APPENDIX A – 2007 EASTERN SAN JOAQUIN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

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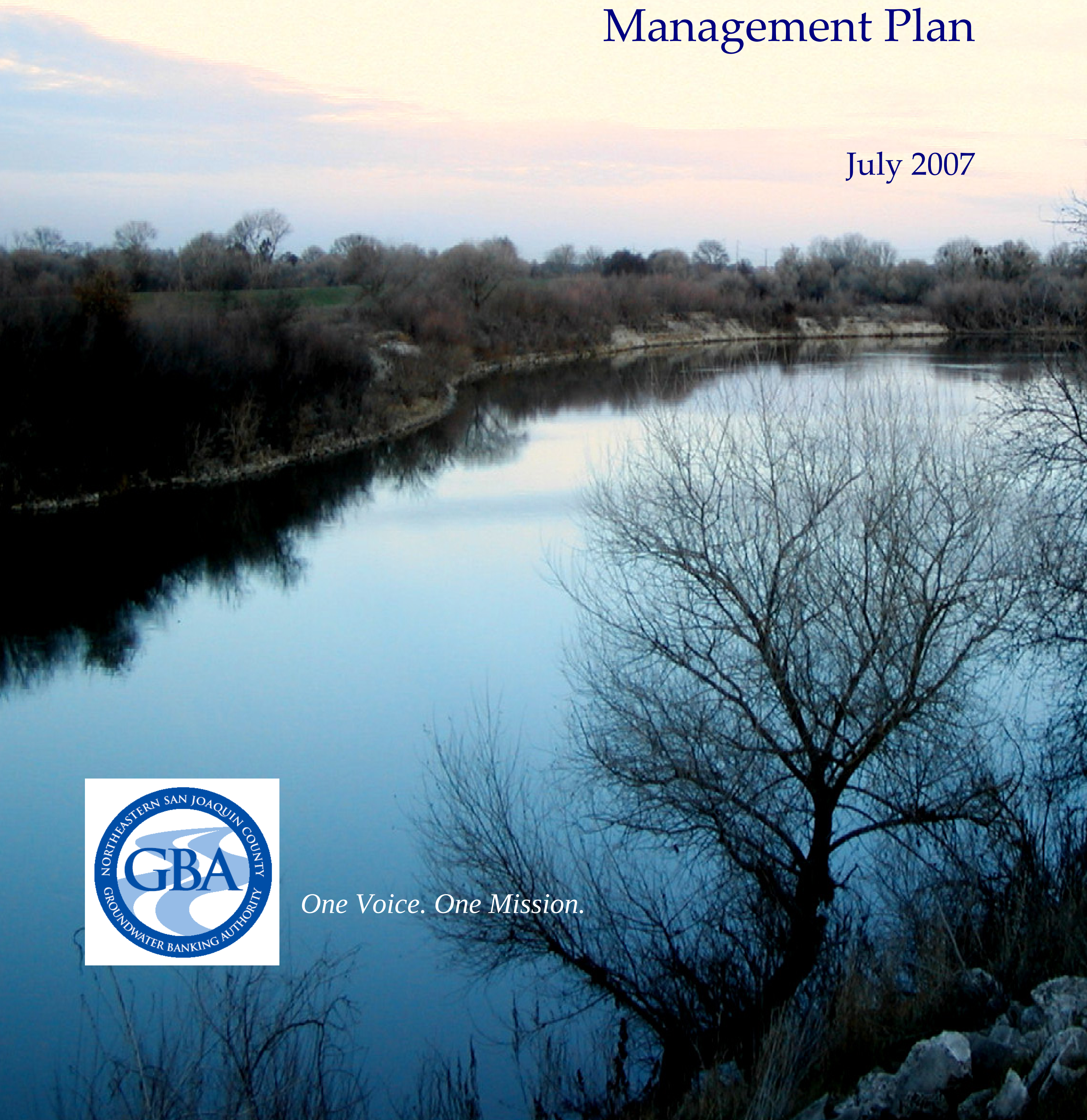
Eastern San Joaquin

Integrated Regional Water Management Plan

July 2007



One Voice. One Mission.

Eastern San Joaquin
Integrated Regional Water Management Plan

Northeastern San Joaquin County
Groundwater Banking Authority

Steven Gutierrez, *San Joaquin County Supervisor, First District*
Chairman

Dan Chapman, *Stockton City Councilman*
Vice-Chairman

T.R. Flinn, *Director, San Joaquin County Public Works*
Secretary

Thomas M. Gau, *Chief-Deputy Director, San Joaquin County Public Works*

Prepared by

Brandon Nakagawa P.E., Tanya Hong-Moreno, Romar Valdez
and C. Mel Lytle, PhD

In Association with

Bookman-Edmonston
Camp Dresser & McKee, Inc.
Peterson Brustad Pivetti, Inc.

July 2007

Copies of the Integrated Regional Water Management Plan may be purchased for $75 from:

Northeastern San Joaquin County
Groundwater Banking Authority
P.O. Box 1810
Stockton, CA 95201
(209) 468-3089

Foreword

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The American West and particularly the State of California is faced with the critical challenge of sustainable development and equitable management of increasingly scarce water resources. The entirety of this concern is framed by greater competition between regional powers for limited surface supplies from major rivers and heightened attention regarding the future use and control of groundwater by overlying landowners, appropriative agencies and the State. Consequently, the Northeastern San Joaquin County Groundwater Banking Authority Joint Exercise of Powers Agreement was established in 2001 to provide a consensus-based forum for local water interests with historically diverse viewpoints regarding the exploitation of water resources in Eastern San Joaquin County. Members agreed to work cooperatively with unanimity toward achieving integrated and regional water resource planning objectives and to speak with one voice. This Integrated Regional Water Management Plan for the Eastern Basin Integrated Conjunctive Use Program is the result of this collaborative effort, which was single-minded in its effort to reinforce local control and to provide regional direction for the sustainable development of vital water resources for the future social, economic and environmental viability of San Joaquin County.

C. Mel Lytle, Ph.D.
Water Resource Coordinator

Acknowledgements

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This Integrated Regional Water Management Plan is a product of the commitment that the Groundwater Banking Authority, its member agencies, together with many interested stakeholders have made to sustain and enhance the integrated and regional nature of water resources in San Joaquin County.

The GBA extends special thanks to staff consultants Mark Williamson, Bookman-Edmonston, Ben Swan, Paul Housain & Brian Heywood, Camp Dresser & McKee, Inc. and Dave Peterson, Peterson Brustad Pivetti, Inc. in the preparation of materials, modeling information and technical review of the IRWMP. In addition, special thanks are extended for grant funding, information and services provided by the California Department of Water Resources, State Water Resources Control Board, the Center for Collaborative Policy and the U.S. Geological Survey.

Finally, the GBA would like to thank staff, the Department of Public Works and the GBA Coordinating Committee and Plan Group members in guiding the preparation and technical review of this Plan. Significant local funding for this work was provided by GBA member contributions and the San Joaquin County Flood Control and Water Conservation District Water Investigation Zone No. 2, a special benefit assessment supported by the taxpayers of San Joaquin County.

Northeastern San Joaquin County Groundwater Banking Authority

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Ed Steffani, North San Joaquin Water Conservation District

Dante Nomellini, Central Delta Water Agency

John Herrick, South Delta Water Agency

Associate Member Agency

San Joaquin County Farm Bureau

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List of Acronyms & Abbreviations

AB – Assembly Bill

ACWA – Association of California Water Agencies

ADAPS – Automatic Data Acquisition and Processing System

af – acre-foot

ASR – Aquifer Storage and Recovery

Authority – Northeastern San Joaquin County Groundwater Banking Authority

Basin – Eastern San Joaquin Region Groundwater Basin

BMO – Best Management Objectives

BMP – Best Management Practice

BOSS – Basin Operations Support System

CalWater – California Water Service Company

CCWD – Calaveras County Water District

CDWA – Central Delta Water Agency

CEQA – California Environmental Quality Act

CERCLA – Comprehensive Environmental Response, Compensation and Liability Act

cfs – cubic feet per second

CSJWCD – Central San Joaquin Water Conservation and Storage District

CVP – Central Valley Project

CVPIA – Central Valley Project Improvement Act

D-858 – Decision 858 from the Office of the State Engineer Division of Water Rights (the predecessor to the State Water Resources Control Board)

DBMS -- database management system

DMM – Demand Management Measure

DMS – Data Management System

DO – Dissolved Oxygen

DPLA – Department of Planning and Local Assistance

DWR – California Department of Water Resources

DWSP – Stockton Delta Water Supply Project

EBMUD – East Bay Municipal Utility District

EC – Electrical Conductivity

EDF – Environmental Defense Fund

EIR – Environmental Impact Report

EIS – Environmental Impact Statement

ESJGB – Eastern San Joaquin Groundwater Basin

ESJPWA – East San Joaquin Parties Water Authority

EWA – Eastern Water Alliance

FEIR – Final Environmental Impact Report

FERC – Federal Energy Regulatory Commission

FRWP – Freeport Regional Water Authority

FSC – Folsom South Canal

ft msl – Feet Mean Sea Level

GBA – Northeaster San Joaquin County Groundwater Banking Authority

GIS – Geographic Information System

GMA – Groundwater Management Area (the portion of San Joaquin region overlying the Eastern San Joaquin and Cosumnes Sub-Basins)

GMP (GWMP) – Groundwater Management Plan

GOES – Geostationary Observational Environmental System

HCP – Habitat Conservation Plan (the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan)

ICU – Integrated Conjunctive Use Program

IRMP – Integrated Resource Management Plan

IRWMP – Integrated Regional Water Management Plan

IS/NOP – Initial Study/Notice of Preparation

ISI – Integrated Storage Investigation

JPA – Joint Powers Agreement

MARS – Mokelumne Aquifer Recharge & Storage Project

MCL – Maximum Contaminant Level

mg/L – milligrams per Liter

mgd – million gallons per day

MMRP – Mitigation Monitoring and Reporting Program

MO – Management Objective

MORE WATER Project – Mokelumne River Regional Water Storage and Conjunctive Use Project

MOU – Memorandum of Understanding

MRWPA – Mokelumne River Water and Power Authority

MSL – Mean Sea Level

MW – Megawatts

NEPA – National Environmental Protection Act

NOC – Notice of Completion

NOD – Notice of Determination

NOP – Notice of Preparation

NSJCGBA –Northeastern San Joaquin County Groundwater Banking Authority

NSJWCD – North San Joaquin Water Conservation and Storage District

OID – Oakdale Irrigation District

PEIR – Programmatic Environmental Report

PG&E – Pacific Gas and Electric Company

ppm – parts per million

QA/QC – Quality Assurance/Quality Control

Reclamation – United States Bureau of Reclamation

ROD – Record of Decision

RWQCB – Central Valley Regional Water Quality Control Board

SARA – Superfund Amendments and Reauthorization Act

SAWS – Stockton Area Water Suppliers

SB – Senate Bill

SCADA – Supervisory Control and Data Acquisition

SCWSP – South County Water Supply Project

SDWA – South Delta Water Agency

SEWD – Stockton East Water District

SJCFCWCD – San Joaquin County Flood Control and Water Conservation District

SJCMHCOSP – San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (Habitat Conservation Plan)

SJCOG – San Joaquin Council of Governments

SSJID – South San Joaquin Irrigation District

Stockton MUD – City of Stockton Municipal Utilities Department

SWP – State Water Project

SWRCB – State Water Resources Control Board

TDS – Total Dissolved Solids

TMDL -- Total Maximum Daily Load

TUD – Tuolumne Utilities District

USACE -- U. S. Army Corps of Engineers

USBR – United States Bureau of Reclamation

USGS – United States Geological Survey

UWMP – Urban Water Management Plan

WCD – Water Conservation District

WHPA – Wellhead Protection Area

WID – Woodbridge Irrigation District

WMP – Water Management Plan

Executive Summary

ES-1 Regional Water Management Agency

Independently, agencies in San Joaquin County have found it difficult to wield the political and financial power necessary to mitigate the conditions of overdraft. County interests have come to realize that a regional consensus-based approach to water resources planning and conjunctive water management increases the chance for success.

Since its formation as a Joint Powers Authority in 2001, the 11-member agency Northeastern San Joaquin County Groundwater Banking Authority (GBA) has employed the consensus based approach in its goal to develop "…locally supported conjunctive use projects that improve water supply reliability in San Joaquin County…and provide benefits to project participants as a whole." Collaboration amongst the GBA member agencies has strengthened the potential for broad public support for groundwater management activities as well as the ability to leverage local, State, and federal funds. Table ES-1 lists the member agencies of GBA.

Table ES-1 Member Agencies of the Northeastern San Joaquin County Groundwater Banking Authority
City of Stockton
California Water Service Company
City of Lodi
Woodbridge Irrigation District
North San Joaquin Water Conservation District
Central San Joaquin Water Conservation District
Stockton East Water District
Central Delta Water Agency
South Delta Water Agency
San Joaquin County Flood Control and Water Conservation District
San Joaquin Farm Bureau Federation*
* Associate Member

The GBA is the regional water management group responsible for the development and implementation of the Eastern San Joaquin Integrated Regional Water Management Plan (IRWM Plan). The Authority together with the San Joaquin County is a Department of Water Resources Conjunctive Water Management Branch MOU partner and has furthered these efforts through this partnership.

ES-2 IRWMP Purpose, Objective and Planning Process

The purpose of this IRWMP is to define and integrate key water management strategies to establish the protocols and course of action for implementation of the Eastern San Joaquin Integrated Conjunctive Use Program (ICU Program). The ICU Program will implement a comprehensive, prioritized set of projects and actions that when implemented will meet adopted Basin Management Objectives and provide regional benefits to area stakeholders.

The IRWM Planning Process began in late 2004 following the completion of the Eastern San Joaquin Groundwater Basin Groundwater Management Plan. The IRWMP planning process was envisioned to take the concept of managing and restoring the underlying Basin from idea to reality. In February 2005, the GBA submitted a grant application to DWR and the SWRCB to partially fund the development of the IRWMP under Proposition 50. The GBA's application ranked seventh in the State and was selected to receive an Integrated Regional Water Management Planning Grant of approximately $500,000 to complete the IRWMP together with a CEQA programmatic environmental document of the ICU Program. The planning process consisted of the

ES-3 Regional Planning Area

For the purposes of this IRWMP, the Eastern San Joaquin Region Water Management Area (WMA) is defined as that portion of the San Joaquin region which overlies the Eastern San Joaquin and Cosumnes Sub-Basins and coincides with the adopted Groundwater Management Area (GMA). The WMA and the overlying agencies are depicted in Figure ES-1. To ensure that every parcel in the WMA is represented, all unorganized areas will be included in the San Joaquin County Flood Control and Water Conservation District.

ES-4 Regional Integration Concepts

The focus of the GBA IRWM Plan is the conjunctive water management needs of the Eastern San Joaquin County; however, the need to coordinate and cooperate internally and externally is undeniable and absolutely necessary for the success of the IRWMP. Water projects will always affect, in some manner or another, an upstream of downstream agency. Projects proposed by the GBA are no different. To facilitate coordination and cooperation, the GBA proposes the following conceptual framework for intra-regional and inter-regional collaboration.

ES-4.1 Intra-Regional Collaboration

Intra-regional coordination refers to collaboration within the boundaries of the Regional Water Management Area. The following concepts are promoted by the GBA to help stakeholders understand how their actions affect areas adjacent to them and throughout the Region.

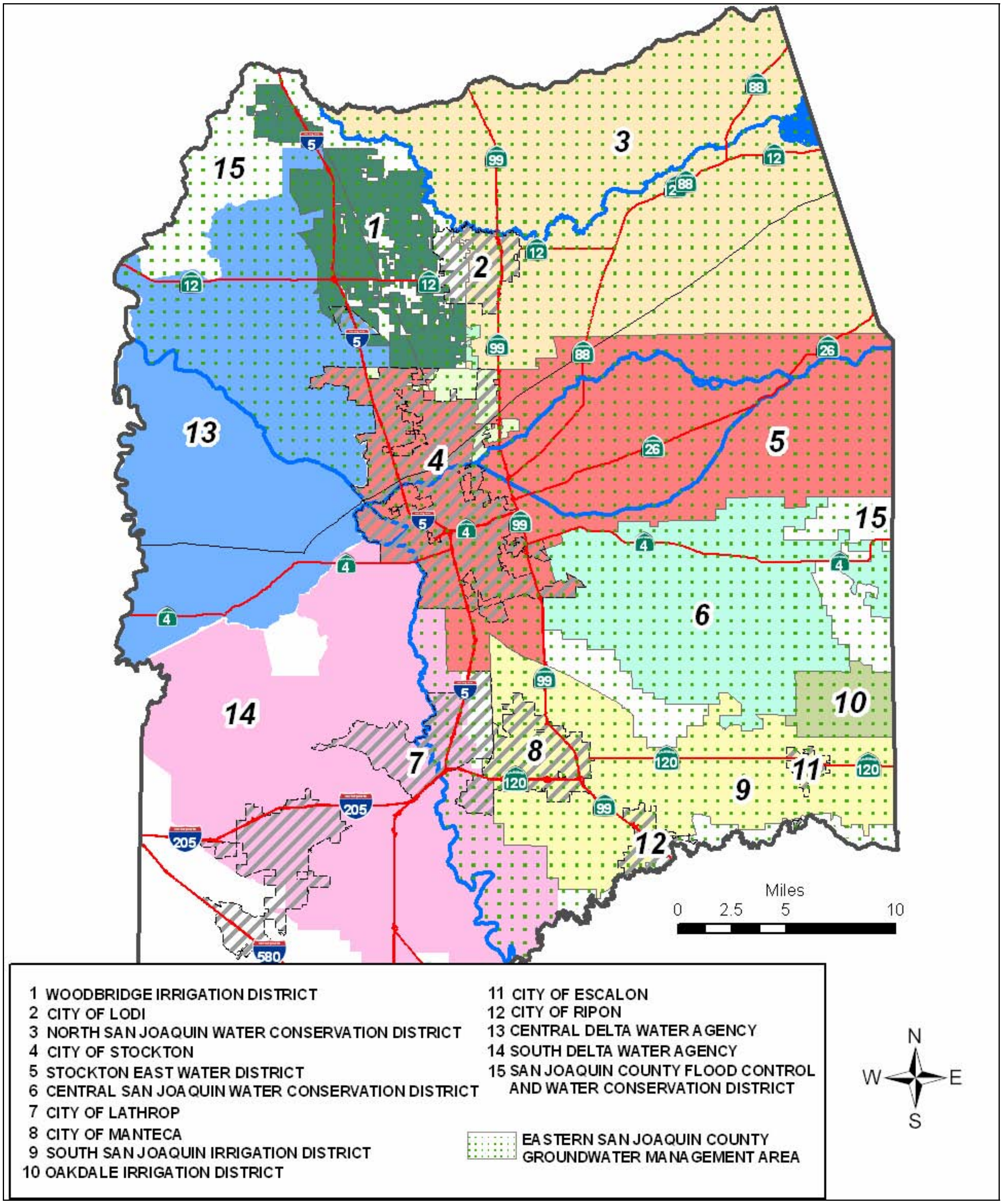

Figure ES-1 Overlying Agencies within the Groundwater Management Area

Source: California Spatial Information Library at http://www.gis.ca.gov/

ES-4.2 Inter-Regional Collaboration

The GBA has defined a Regional Integration Area as that portion of the state that may influence, provide guidance to or contribute to the IRWMP. As shown in Figure ES-2, a Potential Solution Area (mostly upstream or upgradient) may provide water resource solutions to problems addressed in the IRWMP; and as shown in Figure ES-3, a Potential Benefits Area as those areas that may benefit from the development of the Eastern Basin Integrated Conjunctive Use Program. Because of its geographic proximity to the Delta, groundwater banking projects have the potential to benefit almost any part of the state with hydrologic connection.

Figure ES-2 Solution and Benefits Area

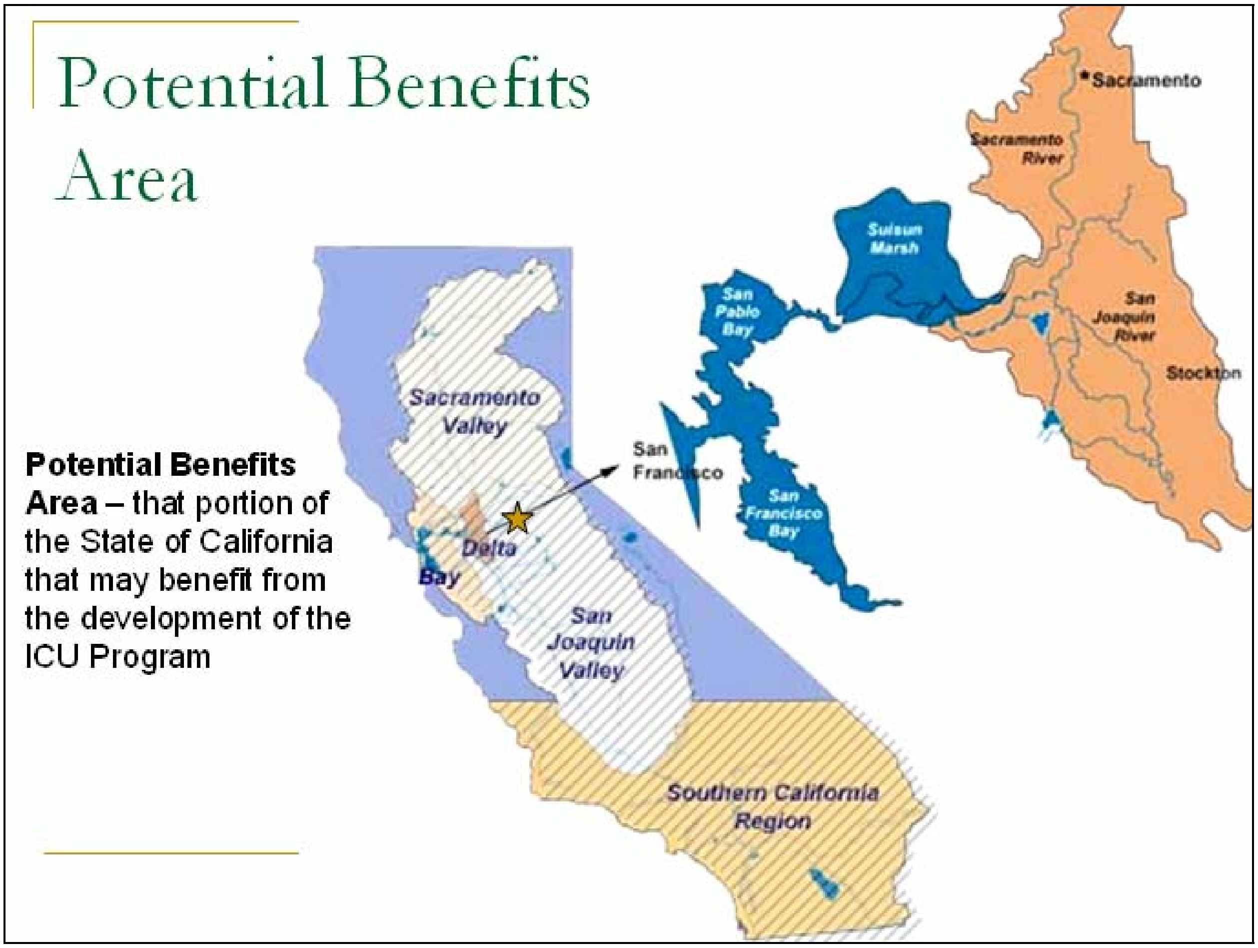

Figure ES-3 Potential Benefits Area

ES-5 Land and Water Use

San Joaquin County's population totals over 660,000 and ranks the fifteenth largest in the State. Its annualized growth is estimated at 2.8 percent until the year 2010. Since 2000, the County has experienced an accelerated population growth because of many relocating their homes from the Bay Area to the Central Valley. The attraction of affordable housing combined with the higher wages of the Bay Area created such movement that placed San Joaquin County as the third fastest growing county within the State.

Accommodating planned growth in San Joaquin County is a huge challenge for land use entities throughout the Regional Planning Area. The current population of San Joaquin is expected to increase by approximately 77 percent by 2030 from nearly 650,000 to over 1.1 million.

For the purposes of this IRWMP, the "current" planning level is assumed to be 2005 for urban and water use while "future" conditions assume a 2030 planning horizon. The IRMWP assumes that urban growth will occur as either infill or entirely within spheres of influence delineated in the latest general plans revisions. To account for the loss of agricultural production, it is assumed that existing agricultural irrigation within the SOI's will be entirely replaced with urban uses by 2030. Agricultural water demands are expected to decrease throughout the Water Management Area as urban development continues. The analysis does not take into account areas that are currently un-irrigated that may become irrigated or increases in housing densities in urban areas. Table ES-2 summarizes the estimated and projected urban and agricultural water demands for the Regional Planning Area.

Table ES-2 Estimated and Projected Water Demands for the Regional Planning Area
Based on DWR Applied Water Demands for the Eastern San Joaquin DAU

Water Use Sector	2005 Estimated Water Demand (acre-feet per year)	2030 Projected Water Demand (acre-feet per year)	Demand Change (acre-feet per year)
Urban	128,379	269,096	+140,717
Agricultural	1,070,017	911,072	-158,945
Total	1,198,396	1,180,168	-18,228

ES-6 Groundwater Level Trends

Beginning in 1850 the development of groundwater for agriculture expanded rapidly. Within the Central Valley one hundred years ago, irrigated agriculture has grown from less than 1 million to an estimated 7 to 8 million acres at present. In average years almost 870,000 acre-feet of groundwater is pumped per year from the Regional Planning Area. In Bulletin 118-80, DWR designated the Eastern San Joaquin Basin as "critically overdrafted".

Figures ES-4 illustrates groundwater table contours for fall 2005. The Fall 2005 contour represent present conditions and serves as the baseline condition for this IRWMP. The contour maps clearly show the significant groundwater depression east of Stockton. Regional groundwater flow now converges on this low point, with relatively steep groundwater gradients (0.0018 feet/feet) westwards towards the cone of depression. Degradation of water quality due to saline migration threatens the long-term sustainability of underlying basin. Salt laden groundwater is unusable for either urban drinking water needs or for irrigating crops. The saline intrusion problem is not well understood by the Authority. Limited studies and monitoring have produced postulates as to the sources and extent of the saline front. Groundwater modeling estimates that inflow from the west is estimated at 42,000 acre-feet per year and is considered an undesirable source of lateral inflow due to elevated chloride levels.

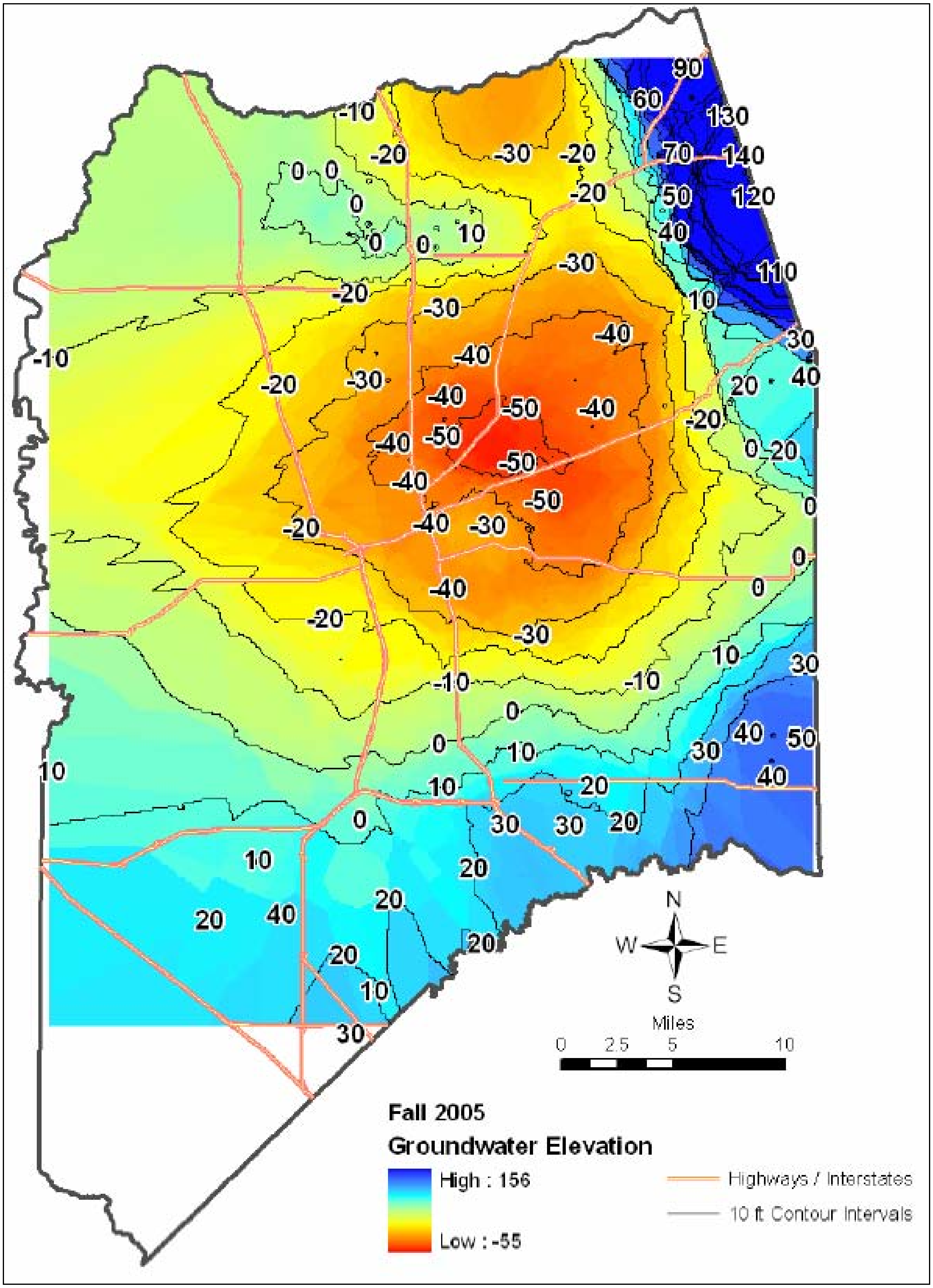

Figure ES-4 Fall 2005 Groundwater Elevations (feet MSL)

ES-7 Integrated Regional Water Management Plan Framework

The Eastern San Joaquin Region IRWMP Framework can be described as a reflection of the values and needs of the community. The IRWMP Framework utilizes a nested tier system that begins with a Problem and Mission statement and then drills down through refining steps leading to specific evaluation and prioritization criteria by which the solution, the ICU Program, is measured and is ultimately implemented. Items in each lower tier directly relate to and support the concepts at each higher level. The IRWMP Framework concept is shown schematically in Figure ES-5.

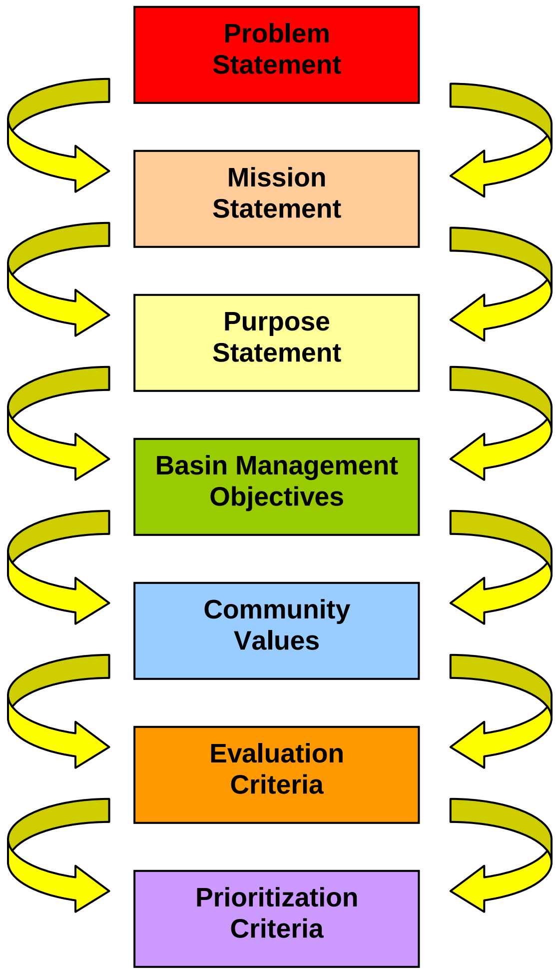

Figure ES-5 IRWMP Framework

ES-8 Basin Operations Criteria

Essentially, Basin Operations Criteria are a quantitative management framework used to accurately monitor and predict changes in basin conditions and gauge ICU Program operations with delineated Basin Operation Areas and Zones in the Groundwater Management Area. Within each of these areas, specific groundwater measurement criteria can be established based on historic groundwater levels as defined by the following:

- **Pre-1960 Elevation** – the Eastern San Joaquin Groundwater Basin contour measured in 1960 will be considered as the criteria set as the top of the basin management framework. It was assumed that this elevation was established prior to significant groundwater overuse during the past 47 years.
- **Fall 1986 Elevation** - the Eastern San Joaquin Groundwater Basin contour measured in 1986 will be considered as the new criteria set for normal conjunctive use operations in the Basin. ICU Program projects will be developed to establish this new elevation, which has been the highest groundwater elevation in the over-drafted portion of the basin in the past 25 years.

- **Fall 1992 Elevation** – the Eastern San Joaquin Groundwater Basin contour measured in 1992 will be considered as the basin management framework baseline. This elevation was achieved following a significant drought period and has been the lowest elevation measured in the Basin.
- **Basin Reserve** – a quantifiable portion of the groundwater management area between the 1986 and 1992 contours that is dedicated as a water resource reserve to be utilized under dry year or drought conditions.
- **Basin Terminal Pool** - that portion of the groundwater management framework below the 1992 historic groundwater contour.

In simplest terms, the establishment of Operations Criteria has classified the Basin into four distinctive profiles that utilize "the Four R's", for ***Regional*** storage, ***Regular*** operations ranges, drought ***Reserve***, and post-drought ***Recovery***. This concept is illustrated in the Figure ES-6 below.

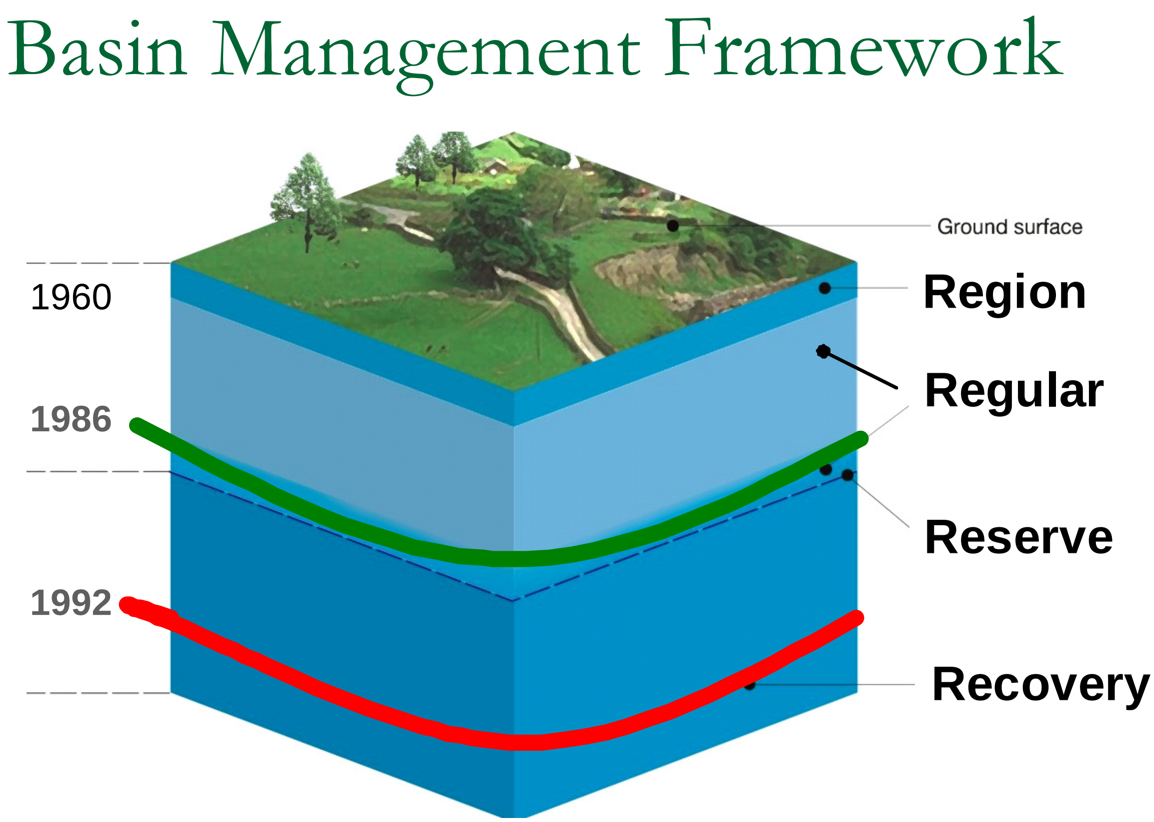

Figure ES-6 Conceptual Operations Criteria Levels – "The 4 R's"

The Basin Conditions Scale is a visual representation of basin groundwater levels or quality intended for the widest possible audience; however: the Basin Conditions Scale could also be applied to more complex operational situations where a series of basin management actions and policies could be initiated or repealed Basin-wide or at the Basin Operations Area or Basin Operations Zone level. The Basin Conditions Scale Concept is depicted in Figure ES- 7.

A ***Basin Condition Trigger*** is defined as a set of groundwater level conditions that, when triggered, initiate or repeal actions or policies established as basin management protocols and operations control of ICU Program operations Basin-wide and/or within a delineated Basin Operations Area or Zone.

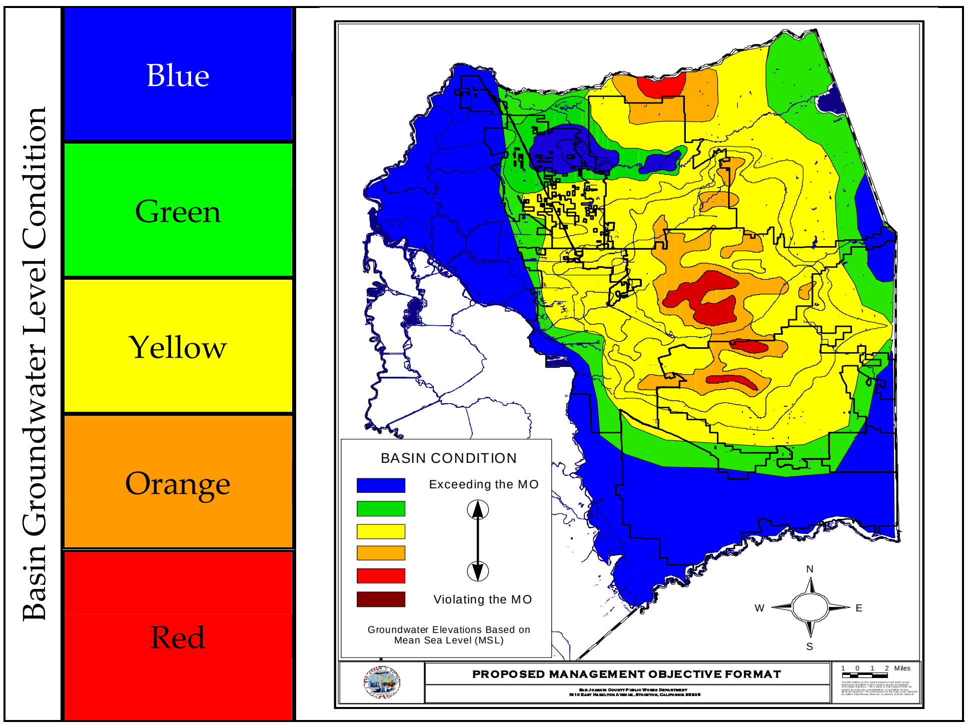

Figure ES-7 Basin Condition Scale and Basin Condition Map

Basin Condition Triggers are applied to both decreasing and increasing groundwater levels. As groundwater levels decline and triggers are set-off, certain more conservative basin operating rules may be instituted such as voluntary agricultural conservation, purchases of transfer water, or declaration of drought conditions. As groundwater levels increase, less stringent basin operations may be instituted such as intra-basin transfers and inter-regional marketing of banked groundwater.

ES-9 Inter-Regional Integration

Intra-regional projects will have all of their facilities within a single region. Their impacts will be generally limited to within a single IRWMP region. Inter-regional projects are those that involve facilities or implementation steps in one or more IRWMP regions and/or have clear and direct impacts and benefits in more than one region. They require coordination with entities in other regions that could be impacted to maximize project and regional benefits. Due to the benefits provided by an inter-regional project, either of the two interested regions could initiate the project process by suggesting it to the other involved regions.

With proper planning and coordination, it is the mutual intention that this overlap of projects with components that cross regional boundaries will not be contentious. Instead, it will provide valuable IRWMP linkages and synergistic effects and provides an example of possible inter-regional projects developed under the IRWMP effort designed to provide ***exo-regional*** benefit. Examples of Inter-Regional include the Mokelumne River Forum, the Sacramento County – South Area Water Council, and the Stanislaus County – Water Summit.

ES-10 Integrated Conjunctive Use Program

The Eastern San Joaquin IRWMP will define and implement the Integrated Conjunctive Use Program the Basin (ICU Program), which is a comprehensive, prioritized suite of projects and actions described in the IRWMP to ensure the reliability and sustainability of water resources in the eastern San Joaquin County Region. All on-going and proposed projects, programs, and studies proposed for the region have been aggregated, integrated, and evaluated on an equal basis, to funnel these regional efforts into a prioritized implementation plan, as illustrated schematically in Figure ES-8.

The ICU Program is a broad-based program to integrate and coordinate water resource management over a large region encompassing all or parts of the watersheds of the Mokelumne, Calaveras, and Stanislaus Rivers and Littlejohns Creek. The plan is designed to be expandable to integrate with the complete watersheds and adjacent areas such as the American River in the future. As such, a set of measurable, performance-based evaluation criteria have been developed that will be applicable to potential future planning and management in a broader region. The purpose of establishing these criteria a priori will support implementation of projects and programs that best meet the region's objectives rather than a small constituency, and identify opportunities for regional collaboration and leadership.

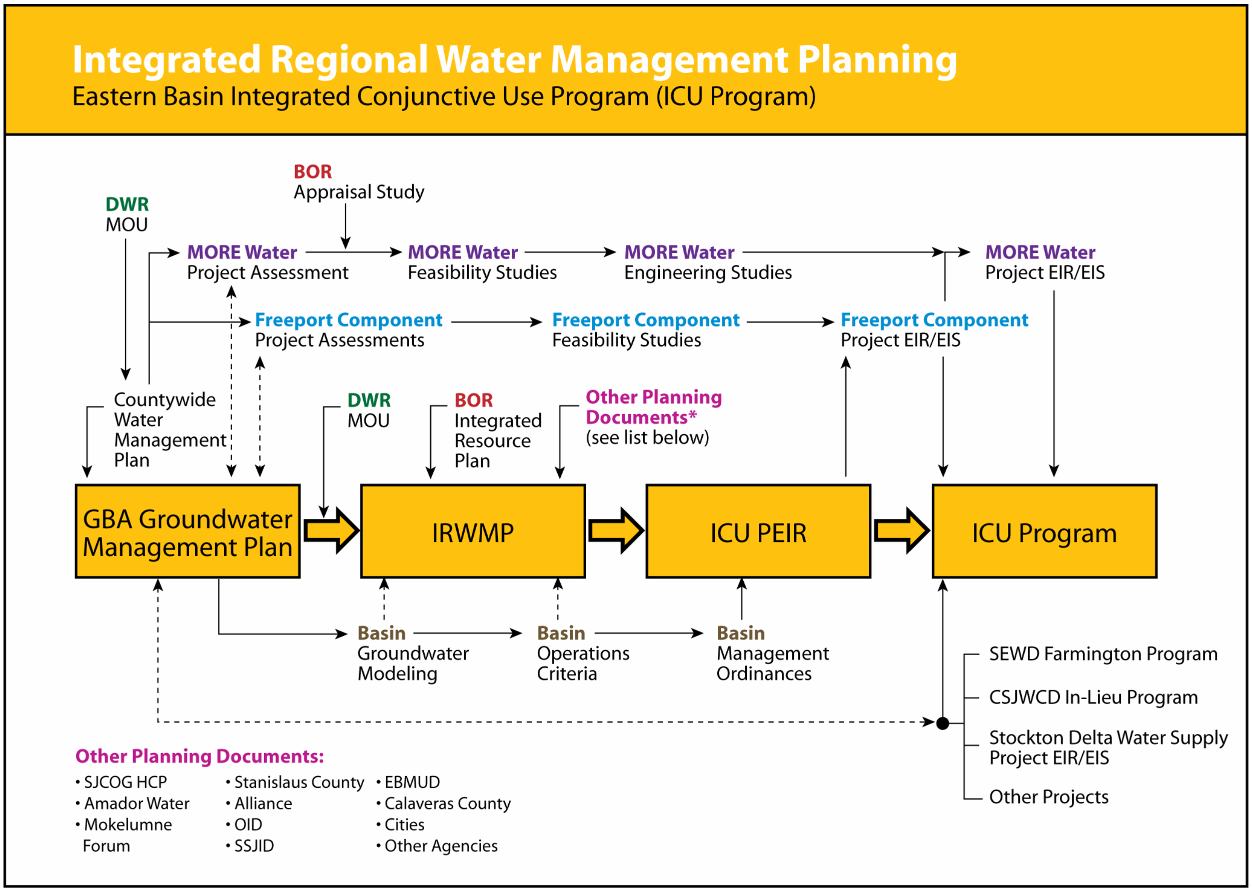

Figure ES-8 Integrated Conjunctive Use Program Schematic

The Plan Management Area is a study in contrasts:

- The area encompasses water districts with and without adequate surface water supplies.
- Some areas have groundwater elevations very close to pre-development levels, and other areas where groundwater levels have continued to drop for decades.
- The area's highly productive though depleted aquifers sit astride the Sacramento-San Joaquin Delta, the switching yard for the majority of California's water supplies.
- A major conveyance facility traverses the area carrying Mokelumne River water to the Bay Area. A second such facility conveying Sacramento River water is under development. However, these conveyances are not paired with storage adequate to meet Bay Area needs.

These contrasting conditions provide substantial opportunities for mutually-beneficial integrated programs that capture surplus supplies from areas with adequate supplies, and use them to replenish depleted aquifers to be used in times of drought. Areas external to the Plan Management Area (in the Statewide Solution Area, see Chapter 2) may pay significant portions of the Plan implementation costs to obtain access to stored water in dry years.

Because the Eastern San Joaquin County Basin is part of a regional aquifer system, shared both internally and externally of the GBA boundaries, integrated regional solutions are essential to solve key regional issues while avoiding, or minimizing conflict. No one solution will fully address the underlying issues facing the area. An integrated mix of water management strategies (conservation, reclamation, new supplies, transfers, stormwater capture, groundwater banking and management are all expected to be part of the solution mix.

Chapter 7 presents an overview of the alternatives development and evaluation processes:

- Identification of water management strategies, supply sources, and projects;
- Development of evaluation and prioritization criteria and associated tools;
- Formulation of alternatives that address GBA objectives; and
- Applying evaluation criteria to rate, rank, and prioritize alternatives.

Chapter 7 describes the development of the projects and programs to address the purpose and need, and the development and application of evaluation and prioritization criteria for establishing rating, ranking, and implementation priority. Major water related infrastructure is depicted in the "Integrated Conjunctive Use Program" map presented as Figure 7-2. The map illustrates existing and proposed reservoirs, waterways, conveyance systems, irrigation systems, treatment plants, and recharge areas.

Water supplies and associated water rights have been secured or have been applied for on most of the stream systems in the region. Water supply sources from the following stream systems were examined:

- Sacramento-San Joaquin Delta
- American River
- Mokelumne River
- Calaveras River
- Littlejohns Creek /Rock Creek

- Stanislaus River
- San Joaquin River

ES-10.1 Water Management Strategies

Through past planning efforts, the GBA, its member agencies, and other regional interests have developed numerous projects and programs that integrate multiple strategies and in turn provide multiple benefits to the community. The mission of the GBA is to promote regional collaboration in a consensus-building environment. The IRWM planning process is a continuum of this mission and is reflected in the projects and programs described in the ICU Program options discussion below.

This Plan has considered all of the resource management strategies identified in the California Water Plan. These strategies include:

Reduce Water Demand

- Agricultural Water Use Efficiency
- Urban Water Use Efficiency

Improve Operational Efficiency and Transfers

- Conveyance
- System Reoperation
- Water Transfers

Increase Water Supply

- Conjunctive Management and Groundwater Storage
- Desalination
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage—CALFED
- Surface Storage—Regional/Local

Improve Water Quality

- Drinking Water Treatment and Distribution
- Groundwater Remediation/Aquifer Remediation
- Matching Water Quality to Water Use

- Pollution Prevention
- Urban Runoff Management

Practice Resources Stewardship

- Agricultural Lands Stewardship
- Economic Incentives (Loans, Grants, and Water Pricing)
- Ecosystem Restoration
- Floodplain Management
- Recharge Areas Protection
- Urban Land Use Management
- Water-Dependent Recreation
- Watershed Management

Other Resource Management Strategies

- Crop idling for water transfers
- Dewvaporation
- Fog collection
- Irrigated land retirement
- Rainfed agriculture
- Waterbag transport/storage technology

Strategies Considered by GBA not included in California Water Plan

- Water Supply Reliability
- Regional Groundwater Banking Partnerships
- Imported water
- Land use planning
- Flood management
- Climate Change

The strategies to be implemented in the IRWMP are displayed in Table ES-2. The practical limitations of GBA authority, geographic realities, and the success and expertise of GBA member entities are the principal reasons for focusing on these strategies. No one single project will meet the objectives of the IRWMP. An integrated combination of several projects, implemented over a wide geographic area will be necessary.

The GBA is the forum that fosters regional integration amongst member agencies and with other regional participants. The GBA will continue to interact with other agencies and groups throughout the region to increase the social, economic, and environmental viability of the Region and beyond. This integration of these strategies increases the potential for broad-based support by spreading benefits to multiple interests and agencies. Integration also produces synergistic effects and makes additional funding sources available.

Resource Management Strategies
Identified in the California Water Plan (Bulletin 160-05, December 2005)

Strategy #	Strategy Considered	Included in IRWMP	Notes
1	Agricultural Lands Stewardship	Considered	Does not address Plan objectives
2	Agricultural Water Use Efficiency	Yes	
3	Conjunctive Management and Groundwater Storage	Yes	Recharging aquifers for conjunctive management of surface and groundwater supplies is key element of Plan
4	Conveyance	Yes	New pipelines, tunnels, canals, and on-farm distribution systems
5	Desalination	Considered	Not practical for region
6	Drinking Water Treatment and Distribution	Yes	
7	Economic Incentives (Loans, Grants, and Water Pricing)	Yes	
8	Ecosystem Restoration	Yes	
9	Floodplain Management	No	
10	Groundwater Remediation/Aquifer Remediation	Yes	Saline intrusion project
11	Matching Water Quality to Water Use	Yes	
12	Pollution Prevention	Yes	
13	Precipitation Enhancement	Considered	Not practical for region
14	Recharge Areas Protection	Yes	
15	Recycled Municipal Water	Yes	
16	Surface Storage—CALFED	Considered	
17	Surface Storage—Regional/Local	Yes	
18	System Reoperation	Yes	
19	Urban Land Use Management	Yes	
20	Urban Runoff Management	No	
21	Urban Water Use Efficiency	Yes	
22	Water Transfers	Yes	
23	Water-Dependent Recreation	Yes	
24	Watershed Management	Yes?	
	Other Resource Management Strategies		
25	Crop idling for water transfers	Considered	
26	Dewvaporation	No	Not practical for region
27	Fog collection	No	Not practical for region
28	Irrigated land retirement	Yes	
29	Rainfed agriculture	No	Not practical for region
30	Waterbag transport/storage technology	No	Not practical for region
	Other Resource Management Strategies Not Included in California Water Plan		
31	Water Supply Reliability	Yes	
32	Regional Groundwater Banking Partnerships	Yes	
33	Imported water	Yes	
34	Land use planning	Yes	

Table ES-2 Resource Management Strategies

ES-10.2 Identification of Potential Projects

The following potential projects are described in Chapter 7 and evaluated as part of the IRWM Plan:

Reduce Water Demand

Demand reduction measures include water conservation and water use efficiency elements:

- Urban Water Use Efficiency
- Agricultural Water Use Efficiency
- Recycled Municipal Water

Improve Operational Efficiency and Transfers

- Conveyance
    - Freeport Regional Water Project
    - MORE Water Project
        - Duck Creek Reservoir – Pardee or Camanche Diversions
        - Lower Mokelumne River Diversions – Non-Structural and Structural
    - New Melones Conveyance Project
    - SEWD Surface Water Distribution Program
    - Eastern Water Alliance Canal and Treatment Plant
- System Re-operation
    - Mokelumne River Storage System Re-operation
    - Lower Mokelumne River Restoration Program
    - Gill Creek and Woodbridge Road Flood Control Improvements
    - Water Transfers
- Increase Water Supply
    - Conjunctive Management and Groundwater Storage
    - Farmington Program
    - CSJWCD Surface Water Delivery Program
    - Recycled Municipal Water
    - Surface Storage—Regional/Local

        - Duck Creek Reservoir
        - South Gulch Reservoir
- Surface Storage, Diversions, and Regional Conveyance Elements
    - City of Stockton Delta Water Supply Project
    - South County Water Supply Project
    - Surface and Regulatory Storage
        - Duck Creek Reservoir
        - Farmington Dam
        - South Gulch Reservoir
        - Lyon's Dam
- Improve Water Quality
    - SEWD Water Treatment Plant Expansion
    - Stockton Delta Water Supply Project
    - Saline Intrusion Barrier Project

Strategies considered though not included in California Water Plan

In addition, the GBA also considered the following water management strategies in the development of the ICU Program:

- Water Supply Reliability
- Inter-Regional Groundwater Banking
- Imported Water
- Land Use Planning
- Smart-Growth
- Flood Management
- Non-Structural Elements
- Recreation and Public Access
- Education (Micke Grove Park Enhancement)
- Climate Change

Environmental Enhancements

Water and planning agencies in San Joaquin County are working to develop a number of water-related environmental enhancements. These include:

- San Joaquin County Habitat Conservation Plan (HCP).
- City of Stockton efforts to increase dissolved oxygen along the Deep Water Ship Channel on the San Joaquin River.
- Studies to characterize, remediate, and manage saline migration into County groundwater aquifers.
- Efforts by cities and planning agencies to establish buffer lands or 'greenbelts' between cities and conservation easements on high value farmland.
- Active groundwater recharge to replenish regional water supplies and restore natural groundwater gradients to area streams and rivers.
- Increased use of recycled water piping (purple pipe) in new and existing developments, and including such requirement in city (e.g. Stockton) general plans.
- Opportunistic habitat creation and enhancement as part of new projects, including in stream releases.
- Studies of fisheries, and providing enhancements such as state of the art fish ladders and screens at New Woodbridge Dam and NSJWCD intakes.
- Providing recreation opportunities at streams, lakes, and linear water features.
- Installing improved fish screens on older diversions along the Calaveras River (e.g. between New Hogan Reservoir and the Bellota Weir) as part of a new Aquatic Habitat Conservation Plan for the river.
- Working with the State Environmental Water Account to develop opportunities to bank water in the Basin for environmental purposes.
- Education programs such as those planned for Micke Grove Regional Park Enhancement.
- USGS Saline Groundwater Monitoring.
- Stockton Delta Water Supply Program will lower TDS discharges to the San Joaquin River.

ES-10.3 Development of Evaluation and Prioritization Criteria and Associated Tools

To choose between potential alternatives, the GBA developed methods to predict performance and assess impact with respect to the Fundamental Objectives. To this end, two integrated models of the hydrologic system were developed:

1. A detailed integrated surface-groundwater model built on the DYNFLOW platform to detailed assessment of the No Action and final alternatives.
2. A screening model built on the Stella modeling platform to allow the quick assessment of many alternatives.

Screening Model – A screening model was developed to compare expected performance of alternative combinations of projects. The model, built on the Stella modeling platform, was designed and constructed with adequate detail to differentiate between the various basins, issues, geographic regions, and water management actions as discussed in Chapter 6. The model was broken down into just five management units. The mathematical relationship between these units was derived from detailed DYNFLOW results. Examples of these generalized relationships are head-flow relationships between relatively large modeling elements[1]. The Stella screening model produced outputs consistent with the quantifiable Basin Operations Criteria.

A major effort in Plan development and alternatives screening was the specification, design, and construction of the screening model. Based on the results of early stakeholder workshops, the appropriate role was determined for the screening model in project evaluation, with consideration given to basin operations, economics, ecosystem maintenance, and other factors. One stakeholder workshop was devoted to confirm that model attributes correctly represented local and regional issues and potential solutions. A key result of the screening model was that recharge of about 140,000 acre-feet per year[2] results in acceptable fluctuations around the 1986 and 1992 level criteria.

Modeling and Impact Assessment - The regional DYNFLOW screening model was used to compare expected performance of alternative combinations of projects and management alternatives for the GBA. The model provides a method to "operate" the Region's water system to try to meet future target demands for water considering

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[1] Whereas the average DYNFLOW modeling unit is less than one square mile, elements in the screening model might be 100 square miles. Subsequent DYNFLOW modeling confirmed that these simplifying assumptions provide a reasonable analog to the more detailed modeling.

[2] Including offsets provided by conservation and reclamation. Since the mechanism driving the migration of saline water is not well understood, no explicit water level targets other than the 1986/1992 criteria were established for saline migration.

various structural and management changes to the system. All modeled program alternatives, each designed to recharge approximately the same amount of water, performed acceptably.

Model operation was simulated at a fixed level of 2030 demand considering the variability of hydrology and imported supply the region will likely face. The historical time-series hydrology as presented in the Water Management Plan was used to approximate the likely hydrologic variability the region will face in the future. The results of the modeling provided a time series of outputs that can be evaluated in many different ways, as described in the Chapter 7 Supplemental Materials.

Evaluation Criteria (Performance Measures)

Define Performance Measures - Performance measures were developed to allow the GBA to screen and select the best combinations of projects and management actions that address key water issues using a four step systems approach. The first step is the clear articulation of what the GBA wanted to accomplish. The intended accomplishments are specified in terms of the Fundamental Objectives together with development of Performance Measures. Performance-based standards allow flexibility but focus on unbiased quantifiable results.

1. Identify key water management **issues**
2. Use **issues** to help define problem
3. Ways to define problem
4. Define **Fundamental Objectives**
5. Define **Performance Measures**

The Performance Measures are evaluation criteria which provide a methodology to compare the relative success of alternative solutions for producing the desired results. This will lead directly to the next steps of generating alternative solutions, evaluation of those alternatives, and ultimately the selection the best alternatives to implement.

Articulation of Fundamental Objectives has been completed through the Groundwater Management Plan and Water Management Plan processes. The objectives defined in previous chapters were adopted by the GBA as a representative statement of what should be accomplished through the process of IRWMP development.

The Performance Measures developed in the IRWMP process provide a set of indicators that can be used to help decide how effectively possible alternatives solutions provide the desired outcomes.

The adopted Performance Measures fall into the following six categories:

Groundwater Storage Levels

Supply-demand Balance
Economics
Water Quality
Equity
Implementability

Prioritization Criteria

The application of the Performance Measures provides an unranked list of project alternatives. Though it is possible that a single alternative could rank the highest for all Performance Measures, it was found that all alternatives received a mixed ranking (e.g. Alternative X provides the most high-quality water, but is twice as expensive as Alternative Y). For this portion of IRWMP development, Prioritization Criteria were developed to select the best projects or alternatives to develop. Adopted Prioritization Criteria are described below:

Need - was assessed based on water level or water quality considerations in the area the supply will be used.

Feasibility – was evaluated on the level of technical development of the project, whether institutions are in place to support project implementation, and whether there is opportunity to phase implementation versus commitment to the full sized project.

Readiness to Proceed - was assessed based on whether water right permits are needed or have been obtained, the level of engineering that has been performed (e.g. conceptual, preliminary, or final design), whether the constituency providing funding has been identified or funding obtained, and whether environmental documentation and mitigations have been completed.

Public and Stakeholder Acceptance - gauges public support or opposition to the proposed project, including support or opposition from agencies or parties outside of the project area.

ES-10.4 Program Alternative Characterization & Formulation

This section describes:

- Characterization of previously identified projects and management actions to a common point of reference
- Formulation of complete program alternatives designed to achieve the Fundamental Objectives

Definition of System and Characterization of Projects

A comprehensive list of projects and actions were developed through a series of stakeholder workshops over 18 months with the GBA Coordinating Committee. The sequence of workshops allowed GBA and stakeholders to work together efficiently to choose the most promising projects and management actions that can be successfully implemented by GBA member agencies.

Information for the various projects was developed in detail sufficient to reflect key differentiating characteristics. This information includes water quantity and availability, as well as cost, seasonality, and other measures that differentiate the projects and actions. Cost information for most projects is based on existing estimates and data from similarly constructed or bid projects. Where cost information was not available, estimates were made using basic unit cost formulas developed in the Basis of Design. Project attributes identified the expected beneficiaries and assessed willingness & ability to pay. Several stakeholder workshops with the Coordinating Committee were used to confirm that the model attributes correctly represent local and regional issues and potential solutions.

Each project or action is described by source of supply, major water regulation and conveyance elements, and groundwater recharge components – e.g. a source linked to an end beneficial use. This Project Classification System is illustrated schematically in Figure ES-9.

Sources of Supply included increased efficiencies in capturing existing supply sources, entitlements, imported supplies, local groundwater, transfers, reallocations, conservation and reclamation. Entitlements to these supplies are based on existing water right permits, water service contracts and agreements, and pending water right applications.

Water Regulation and Conveyance elements included greater use or renovation of existing facilities, new pipelines, tunnels, or canals, associated pumping plants, and surface storage facilities[3] for capture and regulation of peak season flows.

Groundwater recharge or use will be accomplished through both direct recharge and indirect recharge methods. Direct recharge methods include infiltration ponds and groundwater injection wells. Indirect recharge methods include supplying existing groundwater users a surface supply when available in-lieu

[3] New surface storage facilities are not eligible for Proposition 50 Implementation Grant funding.

of their groundwater use. In-lieu recharge can be accomplished by supplying surface water to current agricultural groundwater users, or by treating surface water for urban in-lieu supply. In-lieu recharge can also be accomplished by reducing groundwater extractions as a result of conservation and reclamation programs. A special category of groundwater recharge is recharging water for a saline barrier to reverse flow gradients and halt migration of poor quality groundwater.

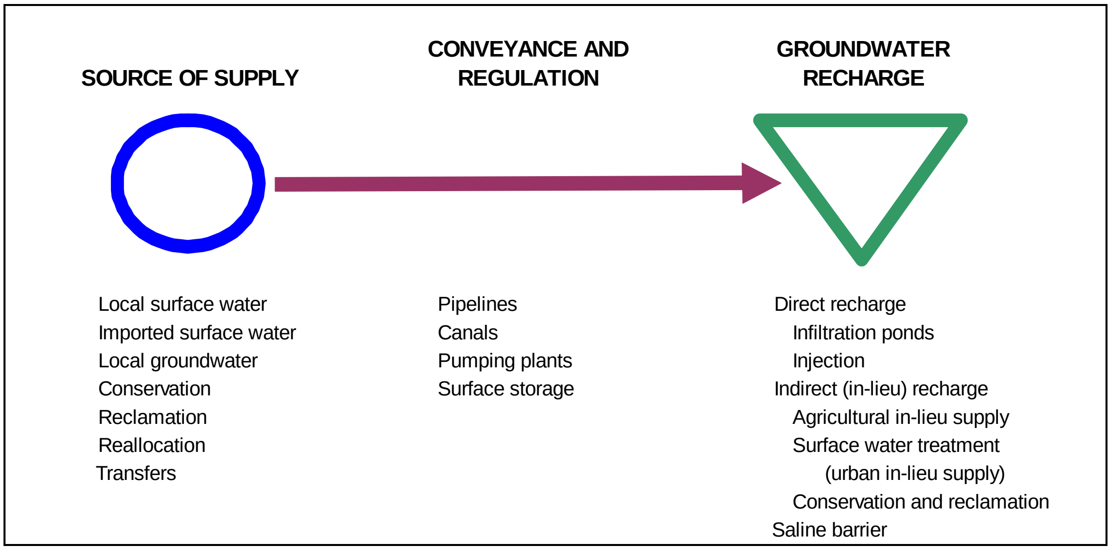


Figure ES-9 Project Classification System

Groundwater banking is supported regionally and statewide as an alternative to constructing new on-stream reservoirs and desalinization plants. It is of paramount importance to the GBA that groundwater banking operations remain under local control, which was the primary reason for the development of Basin Operations Criteria for the Basin as discussed in Chapter 6. The selective timing of withdrawals from surface and groundwater sources can improve the reliability of both water quantity and quality. Such operation is referred to as "conjunctive use." Conjunctive use of surface and groundwater consists of harmoniously combining the use of both water supplies in order to minimize the undesirable physical, environmental and economical effects of each solution and to optimize the balance of water demand and supply.

Conjunctive use of surface water and groundwater sources take advantage of the variability of natural water supplies, manipulating water storage so that less water is wasted during wet seasons. Good conjunctive use practice can be facilitated through cost incentives, e.g. lower the cost of surface water supplies during times of plenty to encourage its use or recharge. Conversely, groundwater costs might be increased during wet years to provide a disincentive for the use this supply. The Metropolitan Water District of Southern California provides cost incentives (in the form of surface water supply discounts) for member agencies to develop local groundwater supplies for use in drought years, which increases the reliability of the entire regional system, and obviates the need for construction large-scale drought supply systems.

ES-10.5 Program Alternatives Formulation

Alternatives were assembled to address GBA objectives of improving water supply sustainability and reliability through:

- Improving water supply reliability;
- Providing multiple benefits;
- Protection and improvement of water quality;
- Providing financial incentives to promote regional integration and conjunctive management;
- Enhancing environmental stewardship;
- An inclusive, integrated planning process incorporating a wide rage of planning processes including land use, flood control, and energy use;
- Scalable implementation;
- Unbiased performance and prioritization criteria; and,
- Monitoring protocols to gauge Plan success

Projects and management actions were compiled into several comprehensive alternatives designed to fully meet the Fundamental Objectives. The alternatives development process went through several iterations of feedback with the GBA membership over the course of several months. The outcome of this process was four Action Alternatives (designated A, B, C, and D), a No Action Alternative, and an alternative describing Existing Conditions.

Existing Conditions Alternative uses:

- 2005 level of demand and supply;
- Existing entitlements and transfers; and,
- Assumptions common to all alternatives[4].

Future No Action Alternative assumes:

- 2030 level of demand;

[4] Includes assumption of existing agency boundaries and powers, and use of 7,000 af/yr of Calaveras River water by Calaveras County Water Agency

- Existing supply projects plus projects with completed engineering and environmental documentation that can reasonably expected to be on-line by 2030;
- Expiration of water transfer agreements and contracts;
- Assumptions common to all alternatives; and,
- Implementation of Common Elements

Action Alternatives assume:

- 2030 level of demand;
- Existing supply projects plus projects with completed engineering and environmental documentation that can reasonably expected to be on-line by 2030;
- Expiration of water transfer agreements and contracts;
- Assumptions common to all alternatives;
- Implementation of Common Elements;
- Implementation of Common Actions; and,
- Implementation of alternative-specific projects

Common Elements

Elements common to all future (2030) alternatives include:

- Conservation per agency Urban Water Management Plans and Agricultural Water Management Plans;
- Stockton Delta Water Supply Project Phase 1 implementation (23 kaf/yr);
- Stockton East Water District Water Treatment Plant expansion to 60 mgd;
- Farmington Phase 1 implementation (22 kaf/yr); and,
- Transfer of Woodbridge water rights to Lodi (6 kaf/yr) and Lodi use as a treated surface water supply.

Common Actions

Elements common to all future (2030) Acton Alternatives include:

- Renewal of transfers to Stockton from Oakdale Irrigation District and South San Joaquin Irrigation District (expire 2019);
- Renewal of NSJWCD Mokelumne River Permit 10477 (expired 2002); and,

- Renewal of SEWD (75 kaf/yr) and CSJWCD (31 kaf/yr) interim Central Valley Project contracts (expire 2022).

Program Alternatives - A series of GBA workshops were conducted over nine months to work through the alternatives development process and to develop the most promising combinations of projects and management actions. General observations on desirability, reliability, and performance were solicited from participants. Promising alternatives were identified and evaluated using the Systems Model described in Chapter 6. A target net annual recharge of 140,000 to 160,000 acre-feet per year was determined to be the level that resulted in acceptable water levels and water level fluctuations according to proposed Basin Operations Criteria. Four program alternatives were further studied and evaluated using the DYNFLOW groundwater model. These four alternatives will be carried forward into the Programmatic Environmental Impact Report. The detailed specifications of the most these four Program Alternatives are presented in Table ES-4.

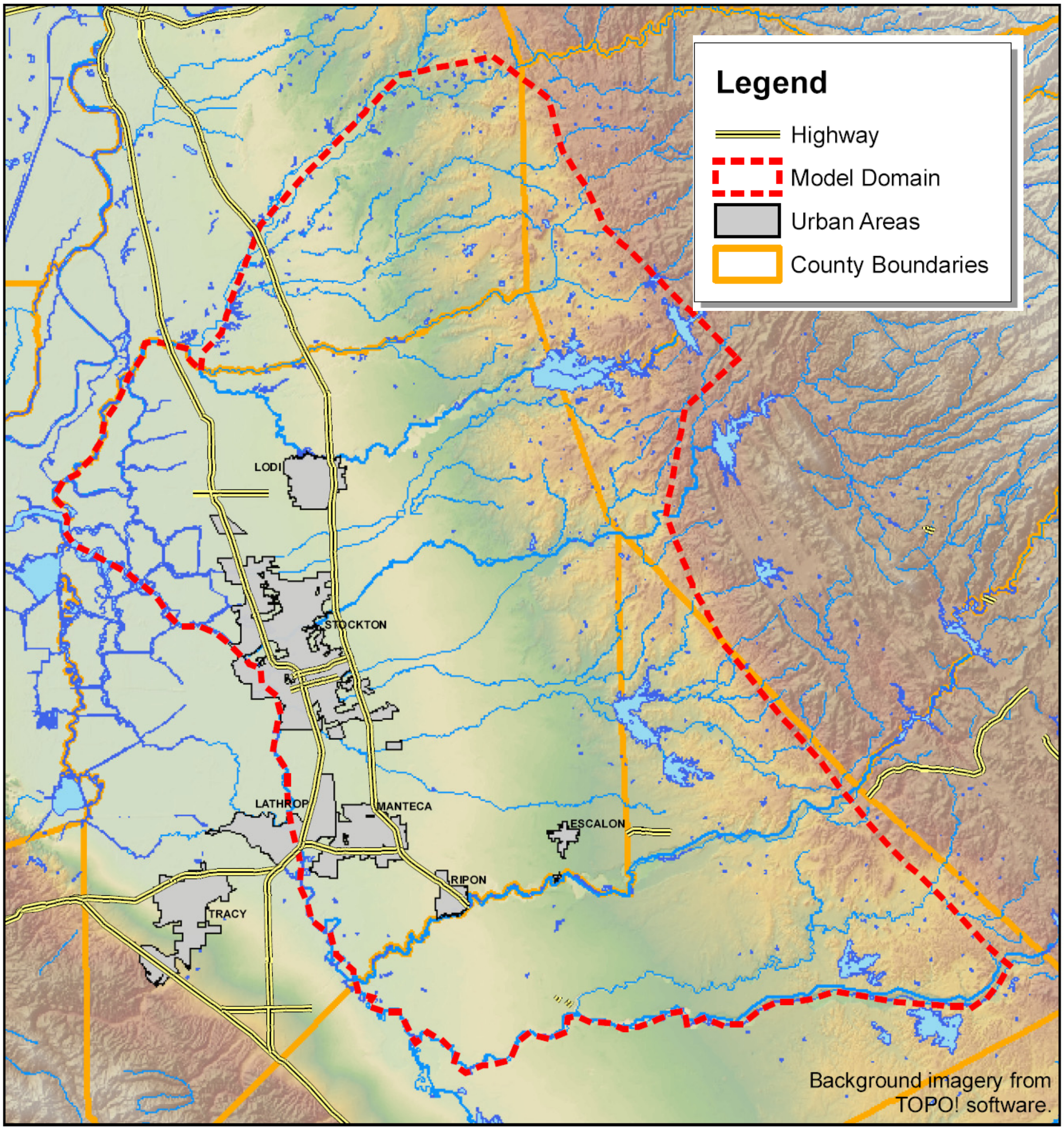
The groundwater model was developed using the DYNFLOW finite-element code. The SJC model domain encompasses portions of San Joaquin, Sacramento, and Stanislaus Counties as shown inFigure ES-10. The major urban areas within the model domain are Stockton, Lodi, Lathrop, Ripon, Manteca, and Escalon. The majority of the county is comprised of agricultural land.

The SJC DYNFLOW model was calibrated over the period from Water Year 1970 through Water Year 2005. In order to simulate the proposed alternatives, an estimated, constant 2030 level of development was applied to the model. Superimposed on the constant 2030 conditions was the historical hydrology from 1970 through 2005. By superimposing the historical hydrology on the constant level of development, the changes of water levels result only from changes in hydrology. The relative impacts of changes in management scenarios can be seen by comparing simulations of different management scenarios. A more complete presentation of the model output is presented in Supplement 2 to Chapter 7.

The four proposed management alternatives defined in Chapter 7 were simulated using the SJC DYNFLOW model. The resulting water levels were plotted and analyzed to assess the impacts of the alternatives. Each alternative was designed to recharge approximately 140,000 acre-feet per year, the quantity found in the screening model which allows water levels to acceptably fluctuate around the target Spring 1986 and Fall 1992 levels. For comparison, the “no-action” alternative (Alternative 0) was also simulated.

	NSJCGBA IRWMP Alternatives	Source	Source Water: Capacity (cfs)	Source Water: Average Supply (KAF/yr)	Source Water: Supply Pattern	Conveyance or Storage	Conveyance Capacity (cfs)	Place of Use	Recharge Type	Evap. Loss	Recharge (KAF/yr)	Demand Pattern
Alternative A	**Projects**											
	Maximum Lodi reclamation	Lodi White Slough WWTP	17.9	8.0	M&I	Pipeline from White Slough	17.9	Lodi	Urban In-lieu	0%	8.0	M&I
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	Farmington Program Phase 2	Stanislaus/Littlejohns	53.4	4.0	Nov-Feb	Pipeline and canal	53.4	SEWD/CSJWCD	Field flooding	5%	3.8	Nov-Feb
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	273.0	20.1	Dec-Jun	Intake/pipeline/WID canals	273.0	Saline barrier	--			Dec-Jun
	MORE Water Pardee diversion	Mokelumne (to Duck Creek)	1,000.0	67.3	Dec-Jun	Tunnel/pipeline to Duck Creek	1,000.0		--			
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	31.9	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	28.7	Year-round
	Regional Banking - Extraction		(138.0)	(15.9)	Jan-Dec	In-river exchange	138.0		Recovery		(15.9)	Year-round
	Duck Creek Reservoir					Duck Creek Reservoir (150 KAF)	400.0	NSJWCD/SEWD	Ag In-lieu	10%	60.6	Mar-Oct
	Saline barrier	Lower Mokelumne diversion				Pipeline/pump station from WID canal	51.8	West Stockton	Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative A			163.5						11.1	150.6	
	Unit Cost ($/AF)											
Alternative B	**Projects**											
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Pardee diversion	Mokelumne (to Duck Creek)	1,000.0	49.6	Dec-Jun	Tunnel/pipeline to Duck Creek	1,000.0		--			
	Freeport Regional Water Project unused capacity	Sac Valley banking partner	155.0	74.5	Dec-Jun	EBMUD Freeport pipeline	155.0	NSJWCD/SEWD	Pond	10%	67.1	Mar-Oct
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	30.0	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	8.3	Year-round
	Regional Banking - Extraction		(276.1)	(52.6)	Jan-Dec	In-river exchange + pumped extraction	276.0		Recovery		(52.6)	Year-round
	Duck Creek Reservoir					Duck Creek Reservoir (150 KAF)	200.0	NSJWCD/SEWD	Ag In-lieu	10%	44.7	Mar-Oct
	Saline barrier	Lower Mokelumne diversion				Pipeline from Mokelumne Aqueduct	51.8	West Stockton	Treatment/Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative B			149.7						16.4	132.8	
	Unit Cost ($/AF)											
Alternative C	**Projects**											
	Maximum Lodi reclamation	Lodi White Slough WWTP	17.9	8.0	M&I	Pipeline from White Slough	17.9	Lodi	Urban In-lieu	0%	8.0	M&I
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	266.0	35.0	Dec-Jun	Intake/pipeline	266.0	NSJWCD/SEWD	Pond	10%	31.5	Dec-Jun
	Freeport Regional Water Project unused capacity	SJCo American River filing	155.0	43.4	Dec-Jun	EBMUD Freeport pipeline	155.0	NSJWCD/SEWD	Pond	10%	39.1	Mar-Oct
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	31.9	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	10.0	Year-round
	Regional Banking - Extraction		(138.0)	(15.9)	Jan-Dec	In-river exchange	138.0		Recovery		(15.9)	Year-round
	Saline barrier	Lower Mokelumne diversion				Pipeline from Mokelumne Aqueduct	51.8	West Stockton	Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative C			150.5						12.0	138.0	
	Unit Cost ($/AF)											
Alternative D	**Projects**											
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	Farmington Program Phase 2	Stanislaus/Littlejohns	53.4	4.0	Nov-Feb	Pipeline and canal	53.4	SEWD/CSJWCD	Field flooding	5%	3.8	Nov-Feb
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	620.0	68.9	Dec-Jun	Intake/pipeline	620.0	NSJWCD/SEWD	Pond	10%	43.3	Dec-Jun
	South Gulch Reservoir/UFC		750.0	20.7	Nov-Apr	Upper Farmington Canal to South Gulch	750.0	SEWD/CSJWCD	Ag In-lieu	10%	18.7	Mar-Oct
	CSJ BN Intermodal ponds	Littlejohns Ck	16.6	4.0	Jan-Dec	Littlejohns Creek		CSJWCD	Pond	10%	3.6	Non-flood
	Saline barrier	Lower Mokelumne diversion				Pipeline/pump station from WID canal	51.8	West Stockton	Treatment/Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Additional transfers from WID, OID, SSJID	Stanislaus	50.0	15.2	Mar-Oct	Existing creeks and conveyances	50.0	SEWD/CSJWCD	Ag In-lieu	10%	13.7	Mar-Oct
	Total Alternative D			161.0						11.6	148.4	
	Unit Cost ($/AF)											

Table ES-4 Program Alternatives A - D



FigureES-10 DYNFLOW Model Domain

ES-10.6 Costs for Implementation of Alternatives

Capital and operations costs were taken from existing reports and studies, or were estimated using unit cost factors included in the Basis of Design. Costs are reported in 2007 dollars and summarized below.

	Total Net Recharge (KAF/yr)	Capital Cost ($M)	O&M Cost ($M/yr)	Annualized Cost ($M/yr)	Unit Cost ($/AF)
Alternative A	**151**	**$921**	**$10.1**	**$68.5**	**$460**
Alternative B	**133**	**$712**	**($1.7)**	**$43.5**	**$330**
Alternative C	**138**	**$584**	**$13.7**	**$50.8**	**$370**
Alternative D	**148**	**$829**	**$10.3**	**$62.8**	**$420**

Capital costs range from $584 to $921 million. Alternative C is the least expensive, and is the only alternative without a new surface storage reservoir. Alternative A is the most expensive, and includes Duck Creek Reservoir and new diversions from Pardee Reservoir and the lower Mokelumne River[5]. Alternatives A, B, and C include regional banking components that provide a net water supply and a net revenue stream which reduces net operations costs[6]. Alternative B includes a large groundwater bank that would recharge a net average of 53 kaf/yr and would produce revenues that would offset other operation costs. These revenues make Alternative B the least expensive on a unit cost basis.

Land requirements include:

- In-lieu distribution networks, recharge ponds, and field flooding. In-lieu surface water distribution systems would be required for 1,800 to over 10,000 acres for the various alternatives, costing an estimated $2,400 per acre, for a cost of up to $25 million in Alternative A.
- Recharge ponds. Alternatives C and D would each require nearly four square miles of recharge ponds totaling over $100 million at an estimated cost of $40,000 per acre.

ES-10.7 Application of Evaluation Criteria

The analyses described above resulted in identification of four promising Program Alternatives, which best address the Fundamental Objectives and underlying issues. Each Alternative identifies 140,000 to 160,000 af/yr of recharge required to meet Basin Management Objectives in each of the identified management units. These promising Alternatives were evaluated in the modeling effort and then rated using the Performance Measures.

Based on Performance Measures and the weighting factors used, there is not one clearly identifiable alternative that would be preferred above the others. Rather, there are four

[5] No cost is assumed for reimbursement of lost EBMUD hydropower revenues since EBMUD power generation is junior to all diversions for water supply

[6] Assumes a fee of $100/af whenever water is placed into or taken from groundwater storage

alternative solutions that are designed to address the Fundamental Objectives. As a result, each of the four alternatives that address various objectives to varying degrees will be carried forward to the Programmatic EIR analysis.

ES-10.8 Application of Prioritization Criteria

The prioritization criteria were next applied to all projects and management actions, whether or not they are represented in the Alternatives. Thus, no project or action is being discarded, but rather the alternatives that are more likely to be implemented are identified to focus implementation efforts. The application of the Prioritization Criteria shows there are three distinct tiers of projects and actions that can be implemented with various degrees of certainty and timeliness.

Significantly, the overall ranking does not change when these weighting criteria are individually altered. Approximating a timeline for additional project development, acquisition of water right permits, performing preliminary and final engineering, completing environmental documentation, obtaining financing, and construction produces possible implementation priorities displayed in Figure ES-12.

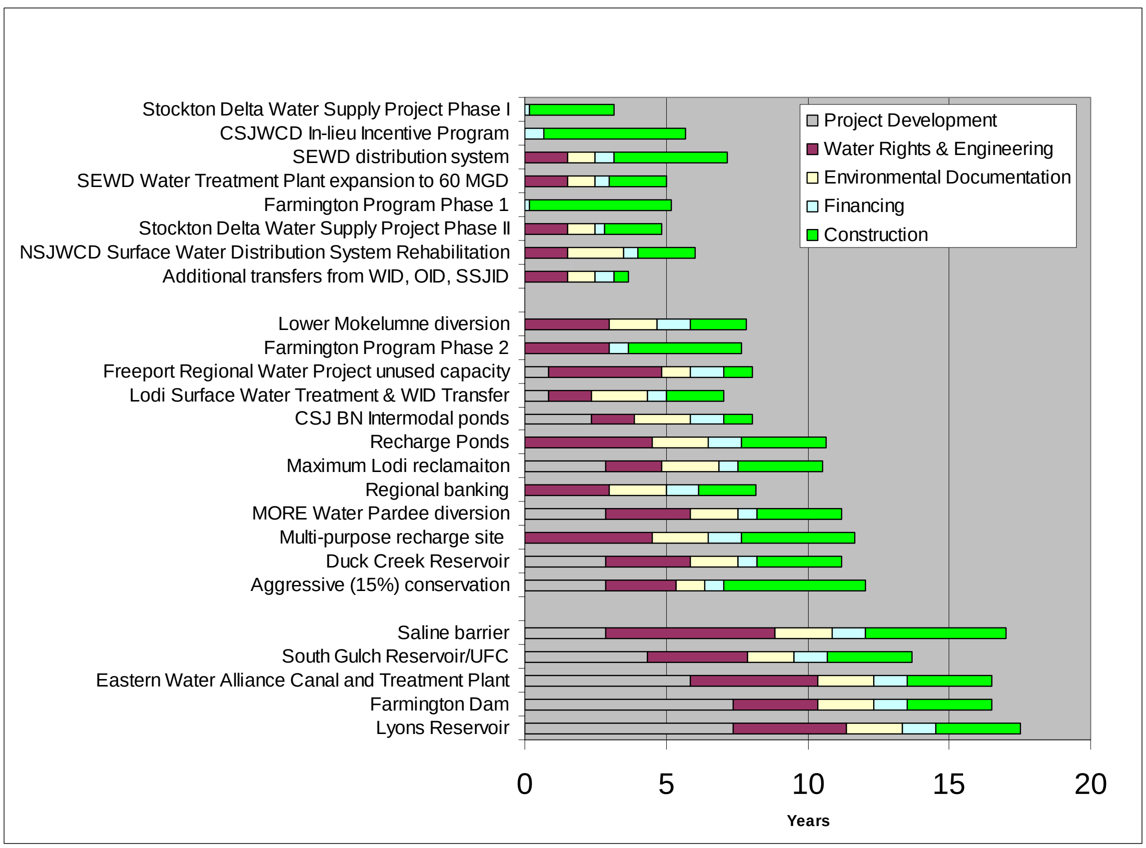


Figure ES-12 Potential Project Implementation Timeline

ES-11 Management Action Plan

Chapter 9 details the actions to be taken to achieve the Basin Management Actions. The GBA is committed to continued inter-agency coordination as IRWM Plan elements are put into action both independently and by implementing agencies.

Inter-agency coordination and collaboration during development of this Plan took place through the GBA Board, the GBA Coordinating Committee, the San Joaquin County Advisory Water Commission, the Mokelumne River Forum, and meetings with the Mokelumne/Amador/Calaveras IRWMP study group. Coordinating Committee members provided input and review on elements of the Plan including the Management Actions presented here. The GBA is committed to continued inter-agency coordination as Plan elements are put into action both independently and by implementing agencies.

ES-11.1 Management Authority

The GBA is a Joint Powers Authority which is represented by individual agencies overlying the Basin with the common interest being the health of the underlying Basin. The GBA is a consensus based forum in which projects can be developed by stakeholders in a manner that maximizes benefits to all involved parties and the region as a whole. Projects developed with input from the stakeholder group ensure consistency with the Plan. The GBA employs a mutual interest-based governance framework that creates a stakeholder group of common interests with the powers to undertake specific goals and objectives.

The enabling act authorizes the GBA to perform planning and study activities in furtherance of acquiring water supplies and improving management of regional water resources. To fulfill this objective, the GBA currently performs the following:

- Preparation of the San Joaquin Count Water Plan and Groundwater Management Plan.
- Assistance with the filing of water rights and assists member agencies to acquire and retain their rights and filings.
- Conducting water monitoring programs and special studies throughout the territory, including the joint USGS/DWR/GBA saline water investigation.
- Preparation of applications for grant funding.
- Acts as a clearinghouse for water resource data.
- Represents GBA member interests in regional forums.

- The GBA has prepared this Integrated Regional Water Management Plan to plan water supplies and use in the region through 2030.

As discussed in this Plan, the management authority of the GBA is considerable in scope and areal extent. The GBA will continue to interact with other agencies and groups throughout the region to increase the social, economic, and environmental viability of the San Joaquin region and beyond. This integration of these strategies increases the potential for broad-based support by spreading benefits to multiple interests and agencies. Integration also produces synergistic effects and makes additional funding sources available.

ES-11.2 Management Actions

The 53 actions listed in Chapter 9 constitute the Groundwater Banking Authority's plan and pledge to implement the Integrated Regional Water Management Plan. Management Actions have been grouped into the following categories:

- **Monitoring –** Monitoring of water parameters such as water levels, water quality, import quantities, water budgets, etc., plus monitoring of population growth and development, effectiveness of water conservation measures, and land subsidence. Data management will be closely tied to this function.

- **Improved Basin Characterization –** Continued exploration, infiltration rate testing, aquifer characterization, modeling, improvements to understating of the water budget.

- **Continued Long-Term Planning –** Includes review of land use plans, additional water supply identification, and Plan updates.

- **Groundwater Protection –** This category could include recharge site management, identification and destruction of abandoned wells, hazardous material response, protection of recharge areas.

- **Construction and Implementation –** Identification of implanting agencies for high priority projects, and coordinate with those agencies in putting them into service.

- **Governance –** Development of regional governance structures to acquire water supplies, manage the groundwater basin, and equitably distribute benefits and costs.

- **Financing –** Implementing the IRWM Plan will require an array of financing mechanisms such as bonds, grants, or low interest loans. Some implementing agencies have available revenue streams for implementing projects, while others do not. Cost savings may be incurred through implantation of conservation and water reuse projects. In addition, cooperative funding agreements between the GBA and local, state, or federal agencies may also provide funding for IRWM Plan projects and management actions.

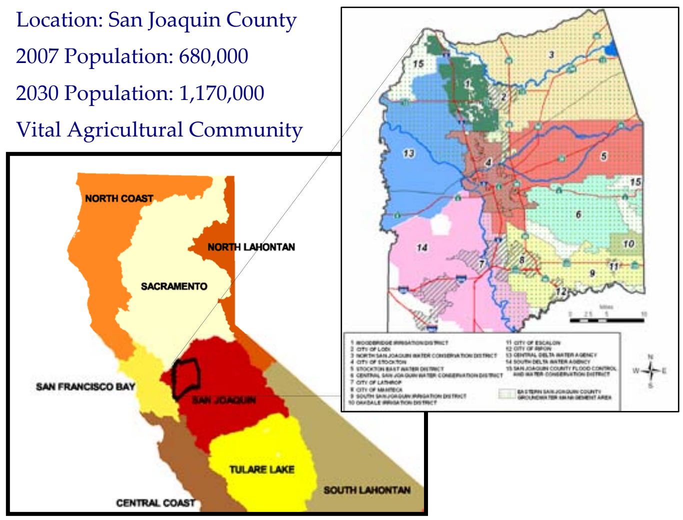
- **Public Participation/Community Outreach –** Continued coordination with the GBA Board and Coordinating Committee, the San Joaquin County Advisory Water Commission, as well as regional water managers and community groups.

Chapter 1 - Introduction

1.1 Water Management Challenges

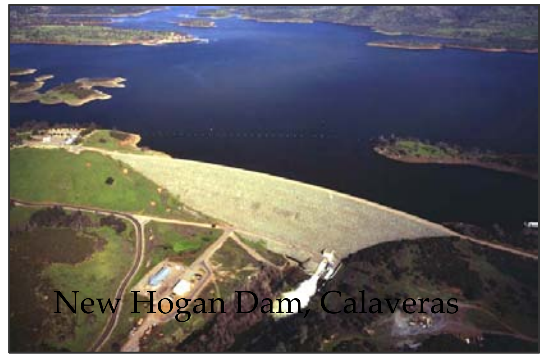
Like many San Joaquin Valley communities, the pressures of rapid urban growth, competitive agricultural commodity markets, and progressively aggressive regulatory requirements will test the ability of the San Joaquin Region to provide access to reliable high quality water, the basis for the region's future sustainability. The water management challenges facing San Joaquin County and surrounding communities are multifaceted and are further complicated by competing inter-regional interests. Simply put, the San Joaquin Region's water supplies are over appropriated, over-drafted and at times overflowing in the San Joaquin Delta.

Location: San Joaquin County
2007 Population: 680,000
2030 Population: 1,170,000
Vital Agricultural Community



Approximately one-third of San Joaquin County is located within the Sacramento-San Joaquin Delta. The Delta is the largest estuary on the west coast and is home to over 750 plant and animal species, many of which are threatened or endangered. The Delta provides drinking water for two-thirds of all Californians and irrigation water for over 7 million acres of highly productive farmland in the San Joaquin Valley and Southern California. Locally, the Delta is a major agricultural producing region, a major boating and recreational attraction, a major transportation corridor to the Greater Bay Area and Central Coast, and soon to become a source of drinking water for the City of Stockton.

Flood management continues to be a major water management issue for the San Joaquin Region. Areas of concern include: urbanization of areas historically in the floodplain, flood risk reduction, levee decertification, financial feasibility, and climate uncertainty. The system of reservoirs throughout the State are operated in most part to provide both flood control and water supply benefits. The question remains, can the system of reservoirs be operated in a manner that meets present and future flood control requirements and the growing demand for reliable high-quality water supplies.



San Joaquin County is currently home to approximately 750,000 people and sustains a $1.75 billion agricultural economy. The population is expected to increase to over 1.17 million by 2030. Water demand countywide is approximately 1,600,000 acre-feet per year, 60 percent of which is quenched by groundwater. The California Department of Water Resources (DWR) has declared the Eastern San Joaquin Groundwater Basin (Basin) "critically overdrafted," indicating that the current rate of groundwater pumping exceeds the rate of recharge and is not sustainable. (DWR, 1980)

Long-term groundwater overdraft has had dramatic effects on water levels and water quality. Portions of the Basin have seen groundwater levels decline by as much as 2 feet per year up to 90 feet below sea level. Groundwater level declines have induced steep gradients from the west Delta inducing the intrusion of highly saline groundwater into the Basin. Several municipal supply wells in the City of Stockton and irrigation wells have been abandoned due to elevated salt levels unsuitable for drinking and agricultural supplies. Recent results from a US Geological Survey Study of the Basin point to several sources of highly saline water impacting the Basin including surface water infiltration, the dissolution of salts near the Delta margin, contributions from underlying deposits and possible irrigation return flow.

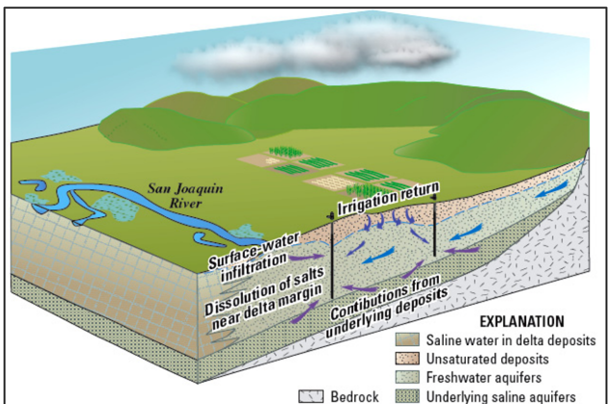
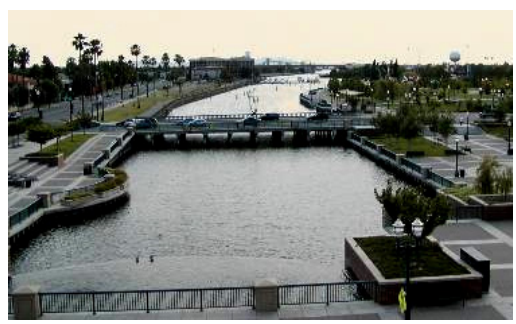


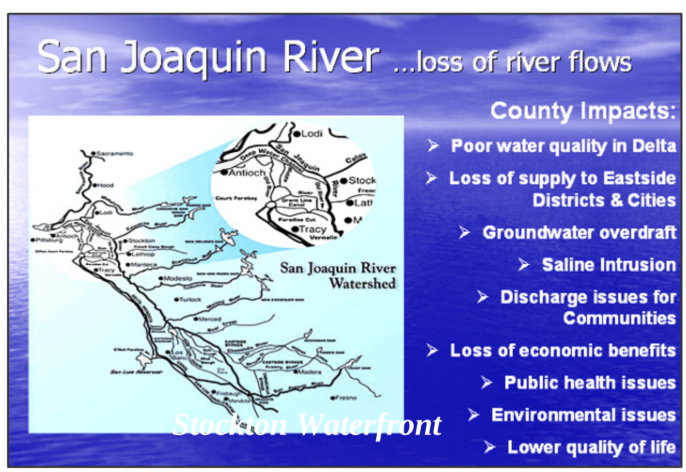
Figure 2. Sources of high-chloride water to wells, Eastern San Joaquin Ground-Water Subbasin, California.

Failure to address water supply and management needs in this Region will ultimately result in severe social, economic, and environmental disruptions to the County. Frequently, the vital agriculture industry in San Joaquin County is stressed due to declining market prices, rising regulatory, labor, and energy costs, and can ill afford threats to its water supply – a fundamental component of its continued existence. Municipal and industrial users simply must have reliable, high-quality supplies to exist and grow. Loss of supplies to saline intrusion, potential loss of basin yield due to subsidence, or simply lack of reliability will translate into business flight, job loss, loss of revenue for public services and a general economic decline. Individual agencies in San Joaquin County have long grappled with declining groundwater levels and unreliable supplemental water supplies due to the historic loss of flow from the San Joaquin River without finding adequate supplemental supplies from neighboring watersheds. Consequently, the need for action to remedy these issues has reached critical mass.

Yet, the problem of significant groundwater overdraft and the resulting decline of groundwater levels in Eastern San Joaquin County has created a "silver-lining" with an estimated 1 to 2 million acre-feet of potential operable groundwater storage capacity, a volume equivalent to Folsom Reservoir. In addition, Eastern San Joaquin County's proximity to major waterways and reservoirs, existing and proposed regional conveyance facilities, and the Sacramento-San Joaquin Delta has amplified the potential for the formation of a major groundwater bank for regional and statewide interests. The full implementation of conjunctive water management could significantly enhance the reliability and sustainability of both water quantity and quality for the San Joaquin County Region.



Water districts and agencies in San Joaquin County have come to recognize that the long-term economic and environmental health of the Region is closely related to access to sufficient water supplies. Consequently, over the past several years, agencies have joined in consensus-based activities where local water interests, with historically diverse viewpoints regarding the use of water resources, have worked cooperatively to develop and



implement water resource projects and to speak with a more unified voice on regional water issues. Recent regional efforts developed successfully through this consensus-based approach have set a foundation where none had existed previously, and by which, additional project development & implementation efforts are now moving forward.

1.2 Regional Water Management Agency

Independently, agencies in San Joaquin County have found it difficult to wield the political and financial power necessary to mitigate the conditions of overdraft. County interests have come to realize that a regional consensus-based approach to water resources planning and conjunctive water management increases the chance for success.

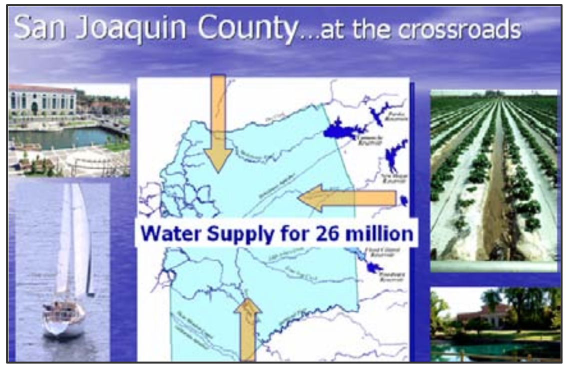
Since its formation as a Joint Powers Authority in 2001, the 11-member agency Northeastern San Joaquin County Groundwater Banking Authority (GBA) has employed the consensus based approach in its goal to develop "…locally supported conjunctive use projects that improve water supply reliability in San Joaquin County…and provide benefits to project participants as a whole." Collaboration amongst the GBA member agencies has strengthened the potential for broad public support for groundwater management activities as well as the ability to leverage local, State, and federal funds. Table 1-1. lists the member agencies of GBA.

The GBA is the regional water management group responsible for the development and implementation of the Eastern San Joaquin Integrated Regional Water Management Plan (IRWM Plan). The Authority together with the San Joaquin County is a Department of Water Resources Conjunctive Water Management Branch MOU partner and has furthered these efforts through this partnership.

Table 1-1 Member Agencies of the Northeastern San Joaquin County Groundwater Banking Authority
City of Stockton
California Water Service Company
City of Lodi
Woodbridge Irrigation District
North San Joaquin Water Conservation District
Central San Joaquin Water Conservation District
Stockton East Water District
Central Delta Water Agency
South Delta Water Agency
San Joaquin County Flood Control and Water Conservation District
San Joaquin Farm Bureau Federation*
* Associate Member

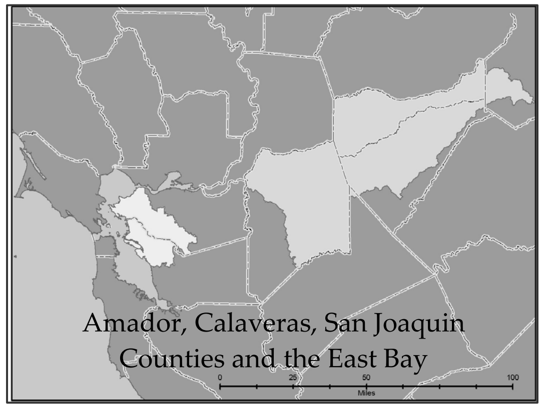
Why is the GBA the appropriate agency for developing an IRWMP?

While the Eastern San Joaquin Regional Planning Area encompasses only about one percent of California, its geography, geology, and historic circumstance place it in a vortex of State water planning issues. The situation is a complex mix of issues that might be intractable at a broader scale. After much deliberation, the GBA decided to broach the issues of regional integration through the development of this IRWMP process with the realization that the magnitude of solutions for the water supply and groundwater management challenges are not simply a local problem but reach out for regional, inter-regional and statewide resolution. The incorporation of alternative water management strategies to reverse water level declines and further intrusion of saline groundwater will require a substantial amount of supplemental water even with the best conservation and recycling programs in place. Past studies indicate that, groundwater overdraft is estimated at a minimum of 150,000 acre-feet per year. Member agencies have come to realize that without the consensus-building forum of the GBA, no one single agency within the region would be able to effectively propose or implement the overall solution to these challenges.



Since its formation, the GBA has become the regional groundwater management and water resources planning agency for the Basin. In 2004, the GBA completed and adopted the Eastern San Joaquin Groundwater Management Plan, compliant with Senate Bill 1938 and Water Code Section 10750 *et. seq*., as a step toward implementing an overall integrated conjunctive use program. The IRWM Plan is a logical step for the GBA on its way to implementation of this program. The GBA's success is attributed to its commitment to the consensus-based approach to water supply planning, significant local, State and Federal support and its ability to speak with one voice on water issues.

The task of developing and implementing an affordable and locally supported conjunctive use program in the San Joaquin Region would be nearly impossible and an extreme financial burden for an individual agency. No single project or program will solve the Basin overdraft, raise groundwater levels, or reverse saline intrusion. Integration of and collaboration on projects and programs is the only way of tackling the enormous task at hand.



In this IRWM planning process, the GBA has sought out opportunities to integrate a variety of water management strategies including Sacramento-San Joaquin Delta issues, flood management, storm water management issues, environmental issues, groundwater management, conservation, reclamation, recycling, water supply & conjunctive use, and inter-regional issues all of which may benefit a wide variety of regional interests. The incorporation of and sensitivity towards these issues and other water management strategies are the focus of this IRWMP with an overall objective to improve and enhance water resources within the GBA's adopted Groundwater Management Area. This area includes a diverse range of water-related interests and objectives and was considered initially by the GBA as a suitable practical limit, which would maximize the level of regional integration. Yet, the smaller planning region could possibly risk developing an IRWM Plan that does not fully consider a wider range of possible inter-regional solutions or impacts, and for that reason, an area of regional integration was also considered as an important component to this planning process and the development of possible solutions.

1.3 IRWMP Purpose, Objective and Planning Process

The purpose of this IRWMP is to define and integrate key water management strategies to establish the protocols and course of action for implementation of the Eastern San Joaquin Integrated Conjunctive Use Program (ICU Program). The ICU Program will implement a comprehensive, prioritized set of projects and actions that when implemented will meet adopted Basin Management Objectives and provide regional benefits to area stakeholders.

The IRWM Planning Process began in late 2004 following the completion of the Eastern San Joaquin Groundwater Basin Groundwater Management Plan. The IRWMP planning process was envisioned to take the concept of managing and restoring the underlying Basin from idea to reality. In February 2005, the GBA submitted a grant application to DWR and the SWRCB to partially fund the development of the IRWMP under Proposition 50. The GBA's application ranked seventh in the State and was selected to receive an Integrated Regional Water Management Planning Grant of approximately $500,000 to complete the IRWMP together with a CEQA programmatic environmental document of the ICU Program. The planning process consisted of the following four major elements:

- Element 1 – Stakeholder Outreach
- Element 2 – ICU Program Development and Management Framework Evaluation
- Element 3 – Management Action Plan
- Element 4 – Programmatic Environmental Impact Report

1.4 Stakeholder Outreach and Coordination

The GBA has made a concerted effort to reach out and involve stakeholders and the public in its IRWM Plan development activities including:

- The GBA itself is a forum to find mutually-beneficial solutions to the areas water problems
- The GBA's Groundwater Management Plan had active participation from areas outside and adjacent to the Management Area
- This effort has been greatly aided by the facilitation support provided through DWR's Integrated Storage Investigation partnership with the GBA
- All GBA planning efforts are open to the public, with agendas and meeting minutes published on the internet
- IRWM planning activities were regularly reported to the County-wide Advisory Water Commission
- San Joaquin County has dedicated staff and financial resources for this high-priority effort
- GBA staff participate in other regional planning activities such as the Mokelumne River Forum

Public Outreach - The GBA regularly provides information to stakeholders and the general public through many avenues. On a regular basis, meeting agendas and minutes are distributed to interested parties, regular attendees and the public via U.S. mail and e-mail. The notifications are also published on the internet at (see below for more information). Besides the GBA website, other avenues of public outreach include regular newsletters,


Lodi Area Vineyard

frequent mailing of complete agenda packets and distribution of press releases.

GBA Website – The GBA website has been online since early 2006 and continues to be maintained on a regular basis (www.gbawater.org). It contains an introduction of the Mission, Member Agencies, Board of Directors with links and meeting information. There are detailed sections for projects, education materials, and detailed meeting notices with the accompanying minutes. As a major purpose in creating accessible information online, there is a section devoted to press releases, newsletters, public notices and other major events and accomplishments. As distribution information to the public and interested parties is important, there is also an area to access the complete project reports relative to the GBA and its member agencies. Contact information is readily available for interested parties to communicate with GBA members and staff.

San Joaquin River Delta

Regular GBA Meetings - The GBA Board convenes on the second Wednesday of the month while the GBA Coordinating Committee meets on the second and fourth Wednesdays of the month. At least one, and most of the time both, of the Coordinating Committee meetings a month have been devoted to IRWM Plan development. The GBA Coordinating Committee will continue to meet every month during IRWM Plan development to provide beneficial interaction. At these meetings, key discussion points and decisions were debated and finalized by the Coordinating Committee and incorporated into the IRWMP by GBA staff.

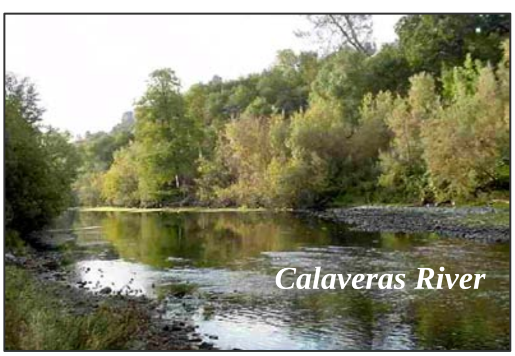
Draft sections of the Plan were also presented to and commented on by the Coordinating Committee. The Authority Board of Directors was regularly updated on the activities of the IRWM Plan at their regular meetings on the 2nd Wednesday of the month. The agenda for each meeting was set as appropriate to discuss the current activities of the active elements. All GBA meetings are open to the public with agendas published on the internet and on a regular mailing list. All GBA meetings are also facilitated by the Center for Collaborative Policy for the purpose of providing an atmosphere conducive to broad-based consensus building and compromise. Funding for facilitation is provided by the DWR DPLA Conjunctive Water Management Branch.

Facilitation by Ms. Carolyn Lott of the California Center for Collaborative Policy has been an integral part to the success of the GBA's consensus based process. The Center's presence has maintained an atmosphere conducive to openness, compromise, and agreement. It is expected that the Center will continue to facilitate Authority meetings throughout the implementation of the Plan.

Federal Advocacy - Since 2000, the San Joaquin Council of Governments (COG), the regional metropolitan planning organization, has coordinated a delegation of over 60 policymakers, governmental officials and business leaders from San Joaquin County to call upon Congressional representatives and administrative staff in Washington D.C. to discuss specific issues and projects of importance to our region. Each year the group presents a targeted list of regional priorities, illustrating cooperation among the local agencies to secure federal support. Projects have included transportation, transit, habitat conservation, economic development, water and education. The eighth annual trip was held April 22-27, 2007. Each city within San Joaquin County, the County, the transit agencies, and the Port of Stockton are invited to submit two to three projects to be considered for the regional priority project list. Non-profit organizations are also eligible to participate in the process by acquiring an endorsement by a local jurisdiction.

The One Voice trip provides opportunities for leaders in local government and business to join together to protect and advance the region's economic health and quality of life. To date, more than $54 million has been generated to address critical needs for our region through One Voice.

Board of Supervisors members and San Joaquin County Public Works Department staff attended the 2007 San Joaquin County Council of Governments One Voice Trip in Washington, D.C. During that trip, strategic meetings were organized with federal legislators and their staff, along with other relevant stakeholders from the GBA, in support of legislative activities. There was a consortium of agencies from San Joaquin County that supported IRWMP and the ICU Program.



IRWMP Specific Outreach Efforts - As the physical boundaries of the Eastern San Joaquin and Cosumnes Sub-Basins extend beyond the political boundaries of San Joaquin County there was a recognized need for increased coordination between agencies outside of the San Joaquin Region. In May 2003, the Authority invited a variety of interest groups from the business, environmental, agricultural, and political sectors to participate in the development of the GBA Groundwater Management Plan. Then again in January 2005, a similar invitation was sent to over 150 stakeholder agencies to solicit participation in the development of the IRWM Plan.

The agency coordination process was vital to have interaction that is both intra-regional and inter-regional in nature. Intra-regional coordination refers to collaboration within the boundaries of the East Basin Groundwater Management Area (GMA) and inter-regional coordination refers to collaboration with agencies outside of the GMA. These concepts are promoted by the GBA to help stakeholders understand how their actions affect areas throughout the region, and to communicate with outside agencies the projects and programs that could positively affect regional water supplies.

IRWM Plan stakeholder agencies have included representatives from over 40 agencies and interest groups that have participated in both the development of the GBA's GWMP and the IRWMP. Those groups include affected parties, environmental representatives, legislators and staff, the general public, local water agencies, cities, etc. The below table lists attendees and their agencies:

Table 1-2 IRWMP Participating Stakeholder Agencies

Local Participants & Agencies	
Ron Addington	Business Council, Inc
Henry Wind	California Water Service Company
Jim Simunovich	California Water Service Company
Paul Risso	California Water Service Company
Stan Ferraro	California Water Service Company
Dante Nomellini	Central Delta Water Agency
Reid Roberts	Central San Joaquin Water Conservation District
Cary Keaton	City of Lathrop
Phil Katzakian	City of Lodi
Mark Lindseth	City of Lodi
Richard Prima	City of Lodi
Charlie Swimley	City of Lodi
Wally Sandelin	City of Lodi
Keith Conarroe	City of Manteca
Bob Granberg	City of Stockton Municipal Utilities Department
Ed Formosa	City of Stockton Municipal Utilities Department
Mark Madison	City of Stockton Municipal Utilities Department
Teresa Tanaka	Linden County Water District
Cliff Kerr	Local Community Member
Craig Thompson	Local Community Member
Ed Steffani	North San Joaquin Water Conservation District
Pete Weinzheimer	North San Joaquin Water Conservation District
Michael McGrew	San Joaquin County Counsel

Ray Borges	San Joaquin County Environmental Health
Brandon Nakagawa	San Joaquin County Public Works
Mel Lytle	San Joaquin County Public Works
T.R. Flinn	San Joaquin County Public Works
Tom Gau	San Joaquin County Public Works
Joe Petersen	San Joaquin Farm Bureau Federation
Tom Orvis	San Joaquin Farm Bureau Federation
John Herrick	South Delta Water Agency
Dave Kamper	South San Joaquin Irrigation District
Steve Stroud	South San Joaquin Irrigation District
Gary Giovanetti	Stockton City Council
Dan Chapman	Stockton City Council
Anthony Barkett	Stockton East Water District
Kevin Kauffman	Stockton East Water District
Loralee McGaughey	Stockton East Water District
Melvin Panizza	Stockton East Water District
Andrew Watkins	Stockton East Water District
Anders Christensen	Woodbridge Irrigation District
State Participants & Agencies	
Tim Parker	Department of Water Resources
Michael Floyd	Department of Water Resources
Mary Bava	Office of Assemblyperson Barbara Matthews
Ann Jordan	Office of State Senator Charles Poochigian
Federal Participants & Agencies	
Bill Peach	US Bureau of Reclamation
David Simpson	Natural Resource Conservation Service
Patrick Dwyer	US Army Corps of Engineers
Eric Reichard	US Geological Survey
John Izbicki	US Geological Survey
Other Participants & Agencies	
Ed Pattison	Calaveras County Water District
Larry Diamond	Calaveras County Water District
Carolyn Lott	California Center for Collaborative Policy
Gina Veronese	Camp, Dresser, & McKee
Paul Hossain	Camp, Dresser, & McKee
Robert Vince	Camp, Dresser, & McKee
Rob Tull	CH2M Hill
Andrea Flores	Contra Costa Water District
Gerald Schwartz	East Bay Municipal Utility District
Mike Tognolini	East Bay Municipal Utility District
Tom Francis	East Bay Municipal Utility District
James Moore	Galt Economic Development Task Force
David Beard	Great Valley Center
Les Chau	Kennedy/Jenks Consultants
Jeroen Preiss	Kennedy/Jenks Consultants

Chris Petersen	Montgomery Watson Harza
Trevor Joseph	Montgomery Watson Harza
William Van Fields	Morada Area Association
Mark S. Williamson	Bookman-Edmonston
Barbara Williams	Sierra Club
John Aud	Stanislaus County
Matt Zidar	WRIME, Inc.
Ginger Bryant	Bryant and Associates
Dave Peterson	Peterson Brustad and Pivetti

GBA staff has also presented information regarding the development of the IRWMP through a concerted outreach effort to both local, regional, State and Federal agencies and organizations including:

- ACWA Groundwater Committee
- ACWA Region 4 Committee
- American Public Works Association
- American River Authority
- American Water Resources Association
- Business Industry Association of the Delta
- City of Stockton Sunrise Rotary Club
- City of Stockton Chamber of Commerce
- Community Water for Life & Earth Day Events
- DWR Conjunctive Water Branch MOU Workshops
- Lodi City Council
- Lodi Grape Commission
- Mokelumne River Association
- Mokelumne River Forum
- San Joaquin County Council of Governments
- San Joaquin County Agricultural Advisory Council
- San Joaquin Farm Bureau Water Committee
- San Joaquin Farm Bureau Annual Agriculture in the Classroom Program
- Stanislaus County Water Summit

IRWMP Public Hearings - The GBA sent letters to interested parties inviting them to participate in the development of an IRWM Plan. The letter expressed the intent to complete an IRWMP to fulfill eligibility requirements for Proposition 50, Chapter 8 funding for project and regional planning activities outlined in the Groundwater Management Plan. The letter also discussed the intent of the IRWM Plan to develop regional planning and appropriate environmental documents to implement new water supply and conjunctive management actions and promote broad-based involvement and regional partnerships.

Public Commenting Period – The IRWM Planning process adheres to California Water Code Section 10540-10541 et. seq., that contains rules to hearings and adoptions and California Government Code 6066 pertaining to formal publication notices.

The GBA formally noticed through publication in accordance with the above and held a Public Hearing on Wednesday, January 12, 2005, at 9:30 a.m., in Conference Room A of the San Joaquin County Public Works Building, 1810 East Hazelton Avenue, Stockton, California, on whether to adopt a Resolution of Intent to Prepare an Integrated Regional Water Management Plan pursuant to Water Code §10530, et seq., for the purpose of enhanced management of water resources in San Joaquin County. The Resolution was adopted unanimously to initiate formulation of this IRWM Plan. A Resolution of Intent to Prepare a Groundwater Management Plan was adopted by the GBA Board of Directors on January 12, 2005.

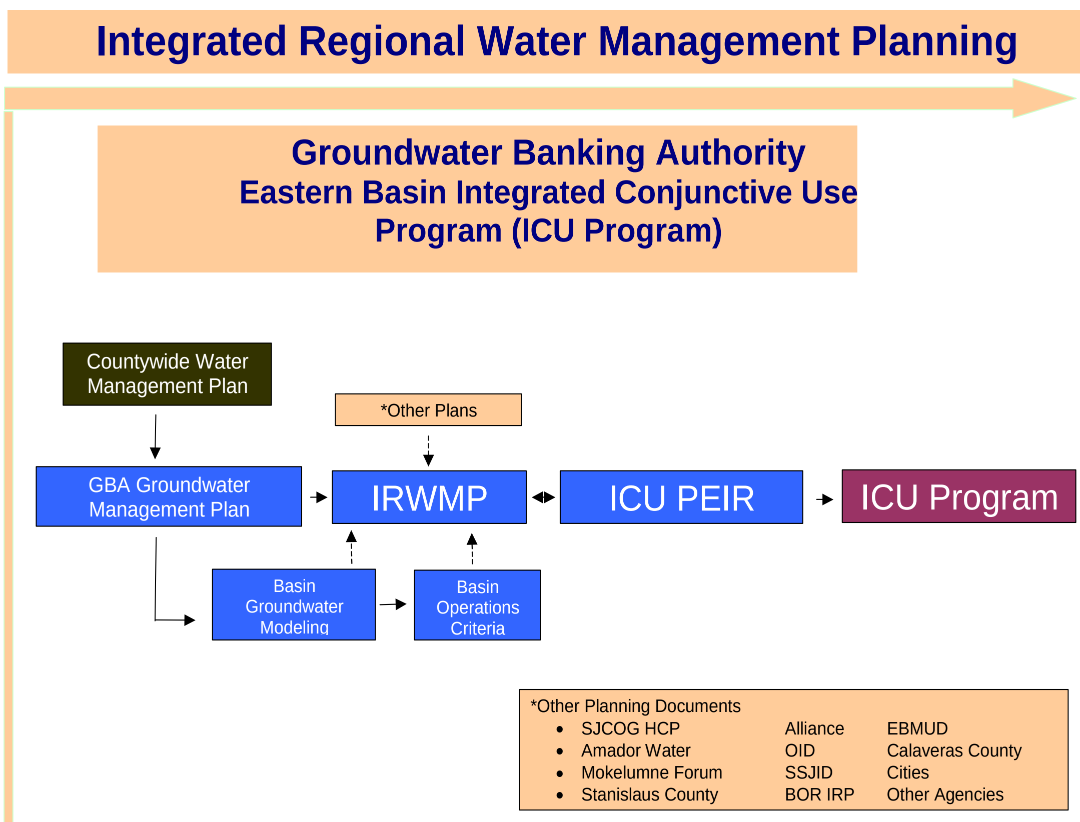
Focus Groups – The GBA has incorporated a stakeholder and public outreach program to generate public support for the IRWMP. It has conducted a series of workshops with the Coordinating Committee and the general public over the past 24 months that has included six workshops to ensure stakeholder participation through each step of the screening process. Some of the workshop task topics have been the following:

- Public Workshop 1 - Regional Priorities—including an overview of the screening process, and articulation of fundamental objectives
- Stakeholder Workshop 1 - Performance Measures – establish criteria to judge the relative merits of projects and management actions
- Stakeholder Workshop 2 - Initial Alternatives – including characterization of projects and management actions
- Stakeholder Workshop 3 - Present Screening Model
- Public Workshop 2 - Preliminary Alternatives
- Stakeholder Workshop 4 - Exploring Promising Combinations of Projects

1.5 Expectations for the IRWM Plan

The GBA is working to develop a strong foundation to guide and support responsible water management in the San Joaquin Region. The central component of this foundation is the IRWMP, which will act as the implementation document for recently completed Surface and Groundwater Management Plan (See Flow Chart below). The Countywide Water Management Plan described water management issues and provided an inventory of water management options. The Groundwater Management Plan focused on objectives for sustainable management options for the Basin. Both documents outlined strategies that will be further developed as part of the IRWMP.

The IRWMP will include several different efforts to complete the planning process and place the GBA, as a regional planning agency, in the best position to compete for State funding through grants and other means, and to facilitate the implementation of high priority projects identified in the ICU Program. Following completion and adoption of the IRWMP, the GBA will develop a supporting programmatic environmental impact report for the ICU Program over the next 12 months.



To summarize, the goal is to develop an IRWMP that can be looked upon as a paradigm for water resource planning in the San Joaquin Region. As such, in addition to containing all of the elements required by legislation, it will serve as the "road map" for sustainable water resource management well into the future.

Chapter 2 - Region Description

San Joaquin County is situated within the Central Valley, a 400-mile long, 50 mile wide northwestward trending, asymmetrical structural trough bordered by the Sierra Nevada mountain range to the east and the Coastal Range to the west. Rivers in the Central Valley flow out of the Sierra Nevada and foothill areas towards the Sacramento/San Joaquin Delta and ultimately into San Francisco Bay. San Joaquin County includes portions of the Sacramento-San Joaquin Delta on its western edge and the Sierra Nevada foothills on the eastern edge. The area of San Joaquin County is approximately 1,400 square miles. Figure 2-1 illustrates the County's location within California.

San Joaquin County encompasses seven incorporated cities: Stockton, Lodi, Manteca, Escalon, Lathrop, Ripon, and Tracy. Urban water agencies in those areas provide water to residential, commercial, and industrial users within their boundaries. Thirteen agricultural water agencies provide water for irrigation in approximately 70% percent of agricultural areas of the County. Approximately 280,000 acres of land in San Joaquin County remain unincorporated. Additional information on urban areas and agricultural agencies is presented in Section 3.

2.1 Geographic Features

The following section describes the geographic information pertinent to IRWM Planning for the Eastern San Joaquin Region.

2.1.1 Surface Water Features

San Joaquin County lies at the northwestern corner of the San Joaquin Hydrologic Region as defined by DWR and shown on Figure 2-1. The major rivers in this hydrologic region are the San Joaquin, Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno. The Calaveras, Mokelumne, and Stanislaus Rivers flow through or border San Joaquin County and at times discharge directly into the Delta or into the San Joaquin River which in turn flows to the Delta. The west and southwestern portion of the County is part of the Delta, and the areas of Primary and Secondary Zones are shown in Figure 2-2. The Delta and other major waterways are also shown on Figure 2-2. Table 2-1 provides a summary of the major reservoirs located in the region. More detailed descriptions of the rivers and the associated facilities are provided in the following sections. (DWR, 2003)

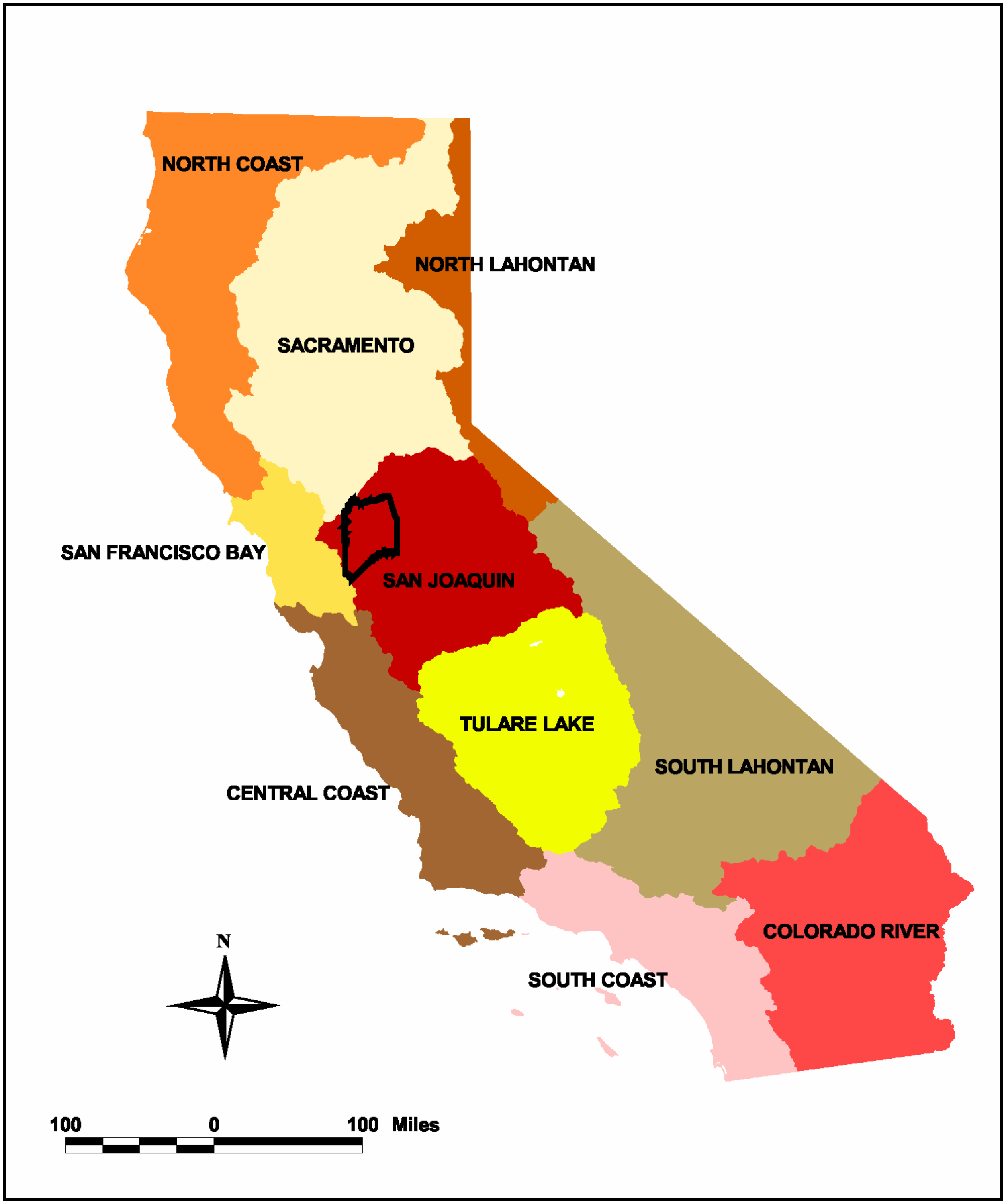


Figure 2-1 Hydrologic Regions of California

Source: California Spatial Information Library at http://www.gis.ca.gov/

Table 2-1 Major Area Reservoirs			
River	Major Reservoirs	Size (acre-feet)	Owning/Operating Agencies
Mokelumne	Pardee Reservoir Camanche Reservoir	197,950 417,120	East Bay MUD
Calaveras	New Hogan Lake	317,000	U.S. Bureau of Reclamation U.S. Army Corps of Engineers Stockton East Water District Calaveras County Water District
Stanislaus	New Melones Reservoir	2,400,000	U.S. Bureau of Reclamation Central Valley Project
	Beardsley Reservoir Donnells Reservoir Tulloch Reservoir	77,600 56,893 68,400	Oakdale Irrigation District, South San Joaquin Irrigation District
Source: State of California, California Statistical Abstract, 2002.			

