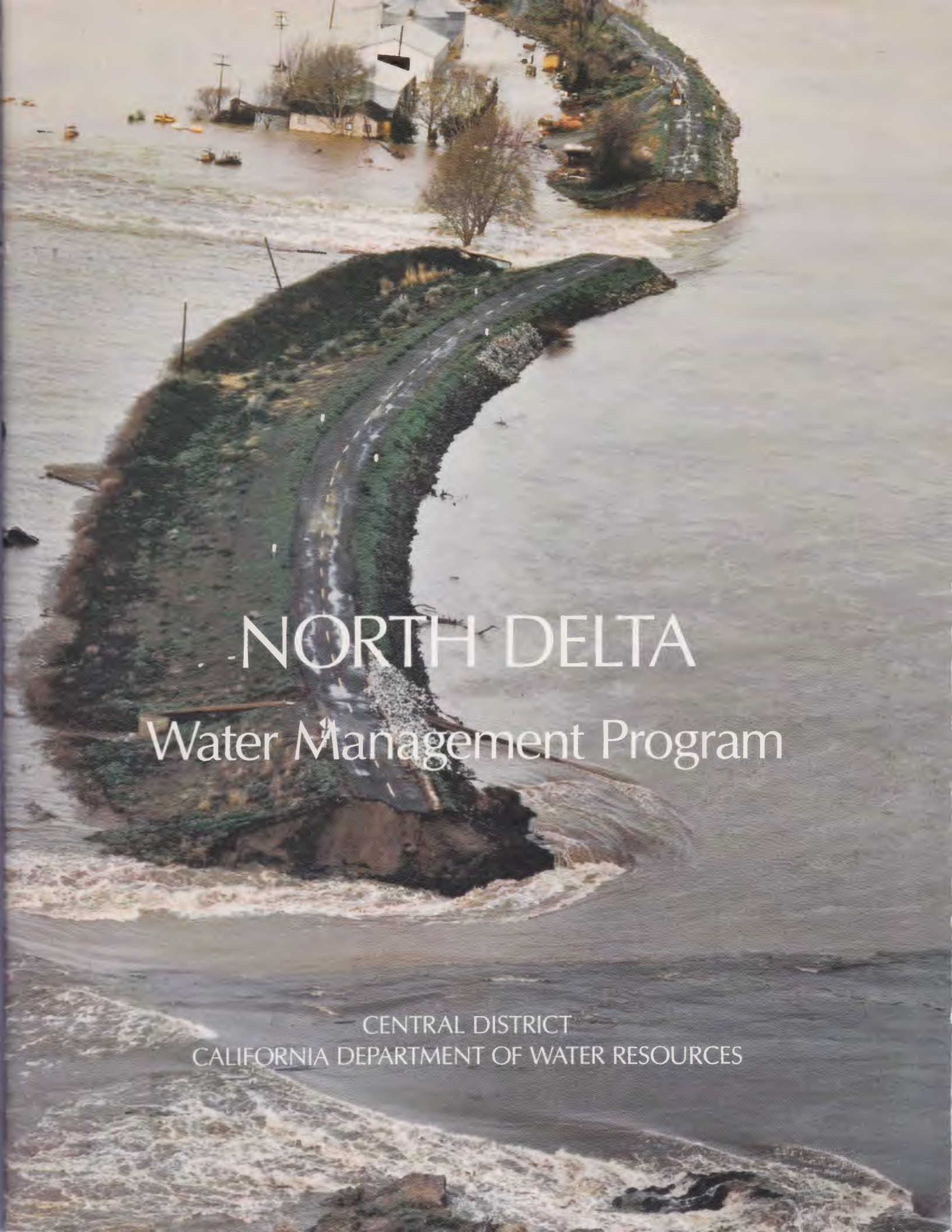

NORTH DELTA

Water Management Program

CENTRAL DISTRICT
CALIFORNIA DEPARTMENT OF WATER RESOURCES

ON THE COVER --

←In February 1986, a double levee failure on Tyler Island, along the North Fork Mokelumne River, flooded more than 8,000 acres, forcing evacuation of area residents and threatening the community of Walnut Grove.
(Sacramento Bee/Randy Pench)

→Snodgrass Slough, near Lambert Road, provides important habitat for wildlife. This area remains in a natural condition, but flooding is common.
(DWR/Central District)

NORTH DELTA
WATER MANAGEMENT PROGRAM

Department of Water Resources
Central District

March 1988

Gordon K. Van Vleck
Secretary for Resources
The Resources Agency

George Deukmejian
Governor
State of California

David N. Kennedy
Director
Department of Water Resources

FOREWORD

Water management issues surrounding the Sacramento-San Joaquin Delta continue to challenge water resource planners in California. Many agree there are problems and urge that they be corrected, but a consensus on how best to solve them has not yet been reached. Problems include frequent flooding due to unstable levees and constricted channels, flow patterns that are unfavorable for fish and water quality, and water level and circulation patterns that hinder irrigation.

During the last several years, various water resources problems have been corrected through application of the public environmental documentation and regulatory permit process. This process has also shown the importance of Federal permit regulations in governing projects in the Delta estuary.

To facilitate planning, the estuary has been divided into three study areas for evaluation of problems and needs unique to each area -- North, South, and West. This report discusses concepts for a North Delta Water Management Program. The long-term planning and environmental documentation process will include other reports and will take about three years to complete.

Planning flexibility afforded by the environmental documentation and regulatory permit process is expected to allow many of the concerns surrounding Delta water management to be resolved.

James U. McDaniel, Chief
Central District

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Chapter 1. INTRODUCTION

The North Delta Water Management Program represents parallel planning and environmental documentation to improve existing conditions in the northern portion of the Sacramento-San Joaquin Delta. The program includes a public review of problems, alternative solutions, impacts, and mitigation to provide information for selecting corrective action. This process brings to light the many interests and their valid concerns related to water resources planning in the Delta. The program will also include investigation of the cumulative effects of any corrective action when coupled with other facilities statewide and in the Delta.

The study area generally includes channel systems south of Sacramento, north of the San Joaquin River, east of Rio Vista, and west of Thornton, as shown in Figure 1.

The Objectives

Multipurpose objectives will be considered to meet the broad range of water management issues surrounding the Delta. Primary objectives of this program are to help alleviate flooding in the towns of Thornton and Walnut Grove, reduce reverse flow in the lower San Joaquin River, improve water quality, reduce fishery impacts, and improve water supply reliability. Secondary objectives are to improve navigation and enhance recreational opportunities.

The Planning Process

The planning process allows flexibility in formulating and selecting project alternatives and mitigation measures, and facilitates coordination of related local, State, and Federal planning. The process will also investigate the cost-sharing allocation among Delta interests, water users, and other beneficiaries. Related planning programs will be coordinated to reinforce benefits and minimize costs.

The environmental documentation process is required for Federal and State regulatory permits and agreements. Federal regulatory permits are required to authorize any selected alternative. Also, numerous State and local regulations apply. This assures involvement by key agencies such as the National

Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and California Department of Fish and Game.

The Department of Water Resources is working closely with the U.S. Army Corps of Engineers to determine the Corps' possible involvement through existing or newly authorized flood control programs. The Corps has already held a preapplication meeting regarding this North Delta Water Management Program and its regulatory permit authority.

The Schedule

The planning and environmental documentation process for the North Delta Water Management Program is scheduled for completion in about three years. The schedule is shown below:

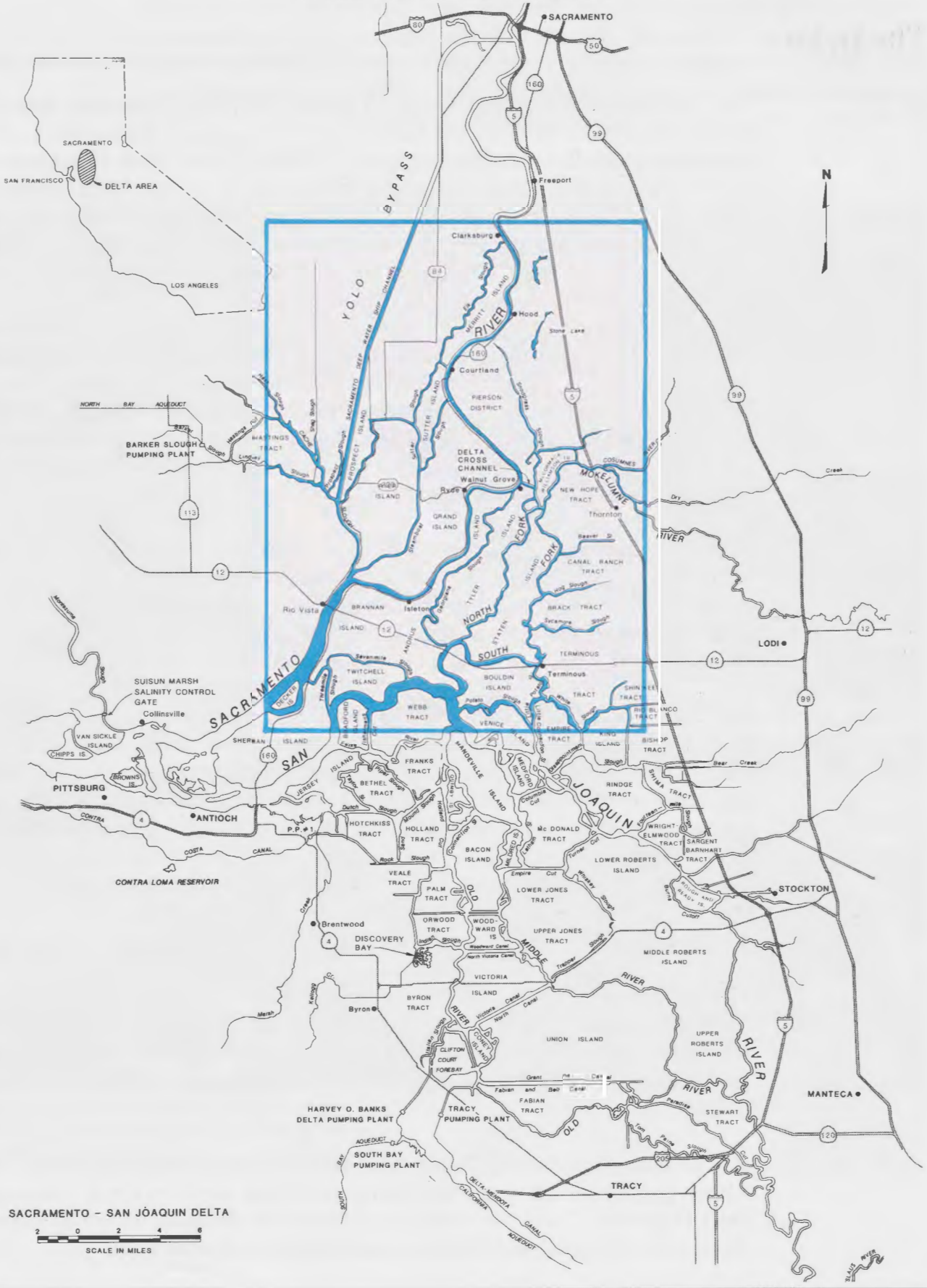
Public Scoping Meetings (completed)	*Mid-1987*
Planning Report	*Early 1988*
Notice of Preparation	*Early 1988*
Scoping Report	*Mid-1988*
Draft Environmental Document	*Late 1989*
Final Environmental Document	*Mid-1990*
Notice of Determination and Record of Decision	*Mid 1990*
Federal Permit Approval	*Late-1990*

The two public scoping meetings were held in August and September 1987 to identify significant issues and possible water management alternatives. This is the planning report.

