Alan C. Lloyd, Ph.D.
Agency Secretary

State Water Resources Control Board

Division of Water Rights
1001 I Street, 14th Floor ♦ Sacramento, California 95814 ♦ 916.341.5300
Mailing Address: P.O. Box 2000 ♦ Sacramento, California 95812-2000
FAX: 916.341.5400 ♦ www.waterrights.ca.gov

Arnold Schwarzenegger
Governor

APPLICATION NO. 12842
(Leave blank)

UNDERGROUND STORAGE SUPPLEMENT to PETITION for CHANGE for PERMIT 10477 (APPLICATION 12842)

1. State amount of water to be diverted to underground storage from each point of diversion in item 3b of form APP.

   a. Maximum Rate of diversions (1) 50 (2) _____ (3) _____ cfs
   b. Maximum Annual Amount (1) 17,000 (2) _____ (3) _____ acre-feet

2. Describe any works used to divert to offstream spreading grounds or injection wells not identified in item 7 of form APP.

Natural waterway will provide opportunities for enhanced infiltration and ground water recharge. In addition, water diverted or re-diverted from natural channels will be conveyed by existing and proposed pump stations, gravity-flow turnouts, canals, and pipelines to various offstream recharge facilities, including flooded fields (created by the construction of low berms), shallow excavated spreading basins, and deeper excavated pits. No injection wells are planned due to high pre-treatment and operational costs. Individual diversion rates are generally expected to be up to 10 cfs. The actual diversion rate will be determined by the capability of individual recharge facilities to percolate the applied water. The report entitled Farmington Groundwater Recharge and Seasonal Habitat Study, Final Report, August 2001 by Montgomery Watson Harza (MWH Report) and an existing recharge project indicate that the rate of percolation in the region varies from 0.25 to well over 1.0 feet per day (Table V-6 in MWH Report).

3. Describe spreading grounds and identify its location and number of acres or location of upstream and downstream limits if onstream.

Enhanced percolation is expected to occur within Bear, Coyote, Gill and Pixley Creeks with the addition of water during non-flow periods. In addition, water will be rediverted to off-stream recharge facilities described in Item 2 above. For infiltration rates in the range of 0.25 to 1.0 feet per day, between 85 and 340 acres of land would be required to infiltrate all of the water sought by this Petition. Existing recharge facilities and certain future recharge sites have been identified on the Petition map. Additional recharge facilities will be determined by field percolation studies, and the total of all recharge sites will not exceed 500 acres and will be located within the place of use identified on the map accompanying the Petition.

4. State depth of groundwater table in spreading grounds or immediate vicinity:
   _____ feet below ground surface on _____ 19 __ measured at a point located within the _____ ¼ of _____ ¼ of Section _____, T _____, R _____, _____ B&M

See Attachment "A" and Engineer's Report, Proposed Groundwater Charge, April 2007, which is attached as Attachment "B."

5. Give any historic maximum and or minimum depths to the groundwater table in the area.
Location _____ Maximum _____ feet below ground surface on _____ (date)
Location _____ Maximum _____ feet below ground surface on _____ (date)

See Attachment "B" Engineer's Report, Proposed Groundwater Charge, April 2007.

6. Describe proposed spreading operation. As described in Item 3, some water will be recharged through enhanced percolation in the natural channels identified on the Petition map. Water will also be re-diverted to off-stream recharge facilities through existing and future re-conveyance and rediversion facilities. The capacity of individual facilities will be designed to match the recharge capabilities of specific recharge facilities depending upon percolation rate. Average percolation rates for sites identified to date range from 0.25 to over 1.0 foot of water per day.

7. Describe location, capacity and features of proposed pretreatment facilities and/or injected wells. No injection well facilities are planned for this water due to high pretreatment and operational costs. It is not anticipated that any pretreatment will be required prior to application of water to recharge facilities.

8. Reference any available engineering reports, studies, or data on the aquifer involved.
The ground water decline in the Eastern San Joaquin County Groundwater Basin (ESJCGB) is well documented. Reference is made to the bibliographies of the MWH Report, as well as the report entitled *San Joaquin County Flood Control and Water Conservation District Water Management Plan, Phase 1 – Planning Analysis and Strategy, October 2001*, prepared by Camp, Dresser & McKee (CDM Report), copies of which are attached for reference as **Attachment 1.**

9. Describe underground reservoir and attach a map or sketch of its location. _____
A general discussion of aquifer characteristics within the San Joaquin Valley is provided in DWR Bulletin 118. Aquifers are generally described as being quite thick with "groundwater wells commonly extending to depth up to 800 feet." According to DWR Bulletin 118, the ESJCGB covers approximately 707,000 acres and extends beyond the boundaries of NSJWCD. Figure 2-5 from the CDM Report (**Attachment 2**) shows groundwater contours in the regional area in the year
2000.

10. State estimated storage capacity of underground reservoir. _____
The CDM Report states that groundwater levels in San Joaquin County are in a state of overdraft. While the capacity of the "underground reservoir" is not stated, it is estimated that between 1970 and 1993, approximately 2,800,000 acre-feet of groundwater was mined, or otherwise "lost" due to lateral inflow of poorer quality groundwater from the Delta area to the west. The CDM Report projects that continuance of current groundwater and surface water management practices will result in the depletion of an additional 2,000,00 acre-feet by 2030.

11. Describe existing use of the underground storage reservoir and any proposed change in its use. _____
The ESJCGB is in overdraft and threatened with further saline intrusion from the Delta. A primary objective of NSJWCD since its formation in 1948 has been to manage the groundwater basin, and secure supplemental water to prevent further overdraft and saline contamination. The future use of the basin is expected to be consistent with historical use.

12. Describe the proposed method and location of measurement of water placed into and withdrawn from underground storage. Water supply will be determined by use of existing measuring devices and at proposed measuring devices to be installed on the facilities that will redivert water into conveyance facilities and natural stream channels. Water delivered to recharge facilities will be determined by use of flow measuring devices at each facility or series of facilities. Each water agency in the Basin, San Joaquin County, and others keep records of how much water is pumped from the ESJCGB each year. The County conducts extensive monitoring of the basin, and with the assistance of other local water agencies, has developed groundwater models that incorporate all input and extraction numbers for the Basin. These models predict both groundwater level trends and movement of the saline contamination of the Basin. The models rely on previous studies to determine anticipated input and Basin contributions to the Delta, and water agency data for extraction from the Basin. Upon initiation of the project, NSJWCD will provide input to these models of the quantities of water placed into underground storage.

All publicly owned and operated wells, those of private water companies and significant industrial operations are metered. Privately owned agricultural and domestic wells are generally not metered, however groundwater use is estimated annually using cropping data, average crop water use statistics, and average domestic use statistics.

4. State depth of groundwater table in spreading grounds or immediate vicinity:

NSJWCD overlies the Eastern San Joaquin County Groundwater Basin ("ESJCGB" or "Basin"), which is a sub-basin of the San Joaquin Valley Basin. The Basin is in a state of critical overdraft. In 1980 it was determined to be one of only eight groundwater basins in California subject to critical conditions of overdraft. *Department of Water Resources Bulletin 118-80, 1980 at p. 44-45*. An average of 867,600 acre-feet is pumped from the Basin each year for agricultural and urban needs. An additional 144,000 acre-feet are lost from the basin annually to streams and lateral outflow. The Basin is recharged by an average of 904,577 acre-feet each year from rain, groundwater lateral flows, and natural and artificial percolation. This results in an average overdraft of approximately 150,000 acre-feet per year. *Eastern San Joaquin Groundwater Basin Groundwater Management Plan, September 2004*.