2.1.1.1 Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta covers more than 738,000 acres in five counties and is comprised of numerous islands within a network of canals and natural sloughs. The Sacramento and San Joaquin Rivers come together in the Delta before they flow to the San Francisco Bay and out to the ocean. The Delta is the largest estuary on the west coast and is home to over 750 plant and animal species, many of which are threatened or endangered. The Delta provides drinking water for two-thirds of all Californians and irrigation water for over 7 million acres of highly productive farmland. Rivers in San Joaquin County all flow into the Delta as they flow out to sea.

2.1.1.2 Calaveras River

The Calaveras River watershed consists of 363 square miles and stretches from the Sierra Nevada foothills to San Joaquin River in west Stockton. Flow in the Calaveras is primarily derived by rainfall with almost no contribution by snowmelt. The United States Army Corps of Engineers (USACE) constructed the multi-purpose New Hogan Dam in 1963 for flood control, municipal, industrial, irrigation, and recreation purposes. New Hogan Reservoir has a capacity of 317,000 acre-feet. The USACE controls flood control releases from New Hogan. SEWD and CCWD operate New Hogan at all other times and have been allocated 56.5% and 43.5% of the New Hogan yield respectively. Currently, CCWD uses approximately 3,500 acre-feet per year of its New Hogan allocation. SEWD currently utilizes CCWD's unused share which is subject to reductions based on CCWD's future demands. It should be recognized that growth projections in Calaveras County are volatile and the continued use of CCWD's New Hogan allocation is uncertain.

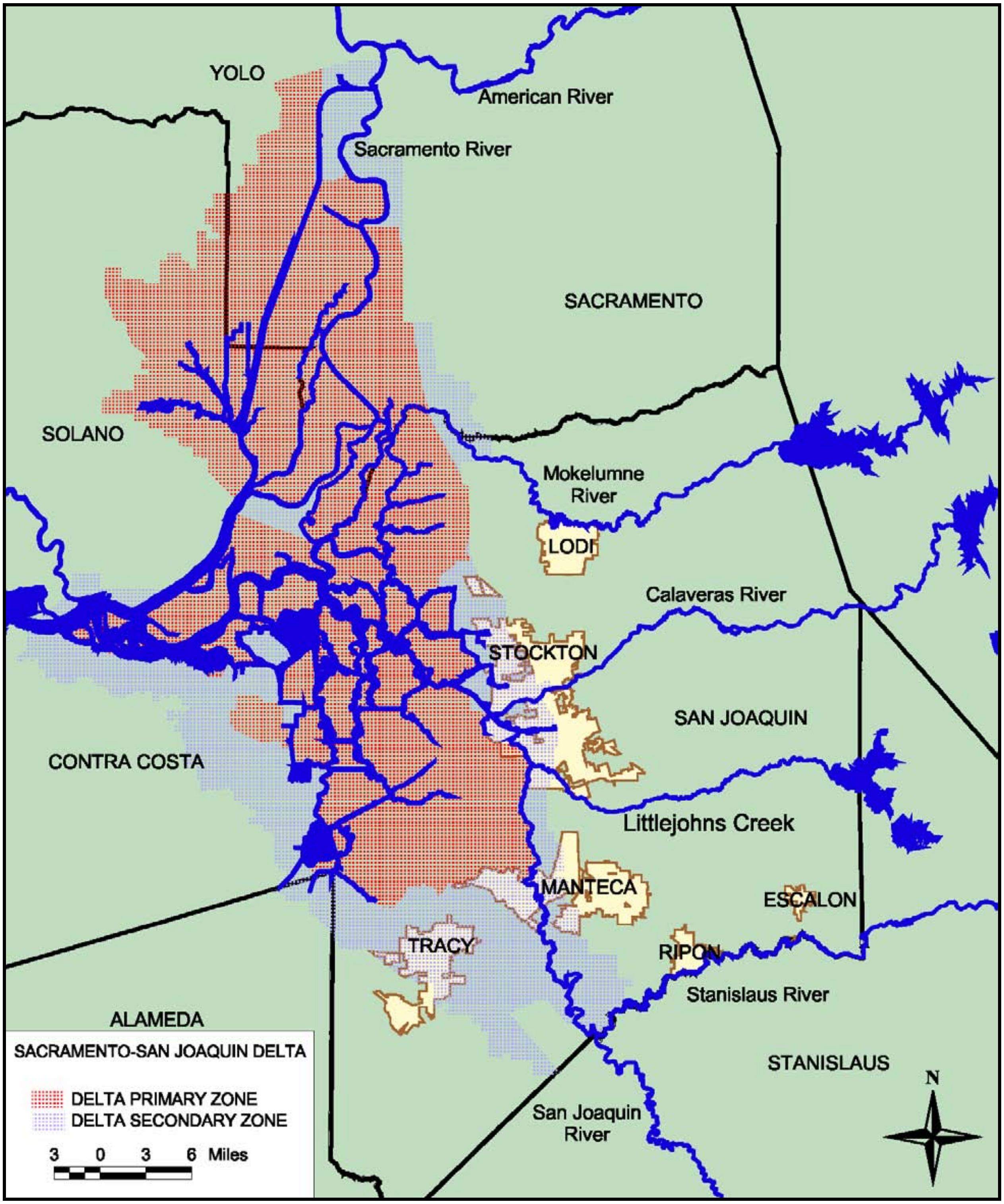


Figure 2-2 Sacramento San Joaquin Delta

Source: California Spatial Information Library at http://www.gis.ca.gov/

2.1.1.3 Mokelumne River

The Mokelumne River watershed encompasses approximately 660 square miles stretching from the high Sierra Nevada mountain range westward to the Delta. Snowmelt comprises a large portion of the watersheds runoff. Major facilities located on the Mokelumne are the Pardee and Camanche Reservoirs on the rivers main stem. Pardee and Camanche are both owned by EBMUD. Pardee Reservoir, which is upstream from Camanche, has a capacity of 197,950 acre-feet and is operated as a water supply reservoir. Reservoir water from Pardee is conveyed by the Mokelumne River Aqueducts to the EBMUD service area some 82 miles away. Pardee Reservoir and Camanche Reservoir, just downstream of Pardee with a capacity of 417,120 acre-feet, are operated in an integrated manner to provide water supply benefits and meet downstream needs including stream flow regulation, flood control, fishery habitat, and the needs of downstream riparian and appropriative diverters. Releases from EBMUD facilities also provide hydro-power benefits. (EBMUD, 20070). Salt Springs Reservoir, a PG&E facility on the North Fork of the Mokelumne, was built in 1963 and is operated for hydropower generation. Water rights on the Mokelumne form a complex hierarchy, with water rights held by Woodbridge Irrigation District, Amador County, Calaveras County, EBMUD, and North San Joaquin Water Conservation District.

2.1.1.4 Stanislaus River

The Stanislaus River watershed consists of approximately 904 square miles with an annual average runoff of approximately 1 million acre-feet. The majority of the runoff occurs from November to July and peaks during the summer months when snow melt is greatest. More than half the runoff is snowmelt-derived (USBR, Website, undated). The USACE constructed New Melones Dam on the Stanislaus River in 1978, replacing the original Old Melones Dam. Old Melones Dam was constructed in 1924 jointly by OID and SSJID, which hold pre-1914 water rights on the Stanislaus River.
New Melones Reservoir has a capacity of 2.4 million acre-feet and is operated as part of the CVP. The average runoff at New Melones for the 74 years from 1904 to 1977 was 1.12 million acre-feet.

There are nine additional reservoirs and two diversion canals upstream from New Melones on the Stanislaus River, including the Donnells, Beardsley, and Tulloch Reservoirs, which were constructed jointly by OID and SSJID and operated by the Tri-Dam Authority (USBR, Website, undated). Tulloch Reservoir, located several miles downstream from New Melones, is used to re-regulate releases from New Melones. SSJID, OID, SEWD, and CJSWCD divert from Goodwin Dam downstream from Tulloch Dam. Water can be diverted by gravity via Goodwin Tunnel to CSJWCD and SEWD.

SSJID and OID have water rights on the Stanislaus River water senior to those of the USBR. Both SEWD and CSJWCD have CVP contracts for New Melones water.

2.1.1.5 San Joaquin River

The San Joaquin River originates in the Sierra Nevada and enters the San Joaquin Valley at Friant Dam. The lower San Joaquin River is defined as the section of the river from its confluence with the Merced River north to Vernalis. The lower San Joaquin River encompasses a drainage area of approximately 13,400 square miles. The majority of the flow in the lower San Joaquin River is derived from inflow from the Merced, Tuolumne and Stanislaus Rivers as the upper San Joaquin River contributes virtually no inflow during the summer months.

2.1.1.6 Other Rivers

Other rivers that have some relevance to discussions on water resources but are not located in San Joaquin County are the Tuolumne River, Cosumnes River and Dry Creek.

The Tuolumne River originates in the Sierra Nevada Mountains and is the largest tributary to the San Joaquin River. It has a watershed of approximately 1,500 square miles and an unimpaired runoff of approximately 1.8 million acre-feet. Flows in the lower reaches of the Tuolumne River are regulated by New Don Pedro Dam, which was constructed in 1971 and is owned by Turlock and Modesto Irrigation Districts. New Don Pedro Reservoir has a capacity of approximately 2 million acre-feet and is operated for irrigation, hydroelectric generation, fish/wildlife protection, recreation, and flood control. Irrigation water is diverted downstream from New Don Pedro at La Grange into the Modesto Main Canal and Turlock Main Canal. The City and County of San Francisco operate several facilities in the upper watershed of the Tuolumne, namely O'Shaughnessy Dam at Hetch Hetchy Valley, Lake Eleanor, and Cherry Lake. These facilities are operated for municipal and industrial supply as well as hydropower.

The Cosumnes River is tributary to the Mokelumne River. The Mokelumne and Cosumnes confluence is located near the town of Thornton and has a watershed area of approximately 540 miles. Flows are primarily rainfall and runoff-derived.

Dry Creek is a relatively minor tributary to the Mokelumne River and forms the northern boundary between San Joaquin and Sacramento Counties. The Cosumnes, Dry Creek, Mokelumne and Calaveras Rivers are collectively referred to as the Eastside Streams.

2.1.1.7 Surface Water Quality

Surface water quality for San Joaquin County water sources can be categorized as either an eastside or Sacramento-San Joaquin Delta source. Eastside rivers and streams are sources of high water quality with generally low total dissolved solids (TDS) loads. Reservoir storage and regulated flow on the Mokelumne, Calaveras and Stanislaus River systems reduces suspended solids as these rivers flow through San Joaquin County. However, during flood events and times of elevated flows, TDS and suspended solid levels can increase.

The Sacramento-San Joaquin Delta water quality is heavily influenced by tidal flows and the operations of the Central Valley and State Water Projects. Generally, the Sacramento-San Joaquin Delta water quality is best during the winter and spring months and poorer through the irrigation season and early fall. Delta Water quality is also very dependant on the ability for higher quality Sacramento River water to dilute poorer quality San Joaquin water in the South and Central Delta. Presently, the Central Valley Regional Water Quality Control Board is undertaking Total Maximum Daily Load (TMDL) proceedings for low dissolved oxygen (DO) in the Stockton Deep Water Ship Channel and salinity and boron in the Lower San Joaquin River.

The San Joaquin River in the South Delta experiences periods of severely degraded water quality. The SWRCB has set flow and water quality objectives at Vernalis, located just downstream of the confluence of the Stanislaus River with the San Joaquin River. The USBR is obligated to meet the Vernalis objectives as a condition of their water right permits.

Water quality in the San Joaquin River is influenced by factors such as rain and snow melt runoff, reservoir operations, and irrigation return flows in the San Joaquin River basin. The CVP service area on the Westside of the San Joaquin Valley drain agricultural return flows with significant elevated salt loads into the San Joaquin River. To meet the Vernalis objective, the USBR supplements flows on the San Joaquin River with releases from New Melones Reservoir on the Stanislaus River by reducing allocations to SEWD and CSJWCD.

Despite the take away, the USBR is unable to meet the Vernalis standard in years when runoff is below average. Eastern San Joaquin County and Delta interests have pushed for the development of water quality objectives up-stream of the confluence of the San Joaquin and Stanislaus Rivers in order to reduce the USBR's reliance on New Melones Reservoir.

2.1.2 Central Valley Groundwater System

The Sierra Nevada Ranges, east of the Central Valley, is comprised of pre-Tertiary igneous and metamorphic rocks. The Coastal Ranges, to the west, is comprised of pre-Tertiary and Tertiary semi-consolidated to consolidated marine sedimentary rocks. The geologic formations within San Joaquin County vary in origination in geologic times ranging from Recent to Pre-Cretaceous. Six to 10 miles of sediment have been deposited within the Central Valley and include both marine and continental gravels, sands, silts and clays. Extensive work has been done by numerous agencies including the USGS and DWR on characterizing the water resources potential of the Central Valley Groundwater system.

During the middle Cretaceous (~100 million years ago), parts of the Central Valley were inundated by the Pacific Ocean resulting in deposition of marine deposits. Marine conditions persisted through the middle Tertiary period after which time sedimentation changed from marine to continental. The material source for the continental deposits are the Coastal Ranges and Sierra Nevada which are composed primarily of granite, related plutonic rocks, and metasedimentary and metavolcanic rocks from Late Jurassic to Ordovician age (Bertoldi, et al, 1991). The Central Valley has one natural surface water outlet, the Carquinez Strait located east of San Francisco Bay (USGS).

Geologic formations within the Central Valley and Eastern San Joaquin County are generally grouped as either east-side or west-side formations based on their location relative to the San Joaquin River, and the source of the sedimentary material of which they are composed. Generally, Eastside formation material originates in the Sierra Nevada and Westside formation material originates in the Coastal Ranges.

Eastern San Joaquin County Groundwater Management Area

San Joaquin County overlies the Eastern San Joaquin, Cosumnes, and Tracy Sub-basins of the greater San Joaquin Valley Groundwater Basin. The Eastern San Joaquin Sub-basin is bounded by the Mokelumne River to the north, the Stanislaus River to the south, the San Joaquin River to the west, and bedrock to the east. The Cosumnes Sub-Basin is defined by the Cosumnes River to the north and west, the Mokelumne River to the South, and bedrock to the east. Figure 2-3 depicts the groundwater sub-basins of San Joaquin County as delineated in DWR Bulletin 118-03.

In 2004, the Authority adopted the Eastern San Joaquin County Groundwater Basin Groundwater Management Plan (GWMP). The GWMP defined the Groundwater Management Area (GMA) as that portion of San Joaquin County overlying the Eastern San Joaquin and Cosumnes Sub-Basins. The GMA is depicted in Figure 2-4. The

Authority had adopted with the GWMP four Basin Management Objectives (MOs) for the GMA. Table 2-3 lists the adopted Basin MOs.

Table 2-3: Adopted Basin Management Objectives	
Management Objective #1: Groundwater Levels	Maintain or enhance groundwater elevations to meet the long-term needs of groundwater users within the Groundwater Management Area.
Management Objective #2: Water Quality	Maintain or enhance groundwater quality underlying the Basin to meet the long-term needs of groundwater users within the Groundwater Management Area.
Management Objective #3: Surface Water Quality	Minimize impacts to surface water quality and flow due to continued Basin overdraft and planned conjunctive use.
Management Objective #4: Water Quality	Prevent inelastic land subsidence in Eastern San Joaquin County due to continued groundwater overdraft.

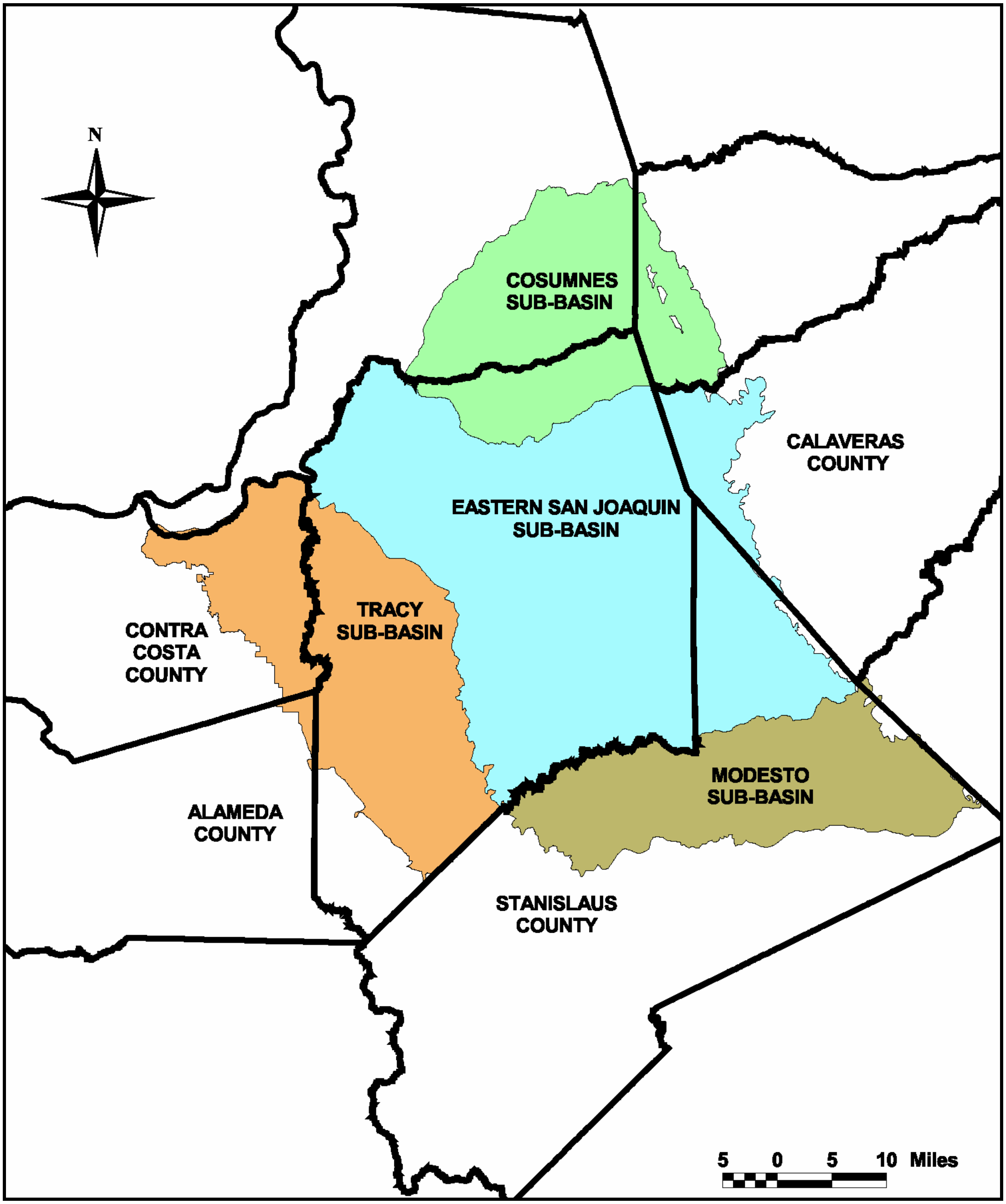


Figure 2-3 Groundwater Sub-Basins of San Joaquin County

Source: California Spatial Information Library at http://www.gis.ca.gov/

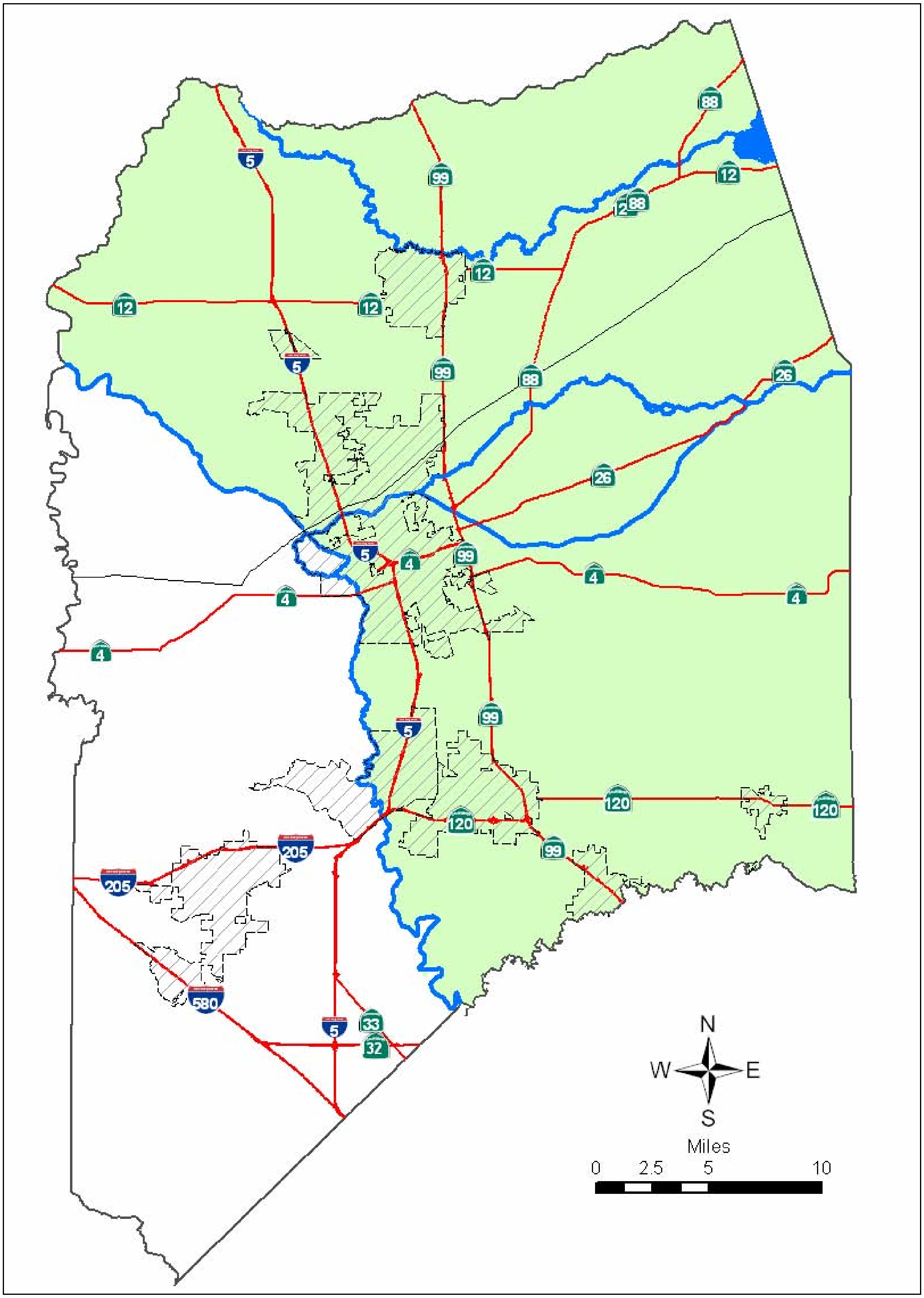


Figure 2-4 Groundwater Management Area

Source: California Spatial Information Library at http://www.gis.ca.gov/

2.1.3 Land-Use Authorities

There are seven incorporated cities within San Joaquin County; Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton, and Tracy. The San Joaquin County General Plan provided the basis for land use decisions outside of the cities. The San Joaquin County Council of Governments, the region's local transportation agency, has been designated the Metropolitan Planning Agency and is required by federal law to periodically develop population projections for the region. Table 2-4 summarizes the population projections for the 7 incorporated cities, unincorporated areas (includes organized communities), and San Joaquin County as a whole. The following section briefly describes each land use authority.

Table 2-4 San Joaquin County Council of Governments Population Projections (2000-2030)

City	2000	2005	2010	2015	2020	2025	2030
Escalon	5,963	6,712	7,526	8,422	9,410	10,524	11,782
Lathrop	10,455	12,369	15,453	19,475	24,144	31,073	41,556
Lodi	56,999	60,913	65,028	69,055	73,130	77,253	81,717
Manteca	49,258	57,499	66,210	75,653	85,605	96,607	108,719
Ripon	10,146	11,794	13,615	15,429	17,413	19,543	21,756
Stockton	243,771	268,270	298,267	331,278	366,332	401,997	438,770
Tracy	56,929	70,541	85,845	102,478	125,192	153,677	189,389
Unincorporated	130,087	141,278	153,657	166,696	180,478	194,564	209,443
San Joaquin Total	563,598	630,613	708,364	792,998	888,536	995,132	1,117,006

Source:
San Joaquin Council of Governments website at http://www.sjcog.org

2.1.3.1 City of Escalon

The City of Escalon is located in the southeastern part of San Joaquin County, and has a population of approximately 6,712. The Escalon General Plan was updated and adopted in 2004 and limits the amount of new building permits to 75 per year. In 2030, the projected population is expected to increase to 11,782 persons. Escalon is currently entirely dependent on groundwater for all potable and non-potable demands. However, Escalon is a partner in Phase II of the South County Surface Water Supply Project and is scheduled to begin receiving up to 2,800 acre-feet of treated Stanislaus River water in 2012.

2.1.3.2 City of Lathrop

The City of Lathrop has a population of 12,369 and is located south of Stockton along the San Joaquin River. The Lathrop General Plan was amended in 2004 and provides for new development on Stewart Tract west of the San Joaquin River; a.k.a. River

Islands. In 2030, the projected population is expected to increase to 41,556 persons. Lathrop began receiving treated surface water from the South County Surface Water Supply Project in 2005 and will ultimately be allocated up to 10,000 acre-feet per year in Phase II of the Project.

2.1.3.3 City of Lodi

The City of Lodi is located northeast of Stockton along the south bank of the Mokelumne River along Highway 99. Lodi has an approximate population of 60,913. The Lodi General Plan was last updated in 1991 and projects modest development in comparison to other cities in the County and the Central Valley. In 2030, the projected population is expected to increase to 81,717 persons. Lodi has relied entirely upon groundwater; however, under a long-term water purchase from the Woodbridge Irrigation District, Lodi is entitled to 6,000 acre-feet per year of Mokelumne River Water. Lodi is currently investigating surface water treatment plant and distribution system options.

2.1.3.4 City of Manteca

The City of Manteca is located south of Stockton and east of Lathrop along Highway 99 and has a population of approximately 57,499. The Manteca General Plan was updated and adopted in 2003 and the projected population is expected to increase to 108,719 persons. Manteca began receiving treated surface water from the South County Surface Water Supply Project in 2005 to augment groundwater supplies and will ultimately be allocated up to 16,400 acre-feet per year in Phase II of the Project.

2.1.3.5 City of Ripon

The City of Ripon is located in South San Joaquin County along the north bank of the Stanislaus River along Highway 99. Ripon has an approximate population of 11,794. The Ripon General Plan was updated in 2006, and in 2030, the projected population is expected to increase to 21,756 persons. Ripon relies entirely upon groundwater for all potable and non-potable demands.

2.1.3.6 City of Stockton

The City of Stockton is the 12th largest city in the State and the 4th largest in the Central Valley. Stockton had an estimated population of 268,270 in 2005 which is projected to increase to 438,770 in 2030. The current Stockton General Plan was adopted in 1990 and is in the process of being updated. The 2035 General Plan Update is expected to be adopted in the summer of 2007. For IRWM Planning purposes, the City of Stockton Metropolitan Area (COSMA) is considered to include areas outside of the city limits in the California Water Service Co. service area and County Service Areas within the Stockton sphere of influence.

2.1.3.7 City of Tracy

The City of Tracy is located in Southwest San Joaquin County nestled along Interstates 5, 205, and 580 just east of the Altamont pass on the way to the Bay Area. In 2005, Tracy had an estimated population of 70,541. The Tracy General Plan was updated in 2006, and in 2030, the projected population is expected to increase to 189,389. Although outside of the Eastern San Joaquin Groundwater Management Area, the City of Tracy receives treated Stanislaus River water through the South County Surface Supply Project and will be allocated up to 10,000 acre-feet per year in Phase II of the Project.

Table 2-5 Summary of Urban Areas Planning Data

City	2005 Population	2005 Urban Footprint (Acres)	2030 Projected Population	2030 Urban Footprint (Acres)
Escalon	6,712	1,500	11,782	2,145
Lathrop	12,369	12,357	41,556	14,527
Lodi	56,999	8,209	81,717	4,000
Manteca	49,258	11,086	108,719	20,244
Ripon	10,146	3,231	21,756	10,760
Stockton Metropolitan Area	268,270	38,278	438,770	70,343
Tracy	70,541	13,877	189,389	19,300
Unincorporated County	141,278		209,443	
San Joaquin Total	**630,613**	**88,538**	**1,117,006**	**140,717**

Notes:

1. Urban footprint areas obtained form San Joaquin County GIS Department.
2. City of Stockton Metropolitan Area is comprised of the City of Stockton, California Water Service, and San Joaquin County service areas.
3. 2030 Urban footprint based on adopted r draft general planning documents.

2.1.4 Water Districts and Agencies

2.1.4.1 Woodbridge Irrigation District

Woodbridge Irrigation District (WID) was organized in 1924 under the Irrigation District Act. In 1928, WID acquired the surface water rights held by its predecessor, a private enterprise, in the mid-1880s. The principal water delivery facilities owned and operated by WID include the Woodbridge Dam located on the Mokelumne River and an extensive earthen canal system over 100 miles long (only 18 miles have been lined) which provides irrigation water to approximately 13,000 acres. Constructed in 1910, Old Woodbridge Dam was replaced in 2006 with a state of the art adjustable weir dam, fish ladders and diversion screens, and an anadromous fish monitoring station.

The boundaries of WID encompass approximately 50,000 acres. Numerous "islands," or lands that are not included in WID, exist within the overall boundaries. The overall boundary including these "islands" is often referred to as the Woodbridge Complex. These islands are technically within WID, but do benefit from relatively high groundwater levels due to recharge of applied surface water and canal seepage to the underlying basin. WID overlaps with portions of the North San Joaquin Water Conservation District, Stockton East Water District (SEWD), and the City of Lodi.

2.1.4.2 North San Joaquin Water Conservation District

The North San Joaquin Water Conservation District (NSJWCD) was organized in 1948 under provisions of the Water Conservation District Act of 1931. In 2005, NSJWCD expanded its boundaries by annexing in general all lands north of the Mokelumne River to the San Joaquin County line and south to Live Oak Road and totals approximately 154,000 acres. Approximately 4,740 acres are within the Lodi city limits and 5,600 acres are within Lodi's sphere of influence. NSJWCD straddles the Mokelumne River and is consequently located in both the Cosumnes and the Eastern San Joaquin Groundwater Sub-basins.

The NSJWCD operates a pump station on the south bank of the Mokelumne River and a system of pipes which deliver water to farmers. The South System also has the ability to deliver water to Bear Creek and Pixley Creek, natural drainage ways also used for irrigation. The NSJWCD also operates a pump station on the north bank of the Mokelumne River near Trethway Road which at one time supplied water to the Acampo. Due to the deterioration of the North System Pipeline, water is no longer conveyed for delivery.

2.1.4.3 Stockton East Water District

The Stockton East Water District (SEWD) was organized in 1948, under provisions of the Water Conservation Act of the State of California. In 1971, SEWD's boundaries were expanded to include the City of Stockton. Future annexations to the City of Stockton automatically become annexed to the SEWD. SEWD also overlaps portions of WID.

In 1963, SEWD installed check dams on the Calaveras River and the Mormon and Mosher Sloughs to facilitate irrigation with surface water along the waterways (in-lieu groundwater recharge), and to increase direct groundwater recharge within the channels.

In 1978, SEWD completed and began delivering water from the Calaveras River through its then 30 MGD capacity drinking water treatment plant to the Stockton urban area. In 1994, the water treatment plant was expanded to 45 MGD to accommodate surface water deliveries from New Melones. More recent enhancements, completed in 2007 resulted in a rated capacity of 50 MGD, with the intention to be permitted to regularly treat 60 MGD.

Within the SEWD boundaries are other small water agencies including the Linden County Water District, and San Joaquin County Community Service Areas of Lincoln Village and Colonial Height CSA.

2.1.4.4 Central San Joaquin Water Conservation District

The Central San Joaquin Water Conservation District (CSJWCD) was formed in 1959 under provisions of the California Water Conservation Act of 1931.

In 1997, the CSJWCD, to mitigate declining groundwater levels, completed construction of facilities to release water into natural channels and install check dams to allow agricultural water users to divert water for irrigation. The irrigation facilities are installed and operated by individual landowners.

The CSJWCD includes approximately 65,100 acres, of which 670 acres are within the sphere of influence for the City of Stockton.

2.1.4.5 South San Joaquin Irrigation District

The South San Joaquin Irrigation District (SSJID) was formed in 1909 under provisions of the California Irrigation Act. SSJID comprises approximately 72,000 acres in the southeast portion of the County.

The SSJID has an extensive irrigation water delivery and distribution composed of systems throughout its boundaries. The majority of its distribution system is composed of pipelines. The SSJID's delivery of surface water for irrigation has minimized the pumping of groundwater for agriculture.

To assist in improving the management of available surface water and groundwater resources, SSJID together with Oakdale Irrigation District, executed an agreement to provide 30,000 acre-feet of water for use within the City of Stockton's urban area. In addition, SSJID has proposed to implement the South County Surface Water Supply Project to transfer treated surface water to the cities of Escalon, Lathrop, Manteca and Tracy.

2.1.4.6 Oakdale Irrigation District

The Oakdale Irrigation District (OID) was formed in 1909 pursuant to the Irrigation District Act. OID and SSJID jointly own facilities on the Stanislaus River to capture, store, and divert water for agricultural use.

OID contains 72,345 acres, but only 12% are within San Joaquin County with the remainder in Stanislaus County. The primary crops within the district are irrigated pasture, grains, rice, and orchards.

2.1.4.7 Central Delta Water Agency

The purpose of the Central Delta Water Agency (CDWA) is to protect water supply within the area and to assist landowners and reclamation districts with water issues. There are 120,000 acres with in the CDWA boundary. The primary land use is agriculture, with crops such as vineyards, trees, row, and field crops.

No facilities are owned by the CDWA. CDWA also represents landowners in flood control matters. The only source of water is surface water from the Delta. Groundwater is not extensively used within the CDWA.

2.1.4.8 South Delta Water Agency

The South Delta Water Agency (SDWA) was formed to represent the area landowners to address water supply problems. Artificially low water levels and salt accumulation induced by the State and Federal Project pumps continue to cause many problems for landowners that need to pump water from these areas. In addition, reduced flows and poor water quality in the Lower San Joaquin River also contribute to the lack of fresh water supplies and poor water quality in the South Delta.

There are approximately 150,000 acres within the SDWA boundaries, with 70 – 80% of the land used for farming. Asparagus, corn and alfalfa are the main crops grown within the agency boundaries, with smaller areas of row crops and vineyards. The remaining acres are urban including parts of Tracy and Lathrop.

SDWA does not own any facilities or water rights. Property owners have individual water rights, and the SDWA helps to protect these property owners. The majority of water used within the agency boundaries is surface water. There are some shallow groundwater wells that are used by individuals, but most of the groundwater is unusable due to salinity.

2.2 Regional Planning Area

For the purposes of this IRWMP, the Eastern San Joaquin Region Water Management Area (WMA) is defined as that portion of the San Joaquin region which overlies the Eastern San Joaquin and Cosumnes Sub-Basins and coincides with the adopted Groundwater Management Area (GMA). The WMA and the overlying agencies are depicted in Figure 2-5. To ensure that every parcel in the WMA is represented, all unorganized areas will be included in the San Joaquin County Flood Control and Water Conservation District.

2.2.1 Appropriateness of Region and Water Management Authority

The WMA was chosen by the community as the appropriate region for the IRWMP for the following reasons:

Magnitude of water supply and groundwater management challenges. Groundwater overdraft and the resulting water level and water quality impacts are significant for the Basin. Reversing water level declines and further intrusion of saline groundwater requires a substantial amount of supplemental water. Past studies indicate that an average of 150,000 acre-feet per year would be needed to operate the Basin within the specified limits.

Practical limit to a regional group. The Groundwater Management Area includes a diverse range of water-related interests and objectives and is considered by the GBA as the practical limit which maximizes the level of regional integration possible. A smaller planning region risks developing an IRWM Plan that does not fully consider the range of solutions or impacts; a larger planning region risks diluting the focus of the IRWM Plan.

2.2.2 Regional Integration Concepts

The focus of the GBA IRWM Plan is the conjunctive water management needs of the astern San Joaquin County; however, the need to coordinate and cooperate internally and externally is undeniable and absolutely necessary for the success of the IRWMP. Water projects will always affect, in some manner or another, an upstream of downstream agency. Projects proposed by the GBA are no different. To facilitate coordination and cooperation, the GBA proposes the following conceptual framework for intra-regional and inter-regional collaboration.

2.2.2.1 Intra-Regional Collaboration

Intra-regional coordination refers to collaboration within the boundaries of the Regional Water Management Area. The following concepts are promoted by the GBA to help stakeholders understand how their actions affect areas adjacent to them and throughout the Region.

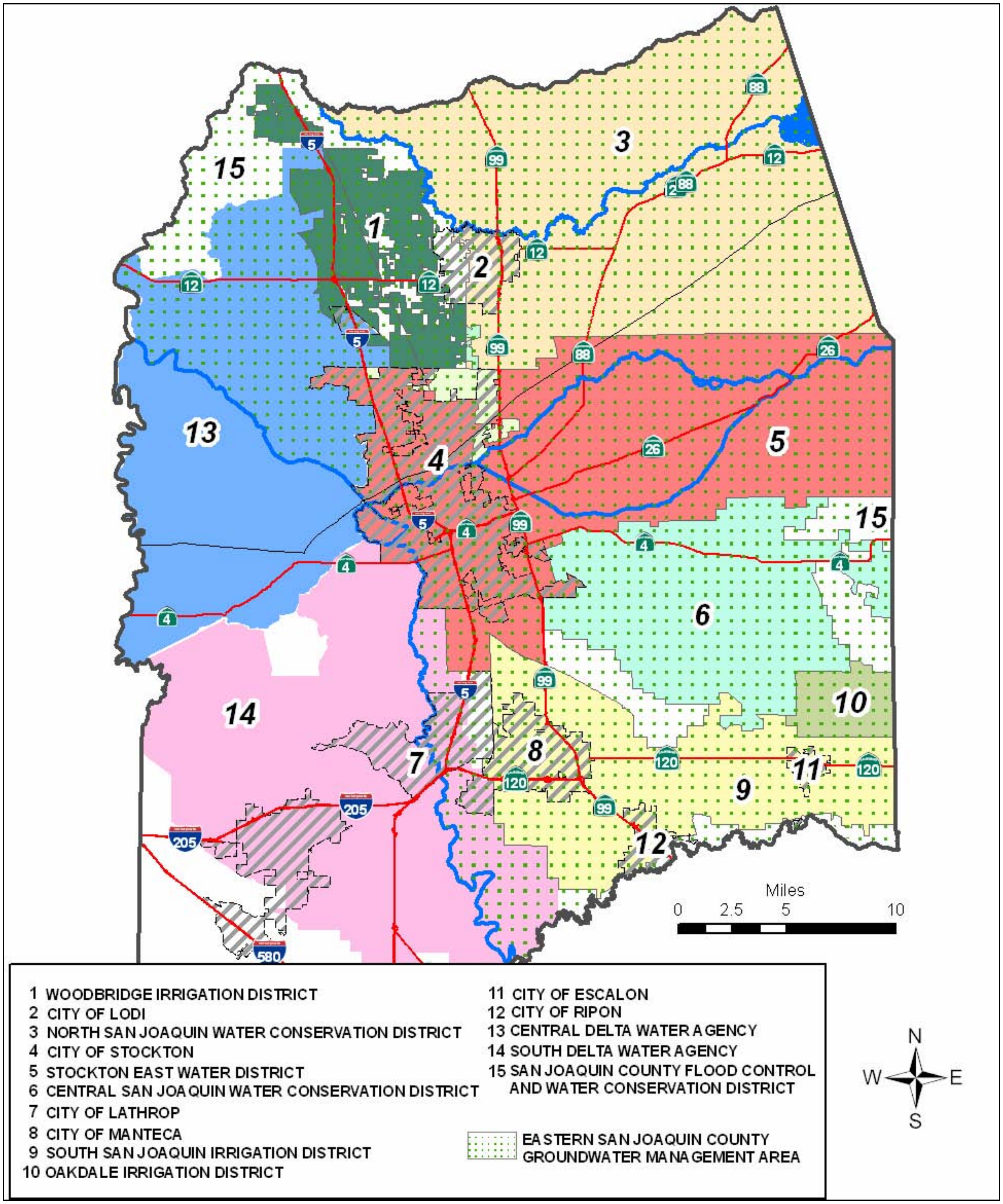


Figure 2-5 Overlying Agencies within the Groundwater Management Area
Source: California Spatial Information Library at http://www.gis.ca.gov/

2.2.2.2 Inter-Regional Collaboration

The GBA has defined a Regional Integration Area as that portion of the state that may influence, provide guidance to or contribute to the IRWMP. As shown in Figure 2-6, a Potential Solution Area (mostly upstream or upgradient) may provide water resource solutions to problems addressed in the IRWMP; and as shown in Figure 2-7, a Potential Benefits Area as those areas that may benefit from the development of the Eastern Basin Integrated Conjunctive Use Program. Because of its geographic proximity to the Delta, groundwater banking projects have the potential to benefit almost any part of the state with hydrologic connection. These concepts are displayed in Figure 2-6, 2-7, and 2-8.

Figure 2-6 Solution and Benefits Area

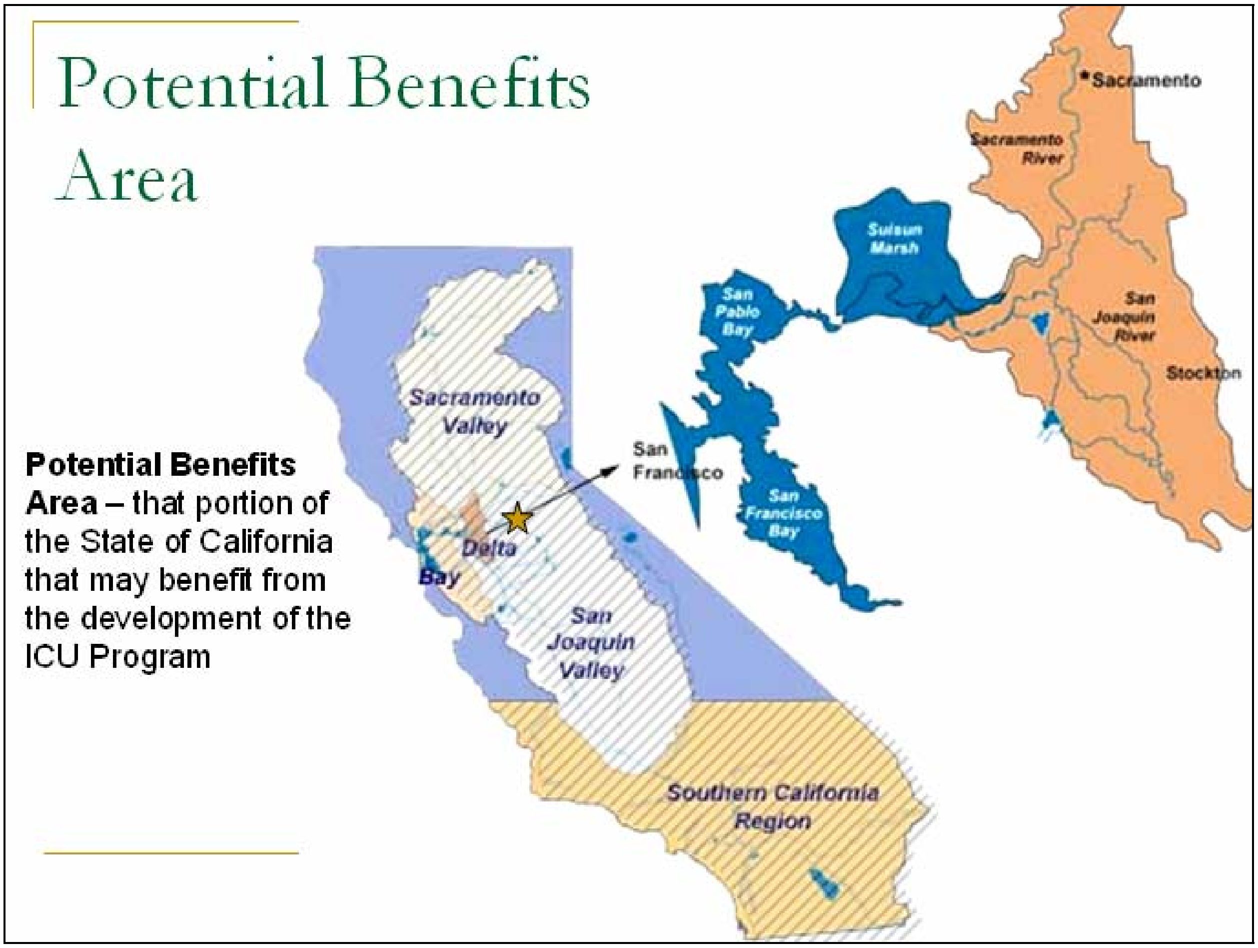


Figure 2-7 Potential Benefits Area

2.3 Regional Economics, Industries, and Resources

2.3.1 Population and Demographics

San Joaquin County's population totals over 660,000 and ranks the fifteenth largest in the State. Its annualized growth is estimated at 2.8 percent until the year 2010. Since 2000, the County has experienced an accelerated population growth because of many relocating their homes from the Bay Area to the Central Valley. The attraction of affordable housing combined with the higher wages of the Bay Area created such movement that placed San Joaquin County as the third fastest growing county within the State.

San Joaquin County has an estimated 206,000 households with an average household size of 3.1 people. Seventy-three percent of these households are families while the remaining 27 percent are non-family households that largely consist of people living alone. The median income for a household is $49,391.

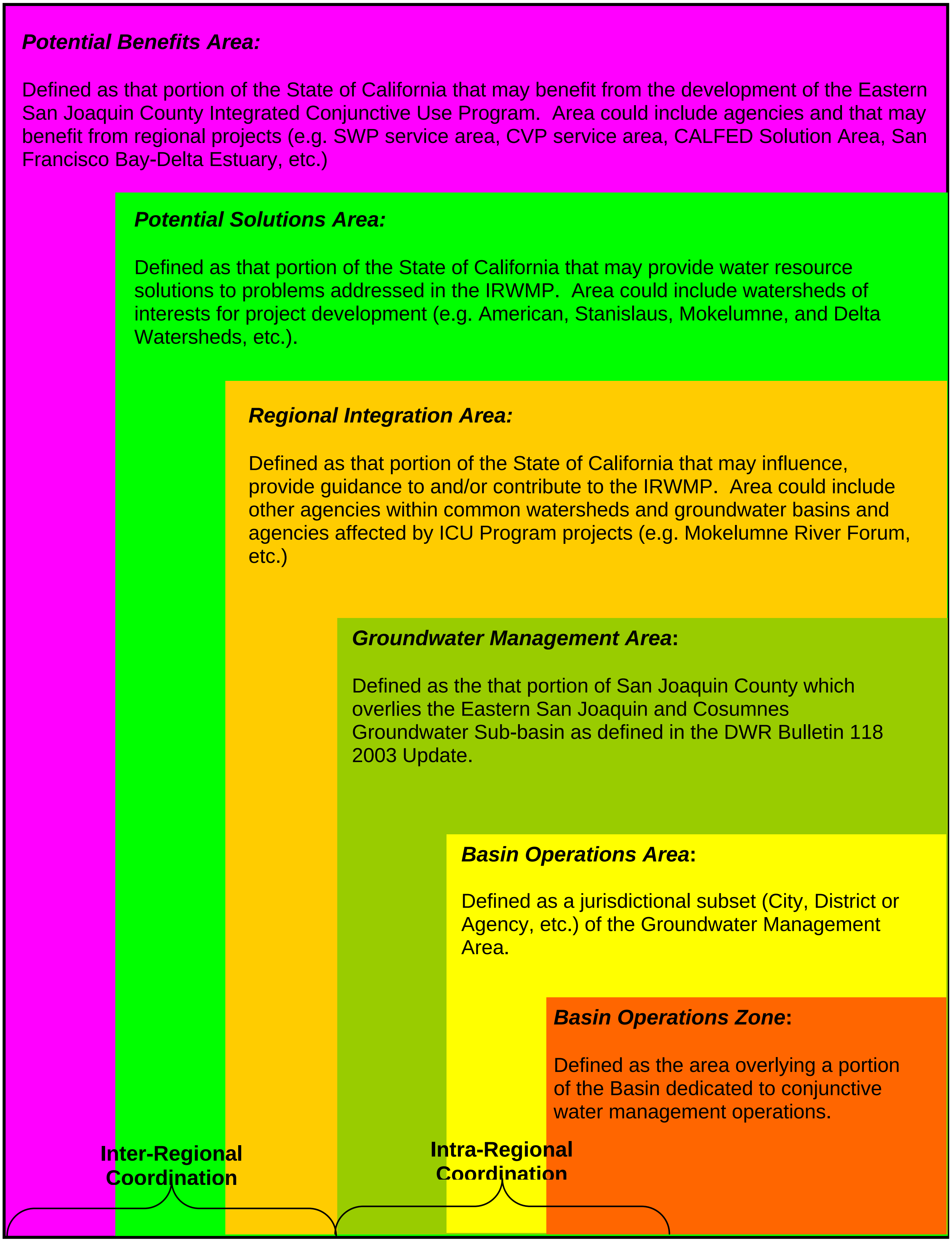


Figure 2-8 Inter-Regional and Intra-Regional Concepts

In 2006, the civilian labor force totaled 282,200 and carried an 8 percent unemployment rate. Much of the County's unemployment is due to seasonal variation in the agricultural industry and other related food processing industries. The services/leisure and hospital industry had captured most of the labor force. Other top ranking areas of employment include the transportation-warehouse-utility industry and government sector.

Total school enrollment for the County estimates at 192,000. 76 percent of people 25 years and older had a high school diploma and 17 percent had a bachelor's degree or higher. Among people 16 to 19 years old, 11 percent were dropouts.

2.3.2 Disadvantaged Communities

A disadvantaged community is defined as a community with an annual MHI less than 80% of the statewide annual MHI. According to the 2000 Census data, 80% of California's statewide annual Median Household Income (MHI) is $37,994. MHI and population data have been received from the Census website along with Census tracts for San Joaquin County. Census tracts are a small, relatively permanent statistical subdivision of a county designed to be homogenous with respect to population characteristics, economic status, and living conditions. Per 2000 Census information, there is a total population of approximately 491,361 with a total of 160,532 households within the Regional Planning Area. 72,522 of those households are in disadvantaged census blocks reported as being at the MHI or below.

As noted in Figure 2-9, the Census tracts in the Disadvantaged Community areas are located in major portions of Thornton and Walnut Grove; areas located in the central and eastern portions of the City of Lodi; neighborhoods in the City of Stockton mostly located in central and eastern regions; throughout eastern Lathrop; and southeastern Manteca. The information provided demonstrates that there are numerous disadvantaged communities in the Regional Planning Area. Analysis of Census 2000 spatial and statistical data was compiled by the San Joaquin County Public Works Department Geographical Information System Division.

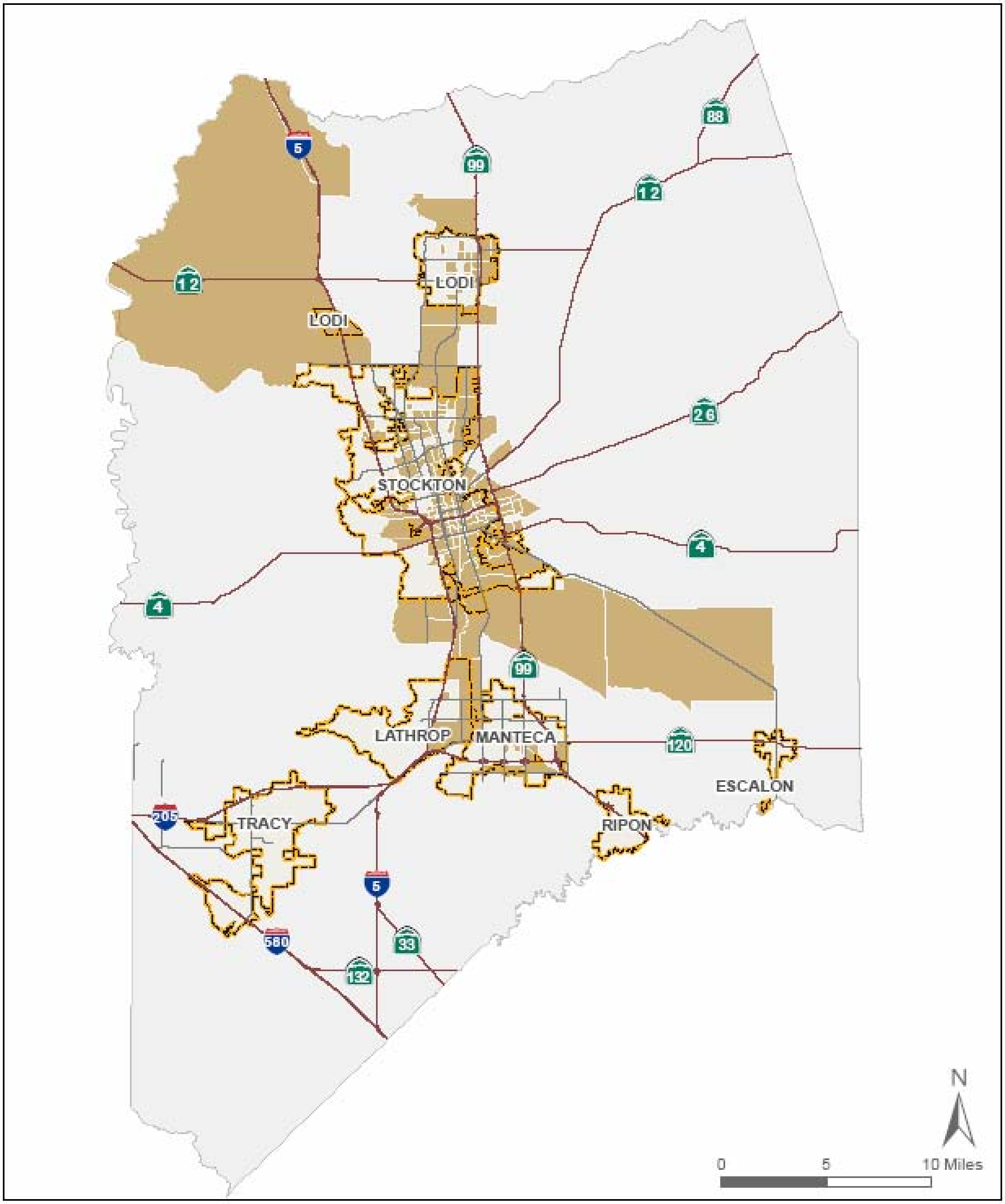


Figure 2-9 Map Disadvantaged Census Blocks
Source: 2000 Census Data and San Joaquin County GIS

2.3.3 Agriculture, Manufacturing, and Processing

The San Joaquin County Agricultural Commissioner's Office reported that the County's agricultural production for 2005 rose a third year in a row and valued at an all time high of $1.75 billion. Agricultural production includes dairy products, grapes, tomatoes, asparagus, almonds and walnuts. Driving the increase of the County's agricultural value were increases in both the production and the price of certain products that outweighed production declines with other products. Significant increases in value were found with livestock and poultry; and fruit and nut crops. Milk had also increased in production and was the County's most valuable agricultural commodity; although, it experienced a net decrease in value of 3 percent. Wine grape acreage, yields, and prices were up in 2005, leading to a 53 percent increase in total grape value from the prior year. Conversely, cherries and other stone fruit crops suffered yield losses because of late spring rains and the lack of adequate chill hours during the winter months.

San Joaquin County's Top Ten Leading Crops for 2005	
Milk	$314,565,000
Grapes	$289,744,000
Almonds	$166,580,000
Tomatoes	$103,551,000
English Walnuts	$97,628,000
Cherries	$91,822,000
Cattle & Calves	$91,057,000
Hay	$69,569,000
Woody Ornamentals	$61,945,000
Asparagus	$59,220,000
All Other Crops	$403,432,000
Source: 2005 San Joaquin County Agricultural Commissioner's Report	

The County's manufacturing industry is valued at over $6.4 billion. It comprises of establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. Within the County, there are 609 establishments with food manufacturing as the most valued industry at $2.5 billion, far exceeding beverage and tobacco product manufacturing in second place, valued at more than $819 million.

Leading Manufacturing Industries	
Food	$2,516,834,000
Beverage & Tobacco	$819,631,000
Fabricated Metal Product	$587,131,000
Plastics & Rubber Products	$457,018,000
Nonmetallic Mineral Product	$448,417,000
Paper	$384,345,000
Wood Product	$263,067,000
Furniture & Related Product	$232,933,000
Chemical	$216,790,000
Transportation Equipment	$190,486,000
Machinery	$96,835,000
Miscellaneous	$74,784,000
Source: United States Census Bureau, 2005	

2.3.4 Housing and Construction

In 2005, San Joaquin County had a total of 217,991 housing units, 5 percent of which were vacant. From 2001 to 2005, County housing prices have increased considerably with the greatest increases in the City of Tracy. Tracy's growth rate of 44 percent exceeded the national average of 35.7 percent. Since 2000, the attraction of affordable housing had many from the Bay Area relocating to San Joaquin County. In March 2006, the County's median price for a three bedroom, two bath home was $385,000 in Lodi; $435,000 in Manteca; $355,000 in Stockton and $540,000 in Tracy. The County's median home price is $429,000, below the State's median value of $535,470 and double the U.S.'s median price of $209,000.

Median Home Sales Prices	
United States	$209,000
California	$535,470
Alameda County	$584,000
Contra Costa County	$540,500
San Joaquin County	$429,000

The rising cost in housing and the increasing number of homes put up for sale has made the sale of homes difficult. In March 2006, over 3,300 homes entered the market, fourfold the amount in March 2005.

Rents in San Joaquin County are relatively stable. From the fourth quarter of 2004 to the fourth quarter of 2005, rent increased just 2.7 percent. As of March 2006, in the Stockton-Lodi area, the median monthly rental price for a three bedroom, two bath apartment was $925; a two bedroom, two bath was $887; and a one bedroom, one bath was $664.

Residential building permits in the County are steady at over 6,000 permits issued in 2004 and 2003 and are increasing at an annual rate of 12%. Permit and mitigation fees are also on the rise making it more expensive for developers to build residential structures.

2.3.5 Other Regional Resources

2.3.5.1 Port of Stockton

The Port of Stockton, California, owns and operates the third largest inland seaport in California and is located on the Stockton Deepwater Ship Channel, 75 nautical miles east of the Golden Gate Bridge. The Port is one-mile from Interstate 5 adjacent to two transcontinental railroad systems.

The importance of the Port of Stockton is vast in that it provides a resource for healthy economy to the region by providing an ideal position for domestic, national and international accessibility. The Port of Stockton utilizes the waterways and the Deep Water Ship Channel to continue quality economy benefit to the community.

2.3.5.2 Stockton Metropolitan Airport

The Stockton Metropolitan Airport is located on the Southern boundary of the city of Stockton in the heart of California's central valley. The Airport is conveniently located between two major north-south thoroughfares; Interstate 5 and State Highway 99. Air traffic primarily consists of freight service and charter flights. On June 16, 2006, Allegiant Air began domestic flight service with five weekly flights to Las Vegas. The Airport is currently updating its Master Plan with the focus of providing more domestic and international flight opportunities for the Stockton Metropolitan Area and the greater Central Valley.

2.3.5.3 University of the Pacific

The University of the Pacific (UOP) is the first chartered institution for higher learning in California and has resided in Stockton since 1925. UOP continues to participate heavily in the advancement of the San Joaquin County community through leadership and participation in locally based research, education, outreach, and community service. Several key areas where UOP participation in the advancement of water related science and policy are described below.

Business Forecasting Center

Founded in 2004, the Business Forecasting Center at the UOP Eberhardt School of Business produces quarterly economic forecasts of the United States, California, and 11 Metropolitan areas from Sacramento to Fresno and the San Francisco Bay Area. The Business Forecasting Center provides a central point of contact for business, government, and other organizations in need of regional demographic data, regional business/economic forecasting, economic impact analysis, economic policy analysis, industry studies, econometric modeling, and survey analysis. Recently, several local water agencies partnered with the Business Forecasting Center to estimate the regional economic impacts of reduced crop yields and cropping limitations due to poor Delta water quality. Publications available from the Business Forecasting Center include:

U.S. Forecast (quarterly) – This publication is a comprehensive, quarterly economic forecast of the U.S. economy, Statewide, and selected California metropolitan areas.

California & Metro Forecast (quarterly) – This publication is a comprehensive, quarterly forecast of the California Economy and 11 metropolitan areas in northern California. Metropolitan areas covered by the forecast include; Modesto, Merced, Yolo, Fresno, Oakland, Sacramento, San Francisco, San Jose, Santa Rosa, Stockton-Lodi, and Vallejo-Fairfield-Napa. This quarterly metropolitan forecast covers several regions in the Central Valley not covered by other forecasts.

San Joaquin County Business Outlook (quarterly) – This publication is an analysis of the current, near future, and long-term economic expectations for San Joaquin County. The publication features a survey of business conditions, consumer confidence, and leading economic indicators.

San Joaquin County Pulse (quarterly) – This publication is a current look at employment, labor force, wage, personal bankruptcies, construction, and real estate data, by city, for the San Joaquin County Region.

Environmental Engineering Research Program

The Environmental Engineering Research Program is nationally recognized for its water quality research program. Scientific research is performed on critical water quality issues that provide scientific support to local, regional and national environmental issues. Their research organization includes a scientific staff (director, staff scientists and post-doctoral students), students (co-op program and student assistants), technical staff (laboratory, field and data technicians), and collaborating faculty (Schools of Engineering, Biology, Pharmacy and the Natural Resources Institute).

Field research capabilities include project collaborators, state of the art field equipment, a sampling van and a sampling boat. This organization is important in that it provides information for water quality impacts of wetlands and riparian habitat, agricultural best management practices (nutrients, pesticides and sediments), and river ecosystem management.

Natural Resources Institute

The University of the Pacific provides a forum on critical natural resource issues in California. The Natural Resources Institute was created to foster and support discussion leading to agreements and legislation that support key natural resource issues. The main objectives are to provide a forum for full and open public discourse engaging key stakeholders involved in critical natural resources issues in California; to develop policy analysis models and methodologies and consensus building approaches; to conduct studies and research related to major natural and water resource issues facing California; and to foster education and knowledge dissemination activities. Recent conferences including "Delta Levees: Avoiding the Next Break" (June 2005), "Striking a Balance – Restoration of San Joaquin River" (October 2005), "Developing

Delta Vision: How to Connect the Dots" (June 2006), and "Calaveras River Restoration Project" (completed early 2006). This Institute is an active organization that provides important collaborative information for and with the community.

2.3.6 Educational and Outreach Resources

The GBA has been involved with creating several avenues to inform the community about their activities. Specific details of the Authority can be found on the internet at www.GBAwater.org. The website provides general information on the activities, accomplishments, and background of the Authority including meeting agendas and minutes, press releases, newsletters, public notices, as well as reports and documents.

The San Joaquin County Flood Control and Water Conservation District also maintains a website with regional ties and resources. Found at www.SJWater.org, information on the Advisory Water Commission, the ALERT Flood Warning System, the Stormwater Management Programs, and the San Joaquin County Groundwater Data Center.

The cities in San Joaquin County and the County itself have coordinated their NPDES stormwater management programs. Efforts include participating in Targeted Opportunities for Pollution Prevention (TOPPS), California Coastal Cleanup Day, Earth Day, and the opening of the Household Hazardous Waste Facility in Stockton.

The San Joaquin County Groundwater Data Center (GDC) is a Countywide centralized interactive groundwater information vehicle that provides access to groundwater data collected and shared by agencies throughout San Joaquin County. Through the internet, stakeholders, industry professionals, decision makers, and the general public have access to groundwater data and historic semi-annual reports. The Authority continues to work closely with SJCFC&WCD staff to develop additional tools and features for the Groundwater Data Center.

On a Regional, Statewide, and National basis, San Joaquin County is involved with and contributes to the Association of California Water Agencies, the Water Education Foundation, the California Water Awareness Campaign, National Public Works Week, and National Water Awareness Month.

2.3.7 Water Related Recreational Resources

Access to water-based recreation is very important to the greater Central Valley community. The Delta and its main local waterways (the Sacramento, San Joaquin, Calaveras, Tuolumne, Stanislaus, Cosumnes, and Mokelumne Rivers and their associated reservoirs) are the primary source of recreation for many Central Valley residents. Water-related recreation activities in the area include:

- Kayaking down the Cosumnes or Mokelumne Rivers.
- Public hunting at Sherman Island Waterfowl Management Area, Franks Tract State Recreation Area, and Big Break in the Delta.
- Fishermen can enjoy the variety of fish species found in the Delta including catfish, sturgeon, steelhead, striped bass, large mouth (black) bass, American shad, salmon, crappie, bluegill, and carp.
- Brannan Island State Recreation Area and Discovery Park in Sacramento, provide extensive picnic grounds adjacent to Delta waterways.
- Numerous other recreational activities include water skiing, sailing, cruising, canoeing, swimming, camping, picnicking, wind surfing, bicycling, sightseeing and bird watching.

Within San Joaquin County alone there are 43 public and private recreational facilities such as marinas, boat launches, campsites, picnic areas and parks. Twenty-three of these facilities are within the Stockton metropolitan area.

There are a total of six marinas located in the San Joaquin region with one on the Middle River, two on the San Joaquin River, two on the South Fork of the Mokelumne River, and one on the Deep Water Channel. It is estimated by the Delta Protection Commission that there are about 118,000 registered boats in the Central Valley -- approximately 3.3 boats for every hundred people. There are a total of 2.13 million boat trips to the Delta annually making the delta an ideal location for the boating business.

Enhancement of public recreation opportunities will be considered in all San Joaquin region water supply projects as a part of the IRWM planning. Examples under consideration or active development include:

- The Coast-to-Crest Trail along the Mokelumne River corridor as specified in the Lower Mokelumne River Stewardship Plan.
- Education center as part of the Stockton Delta Supply Project.
- Maintaining a full Lodi Lake year-round.
- Consideration of public fish migration viewing facilities at Woodbridge Dam in partnership with the Department of Fish and Game and East Bay Municipal Utility District.
- Hiking trails and other public access in conjunction with the Duck Creek regulating reservoir.
- Potential bird watching facilities associated with recharge pond development, for Sandhill Cranes and avian other species.
- Hiking, biking, or equestrian trails along linear features such as pipelines or canals.

Chapter 3 - Water Resource Planning Efforts

Throughout the Eastern San Joaquin Region, several separate yet related planning efforts are concurrently proceeding. The following chapter describes these efforts which include Urban Water Management, Groundwater Management, Watershed, and Habitat Conservation Plans.

3.1 Overview of Existing Urban Water Management Plans

3.1.1 City of Lodi

The City of Lodi is located northeast of Stockton, along Highway 99. According to the City of Lodi Urban Water Management Plan 2005 Update, the 2005 annual demand is estimated at 17,300 acre-feet per year. Future demands in 2030 total 25,100 acre-feet per year.

Lodi currently is entirely dependent on groundwater to satisfy customer needs; however, in the future the City of Lodi has targeted a reduction of groundwater pumping to within an estimated safe yield estimate of 15,000 acre-feet per year. In 2003, Lodi entered into a 40-year agreement with Woodbridge Irrigation District for up to 6,000 acre-feet of Mokelumne River Water. The City is currently in the process of completing a feasibility study to determine the treatment and conveyance facilities necessary to deliver this supply.

Lodi currently provides up to 2,500 acre-feet of tertiary treated wastewater to agricultural users in the vicinity of the Lodi wastewater treatment plant. Lodi, in partnership with the City of Stockton, is exploring the possibility of providing tertiary treated water to planned growth in urban growth in north Stockton and other areas. The Table 3-1 lists the Demand Management Measures (DMMs) currently being implemented or considered by the City of Lodi.

Table 3-1 DMMs implemented or considered by the City of Lodi

DMM	DMM Description	Conservation Program	Implemented
1	Water Survey Programs for Residential Customers	None at this time	B/C = 0.9
2	Residential Plumbing Retrofit	Rebates offered at the time of purchase for water saving devices	Yes
3	System Water Audits, Leak Detection and Repair	Goal to replace 1% of pipeline system annually	Yes
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	Meter implementation program currently under development; majority of commercial, industrial, and landscape connections metered	In Process
5	Large Landscape Conservation Programs and Incentives	None at this time; Water Conservation Ordinance applies to large landscapes,	B/C = 5.6
6	High Efficiency-Washing Machine	None at this time	B/C = 0.7

	Rebate Program		
7	Public Information Programs	Conservation information included in bill inserts, newsletters, brochures, demonstration gardens, special events	Yes
8	School Education Programs	K-6 Classroom presentations See Conservation Coordinator	Yes
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Water surveys not offered at this time; ULFT replacement program is available to CII accounts	B/C = 2.2
10	Wholesale Agency Programs	Not Applicable	Not Applicable
11	Conservation Pricing	Meter implementation program will enable future conservation pricing	In Process
12	Water Conservation Coordinator	Water Conservation Enforcement and Education	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures .	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	Rebates offered at the time of purchase for ULFTs	Yes

3.1.2 Stockton East Water District

The mission of SEWD was established by the State Legislature when the District was provided with additional authority to insure proper management of the Eastern San Joaquin Groundwater Basin and provide supplemental water supplies. In accordance with its mission, SEWD wholesales drinking water to the City of Stockton, Cal Water, and San Joaquin County. By contract, the District is expected to deliver a minimum of 20,000 acre-feet to these urban contractors. From 1992 to 2002, the District delivered 439,048 acre-feet of treated water or about 40,000 acre-feet per year to these urban contractors. Beginning in 2007, the District expects to deliver in excess of 50,000 acre-feet to these urban contractors.

3.1.3 City of Stockton

The City of Stockton Municipal Utility District service area generally encompasses portions of Stockton north of the Calaveras River and South of the California Water service Area. In 2005, the Stockton MUD Demand was approximately 33,000 acre-feet per year and is expected to increase to 43,830 acre-feet per year in 2030. Approximately 39% of the Stockton MUD’s water deliveries come from groundwater, and 61% is treated surface water from SEWD.

The City of Stockton is currently implementing Phase I of the Stockton Delta Diversion Project which will provide up to 33,600 acre-feet per year. The 30 MGD treatment plant and pipeline is slated to being construction in 2008 with delivery scheduled for 2010. The City of Stockton will also target a 0.6 acre-feet per year groundwater extraction rate to slow the rate of migration of saline groundwater from the west. Table 3-2 lists the

Demand Management Measures (DMMs) currently being implemented or considered by the City of Stockton MUD.

Table 3-2 DMMs implemented or considered by the City of Stockton			
DMM	**DMM Description**	**Conservation Program**	**Implemented**
1	Water Survey Programs for Residential Customers	Per capita water usage and water audits	Yes
2	Residential Plumbing Retrofit	Water saving kits	Yes
3	System Water Audits, Leak Detection and Repair	4.8% loss per year and striving to improve	Yes
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	By connection type and commodity priced	Yes
5	Large Landscape Conservation Programs and Incentives	Large landscape ordinance	Yes
6	High Efficiency-Washing Machine Rebate Program	None at this time. Will be studied	No
7	Public Information Programs	Water Awareness Month, special events	Yes
8	School Education Programs	SAWS participant	Yes
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Conservation pricing on wastewater discharges for industrial accounts	Yes
10	Wholesale Agency Programs	SAWS participant	Yes
11	Conservation Pricing	By connection type and commodity priced	Yes
12	Water Conservation Coordinator	Water Conservation Enforcement and Education	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures .	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	None at this time. Will be studied	No

3.1.4 California Water Service Company

According to the Draft California Water Service Stockton District (CalWater) 2007 Urban Water Management Plan, there approximately 41,000 connections in the greater Stockton area primarily south of the Calaveras River. CalWater utilizes surface water delivered from SEWD and groundwater to meet customer demands.

CalWater participated is an investor owned public utility and is stringently regulated by the California Public Utilities Commission. CalWater is a signatory to the California Urban Water Conservation Council. Table 3-3 lists the Best Management Practices (BMPs) currently being implemented or considered by CalWater.

Table 3-3 DMMs implemented or considered by the California Water Service Stockton District			
BMP	**BMP Description**	**Conservation Program**	**Implemented**
1	Water Survey Programs for Residential Customers	Per capita water usage and water audits	Yes
2	Residential Plumbing Retrofit	Water saving kits	Yes
3	System Water Audits, Leak Detection and Repair	4.8% loss per year and striving to improve	Yes
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	By connection type and commodity priced	Yes
5	Large Landscape Conservation Programs and Incentives	Large landscape ordinance	Yes
6	High Efficiency-Washing Machine Rebate Program	None at this time. Will be studied	No
7	Public Information Programs	Water Awareness Month, special events	Yes
8	School Education Programs	SAWS participant	Yes
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Conservation pricing on wastewater discharges for industrial accounts	Yes
10	Wholesale Agency Programs	SAWS participant	Yes
11	Conservation Pricing	By connection type and commodity priced	Yes
12	Water Conservation Coordinator	Water Conservation Enforcement and Education	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures .	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	None at this time. Will be studied	No

3.1.5 City of Manteca

The City of Manteca straddles State Route 99 south of Stockton. According to the City of Manteca 2005 Urban Water Management Plan, potable water supplies consist of a combination of groundwater and treated surface water from the South County Water Supply Program. Manteca will receive up to 11,500 acre-feet per year through 2015 and ultimately up to 18,500 acre-feet per year in Phase II. The utilization of treated surface water will allow the Manteca to meet the target safe-yield target of 1 acre-foot per acre per year. Up to 3.65 MGD of reclaimed waste water is applied to fodder crops on City owned and leased lands.

The City of Manteca is a signatory to the California Urban Water Conservation Council. Table 3-4 lists the Best Management Practices (BMPs) currently being implemented or considered by the City of Manteca.

Table 3-4 BMPs implemented or considered by the City of Manteca

BMP	BMP Description	Conservation Program	Implemented
1	Water Survey Programs for Residential Customers	Per capita water usage and water audits	Yes
2	Residential Plumbing Retrofit	Water saving kits	Yes
3	System Water Audits, Leak Detection and Repair	Completed pre-screen of system	Yes
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	By connection type and commodity priced	Yes
5	Large Landscape Conservation Programs and Incentives	Marketing strategy and program	Yes
6	High Efficiency-Washing Machine Rebate Program	Through CPUC	Yes
7	Public Information Programs	Mailers, announcements, special events	Yes
8	School Education Programs	K-8 classroom and materials	Yes
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Conservation pricing and audits	Yes
10	Wholesale Agency Programs	Not Applicable	N/A
11	Conservation Pricing	By connection type and commodity priced	Yes
12	Water Conservation Coordinator	Full-time	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	None at this time.	No

3.1.6 City of Ripon

The City of Ripon is located at the southern edge of the county along State Route 99. The population in 2002 was approximately 11,500 and is expected to grow to 29,900 by 2020. All of the city's potable water is provided by groundwater wells supplying 4,565 acre-feet in 2002, and this is estimated to increase to 12,310 acre-feet in 2020 in the 2003 City of Ripon Urban Water Management Plan. In 2002, 1,400 acre-feet of non-potable water was supplied by city groundwater wells, and 500 acre-feet of non-potable water was supplied with SSJID contracted surface water. In 2020, the city's non-potable wells are expected to supply the same amount of water, and the SSJID's contract is expected to increase to 5,080 acre-feet. The plan also anticipates 960 acre-feet of non-potable groundwater supplied by Nestle in 2020.

The Table 3-5 lists the Demand Management Measures (DMMs) currently being implemented or considered by the City of Ripon.

Table 3-5 DMMs implemented or considered by the City of Ripon			
DMM	DMM Description	Conservation Program	Implemented
1	Water Survey Programs for Residential Customers	Contemplating a water saving kit program	No
2	Residential Plumbing Retrofit	Unknown	Unknown
3	System Water Audits, Leak Detection and Repair	Unknown	Unknown
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	Flat rate, new units and industrial users metered	No
5	Large Landscape Conservation Programs and Incentives	5-year water audits, non-potable system	Yes
6	High Efficiency-Washing Machine Rebate Program	None at this time. Will be studied	No
7	Public Information Programs	Website, television, mailers, and special events	Yes
8	School Education Programs	Future Program	No
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Future Program	No
10	Wholesale Agency Programs	Not Applicable	no
11	Conservation Pricing	Only for commercial and industrial accounts, non-potable water discounted	Yes
12	Water Conservation Coordinator	Water Conservation Enforcement and Education, Public Works Director	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures .	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	Future Program	No

3.1.7 City of Lathrop

The City of Lathrop is located south of Stockton and west of Manteca along Interstates 5 and 205 and the State Route 120 corridor. According to the City of Lathrop Urban Water Management Plan 2003 Update, potable water supplies consist of a combination of groundwater and treated surface water from the South County Water Supply Program. Lathrop will receive up to 8,000 acre-feet per year through 2015 and ultimately up to 11,791 acre-feet per year in Phase II.

In an effort to reduce potable water demands, the City of Lathrop is committed to implementing water conservation programs and has put into practice ordinances contained in its City of Lathrop Code. These ordinances are triggered by the severity of drought or water emergency and vary in water reduction goals ranging as high as fifty percent. The array of conservation measures include limiting water usage to night time hours, having special requirement for hotels, and limiting car washing to the use of a bucket. Ongoing measures include residential plumbing retrofit and system water audits, leak detection and repair.

The Table 3-6 lists the Demand Management Measures (DMMs) currently being implemented or considered by the City of Lathrop.

Table 3-6 DMMs implemented or considered by the City of Lathrop

DMM	DMM Description	Conservation Program	Implemented
1	Water Survey Programs for Residential Customers	Per capita water usage and water audits	No
2	Residential Plumbing Retrofit	Water saving kits	Yes
3	System Water Audits, Leak Detection and Repair	Water Audit Redords	Yes
4	Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections	By connection type and commodity priced	Yes
5	Large Landscape Conservation Programs and Incentives	Landscape Management Outreach Program	Yes
6	High Efficiency-Washing Machine Rebate Program	Refer customers to PG&E	No
7	Public Information Programs	Newsletters, special events	Yes
8	School Education Programs	Coloring books and other educational material	Yes
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	Metered accounts and commodity priced	No
10	Wholesale Agency Programs	Not applicable	N/A
11	Conservation Pricing	By connection type and commodity priced	Yes
12	Water Conservation Coordinator	Water Conservation Enforcement and Education, Full-time	Yes
13	Water Waste Prohibitions	Restrictions and penalties in place and enforced for wasted water; emergency conservation measures	Yes
14	Residential Ultra-Low Flush Toilet Replacement Program	None at this time	No

3.1.8 City of Escalon

Not required to prepare an UWMP.

3.2 Overview of Existing Groundwater Management Plans

3.2.1 Woodbridge Irrigation District

The Woodbridge Irrigation District (WID), organized in 1924 under the California Irrigation District Act, holds extensive water rights to Mokelumne River Water dating back to the mid-1880s. The boundaries of WID encompass a gross area of approximately 42,900 acres., however, WID is discontinuous resulting in patches of non-district lands within the its boundary. WID overlaps with the North San Joaquin Water Conservation District (NSJWCD), Stockton East Water District (SEWD), and the City of Lodi.

In 1996, WID adopted an AB 3030 Groundwater Management Plan for the purpose of ensuring that groundwater levels would continue to supplement surface water supplies in order to meet the demands of the District. WID's goal for conjunctive use is to maximize the use of surface water for the protection of the underground water supply. WID was also a member agency of the East San Joaquin Parties Joint Powers Authority, a predecessor to the Authority.

WID owns and operates the newly replaced Woodbridge Diversion Dam, located on the Lower Mokelumne River northeast of Lodi, as well as an extensive canal system serving approximately 13,000 acres west of Lodi and north of Stockton. The improvements made to the new Woodbridge Dam include state of the art fish and diversion works which enable WID to keep Lodi Lake full year-round. Through WID's conservation efforts to convert to drip irrigation, WID has contracted with the City of Lodi for up to 6,000 acre-feet per year. Also at the regional level, WID has participated as a member agency of the East San Joaquin Parties Water Authority (ESJPWA) and the Authority.

3.2.2 North San Joaquin Water Conservation District

The North San Joaquin Water Conservation District (NSJWCD), organized in 1948 under provisions of the Water Conservation District Act of 1931, includes approximately 150,000 acres east of the City of Lodi. Approximately 4,740 acres are within the Lodi city limits and 5,600 acres are within Lodi's sphere of influence. NSJWCD straddles the Mokelumne River and is consequently located in both the Cosumnes and the Eastern San Joaquin sub-basins as defined by the DWR Draft Bulletin 118.

In 1996 NSJWCD adopted an AB 3030 Plan to address declining groundwater levels, degradation of groundwater quality, and securing reliable surface water supplies. Actions in their AB 3030 Plan include the continued effort to seek a reliable supplemental water supply from the Mokelumne River and other sources, promotion of more efficient water application methods, participation in regional groundwater management efforts, and the maximum use of surface water supplies through the development of groundwater recharge facilities.

On July 3, 1956, Decision 858 of the California State Engineer predecessor to the State Water Resources Control Board (D-858) denied NSJWCD a water right permit to divert up to 50,000 acre-feet per year and instead approved East Bay Municipal Utility

District's (EBMUD) request to appropriate an amount greater than the request of NSJWCD. D-858 cites the Auburn Dam on the American River as the future source of water for NSJWCD. Auburn Dam was never built. As consolation, a temporary permit was issued to NSJWCD for interim water based on EBMUD's unused entitlements and future demands, but could only be diverted from December 1 to July 1. Through an agreement between both parties, EBMUD stores up to 20,000 acre-feet in the wettest years for delivery to NSJWCD during the irrigation season. The time to put all 20,000 acre-feet per year to beneficial use expired in 2000. NSJWCD request to extend the water right permit is pending before the State Water Resources Control Board (SWRCB).

In order to extend the permit, NSJWCD must show the SWRCB that it can put the water to beneficial use. NSJWCD has received a $462,500 CALFED grant and has participated in the Farmington Groundwater Recharge and Seasonal Habitat Study to demonstrate their ability to utilize its full appropriation. Property owners within NSJWCD have also approved an assessment to levy up to $5/acre to further the recharge effort. Most recently, in May 2007, the NSJWCD Board approved a groundwater charge as a means of funding projects that will enable the District to expand its ability to deliver and recharge water. NSJWCD continues to seek resolution to D-858 through requests to the SWRCB to consider a reallocation of 50,000acre-feet per year of Mokelumne River Water from EBMUD to the District.

At the regional level, NSJWCD is a member agency of the Eastern Water Alliance and the Authority.

3.2.3 Stockton East Water District

The Stockton East Water District (SEWD), as currently structured, was formed in 1948 under the 1931 Water Conservation Act of the State of California. The SEWD was originally organized as the Stockton and East San Joaquin Water Conservation District, an independent political subdivision responsible for acquiring a supplemental water supply and assisting in the development of practices of water use that would promote the required balance between surface water and groundwater.

From 1948 to 1963, SEWD's efforts were in planning, evaluating groundwater conditions and determining requirements for supplemental water. As a result of the SEWD planning and with intensive efforts of part of the SEWD and local agencies, New Hogan Dam was constructed in 1964. The SEWD's first supply of supplemental surface water was contracted with the USBR in 1964 and a final agreement in 1970 guaranteeing 56.5% of New Hogan Reservoir's yield to the District.

Prior to 1963, the SEWD's basic financial structure rested upon a tax on land. In 1963, the Governor of California signed a bill that established groundwater use fees and surface water charges that could be levied by the SEWD. The additional revenues were used by the SEWD to contract for New Hogan water. The SEWD began registering wells within their boundaries. Check dams were built on the Calaveras River, Mormon and Mosher Sloughs for control of surface irrigation water and to promote groundwater recharge. SEWD became actively involved in the pursuit of projects to mitigate declining groundwater levels and to prevent the further intrusion of saline groundwater.

In 1971, SEWD boundaries were expanded to include the entire Stockton urban area. SEWD began plans for a 30 MGD treatment plant to serve the urban area. In 1975, a $25 million bond issue was passed by the SEWD wide election to fund the water treatment plant. The plant was completed in 1977 and went on line in 1978 to reduce the groundwater pumping depression under the urban area and the affects of saline intrusion on urban wells near the Delta. In 1979, the Independent Benefit Commission concluded that the new drinking water treatment plant was a benefit to Stockton's planning areas. Thereafter, SEWD assessed 14,000 acre-feet of additional agricultural acres, and in 2005, annexed an additional 27,000 acres into the district. Today, SEWD's area encompasses approximately 143,300 acres. WID and SEWD share approximately 9,700 acres in North Stockton.

SEWD has actively sought supplemental surface water from the American River via the Folsom South Canal and from the New Melones Reservoir. Efforts to obtain the American River supply have been thwarted by the Environmental Defense Fund (EDF), EBMUD litigation and the Freeport Regional Diversion Project litigation. The District and Central San Joaquin Water Conservation District (CSJWCD) contracted with the USBR in 1983 for 75,000 and 80,000 acre-feet of water respectively from New Melones Reservoir. Under current USBR operation of New Melones, SEWD and CSJWCD are provided with up to its total contract amount of 155,000 acre-feet of water from New Melones annually. In 1983, the District expanded surface water irrigation with the construction of the 12,000 gpm Potter Creek Pump Facility.

In 1991, the SEWD drinking water treatment plant was expanded to 40 MGD to accommodate increased demand from Stockton's urban areas. Construction on the New Melones Conveyance System, in anticipation of a new water supply, was completed in 1994; however, under the Central Valley Project Improvement Act (CVPIA), USBR did not supply water for the project in 1993-1994. In 1995, SEWD began receiving New Melones water, but the amount received was less than the contracted amount due to requirements of the Miller-Bradley bill, which regulated flows on the

San Joaquin River to address water quality and fishery issues. Legal action in this matter is ongoing.

SEWD adopted a Groundwater Management Plan in accordance with Assembly Bill 3030 (AB3030). The goal of the SEWD AB 3030 Groundwater Management Plan is to continue the district's efforts to protect existing water supplies, to relieve pressure on the groundwater basin by seeking supplemental surface water supplies for conjunctive use, and to maintain pressure on USBR to meet the contracted delivery amounts for New Melones water. In 2006, the district adopted a Groundwater Management Plan pursuant to Senate Bill 1938 (SB 1938). The Northeastern San Joaquin County Groundwater Banking Authority (GBA) facilitated adoption of this plan, which is required as a prerequisite for Proposition 50 grant funding.

In 1997, the District entered into a water transfer agreement with Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID). This agreement is for 8,000 to 30,000 acre-feet allocation based on New Melones storage and inflow as of April 1st of each year. The contract period ends 2009 with a possible 10-year renewal pending further studies.

In 2001, SEWD completed the Farmington Groundwater Recharge and Seasonal Habitat Study (Farmington Study) in conjunction with the United States Army Corps of Engineers and other local agencies. The Farmington Study identified areas suitable for recharge and seasonal habitat development, evaluated recharge techniques, conducted pilot recharge tests, developed a final report and recharge guide, and recommended an implementation strategy for the phased Farmington Program.

In 2003, the district completed the Pilot Phase of the Farmington Program, which consists of 60 acres of recharge ponds and fields adjacent to the Joe Waidhofer Drinking Water Treatment Plant. This project was awarded the American Society of Civil Engineers Water/Environmental Project of the Year in 2003 and the San Joaquin Council of Government Regional Excellence award in 2004. The Demonstration Phase, which began in 2003, will investigate and construct up to 1,200 acres of recharge ponds and fields. To date, over 10 sites have been investigated and two sites are moving forward to a demonstration study. In 2006, construction began on another 30-acre recharge site at the drinking water treatment plant. The district estimates a recharge rate of 0.5 feet per day for this site. For more information on the Farmington Program, see the Farmington Groundwater Recharge Site links at www.farmingtonprogram.org.

At the regional level, SEWD has participated as a member agency of the Eastern Water Alliance and the Authority.

3.2.4 Central San Joaquin Water Conservation District

The CSJWCD was formed in 1959 under provisions of the California Water Conservation Act of 1931. The CSJWCD includes approximately 65,100 acres, of which 670 acres are within the sphere of influence for the City of Stockton.

To mitigate declining groundwater levels, the CSJWCD participated in the Goodwin Tunnel Project for the use of New Melones water subject to the contract with the USBR. The contract amount calls for 49,000 acre-feet per year of firm yield and up to an additional 31,000 acre-feet per year on an interim basis to the CSJWCD. Under the existing New Melones Reservoir operations plan, the contracted amount has never been fully delivered. Irrigation facilities have been installed and operated by individual landowners through a surface water incentive program sponsored by the CSJWCD.

At the regional level, CSJWCD has participated as a member agency of the Eastern Water Alliance and the Authority.

3.4.5 South San Joaquin Irrigation District

Formed in 1909 under the Irrigation District Act, SSJID comprises approximately 72,000 acres in the southeastern portion of San Joaquin County, all of which is located within the Basin. The cities of Manteca, Ripon and Escalon comprise approximately 10,000 acres of the District area. SSJID is allocated half of 600,000 acre-feet per year from the Stanislaus River with the other half going to Oakdale Irrigation District. SSJID owns and operates an extensive system of conveyance structures and canals.

Adopted in 1993, the SSJID GWMP outlines the efforts of the district to maintain groundwater levels and continue to utilize its surface water entitlements. As part of the plan, SSJID began regularly monitoring their irrigation wells for water quality. Before the Plan, only the municipal wells used for drinking water supply were tested because of Health Department requirements. SSJID also uses agricultural sites during the off-season for recharge and plans to implement recharge and wellhead protection areas to safeguard groundwater quality.

The estimated safe yield of the Basin within the entire District is 72,000 acre-feet per year. Municipal usage, particularly within the City of is about 2½ times the safe yield. Based on data from 32 wells in the District, the groundwater levels have decreased between 20 to 30 feet in the last 40 years. To address the water supply needs of the urban areas of the District and the Region, SSJID will begin in 2005 the delivery of up to 44,000 acre-feet per year of treated surface water from Woodward Reservoir to the Cities of Escalon, Manteca, Lathrop, and Tracy. The net benefit to the Basin is expected to be approximately 30,000 acre-feet per year. SSJID and OID also provide water to the

City of Stockton through a 10-year transfer agreement for up to 30,000 acre-feet per year of New Melones Water.

3.4.6 Oakdale Irrigation District

Formed in 1909 under the Irrigation District Act, OID comprises about 72,345 acres mostly in the northern portion of Stanislaus County with about 12% overlying the Eastern San Joaquin Sub-basin. With the adoption of an AB 3030 Plan in 1995, OID has taken a proactive approach to preventing groundwater contamination from abandoned wells by educating property owners and improving enforcement policies. OID has also developed guidelines for a wellhead protection program. Flood irrigation practices in OID have helped to recharge the Basin. As stated above, SSJID and OID provide water to the City of Stockton through a 10-year transfer agreement for up to 30,000 acre-feet per year of New Melones Water.

3.4.7 Eastern San Joaquin County Groundwater Basin GWMP

With the passage of SB 1938 in 2002 further emphasized the need for groundwater management in California. SB 1938 requires AB 3030 groundwater management plans to contain specific plan components in order to receive state funding for water projects. Table 1-4 illustrates the recommended components of a groundwater management plan as outlined in AB 3030 and the required sections under SB 1938.

On July 9, 2003, the Authority Board of Directors held a public hearing to initiate the formulation of this AB 3030 Plan. The hearing was formally noticed per Water Code Section 10750 et. seq. and a Resolution of Intent to Prepare a Groundwater Management Plan was adopted by the Authority Board of Directors.

3.4.8 Eastern Water Alliance

The Eastern Water Alliance (Alliance) was formed by a Joint Exercise of Powers Agreement, dated April 18, 2003, between Central San Joaquin Water Conservation District (CSJWCD), North San Joaquin Water Conservation District (NSJWCD), and Stockton East Water District (SEWD).

The purpose of the Alliance is to provide a vehicle for its members to cooperate in the planning, financing, operation and implementation of projects for the long-term recovery, stabilization and enhancement of the Eastern San Joaquin County [groundwater] Basin (Basin), including development and implementation of a groundwater management plan for the Basin. The goal and intent of the Alliance is one of voluntary cooperation among its members in order to improve the condition of the Basin for the collective benefit of all.

3.3 Other Regional Authorities and Planning Efforts

3.3.1 Mokelumne River Forum

Stakeholders with ties to the Mokelumne River have faced conflicting water resource pressures for decades. In order to help resolve these historic conflicts, agencies that rely on the Mokelumne River for water supply and who are interested in working together to identify new water supply alternatives met in 2004 to explore whether there was a commonality of interest to form a stakeholder-supported collaborative process. The entities agreed that significant commonality of interest and political will existed to overcome institutional barriers and resolve conflicts to improve water supply availability and reliability from the Mokelumne River.

Table 3-7 Mokelumne River Forum MOU Signatory Agencies
Alpine County
Amador County
Amador Water Agency
Calaveras County Water District
Calaveras Public Utility District
Central San Joaquin WCD
City of Lodi
City of Stockton
Department of Water Resources
East Bay Municipal Utility District
Jackson Valley Irrigation District
Mokelumne River WPA
North San Joaquin WCD
San Joaquin County
Stockton East Water District

The Mokelumne River Forum (Forum) was established in June 2005 through a Memorandum of Understanding (MOU). The MOU commits participants to seek mutually beneficial and regionally focused solutions that resolve conflicts. These solutions are explicitly intended to meet diverse needs that include: up-country consumptive water and infrastructure (Amador, Calaveras, and Alpine Counties); San Joaquin County water supply (basin overdraft); dry-year drinking water supply; and agriculture, environment, and recreation. The MOU signatories are identified in the box to the right. The Forum is comprised of the signatories "and other organizations and interest groups… that elect to participate in the collaborative process." The San Joaquin Farm Bureau Federation is an example of such an organization; another example is the Upper Mokelumne River Watershed Council. Consistent with the Forum's "open door" policy, there is an active commitment to increase participation by environmental and conservation groups able to represent perspectives from the entire length of the Mokelumne River Basin, and to add participation by organizations such as the Delta Water agencies.

The Forum has met regularly since its creation to collaboratively pursue its objectives. Late in 2006 Forum activities and discussions focused increasingly on ways to coordinate water resource planning efforts across regional boundaries with respect to a variety of topics such as river hydrology, facilities, infrastructure and institutional arrangements required to develop inter-regional projects.

3.3.3 South Sacramento County – South Area Water Council

The GBA has been included as stakeholders in the South Sacramento County effort and have participated in a stakeholder interview process and preparation of an assessment report, which has culminated in the development of a Memorandum of Understanding. The six sponsoring agencies to include:

- Southeast Sacramento County Agricultural Water Authority
- City of Galt
- Rancho Murieta Community Services District
- The Nature Conservancy
- Sacramento County Water Agency
- California Department of Water Resources - Conjunctive Management Program

The GBA will continue to monitor and participate in the planning process for the South Basin of Sacramento County. This has included significant information sharing and coordination on project develop and groundwater modeling activities of the GBA. It has become evident that the fate of the groundwater basin is linked not to a political or jurisdictional boundary between Sacramento and San Joaquin County, but is linked through a hydrologic boundary that is impacted by the activities of water resource management in each area.

3.3.4 Tracy Regional Groundwater Management Plan

The City of Tracy recently adopted on March 6, 2007 the Tracy Regional Groundwater Management Plan (Tracy GWMP) for the Tracy Sub-Basin. The Tracy GWMP addresses issues relating to groundwater levels, groundwater quality, conjunctive use, and other groundwater management actions. Outside of the Authority IRWM Planning area, the Tracy Sub-basin, in sharp contrast to the Eastern San Joaquin, has relatively high groundwater levels; however, the water quality there is poor and often exceeds State standards for salinity. Nonetheless, there are several linkages between the Tracy and the Eastern San Joaquin Sub-Basins that should be further explored and coordinated.

The San Joaquin Delta and the underlying Tracy Sub-Basin is a major source of natural gas for the State. Records dating back to the early 1900's document problems with well destruction activities; it is unknown how wells went unrecorded as well. Improperly abandoned wells are potential conduits for contamination to spread throughout an aquifer. As seen in Eastern San Joaquin near the saline groundwater intrusion front in South Stockton, the USGS has collected preliminary information which suggests that saline groundwater at drinking water well depths share similar hydrocarbon signatures with oil and gas wells often drilled thousands of feet deeper. The data warrants further exploration of the issue before concrete conclusions can be reached.

An additional linkage between the Tracy and Eastern San Joaquin Sub-Basins is inter-basin flow in the sub-surface. Historically, groundwater flowed from the Sierras in a southwesterly direction and ultimately discharged into the San Joaquin River and San Joaquin Delta. As development of groundwater continued to grow in Eastern San Joaquin County, groundwater levels began to fall. The historic discharge of groundwater in the direction of the San Joaquin River reversed and became a source of salinity intruding into the Eastern San Joaquin Basin. The interplay between Sub-Basins is dependent on groundwater gradients on either side of the San Joaquin River which is directly influenced by the management actions of both the Tracy GWMP and this IRWMP.

3.4 Habitat Conservation and Watershed Management Planning

Although the Eastern San Joaquin IRWMP will focus primarily on the issue of water supply, there is an acute awareness amongst member agencies that the Authority must support and encourage stewardship and proactive management of our natural resources. Several member agencies of the Authority are either participants or implementing agencies of the planning processes described below. Throughout this IRWMP, these processes will be referred to and the potential for partnerships further explored.

3.4.1 San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

Adopted in 1991 by the San Joaquin Council of Governments[1], the purpose of the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) is to balance conservation of open space with the future of our community as we accommodate a growing population, protect the region's agricultural economy, and preserve landowner property rights. Growth in San Joaquin County will continue to affect 97 special status plant, fish and wildlife species in 52 vegetative communities scattered throughout including over 43% of the Sacramento-San Joaquin Delta Primary Zone. The SJMSCP provides for the long-term management of plant, fish and wildlife species in accordance with the Federal Endangered Species Act (ESA), the California Endangered Species Act (CESA). The SJMSCP also preserves open space which contributes to the quality of life of the residents of San Joaquin County.

Table 3-8 2007 Fee Schedule San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

Habitat Type	Fee Per Acre
Multi-Purpose Open Space	$ 6,511
Natural	$ 13,022
Agriculture	$ 13,022
Vernal Pool - uplands	$ 34,958
Vernal Pool - wetted	$ 69,858

Source:
San Joaquin Council of Governments website at http://www.sjcog.org/

The SJMSCP, in accordance with ESA Section 10(a)(1)(B) and CESA Section 2081(b) Incidental Take Permits, provides compensation for the conversion of open space to non-open space SJMSCP. Activities affecting open space which are covered under the SJMSCP include urban development, mining, expansion of existing urban boundaries, non-agricultural activities occurring outside of urban boundaries, levee maintenance

[1] The San Joaquin Council of Governments is a Joint Powers Authority comprised of San Joaquin County and the Cities of Stockton, Lodi, Manteca, Lathrop, Escalon, Ripon, and Tracy. SJCOG primary purpose is to serve as the regional transportation planning agency for the region. In addition, SJCOG provides a forum debate issues such as growth, housing, open space, air quality, economic development, and other regionally important issues.

undertaken by the San Joaquin Area Flood Control Agency, transportation projects, school expansions, non-federal flood control projects, new parks and trails, maintenance of existing facilities for non-federal irrigation district projects, utility installation, maintenance activities, managing habitat preserves, and other similar public agency projects. Since 1991, a total of 9,819 acres have been covered by the SJMSCP, and a total of 6,518 acres have been acquired and managed as open space preserves under the program. Table 3-8 lists the 2007 Fee Schedule for activities covered under SJMSCP.

3.4.2 Calaveras River Habitat Conservation Plan

Information is pending expected release by Stockton East Water District and Calaveras County Water District in summer 2007.

3.4.3 Lower Mokelumne River Stewardship Plan

The Lower Mokelumne River Watershed Stewardship Plan, completed in May 2002, is a voluntary program which guides landowners, residents, and stakeholders in maintaining and improving the resources of the Lower Mokelumne River Watershed. The San Joaquin County Resource Conservation District's (RCD) Watershed Coordinator is responsible for coordinating the implementation of the many programs contained in the plan. The U.S. Natural Resource Conservation Service provides assistance and educational outreach materials for farmers, schools, and residents within the watershed. Existing programs under the Stewardship Plan include:

Mokelumne River Watershed Owner's Manual - A stewardship-based workbook to guide homeowners in reducing non-point source pollution. Topics include storm water management, reducing pollutants in runoff, managing hazardous household products, managing swimming pools and similar topics.

Vernal Pool/Agriculture Education & Demonstration Program, Neotropical Migratory Bird Monitoring, & Riparian Restoration Program - The RCD is working with Central Valley Project Improvement Act (CVPIA) agencies to acquire vernal pool grasslands for the purposes of demonstrating economically viable agriculture in a vernal pool environment. The RCD also is overseeing Swanson's hawk surveys and riparian restoration program at the Natural Resources Conservation Service's (NRCS) Plant Materials Facility within the Lower Mokelumne River Watershed.

San Joaquin County Resource Conservation District Technical Assistance Program - In partnership with the NRCS, the RCD provides technical assistance and on-the-ground resource conservation technical assistance to landowners and local organizations and provides expertise in range and soil conservation, biology, agronomy and similar resource conservation areas. Through this technical assistance program, many of the practices voluntarily implemented by landowners to protect their natural resources directly and indirectly protect water quality within the watershed and throughout the San Joaquin region.

RCD/Humboldt State University Historic River Mapping Project - The RCD is working with Humboldt State University to map the history of the Mokelumne River, including the movements of the river along its course. This information will be used to assist to define locations which have historically flooded along the LMR for use in flood management and other programs.

Watershed Speaker's Bureau - The Program maintains a list of speakers available to discuss watershed issues at public presentations for local schools and civic groups.

Promote Improvement of Spawning Habitat for Salmon and Steelhead - Implementation of a public outreach program to identify landowners along the Mokelumne River willing to provide access to the Mokelumne River for gravel restoration projects by EBMUD, USFWS and CDFG for improvement of salmon spawning habitat.

Lower Mokelumne River Riparian Restoration Projects - Support riparian restoration efforts of groups such as Woodbridge Irrigation District (WID), the City of Lodi, the Lower Mokelumne River Partnership, the NRCS and others.

Water Quality Improvement Monitoring Programs - Assist in establishing new monitoring locations and expanding parameters monitoring at existing locations for monitoring water quality and water quality improvement. Monitor "core" indicators including stream flow, dissolved oxygen, biochemical oxygen demand, temperature, pH, turbidity, phosphorous and nitrates.

3.4.4 San Joaquin County and Delta Water Quality Coalition

The San Joaquin County and Delta Water Quality Coalition (Coalition) was formed to provide coverage under the Regional Water Quality Control Board Conditional Waiver of Waste Discharge Requirements for Irrigated Agriculture Program (Ag Waiver Program). The Coalition represents most irrigated agriculture in San Joaquin County and a portion of Eastern Contra Costa County including most of the Sacramento-San Joaquin Delta.

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Chapter 4 - Water Resources Setting

4.1 Climate and Precipitation

The climate in San Joaquin County is characteristic of long-dry summers with an average growing season of 292 days throughout the year. Cold and rainy conditions occur in November and last through April with almost 90% of the annual precipitation falling in these months. The average annual rainfall ranges from eight inches to eighteen inches per year and varies due to orographic effects across the Coastal Foothills in the west to the Sierra Nevada Foothills in the east.

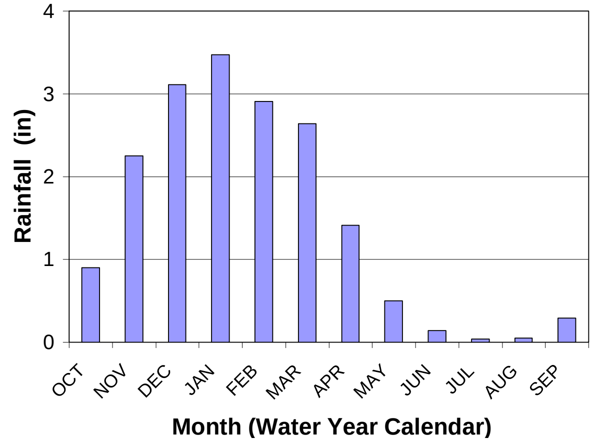

Figure 4-1 Average Monthly Rainfall Distribution (Lodi Station)

Temperatures can exceed 110 degrees in the summer and may also fall to the low 20's in extreme cold weather events (San Joaquin County General Plan 2010). Figures 4-1 and 4-2 depict the annual and monthly variation in precipitation.

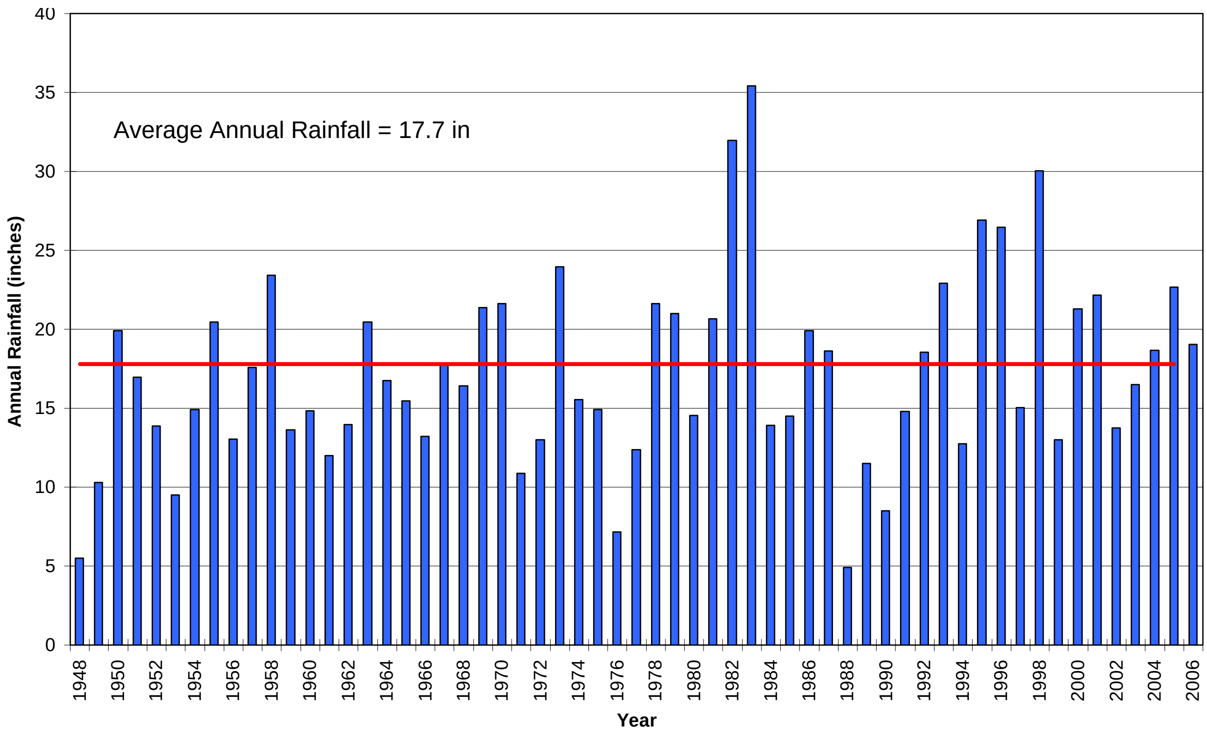

Figure 4-2 Total Annual Rainfall (Lodi Station)

4.2 Urban Land and Water Use

Accommodating planned growth in San Joaquin County is a huge challenge for land use entities throughout the Regional Planning Area. The current population of San Joaquin is expected to increase by approximately 77 percent by 2030 from nearly 650,000 to over 1.1 million. Land use in the Eastern San Joaquin Regional Planning Area is summarized based on GIS mapped urban areas, and the latest DWR land use survey completed in 1996, and the projected urban spheres of influence as reported in adopted or draft general planning documents.

For the purposes of this IRWMP, the "current" planning level is assumed to be 2005 for urban and water use while "future" conditions assume a 2030 planning horizon. The IRMWP assumes that urban growth will occur as either infill or entirely within spheres of influence delineated in the latest general plans revisions. To account for the loss of agricultural production, it is assumed that existing agricultural irrigation within the SOI's will be entirely replaced with urban uses by 2030. Figure 4.3 depicts the 2005 and projected 2030 urban footprints.

Water use within the urban areas of the Regional Planning Area is summarized based on current Urban Water Management Plans, water production data obtained from water service providers, or other general planning documents. Table 4-1 summarizes the current and projected water demands, urban footprint acreage, and water use per acre.

The net increase in annual urban demand from 2005 to 2030 is estimated at 140,717 acre-feet. Several agencies are aggressively implementing many of the best management practices and demand management measures (BMP's/DMM's) recommended. In many cases, the 2030 demands reflect reductions attributed to the implementation of current and future conservation programs. Changes in population density, infill development, subsequent general plan revisions, and increased water conservation may affect the accuracy of the projected water demand.

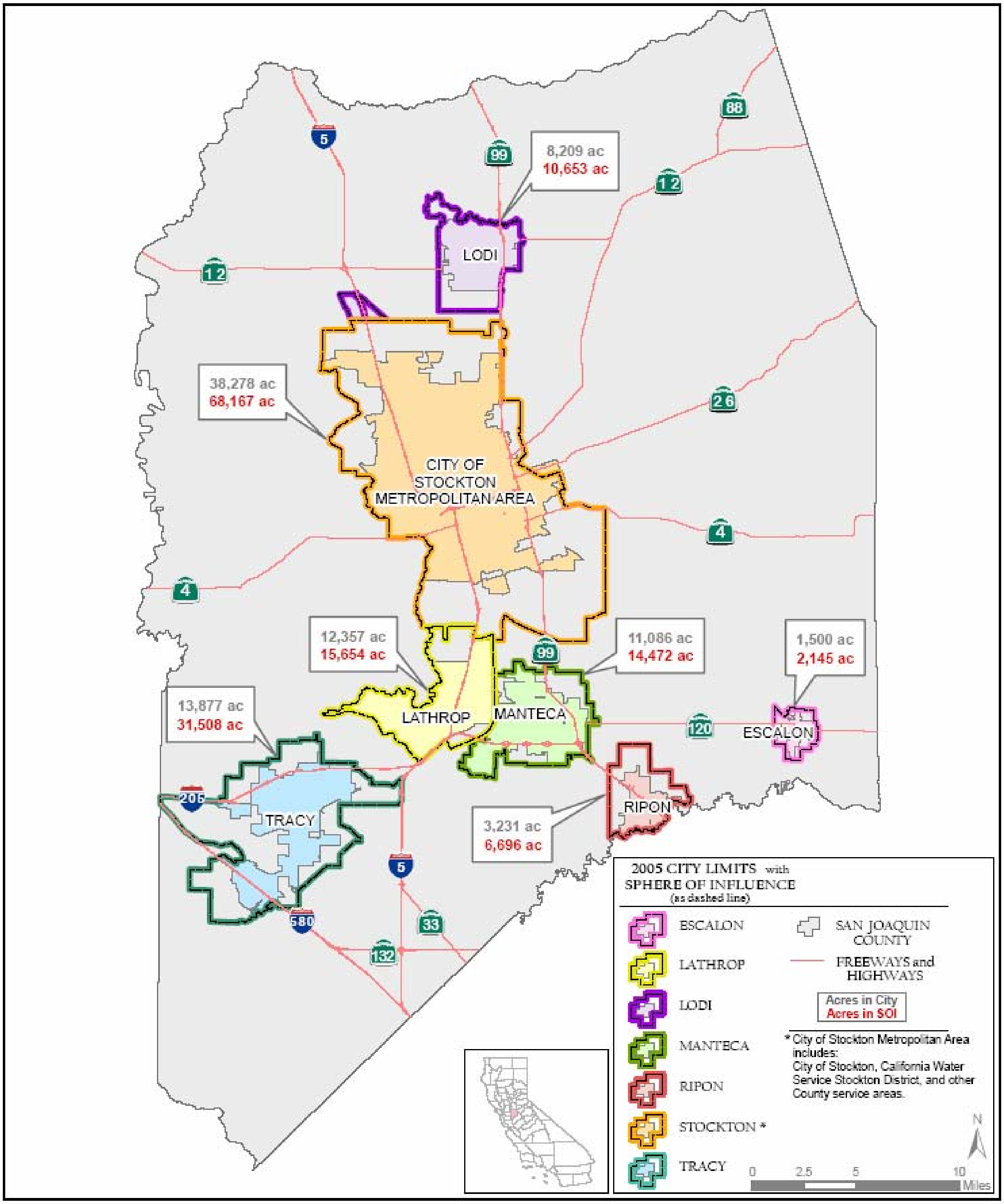

Figure 4-3 2005 Urban Areas and 2030 Spheres of Influence
Source: San Joaquin County GIS Department

Table 4-1 Current and Future Urban Water Demands

City	2005 Water Demand (acre-feet)	2005 City Limit (acres)	2005 Water Use Per Acre (acre-feet/acre)	2030 Water Demand (acre-feet)	2030 SOI (acres)	2030 Water Use Per Acre (acre-feet/acre)	Net Water Use Increase (acre-feet)
Escalon[1]	1,657	1,500	1.1	3,200	2,145	1.5	1,543
Lathrop[2]	4,514	12,357	0.4	19,041	15,654	1.2	14,527
Lodi[3]	17,300	8,209	2.1	21,300	10,653	2.0	4,000
Manteca[4]	15,491	11,086	1.4	35,735	14,472	2.5	20,244
Ripon[5]	5,860	3,231	1.8	16,620	6,696	2.5	10,760
Stockton[6]	67,157	38,278	1.8	137,500	68,167	2.0	70,343
Tracy[7]	16,400	13,877	1.2	35,700	31,508	1.1	19,300
Total	**128,379**	**88,538**	**Average 1.4**	**269,096**	**149,295**	**Average 1.8**	**140,717**

Sources:

1. Escalon 2030 water demands based on projected 2005 well production records. Escalon 2030 SOI from 2035 City of Escalon General Plan Update.
2. Water demands derived from City of Lathrop 2003 Urban Water Management Plan Update. Lathrop 2030 SOI from City of Lathrop 2007 20-year General Plan Update. Current city limits include the River Islands Development Project which is expected to take 20 years before build-out.
3. Water demands from City of Lodi 2005 Urban Water Management Plan Update. Lodi SOI from City of Lodi 2035 Draft General Plan Update.
4. Water demand from City of Manteca 2005 Urban Water Management Plan Update. Manteca SOI from City of Manteca 2003 General Plan Update.
5. Water demand from City of Ripon 2004 Urban Water Management Plan Update. Ripon SOI from City of Ripon 2040 General Plan Update.
6. The quantities provided reflect an estimate of City of Stockton Metropolitan Area defined as the City of Stockton, California Water Service, and San Joaquin County service areas. The respective demands are listed in the 2005 City of Stockton Urban Water Management Plan Update, the 2004 California Water Service Stockton District UMWP, and San Joaquin County Public Works Utilities Division records. Future 2030 water demands from the City of Stockton 2035 Draft General Plan. Stockton SOI from Draft 2035 General Plan Update.
7. Water demand from City of Tracy Regional Groundwater Management Plan. Tracy SOI from City of Tracy 2025 General Plan Update.

4.3 Agricultural Land and Water Use

Irrigation throughout the Regional Planning Area are mostly un-metered, so water use estimates are based largely on cropping patterns and the associated applied water demand. The DWR Division of Planning and Local Assistance collects unit crop and applied water use estimates throughout the State for the preparation of DWR Bulletin 160, the California Water Plan Update. The following sections describe the method, crop inventory, and applied water demand for the Regional Planning Area.

4.3.1 Agricultural Land Use

DWR performs detailed land use surveys Statewide at unspecified intervals. For San Joaquin County, land use surveys were performed in 1976, 1982, 1988, and 1996. The IRWMP utilizes the latest land use survey performed in 1996 and assumes that changes in land use since 1996 are accurate enough to support planning level estimates of agricultural water use. Table 4-2 summarizes the historic land use summaries and illustrates trends of increasing vineyards, orchards, and urban areas, with decreasing amounts of land for pasture, miscellaneous truck and field crops, and farmstead crops.

Table 4-2 San Joaquin County Land Use Summary

Land Use	1976	1982	1988	1996
Urban	59,221	57,557	74,186	86,550
Orchard	87,294	96,322	102,895	107,784
Pasture, Truck, Field, & Farmstead	458,248	439,497	454,778	393,297
Rice	7,918	7,865	6,141	5,991
Vineyards	60,921	65,646	63,860	76,975
Native & Riparian Vegetation	213,922	202,073	201,133	218,056
Water Surface	17,576	27,128	22,755	22,621
TOTAL	905,100	896,088	925,748	911,273

Source: DWR Land Use Surveys - San Joaquin County 1996..
Note: San Joaquin County comprises 901,760 acres. The difference between the land use total and the area of the County is attributed to double-cropping.

To account for changes in urban land use since 1996 to current conditions and beyond, the 2005 "current" and 2030 "future" urban foot prints were spatially overlaid upon the 1996 land use survey. All agricultural lands within the urban foot prints are considered to be entirely converted to urban uses.

Table 4-3 San Joaquin County Land Use Summary

Land Use	2005	2030
Urban	120,860	180,160
Orchard	103,720	95,650
Pasture, Truck, Field, & Farmstead	370,249	328,760
Rice	5,990	5,990
Vineyards	76,070	72,150
Native & Riparian Vegetation	212,510	208,072,
Water Surface	21,550	20,170
TOTAL	910,950	910,95

Source: DWR Land Use Survey and San Joaquin County GIS.

A summary of agricultural and urban land uses 2005, and 2030 is presented in Table 4-3. Figures 4-4 and 4-5 depict the spatial distribution of land use for both the 2005 and 2030 conditions.

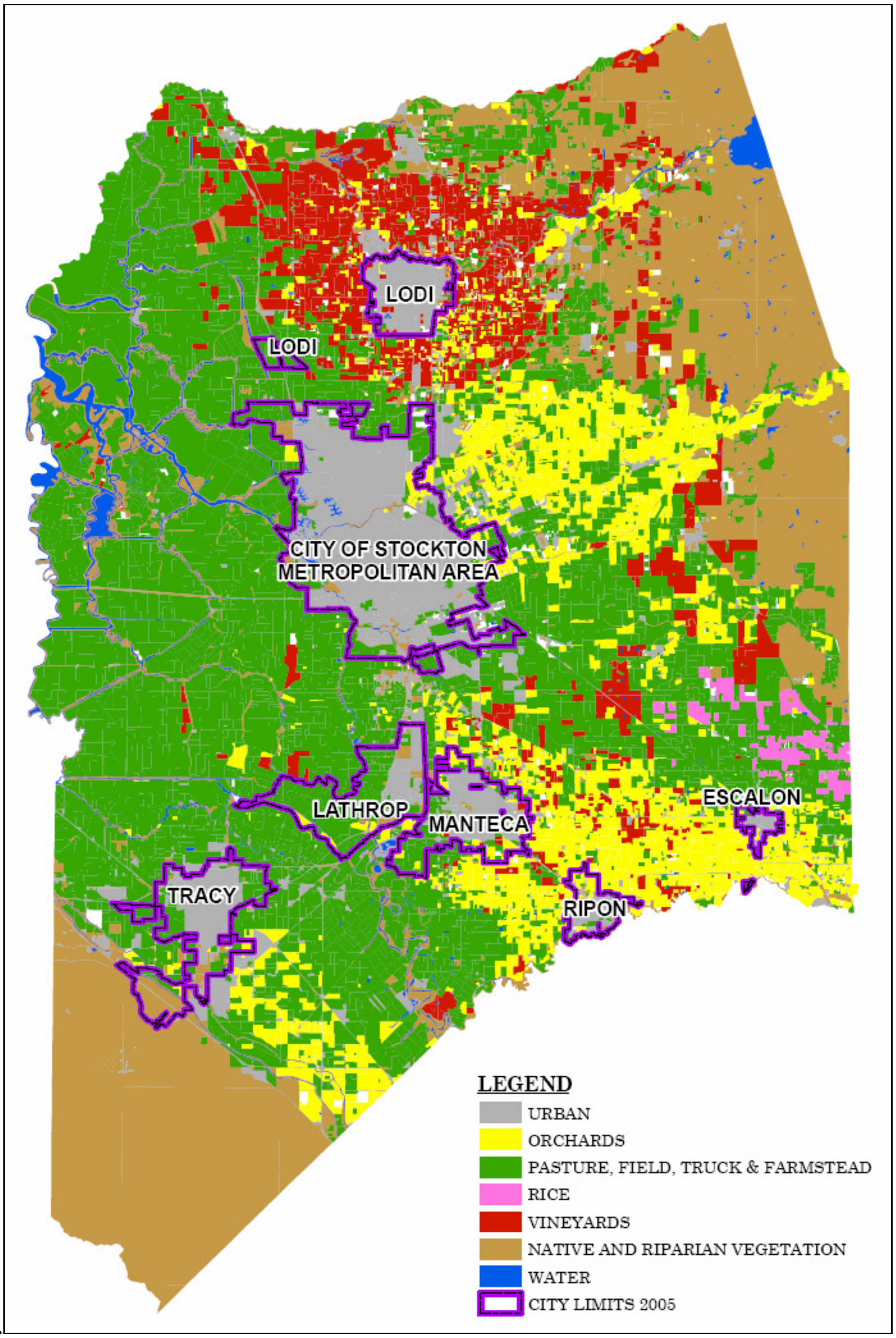

Figure 4-4 2005 City Limits and Land Use Map

Source: DWR Land Use Survey and San Joaquin County GIS Department

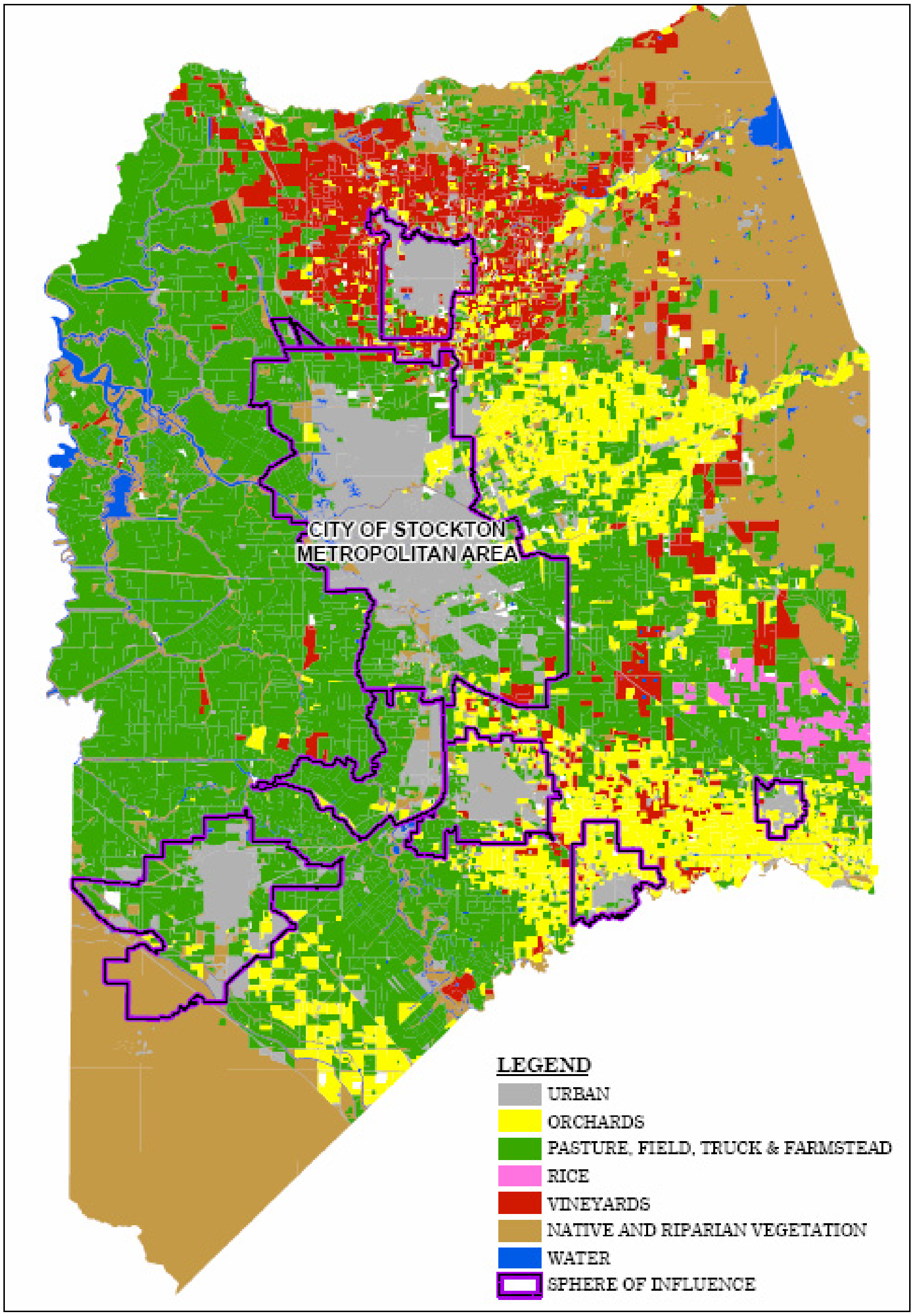

Figure 4-5 2030 Urban Spheres of Influence and Land Use Map
Source: DWR Land Use Survey and San Joaquin County GIS Department

4.3.2 Agricultural Water Use

Agricultural water use is based on various crop Evapotranspiration (ET) and efficiency data collected by DWR. The ET of a crop represents the total amount of water transpired by the plant, retained in the plant tissue, and evaporated from adjacent soil surfaces during the growing period. In dry years, the effective precipitation (EP) is less than normal, thus the amount of applied water (AW) must be increased to meet the total ET of the crop and vice-versa in wet years. Also, the irrigation efficiency of applied water varies due to cultural practices, canal or ditched delivery, pressurized delivery systems, and soil drainage conditions. Unless the irrigator is 100 percent efficient, the amount of applied water is greater than the crop ET. The difference in the applied water demand and the ET is accounted for as either tail-water, lost to the groundwater basin, or recovered and reapplied downstream. Throughout the State, DWR collects land and water use data based on geographical Demand Analysis Units (DAU's) to account for these varying conditions.

