a program to acquire supplemental water to meet restoration goals for fish, wildlife, and habitat (173).

Implement the Anadromous Fish Restoration "Doubling" Program (99).

Department of Fish and Game, with OPR and the Legislature, create an enforcement program for Section 65910 of Governmental Code which requires that open space zoning be consistent with the open space plan, and open space plans be formulated and implemented (28).

Actions for the Management of Water Quality Affecting Fish and Wildlife

Develop water quality standards which support a wide array of plant and wildlife (13, 12).

Address water quality issues for multiple use projects (150).

Operate Spring Creek Debris Dam to minimize toxics exposure to winter-run chinook salmon in order to reduce the risk of jeopardy to their continued existence (175).

Implement SF Estuary habitat and water quality improvements (99).

Implement dissolved oxygen and circulation solutions, San Joaquin River (99).

Improve water quality to improve survival and condition of sturgeon (Feather River) (179).

Improve water quality to improve sturgeon survival (Lower San Joaquin River) (179).

Reduce toxic chemical and trace metal pollution to provide better water quality for anadromous fish (Sacramento-San Joaquin Delta) (179).

Reclamation and DWR should develop salinity standards for the Suisun Marsh that reflect the historical fresh to salt water gradient from east to west, and north to south within the marsh (177).

Set and enforce water quality standards to provide for all salmonid life stages (Mokelumne River) (179).

Actions for Research and Further Study of Biological Resources

Investigate and report on all effects of the Central Valley Project on anadromous fish populations and the fisheries, communities, tribes, businesses and other interests and entities that have now or in the past had significant economic, social or cultural association with those fishery resources (CVPIA, Section 3406 (f)).

Establish inventories including mapping, functional quantification (e.g. hydrologic cycle), biological communities, biological corridors, and listed species for purposes of identifying environmental "hot spots" (73).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must monitor juvenile chinook salmon in the lower Sacramento River on a real-time basis during the period of October 1 through January 31. Reclamation must also develop criteria and then operate the Delta Cross Channel gates to minimize diversion of winter-run chinook salmon juveniles during that interval (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must continue to monitor temperature in the upper Sacramento River (175).

Develop an experimental study program to study the effects of pulse flows on fish eggs and larvae (80).

Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop an ecosystem-centered analysis of the Bay-Delta to promote understanding of the interrelated effects of operating the Federal and State water projects (177).

Complete the National Wetlands Inventory of the Central Valley (94).

To further protect the species in the Estuary, monitoring stations throughout the eastern Delta could be established to obtain information on the effects of non-point discharges on various fish species. With data obtained from this study, new standards could be set to begin the reversal of these adverse effects. Finally, EPA could participate in initiating consultation on the effects of those non-point discharges (174).

Continue and expand monitoring and research of winter run salmon (84).

Evaluate sublethal effects of photonic and conventional tags on salmon (99).

Hydrogeomorphic method (HGM) functional assessment of Bay-Delta Ecosystem (99).

Improve salmon smolt survival models (99).

Determine the level of impact to winter-run associated with Delta water exports during the past water year to measure the effectiveness of the new standards and in-season operational decisions (114).

Determine the level of take (impact to the year-class) occurring real-time to support real-time operations and management decisions (114).

Determine time of arrival, abundance, and distribution of winter-run chinook juveniles in the Delta to assist real-time operations and management decisions (114).

Develop a report on the effects of the Central Valley Project on anadromous fish populations (173).

Provide funding to the U.S. Fish and Wildlife Service to fully evaluate the newly installed Red Bluff Diversion Dam downstream migrant fish protection facilities under the full range of operating conditions (113).

Downstream smolt trapping and estimate program (Red Bluff ladder, screw traps, beach seine survey, trawl stations [Chipps, others]) (84).

Implement fall-run chinook salmon spawning surveys in the mainstem of the Sacramento River (88).

Actions for the Development of Habitat at Specific Sites within the Bay-Delta

Acquire the proposed Stone Lakes National Wildlife Refuge[3] (124).

Convert agricultural lands on Twitchell Island to four habitat types: permanent wetlands (14%), seasonal wetlands (27%), riparian woodland (6%), and grassland (53%) (133).

Expand the SF Bay National Wildlife Refuge (99, 1, 124).

Implement the Sherman Island Wildlife Management Plan, including upland wildlife habitat elements (35).

Medford Island multi-species protection and enhancement project (99).

Prospect Island Restoration (132, 99).

Little Holland Tract purchase (99).

East Delta Fish and Wildlife Management Area near Beaver and Hog Sloughs (99).

Canal Ranch fish and wildlife management area (99).

Winter Island fish and wildlife management area (99).

Actions for Education and Public Out-Reach on Biological Resources

Education program - recreation, wildlife, fisheries (131).

Explain importance of protecting fall-run salmon in the San Joaquin drainage to the public (125).

Provide an understanding and appreciation of fish and wildlife ecology and man's role in environment, and provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established (178).

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[3] Portions of the refuge remain unacquired.

Identify opportunities for education in conjunction with other environmental programs such as Oregon Department of Fish and Wildlife Guidelines for Public Involvement in Cooperative Trout and Salmon Projects (73).

Salmon and trout educational program for schools (99).

Actions for the Funding of Habitat Management Practices

Delta Native Fisheries Recovery Team funding (99).

Seek funding for fisheries and riparian habitat management plan for upper Sacramento River (84).

Department of Fish and Game/Fish and Wildlife Service should seek State and federal approval of a "Delta Restoration Fund" for financing the State's share for construction of multiple-purpose levees and the costs of maintaining vegetation cover on the levees. Funding would be from an annual surcharge on the cost of each acre-foot of water extracted from the Delta by the State Water project and, if federal conformance can be secured, the Central Valley Project (28).

Seek damages for all impacts to trust resources from spills and discharges affecting them and use the finds to improve the resources base (124).

Legislation be enacted to authorize placement of a "Bay-Delta Habitat Restoration Bond Act" on the ballot, with the funds to be administered by Department of Fish and Game (28).

Allocate increased revenues resulting from subsections 3405 (a) and (d) to the Restoration Fund (CVPIA, Section 3405(f)).

Enter into a binding cost-share agreement with the State of California with respect to the timely reimbursement of costs allocated to the State in the CVPIA (CVPIA, Section 3406 (h)).

Create a Restoration Fund (CVPIA, Section 3407(a)).

Keep accounts of all payments deposited in the Restoration Fund on behalf of each Water Contractor and of the total payments received from Power. Deposits to the Restoration Fund which are used to pay for the projects, studies or facilities set forth in subsection 3406 (b) of the CVPIA shall offset an equal amount of the Water Contractor's or Power's assigned repayment obligations resulting from the implementation of any activities described in the Act (148).

Credit moneys donated by Non-Federal entities to the Restoration Fund to foster one or more specific purposes. Such Non-Federal contributions shall be expended by the United States only for the purposes specified by the Contributor and shall not be subject to appropriation (148).

Actions to Manage Special Status Fish Species

General

Implement a fisheries management program for short-term protection of specific aquatic species (71).

Review and modify, if necessary, harvest regulations of aquatic species of concern (124).

To protect rare and endangered fish species from adverse impacts of poaching, the Department of Fish and Game (Department of Fish and Game) should study the feasibility and value of banning night fishing in the Delta (89).

Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop baseline information (i.e., proposed operations plus February 12, 1993, winter-run chinook salmon biological opinion) on project effects on currently unlisted species including longfin smelt, Sacramento splittail, and green sturgeon to prepare for compliance with the Act as new species become listed (177).

Prepare/update recovery plans for all listed species. This includes designation of critical habitat (124).

Monitor status of all candidate species and list them if warranted (124).

Initiate consultation with all federal agencies that propose or are continuing actions that may affect listed species (124).

Review all non-federal proposals and continuing actions that may result in take of listed species and take appropriate actions (124).

When conducting evaluations of Delta agricultural diversion, evaluate and implement pertinent recommendations from the Interagency Ecological Program, Technical Report 37 (128).

Reclamation and DWR, in cooperation with the IEP and other interested parties, should develop a program for threatened and endangered species that allows acquisition and management of areas used as spawning habitat, such as backwater sloughs and shallow channel edges, to prevent destruction and adverse effects caused by in-Delta project activities (177).

Delta Smelt

Develop a taxonomic key to distinguish Delta Smelt from Japanese pond smelt (Wakasagi) (99).

Artificial propagation of threatened Delta smelt (99).

Develop integrated pest management (IPM) plans to reduce the amount of pesticides that potentially affect listed species include the Delta smelt (176).

In the promulgation of the standards, participate in establishing a program to screen all diversions within the area of re-proposed delta smelt critical habitat,

using the current Service recommendations unless and until new recommendations are established, to minimize the adverse impacts associated with diversion of water and adult delta smelt (174).

Monitor contaminants that tend to accumulate in agricultural runoff, especially those contaminants that may potentially affect listed species include the delta smelt (176).

Survey for adult Delta smelt in San Joaquin River and tributary sloughs (99).

Green Sturgeon

Remove green sturgeon from Clifton Court Forebay (99).

Striped Bass

Assist State of California in reoperating existing facilities to improve Delta conditions for striped bass in coordination with efforts to protect and restore native fisheries (CVPIA, Section (3406(b)(18)) (150).

Implement provision 3406(b)(1) of the CVPIA to restore the striped bass fishery (CVPIA, Section (3406(b)(18)) (150).

If requested by the State of California, assist in developing and implementing management measures to restore the striped bass fishery of the Bay-Delta estuary (CVPIA, Section 3406 (b)(18)).

Sacramento Splittail

Develop integrated pest management (IPM) plans to reduce the amount of pesticides that potentially affect listed species include the Sacramento splittail (176).

Monitor contaminants that tend to accumulate in agricultural runoff, especially those contaminants that may potentially affect listed species include the Sacramento splittail (176).

Winter-run Chinook Salmon

Prevent stranding in East Sand Slough of Red Bluff Reservoir in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Develop operational constraints on the SWP and CVP exports to help restore the winter run salmon population (41).

<u>Actions to Manage Terrestrial Special Status Species</u>

General

Initiate consultation with all federal agencies that propose or are continuing actions that may affect listed species (124).

Review all non-federal proposals and continuing actions that may result in take of listed species and take appropriate actions (124).

Sensitive species habitat acquisitions (131).

Investigate the feasibility of developing a Habitat Conservation Plan (or Plans) for the Bay and Delta that promotes the recovery of species and addresses incidental take associated with non-federal actions (124).

Preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered (178).

Adopt listed species recovery as a policy for all public agencies whose actions affect them (124).

Increase the acreage of western pond turtle, white-faced ibis, and tricolored blackbird habitat (101).

Maintain or increase the quality of northern harrier, burrowing owl, and short-eared owl habitat (101).

Lands necessary for the protection and recovery of wetland-associated federally or State-designated endangered, threatened, rare and candidate species should be acquired, restored if appropriate, and permanently protected (1).

Develop a plan to mitigate impacts to contaminated fisheries and wetland habitats of listed and proposed species (176).

Monitor status of all candidate plant and wildlife species and list them if warranted (124, 99).

Prevent violations of Endangered Species Act in SF Estuary (99).

Update, and, where necessary, prepare recovery plans for all listed wildlife species (including designation of critical habitat) (124, 99).

Invertebrates

Implement the vernal pool management plan, include mitigation banks if deemed appropriate, for the highest priority species (Sacramento Orcutt grass, San Joaquin Valley Orcutt grass, Green's tuctoria, hairy Orcutt grass, Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, and vernal pool fairy shrimp) (176).

Survey riparian forests of the Sacramento and San Joaquin valleys for the presence of valley elderberry longhorn beetle and incorporate findings into short- and long-term management programs (171).

Protect existing elderberry stands and increase the distribution of elderberries in suitable areas to provide potential habitat for the valley elderberry longhorn beetle (101).

Aleutian Canada Goose

Continue hunting closures to protect Aleutian Canada goose. Investigate the need for hunting closures for other waterfowl species as necessary (124, 170).

California Black Rail

Federal, State, and local agencies should cooperate in the development of programs to study the California black rail (19).

Federal, State, and local agencies should cooperate in the development of programs to protect habitat for the California black rail (19).

To ensure the protection of local California black rail populations, protection of wetlands (through acquisition, easement, or other means) is required (19).

Survey the populations of California black rail on a marsh-by-marsh basis (including populations in the Delta) to determine the status of populations in northern California (19).

Reclassify the California black rail as Endangered, should the populations continue to decline (California Fish and Game Commission and U.S. Fish and Wildlife Service) (19).

Study the life history requirements of the California black rail, especially nesting and food habitats (19).

Restore degraded wetlands, including establishment of the high marsh areas for California black rail habitat (19).

Prepare a recovery plan for the California black rail that would incorporate the elements of protection and restoration of habitat, cooperative programs, surveys, and needed studies (19).

California Clapper Rail

Preserve, create, restore, and manage large, contiguous expanses of tidal salt marsh and necessary adjacent uplands for the California clapper rail (124, 99).

To ensure compliance with the Stated narrative water quality standard, a detailed California clapper rail and salt marsh harvest mouse habitat and population monitoring plan should be prepared and implemented. A rail and mouse habitat restoration and mitigation plan should be prepared and implemented that compensates for any loss of rail and mouse habitat associated with the proposed action, as determined by monitoring. Also, an analysis should be done to develop a quantifiable standard that meets the objectives of the narrative standard. The plans should be submitted to the Service for review and approval prior to the implementation of the criteria (174).

Implement a captive breeding program for the California clapper rail (124, 99).

California Least Tern

Provide secure colony sites, allow for population recovery, control predators, and protect adjacent foraging area for the California least tern (124).

Protect the California least tern (99).

Giant Garter Snake

Protect existing giant garter snake habitat (and dispersal corridors) and increase the acreage and quality of its habitat (101, 91).

Address the effects of contaminants associated with CVP water usage affecting giant garter snakes (176).

Begin a program to assess the effects of Magnacide H (Acrolein) on the giant garter snake (176).

Continue efforts to gather the life history data necessary for the effective management of giant garter snakes and habitat (91).

Continue survey efforts to locate giant garter snake population (in the Delta) and identify habitats critical to their survival (91, 176).

Design and implementation of a reserve system for giant garter snakes, include a reserve for each known population affected by CVP water deliveries (176).

Develop integrated pest management (IPM) plans to reduce the amount of pesticides that potentially affect listed species include the giant garter snake (176).

Do not implement any water conservation measures that have potential to eliminate/degrade giant garter snake habitat (176).

Establish (minimum) water deliveries to key areas for giant garter snakes to ensure availability of suitable habitat every year (176).

Include in the operation and maintenance plan for water delivery and drainage canals, measures to promote suitable vegetative cover and winter retreat habitat for giant garter snakes (176).

Monitor contaminants that tend to accumulate in agricultural runoff, especially those contaminants that may potentially affect listed species, including the giant garter snake (176).

Study the feasibility of introducing or reintroduction giant garter snakes into favorable habitats within its former range, without mixing northern and southern populations (91).

Study the feasibility of rehabilitating or enhancing present or former giant garter snake habitat in the Delta (91).

Greater Sandhill Crane

Establish a traditional wintering greater sandhill crane population in the Yolo Basin (101).

Initiate landowner cooperation programs, incentive programs, and establish conservation easements to ensure wildlife management activities which benefit the greater sandhill crane (126).

Install power line marking devices near sandhill crane winter roosting and feeding sites in the Central Valley, to reduce the potential loss of greater sandhill crane due to collision with transmission/powerlines (126).

Purchase parcels of land to ensure that critical roosting and loafing sites are available and free from disturbance for greater sandhill cranes (126).

Swainson's Hawk

Protect existing Swainson's hawk nesting and foraging habitat, and increase the acreage or quality of this habitat (101).

Compatible agriculture must be maintained to sustain current Swainson's hawk population levels, as such a program of landowner incentives should be implemented (20).

Future management for the Swainson's hawk should address the need for habitat preservation through legislation (20).

Future management for the Swainson's hawk should address the need for habitat preservation through habitat acquisition (20).

Future management for the Swainson's hawk should address the need for habitat preservation through landowner operation programs (20).

In areas where nesting habitat is limiting and suitable foraging habitat remains, a program of tree planting and riparian restoration should be implemented to benefit the Swainson's hawk (20).

Management needs of the Central Valley population of Swainson's hawks includes ensuring the availability of suitable nesting habitat through the preservation of existing nest trees and potential nesting habitat and maintaining compatible agriculture (20).

Salt Marsh Harvest Mouse

Preserve, create, restore, and manage large, contiguous expanses of tidal salt marsh and necessary adjacent uplands for the salt marsh harvest mouse (124, 99).

To ensure compliance with the Stated narrative water quality standard, a detailed California clapper rail and salt marsh harvest mouse habitat and population monitoring plan should be prepared and implemented. A rail and mouse habitat restoration and mitigation plan should be prepared and implemented that compensates for any loss of rail and mouse habitat associated with the proposed action, as determined by monitoring. Also, an analysis should be done to develop a quantifiable standard that meets the objectives of the narrative standard. The plans should be submitted to the Service for review and approval prior to the implementation of the criteria (174).

Special Status Plants

The Service recommends that EPA conduct annual monitoring of the known populations of the five special status plant species to determine the affects caused by the change in salinity or the potential flooding that may result on these populations. Shifts in vegetation composition also should be monitored. Annual reports should be provided to the Service (174).

Maintain the existing palmate-bracted bird's-beak population and establish at least two other populations of the species to reduce the risk of the species extirpation (101).

Begin preparation of a vernal pool management plan to offset the impacts of CVP water deliveries on vernal pool species. This plan will be part of the vernal pool recovery plan (176).

Contribute to research to identify "biological bottlenecks" such as pollinators, seed dormancy, inbreeding depression, or other factors that may limit recovery ability of vernal pool plant species (176).

Implement the vernal pool management plan, include mitigation banks if deemed appropriate, for the highest priority species (Sacramento Orcutt grass, San Joaquin Valley Orcutt grass, Green's tuctoria, hairy Orcutt grass, Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, and vernal pool fairy shrimp) (176).

Establishment of Floodways and Meander Belts

Expand the floodplain of the rivers entering the Delta as joint flood protection and wildlife conservation areas (13, 12).

Create a seasonal floodplain by modifying or removing levees (13, 12).

Protect and restore areas in the 100 year floodplain as plant and wildlife habitat (13).

Acquire Delta islands as overflow areas (CALFED).

Dual purpose floodway proposal (131).

San Joaquin River overflow onto riparian and wetland areas (131).

Recreate various types of habitat, e.g., through provision of water and land for wetlands, levee setbacks, floodways, etc. (93).

Create a 50,000-acre meander belt from Red Bluff to Chico Landing to provide gravel recruitment, large woody debris, moderate air temperatures, and nutrient input to the lotic system (179).

Establish and maintain a Sacramento River meander belt and limit future bank protection to preserve instream and riparian habitat (21).

Rice Wetlands Project (Store excess river flow on rice fields for later release in Spring) (44).

Convert McCormack-Williamson Tract, Dead Horse Island, and Staten Island, as well as parts of Bouldin Island and Brannan-Andrus Island to a floodway (39).

Dual-Purpose Floodway Proposal, San Joaquin River (99).

For flood control, reduce carryover storage in onstream reservoirs. Construct levee setbacks. Construct floodways to allow water to spread out (as in the Yolo bypass) (93).

Control of Introduced Species

Develop and implement regulations on discharge of ballast (13, 11, 124).

Develop plans and regulations which discourage the further introduction of invasive non-native species in the Estuary (13, 12).

Develop programs for inspection at the borders to control non-native species introductions (13, 11).

Develop educational programs on introduced aquatic species (13, 11).

Exotic vegetation removal (131).

Monitor and, if necessary, recommend expansion of the water hyacinth control efforts into other parts of the drainage (125).

Exotic vegetation removal--San Joaquin River (99).

Develop a comprehensive management plan for obtaining federal assistance in dealing with exotic species (71).

Control problem exotic species already in the Estuary (179, 99, 124).

Develop programs to educate the public about the problems with exotic species and their incidental transport or introduction (124).

Control ship ballast discharges (99).

Implement measures to minimize accidental future introduction of non-native fish species (71).

Prohibit the intentional introduction of aquatic exotic species into the Estuary and its watershed (124, 99, 80).

Study the effects of introduced species (99).

Implement a program to collect and analyze data on the biological needs of exotic species and their relationship with native fishes to determine the impacts of exotic species (71).

Implement programs to determine the impacts of exotic fish species on Bay-Delta fisheries, and the potential benefits of control measures (71).

Control existing exotic species in SF Estuary (99).

Eradication of Northern Pike in Davis Lake (99).

Control water hyacinth and other aquatic weeds in the San Joaquin River and tributaries (99).

Delta Waterfowl Habitat Management

General Actions for the Management of Waterfowl Habitat

Implement management strategies for public waterfowl areas that will enhance their carrying capacity for wintering waterfowl (94).

Implement terrestrial predator control programs (CALFED).

Implement waterfowl habitat enhancement programs in the Central Valley by providing information and coordination with private landowners (Valley Care Program - Ducks Unlimited).

Develop means to encourage landowners to preserve wetlands (94).

Develop methods of using available water most effectively for wetland habitat (94).

Restore wetlands to provide habitat for waterfowl (85).

Enhance existing wetlands to increase waterfowl use by implementing the following: supplementing existing operation and maintenance programs; providing supplemental incentive payments to private landowners; waterfowl disease programs; providing technical assistant; and providing coordination with other local agencies (85).

Actions for Waterfowl Habitat Planning

Identify wetlands under fee-title or easement, and areas with the potential for protection and restoration that would apply toward the Joint Venture's 120,000 acre objective (147).

Monitor land use changes that influence waterfowl activity and threaten habitat (94).

Develop and provide firm water supplies to maintain and improve wetland habitat areas of the Central Valley (173).

Acquire wetland habitat through fee title and conservation easement to provide waterfowl habitat. Priorities should include: habitat with high waterfowl value based on historical waterfowl use patterns; wetlands with lower waterfowl use but adjacent to restorable wetlands; and wetlands the lower waterfowl use not adjacent to restorable uplands (85).

Establish a firm water supply for State and National Wildlife Areas and the Grasslands Resource Conservation District (85).

Develop a plan to secure long term water sources for federal, State, and private waterfowl habitats (94).

Actions to Provide Incentives for Waterfowl Habitat

Provide incentives to encourage farmers to participate in a program, which the Secretary shall develop, under which farmers will keep fields flooded during

appropriate time periods for the purposes of waterfowl habitat creation and maintenance and for Central Valley Project yield enhancement (CVPIA, Section 3406 (b)(22)).

Provide funding for the incentive program on a per acre basis, based upon the geographic area of benefit, the water year type, reservoir storage level, the biological need for habitat distribution, and the Basin of the Valley in which the participating lands are located (CVPIA Section 3406 (b) (22)).

Encourage agricultural landowners, by providing incentives, to keep fields flooded during appropriate time periods for the purpose of waterfowl habitat creation and maintenance and for Central Valley Project yield enhancement, consistent with the overall objectives of Section 3406 of the CVPIA (CVPIA Section 3406 (b) (22)).

Give high consideration for incentives to all lands that have a history of intensive waterfowl use (CVPIA Section 3406 (b) (22)).

Prioritize incentives for agricultural fields located close to Federal, State, and privately owned and managed wetlands (CVPIA Section 3406 (b) (22)).

Prioritize incentives for agricultural fields that produce small grain crops and seed crops. These crops are recognized as having high food value for waterfowl (CVPIA Section 3406 (b) (22)).

Provide incentives to agricultural landowners in the Valley within the Central Valley Project Service Area to provide waterfowl habitat (CVPIA Section 3406 (b) (22)).

Provide incentives to Program participants that agree to flood fields for one or both of the following purposes: 1) for the Fall/Winter period, not less than 80 acre; and 2) for the Spring/Summer breeding season, a minimum of three acres (CVPIA Section 3406 (b) (22)).

Management of suitable agricultural lands to maximize habitat values for migratory birds and other wildlife should be encouraged. Appropriate incentives, such as conservation easements, should be provided by non-profits or other entities to protect this seasonal habitat through donation or through purchase (89).

Agriculture - waterfowl habitat incentive program (99).

Develop an incentives program for farmers to maintain flooded fields creating waterfowl habitat in the Central Valley (173).

Develop means to encourage landowners to preserve wetlands (94).

Waterfowl Habitat and CVP Yield Enhancement Program (CVPIA, Section (3406(b)(22)). Provide incentives to encourage farmers to flood fields for both waterfowl habitat and CVP yield enhancement (150).

Actions for Research and Further Study of Waterfowl and Waterfowl Habitat

Assess the physical condition and reproductive potential of waterfowl relative to winter habitat conditions (94).

Assess winter foods and other requirements of key species and the ability of major habits to produce these resources (94).

Develop and evaluate methods to obtain better quantitative data on abundance and distribution of waterfowl (94).

Evaluate the cause, chronology, and magnitude of non-hunting mortality of waterfowl (94).

Evaluate the influence of weather, agriculture, and hunting on the distribution and abundance of waterfowl (94).

Actions for Site Specific Waterfowl Habitat Planning

Acquire the proposed Stone Lakes National Wildlife Refuge[4] (124).

Time mowing of alfalfa and safflower on Sherman Island so it does not coincide with pheasant and quail hatching (35).

Enhance 443,000 acres of agricultural lands for the benefit of waterfowl in Butte Basin, Colusa Basin, Sutter Basin, Yolo Basin, Delta, San Joaquin Basin, and Tulare Basin (CVPIA Section 3406 (b) (22)).

The US Bureau of Reclamation, US Fish and Wildlife Service, and the California Department of Fish and Game jointly proposed a habitat acquisition and wetland enhancement program that will meet both the requirements of long term mitigation of Kesterson Reservoir and the successful implementation of the Central Valley habitat Joint Venture of the North American Waterfowl Management Plan (168).

Enhance nesting habitat on agricultural lands enrolled in USDA set-aside and Wetlands Reserve Programs (WRP) within the Yolo Bypass (101).

Enhance wintering waterfowl habitat within the Yolo Bypass (101).

Increase the number of waterfowl brood ponds within the Yolo Bypass (101).

Increase duck production by modifying agricultural practices that reduce nesting success within the Yolo Bypass (101).

Increase the acreage of wading bird foraging habitat within the Yolo Bypass (101).

Increase the availability of potential roosting and nesting sites within the Yolo Bypass (101).

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[4] Portions of the refuge remain unacquired.

Increase the acreage of fall shallow-flooded seasonal mudflat habitat within the Yolo Bypass (101).

Increase the acreage of spring shallow-flooded seasonal mudflat habitat within the Yolo Bypass (101).

Increase the acreage of winter foraging and roosting habitat within the Yolo Bypass (101).

Implement Delta waterfowl habitat and subsidence mitigation on Twitchell Island (99).

Restoration of Upstream Anadromous Fish Habitat

General Actions to Improve Upstream Anadromous Fish Habitat

Access habitat above dams through ladders and physical transport. Improve spawning conditions below reservoirs through habitat changes, water releases and temperature control (93).

Investigate and provide recommendations on the feasibility, cost, and desirability of developing and implementing other measures which the Secretary determines would protect, restore, and enhance natural production of salmon and steel-head trout in tributary streams of the Sacramento and San Joaquin Rivers (CVPIA, Section 3406 (e)(6)).

Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Upper Sacramento River from Keswick Dam to Red Bluff Diversion Dam in the American and Stanislaus Rivers downstream from the Nimbus and Goodwin Dams, respectively. The program shall include preventive measures, such as re-establishment of meander belts and limitations on future bank protection activities, in order to avoid further losses of instream and riparian activities (CVPIA, Section 3406 (b), 13).

Expand the gravel replacement and maintenance programs downstream from dams and in the tributaries leading to the Delta (80).

Develop and implement gravel restoration programs on rivers where Central Valley Project dams have blocked replenishment of spawning gravel (173).

Gravel bed restoration (166, 93).

Restore spawning and rearing habitat in Central Valley streams as needed (Program to Restore Spawning and Rearing Habitat) (CVPIA, Section (3406(b)(13)) (150).

Implement alternative methods of stream gradient restoration, including single row sheet pile weirs, sheet pile cell weirs, concrete weir structures, gabion weirs, rock sills (90).

Develop measures to maintain water temperatures suitable for anadromous fish in the Central Valley river and Delta systems (173).

Develop a flow regimes that imitate natural flow changes and avoids dewatering redds or isolating or stranding juveniles on monthly and daily rates of change (179).

Develop and implement a program to eliminate, to the extent possible, losses of anadromous fish due to flow fluctuations caused by the operation of any Central Valley Project storage or re-regulating facility. (CVPIA, Section 3406(b)(9)).

Consider optional ways of minimizing flow fluctuations (Program to Eliminate Fish Losses Caused by Flow Fluctuations) (CVPIA, Section 3406(b)(9)) (150).

Minimize loss of salmon and steelhead due to flow fluctuations (80).

Release Pulse Flows. Consider optional patterns for pulse flows (CVPIA, Section (3406(b)(8)) (150).

Release pulsed flows to assist the timely and safe passage of anadromous fish (CVPIA, Section (3406(b)(8)) (150).

Reoperate to minimize flow fluctuations (Program to Eliminate Fish Losses Caused by Flow Fluctuations)(CVPIA, Section 3406(b)(9)) (150).

Develop and impose a program to eliminate fluctuating flows that may cause anadromous fish loss (173).

Reoperate the CVP, as authorized in Section 3406 (b)(1), to provide fishery flows at minimum or no risk to project contract deliveries (180).

Improve tributary flows through increased storage or water substitution (93).

To restore the fish and wildlife habitat, combine all water movement of the CVP with the (b)(2) water and acquire any additional needed water to create a higher level of "fish friendly" water flow in Central Valley streams (180).

Using the SFRP the Service will provide Reclamation with flow objectives necessary to enhance fisheries production based on hydrologic water year types and CVP operational conditions (180).

Implement a program based on short flow pulses to increase survival of migrating anadromous fish (173).

Develop and implement an integrated river regulation plan that balances carryover storage needs with instream flow needs based on runoff and storage conditions (179).

Upstream diversions (e.g., directly from dams) can reduce entrainment, but cause conflict with need for instream flows below diversion point. Possible accommodations to allow upstream diversions <u>and</u> adequate instream flows include increased use of storage and substitute water (93).

Salmon Attraction/Migration/Spawning Flows (Fall) (99).

Complete an integrated instream flow studies (IFIM) to refine a river regulation programs that actively balances fishery habitat with the flow regime, including needs for adequate temperature, flushing flows, out-migration, channel maintenance, attraction flows, and maintenance of a riparian corridor (179).

An instream flow study is needed to determine optimal flow rates for spawning (84).

Study factors affecting survival of young salmon rearing in river, including quality and quality of rearing habitat; effect of predators (winter runs come first in low numbers; predator population is high due to hatchery smolts in other seasons), and mechanisms for inducing migration (monitor distribution of young through time relative to river conditions) (84).

Provide necessary instream flows and temperatures to benefit salmon and steelhead in the Central Valley to support the implementation of the state and federal mandates to double the natural production of anadromous fishes (124).

Test pulsed flows (84).

Meet flow standards, objectives, and diversion limits set forth in all laws and judicial decisions that apply to Central Valley Project facilities (21).

Meet the obligations legally imposed on the CVP after October 30, 1992 (177).

Capture irrigation tailwater in ponds and reuse for irrigation to reduce warm water discharges (74).

Improve irrigation system performance and management for in-stream temperature reduction through irrigation scheduling, changes in irrigation methods, and changes in irrigation systems including tailwater reuses, to reduce or eliminate tailwater discharges (74).

Capture wetland releases in ponds and/or reuse on other wetlands to reduce warm water discharges (74).

Do not allow discharges from wetlands during the warm summer months (74).

Retire from irrigation land contributing to in-stream heating (74).

Create riparian buffer strips along streams and tributaries to shade stream and keep water temperature down (74).

Not later than five years after the date of enactment of the CVPIA, investigate and provide recommendations to certain committees within the Senate and House of Representatives on the feasibility, cost, and desirability of developing and implementing, including the impact on the project, its users, and the State of California, measures to maintain suitable temperatures for anadromous fish survival in the Sacramento and San Joaquin rivers and their tributaries, and the Sacramento-San Joaquin Delta by controlling or relocating the discharge of irrigation return flows and sewage effluent, and by restoring riparian forests. (CVPIA, Section 3406 (e)(1)).

Oppose changes in flow or in habitat that would increase river temperatures that cause substantial losses (costs) to the fall-run chinook salmon fishery (88).

Evaluate best management practices for minimizing temperature impacts of agricultural drainage return flows on Central Valley Rivers (71).

Develop and implement measures that provide adequate water temperature within the designated spawning areas by mid-October each year (125).

Evaluate streamflow releases from impoundments upstream of the Delta to minimize fishery impacts resulting from flow fluctuations (71).

Release additional cold water from reservoirs to maintain low in-stream temperatures (74).

Implement programs to evaluate temperature impact of reservoirs on fish, and correct any negative effects (71).

Continue restoration of spawning habitat (DFG) (84).

Restore and maintain California's salmon and steelhead populations through habitat restoration practices (167).

Devise alternative methods other than the Gradient Restoration Facility to increase head differential for the Glenn-Colusa Irrigation District diversion (179).

Coordinate and implement an agreement with Anderson-Cottonwood Irrigation District for future canal operations affecting Westside streams (21).

Continue to coordinate with local agencies to develop and implement sediment control measures for Westside streams (21).

Actions to Improve Anadromous Fish Habitat on Antelope Creek

Antelope Creek fish surveys (99).

- Conduct surveys in Antelope Creek for fall-run and late-fall-run chinook spawning habitat (21).

Conduct annual spring-run chinook salmon snorkel surveys in Antelope Creek (21).

Antelope Creek monitoring (99).

Continue to install and monitor thermographs in the headwaters of Antelope Creek to record summer water temperatures in spring-run chinook salmon holding area (21).

Install and operate a thermograph and streamflow gauge near the mouth of Antelope Creek to determine flow-temperature relationships (21).

Create defined stream channel in Antelope Creek (179).

Restore instream flows in Antelope Creek (179).

Evaluate the benefit of drilling new wells to establish a water exchange program with private landowners who divert Antelope Creek water (21).

Establish a program to exchange Antelope Creek surface water for ground water with landowners with existing wells (21).

Consider administrative or legal remedies to obtain streamflows in Antelope Creek to ensure restoration of habitat for salmon and steelhead (21).

Negotiate with the Los Molinos Mutual Water Company for additional flow in Antelope Creek for salmon and steelhead (21).

Evaluate existing spring-run chinook salmon and steelhead holding, spawning, and rearing habitat in Antelope Creek to identify opportunities (21).

Reestablish the abandoned USGS gauging station upstream of the existing agricultural diversion dam on Antelope Creek (21).

Actions to Improve Anadromous Fish Habitat on the American River

Complete instream flow studies on the lower American River and conduct monitoring as required by court order (21).

Implement the H Street Bridge flow schedule (American River) (179).

Require instream flow releases to the American River below Nimbus Dam (21).

Adopt ramping rate criteria to protect eggs and fry of anadromous fish in the American River (21).

Reduce and control instream flow ramping rates and flow fluctuation (American River). Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the American River downstream from Nimbus Dam (21, 179).

Reconfigure Folsom Dam (penstock inlet ports) "shutters" (American River) (179).

Restore spawning and rearing habitat in the lower American River (Program to Restore Spawning and Rearing Habitat) (CVPIA, Section (3406(b)(13)) (150).

Evaluate the need for gravel restoration in the American River (21).

Evaluate establishing vegetative cover along the banks of the American River (21).

American River Fish Habitat Restoration (99).

Terminate current programs that remove woody debris from the river channel (American River) (179).

Actions to Improve Anadromous Fish Habitat on Battle Creek

Cease all diversion of spring water to Eagle Canyon Canal (153).

Increase releases at Eagle Canyon Diversion, including the spring water from Eagle Canyon Canal, from 3 cfs to 40 cfs from September 1 to April 1 and from 3

cfs to 30 cfs for the remainder of the year. This increase stream flow equals approximately 24 TAF/yr (153).

Cease all diversion of water on North Fork Battle Creek (153).

Increase the release of water at Coleman Diversion on South Fork Battle Creek from the present 5 cfs to 50 cfs from October 1 to February 1, and from 5 cfs to 30 cfs for the remainder of the year. This increase in stream flow equals approximately 24 TAF/yr (153).

Through the FERC and water rights processes, obtain increase releases from PG&E power in Battle Creek to provide for anadromous fish (21).

Reduce diversions to PG&E power generation facilities to provide increased flows and improved fish habitat in a 17 mile section of Battle Creek (153).

Restore spawning gravel in the North Fork of Battle Creek (21).

Battle Creek Spawning Gravel Restoration (99).

Restoring Anadromous Fish Habitat in Battle Creek (99).

Prepare and implement a comprehensive plan to restore habitat in Battle Creek for winter- and spring-run chinook salmon and steelhead (21).

After installation of an effective water treatment system at Coleman National Fish Hatchery, allow fall-run salmon to migrate past the hatchery to spawn naturally in Battle Creek (21, 179).

Complete the instream flow study on the Battle Creek (21).

Actions to Improve Anadromous Fish Habitat on Bear Creek

Restore instream flows in Bear Creek (179).

Negotiate for increased instream flows in Bear Creek (21).

Evaluate the effectiveness of pulse flows for facilitate successful juvenile salmonid outmigration (Bear River) (179).

Conduct annual salmon spawning surveys in Bear Creek (21).

Actions to Improve Anadromous Fish Habitat on the Bear River

Conduct an IFIM study to determine instream flow and temperature requirements for all life stages of salmon and steelhead (Bear River) (21, 179).

Evaluate the existing water rights throughout the Bear River watershed and, if warranted, petition the SWRCB for increased instream flow (21).

Implement the Wheatland flow schedule (Bear River) (179).

Implement the Wheatland and Highway 70 water temperature standards (Bear River) (179).

Actions to Improve Anadromous Fish Habitat on Big Chico Creek

Substitute an alternate source of irrigation water for that currently supplied by the M&T Ranch Pumps (Big Chico Creek) (179).

Preserve primary summer holding areas for spring-run chinook salmon in Big Chico Creek (179).

Repair or rebuild the water control structures in Big Chico Creek at Five Mile Dam and Lindo Channel following completion of the hydrologic study (21).

Assist the city of Chico in eliminating siltation problems at One Mile Dam on Big Chico Creek (21).

Prepare a gravel management plan for Big Chico Creek (21).

Replace spawning gravel in the channels of Big Chico Creek modified for flood control (179).

Reestablish the Upper Bidwell Park USGS streamflow gauge in Big Chico Creek (21).

Completing Installation of Big Chico Creek Gauging Station (99).

Install and monitor thermographs in Big Chico Creek (21).

Improve cleaning procedure at One-Mile Pool on Big Chico Creek (179).

Complete a sediment transport and hydrologic study for Big Chico Creek (21).

Big Chico Creek Fish Habitat Improvement (99).

Actions to Improve Anadromous Fish Habitat on Butte Creek

Butte Creek fish management (99).

Butte Creek Fish Habitat Evaluation (99).

Develop and enforce land use plans that create buffer zones between Butte Creek and development (179).

Develop a watershed management program for Butte Creek (179).

Conduct a Butte Creek water quality study (21).

Conduct instream flow study on Butte Creek (21).

Develop hydrologic model for Butte Creek (21).

Acquire water rights as part of the Western Canal Siphon Project for improvement of Butte Creek fisheries (179).

Obtain rights to approximately 105 cfs of water form Parrott-Phelan diversion (Butte Creek) (179).

Adjudicate water rights and provide watermaster service or equivalent for all of Butte Creek (179).

Purchase existing water rights from diverters of Butte Creek (179).

Seek amendments to existing water rights and power licenses to provide additional Butte Creek flow for salmon and steelhead (21).

Maintain a minimum of 40 cfs instream flow below Centerville Diversion Dam (Butte Creek) (179).

Improve spawning and rearing habitat in Butte Creek (21).

Butte Creek Spawning Habitat Improvement (99).

Enhance fish passage at natural barrier below Centerville Diversion Dam on Butte Creek (179).

Enhance fish passage at PG&E diversion dams on Butte Creek (179).

Actions to Improve Anadromous Fish Habitat on the Calaveras River

Calaveras River IFIM Study (99).

Conduct instream flow and stream temperature modeling studies to determine flow needs for spawning and rearing on the Calaveras River(21).

Require adequate instream flows in the Calaveras River for chinook salmon spawning, rearing, and emigration (21).

Implement the Calaveras flow schedule (Calaveras River) (179).

Manage water temperatures for all salmonid life stages, including spawning, incubation, rearing, juvenile outmigration, and adult migration (Calaveras River) (179).

Actions to Improve Anadromous Fish Habitat on Clear Creek

Conduct an instream flow study on Clear Creek (21).

Develop comprehensive program to provide flows from Whiskeytown Dam for production of salmon and steelhead in Clear Creek, following improvement of upstream habitat and fish passage problem at McCormick Saeltzer dam (173).

Obtain increased streamflow below Whiskeytown Dam on Clear Creek to improve migration, spawning, and rearing habitat (21).

Release 200 cfs of water from Whiskeytown Dam to Clear Creek from October to April and 150 cfs the remainder of the year with variable spring-time releases depending on water year type (179).

Maintain water temperatures in Clear Creek at or below 65 degrees F during periods of juvenile rearing, at or below 60 degrees F during adult holding and prespawn, and at or below 56 degrees F during egg incubation (179).

Clear Creek Fish Habitat Improvement (99).

Increase releases and restore habitat (Program to Improve Salmon and Steelhead in Clear Creek) (CVPIA, Section (3406(b)(12)) (150).

Individual elements were once considered as a series of individual options (Program to Improve Salmon and Steelhead in Clear Creek) (CVPIA, Section (3406(b)(12)) (150).

Clear Creek Spawning Gravel Improvement (99).

Clear Creek Spawning Gravel Source Protection (99).

Protect existing sources of natural spawning gravels (e.g. Clear Creek locations) (84).

Purchase land adjacent to Clear Creek to preserve remaining sources of spawning gravel (21).

Restore spawning gravel in Clear Creek for salmon and steelhead (21, 179).

Restrict gravel mining and restore degraded channel in Clear Creek (179).

Prevent habitat degradation in Clear Creek due to sedimentation and urbanization (179).

Dredge behind Saeltzer Dam on Clear Creek to provide a sediment trap (21).

Actions to Improve Anadromous Fish Habitat in the Colusa Basin Drain

Develop defined migrational routes (Colusa Basin Drain) (179).

Develop defined migrational flows (Colusa Basin Drain) (179).

Reduce water temperatures (Colusa Basin Drain) (179).

Replace bridge/ford combinations with bridges or large culverts (Colusa Basin Drain) (179).

Provide siphons to get "beheaded" tributaries streams past irrigation canals (Colusa Basin Drain) (179).

Actions to Improve Anadromous Fish Habitat on Cottonwood Creek

Improve land use practices adjacent to Cottonwood Creek (179).

Develop and implement a gravel management program for Cottonwood Creek (21).

Protect and enhance spawning gravel in Cottonwood Creek (179).

Require stockpiling of spawning gravel from existing mining operations in Cottonwood Creek for subsequent placement in the Sacramento River (21).

Actions to Improve Anadromous Fish Habitat on the Cosumnes River

Determine and set instream flow requirements (Cosumnes River) (179).

Purchase existing water rights to provide adequate flows for all life stages of salmonids (Cosumnes River) (179).

Restrict water diversions during critical periods for salmonids (Cosumnes River) (179).

Actions to Improve Anadromous Fish Habitat on Cow Creek

Conduct an instream flow study in Cow Creek to determine migration, spawning, and rearing needs for fall- and late-fall chinook salmon and steelhead (21, 99).

Work with water right holders to obtain an agreement for adequate flows (50 cfs) in Cow Creek for fall-run salmon migration and spawning and juvenile steelhead (21, 179).

Actions to Improve Anadromous Fish Habitat on Deer Creek

Conduct an instream flow study on the lower reach of Deer Creek (21).

Conduct flow management activities along Deer Creek (179).

Improve transportation flows in the valley reach of Deer Creek (179).

Through negotiations, obtain instream flows for salmon and steelhead in the lower reach of Deer Creek (21).

Conduct a temperature modeling study in Deer Creek below existing diversions (21).

Deer Creek Fish Habitat Evaluation (99).

Protect and restore chinook salmon and steelhead habitat and preserve the long-term productivity of the upper Deer Creek aquatic ecosystem through cooperative watershed management (179).

Improve salmon spawning areas in lower Deer Creek (179).

Deer Creek Spawning Gravel Restoration (21, 99).

Actions to Improve Anadromous Fish Habitat on Elder Creek

Institute an erosion control ordinance to minimize sediment input into Elder Creek (21, 179).

Actions to Improve Anadromous Fish Habitat on the Feather River

Complete the instream flow study on the Feather River (21).

Adopt new flow release criteria for the Feather River following completion of the DWR instream flow study (21).

Require streamflow and temperature standards for the Feather River at specified locations (21).

Increase flows in the low-flow channel (Feather River) (179).

Implement the Gridley flow schedule (Feather River) (179).

Implement the Nicolaus flow schedule (Feather River) (179).

Establish operational criteria for Nelson Slough (Feather River) (179).

Monitor flow and temperatures at the hatchery to insure Feather River temperature compliance from the Fish Barrier Dam to the Thermalito Afterbay Outlet (21).

Monitor flow and temperatures in the Feather River at the riffle one mile below the Thermalito Afterbay Outlet (21).

Avoid peaking power operations at Oroville Reservoir when storage is at or below 1.7 million AF (21).

Maintain 1.5 million AF of carryover storage in Oroville Reservoir on October 1 of each year to preserve cold water for later release into the Feather River (21).

Remove physical and water quality barriers that impede access to spawning habitat (Feather River) (179).

Consider providing experimental high-turbidity pulse flows to stimulate outmigration (Feather River) (179).

Feather River Fish Habitat Evaluation (99).

Complete temperature model for the Feather River (179).

Maintain mean daily water temperatures below 63 degrees F at Gridley and below 68 degrees F throughout the Feather River between February and June for sturgeon spawning; maintain mean daily water temperatures between 61 degrees F and 65 degrees F for at least 1 month between April 1 and June 30 for American Shad (179).

Restore gravel and create spawning habitat (Feather River) (179).

Replenish gravel (Feather River) (reduce spawning habitat degradation) (179).

Identify availability of suitable sturgeon spawning habitat (Feather River) (179).

Actions to Improve Anadromous Fish Habitat on the Merced River

Conduct instream flow, stream temperature modeling, and related studies on the Merced River (21, 99).

Require measurement of instream flow requirements at the Crocker-Huffman and Snelling stream gauges on the Merced River (21).

Instream flow management-- Merced River (131).

Implement the Merced River flow schedule to benefit chinook salmon (179).

Adjust flow schedule to maintain water temperatures at 56 degrees F between October 15 and February 15, and at 65 degrees F between April 1 and May 31 (Merced River) (179).

Reduce impacts of rapid flow fluctuations (Merced River) (179).

Provide 20,000 acre feet of water to the Merced River each October to attract migrate fish from drainage water discharge into the San Joaquin River (143).

Acquire up to 100 TAF/yr of water on the Merced River from Merced Irrigation District for the purposes of increasing Tuolumne River instream flows and improving flow and water quality conditions in the San Joaquin River near Vernalis. Water will be acquired from storage in Lake McClure. The specific release pattern will be coordinated with releases from New Don Pedro Reservoir on the Tuolumne River, and from New Melones Reservoir on the Stanislaus River (153).

Require interim total annual instream flow releases (AF) on the Merced River for fisheries (21).

Improve instream flows in the Merced, Tuolumne, Stanislaus, and San Joaquin rivers for upstream migrating adult salmon (125).

Install and evaluate a temporary electrical or physical migration barrier in combination with greater attraction flows from the Merced River (125).

Establish the water quality objectives on the Merced River for the protection of salmon spawning, rearing, and emigration (21).

Restore habitat for salmon migration, spawning, and rearing in the Merced River by rehabilitating riffle areas, repairing or constructing levees and channels, and isolating mining pit areas from the active channel (21).

Merced River Fish Habitat Restoration (99).

Complete evaluation of spawning, rearing, and migration habitat restoration needs on the Merced River (21).

Gravel Replacement in Merced River (99).

Provide additional law enforcement to protect Merced River salmon habitat through diligent enforcement of screening, water pollution, and streambed alteration Fish and Game Code sections (21).

Actions to Improve Anadromous Fish Habitat on Mill Creek

Conduct a stream flow study on Mill Creek (21).

Investigate flow-temperature relationship in Mill Creek (21).

Install a stage recorder to monitor flows in Mill Creek (21).

Improve transportation flows in the valley reach of Mill Creek (179).

Obtain increased flow in Mill Creek to allow adult and juvenile salmon and steelhead unimpaired up- and downstream passage (21).

Protect and restore anadromous salmonid fisheries habitat and preserve the long-term productivity of the upper Mill Creek aquatic ecosystem through cooperative watershed management (179).

Mill Creek Spawning Gravel Improvement (99).

Improve salmon spawning areas in lower Mill Creek (179).

Renovate existing spawning gravel in Mill Creek (21).

Construct gravel detention structures in Mill Creek to provide new or additional spawning areas (21).

Mill Creek Fish Habitat Evaluation (99).

Continue to provide recommendations to the USFS for developing land use policies to protect spring-run chinook salmon habitat in Mill Creek (21).

Actions to Improve Anadromous Fish Habitat on the Mokelumne River

Require total annual instream flow releases from the Mokelumne River (AF) (21).

Maintain suitable water temperatures for all salmonid life stages to provide for timely salmonid migrations (Mokelumne River) (179).

Establish water quality objectives on the Mokelumne River for the protection of salmon spawning, rearing, and emigration (21).

Maintain adequate dissolved oxygen levels in the Camanche Reservoir (99).

Implement the Woodbridge Dam flow schedule (Mokelumne River) (179).

Provide flows maximizing suitable chinook salmon spawning habitat (Mokelumne River) (179).

Restrict flow fluctuations and reductions to prevent dewatering of salmonid redds (Mokelumne River) (179).

Improve survival of juvenile fall-run chinook salmon in the lower Mokelumne River (99).

Evaluate the feasibility of increasing available rearing habitat (Mokelumne River) (179).

Mokelumne River spawning habitat restoration (99).

Improve spawning habitat on the Mokelumne River by addition of approximately 23,000 cubic yards of gravel (21).

Spawning gravel for the Mokelumne River below Camanche Dam (99).

Replenish gravels suitable for salmonid spawning habitat (Mokelumne River) (179).

Cleanse spawning gravels of fine sediments (Mokelumne River) (179).

Prevent sedimentation of spawning gravels (Mokelumne River) (179).

Restrict gravel extraction within the Mokelumne River floodplain (21).

Actions to Improve Anadromous Fish Habitat on Mud Creek

Replace gravel in the flood-diversion reach of Mud Creek (179).

Actions to Improve Anadromous Fish Habitat on Paynes Creek

Restore adequate instream flows in Paynes Creek (179).

Obtain increased flow in Paynes Creek to allow adult and juvenile salmon and steelhead unimpaired up- and downstream passage (21).

Investigate the feasibility of developing alternative water supplies for diverters in Paynes Creek drainage (21).

Paynes Creek spawning gravel improvement (179, 99).

Replenish gravel on reconstructed spawning riffles in Paynes Creek on an as-needed basis (21).

Actions to Improve Anadromous Fish Habitat on the Sacramento River

Complete the Sacramento River instream flow study (21).

Adopt instream flow, seasonal fluctuations, and ramping rates for the Sacramento River as recommended by DFG (21).

Increased Sacramento River flows, including pulse flows (11).

Evaluate the effectiveness of Sacramento River spring pulse flows on the survival of juvenile anadromous fish (21).

Make use of short pulses of increase water flows to increase the survival of migrating anadromous fish moving into and through the Sacramento-San Joaquin Delta and Central Valley rivers and streams. (CVPIA, Section 3406 (b)(8)).

Continue to refine and improve the upper Sacramento River predictive temperature model with the objective of developing a daily predictive model (113).

Increase minimum carryover storage in the Sacramento and Trinity rivers to provide appropriate downstream water temperature conditions (CVPIA, Section (3406(b)(19)) (150).

Modify the scheduling of Trinity River exports to the Sacramento Basin when effective for Sacramento River temperature control (113).

Develop agreements with operators of large storage and diversion facilities in the Sacramento River basin to remedy project related turbidity and changes in temperature (60).

Address impacts to reservoir-based warm water fisheries as a result of potential drawdowns need to implement minimum carryover storage at Sacramento and Trinity River Reservoirs (CVPIA, Section (3406(b)(19)) (150).

Resolve instream flow, seasonal and daily flow fluctuation problems from Shasta Dam (84).

Improving Flow Regimen in Sacramento River Below Keswick Dam (99).

Implement the Grimes flow schedule on the upper main stem of the Sacramento River (179).

Maintain mean monthly flows of 31,000 cfs at Verona from February to May in wet and above-normal years (179).

Resolve the problems at Anderson-Cottonwood Irrigation District. Operation still affects water levels in prime spawning redds of winter run (84).

Reevaluate existing operation criteria in order to maintain minimum carryover storage at Sacramento and Trinity river reservoirs to protect and restore the anadromous fish of the Sacramento and Trinity rivers (CVPIA, Section 3406 (b)(19)).

Install and operate a structural temperature control device at Shasta Dam and develop and implement modifications in CVP operations as needed to assist in the Secretary's efforts to control water temperatures in the upper Sacramento River in order to protect anadromous fish in the upper Sacramento River (147, 136*, 166).

Construct a water temperature curtain at Shasta Reservoir that will allow selective withdrawal of water to maintain suitable downstream temperatures for fish (84, 71, 173).

Construct a temperature curtain at Shasta Reservoir for selective withdrawal of water in the water column while continuing to generate hydroelectric power (80).

Construct a temperature curtain at Shasta Reservoir for selective withdrawal of water in the water column while continuing to generate hydroelectric power (80).

Install and operate permanent structural temperature control devices at Shasta and Whiskeytown dams and develop and implement modifications in Central Valley Project operations as needed to assist in the Secretary of the Interior's efforts to control water temperatures in the upper Sacramento River (21).

Install a temperature control device at Shasta Dam and modify reservoir operations. Provide a funding mechanism to install a temperature control device at Shasta Lake and modify operations to reduce fish losses (147, 150).

