Water Supply Contracts Between the State of California Department of Water Resources and CLWA including Amendment No. 18 (41,000 Acre-Feet Water Transfer)

UPPER SANTA CLARA VALLEY WATER AGENCY

Location and Size

The Agency is located in Los Angeles County about 40 miles northwest of the city of Los Angeles. The Agency, as of July 1, 1964, encompassed an area of 86,100 acres and had an estimated population of 26,000.

Water Supply and Utilization

The entire water supply utilized within the Agency is obtained from underlying ground water basins. There are no streams within the Agency on which a dependable surface water supply could be developed. Water requirements in excess of the safe yield of the local ground water supply will be met with water from the State Water Project. Primary use of water in 1960 was for irrigated agriculture but by 1970 and thereafter the primary use is expected to be for municipal and industrial purposes.

Items of Contract Information Unique to Agency

Date of Contract - Preamble

April 30, 1963

Agency's Principal Place of Business - Preamble

Newhall

Estimated Year of Initial Water Delivery - Article 6(a)

1972

Date of Request as to Delivery Structures - Article 10(b)

June 30, 1963

Limit on Instantaneous Rate of Delivery - Article 12(c)

42 cfs (Increased by Amendment No. 2 to 48 cfs.)

E. SPECIAL PROVISIONS AND TABLES

45. SPECIAL PROVISIONS

(a) On or before June 30, 1963, the Agency shall furnish to the State its written request specifying the year in which the first delivery of project water from the West Branch Aqueduct as defined in Table H of this contract shall be made to the Agency. The timing of first deliveries of project water from said Branch Aqueduct shall be as so requested by the Agency: *Provided*, That in the event said request is, in the judgment of the State, incompatible with similar requests received from other contractors to be served from or through said Branch Aqueduct, which contractors have executed contracts with the State on or before June 30, 1963, the timing of first deliveries of project water to the Agency and such other contractors from said Branch Aqueduct shall be as established by mutual agreement among the State, the Agency, and said contractors: *Provided further*, That if such agreement has not been reached on or before December 31, 1963, the State may then construct said Branch Aqueduct in accordance with such construction schedules as, in the judgment of the State, will best serve the interests of all those contractors whose service areas are located south of the South Portal of the Tehachapi Tunnels and which have executed contracts with the State on or before June 30, 1963.

(b) The State shall provide sufficient capacity in the transportation facilities, subject to the provisions of Article 17(b), to deliver 11 percent of the Agency's annual entitlement in each of four months in each year. Subject to the foregoing limitation, in scheduling deliveries under Article 12(a) the State will provide for up to 1/9 of the Agency's annual entitlement to be delivered in excess of a rate of 8 1/3 percent of the annual entitlement per month.

(c) The annexations to the Agency, authorized by Ordinance No. 3 of the Agency dated March 13, 1963, are deemed to be approved by the department within the meaning of Article 15(b) and are generally described as the Val Verde--Hasley Canyon Area annexation, comprising approximately 7,280 acres, situated westerly of the Agency.

TABLE H

PROJECT TRANSPORTATION FACILITIES
UPPER SANTA CLARA VALLEY WATER AGENCY

A San Joaquin Valley–Southern California Aqueduct extending to Castaic Reservoir on the West Branch Aqueduct defined below, to the extent such aqueduct is determined by the State to be required for water transportation.

> "West Branch Aqueduct" shall mean that portion of the San Joaquin Valley–Southern California Aqueduct specified in Section 12934(d) (2) of the Water Code extending from the Junction of East and West Branches to a terminus in the vicinity of Newhall, Los Angeles County.

IN WITNESS WHEREOF, the parties hereto have executed this contract on the date first above written.

Approved as to legal form and sufficiency:

P. G. Towner

Chief Counsel
Department of Water Resources
P. O. Box 388
Sacramento, California

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By William E. Warne
Director

Attest:

Helen L. Thompson

Secretary
P.O. Box 328
Newhall, California

UPPER SANTA CLARA VALLEY WATER AGENCY

By Mr G. Bonelli Jr.
President

Approved as to form and execution:

Stanley C Lagerlof
Counsel

By Everett W Nichols
Director

By Earl Schmidt
Director

By [illegible]
Director

By Robert L. Essick
Director

By Roger C. Morey
Director

By E. Ray Fisher
Director

WHEREAS, the State and the Agency are desirous of making certain changes and additions to the above-mentioned contract, while otherwise continuing the contract in full force and effect;

NOW THEREFORE, it is mutually agreed that the following changes and additions are hereby made to the Agency's water supply contract with the State:

Article 46 is added to the contract to read as follows:

46. Amendatory Provisions

a. Surplus Water

Notwithstanding other provisions of this contract, surplus water for agricultural and ground water replenishment use shall be offered to contractors on the following basis. Before surplus water is sold for other than agricultural and ground water replenishment use, each contractor shall have the right, subject to the ability of the State to deliver such water, to contract for agricultural and ground water replenishment use for a portion of the total amount of surplus water available in any year, in an amount which bears the same ratio to the total amount of surplus water available in that year as the sum of the annual entitlements delivered to the contractor for agricultural and ground water replenishment use during the preceding three years bears to the total amount of the annual entitlements delivered for agricultural and ground water replenishment use during the preceding three years of all contractors requesting surplus water: Provided, That if its proportion of such surplus water is not required by or cannot be delivered to any contractor, such amount of additional surplus water shall be offered to other contractors for agricultural and

under the provisions of Article 21.

As used in this subdivision "ground water replenishment use" shall mean the use of project water exclusively by direct application to spreading basins, streambeds, or through other means of direct artificial recharge for the purpose of replenishing overdrawn ground water basins.

b. Surcharge Credit

Notwithstanding other provisions of this contract, the State may include provisions in water supply contracts allowing a credit to a contractor not to exceed the surcharge to be paid by such contractor: Provided, That such credit shall be utilized to reduce the cost of water for agricultural use on other than excess land at a uniform rate per acre-foot not to exceed two dollars ($2) per acre-foot. Any contract including provisions pursuant to this subdivision shall assure that the reductions in the contractors' obligations authorized by this subdivision are made available exclusively for the benefit of agricultural use on land other than excess land and are not directly or indirectly made available for the benefit of agricultural use on excess land.

STATE OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 2 TO WATER SUPPLY
CONTRACT BETWEEN THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES AND
UPPER SANTA CLARA VALLEY WATER AGENCY

THIS CONTRACT, made this 22nd day of December 1964, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Upper Santa Clara Valley Water Agency, a public agency in the State of California, duly organized, existing, and acting pursuant to the laws thereof with its principal place of business in Newhall, California, herein referred to as the "Agency",

WITNESSETH, That:

WHEREAS, the State is authorized to construct and operate facilities for the storage and conveyance of water, certain of which facilities will make water available to the Agency; and

WHEREAS, the State and the Agency have entered into a water supply contract, dated April 30, 1963, as amended November 15, 1963, providing that the State shall supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment; and

1. Subdivision (k) of Article 1 is amended to read as follows:

(k) Minimum Project Yield

"Minimum project yield" shall mean the dependable annual supply of project water to be made available, estimated to be 4,230,000 acre-feet per year, said amount to be determined by the State on the basis of coordinated operation studies of initial project conservation facilities and additional project conservation facilities, which studies shall be based upon:

(1) The estimated relative proportion of deliveries for agricultural use to deliveries for municipal use for the year 1990, and the characteristic distributions of demands for these two uses throughout the year.

(2) An allowable reduction in the agricultural use portion of the minimum project yield, due to drought, of not to exceed fifty percent (50%) in any one year, nor a total of one hundred percent (100%) of one year's supply in any series of seven consecutive years.

(3) Agreements now in effect or as hereafter amended or supplemented between the State and the United States and others regarding the diversion or utilization of waters of the Delta or streams tributary thereto.

2. Table A of the contract entitled "Annual Entitlements Upper Santa Clara Valley Water Agency" is amended to read as follows:

4. Subdivision (a) of Article 16 is amended to read as follows:

(a) Limit on Total of All Maximum Annual Entitlements

The Agency's maximum annual entitlement hereunder, together with the maximum annual entitlements of all other contractors, shall aggregate no more than the minimum project yield as defined herein and in no event more than 4,230,000 acre-feet of project water.

5. Subdivision (b) of Article 45 is amended to read as follows:

(b) The State shall provide sufficient capacity in the transportation facilities, subject to the provisions of Article 17(b), to deliver 11 percent of the Agency's annual entitlement in each of eight and one half months in each year. Subject to the foregoing limitation, in scheduling deliveries under Article 12(a) the State will provide for up to 22 2/3 percent of the Agency's annual entitlement to be delivered in excess of a rate of 8 1/3 percent of the annual entitlement per month.

6. Article 46 is amended to read as follows:

46. Amendatory Provisions

(a) Surplus Water

Notwithstanding other provisions of this contract, surplus water for agricultural and ground water replenishment use shall be offered to contractors on the following basis. Before surplus water is sold for other than agricultural and ground water replenishment use, each contractor shall have the right, subject to the ability of the State to deliver such water and to the

contractor shall furnish certified copies of such records and data concerning the use of water within its boundaries as the State may request.

The provisions of this paragraph shall be applicable only to contractors in the San Joaquin Valley Service Area, contractors in the Southern California Service Area, and contractors in the Central Coastal Service Area. Before surplus water is sold for other than agricultural and ground water replenishment use, each such contractor shall have the right, subject to the ability of the State to deliver such water, to contract for agricultural and ground water replenishment use in accordance with the following formula: contractors in the San Joaquin Valley Service Area shall have a right to contract for sixty-nine percent (69%) of the surplus water available at the Mile 18 Pumping Plant; contractors in the Southern California Service Area shall have a right to contract for twenty-nine percent (29%) of such water; and contractors in the Central Coastal Service Area shall have a right to contract for two percent (2%) of such water: Provided, That within each of these service areas, each contractor shall have the right to contract for agricultural and ground water replenishment use for a portion of the total amount of surplus water available to that service area in any year, in an amount which bears the same ratio to the total amount of surplus water available to the service area in that year as the sum of the annual entitlements, set forth in Table A of this contract, delivered to the contractor for agricultural and ground water replenishment use during the preceding three years bears to the

and Ventura County Flood Control District; "contractors in the Central Coastal Service Area" shall mean: San Luis Obispo County Flood Control and Water Conservation District and Santa Barbara County Flood Control and Water Conservation District.

The provision of this paragraph shall be applicable only to a contractor to which the delivery of project water for municipal use as of 1990 is estimated by the State to be in excess of fifty percent (50%) of such contractor's maximum annual entitlement. For the purpose of fixing such contractor's right to delivery of surplus water, water from a watershed not tributary to the contractor's area which is delivered within the contractor's boundaries for agricultural or ground water replenishment use shall be deemed to be part of the contractor's annual entitlement delivered for such use in computing the quantity of surplus water to which the contractor is entitled under this subdivision: Provided, That the contractor shall not be deemed to have used more than its annual entitlement, as set forth in Table A, for such use. Surplus water shall be deemed to be used by the contractor for agricultural or ground water replenishment use if an equal quantity of water imported from a watershed not tributary to the contractor's area is delivered within the contractor's boundaries for such use.

In providing for the delivery of surplus water to contractors pursuant to this subdivision, the State shall refuse to deliver such surplus water to any contractor to the extent that the State determines that such delivery would tend to encourage the development of an economy within the area served by such contractor which would be dependent upon the sustained delivery of

under the provisions of Article 21. Nothing in this subdivision shall limit the right of the Agency to increase its annual entitlements as otherwise provided in this contract.

As used in this subdivision "ground water replenishment use" shall mean the use of project water exclusively by direct application to spreading basins, streambeds, or through other means of direct artificial recharge for the purpose of replenishing overdrawn ground water basins.

(b) Surcharge Credit

Notwithstanding other provisions of this contract, the State may allow a credit to each contractor not to exceed the surcharge paid by such contractor.

For the purpose of this contract, the surcharge credit shall be determined and applied in the following manner:

(1) The State shall, in each year after the year of initial water delivery, allow a credit to the Agency in the amount of the surcharge forwarded by the Agency to the State in the preceding year.

(2) The Agency shall not establish water rates, or tax or assessment rates, so as to cause the surcharge credit to be passed on to water users in a manner which will bring about a greater reduction in the cost per acre-foot of project water put to use on excess land than such cost of project water put to use on other than excess land.

This subdivision 46(b) shall be separable from all other provisions in this contract, and in the event that any or all of the provisions of this subdivision are in any manner or to any extent

STATE OF CALIFORNIA

DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 3 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UPPER SANTA CLARA VALLEY WATER AGENCY

THIS CONTRACT, made this 24th day of January 1966, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Upper Santa Clara Valley Water Agency, a public agency in the State of California, duly organized, existing, and acting pursuant to the laws thereof with its principal place of business in Newhall, California, herein referred to as the "Agency",

WITNESSETH, That:

WHEREAS, the State is authorized to construct and operate facilities for the storage and conveyance of water, certain of which facilities will make water available to the Agency; and

WHEREAS, the State and the Agency have entered into a water supply contract, dated April 30, 1963, as amended

TABLE A
Annual Entitlements
Upper Santa Clara Valley Water Agency

Year	Total Annual Amount In Acre-Feet
1	1,600
2	3,700
3	5,700
4	7,500
5	9,500
6	11,400
7	13,400
8	15,300
9	17,700
10	20,100
11	22,100
12	24,600
13	26,900
14	29,100
15	30,900
16	32,900
17	35,300
18	37,400
19	39,300
20	41,500
And each succeeding year thereafter, for the term of this contract:	41,500

3. Subdivision (c) of Article 12 is amended to read as follows:

(c) Limit on Rate of Delivery to Agency

In no event shall the State be obligated to deliver water to the Agency through all delivery structures at a total combined instantaneous rate of flow exceeding seventy-six (76) cubic feet per second, except as this rate of flow may be revised by amendments of this article after submission to the State of the Agency's requests with respect to maximum flow capacities to be provided in said delivery structures, pursuant to Article 10.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 4 TO WATER SUPPLY CONTRACT
BETWEEN THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES AND
UPPER SANTA CLARA VALLEY WATER AGENCY

THIS CONTRACT, made this 31st day of December, 1969, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Upper Santa Clara Valley Water Agency,

herein referred to as the "Agency";

WITNESSETH, That

WHEREAS, the State and the Agency have entered into and subsequently amended a water supply contract providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment; and

WHEREAS, Article 22(b) of such water supply contract provides that for each year through the year 1969 the Delta Water Charge shall be the product of $3.50 and the Agency's annual entitlement for the respective year and that beginning in the year 1970, the Delta Water Charge shall be the sum of the capital cost component, minimum operation, maintenance, power and replacement component, and

Thermalito power facilities through Central Valley Project Revenue Bonds and may finance other portions of the project facilities through additional revenue bond issues, bonds issued under other authority granted by the Legislature or the voters, bonds issued by other state agencies, advances from contractors, and other methods under which the financing costs relate to interest rates that may exceed the interest rate of the bonds issued under the Bond Act; and

WHEREAS, either the State or contractors making advances to the State may be subject to interest rates, or other financing costs that relate to interest rates, which will be greater than the "project interest rate" as presently defined in the contracts; and

WHEREAS, the parties desire that (1) the interest costs hereafter incurred by or on behalf of the State in financing the construction of project facilities by means other than the use of moneys provided under the Bond Act will be reflected in appropriate adjustments of the "project interest rate" (excepting the interest costs incurred for the Central Valley Project Revenue Bonds issued prior to the date of this amendment); (2) appropriate credit will be given to any contractor having made an advance of funds to the State corresponding to the bond service obligation payable by such contractor by reason of such advance or if bonds were not used to obtain funds for such advance, then to the net interest cost which would have resulted if the contractor had sold bonds for the purpose of funding the advance; and (3) if any sources of funds other than those provided under the Bond Act are employed to finance the construction of specific project facilities and the interest or other costs of such financing are greater than the cost would have been if bonds issued under the Bond Act had been used, appropriate

"Project interest rate" shall mean the weighted average interest rate of (1) through (6) below computed by dividing (i) the total interest cost required to be paid or credited by the State during the life of the indebtedness or advance by (ii) the total of the products of the various principal amounts and the respective terms in years of all such amounts:

(1) general obligation bonds issued by the State under the Bond Act,

(2) revenue bonds issued by the State under the Central Valley Project Act after May 1, 1969,

(3) bonds issued by the State under any other authority granted by the Legislature or the voters,

(4) bonds issued by any agency, district, political subdivision, public corporation, or non-profit corporation of this State,

(5) funds advanced by any contractor without the actual incurring of bonded debt therefor, for which the net interest cost and terms shall be those which would have resulted if the contractor had sold bonds for the purpose of funding the advance, as determined by the State, and

(6) funds borrowed from the General Fund or other funds in the Treasury of the State of California, for which the total interest cost shall be computed at the interest rate earned over the period of such borrowing

construction of specific project facilities, any additional costs incurred because of such financing will not be charged to the contractors, except for adjustments to the "project interest rate".

Approved as to legal form and sufficiency:

C. Turner

Chief Counsel
Department of Water Resources
P. O. Box 388
Sacramento, California

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

By W. R. Gianelli
Director

Approved as to form and execution:

Counsel

UPPER SANTA CLARA VALLEY
WATER AGENCY

By [illegible]
President

1971 the Delta Water Charge shall be the sum of the capital cost component, minimum operation, maintenance, power and replacement component, and variable operation, maintenance, power and replacement component computed in accordance with Articles 22(c) and (d) of the water supply contract; and

WHEREAS, Articles 22(e) and (g) of such water supply contract provide that the Delta Water Charge as computed in accordance with Articles 22(c) and (d) shall include all projected costs of additional project and supplemental conservation facilities commencing in the years in which the State first incurs capital costs for such facilities after the facilities are authorized; and

WHEREAS, the parties desire that all water supply contracts be amended to postpone inclusion of the projected costs of any authorized additional project and supplemental conservation facilities in the computation of the Delta Water Charge until after the year 1971 and to fix the rate for computing the Delta Water Charge for the year 1971 at $7.24;

NOW, THEREFORE, it is mutually agreed that the following changes and additions are hereby made to the Agency's water supply contract with the State:

1. Subdivision (b) of Article 22 is amended to read as follows:

For each contractor receiving project water in any year through December 31, 1969, the Delta Water Charge shall be the product of $3.50 and the contractor's annual entitlement to project water for the respective year. For each contractor receiving project water in the year 1970, the Delta Water Charge shall be the

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 6 TO WATER SUPPLY CONTRACT
BETWEEN THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES AND
CASTAIC LAKE WATER AGENCY

THIS CONTRACT, made this 27th day of December, 1971, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency";

WITNESSETH, That:

WHEREAS, the State and the Agency have entered into and subsequently amended a water supply contract providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment; and

WHEREAS, Article 22(b) of such water supply contract, as amended, provides that for each year through the year 1969 the Delta Water Charge shall be the product of $3.50 and the Agency's annual entitlement for the respective year, that for the year 1970 the Delta Water Charge shall be the product of $6.65 and the

the Delta Water Charge shall be determined on the basis of an allocation to project purposes, by the separable cost-remaining benefits method, of all actual and projected costs of all those initial project conservation facilities located in and above the Delta, and upon an allocation to the purposes of water conservation and water transportation, by the proportionate use of facilities method, of all actual and projected costs of the following project facilities located below the Delta: The aqueduct intake facilities at the Delta, Pumping Plant I (Delta Pumping Plant), the aqueduct from the Delta to San Luis Forebay (O'Neill Forebay), San Luis Forebay (O'Neill Forebay), and San Luis Reservoir: Provided, That all of the actual and projected costs properly chargeable to the generation and transmission of electrical energy in connection with operation of project conservation facilities shall be allocated to the purpose of water conservation in, above, and below the Delta: Provided further, That allocations to purposes the cost of which are to be paid by the United States shall be as determined by the United States.

Commencing in the year in which the State first awards a major construction contract for construction of a major feature of additional project conservation facilities, or first commences payments under a contract with a federal agency in the event a major feature of additional project conservation facilities is constructed by such federal agency under an agreement requiring the State to pay all or part of the costs of such construction, the Delta Water Charge shall be determined on the basis of the

which are allocated to the purpose of water conservation, in, above, and below the Delta pursuant hereto. Commencing in the year in which the State first awards a major construction contract for construction of a major feature of any supplemental conservation facilities, or first commences payments under a contract with a federal agency in the event a major feature of supplemental conservation facilities is constructed by such federal agency under an agreement requiring the State to pay all or part of the costs of such construction, the Delta Water Charge shall be determined on the basis of the allocations made pursuant to subdivision (e) of this article, and upon an allocation to project purposes, by the separable costs-remaining benefits method and subject to provisos corresponding to those contained in said subdivision (e), of all projected costs of such feature of the supplemental conservation facilities. Commencing in the same year, the computation of the rates to be used in determining the components of the Delta Water Charge shall include the annual entitlements to water under all contracts for supplemental water. If the repayment period of any bonds sold to construct supplemental conservation facilities or the repayment period under any agreement with a federal agency for repayment of the costs of supplemental conservation facilities constructed by such federal agency extends beyond the repayment period of the contract, the Delta Water Charge shall be determined and redetermined on the basis of such extended repayment period as the State determines to be appropriate: Provided, That if the agreement with such federal agency allows repayment of costs

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 7 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND CASTAIC LAKE WATER AGENCY

THIS CONTRACT, made as of the 15th day of October, 1972, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency";

WITNESSETH, That:

WHEREAS, the State and the Agency have entered into and subsequently amended a water supply contract, dated April 30, 1963 (herein referred to as the "Amended Contract") providing that the State shall supply certain quantities of water to the Agency, and that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment; and

WHEREAS, the Amended Contract provides for a surcharge equivalent to the power credit per acre-foot of water to be charged to water users, other than the United States or the State of California, for each acre-foot of project water determined to have been put to agricultural or manufacturing uses on excess land, for collection by the Agency either itself or through a

1. Article 30 entitled "Surcharge for Project Water Used on Excess Land".

2. The next-to-the-last sentence of the fifth paragraph of subdivision (a) of Article 46, entitled "Surplus Water", which sentence reads as follows:

> "A surcharge shall be added to the rate for surplus water furnished to excess land in an amount and under the conditions specified in Article 30 of this contract".

3. Subdivision (b) of Article 46 entitled "Surcharge Credit".

IN WITNESS WHEREOF, the parties hereto have executed this contract amendment on the date first above written.

Approved as to legal form and sufficiency:

By P. G. Turner
Chief Counsel
Department of Water Resources

Attest:

By _____
(Title)

Approved as to form and execution:

By _____
(Title)

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By W. H. Gianelli
Director

CASTAIC LAKE WATER AGENCY

By Earl Schmidt
(Title) President

interest rate, and all other factors which are determinative of such charges; and

WHEREAS, Article 28 also provides that each such redetermination shall include an adjustment of the components of the Transportation Charge to be paid by the Agency for succeeding years which shall account for differences, if any, between projections used by the State in determining the amounts of such components for all preceding years and actual costs incurred by the State during such years, but does not specify the computational details or the method of payment of such adjustments; and

WHEREAS, the State has been including such adjustments as "one-shot" credits or additional charges to be subtracted from or added to the Transportation Charge to be paid by the Agency in the year following the redetermination; and

WHEREAS, the magnitude of such adjustments together with changes in other determinants of charges may be significantly different in comparison with the amounts projected by the State under previous determinations and could impair the planned fiscal operations of the Agency, depending on the method of payment, and the parties desire to amend the contract to provide a method of amortizing the payment of the amounts of such differences over two or more years, depending on the magnitude of the differences; and

WHEREAS, bookkeeping will be simplified if the amortization of the payments of the amounts of such differences is

the State. Such adjustment shall be computed by the State and paid by the Agency or credited to the Agency's account in the manner described in (b) and (c) below.

(b) Adjustment: Transportation Charge-Capital Cost Component

Adjustments for prior underpayments or overpayments of the capital cost component of the Transportation Charge to the Agency, together with accrued interest charges or credits thereon computed at the then current project interest rate on the amount of the underpayment or overpayment and compounded annually for the number of years from the year the underpayment or overpayment occurred to and including the year following the redetermination, shall be paid in the year following the redetermination: Provided, That the Agency may elect to exercise the option whereby when the redetermined Transportation Charge for the following year, with adjustments, including adjustments of the operation, maintenance, power, and replacement components provided for in subdivision (c) of this article, is more or less than the last estimate of the Charge provided pursuant to Article 27 for the corresponding year, without adjustments, an amount equal to the total of such difference shall be deducted from or added to the adjusted capital cost component for that year and paid or credited in accordance with the following schedule:

Percent that Transportation Charge differs from last estimate (+ or -)	Period, in years, for amortizing the difference in indicated charge
for 10% or less	no amortization
more than 10%, but not more than 20%	2
more than 20%, but not more than 30%	3
more than 30%, but not more than 40%	4
more than 40%.	5

the Transportation Charge for the year in which the option is to become effective.

Such option, once having been exercised, shall be applicable for all of the remaining years of the project repayment period.

IN WITNESS WHEREOF, the parties hereto have executed this contract on the date first above written.

Approved as to legal form
and sufficiency:

By R. C. Turner
Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By W. R. Gianelli
Director

Attest:

By Betty L. Castleberry
(Title) Secretary

CASTAIC LAKE WATER AGENCY

By Cecil Schmidt
(Title) President

Approved as to form
and execution:

By [illegible]
(Title) Counsel

delivery of all of its annual entitlement for 1972 on a reasonable schedule; and

WHEREAS, the State has developed a proposed adjustment of the Agency's 1972 entitlement taking into consideration the monthly distribution of 1972 project water deliveries as requested in its five-year delivery schedule submitted to the State in 1967; and

WHEREAS, the Agency has requested that its annual entitlement for the first year of water deliveries be decreased accordingly; and

WHEREAS, the State has determined that a decrease from 1,600 acre-feet to 1,236 acre-feet is justified and that allowing such a decrease in the Agency's 1972 annual entitlement will not impair the financial feasibility of the project facilities;

NOW THEREFORE, it is mutually agreed as follows:

Table A entitled "Annual Entitlements Castaic Lake Water Agency" is amended to read as follows:

TABLE A

ANNUAL ENTITLEMENTS
CASTAIC LAKE WATER AGENCY

Year	Total Annual Amount in acre-feet
1	1,236
2	3,700
3	5,700
4	7,500
5	9,500
6	11,400
7	13,400
8	15,300
9	17,700
10	20,100
11	22,100
12	24,600
13	26,900

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 10 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND CASTAIC LAKE WATER AGENCY

THIS CONTRACT, made as of the 28th day of August, 1974, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency";

WITNESSETH, That:

WHEREAS, the State and the Agency entered into a contract whereby the State will deliver and the Agency will purchase a supply of water to be made available from project facilities constructed by the State; and

WHEREAS, the State and the Agency included in such contract a subarticle, hereinafter referred to as the agricultural and ground water replenishment provision, which entitles the Agency to obtain from the State a supply of surplus water for agricultural and ground water replenishment use when available; and

WHEREAS, Article 21 of such contract also provides for the sale by the State of a supply of surplus water when available; and

(iii) Operational requirements regarding recreation and fish and wildlife uses;

(iv) Generation of power by the System or furnishing of project water required by power contracts;

(v) The exchange of water and the filling, retention, and release of storage in System reservoirs necessary for operational flexibility and to meet the requirements of paragraphs (i) through (iv) of this subdivision.

(vi) Losses of water due to evaporation, leakage, seepage, or other causes to meet the requirements of paragraphs (i) through (v) of this subdivision.

(3) "Ground water replenishment use" shall mean the use of project water exclusively for recharge of ground water basins by direct application to spreading basins, streambeds, or through other means of direct artificial recharge.

(4) "Contractors in the San Joaquin Service Area" shall mean those contractors which are furnished water through delivery structures from the California Aqueduct between Dos Amigos Pumping Plant and the South Portal of the Carley V. Porter Tunnel and from the Coastal Branch, California Aqueduct, from its junction with the California Aqueduct to the site for Devil's Den Pumping Plant.

(5) "Contractors in the Southern California Service Area" shall mean contractors for which water is delivered from the California Aqueduct downstream from the South Portal of the Carley V. Porter Tunnel.

(1) First, the quantity of surplus water to be delivered to noncontractors shall be limited to the quantity available in excess of the requests under the first priority and the second priority.

(2) Second, if there is not sufficient surplus water in excess of the requests under the first priority to meet the requests of contractors under the second priority, the quantity of water to be delivered under the second priority shall be limited to the quantity available in excess of the requests under the first priority and that quantity shall be apportioned in proportion to the amounts of the contractors' current annual entitlements that are to be used for purposes other than agricultural and ground water replenishment uses as determined by the State. If any contractor decides not to use the surplus water available to it under this provision, such surplus water shall be offered on a similar basis to other contractors for such uses.

(3) If there is not sufficient surplus water to meet the requests of contractors under the first priority, the quantity of water to be delivered under that priority shall be limited to the quantity available, and such quantity shall be apportioned to areas upstream and downstream from Dos Amigos Pumping Plant in proportion to the contractors' current annual entitlements that are to be used in such areas for agricultural and ground water replenishment purposes as determined by the State. The quantity of such water available upstream from Dos Amigos Pumping Plant shall be apportioned to contractors upstream from Dos Amigos Pumping Plant in proportion to the amounts of the contractors' current annual entitlements that are to be used for agricultural and ground water

in the judgment of the State to furnish surplus water to it, the contractor shall have a prior right to have such power utilized for furnishing surplus water otherwise available to it pursuant to this article at a cost no higher than that which the State is obligated to pay at the time it orders such power, but it shall have no greater right or priority to receive surplus water. A contractor's commitment may be for any part of the six-year period of its schedule, and the contractor will become bound by such commitment and become entitled to the prior right provided for in the preceding sentence only when the State, after consultation with the contractor, notifies the contractor in writing that it has ordered power based on the contractor's commitment.

(e) Rates.

(1) Surplus water (except further surplus water as described in subdivision (e)(4) of this article) shall be furnished to a contractor for agricultural use and for ground water replenishment use at rates which will return to the State all power costs as defined in subdivision (f) of this article and all incremental operation, maintenance, and replacement costs, and any other incremental costs, incurred in the conservation and transportation of such surplus water as determined by the State, which rates shall include an administrative charge to be determined by the State for each acre-foot of surplus water scheduled for delivery during the year. The amount of such administrative charge shall be credited to general operating costs of the System prior to the allocation of such costs. Incremental costs shall mean those costs which would not be incurred if surplus water were not scheduled for or delivered to the contractor.

article to any contractor which, under Table A of its contract, is scheduled to receive its maximum annual entitlement prior to 1978 and every year thereafter.

(5) Any revenues in excess of operation, maintenance, power and replacement costs and the administrative charge derived from sales of surplus water shall be credited as follows: The Delta water rate or portion thereof paid in accordance with subdivisions (e)(2), (e)(3), or (e)(4) of this article shall be credited to the cost of project conservation facilities, and the balance of such excess revenues, if any, shall be apportioned and credited, as appropriate, to the capital and to the minimum operation, maintenance, power and replacement costs of reaches of the transportation facilities of the System utilized for conveying such water to the purchasers.

(6) The rates and charges for surplus water shall be subject to redetermination by the State to reflect actual costs incurred and the difference shall be promptly credited or debited to the contractor that purchased such surplus water.