Because of the geologic conditions peculiar to the area, when groundwater elevations drop, saline groundwater underlying the Delta to the west of the basin flows into the basin, causing serious water quality deterioration and permanent destruction of that portion of the Basin. *Department of Water Resources Bulletin 118-80, 1980 at p. 44-45*. Salt-water intrusion has already severely impacted the groundwater in the vicinity of Stockton and wells have been abandoned. *Department of Water Resources Bulletin 118-80, 1980 at p. 44-45*. It is estimated that the saline front advances 145 feet east every year and will advance an additional two miles by the year 2020. *Brown and Caldwell, Eastern San Joaquin County Groundwater Study, October 1985, at p. 1-13*. Without additional surface water supplies, it is estimated that groundwater levels in the agricultural region east of Stockton will continue to decline an average of 1.7 feet per year. Id.

NSJWCD has all of the powers of a Water Conservation District in the Water Code.

The place of use service area is within the boundary of the ESJCGB, identified as Subbasin Number 5-22.01 on the attached Figure 35 from California Department of Water Resources Bulletin 118 *California's Groundwater* (Update 2003). As show, the ESJCGB is bounded on the north by the Sacramento/San Joaquin County line, on the south by the Stanislaus River, on the west by the San Joaquin River, and on the east by the interface of the water-bearing alluvium and bedrock associated with the Sierra Nevada foothills. A discussion of groundwater conditions in the ESJCGB is provided in an earlier edition of Bulletin 118 (1980), which states the following:

> "Eastern San Joaquin County Basin. This basin for many years has experienced overdraft, the adverse effects of which include declining water levels that have induced the movement of poor quality water from the Delta sediments eastward near the City of Stockton. Migration of these saline waters has severely impacted the quality of ground water in the vicinity of Stockton. Wells have been abandoned and replacement water supplies have been obtained by drilling additional wells generally to the east.

> To stop the easterly migration of poor quality water would require maintaining higher water levels in the basin and other measures, which, in turn, would probably reduce ground water inflow from the south. Under those higher water level conditions, the estimated supplemental water requirement would be materially greater than at the present. The exact amount of the overdraft and supplemental water requirement is presently under study."

Ground water conditions in the ESJCGB are also discussed in the report entitled *San Joaquin County Flood Control and Water Conservation District Water Management Plan, Phase 1 – Planning Analysis and Strategy, October 2001*, prepared by Camp Dresser & McKee (CDM Report).

5. Give any historic maximum and or minimum depths to the groundwater table in the area.

The estimated "predevelopment" water table is as shown on the attached Figure 11 (**Attachment 3**) taken from U.S. Geological Survey Professional Paper 1401-A. As shown, in the region covered by these applications, the elevation of the predevelopment water table varied from about Elevation 0 on the west near the San Joaquin River to about Elevation 160 on the east near the alluvium-bedrock interface. These contours are shown on the map accompanying this petition. The predevelopment water table would correspond to the historic minimum depth to groundwater, and in alluvial areas generally varied from about 0 on the west near the San Joaquin River to about 20 feet on the east near Bellota.

Section 2.3.1 of CDM Report states that groundwater levels within the ESJCGB show a historical trend of decline, and in some areas have fallen by 40 to 60 feet over the past 20 to 30 years. The main cone of depression is located east of the City of Stockton, where there is a large area with groundwater levels more than 50 feet below sea level. The attached hydrograph of Well Number 02N08E34E00M (**Attachment 4**), obtained from

DWR's Central District web site, illustrates the historic decline in groundwater between 1948 and 1996.

Groundwater data complied by San Joaquin County shows that in the fall of 1998, depth to groundwater was about 20 feet on the west side of Stockton, and about 140 feet near Bellota. Although groundwater levels fluctuate from year-to-year based on hydrologic conditions, it is assumed that the fall 1998 level is at or near the historic maximum depth to ground water. Review of more recent groundwater information, which the County is presently compiling, may show that the maximum depth has increased since 1998.

ATTACHMENT "B"

ENGINEER'S REPORT
PROPOSED GROUNDWATER CHARGE
APRIL 2007

The following report has been prepared in accordance with Section 75561 of the Water Code.

Annual Overdraft

Overdraft of the Eastern San Joaquin County Groundwater Basin has been common knowledge since the early 1900's when falling levels made use of centrifugal pumps impossible unless pits were dug to keep the suction lift under twenty feet. Continuing decline of water levels led to the invention of the vertical turbine pump.

Dangerously low water levels in the Stockton area during the 1970's caused the electorate to vote overwhelming in favor of a Stockton East Water District Treatment Plant to treat surface water from New Hogan Reservoir.

The State formally recognized the problem in 1982 when it designated the Basin as being "critically overdrafted".

A number of studies have been completed over the years, with the first detailed report by Brown and Caldwell, consulting engineers, accepted in 1985. That study estimated the overdraft to be 269,000 acre-feet annually (AFA) for the 600,000 acre area of San Joaquin County lying easterly of the San Joaquin River.

More recent studies have estimated the overdraft to be anywhere from 130,000 to 200,000 AFA. No absolute number is possible, only estimates, at least at this point.

I will use 200,000 AFA as a reasonable estimate of the overdraft. This works out to be about 0.33 AFA for each of the approximate 600,000 acres within the Basin.

At any rate, the 200,000 AFA figure is reasonable for current development. We know that an overdraft of 200,000 AFA causes groundwater levels to fall about 1 foot per year. Some areas see a little more and others a little less. Please see the following table for wells within the District.

ATTACHMENT "B"

Ground Water Elevation Data

Location	Water Elevations Year/Elevation		Year/Elevation		Decline Feet/Year
Source- EBMUD Records					
e/o Clements Rd & n/o Kettleman	1962	17.7	2002	-21.2	1.0
East end of Kettleman	1962	27.2	2002	-25.6	1.3
Kettleman between Tully & Linn	1962	-1.6	2002	-35.8	0.9
Harney at Tully	1962	-3.6	2002	-38.4	0.9
Jack Tone s/o Harney Lane	1962	-10.0	2002	-38.7	0.7
Tully s/o Harney Lane	1962	-3.2	1988	-23.1	0.8
Tully at Live Oak	1962	-11.3	1988	-27.4	0.7
Linn at Sargent	1962	12.9	2002	-27.0	1
Brandt at Tully	1964	2.8	2002	-24.2	0.7
n/o Sargent, e/o Tully	1962	3.2	2002	-29.9	0.8
Kettleman at Linn	1962	5.2	2002	-34.6	1
Source- County Data					
Liberty Road at Mackville Road	1975	20.0	1998	-13.0	1.4
Liberty at Hwy 88	1975	60.0	1998	60.0	0
Clements at Hwy 88	1975	50.0	1998	3.0	2
Clements at Brandt Road	1975	9.0	1998	-22.0	1.3
Clements at Harney Lane	1975	-10.0	1998	-32.0	1
Source - EBMUD Records					
Liberty e/o Bruella	1962	0.6	1978	-40.1	2.5
Liberty e/o Bruella	1973	-19.0	2002	-35.7	0.6
Collier w/o Bruella	1966	-14.4	2002	-33.4	0.5
Collier w/o Mackville	1962	37.8	1999	-4.9	1.2
Collier w/o Hwy 88	1962	52.5	2002	2.9	1.3
Buena Vista Road	1962	73.6	2002	54.8	0.5
n/o Hwy 12 & e/o Hwy 99	1962	61.8	2002	33.3	0.7
Hwy 88 n/o Hwy 12	1962	47.0	2002	8.5	1