The scoping report will describe significant issues identified in the public scoping meetings. The Notice of Preparation, a formal announcement that an environmental document is to be prepared, will offer an additional opportunity for the public and interested agencies to present related facts and express their views.

The draft environmental document will include a comprehensive evaluation of alternatives, impacts, and mitigation. After interested agencies and the public have reviewed the draft document, necessary changes, evaluations, and explanations will be provided for a final document. After this process is completed, a decision on a program will be possible using a State Notice of Determination and Federal Record of Decision.

Figure 1. NORTH DELTA WATER MANAGEMENT PROGRAM AREA OF IMPROVEMENTS



The Delta

The Sacramento-San Joaquin Delta is a unique and valuable resource. Natural runoff and floodflows from the Sacramento, San Joaquin, Mokelumne, and Cosumnes rivers flow into the Delta, which receives runoff from 40 percent of the State's land area. Until reclaimed by levees built in the late 1800s and early 1900s, the Delta was a tidal marsh. The Delta supports hundreds of species of fish, wildlife, and plants. It is part of an interconnected estuary system that includes the Suisun Marsh and San Francisco Bay and provides a passageway to and from the Pacific Ocean for migrating fish.

The Delta covers 700,000 acres interlaced with hundreds of miles of waterways. Much of the land is below sea level and relies on more than 1,000 miles of levees for protection against flooding. Unstable levees and limited channel capacity lead to repeated and expensive flooding. The most serious recent flooding in the north Delta was in February 1986. The levees protect hundreds of miles of highways, pipelines, railroads, and powerlines.

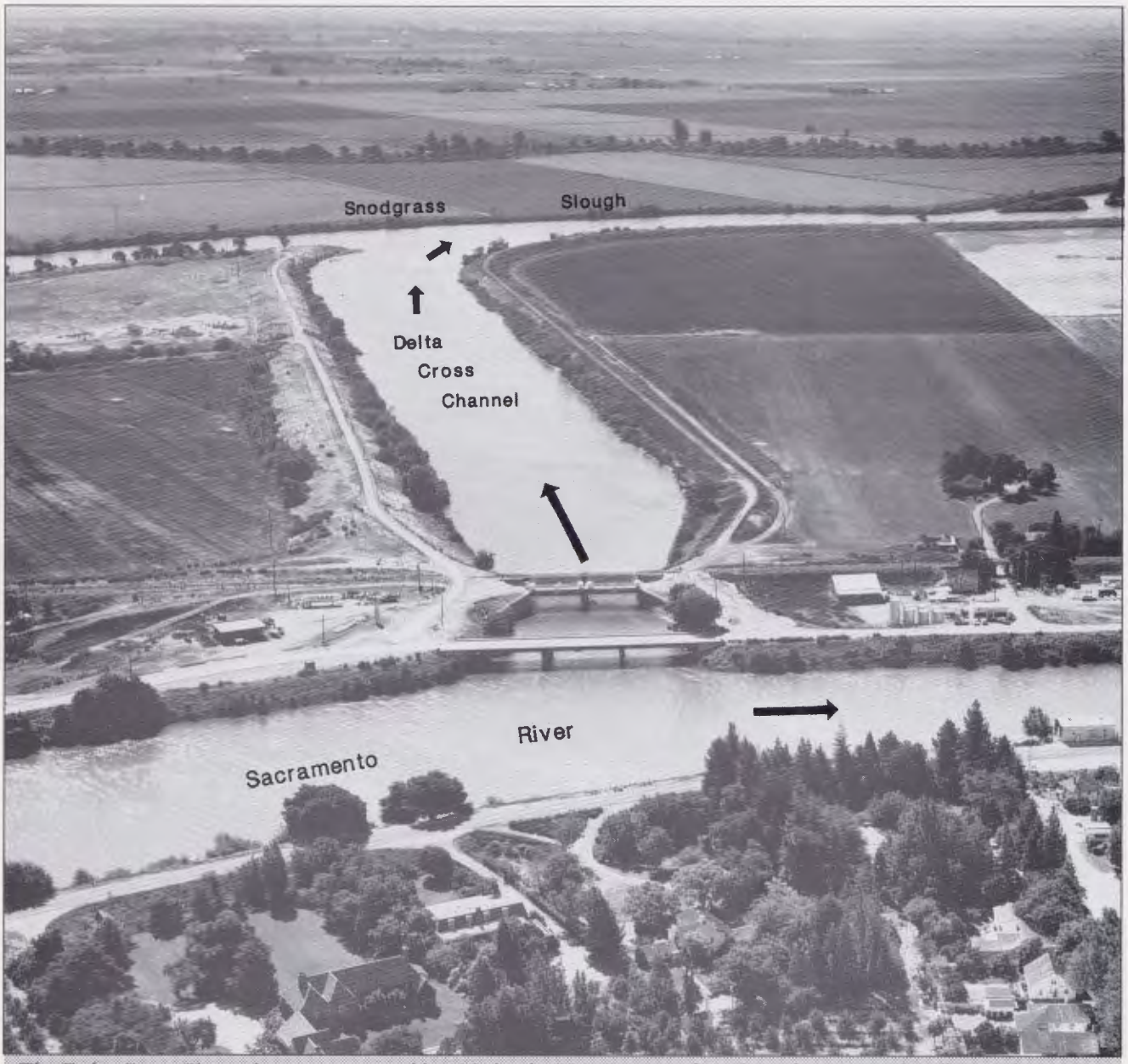
Water projects divert water from Delta channels to meet the needs of about two-thirds of the State's population and to irrigate 4.5 million acres. Export facilities of the Central Valley Project and the State Water Project are in the south Delta, about 12 miles northwest of Tracy. Other diversion facilities include the North Bay Aqueduct, Contra Costa Canal, and 1,800 local irrigation diversions.

The Delta Cross Channel, a Federal facility, was constructed in 1951 to improve water conveyance through the Delta, but further improvements are needed. The Delta Cross Channel, about 30 miles south of Sacramento, diverts water from the Sacramento River into eastern Delta channels, including the South Fork Mokelumne River, which have inadequate capacity and are vulnerable to levee failure during flood periods such as February 1986. Channels in addition to the Delta Cross Channel and South Fork Mokelumne River that convey water across the Delta include Georgiana Slough, North Fork Mokelumne River, San Joaquin River, Old River, and Middle River.

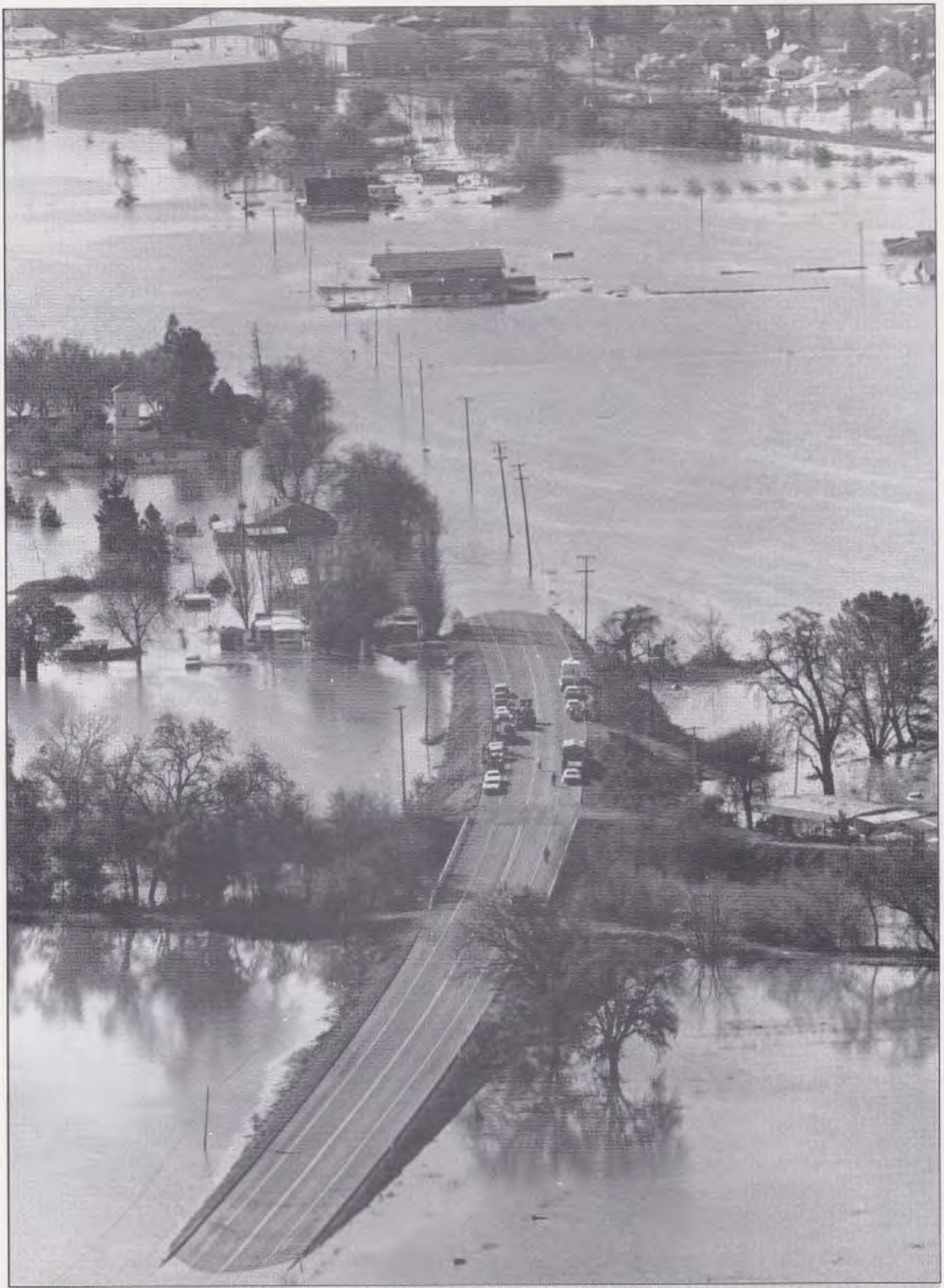
The northern portion of the Delta has many smaller rivers and channels also, which are popular with boaters and anglers. These channels are heavily overgrown with native vegetation and appear to be untouched. The Delta Meadows area, along Snodgrass Slough, has especially heavy recreation use during spring and summer.

The small communities of Courtland, Locke, Walnut Grove, Terminous, and Isleton provide agricultural, recreational, and other services. Local roads and State Highways 12 and 160 provide basic access to the area. Access to recreational areas is limited and is best met with private and rental boats.

The north Delta is basically an agricultural area, but demand for more marinas and boating facilities continues to increase. There are large marinas at Terminous, Walnut Grove, Oxbow (on Georgiana Slough), New Hope, and along the south and east sides of Andrus Island. Sacramento County is receiving requests to change the agricultural zoning to allow more intensive recreational types of development.