Install a temperature control device at Shasta Dam and modify reservoir operations. Develop and implement modifications in CVP operations as needed to assist to control water temperatures in the upper Sacramento River to reduce fish losses (147, 150).

Continue implementation of the Shasta temperature control device (113).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Sacramento River minimum flows at Keswick Dam must exceed 3,250 cfs from October 1 through March 31 (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must reduce night flows in the Sacramento River at Keswick Dam, for the period of July 1 through March 31, as follows: For releases down to 6,000 cfs, flows may not be decreased by more than 15 percent per night or by more than 2.5 percent per hour; For releases between 5,999 and 4,000 cfs, flows must not be decreased by more than 200 cfs per night or by more than 100 cfs per hour; For releases between 3,999 and 3,250 cfs, flows must not be decreased by more than 100 cfs per night (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must maintain daily water temperatures in the Sacramento River at no more than 56°F below Keswick Dam as follows: At Bend Bridge - not in excess of 56°F from April 15 to September 30 and not in excess of 60°F from October 1 to October 31 for certain wet, above normal, and dry operational conditions (in combination with varying Shasta Reservoir carryover storage conditions); At Bend Bridge - not in excess of 56°F from April 15 to August 31; at Jelly's Ferry, not in excess of 56°F from September 1 to September 30 and 60°F from October 1 to October 31 for an operational condition of a dry water year and a corresponding moderately high Shasta Reservoir carryover storage; At Jelly's Ferry - not to exceed 56°F from April 15 to September 30 and not in excess of 60°F from October 1 through 31 for certain dry, critical, and extreme critical operational conditions (in combination with varying Shasta Reservoir carryover storage conditions) (175).

Maintain water temperatures at or below 56 degrees F from Keswick Dam to Bend Bridge except in extreme water years (179).

Temperature controls for the Sacramento River (99).

Temperature controls for Shasta and Whiskeytown dams (99).

Study the effects of Shasta carryover storage on water quality (e.g. water temperature) (84).

Water quality, particularly water temperature, should be evaluated for optimal spawning (does temperature delay or induce spawning?) and incubation (does temperature cause mortality of embryos in redds?) conditions. (This could be determined in lab studies). Temperature is often limiting below Cottonwood

Creek and Battle creeks (about 20 miles below Keswick). (A dam was once considering a dam on Cottonwood as a provider of coldwater releases (and project water) in spring and summer). Since many eggs are spawned below this point, what is the implication? (84).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Sacramento River minimum flows at Keswick Dam must exceed 3,250 cfs from October 1 through March 31 (175).

Maintain water temperatures at or below 56 degrees F from Keswick Dam to Bend Bridge except in extreme water years (179).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must make its annual February 15 forecast of deliveries and monthly updates to this forecast on the basis of precipitation and runoff at least at the 90 percent probability exceedance level (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must provide carryover storage (on September 30) in Shasta Reservoir of at least 1.9 MAF in most years (175).

Manage agricultural return flows from Colusa Drain and Sutter Slough to control water temperatures in the Sacramento River, and install barriers to upstream migration (21).

Restore spawning and rearing habitat in the upper Sacramento River(Program to Restore Spawning and Rearing Habitat) (CVPIA, Section (3406(b)(13)) (150).

Implement gravel replacement and spawning habitat improvement programs at locations in the Sacramento and San Joaquin River system where salmon and steelhead are likely to spawn (71).

Begun spawning gravel introductions (over 10,000 yards of gravel to Redding-Anderson area to date) (84).

Continue monitoring upper Sacramento River spawning gravel restoration (21).

Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the upper Sacramento River from Keswick Dam to Red Bluff Diversion Dam (21).

Gravel spawning beds should be mapped and evaluated for optimal grain size and sediment conditions, as well as distribution relative to adequate water temperatures for spawning below Shasta (84).

Implement gravel replacement and spawning habitat improvement programs at locations in the Sacramento and San Joaquin river system where salmon and steelhead are likely to spawn (71).

Keswick Spawning Gravel Restoration Project (99).

Sacramento river spawning gravel restoration (99).

Study habitat changes over the past twenty years in the reach between Keswick and Red Bluff Diversion Dam, as well as below the Red Bluff Diversion Dam. (Is gravel being washed away and armored?) DFG continues to dump some gravel every few years, is it enough, in the right place, the right kind, are other stream improvements needed in the spawning areas? (84).

Support gravel spawning habitat improvement program(s) (Evaluate existing program, especially below Red Bluff Diversion Dam) (84).

Implement spawning and rearing habitat improvements, including Shasta water intake tower, gravel spawning habitat improvements (especially below Keswick in the Redding area), young rearing habitat improvements, reducing effects of Red Bluff Diversion Dam (i.e. gravel recruitment, water temp, migration blockage), predator control, predator removal program, and quality cleanup of the upper Sacramento below Shasta (84).

Improve rearing habitat in middle and lower river (e.g. establish migrating and rearing corridors in Sutter, Yolo, and Sacramento bypasses) (84).

Support upper Sacramento rearing habitat improvement program (84).

Determine effects of tributaries on Sacramento River habitat (84).

Improvements to Sacramento River westside tributaries (99).

Implement flow, screening, ladders, habitat improvement and other actions on tributaries (Big Chico Creek, Battle Creek, Cottonwood Creek, Butte Creek, Mill Creek, Deer Creek, Cow Creek, Clear Creek) (84).

Implement outmigration habitat improvements, include screen or improve screens of Sacramento River diversions, minimize blockage by Red Bluff Diversion Dam, late fall and winter flow pulses coincide with DCC closure and reduced, diversions and exports (84).

Evaluate the performance of all structural remedies implemented to protect and restore the anadromous fish within the Sacramento River (21).

Continue and expand winter-run chinook salmon studies (136*).

Develop predictive methodology for Sacramento River hydrology, temperature, fish populations, fish harvest. water development, and wetlands (21).

Implement Basin Plan water quality objectives for Sacramento River (RWQCB) (84).

Implementing the Upper Sacramento River Management Program (99).

Implement Keswick improvements (84).

Remove Sacramento River bank rip-rap and restore anadromous fish habitat (21).

Actions to Improve Anadromous Fish Habitat on the San Joaquin River

Develop and implement actions that maintain acceptable water quality in the nursery tributaries and the lower San Joaquin River during the April-May outmigration period (125).

Establish a basinwide Conjunctive Water Use Program to provide adequate flows for anadromous fish (Lower San Joaquin River) (179).

Increase San Joaquin River outflows (11).

Provide 20,000 acre feet of water to the Merced River each October to attract migrate fish from drainage water discharge into the San Joaquin River (143).

Establish minimum instream flows to support fish/riparian habitat for San Joaquin tributaries (131).

Evaluate the benefits of interim increases in outflow in the spring and fall months for the migration of juvenile and adult salmon in the San Joaquin River (21).

Provide mean monthly flows of at least 7,000 cfs at Newman between February and May in wet and above-normal water years to increase sturgeon production (Lower San Joaquin River) (179).

Salmon rearing flows on the San Joaquin River (131, 99).

Salmon stranding loss reduction work on the San Joaquin River (131).

Acquire up to 100 TAF/yr of water on the Merced River from Merced Irrigation District for the purposes of increasing Tuolumne River instream flows and improving flow and water quality conditions in the San Joaquin River near Vernalis. Water will be acquired from storage in Lake McClure. The specific release pattern will be coordinated with releases from New Don Pedro Reservoir on the Tuolumne River, and from New Melones Reservoir on the Stanislaus River (153).

Acquire water from surface water users on the Stanislaus, Tuolumne, and Merced Rivers to provide improved instream flows for anadromous fish and to help meet the Bay-Delta flow and water quality requirements on the San Joaquin River. Its is assumed that water will be make available through re-operation of diversions to and releases for power generation, reductions in storage, and conservation. To the extent possible, releases will be coordinated to provide the maximum fish and wildlife benefits on the these rivers (153).

Improve instream flows in the Merced, Tuolumne, Stanislaus, and San Joaquin rivers for upstream migrating adult salmon (125).

Develop additional instream flows in the San Joaquin River and its tributaries to augment existing schedules (125).

Create adequate fall attraction flows from each spawning tributary within the San Joaquin River drainage (125).

Salmon outmigration flows (Spring), San Joaquin River (99).

Salmon operating criteria, San Joaquin River (99).

Develop a comprehensive plan to address fish and wildlife on the San Joaquin River, including stream flow, channel, and riparian habitat, and water quality improvements needed to re-establish naturally reproducing anadromous fisheries on the San Joaquin River below Friant Dam (21).

Friant Reservoir release schedule revision (99).

Develop a water temperature model for the San Joaquin River (21).

Develop and implement measures to maintain water temperatures in the spawning reaches of the San Joaquin River basin at adequate levels October 15 through mid-March and for juvenile rearing reaches particularly in April and May (125).

Establish water temperature protection objectives for the San Joaquin River at Vernalis (fall and spring) (21).

Evaluate tri-annual amendments to the Regional Water Quality Control Board's 5C Plan for Adequate Protection of Cold Water Beneficial Uses in the San Joaquin Drainage (125).

Modify reservoir operations to maintain mainstem San Joaquin River water temperatures at 56 degrees F between October 15 and February 15, and at 65 degrees F between April 1 and May 31 for chinook salmon; maintain water temperatures between 61 degrees F and 65 degrees F for 1 month between April 1 and June 30 for American shad; and maintain water temperatures between 63 degrees F in spawning areas and below 68 degrees F throughout the San Joaquin in wet and above-normal water years between February and May for white and green sturgeon (Lower San Joaquin River) (179).

Channel and spawning gravel work on the San Joaquin River (131, 99).

Develop a dissolved oxygen model for the San Joaquin River near Stockton area to evaluate all options to decrease or avoid adult migration delays (21).

Evaluate and establish conditions on dredging of the Stockton Turning basin that help avoid dissolved oxygen levels below 6.0 ppm during salmon migration periods (125).

San Joaquin River Basin Fish Habitat Evaluation (99).

Implement gravel replacement and spawning habitat improvement programs at locations in the Sacramento and San Joaquin River system where salmon and steelhead are likely to spawn (71).

Augment existing instream flows in the nursery tributaries of the San Joaquin River in April and May (125).

Increase survival-to-emergence and improve rearing habitats in the San Joaquin River and its tributaries (125).

Actions to Improve Anadromous Fish Habitat on the Stanislaus River

Acquire up to 100 TAF/yr from the South San Joaquin Irrigation District (SSJID) and Oakdale Irrigation District (OID) for the purposes of increasing Stanislaus River instream flows and improving flow and water quality conditions in the San Joaquin River near Vernalis. SSJID and OID would reduce their annual diversions to a maximum of 500 TAF, and would provide up to 100 TAF/yr to Interior. If inflows to New Melones are less than 500 TAF/yr, it is assumed that SSJID/OID would divert up to 500 TAF, and would be eligible to sell any unused water, consistent with their water rights. SSJID/OID will make water available for acquisition through a combination of water conservation measures and groundwater substitution (153).

Improve instream flows in the Merced, Tuolumne, Stanislaus, and San Joaquin rivers for upstream migrating adult salmon (125).

Implement the Stanislaus River flow schedule to benefit chinook salmon (179).

Implement the Vernalis flow schedule to benefit anadromous fish (Lower Stanislaus River) (179).

Instream flow management--Stanislaus River (131).

Reduce impacts of rapid flow fluctuations (Stanislaus River) (179).

Require interim total annual instream flow releases on the Stanislaus River for fisheries (AF) (21).

Complete water temperature modeling study on the Stanislaus River (21, 99).

Evaluate opportunities for alternative methods of providing temperature control at New Melones Reservoir on the Stanislaus River (e.g. installation of a temperature curtain, removal of Old Melones Dam) (21,179, 99).

Operate New Melones, Tulloch, and Goodwin reservoirs to maintain water temperatures at 56 degrees F between October 15 and February 15, and at 65 degrees F between April 1 and May 31 (Stanislaus River) (179).

Stanislaus River Fish Habitat Restoration (99).

Restore spawning and rearing habitat in the lower Stanislaus River (Program to Restore Spawning and Rearing Habitat) (CVPIA, Section (3406(b)(13)) (150).

Complete evaluation of spawning, rearing, and migration habitat restoration needs on the Stanislaus River (21).

Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of Central Valley Project dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Stanislaus River downstream from Goodwin Dam (21).

Gravel replacement in Stanislaus River (99).

Restore habitat for spawning, rearing, and migration on the Stanislaus River by renovating approximately 11,400 square yards of spawning and rearing habitat and modify approximately 14,600 linear feet of channel (21).

Evaluate opportunities to re-establish spring-run salmon and increase late fall-run salmon and steelhead populations in the Stanislaus River Basin (21).

Provide additional law enforcement to protect Stanislaus River salmon habitat through diligent enforcement of screening, water pollution, and streambed alteration Fish and Game Code Sections (21).

Establish water quality objectives on the Stanislaus River for the protection of salmon spawning, rearing, and emigration (21).

Actions to Improve Anadromous Fish Habitat on Stony Creek

Conduct Instream Flow Incremental Methodology (IFIM) in Stony Creek (179).

Investigate the feasibility of obtaining adequate stream flows for salmon in Stony Creek (21).

Comply with Red Bluff Diversion Dam mitigation by providing flows between 100 cfs and 500 cfs of water per day to Stony Creek via the Tehama-Colusa Canal (179).

Develop plan to assess water quality in Stony Creek (179).

Develop water management release strategy for Black Butte Dam on Stony Creek (179).

Add spawning gravel to Stony Creek (179).

Modify gravel extraction permits for Stony Creek (179).

Develop a distinct channel in Stony Creek (179).

Actions to Improve Anadromous Fish Habitat on Thomes Creek

Develop a release strategy for Tehama-Colusa Canal into Thomes Creek between October and May-Until a strategy is developed, flows of 50 cfs should be released from Tehama-Colusa Canal into Thomes Creek (179).

Conduct regular water quality monitoring in Thomes Creek (179).

Modify gravel mining methods in Thomes Creek (179).

Modify timber harvest practices adjacent to Thomes Creek (179).

Modify grazing practices adjacent to Thomes Creek (179).

Stabilize areas of high erosion adjacent to Thomes Creek (179).

Require all gravel extraction permit applications to provide protection for fish passage in Thomes Creek (21).

Institute an erosion control ordinance to protect salmon habitat in Thomes Creek (21).

Actions to Improve Anadromous Fish Habitat on the Trinity River

Trinity River fishery flow evaluation program (99).

Investigate and provide recommendations on the feasibility, cost, and desirability of installing and operating temperature control devices at Trinity Dam and Reservoir to assist in the Secretary's efforts to conserve cold water for fishery protection purposes. (CVPIA, Section 3406 (e)(4)).

Increase minimum carryover storage in the Sacramento and Trinity rivers to provide appropriate downstream water temperature conditions (CVPIA, Section (3406(b)(19)) (150).

Modify the scheduling of Trinity River exports to the Sacramento Basin when effective for Sacramento River temperature control (113).

Develop and implement a comprehensive program to provide flows to allow sufficient spawning, incubation, rearing, and outmigration for salmon and steelhead from Whiskey town Dam as determined by instream flow studies conducted by the CDFG after Clear Creek has been restored and a new fish ladder has been constructed at the McCormick-Saeltzer Dam (CVPIA, Section 3406 (b)(12)).

Continue implementation of the temperature control facilities and operational modifications at Whiskeytown Lake (113).

Install and operate permanent structural temperature control devices at Shasta and Whiskeytown dams and develop and implement modifications in Central Valley Project operations as needed to assist in the Secretary of the Interior's efforts to control water temperatures in the upper Sacramento River (21).

Address impacts to reservoir-based warm water fisheries as a result of potential drawdowns need to implement minimum carryover storage at Sacramento and Trinity river reservoirs (CVPIA, Section (3406(b)(19)) (150).

By September 30, 1996, the Secretary, after consultation with the Hoopa Valley Tribe, shall complete the Trinity River Flow Evaluation Study currently being conducted by the USFWS. Not later than December 31, 1996, the Secretary shall forward the recommendations of the Trinity River Flow Evaluation Study to certain committees within the Senate and House of Representatives (CVPIA, Section 3406 (b)(23)(A) and (B)).

Develop and implement a flow study on the Trinity River to determine suitable flow levels for maintaining chinook salmon and steelhead populations (173).

In order to meet Federal trust responsibilities to protect the fishery resources of the Hoopa Valley Tribe, and to meet the fishery restoration goals of the Act of October 24, 1984, Pub. L. 98-541, provide through the Trinity River Division, for

water years 1992 through 1996, an instream release of water to the Trinity River of not less than 340,000 acre-feet per year for the purposed of fishery restoration, propagation, and maintenance (CVPIA, Section 3406 (b)(23)).

Actions to Improve Anadromous Fish Habitat on the Tuolumne River

Tuolumne River Flow Evaluation (99).

Complete evaluation of spawning, rearing, and migration habitat restoration needs on the Tuolumne River (21).

Instream flow management--Tuolumne River (131).

Implement the Tuolumne River flow schedule to benefit chinook salmon (179).

Acquire up to 100 TAF/yr of water from the Turlock Irrigation District (TID) and Modesto Irrigation District (MID) for the purposes of increasing Tuolumne River instream flow and improving flow and water quality conditions in the San Joaquin River near Vernalis. Water will be made available through changes in the release pattern for power generation at New Don Pedro Dam, groundwater substitution, and conservation. The specific release pattern will be coordinated with releases from Lake McClure on the Merced River, and from New Melones Reservoir on the Stanislaus River (153).

Improve instream flows in the Merced, Tuolumne, Stanislaus, and San Joaquin rivers for upstream migrating adult salmon (125).

Adjust flow schedule to maintain water temperatures at 56 degrees F between October 15 and February 15, and at 65 degrees F between April 1 and May 31 (Tuolumne River) (179).

Evaluate effects of fluctuating flows due to power peaking on salmon spawning and rearing in the Tuolumne River. Develop appropriate flow fluctuation criteria (21).

Reduce impacts of rapid flow fluctuations (Tuolumne River) (179).

Require adequate instream flow releases for the protection of salmon spawning, rearing, and emigration on the Tuolumne River (21).

Gravel replacement in Tuolumne River (99).

Tuolumne River fish habitat restoration (99).

Restore habitat for spawning, rearing, and migration on the Tuolumne River at 17 sites by renovating spawning gravel and riffle areas, increasing side channel diversity, recontouring channels, and isolating predator habitat (21).

Anadromous fish habitat/screen shop at Tuolumne River Salmon Restoration Center (99).

Establish water quality objectives for the protection of salmon spawning, rearing, and emigration on the Tuolumne River (21).

Provide additional law enforcement to protect Tuolumne River salmon habitat through diligent enforcement of screening, water pollution, and streambed alteration Fish and Game Code Sections (21).

Actions to Improve Anadromous Fish Habitat on the Yuba River

Maintain a minimum flow of 175 cfs through the critical Simpson Lane reach during the spawning period in dry and critical years (Yuba River) (179).

Maintain appropriate flows through ladders at Daguerre Point Dam during the spawning season (Yuba River) (179).

Reduce and control instream flow ramping rate (Yuba River) (179).

Implement the Marysville flow schedule (Yuba River) (179).

Evaluate the effectiveness of pulse flows for facilitate successful juvenile salmon outmigration (Yuba River) (179).

Require temperatures and streamflows to protect salmon and steelhead in the Lower Yuba River (21).

Maintain adequate instream flows for temperature control (Yuba River) (179).

Maintain mean daily water temperatures between 61 degrees F and 65 degrees F for at least 1 month between April 1 and June 30 at Marysville (Yuba River) (179).

Regulate gravel extraction to protect salmon and steelhead spawning areas in the Yuba River (21).

Develop a plan to increase rearing habitat for juvenile salmon and steelhead in the Yuba River (21).

Improve spawning and rearing habitat in Yuba River (21).

Yuba River anadromous fish habitat restoration (99).

Purchase streambank conservation easements (Yuba River) (179).

Terminate program to remove woody debris from stream channel (Yuba River) (179).

Place large woody debris in stream channel (Yuba River) (179).

Improvements for Upstream Fish Passage

General Actions to Improve Upstream Fish Passage

Access habitat above dams through ladders and physical transport. Improve spawning conditions below reservoirs through habitat changes, water releases and temperature control (93).

Investigate and provide recommendations on the feasibility, cost, and desirability of developing and implementing measures to eliminate barriers to upstream migration of salmonids in the Central Valley (CVPIA, Section 3406 (e)(3)).

Develop a program to test the use of diversions to guide migrating smolts (41).

Provide for bypass escape in wet years through proper habitat configuration (84).

Reduce fish losses at channel openings (99).

Evaluate "trap and truck" or other measures to avoid high mortality of salmon juveniles and smolts (125).

Salmon trapping and moving (juveniles) (131).

Improve passage at agricultural diversion dams (179).

Minimize diversion barriers usage (179).

Actions to Improve Anadromous Fish Passage on Antelope Creek

Conduct a fish passage problem survey in lower Antelope Creek (21).

Actions to Improve Anadromous Fish Passage on Battle Creek

Allow passage above the Coleman National Fish Hatchery weir (179).

Evaluate effectiveness of fish ladders at PG&E diversions from Battle Creek (179).

Increase bypass flows at PG&E's hydropower diversions from Battle Creek (179).

Improve fish passage at Eagle Canyon in Battle Creek (21, 179, 99).

Actions to Improve Anadromous Fish Passage on Big Chico Creek

Big Chico Creek fish passage improvements (99).

Monitor salmon and steelhead passage on Big Chico Creek (21).

Inspect and repair existing fish ladders in Big Chico Creek (21, 99).

Repair Iron Canyon fish ladder (Big Chico Creek) (179).

Repair the Lindo Channel weir and fishway (Big Chico Creek) (179).

Split low flow between Big Chico Creek and Lindo Channel (179).

Actions to Improve Anadromous Fish Passage on Butte Creek

Monitor fish passage on Butte Creek (21).

Identify and correct fish passage problems at diversions in Butte Creek through dam removal or improvements to existing fish ladders (21).

Enhance fish passage at PG&E diversion dams on Butte Creek (179).

Enhance fish passage at natural barrier below Centerville Diversion Dam on Butte Creek (179).

Butte Creek fish ladder/screen (99).

Build a new high-volume fish ladder at Adams Dam (Butte Creek) (179, 99).

Build a new high-volume fish ladder at Durham Mutual Dam (Butte Creek) (179).

Durham Mutual Dam fish passage improvement (Butte Creek) (99).

Build a new high-volume fish ladder at East-West Diversion Weir (Butte Creek) (179).

Build a new high-volume fish ladder at Gorrill Dam (Butte Creek) (179).

Gorrill Dam fish passage improvement (Butte Creek) (99).

Build a new high-volume fish ladder at McGowan Dam (Butte Creek) (179).

Build a new high-volume fish ladder at McPherrin Dam (Butte Creek) (179).

Build a new high-volume fish ladder at Western Canal Dam (Butte Creek) (179).

Remove Western Canal Dam and replace with siphon (Butte Creek) (179).

Western Canal fish passage improvement (Butte Creek) (99).

Develop and construct a Western Canal Siphon (Butte Creek) (179).

Develop operational criteria for, and potential modification to, Butte Slough outfall (179).

Establish operational criteria for Sanborn Slough Bifurcation (179).

Establish operational criteria for Sutter Bypass Weir #1 (179).

Establish operational criteria for Sutter Bypass Weir #2 (179).

Establish operational criteria for Sutter Bypass Weir #3 (179).

Establish operational criteria for Sutter Bypass Weir #5 (179).

Establish operational criteria for the East and West Barrows (Butte Creek) (179).

Howard Slough fish passage improvement (Butte Creek) (99).

White Mallard Dam fish passage improvement (Butte Creek) (99).

Install culvert and riser at White Mallard Duck Club outfall (Butte Creek) (179).

Install high-volume fish ladder at White Mallard Dam (Butte Creek) (179).

Install high-volume fish ladder on Sutter Bypass Weir #1 (179).

Install high-volume fish ladder on Sutter Bypass Weir #2 (179).

Install high-volume fish ladder on Sutter Bypass Weir #3 (179).

Install high-volume fish ladder on Sutter Bypass Weir #5 (179).

Investigate the possibility of consolidation or replacement of additional diversions below the Western Canal Siphon Project (Butte Creek) (179).

Rebuild and maintain existing culvert and riser at Drumheller Slough outfall (Butte Creek) (179).

Actions to Actions to Improve Anadromous Fish Passage on the Calaveras River

Remove migration barriers affecting salmonids (Calaveras River) (179).

Construct fish passage facilities in the Calaveras River at Bellota Weir (Mormon Slough Diversion), Clements Dam (Clements Road Bridge), and Cherryland Dam, unless sufficient flow is obtained for adult salmon passage (21).

Require removal of all temporary flashboard dams in the Calaveras River, Mormon Slough, and Stockton Diverting Canal during the upstream migration period, or require provision of adequate fish passage facilities at these sites (21).

Actions to Improve Anadromous Fish Passage on Clear Creek

Monitor adult salmon and steelhead passage at Saeltzer Dam on Clear Creek (21).

Develop comprehensive program to provide flows from Whiskeytown Dam for production of salmon and steelhead in Clear Creek, following improvement of upstream habitat and fish passage problem at McCormick Saeltzer dam (173).

Provide effective fish passage above Saeltzer Dam (Clear Creek) (179, 99).

Actions to Improve Anadromous Fish Passage on the Cosumnes River

Remedy passage problems related to diversion dams and barriers to fish (Cosumnes River) (179).

Enforce Fish and Game codes that prohibit construction of unlicensed dams (Cosumnes River) (179).

Evaluate diversion dams and barriers for fish passage problems (Cosumnes River) (179).

Actions to Improve Anadromous Fish Passage on Cottonwood Creek

Eliminate attraction flows in Crowley Gulch (Cottonwood Creek) (179).

Improve fish passage in Cottonwood Creek gravel mine areas (99).

Actions to Improve Anadromous Fish Passage within the Delta

Assist State of California in developing and implementing options requiring physical changes in diversions and export facilities in coordination with efforts to protect and restore native fisheries (CVPIA, Section (3406(b)(18)) (150).

Close the DCC gates from 1 October through 30 June to increase survival of juvenile fish (Sacramento-San Joaquin Delta) (179).

Provide protection for juvenile salmonids (and striped bass) migrate through the Delta from November 1 through June 30, equivalent to protection provided by restricting exports to minimal levels (Sacramento-San Joaquin Delta) (179).

Diversion at Sutter and Steamboat Sloughs (99).

Reduce entrainment and straying of fall-run salmon at CVP and SWP facilities (99).

Test diversion of a portion of the Sacramento River into the Deep Water Ship channel to allow smolts bypass of the Delta channels (41).

Actions to Improve Anadromous Fish Passage on Deer Creek

Evaluate fish passage problems throughout the Deer Creek drainage (21).

Correct problems associated with North Diversion Dam (Deer Creek) (179).

Actions to Improve Anadromous Fish Passage on Elder Creek

Construct a fish passage structure over Corning Canal Siphon (Elder Creek) (21, 179, 99).

Actions to Improve Anadromous Fish Passage on the Feather River

Remove physical and water quality barriers that impede access to spawning habitat (Feather River) (179).

Reduce sturgeon entrainment (Feather River) (179).

Actions to Improve Anadromous Fish Passage on the Merced River

Upgrade Merced River fish screens and bypasses (99).

Provide fish passage around reservoirs allowing access to upstream spawning and rearing habitat (Merced River) (179).

Actions to Improve Anadromous Fish Passage on Mill Creek

Removal of Clough Dam (99).

Remove Clough Dam on Mill Creek and move the existing diversion to allow salmon and steelhead unimpaired access to spawning areas (21, 179).

Actions to Improve Anadromous Fish Passage on the Mokelumne River

Add a concrete sill to the Camanche Dam fish guidance fence (99).

Eliminate barriers (efficiently and timely) to migrate adult salmonids (Mokelumne River) (179).

Improve upstream fish passage in the Mokelumne River at Woodbridge Irrigation District Dam (21).

Woodbridge ID Dam fish passage improvement (99).

Reduce or eliminate mortality and delays of juvenile salmonids associated with passage past the Woodbridge Irrigation District diversion and Woodbridge Dam (Mokelumne River) (179).

Actions to Improve Anadromous Fish Passage on the Sacramento River

Implement structural and operational modifications to eliminate impingement and entrainment of juvenile salmon at the Glenn Colusa Irrigation District water diversion (179, 99).

Develop and implement a program to resolve fishery passage problems at the Anderson-Cottonwood Irrigation District Diversion Dam as well as upstream stranding problems related to Anderson-Cottonwood-Irrigation District Diversion Dam operations (CVPIA, (b)(17)) (136*, 21, 99, 84, 173, 150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Evaluate and coordinate operations of the ACID and the CVP (150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Buy out ACID water rights and retire land (150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Buy ACID water rights; ACID to use groundwater instead of river water (150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Move ACID diversion to Clear Creek (150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Pumped diversion without the dam (150).

Program to Resolve Fish Passage Problems at Anderson-Cottonwood Diversion Dam (CVPIA, Section (3406(b)(17)). Modify facility, the aging diversion structure would be replaced (150).

Anderson-Cottonwood Irrigation District cat walk for stop log removal (99).

Improve fish passage capability at RBDD for salmon migrating upstream and downstream on the river (99, 136).

Program to Minimize Fish Passage Problems at the Red Bluff Diversion Dam (CVPIA, Section (3406(b)(10)). Options currently under study will be reserved for future consideration (150).

Hold additional public workshops to gather more information to confirm the selection of reasonable alternatives identified in the RBDD Appraisal Report, in order to more accurately measure the acceptability of those alternatives and determine whether additional alternatives need to be formulated (136).

Program to Minimize Fish Passage Problems at the Red Bluff Diversion Dam (CVPIA, Section (3406(b)(10)). Modify facility for gates open operation (150).

Raise gates of Red Bluff Diversion Dam (84).

Complete the process to find final solutions to passage problems at Red Bluff Diversion Dam and improve passage conditions beyond opening the dam gates longer than 8 months (179).

Raise Red Bluff Diversion Dam gates for a minimum period from Sept. 15 to June 30 (179).

Maintain the gates at RBDD in a raised position between December 1 and April 1 to enhance salmon migration, and developing alternatives to raising the gates (136*).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must operate the RBDD gates in 1994 with the gates down no earlier than April 30, and with the gates up from September 15 through at least May 14 each year thereafter. NMFS will review proposals for intermittent gate closures of up to 10 days at one time on a case-by-case basis (175).

Implement outmigration habitat improvements, include screen or improve screens of Sacramento River diversions, minimize blockage by Red Bluff Diversion Dam, late fall and winter flow pulses coincide with DCC closure and reduced, diversions and exports (84).

Develop and implement permanent measures to minimize fish passage problems for adult and juvenile anadromous fish at the Red Bluff Diversion Dam in a manner that provides for the use of associated Central Valley Project conveyance facilities for delivery of water to the Sacramento Valley National Wildlife Refuge complex (21, 173, CVPIA, Section 3406 (b)(10)).

Construct a low diversion structure, presumable capable of fish passage without fish ladders, to divert RBDD flows from the Sacramento River some distance upstream from RBDD. Convey water directly to the T-C Canal by pipeline or canal, keeping flow out of the Sacramento River. This would allow permanent opening of the gates at RBDD and unrestricted fish passage at RBDD (alternative not considered reasonable) (136).

Construct a smaller capacity pumping plant to continuously pump T-C Canal diversion requirements to a new regulatory reservoir for later, on demand release.

The gates at RBDD would be continuously open and the river would flow freely, allowing unrestricted fish passage (alternative not considered reasonable) (136).

Convey water equivalent to RBDD diversions directly from Shasta Dam to the T-C Canal by pipeline or canal to allow for permanent opening of the gates at RBDD and unrestricted fish passage at RBDD (alternative not considered reasonable) (136).

Create a terraced artificial channel on the left abutment of RBDD (alternative not considered reasonable) (136).

Create an artificial river channel to convey all Sacramento River flows, except RBDD diversion flows, around the east side of RBDD. RBDD gates would need to be kept lowered to enable diversions by the dam. The channel would follow the alignment of Payne Slough, an old oxbow channel leaving the main river channel some miles upstream of RBDD. The channel would require low fish weirs to allow fish passage over a range of river flows. A new diversion structure, with fish ladders, would be required to divert RBDD diversion flows into the natural channel for later diversion at RBDD (alternative not considered reasonable) (136).

Install "Iowa vane" flow deflectors in the river channel downstream from RBDD to divert water toward the downstream end of the existing fish ladders, increasing the attraction of upstream migrants to the ladders (alternative not considered reasonable) (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 800 cfs and modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 800 cfs to replace the existing fish ladder; and, modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity of 1,000 cfs (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 800 cfs; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; and install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs. RBDD gates would be operated such that the gates would be open from December 1 to April 1. During this time, the river would be free flowing and Lake Red Bluff would not be available. The gates would be kept lowered and Lake Red Bluff would be available during the rest of the year; during this period, the modified and new fish ladders would provide passage from migrating salmon (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 800 cfs; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs; and, install a pumping plant with a capacity of 1,360 cfs. RBDD gates would be kept lowered and diversions made by gravity flow through the RBDD headworks during a period somewhat longer than the peak demand summer months. The longer period would be April 15 to October 1. Lake Red Bluff would be available during this period. The modified and new fish ladders would provide passage for migrating salmon. The pumping plant would enable diversions during the rest of the year (October 1 to April 15), during which time RBDD gates would be kept open, the river would be free flowing, and Lake Red Bluff would not be available (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 2,100 cfs to replace the exiting fish ladder (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity o 2,100 cfs to replace the existing fish ladder and modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 2,100 cfs to replace the existing fish ladder; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 8000 cfs; and, install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs (136).

Construct a new fish ladder on the left abutment of RBDD with a capacity of 2,100 cfs; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; and install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs. RBDD gates would be operated such that the gates would be open from December 1 to April 1 (136).

Modify the existing fish ladder on the left abutment of RBDD to increase its flow capacity to 2,100 cfs; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs; and install a pumping plant with a capacity of 1,360 cfs (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 3,000 cfs to replace the existing fish ladder (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 3,000 cfs to replace the existing fish ladder and modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 3,000 cfs to replace the existing fish ladder; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; and, install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs (136).

Construct a new fish ladder on the left abutment of RBDD with a capacity of 3,000 cfs; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; and install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs. RBDD gates would be operated such that the gates would be open from December 1 to April 1 (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 5,000 cfs to replace the existing fish ladder (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 5,000 cfs to replace the existing fish ladder and modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Install a new fish ladder on the left abutment of RBDD with a flow capacity of 5,000 cfs to replace the existing fish ladder; modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs; and, install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs (alternative not considered reasonable) (136).

Install a new fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs (alternative not considered reasonable) (136).

Modify the existing fish ladder on the right abutment of RBDD to increase its flow capacity to 800 cfs and install a new fish ladder at the center of RBDD with a flow capacity of 1,000 cfs (alternative not considered reasonable) (136).

Program to Minimize Fish Passage Problems at the Red Bluff Diversion Dam (CVPIA, Section (3406(b)(10)). Install pumping facility, predator control/deterrence capabilities, modify fish ladders and tributary intertie. Dam gates would be down mid-May to mid-September (150).

Program to Minimize Fish Passage Problems at the Red Bluff Diversion Dam (CVPIA, Section (3406(b)(10)). Install 1,360 cfs pumping facility with predator control/deterrence capabilities and the existing operations/ladder (150).

Program to Minimize Fish Passage Problems at the Red Bluff Diversion Dam (CVPIA, Section (3406(b)(10)). Install 1,360 cfs pumping facility and modify/construct fish ladders at Red Bluff Diversion Dam (150).

Install a pumping plant with a capacity of 1,360 cfs. RBDD gates would be kept lowered and diversions would be made by gravity flow through the RBDD

headworks during a period somewhat longer than the peak demand summer months. The longer period would be April 15 to October 1. Lake Red Bluff would be available during these months. During this period, the existing fish ladders would provide passage for migrating salmon. The pumping plant would enable diversions during the rest of the year (October 1 to April 15), during which time RBDD gates would be kept open, the river would be free flowing, and Lake Red Bluff would not be available (136).

Install a pumping plant with a capacity of 2,480 cfs. The gates at RBDD would be kept lowered and diversions made by gravity flow through the RBDD headworks during the peak demand summer months (mid-May to mid-July). Lake Red Bluff would be available during these months. During this period, the existing fish ladders would provide passage for migrating salmon. The pumping plant would enable diversions during the rest of the year (mid-July to mid-May), during which time RBDD gates would be kept open, the river would be free flowing, and Lake Red Bluff would not exist (136).

Install a pumping plant with a capacity of 2,720 cfs. This is the estimated peak diversion flow at the RBDD headworks. Therefore, all diversion would be made by the pumping plant, RBDD gates would be kept permanently open, and Lake Red Bluff would not exist (136).

Prepare analyses of the regional economic impacts of the reasonable alternatives identified in the RBDD Appraisal Report (136).

Prepare analyses of the social impacts of the reasonable alternatives identified in the RBDD Appraisal Report (136).

Prepare preliminary financial analyses of the reasonable alternatives identified in the RBDD Appraisal Report (136).

Evaluate the performance of all structural remedies implemented to protect and restore the anadromous fish within the Sacramento River (21).

Modify the Keswick Dam Fish Trap to provide for its efficient operation at all project flow release levels and modify the basin below the Keswick Dam spillway to prevent the trapping of fish (CVPIA, Section 3406 (b)(11)) (136*).

Construct an escape channel from stilling basin to the Sacramento River at Keswick Dam (179).

Construct an effective escape channel in the west corner of the Keswick Dam stilling basin to protect salmon and steelhead (21).

Keswick Dam stilling basin modification (99).

Correct problems at the Keswick fish trap and Tehama-Colusa fish facilities in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Parrott-Phelan Dam fish ladder (99).

Actions to Improve Anadromous Fish Passage on the San Joaquin River

Remove barriers to sturgeon migration (Lower San Joaquin River) (179).

Develop a program to investigate migration barriers removal and construction of fish passage facilities in the Sacramento and San Joaquin River tributaries in order to enhance fish passage and production (173).

Obstruction removal: Dennet Dam and others (131).

Delta Mondota Dam Replacement (99).

Actions to Improve Anadromous Fish Passage on the Stanislaus River

Provide fish passage around reservoirs allowing access to upstream spawning and rearing habitat (Stanislaus River) (179).

Actions to Improve Anadromous Fish Passage on Stoney Creek

Discontinue diversions to the Tehama-Colusa Canal (Stoney Creek) (179).

Investigate the feasibility of constructing a siphon at the Glenn-Colusa Irrigation District canal crossing on Stony Creek (21, 179).

Actions to Improve Anadromous Fish Passage on Thomes Creek

Thomes Creek anadromous fish passage evaluation (21, 99).

Require fish passage when issuing permits for the Tehama-Colusa and Corning Canal siphon crossing on Thomas Creek (21).

Replace Corning Canal Siphon (Thomes Creek) (179).

Actions to Improve Anadromous Fish Passage on the Tuolumne River

Provide fish passage around reservoirs allowing access to upstream spawning and rearing habitat (Tuolumne River) (179).

Actions to Improve Anadromous Fish Passage on the Yuba River

Modify fish ladders at Daguerre Point Dam (Yuba River) (179).

Negotiate removal or modification of the culvert crossing at Patterson Sand & Gravel and other physical and chemical barriers impending anadromous fish migration (Yuba River) (179).

Improve efficiency of fish bypasses at Hallwood-Cordua, Brophy-South Yuba, and Browns Valley water diversions (Yuba River) (179).

Restoration of Upstream Riparian Habitat

General Actions for the Restoration of Upstream Riparian Habitat

The SWRCB and Resources Agency, in consultation with other affected agencies, will establish a definition for riparian areas (73).

Establish priority for more mature communities (riparian forests) while recognizing the value of successional processes (73).

Provide special protection for riparian areas through State, local, and federal incentive and easements (e.g. tax reductions) (73).

The SWRCB/RWQCBs will use Porter Cologne and CWA Section 401 authorities actively and consistently to ensure that beneficial uses supported by riparian areas are fully protected (73).

California shall increase its interaction with the federal agencies and CWA authorization to more fully protect riparian areas (73).

The SWRCB and RWQCBs will use their existing authority under the current legislation to more effectively protect all beneficial uses supported by riparian areas (73).

Encourage consideration of riparian conservation in local and regional plans, in order to minimize the need for piecemeal regulatory protection (82).

Encourage State and federal agencies to develop internal riparian conservation policies and programs which are compatible with their programmatic goals (82).

Encourage replacement of riparian areas impacted by land use modifications with areas of equivalent habitat and value (82).

Encourage the development of riparian areas with habitat of equivalent value to areas likely to be impacted at some point in the future, then assign replacement value to these areas as compensation for habitat lost when impacts occur. Ensure that functions and values, including landscape and regional functions, are maintained by the replacement habitat areas (82).

SWRCB mitigation strategy shall ensure no net loss of riparian and wetland function and value will occur, particularly for riparian and wetland areas not regulated or protected by other State or federal agencies (73).

The Resources Agency will inventory riparian areas Statewide or, compile and disseminate if the inventory currently exists (73).

SWRCB will periodically retain university staff to conduct an independent scientific review of riparian-related activities (73).

The SWRCB/RWQCBs will initiate or strengthen local riparian corridor protection programs. Joint RWQCB/local programs will be developed, as with regulation of onsite disposal systems and storm water runoff using the following approach: a) The SWRCB will provide guidance to the RWQCBs for riparian

corridor protection. b) The RWQCB will amend their Basin Plans, establishing standards for riparian corridor protection, delegating implementation to local governments, and establishing an implementation schedule. RWQCBs will recognize existing local programs and initiatives, and will consider cross-compliance with storm water requirements. c) The SWRCB/RWQCBs will provide technical assistance (e.g., best management practices, model ordinance provisions, methods of establishing setbacks) to local governments to help implement the standards through inclusion in local planning and regulatory programs. d) Local governments will adopt and implement the protective standards through land use plans, drainage and grading ordinances, etc. e) The RWQCBs will directly enforce the Basin Plan standards where local governments fail to do so (73).

Open range live stock degrade water quality be destroying habitat along stream banks. Livestock managers need to include restoration and preservation of water quality, stream side vegetation, and protection of fish habitat in their management goals (79).

Sediment control--watershed and watercourse management (131).

Manage flow to restore riparian vegetation (179).

Restoration of riparian corridor (131).

Riparian habitat acquisitions (131).

Shaded riverine aquatic habitat inventory (131).

Site Specific Actions for the Restoration of Upstream Riparian Habitat

Develop a riparian corridor management plan to protect instream cover (American River) (179).

Revegetate denuded stream reaches and restore and maintain a protected riparian strip along Big Chico Creek (179).

Revegetate denuded stream reaches and restore and maintain a protected riparian strip in all tributaries (Colusa Basin Drain) (179).

Cow Creek Riparian Corridor Protection Zone (99).

Fence riparian corridors to exclude livestock from Cow Creek (21).

Establish a riparian corridor protection zone for Cow Creek (21).

Protect and manage riparian habitat along the Yuba River (21).

Andrew Firebaugh Historical Park (99, 131).

San Joaquin River Parkway Plan (99, 131).

Establish a riparian corridor protection zone to preserve existing salmonid habitat (Cosumnes River) (179).

Conduct flood management activities on Deer Creek, including required flood management activities with minimum damage to the fishery resources and riparian habitat in the lower five miles of Deer Creek (179).

Maintain and restore riparian habitat along lower reaches of Deer Creek (179).

Maintain and restore riparian habitat along lower reaches of Mill Creek (179).

Enhance and maintain riparian corridor to improve juvenile salmonid rearing habitat (Mokelumne River) (179).

Restore and protect instream and riparian habitat important to chinook salmon production (Merced River) (179).

Develop plan to establish a riparian corridor along Stony Creek (179).

Riparian corridor restoration on flood-damaged San Joaquin tributaries (99).

Riparian corridor restoration on the San Joaquin River (99).

Seek general plan amendments to establish protection zones for riparian vegetation throughout the Sacramento River Basin (21).

Continue acquisition of land and conservation easements to protect the riparian corridor along the Sacramento River (21).

Continue planting riparian vegetation along the banks of the Sacramento River (21).

Implement additional Corps funded plantings of riparian areas of upper Sacramento River (84).

Implement pilot site development of riparian habitat restoration program along upper Sacramento River (Corps and Fish and Wildlife Service are looking for funding partners with State) (84).

Manage flow to restore riparian vegetation (Sacramento River) (179).

Riparian Restoration, Sacramento River (Verona to Colusa) (99).

Sacramento River riparian habitat improvement (99).

Sacramento River riparian habitat protection (99).

Sacramento River riprap removal and riparian habitat restoration (84).

Sycamore Pilot Program (52).

Restore and protect instream and riparian habitat important to chinook salmon production (Tuolumne River) (179).

Tuolumne River Regional Park Plan (99, 131).

Restoration of Upstream Wetlands Habitat

General Actions for the Restoration of Upstream Wetlands Habitat

Modify floodways to support wetland habitats (CALFED).

Reuse agricultural drainage to create wetlands (CALFED).

Reuse urban wastewater effluent to create wetlands (CALFED).

Manage groundwater recharge for wetland habitat (CALFED).

Complete the National Wetlands Inventory of the Central Valley (94).

In-channel aggradation control (demonstration project) (131).

Mainstem levee design correction (131).

Develop means to encourage landowners to preserve wetlands (94).

Protection of existing wetlands through acquisitions (131).

Provide alternate or compensating habitat for species affected by water high in trace elements at evaporation ponds, e.g., create wetlands for impacts to shorebirds (74).

California shall increase its interaction with the federal agencies and CWA authorization to more fully protect wetlands areas (73).

Encourage consideration of wetland conservation in local and regional plans, in order to minimize the need for piecemeal regulatory protection (82).

Encourage State and federal agencies to develop internal wetland conservation policies and programs which are compatible with their programmatic goals (82).

Encourage replacement of wetland areas impacted by land use modifications with areas of equivalent habitat and value (82).

Encourage the development of wetland areas with habitat of equivalent value to areas likely to be impacted at some point in the future, then assign replacement value to these areas as compensation for habitat lost when impacts occur. Ensure that functions and values, including landscape and regional functions, are maintained by the replacement habitat areas (82).

The SWRCB will encourage temporary increases in wetland functions and values by encouraging the creation of temporary, "artificial" and "incidental" wetlands out of uplands or prior converted croplands. Efforts will be made to protect sensitive or unique upland habitats from conversion to artificial wetlands. Allow flexibility in regulation only by establishing formal agreements between landowners and regulatory agencies, prior to creation of such wetlands (73).

SWRCB mitigation strategy shall ensure no net loss of wetland function and value will occur, particularly for wetland areas not regulated or protected by other State or federal agencies (73).

SWRCB will encourage advance compensation for loss of small wetlands, while providing adequate safeguards to ensure that values and functions, including landscape and regional functions, are replaced. Locate banks so that local functions and values are preserved. SWRCB will require: 1) success criteria for all mitigation; 2) monitoring for success; 3) guaranteed remediation for failure (e.g. performance bonds); and 4) the mitigation site to be dedicated in perpetuity (73).

SWRCB will periodically retain university staff to conduct an independent scientific review of wetland-related activities (73).

Base water depth for each field in the incentive program on the geographic location of the lands, source of water, and primary habitat benefits desired (CVPIA Section 3406 (b) (22)).

Identify all existing data and maps on privately owned wetlands within the Central Valley. Archive all data for possible future use (147).

Manage each refuge in accordance with an approved Comprehensive Management Plan (CMP) that will guide management decisions and set forth strategies for achieving refuge unit purposes (178).

Preserve a natural diversity and abundance of fauna and flora on refuge lands (178).

Perpetuate the migratory bird resource (178).

Restore drainage-contaminated wetlands (San Joaquin Valley) (143).

Site Specific Actions for the Restoration of Upstream Wetland Habitat

Protect and restore fish and wildlife habitat associated with the 14 federal, State, and private wetland habitat areas and San Joaquin Basin Action Plan lands in the Central Valley (153).

In the Grasslands Subarea, provide alternative wetland habitat near evaporation ponds (169).

In the Grasslands Subarea, restore drainage-contaminated wetlands (169).

Napa-Sonoma Marsh Wildlife Area Project (Cargill Acquisition) (99).

The US Bureau of Reclamation, US Fish and Wildlife Service, and the California Department of Fish and Game jointly propose a habitat acquisition and wetland enhancement program that will meet both the requirements of long term mitigation of Kesterson Reservoir and the successful implementation of the Central Valley habitat Joint Venture of the North American Waterfowl Management Plan (168).

Implement habitat development and enhancement of the San Luis Ranch component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the Freitas-McPike component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the Freitas Ranch component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the West Gallo component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the East Gallo/Kelly component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the Kesterson NWR component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the Los Banos WA Complex component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the San Luis NWR component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement habitat development and enhancement of the Claus component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Implement the habitat development and enhancement of the Schwab component of the San Joaquin Basin Action Plan/Kesterson Mitigation Plan (168).

Delta Inflow/Outflow/Export Management

Actions to Manage Delta Inflow and Outflow

Implement measures to assure water availability to maintain existing habitat in the Delta, Sacramento River, San Joaquin River, and Suisun Marsh (13, 12).

Basin flow and Delta export coordination (131).

Friant Reservoir release schedule revision (131).

Manage the water system to meet Delta standards designed to minimize the intrusion of ocean salinity into the lower San Joaquin River and connecting Delta channels (13).

Establish a Delta watermaster to manage flows (CALFED).

Modify upstream consumptive use (CALFED).

Maintain positive QWEST flows, or an equivalent measure of net seaward flows at Jersey Point, of 1,000 cfs in critical and dry years, 2,000 cfs in below-and above-normal years, and 3,000 cfs in wet years from October 1 through 30 June to increase the survival of outmigrating fish (179).

Increase mean monthly flows at Vernalis to 4,500 cfs, 6,000 cfs, 8,000 cfs, 12,000 cfs, and 21,000 cfs in critical, dry, below-normal, above normal, and wet year types (60-20-20) during smolt migration period to increase the survival of out migrating smolts (179).

Implement the Delta outflow schedule to increase fish production (179).

Increase spring flows and, in exchange, capture more winter flows. This strategy may require increased surface and groundwater storage (93).

Investigate, through experimentation, the biological benefits of pulse flows to transport planktonic fish eggs and larvae into Suisun Bay (71).

Release large flow pulses to assist upstream migrate adults and downstream migrate young (84).

Salmon outmigrating flows (spring) (131).

Salmon attraction/migration/spawning flows (fall) (131).

Increase San Joaquin River outflows (11).

Increased Sacramento River flows, including pulse flows (11).

Meet flow standards and objectives and diversion limits set forth in all laws and judicial decisions that apply to Central Valley Project facilities (CVPIA, Section 3406 (b)(7)).

Evaluate incidental water, power, and recreational benefits as they relate to the peak-flow flood control facility on the North Fork American River upstream from Folsom Dam (134).

Reservoir flood release coordination, San Joaquin River (99).

Upstream diversions (e.g., directly from dams) can reduce entrainment, but cause conflict with need for instream flows below diversion point. Possible accommodations to allow upstream diversions and adequate instream flows include increased use of storage and substitute water (93).

Use existing Rancho Seco pumping facilities from Folsom South Canal (112).

Use existing Rancho Seco regulating reservoir (112).

In order to reduce the risk of jeopardy to the continued existence of delta smelt, the Delta outflow shall be maintained at: a minimum of 3,500 cfs; 6,800 cfs for at least 150 days in wet and above normal years, for 114 days in below normal years, for 109 days in dry years, and for 40 days in critical years; and 12,000 cfs for at least 150 days in wet and above normal years, for 85 days in below normal years, for 64 days in dry years, and for 18 days in critical years (175).

The San Joaquin River component of the flows listed above must be 2,000 cfs in wet and above normal years, 1,500 cfs in below normal years, 1,200 cfs in dry years, and 800 cfs in critical years. These minimum San Joaquin River flows are necessary to keep delta smelt from the vicinity of the project pumps (175).

Adopt water quality and flow standards and operational requirements designed to halt and reverse the decline of indigenous and desirable non-indigenous estuarine biota and contribute to the attainment of other objectives. Implement these standards and requirements in at least three phases: (a) immediate, interim standards and requirements consistent with current legal requirements that would be in place with the Delta in its existing configuration; (b) standards and requirements linked to South Delta Water Management facilities; and (c) standards and requirements, as may be necessary, linked to off-stream storage south of the Delta to facilitate water banking and water-transfer facilities, so long as the last two phases significantly reduce impacts on aquatic estuarine resources and meet all environmental requirements (124).

The San Joaquin River dissolved oxygen objective can be implemented by providing adequate flows in the San Joaquin River (80).

Actions to Manage Delta Exports

Reduce SWP/CVP exports to improve water supply and water quality (43, 13, 8).

Improve quality of drinking water treatment (93).

Improve the quality of water at the export intakes through reductions in Delta island discharges and/or increases in Delta outflow (93).

Address which parts of the service area of the 66 water contracts are being served CVP water without the benefit of State Water Rights Permits, and include an alternative that eliminates water deliveries outside the permitted place of use as defined by State Water Resources Control Board Water Rights Permits (140).

Divert surplus Delta inflows, transferred water, or banked water for later sale and/or release for Delta export or to meet water quality or flow requirements for the Bay-Delta estuary (102).

Alter export pumping schedule to reduce reverse flows and minimize environmental damage. Using water banking facilities, capture surplus water during wet months and reduce pumping during spring spawning periods and dry summer months (2).

Increase the availability of high-quality water in the Delta for export or outflow by storing water on two reservoir island (Bacon Island and Webb Tract), and compensate for wetland and wildlife effects of the water storage operations on the reservoir islands by implementing a habitat management plan on two habitat islands (Bouldin Island and Holland Tract). As an incidental operation of the habitat islands, water released may be sold or used for the same purposes as the water released from the reservoir islands (102).

Modify in-Delta consumptive use (CALFED).

Modify central Delta channel operations (CALFED).

Reservoir flood release coordination (131).

Manage Bacon Island, Webb Tract, Bouldin Island and Holland Tract for year-round diversion and storage of water (102).

Actions to Manage Outflow and Salinity

Establish interim basin outflow objectives, criteria, or standards to protect the upstream migration of adult salmon in the San Joaquin River (21).