(f) Power Costs. Power costs for pumping surplus water shall consist of the cost of capacity, energy and additional transmission service required for the delivery of surplus water, including but not limited to the following:

(1) To the extent utilized for pumping surplus water:

(i) The cost of power purchased for pumping entitlement water,

(ii) The value of project recovery plant generation scheduled for pumping entitlement water, and

contract (disregarding any amendments reducing such Table A executed after July 1, 1974) is first scheduled and unless all of its deferred entitlements are first scheduled: Provided, That at the request of the contractor surplus water may be scheduled in lieu of deferred entitlements and the right to receive such deferred entitlements shall be reduced accordingly. If at the end of any year delivery of scheduled surplus water has prevented any annual entitlement or deferred entitlement from being delivered during that year, then for the purpose of charging for water delivered, deliveries during the year shall be considered first as annual entitlement water to the extent of the annual entitlement, and the balance as deferred entitlement or surplus water in accordance with the option of the contractor previously exercised pursuant to the first sentence of this subdivision.

(3) Before a contractor can receive surplus water under its contract in an amount greater than its annual entitlement for the year as shown in its Table A, it shall first increase its annual entitlement for such year to an amount equivalent to the surplus water scheduled, but it shall not be required to increase its annual entitlement to an amount in excess of 75 percent of its maximum annual entitlement.

(4) The State shall not sell surplus water to a contractor or noncontractor for use directly or indirectly within the boundaries of any other contractor without the written consent of such other contractor, nor shall the State authorize any contractor to supply surplus water for use outside such contractor's boundaries and within the boundaries of any other contractor without the written consent of such other contractor: Provided, That where

and data concerning the use of water within its boundaries as the State may request.

(j) Contracts.

(1) To obtain a supply of surplus water, any contractor or noncontractor shall execute a fuether contract with the State which shall be in conformity with this article and will include at least the following: Further provisions concerning the scheduling of surplus water and provisions as to times and methods of payment.

(2) The State shall not contract to sell surplus water to noncontractors for periods in excess of five years.

IN WITNESS WHEREOF, the parties hereto have executed this contract amendment as of the date first above written.

Approved as to legal form
and sufficiency:

By _____
Acting Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By _____
Director

CASTAIC LAKE WATER AGENCY

By _____
(Title) PRESIDENT

(t) Project Repayment Period

"Project repayment period" shall mean that period of years commencing on January 1, 1961, and extending until December 31, 2035; Provided, that whenever construction of any project facilities is financed by a bond issue with maturity dates later than December 31, 2035, whether the bonds are issued pursuant to the Bond Act or other authority, repayment of the costs of such facilities shall be extended to end on the date of the latest maturities of the bonds with which construction of such facilities is financed.

2. Article 2 of the Agency's Water Supply Contract with the State is amended to read as follows:

(2) Term of Contract

This contract shall become effective on the date first above written and shall remain in effect for the longest of the following:

1. The project repayment period

2. 75 years

3. The period ending with the latest maturity date of any bond issue used to finance the construction costs of project facilities.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 12 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND THE CASTAIC LAKE WATER AGENCY

THIS CONTRACT, made this 12th day of January, 1983, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency";

WHEREAS, the State and the Agency have entered into and subsequently amended a water supply contract providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment; and

WHEREAS, the State and the Agency desire to make certain changes and additions to such contract, while otherwise continuing the contract in full force and effect;

NOW, THEREFORE, it is mutually agreed that the following changes and additions are hereby made to the Agency's water supply contract with the State:

1. Article 1(e) is amended to read:

construction at the same time of alternative new water supply sources which are either reservoirs located north of the Delta or off-Aqueduct storage reservoirs located south or west of the Delta designed to supply water to the California Aqueduct. The following facilities and programs shall hereinafter be referred to as "Local Projects":

(A) On-stream and off-stream surface storage reservoirs not provided for in Section 12938 of the Water Code, that will produce project water for the System for a period of time agreed to by the sponsoring contractor;

(B) Ground water storage facilities that will produce project water for the System for a period of time agreed to by the sponsoring contractor;

(C) Waste water reclamation facilities that will produce project water for the System for a period of time agreed to by the sponsoring contractor;

(D) Water and facilities for delivering water purchased by the State for the System for a period of time agreed to by the sponsoring contractor; provided that the economic test specified herein shall be applied to the cost of these facilities together with the cost of the purchased water; and

(E) Future water conservation programs and facilities that will reduce demands by the sponsoring contractor for project water from the System for a period of time agreed to by the sponsoring contractor and will thereby have the effect of increasing project water available in the Delta for distribution.

(B) All contractors within whose boundaries any portion of such Local Project is located, and who are not sponsoring contractors for such Local Project give their written approval of such Local Project.

(5) "Sponsoring contractor" as used in this Article 1(h) shall mean the contractor or contractors who either will receive the yield from facilities described in 2(A), (B), (C), or (D) above, or agree to reduce demands for project water from the System pursuant to 2(E) above.

(6) In the event of a shortage in water supply within the meaning of Article 18(a), the determination of whether to count, in whole or in part, the yield from facilities described in 2(A), (B), (C), or (D) above, or the reduced demand from future conservation programs described in 2(E) above in the allocation of deficiencies among contractors will be based on a project-by-project evaluation taking into consideration such factors as any limitation on the use of the water from such facilities and whether the sponsoring contractor has access to project water from the Delta as an alternate to such facilities.

3. Article 1(i)(2) is amended to read:

(2) Facilities for the generation and transmission of electrical energy of the following types:

(A) Hydroelectric generating and transmission facilities, whose operation is dependent on the transportation of project water, or on releases to channels downstream of project facilities defined under (1) above. Such facilities shall be called "project aqueduct power recovery plants."

(5) funds advanced by any contractor without the actual incurring of bonded debt therefor, for which the net interest cost and terms shall be those which would have resulted if the contractor had sold bonds for the purpose of funding the advance, as determined by the State, and

(6) funds borrowed from the General Fund or other funds in the Treasury of the State of California, for which the total interest cost shall be computed at the interest rate earned over the period of such borrowing by moneys in the Pooled Money Investment Account of such Treasury invested in securities,

to the extent the proceeds of any such bonds, advances or loans are for construction of the State Water Facilities defined in Section 12934(d) of the Water Code, the additional project conservation facilities, and the supplemental conservation facilities, (except off-aqueduct power facilities and advances for delivery structures, measuring devices and excess capacity) and without regard to any premiums received on the sale of bonds under item (1) above. The "project interest rate" shall be computed as a decimal fraction to five places.

5. Subdivision (h) is added to Article 22 to read:

(h) The determination of the rate for water under the Delta Water Charge shall be made by including the appropriate costs and quantities of water, calculated in accordance with subdivisions (c), (d) and (e) above, for all additional project conservation facilities as defined in Article 1(h) hereinabove. In the event a Local Project as defined in Article 1(h)(2) will,

(d) Notwithstanding the provisions of subdivisions (a) and (b) of this article, or of Article 1(s), the costs of off-aqueduct power facilities shall be determined and allocated as follows:

(1) The off-aqueduct power costs shall include all annual costs the State incurs for any off-aqueduct power facility, which shall include, but not be limited to, power purchases, any annual principal and interest payments on funds borrowed by or advanced to the State, annual principal and interest on bonds issued by the State or other agency, or under revenue bond financing contracts, any requirements for coverage, deposits to reserves, and associated operation and maintenance costs of such facility, less any credits, interest earnings, or other monies received by the State in connection with such facility. In the event the State finances all or any part of an off-aqueduct power facility directly from funds other than bonds or borrowed funds, in lieu of such annual principal and interest payments, the repayment of capital costs as to that part financed by such other funds shall be determined on the basis of the schedule that would have been required under Article 24.

(2) The annual costs of off-aqueduct power facilities as computed in (1) above shall initially be allocated among contractors in amounts which bear the same proportions to the total amount of such power costs that the total estimated electrical energy (kilowatt hours) required to pump through project transportation facilities the desired delivery amounts of annual entitlements for that year, as submitted pursuant to

reallocation shall include appropriate interest at the project interest rate.

9. Subdivision (e) is added to Article 25 to read:

(e) The total minimum operation, maintenance, power and replacement component due that year from each contractor shall be the sum of the allocations made under the proportionate use of facilities method provided in subdivision (b) of this article and the allocations made pursuant to subdivision (d) of this article for each contractor.

10. Subdivision (b) of Article 32 is amended to read:

(b) Interest on Overdue Payments

Upon every amount of money required to be paid by the Agency to the State pursuant to this contract which remains unpaid after it becomes due and payable, interest shall accrue at an annual rate equal to that earned by the Pooled Money Investment Fund, as provided in Government Code Sections 16480, et seq. calculated monthly on the amount of such delinquent payment from and after the due date until it is paid, and the Agency hereby agrees to pay such interest: provided, that no interest shall be charged to or be paid by the Agency unless such delinquency continues for more than thirty (30) days.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 13 TO WATER SUPPLY CONTRACT
BETWEEN THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES AND
CASTAIC LAKE WATER AGENCY

THIS CONTRACT is made this 6th day of June, 1987, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency".

WHEREAS, the State and the Agency have entered into and subsequently amended a water supply contract providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment;

WHEREAS, the State and the Agency wish to provide financing for project facilities with water system revenue bonds and provide for repayment of water system revenue bonds;

WHEREAS, the State and the Agency wish to clarify the definition of the project interest rate without changing the interpretation of Article 1(r), except for the addition of item (7), and to specify that financing costs of water system facilities and East Branch Enlargement facilities shall not be included in calculating the project interest rate; and

(2) Revenue bonds issued by the State under the Central Valley Project Act after May 1, 1969,

(3) Bonds issued by the State under any other authority granted by the Legislature or the voters,

(4) Bonds issued by any agency, district, political subdivision, public corporation, or nonprofit corporation of this State,

(5) Funds advanced by any contractor without the actual incurring of bonded debt therefor, for which the net interest cost and terms shall be those which would have resulted if the contractor had sold bonds for the purpose of funding the advance, as determined by the State,

(6) Funds borrowed from the General Fund or other funds in the Treasury of the State of California, for which the total interest cost shall be computed at the interest rate earned over the period of such borrowing by moneys in the Surplus Money Investment Fund of such Treasury invested in securities, and

(7) Any other financing capability available in the Treasury of the State of California at whatever interest rate and other financing costs are provided in the law authorizing such borrowing. However, the use of other financing from the State Treasury is intended to involve only short term borrowing at interest rates and other financing costs no greater than those charged to other State agencies during the same period until such time as the Department can sell bonds and reimburse the source of the short term borrowing from the proceeds of the bond sale.

between the State and The Metropolitan Water District of Southern California, dated July 2, 1984, and May 15, 1985, which increased the East Branch Aqueduct capacity beyond that set forth in Table B-2 as shown in State Bulletin 132-70;

(5) That portion of Reach 24 (Silverwood Lake) to be determined by reallocation of Reach 24 to reflect the additional use to be made of that reach as a result of the East Branch Enlargement operation; and

(6) That portion of Reach 25 (San Bernardino Tunnel) to be determined by an allocation of total delivery capacity of Reach 25 between the basic East Branch facilities and the East Branch Enlargement as a result of East Branch Enlargement operation.

4. Article 1 (hh) is added to read:

(hh) "Water System Facilities" shall mean the following facilities to the extent that they are financed with water system revenue bonds or to the extent that other financing of such facilities is reimbursed with proceeds from water system revenue bonds:

(1) The North Bay Aqueduct,

(2) The Coastal Branch Aqueduct,

(3) Delta Facilities, including Suisun Marsh facilities, to serve the purposes of water conservation in the Delta, water supply in the Delta, transfer of water across the Delta, and mitigation of the environmental effects of project facilities, and to the extent presently authorized as project purposes, recreation and fish and wildlife enhancement,

(4) Local projects as defined in Article 1(h)(2) designed to develop no more than 25,000 acre-feet of project yield from each project,

shall be calculated in accordance with provisions in Article 5. of this contract.

6.5. Article 28(e) of the Agency's water supply contract with the State is added to read:

28(e) Notwithstanding the provisions of Article 28(b), adjustments for prior overpayments and underpayments shall be repaid beginning in the year following the redetermination by application of a unit rate per acre-foot which, when paid for the projected portion of the Agency's annual entitlement will return to the State, during the project repayment period, together with interest thereon computed at the project interest rate and compounded annually, the full amount of the adjustments resulting from financing after January 1, 1987, from all bonds, advances, or loans listed in Article 1(r) except for Article 1(r)(3) and except for bonds issued by the State under the Central Valley Project Act after January 1, 1987 for facilities not listed among the water system facilities in Article 1(hh). Notwithstanding the immediately preceding exception, such amortization shall also apply to any adjustments in this component charge resulting from a change in the project interest rate due to any refunding after January 1, 1986 of bonds issued under the Central Valley Project Act. However, amortization of adjustments resulting from items 1(r)(4) through (7) shall be limited to a period which would allow the Department to repay the debt service on a current basis until such time as bonds are issued to reimburse the source of such funding. In no event shall this amortization period be greater than the project repayment period.

credits are determined by the State to be available, such credits shall be promptly provided to the contractors and shall be in proportion to the payments under this article from each contractor. Reserves, bond debt service coverage, interest, and other earnings may be used in the last year to retire the bonds.

(b) Annual charges to recover water system revenue bond financing costs shall consist of two elements.

(1) The first element shall be an annual charge to the Agency for repayment of capital costs of water system facilities as determined under Articles 22 and 24 of this contract with interest at the project interest rate. For conservation facilities, the charge shall be a part of the capital cost component of the Delta Water Charge in accordance with Article 22. For transportation facilities, the charge shall be a part of the capital cost component of the Transportation Charge in accordance with Article 24.

(2) The second element shall be the Agency's share of a Water System Revenue Bond Surcharge to be paid in lieu of a project interest rate adjustment. The total annual amount to be paid by all contractors under this element shall be the difference between the total annual charges under the first element and the annual financing costs of the water system revenue bonds. The amount to be paid by each contractor shall be calculated annually as if the project interest rate were increased to the extent necessary to produce revenues from all contractors sufficient to pay such difference for that year. In making that calculation, adjustments in the Agency's Transportation capital cost component charges for prior overpayments and underpayments shall be determined as if amortized over the remaining years of the project repayment period.

of any water system revenue bond issuances and the form of any necessary resolutions or supplements.

(h) Defaults. (1) If a contractor defaults partially or entirely on its payment obligations calculated under this article and sufficient insurance or other security protecting the non-defaulting contractors is not provided under Article 50(f), the State shall allocate a portion of the default to each non-defaulting contractor. The Agency's share of the default shall be equal to an amount determined by multiplying the total default amount to be charged to all non-defaulting contractors by the ratio that the Agency's maximum Table A entitlement bears to the maximum Table A entitlements of all non-defaulting contractors. However, such amount shall not exceed in any year 25 percent of the Water System Revenue Bond financing costs that are otherwise payable by the Agency in that year. The amount of default to be charged to non-defaulting contractors shall be reduced by any receipts from insurance protecting non-defaulting contractors and bond debt service coverage from a prior year and available for such purpose.

(2) If a contractor defaults partially or entirely on its payment obligations under this article, the State shall also pursuant to Article 20, upon six months' notice to the defaulting contractor, suspend water deliveries under Article 20 to the defaulting contractor so long as the default continues. The suspension of water deliveries shall be proportional to the ratio of the default to the total water system revenue bond payments due from the defaulting contractor. However, the State may reduce, eliminate, or not commence suspension of deliveries pursuant to this subparagraph if it determines suspension in the amounts otherwise required is likely to impair the

coverage, such increase shall be handled in the same manner as provided in Article 50(a).

(7) Action taken pursuant to this subarticle shall not deprive the State of or limit any remedy provided by this contract or by law for the recovery of money due or which may become due under this contract.

(i) Power of Termination.

(1) The Department and the Agency agree to negotiate in good faith the development of a means to provide adequate protection for the Department's cash flow into priorities one and two for revenues under Water Code Section 12937(b) with the goal of obtaining agreement by April 1, 1987. The Department and the Agency agree to continue negotiations beyond April 1, 1987 if necessary to meet their common goal of arriving at agreement.

(2) If such an agreement has not been reached by April 1, 1987, and if the Director of Water Resources determines that adequate progress has not been made toward such an agreement, the Director may give notice to the Agency and other contractors that he intends to exercise the power to terminate provided in this subarticle 50(i). The Director's authority to give such a notice shall terminate on July 1, 1988.

(3) After six months from the date of issuing the notice of intent to terminate, but in no event later than January 1, 1989, the Director may terminate the authority of the Department to issue additional series of water system revenue bonds using the repayment provisions of Article 50. The Department shall promptly notify the Agency and other contractors that the Director has exercised the power of termination.

IN WITNESS WHEREOF, the parties have executed this contract on the date first above written.

Approved as to legal form and sufficiency:

By _____
Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By _____
Director

Attest:

By _____
(Title)
Secretary

CASTAIC LAKE WATER AGENCY

By _____
General Manager

to the extent the proceeds of any such bonds, advances or loans are for construction of the State Water Facilities defined in Section 12934(d) of the Water Code, the additional project conservation facilities, and the supplemental conservation facilities, (except off-aqueduct power facilities and advances for delivery structures, measuring devices and excess capacity) and without regard to any premiums received on the sale of bonds under item (1) above. The "project interest rate" shall be computed as a decimal fraction to five places.

WHEREAS, the State and the Agency desire to amend the provisions of such contract related to the delivery and scheduling of entitlement water to allow, under certain conditions, the carry-over of a portion of the Agency's entitlement deliveries from a respective year into the first three months of the next calendar year.

WHEREAS, the carry-over of entitlement by the Agency is not intended to adversely impact current or future project operations.

WHEREAS, the State Water Project contractors and the Department are aware that the carry-over of entitlement water from one year into the next may increase or decrease the costs to other SWP contractors in either year. The tracking of those costs may be too complex and expensive and does not warrant special accounting procedures to be established; however, any significant identifiable cost shall be charged to those contractors causing such cost, as determined by the Department;

WHEREAS, the carry-over of entitlement water is not to affect the payment provisions of the contract.

NOW THEREFORE, it is mutually agreed that the following changes and additions are hereby made to the Agency's Water Supply Contract with the State:

1. Article 1(ii) is added to read:

"Carry-over Entitlement Water" shall mean water from a contractor's annual entitlement for a respective year which is made available for delivery by the State in the next year pursuant to Article 12(e).

conditions consistent with this Article 12(e) that would govern the delivery of the Carry-over Entitlement Water.

The Agency agrees to pay all significant identifiable costs associated with its Carry-over Entitlement Water, as determined by the State.

All scheduling and delivery of Carry-over Entitlement Water shall be carried out pursuant to the provisions of this contract.

The Agency agrees to forego the delivery of any Carry-over Entitlement Water that is lost because of project operations or is not delivered by March 31 of the next year.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 15 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND CASTAIC LAKE WATER AGENCY

THIS AMENDMENT to the Water Supply Contract is made this 11th day of APRIL, 1991, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency".

RECITALS:

WHEREAS, the State and the Agency entered into a contract whereby the State will deliver and the Agency will purchase a supply of water to be made available from project facilities constructed by the State;

WHEREAS, the State and the Agency included in such contract an article which entitles the Agency to obtain from the State deliveries of surplus water when available;

WHEREAS, the State and the Agency desire to amend the provisions of such contract related to the deliveries of surplus water; and

3. Article 21(f) of the Agency's water supply contract with the State is amended to read:

(f) Power Costs.

(1) Beginning January 1, 1991, the Agency shall pay power charges for pumping surplus water as follows:

(A) If during a calendar month it is either not necessary to purchase power for pumping surplus water, or it is necessary to purchase power for pumping surplus water and the purchased power rate is less than or equal to the Melded Power Rate (defined as the average unit charge for pumping entitlement water during the calendar year for all power resources, including on-aqueduct power resources, off-aqueduct power resources, and any other power resources), then the monthly charges to the Agency for the Net Power (gross power used to pump the surplus water less power generated by the surplus water) used to pump surplus water to the Agency shall be determined using the Melded Power Rate.

(2) By receiving surplus or unscheduled water under this Article 21(f), the Agency accepts the responsibility to indemnify, defend, and hold harmless the State, its officers, employees and agents from all liability, expenses, defense costs, attorney fees, claims, actions, liens, and lawsuits of whatever kind, arising out of or related to this article.

(3) Effective January 1, 1991, power charges for delivery of unscheduled water to the Agency shall be calculated in the same manner as provided in this Article 21(f).

4. This Amendment shall take effect on January 1, 1991, only if, by January 31, 1991 an Amendment substantially the same as this one is executed by contractors that together have maximum annual entitlements totaling at least 3,796,007 acre-feet. By February 15, 1991, the State will inform the Agency of whether sufficient contractors had executed the Amendment to cause the Amendment to take effect.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AGREEMENT RELATING TO CONSOLIDATION AND TERMINATION OF THE WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA AND DEVIL'S DEN WATER DISTRICT BEING AMENDMENT NO. 16 TO WATER SUPPLY CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND CASTAIC LAKE WATER AGENCY

THIS CONTRACT is made this 3rd day of January, 1991, pursuant to the provisions of the California Water Resources Development Bond Act, the Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State", and Castaic Lake Water Agency, herein referred to as the "Agency", and Devil's Den Water District, herein referred to as "Devil's Den".

RECITALS:

WHEREAS, the State and the Agency (formerly Upper Santa Clara Water Agency) have entered into and subsequently amended a water supply contract dated April 30, 1963, providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment;

WHEREAS, the State and the Agency desire to make certain changes to the Agency's mentioned contract, while otherwise continuing the Agency's contract in full force and effect.

AGREEMENT:

NOW, THEREFORE, the parties agree that the following changes are made to the Agency's water supply contract with the State, effective January 1, 1992.

1. Table A is amended to read as follows:

TABLE A
ANNUAL ENTITLEMENTS
CASTAIC LAKE WATER AGENCY

Calendar Year		Total Annual Amount in Acre-Feet
1968		3,700
1969		5,000
1970		5,700
1971		6,700
1972	1	8,936
1973	2	12,400
1974	3	15,400
1975	4	18,200
1976	5	21,200
1977	6	24,100
1978	7	24,762
1979	8	28,000
1980	9	30,400
1981	10	32,800
1982	11	34,800
1983	12	37,300
1984	13	39,600
1985	14	41,800
1986	15	43,600
1987	16	45,600
1988	17	48,000
1989	18	50,100
1990	19	52,000
1991	20	54,200
1992	21	54,200
And each succeeding year thereafter, for the term of this contract		54,200

4. Article 12(c) of the Agency's contract with the State is amended to read:

(c) **Limit on Rate of Delivery to Agency**

(1) In no event shall the State be obligated to deliver water to the Agency from Castaic Lake at a total combined instantaneous rate of flow exceeding ninety-nine (99) cubic feet per second, except as this rate of flow may be revised by amendment of this article after submission to the State of the Agency's requests with respect to maximum flow capacities to be provided in said delivery structures, pursuant to Article 10.

(2) In no event shall the State be obligated to deliver water to the Agency through the delivery structure at Devil's Den from Reach 31A at a total combined instantaneous rate of flow exceeding thirty-eight (38) cubic feet per second.

5. The proportionate use of facilities factors in the Agency's Table B will be revised to include:

(a) Additional capacity in the California Aqueduct from the Sacramento-San Joaquin Delta through Reach 31A of the Coastal Aqueduct for transporting 12,700 acre-feet with no more than a total amount in any one month of any year of project water greater than eighteen (18) percent of that portion of the Agency's annual entitlement for that year,

8. Pursuant to Article 15(a), the State consents to the Agency annually taking delivery of up to 12,700 acre-feet of the Agency's Table A annual entitlement water at the turnout to Devil's Den in Reach 31A consistent with Article 5(a) above. In any year when the Department determines that sufficient water is available, Article 12(d), surplus, and unscheduled water may also be delivered to the Agency in Reach 31A based upon the amount of the Agency's Table A annual entitlement requested for delivery in that reach.

9. The Agency agrees to indemnify, defend, and hold harmless the State from any liability, expenses, defense costs, attorney fees, claims, actions, liens and lawsuits of any kind arising out of or related to the actions implementing this amendment.

10. Covenants Between the State and Devil's Den:

The State and Devil's Den agree, in consideration of the assumption hereunder by the Agency and the State of new duties under the Castaic Lake Water Agency contract, that the Devil's Den Contract is terminated effective January 1, 1992, and the State and Devil's Den are discharged, effective January 1, 1992, from their respective duties under the Devil's Den Contract.

IN WITNESS WHEREOF, the parties hereto have executed this contract on the date first above written.

Approved as to legal form and sufficiency:

Acting Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

for Director

CASTAIC LAKE WATER AGENCY

President E. "Jerry" Gladbach

Secretary Betty L. Castleberry

DEVIL'S DEN WATER DISTRICT

President Robert L. Larson

Secretary Laurie Foster

WHEREAS, the contractors and the State have negotiated an amendment to the water supply contracts to implement provisions of the Monterey Agreement (the "Monterey Amendment"); and

WHEREAS, the State and the Agency desire to implement such provisions by incorporating this Monterey Amendment into the water supply contract;

NOW, THEREFORE, IT IS MUTUALLY AGREED that the following changes and additions are hereby made to the Agency's water supply contract with the State:

1. Article 1(d) is amended to read:

(d) **Contractor**

"Contractor" shall mean any entity that has executed, or is an assignee of, a contract of the type published in Department of Water Resources Bulletin No. 141 dated November 1965, with the State for a dependable supply of water made available by the System, except such water as is made available by the facilities specified in Section 12934(d)(6) of the Water Code.

2. Article 1(k) is amended to read:

(k) **Minimum Project Yield**

"Minimum project yield" shall mean the dependable annual supply of project water to be made available, estimated to be 4,185,000 acre-feet per year, said amount to be determined by the State on the basis of coordinated operation studies of initial project conservation facilities and additional project conservation facilities, which studies shall be based upon:

(5) Land acquisition prior to December 31, 1995, for the Kern Fan Element of the Kern Water Bank,

(6) Additional pumps at the Banks Delta Pumping Plant,

(7) The transmission line from Midway to Wheeler Ridge Pumping Plant,

(8) Repairs, additions, and betterments to conservation or transportation facilities existing as of January 1, 1987, and to all other facilities described in this subarticle (hh) except for item (5),

(9) A project facilities corporation yard, and

(10) A project facilities operation center.

4. Article 1(jj) is added to read:

(jj) **Interruptible water**

"Interruptible water" shall mean project water available as determined by the State that is not needed for fulfilling contractors' annual entitlement deliveries as set forth in their water delivery schedules furnished pursuant to Article 12 or for meeting project operational requirements, including storage goals for the current or following years.

5. Article 1(kk) is added to read:

(kk) **Nonproject water**

"Nonproject water" shall mean water made available for delivery to contractors that is not project water as defined in Article 1(j).

Other terms and conditions of the continued service shall be reasonable and equitable and shall be mutually agreed upon. In the event that said terms and conditions provide for continued service for a limited number of years only, the Agency shall have the same option to receive continued service here provided for upon the expiration of that and each succeeding period of continued service.

8. Article 7(a) is amended to read:

(a) **Changes in Annual Entitlements**

The Agency may, at any time or times during the term of this contract, by timely written notice furnished to the State, request that project water be made available to it thereafter in annual amounts greater or less than the annual entitlements designated in Table A of this contract. Subject to approval by the State of any such request, the State's construction schedule shall be adjusted to the extent necessary to satisfy the request, and the requested increases or decreases in said annual entitlements shall be incorporated in said Table A by amendment thereof. Requests for changes in annual entitlements for more than one year shall be approved by the State: *Provided*, That no change shall be approved if in the judgment of the State it would impair the financial feasibility of project facilities.

9. The title of Article 12 is amended to read "Priorities, Amounts, Times and Rates of Deliveries".

Fourth, project water previously stored pursuant to Articles 12(e) and 56.

Fifth, nonproject water to fulfill contractors' annual entitlements for that year not met by the first two priorities.

Sixth, additional interruptible water delivered to contractors in excess of their annual entitlements for that year.

Seventh, additional nonproject water delivered to contractors in excess of their annual entitlements for that year.

13. Article 14 is amended to read:

Curtailment of Delivery

(a) **State May Curtail Deliveries**

The State may temporarily discontinue or reduce the delivery of project water to the Agency hereunder for the purposes of necessary investigation, inspection, maintenance, repair, or replacement of any of the project facilities necessary for the delivery of project water to the Agency, as well as due to outages in, or reductions in capability of, such facilities beyond the State's control or unuseability of project water due to an emergency affecting project facilities. The State shall notify the Agency as far in advance as possible of any such discontinuance or reduction, except in cases of emergency, in which case notice need not be given.

(b) **Agency May Receive Later Delivery of Water Not Delivered**

In the event of any discontinuance or reduction of delivery of project water pursuant to subdivision (a) of this article, the Agency may elect to receive the amount of annual entitlement which otherwise would have been delivered to it during such period under

contractors for domestic supply, fire protection, or sanitation during the year. If a contractor is allocated more water than it requested, the excess water shall be reallocated among the other contractors in proportion to their annual entitlements as provided for above. The foregoing provisions of this subdivision shall be inoperative to the extent necessary to comply with subdivision (c) of this article and to the extent that a contractor's annual entitlement for the respective year reflects established rights under the area of origin statutes precluding a reduction in deliveries to such contractor.

(b) - Deleted

(c) **Permanent Shortage; Contracts for Areas-of-Origin**

In the event that the State, because of the establishment by a party of a prior right to water under the provisions of Sections 11460 through 11463 of the Water Code, enters into a contract with such party for a dependable supply of project water, which contract will cause a permanent shortage in the supply of project water to be made available to the Agency hereunder:

(1) The State shall: (i) equitably redistribute the costs of all transportation facilities included in the System among all contractors for project water, taking into account the diminution of the supply to the Agency and other prior contractors in accordance with the terms of their contracts, and (ii) revise the Agency's annual entitlements and maximum annual entitlement, by amendment of Table A of this contract to correspond to the reduced supply of project water to be made available to the Agency: *Provided*, That such redistribution of costs of transportation facilities shall not be made until there has been reasonable

(d) **Reinstatement of Entitlements**

If after any revision of annual entitlements and maximum annual entitlements pursuant to subdivision (c) of this article, circumstances arise which, in the judgment of the State, justify a revision upward of the same, the State shall, with the consent of the affected contractor, reinstate proportionately the previously reduced entitlements of such contractor to the extent deemed justified, and shall equitably redistribute the costs of the project transportation facilities if inequities would otherwise occur as a result of such reinstatement of entitlements.

(e) **Advance Notice of Delivery Reductions**

The State shall give the Agency written notice as far in advance as possible of any reduction in deliveries to it which is to be made under subdivision (a) of this article and, to the extent possible, shall give the Agency written notice five (5) years in advance of any reduction in its annual entitlements and maximum annual entitlement under subdivision (c) of this article. Reports submitted to the Agency pursuant to Article 16(c) may constitute such notices.

(f) **No Liability for Shortages**

Neither the State nor any of its officers, agents, or employees shall be liable for any damage, direct or indirect, arising from shortages in the amount of water to be made available for delivery to the Agency under this contract caused by drought, operation of area of origin statutes, or any other cause beyond its control.

off-aqueduct, and any other power) incurred in the transportation of such water as if such interruptible water were entitlement water, as well as all incremental operation, maintenance, and replacement costs, and any other incremental costs, as determined by the State. The State shall not include any administrative or contract preparation charge. Incremental costs shall mean those nonpower costs which would not be incurred if interruptible water were not scheduled for or delivered to the contractor. Only those contractors not participating in the repayment of the capital costs of a reach shall be required to pay any use of facilities charge for the delivery of interruptible water through that reach.

(c) **Contracts**

To obtain a supply of interruptible water, a contractor shall execute a further contract with the State which shall be in conformity with this article and shall include at least provisions concerning the scheduling of deliveries of interruptible water and times and methods of payment.