For the Regional Planning Area, ET of applied water (ETAW) and applied water demands were obtained from the DWR DPLA for the years of 1998-2003. Table 4-4 lists the unit crop ETAW, AW, and irrigation efficiency for the available period of record. The average unit crop AW demand was combined with the 1996 DWR land use survey for 2005 and 2030 level of development. The applied agricultural water demands for current and future conditions are summarized in Table 4-5.

Table 4-4 ETAW and AW Data for the San Joaquin County Region

	Eastern San Joaquin County			San Joaquin Delta And Woodbridge			South San Joaquin County		
Crop	**ETAW (AF/ac)**	**IE (%)**	**AW (AF/ac)**	**ETAW (AF/ac)**	**IE (%)**	**AW (AF/ac)**	**ETAW (AF/ac)**	**IE (%)**	**AW (AF/ac)**
Grain	0.3	70	0.5	0.6	67	0.9	0.6	70	0.8
Rice	2.9	56	5.1	2.9	56	5.2	2.9	56	5.1
Sugar Beet	2.4	68	3.6	2.8	68	4.2	2.6	N/A	N/A
Corn	1.6	69	2.4	1.9	69	2.7	1.7	64	2.7
Dry Beans	1.5	65	2.3	1.7	68	2.4	1.6	67	2.3
Safflower	0.8	78	1.0	1.0	78	1.3	0.9	78	1.2
Other Field Crops	2.0	65	3.1	2.4	68	3.5	2.1	67	3.2
Alfalfa	3.1	68	4.5	3.7	68	5.4	3.3	70	4.7
Pasture	3.2	64	5.0	3.6	64	5.7	3.4	64	5.2
Tomatoes	1.8	69	2.7	2.2	69	3.1	2.0	69	2.9
Cucurbits	1.2	67	1.8	1.4	71	2.0	1.3	67	2.0
Onions and Garlic	1.2	67	1.8	1.5	71	2.2	1.5	67	2.2
Potatoes	N/A	N/A	N/A	2.3	71	3.2	N/A	N/A	N/A
Other Truck Crops	2.4	67	3.5	1.8	71	2.5	2.2	67	3.3
Almonds	2.4	68	3.5	2.7	69	3.8	2.5	72	3.4
Deciduous Crops	2.4	70	3.5	2.9	70	4.1	2.7	70	3.8
Subtropical Crops	2.1	70	3.0	2.3	70	3.3	2.3	68	3.4
Vineyards	1.0	80	1.2	1.2	80	1.5	1.1	80	1.4

Table 4-5 Estimated and Projected Agricultural Water Demands for the Regional Planning Area Based on DWR Applied Water Demands for the Eastern San Joaquin DAU		
Agency (Area Within the Regional Planning Area Only)	**2005 Estimated Applied Water Demand (acre-feet per year)**	**2030 Projected Applied Water Demand (acre-feet per year)**
Central Delta Water Agency	111,369	93,451
South Delta Water Agency	55,921	32,793
North San Joaquin WCD	152,853	148,738
Woodbridge ID	71,513	58,392
Stockton East WD	206,217	165,449
Central San Joaquin WCD	140,289	126,855
Oakdale ID	32,554	32,554
South San Joaquin ID	200,031	161,437
Unorganized County Areas	99,270	91,403
Total	1,070,017	911,072

Notes:

1. The figures in this table represent the theoretical applied water requirements for conditions averaged over the 1998 – 2003 period of record as reported by the DWR DPLA .
2. Areas of overlap between city limits, spheres of influence, water districts may cause variation in the reported quantities of applied water.
3. The quantity of water actually pumped, diverted, and applied may differ due to a variety of factors including distribution system inefficiencies and losses (ranging from 10 to 20 %), climate, soil conditions, etc.
4. Changes in cropping patterns, irrigation methods, and development of agriculture lands in areas historically un-irrigated have not been quantified.
5. The urban spheres of influence reflect an estimated 2030 level of development as specified in either adopted or draft general planning documents. Development outside of these spheres of influence are not considered in the analysis.

The assumptions in Table 4-5 simplify the process of predicting future water demands. The analysis undertaken does in no way imply that other changes in urban development and agriculture are not likely, nor are the assumptions intended to discourage implementation of structural or policy changes that improve water use efficiency. For the purposes of the Plan, extensive analysis of the sensitivity of the assumptions on the projected water demand was not undertaken. From a water resources planning perspective, the demands presented are sufficient.

4.4 Surface Water Rights

The California water rights system, considered a dual system, recognizes both riparian and appropriative rights. Appropriative rights date back to the mid-1800's during the California Gold Rush under the "First-in-Time, First-in-Right" doctrine. The Water Commission Act of 1913 required that a permit be issued for appropriation of surface water and that the right be assigned a priority based on the date issued. Today, the SWRCB is the regulatory agency through which surface water rights are appropriated.

Water rights acquired prior to December 14, 1914 are not subject to State Board regulation; however, Article X, § 2 of the California Constitution mandates that water must be put to "… reasonable and beneficial use…" or risk loss of water right. (http://ceres.ca.gov/, 2003)

4.4.1 Historic Water Right Conflicts

Historically, as the Department of the Interior's Central Valley Project was constructed in California, San Joaquin County was directed to look to the American River through the Auburn-Folsom South Unit as a major source of the water it needed to meet its critical deficiencies and has been consistently denied a water supply from this source. At the same time, because of the planned availability of American River water for San Joaquin County, the County was denied other sources of surface water supply, principally from the San Joaquin, Stanislaus and Mokelumne Rivers.

In significant part, the County's reliance on American River water stems from numerous state and federal actions which have foreclosed other alternatives while always directing us to the American River; however, the Folsom South Canal extension into San Joaquin County has never been constructed and San Joaquin County has never received this contemplated water supply from the American River. Listed below are historic decisions that have impacted San Joaquin County water interests' pursuit of surface water supplies from the American River.

A. Bulletin No. 11 of the State Water Rights Board entitled, "San Joaquin County Investigation," dated June 1955, includes a description of the Folsom South Canal extending southward to provide a water supply of approximately 303,000 acre feet annually to San Joaquin County. Bulletin No. 11 indicates that this water and canal is the "probable ultimate supplemental water requirement for the San Joaquin Area."

B. In Decision 858, issued on July 3, 1956, the State Engineer found that the North San Joaquin Water Conservation District could receive water from the American River through the Folsom South Canal and that this course would be cheaper and more dependable then Mokelumne River water which flows through the District. As a result of these findings, the North San Joaquin District was granted only a temporary permit to use water from the Mokelumne River and denied a requested permanent right.

C. Four entities within San Joaquin County, consisting of the North San Joaquin Water Conservation District, Stockton and East San Joaquin Water Conservation District (now Stockton East Water District), City of Stockton, and the California

Water Service Company, all filed to appropriate water from the American River. In Decision 893, adopted on March 18, 1958, the then State Water Rights Board at the request of the Bureau of Reclamation denied those permits. The Board, in granting the permits to the Bureau of Reclamation for the Folsom Project, conditioned the permit to allow time for parties desiring water within Placer, Sacramento, and San Joaquin Counties to negotiate a water supply contract. San Joaquin County interests did diligently negotiate for contracts, approved those contracts, and signed them, but they were not approved at the Washington level by the Bureau of Reclamation, as is noted below.

D. The Bureau of Reclamation report entitled “Folsom South Unit” dated January 1960 clearly identified the needs for supplemental water within San Joaquin County and service to the County through the Folsom South Canal. Again, this gave San Joaquin County reason to rely on a water supply from the American River.

E. In 1967 and 1971, the Bureau of Reclamation furnished draft contracts to San Joaquin County and districts within the County to deliver, in part, American River water through the proposed Folsom South Canal to San Joaquin County. Negotiations regarding these contracts resulted in the Stockton East Water District, the Central San Joaquin Water Conservation District and the North San Joaquin Water Conservation District approving contracts for execution. The contracts were approved by the regional office of the Bureau of Reclamation. Although the contracts were sent to Washington for approval, none were executed by the United States. The contracts were not executed, due to a combination of circumstances and changing policies. Disapproval was not because San Joaquin County did not need the water.

F. Following Decision 1400 issued by the State Water Resources Control Board in April 1972 modifying permits to the Bureau of Reclamation for American River water from the proposed Auburn Dam for delivery of water, in part, to San Joaquin County, San Joaquin County’s agencies continued to work with the Bureau of Reclamation regarding various studies concerning the Auburn-Folsom South Unit.

G. In Board hearings on Applications 14858, 14859, 19303 and 1904, for Stanislaus River water, which led to Decision 1422 in 1973, the Bureau of Reclamation testified that the portion of San Joaquin County north of the Calaveras River would be served by the Folsom South Canal. Furthermore, at the time of adopting the New Melones Basin Allocation in 1981, the Secretary of Interior noted that the provision of only a small amount of water to San Joaquin County from New Melones was acceptable since water would be provided to Eastern San Joaquin County from the American River through the Folsom South Canal.

Contrary to these many reports, studies, policies and decisions of both the State and the Federal Bureau of Reclamation, San Joaquin County has not received water from the American River through the contemplated extension of the Folsom South Canal.

For years, the County has sought to obtain additional surface water supplies to supplement available water supplies, including efforts to obtain water from a source other than the contemplated American River. This includes expending substantial efforts and resources (in excess of 65 million dollars for infrastructure alone) to secure a reliable source of Stanislaus River water. Again, due to changes in State and Federal decisions and policies this supplemental water supply to San Joaquin County is not secure. Listed below are historic decisions that have impacted San Joaquin County water interests' pursuit of reliable surface water supplies pursuant to contractual agreements .

A. As a result of State Water Resources Control Board Decision 1422 issued in 1973, the Bureau of Reclamation received conditional permits for Stanislaus River water to be diverted at New Melones Dam and Reservoir. In order to receive State permission to appropriate the water from these permits was to demonstrate "firm commitments" within the permitted four county service area, which included San Joaquin County. In part, to demonstrate such commitment, the Bureau of Reclamation entered into contracts with both Stockton East Water District and Central San Joaquin Water Conservation District in 1983 for a 155,000 acre-foot annual Stanislaus River water supply.

B. These County districts spent over 65 million dollars on delivery infrastructure. Despite the completion of these delivery facilities in 1993, the Bureau did not deliver water to the districts, but a significant amount of New Melones water was released in 1993 and 1994 for fish purposes to meet the needs of the recently adopted Federal CVPIA. Since 1993 the County districts have only received a small portion of their contracted Stanislaus River water. Instead, the Bureau of Reclamation makes discretionary releases from New Melones to meet Delta flow and salinity standards and for fish purposes that directly take water away from these County districts.

C. The Bureau of Reclamation's discretionary decision to meet Delta flow and salinity standards with this Stanislaus River water occurs despite the State Water

Resources Control Board's Decision 1641 issued in 2000 indicating that these standards could be meet from other sources including: releases from other CVP reservoirs such as Friant; recirculation of water through the Delta Mendota Canal, the Newman Wasteway and the San Joaquin River; construction of a valley drain; and purchases of water from willing sellers to release to meet these standards.

D. The Bureau of Reclamation's discretionary decision to release water from New Melones Reservoir for fish purposes to satisfy provisions of the CVPIA also deprives these County districts of their contracts Stanislaus River water . Nothing within the CVPIA mandates that these releases must be made from New Melones. The releases of Stanislaus River water is completely within the Bureau of Reclamation's discretion.

These federal and state decisions are continuing to deprive County interests of water supplies. As a result, even though it is more costly, the County recognizes that surface water supplies obtained in the future for the most part will need to be on a conjunctive use basis. Any conjunctive use plan as currently envisioned utilizing the Application 29657 filing will use surface water in times of high flows and use stored groundwater in dry years.

4.4.2 Summary of Perfected Water Rights

Over the last 25 years, urban and agriculture areas, which do not have pre-1914 water rights have take strides to utilize more surface water in-lieu of groundwater; however, groundwater remains the primary source of water for Eastern San Joaquin County. In 2005, the Cities of Stockton, Lathrop, Manteca, and Tracy utilized a mix of groundwater and surface water. By 2030, all cities including Lodi, Escalon, and Ripon will incorporate surface water into their respective portfolios. Figures 4-6 depicts the areas of San Joaquin County served by surface water and groundwater.

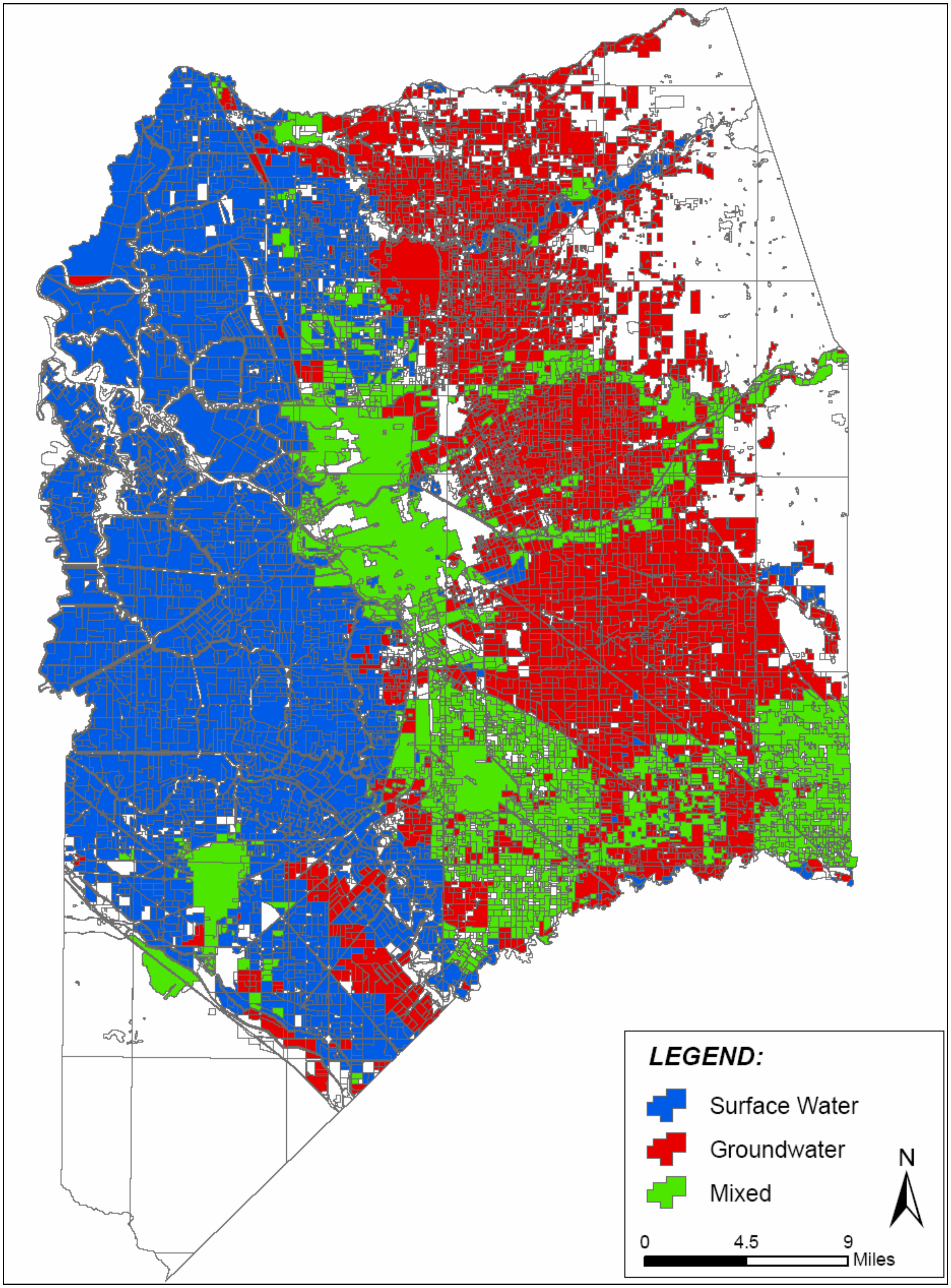

Figure 4-6 Groundwater and Surface Water Use in San Joaquin County
Source: DWR Land Use Survey, San Joaquin County 1996

Water supplies in San Joaquin County are subject to the complex system of riparian and appropriative rights and are further complicated by numerous agreements and water service contracts. Table 4-6 provides a synopsis of the major water rights and contracts held by San Joaquin County water agencies.

The actual quantity of water delivered varies significantly from year to year due to contractual and water right conditions. The actual quantities utilized within San Joaquin County also vary significantly with climatic fluctuations, infrastructure limitations, and facility operation. For example, although SEWD and CSJWCD have a water supply contract with the USBR for up to 155,000 acre-feet per year from New Melones Reservoir, deliveries are infrequent and unreliable. The infrastructure necessary to fully utilize the full contract amount have not been built largely due to the unlikelihood that a substantial portion of the contract amount will ever be reliably delivered.

Current surface water supplies are likely to decrease in the future which speaks . As shown in Table 4-6, there are several current contracts for "interim" supplies, which are available subject to requirements of upstream or senior rights holders. As development increases in areas with senior water rights, San Joaquin County's surface water supplies will be reduced.

Table 4-6 Summary of Current Water Rights and CVP Contracts[1]

District/Agency	Source River/Reservoir	Wet Year Quantity	Dry Year Quantity	Comments
SEWD	Calaveras/ New Hogan	40,115	<40,115	Firm, dry[2]
		27,000	<27,000	Estimated unused portion of CCWD's 43,500 af allocation
	Stanislaus/ New Melones	75,000	<75,000	Interim, subject to other users requirements and availability
WID	Mokelumne/ Pardee & Camanche	60,000	39,000	Firm
		See note 3	0	Non-firm
NSJWCD	Mokelumne/ Camanche	20,000	0	Subject to EBMUD supply and future requirements
CSJWCD	Stanislaus/ New Melones	80,000	<80,000	49,000 af firm supply, 31,000 af interim supply subject to other user's requirements
SSJID/OID	Stanislaus/ New Melones	320,000	<320,000,	Estimated use in County[4]
City of Stockton	Delta	33,600	<33,600	Includes only Phase I of the

				Delta Water Supply Project which is scheduled to deliver water in 2009.[5]
CDWA	Delta	226,000	226,000	Estimated based on current demand and is considered a Riparian Water Right to the Delta.
SDWA	Delta	225,000	225,000	

Notes:

1. The figures in this table are not necessarily authoritative and are provided for general information purposes only. The actual quantity of water available from year to year and the quantity that is actually used vary significantly.
2. New Hogan Reservoir has an estimated yield of 84,100 af/yr. SEWD contract with the Bureau of Reclamation is for 56.5% of the yield, and Calaveras County Water District rights to the remaining 43.5%. CCWD currently uses approximately 3,500 af of its allocation, and riparian demand is 13,000 af. Based on an agreement between CCWD and SEWD, SEWD currently has use of the unused portion of CCWD's allocation.
3. Under the WID-EBMUD water right settlement agreement, 60,000 af per year is the firm portion of the Woodbridge Irrigation District Water Rights. 60,000 af is the minimum amount available to WID during any year when the inflow to Pardee Reservoir is greater than 375,000 af. When the Pardee inflow is less than 375,000 af, the minimum amount available to WID is 39,000 af. WID is entitled to divert water in excess of the 60,000 af under the priority of its water right licenses when such water is available at WID's point of diversion and is surplus to EBMUD's downstream commitments under the Joint Settlement Agreement.
4. OID and SSJID share equally rights to 600,000 af/yr when available. Of its 300,000 af/yr share, OID applies approximately 20,000 af/yr in Eastern San Joaquin County. SSJID is located completely within San Joaquin County. In years when the full allotment is not available, the amount available to the SSJID and the portion of OID in eastern San Joaquin County is less than 320,000 af and is based on an agreement with the USBR.
5. The City of Stockton Water Right is based on Water Code Section 1485 which allows an entity to divert a like amount of water as is discharged to the Delta from a waste water treatment plant. Only Phase I of the Delta Water Supply Project is covered by the water right and is subject to Term 91 which allows for diversion only when the Delta is in a "balanced" condition.

4.4.3 Water Transfers

Within the water rights listed above in Table 4-6, there are several intra-regional water transfer agreements. These transfer agreements are critical to the continued use of surface water in San Joaquin County. These transfers are descried below

SSJID/OID Transfer to SEWD

SSJID and OID, as part of a 10-year water transfer agreement which expires in 2009, makes available to SEWD up to 30,000 acre-feet per year of their pre-1914 water rights on the Stanislaus River. The water is used primarily for urban supplies delivered to the City of Stockton Metropolitan Area through the existing SEWD water treatment plant. The agreement is expected to be renewed pending re-negotiation. SSJID has also on occasion made water available to the CSJWCD for irrigation.

SSJID South County Surface Water Supply Program

The South County Water Supply Program is a cooperative effort between SSJID and the cities of Escalon, Manteca, Lathrop, and Tracy. SSJID makes water available to the Program partners through its pre-1914 rights to the Stanislaus River. Completed in 2005, Phase I consists of an intake facility at Woodward Reservoir, a 44 MGD membrane filtration drinking water treatment plant just west Woodward Reservoir, and over 40 miles of pipe ending in the City of Tracy. 30,000 acre-feet per year is currently being delivered with 44,000 acre-feet annually expected in 2012 under Phase II. The net reduction of groundwater pumping from the underlying Basin is approximately 30,000 acre-feet annually. (SSJID, 1994).

WID transfer to the City of Lodi

In 2003, the WID and City of Lodi entered into a water transfer agreement for up to 6,000 acre-feet per year for a term of 40-years. Through conservation and irrigation efficiency efforts, WID was able to conserve 6,000 acre-feet of water for the transfer. The City of Lodi is in the process of completing a feasibility study for the construction of a drinking water treatment plant to utilize the water. The WID/Lodi transfer agreement has allowed WID to finance the replacement of the aging Woodbridge Dam and incorporate state-of-the-art passage structures and diversion screens for anadromous fish. The New Woodbridge Dam also allow for year-round recreational opportunities for area residents and year-round diversions for recharge. (City of Lodi, 2003)

4.5 Groundwater Conditions

Groundwater conditions have changed drastically since the mid-1850's when much of agricultural interests began to expand into San Joaquin County. Early farmers were dependant on seasonal rains and natural flow from rivers. Groundwater artesian flow also augmented water supplies. With the introduction of the deep well turbine pump in the 1930's, regional groundwater patterns were greatly altered and artesian flows were no longer observed; however, access to groundwater enabled agriculture to spread to other portions of Eastern San Joaquin County. The pre-development and current/post-development groundwater flow patterns are discussed below.

4.5.1 Regional Groundwater Flow Patterns Pre-Development Conditions

Groundwater was used for agriculture in the Central Valley starting around 1850, prior to which time the groundwater system was in a state of hydrologic equilibrium (Williamson, et. al., 1989). Under equilibrium, or steady-state conditions, groundwater flowed from the natural recharge areas along the perimeter of the valley towards the low areas along the San Joaquin River. The natural groundwater and surface water discharge was through the Delta westward to San Francisco Bay. (CDM, 2001)

4.5.2 Post-Development Conditions

Beginning in 1850 the development of groundwater for agriculture expanded rapidly. Within the Central Valley one hundred years ago, irrigated agriculture has grown from less than 1 million to an estimated 7 to 8 million acres at present. In average years almost 870,000 acre-feet of groundwater is pumped per year from the Regional Planning Area. In Bulletin 118-80, DWR designated the Eastern San Joaquin Basin as "critically overdrafted".

Figures 4-7 through 4-10 illustrate groundwater table contours for spring 1986, fall 1992, and spring and fall 2005. Historically, spring 1986 is representative of the recoverability of the Basin in extremely wet conditions. The fall 1992 contour is representative of extreme drought conditions where water levels fell to unprecedented levels. Many private groundwater users were forced to modify or deepen wells during this prolonged drought periods. The spring and fall 2005 contours represent present conditions and serve as the baseline condition for this IRWMP.

The contour maps clearly show the significant groundwater depression east of Stockton. Regional groundwater flow now converges on this low point, with relatively steep groundwater gradients (0.0018 feet/feet) westwards towards the cone of depression, and eastward gradients from the Delta area on the order of 0.0008 feet/feet. The eastward flow from the Delta area is significant because groundwater is typically high in chloride due to mobilization of salt from sediments having a strong marine history (Izbicki, et. al., 2006).

4.5.3 Groundwater Level Trends

The groundwater level trends illustrate the change in groundwater flow patterns described above. Hydrographs for selected wells and sub-regions are presented in Figures 4-12 through 4-37 and a map of the well locations is depicted in Figure 4-11. Wells C, D, E, F, H, I, J, L, M, and R illustrate groundwater levels for selected wells located in and around the principal cone of depression in eastern San Joaquin County. The groundwater levels in these wells clearly illustrate the significant decline in water levels since the 1960s. Wells in this area have a significant seasonal variation of 10 to 20 feet.

Wells A, N, X, and U are representative of groundwater conditions of the western fringes and San Joaquin Delta portions of the underlying Basin. Historically, groundwater flowed from the east to these points of discharge; however, groundwater now flows eastward towards the depression east of Stockton. Groundwater modeling estimates that inflow from the west is estimated at 42,000 acre-feet per year and is considered an undesirable source of lateral inflow due to elevated chloride levels.

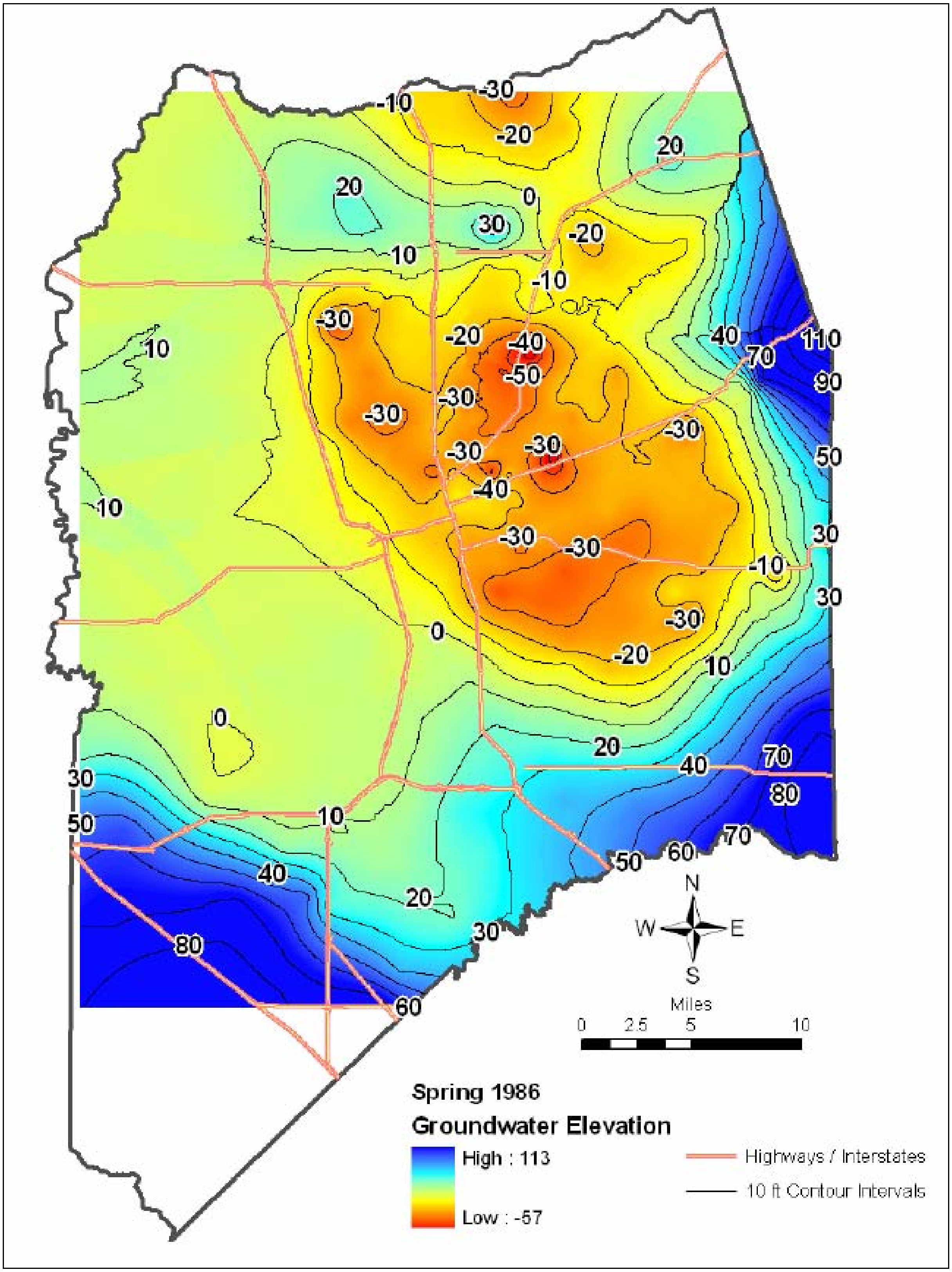

Figure 4-7 Spring 1986 Groundwater Elevations (feet MSL)

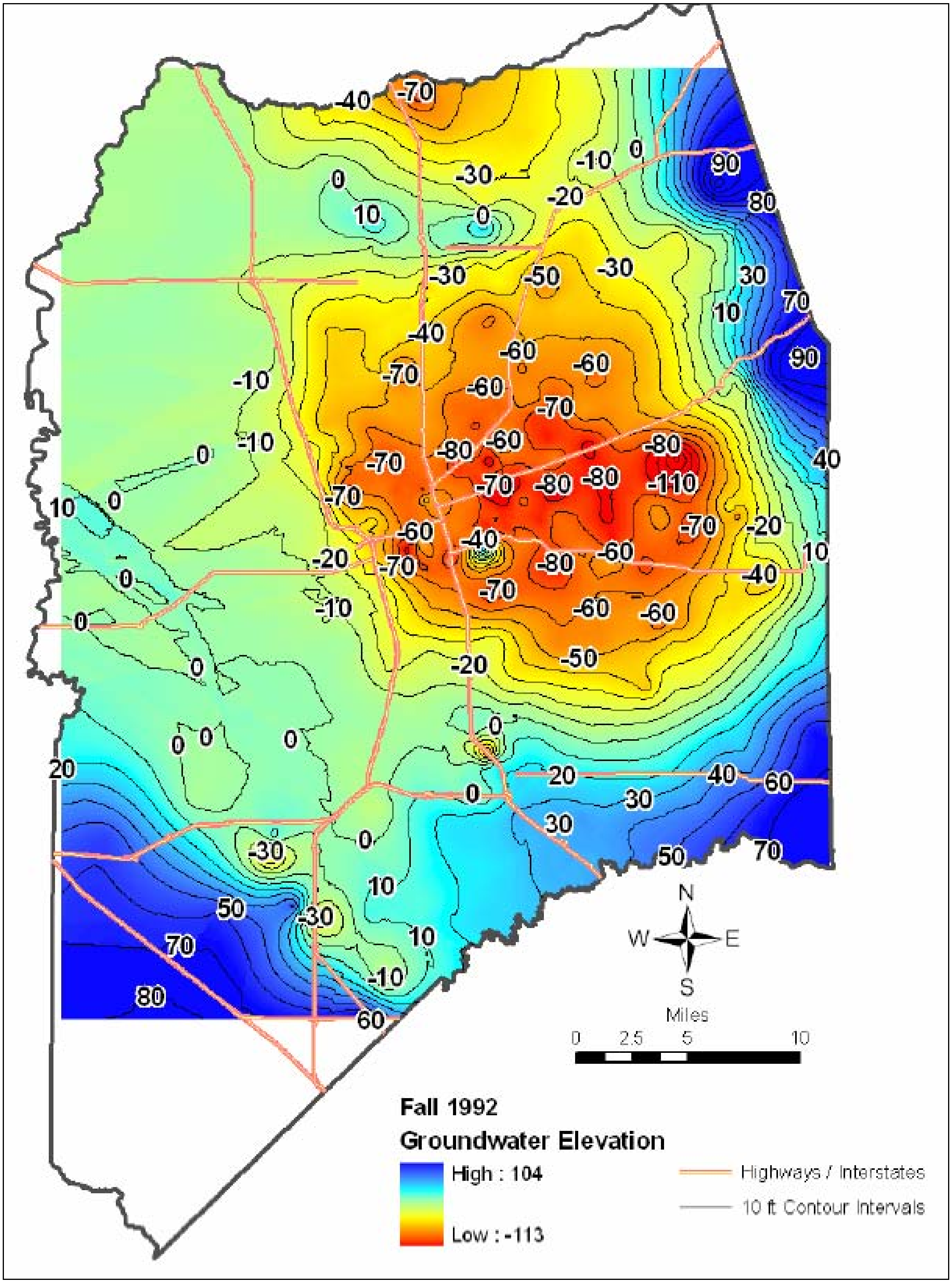

Figure 4-8 Fall 1992 Groundwater Elevations (feet MSL)

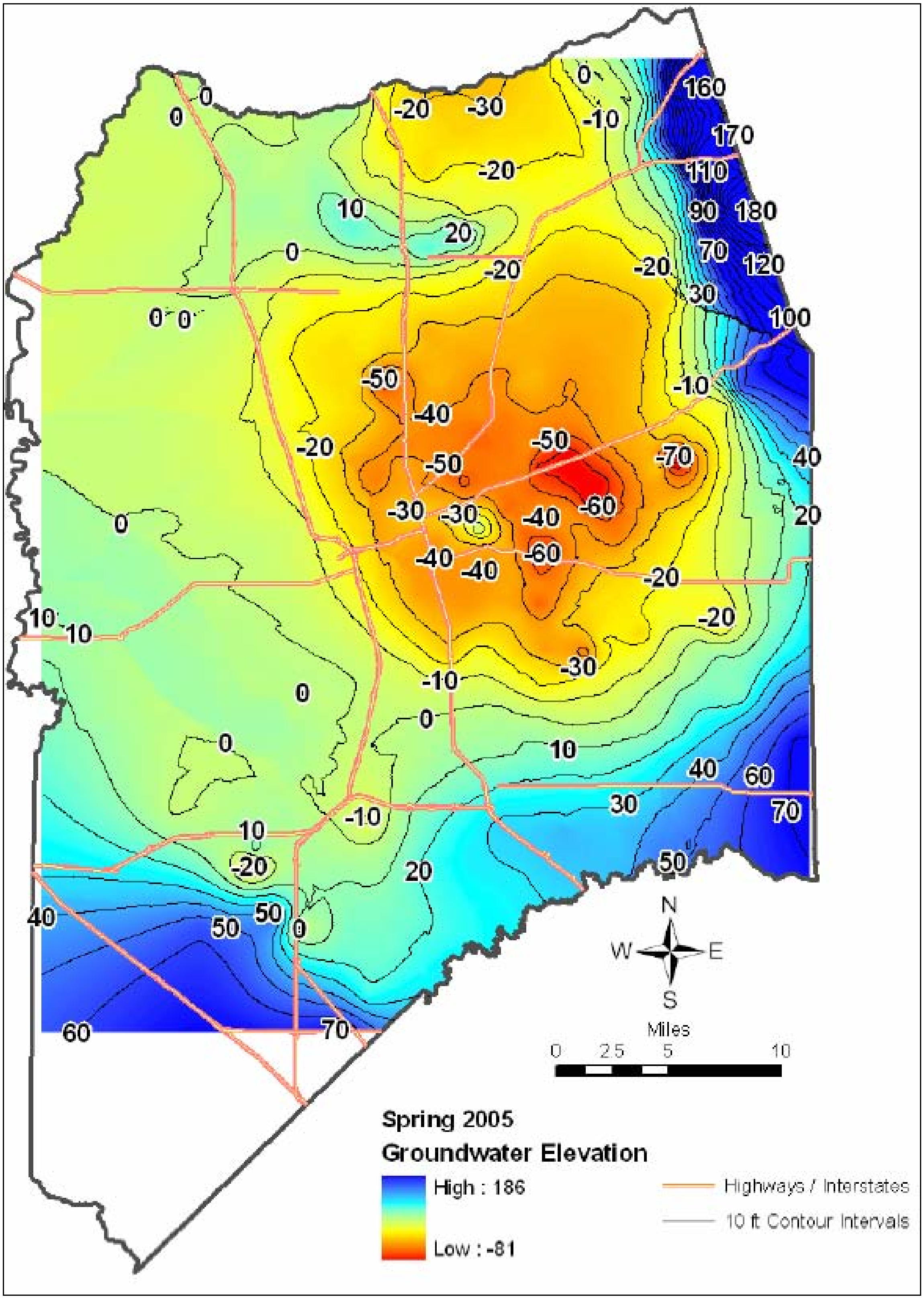

Figure 4-9 Spring 2005 Groundwater Elevations (feet MSL)

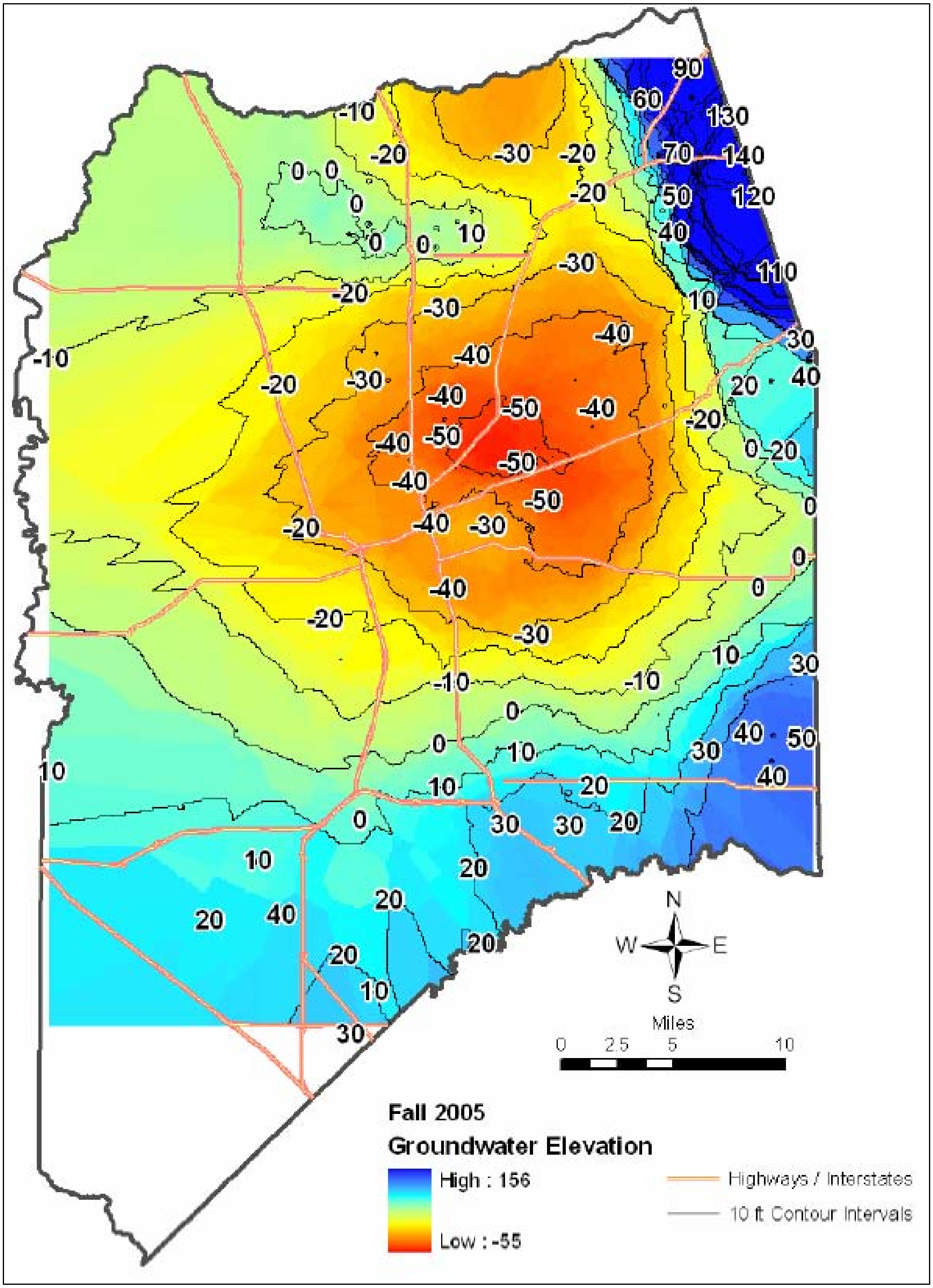

Figure 4-10 Fall 2005 Groundwater Elevations (feet MSL)

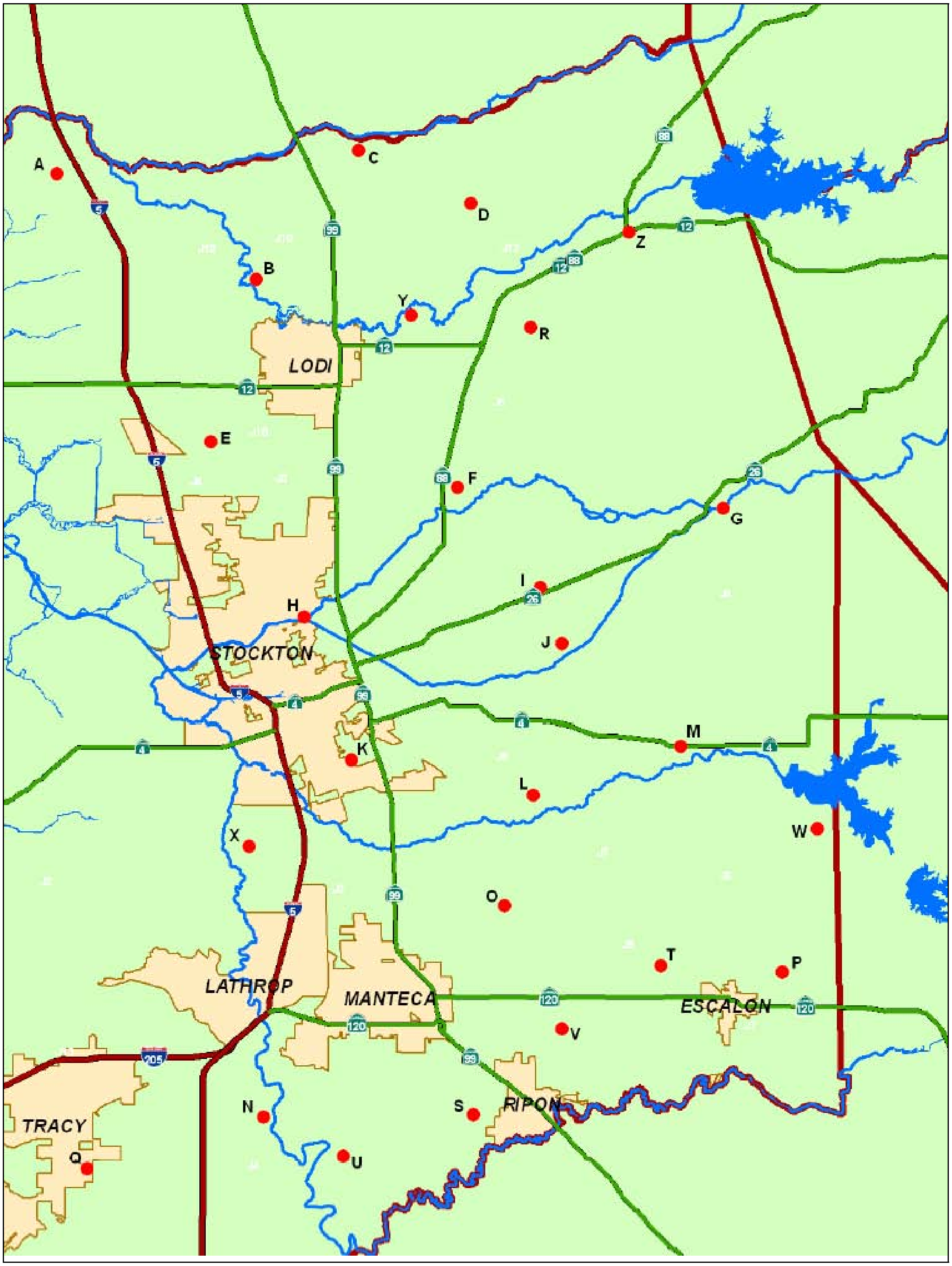

Figure 4-11 Well Hydrograph Locations

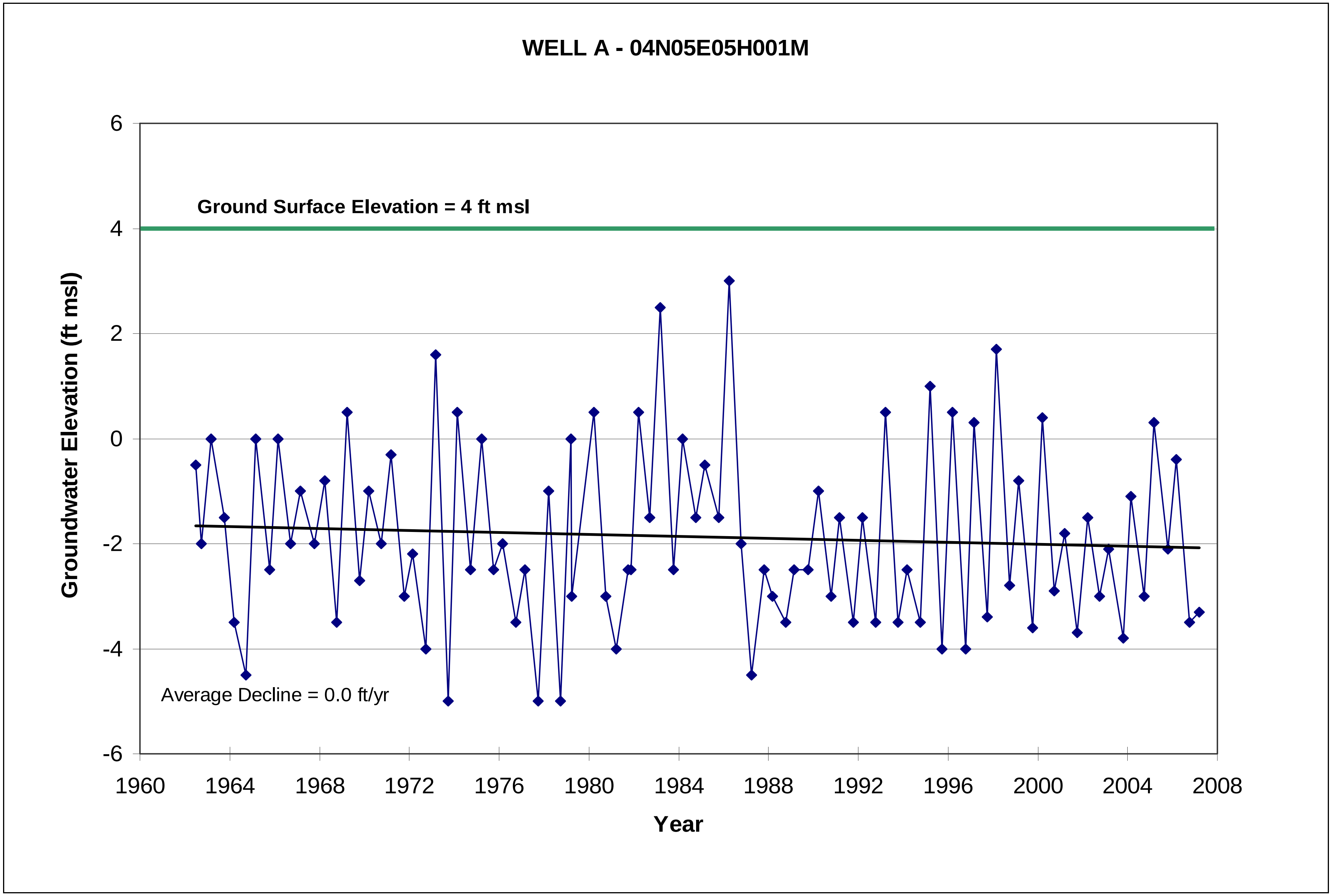

Figure 4-12 Hydrograph Well A – Walnut Grove

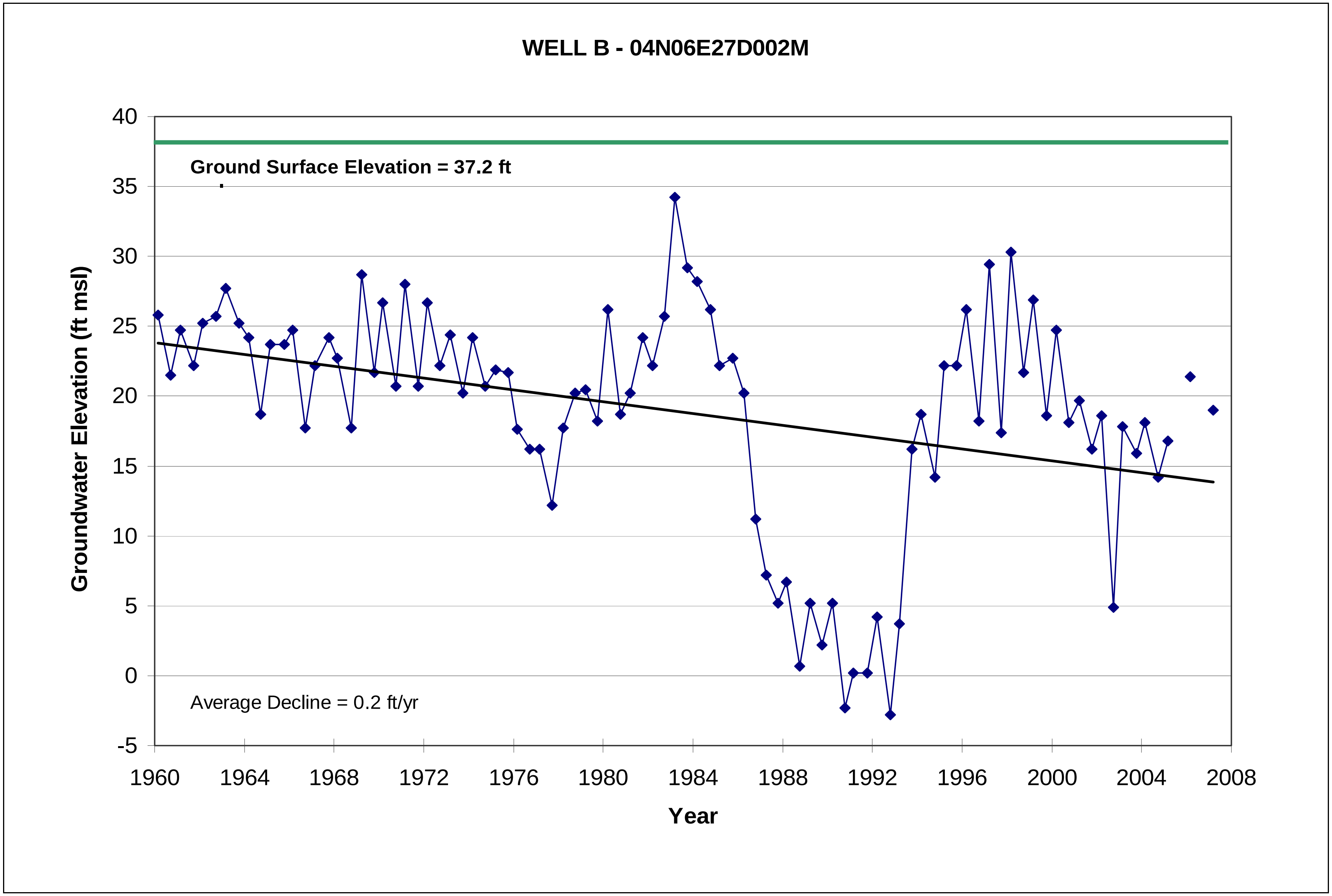

Figure 4-13 Hydrograph Well B – Acampo Road & Hayes Drive

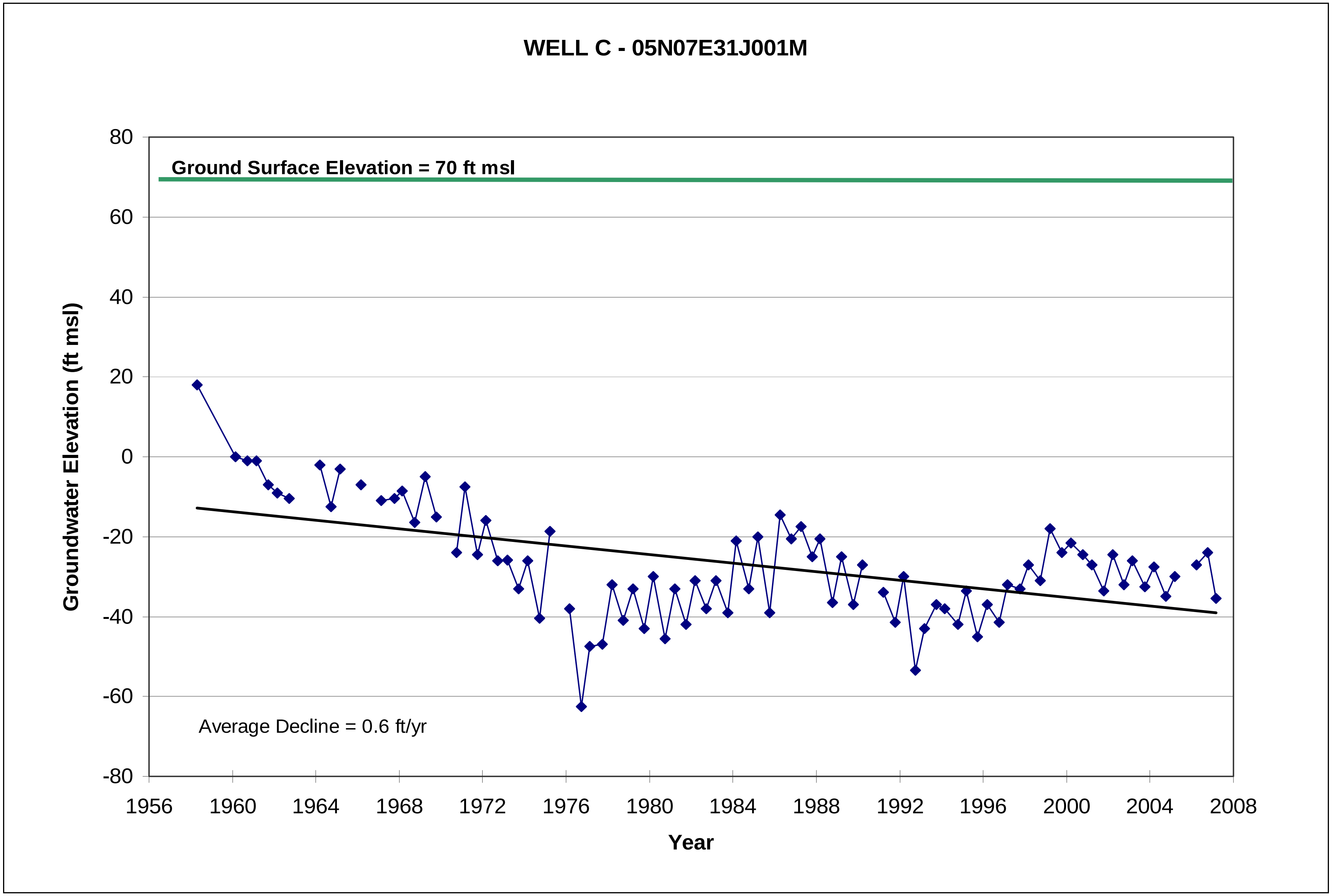

Figure 4-14 Hydrograph Well C – Dry Creek South of Galt

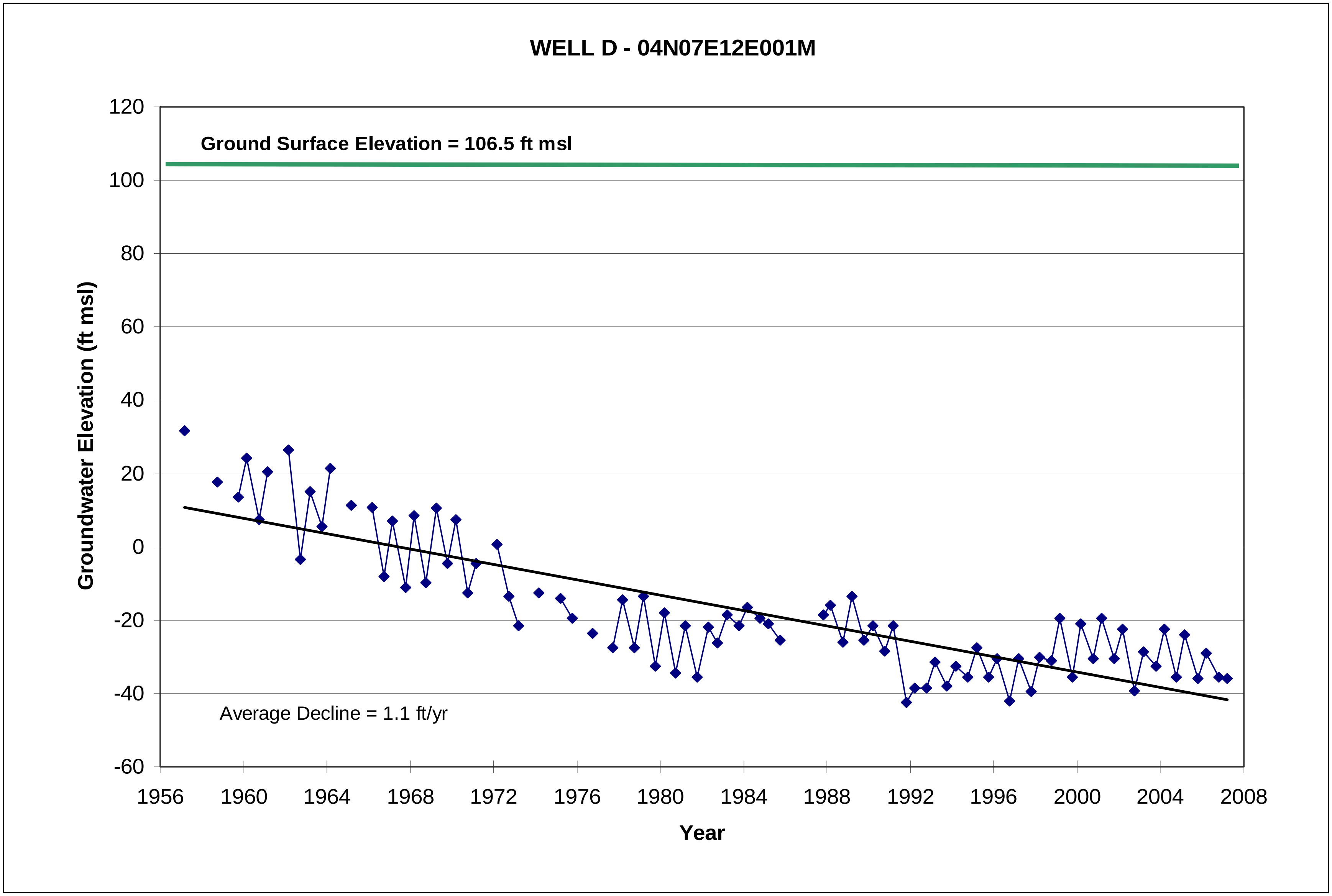

Figure 4-15 Hydrograph Well D – Elliot & Collier Roads

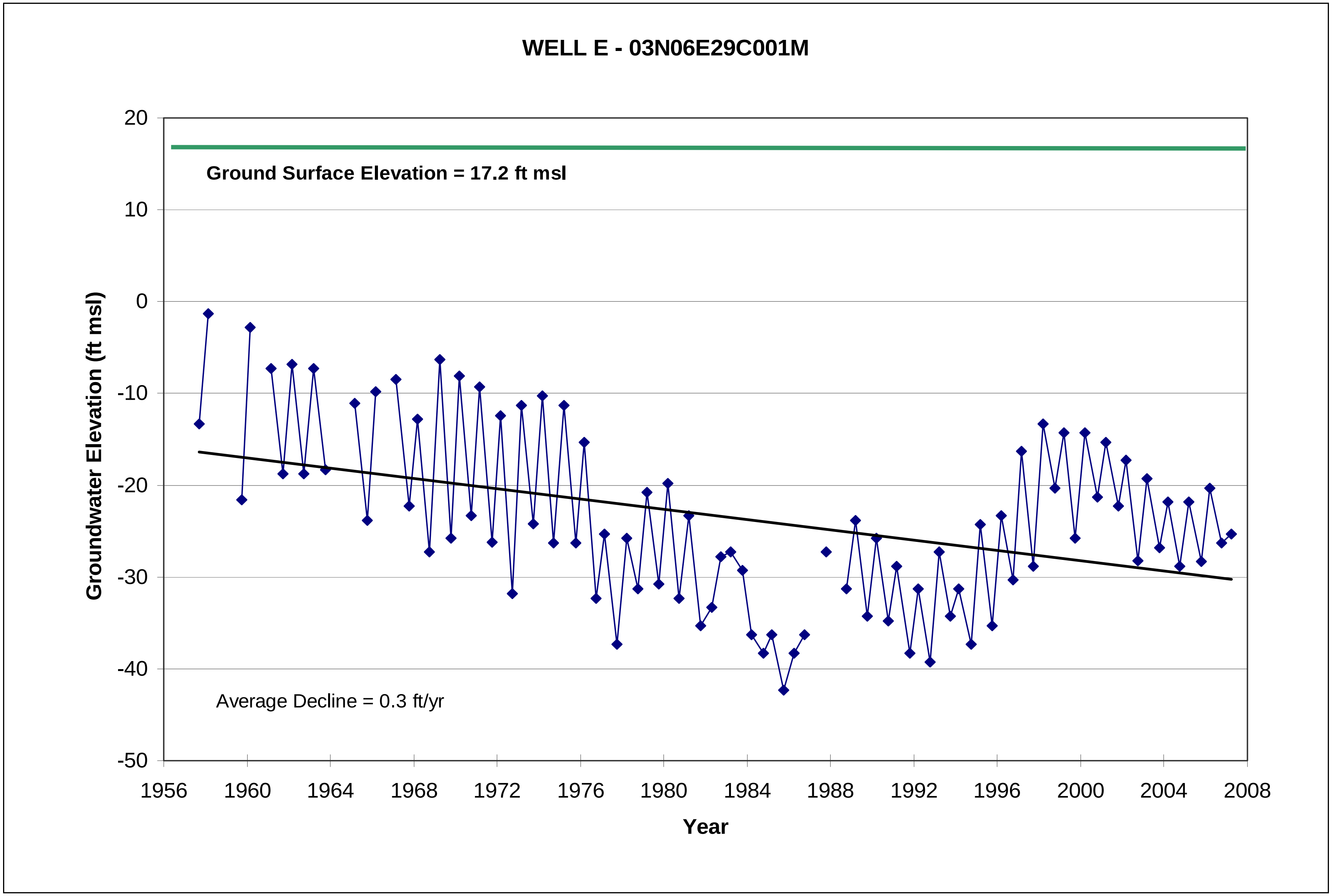

Figure 4-16 Hydrograph Well E – WID Davis Road

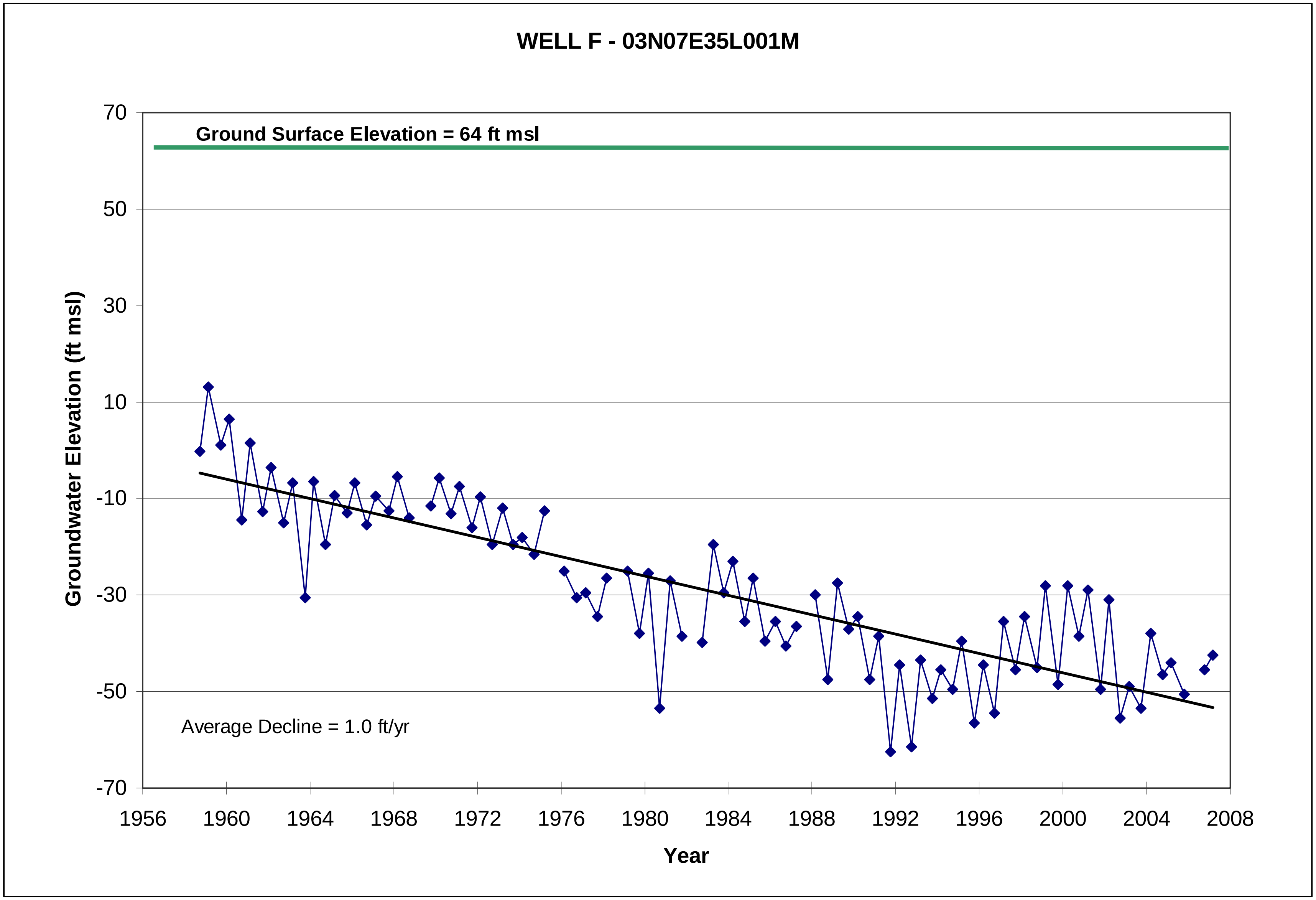

Figure 4-17 Hydrograph Well F – Calaveras River & SR 88

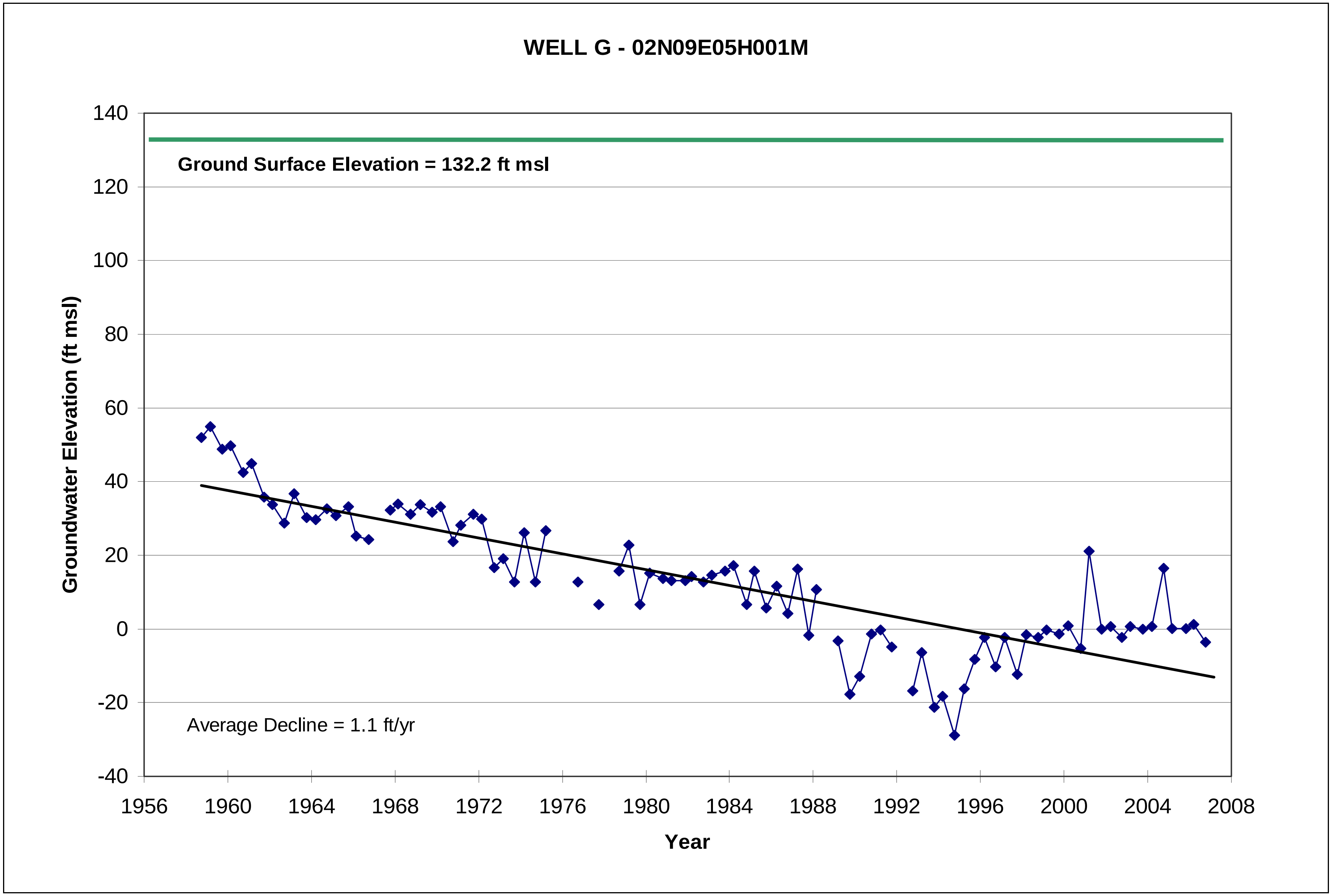

Figure 4-18 Hydrograph Well G – Bellota

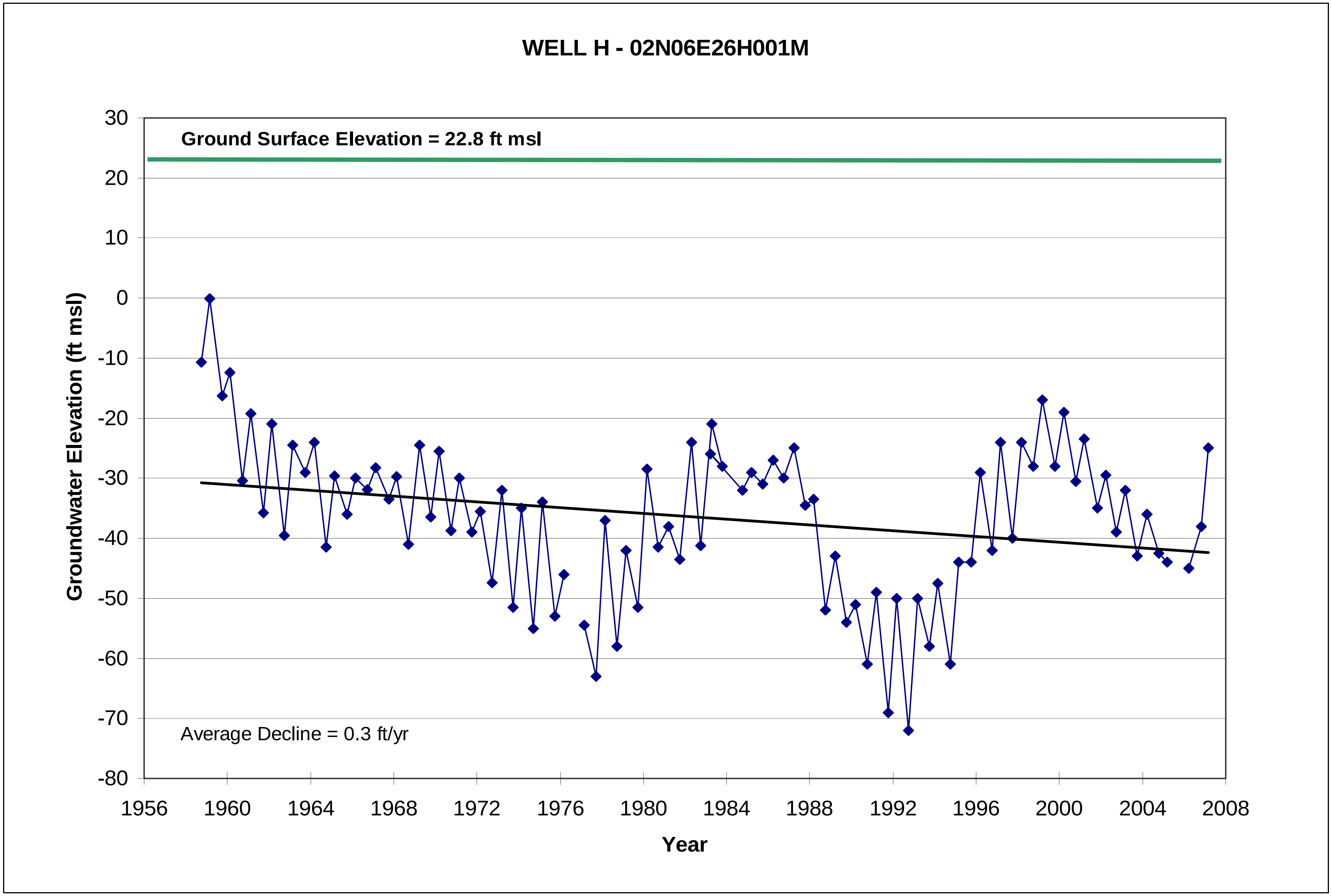

Figure 4-19 Hydrograph Well H – Stockton Diverting Canal

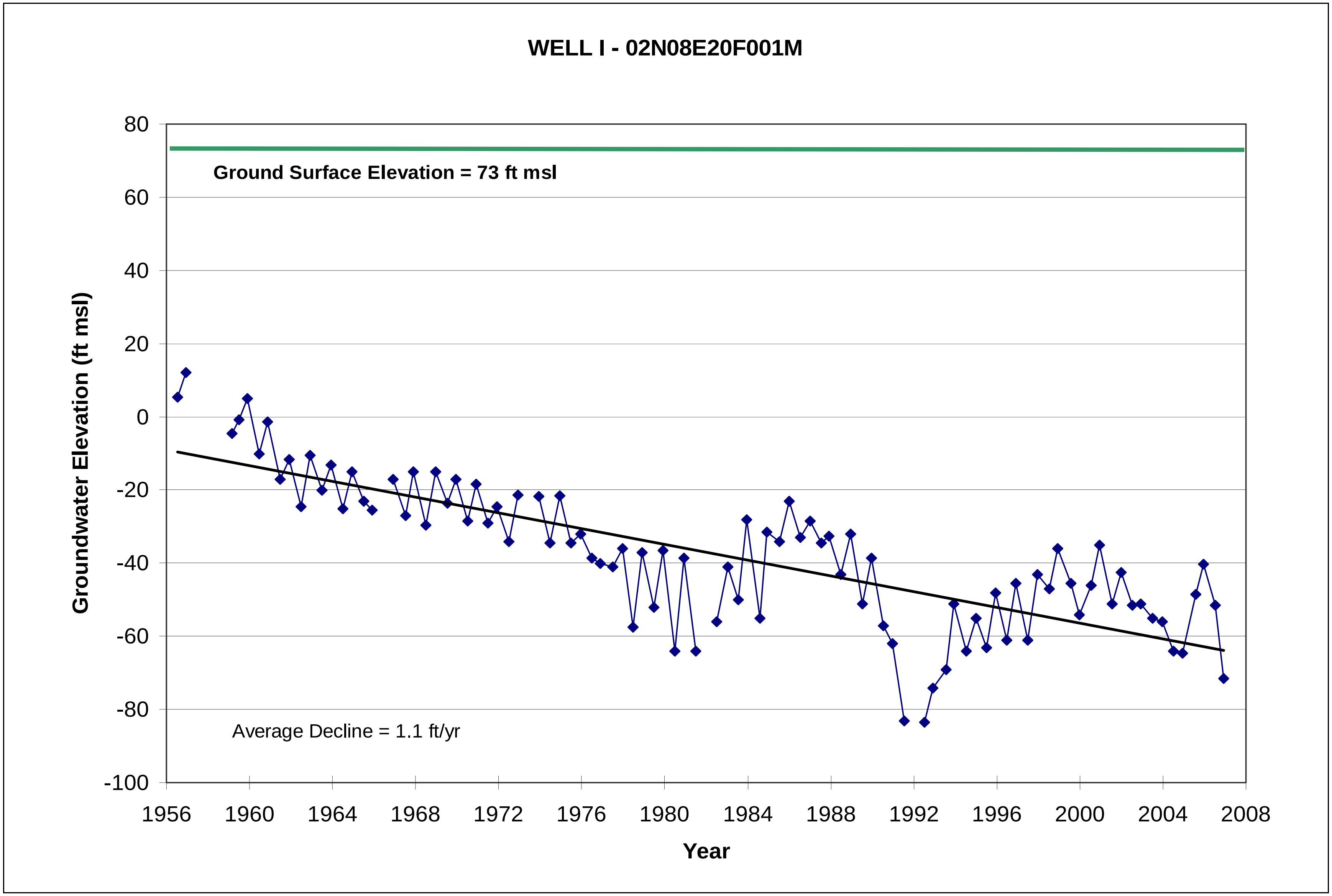

Figure 4-20 Hydrograph Well I – Linden

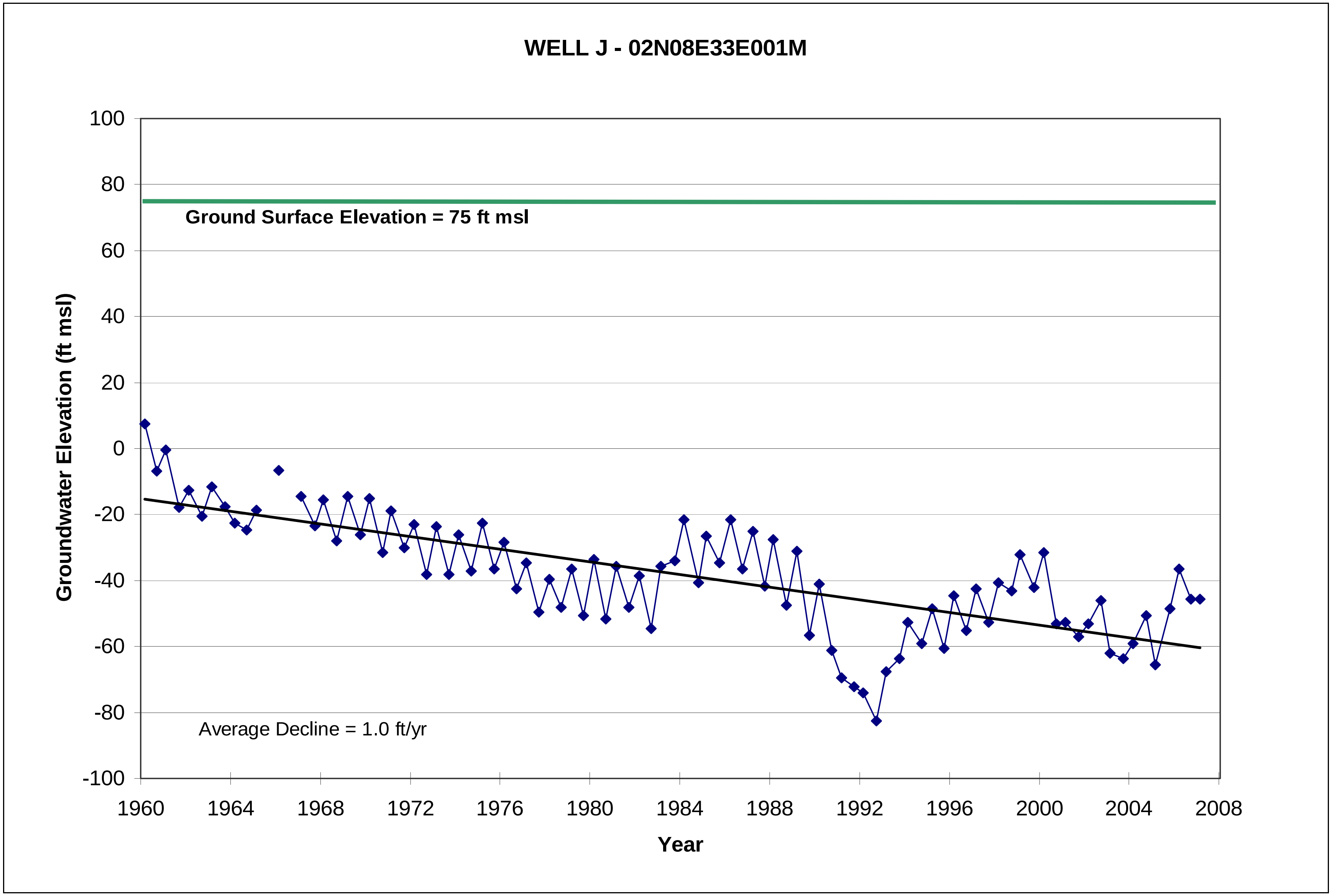

Figure 4-21 Hydrograph Well J – Copperopolis Road & Mormon Slough

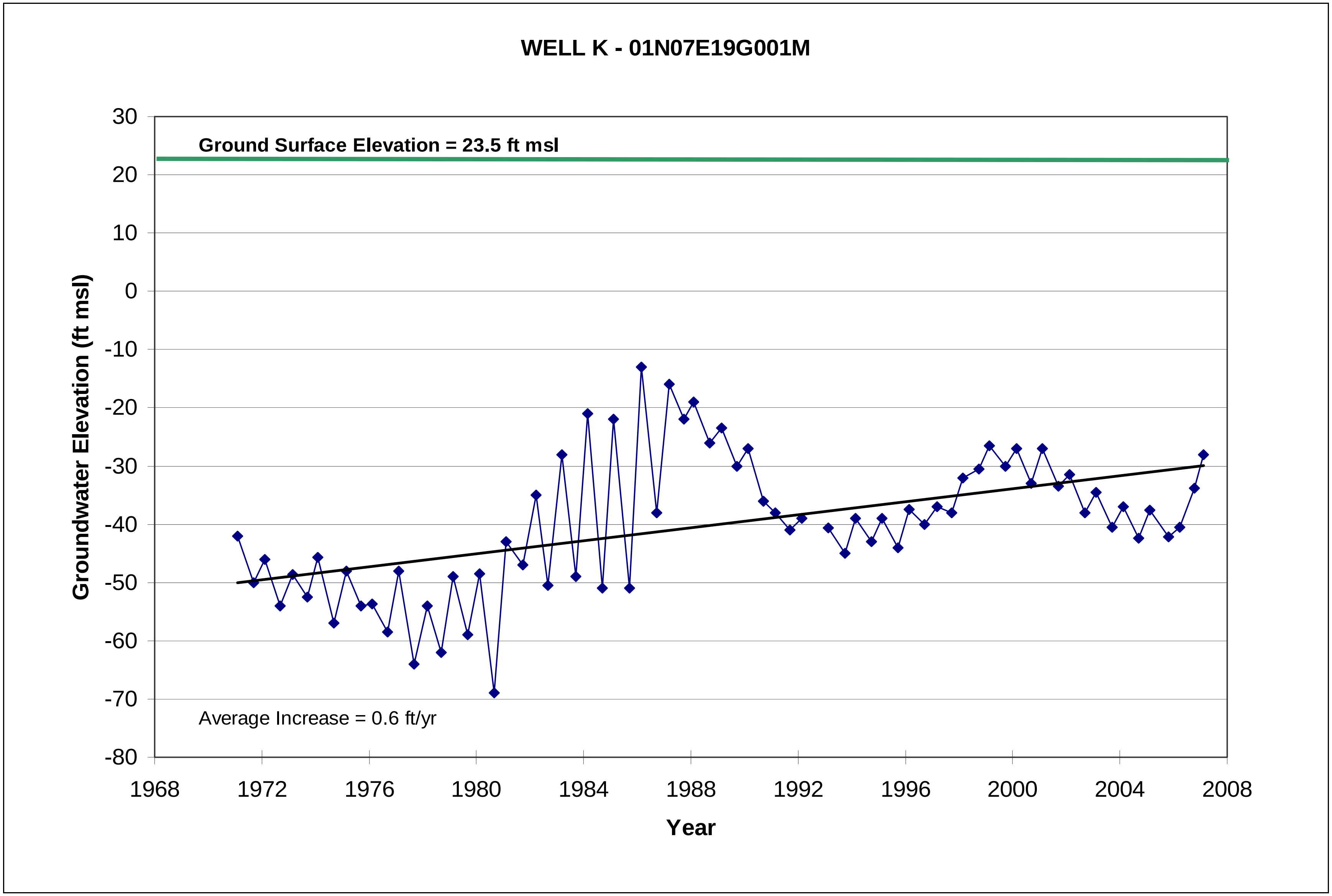

Figure 4-22 Hydrograph Well K – South Stockton

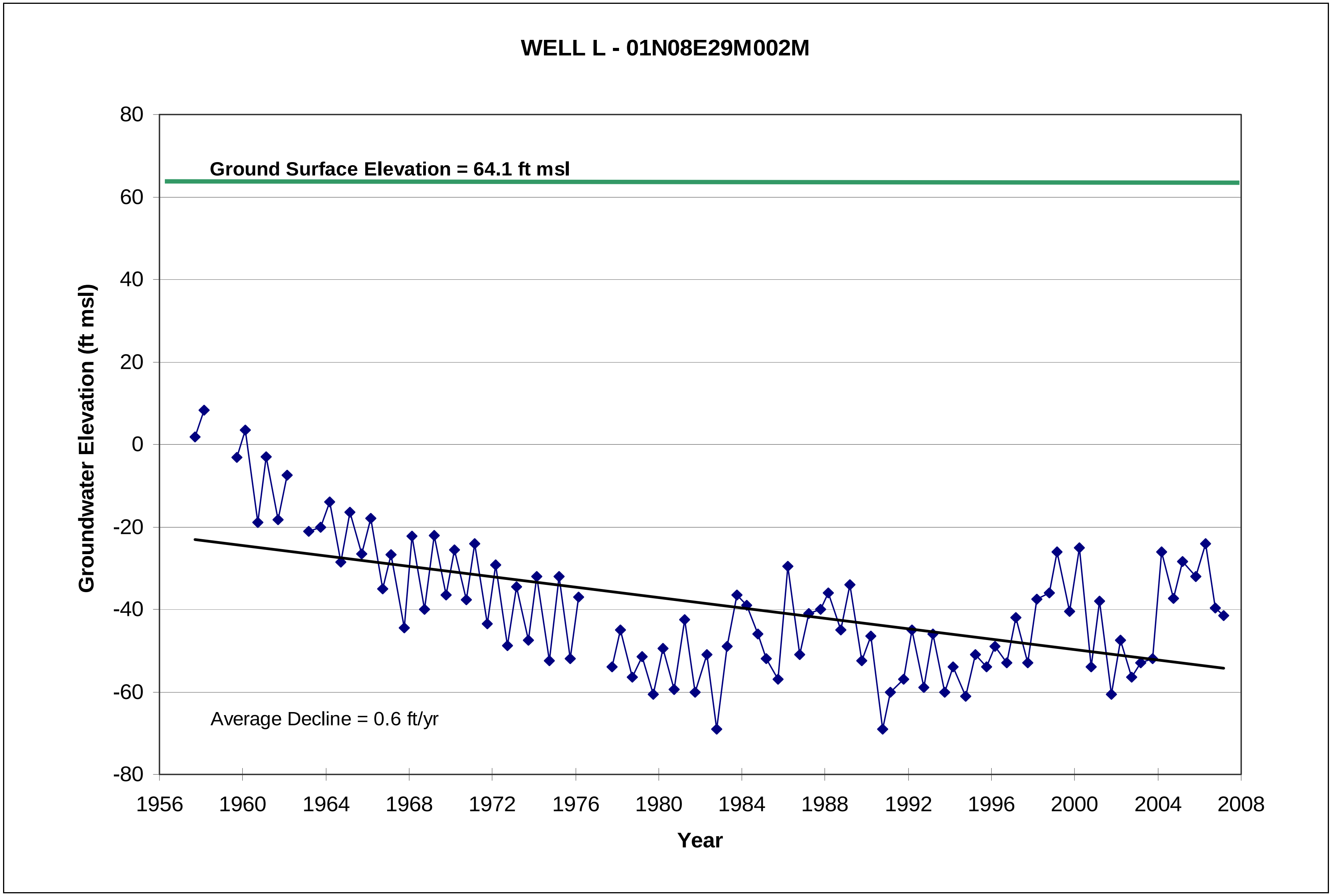

Figure 4-23 Hydrograph Well L – CSJWCD Jack Tone Road

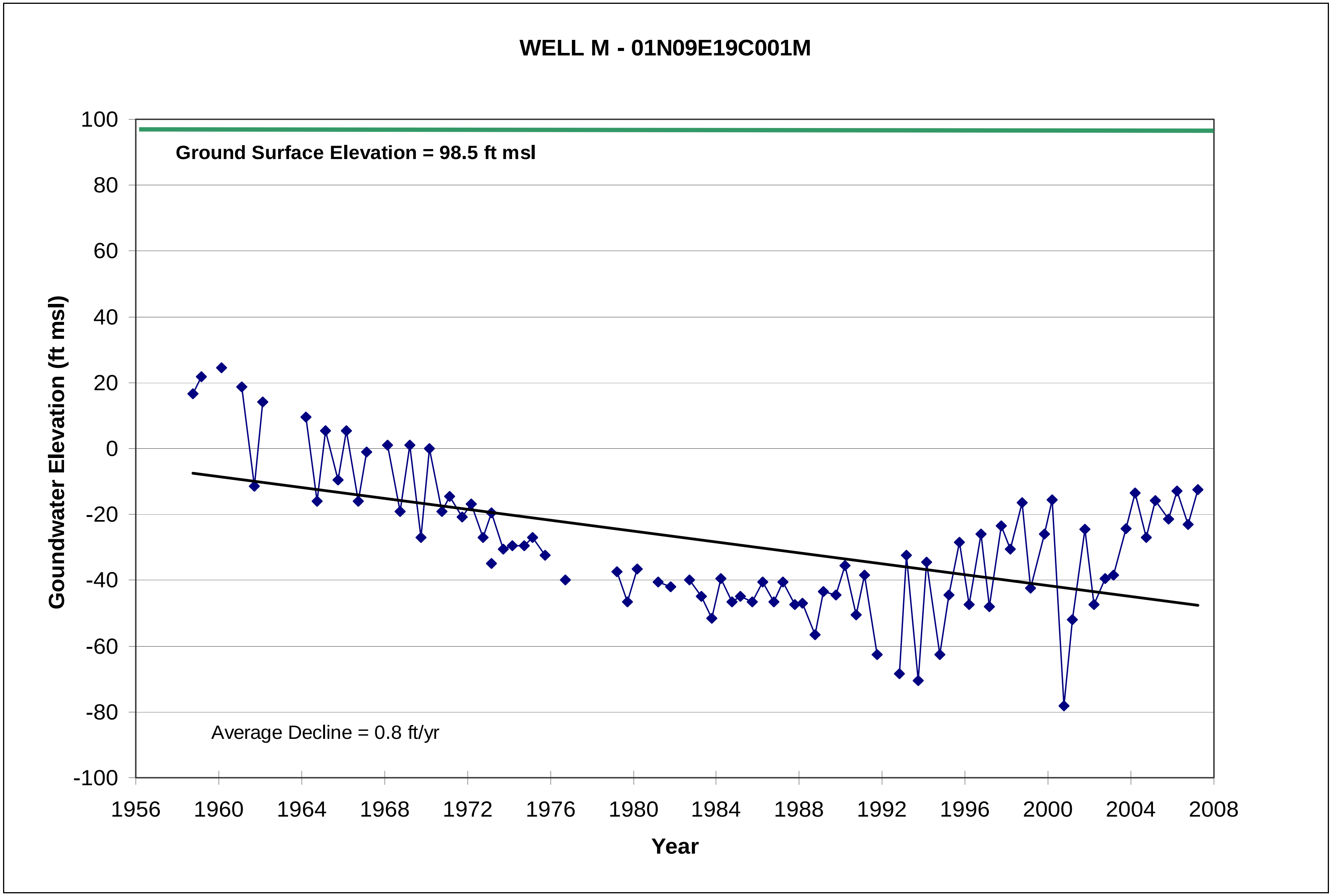

Figure 4-24 Hydrograph Well M – Escalon-Bellota Road & SR 4

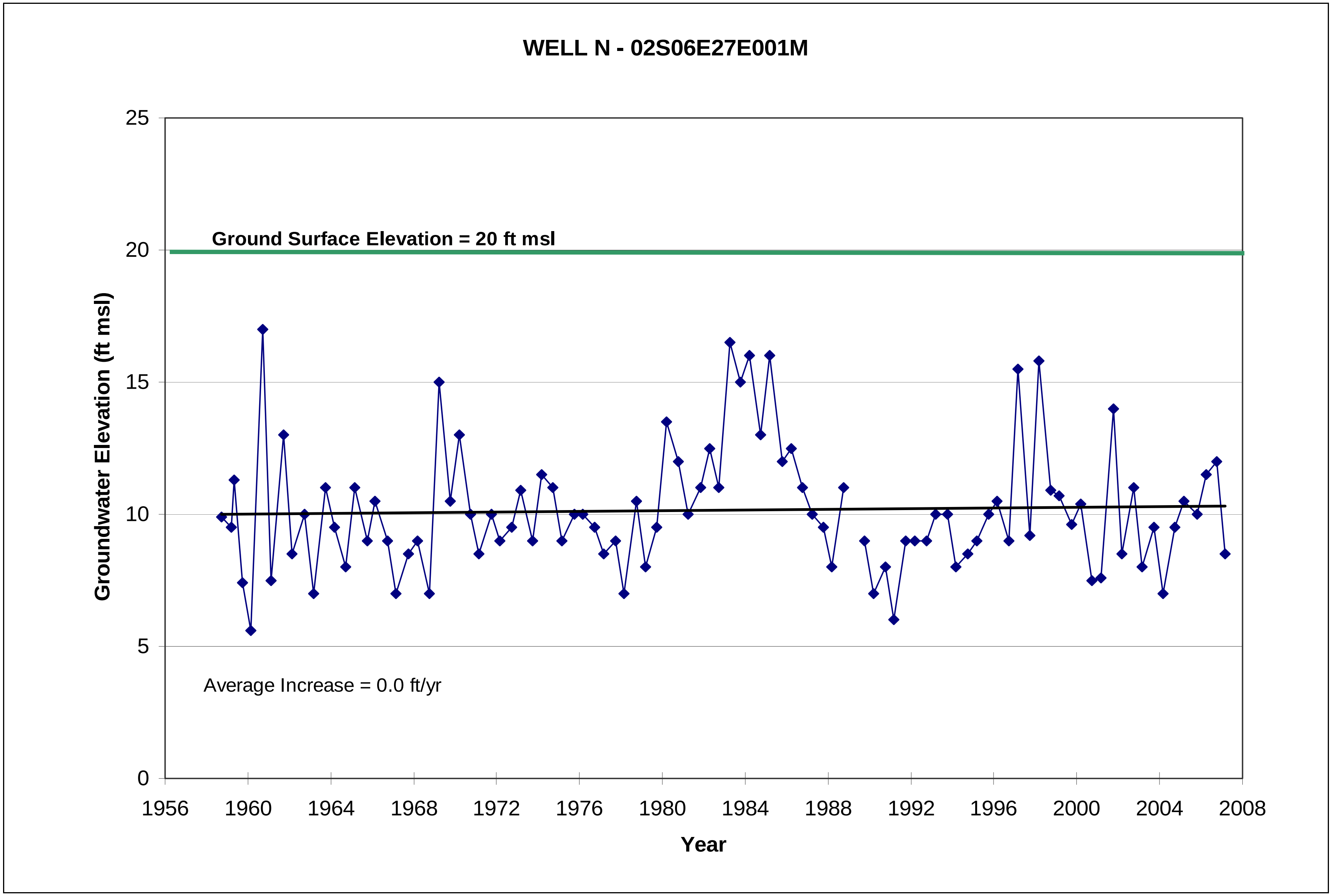

Figure 4-25 Hydrograph Well N – Vernalis

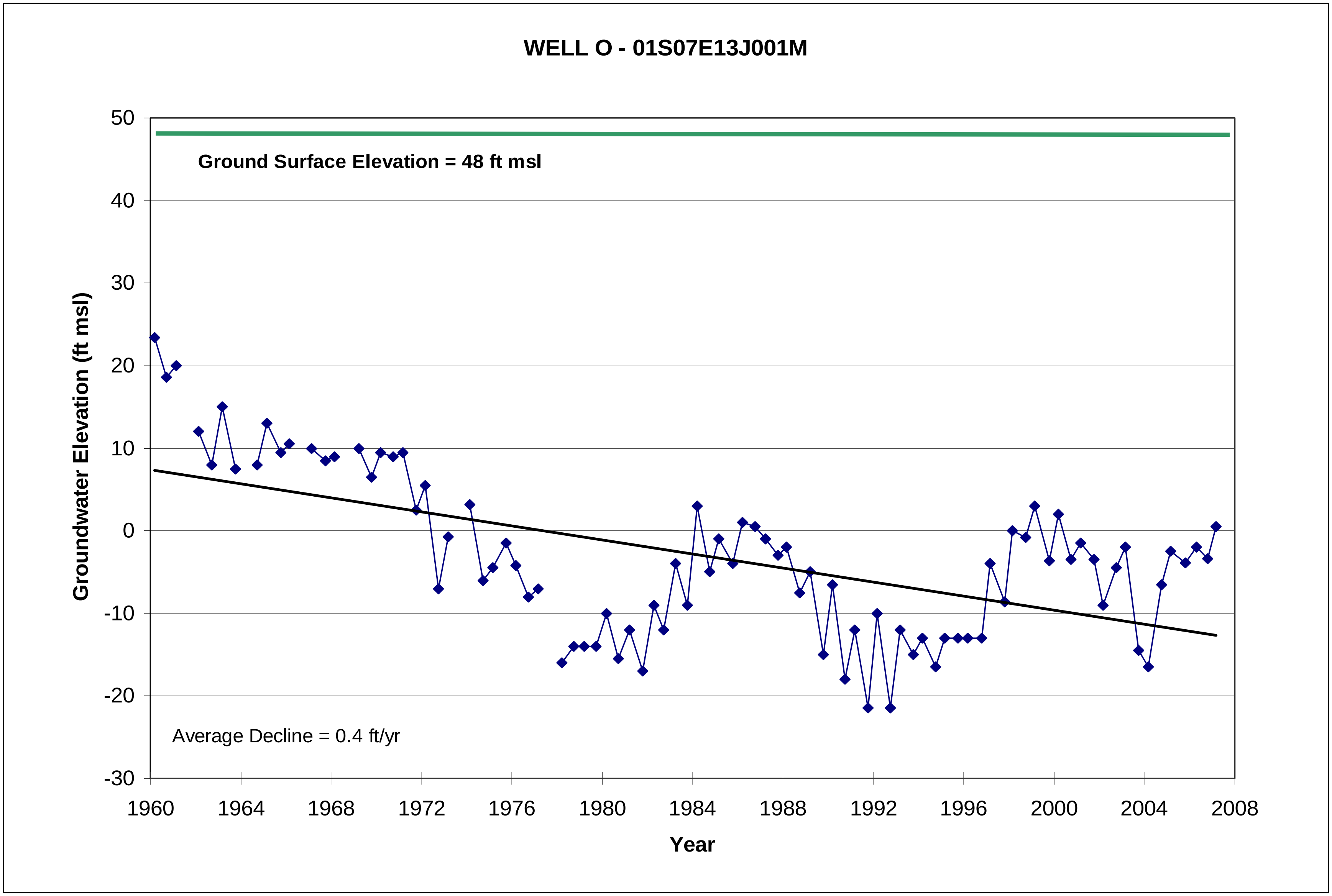

Figure 4-26 Hydrograph Well O – French Camp & Jack Tone Roads

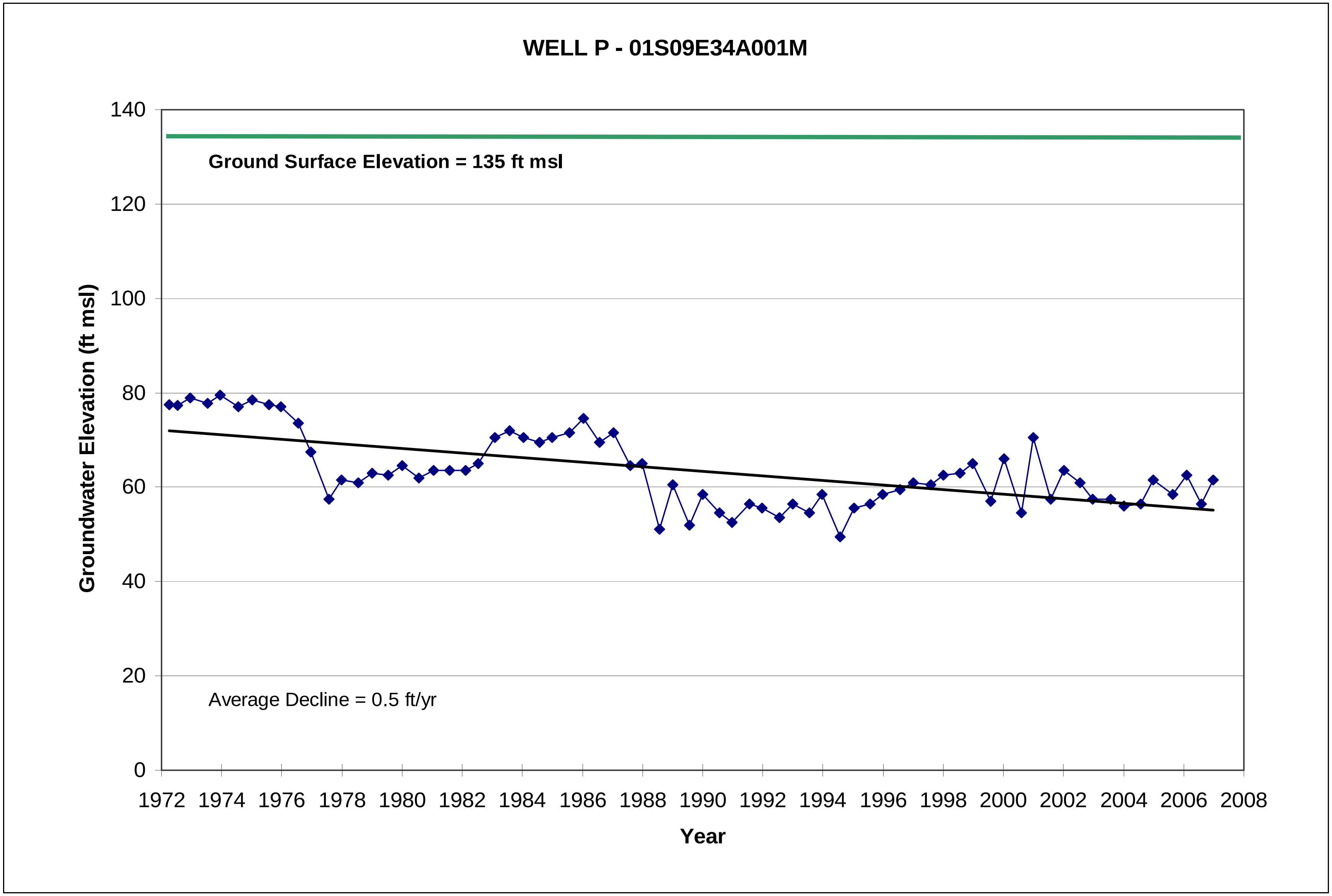

Figure 4-27 Hydrograph Well P – Northeast of Escalon

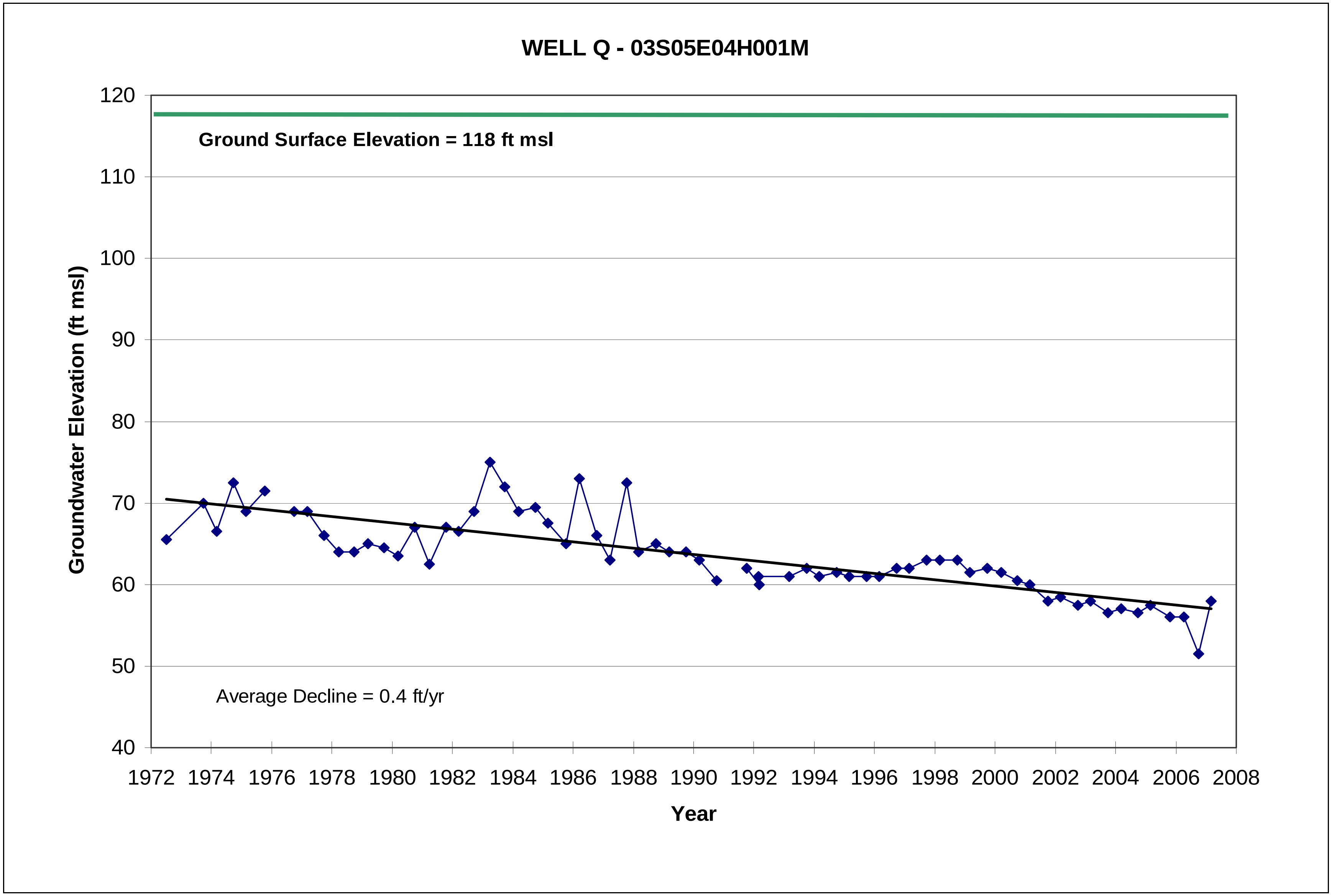

Figure 4-28 Hydrograph Well Q – City of Tracy

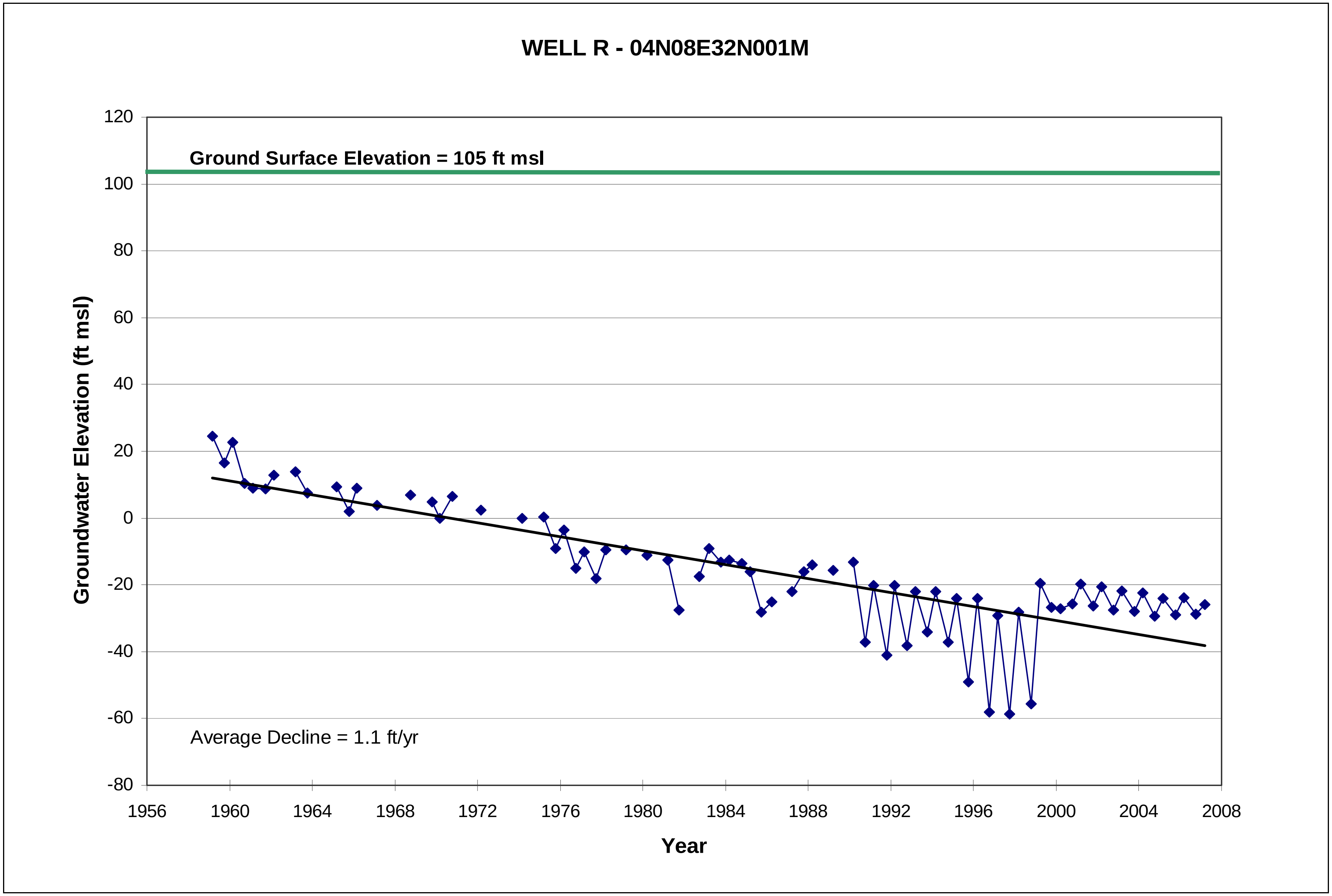

Figure 4-29 Hydrograph Well R – Brandt & Tully Roads

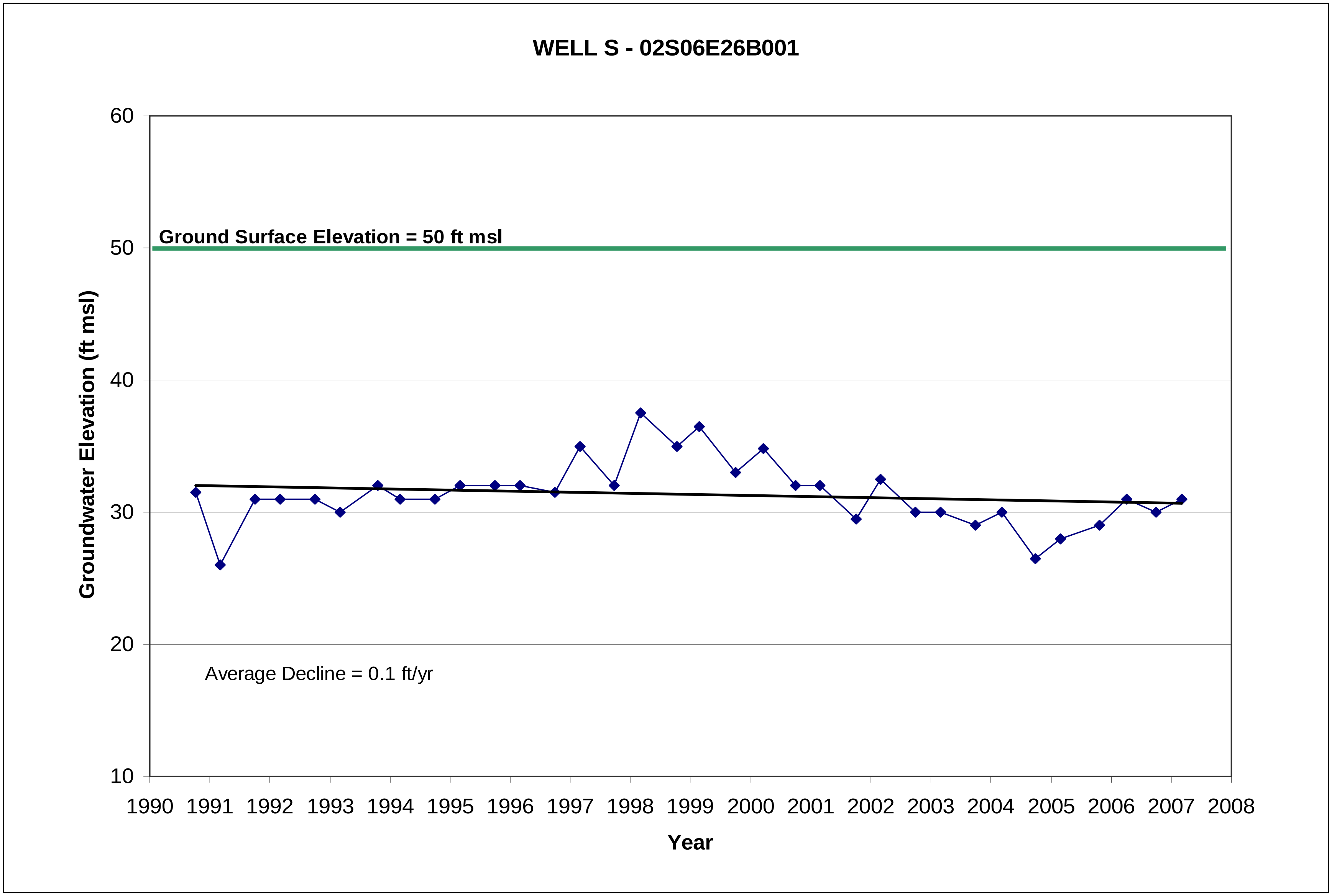

Figure 4-30 Hydrograph Well S – Ripon

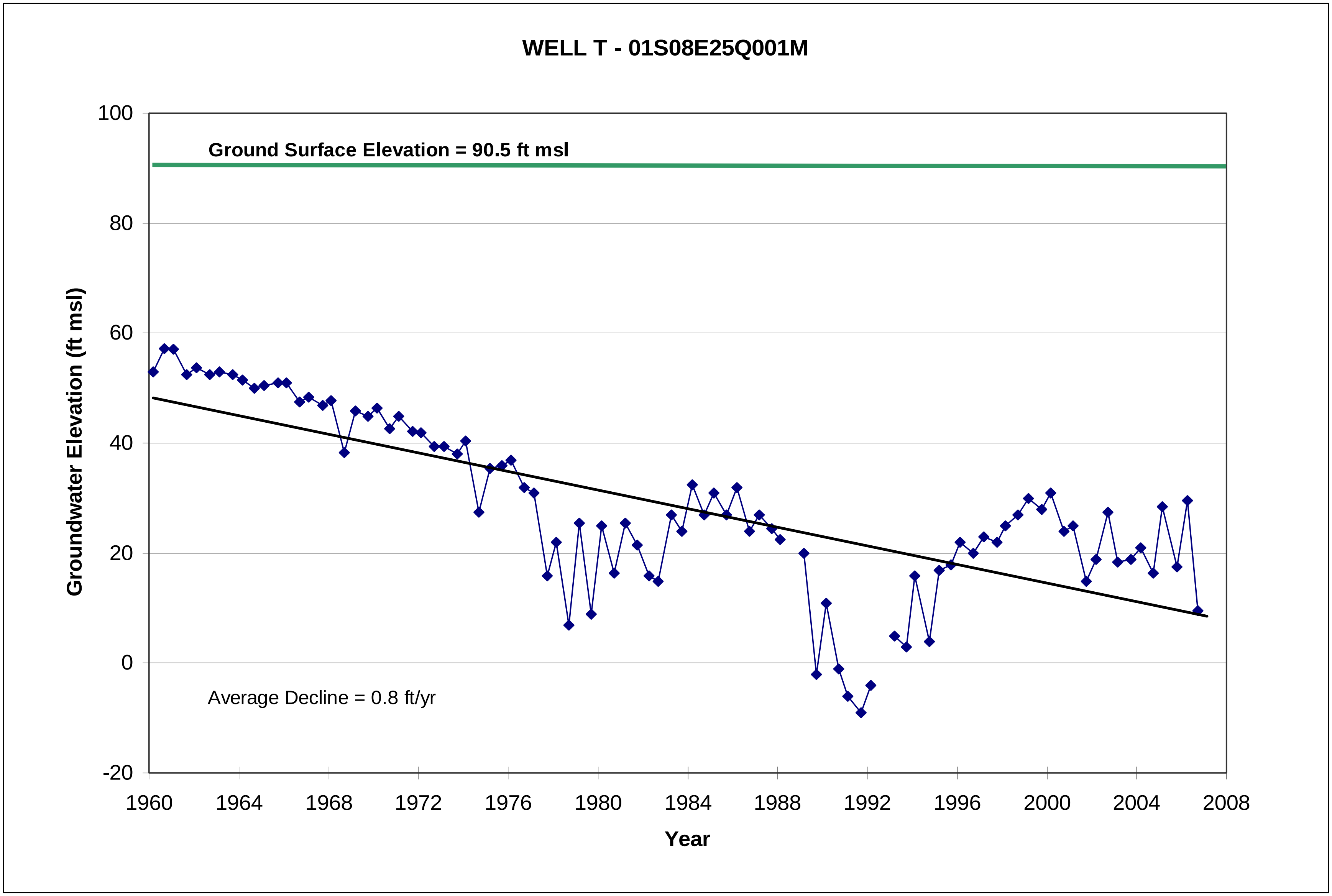

Figure 4-31 Hydrograph Well T –West of Escalon

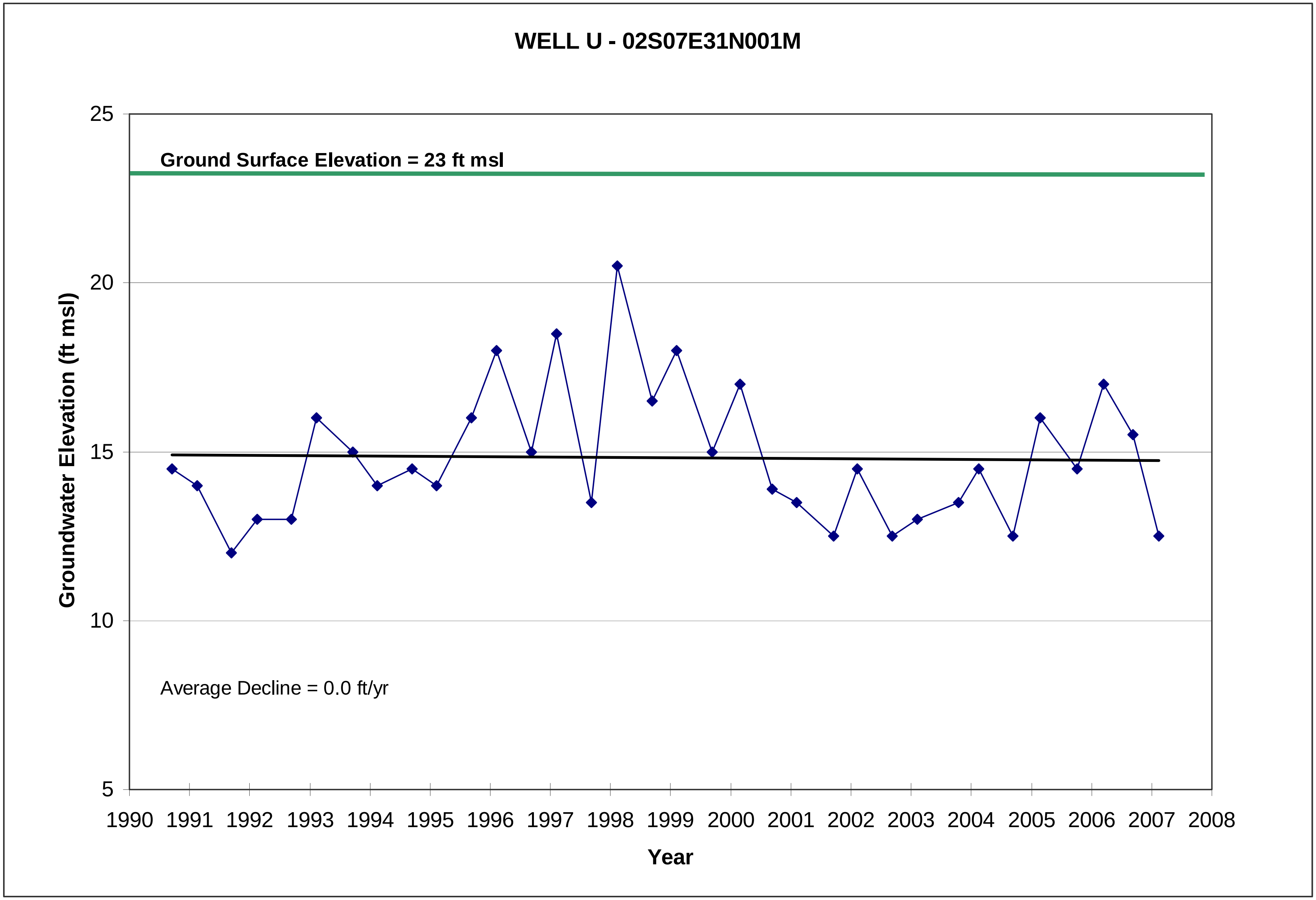

Figure 4-32 Hydrograph Well U – Kasson Road & San Joaquin River

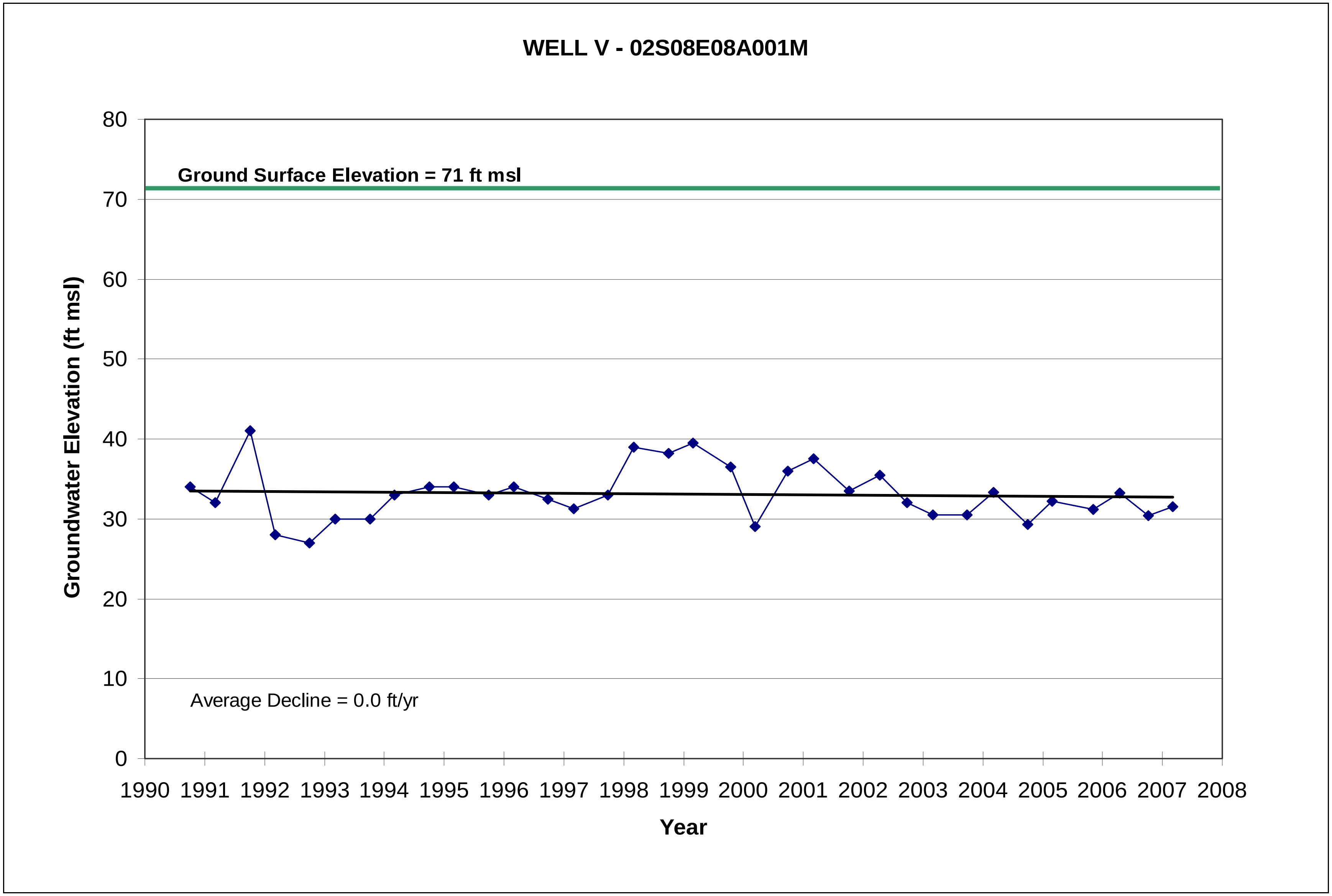

Figure 4-33 Hydrograph Well V – SSJID

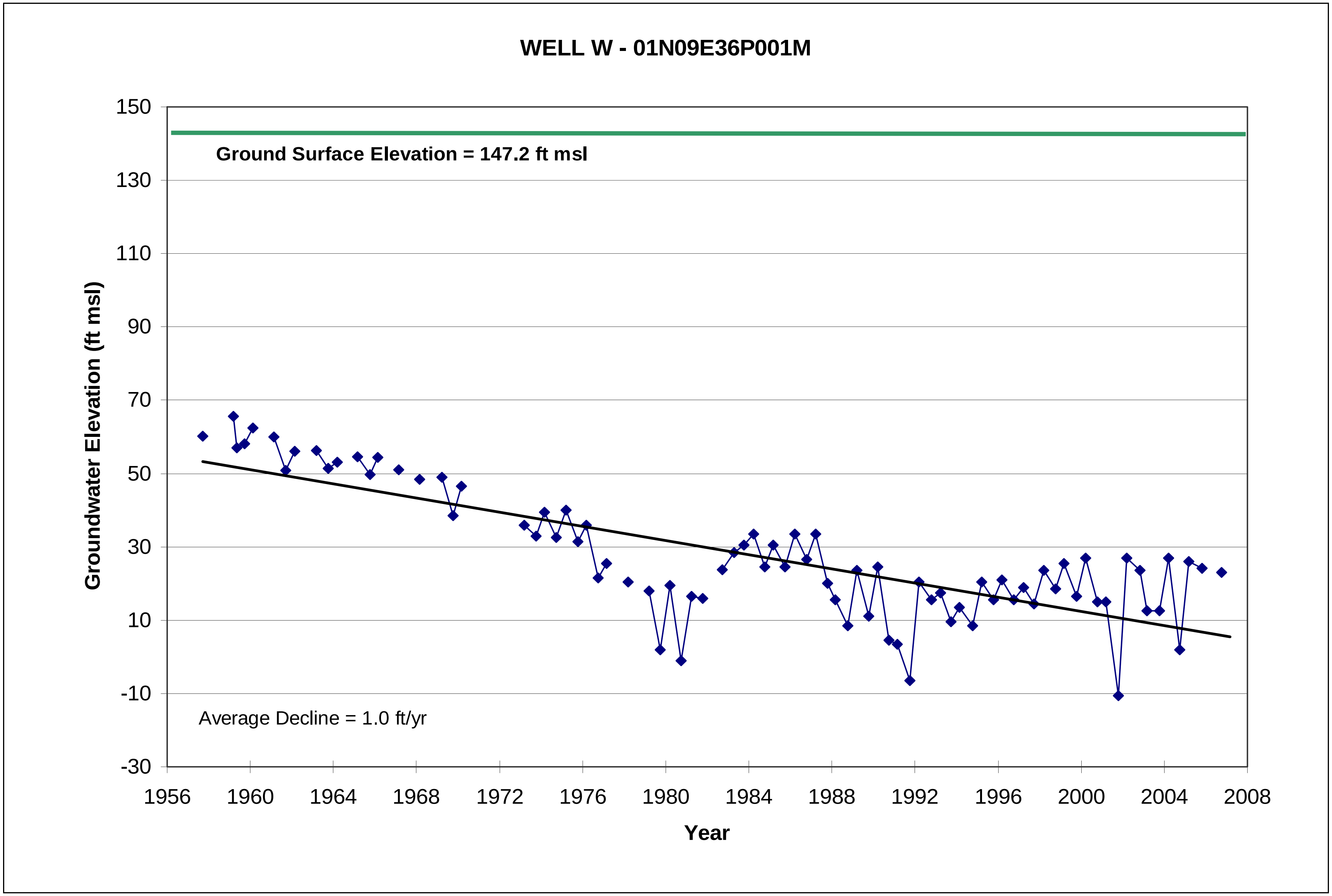

Figure 4-34 Hydrograph Well W – Farmington

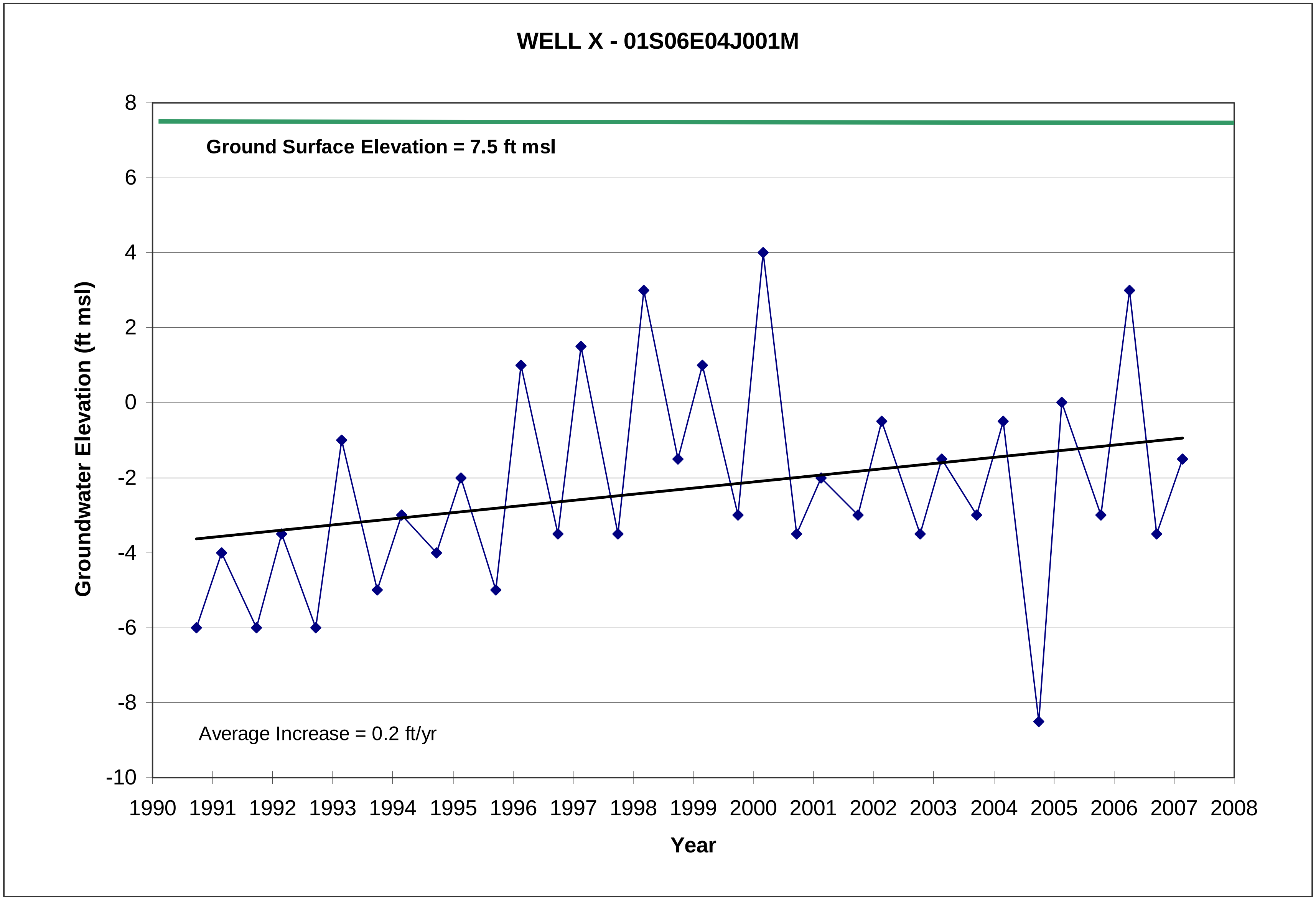

Figure 4-35 Hydrograph Well X – French Camp

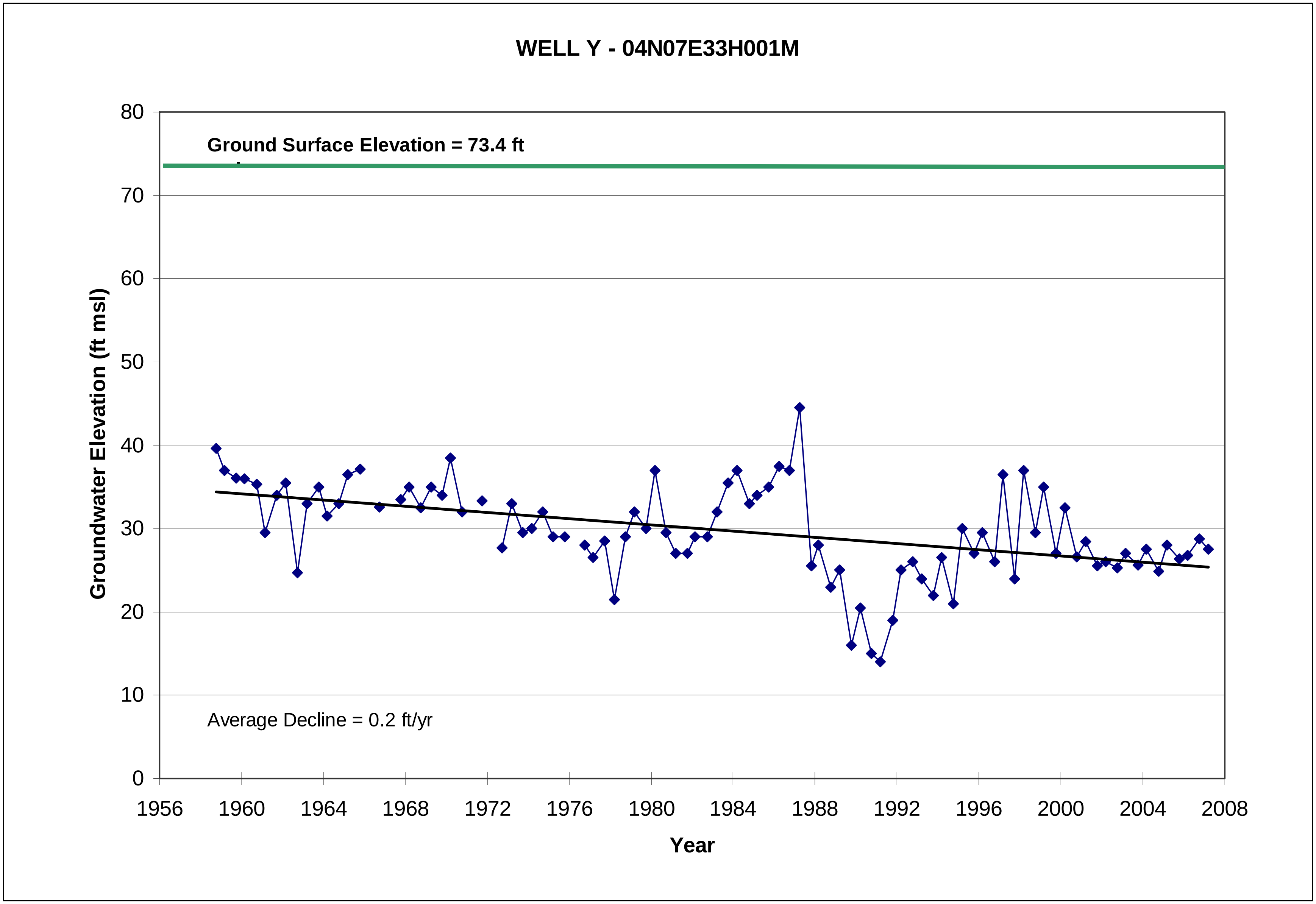

Figure 4-36 Hydrograph Well Y – Mokelumne River Near Victor

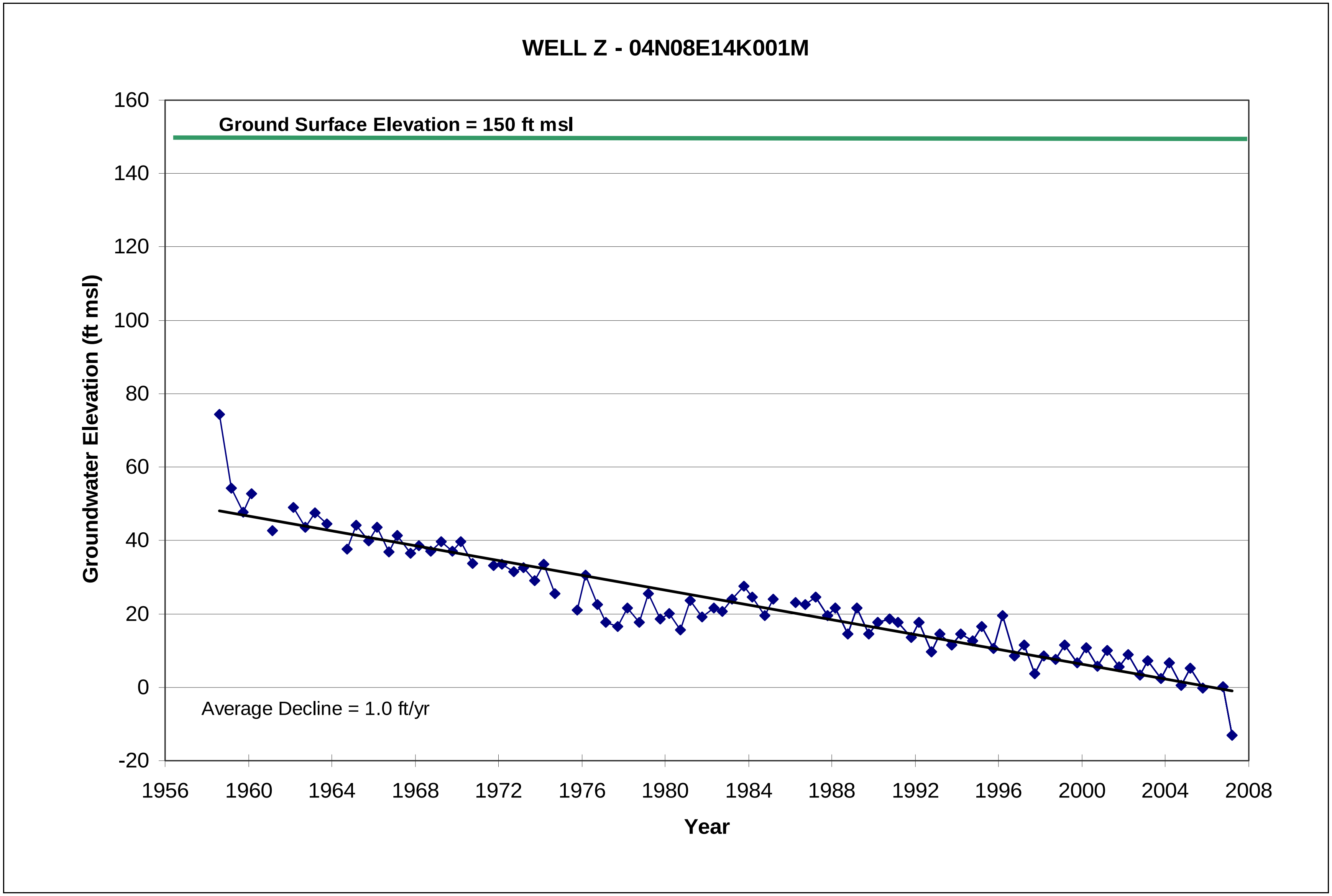

Figure 4-37 Hydrograph Well Z – SR 12 and SR 88

In general wells located further away from the main cone of depression near recharge sources, such as the Mokelumne and Stanislaus Rivers, and areas whose primary source of water is surface water, such as Woodbridge and South San Joaquin Irrigation Districts, show a less dramatic water level decline than other wells, and more noticeable increases in wet years as seen in, 1981 through 1983 (total rainfall in 1983 was more than double the long-term average). The seasonal variation in these wells is distinct but not as pronounced as shown on the other hydrographs.