Establish interim basin outflow objectives, criteria, or standards to protect juvenile salmon and steelhead during April 15 - May 15 (21).

Manage Delta outflows so that they are sufficient to maintain appropriate salinity regime for estuarine dependent species (13, 11).

Operate the State and Federal water projects in a manner that provides a positive San Joaquin River flow downstream through the San Joaquin Delta in April and May (125).

Estuarine salinity monitoring stations (99).

Salinity should be used as an index for the development of some estuarine standards (123).

Standards should be developed using an index that establishes an upstream limit of the position of the 2‰ near-bottom isohaline, averaged over different periods of the year (123).

Estuarine standards should be developed to be used in conjunction with flow standards. One set of standards should be based upon an index of the physical response of the estuary to fluctuations in the input of fresh water. These

standards should have diagnostic value in providing, throughout the year, a level of protection to the estuary and to important ecosystem values and functions consistent with environmental goals and objectives for the Bay/Delta estuary (123).

The downstream position of the 2‰ isohaline should be unconstrained (123).

The potential importance of variations in salinity on different time scales to the structure and dynamics of estuarine ecosystems should be considered in developing salinity standards. Deviations from the patterns of salinity variability in the historical data set could increase the risk of not achieving environmental goals and objectives even if mean positions of the 2‰ near-bottom isohaline were matched with the historical data sets (123).

The salinity distribution should be monitored continuously at a series of at least six stations spaced approximately five kilometers apart and located along the channel between about Emmaton and Carquinez Bridge. Measurements should be made at least near the surface and near the bottom at each station. The data should be telemetered to a convenient location for timely analysis and interpretation. These continuous monitoring data should be supplemented with detailed surveys to map the distribution of salinity in three dimensions. The data should be readily available in a timely way to all interested parties (123).

At this time, the most appropriate basis for setting salinity standards for the portion of the estuary on which this report concentrates is the position of the near-bottom 2‰ isohaline alone, unless it can be shown either that another variable is the controlling variable or that incorporation of additional variables improves the predictive capability (123).

Further research should be conducted to improve prediction of the responses of important estuarine resources to variations in the position of the near-bottom 2‰ isohaline. That research should incorporate other variables where they can be shown to contribute significantly (123).

Salinity standards should be keyed to the existing city, county, regional, state, and federal water diversion and distribution system. Proposed changes to that system should trigger a re-evaluation of the salinity standards to ensure that they will continue to provide the desired level of environmental protection while retaining as much flexibility as possible in meeting the state's other needs for water (123).

Salinity and flow-response matrices should be developed for different biologically important periods of the year. The matrices should summarize the existing state of knowledge of the responses of a rich variety of estuarine organisms and communities as well as estuarine properties and processes, to the location of the near-bottom 2‰ isohaline and associated freshwater discharge to the estuary (123).

A range of environmental/ecosystem restoration goals should be selected, and analyses should be made, to determine the distribution of the 2‰ near-bottom

isohaline throughout the year consistent with those goals. Historical flow and salinity data should be examined to determine how frequently these conditions would have been met before construction of the Central Valley Project; the State Water Project; a variety of city, county, and regional projects that divert water; and before the large-scale reclamation of historical tide marshlands. The results of these analyses would provide a valuable context within which to evaluate the amounts of water needed to achieve a range of ecological goals (123).

Alter export pumping schedule to reduce reverse flows and minimize environmental damage. Using water banking facilities, capture surplus water during wet months and reduce pumping during spring spawning periods and dry summer months (2).

Increase the availability of high-quality water in the Delta for export or outflow by storing water on two reservoir island (Bacon Island and Webb Tract), and compensate for wetland and wildlife effects of the water storage operations on the reservoir islands by implementing a habitat management plan on two habitat islands (Bouldin Island and Holland Tract). As an incidental operation of the habitat islands, water released may be sold or used for the same purposes as the water released from the reservoir islands (102).

Manage Bacon Island, Webb Tract, Bouldin Island and Holland Tract for year-round diversion and storage of water (102).

Actions to Manage In-Delta Circulation

Augment April and May flow at Vernalis and into the south Delta (125).

Increase flows on the San Joaquin River during the agricultural season (59).

Manage reservoir releases and project pumping rates so as to maintain a positive net flow pattern in the lower San Joaquin River (13, 11).

Manage Sacramento River system operations so as to improve migratory and resident fishery habitats (including pulse flows where appropriate) (13).

Manage San Joaquin River operations so as to improve migratory and resident fishery habitats (including pulse flows where appropriate) (13).

Manage water quality in the South Delta through reservoir releases from New Melones and other San Joaquin River system reservoirs (13).

Release water from Clifton Court Forebay at low tide (34).

Restrict State Water Project and Central Valley Project pumping plant diversions from the Delta and concurrently provide transport flows (172).

Manage combined Central Valley Project and State Water Project Delta exports to improve water levels and circulation in the south Delta during the agricultural season (59).

Reduce State Water Project and Central Valley Project pumping during the

irrigation season (59).

Implement the DWR proposed program on solving South Delta water levels and circulation problems (7).

Implement DWR proposed program on solving North Delta flood and water quality problems (7).

Alter export pumping schedule to reduce reverse flows and minimize environmental damage. Using water banking facilities, capture surplus water during wet months and reduce pumping during spring spawning periods and dry summer months (2).

Improve Delta conditions (flow, diversions, salvage efficiency, stress on salvaged fish, etc.) (84).

Actions to Modify SWP and CVP Operations

Reevaluate carryover storage and operational criteria for the Shasta-Trinity Division of the Central Valley Project (21).

Allocate State Water Project water from existing facilities based on entitlements rather than the previously used methodology (127).

Contractors will be provided the opportunity to directly utilize a portion of the respective storage capacities of reservoirs in order to optimize the operation of both local and State Water Project facilities (127).

Develop long term standards to minimize intrusion of ocean salinity (13, 8).

In years when total available State Water Project supplies are less than total Contractor requests for water, water will be allocated in proportion to each Contractor's share of total Contractor entitlements, thereby eliminating the initial supply reduction to Agricultural Contractors, which is currently applied with certain limitations (127).

Manage water project operations with a high degree of coordination between the State Water Project and the Central Valley Project (13).

Separate statewide water planning and data activities from current water project operations (95).

The state should continue to negotiate with the federal government to determine whether, and to what extent, it is appropriate for the federal government to transfer the ownership or operational control of the Central Valley Project (CVP) to a non-federal agency (124).

Ensure proper implementation of the Coordinated Operation Agreement (2).

The State should continue to negotiate with the federal government to determine whether, and to what extent, it is appropriate for the federal government to transfer the ownership or operational control of the Central Valley Project (CVP) to a non-federal agency (124).

Coordinate State Water Project and Central Valley Project Operations (31).

DWR and the Bureau of Reclamation would further integrate and consolidate operations of the CVP and SWP, using better coordination of groundwater and surface water supplies and deliveries, easier implementation of water conservation techniques, market-based water transfers, and groundwater management (102).

CVP contractors use CVP project facilities for water banking (CVPIA, Section 3408(d)) (150).

Address potential impacts to fish populations and other species in and around reservoirs dependent upon on habitat area, water levels and release schedules (154).

Lower minimum carryover storage in Shasta Lake to increase CVP yield (156).

Use a different year type classification for specifying Delta outflow requirements, an operational scheme that allows for more hydrologic variability (156).

Update Coordinated Operating Agreement (COA) Sharing Formula. Revisit the water rights and operational costs of the COA agreement and change operational rules (156).

Reduce carriage water requirements to result in water savings to the CVP and SWP yields (156).

Implement the Interim South Delta Water Management Program, which could augment SWP supplies (156).

Regulate and operate reservoirs to allow for better utilization of wet weather spills, those governed by flood control limits (156).

Operate San Luis Reservoir and the lower Delta Mendota Canal to potentially provide salt flushing at Vernalis on the San Joaquin River. This may provide some relaxation on New Melones water (156).

Implement the Harvey Banks Pumping Plant "Big Pumps" Operating Criteria and Wheeling, which allows for increased pumping under suitable daily and hourly conditions (156).

Implement San Luis Reservoir CVP/SWP Storage Sharing. This option would allow more flexible use of San Luis Reservoir (156).

Adjust the San Joaquin River flows-Delta Mendota Canal releases for salt flushing and fish transport (156).

Deliver water to the DWR North Bay Aqueduct via the Delta Inflow-Putah South Canal option to replace delta diversions (156).

Operate the CVP to meet the fish, wildlife, and habitat restoration goals of the CVPIA, or operate the CVP to achieve specific requirements described in the CVPIA (150).

Operate the CVP to achieve a balance among purposes of the CVP, including meeting other requirements of laws and agreements (150).

Maximize coordination of CVP and SWP and others (150).

Operate the CVP to achieve necessary project repayment (150).

Operate the CVP in coordination with other projects to optimize beneficial uses of water (150).

Operate the CVP to promote the small family farms (150).

Operate CVP to meet all obligations under State and Federal law and all decisions of SWRCB (CVPIA).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must make its annual February 15 forecast of deliveries and monthly updates to this forecast on the basis of precipitation and runoff at least at the 90 percent probability exceedance level (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must provide carryover storage (on September 30) in Shasta Reservoir of at least 1.9 MAF in most years (175).

Meet the CVPIA's fish and wildlife goals through reoperation of the CVP, with the least projected risk of the reduction in deliveries possible, consistent with meeting those goals (180).

For hydrologic conditions wetter than the critical drought period of 1928-1934, the project reduction in deliveries due to management of the (b)(2) water cannot risk more than the 800,000 acre-feet each year. In no case will water reductions in deliveries of water to contractors be more than 800,000 acre-feet (180).

If the CVPIA's fish and wildlife purposes can be met through a combination of reoperation and the (b)(2) water such that the projected impacts to deliveries are less than or equal to 800,000 acre-feet then the requirements of Sections (b)(1) and (b)(2) will be considered fully satisfied (180).

Using long-term computer modeling analysis, Reclamation will evaluate the annual operations forecast of the Project to see if water movement in preparation for deliveries can be done to help achieve the flow targets without measurable risk to water contract deliveries (180).

In order to reduce the risk of jeopardy to the continued existence of delta smelt, the Delta outflow shall be maintained at: a minimum of 3,500 cfs; 6,800 cfs for at least 150 days in wet and above normal years, for 114 days in below normal years, for 109 days in dry years, and for 40 days in critical years; and 12,000 cfs for at least 150 days in wet and above normal years, for 85 days in below normal years, for 64 days in dry years, and for 18 days in critical years (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must re-initiate consultation for certain critical and extreme

critical operational conditions (in combination with low and moderately low Shasta Reservoir carryover storage conditions) (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation and DWR must operate the Delta export facilities to ensure that no reverse flow conditions occur in the western Delta from February 1 through April 30; and that reverse flows from November 1 through January 31 must be no greater than negative 2,000 cfs in the western Delta (175).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, NMFS should review and approve proposed CVP operations prior to the allocation announcement (175).

Actions for Water Importation/Supplemental Water

Snake Colorado Project, divert water from the Snake River and convey it across Eastern Nevada to the Colorado River (161).

Construct California Undersea Aqueduct to convey water from Northern California to Southern California through an undersea conduit resting on the continental shelf (161).

Implement Pacific Southwest Water Plan. The Secretary of the Department of Interior developed this plan to initiate a constructive regional approach that would offset the water deficits in California and Arizona (161).

Address findings of United Western Investigation. The Bureau of Reclamation prepared this interim reconnaissance report, "establishing the engineer possibility and discussing the economic justification of long distance transportation of water (161).

Implement Western Water Project. This project proposed to divert 15 million acre-feet of flood water from the Columbia River to Lake Mead (161).

Implement Sierra-Cascade Project. This proposal would divert water from the Columbia River by aqueduct and pumps to a large natural storage site in the Warner Valley (161).

Implement North American Water and Power Alliance to divert water from the northwest of the continent to the warmer areas of Canada, the United States and Mexico (161).

Implement Western States Water Augmentation Concept. This is a simplified proposal intended to overcome some of the objections of the North American Water and Power Alliance (161).

Implement water imports from Alaska; transport water from Alaska in large nylon pillow tanks (161).

Transport water from Alaska using marine tankers (161).

Acquire supplemental water at lowest cost (CVPIA, Section 3406(b)(3)) (150).

Coordinate supplemental water acquisition with other programs and policies such as drain control, groundwater management/conjunctive use, reclaimed water, etc. (CVPIA, Section 3406(b)(3)) (150).

Acquire supplemental water in a way that minimizes significant impacts to local communities (CVPIA, Section 3406(b)(3)) (150).

Emphasize non-structural verses structural improvements for supplemental water (CVPIA, Section 3406(b)(3)) (150).

Acquire reclaimed water for supplemental water (CVPIA, Section 3406(b)(3)) (150).

Acquire supplemental water to achieve maximum benefits (CVPIA, Section 3406(b)(3)) (150).

Encourage the development of new environmentally sensitive supplemental water development projects (CVPIA, Section 3406(b)(3)) (150).

Look first to non-CVP water supplies for supplemental water (CVPIA, Section 3406(b)(3)) (150).

Modification of Diversion Timing Patterns

Develop and implement a program which provides for modified operations and new or improved control structures at the Delta Cross Channel and Georgiana Slough during times when significant numbers of striped bass eggs, larvae, and juveniles approach the Sacramento River intake to the Delta Cross Channel or Georgiana Slough (CVPIA, Section 3406 (b)(14)).

Evaluate the benefits and costs associated with alternative water conveyance and storage facilities including changes in the points of diversion of the SWP and the CVP in the Delta (80).

Coordinate SWP/CVP diversion timing (CALFED).

Modify diversion timing through Montezuma Salinity Control Gate (CALFED).

Use real-time monitoring and adaptive management (CALFED).

Increase instream flows in Central Valley streams to provide for improved migration and attraction flow conditions for anadromous fish, in accordance with the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA (153).

Manage south Delta export operations to pump when doing so would least affect fish (34).

Curtail diversion during critical fish migration periods (13, 11).

Shift pumping to times when fishery impact is least (13).

Restrict diversions by the Contra Costa Water District when eggs, larvae, or juveniles are present using generalized "windows" or "recent-time" monitoring (172).

Restrict diversions to the North Bay Aqueduct when eggs, larvae, or juveniles are present using generalized "windows' or "recent-time" monitoring (172).

Modify time and rate of water diverted from the river annually to minimize the impacts of diversions on out-migrate juvenile salmonids (American River) (179).

Evaluate and modify (if found to be effective) the water release outlets at Englebright Dam (Yuba River) (179).

Shift diversion patterns, diversion point, and/or diversion screening to reduce environmental impacts (93).

Increase diversion capacity and storage downstream of diversion point to allow greater emphasis on diversion during low impact periods (93).

Initiate legal action on diverters who violate water right allocations (179).

Establish a moratorium on net increases in Delta diversions and withdrawals at the Contra Costa Canal (Sacrament-San Joaquin Delta) (179).

Reduce diversions during peak out-migrations (84).

Implement a program to mitigate fish impacts at Contra Costa Water District pumps. Include option of increasing the diversion capacity of an alternative diversion point to CCWD which obviates the need to divert any water using the Rock Slough Intake (CVPIA, Section 3406(b)(5)) (150).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation must operate the RBDD gates in 1994 with the gates down no earlier than April 30, and with the gates up from September 15 through at least May 14 each year thereafter. NMFS will review proposals for intermittent gate closures of up to 10 days at one time on a case-by-case basis (175).

Increased Rates of Diversion Capacity

Actions to Increase the Rates of Diversion Capacity at the SWP

Increase diversions into Clifton Court Forebay (59).

Construct new intake for Clifton Court Forebay at Italian Slough (northwest corner of Forebay) (59).

Expand the existing Clifton Court Forebay intake by adding five more gates (59).

Enlarge Clifton Court Forebay to include the northwest portion of Victoria Island and the remaining area of Clifton Court Tract (59).

Construct a new intake for Clifton Court Forebay at the confluence of North Victoria Canal and Middle River (59, 34).

Increase diversion capacity and storage downstream of diversion point to allow greater emphasis on diversion during low impact periods (93).

Enlarge Clifton Court Forebay to include a major portion of Byron Tract, with the intake located at the northeast corner, could provide the necessary capacity to meet export requirements without enlarging existing channels or constructing a new channel (31).

Actions to Increase the Rates of Diversion Capacity at Other Diversions

Replace pumps and expand capacity at each of the CCWD pumping plants (87).

Enlarge Reach 3 of the Contra Costa Canal by raising the canal lining so that water surface elevation could be increased about one foot (87).

Construct and operate supplemental intake facilities on Old River, plus a pipeline and a transfer reservoir to divert and pump Delta water supplies to the proposed Los Vaqueros Reservoir and/or released to the Contra Costa Canal for blending purposes (87).

Construct and operate supplemental intake facilities at Clifton Court Forebay, plus a pipeline and a transfer reservoir to divert and pump Delta water supplies to the proposed Los Vaqueros Reservoir and/or released to the Contra Costa Canal for blending purposes (87).

Widen Contra Costa Canal intake channel by 20 feet to obtain a total minimum capacity of about 470 cfs (87).

Construct a new intake structure and channel from Hood to the Mokelumne River parallel to Snodgrass Slough, discharging into Lost Slough, the Mokelumne River, and Beaver Slough (39).

Construct new intake structure and channel in the vicinity of Isleton to connect the Sacramento River to Georgiana Slough (39).

Enlarge Clifton Court Forebay from 2,100 acres to 5,000 acres and provide a new gate at north end (34).

Acquisition of Long-Term Water Supplies for Fish and Wildlife

General Actions for the Acquisition of Long-Term Water Supplies for Fish and Wildlife

Evaluate alternative water sources for managing wetland habitat (94).

Develop a plan to secure long term water sources for federal, state, and private waterfowl habitats (94).

Develop methods of using available water most effectively for wetland habitat (94).

Evaluate alternative water sources for managing wetland habitat (94).

Water for flooding to provide seasonal and year-round wildlife habitat should be provided as part of State and federal programs to provide water for wildlife habitat (89).

Acquire water, as authorized in Section 3406 (b)(3), at times when the doubling goals cannot be met through reoperation or use of the dedicated water (180).

Identify the source of the water to be used in the incentive program (water rights, ground water, river/stream diversion, reservoir storage, surface return flows, or combinations, etc.) (CVPIA Section 3406 (b) (22)).

The quantity and delivery schedules of water measured at the boundaries of each wetland habitat area described in 3406 (d) shall be in accordance with Level 2 of the "Dependable Water Supply Needs" table for those habitat areas as set forth in the Refuge Water Supply Report and Two-thirds of the water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin Action Plan/Kesterson Mitigation Action Plan Report prepared by the BOR (CVPIA, Section 3406 (d)(1)).

Not later than ten years after enactment of CVPIA, the quantity and delivery schedules of water measured at the boundaries of each wetland habitat area described in 3406 (d) shall be in accordance with Level 4 o the "Dependable Water Supply Needs" table for those habitat areas as set forth in the Refuge Water Supply Report and two-thirds of the water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin Action Plan/Kesterson Mitigation Action Plan Report prepared by the BOR (CVPIA, Section 3406 (d)(2)).

Distinguish between stated contract quantities and the amount of water that would be available to contractors after meeting legal environmental requirements (140).

Dedicate the (b)(2) water specifically to support the doubling goals (180).

As outlined in the December 15, 1994 Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government, "All CVP water provided pursuant to these Principles shall be credited toward the CVP obligation under Section 3406 (b)(2) of the Central Valley Project Improvement Act to provide 800,000 acre feet of project yield for specified purposes" (180).

Dedicate and manage annually 800,000 acre-feet of Central Valley Project yield for the primary purpose of: implementing the fish, wildlife, and habitat restoration purposes and measures authorized under CVPIA; and, assisting the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (CVPIA, Section 3406 (b)(2)).

Develop and implement a program in coordination and in conformance with the plan required under 3406(b)(1) for the acquisition of a water supply to supplement the quantity of water dedicated to fish and wildlife purposes under 3406(b)(2) and to fulfill the Secretary's obligations under paragraph 3406(d)(2). The program should identify how the Secretary intends to utilize, in particular the following options: improvements in or modifications of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land (CVPIA, Section 3406 (b)(3)).

Use Project Power for fish and wildlife purposes pursuant to CVPIA (CVPIA).

Provide a substitute water supply to waterfowl areas contaminated with selenium, in order to attain the selenium objectives (63).

Identify alternative long-term water quality and flow standards, water management measures, operational changes, habitat improvements, and facilities as needed to manage the estuarine aquatic resources (including water) for optimum benefit. Develop an EIS/EIR to display the alternative trade-offs identified standards, measures, operational changes, habitat improvements, and facilities (to initiate the selection of preferred alternative). Implement the environmentally preferred alternative (including the adoption of long-term water quality and flow standards and operation requirements) that best optimizes conditions for aquatic resources, efficiently conserves scare water resources, and restores an equitable balance to the estuarine ecosystem (124).

The U.S. Bureau of Reclamation should actively seek authority to reallocate 74,000 acre feet of water annually from the CVP to replace drainage water used on wetlands before 174 (143).

Actions for the Diversion and Conveyance of Fish and Wildlife Water Supplies

Construct or acquire from non-Federal entities such water conveyance facilities, conveyance capacity, and wells as are necessary to implement the requirements of 3406 (d) (CVPIA, Section 3406 (d)(5)).

Deliver water from the GCID Main Canal to the Sacramento NWR through GCID Laterals 26-2, 25-1, and 35-1C. Approximately 90 percent of the water from the GCID Main Canal would be delivered through GCID Lateral 26-2, with the remaining 10 percent delivered through Laterals 25-1 and 35-1C. A new turnout would be constructed at the northeast corner of the refuge to allow delivery through Lateral 25-1 (141).

Develop an in-lieu groundwater exchange program between PID and the Pixley NWR. Currently, some members of the PID pump from the deep aquifer to irrigate their lands. Under the exchange proposal, these members would decrease their annual pumping by 6,000 acre-feet and receiver an equivalent amount of surface water from the FKC through existing PID facilities. This 6,000 acre-feet of surface water would be the water normally purchased to supply the refuge (141).

In the Grasslands Subarea, provide the facilities necessary to deliver 74,000 acre-feet of substitute water, including a Delta-Mendota Canal Turnout with a capacity of 200 cubic feet per second and 1.75 miles of 200-cfs canal and siphons, to the wetlands of South Grasslands (169).

Divert water from the Tehama-Colusa Canal and convey water through a new 28,400-foot, 84-inch-diameter gravity pipeline to the northwest corner of the Sacramento NWR (141).

Divert water from the GCID Main Canal upstream of the Spooner check structure, and convey it through a new 9,000-foot, 66-inch-diameter gravity pipeline to the northwest corner of the Sacramento NWR (141).

Incorporate a 29,600-foot-long concrete-lined canal for conveyance from the Tehama-Colusa Canal to the Sacramento NWR (141).

Deliver water from the Sacramento NWR to the Delevan NWR, via North Fork Logan Creek. The water would flow through Logan Creek to the northern boundary of the Delevan NWR. A rubber dam and pumping plant would be constructed on Logan Creek near the north boundary of Delevan NWR to lift the water from the creek into the refuge. The use of an automatically controlled rubber dam would allow winter flood flows to pass unimpeded down Logan Creek. This alternative would require increasing the capacity of facilities used to deliver water to Sacramento NWR to accommodate the additional flows for Delevan NWR (141).

Convey water from the southeast corner of the Sacramento NWR through a 16,700-foot-long gravity pipeline to the northwest corner of Delevan NWR (141).

Convey water from the GCID Main Canal through Hunters Creek and through GCID Lateral HC-2 to the northwest corner of the Delevan NWR (141).

Use two turnouts on the GCID Main Canal, one at Willits Slough and one at Lateral 41-1 to deliver water to the Delevan NWR. From mid-March through November, both turn-outs would be used in combination, depending on available capacity and delivery schedules (141).

Deliver water from the Sacramento NWR to the Delevan NWR. Water for Delevan NWR would be delivered first to Sacramento NWR, where it would be routed through North Fork Logan Creek to Pool 11 at the southeast corner of Sacramento NWR. The water would be conveyed from Pool 11 through a new

siphon under an existing surface drain, and into GCID's Lateral HC-2. Lateral HC-2 would convey the water to the northwest corner of the Delevan NWR. An existing siphon that conveys Lateral HC-2 under Hunter Creek would be enlarged to increase capacity for the Delevan NWR flows. This alternative would require increasing the capacity of facilities used to deliver water to the Sacramento NWR to accommodate the additional flows for Delevan NWR (141).

Convey water to the Colusa NWR through the GCID Main Canal, through Willits Slough, through Hunter Creek, and into the 2047 Drain. The 2047 Drain would be the primary year-round water source for the Colusa NWR (141).

During mid-March through November, convey water from GCID's Main Canal through Laterals 64-2A and 64-alc to the Colusa NWR (141).

Convey water from the southwest corner of the Delevan NWR to the northwest corner of the Colusa NWR through a 34,800-foot-long, 78-inch-diameter, gravity pipeline which would parallel the 2047 Drain (141).

Convey water from the southwest corner of Thermalito Afterbay (corner of Highway 99 and Hamilton Road) through a 61,600-foot gravity pipeline to the northeast corner (Liberty Road and Pennington Road) of Gray Lodge WMA (141).

Convey water from the southwest corner of Thermalito Afterbay through a 61,600-foot concrete-lined canal to the northeast corner of Gray Lodge WMA. A pump station would be required to lift the design flow of 150 cfs into Gray Lodge WMA (141).

From mid-April through mid-January, convey water from the southern end of Thermalito Afterbay, through the A-Joint Canal, through BWGWD's existing delivery ponds to the Gray Lodge WMA. From Mid-January through mid-April, when BWGWD's facilities are out of service for annual maintenance, this alternative would convey water from the northwest corner of the Thermalito Afterbay, through either the Richvale Main and a new 30-inch-diameter, 400-foot-long pipeline or through a new 51-inch-diameter siphon, through a 51-inch-diameter 12,000-foot-long gravity pipeline or concrete-lined canal, and finally through the Schwind Canal to the northeast corner of Gray Lodge WMA (141).

From mid-April through mid-December, convey water from the southern end of Thermalito Afterbay, through the A-Joint Canal through BWGWD's existing unlined canals to four existing delivery points to Gray Lodge WMA (141).

Convey water from the northwest corner of the Thermalito Afterbay, through either the Richvale Main or Western Canal, through approximately 13 miles of the Cherokee Canal, through a new 1,150-foot-long, 90-inch diameter siphon, through a new 12,000-foot-long, 90-inch-diameter gravity pipeline or concrete lined canal, and through the Schwind Canal to the northeast corner of Gray Lodge WMA. The Schwind Canal would have to be dredged to increase its capacity (141).

Deliver water to the Sutter Extension Canal using a combination of the Main Canal/Sutter Butte Canal and the Feather River, depending on available capacity in the canals. The water will be conveyed from the Sutter Extension Canal and Farington Lateral through a 14,000-foot-long concrete-lined canal or pressure pipeline, into the Wadsworth Canal to the East Borrow Ditch, where it will be diverted onto the Sutter NWR. Variations of this alternative would involve concrete lining and replacing all turnout and check structures in the Main Canal/Sutter Butte Canal to the Sunset Pumping Plant (141).

Convey water to the Sutter NWR from the Thermolito Afterbay through the A-Joint Canal and the Main Canal/Sutter Butte Canal to the Sutter Extension Canal. During the months of May through August, divert additional water for the refuge from the Feather River at the Sunset Pumping Plant into the Sutter Extension Canal, as necessary. A variation of this alternative involves construction of a 32,000-foot-long, 48-inch diameter pressure pipeline and associated pump station (141).

Convey water from the Thermolito Afterbay through the A-Joint Canal and the Main Canal/Sutter Butte Canal to the Sutter Extension Canal. During the months of May through August, additional water would be diverted from the Feather River at the Sunset Pumping Plant into the Sutter Extension Canal, as necessary. Water would be conveyed down the Sutter Extension Canal to the Farington Lateral (141).

Divert water from the California Aqueduct at BVWSD's Turnout 1B, through an existing pipeline, to the Main Drain Canal, and to the Goose Lake Canal for delivery to the Kern NWR turnout structure (141).

Divert water from the California Aqueduct into the Semitropic Water Storage District (SWSD) canal system. Water would be conveyed through the Intake Canal-Main Reach, the Main Canal-North Reach, and the Pond-Poso Canal to Poso Creek. The water would flow through Poso Creek to the Kern NWR (141).

Deliver water from the California Aqueduct to the SWSD. In lieu of pumping groundwater, SWSD would use this water for irrigation. Upon request, the SWSD would return water to Reclamation by pumping stored water through pumpback facilities. The goal of this groundwater banking project is to recharge groundwater and reduce overdraft, to increase operational reliability and flexibility, and to optimize the distribution and use of available water resources (141).

Use exiting Lost Hills Irrigation District facilities to deliver water from the California Aqueduct to the Kern NWR (141).

Divert a maximum of 28 cfs dedicated to the Pixley NWR from the Friant-Kern Canal into Deer Creek. Water would flow approximately 17 miles through Deer Creek to the center of Pixley NWR's southern boundary (141).

Divert water from the Friant-Kern Canal and convey water through a proposed 67,000-foot gravity pipeline to the center of the Pixley NWR's southern boundary. A variation on this alternative involves constructing a pipeline that is sized and routed to supply both the Pixley NWR and the southern portion of the PID service area. An agreement for shared funding of the pipeline would be developed (141).

Deliver water from the Friant-Kern Canal to the Pixley NWR through a portion of DEID's Lateral 111.6W. A new 30- inch-diameter gravity pipeline would be connected to Lateral 111. 6W and extended to the center of the Pixley NWR's southern boundary. A total of 6,000 acre-feet per year diverted from the FKC would be conveyed through the proposed pipeline to the Pixley NWR from October to March, the period corresponding to the lowest existing flows in lateral 111.6W. Recharge basins totaling 84 acres would be constructed inside Pixley NWR. Eight new wells would be constructed to extract 6,000 acre-feet of stored water to meet seasonal water demands. A variation of this alternative involves designing a pipeline between Lateral 111.6W and the Pixley NWR that could be used year round, to meet the fluctuating seasonal water demands. No recharge basins or extraction wells would be required under the latter alternative (141).

Deliver water to the Pixley NWR year-round through Deer Creek and a portion of DEID's lateral 111.6W (141).

Actions to Manage Instream Flow for Fishery Resources

Increase releases and restore habitat (Program to Improve Salmon and Steelhead in Clear Creek) (CVPIA, Section (3406(b)(12)) (150).

Trinity River instream flow release (CVPIA, Section (3406(b)(23)) (150).

Vary the stream flow targets, i.e., CVP operations criteria, for the use of the (b)(2) water with water conditions (180).

Provide necessary instream flows and temperatures to benefit salmon and steelhead in the Central Valley to support the implementation of the State and federal mandates to double the natural production of anadromous fishes (124).

Provide substitute water to users to allow more water to remain in the stream (93).

Actions to Manage Refuge Water Supplies

Receiving wildlife refuges should prepare plans for beneficial use of level 2 and 4 water by September, 1996 (194).

Provide, either directly or through contractual agreements with other appropriate parties, firm water supplies of suitable quality to maintain and improve wetland habitat areas on units of the National Wildlife Refuge System in the Central Valley of California; on the Gray Lodge, Los Banos, Volta, North Grasslands, and Mendota State wildlife management areas; and on the Grasslands Resources

Conservation District in the Central Valley of California (CVPIA, Section 3406 (d)).

Acquire refuge water supplies and with the design, construction and/or acquisition of pumping, and conveyance facilities to deliver the water to refuges (CVPIA, Section (3406(d)(1)) (150).

Use supplemental water to increase water deliveries to refuges and habitat areas from Level 2 to Level 4 (CVPIA, Section (3406(d)(2)) (150).

Reduce deliveries during drought periods to refuges of up to 25 percent (CVPIA, Section (3406(d)(4)) (150).

No reduction in Level 2 water supply during drought periods. Since total yearly allocation for CVP is set depending on year type, no shortage to Level 2 would result in increased shortages somewhere else to achieve the same total delivery (CVPIA, Section (3406(d)(4)) (150).

Reduction of deliveries during drought periods for refuges equal to agricultural reduction. Level 2 shortages to refuges would match agricultural shortage (CVPIA, Section (3406(d)(4)) (150).

Reduction of deliveries during drought periods for refuges equal to priority of supplemental water source. Level 4 shortage equal to that of the source for that supplemental water (CVPIA, Section (3406(d)(4)) (150).

No reduction in Level 4 water supply to refuges during drought periods in. Since total yearly allocation for CVP is set depending on year type, no shortage to Level 4 would result in increased shortages somewhere else to achieve the same total delivery (CVPIA, Section (3406(d)(4)) (150).

All NWR Complexes should update their current refuge objectives in accordance with the "National Wildlife Refuge System Objective Setting and the Adaptive Management Process" guidelines, and develop water management plans which document and address water management needs and uses that will fulfill refuge objectives (193).

Actions for Long-Term Water Supply Planning for Fish and Wildlife

Investigate and report, by not later than September 30, 1997, alternative means of improving the reliability and quality of water supplies currently available to privately owned wetlands in the Central Valley and the need, if any, for additional supplies (CVPIA Section 3406 (d)(6)(A)).

Investigate and report, by not later than September 30, 1997, water supply and delivery requirements necessary to permit full habitat development for water dependent wildlife on 120,000 acres supplemental to the existing wetland habitat acreage identified in Table 8 of the Central Valley Habitat Joint Venture's "Implementation Plan" dated April 19, 1990, as well as feasible means of meeting associated water supply requirements (CVPIA Section 3406 (d)(6)(B)).

Find alternative sources of water for upstream diversions (Colusa Basin Drain) (179).

Evaluate all of the existing data and maps on privately owned wetlands within the Central Valley and provide reasonable alternative plans for securing reliable water supplies of good quality to each of the wetland areas investigated. Prioritize those wetlands in accordance with the priorities established in the Joint Venture Implementation Plan, as follows: Priority 1 - Wetlands with traditionally high waterfowl use; 2) Priority 2 - Wetlands with low to moderate use by waterfowl but adjacent to lands potentially restorable to wetlands; 3) Priority 3 - wetlands with low to moderate use by waterfowl and to adjacent to lands potentially restorable to wetlands. Other considerations include the cost of water supply, cost of conversion, cost of operation and maintenance, adjacent land use, geographic setting, waterfowl species considerations, other wildlife benefits, project size, cost and benefits (147).

Develop and submit to the Congress, a least-cost plan to increase, within fifteen years after the date of enactment of the CVPIA, the yield of the Central Valley Project by the amount dedicated to fish and wildlife purposed under the CVPIA (CVPIA, Section 3408 (j)).

Action Strategies for the Long-Term Allocation of Water for Fish and Wildlife

Acquire water for increased deliveries to wetland habitat areas in the San Joaquin Valley from water users in the San Joaquin Valley. It is anticipated that water will be made available by willing sellers through groundwater substitution, reductions in storage, and conservation. It is estimated that up to 52,421 AF would be acquired annually from DMC exchange contractors, other CVP contractors, SWP contractors and/or from water users on the Merced River (153).

In the Grasslands Subarea, use and estimated 63,500 acre-feet of subsurface drainage water from water quality Zone C, and 17,500 acre-feet of subsurface drainage water from Zone B, by the year 2040, in wetlands (169).

Acquire up to 13,123 acre-feet per year of water for increased deliveries to wetland habitat areas in the Sacramento Valley from Sacramento and Feather River water users. It is assumed that water will be made available by willing sellers through groundwater substitution, reductions in storage, and conservation (153).

Purchase from willing sellers land and associated water rights and other property interests which receives Central Valley Project water under a contract executed with the United States. Target such purchases to areas deemed most beneficial to the overall purchase program (CVPIA, Section 3408 (h)(1).

Meet fish and wildlife needs with minimum project water and maximum supplemental water (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Meet fish and wildlife needs with intermediate levels of project and supplemental water (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Meet fish and wildlife needs with maximum project water and minimum supplemental water (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Dedicate water and manage for the primary purpose of implementing the fish, wildlife, and habitat restoration measures; protecting the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and meeting endangered species obligation (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Allow for implementation under guidelines that provide for substantial latitude for decision making on an annual basis (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Dedicate the water for all purposes. The portion of the needs not met to be provided by supplemental water (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Dedicate water for ESA and CWA. Supplemental water will be used for fish and wildlife restoration only (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Dedicate water for all purposes. Supplemental water will be used for fish and wildlife restoration only (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Dedicate water for fish and wildlife restoration. Supplemental water will meet those fish and wildlife restoration projects not meet by the 800,000 Acre-Feet Program (Program to Dedicate and Manage 800,000 Acre-Feet of CVP Yield for Fish and Wildlife) (CVPIA, Section (3406(b)(2)) (150).

Installation and Improvement of Fish Screens

General Actions to Install or Improve Fish Screens

Develop screening criteria for Delta and river fishes (99).

Long-term implementation plan for unscreened diversions (99).

Eliminate diversion dams and replace with either screened pumping facilities or more intakes to less sensitive areas (93).

Fit screens to diversions into conduits if the Department of Fish and Game determines that a screen is necessary to prevent fish from passing into the conduit (71).

Reduce entrainment at agricultural diversions by a combination of screening, consolidating diversions, and restricting diversion when critical life-stages of fish are present (172).

Identify if the diversion structure associated with conveyance for wetlands is operated or screened to reduce entrainment of anadromous fish if the water source is a stream or slough utilized by anadromous fish. If the diversion is not screened, include a plan of operation that will not result in entrainment of anadromous fish (6019).

Design, install, and effectively operate fish screens or other protective devices at diversions associated with fish mortality (124).

Establish conditions on industrial facilities to control entrainment of eggs, larvae, and juvenile fish (124).

Implement structural and operational modifications to eliminate entrainment at water diversions (screening and screening improvements) (179).

Restore and maintain California's salmon and steelhead populations through fish screen operations (167).

Screen upstream diversions that individually or cumulatively result in significant mortality to fishes that utilize the Estuary (124).

Actions to Install or Improve Fish Screens on the American River

Improve the fish screen at Fairbairn Water Treatment Plant (American River) (179).

Actions to Install or Improve Fish Screens on Battle Creek

Battle Creek fish screens (99, 22).

In the absence of a water exchange program, install fish screens on the agricultural diversion in Battle Creek (21).

Screen all unscreened hydropower diversions in Battle Creek (21, 99).

Construct fish screens at PG&E water diversions from Battle Creek (179).

Screen the tailrace of Coleman Powerhouse (Battle Creek) (179).

Screen Orwick diversion (Battle Creek) (179).

Construct a rack to prevent adult salmon from entering Grover diversion (Battle Creek) (179).

Actions to Install or Improve Fish Screens on Bear Creek

Build and operate fish screens on all unscreened diversions in Bear Creek (179).

Install fish screens on all major water diversions in Bear Creek (21).

Actions to Install or Improve Fish Screens on the Bear River

Bear River fish screening evaluation (99).

Effectively screen all diversions (Bear River) (179).

Actions to Install or Improve Fish Screens on Big Chico Creek

Screen diversions to the Llano Seco Unit (DFG) include those at Little Chico Creek, Angel Slough, the M&T pumps on Big Chico Creek (99), and the Parrot-Phelan diversion on Butte Creek (22, CVPIA Section 3406 (b)(21)).

Install fish screens on Little Dry Creek pumps (179, 22).

Actions to Install or Improve Fish Screens on Butte Creek

Install fish screens on 11 agricultural diversions in Butte Creek that range in capacity from 70 to 1,100 cfs (21).

Screen diversions to the Parrot-Phelan diversion on Butte Creek (22, CVPIA Section 3406 (b)(21)).

Screen diversions to the Upper Butte Basin Wildlife Area (DFG) include Howard Slough (on both openings to Butte Creek) (99, 22).

Butte Slough diversion fish screens (99).

Install fish screens at Sanborn Slough Bifurcation (Butte Creek) (179, 99).

Install fish screens at White Mallard Dam (Butte Creek) (179, 99).

Install fish screens on both diversion at Adams Dam (Butte Creek) (179, 99).

Install fish screens on both diversions at Durham Mutual Dam (Butte Creek) (179, 99).

Install fish screens on both diversions at Gorrill Dam (Butte Creek) (179, 99).

Install fish screens on both diversions at Western Canal Dam (Butte Creek) (179, 99).

Install fish screens on diversions at McGowan Dam (Butte Creek) (179, 99).

Screen diversions to the Hill Slough Wildlife Area (DFG) at the Hill Slough Intake, the Hill Slough Drain, and the McCoy Creek Intakes (Butte Creek) (22).

Actions to Install or Improve Fish Screens on the Calaveras River

Calaveras River fish screening evaluation (99).

Determine the number and capacity of unscreened water diversions on the Calaveras River. Establish a priority for installing screens (21).

Evaluate screening needs and install screens as needed on existing diversions that may affect juvenile out-migrants (Calaveras River) (179).

Screen the Stockton East Water District diversion on the Calaveras River at the Bellota Weir (22).

Actions to Install or Improve Fish Screens on the Cosumnes River

Granlees Diversion Dam fish screening evaluation (99).

Effectively screen all diversions (Cosumnes River) (179).

Determine adequacy of fish screen at Granlees Diversion Dam on the Cosumnes River (21).

Actions to Install or Improve Fish Screens on Cow Creek

Cow Creek Diversions Fish Screens (99).

Effectively screen agricultural diversions in Cow Creek (179).

Screen, as needed, any diversion on Cow Creek (each diversion < 5 cfs) that entrains juvenile salmon or steelhead (21).

Actions to Install or Improve Fish Screens on the Feather River

Evaluate Nelson Slough diversions, Feather River (22).

Reduce sturgeon entrainment (Feather River) (179).

Actions to Install or Improve Fish Screens on the Merced River

Install and maintain fish protection devices at riparian pumps and diversions (Merced River) (179).

Actions to Install or Improve Fish Screens within the Suisun Marsh

Assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing nonfunctioning screens, and relocation of diversions to less fishery-sensitive areas (CVPIA, Section 3406 (b)(21)).

Screen diversions to the Grizzly Island Wildlife Area (DFG) include those at the Grizzly Island Ditch Intakes, the Montezuma Slough Intakes, the Grizzly Bay Intake, the Cut Off Slough Intake, the Suisun Slough Drains, the Suisun Slough

Intake, Cordelia Slough, the Goodyear Slough Drain, the Goodyear Slough Intakes, and the Suisun Bay Drain (22).

Screen the gate at Concord Farms, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at Spinner Island, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at Hook n' Trigger, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at Meins Landing, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at Montezuma Ranch, Suisun Marsh (from Montezuma Slough) (22).

Investigate the effects of the diversion of juvenile winter-run chinook into Montezuma Slough through the Suisun Marsh Salinity Control Structure in order to reduce the risk of jeopardy to their continued existence (175).

Reduce fish entrainment in Twitchell Island irrigation siphons and in Suisun Marsh diversions (41).

Install fish screens within the Suisun Marsh Resources Conservation District (CVPIA Section 3406 (b)(21)).

Screen the diversion at the Can-Can Duck Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Piedmont Rod and Gun Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at California Farms, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at Four Winds Duck Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at Hidden Cove, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Black Dog Gun Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Delta Ke Ranch, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Duck-A-Go-Go, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Gum Tree Farm, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Payton Place, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Shurshot Gun Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at the Slough Farm, Suisun Marsh (from Montezuma Slough) (22).

Screen the gate at Tip End Gun Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at Balboa Farms, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at Grizzly Ranch, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at the Grizzly Duck Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at the Island Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at the Joice Island Gun Club (from Montezuma Slough) (22).

Screen the gates at the Meridian Gun Club, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at the Pintail Ranch, Suisun Marsh (from Montezuma Slough) (22).

Screen the gates at the Westwind Duck Club, Suisun Marsh (from Montezuma Slough) (22).

Suisun Marsh Wetland Diversion screening project (99).

<u>Actions to Install or Improve Fish Screens within the Sacramento-San Joaquin Delta</u>

General Locations

Institute a water diversion evaluation program within the Delta to determine if fish screens are necessary (71).

Evaluate the unscreened diversions in the Sacramento River and the Delta to determine if screens should be installed at these locations (80).

Assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing nonfunctioning screens, and relocation of diversions to less fishery-sensitive areas (CVPIA, Section 3406 (b)(21)).

Develop and implement a demonstration screening program to promote screening technology along the Sacramento River and the Delta in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Avoid Anadromous Fish Losses at Diversions (CVPIA, Section (3406(b)(21)). Evaluate screening technologies, (e.g. hydroacoustics barriers) (150).

Avoid Anadromous Fish Losses at Diversions (CVPIA, Section (3406(b)(21)). Assist the State of California to avoid fish losses at all unscreened and inadequately screened diversions (150).

Avoid Anadromous Fish Losses at Diversions (CVPIA, Section (3406(b)(21)). Assist the State of California to avoid anadromous fish losses attributable to CVP diversions only (150).

Avoid Anadromous Fish Losses at Diversions (CVPIA, Section (3406(b)(21)). Rehabilitate or replace non-functioning screens (150).

Avoid Anadromous Fish Losses at Diversions (CVPIA, Section (3406(b)(21)). Assist the State of California to avoid anadromous fish losses at all unscreened and inadequately screened Delta island diversions by consolidating and screening diversions (150).

Screen unscreened diversions (fry are lost through most of the existing screens and project louver systems) (84).

Agricultural Diversions

Minimize loss and/or entrainment of eggs, larvae, and juveniles at private agricultural diversions (Sacramento-San Joaquin Delta) (179).

Consolidate agricultural diversions in the south Delta, and distribute via overland pipeline(s) or canal(s) (59).

Consolidate agricultural diversions in the Delta and tributaries (99).

Screen consolidated agricultural diversions in the south Delta (59).

Install fish protective devices on agricultural or other diversions in the San Joaquin River and south Delta (125).

Screen Delta agricultural diversions (13, 11).

Screen smaller water diversions in the Delta (13, 11).

Installation at Specific Locations within the Delta

Develop and implement a program to mitigate for fishery impacts associated with operations of the Tracy Pumping Plant. The program shall include, but is not limited to improvement or replacement of the fish screens and fish recovery facilities and practices associated with the Tracy Pumping Plant (CVPIA, Section 3406 (b)(4)).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, Reclamation and DWR must monitor, conduct data analyses, and estimate salvage numbers and estimates of losses to the extent of the incidental take of juvenile winter-run chinook salmon associated with the operation of the Delta export facilities (175).

Install fish screens for the Clifton Court Forebay Intake (13, 11).

Program to Mitigate Fish Impacts at the Tracy Pumps (CVPIA, Section (3406(b)(4)). Upgrade facilities, reoperate facility (150).

Program to Mitigate Fish Impacts at the Tracy Pumps (CVPIA, Section (3406(b)(4)). Upgrade facilities, reoperate with other Delta facilities (150).

Program to Mitigate Fish Impacts at the Tracy Pumps (CVPIA, Section (3406(b)(4)). Upgrade facilities only (150).

Program to Mitigate Fish Impacts at the Tracy Pumps (CVPIA, Section (3406(b)(4)). Reoperate facilities only (150).

Develop and implement a plan to mitigate fishery impacts at the Tracy Pumping Plant (173).

Install fish screens and return systems at Delta water facilities (31).

Reduce entrainment and impingement losses at the PG&E Pittsburg and Contra Costa power plants and other industrial diverters when eggs, larvae, or juveniles are present (172).

Minimize loss and/or entrainment of eggs, larvae, and juveniles at the PG&E power generate plants (Sacramento-San Joaquin Delta) (179).

Minimize loss and/or entrainment of eggs, larvae, and juveniles at the Contra Costa Canal diversion (Sacramento-San Joaquin Delta) (179).

Implement program to mitigate fishery impacts at Contra Costa Canal in Rock Slough by building and operating fish screening and recovery facilities, and modifying project operations (173, 99, 172).

Develop and implement a program to mitigate for fishery impacts resulting from operations of the Contra Costa Canal Pumping Plant No. 1. The program shall provide for construction and operation of fish screening and recovery facilities, and for modified practices and operations (CVPIA, Section 3406 (b)(5)).

Program to Mitigate Fish Impacts at Contra Costa Water District Pumps (CVPIA, Section (3406(b)(5)). Construct facility, reoperate facility (150).

Program to Mitigate Fish Impacts at Contra Costa Water District Pumps (CVPIA, Section (3406(b)(5)). Operate Delta, upgrade facility at Rock Slough and/or build a new intake at Old River, reoperate with other Delta facilities (150).

Install fish screen at the Delta Cross-channel (13, 11).

Install fish screen at the head of Georgiana Slough (13, 11).

Install fish screen at the head of Old River (13, 11).

Install fish screens at the head the Three-mile Slough (13, 11).

Reduce fish entrainment in Twitchell Island irrigation siphons and in Suisun Marsh diversions (41).

Screen any unscreened diversions to the following Delta islands: Venice Island, McDonald Island, Twitchell Island, and Bacon Island (22).

Screen diversions to the Woodbridge Ecological Reserve (DFG) at Hog Island and Sycamore Sloughs (Delta) (22).

Screen the diversion to the Calhoun Cut Ecological Reserve at Calhoun Cut (Delta) (22).

Sherman and Twitchell islands fish screens (99, 22).

Improvement of Existing Facilities

Evaluate upgrading existing fish screening facilities and accelerate planning to implement changes (125).

Improve screen efficiencies at state and federal water project pumping facilities (124, 84, 71).

Use operational criteria that optimize screening efficiencies (e.g. approach velocities) for salmon at the State and Federal water export facilities during San Joaquin smolt outmigrations (125).

Update and improve fish screens at the CVP diversion to entrain fewer fish (71).

Manage existing Delta fish screening operations for higher survival rates (13, 11).

Actions to Install or Improve Fish Screens on Little Chico Creek

Screen diversions to the Llano Seco Unit (DFG) include those at Little Chico Creek (22, CVPIA Section 3406 (b)(21)).

Actions to Install or Improve Fish Screens on the Merced River

Evaluate fish screening needs at 36 small riparian pump irrigation diversions on the Merced River. Set priorities for installation of screens (21).

Merced River fish screening evaluation (99, 22).

Upgrade screens on four medium-sized riparian diversions in the Merced River (diversion capacities [cfs]: 20, 25, 27, 52), and upgrade fish bypasses on two additional diversions (21).

Actions to Install or Improve Fish Screens on the Mokelumne River

Evaluate screening needs at small riparian diversions in the Mokelumne River (21).

Install fish screens in the Mokelumne River at North San Joaquin Water Conservation District diversions (north and south) (21).

Upgrade existing fish screens in the Mokelumne River at Woodbridge Irrigation District Dam (21, 99, 22).

Screen all diversions in the lower Mokelumne River to DFG standards (179, 99).

Actions to Install or Improve Fish Screens on the Sacramento River

Evaluate the unscreened diversions in the Sacramento River and the Delta to determine if screens should be installed at these locations (80).

Develop and implement a demonstration screening program to promote screening technology along the Sacramento River and the Delta in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing nonfunctioning screens, and relocation of diversions to less fishery-sensitive areas (CVPIA, Section 3406 (b)(21)).

Implement mitigation programs for installing fish screens on Glenn-Colusa Irrigation district pumps and replace ineffective recovery facilities to minimize loss of migrating juvenile fish (173).

Resolve entrainment problems at the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant on the Sacramento River (21).

Participate with the State of California and other federal agencies in the implementation of the on-going program to mitigate fully for the fishery impacts associated with operations of the Glenn-Colusa Irrigation District's Hamilton City Pumping Plant. Such participation shall include replacement of the defective fish screens and fish recovery facilities associates with the Hamilton City Pumping Plant (CVPIA, Section 3406 (b)(20)).

Implement structural and operational modifications at Anderson-Cottonwood Irrigation District to eliminate stranding, toxic discharges, improve screens, and eliminate passage problems for chinook salmon and steelhead (179).

Improvements to Tehama Colusa Canal Diversion screening facilities (84).

Prevent entrainment at the intakes of the RBDD pumps in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Screen 316 unscreened diversions on the Sacramento River located between the mouths of the American River and the Delta Cross-channel (22).

Screen 58 unscreened diversions on the Sacramento River located between the mouths of the American and Feather Rivers (22).

Screen any of the following diversions that don't already have screening devices: Reclamation District 108 diversion near Grimes (CVPIA Section 3406 (b)(21)), Sutter Mutual Water Company diversions, Natomas Central Mutual Water Company diversions, Provident Irrigation District diversions, Reclamation

District 1004 diversions, Reclamation District 108 Tyndall Mound diversion (CVPIA Section 3406 (b)(21)), Conaway Conservancy Group diversions, City of Sacramento-Sacramento River Intake, Reclamation District 108 Boyer's Bend diversion, Reclamation District 108 Howell's Landing diversion (CVPIA Section 3406 (b)(21)), Maxwell Irrigation District diversion (CVPIA Section 3406 (b)(21)), and Princeton-Codora-Glenn Irrigation District diversions (CVPIA Section 3406 (b)(21), 22).

Implement outmigration habitat improvements, include screen or improve screens of Sacramento River diversions, minimize blockage by Red Bluff Diversion Dam, late fall and winter flow pulses coincide with DCC closure and reduced, diversions and exports (84).

Screen diversions on the Sacramento River from Keswick Dam to Feather River (99).

Screen diversions within Sutter Bypass where necessary (179).

Screen the diversion at the Yolo Bypass Wildlife Area (22).

Screen the larger diversions along the Sacramento River (21).

Screen the Pelgar Mutual diversion on the Sacramento River (CVPIA Section 3406 (b)(21)).

Screen the Wilson Ranch diversion on the Sacramento River (CVPIA Section 3406 (b)(21)).

Screen unscreened diversions on Sacramento River and tributaries (84).

Screened demonstration diversion from Sacramento River to Mokelumne River (99).

Actions to Install or Improve Fish Screens on the San Joaquin River

Accelerate evaluations of the impact of different types of diversions and install protective devices on priority agricultural or other diversions within the nursery and migration reaches of the San Joaquin River and its tributaries (125).

Assist the State of California in efforts to develop and implement measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions on the Sacramento and San Joaquin rivers, their tributaries, the Sacramento-San Joaquin Delta, and the Suisun Marsh. Such measures shall include but shall not be limited to construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing nonfunctioning screens, and relocation of diversions to less fishery-sensitive areas (CVPIA, Section 3406 (b)(21)).