The Delta Cross Channel was constructed in 1951 by the U.S. Bureau of Reclamation, Central Valley Project, to improve water conveyance through the Delta.
(DWR 5435-52)



Failure of the Mokelumne River levee flooded the community of Thornton on February 20, 1986.
(Sacramento Bee/Randy Pench)

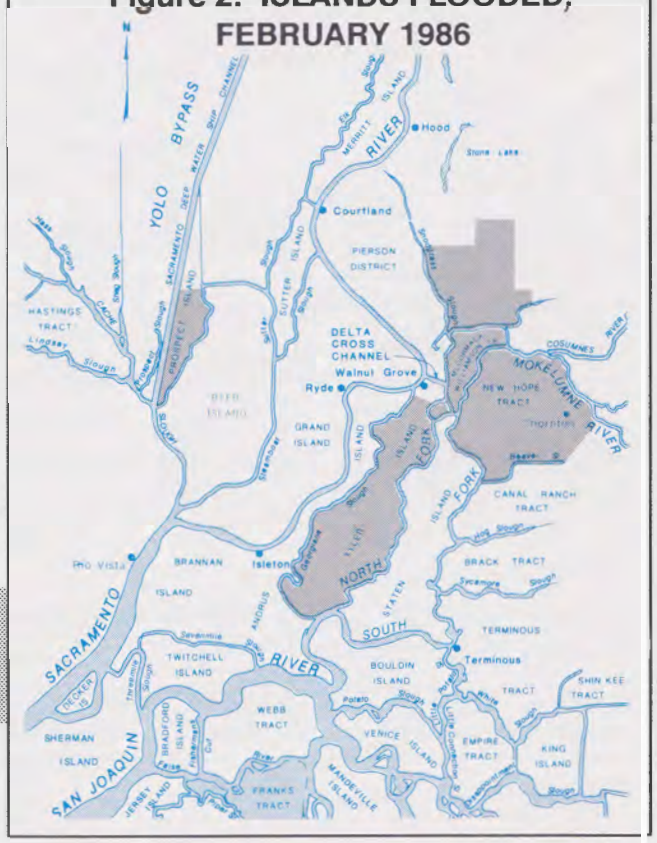
Chapter 2. WATER PROBLEMS IN THE NORTH DELTA

Objectives of the North Delta Water Management Program are to resolve such problems as flood control and increased channel capacity for water transfer. Enlarging channels in the north Delta would improve water transfer and help alleviate flooding, while reducing reverse flow, improving water quality, reducing fishery impacts, and improving water supply reliability.

Flooding

During February 1986 storms, peak floodflows in the Cosumnes River, Mokelumne River, and Dry Creek exceeded channel capacity. In addition to areas that flood periodically, levees failed due to overtopping and instability in the northeast Delta on Dead Horse and Tyler islands and New Hope Tract (Figure 2). Inundation of the two larger islands lowered the flood elevation and probably saved other islands from flooding. For a short time, water flowed over the Delta Cross Channel gates from the Sacramento River into the Mokelumne River system.

Figure 2. ISLANDS FLOODED, FEBRUARY 1986



Winter storms and resultant flooding in 1986 demonstrated the need for improved flood protection in the north Delta.

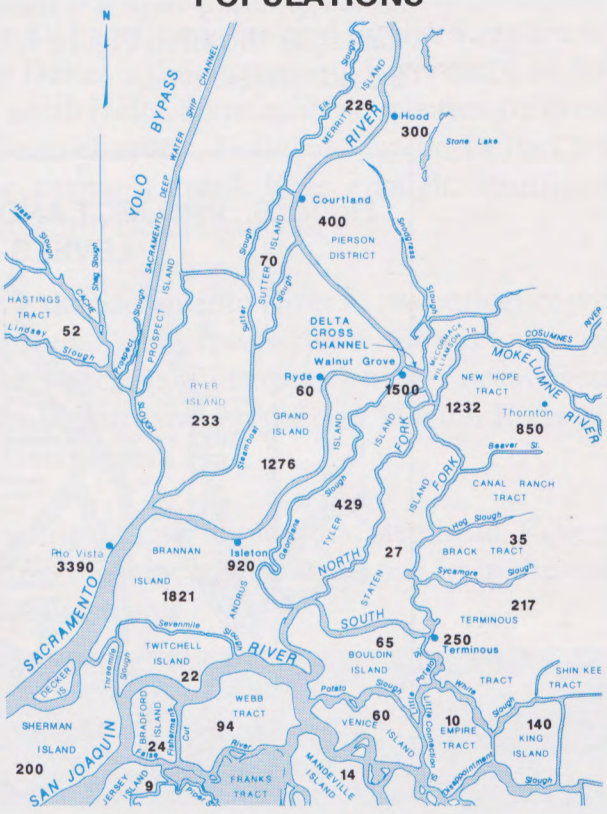
Inflow to northeastern Delta channels is from the Cosumnes River, the Mokelumne River (and Dry Creek), and the Morrison Creek stream group (Figure 3). Of these, only the Mokelumne River has significant upstream storage facilities to help regulate flows. The north and south forks of the Mokelumne River must carry all of the floodflows through the north Delta; there is no bypass system such as that used for the Sacramento River system. The limited channel capacity of the Mokelumne River and its forks restricts floodflows, causing water levels to rise. This causes overtopping and increases water pressure against levees.

Figure 3. DRAINAGE AREAS, NORTHEAST STREAMS

Significant storm runoff flows into north Delta channels from about 2,000 square miles of drainage area. Peak runoff rates from the Morrison Creek drainage basin may increase in the future due to channel modifications that will permit water to move toward north Delta channels at a faster rate. Peak inflow rates can exceed 50,000 cubic feet per second from all drainage, and storage for flood control purposes is very limited.

The 1986 storms forced evacuation of 1,600 people from the area, caused $20 million worth of damage, and flooded Interstate 5 and numerous local roads. Had the Corps of Engineers (with State and local assistance) not raised a temporary levee south of Walnut Grove, the town would have flooded, and residents would have been driven from their homes. This near catastrophe demonstrated the urgent need for a flood control project. Figure 4 shows populations of islands and communities in the north Delta.

Figure 4. ISLAND AND COMMUNITY POPULATIONS



More than 2,000 people, their homes, and valuable farmland are in danger when flooding occurs in the north Delta.

Upstream development could increase peak inflows and lead to further threat of flooding in the north Delta. The Corps of Engineers has conducted engineering and design studies for the Morrison Creek stream group. According to the Corps' March 1987 report on the studies, reservoir storage to regulate Morrison Creek floodflows is not economically feasible. A feasible alternative would be to improve about 25 miles of channel and modify the outlet structure and embankment on Lambert Road.

Sacramento City and County have undertaken some channel and levee work in the Morrison Creek drainage basin and will probably complete most channel improvements within the next 2 or 3 years. Under the Small Flood Control Projects authority, the Corps of Engineers is studying the outlet facility and roadway embankment at Lambert Road.

Another aspect of flood control is levee stability. There are two major designations of levees in the Delta: project and nonproject. Project levees are part of the Federal Flood Control Project and are primarily associated with the Sacramento and San Joaquin rivers. These levees provide dependable flood protection; however, they do not help carry floodflows of the northeastern streams. They constitute about 35 percent of the levee system.

The other 65 percent of the Delta levees were constructed and are maintained by island landowners or local levee and reclamation districts to varying and generally less stringent standards than those for project levees. Nonproject levees generally have less freeboard to protect against overtopping and are less stable. As shown in Figure 5, levees along the Mokelumne River system are of the nonproject type.

Figure 5. PROJECT AND NONPROJECT LEVEES

In addition to limited channel capacity, the entire Mokelumne River system in the north Delta relies on generally weaker, nonproject levees for protection. Various alternatives being considered would improve some levees, as well as channel capacity.

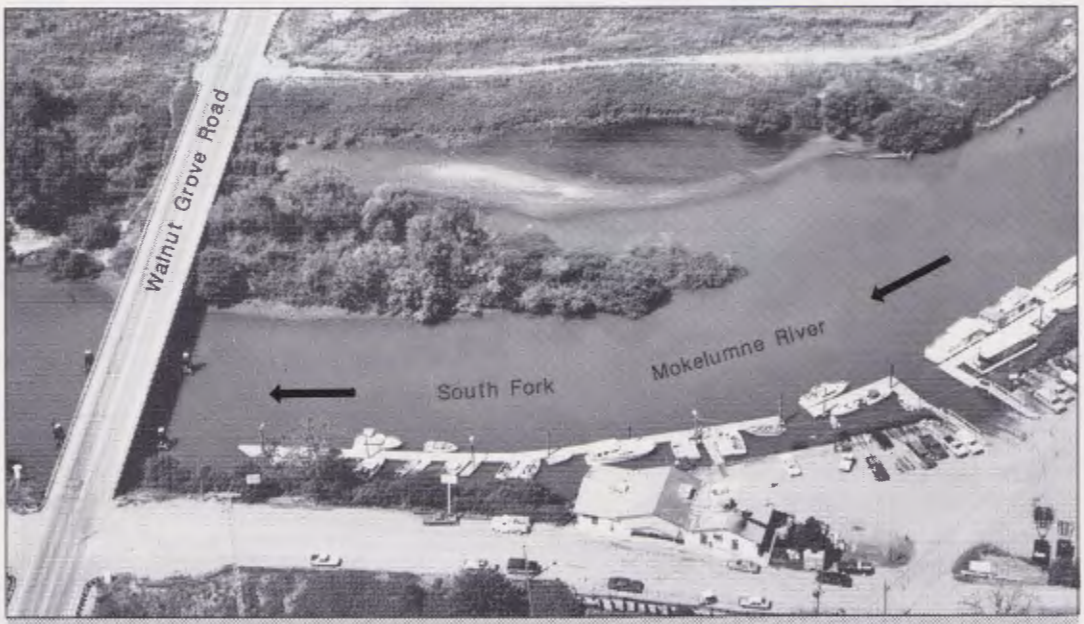
Reverse Flow

A primary objective of the North Delta Water Management Program is to reduce reverse flow and related adverse impacts. The expression "reverse flow" is used to characterize a problem that stems from the lack of capacity in certain Delta channels.

Water supplies for export by the Central Valley Project and the State Water Project are obtained from surplus Delta flows, when available, and from upstream reservoir releases, when Delta inflow is low and surplus flows are not available. These releases enter the Delta via the Sacramento River and then flow by various routes to pumps in the south Delta. Some of these releases are drawn to the pumps through interior Delta channels, facilitated by the Delta Cross Channel. However, because the channels aren't large enough, insufficient amounts of water pass through the north Delta channels.

The remaining water flows on down the Sacramento River to its confluence with the San Joaquin River in the west Delta. When freshwater outflow is low, water in the west Delta becomes brackish because it mixes with saltier ocean water entering as tidal inflow and is drawn upstream into the San Joaquin River and other channels by the pumping plants (Figure 6).

Reverse flow disorients migratory striped bass, salmon, and steelhead. Reverse flow further increases the impacts on fish by pulling small fish from the west Delta nursery area toward the pumping plants.



Channel capacity is reduced by sandbars such as this large one on the South Fork Mokelumne River near New Hope.
(Ed Asmus Photography)

Reverse flow could be moderated or eliminated by improving transfer efficiency of the north Delta channels. The same channel improvements needed for water transfer would also benefit flood control. Also, water supply for the State Water Project would be increased considerably. As it now stands, during operational periods that cause reverse flow, more water than is needed for export must be released from project reservoirs to repel intruding seawater, to maintain required water quality in west Delta channels, and to meet export quality standards. The amount of extra outflow required is substantial. An efficient means of transfer through the north Delta would make better use of freshwater storage, and the State Water Project could gain up to 400,000 acre-feet per year in dependable supply.

Improving hydraulic conditions to encourage more water to follow the desirable path (Figure 7) would also benefit Delta water quality, the fisheries, and reliability of the water supply for many Californians.

