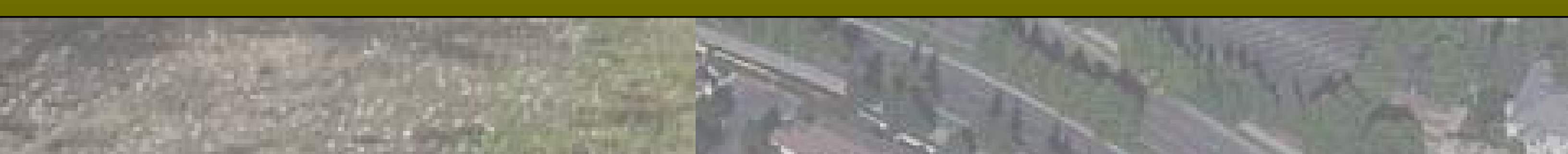
Appendix G: Supplemental Water Supply Information

- Eastern San Joaquin Groundwater Basin Groundwater Management Plan 2004
- DWR Bulletin 118, San Joaquin River HR

September 2004

Eastern San Joaquin Groundwater Basin Groundwater Management Plan

Northeastern San Joaquin County Groundwater Banking Authority



Eastern San Joaquin Groundwater Basin Groundwater Management Plan

Jack A. Sieglock, Chairman
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Copies of the Groundwater Management Plan may be purchased for $50 from:
San Joaquin County Department of Public Works
P.O. Box 1810
Stockton, California 95201

Make checks payable to: San Joaquin County Department of Public Works

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 groundwater resources in the Eastern San Joaquin Groundwater Basin. Members agreed to work cooperatively with unanimity toward achieving water resource planning objectives and to speak with one regional voice. This Groundwater Management Plan is the result of this inexorable collaborative effort, which was single-minded in its effort to reinforce local control and provide direction for the sustainable development of this vital resource for the future social, economic and environmental viability of San Joaquin County.

Mel Lytle, Ph.D.
Water Resource Coordinator

Acknowledgements

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This Groundwater Management Plan (GMP) is a product of the commitment that the Groundwater Banking Authority (GBA) members together with many other interested agencies made to sustain and enhance the groundwater resources of the Eastern San Joaquin Basin. The GBA extends thanks to staff consultants from HDR, Schlumberger Water Services and Camp Dresser & McKee Inc. in the preparation of materials, modeling information and technical review of the GMP. In addition, special thanks are given for grant funding, information and services provided by the California Department of Water Resources, 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 the GMP. Significant 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

Board of Directors

Supervisor Jack A. Sieglock, *Chairman*
San Joaquin County Board of Supervisors

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Anders Christensen
Woodbridge Irrigation District

Director Mel Panizza
Stockton East Water District

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City of Lodi

Reid Roberts
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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 Members

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California Water Service Company

Joe Petersen
San Joaquin County Farm Bureau

Staff

T. R. Flinn, *Secretary*
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Mel Lytle, Ph.D., *Water Resources Coordinator*
San Joaquin County Department of Public Works

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List of 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
BMP – Best Management Practice
Cal Water – California Water Service Company
CCWD – Calaveras County Water District
CDWA – Central Delta Water Agency
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
cfs – Cubic Feet per Second
CSJWCD – Central San Joaquin Water Conservation District
CVP – Central Valley Project
CVPIA – Central Valley Project Improvement Act
DMM – Demand Management Measure
DO – Dissolved Oxygen
DWR – California Department of Water Resources
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
FERC – Federal Energy Regulatory Commission
FSC – Folsom South Canal
FRWP – Freeport Regional Water Authority
GBA – Groundwater Banking Authority
GIS – Geographic Information System
GMP – Groundwater Management Plan
GOES – Geostationary Observational Environmental System
JPA – Joint Powers Agreement
MARS – Mokelumne Aquifer Recharge & Storage
mg/L – Milligrams per Liter
MGD – Million Gallons per Day
MORE WATER – Mokelumne Regional Water Storage and Conjunctive Use Project
MO – Management Objective
MOU – Memorandum of Understanding
MRWPA – Mokelumne River Water and Power Authority
MSL – Mean Sea Level
MW – Megawatts
NSJWCD – North San Joaquin Water Conservation District
OID – Oakdale Irrigation District
RWQCB – 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

SDWA – South Delta Water Agency
SEWD – Stockton East Water District
SJCOG – San Joaquin Council of Governments
SSJID – South San Joaquin Irrigation District
SWP – State Water Project
SWRCB – State Water Resources Control Board
TDS – Total Dissolved Solids
TMDL – Total Maximum Daily Load
USACE – United States Army Corps of Engineers
USBR – United States Bureau of Reclamation
USGS – United States Geological Survey
WHPA – Wellhead Protection Area
WID – Woodbridge Irrigation District

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Executive Summary

ES-1 Background

Independently, agencies in Eastern San Joaquin County have found it difficult to wield the political and financial power necessary to mitigate conditions of critical groundwater 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 successfully implementing groundwater management actions that are equitable, affordable, and provide far reaching benefits locally, regionally, and Statewide.

Organized in 2001, the Northeastern San Joaquin County Groundwater Banking Authority (Authority) employs the consensus based approach in its goal to develop "…locally supported groundwater banking projects that improve water supply reliability in Northeastern San Joaquin County…and provide benefits to project participants and San Joaquin County as a whole." Collaboration amongst the Authority 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. The Groundwater Management Plan for Eastern San Joaquin County (Plan) is a continuation of the collaborative effort to effectively manage the Eastern San Joaquin Groundwater Basin (Basin). Table ES-1 lists the member agencies of the Authority.

Table ES-1 Member Agencies of the Northeastern San Joaquin County Groundwater Banking Authority
City of Stockton
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
California Water Service Company*
San Joaquin Farm Bureau Federation*
* Associate Members

ES-2 Purpose and Objectives

The purpose of the Groundwater Management Plan is to review, enhance, assess, and coordinate existing groundwater management policies and programs in Eastern San Joaquin County and to develop new policies and programs to ensure the long-term sustainability of groundwater resources in Eastern San Joaquin County. To better define the supporting values included with this Plan's purpose, the Authority has listed the following mission values centered on the development of the Plan as outlined in Table ES-2.

Table ES-2 Groundwater Management Plan Mission Values for Success		
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 water 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	Protect the rights of overlying land owners	Increase amount of water put to beneficial use within San Joaquin County

In order to meet the purpose of the Plan and ensure the long-term sustainability of the Basin, the Authority created the following Plan objectives:

1. Maintain long-term sustainability of the Basin through the development of management objectives, practices and conjunctive use projects to benefit the social, economic and environmental viability of Eastern San Joaquin County.
2. Prevent further saline intrusion and degradation of groundwater quality throughout the Basin.
3. Increase understanding of Basin dynamics through the development of a sound research program to monitor, evaluate, and predict Basin conditions.
4. Maintain local control of the groundwater Basin through the responsible management of groundwater resources by overlying cities, counties, water districts, agencies, and landowners.
5. Formulate rational and attainable Basin management objectives to comply with SB 1938 and retain State funding eligibility.
6. Formulate voluntary policies, practices and incentive programs to meet established Basin management objectives.
7. Formulate appropriate financing strategies for the implementation of the Plan.

ES-3 Groundwater Management Area

San Joaquin County overlies the Eastern San Joaquin, Cosumnes, and Tracy Sub-basins of the greater San Joaquin Valley Groundwater Basin. For the purposes of the Plan, the Eastern San Joaquin County Groundwater Management Area (GMA) is defined as the portion of San Joaquin County overlying the Eastern San Joaquin and Cosumnes Sub-Basins. Within the GMA, the member agencies of the Authority will implement the Plan within their respective boundaries. To ensure that every parcel in the GMA is represented, all unorganized areas will be included in the San Joaquin County Flood Control and Water Conservation District. Figure ES-1 depicts the member Agencies of the Authority and their respective boundaries within the GMA.

ES-4 Agency Participation

The physical boundaries of the Eastern San Joaquin and Cosumnes Sub-Basins extend beyond the political boundaries of San Joaquin County. Portions of Calaveras and Stanislaus Counties overlie the eastern fringes of the Basin. Recognizing the need for increased coordination between agencies outside of the GMA, the Authority invited a variety of interest groups from the business, environmental, agricultural, and political communities to participate in the development of the Plan. The Authority values the consensus based approach to groundwater management and strives to coordinate, integrate, and mutually benefit from the groundwater management efforts of its member agencies and those with vested interest in the social, economic, and environmental viability of Eastern San Joaquin County.

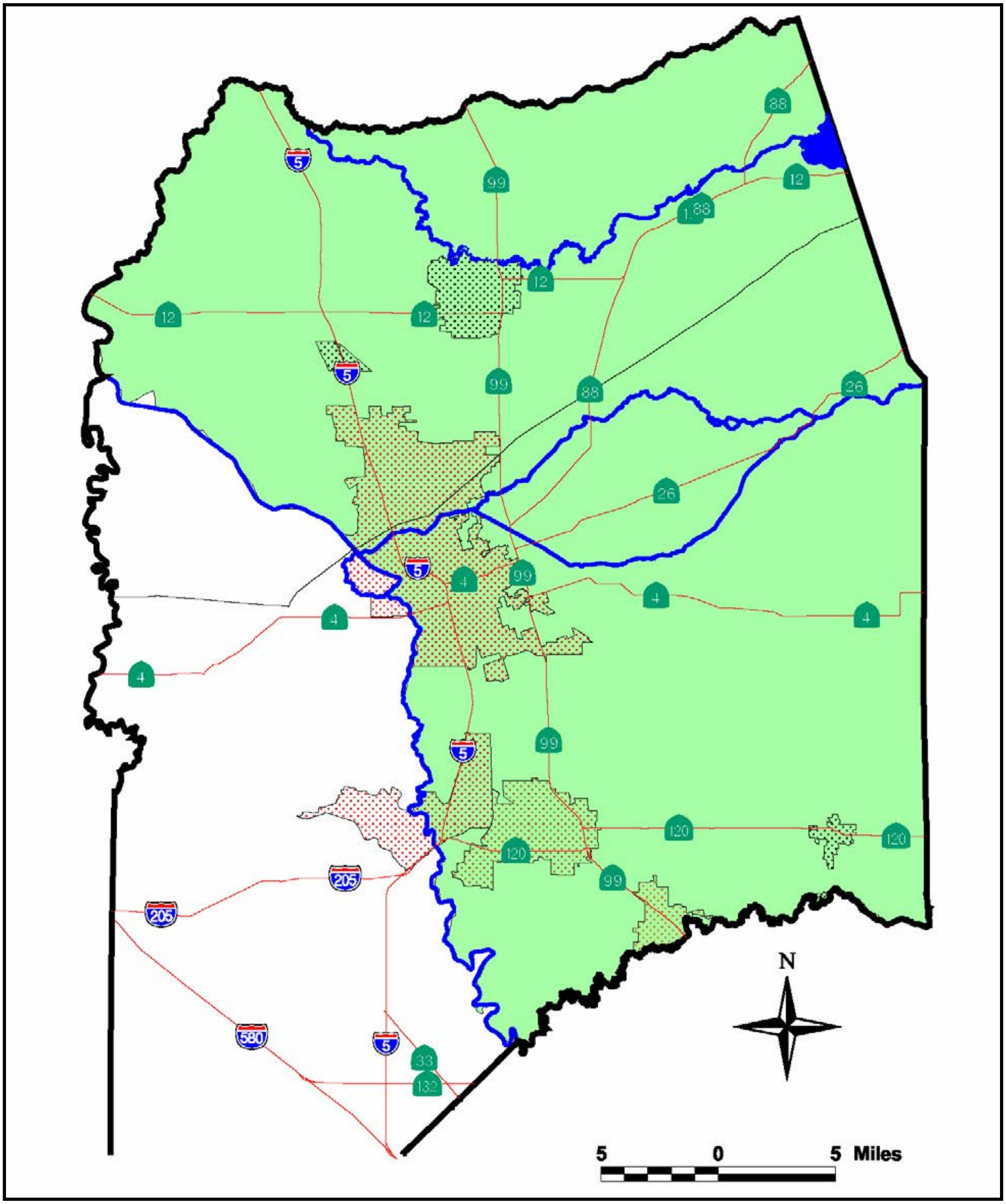


Figure ES-1 Groundwater Management Area
Source: California Spatial Information Library at http://www.gis.ca.gov/

Throughout the planning process, the Authority's Coordinating Committee, a technical sub-group of the Authority, convened every 4th Wednesday of the Month to formulate the Plan. Key discussion points and decisions were debated and finalized by the Coordinating Committee and incorporated into the Plan by Authority 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 Plan at their regular meetings on the 2nd Wednesday of the month. For the purpose of providing an atmosphere conducive to broad-based consensus building and compromise, Authority Coordinating Committee meetings were facilitated through the California Center for Collaborative Policy.

Attendees of these meetings include representatives from over 40 agencies and interest groups. Table ES-3 is a list of meeting attendees and agencies contributing to the plan.

Table ES-3 Groundwater Management Planning Participants

Local Participants & Agencies	
Anders Christensen	Woodbridge Irrigation District
Cary Keaton	City of Lathrop
Dante Nomellini	Central Delta Water Agency
Dave Kamper	South San Joaquin Irrigation District
Ed Formosa	City of Stockton Municipal Utilities Department
Ed Steffani	North San Joaquin Water Conservation District
Gary Giovanetti	Stockton City Council
Joe Petersen	San Joaquin Farm Bureau Federation
John Herrick	South Delta Water Agency
Keith Conarroe	City of Manteca
Kevin Kauffman	Stockton East Water District
Larry Diamond	Calaveras County Water District
Loralee McGaughey	Stockton East Water District
Mark Lindseth	City of Lodi
Mark Madison	City of Stockton Municipal Utilities Department
Mel Lytle	San Joaquin County Public Works
Melvin Panizza	Stockton East Water District
Michael McGrew	San Joaquin County Counsel
Paul Risso	California Water Service Company
Ray Borges	San Joaquin County Environmental Health
Reid Roberts	Central San Joaquin Water Conservation District
Richard Prima	City of Lodi
Steve Stroud	South San Joaquin Irrigation District
Teresa Tanaka	Linden County Water District
T.R. Flinn	San Joaquin County Public Works
Tom Gau	San Joaquin County Public Works
State Participants & Agencies	
Ann Jordan	Office of State Senator Charles Poochigan
Mary Bava	Office of Assemblyperson Barbara Matthews
Tim Parker	Department of Water Resources
Federal Participants & Agencies	
David Simpson	Natural Resource Conservation Service
Eric Reichard	US Geologic Survey

John Izbicki	US Geologic Survey
Patrick Dwyer	US Army Corps of Engineers
	Other Participants & Agencies
Barbara Williams	Sierra Club
Carolyn Ratto	California Center for Collaborative Policy
David Beard	Great Valley Center
Gerald Schwartz	East Bay Municipal Utility District
Gina Veronesc	Camp, Dresser, & McKee
James Cornellius	Calaveras County Water District
James Moore	Galt Economic Development Task Force
John Aud	Stanislaus County
Larry Diamond	Calaveras County Water District
Mark Williamson	Saracino-Kirby-Snow
Robert Vince	Camp, Dresser, & McKee
Ron Addington	Business Council, Inc.

The Authority will continue to seek the input of its neighbors and interest groups during the implementation of the Groundwater Management Plan and any future planning efforts.

ES-5 Consistency with Water Code Section 10750 *et. seq.*

Groundwater management is the planned and coordinated effort of sustaining or improving the health of the underlying basin in order to meet future water supply needs. With the passage of Assembly Bill (AB) 3030 in 1992, local water agencies were provided a systematic way of formulating groundwater management plans and granted the Authority to implement those plans through fees and assessments. AB 3030 also encourages coordination between local entities through joint power authorities or memorandums of understanding.

In 2002, the passage of Senate Bill (SB) 1938 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 ES-4 illustrates the recommended components of a groundwater management plan as outlined in AB 3030 and the required sections under SB 1938. Table ES-4 also indexes the sections of this Plan where the recommended or required AB 3030/SB 1938 components are addressed.

ES-6 Eastern San Joaquin County Hydrogeology

Current and historical groundwater pumping rates exceed the sustainable yield of the underlying groundwater Basin on an average annual basis. Historic groundwater level trends as seen by well hydrographs throughout the Basin illustrate the following trends:

1. In the central portion of the Basin, the groundwater table dropped continuously from the 1950s to the early 1980s. Inclines during the early 1980s are attributed to extreme wet years of heavy rainfall.

2. In the northern part of the Basin, groundwater levels declined into the early 1990s.

3. Beginning in the early 1980s, a distinct drawdown and recovery cycle appears be driven by climatic conditions more than long-term changes in groundwater use.

4. Groundwater levels in the early 1990s had declined to the point where a number of wells throughout the Basin could not be operated. The severity of the situation forced many pumpers to construct new deeper wells.

Table ES-4 Components of a Groundwater Management Plan

Plan Component	Recommended by AB 3030	Required by SB 1938	Plan Sections
Control of saline water intrusion	X		2, 3, 4, 5, 8
Management of wellhead protection and recharge areas	X		4
Regulation of contaminated groundwater	X		4
The administration of a well abandonment	X		4
Elimination of groundwater overdraft	X		2, 3, 4, 5, 8
Replenishment of groundwater	X		2, 3, 4, 8
Groundwater monitoring	X	X	5
Operation of a conjunctive water management system	X		3, 8
Well construction standards	X		4
Financing groundwater management projects	X		6, 7
The development of groundwater management partnerships	X		1, 4, 7, 8
Coordination of land use planning and groundwater management	X		4
Description of participation by interested parties		X	1, 7
Plan to involve agencies overlying the basin		X	1, 7
Basin Management Objectives		X	3
Basin management entity and area map		X	1

Sources: California Department of Water Resources Division of Planning and Local Assistance
http://wwwdpla.water.ca.gov/cgi-bin/supply/gw/management/hq/ab3030/main.pl

California Department of Water Resources Draft 2003 Update Bulletin 118

Figures ES-2 and Figure ES-3 depict the Fall 1993 and Spring 1998 groundwater level contours respectively. The Fall 1993 contour represents the lowest groundwater level contours recorded in the Basin historic record. The Spring 1998 contour represents the recovery of the Basin following years of above average and severe precipitation.

The result of long-term groundwater overdraft is two fold: significant decline in groundwater levels and increased accretions from area waterways. Although increased accretions to the groundwater basin from high quality surface water sources are desirable, accretions in the western fringes of the Basin from the Lower San Joaquin River and older marine geologic formations are generally undesirable primarily due to elevated salt levels. Based on a simplified groundwater balance, as shown in Table ES-5, the net groundwater overdraft is estimated to be approximately 160,000 af/yr.

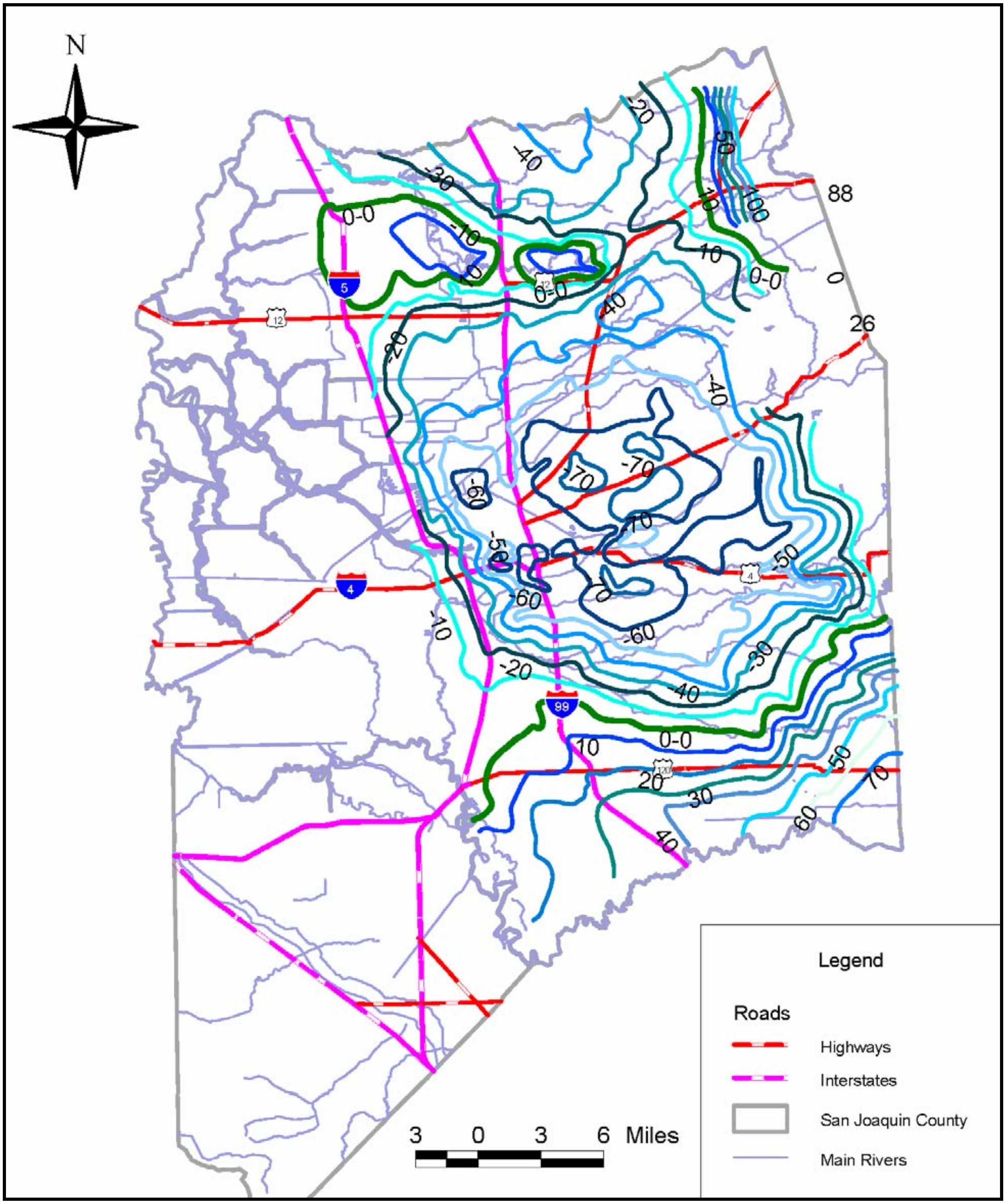


Figure ES-2 Fall 1993 Groundwater Contours
Source: Camp Dresser & McKee Inc.

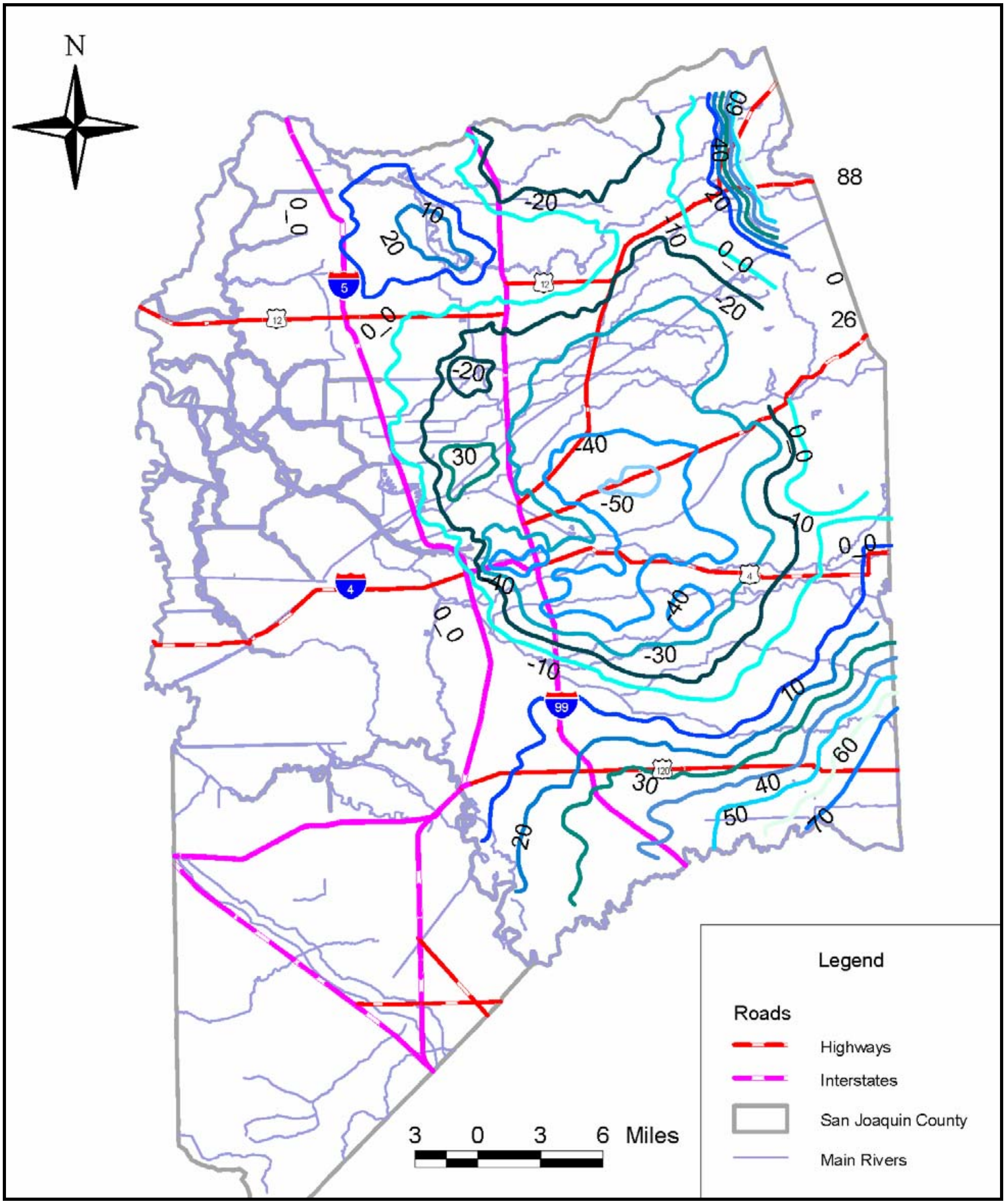


Figure ES-3 Spring 1998 Groundwater Contours
Source: Camp Dresser & McKee Inc.

Table ES-5 Simplified Groundwater Balance for Eastern San Joaquin County		
Groundwater Flow Component	**Average Value**	**Explanation**
Inflows (af)		
Deep Percolation/Recharge	608,400	Net infiltration from rainfall, irrigation, canal leakage etc.
Gain from Streams	198,170	Net inflow from streams to groundwater system
Lateral Inflow	98,000	Net of subsurface inflows and outflows.
Total Inflows	**904,577**	
Outflows (af)		
Groundwater Pumping	867,600	Net agricultural, municipal and industrial pumping
Loss to Streams	108,898	Net outflow from groundwater system to streams
Lateral Outflow	35,300	Subsurface Outflows
Total Outflows	**1,011,815**	
Groundwater Overdraft (af)		
Mined Aquifer Storage	107,238	Total Inflows minus Total Outflows
Estimated Saline Intrusion	42,000	Lateral Saline Intrusion into the Stockton Area
Total Estimated Overdraft	**150,700**	Sum of Mined Aquifer Storage and Saline Intrusion
Source: San Joaquin County Water Management Plan Volume I		

Groundwater flow in the Basin now converges on the depression with relatively steep groundwater gradients eastward from the Delta toward the cone of depression as depicted in Figures ES-2 and ES-3. The eastward flow from the Delta area is significant because of the typically poorer quality water now moving eastward in the Stockton area. Increased lateral inflow from the west is undesirable, as this water is typically higher in TDS and chloride levels and causes the degradation of water quality in the Basin. Figure ES-4 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 ES-4 also depicts the projected 2030 location of the 300 mg/L isochlor under no-action conditions.

Degradation of water quality due to TDS or chloride contamination threatens the long-term sustainability of a very important water resource for San Joaquin County, 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. The saline intrusion problem is not well understood by the Authority. Further studies and monitoring methods are necessary to ensure the problem is addressed and monitored adequately. The Plan further defines the groundwater science and monitoring investigations geared towards both saline intrusion and general Basin understanding.

A no-action or baseline simulation was conducted to predict how current groundwater and surface management practices would impact the groundwater basin in 2030. Groundwater modeling has shown that unless there is a change in how groundwater is used or managed,

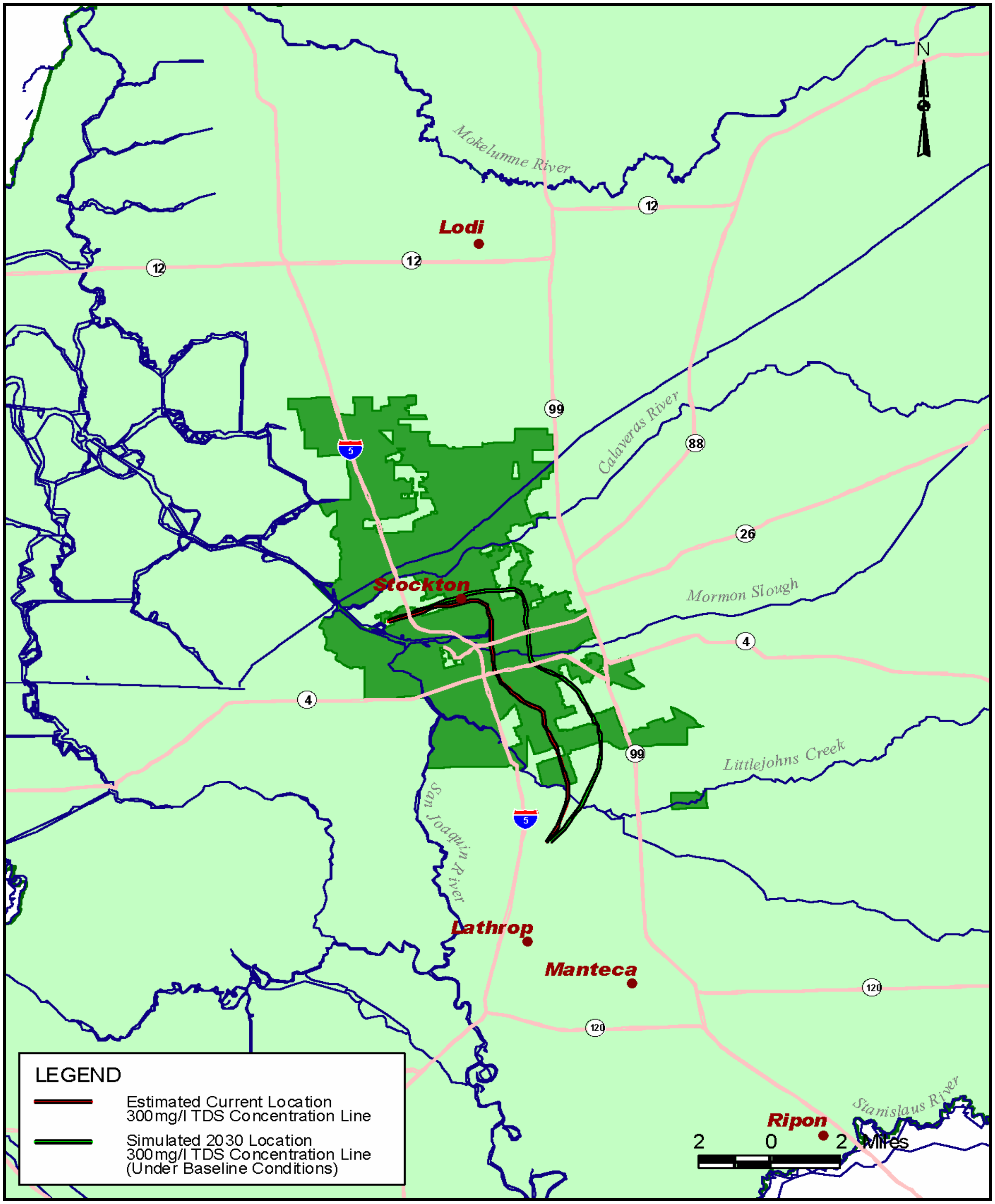


Figure ES-4 Estimated 2000 and 2030 Projected Saline Front
Source: Camp Dresser & McKee, Inc.

levels will continue to decline and storage will continue to be reduced. Figure ES-5 shows the corresponding simulated groundwater table for the year 2030 under baseline conditions. A large portion of the Basin is shown to have groundwater levels 60 to 80 feet below sea level.

Further exacerbating the groundwater conditions, as already mentioned, is the lateral inflow of higher salinity water from the west, which could render parts of the aquifer unusable. Figure ES-4 illustrates the approximate location of the 300 mg/L chloride concentration contour as of 1996 as well as the projected 2030 contour. Groundwater modeling has indicated that the rate of eastward movement of this line is approximately 150 to 250 feet per year. Figure ES-4 also shows the projected location of the 300 mg/L chloride concentration line by the year 2030 under baseline conditions.

ES-7 Basin Management Objectives

SB 1938, created 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 Authority has developed the following qualitative Basin Management Objectives (MO) for the GMA.

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.

ES-8 Groundwater Management Options

Groundwater management tools available to the Authority are explored in the Plan. In order to successfully implement a conjunctive use program that will meet the goals of this Plan, the Authority must first identify and develop a list of water management options. An option, in the context of this Plan, is the method, program or policy suitable for the broader conjunctive use program for Eastern San Joaquin County. The Plan explores the concepts for the acquisition of new and maximization of existing surface water supplies, groundwater recharge techniques, and other options dealing with demand management and water reuse. Table ES-6 lists the groundwater management options explored in the Plan.

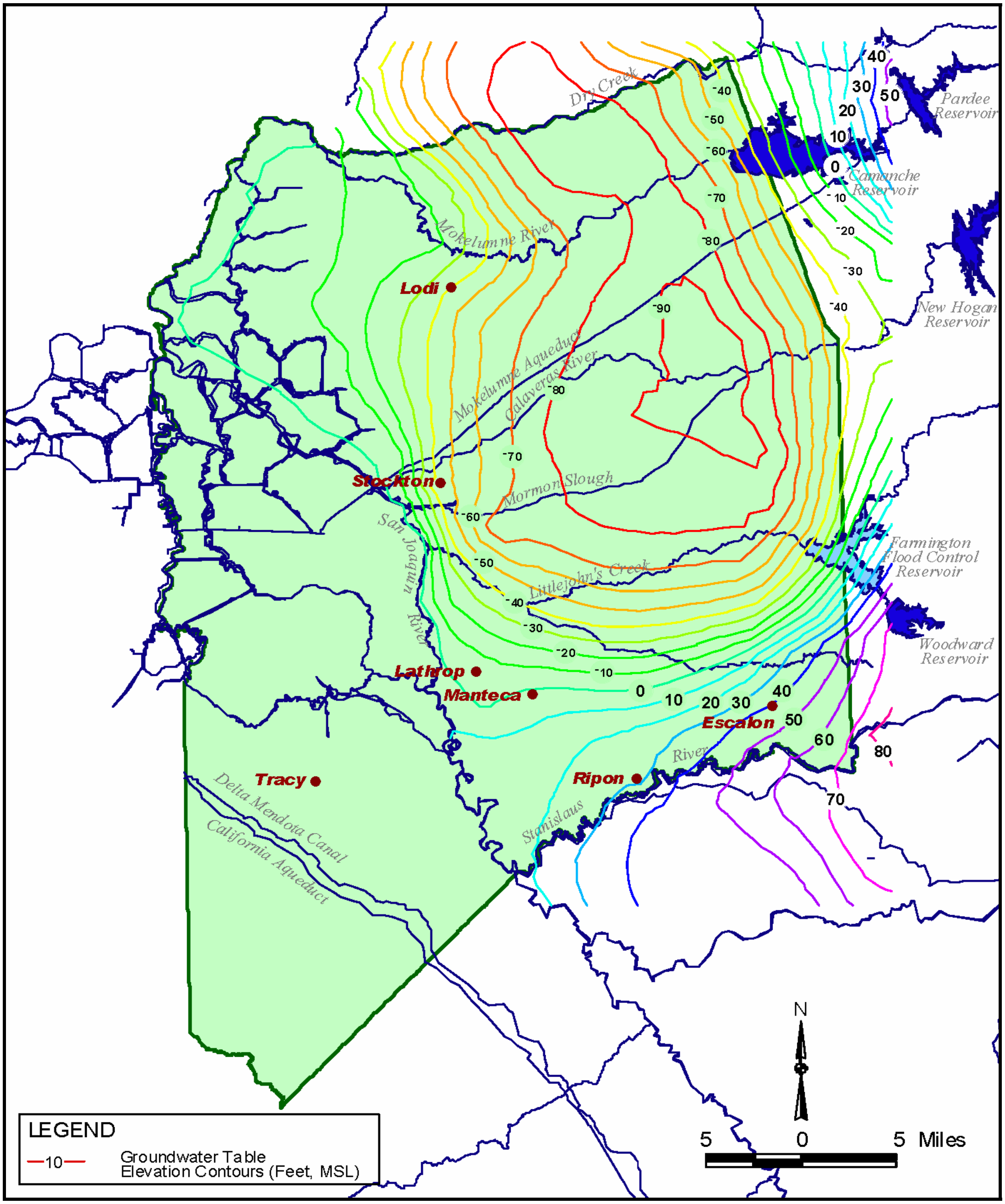


Figure ES-5 Simulated Groundwater Levels Under Baseline Conditions
Source: Camp Dresser & McKee Inc.

Table ES-6 Groundwater Option Comparisons

Option Type	Recharge Method	Improvement Costs ($/af)	Infrastructure Requirements	Land Requirements	Effectiveness	Operation/ Maintenance
Surface Supply Options	Wet Year Flows	~$500	On or off-stream regulating reservoir	Extreme for new reservoir	Very effective based on reservoir size and frequency	Very high requirements
	Water Transfers - Out of Basin	$200-400	Conveyance and storage	Potentially land intensive	Effective based on quantity of water and agreement duration	Varies with infrastructure requirements and year to year availability
	Area of Origin Priority	$0-$350	Use of existing or new infrastructure	Potentially land intensive	Very effective	Varies with infrastructure requirements
	Reservoir Re-operation	~$100	Use of existing infrastructure and storage	Minimal	Less effective	Minimal based on existing facilities
	Water Transfers - In Basin	~$100-$200	Minor conveyance	Minimal	Less effective	Varies with infrastructure requirements and year to year availability
Groundwater Recharge Options	Field Flooding	$50 - $100	Uses Existing Infrastructure	Uses seasonally fallow areas	Somewhat effective only available seasonally	Significant effort
	Spreading Basin/ Recharge Pond	$100 - $150	New Infrastructure	Requires relatively large dedicated areas	Potentially effective, requires detailed field testing	Significant effort
	Recharge Pit	$400 - $450	New Infrastructure	Requires dedicated areas	Potentially effective, requires detailed field testing	Significant effort
	Leaky Canal	Varies	New Infrastructure	Land intensive	Potentially effective, conveyance benefits	Significant effort
	Injection Wells	$150 - $200	New Infrastructure	Requires dedicated areas	Potentially effective, requires extensive well field	Significant effort
	Agricultural In-lieu	$200 - $250	New / Or Existing Infrastructure	Existing Land Use	Very effective based on quantity of water	Additional effort required by owner and district
	Urban In-lieu	~$250-$400	New / Or Existing Infrastructure	Existing Land Use	Very effective based on quantity of water	Requires treatment plant O&M costs
	Regional Groundwater Banking	$200-$300	New / Or Existing Infrastructure	Potentially land intensive	Very effective, financial assistance through third party	Significant effort
Other Options	Water Reclamation	$300-$500	Retrofit of existing facilities	Minimal	Less effective due to treatment costs and public perception	Requires treatment plant O&M costs
	Agricultural Water Conservation	$200-$250	New Infrastructure	Minimal	Potentially effective	Significant effort
	Urban Water Conservation	$200-$250	New Infrastructure	Minimal	Potentially effective	Minimal
	Crop Rotation/Land Fallowing	~$50	None	Potentially land intensive	Potentially effective if mitigated	Minimal

Source: San Joaquin County Water Management Plan Volume I
Farmington Groundwater Recharge and Seasonal Habitat Study

ES-9 Groundwater Contamination

Groundwater contamination and the continued degradation of groundwater quality is a global threat to all groundwater users. The Authority recognizes that the long-term sustainability of the underlying Basin cannot be accomplished without adequate groundwater quality protection, contamination prevention, and remediation programs. The Authority has discussed the issue of managing groundwater protection and contamination programs in Eastern San Joaquin County. A major concern of the Authority is that undertaking regulatory oversight will only duplicate the existing efforts of other regulatory agencies while financially burdening the community beyond its abilities. Increased coordination with regulatory agencies and a concerted effort to ensure its activities do not degrade water quality is potentially less resource intensive for the Authority and a more efficient method of protecting groundwater quality throughout the Basin. The Authority will continue to lead the pursuit against saline groundwater intrusion.

The following policies reflect the Authority's desire to address groundwater contamination and groundwater quality degradation:

1. Coordinate with local, State, and Federal agencies to ensure the underlying Basin is adequately protected against groundwater contamination and to ensure all contaminated sites are documented and mitigated by the responsible parties.

2. Continue to manage efforts to combat saline groundwater intrusion.

3. Strive to improve groundwater quality when technically and economically feasible. Authority actions degrading groundwater quality are not acceptable.

4. Require recharge projects to identify and evaluate impacts to groundwater quality and the potential for mobilization of soil and source water contaminants.

5. Consider current and future water quality standards in the planning and design of projects identified in this Plan.

ES-10 Groundwater Monitoring and Science Program

Since 1971, the San Joaquin County Flood Control and Water Conservation District (County) initiated the collection and management of groundwater data and the production of semi-annual groundwater reports. Currently, the County is undertaking the development of a Web-based interactive tool in order to make groundwater data collected over the years available to the public over the internet. The tool has been coined the San Joaquin County Groundwater Data Center (GDC). The GDC would become the repository for groundwater data and would facilitate groundwater analysis essential to the groundwater management objectives of San Joaquin County. The GDC is not only a technical tool, but also a public outreach tool as well. Through the internet, water users including County and agency staff, industry professionals, decision makers, and the general public will have access to groundwater data and historic semi-annual reports.

The overall goals and objectives of the GDC are:

1. Create and maintain a working groundwater database for San Joaquin County.
2. Develop the tools necessary to analyze groundwater data.
3. Make groundwater information available to decision makers, agency staff, and the general public through the internet.

4. Create an efficient and enforceable QA/QC plan.
5. Utilize the proven and supported technologies in groundwater monitoring, database management, and Geographic Information Systems (GIS).

The Authority and its member agencies are co-participants with the United States Geological Survey (USGS) and California Department of Water Resources (DWR) for the Groundwater Recharge and Distribution of High-Chloride Groundwater from Wells Study (Study). The purpose of the study is to quantify the source, aerial extent, and vertical distribution of high-chloride groundwater and the sources, distribution, 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 total cost of the study is $2,579,350. The proposed USGS contribution will be $625,000 over 5 fiscal years as well as an additional $625,000 from the DWR over the first 3 fiscal years. Member agencies within the Authority will contribute the remaining $1,322,350 over next 5 fiscal years.

In order to ensure that groundwater data is collected in a systematic and consistent manner, the Authority has adopted the Groundwater Monitoring Program Quality Assurance/Quality Control (QA/QC) Plan, prepared by MWH in 1998. The QA/QC Plan addresses the following items: monitoring and sampling preparations, sample collection procedures, chain-of-custody procedures, sample transport, laboratory procedures and methods, and data validation and reporting. The QA/QC Plan can be obtained at the San Joaquin County Department of Public Works Stormwater Management Division. A revised QA/QC plan proposed as part of the GDC is expected to be completed by the Spring of 2005 ad subsequently adopted by the Authority Board.

ES-11 Financing Options

The development of new water supplies and the necessary infrastructure is a major financial undertaking. It is absolutely necessary for the Authority and its member agencies to leverage as much support for outside funding. The Plan provides a general overview of the potential funding sources, programs, and project partnerships available to the Authority from federal, State, and local sources.

ES-12 Plan Governance

Water interests in San Joaquin County have historically been fragmented, but have realized that projects developed in a collaborative process have the potential to exhibit greater and more far reaching benefits to all involved parties while increasing its implementability and fundability. Implementation of the water management options can best be achieved by continuing to work in a collaborative fashion to develop a broad base of political and financial support. The Authority has explored numerous options concerning the appropriate organization and powers needed to implement the plan and the best management framework that addresses the concerns of the Authority member agencies. Although no changes have been formally proposed to the powers and governance structure, the Authority could consider revisions in the future.

The Authority has served as a regional planning body and a forum for member agencies to share their groundwater management efforts and ensure that those efforts do not detrimentally affect other member agencies. In order to avoid potential conflicts between Basin stakeholders, the Authority employs the following policies:

- **Expanded Membership:** The membership in the Authority is diverse as are the challenges facing water Eastern San Joaquin County. In 2001, the Central Delta Water Agency and the South Delta Water Agency became full contributing and voting member agencies to the Authority. Associate membership (ex-officio) was also extended to the California Water Service and the San Joaquin Farm Bureau Federation as their input and support is essential to the success of the Authority. Other members have been contemplated such as SSJID, OID, City of Lathrop, Manteca, Escalon, and Ripon, Calaveras County Water District, Stanislaus County, DWR, Freeport Regional Water Authority, and EBMUD.

- **Continued Use of the Authority as a Forum:** As the Authority looks to implement the Plan, the member agencies will move the outlined projects through the planning, permitting, and design stages and ultimately to construction. In a forum, implementing member agencies will be able to quantify the benefits of its projects to stakeholders and receive comments and suggestions before disputes arise.

- **Continued Facilitation by the California Center for Collaborative Policy:** The California Center for Collaborative Policy (Center) has been an integral part to the success of the Authority'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 and throughout the implementation of the Plan.

ES-13 Integrated Conjunctive Use Program

The Integrated Regional Conjunctive Use Program is the key element in fulfilling the purpose of the Plan to ensure the sustainability of Groundwater resources in Eastern San Joaquin County. The Program is an inventory of viable options available to stakeholders in Eastern San Joaquin County as described by major supply elements, major surface storage and conveyance elements, and groundwater recharge components. Supply elements are grouped by river system and are a combination of reallocations, new water, and transfers. Entitlements to water are supported by legal claims based on existing water right permits, water service contracts and agreements, and pending water right applications. Major surface storage and conveyance elements are considered existing or proposed regional infrastructure intended for the capture and delivery of substantial amounts of water when available. Groundwater recharge components include groundwater recharge infrastructure improvements programs, drinking water treatment facilities, and incentive based agency conjunctive use programs. Table ES-7 describes each of the Integrated Conjunctive Use Program components.

The opportunity for groundwater banking partnerships in Eastern San Joaquin County is considered a viable alternative that creates new water. Groundwater banking is supported regionally and Statewide as an alternative means to new highly-contentious on-stream reservoirs and costly desalinization plants. The underlying Basin has the potential to store over 1 million acre-feet in close proximity to the Delta. The opportunities possible are a logical match for regional and Statewide interests to look to the Authority for groundwater banking opportunities. It is paramount to the Authority that banking rates, extraction rates, and quantities remain under local control.

Table ES-7 Integrated Conjunctive Use Program Elements			
Supply Source	**Water Rights and Contracts**	**Storage/Conveyance**	**GW Recharge**
American River	• 350 cfs diversion at Freeport from Dec. 1 to June 30 • Currently limited to 155 cfs by EBMUD's pipeline • (Average Annual Yield = 44,000 af)	• Proposed Duck Creek Reservoir • SJC Freeport Interconnect • Alliance Canal • Freeport Regional Water Project	• Farmington Program • GW Recharge and Conjunctive Use • ASR Wells • Third Party Banking and Conjunctive Use Partnerships
Mokelumne River	• 1000 cfs diversion to storage Dec. 1. to June 30 • 620 cfs direct diversion • (Average Annual Yield = 60,000 - 100,000 af) • 39,000 to 60,000 af to WID • 20,000 af to NSJWCD subject to others • (Average Annual Yield = 11,000 af)	• MORE WATER Project Tunnel and Pipeline • MORE WATER Project Lower River Diversions • Woodbridge Dam Replacement and Existing Canal System • Existing South System and North System Rehabilitation • NSJWCD - Bear Creek, Pixely Slough, Paddy Creek, Gill Creek • Alliance Canal	• Proposed Duck Creek • Lodi Recharge or use of 6,000 af transfer • Farmington Program • In-lieu and direct recharge by Districts • Third Party Banking and Conjunctive Use Partnerships • ASR Wells
Calaveras River	• 100,000 af 56.5% to SEWD and 43.5% to CCWD • By agreement, SEWD is allowed to utilize CCWD unused supply • 13,000 ac-ft riparian demand	• Peters Pipeline • Mormon Slough • Alliance Canal • South Gulch Reservoir	• Farmington Program • Treatment Plan Expansion - Urban In-lieu • In-lieu and direct recharge • SJAFCA and Other Storm Water Detention Ponds • Third Party Banking and Conjunctive Use Partnerships
Stanislaus River	• 155,000 af contract to SEWD/CSJWCD • 75,000 af interim to SEWD • 49,000 af firm and <31,000 ac-ft interim to CSJWCD • 320,000 af (In San Joaquin County) • 34,000 af (South County Project In-basin delivery) • 30,000 af transfer to SEWD	• Peters Pipeline • CSJWCD - Lone Tree, Duck Creek, Temple Creek, Littlejohns Creek • Alliance Canal • South County Water Supply Project	• Farmington Program • Treatment Plant Expansion • Lathrop, Manteca, and Escalon In-lieu • In-lieu and direct recharge • SJAFCA and Other Storm Water Detention Ponds • Third Party Banking and Conjunctive Use Partnerships
Littlejohns Creek and Rock Creek	• 250,000 af Dec. 1 to April 30 • 60,000 af direct diversion • 190,000 af to storage • (Average Annual Yield = 15,000 af)	• Farmington Canal • CSJWCD - Lone Tree, Duck Creek, Temple Creek, Littlejohns Creek • Alliance Canal • Farmington Canal to South Gulch • Lyons Dam Project	• Farmington Program • CSJWCD Surface Water Incentive Program • In-lieu and direct recharge by Districts • Third Party Banking and Conjunctive Use Partnerships • SJAFCA and SJCOG Storm Water Detention Ponds
Delta	• City of Stockton Delta Water Supply Project • Initially 20,000 af increasing to 125,900 af in 2050 • (Average Annual Yield = 60,000 af)	• Pipeline and Treatment Facility	• Stockton In-lieu and ASR Wells • Third Party Banking and Conjunctive Use Partnerships • Farmington Program

The San Joaquin Groundwater Export Ordinance (Export Ordinance) is purposefully and notoriously stringent in order to protect local groundwater users from groundwater exports. San Joaquin County Board of Supervisors has continually stated that they are willing to amend the Export Ordinance should a project be proposed that can demonstrate local benefits with minimal risk to losing local control of the Basin.

Banking partnerships could provide the Authority with capital to fund portions of Integrated Conjunctive Use Program envisioned above. Conceptually, the Authority could employ various arrangements for the ranging from water storage agreements, surface water transfers/groundwater substitution, and a 'two for one' storage/extraction concept. Potential partners that have shown interest are EBMUD, Metropolitan Water District of Southern California, DWR, CALFED Environmental Water Account, and the City of Tracy. Entities have purchased raw water from other groundwater banks throughout the State at rates upwards of $420/af.

ES-14 Plan Implementation

The Authority is committed to adopting a Plan implementation strategy that is adaptive and incentive driven. This Plan is the first step in the development of a regional document that details how the groundwater basin will be managed and initiates the process that will ultimately define the guidelines and conditions that water districts and others will follow to achieve basin management objectives. Following the adoption of this Plan, the Authority and its members will work to implement the management objectives. The objectives coupled with regular groundwater monitoring and the development of basin operations criteria will establish a framework and the foundational information for future groundwater banking and recharge project operations in the Basin.

To encourage the continued implementation of the Plan, the Authority will complete a periodic assessment of the progress, direction and recommendations regarding Plan objectives. Basin conditions are currently measured by groundwater level and quality monitoring on a semi-annual basis. This assessment activity will be coupled with the annual review of Plan implementation activities and project development in the basin.

To ensure that the Authority is constantly striving to better manage groundwater resources, the following actions will be undertaken:

1. An annual report by March 1st of each year that outlines the accomplishments of the previous year's groundwater management efforts and report the current state of the Basin,

2. A review of the political, institutional, social, or economic factors affecting groundwater management, and

3. Based on the information gained in the above actions, recommendations for any required amendments to the Plan.

ES-15 Future Activities

The adoption of the Plan is merely the beginning of a series of actions the Authority will undertake to help meet future basin demands. As such, many of the identified actions will likely evolve as the Authority takes a more active approach to manage the Basin and meet the outlined objectives. Many additional actions will also be identified in the annual summary report described above. The Plan is therefore intended to be an iterative document, and it will be important to evaluate all of the actions and objectives over time to determine how well they are meeting the overall goal of the plan. The Authority plans to evaluate this entire plan within five years of adoption. In the immediate future, the Authority and its member agencies will undertake the following planned activities described below subsequent to the adoption of the Plan.

Integrated Conjunctive Use Program CEQA Review

The California Environmental Quality Act (CEQA) allows agencies to prepare a Programmatic Environmental Impact Report (EIR) for a proposed course of action. The Integrated Conjunctive Use Program is a grouping of stand alone projects that could have very different specific environmental impacts, but would also have to address many of the same global environmental impacts requiring disclosure under CEQA. The Program EIR will support the implementation of future site-specific projects by:

- Allowing proper consideration of broader scale impacts, alternatives, and mitigation criteria that would extremely difficult in individual site-specific project level EIR.
- Focusing on cumulative impacts and growth inducing impacts with the implementation of the Conjunctive Use Program.
- Addressing policy, design, and management issues at the program level rather than repeatedly considering them at the project level.
- Considering broad policy alternatives and programmatic mitigation measures at an early stage in the development of the Conjunctive Use Program when policy flexibility is greatest.
- Conserving resources and promoting consistency by encouraging the reuse of data.
- Providing the basis for National Environmental Policy Act (NEPA) review and Federal permitting approval processes should federal interest be established in the Conjunctive Use Program or any of the Program elements.