Install a fish protective device in the San Joaquin River at Banta-Carbona Irrigation District diversion, or provide alternative water supplies to the district (179, 21).

Install a fish protective device in the San Joaquin River at West Stanislaus Irrigation District diversion, or provide alternate water supplies to the district (21, 99, 22, 179, CVPIA Section 3406 (b)(21)).

Install a fish protective device in the San Joaquin River at Patterson Irrigation District diversion, or provide alternate water supplies to the district (99, 22, 179, 21).

Install a fish protective device in the San Joaquin River at El Soylo Irrigation District diversion (21, 99, 179, 22).

Evaluate screening needs and set priorities in the San Joaquin River existing small- (< 10 cfs) and medium-size (15-250 cfs) diversions (21).

Install and maintain fish protective devices at small agricultural diversions (Lower San Joaquin River) (179).

Install fish protective devices on agricultural or other diversions in the San Joaquin River and south Delta (125).

North San Joaquin WCD fish screens (99, 22).

Develop and implement a demonstration screening program to promote screening technology along the Sacramento River and the Delta in order to reduce the risk of jeopardy to the continued existence of winter-run chinook salmon (175).

Riparian diversions--pilot screening projects, San Joaquin River (131, 99) (i.e. Vernalis Riparian Corridor San Joaquin River-reference 22).

Salmon straying reduction (Adults), San Joaquin River (99).

Screen the Reclamation District 2095 diversion on the San Joaquin River near Manteca (22).

Actions to Install or Improve Fish Screens on the Stanislaus River

Stanislaus River fish screening evaluation (99).

Evaluate fish screening needs at 44 small riparian pump irrigation diversions on the Stanislaus River. Set priorities for installation of screens (21).

Screen 38 unscreened diversions in the Stanislaus River reach between Knights Ferry and the confluence with the San Joaquin River (22).

Install and maintain fish protection devices at riparian pumps and diversions (Stanislaus River) (179).

Actions to Install or Improve Fish Screens on the Tuolumne River

Tuolumne River fish screening evaluation (99, 22).

Install and maintain fish protection devices at riparian pumps and diversions (Tuolumne River) (179).

Actions to Install or Improve Fish Screens on the Yuba River

Ensure compliance with fish screening requirements in Fish and Game Code Section 6100 for diversions in the Yuba River (21).

Improve efficiency of screening devices at Hallwood-Cordua, Brophy-South Yuba, and Browns Valley water diversions (Yuba River) (179).

Install a fish screen in the Yuba River on Browns Valley Irrigation District Diversion (21, 99).

Replace screens in the Yuba River on South Yuba-Brophy and the Hallwood-Cordua diversions (21).

Actions to Install or Improve Fish Screens at Various Locations within the Bay Area

Screen diversions to the Napa-Sonoma Marsh (DFG) at the Fly Bay Intakes, the Huichica Creek Intake, the Huichica Creek Outlet, and the Ringstrom Bay Intakes (22).

Screen diversions to the Petaluma Marsh (DFG) at the Day Island and Green Point Unit Intakes (22).

Improvement of Bay-Delta System Fish Migration

General Actions for the Installation of Barriers to Guide Fish Movement

Design and install gates or other facilities at channel openings known to be associated with the loss of fishes (124).

Installation of Barriers to Guide Fish Movement on Battle Creek

Block the fish ladders at Eagle Canyon and Coleman diversions (153).

Installation of Barriers to Guide Fish Movement on Cottonwood Creek

Construct a barrier at the mouth of Crowley Gulch on Cottonwood Creek to prevent entry of adult fish (21, 99).

Installation of Barriers to Guide Fish Movement within the Delta

Install a behavioral barrier in Georgiana Slough (13, 11).

Divert downstream migrants into Sacramento Ship Channel (13).

Divert downstream migrants into Sutter Slough and/or Steamboat Slough (13, 11).

Install behavioral barrier at head of Old River (13, 11).

Install behavioral barrier at the Delta Cross-channel (13, 11).

Install behavioral barrier at the head of Three-mile Slough (13, 11).

Install the upper Old River Barrier each fall to improve guidance flows and water quality for fish migrating upstream through the San Joaquin Delta (59, 125).

Evaluate diversion of San Joaquin salmon from their migratory route at Old River and other strategic locations (172).

Close Delta Cross Channel gates when juveniles are present using generalized "windows" or "recent-time" monitoring (172).

Evaluate and install a complete barrier at the Head of Old River from April 1 through May 31 of each year, in conjunction with other south Delta water quality barriers, and monitor its effectiveness (59, 125).

Install and operate a temporary fish barrier on the San Joaquin River at the Merced River confluence each fall to prevent adult salmon from straying into irrigation canals. The barrier should be operated until a decision is made regarding restoration of chinook salmon in the upper San Joaquin River below Friant Dam (21).

Implement a program to test the use of barriers at the head of Old River and other locations within the lower San Joaquin River and Delta to improve survival of migrating chinook salmon and steelhead (71, 80).

Construct, in cooperation with the State of California and in consultation with local interests, a barrier at the head of Old River in the Sacramento-San Joaquin

Delta to be operated on a seasonal basis to increase the survival of young outmigrating salmon that are diverted from the San Joaquin River to Central Valley Project and State Water Project pumping plants and in a manner that does not significantly impair the ability of local entities to divert water CVPIA, Section 3406 (b)(15).

Operate head of Old River barrier to protect migrate adults and juveniles (Lower San Joaquin River) (179, 173).

Construct a Barrier at the Head of Old River to Increase Salmon Survival (CVPIA, Section (3406(b)(15)). Construct a new or improved structure and reoperate export pumping facilities (150).

Construct a Barrier at the Head of Old River to Increase Salmon Survival (CVPIA, Section (3406(b)(15)). Reoperate Delta, operational changes at pumped export facilities would reduce diversion of downstream migrating salmon into Old River (150).

Install physical barriers at head of Old River, Delta Cross Channel, Georgiana Slough or Three-Mile Slough (11).

Investigate and provide recommendations on the feasibility, cost, and desirability of providing modified operations and new or improved control structures at the Delta Cross Channel and Georgiana Slough to assist in the successful migration of anadromous fish (CVPIA, Section 3406 (e)(5)).

Implement a program for evaluating the feasibility of closing Georgiana Slough using physical or acoustical barriers to improve survival of migrating fish (99, 194).

Perform monitoring and project operations modeling to evaluate impacts of the Georgiana Slough test barrier project on Delta fishes (41).

Install culverts in the Georgiana Slough Test Barrier to provide fish passage (41).

Provide a temporary fish ladder, and flow through the ladder, to attract and pass adult salmon over the Georgiana Slough test barrier (41).

Prepare and implement a program for modifying operations and improving control structures at the Delta Cross Channel/Georgiana Slough to increase fish survival and passage (173).

Program to Modify Operations and Improve Delta Cross Channel and Georgiana Slough Facilities (CVPIA, Section (3406(b)(14)). Provide for new or improved structures to reduce the diversion of Stripped Bass, reoperate Delta (150).

Program to Modify Operations and Improve Delta Cross Channel and Georgiana Slough Facilities (CVPIA, Section (3406(b)(14)). Evaluate hydroacoustic screening and trap/truck (salvage operation) operations (150).

Reduce the Delta Cross Channel and Georgiana Slough openings from November to January to improve winter-run salmon populations (84).

To reduce the risk of jeopardy to the continued existence of winter-run chinook salmon, reclamation must close the Delta Cross Channel gates from February 1 through April 30 each year (175).

Installation of Barriers to Guide Fish Movement on the Merced River

Hydroacoustic barriers for Lower Merced River (99).

San Joaquin fall barrier at Merced River (99).

Install and evaluate a temporary electrical or physical migration barrier in combination with greater attraction flows from the Merced River (125).

Installation of Barriers to Guide Fish Movement on the Mokelumne River

Acoustical barriers for Mokelumne river salmon smolts (99).

Installation of Barriers to Guide Fish Movement on the Sacramento River

Test effectiveness of acoustic fish guidance system at Princeton Pumping Plant on the Sacramento River (99).

Test effectiveness of louvered electrical behavioral barrier at Wilkins Slough on the Sacramento River (99).

Installation of Barriers to Guide Fish Movement on the San Joaquin River

Fish exclusion barriers for San Joaquin River gravel pits (99).

San Joaquin fall barrier at Merced River (99).

Support measures to prevent development of a water quality barrier to adult striped bass migration in the San Joaquin River near Stockton (Sacramento-San Joaquin Delta) (179).

Improvement of Fish Salvage Operations

General Actions for the Improvement of Fish Salvage Operations

Implement measures to improve fish salvage and handling operations for reducing mortality of fish salvaged (71).

Actions to Improve Fish Salvage Operations at the Delta Export Facilities

Improve fish handling facilities at the Central Valley Project and State Water Project Fish Facilities (172).

Improve operation of the Skinner Fish Protective Facility, based on results of proposed evaluation studies (59).

Monitor and limit incidental take of winter-run chinook at the Delta export facilities in order to reduce the risk of jeopardy to their continued existence (175).

Improve CVP and SWP salvage operations (Sacramento-San Joaquin Delta) (179, 71, 80).

Improve Delta conditions (flow, diversions, salvage efficiency, stress on salvaged fish, etc.) (84).

Program to Modify Operations and Improve Delta Cross Channel and Georgiana Slough Facilities (CVPIA, Section (3406(b)(14)). Evaluate hydroacoustic screening and trap/truck (salvage operation) operations (150).

Removal and Control of Aquatic Predators

General Actions to Manage Predator Populations

Study factors affecting survival of young salmon rearing in river, including quality and quality of rearing habitat; effect of predators (winter runs come first in low numbers; predator population is high due to hatchery smolts in other seasons), and mechanisms for inducing migration (monitor distribution of young through time relative to river conditions) (84).

Salmon predation reduction (juveniles) (131).

Implement predator control programs in areas where introduced predators are a constraint to maintenance and restoration of native populations (124).

Actions to Manage Predator Populations in the Delta

Predator control programs for SF Estuary (99).

Control predation of fish in Clifton Court Forebay (41, 99, 11).

Reduce predation within Clifton Court Forebay and within other State Water Project and Central Valley Project diversions (172).

Develop and implement a management plan to reduce predation in Clifton Court Forebay and near the John E. Skinner Delta Fish Protection Facility (124).

Implement predator management programs at SWP and CVP intakes to reduce predation losses (71, 179).

Actions to Manage Predator Populations in the Mokelumne River

Remove Woodbridge Dam or delay installing dam flashboards until July to reduce salmon smolt predation (Mokelumne River) (179).

Actions to Manage Predator Populations in the Sacramento River

Implement an array of actions at Red Bluff Diversion Dam including tougher predator control (84).

Implement predator controls at Red Bluff Diversion Dam (stripers and squawfish still are abundant below Red Bluff Diversion Dam despite efforts - get rid of them) (84).

Actions to Manage Predator Populations in the San Joaquin River

Reduce predation mortality on juvenile salmon through harvest of unnaturally high concentrations of predators from spawning and rearing reaches of the San Joaquin River and its tributaries (125, 179).

Salmon predation reduction (Juveniles), San Joaquin River (99).

Actions to Manage Predator Populations in the Yuba River

Exclude piscivores from areas around Hallwood-Cordua, Brophy-South Yuba, and Browns Valley water diversions (Yuba River) (179).

Modify the dam face of the Daguerre Point Dam to reduce juvenile salmonid mortality (Yuba River) (179).

Fish Hatchery Operations

General Actions for Fish Hatchery Operation

Avoid potential competitive displacement of wild, naturally produced juveniles with hatchery-released juveniles by stabilizing hatchery production levels and implementing release strategies designed to minimize detrimental interactions (179).

Implement specific hatchery spawning protocols and genetic evaluation programs to maintain genetic diversity in hatchery and wild stocks (179).

Evaluate transfer of disease between hatchery and natural stocks (179).

Improve hatchery operations and procedures (13, 11).

Develop additional fish hatchery facilities (13, 11).

Mark all central valley hatchery-reared fish (13).

Genetic maintenance (131).

Salmon: artificial production (131).

Salmon fishery re-establishment (131).

Salmon marking: natural production (131).

Produce an acceptable number of hatchery yearling salmon when trapping and hatchery programs are used (125).

Use natural fish in captive breeding programs (125).

Establish a genetic advisory committee using the knowledge and resources of academia and management experts (125).

Investigate and provide recommendations on the feasibility, cost, and desirability of developing and implementing opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries (CVPIA, Section 3406 (e)(2)).

Improve hatchery programs for species of concern (80).

Develop a program to determine the feasibility, cost, and desirability of constructing additional fish hatchery production facilities to supplement or establish natural production (173).

Restore and maintain California's salmon and steelhead populations through artificial propagation (167).

Accelerated chinook rearing programs should be evaluated that would enable release of smolts (from hatcheries) at 6-10g in April, allowing smolts to avoid higher water temperatures (88).

Determine survival rates of early and late migrating hatchery salmon smolts (99).

Ocean pen rearing of juvenile chinook salmon in Monterey Bay (99).

Protect and enhance the fall chinook Salmon population by release juvenile hatchery raised salmon during optimal combinations of date, size, and location (88).

Release of chinook fry should coincide with the highest possible flows (88).

Determine strategies for improving the survival of hatchery fish in regard to release timing (71).

Additional monitoring should go to implementation of a constant fractional mark program (Hankin, 1982) for all hatchery fish (fall-run chinook salmon) (88).

Mark all hatchery fish (99).

Actions for Hatchery Management of Winter-run Salmon Populations

Examine feasibility of establishing a spawning population of winter-run chinook salmon (179).

Winter Run chinook captive broodstock program (WRCCB) at Bodega Marine Laboratory (99).

Implement hatchery supplements to recovery program for winter run (84).

Supplemental hatchery rearing of winter run (84).

Initiated hatchery program, each hatchery is producing some winter-runs (84).

Sacramento River winter-run chinook salmon captive broodstock program (99).

Propagate winter-run chinook salmon at Coleman National Fish Hatchery (136*).

Develop and implement a program for barging hatchery reared winter run smolts (41).

Actions for Fish Hatchery Operation on Big Creek

Operation and maintenance of fish hatchery on Ke Fish Flat, Big Creek (99).

Actions for Fish Hatchery Operation on the Sacramento River and its Upper Tributaries

Investigate developing a disease-free water supply for Coleman National Fish Hatchery on Battle Creek (21).

Rehabilitate and expand the Coleman National Fish Hatchery by implementing the U.S. Fish and Wildlife Service's Coleman National Fish Hatchery Development Plan (CVPIA, Section 3406 (b)(11)).

Perform maintenance and repair on the Coleman National Fish Hatchery, and rehabilitate the facility to improve production capacity for winter-run and spring-run chinook salmon and other salmonids (99, 71).

Propagate winter-run chinook salmon at Coleman National Fish Hatchery (136*).

Rehabilitate Coleman National Fish Hatchery and Modify Keswick Dam Fish Trap and Spillway (CVPIA, Section (3406(b)(11)). Rehabilitate and expand Coleman National Fish Hatchery and modify Keswick Dam fish trap (150).

Rehabilitate Coleman National Fish Hatchery and Modify Keswick Dam Fish Trap and Spillway (CVPIA, Section (3406(b)(11)). Modification/rehabilitation of Keswick Dam fish trap should be a separate option (150).

Rehabilitate Coleman National Fish Hatchery and Modify Keswick Dam Fish Trap and Spillway (CVPIA, Section (3406(b)(11)). Modify the basin below the Keswick Dam spillway (150).

Rehabilitate Coleman National Fish Hatchery and Modify Keswick Dam Fish Trap and Spillway (CVPIA, Section (3406(b)(11)). Construct a new hatchery at a different location (150).

Releases of fish from the Coleman Hatchery in the estuary should be evaluated further (88).

Construct the Keswick Hatchery and a hatchery in the San Joaquin River Watershed (71).

Actions for Fish Hatchery Operation within the Delta

Artificially propagate several major Delta fish species in hatcheries to compensate for losses due to project facilities, screens, and operation (31).

Implement a program that will periodically examine the contribution of hatchery production for fish species such as chinook salmon, steelhead, striped bass, and experimental programs for Delta smelt (41).

Develop artificial propagation techniques for Delta fish (99).

Assist State in restoring the stripped bass fishery (CVPIA, Section (3406(b)(18)). Assist State of California in developing and implementing hatchery production and stocking program in coordination with efforts to protect and restore native fisheries (150).

Actions for Fish Hatchery Operation on the American River

Change hatchery procedures to benefit native stocks (American River) (179).

Actions for Fish Hatchery Operation on the Feather River

Conduct studies on the Feather River hatchery program (179).

Actions for Fish Hatchery Operation on the San Joaquin River

Trap and spawn adult salmon at various locations in the San Joaquin drainage (125).

Use a gene bank (cryogenic preservation) to ensure the protection of San Joaquin fall-run salmon genetic material in the event of a catastrophic loss (125).

Complete genetic differentiation studies in the San Joaquin tributaries and

monitor appropriate indicators through time to help preserve genetic variability and diversity (125).

Construct the Keswick Hatchery and a hatchery in the San Joaquin River Watershed (71).

Hatchery for San Joaquin River fall-run chinook salmon (99).

Actions for Fish Hatchery Operation on the Mokelumne River

Expand the Mokelumne River Fish Hatchery (99).

Fish Harvest Management

Actions for the Harvest Management and the Commercial Fishing Industry

Buy out commercial salmon fisherman (84).

Conduct temporary closure of the mixed-stock commercial and sport fisheries (84).

Minimize incidental take of adult striped bass by commercial bay shrimp fishery (Sacramento-San Joaquin Delta) (179).

Reduce incidental take of non-target species by commercial fishing industry (99).

Implement measures to reduce the incidental take of fish by the commercial shrimp industry (71).

The predicted stock abundance (of fall-run chinook salmon) each year should be used in place of the Central Valley Index (CVI) now used by the Pacific Fishery Management Council as a guide in setting ocean harvest regulations (88).

Selective harvest of hatchery fish (125).

Work with fishermen organizations to reduce the effects of commercial fishing on salmon and steelhead populations (84).

Harvest restrictions of winter runs by commercial and sport fishermen (84).

Develop predictive methodology for Sacramento River hydrology, temperature, fish populations, fish harvest, water development, and wetlands (21).

Work to get fishery managers to more severely restrict winter-run fishery harvest at least temporarily (84).

Develop and implement a fisheries management program to provide short term protection of aquatic species of concern through seasonal and area closures (80).

Impose stricter harvest regulations on both sport and commercial harvesters (American River fall-run chinook salmon; steelhead) (179).

Impose stricter harvest regulations on commercial fishers (Yuba River fall-run chinook salmon; steelhead) (179).

Salmon harvest management, San Joaquin River (99).

Actions to Manage Fish Harvest and Modify Current Sportfishing Regulations

Establish zero salmon limit in the San Joaquin drainage from river mile zero near Chipps Island upstream to the first major dams on all spawning tributaries south of Stockton (125).

Salmon harvest management (131).

Review and modify, if necessary, harvest regulations of aquatic species of concern (124).

Develop more restrictive fishing regulations for the Estuary (13, 11).

Monitor sport fishing and regulations (Calaveras River) (179).

Review and modify existing harvest regulations to protect aquatic species (71).

Conduct temporary closure of the mixed-stock commercial and sport fisheries (84).

Develop predictive methodology for Sacramento River hydrology, temperature, fish populations, fish harvest, water development, and wetlands (21).

Harvest restrictions of winter runs by commercial and sport fishermen (84).

Restrict in-river harvest of winter-run chinook salmon (136*, 84).

Work to get fishery managers to more severely restrict winter-run fishery harvest at least temporarily (84).

Develop and implement a fisheries management program to provide short term protection of aquatic species of concern through seasonal and area closures (80).

Impose stricter harvest regulations on both sport and commercial harvesters (American River fall-run chinook salmon; steelhead) (179).

Change angler regulations on the San Joaquin River (99).

Adopt gear restrictions eliminate illegal harvest of white and green sturgeon (Lower San Joaquin River) (179).

Salmon harvest management, San Joaquin River (99).

Continue prohibition on sport harvest of chinook salmon in the San Joaquin Basin upstream of Mossdale; extend closure on the mainstem San Joaquin River downstream to Chipps Island (179).

Educate anglers to distinguish between green and white sturgeon (99).

Change green sturgeon and chinook salmon fishing regulations (99).

Halt sport fishing for green sturgeon (99).

Assist State in Restoring the Stripped Bass Fishery (CVPIA, Section (3406(b)(18)). Reduce sport fishing (150).

Control and reduce illegal harvest (99).

<u>Actions to Improve Enforcement of Harvest Regulations and Reduce Poaching</u>

Strengthen programs to reduce the poaching of species within the Estuary (124).

Develop an information document requesting voluntary assistance of various constituent groups in activating stream-watch networks to report poaching (125).

Develop funding for additional enforcement of fishing regulations in the Estuary (13, 11).

Elevate law enforcement effort during October through December to curb

poaching losses in designates salmon spawning areas of the San Joaquin drainage (125).

Fishing regulation enforcement (131).

Increase incentives for reporting poachers (125).

Increase law enforcement of fishing regulations (eliminate or reduce poaching) (179, 71, 80).

Salmon and striped bass directed enforcement effort (99).

Strengthen programs to reduce the poaching of species within the Estuary (124, 99).

Conduct weekly on-river patrols in areas where poaching is a concern (Yuba River fall-run chinook salmon; steelhead) (179).

Conduct weekly on-river patrols in areas where poaching is a concern (American River fall-run chinook salmon; steelhead) (179).

Eliminate adverse effects of poaching and angle on salmonid production (Mokelumne River) (179).

Fishing regulation enforcement, San Joaquin River (99).

Provide additional law enforcement (Merced River) (179).

Provide additional law enforcement for illegal take of salmon, stream alteration, pollution, and to ensure adequate protection for juvenile salmon at pumps and diversions (Tuolumne River) (179).

Provide additional law enforcement for illegal take of salmon, stream alteration, pollution, and to ensure adequate protection for juvenile salmon at pumps and diversions (Stanislaus River) (179).

Actions for Research and Further Study

Research and develop methods to reduce the incident of take of non-target species in commercial activities (124).

Research and develop methods to reduce the incident of take of non-target species in commercial activities (124).

Study ocean survival in order to better predict future runs to the river, which will affect how we manage the river for the fish when they return (84).

Determine the effects of poaching and fishing on spawning stock size (Feather River white and green sturgeon) (179).

Investigate the extent that poaching and/or fishing reduces adult spawning stock (Bear River white and green sturgeon) (179).

Life parameters of fall-run chinook salmon reported in of Sacramento Basin Hatcheries to Ocean Catch and River Escapement of Fall Chinook Salmon, and

their relationship to environmental variation should be used to predict stock abundance in advance of each fishing season (88).

Sport harvest of fall-run chinook salmon should be estimated throughout the Sacramento River to analyze trends and potential overharvesting (88).

Evaluate information for San Joaquin salmon and procedures for modifying the Pacific Fisheries Management Council Framework Plan that defines current fish management policies and ocean regulations (125).

Desalination

General Actions for Desalination

Remove total dissolved solids using the reverse osmosis process (144).

Remove total dissolved solids using the electrodialysis reversal process (144).

Improve desalination technologies and cost (CALFED).

Educate users about desalination feasibility (CALFED).

Desalination of seawater (33, 144, 161, 154).

Remove total dissolved solids using the captive deionization process (144).

Desalinization of subsurface tile drainage water/agricultural waste water (161).

Site Specific Actions for Desalinization

Expand desalination of Southern California supplies (CALFED).

Expand desalination of San Joaquin Valley supplies (CALFED).

Implement desalinization of South Coast ground water (33).

Implement desalinization of Imperial drainage water (33).

Implement desalinization of San Joaquin Valley drainage water (33).

Implement desalinization of Riverside County drainage water (33).

Water Conservation

General Actions for Water Conservation Planning

Increase use of district-wide conservation practices (CALFED).

Increase use of on-farm conservation practices (CALFED).

Increase use of municipal conservation practices (CALFED).

Increase use of industrial conservation practices (CALFED).

Water suppliers should implement distribution system water audits, leak detection, and repair (55, 157, 83).

Water suppliers should implement efficiency standards and replacement of existing water using appliances (except toilets and showerheads whose replacements are incorporated as Best Management Practices) and irrigation devices (55).

Review proposed water uses for new commercial and industrial water services and recommend water efficiency measures before completion of building permit process (83, 55, 157).

Water suppliers should regulate distribution system pressure (55).

Water suppliers should implement swimming pool and spa conservation including covers to reduce evaporation (55).

Water suppliers should implement restrictions or prohibitions on devices that use evaporation to cool exterior spaces (55).

Water suppliers should implement point-of-use water heaters, recirculating hot water systems and hot water pipe insulation (55).

Forecast the supply situation in relation to demand. Assess options for effectively managing a water shortage, including supply augmentation and demand reduction (83).

Provide funding for a water conservation coordinator (83).

Water conservation feasibility studies shall be completed and implemented by municipalities and/or water districts (124 122).

Implement urban conservation programs as encompassed in the "Best Management Practices" (BMPs) agreements (2).

Establish and administer an office on CVP water conservation best management practices that shall, in consultation with the Secretary of Agriculture, the California Department of Water Resources, California academic institutions, and CVP water users, develop criteria for evaluating the adequacy of all water conservation plans developed by project contractors (CVPIA, Section 3405 (e), 137).

Implement and expand current federal and state water efficiency programs (95).

Implement urban and agricultural water conservation in State Water Project service areas (59).

In the South Coast Region, cut back on deliveries to Metropolitan Water District member agencies made under the interruptible sea water intrusion barrier program (33).

Water conservation feasibility studies shall be completed and implemented by municipalities and/or water districts (124).

Designate a water conservation coordinator responsible for preparing a water conservation plan (157, 55).

Undertake, in cooperation with Central Valley Project irrigation contractors, water conservation projects or measures needed to meet the requirements of the CVPIA (CVPIA, Section 3408 (i), 83).

Coordinate with other Agencies and the Public to allow the submittal of joint plans and to ensure notification to interested parties that a [water conservation] plan is being prepared (137).

Review the past water conservation plan and activities to allow recognition of past and current District activities toward improved water management (137).

Identify the schedule for program implementation, the budget needed for implementation, and the results expected from full implementation of the [water conservation] project (137).

Establish a comprehensive and continuous commitment to identify, evaluate, and implement Efficient Water Management Practices (EWMP). The Plan should contain the following elements: 1) a system-wide water conservation goal, or a target irrigation efficiency, based upon an assessment of water conservation potential; 2) a water management improvement inventory, which should include a list of EWMPs which are determined as applicable for that supplier in achieving its water conservation target and the estimated economic costs of each measure; 3) an evaluation of the reasonableness and cost-effectiveness of each EWMP or combination of EWMPs; 4) a schedule of implementation and a budget for a specified time period; 5) an assessment of the performance of previously implemented EWMPs including the amount of water saved; 6) a process and incentives for achieving compliance with goals or targets (62).

Focus on water conservation planning to increase water use efficiency. Such planning and implementation emphasizes EWMP that include but are not limited to activities and policies that: 1) evaluate the efficiency of the current storage, delivery and drainage disposition of water; 2) measure and account for water applied; 3) provide water to farmers on demand (also known as arranged-demand water delivery); 4) line canals to prevent seepage to unintended uses; 5) evaluate and recommend improvements to the uniformity with which water is applied; 6) assist farmers in calculating the optimum time and amount of water to apply; 7)

provide farmers with financial or other incentives to improve the efficiency of water use; 8) implement water pricing policies that discourage wasteful use of water; 9) estimate district-wide water balance; 10) initiate and strengthen water conservation and management plans; and 11) adopt performance goals where appropriate (62, 139, 8).

To conserve water: line or pipe canals or ditches; replace mains; replace distribution system controls; repair leaking reservoirs; cover or line open reservoirs within distribution systems to conserve already developed water; construct pipelines to distribute reclaimed water for reuse (to replace existing potable water supplies); replace leaking water tanks; install ultra-low flush toilets; improve on-farm irrigation systems (142).

Reduce current water use through water conservation to augment future water supply needs in Amador County (37).

Sealing leaks in ditches, canals, and flumes and preventing leaks and spills from reservoirs will reduce the conveyance and distribution losses in Plymouth Ditch and Amador Canal. The reduction in water losses will augment water supplies for future needs (37).

Employ water conservation, waste water reclamation, and water transfers to augment the water supplies of the Stanislaus River Basin (58).

Water Conservation Standards (CVPIA, Section (3405(e)). Department of Interior develops guidelines and specifies mechanisms to the used, 1993 criteria (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Department of Interior develops guidelines with targets and leaves conservation methods to water users (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Conserve water to address drainage problems (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Promote water conservation program where it is judged on a cost effective basis, including avoiding environmental costs (150).

Water Conservation Standards (CVPIA, Section (3405(e)). April 1993 Interim Criteria; compliance is required for all contract renewals (150).

Water Conservation Standards (CVPIA, Section (3405(e)). April 1993 Interim Criteria, except that compliance is also required for subcontractors and purchasers of transferred CVP water (150).

Water Conservation Standards (CVPIA, Section (3405(e)). April 1993 Interim Criteria, except that the guidelines also set targets for water saved (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Integrate project power use conservation plans into options along with water use conservation (150).

General Actions to Conserve Water in Agricultural Operations

Increase agricultural water use efficiency in State Water Project service areas (59).

New methods of agricultural water conservation should be researched though pilot projects and implemented where feasible (124).

New methods of agricultural water conservation should be researched though pilot projects and implemented where feasible (124, 99).

Implement efficient agricultural water management practices (99, 8, 2, 154, 157).

Establish a land and water rights purchase program to eliminate irrigated agriculture and improve water quality and conservation (173).

Provide irrigation management improvement services (62).

Adopt performance goals and efficiency targets where appropriate (62).

Plant crops and varieties that are consistent with market opportunities, the cost- and availability of water, and other factors (62).

Allow changes or flexibility in the water contract year to better fit the water use characteristics of the crops being grown (62).

Water Conservation Standards (CVPIA, Section (3405(e)). Promote water conservation by putting a surtax on crops requiring excessive water for the area (150).

Use historic and current crop water use data (evapotranspiration plus leaching requirement) to promote-efficient water management. Agricultural water suppliers should make available to farmers data helpful in adjusting irrigation schedules and improving irrigation water management. For example, current evapotranspiration (ET) data should be used to more accurately estimate water needs in a region during the growing season. In addition, devices or methods which monitor the actual soil moisture in the crop root zone should be promoted by suppliers to assist farmers in accurately scheduling irritations. Farmers should be encouraged to use devices such as tensiometers, moisture blocks, neutron probes, and soil probes in order to determine crop water needs. These devices or methods are very effective when used in conjunction with ET data to more precisely schedule irrigation (62).

Agricultural suppliers should promote: 1) tailoring pre-irrigations to meet the actual needs for leaching and soil moisture storage; and 2) pre-irrigation with an appropriate system which will provide good distribution uniformity and reduce to a minimum undesired deep percolation (62).

Promote/provide evaluations of on-farm irrigation systems. Irrigation evaluations can identify correctable problems such as worn nozzles, uneven spacing, uneven nozzle sizes, excessive run length, etc. Also, evaluations may identify when and where over or under-irrigation occurs (62).

Line ditches and canals or use pipelines when appropriate. Seepage and evaporation losses in ditches and canals can be minimized by replacement with pipelines or lining with bentonite clay, concrete, or newer pour-in-place plastics/textile membranes. To reduce on-farm seepage losses, suppliers should consider helping farmers line earth ditches or replace ditches with pipelines, except where seepage has been determined to be an effective component of a groundwater recharge program (62, 154, 150, 157).

Evaluate storage, conveyance, and drainage systems. Present conditions must be thoroughly assessed in order to adequately evaluate the conservation potential for applying any EWMP. Suppliers should monitor and evaluate the: 1) flexibility of water delivery, including advance notice required to receive, change, and stop farm deliveries, and the latitude allowed the farmer regarding the time-of-day changes that can be made; 2) accuracy of flow measurement and stability of flow rate delivery to farms at various points within the system (i.e., how much the flow rate and pressure fluctuates during the delivery period at a turnout); 3) awareness by supplier personnel of engineering and management solutions to provide water in a flexible and reliable manner to farmers; 4) destination of applied water; 5) on-farm irrigation methods and practices and awareness level of farmers regarding options for improvement (62).

Recommend the use of on-farm tailwater recovery systems where appropriate. Tailwater recovery systems are designed to capture irrigation water that runs off the low end of a field, store it, and reapply it to the same field or on a nearby field. Tailwater systems may be useful for three reasons: they 1) can increase irrigation efficiency; 2) can conserve water; and 3) may reduce drainage problems 62).

Regardless of the method of irrigation used (e.g., furrow, border strip, level-basin/border hand-move sprinklers, solid set sprinklers, and micro irrigation) certain guidelines should be considered routinely as applicable to any method of irrigation, as follows: 1) Occasionally conduct irrigation system evaluations to provide feedback on distribution uniformity (DU) and irrigation scheduling decisions; 2) seek the assistance of farm advisors, irrigation consultants, Soil Conservation Service, or other resources to help identify water management improvement opportunities and to assist in the adoption of economically advantageous practices; 3) know your soil and keep a map available with the soil description, including important physical characteristics of soils such as texture, soil depth, water-holding capacity, soil salinity, and intake rate; 4) monitor soil profile salinity throughout the field to assure that a root-zone salt balance is being maintained; and 5) hire, train, and retain irrigators skilled in effectively managing water and the irrigation equipment involved (62).

Specific Actions to Conserve Water in Agricultural Operations

Allow 10-20% of corn and grain crops Sherman Island to remain unharvested, to reduce the rate of soil subsidence and consumptive water use (35).

For furrow (sloping), implement the following practices to optimize uniformity of water application: 1) increase the rate of water advance to the end of the field by using high initial onflow rates to each furrow, using relatively short furrow lengths, laser grading for a uniform slope, laser grading for steeper slope, and using "torpedoes" or other methods to smooth furrow surfaces after cultivation; and 2) respond to soil texture (water intake rate) variations in the field by using surge irrigation and considering changing to sprinkler or micro irrigation methods (62).

For furrow (sloping), implement the following practices to efficiently control tailwater: 1) reduce onflow rates after water has advanced to the end of the field; 2) capture runoff in a properly planned and designed tailwater recovery system; 3) re-use captured runoff in an efficient manner; and, 4) take advantage of tailwater reduction features available with surge irrigation (62).

For furrow (sloping), implement the following practices to respond to high intake rate soils: 1) use surge irrigation; 2) switch to portable sprinklers during high intake rate periods; 3) irrigate less frequently; and, 4) irrigate alternate furrows (62).

For furrow (sloping), develop a water budget irrigation scheduling strategy which considers: 1) the allowable or desirable crop water stress; 2) available water holding capacity within the effective rooting depth of the crop; 3) water availability and/or delivery constraints; 4) very small water applications (1" - 2") result in poorer uniformity; 5) the ability of rainfall to meet part of the seasonal crop water requirement (effective rainfall); and 6) timing of farm cultural practices such as cultivation, fertilizer applications, harvest, etc. (62).

For furrow (sloping) implement the following practices to optimize water application timing and amount decisions: 1) to help decide when to irrigate, track crop water needs directly by monitoring soil profile moisture and/or plant stress techniques; 2) use a soil moisture (deep wetting front) probe as a tool to help decide when to shut off the water; 3) install and utilize water flow meter/measuring devices or methods to monitor the flow rate so that the volume applied to each irrigation set can be calculated; 4) record irrigation dates and amounts applied to each field and regularly compare soil-based and/or CIMIS-type crop water use data with actual water application records to serve as a check on irrigation scheduling decisions; 5) advocate and support flexible (frequency, rate, and duration) water deliveries from suppliers; 6) if irrigation set times required to "sub the beds" result in excessive deep percolation from the bottom of the furrows, consider: a) probing the beds to check for actual adequacy of wetting; b) re-configuring future beds to reduce subbing time; and c) change

irrigation methods to sprinkler or micro to better provide near-surface moisture (62).

For border strip (sloping) implement the following practices to optimize uniformity of water application: 1) encourage equal water "standing time" throughout each border strip length by matching the water advance rates with recession rates by: a) establishing (tracking) the water recession rate; and b) producing the desired advance rate by increasing or decreasing the onflow rate to each strip, adjusting border spacing, laser grading for a uniform slope, and laser grading for a minimum cross slope and desired irrigation slope; and 2) respond to significant soil texture variations (water intake rate) within each strip by changing to sprinkler irrigation (62).

For border strip sloping implement the following practices to efficiently control tailwater: 1) shut the water off before it has advanced to the end of the field; 2) capture runoff in a properly planned and designed tailwater recovery system; and re-use captured runoff in an efficient manner (62).

For border strip (sloping) implement the following practices to optimize water application timing and amount decisions: 1) develop a water budget irrigation scheduling strategy which considers: a) the amount of water which the strip will "take" (infiltrate) uniformly; b) available water-holding capacity within effective rooting depth of crop; c) allowable or desirable crop water stress; d)water availability and/or delivery constraints; e) the ability of rainfall to meet part of the seasonal crop water requirement (effective rainfall); and, f) timing of farm cultural practices such as cultivation, fertilizer applications, harvest, etc. (62).

For border strip (sloping) implement the following practices to optimize water application timing and amount decisions: 1) to help decide when to irrigate, track crop water needs directly by monitoring soil profile moisture and/or plant stress techniques 2) use a soil moisture (deep wetting front) probe as a tool to check the adequacy of irrigation; 3) install and utilize water flow meter/measuring devices or methods to monitor the flow rate so that the volume applied to each irrigation set can be calculated; 4) record irrigation dates and amounts applied to each field and regularly compare soil-based and/or CIMIS-type crop water use data with actual water application records to serve as a check on irrigation scheduling decisions; 5) advocate and support flexible water deliveries from suppliers (62).

For level-basin/border irrigation (dead level) implement the following practices to optimize uniformity of water application: a) level basins should not be used on high-intake rate soils; b) there should be little water-intake rate variation (uniform soils); c) water onflow or delivery rate should be adequate to cover the basin quickly enough to assure uniform application; and, d) basin must be precision leveled (62).

For level-basin/border irrigation (dead level) implement the following practices to optimize water application timing and amount decisions: 1) develop a water budget irrigation scheduling strategy which considers each of the following:

a)allowable or desirable crop water stress; b) available water-holding capacity within effective rooting depth of crop; c) water availability and/or delivery constraints; d) the ability of rainfall to meet part of the seasonal crop water requirement (effective rainfall); e) timing of farm cultural practices such as cultivation, fertilizer applications, harvest etc.; 2) to help decide when to irrigate, track crop water needs directly by monitoring soil profile moisture and/or plant stress techniques; 3) use a soil moisture (deep wetting front) probe as a tool to check the adequacy of irrigation; 4) install and utilize water flow meter/measuring devices or, methods to monitor the flow rate so that the volume applied to each irrigation set can be calculated; 5) record irrigation dates and amounts applied to each field and regularly compare soil based and/or CIMIS-type crop water use data with actual water application records to serve as a check on irrigation scheduling decisions; 6) advocate and support flexible water deliveries from suppliers (62).

For hand-move or solid set sprinklers implement the following practices to optimize uniform water application: 1) have new systems designed by a competent irrigation designer; 2) set up and operate the system as designed in regard to: operating pressure, lateral move distances, lateral sizes and lengths, number of laterals operated each set, proper placement of laterals; 3) perform regular inspection and maintenance; 5) avoid irrigating during windy periods when practical (62).

For hand-move or solid set sprinklers implement the following practices to minimize evaporation losses: 1) avoid irrigating during windy periods when practical; 2) maintain sprinkler head pressures below the "misting point"; and 3) avoid water applications of one inch or less (62).

For hand-move or solid set sprinklers implement the following practices to optimize water application timing and amount decisions: 1) develop a water budget irrigation scheduling strategy; 2) to help decide when to irrigate, track crop water needs directly by monitoring soil profile moisture and/or plant stress techniques; 3) use a soil moisture (deep wetting front) probe as a tool to check the adequacy of irrigation; 4) install and utilize water flow meter/measuring devices or, methods to gauge the volume of water applied to each irrigation set; 5) record irrigation dates and amount applied to each field and regularly compare soil based and/or CIMIS-type crop water use data with actual water application records to serve as a check on irrigation scheduling decisions; 6) advocate and support flexible water deliveries from suppliers (62).

For micro irrigation (micro sprinkler, micro-jet, or surface or sub-surface drip) implement the following practices to optimize uniform water application: 1) have a new system designed by a competent irrigation designer; 2) operate the system at the design pressure; 3) and perform regular inspection and maintenance (62).

For micro irrigation (micro sprinkler, micro-jet, or surface or sub-surface drip) implement the following practices to optimize water application timing and

amount decisions: 1) develop a water budget irrigation scheduling strategy; 2) to help decide when to irrigate, track crop water needs directly by monitoring soil profile moisture and/or plant stress techniques; 3) use a soil moisture (deep wetting front) probe as a tool to check the adequacy of irrigation; 4) install and utilize water flow meter/measuring devices or, methods to gauge the volume of water applied to each irrigation set; 5) record irrigation dates and amounts applied to each field and regularly compare soil based and/or CIMIS-type crop water use data with actual water application records to serve as a check on irrigation scheduling decisions; and, 6) advocate and support flexible water deliveries from suppliers (62).

Actions to Reduce Industrial/Commercial Water Use

Implement financial incentives for industrial water conservation (83).

Modify equipment (86).

Reduce deionized rinsewater use: eliminate plenum flushes, eliminate continuous trickle flow of deionized water at rinse stations, install a programmed rinse dump system, and use deionized water only during rinsing operations (86).

Treat recirculating cooling water with ozone, reducing blowdown significantly. In lower temperature applications, ozone treatment results in less scale formation on heat exchanger surfaces, allowing cycles of concentration up to 20 or more (86).

Retrofit kitchen faucets to reduce flow (49).

Discourage the use of water to thaw frozen food (49).

Install a remote cooling system for water-cooled icemakers (49).

Evaporative condenser bleed-off reduction (49).

Installation of additional "electric-eye" controls along conveyors to enable container wash sprays to be shut off when gaps occurred in the flow of product (49).

Eliminate CO_2 piping thaw water - this refers to the use of a tube of hot water wrapped around a carbon dioxide pipe to prevent freezing (49).

Pump seal water recovery - filling room (49).

High-pressure hose nozzles (49).

Interlock lubricant flow with conveyor (49).

Replacement of gas-fired boilers (49).

Experiment with wash water reduction (49).

Evaporative coolers/cooling towers bleed-off reduction (49, 86).

Clean-in-place system improvements (49).

Steam and refrigerant piping insulation (49).

Low-volume hose nozzle (49).

Laundry rinse water reuse (49).

Shut-off steam during laundry idle periods (49).

Installation of low NO_2 burners (49).

Water level controls - steam tables (49).

Businesses should use minimum amounts of water to accomplish a task (50).

Businesses should replace potable water supplies with water from non-potable sources (50).

Actions to Reduce Urban Water Use

General

Increase urban water use efficiency in State Water Project service areas (59).

Implement Santa Clara Valley Water Management programs (59).

Implement Urban Best Management Practices, as described in an MOU Regarding Urban Water Conservation in California.(44).

Implement urban water rationing in State Water Project service areas (59).

Implement water management planning assistance in urban areas (33).

Landscaping

Implement landscape water conservation programs in urban areas (33).

Improve irrigation management (131).

Provide technical assistance in irrigation management (33).

Install computer-controlled landscape irrigation system, based on plant water needs (86).

Identify larger than three acre irrigators, contacting them, offer landscape audits and provide cost-effective incentives to help achieve implementation; follow up audits at least every five years (83, 55, 157).

Landscape water conservation requirements for new and existing commercial, industrial, institutional, governmental and multi-family developments (83, 55, 157).

Landscape water conservation for new and existing single-family homes: Provide guidelines, information and incentives for installation of efficient landscape water saving practices. Enact and implement landscape water conservation ordinances (83, 55, 157).

Metering

Provide and use water-measuring devices. Supplier delivery systems, as well as on-farm systems, are improved by water-measuring devices, such as meters, flumes, weirs, electric pump meters, and engine hour meters. These would allow district managers and the growers to accurately evaluate the benefits of infrastructure improvements and changes made in on-farm water use practices. Records can be included with billing statements, showing the previous year's water use for the same period, for example, and so permit evaluation of the effects of changes in irrigation management, crop selection, and land use practices from year to year (62, 157).

Equip all surface water delivery systems within the boundaries of a district or agency contracted to use CVP with water measuring devices or water measuring methods of comparable effectiveness within five years of the date of contract execution, amendment, or renewal (CVPIA, Section 3405 (b)).

Water suppliers will implement metering with commodity rates for all new connections and retrofitting of existing connections (55, 83).

Businesses should install meters at high-flow processes and equipment (50).

Water Metering (CVPIA, Section (3505(b)). Department of Interior measures all CVP deliveries to contractors (150).

Water Metering (CVPIA, Section (3505(b)). Department of Interior requires contractors to measure water deliveries to all individual agricultural and M&I users (150).

Specific Implementation Measures for Conservation

Implement water waste prohibition: enforcement of gutter flooding, sales of self regulating water softeners, single pass cooling systems, non-recirculating car washes and laundry machines, and non-cycling water fountains (83, 55, 157).

Enforce new plumbing code - all new homes are required to have low flush toilets as of January 1, 1992 (157, 55, 83).

Prohibit the sale of non-ultra low flush toilets (157, 55).

Retrofit showers, faucets, and toilets with low-volume devices. Disconnect rest rooms and appliances that are not used (33, 83, 49, 55, 157).

Inspect/replace toilet tank dams (49).

Repair steam leaks (49).

Insulate bare steam and condensate piping (49).

Repair condensate receiver pump set (49).

Automatic controls on softener recycle system (49).

Reduce operational spillage by many practices that affect delivery flexibility (157).

Remove riparian vegetation to reduce consumptive water use (157).

Employ water conservation to prevent pesticide contamination in rivers and streams by withholding water and by keeping drain water out of streams. (79).

Financial Incentives for Water Conservation

Implement low interest loan programs for capital improvements by local public agencies in urban areas (33).

Change the fee structure in order to provide incentives for efficient use of water. Suppliers should seek such additional authorities as needed to derive and use funds from a variety of sources, including water rate design, to provide economic incentives to support Efficient Water Management Practices. Water supply districts should seriously consider the implementation of tiered rates (62).

Non-conservation pricing would be eliminated in favor of conservation oriented water rates (157, 55).

Water agencies should offer financial incentives to customers that achieve conservation (157, 55).

Water Conservation Standards (CVPIA, Section (3405(e)). Promote water conservation by tying lower usage to lower water rates (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Contribute funds for conservation to benefit environmental purposes (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Department of Interior will encourage conservation by letting those conserving water market it (150).

Water Conservation Cost Sharing

Implement government agency cost sharing for water conserving projects and measures, in return for a proportional share of the water conserved equal to its financial contribution (142).

Water Conservation Cost Share (CVPIA, Section (3408(I)). Department of Interior prepares cost share program guidelines. Department of Interior will undertake cost-sharing agreements with CVP contractors to conserve irrigation and M&I water. Water saved will be shared among project participants in proportion to the funding contribution. Department of Interior's shares will be used to meet fish and wildlife needs (150).

Water Conservation Cost Share (CVPIA, Section (3408(I)). Develop option where water obtained is less than proportion of dollars contributed, (i.e. contribute 50% of the dollars but get back only 40% of the water) (150).

Actions for Water Conservation Education and Public Out-Reach

Conduct residential water audits in the South Coast Region (33).

Implement conservation information programs in urban areas (33).

Implement industrial water conservation programs in urban areas (33).

Implement water audits and leak detection programs in urban areas (33).

In the South Coast Region, institute a rationing program designed to minimize adverse economic impacts (provide for business exemptions based on economic hardship) (33).

In the South Coast Region, institute public relations campaign to heighten conservation awareness, use alternative-day watering, gutter-flooder patrols, etc. (33).

Employee education (86).

Provide public information on water conservation (83, 55, 157).

Adopt ongoing school education programs promoting water conservation benefits (i.e. provide educational materials, teacher training, and instructional assistance (83, 55, 157).

Identify and contact the top 10 percent of the industrial and commercial customers directly, offering audits and incentives sufficient to achieve customer implementation of conservation measures, and provide follow up audits at least once every five years if necessary (83, 157).

Interior and exterior water audits and incentive programs for single-family residential, multi-family residential and governmental/institutional customers: Identify the top 20 percent water users, contact them, and provide incentives to help reduce consumption (55).

Water Reclamation

General Actions for the Use of Reclaimed Water

Water Conservation Standards (CVPIA, Section (3405(e)). Conserve water to make it available for other uses (150).

Water Conservation Standards (CVPIA, Section (3405(e)). Use reclaimed wastewater (150).

Reclaim waste water effluent and treat for drinking water supply. (Examples: City of San Diego.) (188).

Ensure that state water quality standards and Basin Plans encourage water reclamation and reuse (124).

If practical, use existing facilities and develop new facilities in order to deliver reclaimed and recycled water for beneficial reuse (124).

Recharge groundwater with reclaimed water (CALFED).

Recycle and treat water for potable reuse (CALFED).

Use reclaimed water for nonpotable urban uses (CALFED).

Implement reclamation measures such as use of gray water, water recycling and desalting, and reuse of agricultural brackish water in State Water Project service areas (59, 51).

Implement wastewater reclamation in the South Coast Region (33).

Implement water reclamation programs in urban areas (33).

Maximize local water recycling as part of a first phase effort involving the export of recycled water (144).

Municipalities and counties should adopt water reclamation ordinances encouraging the use of reclaimed water, to the maximum extant practical, while providing for the protection of public health and the environment (124).

Reclaim agricultural drainage water (154).

Reclaim subsurface drainwater, primarily in areas with perched saline water tables (157).

Treated municipal wastewater can be used to augment water supplies (159, 154).

Use recycled water to create an indirect potable reuse supply for the Bay Area (144).

Water recycling (86).

Water reuse (86).

Water suppliers should implement gray water use (55).

Actions for Agricultural Uses of Reclaimed Water

Divert treated wastewater from San Francisco Bay area to San Joaquin valley (131).

Transport recycled water from the SF Bay area to the southern San Joaquin area for a broad range of uses (144).

Reverse osmosis treated water from Central Coast to Delta islands (146).

Tertiary treated water from Central Coast to Delta islands (146).

Transport recycled water from the SF Bay area to delta islands to meet agricultural water demands (144).

Transport recycled water from the SF Bay area to the Delta-Mendota Canal Service Area to meet agricultural water demands (144).

Transport recycled water from the SF Bay area to the southern portion of the Santa Clara Water District and the San Benito County Water District Area to meet agricultural water demands (144).

Use of reclaimed water for agricultural irrigation purposes should be in accordance with provisions of Sections 13550, 13551, and 13552 of the California Water Code (62).

Actions to Manage Quality of Reclaimed Water

Better manage salinity levels in recycled water by prevention through source control (144).

Better manage salinity levels in recycled water by prevention through treatment (144).

Better manage salinity levels in recycled water by prevention through mitigation solutions at the place of use (144).

Better manage salinity levels in recycled water by prevention using mitigation through agricultural drainage disposal (144).

Reduce the amount of total dissolved solids by pretreating recycled water using the microfiltration method (144).

Actions for the Use of Reclaimed Water for Environmental Use

Reverse osmosis treated water from the Central Coast to Delta salinity repulsion (146).

Transport recycled water from the SF Bay area to the Sacramento-San Joaquin Delta (near Chipps Island) to mitigate salinity intrusion from the Bay (144).

Actions for the Industrial Use of Reclaimed Water

Businesses should recirculate water within a process or group of processes (50).

Businesses should reuse water sequentially (50).

Businesses should treat and reclaim used water (50).

Evaporator condensate recovery (49).

Install a rinse water reclamation system for laundries (49, 86).

Purification water recovery (49).

Recycle pulping water recovered during the dewatering processes (86).

Reuse treated wastewater as makeup for a recirculating cooling tower (86).

Vacuum pump water recycling (49).

Actions for the Treatment of Reclaimed Water

Construct a regional (San Joaquin River basin) water treatment plant using biological removal and ion exchange to remove both boron and selenium (63).

Construct water reuse and recycling facilities to generate at least 244,100 acre feet of additional fresh water displaced by the year 2000 and at least 826,300 acre feet by 2010 (2).

Actions for the Transport of Reclaimed Water

Reverse osmosis treated water from Central Coast to indirect potable use (146).

Reverse Osmosis treated water from the Central Coast to Delta Mendota Canal (146).

Tertiary treated water from Central Coast to Delta Mendota Canal & salt management (146).

Tertiary treated water from Central Coast to south of the Bay (100,000 ac-ft/yr) (146).

Tertiary treated water from Central Coast to south of the Bay (400,000 ac-ft/yr) (146).

Tertiary treated water from Central Coast to south San Joaquin w/Delta Mendota canal conveyance (146).

Tertiary treated water from Central Coast to South San Joaquin w/o Delta Mendota Canal conveyance (146).

Actions for Water Reclamation Education and Public Out-Reach

Encourage use of reclaimed water that meets all health and safety criteria (62)

Evaluate the Recycled Water Database which contains a series of linked files which are used to determine the water quality and quantity information on present and future flow. The original database calculated the current flows and composite water quality for Bay Area wastewater agencies. The database was modified to calculate: 1) Total current wastewater flow, 2) Current composite water quality for 23 wastewater parameters (these parameters included most regulated metals and constituents of concern for irrigation), 3) Recycled water

flow (year 2020) available for export, accounting for flows to local recycling and required flows to the Bay, and 4) Future composite water quality for the 23 wastewater parameters.(144).

Local entities interested in implementing reclamation projects should develop and conduct public education programs (124).

Public education of graywater use for irrigation of landscaping (47).

Actions for the Research and Further Study of Water Reclamation

Water reclamation and reuse feasibility studies should be compiled by each publicly owned treatment works, municipality, and/or water district (124, 99).

Land Retirement and Fallowing

General Actions for the Planning of Land Retirement and Fallowing

Acquire and manage drainage impaired land, and acquire and transfer associated water (139, 93).

Acquire water [through a land retirement program] for purposes identified in the Central Valley Project Improvement Act and/or the San Joaquin Drainage Relief Act (139).

Assist in determining the minimum acreage of contiguous land in which interests need to be acquired to carry out the drainage reduction purposes of the program (SB 1669, Section 14912 (c)) (139).