Ground Water Elevation Data

Location	Historical High** Year/Elevation		Water Elevation Latest Year/Elevation		Decline Feet/ Year
Soucre –County Data					
Collier & Eunice	1963	-8.0	2002	-18.6	0.3
Collier & Kennefick	1960	-4.8	2002	-34.5	0.7
Hwy 99 & Jahant	1960	-0.1	2002	-19.6	0.5
Peltier & Kennefick	1958	11.9	2002	-29.8	0.9
Acampo e/o Hwy 99	1958	16.5	2002	-10.6	0.6
Hwy 99 & Woodbridge	1958	24.5	2002	4.0	0.5
Locke w/o Hwy 88	1963	11.5	2002	-15.6	0.7
Brandt & Tully	1959	16.6	2002	-27.6	1
Hwy 12 & Locust Tree	1958	19.7	2002	-18.8	0.9

ATTACHMENT "B"

Ground Water Elevation Data

	Water Elevation				Decline
	Historical High**		Latest		
Source - County Data	**Year/Elevation**		**Year/Elevation**		**Feet/Year**
Hwy 12 & Alpine	1958	21.4	2002	-18.6	0.9
Kettleman & Curry	1960	15.0	2002	-19.7	0.8
Kettleman & Hwy 99	1983	-2.6	2002	-24.3	1.1
Harney & Vintage	1965	-0.7	2002	-32.0	0.8
Harney & Hwy 88	1965	-2.4	2002	-31.0	0.8
Alpine & Handel	1980	-30.5	2002	-32.0	0.1
Armstrong & Lower Sacramento	1960	0.6	2002	-34.2	0.8
Jack Tone & Live Oak	1958	8.6	2002	-46.7	1.3
Ham and West Lane	1971	-1.2	2002	-21.9	0.7

** San Joaquin County and Stockton East Water District began monitoring levels in the 1950's.

Based upon the above assumption that the average overdraft is 0.33 AFA per acre, the 150,000 acre North San Joaquin Water Conservation District (District) has a current overdraft of 50,000 AFA. But only 100,000 acres of the District have been developed and now use 173,000 AFA of groundwater. Some 50,000 acres are dry pasture which are and will be developed.

Vineyards and houses are moving into the dry pasture area. A 200 acre vineyard is replacing dry pasture across from my 10 acres of irrigated pasture (formerly dry).

Assuming a new groundwater demand of 1.75 AF/acre, development of the 50,000 acres will increase the District overdraft to 137,500 AFA.

Accumulated Overdraft

The accumulated overdraft from the time man began pumping groundwater from the Basin probably approaches ten million acre-feet. It would be impractical to try to bring the Basin back to "natural pre-man" conditions. It is generally accepted that the empty, usable space (accumulated overdraft) is somewhere between two and three million acre-feet.

Again, assuming that the accumulated overdraft is spread uniformly throughout the Basin, the District's share is 500,000 to 750,000 acre-feet.

Groundwater Production for 2005-2006*

The following table develops groundwater use by type of development within the District.

Water Code Section 75507 defines water year as July 1st to June 30th.

ATTACHMENT "B"

Estimated Groundwater Use 2005-2006				
Use Code	**Description**	**Quantity**	**AFA/Unit**	**Total AFA**
0	Single Family Dwelling	100 each	0.5	50
51	Rural Residential	2428 each	1	2,428
52	Rural Residential, 2+ Residences	250 each	2	500
291	Nursery	716 Acres	4	2,864
352	Large Winery	10 each	4	40
353	Small Winery	6 each	2	12
-	Misc. Commercial	100 each	0.5	50
401	Irrigated Orchard	8,185 acres	2.8	22,918
420	Irrigated Vineyard	45,309 acres	1.5	67,964
450	Irrigated Row Crops	7,204 acres	2.8	20,171
460	Irrigated Pasture	11,070 acres	4	44,280
462	Horse Ranch	40 each	2	80
471	Dairy	27 each	5	135
480	Poultry Ranch	13 each	5	65
-	Ag. Residences	1,028 each	1	1,028
-	Golf Courses	592 acres	4	2,368
-	Cemeteries	83 acres	4	332
-	Lodi Schools*			27
-	City of Lodi	-	-	9,300
-	Lockeford Community SVC District	-	-	520
-	County Service Areas	-	-	232
-	Micke Grove park	62 acres	4	248
-	Micke Grove Golf Course	87 acres	4	348
	Subtotal			**175,960**
	Less Surface Water			-3000
	TOTAL			**172,960**
	*Not included in City or Service Areas			

I consider the 2005-2006 groundwater production to be fairly normal. Production increases during dry years and decreases when rainfall is high. It also increases slightly when surface water is not available to the District (drier years).

Estimated Overdraft for 2006-2007-and 2007-2008

As stated earlier, the accepted figure for current average annual overdraft is 50,000 AFA for the District. It is greater in dry years and less in wet years and will increase in the future.

By definition, we divide the historical hydrology into five equal classifications; wet, above normal, below normal, dry, and critically dry. This means that overdraft would be greater during roughly 40% of the time, and less during 40% of the time.

We believe that average natural recharge of the Basin is approximately 1 foot per year, from rainfall, irrigation percolation, and streams.

This means that approximately 600,000 AFA are naturally recharged during an average year. Remember that on an average, approximately 800,000 AFA are currently taken from the Basin, causing a 200,000 AFA overdraft. Remember also, that the average water level decline is about 1 foot per year.

Assuming 2006-2007 (with its very hot summer) and apparently dry winter is a "below normal year", we can say that the overdraft will be greater than average, and probably about 100,000 acre-feet.

And, assuming 2007-2008 will be normal, we estimate the overdraft will be 50,000 acre-feet.

Surface Water Needed for 2006-2007

As indicated above, 50,000 acre-feet of surface water would be required annually to offset an average overdraft of that amount, but surface water is not currently available every year.

The only realistic way to deal with an average overdraft of 50,000 AFA, is to use 100,000 acre-feet or more during wet years because none is available in dry years.

The District is currently fighting to keep its current, temporary right to 20,000 AFA of Mokelumne River water which is available almost 70% of the time. The District must not only increase its use from the current 3,000 AFA to 20,000 AFA, but must also acquire another 80,000 AFA for use during wet years, just to cope with the overdraft caused by existing development. Another 175,000 AFA would be required during wet years to replace groundwater used by possible, future development.

A Catastrophe in the Making

The State decided last November to deny the District's petition for extension of its 20,000 AFA right to Mokelumne River water because the District has not used the full 20,000 AFA.