The Program EIR would also include a healthy technical appendix that would speak to the feasibility of specific project in the Conjunctive Use Program, demand management measures, and other policy alternatives. The Program EIR will also analyze the potential environmental effects of the Basin Management Objectives, assumptions and technical methods, policy alternatives to achieving identified objectives, broad-scale impacts, and establish mitigation criteria for the overall Plan. The Program EIR effort is expected to begin in 2005 and continue for 18 to 24 months

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 could potentially consist of a series of groundwater levels that would correspond to basin condition levels (similar to the US EPA Air Quality Index and the US Department of Homeland Security Advisory System) to indicate the effectiveness of groundwater recharge programs and also potentially when and how much groundwater could be exported. The development of Basin Operations Criteria is a collaborative process that will be undertaken by the Authority immediately following the adoption of the Plan and is expected to be completed by summer 2005. Basin Operations Criteria developed with the framework of the Authority could ultimately provide the basis for a revised Export Ordinance and a new Groundwater Management Ordinance.

1 Introduction

1.1 Background

San Joaquin County is home to approximately 600,000 people and sustains a $1.34 billion agricultural economy. The population is expected to increase to approximately 1.1 million by 2030. Water demand in the county 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) Based on the San Joaquin County Water Management Plan, the Basin is overdrafted by 150,000 af/yr on average. Long-term groundwater overdraft has lowered the groundwater table by 2 ft/yr in some areas to -70 ft (MSL) and has induced the intrusion of highly saline groundwater into the Basin from the west. Without mitigation, such intrusion will degrade portions of the Basin, rendering the groundwater unusable for municipal supply and irrigation.

Failure to address water supply and management needs in Eastern San Joaquin County will ultimately result in severe economic disruptions to the County. Agriculture in San Joaquin County, valued at $1.34 Billion, is already 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. 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 general economic decline. Individual agencies in Eastern San Joaquin County have long grappled with declining groundwater levels and unreliable supplemental water supplies.

Conversely, long term overdraft has created opportunities for groundwater banking to the benefit of regional and statewide interest. Overuse of groundwater has depleted a substantial portion of stored groundwater in the Basin and has made available volume for potential regulatory storage. It is estimated that at least 1.2 million af, a volume equivalent to Folsom Lake, could be used to store wet year water for use in subsequent dry years. However, to do so would require the monumental task of overcoming the institutional, political, financial, and physical challenges of groundwater banking.

Independently, agencies in Eastern 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. Regional planning efforts such as the San Joaquin County Water Management Plan (adopted by the County Board of Supervisors in October 2002) and the Mokelumne Aquifer Storage, Recovery Study (MARS Study), and the South County Surface Water Supply Project have proven successful ventures.

Since its formation in 2001, the Northeastern San Joaquin County Groundwater Banking Authority (Authority) has employed the consensus based approach in its goal to develop "…locally supported groundwater banking projects that improve water supply reliability in Northeastern San Joaquin County…and provide benefits to project participants and San Joaquin County as a whole." Collaboration amongst the Authority 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 the Authority.

Table 1-1 Member Agencies of the Northeastern San Joaquin County Groundwater Banking Authority
City of Stockton
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
California Water Service Company*
San Joaquin Farm Bureau Federation*
* Associate Members

1.2 Purpose and Objectives

Over the past several years, the Authority has provided a consensus-based forum of local public water interests to work cooperatively with one voice to study, investigate, and plan locally supported groundwater banking and conjunctive use projects in the Eastern San Joaquin County. The Authority Board convenes monthly while the Authority Coordinating Committee meets twice a month on planning activities with cooperative assistance provided by the California State Department of Water Resources and the Center for Collaborative Policy.

San Joaquin County has made substantial progress related to water resource planning and continues to build on the momentum gained by local achievements in such endeavors through the Authority. In a report published by the Center for Collaborative Policy entitled, "Stakeholder Assessment for San Joaquin County – Conditions, Issues, and Options for Collaborative Solutions", the report suggested a core group of issues fundamental to continuing a comprehensive approach to solving the water resource needs within the County. The report concluded that the keys to successful planning efforts include:

- Development of a common understanding of the operations of water sub-basins within the County and the necessity of conjunctive use to the health of these basins and the County's economy in the future
- Use of consensus decision-making
- Grouping of members who are consistent in attendance, clear in communication, and conscientious in relaying information and views between their constituency and the group

One of the major activities the Authority has dedicated itself to this past year is the Groundwater Management Plan (Plan). The purpose of the Plan is to review, enhance, assess, and coordinate existing groundwater management policies and programs in Eastern San Joaquin County and to develop new policies and programs to ensure the long-term sustainability of groundwater resources in Eastern San Joaquin County. To better define the supporting values included with this Plan's purpose, the Authority has listed the following mission values centered on the development of the Plan as outlined in Table 1-2.

Table 1-2 Groundwater Management Plan Mission Values for Success		
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 water 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	Protect the rights of overlying land owners	Increase amount of water put to beneficial use within San Joaquin County

In order to meet the purpose of the Plan and ensure the long-term sustainability of the Basin, the Authority created the following Plan objectives:

1. Maintain long-term sustainability of the Basin through the development of management objectives, practices and conjunctive use projects to benefit the social, economic and environmental viability of Eastern San Joaquin County.
2. Prevent further saline intrusion and degradation of groundwater quality throughout the Basin.
3. Increase understanding of Basin dynamics through the development of a sound research program to monitor, evaluate, and predict Basin conditions.
4. Maintain local control of the groundwater Basin through the responsible management of groundwater resources by overlying cities, counties, water districts, agencies, and landowners.
5. Formulate rational and attainable Basin management objectives to comply with SB 1938 and retain State funding eligibility.
6. Formulate voluntary policies, practices, and incentive programs to meet established Basin management objectives.
7. Formulate appropriate financing strategies for the implementation of the Plan.

1.3 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 northwest, the Mokelumne River to the South, and bedrock to the east. Figure 1-1 depicts the groundwater sub-basins of San Joaquin County as described in DWR Draft Bulletin 118 Update 2003. For the purposes of the Plan, the Eastern San Joaquin County Groundwater Management Area (GMA), depicted in Figure 1-2, is defined as the portion of San Joaquin County overlying the Eastern San Joaquin and Cosumnes Sub-Basins.. Within the GMA, the member agencies of the Authority will implement the Plan within their respective boundaries. To ensure that every parcel in the GMA is represented, all unorganized areas will be included in the San Joaquin County Flood Control and Water Conservation District. Figure 1-3 depicts the member Agencies of the Authority and their respective boundaries within the GMA.

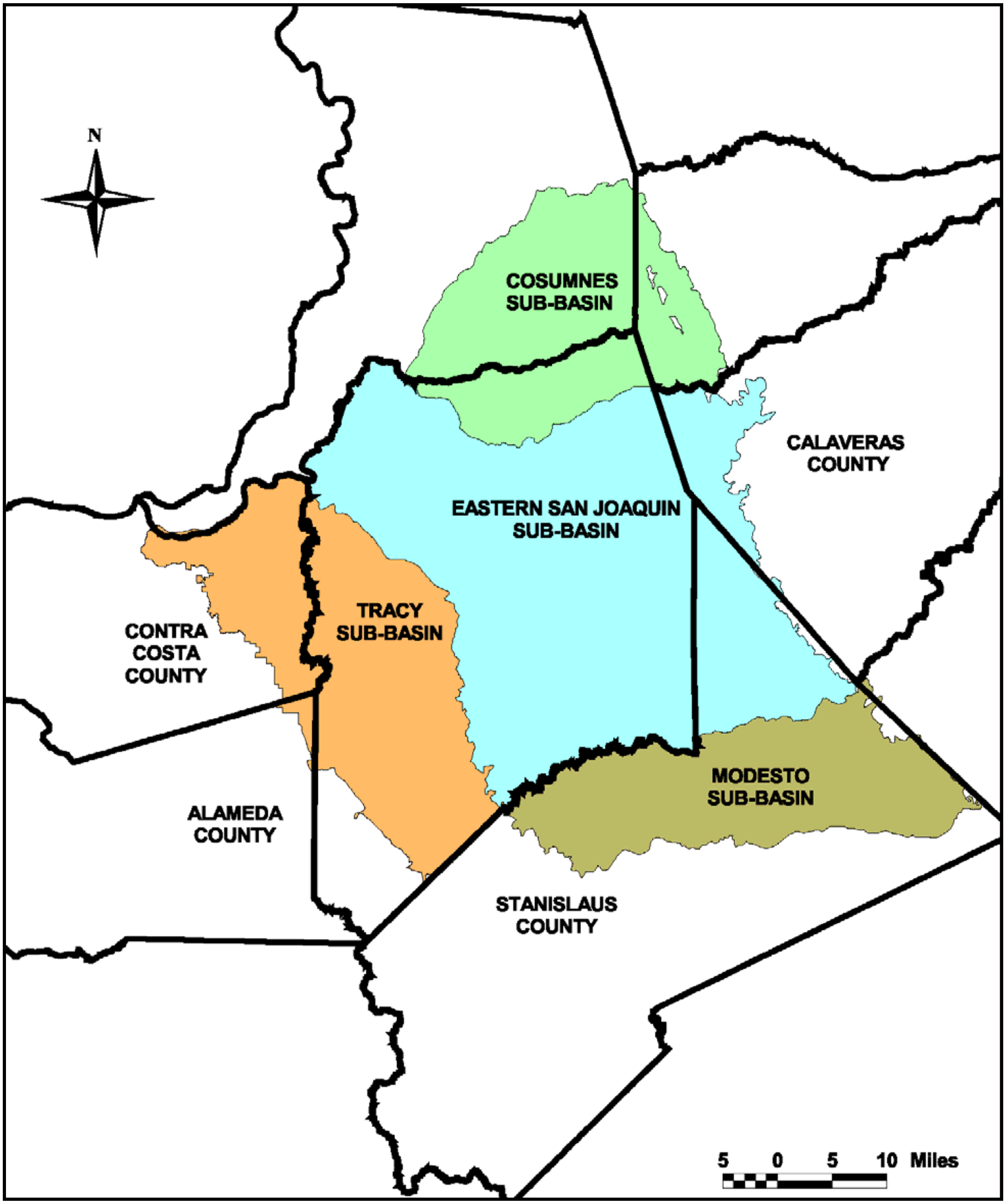


Figure 1-1 Groundwater Sub-Basins of San Joaquin County
Source: California Spatial Information Library at http://www.gis.ca.gov/

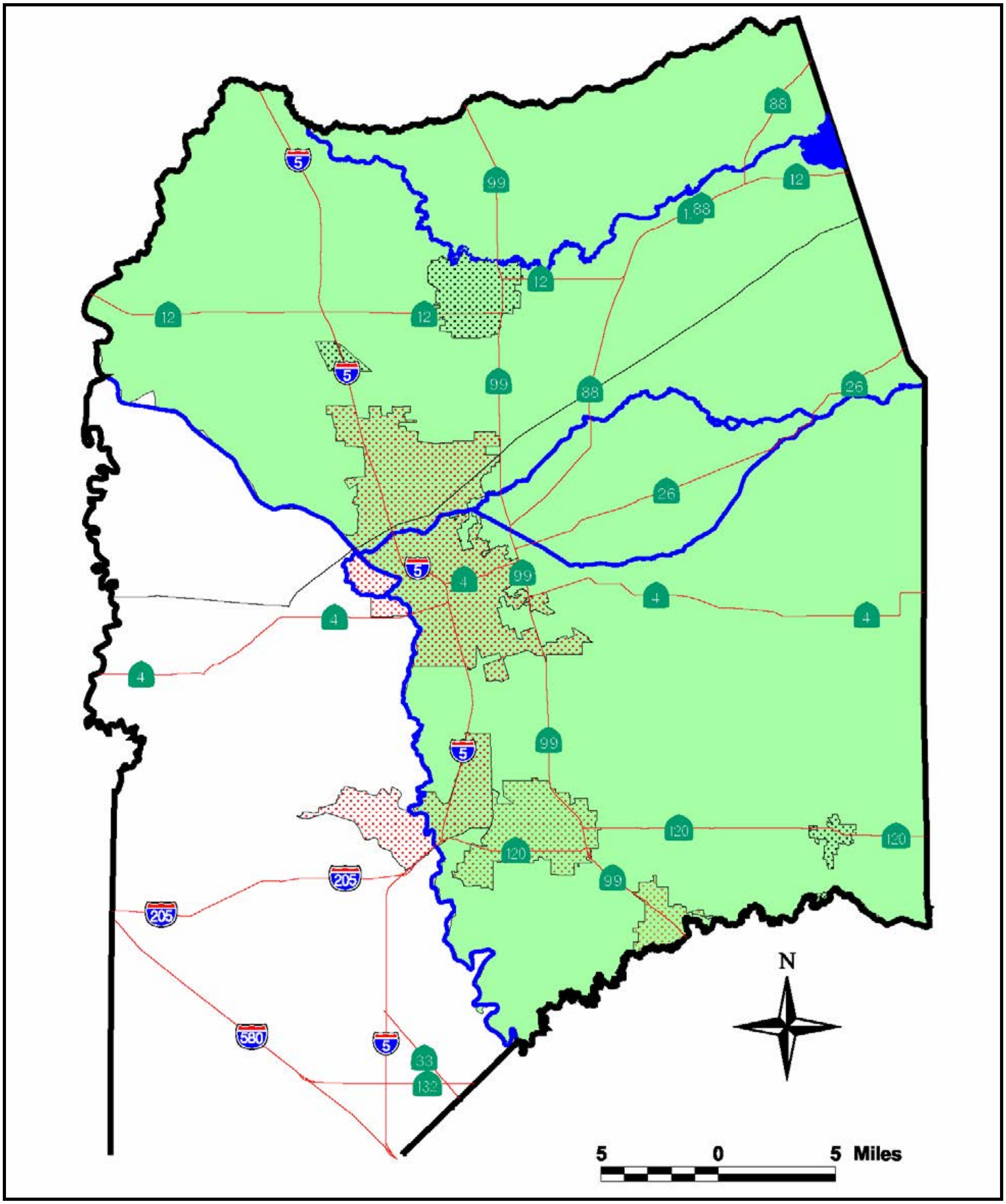


Figure 1-2 Groundwater Management Area
Source: California Spatial Information Library at http://www.gis.ca.gov/

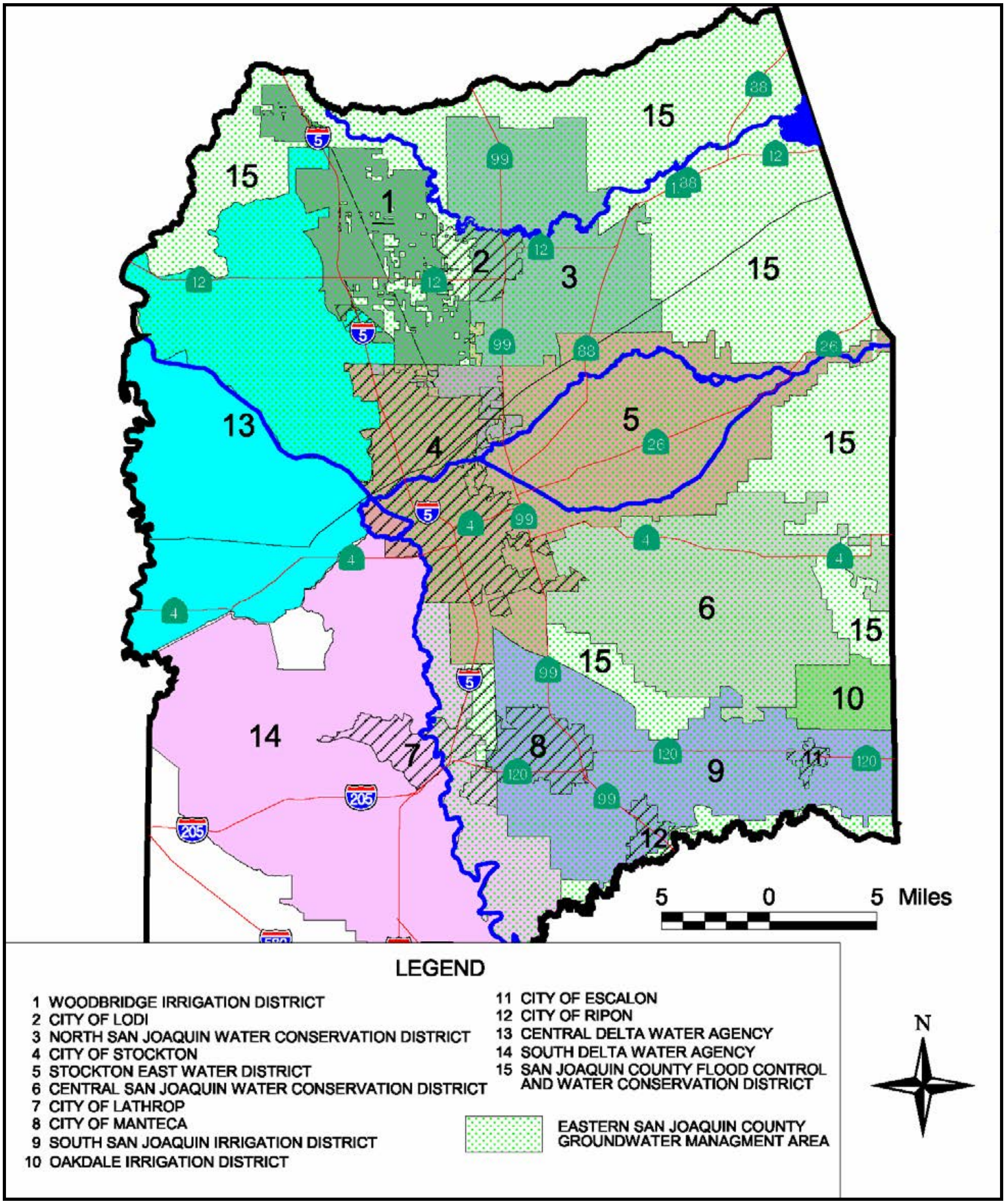


Figure 1-3 Overlying Agencies within the Groundwater Management Area
Source: California Spatial Information Library at http://www.gis.ca.gov/

1.4 Agency Participation

The physical boundaries of the Eastern San Joaquin and Cosumnes Sub-Basins extend beyond the political boundaries of San Joaquin County. Portions of Calaveras County and Stanislaus County overlie the Eastern San Joaquin Sub-basin. Recognizing the need for increased coordination between agencies outside of the GMA, in May 2003, the Authority invited a variety of interest groups from the business, environmental, agricultural, and political communities to participate in the development of the Plan. The Authority values the consensus based approach to groundwater management and strives to coordinate, integrate, and mutually benefit from the groundwater management efforts of its member agencies and those with vested interest in the social, economic, and environmental viability of Eastern San Joaquin County.

Throughout the planning process, the Authority's Coordinating Committee, a technical sub-group of the Authority, convened every 4th Wednesday of the Month to formulate the Plan. Key discussion points and decisions were debated and finalized by the Coordinating Committee and incorporated into the Plan by Authority 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 Plan at their regular meetings on the 2nd Wednesday of the month. For the purpose of providing an atmosphere conducive to broad-based consensus building and compromise, Authority Coordinating Committee meetings were facilitated through the California Center for Collaborative Policy.

Attendees of these meetings include representatives from over 40 agencies and interest groups. Table 1-3 is a list of meeting attendees and agencies contributing to the Plan.

Table 1-3 Groundwater Management Planning Participants

Participant	Agency
Andy Christensen	Woodbridge Irrigation District
Cary Keaton	City of Lathrop
Dante Nomellini	Central Delta Water Agency
Dave Kamper	South San Joaquin Irrigation District
Ed Formosa	City of Stockton Municipal Utilities Department
Ed Steffani	North San Joaquin Water Conservation District
Gary Giovanetti	Stockton City Council
Joe Petersen	San Joaquin Farm Bureau Federation
John Herrick	South Delta Water Agency
Keith Conarroe	City of Manteca
Kevin Kauffman	Stockton East Water District
Larry Diamond	Calaveras County Water District
Loralee McGaughey	Stockton East Water District
Mark Lindseth	City of Lodi
Mark Madison	City of Stockton Municipal Utilities Department
Mel Lytle	San Joaquin County Public Works
Melvin Panizza	Stockton East Water District
Michael McGrew	San Joaquin County Counsel
Paul Risso	California Water Service Company
Ray Borges	San Joaquin County Environmental Health
Reid Roberts	Central San Joaquin Water Conservation District
Richard Prima	City of Lodi
Steve Stroud	South San Joaquin Irrigation District

Teresa Tanaka	Linden County Water District
Tom Flinn	San Joaquin County Public Works
Tom Gau	San Joaquin County Public Works
State Participants & Agencies	
Ann Jordan	Office of State Senator Charles Poochigan
Mary Bava	Office of Assemblyperson Barbara Matthews
Tim Parker	Department of Water Resources
Federal Participants & Agencies	
David Simpson	Natural Resource Conservation Service
Eric Reichard	US Geologic Survey
John Izbicki	US Geologic Survey
Patrick Dwyer	US Army Corps of Engineers
Other Participants & Agencies	
Barbara Williams	Sierra Club
Carolyn Ratto	California Center for Collaborative Policy
David Beard	Great Valley Center
Gerald Schwartz	East Bay Municipal Utility District
Gina Veronesc	Camp, Dresser, & McKee
James Cornellius	Calaveras County Water District
James Moore	Galt Economic Development Task Force
John Aud	Stanislaus County
Larry Diamond	Calaveras County Water District
Mark Williamson	Saracino-Kirby-Snow
Robert Vince	Camp, Dresser, & McKee
Ron Addington	Business Council, Inc.

The Authority will continue to seek the input of its neighbors and interest groups during the implementation of the Groundwater Management Plan and any future planning efforts.

1.5 Consistency with Water Code Section 10750 *et. seq.*

Groundwater management is the planned and coordinated effort to sustain or improve the health of a groundwater basin in order to meet the future water supply needs of groundwater users. With the passage of Assembly Bill (AB) 3030 in 1992, local water agencies were provided a systematic way of formulating groundwater management plans and a means to implement those plans through fees and assessments. AB 3030 also encourages coordination between local entities through joint power authorities or memorandums of understanding.

In 2002, the passage of Senate Bill (SB) 1938 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 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. Table 1-4 also indexes the sections of this Plan where the recommended or required AB 3030/SB 1938 components are addressed.

Table 1-4 Components of a Groundwater Management Plan			
Plan Component	**Recommended by AB 3030**	**Required by SB 1938**	**Plan Sections**
Control of saline water intrusion	X		2, 3, 4, 5, 8
Management of wellhead protection and recharge areas	X		4
Regulation of contaminated groundwater	X		4
The administration of a well abandonment	X		4
Elimination of groundwater overdraft	X		2, 3, 4, 5, 8
Replenishment of groundwater	X		2, 3, 4, 8
Groundwater monitoring	X	X	5
Operation of a conjunctive water management system	X		3, 8
Well construction standards	X		4
Financing groundwater management projects	X		6, 7
The development of groundwater management partnerships	X		1, 4, 7, 8
Coordination of land use planning and groundwater management	X		4
Description of participation by interested parties		X	1, 7
Plan to involve agencies overlying the basin		X	1, 7
Basin Management Objectives		X	3
Basin management entity and area map		X	1

Sources: California Department of Water Resources Division of Planning and Local Assistance
http://wwwdpla.water.ca.gov/cgi-bin/supply/gw/management/hq/ab3030/main.pl

California Department of Water Resources Draft 2003 Update Bulletin 118

1.6 Current Groundwater Management Efforts

To ensure that groundwater management efforts are not duplicated or conflicting, the Authority has reviewed existing groundwater and urban water management plans of member agencies, which are attached in the Technical Appendix.

1.6.1 Overview of Existing Groundwater Management Plans

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 aging Woodbridge Diversion Dam located on the Lower Mokelumne River northeast of Lodi and an extensive canal system serving approximately 13,000 acres. Due to the deterioration and age of the Woodbridge Diversion Dam, WID has worked very hard to obtain the necessary approvals for its replacement. Through WID's conservation efforts to convert to drip irrigation, WID has made available up to 6,000 af/yr to the City of Lodi at a cost of $200/af. WID intends to use the proceeds of the water purchase agreement to finance the current construction activities to replace the Woodbridge Diversion

Dam in order to continue to fully utilize its right to Mokelumne River water and meet the goals of their AB 3030 Plan. Also at the regional level, WID has participated as a member agency of the East San Joaquin Parties Water Authority (ESJPWA) and the Authority.

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 53,100 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 af/yr and instead approved East Bay Municipal Utility District's (EBMUD) request to appropriate an amount greater than the request of NSJWCD. 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 permit expired in 2002.

In order to renew 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. NSJWCD continues to seek resolution to D-858 through requests to the SWRCB to consider a reallocation of 50,000af/yr of Mokelumne River Water from EBMUD to the District.

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

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 treatment plant was a benefit to the planning areas. SEWD began to assess 14,000 af of additional agricultural acres. The total area within SEWD is approximately 116,300 acres, of which 47,600 acres (approximately 41%) are within the City of Stockton. 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 af of water respectively from New Melones Reservoir. In 1983, the District expanded surface water irrigation with the construction of the 12,000 gpm Potter Creek Pump Facility.

The Water Treatment Plant capacity was increased in 1991 to accommodate increased demand from the Stockton Urban areas. Construction on the New Melones Conveyance System was completed in 1994. Under the Central Valley Project Improvement Act (CVPIA), the USBR provided no water to SEWD in 1993 and 1994. In 1995 SEWD began receiving New Melones water, but less than the contracted amount because of the Miller-Bradely bill requirements regarding water quality issues on the San Joaquin River and fish flows. Legal action is ongoing.

Under current USBR operation of New Melones, SEWD and CSJWCD are provided up to 90,000 af water from New Melones annually. Water allocation is based on March-September water forecast plus February end-of-month storage in New Melones.

In 1995, SEWD adopted an AB3030 Groundwater Management Plan. The goal of their Plan is to continue past efforts to seek supplemental surface water supplies for conjunctive use, to protect existing supplies, and to further pressure the USBR to meet the contracted delivery amounts for New Melones water.

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 af allocation based on New Melones storage and inflow as of April 1 of each year. The contract period ends 2009 with a possible 10-year renewal pending further studies.

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 in 2001. 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 developed an implementation strategy for the phased Farmington Program.

In 2003, SEWD completed the Pilot Phase of the Farmington Program, which consists of 60 acres of recharge ponds and fields adjacent to the SEWD Water Treatment Plant. The Demonstration Phase beginning in 2003 will investigate and construct up to 1,200 acres of recharge ponds and fields.

In 2003, SEWD applied for a Proposition 13 Groundwater Recharge Storage Construction Grant for the Peters Pipeline portion of the Farmington Program. The proposed project consists of a six-mile long 60-inch diameter pipeline, which will distribute irrigation and recharge water as well as water to the SEWD Water Treatment Plant.

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

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.

CSJWCD has not adopted formally an AB 3030 Plan, however, in 1997, to mitigate declining groundwater levels, the District 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 af/yr of firm yield and up to an additional 31,000 af/yr on an interim basis to the District. 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 District.

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

South San Joaquin Irrigation District – Formed in 1909 under the Irrigation District Act, SSJID comprises about 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 af/yr 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 Plan 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 af/yr. 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 af/yr 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 af/yr. SSJID and OID also provide water to the City of Stockton through a 10-year transfer agreement for up to 30,000 af/yr of New Melones Water.

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 a 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 af/yr of New Melones Water.

1.6.2 Overview of Existing Urban Water Management Plans

City of Lodi – The City of Lodi is located northeast of Stockton, along Highway 99. According to the 2001 City of Lodi Urban Water Management Plan, 24 wells provide a population of 57,935 with water from the Basin. In 1999, City of Lodi wells produced 16,587 af with a projected 2020 demand of 22,727 af assuming a 1.5 percent constant growth rate. Since 1977, the City of Lodi has enforced stringent water conservation programs and is considering implementing other economically feasible Best Management Practices (BMPs). BMPs considered include Large Landscape Conservation Programs and Incentives, Commercial, Industrial and Institutional Conservation Programs, Residential Ultra Low Flush Toilet Rebate Programs, and Water Metering.

The City of Lodi's future water use projections indicate that groundwater in the area should be sufficient to meet the City's needs over the next 20 years. However, they have recognized that groundwater levels are declining, and have participated in the East San Joaquin Parties Water Authority to discuss and be a party to solutions. In 2003, the City of Lodi approved a 40-year agreement with WID for the purchase of 6,000 af/yr of Mokelumne River Water. The City is currently considering various methods to utilize the water either through direct recharge, injection, or treatment to potable standards.

Stockton East Water District – The mission of SEWD was established by the legislature when the District was created and to insure proper management of the 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 delivers a minimum of 20,000 af/yr. From 1992 to 2002, the District delivered 439,048 af of treated water or about 40,000 af/yr to these urban contractors. As a wholesaler, SEWD has no authority over mandatory prohibitions on water use for the Stockton Urban Area.

City of Stockton – The City of Stockton has a population of approximately 243,700 and has three water suppliers to serve the area: City of Stockton Municipal Utility District (Stockton MUD) (38,300 connections); California Water Service Company (42,250 connections within the city, 10,950 outside of city limits); and County of San Joaquin (2,387 unmetered connections through County Maintenance Districts). The Stockton MUD service area generally encompasses north of the Calaveras River, however, the City also serves areas in South Stockton.

The Stockton MUD has 22 wells in North Stockton and seven wells in South Stockton providing groundwater to its customers. SEWD also provides surface water to the three suppliers. Approximately 45% of the Stockton MUD's water deliveries come from groundwater, and 55% is treated surface water from SEWD. Saline intrusion in the Stockton area is a continual concern even with surface water deliveries from SEWD to offset some pumping.

Adopted in 2000, the City of Stockton Urban Water Management Plan outlines numerous demand management measures (DMM) to promote conservation including an extensive water conservation education program. The Stockton Area Water Suppliers (SAWS) which includes SEWD, Stockton MUD, San Joaquin County, and Calwater, coordinates monthly to oversee implementation of the conservation education program. SAWS has sponsored the award winning Sally-Save-Water campaign since 1990. The Sally-Save-Water campaign actively promotes water conservation through school visits, television advertisements, educational videos, posters and handouts. The campaign has also been recognized for its achievements by receiving a San Joaquin County Council of Governments Regional Excellence Awards. SAWS is also active in the promotion of the statewide declaration of May as Water Awareness Month.

Projected growth of the City of Stockton is expected to increase from its 2000 demand of 68,000 af/yr to the 2015 General Plan build out demand of 85,330 af/yr and ultimately to 177,900af/yr in 2050. In order to address the increase in demand, the City of Stockton is currently working to perfect a water right application for a Delta water supply. Citing Water Code Section 1485 and the watershed of origin priority, the City seeks to secure up to 125,900 af/yr from the Delta to the urban area. The Delta Water Supply Project is a major component in the efforts of the Authority to restore the health of the Basin.

California Water Service Company (Associate Member of the Authority) – The California Water Service Company (Calwater) serves approximately 42,250 connections within the City of Stockton primarily south of the Calaveras River as well as 10,950 beyond the City limits. Calwater is contracted to receive 50% to 55% of SEWD treated water deliveries and supplements the supply with 34 active wells.

In 2001, an Urban Water Management Plan was adopted for the Stockton District Calwater service area. Calwater actively participates in the conservation activities of the SAWS and has implemented an ultra low flush toilet rebate program and a plumbing retrofit program. Calwater participated in the activities of the East San Joaquin Parties Water Authority and have been contributing Associate Member of the Authority. Calwater is limited in its financial participation to the Authority because it is an investor owned public utility and is stringently regulated by the California Public Utilities Commission.

City of Manteca – The City of Manteca straddles State Route 99 south of Stockton. According to the 2002 City of Manteca Urban Water Management Plan, 16 wells provide groundwater to a population of approximately 50,000 with more wells planned for construction. Manteca is currently entirely dependant on groundwater to for its municipal and industrial needs. Since 1998, the City has implemented the following BMPs: Large Landscape Conservation Programs and Incentives, Commercial, Industrial, and Institutional Conservation Programs, Residential Water Audits, Water Metering, Residential Plumbing Retrofit, Public Information and Education Programs, Conservation Coordinator, Conservation Pricing, and Water Waste Prohibition. 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 expected to grow to over 130,000 by 2025. Recognizing the need for a reliable water supply to meet the demands of growth, the City of Manteca will participate with SSJID in the South County Surface Water Supply Project. At build out in 2025, the City will receive up to 18,500 af/yr of high quality water from the Project.

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 af in 2002, and this is estimated to increase to 12,310 af in 2020 in the 2003 City of Ripon Urban Water Management Plan. In 2002, 1,400 af of non-potable water was supplied by city groundwater wells, and 500 af 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 af. The plan also anticipates 960 af of non-potable groundwater supplied by Nestle in 2020.

The City of Ripon Urban Water Management Plan contains 14 demand management measures (DMM) to promote conservation. A few of these are interior and exterior water audits for single family and multi-family customers, large landscape conservation programs and incentives, school education, and water waste prohibition.

City of Lathrop – Information not received prior to release of Plan.

City of Escalon – Information not received prior to release of Plan.

1.6.3 Overview of Groundwater Management by San Joaquin County

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.

Northeastern San Joaquin County Groundwater Banking Authority – Organized in 2001, the Authority 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/yr. 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 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 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 2008. 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 Interconnect, a proposed interconnecting pipeline project, which would take advantage of this opportunity. Thus far, the Authority has commissioned a water availability analysis to determine the feasibility of amending a County water right application on the American River to coincide with the Freeport Project.

County Groundwater Export Ordinance – In 2000, the Board of Supervisors adopted 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. Ordinance Authority does not extend into the incorporated city limits of the County's municipalities. The Board of Supervisors has in the past indicated that a more workable 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.

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.

Mokelumne River Water Right Applications – In 1990, the Mokelumne River Water and Power Authority (MRWPA) filed with the State Water Resources Control Board (SWRCB) Water Right applications for unappropriated wet year flows on the Mokelumne River and obtained a Federal Energy Regulatory Commission (FERC) Preliminary Permit to further study the associated power generation potential. The application sought to capture water behind a new on-stream dam located at Middle Bar upstream of Pardee Reservoir or at a site off-stream at the proposed Duck Creek Reservoir. The Application also included the ability for County interest to divert wet year flows off of the Lower Mokelumne River from Camanche Dam to Interstate 5.

In 2003, the MRWPA retained the services of HDR Engineering, Inc. to move forward the Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE WATER Project) and prepare the necessary environmental documentation to perfect the water right applications and obtain all necessary permissions. The MORE WATER Project could potentially bring 60,000 – 100,000 af/yr to the Basin.

American River Water Right Applications – In 1990, the County also filed an application for unappropriated flows on the American River. The Application seeks to divert and store water between December 1 and June 30 from Nimbus Dam via the Folsom South Canal on the Lower American River and from the South Fork of the American River via a series of proposed pipelines and reservoirs. The County has amended its application in order to divert American River water from the Sacramento River at Freeport as well. The size of the Freeport diversion limits the amount of potential water delivered San Joaquin County under the amended application. The potential annual average yield to the County using the Freeport Project capacity is estimated at 44,000 af/yr.

1.6.4 Overview of Groundwater Management Outside the GMA

Calaveras County Water District – Calaveras County Water District's (CCWD) boundaries coincide with the boundaries of Calaveras County. Approximately 70 square miles of the Camanche and Valley Springs areas in Calaveras County overly the Eastern San Joaquin Groundwater Sub-basin. In 2001, CCWD adopted an AB 3030 Groundwater Management Plan specifically for the Camanche Valley Springs area. The goals and objectives of the Plan are to develop a better understanding of the Basin dynamic and the establishment of a groundwater management program that will ensure the sustainability of the Basin. CCWD coordinates closely with numerous local, State, and Federal agencies as well as SEWD and EBMUD.

East Bay Municipal Utility District – EBMUD provides water and wastewater services to over 1.2 million customers east of the San Francisco Bay Area in Alameda and Contra Costa Counties. EBMUD owns and operates two major reservoirs on the Mokelumne River: Pardee and Camanche Reservoirs. Pardee Reservoir, built in 1929, is the primary source of drinking water for EBMUD. Camanche Reservoir, completed in 1969, is a multipurpose reservoir serving a variety of interests on the Lower Mokelumne River including WID's water rights, in-stream flow requirements, and recreation.

In times of severe drought, Pardee and Camanche cannot meet the needs of all of its down stream requirements and its customers. For a number of years, EBMUD and ESJPWA studied the possibility of a large scale conjunctive use project in Eastern San Joaquin County beneficial to both parties. A combined project has not yet been negotiated. EBMUD has also fought for over thirty years to uphold a Federal Central Valley Project contract for water from the American River at Nimbus. Opposition to the diversion by Sacramento County interests prompted both sides to develop a mutually beneficial project to divert American River water from the Sacramento River near the town of Freeport. In 2002, the Freeport Regional Water Authority was formed to move the Project forward. EBMUD is allowed to take no more than 133,000 af in one year and no more than 165,000 af in any three year period. EBMUD is expected to divert from Freeport in one-third of all years (http://www.ebmud.com/, 2003).

Despite the Freeport Project, EBMUD must address the 20,000 af shortage in a severe drought even while imposing a 25 percent water use reduction through rationing. Several conjunctive use projects involving aquifer storage and recovery (ASR) are currently being evaluated at several sites throughout the East Bay and the Mokelumne River watershed. San Joaquin County is a potential partner for a conjunctive use project.

2 Hydrogeology

2.1 Regional Geology and Stratigraphy

San Joaquin County is situated within the Central Valley, a 400-mile long, 50 mile wide northwestward trending, asymmetrical structural trough. 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.

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 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. Table 2-1 shows a generalized stratigraphic column for San Joaquin County. The most important fresh water-bearing formations in Eastern San Joaquin County are the Mehrten, Laguna, Victor, and alluvial deposits. The formations are described below.

Mehrten

The Mehrten Formation is considered the oldest significant fresh water-bearing formation within Eastern San Joaquin County. It is exposed in the eastern most portion of the county, and slopes steeply from 90 to 180 feet per mile reaching a depth of 800 to 1,000 feet and a thickness of 400 to 600 feet in the Stockton sands, and gravels, the formation is often subdivided into upper and lower units. The upper unit is reported to contain finer grained deposits (black sands interbedded with brown-to-blue clay) and the lower unit consists of dense tuff breccia. Consequently, groundwater is reported to be semi-confined in the Stockton area. The Mehrten Formation has moderate to high permeability where black sands occur (DWR, 1967, Brown & Caldwell, 1985).

Laguna

The Laguna Formation outcrops in the northeastern part of the County and dips at 90 feet per mile (DWR, 1967), and reaches a maximum thickness of 1,000 feet. It consists of discontinuous lenses of unconsolidated to semi-consolidated sand and silt with lesser amounts of clay and gravel. The Laguna Formation is moderately permeable with some reportedly highly permeable coarse-grained beds and generally unconfined, but semi-confined conditions probably exist locally. Some studies have suggested that an extensive aquitard, namely the Corcoran Clay, extends into the Laguna Formation or separates the Laguna and Mehrten Formations (Brown & Caldwell, 1985).

Table 2-1 Stratigraphic Column for San Joaquin County

System	Series	Formation	Location	Thickness (feet)	Rock Characteristics and Environment	Hydrogeologic Description
Quaternary	Recent	Stream Channel Deposits	Eastside & Westside		Continental unconsolidated gravel, course to medium sand deposited along present stream channels.	High permeability, unimportant to groundwater except as avenue for percolation.
	Late to Pleistocene	Alluvial Fan Deposits	Westside	0 to 150±	Continental fan deposits-heterogeneous, discontinuous mixtures of gravel silt & clay.	Moderate to locally high permeability, unconfined aquifers.
		Recent Alluvium and Victor	Eastside	0 to 150±	Continental fan and interfan material, locally some basin type. Lenticular gravel, sand, silt, & clay	Moderate permeability, unconfined aquifers.
Tertiary	Plio-Pleistocene	Flood Basin Deposits	Eastside & Westside	0 to 1400±	Continental basin equivalent of Laguna, Tulare, and younger formations. Clay, silt, & sand, organic in part.	Generally low permeability, saturated environments, unconfined to confined.
	Mio-Pliocene	Tulare	Westside	0 to 1400±	Continental semi-consolidated clay, sands, & gravel. Contains Corcoran Clay member.	Moderate permeability, generally unconfined above Corcoran Clay, confined below.
	Upper Miocene	Laguna	Eastside	0 to 1000±	Continental, semi to unconsolidated silt, sands, & gravel poorly sorted, include Arroyo Seco gravel pediment of Mokelumne River area.	Moderate permeability, unconfined to locally semi-confined. Restricted perched bodies in some areas
Cretaceous		Merhten	Eastside	0 to 600±	Continental andesitic derivatives of silt, sand, & gravel & their indurated equivalents; tuff; Breccias; agglomerate.	Moderate to high permeability, where "black sands" occur. Confined to unconfined. Saline west of Stockton.
	Miocene	San Pablo Group	Westside	0 to 1000±	Continental to marine massive sandstone & shale. Westside equivalent to Merhten & Valley Springs formations, in part.	Low permeability. Saline in part. Essentially non-water bearing except along fractures & joints.
	Eocene	Valley Springs	Eastside	7 to 500±	Continental to marine rhyolitic ash, clay, sand, gravel & their induriated equivalents.	Low permeability. Saline in Stockton area. Not considered significant in groundwater studies.
Jurassic		Eocene Undifferentiated	Westside	?	Marine shale, siltstone, & sandstone.	Contains saline waters except where flushed in outcrop areas. Unimportant to freshwater basin except as possible contaminant source.
	Cretaceous	Cretaceous Undifferentiated	Westside	?	Marine shale, siltstone, & sandstone.	Contains saline waters, unimportant to freshwater basin except as possible contaminant source.
	Jurassic	Franciscan Group, Undifferentiated	Westside	?	Marine shale, sandstone, chert metamorphica, serpentine.	Unimportant to freshwater basin except as possible contaminant source.

Source: San Joaquin County Water Management Plan Volume II

<u>Victor</u>

The Victor Formation is of Holocene to Pleistocene Age and consists primarily of stream deposited unconsolidated gravel, sand, silt, and clay. Coarse sands and gravels are found to the east, and sands, silts and clays towards the west. This formation is generally more permeable than underlying formations, and groundwater is typically unconfined (CDM, 2001).

<u>Alluvial/Stream channel deposits</u>

Stream channel deposits are found along major stream and river courses within the study area. Generally they consist of unconsolidated gravel and coarse sand with high permeabilities (CDM, 2001).

2.2 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 concern are shown above. The Delta and other major waterways are shown on Figure 2-2 and are discussed in more detail below (DWR, 2003).

2.2.1 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. Table 2-2 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.

Table 2-2 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. Army Corps of Engineers Stockton East Water District
Stanislaus	New Melones Reservoir	2,400,000	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.

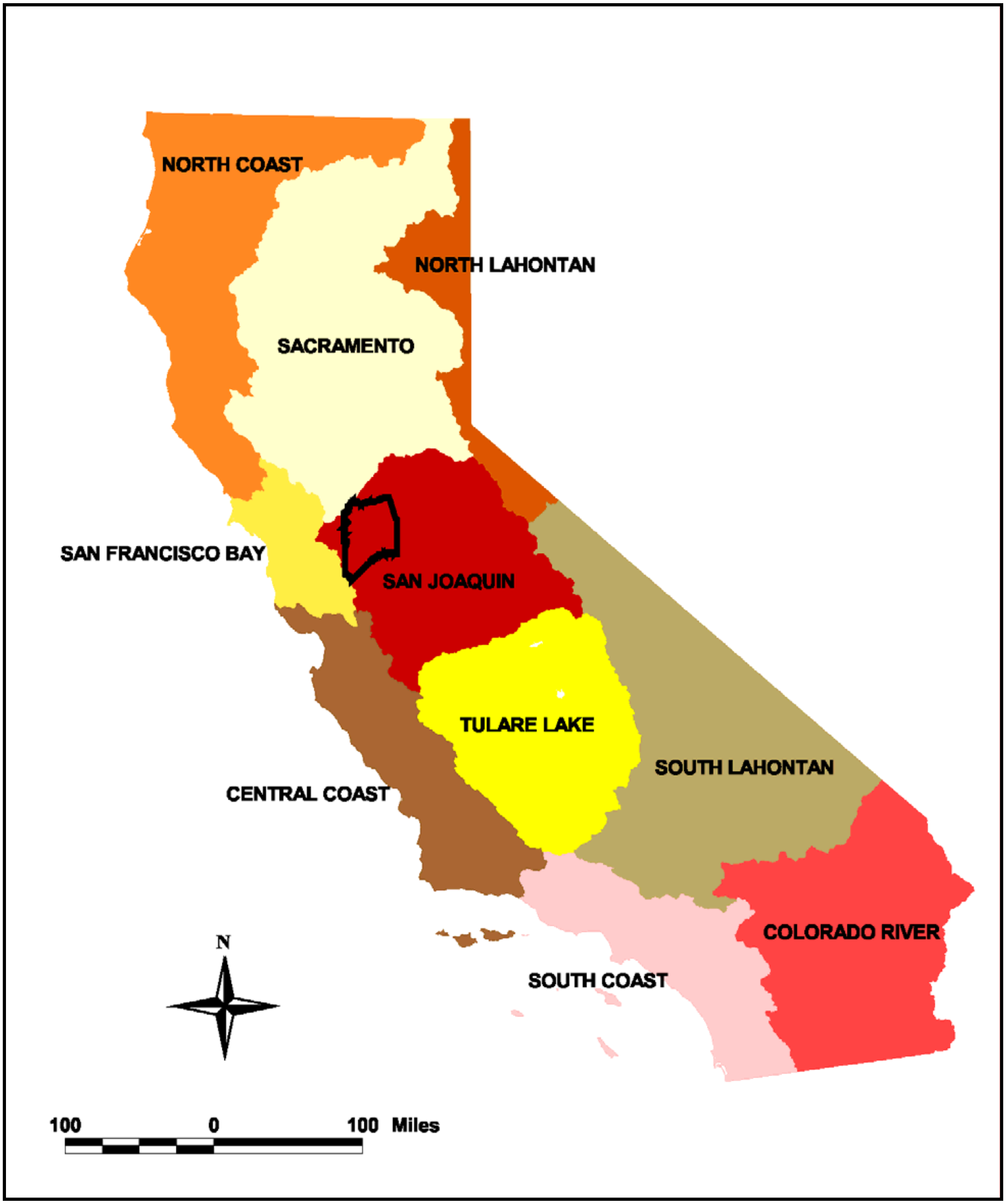


Figure 2-1 Hydrologic Regions of California
Source: California Spatial Information Library at http://www.gis.ca.gov/

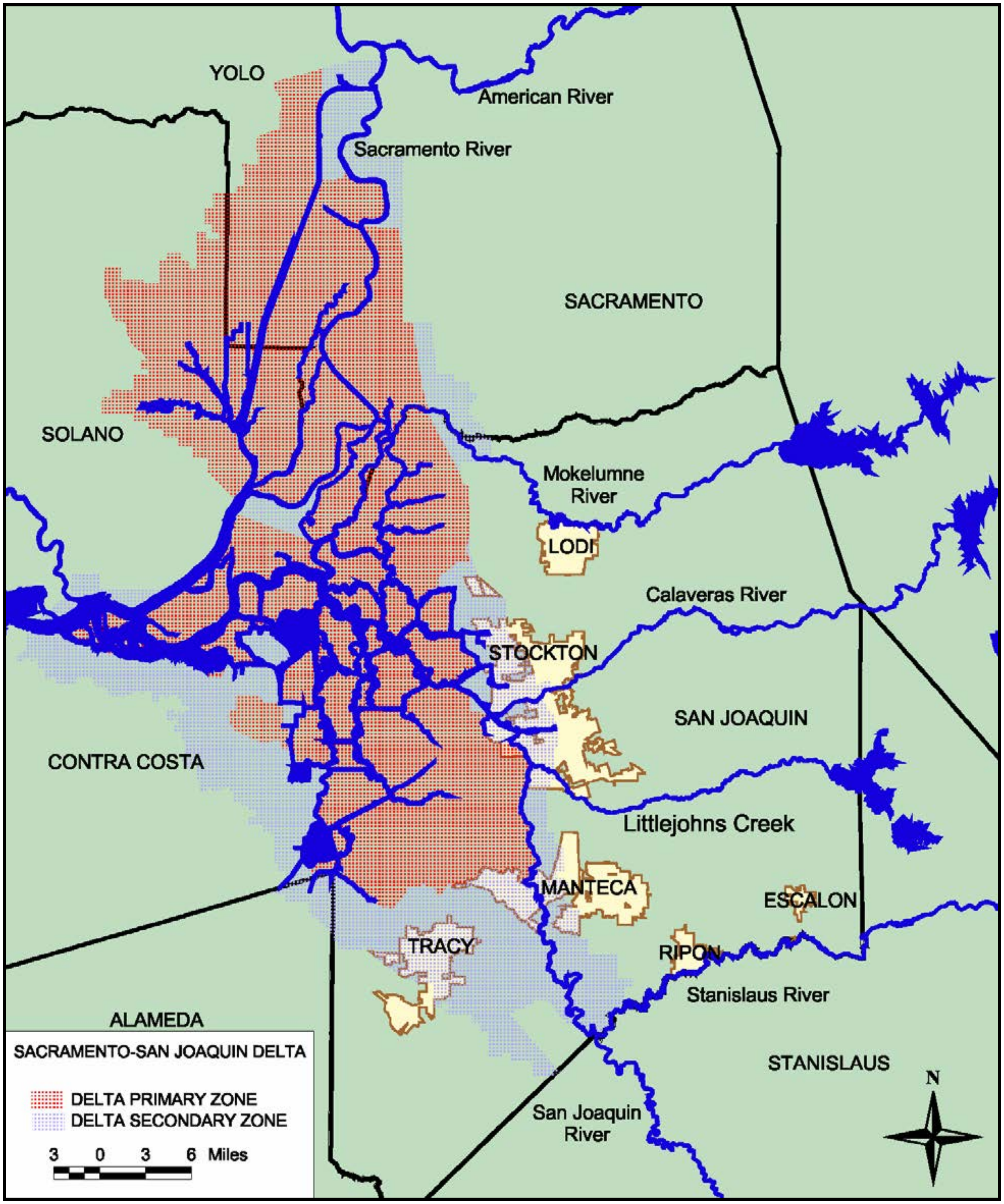


Figure 2-2 Sacramento San Joaquin Delta
Source: California Spatial Information Library at http://www.gis.ca.gov/

2.2.2 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, and irrigation purposes. New Hogan Reservoir has a capacity of 317,000 af. The USACE controls flood control releases from New Hogan. SEWD operates New Hogan at all other times. SEWD and 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 af/yr and estimates it will use up to 5,300 af/yr by 2040 (Calaveras County Water District, 1996).

2.2.3 Mokelumne River

The Mokelumne River watershed encompasses approximately 660 square miles stretching from the high Sierra Nevadas westward to the Delta. Snowmelt comprises a large portion of the watersheds 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 rivers 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 River Aqueducts to the EBMUD service area some 82 miles away. Camanche Reservoir, with a capacity of 417,120 af, is operated for flood control and also to meet instream flow requirements and down stream entitlements. Both Pardee and Camanche generate incidental hydro power at 30 MW and 9.9 MW respectively (EBMUD, Urban Water Management Plan 2000). 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.

2.2.4 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 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 af 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 af.

There are 9 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 and SEWD divert from Goodwin Dam downstream from Tulloch Dam. Water can be diverted by gravity via Goodwin Tunnel to CSJWCD and SEWD. SSJID and OID are the principal users of Stanislaus River water in San Joaquin County. Both SEWD and CSJWCD interim CVP contracts for New Melones water.

2.2.5 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 as the upper San Joaquin River contributes virtually no inflow during the summer months.

2.2.6 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 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 water 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 a tributary of the Mokelumne River. It meets the Mokelumne near the town of Thornton and has a watershed area of approximately 540 miles. Flows are primarily rain/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.

2.2.7 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 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 Bureau of Reclamation 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 Bureau 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.

2.3 Regional Groundwater Flow Patterns

Regional groundwater flow patterns have been significantly altered since pre-development conditions. The pre-development and current/post-development groundwater flow patterns are discussed below.

2.3.1 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. Under pre-development conditions groundwater gradients within San Joaquin County were likely similar to the topographic gradient, or around 0.0012 ft/ft.

2.3.2 Post-Development Conditions

Beginning in 1850 the development of groundwater for agriculture expanded rapidly. Within the Central Valley, irrigated agriculture has grown from less than 1 million acres around the turn of the century, to an estimated 7 to 8 million acres at present. Within eastern San Joaquin County, an estimated 800,000 af/yr of groundwater was being extracted by 1993. In Bulletin 118-80, DWR designated the Basin as ‘critical overdrafted’.

Figures 2-1 through 2-4 illustrate groundwater table contours for spring and fall 1993 and 1998. The map clearly shows the significant cone of 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 of the typically poorer quality water.

2.3.3 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 2-7 through 2-21 and a map of the well locations is shown on Figure 2-22.

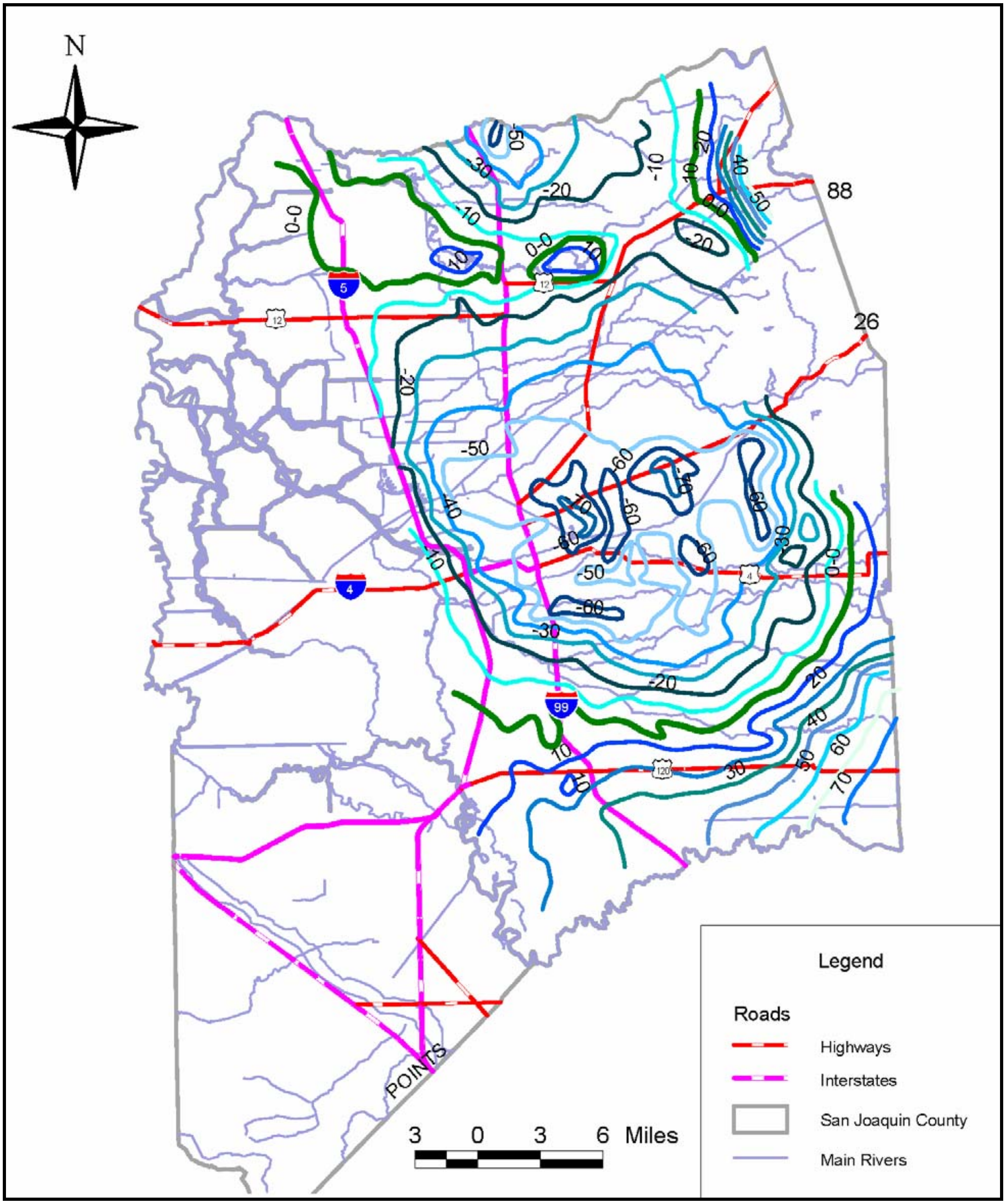


Figure 2-3 Spring 1993 Groundwater Contours
Source: Camp Dresser & McKee Inc.