17. Article 22(j) is amended to read:

(j) Notwithstanding provisions of Article 22(a) through (i), the capital cost component and the minimum OMP&R component of the Delta Water Charge shall include an annual charge to recover the Agency's share of the conservation portion of the water system revenue bond financing costs. Charges to the Agency for these costs shall be calculated in accordance with provisions in Article 50 of this contract. Charges for the conservation portion of the water system revenue bond financing costs shall not be affected by any reductions in payments pursuant to Article 51.

subdivision shall be controlling as to allocations of capital costs to the Agency. Proportionate use of facilities factors for prior years shall not be adjusted by the State in response to changes or transfers of entitlement among contractors unless otherwise agreed by the State and the parties to the transfer and unless there is no impact on past charges or credits of other contractors.

19. Article 24(g) is amended to read:

(g) Notwithstanding provisions of Article 24(a) through (d), the capital cost component of the Transportation Charge shall include an annual charge to recover the Agency's share of the transportation portion of the water system revenue bond financing costs. Charges to the Agency for these costs shall be calculated in accordance with the provisions of Article 50 of this contract. Charges for the transportation portion of the water system revenue bond financing costs shall not be affected by any reductions in payments pursuant to Article 51.

20. Article 25(d)(3) is amended to read:

(3) An interim adjustment in the allocation of the power costs calculated in accordance with (2) above, may be made in May of each year based on April revisions in approved schedules of deliveries of project and nonproject water for contractors for such year. A further adjustment shall be made in the following year based on actual deliveries of project and nonproject water for contractors provided, however, in the event no deliveries are made through a pumping plant, the adjustments shall not be made for that year at that plant.

the charges for the year before that for obligations under subdivisions (c)(2)(ii) and (iii) of this article.

(b) **State Water Facilities Capital Account**

(1) The State shall establish a State Water Facilities Capital Account to be funded from revenues available under Water Code section 12937(b)(4). Through procedures described in this article and as limited by this article, the State may consider as a revenue need under subdivision (c)(2)(v) of this article and may deposit in the State Water Facilities Capital Account the amounts necessary to pay capital costs of the State Water Facilities for which neither general obligation bond nor revenue bond proceeds are available, including but not limited to planning, reconnaissance and feasibility studies, the San Joaquin Valley Drainage Program and, through the year 2000, the CALFED Bay-Delta Program.

(2) The Director of the Department of Water Resources shall fully consult with the contractors and consider any advice given prior to depositing funds into this account for any purposes. Deposits into this account shall not exceed the amounts specified in subdivision (c)(2)(v) of this article plus any amounts determined pursuant to subdivision (e)(1)(iii) of this article.

(3) The State shall use revenue bonds or other sources of moneys rather than this account to finance the costs of construction of any major capital projects.

(c) **Calculation of Financial Needs**

(1) Each year the State shall calculate in accordance with the timing provisions of Articles 29 and 31 the amounts that would have been charged (but for this article) to each contractor as provided in other provisions of this contract.

(3) Subject to the provisions of subdivision (e) of this article, the State shall reduce the annual charges in the aggregate for all contractors by the amounts by which the hypothetical charges calculated pursuant to subdivision (c)(1) above exceed the revenue needs determined pursuant to subdivision (c)(2) above. The reductions under this article shall be apportioned among the contractors as provided in subdivisions (d), (e), (f) and (g) of this article. Reductions to contractors shall be used to reduce the payments due from the contractors on each January 1 and July 1; *Provided*, however, that to the extent required pursuant to subdivision (h) of this article, each Agricultural Contractor shall pay to the Agricultural Rate Management Trust Fund an amount equal to the reduction allocated to such Agricultural Contractor. Any default in payment to the trust fund shall be subject to the same remedies as any default in payment to the State under this contract.

(4) The State may submit a supplemental billing to the Agency for the year in an amount not to exceed the amount of the prior reductions for such year under this article if necessary to meet unanticipated costs for purposes identified in Water Code section 12937(b)(1) and (2) for which the State can issue billings under other provisions of this contract. Any supplemental billing made to the Agency for these purposes shall be in the same proportion to the total supplemental billings to all contractors for these purposes as the prior reduction in charges to the Agency in that year bears to the total reductions in charges to all contractors in that year and shall be treated as reducing the amount of the reduction made available for that year to the Agency by the amount of the supplemental bill to the Agency.

Agricultural Contractors, and the remaining reductions shall be apportioned among the Urban Contractors.

(iii) In 1999 reductions in the amount of $32 million are projected to be available and shall be applied as follows: the first $10 million of reductions shall be apportioned among the Agricultural Contractors, and the remaining reductions shall be apportioned among the Urban Contractors.

(iv) In 2000 reductions in the amount of $33 million are projected to be available and shall be applied as follows: the first $10 million of reductions shall be apportioned among the Agricultural Contractors, and the remaining reductions shall be apportioned among the Urban Contractors.

(3)(i) In the event that the aggregate amount of reductions in any of the years 1997 through 2000 is less than the respective amount projected for such year in subdivision (d)(2) above, the shortfall shall be taken first from reductions that would have been provided to Urban Contractors. Only after all reductions to Urban Contractors have been eliminated in a given year shall the remaining shortfall be taken from reductions scheduled for Agricultural Contractors. Any projected reductions not made available due to such shortfalls in the years 1997 through 2000 shall be deferred with interest at the project interest rate to the earliest subsequent years when reductions in excess of those projected for those years are available. Such deferred reductions with interest at the project interest rate shall be applied to the charges of the contractors whose reductions have been deferred.

(ii) In the event that the aggregate amount of reductions available in any of the years 1997 through 2000 is

(5) Annual charges to a contractor shall only be reduced prospectively from and after the date it executes the Monterey Amendment to this contract. Apportionments of reductions shall be calculated on the assumption that all contractors have executed such amendment.

(e) **Review of Financial Requirements**

(1) In 2001 and every fifth year thereafter the Director of the Department of Water Resources, in full consultation with the contractors, will review the financial requirements of the State Water Resources Development System and determine the following:

(i) The amount of revenues that are needed for State Water Resources Development System purposes in addition to those needed for the purposes specified in subdivisions (c)(2)(i), (ii), (iii), and (iv) of this article;

(ii) If the aggregate amount that would have been charged to all contractors in any year but for this article exceeds the sum of (A) the amount of revenues needed for the purposes specified in subdivisions (c)(2)(i), (ii), (iii) and (iv), plus (B) $40.5 million, plus (C) the amount determined pursuant to subdivision (c)(2)(v) of this article, the amount of such excess.

(iii) The amount of the excess determined in subdivision (e)(1)(ii) above that should be collected by the State for additional State Water Resources Development System purposes and the amount of such excess that should be used for further annual charge reductions.

(2) After making the determinations required above, the State may collect the revenues for additional State Water Resources

account in excess of this requirement shall be returned to general project revenues.

(vi) Sixth, remaining amounts if any shall be used for reductions divided on a 24.7% - 75.3% basis between the Agricultural Contractors and the Urban Contractors respectively.

(f) **Apportionment of Reductions among Urban Contractors.** Reductions in annual charges apportioned to Urban Contractors under subdivisions (d) and (e) of this article shall be further allocated among Urban Contractors pursuant to this subdivision. The amount of reduction of annual charges for each Urban Contractor shall be based on each Urban Contractor's proportionate share of total allocated capital costs as calculated below, for both project conservation and project transportation facilities, repaid by all Urban Contractors over the project repayment period.

(1) The conservation capital cost component of the reduction allocation shall be apportioned on the basis of maximum annual entitlement. Each Urban Contractor's proportionate share shall be the same as the percentage of that contractor's maximum annual entitlement to the total of all Urban Contractors' maximum annual entitlements.

(2) The transportation capital cost component of the reduction allocation shall be apportioned on the basis of transportation capital cost component repayment obligations, including interest over the project repayment period. Each Urban Contractor's proportionate share shall be the same as the percentage that the contractor's total transportation capital cost component repayment obligation is of the total of all Urban Contractors' transportation capital cost component repayment obligations.

calculated in subdivision (f)(2) of this article by seventy percent (70%).

(iii) A total, weighted capital cost percentage shall be calculated for each Urban Contractor by adding the weighted conservation capital cost component percentage to their weighted transportation capital cost component percentage.

(4) The total amount of the annual charges to be reduced to Urban Contractors in each year shall be allocated among them by multiplying the total amount of annual charges to be reduced to the Urban Contractors by the total, weighted capital cost percentages for each such contractor. If the amount of the reduction to an Urban Contractor is in excess of that contractor's payment obligation to the Department for that year, such excess shall be reallocated among the other Urban Contractors.

(5) In the case of a permanent transfer of urban entitlement, the proportionate share of annual charge reductions associated with that entitlement shall be transferred with the entitlement to the buying contractor. In the case of an entitlement transfer by either Santa Barbara County Flood Control and Water Conservation District or San Luis Obispo County Flood Control and Water Conservation District, the reductions in annual charges to that agency shall be allocated (a) on the basis of that entitlement being retained by that agency which bears Coastal Branch Phase II transportation costs, (b) on the basis of that entitlement being retained by that agency which does not bear Coastal Branch Phase II transportation costs, and (c) on the basis of the balance of that agency's entitlement which also does not bear Coastal Branch Phase II transportation costs.

Transportation Charge (excluding off-aqueduct power charges) and Water Revenue Bond Surcharge shall be totaled for the years 1997 through 2035.

(iii) Kern County Water Agency and Dudley Ridge Water District totaled costs shall be reduced for the 45,000 acre-feet of annual entitlement being relinquished by them.

(iv) Any reductions in an Agricultural Contractor's totaled costs resulting from the transfer of any of the 130,000 acre-feet of annual entitlement shall be re-added to that contractor's costs.

(v) Each Agricultural Contractor's proportionate share shall be computed by dividing that contractor's total costs by the total costs for all Agricultural Contractors determined pursuant to subparagraphs (ii), (iii) and (iv) above.

(2) The reductions in annual charges, for 1997 through 2001, shall be calculated using the method described in subdivision (g)(1) of this article.

(3) The allocation shall be recalculated using the same method described in subdivision (g)(1) of this article every five years beginning in 2002, if any Agricultural Contractor requests such a recalculation. Any recalculation shall be based on project cost data beginning with the year that the recalculation is to become effective through 2035.

(h) **Agricultural Rate Management Trust Fund**

(1) **Establishment.** Through a trust agreement executed contemporaneously with this amendment, the State and the Agricultural Contractors that sign the Monterey Amendments shall

the percentage of the total of that contractor's statement of charges for that year, as redetermined by the State on or about May 15th of that year, for (a) the Delta Water Charge; (b) the capital cost and minimum operation, maintenance, power and replacement components of the Transportation Charge (including off-aqueduct power charges); and (c) the water system revenue bond surcharge, that is equal to the percentage of that contractor's annual entitlement for that year that was not allocated to it by the State by April 15th of that year.

(ii) In addition to the provisions of subdivision (h)(4)(i) of this article, if on April 15 of any year any of the irrigable land within the Tulare Lake Basin Water Storage District (Tulare) is flooded, and Tulare in writing requests the trustee to do so, the trustee shall, to the extent there are funds in Tulare's account, distribute to the State from such account for the benefit of Tulare an amount equal to the percentage of the total of Tulare's statement of charges for that year, as redetermined by the State on or about May 15th of that year, for (a) the Delta Water Charge; (b) the capital cost and minimum components of the Transportation Charge (including off-aqueduct power charges); and (c) the water system revenue bond surcharge, that is equal to the percentage of the irrigable land within Tulare that is flooded on April 15.

(iii) Each Agricultural Contractor shall remain obligated to make payments to the State as required by other articles in this contract. Any amount to be disbursed pursuant to subdivisions (h)(4)(i) and (h)(4)(ii) shall be paid by the trustee to the State on July 1 of the year involved and shall be credited by the State toward any amounts owed by such respective Agricultural

subdivision (d) of this article so long as the amount in that contractor's account is less than its share of the Cap.

(7) **Distribution of Funds in Excess of the Cap.** Whenever accumulated funds (including interest) in an Agricultural Contractor's account in the trust fund exceed that contractor's share of the Cap, or the estimated remaining payments the contractor is required to make to the State prior to the end of the project repayment period, that contractor may direct the trustee to pay such excess to the contractor.

(8) **Termination of Trust Fund.** At the end of the project repayment period, the Agricultural Rate Management Trust Fund shall be terminated and any balances remaining in the accounts for each of the Agricultural Contractors shall be disbursed to the respective Agricultural Contractors.

(i) **Definitions.** For the purposes of this article, the following definitions will apply:

(1) "Agricultural Contractor" shall mean the following agencies as they now exist or in any reorganized form:

(i) County of Kings,

(ii) Dudley Ridge Water District,

(iii) Empire West Side Irrigation District,

(iv) Kern County Water Agency for 993,300 acre-feet of its entitlement,

(v) Oak Flat Water District,

(vi) Tulare Lake Basin Water Storage District.

(2) "Urban Contractor" shall mean every other agency having a long term water supply contract with the State as they exist as of the date of this amendment or in any reorganized form as well as

24. Article 53 is added to read:

53. PERMANENT TRANSFERS AND REDUCTIONS OF ENTITLEMENT

(a) Article 41 provides that no assignment or transfer of a contract or any part thereof, rights thereunder or interest therein by a contractor shall be valid unless and until it is approved by the State and made subject to such reasonable terms and conditions as the State may impose. In accordance with State policy to assist water transfers, the State and the County of Kings, Dudley Ridge Water District (DRWD), Empire West Side Irrigation District, Kern County Water Agency (KCWA), Oak Flat Water District and Tulare Lake Basin Water Storage District (for the purposes of this article the "Agricultural Contractors") shall, subject to the conditions set forth in this article, expeditiously execute any necessary documents and approve all contracts between willing buyers and willing sellers until permanent transfers totaling 130,000 acre-feet of annual entitlements of the Agricultural Contractors and, to the extent provided in such contracts, rights in project transportation facilities related to such annual entitlement have been made to other contractors (the "Urban Contractors") or noncontractors in accordance with the provisions of this article. Such approval requirement shall apply to all contracts executed prior to January 1, 2011. KCWA shall be responsible for approval of such transfers for any portion of the 130,000 acre-feet not previously made available under this article by the other Agricultural Contractors. A contract between a willing buyer and a willing seller shall mean a contract between (1) a buyer which is an Urban Contractor or, to the extent provided in subdivision (e) of this article, a noncontractor and (2) a seller which is an Agricultural Contractor

entitlements as well as transportation rights in accordance with the following terms and procedure:

(1) The Agricultural Contractor shall provide the State a copy of a bona fide contract or Proposed Contract (the "Proposed Contract") and the State shall, within five working days of receipt, provide copies of such Proposed Contract to all Urban Contractors together with a Notice of Proposed Contract stating the date on or before which a Notice of Intent to Exercise a Right of First Refusal (NOI) must be delivered to both the State and the seller, which date shall be 90 days from the date the State mails the Notice of Proposed Contract.

(2) The Proposed Contract shall provide for the transfer of rights in project transportation facilities sufficient to deliver to the seller's service area in any one month eleven percent (11%) of the annual entitlement being transferred or such greater amount as the seller determines to sell; *Provided*, however, that sellers shall not be obligated to sell any transportation rights in the Coastal Aqueduct.

(3) To exercise the right of first refusal, an Urban Contractor shall deliver to the State and the seller its NOI within the time period stated in the Notice of Proposed Contract and shall proceed in good faith to try to complete the transfer to the Urban Contractor. If two or more Urban Contractors deliver NOI's to the State, the amount of annual entitlement and transportation rights being sold shall be allocated among those Urban Contractors that are prepared to perform the purchase by the Performance Date provided for herein in proportion to their maximum annual entitlements, or in another manner acceptable to the Urban Contractors delivering the

(5) If an Urban Contractor issuing a NOI fails to complete its exercise of the Right of First Refusal by the Performance Date, the seller shall be free to sell its entitlement in substantial conformance with the terms and conditions set forth in the Proposed Contract . An Urban Contractor issuing a NOI may assign its rights to exercise a right of first refusal to another Urban Contractor and the assignee shall have the same rights as the assignor to complete the purchase by the Performance Date.

(6) In exercising the Right of First Refusal, an Urban Contractor, at its option, may either agree to perform the Proposed Contract in its entirety, including all of its terms and conditions, or agree to pay the price offered under the Proposed Contract for the annual entitlement and transportation rights without condition and without being entitled to enforce or being subject to any other provisions of the Proposed Contract.

(e) As used in this article, "price" shall mean the dollar amount of consideration provided for in the Proposed Contract.

(f) Upon the effective date of any such transfer, the seller shall be relieved of and the buyer shall become liable to the State for all prospective Delta Water Charges, the related Transportation Charges and any other charges for the annual entitlements and associated transportation rights transferred unless the seller and buyer provide otherwise in the contract for the transfer and the State approves such other provisions. However, the contractor making the sale shall remain obligated to the State to make the payments if the buyer defaults on its payments to the State related to the water transferred and is not a party to a long term water supply contract of the type contained in Department of Water

impaired. The capital cost and minimum operation, maintenance, power and replacement components of the Transportation Charges shall then be reallocated among the other entities participating in repayment of costs of that reach. For the purposes of this determination, all payments received by the State from the seller relating to the annual entitlement sold shall be deemed to have been received from the buying contractor. Any increased Transportation minimum operation, maintenance, power and replacement component charges allocated to the buying contractor pursuant to this subdivision (g) shall begin January 1 of the year following the effective date of the transfer.

(h) Individual contractors may transfer entitlements among themselves in amounts in addition to those otherwise provided for in this article. The State shall expeditiously execute any necessary documents and approve all contracts involving permanent sales of entitlements among contractors, including permanent sales among Urban Contractors. Such sales shall be subject to the provisions of subdivisions (b), (f) and (g) of this article; *Provided*, however, that for a buying contractor needing transportation capacity in excess of the capacity factors on which its charges are based in any reach, reallocation of the Transportation capital cost component charges for transfers other than (i) the 130,000 acre-feet provided for in this article and (ii) the approximate 33,000 acre-feet of transfers proposed from contractors located in Santa Barbara or San Luis Obispo counties, shall be determined both prospectively and retroactively.

(i) On January 1 following the year in which such Monterey Amendments take effect and continuing every year thereafter until

25. Article 54 is added to read:

54. Usage of Lakes Castaic and Perris

(a) The State shall permit the contractors participating in repayment of the capital costs of Castaic Lake (Reach 30) and Lake Perris (Reach 28J) to withdraw water from their respective service connections in amounts in excess of deliveries approved pursuant to other provisions of the state water contracts. Each such contractor shall be permitted to withdraw up to a Maximum Allocation from the reach in which it is participating. The contractors participating in repayment of Castaic Lake may withdraw a collective Maximum Allocation up to 160,000 acre-feet pursuant to this article, which shall be apportioned among them pursuant to the respective proportionate use factors from the Department of Water Resources' Bulletin 132-94, Table B-1 upon which capital cost repayment obligations are based, as follows:

Castaic Lake

Participating Contractor	Proportionate Use Factor	Maximum Allocation (Acre Feet)
The Metropolitan Water District of Southern California	0.96212388	153,940
Ventura County Flood Control and Water Conservation District	0.00860328	1,376
Castaic Lake Water Agency	0.02927284	4,684
Total	**1.00000000**	**160,000**

delivery schedule at any time, and the modified schedule shall be subject to review in the same manner. If necessary, the State may modify the schedule after consultation with the contractor and other contractors participating in repayment of that reach but may not change the total quantity of water to be withdrawn. As part of the consultation, the State shall advise a contractor if it determines a withdrawal will adversely impact the rate of delivery provided for the contractor in this contract. The State shall not be responsible for any such impacts.

(c) A contractor may withdraw all or a portion of its Maximum Allocation. It shall restore any withdrawn portion of such allocation by furnishing an equivalent amount of replacement water to the reservoir from which the water was withdrawn within five years from the year in which the withdrawal takes place. The unused portion of the allocation, in addition to any replacement water furnished to the reservoir, shall remain available for subsequent withdrawal. The State shall keep an accounting of the contractor's storage withdrawals and replacements. In any year, the State shall permit a contractor to withdraw an amount equivalent to the contractor's Maximum Allocation minus remaining replacement water requirements due to previous withdrawals. If the contractor fails to schedule and replace the withdrawn water within the five-year return period, the State shall provide the replacement water from water scheduled for delivery to the contractor in the sixth year or as soon as possible thereafter. The total amount of scheduled annual entitlement which a contractor can use in any one year for restoring its Maximum Allocation and storing water in surface storage facilities

A contractor may use any of this total amount for replacement water but cannot use any more than that provided for in Article 56 to add to storage in project surface conservation facilities and in nonproject surface storage facilities. There shall be no limit under this article on the amount of scheduled annual entitlement a contractor can use to restore its Maximum Allocation in a year when its percentage of annual water supply allocation is one-hundred percent (100%), nor shall there be any limit under this article on the amount of interruptible water, nonproject water or water obtained through an exchange which a contractor can use to restore its Maximum Allocation.

(d) For any replacement water furnished to reservoir storage pursuant to this article, the responsible contractor shall pay the State charges for the conservation, if any, and transportation of such replacement water as are associated with the type of replacement water that is furnished, as if such water were delivered to the turnout at the reservoir to which the replacement water is furnished. Adjustments from estimated to actual costs shall be subject to provisions applicable to the type of replacement water. The State shall not charge contractors for water withdrawn pursuant to this article.

(e) The State shall operate capacity in Castaic and Perris Reservoirs, not required for purposes of Maximum Allocation deliveries, in compliance with the requirement of Article 17(b) of The Metropolitan Water District of Southern California's water supply contract with the State to maintain an amount of water reasonably sufficient to meet emergency requirements of the contractors participating in repayment of that reach. A

26. Article 55 is added to read:

55. Transportation of Nonproject Water

(a) Subject to the delivery priorities in Article 12(f), contractors shall have the right to receive services from any of the project transportation facilities to transport water procured by them from nonproject sources for delivery to their service areas and to interim storage outside their service areas for later transport and delivery to their service areas: *Provided*, that except to the extent such limitation in Section 12931 of the Water Code be changed, a contractor shall not use the project transportation facilities under this option to transport water the right to which was secured by the contractor through eminent domain unless such use be approved by the Legislature by concurrent resolution with the majority of the members elected to each house voting in favor thereof.

(b) For any nonproject water delivered pursuant to this article, contractors shall pay the State the same (including adjustments) for power resources (including on-aqueduct, off-aqueduct, and any other power) incurred in the conservation and transportation of such water as if such nonproject water were entitlement water, as well as all incremental operation, maintenance, and replacement costs, and any other incremental costs, which may include an administrative or contract preparation charge, all as determined by the State. Incremental costs shall mean those nonpower costs which would not be incurred if nonproject water were not scheduled for or delivered to contractors. Only those contractors not participating in the repayment of a reach shall be required to pay a use of facilities

limits and in accordance with the provisions provided for in this subdivision (c) and any applicable water right laws, by setting forth on the preliminary water delivery schedule submitted to the State on or before October 1 of each year pursuant to Article 12(a) the quantity of project water it wishes to store in the next succeeding year. There shall be no limit on the amount of project water a contractor can store outside its service area during any year in a then existing and operational groundwater storage program. The amount of project water a contractor can add to storage in project surface conservation facilities and in nonproject surface storage facilities located outside the contractor's service area each year shall be limited to the lesser of the percent of the contractor's Table A annual entitlement shown in column 2 or the acre-feet shown in column 3 of the following table, depending on the State's final water supply allocation percentage as shown in column 1. However, there shall be no limit to storage in nonproject facilities in a year in which the State's final water supply allocation percentage is one hundred percent. These limits shall not apply to water stored pursuant to Article 12(e).

(2) Storage capacity in project surface conservation facilities at any time in excess of that needed for project operations shall be made available to requesting contractors for storage of project and nonproject water. If such storage requests exceed the available storage capacity, the available capacity shall be allocated among contractors requesting storage in proportion to their annual entitlements designated in their Table A's for that year. A contractor may store water in excess of its allocated share of capacity as long as capacity is available for such storage.

(3) If the State determines that a reallocation of excess storage capacity is needed as a result of project operations or because of the exercise of a contractor's storage right, the available capacity shall be reallocated among contractors requesting storage in proportion to their annual entitlements designated in their Table A's for that year. If such reallocation results in the need to displace water from the storage balance for any contractor or noncontractor, the water to be displaced shall be displaced in the following order of priority:

First, water, if any, stored for noncontractors.

Second, water stored for a contractor that previously was in excess of that contractor's allocation of storage capacity.

Third, water stored for a contractor that previously was within that contractor's allocated storage capacity.

The State shall give as much notice as feasible of a potential displacement.

point of return to the aqueduct to the turn-out in the contractor's service area. In addition, the contractor shall pay all incremental operation, maintenance, and replacement costs, and any other incremental costs, as determined by the State, which shall not include any administrative or contract preparation charge. Incremental costs shall mean those nonpower costs which would not be incurred if such water were scheduled for or delivered to the contractor's service area instead of to interim storage outside the service area. Only those contractors not participating in the repayment of a reach shall be required to pay a use of facilities charge for use of a reach for the delivery of water to, or return of water from, interim storage.

(7) A contractor electing to store project water in a nonproject facility within the service area of another contractor shall execute a contract with that other contractor prior to storing such water which shall be in conformity with this article and will include at least provisions concerning the point of delivery and the time and method for transporting such water.

(d) **Sale of Project Water For Use Outside Service Area**

(1) If in any year a contractor has been allocated annual entitlement that it will not use within its service area, the contractor has not elected to store project water in accordance with the provisions of subdivision (c) of this article during that year, and the contractor has not elected to carry over entitlement water from the prior year pursuant to the provisions of Article 12(e), the contractor may sell such annual entitlement for use outside its service area in accordance with the following provisions.

(4) Each year the price per acre-foot to be paid by the State to contractors selling water remaining in the Pool or placed in the Pool after February 15, but on or before March 15 that is purchased by a contractor requesting such purchase by April 1 or by the State on April 1 shall be equal to twenty-five percent (25%) of the Delta water rate as of that date. The price per acre-foot to be paid to the State for the purchase of water from the Pool by a contractor placing a request for such purchase between March 2 and April 1 shall be equal to twenty-five percent (25%) of the Delta water rate as of the later date. Any water placed in the Pool on or before March 15 that is not purchased by a contractor or the State by April 1 may be withdrawn from the Pool by the selling contractor.

(5) If there are more requests from contractors to purchase water from the Pool than the amount in the Pool, the water in the Pool shall be allocated among those contractors requesting such water in proportion to their annual entitlements for that year up to the amount of their requests. If requests to purchase water from the Pool total less than the amount of water in the Pool, the sale of Pool water shall be allocated among the contractors selling such water in proportion to their respective amounts of water in the Pool.

(6) Any water remaining in the Pool after April 1 that is not withdrawn by the selling contractor shall be offered by the State to contractors and noncontractors and sold to the highest bidder: *Provided*, that if the highest bidder is a noncontractor, all contractors shall be allowed fifteen days to exercise a right of first refusal to purchase such water at the price offered by

Article 12(e) for carrying over water from the last three months of that year into the first three months of the succeeding year.

(f) **Bona Fide Exchanges Permitted**

Nothing in this article shall be deemed to prevent the Agency from entering into bona fide exchanges of project water for use outside the Agency's service area with other parties for project water or nonproject water if the State consents to the use of the project water outside the Agency's service area. Also, nothing in this article shall be deemed to prevent the Agency from continuing those exchange or sale arrangements entered into prior to September 1, 1995, which had previously received any required State approvals. A "bona fide exchange" shall mean an exchange of water involving a contractor and another party where the primary consideration for one party furnishing water to another is the return of a substantially similar amount of water, after giving due consideration to the timing or other nonfinancial conditions of the return. Reasonable payment for costs incurred in effectuating the exchange and reasonable deductions from water delivered, based on expected storage or transportation losses may be made. A "bona fide exchange" shall not include a transfer of water from one contractor to another party involving a significant payment unrelated to costs incurred in effectuating the exchange. The State, in consultation with the contractors, shall have authority to determine whether transfers of water constitute "bona fide exchanges" within the meaning of this paragraph and not disguised sales.

October 1, 1996 date and the January 1, 2000 date may be extended by unanimous agreement of the State, Kern County Water Agency and The Metropolitan Water District of Southern California.

(b) The State shall administer the water supply contracts of any contractors that do not execute the Monterey Amendment so that such contractors are not affected adversely or to the extent feasible beneficially by the Monterey Amendments of other contractors' water supply contracts.

(c) If a court of competent jurisdiction issues a final judgment or order determining that any part of a contractor's Monterey Amendment is invalid or unenforceable, all provisions of that amendment shall be of no force or effect as to such contractor, except as provided in subdivisions (e) and (f) of this paragraph.

(d) If any part of the Monterey Amendment of the Kern County Water Agency's or The Metropolitan Water District of Southern California's contracts or if the conveyance of the Kern Fan Element of the Kern Water Bank to the Kern County Water Agency provided for in Article 52 is determined by a court of competent jurisdiction in a final judgment or order to be invalid or unenforceable, the Monterey Amendments of all contractors and the Kern Water Bank Contract shall be of no force and effect except as provided in subdivisions (e) and (f) of this paragraph.

(e) Notwithstanding subdivisions (c), (d) and (f) of this paragraph, if any part of the Monterey Amendment of the Kern County Water Agency's or The Metropolitan Water District of Southern California's contract is determined by a court of competent jurisdiction in a final judgment or order to be invalid

District of Southern California. In cases arising under subdivision (c) or (d), the affected contractor whose Monterey Amendment has been determined to be partially invalid or unenforceable must first request the waiver.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment on the date first above written.

Approved as to legal form and sufficiency

Susan N. Weber
Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Director

CASTAIC LAKE WATER AGENCY

ATTEST:

Robert H. Clark
ASSISTANT SECRETARY

GENERAL MANAGER

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 18 TO THE WATER SUPPLY CONTRACT
BETWEEN
THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
AND
CASTAIC LAKE WATER AGENCY

THIS AMENDMENT to the Water Supply Contract is made this 31st day of March, 1999, pursuant to the provisions of the California Water Resources Development Bond Act, the Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources, herein referred to as the "State," and Castaic Lake Water Agency, herein referred to as the "Agency."

RECITALS:

A. The State and the Agency have entered into and subsequently amended a Water Supply Contract (the "Water Supply Contract") providing that the State will supply certain quantities of water to the Agency, and providing that the Agency shall make certain payments to the State, and setting forth the terms and conditions of such supply and such payment.

B. The contractors and the State have amended the Water Supply Contracts to implement provisions of the Monterey Agreement (the "Monterey Amendment").

C. Among other things, Article 53 of the Water Supply Contract provides for the permanent transfer of up to 130,000 acre-feet of agricultural entitlement water to urban agencies.

D. The Agency and the Wheeler Ridge-Maricopa Water Storage District have entered into an Agreement to Purchase Wheeler Ridge-Maricopa Water Storage District State Water Project Entitlement to Water executed as of this date to provide for the sale by Kern County Water Agency, herein referred to as "KCWA", on behalf of Wheeler Ridge-Maricopa to the Agency of 41,000 acre-feet per year of KCWA's annual entitlement that has been allocated to Wheeler Ridge-Maricopa by KCWA under the contract between Wheeler Ridge-Maricopa and KCWA dated January 8, 1970 and all amendments thereto.

E. The State and Agency wish to set forth their agreement as to such matters as (i) the 41,000 acre-feet per year increase in the Agency's annual entitlement, (ii) the transfer of related transportation repayment obligations, and (iii) the revision of proportionate use of facilities factors set forth in the Water Supply Contract.

F. The State and KCWA are simultaneously with the execution and delivery of this Amendment, entering into Amendment No. 28 to KCWA's Water Supply Contract between KCWA and the State in order to reflect (i) the transfer of Table A Entitlement described herein, (ii) the transfer of related transportation repayment obligations, and (iii) the revision of proportionate use of facilities factors.