The District petitioned the State for reconsideration of the denial and has been granted a hearing on June 21, 2007. The District must show construction and financing plans at the hearing or will lose the water right.

More recently, the State canceled the County's water right application for Mokelumne River water.

Should a majority of the people within the District oppose the groundwater charge, the District will definitely lose its water right, and the County will probably lose its first priority position for water from the Mokelumne River.

North San Joaquin Water Conservation District and all other agencies within Eastern San Joaquin County must take immediate action to correct the overdraft. If nothing is done, the State will proceed with "adjudication" of the Basin.

Adjudication means limiting groundwater pumping to natural recharge. It would result in

all pumpers being restricted to approximately 75% of what they pump today. It would also eliminate any future development that would need more than 75% of the current groundwater use for a specific location.

Prepared by:

Edward M. Steffani
Registered Civil Engineer
R. C. E. 12852

ATTACHMENT 1

REFERENCES

American Association of Testing and Materials. 1990. Standard D 2488 - 90 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

Bein, Robert, William Frost and Associates, for County of San Joaquin. August 1999. "Final Environmental Impact Report for the Stockton Intermodal Facility." State Clearinghouse Number 98082047.

Bouwer, Herman. 2000. Causes of Infiltration Decreases in Systems for Artificial Recharge of Groundwater, in Innovations in Artificial Recharge, Conference Proceedings, Association of Ground Water Agencies and American Ground Water Trust, May 4-5, Ontario, CA.

Bouwer, Herman. 1999. Artificial Recharge of Groundwater: Systems, Design, and Management; Chapter 24 in Hydraulic Design Handbook, Larry Mays (editor-in-chief), McGraw-Hill.

Bouwer, Herman. 1978. Groundwater Hydrology. McGraw-Hill.

California Department of Conservation Division of Mines and Geology. 1992. Preliminary Fault Activity Map of California. Open-File Report 92-03.

California Department of Conservation Division of Mines and Geology web page. *www.conserv.ca.gov/dmg/rghm/a-p/mapidx/index*

California Department of Pesticide Regulations (Troiano, J., Marade, J., Spurlock, F.). 1999. Empirical Modeling of Spatial Vulnerability Applied to a Norflurazon Retrospective Well Study in California.

California Department of Water Resources. 1963. Bulletin No. 133: Folsom-East Sacramento Ground Water Quality Investigation.

_____. 1967. Bulletin No. 146: San Joaquin County Ground Water Investigation.

_____. July 1969. Water Well Standards, San Joaquin County, Final Supplement. Bulletin 74-5.

_____. 1974. Bulletin 118-3: Evaluation of Ground Water Resources: Sacramento County.

_____. 1975. Bulletin 118: California's Ground Water.

_____. 1980. Bulletin 118-80: Ground-Water Basins in California.

_____, Central District. 1989. Ground Water Study, San Joaquin Valley, Fourth Progress Report.

_____, Central District. 1990. Ground Water Trends in the San Joaquin Valley.

_____. 1991. Changing Practices in Ground Water Management -the Pros and Cons of Regulation.

_____, Central District. 1992. Historical Unconfined Ground Water Trends in the San Joaquin Valley.

_____. 1999. Land Use Maps (DRW Web Page).

California State Department of Public Works, Division of Water Resources. 1955. Water Quality Investigation Report No. 7: Quality of Ground Water in the Stockton Area, San Joaquin County.

California State Geologist. August 1988. Special Report 160.

California State Water Project Authority (McClure, C.R.). 1956. Investigation of the Sacramento-San Joaquin Delta, Report No. 1, Ground Water Geology.

Davies, Darian. 2000. A Study of Perched Mound Growth and Dissipation: Potential Effects on Artificial Recharge Efficiency. M.S. Thesis, University of Arizona.

CH2M HILL, for Central San Joaquin Water Conservation District. 1991. Irrigation Distribution System Project-Stockton, California.

Driscoll, Fletcher G. 1986. Groundwater and Wells, Second Edition. St. Paul: Johnson Filtration Systems, Inc.

East San Joaquin Parties Water Authority (ESJPWA) (in conjunction with EBMUD). July 9, 1999. Beckman Test Injection/ Extraction Project, Final Report. Prepared by Boyle Engineering Corp.

EIP Associates for Stockton East Water District. December 1987. "Farmington Canal Project, Draft Environmental Impact Report."

Gosselink, J.G., and Mitsch W.J. 2000. Wetlands, Third Edition. John Wiley & Sons, Inc., New York, NY.

J.H. Kleinfelder and Associates. 1986. Geotechnical Services, Sanitary Sewer Facility Expansion, Linden, California.

Kleinfelder Inc. 1995. Results of Soil Borings Groundwater Recharge Study, San Joaquin, California.

Knudson, K. L., and William R. Lettis. Preliminary Maps Showing Quarternary Geology of 20 7.5 Minute Quadrangles, 1:100,000, Eastern Stockton, California.

Montgomery Watson. 1999. Farmington Groundwater Recharge/Wetlands Feasibility Study Final Technical Memorandum I: Identification of Candidate Areas.

_____. July 2000. Farmington Groundwater Recharge/Wetlands Feasibility Study Technical Memorandum II: Drilling Results and Pilot Test Site Design.

_____. September 2000. Farmington Groundwater Recharge/Wetlands Feasibility Study Technical Memorandum III: Pilot Test Results.

_____. December 2000. Salinity Assessment and Monitoring Well Network Evaluation, Final Technical Memorandum. Prepared for SJCFCWCD.

_____. February 2001. City of Stockton Delta Water Supply Project, Draft Technical Memorandum 1b: Surface Water Availability Analysis.

Peyton, Dennis E , 2001. Fines Control System- Modified Recharge Basin Floors Maximize Infiltration Efficiency. Presented at the 10th Biennial Symposium on the Artificial Recharge of Groundwater, Tucson, AZ, June 7-9.

Pyne, R. David G. 1995. Groundwater Recharge and Wells, A Guide to Aquifer Storage Recovery. Boca Raton: CRC Press, Inc.

_____. 2000. Task Order 2, In-Kind Services for Farmington Groundwater Recharge/Wetlands Feasibility Study for the San Joaquin County Flood Control and Water Conservation District, Final Task 1 Technical Memorandum: Interpret Geologic and Geophysical Logs.

_____. 1996. Mokelumne Aquifer Recharge and Storage Project Report. Prepared in association with CH2M HIL and Eastern San Joaquin Parties for East Bay Municipal Utility District.

Ridenbaugh Press, 2001. http://www.ridenbaugh.com/srba/watglos.htm

San Joaquin County. 1996. Ceres: State Historical Landmarks, San Joaquin County. California Resources Agency.
http://ceres.ca.gov/geo_area/counties/San_Joaquin/landmarks.html

San Joaquin County Department of Public Works. 1989. Water Investigation Zone No. 2 Engineer's Report.

San Joaquin County Flood Control and Water Conservation District (FCWCD). 1982. Report of Engineer on Investigation Zone No. 1 Groundwater Study.

_____. 1975-1999. San Joaquin County Semi Annual Ground Water Reports.

_____. 1985. Eastern San Joaquin County Groundwater Study. Prepared by Brown & Caldwell Consulting Engineers.

Soil Conservation Service. 1992. Soil Survey of the Stockton Area, California.