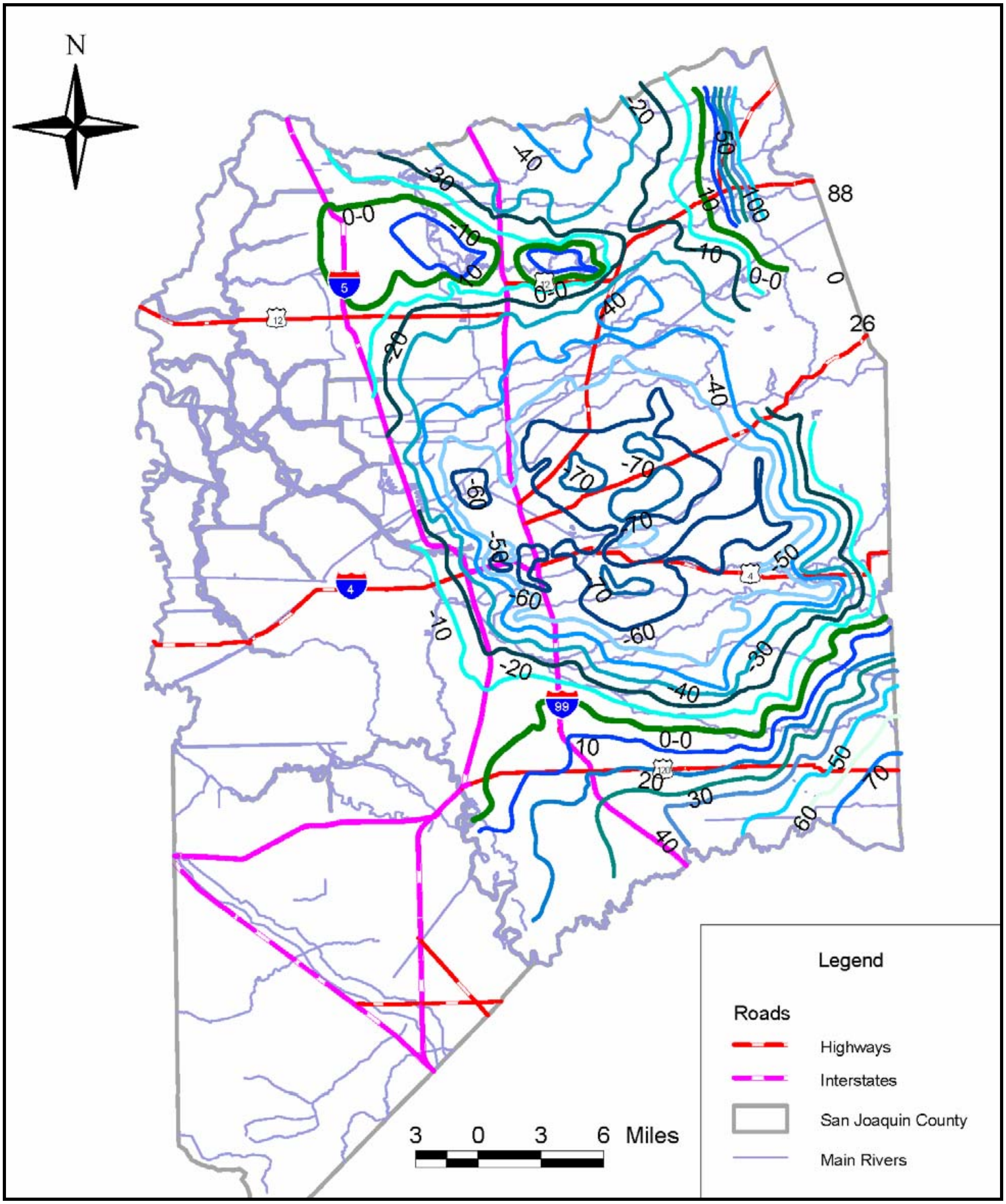


Figure 2-4 Fall 1993 Groundwater Contours
Source: Camp Dresser & McKee Inc.

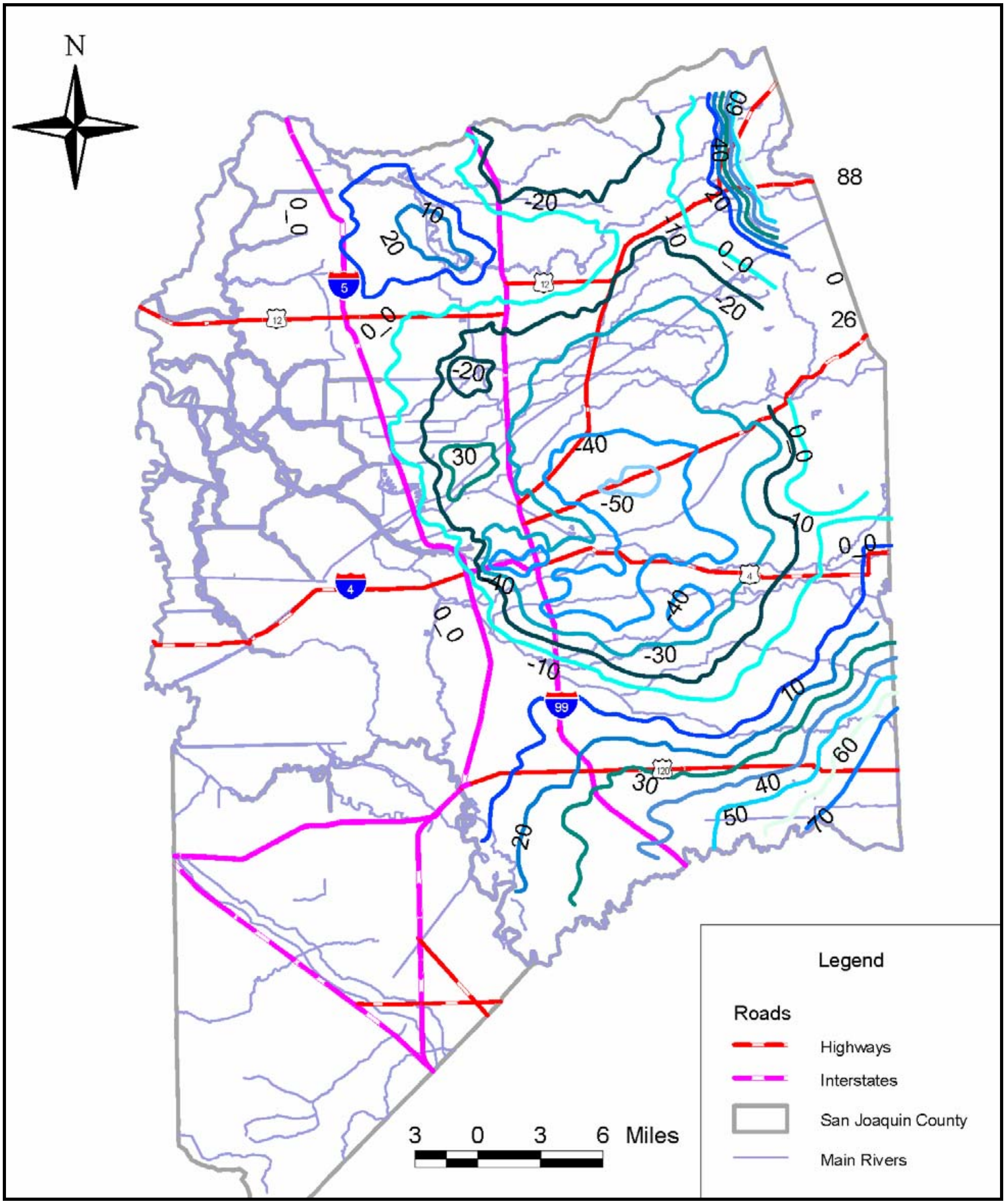


Figure 2-5 Spring 1998 Groundwater Contours
Source: Camp Dresser & McKee Inc.

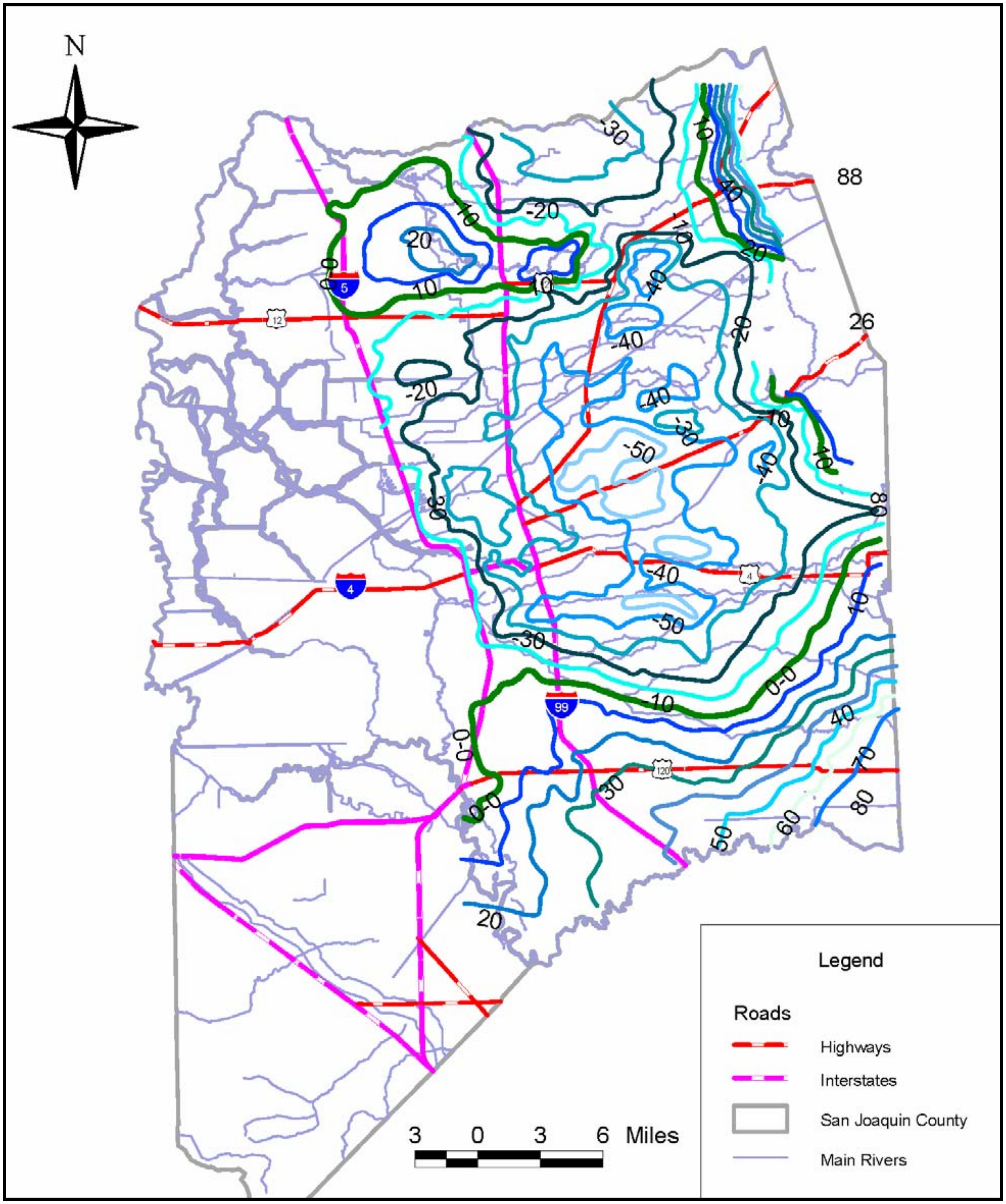


Figure 2-6 Fall 1998 Groundwater Contours
Source: Camp Dresser & McKee Inc.

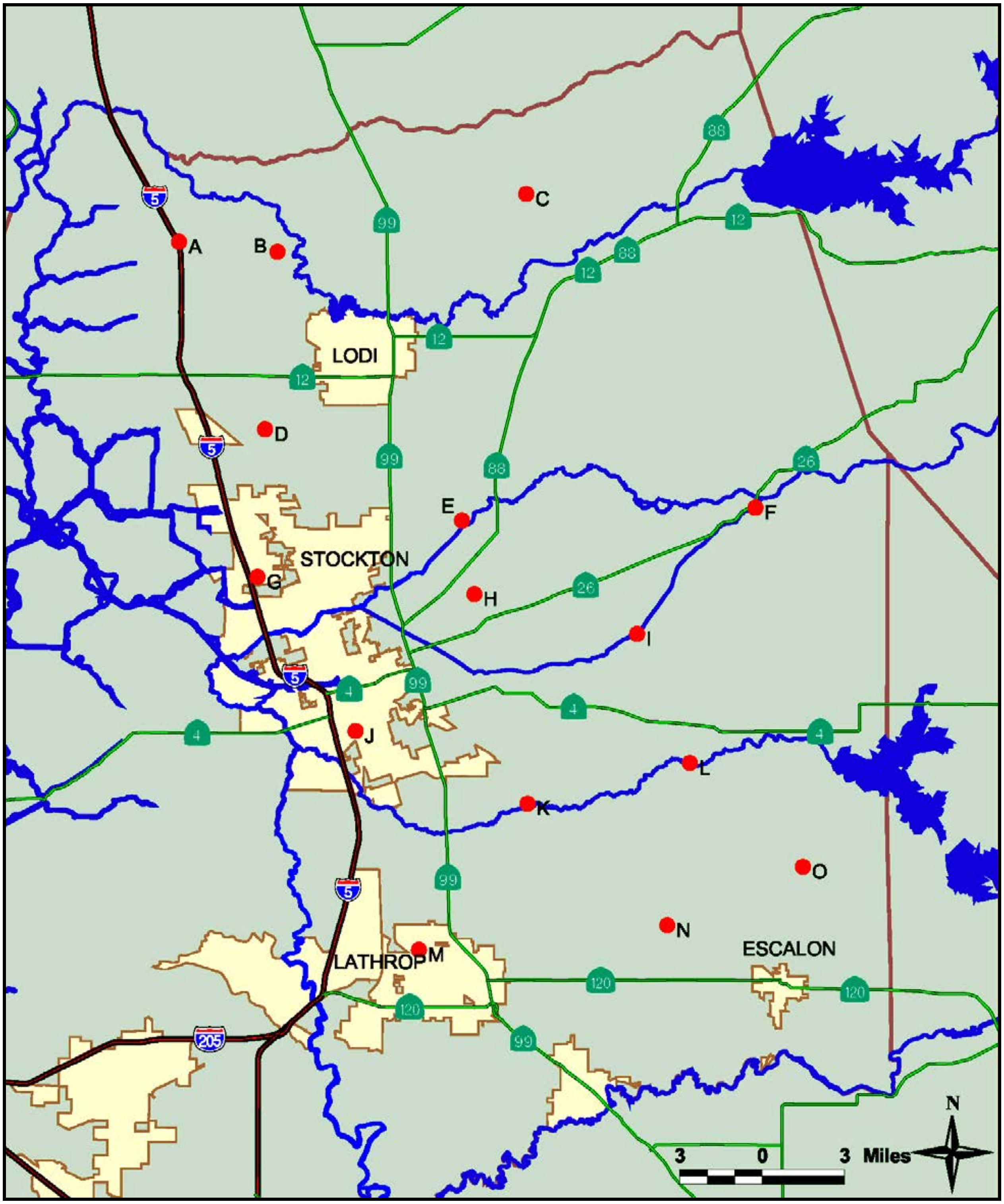


Figure 2-7 Groundwater Well Locations
Source: California Department of Water Resources, Water Data Library at
http://well.water.ca.gov/

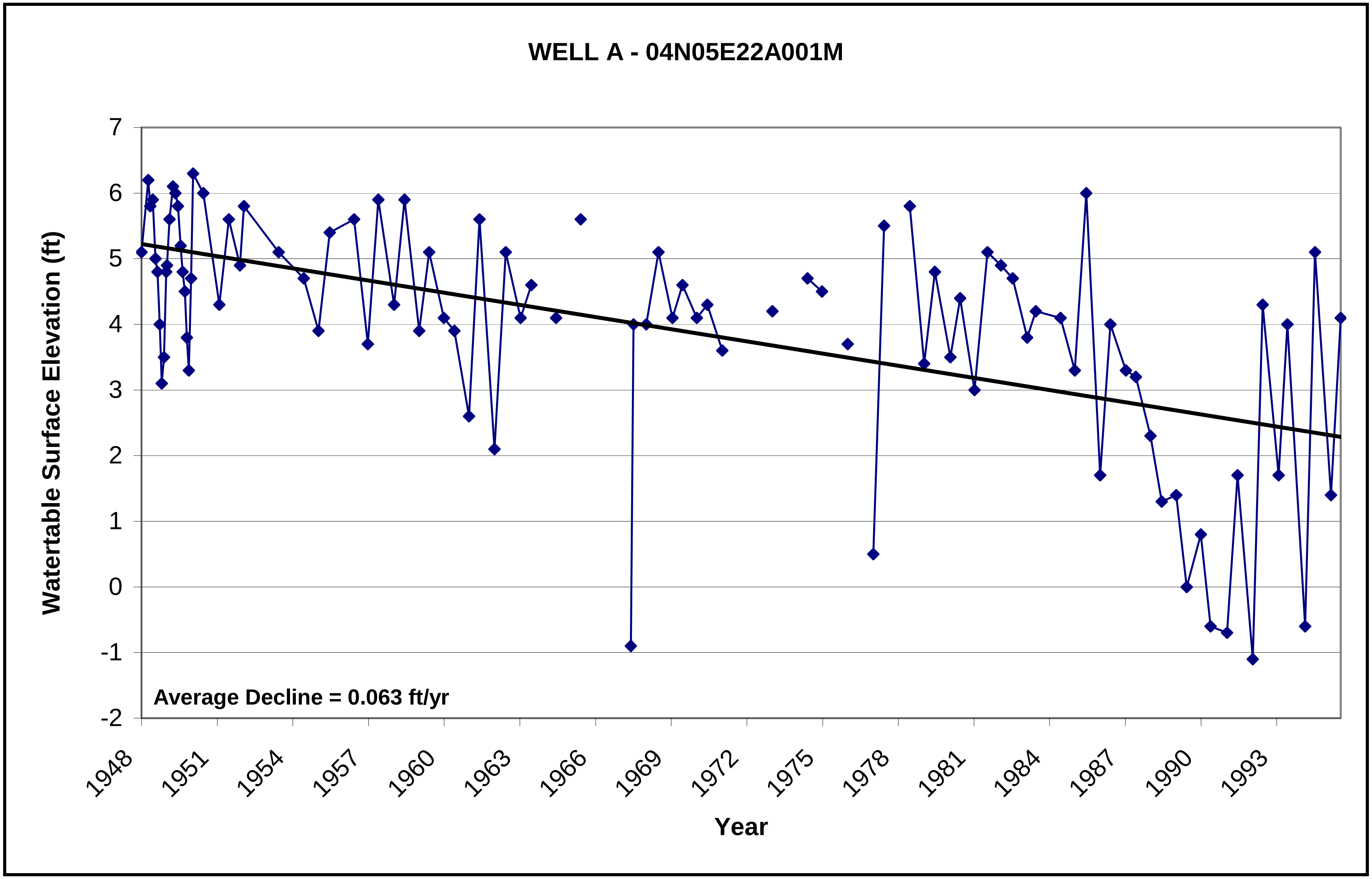


Figure 2-8 Hydrograph Well A
Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

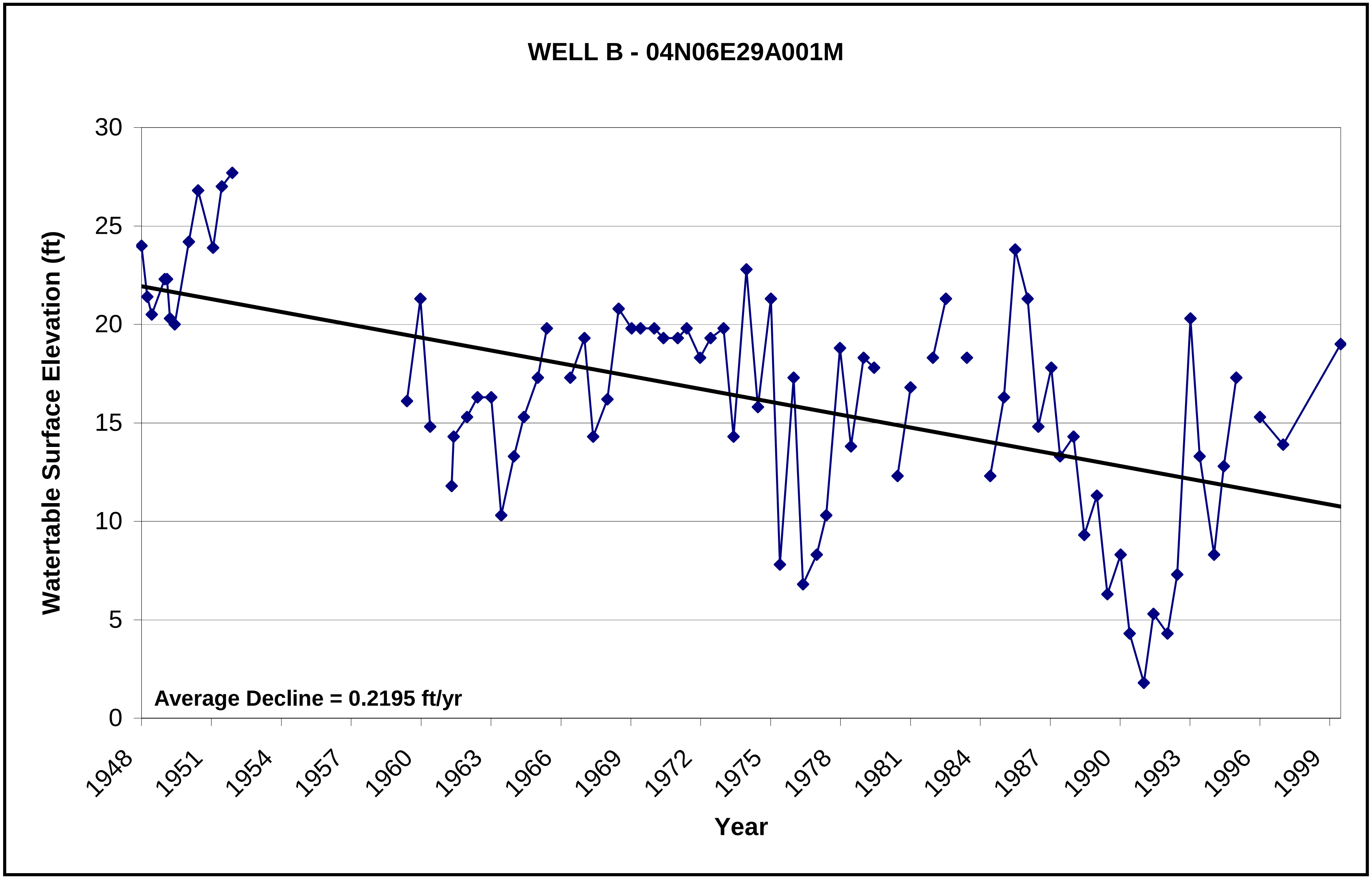


Figure 2-9 Hydrograph Well B
Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

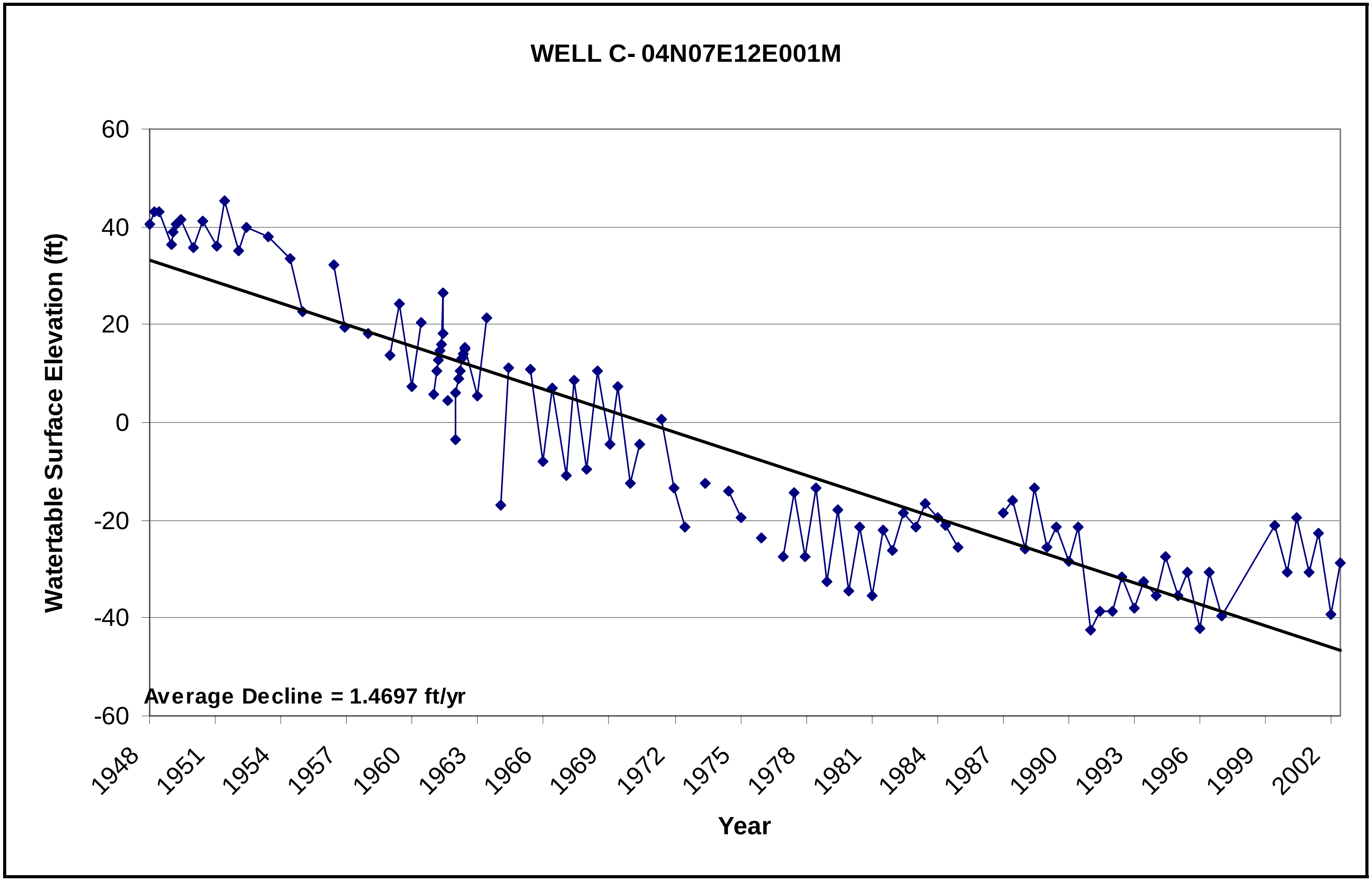


Figure 2-10 Hydrograph Well C

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

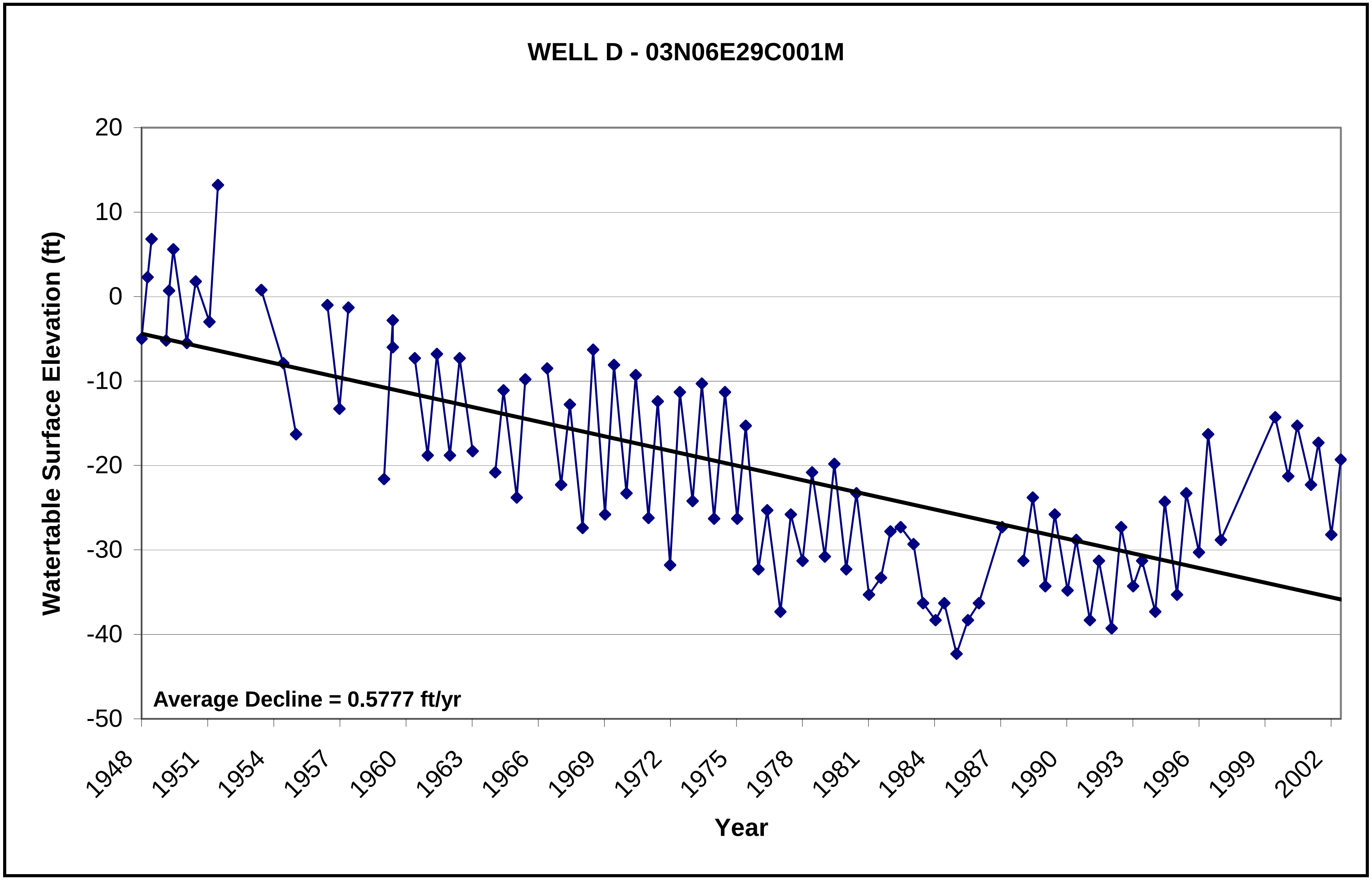


Figure 2-11 Hydrograph Well D
Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

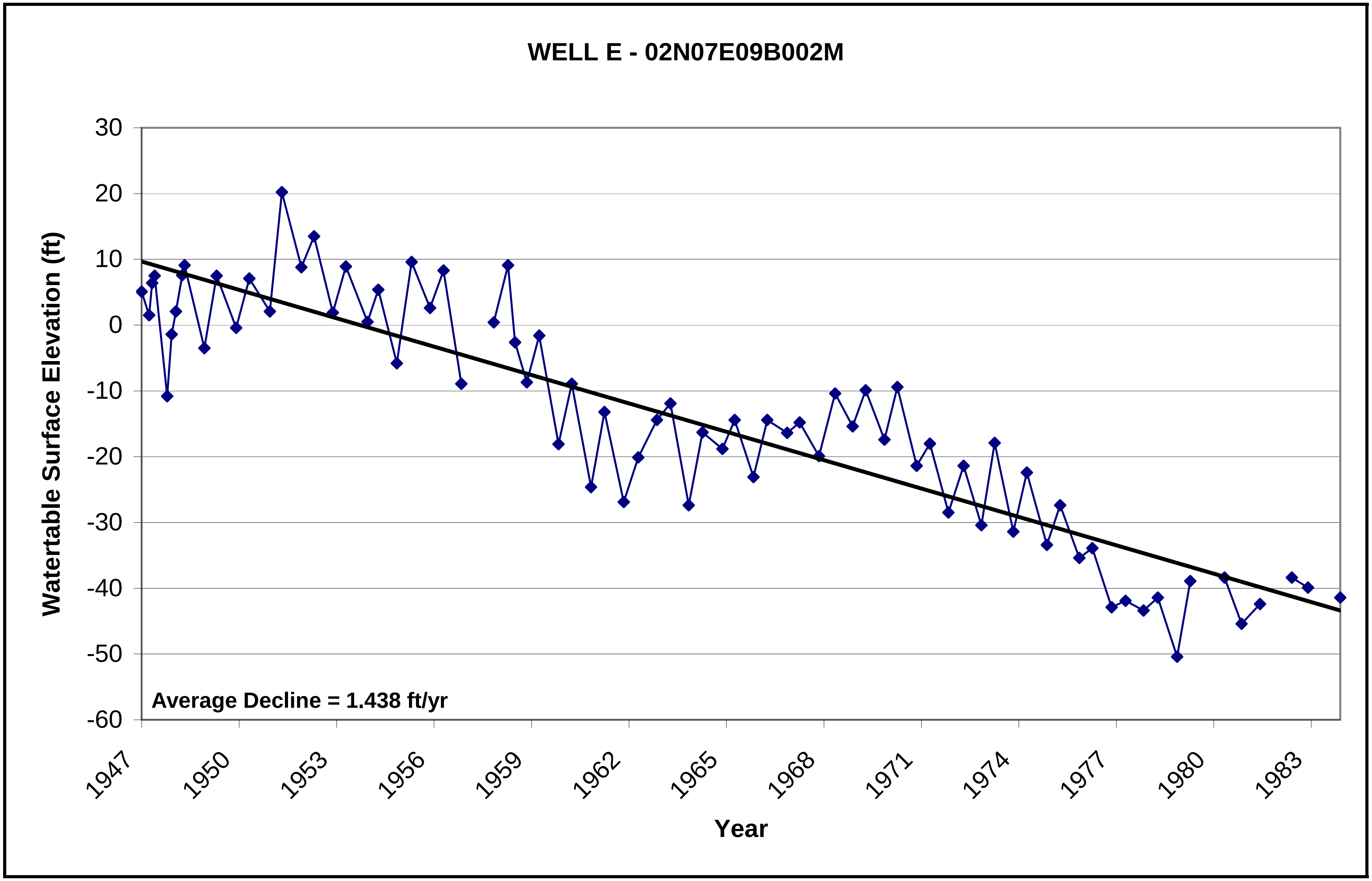


Figure 2-12 Hydrograph Well E

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

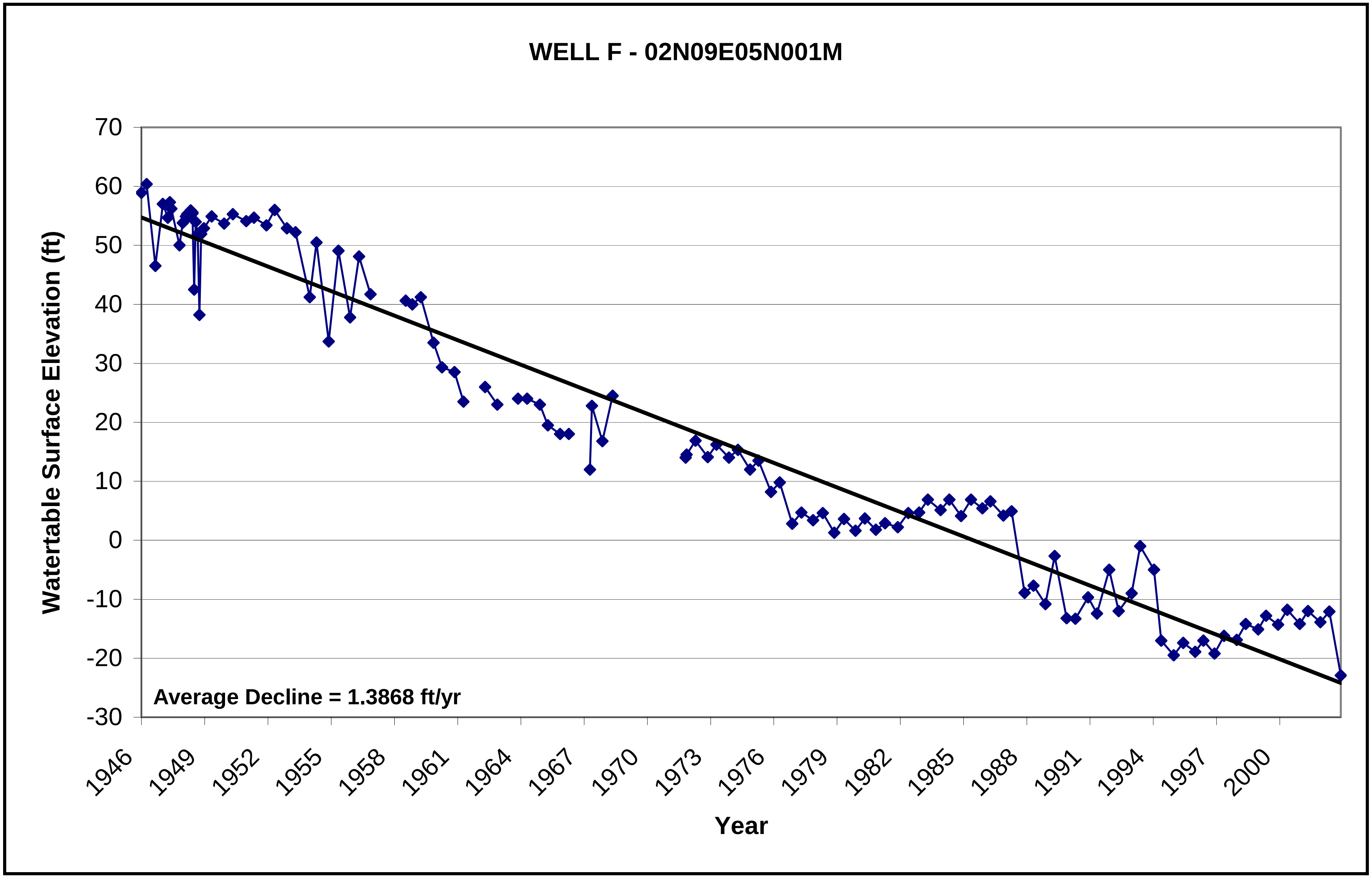


Figure 2-13 Hydrograph Well F

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

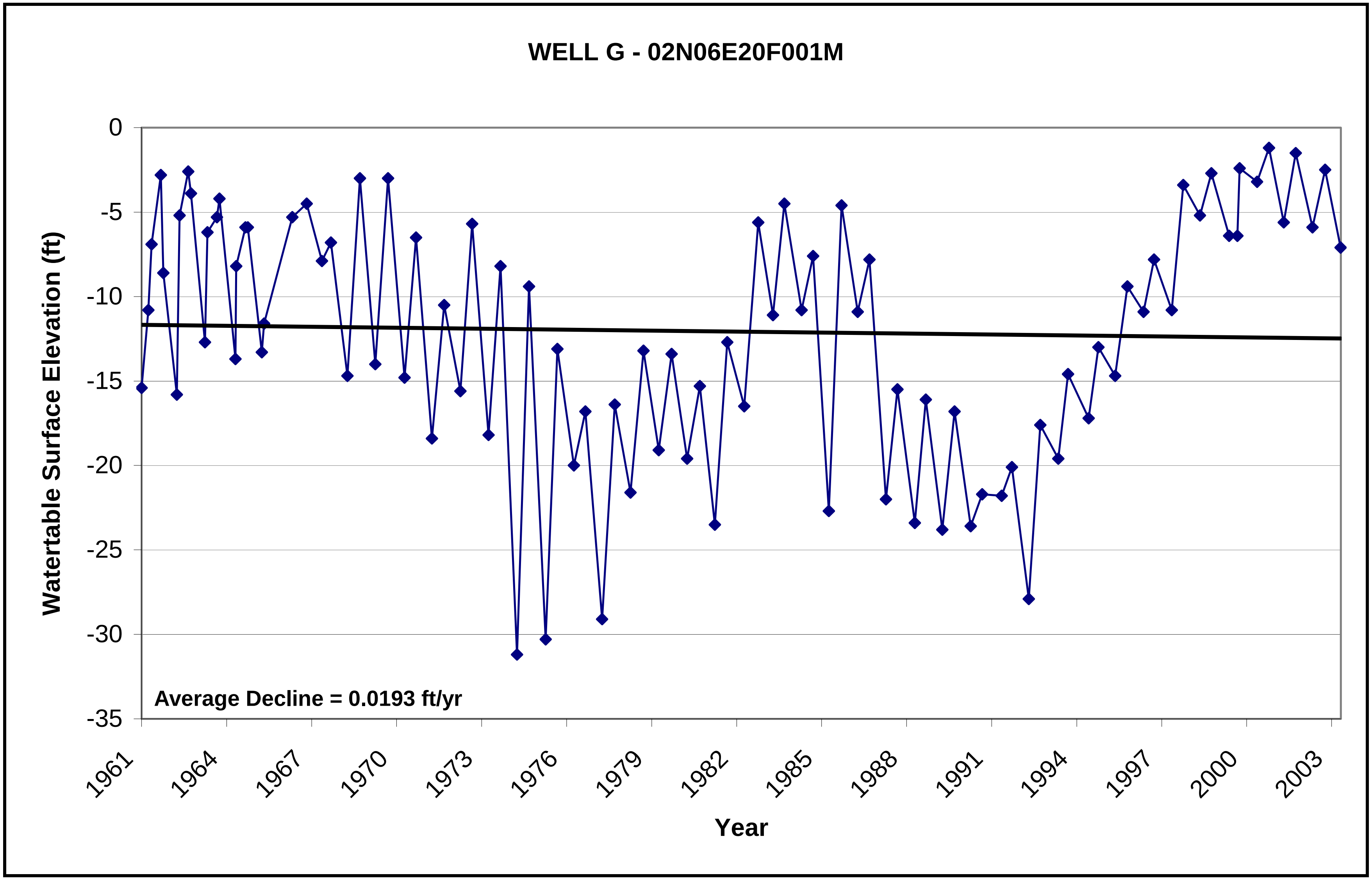


Figure 2-14 Hydrograph Well G

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

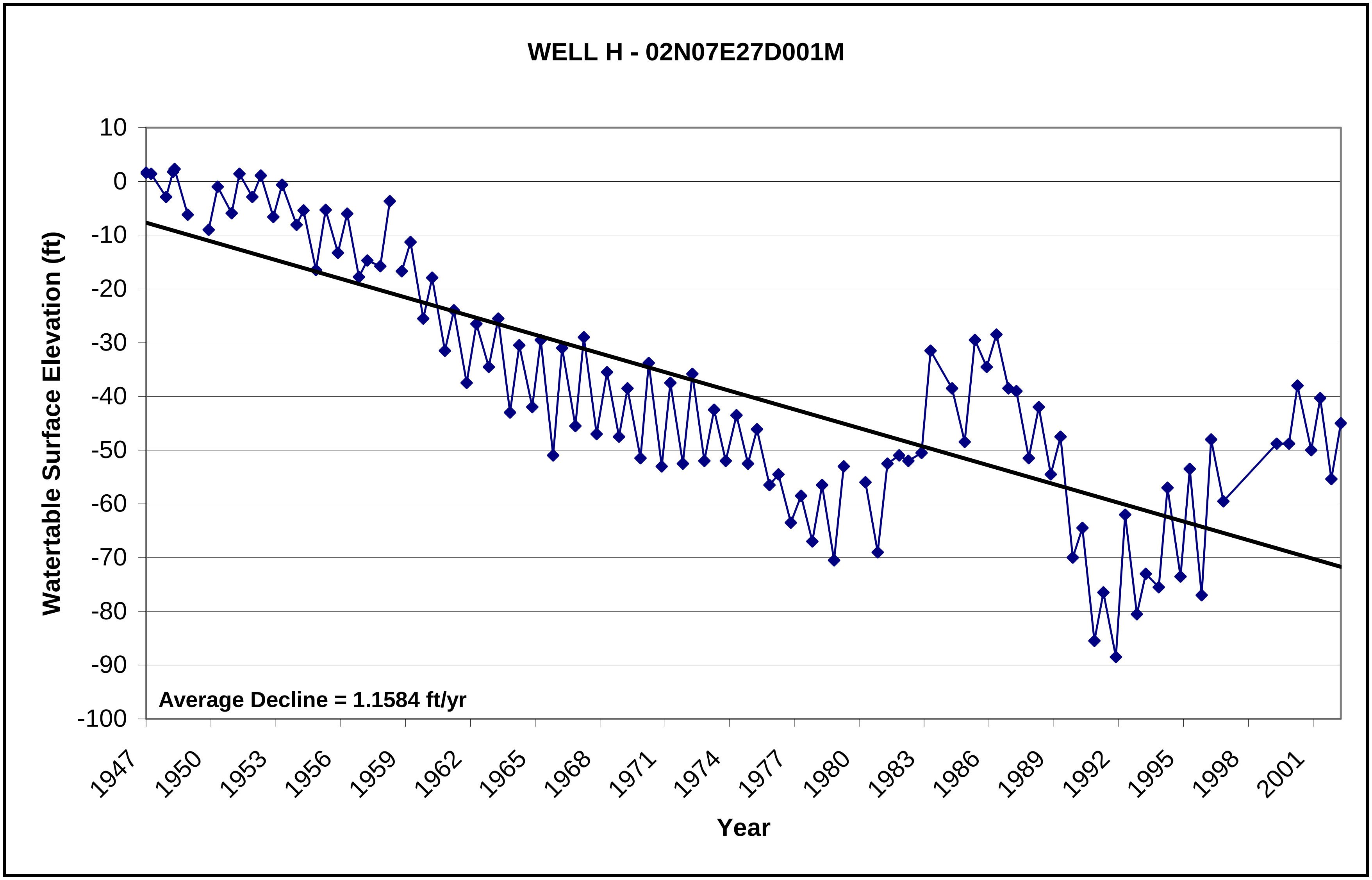


Figure 2-15 Hydrograph Well H

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

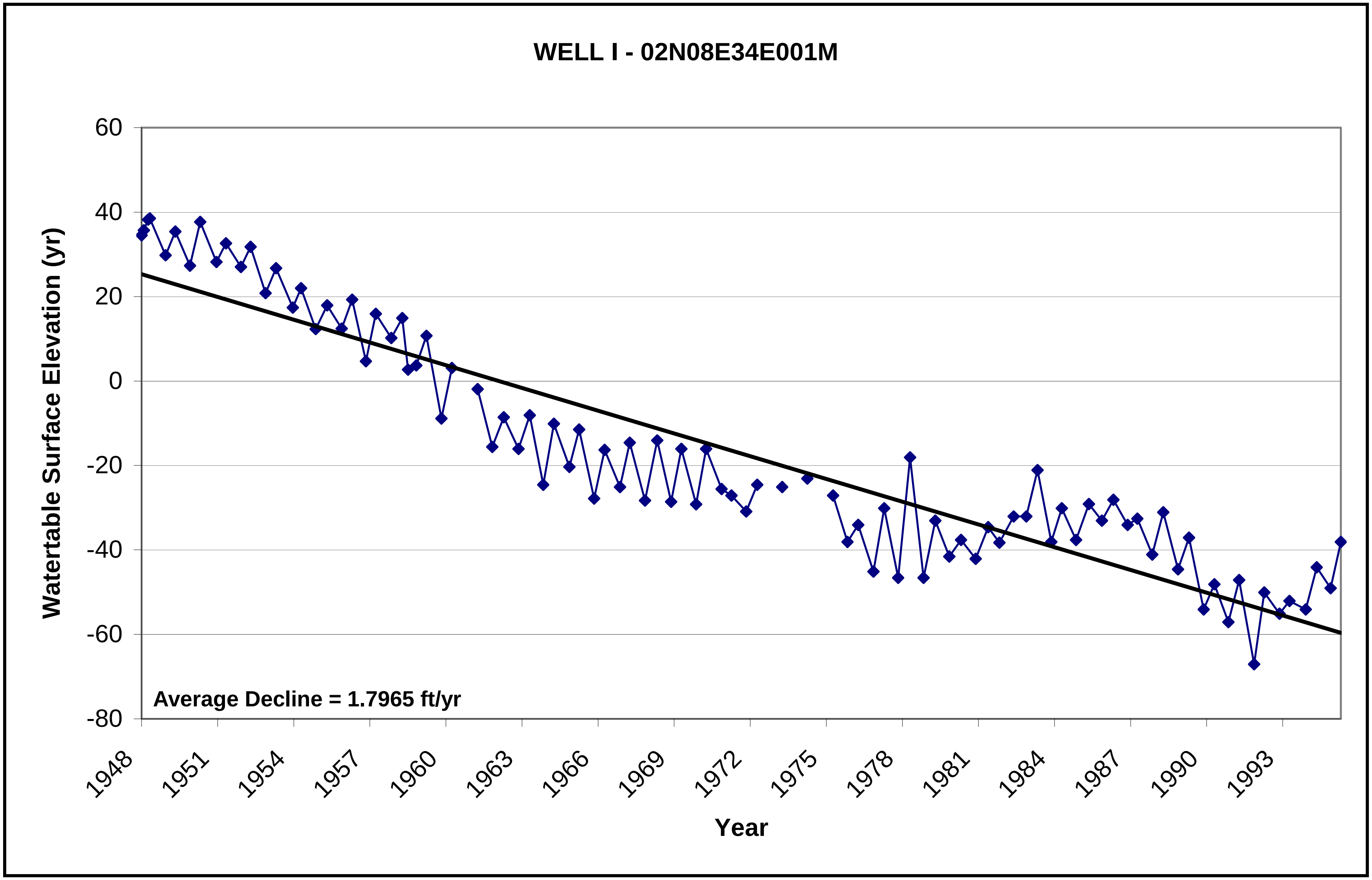


Figure 2-16 Hydrograph Well I

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

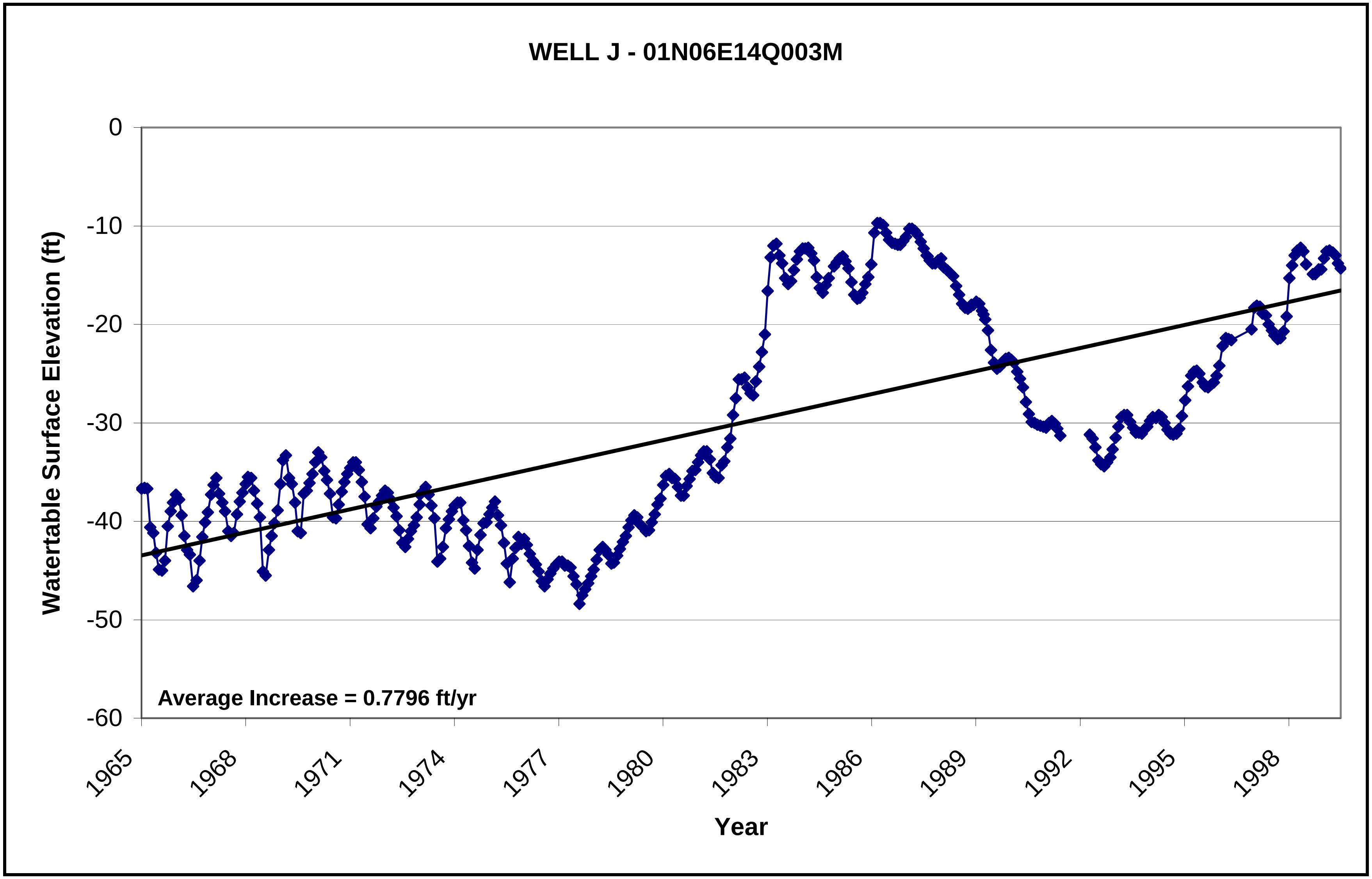


Figure 2-17 Hydrograph Well J
Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