4.5.4 Surface Water Interaction

A large number of streams and rivers dissect the Regional Planning Area. The rivers that have a regional impact on the hydrogeology are Cosumnes River, Lower Mokelumne River, Dry Creek, Calaveras River, Stanislaus River, and Lower San Joaquin River. Based on groundwater modeling results for the five-year period from 1989 to 1993, portions of the Lower Mokelumne River (in the vicinity of Woodbridge Irrigation District and the San Joaquin Delta) and the Lower San Joaquin River (near the confluence of the Stanislaus River) were gaining reaches. The Calaveras River, Dry Creek, Stanislaus River (upstream of Ripon), and the upstream reaches of the Lower Mokelumne and Lower San Joaquin Rivers were all losing reaches. The Calaveras, Dry Creek, and certain portion s of the Lower Mokelumne are hydraulically disconnected from the underlying aquifer.

4.5.5 Saline Groundwater Migration and Groundwater Quality

Groundwater flow in the Basin now converges on the depression with relatively steep groundwater gradients eastward from the Delta toward the depression East of Stockton. The eastward flow from the Delta area is significant because of the typically poorer quality water now moving eastward in the Stockton area.

Degradation of water quality due to saline migration threatens the long-term sustainability of underlying basin. Salt laden groundwater is unusable for either urban drinking water needs or for irrigating crops. The saline intrusion problem is not well understood by the Authority. Limited studies and monitoring have produced postulates as to the sources and extent of the saline front. Figure 4-38 illustrates the approximate location of the 300 mg/L isochlor as measured in 2000. Projections indicate that the rate of eastward migration of the saline front is approximately 150 to 250 feet per year. Figure 4-38 also shows the projected 2030 location of the 300 mg/L isochlor under no-action conditions.

4.5.6 USGS/DWR/Authority Joint Study

Further studies and monitoring methods are necessary to ensure the problem is addressed and monitored adequately. In 2003, the Authority, the DWR Conjunctive

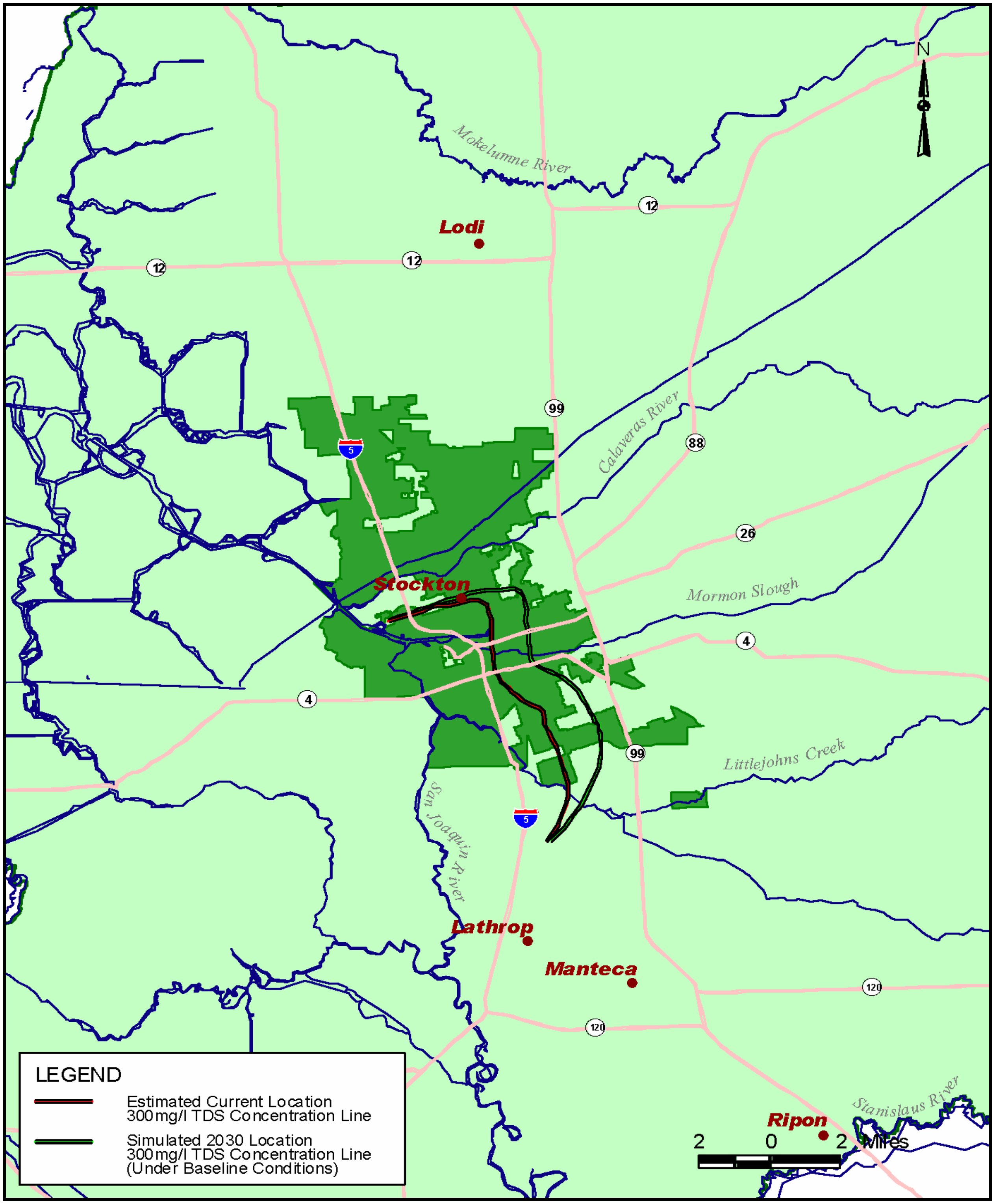

Figure 4-38 Estimated 2000 and Projected 2030 Saline Front
Source: Camp Dresser & McKee, Inc.

Water Management Branch, and the United States Geological Survey (USGS) embarked on a 5-year, $2.7 million, study of the saline intrusion crisis. The purpose of the Study is to quantify the source, aerial extent, and vertical distribution of high-chloride groundwater and the sources, distributions, and rates of recharge to aquifers along selected flow paths in Eastern San Joaquin County. The information gained from the Study will answer many questions with respect to future water levels, water quality, and storage potential under current and future management of the Basin.

The work done by the USGS thus far has been focused on identifying the sources of chloride using traditional and cutting edge sampling and geochemical characterization techniques. The USGS has compiled an extensive water level and water quality geographical information system (GIS) consisting of over 4000 wells throughout the Region. Historic water quality samples have shown that over time, an increasing number of wells have shown an increase in salinity concentrations. Figure 4-39 depicts the number of wells showing elevated chloride concentrations in 1984 and 2004.

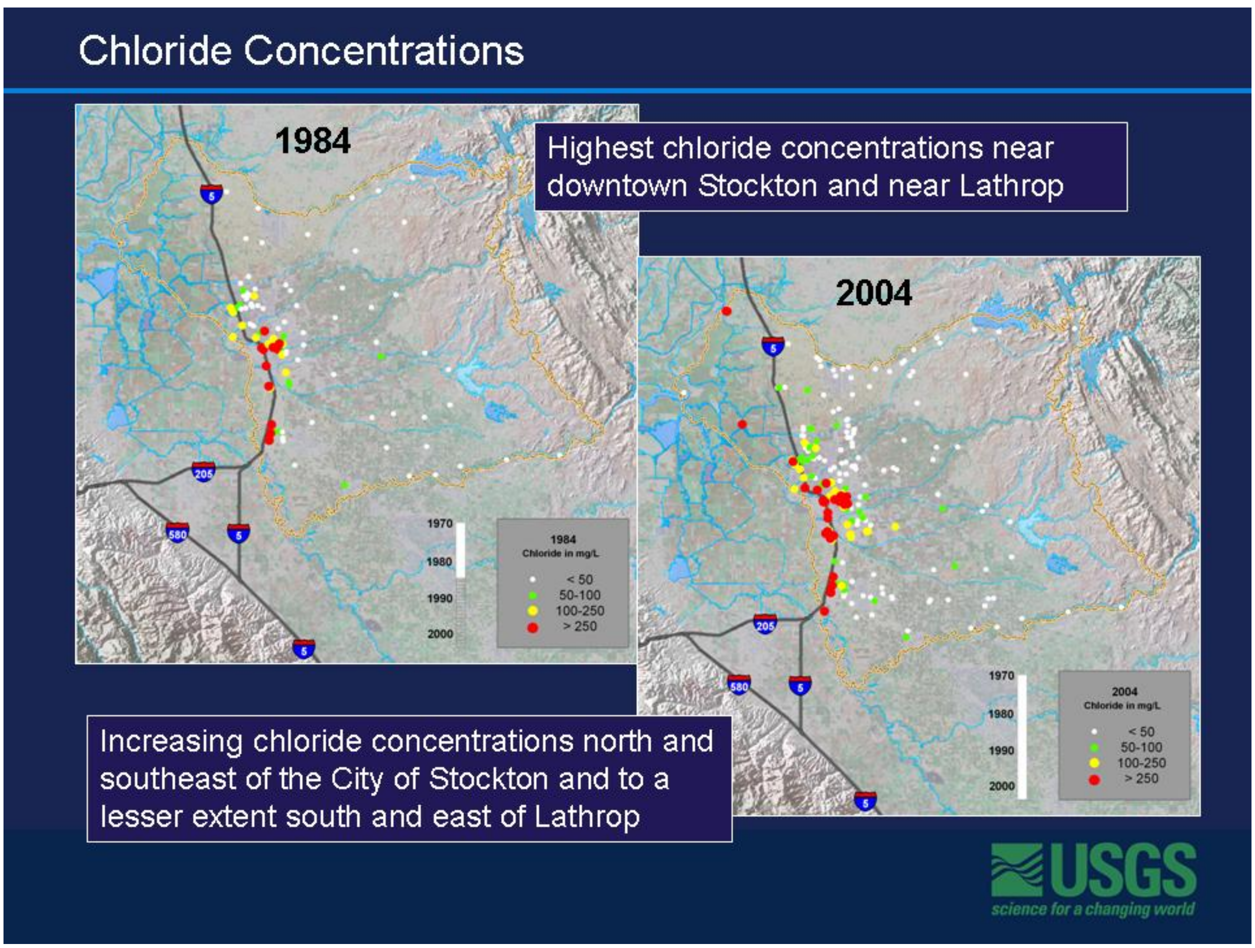

Figure 4-39 Wells Showing Elevated Chloride Concentrations in 1984 and 2004

The USGS has drilled a total of five multiple-completion monitoring wells at select locations along key transects in the greater Stockton Area. There are now seven total sentinel monitoring wells drilled at multiple depths specifically to monitor changes in the areal extent of saline groundwater. During drilling activities, lithologic information was gathered first hand along with core samples. The core samples were used to date the deposition history of the sediments and infer the age of pore water. A map depicting the monitoring well locations is included as Figure 4-40.

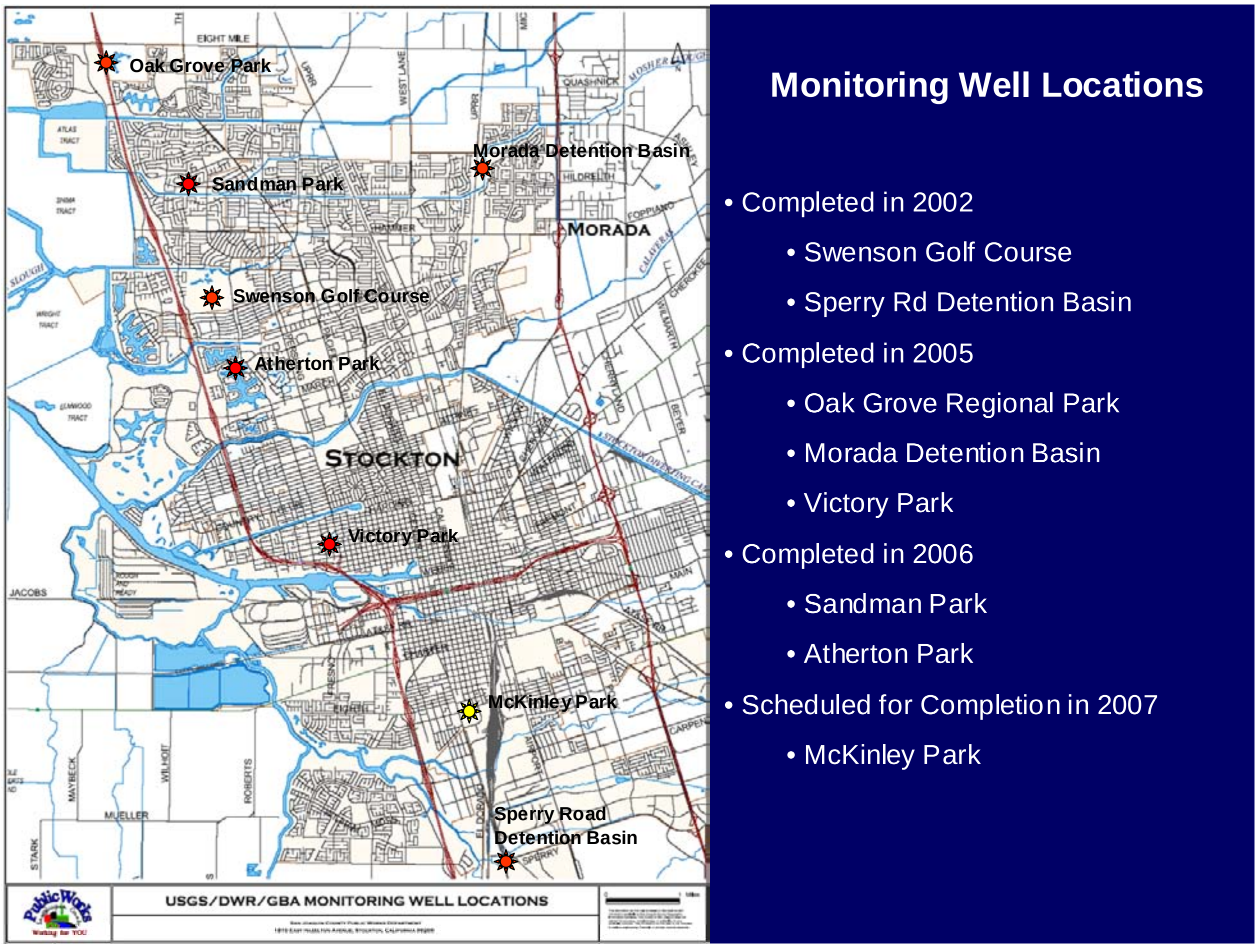

Figure 4-40 Map of Saline Groundwater Monitoring Well Sites

The USGS has also sampled existing production wells using special sampling equipment which allows samplers to collect depth dependent bore-flow and water quality data. Depth-dependant sampling using this method provides information on the transmisivity of aquifer layers and the associated water quality of these layers. IN general, the data suggests that in water most wells produce the majority of the well yield from specific aquifer zones around the 200 ft depth. These shallower depths also have increasing trends of nitrate and salinity levels. The deeper depths show increasing arsenic levels.

Figure 4-41 presents the depth-dependant sampling results for City of Stockton Well 1N/7E-20N1. Groundwater, at depths greater than 270 ft bgs, has elevated arsenic concentrations which exceed the Federal MCL of 10 micrograms per litter. Other wells have also shown a correlation between depth and elevated arsenic and pH levels with depth.

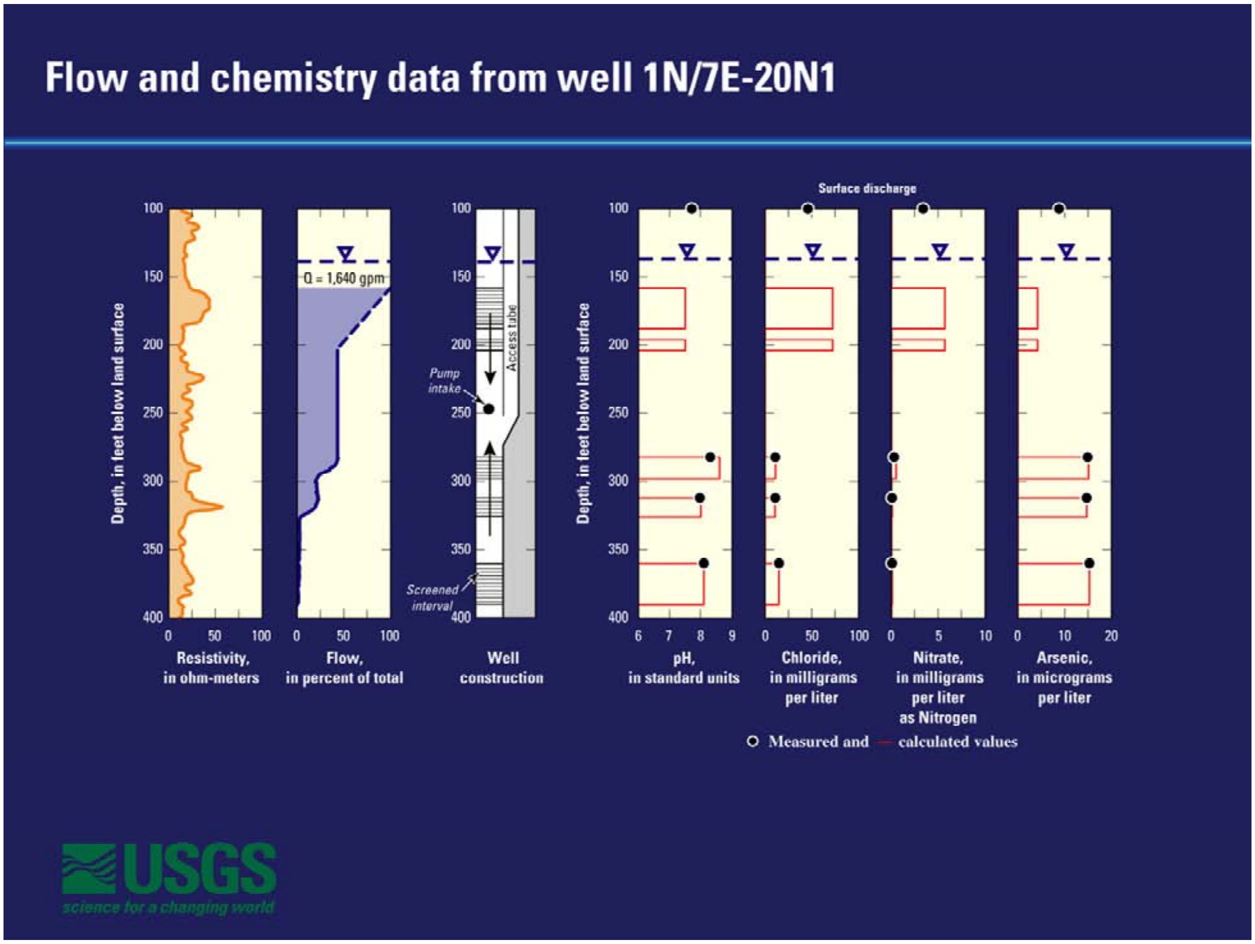

Figure 4-41 Depth-dependent Sampling Summary for Stockton Well 1N/7E- 20N1

Eliminating well yield from depths greater than 270 ft bgs can reduce arsenic concentrations to 7 micrograms per litter in the final discharge of the production water. The loss in well yield for Stockton Well 1N/7E-20N1 is approximately 20 percent yet the avoided cost of arsenic treatment is well worth exploring. The City of Stockton has since successfully retrofitted an existing well with packers and have reduced the arsenic concentrations to under federal MCL. Figure 4-42 below summarizes the potential for arsenic concentration reduction by reducing well yields from deeper depths.

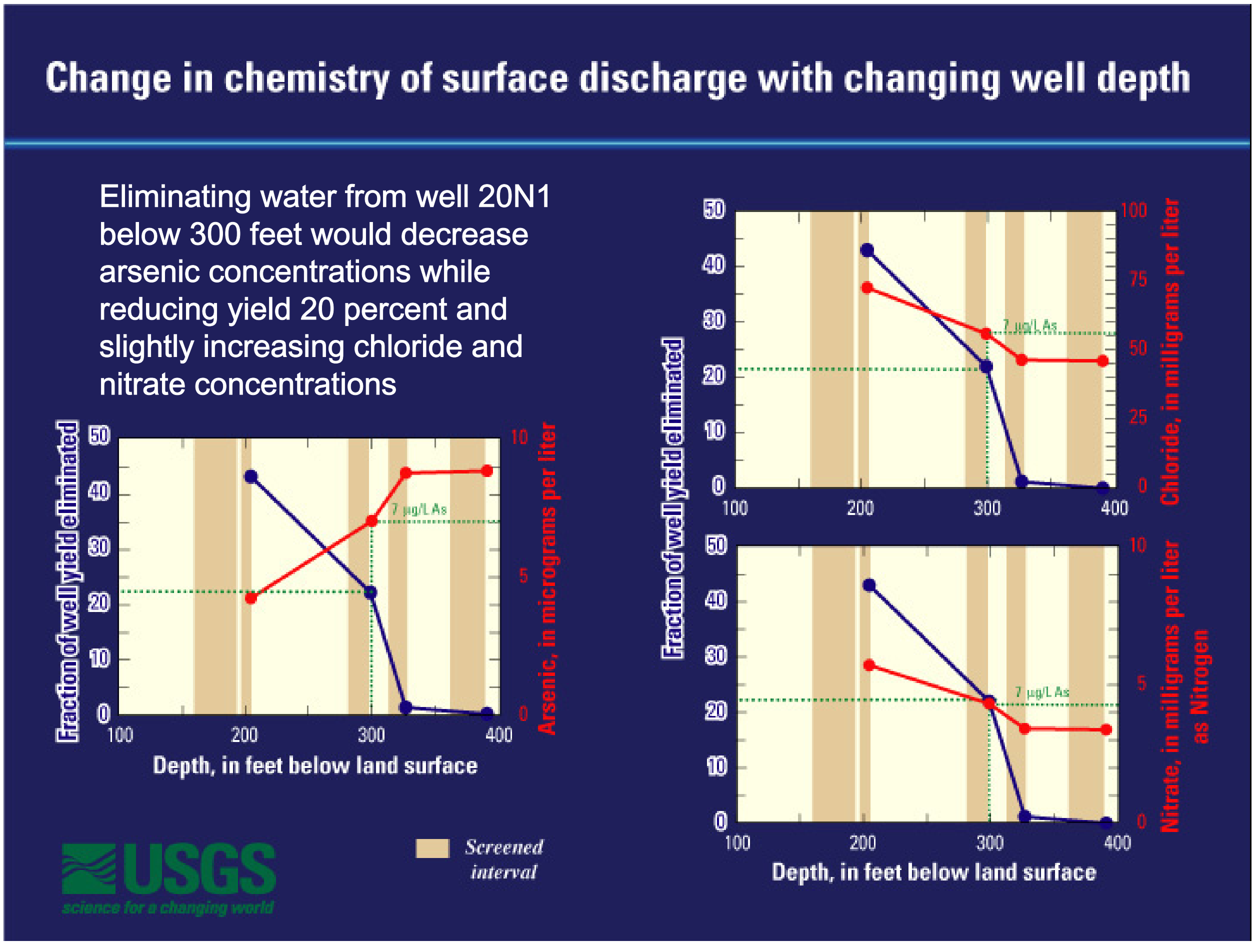

Figure 4-42 Conceptual Presentation of Arsenic Reduction

In 2006, the USGS published Open File Report 2006-1309 which identified the sources of High-chloride groundwater in Eastern San Joaquin County. The report conclude that a possible source of elevated chloride levels in shallow wells at depths less than 100 ft bgs can be attributed to irrigation return and San Joaquin River accretions and is evident in evaporative history of samples. Another source of high-chloride water is the mobilization of ancient sea water entrained during which shows a distinct marine history consistent with the deposition history of the Delta. It is also possible that either prolonged pumping and improperly destroyed oil and gas wells have catalyzed the migration of these entrained sources of chloride. OFR 2006-1309 has been included as supplemental information to this section.

USGS
science for a changing world

Open File Report 2006-1309
Prepared in cooperation with Northeastern San Joaquin Groundwater Banking Authority and California Department of Water Resources

Sources of High-Chloride Water to Wells, Eastern San Joaquin Ground-Water Subbasin, California

By John A. Izbicki, Loren F. Metzger, Kelly R. McPherson, Rhett R. Everett, and George L. Bennett V

Introduction

As a result of pumping and subsequent declines in water levels, chloride concentrations have increased in water from wells in the Eastern San Joaquin Ground-Water Subbasin, about 80 miles east of San Francisco (Montgomery Watson, Inc., 2000). Water from a number of public-supply, agricultural, and domestic wells in the western part of the subbasin adjacent to the San Joaquin Delta exceeds the U.S. Environmental Protection Agency Secondary Maximum Contaminant Level (SMCL) for chloride of 250 milligrams per liter (mg/L) (fig. 1) (*link to animation showing chloride concentrations in water from wells, 1984 to 2004*). Some of these wells have been removed from service. High-chloride water from delta surface water, delta sediments, saline aquifers that underlie freshwater aquifers, and irrigation return are possible sources of high-chloride water to wells (fig. 2). It is possible that different sources contribute high-chloride water to wells in different parts of the subbasin or even to different depths within the same well.

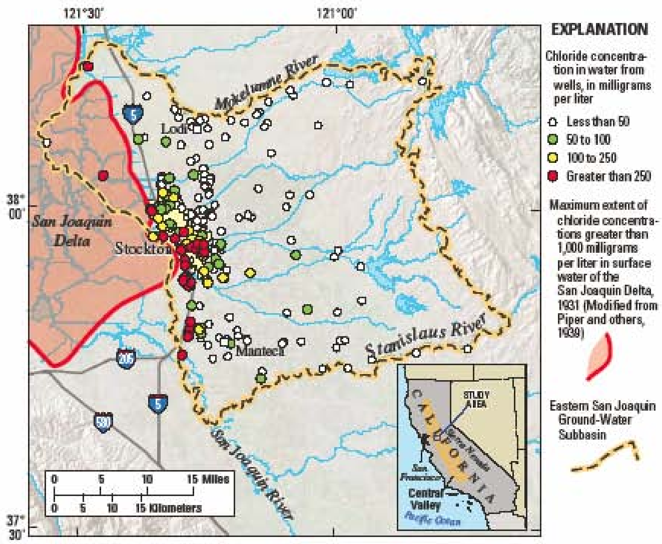

Figure 1. Chloride concentrations in water from wells in the Eastern San Joaquin Ground-Water Subbasin, California, 1984–2004.

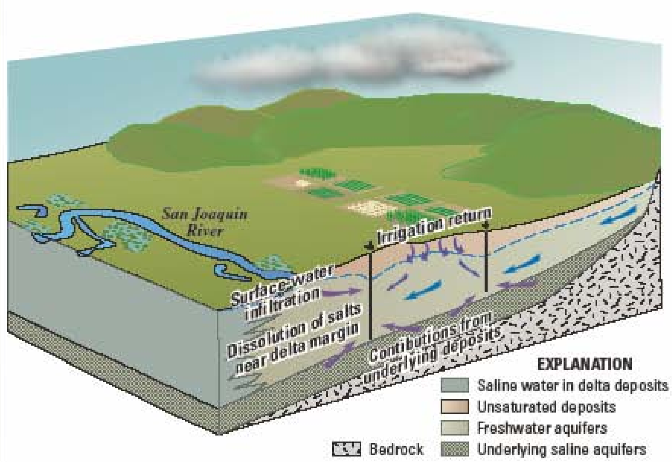

Figure 2. Sources of high-chloride water to wells, Eastern San Joaquin Ground-Water Subbasin, California.

U.S. Department of the Interior
U.S. Geological Survey

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November 2006

Sources of High-Chloride Water to Wells

Hydrogeology

The study area is the Eastern San Joaquin Ground-Water Subbasin near Stockton, California. The ground-water subbasin is about 1,100 square miles (California Department of Water Resources, 2006) and is part of the larger San Joaquin Ground-Water Basin that forms the southern half of the Central Valley of California. The climate of the area is characterized by hot, dry summers and cool, moist winters. Average annual precipitation ranges from about 10 to 18 inches (Soil Conservation Service, 1992). Precipitation is greater in the Sierra Nevada to the east of the study area. Runoff from those mountains, primarily as snowmelt, sustains flows in rivers and streams that cross the study area. The largest of these, the Mokelumne and Stanislaus Rivers, bound the study area to the north and south, respectively. The San Joaquin River, which drains the San Joaquin Valley to the south, bounds the study area to the west, and the foothills of the Sierra Nevada bound the study area to the east (fig. 1).

The study area is underlain by several thousand feet of consolidated, partly-consolidated, and unconsolidated sedimentary deposits (California Department of Water Resources, 1967). Volcanic deposits about 1,000 feet (ft) below land surface in the Stockton area, and at shallower depths to the east, separate overlying deposits from underlying marine deposits. Although they contain freshwater near the mountain front, the marine deposits contain saline water in most parts of the study area. The marine deposits have been explored for oil and gas and for the potential storage of waste. The overlying deposits can be divided into alluvial-fan deposits eroded from the Sierra Nevada, and delta deposits along the San Joaquin River. The alluvial-fan deposits are pumped extensively for water supply.

Under predevelopment conditions prior to the onset of ground-water pumping, ground-water movement in the alluvial-fan deposits was from the front of the Sierra Nevada to ground-water discharge areas near the San Joaquin Delta. Ground-water discharge to springs and seeps in this area was fresh and low in dissolved solids (Mendenhall, 1908). Surface water also infiltrated from the upstream reaches of rivers and streams into underlying alluvial deposits and ground water discharged along the downstream reaches of these streams (Piper and others, 1939). Regional ground-water movement in the San Joaquin Valley under predevelopment conditions was from south to north along the axis of the valley, with regional ground-water discharge to the delta. In a large part of the study area, ground water in deep wells completed below the volcanic deposits flowed to land surface under artesian conditions. Water from most of these deep artesian wells was saline (Mendenhall, 1908) and not used for agricultural or public supply. Saline water extracted from deep wells, especially those used for natural gas production, was "allowed to waste" (Mendenhall, 1908), or in the Stockton area was used for recreational swimming pools because of its warm temperature (fig. 3).

Figure 3. Recreational pools developed from saline ground water discharge in the San Joaquin Ground-Water Subbasin, Stockton, California, circa 1910. (Photograph courtesy of the Stockton Record.)

In 2000, the study area had a population of about 580,000 (CDM, Inc., 2001), and population is expected to increase to more than 1.2 million by 2040 (CDM Inc., 2001). Ground-water recharge is about 900,000 acre-feet per year (acre-ft/yr), and pumping exceeds recharge by 150,000 acre-ft/yr. Water levels in parts of the subbasin declined to below sea level in the early 1950's (California Department of Water Resources, 1967). The pumping depression expanded and shifted eastward in recent years (*link to animation showing changes in water-level contours, 1974 to 1999*), and water levels in parts of the basin were declining at rates as high as 2 feet per year (Northeastern San Joaquin County Groundwater Banking Authority, 2004). Within the pumping depression, ground water flowed from recharge areas near the mountain front, from major streams and rivers, and from the San Joaquin Delta toward pumping wells.

Purpose and Scope

The purpose of this report is to illustrate the types of data collected, and to present preliminary (2006) results from an ongoing study of the source of high-chloride water to wells in the Eastern San Joaquin Ground-Water Subbasin. The scope of the study includes test-drilling, geophysical logging, and identification of the source of high-chloride water to wells using geochemical techniques. The study couples a basin-wide areal assessment of water quality with more detailed geologic, geophysical, and geochemical data collection along geologic sections in the area affected by declining water levels and increasing chloride concentrations (fig. 4). Although beyond the scope of this preliminary report, extrapolation of data along the cross-sections is intended to extend detailed data collected from multiple-well monitoring sites and from large-capacity wells to other wells along the geologic sections. This approach will aid in the development and a more complete understanding of how the spatial and vertical distribution of subsurface geology, hydrology, and geochemistry combine to influence the movement of high-chloride water to wells.

Test Drilling and Well Installation

Test drilling and well installation was done to obtain samples of geologic materials, lithologic and geophysical logs, and to install wells for use as measuring points for water-level and water-quality data collection. Between May and October 2005, three multiple-well sites—each containing three to

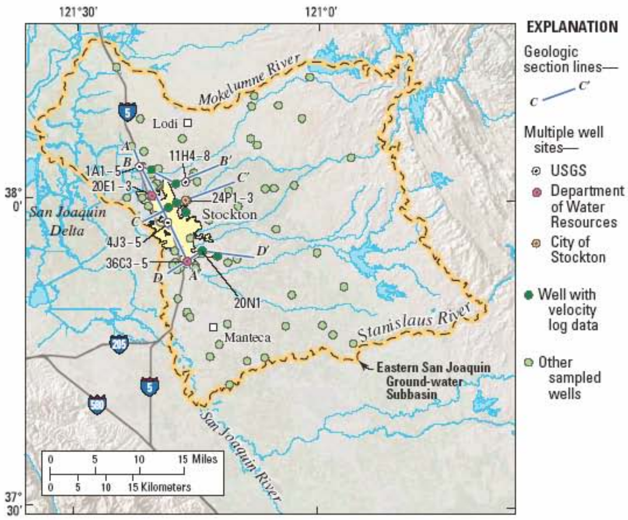

Figure 4. Location of selected wells and geologic sections, Eastern San Joaquin Ground-Water Subbasin, California.

five 2-inch diameter monitoring wells with PVC casings installed at different depths, were completed. Data from these sites were supplemented with data from multiple-well sites installed previously at two locations by the California Department of Water Resources (2003), and at an additional location by the City of Stockton (fig. 4).

Geophysical logs and well-construction data for multiple-well site 2N/5E-1A1–5, installed near the eastern edge of the San Joaquin Delta, are shown in figure 5. This site was selected because two wells less than one-half mile east of this site were removed from service as a result of high-chloride concentrations. Water levels at this multiple-well site ranged from about 13 to 27 ft below land surface in May 2005, and depth to water increased with well depth. The site is located in what would have been a ground-water discharge area under predevelopment conditions, and the increase in depth to water with well depth is probably the result of regional ground-water pumping. In May 2005, chloride concentrations at this site ranged from 550 to 1,800 milligrams per liter (mg/L). At that time, the shallowest and deepest wells had chloride concentrations of 1,800 and 1,700 mg/L, respectively (fig. 5). Data from the wells at this site and from monitoring wells at other multiple-well sites will be used to evaluate the chemical and isotopic composition of potential sources of high-chloride water to these wells.

The two other multiple-well sites 1N/6E-4J3–5 and 2N/6E-11H4–8 (fig. 4) were drilled to depths of 600 and 643 ft below land surface, respectively. In January 2006, chloride concentrations in water from sites -4J3–5 near the San Joaquin Delta ranged from 120 to 510 mg/L, with the highest concentration in well -4J4 that was completed between 360 and 340 ft below land surface. In May 2005, chloride concentrations in water from sites -11H4–8, near ground-water recharge ponds east of the delta, were between 9.9 and 3.4 mg/L.

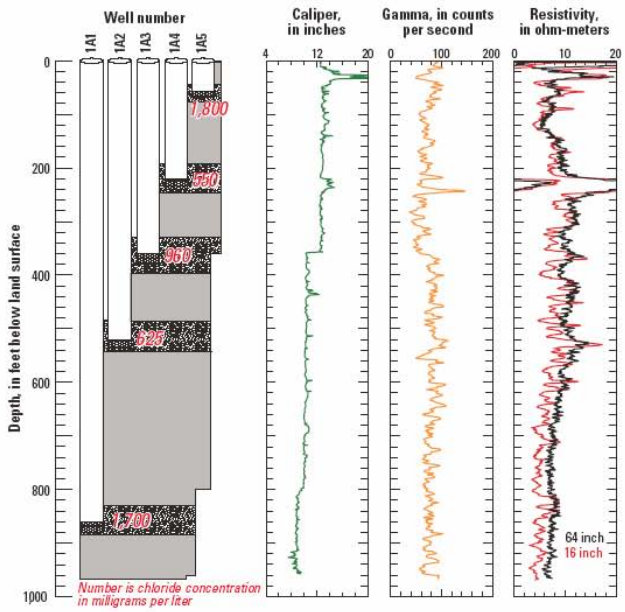

Figure 5. Selected geophysical logs and well-construction data for multiple-well site, 2N/5E-1A1–5, Eastern San Joaquin Ground-Water Subbasin near Stockton, California, May 2005.

Borehole Geophysical Data

In addition to geophysical logs collected during test drilling, two types of borehole geophysical data were collected as part of this study. Electromagnetic (EM) logs were collected from selected multiple-well sites to evaluate changing water quality at depth. Fluid-velocity logs were collected under pumping conditions from selected public supply wells to determine the depth at which water enters those wells. Velocity logs were coupled with depth-dependent water-quality data, also collected under pumping conditions, to determine the quality of water entering the well at different depths.

Electromagnetic logs

Only a limited number of wells screened over selected intervals can be installed at multiple-well monitoring sites. As a consequence, changes in water quality are not measured directly through much of the aquifer thickness. To address this issue, the deepest well at multiple-well sites was used as access tubes for repeated measurement of electromagnetic resistivity through the entire aquifer thickness penetrated by the well. EM logs collected through the PVC casings of monitoring wells are sensitive to the lithology of the deposits and to the resistivity of the pore fluids within the deposits (McNeill and others, 1990). Because the lithology remains constant with time, repeated EM logs differ only if the fluid resistivity changes as a result of the movement of water of differing quality at depth (Williams and others, 1993). The radius of the material measured by the logging tool is between 10 and 50 inches, and as a result the tool is relatively insensitive to borehole fill material adjacent to the well (McNeill and others, 1990). These properties make EM resistivity a suitable tool for identifying changes in water quality, particularily changes in salinity, at locations from which ground-water samples cannot be collected directly.

EM resistivity values at corresponding depths from logs collected within well 2N/6E-20E1 in June 2004 and January 2006 are shown in figure 6. In the time between collection of the two logs, EM resistivity values decreased in a narrow interval between 400 and 402 ft below land surface (fig. 6). The January 2006 values, between 400 and 402 ft, were among the lowest collected from the well. Because the lithology has not changed, decreased EM resistivity at this depth may be the result of decreased fluid resistivity (increased fluid conductivity) resulting from increased salinity between the two logging dates. Horizontal movement of poor-quality water through thin, permeable zones that are either areally extensive, or well-connected hydraulically, commonly occurs in coastal California aquifers (Nishikawa, 1997). Given this scenario, the three monitoring wells at this site (screened from 472 to 507, 289 to 319, and 189 to 209 ft below land surface, respectively) would not have detected changes in water quality that caused changes in EM resistivity observed near 400 ft.

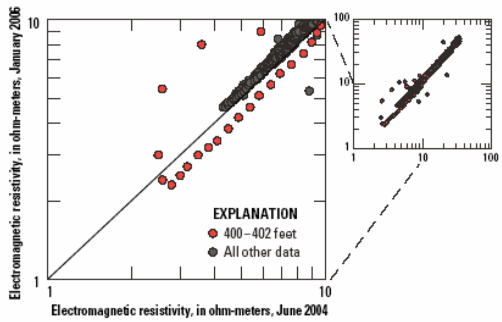

Figure 6. Comparison of electromagnetic resistivity values collected in well 2N/6E-20E1, Eastern San Joaquin Ground Water Subbasin near Stockton, California.

Decreases in EM resistivity consistent with increasing chloride concentrations also were observed between 40 and 45 ft below land surface in EM logs collected from well 1N/6E-36C3 between June 2004 and January 2006. Previous work (California Department of Water Resources, 1967) indicated the presence of poor-quality water near the water-table in this part of the study area and suggested that this shallow ground water may have been the source of high-chloride water in some production wells.

Additional EM logging at these sites would be required to determine if EM resistivity values will continue to decrease through time. Additional data collection, possibly including the installation of new wells, may be required to determine if changes in EM resistivity are the result of changes in water quality or the result of some other cause.

Fluid-velocity logs and depth-dependent water-quality sample collection

Fluid-velocity logs from unpumped and pumped wells were collected using an EM flowmeter. The EM flowmeter measures uphole or downhole velocities according to Faraday's Law, where the voltage generated by the movement of charged ions in water flowing through an induced magnetic field is proportional to the velocity of water flowing through the field. The tool has a range from 0.3 to 260 feet per minute, and is suitable for both the low velocities in unpumped wells and the high velocities in pumped wells (Newhouse and others, 2005). Fluid resistivity and fluid temperature data collected during logging were used to constrain interpretations of fluid-velocity logs.

Fluid-velocity logs from pumped wells were coupled with water-quality samples collected under pumping conditions from selected depths within the well. Sample depths were selected on the basis of measured velocity logs, lithologic logs, geophysical logs, and well-construction data. The samples were collected using a commercially available, small-diameter gas-displacement pump (Izbicki, 2004). Water samples collected using this method are mixtures of water that entered the well from different depths. However, when coupled with velocity log data,

Borehole Geophysical Data

In addition to geophysical logs collected during test drilling, two types of borehole geophysical data were collected as part of this study. Electromagnetic (EM) logs were collected from selected multiple-well sites to evaluate changing water quality at depth. Fluid-velocity logs were collected under pumping conditions from selected public supply wells to determine the depth at which water enters those wells. Velocity logs were coupled with depth-dependent water-quality data, also collected under pumping conditions, to determine the quality of water entering the well at different depths.

Electromagnetic logs

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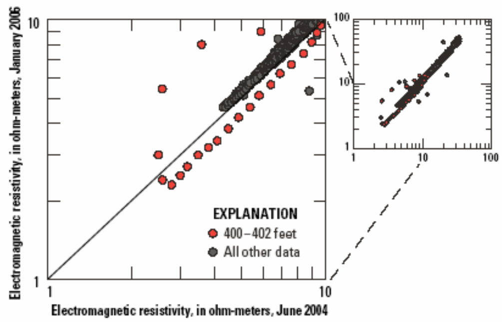

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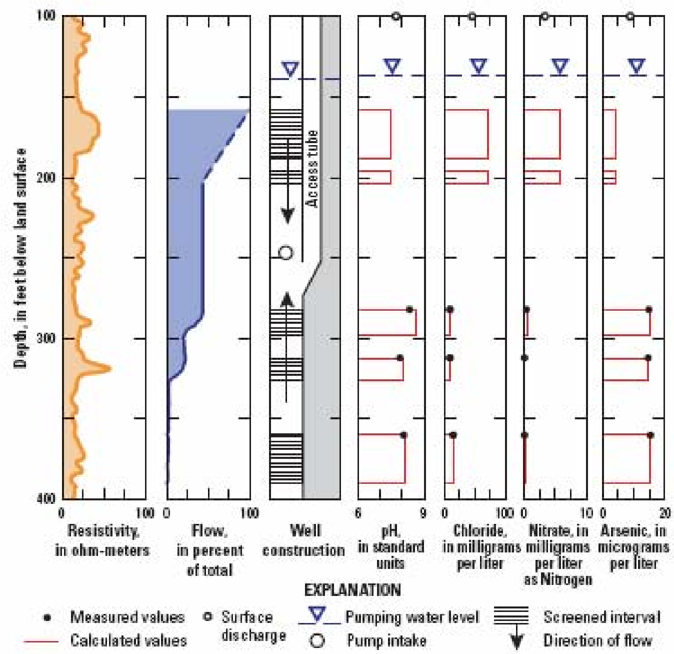

Figure 7. Fluid velocity and depth-dependent water-quality data from well 1N/7E-20N1, Eastern San Joaquin Ground-Water Subbasin, California, August 2004.

depth-dependent water-quality data can be used to estimate the quality of water entering a well from selected depths in an aquifer (Izbicki, 2004).

Fluid-velocity logs from well 1N/7E-20N1 show that slightly more than one-half of the water entered well -20N1 through the two upper screens located 158 to 204 ft below land surface (fig. 7). Most of the remaining water entered the well through screens at 282 to 298 and 312 to 326 ft below land surface. Only a small amount of water entered the well through the deepest screen 360 to 390 ft below land surface (fig. 7). In well -20N1, the higher yielding upper zones correspond to electrically resistive sand and gravel units indicated on the electric log (fig.7). Where present in other wells, this high-resistivity zone also contributes large amounts of water to wells. The small amount of yield from the deepest screen was unexpected on the basis of lithologic and geophysical logs, and may reflect increased consolidation and decreased hydraulic conductivity of alluvial deposits with depth.

Depth-dependent water-quality samples collected within well -20N1 under pumping conditions reflect the vertical distribution of water-quality within the aquifer (fig. 7). Chloride and nitrate concentrations are higher in water entering from the upper well screens than the deeper well screens. In contrast, pH and arsenic concentrations were higher in water entering from the deeper parts of the well. Arsenic concentrations in the deeper parts of well -20N1 were as high as 15 micrograms per liter (µg/L). Mixing of water having lower arsenic concentrations from shallower depths within the well caused water discharge at the surface to approach the Maximum Contaminant Level (MCL) for arsenic of 10 µg/L (U.S. Environmental Protection Agency, 2006). Changes in well drilling and construction practices could exclude zones having high concentrations of constituents such as chloride, nitrate, or arsenic from newly installed wells, and modifications in well design could exclude zones contributing poor-quality water to existing wells—thereby improving the quality of water from those wells.

By January 2006, fluid velocity logs coupled with depth-dependent water-quality data had been collected from eight wells that are distributed along the sections shown in figure 4. Data from these wells will be used with geochemical data collected from the surface discharge of wells throughout the study area to determine the sources of high-chloride water to wells.

Sources of High-Chloride Water to Wells

Prior to the construction of reservoirs on rivers tributary to the San Joaquin Delta, water having chloride concentrations as high as 1,000 mg/L intruded the delta during low-flow periods (Piper and others, 1939) (fig. 1). Under present-day (2006) conditions, surface flows are managed to protect freshwater resources in the delta and to prevent the inland movement of seawater. However, high-chloride water may originate from water trapped in delta sediments during their deposition—constituents dissolved within this water may retain a chemical composition consistent with a seawater origin. High-chloride water also may originate from soluble salts emplaced in sediments from ground-water discharge along the delta margin—constituents dissolved within this water would have a chemical composition different from seawater. It is likely that water from deeper aquifers that underlie freshwater aquifers pumped for supply also has markedly different chemical composition and may contribute high-chloride water to wells in different parts of the subbasin. In addition, irrigation return may increase chloride concentrations near the water table. To further complicate the issue, multiple sources of high-chloride water may occur at different depths within the same well. Water from wells was sampled and analyzed for major-ions, selected minor ions, and its isotopic (oxygen-18

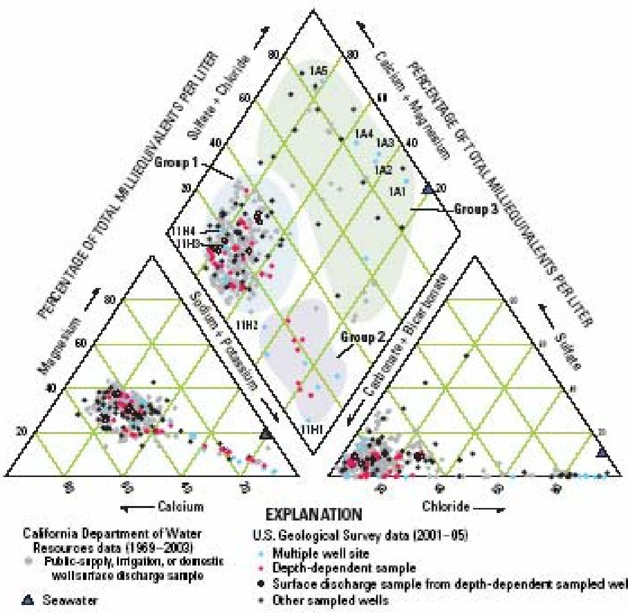

Figure 8. Major-ion chemistry of water from selected wells in the Eastern San Joaquin Ground-Water Subbasin, California, 2004–2005.

and deuterium) composition, to determine the composition of fresh and high-chloride waters in the study area and the sources of high-chloride water to wells.

Major-Ion Composition of Water from Wells

The major-ion composition of 100 water samples from 76 public-supply, irrigation, domestic, and observation wells collected as part of this study between May 2004 and January 2006, and 245 historical samples from 42 wells were evaluated using a trilinear diagram (fig. 8). A trilinear diagram shows the proportions of the major cations (calcium, magnesium, and sodium plus potassium) and the major anions (carbonate plus bicarbonate, sulfate, and chloride) on a charge-equivalent basis (Hem, 1985). Cations are plotted on the lower left triangle, anions on the lower right triangle, and the central diamond integrates the data.

On the basis of their distribution within the trilinear diagram, data were separated into three groups having different chemical compositions. Group 1 represents the majority of sampled wells. Group 2 consists of depth-dependent samples from deeper depths within sampled public-supply wells, and samples from deeper observation wells at multiple-well sites. The composition of water from deeper aquifers represented by these samples is not apparent in historical data collected from the surface discharge of wells; because ground water from deeper depths mixes within the wells with ground water from shallow depths during pumping, thereby masking the composition of the deeper ground water. As a result of mixing within the well during pumping, samples from the surface discharge public-supply wells plot within Group 1 even though deeper samples from the same well plot within Group 2. All samples within Groups 1 and 2 had chloride concentrations of less than 100 mg/L. In contrast, all but two samples within Group 3 were from wells that had chloride concentrations greater than 100 mg/L. This group included several public-supply wells that are no longer in use due to chloride concentrations that were greater than the Secondary Maximum Contaminant Level (SMCL) of 250 mg/L (U.S. Environmental Protection Agency, 2006). The major-ion composition of water from wells did not trend consistently toward the composition of seawater as chloride concentrations increased.

Minor-Ion Composition of Water from Wells

Certain minor ions in water, such as bromide, iodide, barium, and boron are present naturally in high-chloride water from different sources, and have been used to determine the origin of high-chloride water to wells (Piper and Garrett, 1953; Izbicki and others, 2005). Analysis of this combination of minor ions is especially effective because their differing abundances, chemical properties, and biological reactivity can produce a wide range of compositions, relative to chloride concentrations; these compositions reflect different geology, source-water composition, and aquifer chemistry. Of the four minor ions analyzed in this study, iodide commonly has the largest range in environmental compositions, relative to chloride and is commonly very useful in determining the source of high-chloride water to wells.

Iodide is depleted in seawater through uptake by marine organisms (Izbicki and others, 2005). As these organisms die, are buried, and decay, water within marine deposits may become enriched in iodide. In the plot of chloride-to-iodide ratio as a function of chloride (fig. 9), data are bimodally distributed and reflect contributions of high-chloride water from at least two sources. The chloride-to-iodide ratio from some wells follows a seawater mixing line with increasing chloride concentrations, and reflects high-chloride seawater minimally altered by contact with aquifer material.
Water from most observation wells and from depth-dependent samples collected within the deeper parts of public-supply wells plotted to the right of the seawater mixing line. The iodide-enriched composition of water from these wells is similar to that of water from marine rocks and oil-field brine sampled elsewhere in

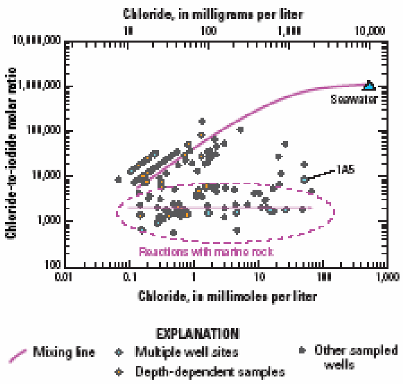

Figure 9. Chloride-to-bromide and chloride-to-iodide ratios as a function of chloride concentration in water from selected wells in the Eastern San Joaquin Ground-Water Subbasin, California, 2004–2005.

California (Piper and Garrett, 1953; Izbicki and others, 2005). Several wells having high-chloride water, including the shallow observation well -1A5 at the Oak Grove Park multiple-well site, have chloride-to-iodide ratios intermediate between compositions expected from seawater mixing and from deep brines. Water from these wells may be complex mixtures of high-chloride water from multiple sources, or the water may have reacted with aquifer materials to remove iodide from the solution.

Oxygen-18 and Deuterium Composition of Water from Wells

Oxygen-18 and deuterium are naturally occurring stable isotopes of oxygen and hydrogen, respectively. Oxygen-18 ($\delta^{18}O$) and deuterium (δD) abundances are expressed as ratios, in delta notation as per mil (parts per thousand) differences, relative to the standard known as Vienna Standard Mean Ocean Water (VSMOW). By convention, the value of VSMOW is 0 per mil. Negative per mil values have more of the lighter isotope than VSMOW (Craig, 1961), and highly negative per mil values have more of the lighter isotope than less negative values.

Most of the world's precipitation originates from the evaporation of seawater. As a result, the $\delta^{18}O$ and δD composition of precipitation throughout the world is correlated linearly and distributed along a line known as the global meteoric water line (Craig, 1961). In many areas, water samples plot along a line slightly below the global meteoric water line that is known as the local meteoric water line. The $\delta^{18}O$ and δD composition of a water sample, relative to the global meteoric water line and relative to the composition of water from other areas, provides a record of the source and evaporative history of the water, and can be used as a tracer of the movement of the water. Differences in the $\delta^{18}O$ and δD composition of water from the global meteoric water line may result from differences in the temperature of condensation of precipitation that recharged the ground water. These differences may result from condensation at different altitudes, from seasonal or short-term climatic changes, or from long-term climatic changes such as those that occurred at the end of the Pleistocene Epoch. Partial evaporation of a water sample shifts the $\delta^{18}O$ and δD composition to the right of the global meteoric water line along an evaporative trend line (International Atomic Energy Agency, 1981).

The $\delta^{18}O$ and δD composition of water from wells in the study area ranged from –6.3 to –11.2 per mil and –48 to –81 per mil with a median composition of –8.4 and –60 per mil, respectively (fig. 10). Most samples plot parallel to, but below, the global meteoric water line.

The more negative values are from shallow wells, typically about 100 ft deep, along the Mokelumne and Stanislaus Rivers (fig. 10). These rivers drain the higher altitudes of the Sierra Nevada to the east of the study area, and water from these wells probably originated as precipitation at cooler temperatures associated with higher altitudes instead of precipitation at warmer temperatures associated with lower altitudes. There was no consistent trend toward increasingly negative values from deeper wells at multiple-well sites installed as part of this study. However, δD values between –70 and –68 per mil were obtained from shallower wells at a multiple-well site 2N/6E-11H4–8 near ground-water

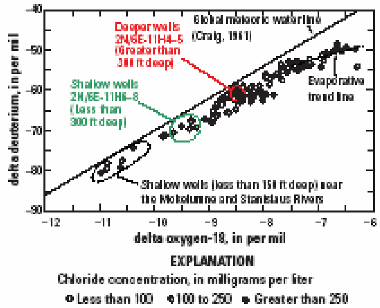

Figure 10. Oxygen-18 and delta deuterium composition of water from selected wells in the Eastern San Joaquin Ground-Water Subbasin, California, 2004–2005.

recharge ponds. These data are consistent with movement of recharge water from the ponds (that originated from reservoirs in the Sierra Nevada) to depths as great as 300 ft.

The less negative samples plot to the right of the local meteoric water line along an evaporative trend line (fig. 10). Although most high-chloride water plots to the right of the meteoric water line, chloride concentrations do not consistently increase with the evaporative shift in $\delta^{18}O$ and δD isotopic composition. These data suggest that the high-chloride concentrations are the result of processes other than evaporative concentration of ground water, and are consistent with high-chloride water mobilized from delta sediments or deeper deposits.

Summary

Water levels are declining and chloride concentrations are increasing in water from wells in the Eastern San Joaquin Ground-Water Subbasin near Stockton, California, as a result of pumping in excess of recharge. A study approach that utilizes a combination of data collection activities including (1) drilling and monitoring well installation, (2) borehole geophysical data collection from monitoring wells and large-capacity pumping wells, and (3) geochemical data collection was developed to evaluate the areal and vertical distribution of chloride within freshwater aquifers and

to determine the sources of high-chloride water to wells. The study couples a basin-wide areal assessment of water quality with detailed geologic, geophysical, and geochemical data collected along geologic sections in the area affected by declining water levels and increasing chloride concentrations.

Preliminary results show that water from multiple-well site 2N/5E-1A1–5 near the San Joaquin River Delta had chloride concentrations as high as 1,800 mg/L. High chloride concentrations were present at this site to almost 1,000 ft below land surface. EM logs collected from well 2N/6E-20E1 north of Stockton showed decreased EM resistivity. EM logs collected in well 1N/6E-36C3 south of Stockton, showed decreases in EM resistivity at shallower depths between 40 and 45 ft below land surface. High-chloride water from shallow depths has been observed in production wells in this part of the study area. Additional EM logging at these sites would be required to determine if EM resistivity values continue to decrease through time and if decreasing resistivity is the result if increasing salinity.

Water-quality in the study area changes with depth, and the major-ion composition of water from deeper aquifers is obscured by mixing within wells during pumping. As a consequence, the composition of water from deeper deposits penetrated by wells is not apparent in historical data collected primarily from the surface discharge of wells. Changes in the iodide composition of water from wells with elevated chloride concentrations are consistent with a marine origin of the chloride dissolved in water from wells. Entrainment of seawater in delta deposits may have occurred during deposition of delta sediments. Subsequent mobilization of this entrained water may have occurred as a result of ground-water pumping. High-chloride water in deeper parts of the aquifer is enriched in iodide, relative to seawater compositions and also contributes to increasing chloride concentrations in water from some wells. Such enrichment is common in deeper ground water from oil- and gas-producing regions in California (Piper and Garrett, 1953; Izbicki and others, 2005). Shifts in the $\delta^{18}O$ and δD composition of water from some shallower wells are consistent with partial evaporation of water and irrigation return water. However, increases in chloride concentrations from evaporation of irrigation water are small compared to chloride inputs from the delta and underlying deposits.

Acknowledgements

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Chapter 5 - Integrated Regional Water Management Plan Framework

The Eastern San Joaquin Region IRWMP Framework can be described as a reflection of the values and needs of the community. The IRWMP Framework utilizes a nested tier system that begins with a Problem and Mission statement and then drills down through refining steps leading to specific evaluation and prioritization criteria by which the solution, the ICU Program, is measured and is ultimately implemented. Items in each lower tier directly relate to and support the concepts at each higher level. The IRWMP Framework concept is shown schematically in Figure 5-1. Each element is further defined below.

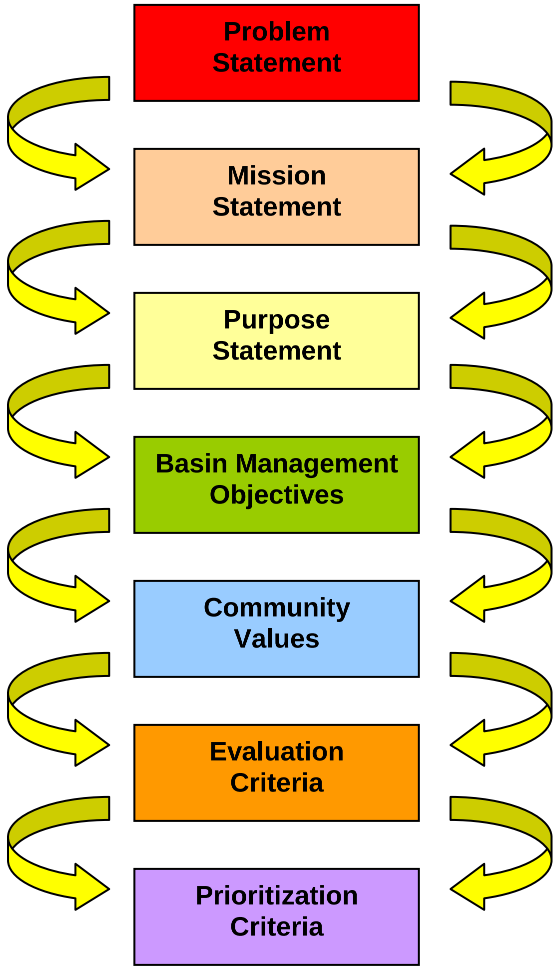


Figure 5-1 IRWMP Framework

5.1 Problem Statement

Long-term groundwater overdraft due to lack of sufficient surface water supplies and long-term reliance on groundwater threatens the social, economic, and environmental viability of the San Joaquin Region. Without action, groundwater levels will continue to decline resulting in saline groundwater intrusion from the west, reduction in groundwater quality due to elevated nitrates and salts, increased pumping costs, increased seepage losses from local rivers and streams, increased lateral inflow form neighboring sub-basins, and other potentially devastating groundwater and surface water impacts.

5.2 Mission Statement

The Mission of the GBA is to employ a consensus-based approach to collaboratively develop stakeholder-supported projects and programs that mitigate and prevent the impacts of long-term groundwater overdraft. Managing the underlying groundwater basin is critical in providing reliable water supplies, which are essential for the economic, social, and environmental viability of the San Joaquin Region. Developing an IRWMP is key to carrying out this Mission.

5.3 Purpose Statement

The Purpose of the Eastern San Joaquin IRWMP is to define and integrate key water resource strategies and to establish the protocols and course of action for implementation of the Eastern San Joaquin Integrated Conjunctive Use Program (ICU Program). The ICU Program is a comprehensive prioritized menu of projects and actions that fulfills the Mission of the Authority.

There are several key issues that stakeholders have expressed as central to the IRWMP and should either be addressed by the IRWMP or at least considered in the development of the IRWMP. These issues are listed as follows:

- Groundwater overdraft;
- Saline groundwater intrusion;
- Degradation of groundwater quality;
- Subsidence and irrecoverable basin storage capacity;
- Environmental quality of the community;
- Health of the Sacramento-San Joaquin Delta;
- Supply reliability during multi-year droughts;
- Competing urban, agricultural, and environmental water demands;
- Planned urban growth;
- Recreational opportunities and access;
- Expansion of agriculture into areas historically un-irrigated;
- Groundwater management and governance;
- Sustainability of economies dependant on sufficient water supplies of adequate quality;
- Limited opportunities to develop new surface water sources;
- Complexity of cooperation involving numerous local, regional, State, and Federal agencies;
- Flood protection; and,
- Funding and financing.

5.4 Basin Management Objectives

The Objective for the IRWM Plan was developed by the GBA to address the underlying issues listed above, consistent with the Plan Purpose. The Objective statement adopted by the GBA is as follows:

The Need for the IRWMP supporting the GBA's Integrated Conjunctive Use Program was identified as part of the development of the Groundwater Management Plan (2004), the Countywide Water Management Plan (2002), and the Mokelumne Aquifer Recharge and Storage Project (1996). The Need is defined by the following key Issues:

It is the Objective of the GBA to: Ensure the long-term sustainability of water resources in the San Joaquin Region while:

- Equitably distributing benefits and costs;
- Minimizing adverse impacts to agriculture, communities, and the environment;
- Maximizing efficiency and beneficial use of supplies; and,
- Protecting and enhancing water rights and supplies.

5.5 Community Values

The IRWMP Objectives stated above define the overall goal of the Plan to address the key issues. The Objectives alone do not define the standards of what is desirable or the qualities of the program that are considered worthwhile. The Objectives will be tailored to the standards of the community through application of the GBA's values. The statement of values developed as part of the Groundwater Management Plan and Water Management Plan development is as follows:

The ICU Program should:

- Be implemented in an equitable manner
- Maintain or enhance the local economy
- Protect groundwater and surface water quality
- Be affordable
- Minimize adverse impacts to entities within the County
- Provide more reliable supplies
- Exhibit multiple benefits to local land owners and other participating agencies
- Maintain overlying landowner and Local Agency control of the Groundwater Basin
- Restore and maintain groundwater resources
- Minimize adverse impacts to the environment, community, and culture
- Protect the rights of overlying land owners
- Increase amount of water put to beneficial use within the San Joaquin region
- Support beneficial conservation programs

5.6 Evaluation Criteria

Evaluation criteria (or "Performance Measures") were developed to allow the GBA to screen and select the best combinations of projects and management actions that address key water issues using a systems approach. Each Performance Measure addresses a particular issue related to meeting the fundamental Objectives. The development and application of these Evaluation Criteria are presented in Chapter 7.

5.7 Prioritization Criteria

The application of Performance Measures provides an unranked list of project alternatives. Prioritization Criteria were developed to select the best or most promising alternatives and a timeline for their development. Prioritization Criteria and their application are presented in Chapter 7.

Chapter 6 - Basin Operations Criteria & Management Framework

6.1 Groundwater Management Overview

The groundwater underlying San Joaquin County has historically provided the people and lands of San Joaquin County with water for agricultural, domestic, municipal, and other purposes. Much of the farm production of the County depends upon the use of groundwater to produce grapes, nuts, fruit, and vegetable crops which significantly contribute to the gross value of all agricultural crops produced in the County, estimated at over one billion seven hundred fifty million dollars ($1,750,000,000) in 2006. The groundwater of San Joaquin County also provides water to several communities in the County, particularly to the cities of Lodi, Stockton, Manteca, Lathrop, Escalon, Ripon, and Tracy, some of which rely almost exclusively on this source. This over reliance on groundwater due to insufficient surface water supplies has led to over use of the available resource.

As a result, the California Department of Water Resources in Bulletin 118-80 identified the groundwater underlying the eastern portion of the County as subject to critical conditions of overdraft. A basin is subject to critical conditions of overdraft, according to Bulletin 118-80, when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts. However, though portions of the groundwater underlying the County are subject to critical conditions of overdraft, the adverse impacts do not necessarily occur throughout the entire County, according to Bulletin 118-80.

A study conducted in 1985 by the engineering firm of Brown & Caldwell, under the sponsorship of state, federal and local agencies, confirmed that serious over-drafting of the groundwater underlying the eastern portion of the County was occurring. The study found that if the County did not obtain additional supplemental water, by the year 2020 overdraft would result in a 1.9 foot drop per year in the regional water level and that the groundwater elevations in areas east of Stockton would be one hundred sixty (160) feet below sea level, or about one hundred (100) feet lower than then existing levels. The study also predicted that an ancient saline front would advance eastward under the City of Stockton by a distance of 1.3 to 2.3 miles by the year 2020.

Existing conditions as confirmed by current investigations tend to provide evidence in the accuracy of the Brown & Caldwell Study. According to the recent US Geological Survey Joint Salinity Study (2006), the saline front underlying the City of Stockton has encroached further eastward under the City and the groundwater underlying a portion of the eastern part of the County has experienced decreases in water quality, despite the recent high levels of precipitation during the winter of 2005-06.

East San Joaquin Parties Water Authority – In 1995, County water interests facilitated the ESJPWA to conceive and implement a joint conjunctive use and groundwater banking project with EBMUD. Several alternatives were developed and explored with the goal of implementing the Mokelumne Aquifer Recharge and Storage Project (MARS). In wet years, supplemental surface water obtained would be used by County interest in-lieu of groundwater or be actively recharged using various methods. In dry years, EBMUD would be allowed to extract and export from the Basin a portion of the recoverable supply for use in the EBMUD service area.

In order to technically support the concept of aquifer storage and recovery, the ESJPWA undertook the Beckman Injection/Extraction Study (Beckman Study). The Beckman Study involved the injection of water from EBMUD's Mokelumne River entitlement via the Mokelumne Aqueduct and subsequent monitoring. The Beckman Study provided insight into the Groundwater Basin's ability to accept injected water. The Beckman Study concluded that the migration of injected water is attributed to many factors including seasonal hydrogeology, regional pumping patterns, and prevailing groundwater gradients. In 2002, the Authority continued the work of the ESJPWA and completed the Beckman Test Final Report. The Report concluded water injected at the site remained in the general vicinity. Further studies are needed to evaluate long-term storage and the overall recoverability of injected water from the underlying aquifer. Further analysis has concluded that the test area is suitable for recharge and that the recoverability of injected water is high.

San Joaquin County Groundwater Export Ordinance – In 2000, the Board of Supervisors amended the Groundwater Export Ordinance to prevent the deliberate export of groundwater for use outside of the County and condition the extraction of banked groundwater by out-of-County partners without a permit. The Export Ordinance requires stringent monitoring and extraction protocols deemed necessary to protect adjacent landowners and underlying basin from adverse impacts. The Board of Supervisors has indicated that a less restrictive form of the Groundwater Export Ordinance is possible should stakeholders propose changes in the context of a workable project.

San Joaquin County Water Management Plan – Adopted in 2002, the San Joaquin County Flood Control and Water Conservation District facilitated the development of the San Joaquin County Water Management Plan. Over the course of almost two-years, stakeholders representing over 30 water interests, have met to synthesize a plan that addresses overdraft conditions in the Basin, prevent further degradation of groundwater quality due to saline water intrusion, increases water supply reliability, meets the projected year 2030 County water demand, identifies viable water supply and recharge options, identifies the institutional structure to implement the options. Since the Water Management Plan's adoption, the County has continued to promote the goals of the Plan through the support of other agencies, the facilitation of the Advisory Water Commission and the Authority.

Northeastern San Joaquin County Groundwater Banking Authority – Organized in 2001, the GBA has provided a consensus-based forum to local, State, and federal water interests to work cooperatively with one voice to study, investigate, plan, and develop locally supported groundwater banking and conjunctive use projects in Northeastern San Joaquin County.

The System Plan, completed in 2002, outlined specific groundwater recharge options into a conjunctive water management system with the capability of recharging up to 300,000 af per year. Projects in the System Plan included the Freeport Interconnect Project, the Farmington Groundwater Recharge and Seasonal Habitat Project, the City of Stockton Delta Diversion Project and direct groundwater recharge through well injection and seasonal field flooding. Potentially new water supplies may come from surplus flows on the American River, Mokelumne River, Calaveras River, Littlejohns Creek, Stanislaus River, and the Delta.

Also in 2002, the GBA continued the work of the ESJPWA and completed the Beckman Test Final Report. The Report concluded water injected at the site remained in the general vicinity and that the test area exhibited a high degree of injected water recoverability. Further studies are needed to evaluate long-term storage and the overall recoverability of injected water from the underlying aquifer.

For over 30 years, the EBMUD and Sacramento County Water interests have fought over the future of the American River. In 2000, the parties agreed to a joint project whereby Sacramento interests and EBMUD would receive American River water on the Sacramento River near the town of Freeport. The project, coined the Freeport Regional Water Project, is expected to deliver water to the Mokelumne Aqueducts in Northeast San Joaquin County by 2009. The EBMUD is only allowed to receive American River water in the driest 35 percent of all years. In the remaining years, San Joaquin County could divert a significant amount of water through the Freeport Project. The Authority is currently in discussions with EBMUD on the development of the San Joaquin County Freeport Element, a proposed interconnecting pipeline project, which would take advantage of this opportunity. Thus far, the Authority has commissioned a water availability analysis and amended the County's water right application on the American River to coincide with the Freeport Project.

San Joaquin County Groundwater Monitoring Program – Since 1971, the San Joaquin County Flood Control and Water Conservation District has monitored groundwater levels and groundwater quality on a semi-annual basis. Over 300 wells are sampled by the District, and data from an additional 200 wells are incorporated into the groundwater level database. Groundwater levels are published in both the spring and fall reports. Groundwater quality data is collected once a year in the fall months for publication in the Fall Groundwater Report.

In 2000, the County completed an evaluation of the existing groundwater monitoring program in order to identify its adequacy. The evaluation concluded that the groundwater monitoring program is relatively adequate for groundwater levels, but does not collect enough saline water intrusion data. The recommendation was to increase the groundwater quality monitoring effort and perform an extensive hydrogeologic investigation of the Groundwater Basin in the region of the saline front. In 2002, the County worked with the DWR to drill two multiple depth well clusters in the City of Stockton along the projected saline front. Additionally, a joint study with the US Geologic Survey, the DWR, and member agencies of the Authority could further the efforts to better understand saline groundwater intrusion and the overall hydrogeology of the Basin.

Eastern San Joaquin Groundwater Management Plan – State Senate Bill 1938, passed in 2002, requires that agencies that elect to, "Prepare and implement a groundwater management plan that includes basin management objectives for the groundwater basin that is subject to the plan. The plan shall include components relating to the monitoring and management of groundwater levels within the groundwater basin, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin." In addition, local agencies that do not adopt or participate in a plan fulfilling the requirements of SB 1938 shall not be eligible for State funding intended for groundwater projects. The GBA has adopted the following qualitative Basin Management Objectives:

Management Objective #1: Groundwater Levels Maintain or enhance groundwater elevations to meet the long-term needs of groundwater users within the Groundwater Management Area.

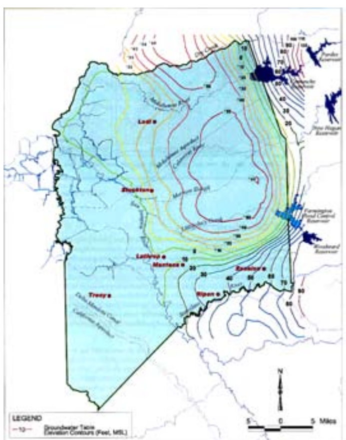
Management Objective #2: Water Quality Maintain or enhance groundwater quality underlying the Basin to meet the long-term needs of groundwater users within the Groundwater Management Area.

Management Objective #3: Surface Water Quality Minimize impacts to surface water quality and flow due to continued Basin overdraft and planned conjunctive use.

Management Objective #4: Water Quality Prevent inelastic land subsidence in Eastern San Joaquin County due to continued groundwater overdraft.

6.2 Basin Management Framework

Groundwater Level Plan Elements



Management Objective #1: Groundwater Level Plan Elements

1. Increase use of available and new surface water supplies;
2. Implementation of local and regional conjunctive use programs;
3. Development of Basin Operations Criteria;
4. Development of urban and agricultural incentive-based conservation and demand management programs;
5. Development of local and outside revenue sources.

Following the completion of the Eastern San Joaquin Groundwater Management Plan in 2004 with its adopted Basin Management Objectives, additional stakeholder discussions where conducted by the GBA Coordinating Committee to undertake the development of a basin management framework and operations criteria, as one of the specified objectives outlined in the Groundwater Level Plan Elements, that would be designed to help predict and manage the effects of groundwater recharge and use programs in the Basin. This effort was based on the assumption that the Eastern San Joaquin Groundwater Basin could be operated conjunctively without adjudication through enhanced groundwater recharge and sustainable use.

Groundwater Management Area - It was agreed on by the Committee that in order to operate the Basin in a conjunctive manner and to achieve adopted management objectives, the Groundwater Management Area described in the Groundwater Management Plan could be subdivided in a way to allow for continued local control, project responsibility and monitoring capability. This subdivision of the Basin was made beginning with the adopted Groundwater Management Area as shown in Figure 6-1.

Groundwater Management Area

Groundwater Management Area – that portion of San Joaquin County that overlies the Eastern San Joaquin County, Cosumnes, and Tracy Sub-Basins of the greater San Joaquin Valley Groundwater Basin.

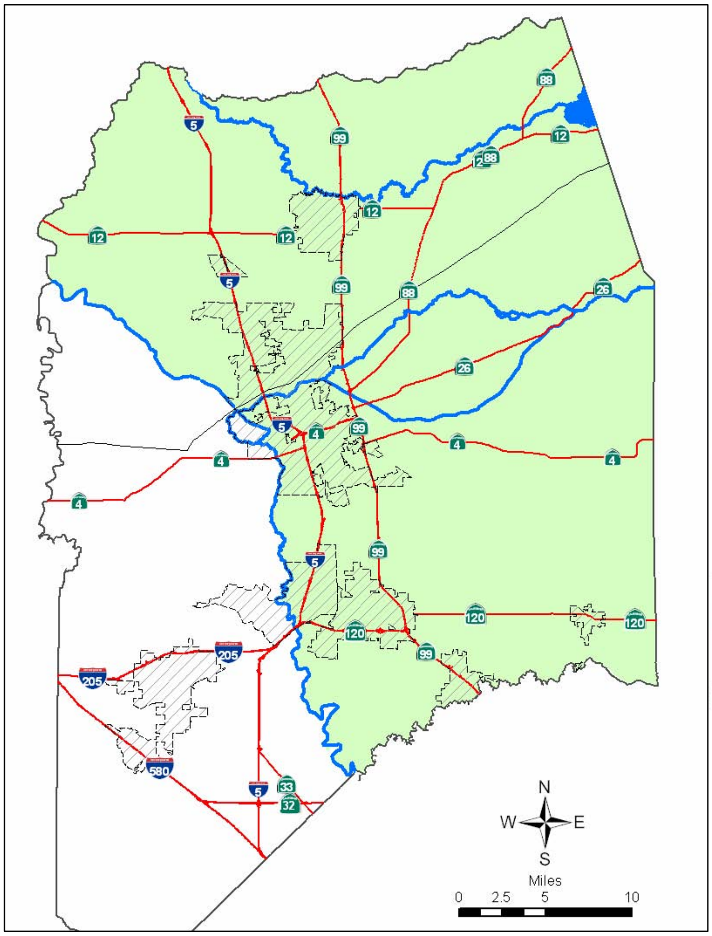


Figure 6-1 Groundwater Management Area

Basin Operation Areas – the Groundwater Management Area would then further divided into Basin Operation Areas, which are jurisdictionally defined subsets of the area that overlies the Basin established within existing city, water district or agency boundaries (See Figure 6-2).

As organized, the 15 managing agencies within the Eastern San Joaquin Basin Operation Areas (BOA) would include the following:

1. Woodbridge Irrigation District
2. City of Lodi
3. North San Joaquin Water Conservation District
4. City of Stockton
5. Stockton East Water District
6. Central San Joaquin Water Conservation District

7. City of Lathrop
8. City of Manteca
9. South San Joaquin Water Conservation District
10. Oakdale Irrigation District
11. City of Escalon
12. City of Ripon
13. Central Delta Water Agency
14. South Delta Water Agency
15. San Joaquin County Flood Control and Water Conservation District

Within a given BOA, an agency would be responsible for the appropriate management and monitoring of conjunctive use projects and to work with the GBA to collectively achieve adopted management objectives for the Basin.

Basin Operation Areas

Basin Operation Areas – a jurisdictional subset (City, District or Agency, etc.) of the Eastern San Joaquin Groundwater Management Area.

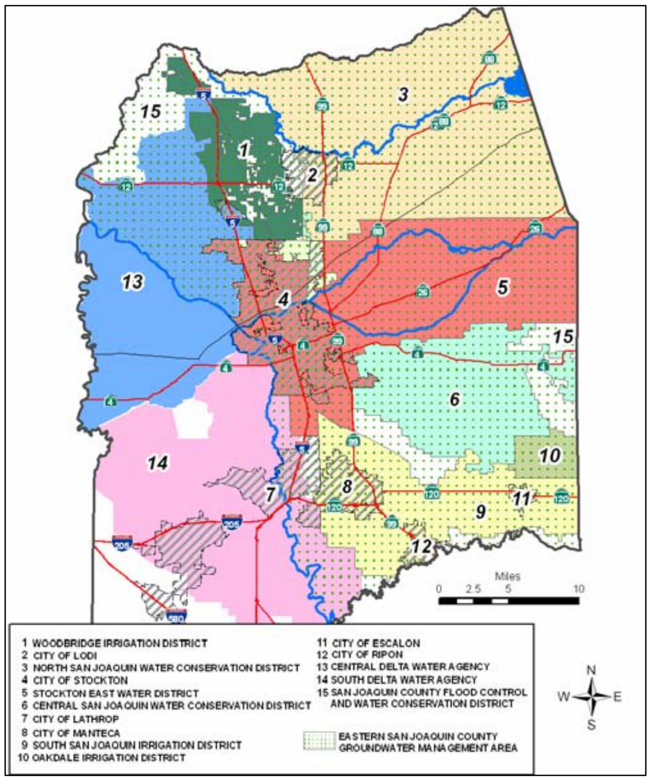


Figure 6-2 Groundwater Basin Operation Areas

Basin Operation Zone - Within Operation Areas, project zones would be established for conjunctive water project management (See Figure 6-3). Basin Operation Zones (OZ) would be located within a BOA where groundwater recharge and use projects are located within an Operation Area. It may be considered that any area which is potentially impacted by changes in basin hydrological conditions due to project operations would fall within a given zone.

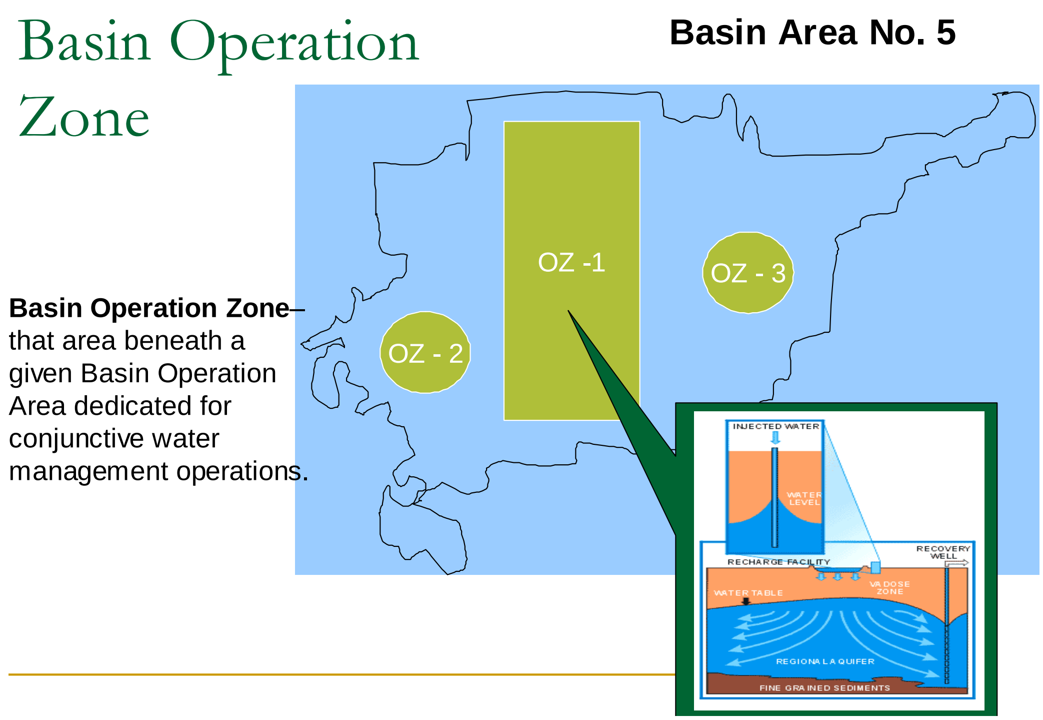


Figure 6-3 Groundwater Basin Operation Zone

6.3 Basin Operations Criteria

Originally tied to the development of Basin Management Objectives, Basin Operations Criteria would set quantitative target groundwater levels and descriptive basin condition levels. Basin Operations Criteria would consist of a series of groundwater levels triggers that would correspond to basin condition levels to indicate the effectiveness or impact of conjunctive use projects within either the GMA, a BOA or OZ. With the application of Basin Operations Criteria together with the Management Framework could ultimately provide the basis for an updated groundwater export ordinance or possibly new groundwater management ordinances that include a more detailed description of future groundwater management practices.

Essentially, Basin Operations Criteria are a quantitative management framework used to accurately monitor and predict changes in basin conditions and gauge ICU Program operations with delineated Basin Operation Areas and Zones in the Groundwater Management Area. Within each of these areas, specific groundwater measurement criteria can be established based on historic groundwater levels as defined by the following:

- **Pre-1960 Elevation** – the Eastern San Joaquin Groundwater Basin contour measured in 1960 will be considered as the criteria set as the top of the basin management framework. It was assumed that this elevation was established prior to significant groundwater overuse during the past 47 years.
- **Fall 1986 Elevation** - the Eastern San Joaquin Groundwater Basin contour measured in 1986 will be considered as the new criteria set for normal conjunctive use operations in the Basin. ICU Program projects will be developed to establish this new elevation, which has been the highest groundwater elevation in the over-drafted portion of the basin in the past 25 years.
- **Fall 1992 Elevation** – the Eastern San Joaquin Groundwater Basin contour measured in 1992 will be considered as the basin management framework baseline. This elevation was achieved following a significant drought period and has been the lowest elevation measured in the Basin.
- **Basin Reserve** – a quantifiable portion of the groundwater management area between the 1986 and 1992 contours that is dedicated as a water resource reserve to be utilized under dry year or drought conditions.
- **Basin Terminal Pool** - that portion of the groundwater management framework below the 1992 historic groundwater contour.

The projects and programs developed as part of the ICU Program will ultimately seek to conjunctively operate the basin under normal conditions at a groundwater elevation that is at or above the historic 1986 hydrologic contour. In that way, basin operation will meet both the quantitative basin operations criteria developed in this management framework and the qualitative basin management objectives adopted under the Groundwater Management Plan.

In simplest terms, the establishment of Operations Criteria has classified the Basin into four distinctive profiles that utilize "the Four R's", for ***Regional*** storage, ***Regular*** operations ranges, drought ***Reserve***, and post-drought ***Recovery***. This concept is illustrated in the Figure 6-4 below.

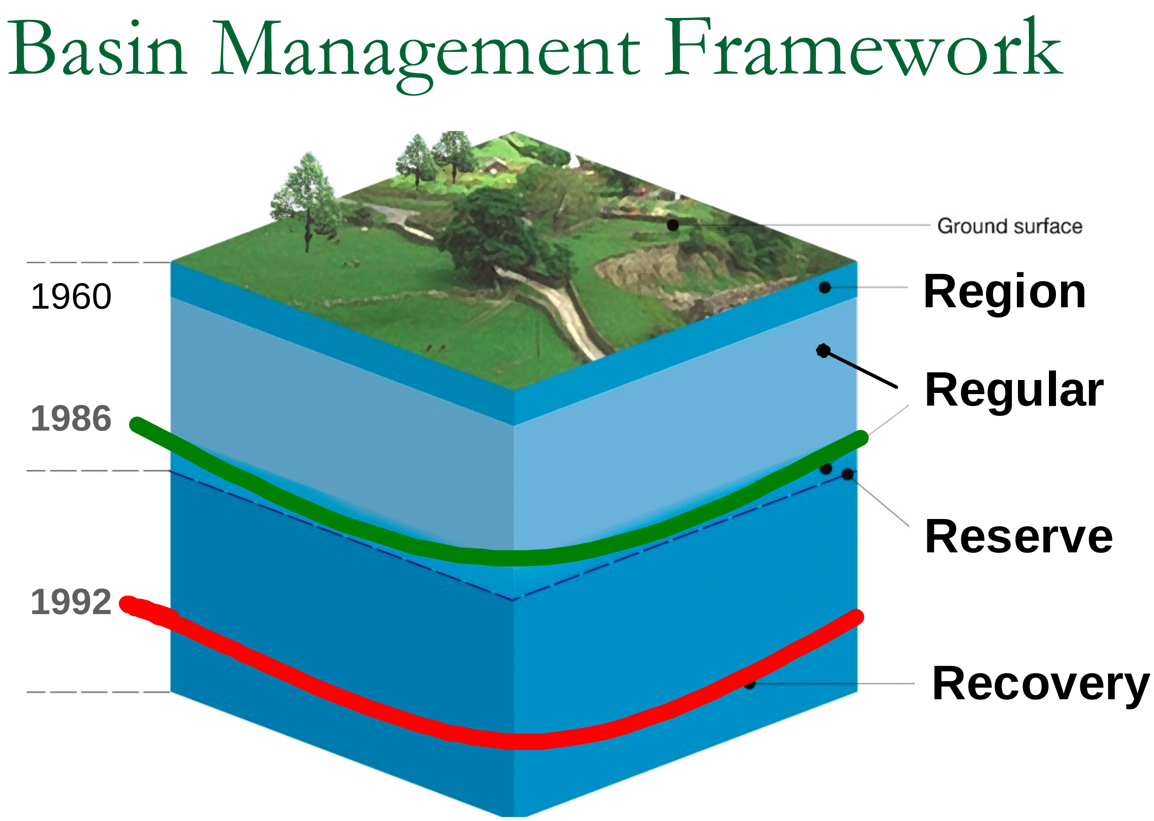


Figure 6-4 Conceptual Operations Criteria Levels – "The 4 R's"

As the foundation of the Basin Operations Criteria, GBA Coordinating Committee has proposed the ***Basin Conditions Scale*** – a color-coded scale designed to illustrate basin groundwater level or quality conditions similar to the US EPA Air Quality Index and the US Department of Homeland Security Advisory System. Colors are associated with overall groundwater basin health where an area under Condition Blue represents a healthy basin supply at Pre-1960 levels and an area under Condition Red represents an area below the historical low levels measured in 1992. Figure 6-5 displays the Basin Condition Scale and Basin Condition Map concept.

In its simplest state, the Basin Conditions Scale is a visual representation of basin groundwater levels or quality intended for the widest possible audience; however: the Basin Conditions Scale could also be applied to more complex operational situations where a series of basin management actions and policies could be initiated or repealed Basin-wide or at the Basin Operations Area or Basin Operations Zone level.

A ***Basin Condition Trigger*** is defined as a set of groundwater level conditions that, when triggered, initiate or repeal actions or policies established as basin management protocols and operations control of ICU Program operations Basin-wide and/or within a delineated Basin Operations Area or Zone.

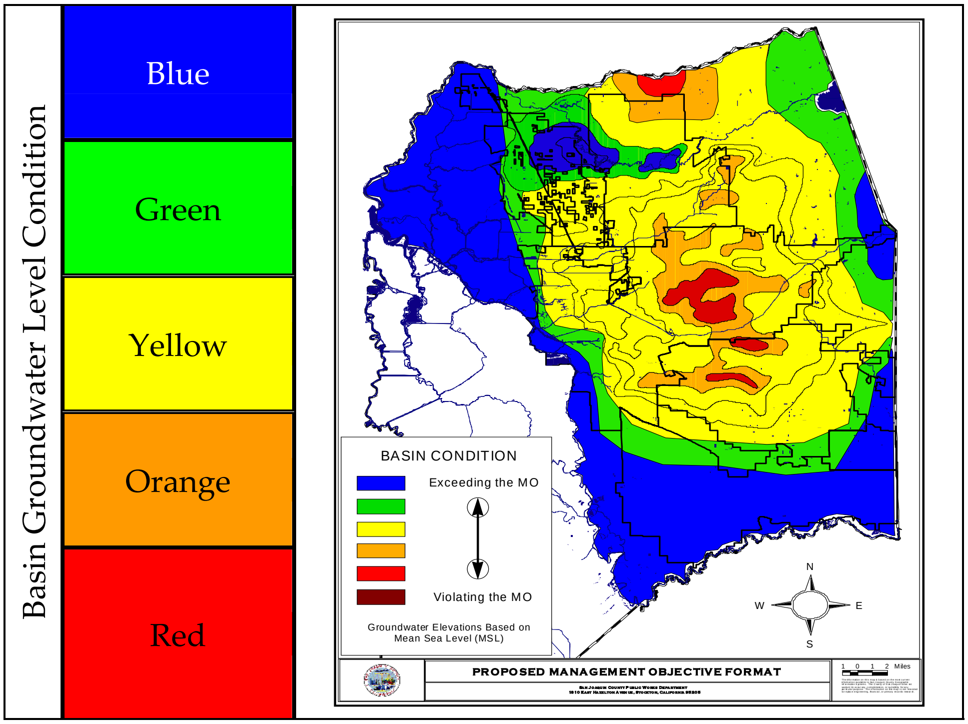
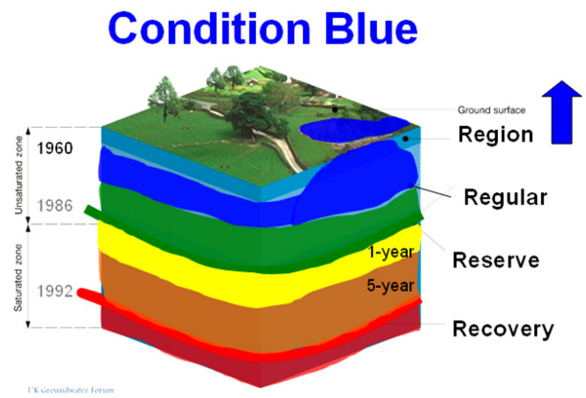


Figure 6-5 Basin Condition Scale and Basin Condition Map

Basin Condition Triggers are applied to both decreasing and increasing groundwater levels. As groundwater levels decline and triggers are set-off, certain more conservative basin operating rules may be instituted such as voluntary agricultural conservation, purchases of transfer water, or declaration of drought conditions. As groundwater levels increase, less stringent basin operations may be instituted such as intra-basin transfers and inter-regional marketing of banked groundwater. The following is a listing of proposed Basin Operations Triggers with potential actions and policies as outlined under specified basin conditions:

Condition Blue



- **Groundwater level fluctuating between Pre-1960 and 1986 contour**
- **Basin Operations Level:** Above normal or at maximum
- **Basin Storage Capacity:** based on need in excess of normal operational demand and equal to ___acre-feet
- **Local Use:** Full to all users equal to ___acre-feet
- **Regional Use:** permitted within IRWMP Benefits Area up to ___acre-feet

Condition Green

- **Groundwater level fluctuating at or near 1986 contour**
- **Basin Operations Level:** Normal
- **Basin Storage Capacity:** based on normal agency operational demand of ___acre-feet
- **Local Use:**
  - Full to all users within Groundwater Management Area (GMA)
  - Local transfers and export of ___acre-feet
- **Regional Use:** Permitted within Regional Integration Area of ___acre-feet

Condition Yellow

- **Groundwater level fluctuating below 1986 contour**
- **Basin Operational Level:** Below normal
  - Preliminary drought contingency plans within GMA
- **Basin Storage Capacity:** based on 1-year drought reserve of ___acre-feet
- **Local Use:**
  - Full to all users within GMA
  - Local transfers and export of ___acre-feet

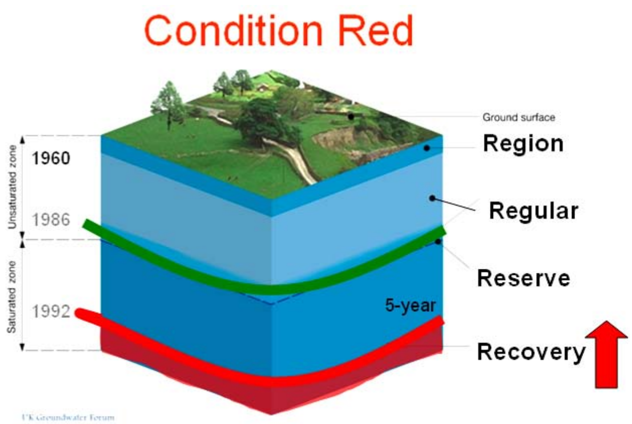
- **Regional Use:** Limited to Project Specific Permit Conditions

Condition Orange

- **Groundwater level fluctuating below 1986 contour & 1-year drought reserve elevation**
- **Basin Operations level:** Significant drought condition
  - Full Drought Contingency Plans within Basin Operation Areas (BOA)
  - Voluntary restrictions in place within GMA
- **Basin Storage Capacity:** based on 2 to 5-year drought reserve of ___acre-feet
- **Local Use:**
  - Local transfers encouraged within GMA of ___acre-feet
  - Full allocations to BOA pumpers
- **Regional Use:** Not Recommended; Limited to Project Specific Permit Conditions

Condition Red

- **Groundwater level below 1992 contour[1] & 5-year drought reserve elevation**
- **Basin Operations Level:** Critical drought condition
  - **State of Emergency**
- **Basin Storage Capacity:** terminal pool
- **Local Use:** Limited within GMA
  - Local transfers highly encouraged within GMA of ___acre-feet
  - Priority allocations to BOA pumpers
- **Regional Use:** Not Permitted



[1] Based on discussions at the GBA Coordinating Committee, fall 1992 levels are perceived to be the lowest recorded water level in the Basin. The decline of groundwater levels due to historic groundwater overdraft from the 1960's coupled with the onset of consecutive drought years from 1987-1992 forced numerous groundwater users to deepen or modify well systems. GBA Coordinating Committee members have postulated that should basin levels drop below the historic fall 1992 level, the event could possibly trigger a massive re-investment in well infrastructure to accommodate new groundwater levels.

6.4 Preliminary DYNFLOW Modeling of Basin Operations Criteria

The GBA has been in the process of developing a number of groundwater management strategies with the goal of managing the viability of groundwater as a sustainable source of water for the County. One potential strategy is to adopt operational groundwater levels which could be used to trigger voluntary actions intended to maintain ground levels within the specified operating range.

In order to test the applicability of the Basin Condition Scale, several initial modeling runs using the DYNFLOW Groundwater Model were performed. Eight modeling scenarios were created simulating the Base Case where no action is taken to supplement natural recharge and several recharge scenarios where annually, supplemental water is recharged in the central portion of the basin where groundwater levels are the lowest. Table 6-1 describes each scenario.

Table 6-1 Range of Recharge Scenarios Modeled

Base Case	1	2	3	4	5	6	7
0	30,000	45,000	75,000	120,000	200,000	300,000	400,000
Annual average recharge rate (acre-feet per year) applied in central portion of the Basin							

For the initial evaluation of this strategy, two historic groundwater levels were proposed for operating criteria – the fall 1992 level as the lower level and the fall 1986 as the upper level.

The fall 1992 groundwater level generally represents the lowest historical level experienced in the basin. Accordingly, well infrastructure is built to operate at this historic low level and the potential for negative impacts exists if groundwater levels are drawn-down below the fall 1992 level. The fall 1986 level is one of highest levels experienced in the basin in the last 25 to 30 years. If groundwater levels can be maintained near this level, the basin would have several or more years of stored groundwater to meet demands without dropping below the fall 1992 level. Additionally, if levels can be maintained higher than the fall 1986 level, then conjunctive use projects could potentially be implemented providing both regional and local benefits.

The purpose of the initial analysis was to quantify the volume of water that is required to be recharged or provided in-lieu to maintain groundwater levels near or above the proposed operating levels. The Eastern San Joaquin County Groundwater Basin Groundwater Model was applied to perform this evaluation, the results of which are documented in the May 23, 2005 CDM Technical Memorandum.

Based on the simulated recharge scenarios, a basin-wide recharge rate (either in-lieu or direct recharge) of approximately 120,000 acre-feet per year (Scenario 4) will tend to stabilize groundwater levels above the fall 1992 level. The base 2030 change in storage line illustrates a cumulative loss of stored groundwater over the 30-year simulation period of approximately 1 million acre-feet. With the 120,000 acre-feet per year recharge scenario (Scenario 4) the net 1 million acre-feet loss is improved to a 500,000 acre-feet gain.

Figure 6-6 illustrates on how groundwater levels would fluctuate over the 30-hydrology for each scenario. The Base Case Scenario shows that no-action would result in further decline of groundwater levels below the 1992 level. Scenarios 4 and 5 show that an estimated 120,000 to 200,000 acre-feet of recharge is needed to maintain a Basin operational level above the historical 1992 level and near the 1986 level.

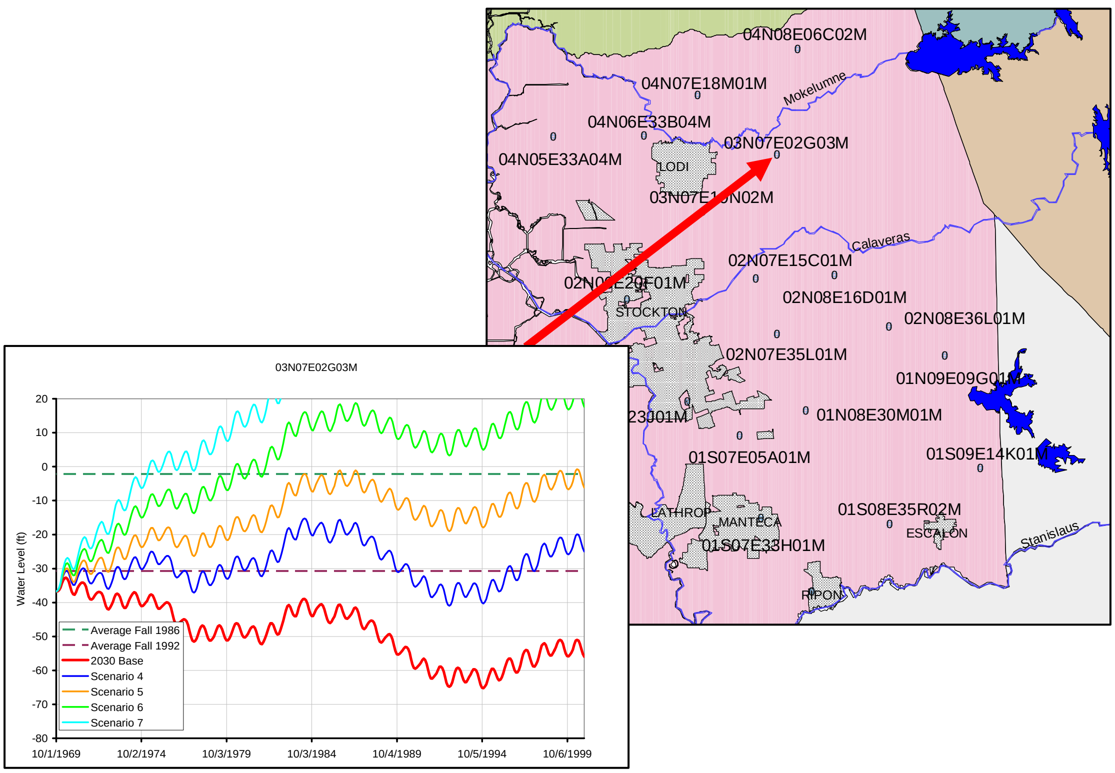


Figure 6-6 Modeled Basin Response in NSJWCD Well

The Basin Condition Triggers together with the Basin Conditions Scale can be integrated as shown Figure 6-7 when overlain on simulated and historic groundwater well hydrologic data beginning in 1968 through 2003.

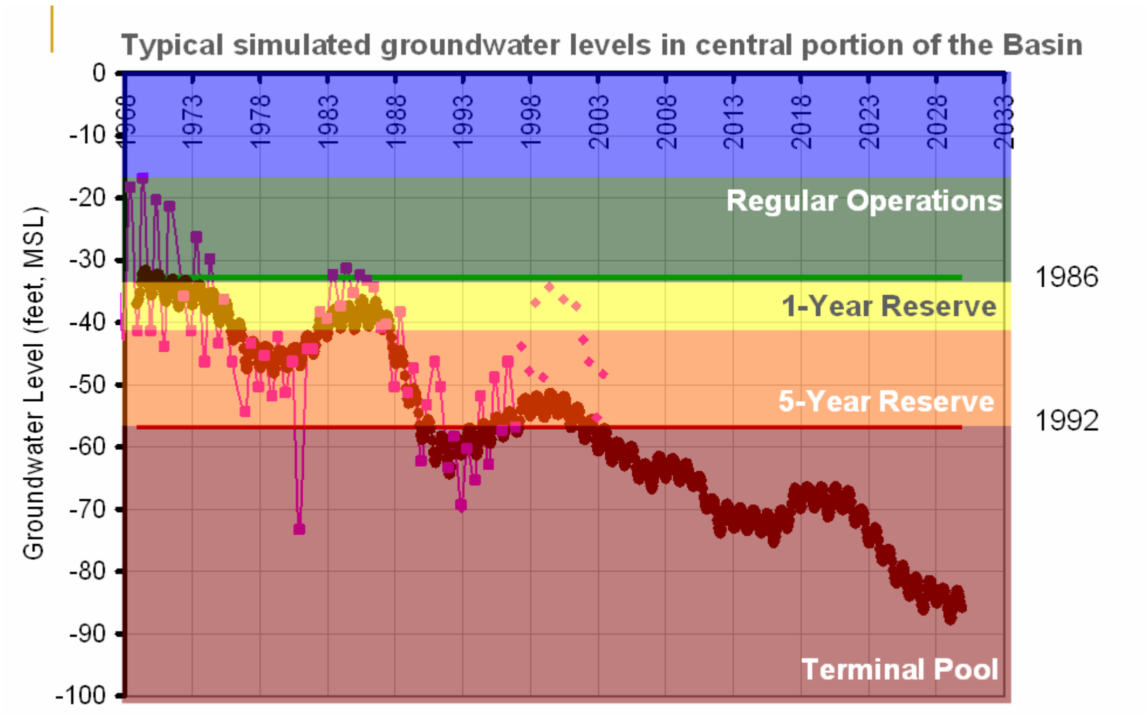


Figure 6-7 Basin Conditions Scale and Trigger Levels

6.5 IRWMP Systems Model Development

As the IRWMP was further developed additional modeling was conducted to describe the effects of several project alternative concepts on the Basin. The developed Model was based on the use of a programming environment called STELLA or Systems Thinking Experimental Learning Laboratory with Animation, developed by High Performance Systems, Inc. is a systems modeling industry standard. This modeling platform was selected because of its flexible and relatively simple programming environment. Models are constructed by dragging and dropping pre-defined elements of a system and it can be used to represent a biological, physical, water delivery, or even financial system. The model can be as complex or simple as the user wants and can represent several different types of systems interactively working together, such as a water flow model combined with a mass balance for water quality. In addition, the STELLA software provides graphical interfaces that create an engaging virtual environment, increasing the ability of technical staff, decision-makers and stakeholders to understand the dynamic nature of complex systems.

The IWRMP System Model (System Model) was designed to simulate water demands and supplies for each management zone within the Eastern San Joaquin Groundwater Basin (Basin) and selected quantitative benefits of initial IWRMP alternatives. The specific objective of the system model was integrate the available data, information and modeling results on Basin hydrology and regional water management alternatives into a relatively easy to use simulation platform. Once developed, the system model was then used to evaluate the water management measures including basin operations criteria and groundwater basin operations for a wide range of regional water management alternatives.

The System Model was essentially developed to be a water balance model based on several different management zones coinciding with GBA member district boundaries or urban spheres of influence. The model was programmed to simulate a single planning year (the 2030 level of development) over a historical 30 hydrology year sequence from 1970 to 2000. This allowed the model to be used to determine the alternative and system performance for any type of hydrologic condition. Computations were performed on a monthly time step. Under the Basin Management Framework, there are 15 different proposed operation areas within the entire county, which generally coincide with urban or water district boundaries. These different zones are also referred to Basin Operation Areas. To reduce the complexity of the system model, water balances were tracked and computed for five theoretical Basin Operation Areas including:

1. South San Joaquin Irrigation District, Oakdale Irrigation District, and the Cities of Ripon, Manteca/Lathrop & Escalon
2. City of Stockton
3. Stockton East Water District & Central San Joaquin Water Conservation District
4. North San Joaquin Water Conservation District & City of Lodi
5. Woodbridge Irrigation District

The system model incorporated a number of different systems such as the groundwater aquifers, water conveyance, on-farm use, and reservoirs in one model. Therefore, the physical system was represented in the model at a conceptual level only – i.e. the model does simulate any hydraulic or hydrologic routing. In addition to the physical water delivery system, the model parameters include water demands, existing water supplies (groundwater, reclaimed water and imported water), and potential water supply options (e.g., new surface water sources, conservation, groundwater conjunctive use, and other water management strategies etc). Additionally, the refined Basin Operations Criteria and Framework could be evaluated under a more localized setting. Figure 6-8 depicts the Basin subdivided into five areas is shown below.