Figure 6. FLOW DISTRIBUTION, WITH AND WITHOUT REVERSE FLOW

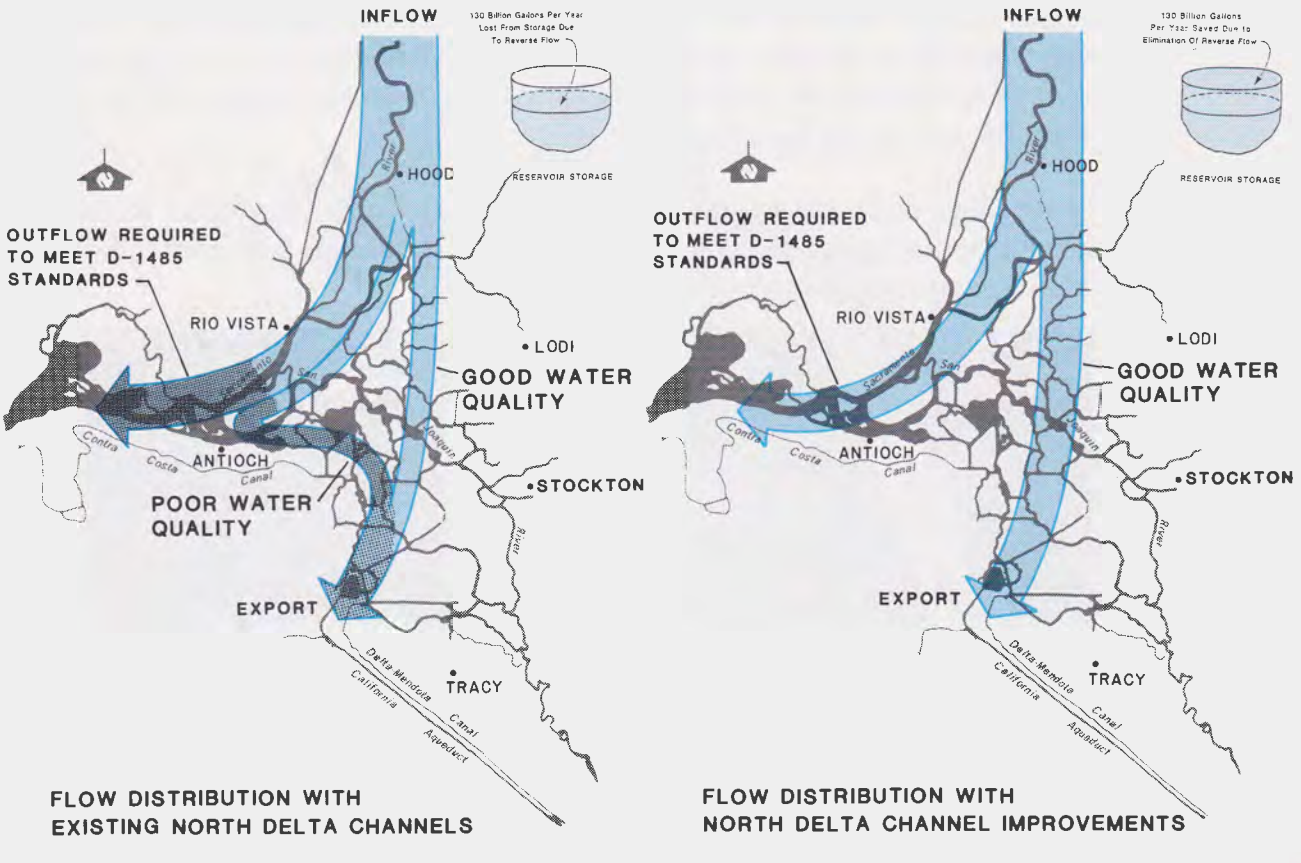
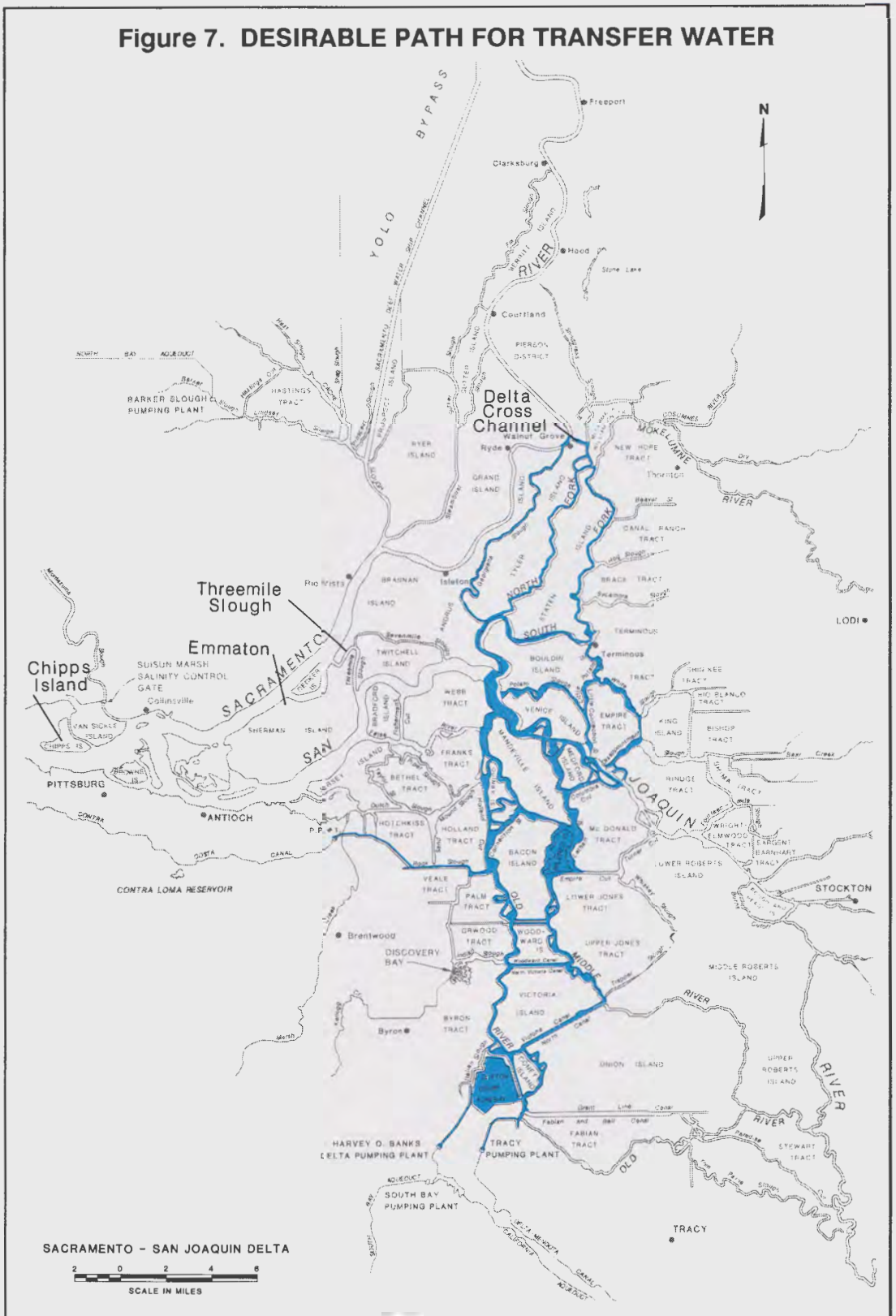


Figure 7. DESIRABLE PATH FOR TRANSFER WATER



Channels of the Sacramento-San Joaquin Delta are an integral part of the State Water Project and Central Valley Project system. Today's transfer system started with construction of the Delta Cross Channel, in 1951. Further channel improvements are needed to correct existing problems. The North Delta Water Management Program, combined with other levee rehabilitation programs, can provide for an efficient and dependable system.


YOLO BYPASS
PROSPECT ISLAND
Walnut Grove
RIVER
ISLAND
SACRAMENTO
TYLER
Isleton
NORTH
SOUTH

During the February 1986 floods, peak flows from the Mokelumne and Cosumnes Rivers and Dry Creek exceeded channel capacity, causing extensive flooding. Glanville, McCormack-Williamson, and New Hope Tracts, Tyler and Dead Horse Islands, and the community of Thornton were flooded from either levee overtopping or levee failure. More than 2-1/2 miles of Interstate 5 north of the Mokelumne River and numerous local roads were under water. About 1,600 people were evacuated, and $20 million in damage was caused by the flood. Future upstream development could increase peak inflows and cause further threat of flooding in the north Delta. Improvements to the South Fork Mokelumne River can help protect against such extensive flooding in the future.

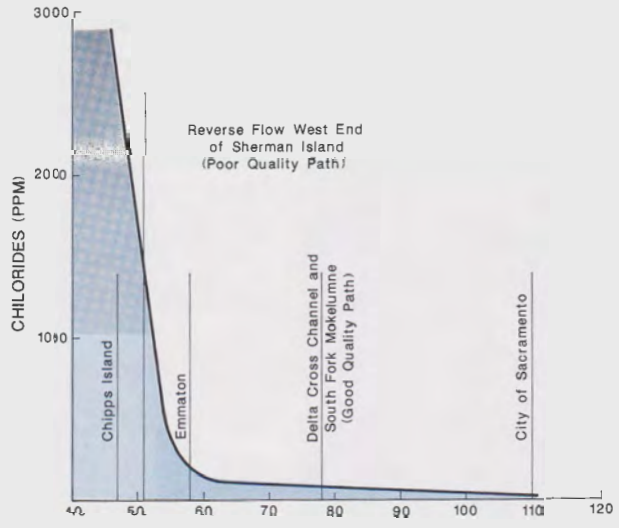
◀ Location of 1986 levee break.

Water Quality

Water quality in the Delta is protected by many standards established by the State Water Resources Control Board and by the Coordinated Operation Agreement between the Bureau of Reclamation and the Department of Water Resources. In addition, various contracts with Delta users also include other levels of water quality protection. The standards are periodically reviewed to protect beneficial uses of the water supplies. However, water quality conditions can be further improved by reducing reverse flow.

Figure 8, a graph of the Sacramento River salinity gradient, illustrates the undesirable nature of the reverse flow path.

Figure 8. SALINITY GRADIENT, SHOWING INCREASING CHLORIDES WITH REVERSE FLOW CONDITIONS



At the City of Sacramento, 110 miles from the Golden Gate, chloride concentrations (a measure of ocean salinity) are low, and they remain so past the Delta Cross Channel and South Fork Mokelumne River. Water from these sources is low in ocean salts. Downstream of Emmaton, chloride levels begin increasing at a faster rate.

The Delta Cross Channel, Georgiana Slough, and Threemile Slough leave the Sacramento River in the good quality portion of the gradient and can provide a desirable path for water supplies. The reverse flow path continues into the portion of the salinity gradient near the western end of Sherman Island, about 50 miles from the Golden Gate. In this area, the water is blended with water having chloride levels of more than 1,000 parts per million.