G. This Amendment is permitted by the terms of the Water Supply Contract, and except as amended herein, the provisions of the Water Supply Contract will remain in full force and effect.

NOW, THEREFORE, it is mutually agreed that the following changes are hereby made to the Agency's Water Supply Contract:

1. Article 53(j) is added to read:

   (j) In accordance with Article 53(a) the Agency is increasing its Table A annual entitlements by 41,000 acre-feet beginning in year 2000 and each succeeding year thereafter for the term of the contract through a sale from Kern County Water Agency of 41,000 acre-feet of the 130,000 acre-feet made available to Urban Contractors. As a result of this sale, Table A as designated in Article 6(b) is amended as follows:

TABLE A

ANNUAL ENTITLEMENTS
CASTAIC LAKE WATER AGENCY
(Acre-feet)

Year		
1	(1968)	3,700
2	(1969)	5,000
3	(1970)	5,700
4	(1971)	6,700
5	(1972)	8,936
6	(1973)	12,400
7	(1974)	15,400
8	(1975)	18,200
9	(1976)	21,200
10	(1977)	24,100
11	(1978)	24,762
12	(1979)	28,000
13	(1980)	30,400
14	(1981)	32,800
15	(1982)	34,800
16	(1983)	37,300
17	(1984)	39,600
18	(1985)	41,800
19	(1986)	43,600
20	(1987)	45,600
21	(1988)	48,000
22	(1989)	50,100
23	(1990)	52,000
24	(1991)	54,200
25	(1992)	54,200
26	(1993)	54,200
27	(1994)	54,200
28	(1995)	54,200
29	(1996)	54,200
30	(1997)	54,200
31	(1998)	54,200
32	(1999)	54,200
~~33~~	~~(2000)~~	~~54,200~~
33	(2000)	**95,200**
And each succeeding year thereafter, for the term of this contract as an annual entitlement:		~~54,200~~ **95,200**

The following apply to this sale:

(1) Increases in the Agency's Delta Water and Transportation Charges and Water System Revenue Bond Surcharge resulting from the increase in the Agency's annual entitlements for 2000 and each year thereafter shall commence January 1, 2000, and be identified by the State and included in its annual Statement of Charges to the Agency.

(2) All future adjustments in charges and credits of past costs associated with the 41,000 acre-feet of annual entitlement (or applicable portion thereof) and the related transportation capacity in Reaches 1 through 16A of the California Aqueduct shall be attributable to the Agency as if the Agency's annual entitlement and the related transportation capacity had been increased by the 41,000 acre-feet of annual entitlement purchased from the KCWA in years prior to January 1, 2000.

(3) For cost allocation and repayment purposes, Exhibit A attached hereto shows entitlement and capacity amounts for each aqueduct reach in which the Agency participates. These redetermined values shall be used to derive the proportionate use of facilities factors as set forth in Table B as designated in Article 24(b). The capacity amounts shown in Exhibit A are estimated values. Actual values will be used by the State in implementing the terms of this Amendment and in redetermination of Table B of this Water Supply Contract under Article 28.

2. Article 12(c)(1) which defines the limits on the instantaneous rate of flow to the Agency from Castaic Lake based on peaking factors, is modified to delete "ninety-nine (99)" and replace it with "one hundred fifty (150)."

3. This Amendment is contingent upon the effectiveness of Water Supply Contract Amendment No. 28, between the State and the KCWA. If either amendment ceases to be effective, the State may identify the date on which the contract amendments shall be deemed inoperative, for the purpose of assuring timely repayment of contract obligations and orderly administration of the long-term water supply contracts.

4. The Agency agrees to indemnify, defend, and hold harmless the State and any of its officers, agents, or employees from any liability, expenses, defense costs, attorney fees, claims, actions, liens and lawsuits of any kind arising from or related to any and all actions implementing this Amendment and associated agreements.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment on the date first above written.

Approved as to legal form and sufficiency:

for Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Stephen L. Kashiwada
for Director

ATTEST:

Robert H. Clark
Signature

Ass't Secretary
Title

CASTAIC LAKE WATER AGENCY

William C. Cheng
Signature

President, Board of Directors
Title

CASTAIC LAKE WATER AGENCY
ANNUAL ENTITLEMENT AND CAPACITY VALUES FOR EACH REACH FOR COST ALLOCATION AND REPAYMENT ONLY

The values related to this transfer are estimated to be as follows:

California Aqueduct[1]	Before Transfer		Entitlement Transferred from KCWA (AF) (3)	Capacity Transferred from KCWA (cfs) (4)	Additional Capacity Required (cfs) (5)	After Transfer	
	Annual Entitlement (AF) (1)	Capacity (cfs) (2)				Total Annual Entitlement (AF) (6)	Total Capacity (2)+(4)+(5) (cfs) (7)
Reach 1	54,200	95	41,000	122	0	95,200	217
Reach 2A	54,200	95	41,000	122	0	95,200	217
Reach 2B	54,200	95	41,000	122	0	95,200	217
Reach 3	54,200	95	41,000	122	0	95,200	217
Reach 4	54,200	95	41,000	122	0	95,200	217
Reach 5	54,200	95	41,000	122	0	95,200	217
Reach 6	54,200	95	41,000	122	0	95,200	217
Reach 7	54,200	95	41,000	122	0	95,200	217
Reach 8C	54,200	95	41,000	122	0	95,200	217
Reach 8D	54,200	95	41,000	122	0	95,200	217
Reach 9	54,200	75	41,000	122	0	95,200	197
Reach 10A	54,200	75	41,000	122	0	95,200	197
Reach 11B	54,200	75	41,000	122	0	95,200	197
Reach 12D	54,200	75	41,000	122	0	95,200	197
Reach 12E	54,200	75	41,000	122	0	95,200	197
Reach 13B	54,200	75	41,000	122	0	95,200	197
Reach 14A	54,200	75	41,000	120	0	95,200	195
Reach 14B	54,200	75	41,000	77	0	95,200	152
Reach 14C	54,200	75	41,000	46	11	95,200	132
Reach 15A	54,200	75	41,000	39	18	95,200	132
Reach 16A	54,200	75	41,000	25	32	95,200	132
Reach 17E	54,200	75	41,000	0	57	95,200	132
Reach 17F	54,200	75	41,000	0	57	95,200	132
West Branch							
Reach 29A	54,200	75	41,000	0	57	95,200	132
Reach 29F	54,200	75	41,000	0	57	95,200	132
Reach 29G	54,200	75	41,000	0	57	95,200	132
Reach 29H /2/	54,200	--	41,000	0	--	95,200	--
Reach 29J	54,200	75	41,000	0	57	95,200	132
Reach 30 /2/	54,200	--	41,000	0	--	95,200	--

[1] These numbers apply to the reaches as set forth in Bulletin 132, Figure B-4, "Repayment Reaches and Descriptions."

[2] Aqueduct capacity in cfs is not applicable to Pyramid Lake (Reach 29H) and Castaic Lake (Reach 30). The maximum instantaneous flow rate for deliveries to the Agency from Castaic Lake is 150 cfs.

Valencia Water Company Water Management Program Approved November 29, 2001, and Related CPUC Decisions

VALENCIA WATER COMPANY

WATER MANAGEMENT PROGRAM

DECEMBER 16, 1999

Revised April 10, 2000
Further Revised May 14, 2001

Approved by Commission Nov. 29, 2001
(D.01-11-048)

Valencia Water Company

VALENCIA WATER COMPANY

WATER MANAGEMENT PROGRAM

DECEMBER 16, 1999

Revised April 10, 2000
Further Revised May 14, 2001

Approved by Commission Nov. 29, 2001
(D.01-11-048)

VALENCIA WATER COMPANY

WATER MANAGEMENT PROGRAM

At the direction of the Public Utilities Commission, Valencia Water Company filed Application 99-12-025 for Commission approval of an updated Water Management Program on December 14, 1999. The Water Management Program submitted on that date, which was later admitted into evidence in Application 99-12-025 as Exhibit 3, is provided under Tab A.

On April 10, 2000, Valencia Water Company served its prepared direct testimony in Application 99-12-025. The prepared direct testimony of Robert J. DiPrimio, President of Valencia, which was later admitted into evidence in Application 99-12-025 as Exhibit 1, included a review of recent water supply and demand information and revised Table III-1 and Figure III-2 of the Water Management Program to reflect the latest information as of that date. The updated Table III-1 and Figure III-2, as attached to Mr. DiPrimio's prepared direct testimony, are provided under Tab B.

On May 14, 2001, at the direction of the presiding Administrative Law Judge in Application 99-12-025, Valencia Water Company updated its Water Management Program through testimony and by submitting a further revision of Figure III-2. The revision of Figure III-2 was later admitted into evidence in Application 99-12-025 as Exhibit 51. This most recent update of Figure III-2 is provided under Tab C.

VALENCIA WATER COMPANY

WATER MANAGEMENT PROGRAM

DECEMBER 16, 1999

VALENCIA WATER COMPANY

WATER MANAGEMENT PROGRAM

DECEMBER 16, 1999

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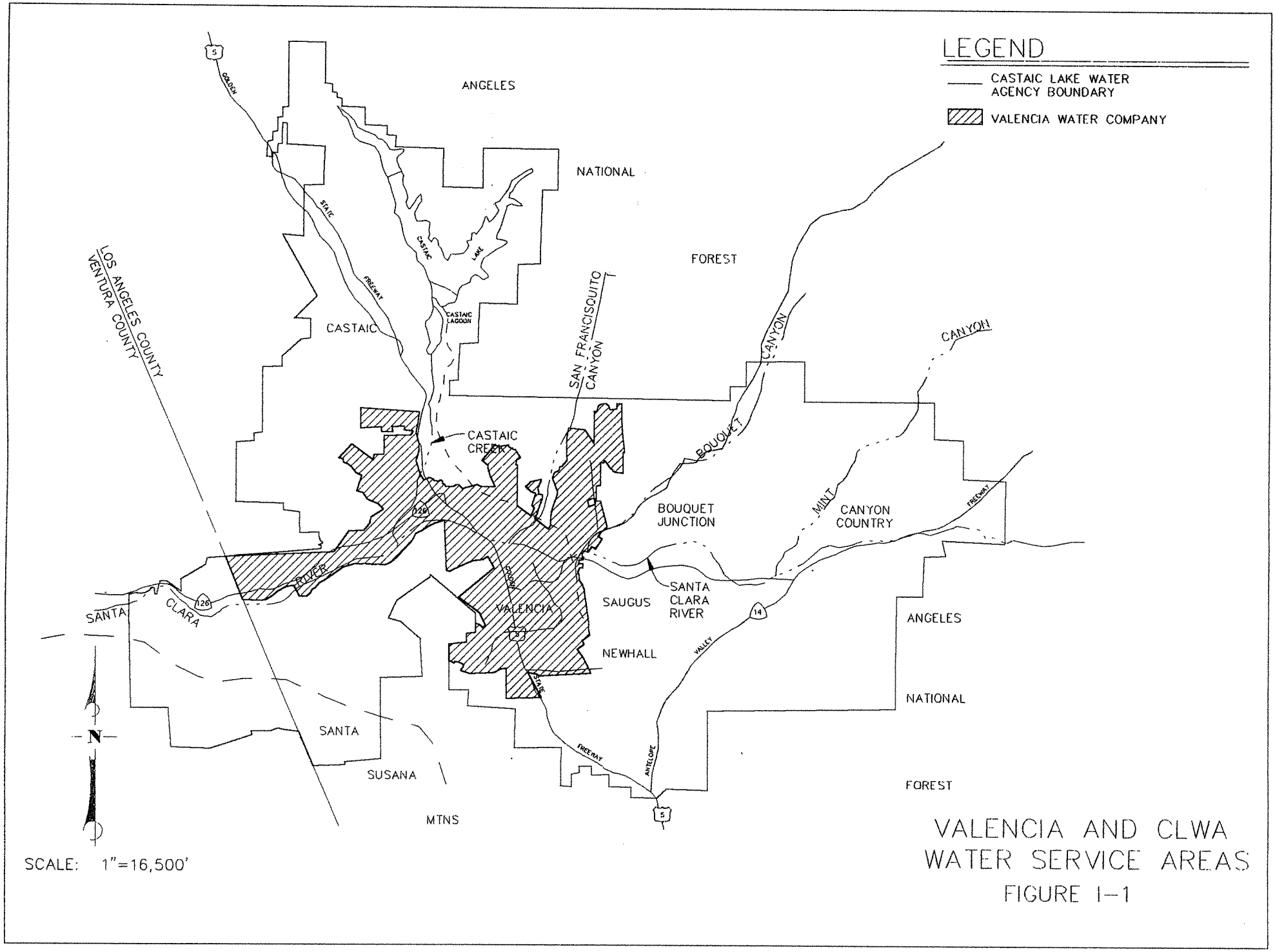
SECTION I

NARRATIVE DESCRIPTION OF UTILITY AND SERVICE AREA

I.a) GEOGRAPHICAL LOCATION

Valencia Water Company is located in the Santa Clarita Valley (Valley) which is in the northern portion of Los Angeles County. For most residents of the Valley, domestic water service is provided by four retail water purveyors. They are Los Angeles County Waterworks District 36, Newhall County Water District, Santa Clarita Water Company and Valencia Water Company (Valencia). The Castaic Lake Water Agency (CLWA) is a wholesaler that obtains water from California's State Water Project. CLWA also provides retail water service as a result of its recent acquisition of the Santa Clarita Water Company in September, 1999. The service areas of Valencia and CLWA are shown on Figure I-1.

The Valley is an irregular shaped area of approximately 500 square miles and lies approximately 35 miles northwest of downtown Los Angeles. Rolling hills, mountains, and alluvial valleys constitute the major physical features of the Valley. The largest of the alluvial valley areas is along the main stem of the Santa Clara River which traverses the region in an east-west direction. Additional significant valley areas are the South Fork of the Santa Clara River in the Newhall-Saugus-Valencia area, the Castaic Valley, San Francisquito Canyon, and Bouquet Canyon. Smaller alluvial valleys occur along several other canyons. Elevations range from approximately 800 feet above sea level at the downstream (westerly) end of the region to a maximum of approximately 3,100 feet above sea level.



VALENCIA AND CLWA WATER SERVICE AREAS

FIGURE 1-1

I b) CUSTOMER DESCRIPTION

The service area of Valencia is developed to include a mix of residential and commercial land uses, mostly comprised of single family homes, apartments, condominiums and a number of local shopping centers and neighborhood commercial developments. The City of Santa Clarita and Los Angeles County are the largest overall water users for irrigation purposes. Magic Mountain Amusement Park is the largest individual commercial user. The service area also includes two golf courses, the Valencia Industrial Center and the Valencia Commerce Center. Heavy industry is non-existent and light industry can be classified as service oriented with light manufacturing/assembly endeavors. All services are metered, with the exception of fire services.

I.c) PLANNED SYSTEM IMPROVEMENTS WHICH WILL AFFECT SUPPLY

Valencia plans improvements to its water system incrementally as demand for water service increases. Improvements are made based upon reliably meeting customer water demands, compliance with applicable PUC rules and regulations governing service, providing operational flexibility during periods of drought and peak summer usage, and meeting Los Angeles County fire flow requirements.

The principal system improvements for imported water and recycled water are planned and constructed by CLWA. CLWA has in place a Capital Improvement Program that will permit it to provide additional facilities as they become necessary. This program is funded primarily by new connection fees and is, therefore, not a burden on existing customers. CLWA's capital program is discussed in more detail in Section III.a). Additionally, CLWA has developed its *draft Integrated Water Resources Plan Water Demand and Supply Evaluation (IWRP)* (1998). This document presents the results of an evaluation of future water supply needs in the service area of CLWA and serves as a principal planning document for its Capital Improvement Program.

In 1993, CLWA prepared a draft *Reclaimed Water System Master Plan* that outlined a multi-phase program to deliver recycled water in the Valley. CLWA has completed environmental review and is constructing phase I of the project which will deliver approximately 1,700 acre-feet of recycled water. Overall, the program is expected to reclaim up to 10,000 acre-feet of highly treated (tertiary) wastewater suitable for reuse on golf courses, landscaping and other non-potable uses. Valencia encourages the use of recycled water as an important program to maximize current supplies in meeting overall water needs for the Valley.

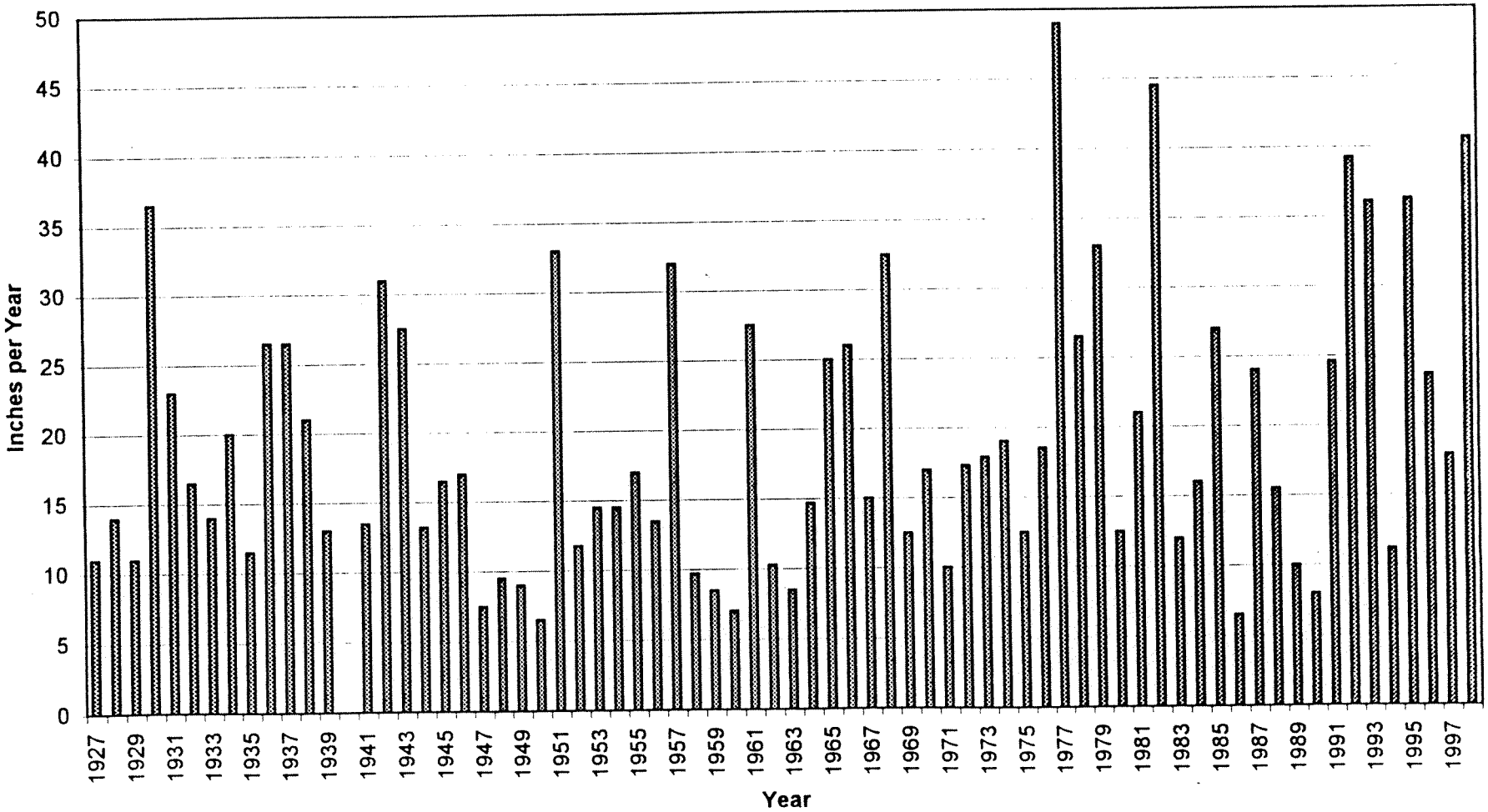
I.d) EFFECTS OF DROUGHT ON SYSTEM

Droughts have occurred locally in 1947-50, 1958-60 and 1990-91. Recent statewide droughts have occurred in 1976-77 and 1987-91. The rainfall data in Figure I-2 graphically illustrates the time periods with low rainfall. Since the area's water supplies are dependent upon rainfall conditions both locally and statewide, it is important to note that wet and dry year conditions do not always occur at the same time in Northern and Southern California. As a result, Valencia and the other Valley water purveyors can adjust the mix of available water resources on a year-to-year basis in response to local and statewide hydrologic conditions.

Prior to the 1990-1991 drought, there was minimal impact on the Santa Clarita Valley other than requiring additional well production to compensate for the lack of spring rainfall for crops, lawns and gardens. It was not until 1990-1991 that the state-wide drought impacted the water supply in the Santa Clarita Valley. The drought caused cutbacks in imported water supply. Water production declined in some alluvial wells operating in the shallow, outlying reaches of the aquifer. However, because Valencia's alluvial wells are located in the major water bearing reaches of the aquifer, none of Valencia's alluvial wells experienced loss of production during this time.

In addition to its alluvial groundwater supply, Valencia pumped water from the Saugus Formation, and along with requesting customers to voluntarily conserve 10 percent,

Santa Clarita Valley
Annual Rainfall
Figure I-2



customer water demands were met for the duration of the drought. CLWA elected not to participate in the state's Drought Water Bank because alternate local supplies were available to meet Valley water demands. Members of the Upper Santa Clara Valley Water Committee (which includes Valencia, CLWA, Los Angeles County Waterworks District 36, Newhall County Water District, and Santa Clarita Water Company) signed a Drought Emergency Water Sharing Agreement, agreeing to share water from all sources and to facilitate beneficial water transfers, exchanges and wheeling arrangements. Also, the Committee worked with the City of Santa Clarita and the County of Los Angeles to implement water use ordinances for Valley residences, review water consumption and supply data, and recommend measures to encourage conservation.

Since the 1990-91 drought, Valencia, CLWA and the other water purveyors have continued to work cooperatively to ensure customer demands are met under varying hydrologic conditions and with overall increasing demands from planned growth. These efforts have included water resource planning activities, acquisition of new water supplies and construction of transmission and treatment facilities. These activities are reported in Section III of this report.

I.e) VALENCIA WATER COMPANY SERVICE AREA

Figure I-1 shows the existing boundaries of Valencia's service area, as well as the service area of CLWA.

I.f) VALLEY PRECIPITATION

The Valley is characterized as having a Mediterranean climate. Winter temperatures are slightly lower and summer temperatures slightly higher than in coastal areas. Temperatures range from maximums near 110°F during the summer months to minimums near 20°F during the winter. Typically, dry years are followed by wet years in a cyclical pattern. The ten-year average annual precipitation (1988-1998) for the valley is 24 inches. Figure I-2 shows the annual historical rainfall in the Valley. As this graph shows, there have been 12 years with precipitation above 30 inches, and ten years when precipitation has fallen below 10 inches.

SECTION II

PREVIOUS WATER MANAGEMENT PROGRAM

II.a) ACCOMPLISHMENTS OF PREVIOUS CONSERVATION PROGRAMS

CLWA, working in cooperation with the retail water purveyors, has implemented most of the conservation efforts in the Valley over the last five years. Valencia supports these conservation efforts indirectly through the water rates paid to CLWA for purchased water

Customer Bills

Valencia provides all metered customers with historical usage on their monthly billing statements. This allows customers to compare their water usage with the same period of the prior year, and to monitor their water usage over time. Additionally, each monthly bill includes brief messages promoting conservation, such as "Use Water Wisely". This program has been very effective because it reaches such a large percentage of Valencia's customers, and because of the fact that customers are reminded on a monthly basis about their usage and about the importance of conservation.

Conservation Water Kit Program

This program targets older homes in the Valley which were constructed prior to enactment of ordinances requiring low-flow toilets and showers. The kits are available in Valencia's lobby for customers to take, and are distributed through the mail upon request from customers. The kits contain toilet displacement bags, shower flow restrictors and leak detection tablets. The program has resulted in water savings as well as a heightened awareness of conservation activities.

Education of Residential Customers

The goal of this program is to instill a water conservation ethic in students. The education program is sponsored by CLWA, and has been extremely successful during the last five years. The program includes distribution of education packets and giveaways featuring conservation messages to students. This program is ongoing and is described in more detail in Section IV.a) CLWA Conservation Programs. This program reaches approximately 6,000 students, grades kindergarten through sixth, every year.

Landscape Brochure Distribution

The goal of this program has been to educate the public about landscapes which are best adapted to the Mediterranean climate of the Valley. The original program discussed in the previous Water Management Program has been expanded to include multiple brochures on landscape education. The landscape brochure distribution program now works in conjunction with the Landscape Education Program which is described in more detail in Section IV.a) CLWA Conservation Programs.

Information to Residential Customers

Public information to customers involves promoting water conservation through public information programs which include newspaper articles, radio, direct mail, brochures, newsletters, web sites, and public events. CLWA has used all of these means to successfully promote conservation during the last five years, and continues to do so. These measures are described in more detail in Section IV.a) CLWA Conservation Programs.

II.b) 1995 WATER MANAGEMENT PLAN

The 1995 WMP reports regional water supply information, which shows the minimum and maximum water supply available in the Valley of 102,260 acre-feet and 110,800 acre-feet, respectively. This represents the area's water supply over a range of operational and hydrologic conditions.

The 1995 WMP reports the on-going planning efforts of Valencia, CLWA and the other local retail water purveyors which to date, have yielded significant improvements to the Valley's water supply capacity and Valencia's ability to deliver from multiple sources of water within its service area. The sources of water identified in the report are 1) Santa Clara Alluvial Aquifer, 2) Saugus Formation, 3) imported water from the State Water Project, and 4) recycled water.

Valencia's 1995 WMP concluded that sufficient supply was available to meet projected water demands for the foreseeable future. Water demand projections were normalized from actual Valencia customer data using the PUC's approved statistical method and reasonable assumptions for customer growth. As illustrated in Table II-1, the water demand forecasted in the 1995 WMP has closely matched actual recorded water demands over the last five years. Accordingly, Valencia believes its planning assumptions and methods used to forecast water demands are reasonable and appropriate for use in calculating projected water demands in the updated WMP.

TABLE II-1
1995 Water Management Program
Projected vs. Actual Demands
(Acre-Feet)

	1995	2000
Projected in 1995 WMP	18,000	22,065
Actual 1995	17,641	-
Latest Projection for 2000	-	23,088

It is important to note that the 1995 WMP recognized that imported water from the State Water Project is subject to reduction during droughts. Several water supply programs were identified to overcome temporary water supply shortfalls in the future, should a reduction occur. The programs identified were acquisition of additional State Water Project supply, short and long term water transfers, water conservation and public information, regional and local conjunctive use of groundwater and imported water supplies and water reclamation.

SECTION III

WATER SOURCES AND SUPPLY OUTLOOK

III.a) INTRODUCTION

This section describes the water supplies available to Valencia and illustrates how they are used when meeting existing and projected water demands. Historically, local groundwater pumped from the Alluvial Aquifer and Saugus Formation were the primary sources of water in the Santa Clarita Valley. In 1980, CLWA began delivering imported water from the State Water Project to the four retail water purveyors in the Valley. CLWA and these four entities meet regularly as the Upper Santa Clara Valley Water Committee (Committee) to coordinate the beneficial use of water in the Valley.

Since being formed in 1967, the Committee has hired consultants to conduct technical studies and coordinate water management activities that have formed the basis of the knowledge and understanding of the Valley's water resources. Ultimately, these efforts have resulted in delivery of reliable and high quality water service for Valley customers while developing coordinated resource protection strategies for its continued use.

It should be noted that the groundwater basin in the Valley is unadjudicated. Therefore, neither Valencia nor the other purveyors have "water rights", as would be the case in an adjudicated basin, that dictate their water supply. The total supply available to all purveyors in the basin and the ability of Valencia to access those supplies determines the amount available to Valencia to meet its long-term supply needs. The imported water supply is allocated to water service areas established by CLWA allowing water to be delivered to these service areas when needed. It is based upon the collection of connection fees paid by new development and allocated to water service areas to fund CLWA's capital program. Generally, however, the imported water supply is delivered on a first come, first serve basis.

Therefore, in order to assess Valencia's capacity to deliver water to existing customers as well as meet planned future developments, this WMP will present information about the **total supply** available not only to Valencia, but to the other three retail purveyors as well. This **regional** perspective is appropriate and consistent with the previous WMPs submitted by Valencia to the PUC. It also reflects Valencia's opinion that its water supplies are dependent upon the **total supply** available **and** Valencia's capacity to access and deliver those supplies to its customers.

Reference Documents

The following reference documents were used by Valencia to complete and update its WMP:

1) *1995 Water Management Program* prepared by Valencia Water Company. This report was approved by the PUC during Valencia's last general rate case (Decision No. 94-12-020).

2) *1998 Santa Clarita Valley Water Report* prepared by the Upper Santa Clara Valley Water Committee, dated February, 1999. This report was requested by the Los Angeles County Board of Supervisors and provides factual information about the current water resources within the Santa Clarita Valley. Updated annually, this report is intended to provide timely and accurate information about both water supply and demand conditions within the Santa Clarita Valley.

3) *Castaic Lake Water Agency Draft Integrated Water Resources Plan Water Demand and Supply Evaluation (IWRP)* (1998). This document presents the results of an evaluation of future water supply needs in the service area of Castaic Lake Water Agency.

Description of Water Resources

The WMP identifies six basic water resources available to Valencia. They are: groundwater, imported water supplied by CLWA, recycled water, firming water (i.e.: State's Drought Water Bank, acquiring additional SWP entitlement, and local supply augmentation), conjunctive use programs, and conservation. The WMP emphasizes developing water supplies that increase the diversity of supply available to Valencia.

Diversity of supply is considered a key element of reliability, giving Valencia the ability to draw upon multiple sources of supply during future dry years.

1) Alluvial Aquifer: The Alluvial Aquifer has historically been the main source of water within the region prior to importation of water from the State Water Project. In 1998, the local purveyors operated 35 wells and produced approximately 24,000 acre-feet of water from this aquifer for domestic consumption. Based on information from the *1998 Water Report* and *IWRP*, the aquifer has an adopted perennial yield of 32,500 acre-feet per year. Current operating results indicate the aquifer is in good operating condition. An excerpt from the *1998 Water Report (page 6)* describes how the aquifer is managed:

> *The current management practice of the Committee is to maximize use of the Alluvial Aquifer because of the aquifer's ability to store and produce good quality water on an annual basis. During times of average and wet precipitation, the amount of water pumped from the Alluvial Aquifer can exceed the perennial yield without consequence. However, during prolonged dry periods, exceeding the perennial yield may stress the aquifer by temporarily lowering water levels. Historical groundwater data collected from the Alluvial Aquifer over many hydrologic cycles provides assurance that groundwater elevations return to normal in average to wet years following periods of abnormally low rainfall.*

The *1998 Water Report* and *IWRP* indicate that during wet periods, production from the Alluvial Aquifer can be as much as 40,000 acre-feet per year (CLWA draft *IWRP* page 5-2). The *IWRP* suggests that sound basin management considers additional pumping when the aquifer is full (i.e., groundwater elevations are high) to create storage space so that capture of local runoff is increased.

Valencia currently operates 18 wells in the Alluvial Aquifer and has an operational production capacity of approximately 19,700 gallons per minute to meet average day and maximum day demands.