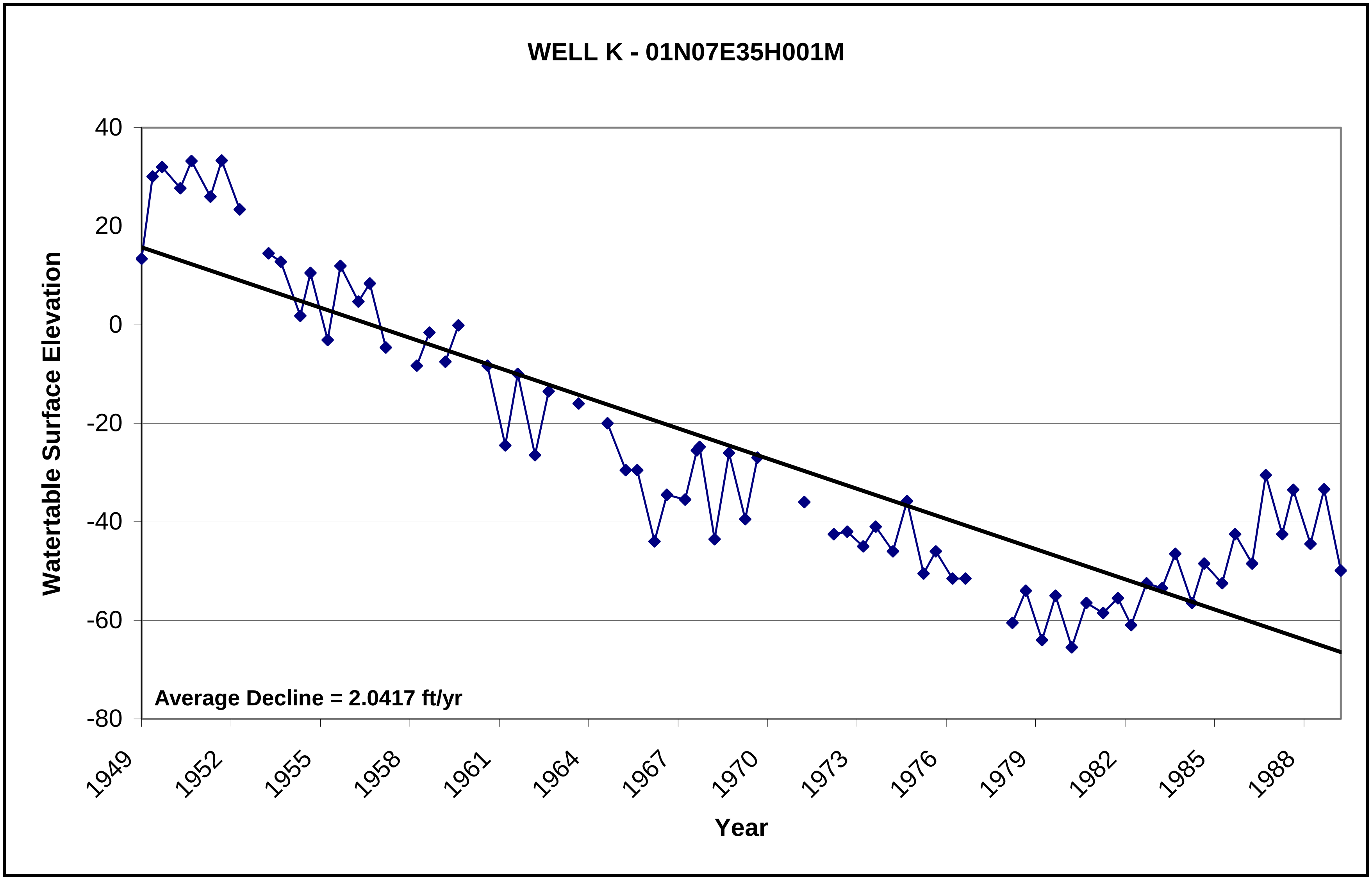


Figure 2-18 Hydrograph Well K

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

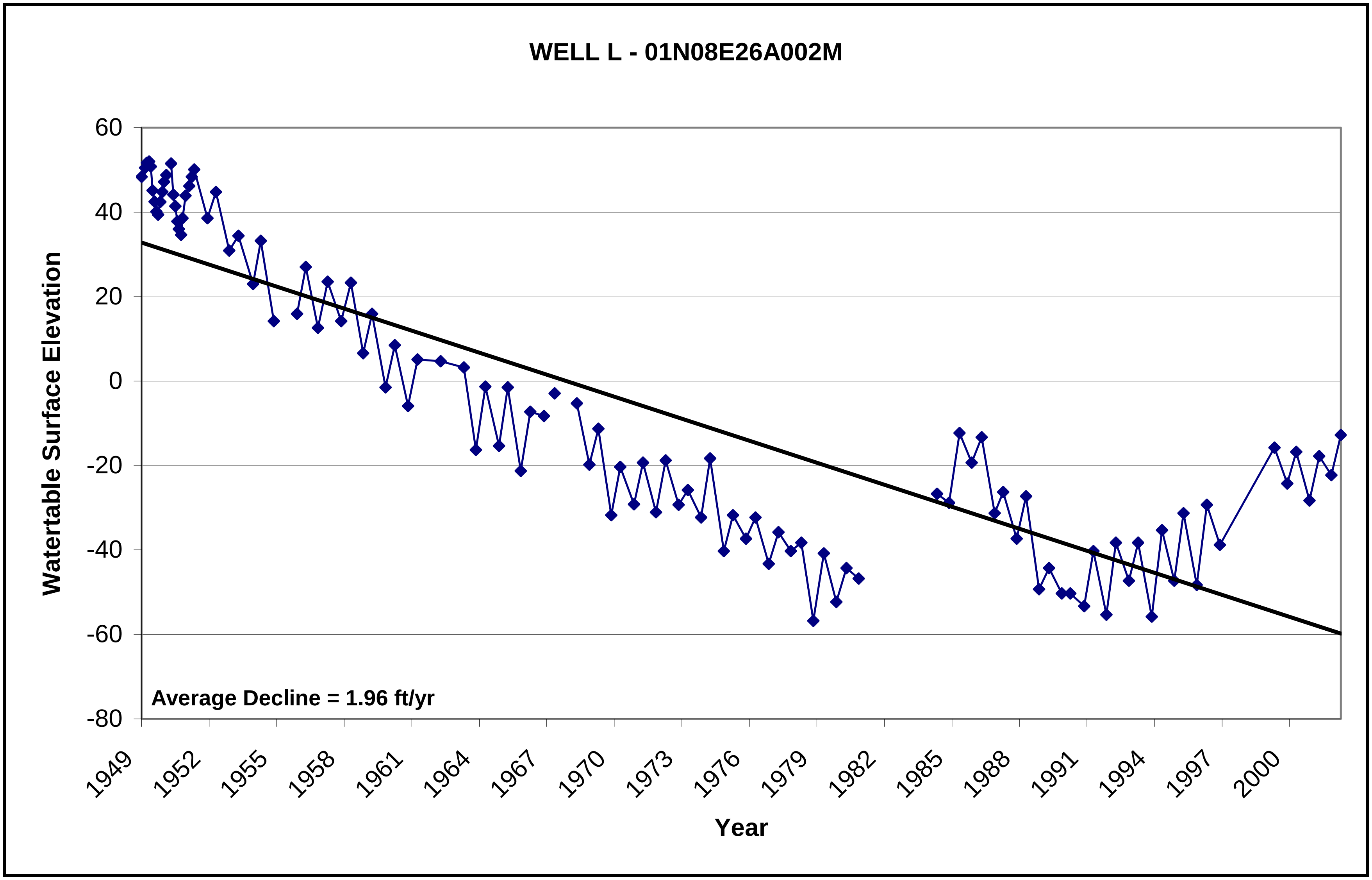


Figure 2-19 Hydrograph Well L

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

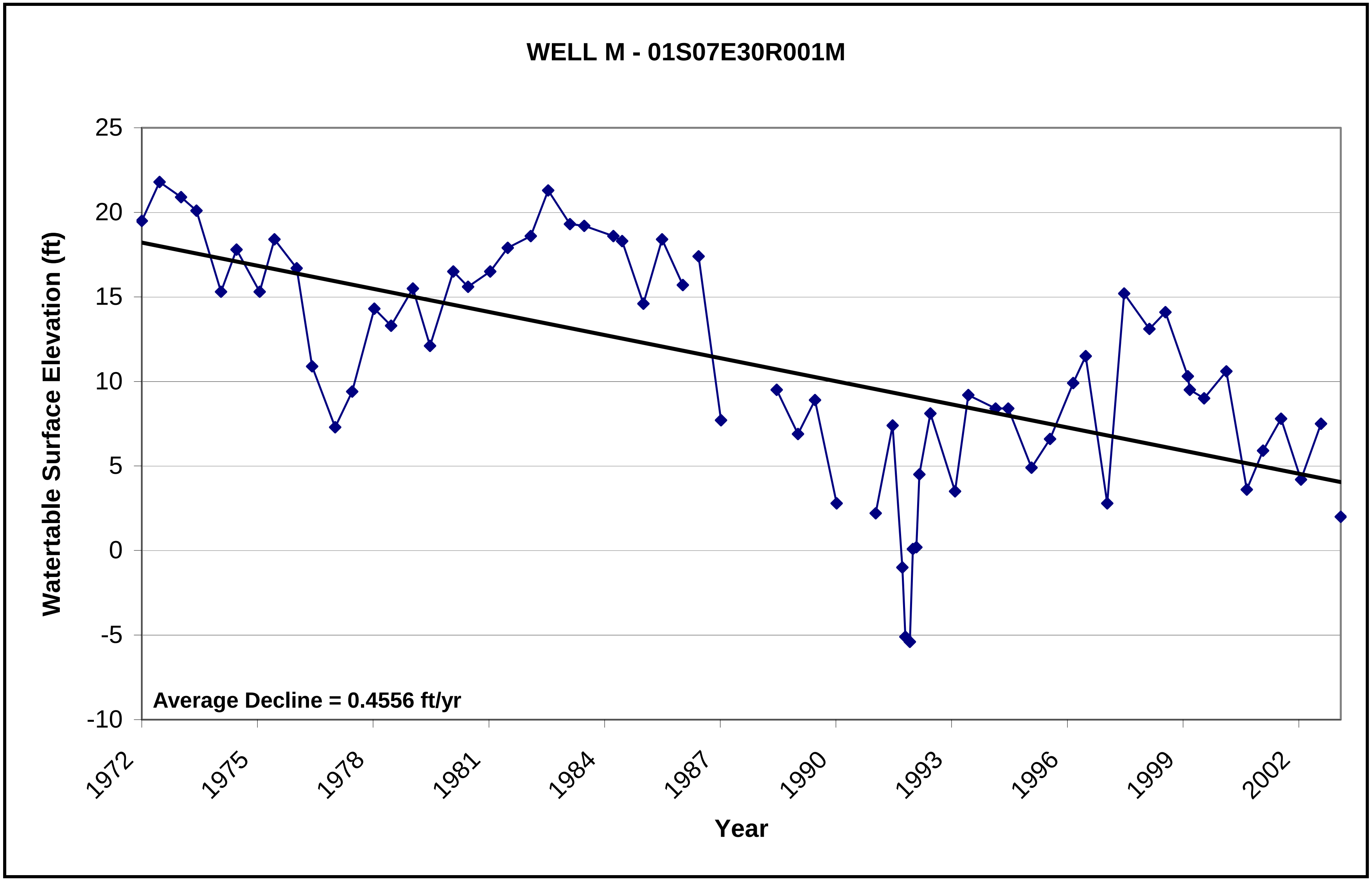


Figure 2-20 Hydrograph Well M

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

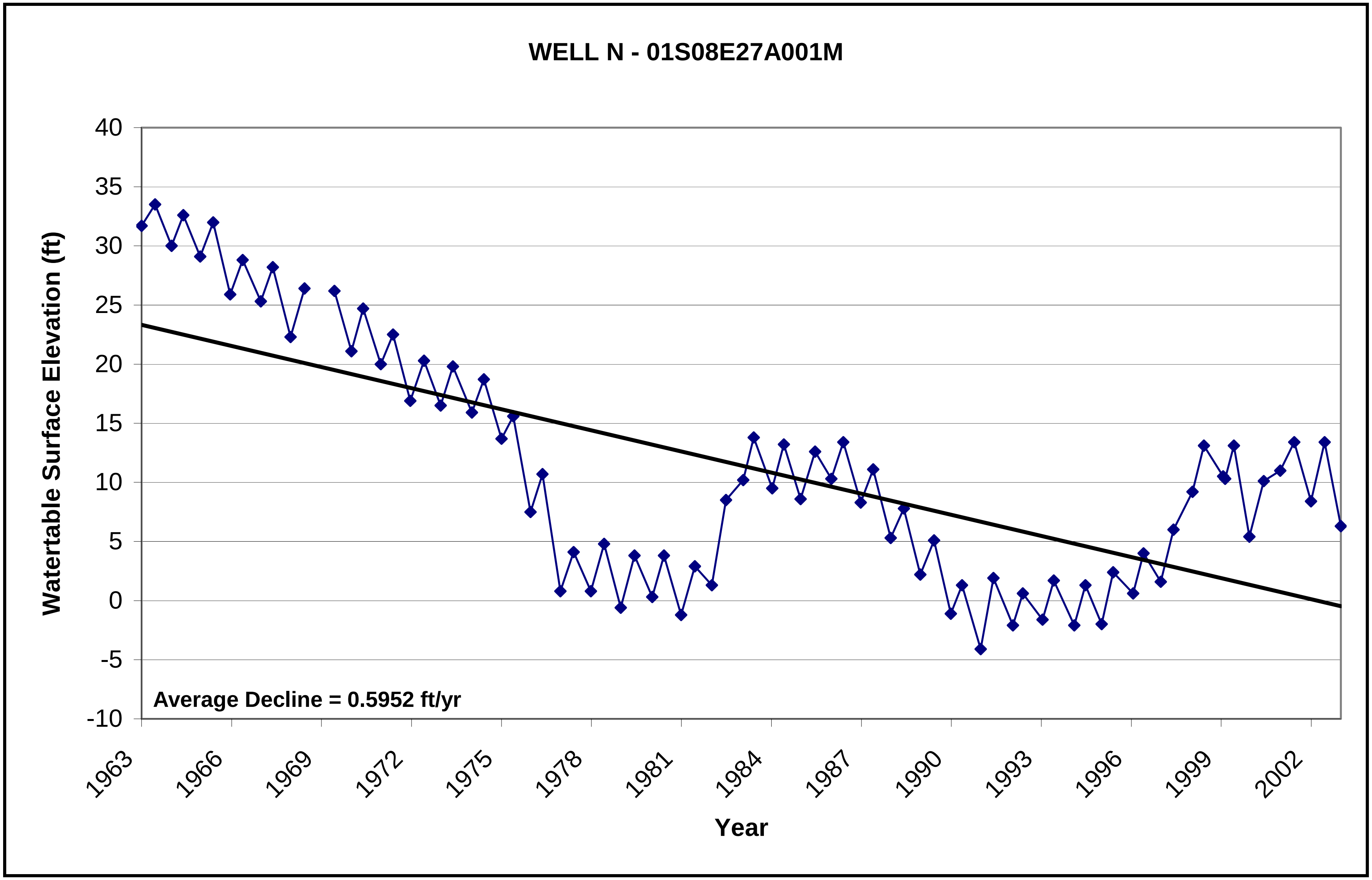


Figure 2-21 Hydrograph Well N
Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

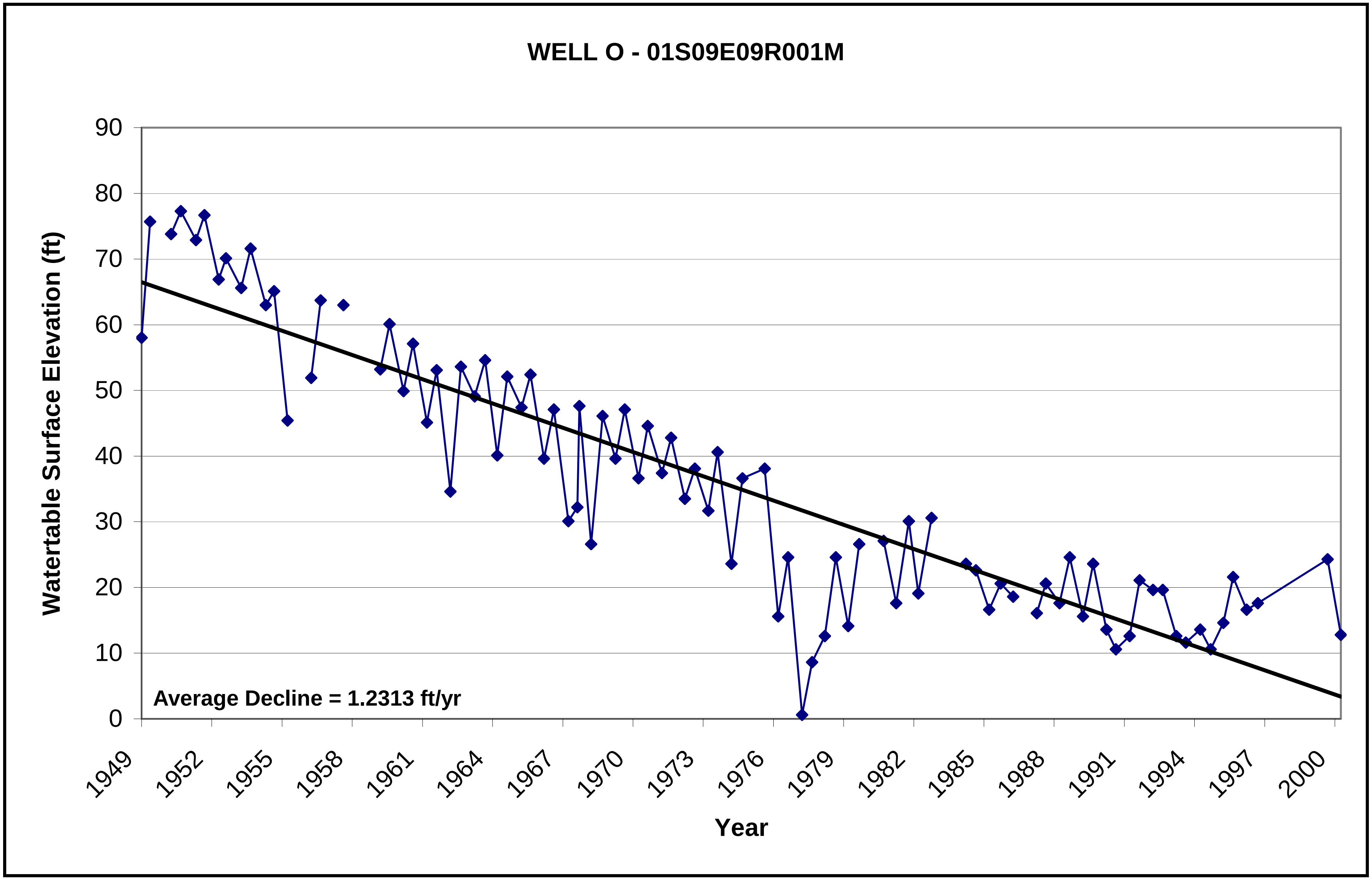


Figure 2-22 Hydrograph Well O

Source: California Department of Water Resources, Water Data Library at http://well.water.ca.gov/

Figures 2-9, 11, 12, 14, 15, 17, 18, and 21 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, an average drop of 60 feet. The hydrographs of these wells illustrate average groundwater level drops of around 1.3 feet per year. In general, the lowest groundwater levels were reached in the late 1970s, recovering 10 to 20 feet, but then declined again in the mid-1990s. Wells in this area have a significant seasonal variation of 10 to 20 feet.

Figures 2-7, 8, 10, 13, 16, 19, and 20 illustrate groundwater levels for wells located further away from the main cone of depression, primarily further west and north. These wells show a less dramatic drop than the other wells, and more noticeable increase due to the wet years of 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. In summary, the hydrographs reviewed illustrate the following general patterns:

1. In the central part of the County the groundwater table dropped continuously from the 1950s and possibly earlier to the mid 1980s. The decline was temporarily reversed due to climatic events.

2. In the northern part of the County groundwater table decline continued into the early 1990s.

3. Starting in the early 1980s a distinct drawdown and recovery cycle appears to have developed. The cycle covers a 10 to 15 year time period, and appears to be driven by climatic conditions more than long-term changes in groundwater use. This recovery and drawdown cycle may indicate that groundwater levels are beginning to equilibrate under current groundwater/surface water use patterns.

2.3.4 Groundwater Discharge and Recharge

The estimates of groundwater discharge and recharge presented in these sections are based on the modeling conducted by CDM for the San Joaquin County Water Management Plan, and the modeling originally conducted for the American River Water Resources Investigation (AWRI, 1996), and updated in 1999 for the Bureau of Reclamation by CH2MHill (CH2MHill, 1999). The results are for the Basin only.

2.3.4.1 Groundwater Pumping

Groundwater pumping records are not typically available for all wells within the study area. The approach adopted by DWR and other agencies to estimate groundwater withdrawals is based on land use. Figure 2-23 illustrates the ‘simulated’ total agricultural and municipal groundwater pumping for the model domain. Average annual groundwater withdrawal for the period from 1970 to 1993 for the Eastern San Joaquin portion of the model was 850,000 af.

2.3.4.2 Lateral Outflow

Under predevelopment conditions, lateral outflow from the Basin discharged to the San Joaquin River and the Delta area. For the period from 1970 to 1993, the net flow was positive, indicating no net groundwater outflow from study area.

2.3.4.3 Deep Percolation

The amount of water from natural and human activities that reaches the groundwater table is referred to as deep percolation. Deep percolation is the net of rainfall, applied irrigation water,

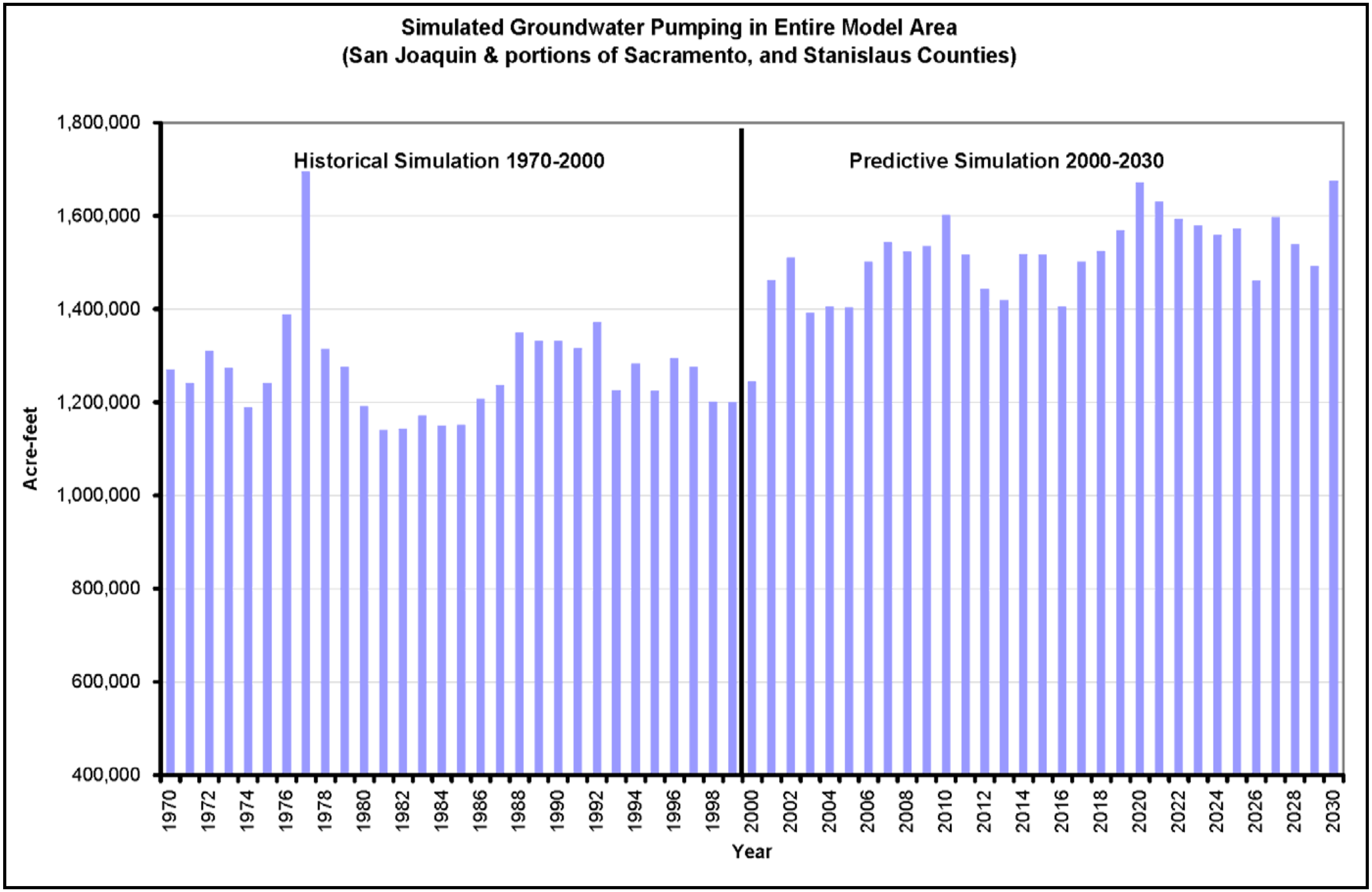


Figure 2-23 Simulated Groundwater Pumping
Source: Camp Dresser & McKee Inc.

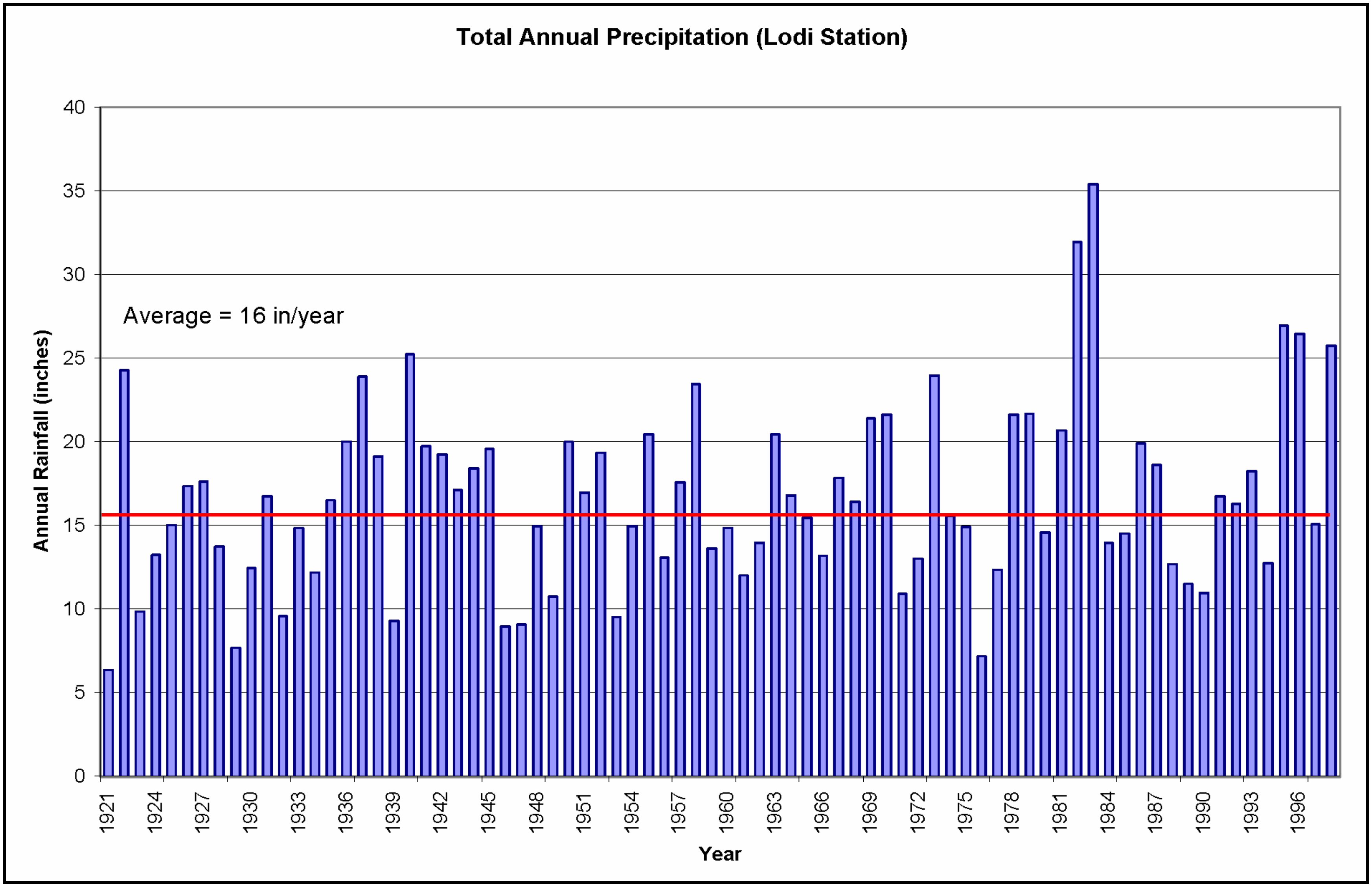


Figure 2-24 Annual Precipitation (Lodi Station)
Source: Camp Dresser & McKee Inc.

consumptive use, evapotranspiration, runoff, and unsaturated zone retention. Average rainfall within the study area is 14-16 inches per year. Figure 2-24 illustrates total annual rainfall for the Lodi Station. Within the Basin the estimated net deep percolation based on the modeling results is 590,000 af. Figure 2-25 illustrates the deep percolation for eastern San Joaquin County.

2.3.4.4 Lateral Inflow

Lateral inflow into the study area occurs primarily across the northern, western and southern boundaries. Under predevelopment conditions a net outflow existed, however due to the changed hydraulic conditions in eastern San Joaquin area there is now a net groundwater inflow. The groundwater model estimates net lateral inflow to be 120,000 af for the 1970 to 1993 period.

2.3.5 Surface Water Interaction

A large number of streams and rivers dissect the study area. The rivers that have a regional impact on the hydrogeology are Cosumnes River, Mokelumne River, Dry Creek, Calaveras River, Stanislaus River, Tuolumne River, and San Joaquin River.

Based on modeling results for the five-year period from 1989 to 1993, the Tuolumne and the upstream reaches of the Mokelumne and San Joaquin Rivers were gaining rivers – that is groundwater discharged into the rivers. The Calaveras, Dry Creek, Stanislaus, and the downstream reaches of the Mokelumne and San Joaquin Rivers were all losing rivers – i.e. surface water recharged the groundwater. On average from 1970 to 1993, there was a groundwater gain from streams of 140,000 af and a groundwater loss to streams of 100,000 af. The net gain to the groundwater system was 40,000 af.

2.3.6 Groundwater Balance

Current and historical groundwater pumping rates exceed the sustainable yield of the underlying groundwater basin on an average annual basis. Based on a simplified groundwater balance, as shown in Table 2-3, the net groundwater overdraft over the historic hydrologic record is estimated to be approximately 150,000 to 160,000 af/yr. The net groundwater overdraft is defined as the difference between total basin outflow and inflow plus the estimated accretions from the San Joaquin River and lateral basin inflow in west Stockton. Because much is unknown about the source and rate of migration of the saline front, the conceptual groundwater model assumes that all basin inflow in west Stockton is saline.

The result of long-term groundwater overdraft is two fold: significant decline in groundwater levels and increased accretions from area waterways. Although increased accretions to the groundwater basin from high quality surface water sources are desirable, accretions in the western fringes of the Basin and the Lower San Joaquin River are undesirable due to elevated salinity levels. Saline groundwater intrusion has forced the closure of several wells in the Calwater service area.

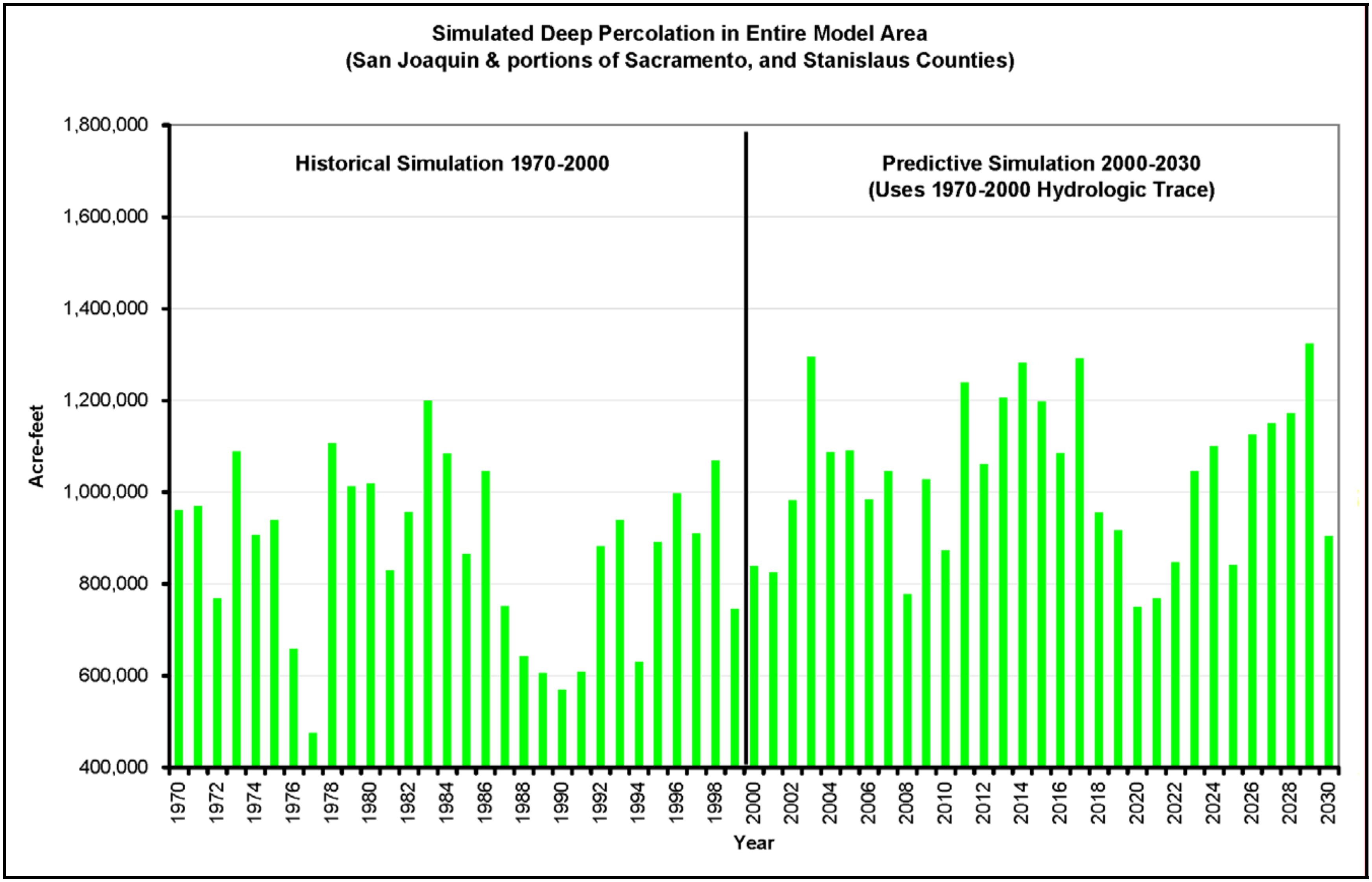


Figure 2-25 Simulated Deep Percolation
Source: Camp Dresser & McKee Inc.

Table 2-3 Simplified Groundwater Balance for Eastern San Joaquin County		
Groundwater Flow Component	**Average Value**	**Explanation**
Inflows (af)		
Deep Percolation/Recharge	608,400	Net infiltration from rainfall, irrigation, canal leakage etc.
Gain from Streams	198,170	Net inflow from streams to groundwater system
Lateral Inflow	98,000	Net of subsurface inflows and outflows.
Total Inflows	**904,577**	
Outflows (af)		
Groundwater Pumping	867,600	Net agricultural, municipal and industrial pumping
Loss to Streams	108,898	Net outflow from groundwater system to streams
Lateral Outflow	35,300	Subsurface Outflows
Total Outflows	**1,011,815**	
Groundwater Overdraft (af)		
Mined Aquifer Storage	107,238	Total Inflows minus Total Outflows
Estimated Saline Intrusion	42,000*	Lateral Saline Intrusion into the Stockton Area
Total Estimated Overdraft	**150,700**	Sum of Mined Aquifer Storage and Saline Intrusion
Notes		
Source: San Joaquin County Water Management Plan Volume I		

2.3.7 Saline Groundwater Intrusion

Groundwater flow in the Basin now converges on the depression with relatively steep groundwater gradients eastward from the Delta toward the cone of depression as depicted in Figures 2-3 and 2-4. The eastward flow from the Delta area is significant because of the typically poorer quality water now moving eastward in the Stockton area. Increased lateral inflow from the west is undesirable, as this water is typically higher in TDS and chloride levels and causes the degradation of water quality in the Basin. Figure 2-9 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 2-9 also shows the projected 2030 location of the 300 mg/L isochlor under no-action conditions.

Degradation of water quality due to TDS or chloride contamination threatens the long-term sustainability of a very important water resource for San Joaquin County, 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. The saline intrusion problem is not well understood by the Authority. Further studies and monitoring methods are necessary to ensure the problem is addressed and monitored adequately. Section 4 discusses further the current groundwater monitoring program and future actions to be undertaken by the Authority and its member agencies.

2.3.8 Baseline Conditions

A no-action, or baseline simulation, was conducted to predict how current groundwater and surface management practices, projected out to 2030, would impact the Basin. Groundwater modeling has shown that unless there is a change in how groundwater is used or managed, levels will continue to decline and storage will continue to be reduced. Figure 2-26 shows the corresponding simulated groundwater table for the year 2030 under baseline conditions. A large portion of the Basin is shown to have groundwater levels 60 to 80 feet below sea level.

Further exacerbating the groundwater conditions, as already mentioned, is the lateral inflow of saline water from the west, which could render parts of the aquifer unusable. Figure 2-27 illustrates the approximate location of the 300 mg/l chloride concentration contour as of 1996 as well as the projected 2030 contour. Groundwater modeling has indicated that the rate of eastward movement of this line is approximately 150 to 250 feet per year. Figure 2-27 also shows the projected location of the 300 mg/L chloride concentration line by the year 2030 under baseline conditions.

In other portions of California's Central Valley, declining groundwater levels have also resulted in land subsidence. Generally, this is not a widespread problem in the Basin, but may be a localized issue in some areas.

2.4 Urban Water Demands

The population of San Joaquin County is growing rapidly. The current population is expected to increase by approximately 83 percent by 2030 from nearly 600,000 to 1.1 million. While increases in urban water demands will largely be offset by the development of agricultural lands, the changes in differing water quality needs and demand patterns will further stress the ability of urban purveyors to meet the areas water needs. Because water use per acre varies by city, an analysis of each cities acreage and usage was undertaken. The area for each city was determined from 1996 DWR Land Use Surveys.

In consideration of planned growth, future water demands are based on each city's sphere of influence. Future water demands assume that by the 2030 planning horizon, each city's sphere of influence will be fully developed and will maintain a similar water demand. Table 2-4 indicates that the total 1996 urban demand was 82,600 af annually, which is projected to increase by 146,000 af/yr to 241,100 af/yr by 2030. Unforeseeable changes such as general plans revisions, changes in population density and increased water conservation can affect the accuracy of the projected water demand. It is recommended that the projections be updated as DWR Land Use Surveys for San Joaquin County become available.

2.5 Agricultural Water Demands

The agricultural water demands presented in this Plan are based on the 1996 DWR Land use survey. Based on the associated land use and crop type, applied water demands under average conditions were identified and summarized by Water District in Table 2-5. The entire applied water demand for non-urban and non-riparian vegetative areas in San Joaquin County in 1996 is approximately 1,522,000 af/yr, 954,000 af of which is needed in Eastern San Joaquin County. Table 2-5 assumes that agricultural lands outside of the urban spheres of influence will remain in production and that any agricultural lands within the urban spheres of influence will be developed by the 2030 planning horizon. The decrease in agricultural demand within city's sphere of influence is estimated to be 132,000 af. With this decrease, the projected agricultural demand in 2030 is estimated to be 1,390,000 af per year.

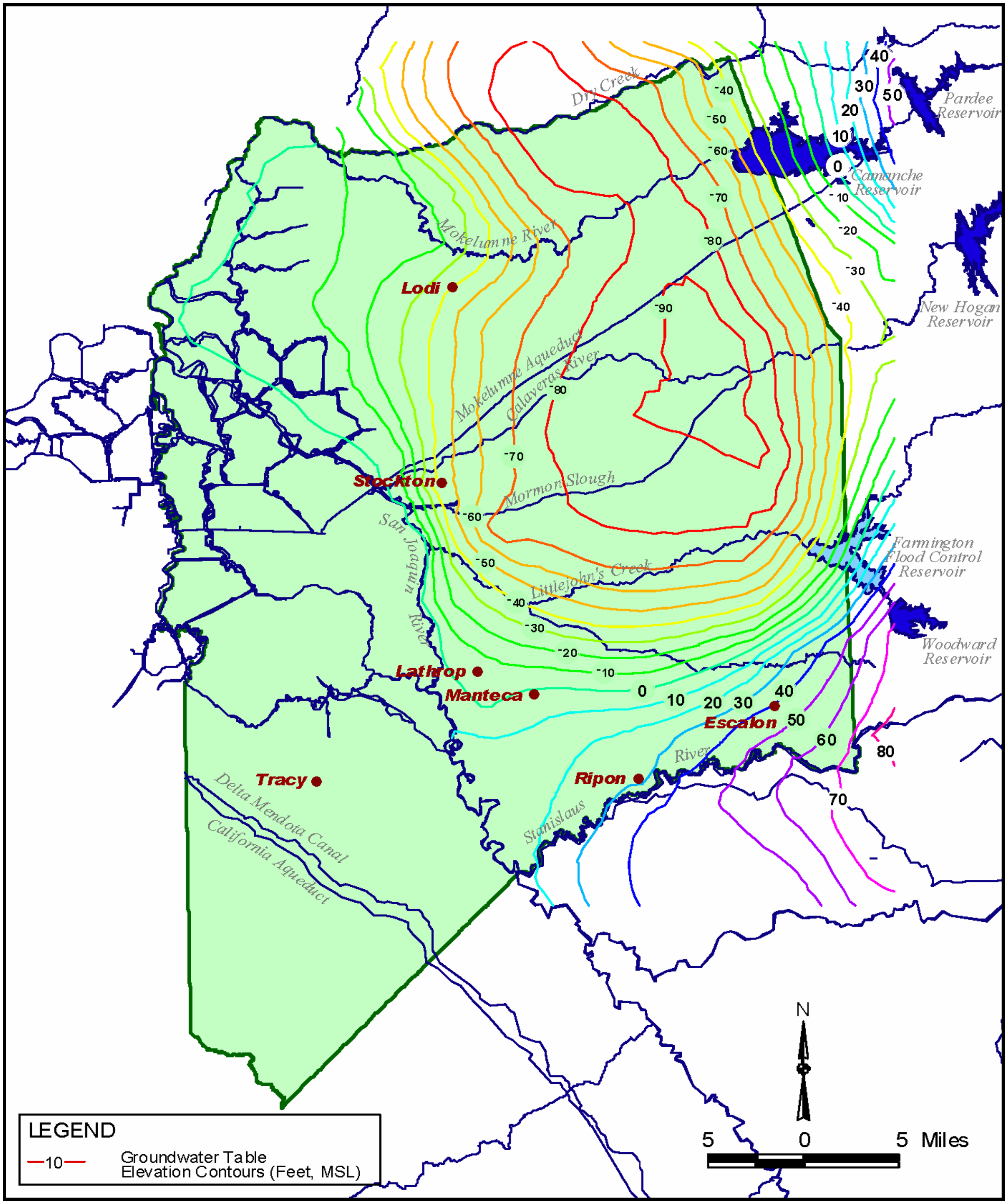


Figure 2-26 Simulated 2030 Groundwater Table Under Baseline Conditions
Source: Camp Dresser & McKee Inc.

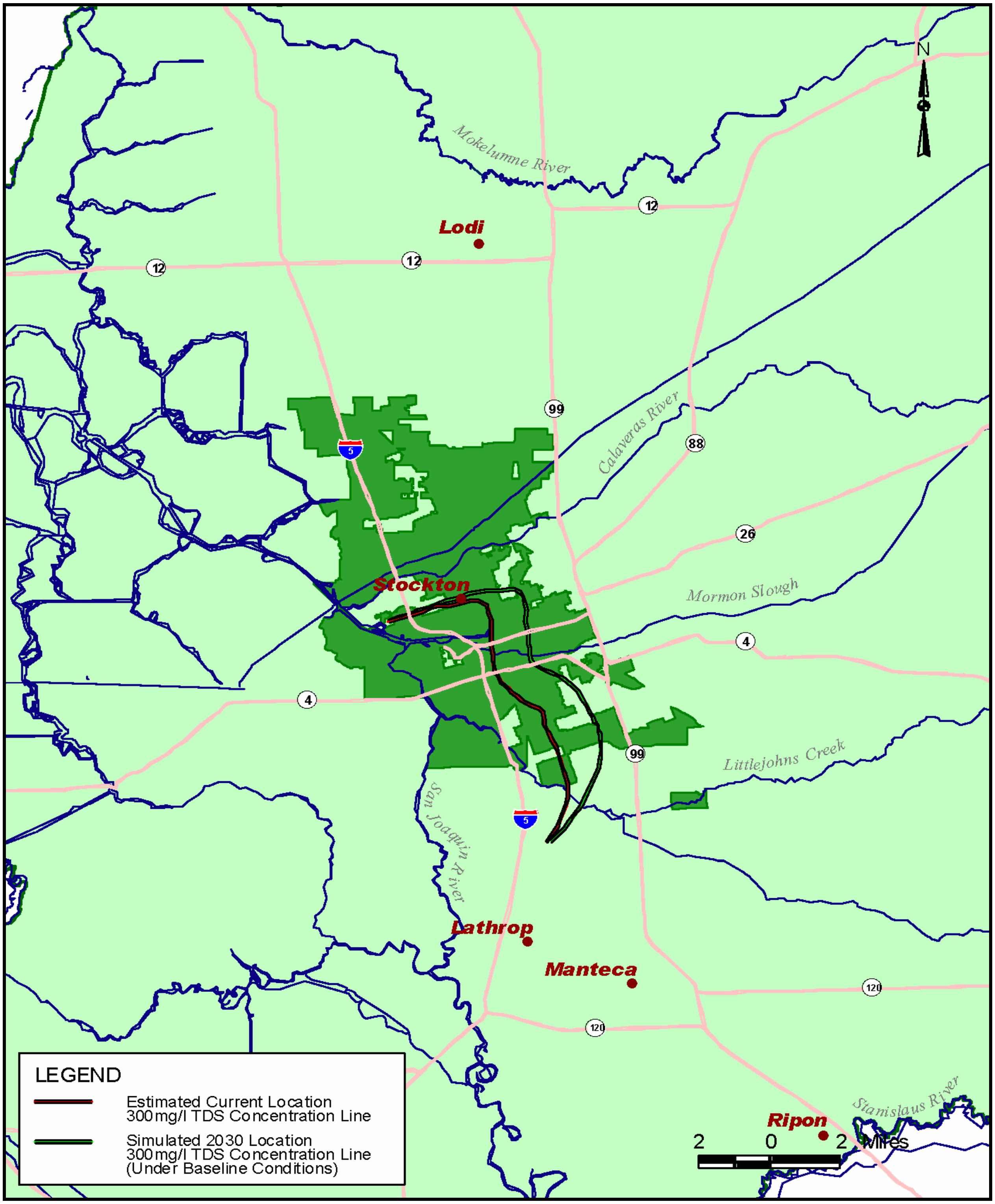


Figure 2-27 Estimated 2000 and Projected 2030 Saline Front
Source: Camp Dresser & McKee, Inc.

Table 2-4 Future Urban Water Demands

City	"1996" Current Demand[3] (af)	Current Land Use (acres)	Water Use/ Acre[4] (af/ac)	Future Land Use (acres)	Future Demand (af)	Net Increase in Demand (af)
Escalon	1,400	932	1.5	2,106	3,200	1,800
Lathrop [1]	2,900	3,409	0.85	13,254	11,300	8,400
Lodi	16,600	6,071	2.7	9,650	26,400	9,800
Manteca	11,200	5,056	2.2	14,140	31,300	20,100
Ripon	3,500	1,764	2.0	6,676	13,200	9,700
Stockton [2]	47,000	29,746	1.6	61,353	96,900	49,900
Total	**82,600**				**241,100**	**146,600**

Source: San Joaquin County Water Management Plan Volume I
Notes:

1. Lathrop water use per acre is lower than the remainder of the cities because their developments are less dense than other cities. The city's future projections indicate that their water use per acre will increase to 1.4 ac-ft/ac. To maintain consistency, the water use per acre has been calculated as if it will stay the same over time. It is difficult to predict how development patterns will change, and the error that could be associated with this assumption is less than 0.5 percent of the future County demand.
2. The demand for the city of Stockton only reflects the water use within city limits. Water providers for the Stockton area also provide significant water to the urban areas outside of the city limits. Total water deliveries for the Stockton urban area are approximately 62,000 ac-ft.
3. Current year represents "1996". Individual city water usage data is based on information gathered during the development of the San Joaquin County Water Management Plan, 2001.
4. Water usage on a per acre basis is used to simulate groundwater withdrawals in the Camp Dresser & McKee developed DYNFLOW Groundwater Model for Eastern San Joaquin County.

The estimated and projected water demands presented are based on the following assumptions:

1. Drastic changes in cropping patterns will not change drastically.

2. Applied water demands include evapotranspiration, system losses, tailwater drainage, and percolation to groundwater.

3. Applied water demands do not include conveyance losses or off-farm demands. The applied water demand is the information necessary for the groundwater model, which also takes into account the differences in consumptive use for each parcel of land. Urban areas have different consumptive use than agricultural areas, and consumptive use also varies between different types of crops. Therefore, the applied water demand will usually be less than the diversion amounts maintained by each district.

The decrease of 132,000 af of agricultural water use can be compared to an increase in urban water use of 146,000 af. In terms of net demand, this is not a significant change. This similarity in demand is due to an approximate one-to-one conversion rate between urban and agricultural use for each acre. The usage rates for agricultural and urban water use are similar, with urban water use slightly higher per acre. Most land around urban areas is currently farmed; thus, in order for the urban areas to expand, agricultural land would be converted at an approximate one-to-one ratio. Because each acre of new urban land results in 1 less acre of agricultural land, and the water use figures are similar, the water demands are projected to remain essentially constant throughout the planning period.

Table 2-5 Estimated and Projected Agricultural Water Demands
(Applied Water Requirement under Average Conditions)

District (Within San Joaquin County Only)	1996 Estimated Applied Water Demand (af/yr)	2030 Projected Applied Water Demand (af/yr)
North Delta Water Agency	**37,244**	**37,244**
Central Delta Water Agency	**209,622**	**209,622**
South Delta Water Agency	206,759	206,759
West Side ID	17,205	17,205
City of Tracy	34,192	-
Banta-Carbona	42,585	42,585
Lathrop	21,225	-
South Delta Area (Total)	**321,966**	**266,549**
Del Puerto WD	**15,529**	**15,529**
Plain View WD	**11,217**	**11,217**
North San Joaquin WCD	**88,022**	**88,022**
Woodbridge ID	**102,517**	**102,517**
Lodi	**5,124**	**-**
Stockton East WD	151,210	151,210
Stockton	38,701	-
SEWD (Total)	**189,911**	**151,210**
Central San Joaquin WCD	**159,554**	**159,554**
Oakdale ID	**48,391**	**48,391**
South San Joaquin ID	126,709	126,709
Manteca	21,663	-
Escalon	1,761	-
Ripon	9,508	-
SSJID (Total)	**159,641**	**126,709**
Unincorporated Areas	**173,390**	**173,390**
Total	**1,522,128**	**1,389,954**

Notes:

1. This table was modified based on comments received on the Draft SJCWMP. It was compiled from the DWR land use information linked to Private, State and Federal water district outlines in a GIS system. There are significant areas of overlap between city limits, spheres of influence, and between water districts themselves. Bearing this in mind, there are bound to be variations and differences between these estimates and those compiled using different methodology. The figures in this table represent theoretical applied water requirements for average conditions.
2. The quantity of water actually pumped, diverted and applied will be significantly different due to a variety of factors including distribution system inefficiencies and losses (ranging from 10 to 20 %), climate, soil conditions, etc. The loss of agricultural land to urban expansion is illustrated by the reduction in agricultural acreage currently located within urban spheres of influence.
3. Agricultural lands in urban areas and urban spheres of influence are phased out completely by 2030. Other changes are likely to impact water demand, such changes in cropping patterns, irrigation methods, and farming of previously vacant land. However, these changes have not been quantified in any systematic or reliable basis.
4. Urban development will be undertaken by increasing urban densities through infill of spheres of influence. Development according to this guideline has yet to gain market acceptance and widespread application in the County. However, current development patterns, and their associated average unit water usage rates, are assumed to apply in the future.
5. Local urban development practices will result in new developments with similar water use rate. Water use figures were calculated for each individual urban area, and these figures were applied to future development. Each urban area has a unique unit water use rate based upon local factors, such as amounts of open space and conservation practices. As best management practices are implemented with respect to water conservation, projected water demands for urban developments may actually be conservative as compared to past conservation efforts.
6. The urban spheres of influence reflect 2030 development. The urban spheres reflect the local plans for where expansion could occur in the future, but it is possible that the development will occur in different areas, or in different amounts than predicted. The State Department of Finance predicts future populations; the projected 2030 population can fit within the spheres at current urban densities.