Another concern is that Delta water contains precursors of trihalomethanes (THMs), suspected carcinogens produced when chlorine used for disinfection reacts with natural substances during the water treatment process. Dissolved organic compounds that originate from decayed vegetation act as precursors by

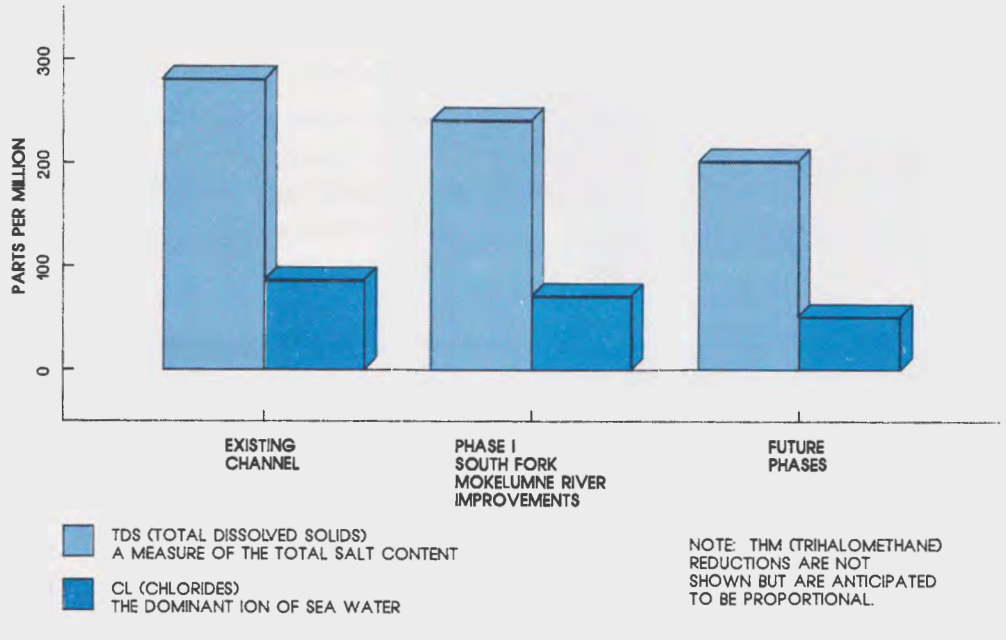
providing a source of carbon in trihalomethane formation reactions. During periods of reverse flow, bromides from the ocean intermix with Delta water at the western edge of Sherman Island. When bromides are present in water along with organic THM precursors, trihalomethanes are formed that contain bromine as well as chlorine.

Drinking water supplies taken from the Delta are treated to meet current THM standards; however, more restrictive standards are being considered. If adopted, tighter standards will increase the cost and difficulty of treating present Delta water sources. By reducing reverse flow, export water would follow a more direct path, avoiding ocean bromides and thus reducing THMs.

The degree to which water quality could be improved by the North Delta Water Management Program depends on the course of action selected. Project alternatives and phases being considered are described in Chapter 3.

Figure 9 shows estimated water quality improvement with each possible project phase. The water quality improvement would be due to a reduction in reverse flow. It is estimated that total dissolved solids and chlorides would decrease by 10 to 40 percent and that bromides would decrease proportionately.

Figure 9. ESTIMATED LONG-TERM AVERAGE EXPORT WATER QUALITY IMPROVEMENTS FROM REVERSE FLOW REDUCTION

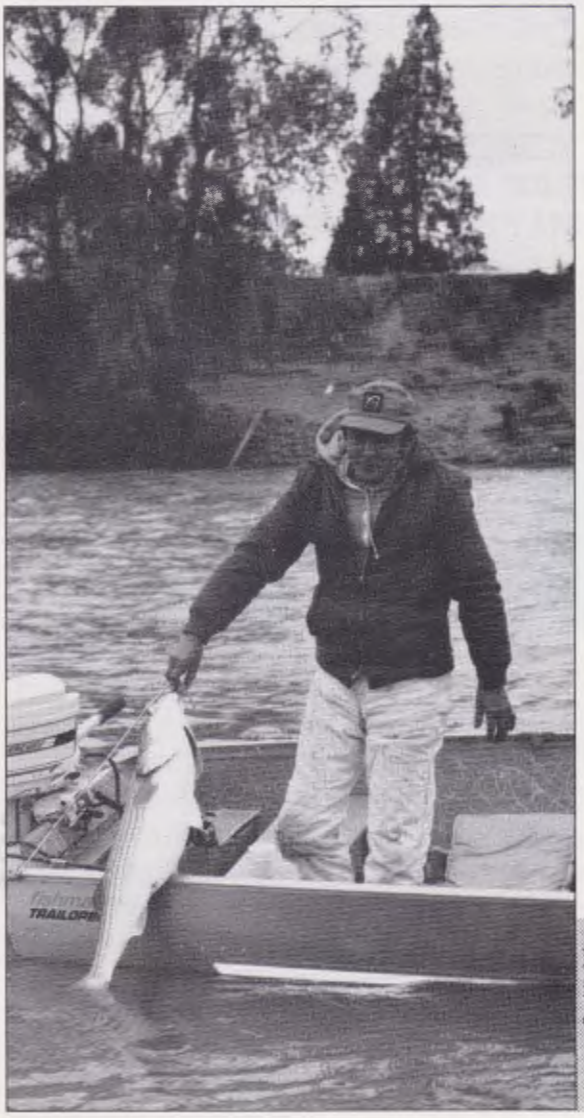


Fisheries

Some steps taken to improve and protect the Delta fishery include:

- *Protection standards for flow, quality, export, and operation of the Delta Cross Channel;*
- *A fish protection agreement for the Banks Pumping Plant;*
- *Improved screens for the State Water Project, and Pacific Gas and Electric Company;*
- *Protective laws for fish and wildlife; and*
- *Funding for environmental research and monitoring.*

Additional improvement can be provided by reduction of reverse flows, which create an undesirable environment for migrating fish, young striped bass, and fish food organisms. Reverse flows increase direct impacts on fish at the Skinner Fish Facility, primarily because striped bass larvae and juveniles are in high concentrations where reverse flow exists in the Sacramento River and west Delta. During reverse flow conditions, higher concentrations of fish are carried to State and Federal export facilities. Also, young striped bass that have been spawned in the lower San Joaquin River between Antioch and Venice Island (within the area of reverse flow) are drawn to the pumping plants.



Delta waters are important to both migrating and resident fish. Striped bass fishing is especially popular.

DWR 3891-1

June, July, and August are the months of greatest striped bass entrainment losses at the Skinner Fish Facility because of the direction and quantity of flow and the abundance of striped bass. With reduction of reverse flow, present striped bass losses due to direct entrainment could be reduced significantly. Salmon and other fishery concerns require investigation and will be evaluated in the environmental documentation process.

Water Supply Reliability

A primary purpose of the State Water Project is to provide a safe, reliable water supply for people, farms, and industry in California. The Delta is the natural collecting area of the Central Valley's fresh water and is actually an insecure part of each of the export projects. Improvements from the North Delta Water Management Program, plus other programs to improve reliability of the Delta's levees, will in turn greatly enhance the reliability of the State Water Project and other Delta diverters.

The Delta is also connected to the downstream saline bays and is subject to tidal action and salinity intrusion during low outflow periods. Releases from upstream reservoirs presently maintain summer outflow to meet State Water Resources Control Board criteria (Decision 1485).

Present water transfer operations require that Delta outflow needed to meet salinity criteria for project water quality sometimes be in excess of that needed for Decision 1485 criteria. Therefore, at certain times of the year, additional outflow is needed to move salinity farther downstream so that reverse flow can occur without serious degradation of export water quality (Figure 6, page 12).

The Department is constantly reviewing methods to extend the supply of the State Water Project. A great deal of effort has been spent on conservation, reclamation, and water marketing measures. If North Delta Water Management improves Delta water transfer into the more easterly Delta channels, then reverse flow will be reduced or eliminated. This will save water through more efficient use of Delta outflow to meet Decision 1485 criteria, while improving water quality and reliability. Figure 6 shows the more efficient operation and potential water savings.

Chapter 3. WATER MANAGEMENT PLANNING

Environmental documentation will be an important factor in developing a plan and a cost-sharing allocation. Water management planning in the north Delta will include consideration of multi-purpose objectives, including solutions to the problems of flooding and water transfer. This planning will investigate the cost and cost-sharing of various alternatives, the environmental benefit or harm, and the benefits received.

Environmental Documentation

The public environmental documentation process is being used to gather information on impacts, alternatives, and mitigation for a North Delta Water Management Program. Also, information needed for Federal, State, and local permits is being incorporated into this process.

The California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) mandate preparation of environmental impact reports and environmental impact statements when planning public or private projects. The acts establish methods for preparing these reports and arriving at a decision. This process is required to obtain Federal permits.

In planning for a North Delta Water Management Program, the Department of Water Resources will comply with CEQA and NEPA requirements, as well as with State Water Resources Control Board water right standards. In accordance with requirements of CEQA and NEPA, all the alternatives addressed will be discussed in the environmental documents. The process will study alternatives for flood protection; effects on the State-developed water supply; cumulative impacts; growth-inducing impacts; effects on wildlife, vegetation, the fishery, water quality, and recreation; and mitigation measures for adverse impacts that cannot be avoided.

Permits

Several State and Federal permits will be required before implementation of any North Delta Water Management Program activities. Table 1 lists permits that will be considered during the planning process and specifies conditions and permitting agencies. Some will apply to this program and others will not.

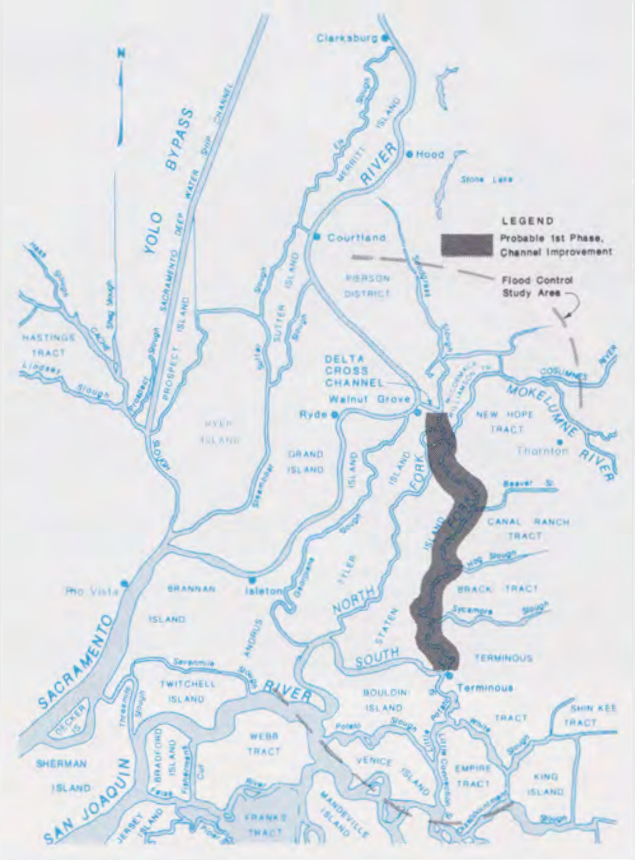
Table 1. POTENTIAL PERMITS

Agency	Permit Description	Permit Conditions
State Lands Commission	Dredging Permit	Required for any proposal to dredge in State-owned swamps, overflows, marshes, tidelands, and submerged lands or in the beds of navigable waters where the State has mineral rights.
	Land Use Lease	Required for any proposal to use State-owned lands for purposes other than dredging; mining; or oil, gas, or geothermal exploration.
Corps of Engineers (in coordination with U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Environmental Protection Agency)	Dredging Permit (Section 404, Clean Water Act) Navigation Permit (Section 10, Rivers and Harbors Act)	Required for any proposal to locate a structure, excavate, or discharge dredged or fill material into waters of the United States or to transport dredged material for the purpose of dumping it into ocean waters. Required for any proposal to divert or alter navigable waters in the United States, including wetlands.
Department of Fish and Game	Navigation Dredging Permit	Required for any proposal to use suction or vacuum dredging equipment in any river, stream, or lake designated as open.
	Stream or Lake Alteration Agreement	Required for any activity that will change the natural state of any river, stream, or lake in California.
Caltrans	Encroachment Permit	Required for any proposal to do work or place an encroachment on or near a State highway or proposal to develop and maintain access to or from any State highway.
	Utility Encroachment Permit	Required for work done by public utility companies providing services, such as gas, electricity, telephone, for most work within the right of way of a State highway.
Reclamation Board	Encroachment Permit	Required for any activity along or near the banks of the Sacramento and San Joaquin rivers or their tributaries. The Reclamation Board also issues encroachment permits for activity on any "designated floodway" or flood control plan adopted by the Legislature or the Board within the Central Valley.
Air Pollution Control District	Authority to Construct	Required for any proposal to construct, modify, or operate a facility or equipment that may emit pollutants from a stationary source into the atmosphere.
	Permit to Operate	Required for any proposal to operate equipment that emits pollutants into the atmosphere. A Permit to Operate must be obtained from the Air Pollution Control District (APCD) for the area in which the equipment is located. The project sponsor may apply for the permit only after obtaining an Authority to Construct from the APCD and completing the construction or modification according to the terms of the Authority to Construct.
Public Utilities Commission	Certificate of Public Convenience	Required for all common carriers before constructing or enlarging any system, facility, transmission line, or pipeline. Common carriers are private gas, electrical, telephone, telegraph, water, sewer and heat corporations with facilities available for public hire.
California Energy Commission	Notice of Intention and Application for Certification	Required for any proposal to construct a thermal power plant or electric transmission line.
State Water Resources Control Board, Division of Water Rights	Permit to Appropriate Water	Required for proposal to divert water from a surface stream or other body of water for use on nonriparian or any proposal to store unappropriated surface water seasonally.
Department of Water Resources, Division of Safety of Dams	Approval of Plans and Specifications and Certificate of Approval	Required for any proposal to construct or enlarge a dam or reservoir.
Involved Counties	Land Use Approval	Required for any proposal to alter land use.