2) Saugus Formation: The second source of groundwater production in the Valley is the Saugus Formation. The areal extent of the Saugus Formation is approximately 85 square miles. It is a very important source of supply because it underlies the Alluvial Aquifer and is estimated to contain approximately 1.4 million acre-feet of water in storage, which is about seven times more than the amount found in the Alluvial Aquifer. This quantity of water in storage provides Valley purveyors with a large underground reservoir capable of providing the local purveyors with a reliable annual supply as well as a dry year supply when needed.

   The Saugus Formation has not been fully developed but available information reported in the *1998 Water Report* and CLWA's *IWRP* indicates that recharge ranges between 11,000-13,000 acre-feet in dry years and 20,000-22,000 acre-feet in wet years. It is believed that the Saugus Formation could produce up to 40,000 acre-feet or more of groundwater per year. This increased level is assumed to be limited to dry years (short term) when importation of water is reduced. The Saugus Formation is currently full and maintaining the substantial volume of water in storage is an important strategy to help "drought proof" water supplies in the Valley.

   At the present time, there are 12 Saugus wells operated by the purveyors with a current operational production capacity of approximately 23,000 acre-feet per year. This basin capacity excludes three existing wells that are temporarily out of service due to the detection of ammonium perchlorate. The detection of this contaminant is localized to those three wells and the on-going remedial activities of the Committee are further discussed on page 12 of the *1998 Water Report*.

Valencia currently operates 5 wells in the Saugus Formation and has an operational production capacity of approximately 10,000 gallons per minute to meet average day and maximum day demands.

3) Imported Water: The State Water Project (SWP) began in the early 1960s when public agencies (SWP Contractors) throughout the State of California each executed an individual water supply contract with the Department of Water Resources (DWR) that became the ways and means for the construction and operation of SWP facilities designed to deliver water to the Contractors. Each such contract sets forth a maximum annual entitlement called the "Table A Entitlement." A SWP Contractor may annually request that DWR deliver water in the following year in any amount up to the Contractor's Table A Entitlement. The SWP contracts provide that in a year when DWR is unable to deliver the full amount of contractor requests, deliveries will be allocated according to the Table A entitlements of each contractor. Some Contractors (including CLWA) have never requested delivery of their full annual entitlement because lower growth, other water supplies, and water conservation efforts have held their demand for SWP water below these projections. Other Contractors order their full Table A entitlements nearly every year.

CLWA is the SWP contractor or wholesaler of imported water in the Valley. CLWA operates two water treatment plants capable of producing 55 million gallons of water per day. Both plants are designed to be expanded as water demands increase. From the plants, treated water is delivered by gravity to each of the four purveyors through a distribution network of pipelines and turnouts.

CLWA has an SWP Table A entitlement of 95,200 acre-feet per year. The SWP is not complete and supplies are subject to reduction when state-wide droughts occur. As a result, CLWA and the local retail purveyors have worked together to plan and develop operational strategies to augment the Valley's water supply when imported water is reduced. A discussion of alternate or "firming water" supplies is described later in this section of the report. An expanded discussion of

alternative water supplies available to Valencia and the other water companies is presented in Section 4 of CLWA's *IWRP*.

It is important to note that CLWA funds a $500 million capital improvement program by collecting connection fees from new developments, which are set by the CLWA Board of Directors and periodically adjusted for changes in the program and estimated costs. The program is designed to fund a wide array of projects deemed necessary by CLWA to meet the water needs for planned developments identified in the general plans of the City of Santa Clarita and the Counties of Los Angeles and Ventura. The program includes construction of facilities for the treatment, storage, and transmission of water as well as acquisition of additional water supplies.

CLWA's Capital Improvement Program has been developed to fulfill its stated mission, which is to provide reliable, quality water at a reasonable cost. Several of the projects are designed to provide, when needed, additional facilities and/or water supplies increasing the dependability of SWP supply. The program's implementation has firmed-up SWP supply in the form of additional water supplies in the earlier years, followed by development of water banking, storage, and conjunctive use in later years. Facilities and water supplies are added on an incremental basis and at least 3 to 5 years ahead of need to ensure infrastructure keeps pace with planned development.

Valencia currently operates 6 connections (Turnouts) with CLWA and has an operational production capacity of approximately 31,500 gallons per minute to meet average day and maximum day demands.

4) Recycled Water: CLWA has developed a master plan for delivering highly treated recycled water in the Valley. Recycled water is available from two existing water reclamation plants operated by the County Sanitation Districts of Los Angeles County. CLWA is constructing phase I of the project which will

deliver up to 1,700 acre-feet of water for non-potable use. Valencia encourages the use of recycled water as an important program to maximize current supplies in meeting overall water needs for the Valley.

5) Firming Water: Firming water supplies are defined as alternate short term supplies (1 to 3 years) made available to the local purveyors to be used when imported water is reduced during drought conditions. For purposes of Valencia's WMP, three firming supply options are included in this report. They are: 1) acquiring additional SWP entitlement, 2) the Drought Water Bank, operated by the State of California, and 3) local supply augmentation.

In 1999, CLWA acquired 41,000 acre-feet of SWP Table A Entitlement (via a permanent transfer) from Kern County Water Agency and its member unit the Wheeler Ridge-Maricopa Water Storage District. This transfer was completed under the terms of the Monterey Agreement, in which agricultural SWP Contractors agreed, on a willing seller willing buyer basis, to make available 130,000 acre-feet of entitlement for permanent transfer to urban SWP Contractors. By this permanent transfer, CLWA SWP Table A Entitlement is 95,200 acre-feet per year. In CLWA's *IWRP*, additional imported water was identified as one component of an overall plan to increase the reliability and availability of water within its service area. For the foreseeable future, this transfer increases their total supply while providing a significant "drought buffer" even in times of shortage.

The State Drought Water Bank is implemented as needed by an executive order of the Governor or a finding by DWR's Director that water deliveries will be curtailed. The purpose of the Bank is to help California's urban, agricultural and environmental interests meet their water supply needs during water short years. This procedure was used successfully in 1991, 1992 and 1994 when DWR purchased water from willing sellers and sold the water to willing buyers under a set of allocation guidelines. Although CLWA's allocation of imported water was

reduced in 1991, it did not participate in the Drought Water Bank program because other alternate supplies were available to meet Valley water demands. For purposes of planning, CLWA's *IWRP* identified short-term deliveries of 20,000 acre-feet or more of water purchased from the state's Drought Water Bank in dry years if needed, to augment the Valley's water supplies.

It is important to note that there are several other state programs in place that CLWA can utilize to "firm up" SWP supplies when they are reduced. A partial listing of programs includes the Supplemental Water Purchase Program, the Interruptible Water Service Program and the SWP Turn-back Pool. These programs are discussed in detail in Section 3, page 3-16 of CLWA's *IWRP*. In summary, these programs provide substantial opportunity for CLWA to increase its water supply and effectively implement water management activities to enhance supply reliability.

Local supply augmentation includes demand management programs (voluntary and mandatory rationing programs) and conjunctive use of stored local groundwater. For planning purposes, the WMP assumes that Valencia customers could voluntarily conserve 10 percent from their normal usage. This is reasonable since Valencia customers, during the last drought in 1991, voluntarily conserved over 20 percent.

As discussed in item 2 above, the Saugus Formation could produce up to 40,000 acre-feet of water per year. This assumes approximately 30,000 acre-feet of water could be withdrawn on a short term basis from the Saugus Formation in addition to the dry year recharge rate of 11,000 acre-feet. In order to achieve this level of production, existing agricultural wells could be converted for domestic use and/or new wells could be constructed.

At the present time, the Valley's primary supplies of groundwater, imported water and recycled water are adequate to meet existing and projected demands for the

foreseeable future. As water demands increase, Valencia, CLWA and the other purveyors will analyze and determine the most beneficial mix of supply options available on a short term basis to meet customer demands. In summary, Valencia's WMP has identified approximately 50,000 acre-feet of firming water supplies (excluding 10 percent voluntary conservation) that is available to Valencia and the other purveyors to be used if and when SWP supplies are reduced.

6) Future Water Sources: Water supply and facilities for the Valley have increased incrementally over the years in order to keep pace with customer demands. It is not reasonable for service providers to build all that is necessary and acquire water rights to accommodate projected water demands twenty to thirty years in the future. CLWA and the local purveyors plan for new supplies and facilities a minimum of 3 to 5 years ahead of need. In its *IWRP*, CLWA addressed opportunities to increase the sources of both local and imported water supplies over time. These programs include:

Acquisition of Additional SWP Entitlements. CLWA has recently purchased under the Monterey Agreement an additional entitlement of 41,000 acre-feet. In the near term, this additional supply of water will provide added reliability to CLWA's base water supplies. At the present time, additional SWP entitlement is available and CLWA is evaluating the benefits of acquiring additional entitlement along with other programs such as water banking and other storage opportunities needed for planned growth within the Valley.

Devils Den Ranch Groundwater. CLWA is studying the potential to develop groundwater supplies from property it owns on the west side of the San Joaquin Valley near the Kings-Kern County line. Known as the Devil's Den Ranch, water from this groundwater basin could be pumped into the California Aqueduct and delivered to CLWA.

Water Conservation. CLWA will continue to develop and implement its comprehensive water conservation program in cooperation with the four retail agencies. The major emphasis will be on landscape water conservation activities. Based on empirical data on the impact of conservation measures in other cases, which range from 10 to 20 percent, a minimum 10 percent reduction in water demand through conservation is expected.

Water Transfers and Banking. CLWA will continue to pursue transfer and banking activities with other agencies. Particular emphasis will be placed on acquiring additional SWP entitlement under the Monterey Agreement. CLWA will also investigate the opportunities to bank its existing and future surplus SWP entitlement with agencies in Kern County and other neighboring agencies.

Expanded Lake Storage. CLWA will investigate with the MWD and Department of Water Resources the possibility of expanded storage in Castaic Lake beyond its current allocation. Also, flood flows into Castaic Lake will be evaluated to determine if there are opportunities to capture and store local storm water flows.

Recycled Water. CLWA plans to fully implement a cost-effective water recycling program with the four retail purveyors and the Los Angeles County Sanitation Districts, and seek loans from the State and others for a portion of the capital costs.

Groundwater Management. The Committee plans to construct additional wells in the Saugus Aquifer for use during droughts. A phased program to develop these wells would provide valuable additional water supply reliability.

Artificial Groundwater Recharge. CLWA will be evaluating the feasibility of artificial groundwater recharge of the Alluvial and Saugus Aquifers. The Alluvium can best be recharged using off-stream or in-stream spreading facilities. The Saugus can best be recharged by direct injection of imported treated water.

Groundwater Quality Protection Strategy. The Committee plans to expand its coordinated groundwater quality program to reduce the risk of contamination of the drinking water supply.

Conjunctive Use. The Committee plans to assess potential conjunctive use programs. Conjunctive use is the coordinated operation of local and imported water supplies to achieve improved overall water supply management.

In summary, various water supply augmentation programs are being pursued to ensure that new supplies are planned and ultimately added over time. The Valley's water supply is not limited by the current available supply. These long-term planning activities by Valencia, CLWA and the other Committee members are reasonable and appropriate to ensure that new supplies are brought on-line when needed to meet customer demands.

III.b) SUMMARY OF AVAILABLE WATER SUPPLY

The total available water supply for Valencia and the other retail water purveyors is illustrated in Figure III-1. As stated earlier, the Valley is subject to a wide range of hydrologic conditions and water supply variability. In some years, a wet year supply exists and in other years, it is reduced. Figure III-1 shows the supply options available to Valencia and the other purveyors from a wet year to a dry year condition. In summary, the supply ranges from 156,900 acre-feet to 142,800 acre-feet.

Valencia's WMP considers that drought periods may affect available water supplies in any single year and for a duration not longer than three consecutive years. According to DWR, long droughts in excess of three years are rare in Northern California. Except for the period of 1929-1934, there is no evidence of previous droughts exceeding three years in length from historical records dating back to the early 1870s.[1] It is important to note that hydrologic conditions vary from region to region throughout the state. Dry conditions in Northern California affecting SWP supply may not affect local supplies in Southern California. Conversely, dry conditions in Southern California may not impact water deliveries from Northern California. For this reason, Valencia, CLWA and the other Committee members have emphasized developing water supplies that add diversity to the Valley's water resources. Diversity of supply is considered a key element of reliability, giving Valencia the option of drawing on multiple sources of supply during future dry year conditions and thereby making the Valley water purveyors less dependent upon the SWP.

Figure III-1 also illustrates how Valencia and the other Committee members can implement strategies (i.e., banking, transfers) utilizing existing available surplus supplies for use during dry years. This approach strives to balance the available water resources between wet years and dry years resulting in an overall long term increase in water supply yield, especially during dry years, and ultimately defers or eliminates the need to acquire additional new sources of water. It is not reasonable to develop long term water

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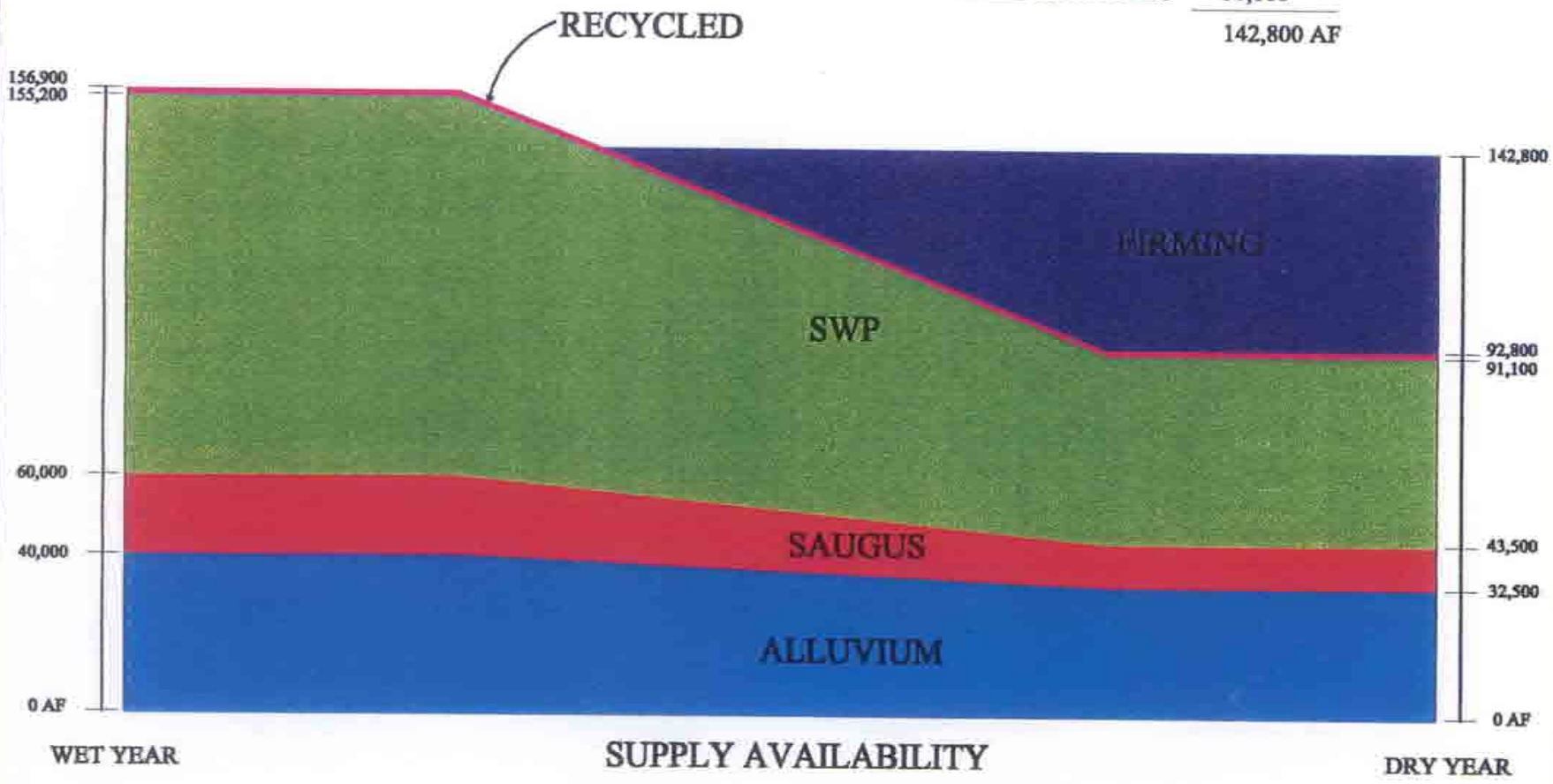
[1] *The Hydrology of the 1987-1992 California Drought*, Department of Water Resources, Maurice Roos, Chief Hydrologist (October 1992)

SANTA CLARITA VALLEY WATER SUPPLIES

FIGURE III-1

FULL SUPPLY	
ALLUVIUM	40,000
SAUGUS	20,000
SWP	95,200
RECYCLED	1,700
	156,900 AF

DRY YEAR	
ALLUVIUM	32,500
SAUGUS	11,000
SWP	47,600
RECYCLED	1,700
	92,800 AF
FIRMING SUPPLIES	50,000
	142,800 AF



supplies to meet future water demands based solely upon dry year estimates. To do so would result in an over-subscription in water supplies causing an undue cost burden for customers. Valencia, CLWA and the other Committee members add water supply and facilities on an incremental basis and in advance of need.

III.c) WATER DEMANDS

Water Demands-Valley Wide

In its *IWRP*, CLWA evaluated the long-term water demands resulting from applicable county and/or city plans within its service area. The *IWRP* calculated a range of water demands based upon existing urban land use plans and estimated water demand factors for those uses. The *IWRP* estimated Valley build-out water demands of 149,000 to 201,000 acre-feet per year. Valencia believes this information is useful for water planners to assess ultimate build-out water demands for the Valley, but is not appropriate for use in Valencia's WMP. The WMP is required to project water demands over a 20-year timeframe. The *IWRP* water demand projections are not based on any specific timeframe. It simply provides a build-out or ultimate estimate of water demands for the Valley based on existing land use approvals and the City and County General Plans.

The approach used in Valencia's WMP utilizes Los Angeles County's Development Monitoring System (DMS) to forecast future water demands. The County's Regional Planning Department maintains DMS and calculates the water demands of all subdivision and parcel map projects occurring within the unincorporated lands of Los Angeles County and the City of Santa Clarita. The County DMS reports existing water demands and projected water demands from all pending, approved and recorded projects in each of the retail purveyors' service areas.[2] Table III-1 shows a DMS build-out water demand of 79,394 acre-feet for the Valley.[3]

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[2] Pending projects are those for which the developer has submitted a tract map to the County for approval, and the project is under review by the County. Approved projects are those which the County has approved the tract map, and the developer may begin construction of the project. Recorded projects are those which have met all requirements according to the General Plan, and the County has accepted the project as complete.

TABLE III-1 Santa Clarita Valley DMS Build-Out Water Demands (Acre-Feet)					
	Existing Total Demand	Pending Demand	Approved Demand	Recorded Demand	TOTAL
Newhall County	8,087	2,640	1,177	564	12,468
Santa Clarita	20,319	2,272	3,515	790	26,896
LA County Dist. #36	578	477	207	90	1,352
Valencia	19,874	1,540	2,408	1,245	25,067
TOTAL PURVEYOR DEMAND	**48,858**	**6,929**	**7,307**	**2,689**	**65,783**
Other	13,611	0	0	0	13,611
TOTAL DEMAND	**62,469**	**6,929**	**7,307**	**2,689**	**79,394**

The "Other" demand listed above is reported in the *1998 Water Report* as groundwater primarily used for agricultural purposes and domestic use for Los Angeles County's Peter J. Pitchess Detention Center. It is assumed that agricultural demands will decline over time and will be offset to a lesser extent by increasing urban water use as development occurs. For purposes of planning, Valencia's WMP conservatively includes the existing agricultural demands in its analyses of future urban water demand projections.

In summary, the County's DMS report provides Valencia and the PUC with the most accurate and up-to-date summary of all building activity and corresponding water demands likely to receive water service from Valencia and the other retail purveyors in the foreseeable future. Some of these projects reported in DMS would require Valencia to file an advice letter with the PUC requesting an extension of service. When Valencia files an advice letter to extend service, the County's DMS report would be available to the PUC for review as a method to ensure itself that Valencia had sufficient supply and would not be overextending its ability to serve new customers. The DMS report is updated on a regular basis by Los Angeles County and provides a Valley-wide

[3] DMS water demands obtained from Mr. Bill Miller at Los Angeles County Regional Planning Department, report dated July 28, 1999.

perspective regarding the current availability of supply to meet existing and projected water demands.

Water Demands- Valencia

Table III-2 shows total water demand for Valencia from 1990 and projected through 2020. The projected demand is based on estimates of customer growth and usage per customer for each class of customers. The annual usage factors for each class of customers were derived from a multiple regression analysis study which statistically analyzed historical usage, rainfall, and temperature data to project future usage under normal conditions. The annual usage factor for the single family residential class of customers, which represents more than half of Valencia's total demand, is .60 acre-feet per year per customer. The average of Valencia's actual historical usage per residential customer since 1988 is .57 acre-feet, which provides additional support for the reasonableness of the .60 acre-feet used for these demand projections.

Using the CPUC approved regression analysis model and assuming 800 new customers per year (based on a long-term historical average), Valencia's service area demand, projected to year 2020, is approximately 41,000 AF. It should be noted that per capita water usage by Valencia's customers is declining over time. Residential customer demand was calculated to be approximately .62 acre-feet per year in Valencia's 1995 general rate case. Using the same CPUC approved regression analysis model used in the 1995 general rate case, updated to reflect current data, residential customer demand is now approximately .60 acre-feet per year. This decrease reflects the ongoing conservation efforts in the community.

TABLE III-2 Valencia Water Company Water Demand (Acre-Feet)							
Water Use Sectors	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
	Actual		Projected				
Single family residential	9,351	9,544	12,067	14,646	16,991	19,336	21,681
Multi-family residential	857	954	1,093	1,314	1,525	1,736	1,947
Commercial	2,753	2,750	4,754	5,683	6,488	7,292	8,097
Industrial	1,669	1,332	1,564	1,866	2,163	2,460	2,758
Institutional / governmental	1,556	2,725	3,270	3,931	4,559	5,187	5,815
Golf Course Irrigation	386	336	340	680	680	680	680
Total	**16,572**	**17,641**	**23,088**	**28,120**	**32,406**	**36,691**	**40,978**

III.d) WATER SUPPLY OUTLOOK

Valencia uses the following water reliability goal for its water supply: Water demands are met 95 percent of the time or 19 out of 20 years. In the remaining 5 percent of the time, it is assumed that the maximum allowable supply shortage will be 10 percent of demands. Valencia, as well as the other local purveyors chose this level even though during the last drought of the early 1990's, a 10 percent reduction was targeted, and 20 percent was actually achieved on a voluntary basis.

Valencia's WMP describes many water management options available to meet future water supply needs. It is recognized that the various water supplies available to Valencia and the other water purveyors have different reliability characteristics. As such, Valencia has met this challenge by planning and developing its own water system ensuring that it is flexible in its operation and capable of accessing and delivering a diverse mix of water at any given time. In this way, Valencia has addressed reliability in that its customers are not limited to receiving only one source of supply.

The recent drought of the early 1990's provided an illustration of the benefits of having a diverse supply. Valencia was not subject to any water shortages except for one year because three primary sources of water were available: the SWP, Alluvial Aquifer and the Saugus Formation. Those areas of the state that were solely dependent on the SWP or

local surface waters, such as Santa Barbara and Ventura Counties, were affected immediately and suffered severe cutbacks during the initial years of the drought. This was not the case for Santa Clarita Valley residents because alternate supplies were only needed in the fifth year (1991) of the drought after the SWP experienced temporary reductions in supply. Since 1991, on-going water development activities by the Committee have increased water supply to the region, enhancing water reliability.

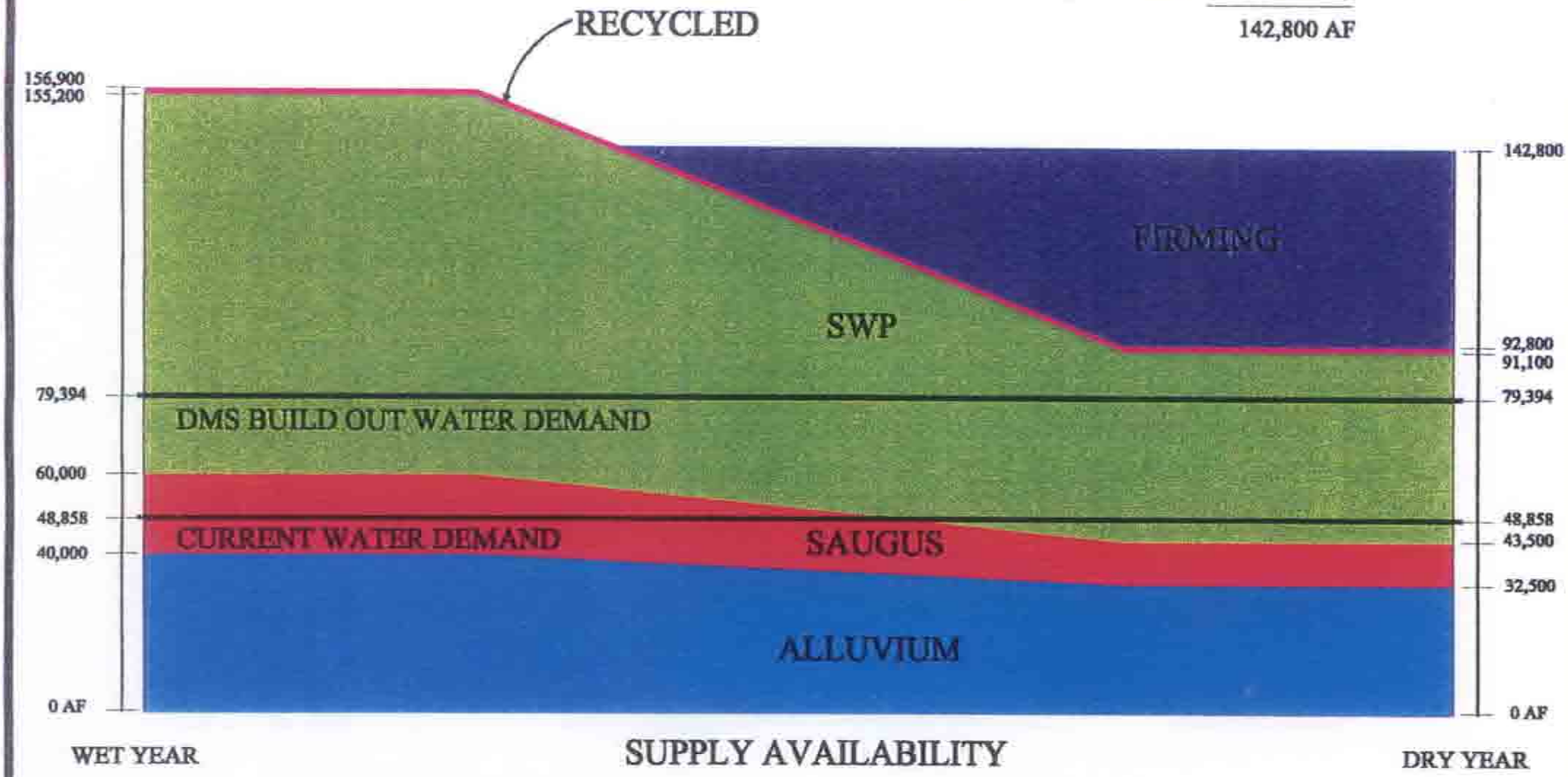
Figure III-2 compares the current available water supply under varying conditions with total demand (existing and projected) reported in DMS. Because the Valley's water supplies are diverse and Valencia has existing facilities to access those supplies, no supply deficiencies are forecasted in this WMP. CLWA's existing SWP Entitlement provides sufficient reliability for the foreseeable future to meet projected demands. In the event of an extended dry period (up to three years), Valencia along with the other water companies have access to alternate supplies to ensure dependable service to customers.

SANTA CLARITA VALLEY WATER SUPPLIES

FIGURE III-2

FULL SUPPLY	
ALLUVIUM	40,000
SAUGUS	20,000
SWP	95,200
RECYCLED	1,700
	156,900 AF

DRY YEAR	
ALLUVIUM	32,500
SAUGUS	11,000
SWP	47,600
RECYCLED	1,700
	92,800 AF
FIRMING SUPPLIES	50,000
	142,800 AF



*Current water demand of 48,858 acre-feet as reported in Table III-5 of the 1998 Water Report.

SECTION IV

WATER CONSERVATION PROGRAMS TO BE IMPLEMENTED

The majority of water conservation programs implemented by Valencia have little or no cost associated with them, usually requiring little more than the dissemination of literature, public information, and inexpensive kits for home conservation. Most of the conservation efforts in the Valley are managed by CLWA in cooperation with the retail water purveyors. Valencia's direct investment in these programs is minimal but funds them indirectly through water rates paid to CLWA for purchased water. For this reason, there was no need to conduct elaborate economic tests to justify Valencia's participation in these water conservation programs.

IV.a) CLWA CONSERVATION PROGRAMS

CLWA's various water conservation programs are geared toward eliminating wasteful water use practices, developing public information on current and potential conservation practices and implementing worthwhile programs on a timely basis. Public education and conservation programs are important elements toward meeting future water demands.

Youth Elementary Education Program

Approximately 6,000 students per year participate in CLWA's Elementary Education Program, provided as a community service to students grades K-6. Conducted in partnership with the Valley elementary schools, children in the program learned different aspects about water and its importance to life. The California State accredited program offered by CLWA also includes a pilot program on water for grades K-3.

Thousands of education packets and materials featuring water conservation messages were distributed through the Elementary Education Program and to children attending public events. Examples of youth education item giveaways are water conservation

rulers (which graphically shows that only 1/3 of 1% of Earth's water is available for consumption) and water bottles (which display a penguin and the slogan "It's cool to be water-wise").

Water Conservatory Garden and Learning Center

Approximately 100 people per week visit CLWA's conservatory Garden and Learning Center to learn more about water-wise landscaping. The seven-acre garden in the heart of the Valley features educational signs and hundreds of varieties of roses and plants that are best suited for the extreme climates of the Valley. A comprehensive Conservatory Garden Guide is available at the offices of CLWA. The guide lists important planting details about hundreds of plant species.

Conservatory Garden Docent Program

The Conservatory Garden Docent Program provides an opportunity for community volunteers to become involved in the maintenance and public presentation of the garden. Docents are in the garden every weekend and during most special events. In 1998, local residents and community groups contributed a total of 2,655 volunteer docent hours.

Adult Landscape Education Program

A total of 600 adults participated in the 1997-98 Landscape Education Program, which offered 11 monthly workshops on different aspects of water-wise landscaping. The workshops are held each year from January through October at the Conservatory Garden and Learning Center. Topics include Irrigation Basics, Selecting Fall Plants, Soils and Landscape Design. To promote the program, brochures showing the schedule of workshops are distributed through point of purchase displays at local nurseries. The most current schedule of landscape education workshops is included in Appendix A. Additionally, Appendix B includes CWLA's newsletter, *Water Currents*, which provides information to the public about the landscape education program.

Speaker's Bureau

As another public service to the community, CLWA directors and staff serve as speakers at local events and civic organization meetings. Since the program inception in November 1997, over 300 people have attended Speaker Bureau presentations on topics including: the Conservatory Garden and Learning Center, the History of Water in California and in the Valley, the State Water Project and CLWA Facilities, Water Quality, and the Elementary Education Program. Each presentation begins and ends with a discussion of the value of water in our State and in Southern California.

Public Information – Print and Broadcast Media, Direct Mail and Web Site

CLWA disseminates water conservation information in many of its public materials and notifications, as described below.