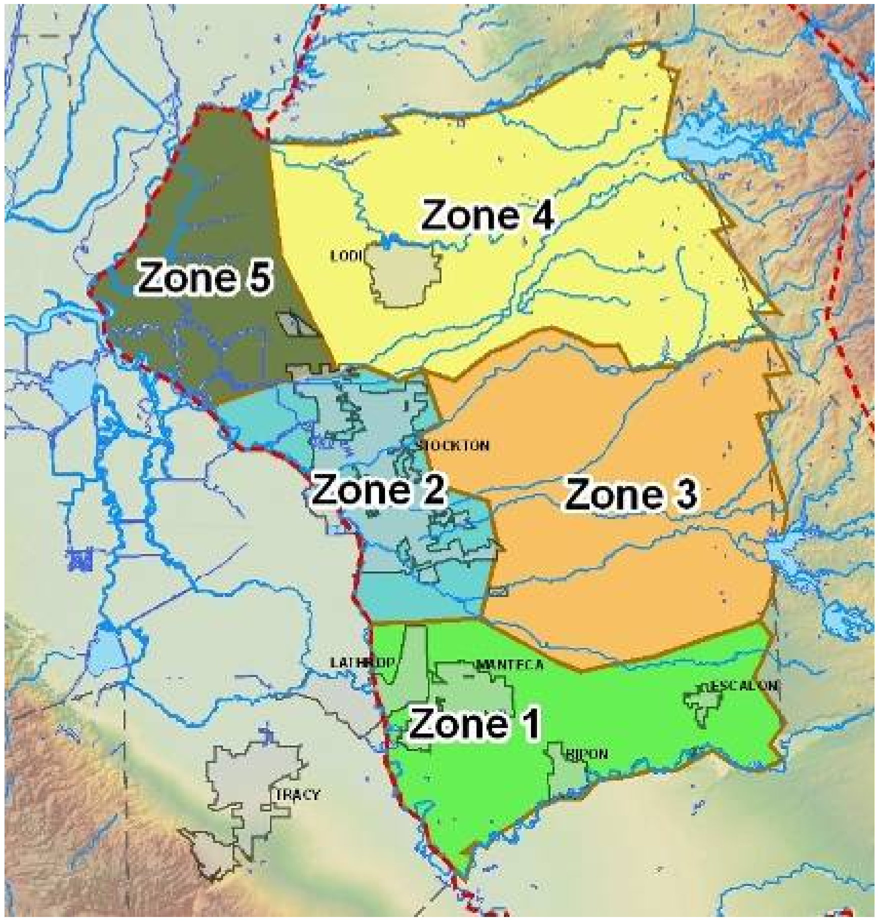


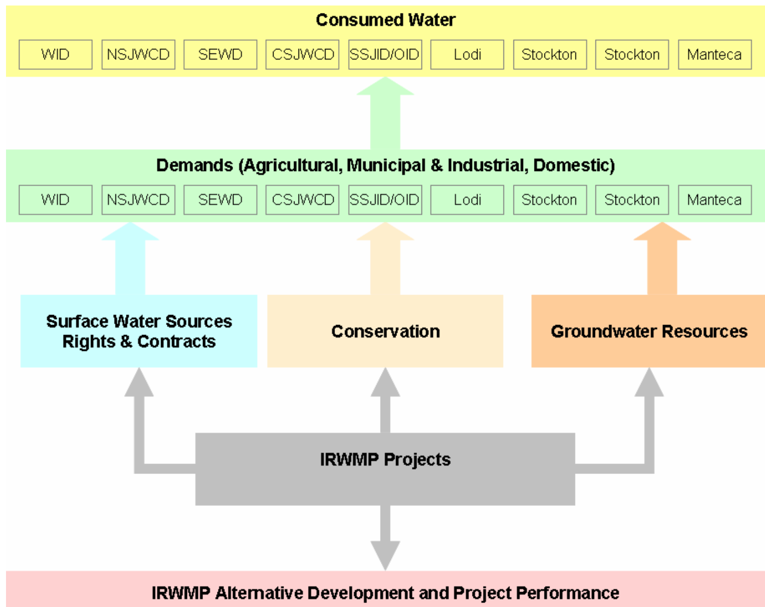
Figure 6-8 Initial Basin Operation Areas used in STELLA Systems Modeling

The numerical model was organized into several individual modules described below. A conceptual representation of the overall model is shown below.

Demand Module - The demand module incorporated the 2030 level of development demands for the all the operation areas including monthly agricultural, municipal and industrial (M&I) and domestic demand. The 2030 level of demand was factored according to year type.

- Agricultural demand was calculated from crop acreage per district/detail analysis unit (DAU), crop type, evapo-transpiration rates, and irrigation method/efficiency
- M&I demand was input to the model based on projected 2030 levels of demand for all the major cities in the study area

- Domestic demands were derived from the existing estimates in the DYNFLOW groundwater model



Surface Water Supplies and Infrastructure Module - Existing water supplies were incorporated as individual water contracts, rights, groundwater and imports & exports for each operation area. Demand was generally satisfied with the following priority: available surface water rights and contracts and the remainder by groundwater pumping. Imports and exports from an operation area (such as the SEWD 'export' to City of Stockton) were also tracked. Groundwater was assumed to be unlimited. Specific logic was added when required to adjust the general priority of the use of supplies described above. For each operation area, physical infrastructure limits were incorporated into the model. Two parameters were used to control surface water delivery – conveyance capacity limits, and on-farm distribution system limits

Groundwater Module - A simplified groundwater budget was calculated for each time-step for each Basin Operation Area. The groundwater budget was based on the following parameters.

- Calculated groundwater pumping based on inputs from the demand and surface water supply module
- Deep percolation rates as computed from the calibrated groundwater model for the historical hydrology
- River/stream seepage rates as computed from the calibrated groundwater model for the historical hydrology
- Seepage from irrigation as a function of applied water, and typical seepage rates from the groundwater model
- Change in storage computed as the net of the inflows and outflows

Based on the computed change in storage, and consequent change in groundwater levels was computed. The lateral inflow into each management zone will then be computed based on a simplified relationship between groundwater heads and lateral inflow from the groundwater model.

Figure 6-9 below illustrates a calculated groundwater level using the groundwater accounting methodology outlined above for the SEWD Basin Operation Area compared to the simulated average groundwater table from the groundwater model. The figure shows there was good agreement between the groundwater model output and the simplified system model accounting. The degree of agreement using these two methods varied according to complexity of the groundwater flow regime in each operation area.

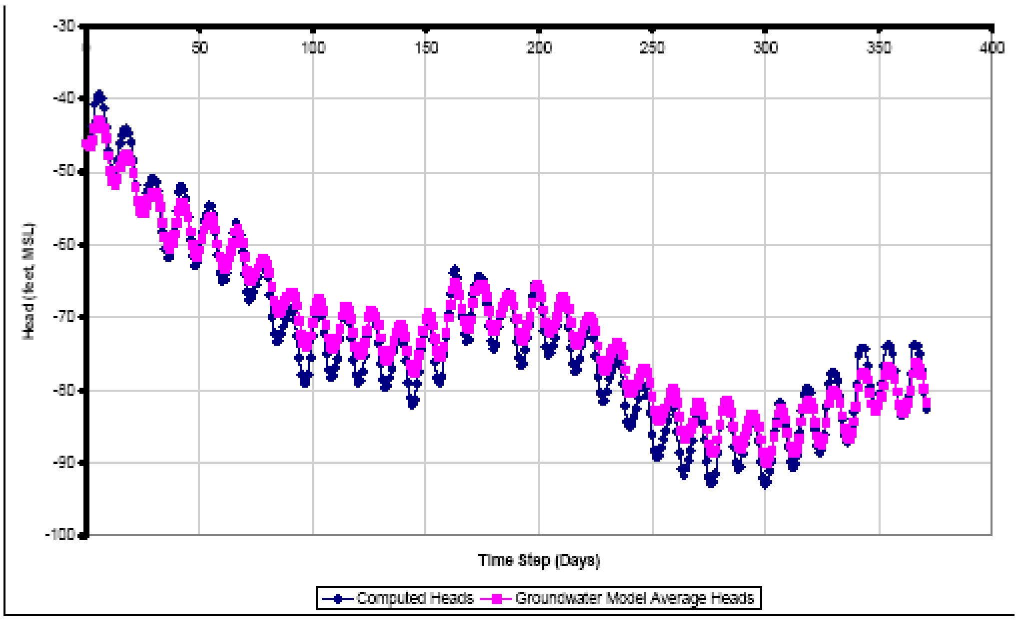
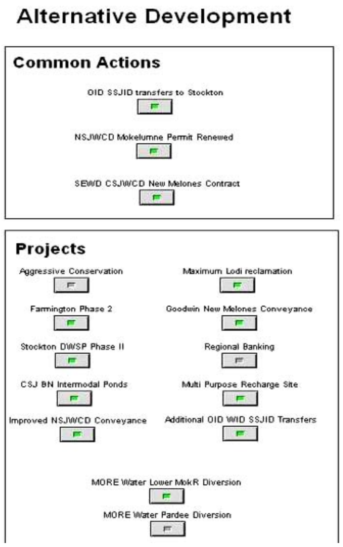


Figure 6-9 Comparison of Groundwater Model Simulated Heads and Simplified Representation for System Model

IRWMP Modules - Projects already identified by the GBA Coordinating Committee were programmed into separate modules and were then linked to the appropriate source modules (i.e., groundwater, surface water or conserved water). The user will be able to group individual projects into alternatives and run scenarios.

Figure 6-10 illustrates a partial screen shot for the IRWMP STELLA Systems Model for the Eastern San Joaquin Groundwater Basin. A preliminary list of the IRWMP projects that were programmed into the system model is listed below:

Urban Water Conservation - Urban water conservation elements were incorporated into the model as a simple potential percentage reduction in demand for each operation area.



- **Agricultural Water Use Efficiency.** Specific agricultural water use efficiency projects were incorporated into the model as appropriate. Projects included modification of irrigation methods or efficiency, or reduction of irrecoverable irrigation losses. If project specific information was available, such as acreage of improved irrigation efficiency was available, such details were incorporated into the model.

- **Recycled Water Use.** Recycled water projects were programmed as specific projects. For example, tertiary treated wastewater in the City of Lodi could potentially be recharged to the groundwater system or used in other ways.

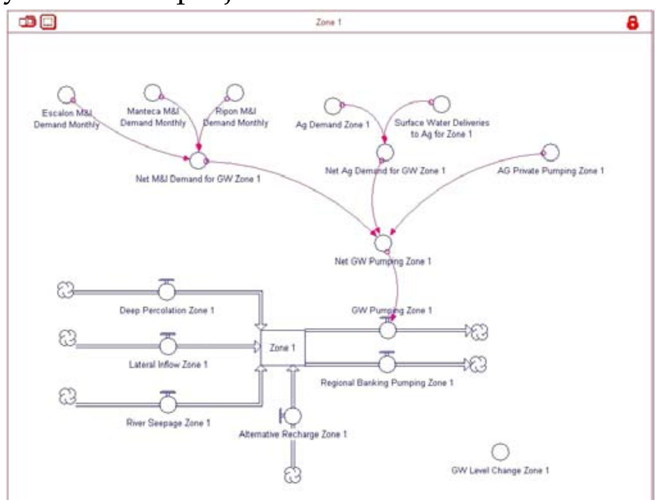


Figure 6-10 Systems Model Template

- **Surface Storage, Diversions and Regional Conveyance Projects.** Eight different projects involving new surface water storage, diversions and conveyance were identified in the model. These projects are described below.

  - City of Stockton Delta Water Supply Project
  - Freeport Regional Water Project Unassigned Capacity
  - MORE Water Project – Duck Creek Reservoir
  - Lower Mokelumne River Diversions
  - Eastern Water Alliance Canal
  - Gill Creek and Woodbridge Road Flood Control Improvements

  - South Gulch Reservoir
  - Lyon's Dam

- **Groundwater Recharge Components**
  - Farmington Program
  - SEWD Water Treatment Plant Expansion
  - CSJWCD Surface Water Delivery Program
  - NSJWCD Conjunctive Use Program

The individual projects listed above were programmed into the system model. Each project was typically represented by the following parameters:

- Reduction in M&I demand associated with either urban conservation programs;
- Reduction in agricultural demand associated with water use efficiency measures;
- Increased surface water supplies;
- Increased conveyance capacity;
- New conveyance "links" or connections;
- Increased farm delivery capacity;
- New or increased surface water storage;
- New or increased groundwater recharge; and,
- New or increase conjunctive operations and/or banking.

Performance Measures Module - The overarching objective of the GBA ICU Program is to ensure the long-term sustainability of water resources in the San Joaquin region while:

- Equitably distributing benefits and costs
- Minimizing adverse impacts to agriculture, communities and the environment
- Maximizing efficiency and beneficial use of supplies, and
- Protecting and enhancing local water rights and supplies.

The performance of both individual projects and the various program alternatives were tracked relative to these goals set within the Basin Operations Criteria and Management Framework for the Basin.

6.6 IRWMP Systems Model Analysis & Results

Upon completion of programming, testing and debugging of the Systems Model, it was used to evaluate an individual projects' ability to meet the fundamental objectives as represented by the performance measures. This initial analysis supported the refinement of individual project alternative components and yield, and assisted in initial screening of projects.

Four initial program alternatives combining several project and program elements including the no action alternative were evaluated. This evaluation was focused on the alternative's ability to meet proposed Basin Operations Criteria. A detailed listed of the various project components included in each of the "Strawman" proposal alternatives can be found in Figure 6-11 and included the following elements:

- No Action – only Common Elements
- Alternative 1 – Demand-Side Focus: Common Elements, Common Actions, demand management measures
- Alternative 2 – Local Supply Focus: Common Elements, Common Actions, supplies originating in management area
- Hybrid Alt – New Supply Focus: Common Elements, Common Actions, supplies diverted from outside management area, and regional banking

7/14/06 PRELIMINARY NSJCGBA Alternatives Supply & Cost	Alt 0	Alt 1	Alt 2	New Supply Max Hybrid
Projects				
Aggressive (15%) conservation		X		X
Maximum Lodi reclamaiton		X	X	
Ag application of reclaimed water		X		
Stockton DWSP Phase II			X	X
Farmington Phase 2			X	X
Improved NSJWCD conveyances			X	X
Goodwin/New Melones Conveyance	X	X	X	X
Alliance Canal			X	
Integrated Import Projects				
MORE Water				
Lower Mokelumne diversion			X	
Lower Mokelumne diversion				X
Pardee diversion				X
Freeport unused capacity				X
Regional banking				
Recharge				X
Extraction				X
Duck Creek Reservoir				X
South Gulch Reservoir				X
Recharge elements				
In-lieu			X	X
Field flooding				X
Pond			X	X
Multi-pupose recharge site			X	X
CSJ BN Intermodal ponds			X	X
Local groundwater banking				
Recharge			X	
Extraction			X	
Saline barrier				X
Management Actions				
Incentives for surface water use (CSJ CIP)		X		X
Incentives for drought fallowing		X		
Incentives for conversion to lower water uses		X		
Additional transfers from WID, OID, SSJID			X	X
Land Retirement		X		
Allow lower basin equilibrium				X

Figure 6-11 Initial Strawman Proposal

It was anticipated each alternative would maintain groundwater levels within Operation Areas 1 - 5 between the 1986 and 1992 hydrologic contours. With the Systems Model, each alternative was then tested and minimum, maximum and median groundwater levels were calculated for each operation area as shown in the following Figures 6-12 through 6-16.

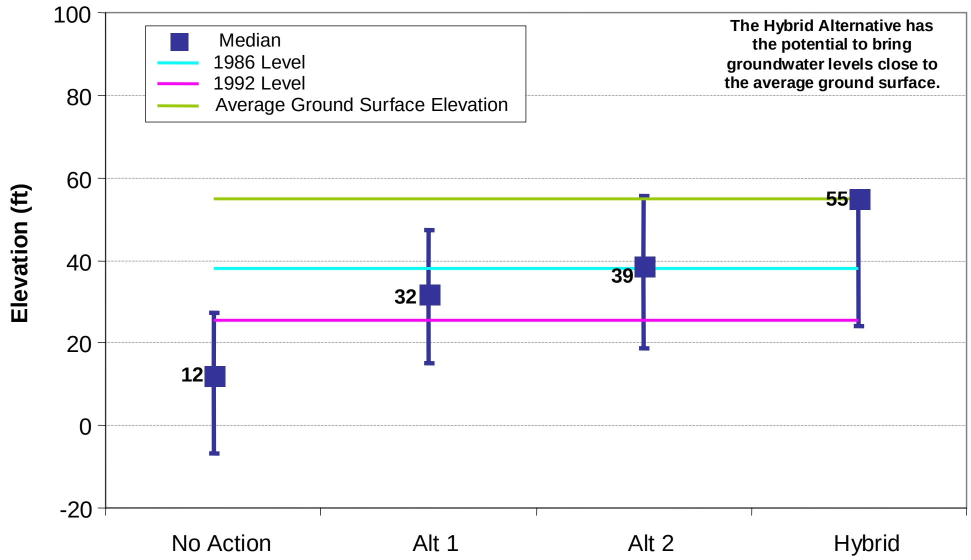


Figure 6-12 Groundwater Levels for Zone 1

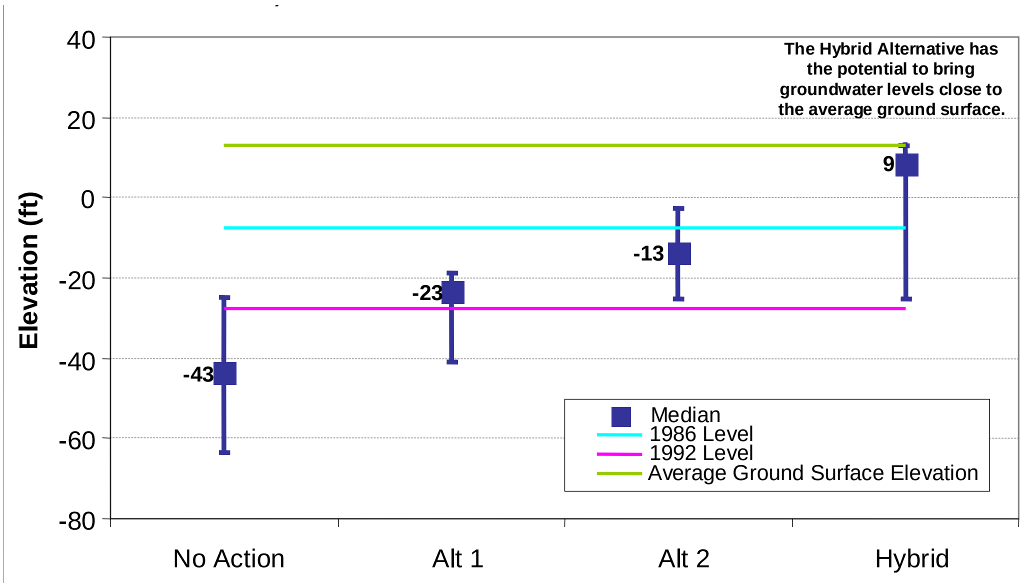


Figure 6-13 Groundwater Levels for Zone 2

Results indicate that the No Action alternative failed to improve average groundwater levels in any of the Operation Areas. Alternative 1 – Demand-Side Focus showed some improvement towards the 1986 level and maintained groundwater levels above the 1992 level in all areas. Alternative 2 – Local Supply Focus appeared to meet 1986 levels under the majority of years and in most areas. While the Hybrid Alt – New Supply Focus provided more water than necessary to meet 1986 levels and in some cases brought groundwater levels near the surface. In most cases, Alternatives 2 & 3 were most successful in maintaining the Basin within the proposed Basin Operations Criteria except in Area 5. Area 5 within the Woodbridge Irrigation District is not in the area of significant groundwater overdraft and has maintained historically high groundwater levels.

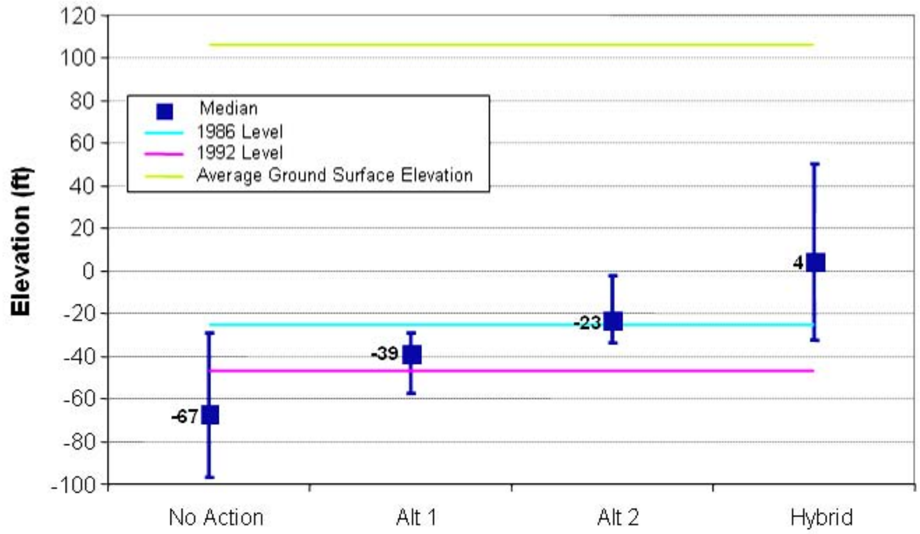


Figure 6-14 Groundwater Levels for Zone 3

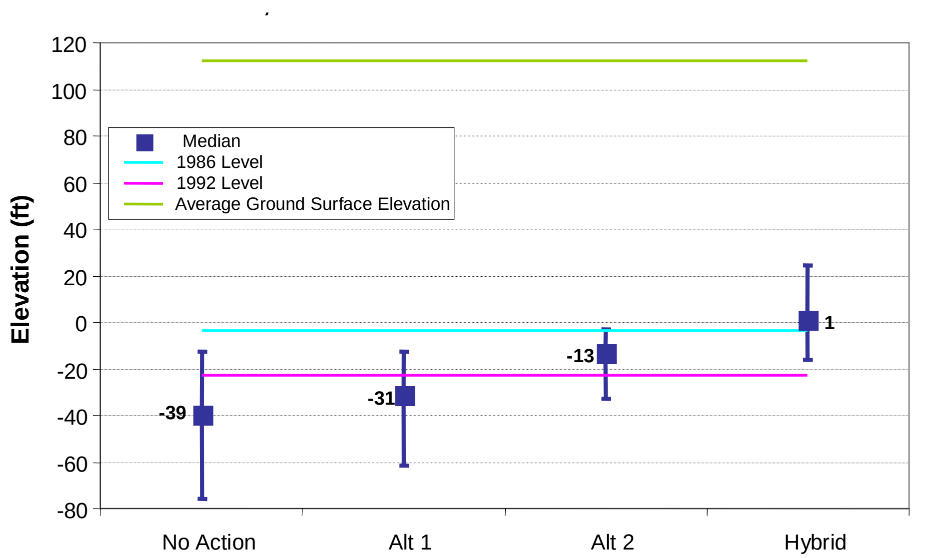


Figure 6-15 Groundwater Levels for Zone 4

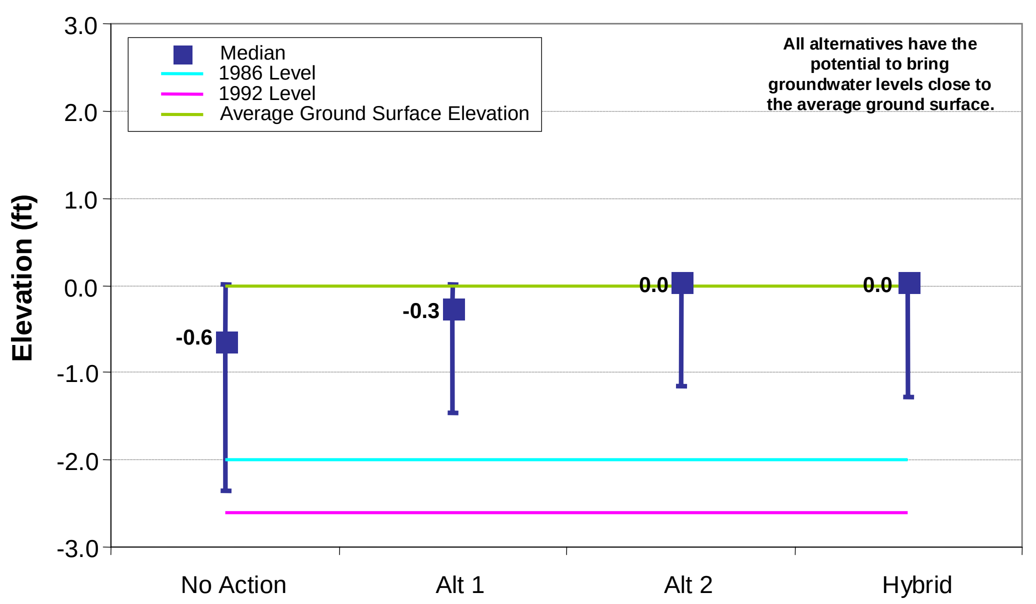


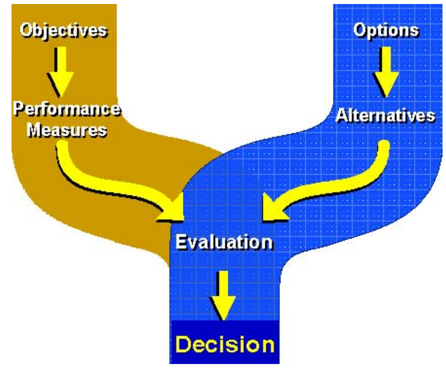
Figure 6-16 Groundwater Levels for Zone 5

In conclusion, the Systems Model was successful in comparing initial program alternatives and screening how each alternative could meet operations criteria within a proposed basin management framework. From this analysis, the criteria and framework proposed for the Basin appeared to be applicable and warranted additional analysis as the program alternatives were further refined. Future model use may be to provide operational decision support. More specifically, support decisions on how to use available flood flows available in a particular year based on current hydrologic conditions.

6.7 Groundwater Management Decision Support Tools

Decision support is both a process and a set of tools that help agencies make informed decisions regarding groundwater management, which are complex and often controversial. As a process, decision support helps develop collaboration and leads to discovery of consensus among key stakeholders. As a set of tools, decision support can help organize data, analyze alternatives, and interpret results that incorporate stakeholder values and uncertainty.

There are many different types of decision support tools, each with a specific purpose. Selection of the proper tool(s) should be based on the type of decision being made and the complexity of the problem. It is also important to recognize that there are different levels of decision-making: (1) strategic, (2) tactical, and (3) operational. Each level of decision-making requires different degrees of detail from an analysis standpoint. At the strategic level, more generalized system simulation models may be more appropriate



for evaluating alternatives. This is a *descriptive* approach in which alternatives are tested against a wide variety of objectives, and under different scenarios of what the future could look like.

As the decision-making moves to tactical, optimization (or linear programming) may be needed. This is a more *prescriptive* approach, where objectives and system constraints are well understood and the definition of "optimal" can be clearly determined.

When the decision-making moves to operational, very detailed mathematical models that *predict* the outcomes in hours are usually needed. Such real-time forecast models are often tied to SCADA systems for water supply operations.

Water resource management and policy decisions have traditionally been made by engineers and planners analyzing information, with policy makers making the final decisions unilaterally. In recent years, however, public scrutiny of infrastructure and environmental decisions has intensified—requiring more transparent and verifiable decision processes and tools designed to provide defensible guidance on water resource management issues. Some of the reasons that traditional decision-making techniques are inadequate in today's circumstances include:

- **Regionalization** – Consensus must often be reached by multiple jurisdictional authorities. Stakeholders and decision-makers increasingly recognize that sustainable use and management of water resources requires that decisions be made on a watershed basis.
- **Public Awareness and Advocacy** – Support from public stakeholders and activist groups can significantly increase the viability of institutional decisions, and hence, should be included in the decision process. When stakeholders become engaged and feel that they have an ownership in the process, wide spread public support for large infrastructure investments and environmental improvements has a better chance of occurring.
- **Multiple and Competing Uses** – Many water systems, originally designed to support single uses such as water supply, are now relied upon to produce additional benefits, such as flood attenuation, recreation, and environmental enhancements.

- **Over-complexity of Existing Tools** – When comparing diverse alternatives, many traditional modeling tools are too complex, discipline-specific, data intensive, and difficult to adapt to changing needs. They are also incapable of simultaneously simulating all of the different system components (such as source of supply, system distribution, water quality, environmental, and financial).

It is anticipated that further development of the GBA's STELLA Systems Model could aid as a decision support tool in groundwater basin management and implementation of the ICU Program.

6.8 Integration of Groundwater Management Strategies

The GBA seeks to foster prudent groundwater management strategies to avoid significant adverse overdraft-related environmental, social and economic impacts. The development of Basin Operations Criteria has been a collaborative process undertaken by the GBA to further advance possible basin management structure to avoid such impacts while maintaining local control of this important resource.

The San Joaquin County Groundwater Export Ordinance (Ordinance No. 4064, Section 5-8100) approved in 2000 currently protects Basin users from the potential ill-effects of groundwater export. However, groundwater overuse from local pumping continues to cause additional declines in groundwater levels even with the export ordinance in place.

The GBA will explore as part of the Management Action Plan outlined in Chapter 9, the potential of integrating additional management strategies that would facilitate the implementation and enforcement of Basin Operations Criteria within the principals and intentions of the Export Ordinance and with adequate local control and oversight. Basin Operations Criteria developed within the proposed management framework could ultimately provide the basis for a revised export ordinance and new groundwater management ordinances.

Chapter 7 - Integrated Conjunctive Use Program

The Eastern San Joaquin IRWMP will define and implement the Integrated Conjunctive Use Program the Basin (ICU Program), which is a comprehensive, prioritized suite of projects and actions described in the IRWMP to ensure the reliability and sustainability of water resources in the eastern San Joaquin County Region. All on-going and proposed projects, programs, and studies proposed for the region have been aggregated, integrated, and evaluated on an equal basis, to funnel these regional efforts into a prioritized implementation plan, as illustrated schematically in Figure 7-1.

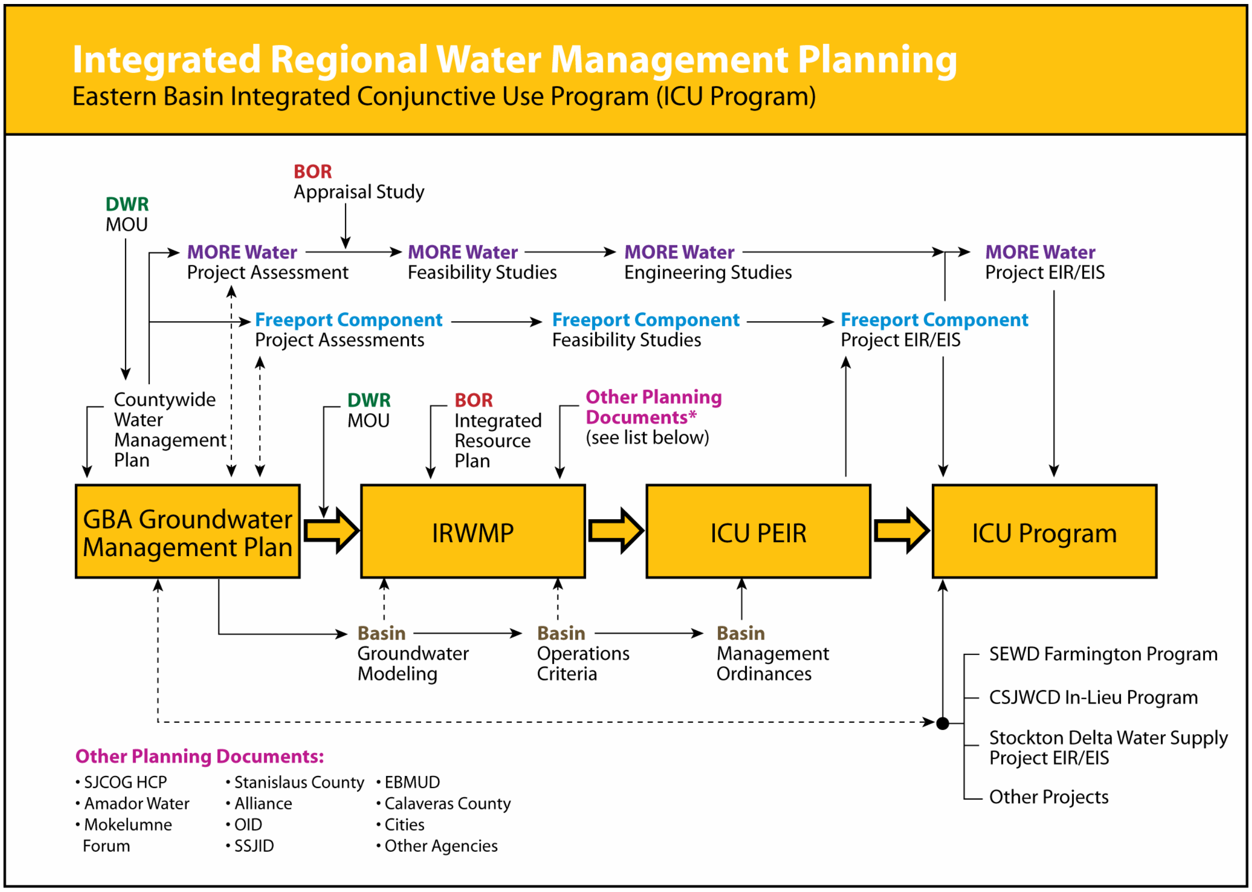


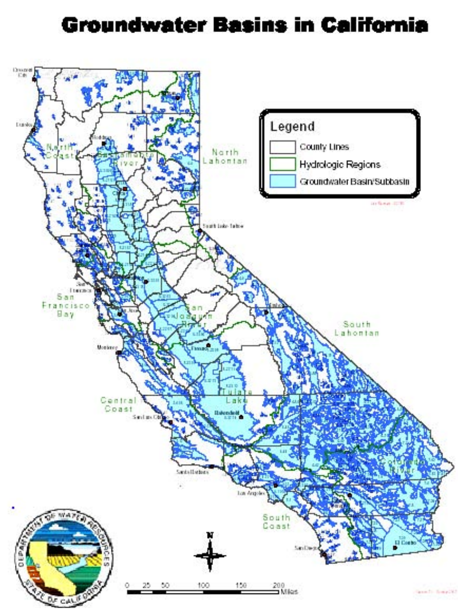
Figure 7-1 Integrated Conjunctive Use Program Schematic

The ICU Program is a broad-based program to integrate and coordinate water resource management over a large region encompassing all or parts of the watersheds of the Mokelumne, Calaveras, and Stanislaus Rivers and Littlejohns Creek. The plan is designed to be expandable to integrate with the complete watersheds and adjacent areas such as the American River in the future. As such, a set of measurable, performance-based evaluation criteria have been developed that will be applicable to potential future planning and management in a broader region. The purpose of establishing these criteria a priori will support implementation of projects and programs that best meet the region's objectives rather than a small constituency, and identify opportunities for regional collaboration and leadership.

The Plan Management Area is a study in contrasts:

- The area encompasses water districts with and without adequate surface water supplies.
- Some areas have groundwater elevations very close to pre-development levels, and other areas where groundwater levels have continued to drop for decades.
- The area's highly productive though depleted aquifers sit astride the Sacramento-San Joaquin Delta, the switching yard for the majority of California's water supplies.
- A major conveyance facility traverses the area carrying Mokelumne River water to the Bay Area. A second such facility conveying Sacramento River water is under development. However, these conveyances are not paired with storage adequate to meet Bay Area needs.

These contrasting conditions provide substantial opportunities for mutually-beneficial integrated programs that capture surplus supplies from areas with adequate supplies, and use them to replenish depleted aquifers to be used in times of drought. Areas external to the Plan Management Area (in the Statewide Solution Area, see Chapter 2) may pay significant portions of the Plan implementation costs to obtain access to stored water in dry years.



Because the Eastern San Joaquin County Basin is part of a regional aquifer system, shared both internally and externally of the GBA boundaries, integrated regional solutions are essential to solve key regional issues while avoiding, or minimizing conflict. No one solution will fully address the underlying issues facing the area. An integrated mix of water management strategies (conservation, reclamation, new supplies, transfers, stormwater capture, groundwater banking and management are all expected to be part of the solution mix.

7.1 Process Overview

This Chapter presents the following:

- Identification of water management strategies, supply sources, and projects;
- Development of evaluation and prioritization criteria and associated tools;
- Formulation of alternatives that address GBA objectives; and
- Applying evaluation criteria to rate, rank, and prioritize alternatives.

As described in Chapter 5, the Eastern San Joaquin IRWM Plan was developed using a nested tier system, which focuses Purpose and Need, Objectives, and Values into increasingly refined evaluation and prioritization criteria that are used to guide the selection of an implementation strategy that meets the IRWMP Purpose. Items in each lower tier directly relate to and support the concepts at each higher level. Chapter 5 presents a discussion of the GBA mission, the purpose and need for the IRWMP, issues to be addressed, and the IRWMP objective statement. Chapter 7 describes the development of the projects and programs to address the purpose and need, and the development and application of evaluation and prioritization criteria for establishing rating, ranking, and implementation priority.

7.2 Identification of Supply Sources, Water Management Strategies, and Projects

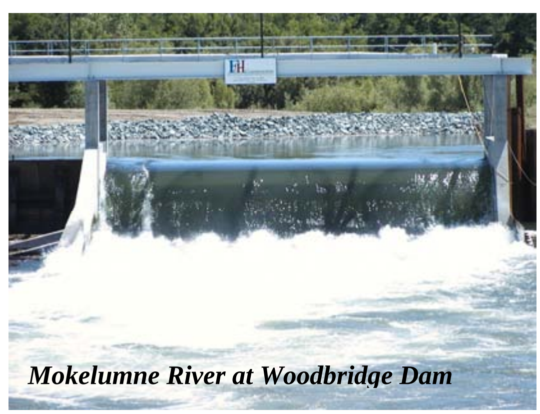
7.2.1 Major Water Related Infrastructure

Major water related infrastructure is depicted in the "Integrated Conjunctive Use Program" map presented as 2. The map illustrates existing and proposed reservoirs, waterways, conveyance systems, irrigation systems, treatment plants, and recharge areas.

7.2.2 Surface Water Supplies

Water supplies and associated water rights have been secured or have been applied for on most of the stream systems in the region. Water supply sources from the following stream systems are discussed below:

- **Sacramento-San Joaquin Delta**
- **American River**
- **Mokelumne River**
- **Calaveras River**
- **Littlejohns Creek /Rock Creek**
- **Stanislaus River**
- **San Joaquin River**



Mokelumne River at Woodbridge Dam

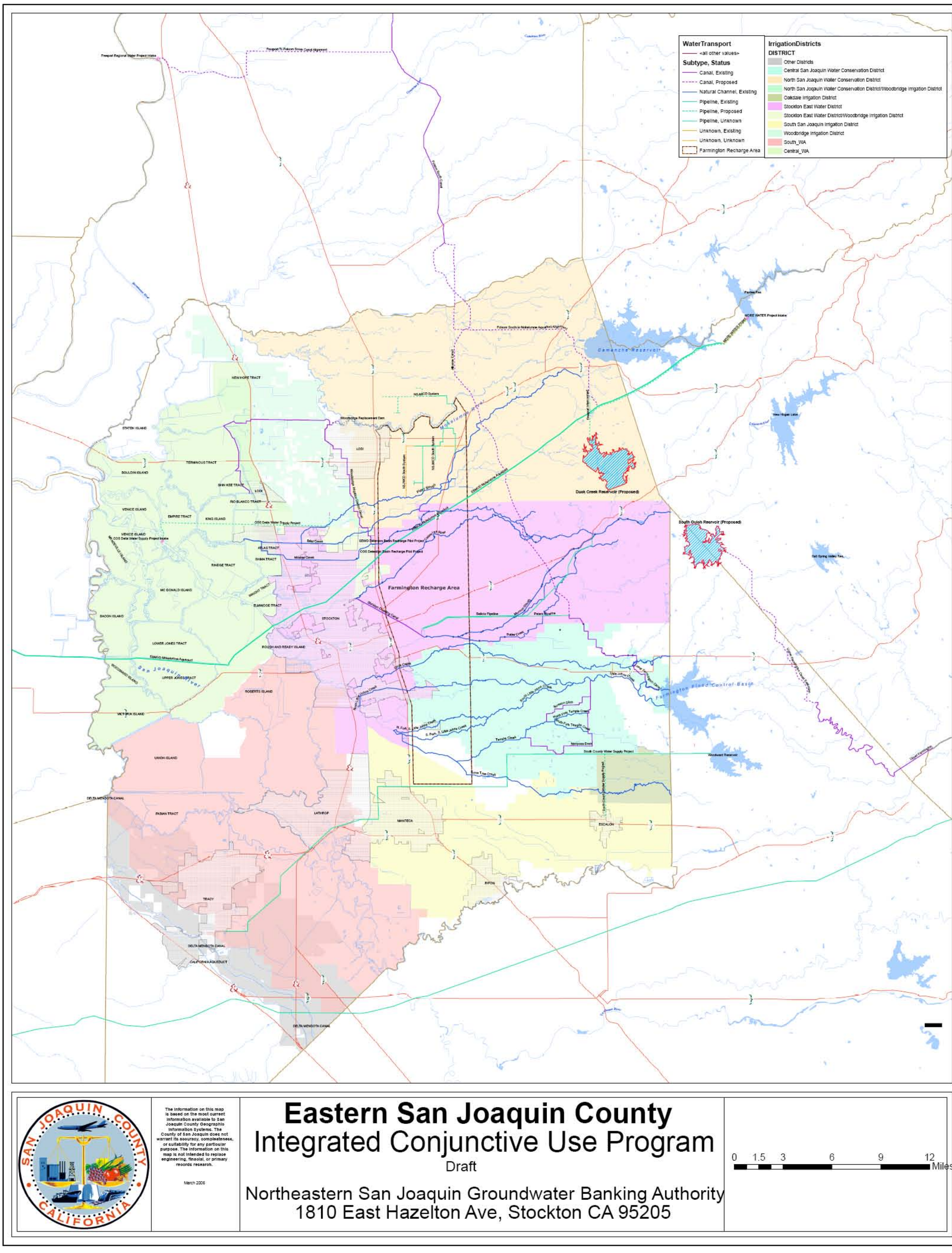


Figure 7- 2 Integrated Conjunctive Use Program Infrastructure Map

7.2.2.1 Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta covers more than 738,000 acres in five counties and is comprised of numerous islands within a network of canals and natural sloughs. The Sacramento and San Joaquin Rivers come together in the Delta before they flow to the San Francisco Bay and out to the Pacific Ocean. The Delta is the largest estuary on the U.S. West Coast and is home to over 750 plant and animal species, many of which are threatened or endangered. The Delta provides drinking water for two-thirds of all Californians and irrigation water for over seven million acres of highly productive farmland. Rivers in the Region all flow through the Delta on their way to San Francisco Bay and the Pacific Ocean. More detailed descriptions of the rivers and the associated facilities are provided in the following sections.

7.2.2.2 American River

The American River watershed lies to the north of San Joaquin County, outside of the Water Management Area, and encompasses a drainage area of 1875 square miles[1]. San Joaquin County has a pending application to appropriate water from the South Fork American River. The State Water Resources Control Board designated this Application 29657 and assigned it a priority date of February 9, 1990. An amendment to this application was filed with the SWRCB on August 12, 2003.

Water to be Appropriated under Amended Application 29657 (acre-feet per year)	
Direct Diversion	147,000
Storage	147,000
Total	147,000
Maximum Diversion Rate	350 cfs
Period of Diversion or Collection:	12/1 - 6/30
Priority Date:	February 9, 1990

Amended Application 29657 seeks the right to divert for direct use up to 350 cubic feet per second (cfs) from December 1 through June 30 each year, up to 147,000 acre-feet per year. A diversion to storage up to 147,000 acre-feet per year is also proposed. A maximum of 147,000 would be taken by direct diversion and diversion to storage during any one year.

The Amended Application 29657 moves the proposed point of diversion to the Freeport diversion site on the Sacramento River. The Sacramento County Water Agency and East Bay Municipal Utility District (EBMUD) are in the process of constructing a 286 cfs diversion at the Freeport site. Of this capacity, 131 cfs would be used in most years to meet needs within Sacramento County. The other 155 cfs would be conveyed to a connection point with EBMUD's Mokelumne Aqueduct in San Joaquin County. EBMUD only needs this capacity in the one-third driest years. The capacity could be

[1] Above Folsom Dam, the principal regulating reservoir

made available to San Joaquin County or other users about two-thirds of the time in average and wetter years.

SWRCB is authorized to declare a stream fully appropriated. If a stream is declared fully appropriated, SWRCB may reject any water right application filed on that stream. If a stream has been declared fully appropriated for part of a year, the application may be modified by the Board. SWRCB has declared the American River system fully appropriated for the period from July 1 through October 31. The Amended Application limits the period of diversion to the period from December 1 through June 30.

7.2.2.3 Mokelumne River


Upper Mokelumne Watershed

The Mokelumne River watershed encompasses approximately 660 square miles stretching from the high Sierra Nevada westward to the Delta. Snowmelt comprises a large portion of the watershed's runoff. Major facilities located on the Mokelumne are the Salt Springs Reservoir on the North Fork of the Mokelumne and the Pardee and Camanche Reservoirs on the river's main stem. Salt Springs Reservoir is a PG&E facility built in 1963 and is operated for hydropower generation. Pardee and Camanche are both owned by EBMUD. Pardee Reservoir, which is upstream from Camanche, has a capacity of 197,950 af and is operated as a water supply reservoir. Reservoir water from Pardee is conveyed by the Mokelumne Aqueducts to the EBMUD service area 82 miles away. Camanche Reservoir, with a capacity of 417,120 af, is operated for flood control and to meet in stream and downstream requirements[2]. Both Pardee and Camanche generate incidental hydropower at 30 MW and 9.9 MW, respectively[3]. Water rights on the Mokelumne form a complex hierarchy, with water rights held by Woodbridge Irrigation District, Amador County, Calaveras County, EBMUD, North San Joaquin Water Conservation District, the City of Lodi, and others.

7.2.2.4 Calaveras River

The Calaveras River watershed consists of 363 square miles and stretches from the Sierra Nevada foothills to San Joaquin River in west Stockton. Flow in the Calaveras is primarily derived from rainfall with almost no contribution by snowmelt. The United

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[2] EBMUD describes its reservoir operations as follows: "Pardee and Camanche Reservoirs are operated in an integrated manner to provide water supply benefits and meet downstream needs including stream flow regulation, flood control, fishery habitat, and the needs of downstream riparian and appropriative diverters. Releases from EBMUD's facilities also provide hydropower benefits."

[3] EBMUD, Urban Water Management Plan 2000

States Army Corps of Engineers (USACE) constructed the multi-purpose New Hogan Dam in 1963 for flood control, municipal, industrial, and irrigation purposes. New Hogan Reservoir has a capacity of 317,000 af. The USACE controls flood control releases from New Hogan. Stockton East Water District (SEWD) operates New Hogan at all other times. SEWD and Calaveras County Water District (CCWD) have rights to the yield from New Hogan. The current supply available to SEWD is subject to reductions based on CCWD's future demands. CCWD currently uses approximately 3,500 acre-feet per year and estimates it will use up to 7,000 acre-feet per year by 2040[4].

7.2.2.5 Littlejohns Creek /Rock Creek

The Littlejohns/Rock Creek is a large, low-lying drainage meandering through Calaveras, Stanislaus, and San Joaquin counties. Flood flows on the creeks are attenuated by Farmington Dam, an earthen dam built strictly for flood control by the U.S. Army Corps of Engineers (USACE). SEWD constructed a diversion structure immediately downstream of the dam in 1994 to divert water into the Lower Farmington Canal and Rock Creek, which can supply water to portions of the SEWD and CSJWCD service areas. The unlined Canal has a current capacity to convey 300 cfs to Duck Creek[5] and 200 cfs to its terminus near Peters.

7.2.2.6 Stanislaus River

The Stanislaus River watershed consists of approximately 904 square miles with an annual average runoff of approximately 1 million af. The majority of the runoff occurs from November to July, and peaks during the summer months when snowmelt is greatest. More than half the runoff is derived from snowmelt[6]. The USACE constructed New Melones Dam on the Stanislaus River in 1978, replacing the original Melones Dam. Old Melones Dam was constructed in 1924 jointly by OID and SSJID, which hold pre-1914 water rights on the Stanislaus River. New Melones Reservoir has a capacity of 2.4 million af and is operated as part of the Central Valley Project. The average runoff at New Melones for the 74 years from 1904 to 1977 was 1.12 million af.

There are nine additional reservoirs and two diversion canals upstream from New Melones on the Stanislaus River, including the Donnells, Beardsley, and Tulloch reservoirs, which were constructed jointly by OID and SSJID and operated by the Tri-Dam Authority. Tulloch Reservoir, located several miles downstream from New

[4] Calaveras County Water District, 1996. Recently updated projections provided by CCWD show demands of over 14,000 acre-feet by 2035. Unused CCWD supplies used by SEWD are subject to the terms and limitation in their 1970 contract. Increasing growth in Calaveras County makes demand projections highly volatile and CCWD is continually revising these projections. CCWD states that in the future they intend to rely on their New Hogan allocation for multi-year water supply reliability and drought protection purposes.
[5] Note this is Duck Creek is different than the stream to be impounded by the proposed Duck Creek Reservoir
[6] USBR website

Melones, is used to re-regulate releases from New Melones. SSJID, OID, SEWD, and CSJWCD divert from Goodwin Dam downstream from Tulloch Dam. Water can be diverted by gravity via Goodwin Tunnel to CSJWCD and SEWD. A settlement agreement between the U.S. Bureau of Reclamation, SSJID and OID, gives the two irrigation districts a right to divert a combined total of 600,000 acre-feet per year of Stanislaus River water. SEWD and CSJWCD have CVP contracts for up to a total of 155,000 acre-feet per year of New Melones water.

7.2.2.7 San Joaquin River

The San Joaquin River originates in the Sierra Nevada and enters the San Joaquin Valley at Friant. The lower San Joaquin River is the section of the river from its confluence with the Merced River north to Vernalis. The lower San Joaquin River encompasses a drainage area of approximately 13,400 square miles. The majority of the flow in the lower San Joaquin River is derived from inflow from the Merced, Tuolumne and Stanislaus rivers since the construction of the Friant Dam on the upper San Joaquin River, which contributes virtually no inflow during the summer months. Plans for reoperation of the upper river system to provide a live stream are being developed.

7.2.2.8 Dry Creek

Dry Creek is a minor, low-lying tributary to the Mokelumne River and forms the boundary between San Joaquin and Sacramento counties east of Lodi. Runoff is in response to local rainfall events, primarily in winter and spring months.

Dry Creek and the Cosumnes, Mokelumne and Calaveras rivers are collectively referred to as the Eastside Streams.

7.2.2.9 Other Rivers

Other rivers that have some relevance to discussions on water resources but are not located in the Region include the Tuolumne River, Cosumnes River, and Sacramento River.

The Tuolumne River originates in the Sierra Nevada Mountains and is the largest tributary to the San Joaquin River. It has a watershed of approximately 1,500 square miles and an unimpaired runoff of approximately 1.8 million af. Flows in the lower reaches of the Tuolumne River are regulated by New Don Pedro Dam, which was constructed in 1971 and is owned by Turlock and Modesto Irrigation Districts. New Don Pedro Reservoir has a capacity of approximately 2 million af and is operated for irrigation, hydroelectric generation, fish/wildlife protection, recreation, and flood control. Irrigation water is diverted downstream from New Don Pedro at La Grange into the Modesto Main Canal and Turlock Main Canal. The City and County of San

Francisco operate several facilities in the upper watershed of the Tuolumne, including Hetch Hetchy Reservoir, Lake Eleanor and Cherry Lake. These facilities are operated for municipal supply as well as hydropower.

The Cosumnes River is a tributary of the lower Mokelumne River, converging near the town of Thornton. The Cosumnes has a low-lying watershed of approximately 540 square miles, and flows are derived primarily from rainfall runoff.

Based on existing water rights and water rights filings, water supplies from the major streams are primarily available outside of the irrigation season. Most supplemental water supplies must be used directly to meet demands, recharged into percolation ponds, or stored for later use.

7.2.3 Surface Water Quality

Surface water quality for the Region's water sources can be categorized as either an eastside or Sacramento-San Joaquin Delta source.

Eastside rivers and streams have high water quality with generally low total dissolved solids (TDS) loads. Reservoir storage and flow regulation on the Mokelumne, Calaveras and Stanislaus River systems reduce suspended solids in these rivers through the Region. However, during flood events and times of elevated flows, TDS and suspended solid levels can increase. In general, water quality for these sources is sufficient to support urban, agricultural, and environmental beneficial use.

The Sacramento-San Joaquin Delta water quality is heavily influenced by the operations of the Central Valley Project and State Water Project. Generally, the Sacramento-San Joaquin Delta water quality is best during the winter and spring months and poorer through the irrigation season and early fall. Delta water quality is also very dependent on higher quality Sacramento River water to dilute poorer quality San Joaquin River water in the south and central Delta. The Central Valley Regional Water Quality Control Board has proceedings underway to remedy Total Maximum Daily Load (TMDL) and low dissolved oxygen (DO) in the Stockton Deep Water Ship Channel, and for salinity and boron in the Lower San Joaquin River. Water quality in the Delta has limited the types of crops grown on Delta islands, and can at times cause fish kills during periods of low inflow.

The San Joaquin River in the South Delta experiences periods of severely degraded water quality. The SWRCB has set flow and water quality objectives at Vernalis, located just downstream of the confluence of the Stanislaus River with the San Joaquin River. The USBR is obligated to meet the Vernalis objectives as a condition of their water right permits. Water quality in the San Joaquin River is influenced by factors such as rain and snowmelt runoff, reservoir operations, and irrigation return flows in the San Joaquin River basin. The CVP service area on the west side of the San Joaquin Valley drain agricultural return flows with significant elevated salt loads into the San Joaquin River. To meet the Vernalis objective, the Bureau of Reclamation supplements flows on the San Joaquin River with releases from San Joaquin River tributaries, including New Melones Reservoir on the Stanislaus River which reduces allocations to SEWD and CSJWCD[7]. Despite this, the Bureau is unable to meet the Vernalis standard in years when runoff is below average. Region and Delta interests have pushed for the development of water quality objectives upstream of the confluence of the San Joaquin and Stanislaus Rivers. These objectives have been mandated by the SWRCB, and discussions are ongoing between the SWRCB, the U.S. Bureau of Reclamation, and San Joaquin Valley water agencies to determine how to meet these objectives.

7.2.4 Water Management Strategies

Through past planning efforts, the GBA, its member agencies, and other regional interests have developed numerous projects and programs that integrate multiple strategies and in turn provide multiple benefits to the community. The mission of the GBA is to promote regional collaboration in a consensus-building environment. The IRWM planning process is a continuum of this mission and is reflected in the projects and programs described in the ICU Program options discussion below.

This Plan has considered all of the resource management strategies identified in the California Water Plan. These strategies include:

Reduce Water Demand

- Agricultural Water Use Efficiency
- Urban Water Use Efficiency

Improve Operational Efficiency and Transfers

- Conveyance
- System Reoperation
- Water Transfers

Increase Water Supply

- Conjunctive Management and Groundwater Storage
- Desalination
- Precipitation Enhancement

[7] The Vernalis salinity objective is partially met with flows voluntarily provided through the San Joaquin River Group's Vernalis Adaptive Management Plan

- Recycled Municipal Water
- Surface Storage—CALFED
- Surface Storage—Regional/Local

Improve Water Quality

- Drinking Water Treatment and Distribution
- Groundwater Remediation/Aquifer Remediation
- Matching Water Quality to Water Use
- Pollution Prevention
- Urban Runoff Management

Practice Resources Stewardship

- Agricultural Lands Stewardship
- Economic Incentives (Loans, Grants, and Water Pricing)
- Ecosystem Restoration
- Floodplain Management
- Recharge Areas Protection
- Urban Land Use Management
- Water-Dependent Recreation
- Watershed Management

Other Resource Management Strategies

- Crop idling for water transfers
- Dewvaporation
- Fog collection
- Irrigated land retirement
- Rainfed agriculture
- Waterbag transport/storage technology

In addition, the GBA considered the following water management strategies in the development of the ICU Program:

Strategies Considered by GBA not included in California Water Plan

- Water Supply Reliability
- Regional Groundwater Banking Partnerships
- Imported water
- Land use planning
- Flood management
- Climate Change

The strategies to be implemented in the IRWMP are displayed in Table 7-1. The practical limitations of GBA authority, geographic realities, and the success and expertise of GBA member entities are the principal reasons for focusing on these strategies. No one single project will meet the objectives of the IRWMP. An integrated combination of several projects, implemented over a wide geographic area will be necessary.

Resource Management Strategies Identified in the California Water Plan (Bulletin 160-05, December 2005)			
Strategy #	Strategy Considered	Included in IRWMP	Notes
1	Agricultural Lands Stewardship	Considered	Does not address Plan objectives
2	Agricultural Water Use Efficiency	Yes	
3	Conjunctive Management and Groundwater Storage	Yes	Recharging aquifers for conjunctive management of surface and groundwater supplies is key element of Plan
4	Conveyance	Yes	New pipelines, tunnels, canals, and on-farm distribution systems
5	Desalination	Considered	Not practical for region
6	Drinking Water Treatment and Distribution	Yes	
7	Economic Incentives (Loans, Grants, and Water Pricing)	Yes	
8	Ecosystem Restoration	Yes	
9	Floodplain Management	No	
10	Groundwater Remediation/Aquifer Remediation	Yes	Saline intrusion project
11	Matching Water Quality to Water Use	Yes	
12	Pollution Prevention	Yes	
13	Precipitation Enhancement	Considered	Not practical for region
14	Recharge Areas Protection	Yes	
15	Recycled Municipal Water	Yes	
16	Surface Storage—CALFED	Considered	
17	Surface Storage—Regional/Local	Yes	
18	System Reoperation	Yes	
19	Urban Land Use Management	Yes	
20	Urban Runoff Management	No	
21	Urban Water Use Efficiency	Yes	
22	Water Transfers	Yes	
23	Water-Dependent Recreation	Yes	
24	Watershed Management	Yes?	
	Other Resource Management Strategies		
25	Crop idling for water transfers	Considered	
26	Dewvaporation	No	Not practical for region
27	Fog collection	No	Not practical for region
28	Irrigated land retirement	Yes	
29	Rainfed agriculture	No	Not practical for region
30	Waterbag transport/storage technology	No	Not practical for region
	Other Resource Management Strategies Not Included in California Water Plan		
31	Water Supply Reliability	Yes	
32	Regional Groundwater Banking Partnerships	Yes	
33	Imported water	Yes	
34	Land use planning	Yes	

Table 7-1 Resource Management Strategies

The GBA is the forum that fosters regional integration amongst member agencies and with other regional participants. The GBA will continue to interact with other agencies and groups throughout the region to increase the social, economic, and environmental viability of the Region and beyond. This integration of these strategies increases the potential for broad-based support by spreading benefits to multiple interests and agencies. Integration also produces synergistic effects and makes additional funding sources available.

7.3 Identification of Potential Projects

7.3.1 Reduce Water Demand

Demand reduction measures include water conservation and water use efficiency elements:

- Urban Water Use Efficiency
- Agricultural Water Use Efficiency

Urban Water Use Efficiency (Strategy 21)

Urban water conservation programs in California have shown potential water savings are in the order of 10 to 20 percent. In the Region, urban conservation could result in 20,000 ac-ft/year of demand reduction which would reduce reliance on existing supplies by a like amount. Demand management measures (DMM) include distribution system leak-reduction programs, household metering, rebates and other financial incentives, tiered pricing to discourage high use, education of school children and the public and market-enforced transition to water-saving household plumbing devices. Typical costs of such DMMs (excluding meter installation) are in the range of $2 to $4.50 per capita per year in California cities. For households not already metered, the installation of a household meter typically costs about $450.

Urban Water Conservation	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯
Water Supply Reliability	✯
Water Quality Protection and Improvement	
Conjunctive Use	
Surface Storage	
Water Conservation	✯✯✯
Water Recycling	
Regional Groundwater Banking Partnerships	
Water Transfers	
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	
Recreation and Public Access	
Wetlands Enhancement and Creation	
✯✯✯ Primary Strategy◎ ✯✯ Secondary Strategy ✯ Potential Strategy	

Urban water purveyors overlying the Basin have for the most part implemented DMMs that are cost effective (as stated above in the summary of Urban Water Management Plans). As the GBA and its member agencies begin to implement larger regional projects, more focus will be given to implementation of more ambitious DMMs. Urban water conservation is considered an essential component to the ICU Program.

Agricultural Water Use Efficiency (Strategy 2)

Agricultural water use efficiency is defined as the degree to which water can be applied without waste. Waste is classically considered as irrecoverable losses in the form of evaporation, weed growth, tail water drainage, and losses to an unusable groundwater source. Efficient use of groundwater in the Region makes sense because more efficient application methods reduce the amount of water pumped from the Basin. Though efficient use of surface water is also prudent, the loss of recharge to the Basin is contrary the activities of the GBA to raise groundwater levels. In both cases, reduced tail water drainage can cause a diminution of flow to in stream and downstream users lower in watershed and in the Delta.

Agricultural Water Use Efficiency	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯
Water Supply Reliability	✯
Water Quality Protection and Improvement	✯
Conjunctive Use	
Surface Storage	
Water Conservation	✯✯✯
Water Recycling	
Regional Groundwater Banking Partnerships	
Water Transfers	✯✯
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	
Wetlands Enhancement and Creation	
✯✯✯ Primary Strategy ✯✯ Secondary Strategy ✯ Potential Strategy	

Currently, agricultural water use efficiency practices are implemented voluntarily based on perceived benefit to individual landowners and/or sponsoring irrigation and water conservation districts. An example of a successful agricultural water use efficiency program is the drip irrigation conversion program sponsored by the Woodbridge Irrigation District (WID). WID has created an incentive program where growers are reimbursed for constructing surface water drip irrigation systems. These systems encourage growers to drip irrigate vineyards with surface water rather than with groundwater. The savings, estimated at 6,000 acre-feet per year WID-wide, is now available to the City of Lodi through a 40-year water transfer agreement. Although the benefit of groundwater recharge is lost in the WID service area, where groundwater levels have been historically high, the conserved water will now be supplied directly to the City of Lodi, which is currently entirely dependent on groundwater.

In order to explore the potential benefits and impacts of a Basin-wide agricultural water use efficiency program, in January 2005, the GBA submitted to the DWR Office of Water Use Efficiency for a 2004 Proposition 50 Water Use Efficiency Program grant. The proposal sought funds to develop the Eastern San Joaquin County Agricultural Water Use Efficiency Feasibility Study to determine if a net water savings to the Basin can be achieved through the implementation of affordable agricultural water use efficiency and water conservation practices and policies.

The GBA has defined the following goals for a Basin-wide agricultural water use efficiency program:

- Demonstrate a net water savings to the Basin
- Minimize adverse effects to the environment
- Ensure sufficient water quality and quantity for downstream water users
- Be affordable for the community, and
- Maintain or enhance the local economy.

Recycled Municipal Water (Strategy 15)

Municipal and industrial water recycling is becoming increasingly prevalent throughout the State as dischargers are hard-pressed to comply with increasingly stringent waste discharge requirements. Tertiary treated wastewater is increasingly becoming a marketable commodity and a significant source of non-potable water. The City of Lodi is currently treating its wastewater to a tertiary level and is actively investigating water recycling and reuse projects. The City of Stockton's water right structure makes large scale reuse unlikely, however Stockton's Section 1485 water right makes the Delta Water Supply Project essentially a one-for-one recycling project, as all of the diverted water is available for full municipal and industrial use, not just for non-consumptive uses.

Recycled Water	
Water Management Strategies	Strategies Integrated
Groundwater Management	☆
Water Supply Reliability	☆
Water Quality Protection and Improvement	☆☆
Conjunctive Use	
Surface Storage	
Water Conservation	
Water Recycling	☆☆☆
Regional Groundwater Banking Partnerships	
Water Transfers	
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	☆☆☆
Recreation and Public Access	
Wetlands Enhancement and Creation	
☆☆☆ Primary Strategy ☆☆ Secondary Strategy ☆ Potential Strategy	

7.3.2 Improve Operational Efficiency and Transfers

- Conveyance
- System Re-operation
- Water Transfers

Conveyances (Strategy 4)

Freeport Regional Water Project

The Freeport Regional Water Project (Freeport Project) is the culmination of EBMUD and Sacramento County Water Agency (SCWA) efforts to secure supplemental water from the Lower American River. The purpose of the FRWP is to increase water service reliability for EBMUD customers, reduce rationing during droughts, and facilitate conjunctive use of surface water and groundwater supplies in central Sacramento County. The Freeport Project will also provide EBMUD with flexibility in the event of an emergency or during Pardee System maintenance.

Freeport Regional Water Project	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯✯✯
Water Supply Reliability	✯✯✯
Water Quality Protection and Improvement	✯✯
Conjunctive Use	✯✯✯
Surface Storage	✯✯
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✯✯✯
Water Transfers	✯✯✯
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	
Wetlands Enhancement and Creation	
✯✯✯ Primary Strategy◎ ✯✯ Secondary Strategy ✯ Potential Strategy	

In order to protect the Lower American River, EBMUD and the Bureau of Reclamation amended EBMUD's CVP contract for American River to allow EBMUD entitlements to be taken downstream on the Sacramento River near the town of Freeport. EBMUD is entitled to divert up to 133,000 af in any one year and no more than 165,000 af total in any three-consecutive years, and only when other supplies have been substantially depleted. It is estimated that diversions will occur only in the driest one-third of all years. EBMUD American River entitlements are also subject to curtailments pursuant to CVP drought conditions and regulatory requirements.
The Freeport Project concept consists of the following facilities:

- 185 mgd (286 cfs) intake facility and pumping plant on the Sacramento River near the community of Freeport;
- 84-inch pipeline to convey water east to an 85 mgd SCWA water treatment plant;
- 66-inch pipeline from the SCWA turnout east to the existing FSC;
- 100 mgd (155 cfs) pumping plant near the terminus of the FSC;
- 100 mgd (155 cfs) 66-inch pipeline from the terminus of the FSC to the Mokelumne Aqueducts; and
- Aqueduct pumping plant and pre-treatment facility near Camanche Reservoir.

The 2004 cost estimate for the Freeport Project was estimated at $690 million, $439 million of which will be funded by EBMUD[8]. Costs have increased significantly since then. Additional operations and maintenance costs are estimated to be approximately $130 per af[9]. The preferred Freeport Project Alternative is depicted in Figure 7-3. Construction of the intake and EBMUD portion of the Freeport Project is set to begin in 2007 and is expected to be completed in 2009.

In 1990, San Joaquin County submitted an application to the SWRCB to appropriate wet-year water from South Fork of the American River. In August 2003, the application was amended to coincide with the point of diversion of the Freeport Project at a rate of 350 cfs. To support the amendment of the water right application, the GBA co-sponsored the South Fork American River Water Availability Study.

The Water Availability Study concluded that substantial water is available on the South Fork of the American River and would likewise be available for diversion downstream at Freeport on the Sacramento River in normal and wet years. Based on the 155 cfs Freeport Project capacity, the average annual yield is approximately 44,000 af per year. The amended water right application allows for diversion from December 1 to June 30. However, in the months of July through November, other supplies available either from the American or Sacramento Rivers through exchanges, transfers, banking partnerships, federal contracts, and additional water right fillings could significantly increase the yield to the Region.

The most recent water availability study conducted by San Joaquin County together with the GBA and the State Department of Water Resources[10] has further substantiated that the American River has water available for appropriation under Application 29657:

> *"…County use of the available unassigned capacity in the East Bay Municipal Utility District proposed Freeport Regional Water Project (FRWP) pipeline could provide an average of 53,000 acre-feet per year, and a maximum of approximately 62,000 acre-feet per year in above normal and wet years."*

Several key inferences concerning water availability to the County from this report include the following:

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[8] Freeport Regional Water Authority website, 2004

[9] EBMUD, 2003 personal communication. EBMUD has yet to finalize an updated estimate of FRWP O&M costs.

[10] WRIME, August 2006, "*Potential Use of Unassigned Freeport Regional Water Project Pipeline Capacity*"

1. Based on the hydrologic analysis of CALSIM modeling results for the period from 1922 to 1992, and review of existing stream flow data, there appears to be sufficient water available on the South Fork of the American River for use and diversion from December through June, in accordance with the intent of Application 29657.

2. Procuring a water right permit will be challenging and is likely to be closely reviewed by parties to the Sacramento Water Forum Agreement, Central Valley Project (CVP) contractors, State Water Project (SWP) contractors, and those stakeholders already using water from the American River, or which have a vested interest as a result of current operating plans or agreements (CALFED, OCAP, etc.), and/or have planned on future use of the water.

3. The County does not seek or rely on storage in any CVP facilities and would pass all water through Folsom from December 1 through June 30. This should be consistent with the proposed Water Forum Flow Management Standards (FMS) developed as part of the successor efforts to the Sacramento Water Forum. The proposed FMS will be considered by the SWRCB for adoption once the FMS and associated agreements have been finalized.

4. The County's use of South Fork American River water is subject to interpretation by the SWRCB and could meet the definition of a water right in a protected area under the Watershed Protection Act. This would allow the County, as a new in-basin water user, first priority to natural flows for all of the County's in-basin purposes, and would give the County a higher relative priority than the water right of the CVP and SWP exporters.

5. Moving the point of diversion to the FRWP site on the Sacramento River would not result in any increase in diversion from the amount obtainable at the original point of diversion on the American River (350 cfs). The maximum amount of water to be diverted is constrained by the 155 cfs EBMUD pipeline capacity.

6. Future demands for CVP contractors, CVP settlement contractors and other water right holders on the American River have been accounted for in the future baseline analysis (2030 LOD) for the Water Forum, CVP Operating Criteria and Plan (OCAP), and FRWP environmental and technical analyses. These assumptions did not include water for the County or others that might seek to claim area of origin water right.

7. It could be assumed that the County's diversion at the amounts being proposed pursuant to Application 29657 should have been accounted for in the volumes and period of diversion analyzed for the FRWP, OCAP, and Sacramento Water Forum environmental documents.

In addition, The Nature Conservancy is also exploring use of Freeport Project excess capacity for possible augmentation of flows in the Cosumnes River for habitat ecosystem enhancements in the Lower Cosumnes River Preserve. The City of Folsom is negotiating for a portion of Sacramento County's capacity in the Freeport pipeline.

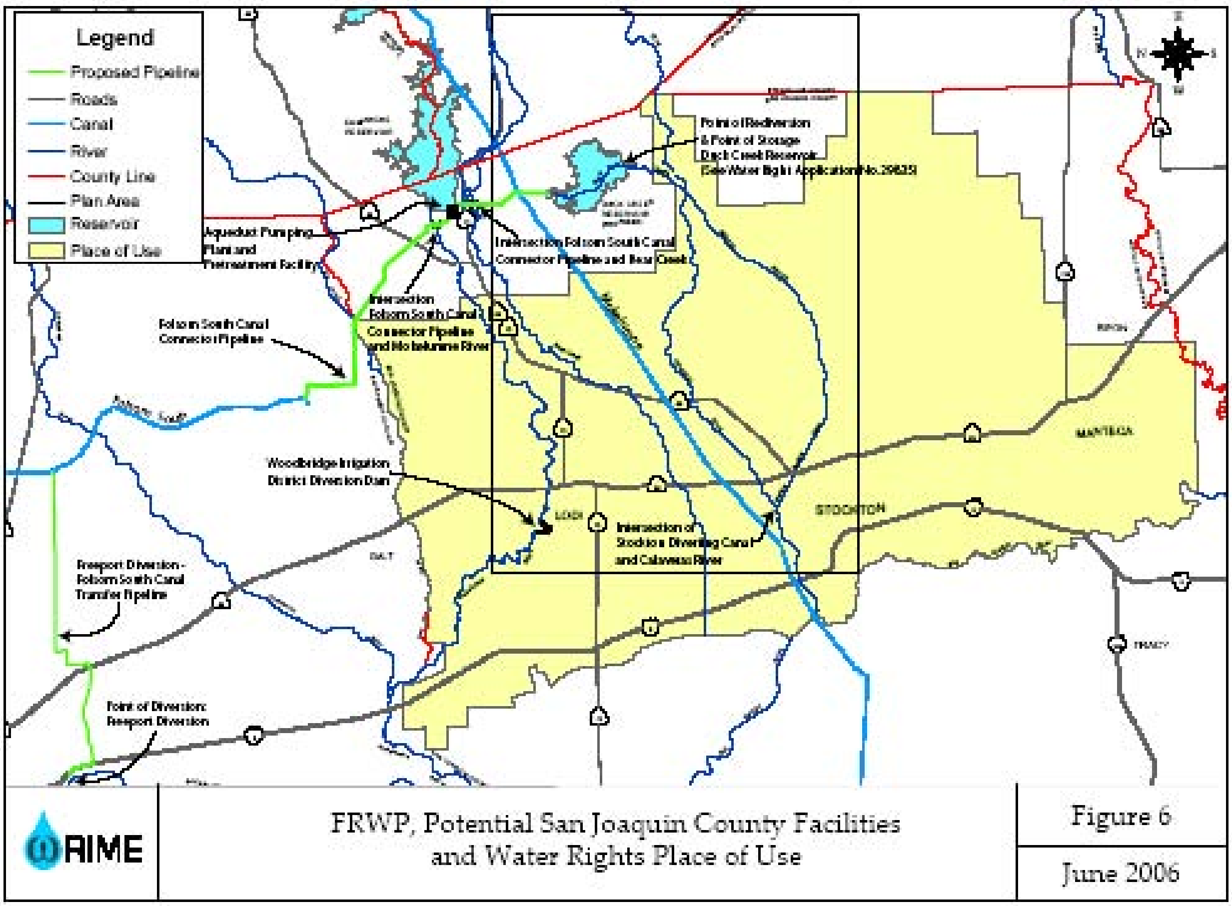


Figure 7-3 FRWP & Proposed Facilities in San Joaquin County

MORE WATER Project

In 1990, the Mokelumne River Water and Power Authority (MRWPA) filed a water rights application with the SWRCB for unappropriated wet year flows on the Mokelumne River[11]. The application cited three alternatives for the capture of water:

- The proposed Middle Bar Reservoir, a new "on-stream" 40,000 to 434,000 af reservoir
- The proposed Duck Creek Reservoir, a new "off-stream" 100,000 to 150,000 af regulating reservoir, and
- Direct diversions off the Lower Mokelumne River between Camanche Reservoir and Interstate 5.

The alternatives are collectively known as the Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE WATER Project). In May 2004, the MRWPA completed Phase I – Reconnaissance Study of the MORE WATER Project. Phase I screened these and other alternatives meeting the MORE WATER Project purpose and need. The Middle Bar Reservoir alternative was eliminated from the list due to numerous adverse impacts to whitewater rafting opportunities, riparian upland areas, oak savannah habitat, and wildlife.

The top five ranking alternatives will be carried forward and further explored in a detailed engineering feasibility analysis as part of the MORE WATER Project Phase II and are described below. Preliminary yield and cost estimates are presented in Table 7-2.

MORE WATER Project	
Water Management Strategies	Strategies Integrated
Groundwater Management	✭✭✭
Water Supply Reliability	✭✭✭
Water Quality Protection and Improvement	✭✭
Conjunctive Use	✭✭✭
Surface Storage	✭✭✭
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✭✭✭
Water Transfers	✭✭✭
Flood Management	✭✭
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	
Recreation and Public Access	✭
Wetlands Enhancement and Creation	✭
✭✭✭ Primary Strategy◎ ✭✭ Secondary Strategy ✭ Potential Strategy	

Mokelumne River Storage System Re-operation - This alternative includes re-operating Pardee Dam and Reservoir, Camanche Dam and Reservoir, and PG&E Project 137 systems to generate additional water supply. Working with the USACE, it may be possible to redefine the flood control operating guidelines for the Mokelumne River. The latest trends in weather forecasting and hydrologic modeling could be utilized to

[11] EBMUD and other agencies have filed protests on the MORE Water water rights application.

operate the flood control capabilities of the Mokelumne storage system less conservatively to allow for greater conservation storage capacity. Re-operation could also consist of allocating more flood control storage to PG&E Project 137 thus reducing the required flood control storage defined by the rule curves of Pardee and Camanche Reservoirs. The yield of the re-operation alternative is on the order of 10,000 af.

Table 7- 2 More Water Project Average Annual Yield and Cost Analysis Results

	Lower Mokelumne River Diversion - Structural	Duck Creek Dam and Reservoir Construction			
		Camanche Reservoir Diversion		Pardee Reservoir Diversion	
		No Hydropower Impacts	Hydropower Impacts	No Hydropower Impacts	Hydropower Impacts
Annual Project Yield (af)	49,200	82,300	90,300	82,300	90,300
Annual Cost ($ per af)	$150	$213	$196	$156	$147

Source: MORE WATER Project Phase I - Reconnaissance Study Summary Report, 2004

Duck Creek Reservoir - Pardee or Camanche Diversions - The proposed Duck Creek Reservoir is an approximately 150,000 af capacity off-stream reservoir located in eastern San Joaquin County. The Duck Creek watershed drains into the Calaveras River at the divergence of the Calaveras River and Mormon Slough at Bellota. The Duck Creek dam system would consists of a 6000′ earthen main dam at the south end and a series of smaller saddle dams to the west. The optimal size of the reservoir will be determined in the engineering feasibility study. Water would be diverted at either Pardee Reservoir or Camanche Reservoir for storage in Duck Creek Reservoir. A map and diagram of the Pardee Reservoir alternative are shown in Figures 7-4 and 5, respectively. The Camanche Reservoir alternative would be similar. A diagram of the proposed reservoir is shown in Figure 7-6.

The water right application seeks to divert up to 1,000 cfs to storage and 620 cfs by direct diversion. The total maximum diversion capacity is 1,620 cfs from either Pardee or Camanche Reservoirs. Water diverted from Pardee Reservoir at a rate of 1,620 cfs would require a diversion structure and tunnel. Regulated releases from Bellota would be re-diverted to the SEWD water Treatment Plant, Mormon Slough, Potter Creek, Mosher Slough, the Lower Calaveras River, and potentially the proposed Alliance Canal for beneficial use or direct groundwater recharge.

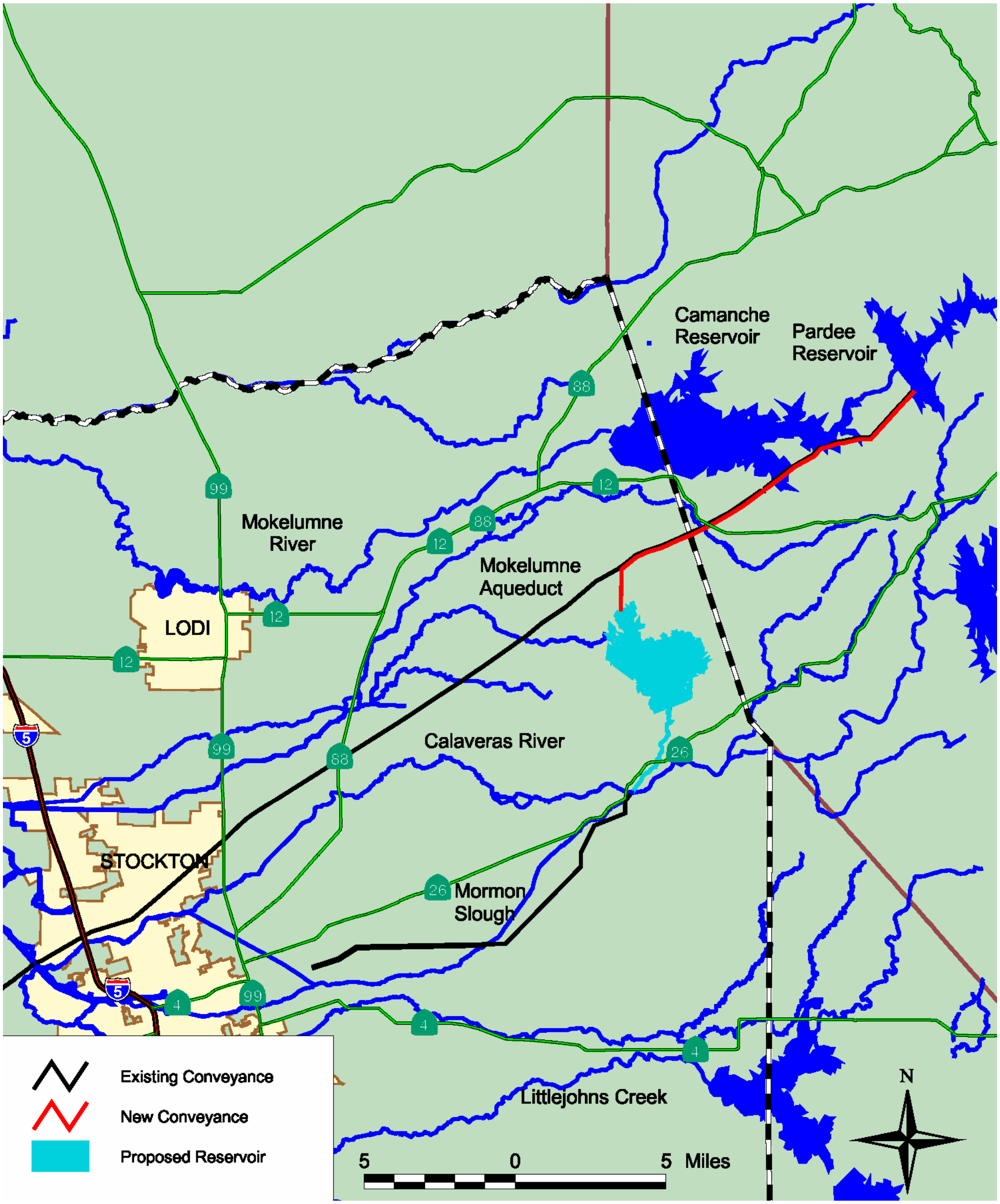


Figure 7- 4 Duck Creek Reservoir with Pardee Reservoir Diversion

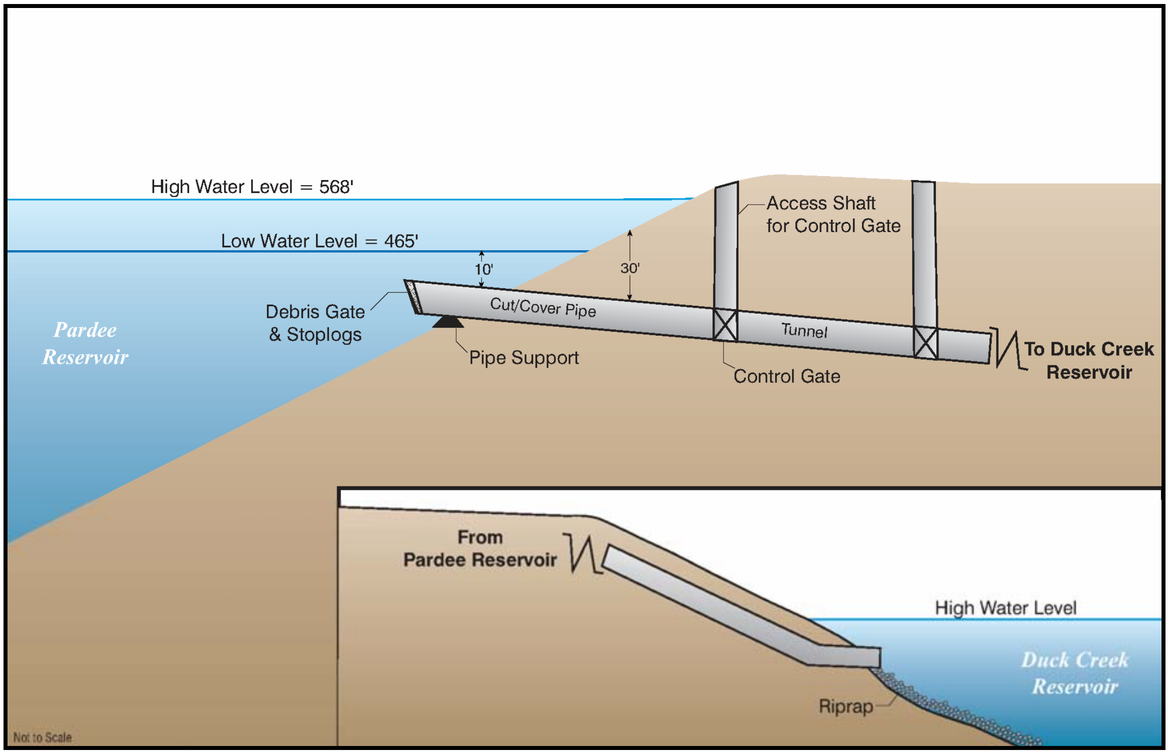


Figure 7- 5 Duck Creek from Pardee Reservoir Inlet and Outlet Diagram

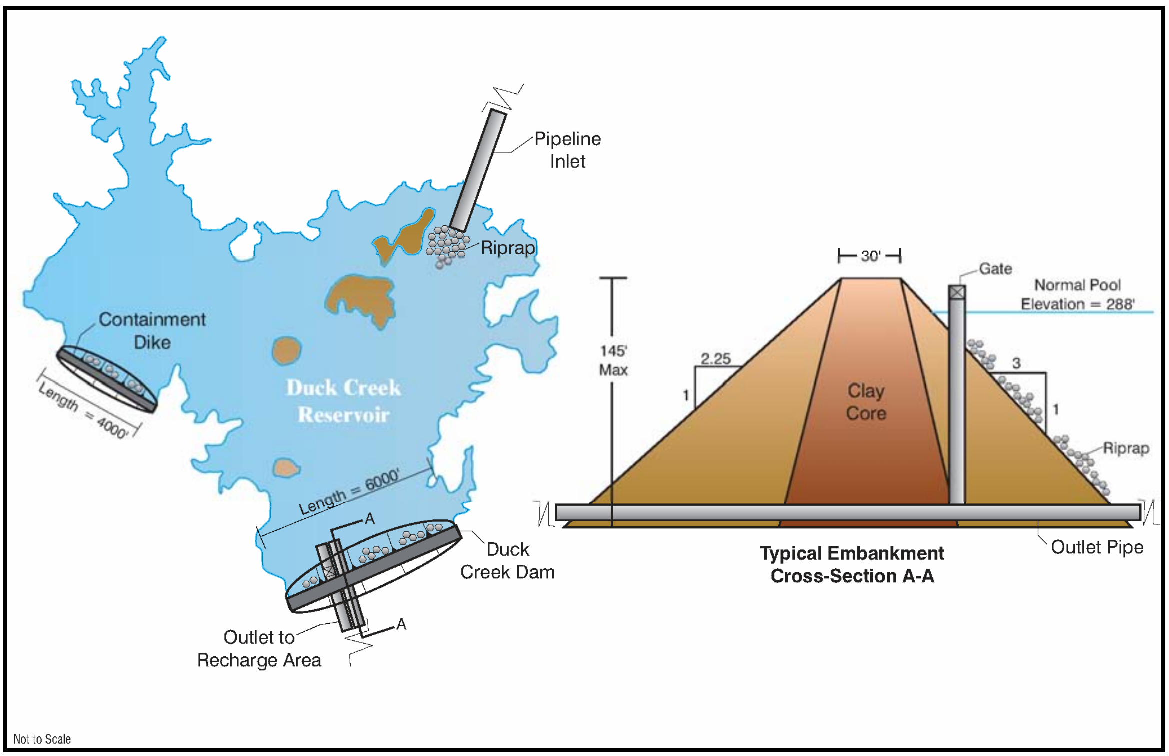


Figure 7- 6 Proposed Duck Creek Reservoir Diagram

Lower River Diversions – Non-Structural and Structural - The water right application also includes diversions along the lower Mokelumne River from below Camanche Reservoir to Interstate 5. Non-Structural implies the use of existing facilities with minor improvements. Under the non-structural alternative, NSJWCD existing diversion pumps and irrigation systems could be used to maximize recharge and in-lieu distribution, as illustrated in Figure 7-7. Additionally, diversion from the Woodbridge Dam could keep the WID canal system with a capacity of approximately 400 cfs full year round, thus enabling groundwater recharge from Lodi to north Stockton. Structural alternatives consist of new diversion structures such as check dams, pump stations, and fish screens where flows would be diverted to supply direct recharge facilities or irrigation in-lieu deliveries.

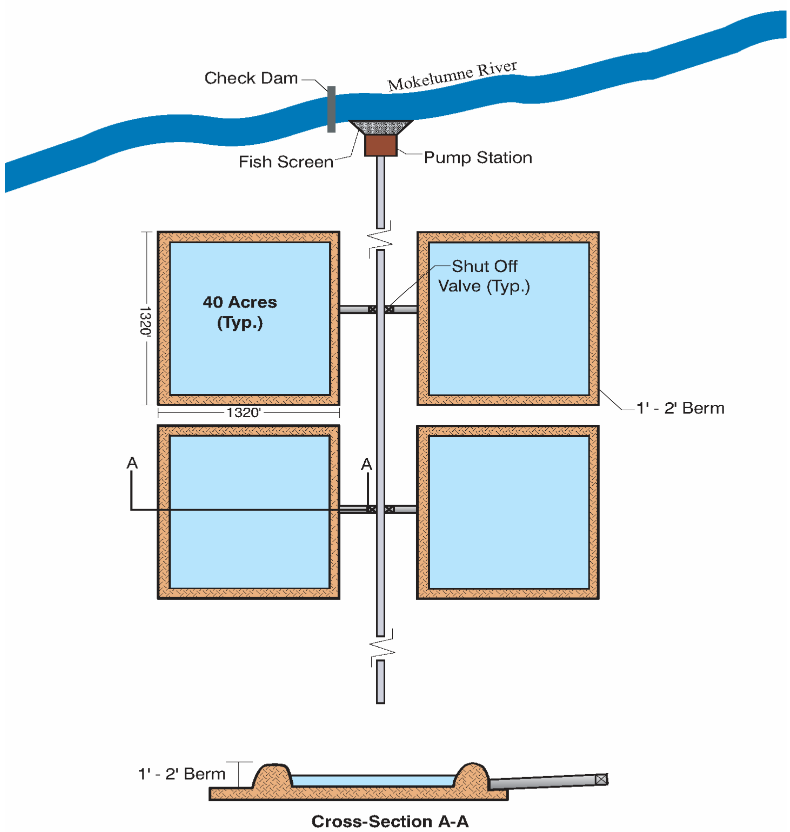


Figure 7- 7 Structural Lower River Diversion Schematic

New Melones Conveyance Project

The New Melones Conveyance Project was constructed in order to deliver contractual CVP entitlements to CSJWCD and SEWD from New Melones Reservoir on the Stanislaus River. Water is diverted through the Goodwin Tunnel and conveyed through the Upper Farmington Canal and a series of natural creeks to the Farmington Flood Control Reservoir. The Lower Farmington Canal conveys water from the Farmington Flood Control Reservoir to its terminus near the community of Peters. The Lower Farmington Canal is connected to Mormon Slough by a 78-inch pipeline where water can be re-diverted for irrigation. The 78-inch pipeline also interconnects with the Bellota Pipeline enabling high-quality New Melones water to be conveyed to the SEWD Water Treatment Plant for delivery to residents of the City of Stockton. Figure 7-8 illustrates the New Melones Conveyance System.

New Melones Conveyance Project	
Water Management Strategies	Strategies Integrated
Groundwater Management	☆☆☆
Water Supply Reliability	☆☆
Water Quality Protection and Improvement	☆☆
Conjunctive Use	☆☆☆
Surface Storage	
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	☆☆☆
Water Transfers	☆☆☆
Flood Management	☆
Stormwater Capture and Management	☆☆
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	☆
Recreation and Public Access	
Wetlands Enhancement and Creation	☆
☆☆☆ Primary Strategy ☆☆ Secondary Strategy ☆ Potential Strategy	

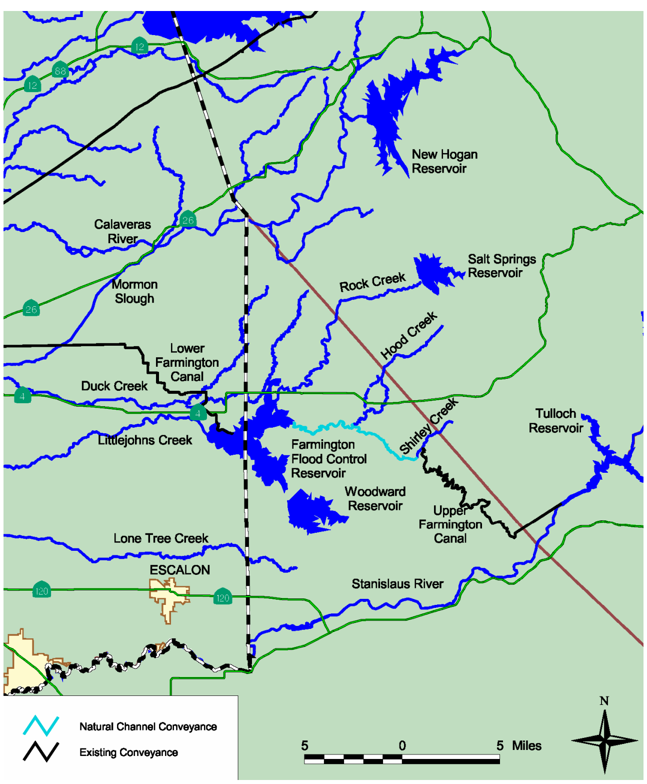


Figure 7-8 New Melones Conveyance System

The Goodwin Tunnel, completed in 1992, is approximately 3.3 miles long and 14 feet in diameter, with a design flow capacity of 850 cfs. It originates on the north bank of the Stanislaus River, just upstream from Goodwin Diversion Dam in Calaveras County. The Goodwin Tunnel connects with the Upper Farmington Canal, an open trapezoidal channel that extends approximately 7.9 miles to its current terminus near Shirley Creek. Water then flows through the natural creek system of Shirley, Hoods, and Rock Creeks where it finally enters the Farmington Flood Control Reservoir. The maximum capacity of the natural portion of the conveyance system is approximately 550 cfs. The Upper Farmington Canal was envisioned to extend northward to the proposed South Gulch Reservoir where excess water from the Stanislaus River could be stored and conveyed through the Calaveras River System (Farmington, 2000).

The Peters Pipeline is an addition to the New Melones Conveyance System. The Peters Pipeline is a 6-mile, 60-inch diameter pipeline located parallel to the existing 54-inch diameter Bellota Pipeline from the 78-in pipeline at Mormon Slough to the SEWD Water Treatment Plant. Figure 7-9 illustrates the Peters Pipeline route. Water conveyed in Peters Pipeline can be used to increase the delivery capacity at the SEWD Water Treatment Plant and to provide irrigation water to growers in-lieu of groundwater pumping. A series of turnouts and laterals from the Peters Pipeline will enable SEWD to serve surface water to areas traditionally reliant on groundwater through integration with the Farmington Program. The average annual increase in water delivery by the New Melones Conveyance System is approximately 7,500 acre-feet per year. The total cost of the Peters Pipeline Project is $7,401,260. SEWD received a Proposition 13 grant for 50% of the project cost. A conceptual design of local irrigation distribution improvements is shown in Figure 7-10.

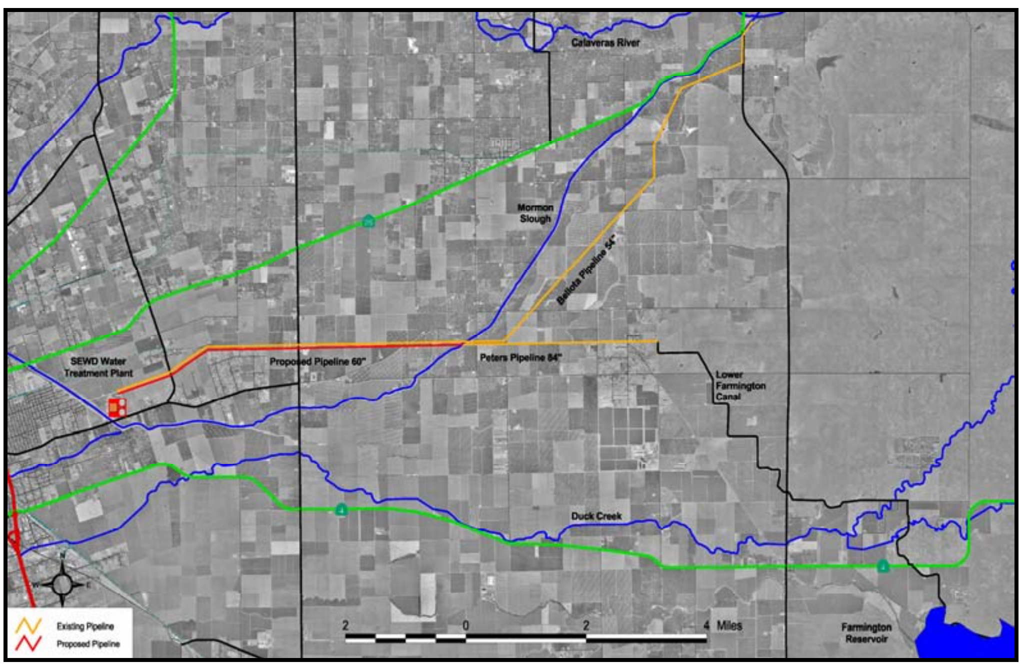


Figure 7-9 Peters Pipeline Alignment

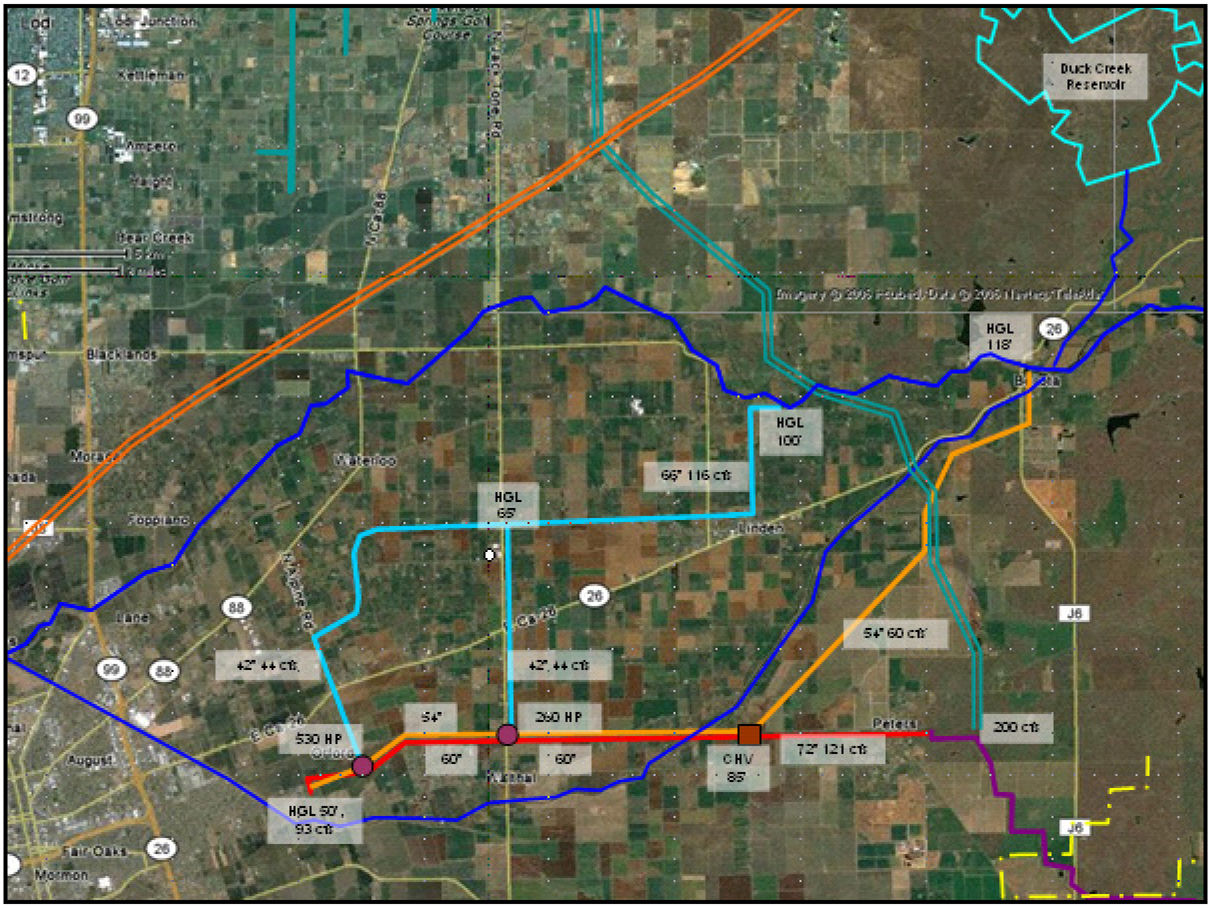


Figure 7-10 SEWD Surface Water Distribution Program Schematic

Lower Mokelumne River Restoration Program (Strategy 8)

Old Woodbridge Diversion Dam (Woodbridge Dam) was a 12-foot tall removable flash board dam built in 1910. The Woodbridge Dam is operational from March to October at which time Lodi Lake is heavily used for recreation. The Woodbridge Dam feeds a 100-mile series of canals west of Lodi to Northeast Stockton. The location of the dam and canals is shown in Figure 7-11.

The Woodbridge Dam itself was considered an impediment to anadromous fish and is recognized as a key area for the restoration of fall run Chinook Salmon by the National Marine Fishery Service (NMFS) and the California Department of Fish and Game (CDFG) (CDM, WMP, 2002).

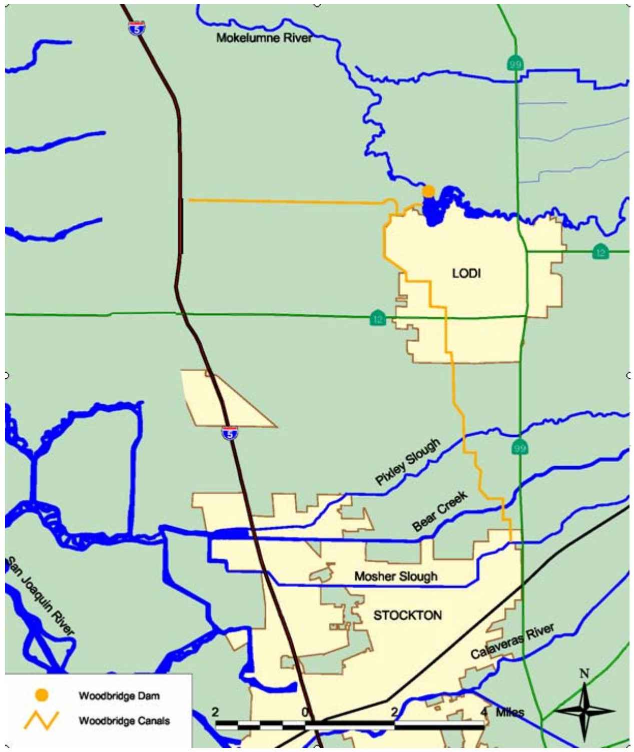


Figure 7-11 Woodbridge Irrigation District Diversion Dam and Canal System

In 2000, WID completed the Lower Mokelumne River Restoration Program Final EIR/EIS for new improved fish passage facilities. The Program consists of the removal of the old flash board dam and the construction of a new adjustable weir dam with state of the art fish ladders and a monitoring station for migrating anadromous fish. The new dam was completed in 2006.

Additionally, a fish screen and new diversion pipeline extending form Lodi Lake to the canal system will prevent incidental takes of salmon smolts and juveniles without the loss of water deliveries to WID customers. The improvements exceed Lower Mokelumne River environmental restoration goals while maintaining irrigated agriculture in Woodbridge. The new Woodbridge Dam will operate year round keeping Lodi Lake full in all months. Year round diversions could facilitate groundwater recharge and interim deliveries to other in-basin partners including the City of Stockton and SEWD[12]. The new dam was funded in part through a sale of conserved water to the City of Lodi.

[12] http://www.spk.usace.army.mil/pub/outgoing/co/reg/pn/199900057.pdf, 2002

In 2003, the City of Lodi and WID reached an agreement by which the City of Lodi would purchase 6,000 acre-feet per year at a cost of $200 /af for a term of 40-years. Through a drip irrigation conversion incentive program, WID was able to conserve 6,000 af of water for the sale. The annual payment of $1.2 million dollars per year is fixed even if the City of Lodi is ready to put its water to beneficial use; however, a three year banking clause allows the City of Lodi to gain credit for the undelivered water up to a total of 18,000 af. The City of Lodi is currently exploring various alternatives to put the water to beneficial use including drinking water treatment and distribution, or groundwater recharge[13].

Lower Mokelumne River Restoration Program	
Water Management Strategies	Strategies Integrated
Groundwater Management	☆☆
Water Supply Reliability	☆☆☆
Water Quality Protection and Improvement	☆☆
Conjunctive Use	☆
Surface Storage	☆☆☆
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	☆
Water Transfers	☆☆☆
Flood Management	
Stormwater Capture and Management	☆☆
Ecosystem Restoration	☆☆☆
Environmental and Habitat Protection and Improvement	☆☆☆
Recreation and Public Access	☆☆☆
Wetlands Enhancement and Creation	☆
☆☆☆ Primary Strategy ☆☆ Secondary Strategy ☆ Potential Strategy	

The Woodbridge Dam replacement and Lower Mokelumne River fish passage improvements are lauded by the San Joaquin County Community as a “win-win” situation for agricultural, environmental, wildlife, and urban interests. The replacement of the aging Woodbridge Dam is of great benefit to area farmers and the Woodbridge wine-grape industry. Fish passage improvements will also aide the migration of salmon which have historically been strong on the Mokelumne. The City of Lodi will not only acquire a reliable source of surface water but also reap the benefits of a year-round Lodi Lake recreation area.

Eastern Water Alliance Canal and Treatment Plant (Strategy 4)

The Eastern Water Alliance (EWA) Canal concept is essentially a locally driven completion of the Folsom South Canal. The Alliance could construct an open canal along the 100-ft contour or pipeline equivalent in order to connect the FSC to the Mokelumne River, Calaveras River, and New Melones Conveyance System. The proposed alignment is shown in Figure 7-12. The Alliance Canal could facilitate water transfers and the diversion of wet year flow to the recharge basins and irrigated lands throughout the Region. The ultimate capacity of the Alliance Canal varies; however, the Alliance Canal would transport water both from north to south and vice versa. If left unlined, the canal could also double as a groundwater recharge facility.

[13] http://www.lodi.gov/city-council/html/body_2003-03-11s.htm, 2003

Preliminary discussions have suggested that a 300-feet-wide canal would provide the equivalent recharge of over 1000 acres of recharge basins. Capital costs for the originally envisioned 85-ft wide, 8-ft deep, 2:1 side sloped, 6-mile long unlined canal constructed from the Mokelumne River to the Lower Farmington Canal would cost approximately $15 to $20 million (SEWD, 2000).

Eastern Water Alliance Canal	
Water Management Strategies	Strategies Integrated
Groundwater Management	✭✭✭
Water Supply Reliability	✭✭
Water Quality Protection and Improvement	✭✭
Conjunctive Use	✭✭
Surface Storage	✭✭
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✭✭
Water Transfers	✭✭
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	✭
Environmental and Habitat Protection and Improvement	
Recreation and Public Access	
Wetlands Enhancement and Creation	✭
✭✭✭ Primary Strategy◎ ✭✭ Secondary Strategy ✭ Potential Strategy	

Also shown in Figure 7-12 are conceptual locations for groundwater recharge facilities and a potential regional treatment plant. As proposed by the EWA, the regional water treatment plant could meet the needs of Stockton, Lodi, and EBMUD based on the following needs:

- The City of Lodi has purchased WID surface water and has no treatment facility.
- The City of Stockton is considering a similar contract to purchase WID surface water.
- The Mokelumne River Water and Power Authority is pursing a surface water entitlement.
- EBMUD needs to treat water diverted through its Freeport facility but has determined that a new treatment plant is not needed, but may reconsider an independent facility in the future.
- A joint, continuously operating facility would result in the lowest cost treated water for all areas.

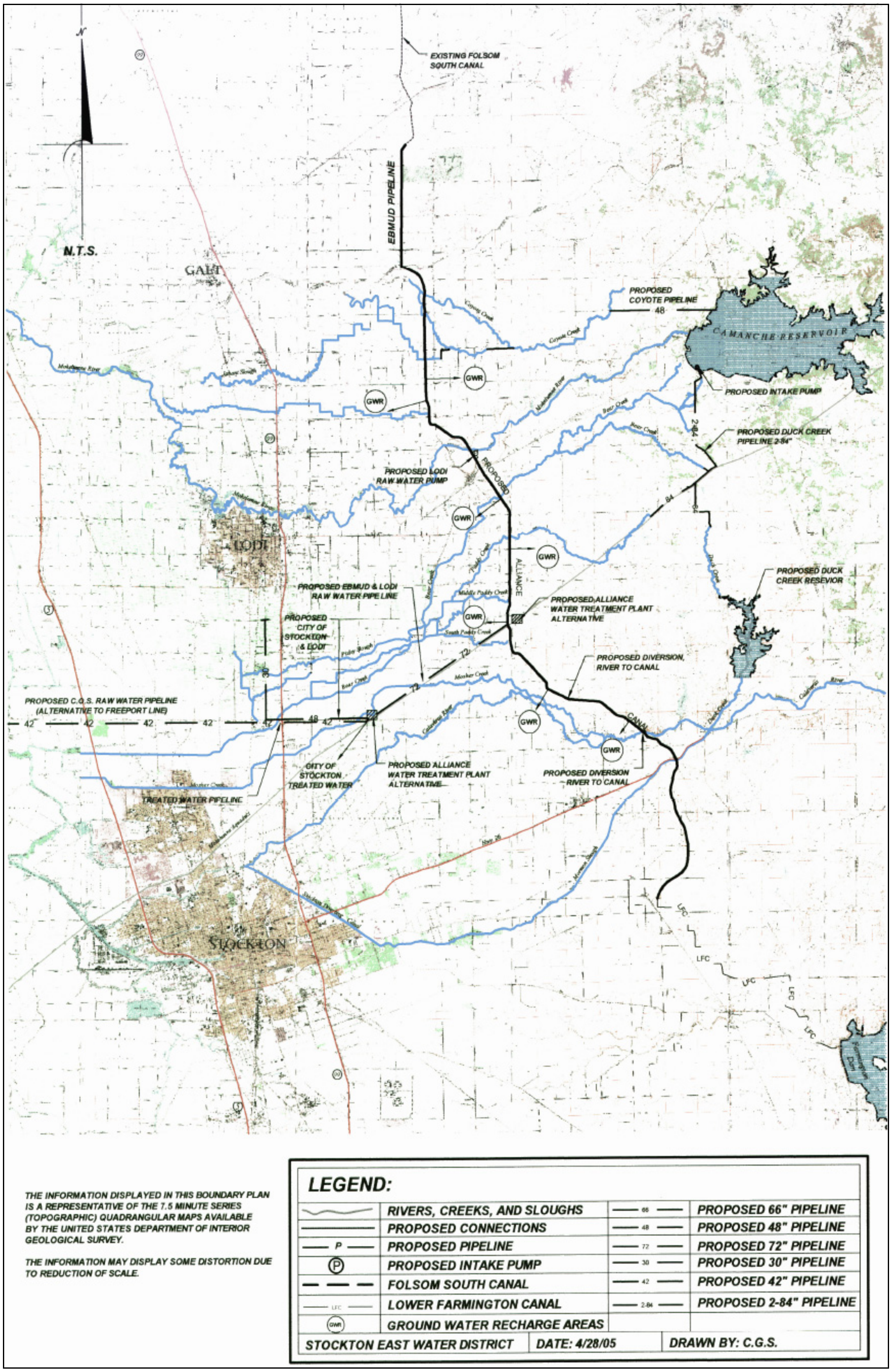


Figure 7-12 Alliance Canal and Water Treatment Plant Concept

Gill Creek and Woodbridge Road Flood Control Improvements (Strategy 24)

The Gill Creek and Woodbridge Road watersheds are located approximately four miles north of the City of Lodi and cover about 14.4 square miles of relatively flat terrain. The area has a history of drainage deficiencies resulting in long-duration shallow flooding resulting from infill or disking of natural drainage ways, changes in land use, rural residential development, and undersized culvert crossings and pump stations.

Gill Creek and Woodbridge Road Flood Control Improvements	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯✯
Water Supply Reliability	✯✯
Water Quality Protection and Improvement	✯✯✯
Conjunctive Use	✯✯
Surface Storage	✯
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✯✯
Water Transfers	✯✯
Flood Management	✯✯✯
Stormwater Capture and Management	✯✯✯
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	
Wetlands Enhancement and Creation	✯
✯✯✯ Primary Strategy ✯✯ Secondary Strategy ✯ Potential Strategy	

Historically, the proposed solution focused on increased channel capacities along Gill Creek; however, current regulations regarding downstream impacts, stormwater quality, and permitting present challenges to a diversion focused project.

In 2004 the San Joaquin County Department of Public Works Stormwater Management Division completed the Gill Creek and Woodbridge Road Watersheds Reconnaissance Study (Gill Creek Study) to identify and recommend a project that would provide a 100-year level of protection to structures and a 25-year level of protection to agriculture in the study area.

The Gill Creek Study explored three alternatives with the following focuses: channel enlargement, detention, and diversion into the Lower Mokelumne River. The Gill Creek Study identified detention as the preferred alternative which includes minor channel improvements and the construction of up to 15 detention basins covering a total area of 65 acres spread throughout the watersheds. A map of the preferred alternative can be seen in Figure 7-13.

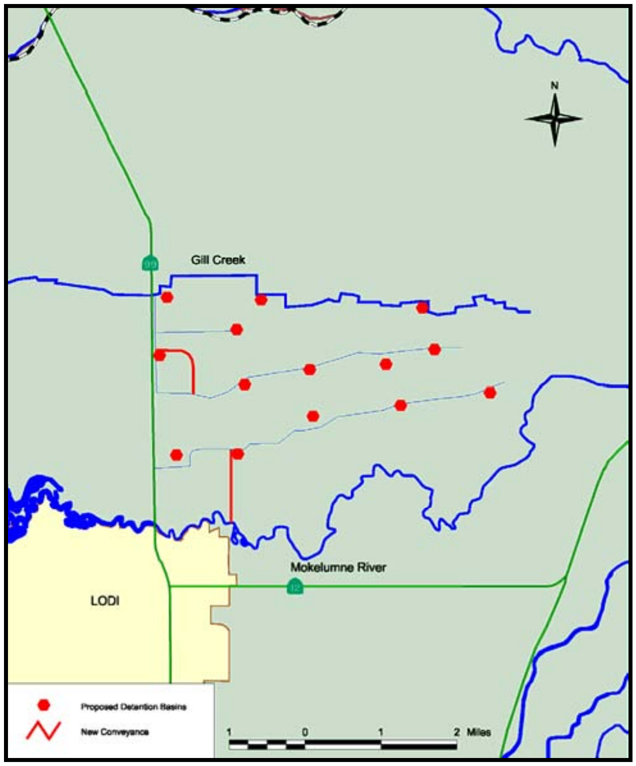


Figure 7-13 Gill Creek and Woodbridge Road Flood Control Improvements

The preferred alternative also has the potential to provide addition benefits as the channels and detention basins could be used to convey Mokelumne River Water for irrigation and direct recharge. The NSJWCD owns an existing 30 cfs irrigation system near Tretheway Road extending west along Acampo Road. Improvements to the NSJWCD North Irrigation System or an additional system could serve the conjunctive water management needs of the area. The preferred alternative is expected to cost approximately $25 million with an expected benefit of close to $30 million in prevented structural and agricultural damages. The next step is to perform a feasibility study where the conjunctive use and flood control operation can be explored further and the benefits quantified[14].

7.3.3 Increase Water Supply

Strategies to increase water supply include:

- Conjunctive Management and Groundwater Storage
- Desalination
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage—CALFED
- Surface Storage—Regional/Local

[14] San Joaquin County Department of Public Works, 2004

Conjunctive Use and Groundwater Recharge Components (Strategy 3)

The following descriptions describe identified groundwater recharge and conjunctive use components. The components include groundwater recharge infrastructure and improvements, modifications to drinking water treatment facilities, and agency conjunctive use programs.

Farmington Program

In 1997, the U. S. Army Corps of Engineers (USACE) completed the Farmington Dam and Reservoir Conjunctive Use Study, which evaluated potential structural and operational changes at Farmington Dam and Reservoir as part of a conjunctive use program. The study found that long-term storage at Farmington Reservoir is not cost-effective; however, operational modifications and the construction of groundwater recharge facilities are cost-effective. Consequently, the USACE, SEWD, and local water interests embarked on the development of a groundwater recharge program. In 1999 the U.S. Congress authorized up to $25 million for construction of groundwater recharge and conjunctive use projects in the Region.

Farmington Program	
Water Management Strategies	**Strategies Integrated**
Groundwater Management	✯✯✯
Water Supply Reliability	✯✯
Water Quality Protection and Improvement	✯✯
Conjunctive Use	✯✯✯
Surface Storage	✯
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✯✯
Water Transfers	✯
Flood Management	✯
Stormwater Capture and Management	✯
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	
Wetlands Enhancement and Creation	✯✯

✯✯✯ Primary Strategy
✯✯ Secondary Strategy
✯ Potential Strategy

In 2001, SEWD completed the Farmington Groundwater Recharge/Seasonal Habitat Study (Farmington Study) to evaluate the physical and financial feasibility of a groundwater recharge program in the Region. Through pilot testing, the study team found that the most effective area for groundwater recharge is the area bounded by Highway 99, Jack Tone Road, the City of Manteca, and the Mokelumne River. A map of the general area is shown in Figure 7-14.

In November of 2003, the District received $1.3 million from the DWR for a Proposition 13 grant to complete the first pilot project facilities adjacent to the SEWD Treatment Plan. The pilot project is a permanent facility consisting of one 19-acre pond and three recharge basins totaling 35 acres. These facilities are expected to recharge 7,000 acre-feet per year. In February of 2004, the pilot project was named the Water/Environment Project of the Year, 2003, by the American Society of Civil Engineers.

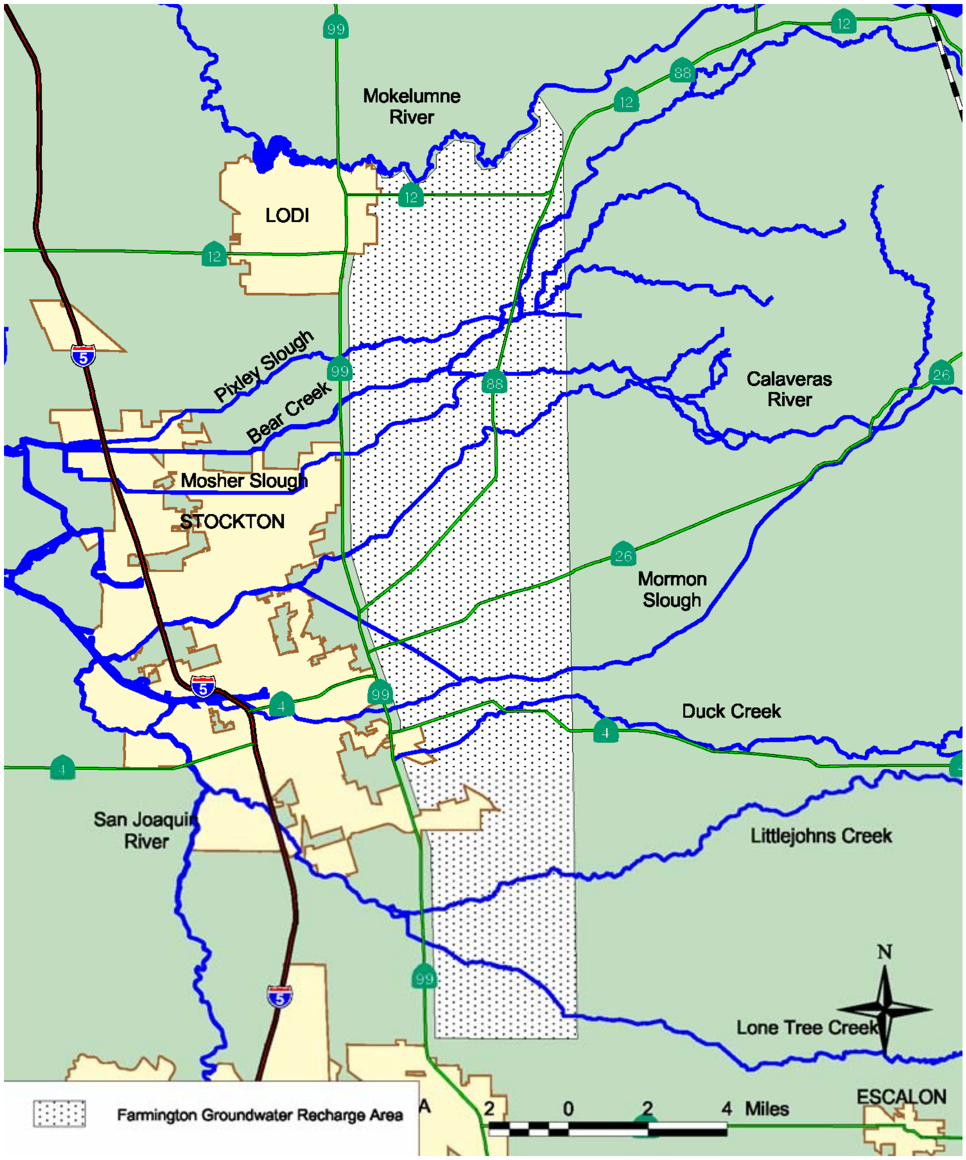


Figure 7-14 Farmington Groundwater Recharge Area

The Farmington Program Base Project (Farmington Program) objective is to recharge an average of 35,000 af of water annually by directly recharging surface water on 800 to 1,200 acres of land in the area described above. (See Figure 7-15.) The Farmington Program is a flexible program by which willing landowners with 20 to 100 acre parcels may enter into short-term and long-term agreements and receive market-based compensation for the use of their land for groundwater recharge. In addition all improvements are paid for through the Farmington Program. The arrangement allows the rotation of groundwater recharge practices with traditional land use making water a cash crop for farmers in the program.

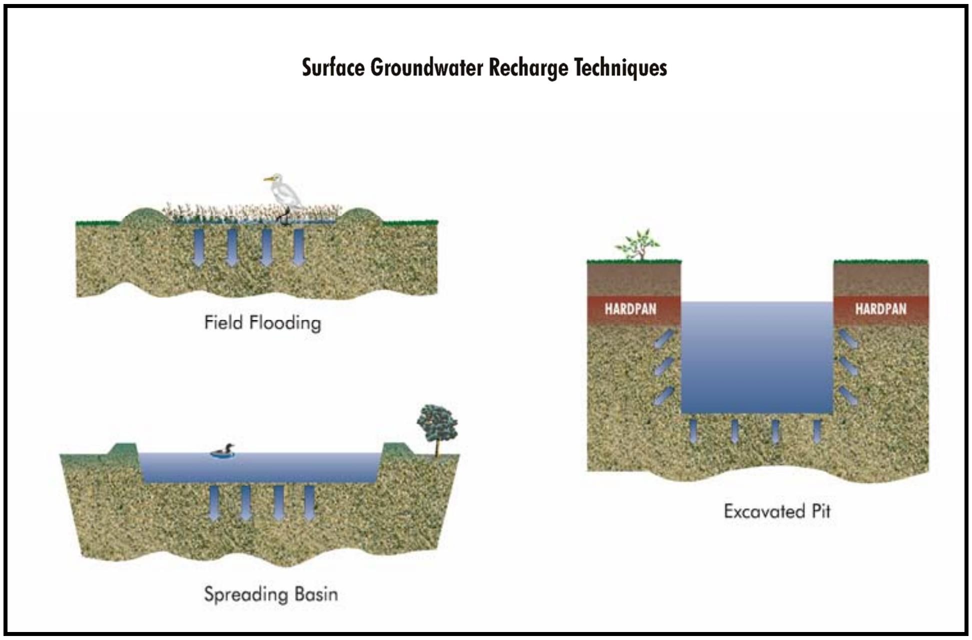


Figure 7-15 Groundwater Recharge Techniques

CSJWCD Surface Water Delivery Program

CSJWCD holds CVP contract entitlements for water from New Melones Reservoir with the USBR. The total amount available to CSJWCD under the contract is 80,000 acre-feet per year, 49,000 of which is said to be a firm supply. The CSJWCD irrigation system currently can deliver approximately 35,000 acre-feet per year through a series of ditches and natural creeks including Littlejohns, Temple, Lone Tree, and Duck Creeks. The system could be expanded to deliver up to 50,000 acre-feet per year if water should become available. Figure 7-16 depicts the CSJWCD irrigation system. Since the completion of the New Melones Conveyance System, surface water deliveries have elevated groundwater levels by as much as 15 ft in some areas within the CSJWCD.

CJSWCD Surface Water Delivery Program	
Water Management Strategies	**Strategies Integrated**
Groundwater Management	☆☆☆
Water Supply Reliability	☆☆☆
Water Quality Protection and Improvement	☆☆
Conjunctive Use	☆☆☆
Surface Storage	☆
Water Conservation	☆
Water Recycling	
Regional Groundwater Banking Partnerships	
Water Transfers	☆
Flood Management	
Stormwater Capture and Management	☆☆
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	
Recreation and Public Access	
Wetlands Enhancement and Creation	
☆☆☆ Primary Strategy◎ ☆☆ Secondary Strategy ☆ Potential Strategy	

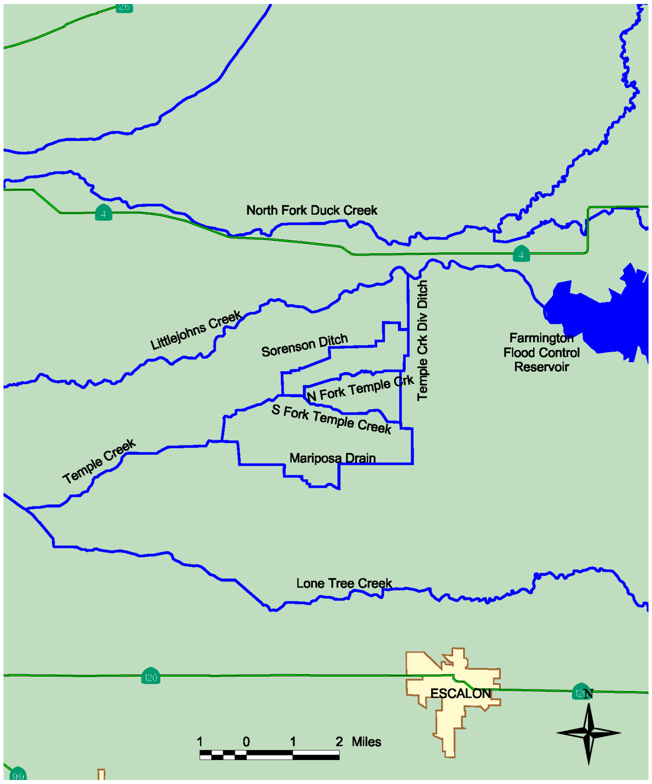


Figure 7-16 CSJWCD Irrigation System

Mariposa Lakes

Mariposa Lakes is a large 3800 acre planned development in southwest Stockton that is envisioned to include recharge and reclaimed use features. The development annexation was approved by the voters as Measure H in 2006, and may ultimately provide housing for as many as 50,000 people.