The assumptions in Table 2-5 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.

2.6 Water Supplies

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)

The State defines groundwater as either the underflow of a surface stream, a definite underground stream, or percolating waters. The appropriative water rights system applies to the first two definitions, but does not apply to percolating waters. Percolating waters are treated similarly to riparian water rights in that groundwater may be put to beneficial use in an amount proportional to the size and needs of the property. Only relatively recently have local public agencies and the State begun to look at the management of groundwater to prevent excessive overdraft. Disputes in groundwater rights have created adjudications in some basins whereby groundwater is extracted by court order.

2.6.1 Surface Water Supplies

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 2-6 provides a synopsis of the major water rights and contracts held by San Joaquin County water agencies. It is estimated that San Joaquin County has approximately 1.2 million af/yr of surface water available. This amount includes approximately 500,000 af/yr applied by farmers in the Delta.

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 has an interim contract with USBR for 75,000 af/yr from New Melones Reservoir, this full quantity has yet to be made available to SEWD.

Surface water supplies are likely to decrease in the future. As shown in Table 2-6, 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.

2.6.2 Groundwater Supplies

Groundwater pumping quantities in San Joaquin County are not recorded at the water district or county level. Consequently, an accurate assessment of the quantity of groundwater used is difficult to establish. The approach adopted by DWR and other agencies to estimate groundwater withdrawals is based on land use and population. Using a similar approach with groundwater modeling, CDM estimated that the total agricultural and municipal groundwater pumping in Eastern San Joaquin County has averaged approximately 870,000 af/yr for the last 20 to 30 years. Sustaining the current rate of groundwater pumping in Eastern San Joaquin

County will further decline groundwater levels and saline groundwater will continue to migrate east into the Basin as described in Section 2.2.8.

Table 2-6 Summary of Current Water Rights and 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/ Camanche	60,000	39,000	Firm
		See note[3]	0	Nonfirm
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]
CDWA	Delta	226,000	226,000	Estimated based on current demand.
SDWA	Delta	225,000	225,000	
City of Tracy	Delta Mendota Canal/CVP	10,000	10,000	CVP Contract and water purchase agreements with Local Irrigation Districts
		7,500	7,500	
West Side ID	San Joaquin River	30,000	30,000	Dependent on flow
	Delta Mendota Canal/CVP	7,500	7,500	CVP Contract
Plain View WD	Delta Mendota Canal/CVP	21,000	21,000	CVP Contract
Banta-Carbona WD	Delta Mendota Canal/CVP	25,000	25,000	CVP Contract
	San Joaquin River	30,000	30,000	Depends on flow
Hospital WD	Delta Mendota Canal/CVP	34,000	34,000	CVP Contract

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 is less than 320,000 af and is based on a formula which is part of the agreement with USBR.

3 Basin Management Objectives

Senate Bill (SB) 1938, created 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 Authority has developed the following qualitative Basin Management Objectives (MO) for the GMA.

3.1 Groundwater Levels

Management Objective #1: Groundwater Levels

Maintain or enhance groundwater elevations to meet the long-term needs of groundwater users within the Groundwater Management Area.

Groundwater Management Plan elements contributing to the success of Basin MO #1:

1 Increased use of available and new surface water supplies;

2 Implementation of local and regional conjunctive use programs and projects;

3 Urban and agricultural incentive based conservation and demand management programs;

4 Basin-wide monitoring and science programs;

5 Development of operations criteria for protection against prolonged droughts and the prevention of Basin mismanagement; and

6 Development of sufficient local and outside revenue sources for projects and programs to meet the Basin MO #1.

3.2 Groundwater Quality

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.

Groundwater Management Plan elements contributing to the success of Basin MO #2:

- Development and implementation of saline groundwater intrusion control projects and programs;
- Increased coordination with regulatory agencies to better protect against and mitigate groundwater contamination;

- Monitoring and science programs focused on the source and migration of saline groundwater;
- Development of operations criteria for protection against prolonged droughts and the prevention of Basin mismanagement; and
- Development of sufficient local and outside revenue sources to meet Basin MO #2.

3.3 Surface Water Quality and Flow

Management Objective #3: Surface Water Quality

Minimize impacts to surface water quality and flow due to continued Basin overdraft and planned conjunctive use.

Groundwater Management Plan elements contributing to the success of Basin MO #3:

- Utilization of surface water supplies when available in a regional groundwater recharge program or conjunctive use program that is sensitive to downstream users and the environment;
- Avoidance or mitigation of projects that detrimentally affect surface water quality and flow;
- Increased understanding of the interaction between surface water and groundwater through basin-wide monitoring and science programs;
- Regular updates to the Eastern San Joaquin County Groundwater Model as new data becomes available; and
- Development of sufficient local and outside revenue sources for projects and programs to meet the Basin MO #3.

3.4 Inelastic Land Subsidence

Management Objective #4: Water Quality

Prevent inelastic land subsidence in Eastern San Joaquin County due to continued groundwater overdraft.

Groundwater Management Plan elements contributing to the success of Basin MO #4:

- Continue to monitor observations of datums and bench marks in order to assess if an inelastic land subsidence problem exists in Eastern San Joaquin County; and
- Should problems exist, the Authority will re-evaluate the need for inelastic land subsidence monitoring and prevention programs.

4 Groundwater Management Options

4.1 Conjunctive Use Options

Conjunctive Use, as defined by the DWR 2003 Draft Bulletin 118, is:

> "The coordinated and planned management of both surface and groundwater systems in order to maximize the efficient use of the resource; that is, the planned and managed operation of a groundwater basin and a surface water storage system combined through a coordinated conveyance infrastructure. Water is stored in the groundwater basin for later and planned use by intentionally recharging the basin during years of above-average water supply."

In order to successfully implement a conjunctive use program that will meet the goals of this Plan, the Authority must first identify and develop a list of water management options. An option, in the context of this Plan, is the method, program, or policy suitable for the broader conjunctive use program for Eastern San Joaquin County. The following section defines the concepts for the acquisition of new and maximization of existing surface water supplies, groundwater recharge techniques, and other options dealing with demand management and water reuse.

4.1.1 Surface Water Options

4.1.1.1 New Surface Water Supplies

Opportunities to obtain new surface water rights within California are limited. The SWRCB has designated most rivers in the region as generally fully appropriated in the summer months when demands for water are at their peak. Methods to acquire new surface water are described below.

Wet Year Flows

Wet year water, also known as flood-flows or unregulated flows, are defined as either releases made from upstream storage reservoirs to maintain adequate flood storage capacity or flows in excess of in-stream flow requirements. Developing cost effective methods to capture and store flood water is a major challenge due to the intensity and infrequency of major storm/runoff events. Capturing flood-flows are often associated with new or expanded reservoir storage either off-stream or on-stream. Major rivers and streams accessible to Eastern San Joaquin County have generally unappropriated flows in the late fall through spring months and are subject to water right permit approval by the SWRCB.

Water Transfers from Out-of-Basin

Water transfers have become a key component in water resources planning throughout the State. Entities import water from willing sellers to supplement their supplies. Water transfers often benefit both parties by helping sellers recover water development costs at prices often far below the cost of developing new supplies. The water rights of the sellers are not impacted by water transfers, which is an incentive for entities to promote conservation and water use efficiency. An example of a water transfer agreement in California is the transfer of Colorado River water from Imperial Irrigation District to the City of San Diego in return for irrigation system improvements and compensation for lost revenue due to land fallowing. Water transfers are subject to approval by the SWRCB except in the case of existing Pre-1914 water rights.

Exercise of Area of Origin Priority

The system of appropriated surface water rights in California is based on a system of hierarchy and priority. However, protected areas or Areas of Origin within the Sacramento/San Joaquin Delta watershed receive priority when considering water right appropriations. Water code §1216 states that, "A protected area shall not be deprived directly or indirectly of the prior right to all the water reasonably required to adequately supply the beneficial needs of the protected area… by a water supplier exporting or intending to export water for use outside a protected area…" Historically, the interpretation of the statute has favored those who export water from the Delta, nevertheless pending legal action and political pressure could increase water allocations to Eastern San Joaquin County and give priority to future water right applications.

4.1.1.2 Maximizing Existing Surface Water Supplies

Agencies within Eastern San Joaquin County have existing water rights and contracts that cannot be fully utilized for a variety of factors including supply reliability and infrastructure limitations. The following section describes methods to maximize the use of existing supplies.

Re-operation of Existing Facilities

The re-operation of existing reservoirs is the intentional drawdown of stored water below the minimum capacity required for flood control purposes. In the context of a conjunctive use program, reservoir re-operation potentially utilizes a reservoir's carryover storage for groundwater recharge allowing for greater flood control capacity and a reduction in the foreseeable frequency of reservoir spills. Changes in the mode of operation could detrimentally affect other reservoir benefits such as hydropower, water supply, temperature control, and recreation. These impacts can vary the reservoirs ability to be re-operated for increased water supply benefits.

In-Basin Water Transfers and Purchases

Similar to water transfers from out-of-basin entities, agencies with extensive surface water rights could make water available to other agencies with limited water rights overlying more depressed groundwater levels within Eastern San Joaquin County. Additional investments in infrastructure resulting in increased efficiency could facilitate the transfer or sale of water. In order to avoid the loss of water rights through non-use, water districts and agencies could transfer their rights to other in-basin users. Examples of in-basin water transfer include purchases by the City of Tracy from the West Side and Banta-Carbona Irrigation Districts and by the City of Stockton from SSJID/OID.

4.1.2 Groundwater Recharge Options

In 2001 SEWD, in conjunction with the USACE and other local sponsors, completed the Farmington Groundwater Recharge/Seasonal Habitat Study. This Study explored the feasibility of groundwater recharge methods in the context of San Joaquin County's available surface water supplies and availabilities. The Study explores the benefits and drawbacks of the various methods used to recharge groundwater including detailed cost comparisons. The groundwater recharge methods are discussed below and summarized in Table 4-1.

4.1.2.1 Direct Recharge to Groundwater

Field Flooding

Field flooding consists of ponding surface water on seasonally fallowed agricultural areas in the late fall, winter, and early spring months for the purpose of recharging the groundwater Basin. In general this option could be used in fields with permeable soils and with little or no vertical impediments. Very few minor site preparations are necessary to percolate substantial amounts of water, making this method economical. Recharge efficiencies can also be increased with the addition of internal berms and check structures creating recharge cells for the purpose of keeping water from draining from the field too quickly. Field flooding is not effective on permanent crops such as orchards, but is very feasible on vineyards and certain row crops. There could be additional environmental benefits to this approach, such as providing seasonal habitat to migratory waterfowl.

Spreading Basins and Recharge Ponds

Unlike field flooding, spreading basins or recharge ponds are dedicated facilities constructed solely for recharge and seasonal habitat. Spreading basins are not rotated into production during the growing season. Spreading basins consist of relatively shallow basins, which are excavated to a depth of several feet. If present, shallow fine-grained sediment, hardpan, or clay may be excavated to provide more favorable recharge conditions in recharge ponds.

Recharge Pits

Recharge pits are similar to spreading basins and recharge ponds but are generally deeper and may be located in an existing natural or manmade depression such as a gravel quarry or flood control detention basin. Recharge pits require extensive excavation making them well suited for areas with an extensive aquitard or hardpan layer. Although not as cost effective as field flooding or spreading basins, existing quarries and flood control detention basins could serve as seasonal recharge pits with minor site improvements and minor changes in operation.

4.1.2.2 Injection Wells

Injection wells pump water directly into the groundwater aquifer. Injecting water into the aquifer system is an effective option for providing hydraulic control in well-defined hydrogeologic and hydraulic conditions. Complex injection/extraction well systems can be used for aquifer storage and recovery (ASR) projects. ASR systems often use treated water sources such as municipal supplies meeting safe drinking water requirements. Injection wells are also applicable in coastal settings where high quality reclaimed wastewater is injected to create a hydraulic barrier to seawater intrusion. Capital costs for ASR facilities include conveyance, treatment, and well construction costs.

4.1.2.3 In-lieu Recharge

In-lieu recharge is the direct substitution of surface water for groundwater creating a reduction in amount of groundwater pumped. Surface water can be substituted for groundwater in both urban and agricultural areas.

Agricultural In-lieu

Agricultural in-lieu recharge offers significant opportunities within Eastern San Joaquin County. To successfully implement agricultural in-lieu, the delivery capacity of the conveyance system needs to be expanded and on-farm dual irrigation systems constructed. In the past water supply reliability and availability have deterred the use of surface water. If additional firm entitlements are not obtained for diversion during the irrigation season, additional storage and conveyance would be needed to meet the demands of growers. Successful in-lieu programs are often incentive based and will require the financial and political support of the community.

Urban In-lieu

Urban in-lieu recharge consists of utilizing surface water to meet municipal and Industrial (M&I) demands. Should reliable surface water sources become readily available to urban areas, urban in-lieu recharge programs can be achieved on the order of current water service costs. Although urban areas require capital investments for treatment facilities, cities often have existing distribution facilities or the means to construct them through connection and development fees.

4.1.3 Regional Groundwater Banking

Groundwater overdraft and the resulting decline of groundwater levels in Eastern San Joaquin County have created an estimated at 1 to 2 million af of 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 the potential to become a major groundwater bank for regional and statewide interests.

Groundwater banking partnerships are recognized as key water management options for water agencies throughout the State to balance water needs. Currently, the DWR Conjunctive Water Management Branch supports the activities of San Joaquin County and the Authority through in-kind services and direct financial assistance to encourage the full utilization of the underlying basin. The benefits of a fully operable groundwater bank in Eastern San Joaquin County to the State and other regional interests are appreciable and have prompted interests for further information. Interested agencies include the DWR, Bureau of Reclamation, CALFED Environmental Water Account, CALFED Storage, Metropolitan Water District of Southern California, State Water Contractors, EBMUD, Amador County Water Agency, and Calaveras County Water Agency.

Groundwater banking partnerships involving the exportation of groundwater in unincorporated San Joaquin County is governed by the San Joaquin County Groundwater Export Ordinance. County ordinance authority does not extend into the incorporated city limits of the municipalities. The Ordinance requires stringent monitoring and extraction protocols deemed necessary to protect adjacent landowners and underlying basin from the potential adverse impacts of groundwater export. The Board of Supervisors has indicated that a more workable form of the Groundwater Export Ordinance is possible should stakeholders propose positive changes that would facilitate banking partnerships while maintaining principle protections for groundwater users.

Other factors deemed important to local stakeholders include the establishment of 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 could potentially consist of a series of groundwater levels that would correspond to basin condition levels (similar to the US EPA Air Quality Index and the US Department of Homeland Security Advisory System) to indicate the effectiveness of groundwater recharge programs and also potentially when and how much groundwater could be exported. The development of Basin Operations Criteria is a collaborative process that will be undertaken by the Authority immediately following the adoption of the Plan and is expected to be completed by summer 2005.

The Authority will also explore potential governance structures 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 with the framework of the Authority could ultimately provide the basis for a revised Export Ordinance and a new Groundwater Management Ordinance. Potential groundwater management governance structures are further explored in Section 7 of the Plan.

Table 4-1 Groundwater Option Comparisons

Option Type	Recharge Method	Improvement Costs ($/af)	Infrastructure Requirements	Land Requirements	Effectiveness	Operation/ Maintenance
Surface Supply Options	Wet Year Flows	~$500	On or off-stream regulating reservoir	Extreme for new reservoir	Very effective based on reservoir size and frequency	Very high requirements
	Water Transfers - Out of Basin	$200-400	Conveyance and storage	Potentially land intensive	Effective based on quantity of water and agreement duration	Varies with infrastructure requirements and year to year availability
	Area of Origin Priority	$0-$350	Use of existing or new infrastructure	Potentially land intensive	Very effective	Varies with infrastructure requirements
	Reservoir Re-operation	~$100	Use of existing infrastructure and storage	Minimal	Less effective	Minimal based on existing facilities
	Water Transfers - In Basin	~$100-$200	Minor conveyance	Minimal	Less effective	Varies with infrastructure requirements and year to year availability
Groundwater Recharge Options	Field Flooding	$50 - $100	Uses Existing Infrastructure	Uses seasonally fallow areas	Somewhat effective only available seasonally	Significant effort
	Spreading Basin/ Recharge Pond	$100 - $150	New Infrastructure	Requires relatively large dedicated areas	Potentially effective, requires detailed field testing	Significant effort
	Recharge Pit	$400 - $450	New Infrastructure	Requires dedicated areas	Potentially effective, requires detailed field testing	Significant effort
	Leaky Canal	Varies	New Infrastructure	Land intensive	Potentially effective, conveyance benefits	Significant effort
	Injection Wells	$150 - $200	New Infrastructure	Requires dedicated areas	Potentially effective, requires extensive well field	Significant effort
	Agricultural In-lieu	$200 - $250	New / Or Existing Infrastructure	Existing Land Use	Very effective based on quantity of water	Additional effort required by owner and district
	Urban In-lieu	~$250-$400	New / Or Existing Infrastructure	Existing Land Use	Very effective based on quantity of water	Requires treatment plant O&M costs
	Regional Groundwater Banking	$200-$300	New / Or Existing Infrastructure	Potentially land intensive	Very effective, financial assistance through third party	Significant effort
Other Options	Water Reclamation	$300-$500	Retrofit of existing facilities	Minimal	Less effective due to treatment costs and public perception	Requires treatment plant O&M costs
	Agricultural Water Conservation	$200-$250	New Infrastructure	Minimal	Potentially effective	Significant effort

	Urban Water Conservation	\$200-\$250	New Infrastructure	Minimal	Potentially effective	Minimal
	Crop Rotation/Land Fallowing	~\$50	None	Potentially land intensive	Potentially effective if mitigated	Minimal
Source:	San Joaquin County Water Management Plan Volume I					
	Farmington Groundwater Recharge and Seasonal Habitat Study					

4.1.3 Water Reclamation

Water reclamation or water reuse is the treatment of water that has been used previously and would otherwise be discharged out of the Basin. Municipal and industrial wastewater reclamation is becoming increasingly prevalent throughout the State as a viable alternative for compliance with regulatory waste discharge requirements. As municipalities and industries move to meet these waste discharge requirements with tertiary treatment, high quality supplies may become available for irrigation or other non-potable uses. Pending further growth of the reclaimed water market, Eastern San Joaquin County could put to beneficial use a substantial non-potable water supply; however, the resulting reduced supply to downstream users would need to be mitigated.

4.1.4 Water Conservation

Demand management is a key component for long-term planning and management of water resources. Implementation of best management practices (BMPs) can be more economical than developing new water sources and less damaging to the environment.

Urban Water Conservation

Active urban water conservation programs throughout the State potentially save 10 to 20 percent of the historical demand. BMPs included in such programs include water metering, tiered water pricing, rebates for water saving appliances and amenities, water-saving household plumbing devices, and education and outreach. Urban water conservation programs are eligible for State and Federal grants.

Agricultural Water Conservation

Crop science has determined that plants consumptively use a fraction of the total water applied during irrigation. Agricultural water conservation relates mainly to the use of more efficient irrigation technologies that reduce the amount of water applied while still meeting the consumptive needs of the plant. Increasing irrigation efficiency decreases the amount of water that is lost through evaporation during conveyance or application and the discharge of tailwater to surface streams. Growers moving from flood irrigation to drip and sprinkler systems often report irrigation efficiencies upwards of 90 percent.

It should be noted that the conversion to drip and sprinkler irrigation is not suited for all crop types and in some cases does not provide its intended benefits. Some crops are sensitive to changes in irrigation methods and may either produce crops of poorer quality or, in some cases, actually increase the consumptive demand of the plant. Excess applied surface water resulting in tailwater drainage is a benefit to the groundwater Basin when allowed to percolate and may be a major source of water for downstream users who depend on return flows. Extensive analysis should be undertaken prior to implementation of agricultural water conservation measures to ensure the intended benefits are realized.

Voluntary Crop Rotation
A voluntary crop rotation program is intended to be exclusively at the discretion of the local grower. Removing acreage from production does in fact save water; however, the economic consequences are not acceptable to the member agencies of the Authority. As an incentive based program, growers opting for crop rotation could be compensated based on conserved water thus reducing the economic impacts. Substantial analysis must be undertaken to ensure that crop rotations do not adversely impact the agribusiness of Eastern San Joaquin County, downstream users depending on return flows, or the environment.

4.2 Groundwater Contamination

Groundwater contamination and the continued degradation of groundwater quality is a global threat to all groundwater users. The Authority recognizes that the long-term sustainability of the underlying Basin cannot be accomplished without adequate groundwater quality protection, contamination prevention, and remediation programs. As depicted in Table 3-2, numerous local, State, and Federal agencies currently regulate activities with potential impacts to groundwater quality and enforce monitoring and remediation requirements.

The Authority has discussed the issue of managing groundwater protection and contamination programs in Eastern San Joaquin County. A major concern of the Authority is that undertaking regulatory oversight will only duplicate the existing efforts of other regulatory agencies while financially burdening the community beyond its abilities. Increased coordination with regulatory agencies and a concerted effort to ensure its activities do not degrade water quality is potentially less resource intensive for the Authority and a more efficient method of protecting groundwater quality throughout the Basin. The Authority will continue to lead the pursuit against saline groundwater intrusion.

The following policies reflect the Authority's desire to address groundwater contamination and groundwater quality degradation:

1. Coordinate with local, State, and Federal agencies to ensure the underlying Basin is adequately protected against groundwater contamination and to ensure all contaminated sites are documented and mitigated by the responsible parties.

2. Continue to manage efforts to combat saline groundwater intrusion.

3. Strive to improve groundwater quality when technically and economically feasible. Authority actions degrading groundwater quality are not acceptable.

4. Require recharge projects to identify and evaluate impacts to groundwater quality and the potential for mobilization of soil and source water contaminants.

5. Consider current and future water quality standards in the planning and design of projects identified in this Plan.

Table 4-2 Local, State, and Federal Regulatory Agencies Involved in Groundwater Quality Protection and Remediation

	Agency	Well Standards	Direct Groundwater Recharge	Land Fills	Pesticide Use	Ag/Urban Runoff	Database	Underground Storage Tanks	Water Quality Standards	Groundwater Remediation	Standardized Laboratory Analysis	Groundwater Monitoring and Science
Local	San Joaquin County - Environmental Health	X	X	X			X	X		X		
	Local Solid Waste Agencies			X						X		
	San Joaquin County - Agricultural Commissioner		X		X	X	X					
State	Department of Water Resources	X	X				X		X			X
	State Water Resources Control Board		X	X	X	X	X	X	X	X		
	Central Valley Regional Water Quality Control Board		X	X	X	X	X	X	X	X		
	Integrated Waste Management Board			X						X		
	Department of Pesticide Regulation		X		X	X	X					
	Department of Health Services		X						X		X	
Federal	Environmental Protection Agency		X	X	X	X	X	X	X	X	X	X
	US Geological Survey	X	X							X		X

5 Groundwater Monitoring Program

Marked changes in groundwater levels and groundwater quality during the 1960's prompted the DWR to initiate a groundwater investigation in Eastern San Joaquin County. Completed in 1967, DWR Bulletin No. 146 San Joaquin County Groundwater Investigation recommended that a groundwater monitoring program be established to track changes throughout the Basin. In the fall of 1971, the San Joaquin County Flood Control and Water Conservation District (County) initiated the collection and management of groundwater data and the production of semi-annual groundwater reports.

In December of 2000, Montgomery Watson Harza (MWH) performed an evaluation of the County's groundwater monitoring program and recommended improvements to better assess groundwater level conditions and saline intrusion and to develop measurement and sample collection protocols. Since that time the County has continued to implement the recommendations of the evaluation and will work closely with and meet the monitoring needs of the Authority.

5.1 Current Groundwater Monitoring Program

The current groundwater level monitoring program includes semi-annual groundwater level measurements of over 550 wells (exact number varies from year to year) of which approximately 300 are measured by County staff. Water level measurements are taken in October and April in order to capture groundwater levels after and before peak groundwater pumping occurs. According to the MWH evaluation, both the frequency of measurement and the spatial adequacy of the monitoring well network are sufficient to determine regional groundwater trends throughout the Basin.

The data collected is stored electronically in a database for further analysis. DWR posts a portion of the data on the internet at http://wdl.water.ca.gov/gw/admin/main_menu_gw.asp. In 2003, San Joaquin County Public Works Staff, in conjunction with Kennedy/Jenks Consultants, reformatted the database to facilitate advanced analysis of groundwater data in a Geographic Information System (GIS). Future upgrades include electronic data collection and the availability of the groundwater database and analysis capabilities over the internet.

As documented in Section 2, saline intrusion from the west threatens the health of the underlying Basin. The County supports a limited effort groundwater monitoring program which includes the annual groundwater quality sampling of approximately 40 municipal and domestic supply wells (exact number varies from year to year) measured by County staff or obtained from the various urban water purveyors. The analysis typically includes chloride, electrical conductivity (EC) and total dissolved solids (TDS). Water quality sampling occurs in October when chloride levels are generally highest during the year. According to the MWH evaluation, the spatial adequacy of the monitoring well network is not sufficient to determine the source, aerial and vertical extent, and the rate of migration of saline groundwater. The data collected is stored electronically in a database for further analysis.

5.1.1 San Joaquin County Groundwater Data Center

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. Over half of the water used in San Joaquin County comes from groundwater. It is vital that we protect and ensure the long-term health and sustainability of the underlying groundwater basin. The San Joaquin County GDC is the foundation for Countywide groundwater management efforts pursued by its water interests.

The GDC is essential to the groundwater management activities of the County. Currently, there is no centralized groundwater information source for San Joaquin County. Monitoring efforts undertaken by the San Joaquin County Flood Control and Water Conservation District (SJCFC&WCD), the San Luis and Delta-Mendota Water Authority (SLDMWA), the Northeastern San Joaquin County Groundwater Banking Authority (GBA), and other individual agencies and water districts generate data that reside in separate databases. The GDC would become the repository for groundwater data and would facilitate groundwater analysis essential to the groundwater management objectives of San Joaquin County. The GDC is not only a technical tool, but a public outreach tool as well. Through the internet, water users including County and agency staff, industry professionals, decision makers, and the general public will have access to groundwater data and historic semi-annual reports. Additionally, the concept of the GDC will extend into ongoing groundwater programs including the joint GBA/DWR/USGS Groundwater Recharge and Salinity Study and the Farmington Recharge Program.

Over the next 20-30 years, hundreds of millions of dollars will be invested for the management of groundwater in San Joaquin County. Water demand projections, basin health, and groundwater management effectiveness is based on groundwater data. The GDC is also a commitment to the development of a comprehensive quality assurance and quality control plan (QA/QC) that increases confidence in the quality and reliability of groundwater data.

The overall goals and objectives of the GDC are:

1. Create and maintain a working groundwater database for San Joaquin County.
2. Develop the tools necessary to analyze groundwater data.
3. Make groundwater information available to decision makers, agency staff, and the general public through the internet.
4. Create an efficient and enforceable QA/QC plan.
5. Utilize the proven and supported technologies in groundwater monitoring, database management, and Geographic Information Systems (GIS).

GDC Features:

1. *Create and maintain a working groundwater database for San Joaquin County.*

   The backbone of the GDC is the groundwater database. From the database, groundwater information can be queried and exported to groundwater analysis programs and applications. The groundwater database should have the following characteristics:

   - Secure from inadvertent or malicious deletions or manipulations
   - Efficiently designed to limit extraneous information
   - Expandable to include additional water quality fields, geologic data, well construction information, etc.
   - Portable data entry forms
   - Maintainable by existing staff with intermediate level database expertise

2. <u>*Develop the tools necessary to analyze groundwater data.*</u>

   GIS applications used to perform groundwater analysis are increasingly powerful. ESRI, the leader in GIS technology, has developed proven GIS tools that are capable of performing the following:

   - Groundwater level and water quality contouring
   - 3-D visualization of groundwater characteristics
   - Geospatial report generation
   - Relational data analysis

3. <u>*Make groundwater information available to decision makers, agency staff, and the general public through the internet.*</u>

   GIS is now available via the internet. Users will be able to access the database through the internet and will be able to query selected well data and view graphical representations of groundwater conditions. This eliminates the need for users to be trained in GIS and also the associated software license costs. The following is a list of on-line features:

   - Downloadable historic semi-annual groundwater reports
   - Graphical user interface (GUI)
   - County base map with crop information, well locations, agency boundaries, recharge areas, well fields, water level contours, etc.
   - Data query and download into MS Excel or HTML

4. <u>*Create an efficient and enforceable QA/QC plan:*</u>

   To effectively manage groundwater, decision makers need to know what is physically going on in the sub-surface. Over the next 20-30 years, San Joaquin County will invest hundreds of millions of dollars for projects in restoring and protecting the underlying groundwater basin. Therefore, confidence in the integrity and accuracy of groundwater data is of utmost importance. Also, State law mandates that agencies adopt groundwater monitoring protocols for quality assurance and quality control (QA/QC). By eliminating manual data entry through electronic data logging and utilizing advances in portable Global Positioning Systems, we can reduce human errors, create a monitoring system with quality assurance tests, and minimize labor costs associated with data entry and database correction. The new QA/QC plan will include:

   - Electronic data logging using Palm Pilots
   - Electronic data upload to database
   - Remote database entry forms
   - Location checks using hand-held GPS units
   - Telemetry and remote data logging
   - Monitoring protocols
   - Sampling techniques
   - Acceptable laboratory methods
   - Health and safety
   - Database security

5. *Utilize proven and supported technologies in groundwater monitoring, database management, and Geographic Information System (GIS).*

   Proven software and hardware technologies continue to redefine the field of environmental monitoring. The following applications will power the GDC:

   - ArcView 3.x/8.x
   - ArcView Spatial Analyst
   - ArcView 3-D Analyst
   - ArcPad
   - ArcIMS Application
   - Dedicated Server
   - ArcInfo
   - MS Access
   - MS SQL Server
   - Pendragon Forms
   - Personal Data Assistant (PDA)
   - Global Positioning System (GPS)

The GDC is expected to be publicly available in 2005.

5.1.2 Status of Monitoring Network Enhancements

As part of the monitoring program evaluation, MWH recommended that the depth specific monitoring well clusters be installed along the estimated saline front to capture better the geologic factors and physical flow driving saline intrusion. The report envisioned five general locations along Interstate 5 from North Stockton to the Lathrop and Manteca. Of the 5 recommended well clusters, two have been installed by the DWR at the Swenson Golf Course and the Sperry Road/McKinley Avenue stormwater detention basin in the City of Stockton. The County and the DWR continue to coordinate monitoring and installation efforts.

5.1.3 USGS and DWR Partnership

The Authority and its member agencies are co-participants with the United States Geological Survey (USGS) and DWR for the Groundwater Recharge and Distribution of High-Chloride Groundwater from Wells Study (Study). 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.

Historically, high-chloride groundwater along the San Joaquin River boundary of the Eastern San Joaquin Sub-basin (Basin) has been defined by interpolating the 300 mg/L isochlor based on limited groundwater quality data. Samples have measured in excess of 2,000 mg/L chloride. Consequently, the aerial and vertical distribution of high-chloride groundwater is poorly defined and the source of the high-chloride groundwater is unknown. Postulates on the origins of high-chloride groundwater include the accretion of poor-quality water from the San Joaquin River, incidental recharge of applied irrigation water and return flow, and upwelling of groundwater from beneath the base of freshwater. Also, local efforts to augment the natural recharge rate are ongoing; however, the cumulative effect of ongoing groundwater recharge projects on water levels and water quality in aquifers is unknown. The scope of Study is explained in detail below.

1. Assembly and review of existing geologic, hydrologic, and water-quality data

Existing well logs, groundwater level, and groundwater quality data will be compiled and assembled into a GIS database. The GIS database will be used, updated, and revised throughout the study and will be the basis for a 3-D visualization. The GIS database will be used to evaluate the aerial extent of high-chloride water, and to draw geologic sections through the study area that define the aerial and vertical extent of aquifer deposits along three selected flow paths from sources of recharge to discharge areas near the delta. The aerial extent of high-chloride water and the geologic sections will be used to define data gaps that guide test-drilling and installation of observation wells. Existing water-quality data in the area of high-chloride water and along the three study flow paths will be used to define the quality of native ground water and its geochemical evolution prior to collection of new data.

2. Collection of geochemical and geophysical data

Water chemistry data will be collected from up to 60 existing production and the 12 observation wells installed as part of this study. The data will be used to define the source, movement, and age of water from wells and the aerial and vertical extent and source of high-chloride water to wells along the three study flow paths. Samples will be analyzed for major ions, nutrients, selected trace elements, and stable oxygen and hydrogen isotopes.

Selected trace elements including bromide, iodide, boron, and barium will be used in conjunction with chloride data to determine the source of high-chloride water in wells. The stable isotopic composition of water from wells also will be used to determine the hydrologic and evaporative history of the Basin. Selected samples will be analyzed for tritium, carbon-14, and carbon-13 to determine the age of groundwater. Selected samples will also be analyzed for noble gasses to determine the recharge mechanism as either focused recharge from stream infiltration or aerial recharge from precipitation or irrigation return.

Electromagnetic logs will be collected from existing observation wells and at the multiple-well sites drilled as part of this study. The logs will be used to determine if saline water is present at depths not sampled by well screens. Sequential logs done annually as part of this study will be used to determine if chloride concentrations are increasing at depths where screens are not located.

Well-bore flow and depth-dependent water quality data (Izbicki and others, 1996) will be collected from selected production wells to determine at what depths high-chloride water enters the well under pumping conditions. Water movement through selected abandoned wells will be measured using low-flow current meters (such as an electromagnetic or heat-pulse current meter) to determine the direction and rate of water movement through the well casing under non-pumping conditions.

3. Test drilling and well installation

Three multiple-well sites, each containing three to four 2-inch diameter wells, will be drilled along one study flow path. The wells will define movement of recharge water laterally and vertically through the flow system. Deeper wells at each site will define potential high-chloride source water from underlying bedrock. Similarly, shallower wells at each site will define potential high-chloride source water from irrigation return and, at the down gradient site, brackish water from delta sediments.

4. Telemetry

Selected wells (as many as 10) will be instrumented to provide real-time water-level data and potentially water-quality data (such as pH and specific conductance). Data will be output through satellites using the Geostationary Observational Environmental System (GOES) and uploaded to the Automatic Data Acquisition System (ADAPS) on California District computers. Graphical and tabular data will be available in near-real time through the Internet. Where available the data also will be output through local Supervisory Control and Data Acquisition (SCADA) systems. Equipment will be calibrated and serviced at 15-week intervals by U.S. Geological Survey personnel.

5. 3-D Visualization

Spatial data will be stored in a GIS which will be the basis of a 3-D visualization of the ground water flow system using Earth Vision computer software. The visualization will incorporate hydrogeologic units and spatially connect data in the area of high-chloride water and along study flow paths. The visualization will be a tool to evaluate data uncertainty and illustrate the effects of aquifer hydraulic properties and ground-water flow on the movement of high-chloride water toward wells.

6. Data Interpretation and Report Preparation

Sources of high-chloride water to wells will be determined primarily from trace-element to chloride ratios and further refine by ^{18}O and Deuterium analysis. Results will be compared to similar data collected in coastal aquifers elsewhere in California. The recharge temperature and tritium/helium-3 age of younger ground water will be estimated using the computer program NOBLEGAS. Recharge temperature will be used to evaluate focused sources (such as infiltration from stream flow) and diffuse sources (such as infiltration of precipitation, and irrigation return) of ground-water recharge. Changes in ground water chemistry and the age of older ground water interpreted from carbon-14 data will be evaluated along selected flow paths using the computer program NETPATH.

Interim papers describing the source of high-chloride water to wells and the movement and age of water from wells will be published during the course of the study. Annual progress meetings with cooperators and stakeholders will be held. A final report integrating information from all aspects of the study including data review, well installation, data collection, telemetry, and 3-D visualization will commence at the end of the Study.

7. Project Costs

The total cost of the study is $2,579,350. The proposed USGS contribution will be $625,000 over 5 fiscal years as well as an additional $625,000 from the DWR over the first 3 fiscal years. Member agencies within the Authority will contribute the remaining $1,322,350 over next 5 fiscal years.

5.2 Monitoring Protocols

In order to ensure that groundwater data is collected in a systematic and consistent manner, the Authority has adopted the Groundwater Monitoring Program Quality Assurance/Quality Control (QA/QC) Plan, prepared by MWH in 1998. The QA/QC Plan addresses the following items: monitoring and sampling preparations, sample collection procedures, chain-of-custody procedures, sample transport, laboratory procedures and methods, and data validation and reporting. The QA/QC Plan can be obtained at the San Joaquin County Department of Public Works Stormwater Management Division. The revised QA/QC plan proposed as part of the GDC is expected to be completed by the spring of 2005.

6 Financing Options

The development of new water supplies and the necessary infrastructure is a major financial undertaking. It is absolutely necessary for the Authority and its member agencies to leverage as much support for outside funding. The following section is intended to provide stakeholders with a general overview of the potential funding sources, programs, and project partnerships available to the Authority.

6.1 Funding Sources

6.1.1 Federal Funding

Federal funds can be made available to the Authority and its member agencies through a variety of mechanisms including, but not limited to, subsidies, appropriations, in-kind services, grants, loans and cost-sharing agreements. Securing these funds is accomplished through the following processes.

Legislative Approach - Federal funding can be secured through the legislative process to directly fund an approved project. This approach is initiated by a request by the Authority to a local congressional representative. The project may require the establishment of Federal interest through an act of Congress and funded in subsequent years (e.g. Farmington Program). If, however, the project is consistent with the goals and objectives of an existing Federal program, an appropriation can be made that same year (e.g. MORE WATER Project). Competition for funds through Congress is fierce and will require the broad support of local, regional, and State interests.

Federal Agency Interest - Funding can also be secured for projects directly from Federal agencies. Local projects, consistent with the goals and objectives of an agency, are eligible for funds and in-kind services through directed actions and partnerships (e.g. Joint USGS/DWR/Authority Groundwater Recharge and Distribution of High-Chloride Groundwater from Wells Study). Federal agencies commit to projects during their respective internal budgeting processes and have the flexibility to disperse funding over several years.

Federal Assistance Programs - Finally, a third option is to apply for project funding under an existing grant, loan, or assistance program administered by any of the various Federal agencies. Potential partnering agencies include the USBR, Environmental Protection Agency (EPA), USACE, United States Department of Agriculture (USDA), National Fish and Wildlife Service (NFWS), and the National Oceanic and Atmospheric Administration (NOAA). Eligibility, cost sharing, and application requirements vary between the programs.

6.1.2 State Funding

State funds are similar to Federal funds in that they can also be secured through the legislative process, state agency interest, and through competitive grants and assistance programs. The availability of State funds for water resources projects is a reflection of the current fiscal climate and can vary significantly. Voter approval of Proposition 50, the $3.4 Billion Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, is expected to carry many of the water resources development programs of interest to the Authority for the next few fiscal years including CALFED, Integrated Storage Investigations, and other groundwater recharge construction grants and loans.

Legislative Approach – Although the dollar amounts available from the State are usually not as substantial as Federal, the State process can be somewhat more streamlined than the

Federal approach. Appropriating funds through the State legislature is extremely competitive and subject to the State budget climate.

State Agency Interest – Discretionary funds may be available in the form of directed action assistance or in-kind services. Partnerships with the agencies such as the DWR Division of Planning and Local Assistance (DPLA) and CALFED may yield monies and services to projects (e.g. Joint USGS/DWR/Authority Groundwater Recharge and Distribution of High-Chloride Groundwater from Wells Study).

State Assistance Programs - Finally, a third option is to apply for project funding under an existing grant, low interest loan or assistance program administered by any of the various State agencies. Under Proposition 13, the Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act of 2000, approximately $200 million statewide for groundwater management and recharge projects were provided through the DWR DPLA. Similarly, Proposition 13 provided a major source of funding for the CALFED Bay-Delta Program and other such programs administered by SWRCB. Most recently, voters approved the $3.44 Billion Proposition 50, the Water Quality, Supply and Safe Drinking Water Projects, Coastal Wetlands Purchase and Protection Act of 2002. Proposition 50 is expected to provide similar funding opportunities for the next few years.

6.1.3 Local Funding

Local funds are available from a variety of sources including general funds, water rates, developer fees, connection fees, capital improvement programs, acreage or *ad valorem* assessments, and taxes. Local funds can be raised by individual agencies and districts or through more regional efforts such as the San Joaquin Council of Governments (SJCOG). The implementation of assessments and taxes is subject to Proposition 218 voting requirements. The Authority member agencies have the power to issue bonds for capital projects separately or jointly as the Authority. The following sections briefly explore the revenue generating mechanisms available for bond repayment and annual operations and maintenance costs.

Assessments – The Authority has the power to implement a number of funding mechanisms available including the exercise of provisions set forth in Water Code Sections 10750 *et. seq*. Upon adoption of the Plan, the Authority could choose to equitably assess parcels within the GMA for the purpose of implementing the Plan subject to a Proposition 218 vote. The Authority does not have a time table by which this particular funding mechanism will be exercised. In addition, benefit assessments consistent with the existing statutory authorities of the member agencies could be used to generate revenues.

Sales Tax – Local sales tax measures such as Measure K, the ½ % regional transportation sales tax initiative, could be pursued by the Authority for the implementation of the Plan. The Authority or a similar broad stakeholder based Authority is necessary to garner the support of the voters. Through 2011, over its 20 year life span, Measure K is expected to generate over $750 million.

Water Service Fees – The Authority or its member agencies could revise or formulate a fee structure for the water served either at the wholesale or retail level. Revenue generated could be directed towards the debt service of capital projects or for the implementation of the Plan.

Developer Fees – Mitigation fees paid by new urban developments are currently collected by cities and counties. Specifically, a Water Impact Mitigation Fee is collected per new residential building permit within a defined area to finance capital repayment of bonds used to construct the

Goodwin Tunnel Project and the New Melones Conveyance Project. Similar development fee structures could be developed by the member agencies of the Authority to ensure that urban growth is apportioned their fair share for future water resources in Eastern San Joaquin County.

Groundwater Banking and Transfer – Enormous opportunity exists for the utilization of the underground storage potential of the underlying Basin estimated at 1.2 – 1.5 million acre-feet. To regional and Statewide interests, the benefits of a conjunctive use program involving over a million acre-feet of underground storage is undeniable. Constructing and financing the infrastructure necessary to accommodate a groundwater bank of this magnitude will require several sources of funding for capital recovery, operations and maintenance, and mitigation. The evolving California water market could potentially enable Eastern San Joaquin County to provide economic alternatives to regional and statewide water interests while also concurrently meeting the Basin Management Objectives. The San Joaquin County Groundwater Export Ordinance currently protects Basin users from the potential ill-effects of export, however the San Joaquin County Board of Supervisors are amenable to proposed amendments made by Basin stakeholders and banking partners.

7 Plan Governance

Water interests in San Joaquin County have historically been fragmented, but have realized that projects developed in a collaborative process have the potential to exhibit greater and more far reaching benefits to all involved parties while increasing its implementability and fundability. Implementation of the water management options can best be achieved by continuing to work in a collaborative fashion to develop a broad base of political and financial support. Currently, the powers and term of the Authority are limited thus, if the Authority member agencies decide that the Authority should implement the Plan, then additional powers are necessary. The Authority has explored numerous options concerning the appropriate organization and powers needed to implement the plan and the best management framework that addresses the concerns of the Authority member agencies.

7.1 Member Agency Concerns

Throughout the development of the Plan, the Stakeholder group voiced their concerns over the purpose and need for a new or expanded Authority. The following concerns are presented as follows:

- Does the purpose, goals, and objectives of the current Authority provide for the implementation of the Authority Plan?
- What powers are necessary for the implementation of the Authority Plan?
- Does expanding the powers of the Authority threaten projects previously set in motion by individual agencies or smaller partnerships?
- How will stakeholders be represented in the new Authority?
- How can we engage all Basin stakeholders including those who showed no interest in participating in the past?
- How do we include Cal Water in a Joint Powers Authority?
- How will individuals and special interest groups be allowed to participate?
- How will the Authority relate to other groundwater management efforts in San Joaquin County (e.g. San Joaquin County Groundwater Export Ordinance, Mokelumne River Water and Power Authority – MORE WATER Project, Eastern Water Alliance – SEWD, NSJWCD, & CSJWCD)
- How will the Authority coordinate with Basin neighbors outside of the Groundwater Management Area?
- How will the new Authority be funded?
- Should the Authority be allowed to construct projects or should the member agencies be the ones to construct projects?
- Should votes be weighed by acreage, water use, monetary contribution, or not weighted at all?

With the above concerns in mind, the Authority is currently exploring a number of potential governance models suitable for the unique situation in Eastern San Joaquin County.

7.2 Organizational Structures

Organized stakeholder groups come in all shapes and sizes and hold varying degrees of authority and powers. The form of a stakeholder group is entirely dependant on its function or activities. Stakeholders can be coordinated under one of various organizational structures for representation, including 1) Joint powers agreement (JPA), 2) Memorandum of understanding, 3) various types of water districts (e.g., water replenishment district, water conservation district). The following subsections discuss each type of organizational structure in more detail.

7.2.1 Joint Powers Agreement

Pursuant to Government Code Section 6500 *et. seq*., two or more public agencies may enter into a joint powers agreement for the purpose of exercising those powers common to each of the member agencies. Powers include but are not limited to: execution of contracts; employment of staff; issuance of bonds, acquisition of property, construction, operation and maintenance of facilities, and incurrence of debt. JPAs have the authority to prepare, adopt, and implement groundwater management plans developed pursuant to Water Code section 10750 *et. seq.* JPAs may also seek additional powers through the legislature.

Case Study: San Joaquin Council of Governments – The San Joaquin Council of Governments (SJCOG) is a joint powers authority comprised of the County of San Joaquin and the Cities of Stockton, Lodi, Manteca, Tracy, Ripon, Escalon and Lathrop. SJCOG serves as the regional transportation planning agency for San Joaquin County. SJCOG also analyzes population statistics, airport land use, habitat and open space planning, and other regional issues. SJCOG fosters intergovernmental and public coordination within San Joaquin County, in neighboring jurisdictions, and with other various State and federal agencies.

Measure K, the half-cent sales tax measure passed in 1990 for San Joaquin County, is administered by SJCOG and overseen by its Board of Directors. The SJCOG Board of Directors consists of one voting member from each of the member agencies and an additional member from San Joaquin County. Over the twenty-year life of Measure K, an estimated $750,000,000 will have been generated for regional transportation projects.

7.2.2 Memorandum of Understanding

A memorandum of understanding (MOU) is a somewhat more flexible organizational structure that allows signatory agencies to pursue a common purpose or goals. The organization formed by the MOU cannot directly enter into any contracts, incur debt, or employ staff directly. An organization formed under an MOU is adequate for consensus building and facilitation.

Case Study: : The Butte Basin Water Users Association - The Butte Basin Water Users Association in Butte County is an example of a group formed under an MOU who share common interests. In response to water management challenges encountered during consecutive drought years through the mid-1990's, agricultural and urban water purveyors organized themselves to combine financial and technical resources to better understand and manage the surface water and groundwater resources. In addition to promoting improved water management by individual agencies through the collective sharing of information, the organization was able to demonstrate broad local support for their efforts.

7.2.3 Various Types of Water Districts

The State of California recognizes the formal organization of various water districts as political subdivisions of the State. Examples of water districts include County water agencies, County water districts, resource conservation districts, water districts, water conservation districts, irrigation districts, water storage districts and water replenishment districts. In addition, specific legislation may also be sought to create a special district or to enhance its powers. Many of the individual entities represented on the water management plan stakeholder committee have utilized one of these acts as the basis for their organizational structure. Stakeholders may chose to annex adjacent lands, organize as a new special water district, or be incorporated into an existing district to exercise its powers. Additionally, a specific benefit zone can be created under the San Joaquin County Flood Control and Water Conservation District for the purpose of implementing a groundwater management program in Eastern San Joaquin County.

7.3 Management Framework Models

A Management framework model is a depiction of the relationship between the basin stakeholders, Authority, Groundwater Management Plan, and the Groundwater Export Ordinance. The following management framework models are depicted below.

7.3.1 Individual Interest-based

Depicted in Figure 7-1, an individual interest-based management framework reflects a philosophy whereby stakeholders would govern and develop water resources projects individually. Historically, this has been the approach to groundwater management and water resources development in San Joaquin County.

In the individual interest-based model, water districts, cities, and other mutual partnerships are free to develop and implement projects independently. Input from the public and comments from other affected agencies are dealt with during regular or mandated outreach opportunities or progress meetings. Individual entities may choose to develop projects pursuant to a regional groundwater management plan. However, project decision-making authority would remain exclusively within the jurisdiction of the entity sponsoring the project. Fund raising would also be the sole responsibility of the sponsoring entity.

The individual interest-based management approach allows agencies to focus their resources on projects specific to its needs; however, this approach may hinder the ability for agencies to coordinate project development in order to best meet the needs of the involved agencies and the region. Competition for State and federal funding is also an issue as projects demonstrating broad benefits to multiple agencies are given funding priority over narrowly scoped projects developed by individual entities.

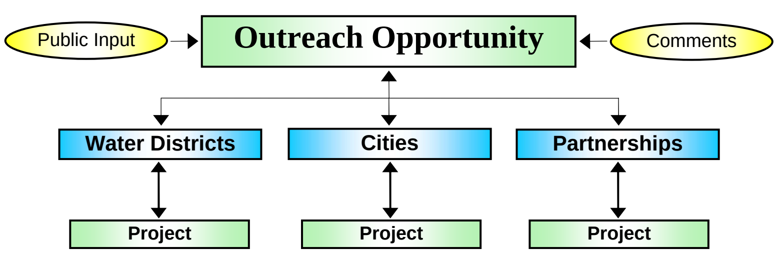


Figure 7-1 Individual Interest-based Model

7.3.2 Mutual Interest-based

The mutual interest-based model reflects a governance framework that creates a stakeholder group of common interests with the powers to undertake specific goals and objectives. The current Authority structure is a form of the mutual interest based approach. A stakeholder group such as a JPA or coalition, represented by individual agencies overlying the Basin, would be responsible for providing a consensus based forum in which projects can be developed by Basin 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 would ensure consistency with the Plan.

The distinct advantage to this approach is the benefit of regionalism. Broad based support for a project is a deterrent to 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.

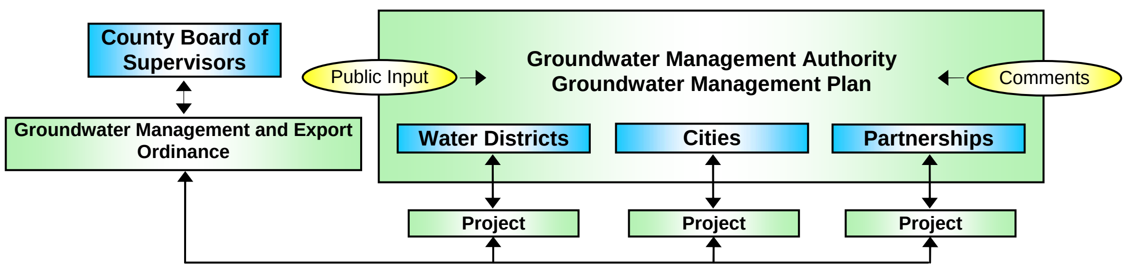


Figure 7-2 Mutual Interest-based Model

Presented in Figure 7-2 is an example of a mutual interest-based governance framework in the context of the current Authority governance structure and groundwater management efforts. 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. The Board of Supervisors of San Joaquin County would remain a member agency of the Authority.

7.4 Dispute Resolution

The Authority has served as a regional planning body and a forum for member agencies to share their groundwater management efforts and ensure that those efforts do not detrimentally affect other member agencies. In order to avoid potential conflicts between Basin stakeholders, the Authority employs the following:

- **Expanded Membership:** Authority membership is diverse as are the myriad of water challenges and issues facing Eastern San Joaquin County. In 2001, the Central Delta Water Agency and the South Delta Water Agency became full contributing and voting member agencies to the Authority. In 2004, amendments to the Authority JPA included language to include California Water Service Company as an appointed voting member to the Authority Board of Directors. Associate membership (ex-officio) was also extended to the San Joaquin Farm Bureau Federation as their input and support is essential to the success of the Authority. Other members have been contemplated such as SSJID, OID, City of Lathrop, Manteca, Escalon, and Ripon, Calaveras County Water District, Stanislaus County, DWR, Freeport Regional Water Authority, and EBMUD.

- **Continued Use of the Authority as a Forum:** As the Authority looks to implement the Plan, the member agencies will move the outlined projects through the planning, permitting, and design stages and ultimately to construction. In a forum, implementing member agencies will be able to quantify the benefits of its projects to stakeholders and receive comments and suggestions before disputes arise.

- **Continued Facilitation by the California Center for Collaborative Policy:** The California Center for Collaborative Policy (Center) has been an integral part to the success of the Authority'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 and throughout the implementation of the Plan.

8 Integrated Regional Conjunctive Use Program

The following section describes the options available to the Authority in the development of the Integrated Regional Conjunctive Use Program. The Conjunctive Use Program is the key element in fulfilling the purpose of the Plan to ensure the sustainability of Groundwater resources in Eastern San Joaquin County. For organizational purpose, project options are grouped into water supply elements by source, surface water storage and major conveyance projects, and groundwater recharge components by program or entity.

8.1 Supply Elements

Supply elements are grouped by river system and are a combination of reallocations, new water, and transfers. Entitlements to water are supported by legal claims based on existing water right permits, water service contracts and agreements, and pending water right applications. A map of the waterways discussed can be seen in Figure 8-1.

8.1.1 Stanislaus River

As listed in Table 2-5, Stanislaus River supplies are available to the SSJID and OID via pre-1914 water rights and to the Stockton East Water District and Central San Joaquin Water Conservation District through Central Valley Project (CVP) contracts. SSJID and OID are senior water right holders to 600,000 af per year from the yield of New Melones Reservoir, 320,000 af of which are used directly in the GMA. SEWD and CSJWCD hold junior contracts for a total of 155,000 af subject to other users requirements.

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 snow melt is greatest. More than half the runoff is snowmelt-derived (USBR, Website, updated). The USACE constructed New Melones Dam on the Stanislaus River in 1978, replacing the original Old Melones Dam constructed in 1924 jointly by OID and SSJID. New Melones Reservoir has a capacity of 2.4 million af and is operated as part of the CVP under the USBR's Interim Operations Plan. The average annual runoff at New Melones for the 74 years from 1904 to 1977 was 1.12 million af.