Newspapers/Magazines/Directories:

Press releases and advertisements promoting water conservation and CLWA programs (as described above) are submitted and appear throughout the year in: The Signal, The Daily News, The Magazine of Santa Clarita, and the Valley Chamber Business Directory.

Radio:

A series of five public service announcements along with 21 advertisements air monthly on a year-round basis on the local radio station, KBET-AM. The 60-second paid spots alternately present information on water-wise landscaping and residential water conservation. The three-minute public service announcements are abbreviated versions of the CLWA Speakers Bureau speeches.

Direct Mail: Approximately 50,000 1998 Water Quality Reports were mailed to businesses and residences in accordance with State and Federal law. CLWA and the retail purveyors used the eight-page report to feature a series of main headline statements on water conservation and preservation. One page of the report was devoted to water conservation tips and information. On the back cover of the report was a popular multiple-choice "Water IQ" test.

CLWA Newsletter *Water Currents*

The CLWA newsletter, *Water Currents*, was mailed in the same envelope with the Annual Water Quality Report. The message on the front of the envelope was: "Use Water Wisely. Every Drop Counts." A subsequent envelope was printed with the message, "Summer is Here. Use Water Wisely."

Each quarterly CLWA newsletter features water conservation tips and includes a return post card which people can use to request more information on landscape education workshops, elementary school education programs, CLWA Speakers Bureau and other water conservation issues. A new feature of *Water Currents* is a column called "Talking Purely About Water" which provides information on how people can preserve water resources. A copy of the Summer 1999 issue of *Water Currents* is attached as Appendix B.

Theater On-Screen Advertising

A theater on-screen advertising campaign by CLWA is currently underway on 24 movie screens in two theaters in the Valley. The Disney Productions feature movie, "Mighty Joe Young", was filmed at the CLWA Conservatory Garden. While this hit movie was appearing in the local theaters, water conservation messages presented by CLWA appeared prior to all the theater's movies. Due to the success of the program and the large number of people this type of advertising reaches, CLWA has continued the on-screen advertising which promotes conservation and invites the public to visit the Conservatory Garden.

Throughout the year, CLWA distributes a series of brochures entitled, "The Value of Water," "Castaic Lake Water Agency," "The Conservatory Garden and Learning Center," and the "CLWA Speakers Bureau." "The Value of Water" brochure shows tables and graphs of how much water is used for agriculture, business, the environment, and residential purposes. The other full color brochures in the series stress the importance of wise-water use.

CLWA Web Site

The CLWA web site, http://www.clwa.org/ presents extensive up-to-date information on many aspects of CLWA, its activities, and its facilities. The web site features a variety of high resolution, color photos for browsers to select to view. During 1998, the CLWA web site received 4,000 hits.

Public Tours of Rio Vista Water Treatment Plant

To help people better understand and appreciate the treatment and transmission of imported State Water Project water, public tours of Rio Vista Water Treatment Plant are provided every Thursday and on the third Saturday of each month at 1 p.m. A total of 1,600 people toured the plant in 1998.

Public Events and Activities

To help people better understand and appreciate the water resources of the State of California, CLWA conducted two State Water Project tours, a Water Issues Committee, a Los Angeles County Public Library Program, and a California Water Awareness Month Open House. CLWA participated as an exhibitor in the Valley Chamber of Commerce Business Mixer, and in the City of Santa Clarita's River Rally. CLWA also participated in the October 1998 Business Expo which was attended by approximately 13,000 – 15,000 people. CLWA participated in the City of Santa Clarita Emergency Preparedness Expo which is a city sponsored event featuring local businesses providing services and information related to emergency preparedness. Thousands of individuals participated in other CLWA and community public events.

California State Water Awareness Campaign

About 700 guests attended the CLWA annual Open House, which celebrates California Water Awareness Month. At the Open House, participants were asked to provide a water saving tip to share with others. The tips are printed in CLWA newsletters. Also, each May, children's suggestions on how to save water are aired every morning on the local radio station, KBET-AM.

As part of the Water Awareness Campaign, CLWA annually invites a group of active community members to tour the State Water Project. The inspection trip, which began at the Rio Vista Water Treatment Plant, allowed participants to see where the imported water supply used locally originates and the path it travels to reach the Valley. The State Water Project tour is conducted by CLWA to help better educate local residents and business representatives about the importance of water to the Valley.

Civic / Private Special Events

In 1998, the public facilities of CLWA were used by dozens of community clubs and organizations for meetings and receptions. The CLWA administrative building and its adjacent Conservatory Garden also were used for a variety of private celebrations throughout the year.

The objective of CLWA in opening its doors for public use was to provide wide-spread exposure to the practice of water-wise landscaping and the basic practices of water treatment and transmission. A total of 4,200 guests attended civic and private special events held at CLWA. It is considered that the vast majority of these individuals would not have visited the water treatment plant and conservation garden otherwise.

Many of the special events raised money for non-profit service organizations in the community.

Water Conservation Giveaway Items

Thousands of water conservation items were distributed at the public events and activities described above. Some of the items included:

- Notepads printed with the headline "Water is Precious. Use Water Wisely."
- Toothbrushes imprinted with the headline "Save Water. Turn Off Your Tap."
- Magnets imprinted with public hours for the Garden and the Rio Vista tours
- Water Bottles imprinted with "It's Cool to be Water-Wise"
- Totebags imprinted with "Help Conserve and Preserve All Natural Resources."

- Poppy seeds with text on planting this drought-resistant California State Flower
- Rio Vista Water Bottles: CLWA distributed thousands of bottles of water treated at Rio Vista in an attempt to help local residents understand that their tap water is safe to drink.

Water Conservation Awards

In 1998 and 1999, CLWA was awarded first place in The Association of California Water Agencies (ACWA) Theodore Roosevelt Environmental Award. CLWA was one of three finalists in the Clair A. Hill Award for Excellence, and received three of nine first place awards in the Water Management Awareness Program. During 1998 and 1999, CLWA received certification in the ACWA Water Management Program and was honored for their achievements at the ACWA Fall Conference.

Connection Fees

Connection fees are paid by developers to CLWA based on water demand. Developers therefore have a strong incentive to take measures to conserve water within their developments, such as irrigation drip systems and drought tolerant plants.

IV.b) VALENCIA WATER CONSERVATION PROGRAMS

In addition to the programs administered by CLWA as described above, Valencia has several of its own water conservation programs. It should be noted that per capita water usage by Valencia's customers continues to decline over time. Residential customer demand was calculated as approximately .62 acre-feet per year in Valencia's 1995 general rate case. Using the same CPUC approved regression analysis model used in the 1995 general rate case, updated to reflect current data, residential customer demand is now approximately .60 acre-feet per year. This decrease reflects the ongoing conservation efforts in the community.

Customer Bills

This program has been reaching all metered customers on a monthly basis, which represents more than 95% of Valencia's customers. All metered customers are provided with historical usage on their monthly billing statements. This allows customers to compare their water usage with the same period of the prior year, and to monitor their water usage over time. Additionally, each monthly bill includes brief messages promoting conservation, such as "Use Water Wisely". This program has been very effective because it reaches such a large percentage of Valencia's customers, and because of the fact that customers are reminded on a monthly basis about their usage and about the importance on conservation.

Adopt-a-School

Valencia has participated in the local Adopt-a-School program for the last two years. In this program, a Valencia representative visits local elementary schools and teaches the students about water conservation and water saving techniques. Water education materials are also distributed.

Stevenson Ranch Family Festival

Valencia has participated in the Stevenson Ranch Family Festival for the last two years. Stevenson Ranch is one of the communities within Valencia's service area. At the festival, Valencia has a booth where Valencia representatives answer questions from the public and distribute information on conservation and water saving techniques.

City of Santa Clarita Emergency Preparedness Expo

Valencia participates in the City of Santa Clarita Emergency Preparedness Expo which is a city sponsored event featuring local businesses providing services and information related to emergency preparedness. At this event, Valencia has a booth where Valencia representatives answer questions from the public and distribute information on conservation and water saving techniques.

Water Conservation Kits

Water Conservation Kits are available in the lobby of Valencia's offices, and kits are also distributed through the mail upon customer request. The kits include a water saver for shower heads, a toilet displacement bag, a dye tablet for leak detection, as well as information on water saving techniques.

IV.c) VALENCIA WATER LOSS REDUCTION TECHNIQUES

Valencia has many standard procedures which help to minimize water losses. Valencia consistently tracks unaccounted for or slippage water to ensure slippage remains at a reasonable level based on industry averages. All Valencia employees are trained to continually watch for leaks and any leaks noted are repaired immediately. Employees are instructed to watch for and put a stop to any unauthorized hydrant use throughout the service area to discourage this practice.

All services within Valencia's system are metered, with the exception of fire services. Customer water meters are changed out on a regular rotation to help ensure their accuracy. Meters for main line facilities are checked and calibrated on routine schedules which vary with the type of meter and the local service conditions.

Valencia has a regular schedule for exercising valves to insure proper operation to facilitate blocking or rerouting flows during emergencies which include major main breaks.

Valencia has very little corrosion because most pipelines are either plastic, ductile iron, or asbestos cement. The ground and surface waters are not considered to be corrosive, the soils are not considered to induce corrosion, and the groundwater table is below pipeline construction zones.

APPENDIX A

CLWA LANDSCAPE EDUCATION PROGRAM

Castaic Lake Water Agency

LANDSCAPE EDUCATION WORKSHOPS

All Workshops are from 9:00 a.m. to 12:00 noon and include question and answer periods
We repeat these classes each year, and generally meet the third Saturday each month.

Soils and Fertilizers Prepare your soil for improved plant health (Healthy plants use less water)	**November 20, 1999**
Pruning Methods to prune most any plant Hands-on pruning for roses and fruit trees	**January 15, 2000**
Propagation Grow new plants from seeds, cuttings, grafting, division, and more.	**February 19, 2000**
Plant Selection: Trees and Shrubs	**March 18, 2000**
Irrigation Basics Sprinkler and Drip Irrigation Design and Installation	**April 15, 2000**
Water Management/Audit Techniques for managing water in and around your home (Easy ways to save water and money)	**May 20, 2000**
Turf Selection/Maintenance Selecting and maintaining a healthy lawn	**June 17, 2000**
Landscape Design Principles New home or old... Learn the basics of good landscape design	**July 15, 2000**
Pest Diagnosis: Weeds Identify and control weeds	**August 19, 2000**
Pest Diagnosis: Diseases & Insects Identify and control plant diseases and Insects	**September 16, 2000**
Fall Plant Selection: Annuals and Perennials	**October 21, 2000**

APPENDIX B

WATER CURRENTS – SUMMER 1999

ASTAIC
A K E

RECEIVED
AUG 09 1999

SUMMER 1999

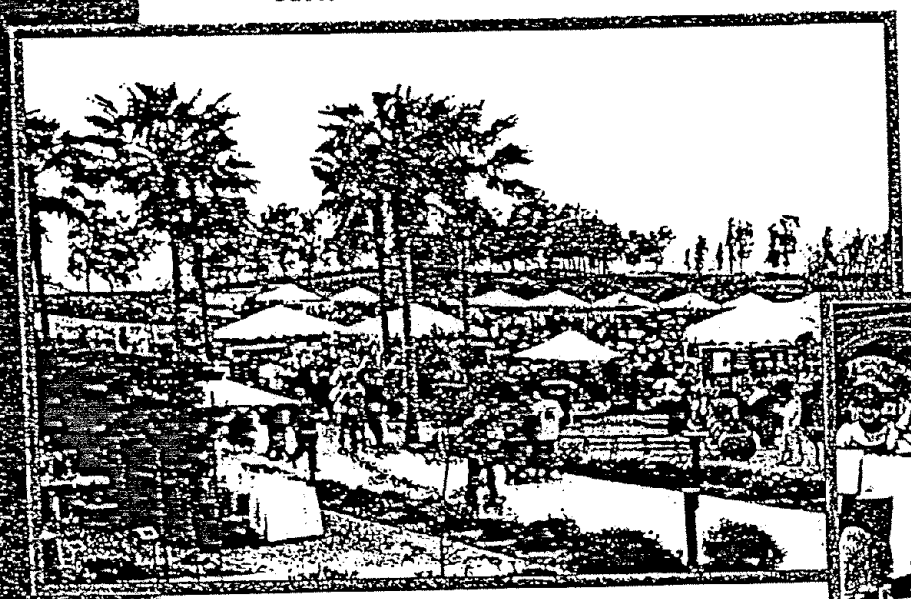
Water Currents

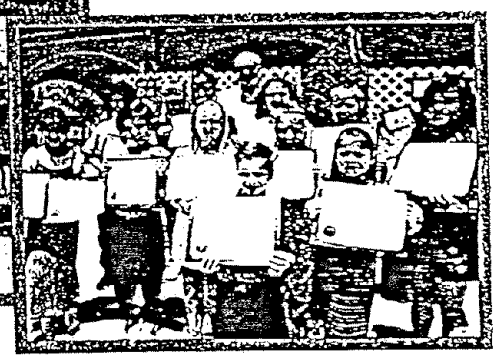
ATER
GENCY

Locals Celebrate Water Awareness, Support Worthy Causes at Castaic Lake Water Agency

On Sunday, May 2, over 1,000 people attended the annual "Taste of the Town" fundraiser, held in the beautiful seven-acre Conservatory Garden at Castaic Lake Water Agency. The event showcased the talents of more than two dozen local restaurants and caterers. Taste of the Town proceeds benefit the Santa Clarita Valley Child and Family Development Center.

About 1,300 people attended CLWA's Open House on Saturday, May 15.





The popular annual event featured guided tours of CLWA's state-of-the-art Rio Vista Treatment Plant, as well as Landscape Education Workshops and self-guided tours of the Conservatory Garden.

On display was the work of hundreds of aspiring young artists who entered the CLWA-sponsored Water Awareness Coloring Contest. Winners received certificates in a special awards ceremony. (See page 6.)

At a game booth, guests were invited to test their water knowledge (and win prizes) by answering questions concerning water-related issues and trivia. As in years past, local nurseries, area agencies and community businesses were on hand to promote the products and services they provide.

CLWA holds its annual Open House each [illegible] celebration of California Water Awareness [illegible]

In this issue . . .

State Water Project Trip

Water Conservation Tips

Composting Classes Offered

Landscape Education Program

. . . and more!

Community Leaders Embark Upon a Comprehensive Three-Day Inspection Trip of the State Water Project

As part of the state-wide California Water wareness Campaign, Castaic Lake Water Agency nvited a group of active community members to our the State Water Project. The inspection trip, hich began at the Rio Vista Water Treatment Plant in anta Clarita, allowed participants to see where the nported water supply used locally originates and the ath it travels to reach the Santa Clarita Valley.

After touring the Rio Vista Plant, participants raveled to Castaic Lake to visit the Earl Schmidt iltration Plant. From there, participants visited the dmonston Pumping Plant and the Vista del Lago isitor Center at Pyramid Lake.

On the second day of the tour, those attending had the opportunity to visit Oroville Lake and Dam, the Edward G. Hyatt Power Plant, and the Feather River Fish Hatchery.

The third and final day of the outing included a tour of the Sacramento/San Joaquin Delta and the Harvey O. Banks Pumping Plant.

Community leaders involved represented local businesses, school districts, non-profit organizations, sports groups, water providers, landholders, government divisions, environmental groups, and the press.

The State Water Project Inspection Trip is conducted annually by CLWA, to help better educate local residents and business representatives about the importance of water to the Santa Clarita Valley.

Inspection trip participants seen here at the CLWA Rio Vista Water Treatment Plant and Conservatory Garden.

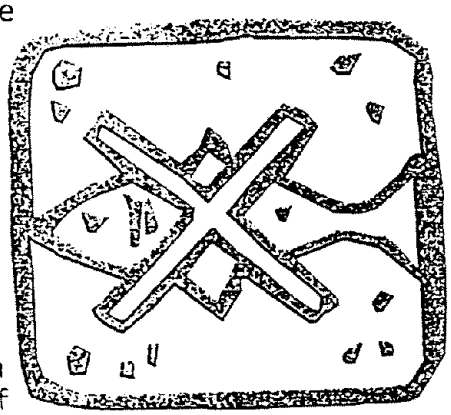
City staff member, Jeanne Santizo, and AYSO soccer player Tyler Roth pictured above at the Harvey O

At Edmonston Pumping Plant (at the base of the Grapevine), State Water Project Inspection Trip guests learned how water is pumped up 2,000 feet in elevation.

'alking "Purely About" Vater . . .

NO DUMPING.
THIS DRAINS TO OCEAN.

You have probably seen these familiar words enciled on storm drains throughout the Santa arita Valley. Since the Pacific Ocean seems a long ays away, sometimes it's easy to forget that water oured into local storm drains eventually winds up ere. If run-off water has been contaminated with xic substances, these ollutants pour into e ocean as well.



When water is sted for toxins in a boratory, it is com- non for substances be measured in *arts per billion.* only takes a small uantity of certain ubstances to foul an normous amount of vater.

For instance, one quart of motor oil can form an il slick covering thousands of square feet and can contaminate 250,000 gallons of water. One cup of PCBs (a dry cleaning industry byproduct) can contami- nate the water supply of four families for a year.

Take a quick look around your home and identify substances that are toxic to the environment. Pay particular attention to batteries, petroleum products, paints and solvents. They will often carry messages such as "do not dispose of in a landfill," or "do not discharge into public sewer system." You can help to protect our environment by heeding these warnings.

On July 1, 1999, the City of Santa Clarita Department of Environmental Services introduced a door-to-door hazardous waste pilot program. Residents of Santa Clarita can call 1-800-499-7587 to schedule an appointment for free hazardous waste pick-ups at their homes.

Materials collected between now and September 30, 1999, include: antifreeze, auto batteries, used motor oil, latex paint, oil-based paint, pesticides, herbicides, household cleaners and other toxic substances.

"You never want to put household hazardous materials in the storm drains or in the trash," said City Recycling Coordinator, David Peterson. "The City's new program will contribute to the sustainability of our quality of life in Santa Clarita."

Castaic Lake Water Agency offers information about hazardous materials. For a copy of a hazardous materials handout, fill out the postcard in this newsletter and mail it to the Agency. Please help out by doing

Castaic Lake Water Agency Landscape Education Program

All workshops are 9 a.m. - noon at the Conservatory Garden at Rio Vista Treatment Plant

Pest Diagnosis: Weeds

August 21

Pest Diagnosis: Diseases & Insects

September 18

Plant Selection: Annuals & Perennials

October 16

Call 297-1600 to Register

A Community

GROWS

Where Water

FLOWS

All living things depend on water.

A supply of clean, pure water is essential for life. Do your part to protect and conserve this precious natural resource. Please use only your fair share.

Use Water Wisely.

It's A Way of Life!

If you would like to be added to our mailing list or receive more informatio about local water resources, please fill out this card and drop it in the mail.

Name _____

Address _____

City _____ State _____ Zip _____

CASTAIC LAKE WATER AGENCY

Please send me information regarding the following:

- ❑ Landscape Education Workshops
- ❑ Elementary School Education Program
- ❑ CLWA Speakers Bureau
- ❑ Emergency Preparedness Information on Water
- ❑ 1999 Water Quality Report
- ❑ Water Conservation/Water Preservation

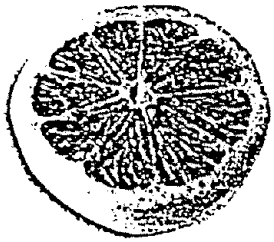
WATER CONSERVATORY
GARDEN & LEARNING CENTER

A COMMUNITY PROJECT SPONSORED BY
CASTAIC LAKE WATER AGENCY

Open: Tuesday through Friday
8 a.m. – 5 p.m.
Saturdays 9 a.m. – 3 p.m.
Closed: Sundays, Mondays and Holidays

CASTAIC LAKE WATER AGENCY

LOCATED AT
27234 BOUQUET CANYON ROAD
IN SANTA CLARITA



It takes a lot of water to produce food.

It takes 14 gallons of water to grow an orange, and 48 gallons to produce a cup of milk. An 8-ounce steak requires 1,232 gallons! And it takes lots more water to manufacture the packaging.

Use Water Wisely.

It's A Way of Life!

Postage Required
Post Office wi
not deliver
without prope
postage.

CASTAIC LAKE WATER AGENCY
27234 BOUGUET CANYON RD
SANTA CLARITA CA 91350-2102

tudent Artists Honored at LWA Open House

Award-winning student artists in grades K-6 were nored at the Castaic Lake Water Agency Open House, - their entries in the Water Awareness Month loring Contest. The following elementary school stu- nts received certificates, ribbons and prizes for their lorful drawings:

and Prize Winner anpreet Kaur, darcreek School, t place (K-2) - anpreet Kaur, darcreek School, d Place (K-2) - thy Simonet, netree School, d Place (K-2) - vin Hancock, netree School, onorable ention (K-2) - eston Kilbride, netree School, t place (3-4) - aura Jane hiteside, edarcreek School, 2nd Place (3-4) - Julie Ann Traurig, anta Clarita Elementary, 3rd Place (3-4) - Adam Lewis, anta Clarita Elementary, Honorable Mention (3-4) - ennifer Arango, Santa Clarita Elementary School, st place (5-6) - Merlinda Salas, Canyon Springs School, nd Place (5-6) -Omar Vargas, Canyon Springs School, rd Place (5-6) - Paulina Franco, Canyon Springs School, onorable Mention (3-4) - Brooke Bergiadis, Highlands lementary School.

The theme of the 1999 CLWA Coloring Contest as, "Where does my drinking water come from?" undreds of entries were received by the CLWA ducation Department from elementary schools nroughout the Santa Clarita Valley. (Winners are ictured on the cover of this newsletter.)

Mark Your Calendar to Attend Yard Waste Classes

You are invited to join in Los Angeles County Yard Waste Workshops, being held at the Conservatory Garden at Rio Vista Water Treatment Plant. Upcoming local classes are being held at 1 p.m. on Saturday, September 18 and November 20, 1999. Gardening gloves, water bottles, and AMC Theater and Starbucks discount coupons are distributed to participants. For [illegible] 888-253-2652)

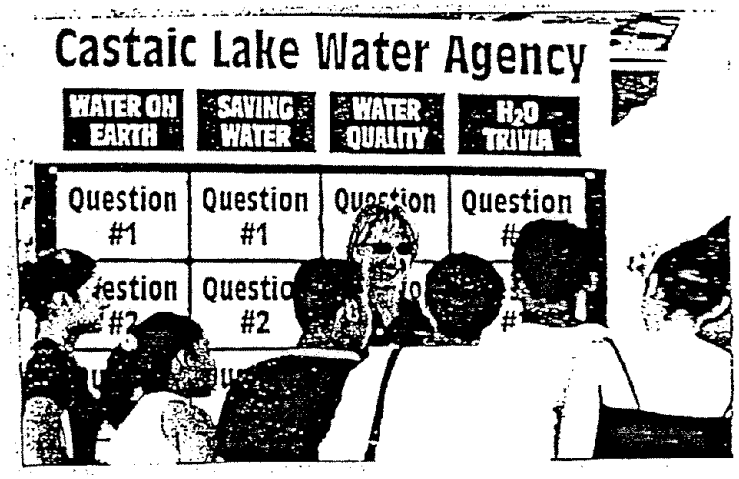
School Program Chalks Up Record-Breaking Year

Almost 6,000 students in grades K-6 were involved in the Castaic Lake Water Agency Elementary School Education Program this past school year. This participation represents an increase of 82% over the previous school year. Highlighting the 1998/1999 program was the introduction of a new grade 4 program, which focuses on microscopic testing and treatment of water samples at the CLWA Earl Schmidt Filtration Plant Laboratory.

Surf to CLWA on the Web

Computer users can find up-to-date information on educational programs, meeting dates and agendas, water-saving hints, and water trivia on the internet. To learn more about CLWA, check out the Agency's web site at:

www.clwa.org



As a public service, CLWA participated as an exhibitor at the 1999 Santa Clarita Valley Country Fair. Guests were invited to play the "Water Game," answering questions about water-related topics. The Country Fair was held July 3 and 4 at Newhall Park. The annual event benefits the Theatre Arts for Children organization.

Water Currents

is a publication of
Castaic Lake Water Agency
27234 Bouquet Canyon Road
Santa Clarita, CA 91350

For newsletter information ca
Liza Stratton at (661) 297-160[illegible]

APPENDIX C

NEWSPAPER ARTICLE ON RECYCLED WATER

The Signal, November 1999

McKeon pours support into CLWA bill

Legislation to fund $76.5 million water reclamation project.

By Chris Dickerson
Signal Staff Writer

U.S. Rep. Howard P. "Buck" McKeon, R-Santa Clarita, announced Tuesday that he has introduced a bill that would provide federal funding for a $76.5 million water reclamation project proposed by the Castaic Lake Water Agency.

House Resolution 3322 will authorize the secretary of the Interior, in cooperation with CLWA, to "participate in the design, planning, and construction of a project to reclaim and reuse wastewater within and outside of the service area of the Castaic Lake Water Agency."

The bill stipulates that the federal government shall provide up to 25 percent of the project's costs.

"I am happy to seek this assistance for the CLWA as it embarks on this important project," McKeon said in a written statement. "Making use of reclamated water will free up more drinking water for the citizens of the Santa Clarita Valley. It's great that the CLWA is planning now to take the steps necessary to provide water for the valley far into the future."

Under the plan, CLWA, the Santa Clarita Valley's water wholesaler, will provide approximately 9,000 acre feet per year of water to existing customers — 3,700 acre feet for golf courses, 1,300 acre feet for parks, 1,100 acre feet for residential landscaping, 1,000 acre feet for schools, 700 acre feet for a co-generation plant, 500 acre feet for commercial/industrial and 500 acre feet for Six Flags Magic Mountain.

About 7,300 acre feet per year of the recycled water will also go for future users, including planned residential developments, industrial development and golf courses.

The recycled water comes from effluent that is treated at existing facilities owned and operated by the Los Angeles County Sanitation

See CLWA, page A3

CLWA

Continued from page A1

Districts.

The components of CLWA's recycled water project include a reuse pump station located at each water reclamation plant to provide recycled water to the distribution system; about 429,000 linear feet of distribution pipe ranging in size from 6 to 38 inches in diameter; 10 booster pump stations with varying capacities located throughout the distribution system; and 12 above-ground reservoirs providing a total storage capacity of 24.5 million gallons.

CLWA is embarking on the reclamation project to make more efficient use of its available water.

The Water Use Efficiency component of the CALFED Bay-Delta Program is expected to bypass more than 3 million acre feet of water demand annually by the year 2020 through locally implemented conservation efforts like water recycling. CALFED, the U.S. Bureau of Reclamation and the state Department of Water Resources are encouraging regional water recycling opportunities that maximize reuse at minimal cost.

"Because the Santa Clarita Valley is growing rapidly, new developments can be planned to include the infrastructure necessary to provide recycled water to new communities," McKeon said. "Construction of these facilities at the onset of development is much more cost-effective than retrofitting existing facilities. Being able to use recycled water for industrial and similar uses frees up drinking water for households."

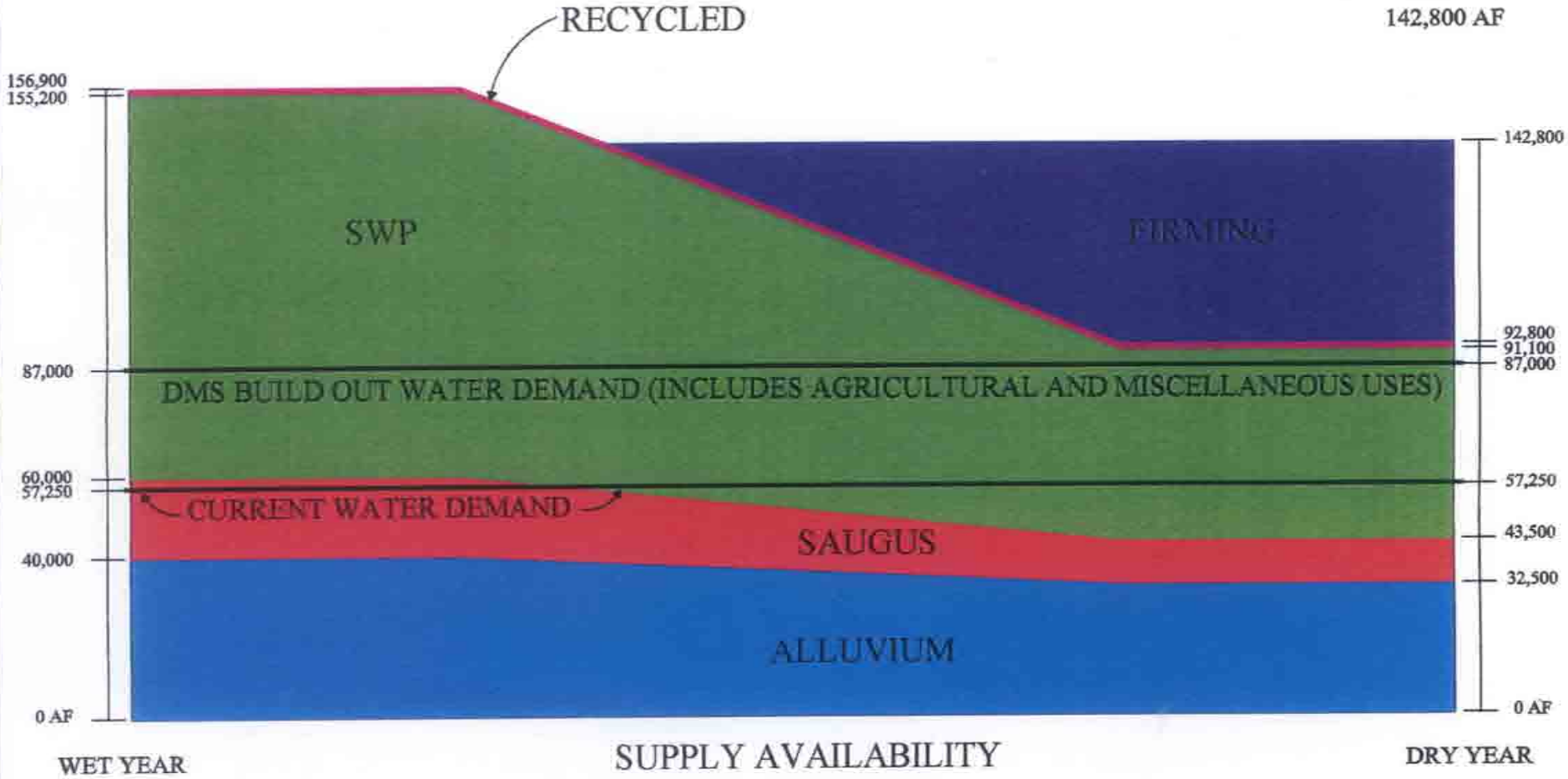
TABLE III-1 (Revised) Santa Clarita Valley DMS Build-Out Water Demands (Acre-Feet)					
	Existing Total Demand	Pending Demand	Approved Demand	Recorded Demand	TOTAL
Newhall County	9,348	3,790	1,260	1,264	15,662
Santa Clarita	24,513	2,294	3,646	967	31,420
LA County Dist. #36	654	617	114	204	1,589
Valencia	22,735	2,647	4,602	1,255	31,239
TOTAL PURVEYOR DEMAND	**57,250**	**9,348**	**9,622**	**3,690**	**79,910**
Other (Note 1)	17,174	0	0	0	7,100
TOTAL DEMAND	**74,424**	**9,348**	**9,622**	**3,690**	**87,010**

Note 1: Long term agricultural demand and other miscellaneous uses are estimated to decrease from 17,174 acre-feet per year to 7,100 acre-feet per year over time.