Stockton East Water District. 1987. Prepared by Woodward-Clyde Consultants. Geotechnical Explorations for Lower Farmington Canal Project.

_____. 1998. Additional Geoelectrical Surveys at Selected Sites for Ground-Water Recharge Evaluation, San Joaquin, California.

_____. 1998. ESJP Sand Holes Project. Prepared by JBM Consultants.

_____. 1998. Stockton East Water District 205(j) Groundwater Quality Study. Final Report. Prepared by Woodward-Clyde Consultants.

_____. 1999. San Joaquin County Multi-Species Habitat Conservation and Open Space Plan. Document funded by National Fish and Wildlife Foundation.

Thomas, G. A., Fullerton, D. K., et al. 1997. Feasibility Study of a Maximal Groundwater Banking Program for California: A Working Draft.

U.S. Army Corps of Engineers, House Document No. 545, 78th Congress, 2nd Session. Farmington Dam authorized for construction by Flood Control Act approved 22 December 1944. Project purposes were flood control and irrigation.

_____. 1947. Preliminary Definite Project Report: Farmington Dam and Reservoir and Alternatives Thereto, Selection of Plan Improvement. Reported on selected plan studies. Irrigation purpose deleted because of objections of local residents and lack of need at that time.

_____. 1959. Reconnaissance Report for Flood Control on Duck Creek, San Joaquin County, California. Report on need for Duck Creek flood control work.

_____. 1967. Reservoir Regulation Manual, Farmington Reservoir, California. Revised October 1967.

_____. 1974. Flood Plain Information Report: Southeast Stream Group, Stockton, California.

_____. 1974. Unpublished Office Study: Feasibility of Storing Conservation Water in Farmington Reservoir, Littlejohns and Rock Creeks, California.

_____. 1975. Flood Plain Information Report: Southwest Stream Group, Stockton, California.

_____. 1981. Reconnaissance Report: Littlejohns Creek Stream Group Investigations.

_____. 1981. Reconnaissance Report, New Hogan Fishery Investigation, California.

_____. 1983. Hydrology Office Report, Littlejohns Creek Stream Group, California.

_____. 1985. Supplemental Studies to the June 1981 Reconnaissance Report, Office Summary, Littlejohns Creek Stream Group Investigation, California.

_____. 1995. Initial Appraisal Report: Farmington Dam Initial Appraisal Report on the Proposal to Transfer Ownership to Stockton East Water District.

_____. 1997. Reconnaissance Report: Stockton Metropolitan Area, California.

_____. 1997. Conjunctive Use Study: Farmington Dam and Reservoir, California, WRDA 1996 – Section 411 Conjunctive Use Study.

_____. .1998. Real Estate Plan. ER 405-1-12, Change 31. May 1.

U.S. Department of the Interior – Bureau of Reclamation, Mid-Pacific Region. November 1975. Folsom South - Lower American River Alternatives, Central Valley Project, California.

_____. January 1995. American River Water Resources Investigation Planning Report and Draft Environmental Impact Report/Environmental Impact Statement.

_____ and U.S. Fish and Wildlife Service. 1995. Surface Storage and Conveyance Technical Appendix # 6 to the final least-Cost CVP Yield Increase Plan. September.

U.S. Environmental Protection Agency. Values and Functions of Wetlands. *http://www.epa.gov/OWOW/wetlands/wetlanda.html*

U.S. Fish and Wildlife Service. 1998. The Agricultural Waterfowl Incentive Program, Accomplishment Report, FY 1998. Central Valley Project Improvement Act.

_____. 1999. The Agricultural Waterfowl Incentive Program, Accomplishment Report, FY-1998.

U.S. Geological Survey (Stearns, H.T., et al.). 1930. Ground Water in the Stockton Area, California. USGS Open-File Report.

_____ (Berkstresser, C.F.). 1973. Map showing Base of Fresh Ground Water, approximately 3,000 micromhos, in the Sacramento Valley and the Sacramento-San Joaquin Delta, California. USGS Water Resources Investigations Report 40-73.

_____ (Page, R.W.). 1973. Base of Fresh Ground Water (approximately 3,000 micromhos), San Joaquin Valley, California. USGS Hydrologic Investigations Atlas HA-489.

_____ (Sorenson, S.K.). 1981. Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California. USGS Water Resources Investigations Report 81-26.

_____ (Ireland, R.V.). 1982. Water Resources Investigation Report 83-4207.

_____ (Mitten, H.T.). 1982. Preliminary Evaluation of the Potential for Artificial Ground-Water Recharge in Eastern San Joaquin County, California. USGS Open-File Report 82-123.

_____ (Templin, W.E.). 1984. Ground-Water-Quality Monitoring Network Design for the San Joaquin Valley Ground-Water Basin, California. USGS Water Resources Investigations Report 83-4080.

_____ (Mitren, Ireland, & Hamlin, S.N.). 1987. Evaluation of the Potential for Artificial Ground-Water Recharge in Eastern San Joaquin County, California. Phase 1, 2 & 3. USGS Open File Report 82-123, and Water Resources Investigations Reports 83-4207, 87-4164, resp.

_____ (S. N. Hamlin). 1987. Evaluation of the Potential for Artificial Ground-Water Recharge in Eastern San Joaquin County, California. Phase 3. Water Resources Investigations Report 87-4164.

_____ (Shelton, L.R., and Miller, L.K.). 1988. Water Quality Data, San Joaquin Valley, California. March 1985 to March 1987. USGS Open-File Report 88-479.

_____ (Williamson, A. K., et al.). 1989. Ground-Water Flow in the Central Valley, California. USGS Professional Paper 1401-D.

_____ (Bertoldi, G. L., et al.). 1991. Ground Water in the Central Valley, California - A Summary Report. USGS Professional Paper 1401-A.

_____ (Dubrovsky, N.M., et al.). 1991. Geochemical Relations and Distribution of Selected Trace Elements in Ground Water of the Northern Part of the Western San Joaquin Valley, California. USGS Water-Supply Paper 2380.

_____ (Page, R.W.). 1996. Geology of the Fresh Ground-Water Basin of the Central Valley, California. USGS Professional Paper 1401-C.

Wetlands and Their Economic Benefits. *http://www.biopoint.com/webessay.html*

Section 9
References

American River Basin Cooperating Agencies. 2000. Regional Water Master Plan Phase II Task 5 Develop and Refine Groundwater Model North American River IGSM Water Level Hydrographs 1970-1995-Draft.

American River Water Resources Investigation, 1995, Plan Formulation Report and Administrative Draft Environmental Impact Report/Environmental Impact Statement. (Excerpts from Draft EIR/EIS).

Bertoldi, G. L., 1991, Ground Water in the Central Valley, California - A Summary Report, Regional Aquifer-System Analysis-Central Valley, California, U.S. Geological Survey, Professional Paper 1401-A.

Borcalli & Associates, Inc. 1995. County Water Master Plan (revised 1996). Borcalli & Associates, Sacramento, CA. Report Prepared for Calaveras County Water District.

Boyle Engineering Corporation. 1999. Beckman Test Injection/Extraction Project. Boyle Engineering, Sacramento, CA. Report prepared for East San Joaquin Parties Water Authority in Conjunction with East Bay Municipal Utility District.