Approximately 3000 acre-feet per year will be distributed in a reclaimed water system for irrigation of parks and open space. Water to be pumped to refill planned sealed-bottom recreational lakes will require recharge of similar or greater amounts in the area. Other surface water sources are being explored. The residential development is expected to use less net water than previous agricultural uses of the site.

7.3.4 Surface Storage, Diversions, and Regional Conveyance Elements

The following projects have been identified as potential surface storage reservoirs, diversions, or new conveyance facilities.

City of Stockton Delta Water Supply Project (Strategy 6)

In 1996, the City of Stockton filed a water right application with the SWRCB seeking to appropriate initially 33,600 acre-ft per year of water from the Delta, increasing to

Delta Water Supply Project	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯✯✯
Water Supply Reliability	✯✯✯
Water Quality Protection and Improvement	✯✯✯
Conjunctive Use	✯✯✯
Surface Storage	
Water Conservation	✯
Water Recycling	✯✯✯
Regional Groundwater Banking Partnerships	✯
Water Transfers	✯✯
Flood Management	✯
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	✯
Wetlands Enhancement and Creation	
✯✯✯ Primary Strategy ✯✯ Secondary Strategy ✯ Potential Strategy	

125,900 acre-feet per year in 2050. The application specifies a place of use that coincides with the adopted 1990 City of Stockton General Plan boundary as shown in Figure 7-17. The City filed the water right application under two legal authorities: California Water Code Section 1485, the recapturing of treated wastewater discharge in the Delta, and California Water Code Sections 11460 and 12200 et seq., area of origin provisions and the Delta Protection Act, respectively. The City currently discharges approximately 35,000 acre-fee per year of treated wastewater into the San Joaquin River. Diversions from the Delta are extremely contentious and therefore somewhat restrictive due to constraints under the State and the Federal Endangered Species Act. The City of Stockton also expects to be limited by SWRCB Term 91[15] conditions for diversions under Water Code Sections 11460 and 12200 et seq. Term 91 limits diversion to when Delta outflow is higher than regulatory minimum requirements. In 2003, the City of Stockton completed the Delta Water Supply Project (DWSP) Feasibility Report, and certified its Environmental Impact Report in 2005.

The DWSP consists of a new intake facility and pump station to be located at the southwestern tip of Empire Tract on the San Joaquin River, a raw water conveyance pipeline, a new water treatment plant along Lower Sacramento Road in North Stockton, treated water pipelines, and groundwater injection and extraction wells. The intake, pipeline and treatment plant locations are shown in Figure 7-18. The facilities will be constructed in such a way as to provide the necessary security required for such a facility but also to provide public access for the surrounding community to educate water users on the importance of water management issues. In addition, sustainable design alternatives will be explored as a LEED (Leadership in Energy and Environmental Design) Certification will be pursued for the water treatment plant.

Based on an Opinion of Probable Construction Cost completed by HDR Engineering, Inc. in 2007 as part of the DWSP Cost Study, the estimated capital costs of the facilities are:

[15] Term 91 limitations do not apply to water diverted under Stockton's Section 1485 rights

- Intake Facility and Pump Station: $15 million
- Raw Water and Treated Water Pipelines: $80 million
- Water Treatment Plant (30 mgd): $67 million

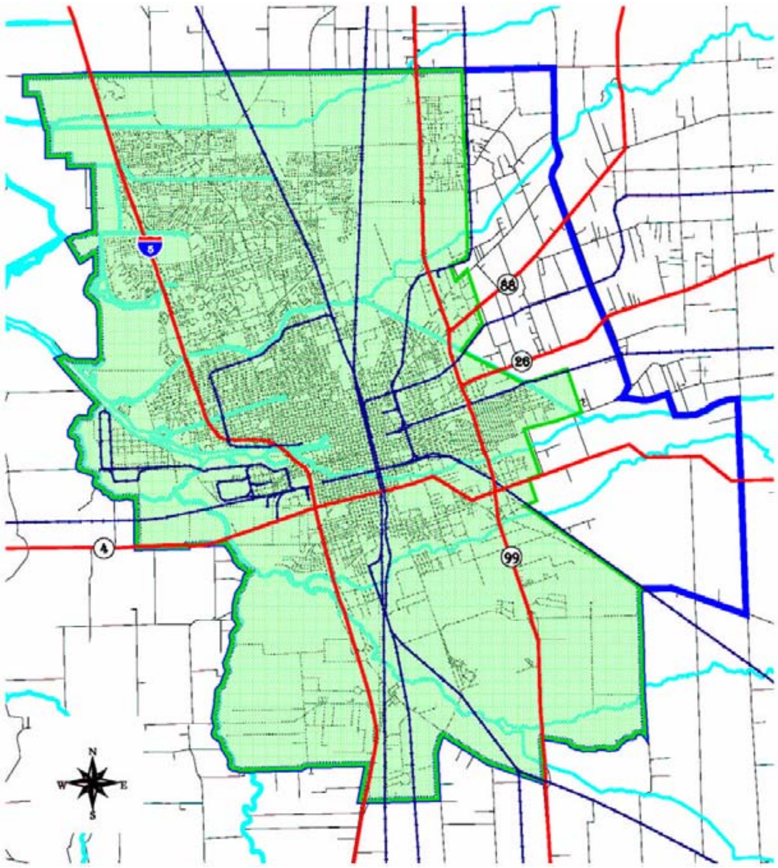


Figure 7-17 City of Stockton 1990 General Plan Boundary

The same DWSP Cost Study indicates preliminary Operations and Maintenance costs (assuming water delivery by 2010) at $2.8 million annually. The cost of the groundwater injection and extraction facilities is unknown at this time.

The DWSP will not only replace declining and unreliable surface water supplies in the region, but will also protect and restore groundwater resources by pumping less from the region's groundwater basin.

Past groundwater studies in the region show that the maximum, sustainable, long-term yield from the aquifer is 0.75 to 1 acre-foot per acre per year. The City of Stockton selected a long-term average of 0.6 af per acre per year as the target groundwater extraction rate which corresponds to an extraction amount of 40,000 af per year to combat historic overdraft conditions and the intrusion of saline groundwater into the underlying Basin. The DWSP will also include an aquifer storage and recovery (ASR) program to better meet long-term needs of the City of Stockton.

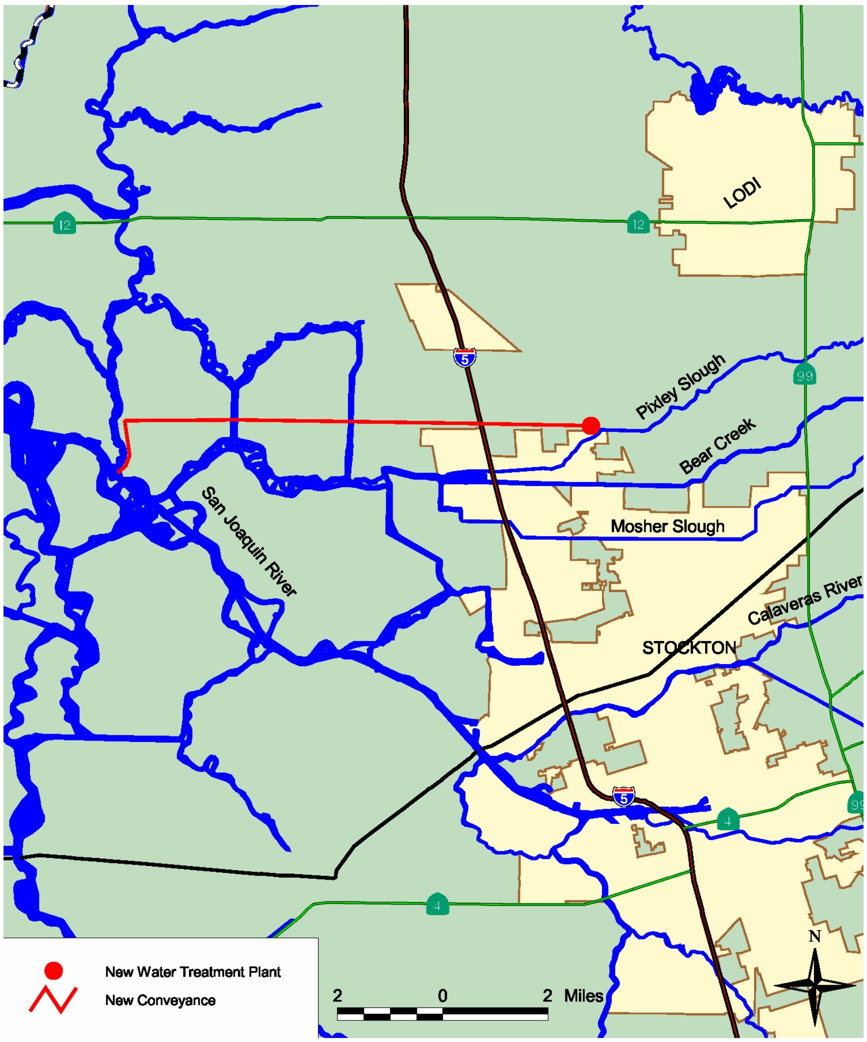


Figure 7- 18 Project Intake and Treatment Plant Sites

The DWSP is a conjunctive use program that integrates surface water and groundwater management. In wet years, when surface water is available, surface water use would be maximized and the groundwater would be allowed to recharge. Conversely, in drier years, when surface water is not available, use of groundwater would increase. In addition to allowing the basin to recharge naturally during wet years by minimizing pumping, artificial recharge techniques are available. Injecting surface water into the basin involves utilizing existing retrofitted wells or constructing injection/extraction wells for this purpose.

The groundwater component of the project would involve construction and operation of groundwater injection and recovery wells to both inject and extract treated Delta surface water to and from the local groundwater aquifer. Approximately 10 mgd of groundwater injection capacity would be needed at the end of the Phase 1 to begin a pilot program to bank available surface water in the ground.

Injection wells will be located east of the area in the City where there is poor groundwater quality, primarily adjacent to the Delta, to avoid degradation of the high quality surface water to be injected. Aquifer storage of treated surface water must comply with permit requirements of the RWQCB and must be in compliance with the Board's anti-degradation policy (Resolution 68-16), which prohibits activities with the potential to degrade the quality of state surface or groundwater. In addition, SWRCB guidance will be needed for groundwater banking programs to insure no injury to local, legal groundwater users[16].

The thickness, texture, and lateral extent of water bearing formations beneath Stockton are favorable for groundwater storage. The producing zones beneath Stockton include the Laguna Formation, which starts at about 100 feet below ground surface (bgs) and continues to approximately 1,000 ft bgs. Below this zone is the Mehrten Formation which is between 500 and 700 ft thick in the Stockton area. DWR describes the base of freshwater to be at approximately 1,000 feet beneath Stockton. In general, this freshwater exists in the Laguna Formation within its various sequences of deposits of interbedded and discontinuous gravels, sands, silts and clays. The Laguna Formation is generally unconfined, although the heterogeneous nature of the formation causes it to behave as semi-confined at depth in some areas.

The lowered groundwater levels in Stockton and the agricultural area to the east have created favorable conditions for groundwater storage. The general flow of groundwater under predevelopment conditions is from northeast to southwest. However, historical groundwater pumping has altered the flow direction which is now toward groundwater depressions generally in the center of the East San Joaquin basin. The historical use of groundwater has lowered water levels to over 70 ft below mean sea level (msl) (over 100 ft bgs) beneath some portions of the Eastern San Joaquin Basin.

Well log data in the Stockton area were used by the DWR[17] to construct an isopach map (Figure 7-19) contouring the cumulative thickness of sand in the 0-500 foot depth interval below ground surface. Areas of thicker cumulative sand are more favorable for

[16] Environmental Science Associates, January 2003, "*City of Stockton Delta Water Supply Project Feasibility Study, Final Report*"
[17] Reported in Environmental Science Associates, January 2003, op. cit.

groundwater storage projects because water can be injected and withdrawn from the aquifer more quickly and because water injected into the aquifer in these areas is less likely to be lost before being extracted.

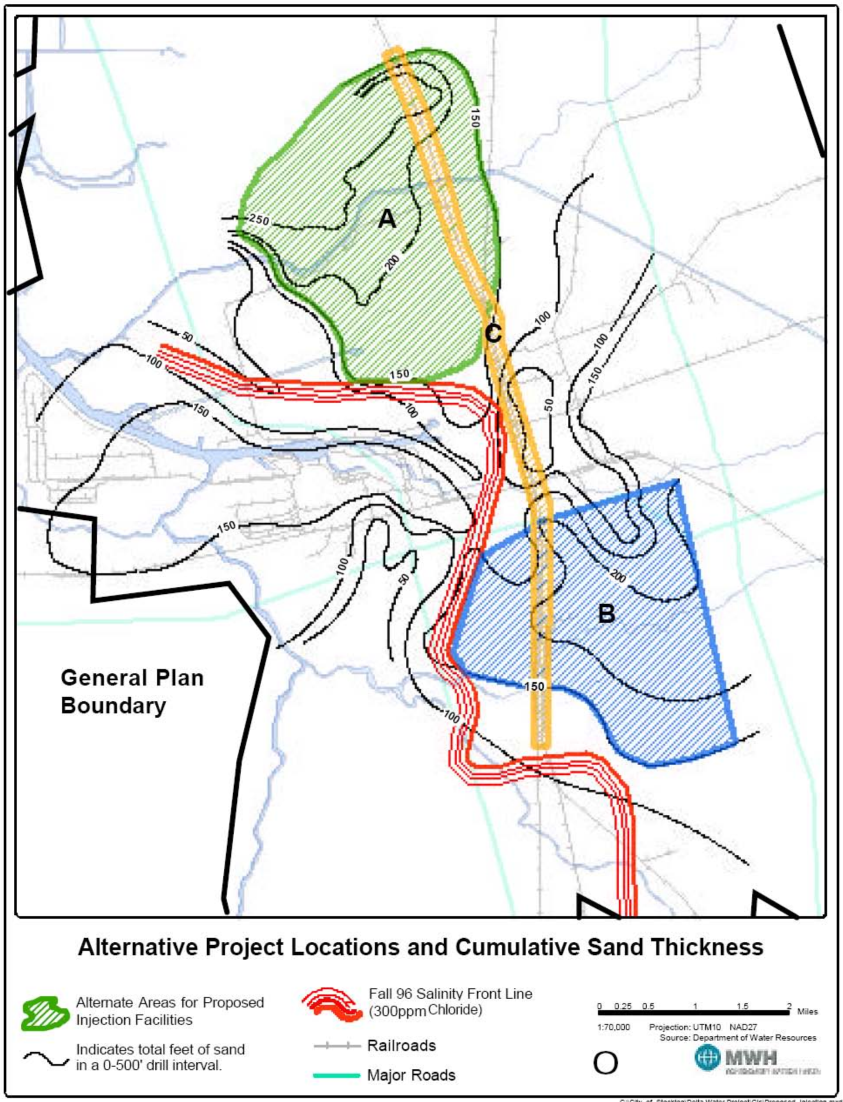


Figure 7-19 Isopach Diagram

A comprehensive description of the Delta Water Supply Project can be found in the project's Final Environmental Impact Report[18], which is incorporated into this Plan by reference. Design of the DWSP facilities is underway. Construction is expected to commence in 2008 with actual water delivery scheduled for 2010.

[18] Environmental Science Associates, October 2005, "*Stockton Delta Water Supply Project Final Program Environmental Impact Report*", State Clearinghouse No. 2003112060

Subsequent phases include a 10 mgd pilot aquifer storage and recovery (ASR) program to bank treated surface water in the underlying aquifer. The pilot ASR program involves retrofitting up to 10 existing wells for injection and extraction at an estimated cost of $200,000. After the completion of the pilot program, costs will be determined for an expanded program to serve as a groundwater bank.

In the Feasibility Study, three potential banking sites were identified: Site A, north of Alpine Road and west of Highway 99, site B, south of Alpine Road and west of Highway 99, and site C, located along the Southern Pacific Railroad, and illustrated in Figure 7-20.

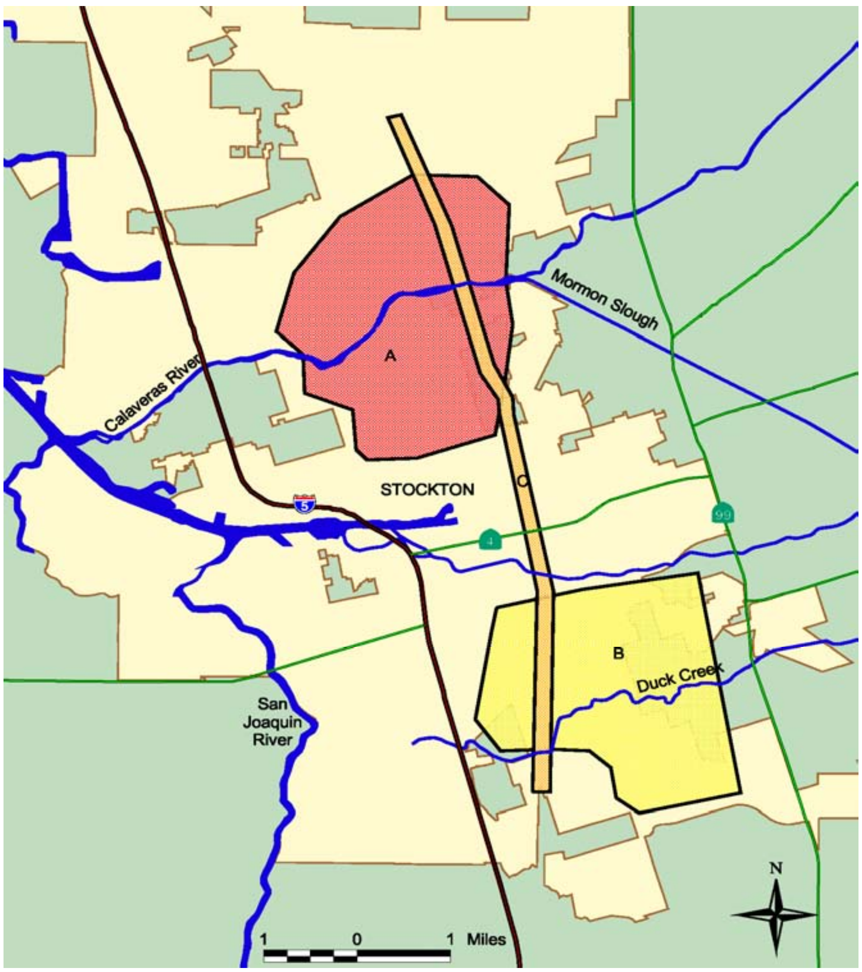


Figure 7-20 Potential Banking Sites

South County Water Supply Program

The South County Water Supply Program is a cooperative effort between South San Joaquin Irrigation District (SSJID) and the cities of Escalon, Manteca, Lathrop, and Tracy. The goals of the South County Water Supply Program are to:

- Provide a safe and reliable supplemental water supply for the south Region
- Put to beneficial use conserved water from SSJID entitlements
- Keep conserved water within SSJID and San Joaquin County, and
- Reduce the heavy reliance on groundwater for the urban areas of the southern portion of the Region.
- Additional benefits directly impacting the Delta is the reduction of salt from City of Tracy waste discharges due to improved source water quality.

South County Water Supply Project	
Water Management Strategies	Strategies Integrated
Groundwater Management	✯✯✯
Water Supply Reliability	✯✯✯
Water Quality Protection and Improvement	✯✯✯
Conjunctive Use	✯✯✯
Surface Storage	✯
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	✯
Water Transfers	✯✯✯
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	✯
Recreation and Public Access	✯✯✯
Wetlands Enhancement and Creation	✯
✯✯✯ Primary Strategy◎ ✯✯ Secondary Strategy ✯ Potential Strategy	

SSJID has pre-1914 rights to Stanislaus River water. Water served to the participating cities is made available from the implementation of conservation practices, more efficient means of irrigation by SSJID, and through the loss of irrigated agriculture to planned urban growth. The South County Program consists of an intake facility at Woodward Reservoir, a 44 mgd state-of-the-art membrane filtration water treatment plant just west Woodward Reservoir near Dodds Road, and over 40 miles of pipe ending in the City of Tracy. A map of the project is presented as Figure 7-21.

Phase I of the South County Program will serve up to 30,000 af per year though 2010. Phase II will increase deliveries to 44,000 af annually and provide a net reduction of groundwater pumping from the underlying Basin of approximately 30,000 af annually. The total cost of the project is estimated at $126 million. (SSJID, 2001) The Cities of Escalon, Lathrop, and Manteca typically exceed the 1.0 af per acre safe yield of the Basin. The South County Program would allow those cities to pump groundwater within the safe yield (SSJID, 1994). The South County Program has ensured that recreation and access to Woodward Reservoir will be restored once the intake facilities have been constructed. Water deliveries are scheduled to commence in summer 2005.

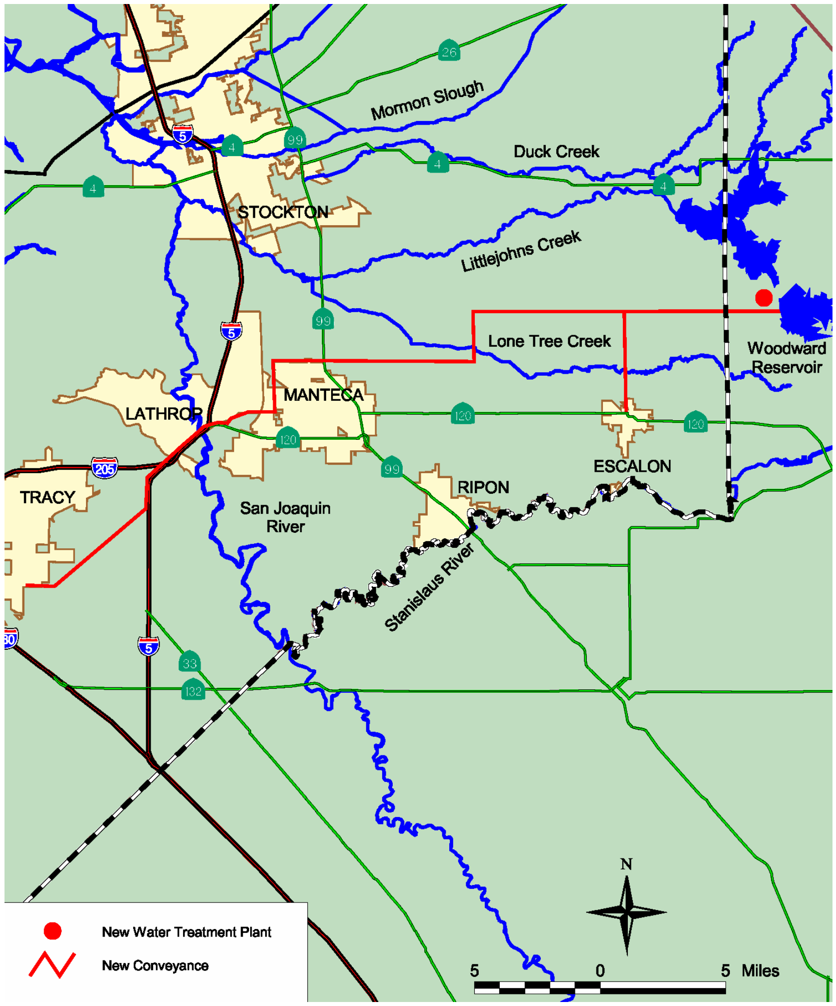


Figure 7–21 South County Water Supply Project

Surface & Regulatory Storage (Strategy 17)

Duck Creek Reservoir

An off-stream regulating reservoir on Duck Creek is being studied as part of the Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE Water Project) under development by the Mokelumne River Water and Power Authority (MRWPA). A Phase 1 Reconnaissance Study completed in June 2004. The MRWPA has received Federal authorization through the U.S. Bureau of Reclamation in 2006 to prepare a feasibility study. A new river operation model of the Mokelumne River system called MOCASIM as also been completed under Phase 2 in 2006.

MOKELUMNE RIVER
WATER AND POWER AUTHORITY
ESTABLISHED 1990

The primary source of water for Duck Creek Reservoir is a proposed 1,000 cfs tunnel/pipeline from Pardee Reservoir (see Figure 7-22). The Reservoir could also be filled from an 800 cfs tunnel from New Hogan reservoir, or from a new diversion on the Calaveras River. If Calaveras River flows are given priority, an average of 47,600 acre-feet per year could be stored in Duck Creek Reservoir for release during the irrigation season. If Mokelumne River flows are given priority for filling the reservoir, an additional 13,700 acre-feet of Calaveras River water could be re-regulated after the Mokelumne source is fully utilized.

Water released from Duck Creek Reservoir would enter the Calaveras River upstream of the Bellota Weir, where it could be routed to the Bellota Pipeline, to the proposed Cox Road distribution system, or diverted along the Calaveras River or Mormon Slough.

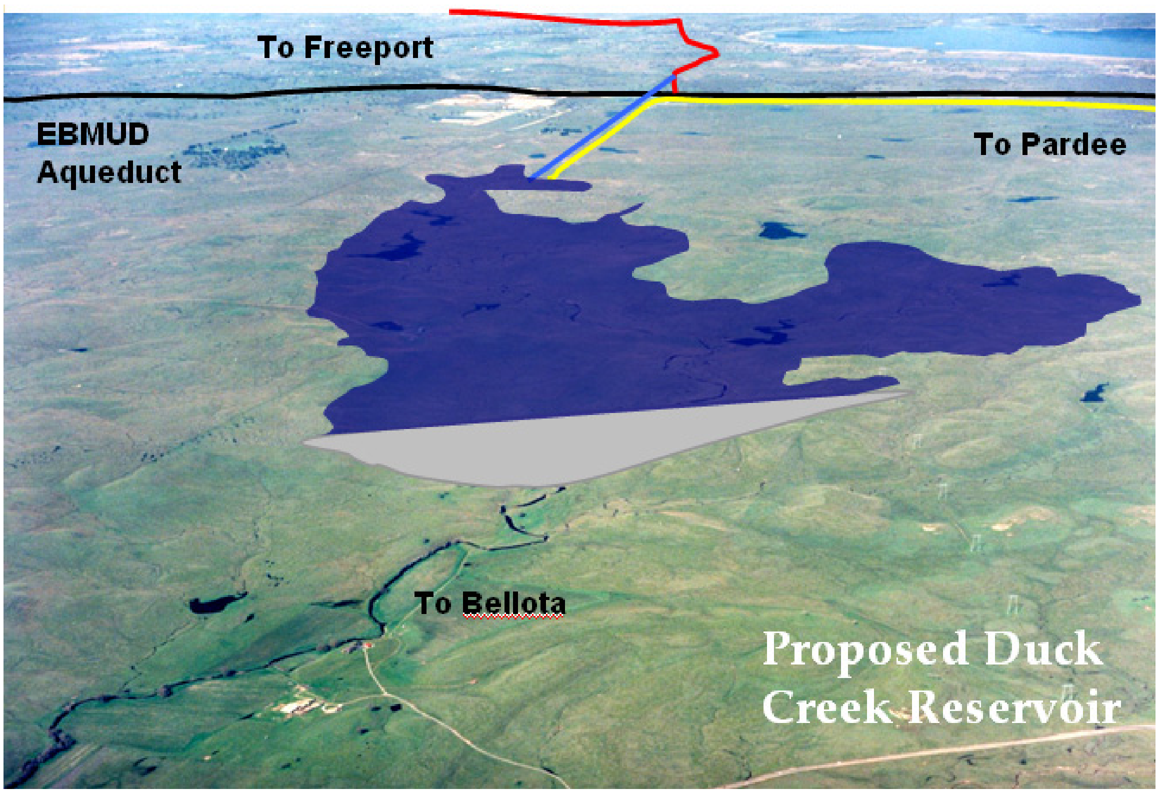


Figure 7-22 Proposed Duck Creek Reservoir with Diversions from Pardee Reservoir & Freeport Regional Water Project – Folsom South Canal Connection Pipeline

Farmington Dam

Farmington Dam is an earthen dam built in 1951 that extends about 7,800 feet long and is located in southeastern San Joaquin County. The Dam has a high surface area to volume ratio that allows higher evaporation from the reservoir surface than for lower surface area to volume ratio reservoirs. The reservoir holds a maximum of 52,000 AF of water and covers 4,100 acres in the Littlejohns and Rock Creek watersheds[19].

The Dam was built strictly for flood control and was not intended to hold water for any length of time. The dam has a pervious foundation and, as such, seeps at the downstream toe during high reservoir water levels. Because of this, raising the dam height is not an option, without total removal of the existing dam and starting with a new base and foundation.

In 1994, SEWD built a diversion structure immediately downstream of the Farmington Dam to divert water into the Lower Farmington Canal, also built by SEWD. The USACOE originally allowed for diversion of water into the Canal during non-flood months only. Since then, the USACOE has allowed year round diversion of water into the Farmington Canal for delivery of M & I and agricultural water to SEWD's Bellota and Peter pipelines approximately 10 miles northwest of the Farmington Dam. The Canal has the ability to carry 300 cfs to Duck Creek and 200 cfs the majority of its length to the SEWD pipelines.

South Gulch Reservoir

In 1984, SEWD completed the South Gulch Water Conservation Project Technical Reconnaissance Report to evaluate the feasibility of the proposed South Gulch Reservoir. South Gulch Reservoir is located approximately 22 miles east of Stockton, and approximately seven miles southwest of New Hogan Dam. The proposed dam location is six-tenths of a mile upstream from the South Gulch and Calaveras River confluence. The South Gulch Reservoir surface area is approximately 3,000 acres with a potential storage capacity of 130,000 to 180,000 acre-feet.

In conjunction with the construction of the South Gulch Dam, the Upper Farmington Canal would be completed to convey water from the Stanislaus River. Additionally, a diversion structure on the Calaveras River just down stream of New Hogan Reservoir could be constructed to convey excess water to the proposed South Gulch Reservoir in wet years[20]. A map of the proposed reservoir is presented as Figure 7-23.

[19] Farmington Groundwater Recharge Seasonal Habitat Study, Final Report, August, 2001

[20] This conveyance would be constructed if Mokelumne flows were given priority for filling Duck Creek Reservoir.

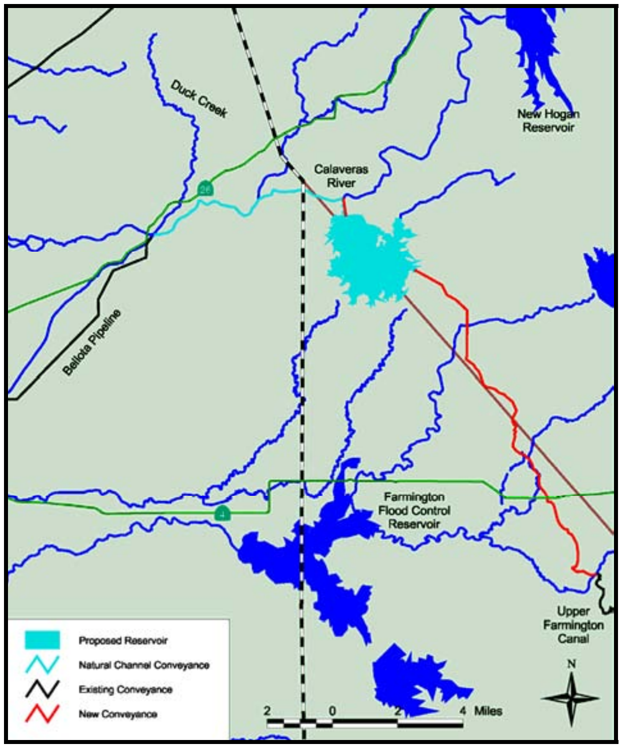


Figure 7-23 Proposed South Gulch Reservoir

Lyon's Dam

The Tuolumne Utilities District (TUD) obtains the majority of its water supply from the South Fork of the Stanislaus River. In 1983 TUD entered into an agreement with PG&E for the use of all water diverted through Strawberry (Pinecrest) Reservoir and Lyons Reservoir in excess of the required in-stream flows. The amount of water available annually is dependent upon the natural flow of the South Fork of the Stanislaus River which has an average annual yield of approximately 100,000 af including 24,000 af combined storage in Strawberry and Lyons Reservoirs[21].

TUD is currently evaluating the possibility of replacing the existing Lyons Dam to create a larger reservoir to provide enough water for future development. The current capacity of Lyons Reservoir is 6,219 af, and the current spillway elevation is 4,214-ft. TUD has contemplated either a 25,000 af or 50,000 af reservoir with surface elevations of 4,285-ft and 4,328-ft respectively. Both options would be located 800-ft downstream of the current dam. The estimated cost of a new 50,000 af reservoir is $26 million. A map of the 50,000 af option is shown in Figure 7-24. SEWD has expressed interest in partnering with TUD for supplemental water supplies from the Lyons Reservoir enlargement.

[21] www.tuolumneutilities.com/uwmp.pdf, 2000

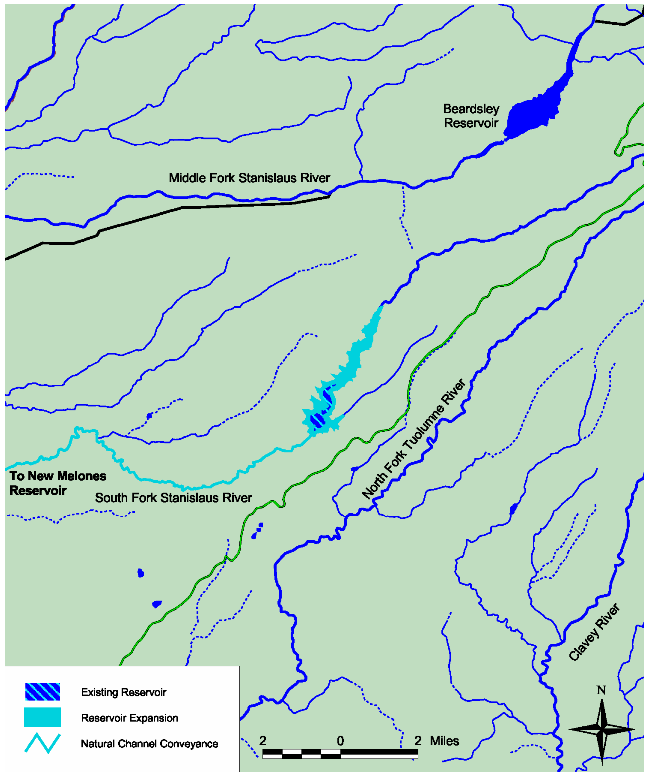


Figure 7-24 Lyons Reservoir Expansion

7.3.5 Improve Water Quality

California Water Plan strategies considered that improve water quality include:

- Drinking Water Treatment and Distribution
- Groundwater Remediation/Aquifer Remediation
- Matching Water Quality to Water Use
- Pollution Prevention
- Urban Runoff Management

SEWD Water Treatment Plant Expansion (Strategy 6)

The current permitted capacity of the Dr. Joe Waidhofer Water Treatment Plant (SEWD Treatment Plant) is 50 mgd, and the capacity of the planned expanded facility is 60 to 70 mgd. Currently turbidity occasionally limits production resulting in an average yearly production of approximately 50,000 af per year to its urban contractors in the City of Stockton. An expanded SEWD Treatment Plant is expected to supply up to 62,000 af per year. Currently, raw water sent to the SEWD Treatment Plant originates from either New Hogan Reservoir on the Calaveras River or New Melones Reservoir on the Stanislaus River.

Stockton Delta Water Supply Project (Strategy 6)

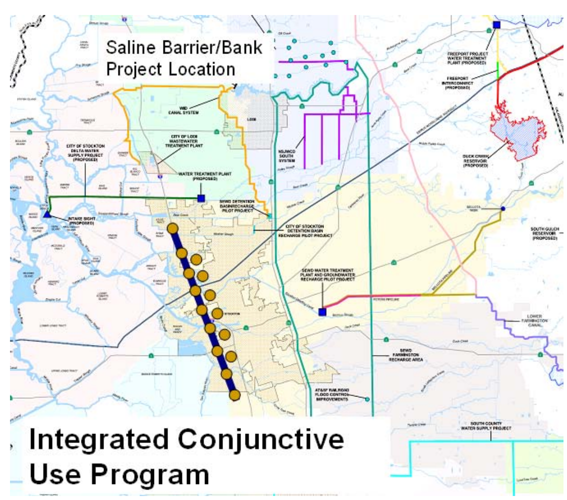
The Stockton Delta Water Supply Project (described above under Surface Storage, Diversions, and Regional Conveyance Elements) will add significant surface water treatment capacity to the region.

Saline Intrusion Barrier Project (Strategy 10)

Because groundwater extractions have reversed the pre-development east-to-west groundwater flow pattern, deep connate saline water has begun to migrate easterly toward the pumping depression. The 300 ppm chloride line, the salt concentration where the water becomes unsuitable for most uses, extends eastward almost to Highway 99 in Southwestern Stockton. Eastward saline migration has resulted in municipal production wells in Stockton to be removed from production.

SEWD Water Treatment Plant Expansion	
Water Management Strategies	**Strategies Integrated**
Groundwater Management	☆☆☆
Water Supply Reliability	☆☆☆
Water Quality Protection and Improvement	☆
Conjunctive Use	☆☆
Surface Storage	☆
Water Conservation	
Water Recycling	
Regional Groundwater Banking Partnerships	
Water Transfers	☆
Flood Management	
Stormwater Capture and Management	
Ecosystem Restoration	
Environmental and Habitat Protection and Improvement	
Recreation and Public Access	
Wetlands Enhancement and Creation	
☆☆☆ Primary Strategy◎ ☆☆ Secondary Strategy ☆ Potential Strategy	

Degradation of water quality due to TDS or chloride contamination threatens the long-term sustainability of a very important water resource for the Region, since water high in TDS and/or chloride is unusable for either urban drinking water needs or for irrigating crops. Damage to the aquifer system could for all practical purposes be irreversible due to saline water intrusion, withdrawal of groundwater from storage, and potentially subsidence and aquifer consolidation. Figure 7-25 depicts the wells within the Basin with historic chloride measurements.



The Saline Intrusion Barrier Project will characterize and quantify the problem and develop a range of solutions. Possible solutions include:

- Raising regional groundwater levels to reduce or eliminate the easterly gradient,

- Constructing injection wells to repel the advance of saline water, or
- Constructing a line of extraction wells to create a barrier to further migration, and treating and reusing this pumped water.

Little is yet know about the source, extent, and mechanism for this saline water movement, and thus the best solution has not yet been identified. The GBA has been working with the USGS, DWR and other agencies in a multi-year effort of exploration, testing, and monitoring to provide a scientific basis for a potential solution. The initial study is to be completed in 2009. Figure 7-26 depicts several of the hydrogeologic activities undertaken by the USGS.

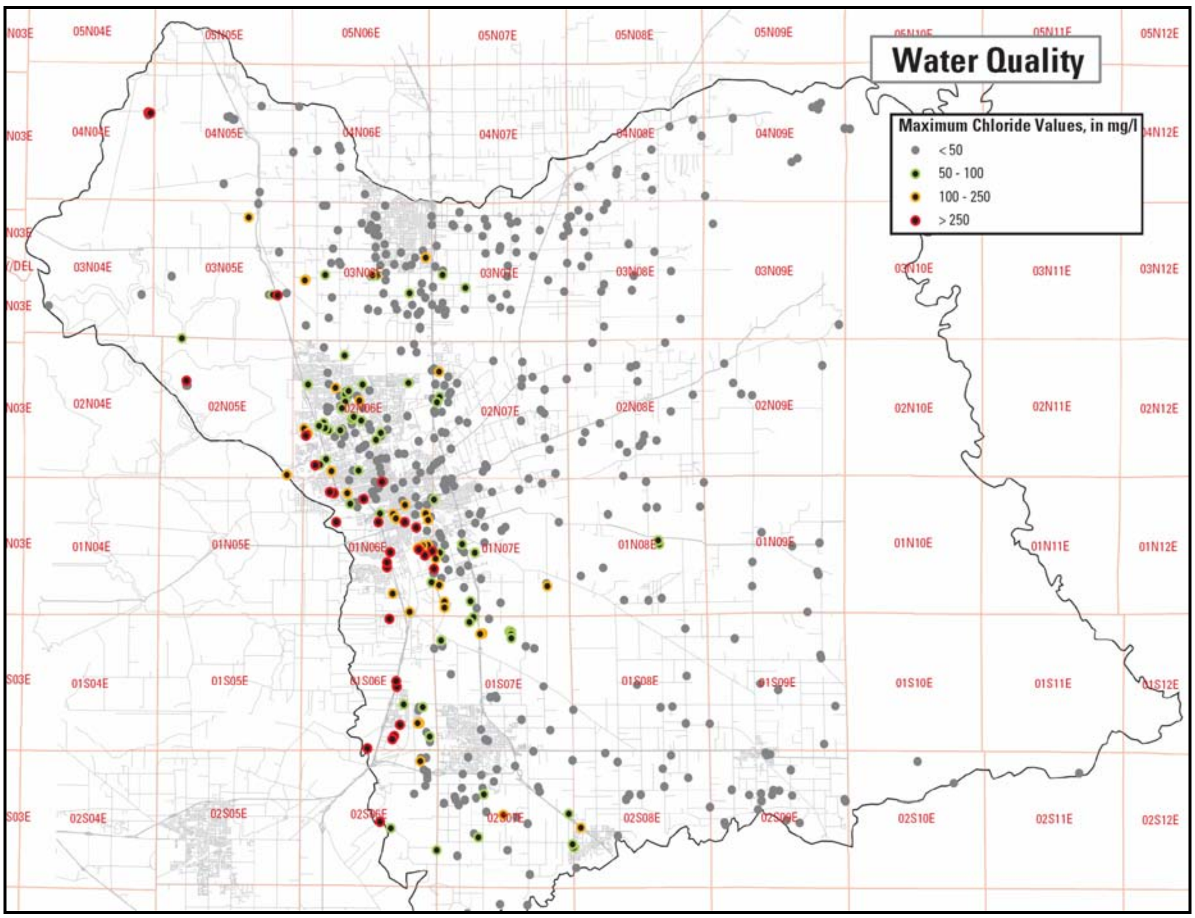


Figure 7-25 Chloride monitoring wells

Figure 7-26 Installation of Monitoring Wells in Victory Park, Stockton. Note examples of multiple cluster well types.

7.3.6 Strategies considered though not included in California Water Plan

In addition, the GBA also considered the following water management strategies in the development of the ICU Program:

- Water Supply Reliability
- Inter-Regional Groundwater Banking
- Imported Water
- Land Use Planning
- Smart-Growth
- Flood Management
- Non-Structural Elements
- Recreation and Public Access
- Education (Micke Grove Park Enhancement)
- Climate Change

Intra-Regional and Inter-Regional Cooperation (Strategy 32)

Intra-regional coordination refers to collaboration within the boundaries of the Eastern Basin Groundwater Management Area (GMA). Inter-regional coordination refers to collaboration with agencies outside of the GMA. Figure 7-27 defines and depicts the concept of inter-regional and intra-regional coordination. The concept has been promoted by the GBA to help stakeholders understand how their actions affect areas throughout the region, and to communicate with outside agencies regarding the projects and programs that could positively affect regional water supplies and provide significant ***exo-regional*** benefit.

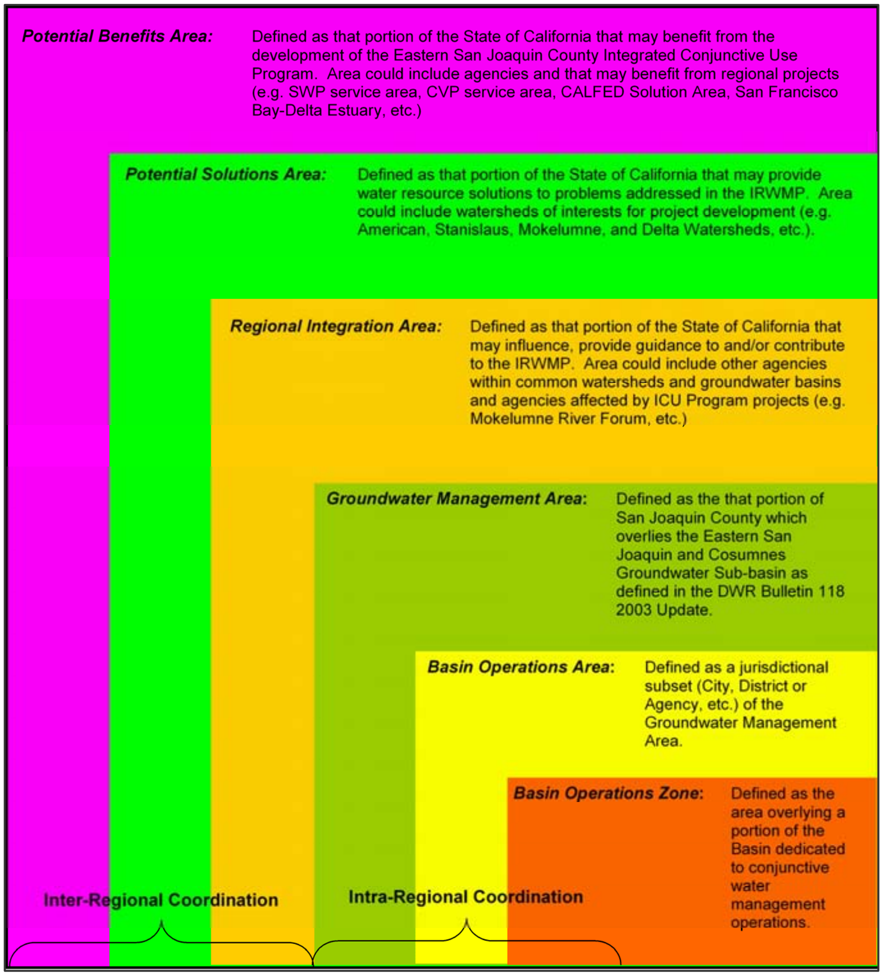
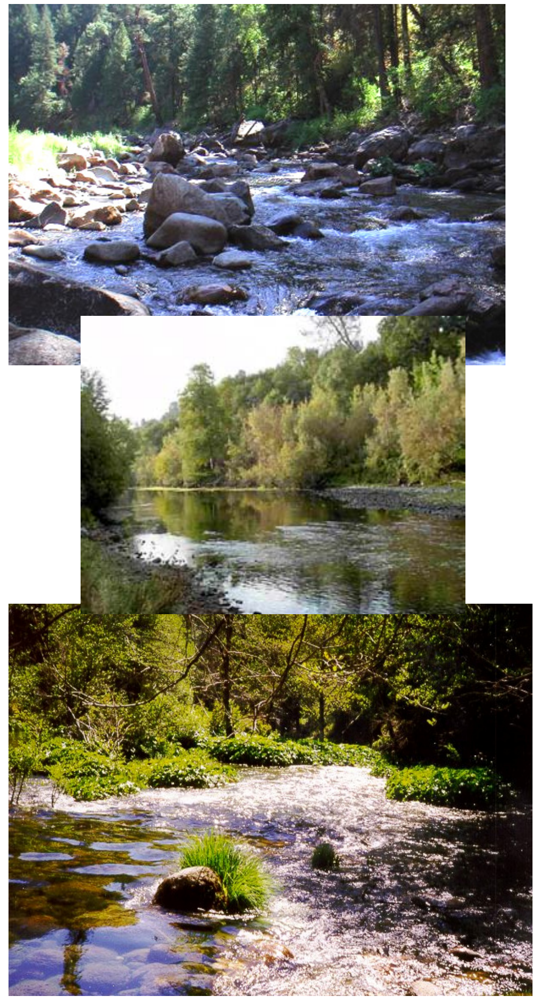


Figure 7-27 Inter and Intra-Regional Coordination Concepts

The Regional Integration Area is the key to the success of the IRWM Planning Process. The groundwater basins and the watersheds of the Region extend beyond political boundaries and the GBA will carefully consider the implementation of water projects that may affect adjacent areas. The GBA has targeted specific agencies within the Regional Integration Area to explore the potential for coordination of projects that either benefit or protect affected agencies. Examples of inter-regional cooperation are discussed in Chapter 8.

7.3.7 Environmental Enhancements

Water and planning agencies in San Joaquin County are working to develop a number of water-related environmental enhancements. These include:



- San Joaquin County Habitat Conservation Plan (HCP). The HCP was developed by the San Joaquin Council of Governments and other stakeholders, and was adopted in 2001. The Plan addresses terrestrial impacts of development and identifies and provides for purchase of mitigation lands.
- City of Stockton efforts to increase dissolved oxygen along the Deep Water Ship Channel on the San Joaquin River.
- Studies to characterize, remediate, and manage saline migration into County groundwater aquifers.
- Efforts by cities and planning agencies to establish buffer lands or 'greenbelts' between cities and conservation easements on high value farmland.
- Active groundwater recharge to replenish regional water supplies and restore natural groundwater gradients to area streams and rivers.
- Increased use of recycled water piping (purple pipe) in new and existing developments, and including such requirement in city (e.g. Stockton) general plans.
- Opportunistic habitat creation and enhancement as part of new projects, including in stream releases.
- Studies of fisheries, and providing enhancements such as state of the art fish ladders and screens at New Woodbridge Dam and NSJWCD intakes.
- Providing recreation opportunities at streams, lakes, and linear water features.
- Installing improved fish screens on older diversions along the Calaveras River (e.g. between New Hogan Reservoir and the Bellota Weir) as part of a new Aquatic Habitat Conservation Plan for the river.

- Working with the State Environmental Water Account to develop opportunities to bank water in the Basin for environmental purposes.
- Education programs such as those planned for Micke Grove Regional Park Enhancement.
- USGS Saline Groundwater Monitoring.
- Stockton Delta Water Supply Program will lower TDS discharges to the San Joaquin River.

7.4 Development of Evaluation and Prioritization Criteria and Associated Tools

7.4.1 Developing the Basis of Design

To develop an unbiased method for sizing, evaluating, and developing costs for projects included in the Integrated Conjunctive Use Program, a "basis of design" was prepared at the outset of this planning effort. The Basis of Design includes data sources, operating assumptions, unit cost and unit operation data, and other key parameters. See Chapter 7 Supplemental Materials for the Basis for Design Table.

7.4.2 Surface and Groundwater Models

To choose between potential alternatives, the GBA developed methods to predict performance and assess impact with respect to the Fundamental Objectives. To this end, two integrated models of the hydrologic system were developed.

1. A detailed integrated surface-groundwater model built on the DYNFLOW platform to detailed assessment of the No Action and final alternatives
2. A screening model built on the Stella modeling platform to allow the quick assessment of many alternatives.

Successful alternatives screening requires an appropriate screening model to compare expected performance of alternative combinations of projects. The Stella model was designed and constructed with adequate detail to differentiate between the various basins, issues, geographic regions, and water management actions as discussed in Chapter 6. The model was broken down into just five management units. The mathematical relationship between these units was derived from detailed DYNFLOW results. Examples of these generalized relationships are head-flow relationships between relatively large modeling elements[22]. The Stella screening model produced outputs consistent with the quantifiable Basin Operations Criteria.

[22] Whereas the average DYNFLOW modeling unit is less than one square mile, elements in the screening model might be 100 square miles. Subsequent DYNFLOW modeling confirmed that these simplifying assumptions provide a reasonable analog to the more detailed modeling.

A major effort in Plan development and alternatives screening was the specification, design, and construction of the screening model. Based on the results of early stakeholder workshops, the appropriate role was determined for the screening model in project evaluation, with consideration given to basin operations, economics, ecosystem maintenance, and other factors. One stakeholder workshop was devoted to confirm that model attributes correctly represented local and regional issues and potential solutions. A key result of the screening model was that recharge of about 140,000 acre-feet per year[23] results in acceptable fluctuations around the 1986 and 1992 level criteria.

In September 2006, this information was presented to the GBA Coordination Committee who found the performance to be acceptable. This type of analysis and comparison allowed Coordinating Committee members to screen the range of projects and actions that best address GBA issues and fundamental objectives. From this, all detailed program alternatives were assembled to provide average annual recharge of at least 140,000 acre-feet per year, with an upper limit of about 160,000 acre-feet per year.

Modeling and Impact Assessment - The regional DYNFLOW screening model was used to compare expected performance of alternative combinations of projects and management alternatives for the GBA. The model provides a method to "operate" the Region's water system to try to meet future target demands for water considering various structural and management changes to the system. All modeled program alternatives, each designed to recharge approximately the same amount of water, performed acceptably.
Model operation was simulated at a fixed level of 2030 demand considering the variability of hydrology and imported supply the region will likely face. The historical time-series hydrology as presented in the Water Management Plan was used to approximate the likely hydrologic variability the region will face in the future. The results of the modeling provided a time series of outputs that can be evaluated in many different ways, as described in the Chapter 7 Supplemental Materials.

Sample DYNFLOW model output showing flow velocity vectors is presented as Figure 7-28, and the No Action water level contours are presented in Figure 7-29.

[23] Including offsets provided by conservation and reclamation. Since the mechanism driving the migration of saline water is not well understood, no explicit water level targets other than the 1986/1992 criteria were established for saline migration.

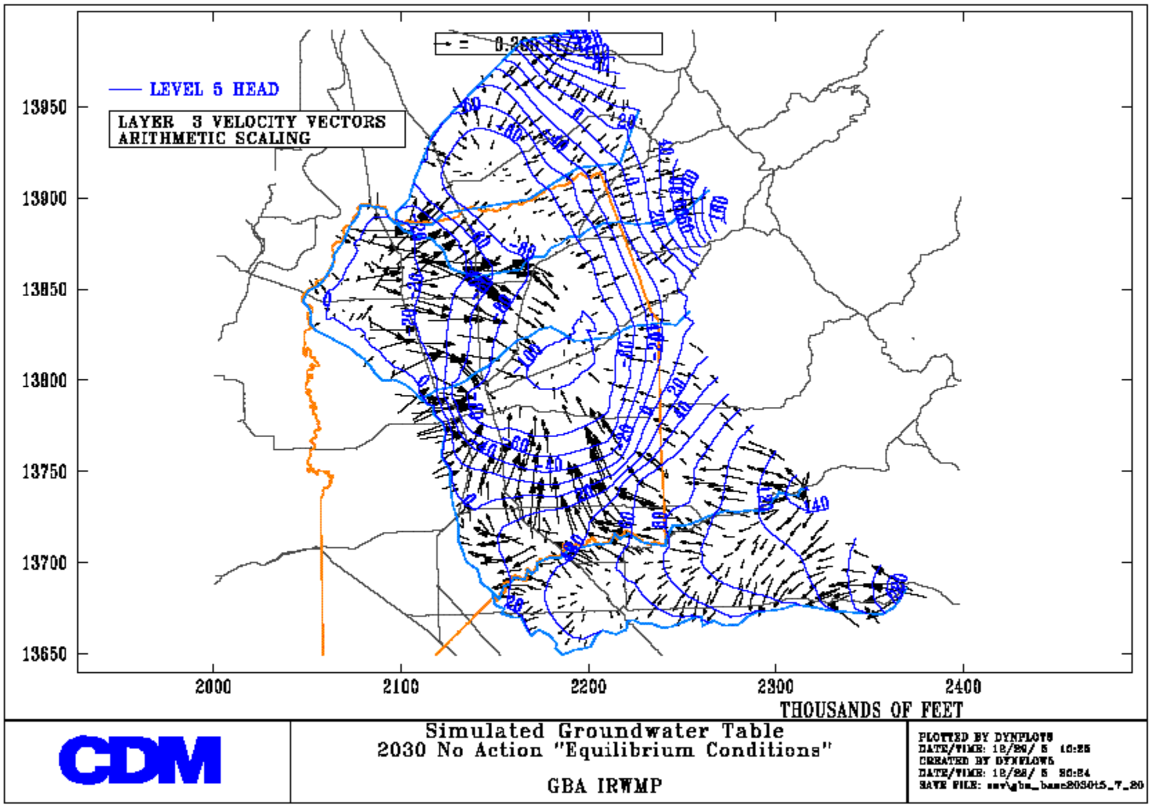


Figure 7-28 Sample DYNFLOW Output showing Flow Velocity Vectors under 2030 No Action Conditions

7.4.3 Evaluation Criteria (Performance Measures)

Define Performance Measures - Performance measures were developed to allow the GBA to screen and select the best combinations of projects and management actions that address key water issues using a four step systems approach. The first step is the clear articulation of what the GBA wanted to accomplish. The intended accomplishments are specified in terms of the Fundamental Objectives together with development of Performance Measures. Performance-based standards allow flexibility but focus on unbiased quantifiable results.

The Performance Measures are evaluation criteria which provide a methodology to compare the relative success of alternative solutions for producing the desired results. This will lead directly to the next steps of generating alternative solutions, evaluation of those alternatives, and ultimately the selection the best alternatives to implement.

1. Identify key water management **issues**
2. Use **issues** to help define problem
3. Ways to define problem
4. Define **Fundamental Objectives**
5. Define **Performance Measures**

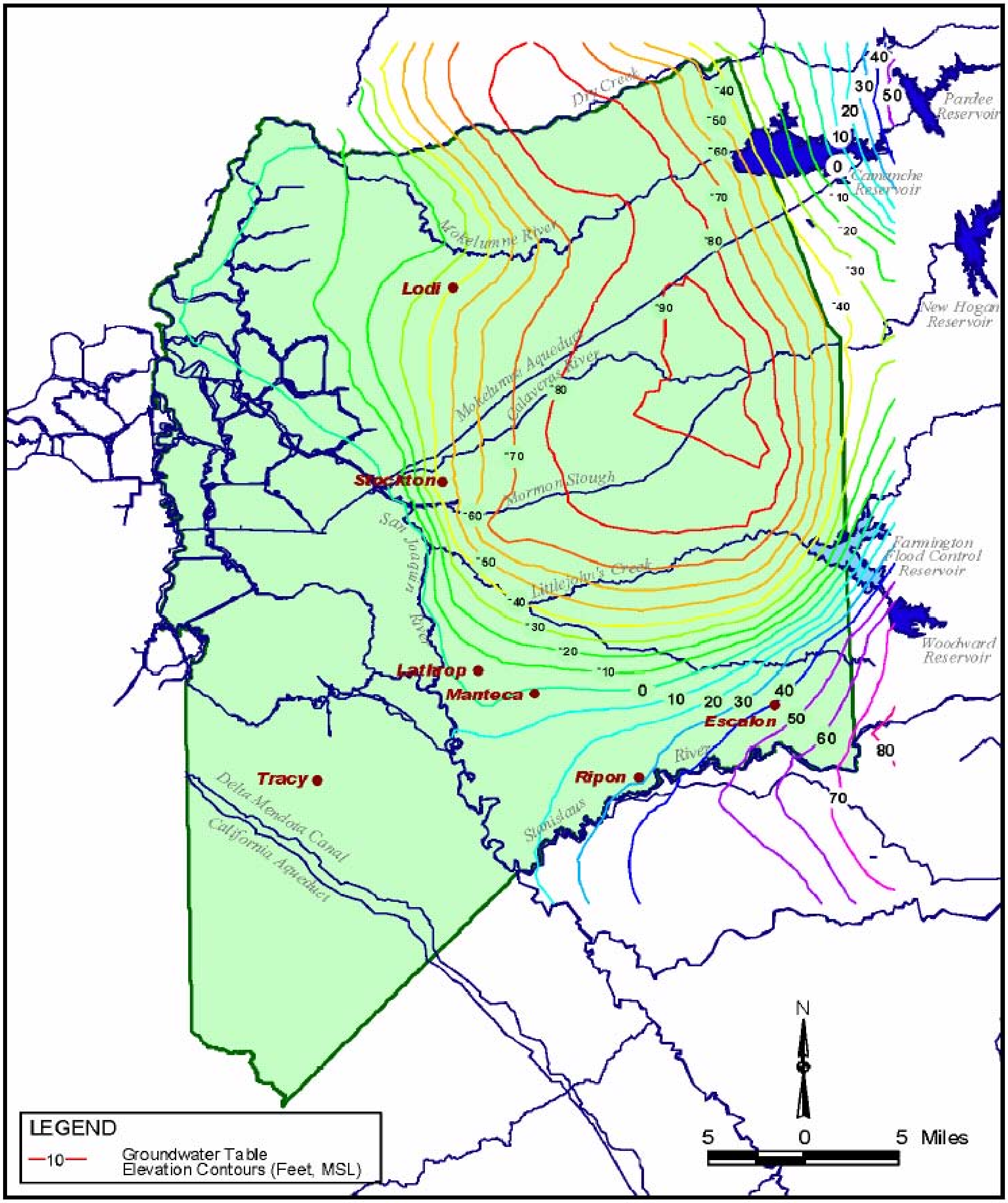


Figure 7-29 DYNFLOW No Action Groundwater Elevation Contours

Articulation of Fundamental Objectives has been completed through the Groundwater Management Plan and Water Management Plan processes. The objectives defined in previous chapters were adopted by the GBA as a representative statement of what should be accomplished through the process of IRWMP development.

The Performance Measures developed in the IRWMP process provide a set of indicators that can be used to help decide how effectively possible alternatives solutions provide the desired outcomes.

A Performance Measure is a comparison of an indicator to some desired standard. These measures are crafted to use indicators that satisfy a Fundamental Objective, which in turn addresses one or more underlying Issues. Key to this will be addressing the following questions:

- What indicators are used to determine satisfaction of an Objective?
- What information is needed?
- How do you know the Objective has been satisfied?
- What are the standards of measurement?

The Performance Measures were applied to predict performance and measure indicators against these standards. The following key questions were addressed:

- If you make the changes you imagine, are your objectives likely to be achieved?
- If you make these changes, to what degree will your objectives be achieved?
- How do these changes affect the rest of the system?

The Performance Measures were developed and confirmed in two Stakeholder Workshops. Stakeholder Workshop 1 reviewed key water management issues and how they might be addressed through Basin Management Objectives. Staff proposed “strawman” measures which the GBA stakeholders provided critique and comment. A second Stakeholder Workshop proposed weighting criteria for prioritizing projects.

The adopted Performance Measures fall into the following six categories:

1. **Groundwater Storage Levels**
2. **Supply-demand Balance**
3. **Economics**
4. **Water Quality**
5. **Equity**
6. **Implementability**

Groundwater Storage Levels - were evaluated using the DYNFLOW groundwater model for future equilibrium conditions. Since the Eastern San Joaquin Basin is open to groundwater inflow and outflow on its northern, western, and southern boundaries, the model was run through multiple consecutive hydrologic cycles until increased water levels and induced water outflows were balanced with groundwater recharge. Since all 2030 Action Alternative are provided widely distributed recharge water in approximately equivalent amounts the performance of each alternative was expected to perform similarly.

Supply-demand Balance - is evaluated by the alternatives ability to provide increased equilibrium storage, the ability to provide water through drought periods, ability to meet planned future demands, and the efficiency of meeting water supply demands through maximizing water conservation and reclamation opportunities.

Economics – were evaluated by tabulating project capital operation and maintenance costs and potential revenues from water banking arrangements, less offsets from project mitigation costs.

Water Quality - was evaluated based on any changes in concentration of constituents of concern in groundwater supplies, and impacts to water quality in the Delta and other areas of concern through project operation. No water quality issues or improvements except for varying quantities of treated wastewater discharge were identified.

Equity - was a subjective assessment of fair and equitable distribution of benefits, costs, and impacts, with particular evaluation of impacts or benefits to disadvantaged communities.

Implementability - was an evaluation of project complexity, whether water rights have been secured, readiness to proceed, flexibility in meeting multiple solutions (e.g. water supply and flood control), and whether environmental impacts have been fully mitigated. The adopted Performance Measures are displayed in the Chapter 7 Supplemental Materials.

7.4.4 Prioritization Criteria

The application of the Performance Measures provides an unranked list of project alternatives. Though it is possible that a single alternative could rank the highest for all Performance Measures, it was found that all alternatives received a mixed ranking (e.g. Alternative X provides the most high-quality water, but is twice as expensive as Alternative Y). For this portion of IRWMP development, Prioritization Criteria were developed to select the best projects or alternatives to develop. Adopted Prioritization Criteria are presented in Table 7-3.

Table 7-3 Prioritization Criteria

1. **Need**
2. **Feasibility**
   - **Technical**
   - **Ability to phase**
   - **Institutional**
3. **Readiness to Proceed**
   - **Water Rights**
   - **Engineering**
   - **Identified Financing**
   - **Environmental Documentation**
4. **Public and Stakeholder Acceptance**

Need - was assessed based on water level or water quality considerations in the area the supply will be used.

Feasibility – was evaluated on the level of technical development of the project, whether institutions are in place to support project implementation, and whether there is opportunity to phase implementation versus commitment to the full sized project.

Readiness to Proceed - was assessed based on whether water right permits are needed or have been obtained, the level of engineering that has been performed (e.g. conceptual, preliminary, or final design), whether the constituency providing funding has been identified or funding obtained, and whether environmental documentation and mitigations have been completed.

Public and Stakeholder Acceptance - gauges public support or opposition to the proposed project, including support or opposition from agencies or parties outside of the project area.

7.5 Program Alternative Characterization & Formulation

This section describes:

- Characterization of previously identified projects and management actions to a common point of reference
- Formulation of complete program alternatives designed to achieve the Fundamental Objectives

7.6 Definition of System and Characterization of Projects

A comprehensive list of projects and actions were developed through a series of stakeholder workshops over 18 months with the GBA Coordinating Committee. The sequence of workshops allowed GBA and stakeholders to work together efficiently to choose the most promising projects and management actions that can be successfully implemented by GBA member agencies. The concept of the inter-regional Solution Area has been described previously. These planning concepts have been proposed as the various system boundaries, which include the Regional Integration Area, Solution Area, and Benefits Area, and Management Zone. During the alternative formulation process, these concepts were re-confirmed by the GBA Coordinating Committee.

In this task, information for the various projects was developed in detail sufficient to reflect key differentiating characteristics. This information includes water quantity and availability, as well as cost, seasonality, and other measures that differentiate the projects and actions. Cost information for most projects is based on existing estimates and data from similarly constructed or bid projects. Where cost information was not available, estimates were made using basic unit cost formulas developed in the Basis of Design. Project attributes identified the expected beneficiaries and assessed willingness & ability to pay. Several stakeholder workshops with the Coordinating Committee were used to confirm that the model attributes correctly represent local and regional issues and potential solutions.

Each project or action is described by source of supply, major water regulation and conveyance elements, and groundwater recharge components – e.g. a source linked to an end beneficial use. This Project Classification System is illustrated schematically in Figure 7-30.

Sources of Supply included increased efficiencies in capturing existing supply sources, entitlements, imported supplies, local groundwater, transfers, reallocations, conservation and reclamation. Entitlements to these supplies are based on existing water right permits, water service contracts and agreements, and pending water right applications.

Water Regulation and Conveyance elements included greater use or renovation of existing facilities, new pipelines, tunnels, or canals, associated pumping plants, and surface storage facilities[24] for capture and regulation of peak season flows.

[24] New surface storage facilities are not eligible for Proposition 50 Implementation Grant funding.

Groundwater recharge or use will be accomplished through both direct recharge and indirect recharge methods. Direct recharge methods include infiltration ponds and groundwater injection wells. Indirect recharge methods include supplying existing groundwater users a surface supply when available in-lieu of their groundwater use. In-lieu recharge can be accomplished by supplying surface water to current agricultural groundwater users, or by treating surface water for urban in-lieu supply. In-lieu recharge can also be accomplished by reducing groundwater extractions as a result of conservation and reclamation programs. A special category of groundwater recharge is recharging water for a saline barrier to reverse flow gradients and halt migration of poor quality groundwater.

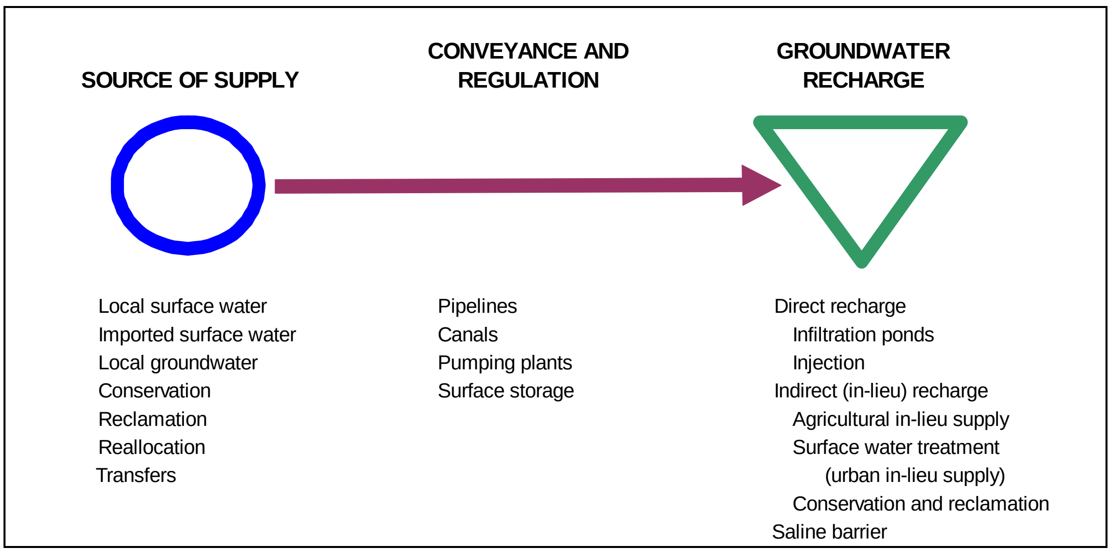
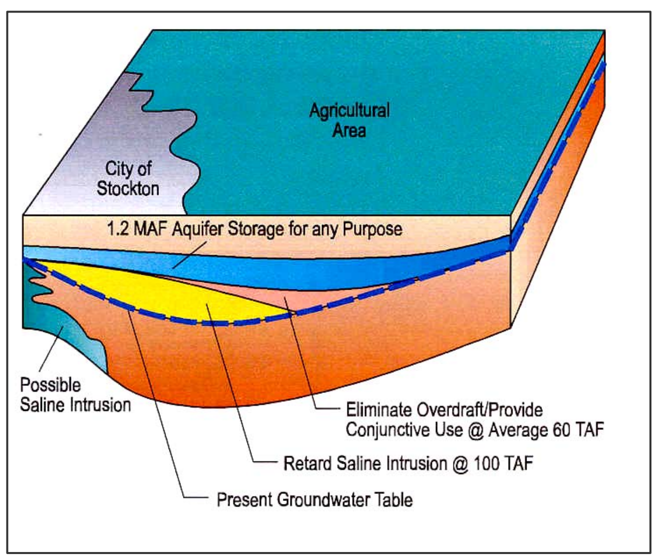


Figure 7-30 Project Classification System



The geographic proximity of the Eastern San Joaquin groundwater basin to the Sacramento-San Joaquin Delta provides the potential for regional groundwater banking partnerships that can produce new water supplies for the County. Groundwater banking is supported regionally and statewide as an alternative to constructing new on-stream reservoirs and desalinization plants. As shown in Figure 7-31, the potential Benefits Area extends over most of the State with interconnected infrastructure. The underlying groundwater basin has the potential to store over 1 million acre-feet. Possible opportunities with inter-regional and statewide interests are a logical match with groundwater banking opportunities in the GBA Management Area.

It is of paramount importance to the GBA that groundwater banking operations remain under local control, which was the primary reason for the development of Basin Operations Criteria for the Basin as discussed in Chapter 6. The selective timing of withdrawals from surface and groundwater sources can improve the reliability of both water quantity and quality. Such operation is referred to as "conjunctive use." Conjunctive use of surface and groundwater consists of harmoniously combining the use of both water supplies in order to minimize the undesirable physical, environmental and economical effects of each solution and to optimize the balance of water demand and supply.

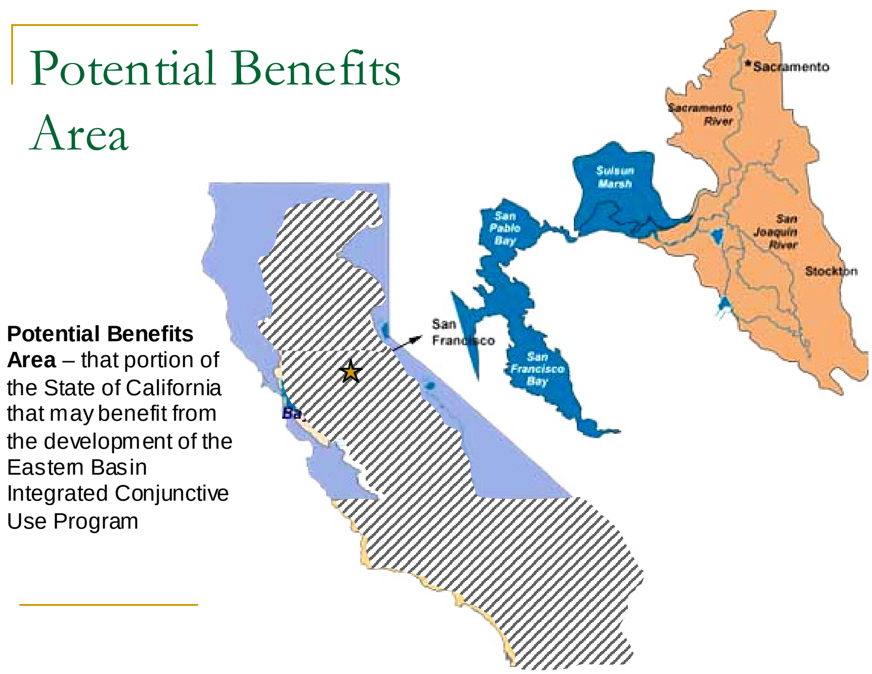


Figure 7-31 Potential Statewide Benefits Area

Conjunctive use of surface water and groundwater sources take advantage of the variability of natural water supplies, manipulating water storage so that less water is wasted during wet seasons. Good conjunctive use practice can be facilitated through cost incentives, e.g. lower the cost of surface water supplies during times of plenty to encourage its use or recharge. Conversely, groundwater costs might be increased during wet years to provide a disincentive for the use this supply. The Metropolitan Water District of Southern California provides cost incentives (in the form of surface water supply discounts) for member agencies to develop local groundwater supplies for use in drought years, which increases the reliability of the entire regional system, and obviates the need for construction large-scale drought supply systems.

7.7 Program Alternatives Formulation

Alternatives were assembled to address GBA objectives of improving water supply sustainability and reliability through:

- Improving water supply reliability
- Providing multiple benefits
- Protection and improvement of water quality
- Providing financial incentives to promote regional integration and conjunctive management
- Enhancing environmental stewardship
- An inclusive, integrated planning process incorporating a wide rage of planning processes including land use, flood control, and energy use
- Scalable implementation
- Unbiased performance and prioritization criteria
- Monitoring protocols to gauge Plan success

Projects and management actions were compiled into several comprehensive alternatives designed to fully meet the Fundamental Objectives. The alternatives development process went through several iterations of feedback with the GBA membership over the course of several months. The Systems Model described in Chapter 6 was used to help guide this process and provide an initial gauge of performance. The outcome of this process was four Action Alternatives (designated A, B, C, and D), a No Action Alternative, and an alternative describing Existing Conditions.

Existing Conditions Alternative uses:

- 2005 level of demand and supply
- existing entitlements and transfers
- assumptions common to all alternatives[25]

Future No Action Alternative assumes:

- 2030 level of demand

[25] Includes assumption of existing agency boundaries and powers, and use of 7,000 acre-feet per year of Calaveras River water by Calaveras County Water Agency

- existing supply projects plus projects with completed engineering and environmental documentation that can reasonably expected to be on-line by 2030
- expiration of water transfer agreements and contracts
- assumptions common to all alternatives
- implementation of Common Elements

Action Alternatives assume:

- 2030 level of demand
- existing supply projects plus projects with completed engineering and environmental documentation that can reasonably expected to be on-line by 2030
- expiration of water transfer agreements and contracts
- assumptions common to all alternatives
- implementation of Common Elements
- implementation of Common Actions
- implementation of alternative-specific projects

7.7.1 Common Elements

Elements common to all future (2030) alternatives include:

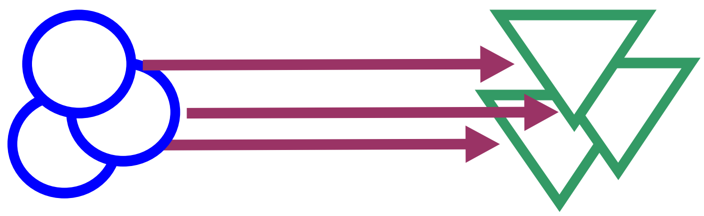
- Conservation per agency Urban Water Management Plans and Agricultural Water Management Plans
- Stockton Delta Water Supply Project Phase 1 implementation (23 kacre-feet per year)
- Stockton East Water District Water Treatment Plant expansion to 60 mgd
- Farmington Phase 1 implementation (22 kacre-feet per year)
- Transfer of Woodbridge water rights to Lodi (6 kacre-feet per year) and Lodi use as a treated surface water supply

7.7.2 Common Actions

Elements common to all future (2030) Acton Alternatives include:

- Renewal of transfers to Stockton from Oakdale Irrigation District and South San Joaquin Irrigation District (expire 2019)
- Renewal of NSJWCD Mokelumne River Permit 10477 (expired 2002)
- Renewal of SEWD (75 kacre-feet per year) and CSJWCD (31 kacre-feet per year) interim Central Valley Project contracts (expire 2022)

Program Alternatives - A series of GBA workshops were conducted over nine months to work through the alternatives development process and to develop the most promising combinations of projects and management actions. General observations on desirability, reliability, and performance were solicited from participants. Promising alternatives were identified and evaluated using the Systems Model described in Chapter 6. A target net annual recharge of 140,000 to 160,000 acre-feet per year was determined to be the level that resulted in acceptable water levels and water level fluctuations according to proposed Basin Operations Criteria. Four program alternatives were further studied and evaluated using the DYNFLOW groundwater model. These four alternatives will be carried forward into the Programmatic Environmental Impact Report. The detailed specifications of the most these four Program Alternatives are presented in Table 7-4.



	NSJCGBA IRWMP Alternatives	Source	Source Water: Capacity (cfs)	Source Water: Average Supply (KAF/yr)	Source Water: Supply Pattern	Conveyance or Storage	Conveyance Capacity (cfs)	Place of Use	Recharge Type	Evap. Loss	Recharge (KAF/yr)	Demand Pattern
Alternative A	**Projects**											
	Maximum Lodi reclamation	Lodi White Slough WWTP	17.9	8.0	M&I	Pipeline from White Slough	17.9	Lodi	Urban In-lieu	0%	8.0	M&I
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	Farmington Program Phase 2	Stanislaus/Littlejohns	53.4	4.0	Nov-Feb	Pipeline and canal	53.4	SEWD/CSJWCD	Field flooding	5%	3.8	Nov-Feb
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	273.0	20.1	Dec-Jun	Intake/pipeline/WID canals	273.0	Saline barrier	--			Dec-Jun
	MORE Water Pardee diversion	Mokelumne (to Duck Creek)	1,000.0	67.3	Dec-Jun	Tunnel/pipeline to Duck Creek	1,000.0		--			
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	31.9	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	28.7	Year-round
	Regional Banking - Extraction		(138.0)	(15.9)	Jan-Dec	In-river exchange	138.0		Recovery		(15.9)	Year-round
	Duck Creek Reservoir					Duck Creek Reservoir (150 KAF)	400.0	NSJWCD/SEWD	Ag In-lieu	10%	60.6	Mar-Oct
	Saline barrier	Lower Mokelumne diversion				Pipeline/pump station from WID canal	51.8	West Stockton	Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative A			163.5						11.1	150.6	
	Unit Cost ($/AF)											
Alternative B	**Projects**											
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Pardee diversion	Mokelumne (to Duck Creek)	1,000.0	49.6	Dec-Jun	Tunnel/pipeline to Duck Creek	1,000.0		--			
	Freeport Regional Water Project unused capacity	Sac Valley banking partner	155.0	74.5	Dec-Jun	EBMUD Freeport pipeline	155.0	NSJWCD/SEWD	Pond	10%	67.1	Mar-Oct
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	30.0	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	8.3	Year-round
	Regional Banking - Extraction		(276.1)	(52.6)	Jan-Dec	In-river exchange + pumped extraction	276.0		Recovery		(52.6)	Year-round
	Duck Creek Reservoir					Duck Creek Reservoir (150 KAF)	200.0	NSJWCD/SEWD	Ag In-lieu	10%	44.7	Mar-Oct
	Saline barrier	Lower Mokelumne diversion				Pipeline from Mokelumne Aqueduct	51.8	West Stockton	Treatment/Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative B			149.7						16.4	132.8	
	Unit Cost ($/AF)											
Alternative C	**Projects**											
	Maximum Lodi reclamation	Lodi White Slough WWTP	17.9	8.0	M&I	Pipeline from White Slough	17.9	Lodi	Urban In-lieu	0%	8.0	M&I
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	266.0	35.0	Dec-Jun	Intake/pipeline	266.0	NSJWCD/SEWD	Pond	10%	31.5	Dec-Jun
	Freeport Regional Water Project unused capacity	SJCo American River filing	155.0	43.4	Dec-Jun	EBMUD Freeport pipeline	155.0	NSJWCD/SEWD	Pond	10%	39.1	Mar-Oct
	Regional Banking - Recharge	AmCo/CalCo/EBMUD Mokelumne rights	138.0	31.9	Jan-Dec	EBMUD Mokelumne Aqueduct	138.0	NSJWCD/SEWD	Injection/Pond	10%	10.0	Year-round
	Regional Banking - Extraction		(138.0)	(15.9)	Jan-Dec	In-river exchange	138.0		Recovery		(15.9)	Year-round
	Saline barrier	Lower Mokelumne diversion				Pipeline from Mokelumne Aqueduct	51.8	West Stockton	Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Total Alternative C			150.5						12.0	138.0	
	Unit Cost ($/AF)											
Alternative D	**Projects**											
	Stockton Delta Water Supply Project Phase II	Delta	77.4	33.3	Jan-Dec	DWSP Pipeline	77.4	Stockton	Urban In-lieu	0%	33.3	M&I
	Farmington Program Phase 2	Stanislaus/Littlejohns	53.4	4.0	Nov-Feb	Pipeline and canal	53.4	SEWD/CSJWCD	Field flooding	5%	3.8	Nov-Feb
	NSJWCD Surface Water Distribution System Rehabilitation	Mokelumne	80.0	9.5	Dec-Jun	Rehabilitated NSJWCD system	80.0	NSJWCD	Ag In-lieu	10%	8.6	Mar-Oct
	MORE Water Lower Mokelumne diversion	Mokelumne	620.0	68.9	Dec-Jun	Intake/pipeline	620.0	NSJWCD/SEWD	Pond	10%	43.3	Dec-Jun
	South Gulch Reservoir/UFC		750.0	20.7	Nov-Apr	Upper Farmington Canal to South Gulch	750.0	SEWD/CSJWCD	Ag In-lieu	10%	18.7	Mar-Oct
	CSJ BN Intermodal ponds	Littlejohns Ck	16.6	4.0	Jan-Dec	Littlejohns Creek		CSJWCD	Pond	10%	3.6	Non-flood
	Saline barrier	Lower Mokelumne diversion				Pipeline/pump station from WID canal	51.8	West Stockton	Treatment/Injection	0%	18.7	Year-round
	Management Actions								--			
	CSJWCD In-lieu Incentive Program	Littlejohns Ck	100.0	5.3	Mar-Oct	Existing CSJWCD conveyances		CSJWCD	Ag In-lieu	10%	4.8	Ag In-lieu
	Additional transfers from WID, OID, SSJID	Stanislaus	50.0	15.2	Mar-Oct	Existing creeks and conveyances	50.0	SEWD/CSJWCD	Ag In-lieu	10%	13.7	Mar-Oct
	Total Alternative D			161.0						11.6	148.4	
	Unit Cost ($/AF)											

Table 7-4 Program Alternatives A - D

7.8 DYNFLOW Groundwater Modeling of Alternatives

7.8.1 Introduction

To assess the regional impacts of the proposed alternatives, the existing San Joaquin County (SJC) groundwater model was used to simulate changes in water levels due to the proposed projects.

The existing groundwater model was developed using the DYNFLOW finite-element code. The SJC model domain encompasses portions of San Joaquin, Sacramento, and Stanislaus Counties as shown in Figure 7-32. The major urban areas within the model domain are Stockton, Lodi, Lathrop, Ripon, Manteca, and Escalon. The majority of the county is comprised of agricultural land.

The SJC DYNFLOW model was calibrated over the period from Water Year 1970 through Water Year 2005. In order to simulate the proposed alternatives, an estimated, constant 2030 level of development was applied to the model. Superimposed on the constant 2030 conditions was the historical hydrology from 1970 through 2005. By superimposing the historical hydrology on the constant level of development, the changes of water levels result only from changes in hydrology. The relative impacts of changes in management scenarios can be seen by comparing simulations of different management scenarios.

A more complete presentation of the model output is presented in Supplement 2 to this chapter.

7.8.2 Simulation of Alternatives

The four proposed management alternatives defined in Chapter 7 were simulated using the SJC DYNFLOW model. The resulting water levels were plotted and analyzed to assess the impacts of the alternatives. Each alternative was designed to recharge approximately 140,000 acre-feet per year, the quantity found in the screening model which allows water levels to acceptably fluctuate around the target Spring 1986 and Fall 1992 levels.

For comparison, the “no-action” alternative (Alternative 0) was also simulated. Simulated water levels at 22 monitoring locations were plotted for each of the four management alternatives as well as the no-action alternative. Water level hydrographs for each of these locations are presented in Supplement 2. Three typical water level plots are presented as Figure 7-33. In addition to the simulated water levels at these wells, the observed water levels from Spring 1986 and Fall 1992 are also shown. These water levels represent the target high and low water levels, respectively.

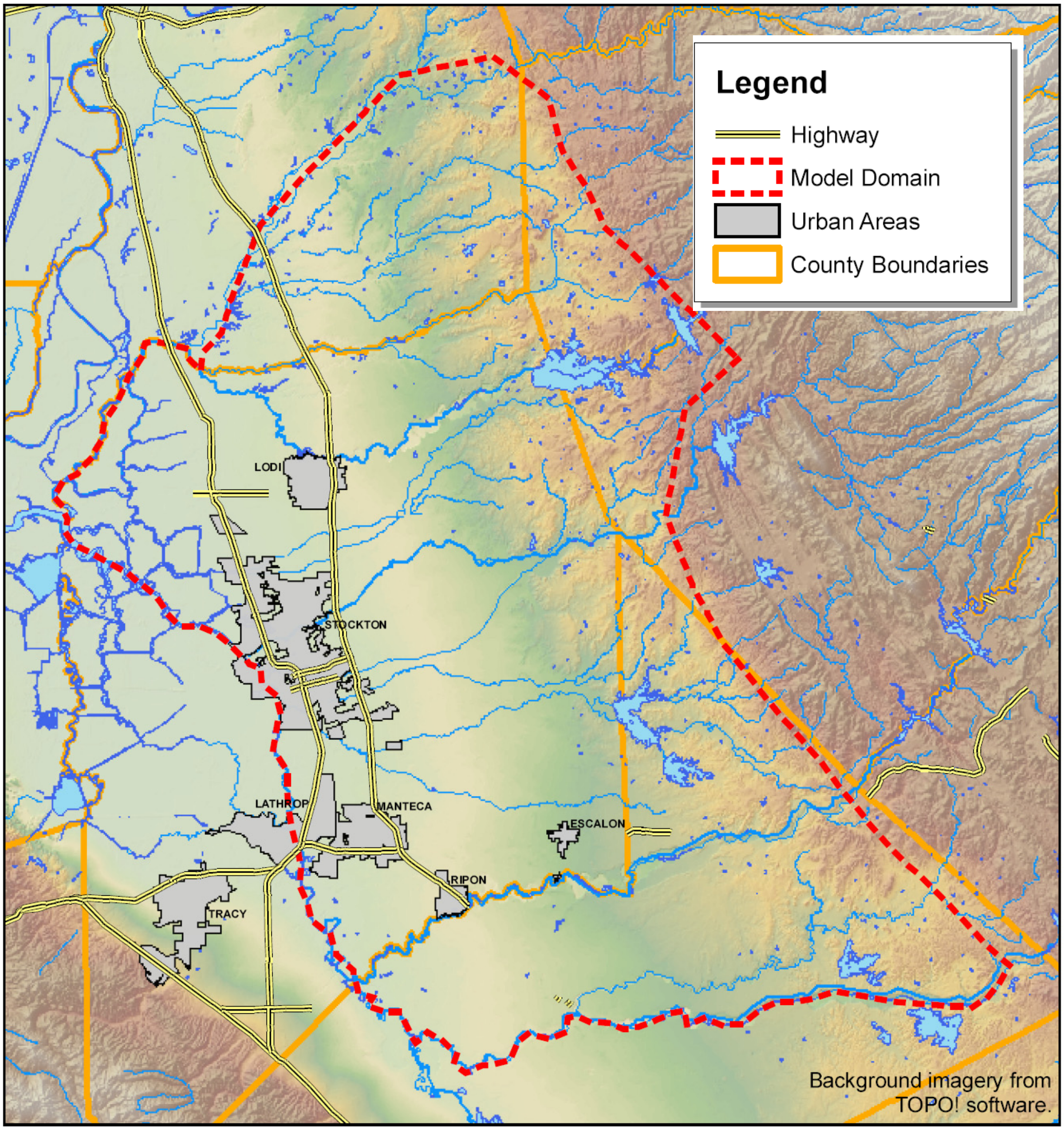
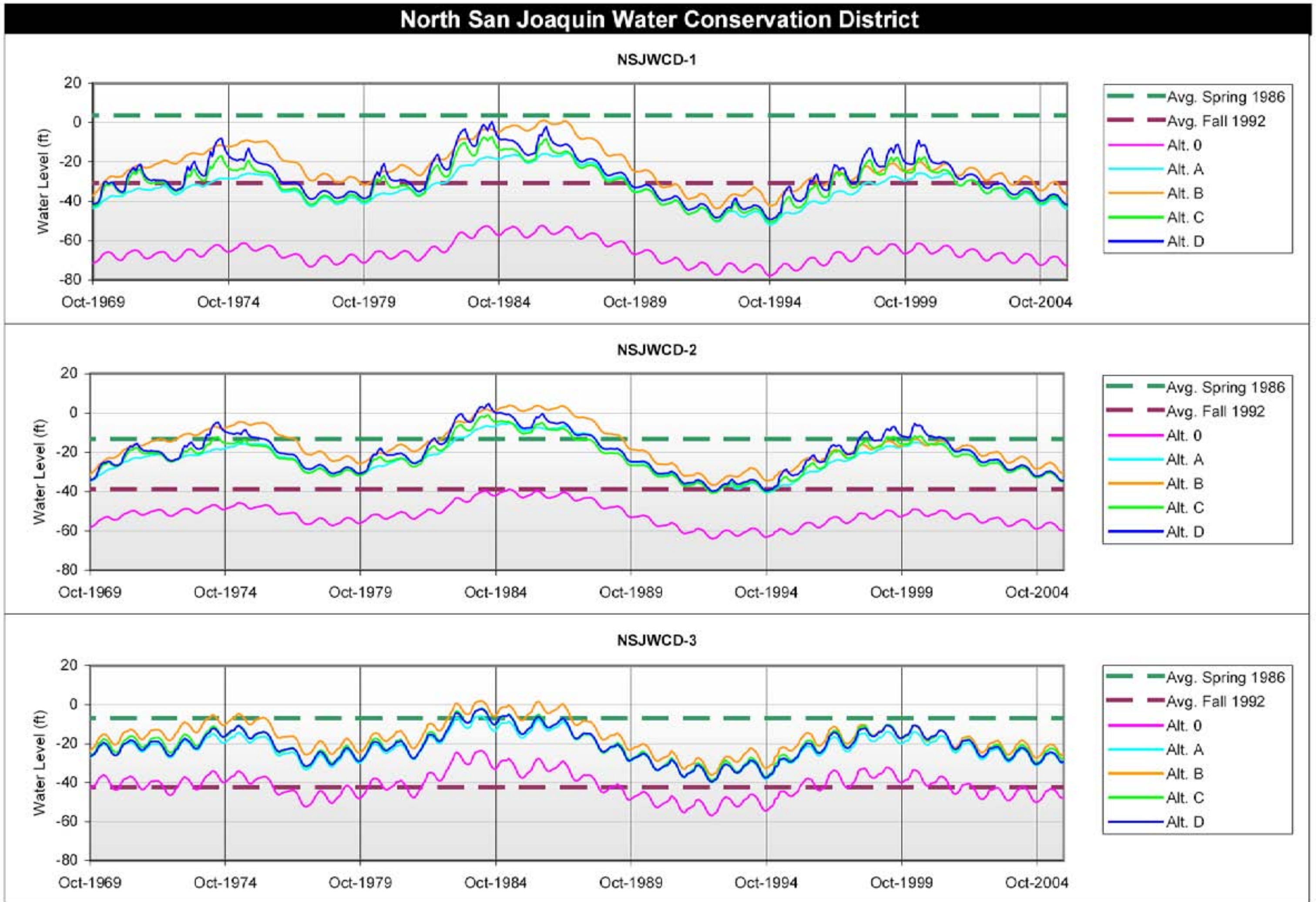


Figure 7-32 DYNFLOW Model Domain

Figure 7-33 Typical Modeled Groundwater Levels



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: North SJ WCD
7/6/2007

Figure MODEL-3g
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios

Figure 7-34 shows the location of an east/west cross section across the county through the area with the lowest water levels. Figures MODEL-5a, -5b, -5c, and -5d show the simulated water levels from Alternatives A, B, C, and D, respectively, along this cross-section. Each cross-section figure shows the following:

- Simulated Spring 1986 and Fall 1992 water levels under the alternative in question (solid blue and orange lines)
- Simulated Spring 1986 and Fall 1992 water levels for the no-action alternative (dashed blue and orange lines)
- Measured Spring 1986 and Fall 1992 water levels at 3 monitoring wells that lie along the cross section

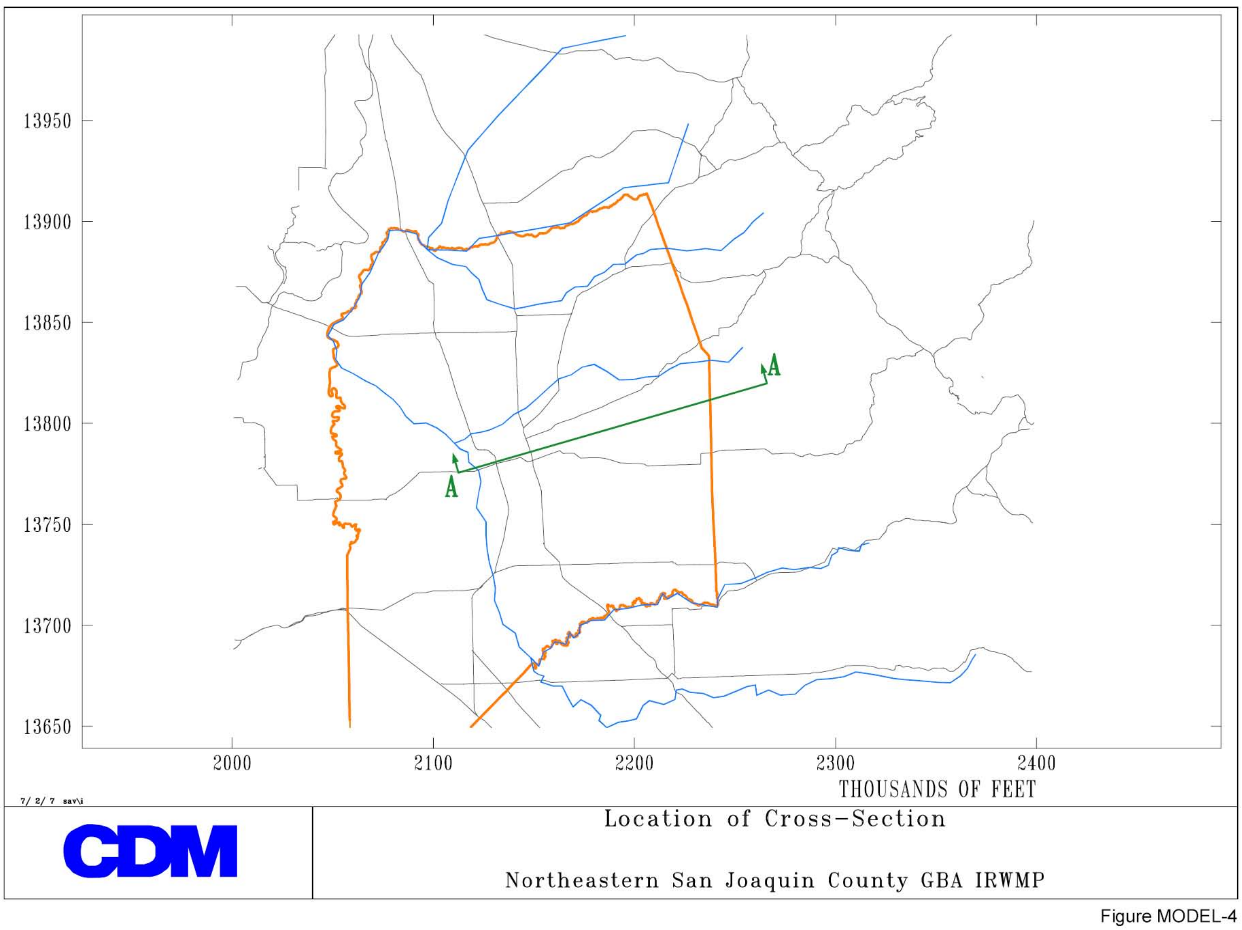
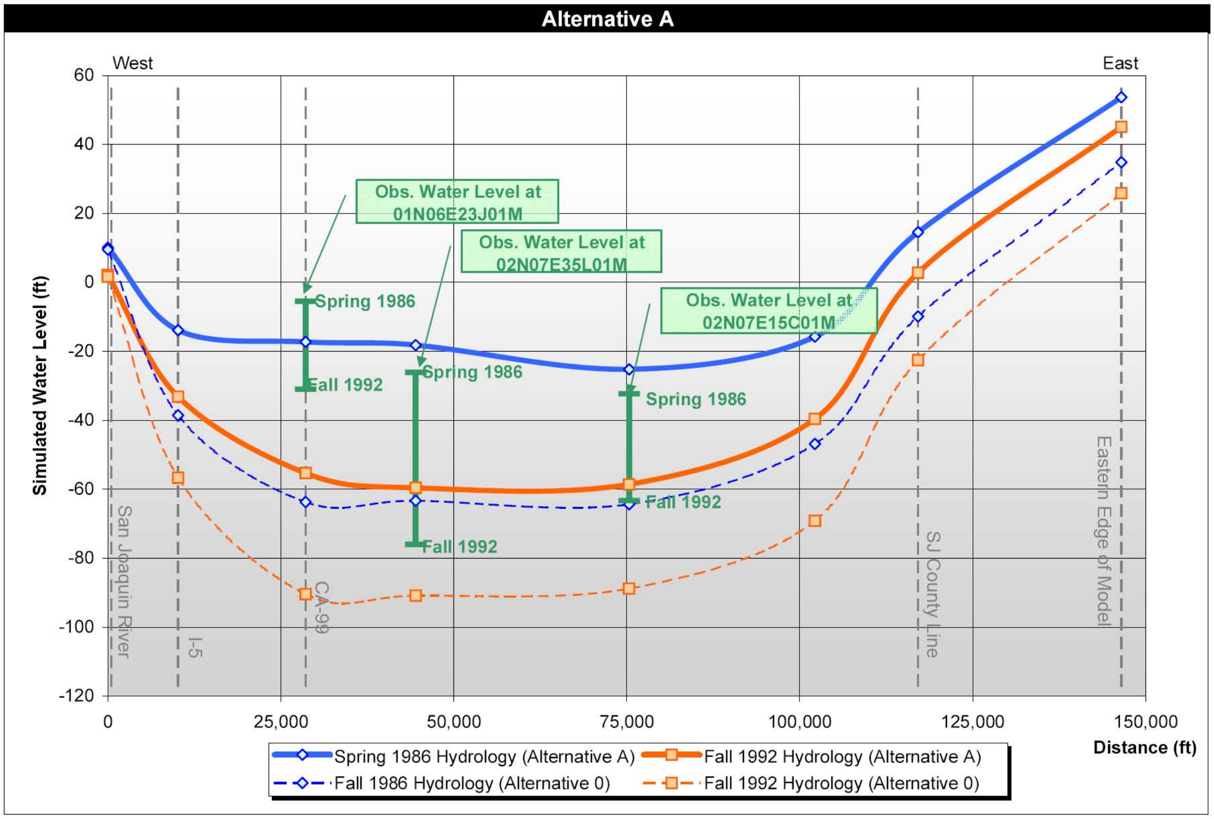


Figure 7-34 Cross Section A-A

It should be noted that these figures show the water levels at two distinct times. The results of the entire 35 year transient simulation are not shown. Cross-sectional output for Alternative A is presented as Figure 7-35. Plots for all alternatives are presented in Supplement 2.



IRWMP_Results_HdDiff_ALTA.xls: Figure
7/6/2007

Figure MODEL-5a
Simulated Groundwater Table
East/West Cross-Section

Figure 7-35 Cross Sectional Groundwater Elevations for Alternative A

In order to visualize the regional impacts to water levels due to the alternatives the simulated water levels were contoured over the entire model domain. Contours of the water table were developed for the no-action alternative and Alternatives A, B, C, and D. For each of the alternatives, the water table was contoured for the Spring 1986 and Fall 1992 periods. These water level contours are presented in Supplement 2.

To assess the relative improvement in water levels with respect to the no-action condition, the difference between the simulated water levels under a management alternative and the no-action alternative was also contoured. Again, these contours were developed for the Spring 1986 and Fall 1992 periods. A typical change in water level plot is presented as Figure 7-36.

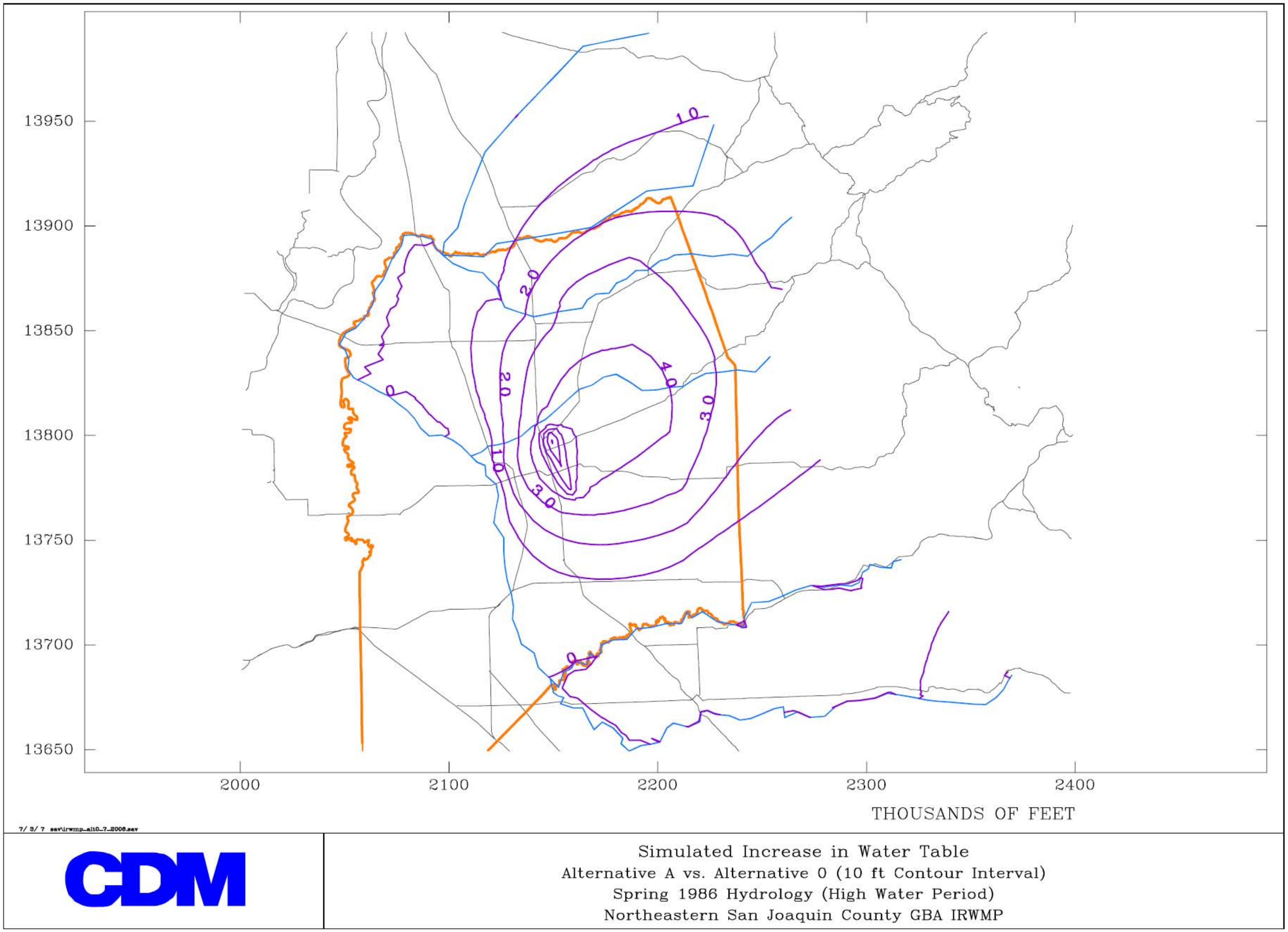


Figure MODEL-7a

Figure 7-36 Change in Groundwater Elevations, Alternative A vs. No Action

7.9 Costs for Implementation of Alternatives

Capital and operations costs were taken from existing reports and studies, or were estimated using unit cost factors included in the Basis of Design. Costs are reported in Table 7-5 in 2007 dollars and summarized below.

	Total Net Recharge (KAF/yr)	Capital Cost ($M)	O&M Cost ($M/yr)	Annualized Cost ($M/yr)	Unit Cost ($/AF)
Alternative A	151	$921	$10.1	$68.5	$460
Alternative B	133	$712	($1.7)	$43.5	$330
Alternative C	138	$584	$13.7	$50.8	$370
Alternative D	148	$829	$10.3	$62.8	$420

Capital costs range from $584 to $921 million. Alternative C is the least expensive, and is the only alternative without a new surface storage reservoir. Alternative A is the most expensive, and includes Duck Creek Reservoir and new diversions from Pardee Reservoir and the lower Mokelumne River[26]. Alternatives A, B, and C include regional banking components that provide a net water supply and a net revenue stream which reduces net operations costs[27]. Alternative B includes a large groundwater bank that would recharge a net average of 53 kacre-feet per year and would produce revenues that would offset other operation costs. These revenues make Alternative B the least expensive on a unit cost basis.

Also shown in Table 7-5 are the land requirements for in-lieu distribution networks, recharge ponds, and field flooding. In-lieu surface water distribution systems would be required for 1,800 to over 10,000 acres for the various alternatives, costing an estimated $2,400 per acre, for a cost of up to $25 million in Alternative A. Alternatives C and D would each require nearly four square miles of recharge ponds totaling over $100 million at an estimated cost of $40,000 per acre. Land for field flooding would be leased for approximately six months per year.

[26] No cost is assumed for reimbursement of lost EBMUD hydropower revenues since EBMUD power generation is junior to all diversions for water supply

[27] Assumes a fee of $100/af whenever water is placed into or taken from groundwater storage

	NSJCGBA IRWMP Alternatives Cost	Recharge	Groundwater Recharge			Cost			
			In-lieu acres (3 af/ac, 20% peak month	Recharge Ponds	Field Flooding	Burdened Capital Cost	Operating Cost	Present Value Cost (50y, 6%)	Annulized Cost (50y, 6%)
		(KAF/yr)	(ac)	(ac)	(ac)	($M)	($M/yr)	($M)	($M/yr)
Alternative A	**Projects**								
	Maximum Lodi reclamaiton	8.0				$140	$0.4	$146	$9.3
	Stockton Delta Water Supply Project Phase II	33.3				$113	$3.3	$165	$10.5
	Farmington Program Phase 2	3.8			420	$17	$0.3	$21	$1.3
	NSJWCD Surface Water Distribution System Rehabilitation	8.6	1,190			$22	$0.1	$23	$1.5
	MORE Water Lower Mokelumne diversion					$86	$3.4	$140	$8.9
	MORE Water Pardee diversion					$213	$5.0	$292	$18.5
	Regional Banking - Recharge	28.7		550		$40	($2.9)	($6)	($0.4)
	Regional Banking - Extraction	(15.9)				$25	($0.9)	$10	$0.6
	Duck Creek Reservoir	60.6	8,420			$205	$1.3	$226	$14.3
	Saline barrier	18.7				$59	$0.1	$61	$3.8
	Management Actions								
	CSJWCD In-lieu Incentive Program	4.8	660			$2		$2	$0.2
	Total Alternative A	150.6	10,270	550	420	$921	$10.1	$1,080	$68.5
	Unit Cost ($/AF)								$460
Alternative B	**Projects**								
	Stockton Delta Water Supply Project Phase II	33.3				$113	$3.3	$165	$10.5
	NSJWCD Surface Water Distribution System Rehabilitation	8.6	1,190			$22	$0.1	$23	$1.5
	MORE Water Pardee diversion					$213	$5.0	$292	$18.5
	Freeport Regional Water Project unused capacity	67.1		620		$46	($6.7)	($60)	($3.8)
	Regional Banking - Recharge	8.3		550		$36	($0.8)	$23	$1.4
	Regional Banking - Extraction	(52.6)				$25	($4.0)	($38)	($2.4)
	Duck Creek Reservoir	44.7	6,210			$197	$1.3	$218	$13.8
	Saline barrier	18.7				$59	$0.1	$61	$3.8
	Management Actions								
	CSJWCD In-lieu Incentive Program	4.8	660			$2		$2	$0.2
	Total Alternative B	132.8	8,060	1,170		$712	($1.7)	$686	$43.5
	Unit Cost ($/AF)								$330
Alternative C	**Projects**								
	Maximum Lodi reclamaiton	8.0				$140	$0.3	$145	$9.2
	Stockton Delta Water Supply Project Phase II	33.3				$113	$3.3	$165	$10.5
	NSJWCD Surface Water Distribution System Rehabilitation	8.6	1,190			$22	$0.1	$23	$1.5
	MORE Water Lower Mokelumne diversion	31.5		1,060		$150	$3.4	$204	$12.9
	Freeport Regional Water Project unused capacity	39.1		620		$46	$8.7	$183	$11.6
	Regional Banking - Recharge	10.0		550		$36	($1.0)	$20	$1.3
	Regional Banking - Extraction	(15.9)				$17	($1.2)	($2)	($0.1)
	Saline barrier	18.7				$59	$0.1	$61	$3.8
	Management Actions								
	CSJWCD In-lieu Incentive Program	4.8	660			$2		$2	$0.2
	Total Alternative C	138.0	1,850	2,230		$584	$13.7	$801	$50.8
	Unit Cost ($/AF)								$370
Alternative D	**Projects**								
	Stockton Delta Water Supply Project Phase II	33.3				$113	$3.3	$165	$10.5
	Farmington Program Phase 2	3.8			420	$17	$0.3	$21	$1.3
	NSJWCD Surface Water Distribution System Rehabilitation	8.6	1,190			$22	$0.1	$23	$1.5
	MORE Water Lower Mokelumne diversion	43.3		2,460		$240	$3.4	$294	$18.7
	South Gulch Reservoir/UFC	18.7	2,590			$254		$254	$16.1
	CSJ BN Intermodal ponds	3.6		70		$4		$4	$0.3
	Saline barrier	18.7				$59	$0.1	$61	$3.8
	Management Actions								
	CSJWCD In-lieu Incentive Program	4.8	660			$2		$2	$0.2
	Additional transfers from WID, OID, SSJID	13.7	1,900			$7	$3.0	$55	$3.5
	Total Alternative D	148.4	6,340	2,530	420	$829	$10.3	$990	$62.8
	Unit Cost ($/AF)								$420

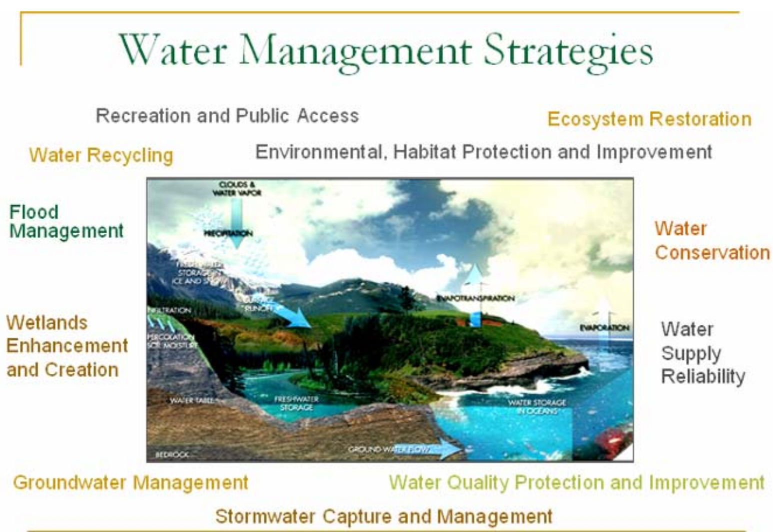
Table 7-5 - Alternatives Cost

7.10 Applying Evaluation Criteria to Rate, Rank, and Prioritize Alternatives

7.10.1 Application of Evaluation Criteria

The analyses described above resulted in identification of four promising Program Alternatives, which best address the Fundamental Objectives and underlying issues. Each Alternative identifies 140,000 to 160,000 acre-feet per year of recharge required to meet Basin Management Objectives in each of the identified management units. These promising Alternatives were evaluated in the modeling effort and then rated using the Performance Measures.

Alternatives will be examined to determine whether there are identifiable environmental fatal flaws or permitting issues before moving into the environmental documentation element. Hydrologic impacts from new diversions on minimum in stream flow requirements are not expected since all in-stream flow requirements are honored in the modeling. Data gaps and base mapping requirements were identified. Geographic information system (GIS) data from readily available local, state, and federal sources were collected to construct an initial GIS database.



Limited additional engineering was performed for these Program Alternatives. However, project-specific information on recharge performance is not yet available to differentiate performance between projects. For example, infiltration rates for most potential recharge pond sites are not known and consequently all projects are presumed to perform alike, barring differentiating information. Existing data from projects in an advanced stage of study were compiled and used to further define project performance, location and footprint. This information includes soils information, infiltration tests, pilot tests performed by the GBA or others, field survey of environmentally sensitive plant or animal communities, real estate and other cost data, pumping tests, and localized groundwater modeling.

Important background reports, data, maps, and necessary documentation were compiled and reviewed. Significant issues to be addressed were identified, known project constraints documented, and the analysis approach necessary to prepare a defensible EIR was defined.

Alternatives Assessed against Performance Measures - Preliminary findings obtained from the Systems Model were presented at a GBA workshop to promote brainstorming of other potential alternatives for meeting GBA's fundamental objectives. This workshop conducted with the GBA Coordinating Committee allowed stakeholders to propose and discuss possible combinations of projects and management actions designed to meet GBA objectives. The Systems Model was then applied to predict the likely results of the proposed alternatives so stakeholders can compare the relative merits of each alternative using the agreed upon performance criteria.

From this process, the four initial Program Alternatives[28] supported by the GBA that best satisfy the fundamental objectives were recommended for further study in the Programmatic EIR. Recommendations for additional data and further analyses required to implement the long-term solutions were identified. The steps required to develop a comprehensive water management strategy implementing the best alternatives (the Management Action Plan) were also presented to the GBA.

The rating of these Program Alternatives against the proposed Performance Measures is shown in Table 7-6. Based on the weighting factors shown in this table, there is not one clearly identifiable alternative that would be preferred above the others. Rather, there are four alternative solutions that are designed to address the Fundamental Objectives. As a result, each of the four alternatives that address various objectives to varying degrees will be carried forward to the Programmatic EIR analysis.

[28] An alternative is a combination of projects and other management actions designed to meet the GBA's long-term objectives.

	Performance Measures	Indicator	Standard	Weight	Alt 0	Alt A	Alt B	Alt C	Alt D	Explanation
Storage levels	Groundwater accessibility	Water level above top of well screen	Percent of area always above 1992 level	5	L	H+	H-	H	H+	
	Management of saline water migration	Groundwater gradients west of Hwy 99	Percentage of months positive westward gradient exists	3	L	H-	H-	H-	H-	
Supply-demand balance	Water supply sustainability	Equilibrium storage	Rank projects on magnitude of change from No Action	3	L	H+	H-	H	H+	
	Water supply operations and contingency plans	Drought contingency supplies	Maximum storage loss (range)	3	L	H-	M	H-	H	
	Benefits related to water supply	Ability to supply water to planned growth	Percent of planned demands that will be met (assume growth cannot be supplied from groundwater in overdrafted areas)	3	L	H	H	H	H	
	Efficiency	Water conservation and reclamation opportunities maximized	Percentage of BMPs adopted and fully implemented; Annual volume of reclaimed water use	3	M	H	M	H	M	UWMP conservation levels in all Alts; Alts A&C reclamation;
Economics	Project costs	Capital cost Operation & maintenance costs Revenues from water supply or banking projects	Rank projects by 50-year present value of net capital and operating costs	5	H	L	M-	M+	L+	L= >$800M capital, M = $500-800M capital; H= <$500M
	Mitigation requirements	Project mitigation costs	Rank projects in order of increasing mitigation requirements from unavoidable impacts, habitat enhancement, cost of dewatered well replacement	3	H-	L+	M-	M+	M-	Alts A&B Duck Ck Res; Alt D South Gulch Res; Alt A Pardee diversion; Alt D large Lower Mokelumne diversion
Water Quality	Expected changes in water quality	Change in concentration of constituents of concern in groundwater	Improvement in water quality relative to existing concentrations and regulatory requirements	3	L	H-	H-	H-	H-	Nitrate mobilization
		Impacts/benefits to water quality in Delta, Lower SJR, and other areas of CalFed concern	Change in X2 position; wastewater discharges	3	M	L+	M-	L+	M-	Alt A&C: Max Lodi reclamation (reduced wastewater discharges)
Equity	Fair and equitable distribution of benefits and costs	Proposed solutions are unbiased and objective, reasonable and consistent	Subjective evaluation required (rate on five-point scale)	1	L	H	H	H	H	
		Proposed solutions are likely to result in few claims or grievances		1	L	M-	M	M+	M+	Alt 0: limits devel't; Alts A&C: high cons/rec; Alt D: Locally based
		Proposed solutions help all people to meet reasonable goals		1	L	H	H	H	H	
		Proposed solutions preserve socio-cultural values (e.g. mix of livelihoods)		1	L	M	M	L+	M	Alt 0: limits devel't; Alts A&C: high cons/rec; Alt D: Locally based
		The solution is in the best interests of all concerned		1	L	M	M	M	M	
		There is a willingness to pay for the applied solution		1	L	M-	M-	M	M-	
	Redirected impacts	The applied solutions do not cause secondary or redirected impacts		1	L	M-	M-	M-	M-	Alt 0: saline intrusion
	Benefits to disadvantaged communities	There are identifiable benefits to disadvantaged communities as part of project design		1	L	L+	L+	L+	L+	
Implement-ability	Institutional complexity	The number of permits is minimized	Number of permits	1	H	L	M-	M	M	
		The number of agency approvals is minimized	Number of approvals	1	H	L	M-	M	M	
		Points of storage are located near points of use	Distance from storage to use sites	1	H	H-	H-	H-	M+	
			Number of entities involved	1	H-	M	M-	M	H-	
	Water rights	Existing rights utilized (or new water rights required)	Average AF/yr of existing rights used (or AF/yr of new rights required)	1	L	H	M+	H-	M+	
	Readiness to proceed	Environmental documentation	None, NOP, Draft, Final, Adopted	1	H-	M	M	M	M+	
		Design	None, Conceptual, Draft, Final, Bid	1	M+	M-	M	M	M-	
		Identified funding source	None, Partial, Full	1	H-	M	M	M+	M	
	Flexibility	The applied solutions solve more than one problem (e.g. flood management, recreation, storm water management benefits)	Quantifiable flood control, flood reduction, or flood damage reduction; explicit enhancement of recreation as part of project design; beneficial use of floodwaters	1	M	H-	M+	H-	M	Alts 2&3: Multi-purpose site; Alt 4: Barrier w/RO
		The applied solutions do not significantly limit implementation of other projects or management solutions	No identified conflicts with other existing or proposed projects	1	H	M+	M+	H-	H-	
	Environmental impact	Habitat enhancement or protection	Habitat is enhanced or preserved as part of program design	1	L+	M+	L+	M	M	
		Environmental impacts are fully mitigated	Magnitude of unmitigable impacts	1	H	M	M+	H-	M	Alts A&B: Duck Creek Res; Alt D: So Gulch Res

Table 7-6 Application of Performance Measures to Program Alternatives A - D

7.10.2 Application of Prioritization Criteria

The prioritization criteria were next applied to all projects and management actions, whether or not they are represented in the Alternatives. Thus, no project or action is being discarded, but rather the alternatives that are more likely to be implemented are identified to focus implementation efforts. The application of these criteria is displayed in Table 7-7. Using the weighting factors displayed in Table 7-7, there are three distinct tiers of projects and actions that can be implemented with various degrees of certainty and timeliness.

Significantly, the overall ranking does not change when these weighting criteria are individually altered. Approximating a timeline for additional project development, acquisition of water right permits, performing preliminary and final engineering, completing environmental documentation, obtaining financing, and construction produces possible implementation priorities displayed in Figure 7-37.