SANTA CLARITA VALLEY WATER SUPPLIES
FIGURE III-2
(REVISED)

WET YEAR	
ALLUVIUM	40,000
SAUGUS	20,000
SWP	95,200
RECYCLED	1,700
	156,900 AF

DRY YEAR	
ALLUVIUM	32,500
SAUGUS	11,000
SWP	47,600
RECYCLED	1,700
	92,800 AF
FIRMING SUPPLIES	50,000
	142,800 AF



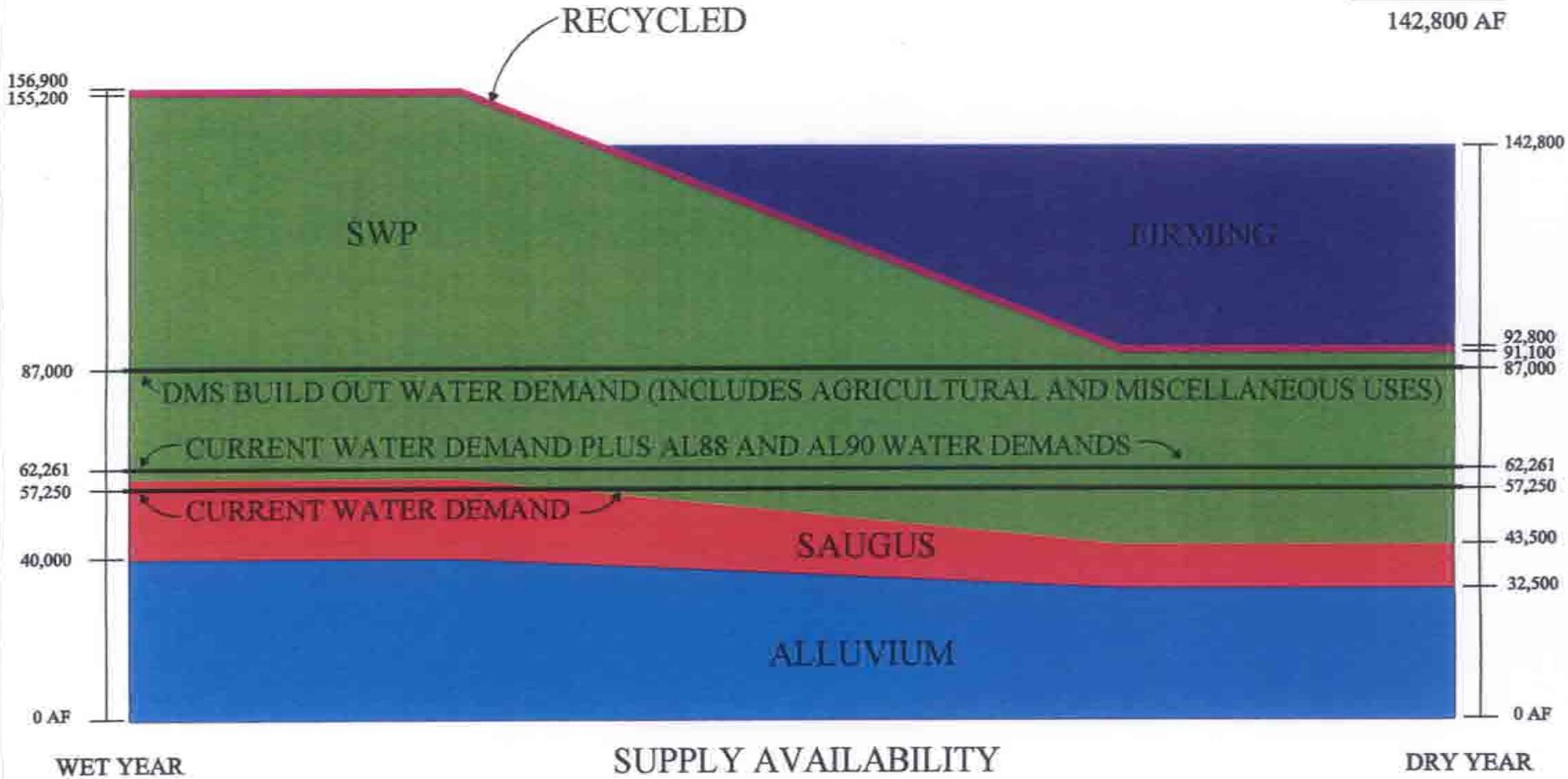
*Current water demand of 57,250 acre-feet as reported in Table IV-1 of the 1999 Water Report.

SANTA CLARITA VALLEY WATER SUPPLIES
FIGURE III-2

(REVISED - TO SHOW DEMANDS FOR AL88 AND AL 90)

	WET YEAR
ALLUVIUM	40,000
SAUGUS	20,000
SWP	95,200
RECYCLED	1,700
	156,900 AF

	DRY YEAR
ALLUVIUM	32,500
SAUGUS	11,000
SWP	47,600
RECYCLED	1,700
	92,800 AF
FIRMING SUPPLIES	50,000
	142,800 AF



*Current water demand of 57,250 acre-feet as reported in Table IV-1 of the 1999 Water Report.
**Water demands for AL88 and AL90 are included in DMS build out water demand.

2002 Point of Delivery Agreement (Semitropic Groundwater Banking Program) December 19, 2002

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

2002 POINT OF DELIVERY AGREEMENT AMONG THE DEPARTMENT OF WATER RESOURCES OF THE STATE OF CALIFORNIA CASTAIC LAKE WATER AGENCY AND KERN COUNTY WATER AGENCY

SWPAO #02015

SWPAO #02015

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

2002 POINT OF DELIVERY AGREEMENT AMONG THE DEPARTMENT OF WATER RESOURCES OF THE STATE OF CALIFORNIA CASTAIC LAKE WATER AGENCY AND KERN COUNTY WATER AGENCY

THIS AGREEMENT is made this 19th day of December, 2002, pursuant to the provisions of the California Water Resources Development Bond Act and other applicable laws of the State of California, among the State of California, acting by and through its Department of Water Resources, herein referred to as the "DEPARTMENT," the Kern County Water Agency, herein referred to as the "AGENCY," a political subdivision of the State of California created by an Act of the California State Legislature (Statutes 1961, Chapter 1003 or as amended), and the Castaic Lake Water Agency, herein referred to as "CASTAIC LAKE," a political subdivision of the State of California created by an Act of the California State Legislature (Statues 1962, Chapter 103 or as amended).

RECITALS

A. CASTAIC LAKE and Semitropic Water Storage District, herein referred to as "Semitropic," a Member Unit of the AGENCY, entered into an agreement dated October 9, 2002, herein referred to as "CASTAIC LAKE/Semitropic Program Agreement," which provides for the storage and recovery rights on an interim

basis in the Semitropic Water Banking and Exchange Program, which is owned, operated, and maintained by Semitropic.

B. The DEPARTMENT, AGENCY, and Semitropic have entered into an agreement entitled "Agreement Among Department of Water Resources, State of California, Kern County Water Agency and Semitropic Water Storage District for Introduction of Local Water into the California Aqueduct," executed on May 2, 1995 and subsequently amended. Such agreement, hereafter referred to as the "Semitropic Turn-in Agreement," contains terms and conditions governing the introduction of Local Water into the California Aqueduct. Under certain circumstances, water stored on behalf of CASTAIC LAKE could be recovered by Semitropic and introduced into the California Aqueduct under the terms of such turn-in agreement.

C. Pursuant to Article 15(a) of CASTAIC LAKE'S long-term Water Supply Contract with the DEPARTMENT, the DEPARTMENT hereby finds that the delivery and temporary storage of water outside CASTAIC LAKE'S service area under this Agreement and the CASTAIC LAKE/Semitropic Program Agreement will not materially impair CASTAIC LAKE'S capacity to make payments to the DEPARTMENT.

D. This Agreement applies to CASTAIC LAKE'S 2002 approved Table A water.

E. CASTAIC LAKE has not elected to sell SWP water during the year 2002 pursuant to CASTAIC LAKE'S Water Supply Contract with the DEPARTMENT.

F. The purpose of this Agreement is to set forth provisions governing the delivery of up to 24,000 acre-feet of CASTAIC LAKE'S 2002 approved Table A water for

storage in the Semitropic Water Banking and Exchange Program, and for the future return of such water by exchange of a like amount of the AGENCY'S Table A water, or recovery by direct pumpback of CASTAIC LAKE'S stored water into the California Aqueduct from the Semitropic Water Banking and Exchange Program.

G. Consistent with the California Environmental Quality Act, CASTAIC LAKE prepared and on August 6, 2002 filed with the Office of Planning and Research, a draft, *Initial Study and Proposed Negative Declaration for the CASTAIC LAKE Water Agency 2002 Groundwater Banking Project* (SCH# 2002081032). CASTAIC LAKE'S Board adopted findings and a Negative Declaration at their October 3, 2002 Board meeting, concluding that implementation of the project will not have a significant effect and impact on the environment. The Department of Water Resources, acting as a responsible agency, has considered the negative declaration prepared by CASTAIC LAKE in deciding to enter into this agreement and will file a Notice of Determination with the Office of Planning and Research.

AGREEMENT

The DEPARTMENT approves delivery of up to 24,000 acre-feet of CASTAIC LAKE'S 2002 approved Table A water for storage in the Semitropic Water Banking and Exchange Program within the AGENCY'S service area, and for the future return of such water by exchange of a like amount of the AGENCY'S approved Table A water or recovery by direct pumpback under the following terms and conditions:

1. TERM

Upon execution by all parties, this Agreement shall be effective as of January 1, 2002, and shall provide for the delivery of up to 24,000 acre-feet of CASTAIC LAKE'S 2002 approved Table A water to the Semitropic Water Banking and Exchange Program at reach 10A of the California Aqueduct from January 1, 2002 through December 31, 2002. This Agreement shall terminate with the delivery of all return water to CASTAIC LAKE under this Agreement or December 31, 2012, whichever comes first, unless the CASTAIC LAKE/Semitropic Program Agreement is fully terminated. In that event, this Agreement will be terminated on the same date as the termination of the CASTAIC LAKE/Semitropic Program Agreement.

2. USE OF STORED WATER

a. SWP water delivered by the DEPARTMENT to AGENCY on behalf of CASTAIC LAKE under this Agreement will not be sold to or by the AGENCY but will be temporarily stored for CASTAIC LAKE and later recovered by direct pumpback or exchanged for a like amount of the AGENCY'S approved Table A water or other water, to be used in CASTAIC LAKE'S service area. All water stored pursuant to this agreement shall be returned to CASTAIC LAKE by December 31, 2012. The specific provisions for storage and return of CASTAIC LAKE'S water in the Semitropic Water Banking and Exchange Program are governed by the CASTAIC LAKE/Semitropic Program Agreement. As provided in said agreement, 90 percent of CASTAIC LAKE'S water delivered to Semitropic

will be returned to CASTAIC LAKE for use in CASTAIC LAKE'S service area in future years, unless CASTAIC LAKE and the AGENCY agree that the actual losses are different than the assumed 10 percent as therein provided.

b. In the event return water is delivered to CASTAIC LAKE by exchange, the parties acknowledge that the AGENCY shall be entitled to an equivalent amount of CASTAIC LAKE'S water previously stored in the Semitropic Water Banking and Exchange Program.

3. USE OF CALIFORNIA AQUEDUCT CAPACITY FOR STORED AND RETURN WATER

Conveyance of the storage and return water in the California Aqueduct shall be in accordance with a schedule approved by the DEPARTMENT. CASTAIC LAKE'S water supply contract with the DEPARTMENT shall govern priority of delivery for return water. CASTAIC LAKE shall be responsible for any demonstrable adverse impacts that may result from deliveries under this Agreement as determined by the DEPARTMENT. To the extent CASTAIC LAKE increases its requests for Table A water as a result of this Agreement, such increases shall not be considered an adverse impact.

4. DELIVERY SCHEDULES FOR STORED/RETURN WATER

a. State Approval of Delivery Schedules: In coordination with and upon approval of the AGENCY, CASTAIC LAKE shall be responsible for scheduling delivery of CASTAIC LAKE'S water with the DEPARTMENT. All water delivery schedules and revisions shall be in accordance with

Article 12 of CASTAIC LAKE'S Water Supply Contract with the DEPARTMENT. The DEPARTMENT'S approval of the schedules is dependent upon the times and amounts of the scheduled water and the overall delivery capability of the SWP. Water delivered to CASTAIC LAKE or AGENCY shall be scheduled when the sum of deliveries scheduled to CASTAIC LAKE or AGENCY under this agreement, plus the scheduled approved annual Table A deliveries, plus deliveries pursuant to any other agreements do not exceed the quantities on which the Proportionate Use-of-Facilities factors are based pursuant to CASTAIC LAKE'S and AGENCY'S Water Supply Contracts with the DEPARTMENT, unless the DEPARTMENT determines that the deliveries will not adversely impact Table A deliveries to SWP contractors or adversely impact SWP operations or facilities. The DEPARTMENT shall not be obligated to convey water for storage or return water at times when such delivery would adversely impact SWP operations or facilities, other SWP contractors' water deliveries or costs, or delivery of Table A water or other water supplies to the AGENCY.

a. Delivery Schedules for Stored Water: As part of coordinating delivery schedules with the AGENCY, CASTAIC LAKE shall submit a delivery schedule for delivery of CASTAIC LAKE'S water into storage, which shall include but not necessarily be limited to amounts, times, rates of delivery, and points of delivery, to the AGENCY for review and approval. The AGENCY shall review the proposed schedule with CASTAIC LAKE and as

promptly as possible shall inform CASTAIC LAKE of its decision to either approve, propose modifications, or withhold approval. The AGENCY agrees that it shall not arbitrarily withhold approval or propose unreasonable modifications. The AGENCY may deny approval of, or propose modification to, CASTAIC LAKE'S delivery schedule under this Agreement, if on the basis of a with and without analysis, the AGENCY determines that such deliveries would adversely impact the AGENCY'S water management activities, finances, water supply or operations, and CASTAIC LAKE does not agree to mitigate for such impacts. The base case (without analysis) shall be those conditions estimated to occur in the absence of the CASTAIC LAKE/Semitropic Program Agreement. Upon receipt of the AGENCY'S approval, CASTAIC LAKE shall submit the delivery schedule to the DEPARTMENT for approval. The DEPARTMENT shall not approve any CASTAIC LAKE schedule that has not been approved by the AGENCY.

c. Delivery Schedules for Return Water: CASTAIC LAKE shall, as soon as possible, submit a schedule to the AGENCY specifying the quantity of CASTAIC LAKE'S previously stored water to be returned by recovery and direct pumpback or by exchange of a portion of the AGENCY'S approved Table A water or other water. If delivered by exchange, the parties shall provide copies of all necessary agreements. Said schedules shall specify the amount, month, and year when said return water was previously stored. The AGENCY may propose modifications to the proposed

schedule for the return of CASTAIC LAKE'S previously stored water if, on the basis of a with and without analysis, the AGENCY determines that such scheduled deliveries will adversely impact the AGENCY'S finances, water supply or operations, and CASTAIC LAKE does not agree to mitigate for such impacts. The AGENCY agrees that it shall not propose unreasonable modifications. The base case (without analysis) shall be those conditions estimated to occur in the absence of the CASTAIC LAKE/ Semitropic Program Agreement.

5. APPROVED TABLE A WATER

Water returned to CASTAIC LAKE under this Point of Delivery Agreement shall not be considered by the DEPARTMENT in the determination of approved Table A water under Article 18 or allocation of other SWP water to CASTAIC LAKE under CASTAIC LAKE'S Water Supply Contract with the DEPARTMENT.

6. RETURN WATER DELIVERED INTO AQUEDUCT

Water returned by recovery and direct pumpback to the California Aqueduct from the Semitropic Water Banking and Exchange Program on behalf of CASTAIC LAKE shall meet the terms of the Semitropic Turn-in Agreement.

7. STORED/RETURN WATER RECORDS

CASTAIC LAKE shall certify to the DEPARTMENT'S State Water Project Analysis Office by January 31, of each year, the following information for the previous calendar year:

a. The quantity of water delivered and stored under this Agreement.

b. The quantity of water stored under this Agreement that will be available for return to CASTAIC LAKE.

c. The actual losses of stored water, if CASTAIC LAKE and the AGENCY agree that actual losses are different than the 10 percent assumed in the CASTAIC LAKE/Semitropic Program Agreement.

d. The quantity of water returned to CASTAIC LAKE pursuant to this agreement.

The DEPARTMENT will maintain monthly records accounting for the delivery of CASTAIC LAKE'S SWP water supplies delivered pursuant to this Agreement for storage in the Semitropic Water Banking and Exchange Program and future return water delivered from the AGENCY to CASTAIC LAKE.

8. CHARGES

a. Water Delivered to Storage:

CASTAIC LAKE shall pay the DEPARTMENT the 2002 Variable Operation, Maintenance, Power and Replacement Component of the Transportation Charge and Off-Aqueduct Power Facility Costs for power resources incurred in the transportation of such water to Semitropic turnouts in Reach 10A of the California Aqueduct.

b. Return Water Delivered:

(1) When the AGENCY returns stored water by recovery and direct pumpback to Reach 10A of the California Aqueduct for delivery to CASTAIC LAKE'S service area, CASTAIC LAKE shall pay the DEPARTMENT the Variable Operation, Maintenance, Power and

Replacement Component of the Transportation Charge and Off-Aqueduct Power Facility Costs for power resources incurred in the delivery of such water from Reach 10A of the California Aqueduct to CASTAIC LAKE'S turnouts in Reach 30A of the California Aqueduct.

(2) When the AGENCY returns stored water by an exchange of its allocated Table A water, the AGENCY shall be entitled to a like amount of CASTAIC LAKE'S previously stored water and the AGENCY will release a like amount of the AGENCY'S Table A water on behalf of Semitropic at Reach 10A. The AGENCY shall pay the Variable Operation, Maintenance, Power and Replacement Component of the Transportation Charge and Off-Aqueduct Power Facility Costs for power resources incurred as if such water were conveyed to the AGENCY from the Delta to Reach 10A of the California Aqueduct. CASTAIC LAKE shall pay the Variable Operation, Maintenance, Power and Replacement Component of the Transportation Charge and Off-Aqueduct Power Facility Costs for power resources incurred from Reach 10A to CASTAIC LAKE'S turnout structures in Reach 30A.

b. In addition to the charges identified above, CASTAIC LAKE agrees to pay to the DEPARTMENT any additional identified non-power costs that would otherwise be borne by the SWP contractors not signatory to this

Agreement or by the DEPARTMENT as a result of the DEPARTMENT providing service under this Agreement.

d. Payment terms shall be in accordance with the AGENCY'S and CASTAIC LAKE'S Water Supply Contracts with the DEPARTMENT.

9. APPROVALS

The delivery of water under this Agreement shall be contingent on and subject to any necessary approvals and shall be governed by the terms and conditions of such approvals and any other applicable legal requirements. CASTAIC LAKE shall be responsible for securing any required approvals, permits or orders. CASTAIC LAKE shall furnish to the DEPARTMENT copies of all approvals acquired for the delivery and storage of water under this Agreement.

10. LIABILITY

a. The DEPARTMENT is only providing water delivery service through the SWP and assumes no liability for the AGENCY'S or CASTAIC LAKE'S water under this Agreement beyond the designated points of delivery.

b. In the event of a claim of liability against the DEPARTMENT or the AGENCY or their officers or their employees, individually or severally, that arises as a result of this Agreement or other related agreements, CASTAIC LAKE shall defend, indemnify, and hold the AGENCY, the DEPARTMENT, and any of their officers or employees harmless from any such claim, except to the extent that such claim arises from the sole negligence or willful misconduct of the AGENCY and/or the DEPARTMENT.

11. NO MODIFICATION OF WATER SUPPLY CONTRACTS

This Agreement shall not be interpreted to modify the terms or conditions of either the Water Supply Contract between the DEPARTMENT and the AGENCY dated November 15, 1963, or the Water Supply Contract between the DEPARTMENT and CASTAIC LAKE dated April 30,1963, as both are amended up to and including the date of this Agreement.

12. CLAIMS DISPUTE

In the event of dispute regarding interpretation or implementation of this Agreement, the Director of the Department of Water Resources and general managers of CASTAIC LAKE and the AGENCY shall endeavor to resolve the dispute by meeting within 30 days after the request of a Party. If the dispute is unresolved, the Parties shall use the services of a mutually acceptable consultant in an effort to resolve the dispute. Parties involved in the dispute shall share the fees and expenses of the consultant equally. If a consultant cannot be agreed upon, or if the consultant's recommendations are not acceptable to the Parties, and unless the Parties otherwise agree, the matter may be resolved by litigation and any Party may at its option pursue any available legal remedy including, but not limited to, injunctive and other equitable relief.

13. ASSIGNMENT OF AGREEMENT

This Agreement shall not be assignable by the AGENCY or CASTAIC LAKE in whole or in part without the written consent of the DEPARTMENT, AGENCY and CASTAIC LAKE.

14. MODIFICATION OF AGREEMENT

No modification of the terms of this Agreement shall be valid unless made in writing and signed by the Parties to this Agreement.

15. SIGNATURE CLAUSE

The signatories represent that they have been appropriately authorized to enter into this Agreement on behalf of the Party for whom they sign.

IN WITNESS WHEREOF, the Parties hereto have entered into this Agreement.

Approved as to legal form
and Sufficiency

Chief Counsel
DEPARTMENT OF WATER RESOURCES

STATE OF CALIFORNIA
DEPARTMENT OF WATER
RESOURCES

Director

KERN COUNTY WATER AGENCY

Name

General Manager
Title

DEcember 10, 2002
Date

CASTAIC LAKE WATER AGENCY

Name

GENERAL MANAGER
Title

12/6/02
Date

AGlasgow:DJohnson
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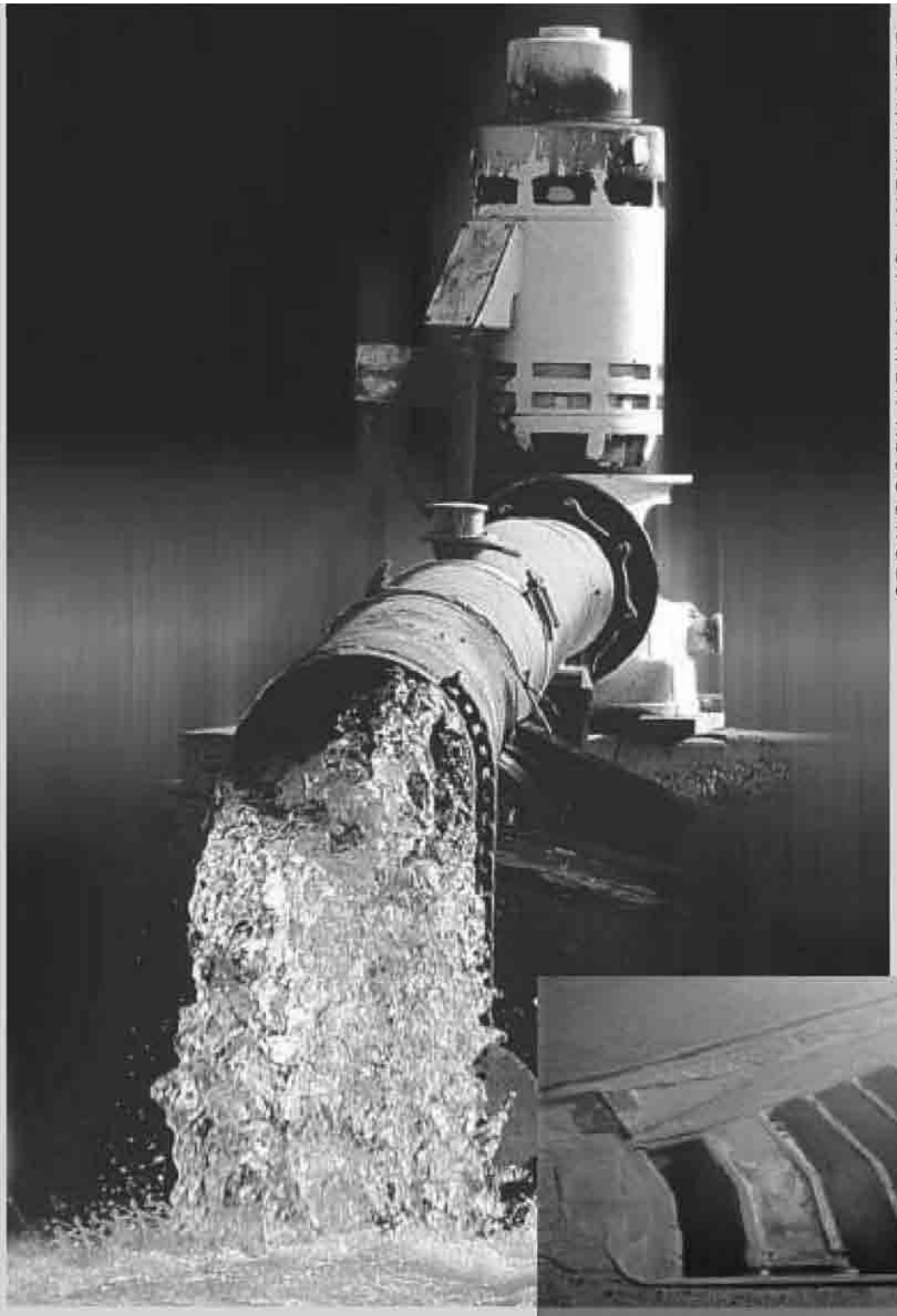
SPELL CHECKED: November 19, 2002
FINALIZED:



DEPARTMENT OF WATER RESOURCES

BULLETIN 118 - UPDATE 2003

CALIFORNIA'S GROUNDWATER

Cover photograph:
A typical agricultural well with the water discharge pipe and the electric motor that drives the pump.

Inset photograph:
Groundwater recharge ponds in the Upper Coachella Valley near the Whitewater River that use local and imported water. Recharge ponds are also called spreading basins or recharge basins.

State of California
The Resources Agency
Department of Water Resources

CALIFORNIA'S GROUNDWATER

BULLETIN 118 *Update 2003*

October 2003

GRAY DAVIS
Governor
State of California

MARY D. NICHOLS
Secretary of Resources
The Resources Agency

MICHAEL J. SPEAR
Interim Director
Department of Water Resources

If you need this publication in an alternate form, contact the Department's Office of Water Education at 1-800-272-8869.

Foreword

Groundwater is one of California's greatest natural resources. In an average year, groundwater meets about 30 percent of California's urban and agricultural water demands. In drought years, this percentage increases to more than 40 percent. In 1995, an estimated 13 million Californians, nearly 43 percent of the State's population, were served by groundwater. The demand on groundwater will increase significantly as California's population grows to a projected 46 million by the year 2020. In many basins, our ability to optimally use groundwater is affected by overdraft and water quality impacts, or limited by a lack of data, management, and coordination between agencies.

Over the last few years, California voters and the Legislature have provided significant funding to local agencies for conjunctive use projects, groundwater recharge facilities, groundwater monitoring, and groundwater basin management activities under Proposition 13 and the Local Groundwater Management Assistance Act of 2000. Most recently, the 2002 passage of Proposition 50 will result in additional resources to continue recent progress toward sustaining our groundwater resources through local agency efforts. We are beginning to see significant benefits from these investments.

The State Legislature recognizes the need for groundwater data in making sound local management decisions. In 1999, the Legislature approved funding and directed the Department of Water Resources (DWR) to update the inventory of groundwater basins contained in Bulletin 118 (1975), *California's Ground Water* and Bulletin 118-80 (1980), *Ground Water Basins in California.* In 2001, the Legislature passed AB 599, requiring the State Water Resources Control Board to establish a comprehensive monitoring program to assess groundwater quality in each groundwater basin in the State and to increase coordination among agencies that collect groundwater contamination information. In 2002, the Legislature passed SB 1938, which contains new requirements for local agency groundwater management plans to be eligible for public funds for groundwater projects.

Effective management of groundwater basins is essential because groundwater will play a key role in meeting California's water needs. DWR is committed to assisting local agencies statewide in developing and implementing effective, locally planned and controlled groundwater management programs. DWR is also committed to federal and State interagency efforts and to partnerships with local agencies to coordinate and expand data monitoring activities that will provide necessary information for more effective groundwater management. Coordinated data collection at all levels of government and local planning and management will help to ensure that groundwater continues to serve the needs of Californians.

Michael J. Spear
Interim Director

State of California
Gray Davis, *Governor*

The Resources Agency
Mary D. Nichols, *Secretary for Resources*

Department of Water Resources
Michael J. Spear, *Interim Director*

L. Lucinda Chipponeri
Deputy Director

Peggy Bernardy
Chief Counsel

Stephen Verigin
Acting Chief Deputy Director

Jonas Minton
Deputy Director

Peter Garris
Deputy Director

Vernon T. Glover
Deputy Director

Division of Planning and Local Assistance
Mark Cowin, Chief

Statewide Water Planning Branch
Kamyar Guivetchi, Chief

Conjunctive Water Management Branch
John Woodling, Chief

This Bulletin was prepared under direction of
Doug Osugi
by
Robert Swartz, *Senior Engineering Geologist*
and
Carl Hauge, *Chief Hydrogeologist*

Final coordination by
Mary Scruggs and **Joe Yun**
with assistance from
Tom Hawkins **Derick Louie**
Tom Lutterman **Darby Vickery** **Ilene Wellman-Barbree** **Judy Colvin**

Data collection, regional information, and basin descriptions provided by Department district offices

Northern District

Dwight Russell, *District Chief*

William Mendenhall, *Chief, Resources Assessment Branch*

Toccoy Dudley, *Chief, Groundwater Section*

Mike Ward, *Engineer WR, technical lead*

Todd Hillaire **Noel Eaves** **Dan McManus** **Bill Ehorn** **Debbie Spangler**
Kelley Staton **Doti Watkins** **Charlene Sundermann** **Bruce Ross**

Central District

Karl Winkler, *District Chief*

Emil Calzascia, *Chief, Water Management*

Bob Niblack, *Chief, Geology and Groundwater Section*

Chris Bonds, *Engineering Geologist, technical lead*

Sandra Maxwell **Mark Souverville** **Tanya Meeth** **Bill Waggoner** **Solomon Mesghina**
Bill Brewster **Anne Roth**

San Joaquin District

Paula J. Landis, *District Chief*

Brian Smith, *Chief, Resource Assessment*

Ben Igawa, *Chief, Groundwater Section*

Al Steele, *Engineering Geologist, technical lead*

Bruce Myers **Anna Mancillas** **Ken Winden** **Amanda Mayes** **Noemi Baca**

Southern District

Mark Stuart, *District Chief*

Bob Pierotti, *Chief, Groundwater Section*

Tim Ross, *Engineering Geologist, technical lead*

Gary Guacci **Richard Lewy** **Dan Gamon** **Brian Moniz** **Randall Davis** **Jen Wong**
Nuna Tersibahian **Monica Lee** **Jeremy Lancaster** **Tammy Surco** **Mark Stuhlman**

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California Department of Pesticide Regulation
California Department of Toxic Substances Control
California Department of Health Services
California State Water Resources Control Board
California Regional Water Quality Control Boards
United States Geological Survey
United States Bureau of Reclamation

We also wish to thank numerous reviewers who provided valuable comments on the April 2003 public review draft of this bulletin.