Brown and Caldwell Consulting Engineers. 1985. Eastern San Joaquin County Groundwater Study, San Joaquin County Flood Control and Water Conservation District, Final Report. Brown and Caldwell, Sacramento, CA. Prepared for San Joaquin County Flood Control and Water Conservation District.

Brown & Caldwell Consulting Engineers, 1995, Final Report, Eastern San Joaquin County Groundwater Study, San Joaquin County Flood Control and Water Conservation District.

Brown and Caldwell Consulting Engineers. 2001. Urban Water Management Plan. Brown and Caldwell, Rancho Cordova, CA. Prepared for the City of Lodi.

Calaveras County Water District. 1996. County Water Master Plan.

CALFED Bay-Delta Program. 1999. Water Use Efficiency Program Plan, Draft Programmatic EIS/EIR Technical Appendix.

California Department of Water Resources, 1997. Bulletin 160-98. Accessed July 20, 2001. Available from: http://wwwowe.water.ca.gov/pubs.jsp

California State Water Resources Control Board, 1978, Maps of Salinity Intrusion into the Bay-Delta Area.

Carollo Engineers. 1996. Recycled Water Market Evaluation. Report Prepared for the City of Stockton, Department of Municipal Utilities.

CH2Mhill, 1999, Stanislaus Basin Integrated Groundwater and Surface Water Model Report, Prepared for U.S. Bureau of Reclamation.

City of Lathrop. 1991. Comprehensive General Plan and Environmental Impact Report for the City of Lathrop, California.

City of Lodi. 1996. 1995 City of Lodi Urban Water Management Plan.

City of Ripon. 1997. General Plan 2035, Volume I-Policy Document and Volume II-Environmental Impact Report.

City of Stockton. 1990. General Plan, Background Report. Stockton, CA

City of Stockton. 1990. General Plan, Policy Document. Stockton, CA.

City of Stockton, Department of Municipal Utilities. 1996. 1995 Update Urban Water Management Plan-Draft.

City of Tracy and The Planning Center. 1993. General Plan, An Urban Management Plan. Tracy, CA.

Department of Water Resources, 1967, San Joaquin County Groundwater Investigation, Bulletin No. 146.

Department of Water Resources, 1994. General Comparisons of Water District Acts, Bulletin 155. Accessed June 20, 2001. Available from http://elib.cs.berkeley.edu/kopec/b155/html/home.html

Department of Water Resources, 1998, The California Water Plan Update, Bulletin No. 160-98.

Environmental Science Associates (ESA). 1999. South County Surface Water Supply Project Environmental Impact Report. ESA, California. Prepared for South San Joaquin Irrigation District.

Groundwater Atlas of the United States - Segment 1 California Nevada, U.S. Geological Survey.

Haight and Weatherby. 1970. Calveras County Comprehensive Water and Sewer Study. Haight and Weatherby, San Andreas, California. Report prepared for Calveras County Water District.

J. Laurence Mintier & Associates, Jones & Stokes Associates, Joseph R. Holland and Pepper Associates. 1988. Manteca General Plan-Assessment Report (Final EIR). Report prepared for City of Manteca.

J. Laurence Mintier & Associates, Jones & Stokes Associates, Joseph R. Holland and Pepper Associates. 1988. Manteca General Plan-Background Report. Report prepared for City of Manteca.

J. Laurence Mintier & Associates, Jones & Stokes Associates, Joseph R. Holland and Pepper Associates. 1988. Manteca General Plan-Policy Document. Report prepared for City of Manteca.

James M Montgomery Consulting Engineers Inc. (JMM) 1990. Documentation and User's Manual for Integrated Groundwater and Surface Water Model. JMM. Report prepared for U.S. Bureau of Reclamation, California Department of Water Resources, California State Water Control Board, Contra Costa Water District, California.

Jones & Stokes Associates Inc. 1991. City of Lodi General Plan- Policy Document. Jones & Stockes, Sacramento, California. Report prepared for the City of Lodi.

Kennedy/Jenks Consultants. 1994. Final Report, Water Master Plan, City of Tracy, California. Kennedy/Jenks, San Francisco, California. Report prepared for the City of Tracy.

Kennedy/Jenks Engineers. 1985. Final Report, Water System Master Plan, City of Manteca. Kennedy/Jenks, San Francisco, California. Report prepared for the City of Manteca.

Kjeldsen-Sinnock & Associates, Inc. 1981. City of Escalon Master Water Plan. Kjeldsen-Sinnock & Associates, Inc., Stockton, California. Report prepared for the City of Escalon.

Lew-Garcia-Davis Engineers/surveyors. 1992. Water System Master Plan, City of Lathrop. Lew-Garcia-Davis, Ceres, California.

Montgomery Watson, 1990, Central Valley Ground-Surface Water Model, Central Valley, California (CVGSM).

Montgomery Watson Americas, Inc. in association with CH2M HILL. 1996. Mokelumne Aquifer Recharge and Storage Project. Montgomery Watson, Sacramento, CA. Report prepared for East Bay Municipal Utility District and the Eastern San Joaquin Parties

Montgomery Watson, 1999, Final Technical Memorandum I, Identification of Candidate Recharge Areas and Pilot Test Sites, Farmington Groundwater Recharge/Wetlands Feasibility Study. U.S. Army Corps of Engineers.

Montgomery Watson. 2000. Farmington Groundwater Recharge/Wetlands Feasibility Study. Draft—Technical Memorandum II Drilling Results & Pilot Test Design. Montgomery Watson, Sacramento, CA. Report Prepared for U.S. Army Corps of Engineers, Stockton East Water District, City of Stockton, San Joaquin County, Central San Joaquin Water Conservation District, North San Joaquin Water Conservation District.

Oakdale Irrigation District. 1995. Groundwater Management Plan.

Nolte Associates, Inc. 2000. City of Lathrop Water, Wastewater, Recycled Water Master Plan. Nolte Associates, Sacramento, CA. Report prepared for the City of Lathrop.

Page, R. W., 1986, Geology of the Fresh Ground-Water Basin of the Central Valley, California, with Texture Maps and Sections. Regional Aquifer-System Analysis: U.S. Geological Survey, Professional Paper 1401-C.

Pichard, Terry L., Verdegaal, Paul S., 2001. Irrigation of Quality Wine Grapes. University of California, Davis.

PSOMAS. 1990. City of Lodi, Water Master Plan. Report prepared for the City of Lodi.

Sacramento Metropolitan Water Authority, U.S. Bureau of Reclamation. 1995. American River Water Resources Investigation Plan Formulation Report and Administrative Draft Environmental Impact Report/Environmental Impact Statement.

Sacramento Metropolitan Water Authority and U.S. Department of the Interior Bureau of Reclamation. 1996. American River Water Investigation (ARWI). Planning Report and Draft Environmental Impact Report/Environmental Impact Statement. Appendices, Volume I

San Joaquin County. 1992. General Plan 2010, Volume I: Policies/Implementation

San Joaquin County. 1992. General Plan 2010, Volume II: Community Plans.

San Joaquin County. 1992. General Plan 2010, Volume III: Technical Appendices.

San Joaquin County. 2000. General Plan 2010 Review.

Stoddard & Associates. 1995. Groundwater Management Plan for the Northern Agencies in the Delta-Mendota Canal Service Area and a Portion of San Joaquin County. Stoddard & Associates, Los Banos, CA. Report Prepared for San Luis & Delta-Mendota Water Authority.