Collect information on potential self-sustainability of a land retirement program as outlined under SB 1669 (139).

Consider [land retirement] offers from any and all sources, including but not limited to individual landowners, duly authorized persons or organizations representing groups of landowners, water districts, or combinations thereof (139).

Consider any and all types of [land retirement] transaction possibilities, including temporary retirement (139).

Create a self supporting land retirement program through the sale of conserved water (139).

Distribution of conserved water saved through land retirement must maximize amounts for environmental purposes (139).

Evaluate and rank applications for participation in the land retirement program according to the following criteria: severity of drainage problems; agricultural productivity; water included in offer; wildlife habitat potential; potential for monitoring and evaluating effects, and; structure of offer (139).

Evaluate Federal, State, and local agency roles in implementation of the land retirement program (139).

Evaluate procedures and processes for land retirement prior to promulgation or adoption of final rules and regulations (139).

Evaluate the level of interest and the nature and range of potential proposals from landowners under a land retirement program (139).

Facilitate voluntary retirement of land (from irrigation) which is not economically feasible to farm (62).

Fallowed and retired agricultural land under the CVPIA could be restored to wildlife habitat as one way of offsetting inevitable urban growth (154).

Manage the land acquired through the land retirement program as habitat or non-irrigated agriculture (139).

One-third of the water conserved through land retirement but not sold may be used by local agencies for environmental purposes or groundwater recharge (139).

Protect, restore and/or enhance fish and wildlife habitat by retiring agricultural land (139).

Retire agricultural lands with a severe drainage and toxic contamination problem and transfer of the water to other uses (2).

Evaluate and rank a single pool of prospective acquisitions and utilize both Federal and State resources, as available, to effect the greatest net benefit to the overall [land retirement] program objectives (139).

Purchase agricultural land which: (A) would, if permanently retired from irrigation, improve water conservation by a district, or improve the quality of an irrigation district's agricultural wastewater; (B) are no longer suitable for sustained agricultural production because of permanent damage resulting from severe drainage or wastewater management problems, groundwater withdrawals, or other causes (CVPIA, Section 3408 (h)(2)).

Enforce the 1982 Reclamation Reform Act acreage limitations (95).

Retire agricultural land in State Water Project service areas (59).

Implement land fallowing and short-term water transfer programs in State Water Project service areas (59).

Develop incentive payments to landowners (131).

Land retirement (131).

Site Specific Actions for Land Retirement and Fallowing

Land Retirement (CVPIA, Section (3408(h)). Fallow land for drought management, temporary (150).

Land Retirement (CVPIA, Section (3408(h)). Include flexibility to retire non-CVP lands in retirement program. Could be used in the acquisition of supplemental water (150).

Land Retirement (CVPIA, Section (3408(h)). Minimize third party socioeconomic impacts (150).

Land Retirement (CVPIA, Section (3408(h)). Retire drainage poor land (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land as an alternative to physical fixes (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land for fish and wildlife habitat. Primary objective is the acquisition of currently irrigated lands for fish and wildlife habitat. Could include riparian, wetland, and upland habitat (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land for water supply. Primary objective is the acquisition of water supplies for other uses (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land for wetland/conjunctive use (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to improve/increase endangered species habitat (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to improve/increase fish and wildlife habitat (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to offset high mitigation costs (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to reduce drainage problems. Implement requirements of San Joaquin Valley Drainage Program. Primary objective is to remove from irrigation lands that contribute to drainage and water quality problems (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to reduce groundwater overdraft (150).

Land Retirement (CVPIA, Section (3408(h)). Retire land to supplement water in other areas short of water (150).

Focus the land retirement program on the 75,000 acres referenced in the final report of the San Joaquin Valley Drainage Program (139).

In the Kern Subarea, retire 32,000 acres of irrigated agricultural lands (169).

In the Tulare Subarea, retire 7,000 acres of irrigated agricultural lands (169).

In the Westlands Subarea, retire 33,000 acres of irrigated agricultural lands (169).

Allow natural vegetation to take over Sherman Island, to reduce the rate of soil subsidence and consumptive water use (33).

Retiring salt and drainage-impaired lands in the San Joaquin Basin (99).

Water Pricing

The State Water Project Contractors and DWR will develop a number of financial programs with State Water Project funds that will (1) establish a State Water Project operating reserve, (2) establish a program for water rate management, and (3) provide for revenue bond financing of specific planned future operation and maintenance facilities, if such facilities are constructed (127).

Establish incentives for pricing to reduce demand (CALFED).

Educate users about pricing feasibility (CALFED).

Remove legal obstacles to pricing incentive programs (CALFED).

Repayment schedules for federal water projects should more accurately reflect the costs of providing water to different users (95).

Adjust urban and agricultural water rates to reflect the cost of service, including non-market costs (95).

Eliminate double subsidies (95).

Eliminate pricing policies that subsidize the inefficient use of water at taxpayer expense (95).

Gradually reduce, then eliminate, most federal and state water subsidies (95).

Gradually reduce, then eliminate, federal crop subsidies for growing low-value, water intensive crops (95).

Assess water contractors, on an annual basis, a pre-renewal mitigation and restoration payment (Pre-Renewal Charge) for each acre-foot of delivered Project Water (148).

Subject all new, renewed and amended Water Service, Water Rights Settlement or Repayment Contracts executed after October 30, 1992, to tiered water rates (148).

All Water Contractors who receive Project Water from the Friant Division pursuant to a Water Service, Water Rights Settlement or Repayment Contract shall pay to the United States the applicable Friant Surcharge for each acre-foot of Delivered Project Water. The Friant Surcharges shall continue until such time as flows of sufficient quantity, quality and timing are provided at or below Gravelly Ford to meet the anadromous fishery needs of the San Joaquin River (148).

Assess and collect an annual charge for all Project Water which is used for M&I purposes (148).

Determine, assess, and collect additional annual mitigation and restoration payments on Project Irrigation Water and M&I Water, additional Project Water, Project Water provided pursuant to a Water Rights Settlement Contract, Flood

Water used for M&I purposes, and Section 215 Water if any, which is sold and delivered to the Water Contractors (148).

Water Pricing Reform (CVPIA, Section (3405(d)). Tiered prices; contractors have option to tier to individual users (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Full-Cost pricing on all water sold (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Revenue-neutral tiered prices; contractors have option to tier to individual users (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Market pricing, price based on fair market value (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Full cost pricing plus additional environmental costs, "full social cost" (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Meet repayment obligations assigned to water supply (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Encourage economically efficient use of water (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Encourage water conservation and habitat improvement (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Discourage groundwater overdraft (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Promote and maintain rural economies (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Repay project costs including interest on capital investment (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Price should not penalize reasonable and beneficial use of water (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Price should discourage unreasonable use of water (150).

Water Pricing Reform (CVPIA, Section (3405(d)). New water service should pay full O&M and capital with interest (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Impose seasonal water rates to encourage water use at times that enhance wildlife benefits (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Price should reflect environmental benefits of agricultural and M&I water use (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Pricing should discourage excessive urban development (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Options are needed that address actual costs based on recovery of full O&M and capital costs through water rates and conservation incentives (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Tiered prices; contractors required to adopt tiered prices to individual users (150).

Water Pricing Reform (CVPIA, Section (3405(d)). Encourage desirable water uses or discourage undesirable uses (150).

Watershed Management

General Watershed Management Actions

Develop Watershed Plans as partnership between local interests and government agencies responsible for managing resources; Plans would contain a problem statement, a comprehensive resource management strategy which specifies preventative and remedial measures, and implementation mechanism for each measure, and a monitoring plan (68).

RWQCBs should allow use of local autonomy with flexibility and accountability for voluntary compliance through CRMPs or similar watershed and subwatershed resource planning groups (75).

Strengthen interagency participation and coordination by establishing interagency coordination committees to designate lead entities that will develop watershed management plans and coordinate implementation (73).

Require all state, federal and local agencies that have an effect on or of hydromodification to participate in the development of a Watershed Management Plan. Establish Memoranda of Understanding among participants (73).

Evaluate suitability, effectiveness, and goals of existing regulatory operations; recommend modifications suitable for needs of watershed management. Utilize public review and comment for developing regulatory modifications (73).

Include in the watershed assessment: hydrology and sediment regime for functional watercycle including nutrient pathways, plant succession and energy flow; historic conditions and current status of wetland, riparian habitat extent, reasons for change, predictive trends and restoration potential; land use, land use patterns, and human activities that affect watershed functions and values (73).

Consider as watershed management options: development in and near sensitive areas; urban agricultural interface; buffer zones adjacent to sensitive areas; economic activities in and near sensitive areas that are compatible with protection and restoration goals; point source pollution sources and reduction programs; nonpoint source pollution sources and reduction programs; strategies for restoration of functions which have been altered through human activity; species and habitat protection; and alternative practices for existing activities (73).

Watershed Management Plans shall not be construed to exempt any person from the requirements of any federal or state law, regulation, guideline, or policy, including permitting requirements for individual projects and requirements pertaining to avoidance of adverse impacts to wetlands and other aquatic sites (73).

Adopt Watershed Management Plans as planning documents of local government land use permitting agencies. Develop and adopt ordinances to implement such plans. Once adopted as planning documents by local government land use

planning agencies and reviewed and adopted by state agencies, state and local actions shall be consistent with that plan (73).

The SWRCB/RWQCBs will encourage the development of formal watershed management plans by providing some assurance that such a plan, if fully protective of beneficial uses, will simplify permitting (73).

To support watershed planning, develop staff expertise in hydrology, fluvial geomorphology, wetland/riparian habitat analysis, cumulative watershed effects analysis, etc. (73).

Where a Watershed Management Plan is in place, mitigation guidelines will be consistent with that plan (73).

SWRCB staff involved with watershed groups will actively seek participation of all relevant agencies at the local level in the watershed management efforts (82).

Local governments should incorporate watershed information into the planning and management processes, including a requirement to specifically address watersheds in the Conservation and Open Space Elements (or local equivalents) of General Plans (69).

At least one watershed management pilot project based on a hydrologic area should be designated within each areawide NPDES municipal permit by a municipal permittee in coordination with the appropriate Regional Board (69).

RWQCBs with areas not covered by municipal NPDES storm water permits should designate at least one new pilot watershed project based on a hydrologic area not within the jurisdiction of a municipal program (69).

With the RWQCB, Department of Pesticide Regulation and other agency assistance, or under their own initiative, stakeholders should form a Watershed Planning Group to develop a Local Prevention Plan that includes a management practices checklist and a locally developed table of potential problem pesticides. After a Watershed Planning Group develops a Local Prevention Plan, it should submit the plan to the RWQCB and Department of Pesticide Regulation for comment. Local agencies and the Watershed Planning Group should provide grower outreach and public education about the Local Prevention Plan, and participating growers should develop a written resources management plan or rely on the management practices checklist in the Local Prevention Plan (75).

Flood management programs, policies and projects shall be consistent with Watershed Management Plans (73).

Establish periodic cross-education for other program requirements and procedures (73).

The SWRCB will encourage coordination among flood control agencies in shared basins (73).

Education programs should emphasize pollution prevention and be related to watershed management (69).

The Coordinating Watershed Management Planning group shall identify the lead entity for public outreach and involvement and educating landowners, land users and resource managers and the local community affecting or influencing watersheds about physical processes in their watershed. Such education shall include functions and values of wetlands, riparian areas (73).

The SWRCB, Coastal Commission, Department of Fish and Game, State Lands Commission, and U.S. Environmental Protection Agency will seek changes in the practices of the Federal Emergency Management Agency to ensure that it does not subsidize imprudent development in floodplains (73).

The SWRCB, Coastal Commission, Department of Fish and Game, State Lands Commission, and U.S. Environmental Protection Agency and will use their existing public information programs to develop and distribute relevant information (e.g., brochures) (73).

Hold forums to disseminate information to the public (e.g. watershed conferences) (73).

Provide increased encouragement for voluntary implementation of the Coordinated Resource Management and Planning (CRMP) group approach through Resource Conservation Districts or other resource conservation groups to meet stakeholder interests and increase sense of stewardship within the watershed planning area (75).

Actions to Improve Water Quality

California Department of Forestry should continue to regulate timber harvest and associated water quality issues through the Timber Harvest Plan process (183).

Cosumnes River Preserve demonstration farm (99).

Cosumnes River Watershed Project (99).

Cosumnes River Watershed Water Quality Project (99).

Retool monitoring programs to measures a broader definition of beneficial uses, and design them explicitly to measure progress toward attainment of water-quality goals (82).

Assess the condition of watersheds and identify and prioritize watersheds in which remediation efforts are most likely to produce beneficial results (82).

Identify target and pilot watersheds for remediation (82).

Use monitoring to evaluate the effectiveness of watershed plans and BMPs, and to track the progress of problem resolution (82).

Develop and conduct a coordinated, comprehensive water quality monitoring program to evaluate the effectiveness of present and future implemented management practices (75).

Construct a regional (San Joaquin River basin) water treatment plant using biological removal and ion exchange to remove both boron and selenium (63).

Establish specific goals for reducing the discharge of toxic pollution over time and discourage reliance on toxic materials. All dischargers should implement measures to reduce pollutants at their source (124).

Pursue a mass emissions strategy to reduce pollutant dischargers into the Estuary from point and nonpoint sources and to address the accumulation of pollutants in estuarine organisms and sediments (124).

Clean up contaminants presently affecting fish, wildlife, their habitats, and food supplies (124).

Findings of water quality impairment should be ranked according to severity and then trigger specific regulatory actions by the RWQCBs and Department of Pesticide Regulation. An action plan should describe the specific steps to be taken and an implementation schedule (75).

Expand monitoring of programs regulating forestry on private timberlands through Management Agency Agreements (MAA), such as between the State Board of Forestry and the State Water Board to ensure measures are used to prevent or minimize water quality problems (68).

Management of forest roads to control cumulative erosion and sedimentation effects (183).

National Forest Service should continue to implement and develop BMPs for control of water quality (183).

Rehabilitate damaged areas to remedy land practices that have affected the river (Cosumnes River) (179).

Sediment Control- watershed and watercourse management, San Joaquin River (99).

Stream protection BMPs should be revised to accommodate current understandings of hillside hydrology (183).

The use of State research universities to conduct monitoring cooperatively with extant State and federal agencies and research laboratories, could refine BMPs into effective guidelines (183).

To protect and insure high water quality objectives on rangeland, Residual Dry Matter guidelines should be implemented in appropriate watersheds (183).

Actions to Increase Water Yield

Analyze current projected water demands for the American River Basin (134).

To increase stream flow from high elevation basins in California, implementation of vegetation management, snow management, weather modification are suggested (183).

To increase water yield form National Forests in California by 354,000 maf, implement the Preferred Alternative as described in the Forest Management Plan from each of the 18 National Forests in California (183).

To increase water yield from National Forests in California by 34.5 maf, implement the Maximum Water Yield Alternative as described in the Forest Management Plan from each of the 18 National Forests in California (183).

Vegetation management for water supply augmentation, including manipulation of shrub and tree habitats (183).

Actions for Managing in-Delta Water Quality

To provide adequate dilution of any potential discharges, new marinas or marina expansions should not be permitted within 1.5 kilometers (0.9 miles) of any drinking water intake located in an open waterways, nor within any waterway or dead-end slough that terminates in a drinking water intake. Projects not meeting this criteria should be considered on a case-by-case basis to determine if a proposed project can be mitigated to provide comparable effectiveness (89).

New, expanded, or renovated marinas should minimize toxic discharges (including paint, paint chips, chemicals, heavy metals, tribytulin, oil, grease, and fuel) and prohibit discharges of untreated sewage as required under local, State, and federal laws and regulations (89).

General Actions to Manage Point and Non-point Sources of Contamination

Complete a management plan for key contaminants of aquatic ecosystems in the Central Valley (176).

Control point sources of toxic substances (99).

Control sources of selenium and mercury (99).

Department of Fish and Game/Fish and Wildlife Service, should seek the creation of a State-federal task force to develop a State policy and program under the Clean Water Act "208" non-point water pollution control authority to protect, enhance, and restore riparian vegetation and wetlands for their value as erosion retardants and sediment filters (28).

Establish a monitoring plan program to provide the information necessary to target corrective actions for specific sources, routes of transport, effects, and fates of contaminants in the Central Valley (176).

The potential for more one-stop shopping for growers, Pest Control Advisors, and other pesticides users should be explored, such as piggybacking the availability of pesticide data between UC Cooperative Extension Farm Advisors and the County Agricultural Commissioner (75).

Public recognition should be given for adoption of improved practices and/or to IPM innovators by giving growers awards, by media publicity and Public Service Announcements, and by giving high level recognition for achievements (75).

State and/or local agencies or organizations should provide technical assistance and incentives to growers who voluntarily choose to develop a written resource management plan. This plan may include grower-selected management practices or the plan checklist of selected practices for those fields and areas being treated with pesticides identified locally as being of possible concern (75).

The onsite wastewater management district should perform the following activities: 1) determine the extent of water quality degradation and threats to public health from onsite disposal system discharges; 2) develop standards for new and upgraded onsite disposal systems to protect water quality and beneficial uses; 3) implement measures necessary for nitrogen reduction; 4) inspect onsite disposal systems on a regular basis; 5) require regular onsite disposal system maintenance; 6) upgrade malfunctioning systems to meet standards; and 7) implement community disposal projects if they are found to be necessary for water quality protection or more cost-effective than upgrade of individual onsite disposal systems (76).

Promote values and importance of riparian areas as incentives (73).

Provide incentives for flood management approaches that minimize the need for channelization and channel hardening (73).

The SWRCB should establish an aggressive public education and outreach program to create public awareness of both the importance of the NPS program and the necessary role of the public in providing support for its implementation (70).

The results of monitoring studies related to pesticide management will be made widely available in a timely manner to both regulatory agencies and affected communities (82).

Develop generic public information materials for dissemination by the local governments (82).

Identify opportunities to support outreach and education efforts which will, where possible, utilize existing programs such as American Public Work Association, BMP training courses, extension of the Storm Water Quality Task Force Public Information/Participation programs, and coordination with local programs such as the Sacramento Valley Pollution Prevention Committee (82).

Make better use of universities in developing and disseminating scientific knowledge (73).

Youth groups, business and industrial groups, environmental organizations and ecology clubs at schools should be included in public service and public awareness programs related to water quality and pollution prevention (69).

Regulators will develop written criteria so that applicants will be able to recognize subject areas and types of work that could raise issues or complications in the permit process so that the applicant will better know that early consultation is advisable. To make this early consultation possible, regulatory agencies will consider: 1) an application fee structure to pay for extra work of regulatory staff; 2) additional resource agency staff to provide this pre-application review; 3) re-prioritizing staff time commitments so that early coordination is possible; 4) including criteria that would assist in identifying subject areas that could raise issues; 5) including all relevant agencies: resource, regulatory, local and transportation agencies; 6) including a pre-application meeting pre-CEQA, utilizing developer funding; and 7) making the process mandatory for the state and invite all others (73).

The SWRCB, RWQCBs and other agencies, in consultation with the development community, will require agency outreach to the development community with specific time requirements for agency personnel (time requirement should apply to development community only) (73).

Target education at the following groups: 1) landowners; 2) project developers; 3) educators (see San Francisco Estuary Institute); 4) professional societies; 5) Flood Management Agencies; and 6) Transportation Agencies (73).

In disseminating information, the SWRCB and other concerned entities will use such means as: a) University of California Extension; b) agency technical centers (e.g., U.S. Soil Conservation Service, U.S. Army Corps of Engineers); c) California Water Commission; d) presentations to professional societies (e.g., flood management association meetings); e) demonstration projects and technology transfer for developers; and f) a manual for flood management districts on ways to protect resources during operation and maintenance (73).

RWQCBs are requested to consider establishing agreements with local health departments regarding the lead or shared responsibility for inspection of pumpout facilities (82).

Develop the State program capabilities required for delegation pursuant to CWA §404(h) or for issuance of a US Army Corps of Engineers State Programmatic General Permit pursuant to 33 CFS 320 et seq. (82).

The RWQCB, Department of Pesticide Regulation, NRCS, RCDs, UC Cooperative Extension and County Agricultural Commissioners should identify vulnerable watersheds based on pesticides used, soil types, management practices, existing monitoring data and potential water quality problems. Other sources for identification can include the following: the State/Regional Board periodic water quality assessments, pesticide use reports, and Department of Pesticide Regulation studies and registration activities (75).

An analysis should be conducted to determine if increases in water quality violation penalties are warranted (75).

Establish inventories including mapping, functional quantification (e.g. hydrologic cycle), biological communities, biological corridors, and listed species for purposes of identifying environmental "hot spots" (73).

SWRCB and RWQCB staff should enhance the technical approach to monitoring (82).

Educate the development community, including developers, contractors, architects, and local government planners, engineers, and inspectors, on nonpoint source pollution problems associated with development and redevelopment and construction activities and involve them in problem definitions and solutions (69).

SWRCB/RWQCBs should work through the California Board of Education and County Departments of Education to incorporate water quality issues into the curriculum (69).

In concert with the Onsite Disposal Systems Advisory Group and RWQCB staff, the NPS program will prepare a formal guidance memorandum regarding the application of SWRCB Resolutions No. 68-16 and No. 88-63 to onsite disposal systems (82).

As part of the preparation of workplans, each RWQCB will be asked to consider redirection of staff to support onsite disposal system activities (82).

Convene an interest-based group to review the next certification of nationwide permits (required in 1996) (73).

The SWRCB should carry out the following process for addressing NPS pollution:

> To address NPS pollution, the SWRCB should work through the Regional Boards to assess pollution and prioritize areas (watersheds) for action. In each prioritized area, agencies responsible for protecting natural resources, land users, technical agencies, and other stakeholders should form a Watershed Group to take the necessary steps to solve local problems and set goals for implementation of a watershed NPS program. Each Watershed Group should develop a Watershed Plan identifying local NPS problems and setting a schedule for implementation by confined animal facilities.
>
> After review and approval of the local Watershed Plan, the Regional Board should adopt the Watershed Plan as an implementation element of the Board's Basin Plan. The Board and each Watershed Group should agree on a time period for local implementation of the Plan by the Watershed Group; at the end of this period the Board should again review the Plan and determine whether satisfactory progress has been achieved. If satisfactory progress has not been achieved, the Board must take appropriate action which may include extending the implementation period, requesting Plan modification, or exercising its regulatory authority.

Following adoption of the Watershed Plan, confined animal facilities operators shall implement appropriate practices with leadership, financial, and technical assistance provided by the Watershed Group (70).

The SWRCB should encourage RWQCBs to delegate the authority and support the efforts of local jurisdictions for the approval of alternative nonstandard onsite disposal systems. The role of the SWRCB should be to provide technical assistance and oversight to assure proper application of alternative technology for onsite disposal systems (76).

The SWRCB should require RWQCBs to work with local agencies to ensure that there are suitable septage disposal facilities available for existing and proposed onsite disposal systems (76).

The SWRCB should adopt a positive incentive based program to implement its nonpoint source pollution program, rather than the traditional negative fees and penalties programs of the past that result in antagonistic rather than cooperative relationships between the regulatory community and the private sector (77).

The Department of Pesticide Regulation and RWQCBs should coordinate prioritization of resources, monitoring, and program implementation on the basis of relative risk (75).

The Department of Pesticide Regulation should accept written resource management plans and marked checklists of selected management practices voluntarily developed by growers and other pesticide users through RCDs, NRCS, UC Cooperative Extension, County Agricultural Commissioners and others as evidence of voluntary compliance (75).

An effective, coordinated surface water monitoring program should be developed. The SWRCB, RWQCBs, the Department of Pesticide Regulation, and the Department of Fish and Game should all be included in the development of a comprehensive monitoring program. Additional monitoring needs should be identified, and any proposed statewide comprehensive monitoring program and appropriate funding mechanisms should be developed in public forums (75).

The Department of Pesticide Regulation and RWQCBs should maintain monitoring programs for accountability of voluntary compliance and effectiveness of installed management practices (BMPs, etc.) (75).

The California Mussel Watch Program to monitor bioaccumulation of pesticides should be restored (75).

The local management plan should be developed for the purpose of meeting specific water quality improvement goals. Growers should be considered in compliance if they are implementing management practices in accordance with a recommended management plan. Plans should be periodically reviewed to assure that implementation will in fact result in meeting specified water quality improvement goals. Growers operating according to the recommended

management plan should not be subject to additional regulation or requirements (75).

Cooperating state agencies and interested parties should work towards developing mechanisms to encourage joint projects between urban water entities and upstream non-point sources which would result in tangible benefits to both parties and overall reductions in pollution. The mechanism should be voluntary and incentive based, with the following program elements: 1) BMPs would be used as the pollution control method, with some type of monitoring to measure progress; 2) projects should not be limited to beneficiaries in one watershed, but should encourage downstream entities that benefit from cleanup in another watershed to participate; 3) RWQCBs, with oversight by the SWRCB, would oversee implementation, with MOUs between regional boards where a project extends beyond a watershed; 4) funds would be allocated on a merit system, with those projects providing the best cost-benefit ratio given priority (75).

Implement programs to ensure the satisfactory performance of all existing onsite disposal systems, promote the upgrade of substandard onsite disposal systems and require repair of malfunctioning onsite disposal systems (76).

Develop onsite wastewater management districts in areas where new or operating onsite disposal systems require management to prevent adverse impacts on water quality and/or public health. The wastewater management districts should implement a management plan which improves wastewater disposal practices to protect water quality, beneficial uses, and public health (76).

The Regional Transportation Planning Agencies (RTPAs) should be encouraged to incorporate nonpoint source structural BMPs into their Transportation Improvement Programs (TIPs) (69).

Congestion Management Agencies (CMAs) should incorporate structural BMPs and the analysis of particulate matter ($PM_{2.5}$, PM_{10}, and $>PM_{10}$) into their Congestion Management Plans (CMPs) (69).

CMAs should support the use of alternative transportation for people, goods, and services beyond its current level of effort(69).

CEQA and NEPA lead agencies should include reasonable dollar figures on water quality management/maintenance in the life cycle costs of roadway systems when comparing alternatives (69).

Caltrans should require training for nonpoint source prevention and control for road construction contractors through Cooperative Training Assistance Program (CTAP) or Caltrans courses (69).

Regional, local, and state transportation agencies should provide unit cost data on sediment and erosion control bid items (69).

The Resources Agency and CalEPA should urge the California Transportation Commission (CTC) to raise the dollar value per acre of state highway landscaping jogs, and to redefine highway landscaping to include water pollution control (69).

The SWRCB and Department of Pesticide Regulation should prioritize pesticides for potential water quality impacts, and the SWRCB and RWQCBs should identify areas in which to set water quality goals, objectives, and standards. This effort should recognize that the management practices to be implemented within three years of US EPA approval of the State Implementation Plan are to protect water generally (75).

The SWRCB and Department of Pesticide Regulation should request that additional measures, if necessary to meet water quality goals, objectives, and standards and protect beneficial uses, be implemented within ten years of US EPA approval instead of the current limit of eight years (75).

RWQCBs should be encouraged to waive Tier III waste discharge requirements of the SWRCB NPS Plan when Tier II practices have been implemented (75).

The SWRCB/RWQCBs should review progress in solving pesticide water quality problems when they conduct their periodic water quality assessment process (typically the triennial review of the basin plan) (75).

Adopt local and regional policies and procedures for onsite disposal systems to protect beneficial water uses and ensure compliance with numerical and narrative water quality objectives and statewide plans and policies (76).

State and local agencies should implement programs which: 1) provide public education on onsite disposal systems; 2) monitor onsite disposal system performance; 3) ensure that septage disposal facilities are available; 4) identify malfunctioning onsite disposal systems and areas which would benefit from the development of wastewater management plans; 5) develop and implement repair standards; 6) ensure coordination between land use agencies and agencies overseeing onsite disposal systems to upgrade existing onsite disposal systems whenever there is a major remodel or an increase in wastewater discharge; and 7) prohibit discharge of deleterious materials which may inhibit onsite disposal system performance, degrade water quality, and/or contaminate septage (76).

The SWRCB should clarify and provide formal guidance to the RWQCBs regarding the applications to onsite disposal systems of the SWRCB Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California" and Resolution No. 88-63, "Sources of Drinking Water" policy (76).

The SWRCB should consider such issues as: a) timing of permitting; b) information requirements; c) developing joint application forms; d) establishing umbrella MOUs/MOAs; e) developing guidelines on where to go for permits for hydromodification (may have been developed by the Office of Permit Assistance); and f) consolidated permitting (73).

The SWRCB, RWQCBs and other regulatory agencies will provide regulatory incentives for project designs that minimize the need for channelization and channel hardening, including regulatory flexibility, expedited permit review, and waived or reduced fees (73).

The SWRCB will use available grant funds to assist development of channel design criteria, and to establish risks, uncertainties, and failure modes, for measures which minimize the need for channelization and channel hardening, e.g.:

1. develop criteria for alternative bank protection other than rip rap;
2. develop criteria for larger channel sizes to allow establishment of riparian vegetation while allowing passage of design flows;
3. determine and develop standards for hydraulic capacities of channels with various types and maturity of riparian vegetation;
4. develop criteria for in-stream debris basins which include capacity for vegetation;
5. identify considerations in planning multiple-use flood management facilities (i.e., facilities which provide habitat, flood retention, groundwater recharge, pollution filtration, aesthetic, and drainage functions);
6. develop criteria for multiple objective two-stage channel designs with low-flow channels;
7. develop criteria for levees wide enough to fill multiple needs and use multiple funding sources (e.g., establishment of vegetation, provision of road and utility rights-of-way) (73).

The SWRCB will use available grant funds and develop agreements with other concerned entities (e.g. the Department of Water Resources, the California Association of Flood Control Agencies, and the California Building Industry Association) to assist entities engaged in hydromodification activities by disseminating up-to-date technical information on:

a. flood management methods which preserve natural riparian values;
b. construction and long-term maintenance costs of traditional and alternative flood management approaches;
c. methods to involve flood control beneficiaries in the design process so they will act as advocates for maintenance funding and provide minor maintenance (e.g., litter cleanup);
d. developing setbacks in floodplains and designating floodways with established performance standards;
e. examples of existing ordinances and policies which minimize the need for channelization and channel hardening (73).

The SWRCB and Coastal Commission should support changes by the California Department of Water Resources to its State Flood Control Subvention Program to: a) allow funding of project features that minimize the need for channelization; and b) establish a requirement for watershed planning when funding the local share of federally funded projects (73).

The SWRCB, Coastal Commission, Department of Water Resources, and U.S. Environmental Protection Agency will support changes to the U.S. Army Corps of Engineers' "Principles and Guidelines" for funding of flood management projects to include riparian and other natural values in project cost/benefit analysis and use public participation to help determine costs and benefits (73).

The SWRCB and other planning and regulatory agencies will establish and apply the following policies where existing channels and floodplains provide beneficial uses and protect water quality:

New development shall be designed to minimize changes in watershed hydrology, maintain natural channel configurations, and, as much as possible, avoid floodplain encroachment allow natural flooding, in order to protect beneficial uses and avoid increased downstream flooding.

Channelization and channel armoring shall only be done as a last resort, where extensive, permanent structures need flood protection, existing development severely limits existing and potential beneficial uses, and there are no practicable alternatives.

Decisions to permit instream activities (e.g. gravel mining, bridge abutment construction, percolation pond construction, storm drain construction) will ensure that secondary and cumulative geomorphologic consequences will not adversely impact beneficial uses (73).

The SWRCB and other planning and regulatory agencies will promote multi-objective strategies that maintain or reestablish natural hydrologic functions:

Integrate flood management measures and other elements of development design (e.g., greenways and open space dedications, bikeways and pedestrian paths, utility corridors).

Encourage projects proposed jointly by flood management agencies, developers, and resource agencies or environmental groups.

Share the operation and maintenance responsibilities for multi-objective facilities among the benefited interests (e.g., flood management agencies and resource agencies).

Develop setbacks in floodplains, designate floodways with established performance standards, and address potential loss of tax revenue to local government.

Ensure cross-compliance with NPDES storm water permit program (73).

The SWRCB and other planning and regulatory agencies will encourage flood management agencies to extend drainage project boundaries to include the entire drainage, not just the area of instream structural improvements, in determining management measures and imposing costs (73).

The SWRCB, Coastal Commission, and the Department of Water Resources will support efforts by local flood management agencies to broaden their authorities to minimize the need for channelization (73).

RWQCBs will work cooperatively with flood control agencies to correct perceived abuses of "emergency" provisions by advising these agencies of regulatory requirements and becoming familiar with how flood control agencies distinguish between emergency and routine maintenance projects (73).

RWQCBs will expeditiously process permit applications for projects which meet the regulatory definition of "emergency," even if such applications do not meet all criteria for being complete (73).

In consultation with flood control agencies, RWQCBs will develop and apply standard permit conditions for emergency situations to speed permit issuance (e.g., a condition that fill discharges associated with emergencies should not include oil or other pollutants and should be armored or contained) (73).

For projects that do not meet the regulatory definition of emergency, RWQCBs will enforce all regulatory requirements, including submittal of adequately detailed permit applications and assurance that beneficial uses will not be permanently impaired (73).

RWQCBs will monitor use of "emergency" provisions and penalize abuses (73).

The SWRCB, DFG and others with enforcement authority over NPS problems should recognize a "due diligence safe harbor" against regulatory enforcement proceedings for confined animal facility operators when there is an otherwise non-permitted discharge, and: 1) the operator is a participant/cooperator in a local Watershed Group, and is engaging in management practices implemented in accordance with an approved Watershed Plan; and 2) the operator takes prompt action to abate the discharge when it is discovered, and, when necessary and appropriate, takes reasonable steps to reduce the likelihood of further such discharges (70).

Establish water quality objectives, implementation options, and other details characteristic of statewide water quality plans through the normal planning process (82).

Develop a consistent statewide approach to Polluted Urban Runoff management (82).

Staff of the Nonpoint Source and Storm Water Sections will develop an issue paper for SWRCB consideration discussing a comprehensive statewide approach to urban runoff management (82).

Facilitate permitting for minor projects by convening an interest-based group of reauthorized nationwide permits in 1996 (82).

The Regional Board should consider appropriate portions of the drainage canals in the San Joaquin River drainage study area as mixing zones, consistent with regulations adopted under the Federal Clean Water Act (63).

The Regional Board should consider the following prohibitions:

1) No water with a selenium concentration greater than 5 ppb should be discharged directly into the Delta-Mendota Canal if such discharges substantially affect the load of selenium in the Delta-Mendota Canal.

2) No new subsurface drainage system should be constructed which discharges to surface waters in the San Joaquin River basin unless the long term water quality objectives for salinity, boron, molybdenum and selenium are being met downstream of its discharge location and will continue to be met after the discharge commences (63).

The RWQCB should coordinate water quality monitoring to determine management practices effectiveness, with emphasis on pesticides determined to be of local concern. If the monitoring identifies a problem, the program should return to the Department of Pesticide Regulation and RWQCB to consider further reevaluation or other action (75).

Set performance standards for evaluating implementation effectiveness while acknowledging seasonal and regional variations. Use adaptive management schemes as necessary for course correction as determined by monitoring in order to meet performance standards (73).

The SWRCB/RWQCBs should strongly encourage areawide watershed planning, policy adoption and regional storm water quality control implementation (69).

SWRCB/RWQCBs should identify and provide incentives for local governments to commence watershed planning in order to maximize the use of limited resources and to maximize the benefits of NPS pollution controls (69).

SWRCB/RWQCBs should consider reorganization of programs and staffing priorities to assign more staff to review projects at the planning level, nonpoint source pollution issues, and watershed management tasks (69).

RWQCBs should encourage local governments to cooperate with other groups such as Resource Conservation Districts (RCDs) on watershed management programs (69).

SWRCB should revise the California Nonpoint Source Management Plan to incorporate Existing Development practices a, b, d, e and f from Chapter 4 of the EPA *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (69).

SWRCB should examine the possibility of conditioning certain state grants and loans to local governments to require the development and implementation of water quality management programs (69).

SWRCB/RWQCBs should cooperate with air quality management districts in the certification of dust palliatives to control fugitive dust (69).

SWRCB/RWQCBs should cooperate with air quality management districts to identify issues of common concern and to seek solutions which would assist in the reduction of both air and water pollution (69).

SWRCB/RWQCBs should encourage the development of water quality awareness programs by the California State Association of Counties (CSAC) and the California League of Cities (69).

Municipal storm water monitoring programs should be designed to support watershed assessments and planning (69).

In order to determine where impacts to watersheds are occurring, GIS programs in California should be coordinated (69).

Municipal NPDES permittees and RWQCBs should share information, by hydrologic subareas, of all point source permittees, including industrial and construction permittees (69).

Local governments should be encouraged to include watershed information in the appropriate elements of their general plans and to require that watershed consideration be included in environmental documentation (69).

Pollution prevention programs should be designed to emphasize source reduction (69).

Pollution prevention programs should be related to watershed management (69).

SWRCB/RWQCBs should establish forums to promote the discussion and resolution of policy conflicts with local and state agencies in the design of transportation corridors (69).

SWRCB/RWQCBs should work with Caltrans, to formalize the representation of Caltrans, and other appropriate transportation agencies at the Interagency Advisory Committee on nonpoint source issues (69).

SWRCB should work with federal and state agencies to promote research on controlling nonpoint source pollution including: alternative automotive materials; effectiveness of treatment systems; effectiveness of maintenance systems; pollutant fate and transport; regional specificity of predictors; and facilities design for pollutant containment (69).

Caltrans, toll bridge authorities, and local agencies involved in the operation, construction, or maintenance of roads, highways, and bridges should revisit cooperative agreements they have with each other in order to improve the terms for accepting storm water connections (69).

Programs should be developed through UC Master Gardeners to encourage safe home use of pesticides and proper disposal. Support of programs could be solicited from chemical industry leadership (75).

Programs should be developed to target rural and urban schools, FFA clubs and conferences, 4-H clubs and conferences, home gardening shows, county fairs, periodicals and gardening magazines, etc. with information developed by UC Cooperative Extension, CAPCA, PAPA, the Department of Pesticide Regulation, and RWQCBs. Utilize existing public education programs, such as the CAPCA Plant Doctor program and the Agriculture in the Classroom program (75).

RWQCB and Department of Pesticide Regulation representatives should attend Irrigation District and RCD Board meetings as well as other appropriate regional forums to discuss identified problems and ongoing activities to solve them (75).

RWQCBs, in cooperation with other agencies and interested parties, should explore the potential to create point/NPS upstream/downstream partnerships for resource trading in a watershed (75).

The proposed MAA between the SWRCB and Department of Pesticide Regulation should address the development of a comprehensive strategy to coordinate monitoring conducted for the many existing water quality regulatory programs. The coordinated monitoring program can then be used to establish priorities and target efforts as well as assist in identifying additional monitoring needs (75).

The SWRCB and RWQCBs will recognize watershed-level impacts resulting from individual discharges and apply watershed management principles in all permit decisions, even in the absence of a watershed management plan (73).

Emphasizing a watershed approach, provide additional attention to the cumulative impacts of onsite disposal systems (82).

Site and design onsite disposal systems to protect surface and ground waters (76).

Onsite disposal system site evaluations should be performed by individuals who are qualified to examine and assess soil, geologic, and hydraulic properties as related to subsurface effluent disposal (76).

Onsite disposal system siting and design criteria should include the following elements at a minimum: 1) subsurface disposal; 2) setbacks from wells, waterbodies, cut banks, natural bluffs, sharp changes in slope, and unstable landforms; 3) natural ground slope and stability; 4) depth to groundwater; 5) soil conditions and percolation rates; 6) soil depth; 7) cumulative/land use density impact; 8) replacement or reserve area; 9) septic tank size; 10) method of disposal; 11) projected flow; and 12) strength and source of the wastewater (76).

Local governments should relate the development of local and areawide storm water programs to known water quality problems and beneficial uses of receiving waters (69).

Local governments should emphasize education for pollution prevention rather than regulation (69).

Local government management practices should emphasize pollution prevention over pollution control; when source control is necessary, nonstructural controls should take priority (69).

Municipal NPDES permits should have watershed specific components (69).

All municipal NPDES permits and Waste Discharge Requirements (WDRs) should be considered for reissuance on a watershed basis (69).

All NPDES municipal storm water permit applications and Notices of Intent (NOIs) should be coded by hydrologic subarea (69).

Utilize land treatments such as brush management, prescribed burning, critical area planting, range seeding, grazing mechanical treatments, stream corridor improvements, wetland habitat management, woodland development or restoration, and upland habitat management to minimize adverse impacts on water quality (81).

The control of urban nonpoint source pollution should be approached in a hierarchical manner with pollution prevention given the highest priority, followed by source control and treatment controls (69).

Develop formal cooperative agreements to coordinate authority, resources and funding availability of participants responsible for mixed timberland ownership areas where Cumulative Watershed Effects (CWE) are a problem (68).

Identify adequate incentives and management techniques for private range owners to protect water quality and livestock production values (68).

Reduce point and nonpoint source pollutant discharges to the SF Estuary (99).

Remediate pollution threats to public health and wildlife in SF Estuary (99).

Coordination & management of studies on effects of contaminants in Delta and SF Estuary ecosystem (99).

Subalpine forest vegetation management can increase water runoff from small water sheds (161).

Chaparral brushland vegetation management can increase water runoff from small water sheds (161).

Actions to Change Water Quality Policy

Logging practices have degraded water quality and fishery habit by sedimentation of stream beds. The United States Forest Service and the Board of Forestry have adopted logging and forestry practices, and regulations to protect fish and water quality (79).

Develop Master Agency Agreement (MAA) and Best Management Practices (BMP) between the State Water Board and the Department of Pesticide Regulation to monitor forest chemical management (68).

At the appropriate time, amend the NPS Management Plan or SWRCB and/or Regional Water Quality Control Plans to incorporate the Rangeland Plan (82).

The SWRCB should provide technical assistance to RWQCBs and local agencies for the development of regional and local policies and criteria addressing cumulative impacts (76).

Establish incentives for projects which retain or re-establish natural hydrologic functions (e.g., channel restoration projects and low-impact development projects):

> The SWRCB, RWQCBs and other regulatory agencies will provide regulatory incentives, including expedited permit review, regulatory flexibility, simplified monitoring and reporting requirements, and waived or reduced fees, for project designs that retain or re-establish natural hydrologic functions.
>
> The SWRCB, in conjunction with flood management agencies, will review liability issues for both traditional flood management approaches and for alternative approaches which retain or re-establish natural hydrologic functions but may incur greater potential liability than traditional approaches (e.g., infiltration pond hazards, failure of innovative techniques).
>
> Planning, regulatory, and resource agencies will encourage project proponents to seek cost sharing or other economic incentives for multi-objective site development (73).

SWRCB and RWQCBs should adopt statewide and regional policy addressing the prevention and control of urban runoff pollution (69).

Local governments should be encouraged to develop ordinances to address all sources that may cause water quality impairment (69).

The revised California Nonpoint Source Management Plan should incorporate the pollution prevention Management Measure from Chapter 4 of the EPA *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (69).

RWQCBs should establish meaningful water quality goals, objectives, and standards based on impacts to human health or the environment. Attainment of goals, objectives and/or standards should be economically feasible. Impact monitoring should precede development of goals, objectives, and/or standards (75).

RWQCBs should adjust goals, objectives, and standards when necessary based on local conditions during the triennial Basin Plan Review. Periodic review (3-4 years) should reevaluate goals, objectives, and standards in areas where existing management practices do not result in improved water quality (75).

The State and local jurisdictions should develop new policies and regulations which provide for the analysis, review, and mitigation of potential cumulative impacts of onsite disposal systems. Cumulative impact policies/regulations should, at a minimum: 1) identify potential impacts of concern; 2) specify when cumulative impact analysis should be conducted; 3) establish guidelines which specify the level and methods of investigation and analysis; 4) provide for the cumulative impact analysis to address the effects on a watershed basin; 5) establish criteria for determining the accepted level of cumulative impact; and 6) establish criteria for determining a mitigation goal when cumulative impacts must be mitigated (76).

The SWRCB will work with the Office of Planning and Research to develop CEQA requirements for wetlands and watershed analysis (e.g. an appendix) (73).

Stormwater quality plans, policies and best management practices should be integrated into planning and permitting processes (82).

Develop an example CEQA Checklist that explicitly addresses watershed, water quality, and nonpoint source pollution impacts (82).

SWRCB should recommend to the Governor's Office of Planning and Research that it pursue amendments to the CEQA Guidelines to include appropriate revisions to the CEQA Checklist and Applicant's Environmental Information Forms to address watershed, water quality, and nonpoint source pollution impacts (69).

More fully utilize the existing and expand, where appropriate, the legal and regulatory framework to facilitate voluntary water marketing agreements among agricultural, urban, and environmental interests (124).

Address and resolve, as appropriate, the impacts on water reclamation and water conversation caused by the discharge of brine from self-regenerating water softeners and other sources into the wastewater stream (124).

Adopt water quality objectives that effectively protect estuarine species and human health (124).

Recommend institution and financial changes needed to place more focus on pollution prevention (124).

Where programmatic or policy conditions present problems for watershed management, the SWRCB through the IAC will act as a conduit for addressing and resolving those problems (82).

Treat water quality monitoring results as a catalyst for watershed planning relative to pesticide management (82).

Actions to Modify the Weather and Manage Snowpack

Cloud seeding throughout the entire Central Valley Project Basin (161) and the associated impacts (154).

Cloud seeding all high elevation drainage basins not currently being operationally seeded (161).

Cloud seeding performed in the Clair Engle Reservoir region to increase runoff into the reservoir (161).

Cloud seeding in the Shasta Reservoir Region (161).

Weather Modification/Snowpack Management study in the Sacramento River Basin (154).

Weather Modification/Snowpack Management study in the Feather River Basin (154).

Weather Modification/Snowpack Management study in the Yuba River Basin (154).

Weather Modification/Snowpack Management study in the Bear River Basin (154).

Weather Modification/Snowpack Management study in the American River Basin (154).

Weather Modification/Snowpack Management study in the Mokelumne River Basin (154).

Weather Modification/Snowpack Management study in the Calaveras River Basin (154).

Weather Modification/Snowpack Management study in the Stanislaus River Basin (154).

Weather Modification/Snowpack Management study in the Tuolumne River Basin (154).

Weather Modification/Snowpack Management study in the Merced River Basin (154).

Weather Modification/Snowpack Management study in the San Joaquin River Basin (154).

Weather Modification/Snowpack Management study in the Kings, Kaweah and Tule River Basins (154).

Weather Modification/Snowpack Management study in the Kern River Basin (154).

Implement watershed management practices (snowpack management, vegetation manipulation) to increase water yield and improve water quality in the Feather River Basin (Plumas National Forest) (104).

Implement watershed management practices (snowpack management, vegetation manipulation) to increase water yield in the Yuba River Basin (Downieville Ranger District) (104).

Implement watershed management practices (snowpack management, vegetation manipulation) to increase water yield and improve water quality in the American River Basin (El Dorado National Forest) (104).

Implement watershed management practices (snowpack management, vegetation manipulation) to increase water yield and improve water quality in the Stanislaus River Basin (Niagara and Eagle Creek watersheds) (104).

Implement watershed management practices (snowpack management, vegetation manipulation) to increase water yield and improve water quality in the San Joaquin River Basin (specifically in the watersheds of the Mammoth Pool and Big Creek systems) (104).

Actions for the Funding of Watershed Management Programs

The state shall seek federal financial and technical assistance and shall provide watershed level financial and technical assistance and support field positions to assist Watershed Management planning, implementation and monitoring (73).

The State should aggressively pursue Section 319 Federal Water Pollution Control Act grant monies (75).

Secure stable funding for an expanded, comprehensive monitoring and assessment program for nonpoint pollution and watershed protection efforts (82).

The SWRCB and Coastal Conservancy will allocate grant funds to support incorporation of watershed education into school science curricula and promote grass-roots education efforts (e.g., adopt-a-watershed and citizen monitoring programs) (73).

Develop incentives for private land owners to increase stream flow, increase water yield, and improve water quality (104).

New or Expanded On-Stream Storage

General Action for On-Stream Storage Facilities and Projects

Modify operations of existing onstream reservoirs (CALFED).

In the South Coast Region, use local reservoir carryover storage, as available (33).

Enlarge existing storage facilities and develop new surface storage facilities (144, 154).

Water reservoirs that are consistent with other uses in the Delta should be permitted (89).

Actions for Increased Storage Down-Stream from the Delta

Salinas Reservoir Expansion Project (City of San Luis Obispo) (50).

Actions for Increased In-Delta Storage and Storage Upstream from the Delta

Develop additional conservation storage north of the Delta (13).

Develop additional storage for high-quality water upstream of the Delta to release for salinity control requirements (13, 8).

New Los Padres Reservoir - MPWMD (enlarge existing reservoir) (51).

Clair Engle Lake enlargement (storage) (51).

Mendota Dam replacement (131).

Friant Dam enlargement (131).

Construct and operate the Middle Bar dam and reservoir (112, 160, 154).

Raise Pardee dam and reservoir (112).

Construct and operate a regulating reservoir near Camanche and a pipeline to Camanche (112).

Construct and operate Devil's Nose dam and reservoir on the North Fork Mokelumne River (112, 37).

Thomes-Newville Reservoir (31).

Other storage sites in tributaries to the Delta: Millville, Wing, Schoenfield, Gallatin, Sites, Garden Bar, and Nashville reservoirs (31).

Enlarge Shasta Lake to 14.3 million acre-feet (160, 31, 51).

Implement the Cottonwood Creek Project, which consists of two lakes, Dutch Gulch Lake at 900,000 acre-feet storage and Tehama Lake at 700,000 acre-feet storage (31, 160, 154).

Construct Marysville Lake, a proposed reservoir in the Yuba River Basin at the Parks Bar and Narrows (31, 160, 154).

Construct Garden Bar Reservoir, a proposed reservoir on the Bear River upstream of Camp Far West Reservoir (160, 154).

Construct Auburn Dam on the American River (31, 160, 154).

Construct Clay Station Reservoir along the Folsom South Canal to store water during periods when excess water is available from Folsom Dam (112, 160, 154).

Enlarge Folsom, increasing the reservoir capacity to 1.34 million acre-feet (160, 154).

Enlarge Farmington, increasing the reservoir storage to 160,000 acre-feet (160, 154).

Enlarge Friant, to increase the storage capacity of Millerton Reservoir to 1.3 million acre-feet (160, 154).

Raise Monticello Dam by 645 feet to increase the gross capacity of Lake Berryessa by 11.4 million acre-feet (160, 154).

Construct the proposed Cosumnes River Water and Power Project to augment Amador County water needs by developing a substantial water supply (37).

New or Expanded Off-Stream Storage

General Actions for the Off Stream Storage Facilities and Projects

Modify operations of existing offstream reservoirs (CALFED).

San Diego Emergency Water Storage Project (51).

Enlarge existing storage facilities and develop new surface storage facilities (154).

Provide storage enlargement (144).

Evaluate surface reservoir storage options for recycled water that could be used for agricultural irrigation during the summer and reduce the amount of discharged treated effluent into the San Francisco Bay during the winter (144).

Actions for the Increased Storage Down-Stream of the Delta

In the South Coast Region, cut back on deliveries to Metropolitan Water District member agencies for reservoir carryover storage (39).

Domenigoni Valley Reservoir-Metropolitan Water District of Southern California for offstream storage of State Water Project and Colorado River water (51).

Provide offstream storage: enlarged Los Banos Detention Reservoir (31).

Provide offstream storage at the Sunflower site (31).

Provide offstream storage: enlarged Little Panoch Creek Reservoir (31).

Provide offstream storage on Kellogg Creek (31).

Los Vaqueros Reservoir-Contra Costa Water District for offstream storage and emergency supply (51).

Construct and operate the Los Vaqueros Reservoir, including a 192-foot earthen dam on Kellogg Creek seven miles south of Brentwood, to provide CCWD with offstream storage for water quality enhancement and emergency storage purposes (87).

Provide offstream storage on Orestimba Creek (31).

Construct Los Banos Grandes. The proposed offstream storage reservoir would be located on Los Banos Creek in western Merced County (31, 51, 160, 154).

Actions for the Increased In-Delta Storage and Storage Upstream of the Delta

Construct a 350,000 acre-foot reservoir in the Montezuma Hills (59).

Red Bank Project (storage) (51).

Westside Reservoirs (storage) (51).

Fine Gold Creek offstream storage project (131).

Montgomery Reservoir off-stream storage project (131).

Provide offstream storage at Del Puerto Canyon (31).

Provide offstream storage on Crow Creek (31).

Provide offstream storage at the Garzas site (31).

Provide offstream storage on Little Salada Creek (31).

Provide offstream storage on Ortigalita Creek (31).

Provide offstream storage at the Quinto site (31).

Provide offstream storage on Salada Creek (31).

Provide new surface storage facilities (144).

Construct Deer Creek, an offstream 600,000 acre-feet reservoir that would store American River water delivered by the Folsom South Canal (160, 154).

Construct Duck Creek, divert surplus water from the Mokelumne River at Pardee Reservoir for conveyance to a new offstream storage reservoir (160, 154).

Construct South Gulch, a 14,000 acre-feet offstream storage reservoir that would receive water by conveyance from Calaveras and Stanislaus Rivers (160, 154).

Construct Montgomery Reservoir, This option is for a 240,000 acre-feet reservoir in Dry Creek immediately north of the Dry Creek/Merced River confluence (160, 154).

Construct Fine Gold. The Fine Gold Creek pump/storage project consists of a 350,000 acre-feet reservoir on Fine Gold Creek and during flood flows water would be pumped from Millerton Reservoir to Fine Gold Reservoir for power and water supply releases (160, 154).

Construct off-stream storage reservoirs to store spills from New Melones and New Hogan Reservoirs (58).

Actions to Increase Storage Within the Delta

Increase in-Delta storage to provide operational flexibility for fisheries (13, 11).

Study storage of surface water on Delta island (99, 124, 122, 102).

Implement the Delta Wetlands project, a water supply project using four Delta islands: Boulding Island, Holland Tract, Webb Tract and Bacon Island (102, 103, 160, 154).

Groundwater Banking and Conjunctive Use

General Actions for the Management of Groundwater Resources

Potable water supplies to serve Delta uses can be obtained from surface waters or groundwater. Development of groundwater wells should be monitored to ensure wells do not result in overdraft and possible intrusion of saline water into groundwater supplies (89).