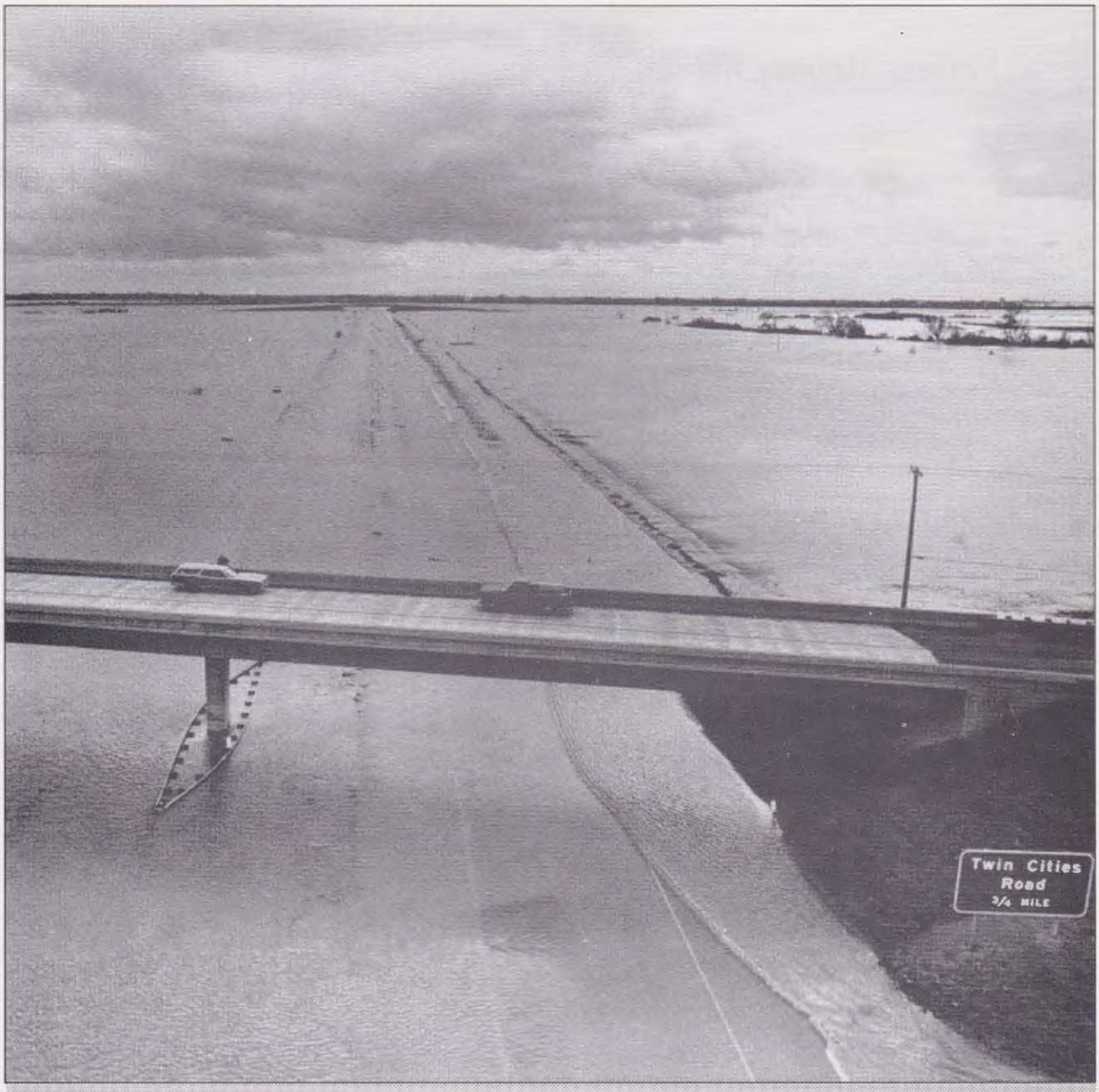
Some Actions Being Considered

The North Delta Water Management Program will be implemented in phases. A probable alternative being considered for the first phase is to increase hydraulic capacity of the South Fork Mokelumne River by dredging, levee setbacks, and levee improvements (Figure 10). The present channel cross-sectional area is about 2,000 square feet near the Delta Cross Channel to more than 8,000 square feet near Terminous. Flood elevations are highest where the cross-sectional area is smallest. The area to be investigated for the first phase extends generally from Interstate 5 to the San Joaquin River. Enlarging the cross sectional area would provide significant flood control benefits and increase the amount of water following the desirable path to the export pumps.

Figure 10. FIRST PHASE, NORTH DELTA WATER MANAGEMENT, CHANNEL IMPROVEMENT

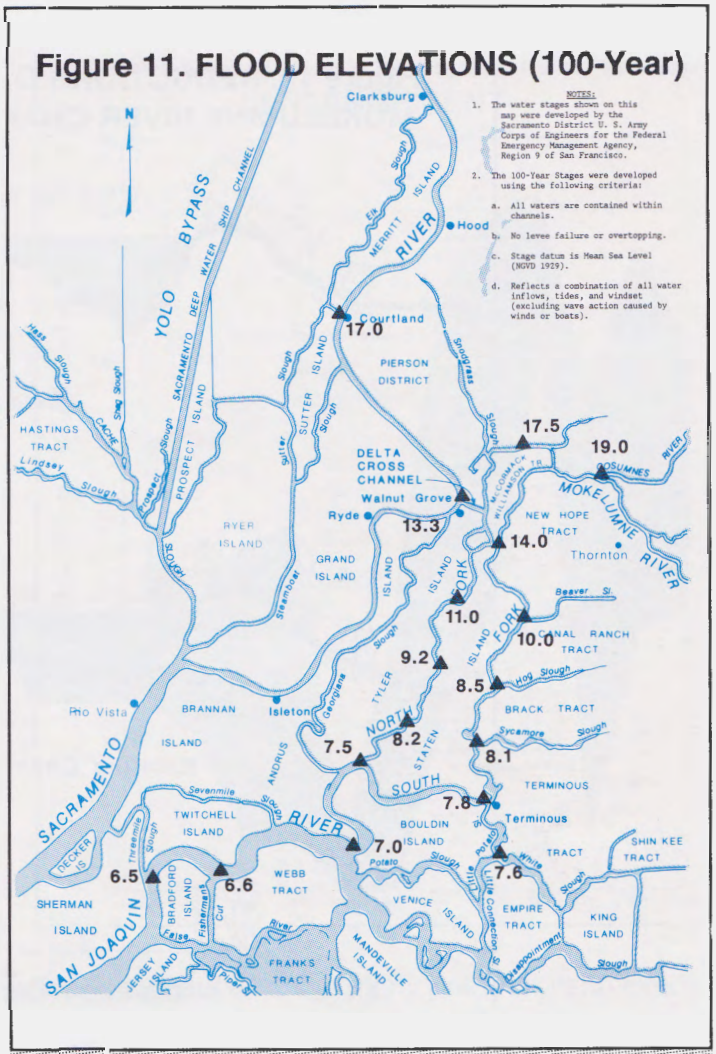


Also to be considered will be modifying or raising the Delta Cross Channel gates to prevent Sacramento River floodwaters from flowing into the Mokelumne River system, as happened for a short period during the February 1986 storms.



During the February 1986 storms, Interstate 5 was closed for about 2 weeks in the Walnut Grove-Thornton area because of the flooding.
(Sacramento Bee/Randy Pench)

Figure 11 illustrates flood elevations developed by the Corps of Engineers in December 1986. Statistically, these elevations have the probability of occurring once every 100 years, and they are the criteria used in developing levee standards for the Flood Hazard Mitigation Plan (August 1986) required by the Federal Emergency Management Agency (FEMA).



The high flood elevations in the Walnut Grove-Thornton area demonstrate the effects of unregulated peak flood-flows, which are slowed by the restrictions in the South Fork Mokelumne River.

Preliminary analysis indicates that dredging the South Fork Mokelumne River could provide a 5 to 10 percent reduction of these flood elevations and that dredging accompanied by levee setbacks could result in reductions of well over 10 percent (Figure 12). Levee overtopping and subsequent failures following the February 1986 storms might have been substantially reduced by such channel improvements.