Urban growth in South San Joaquin County in the Cities of Lathrop, Manteca, Escalon and Ripon and the increased irrigation efficiencies made over the years have made water available for transfer by SSJID and OID. Beginning in 2005, SSJID will serve the urban communities of Escalon, Manteca, Lathrop, and Tracy with surplus water through the South County Surface Water Supply Project. SSJID and OID also currently make available to SEWD up to 30,000 af/yr through the New Melones Conveyance System specifically for urban use as part of a 10-year water transfer agreement which expires in 2009. The agreement is renewable pending future water availability and negotiation. SSJID and OID have also made on occasion water available to CSJWCD for irrigation.

In 1978, New Melones Dam was completed and the reservoir was filled. At the time of development and construction of New Melones, the expected yield of the project was fully allocated to meet the needs of the contracts in the Eastside Unit of the CVP. SSJID and OID held the most senior of rights and were allocated their full historic diversion amount. CSJWCD executed both a firm and interim CVP contract and SEWD an interim CVP contract; both are junior to other CVP contract for New Melones water. The CVP contracts provide up to 155,000 af per year subject to inflow, storage, and senior requirements. CSJWCD would receive up to 49,000 af of firm yield and an additional 31,000 af when available. SEWD would receive up to 75,000 af when available.

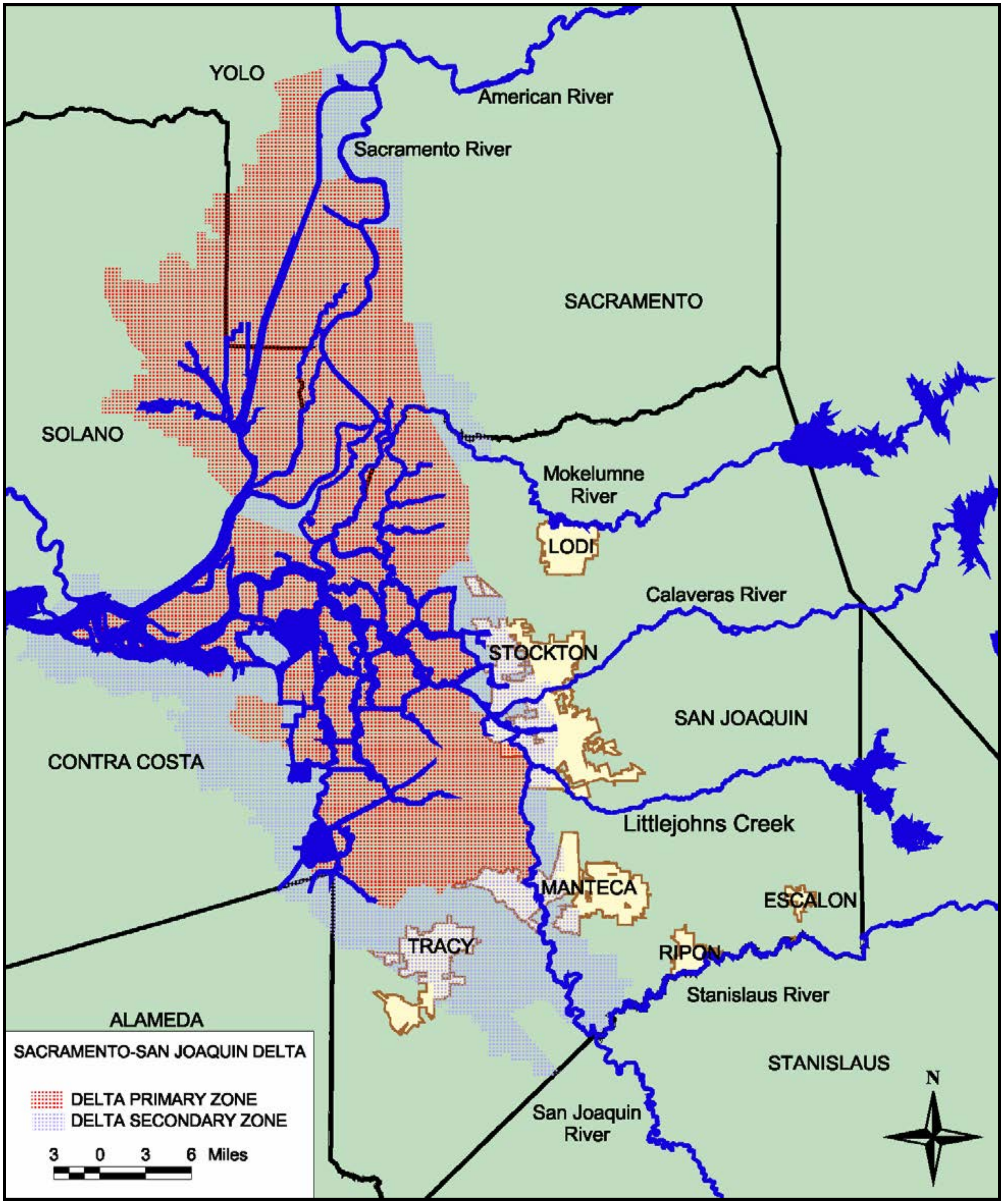


Figure 8-1 Regional Waterways

The severity in the quantity and quality of flow in the San Joaquin River directly affects the operation of New Melones Reservoir. Quality and flow of the San Joaquin River has seriously deteriorated since the completion of the Friant Dam, the Delta Mendota Canal, and California Aqueduct. Inflow to the Delta from the San Joaquin River consists primarily of high saline drainage from farmlands and wetlands in the CVP's Westside service area. As a result, hundreds of thousands of tons of concentrated salt flow into the San Joaquin River each year. The SWRCB established flow and water quality standards on the San Joaquin River near Vernalis and directed the USBR to meet these standards. Consequently, the USBR has elected to meet the Vernalis standards with substantial releases from New Melones Reservoir. These releases for water quality purposes directly reduce the amount of water available for the Stockton East Water District and the Central San Joaquin Water Conservation District under their respective CVP interim contracts. The USBR and the Central Valley Regional Water Quality Control Board have shown little interest in addressing salt drainage or the restoration of flows in the San Joaquin River in a manner that does not harm San Joaquin County interests.

Additionally, the Central Valley Improvement Act of 1992 (CVPIA) required more releases from the CVP for fish and wildlife system wide. The resulting actions have disproportionately affected New Melones Reservoir thus reducing the amount of water available for SEWD and CSJWCD. The USBR has made no real substantial progress towards revising the Interim Operations Plan for New Melones Reservoir, implementing source control programs for salinity in the CVP Westside service area, nor finding alternative sources for meeting the SEWD and CSJWCD water service contracts.

CDWA and SDWA are directly affected by the quantity and quality of flow in the San Joaquin River. CDWA and SDWA have been the lead proponents of alternative means for the USBR to meet the Vernalis flow objective. While CDWA and SDWA recognize the use of New Melones to improve water quantity and flow in the San Joaquin River at Vernalis, it is neither a permanent solution nor a solution that is acceptable economically to San Joaquin County as a whole. San Joaquin County, Delta interests, and Eastern San Joaquin County have been supportive of measures that would restore the San Joaquin River through in-stream releases at Friant Dam, the establishment of water quality and flow standards upstream of Vernalis, and recirculation of Delta exports through the Delta-Mendota Canal and the San Joaquin River. Modeling has shown that any of the above options if implemented would free up water in New Melones for the SEWD/CSJWCD contract entitlements.

8.1.2 Calaveras River

The Calaveras River is the primary surface water supply for the City of Stockton and SEWD. In 1963, the USACE constructed New Hogan Dam for flood control, recreation, and water supply purposes. The Calaveras River watershed consists of 363 square miles and stretches from the Sierra Nevada foothills to San Joaquin River in west Stockton. New Hogan Reservoir is primarily derived from rainfall and has a capacity of 317,000 af. The USACE operates New Hogan when flood control releases are necessary and reserves approximately 165,000 af of reservoir capacity for flood control storage. SEWD operates New Hogan and schedules releases at all other times. By agreement, SEWD is entitled to 56.5% of the yield to New Hogan with the remaining yield reserved for Calaveras County Water District (CCWD). Currently, SEWD utilizes CCWD’s unused supply. CCWD currently uses approximately 3,500 af per year and estimates it will use up to 5,300 af per year in 2040; however, growth in Calaveras County could spur interest in expanding use of its New Hogan supply (CCWD, 1996).

8.1.3 Mokelumne River

The Mokelumne River watershed encompasses approximately 660 square miles stretching from the high Sierra Nevadas westward to the Delta. 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 rivers main stem. Salt Springs Reservoir, the largest of seven Pacific Gas & Electric (PG&E) reservoirs (Project 137), was 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 River Aqueducts to the EBMUD service area some 82 mile away. Camanche Reservoir, with a capacity of 417,120 af, is operated for flood control and also to meet instream flow requirements and down stream entitlements. Snowmelt comprises a large portion of the watersheds runoff. Both Pardee and Camanche generate incidental hydro power at 30 MW and 9.9 MW respectively. (EBMUD, Urban Water Management Plan 2000)

In-stream flow requirements and water rights on the Mokelumne form a complex hierarchy of entitlements. Under the Joint Settlement Agreement on the Lower Mokelumne River Project (JSA), minimum in-stream flows, reservoir pool elevations, and fisheries enhancements are implemented conditional to the FERC Permit of Pardee and Camanche Reservoirs. Subsequently, the D-1641 of the SWRCB reaffirms the validity of the JSA commitment to establishing adequate Bay-Delta flows and water quality. Additionally, provisions in the Lodi Decree protect groundwater levels in the City of Lodi from flow related deficiencies and inadequate groundwater levels. Table 8-1 depicts the target JSA release and in-stream flow requirements.

Table 8-1 Lower Mokelumne In-stream Flow Requirements

Year Type	Requirements (cfs)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual (af)
Normal	Minimum Camanche Reservoir Release	325	325	325	325	325	325	325	325	325	100	100	100	194,000
Below Normal		250	250	250	250	250	250	250	250	250	100	100	100	154,000
Dry		220	220	220	220	220	220	220	220	100	100	100	100	130,000
Critical		115	130	130	130	130	130	130	100	100	100	100	100	80,000
Normal	Expected Flow below Woodbridge Diversion Dam	100	100	100	100	100	100	150	300	300	25	25	25	86,000
Below Normal		100	100	100	100	100	100	150	200	200	20	20	20	73,000
Dry		80	80	80	80	80	80	150	150	20	20	20	20	52,000
Critical		75	75	75	75	75	75	75	15	15	15	15	15	52,000

Note: Minimum releases from Camanche Reservoir are approximately and should not be used to determine the actual available quantity of water available for new uses on the Mokelumne River.

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

EBMUD must also meet the requirements of both upstream and downstream water right holders. Increasing demands of upstream developments in Alpine, Amador, and Calaveras Counties are recognized by the SWRCB as having priority to Mokelumne River water. Downstream users served by Camanche Reservoir include WID and NSJWCD. WID holds both pre and post-1914 water rights. In years when Mokelumne inflow is greater than 375,000 af, WID is entitled to 60,000 af. When Mokelumne inflow is less that 375,000 af, WID is entitled less than 60,000 af to a minimum of 39,000 af. Through conservation and irrigation efficiency efforts, WID has made 6,000 af per year available to the City of Lodi. Under the agreement, the

City of Lodi will pay WID $200 per af for water delivered by the existing WID canal system. WID will use the proceeds to replace the aging WID Dam. The new WID Dam will allow Lodi Lake to remain full year round thus enabling WID to serve recharge areas during the late fall and winter months. The dam will also feature state of the art fish ladders making it easier for spawning salmon to reach the Fish Hatchery at Camanche Reservoir.

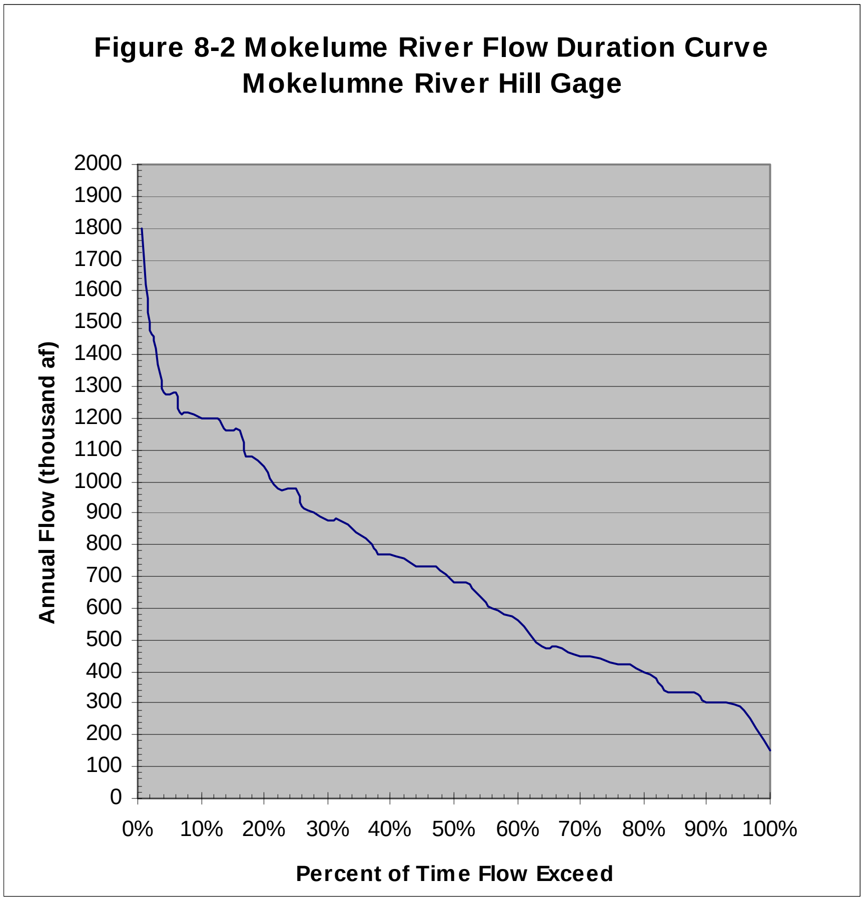
NSJWCD has attempted to acquire a firm supply from the Mokelumne River through the SWRCB, however, in D-858 of 1956, the State Engineer gave priority to EBMUD for Mokelumne River water and cited the Folsom South Canal (FSC) as the preferred surface water supply for NSJWCD. The FSC was planned as part of the Auburn-Folsom South Unit of the CVP for the conveyance of American River Water stored behind Folsom Dam and the proposed Auburn Dam. Auburn Dam and the remaining reaches of the FSC were never completed. The USBR has no plans or intentions to extend the FSC into San Joaquin County to its planned terminus 20 miles southeast of Stockton.

Also in D-858, the State Engineer granted NSJWCD a permit to divert Mokelumne River water from December 1st to July 1st which is surplus to EBMUD's needs until the FSC is completed as envisioned by the CVP or until EBMUD uses its full entitlements. EBMUD has agreed to store up to 20,000 af per year pursuant for NSJWCD subject to inflow and other requirements. The interim nature of the water supply and the extensive use of private groundwater wells have reduced the

Table 8-2 Water Available from the Mokelumne River (af)

Year	Total		Year	Total	
1922	194,274		1961	0	
1923	7,909		1962	0	
1924	0		1963	0	
1925	0		1964	0	
1926	0		1965	316,779	
1927	0		1966	6,968	
1928	0		1967	289,774	
1929	0		1968	0	
1930	0	13-year Period	1969	463,970	
1931	0		1970	209,374	
1932	0		1971	93,591	
1933	0		1972	0	
1934	0		1973	0	
1935	0		1974	272,910	
1936	0		1975	97,983	
1937	19,096		1976	0	
1938	519,170		1977	0	
1939	0		1978	0	
1940	0		1979	0	
1941	119,569		1980	156,188	
1942	274,525		1981	0	
1943	286,933		1982	656,659	
1944	0		1983	1,146,269	
1945	0		1984	380,946	
1946	33,755		1985	4,503	
1947	0		1986	378,552	
1948	0		1987	0	
1949	0		1988	0	
1950	0		1989	0	
1951	453,705		1990	0	8-year Period
1952	603,929		1991	0	
1953	18,421		1992	0	
1954	0		1993	0	
1955	0		1994	0	
1956	341,038		1995	500,787	
1957	0				
1958	322,485		**Minimum:**	**0**	
1959	0		**Maximum:**	**1,146,269**	
1960	0		**Average:**	**43,173**	
Number of diversion years in 74-yr period:				**26**	**(35%)**

Source: MORE WATER Project Phase I – Reconnaissance Study Summary Report, 2004 demand for surface water to less than 3,000 af per year. Water demands in the EBMUD service area are not expected to rise considerably over the next 20 to 40 years. Water for NSJWCD is available from the Mokelumne River in above average and wet years.



Additional supply from the Mokelumne River is possible in a major regional conjunctive use project. The Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE WATER Project) is currently being studied by the Mokelumne River Water and Power Authority (MRWPA). In 1990 the MRWPA submitted applications to the SWRCB for unappropriated flood flows on the Mokelumne River from December 1 to June 30. The application seeks to divert up to 1000 cfs to storage and up to 620 cfs for direct use. Historic alternatives for capturing the water include Middle Bar Dam and on-stream reservoir, Duck Creek Reservoir and off-stream diversion, and direct diversions on the Lower Mokelumne River from Camanche Reservoir to Interstate 5. Preliminary studies have shown that substantial 'new water' is available for use in Eastern San Joaquin County; however, the facilities necessary to capture water intermittently are expensive and may remain idle in some years. Table 8-2 depicts the available water from the Mokelumne River surplus to all in-stream and user requirements over the historic 74-year hydrologic record. Based on the historic Mokelumne Hill gage record, there is substantial water available on an interim basis as depicted in Figure 8-2.

8.1.4 Sacramento-San Joaquin Delta

The City of Stockton has long looked to the Sacramento-San Joaquin Delta as a potential source of water to meet long-term needs. In 1996 the City of Stockton submitted an application to the SWRCB seeking an increasing amount of water from 20,000 af initially up to 125,900 af per year. The Delta Water Supply Project seeks to replace existing surface supplies subject to future reductions, protect and restore groundwater levels to within a target safe yield of 0.6 af per acre, and provide a reliable water supply for planned growth outlined in the 1990 City of Stockton General Plan. The basis for the water right is Water Code Section 1485 whereby an agency may appropriate water from the Delta in a like amount to water discharged upstream into the San Joaquin River less any losses and the Area of Origin and Delta Protection Statutes which were enacted to protect against water exports. Any new diversion from the Delta is extremely contentious.

The health of the Delta is also linked to the water supply of Eastern San Joaquin County. Inflow into the Delta from the San Joaquin River is of poor quality and is diluted by higher quality flows from the Sacramento River. A number of Total Maximum Daily Load (TMDL) actions are underway for the San Joaquin River. The Regional Board is required to establish a TMDL load allocation for high priority impaired water bodies under the Federal Clean Water Act. A low dissolved oxygen TMDL is currently being formulated for the Stockton Deepwater Ship Channel which includes effluent from the City of Stockton Regional Water Quality Control Facility (Wastewater Treatment Plant). Additionally, a TMDL for salt and Boron is being formulated to control salt drainage into the San Joaquin River to meet the Vernalis standard. Improvement in delta water quality is the highest priority for both Delta interests and the City of Stockton Diversion Project.

8.1.5 American River

Eastern San Joaquin County has long been promised water from the American River by both the State and Federal Governments. The planned construction of the Auburn Dam, FSC and other smaller regulating reservoirs never came to fruition. The USBR’s inaction and the current regulatory restrictions on water resources development have forced Eastern San Joaquin County to weigh other more expensive alternative water sources.

In 1990 San Joaquin County submitted an application to the SWRCB to appropriate wet-year water from either the South Fork of the American River via the completed Auburn-Folsom South Unit of the CVP or from Lake Natomas on the Lower American River. The application requests a diversion of up to 620 cfs between December 1 and June 30 subject to availability of unappropriated flow. The construction of the Auburn Dam, the Countyline and Clay Station Reservoirs, and the extension of the Folsom South Canal into San Joaquin County were never undertaken. In addition Sacramento County and environmental interests have long opposed the substantial delivery of water from Nimbus Dam to the detrimental health of the Lower American River.

In August 2003, San Joaquin County amended its American River application to move and consolidate the points of diversion on the South Fork of the American River and Nimbus Dam to the Sacramento River to coincide with the point of diversion of the Freeport Regional Diversion Project (Freeport Project) at a diversion rate of 350 cfs. In order to maintain the priority filing date, San Joaquin County needed to demonstrate that the amended amount requested at Freeport on the Sacramento River would be available on the South Fork American River. To support the amendment of the water right application, the Authority co-sponsored the San Joaquin County Amended Water Right Application 29657 South Fork American River Water Availability Study (Water Availability Study).

The Water Availability Study explores the hydrologic, regulatory, and water right constraints of the American River System. 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. The Water Availability Study also concluded that the 155 cfs Freeport Project capacity severely limits the amount available to San Joaquin County. By increasing the capacity of the diversion and conveyance elements of the Freeport Project to 350 cfs, the Authority could maximize its use of the American River Water Right Application.

The Water Availability Study concluded that the average annual yield available to San Joaquin County is limited by the physical capacity of the Freeport Project capacity of 155 cfs or approximately 44,000 af per year. An increase in capacity to 286 cfs could potentially increase the average annual yield to 72,000 af per year. In the months of July-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 San Joaquin County. A more detailed description of the Freeport Project is found in Section 8.2.1.

8.2 Surface Storage and Major Conveyance Elements

The water sources described above require substantial investments in storage and conveyance in order to capture and put to beneficial use substantial amounts of water. The following elements are considered major reservoirs or new conveyance facilities. Final use is discussed in Section 8.3.

8.2.1 Freeport Regional Water Project

The Freeport Regional Water Authority (FRWA) was created by exercise of a joint powers agreement between Sacramento County Water Agency (SCWA) and EBMUD. FRWA's basic project purpose is to increase water service reliability for 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. The Freeport Project will provide up to 85 mgd of surface water to SCWA to be used conjunctively with groundwater to meet future supply needs of central Sacramento County and provide up to 100 MGD to EBMUD in dry years.

In 1970, EBMUD entered into a contract with the USBR for delivery of CVP water from the American River to be taken at Nimbus through the FSC to the Mokelumne Aqueduct. Legal challenges by American River interests culminated in the 1990 ruling of Alameda Superior Court Judge Richard Hodge (Hodge Decision). The Hodge Decision conditioned EBMUD's diversion from Nimbus on maintaining minimum in-stream flow requirements on the Lower American River necessary to protect the fishery. EBMUD continued to work with Sacramento County interests on diversion alternatives that could meet the dry year needs of EBMUD, protect and uphold the National Wild and Scenic Rivers designation of the Lower American River, and provide benefits to the region.

In 1993 the Sacramento Area Water Forum (Water Forum), a diverse group of water interests from the business, agricultural, environmental, citizen, and local government communities, began a collaborative process to devise a comprehensive plan to "Provide a reliable and safe water supply for the region's economic health and planned development to the year 2030, and Preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River." (Water Forum Agreement, 2000) In the context of the Water Forum, EBMUD and Sacramento County successfully developed a project that would move EBMUD's American River Diversion from Nimbus to the Sacramento River near the town of Freeport. In January 2001, EBMUD, Sacramento County interests, and the USBR executed a Memorandum of Agreement to fully explore the engineering feasibility of joint use facilities under the Freeport Project concept.

On July 20, 2001, EBMUD executed an Amendatory Contract with the USBR for water from the American River. Under the terms of the Amendatory Contract, EBMUD is entitled to divert its CVP supply from the Sacramento River only if its March 1st forcast of the expected October 1st total system storage is less than 500,000 af. The Amendatory Contract entitles EBMUD to divert up to 133,000 af in any one year and no more than 165,000 af total in any three-consecutive year period. While the Amendatory Contract allows for the diversion of up to

133,000 af in any one year, the diversion and transmission system is sized to convey no more than 112,000 af annually to the Mokelumne Aqueducts. Hydrologic records predict that the condition is expected to occur 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:

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

The total preliminary cost of the Freeport Project is estimated at $690 million, $439 million of which will be funded by EBMUD (Freeport Regional Water Authority Website, 2004). Additional operations and maintenance costs are estimated to be approximately $130 per af. (Williamson, 2003)

In August 2003, the FRWA released the Freeport Regional Water Project (Freeport) Draft Environmental Impact Report/Environmental Impact Statement DEIR/EIS. The Freeport DEIR/EIS discloses potential environmental impacts of various alternatives to the Freeport Project. The preferred Freeport Project Alternative is depicted in Figure 8-3. The Final EIR/EIS was released in March 2004 and was certified on April 15, 2004. Construction of the intake and EBMUD portion of the Freeport Project is set to begin in 2007 and be completed in 2009 (Freeport Regional Water Authority Website, 2004).

Following the execution of the amendatory contract with the USBR, over 100 agencies served by the State Water Project (SWP) and CVP opposed the concept of EBMUD diverting water from the Delta in dry years. In 2003 State and Federal Contractors agreed to drop all but one suit and have pledged support for the Freeport Project through its construction. The terms of the settlement included provisions to include the EBMUD Amendatory Contract as an export under the Coordinated Operations Agreement. The settlement reduces the water supply impacts to the State and Federal Contractors. A separate settlement with the Santa Clara Valley Water District (SCVWD) would defer 6,500 af of EBMUD's diversion entitlement during the 1st year of a drought. Should the drought continue into a 2nd consecutive year, SCXWD would make available a like amount for EDMUD to divert.

On January 27, 2004, Contra Costa Water District (CCWD) became the last CVP Contractor to settle litigation against the Freeport Project. Under the terms of the settlement, the FRWA would use the joint Freeport project facilities to wheel up to 3,200 af per year under an existing CCWD CVP contract to the Los Vaqueros Reservoir near Brentwood. The settlement terms would offset the effects of lower quality water at the Los Vaqueros Reservoir intake in the Delta in years when EBMUD is diverting through the Freeport Project. The settlement with CCWD is the first allocation of EBMUD's unused capacity in the Freeport Project (California Water Law and Policy, 2004).

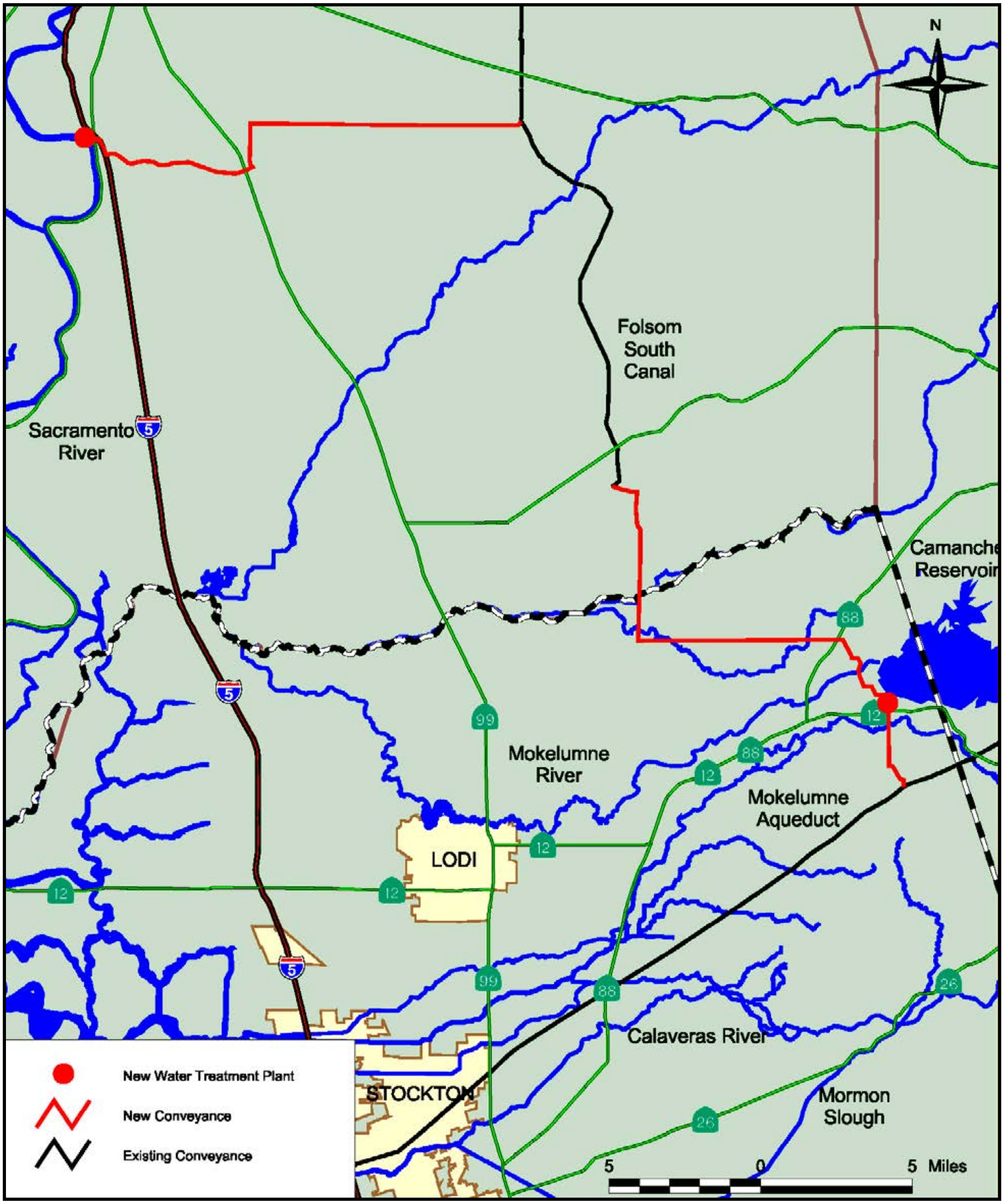


Figure 8-3 Freeport Regional Water Project
Source: Freeport Regional Water Authority at http://www.freeportproject.org

Assuming the Freeport Project is utilized by EBMUD in one-third of all years and the County is able to secure a wet-year water right on the American River, the maximum annual diversion amount would be approximately 65,000 af/yr at an average annual yield of 44,000 af/yr. The Water Availability Study suggests that in years when EBMUD is not utilizing the Freeport Project, the full amount will be available to the Authority under the County Water Right. Additional supplies obtained through third party groundwater banking and water transfers could also increase the yield to the Authority.

8.2.2 MORE WATER PROJECT

In 1990 the Mokelumne River Water and Power Authority (MRWPA) filed a water right application with the SWRCB for unappropriated wet year flows on the Mokelumne River. The application cited three alternatives for the capture of water at 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, or through direct diversions off the Lower Mokelumne River between Camanche Reservoir and Interstate 5. The classic alternatives are collectively known as the Mokelumne River Regional Water Storage and Conjunctive Use Project (MORE WATER Project).

The MRWPA filed an additional water right application for power generation at the proposed Middle Bar Dam with an estimated power generation capacity of approximately 85 megawatts (MW) per year. The MRWPA also obtained 3 consecutive Preliminary Permits from the Federal Energy Regulatory Commission (FERC) for the proposed Middle Bar Dam alternative. The fourth consecutive Preliminary Permit, obtained for the proposed Duck Creek Reservoir alternative on January 22, 2004, is current for a period of three years through December 2006. The Preliminary Permit protects the MRWPA's priority to study the power generation potential of the proposed Duck Creek Reservoir (FERC, 2004).

In 2003 the MRWPA retained the services of HDR, Inc. in order to fully evaluate the engineering feasibility of the MORE WATER Project and devise and implement a strategy that would satisfy the requirements of CEQA, NEPA, the Water Right Applications, and all applicable permits. Funding for HDR services have come from contributions by the City of Stockton, the City of Lodi, and the MRWPA. The Authority is also looking to secure funding assistance through the Congressional appropriations process, State grants, and other interested agencies.

In May 2004, the MRWPA completed Phase I – Reconnaissance Study of the MORE WATER Project. Phase I evaluated all historic information available regarding the water right applications, the FERC filings, Mokelumne River hydrology, and any past studies done on the classic alternatives. From the information gained, the classic alternatives and other alternatives meeting the MORE WATER Project purpose and need were conceptualized and evaluated. The following alternatives were considered in Phase I:

- Pardee Dam and Reservoir Replacement/Enlargement
- Middle Bar Dam and Reservoir
- Mokelumne River Storage System Re-operation
- Devil's Nose Dam and Reservoir Construction
- Duck Creek Reservoir – Pardee Diversion
- Duck Creek Reservoir – Camanche Diversion

- South Gulch Dam and Reservoir with New Hogan Reservoir and Pardee Diversion
- Alliance Canal
- Lower Mokelumne River Diversions – Structural and Non-Structural

The list of alternatives was further reduced by eliminating projects too contentious to implement under the current regulatory and political climate. The historic Middle Bar Dam and 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 Devil's Nose Dam was also eliminated from further consideration likewise due to the impacts on pristine up-county areas. The remaining alternatives were ranked based on a variety of factors weighing the benefits and likelihood of implementation. Table 8-3 shows the weighed screening criteria and evaluation results. The top five ranking alternatives will be carried forward and further explored in a detailed engineering feasibility analysis as part of the next phase of the MORE WATER Project and are described below.

Table 8-3 MORE WATER Project Alternatives Screening Results

Weight	**0**	**3**	**3**	**1**	**2**	**1**	**5**		
ALTERNATIVE	**Cost per acre-foot**	**Regulatory Feasibility**	**Political Feasibility**	**Financial Feasibility**	**Environmental Feasibility**	**Water Quality**	**Benefits Achieved**	**Sum Product**	**Relative Ranking**
Duck Creek Dam - Pardee Reservoir Diversion	H	M	M	H	M	H	H	37	1
Duck Creek Dam - Camanche Reservoir Diversion	H	M	M	H	M	H	H	37	2
Lower Mokelumne River Diversions-Non structural	L	H	H	H	H	H	L	35	3
Lower Mokelumne River Diversion-Structural	L	M	H	M	M	H	M	34	4
Mokelumne River Storage System Re-operation	L	H	M	M	H	H	L	31	5
New Hogan Reservoir Diversion with South Gulch Dam Reservoir Construction	H	L	M	M	M	H	M	29	6
Pardee Dam and Reservoir Replacement/Enlargement	M	L	L	M	L	H	H	28	7

Cost: Relative cost per acre-foot for each alternative. High = $$$ per af. Medium = $$ per af. Low = $ per af
Regulatory Feasibility: High: Good chance for regulatory support (i.e., regulatory agency concurrence). Medium: Moderate chance for legal support. Low: Low chance for support (i.e. regulatory agencies opposed).

Political Feasibility: High: Good chance for political support (i.e., elected officials/powerful interest groups support). Medium: Moderate chance for political support. Low: Low chance for support (i.e. elected officials/powerful interest groups opposed).

Financial Feasibility: High: High chance for financing partners outside of the Authority. Medium: Moderate chance for partners. Low: Low chance for partners outside of the Authority.

Environmental Feasibility: High: Limited environmental impacts that can be mitigated to level of insignificance. Medium: Adverse environmental impacts that can be mitigated. Low: Adverse environmental impacts that cannot be mitigated.

Water Quality: High: No effect to downstream or County users. Medium: Potential effect to downstream users that can be mitigated. Low: Adverse effect to downstream or County users.

Benefits Achieved: High: High Yield Medium: moderate yield. Low: low yield.

NOTE: Sum Product = high, medium, low ranking of 3,2, and 1 respectively, multiplied by weighted factor (ranging form 1 to 5) for each screening criterion.

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

Mokelumne River Storage System Re-operation

This alternative includes re-operating Pardee Dam and Reservoir, Camanche Dam and Reservoir, and 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 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.

Duck Creek Reservoir (Pardee or Camanche Diversions)

The proposed Duck Creek Reservoir is an off-stream reservoir located in Eastern San Joaquin County in the Duck Creek watershed which drains into the Calaveras River at 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 coffer dams to the west. The optimal size of the reservoir will be determined in the engineering feasibility study. Figure 8-4 is the elevation-area-capacity curve for the proposed Duck Creek Reservoir.

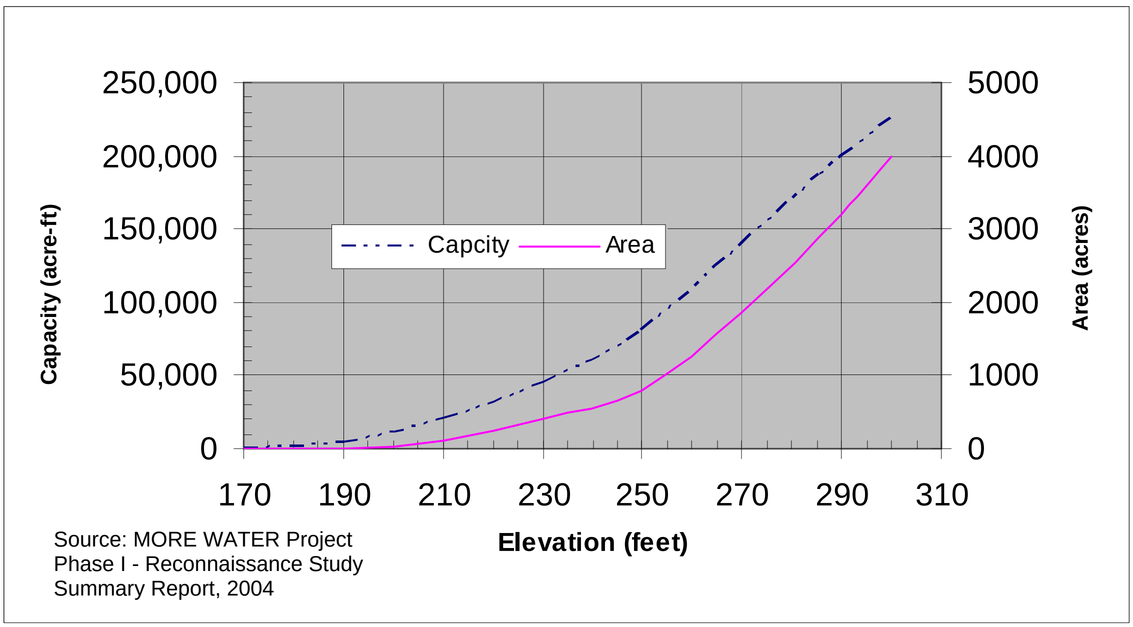


Figure 8-4 Duck Creek Reservoir Elevation-Area-Capacity Curve

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 Figure 8-5 and Figure 8-6, respectively. A diagram of the Camanche Reservoir alternative is shown in Figure 8-7, and a diagram of the proposed reservoir is shown in Figure 8-8. 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 Regulated releases from

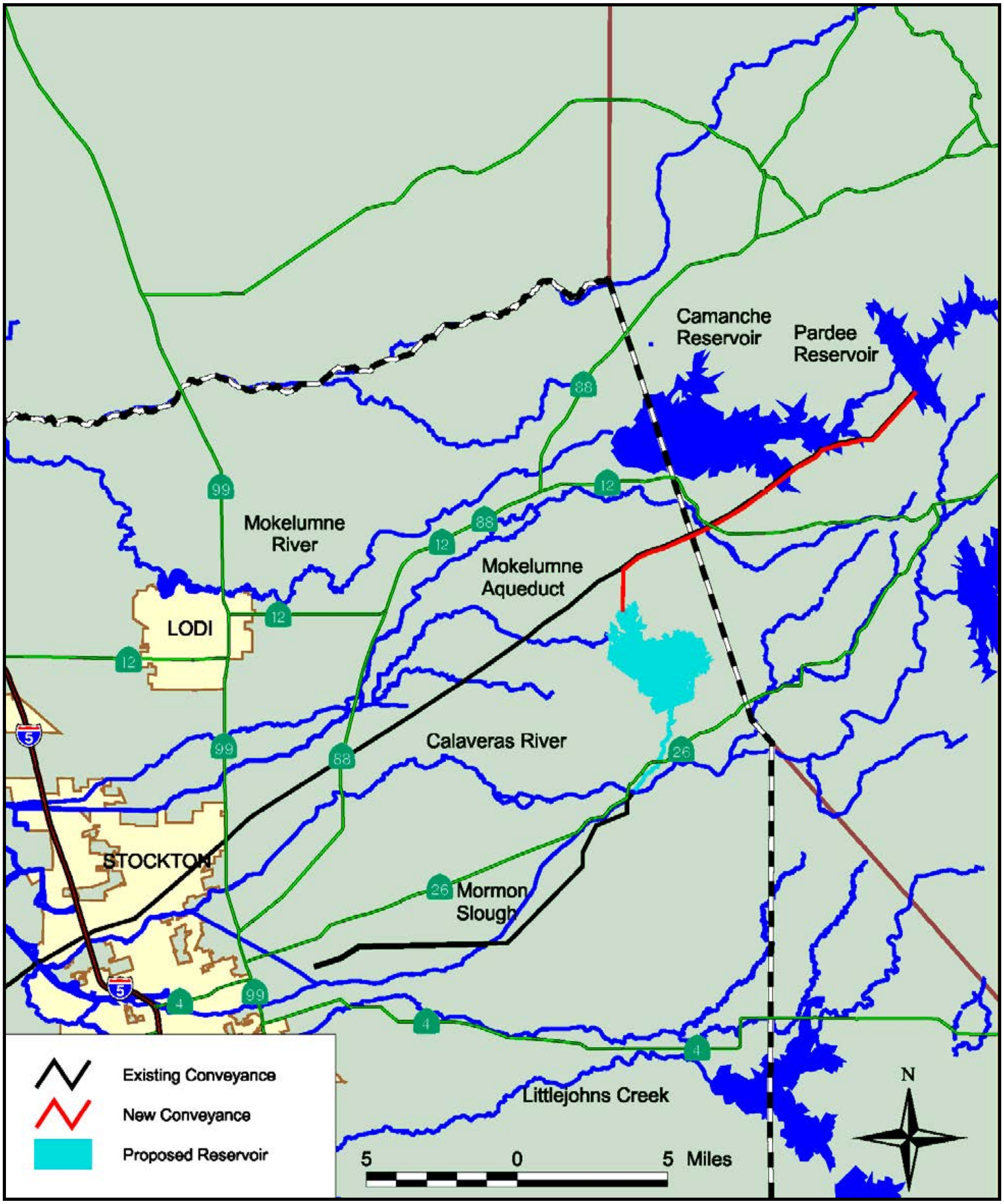


Figure 8-5 Duck Creek from Pardee Reservoir

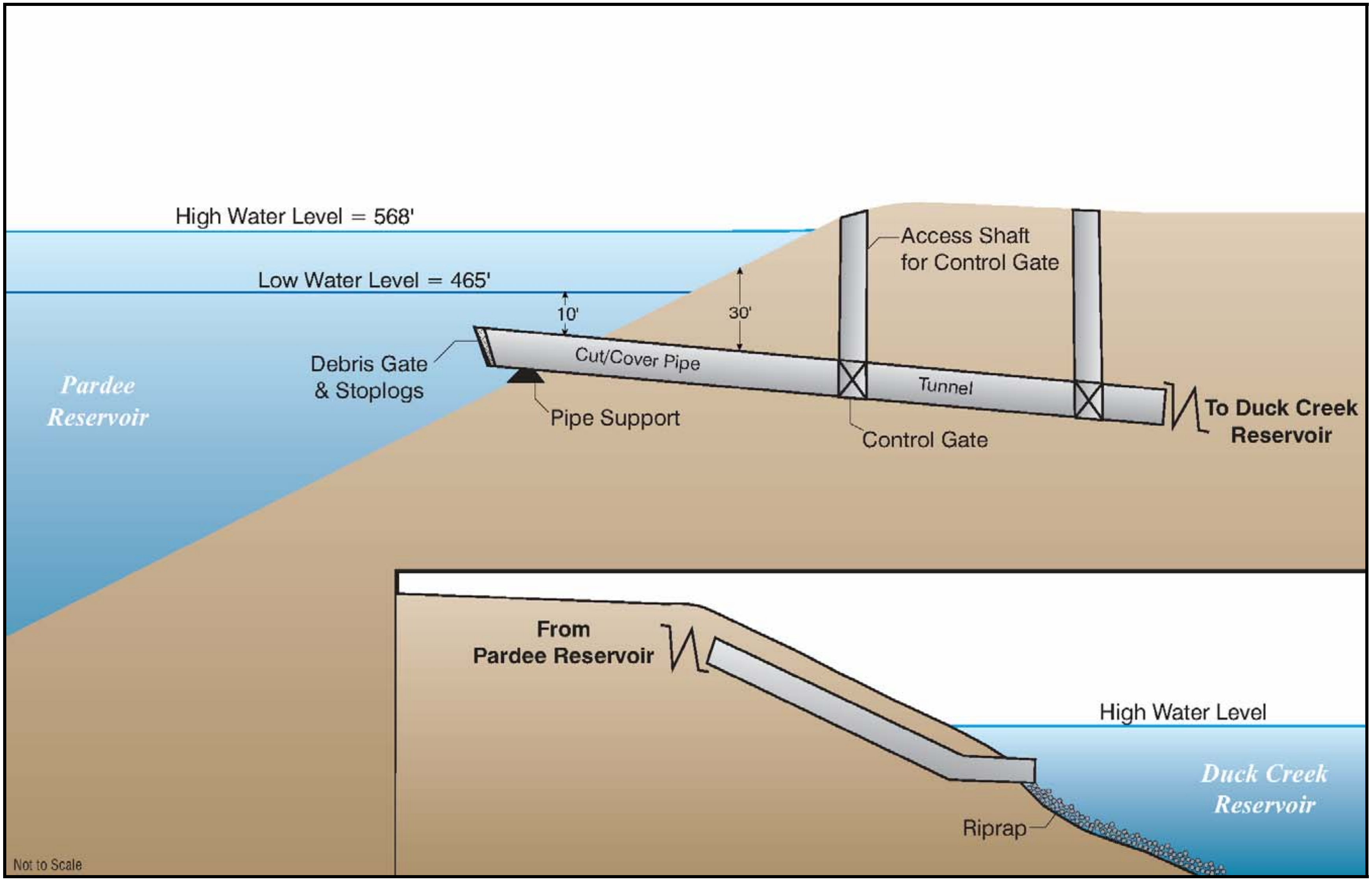


Figure 8-6 Duck Creek from Pardee Reservoir Inlet and Outlet Diagram
Source: HDR, Inc.

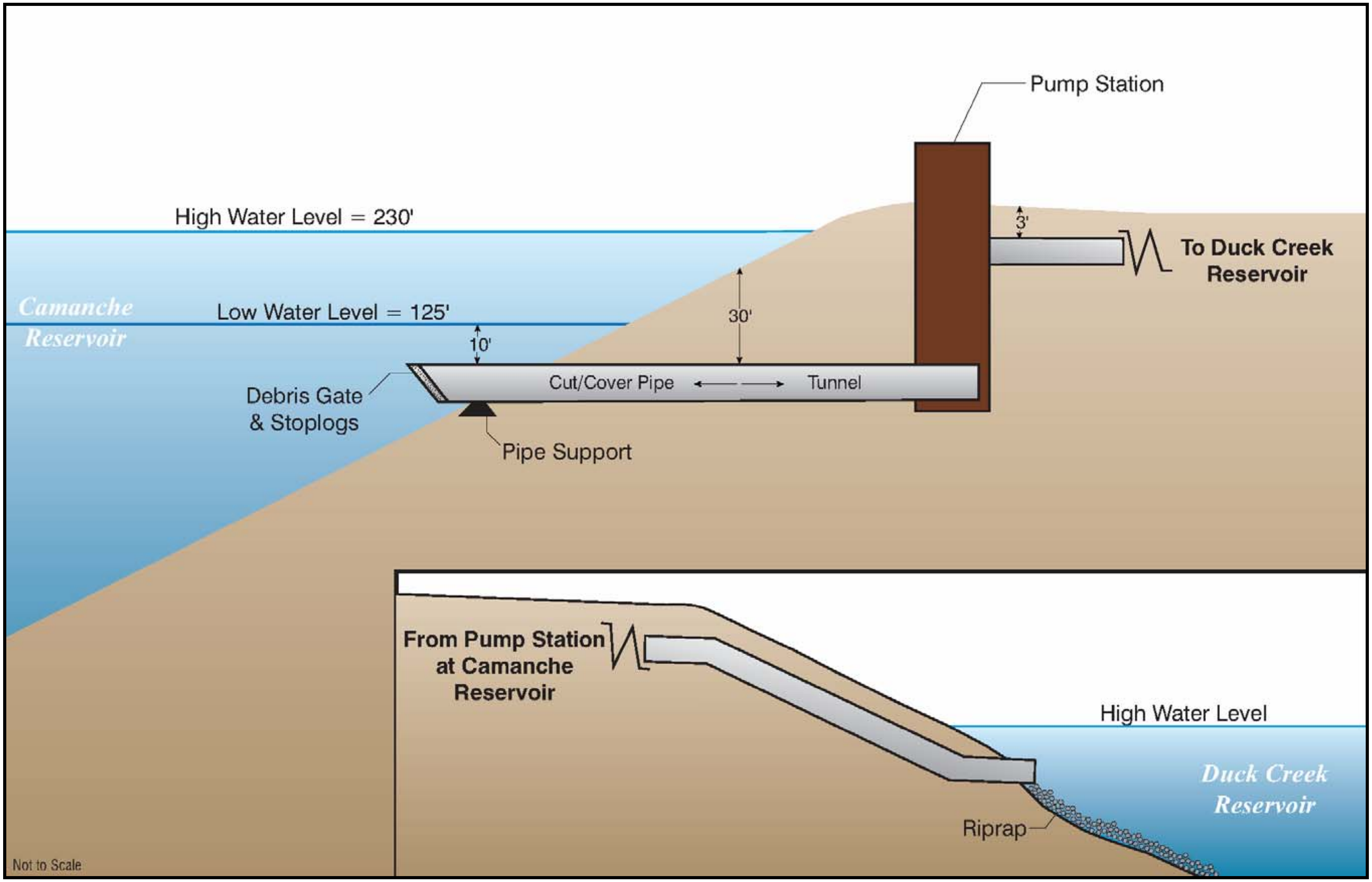


Figure 8-7 Duck Creek from Camanche Reservoir Inlet and Outlet Diagram
Source: HDR, Inc.

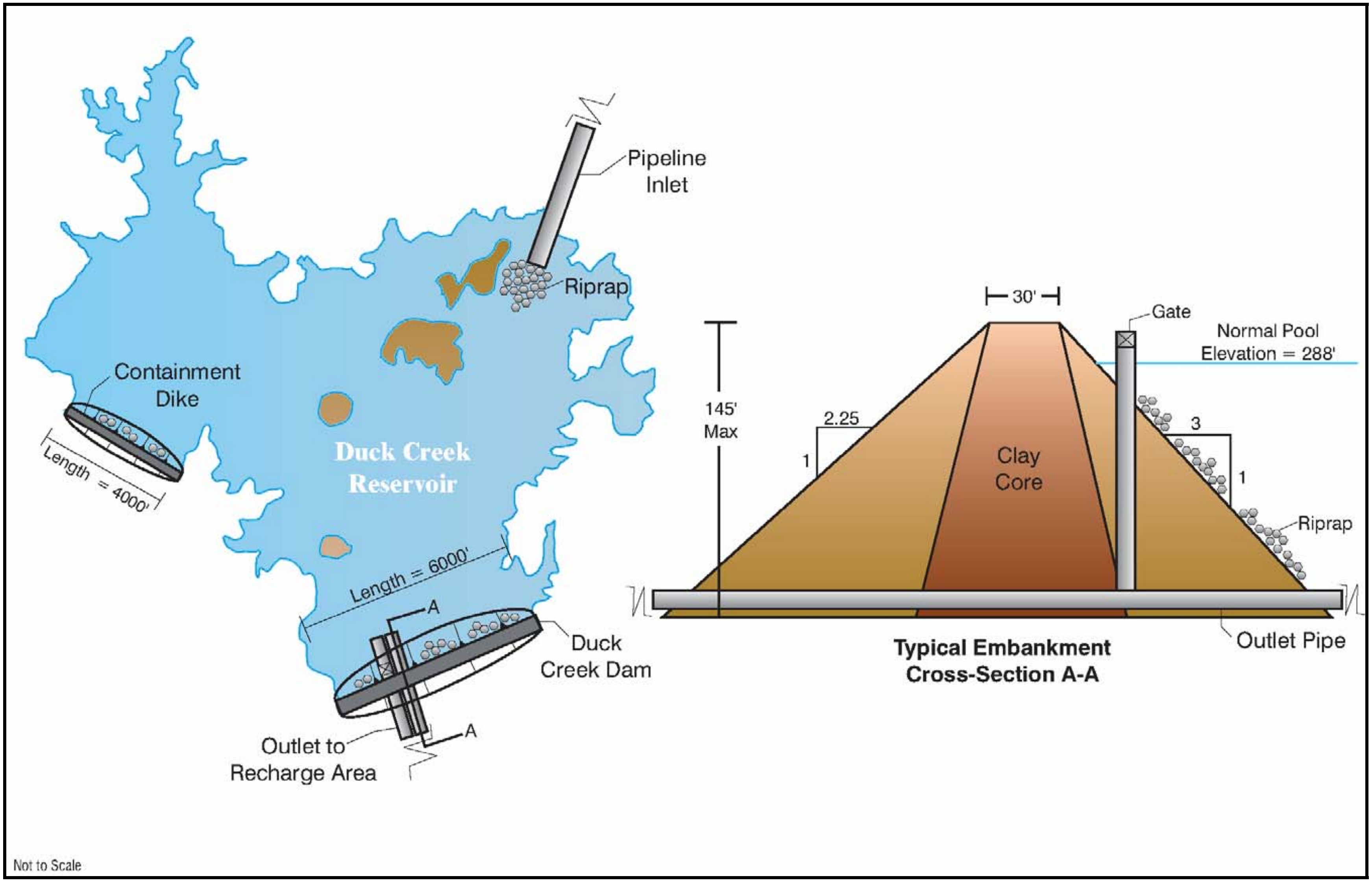


Figure 8-8 Proposed Duck Creek Reservoir Diagram
Source: HDR, Inc.

the Reservoir to 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. Evaporation is potentially a major concern for shallow large surface area reservoirs; however, the operation of the proposed Duck Creek Reservoir would completely drain Duck Creek Reservoir to maximize use in anticipation for the next season's divertible flows. Evaporation rates for the duck creek area are shown in Figure 8-9.