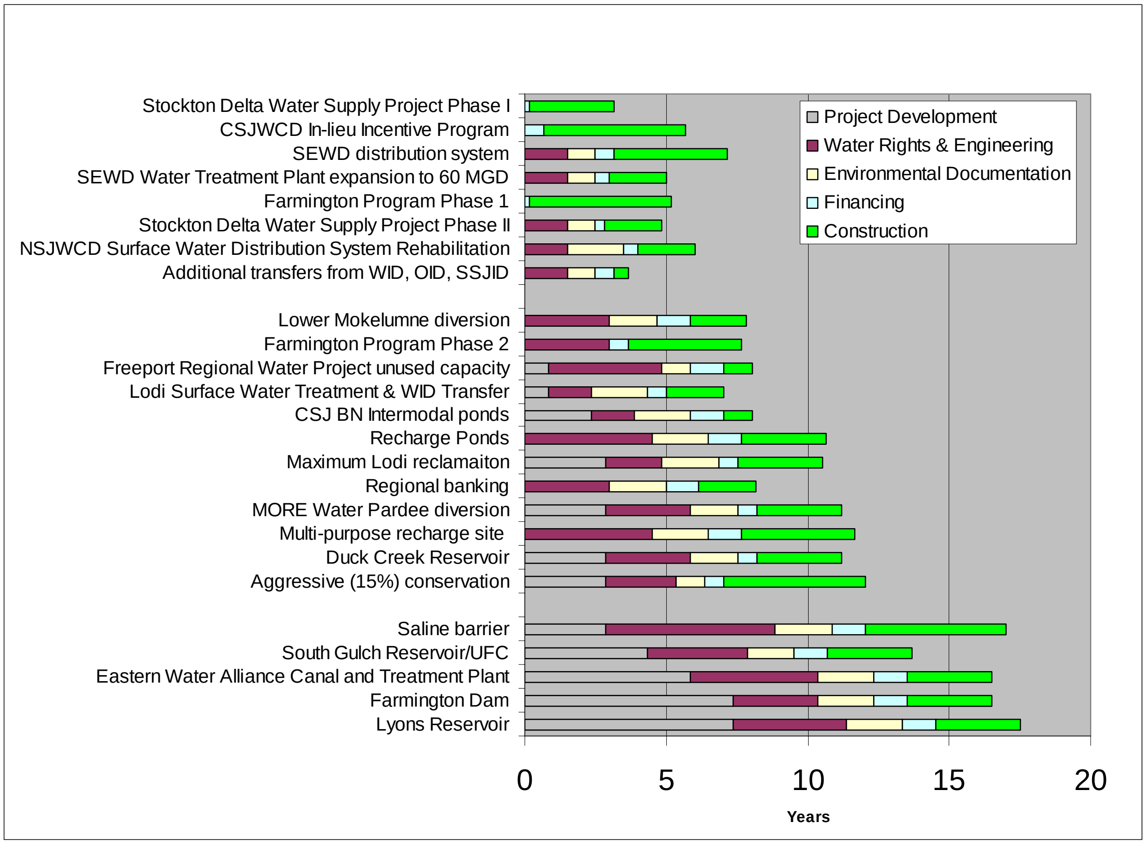


Figure 7-37 Potential Project Implementation Timeline

Project	Need	Feasibility: Technical	Feasibility: Ability to Phase	Feasibility: Institu-tional	Readiness to Proceed: Water Rights	Readiness to Proceed: Engineer-ing	Readiness to Proceed: Identified Financing	Readiness to Proceed: Environ-mental Documen-tation	Public and Stakehold-er Accept-ance	Tier
Weight:	**1**	**3**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	
Stockton Delta Water Supply Project Phase I	H	H	M	H	H	H	H	H	H	1
CSJWCD In-lieu Incentive Program	H	H	H	H	H	H	M	H	H	1
SEWD distribution system	H	H	H	H	H	M	M	M	H	1
SEWD Water Treatment Plant expansion to 60 MGD	M	H	M	H	H	M	M+	M	H	1
Farmington Program Phase 1	H	M	H	M	H	H	H	H	M	1
Stockton Delta Water Supply Project Phase II	M	H	M	M	M	H	H-	M	H	1
NSJWCD Surface Water Distribution System Rehabilitation	H+	H	H	H	H-	L	M+	L	M	1
Additional transfers from WID, OID, SSJID	H	H	H	L+	M	H	M	M	M	1
Lower Mokelumne diversion	H	M	H	M	M	M	L	L+	M	2
Farmington Program Phase 2	H	L+	H	M	M	M	M	H	M	2
Freeport Regional Water Project unused capacity	H	H	L	M	L+	M	L	M	L+	2
Lodi Surface Water Treatment & WID Transfer	H-	M	L	H-	H	M	M	L	M	2
CSJ BN Intermodal ponds	M	M	M	L+	H	M	L	L	M	2
Recharge Ponds	H	M	H	L+	M	L	L	L	M	2
Maximum Lodi reclamaiton	L	M	M	M	H+	L+	M	L	M	2
MORE Water Pardee diversion	H	M	L	L	M	M	M	L+	M	2
Regional banking	H	M	H	L	H	L	L	L	M	2
Multi-purpose recharge site	H	H	H	L	M	L	L	L	L	2
Duck Creek Reservoir	H	M	L	L	M	M	M	L+	M	2
Aggressive (15%) conservation	M	M	H	L	H+	L	M	M	L	2
Saline barrier	M	L	M	M	L	L	L	L	M	3
South Gulch Reservoir/UFC	M	L	L	M	M	M-	L	L+	M	3
Eastern Water Alliance Canal and Treatment Plant	L	L	M	L	M	L	L	L	M	3
Farmington Dam	M	L	L	L	H	L	L	L	L	3
Lyons Reservoir	M	L	L	L	M	L+	L	L	L	3

Table 7-7 Application of Prioritization Criteria

Chapter 7 - Supplemental Materials

1. Performance Measures

		Indicator	Standard
Storage levels	Groundwater accessibility	Water level above top of well screen	Percent of area always above 1992 level
	Management of saline water migration	Groundwater gradients west of Hwy 99	Percentage of months positive westward gradient exists
Supply-demand balance	Water supply sustainability	Equilibrium storage	Rank projects on magnitude of change from No Action
	Water supply operations and contingency plans	Drought contingency supplies	Maximum storage loss (range)
	Benefits related to water supply	Ability to supply water to planned growth	Percent of planned demands that will be met (assume growth cannot be supplied from groundwater in overdrafted areas)
	Efficiency	Water conservation and reclamation opportunities maximized	Percentage of BMPs adopted and fully implemented; Annual volume of reclaimed water use
Economics	Project costs	Capital cost	Rank projects by 50-year present value of net capital and operating costs
		Operation & maintenance costs	
		Revenues from water supply or banking projects	
	Mitigation requirements	Project mitigation costs	Rank projects in order of increasing mitigation requirements from unavoidable impacts, habitat enhancement, cost of dewatered well replacement
Water Quality	Expected changes in water quality	Change in concentration of constituents of concern in groundwater	Improvement in water quality relative to existing concentrations and regulatory requirements
		Impacts/benefits to water quality in Delta, Lower SJR, and other areas of CalFed concern	Change in X2 position; wastewater discharges
Equity	Fair and equitable distribution of benefits and costs	Proposed solutions are unbiased and objective, reasonable and consistent	Subjective evaluation required (rate on five-point scale)
		Proposed solutions are likely to result in few claims or grievances	
		Proposed solutions help all people to meet reasonable goals	
		Proposed solutions preserve socio-cultural values (e.g. mix of livelihoods)	
		The solution is in the best interests of all concerned	
		There is a willingness to pay for the applied solution	
	Redirected impacts	The applied solutions do not cause secondary or redirected impacts	
	Benefits to disadvantaged communities	There are identifiable benefits to disadvantaged communities as part of project design	
Implement-ability	Institutional complexity	The number of permits is minimized	Number of permits
		The number of agency approvals is minimized	Number of approvals
		Points of storage are located near points of use	Distance from storage to use sites
			Number of entities involved
	Water rights	Existing rights utilized (or new water rights required)	Average AF/yr of existing rights used (or AF/yr of new rights required)
	Readiness to proceed	Environmental documentation	None, NOP, Draft, Final, Adopted
		Design	None, Conceptual, Draft, Final, Bid
		Identified funding source	None, Partial, Full
	Flexibility	The applied solutions solve more than one problem (e.g. flood management, recreation, storm water management benefits)	Quantifiable flood control, flood reduction, or flood damage reduction; explicit enhancement of recreation as part of project design; beneficial use of floodwaters
		The applied solutions do not significantly limit implementation of other projects or management solutions	No identified conflicts with other existing or proposed projects
	Environmental impact	Habitat enhancement or protection	Habitat is enhanced or preserved as part of program design
		Environmental impacts are fully mitigated	Magnitude of unmitigable impacts

2. DYNFLOW Program Alternatives Modeling

Introduction

To assess the regional impacts of the proposed alternatives, the existing San Joaquin County (SJC) groundwater model was used to simulate changes in water levels due to the proposed projects.

The existing groundwater model was developed using the DYNFLOW finite-element code. The SJC model encompasses portions of San Joaquin, Sacramento, and Stanislaus Counties as shown in Figure 7-32. The major urban areas within the model domain are Stockton, Lodi, Lathrop, Ripon, Manteca, and Escalon. The majority of the county is comprised of agricultural land.

The SJC DYNFLOW model was calibrated over the period from Water Year 1970 through Water Year 2005. In order to simulate the proposed alternatives, an estimated, constant 2030 level of development was applied to the model. Superimposed on the constant 2030 conditions was the historical hydrology from 1970 through 2005. By superimposing the historical hydrology on the constant level of development, the changes of water levels result only from changes in hydrology. The relative impacts of changes in management scenarios can be seen by comparing simulations of different management scenarios.

Simulation of Alternatives

The four proposed management alternatives defined in Chapter 7 were simulated using the SJC DYNFLOW model. The resulting water levels were plotted and analyzed to assess the impacts of the alternatives. As a measure for comparison, the “no-action” alternative (Alternative 0) was also simulated.

Simulated water levels at 22 monitoring locations were plotted for each of the four management alternatives as well as the no-action alternative. Figure MODEL-2 shows the locations of these 22 wells within the domain of the SJC DYNFLOW model. Figures MODEL-3a through MODEL-3n show the simulated water levels at these 22 wells. Table MODEL-1 correlates the figure number to geographic region where the well is located.

Table MODEL-1

Figure Number	Location
MODEL-3a	Delta
MODEL-3b	Galt Irrigation District
MODEL-3c	Goose Creek
MODEL-3d	Manteca City
MODEL-3e	Modesto City
MODEL-3f	Modesto Irrigation District
MODEL-3g	North San Joaquin Water Conservation District
MODEL-3h	Woodbridge Water District
MODEL-3i	Stockton East Water District
MODEL-3j	City of Stockton
MODEL-3k	Central San Joaquin Water Conservation District
MODEL-3l	Oakdale Irrigation District
MODEL-3m	South San Joaquin Irrigation District
MODEL-3n	Valley Springs

In addition to the simulated water levels at these wells, the observed water levels from Spring 1986 and Fall 1992 are also shown. These water levels represent the target high and low water levels, respectively.

Figure MODEL-4 shows the location of an east/west cross section across the county through the area with the lowest water levels. Figures MODEL-5a, -5b, -5c, and -5d show the simulated water levels from Alternatives A, B, C, and D, respectively, along this cross-section. Each cross-section figure shows the following:

- Simulated Spring 1986 and Fall 1992 water levels under the alternative in question (solid blue and orange lines)

- Simulated Spring 1986 and Fall 1992 water levels for the no-action alternative (dashed blue and orange lines)
- Measured Spring 1986 and Fall 1992 water levels at 3 monitoring wells that lie along the cross section

It should be noted that these figures show the water levels at two distinct times. The results of the entire 35 year transient simulation are not shown.

In order to visualize the regional impacts to water levels due to the alternatives the simulated water levels were contoured over the entire model domain. Contours of the water table were developed for the no-action alternative and Alternatives A, B, C, and D. For each of the alternatives, the water table was contoured for the Spring 1986 and Fall 1992 periods. For the contour figures, Table MODEL-2 correlates the figure number to the alternative and time period.

Table MODEL-2

Figure Number	Alternative	Time Period
MODEL-6a	0 (no-action)	Spring 1986
MODEL-6b		Fall 1992
MODEL-6c	A	Spring 1986
MODEL-6d		Fall 1992
MODEL-6e	B	Spring 1986
MODEL-6f		Fall 1992
MODEL-6g	C	Spring 1986
MODEL-6h		Fall 1992
MODEL-6i	D	Spring 1986
MODEL-6j		Fall 1992

To assess the relative improvement in water levels with respect to the no-action condition, the difference between the simulated water levels under a management alternative and the no-action alternative was also contoured. Again, these contours were developed for the Spring 1986 and Fall 1992 periods. For these difference contours, Table MODEL-3 correlates the figure number to the alternative and time period.

Table MODEL-3

Figure Number	Alternative	Time Period
MODEL-7a	A	Spring 1986
MODEL-7b		Fall 1992
MODEL-7c	B	Spring 1986
MODEL-7d		Fall 1992
MODEL-7e	C	Spring 1986
MODEL-7f		Fall 1992
MODEL-7g	D	Spring 1986
MODEL-7h		Fall 1992

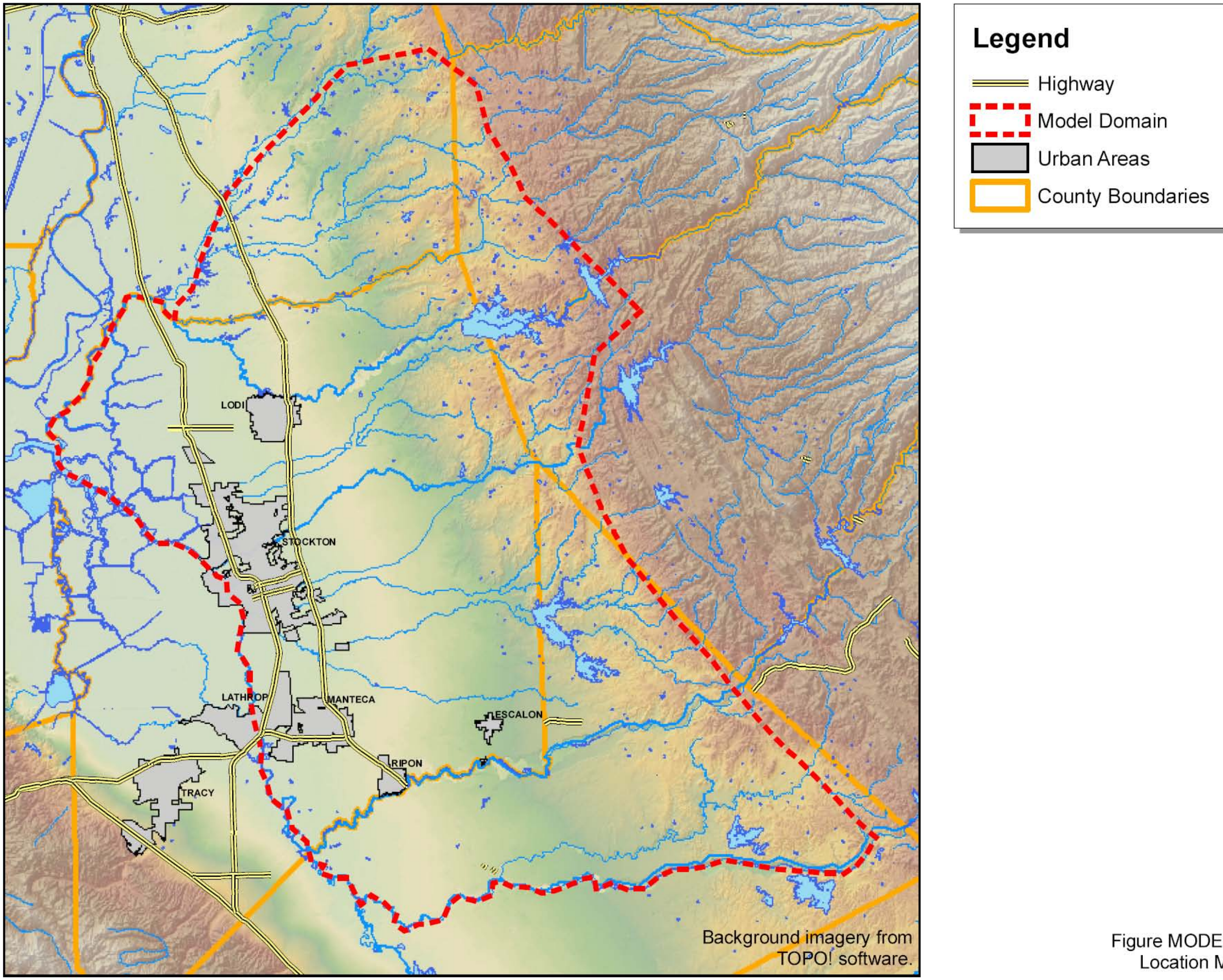
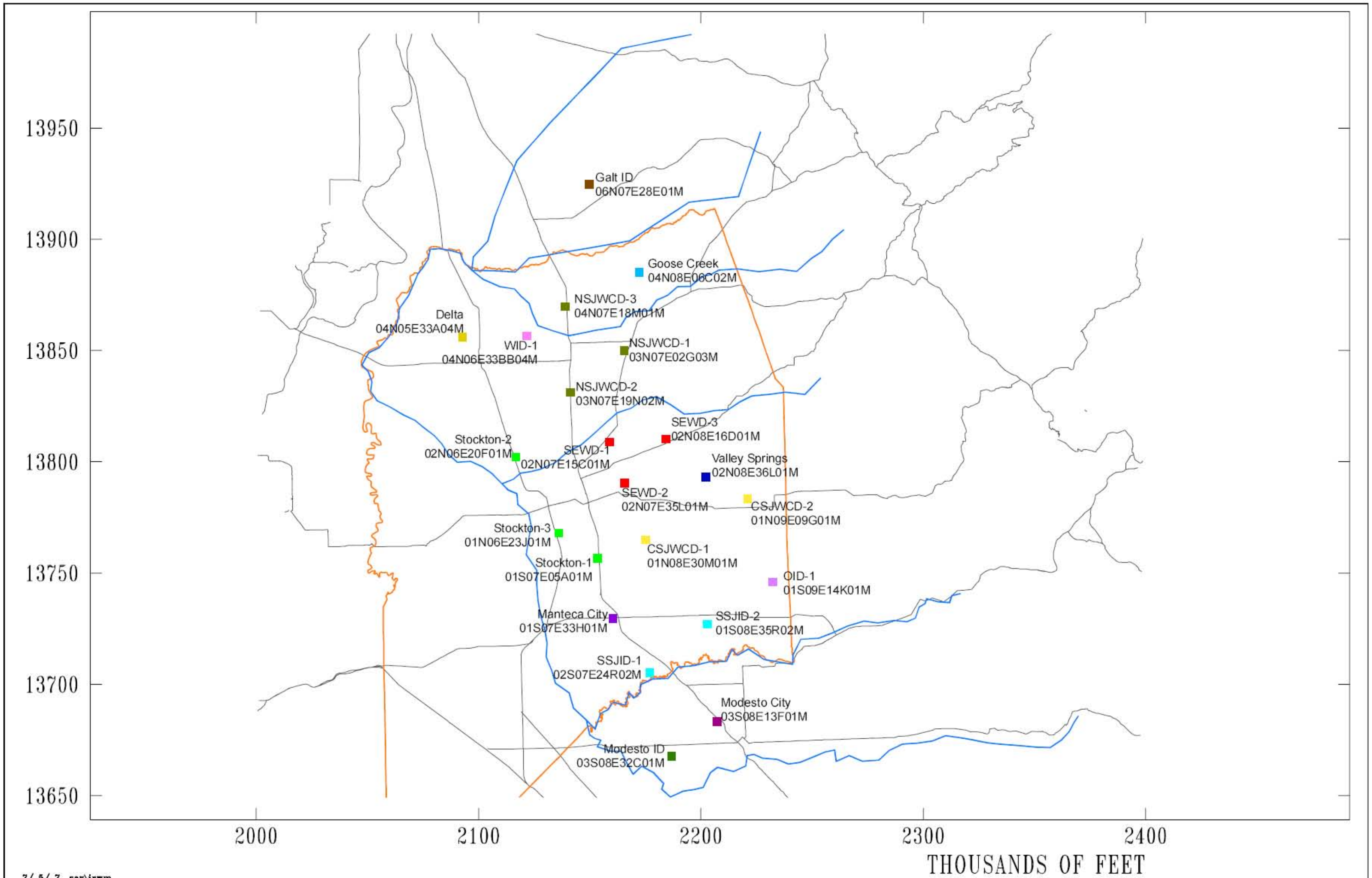


Figure MODEL-
Location Ma

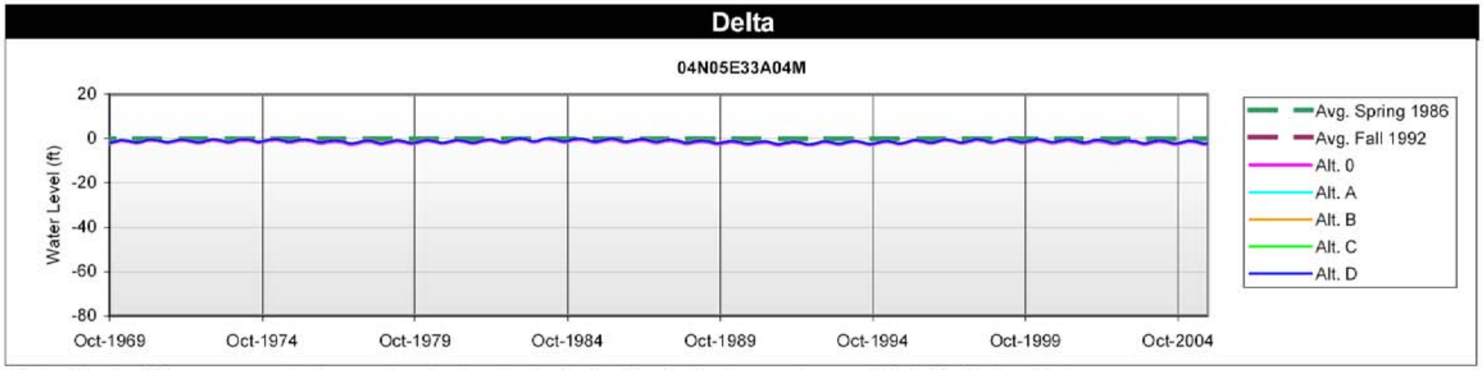


CDM

Well Locations

Northeastern San Joaquin County GBA IRWMP

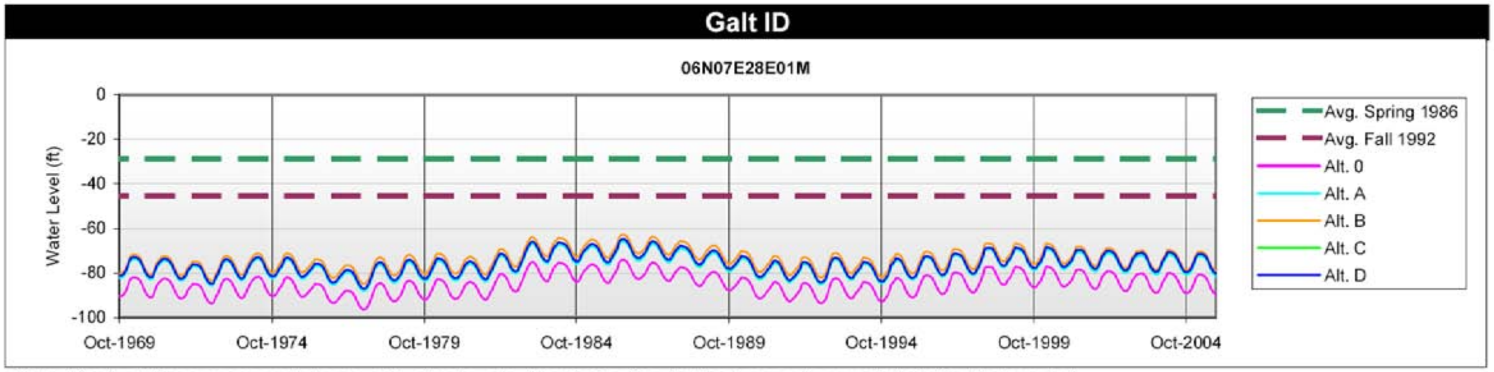
Figure MODEL-2



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: Delta
7/6/2007

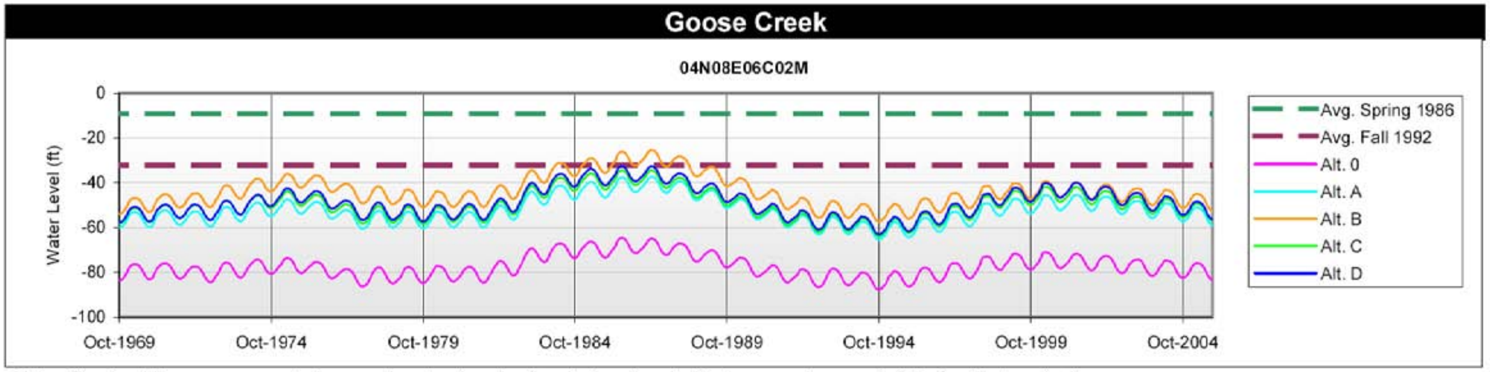
Figure MODEL-3a
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

RWMP_Results_WaterLevels_ALT.xls: Galt ID
7/6/2007

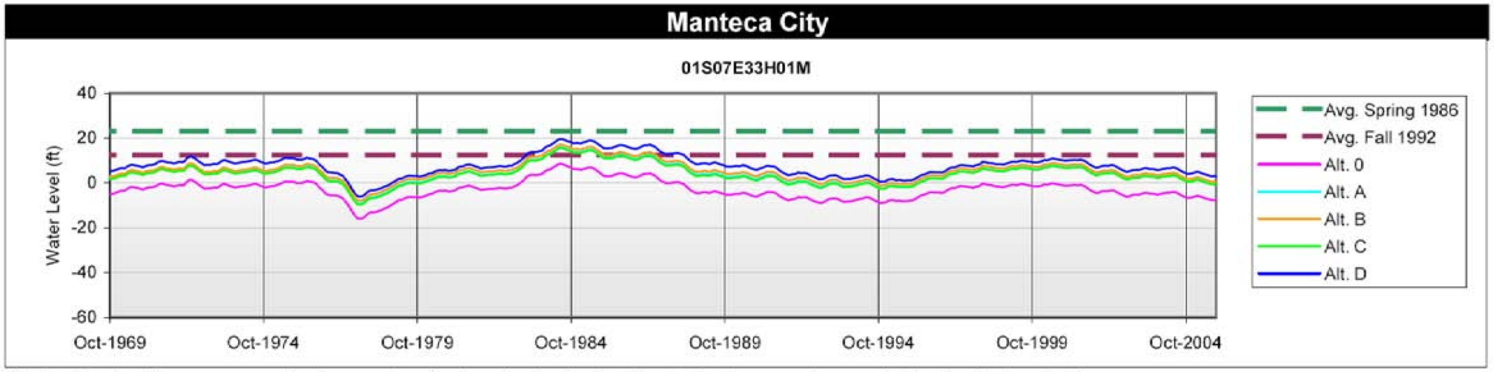
Figure MODEL-3b
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

RWMP_Results_WaterLevels_ALT.xls: Goose Creek
7/6/2007

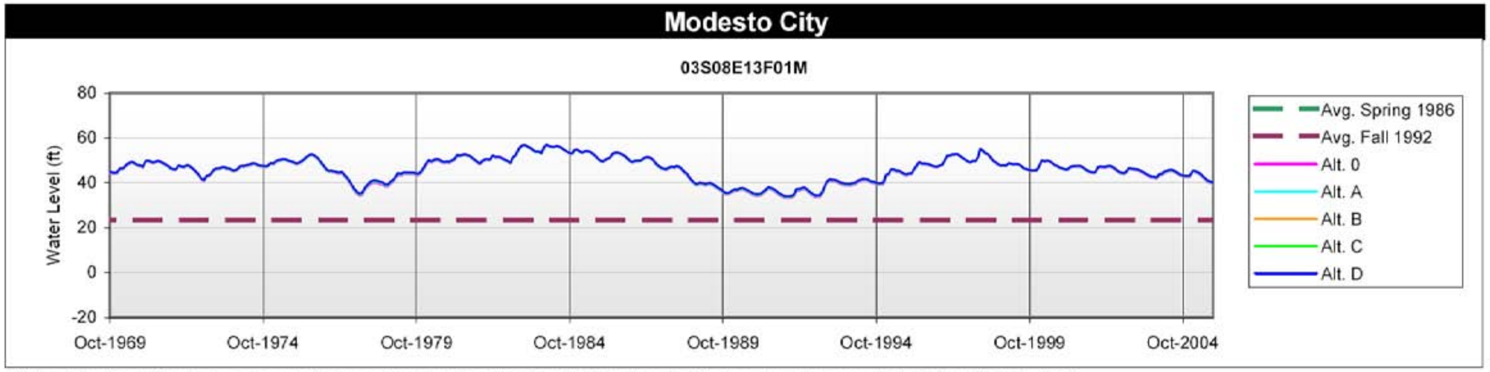
Figure MODEL-3c
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

RWMP_Results_WaterLevels_ALT.xls: Manteca City
7/6/2007

Figure MODEL-3d
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

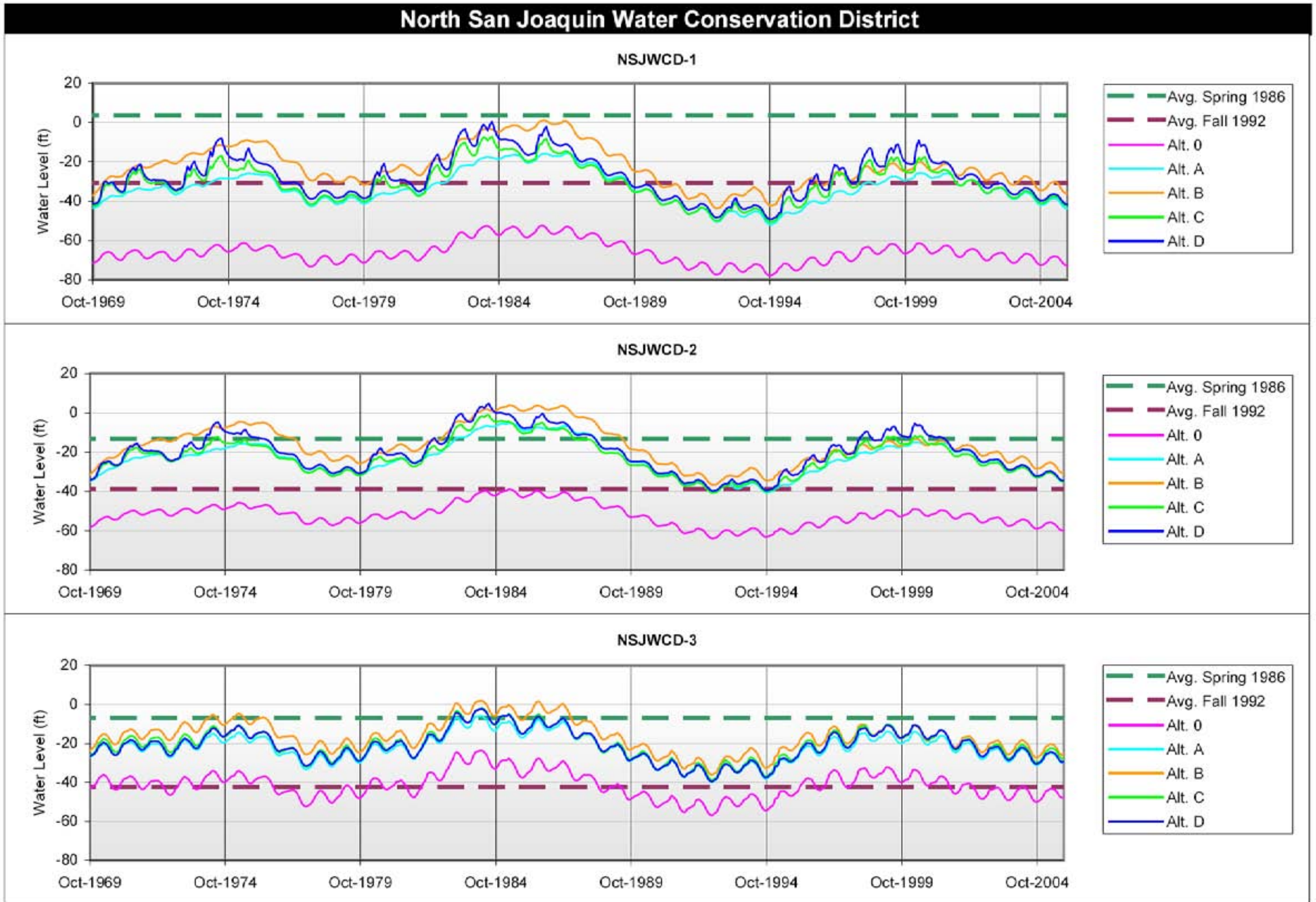
RWMP_Results_WaterLevels_ALT.xls: Modesto City
7/6/2007

Figure MODEL-3e
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios

Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: Modesto ID
7/6/2007

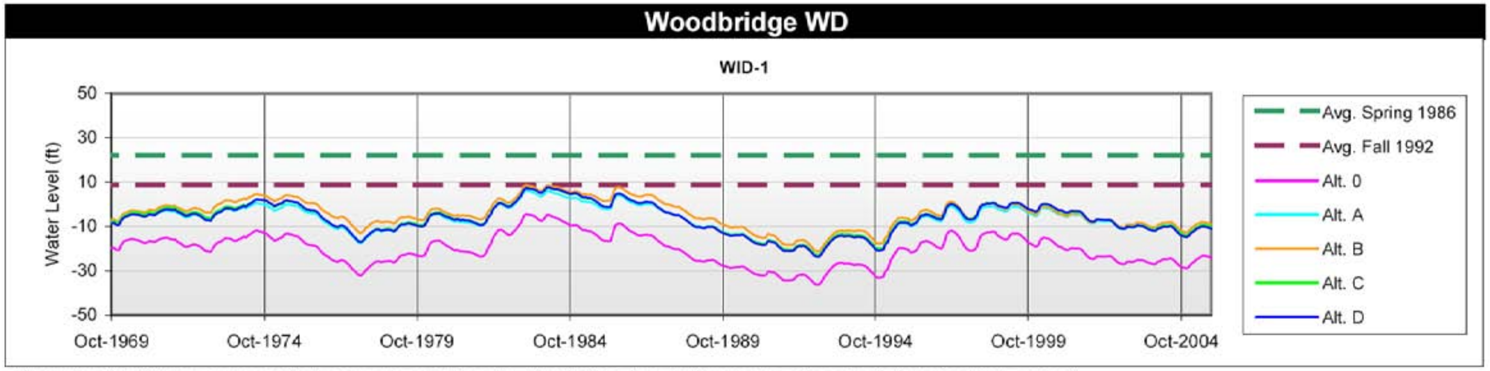
Figure MODEL-3f
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: North SJ WCD
7/6/2007

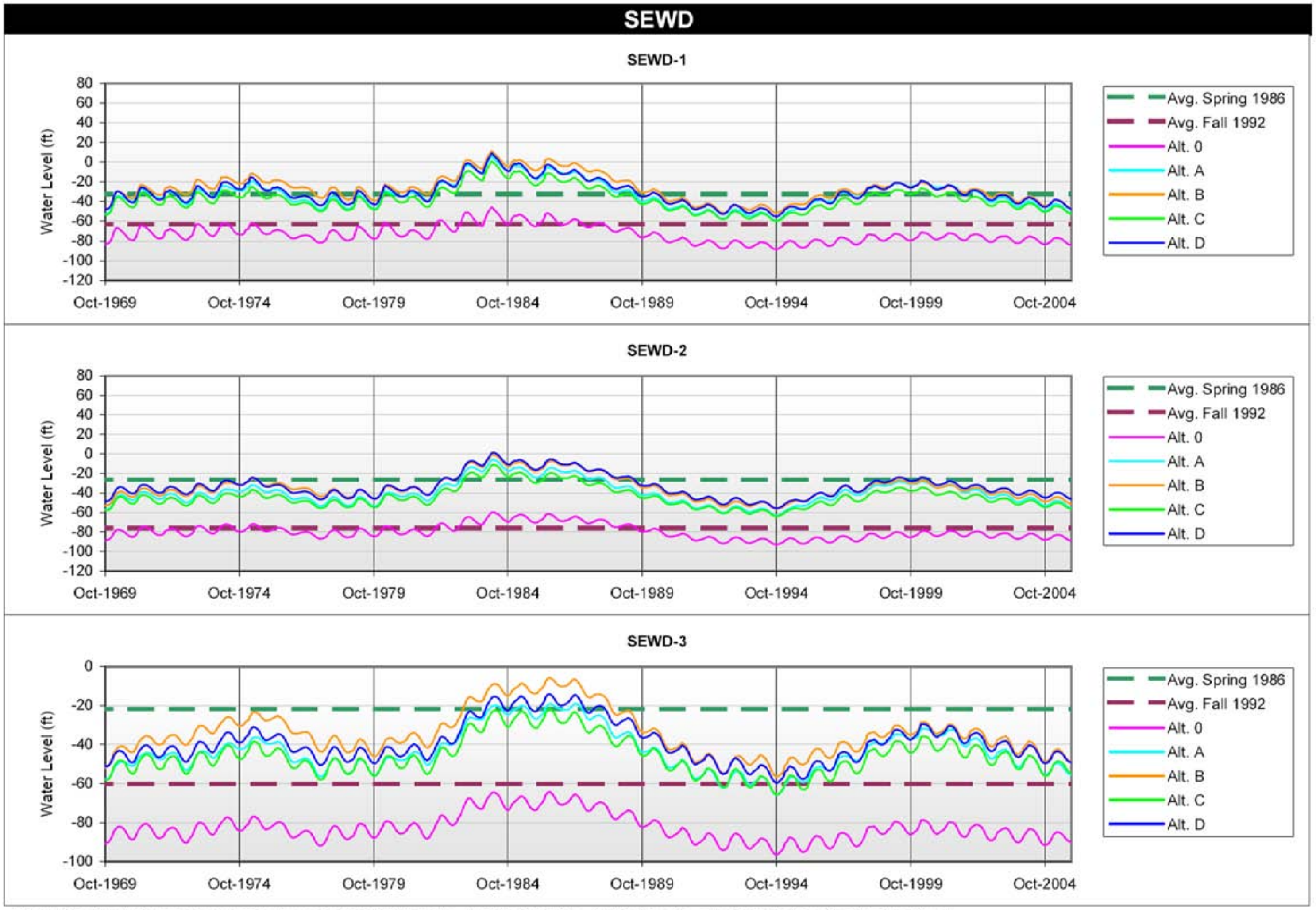
Figure MODEL-3g
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

RWMP_Results_WaterLevels_ALT.xls: Woodbridge WD
7/6/2007

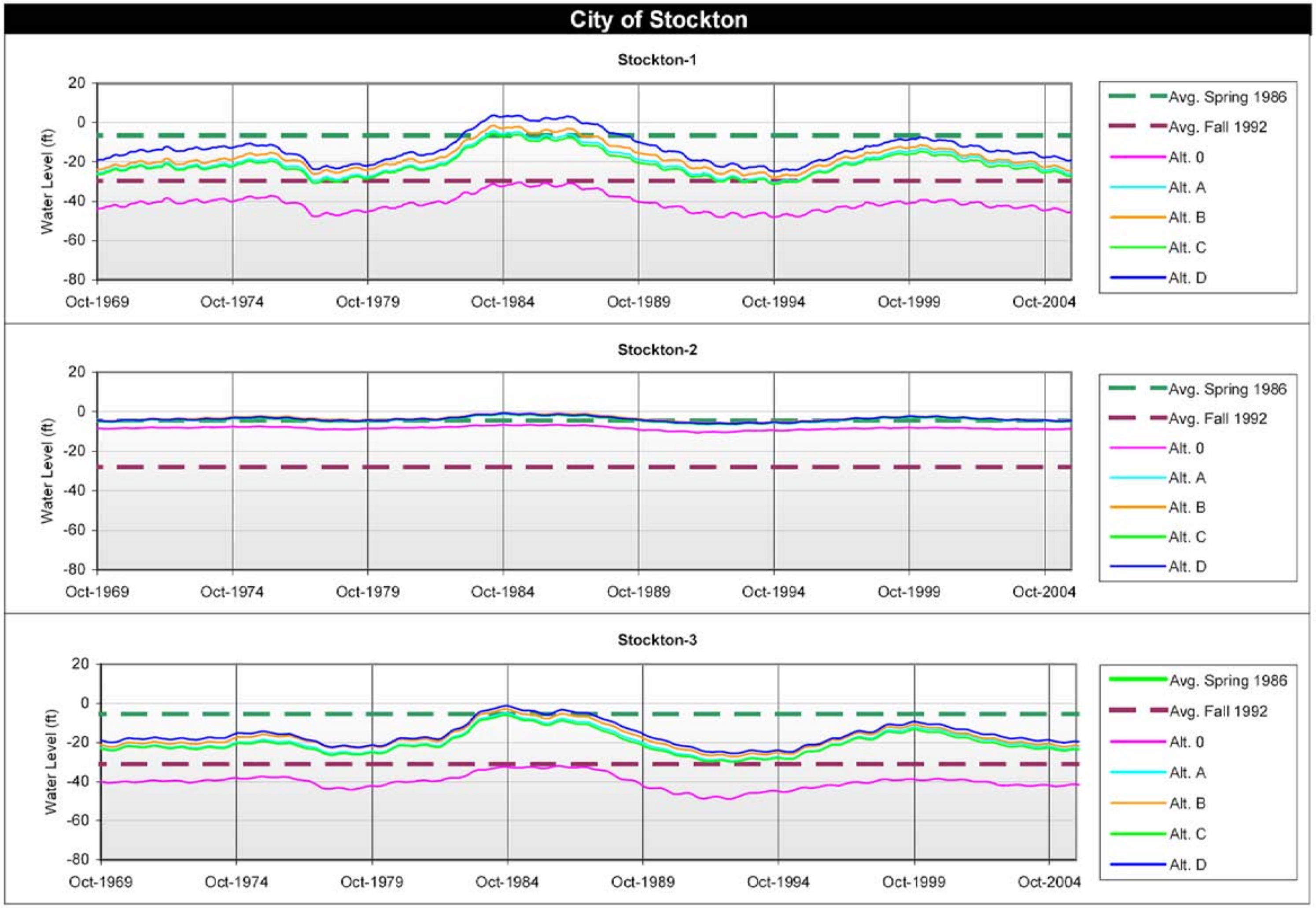
Figure MODEL-3h
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

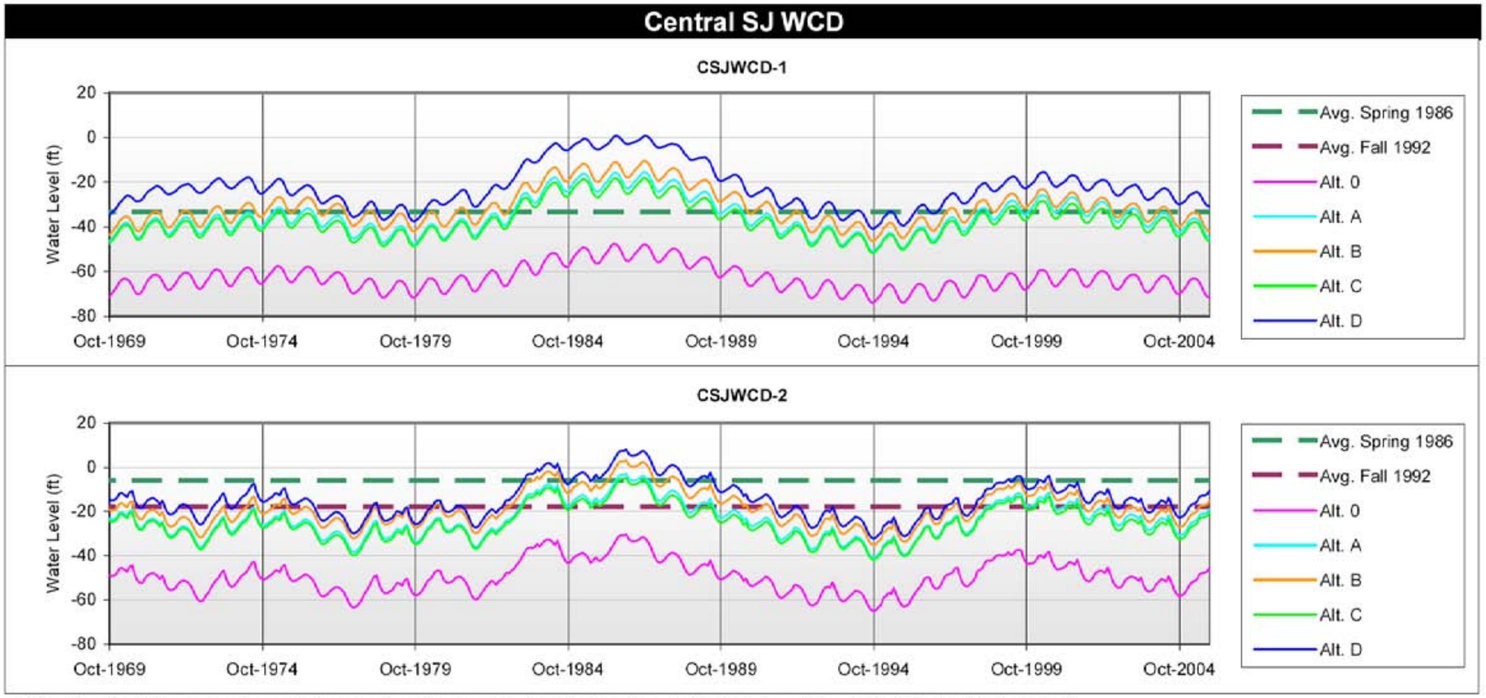
RWMP_Results_WaterLevels_ALT.xls: SEWD
7/6/2007

Figure MODEL-3i
Simulated Groundwater Response for 2030 Level of Development and Selected Recharge Scenarios



IRWMP_Results_WaterLevels_ALT.xls: Stockton City
7/6/2007

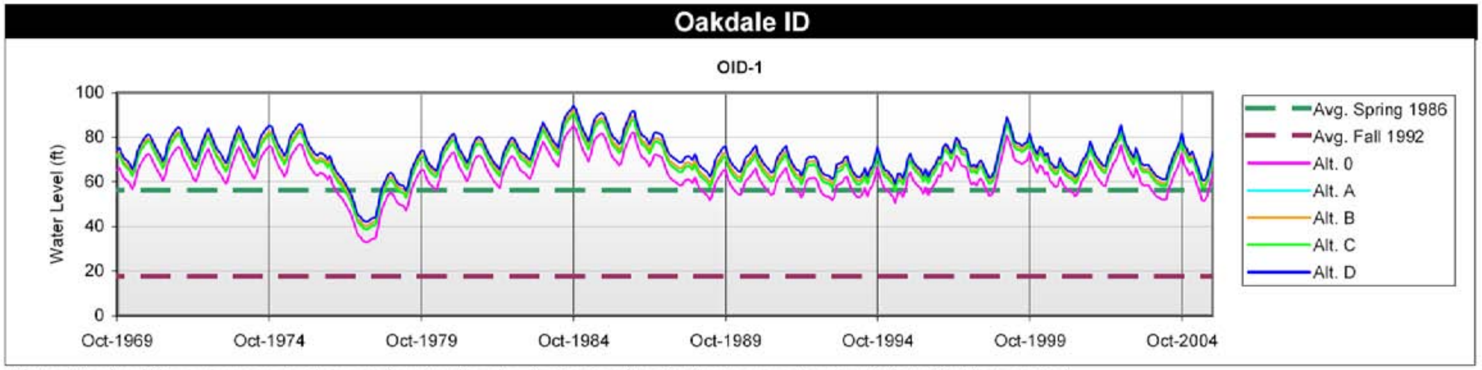
Figure MODEL-3j
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: Central SJ WCD
7/6/2007

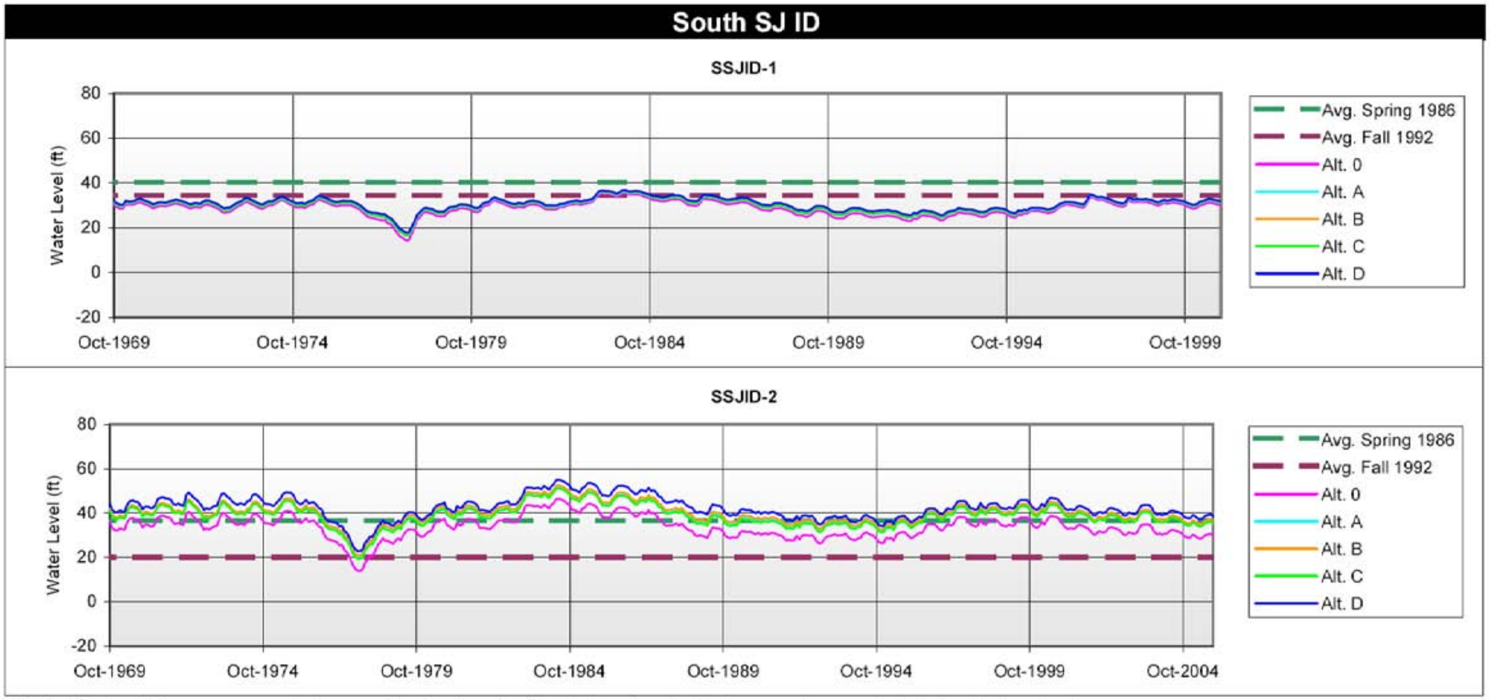
Figure MODEL-3k
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

RWMP_Results_WaterLevels_ALT.xls: Oakdale ID
7/6/2007

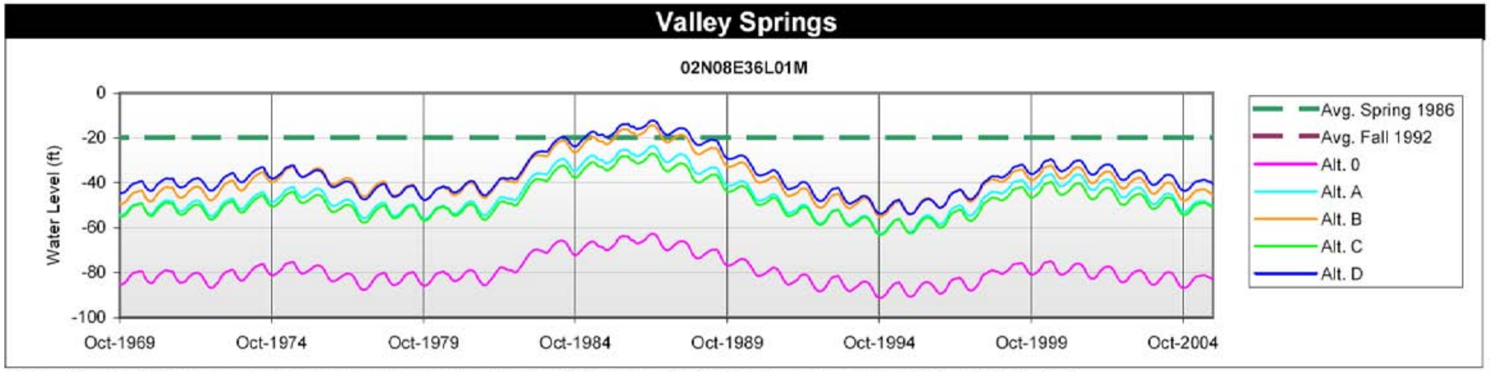
Figure MODEL-3I
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: South SJ ID
7/6/2007

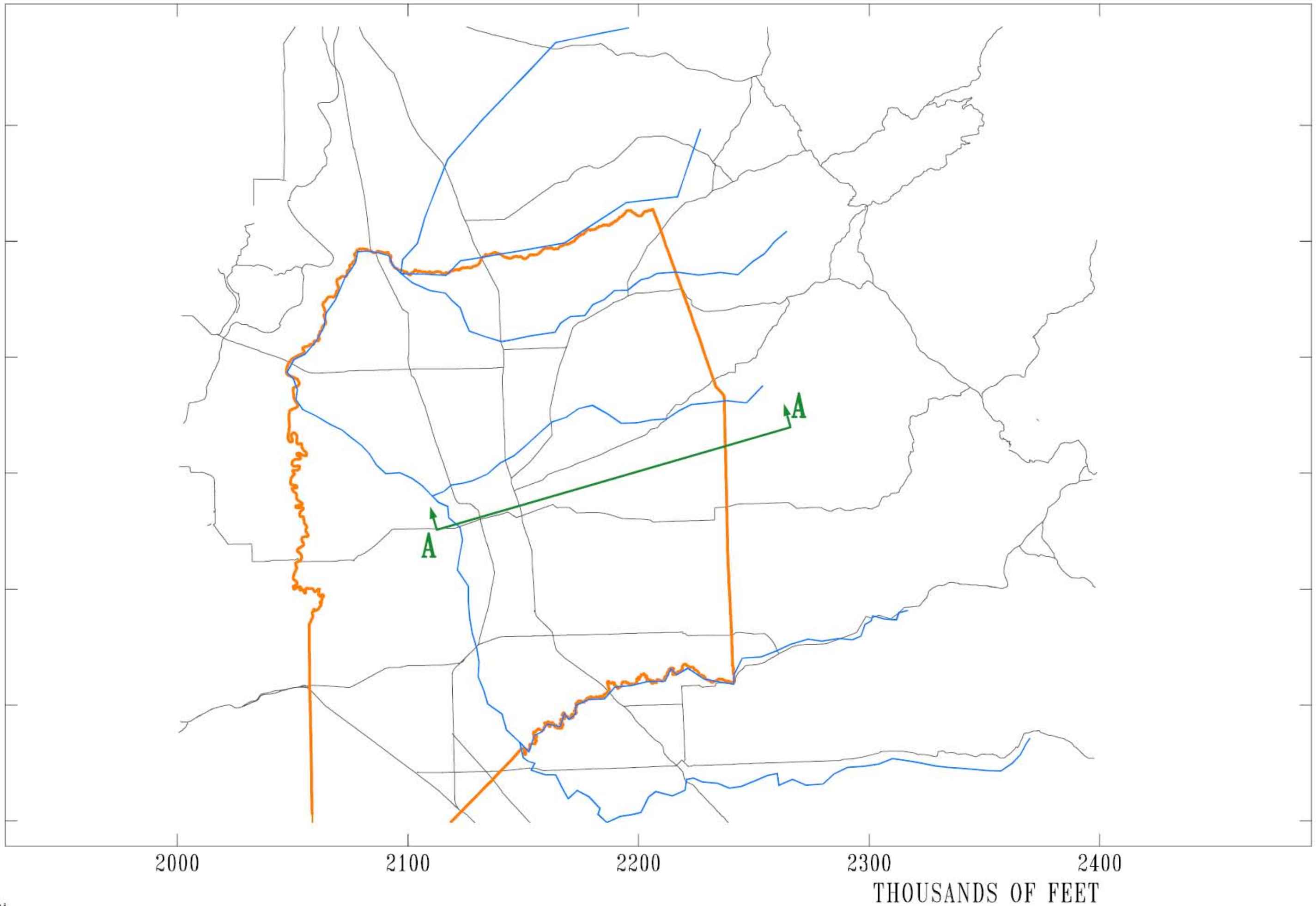
Figure MODEL-3m
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Note: Dashed lines represent observed water levels. A missing line indicates no observed data for that period.

IRWMP_Results_WaterLevels_ALT.xls: Valley Spg
7/6/2007

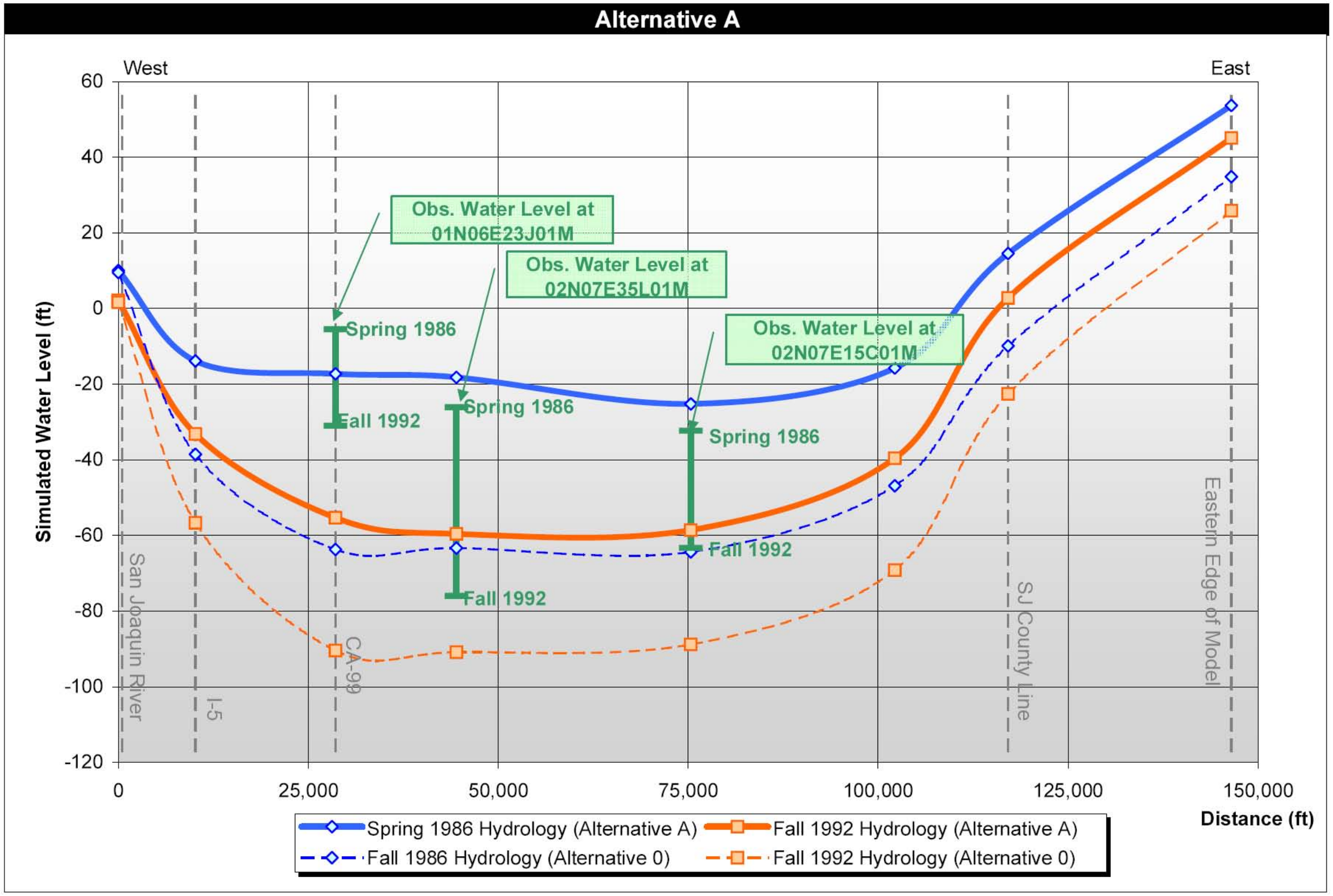
Figure MODEL-3n
Simulated Groundwater Response for 2030 Level of Development
and Selected Recharge Scenarios



Location of Cross-Section

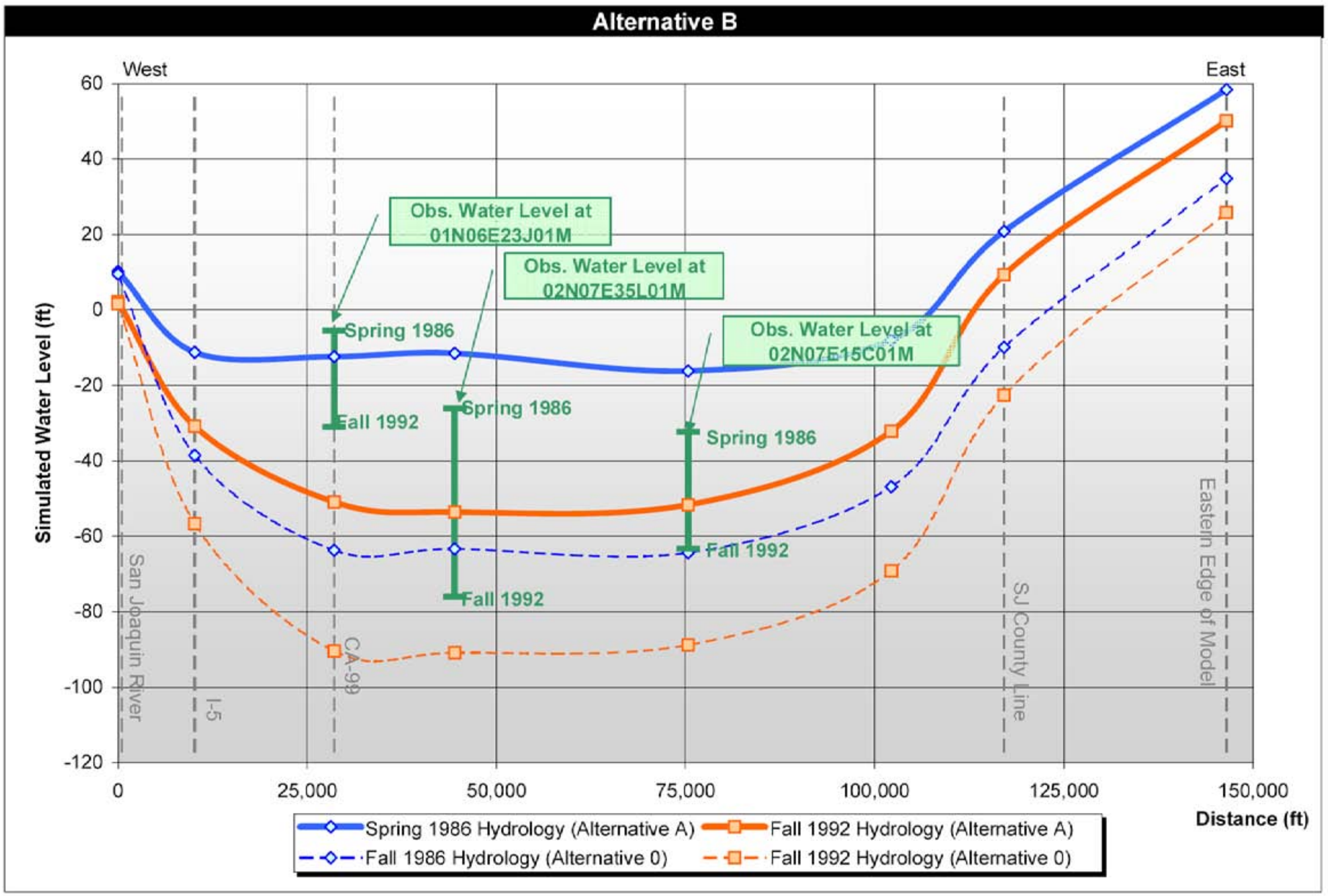
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-4



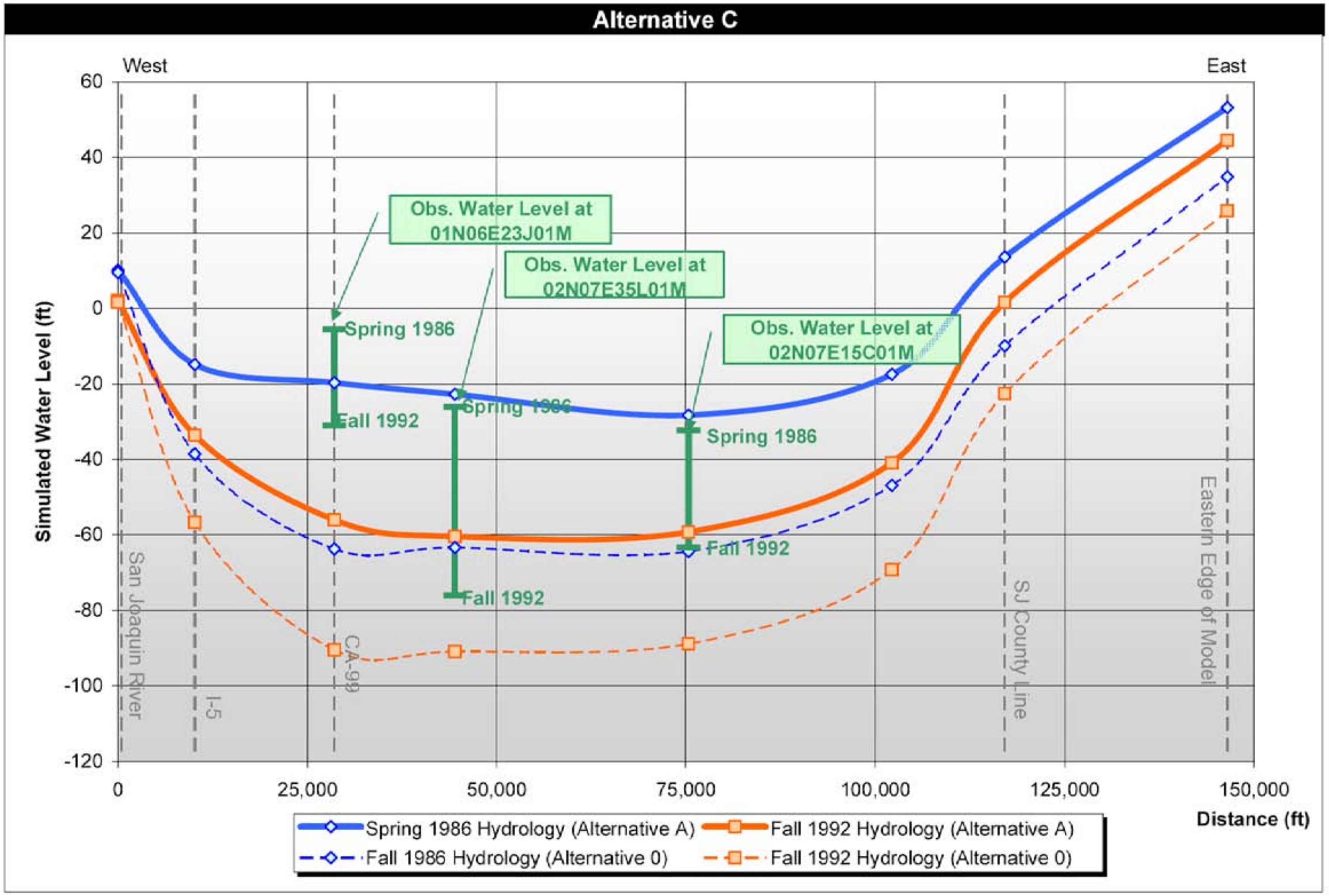
IRWMP_Results_HdDiff_ALTA.xls: Figure
7/6/2007

Figure MODEL-5a
Simulated Groundwater Table
East/West Cross-Section



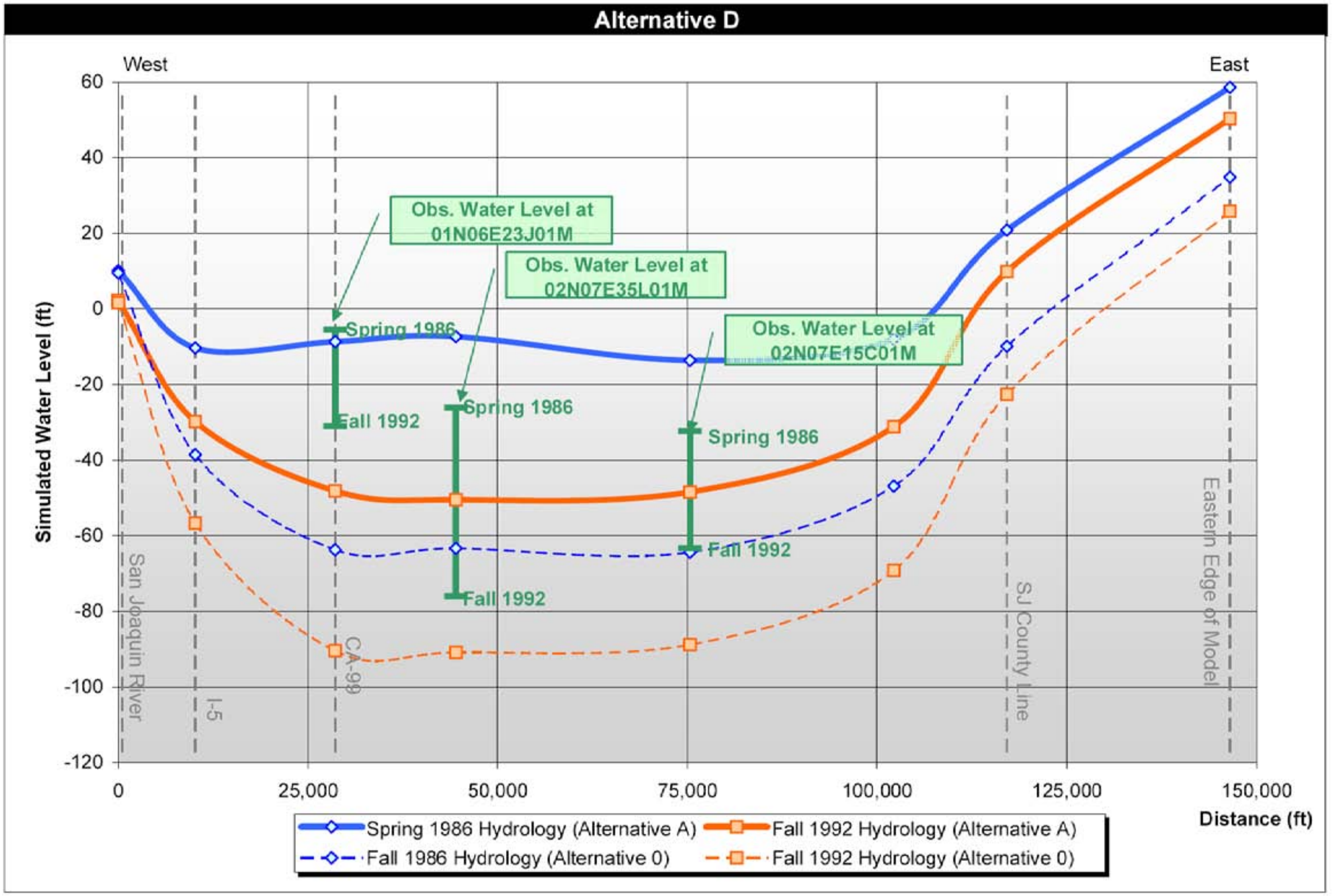
RWMP_Results_HdDiff_ALTB.xls: Figure
7/6/2007

Figure MODEL-5b
Simulated Groundwater Table
East/West Cross-Section



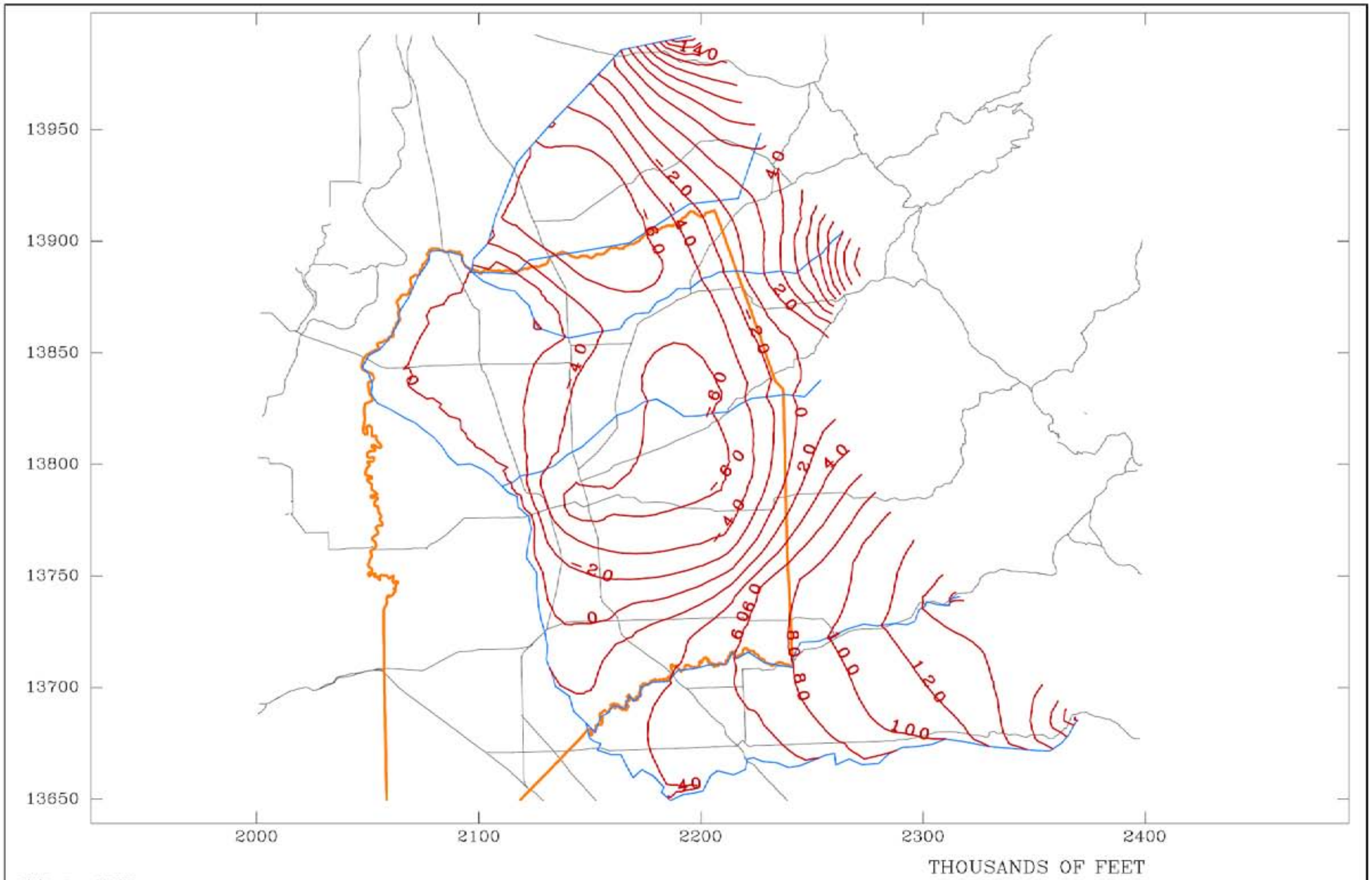
RWMP_Results_HdDiff_ALTC.xls: Figure
7/6/2007

Figure MODEL-5c
Simulated Groundwater Table
East/West Cross-Section



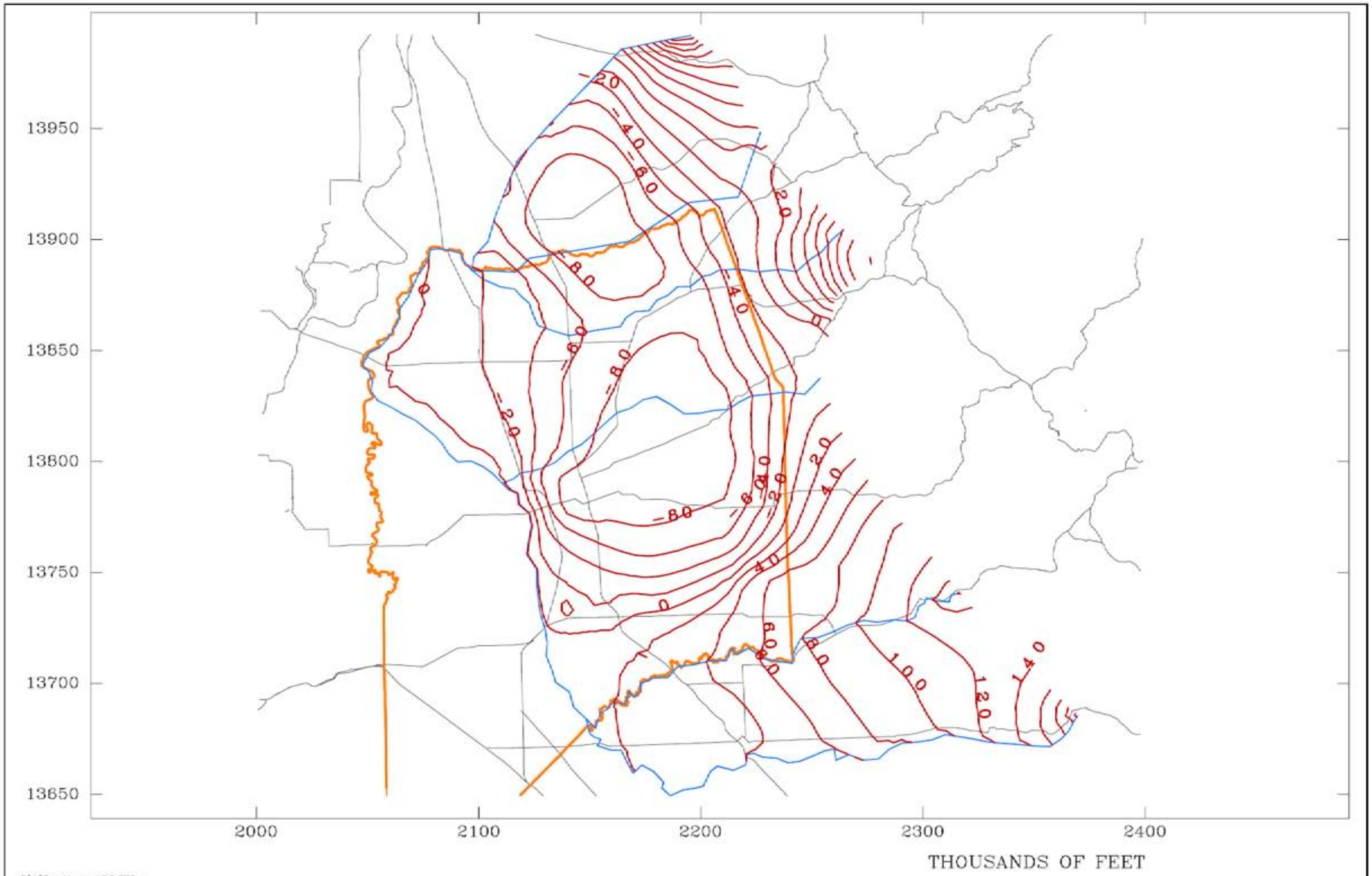
IRWMP_Results_HdDiff_ALTD.xls: Figure
7/6/2007

Figure MODEL-5d
Simulated Groundwater Table
East/West Cross-Section



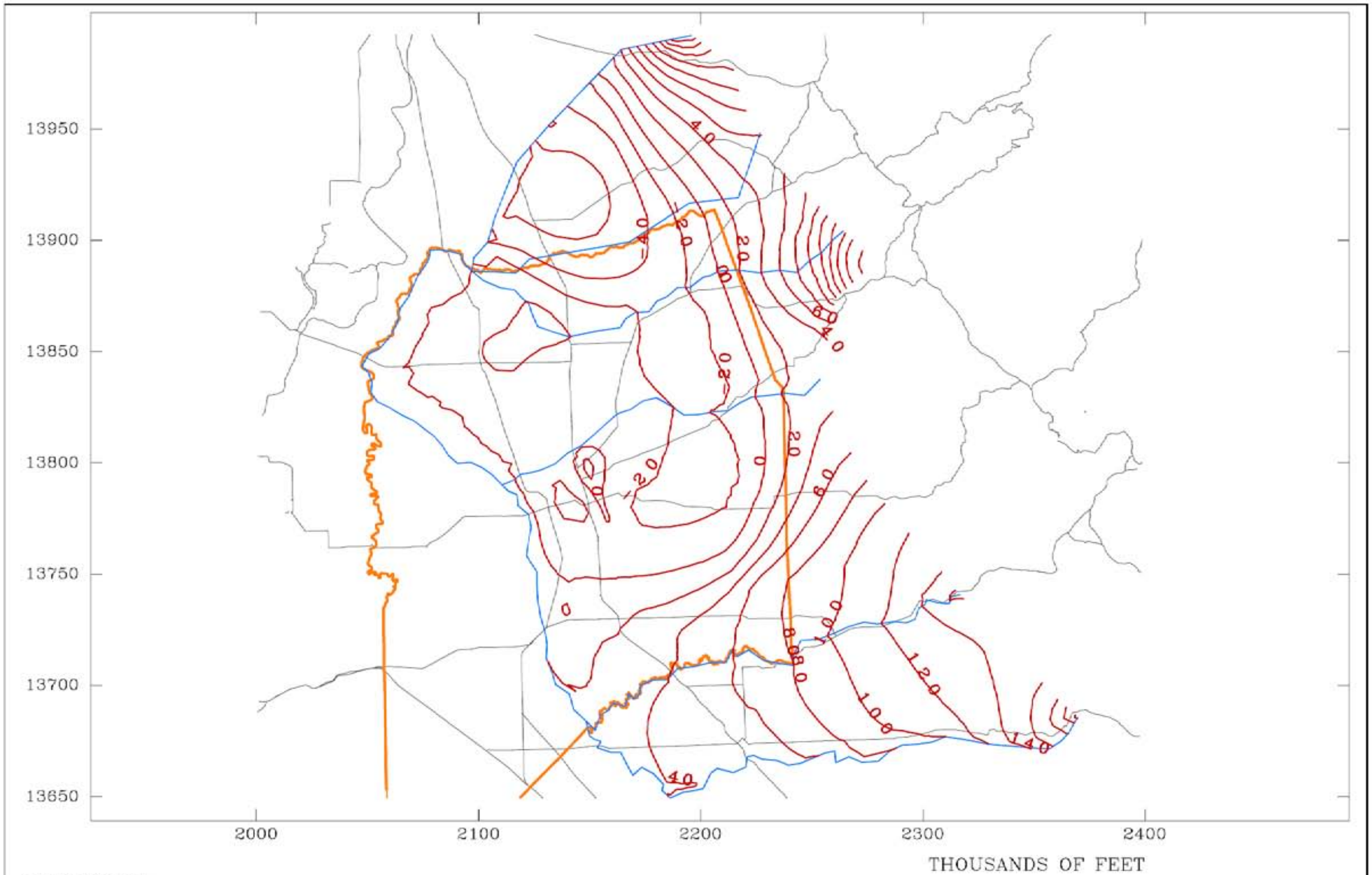
Simulated Water Table: Alternative 0
20 ft Contour Interval
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6a



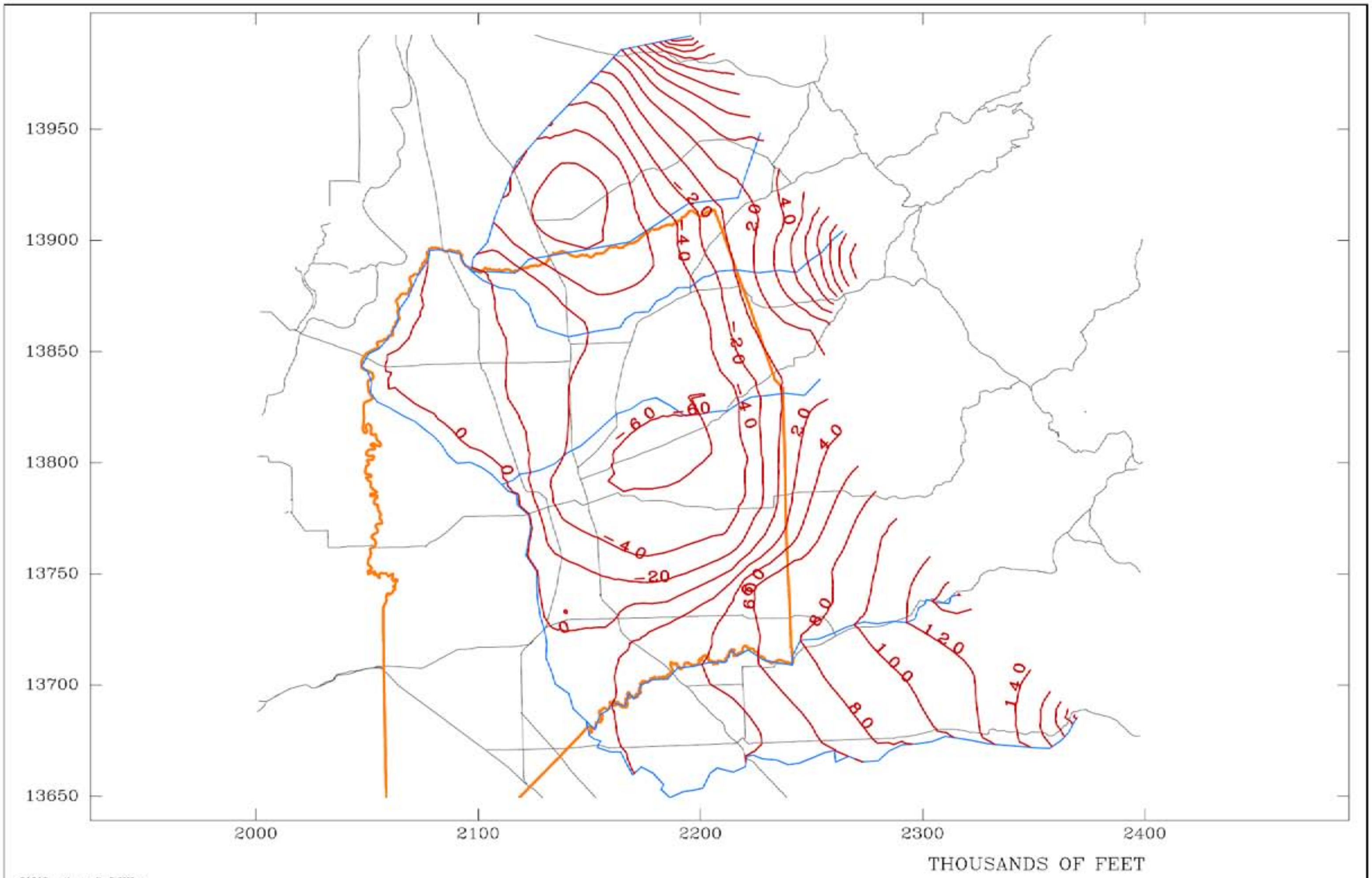
Simulated Water Table: Alternative 0
20 ft Contour Interval
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6b



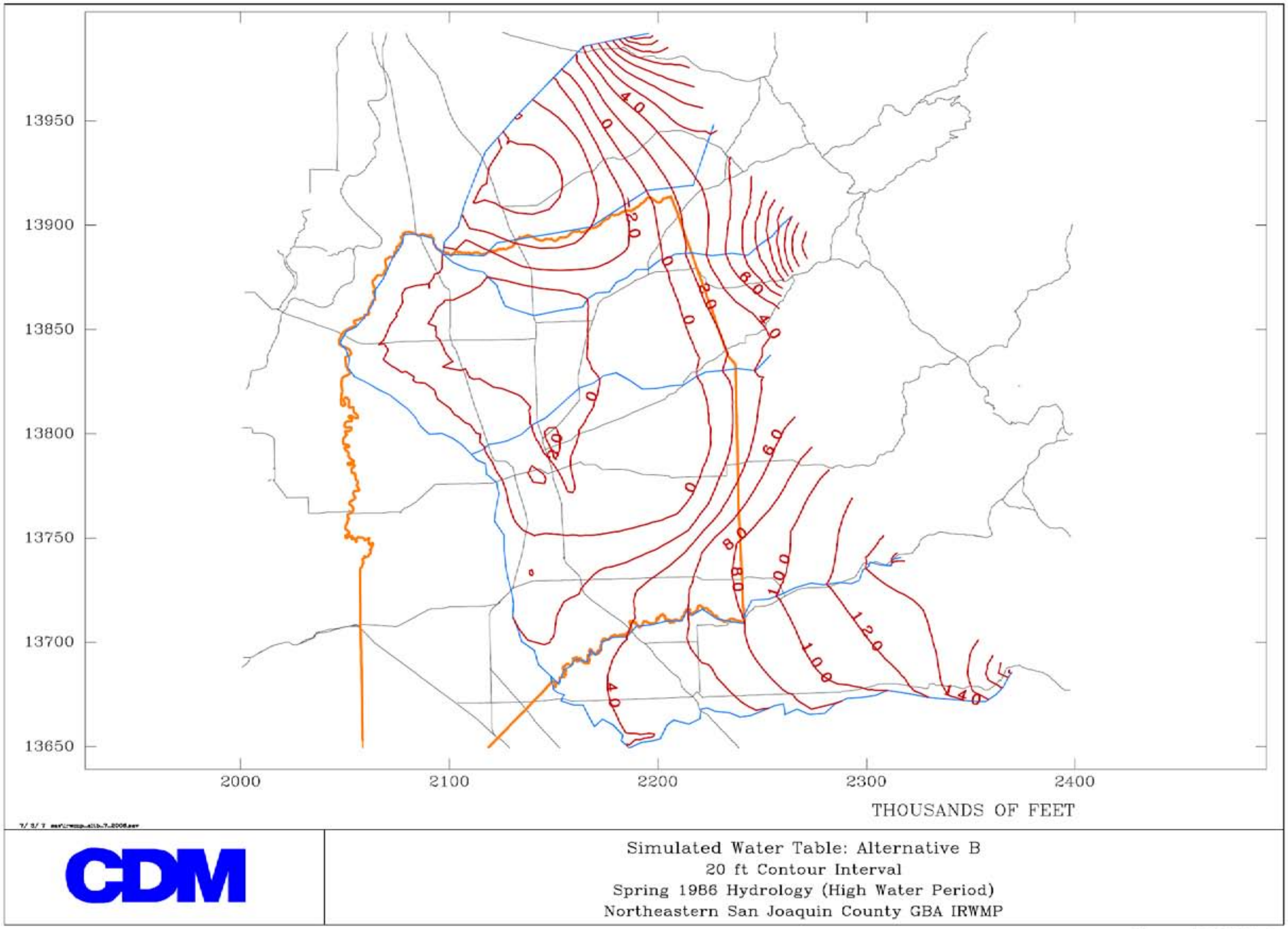
Simulated Water Table: Alternative A
20 ft Contour Interval
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6c



Simulated Water Table: Alternative A
20 ft Contour Interval
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6d



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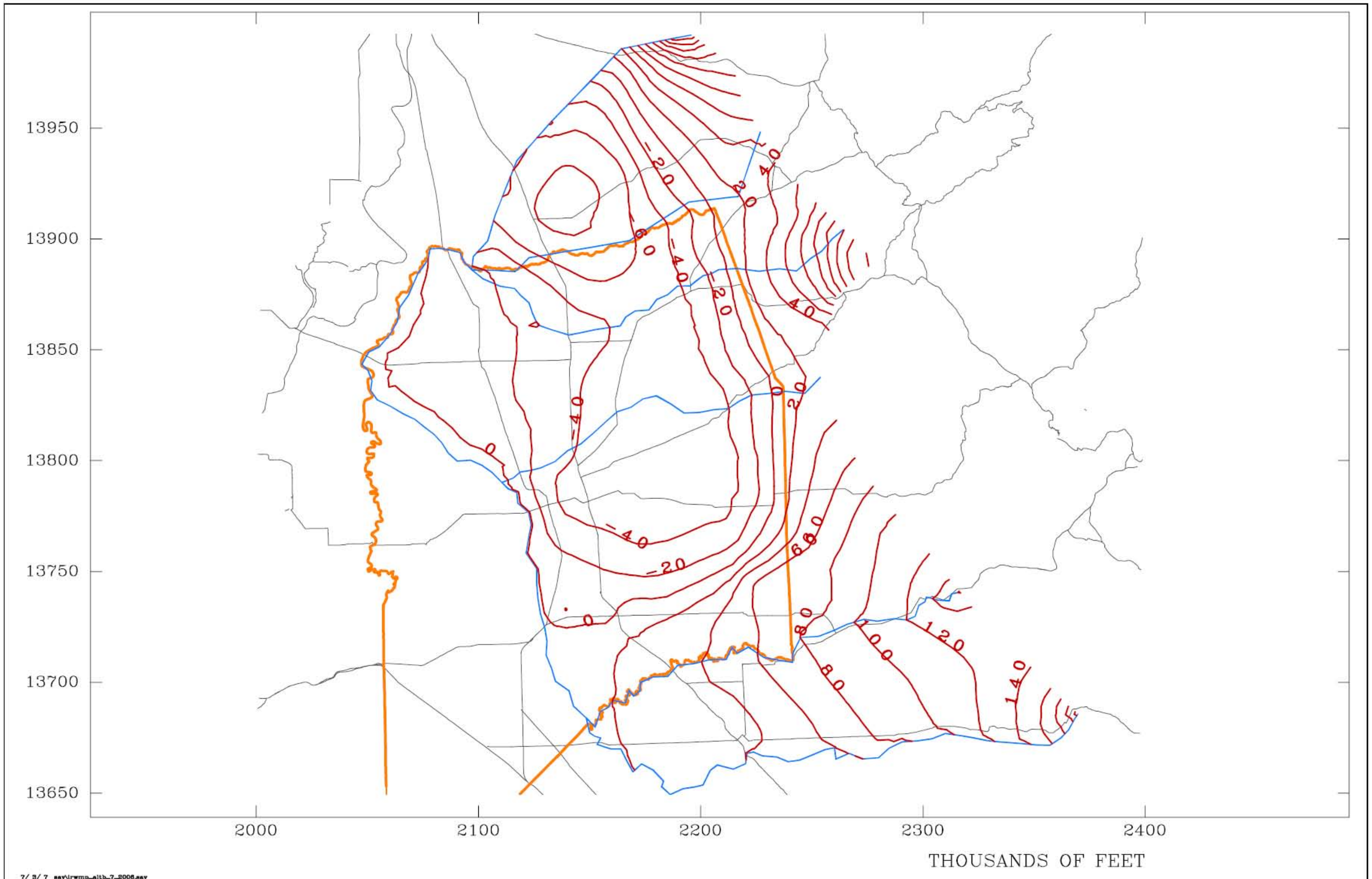
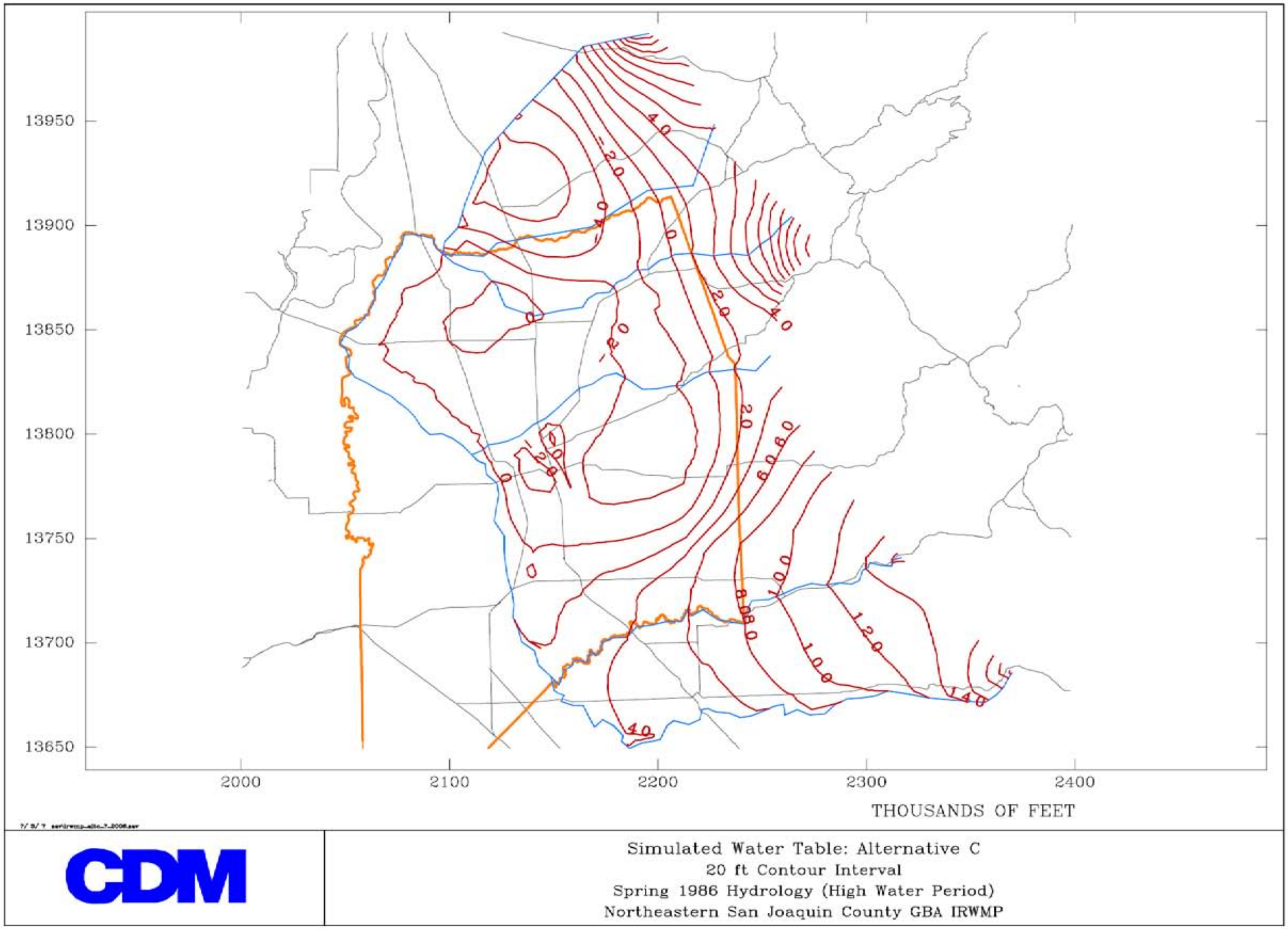


CDM

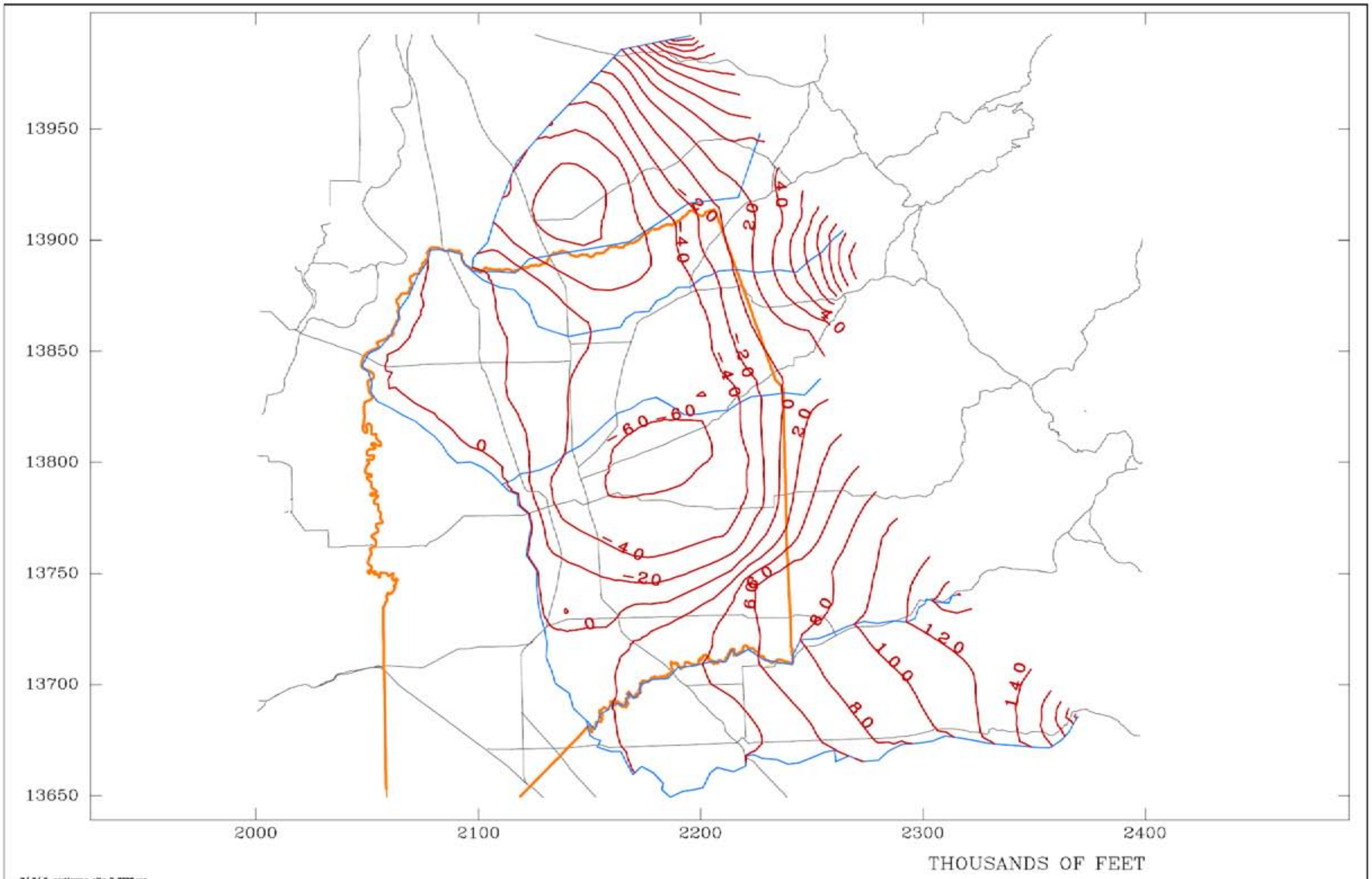
Simulated Water Table: Alternative B
20 ft Contour Interval
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6f



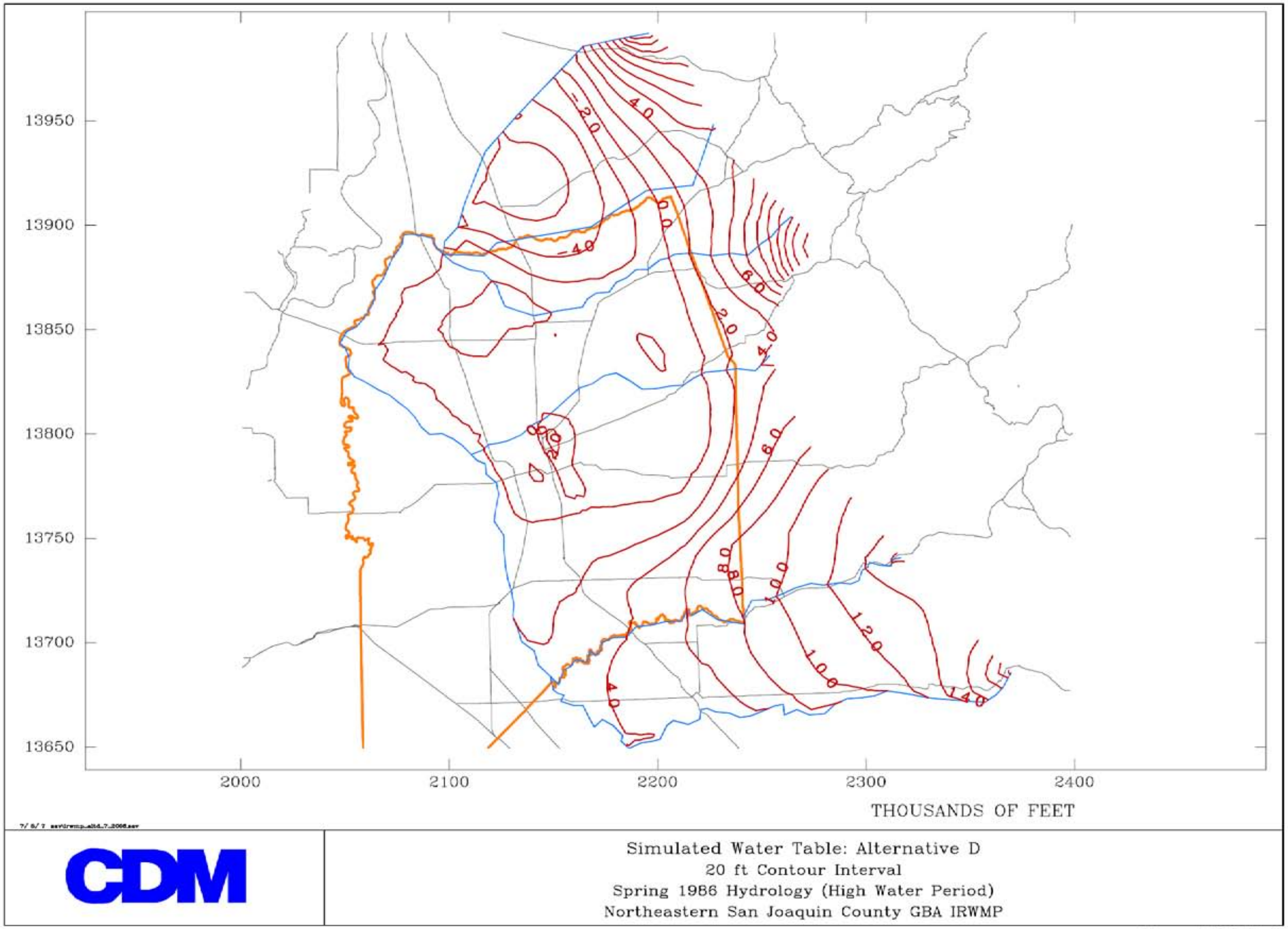
Simulated Water Table: Alternative C
20 ft Contour Interval
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6g



Simulated Water Table: Alternative C
20 ft Contour Interval
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6h



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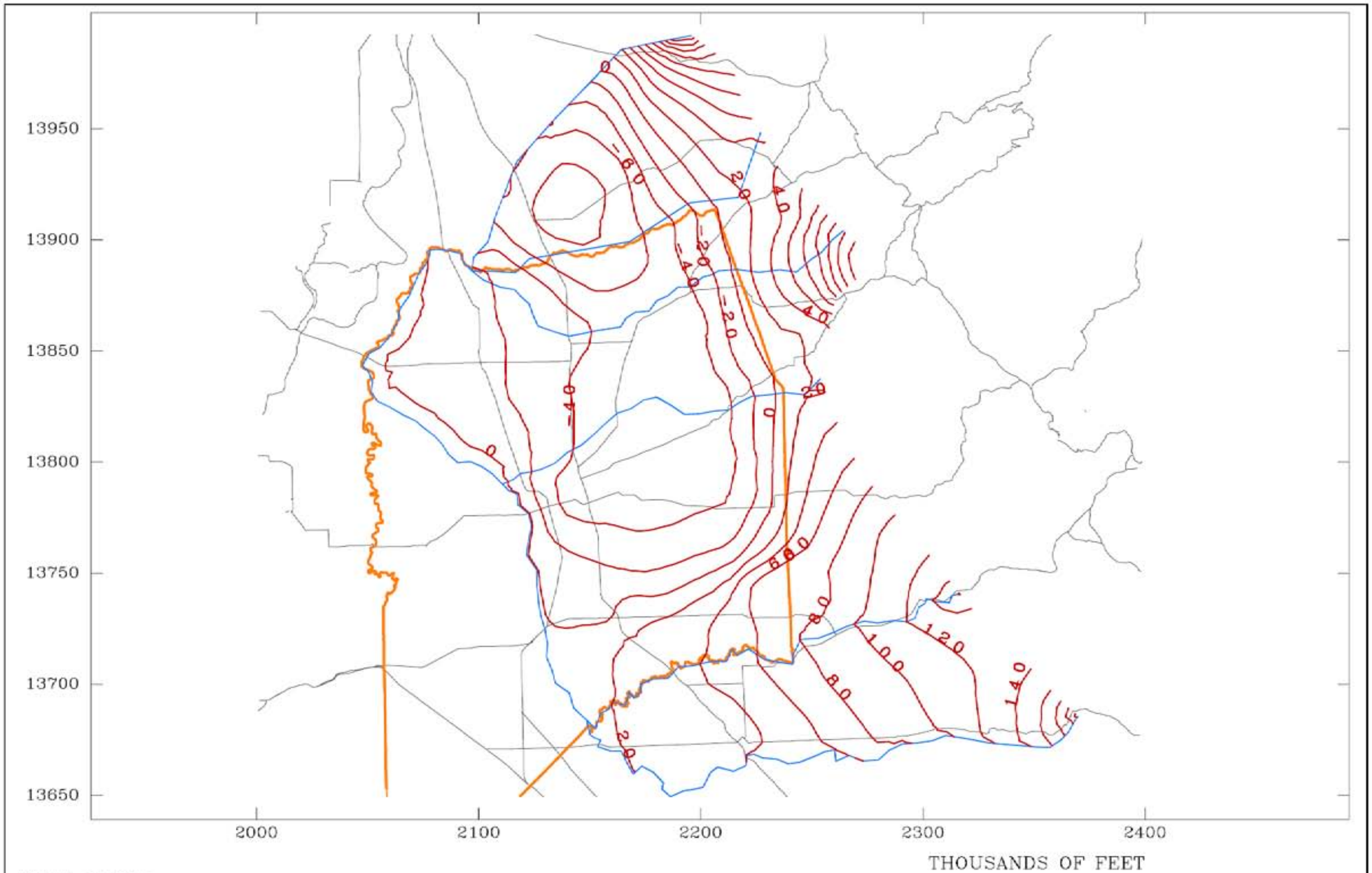
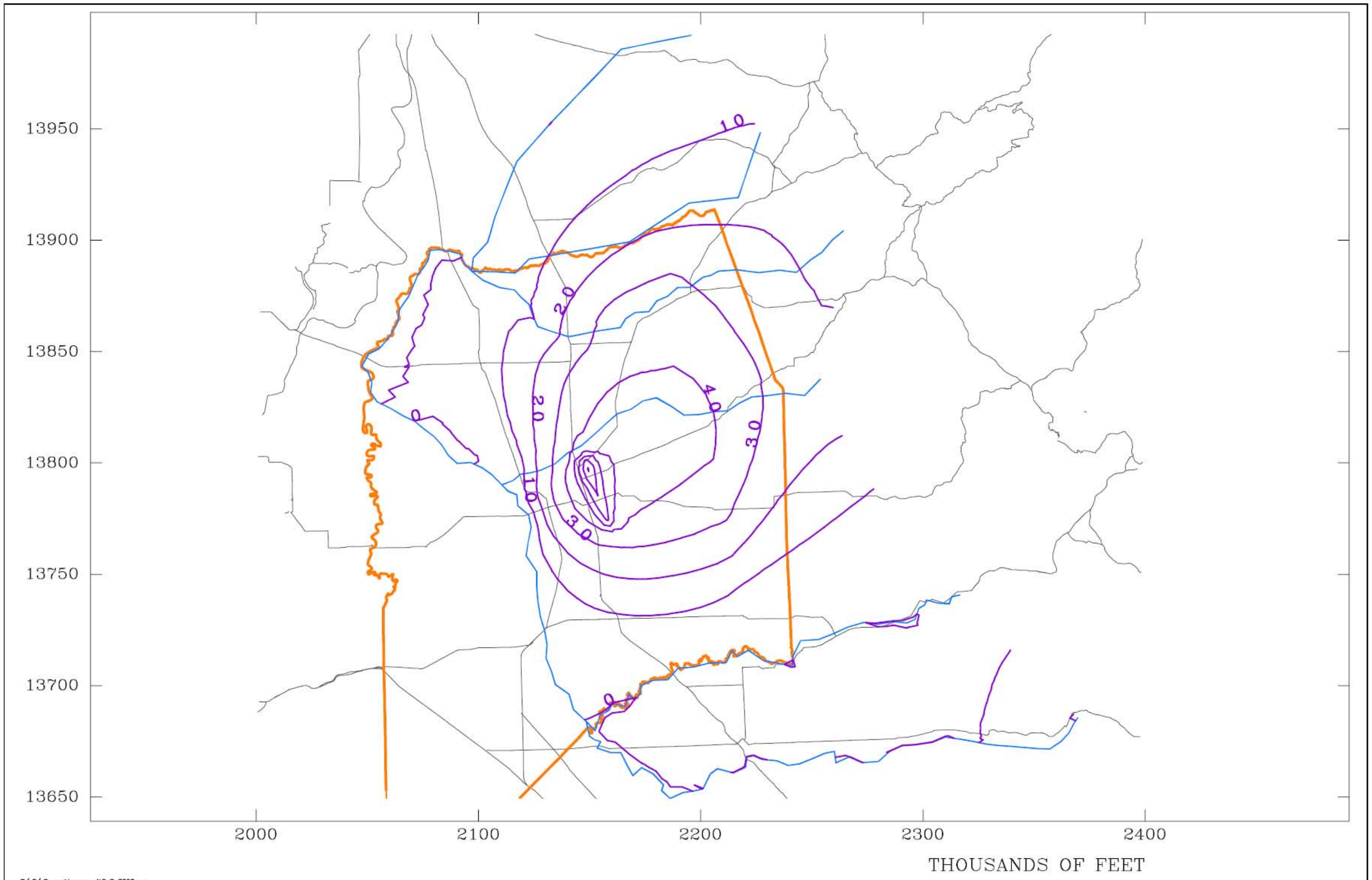


CDM

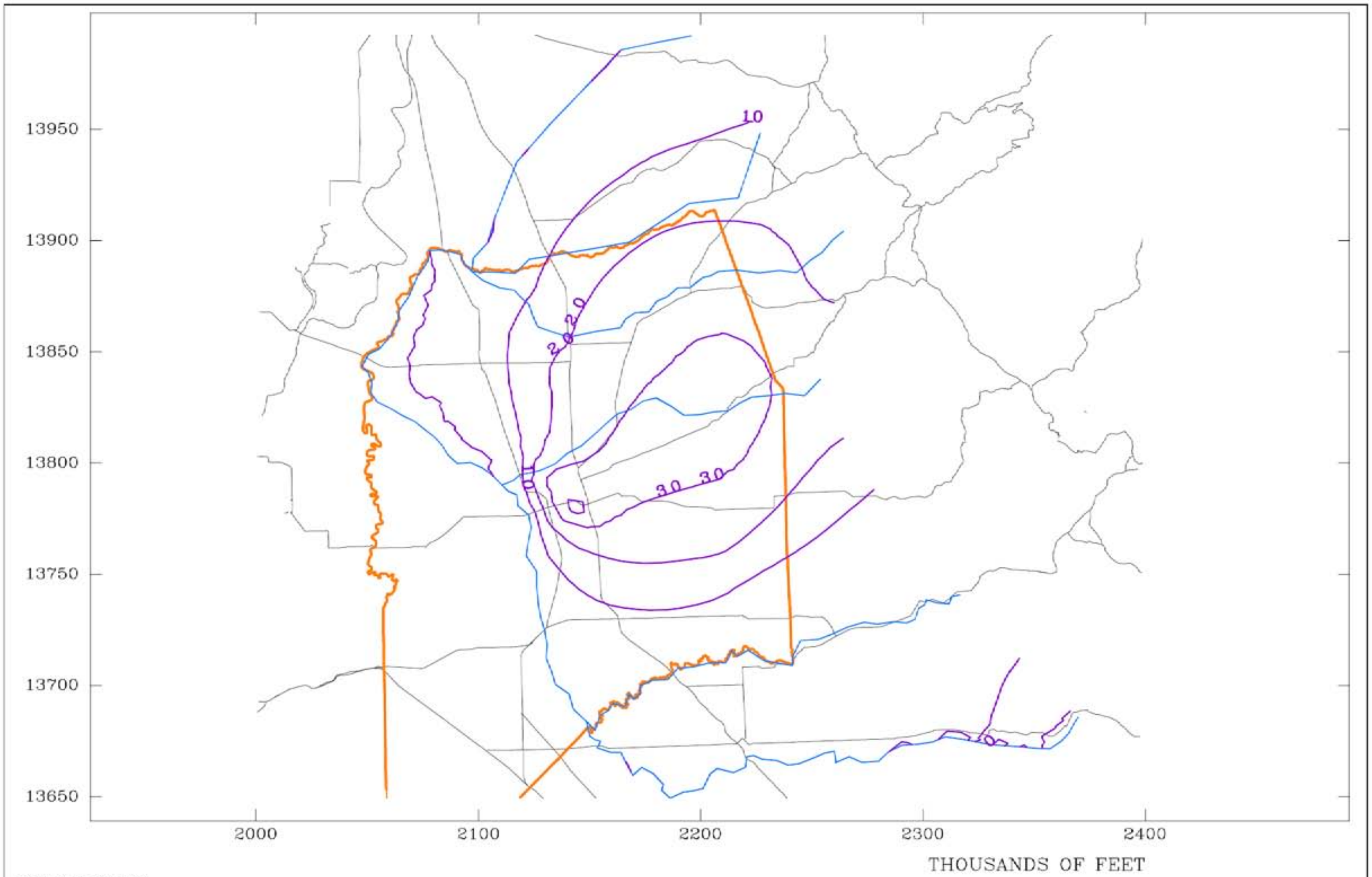
Simulated Water Table: Alternative D
20 ft Contour Interval
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-6j



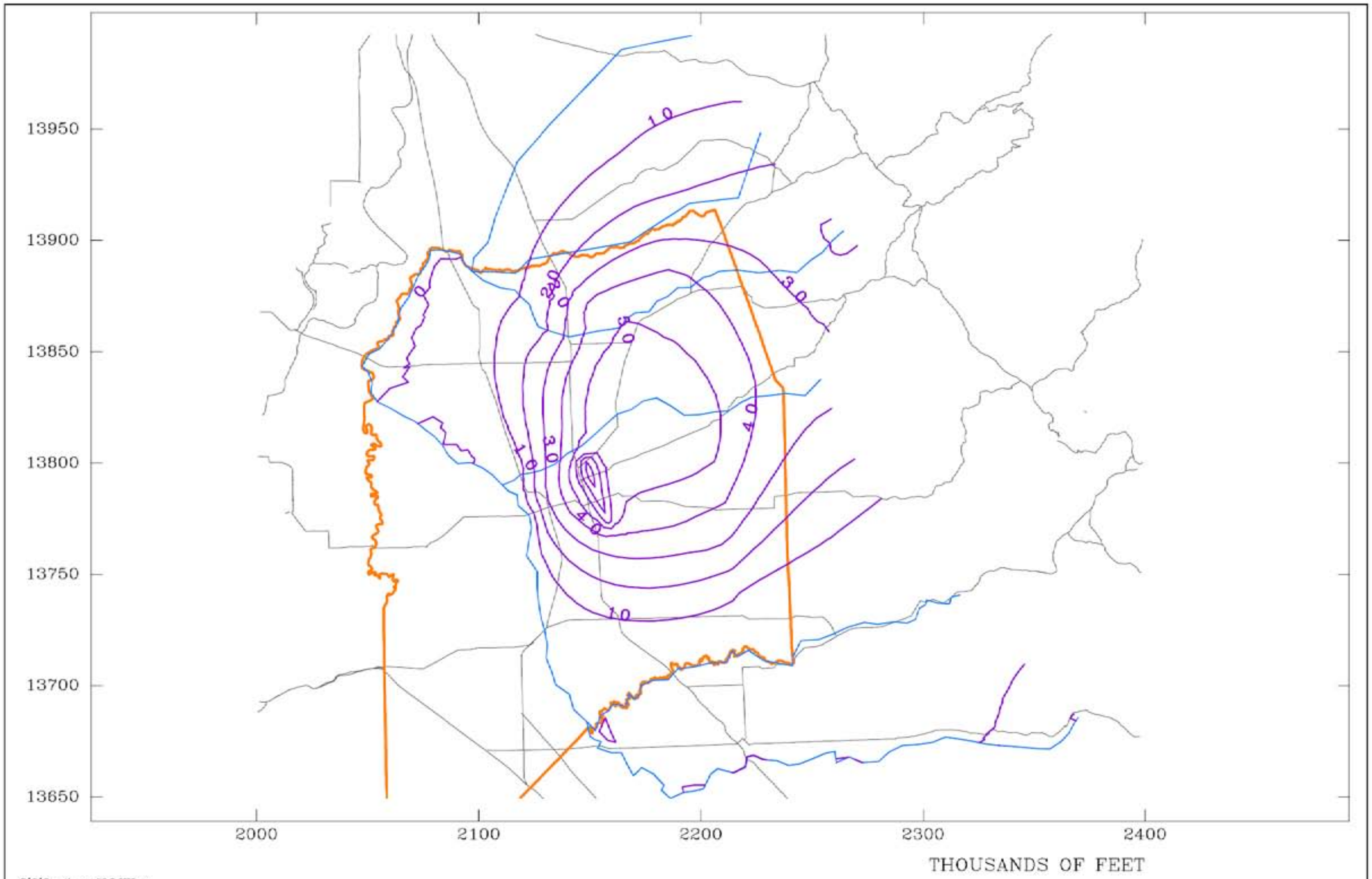
Simulated Increase in Water Table
Alternative A vs. Alternative 0 (10 ft Contour Interval)
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-7a



Simulated Increase in Water Table
Alternative A vs. Alternative 0 (10 ft Contour Interval)
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

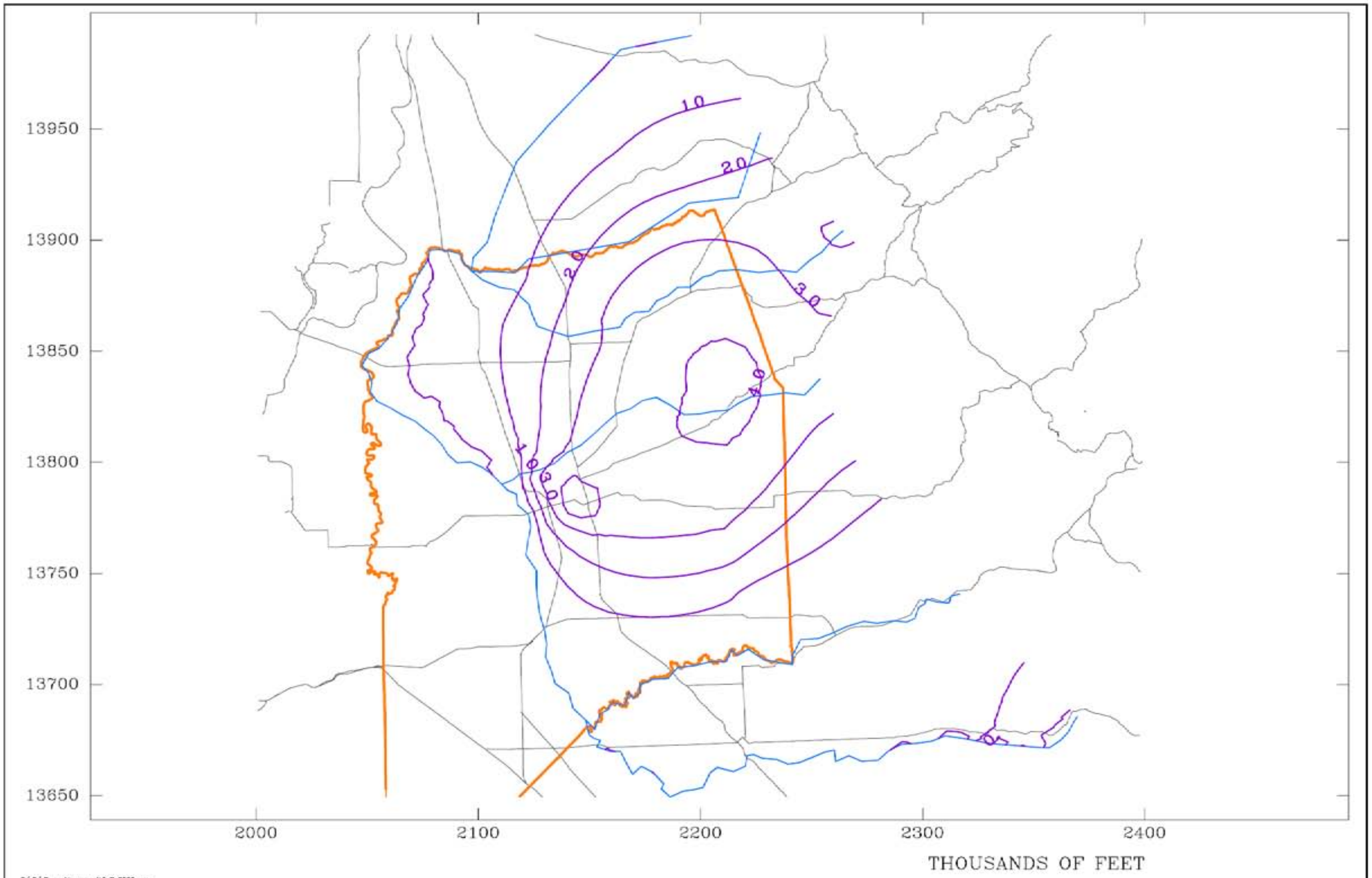
Figure MODEL-7b



CDM

Simulated Increase in Water Table
Alternative B vs. Alternative 0 (10 ft Contour Interval)
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

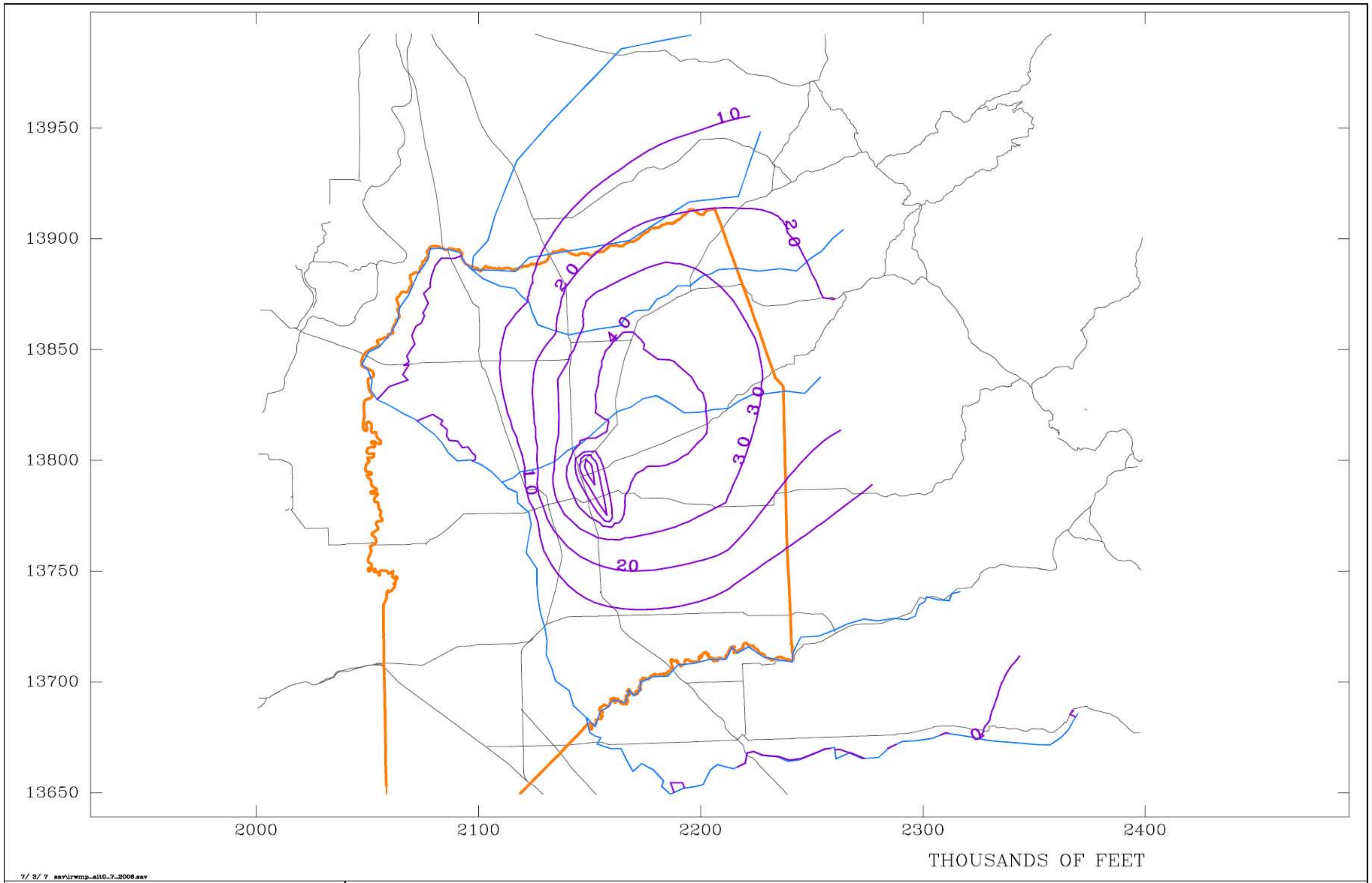
Figure MODEL-7c



CDM

Simulated Increase in Water Table
Alternative B vs. Alternative 0 (10 ft Contour Interval)
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

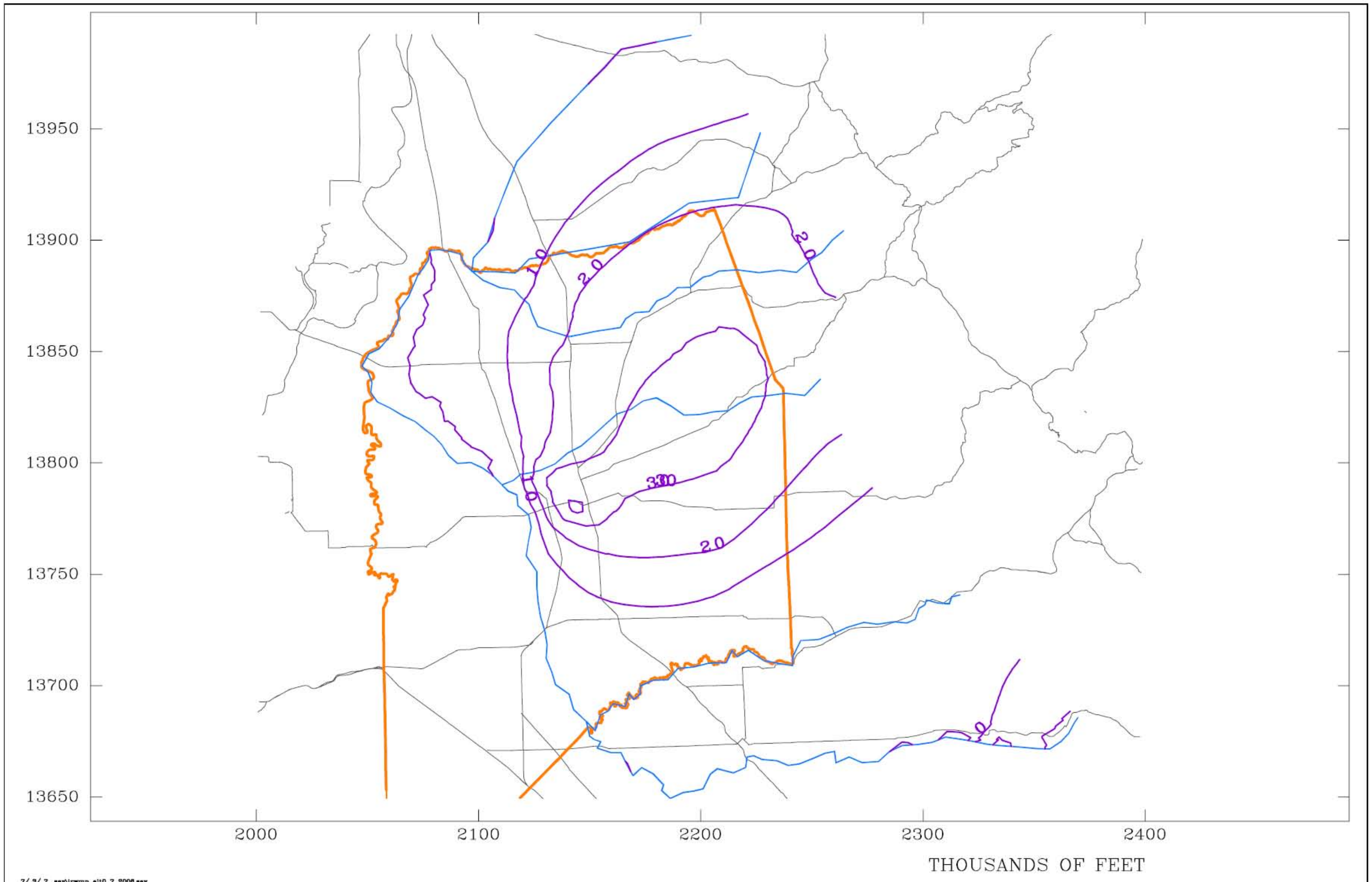
Figure MODEL-7d



CDM

Simulated Increase in Water Table
Alternative C vs. Alternative 0 (10 ft Contour Interval)
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

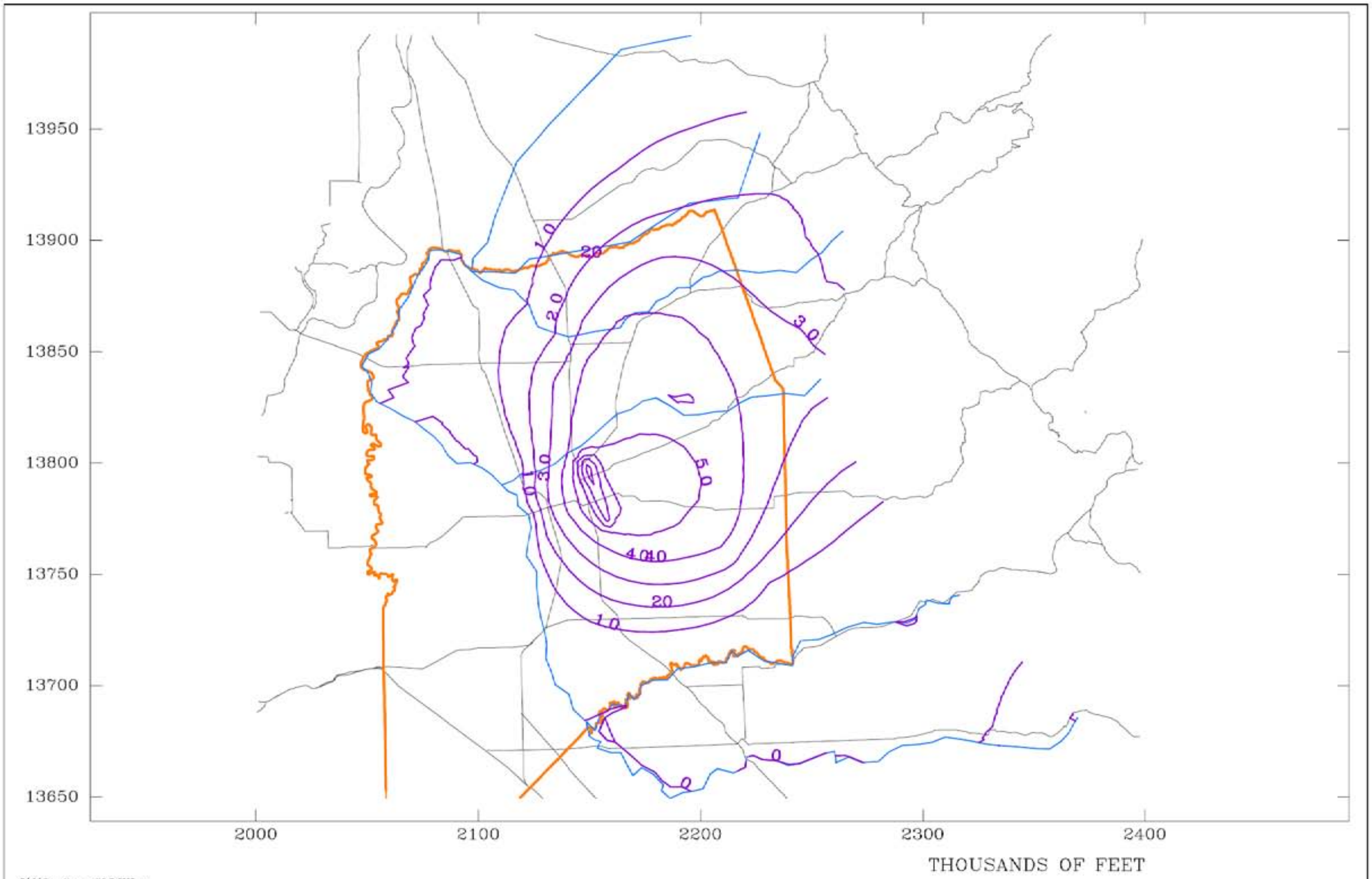
Figure MODEL-7e



CDM

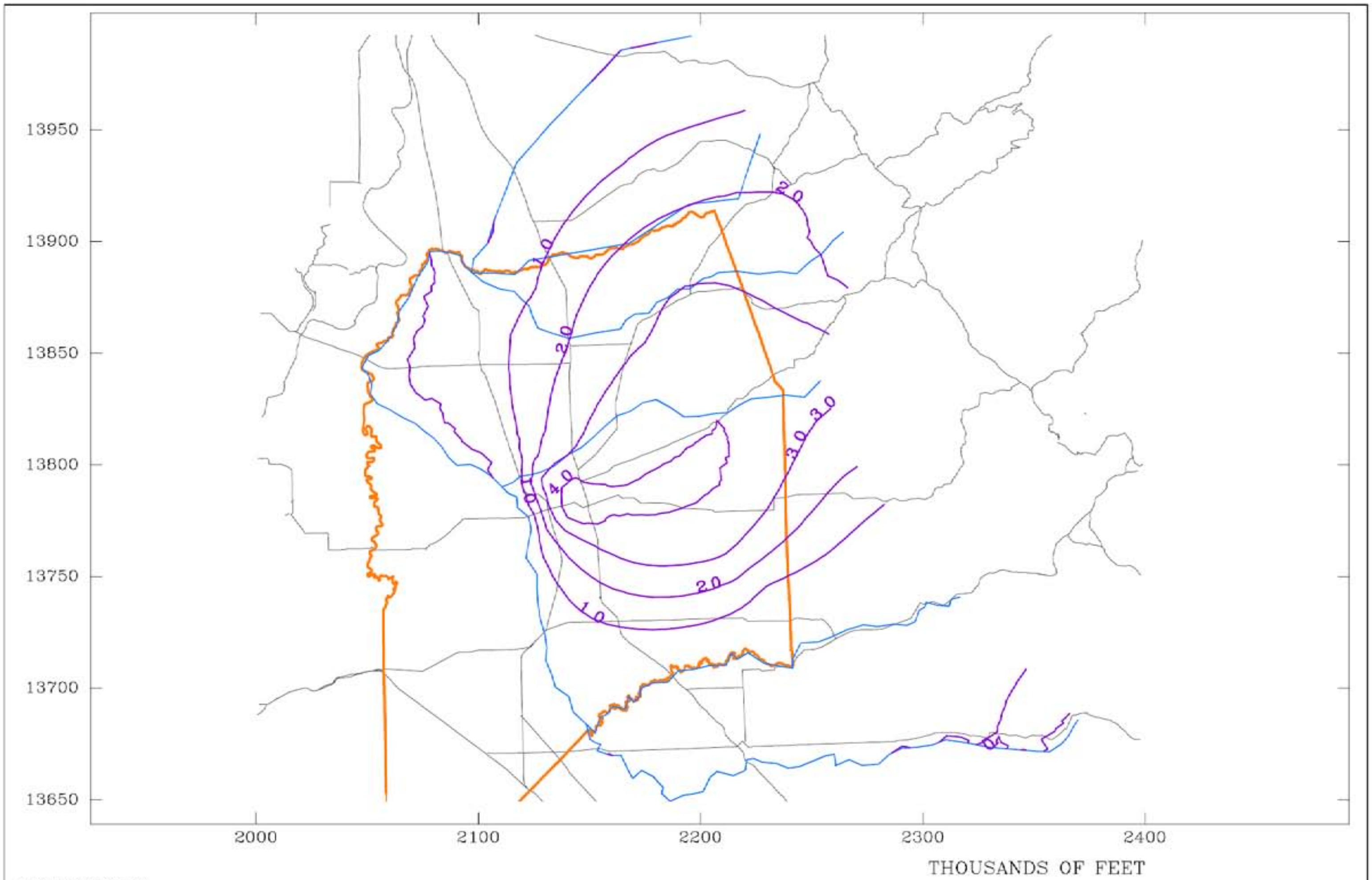
Simulated Increase in Water Table
Alternative C vs. Alternative 0 (10 ft Contour Interval)
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-7f



Simulated Increase in Water Table
Alternative D vs. Alternative 0 (10 ft Contour Interval)
Spring 1986 Hydrology (High Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-7g



Simulated Increase in Water Table
Alternative D vs. Alternative 0 (10 ft Contour Interval)
Fall 1992 Hydrology (Low Water Period)
Northeastern San Joaquin County GBA IRWMP

Figure MODEL-7h

3. Basis of Design Tables

Northeast San Joaquin County Groundwater Banking Authority
Integrated Regional Water Management Plan

Basis of Conceptual Design

Category	Criterion		Value
6	Wastewater Discharge and Recycling		
		Stockton	Note 6.1 provides estimates of discharge to the Delta. The equivalent of the full discharge will be re-diverted to the Stockton Delta Water Supply Project, effectively "recycling" 100% of the effluent for beneficial use in the City.
		Lodi	Note 6.2 provides estimates of discharge to the Delta.
		Unincorporated urban	Unincorporated "islands" in Stockton and Lodi are discussed for those Cities above. All of the other small systems in the study area percolate 100% of their treated effluent to the groundwater, thereby preserving the water in the regional water budget.
7	Flood Management & Storm Drainage		
	Urban storm drainage		
		Stockton	Nearly all of Stockton's storm drains discharge to streams which flow to the Delta. Very little detention or retention are provided at present. However, the draft Stormwater Master Plan for the new General Plan calls for all new growth areas to be served by detention facilities.
		Lodi	Lodi's General Plan covers 6,795 ac, of which 3,095 drains to the Mokelumne R., and 3,700 ac drains to the WID South Main Canal. Of the portion draining to the Mokelumne, 1,755 ac is served by detention basins which "peak shave" flows exceeding 2-year peak flows in the storm drain system. Lodi operates 2 existing detention basins, and is planning 2 more. Flows in the WID South Main Canal discharge to Pixley Slough in the non-irrigation season. Lodi has an agreement with WID that provides Lodi with irrigation water in the same quantity stormwater discharged to their system during the winter, provided canal capacity exists.
		Unincorporated urban	Unincorporated "islands" in Stockton and Lodi are discussed for those Cities above. All of the other small systems in the study area discharge all of their runoff to local streams, which flow to the Delta.
	Flood Management		
		Mokelumne R.	Levees through Lodi are not certified for 100-year protection, so a floodplain exists.
		Calaveras R.	Certified levees protect Stockton from the 100-yr flood, but not unincorporated areas upstream of Solari Ranch Road.
		Stanislaus R.	Upstream dams provide protection, however a floodplain exists within the bottomland along the Stanislaus River.
		Bear Creek System	Certified levees protect Stockton from the 100-yr flood, but not unincorporated areas upstream of Harney Ln.
		Duck Creek	Uncertified levees provide some protection, but 100-yr floodplain exists along the valley floor.
		Littlejohns Creek	Uncertified levees provide some protection, but 100-yr floodplain exists along the valley floor.
		Lone Tree Creek	Uncertified levees provide some protection, but 100-yr floodplain exists along the valley floor.
		San Joaquin R.	Certified levees protect Stockton from the 100-yr flood.
		Delta	As development pushes onto new Delta islands, developers are required to improve the levees and obtain FEMA certification prior to occupancy.
8	Conveyance		
	Capacities		
		WID South Main Canal	414 cfs
		NSJWCD	98 cfs
		EBMUD pipelines	500 cfs
		Freeport Regional Pipeline Project	155 cfs (limiting segment)
		Lower Farmington Canal	550 cfs
		SEWD Bellota Pipeline	73 cfs
		SEWD Peters Pipeline	93 cfs
	Losses		
		Pipelines	0%
		Canals	10%
		Mokelumne R.	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		Calaveras R.	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		Stanislaus R.	CALSIM II includes estimates
		Bear Creek System	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		Duck Creek	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		Littlejohns Creek	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		Lone Tree Creek	Varies based on water management practices and hydrology. Utilize CDM Integrated Groundwater/Surface Water Model (IGSM) for each alternative.
		San Joaquin R.	0%
		Delta	0%
	Sizing Criteria		
		Pipelines - force mains	Velocity: 2 fps minimum for sustained flow pipelines, 3.5 fps minimum to re-suspend solids in intermittent pipelines, 8 fps maximum, although a maximum headloss of 8 ft/1000 ft of pipe is a better criteria. Roughness: Hazen-Williams formula with CH = 80 for unlined concrete, 100 for unlined steel or ductile iron, 140 for PVC, 130 for cement morter lining.
		Pipelines - gravity	Velocity: 2 fps minimum for sustained flow pipelines, 3.5 fps minimum to re-suspend solids in intermittent pipelines, 10 fps maximum for gravity mains. Roughness: same as force mains, assuming full pipe flow.
		Tunnels	Size: Minimum 6 ft diameter for hand excavation and 8' for machine boring. Velocity: 2 fps minimum for sustained flow tunnels, 3.5 fps minimum to re-suspend solids in intermittent tunnels, 10 fps maximum. Roughness: Manning equation with n = 0.014 for concrete lining, 0.035 for unlined rock.