Establish incentives for conjunctive use (CALFED).

Modify Water Code to encourage conjunctive use (CALFED).

Groundwater reclamation/use (51).

Conjunctive use demonstrations (131).

Recharge groundwater supplies with wastewater effluent from publicly owned treatment works. (Examples: City of San Diego.) (188).

Recognize groundwater recharge as a beneficial use of project water for all of the Interim Contract Renewal alternatives (140).

Evaluate and adopt, where appropriate, mechanisms to manage groundwater to protect the long-term integrity of groundwater basins (124).

Farmers should be encouraged to voluntarily measure groundwater withdrawals. Well monitoring is critical to evaluation of management programs (62).

Adopt water management practices that benefit and preserve long-term groundwater resources with respect to quality and quantity (99, 62).

Develop reliable, consistent methods for estimating ground water pumping (169).

Determine the hydraulic and water-quality feasibility of controlling the water table by pumping from wells in selected area (169).

Continue development of quantitative analyses of ground water flow systems (169).

Maximize groundwater recharge using available supplies from the American River, Mokelumne River, Calaveras River, Littlejohns Creek, and Stanislaus River. Recharge would occur through a combination of direct injection (up to 75 TAF in wet years) and in-lieu recharge (up to 265 TAF in wet years) (112).

Implement the seven steps for managing ground water supplies (40).

Evaluate aquifer storage options (for recycled water) that could be used for agricultural irrigation during the summer and reduce the amount of discharged treated effluent into the San Francisco Bay during the winter (144).

Implement a program to protect groundwater and reduce overdrafting during the next 20 years (2).

Management (whether regulation or other means) to equalize long term withdrawals with replenishment (93).

Reduce withdrawals through land retirement, conservation, or crop shifting, but retain ability of groundwater to serve as a dry year buffer (93).

Increase replenishment through substitute supplies, particularly in wet years (93).

Improve quality of underground supplies (CVPIA) (150).

Potable water supplies to serve Delta uses can be obtained from surface waters or groundwater. Development of groundwater wells should be monitored to ensure wells do not result in overdraft and possible intrusion of saline water into groundwater supplies (89).

General Actions for Conjunctive Use Programs

Improve water management through conjunctive use (144, 8).

Department of Interior will develop conjunctive use facilities to benefit fish and wildlife (CVPIA) (150).

Department of Interior will encourage the development of conjunctive use facilities by contractors for all project purposes (CVPIA) (150).

Options should be added which look at "surface" conjunctive use, such as rice storage, offstream and on-stream storage projects (CVPIA) (150).

Maximize conjunctive use of water through groundwater recharge (124).

Evaluate and encourage conjunctive benefits of domestic water supply projects (125).

Promote conjunctive use of ground and surface waters. Where it is impractical for a supplier to implement a conjunctive use program, suppliers should consider a program with other suppliers (62).

Develop a conjunctive use program to increase Delta water supplies in drought years (102).

Maximize conjunctive use of water through groundwater recharge (99).

State Water Project water may be stored from year to year in State Water Project surface conservation storage facilities or in non-State Water Project surface storage facilities outside a Contractor's service area. There are no limits on groundwater storage of State Water Project water outside a Contractor's service area (127).

Actions for the Management of Groundwater and Conjunctive Use in the Bay Area

Ground Water Storage Capacity of a Portion of the East Bay Plain, Alameda County, California. This study provides an estimate of the storage capacity of the groundwater basin. At some point in the future, it may be necessary to depend on this basin as a source of water (46).

Divert Mokelumne Aqueduct water for in-lieu recharge in North San Joaquin Water Conservation District; extract recharged water from the aquifer during dry years for delivery to EBMUD (112).

When water is available to EBMUD via the Folsom South Canal, pump water to Camanche. Save a like amount of water in Pardee Reservoir for delivery to EBMUD customers (112).

Direct recharged water back to Camanche Reservoir and divert additional Mokelumne River water from Pardee into Mokelumne Aqueducts for delivery to EBMUD during dry years (112).

Divert water from WID and North San Joaquin Water Conservation District for in-lieu recharge in WID plus direct recharge through basins in North San Joaquin Water Conservation District during wet years; exchange WID water, direct recharged water back to Camanche Reservoir and divert additional Mokelumne River water from Pardee into Mokelumne Aqueducts for delivery to EBMUD during dry years (112).

Divert water from Beaver Slough for in-lieu recharge in WID and Stockton East Water District during wet years; exchange WID water, direct recharged water back to Camanche Reservoir and divert additional Mokelumne River water from Pardee into Mokelumne Aqueducts for delivery to EBMUD during dry years (112).

In wet years, deliver American River water via the Folsom South Canal for delivery to the EBMUD service area (112).

Actions for the Storage of Groundwater in the San Joaquin Basin

Property comprising the Kern Fan Element (KFE) of the Kern Water Bank (KWB) currently owned by DWR will be sold or leased (with an option to purchase) on a long-term basis to designated Agricultural Contractors (127).

The recommended alternative considered for the Kern Fan Element in the 1986 Final EIR has the following features: 1) purchase of up to 46,000 acres; 2) construction of a 10 mile canal and three pumping plants with capacities ranging from 200 to 500 cfs; 3) construction of 60 new wells and conversion of 50 existing wells; 4) construction of 1,600 acres of recharge basins; 5) construction of surface facilities to connect the new canal to the recharge basins and to connect the wells to the conveyance facilities; and 6) use of the City of Bakersfield 2,800 acre recharge area, as available (36, 51).

Alternative 1 considered for the Kern Fan Element in the 1986 Final EIR, suggested the purchase of 30,000 acres of land from Tennaco West, Inc., with the same facilities and project benefits as to recommended alternative (36).

Alternative 2 considered for the Kern Fan Element in the 1986 Final EIR, limited land purchase to 3,500 acres which were just adequate to site the groundwater recharge and extraction facilities (36).

Alternative 4 considered for the Kern Fan Element in the 1986 Final EIR, consisted of development of the proposed Los Banos Grandes Reservoir. (36).

Alternative 5 considered for the Kern Fan Element in the 1986 Final EIR, involved continuation of existing land use on the Tenneco West, Inc. property, with no construction of SWP recharge and extraction and no contribution to SWP water supplies (36).

Complete investigation of surface water and ground water interaction in the San Joaquin River so that the quantity, quality and timing of ground-water contributions to river flows can be evaluated (169).

Improve conjunctive use of groundwater and surface water in the San Joaquin basin to enhance water supplies (131).

Accelerate planning studies for additional off-stream storage and conjunctive use programs which benefit protection of salmon habitats in the San Joaquin River and its tributaries (125).

Directly recharge 40,000 acre-feet of Mokelumne Aqueduct water using injection wells in eastern San Joaquin County during wet years; extract 50,000 acre-feet of recharged water from the aquifer during dry years using the same well field as developed for recharge (112).

Divert water from the Mokelumne Aqueduct for recharge using injection wells in the North San Joaquin Water Conservation District, Stockton East Water District, or other areas during wet years; direct recharged water back to Camanche Reservoir and divert additional Mokelumne River water from Pardee into Mokelumne Aqueducts for delivery to EBMUD during dry years (112).

In dry years, deliver treated water (either diverted at Freeport or groundwater) from American River Water Forum interests into the Freeport South pipeline for delivery to the Mokelumne Aqueducts near Stockton (112).

Enter into a new conjunctive use program with local interests for New Melones releases to the south Delta (34).

Recharge North San Joaquin Water Conservation District water via recharge basins in North San Joaquin Water Conservation District, Stockton East Water District, or other areas during wet years; extract recharged water from the aquifer during dry years for delivery to EBMUD (112).

Recharge Mokelumne Aqueduct water via recharge basins in North San Joaquin Water Conservation District, Stockton East Water District, or other areas during wet years; extract recharged water from the aquifer during dry years for delivery to EBMUD (112).

Implement the Stanislaus River Basin and Calaveras River Water Use Program (43, 50).

Study conjunctive use south of Wilton, Element 435 (158, 154).

Study conjunctive use north of Clay, Element 436 (158, 154).

Study conjunctive use southeast of Lodi, Element 547 (158, 154).

Study conjunctive use southwest of Manteca, Element 610 (158, 154).

Study conjunctive use northwest of Volta, Element 749 (158, 154).

Study conjunctive use Oro Loma, Element 843 (158, 154).

Study conjunctive use north of Modesto along Highway 99, Element 638 (158, 154).

Study conjunctive use east of Atwater, Element 734 (158, 154).

Study conjunctive use northeast of Merced, Element 739 (158, 154).

Study conjunctive use northeast of Red Top, Element 784 (158, 154).

Study conjunctive use west of La Vina, Element 853 (158, 154).

Study conjunctive use north of Raison City, Element 927 (158, 154).

Study conjunctive use north of Monmouth and west of Highway 99, Element 1001 (158, 154).

Study conjunctive use south of Kingsburg, Element 1045 (158, 154).

Study conjunctive use Hanford, Element 1057, (158, 154).

Study conjunctive use west of Visalia and east of Highway 99, Element 1094 (158, 154).

Study conjunctive use southwest of Tipton, Element 1168 (158, 154).

Study conjunctive use west of McFarland, Element 1237 (158, 154).

Study conjunctive use southwest of Bakersfield, Element 1333 (158, 154).

Conjunctive use, San Joaquin Valley, 100,000 acre-feet of transferred water (CVPIA) (150).

Conjunctive use, 100,000 acre-feet of new water, San Joaquin Valley (CVPIA) (150).

Stanislaus River Basin and Calaveras River Water Use Program. A study alternative to be considered is the conjunctive use of surface and groundwater resources in the study area (58).

Actions to Store Water in the Sacramento Basin

Deliver American River water to Zone 7 via SWP facilities for groundwater storage when EBMUD is not able to utilize it (112).

Implement the Sacramento Valley Conjunctive Use Program (50).

Study conjunctive use east of Anderson along I-5, Element 21 (158, 154).

Study conjunctive use west of Orland, Element 124 (158,154).

Study conjunctive use west of Orland, Element 125 (158, 154).

Study conjunctive use southwest of Orland along I-5, Element 141 (158, 154).

Study conjunctive use south of Chico along Highway 99, Element 135 (158, 154).

Study conjunctive use near Wheatland, Element 319 (158, 154).

Study conjunctive use east of Sutter Bypass, Element 342 (158, 154).

Study conjunctive use northeast of Rio Linda, Element 381 (158, 154).

Study conjunctive use northwest of Woodland, Element 348 (158, 154).

Study conjunctive use southwest of Davis, Element 443 (158, 154).

Conjunctive use, 100,000 acre-feet of new water, Sacramento Valley (CVPIA) (150).

Conjunctive use, 500,000 acre-feet of new water, Sacramento Valley (CVPIA) (150).

In wet years, take American River water at Freeport for use by American River Water Forum interests (112).

In wet years, make excess American River water available for use by American River Water Forum interests and/or East San Joaquin County parties at Freeport (112).

Actions to Store Water in the South Coast Region

In the South Coast Region, use local ground water banked through an exchange agreement with another agency, as available (39).

In the South Coast Region, use local ground water banked within the service area in previous year, as available (39).

In the South Coast Region, cut back on deliveries for ground water recharge through in-lieu agreement with Metropolitan Water District member agencies (39).

Implement the North Las Posas Basin Project (50).

Implement the Arvin-Edison-MWDSC Conjunctive Use Program (50).

Improvement of Through Delta Conveyance

General Actions to Improve Through Delta Conveyance

Modify Delta levees to increase flow cross sections (CALFED).

Expand existing intakes at the Delta export facilities (CALFED).

Construct expanded export intake/forebay pumping system (CALFED).

Actions for the Construction of Channels and Conveyance Facilities

Construct a cross channel from Hood to Clay to connect to an extended Folsom South Canal (7).

Construct a cross channel from Isleton to Georgiana Slough (7).

Construct a new channel the size of the existing Central Valley Project intake channel to connect the existing Central Valley Project intake channel with Clifton Court Forebay (34).

Construct a new Sacramento River connecting channel near Hood or Isleton to further improve efficiency of water transfer through the Delta (33).

Construct a second cross channel from the Sacramento River to the Central Delta (Hood to Beaver Slough) (13, 11).

Construct a second cross channel to complement the Delta Cross Channel (13, 11).

Construct an earth-lined canal across Roberts Island between Middle River and the San Joaquin River (59).

Construct the Central Delta Canal (31, 59).

Construct the Isleton Cross Channel (31, 59).

Construct the Mathena Landing Canal (59, 31).

Construct the North Stub Canal (59).

Construct the South Stub Canal (59).

Construct the West Delta Canal (59, 31).

Construct Western Delta Overland Agricultural Water Facilities. It may be more economical and efficient to meet agricultural water requirements in the western Delta by an overland water conveyance system that brings good quality water from interior Delta channels rather than by maintaining water quality in the western Delta channels (31).

Implement Dual Transfer System. Under this concept, about half the water being exported by the State Water Project and Central Valley Project would flow through existing channels and half in a new channel. A new channel could be built from Hood to Clifton Court Forebay to transfer all State Water Project flows in all but the high-flow, high-diversion months. East Delta Conveyance Channel

would be met by existing project facilities, which take water directly from existing Delta channels. The East Delta Conveyance Channel would siphon under the Mokelumne River, Disappointment Slough, San Joaquin River, Middle River, and Old River (31).

The transfer of Sacramento River water to the central Delta could be greatly increased by building the New Hope Cross Channel (31, 59).

Construct a full isolated facility on the eastern periphery of the Delta to convey drinking water, agricultural water, and environmental water (13, 7).

Construct a small isolated facility on the eastern periphery of the Delta to convey drinking water (13, 7).

Construct a small Isolated Transfer Facility. Build a screened intake at Hood, north of the Delta, to carry water through an isolated channel large enough to fill either the Delta Mendota or the California Aqueducts (189, 11).

Construct an east Delta conveyance channel, one-third the size of an isolated facility, to connect the Sacramento River to Clifton Court Forebay (59).

Construct an isolated water transfer facility on the western periphery of the Delta (13, 7).

Construct dual facilities to transfer water through the Delta and also on the periphery (13, 8).

Construct the Delta Isolated Facility, a canal originating at the town of Hood in the north of the Delta, to carry water through an isolated channel to the beginning of the California Aqueduct (154).

Construct the Isolated facility, a 43-mile-long isolated canal from Hood on the Sacramento River to Clifton Court Forebay (11, 13, 160).

Actions for Channel Modification to Improve Through Delta Conveyance

Breach eastern Delta islands levees along the through Delta path to create fishery habitat and increase the cross section of flow toward the pumps (189).

Construct channel improvements and barriers in the south Delta to manage flow patterns and isolate Delta agricultural drainage from water project diversion points (13).

Dredge and enlarge West Canal, constructing a setback levee approximately 300 feet into Coney Island (59).

Dredge and set back levee on Middle River (34).

Dredge and set back levee on Old River (34).

Dredge channels of the North and South Forks of the Mokelumne River and enlarge channels by constructing setback levees to increase water supply/reliability (13).

Dredge Middle River between Old River and Highway 4 (34).

Dredge Middle River east of Victoria and Woodward Islands and include levee setbacks as needed (34).

Dredge Old River north of Coney Island and include levee setbacks as needed (34).

Dredge Old River west of Sugar Cut (34).

Dredge Salmon Slough (34).

Dredge Snodgrass Slough from the Delta Cross Channel to New Hope Landing (39).

Dredge south Delta channels to facilitate consolidation of agricultural diversions (59).

Dredge the channels from the Delta Cross Channel to New Hope Landing (39).

Dredge the North Fork Mokelumne River and other channels from the Delta Cross Channel to New Hope Landing (39).

Dredge the South Fork and North Fork Mokelumne River from New Hope Landing to San Joaquin River (39).

Dredge the South Fork Mokelumne River and other channels from the Delta Cross Channel to New Hope Landing (39).

Dredge the South Fork Mokelumne River from New Hope Landing to San Joaquin River, plus a short segment of Snodgrass Slough from the Delta Cross Channel to New Hope Landing, to increase flow capacity and reduce reverse flow in the San Joaquin River and central Delta (39).

Dredge the South Fork Mokelumne River from New Hope Landing to San Joaquin River (39).

Dredge Victoria and North Canals and include levee setbacks as needed (34).

Dredge Woodward and North Victoria Canals and include levee setbacks as needed (34).

Enlarge North and South Forks of Mokelumne River (11).

Enlarge the Mokelumne River and North Fork Mokelumne River from I-5 to the San Joaquin River (39).

Enlarge the proposed Sacramento River Hood-Clay connection (59).

Enlarge the South Fork Mokelumne River through a combination of dredging the existing channel and excavating a new parallel channel from I-5 to the San Joaquin River (39).

Excavate channels parallel to the North Fork Mokelumne River (39).

Georgiana Slough or the North or South Forks of the Mokelumne River could be enlarged (31).

Improve channel configuration by preserving the existing channel configuration along with enhancing certain valuable features. (Examples of those features would include; 1) the protection and development of channel island berms; 2) channel widening or levee setbacks; 3) dredging; and development of waterside recreation destination spots.) (8).

Increase hydraulic capacity of the South Fork Mokelumne River by dredging, levee setbacks, and levee improvements (33).

Modify Delta channels to deliver higher quality water from the Sacramento River and east side streams more directly to points of diversion in the southern Delta (13, 8).

Perform channel dredging along Old River between North Victoria Canal and West Canal (59).

Widen a portion of Middle River to increase hydraulic capacity (59).

Widen eastern Delta channels to convey water (189).

Actions for New Diversion Strategies to Improve Delta Conveyance

Construct siphons on Tom Paine Slough through the existing tide gate embankment (34).

Divert water from the Sacramento River into Snodgrass Slough, using the slough as a connecting channel to the Mokelumne River system (33).

Place a siphon under the San Joaquin River for the Mokelumne River to control water transfer through existing channels (59).

Pump water from Clifton Court Forebay via a pipeline to SDWA agricultural water users (59).

Actions to Modify Existing Infrastructure to Improve Delta Conveyance

Construct the Delta Island Transfer Facility by converting some of the Delta islands into a large storage/conveyance system intertied by siphons to convey water to the export pumps (189).

Convey water to the export pump using a combined system of Delta island storage and an isolated canal (189).

Flood a chain of islands to convey Sacramento River water to the export facilities (7).

Modify Delta islands to store and convey water diverted from the Sacramento River (13, 7).

Modify the Sacramento Deep Water Ship Channel to convey water, construct a downstream storage facility, and develop facilities to convey water from the

storage facility to Clifton Court Forebay (13).

Use Georgiana Slough for conveying water to the export facilities (7).

Use Sacramento Deepwater Channel as a isolated facility with in-Delta reservoirs and siphons (11).

Actions for the Improvement of Through Delta Conveyance with Additional Pumping Plants

Construct pumping plants. A pumping plant could also be constructed near the Delta Cross Channel for the remaining through-Delta alternatives with enlarged North Delta channels. The pumping plant option considered for the East Delta Conveyance Channel would have a capacity of 7,500 cubic feet per second and a lift of about eight feet (31).

In conjunction with an isolated canal, construct a 700 cfs pumping plant in Middle River to convey water up-river (59).

Plans for the Improvement of Through Delta Conveyance

Implement Combination Waterway Control and Central Delta Plan (31).

Implement Roberts Island Canal Plan (43).

Implement Waterway Control Plan (31).

Implement Central Delta Plan (31).

Implement Cross-Delta Transfer Plan (31).

Other Actions for the Improvement of Through Delta Conveyance

Control in-channel aggregation (Demonstration Project), San Joaquin River (99).

Enlarge existing conveyance capacity and develop new conveyance facilities (154).

Remove sediment from San Joaquin River mainstem (99).

The Delta waterways should continue to serve as a primary transportation system moving water to the State's natural and developed water systems (89).

Construction and Improvement of Conveyance Facilities

Inland feeder - Metropolitan Water District of Southern California (51).

San Felipe Extension - Pajaro Valley Water Authority Water Augmentation Program (51).

In-basin water transfer facilities. These facilities would convey water from the San Joaquin River and its tributaries to the Delta-Mendota Canal or the California Aqueduct (131).

Construct and operate a pipeline from the Sacramento River at Freeport, south to the lower Mokelumne River area and/or to the Mokelumne Aqueducts near Stockton (112).

Construct and operate a pipeline connection to/from the Mokelumne Aqueducts and Kellogg Reservoir (112).

Construct and operate a pipeline connection between Mokelumne Aqueduct and the proposed Duck Creek Reservoir (112).

Construct and operate a pipeline connection from near Rancho Seco to near Camanche Reservoir (112).

Construct and operate a regulating reservoir near Camanche and a pipeline to Camanche (112).

Construct and operate a pipeline connection from the Folsom South Canal to Clay Station Reservoir (112).

Construct and operate North-South Conveyance (unlined flat canal) to carry water for recharge. The principal source of water supply for recharge would be American River at Folsom South Canal (112).

Construct and operate Freeport diversion to Folsom South Canal and North-South Conveyance. Water from Sacramento River at Freeport would be used for recharge (112).

Construct and operate pipeline from Folsom South Canal to Mokelumne Aqueducts and unlined flat canal south of the Mokelumne River. The principal source of water supply for recharge would be the Mokelumne River at Pardee Reservoir (112).

Construct and operate the Beaver Slough diversion to North-South Conveyance. The principal source of water supply for recharge would be the Delta at Beaver Slough (112).

Enlarge Farmington Canal if necessary and North-South Conveyance. The principal source of water supply for recharge would be the Stanislaus River at Goodwin (112).

CCWD could provide additional capacity in the Contra Costa Canal downstream of pumping plant no. 4 (87).

Construct and operate the Los Vaqueros Pipeline between the proposed Neroly Blending Facilities and the proposed Los Vaqueros Reservoir (87).

Complete the Folsom South Canal conveyance system from the Lower American River for use on the Folsom South Service Area that was never completed due to the halt in construction of Auburn Dam (160, 59, 154, 50).

Construct and operate a pipeline connection from Folsom South Canal to Mokelumne Aqueducts to deliver American River water to Mokelumne Aqueducts for delivery to EBMUD (112).

Construct and operate a pipeline connection from the Sacramento River at Freeport, east to Folsom South Canal, to deliver CVP water to Mokelumne Aqueducts when Hodge flows are not present (112).

Construct the Mid Valley Canal to provide supplemental water to the east side of the San Joaquin Valley to improve the groundwater overdraft problem (160, 154).

Build the East Side Canal, which would skirt the east side of the Sacramento Valley and ultimately connect up to the California Aqueduct (189).

Implement the South Delta Agreement (154).

Implement the Stanislaus River Basin and Calaveras River Water Use Program, which involves construction of additional diversion and conveyance facilities for delivery of water to Stockton East Water District (SEWD) and Central San Joaquin Water Conservation District (CSJWCD) (58).

Construct a channel from the Sacramento River to the extended Folsom South Canal (FSC) and extend to the Stanislaus River (13).

Construct an isolated facility to divert water from the Sierra streams to the existing Project facilities (13, 8).

Construct and operate a pipeline connection from Folsom South Canal to Mokelumne Aqueducts to deliver American River water to Mokelumne Aqueducts for delivery to EBMUD (112).

Construct and operate a pipeline connection from the Sacramento River at Freeport, east to Folsom South Canal, to deliver CVP water to Mokelumne Aqueducts when Hodge flows are not present (112).

Widen Contra Costa Canal intake channel by 20 feet to obtain a total minimum capacity of about 470 cfs (87).

Enlarge Reach 3 of the Contra Costa Canal by raising the canal lining so that water surface elevation could be increased about one foot (87).

CCWD could provide additional capacity in the Contra Costa Canal downstream of pumping plant no. 4 (87).

Construct a new lined drainage conveyance facility to bypass the Grassland Water District and discharge above or below the Merced River (63).

Implement Westside Sacramento Valley Storage and Conveyance Concept (50).

Construct DMC Westly Wasteway (43).

Implement the Sierra Source Project (50).

Construct Mid-Valley Canal. This canal would transport water from the San Luis Reservoir complex south and east to alleviate ground water overdraft from Merced to Kern County (31. 51, 160, 154).

Changes in Locations of Diversions

Develop facilities to divert State Water Project water from Italian Slough rather than Clifton Court Forebay during critical periods for fisheries (13, 11).

Shift diversion patterns, diversion point, and/or diversion screening to reduce environmental impacts (93).

Obtain approvals for expanded export capacities (CALFED).

Increase diversion capability at Red Bluff Diversion Dam (CALFED).

Divert Sacramento River at a point were salinity is reduced, to be conveyed directly to exporters (8).

Relocate the M&T diversion in Big Chico Creek to the Sacramento River and install fish screens (21).

Divert Sacramento River water at a point where organic load is reduced, to be conveyed directly to exporters (8).

Divert water from the Sierra at a point where pristine quality can be obtained, to be conveyed directly to exporters (8).

Build a five-mile-long intake channel built from Middle River to Clifton Court Forebay. The new channel would be large enough (8,000 cubic feet per second peak capacity) to increase the average daily export capacity by 4,000 cubic feet per second for the State Water Project. Take all State Water Project and Central Valley Project water through a new intake channel, that would have a cross section of about 10,000 square feet and would extend 15 miles to the Stockton Ship Channel in the San Joaquin River. The intake structure would prevent reverse tidal flows and adverse currents in the ship channel (31).

Water quality at Delta drinking water intakes should be maintained or enhanced (89).

Move intakes to regions of higher quality (93).

Move pumps to the Sacramento River, where sufficient bypass flows exist, to avoid entrainment of juvenile salmonids (screen pumps)(Colusa Basin Drain) (179).

Eliminate, relocate, or reduce Sherman and Twitchell Island diversions to improve survival of eggs, larvae, and juveniles of striped bass and white and green sturgeon (Sacramento-San Joaquin Delta) (179).

Consolidate diversion points into one protective diversion point (93).

Implement a program to mitigate fish impacts at the Tracy pumps: relocate and consolidate with other major Delta diversions (CVPIA, Section 3406(b)(4)) (150).

Implement a program to mitigate fish impacts at Contra Costa Water District pumps: relocate the existing diversion site from Rock Slough to the site of the proposed Los Vaqueros Intake on Old River (CVPIA, Section 3406(b)(5)) (150).

Implement a program to mitigate fish impacts at Contra Costa Water District pumps: relocate and consolidate the intake with other major Delta diversions (CVPIA, Section 3406(b)(5)) (150).

Avoid anadromous fish losses at diversions; relocate diversions to less fishery sensitive areas (CVPIA, Section 3406(b)(21)) (150).

Avoid anadromous fish losses at diversions; evaluate other methods of diverting water, e.g. Archimedes screw pumps (CVPIA, Section 3406(b)(21)) (150).

Assist State in restoring the striped bass fishery; relocate and consolidate the Delta intakes with other Delta diversion (CVPIA, Section 3406(b)(18)) (150).

Construct and operate Freeport diversion to Folsom South Canal and North-South Conveyance. Water from Sacramento River at Freeport would be used for recharge (112).

Construct and operate the Beaver Slough diversion to North-South Conveyance. The principal source of water supply for recharge would be the Delta at Beaver Slough (112).

Assist State of California in developing and implementing options requiring physical changes in diversions and export facilities in coordination with efforts to protect and restore native fisheries (CVPIA, Section (3406(b)(18)) (150).

Relocate Contra Costa Canal intake to Clifton Court Forebay (34).

Water Transfers

Coordinate diversion and conveyance of transfers (CALFED).

An annual turn-back pool of water is created and administered by DWR under which water allocated but not needed by a Contractor may be sold to interested contractors and/or DWR at a percentage of the Delta Water Rate, or to non-contractors (127).

Contractors shall have the right to transport non-Project water in State Water Project facilities at the melded State Water Project power rate (127).

Permanent Sales of Entitlement. Agricultural Contractors will make available for permanent transfer (on a willing buyer-willing seller basis) 130,000 AF of annual entitlements to Urban Contractors, or to non-Contractors after a right of first refusal by Urban Contractors (127).

Transfers by unidentified holders of water entitlements, water rights, and water supplies who feel they have excess water to sell on a short-term or long-term basis (from the State Water Project, the Central Valley Project, and any other water resource or project) to unidentified Southern and Central California purveyors who wish to acquire that water (127).

Water Transfer: Statewide Supply Management (51).

Consolidate all water transfer laws by enacting a comprehensive statute governing transfers of water and water rights (183).

Broaden the law governing transfers of water rights (183).

Protect water rights during and after transfer by clarifying and strengthening the rights of transferors and transferees. This would be achieved by: 1) declaring the conservation and transfer of water to be a reasonable and beneficial use by the transferor; 2) requiring that assessment of waste and unreasonable use during the term of the transfer agreement be made by reference of the transferors use; 3) ensuring the full reversion of rights to the transferor at the conclusion of the term of the transfer agreement, and 4) the previous transfer of water will not be considered in determining waste and unreasonable use (183).

Identify and reduce adverse impacts on rural communities and the environment from higher water costs or water transfers (95).

Acquire Butte Creek water rights from willing sellers (21).

Provide legislative, regulatory, and administrative support to those water transfers that improve water efficiency, enhance California's natural environment, and promote the overall well being of rural communities (95).

More fully utilize the existing and expand, where appropriate, the legal and regulatory framework to facilitate voluntary water marketing agreements among agricultural, urban, and environmental interests (124).

Reallocate water supply in State Water Project service areas, for short- or long-term transfers (59).

Create a voluntary expedited transfer system (183).

Create expedited transfer procedures for transfers of conserved and "unutilized" water (183).

Authorize user initiated transfers of water supplied by local water agencies (183).

Authorize the acquisition of water by members and customers of local water agencies (183).

Protect third party interests through a variety of categorical limitations on transfers and compensation of third-party injuries that may occur despite these protections (183).

Authorize transfers to instream users (183).

Authorize future state water banks and regional and local water banks (183).

Evaluate the use of alternative water supplies for riparian diversions from the lower San Joaquin River during April and May (125).

Combine efforts to minimize the adverse effects of urbanization on agricultural productivity with efforts to protect certain water supplies for agricultural communities (95).

Identify and protect strategic farmland from urban development (95).

Study the protection of prime agricultural land and the water required to support these lands (95).

Use the surface and subsurface conjunctive-use model of the San Joaquin Valley (as developed for the Drainage Program) to evaluate water transfers and marketing scenarios (169).

Transfer all or a portion of the water for project purposes or any purpose recognized as beneficial under applicable State law (CVPIA).

Limit all transfers to Project water that would have been consumptively used or irretrievably lost to beneficial use during the year or years of the transfer (138).

Subject the quantity of Project water available from transfers to the amount of water available annually under the Project water service or repayment contracts, water rights settlement or exchange contracts under which the transfer is being made (138).

All transfers of Project water shall be consistent with Federal and State laws, including compliance with all environmental requirements of NEPA, ESA, FWCA, CEQA, and CESA (138).

Include a comprehensive groundwater basin study or evaluation of ground-water supplies to ensure the transfer for all proposals for long-term transfers of Project

water. This will ensure that transfers will have no significant long-term adverse impact on ground water conditions in the transferor's service area or inter-related surface system (138).

Require prior approval by the State Water Resources Control Board for all transfers of Project water outside the water rights permitted place of use for the Project (138).

Ensure that no transfer will be approved if Reclamation, in consultation with the U.S. Fish and Wildlife Service, determines that such transfers would result in significant reduction in quantity or decrease in the quality of water supplies currently used for fish and wildlife purposes, unless Reclamation, in consultation with the Service, determines pursuant to findings setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer (138).

Transferred irrigation water shall be paid for by the water Contractor at the Full Cost Rate applicable to the Water Contractor (148).

Transferred municipal and industrial water shall be paid for by the water Contractor at the M&I water rate applicable to the Water Contractor as determined by Reclamation consistent with the then current Project M&I rate setting policy and applicable reclamation law (148).

Facilitate voluntary transfers of water between suppliers. Water suppliers should work to remove or mitigate any unnecessary barriers to the voluntary transfer, exchange or marketing of conserved water (62).

Consider proposals for water transfers that will benefit both buyer and seller, taking into account measures which resolve third-party and other impacts (62).

Conduct voluntary, market-based temporary and long-term water transfers directly using the Delta (102).

Reallocate New Melones (43).

Obtain Hetch Hetchy supplies (43).

Require that the State Water Resources Control Board adopt adequate and complete water quality standards for the Delta and Bay before new water banking facilities are operated to increase exports. New standards should at least include increased spring outflows, reduced pumping in critical months, appropriate temperature controls, and improved salinity objectives (2).

Local Water Purchase and Transfer: On a temporary basis during drought years, it may be possible to increase the State Water Project supply by buying water from farmers, water districts, and others in the Sacramento Valley (31).

Evaluate the benefits of recycled water transfers that could reduce the demand on the available supply of non-recycled water (144).

Enactment of water marketing to encourage and facilitate voluntary transfers as adopted by the Bay Area Economic Forum (2).

Construct water banking facilities and improve through-Delta transfer of exports by implementing the South Delta Water Management Program, installing additional pumps, building Los Banos Grandes Reservoir, and developing the underground Kern Water Bank (2).

Implement demand management. This option uses a combination of conservation, reclamation, and water transfers. This option proposes high diversions to storage during wet periods and reduced diversions during critical periods and proposes to use storage to buffer diversion fluctuations (189).

Establish water transfer guidelines with Bureau of Reclamation as a broker with associated fee for environmental benefits (CVPIA, Section 3405(a)) (150).

Department of Interior prepares water transfer guidelines with restrictions (CVPIA, Section 3405(a)) (150).

The Department of Interior will not actively participate as a broker, but will prepare guidelines that restrict how water transfers may occur. Department of Interior will retain approval over all transfers (CVPIA, Section 3405(a)) (150).

Department of Interior will actively market available capacity of its facilities for CVP and non-CVP water transfers (CVPIA, Section 3405(a)) (150).

Defer water transfer program to State of California (CVPIA, Section 3405(a)) (150).

Protect against stealing of water currently used for environmental purposes (CVPIA, Section 3405(a)) (150).

Aid in developing groundwater management plans that are conditions of water transfers (CVPIA, Section 3405(a)) (150).

Don't restrict water transfers that could have occurred prior to the Act (CVPIA, Section 3405(a)) (150).

Prepare water transfer guidelines that take into account environmental purposes of the Act, not just marketing purposes (CVPIA, Section 3405(a)) (150).

Prepare water transfer guidelines that minimize third party impacts (CVPIA, Section 3405(a)) (150).

Limit water transfers to within-basin (CVPIA, Section 3405(a)) (150).

Limit water transfers across the Delta (CVPIA, Section 3405(a)) (150).

Implement water transfers outside CVP service area (CVPIA, Section 3405(a)) (150).

Transfer non-CVP water into the CVP system (CVPIA, Section 3405(a)) (150).

Combine the following water transfer elements: 1) limit transfers to within-basin; 2) limit transfers across the Delta; and 3) evaluate transfers outside CVP service area (CVPIA, Section 3405(a)) (150).

Limit water transfer options to one that encourages transfers consistent with the water transfer provisions of the Act (CVPIA, Section 3405(a)) (150).

Require that power required to transfer water to non-CVP water users be supplied by the recipient of the transfer (CVPIA, Section 3405(a)) (150).

Long-Term Planning for Drought Contingencies

General Actions for Long-Term Planning for Drounght Contingencies

Increase water storage capacities at user locations (CALFED).

Establish incentives for long-term planning (CALFED).

Conduct Integrated Resources Planning (CALFED).

Establish incentives for long-term conservation (CALFED).

Develop alternate supplies for drought situations (CALFED).

Actions to Acquire Long-Term Water Supplies for Drought Situations

In the South Coast Region, purchase emergency imported supply through long-term water marketing agreement (39).

In wet years, store Mokelumne River water in enlarged Pardee Reservoir (112).

In wet years, Mokelumne River water would be stored in Devil's Nose Reservoir (112).

In wet years, American River water would be delivered at Folsom South Canal for delivery to the Mokelumne Aqueducts or for storage at Clay Station Reservoir (112).

In wet years, store Mokelumne River water in Kellogg Reservoir (112).

In wet years, store Mokelumne River water at proposed Duck Creek Reservoir (112).

In wet years, store Mokelumne River water in the proposed Middle Bar Reservoir (112).

In dry years, deliver Kellogg water through the Mokelumne Aqueducts for use in the EBMUD and Contra Costa Water District service areas (112).

In dry years, use proposed Duck Creek Reservoir water for EBMUD and San Joaquin County via a connection to the Mokelumne Aqueducts (112).

Use water stored in Pardee Reservoir for Amador County (112).

In dry years, use proposed Middle Bar water for EBMUD, San Joaquin County and Amador County (112).

In dry years, use enlarged Pardee Reservoir water for EBMUD, San Joaquin County, and Amador County (112).

In dry years, Devil's Nose Reservoir would provide water for EBMUD, San Joaquin County and Amador County (112).

In dry years, Clay Station would provide water for EBMUD (112).

Water Resources Data and Information Management

General Actions for Water Recourses Data and Information Management

Develop readily usable and broadly available models and supporting data to evaluate the ecological and hydrologic effects of existing and alternative operations of public and private water facilities and systems in the Sacramento, San Joaquin, and Trinity River watersheds (CVPIA, Section 3406 (g)).

The Secretary shall submit a detailed report to certain committees within the House of Representatives and Senate which describes all significant actions taken by the Secretary pursuant to CVPIA and progress toward achievement of the intent, purposes and provisions of the CVPIA (CVPIA, Section 3408 (f)).

Develop public information programs. Suppliers could provide farmers with information on the potential for on-farm water conservation. Programs should be developed that explain why as well as how improving irrigation management is beneficial (62).

Develop a Wetland and Riparian GIS database for four key regions in California, as follows: 1) the Sacramento Valley; 2) San Francisco Bay/Delta; 3) Northern San Joaquin Valley, and 4) the South Coast (116).

Inventory water resources to describe the quantity and quality of water resources (sources, uses, and discharges) in the District in order to form a basis for evaluating improvements by and within the District, and to provide the reader with an understanding of water available to the District, water used within the District, and water discharged from the District (137).

Water and land managers, universities, agencies, and individuals should emphasize the following study categories and subjects, and support the development of information transfer programs to extend study results to appropriate user groups: drainage management; geohydrology; and economics (169).

Retain the flexibility [in the Interim Renewal Contracts] to reduce water deliveries, as necessary, to protect endangered species, achieve water quality standards, and meet other public trust obligations (140).

To allow for the variability in stream flow objectives, biological data for each CVP controlled river and stream will be developed for corresponding hydrologic and operational conditions as identified in the AFRP after application of reasonableness criteria (180).

The potential for more one-stop shopping for growers, Pest Control Advisors, and other pesticides users should be explored, such as piggybacking the availability of pesticide data between UC Cooperative Extension Farm Advisors and the County Agricultural Commissioner (75).

The SWRCB should set up an electronic California NPS Information Exchange Bulletin Board with timely educational and technical information that would be user friendly. This could be managed by UC Extension or by CSU Fresno on their ATI-Net (75).

A centralized data base should be created and monitoring data used to discover and prioritize problems, act as a trigger, and focus efforts on demonstrated needs (75).

Department of Pesticide Regulation should adapt the 100 percent Pesticide Reporting System for Geographic Information Systems (GIS) processing and these data should be used to prepare watershed summaries and have County Agricultural Commissioners provide feedback from these summaries to UC Cooperative Extension Farm Advisors, PCAs, and affected watershed resource planning groups (75).

The onsite wastewater management district should perform the following activities: 1) determine the extent of water quality degradation and threats to public health from onsite disposal system discharges; 2) develop standards for new and upgraded onsite disposal systems to protect water quality and beneficial uses; 3) implement measures necessary for nitrogen reduction; 4) inspect onsite disposal systems on a regular basis; 5) require regular onsite disposal system maintenance; 6) upgrade malfunctioning systems to meet standards; and 7) implement community disposal projects if they are found to be necessary for water quality protection or more cost-effective than upgrade of individual onsite disposal systems (76).

Exchange information by utilizing information databases, watershed registries, on-line information exchange, and systematic programs that transfer information at the local watershed level. Identify state, federal and local resources information programs. Highlight value of information exchange program for facilitating cooperative "win-win" solutions to wetlands/riparian/land use problems (73).

Agencies will participate in the CEQA process in order to coordinate the gathering of information (73).

The SWRCB will work with the Office of Planning and Research to develop an assessment of the feasibility of developing a system of data retrieval from information gathered through CEQA (73).

Aquatic resources database (131).

Atlas of the San Joaquin River and its tributaries (131).

Create an organization that collects, maintains, and freely distributes state water resources data (95).

Create and maintain a library (clearinghouse) containing all available reports, maps, appropriate models, data, and photographs relating to Delta issues (7).

Curtail diversion during critical fish migration periods (13, 11).

Develop on-line data collection and dissemination networks to provide farmers with immediate meteorological and hydrological information on climate, soil conditions, and crop water needs (95).

Geographic information system (131).

Implement real time operational management to improve migratory fish habitat (13).

Inventory all water diversions in the Yuba River drainage from Englebright Dam to the Feather River (21).

Work with universities to expand/develop watershed information centers (73).

SWRCB will work with the Office of Planning and Research to establish an information management system for information gathered through CEQA and to facilitate retrieval of information relating to wetland, riparian and water quality issues, including mitigation (73).

Shift pumping to times when fishery impact is least (13, 11).

Utilize the mitigation monitoring process to improve staff knowledge of wetland, riparian and water quality issues (73).

SWRCB will develop a mechanism to track information provided in mitigation monitoring, reports, for use in future analyses. Information access should be incorporated into mechanism (73).

SWRCB will convene scientific and technical review panels to assist information gathering and analysis, when appropriate (73).

To support information dissemination, SWRCB will develop staff expertise in information management, e.g., information specialist position (73).

Actions for Real-time Monitoring and Management

Develop and implement a mechanism for real-time water projects operations coordination between the Central Valley Project and State Water Project in the Sacramento River Basin (21).

Install an electronic fish counter on one of the diversion dams on Deer Creek (21).

Real time water quality management network, phase 2 (131).

Real-time water quality management network, phase 1 (131).

Drainage Management--Real Time, San Joaquin River (99).

Real-Time Water Quality Management Network, Phase 1, San Joaquin River (99).

Real-Time Water Quality Management Network, Phase 2, San Joaquin River (99).

Use radio transmitters and listening stations to assess effects of water diversions on migrate salmon smolts (99).

Refine and coordinate existing monitoring programs to (i) better evaluate ecosystem responses to immediate, phased, and long-term water quality and flow standards; (ii) more fully characterize ecosystem processes and properties; and (iii) enhance predictive capabilities of ecosystem models (124, 122).

Develop real time operational management capabilities (11).

Develop fish entrainment monitoring protocol to identity periods of increased susceptibility of fish species (71).

Develop a county by county index of public agencies with ground water related responsibilities in California, indicating level and type of involvement (65).

Develop an inventory of activities to characterize the groundwater activities conducted by public agencies in California (66).

Develop an inventory of databases that contain information on groundwater in California, including how the information is stored and how it may be accessed (67).

SWRCB should adopt a central monitoring data base in California (69).

The SWRCB should establish a SWRCB staff position and a working committee to review, update, and distribute technical information and memoranda regarding alternative systems and new onsite disposal systems technology issues (76).

The SWRCB should support and fund a review and update of policies, literature, and technologies related to cumulative impacts associated with onsite disposal systems (76).

The Department of Pesticide Regulation, in consultation with the SWRCB, RWQCBs, and others should develop a "checklist" to assist site-specific evaluation to identify pesticide management practices appropriate for a given farming operation including background information and a list of contacts for technical assistance (75).

Develop mechanisms to work with state, federal agencies in identifying and addressing information gaps (73).

Establishment of an Institution for Integrated Long-Term Water Management

General Actions for the Establishment of an Institution for Integrated Long-Term Water Management

Establish long-term guarantees for management (CALFED).

Establish institution to implement guarantees (CALFED).

Coordinate groundwater and surface water management (CALFED).

Implement long-term agreements to protect the Bay-Delta region (95).

Provide and encourage opportunities for direct citizen involvement in following the CCMP and making any necessary revisions to it (124).

Serve as a public involvement and education resource for government agencies taking the lead in CCMP management actions (124).

Ensure provisions for a central collection and distribution (clearinghouse) point for communication and coordination of all information concerning CCMP issues and the Estuary (124).

Develop, promote, and support multicultural understanding of and involvement in Estuary issues and the decision-making process for these issues (124).

Work with education groups, interpretive centers, decision-makers, and the general public to build awareness, appreciation, knowledge, and understanding of the Estuary's natural resources and the need to protect them. This would include how these natural resource contribute to and interact with social and economic values (124).

Create an independent planning organization by streamlining existing water planning groups (95).

Develop a coordinated multi-agency management plan for the Lower American River (21).

Make California water planning more equitable and democratic by bringing in groups that have been excluded from the process (95).

Establish a Central Valley Project office of water conservation (CVPIA, Section 3405(e)).

The SWRCB should establish a SWRCB/RWQCB committee to develop a consistent approach to policy interpretation, regulation implementation, and development of standards for onsite disposal systems (76).

The SWRCB, RWQCBs, Department of Fish and Game, California Coastal Commission, Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and other responsible and trustee agencies will

establish formal agreements between agencies on program-level issues in order to streamline the permitting process and better protect resources (73).

The SWRCB/RWQCBs will work actively to minimize regulatory complexity, consistent with complying with environmental mandates and full protection of beneficial uses. Priority should be given to the "streamlining" recommendations presented in other Elements of this TAC's report, e.g., early consultation; formal interagency agreements. For activities that retain or reestablish natural hydrologic functions and beneficial uses, provide regulatory flexibility, expedited review, reduced fees and simplified monitoring and reporting (73).

Adopt water quality certification for those activities that have minor impacts, in order to: 1) facilitate permitting for minor projects; and 2) make RWQCB staff available to participate in WSM planning and other planning efforts and regulated activities that impact resources (73).

Integrate stormwater management considerations into the CEQA process at the local and state levels (82).

Minimize regulatory complexity, consistent with protecting water quality and complying with environmental mandates through improved interagency coordination, more effective use of CEQA, provision of regulatory incentives and technical assistance for applicants, and cooperation with flood control and public works agencies to support appropriate use of self-declared "emergencies" by public agencies (82).

SWRCB should consider issuing a simplified General NPDES Storm Water Permit without extensive water quality monitoring requirements for smaller cities and counties in California (69).

SWRCB/RWQCBs should encourage Caltrans and local transportation agencies to establish standard procedures to ensure adequacy of the storm water pollution prevention plans for all public works projects prior to contract advertising for the project (69).

SWRCB/RWQCBs should encourage Caltrans and local transportation agencies to work with the Soil Conservation Service to develop model specifications for bid items on erosion and sediment control features for use in state and local public works contracts (69).

SWRCB/RWQCBs should work with local, state, and federal agencies to establish minimum storm intensity/duration and frequency standards for sediment control during and after construction (69).

SWRCB/RWQCBs should promote coordination within the existing regulatory framework among state, regional and local agencies regulating pollutant sources impacting air, land, and water (69).

SWRCB/RWQCBs should work with the Federal Highways Administration (FHWA), Caltrans, and local transportation agencies to ensure water quality

protection concern area addressed in FHWA biannual regional audits of highway drainage systems (69).

SWRCB and USEPA should encourage the regional permits between Caltrans Districts and multiple RWQCBs to ensure consistency and cost effectiveness (69).

SWRCB should encourage Caltrans to use strong mechanisms in their contract specifications to ensure protection of beneficial uses and enforcement for non-compliance (69).

RWQCBs and Caltrans should establish procedures to make available to RWQCB staff, current project updates including monthly lists of District STATUS books, and "Status of Going Contracts" calendars (69).

The SWRCB and the Department of Pesticide Regulation should fully implement the existing MOU, accelerate development of their proposed MAA and then establish priorities ultimately resulting in a cost-efficient, multi-agency, multi-disciplinary approach to problem solving. The proposed MAA between the SWRCB and Department of Pesticide Regulation should serve as a road map for solving pesticide-related water quality problems through improved coordination between the Department of Pesticide Regulation, the SWRCB and the RWQCBs, and by implementing voluntary and regulatory control programs (75).

A mechanism should be provided within the proposed MAA between the SWRCB and Department of Pesticide Regulation to establish criteria for determining the success of management practices (75).

The SWRCB, Department of Pesticide Regulation, CDFA, and DFG should form a team to better coordinate existing enforcement programs. This should include improving the current response mechanism with specific steps spelled out (priority based implementation) (75).

The SWRCB, RWQCBs, and Department of Pesticide Regulation should maintain and strengthen the three-tiered approach as described in the NPS Plan and modified in the existing MOU to include increased Department of Pesticide Regulation regulatory action in Tier II of the SWRCB NPS Plan (75).

The SWRCB should enter into memorandums of understanding (MOU) with other State agencies which are involved with onsite disposal systems to clearly designate RWQCBs as the agency responsible for the implementation of policies and guidelines for onsite disposal systems (76).

The SWRCB should coordinate regulatory and enforcement programs with other regulatory agencies to prevent conflicting and duplicative requirements (70).

SWRCB staff will work with the IAC to identify those agencies and private organization willing to become partners in interagency technical assistance teams (82).

SWRCB staff will participate in interagency initiatives that further protection of water quality and that are sponsored by other agencies (82).

SWRCB and RWQCB staff should enhance cooperation with other interest groups, especially government agencies (82).

Complete the Management Agency Agreement (MAA) between DPR and SWRCB (82).

Undertake a review of the value, benefit and feasibility of developing MAAs with the California Department of Fish and Game, the California Board of Forestry/Department of Forestry and Fire Protection, and the California Department of Transportation (82).

SWRCB, RWQCBs, Department of Fish and Game, California Coastal Commission, Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and other responsible and trustee agencies will make sufficient technical staff available to applicants as early in the planning process as requested by the applicant (73).

The State Board, in accepting responsibility for making the voluntary process work, should work with Regional Boards, agricultural industry groups, SCS, UC Cooperative Extension, other resource management agencies, EPA and others to determine how to put these essentials in place in prioritized NPS problem areas (70).

Regional Boards will be requested to consider initiating pilot programs to provide for staff to be involved in CEQA review and local planning processes (82).

Cooperating state agencies and interested parties should work towards developing mechanisms to encourage joint projects between urban water entities and upstream non-point sources which would result in tangible benefits to both parties and overall reductions in pollution. The mechanism should be voluntary and incentive based, with the following program elements: 1) BMPs would be used as the pollution control method, with some type of monitoring to measure progress; 2) projects should not be limited to beneficiaries in one watershed, but should encourage downstream entities that benefit from cleanup in another watershed to participate; 3) RWQCBs, with oversight by the SWRCB, would oversee implementation, with MOUs between regional boards where a project extends beyond a watershed; 4) funds would be allocated on a merit system, with those projects providing the best cost-benefit ratio given priority (75).

Municipal storm water monitoring should include a volunteer citizens' monitoring and reporting program (69).

Encourage Resource Conservation Districts, the USDA Natural Resources Conservation Service, UC Cooperative Extension, County Agricultural Commissioners, and other government "outreach" agencies to actively solicit participants. Pest Control Advisors should be included as a vital link in outreach efforts (75).

The Department of Pesticide Regulation, in cooperation with RWQCBs and County Agricultural Commissioners, should tighten the linkage between outreach efforts, local technical assistance, and incentives available for growers and other pesticide users (75).

RWQCBs and the Department of Pesticide Regulation should assist watershed resource planning groups to establish their water quality improvement goals by providing educational and technical assistance, and RWQCBs should establish objectives with consideration of economic feasibility and the point of diminishing returns (75).

The Department of Pesticide Regulation and RWQCBs should initiate group planning efforts by sending a letter to individuals and organizations in a local water quality problem area describing impacts and causes and request a response of interest within some time period such as 90 days. Copies of the letter should also be sent to the UC Cooperative Extension Farm Advisor, County Agricultural Commissioner, RCD, NRCS, and appropriate pesticide manufacturers and distributors (75).

The Department of Pesticide Regulation should identify and contact local stakeholders and agencies in areas of concern (County Agricultural Commissioners, County Farm Bureaus, grower associations, PCAs, pesticide distributors, NRCS, RCDs, etc.) to make them aware of the potential water quality problem (75).

With the RWQCB, Department of Pesticide Regulation and other agency assistance, or under their own initiative, stakeholders should form a Watershed Planning Group to develop a Local Prevention Plan that includes a management practices checklist and a locally developed table of potential problem pesticides. After a Watershed Planning Group develops a Local Prevention Plan, it should submit the plan to the RWQCB and Department of Pesticide Regulation for comment. Local agencies and the Watershed Planning Group should provide grower outreach and public education about the Local Prevention Plan, and participating growers should develop a written resources management plan or rely on the management practices checklist in the Local Prevention Plan (75).

The RWQCB should identify and contact local stakeholders and local agencies in the affected watersheds to apprise them of the problem, and ask them to meet and develop a plan or modify an existing plan for identifying and implementing appropriate strategies to address the problem (75).

The RWQCB, Department of Pesticide Regulation, local stakeholders and technical assistance agencies should agree on a schedule for submitting a plan to address local water quality problems; copies of the final plan should be sent to the RWQCB and Department of Pesticide Regulation for comment (75).

Regulators will develop written criteria so that applicants will be able to recognize subject areas and types of work that could raise issues or complications

in the permit process so that the applicant will better know that early consultation is advisable. To make this early consultation possible, regulatory agencies will consider: 1) an application fee structure to pay for extra work of regulatory staff; 2) additional resource agency staff to provide this pre-application review; 3) re-prioritizing staff time commitments so that early coordination is possible; 4) including criteria that would assist in identifying subject areas that could raise issues; 5) including all relevant agencies: resource, regulatory, local and transportation agencies; 6) including a pre-application meeting pre-CEQA, utilizing developer funding; and 7) making the process mandatory for the state and invite all others (73).

Agencies will participate in the CEQA process in order to coordinate the gathering of information (73).

The SWRCB, other agencies and the development community will cooperatively develop a technical assistance program for project design which will: 1) include guidelines for designing to avoid wetlands and riparian areas; and 2) promote values (e.g., flood management, amenities) as an incentive to incorporate wetland areas and riparian corridors into site design (73).

The SWRCB, RWQCBs, and other agencies will identify liaison personnel to direct inquiries to appropriate personnel (73).

The SWRCB should cooperate with and promote efforts of agricultural industry groups, technical assistance agencies, education and research institutions, etc. in developing information/education opportunities (70).