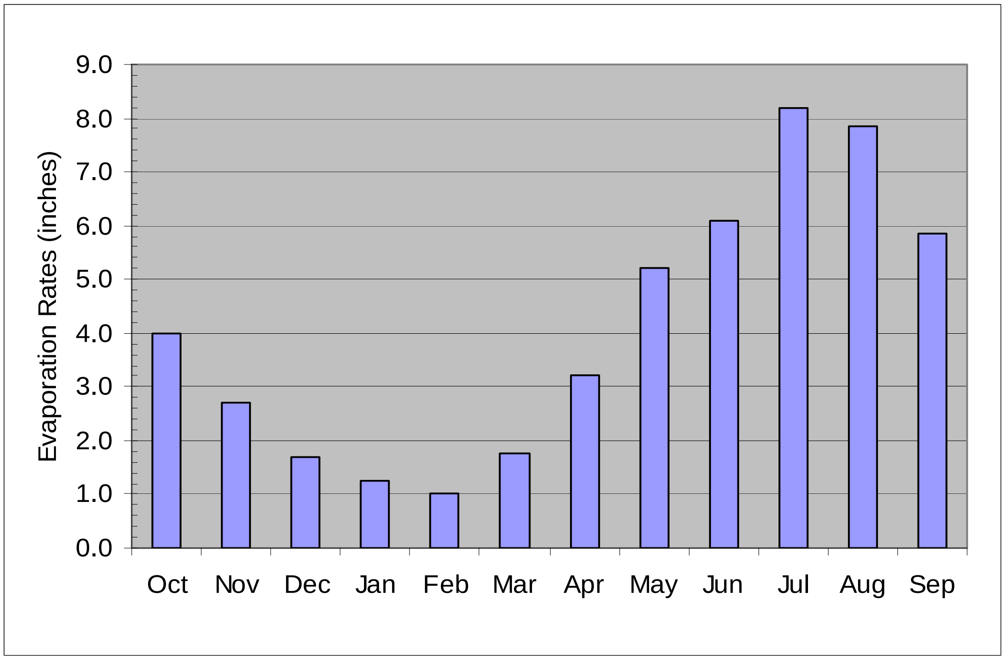


Figure 8-9 Duck Creek Reservoir Evaporation Rates

Lower River Diversions – Non-Structural and Structural

The water right application 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. Additionally, the new Woodbridge Dam when completed will be able to supply the WID canal system 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. A diagram of the structural lower river diversion schematic can be seen in Figure 8-10.

During the course of Phase I, numerous agencies from the regulatory community warned that the MRWPA would be vulnerable to legal opposition because other less environmentally damaging alternatives to reversing the historic overdraft in Eastern San Joaquin County (i.e. agricultural and urban water conservation, water recycling, tiered water rate systems, etc.).

To evaluate the alternatives carried forward, the MRWPA developed the MORE Model of the Mokelumne River System based on the EBMUDSIM proprietary software package. Figure 8-11 is a schematic of the MORE Model. The MORE Model preliminary yield and cost estimates are presented in Table 8-4.

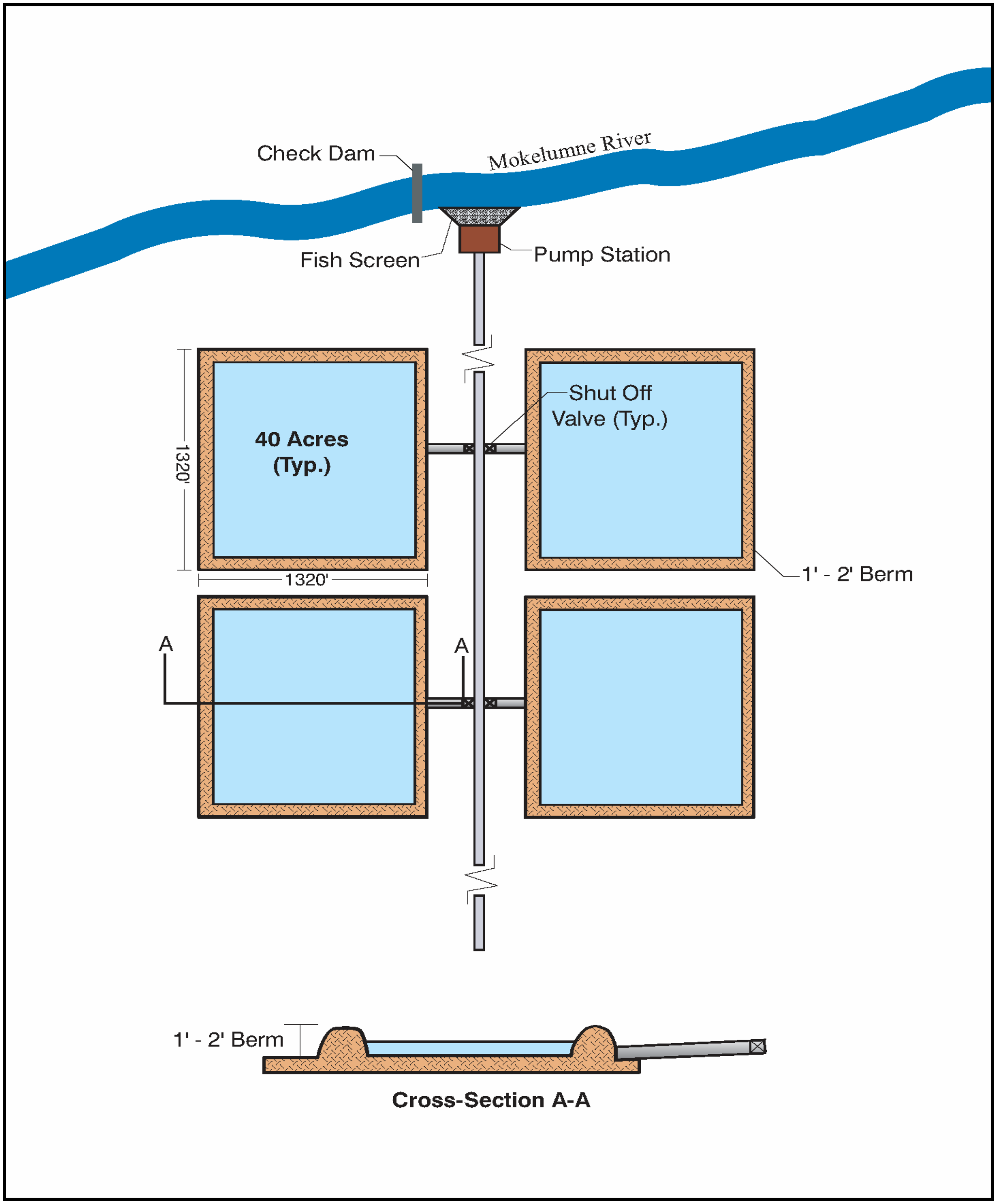


Figure 8-10 Structural Lower River Diversion Schematic
Source: HDR, Inc.

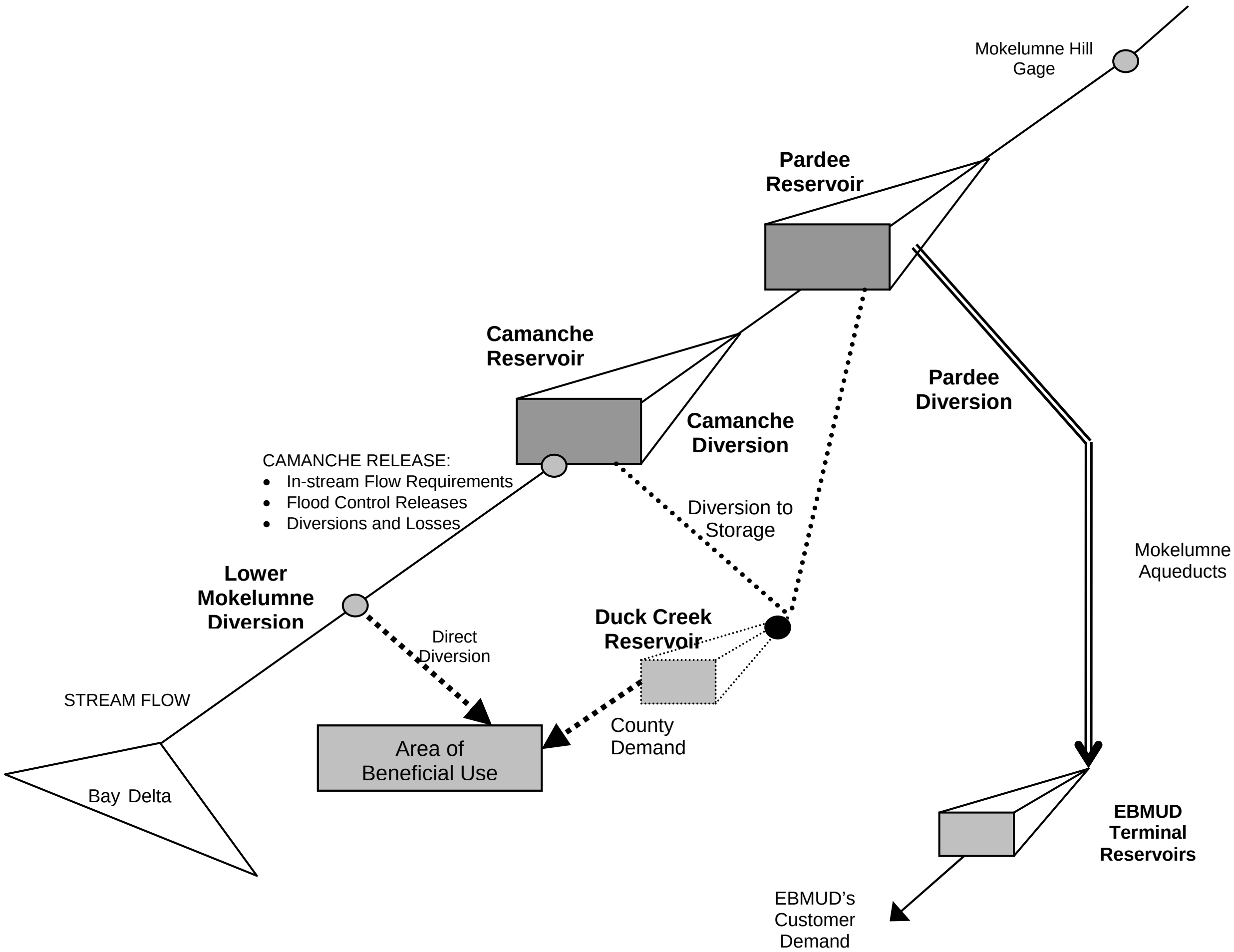


Figure 8-11 Schematic Diagram of the MORE Model

Table 8-4 MORE WATER Project Preliminary 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

8.2.3 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 customers in the City of Stockton. Figure 8-12 illustrates the 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 Canal 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 a proposed addition to the New Melones Conveyance System. The Peters Pipeline is a 6-mile, 60-inch diameter pipeline that will be located parallel to the existing 54-inch diameter Bellota Pipeline from the 78-in pipeline at Mormon Slough to the Water Treatment Plant. Figure 8-13 illustrates the proposed Peters Pipeline route. Water conveyed in Peters Pipeline will be used to increase the delivery capacity at the SEWD Water Treatment Plant. 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 af/yr. The total cost of the Peters Pipeline Project is $7,401,260. SEWD has been selected to receive a Proposition 13 grant for 50% of the project cost. Local cost share for the Peters Pipeline Project will come from available funds of the New Melones Conveyance Project.

8.2.4 South County Water Supply Program

The South County Water Supply Program (South County Program) is a cooperative effort between SSJID and the cities of Escalon, Manteca, Lathrop, and Tracy. The goals of the South County Water Supply Program are to:

1. Provide a safe and reliable supplemental water supply for South San Joaquin County;
2. Put to beneficial use conserved water from SSJID entitlements;
3. Keep conserved water within SSJID and San Joaquin County; and
4. Reduce the heavy reliance on groundwater for the urban areas of South San Joaquin County.

As previously noted, 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 can be seen in Figure 8-14. Phase I of the South County Program will serve up to

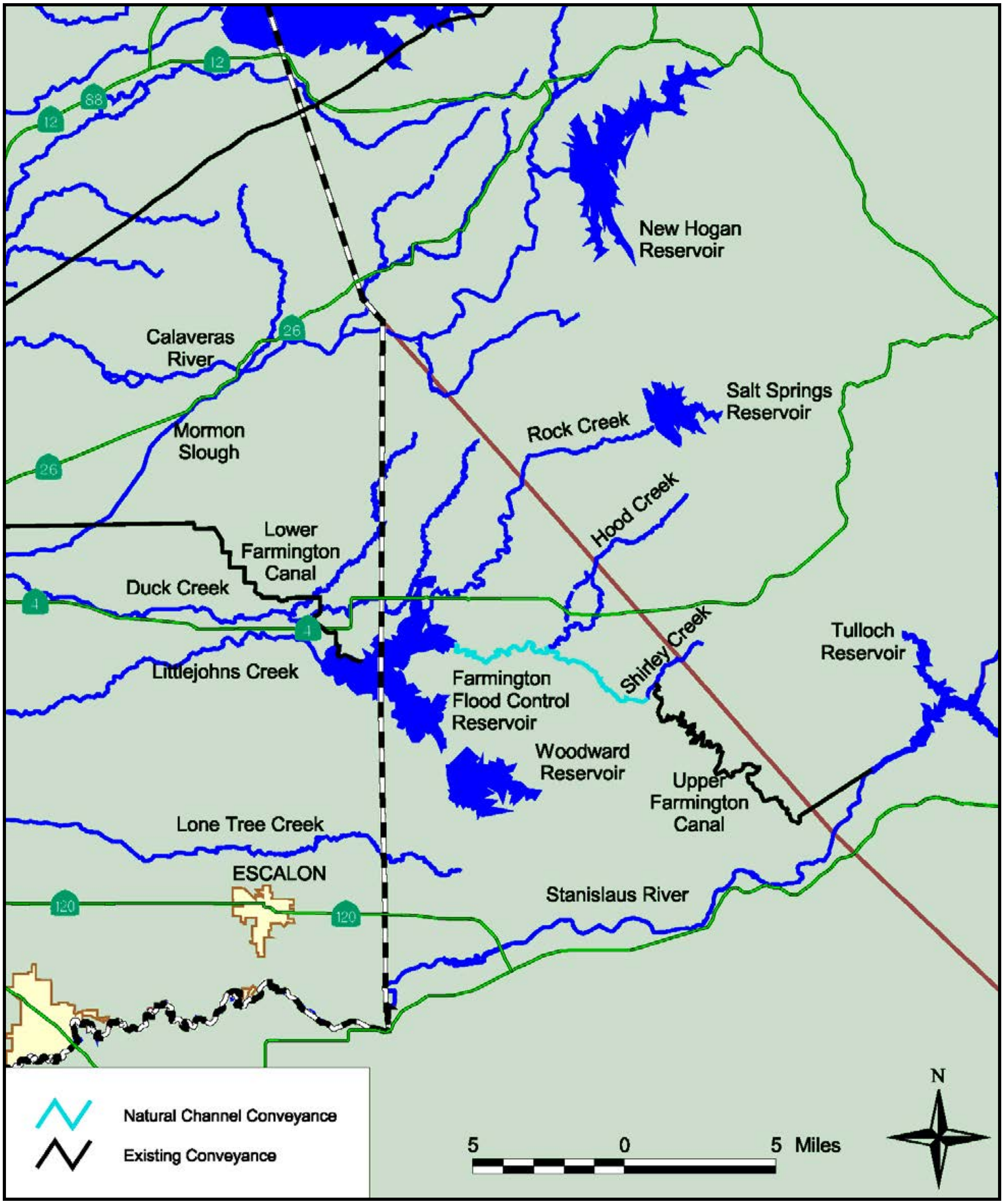


Figure 8-12 New Melones Conveyance System
Source: Farmington Groundwater Recharge/Seasonal Habitat Study, 2001

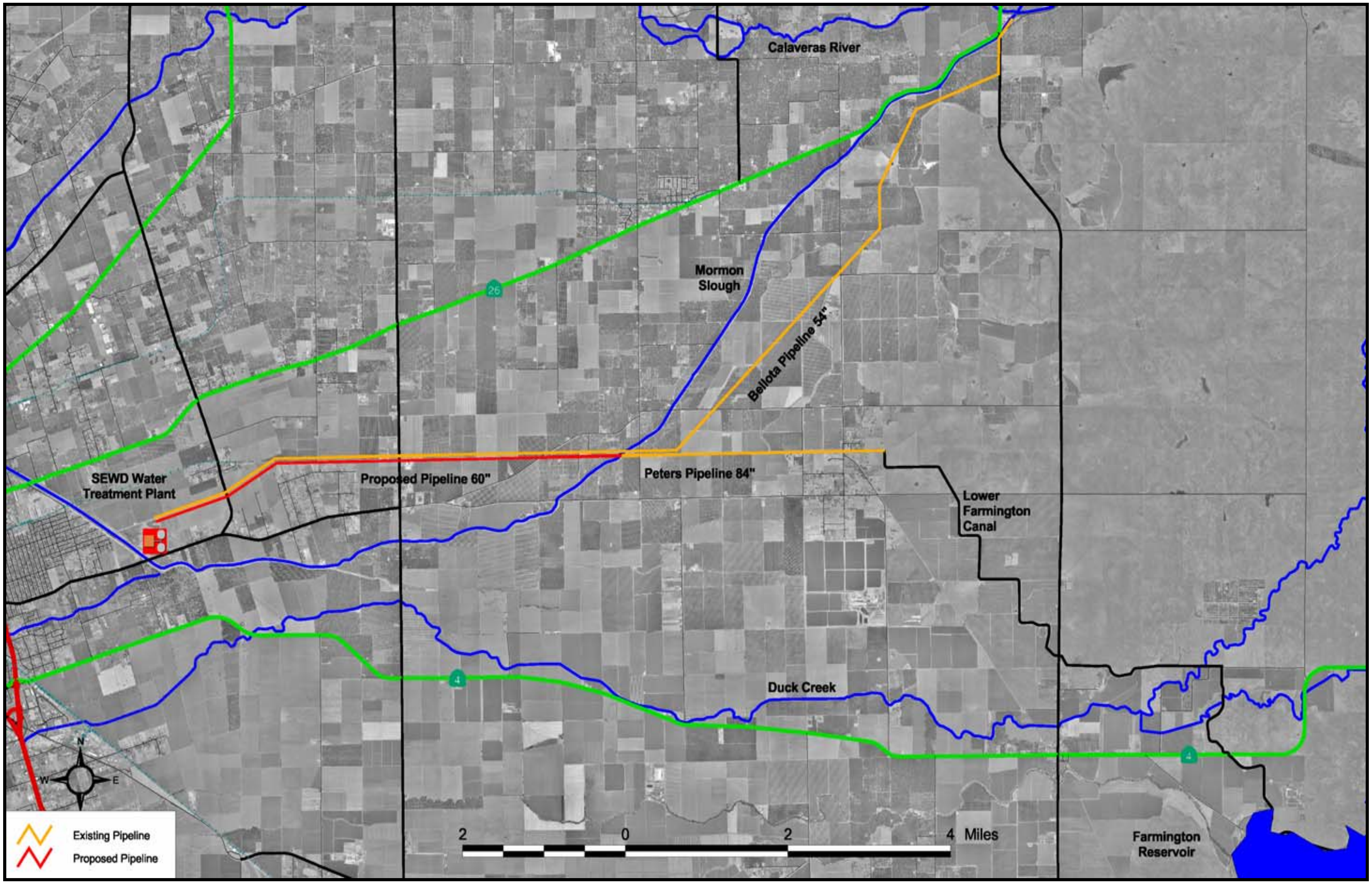


Figure 8-13 Proposed Peters Pipeline Alignment
Source: Farmington Groundwater Recharge/Seasonal Habitat Study, 2001

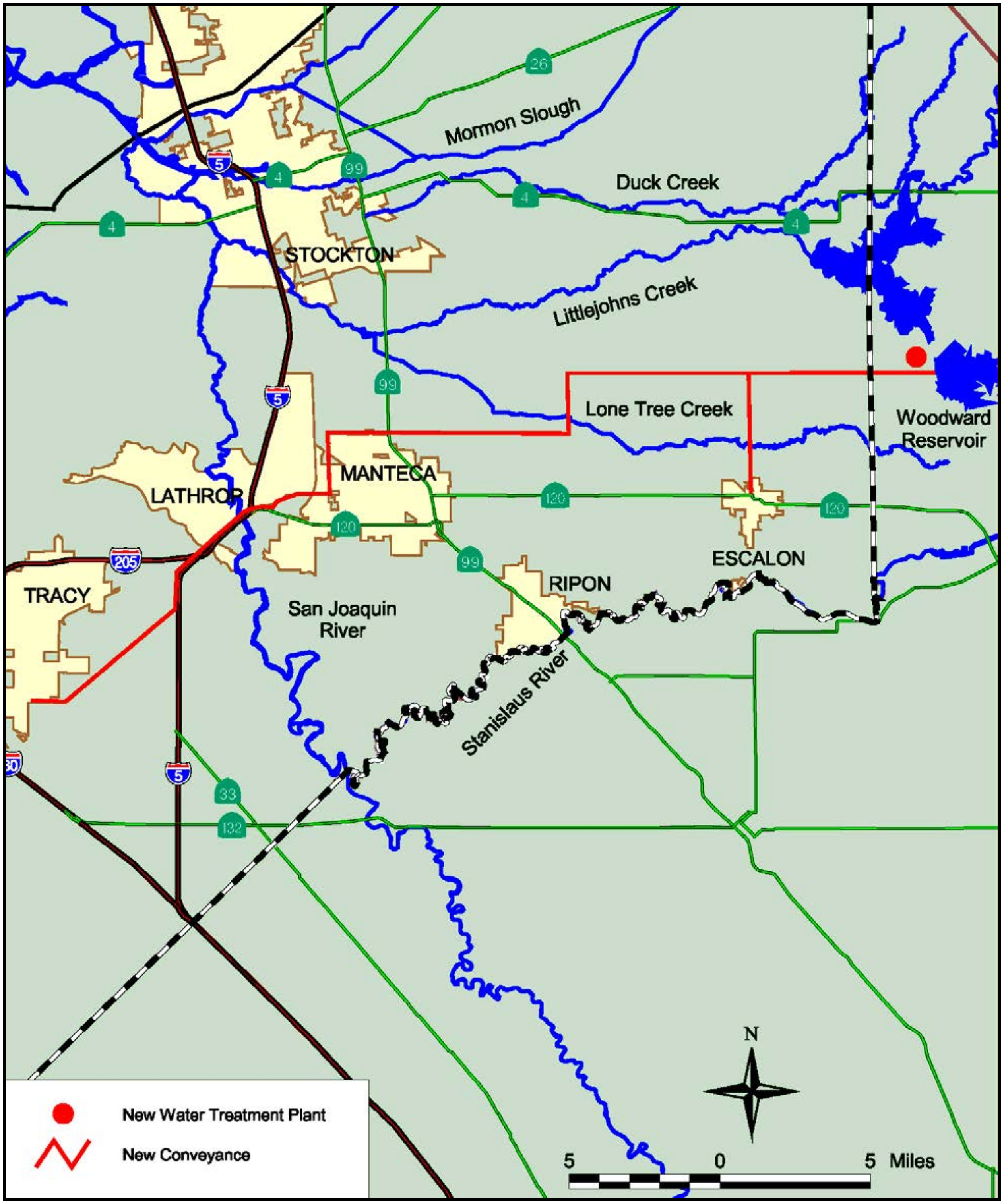


Figure 8-14 South County Water Supply Project
Source: SSJID, 2003

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).

8.2.5 Woodbridge Dam Replacement and Canal System

The Woodbridge Diversion Dam (Woodbridge Dam) is 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 8-15. The Woodbridge Dam itself is 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).

In 2000, WID completed the Lower Mokelumne River Restoration Program Final EIR/EIS for new improved fish passage facilities. The project 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. 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 proposed 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. (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 af/yr 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, groundwater recharge, or injection. (http://www.lodi.gov/city-council/html/body_2003-03-11s.htm, 2003)

8.2.6 Eastern Water Alliance Canal

The Eastern Water Alliance Canal is essentially a locally driven completion of the Folsom South Canal. In concept, 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 8-116. The Alliance Canal would facilitate water transfers and the diversion of wet year flow to the recharge basins and irrigated lands throughout Eastern San Joaquin County. 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. Preliminary discussions have suggested that a canal 300-feet wide 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

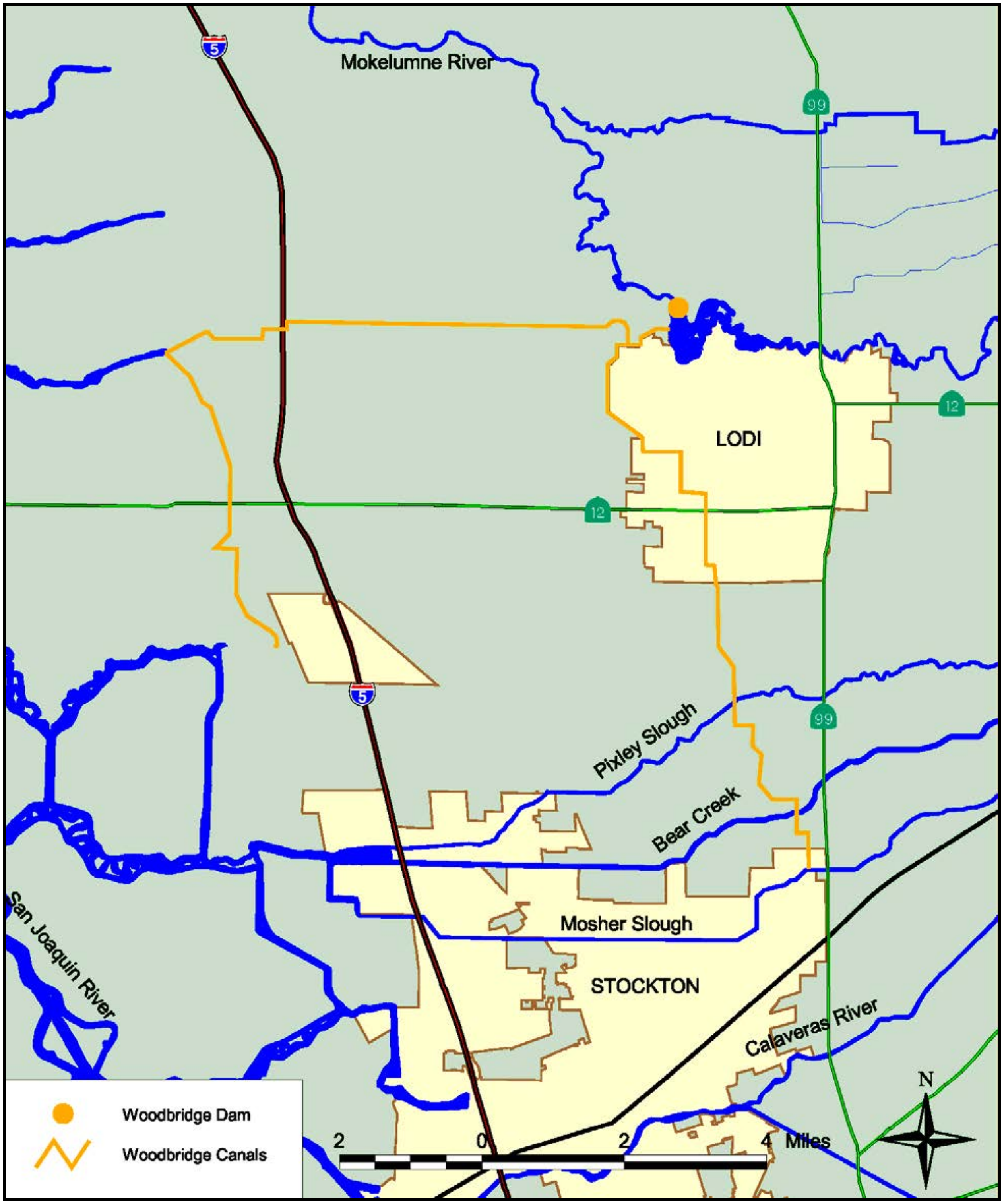


Figure 8-15 Woodbridge Irrigation District Diversion Dam and Canal System

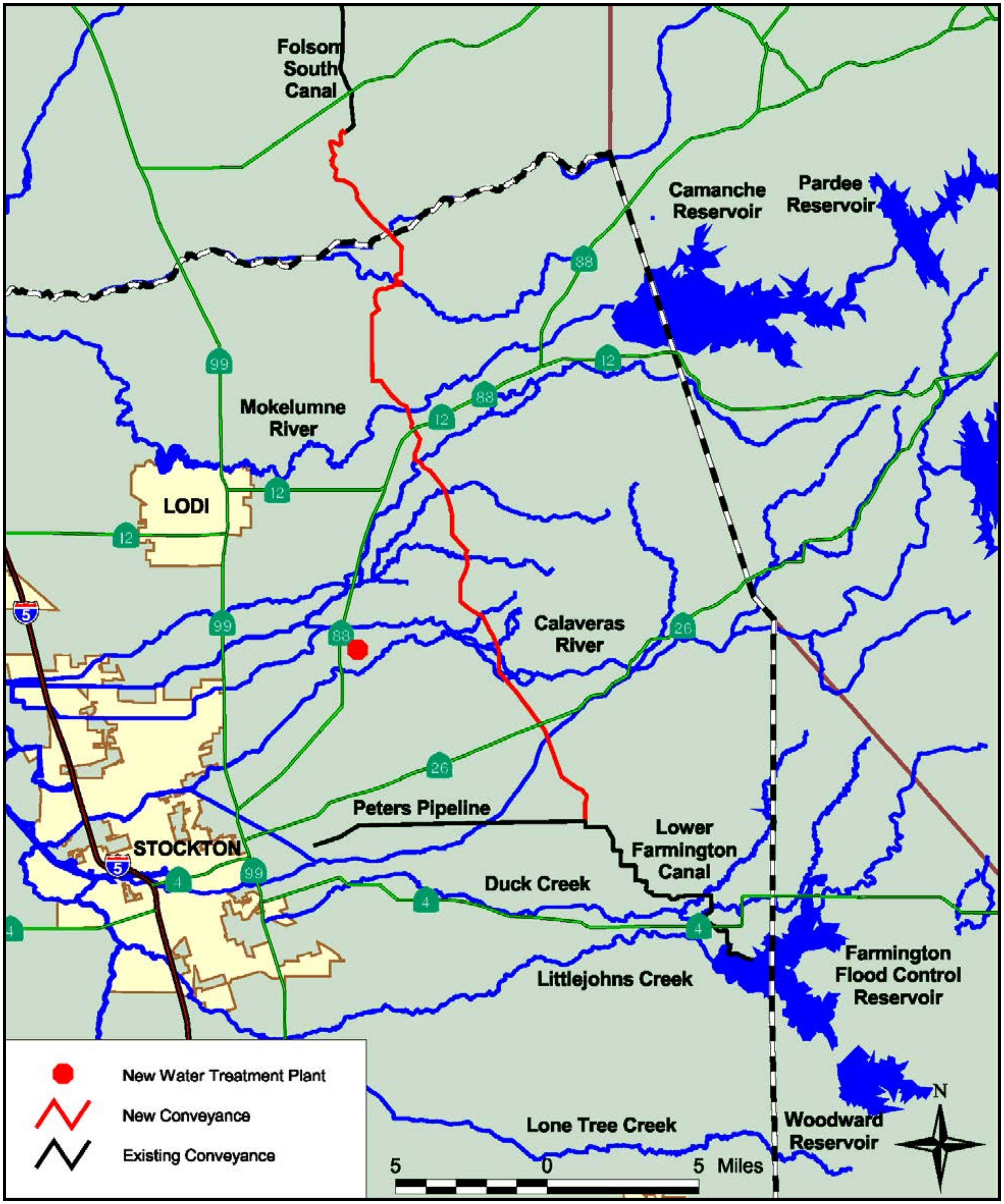


Figure 8-16 Alliance Canal Alignment

Mokelumne River to the Lower Farmington Canal would cost approximately $15 to $20 million (SEWD, 2000).

8.2.7 Gill Creek and Woodbridge Road Flood Control Improvements

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 including infill or disking of natural drainage ways, changes in land use, rural residential development, and undersized culvert crossings and pump stations. Historically, the proposed solution focused on increased channel capacities along Gill Creek; however, current regulations regarding down stream 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 8-17. 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 (San Joaquin County Department of Public Works, 2004).

8.2.8 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, California, 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 storage capacity of 130,000 to 180,000 af. In conjunction with the construction of the South Gulch Dam, the Upper Farmington Canal would be completed to supply excess water from the Stanislaus River. Additionally, a diversion structure on the Calaveras River just down stream of New Hogan Reservoir would convey excess water to the proposed South Gulch Reservoir in wet years. A map of the proposed reservoir can be seen in Figure 8-18. The project is one of the key proposed facilities of the Eastern Water Alliance. (Aqua Resources, Inc. *et al*, 1984)

8.2.9 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

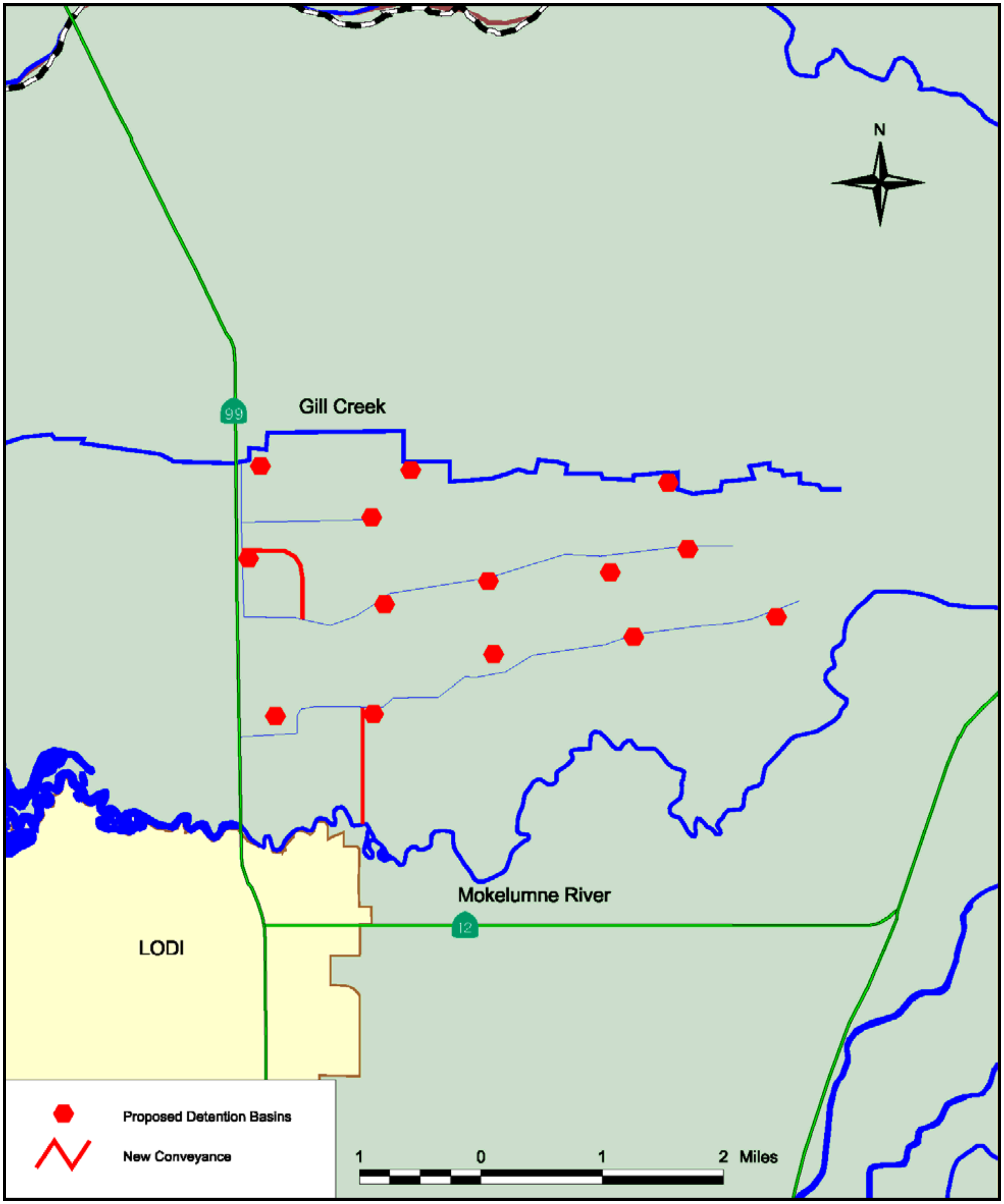


Figure 8-17 Gill Creek and Woodbridge Road Flood Control Improvements
Source: San Joaquin County Department of Public Works, 2004

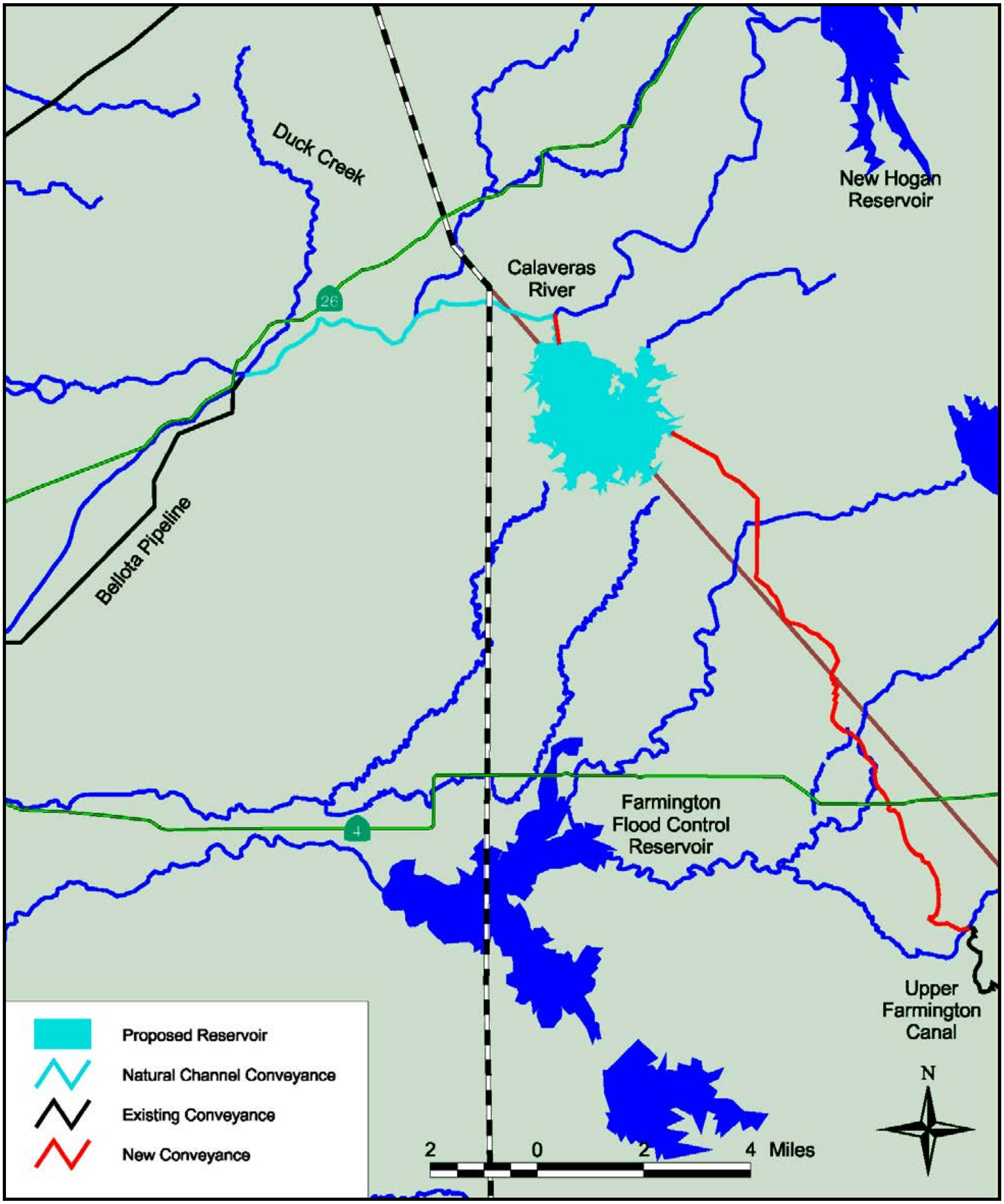


Figure 8-18 Proposed South Gulch Reservoir
Source: Aqua Resources, Inc. *et al*, 1984

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 (http://www.tuolumneutilities.com/uwmp.pdf, 2000).

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 8-19. SEWD has expressed interest in partnering with TUD for supplemental water supplies from the Lyons Reservoir enlargement (http://www.cserc.org/news/newsletter/2003winter/Lyons.html, 2003).

8.3 Groundwater Recharge Components

For planning purposes, the following descriptions represent the final use of water. The components include groundwater recharge infrastructure and improvements, drinking water treatment facilities, and agency conjunctive use programs.

8.3.1 Farmington Program

In 1997, the 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 Eastern San Joaquin County.

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 Eastern San Joaquin County. 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 8-20. The Farmington Study also explored the feasibility of various recharge techniques and concluded that the most efficient method of groundwater recharge in Eastern San Joaquin County is the use of field flooding, recharge basins, and excavated pits. Each method varies in average water depth from a few inches to several feet. Figure 8-21 illustrates the various methods of recharge used in the Farmington Program. Existing structures and improvements such as flood detention basins, quarry excavations, canals, and clarifiers can also be easily modified and incorporated in to the project.

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 af/yr. In February of 2004, the pilot project was named the Water/Environment Project of the Year, 2003, by the American Society of Civil Engineers.

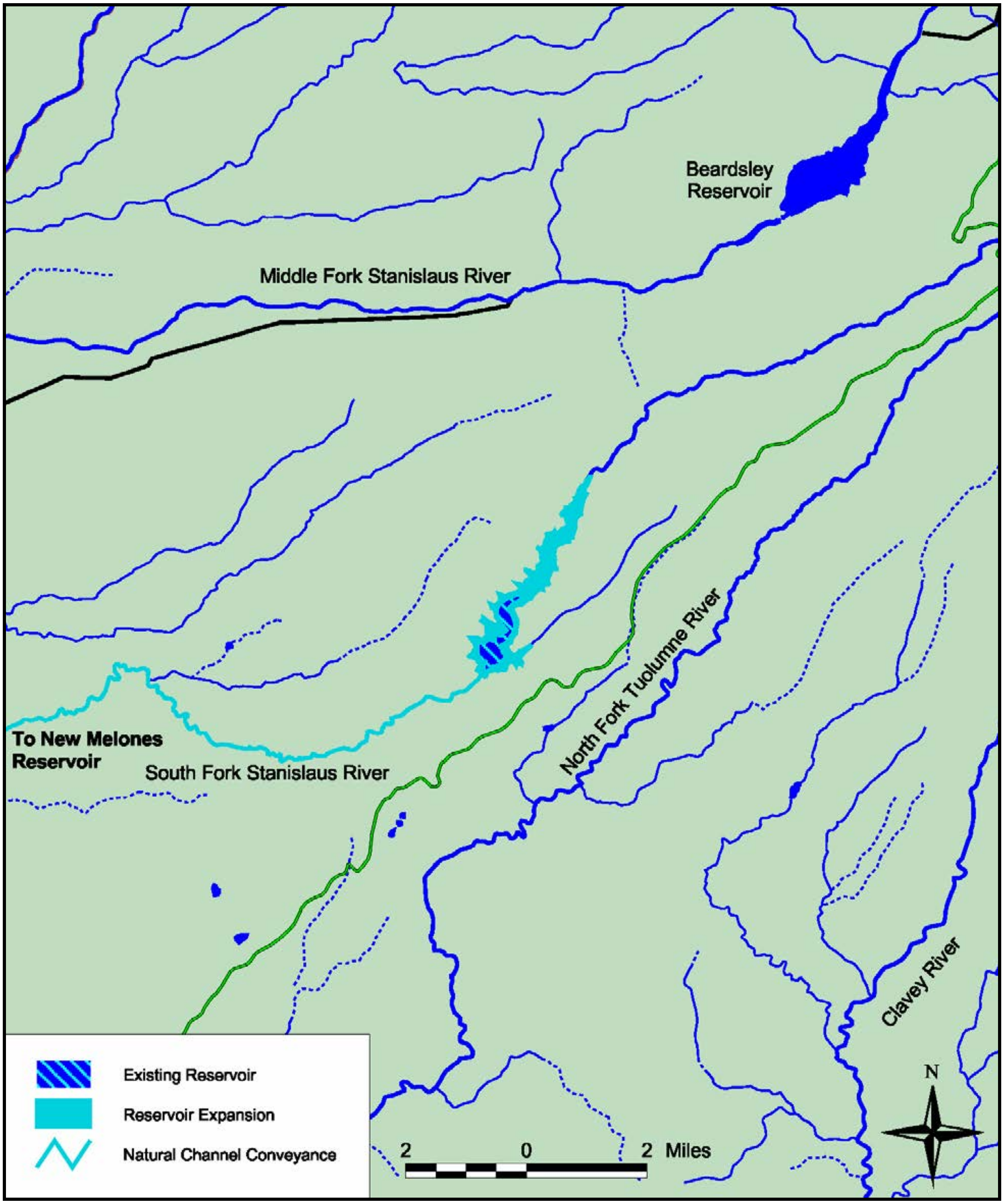


Figure 8-19 Lyons Reservoir Expansion
Source: http://www.tuolumneutilities.com/uwmp.pdf, 2000

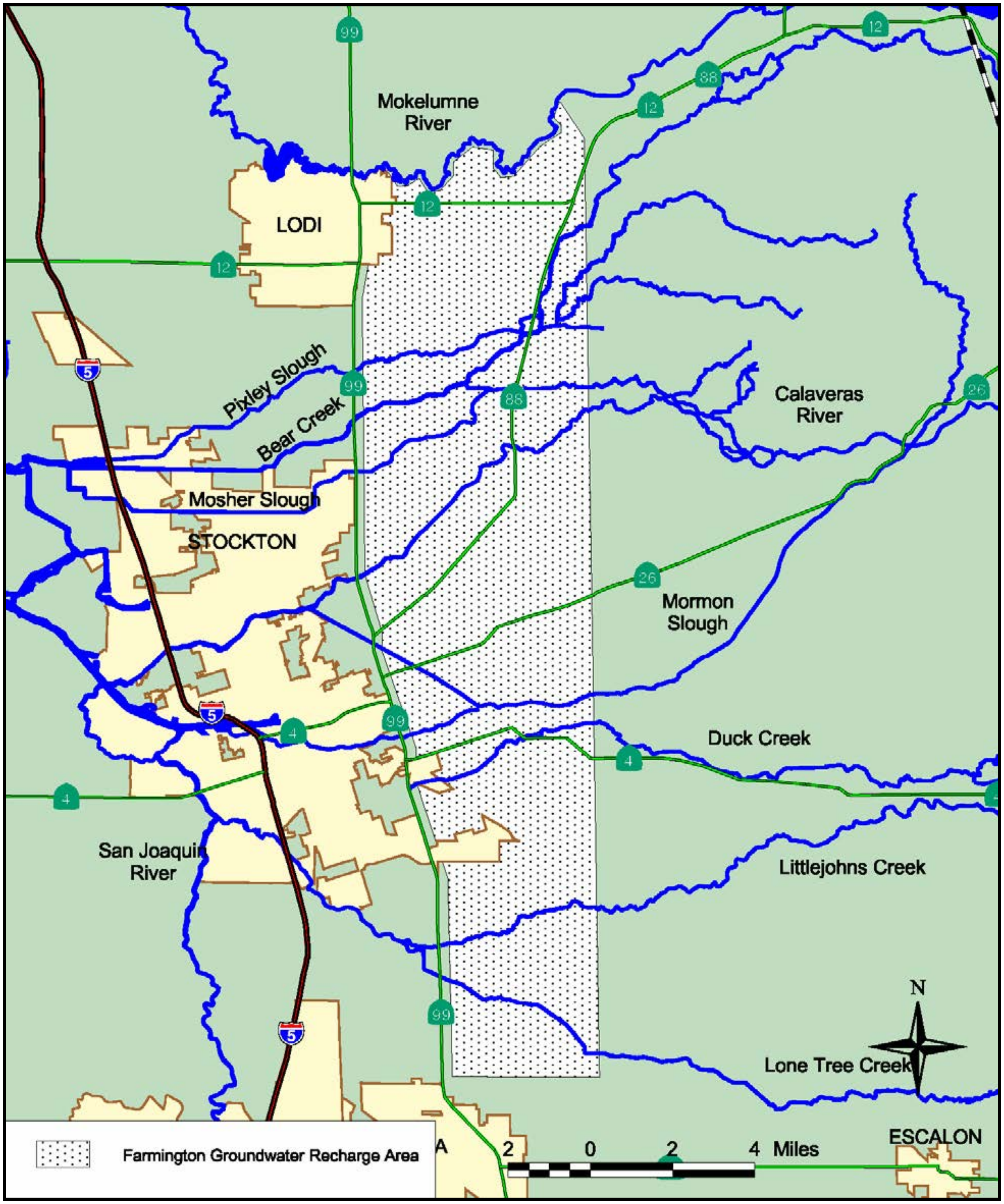


Figure 8-20 Farmington Groundwater Recharge Area
Source: Farmington Groundwater Recharge/Seasonal Habitat Study, 2001

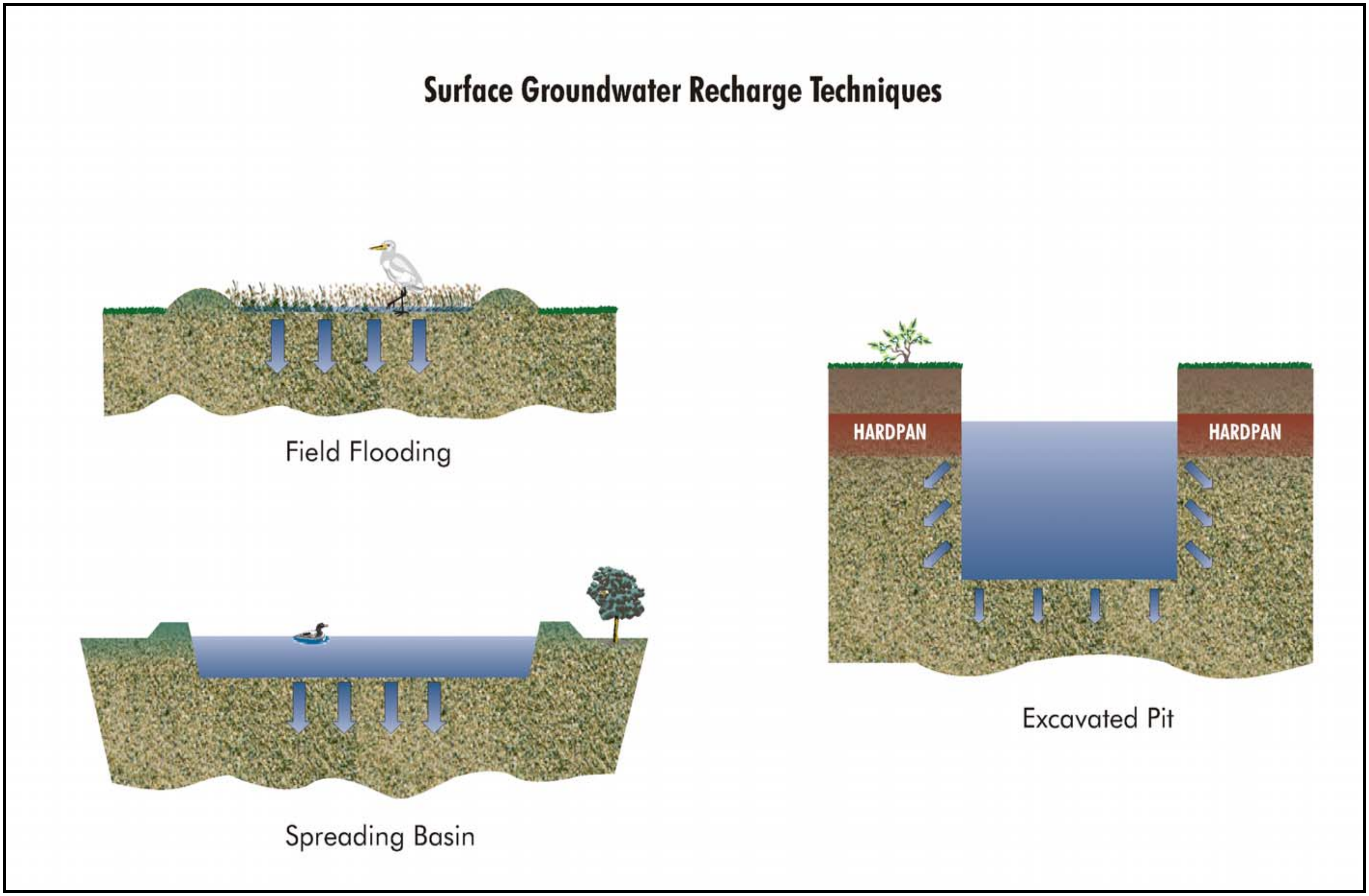


Figure 8-21 Surface Groundwater Recharge Techniques
Source: Farmington Groundwater Recharge/Seasonal Habitat Study, 2001

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. 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. The Farmington Groundwater Recharge Program is currently seeking out landowners who are willing to participate in the program by providing fields that can be flooded.

The planned capacity of the Farmington Program is approximately 35,000 af/yr. The following water sources are assumed available for the Farmington Program:

- 10,000 af/year from Stanislaus River
- 10,000 af/year from Littlejohns Creek
- 5,000 af/year from Calaveras River
- 10,000 af/year from Mokelumne River

8.3.2 City of Stockton Delta Water Supply Project

In 1996, the City of Stockton filed a water right application with the SWRCB seeking to appropriate initially 20,000 are-ft per year of water from the Delta, increasing to 125,900 af 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 8-22. 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 af 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 (ESA). The City of Stockton also expects to be limited by SWRCB Term 91 conditions, which limits diversion to when Delta outflow is higher than regulatory minimum requirements. (City of Stockton, 2003) In 2003 the City of Stockton completed the Delta Water Supply Project (DWSP) Feasibility Report.