Basis of design table 1 9/27/2005

Northeast San Joaquin County Groundwater Banking Authority
Integrated Regional Water Management Plan

Basis of Conceptual Design

Category	Criterion	Value
	Canals	Velocity: 2 fps minimum for sustained flow canals, 3.5 fps minimum to re-suspend solids in intermittent lined canals, 3.5 fps maximum in earth canals, 7 fps in lined canals. Side slopes: 2.5H to 1V. Minimum b/h ratio: 2. Roughness: Manning equation with n = 0.015 for concrete lining, 0.020 for gunite lining, and 0.025 for unlined but maintained. Freeboard: 2' up to 100 cfs, 2.5' up to 200 cfs, 3' up to 500 cfs, 3.5' up to 1000 cfs.
	Dam freeboard	Case by case calculation of wind setup plus wave runup per State Division of Dam Safety requirements.
	Dam spillways	Chute spillway and/or flood storage to convey and/or store the probable maximum flood per State Division of Dam Safety requirements.
	Dam outlet works	Constructed per State Division of Dam Safety requirements for a capacity equal to the maximum required conservation release rate or evacuation, whichever is larger.
	Dam embankments	Case by case assumptions for topwidth, water-side slope, outboard slope, and foundation treatment will be made by a qualified geotechnical engineer, using State Division of Dam Safety requirements.
	Canal embankments	Topwidth = 12', water-side slope = 2.5H to 1V, outboard slope = 2H to 1V.
	Levee embankments	Topwidth = 12' for minor creeks, 16' for larger waterways, water-side slope = 3H to 1V, outboard slope = 2H to 1V, foundation treatment per State Reclamation Board Standards.
	Recharge and detention/retention basins	Side slope 5H to 1V, basin depth based on inlet pipe or depth to percolating soils, 20' wide gravel road surrounding basin with chainlink fence where near urban area, basin floor sloped 0.005 and/or stepped to facilitate staged drying.
	Fish screens	Assume Delta Smelt conditions as a worse case for sizing: maximum approach velocity of 0.2 fps, minimum sweeping velocity of 0.4 fps, screen openings of 1.75 mm, minimum open area of 27%.
	Pump stations	Redundancy: largest pump out of service. Backup power: none for non-potable service. Pump type: vertical turbine pumps in sump or cans for most applications.
	Ag wells	1,000 gpm/well
	Urban wells	2,500-3,500 gpm/well, 600' depth, and 60' static depth to groundwater for new wells.
	ASR wells	Discharge capacity same as for urban wells. Recharge capacity 2/3 of discharge capacity.
9	Aquatic Habitat	
	HCP needs for wetlands	As of 1996, there were 52,800 Ac of wetlands in the County. The County HCP projecting conversion of 5,500 Ac by 2051. County calls for 3:1 mitigation for future take due to development. Mitigation areas created by projects would have a $36,000/Ac benefit, based on HCP 2005 fee structure.
	HCP needs for riparian	As of 1996, there were 86,700 Ac of riparian lands in the County. The County HCP is projecting conversion of 7,100 Ac by 2051. County HCP calls for 3:1 mitigation for future take due to development. Mitigation areas created by projects would have a $36,000/Ac benefit for wetted ground, and $6,000/Ac for upland ground, based on HCP 2005 fee structure.
	Constraints on rivers	
	Mokelumne R.	Screening for salmon above WID dam, smelt below, habitat concerns along riparian corridor, temperature concerns.
	Calaveras R.	Screening for salmon above the Diverting Canal, smelt below, habitat concerns along riparian corridor, temperature concerns.
	Stanislaus R.	Screening for salmon, habitat concerns along riparian corridor, temperature concerns.
	Bear Creek System	Screening for salmon, habitat concerns along riparian corridor, temperature concerns.
	Duck Creek	Screening for salmon, habitat concerns along riparian corridor, temperature concerns.
	Littlejohns Creek	Screening for salmon, habitat concerns along riparian corridor, temperature concerns.
	Lone Tree Creek	Screening for salmon, habitat concerns along riparian corridor, temperature concerns.
	San Joaquin R.	Screening for smelt, habitat concerns along riparian corridor, temperature, water quality concerns.
	Delta	Screening for smelt, habitat concerns along riparian corridor, temperature, water quality concerns.
10	Capital Costs (6/05 dollars)	
	Pipelines	
	Force mains	$10-13/diameter inch/ft, plus $2/dia in/ft if pipe is in a street, plus $3/dia in/ft for rock excavation
	Gravity	$10-13/diameter inch/ft, plus $2/dia in/ft if pipe is in a street, plus $3/dia in/ft for rock excavation
	Dewatering add-on	$100,000/mile
	Waterway, highway, or RR crossing add-on	$25/dia in/ft add-on to pipe cost for length of bore
	Pump stations	
	Pump stations (sump-type)	Construction cost ($M) = 550,000 (capacity in mgd)^0.75
	Intakes	45% of pump station cost
	Fish screens	$2,000/cfs
	Electric transmission	$20,000-40,000/mi
	Storage tanks	$1/gal
	Canal turnouts	Assume $25,000 for a simple 18-24" gravity turnout.
	Wells	
	Ag	$60,000/well
	Urban	$1M/well, not including land. Wells are normally placed on City property or dedicated land.
	ASR	$1.2M/well, not including land. Wells are normally placed on City property or dedicated land.
	Excavation	
	Topsoil (scrapers, deposit at local stockpile)	$3/cy
	Unclassified (scrapers, deposit at local stockpile)	$2-3/cy
	Unclassified (excavator, deposit at local stockpile)	$6/cy
	Rock (ripping, scraper or loader, deposit at local stock	$60/cy
	Rock (blasting, loader, deposit at local stockpile)	$120/cy
	Hauling	$1.50/cy/mi
	Fill (pick up, place, compact)	
	Compacted Earth (haul from local stockpile)	$13/cy
	Aggregate base (imported)	$55/cy

Basis of design table 2 9/27/2005

Northeast San Joaquin County Groundwater Banking Authority
Integrated Regional Water Management Plan

Basis of Conceptual Design

Category	Criterion		Value
		Rock/riprap (imported)	$90/cy, or $130/cy grouted
		Topsoil (haul from local stockpile)	$6/cy (Minimal compaction)
	Other earthwork		
		Hydroseeding	$0.30/sy
		Clearing/grubbing	$500/ac
	Tunnels (rock)		$2,100/LF for 13' dia tunnel
	Concrete		
		Walls	$800/cy
		Slab	$600/cy
		Mass	$300/cy
		Canal lining	$1.50/sf
	Fencing (chainlink)		$18/LF
	Treatment plants		
		Surface water	Construction cost ($M) = 4.7842(capacity in mgd)^0.699
		Groundwater	$3.0M/1,500 gpm well or $5.4M/3,000gpm well for arsenic removal; $1.8M/1,500 gpm well or $3.2M/3,000gpm well for nitrate removal;$1.4M/1,500 gpm well or $2.4M/3,000gpm well for TCE removal
		Wastewater	Secondary treatment = $6.8/gal; tertiary add-on = $1.8/gal
	On-farm irrigation systems		
		Furrow	$100/ac/yr (annualized capital cost)
		Drip	$200/ac/yr (annualized capital cost)
	Water conservation programs (includes O&M)		
		Urban-moderate	Varies widely. Stockton currently complies with the 14 BMPs (including metering), so further conservation potential is very limited. Lodi complies with many of the BMPs, and therefore has what is considered a moderate program. However, Lodi is currently unmetered.
		Urban-aggressive	Metering Lodi would cost $800/meter, which equates to about $500/acre foot saved.
		Agriculture-moderate	$50-100/AF saved
		Agriculture-aggressive	$200-300/AF saved for the margin between moderate and aggressive
	Land (fee title)		
		Pasture	$5,000/Ac
		Field and row crops	$12,000/Ac
		Trees	$25,000/Ac
		Vines	$40,000/Ac
		Urban fringe	$400,000/Ac
		Urban	$500,000/Ac
		Easement/fee ratio	100%; Land use would be restricted, so easements and land purchases cost the same.
	Restoration		
		River/Creek	Major river restoration $3 - 4M/mile. Creek restoration $100-500k/mile.
		Wetland	Wetland mitigation through the San Joaquin County Habitat Conservation Program is $36,000/ac.
	Engineering		10% of construction cost
	Special Engineering Investigations		Construction cost multipliers: surveying 2%, geotechnical 2%, corrosion 1%
	Construction Management		10% of construction cost
	Environmental Document		$100k small projects (up to $5M construction), $500k medium projects ($5-25M), $2M major projects ($25+M)
	Special Environmental Investigations		Costs for species surveys, biological assessments/relocations, cultural resource assessments/relocations are project-specific.
	Permitting		$50k small projects, $150k medium projects, $500k major projects
	Administration & Legal		5% of construction cost
	Financing front-end costs		3% of construction cost
	Construction Contingency		25% of construction cost
	Factor for Items Not Included		20% of construction cost
11	Operation & Maintenance Costs (6/05 dollars; does not include replacements)		
	Electricity		
		Capacity charge	$23.50/kw/mo
		User fee (rate)	$0.13/kwhr
	HCP - aquatic habitat		First 2 yr covered in construction cost, then zero cost thereafter.
	Pipelines (maintenance only)		
		Force mains	$2,100/mi/yr to exercise blowoffs and valves, plus $1,000/mi every 10 yr for corrosion testing
		Gravity	$4,000/mi/yr to remove sediments
	Pump stations		
		Pump stations (maintenance only)	5% of construction/yr
		Intakes	5% of construction/yr
		Fish screens	5% of construction/yr
	Wells		
		Ag	$40/AF
		Urban	$50/AF
		ASR	$20/AF
	Canals		
		Unlined	$10,000/mi/yr
		Lined	$10,000/mi/yr
	Levees		$10,000/mi/yr
	Recharge/drainage basins		$600/ac/yr
	Tunnels		1.5% of construction/yr
	Dams		1.5% of construction/yr
	Treatment plants		
		Surface water	$1.2M/yr for 5mgd, $2.0M/yr for 10mgd, $4.1M/yr for 25mgd, $7.5M/yr for 50mgd
		Groundwater	$0.32M/yr for 1500gpm or $0.56M/yr for 3000gpm arsenic or nitrate removal; $0.22M/yr for 1500gpm or $0.39M/yr for 3000gpm TCE removal

Basis of design table 3 9/27/2005

Northeast San Joaquin County Groundwater Banking Authority			
Integrated Regional Water Management Plan			
Basis of Conceptual Design			
Category	**Criterion**		**Value**
		Wastewater	$600k/yr per mgd for 2mgd, $250k/yr per mgd for above 10 mgd
	On-farm irrigation systems		
		Furrow	$75/ac/yr (annualized capital cost)
		Drip	$100/ac/yr
12	Economic Analysis		
	Basis of Comparison		Annualized cost
	Interest		5%
	Construction cost escalation		10%/yr through 2012, 8% through 2020, 3%/yr thereafter
	O&M cost escalation		
		Labor dominated features	5%
		Materials dominated features	10%
		Energy dominated features	5%
	Useful life		
		Pipelines	100 years
		Wells (not including mechanical/electrical)	40 years
		Earthwork	100 years
		Concrete	80 years
		Mechanical/electrical	20 years
	Salvage value		0%

Notes

6.1 Stockton treated wastewater discharge to the Delta:

Month	Stockton WWTP Effluent, acre feet per month					
	2002	2003	2004	2002-2004 Avg.	Projected 2025	Projected 2050
January	3,365	3,214	2,921	3,167	5,383	7,600
February	2,089	2,416	2,482	2,329	3,960	5,590
March	2,499	2,405	2,986	2,630	4,470	6,311
April	1,967	2,217	2,348	2,177	3,701	5,225
May	2,522	2,251	2,537	2,437	4,142	5,848
June	2,027	2,072	2,359	2,152	3,659	5,166
July	2,482	2,308	2,430	2,407	4,091	5,776
August	2,541	2,266	2,373	2,393	4,069	5,744
September	2,450	2,705	2,911	2,689	4,571	6,453
October	2,897	2,466	2,540	2,634	4,478	6,322
November	2,455	1,848	2,411	2,238	3,805	5,371
December	2,612	2,880	1,889(c)	2,460	4,182	5,904
Annual Total	29,905	29,047	30,187(c)	29,713	50,512	71,311

(a) Partail data available, through December 21, 2004.
(b) Source: West Yost & Assoc., draft Wastewater Master Plan, 12/04

6.2 Lodi treated wastewater discharge to Delta:

Year	Discharge to Delta		Notes
	(mgd)	(AF/yr)	
1990	6.23	7,000	
1995	6.00	6,700	
2000	6.64	7,400	
2005	7.23	8,100	
2010	7.87	8,800	
2015	8.59	9,600	
2020	9.27	10,400	
2032	11.60	13,000	Approx. General Plan buildout

(a) All water is treated to tertiary standards, and is available for reuse.
(b) Source: West Yost & Assoc., draft Wastewater Master Plan, 1/01

Northeast San Joaquin County Groundwater Banking Authority
Integrated Regional Water Management Plan

Basis of Conceptual Design

Category	Criterion		Value
1	Water Demand (Applied Water)		
	Urban		
		Stockton	
		Lodi	
		Unincorporated urban	
	Agriculture		[include monthly demand pattern]
		Pasture	
		Field and row crops	
		Trees	
		Vines	
2	Fate of Applied Water		
	Urban		[Baseline, moderate conservation, and aggressive conservation]
		Consumptive use	
		Evaporation	
		Wastewater	
		Runoff	
		Deep percolation	
	Agriculture		[Baseline, moderate conservation, and aggressive conservation]
		Consumptive use	
		Evaporation	
		Runoff	
		Deep percolation	
3	Water Availability		
	Hydrologic analysis tools, analysis period		
		American R. (via Sacramento R.)	
		Mokelumne R.	
		Calaveras R.	
		Stanislaus R.	
		Bear Creek System	
		Duck Creek	
		Littlejohns Creek	
		Lone Tree Creek	
		San Joaquin R.	
		Delta	
	Existing study area supplies (water rights and contracts)		
		American R. (via Sacramento R.)	
		Mokelumne R.	
		Calaveras R.	
		Stanislaus R.	
		Bear Creek System	
		Duck Creek	
		Littlejohns Creek	
		Lone Tree Creek	
		San Joaquin R.	
		Delta	
4	Aquifer Operations		
	Hydrologic analysis tools, analysis period		
	Boundary conditions		
		North	
		West	
		South	
		East	
	Operating levels		
		Upper target level	1986 water table
		Lower target level	1992 water table
		Blue zone	Above upper target level
		Green zone	Above upper target level
		Yellow zone	Between upper and lower targets
		Orange zone	Between upper and lower targets
		Red zone	Below lower target. Conservation strengthened, export extractions curtailed
	Extraction parameters		[Annual total and peak capacity]
		Well production	
		Screened depth	
		Maximum point drawdown	
	Recharge parameters		[Annual total and peak capacity]
		Percolation rates	See map
		Evaporation	
5	Water Quality		
	Runoff		
		Urban	
		Ag	
	Streams		
		Mokelumne R.	
		Calaveras R.	
		Stanislaus R.	
		Bear Creek System	

Basis of design table 1 9/27/2005

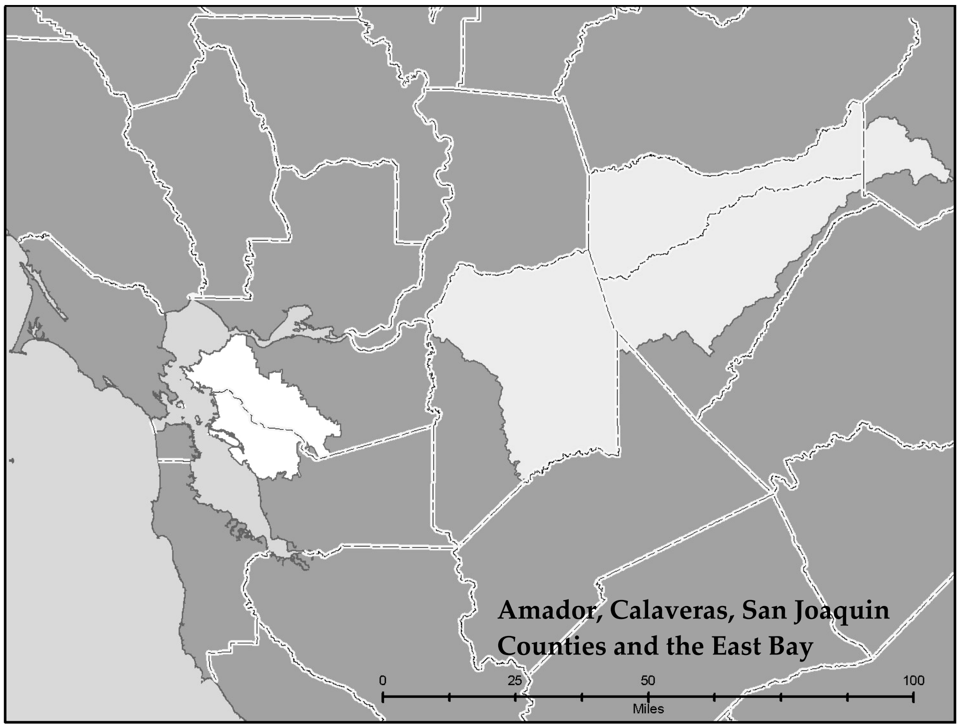
Northeast San Joaquin County Groundwater Banking Authority
Integrated Regional Water Management Plan

Basis of Conceptual Design

Category	Criterion		Value
		Duck Creek	
		Littlejohns Creek	
		Lone Tree Creek	
		San Joaquin R.	
		Delta	
	Groundwater		

Chapter 8 - Inter-Regional Integration

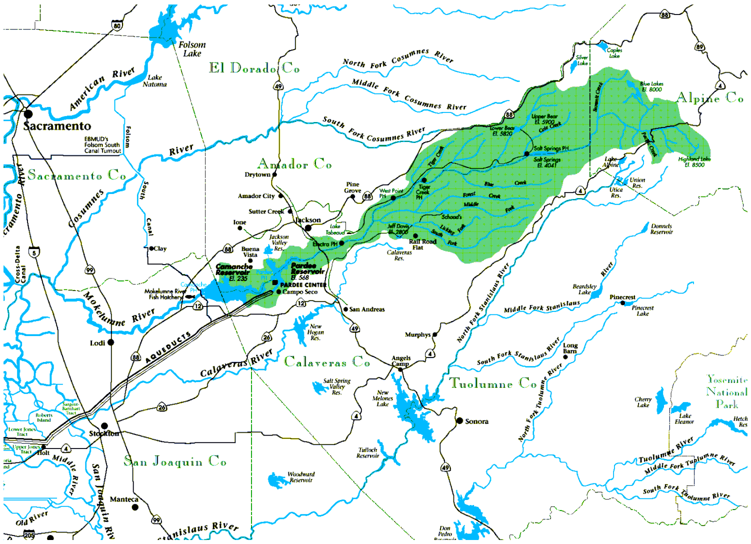
Proposition 50 Chapter 8 has asked governmental and non-governmental entities to define planning regions based on any number of criteria ranging from physical to political. Authors of the *Guidelines* acknowledged that "individual agencies or organizations may participate in different regional efforts depending on geography, Plan objectives, or other relevant factors."



Intra-regional projects will have all of their facilities within a single region. Their impacts will be generally limited to within a single IRWMP region. Inter-regional projects are those that involve facilities or implementation steps in one or more IRWMP regions and/or have clear and direct impacts and benefits in more than one region. They require coordination with entities in other regions that could be impacted to maximize project and regional benefits. Due to the benefits provided by an inter-regional project, either of the two interested regions could initiate the project process by suggesting it to the other involved regions.

With proper planning and coordination, it is the mutual intention that this overlap of projects with components that cross regional boundaries will not be contentious. Instead, it will provide valuable IRWMP linkages and synergistic effects and provides an example of possible inter-regional projects developed under the IRWMP effort designed to provide ***exo-regional*** benefit.

8.1 Mokelumne River Basin



Water is vital to survival and is a key resource for natural systems. A source of water, such as a river or stream, is foundational for the development of communities, industries and agriculture. River flow, however, is finite and its availability for beneficial use often creates tension among competing interests, especially in dry years. Stakeholders along the Mokelumne River have faced these conflicting water resource pressures for decades.

In order to help resolve these historic conflicts, water-related entities that rely on the Mokelumne River for water supply and who were interested in working together to identify new water supply alternatives met in 2004 to explore whether there was a commonality of interest to form a stakeholder-supported collaborative process. The entities agreed that significant commonality of interest and political will existed to overcome institutional barriers and resolve conflicts to improve water supply availability and reliability from the Mokelumne River.

Participants in the Mokelumne/Amador/Calaveras (M/A/C) and GBA IRWMP efforts view that there is a logical separation in place between their regions. However, they also recognize that they share a common boundary, and in particular a hydrologic and hydrogeologic connection along that boundary. Hence there are certain lands and projects that by definition should be included in a joint context in their IRWMPs. This created a need for further project definition, specifically that there are intra-regional projects and inter-regional projects.

8.1.1 Separate But Connected Regions

The shared boundary overlap between the M/A/C IRWMP and the GBA IRWMP inherently encouraged the current coordination efforts which have lead participants to voice their commitment to allow for future coordinated projects. Figure 8-1 shows the regional boundaries and what may be considered an overlapping area.

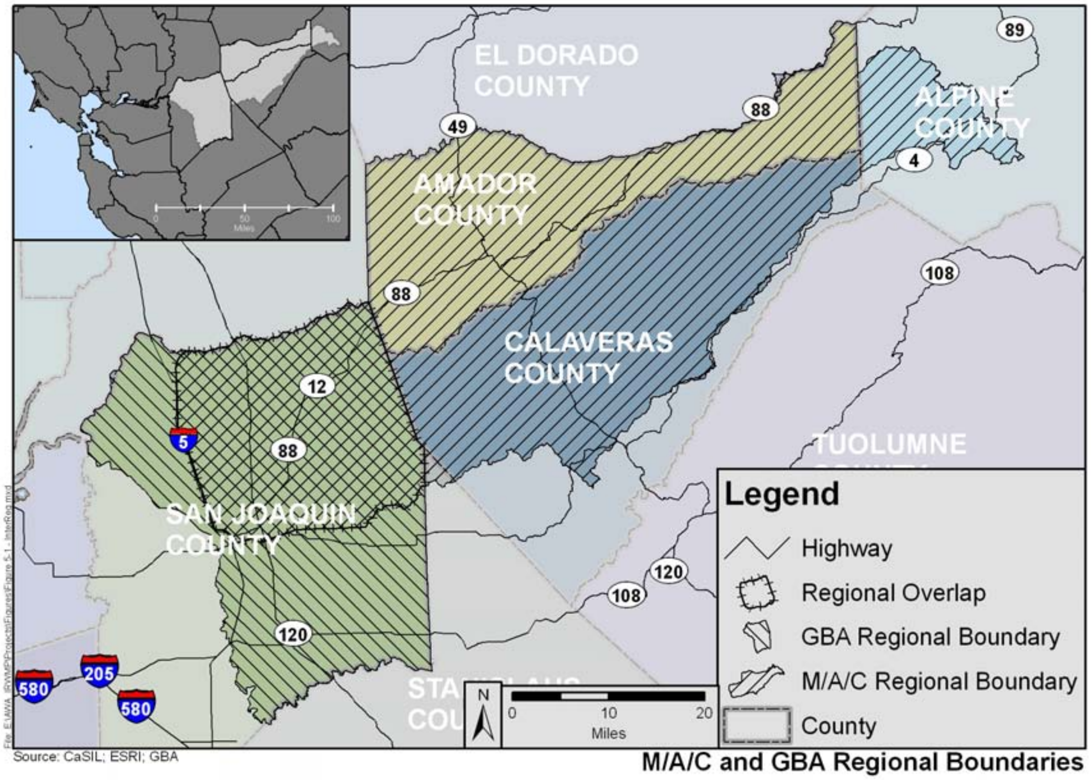


Figure 8-1 M/A/C and GBA Regional Boundaries

An IRWM regional boundary is not defined solely by the fact that it abuts that of another region. Maintaining separate GBA and M/A/C regions has been done for a number of reasons, some of which are listed below.

Water Supply – The two regions utilize different water supplies. The M/A/C region currently relies on surface water for approximately 98% of its supply. The GBA region also uses surface water but relies heavily on the groundwater supplies and storage. Hence resource managers within the respective regions use different techniques and infrastructure to meet their current customer needs. Further, their planning exercises, such as the identification of measures to maximize efficiency and use of existing supplies, as well as their development of new and/or expanded sources of water supplies are often particularly tied to whether they rely primarily on a surface water source, as per most M/A/C agencies and stakeholders, or a groundwater source, as per most GBA agencies and stakeholders.

Established Organizations & History – The two regions can be generally described by their geographic/ topographic location. The GBA region is characterized as Central Valley, while the M/A/C region is a Foothill/Sierra region. Each region has already established working groups and committees and understand the needs of the other agencies within its region and the issues that each face. In most part the needs are defined by the activities that can be performed within the respective topographic setting (e.g., farming in the Central Valley). The individual regions are familiar with their constituents and interest groups, and can therefore, be more responsive to their interests and needs. Often, interests and needs share a commonality, such as the concern regarding saline intrusion into the groundwater supply.

The Mokelumne River Forum (MRF) is a collaborative process that has formed with the goal of operating across regional boundaries to address the differing and common interests within the Mokelumne River basin and provide opportunities for inter-regional cooperation. Although the MRF is operating across boundaries most projects are planned and completed through intra-regional avenues.

Socioeconomic Differences – The GBA region has a much higher population density (San Joaquin County has a population density of about 403 people/sq. mile) and the existence of major urban centers such as the Cities of Lodi and Stockton. Outside of those urban centers, the region is primarily agricultural. The M/A/C region does not have urban centers but instead has a number of smaller towns with a much lower population density than is present within the GBA region (the counties of Amador and Calaveras have population densities of about 59 and 40 people/sq. mile, respectively). The M/A/C region is primarily open space and forest. These differences in population density and industry impact the manner in which various agencies approach the planning, implementation, and financing of individual projects.

Although the justification for separate regions is undeniable, there is also an undeniable opportunity to take advantage of instances where resources from the respective regions can combine to meet a broader range of needs and provide greater *exo-regional* benefits. Examples of this include the potential to develop a conjunctive use project that would serve both GBA and M/A/C participants as well as the potential for the expanding existing reservoirs such that the added supply could serve both regions. Both of those examples are described in the section that follows. It should be noted that the project example at best could be considered in a preliminary stage, as a host of planning activities would need to be performed to move them past a conceptual level.

Showing a connection between the two regions is recognition of the importance of inter-regional projects. However, participants in both the GBA and the M/A/C IRWMP regions realize that these inter-regional projects are long-term efforts that must be carefully planned and require a more complex if not exhaustive outreach, evaluation and development process. Connecting, but not combining the two regions allows the participants in each region to independently pursue projects that benefit their own region, but also to coordinate with their neighbor when feasible.

8.1.2 Mokelumne River Forum

The Mokelumne River Forum (Forum) was established in 2005 through a Memorandum of Understanding (MOU). The MOU commits participants to seek mutually beneficial and regionally focused solutions that resolve conflicts. These solutions are explicitly intended to meet diverse needs that include: up-country consumptive water and infrastructure (Amador, Calaveras, and Alpine Counties); San Joaquin County water supply (basin overdraft & saline intrusion); dry-year drinking water supply (EBMUD); and agriculture, environment, and recreation. The MOU signatories are identified in the box to the right. The Forum is comprised of the signatories "and other organizations and interest groups . . . that elect to participate in the collaborative process." The San Joaquin Farm Bureau Federation is an example of such an organization; another example is the Upper Mokelumne River Watershed Council. Consistent with the Forum's "open door" policy, there is an active commitment to increase participation by environmental and conservation groups able to represent perspectives from the entire length of the Mokelumne River Basin, and to add participation by organizations such as the Delta Water agencies.

Forum MOU Signatory Agencies
Alpine County
Amador County
Amador Water Agency
Calaveras County Water District
Calaveras Public Utility District
Central San Joaquin WCD
City of Lodi
City of Stockton
Department of Water Resources
East Bay Municipal Utility District
Jackson Valley Irrigation District
Mokelumne River W&PA
North San Joaquin WCD
San Joaquin County
Stockton East Water District
Woodbridge Irrigation District

The Forum has met regularly since its creation to collaboratively pursue its objectives. Late in 2006 Forum activities and discussions focused increasingly on ways to coordinate water resource planning efforts across regional boundaries with respect to a variety of topics such as river hydrology, facilities, infrastructure and institutional arrangements required to develop inter-regional projects. One example of such coordination across regional boundaries can be found in a review of the work products recently generated as part of the GBA's IRWMP efforts in San Joaquin County and the M/A/C IRWMP efforts of the Foothill/Sierra Region. While each of the respective IRWMP efforts focuses on meeting the needs of their specific geographic regions, a unique opportunity exists to meet a broader range of needs and provide greater exo-regional benefit.

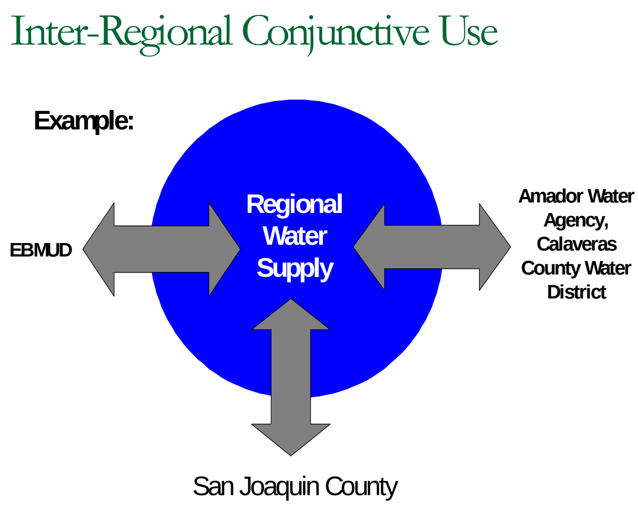
Participants in these separate efforts recognized that they share a common boundary, and in particular a hydrologic and hydro-geologic connection along that boundary.

This connection has encouraged the current coordination of IRWMP efforts and commitment to explore inter-regional projects. Inter-regional projects involve facilities or implementation steps in one or more IRWMP regions and/or have clear and direct impacts and benefits in more than one region. Therefore, they require coordination with entities in other regions that could be impacted to maximize project and regional benefits. The figure below shows the regional boundaries with overlapping area.

During the later part of 2006, the Forum decided to investigate the inter-regional project concepts identified in both the M/A/C and GBA IRWMP to determine feasibility based on size, benefits/costs, institutional impediments, and water rights.

8.1.3 Inter-Regional Project Overview

An adequate and reliable water supply is a fundamental requirement for a sustainable California and in particular for the health and well being of stakeholders along the Mokelumne River. In wet years, California's water needs can be met entirely. This, however, is not necessarily true for all water agencies that rely on the Mokelumne River. In dry years, droughts initiate not only local and regional but statewide emergencies. Droughts threaten lives and livelihoods, can uproot families, disrupt industry and have a devastating impact on farming industries. The fallout of a massive multi-year drought stresses communities and is extremely costly.



The Forum is exploring a partnership to address these challenges. In concept, water recharged and stored underground in wet years would provide a margin of safety to certain communities in times of drought. Excess storage and conveyance capacity likewise would benefit other communities that are looking for long-term dry year supplies. There are several examples statewide where competing groups have worked cooperatively to operate shared water systems, such as cooperative groundwater banks that provide a margin of safety to partners in times of drought.

The **Mokelumne Inter-Regional Conjunctive Use Project** (IRCUP) is a concept proposal to conjunctively manage a portion of the Mokelumne River water supplies to be stored in the Eastern San Joaquin Groundwater Basin for subsequent regional use to meet diverse needs of project partners. The initial project concept is based on the premise of a three-way groundwater banking, exchange and transfer agreement where the IRCUP would provide greater water supply sustainability and reliability benefits in Amador, Calaveras, and San Joaquin Counties and in the East Bay Municipal Utility District (EBMUD) service area. The project would also demonstrate the benefits of improved conjunctive management as part of the GBA's overall Integrated Conjunctive Use Program for the Eastern San Joaquin Basin.

8.1.4 Interests, Benefits, and Roles

Integrated regional water management has the potential to satisfy diverse interests and provide a range of benefits as contemplated in the Forum MOU. This approach also could provide a foundation for larger cooperative efforts and improve prospects for possible State grant funding. IRCUP offers potential benefits for MOU signatories as well as other organizations and interest groups. Integrated regional water management also requires expertise and resources to fill different roles. The precise mix of roles, commitments, interests, and benefits will require extensive negotiations in the future. The following is an example of what that mix may include for some Forum members.

Amador Water Agency (AWA) & Participating Water Interests - AWA faces increasing water demands as development pressures stress their existing supplies and service infrastructure. AWA would benefit through additional reliable year-round supplies. Their level of benefit from an IRCUP would be based on how the project is configured. Benefits could include an additional consumptive water supply in the range of 10,000 acre-feet per year (of safe yield). That yield would be realized/ conveyed through the use of existing facilities or the use of newly constructed facilities. Other benefits could be derived through the development of storage and transmission agreements with partner agencies. In addition, AWA seeks to have their existing water rights, water supply, storage and transmission agreements and other contractual protections & obligations honored by project partners. AWA would also benefit from the additional revenues that could be generated by project implementation. Jackson Valley Irrigation District is seeking additional water supply to meet incidental domestic supply and unmet irrigation needs.

Calaveras County Water District & Calaveras Public Utility District – Calaveras County water agencies also face increasing water demands due to a growing population. They too have a need to expand their existing supplies, update their service infrastructure, storage, and/or construct new facilities. Similar to AWA, their level of benefit from the IRCUP would be based on how the project is configured. They seek to gain recognition for their 27,000 acre-feet per year senior water right reservation, and seek opportunities to use this water supply entitlement through construction of new facilities. They also would benefit from an increased source of revenue that could be realized by the use of reservation waters.

San Joaquin County & Participating Water Interests (County) - the County is undergoing a rapid transition, as lands that once supported agriculture are being converted to meet the needs of an influx of new residents at nearly 700,000 and projected to increase by 157% by the year 2040. Urban, environmental and agricultural interests place competing demands on water, with an added complication created by a management structure involving numerous local water agencies. State and Federal agencies are players as well, having both facilities and resource responsibilities in and adjacent to the County.

Surface water resources in San Joaquin County are largely appropriated and tightly controlled resulting in local scarcity. Four major river systems (the Mokelumne, Calaveras, San Joaquin, and Stanislaus) and the Sacramento-San Joaquin Delta flow through the County, yet much of the water is exported to meet the increasing urban needs of those outside its geopolitical boundary. There are limited opportunities to develop new surface water sources for the County, and those few remaining opportunities will require significant political and financial commitment. Due to this lack of adequate surface water supplies, County water purveyors have relied heavily on groundwater to supply both its predominantly agricultural and, more recently, urban needs. This reliance on groundwater has resulted in significant overdraft of the groundwater basin of up to approximately 150,000 to acre-feet annually and is projected to increase up to approximately 175,000 acre-feet annually if nothing is done to correct this problem. A result of water level declines has been the intrusion of saline groundwater from the Delta. Continued pumping of groundwater and deterioration of water quality in the basin threaten the long-term viability of groundwater use in San Joaquin County. The GBA's IRWMP development has centered on correcting the overdraft condition and to prevent further saline intrusion through the incorporation of several water management strategies together with additional new water supply from projects like the City of Stockton's Delta Water Supply Project, SEWD's Farmington Program, the MORE WATER Project and EBMUD's Freeport Project assigned pipeline capacity.

A possible "silver-lining" to groundwater overdraft and the resulting decline of groundwater levels in Eastern San Joaquin County is the creation of an estimated 1 to 2 million acre-feet of potential operable groundwater basin storage. In addition, Eastern San Joaquin County's proximity to major waterways and reservoirs, existing and proposed regional conveyance facilities, and the Sacramento-San Joaquin Delta has amplified the potential for the County to use this storage potential for regional and statewide interests.

East Bay Municipal Utility District (EBMUD) - EBMUD owns and operates Pardee and Camanche Reservoirs on the Mokelumne River and holds 364,000 acre-fee/year of water entitlements to meet the existing needs of 1.3 million people and the increasing customer needs in 20 cities and 15 unincorporated service areas in Alameda and Contra Costa Counties. During drought periods, the Mokelumne River can no longer meet EBMUD's projected customer demands, even with 25 percent rationing imposed on total customer demand. EBMUD also holds stewardship responsibilities for the fishery resources in the Lower Mokelumne River basin and must meet operational and regulatory constraints to maintain adequate in-stream flows. EBMUD seeks, 1) to improve water supply reliability, particularly during drought periods, by exploring conjunctive management of its Mokelumne River facilities and working to ensure that the IR-CUP does not adversely affect EBMUD's existing and long-term Mokelumne supply operations, water rights, and property rights; 2) to have existing water supply entitlements and obligations honored; and 3) to ensure that the project as implemented does not adversely impact downstream fisheries. EBMUD also desires to work collaboratively with other Mokelumne River stakeholders to resolve conflicts and overcome institutional barriers that have limited progress towards lasting solutions that solve the water and natural resources management problems in the region.

Other Forum members: There will be other entities (water agencies, landowners, farming interests, environmental interest groups, non-profit organizations, etc.) that for various reasons would not seek the same role or level of commitment as the agencies described above, yet who would seek specific benefits from any potential Mokelumne River water supply project. These benefits would also be part of the overall mix, although specific roles, commitments, and interests remain to be fully explored within the Forum. Table 8-1 reflects one possible set of entities whose interests also could be part of a broad, regionally based solution.

Table 8-1 Additional Project Stakeholders
North San Joaquin Water Conservation District
Stockton East Water District
Woodbridge Irrigation District
City of Lodi
City of Stockton
Stockton East Water District
Central Delta Water Agency
South Delta Water Agency
Contra Costa Water District
San Joaquin Farm Bureau
Foothill Conservancy

8.1.5 Project Components

The project has been conceived to utilize existing conditions and opportunities to the advantage of all stakeholders. The conceptual operation of the IR-CUP is illustrated in the following Figure 8-2. Representative project elements are briefly summarized below.

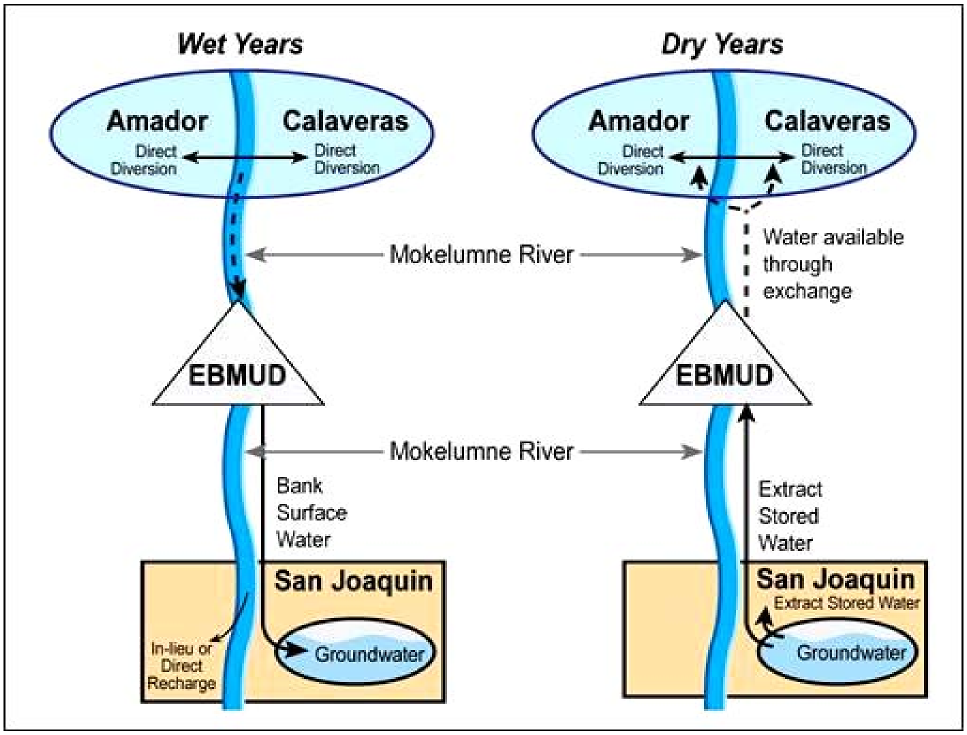


Figure 8-2 Inter-regional Conjunctive Use Project Schematic

Surface Water Supply - Amador County and Calaveras County water purveyors may secure additional surface water rights through a "partial assignment" under the 1927 State Filings, which pre-committed a major portion of the Mokelumne River's flow for their future use. The new assignment would allow diversions from the River to be used within Amador and Calaveras Counties, and other water diversions could be banked in the Eastern San Joaquin Groundwater Basin for later use in Amador, Calaveras, and San Joaquin Counties and in EBMUD service area.

Wheeling Facilities - Through multi-lateral agreements among the parties, EBMUD facilities may be used to convey water to San Joaquin County. The project partners could initially rely on EBMUD's existing facilities to exchange the banked water to Amador and Calaveras Counties.

Groundwater Storage - A portion of the Mokelumne River supply may be conveyed through EBMUD facilities for storage and regional use in the Eastern San Joaquin Groundwater Basin (Basin). Various in-lieu and direct recharge projects located in North San Joaquin Water Conservation District, Stockton East Water District, Central

San Joaquin Water Conservation District and/or Woodbridge Irrigation District could be used to recharge water in wet years for use in dry years. Regional use facilities would be operated as part of the overall ICU Program in a way that is consistent with objectives adopted under the GBA's Groundwater Management Plan to contribute toward the goal of solving the groundwater overdraft in the critical areas within San Joaquin County. If the project proves to be feasible in helping to reverse the overdraft condition in the groundwater basin, some or all of the partners could pursue additional phases to expand the conjunctive use projects.

Institutional Arrangements and Financing - Each participating agency will need to negotiate institutional arrangements that would enable the IR-CUP to proceed:

- Potential Sources of Water Entitlement – As stated, Amador County and Calaveras County water purveyors could secure surface water rights through their 1927 State Filings in accordance with Water Code Section 10500, et seq. and the participating agencies shall respect such county of origin water rights and existing contractual protections.
- Other Water Rights, Transfers & Exchanges – Additional water supply may be developed from other proposed (Mokelumne River Water & Power Authority - Application 29835) and existing water rights [EBMUD Permit 10478 (Application 13156)] or contracts. This type of project will likely contain most, if not all, of the common project components discussed previously (local diversions, groundwater storage, transfers, and exchanges).
- Groundwater Export Ordinance – The project will operate within established basin management objectives, operations criteria and will be consistent with the directives outlined in the Groundwater Export Ordinance. With these protections in place, San Joaquin County could grant permits enabling Amador, Calaveras and EBMUD to store water in the groundwater basin during wet years for use in dry years.
- Infrastructure Facilities Usage and Ownership – The partners shall develop and/or modify agreements for water transfers and exchanges that respect the interests & project benefits of the partners, the use and ownership of project participant's storage & conveyance facilities, established management objectives and operations criteria and existing contractual protections for Amador and Calaveras Counties.
- Securing Funding – Project partners shall jointly participate in a cost-sharing agreement, and seek state and federal grant funding to offset a portion of the

project costs. Capital and operation costs will be born by project partners in proportion to benefits received.

Regional Flexibility - The concept of an inter-regional conjunctive use project is flexible and expandable and could take many forms or be split into several different projects. As an example of this flexibility and expandability and to increase the overall water supply yield, the project could be integrated with expanded EBMUD facilities at Pardee Reservoir or off-stream facilities such as the MORE WATER Project – Duck Creek Reservoir as proposed by San Joaquin County, the raise Bear Reservoir as proposed by Amador Water Agency, and/or a host of other agency-specific projects as may be developed. In addition, the IR-CUP could also be integrated with new inter-ties to adjacent basins such as the Calaveras River, or by using unassigned pipeline capacity as may be available from the Freeport Regional Water Project (FRWP) as currently being developed by EBMUD and its FRWP project partner. These facilities could link the Mokelumne River watershed to adjacent river basins to further diversify and expand the water resources available to the project partners to sustain greater regional use.

The preliminary phase of the IRCUP concept holds significant potential for near-term implementation because it may not require the construction of new direct diversion facilities. Instead, it could utilize existing facilities such as the EBMUD's Pardee and Camanche Reservoirs and the Mokelumne Aqueducts, the North San Joaquin Water Conservation District (NSJWCD)'s pumping facility, and/or the Woodbridge Irrigation District's (WID) diversion facility to supply yet to be constructed in-lieu and direct recharge facilities. Flows would be diverted through one or more of these systems for conjunctive use and banking during periods when capacity exists. An IR-CUP project concept of this nature may provide a range of average annual yields from 10,000 to possibly 50,000 acre-feet for conjunctive use and groundwater banking.

8.1.6 Concepts for Additional Consideration

The Mokelumne River together with other rivers and streams that flow through Amador, Calaveras and San Joaquin County has significant wet-period flows. A major challenge when conjunctively utilizing flows from such river systems is that water supply availability typically occurs dramatically over a relatively short time period or flow can be significantly reduced during drought times. A comprehensive method of flow capture, regulatory storage and utilization should be integrated to meet the water needs of those that rely on such sources.

The following concepts explore potential on-stream storage and off-stream storage & regulating facilities that could be integrated with conjunctive use projects like the IR-CUP to enhance the capacity of flow capture and utilization for the project partners.

Bear River Reservoir Expansion Project - Raising the existing Lower Bear dam by 32 feet is a likely alternative identified as a means to increase surface water storage capacity in the upper Mokelumne watershed. While any of the three alternative projects listed would be constructed entirely within the M/A/C region, coordination is desirable with entities within the GBA region. The additional 26,407 acre-feet of storage could impact the releases from the Bear River which in turn could impact downstream entities and the environment but if done properly, it could be beneficial. Coordination is desired to minimize and/or mitigate negative impacts on the River system as well as maximize potential benefits to stakeholders, upstream and downstream within both regions.

Based on a preliminary review of the concept as developed to date, the Bear River Reservoir Expansion Project would benefit both regions by providing additional control over stream flow, reservoir release timing, and release magnitude. There are obvious benefits to a conjunctive use project. Releases can be timed to not overwhelm diversion and recharge facilities while still allowing for habitat and pathways for natural species.

Duck Creek Dam and Reservoir - This concept as part of the MORE WATER Project includes capturing flows at Pardee or Camanche Reservoirs on the Mokelumne River and conveying up to 1,620 cfs via a gravity tunnel and pipeline or pump station to a new regulating reservoir at Duck Creek with a capacity of 150,000 acre-feet. The water held in the Duck Creek Reservoir would be conveyed at the Bellota Weir to conjunctive use areas on the Calaveras River and/or Mormon Slough. Based on pre-feasibility estimates as provided by San Joaquin County, a project concept of this nature could provide a range of average annual yields from 80,000 to 120,000 acre-feet for conjunctive use and groundwater banking.

8.1.7 Proposed Scope of Work

The Mokelumne Forum participants propose the following conceptual scope of work to determine the engineering feasibility and prepare the associated environmental documentation to support the policy and financial decisions and ultimately construct facilities for the Mokelumne Inter-Regional Conjunctive Use Project (IR-CUP). The conceptual scope of work is broken down into four major tasks, which include an Engineering Feasibility Study, Legal/Institutional Arrangements, Environmental Documentation (CEQA and/or NEPA), and Stakeholder Outreach and Facilitation. The tasks are briefly described below:

- The **Engineering Feasibility Study** will enable Forum Participants to develop alternate project configurations and concepts. Several project alternatives would be developed and defined in terms of facilities (new and existing), location, project design & operations, potential yield, groundwater basin operations, cost, impacts, benefits, institutional barriers, water rights, legal, etc. It is envisioned that the project information developed would be of sufficient detail for the Forum participants to make informed decisions leading to the selection of a preferred project alternative.

- The **Legal/Institutional Arrangements** task is intended to review matters regarding project development responsibilities as well as project ownership, maintenance and operational issues. Options for how legal arrangements between the project partners would be formed will be reviewed and provided for consideration.
- The **Environmental Documentation** task is intended to disclose the environmental impacts of the project pursuant to the California Environmental Quality Act and/or the National Environmental Policy Act. This task consists of a combination of programmatic and/or project-specific environmental documents necessary to acquire any and all permits necessary to construct facilities.
- The **Financing Plan** task will investigate alternative means to finance planning, design, construction, and operation and maintenance (O&M) of the project. State and Federal sources of capital funds will be investigated, along with mechanisms for raising local capital and O&M funds. Analysis of benefits among participating agencies, and apportionment of costs will be included in this task.
- The **Outreach and Facilitation** task has two points of focus. The first is to maintain an atmosphere of open dialogue, consensus building, and cooperation among Forum members, whether they are MOU signatories or other organizations or interest groups. The second is to keep the general public informed and engaged throughout the process. Outreach tools may include a website, pamphlets, public meetings, and open forums. High-level facilitation and decision making support by the Center for Collaborative Policy or other third party expert throughout the process is assumed.

8.1.8 Key Considerations

The historically competing interests, different water needs, and different values among Forum members add complexity and highlight the need for a consistent commitment to collaborative problem solving in all of the tasks described above, and particularly development of Legal/Institutional Arrangements and Outreach and Facilitation.

8.2 Sacramento County – South Area Water Council

For some time the GBA has been in contact with and monitored the progress of water agencies in developing a collaborative water planning process for the South Basin of Sacramento County. This has included significant information sharing and coordination on project develop and groundwater modeling activities of the GBA. It has become evident that the fate of the groundwater basin is linked not to a political or jurisdictional boundary between Sacramento and San Joaquin County, but is linked through a hydrologic boundary that is impacted by the activities of water resource management in each area. Groundwater modeling completed by the GBA DYNFLOW Model illustrates the nature of this hydrologic linkage in that future no action scenarios predict the joining of over-drafted groundwater depressions in both south Sacramento County and northern San Joaquin County into a larger groundwater depression (See Figure 8-3).

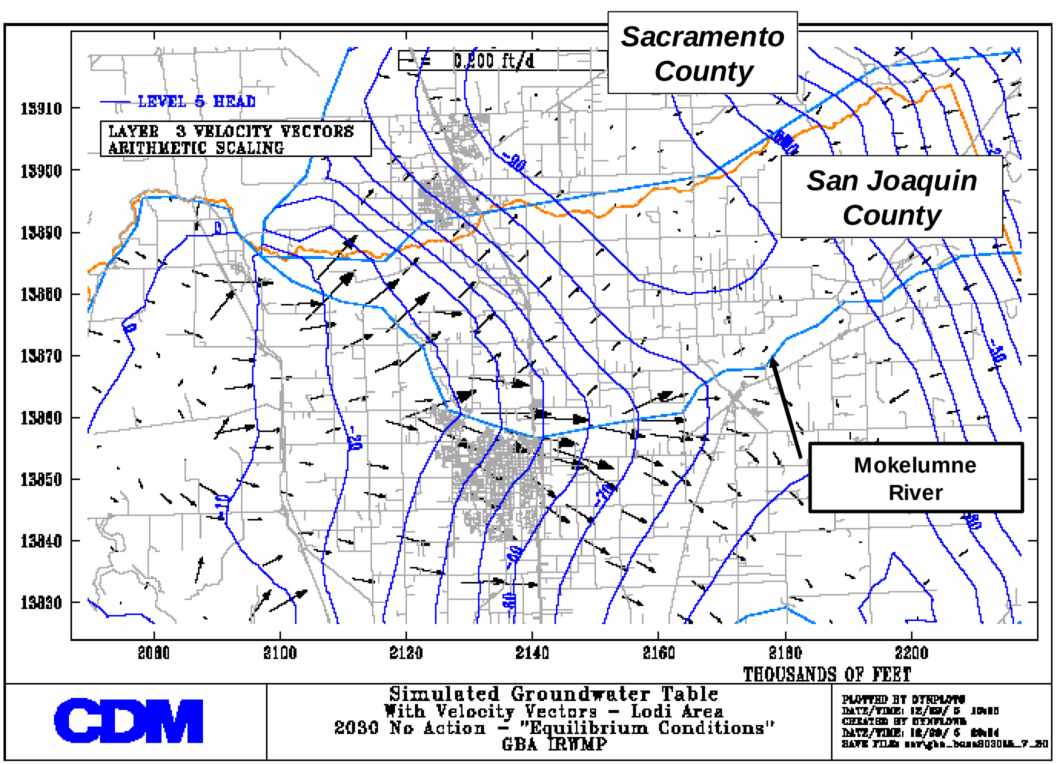


Figure 8-3 Groundwater Model Depiction of Future Equilibrium along the Sacramento-San Joaquin County Line Given No Action Conditions

The GBA has been included as stakeholders in the South Sacramento County effort and have participated in a stakeholder interview process and preparation of an assessment report, which has culminated in the development of a Memorandum of Understanding by the six sponsoring agencies to establish basic goals and objectives including:

- Southeast Sacramento County Agricultural Water Authority
- City of Galt
- Rancho Murieta Community Services District
- The Nature Conservancy
- Sacramento County Water Agency
- California Department of Water Resources - Conjunctive Management Program

Within this MOU, important consideration was given to improved groundwater management in both Sacramento as well as San Joaquin County as follows:

> *F. The Parties recognize that there may be opportunities to improve groundwater management through the conjunctive use of groundwater, surface water, and recycled wastewater resources to increase the reliability of regional water supplies through regional conjunctive use efforts that may include groundwater and surface water storage.*
>
> *G. The Parties have determined that an effective conjunctive use program will require an accurate and mutually agreed upon determination of the sustainable yield of the South Sacramento County Groundwater Basin.*
>
> *H. The Parties recognize that an effective water management program must protect and enhance the environmental values of the Cosumnes River corridor while not jeopardizing existing or planned future uses.*
>
> *I. The Parties recognize the importance of coordination with water management efforts in adjacent areas, such as San Joaquin County, and will establish open communication and opportunities for collaboration with relevant entities in adjacent basins.*

In particular, MOU Section I specifically recognizes the important of better coordination with water management efforts in adjacent areas including San Joaquin County. The will ensure appropriate communication and possible opportunities for collaboration on projects in the future.

8.3 Stanislaus County – Water Summit

Though less developed, yet equally important in water resource coordination between San Joaquin County and Stanislaus County has also been under development. Stanislaus County under the direction of the County Planning and Community Development Department has been holding WATER SUMMIT meetings with numerous potential stakeholder interests including San Joaquin County. These meetings have led to the completion of an initial assessment of these stakeholders designed to better understand the topics to be discussed, how to make the effort more productive, their outcome and who should be invited as stakeholders.

Of those items to be discussed in the assessment, several have potential ramifications to San Joaquin County and the GBA IRWMP. Those include the following:

- Groundwater recharge, benefits, concerns & upcoming regulation
- Science, law, governance and policy
- Drought, agency action & public response
- Analysis of other regional water efforts
- Sustainable, integrated water planning

Cooperation on issues of mutual concern was one of the overriding suggestions for potential outcome. Several others of potential interest to San Joaquin County and the GBA IRWMP include the following:

- A regional water strategy
- A regional water consortium or advisory body
- A standing/uniform voice for dealing with water issues and policy
- A new Integrated Regional Water Management Plan, linking Stanislaus County water agencies with other watershed stakeholders

The GBA will continue to monitor and participate in the developments of the WATER SUMMIT activity in Stanislaus County to better integrate activities on the Stanislaus and San Joaquin Rivers that may be of mutual interest.

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Chapter 9 - Management Action Plan

This chapter details the actions to be taken to achieve the Basin Management Actions. The GBA is committed to continued inter-agency coordination as IRWM Plan elements are put into action both independently and by implementing agencies.

Inter-agency coordination and collaboration during development of this Plan took place through the GBA Board, the GBA Coordinating Committee, the San Joaquin County Advisory Water Commission, the Mokelumne River Forum, the Eastern Water Alliance, and meetings with the Mokelumne/Amador/Calaveras IRWMP study group. Coordinating Committee members provided input and review on elements of the Plan including the Management Actions presented here. The GBA is committed to continued inter-agency coordination as Plan elements are put into action both independently and by implementing agencies.

9.1 Basin Management Authority

The GBA is a Joint Powers Authority which is represented by individual agencies overlying the Basin with the common interest being the health of the underlying Basin. The GBA is a consensus based forum in which projects can be developed by stakeholders in a manner that maximizes benefits to all involved parties and the region as a whole. Projects developed with input from the stakeholder group ensure consistency with the Plan. The GBA employs a mutual interest-based governance framework that creates a stakeholder group of common interests with the powers to undertake specific goals and objectives.

The enabling act authorizes the GBA to perform planning and study activities in furtherance of acquiring water supplies and improving management of regional water resources. To fulfill this objective, the GBA currently performs the following:

- Preparation of the San Joaquin County Water and Groundwater Management Plans
- Assistance with the filing of water rights and assists member agencies to acquire and retain their rights and filings
- Conducting water monitoring programs and special studies throughout the region, including the joint USGS/DWR/GBA saline water investigation
- Preparation of applications for grant funding
- Acts as a clearinghouse for water resource data
- Represents GBA member interests in regional forums
- The GBA has prepared this Integrated Regional Water Management Plan to plan water supplies and use in the region through 2030

As discussed in this Plan, the management authority of the GBA is considerable in scope and areal extent. The GBA will continue to interact with other agencies and groups throughout the region to increase the social, economic, and environmental viability of the Eastern San Joaquin County Region and beyond. This integration of these strategies increases the potential for broad-based support by spreading benefits to multiple interests and agencies. Integration also produces synergistic effects and makes additional funding sources available.

9.2 Management Actions

The 53 actions listed in this section constitute the GBA's plan and commitment to implement the Integrated Regional Water Management Plan. Management Actions have been grouped into the following categories:

- **Monitoring –** Monitoring of water parameters such as groundwater levels, water quality, import quantities, water budgets, etc., plus monitoring of population growth and development, effectiveness of water conservation measures, and land subsidence. Data management will be closely tied to this function.
- **Improved Basin Characterization –** Continued exploration, infiltration rate testing, aquifer characterization, modeling, improvements to understating of the water budget.
- **Continued Long-Term Planning –** Includes review of land use plans, additional water supply identification, and Plan updates.
- **Groundwater Protection –** This category could include recharge site management and protection, identification and destruction of abandoned wells.
- **Construction and Implementation –** Identification of implementing agencies for high priority projects, and coordinating with those agencies in putting them into service.
- **Governance –** Development of regional governance structures to acquire water supplies, manage the groundwater basin, and equitably distribute benefits and costs.
- **Financing –** Implementing the IRWM Plan will require an array of financing mechanisms such as bonds, grants, or low interest loans. Some implementing agencies have available revenue streams for implementing projects, while others do not. Cost savings may be incurred through implantation of conservation and water reuse projects. In addition, cooperative funding agreements between the GBA and local, state, or federal agencies may also provide funding for IRWM Plan projects and management actions.

- **Public Participation/Community Outreach –** Continued coordination with the GBA Board and Coordinating Committee, the San Joaquin County Advisory Water Commission, as well as regional water managers and community groups.

The specific actions as grouped into these eight elements are presented below:

9.2.1 Monitoring

As regional groundwater manager, the GBA has the authority for monitoring regional groundwater quantity and quality, and has implemented programs to accomplish this in cooperation with other County agencies. The State Water Resources Control Board is the primary State agency responsible for water quality management issues in California. Much of the responsibility for implementation of the SWRCB's policies is delegated to nine Regional Water Quality Control Boards. The Central Valley RWQCB overlies the GBA.

Those that will cooperate in monitoring efforts include local water agencies, independent well owners, the Department of Water Resources, and the U.S. Geological Survey. Information collected or compiled by the GBA is utilized by local water managers and planners.

> **Action:** GBA will continue to perform monitoring activities, and will endeavor to improve methodologies to quantify components of the water budget, and to facilitate integration of collected information with the GBA data set.

9.2.1.1 Groundwater Levels

The GBA, in conjunction with member agencies and other County departments has several programs for groundwater level monitoring, and has been increasing in-house staff efforts for collection, compilation, and archiving an increasing quantity of collected data. This work is supplemented by efforts of the U.S. Geological Survey (USGS) as part of a cooperative water services program with GBA. These include groundwater wells from which the samples are taken annually or semi-annually. Monitoring wells are concentrated primarily near existing areas of production.

The GBA is working to increase use of water level measurements to better quantify the movement and storage of groundwater, and to effectively increase understanding of the groundwater basins. This effort will include improvements to existing data collection programs through improved use of technology, including automated data collection processes and use of spatial database software. These processes should provide consistent data collection, a more geographically representative range of data, and measurements that are more discrete at depth and over time. Current efforts are focused on development of the GBA's saline water investigation program and a computerized geographic information database system.

1. **Action:** GBA will recommend that sufficient monitoring wells are installed around each recharge site to provide information needed to determine vertical and horizontal groundwater flow conditions and potential groundwater mounding in the vicinity of each site. In general, this means that monitoring points will be established around each recharge site, depending upon local conditions. Sites with complex geology may require multiple completion wells to monitor water levels in all affected strata. Movement of recharged water will be tracked to monitor recharge effectiveness.

2. **Action:** Existing monitoring wells will be maintained and gaps in data identified. The need for additional monitoring wells will be assessed and a plan developed for construction of additional wells if necessary. This assessment could lead to the identification and elimination of some superfluous measurement points.

3. **Action:** GBA will develop an impartial procedure to determine compliance with Basin Operations Criteria, and provide a report at appropriate regular intervals on where aquifer levels stand in relation to level-based BMOs.

9.2.1.2 Water Quality

The GBA has initiated a monitoring effort to greatly enhance the cooperative water services program between GBA and USGS described above, which includes wells from which water quality samples are taken. Individual water purveyors monitor drinking water quality. Water quality enforcement responsibilities reside with the RWQCBs and the State Department of Health Services.

1. **Action:** GBA will continue water quality monitoring efforts and will collect and summarize drinking water quality data from cities, coordinating these efforts with other entities including USGS, the State Department of Health Services, the Central Valley Regional Water Quality Control Board, the State Department of Water Resources, and others. GBA will explore the viability of acting as a regional clearinghouse for this data. Data will be compiled, compared and tracked in a data management system. All data will be made available to area water purveyors. Needs for additional water quality sampling will be determined.

2. **Action:** GBA will continue cooperative studies to install and monitor water quality and movement along the saline front.

3. **Action:** GBA will continue or begin coordination and data exchange with state, regional and county agencies to support efforts to ensure groundwater quality concerns are understood by the agencies and can be appropriately addressed. GBA will compile all reasonably available data including data on areas with known contaminants and/or poor quality groundwater and perform a trend analysis. This data will be used to site recharge and extraction facilities to maximize protection of water supplies.

9.2.1.3 Water Supply Measurement

Supply components of the water balance include streamflow, subsurface flow across subarea boundaries, and imported water supplies. GBA has quantified these quantities in its groundwater modeling studies, and has prepared estimates of future conditions.

1. **Action:** GBA will assess current methods for estimating subsurface flow across subarea boundaries, and will develop additional monitoring points, follow through with plans to automate inventory of water supply components, or take other appropriate measures to improve the accuracy of these estimates.

2. **Action:** GBA will continue to account for and report quantities of water imported for groundwater replenishment. A database application will also be developed to enhance current ability to inventory and value water within GBA storage programs.

9.2.1.4 Population Growth and Development

As reported in Chapter 2, the GBA population is expected to more than double by 2030. Water to meet the demands of most of this growth will be supplied by existing purveyors, or through water importation. The GBA will take the following steps to track the expected growth and ensure consistency with projected planned growth:

1. **Action:** GBA will work with cities, the County, and water agencies to track building permits in order to monitor the pace of growth as compared to that projected in this Plan. This comparison will be made at least every five years. If actual growth varies significantly from the Plan benchmark, the pace of Plan implementation will be adjusted or revisited.

2. **Action:** Under Senate Bills 221 and 610, the developers of new housing developments with 500 or more housing units, or commercial and industrial

development with equivalent demands, must receive written verification from the local water supply agency that a sufficient water supply exists to provide the needs of the new development. The GBA will provide information regarding regional water balances and availability of supplemental supply to local purveyors to allow them to reach appropriate conclusions regarding the sufficiency of supply.

3. **Action:** GBA will work with local planning agencies to ensure that areas that should be set aside to recharge the groundwater basin are reserved for that purpose and are not subject to development.

9.2.1.5 Effectiveness of Water Conservation Measures

There are numerous reasons for evaluating water conservation measures:

- To provide a review or the program in context of its intended goals
- To allow for modification of programs that are not meeting intended goals
- Better projection of water demands
- To document performance of pilot programs and for design of full-scale programs.

The Urban Water Management Plans of area purveyors seek to reduce regional water use to achieve a sustainable, reliable supply to meet regional water demands.

1. **Action:** GBA will work with area water purveyors and serve as a clearinghouse for water conservation measures and performance data. Water conservation programs will be evaluated through the GBA and actions taken as needed. Evaluation will include at least the following:
    - Summarize baseline water usage for water purveyors' 2005 Urban Water Management Plans
    - Establish and summarize Demand Management Measures
    - Track implementation of Demand Management Measures
    - Tabulate per capita water use by member agency and subarea annually or at a reporting interval deemed appropriate by the GBA
2. **Action:** Increased regional water conservation efforts will be identified and plans developed for implementation of cost effective demand management measures based on the reports on effectiveness.

9.2.1.6 Evapo-transpiration

The California Irrigation Management Information System (CIMIS) is a repository of meteorological data collected from an integrated network of over 100 computerized weather stations located in key agricultural and municipal sites throughout the state. The system helps growers and turf managers in determining when to irrigate and how much water to apply. Efficient water use will maximize the benefits from existing water supplies.

1. **Action:** GBA will review the adequacy of the existing evapotranspiration network and work to expand the number of measuring stations as necessary.

2. **Action:** GBA will make collected data available to agricultural and large urban landscape irrigators to encourage and facilitate the use of evapotranspiration data to increase irrigation efficiency.

9.2.1.7 Data Management

The GBA has numerous data management systems existing or in development to support its various monitoring programs. It is imperative for the GBA to implement a data management system as a means to store, archive, and access data in a timely, unambiguous way meaningful to decision makers.

The GBA compiles records of producers, production wells, and annual production. DWR maintains a database to store river flow, water quality and water level data collected by the County, USGS, and water agencies. Significant additional information is anticipated to be collected as part of this Plan to better characterize the groundwater system and the performance of recharge projects.

1. **Action:** GBA will continue development of a data management system based on a relational database structure to efficiently compile, store, archive, and access collected data. The system will be designed to provide data for a geographic information system and to accommodate data from additional collection efforts developed through implementation of this Plan.

2. **Action:** GBA will make compiled data available to local water suppliers.

9.2.1.8 Extraction Sites/Consumption

GBA collects production data in the area to model and compute regional water balances.

1. **Action:** Additional production wells will be constructed in the future to accommodate the expected increase in population. The GBA will collect data and verify the location and production from these new wells in addition to existing well production.

9.2.2 Improved Basin Understanding

9.2.2.1 Infiltration Rates

Numerous groundwater recharge projects will be required to meet the water balance objectives of this Plan. In order to understand the feasibility of, and best locations for, these projects, more data is needed as to the infiltration rates in different areas of the aquifer system. Significant piloting efforts must be undertaken.

Action: GBA will work with local agencies to develop a plan to expand and implement infiltration pilot testing to identify suitable recharge sites capable of recharging groundwater at a rate adequate to meet forecasted needs.

9.2.2.2 Aquifer Characterization

Recharging the large quantities of water projected in this Plan will require extensive investigation of aquifer properties and storage capacities. Means to effect this aquifer characterization include geophysical testing, aquifer stress tests, and expanded monitoring networks. Methods for geophysical testing include surface geophysical methods such as seismic reflection and refraction, gravity surveys and resistivity imaging, and down-well methods such as electronic logging, pump testing, and other methods. These methods are used to develop a mapping of the aquifer flow system that can be used to optimize the interaction of groundwater recharge and extraction activities. New down-well technologies are available that can provide refined, depth-specific aquifer properties cost-effectively.

1. **Action:** GBA will expand its aquifer characterization program to improve understanding of basin conditions, leading to more effective recharge project operations. Geophysical methods will be employed as appropriate to identify the sites most appropriate for groundwater recharge.

2. **Action:** GBA will expand its monitoring well network as appropriate to track aquifer response from pilot and full-scale groundwater recharge and production facilities.

3. **Action:** Data collected will be compatible and integrated with regional modeling and data management efforts.

9.2.2.3 Modeling

To date, at least three models of GBA groundwater basins have been developed to aid in management of the water system:

- A surface water/groundwater simulation model of the eastern County based on the IGSM platform for the Mokelumne Aquifer Recharge and Storage study
- A regional surface water/groundwater simulation model build on the Dynflow modeling platform
- A screening model of the aquifer system built on the Stella modeling platform

Modeling of the groundwater basin can be useful to help determine the best locations for recharge or extraction sites and to help optimize operation of the groundwater basin. The existing models described above provide insight into these questions, but have limitations at project-level scale. The existing models are appropriate for conceptual regional planning efforts, but more refined models will be necessary for in-depth analysis of a large-scale recharge system, or for site-specific analysis. The initial focus should be on additional data collection to support the detailed effort.

1. **Action:** GBA will enhance and expand its groundwater modeling capability. The initial efforts of this modeling program will be focused on data compilation, assessment, and conceptual model development. The model will make use of data contained in the existing models, and will be compatible with and integrated with data collected in the geophysical aquifer testing efforts. The model should supply a regional context for water management, including considerations of groundwater overdraft in the south Sacramento County area.

2. **Action:** The GBA will assess the need and determine a process to implement a water quality management model for management of saline water or other constituents such as nitrates.

9.2.2.4 Update Water Budget

The water budgets prepared for GBA studies include groundwater flow, surface water inflows and outflows, deep percolation of precipitation estimates, groundwater production, and saline water migration. Each of these components are estimates which could be improved with new information.

1. **Action:** GBA will develop improved estimates of water budget components to provide a refined assessment of basin interactions and Basin Operations Criteria. Improved groundwater level monitoring and modeling to provide a better estimate of subsurface flow is a component that might be implemented near-term.

2. **Action:** GBA will utilize their data systems to develop and produce annual Authority-wide progress reports on key water budget components including water inflows, outflows, and change in storage by subarea and make recommendations on how these quantities can be better measured.

9.2.3 Continue Long-Term Planning

Since inception, the GBA and predecessor agencies have been developing and updating plans to guide the Authority as it carries out its mission to ensure sufficient water availability for present or future beneficial uses in the region. The GBA will continue its commitment to long-term planning. The following section describes the planning efforts the GBA is focusing on.

9.2.3.1 Vulnerability Assessment

The California Department of Health Services has prepared a checklist of security measures for water utilities. According the checklist, recommended actions to better secure water related facilities include the following:

1. At offices, well houses, treatment plants and vaults, make it a rule that doors are locked and alarms set
2. Tell employees to ask questions of strangers at facilities
3. Limit access to facilities. Indicate restricted areas by posting “Employees Only” signs
4. Increase lighting in parking lots, treatment bays and other areas with limited staffing
5. Remove keys for equipment
6. Invite local law enforcement to become familiar with facilities and establish a protocol for reporting and responding to threats
7. Discuss detection, response, and notification issues with public health officials and establish a protocol
8. Establish a chain of command and emergency call list in case of emergencies
9. Provide copies of operational procedures to law enforcement and emergency management personnel
10. Limit access to water supply reservoirs
11. Fence and lock vulnerable areas

Action: GBA will inform and work cooperatively with groundwater purveyors in their efforts to ensure that minimum water security measures are in place. Additional security measures will be identified and implemented as necessary. GBA will implement these measures on its facilities (e.g. .monitoring wells) where appropriate.

9.2.3.2. Review Land Use Plans

Land use plans in the basin are developed by a number of different entities including the County and each of the cities through their General Plans, General Plan Amendments and Public Facilities Element amendments.

Action: GBA will coordinate with local planning agencies to ensure that growth projections, proposed land use changes, and types of proposed developments are consistent with water planning efforts, as required by SB 221, SB 610 and future legislation. Significant deviations from projected growth and water needs will be noted and corrective action taken. Corrective actions could include securing additional sources of water, or making a finding pursuant to SB221 or SB 610 that an adequate water supply does not exist and notifying the water purveyor.

9.2.3.3 Identify Future Water Supplies

The County and local agencies have water rights and water rights filings for significant amounts of water. The water supply-demand analysis performed as part of this Plan indicates that, assuming planned municipal conservation, an additional 140,000 to 160,000 acre-feet per year will be needed by 2030 to stabilize groundwater at target levels. GBA has initiated efforts to determine additional sources where this needed supply might be obtained. Potential options include pre-banking of existing supplies, new appropriations, water banking or exchange arrangements, water transfers, developing water conservation or desalination credits, and aggressive management of existing supplies, including exploring higher levels of conservation. GBA agencies have explored groundwater banking arrangements with the Environmental Water Account, Amador and Calaveras counties, and EBMUD. The feasibility of these options has yet to be determined.

1. **Action:** GBA will continue to research options for meeting 2030 water needs, categorize and prioritize the options, and examine and implement the higher-priority options.

2. **Action:** GBA will stay actively involved in planning processes that are conducted by the Department of Water Resources, adjacent counties, and other

water planning agencies. GBA will advocate for operations that enhance its supply, track changes in supply reliability, and adjust its plans accordingly.

9.2.3.4 Regular Updates

This Integrated Regional Water Management Plan contains elements that address several planning procedures, including an Integrated Water Management Plan, and Groundwater Management Plan. As required by the Urban Water Management Planning Act, California Water Code, Section 10610 et seq., the UWMP plans of local water purveyors must be updated every five years in years ending in zero and five. Additionally, GBA will prepare biennial updates on the status of completion of the various aspects of the Groundwater Management Plan. GBA will produce the biennial updates on the other activities contained in these Management Actions. The information contained in the biennial updates should be used to evaluate how often it will be necessary to update the Groundwater Management Plan.

1. **Action:** GBA will produce a biennial report summarizing progress made in achieving Plan Actions for the previous two years, considering monitored performance of the water management system. Minor adjustments to planning assumptions, operations, or Actions will be adopted as necessary. If significant deviations from the Plan are determined to exist, the Plan will be revised in its entirety.

2. **Action:** GBA will perform a comprehensive update revision of the Integrated Regional Water Management Plan at least every ten years. The performance of implemented projects will be compared to original project objectives to ensure objectives were met.

3. **Action:** GBA will review purveyor updates to their Urban Water Management Plan every five years, in years ending in zero or five, determine consistency with IRWM Plan objectives and assumptions, and update the Plan as necessary.

9.2.4 Groundwater Protection

The general goal of groundwater protection activities is to maintain the groundwater and the aquifer to ensure a reliable high quality supply. Activities to meet this goal include continued and increased monitoring, data sharing, education and coordination with other agencies that have local or regional authority or programs. The GBA currently has no groundwater production wells that it operates, but could in the future. To increase its groundwater protection activities, GBA will work with member agencies to take action as presented below.

9.2.4.1 Recharge Site Management Activities

Management activities for protection of recharge sites include:

- Establishing Site Control Zones to protect the area immediately surrounding the site from potentially contaminating activities
- Controlling access to recharge zones
- Well and recharge facility construction standards
- Researching and mapping pollution sites to minimize siting and operational conflicts

The Drinking Water Source Assessment and Protection (DWSAP) program was developed by the California Department of Health Services to meet requirements in amendments to the Safe Drinking Water Act. All wells providing public drinking water supplies must comply with this program. The DWSAP program is intended to address assessments and facilitate the development of protection programs for ground and surface waters. The Department of Health Services and larger water utilities perform these assessments for pre-2002 wells. The well owner is generally required to perform the assessment for newer wells. The DWSAP consists of the following:

- Delineating the two-, five-, and ten-year time of travel capture zones for wells
- Inventorying possible contaminating activities
- Determining vulnerability of wells to potential contaminants

1. **Action:** For probable recharge locations, GBA could perform an inventory and map potential sources of contamination including toxic investigation sites, industrial sites, gas stations, dairies, and sites investigated by the RWQCBs, and use this information in selecting recharge sites and in planning recharge site operation in order to minimize the potential for water supply contamination. GBA will compile existing DWSAP reports developed for existing wells to aid in mapping potentially contaminating activities.

2. **Action:** GBA will coordinate with regional water quality agencies, including the U.S. EPA, California EPA, Central Valley RWQCB, the California Department of Health Services, and San Joaquin County Environmental Health Services to identify potential water quality threats to candidate recharge sites, and compile this information into a data management system for use in selection of recharge sites.

9.2.4.2 Identification and Destruction of Abandoned Wells

The presence of abandoned groundwater wells represents a potential hazard to the quality of the groundwater basin. Abandoned and improperly destroyed wells can act as conduits for contaminants to reach drinking water supplies. Deep oil and gas exploration wells may be allowing migration of saline water from deep aquifer units. It is vital for the long-term protection of the basin that abandoned wells be located and destroyed. Well records kept by the GBA and the County Department of Environmental Health Services can help in the process of identifying existing abandoned wells and in identifying wells that are abandoned (stop production) in the future.

While it is the landowner's responsibility to destroy an abandoned well, local water agencies should be proactive about making sure that abandoned wells are in fact destroyed. The destruction of abandoned groundwater wells should be performed in accordance with state standards. California Water Code Section 13750.5 requires that those responsible for the destruction of water wells possess a C-57 Water Well Contractor's License. Whenever a water well is destroyed, a report of completion must be filed with the California Department of Water Resources within 60 days of the completion of the work. The San Joaquin County Department of Public Health, Division of Environmental Health Services is responsible for permitting and inspecting construction and destruction of wells.

1. **Action:** GBA will work with the County to develop a plan to identify and destroy abandoned wells. Federal and State grants will be sought for these purposes, as appropriate. GBA will encourage local water agencies to actively search for existing abandoned wells in their service areas so that they can be destroyed. Consideration will be given to developing ordinances requiring protocols for identification of abandoned wells upon sale or transfer of property.

9.2.4.3 Protection of Recharge Areas

The following efforts will be undertaken to protect recharge areas:

1. **Action:** Through review of General Plans and other land use plans, the GBA will identify potential projects that may have a significant impact on the quality or quantity of water supplies entering the basin through recharge sites, establish buffer zones, and provide this information to the planning agency. GBA will identify sites with high potential for recharge (e.g. sandy loam surrounding Lodi) and proactively identify them to land use planning agencies. More information on land use planning efforts is provided in the Monitoring section of this chapter.

2. **Action:** GBA will continue to coordinate with watershed related entities including the Regional Water Quality Control Board, DWR, and U. S. Bureau of Land Management.

3. **Action:** The GBA will continue to lead regional efforts to characterize, monitor, and halt saline migration.

9.2.5 Construction and Implementation

Table 4 in Chapter 7 shows the recommended priority of each project and management action. The projects that have the highest priority include the Stockton Delta Water Supply Project, CSJWCD in-lieu incentive program, SEWD surface water distribution system, SEWD treatment plant expansion, Farmington Program, and NSJWCD surface water distribution system rehabilitation. Municipal water conservation is also considered to have the highest priority because measures will need to be initiated immediately in order to achieve UWMP targets assumed for all Action Alternatives. Maintaining existing water rights permits and contracts is also essential to meet planned water needs. Recharge or storage of additional imported water from the American, Mokelumne, Calaveras and Stanislaus Rivers will require feasibility studies to establish rights, alignments, costs, and optimal locations for building the necessary recharge facilities.

Projects and management actions with a high priority are those expected to begin implementation within the next five years. Those with a moderate priority are those expected to begin implementation within the next five to ten years, and those with lower priority will be pursued within a ten to twenty year time-frame.

1. **Action:** GBA will identify implementing agencies for high priority projects and management actions, and will coordinate with those agencies in putting them into service. High priority projects and management actions are those expected to begin implementation within the next five years, and include:

- Implementing water conservation to UWMP levels
- Securing renewal of transfers from OID and SSJID, renewal of the NSJWCD Mokelumne River permit, and renewal of SEWD and CSJWCD CVP contracts
- Stockton Delta Water Supply Project, Phase I
- CSJWCD in-lieu incentive program
- SEWD in-lieu distribution system expansion
- SEWD Water Treatment Plant expansion to 60 mgd

- Farmington Program Phase 1
- NSJWCD surface water distribution system rehabilitation

2. Action: GBA will identify implementing agencies for moderate priority projects and management actions, and will coordinate with those agencies in putting them into service. Moderate priority projects and management actions are those expected to begin implementation within the next five to ten years, and include:

- Continued implementation of high priority projects and actions
- Additional water transfers from WID, OID, and SSJID
- Stockton Delta Water Supply Project, Phase II
- New diversions on the Lower Mokelumne River
- Farmington Program Phase 2
- Conveyance of American River water rights filing through unused Freeport Project pipeline capacity
- Lodi surface water treatment plant
- SCJWCD Burlington-Northern recharge ponds
- Large-scale recharge pond construction, including in the Multi-purpose area south of Lodi
- Lodi reclamation
- MORE WATER with Pardee diversion to Duck Creek Reservoir
- Regional water banking
- Aggressive water conservation

3. Action: GBA will identify implementing agencies for lower priority projects and management actions, and coordinate in putting them into service. Lower priority projects and management actions are those expected to begin implementation within the next ten to twenty years, and include:

- Continued implementation of high and moderate priority projects and actions
- Saline Barrier Project
- South Gulch Reservoir and Upper Farmington Canal
- Farmington Dam
- Lyons Dam

9.2.6 Governance

The Groundwater Banking Authority is currently only empowered to perform planning studies, investigations and install groundwater monitoring facilities, but it has long been contemplated to amend the JPA agreement to allow project implementation, construction and ownership of facilities once these projects are ready to move forward. The GBA is a logical entity for this role because the GBA:

- is programmatic in its scope
- encompasses the entire Management Area
- provides representation from all water supply entities including cities, county and water districts
- facilitates participation of all water suppliers and regional interests
- has the institutional capacity to finance and manage projects
- performs regional planning, monitoring, reporting, and adapts its planning to changing conditions

Most projects will be implemented by local water suppliers, with only planning assistance from the GBA. The regional scope of the GBA can assist these local agencies with efficient use of monitoring and planning funds, providing manifold benefits.

Working through an interest-based planning process resulting in a program to ensure the reliability and sustainability of the region's water supplies will significantly reduce conflict between water users, both within the Planning Area and within the Solution Area. Regional planning efforts like the 2004 Eastern San Joaquin Groundwater Management Plan and 2002 San Joaquin County Water Management Plan have significantly advanced this goal.

The GBA employs a mutual interest-based governance framework that creates a stakeholder group of common interests with the powers to undertake specific goals and objectives. The GBA is a Joint Powers Authority which is represented by individual agencies overlying the Basin with the common interest being the health of the underlying Basin. The GBA is a consensus based forum in which projects can be developed by stakeholders in a manner that maximizes benefits to all involved parties and the region as a whole. Projects developed with input from the stakeholder group ensure consistency with the Plan.

The distinct advantage to this approach is the benefit of regionalism. Broad-based support for projects potentially deters or reduces litigation, protest, and opposition. In addition, regional projects are more competitive in the funding arena both at the State and federal levels. A potentially negative aspect of this management framework is the perceived loss of control over a project. Nonetheless, a project will be weighed and measured on its merits and its fate decided on by its constituents. It is highly unlikely that a mediocre project without broad-based consensus will survive an onslaught of political, legal, and regulatory challenges.

Presented in Figure 9-1 is the current Authority governance structure. The Authority is a forum for its member agencies to develop groundwater recharge and banking projects and programs. The forum creates accountability for its member agencies to health of the underlying Basin. Development within the Authority ensures that projects are consistent with the Basin Management Objectives developed in this Plan to sustain the health of the Basin. The Authority would not be governed by the County Board of Supervisors, however, as currently structured, should a Groundwater Export Permit be necessary for an export project, Board of Supervisor approval would be required.

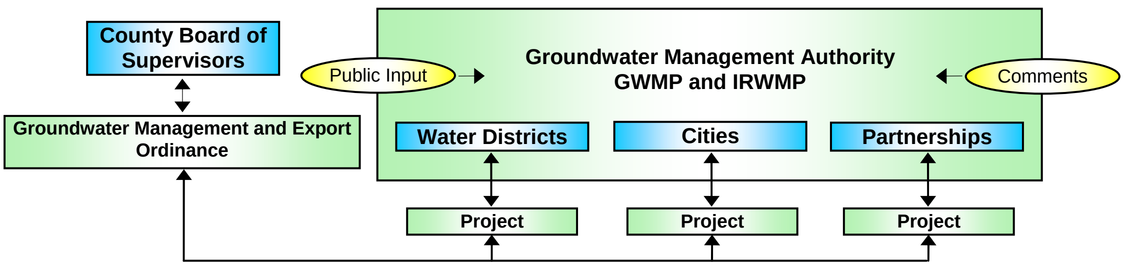

Figure 9-1 Mutual Interest-based Model

1. **Action:** The GBA membership will identify projects best implemented by a regional entity and amend the JPA agreement as appropriate to allow GBA (or successor Groundwater Basin Authority to construct, operate and manage such projects.

2. **Action:** The GBA will make recommendations on Regional Governance options to best address IRWMP Objectives and facilitate implementation, and application and distribution of grant funds for the Projects and Actions identified in this Plan See Figure 9-2.

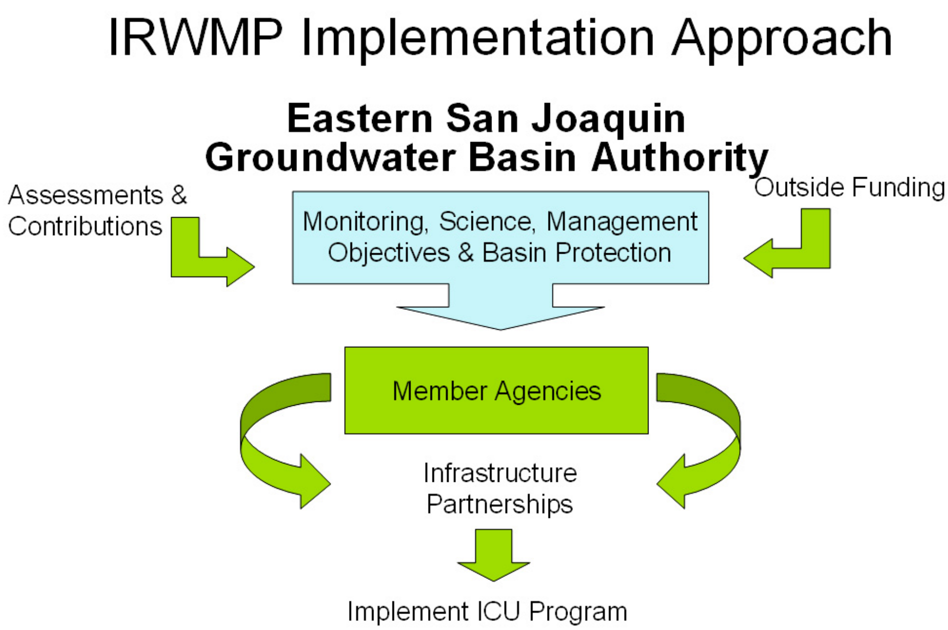

Figure 9-2 Potential Implementation Approach of Groundwater Basin Authority

9.2.7 Financing

Implementing the Integrated Regional Water Management Plan (IRWMP) will require an array of financing mechanisms, such as bonds, grants, or low interest loans. Cost savings may be incurred through implementation of conservation and water reuse projects. In addition, cooperative funding agreements between GBA and other water managers in the GBA service area or cost-share agreements between GBA and local, state, or federal agencies may also provide funding for RWMP projects and management actions. Water banking arrangements have the potential to provide a revenue stream to pay for needed capital improvements. A discussion of potential financing mechanisms is presented in a subsequent section of this chapter.

1. **Action:** As project and management actions in the IRWMP are defined in more detail, GBA will conduct a review of federal, state, and regional funding sources as well as potential assessments, fees, and charges to develop a financing plan that comprises an array of financing mechanisms appropriate for each IRWMP project or management action, including bond funding, low-interest loans and grants, and cooperative cost-share agreements.

2. **Action:** GBA will develop a multi-year Capital Improvement Program (CIP) for the ICU Program using the IRWMP as its basis. The plan will include a schedule, priority and cost for implementation.

3. **Action:** GBA will research and pursue grants, with an emphasis on funds from Propositions 50 and 84, and identify potential Federal funds to be used for CIP implementation.

4. **Action:** GBA will identify local cost-sharing partners among the benefiting entities and determine the best mix of debt, fees and charges for implementing projects and management actions.

9.2.8 Public Participation/Community Outreach

GBA formed a Coordinating Committee comprised of local stakeholders and water purveyors. The Committee met regularly during development of the Integrated Regional Water Management Plan, reviewing and providing comments and suggestions on the Plan. Committee members are listed in Chapter 1. GBA will continue to consult with the Committee on project implementation and financing.

GBA publishes a periodic newsletter which is mailed to those on its growing distribution list. Regular updates on the development of the Integrated Regional Water Management Plan have been included.

GBA has an established Speakers Bureau which provides Board members and Authority staff to address water related topics with local audiences.

1. **Action:** GBA will continue to coordinate, participate in, and implement recommendations of the GBA Board and Coordinating Committee.

2. **Action:** GBA will continue to develop and publish its newsletter.

3. **Action:** GBA will maintain its Speakers Bureau to provide timely water related information to the public.

4. **Action:** GBA's web site (http://www.gbawater.org/) contains information on GBA projects, water supplies and resources, water education, Authority publications, a calendar of events, meeting agendas, and general information about GBA. GBA will continue to provide this service.

9.3 Implementation Schedule

A schedule for implementation of the ICU Program is provided in Figure 7-37 in Chapter 7 of this IRWMP.

9.4 Financing Plan

This section provides a description of the range of financing options available to the GBA and its member agencies. This information will help guide selection of financing options as IRWM Plan projects and actions move into implementation.

9.4.1 Sources of Capital Funding

There are a variety of capital funding sources which can be utilized to finance new facilities associated with water resource projects. These include pay as you go, grants, low interest loans, bonds, certificates of participation and public-private partnerships. Each of these capital funding sources is described below.

Pay As You Go - Pay as you go capital funding refers to meeting construction payment obligations from current operating revenues as construction proceeds. This approach is commonly utilized by large utilities or public agencies which have excess revenues or net incomes significantly larger than construction payment obligations. Smaller public agencies also favor this approach, if feasible, for small construction projects as the issuance costs for a bond financing can be substantial in relation to the capital generated. Obviously, if a construction budget is large in relation to the available margin of revenues above expenses for the project proponent, this approach is not feasible.

Grants

From time to time, both the federal and state governments have grant programs to help fund assorted water infrastructure projects.

Federal - No current grant programs for clean water infrastructure facilities are believed to be available by the federal government. In view of the recent southeastern US hurricane damage, impacting numerous water and wastewater system facilities, it is unlikely any non-earmarked federal grant program for water facility construction outside of this region will be available for the foreseeable future.

State (Proposition 50 and Proposition 84) - California has one current grant program available to finance water infrastructure. Proposition 50 (known as the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002) authorized the Legislature to appropriate funds for Integrated Regional Water Management (IRWM) projects. This grant program is jointly administered by the Department of Water Resources and State Water Resources Control Board.

Chapter 8 of the act provides about $380 million for Integrated Regional Water Management Projects. Grant funding will be available to local agencies for projects that are formulated through an integrated regional planning process. Funding is available for implementation of regional projects (Implementation Grant) and to support development of Integrated Regional Water Management Plans (IRWMPs). Two cycles of funding are being used to select projects for funding. The first cycle projects submitted deadline is past leaving only on the order of $200 million available for cycle two funding which is scheduled to begin later in 2006. To qualify for Implementation Grant funding, the proposed projects need to be the outcome of an IRWMP. Such plans should be developed and adopted by agencies in the region no later than January 1, 2007. Only one Implementation Grant application will be accepted from each region. However, each grant application may request funding for more than one project. Each grant is limited to a maximum of $50 million.

Loans (low interest) - As with grant programs, both the federal and state governments frequently have low interest loan programs available to support water infrastructure projects.

Bonds

General Obligation Bonds - General obligation bonds (also termed GO bonds) are issued by public agencies (state, counties and cities, and special districts) to raise capital for public works and other purposes, including water system infrastructure construction. They are guaranteed by the faith, credit and taxing power of the issuer. Although typically secured by a pledge of the issuer's ad valorem taxing power, in some cases repayment security may derive from other revenue sources such as user charges. For example, water replenishment districts are authorized to issue GO bonds based on a repayment commitment from replenishment assessments. Authority to issue GO bonds normally must be obtained from public agency voters with a two-thirds approval. Other restrictions also apply. For example, a city is limited in its ability to issue GO bonds in the aggregate not to exceed 15 percent of all assessed property, both real and personal, within the city. Likewise, counties have a GO debt limit of 5 percent of all assessed valuation. In view of the low default rates of GO bonds, market interest rates are typically lower than for revenue bonds.

Revenue Bonds - Revenue bonds are used to finance capital infrastructure which is revenue producing. Revenue bonds are special obligations of the issuing entity with repayment solely from the revenues produced by the constructed infrastructure and from no other source of funds. Normally, revenues derived from the constructed facilities must also be sufficient to cover the cost of maintaining and operating the facility. In addition, bond covenants pledge that net revenues will be equal to an amount sufficient to meet all repayment and expense obligations plus an operating margin or coverage which typically varies from about 1.2 to 1.5 times the amount of the debt service. Coverage margins typically reflect the source of the loan as well as the financial characteristics and credit worthiness of the issuing agency. Water systems facilities are typically financed with the use of revenue bonds in accordance with the Revenue Bond Law of 1941. In accordance with this Act, an election must be held with a majority of the voters at the election approving the revenue bond issue.

Assessment Bonds (1911 or 1915 Acts) - Since the passage of Proposition 13 limiting the allowable increases in annual property taxes, the creation of assessment districts, in existence since the early 1900s, has been a popular alternative method of financing public infrastructure. Approximately one third of privately owned property in California is included within an assessment district. Assessment districts are created in accordance with either the Improvement Act of 1911 or the Municipal Improvement Act of 1913. The former act can also be used to fund improvement maintenance. These two acts set forth the procedures for implementing an improvement project and for levying the assessment to pay for such work. Assessment bonds to fund capital improvements can be issued by assessment districts in accordance with associated assessment bond acts. The prior referenced Improvement Act of 1911 provides for authorization to levy assessments and issue related bonds. However, the Improvement Act of 1913 has no bond procedures, but improvements can be financed through a subsequent bond act known as the Improvement Bond Act of 1915 (solely a bond act). These acts may be utilized in various combinations. There may be a 1911 act assessment with a 1911 or 1915 act bond; or a 1913 act assessment with a 1911 act or 1915 act bond. However, there is no such thing as a 1913 act bond or a 1915 act assessment.

An assessment district is created by a local sponsoring governmental agency. Property owners typically initiate the assessment district creation by circulating a petition which must be signed by property owners representing 60% of the benefited land area. It is essential that properties within the assessment district, which will bear the burden of tax levies to pay for the bond financings receive a direct and special benefit (as distinguished from general benefits obtained by the community as a whole). Following the creation of the assessment district bonds can be approved by the governing board only after the preparation of an Engineer's Report and at the conclusion of a public hearing. In accordance with Proposition 13, the property assessment cannot be based directly on the value of each property but on a mathematical formula that takes into account how much each property will benefit from the constructed infrastructure. Each parcel in the assessment district is obligated for a fixed percentage of the total district debt and will be assessed each year for that portion of the annual debt service.

Certificates of Participation - Proposition 13, passed by the voters in 1978, raised the voter approval threshold for bond debt financing by public agencies from a simple majority to two-thirds. Thereafter, public agencies found it more difficult and cumbersome to obtain debt financing. In response, the alternative of financing with the use of Certificates of Participation (COP) became a widespread practice. In essence, COPs are lease financing agreements which are created in the form of securities that can be purchased by investors as they would any debt instruments. COPs are legally not considered debt, however, thereby not requiring voter debt approval, but only a majority approval by a governing body. COPs are a long term financing approach through a lease or lease purchase agreement that legally is not considered indebtedness under the state constitutional debt limitations and restrictions.

COPs are issued under the following procedure:

1. The public agency identifies the leasable asset, and the purpose and amount of the associated debt.
2. The public agency leases or transfers the asset to a Lessor
3. The Lessor leases the asset back to the public agency.
4. The Lessor transfers its right to receive lease payments to a Trustee (usually a non-profit corporation).
5. The Trustee sells COPs.

COPs are tax exempt, marketable and transferable. However, they normally have a slighter higher interest rate than comparable bond instruments.

Private – Public Partnerships - Public Private Partnerships (PPPs) can involve a wide variety of contractual relationships between the public and private sectors to optimize private sector involvement in public projects with the goal of optimal cost savings and operational performance. Project design involving the private sector in public operations can range from a simple outsourcing of public sector functions to a private operator to the other end of the spectrum where privatization is accomplished through the sale of public sector assets to a private sector purchaser and operator. Risk sharing and economic return allocation will vary depending on the level of complexity involved with PPP arrangements.

With regard to alternative sources of capital funding, two alternative arrangements are worthy of consideration. The first is known as Build-Own-Operate (BOO). For this type of arrangement, a private contractor constructs and operates a facility for performing public services without transferring ownership of the facility to the public sector. Legal title to the facility remains with the private sector entity. The second alternative PPP arrangement which would provide a source of capital funding for water system infrastructure is known as Build-Operate-Transfer (BOT). Under this option, the private partner builds a facility to the specifications agreed to by the public agency, operates the facility for a specified time period under a contract or franchise agreement with the GBA, and then transfers the facility to the public agency at the end of the specified period of time. Usually, the private partner provides all or part of the financing, so the contract is structured to be of sufficient length to enable the private partner to realize a reasonable return on investment.

The two PPP examples above would provide a source of capital funding from the private sector. Private sector funding would be through conventional approaches such as corporate utility bond sales, use of corporate retained earnings, marketing of corporate preferred or common stock and other conventional financing methods. However, such private sector funding would likely be higher in cost than utilizing alternative public agency sector financing approaches. One mitigating method of lowering private sector financing of public sector projects is through the use of private activity bonds. These tax exempt bonds could be issued by or on behalf of local or state government for the purpose of providing financing benefits for qualified projects. These bonds are typically used to attract private financing for projects that have some public benefit.

Unfortunately, under the rules governing private activity bonds enforced by the Internal Revenue Service, federally mandated state volume cap restrictions have limited their use for less politically attractive water and wastewater infrastructure financing needs. In California, no private activity bonds have been authorized for water infrastructure in recent years. However, a congressional bill (Clean Water Investment and Infrastructure Security Act of 2005) would amend the Internal Revenue Code of 1986 to provide that the volume cap for private activity bonds shall not apply to bonds for water and wastewater facilities. This legislation is currently in committee. If successful, this legislation would provide the opportunity to sell tax exempt private activity bonds for PPP contract arrangements thereby lowering the financing cost for such projects when compared to private sector financing alone.

9.4.2 Sources of Repayment Revenues

There are various alternative land secured taxes (property taxes) available to utilize in generating revenues to guarantee or support capital repayment. These include general ad valorem taxes, special taxes (Mello Roos), special assessments and water standby and/or delivery parcel fees. Other potential sources of repayment revenues include user charges, pump taxes or replenishment assessment fees, development impact fees, connection or capacity fees, and reserve funds. Each alternative is described in the following subsections.

Property Taxes

General Ad Valorem Taxes - Since 1978 with the passage of Proposition 13, California has had an acquisition-value assessment system for the levying of ad valorem property taxes. This system provides that property is to be assessed at its acquisition value either through a change of ownership or new construction (all property at the time of Proposition 13 passage was initially established at 1975-76 assessed values). The property tax rate cannot exceed 1 percent o f the assessed value without a voter approved override. Further, the assessed value of residential property can increase by the consumer price index each year up to a maximum of 2 percent. Property 218, passed in 1996, further requires all local governments to obtain a majority vote approval for new or increased general taxes.

Because GO bonds normally are repaid from ad valorem property taxes, a two-thirds voter approval must be obtained to override the limitations of Proposition 13.

Special Tax (Mello-Roos) - A commonly utilized approach for financing infrastructure through land secured debt is through the creation of a Mello-Roos Community Facilities District (CFD). The legislation creating this financing vehicle approach was enacted in 1982 by the state legislature to provide an alternative means of financing public infrastructure and service in response to the 1978 passage of Proposition 13. This legislation complies with proposition 13 allowing local governments to create defined areas which, in accordance with a two-thirds approval vote, are subject to special taxes to pay for public improvements and services necessary to serve the created area. The targeted area subject to a special tax is known as a Community Facilities District (CFD). Water and sewer lines, as well as utility improvements are among those facilities which can be financed through a Mello Roos CFD. Projects financed through this approach are not required to meet a special benefit test in view of financing through a tax as apposed to an assessment. However, there should be a relationship between the special tax levied and benefits received to a specific land use. There are two primary restrictions on the amount of financing available for any CFD. One is the value to lien ratio, which is the ratio of the land value to the principle amount of the special tax lien. A minimum value to lien ratio of 4 to1 is required by statute. Second, although not a legal limit, a total effective tax rate (ad valorem property tax rate, plus voter approved bonded indebtedness; and other taxes, assessments and parcel charges) should not exceed 2% of market value which is considered a level of tax payer resistance for residential development throughout the state.

Special Assessments (CSD Financing and Assessment Bonds) - Some public agencies, such as a Community Services District, have the authority to levy special assessments in order to finance their facilities and services. A CSD is an independent special district as frequently created to provide a wide variety of public facilities and services such as supplying domestic, irrigation, industrial, fire protection and recreational water. In selected cases CSD's have also been granted addition powers on an individual basis, such as the authority to operate and construct hydroelectric generation facilities. In addition to many other funding alternatives, a CSD can levy a special assessment upon formation of an improvement district, which fees assessed must directly relate to the benefits being received by the property incurring the obligation. The CSD services may be broken into zones to target limited benefited areas within the district for the purpose of financing. For each zone created, special assessments or taxes may be levied to pay for the improvements or service being provided, as well as bonds issued to raise capital funds.

As indicated above, the creation of an assessment district and the marketing of associated bonds for capital improvements create debt service requirements for parcel owners. Each parcel in an assessment district has an associated responsibility for a fixed percentage of assessment district debt and is levied that portion of the debt service due on the bond financing each year.

Water Standby/Delivery Parcel Fees - The Metropolitan Water District of Southern California and its sub-agency, the West Basin Municipal Water District in the past both have imposed a standby charge on all assessable parcels in their respected service areas in accordance with statutory authority. The imposition of a water standby charge is subject to voter (land owner) approval consistent with the passage of Proposition 218. In the case of West Basin Municipal Water District, the GBA is required to establish the standby charge each year following a public hearing. However, unless the standby charge is increased, there is no additional statutory protest procedure, referendum requirement, or other alternative procedure available to protest the standby charge imposition. Standby charges are collected through the County of Los Angeles real property general tax roles.

User Charges - Under this approach, the cost for principle and interest payments per loan or bond repayment terms are collected by surcharges or an addition to the monthly service charges for water delivered. These collected surcharges are accrued by the public agency to make annual payments (or payments based on other terms) to the lender. Public agencies making improvements to water systems have in the passed borrowed safe drinking water funds from the state with a surcharge mechanism attached to water rates or service created for loan repayment. This kind of user fee is

not approved by a vote of the users or rate payers. They are generally established following public hearings and adoption by the governing public agency board.
Pump Tax or Replenishment Assessment Fees - A pump tax or water replenishment assessment tax is a revenue producing approach whereby each ground water pumper pays a tax or replenishment assessment fee on each acre foot of ground water pumped. Revenues produced from ground water production are used to purchase water for ground water replenishment, pay for operating expenses and administrative costs for the public agency responsible for the management of the ground water basin, repay bonded indebtedness or other sources of capital funding, and other purposes.

A water replenishment assessment or pump tax system was first utilized in California by the Orange County Water District in the early 1950's to purchase replenishment water to reduce an accumulated overdraft of the Orange County Ground Water Basin. The pump tax system was adopted by the California Legislature on behalf of the District and was subsequently tested in Superior Court and the Court of Appeals with a constitutional challenge. Ultimately, this financing approach was upheld by the state Fourth District Court of Appeals and is now used by a number of public water districts in the state including Chino Basin Watermaster, Water Replenishment District of Southern California, Santa Clara Valley Water District and others. This approach is considered to be an equitable and fair allocation of the taxing burden for water management purposes to those who are the direct beneficiaries. Institution of a pump tax system requires measurement and records of water production from all active wells operating within a ground water basin in order to produce accurate ground water production data against which a water replenishment assessment can be applied.

Although the replenishment assessment is primarily levied for ground water replenishment and management expenses, revenues are also used to finance capital projects. For example, in 1989, the Water Replenishment District of Southern California successfully requested legislation which clarified the District's water quality management role and established a funding mechanism for ground water quality enhancement and protection. The Legislature provided authority for water replenishments districts in California to establish programs for the prevention, control and clean up of ground water contamination. The new law allowed a portion of the replenishment assessment on pumping to be established to raise funds to finance projects to remove and control contaminants in ground water supplies, as well as projects implemented to prevent ground water quality contamination. Such projects can include new facilities to meet the objectives of water quality enhancement and protection. The assessment portion approved for water quality projects may not exceed fifty percent of the five year average water replenishment assessment including the current and previous four years.

Development Impact Fees - Impact fees are not taxes and, therefore, do not require a voter approval. These are one time charges levied on new construction projects by a local public agency to fund new public facility infrastructure in support of new development. Impact fees are commonly used to create revenue to support funding of sewer and water treatment plant expansion to meet new development. Operational expenses cannot be paid for from impact fees. In addition, these charges are distinct from connection fees (see below). The Mitigation Fee Act, passed by the State Legislature in the late 1980's, permits a broad range of public facilities to be finance through this revenue source including water distribution and treatment facilities, water storage, sewage treatment and disposal plant infrastructure, storm drainage facilities and many other publicly constructed infrastructure. Among other requirements, impact fees can be imposed by local government if they: 1) Identify the purpose of the fee; 2) Identify the uses of the fee, including identification of the infrastructure improvements to be financed; 3) Show a reasonable relationship between the type of development and the fees use; and 4) Present a reasonable relationship between the amount of the fees and the cost of the facilities constructed as a result of the fees. Impact fees cannot provide security for bonds although they can be used in association with debt financing to help retire bonds secured by other means.

Connection or Capacity Fees - Another alternative to utilize for the funding of new development infrastructure is through the use of connection fees (also called capacity fees). As with impact fees discussed above, connection fees are assessed on a one time basis when the customer makes the connection to a water, sewer, or storm drainage system. Funds raised through this approach are used to pay for capital improvements required by the system infrastructure required for new demands in growth.

Reserves - A source of repayment revenues for capital funding may be derived from the use of reserve funds. Reserve accounts are established to accrue a level of current revenues in support of future capital needs as projected in a public agency's capital improvement plan. For example, in the past the Santa Clara Valley Water District established a reserve fund for immediate or emergency replacement of water system infrastructure with annual accrued amounts paid into the fund at approximately 2 percent of the book value of the water enterprise plant and equipment. Naturally, the use of reserve funds for capital funding is only feasible if a fund has been in existence for a sufficient number of years to build up an adequate balance upon which to draw from.

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