Surface Water Resources Inc. November 2000. Memorandum on Surface Water Availability.

United States Bureau of Reclamation. New Melones Dam. Accessed July 20, 2001. Available from: http://dataweb.usbr.gov/dams/ca10246.htm

United States Department of the Interior Bureau of Reclamation. 12/08/00. Long Term Contract Renewal Process. Available from http://www.mp.usbr.gov/cvpia/3404c/ea_eis/index.html

Williamson, A. K., 1989, Ground-Water Flow in the Central Valley, California, Regional Aquifer-System Analysis: U.S. Geological Survey, Professional Paper 1401-D.

Woodbridge Irrigation District. 1994. Woodbridge Irrigation District Agricultural Water Management Plan Informal Report.

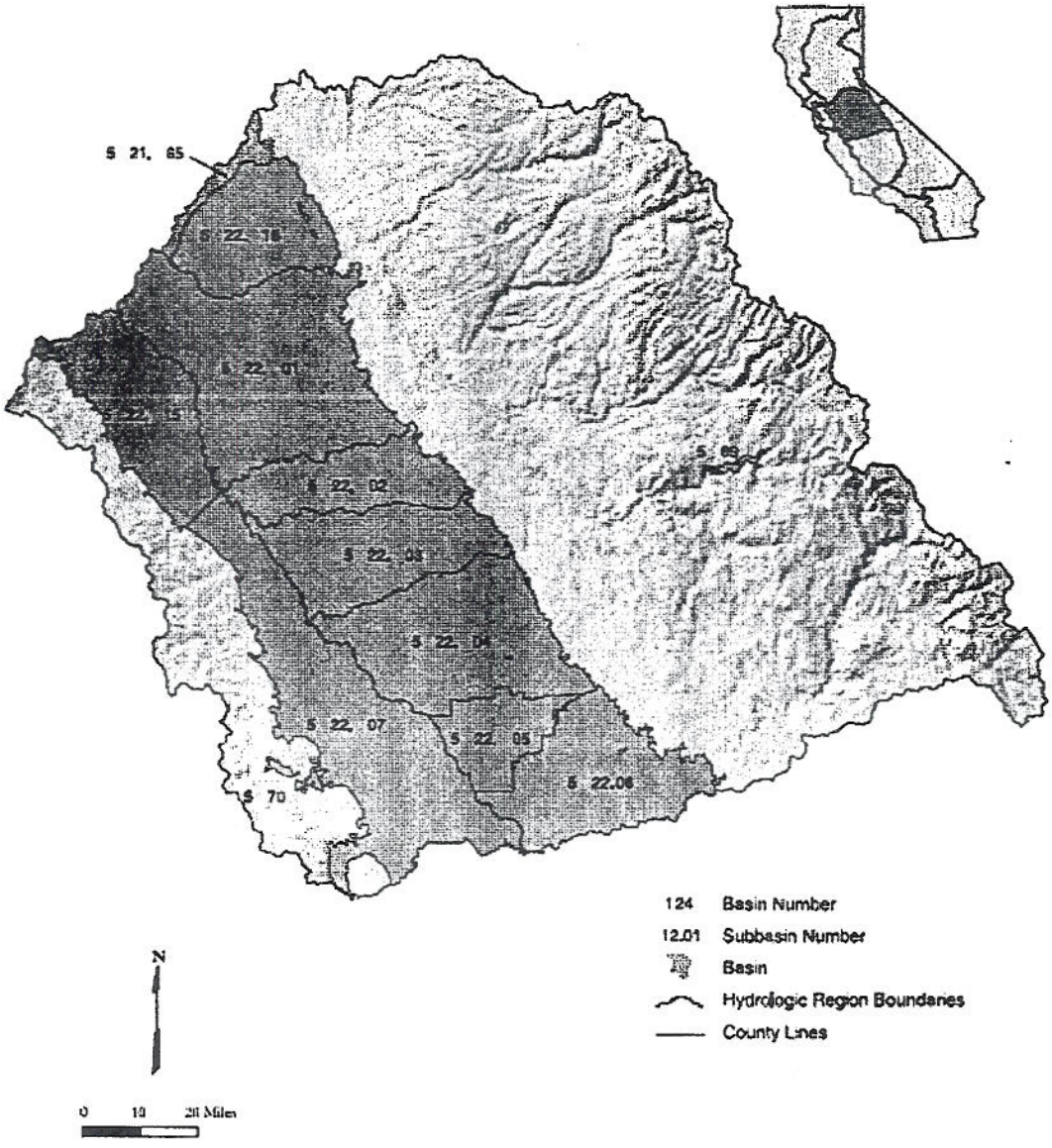
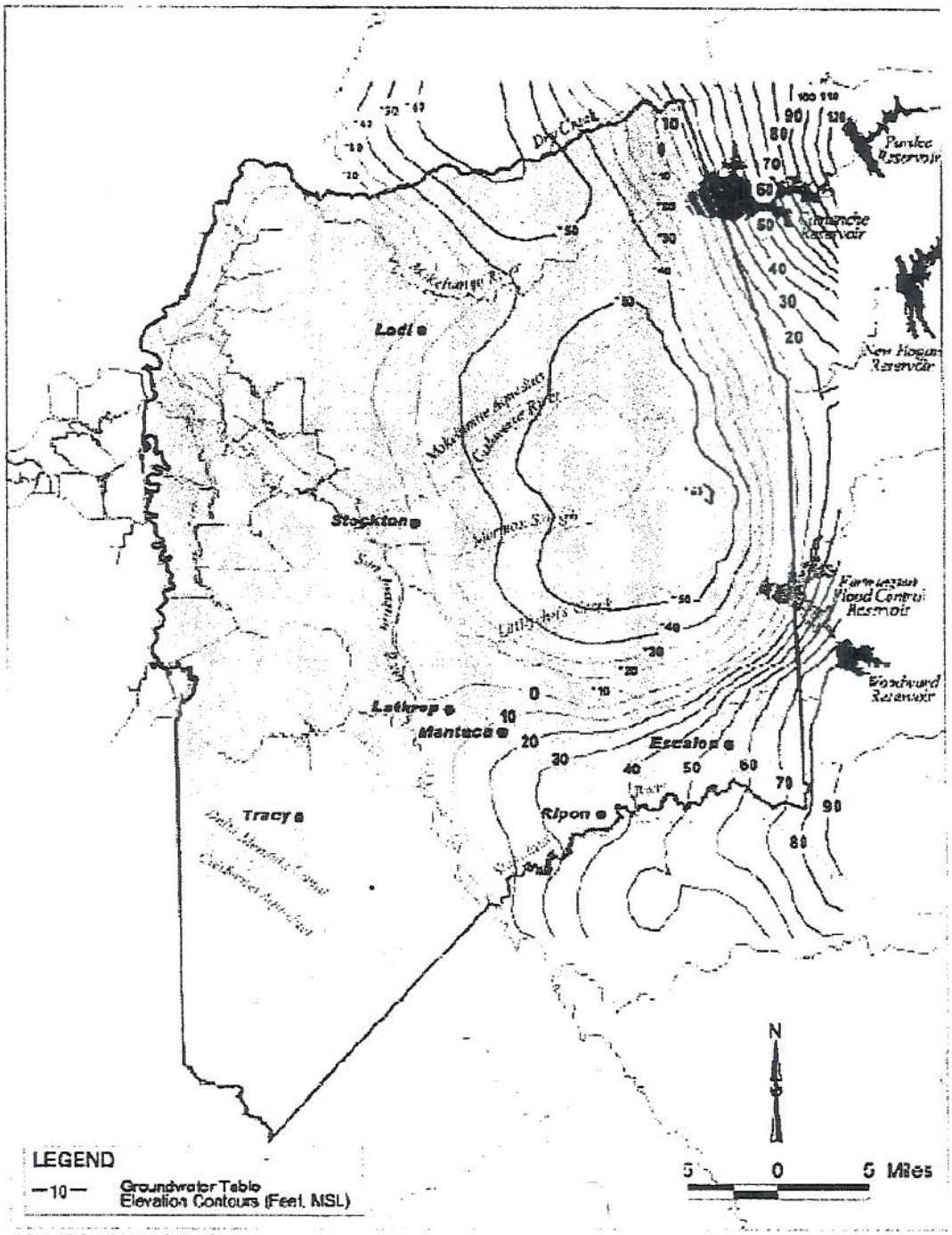