Figure 12. REDUCTIONS OF 100-YEAR FLOOD STAGE FROM MOKELUMNE RIVER CHANNEL CAPACITY IMPROVEMENTS

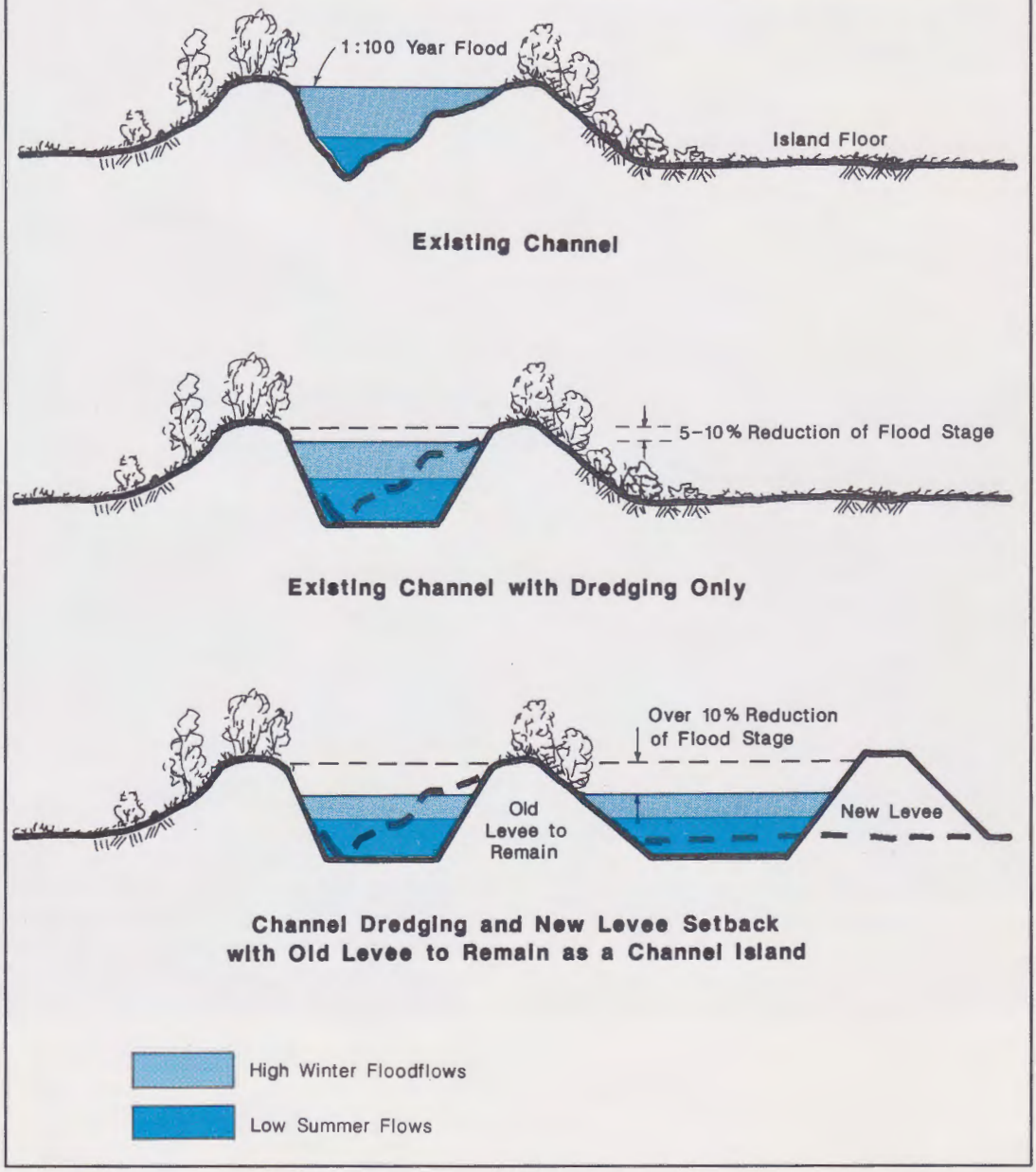
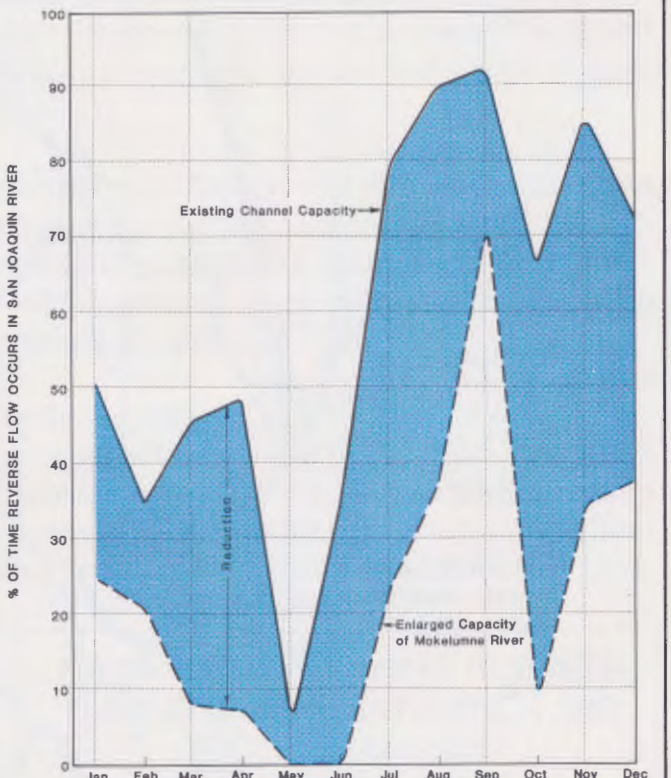


Figure 13 compares the percent of time reverse flow occurs with existing and enlarged channel capacity. These reverse flow changes occur because improvement of the South Fork Mokelumne River provides better hydraulics for water to follow the desirable path rather than the undesirable, reverse flow path.

Figure 13. REVERSE FLOW REDUCTION WITH SOUTH FORK MOKELUMNE RIVER ENLARGEMENT



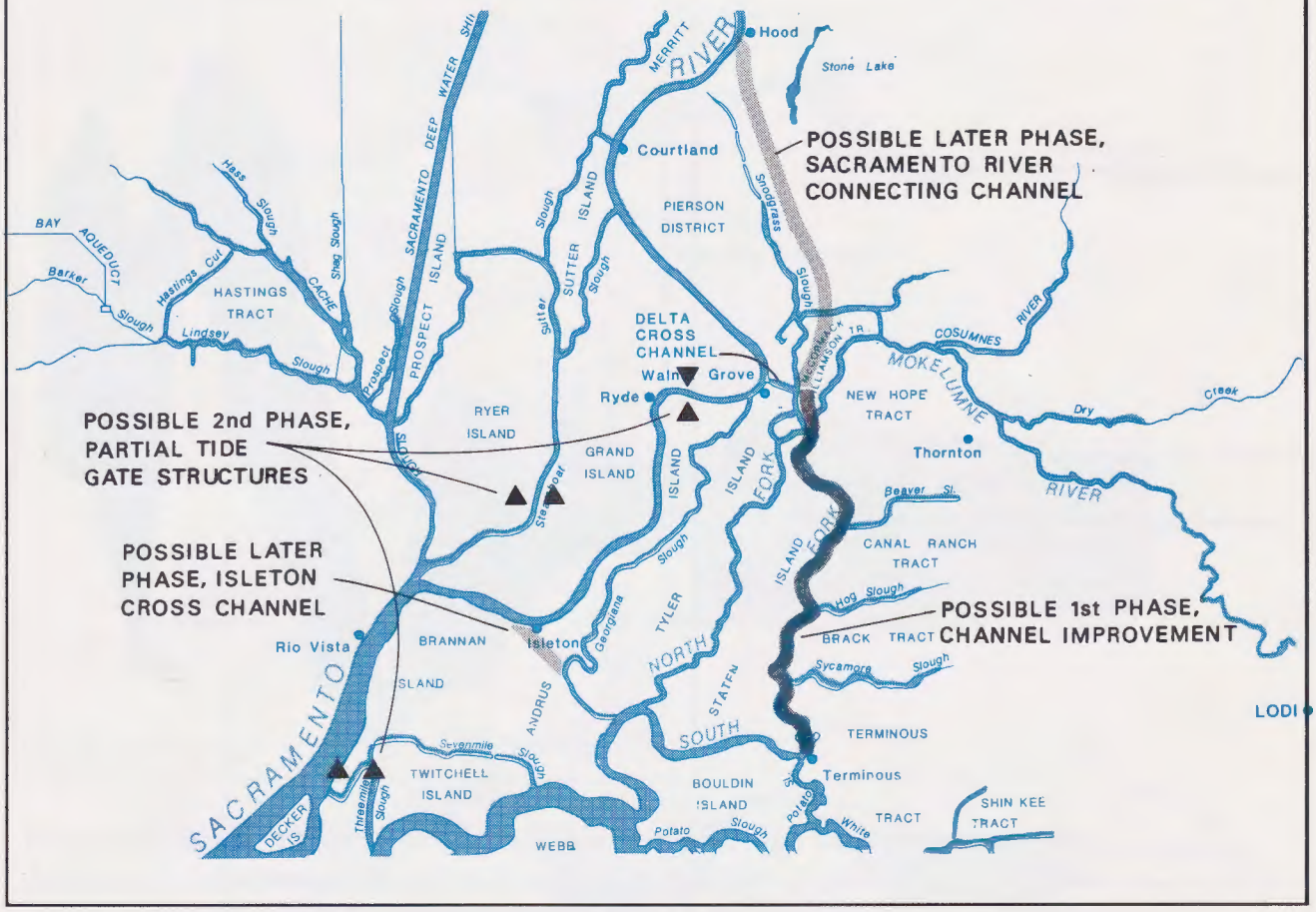
Significant reductions in reverse flow would occur in all months with the possible first phase, South Fork Mokelumne River enlargement.

As a consequence of this reverse flow reduction, the quality of Delta and export water supplies would be improved, adverse fishery impacts would be diminished, and the water supply would be more reliable because of more efficient management of reservoir storage.

Secondary project objectives such as navigational improvements would also be furthered by phase one improvements. By dredging these areas, more uniform depths, free of snags, could be obtained. In addition, recreational opportunities would benefit from this phase. (The Davis-Dolwig Act of the State Water Project authorizes recreation as a purpose and states that recreation facilities will be considered with any action.) By the year 2000, demand for recreation will increase dramatically.

After completion of phase one, operational experience will be gained and monitoring will be conducted before consideration of future phases. If monitoring shows that additional work is needed to further reduce reverse flow and to furnish further benefits, later phases will be evaluated. Phases of the North Delta Water Management Program now being considered are shown in Figure 14.

Figure 14. NORTH DELTA WATER MANAGEMENT PROGRAM ALTERNATIVES



The Delta river system is open to the Pacific Ocean via the Golden Gate and is influenced by tides. Each high water stage produces a flood tide that flows landward through Delta channels and raises water elevations. As the tidal cycle reverses, it produces an ebb tide that flows toward the ocean and lowers water levels in the Delta. Two high tides and two low tides occur each day. This regular cycle of changing flow directions and water elevations can be used to create desired hydraulic conditions by use of gate-type structures designed to open and close on different stages of the tide.

A second phase might consist of partial tide gate structures in the Sacramento River or Steamboat Slough. The structures would raise water levels slightly in the Sacramento River during low-flow conditions so that more water would flow

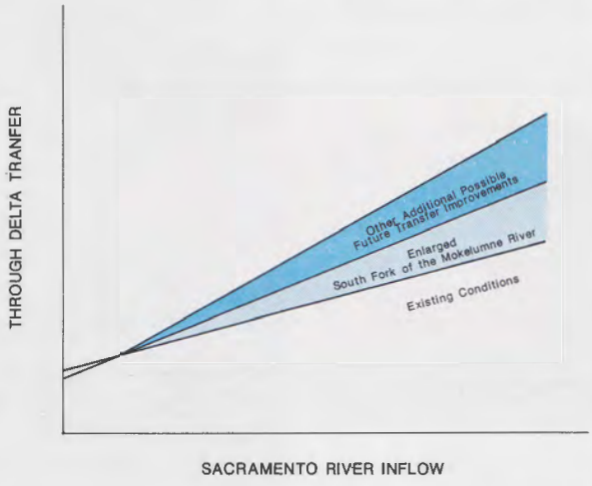
through the Delta Cross Channel and Georgiana Slough into the Mokelumne River system, a desirable path for export supplies. This also would diminish the amount of water following the undesirable reverse flow path around Sherman Island in the west Delta.

These structures would be open during flood conditions and would be designed not to interfere with floodflows. The structures would have permanent openings in the center to minimize impacts on navigation and fish, and they would be operated to comply with State Water Resources Control Board protective standards. Gates would be opened to let the incoming tide pass and would be closed to restrict the ebb, or declining, tide. The specific location and design of these structures has not yet been determined.

A third phase to reduce reverse flow might be a partial tide gate structure in Threemile Slough. A fourth phase might be a new Sacramento River connecting channel near Hood or Isleton to further improve efficiency of water transfer through the Delta. A new connecting channel would allow more water to be conserved in reservoirs to increase water supply reliability.