During renewal of existing Long Term Contracts, state clearly the responsibilities of both Department of Interior and water contractors (CVPIA, Section 3404(c)) (150).

During renewal of existing Long Term Contracts, permit or encourage participants in voluntary programs (e.g. land retirement, conjunctive use, etc.) (CVPIA, Section 3404(c))(150).

During renewal of existing Long Term Contracts, contracts should state clearly that Department of Interior and water contractors have responsibility for achieving compliance with CVPIA (CVPIA, Section 3404(c)) (150).

During renewal of existing Long Term Contracts, contracts shall be renewed in a manner to avoid litigation (CVPIA, Section 3404(c)) (150).

During renewal of existing Long Term Contracts, consider active management for contracting rather than assuming that contract deliveries would be tailored to environmental needs (CVPIA, Section 3404(c)) (150).

During renewal of existing Long Term Contracts, consider no contract renewal (CVPIA, Section 3404(c)) (150).

During renewal of existing Long Term Contracts, consider contract renewal for periods shorter than 25 years (CVPIA, Section 3404(c)) (150).

Contract for additional storage and delivery of Project and non-Project water. This would allow the use of available storage and conveyance capacity in non-project facilities to be utilized for project purposes, such as water banking, conveyance of transferred water, etc. to benefit fish and wildlife, as well as other project purposes (CVPIA, Section 3408(c)) (150).

Contract for additional storage and delivery of Project water (CVPIA, Section 3408(c)) (150).

Contract for additional storage and delivery of non-Project water (CVPIA, Section 3408(c)) (150).

Establishment of Export Capacity Market

General Actions for the Establishment of an Export Capacity Market

Establish procedures for allocation of export capacity (CALFED).

Establish institution to allocate export capacity (CALFED).

Coordinate water transfers and export capacity (CALFED).

Market export capacity for environmental benefits (CALFED).

Facilitate voluntary water-marketing agreements (99).

Renegotiate expiring federal contracts to shorten the term and revise the pricing structure (2).

Implement feasible changes to the water market, including redefining water rights; establish environmental standards; provide compensation; and the focus of regulators (3).

Integration of Land-Use and Water Supply Planning

General Actions for the Integration of Land-Use and Water Supply Planning

In the course of preparing the Stanislaus River Basin and Calaveras River Water User Program Environmental Impact Statement and in consultation with the State of California, affected counties, and other interests, evaluate and determine existing and anticipated future basin needs in the Stanislaus River Basin. During the evaluation the Secretary shall investigate alternative storage, release, and delivery regimes, including but not limited to conjunctive use operations, conservation strategies, exchange arrangements, and the use of base and channel maintenance flows (CVPIA, Section 3406 (c)(2)).

Integrate land-use and water-supply planning for new development in urban areas (95).

Introduce State urban growth management legislation, set statewide goals for land use planning to protect and restore wetland habitats and stream environment zones (103).

Require all new urban developments to demonstrate a secure, permanent supply of water before permits are approved (95).

In the course of preparing the Stanislaus River Basin and Calaveras River Water Use Program EIS, evaluate and determine existing and anticipate future needs in the Stanislaus River basin (21).

Evaluate water demand and recognize that, during the interim period, demand would be virtually the same in the service area as during the study period. There is clearly demand for even far more water than the amount currently under contract (140).

Enter into contracts with any Federal agency, California water user or water agency, State agency, or private non-profit organization for the exchange, impoundment, storage, and delivery of Central Valley Project and non-project water for domestic, municipal, industrial, fish and wildlife, and any other beneficial purposes (CVPIA, Section 3408 (c)).

Enter into agreements to allow project contracting entities to use project facilities, where such facilities are not otherwise committed or required to fulfill project purposed or other Federal obligations, for supplying carry-over storage of irrigation and other water for drought protection, multiple-benefit credit-storage operations, and other purposes (CVPIA, Section 3408 (d)).

University of California, Agricultural Extension Service, assist landowners in developing management practices and informing growers of optimum strategies for soil fertility and stabilization (68).

US Agricultural Stabilization and Conservation Service provide grants and low interest loans to farmers for improvements which retain valuable topsoil in cultivated areas (68).

Implement 1992 laws which require water suppliers delivering more than 50,000 acre-feet of water per year to prepare water management plans focused upon water conservation measures, improved irrigation efficiency, and environmental enhancement (68).

Use grant funds from Regional Water Boards for education and demonstration projects to effectively reduce pollution problems from confined animal facilities (68).

Multiple use of agricultural lands for commercial agriculture, wildlife habitat, and, if appropriate, recreational use, should be supported, and funding to offset management costs pursued from all possible sources. Public agencies shall provide funds to replace lost tax base when land is removed from private ownership (89).

Reduce water demand (93).

To help meet EPA proposed water quality standards, EPA should work with the State of California's water users to develop a full range of strategies to improve water resource management. Some strategies may include: water conservation, waste-water reclamation, conjunctive use and other groundwater programs, water transfers, growth management and land retirement (1985).

Prepare an evaluation of the water supply needs of the Stanislaus River, the San Joaquin River, the Delta, and San Francisco Bay (173).

Implement the Water Acquisition Program pursuant to PL 102-575 Title 34 (CVPIA) (99).

Investigate Level I and Level II water supply alternatives to evaluate future water management options that may potentially expand the supply (144).

Address the conclusions of the Amador County, Mountain Counties Water Management Studies, which identified water related problems and issues, evaluated present and future water use and available water supplies, and analyzed the adequacy of the supplies to meet future water needs (37).

Develop a plan for the long term uses of groundwater and surface water resources in the Stanislaus River Basin and the Calaveras River Basin (58).

Extend the Tehama-Colusa Canal service area--storage and delivery facilities constructed to provided service to the added service area (CVPIA, Section 3412)) (150).

Extend the Tehama-Colusa Canal service area--do not construct facilities. This is just an administrative act expanding the service area (CVPIA, Section 3412)) (150).

Develop water supply projects to meet the municipal and industrial demands in south San Joaquin County (58).

Implementation of the CVPIA should consider cumulative impacts resulting from urbanization, such as degradation of habitats by encroachment and development (154).

Installation and Operation Flow Barriers

General Actions for the Installation of Flow Barriers

Install weirs to control salinity intrusion (CALFED).

Construct flow restriction in the downstream part of the system (11).

Construct control structures. The control structures would be diversion dams, with facilities for commercial and recreational navigation and fish passage and gates to pass flood flows (31).

Construct tidal flow controllers. Tidal flow controllers would be similar to the control structures, except a permanent opening would be left in mid-channel to allow boats and fish to pass, and the gates would be opened to let the incoming tide pass and closed to inhibit the ebb tide (31).

Construct or Modify Barriers to Improve Water Quality

Modify tidal pumping into Clifton Court Forebay to reduce drawdown in south Delta channels (33).

In conjunction with deepening of the Baldwin and Stockton Deep water Ship Channels, construct a submerged sill in Carquinez Strait to block off the heavier saline water (59).

Modify or raise the Delta Cross Channel gates to prevent Sacramento River floodwaters from flowing into the Mokelumne River system (33).

Add three more gates to the Delta Cross Channel gate structure (39).

Construct a partial tide gate structure in the Sacramento River (33, 39).

Construct a partial tide gate structure in Steamboat Slough (33, 39).

Construct a partial tide gate structure in Threemile Slough (33, 39).

Construct a barrier to physically separate saline water of the San Francisco Bay system from fresh water of the Delta (33).

Construct a flow control structure on Middle River near the confluence with Victoria Canal, North Canal and Trapper Slough (59, 34).

Construct a flow control structure on Grant Line Canal at the confluence with Old River (59, 39).

Construct a flow control structure on Old River east of the Delta-Mendota Canal (59, 39).

Construct a barrier in the Sacramento River between Chipps Island and Mallard Island (59).

Construct dikes across Spoonhill Creek (59).

Construct a barrier across Carquinez Strait between Crockett and Benicia (59).

Construct a barrier across San Pablo Strait between San Francisco Bay and San Pablo Bay (59).

Construct barriers to convert part of Suisun Bay and the upper reaches of the Carquinez Straits to fresh water embayments (13).

Install operable barriers to better manage flow in the Delta channels (13, 7).

Construct channel improvements and barriers in the south Delta to manage flow patterns and isolate Delta agricultural drainage from water project diversion points (13).

Manage flow patterns in the Delta channels so as to redirect Delta island drainage and San Joaquin Valley drainage away from Project facilities (13).

Implement dissolved oxygen and circulation solutions. This project includes increase flows on the San Joaquin River and the installation and operation of flow barriers to control dissolved oxygen levels in the San Jaoquin River near Stockton (131).

Construct Bay barriers. Barriers in the San Francisco Bay system would physically separate saline water of the bay from the fresh water of the Delta and have been proposed and studied many times since the late 1800s. The numerous barrier sites studied have ranged from a few miles upstream of the Golden Gate up to Chipps Island (31).

Construct a submerged sill in Carquinez Strait: The proposed sill would extend from the bottom of Carquinez Strait to about 50 feet below the water surface at mean lower-low water (31).

Implement the South Delta Barrier Program (99).

Install barriers in Delta channels to redirect flow of drainage discharges (8).

Conduct regular monitoring of water quality in Georgiana Slough following experimental closure to determine if water quality thresholds have been exceeded and take steps to eliminate water quality problems (41).

The San Joaquin River Dissolved Oxygen Objective can be implemented by installing flow barriers in the delta to increase flow in the river past Stockton (80).

Evaluate the advisability of closing Georgiana Slough by using either a physical barrier or an acoustical barrier (80).

Management of Agricultural Drainage

General Actions to Manage Bacterial Contamination

Use only material that has been thoroughly composted to kill all pathogenic bacteria (74).

Improve irrigation system performance and management to reduce discharge and bacterial movement, including irrigation scheduling, changes in irrigation methods, and changes in irrigation systems including tailwater reuse (74).

Immediately incorporate waste into the soil to begin natural breakdown and reduce potential for contact between the waste and irrigation water (74).

Haze birds from wetlands to prevent bacterial pollution by birds (74).

Drain wetlands to prevent them from becoming an attractive nuisance to bacteria (74).

Reduce or eliminate wetland discharges to reduce all bacteria in the discharges (74).

Capture tailwater from lands receiving water to intercept and reuse it, reducing bacterial discharge (74).

Capture wetland return flows in ponds and/or reuse, reducing bacterial discharge (74).

Use chlorine or other disinfectant to kill bacteria in all water releases (74).

Use top soil as a natural filter for bacteria through groundwater recharge (74).

Provide an alternative water supply to domestic uses to reduce bacterial distribution (74).

Provide incentives to farmers to produce crops that are not eaten raw or regulate marketing of crops from lands using human or animal waste (74).

Provide alternate or enhanced recreational opportunities in other waterbodies as stream becomes a treatment process for bacteria (74).

Prohibit all use of animal or human waste on irrigated land (74).

General Actions to Control Contamination from Livestock Operations

The goal of maintaining or improving the quality of water should be included in ranch management plans for livestock operations (81).

Ranch water quality goals need to be linked to water quality problems (impaired beneficial uses) identified by the RWQCBs for the local basin or sub-basin (81).

Protect water quality through grazing management practices such as prescribed grazing and use exclusion (81).

Plan, construct and utilize structural range improvements to facilitate proper livestock grazing use, thereby enhancing or maintaining water quality. These

improvements may include grade stabilization, spring development, landslide treatments, streambank protection and the construction and use of access roads, fencing, pipelines, ponds, sediment basins, stock trails or waterways, troughs and tanks, wells, and stream crossings (81).

Livestock management practices such as animal health, feeding and salting should be done in a manner to protect water quality (81).

Take into consideration the location and/or design of livestock feeding, working, holding, chemical storage and shipping facilities in proper proximity for water quality protection (81).

Separate clean and contaminated water using terraces within confined animal facilities (70).

Prevent run-on from entering and runoff from exiting storage areas at confined animal facilities by covering storage piles and routing uncontaminated runoff around storage areas (70).

Separate clean and contaminated water using dikes within confined animal facilities (70).

Separate clean and contaminated water using diversion channels across slopes within confined animal facilities (70).

Protect heavily used areas of confined animal facilities, and control sediment, by establishing vegetative cover, by surfacing with suitable materials, or by installing needed structures (70).

Separate clean and contaminated water within confined animal facilities using roof runoff management (70).

At confined animal facilities, size liquid waste containment structures in accordance with the latest recommended design criteria for the local area (70).

Improve liquid waste collection and storage at confined animal facilities using waste storage ponds (impoundments made by excavation or earth fill for temporary storage of animal or other agricultural wastes) (70).

Improve liquid waste collection and storage at confined animal facilities using waste storage structures (fabricated structures for temporary storage of animal wastes or other organic agricultural wastes) (70).

Improve liquid waste collection and storage at confined animal facilities using waste treatment lagoons ponds (impoundments made by excavation or earth fill for biological treatment of animal or other agricultural wastes) (70).

Improve solid waste collection and storage at confined animal facilities by using and maintaining a solids separator (70).

Prevent leachate from forming and entering groundwater at confined animal facilities by armoring storage area surfaces (70).

Provide effective liquid waste disposal and irrigation at confined animal facilities through the application of manure and/or runoff water to agricultural land (70).

Provide effective liquid waste disposal and irrigation at confined animal facilities through the use of agricultural wastes or other wastes on land in an environmentally acceptable manner while maintaining or improving soil and plant resources (70).

Provide effective liquid waste disposal and irrigation at confined animal facilities through the use of sediment basins to collect and store debris and sediment (70).

Provide effective liquid waste disposal and irrigation at confined animal facilities through the use of water and sediment control basins (70).

Provide effective liquid waste disposal and irrigation at confined animal facilities through the construction of wetlands designed and managed to treat agricultural wastewater (70).

Provide effective solid waste application and disposal at confined animal facilities by using agricultural wastes or other wastes on land in an environmentally acceptable manner while maintaining or improving soil and plant resources (70).

Provide effective solid waste application and disposal at confined animal facilities through the application of manure and/or runoff water to agricultural land (70).

Provide effective solid waste application and disposal at confined animal facilities by using composting facilities (70).

Provide effective solid waste application and disposal at confined animal facilities by contracting for the frequent removal of stored solids for reuse in some secondary market, e.g., mixing with green waste (70).

Provide effective solid waste application and disposal at confined animal facilities by recycling solids onsite, e.g., using as bedding material (70).

Confined animal facilities operators should protect existing environmental resources by excluding livestock from riparian areas (70).

Confined animal facilities operators should protect existing environmental resources by using filter strips as buffers between heavy use areas and runoff channels (70).

Confined animal facilities operators should protect existing environmental resources by controlling animal diet to reduce solids output (70).

Confined animal facilities operators should protect existing environmental resources by designing new facilities and purchasing sufficient land to handle the waste load from the projected herd size (70).

Confined animal facilities operators should protect existing environmental resources by scheduling land disposal operations in a timely manner to avoid conflicting weather conditions (70).

Confined animal facilities operators should protect existing environmental resources by disposing of dead animals in an environmentally sensitive and lawful manner (70).

Confined animal facilities operators should maximize the benefit/cost ratio of waste management practices by using manure solids as a value added product such as bedding or reselling as compost or compost additive (70).

Confined animal facilities operators should maximize the benefit/cost ratio of waste management practices by conducting soil and forage sampling prior to manure application, for rate adjustment (70).

Confined animal facilities operators should maximize the benefit/cost ratio of waste management practices by balancing solids application rates with crop or pasture needs (70).

Confined animal facilities operators should maximize the benefit/cost ratio of waste management practices by balancing liquid application rates with crop or pasture needs (70).

All confined animal facilities should conduct informal individual NPS assessments and address identified problems expeditiously, before regulatory involvement is necessary (70).

General Actions to Control Contaminants from Fertilizer and Nutrient Application

Implement water exchanges between a party that is adversely affected by its nutrient laden water and a party that can utilize nutrient laden water and has high quality water available for exchange (74).

Use tailwater recovery systems to collect surface irrigation runoff for reuse, preventing nutrients from leaving the site. (74).

Use strips of vegetation bordering or separating irrigated land from waterways, to capture nutrients adsorbed to soil particles or organic material mobilized by water runoff. (74).

Line pond and conveyance facilities for nutrient laden water such as captured irrigation tailwater from agriculture/nursery land. (74).

Review ways to improve timing, amount, placement, and method of agricultural nutrient application (74).

Treat domestic water supply to minimize nutrients. (74).

Reuse captured nutrient laden water for agricultural uses, adjusting commercial fertilization accordingly (74).

In order to ensure that fertilizer is being handled in a manner that is as safe as possible, all storage facilities should be adequately maintained and protected from the weather (77).

Secondary containment as well as impervious pads should be utilized for the storage of liquid fertilizers (77).

Impervious pads and berms should be used whenever possible for the storage of both dry fertilizers and organics to contain leaching and runoff (77).

The maintenance of fertilizer storage facilities should meet both government and California Fertilizer Association standards (77).

In the event of a fertilizer spill, the spilled material should be isolated, contained, and cleaned up as soon as possible (77).

Maintain proper calibration of fertilizer application equipment (77).

Fertilizers should be selected that provide adequate but not excessive levels of soil nutrients provided throughout the growing season (77).

The application of fertilizers should be by a method designed to deliver it to the area of maximum crop plant uptake. The idea is to position and concentrate the fertilizer near the majority of the crop roots, instead of leaving it spread out over 100 percent of the field. This practice would include either placing fertilizer on the seed row and watering it in, knifing fertilizer near the seed row, or broadcasting fertilizer and then listing it up into the bed (77).

When applying fertilizers, applicators should take special care to be sure that application valves are shut off during turns and that equipment be properly calibrated to insure even applications at proper agronomic rates. Growers should be sure to maintain ongoing safety and environmental education training programs (77).

All wells connected to an irrigation system equipped for fertigation should be protected against fertilizer flowing back into the well. Vacuum relief valves, low pressure drains, air gaps, interlocking circuits between the irrigation pump and the injection pump, and check valves installed between the pump discharge pipe and injection point can all be used in some combination to prevent backflow (77).

Provide ongoing education and awareness programs to all levels of fertilizer handlers and users (77).

The applications of nutrients should be limited to that amount necessary to meet projected crop needs at the time when the crop needs it most, as nutrient leaching and runoff could increase rapidly when the amount applied exceeds that required to attain maximum or near maximum yield (77).

The SWRCB should advocate greater nutrient management education programs. Farming organizations such as the Farm Bureau, California Alliance of Family Farmers, UC Cooperative Extension, Fertilizer Research & Education Program, Agricultural Commissioners, Soil Conservation Service as well as Grower Shipper Association, California Fertilizer Association and other industry based entities should participate in the planning and implementation of educational programs (77).

Each crop's nutrient needs should be managed separately, and when possible, soil analysis should be conducted on at least an annual basis. Growers should be aware of the nutrients already available in the soil before deciding how much to add (77).

The nitrogen content in irrigation water should be taken into consideration when fertilizer decisions are being made. By analyzing well water and determining its nitrogen content, a grower can conserve on the amount of nitrogen that is added to their fields, thereby increasing the efficiency of their fertilizer applications (77).

As the amount of nutrient that a plant takes up is relative to the size of the plants, when possible small amounts of fertilizer concentrated around the root zone should be applied for the early growth stages of crops. Decisions on late season fertilizer application can be aided by plant tissue testing (77).

When a crop is grown during the rainy season, or when making irrigation decisions, a major portion of the plants' nutrient needs should not be applied within 24 hours of when a large rainstorm is expected, or before a large irrigation, so as not to wash recently applied fertilizer out of the root zone (77).

The application of irrigation water should be timed to minimize water and nitrogen loss by leaching and runoff. However, providing adequate irrigation water for the evaporation and transpiration losses must be integrated with other requirements, such as leaching of excess salts (77).

When nitrogen or other nitrogen based amendments are applied repeatedly at excessive levels to the same field, it is possible for nitrogen levels to build-up to excessive amounts. In such cases there needs to be ongoing soil testing and plant tissue analysis programs to make sure that the crops total nitrogen requirement is not exceeded (77).

When organic materials are added to soil, consideration must be given to the amount of nitrogen applied as well as the release times (77).

General Actions to Control Erosion and the Movement and Discharge of Sediment

Use wide, shallow, low velocity channels with erosion-resistant vegetation for disposal of runoff from fields, diversions and terraces (74).

Flatten steep slopes to reduce erosive velocities in furrows and establish a uniform slope to improve irrigation water distribution (74).

Plant permanent cover crops between tree rows in orchards to minimize soil erosion, reduce water runoff, soil compaction and downstream deposition (74).

Plant temporary cover crops between tree rows in orchards to minimize soil erosion, reduce water runoff, soil compaction and downstream deposition (74).

Cut back stream irrigation to reduce furrow erosion and distribute water more uniformly (74).

Use sprinklers for pre-season irrigation to reduce water use, runoff and soil erosion (74).

Place portable check dams at intervals in agricultural tailwater ditches to prevent sediment from being carried into return ditches and streams (74).

Use filter strips to remove sediment from irrigation runoff by filtration, infiltration and reduced water velocities (74, 75).

Install sediment basins at the end of tailwater ditches to minimize sediment from agricultural surface runoff deposited to receiving waters (74).

Mechanically remove accumulated agricultural sediment for use or disposal at an alternate site (74).

Use water to flush settled or suspended agricultural sediment (hydrologic flushing) (74).

Use sediment basins, depressions to capture and retain water borne sediments with attached pesticides, to hold water until sedimentation has occurred, then release water (74).

Capture sediments in basins and re-incorporate into the fields from which they came (74).

Reduce soil erosion due to rainfall and irrigation to acceptable soil loss tolerances using conservation practices such as crop rotations, crop residue management, cover crops, and conservation tillage (75).

Further studies should be made on the advisability of reducing total dissolved solids and turbidity levels in the Sacramento River by eliminating or reducing spills from the Colusa and Sutter Basin Drains (64).

General Actions to Manage Contaminants form Pesticide, Herbicide, and Insecticide Use

Change application practices for insecticides, herbicides, and fertilizers (172).

Change residence times of insecticides, herbicides, and fertilizers (172).

Develop a comprehensive strategy to reduce pesticides coming into the Estuary (124).

To counter the adverse effects of larval development, EPA needs to address and subsequently raise the standards on the amount of pesticides and herbicides that would be allowed to be sprayed or otherwise placed on agricultural lands within the Suisun Marsh and Delta region (174).

Reduce pesticide loads to the San Francisco Estuary (99).

Change residence times of insecticides, herbicides, and fertilizers (99).

Change application practices for insecticides, herbicides, and fertilizers (99).

Determine susceptibility of fish to various metals and pesticides (99).

Expansion of BIOS Project to address aquatic toxicity from priority insecticides in SF Bay/Delta (99).

Evaluate each water district's water uses, crop patterns, and agricultural drainage; and examine the pesticides in use and the species that may be affected (2008).

In cooperation with water districts, begin development of integrated pest management (IPM) plans to reduce the amount of pesticides applied to CVP lands and conveyance facilities (2008).

Improve irrigation efficiency through irrigation scheduling and changes in irrigation methods to reduce excessive surface runoff and deep percolation losses, thereby reducing the mobilization potential of pesticides (74).

Use grassy filter strips leading to runoff site of tailwater, reducing water velocity and allowing settling of sediments with attached pesticides (74).

Use constructed or natural vegetative/aquatic areas where surface runoff can be applied to trap pesticides (74).

Implement an integrated pest management program to use less pesticides (74).

Use lower toxicity pesticides (74).

Use insect parasites and predators for pest control (74).

Use pathogens for pest control (74).

Implement a selective crop rotation program and changes in planting and harvest dates to interrupt the life cycle of pests (74, 75).

Apply pesticides with ground equipment as opposed to aerial application (74).

Consider mechanical control alternatives to pesticide use, especially for weed problems. These should be selected so as to not aggravate any soil erosion problem, increase the amount of sediment in runoff, or be considered as adversely impacting air quality in PM_{10} non-attainment areas (75).

When pesticide applications are necessary, compare suitable available pesticides considering their persistence, toxicity, runoff and leaching potentials, and volatility characteristics based on combined available data from sources such as the Department of Pesticide Regulation, a Pest Control Advisor, UC Cooperative Extension Farm Advisor, County Agricultural Commissioner, Resource Conservation District, and the USDA Natural Resources Conservation Service (75).

Select pesticide application methods that would minimize volatilization losses and potential runoff losses (75).

Frequently recalibrate spray equipment during the crop season and recheck pesticide application rate in the field when changing to a new rate (75).

Before using a water supply, check that the anti-backflow devices on hoses and pipes used for filling tank mixes and between water source and irrigation system

are working properly and comply with CCR Chapter 3, Pest Control Operations, Article 1, Section 6610 on Backflow Prevention (75).

Perform pesticide tank mixing operations at least 100 feet away from well heads and sink holes (75).

Consider changing to an earlier or delayed crop planting date to reduce damaging levels of pest infestation and the related need for pesticide use, if feasible (75).

Consider expanded use of IPM strategies including maximizing use of biological pest controls involving beneficial insects and use of pheromones (75).

Base decisions to use pesticides on monitoring and establishing an economic threshold for each pest problem on the growing or planned crop. Perform in-field evaluations for each pest problem (75).

Compare the leaching potential and runoff potential of the soils in each field to be treated to the solubility, leaching potential and runoff potential of the pesticides identified locally as being of concern in the region, watershed, or subwatershed based on data combined from sources such as the Department of Pesticide Regulation, a Pest Control Advisor, Resource Conservation District, and the USDA Natural Resources Conservation Service. When the combination of soil and pesticide characteristics result in a high or medium pesticide loss potential rating for a field, select the lowest risk, suitable pesticide (75).

Minimize use of pesticides identified locally as being of concern in the region, watershed, or subwatershed (75).

Consider using lower pesticide application rates than those called for on the label if the grower's Pest Control Advisor, UC Cooperative Extension or County Agricultural Commissioner indicates that such lower rates will provide adequate control without adversely affecting pest resistance management efforts. Take into account chemical formulation and weather conditions and if pest resistance management will be compromised (75).

If appropriate, use surface or subsurface bank application of pesticides such as treating only the top of the seedbed to reduce total amount applied (75).

Prior to each application, consider weather conditions such as fog and predicted rain, scheduled irrigation, and pesticide characteristics for their potential driving forces of pesticide offsite movement by leaching and runoff (75).

Properly rinse spray equipment and use closed mixing systems in compliance with CCR Chapter 3, Subchapter 3, Article 2, Section 6746 to facilitate a "triple rinse" of the empty pesticide container in compliance with CCR Chapter 3, Subchapter 3, Article 4, Section 6684 and safely apply the rinseate to the target field or dispose of safely (75).

Use returnable, refillable DOT liquid pesticide containers when available. Properly dispose of pesticide containers in compliance with CCR Chapter 3, Subchapter 2, Article 4, Sections 6670 - 6686 (75).

Store pesticides in their original containers and in a secure and dry site. Properly dispose of unneeded pesticides in compliance with CCR Chapter 3, Subchapter 2, Article 4, Sections 6670 - 6686 (75).

Install irrigation tailwater return systems to reduce off-site runoff and allow more time for pesticide decay, if technically and economically feasible (75).

Minimize use of dry wells for disposing of runoff and drainage water containing pesticides (75).

Improvements should be made in the coordination of and opportunities for collection of unneeded pesticides from growers (75).

The Department of Pesticide Regulation and County Agricultural Commissioners should facilitate collection of unneeded pesticides from growers and other users (75).

The Department of Pesticide Regulation should accept written resource management plans and marked checklists of selected management practices voluntarily developed by growers and other pesticide users through RCDs, NRCS, UC Cooperative Extension, County Agricultural Commissioners and others as evidence of voluntary compliance (75).

State and/or local agencies or organizations should provide technical assistance and incentives to growers who voluntarily choose to develop a written resource management plan. This plan may include grower-selected management practices or the plan checklist of selected practices for those fields and areas being treated with pesticides identified locally as being of possible concern (75).

University of California as well as private sector application equipment research and development should be encouraged to develop new application spray systems to reduce pesticide dosage (75).

Increase support for basic and applied research to understand biological systems and interactions, establishing pest population economic thresholds, developing safer pest control methods, offsite movement control techniques, improved cropping systems, and more efficient application techniques (75).

Manufacturers should be approached to perform analyses to support monitoring in areas where their pesticides are believed of concern (75).

Implement an expanded, cooperative, educational outreach program involving the Department of Pesticide Regulation, SWRCB, RWQCBs, Pest Control Advisors, Resource Conservation Districts, Irrigation Districts, UC Cooperative Extension, County Agricultural Commissioners, and other appropriate entities. Outreach efforts should be based on regional watershed or subwatershed boundaries (75).

Encourage Resource Conservation Districts, the USDA Natural Resources Conservation Service, UC Cooperative Extension, County Agricultural Commissioners, and other government "outreach" agencies to actively solicit

participants. Pest Control Advisors should be included as a vital link in outreach efforts (75).

Outreach staffs should be trained and equipped in a variety of fields so they can deliver the same information regarding soil erosion, irrigation, pesticides, etc. (75).

SWRCB, RWQCBs, and the Department of Pesticide Regulation staffs should make presentations at regularly scheduled meetings of target groups and commodity boards on existing problems and proposed prevention methods. Presentations should include general information and a specific list of problems which need to be addressed (75).

Existing non-government grower outreach programs that promote reduced use of pesticides, such as the Biologically Integrated Orchard Systems (BIOS) project in Merced County, Lighthouse Farm Network meetings and field days, and the Campbell Soup Company IPM Program, should be strengthened (75).

Growers should be helped to identify and explore suitable alternative pesticide management practices (BMPs, etc.) and weigh the costs and benefits of each. This effort should involve UC Cooperative Extension Farm Advisors in training outreach staff on local conditions and the importance of presenting more than one alternative. Growers should be helped to demonstrate and implement suitable pest management alternatives (75).

Support efforts to draw more participants to informational meetings and seminars conducted by pesticide manufacturers and distributors (75).

The Department of Pesticide Regulation should incorporate groundwater, runoff, and leaching questions on pesticide applicators' licensing tests and in their continuing education courses (75).

The Department of Pesticide Regulation should identify and contact local stakeholders and agencies in areas of concern (County Agricultural Commissioners, County Farm Bureaus, grower associations, PCAs, pesticide distributors, NRCS, RCDs, etc.) to make them aware of the potential water quality problem (75).

With the RWQCB, Department of Pesticide Regulation and other agency assistance, or under their own initiative, stakeholders should form a Watershed Planning Group to develop a Local Prevention Plan that includes a management practices checklist and a locally developed table of potential problem pesticides. After a Watershed Planning Group develops a Local Prevention Plan, it should submit the plan to the RWQCB and Department of Pesticide Regulation for comment. Local agencies and the Watershed Planning Group should provide grower outreach and public education about the Local Prevention Plan, and participating growers should develop a written resources management plan or rely on the management practices checklist in the Local Prevention Plan (75).

Assistance should be provided to growers who voluntarily develop a written resource management plan. This plan should include pesticide management practices or use a locally developed checklist of selected practices for those fields and areas being treated with pesticides identified locally as being of concern in the region, watershed, or subwatershed. The Department of Pesticide Regulation, RCDs, NRCS, UC Cooperative Extension Farm Advisors, County Agricultural Commissioners, private consultants, and others who are qualified should provide this assistance (75).

The Department of Pesticide Regulation, in cooperation with RWQCBs and County Agricultural Commissioners, should tighten the linkage between outreach efforts, local technical assistance, and incentives available for growers and other pesticide users (75).

The Department of Pesticide Regulation should identify and contact local stakeholders and agencies in areas of concern (County Agricultural Commissioners, County Farm Bureaus, grower associations, PCAs, pesticide distributors, NRCS, RCDs, etc.) to make them aware of the potential water quality problem (75).

Promote disposal of growers' unneeded pesticides (82).

Department of Pesticide Regulation (DPR) should put restrictions on the use of certain agricultural chemicals to address water quality problems (68).

Develop and implement program to minimize or eliminate pesticide discharge to major surface waters receiving irrigation return flows from nonpoint sources (60).

Implement investigations to identify pesticide sources in major surface waters when pesticides are detected more than once (60).

Require that discharges implement management practices that result in full compliance of water quality objectives related to pesticide discharges (60).

Review pesticide control program at public hearings to determine monitoring results and specific pesticides of concern, to determine changes or trends in pesticide use that may impact water quality, to consider approval of proposed management practices for controlling pesticide discharge, to establish a review schedule for management practices of specific pesticides, and to consider enforcement action (60).

Analyses for tissue residue levels of molinate and thiobencarb as wells as other chemicals should be added to the suite of analyses for samples collected in areas likely to be affected by the discharge of rice field water (64).

The regional board should continue to work with the California Department of Food and Agricultural to refine and implement water management practices that reduce pesticide discharges. Such work should include encouragement of irrigation return flow reuse and chemical-by-chemical refinement of field level best management practices (64).

Avoid complete drainage of rice field water or high tail-water flows after the water holding period (WHP), as this results in high net discharges of molinate residues (64).

Use moderate WHPs with water flow restrictions rather than longer WHPs. This will allow greater grower flexibility (64).

Encourage increased use of preflood molinate by reducing the required WHP. Preflood WHPs do not warrant an 8 day WHP (64).

Avoid shallow water in rice fields since this encourages weed growth and competition and increases reliance on herbicides to achieve adequate weed control (64).

Avoid drainage after the WHP since this encourages the growth of highly competitive weeds (64).

Promote the expansion of farm tail-water recycling through a three part program which would: 1) develop and test new types of farm recycling-impoundment systems including the use of set aside acreage; 2) perform limited water quality monitoring of new system prototypes to determine the minimum effective recirculation or impoundment period necessary to reduce rice herbicide levels to meet water quality guidelines recommended by DHS and DFG; and 3) further promote the development and use of such systems by restricting a greater percentage of tiobencarb use to recycling systems (64).

Promote expansion of drain water recirculation within Sacramento Valley reclamation districts or other large rice growing areas. Steps which could be taken include: 1) identification of districts which have the potential or present means to recirculate and impound drain water; 2) investigate cost-effective return flow management strategies which would increase the residence time of rice field tail-water; and 3) investigate the potential sources of funding to provide the necessary capital to construct recirculation facilities (64).

<u>General Actions to Control and Reduce Salt Accumulation and Salinity in Agricultural Drainage</u>

Manage instream salt discharges by discharging only during high flow periods (93).

Salt export enhancement--wet year water delivery manipulations (99).

Reduce nutrients applied to the soil that increase soil salinity (74).

Where groundwater is highly saline utilize surface water in lieu of groundwater for irrigation (74).

Exchange water (higher in salinity) for higher quality water in drainage problem areas (74).

Institute a regional system of drainage collector lines to collect and transport poor quality water to a salt sink (74).

Use on-farm collector drains to collect irrigation water for reuse with or without blending or dispose of in a salt sink (74).

Collect agricultural drainage water and tailwater for application to salt tolerant crops or for other uses such as oil/geothermal field injection (74).

Apply agricultural drainage water to salt tolerant trees and plants (agroforestry) (74).

Dispose of irrigation water salts to the ocean directly through a constructed conduit or indirectly through releases into existing water bodies flowing into the ocean (74).

Allow evaporation of drainage water and subsequent disposal of solid salts in landfills (74).

Inject drainage water into deep subsurface aquifers to dispose of salts (74).

Identify markets for salt and trace elements in drainage effluent depending on purity levels attained (74).

On-farm evaporation ponds can be used to dispose of drainage water, with storage or disposal of salt (74).

Use waters on a regional basis depending on salt load, use, and local conditions, with final disposal to a salt sink (74).

Reuse drainage water to irrigate salt tolerant crops and other salt tolerant trees and halophytes, to reduce drainage volume prior to ultimate disposal (74, 71).

Reduce salt load in imported water by creating barriers which block the flow of saline water or import water during high spring flows and lower salt concentration (74).

Line reservoirs and conveyance facilities or install pipelines to reduce seepage and the resulting salt load in groundwater (74).

Implement source control programs that reduce the discharge of salts to the San Joaquin River resulting from the application of irrigation water (71).

Develop ponds for storage and evaporation of drainage water after reuse on salt-tolerant plants to facilitate segregation and containment of salts (71).

Re-evaluate alternatives for completing a drain to discharge salts from agricultural drainage outside of the San Joaquin Valley (71).

Perform field tests of tolerance of agricultural crops, halphytes, and salt-tolerant trees to constituents in drainage water (169).

Investigate the propagation and marketing of salt-tolerant crops that use saline drainage water as an irrigation supply (169).

Demonstrate the use of an accelerated evaporation system, using a sprinkler system similar to the University of Texas at El Paso's experimental system and

the use of temperature-gradient solar pond system for salt disposal and generation of electricity (169).

Maintain a long-term view of the use of land and water resources and also give attention to drainage and salinity impacts on productivity of immediate and downslope lands (62).

General Actions to Control and Reduce Selenium and Other Trace Elements

Reinforce existing programs and develop new incentives where necessary to reduce selenium levels in agricultural drainage water (124).

Improve the management and control of agricultural sources of toxic substances (124).

Reinforce existing programs and develop new incentives where necessary to reduce selenium levels in agricultural drainage water (122).

Disposal of agricultural drainage in the San Joaquin Valley by implement innovative treatment processes for selenium removal: including microalgal - bacterial, microbial volatization, percolation ponds, ferrous hydroxide, iron fillings (harza process), anaerobic bacterial (binnic process), and reverse osmosis (135).

Reduce selenium levels in agricultural drainage (99).

Retire agricultural lands in which underlying shallow ground water contains elevated levels of selenium and the soils are difficult to drain (2008).

Gain a better understanding, and quantification of: a) selenium loading from the Grasslands Basin, and b) in-transit selenium losses (143).

Exchange water with different contaminants, e.g., exchange a wetland supply containing moderate selenium for an agricultural supply containing moderate boron (74).

Cease irrigation of lands contributing trace elements through transfer of water rights, purchase, or other deed restrictions (74).

Where trace elements are present in water supply, change to an uncontaminated source (74).

Use evaporation ponds to isolate trace elements and keep them from receiving waters (74).

Discharge drainage high in trace elements to the San Joaquin River or the Salton Sea (74).

Trace elements would be removed from drainage water and marketed, possibly in conjunction with salt or other components (74).

Use treatment technologies to remove or detoxify trace elements in drainage water (74).

Prepare a study plan to reevaluate selenium and boron objectives (60).

Impose waste discharge requirements to control agricultural subsurface drainage discharges containing toxic trace elements (60).

With financial and technical assistance from State and Federal agencies, water districts should lead in developing plans to identify lands in drainage problem areas in which the combined characteristics of high concentrations of selenium and difficult-to-drain soils would make these lands candidates for retirement from irrigation (169).

Investigate solubility controls for specific elements of concern (selenium, arsenic, molybdenum, and uranium) in various geologic conditions. Specifically, expand studies to include basin and lacustrine environments that dominate the Tulare Basin where drain water disposal options are severely limited and conditions are highly varied (169).

Develop a cost-effective treatment method to remove selenium from drainage water (169).

Determine the capacity of geochemically reduced Sierra Nevada sediments to remove selenium (169).

General Actions to Reduce the Effects of Agricultural Drainage by Implementing Best Management Practices

Implement agricultural water manage, emphasizing the Efficient Water Management Practices developed as a result of the Agricultural Water Supplies Efficient Water Management Practices Act of 1990 (44).

Improve agricultural practices that reduce introduction of pollutants into the Estuary (124).

Develop and implement irrigation best management practices to reduce the volume of wastewater (2008).

Growers should perform a self-assessment to determine their risks in contributing to nonpoint source pollution and to develop management plans to minimize their contribution to water degradation (77).

The Regional Board may define agricultural Best Management Practices and require their use to implement water quality objectives (63).

The Regional Board should consider adoption of agricultural best management practices in the San Joaquin River Basin Plan to assist in achieving the recommended water quality objectives (63).

Regulatory or Policy Changes designed to Ameliorate Problems related to Agricultural Drainage

Grant deference to the San Joaquin Valley Drainage Program Report (CVPIA, Section 3405(e)(3)).

Governmental, agricultural, public, and environmental interests should work together to develop a mechanism to ensure implementation of Efficient Agricultural Water Management Practices (122).

To allow the declining species in the Delta a better chance to recover, EPA should take steps to further up-grade habitat that has become degraded as a result of contaminants that have entered, or continue to enter, the water ways. To accomplish this, EPA should set more protective water quality standards to limit the amount of toxic agricultural runoff that enters the surrounding water ways. Further, adequately timed pulse flows to dilute and subsequently counter the adverse impacts of contaminated agricultural water could be established to provide further protection to the species of concern in the Bay/Delta (1985).

Programs to regulate agricultural drainage in the Delta should be accompanied with education programs, be implemented over time, and should, where needed, provide financial assistance such as grants and interest-free loans to ensure compliance. Any regulation of Delta agricultural discharges must recognize that a) dischargers must be permitted to discharge back to the channels any dissolved solid loads that were derived from the channels in irrigation diversions and seepage inflows, and b) any net addition of dissolved carbon compounds must be compared to the addition of such compounds that would occur with any other land use option that would provide equal protection of the land and channel configuration and would consume no more water (89).

Survey tributaries for toxic materials, follow with cleanup projects as needed; expand enforcement of dumping ordinance (Colusa Basin Drain) (179).

Use regulatory incentives and/or disincentives such as tiered water pricing, tradable discharge permits, effluent limitations, regulatory mandates and enforcement (74).

RWQCBs should accept, as evidence of compliance under Tier II of the SWRCB NPS plan, written resource management plans and marked checklists of selected agricultural users through RCDs, NRCS, UC Cooperative Extension, County Agricultural Commissioners, and others (75).

The local management plan should be developed for the purpose of meeting specific water quality improvement goals. Growers should be considered in compliance if they are implementing management practices in accordance with a recommended management plan. Plans should be periodically reviewed to assure that implementation will in fact result in meeting specified water quality improvement goals. Growers operating according to the recommended management plan should not be subject to additional regulation or requirements (75).

Growers should be aware of current EPA standards in the use of wastes and should maintain appropriate records of amounts of wastes used and ongoing testing, in case of future problems (77).

The SWRCB should coordinate implementation strategies/approaches recommended by all agriculture TACs (70).

The SWRCB should cooperate with and promote efforts of agricultural industry groups, technical assistance agencies, education and research institutions, etc. in developing information/education opportunities (70).

In order to achieve water quality objectives, the Regional Board can establish waste discharge requirements on specific agricultural dischargers. If the Regional Board decides that it is necessary to implement waste discharge requirements, the parties responsible would need to be determined. Because of the numerous farming operations in the San Joaquin River drainage study area which discharge directly to waters of the State, the Regional Board may place joint requirements on all of those individuals (63).

Form a San Joaquin Valley-wide Drainage District to do the following: 1) help member farming operations develop and implement environmentally acceptable solutions to their drainage problems; 2) assist farm operators in complying with waste discharge requirements needed to protect beneficial uses of the State's waters; and 3) ensure an equitable distribution of costs between upgradient and downgradient areas in achieving water quality objectives (63).

The SWRCB should consider using its waste, unreasonable use and unreasonable method of use authority to regulate inefficient agricultural water use practices in drainage problem areas (63).

Implement institutional measures to help reduce drainage problems (71).

Continue or initiate the activities identified by the San Joaquin Valley Drainage Program (71).

Control agricultural drainage discharges by including upslope irrigators and water facility operators in the Basin Plan program (60).

Implement a program to reconsider site-specific water quality objectives for Mud Slough, Salt Slough, San Joaquin River, and Sack Dam to Vernalis (60).

Impose a submittal and approval program for agricultural subsurface drainage operation plans (60).

Each water district should, by 1992, set objectives in their operation plans that would reduce deep percolation by the amounts stated in the Final Report of the San Joaquin Valley Drainage Program. State and Federal agencies should help local water districts accomplish their water conservation improvement plans (169).

The State of California and the U.S. Department of the Interior should jointly consider the finding, forecasts, and plans of the Drainage Program with respect to drainage problems, and should look for opportunities to encourage amelioration and resolution of these problems. This should be achieved through ongoing operations, planning, construction, and, if considered necessary, new legislation,

promulgation of rules an regulations, and appropriate language in contracts and administrative reviews (169).

Local initiatives need to be recognized, supported, and enhanced by coordinated, comprehensive Federal and State actions undertaken to manage drainage problems (169).

Policy actions by agencies supplying, distributing, and regulating irrigation water and managing drainage facilities are needed now and in the future (169).

Both the Federal and State governments should explore ways of providing a portion of the financing needed to implement irrigator source-control actions and to invigorate existing programs (169).

Within the Federal water service area, the Department of the Interior should lead in planning for the regional drainage-water treatment and disposal needs that will arise from management and reuse of drainage water within local water districts (169).

General Actions Involving Crop Choice and Irrigation Practices

Disposal of agricultural drainage in the San Joaquin Valley by onfarm irrigation system improvements (135).

Modify Delta cropping patterns so as to reduce island drainage (13).

Reduce the quantity of agricultural drainage in the San Joaquin Valley through improved water application techniques (13, 8).

Implement agricultural drainage reduction program (39).

Reduce San Joaquin River agricultural drainage (59).

Reduce pollutant loads from agricultural practices (99).

Improve management and control of agricultural sources of toxic substances (99).

Improve on-farm water conservation and source control on all irrigated lands and reduce deep percolation on lands having drainage problems by 0.35 acre feet per acre per year (on the average) (143).

Change from less efficient method to more efficient method of irrigation, e.g., from surface irrigation to sprinklers, or improve system design (74).

Improve irrigation efficiency to practical levels (optimal water application without reduction in yield, quality or excessive cost) through: irrigation scheduling: irrigation system design, operation, maintenance; appropriate method; irrigation system/field monitoring; and/or improved technical skills of irrigators (74).

Allocate water by crop, field, season, etc. to increase irrigation efficiency and reduce the potential for deep percolation and runoff (74).

Adjust cropping patterns with drought tolerant crops to increase irrigation efficiency, reduce deep percolation and runoff (74).

Breed more water efficient crop varieties to increase irrigation efficiency, reduce deep percolation and runoff (74).

Use irrigation scheduling techniques to match applied water with crop water needs, e.g., ET models, evaporation pans, soil moisture sensors (74).

Grow cover crops during fallow periods in vegetable farmland to reduce soil nitrate available for leaching by rainfall and subsequent irrigations (74, 77).

Practice surge irrigation to improve water distribution and efficiency, reduce drainage and deep percolation and minimize runoff (74).

Use storage facilities or intermittent subsurface retention of irrigation water with timed releases to rivers and streams when flows provide for sufficient in-stream dilution (74).

Use drip irrigation systems in agricultural applications for more efficient water distribution (74).

Provide more intensive management of current farm operations, e.g., automating systems, changing set times, tillage practices affecting infiltration, etc. (74).

Use polymers (polyacrylamide) in agricultural practices to increase water infiltration rates (74).

Use gated pipes in agricultural irrigation for improved irrigation uniformity and reduced tailwater discharge (74).

Shorten agricultural furrow length to improve water distribution and reduce tailwater discharge (74).

Use agricultural tailwater return systems to route surface runoff back to its inflow point, improving water distribution and minimizing deep percolation (74).

Improve irrigation system performance and management through irrigation scheduling, changes in irrigation methods and systems including tailwater reuse, educational programs, low interest loans, mobile lab programs and water pricing (74).

Recycle return flows and subsurface drainage water for blending with irrigation water (74).

Any irrigation scheduling technique must recognize crop-specific soil moisture requirements (77).

The mix of on-site practices appropriate to address a pollution problem should be the product of a Farm Plan. Through the farm planning process, operator selected practices are chosen which: 1) fit into the land user's operation and budget; 2) meet the objectives of the Watershed Plan and Basin Plan; 3) addresses identified on-site problems; 4) can be implemented on a schedule which can be

accommodated to the land user's business needs; and 5) improves instead of aggravating other resource concerns (70).

Change Delta agriculture to earlier crops to reduce irrigation demand (8).

Apply water conservation measures to control agricultural subsurface drainage (60).

The State of California should expand and intensify its program of on-farm water conservation to focus especially on demonstrating alternative source control measures on drainage-problem lands (169).

Seek resolution to local detrimental effects to others from changes in tailwater flow or water quality (62).

General Actions for the Disposal or Treatment of Agricultural Drainage

Collect Delta drainage and treat for organics (13, 8).

Collect Delta drainage and treat for salt (13, 8).

Develop facilities to treat sub-surface agricultural drainage from the San Joaquin Valley prior to discharging it to the Delta (13, 8).

Construct drainage facilities with safe discharge point or treatment (93).

Disposal of agricultural drainage in the San Joaquin Valley by thermal evaporation (cogeneration) (135).

Disposal of agricultural drainage in the San Joaquin Valley by evaporation ponds (135).

Disposal of agricultural drainage in the San Joaquin Valley by discharge to shallow ground-water aquifer depressions (135).

Disposal of agricultural drainage in the San Joaquin Valley by ground-water pumping (135).

Disposal of agricultural drainage in the San Joaquin Valley by deep well injection (135).

Disposal of agricultural drainage in the San Joaquin Valley by injection into saline ground water underlying the zone of freshwater (135).

Disposal of agricultural drainage in the San Joaquin Valley in landfill facilities (class ii) (135).

Disposal of agricultural drainage in the San Joaquin Valley by evaporation in solar energy ponds (135).

Disposal of agricultural drainage in the San Joaquin Valley by onfarm tile drainage systems (135).

Disposal of agricultural drainage in the San Joaquin Valley by tilewater collection facilities (135).

Disposal of agricultural drainage in the San Joaquin Valley by tilewater recycling facilities (135).

Disposal of agricultural drainage in the San Joaquin Valley by water marketing (135).

Disposal of agricultural drainage in the San Joaquin Valley through eastside reuse (135).

Disposal of agricultural drainage in the San Joaquin Valley by seepage reduction (135).

Disposal of agricultural drainage in the San Joaquin Valley by treatment and disposal (135).

Treat agricultural drainage in the Delta(43).

Agricultural demonstration projects in the Delta (99).

Use well-designed irrigation systems and good irrigation water management to minimize leaching losses from deep percolation. Consider use of drip, sprinkler, flexible pipe, and surge systems (75).

Separate surface and tile agricultural drainage in the San Joaquin River basin (63).

Implement program requiring that evaporation ponds meet minimum design standards, have waste discharge requirements, and be part of a regional plan to control agricultural subsurface drainage (60).

Develop measures to renovate or close aged or toxic evaporation ponds (169).

Within the State Water Project service area, the State of California should lead in planning for the regional drainage-water treatment and disposal needs that will arise from management and reuse of drainage water within local water districts (169).

Site Specific Actions to Ameliorate Drainage Problems in the Grasslands Sub-Area

Implement an interim operational measures to remove unusable agricultural drainage water from wetland water supply conveyance channels to the Grasslands area (143).

In the Grasslands Subarea, use the Grassland Task Force water districts as the nucleus of a regional drainage entity to coordinate and jointly manage subarea-wide drainage problems (143, 169).

In the Grasslands Subarea, provide the facilities required to intercept contaminated subsurface drainage water now being discharged into open channels within the grasslands wildlife habitat, and convey these to the San Luis Drain (143, 169).

In the Grasslands Subarea, renovate and extend the San Luis Drain, bypassing 20,000 acre-feet of contaminated drainage water around wetlands (similar to the Zahm-Sansoni-Nelson plan) (169).

In the Grasslands Subarea, improve on-farm water conservation and source control on all irrigated lands and reduce deep percolation on lands having drainage problems 0.35 acre-feet per acre per year (on the average) as soon as possible (169).

In the Grasslands Subarea, intensify and complete local demonstration projects on source control and treatment of drainage water (169).

In the Grasslands Subarea, the U.S. Bureau of Reclamation should actively seek authority to reallocate 74,000 acre-feet of water annual from the Central Valley Project to replace drainage water used on wetlands before 1985 (169).

In the Grasslands Subarea, provide 20,000 acre-feet of water to the Merced River each October to attract migrating fish from drainage water discharging to the San Joaquin River (169).

In the Grasslands Subarea, practice source control on 93,600 acres of irrigated land (169).

In the Grasslands Subarea, reuse drainage water to irrigate 2,600 acres of salt-tolerant trees and halophytes (169).

In the Grasslands Subarea, operate 120 acres of evaporation ponds and 130 acres of solar ponds (169).

In the Grasslands Subarea, pump the semiconfined aquifer under about 10,000 acres of land (169).

In the Grasslands Subarea, retire 3,000 acres of irrigated agricultural lands (169).

In the Grasslands Subarea, discharge about 102,000 acre-feet of drainage water to wetlands and/or the San Joaquin River, while meeting river water quality standards (169).

In the Grasslands Subarea, provide on a firm basis, 129,000 acre-feet per year of adequate-quality water form existing sloughs, ditches, and canals that serve the area. This volume of water could be obtained by: providing up to about 74,000 acre-feet from the CVP through the Delta-Mendota Canal for diversion into wetland area; delivering an average of 45,000 acre-feet of tailwater, operational spills, and local runoff of adequate quality form water-quality Zone C to Salt Slough for use in wetlands; and delivering up to 10,000 acre-feet of tailwater, operational spills, and local runoff from water-quality Zone B to Los Banos Creek and vicinity (169).

Modify the existing beneficial uses for the water bodies in the Grassland watershed, including Mud Slough (north), Salt Slough, and the wetland supply channels. The existing beneficial uses are likely not appropriate because of the

difference in geology and hydrology of the watersheds that provide the primary source of flow for the San Joaquin River, as compared to the watershed that drains into Mud Slough (north) and Salt Slough and other Grassland channels. In addition, the current uses of Mud Slough (north) and Salt Slough have developed from discharges to the sloughs, mainly agricultural and wetland drainage and are, therefore, effluent-dominated water bodies. The proposed beneficial uses would reflect these historic uses and site specific conditions (61).

Site Specific Actions to Ameliorate Drainage Problems in the Kern Subarea

In the Kern Subarea, Kern County Water Agency and local water districts should form a drainage management entity responsible for coordination and joint management of subarea-wide drainage problems (169).

In the Kern Subarea, improve on-farm water conservation and source control on all irrigated lands and reduce deep percolation on lands having drainage problems by 0.35 acre-feet per acre per year (on the average) as soon as possible (169).

In the Kern Subarea, initiate intensive studies of the ground-water resources of the old Buena Vista and Kern lakebeds (169).