Figure 35 San Joaquin River Hydrologic Region



SAN JOAQUIN COUNTY
WATER MANAGEMENT PLAN

CDM Camp Dresser & McKee

Figure 2-5
SIMULATED GROUNDWATER TABLE CONTOUR MAP FOR 2000

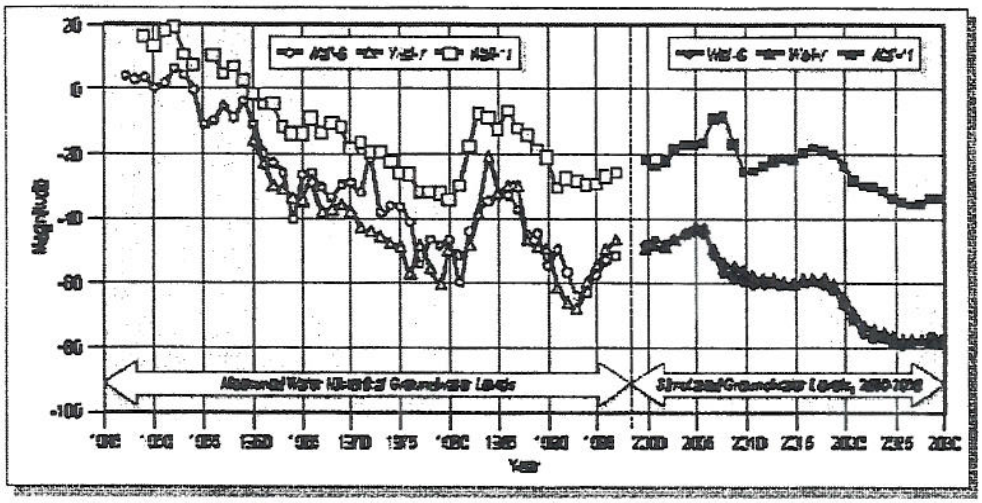


Figure 2-6

Decline of Historic and Projected Groundwater Levels

ATTACHMENT 3

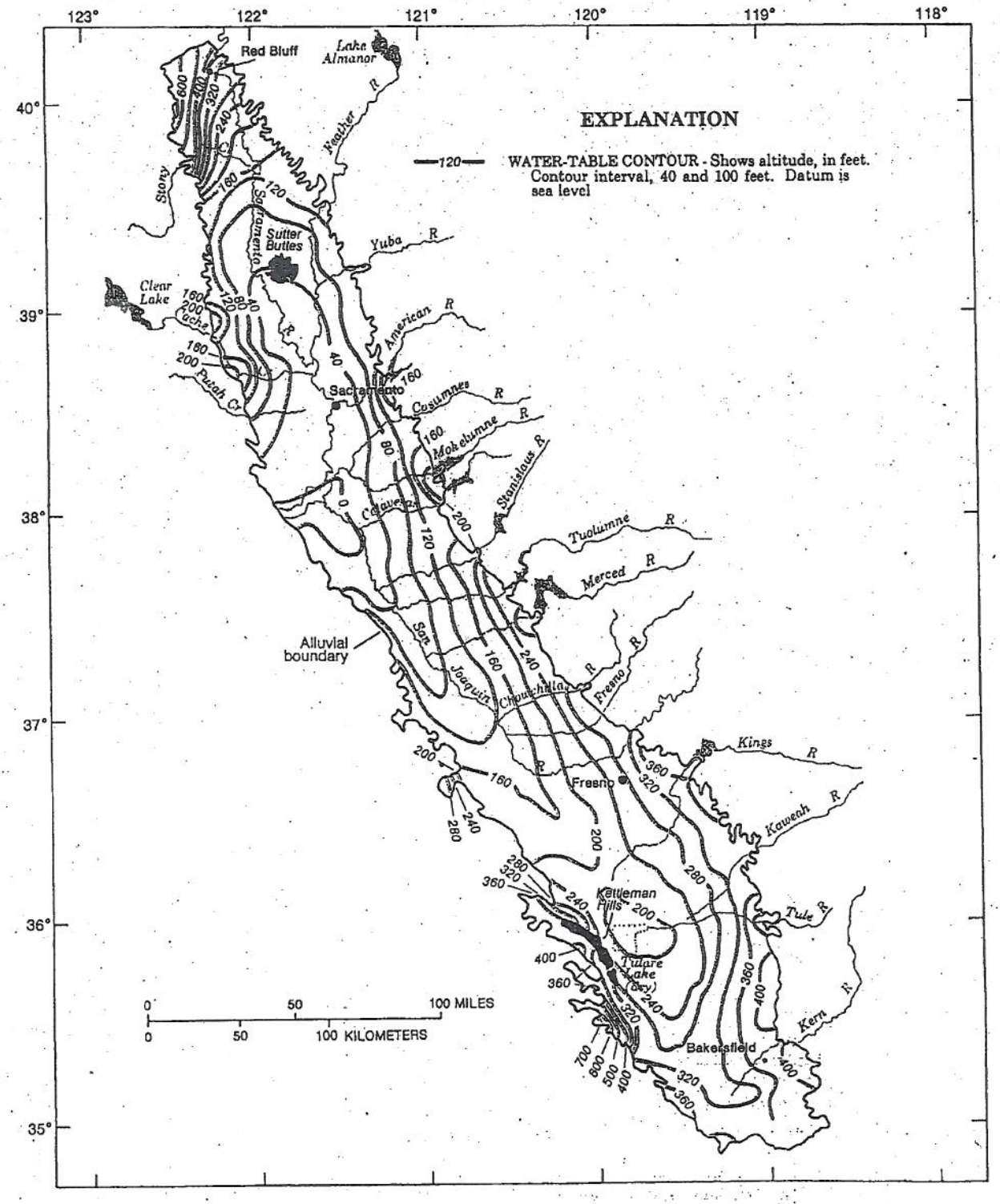


FIGURE 11.—Estimated predevelopment water table (modified from Williamson and others, 1989).

ATTACHMENT 4