The DWSP consists of a new diversion structure in the delta at the southwestern tip of Empire Tract on the San Joaquin River, a raw water conveyance pipeline, a new water treatment plant along Eight Mile Road, treated water transmission facilities, and groundwater injection and extraction wells, as shown in Figures 8-23 and 8-24. The estimated capital costs of the facilities are:

- River Intake and Pumps: $18 million
- Raw Water Conveyance: $35 million
- Water Treatment Plant (30 MGD): $59 million
- Treated Water Pipelines: $9 million

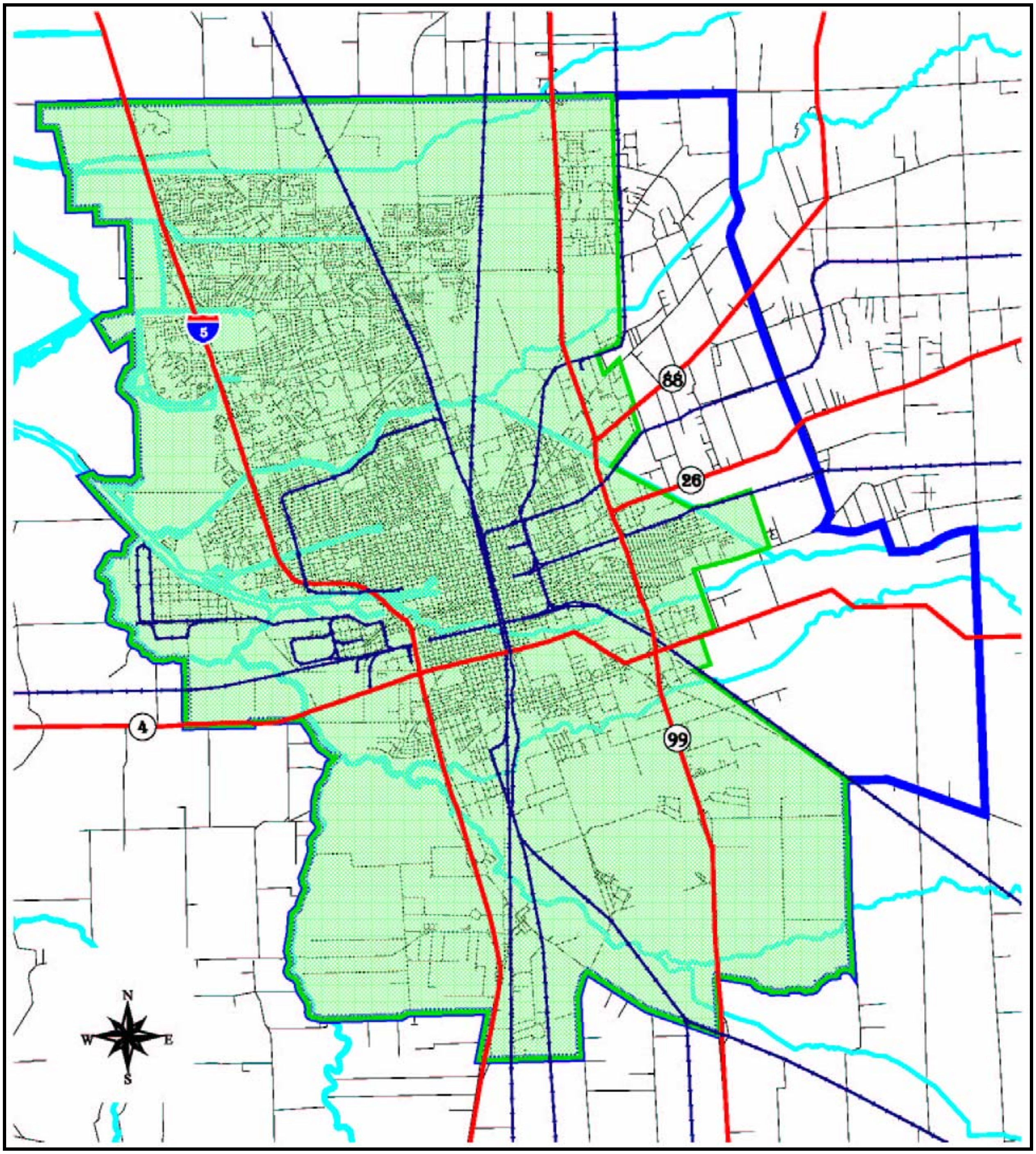


Figure 8-22 City of Stockton General Plan Boundary
Source: City of Stockton Delta Water Supply Project Engineering Feasibility Study, 2003

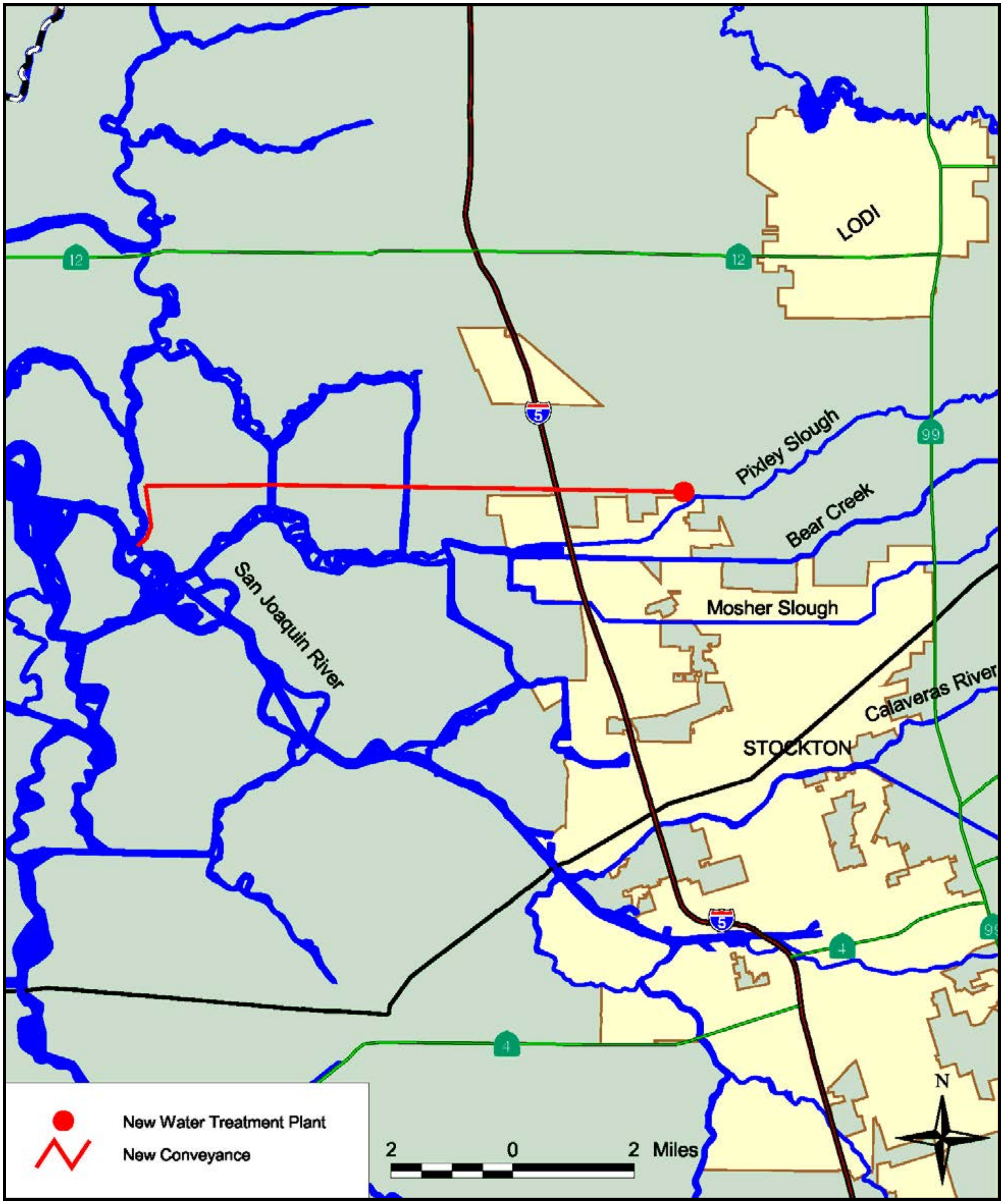


Figure 8-23 Delta Water Supply Project Intake and Treatment Plant
Source: City of Stockton Delta Water Supply Project Engineering Feasibility Study, 2003

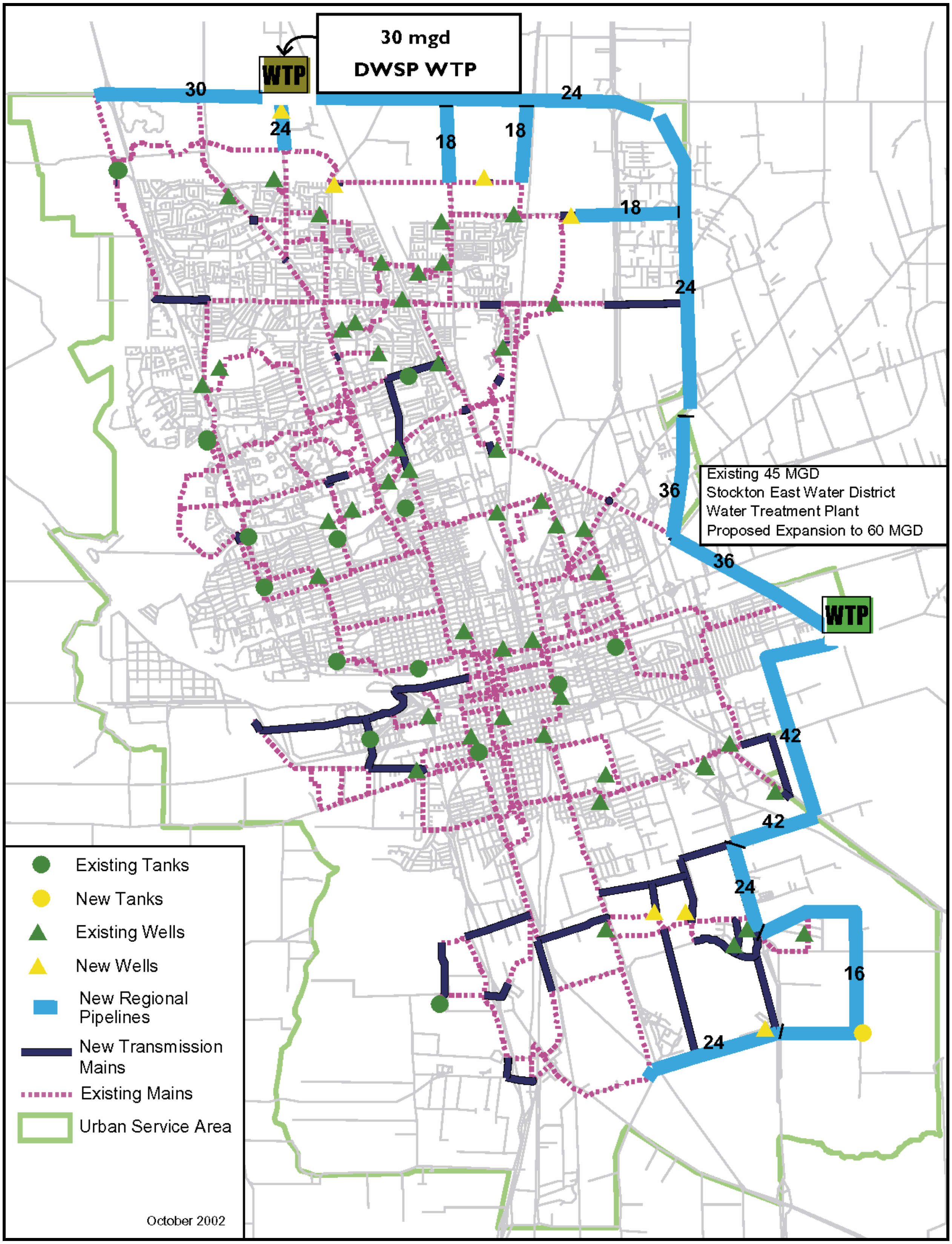


Figure 8-24 Delta Water Supply Project Distribution System
Source: City of Stockton Delta Water Supply Project Engineering Feasibility Study, 2003

Operations and Maintenance costs are expected to steadily increase to $5.75 million by 2015. The cost of the groundwater injection and extraction facilities is unknown at this time. The estimated cost of raw water delivery is approximately $200 per af, and the cost of delivery of fully treated water is expected to be about $350 per af.

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 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.

The City of Stockton is currently preparing a project level EIR/EIS with an anticipated groundbreaking date of 2008 and water delivery scheduled for 2010. The aggressive schedule is indicative of the uncertainty in final revised State Maximum Contaminant Level (MCL) for arsenic. At present the City of Stockton meets or exceeds the Federal MCL for arsenic; however, more conservative State regulations may force numerous well closures forcing the City of Stockton to rely more heavily on the DWSP and alternative sources.

Subsequent phases include a 10 MGD pilot 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 - Figure 8-25 (City of Stockton, 2003).

8.3.3 SEWD Water Treatment Plant Expansion

The current capacity of the Dr. Joe Waidhofer Water Treatment Plant (SEWD Treatment Plant) is 45 MGD, and the capacity of the planned expanded facility is 60 to 65 MGD. Currently turbidity occasionally limits production to 30 MGD resulting in an average yearly production of approximately 41,000 af. 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. The combination of available water from these sources totals 90,099 af per year. The additional 28,000 af could be used for groundwater recharge and extracted during dry years. The estimated cost for the expansion is $26.9 to $33.4 million (SEWD, 2003).

8.3.4 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 af/yr, 49,000 of which is said to be a firm supply. Because of current USBR operations of the New Melones Reservoir, in water year 2003, an above normal year for precipitation in the Stanislaus River watershed, the contract amount received was 10,000 af. CSJWCD delivered this amount in its irrigation system while SEWD did not receive any allocation in water year 2003. The CSJWCD irrigation system currently has the infrastructure capabilities to deliver approximately 35,000 af/yr for direct irrigation through a series of ditches and natural creeks, including Littlejohns, Temple, Lone Tree and Duck Creeks. The current system can be expanded to deliver up to 50,000 af/yr should water become available. Figure 8-26 depicts the CSJWCD irrigation system.

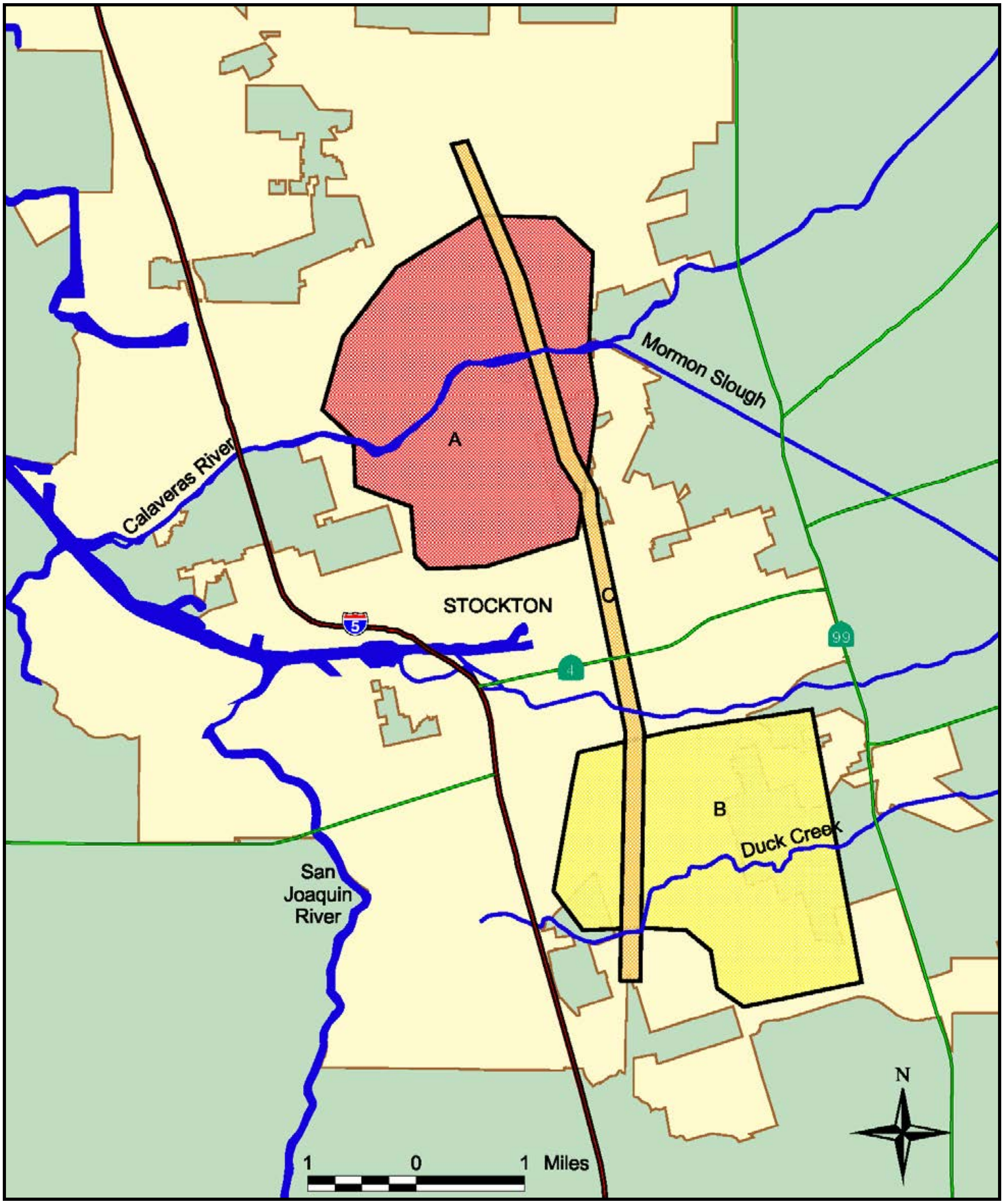


Figure 8-25 Delta Water Supply Project Potential Banking Sites
Source: Delta Water Supply Project Engineering Feasibility Study, 2003

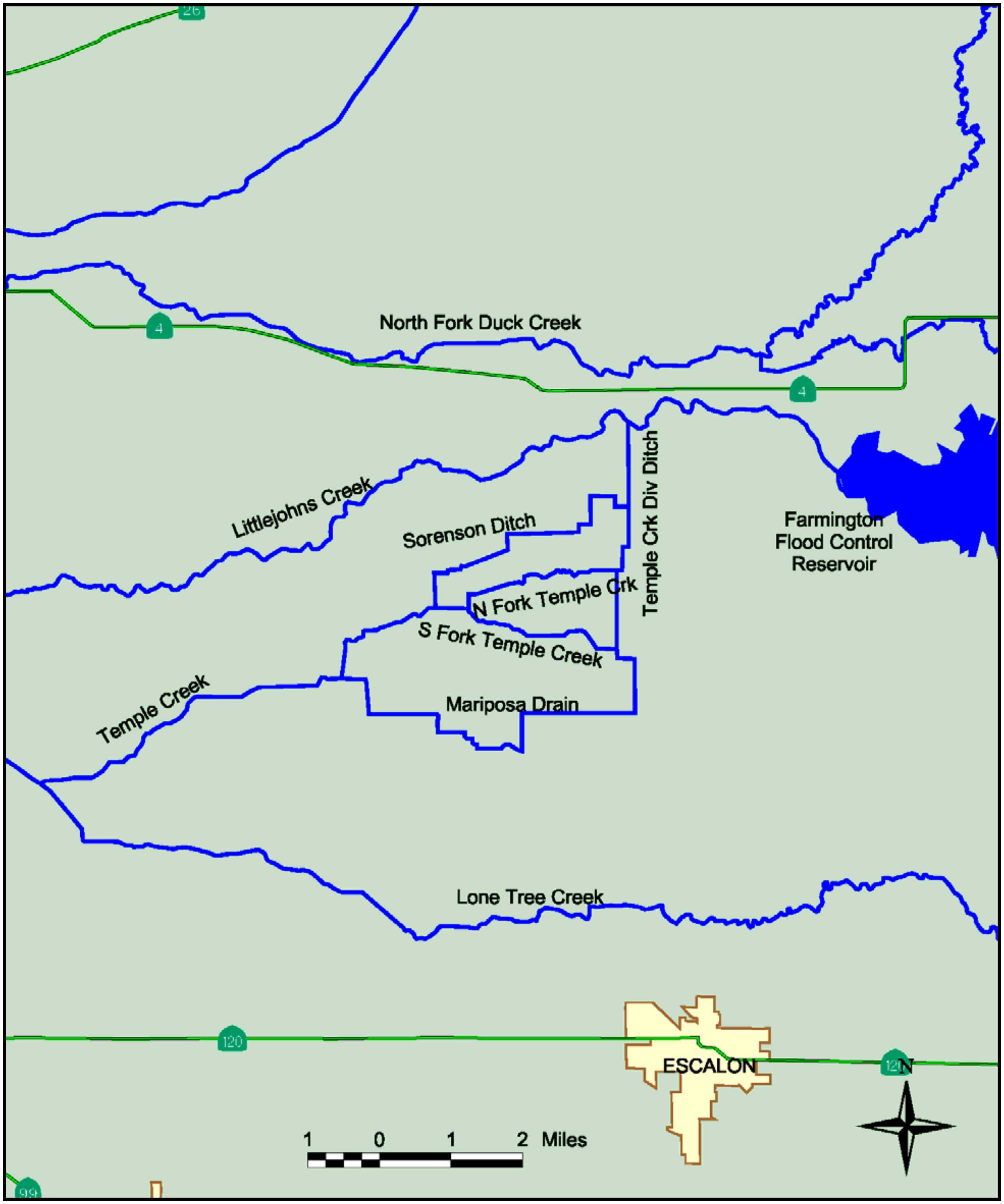


Figure 8-26 CSJWCD Irrigation System

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.

8.3.5 NSJWCD Conjunctive Use Program

NSJWCD owns and operates two surface water irrigation systems on the Lower Mokelumne River. NSJWCD holds interim water rights and relies on EBMUD to store its divertible allotment at Camanche for use during the irrigation season. The interim nature of the water requires farmers to maintain two irrigation systems thus reducing the demand for surface water to less than 3,000 af/yr. NSJWCD has rights to divert up to 20,000 af/yr when available at an average annual yield of approximately 11,000 af/yr.

The north system consists of a 30 cfs pipeline and intake pump near Trethway Road where it veers west along Acampo Road. The north system pipeline is in disrepair and requires extensive improvements. Repair and expansion of the north system is highly compatible with the Gill Creek and Woodbridge Road Flood Control Improvements Project. The South system is much larger and consists of pump station and a series of laterals that discharge into both Bear Creek and Pixley Slough. Growers along either the natural drainages or the pipeline are able to divert for irrigation. Both systems can be easily integrated into the MORE WATER Project direct diversion alternative should permanent or long-term groundwater recharge facilities be constructed. A map of NSJWCD's distribution system is shown in Figure 8-27.

In 2000, NSJWCD was selected to receive $462,500 from a CALFED grant to study groundwater recharge in the Mokelumne River watershed. The project includes a five-year pilot study involving the spreading of wet-year water on two four-acre ponds. Up to 50 percent of the recharged water, minus losses, would be available for extraction by wells for discharge into the Delta during dry and critically dry years. The impact of dibromo-chloro-propane (DBCP) on groundwater quality and its implications for larger-scale conjunctive use projects would also be evaluated.

In 2003, land owners in NSJWCD approved an acreage assessment dedicated to groundwater recharge. Beginning in 2003, land owners would be assessed $1 per acre up to a maximum of $5 per acre. Revenues generated in 2003 and 2004, estimated at $50,000, were used to construct a series of two pilot recharge ponds; one north of the Mokelumne River and one to the south. NSJWCD is also a local participant in the Farmington Program and a member of the Eastern Water Alliance.

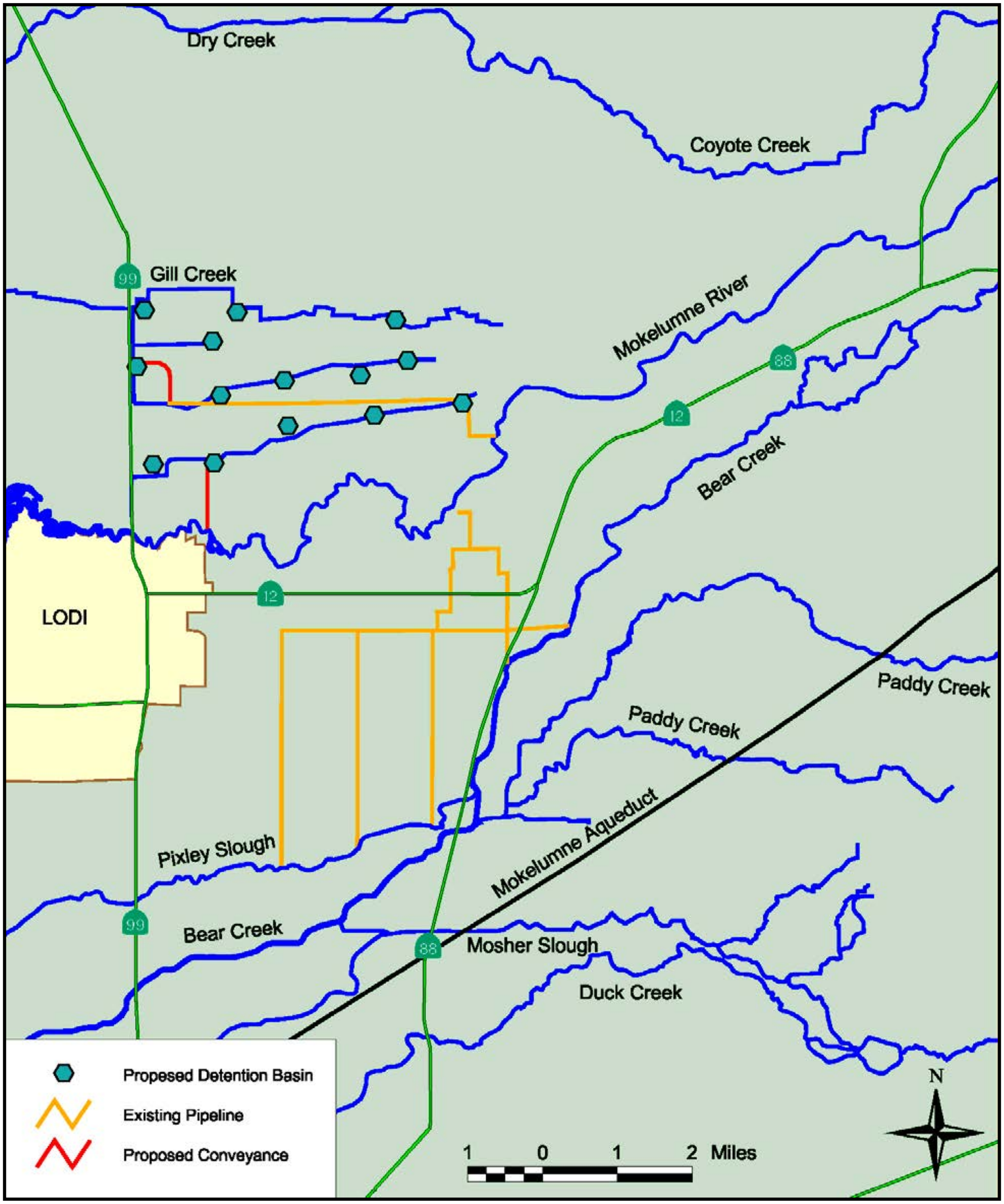


Figure 8-27 NSJWCD Distribution System

9 Plan Implementation

The Authority is committed to adopting a Plan implementation strategy that is adaptive and incentive driven. This Plan is the first step in the development of a regional document that details how the groundwater basin will be managed and initiates the process that will ultimately define the guidelines and conditions that water districts and others will follow to achieve basin management objectives. Following the adoption of this Plan, the Authority and its members will work to implement the management objectives. The objectives coupled with regular groundwater monitoring and the development of basin operations criteria will establish a framework and the foundational information for future groundwater banking and recharge project operations in the Basin.

9.1 Plan Implementation Reports

To encourage the continued implementation of the Plan, the Authority will complete a periodic assessment of the progress, direction and recommendations regarding Plan objectives. Basin hydrogeologic conditions are currently measured by groundwater level and quality monitoring on a semi-annual basis. This assessment activity will be coupled with the annual review of Plan implementation activities and project development in the basin.

To ensure that the Authority is constantly striving to better manage groundwater resources, the following actions will be undertaken:

1. Produce an annual report by March 1st of each year that outlines the accomplishments of the previous year's groundwater management efforts and report the current state of the Basin;

2. Review changes in political, institutional, social, or economic factors affecting groundwater management; and

3. Based on the information gained in the above actions, provide recommendations for any required amendments to the Plan.

9.2 Future Activities

The adoption of the Plan is merely the beginning of a series of actions the Authority will undertake to help meet future basin demands. As such, many of the identified actions will likely evolve as the Authority takes a more active approach to manage the basin and meet the outlined objectives. Many additional actions will also be identified in the annual summary report described above. The Plan is therefore intended to be an iterative document, and it will be important to evaluate all of the actions and objectives over time to determine how well they are meeting the overall goal of the plan. The Authority plans to evaluate this entire plan within five years of adoption. In the immediate future, the Authority and its member agencies will undertake the following planned activities described below subsequent to the adoption of the Plan.

9.2.1 Integrated Conjunctive Use Program CEQA Review

The California Environmental Quality Act (CEQA) allows agencies to prepare a Programmatic Environmental Impact Report (EIR) for a proposed course of action. The Integrated Conjunctive Use Program is a grouping of stand alone projects that could have very different specific environmental impacts, but would also have to address many of the same global environmental impacts requiring disclosure under CEQA. The Program EIR will support the implementation of future site-specific projects by:

- Allowing proper consideration of broader scale impacts, alternatives, and mitigation criteria that would extremely difficult in individual site-specific project level EIR.
- Focusing on cumulative impacts and growth inducing impacts with the implementation of the Conjunctive Use Program.
- Addressing policy, design, and management issues at the program level rather than repeatedly considering them at the project level.
- Considering broad policy alternatives and programmatic mitigation measures at an early stage in the development of the Conjunctive Use Program when policy flexibility is greatest.
- Conserving resources and promoting consistency by encouraging the reuse of data.
- Providing the basis for National Environmental Policy Act (NEPA) review and Federal permitting approval processes should federal interest be established in the Conjunctive Use Program or any of the Program elements.

The Program Environmental Impact Report (EIR) would also include a healthy technical appendix that would speak to the feasibility of specific Conjunctive Use Program projects, demand management measures, and other policy alternatives. The Program EIR will also analyze the potential environmental effects of the Basin Management Objectives, assumptions and technical methods, policy alternatives to achieving identified objectives, broad-scale impacts, and establish mitigation criteria for the overall Plan. The Programmatic EIR effort is expected to begin in 2005 and continue for 18 to 24 months.

9.2.2 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 could potentially consist of a series of groundwater levels that would correspond to basin condition levels (similar to the US EPA Air Quality Index and the US Department of Homeland Security Advisory System) to indicate the effectiveness of groundwater recharge programs and also potentially when and how much groundwater could be exported. The development of Basin Operations Criteria is a collaborative process that will be undertaken by the Authority immediately following the adoption of the Plan and is expected to be completed by summer 2005. Basin Operations Criteria developed with the framework of the Authority could ultimately provide the basis for a revised Export Ordinance and a new Groundwater Management Ordinance.

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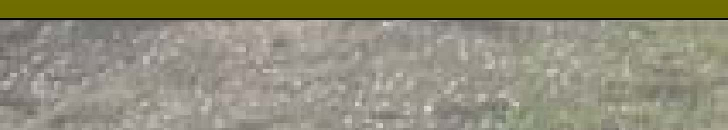

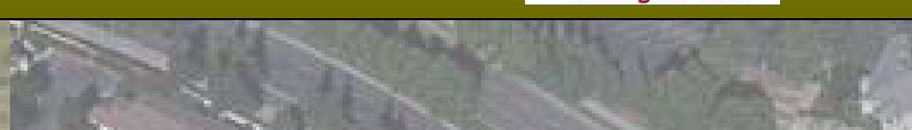

San Joaquin River Hydrologic Region

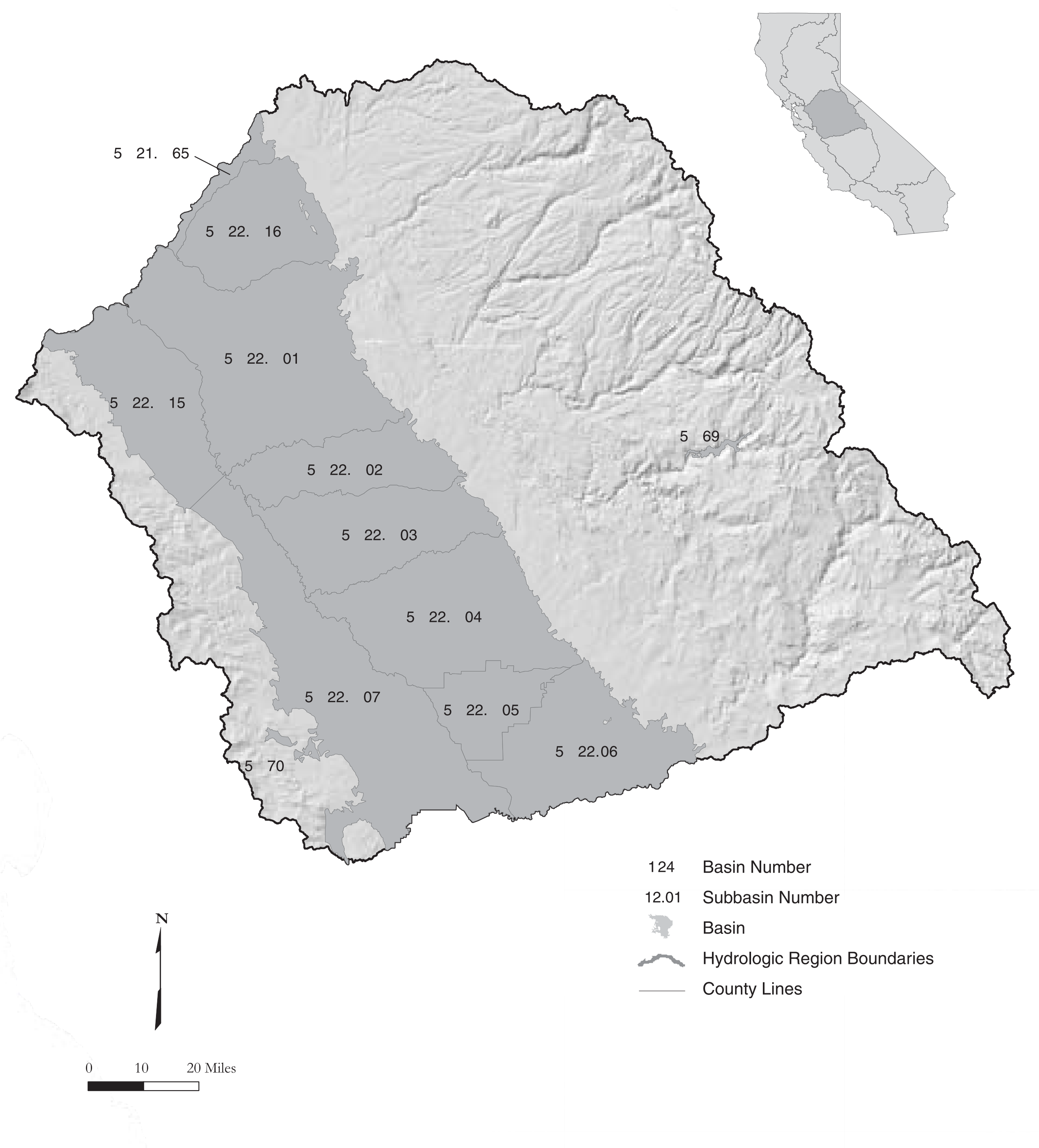

Figure 35 San Joaquin River Hydrologic Region

Basins and Subbasins of the San Joaquin River Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.01	Eastern San Joaquin
5-22.02	Modesto
5-22.03	Turlock
5-22.04	Merced
5-22.05	Chowchilla
5-22.06	Madera
5-22.07	Delta-Mendota
5-22.15	Tracy
5-22.16	Cosumnes
5-69	Yosemite Valley
5-70	Los Banos Creek Valley

Description of the Region

The San Joaquin River HR covers approximately 9.7 million acres (15,200 square miles) and includes all of Calaveras, Tuolumne, Mariposa, Madera, San Joaquin, and Stanislaus counties, most of Merced and Amador counties, and parts of Alpine, Fresno, Alameda, Contra Costa, Sacramento, El Dorado, and San Benito counties (Figure 35). The region corresponds to a portion near the middle of RWQCB 5. Significant geographic features include the northern half of the San Joaquin Valley, the southern part of the Sacramento-San Joaquin Delta, the Sierra Nevada and Diablo Range. The region is home to about 1.6 million people (DWR 1998). Major population centers include Merced, Modesto, and Stockton. The Merced area is entirely dependent on groundwater for its supply, as will be the new University of California at Merced campus.

Groundwater Development

The region contains two entire groundwater basins and part of the San Joaquin Valley Groundwater Basin, which continues south into the Tulare Lake HR. The San Joaquin Valley Groundwater Basin is divided into nine subbasins in this region. The basins underlie 3.73 million acres (5,830 square miles) or about 38 percent of the entire HR area.

The region is heavily groundwater reliant. Within the region groundwater accounts for about 30 percent of the annual supply used for agricultural and urban purposes. Groundwater use in the region accounts for about 18 percent of statewide groundwater use for agricultural and urban needs. Groundwater use in the region accounts for 5 percent of the State's overall supply from all sources for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins, with groundwater wells commonly extending to depths of up to 800 feet. Aquifers include unconsolidated alluvium and consolidated rocks with unconfined and confined groundwater conditions. Typical well yields in the San Joaquin Valley range from 300 to 2,000 gpm with yields of 5,000 gpm possible. The region's only significant basin located outside of San Joaquin Valley is Yosemite Valley. Yosemite Valley Basin supplies water to Yosemite National Park and has substantial well yields.

Conjunctive Use

Since near the beginning of the region's agricultural development, groundwater has been used conjunctively with surface water to meet water needs. Groundwater was and is used when and where surface water is unable to fully meet demands either in time or area. For several decades, this situation was more of an incidental conjunctive use than a formal one. Historical groundwater use has resulted in some land subsidence in the southwest portion of the region.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are TDS, nitrate, boron, chloride, and organic compounds. The Yosemite Valley Groundwater Basin has exceptionally high quality groundwater.

Areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. The high TDS content of west-side groundwater is due to recharge of streamflow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts due to evaporation and poor drainage. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Boron and chloride are likely a result of concentration from evaporation near the valley trough. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected in groundwater throughout the region, but primarily along the east side of the San Joaquin Valley where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is dibromochloropropane (DBCP), a now-banned soil fumigant and known carcinogen once used extensively on grapes and cotton. Industrial organic contaminants include TCE, dichloroethylene (DCE), and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Water Quality in Public Supply Wells

From 1994 through 2000, 689 public supply water wells were sampled in 10 of the 11 basins and subbasins in the San Joaquin River HR. Samples analyzed indicate that 523 wells, or 76 percent, met the state primary MCLs for drinking water. One-hundred-sixty-six wells, or 24 percent, have constituents that exceed one or more MCL. Figure 36 shows the percentages of each contaminant group that exceeded MCLs in the 166 wells.

Table 28 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Changes from Bulletin 118-80

The subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report. Additionally, the Cosumnes Subbasin has been added to the subbasins within the San Joaquin River HR. It is worth noting that the southern portion of the South American Subbasin of the Sacramento Valley Groundwater Basin is also included as part of this HR. The subbasin names and numbers within the region are listed in Table 29.

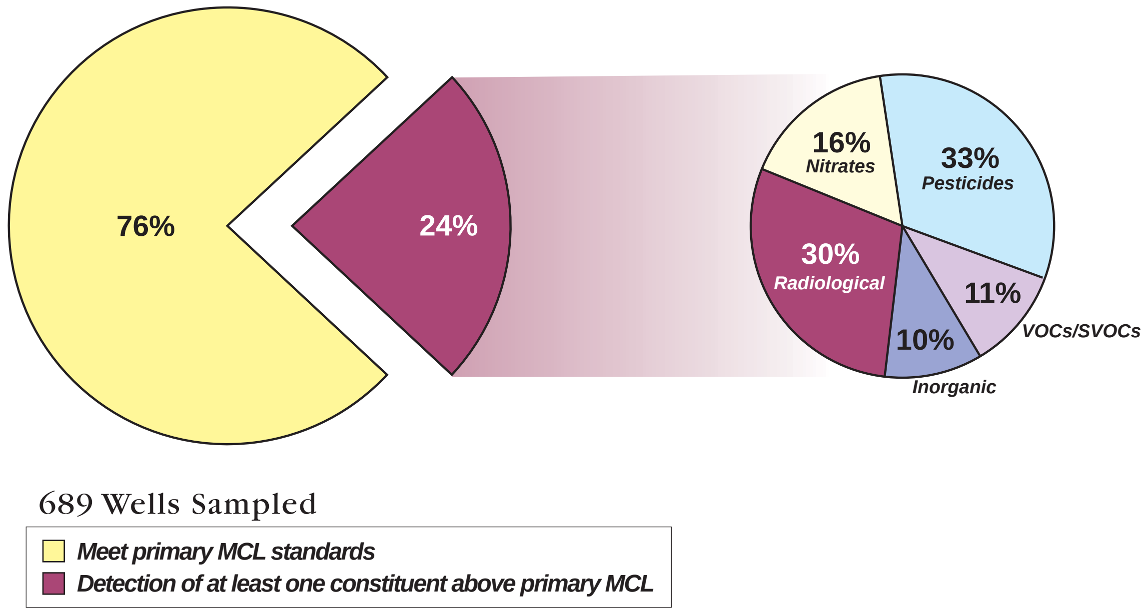

Figure 36 MCL exceedances in public supply wells in the San Joaquin River Hydrologic Region

Table 28 Most frequently occurring contaminants by contaminant group in the San Joaquin River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Aluminum – 4	Arsenic – 4	4 tied at 2 exceedances
Inorganics – Secondary	Manganese – 123	Iron – 102	TDS – 9
Radiological	Uranium – 33	Gross Alpha – 26	Radium 228 – 6
Nitrates	Nitrate (as NO_3) – 23	Nitrate + Nitrite – 6	Nitrate Nitrogen (NO_3-N) – 3
Pesticides	DBCP – 44	Di(2-Ethylhexyl)phthalate – 11	EDB – 6
VOCs	PCE – 8	Dichloromethane – 3	TCE – 3

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Table 29 Modifications since Bulletin 118-80 of groundwater basins and subbasins in San Joaquin Hydrologic Region

Subbasin name	New number	Old number
Eastern San Joaquin	5-22.01	5-22
Modesto	5-22.02	5-22
Turlock	5-22.03	5-22
Merced	5-22.04	5-22
Chowchilla	5-22.05	5-22
Madera	5-22.06	5-22
Delta-Mendota	5-22.07	5-22
Tracy	5-22.15	5-22
Cosumnes	5-22.16	5-22

Table 30 San Joaquin River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.01	EASTERN SAN JOAQUIN	707,000	A	1,500	-	345	69	540	310	30 - 1,632
5-22.02	MODESTO	247,000	B	4,500	1000-2000	230	15	209	60-500	200-8300
5-22.03	TURLOCK	347,000	B	4,500	1000-2000	307	0	163	200-500	100-8300
5-22.04	MERCED	491,000	B	4,450	1500-1900	378	0	142	200-400	100-3600
5-22.05	CHOWCHILLA	159,000	B	4,750	750-2000	203	0	28	200-500	120-6400
5-22.06	MADERA	394,000	B	4,750	750-2000	378	0	127	200-400	100-6400
5-22.07	DELTA-MENDOTA	747,000	B	5,000	800-2000	816	0	120	770	210-86,000
5-22.15	TRACY	345,000	C	3,000	500-3,000	18	14	183	1,190	210-7,800
5-22.16	COSUMNES	281,000	A	1,500	-	75	13	72	218	140-438
5-69	YOSEMITE VALLEY	7,500	C	1,200	900	0	0	3	54	43-73
5-70	LOS BANOS CREEK VALLEY	4,840	C	-	-	0	0	0	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

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San Joaquin Valley Groundwater Basin
Eastern San Joaquin Subbasin

Groundwater Basin Number: 5-22.01
- County: San Joaquin, Stanislaus, and Calaveras
- Surface Area: 707,000 acres (1,105 square miles)

Basin Boundaries and Hydrology

The San Joaquin Valley comprises the southernmost portion of the Great Valley Geomorphic Province of California. The Great Valley is a broad structural trough bounded by the tilted block of the Sierra Nevada on the east and the complexly folded and faulted Coast Ranges on the west. The Eastern San Joaquin Subbasin is defined by the areal extent of unconsolidated to semiconsolidated sedimentary deposits that are bounded by the Mokelumne River on the north and northwest; San Joaquin River on the west; Stanislaus River on the south; and consolidated bedrock on the east.

The Eastern San Joaquin Subbasin is bounded on the south, southwest, and west by the Modesto, Delta-Mendota, and Tracy Subbasins, respectively and on the northwest and north by the Solano, South American, and Cosumnes Subbasins. The Solano and South American are subbasins of the Sacramento Valley Groundwater Basin.

The Eastern San Joaquin Subbasin is drained by the San Joaquin River and several of its major tributaries namely, the Stanislaus, and Calaveras, and Mokelumne Rivers. The San Joaquin River flows northward into the Sacramento and San Joaquin Delta and discharges into the San Francisco Bay. Annual precipitation within the subbasin ranges from about 11 inches in the southwest to about 25 inches in the northeast.

Hydrogeologic Information

Water Bearing Formations

Water bearing formations of significance in the Eastern San Joaquin Subbasin consist of the Alluvium and Modesto/Riverbank Formations, Flood Basin Deposits, Laguna Formation, and Mehrten Formation. The Mehrten Formation is considered to be the oldest fresh water-bearing formation on the east side of the basin, even though the underlying Valley Springs Formation produces minor quantities. Information on water bearing units and groundwater conditions was taken primarily from (DWR 1967).

Alluvium and Modesto/Riverbank Formations (Undifferentiated). These units are exposed within the subbasin along a band approximately 15 miles wide that extends from about Stockton eastward. These units are Recent to Late Pleistocene in age and consist primarily of sand and gravel in the fan areas while clay, silt, and sand are dominant in the interfan areas. These units range in thickness from a thin veneer on the east side of the basin to over 150 feet near the center of the basin. Groundwater occurs unconfined within these units. Well yields to 650 ± gpm are reported. Because these units are limited in thickness, most wells penetrate them in order to tap deeper aquifers in the area. Average specific yields in the 10- to 200-foot depth range vary from about 7 to 15 percent within the boundaries of the

Tuolumne River Storage Unit (Davis et al. 1959). The average specific yield for fresh water bearing units in the San Joaquin County Groundwater Investigation area as defined in (DWR 1967) is 7.3 percent. The Victor Formation as defined in (DWR 1967) is correlative with these units.

Flood Basin Deposits. This unit is exposed in the Delta area of the San Joaquin Valley. These deposits are basinward, fine-grained forms of the Laguna, Riverbank, Modesto, and Recent formations and, therefore, range in age from Pliocene to Recent. They are generally much finer grained with a higher percentage of fine sand and clays than their depositional equivalents to the east and west. Occasional gravel beds occur along the present waterways and are probably representative of the type of underlying lithology distribution. This unit ranges in thickness from 0 to 1,400 ± feet. Groundwater in this unit occurs under unconfined to confined conditions. The unit, in general, has low permeabilities and may create semi-confined to confined conditions when interfingered with the Alluvium and Modesto/Riverbank Formations. Occasional pockets of fresh water are found in the Delta deposits, but generally speaking the formation contains poor quality water. This unit is designated as Dos Palos Alluvium by (Wagner et al. 1990).

Laguna Formation. The Laguna Formation is Plio-Pleistocene in age and consists of discontinuous lenses of stream laid sand and silt with lesser amounts of clay and gravel. There are no regionally significant fine-grained intervals that could cause water pressure conditions, although the heterogeneous nature of the sediments causes local confinement. From the Mokelumne River area, the formation thickens from approximately 400 feet to approximately 1,000 feet in the Stockton area. Regionally, yields of 1,500 gpm have been reported from highly permeable beds, but average yields are about 900 ± gpm. Groundwater occurs under unconfined to locally semiconfined conditions within this unit. Occasional minor perched water zones are encountered in this formation, particularly in the Mokelumne River area.

Mehrten Formation. This formation is exposed in the easternmost part of the subbasin where it forms readily identifiable, nearly flat-topped hills. The formation is late Miocene to Pliocene in age and is composed of moderately to well indurated andesitic sand to sandstone interbedded with conglomerate, tuffaceous siltstone, and claystone. The Mehrten Formation is approximately 400 feet thick in eastern surface outcrops to over 600 feet thick in the subsurface near Stockton. It is reported to be 1,300 ± feet thick at McDonald Island. The top of the Mehrten Formation occurs at depths of approximately 800 to 1,000 feet in the Stockton area. Regional studies indicate that Mehrten Formation sands commonly yield on the order of 1,000 gpm from wells. The formation appears to be semiconfined at least locally in the Stockton area, due to the inferred extensive fine-grained beds in its upper part. The average specific yield for fresh water bearing units in the San Joaquin County Groundwater Investigation area as defined in (DWR 1967) is 7.3 percent.

Groundwater Level Trends

Measurements over the past 40 years show a fairly continuous decline in groundwater levels in Eastern San Joaquin County (USACE 2001). Groundwater levels have declined at an average rate of 1.7 feet per year and have dropped as much as 100 feet in some areas. It is estimated that groundwater overdraft during the past 40 years has reduced storage in the basin by as much as 2 million acre feet.

Due to the continued overdraft of groundwater within the subbasin, significant groundwater depressions are present below the City of Stockton, east of Stockton, and east of Lodi (SJCFC 1999). Several of these groundwater depressions extend to depths of about 100 feet below ground surface (or more than 40 feet below mean sea level).

Groundwater Storage

Groundwater Storage Capacity. The total available groundwater storage capacity from a depth of 20 feet to the base of the groundwater basin is about 42,400,000 af based on a total aquifer material volume of 579,900,000 af and an average specific yield of 7.3 percent (DWR 1967). This estimate was based on a study area that encompassed approximately 586,000 acres. Since the currently defined subbasin size is over 707,000 acres, the storage value mentioned above underestimates the total storage capacity for the subbasin as defined in Bulletin 118 – Update 2002.

Groundwater in Storage. No published groundwater in storage estimates were identified.

Groundwater Budget (Type A)

A hydrologic balance for a study area approximately matching the subbasin was prepared by Brown & Caldwell (SJCFC 1985). The balance consists of an inventory of inflow and outflow items for the period 1963 – 1982. Inflow estimates include: average annual infiltration from applied water and precipitation (593,356 af); average annual seepage from surface water (141,127 af); and average annual net subsurface inflow (3,586 af). Outflow estimates include: average annual municipal and industrial pumpage (47,493 af); and average annual agricultural pumpage (761,828 af). This balance shows that there has been a total net outflow from the system of about 1.5 million acre feet over the 20 year study period which represents an average annual outflow (or overdraft) of about 70,000 acre feet.

The (USBR 1996) estimated the 1990 annual groundwater extraction in San Joaquin County to be about 731,000 af/year, which exceeds the estimated safe yield of 618,000 af/year. This results in an estimated overdraft of 113,000 af/year. It is estimated that 70,000 af/year of overdraft occurs in northeastern San Joaquin County and about 35,000 af/year of overdraft occurs in the Stockton East Water District area.

Groundwater Quality

Characterization. The majority of the groundwater in the basin is characterized by calcium-magnesium bicarbonate or calcium-sodium bicarbonate types (Sorenson 1981). Bicarbonate is the predominant anion in the eastern part of the basin. Large areas of chloride type water occur along the western margin of the subbasin along the San Joaquin River. Based on analyses of 174 water supply wells in the subbasin, TDS ranges from 30 to

1,632 mg/L and averages about 310 mg/L. TDS ranged from 50 to 3,520 mg/L with a mean of 463 and median of 269 according to the groundwater chemistry study in San Joaquin County and part of Contra Costa County by (Sorenson 1981). Specific conductance of groundwater ranged from 78 to 5,390 µmhos/cm, with a mean value of 685 and a median of 356. Some of the highest specific conductance values were found along the western part of the subbasin and San Joaquin River alignment.

Impairments. As a result of declining water levels, poor quality water has been moving east along a 16-mile front on the east side of the Delta (DWR 1967). The degradation was particularly evident in the Stockton area where the saline front was moving eastward at a rate of 140 to 150 feet per year. Data from 1980 and 1996 indicate that the saline front has continued to migrate eastward up to about one mile beyond its 1963 extent (USACE 2001). Large areas of elevated nitrate in groundwater exist within the subbasin located southeast of Lodi and south of Stockton and east of Manteca extending towards the San Joaquin – Stanislaus County line.

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	182	8
Radiological	179	8
Nitrates	189	7
Pesticides	191	21
VOCs and SVOCs	185	6
Inorganics – Secondary	182	71

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Production characteristics

	Well yields (gal/min)
Municipal/Irrigation	Well yields in the fresh water-bearing formations underlying the basin range (in general) from about 650 to 1,500 gpm.
	Total depths (ft)
Domestic	Range: 25-993 Average: 242 (Based on 1551 well completion reports)
Municipal/Irrigation	Range: 75-780 Average: 349 (Based on 224 well completion reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	99 /semiannually, and 15 /monthly
San Joaquin County Flood Control and Water Conservation District (SJCFC) and cooperators	Groundwater levels	246 /semiannually
SJCFC and cooperators	TDS, turbidity, chloride, and EC	Approximately 26 /annually
Department of Health Services and cooperators	Title 22 water quality	540 /annually

Basin Management

Groundwater management: (DWR 1999)	San Joaquin County enacted a groundwater management ordinance in 1996; AB 3030 plans have been adopted by the following entities: County of Stanislaus ; North San Joaquin WCD (3/5/96); Oakdale ID (9/22/95); San Joaquin County FC&WCD (2/11/97); South San Joaquin ID (2/14/95); Stockton East WD (11/1/95); and Woodbridge ID.
Water agencies: Public and Private	Lockeford CSD, North Delta WA, North San Joaquin WCD, Oakdale ID, City of Lathrop WD, City of Lodi Service Area, City of Manteca WSA, Calaveras County WD, California Water Service Company, Central Delta WA, Central San Joaquin WCD, City of Escalon WSA, Reclamation District No. 828, River Junction Reclamation District No. 2064, Rock Creek WD, South Delta WA, South San Joaquin ID, Stockton East WD, Valley Springs PUD, Woodbridge ID, Woodbridge WUCD, and City of Stockton MUD. Northeastern San Joaquin County Groundwater Banking Authority adopted a groundwater management plan.

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Errata

Changes made to the basin description will be noted here.