The general relationship between flow in the Sacramento River and water movement through the Delta for existing conditions, South Fork Mokelumne River enlargement, and other possible phases is shown in Figure 15. This relationship shows that each phase provides increased capability to transfer more water from the Sacramento River to provide a desirable path to export facilities.

Figure 15. RELATIONSHIP BETWEEN FLOW IN SACRAMENTO RIVER AND WATER TRANSFER THROUGH THE DELTA



This diagram shows how a phased program of possible transfer improvements can combine in the future to improve through-Delta transfer along the desirable quality path.

Concepts Not Now Being Considered

Some other concepts have been examined and set aside because significant issues challenge their feasibility or because they do not meet the project objectives.

One concept is to divert water from the Sacramento River into Snodgrass Slough, using the slough as a connecting channel to the Mokelumne River system. Doing so would adversely affect this environmentally sensitive area, which includes the scenic Delta Meadows.

A barrier to physically separate saline water of the San Francisco Bay system from fresh water of the Delta is an alternative proposed and studied many times since the late 1800s. Such a barrier would not meet the flood control objectives in the Thornton-Walnut Grove area. Any barrier downstream of Sherman Island would permit the existing flow pattern to continue and might not benefit the fishery. In addition, loss of tidal action might adversely affect levee stability, water quality upstream of the barrier, and scenery. It might also cause increases in algae and encourage water hyacinth production. (See the November 1983 report, *Alternatives for Delta Water Transfer*, for more information.)

One of the most controversial water projects ever proposed in California was the Peripheral Canal. This would have extended 43 miles, from Hood on the Sacramento River to the export pumps near Tracy. After years of debate, the project was overwhelmingly rejected in the June 1982 election.

Millions visit the Delta to relax each year. Houseboating is especially popular in north Delta channels. These people are enjoying the scenic Snodgrass Slough area. *(DWR 6910-88)*

Chapter 4. RELATED DELTA WATER MANAGEMENT PLANNING

Water management programs are also being planned for the south and west Delta. These and programs for levee improvements are discussed below.

South Delta Water Management Planning

The Department of Water Resources and the U.S. Bureau of Reclamation held public meetings in April 1987 to discuss water management alternatives in the south Delta. Information from those meetings will be used to identify significant issues and begin environmental documentation. This work was initiated under an October 1986 agreement (South Delta Agreement) between the Bureau of Reclamation, Department of Water Resources, and South Delta Water Agency, which committed all three parties to work together to develop mutually acceptable, long-term solutions to water supply problems of the South Delta Water Agency.

Objectives of the South Delta Agreement are to improve water levels, circulation patterns, and quality in the south Delta. Evaluation of alternatives to meet these objectives will also take into account broader objectives of the Bureau of Reclamation and Department of Water Resources concerning fisheries; overall efficiency of Central Valley Project and State Water Project operations; water supply reliability through improved capability for banking winter supplies; navigation; and flood control. (For more information, refer to the Department report, *South Delta Agricultural Water Supply Project, Three Agency Work Plan.*)

In addition, the Department of Water Resources is examining a possible conjunctive use program with local interests for New Melones water, which would allow the State Water Project to use the water during dry years and simultaneously improve water quality in the south Delta. This program would provide additional good quality New Melones releases to the San Joaquin River.

West Delta Water Management Planning

Because Sherman Island is so important in protecting the reliability and quality of the Delta water supply, its needs will be investigated as part of the West Delta Water Management Program. This planning will address subsidence, flood control, wildlife habitat, highways and utilities protection, recreation, and Delta water supply reliability.

One alternative being considered is a wildlife management plan for Sherman Island. Such a plan, coordinated with other Delta planning, has the potential to develop a number of significant benefits, such as levee improvements for flood control, fish and wildlife enhancement, land management to slow subsidence, recreational opportunities, and better water supply management.

Delta Levee Legislation

The California Legislature recently passed Senate Bill 34; the Governor signed the bill on March 12, 1988. This bill will increase the financial assistance to Delta reclamation and levee districts maintaining nonproject levees. The legislation contains a provision for the local districts to pay the first $1,000 for each mile of levee maintenance and rehabilitation, and then the State will pay up to 75 percent of the cost exceeding $1,000 per mile. This legislation will provide $6 million annually for 10 years.

Senate Bill 34 also contains a new Delta Flood Protection Fund of $6 million annually for 10 years for special flood control projects in the Thornton-Walnut Grove area and to improve eight west Delta islands that are vital to water quality. In addition, the legislation contains $5 million annually for 10 years for environmental mitigation projects.

Corps of Engineers

The U.S. Army Corps of Engineers continues to study the possibility of a federally authorized flood control project in the Delta, which would provide Federal assistance for improving the levees.

SUMMARY OF LAWS, PROGRAMS, AND OTHER ACTIVITIES RELATED TO DELTA WATER MANAGEMENT PLANNING*

Burns-Porter Act - Authorized sale of bonds to help finance initial facilities of the State Water Project.

Delta Protection Act - States that no public or private entity will divert Delta channel water to which users within the Delta are entitled.

Davis-Dolwig Act - Identifies recreation and enhancement of fish and wildlife as additional objectives of the State Water Project.

South Delta Water Management Program - Program aimed at improving water levels, circulation patterns, quality, and increasing project exports for winter banking in the south Delta.

West Delta Water Management Program - Consideration of various wildlife management options as an alternative to constructing an overland water supply system on Sherman Island.

Bay-Delta Protection Programs - Evaluation of environmental effects of Central Valley Project and State Water Project operation on the Bay-Delta estuary.

Monitoring - DWR monitoring of 32 water quality parameters to ensure compliance with protective standards and to ensure that public health concerns are met.

Coordinated Operation Agreement - Commits the Department and the U. S. Bureau of Reclamation to meet water quality and flow protective standards for the estuary.

Delta Levee Maintenance Subventions Program - Annually provides State financial assistance to Delta reclamation districts in rehabilitating nonproject levees.

FEMA and OES - The Federal Emergency Management Agency and the State Office of Emergency Services provide disaster assistance to the Delta. FEMA has established minimum levee standards to be achieved by reclamation districts to qualify for future disaster assistance.

Suisun Marsh - State and Federal agencies have jointly constructed and emplaced Suisun Marsh protective facilities.

North Bay Aqueduct - The recently completed 26.5-mile SWP water delivery facility diverts from Delta channels and provides service to Solano and Napa counties.

Banks Pumping Plant Improvement - Within 5 years, four additional pumps will be installed at the Harvey O. Banks Delta Pumping Plant.

Fish Protection Agreement of 1985 - Provides for preservation of fishery resources and habitat affected by SWP diversions and facilities.

John E. Skinner Delta Fish Facility Improvements - About $4.5 million in screen improvements were installed at the facility to further reduce fishery impacts.

Water Conservation - The Legislature, DWR, and water agencies are working to improve the efficiency of urban and irrigation water use.

California Irrigation Management Information System (CIMIS) - This project informs growers of evapotranspiration rates and water needs within a projected time.

Wheeling-Purchase Agreement - The Coordinated Operation Agreement requires DWR and USBR to develop an agreement to improve the use of existing Federal and State projects for water supply use and transport.

Water Marketing and Transfers - Being investigated by DWR and others to ensure efficient use of existing supplies.

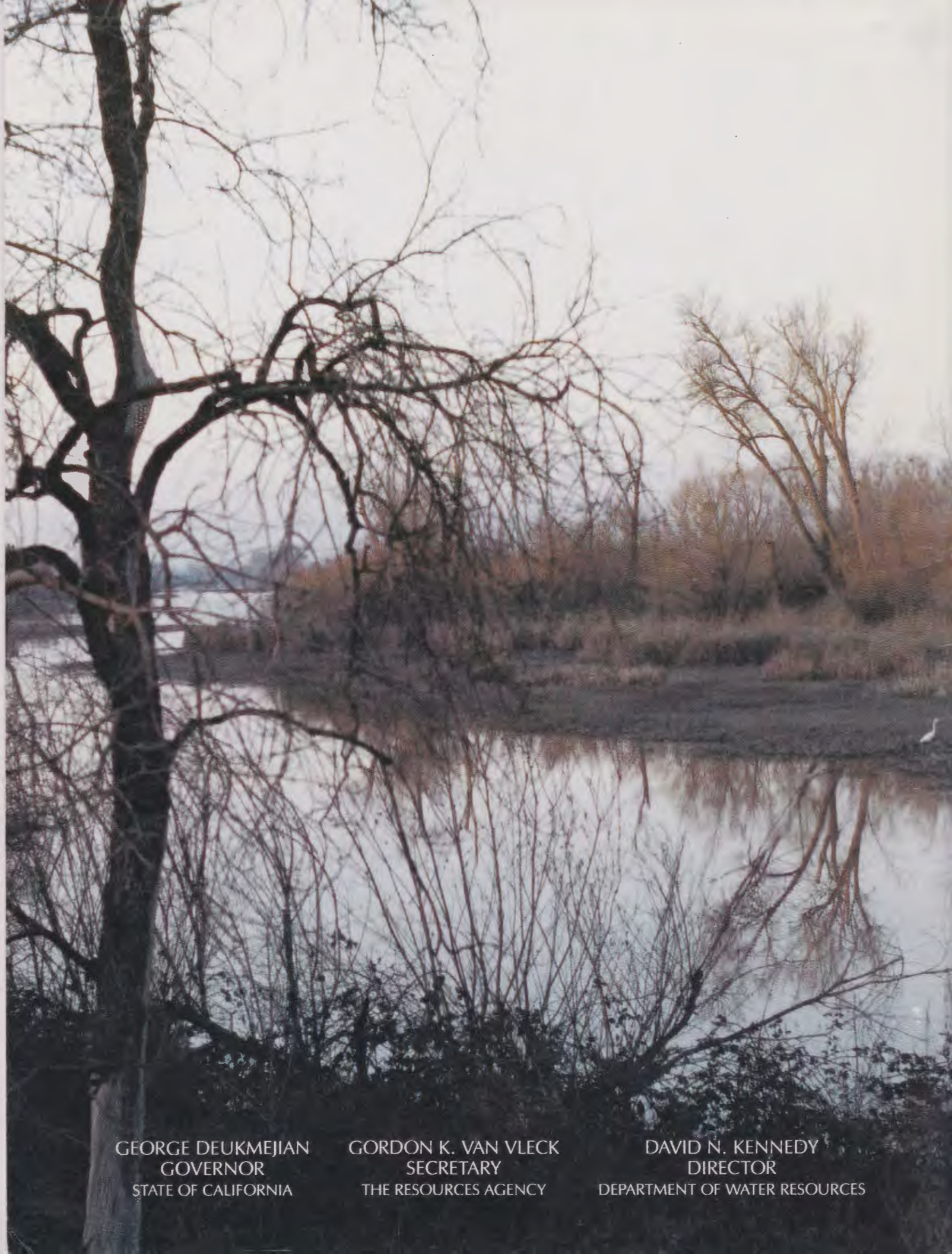
Water Storage Projects - The Los Banos Grandes Reservoir and the Kern Water Bank are proceeding through the planning phase and toward development south of the Delta.

Water Transportation Facilities - DWR has begun a $300 million project to enlarge the East Branch of the California Aqueduct to accommodate increased water deliveries.

State Board Hearings - The State Water Resources Control Board is conducting hearings on water right permit conditions of diverters of Delta water supplies, including the SWP and CVP.

New Melones - Stockton-East Water District, Central San Joaquin Valley Water Conservation District, and DWR have been working on a conjunctive use program for New Melones Reservoir releases to south Delta channels in dry and critical years.

* Additional information on these subjects may be found in Bulletin 160-87, California Water: Looking to the Future.



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