In the Kern Subarea, practice source control on 105,900 acres of irrigated land (169).

In the Kern Subarea, reuse drainage water to irrigate 9,700 acres of salt-tolerant trees and halophytes (169).

In the Kern Subarea, operate 1,100 acres of evaporation ponds and 1,100 acres of solar ponds (169).

Site Specific Actions to Ameliorate Drainage Problems in the Northern Subarea

In the Northern Subarea, investigate, in detail, measures that may be needed if stricter salt standards are established for the San Joaquin River/Delta (169).

In the Northern Subarea, a measure that should be studied further in relation to more restrictive water quality objectives in the San Joaquin River is pumping shallow groundwater into the river during high flows to create underground storage space for percolating agricultural drainage water. A variation of this option would be to intercept shallow, salty groundwater moving to the river and pump it into surface-water storage ponds used as wildlife habitat. The ponds could be drained to the river during high flows and refilled during low-flow periods (169).

Site Specific Actions to Ameliorate Drainage Problems in the Tulare Subarea

In the Tulare Subarea, develop a formal association of water districts (built around the existing Tulare Lake Drainage District) for coordinated and joint management of subarea-wide drainage problems (169).

In the Tulare Subarea, improve on-farm water conservation and source control on all irrigated lands and reduce deep percolation on lands having drainage problems by 0.2 acre-feet per acre per year (on the average) as soon as possible (169).

In the Tulare Subarea, accelerate the pace and decrease the number of field demonstrations of source control measures and evaporation pond experiments, including especially the reuse of water on trees and modification of pond systems and their management to make ponds bird-free or bird-safe (169).

In the Tulare Subarea, demonstrate in the field the use of alternative safe-water habitat near an existing evaporation pond containing elevated levels of selenium (169).

In the Tulare Subarea, design and develop a 5,000-acre demonstration unit of closely-spaced, low-volume wells in the semiconfined aquifer for planned drawdown of the high water table in the area of good quality ground water in the Kings River Delta (169).

Evaluate, in detail, the aerial and vertical variability of ground-water quality in the Tulare Subarea and in all water-quality zones considered for the ground-water management component of the San Joaquin Drainage Management Plan (169).

In the Tulare Subarea, practice source control on 316,700 acres of irrigated land (169).

In the Tulare Subarea, reuse drainage water to irrigate 24,500 acres of salt-tolerant trees and halophytes (169).

In the Tulare Subarea, operate 3,000 acres of evaporation ponds (169).

In the Tulare Subarea, pump the semiconfined aquifer under about 40,000 acres of land (169).

Site Specific Actions to Ameliorate Drainage Problems in the Westlands Subarea

In the Westlands Subarea, improve on-farm water conservation and source control on all irrigated lands and reduce deep percolation on lands having drainage problems by 0.35 acre-feet per acre per year (on the average) as soon as possible (169).

In the Westlands Subarea, accelerate the pace and increase the number of field demonstrations of source control measures and drainage water treatment research, including especially reuse of drainage water on trees and removal of selenium from drainage water (169).

In the Westlands Subarea, develop guidelines for retirement of irrigated lands that have high selenium concentrations in shallow ground water and that are difficult to drain (169).

In the Westlands Subarea, design and develop a 5,000-acre demonstration unit of closely-spaced, low-volume wells in the semiconfined aquifer for planned drawdown of the high water table (169).

In the Westlands Subarea, practice source control on 159,000 acres of irrigated land (169).

In the Westlands Subarea, reuse drainage water to irrigate about 12,100 acres of salt-tolerant trees and halophytes (169).

In the Westlands Subarea, operate 400 acres of evaporation ponds and about 1,500 acres of solar ponds (169).

In the Westlands Subarea, pump the semiconfined aquifer under about 19,000 acres of land (169).

Actions for the Funding of Urban and Industrial Discharge Programs

The SWRCB should provide funding and support for educational and technical onsite disposal systems programs serving government regulators, the private sector, and the general public (76).

The SWRCB should provide grant funding to local agencies for the development of onsite disposal systems management programs, and direct the RWQCBs to prepare a priority list of problem areas requiring special onsite system management (76).

The SWRCB should make State Revolving Fund monies available for individual system upgrades through programs administered by local agencies (76).

Funding must be provided on a long-term basis for ongoing monitoring of surface and groundwater quality, and for management practice research (70).

The State should vigorously address adjustment of the federal formulas for allocation of federal monies for water quality problems, currently inequitable for California (75).

The SWRCB should support and fund a review and update of policies, literature, and technologies related to cumulative impacts associated with onsite disposal systems (76).

The SWRCB should provide specific funding for RWQCBs staff to address onsite disposal system issues (76).

The SWRCB should make grants or loans available for the evaluation and planning of septage disposal facilities (76).

The SWRCB should support through grants or other programs, the development of improved onsite disposal systems inspection and maintenance practices, including, but not limited to: 1) a uniform standard-of-practice for the routing inspection of onsite disposal systems during real estate transfers or refinancing of properties; 2) inspection and reporting protocols and certification for septic tank pumpers; 3) innovative local programs which promote greater attention to inspection and maintenance of onsite disposal systems by the system users and the onsite disposal systems industry, in general; and 4) data management systems to

provide better tracking of inspection, maintenance, and performance information for onsite disposal systems (76).

The SWRCB, RWQCB, and other agencies will provide adequate funding for their staffs to comment on CEQA documents (73).

The SWRCB should seek state and federal legislation to provide mechanisms to fund the additional resources required to implement the NPS program at the state and local level (70).

Since participation of the RWQCBs is essential for the success of the NPS program, and their ability to participate will be limited if funding is not provided, high priority should be given to funding additional RWQCB staff and other necessary resources (70).

Division staff will seek funding to: a) continue the ambient toxicity testing programs of the SWRCB and RWQCBs, and follow up with toxicant identification evaluation; b) continue the State Mussel Watch and Toxic Substances Monitoring programs, which measure concentrations of agricultural and other pollutants in fish and shellfish; and c) continue to participate in the Department of Fish and Game's biological assessment protocol development efforts (82).

Provide funding and support from the SWRCB for technical assistance for alternative onsite disposal system technologies (82).

The SWRCB should provide funding and support for educational and technical onsite disposal systems programs serving government regulators, the private sector, and the general public (76).

Actions for Education and Public Outreach on Agricultural Drainage Issues

Different models for delivering information should be searched out, i.e., grower to grower networks, grower to PCA/PCA to grower networks, UC Cooperative Extension to grower/grower to UC Cooperative Extension networks, and processor/grower collaboratives. Develop better forums for exchange of information between conventional growers and sustainable agriculture and organic growers (75).

Trust relationships should be developed between outreach staff and growers by having outreach staff spend more time and effort on site providing helpful and practical technical assistance (75).

The U.S. Department of the Interior and the State of California should jointly develop a technical assistance program to ameliorate the drainage problem, by providing water districts with geohydrological and economic information and analytical techniques useful in investigating local areas for possible conjunctive surface-a and ground-water use, land retirement, on-farm drainage, source control, and reuse. Technical assistance is also need in environmental impact assessment, toxicity assessment, and habitat restoration (169).

Develop effective training programs for personnel involved in drainage management (169).

Actions for the Monitoring of Agricultural Drainage

Monitor water quality particularly at agricultural return outfalls (Bear River) (179).

Begin monitoring contaminants that tend to accumulate in agricultural runoff and that are known to be toxic, including selenium, boron, molybdenum, uranium, and arsenic (2008).

All local water supply and drainage agencies should participate in joint, coordinated programs to monitor the volume and quality of drainage water in the collection, treatment, and/or disposal systems (169).

The U.S. Department of the Interior and the State of California should jointly design a scientifically reliable and cost-effective network of physical and biological monitoring stations that will detect change in the environment caused by subsurface agricultural drainage problems and attempts to solve these problems. Areas expected to experience expansion of high water tables should be included (169).

Actions to Protect Wetlands from Contaminants in Agricultural Drainage

Renovate and extend the San Luis Drain, bypassing 20,000 acre feet of contaminated drainage water around wetlands (143).

Federal and State fish and wildlife agencies, in cooperation with private wetland owners, and Federal and State water development agencies should jointly plan the facilities required for delivery of water to wildlife areas affected by subsurface drainage water (169).

Actions Involving the Use of Agricultural Drainage Water in Wetlands

Drainage management--recirculation of wetland return flows (131).

San Joaquin overflow onto riparian and wetland areas (99).

Use constructed wetlands to stop nutrients and other elements captured in irrigation runoff (74).

Reuse wetland releases on irrigated agricultural land (74).

Utilize agricultural return flow in wetlands as a biofilter (74).

Use grass filter strips or natural grassland areas to detoxify water (74).

Include public and private managed wetlands in the Basin plan program to obtain water quality objectives (60).

Actions Involving Research and Studies

Intensify and complete local demonstration projects on source control and treatment of drainage water (143).

Continue the effort initiated by he San Joaquin Drainage Program to determine the nature, geographic extent, and severity of contamination of fish, wildlife, and their habitats by subsurface drainage water. Special attention should be given to: evaporation ponds and neighboring public and private wildlife areas; agroforestry plantations; the San Joaquin River, Delta, and San Francisco Bay; and the six substances of concern (arsenic, boron, chromium, molybdenum, selenium, and total dissolved solids) and ten additional trace elements and metals: cadmium, copper, lithium, manganese, mercury, nickel, strontium, uranium, vanadium, and zinc (169).

Continue the effort initiated by the San Joaquin Drainage Program to define, for fish and wildlife, safe and toxic concentrations (and associated biological effects) of subsurface drainage water substances of concern in water and in food. Special attention should be given to: independent toxicity of trace elements other than arsenic, boron, and selenium (for example, cadmium, chromium, copper, lithium, manganese, mercury, molybdenum, nickel, strontium, total dissolved solids, uranium, vanadium, and zinc); interactive effects of trace elements in drainage water; effects of water chemistry (for example, pH and salinity) on independent and interactive toxicity; and site-specific toxicity (for example, in valley aquatic and wetland habitat, evaporation ponds, and agroforestry plantations) (169).

Continue the effort initiated by the San Joaquin Drainage Program to identify and evaluate measures to: protect remaining fish and wildlife resources of the San Joaquin Valley from drainage-related impacts; restore drainage water contaminated habitats; provide water supplies to substitute for drainage water previously used by fish and wildlife; and improve fish and wildlife resources (169).

The U.S. Department of the Interior and the State of California should jointly study the benefits of implementation of the San Joaquin Drainage Plan (169).

The agencies with more responsibility for delivery of water to the study area [as defined in the Final Report of the San Joaquin Valley Drainage Program) should increase their work with the university extension system and water districts to demonstrate ways to improve the efficiency of irrigation water application and thereby reduce potential drainage-water volumes (169).

The U.S. Department of Agriculture of the Interior should consider the information, techniques, and experience accumulated in the Drainage Program and extend appropriate aspects of the knowledge base to other land areas in the western United States that are experiencing similar agricultural drainage and drainage-related problems (169).

Further identify chemical forms of substances of concern in different media (air, water, soil, sediment, biota) (169).

Further identify environmental conditions (pH, oxidation-reduction, etc.) in which different chemical forms of substance of concern occur in different environmental media (169).

Continue studies conducted by the University of California to assess the uptake of substances of concern into edible biota related to specific environmental conditions (169).

Place research emphasis on the environmental fate of substances of concern via typical routes of human exposure (for example, food-chain transfer of organic forms of trace elements) (169).

Perform additional chronic toxicity testing on specific chemical forms of substances clearly associated with the drainage problems (169).

Further identify contaminant threshold concentrations in edible animals in tissues used for human consumption (169).

Further identify contaminant threshold concentrations in edible plants in tissues used for human consumption (169).

Characterize consumption patterns of populations at risk (169).

Additional studies should be made to see if the large quantities of agricultural drainage's can be used to meet present and future water demands in Yolo and Lake Counties (64).

Actions to Fund Programs to Address Agricultural Drainage Problems

The SWRCB and RWQCBs, in cooperation with the Department of Pesticide Regulation and the California Department of Food and Agriculture (CDFA) should link research programs to technical assistance through funding grants or advocating grants for identified needs. The State Board should seek special funding to accelerate the work of programs, such as the University of California Statewide IPM Program, UC Sustainable Agriculture Research and Education Program, and the UC Center for Pest Research (75).

When Congress next considers reauthorization of the Clean Water Act, the State should strongly advocate increased funding for a wider range of Section 319 projects. Projects eligible for assistance should be expanded to provide that Best Management Practices which result in water quality improvements are eligible for funding. Provisions for SRP loan forgiveness should also be broadened to include eligible agricultural practices (75).

The SWRCB and the Department of Pesticide Regulation, and other interested state agencies, should work with Congressional representatives to request that Congress increase the cost-share percentage for pesticide reduction and other water quality related practices, such as Special Practice 53 - Integrated Crop Management, offered by the USDA Agricultural Conservation Program (ACP) as well as increase the $3,500 annual limit for ACP benefits and try to expand the crop insurance program to cover crops grown using innovative methods (75).

All areas contributing to a problem of subsurface agricultural drainage water should share in the costs of resolution and management of that problem. With respect to contributing areas, the cost-sharing formulas should be based on best available scientific information, and they should be re-evaluated and updated periodically in light of new information. Both direct indicators (upslope-downslope hydraulic relationships, for example) and indirect indicators (water supply received, for example) should be considered for inclusion in cost-sharing formulas (169).

All beneficiaries should pay for drainage-management costs in proposition to benefits received (169).

There are both market and nonmarket national, state, and local benefits to be realized from the management of drainage problems. All beneficiaries should be identified (169).

Because of the widespread occurrence of the drainage problem on the western side of the valley and the lack of scientific data on specific sites, costs should be distributed over the largest practicable land area - a whole service area or an association of water districts, for example - rather than one small water district (169).

The State of California should examine the need for new legislation to remove obstacles or to create opportunities for water marketing so that funds from water sales may be used for payment of drainage costs (169).

Actions for the Dilution of Agricultural Drainage

Dilute subsurface drainage discharges with fresh water or other less toxic source water such as surface irrigation return flows to reduce pollutant concentration (74).

Increase releases of water from New Melones to dilute Valley agricultural drainage (8).

Actions for the Export of Drainage Water from the its Source

Develop facilities to divert agricultural drainage from the Colusa Basin to areas which are not tributary to the Delta export facilities (13).

Drainage management--isolated drain out of basin (131).

Intercept drainage from the west side of the San Joaquin Valley and discharge it to areas which are not tributary to the Delta export facilities (13).

Reroute Delta drainage and discharge at a common point (13, 8).

Drainage management--isolated drain routed to below Merced River inflow (131).

Drainage management--real time (131).

Improve land and water management on Delta islands to improve water quality in

the Delta channels (13 8).

Implement the Delta Agricultural Drainage Management Plan (collect and divert drainage to another location in the Delta, or treated to reduce THM precursors at the Delta pumps (50).

Dispose agricultural drainage in the San Joaquin Valley by discharge to San Joaquin Delta (135).

Dispose agricultural drainage in the San Joaquin Valley by discharge to the ocean (135).

Dispose agricultural drainage in the San Joaquin Valley by San Luis Drain northern extension (135).

Dispose of agricultural drainage in the San Joaquin Valley by San Luis Drain southern extension (135).

Dispose agricultural drainage in the San Joaquin Valley by South Grassland bypass facilities (135).

Drainage Management-- isolated drain routed to below Merced River inflow (99).

Convey drainage water high in trace elements out of the basin of origin for export or ocean disposal (74).

Use unused portions of the San Luis Drain to carry existing agricultural drainage around the Grassland Water District and Mud and Salt sloughs (63).

Intercept Westside San Joaquin Valley drainage and transport to Ocean (8).

Route Colusa Basin Main Drain discharge to Yolo Bypass (8).

In the event that out-of-valley disposal is pursued in the future, develop information to asses the potential effects on fish and wildlife habitats and populations, and public uses of those resources in the receiving waters and lands. In light of recommendations for consideration of disposal in these areas, special attention should be given to the Sacramento-San Joaquin Delta, San Francisco Bay, and the Pacific Ocean (169).

Actions for the Management of Groundwater and Agricultural Drainage

Inspect old wells and bring them up to the safeguards required for new wells to prevent point contamination from seepage to the groundwater (75).

Lower near-surface water tables by pumping groundwater from deep wells in a semi-confined aquifer for management of agricultural drainage problems (71).

With financial and technical assistance from State and Federal agencies, water districts should lead in developing plans to identify locations in drainage problem areas where there may be an opportunity to lower the high water table by pumping from deep in the semiconfined aquifer (above the Corcoran Clay), and design the facilities, reach agreements, and obtain policy approvals required to carry out pumping (169).

Plans for installation and operation of well fields designed to pump from the semiconfined aquifer to lower the high water table should be completed cooperatively by Federal and State agencies and water districts. In the Federal service area, the Bureau of Reclamation should work with Westland, Broadview, Panache, San Luis, and Firebaugh Canal water districts to design well fields for areas identified in the Final Report of the San Joaquin Valley Drainage Program. In the State service area, the Department of Water Resources should work with Kern County Water Agency and Empire Westside, Riverside, Stratfor, and Laguna irrigation districts, Lakeside Irrigation Water District, Kings County Water District, and Kings River Conservation District for the same purpose. Services of the U.S. Geological Survey should be used in locating favorable areas and in developing plans (169).

Actions for Land Retirement to Reduce Agricultural Drainage Problems

Retire agricultural lands where large quantities or concentrations of contaminants drain into the Delta (172).

Retire land with poor drainage disposal in western San Joaquin Valley (59).

Drainage Management in the San Joaquin Valley by alternative land use (135).

Retire San Joaquin Valley agricultural lands (99).

Stop irrigation on lands with poor drainage to reduce drainage effluent (74).

Cease irrigating land determined to be a significant contributor of pollutants (74).

Actions for the Management of the San Joaquin River and Agricultural Drainage

Drainage management--San Joaquin River recirculation (131).

Reduce drainage contamination of the San Joaquin River (2).

Drainage Management--recirculation of wetland return flows, San Joaquin River (99).

Drainage Management--recycling, San Joaquin River (99).

Drainage Management--San Joaquin River recirculation (99).

Gain a better understanding and determine whether a single regional drainage conveyance facility will facilitate drainage management and promote improved water quality in the San Joaquin River (143).

Reduce peak agricultural drainage flow in the San Joaquin River basin through either a surface regulating reservoir or changes in tile sump pumping to allow interim storage in the soil profile (63).

Collect and treat agricultural drainage in the San Joaquin River basin only from "hot spots" (63).

Control and limit discharges of agricultural drainage water to the San Joaquin River during the winter and spring periods when more river dilution water is available (71).

Complete development of a streamflow and solute transport model for the San Joaquin River and couple it with reservoir operations models so that management alternatives can be evaluated (169).

Management of Urban/Industrial Drainage and Wastewater Discharge

General Measures to Reduce Contamination Associated with Construction Sites

Plan, design and develop new development sites to protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss (69).

Increase key nutrient inputs to estuary (CALFED).

Encourage facilities associated with reuse of treated wastewater (150).

Plan, design and develop new development sites to limit increase of impervious areas, except where necessary (69).

Plan, design and develop new development sites to limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss (69).

Plan, design and develop new development sites to limit disturbance of natural drainage features and vegetation (69).

Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction of new development (69).

Prior to land disturbance by new development, prepare and implement an effective erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions (69).

Limit application, generation, and migration of toxic substances on construction sites (69).

Ensure the proper storage and disposal of toxic materials at construction sites (69).

Apply nutrients at rates necessary to establish and maintain vegetation at construction sites without causing significant nutrient runoff to surface waters (69).

To the extent feasible, preserve, and where possible, create or restore areas that provide water quality benefits, such as riparian corridors and wetlands, and promote the design of new development so that it protects the natural integrity of drainage systems and water bodies (69).

Avoid conversions of areas particularly susceptible to erosion and sediment loss and/or establish development guidance that identifies these areas and protects them from erosion and sediment loss (69).

Require the integration of storm water quality protection into construction and post-construction activities at development sites (69).

Wherever practicable, maintain peak runoff rates at pre-development levels (69).

Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction of roads, highways and bridges (69).

Prior to land disturbance for roads, highways and bridges, prepare and implement an approved erosion control plan or similar administrative document that contains erosion and sediment control provisions (69).

Limit the application, generation, and migration of toxic substances on road, highway and bridge construction sites (69).

Ensure the proper storage and disposal of toxic materials at road, highway and bridge construction sites (69).

Apply nutrients at rates necessary to establish and maintain vegetation at road, highway and bridge construction sites without causing significant nutrient runoff to surface waters (69).

Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loading to surface waters (69).

Develop and implement runoff management systems for existing roads, highways and bridges to reduce pollutant concentrations and volumes entering surface waters (69).

General Actions to Reduce or Control Non-Point Source Discharge

Improve management and control of urban runoff from public and private sources (99).

In order to minimize nonpoint source pollution associated with personal vehicles, urban/suburban areas should be designed to maximize the use of: (a) alternative modes of transportation through construction of dedicated traffic lanes; (b) mass transit systems by requiring easements/rights of way; and (c) alternative fuel and zero-emission vehicles (or hybrids) by providing fueling recharging stations (69).

Each city and county and the state agencies should devise ways to utilize existing permitting and inspection programs to help complement Storm Water Management Plans and the State Nonpoint Source Program (69).

RWQCBs should refer local governments to the *California Storm Water Management Practices (BMP) Handbooks* and the EPA *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* for assistance in creating their own water quality programs (69).

A pilot program should be established by at least on RWQCB to develop small nonpoint source pollution prevention programs (69).

All RWQCBs should work with local jurisdictions to implement nonpoint source pollution prevention programs in small cities and towns not covered by municipal NPDES storm water permits (69).

Government agencies should examine municipal landscape/facility maintenance/pest control programs and make necessary modifications in order to prevent contributions of toxic materials to receiving waters (69).

Develop interagency agreements with CalTrans and other road building entities to address nonpoint source pollution from roads, highways and bridges (68).

Develop Waste Discharge Requirements (WDR) for road, highway, and bridge related activities not covered by the NPDES storm water permits (68).

General Actions to Control or Reduce Contaminants in Urban and Storm Water Runoff

Identify illicit and unauthorized stormwater discharges (194).

Coordinate with local agencies to develop stream overflow areas to attenuate storm water runoff into Westside streams from urban areas (21).

Address and resolve, as appropriate, the impacts on water reclamation and water conversation caused by the discharge of brine from self-regenerating water softeners and other sources into the wastewater stream (124).

Coordinate with local agencies to develop a program to improve water quality of runoff into Westside streams from urban areas (21).

Develop control measures to reduce pollutant loading form energy and transportation systems (124).

Divert effluent from publicly owned treatment works to constructed wetlands for waste water enhancement. (Example: City of Martinez Waste Water Treatment Plant; City of Palo Alto Water Control Plant.) (110).

Implement urban runoff management from areas conveying toxic material into the San Joaquin River (131).

Improve the management and control of urban runoff from public and private sources (124).

Urban runoff management, San Joaquin River (99).

Seek one or two regional boards to assist in developing regional urban runoff policy or guidance (82).

Improve support for small community stormwater management (82).

Assist parties interested in developing a Model Storm Water Program, including an urban runoff ordinance and language for inclusion in General Plans (82).

Regional Boards should ensure effective implementation of municipal storm water programs that include the TAC Recommendations through one of three mechanisms: (a) Water Code Section 13225(c) authority to require reports from local governments on implementation of storm water programs; (b) individual NPDES storm water permits issued to specific storm water programs; or (c) a

general NPDES storm water permit requiring implementation of a municipal storm water program (69).

SWRCB/RWQCBs need to provide technical and financial assistance to small communities, including, at a minimum, development of a model municipal storm water program, educational information, and staff training (69).

All local governments should adopt and implement a storm water runoff control program (69).

The SWRCB, in a coordinated effort with the RWQCBs, should provide assistance to small local governments for development and implementation of an urban runoff control program (69).

Municipal storm water programs should focus initially on O&M activities of public agencies (69).

RWQCBs should work with municipal storm water program staffs to educate decision-makers in local governments about Regional Water Quality Control Plans (Basin Plans) and their relationship to storm water programs (69).

Municipal storm water monitoring programs should be designed to support watershed assessments and planning (69).

Implement best management practices for urban runoff; investigate relocation of waste water treatment discharges (8).

Contamination of streams and rivers by urban runoff can be reduced by managing runoff in urban areas (79).

The regional board should continue to work with The City and County of Sacramento to abate the effects of urban runoff on water quality in the Sacramento River and its tributaries (64).

The regional board should expand its consideration of the effects of urban runoff to other metropolitan areas likely to affect water quality in the Sacramento River system (64).

Actions Involving the NPDES and Other Related Permits

Implement Regional Water Quality Control Board waste discharge requirements for operation of the One Mile Recreation Area in Big Chico Creek (21).

Through administration of the NPDES Municipal Storm Water Program, RWQCBs should require that each city and county have the legal authority to control sources of urban runoff pollution into their storm drain system(s), waterbodies, and associated habitats (69).

SWRCB/RWQCBs should develop a list of sources (land use activities) currently not covered by the Municipal, Industrial, or Construction NPDES storm water permits that may significantly contribute to water quality degradation, and develop programs to ensure that these sources are controlled (69).

In order to assist the RWQCBs in identifying industries and construction projects that should be covered by general permits, municipal storm water programs should provide pertinent available information to RWQCBs (69).

Local governments should advise those industries and construction projects with which they come into contact of the requirement to be covered by the state general permits (69).

USEPA should consider new NPDES regulations to deal with Phase II sources of polluted runoff, including municipalities with population under 100,000, construction sites with less than five acres, and commercial and small industrial sites (68).

Actions for the Establishment of Water Quality Criteria and Reduction of Priority or Targeted Pollutants

Municipal storm water programs should determine local water quality goals and focus efforts on the reduction of priority pollutants (69).

RWQCBs should assist local governments with financial and technical assistance for pilot retrofit projects designed to reduce targeted pollutants (69).

The San Joaquin River Dissolved Oxygen Objective can be implemented by regulating the effluent discharge from the Stockton Wastewater Treatment Plant and other upstream sources that contribute to the BOD load (80).

Water quality criteria for molinate, thiobencarb, copper, cadmium and zinc included in the Sacramento River Toxic Chemical Risk Assessment Project Final Report, should be considered by the CVRWQCB in developing water quality objectives for the protection of aquatic life and in implementing control programs to reduce the discharge of these chemicals to the Sacramento River (64).

State and Regional board staff should cooperatively develop methodologies for translating water quality objectives for implementation into water quality control programs (64).

Actions for the Treatment of Urban and Industrial Discharge

Implement plans and regulations which reduce the impact on the fishery from once-through cooling processes for industrial plants (thermal pollution) (13, 11).

Local governments should consider use of open space programs to maintain and enhance water quality (69).

Include a filtration system in building marinas, which separates oil from water pumped from around berths, thereby keeping oil out of sewer system and improving regional water quality (68).

Natural gas production will continue to be an important use of Delta resources. Structures needed for gas extraction should be consolidated to minimize displacement of agriculture and wildlife habitat. In compliance with existing

laws, facilities no longer needed for gas extraction should be completely removed to allow restoration of agriculture or wildlife habitat areas. Counties should ensure that there are appropriate buffers between gas processing and storage facilities and residential and recreational uses to protect lives and properties (89).

Implement effective runoff control strategies in marinas, including the use of pollution prevention activities (72).

Design marina fueling stations to allow for ease in cleanup of spills (72).

Install pumpout, dump station, and restroom facilities where needed at new and expanding marinas to reduce the release of sewage to surface waters (72).

Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats and operation of marinas to limit entry of solid wastes to surface waters (72).

Reduce sewage discharge into Churn Creek (21).

Separate industrial from municipal sewage (172).

Provide and maintain appropriate storage, transfer, containment, and disposal facilities at marinas for liquid material such as oil, harmful solvents, antifreeze, and paints, and encourage recycling of these materials (72).

Reduce the amount of fuel and oil from boat bilges and fuel tank air vents entering marina and surface waters (72).

For boats that are in the water at marinas, perform cleaning operations to minimize, to the extent practicable, the release to surface waters of (a) harmful cleaners and solvents and (b) paint from in-water hull cleaning (72).

Public education/outreach/training programs should be instituted for boaters, boating groups, marina owners and operators, waterfront agencies, service providers and other related groups to increase the availability and proper use of disposal equipment and techniques for polluting materials as well as promote the use of alternative and environmentally safe materials and practices (72).

Ensure that sewage pumpout facilities at marinas are maintained in operational conditions and encourage their use (72).

Promote a self certification program for in-water hull cleaning (82).

The SWRCB Ocean Waters Unit will continue evaluating the utility of switching from total and fecal coliform indicators to enterococcus as an indicator of public health risk (82).

Actions for Research and Further Studies on Urban and Industrial Discharge

Perform waste load allocations for receiving waters (121).

The regional board should continue to work with wastewater dischargers to improve monitoring data being developed by the monitoring programs. In particular, emphasis should be placed on: 1) lowering analytical detection limits

for trace metals; 2) increasing whole effluent and ambient receiving water toxicity testing; and 3) monitoring synthetic organics from urban storm drain runoff and NPDES permitted facilities where applicable (64).

Monitoring techniques such as resin column concentrating methods or in situ bivalve monitoring should be utilized to obtain information on biologically significant levels of toxic substances in the Sacramento River system (64).

The state and regional Board should develop and support an effective baseline monitoring program which would provide data necessary to assess the effects of point and non-point sources of toxic substances (64).

Model environmental compliance program at federal facilities within the jurisdiction of the Estuary Project (99).

Continue the Municipal Water Quality Investigations (MWQI) Program. This program is a Delta water quality monitoring program focusing on human health concerns (48).

Pursue further studies to identify a surrogate measurement such as specific absorbence for continuously monitoring the organic carbon in the Delta (48).

Use automated sampling devices to collect daily or hourly samples to study the magnitude of water quality changes at sampling sites in the Delta (48).

Additional toxicity data on molinate, thiobencarb, copper, cadmium and zinc are needed to fully evaluate the sensitivity of resident species under local water conditions, and more fully evaluate the toxicity of ambient waters (64).

Actions for Education and Public Outreach on Urban and Industrial Discharge

Implement public education program to minimize waste loads (189).

Establish a model environmental compliance program at federal facilities within the jurisdiction of the Estuary Project (124).

Implement water education programs in urban areas (39).

Department of Parks and Recreation (DPR) rangers should continue to patrol the State parks, and provide as much supplemental assistance to local governments and to Department of Fish and Game as possible. DPR rangers should enforce hunting and fishing laws and enforce pollution laws on the waters of the State parks (89).

Educate government agencies and officials to achieve better communication, consistency, collaboration, and coordination at the federal, state and local levels when addressing urban runoff (69).

Establish statewide education programs, including curricula, on watershed awareness and nonpoint source pollution problems and solutions, based on a state lead role building upon and coordinating with existing local programs (69).

RWQCBs should coordinate with local governments regarding water quality concerns and programs (69).

SWRCB/RWQCBs should encourage state and local government agencies, including special districts, to operate their programs and facilities in a manner that protects water quality by setting examples through the operation of their own facilities and programs (69).

Municipal storm water programs should work through local school districts to incorporate water quality issues into the curriculum (69).

UC Cooperative Extension should increase involvement in urban areas to improve public awareness about the potential for urban pesticide use to contribute to water quality problems (75).

Programs should be developed through UC Master Gardeners to encourage safe home use of pesticides and proper disposal. Support of programs could be solicited from chemical industry leadership (75).

Programs should be developed to target rural and urban schools, FFA clubs and conferences, 4-H clubs and conferences, home gardening shows, county fairs, periodicals and gardening magazines, etc. with information developed by UC Cooperative Extension, CAPCA, PAPA, the Department of Pesticide Regulation, and RWQCBs. Utilize existing public education programs, such as the CAPCA Plant Doctor program and the Agriculture in the Classroom program (75).

Develop and distribute Public Service Announcements for radio, TM, and movie theaters on protecting water quality from pesticides and on proper pesticide disposal (75).

The Department of Pesticide Regulation, in cooperation with RWQCBs and County Agricultural Commissioners, should tighten the linkage between outreach efforts, local technical assistance, and incentives available for growers and other pesticide users (75).

Conduct public education on the maintenance of on-site disposal systems to reduce ground water and surface water contamination (68).

Residents must be educated of water quality issues in their communities (79).

Dredged Material Management

General Actions for the Management of Dredged Material

Identify dredged material re-use and nonaquatic disposal opportunities and constraints (124).

Identify dredged material disposal options, including cost estimates and alternative disposal methods. Conduct periodic review as necessary (124).

Dispose dredged materials at nonaquatic or other suitable sites (CALFED).

Ensure material used for levee maintenance is noncontaminated (CALFED).

Develop management plans which will reduce in-bay disposal of dredge materials (13, 11).

Eliminate or reduce dredging and dredge spoil contribution to water pollution (179).

Maintain an inventory of channel areas where toxic materials have been identified (89).

Actions for the Management of Delta Sediments

Remove contaminated sediments in critical habitat sites (CALFED).

Material dredged from Delta channels should, if feasible, be stored at upland sites for levee maintenance and repair, and other feasible uses in the Delta. Impact to wildlife caused by storage of dredged materials should be mitigated (89).

Develop a long term dredge spoils management program to protect water quality (178).

Develop sediment quality objectives (99).

Because of the need to continually dredge the channels serving the two ports, it is essential to maintain spoil sites and not allow existing spoil sites to be converted to industrial or other uses which preclude or limit their use as a spoil sites (89).

Expedite the clean up of toxic hot spots in estuarine sediments (124).

Sediment removal from San Joaquin mainstem (131).

Study the sediment dynamics of the estuary (99).

Actions for the Management of Dredging Operations

Develop and impose management requirements for all "significant" dredge operations and upland disposal operations to protect water quality (178).

Prohibit dredging of Stockton ship channel during critical periods that may affect juvenile and adult salmon migrations (Lower San Joaquin River) (179).

Prohibit dredging operations during late summer and fall in the Stockton Ship Channel to protect water quality for anadromous fish (24).

Time dredging for periods when there is minimal tidal movement (172).

Use silt curtains or suction dredging to localize sediment movement (172).

Management of Mine Drainage

General Actions for the Management of Mine Drainage

Reduce toxic loading from mines (124, 99).

Recycle and extract metals from acid-rock drainage to abate pollution from abandoned mines (78).

Reconsider unobtainable cleanup standards (78).

Form dedicated abandoned mine specialty groups at the RWQCBs (78).

Form an abandoned mines agency (78).

Address acute local pollution problems from abandoned mines immediately (78).

Develop an environmental credit system for cleanups of abandoned mines (78).

Focus on historic preservation and endangered species in making decisions about cleaning up abandoned mine sites (78).

The SWRCB should promote, to Cal EPA, the formation of a multi-agency policy oversight committee on abandoned mines. The committee would be politically accountable for monitoring the effectiveness of abatement projects, pursuing funding, establishing criteria for prioritizing, deciding priorities, and concurring on abatement projects in an effort to unify and consolidate abandoned mine abatement expertise (78).

The SWRCB should approve a task force of State Board, Regional Board, and Office of Mine Reclamation staff to work on abandoned mines (78).

The SWRCB will request the Abandoned Mines Oversight Committee broaden its scope to include water quality standards for mine impacted waters, funding sources, project effectiveness, public participation, and technical and financial expertise in the management of abandoned mines (82).

Central Valley RWQCB should implement mine sealing programs to reduce toxic discharges (68).

Implement short-term program to correct mercury discharge problems in upstream areas of the Sacramento River and San Joaquin River Basins, and monitor the Delta to determine if upstream control measures are working (60).

Continue to use the wet extraction test (WET) as one of the criteria for regulating a mining waste facility, however change the reporting results to exceeded or not exceeded (181).

Use site specific factors in setting containment criteria for mining wastes (181).

Prevent fragmentation of regulatory authority over mining wastes (181).

Improve communication between the State and Regional Water Board Staffs (181).

Maintain Department of Health Services regulatory authority over abandoned mine sites (181).

Develop a policy document for water monitoring at mine sites (181).

Develop a standardized format for groundwater monitoring reports (181).

Continue to require mines to comply with the toxic pits clean up act (181).

Site Specific Actions for the Management of Mine Drainage

Complete EPA superfund cleanup of Iron Mountain Mine by 1996 (179).

Control effluent from Iron Mt. Mine Superfund site until Basin Plan objectives are met (21).

Implement pollution controls at Iron Mountain Mine (99, 84).

Clean up Iron Mountain Mine located about 9 miles northwest of the City of Redding. Acid mine drainage discharge into Keswick Reservoir via Spring Creek (181,84, 136*).

Clean up the Mammoth Mine Complex in Shasta County. The Mammoth Mine Complex consists of three mines, Mammoth, Golinsky and Sutro, located about 3.5 miles northwest of Shasta Dam and 13 miles northwest of the City of Redding. Acid mine drainage from the complex discharge into Shasta Lake Via Little Backbone Creek and Shoemaker Gulch (181).

Clean up the Leviathan Mine which is an abandoned sulfur mine located on the eastern slope of the Sierra Nevada in Alpine County about 25 mile southeast of Lake Tahoe (181).

Clean up the Walker Mine which is an inactive copper mine located about 20 miles east of Quincy in Plumas County California. Acid mine drainage is discharged into Dolly Creek (181).

Clean up the Atlas Asbestos Mine and Coalinga Mill located northwest of Coalinga in Fresno County, California. Both are on the National Priority List (federal superfund). The EPA considers that there is sufficient risk of high levels of airborne asbestos in the area (181).

Clean up the Sulfur Bank Mine which lies on the east end of Oak Arm of Clear Lake. The mine was one of the largest producers of mercury in California. The mine dumps extend into the Oaks Arm and elevated levels of mercury are present in the top layer of sediment from the Oaks arm (181).

Clean up the Gray Eagle Mine which is located about five miles north of Happy Camp in Siskiyou County California. Acid mine drainage is discharged into Luther Gulch a tributary of Indian Creek and the Klamath River (181).

Eliminate Department of Health Services regulatory authority over new and existing mines. The regulatory authority over mining wastes should rest entirely on the State and Regional Water Boards (181).

Clean up the Balaklala, Keystone and Shasta King Mines which lie within the Shasta Trinity National Forest about four miles west of Shasta Dam. Acid mine drainage from all three mines discharge into Shasta Lake via West Squaw Creek (181).

Actions for Research and Further Study of Mine Drainage

Study acid-rock drainage abatement technology including source control (78, 60).

Support research and development into low cost, low maintenance, effective abandoned mine pollution abatement technology (78).

Undertake an inventory of abandoned mines in cooperation with other agencies. The inventory shall consist of site visits to identify the magnitude of water quality impacts from each site. As information on sites is gathered, the most problematic sites will be identified and listed in a staff report, to be revised annually as information is available (82).

Develop a mass emission program to control the loads of metals entering receiving waters and the Delta (60).

Continue monitoring metals in the Delta and main tributaries to assess compliance with water quality objectives, to evaluate impacts on beneficial uses, and to coordinate monitoring and metal reduction programs (60).

Implement studies to determine input loads from mine tailings for establishing priorities for abatement activities (60).

Employ an additional test using sulfuric acid if the mining waste stream exceeds the toxicity criterion for lead (181).

Develop a new laboratory test to determine the net acid generating potential of the waste stream (181).

Develop a new laboratory test for measuring the net acid generating potential of a waste material (181).

Conduct a study to determine the adequacy of current mine reclamation and closure requirements (181).

Review the factors that influence the long term integrity of liners (181).

Conduct a field investigation on the mobilization and destruction of cyanide contaminated wastes from gold mining operations (181).

Conduct a review of attenuation of metals and other contaminants in bedrock (181).

Conduct experiments at a selected mine site in California to establish the effectiveness of using bactericides to control acid mine drainage (181).

Conduct experiments aimed at developing a toxicity model of the mine effluent (181).

Conduct an exploratory program aimed at determining the potential for using wetlands to control acid mine drainage (181).

There are many mines, other than the Iron Mountain Mine, which also may be contributing significant amounts of toxic substances to the Sacramento river System. The regional board should assess contributions of trace elements from other mines through out the region (64).

Actions for Education and Public Out-Reach on Mine Drainage Issues

Inform the public about the "what's, where's and how's" of abandoned mine pollution (78).

Promote passive treatment technology for abandoned mines (78).

Promote revegetation of abandoned mines (78).

Answer questions about regional pollution from abandoned mines (78).

Compile a computerized database of mining information (181).

Actions for Funding Management of Mine Drainage

Provide incentives such as in-kind services, tax credits for cleanup of abandoned mines (78).

Pool cleanup funds for abandoned mines (78).

Levee Maintenance and Stabilization

General Actions for Delta Levee Maintenance and Stabilization

Streamline the regulatory process by combining the following approaches: 1) include all foreseeable activities related to improvement and maintenance of all Delta levees and channels, floodfight, levee restoration and island reclamation in a programmatic CEQA/NEPA document; 2) include specific elements in the project that will encourage regulators to furnish timely approval of all activities; 3) draft and support passage of legislation to set specific reasonable time limits within which any State or Federal organization approving or disapproving a project must act; and 4) assign the responsibility of streamlining the permitting to the regulatory agencies by executive order (7).

Reduce the organic content of levee maintenance material so as to improve channel water quality (13, 8).

Bolster levees (93).

Consider the risk of development on or behind levees from ground failure and shaking (6).

Delta levee stabilization (99).

Implement an inspection program to ensure compliance with maintenance standards (7).

Implement land elevation surveys in the Delta (38).

Implement levee encroachment studies in the Delta (38).

Increase Delta levee stability in areas of threatened conditions (38).

Link islands together to form polders through the construction of embankments which close off the channels between the islands; strengthen the exterior levees of the polders to protect against 50-year flood events (29, 31).

Streamline permits for levee work in the Delta (6).

Utilize flow modifications (impermeable groins and vanes) to stabilize levees (100).

General Actions for the Management of Levee Vegetation

Allow natural vegetation to establish itself on Delta levees except in the paved roadway areas for increased stability (29).

Plant 290 miles of improved nonproject Delta levees with vegetation for increased stability (29).

Plant 508 miles of improved nonproject Delta levees with trees, grasses and shrubs for increased stability (29).

Plant trees, shrubs and grasses on the waterside slope of Delta levees between the top of the riprap and the levee crown for increased stability (29).

Utilize vegetation to protect and stabilize levees (100).

General Actions for Controlling Subsidence

Modify agricultural practices to reduce subsidence (CALFED).

Use infilling to correct past subsidence (CALFED).

Controlling subsidence should be a significant element of any Delta flood control plan (6).

Allow natural vegetation to take over Sherman Island, to reduce the rate of soil subsidence and consumptive water use (33).

As new information on best management practices to control subsidence of peat soils becomes available, the Commission should review that information and, if appropriate, amend the Plan (89).

Hold water in islands to reduce hydrostatic pressure and eliminate subsidence (93).

Reduce long term levee maintenance and improvement costs by controlling subsidence. Subsidence could potentially be controlled by shallow flooding and/or placing dredged fill (7).

Study and monitor Delta subsidence (38).

Actions for the Coordinated Management of Delta Levees

A "clearinghouse" for material suitable for levee maintenance should be created to assist in distributing appropriate materials to sites slated for maintenance work. Materials which have value for levee maintenance work, such as materials routinely dredged from Delta channels or materials otherwise exacted from within the Delta area, should be reserved first for levee maintenance work. Other uses should be considered only if the material is not needed or is unsuitable for levee maintenance work. Regulations should establish priorities for in-Delta use of soil excavated from within the Delta (89).

Consolidate Reclamation Districts where efficiencies of scale would result in cost savings and levee systems of two or more reclamation districts provide protection to the same area (89).

Coordinate the use of dredged material on Delta levees (38).

Create an organization to implement the Delta levees and channel element of the plan for "fixing the Delta." (7).

Establish temporary task force of all concerned agencies and selected authorities from the private sector to review and revise the Corps of Engineers project levee maintenance guidelines for the Sacramento and San Jaoquin Rivers; for formal submittal to the Corps by Fish and Wildlife Service, Department of Fish and Game, and the Resources Agency. A consensus statement of multiple-purpose levee restoration and maintenance guidelines, guide this effort (28).

If funding is made available to the reclamation districts for levee maintenance, mitigation for removal of vegetation required to maintain existing levees should be coordinated through a memorandum of understanding between reclamation districts, State, and federal agencies, which results in minimal fiscal impacts to reclamation districts and which will result in "no long term loss" of habitat in the legal Delta (89).

Maintain an inventory of the current status of Delta levees meeting various standards (HMP; PL-99; etc.) (89).

Actions for Disaster Planning

Call for an overall earthquake emergency response and recovery plan. It should include procedures for rapidly coping with levee failures following a major distant or local earthquake. It also should clearly specify which organizations are responsible for repair of the Delta levees after a destructive earthquake (6).

The program for emergency levee repair should be strengthened. The program should include: definition of an emergency; designation of emergency funds; emergency contracting procedures; emergency permitting procedures and the designation of a State agency to provide immediate response to floodfight, close levee breaks, and dewater flooded areas where local agencies are unable to respond. An emergency program should develop a funding program to assist reclamation districts that are unable to pay such costs (89).

Actions for the Funding of Levee Improvement Projects

Due to the difficulty in identifying all the beneficiaries of both State and federal levees and the entities that cause adverse impacts to the levees, the simplest way to collect the funds needed to maintain the levees would be through non-fundable allocations from both the State and federal government to fund regular, on-going levee maintenance (89).

Landowners, through reclamation districts, should pay a portion of levee maintenance costs. The overall citizenry of California and the United States that benefits from the state and federal water projects, commerce and navigation, travel, production of crops, recreation, and protection of fish and wildlife habitat should also pay a substantial portion of the cost of maintaining the Delta levee. New programs of determining assessments on mineral leases and other beneficiaries should be evaluated by reclamation districts (89).

Provide funding for the repair of any threatening western Delta levee conditions that may occur in the future (38).

State and federal water projects are beneficiaries of the Delta waterways and levees; the projects should fund that portion of levee erosion caused by water transport and should continue programs that fund protection of Delta levees (89).

To lower levee maintenance costs, streamlined permitting systems for authorization of dredging for levee maintenance and rehabilitation work,

including the improvement of wildlife habitat and habitat mitigation sites, and for levee upgrading to mandated standards to protect public health and safety, should be instituted, with one state agency designated as lead agency and one federal agency designated as lead agency. Federal agency concurrence in such designations should be obtained (89).

Reimburse local agencies for acquisition of wildlife habitat easements up to 400 feet in width along Delta levees in areas where DWR determines an easement necessary to control subsidence and maintain structural stability (38).

Utilities should be required to contribute a fair share to the cost of levee maintenance and other local services and should not result in a reduction of assessable acreage for reclamation districts (89).

Actions for the Improvement of Levee Maintenance Programs

Implement uniform maintenance standards (CALFED).

California Department of Fish and Game should work with the Reclamation Districts to make sure that needed levee maintenance is accomplished (6).

Include improvement standards, minimum levee maintenance criteria and an inspection program in Delta levee target maintenance and improvement levels (7).

Levee maintenance, rehabilitation, and upgrading should be established as the first and highest priority of use of the levee. No other use whether for habitat, trails, recreational facilities, or roads should be allowed to unreasonably adversely impact levee integrity or maintenance (89).

Site Specific Actions to Control Subsidence and Improve Delta Levees

Berm for Canal Ranch Beaver Slough levee (99).

Continue reconstruction and maintenance of Delta levees to ensure seismic safety and security of the water supply (2).

Minimize tilling of crops on Sherman Island to reduce the rate of soil subsidence (35).

Perform land-side levee improvements on Jersey Island using dredged material from San Francisco Bay (133).

Perform land-side levee improvements on Jersey Island using off-island borrow material (133).

Perform land-side levee improvements on Jersey Island using on-island borrow material (133).

Perform land-side levee improvements on Twitchell Island using dredged material from San Francisco Bay (133).

Perform land-side levee improvements on Twitchell Island using off-island borrow material (133).

Perform land-side levee improvements on Twitchell Island using on-island borrow material (133).

Perform land-side levee improvements on Webb Tract using dredged material from San Francisco Bay (133).

Perform land-side levee improvements on Webb Tract using off-island borrow material (133).

Perform land-side levee improvements on Webb Tract using on-island borrow material (133).

Rehabilitate nonproject levees on Sherman Island (33).

Stabilize levees in eight western Delta islands (13, 7).

Improvement of Flood Protection Levels and Seismic Stabilities

General Actions for Improvement of Levee Designs

Fill near-shore dredger cuts with ship channel dredge spoils to reduce seepage, improve levee stability and provide near-shore shallow water (6).

Consider the use of new designs, extensive monitoring, and economical borrow sources in developing realistic future costs for levee rehabilitation (6).

Construct landside berms along Delta levees to serve as counterweights for water pressure (29).

Deposit silty water or clean dredge spoils in islands to begin rebuilding levels (93).

Improve Delta levees by raising, widening and strengthening the embankments as needed (29).

Levee setbacks; reduce the length of levees to be maintained during flood stages (93).

Utilize armoring or revetment to protect and stabilize levees (100).

Utilize set-back levee designs for protection and stabilization of levees (100).

General Actions for Planning Delta Levee Improvements

Relocate levees to more stable sites (CALFED).

Improve 290 miles of nonproject Delta levees to protect against 50-year flood events (29).

Improve 508 miles of nonproject Delta levees to protect against 100-year flood events (29).

Gradually improve Delta levee sections to higher levels of protection, such as DWR's Bulletin 192-82 standards (38).

Actions for the Improvement of Flood Protection Levels

Widen floodways to increase flood conveyance (CALFED).

Establish and manage flood overflow areas (CALFED).

Implement floodplain management regulations such as zoning ordinances, subdivision regulations, and building codes at the local level, as required by the National Flood Insurance Program (133).

Continue to improve the dissemination of flood warning information through the State Office of Emergency Services and the National Weather Service (133).

Raise structures in floodplains to levels that would avoid flooding of the buildings (133).

Relocate existing structures to areas outside the floodplain (133).

Work with flood management agencies, land use agencies, and the building industry to encourage the implementation of flood damage prevention measures which maintain natural hydrologic features to the extent feasible and minimize the need for channel modification (82).

Study alternative means for flood control in the American River watershed, in Natomas, and in the Lower Dry Creek watershed (134).

Increase the level of flood protection in the Sacramento area by restoring the structural integrity of the existing levee system (134).

Identify interim measures to help provide a 100-year (FEMA) level of flood protection until a long-term solution can be agreed upon and implemented (134).

Provide a long-term solution to the flood problem in the Sacramento area (134).

Increase the flood control storage space in Folsom Reservoir (134).

Increase the channel capacity of the lower American River with levee and channel improvements (134).

Lower the spillway at Folsom Dam (134).

Construct a flood control detention dam near Auburn (134).

Construct levee and channel improvements in and around Natomas (134).

Dual-Purpose Floodway Proposal, San Joaquin River (99).

For flood control, reduce carryover storage in onstream reservoirs. Construct levee setbacks. Construct floodways to allow water to spread out (as in the Yolo bypass) (93).

Lands currently managed for wildlife habitat, such as private duck clubs or publicly-owned wildlife areas, should be preserved and protected, particularly from destruction from inundation (89).

Actions to Improve Seismic Stabilities

As much as feasible, levees should be designed and maintained to protect against damage from seismic activity. Those standards should not promote increased intensity or density of use beyond those designated as of January 1, 1992 (89).

Establish target levels of seismic stability for levees in the Delta (7).

Perform studies of potential earthquake risk to help develop contingency plans in the event of earthquake-induced failures. These studies should be focused upon critical levees on the western side of the Delta (7).

Conduct further investigations involving field and laboratory testing to reduce the uncertainties and better define the expected performance of the levees during future earthquakes. In particular, determine the ability of the soft organic soils beneath the levees to either amplify or dampen motions (6).

Address the implications of seismic hazards in the Delta on existing and future

developments. Identify areas expected to experience the strongest earthquake ground motion and ground failure and the implications of levee failure on land uses, the environment and fresh water transport (6).

Consider the Delta area's vulnerability to earthquake damage when addressing existing and future development, water transport and other safety issues (6).

Rerouting and Protection of Infrastructure from Flooding and Seismic Risk

Maintain/reconstruct levees around infrastructure (CALFED).

Reconstruct infrastructure to increase reliability (CALFED).

Relocate/reroute infrastructure (CALFED).

Relocate export facilities to more stable sites (93).

Establishment of Long-Term Funding Mechanisms

General Actions for the Establishment of Long-Term Funding

Implement long term cost sharing arrangements extending beyond the year 2000 (191).

Funding options shall be identified at the federal, state, regional and local level, including grants, taxes, incentives, land exchange, in lieu payments, mitigation funds and tax credits (73).

Fund research needs in areas of overlap between academic and agency interests through programs such as the UC Water Resources Center (73).

SWRCB should support an increase in total funding dollars for environmental enhancement grants pursuant to the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and encourage local, regional, and state agencies to apply for these grants (69).

Explore innovative funding techniques in order to secure financial participation by all parties that benefit from the protection afforded by the Delta levees (7).

Establish a disaster contingency funding program (CALFED).

Establish a Bay-Delta financing authority (CALFED).

Provide low-cost debt financing for local agencies (CALFED).

Establish a bind financing mechanism (CALFED).

Establish a statewide water utility surcharge (CALFED).

Actions for the Development of an Emergency Funding Program

Develop Contingency Plans to reclaim flooded islands. Contingency Plans could include: 1) the continuation of disaster assistance programs; and/or 2) establishing a fund which is supported by beneficiaries of Delta levees for use in reclamation of flooded islands (7).

Create an emergency fund (191).

Set up an emergency fund of approximately $20,000,000 to pay for the repair of failed levees and the recovery of an inundated island or tract (6).

Actions for the Long-Term Funding of Levee Maintenance

Establish a reliable and equitable long-term funding mechanism for the improvement and maintenance of the Delta levee system to sustain its associated uses (7).

Establish a comprehensive cost sharing arrangement for Delta levee improvements that address all beneficiaries (7).

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The following reference list includes documents, programs and activities prepared by numerous agencies and organizations that deal with Delta issues, including fisheries, and water supply reliability.

These sources of information assisted in the identification of specific actions (restorations, policies, operational changes, structures) which have already been identified through previous public and private planning efforts that address problems in the Sacramento-San Joaquin Delta, and Suisun Bay and Suisun Marsh.

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