Acronyms and abbreviations

AB Assembly Bill
BMO Basin management objective
CAS California Aquifer Susceptibility
CVP Central Valley Project
DBCP Dibromochloropropane
DCE Dichloroethylene
DHS California Department of Health Services
DPR California Department of Pesticide Regulation
DTSC California Department of Toxic Substances Control
DWR California Department of Water Resources
DWSAP Drinking Water Source Assessment Program
EDB Ethylene dibromide
EC Electrical conductivity
EMWD Eastern Municipal Water District
EWMP Efficient water management
EPA U.S. Environmental Protection Agency
ESA Federal Endangered Species Act
ET Evapotranspiration
ETAW Evapotranspiration of applied water
EWA Environmental Water Account
GAMA Groundwater Ambient Monitoring and Assessment
GIS Geographic information system
GMA Groundwater Management Agency
gpm Gallons per minute
GRID Groundwater Resources Information Database
GRIST Groundwater Resources Information Sharing Team
H & S Health and Safety Code
HR Hydrologic region
ISI Integrated Storage Investigations
ITF Interagency Task Force
JPA Joint powers agreement
maf Million acre-feet
MCL Maximum contaminant level
mg/L Milligrams per liter
MOU Memorandum of understanding
MTBE Methyl tertiary-butyl ether
OCWD Orange County Water District
PAC Public Advisory Committee
PCE Tetrachloroethylene
PCA Possible contaminating activity
PPIC Public Policy Institute of California
ROD Record of Decision
RWQCB Regional Water Quality Control Board
SB Senate Bill
SGA Sacramento Groundwater Authority
SVOC Semi-volatile organic compound
SVWD Scotts Valley Water District
SWRCB State Water Resources Control Board

taf Thousand acre-feet
TCE Trichloroethylene
TDS Total dissolved solids
UWMP Urban water management plan
USACE U.S. Army Corps of Engineers
USBR U.S. Bureau of Reclamation
USC United States Code
USGS U.S. Geological Survey
VOC Volatile organic compound
WQCP Water Quality Control Plan

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Findings

Major Findings

1. **Groundwater provides about 30% of the State's water supply in an average year, yet in many basins the amount of groundwater extracted annually is not accurately known.**
   - In some regions, groundwater provides 60% or more of the supply during dry years.
   - Many small- to moderate-sized towns and cities are entirely dependent on groundwater for drinking water supplies.
   - 40% to 50% of Californians rely on groundwater for part of their water supply.
   - In many basins, groundwater use is indirectly estimated by assuming crop evapotranspiration demands and surveying the acreage of each crop type.

2. **Opportunities for local agencies to manage their groundwater resources have increased significantly since the passage of Assembly Bill 3030 in 1992. (Water Code § 10750 et seq.). In the past several years more agencies have developed management programs to facilitate conjunctive use, determine the extent of the resource, and protect water quality.**
   - The act provides the authority for many local agencies to manage groundwater.
   - The act has resulted in more than 200 local agencies adopting groundwater management plans to date.
   - The act encourages regional cooperation in basins and allows private water purveyors to participate in groundwater management through memoranda of understanding with public agencies.
   - Many local agencies are recognizing their responsibility and authority to better manage groundwater resources.

3. **Agencies in some areas have not yet developed groundwater management plans.**
   - Concerns about cooperative management, governance, and potential liabilities have kept some agencies from developing management plans.
   - Development of management programs to maintain a sustainable groundwater supply for local use has not been accomplished throughout the State.

4. **A comprehensive assessment of overdraft in the State's groundwater basins has not been conducted since Bulletin 118-80, but it is estimated that overdraft is between 1 million and 2 million acre-feet annually.**
   - Historical overdraft in many basins is evident in hydrographs that show a steady decline in groundwater levels for a number of years.
   - Other basins may be subject to overdraft in the future if current water management practices are continued.
   - Overdraft can result in increased water production costs, land subsidence, water quality impairment, and environmental degradation.
   - Few basins have detailed water budgets by which to estimate overdraft.
   - While the most extensively developed basins tend to have information, many basins have insufficient data for effective management or the data have not been evaluated.
   - The extent and impacts of overdraft must be fully evaluated to determine whether groundwater will provide a sustainable water supply.
   - Modern computer hardware and software enable rapid manipulation of data to determine basin conditions such as groundwater storage changes or groundwater extraction, but a lack of essential data limits the ability to make such calculations.
   - Adequate statewide land use data for making groundwater extraction estimates are not available in electronic format.

5. **Surface water and groundwater are connected and can be effectively managed as integrated resources.**
   - Groundwater originates as surface water.
   - Groundwater extraction can affect flow in streams.
   - Changes in surface water flow can affect groundwater levels.
   - Legal systems for surface water and groundwater rights can make coordinated management complex.

6. **Groundwater quality and groundwater quantity are interdependent and are increasingly being considered in an integrated manner.**
   - Groundwater quantity and groundwater quality are inseparable.
   - Groundwater in some aquifers may not be usable because of contamination with chemicals, either from natural or human sources.
   - Unmanaged groundwater extraction may cause migration of poor quality water.
   - Monitoring and evaluating groundwater quality provides managers with the necessary data to make sound decisions regarding storage of water in the groundwater basin.
   - State agencies conduct several legislatively mandated programs to monitor different aspects of groundwater quality.
   - California Department of Water Resources (DWR) monitors general groundwater quality in many basins throughout the State for regional evaluation.

7. **Land use decisions affecting recharge areas can reduce the amount of groundwater in storage and degrade the quality of that groundwater.**
   - In many basins, little is known about the location of recharge areas and their effectiveness.
   - Protection and preservation of recharge areas are seldom considered in land use decisions.
   - If recharge areas are altered by paving, channel lining, or other land use changes, available groundwater will be reduced.
   - Potentially contaminating activities can degrade the quality of groundwater and require wellhead treatment or aquifer remediation before use.
   - There is no coordinated effort to inform the public that recharge areas should be protected against contamination and preserved so that they function effectively.

Additional Important Findings

8. **Funding to assist local groundwater management has recently been available in unprecedented amounts.**
   - Proposition 13 (Water Code, § 79000 et seq.) authorized $230 million in loans and grants for local groundwater programs and projects, almost all of which has been allocated.
   - The Local Groundwater Management Assistance Act of 2000 (Water Code, § 10795) has resulted in more than $15 million in grants to local agencies in fiscal years 2001, 2002, and 2003.
   - Proposition 50 (Water Code, § 79500 et seq) will provide funding for many aspects of water management, including groundwater management and groundwater recharge projects.
   - Funding for the California Bay-Delta program has provided technical and facilitation assistance to numerous local groundwater planning efforts.

9. **Local governments are increasingly involved in groundwater management.**
   - Twenty-four of the 27 existing county groundwater management ordinances have been adopted since 1990.
   - Most ordinances require the proponents of groundwater export to demonstrate that a proposed project will not cause subsidence, degrade groundwater quality, or deplete the water supply before the county will issue an export permit.
   - While the ordinances generally require a permit for export of groundwater, most do not require a comprehensive groundwater management plan designed to ensure a sustainable water resource for local use.
   - Some local governments are coordinating closely with local water agencies that have adopted groundwater management plans.
   - Many local governments are monitoring and conducting studies in an effort to better understand groundwater resources.

10. **Despite the increased groundwater management opportunities and activities, the extent of local efforts is not well known.**
    - There is no general requirement that groundwater management plans be submitted to DWR, so the number of adopted plans and status of groundwater management throughout the State are not currently known.
    - There are no requirements for evaluating the effectiveness of adopted plans, other than during grant proposal review.
    - No agency is responsible for tracking implementation of adopted plans.
    - Unlike urban water management plans, groundwater management plans are not required to be submitted to DWR, making the information unavailable for preparing the California Water Plan.

11. **Despite the fact that several agencies often overlie each groundwater basin, there are few mechanisms in place to support and encourage agencies to manage the basin cooperatively.**
    - Some local agencies have recognized the benefits of initiating basinwide and regional planning for groundwater management and have recorded many successes.
    - Regional cooperation and coordination depends on the ability of local agencies to fund such efforts.
    - There is no specific State or federal program to fund and support coordination efforts that would benefit all water users in a region and statewide.

12. **The State Legislature has recognized the need to consider water supplies as part of the local land use planning process.**
    - Three bills—Senate Bill 221[1], SB 610[2], and AB 901[3]—were enacted in 2001 to improve the assessment of water supplies. The new laws require the verification of sufficient water supply as a condition for approving certain developments and compel urban water suppliers to provide more information on the reliability of groundwater as an element of supply.
    - The Government Code does not specifically require local governments to include a water resources element in their general plans.

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[1] Business and Professions Code Section 11010, Government Code Sections 65867.5, 66455.3, and 66473.7.
[2] Public Resources Code Section 21151.9, Water Code Sections 10631, 10656, 10657, 10910-10912, 10915.
[3] Water Code Sections 10610.2, 10631, 10634.

13. **The need to monitor groundwater quality and contamination of groundwater continues to grow.**
    - As opportunities for developing additional surface water supplies become more limited, subsequent growth will increasingly rely on groundwater.
    - Human activities are likely the cause of more than half the exceedances of maximum contaminant levels in public water supply wells.
    - New contaminants are being regulated and standards are becoming more stringent for others, requiring increased monitoring and better management of water quality.

14. **Monitoring networks for groundwater levels and groundwater quality have not been evaluated in all basins to ensure that the data accurately represent conditions in the aquifer(s).**
    - Groundwater levels are monitored in about 10,000 active wells including those basins where most of the groundwater is used.
    - Groundwater levels are not monitored in approximately 200 basins, where population is sparse and groundwater use is generally low.
    - Groundwater quality monitoring networks are most dense near population centers and may not be representative of the basin as a whole.
    - Many of the wells being monitored are not ideally constructed to provide water level or water quality information that is representative of a specific aquifer.
    - Many wells are too deep to monitor changes in the unconfined (water table) portion of basins.

15. **The coordination of groundwater data collection and evaluation by local, State, and federal agencies is improving.**
    - The State Water Resources Control Board (SWRCB) recently formed the Groundwater Resources Information Sharing Team (GRIST) consisting of several State and federal agencies with groundwater-related programs.
    - DWR established a website in 1996 that has provided water-level data and hydrographs for more than 35,000 active and inactive wells monitored by DWR and cooperating agencies.
    - DWR collects and maintains water level data in part through partnerships with local agency cooperators.
    - DWR staff collaborated with many local, State, and federal agencies in developing this update of Bulletin 118.
    - SWRCB recently formed an interagency task force to develop a comprehensive groundwater quality monitoring program for assessing every groundwater basin in the State as required by the Groundwater Quality Monitoring Act of 2001 (AB 599; Water Code, § 10780 et seq.).
    - Water purveyors have concerns about balancing public access to data with water supply security.

16. **Boundaries of groundwater basins have been determined using the best available geologic and hydrologic information. These boundaries are important in determining the availability of local water supplies.**
    - Basin boundaries were derived primarily by identifying alluvial sediments on geologic maps using the best available information, but are subject to change when new information becomes available.
    - The Water Code requires the use of basin boundaries defined in Bulletin 118 in groundwater management plans and urban water management plans.
    - The location of basin boundaries will become more critical as the demand for water continues to increase.
    - Subbasin boundaries may be delineated for management convenience rather than based on hydrogeologic conditions.

17. **Little is known about the stream-aquifer interaction in many groundwater basins.**
    - Groundwater and surface water are closely linked in the hydrologic cycle.
    - The relationship between streamflow and extraction of groundwater is not fully understood in most basins and is generally not monitored.
    - Groundwater extraction in many basins may affect streamflow.
    - Interaction of groundwater flow and surface water may affect environmental resources in the hyporheic zone.
    - An understanding of stream-aquifer interaction will be essential to evaluating water transfers in many areas of the State.

18. **Although many new wells are built in fractured rock areas, insufficient hydrogeologic information is available to ensure the reliability of groundwater supplies.**
    - Population is increasing rapidly in foothill and mountain areas in which groundwater occurs in fractured rock.
    - The cumulative effect of groundwater development may reduce the yield of individual wells, lower the flow of mountain streams, and impact local habitat.
    - Characterization of groundwater resources in fractured rock areas can be very expensive and complex.
    - Many groundwater users in these areas have no other water supply alternatives.
    - Recent dry years have seen many wells go dry in fractured rock areas throughout the State.
    - Groundwater management in these areas is beginning, but there is insufficient data to support quantitative conclusions about the long-term sustainable yield.

19. **When new wells are built, drillers are required to file a Well Completion Report with DWR. That report contains a lithologic log, the usability of which varies considerably from driller to driller.**
    - The Well Completion Reports are confidential and not available to the public, as stipulated by the Water Code, unless the owner's permission is obtained.
    - The usefulness of the information in Well Completion Reports varies but is not fully realized.
    - Public access to Well Completion Reports would increase understanding of groundwater conditions and issues.
    - There is no provision in the Water Code that requires submission of geophysical logs, which would provide an accurate log of the geologic materials within the aquifer.
    - Geophysical logs would provide a greatly improved database for characterization of aquifers.

Recommendations

Major Recommendations

1. **Local or regional agencies should develop groundwater management plans if groundwater constitutes part of their water supply. Management objectives should be developed to maintain a sustainable long-term supply for multiple beneficial uses. Management should integrate water quantity and quality, groundwater and surface water, and recharge area protection.**
   - Groundwater management in California is a local agency responsibility.
   - In basins where there is more than one management agency, those agencies should coordinate their management objectives and program activities.
   - A water budget should be completed that includes recharge, extraction and change in storage in the aquifer(s).
   - Changes in groundwater quality should be monitored and evaluated.
   - Stakeholders should be identified and included in development of groundwater management plans.

2. **The State of California should continue programs to provide technical and financial assistance to local agencies to develop monitoring programs, management plans, and groundwater storage projects to more efficiently use groundwater resources and provide a sustainable supply for multiple beneficial uses. DWR should:**
   - Post information about projects that have successfully obtained funding through various grant and loan programs.
   - Provide additional technical assistance to local agencies in the preparation of grant and loan applications.
   - Continue outreach efforts to inform the public and water managers of grant and loan opportunities.
   - Participate, when requested, in local efforts to develop and implement groundwater management plans.
   - Continue to assess, develop, and modify its groundwater programs to provide the greatest benefit to local agencies.
   - Develop grant criteria to ensure funding supports local benefits as well as Statewide priorities, such as development of the California Water Plan and meeting Bay-Delta objectives.

3. **DWR should continue to work with local agencies to more accurately define historical overdraft and to more accurately predict future water shortages that could result in overdraft.**
   - A water budget should be developed for each basin.
   - The annual change in storage should be determined for each basin.
   - The amount of annual recharge and discharge, including pumping, should be determined.
   - Changes in groundwater quality that make groundwater unusable or could allow additional groundwater to be used should be included in any evaluation of overdraft.

4. **Groundwater management agencies should work with land use agencies to inform them of the potential impacts various land use decisions may have on groundwater, and to identify, prioritize, and protect recharge areas.**
   - Local planners should consider recharge areas when making land use decisions that could reduce recharge or pose a risk to groundwater quality.
   - Recharge areas should be identified and protected from land uses that limit recharge rates, such as paving or lining of channels.

- Both local water agencies and local governments should pursue education and outreach to inform the public of the location and importance of recharge areas.
- DWR should inform local agencies of the availability of grant funding and technical assistance that could support these efforts.

5. **DWR should publish a report by December 31, 2004 that identifies those groundwater basins or subbasins that are being managed by local or regional agencies and those that are not, and should identify how local agencies are using groundwater resources and protecting groundwater quality.**
   - Such information will be necessary to confirm whether agencies are meeting the requirements of SB 1938 (Water Code Section 10753.7).
   - Collection and summary of existing groundwater management plans will provide a better understanding of the distribution and coordination of groundwater management programs throughout the State.
   - Successful strategies employed by specific local agencies should be highlighted to assist others in groundwater management efforts.
   - Similarly, the impact of groundwater management ordinances throughout the State should be evaluated to provide a better understanding of the effect of ordinances on groundwater management.

6. **Water managers should include an evaluation of water quality in a groundwater management plan, recognizing that water quantity and water quality are inseparable.**
   - Local water managers should obtain groundwater quality data from federal, state, and local agencies that have collected such data in their basin.
   - Local agencies should evaluate long-term trends in groundwater quality.
   - Local agencies should work closely with the SWRCB and DWR in evaluating their groundwater basins.
   - Local agencies should establish management objectives and monitoring programs that will maintain a sustainable supply of good quality groundwater.

7. **Water transfers that involve groundwater (or surface water that will be replaced with groundwater) should be consistent with groundwater management in the source area that will assure the long term sustainability of the groundwater resource.**

8. **Continue to support coordinated management of groundwater and surface water supplies and integrated management of groundwater quality and groundwater quantity.**
   - Future bond funding should be provided for conjunctive use facilities to improve water supply reliability.
   - Funding for feasibility and pilot studies, in addition to construction of projects will help maximize the potential for conjunctive use.
   - DWR should continue and expand its efforts to form partnerships with local agencies to investigate and develop locally controlled conjunctive use programs.

9. **Local, State, and federal agencies should improve data collection and analysis to better estimate groundwater basin conditions used in Statewide and local water supply reliability planning. DWR should:**
   - Assist local agencies in the implementation of SB 221, SB 610, and AB 901 to help determine water supply reliability during the local land use planning process.
   - Provide and continue to update information on groundwater basins, including basin boundaries, groundwater levels, monitoring data, aquifer yield, and other aquifer characteristics.

- Identify areas of rapid development that are heavily reliant on groundwater and prioritize monitoring activities in these areas to identify potential impacts on these basins.
- Evaluate the existing network of wells monitored for groundwater elevations, eliminate wells of questionable value from the network, and add wells where data are needed.
- Work cooperatively with local groundwater managers to evaluate the groundwater basins of the State with respect to overdraft and its potential impacts, beginning with the most heavily used basins.
- Expand DWR and local agency monitoring programs to provide a better understanding of the interaction between groundwater and surface water.
- Work with SWRCB to investigate temporal trends in water quality to identify areas of water quality degradation that should receive additional attention.
- Estimate groundwater extraction using a land use based method for over 200 basins with little or no groundwater budget information.
- Integrate groundwater budgets into the California Water Plan Update process.

10. **Increase coordination and sharing of groundwater data among local, State, and federal agencies and improve data dissemination to the public. DWR should:**
    - Use the established website to continually update new groundwater basin data collected after the publication of California's Groundwater (Bulletin 118-Update 2003).
    - Publish a summary update of Bulletin 118 every five years coincident with the California Water Plan (Bulletin 160).
    - Publish, in cooperation with SWRCB, a biennial groundwater report that addresses current groundwater quantity and quality conditions.
    - Coordinate the collection and storage of its groundwater quality monitoring data with programs of SWRCB and other agencies to ensure maximum coverage statewide and reduce duplication of effort.
    - Make groundwater basin information more compatible with other Geographic Information System-based resource data to improve local integrated resources planning efforts.
    - Compile data collected by projects funded under grant and loan programs and make data available to the public on the DWR website.
    - Encourage local agency cooperators to submit data to the DWR database.
    - Maximize the accuracy and usefulness of data and develop guidelines for quality assurance and quality control, consistency, and format compatibility.
    - Expand accessibility of groundwater data by the public after considering appropriate security measures.
    - State, federal and local agencies should expand accessibility of groundwater data by the public after considering appropriate security measures.
    - Local agencies should submit copies of adopted groundwater management plans to DWR.

Additional Important Recommendations

11. **Local water agencies and local governments should be encouraged to develop cooperative working relationships at basinwide or regional levels to effectively manage groundwater. DWR should:**
    - Provide technical and financial assistance to local agencies in the development of basinwide groundwater management plans.
    - Provide a preference in grant funding for groundwater projects for agencies that are part of a regional or basinwide planning effort.
    - Provide Proposition 50 funding preferences for projects that are part of an integrated regional water management plan.

12. **Groundwater basin boundaries identified in Bulletin 118 should be updated as new information becomes available and the basin becomes better defined. DWR should:**
    - Identify basin boundaries that are based on limited data.
    - List the kind of information that is necessary to better define basin boundaries.
    - Develop a systematic procedure to obtain and evaluate stakeholder input on groundwater basin boundaries.

13. **Improve the understanding of groundwater resources in fractured rock areas of the State.**
    - DWR, in cooperation with local and federal agencies, should conduct studies to determine the amount of groundwater that is available in fractured rock areas, including water quality assessment, identification of recharge areas and amounts, and a water budget when feasible.
    - Local agencies and local governments should conduct studies in their areas to quantify the local demands on groundwater and project future demands.
    - The Legislature should consider expanding the groundwater management authority in the Water Code to include areas outside of alluvial groundwater basins
    - DWR should include information on the most significant fractured rock groundwater sources in future updates of Bulletin 118.

14. **Develop a program to obtain geophysical logs in areas where additional data are needed.**
    - DWR should encourage submission of geophysical logs, when they are conducted, as a part of the Well Completion Report.
    - The geophysical logs would be available for use by public agencies to better understand the aquifer, but would be confidential as stipulated by the Water Code.
    - DWR should seek funding to work with agencies and property owners to obtain geophysical logs of new wells in areas where additional data are needed.
    - Geophysical logs would be used to better characterize the aquifers within each groundwater basin.

15. **Educate the public on the significance of groundwater resources and on methods of groundwater management.**
    - DWR should continue to educate the public on statewide groundwater issues and assist local agencies in their public education efforts.
    - Local agencies should expand their outreach efforts during development of groundwater management plans under AB 3030 and other authority.
    - DWR should develop educational materials to explain how they quantify groundwater throughout the State, as well as the utility and limitations of the information.
    - DWR should continue its efforts to educate individual well owners and small water systems that are entirely dependent on groundwater.

Introduction

Introduction

Groundwater is one of California's greatest natural resources. In an average water supply year, groundwater meets about 30 percent of California's urban and agricultural demand. In drought years, this percentage increases to 40 percent or even higher (DWR 1998). Some cities, such as Fresno, Davis, and Lodi, rely solely on groundwater for their drinking water supply. In 1995, an estimated 13 million Californians (nearly 43 percent of the State's population) used groundwater for at least a portion of their public supply needs (Solley and others 1998). With a projected population of nearly 46 million by the year 2020, California's demand on groundwater will increase significantly. In many basins, our ability to optimally use groundwater is affected by overdraft and water quality, or limited by a lack of data, lack of management, and coordination between agencies.

In the last few years, California has provided substantial funds to local agencies for groundwater management. For example, the nearly $2 billion Water Bond 2000 (Proposition 13) approved by California voters in March 2000 specifically authorizes funds for two groundwater programs: $200 million for grants for feasibility studies, project design, and the construction of conjunctive use facilities; and $30 million for loans for local agency acquisition and construction of groundwater recharge facilities and grants for feasibility studies for recharge projects. Additionally, the Local Groundwater Management Assistance Act of 2000 (AB 303) resulted in $15 million in fiscal years 2001, 2002, and 2003 for groundwater studies and data collection intended to improve basin and subbasin groundwater management. These projects focus on improving groundwater monitoring, coordinating groundwater basin management, and conducting groundwater studies.

The State Legislature has increasingly recognized the importance of groundwater and the need for monitoring in making sound groundwater management decisions. Significant legislation was passed in 2000, 2001 and 2002. AB 303 authorizes grants to help local agencies develop better groundwater management strategies. AB 599 (2001) requires, for the first time, that the State Water Resources Control Board (SWRCB), in cooperation with other agencies, develop a comprehensive monitoring program capable of assessing groundwater quality in every basin in the State with the intent of maintaining a safe groundwater supply. SB 610 (2001) and SB 901 (2001) together require urban water suppliers, in their urban water management plans, to determine the adequacy of current and future supplies to meet demands. Detailed groundwater information is required for those suppliers that use groundwater. SB 221 (2001) prohibits approval of certain developments without verification of an available water supply. These bills are significant with respect to groundwater because much of California's new development will rely on groundwater for its supply.

Finally, SB 1938 (2002) was enacted to provide incentives to local agencies for improved groundwater management. The legislation modified the Water Code to require that specific elements be included in a groundwater management plan for an agency to be eligible for certain State funding administered by the Department of Water Resources for groundwater projects. AB 303 is exempt from that requirement.

History of Bulletin 118

DWR has long recognized the need for collection, summary, and evaluation of groundwater data as tools in planning optimal use of the groundwater resource. An example of this is DWR's Bulletin 118 series. Bulletin 118 presents the results of groundwater basin evaluations in California. The Bulletin 118 series was preceded by Water Quality Investigations Report No. 3, *Ground Water Basins in California* (referred to in this bulletin as Report No. 3), published in 1952 by the Department of Public Works, Division of Water Resources (the predecessor of DWR). The purpose of Report No. 3 was to create a base index map of the "more important ground water basins" for carrying out DWR's mandate in Section 229 of the Water Code. Section 229 directed Public Works to:

> …investigate conditions of the quality of all waters within the State, including saline waters, coastal and inland, as related to all sources of pollution of whatever nature and shall report thereon to the Legislature and to the appropriate regional water pollution control board annually, and may recommend any steps which might be taken to improve or protect the quality of such waters.

Report No. 3 identified 223 alluvium-filled valleys that were believed to be basins with usable groundwater in storage. A statewide numbering system was created in cooperation with the State Water Pollution Control Board (now the State Water Resources Control Board) based on the boundaries of the nine Regional Water Quality Control Boards. In 1992, Water Code Section 229 was amended, resulting in the elimination of the annual reporting requirements.

In 1975, DWR published Bulletin 118, *California's Ground Water*, (referred to in this report as Bulletin 118-75). Bulletin 118-75 summarized available information from DWR, U.S. Geological Survey, and other agencies for individual groundwater basins to "help those who must make decisions affecting the protection, additional use, and management of the State's ground water resources."

Bulletin 118-75 contains a summary of technical information for 248 of the 461 identified groundwater basins, subbasins, and what were referred to as "areas of potential ground water storage" in California as well as maps showing their location and extent. The Bulletin 118-75 basin boundaries were based on geologic and hydrogeologic conditions except where basins were defined by a court decision.

In 1978, Section 12924 was added to the California Water Code:

> The Department shall, in conjunction with other public agencies, conduct an investigation of the State's groundwater basins. The Department shall identify the State's groundwater basins on the basis of geologic and hydrogeologic conditions and consideration of political boundary lines whenever practical. The Department shall also investigate existing general patterns of groundwater pumping and groundwater recharge within such basins to the extent necessary to identify basins which are subject to critical conditions of overdraft.

DWR published the report in 1980 as *Ground Water Basins in California: A Report to the Legislature in Response to Water Code Section 12924* (referred to in this report as Bulletin 118-80). The bulletin included 36 groundwater basins with boundaries different from Bulletin 118-75. The changed boundaries resulted by combining several basins based on geologic or political considerations and by dividing the San Joaquin Valley groundwater basin into many smaller subbasins based primarily on political boundaries. These changes resulted in the identification of 447 groundwater basins, subbasins, and areas of potential groundwater storage. Bulletin 118-80 also identified 11 basins as subject to critical conditions of overdraft.

Box A Which Bulletin 118 Do You Mean?

Mention of an update to Bulletin 118 causes some confusion about which Bulletin 118 the California Department of Water Resources (DWR) has updated. In addition to the statewide Bulletin 118 series (Bulletin 118-75, Bulletin 118-80, and Bulletin 118-03), DWR released several other publications in the 118 series that evaluate groundwater basins in specific areas of the State. Region-specific Bulletin 118 reports are listed below.

- Bulletin 118-1. Evaluation of Ground Water Resources: South San Francisco Bay
  Appendix A. Geology, 1967
  Volume 1. Fremont Study Area, 1968
  Volume 2. Additional Fremont Study Area, 1973
  Volume 3. Northern Santa Clara County, 1975
  Volume 4. South Santa Clara County, 1981
- Bulletin 118-2. Evaluation of Ground Water Resources: Livermore and Sunol Valleys, 1974
  Appendix A. Geology, 1966
- Bulletin 118-3. Evaluation of Ground Water Resources: Sacramento County, 1974
- Bulletin 118-4. Evaluation of Ground Water Resources: Sonoma County
  Volume 1. Geologic and Hydrologic Data, 1975
  Volume 2. Santa Rosa Plain, 1982
  Volume 3. Petaluma Valley, 1982
  Volume 4. Sonoma Valley, 1982
  Volume 5. Alexander Valley and Healdsburg Area, 1983
- Bulletin 118-5. Bulletin planned but never completed.
- Bulletin 118-6. Evaluation of Ground Water Resources: Sacramento Valley, 1978

The Need for Bulletin 118 Update 2003

Despite California's heavy reliance on groundwater, basic information for many of the groundwater basins is lacking. Particular essential data necessary to provide for both the protection and optimal use of this resource is not available. To this end, the California Legislature mandated in the Budget Act of 1999 that DWR prepare:

> ...the statewide update of the inventory of groundwater basins contained in Bulletin 118-80, which includes, but is not limited to, the following: the review and summary of boundaries and hydrographic features, hydrogeologic units, yield data, water budgets, well production characteristics, and water quality and active monitoring data; development of a water budget for each groundwater basin; development of a format and procedures for publication of water budgets on the Internet; development of the model groundwater management ordinance; and development of guidelines for evaluating local groundwater management plans.

The information on groundwater basins presented in Bulletin 118 Update 2003 is mostly limited to the acquisition and compilation of existing data previously developed by federal, State, and local water agencies. While this bulletin is a good starting reference for basic data on a groundwater basin, more recent data and more information about the basin may be available in recent studies conducted by local water management agencies. Those agencies should be contacted to obtain the most recent data.

Report Organization

Bulletin 118 Update 2003 includes this report and supplemental material consisting of individual descriptions and a Geographic Information System-compatible map of each of the delineated groundwater basins in California. The basin descriptions will be updated as new information becomes available, and can be viewed or downloaded at http://www.waterplan.water.ca.gov/groundwater/118index.htm (Appendix A). Basin descriptions will not be published in hard copy.

This report is organized into the following topics:

- Groundwater is one of California's most important natural resources, and our reliance on it has continued to grow (Chapter 1).
- Groundwater has a complex legal and institutional framework in California that has shaped the groundwater management system in place today (Chapter 2).
- Groundwater management occurs primarily at the local water agency level, but may also be instituted at the local government level. At the request of the Legislature, DWR has developed some recommendations for a model groundwater management ordinance and components for inclusion in a groundwater management plan (Chapter 3).
- Groundwater has had a flurry of activity in the Legislature and at the ballot box in recent years that will affect the way groundwater is managed in California (Chapter 4).
- Groundwater programs with a variety of objectives exist in many State and federal agencies (Chapter 5).
- Groundwater concepts and definitions should be made available to a wide audience (Chapter 6).
- Groundwater basins with a wide range of characteristics and concerns exist in each of California's 10 hydrologic regions (Chapter 7).

Chapter 1
Groundwater – California's Hidden Resource

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In 1975, *California's Ground Water – Bulletin 118* described groundwater as "California's hidden resource." Today, those words ring as true as ever. Because groundwater cannot be directly observed, except under a relatively few conditions such as at a spring or a wellhead, most Californians do not give much thought to the value that California's vast groundwater supply has added to the State. It is unlikely that California could have achieved its present status as the largest food and agricultural economy in the nation and fifth largest overall economy in the world without groundwater resources. Consider that about 43 percent of all Californians obtain drinking water from groundwater. California is not only the single largest user of groundwater in the nation, but the estimated 14.5 million acre-feet (maf) of groundwater extracted in California in 1995 represents nearly 20 percent of all groundwater extracted in the entire United States (Solley and others 1998).

California's Hydrology

California's climate is dominated by the Pacific storm track. Numerous mountain ranges cause orographic lifting of clouds, producing precipitation mostly on the western slopes and leaving a rain shadow on most eastern slopes (Figure 1 and Figure 2). These storms also leave tremendous accumulations of snow in the Sierra Nevada during the winter months. While the average annual precipitation in California is about 23 inches (DWR 1998), the range of annual rainfall varies greatly from more than 140 inches in the northwestern part of the State to less than 4 inches in the southeastern part of the State.

Snowmelt and rain falling in the mountains flow into creeks, streams, and rivers. The average annual runoff in California is approximately 71 maf (DWR 1998). As these flows make their way into the valleys, much of the water percolates into the ground. The vast majority of California's groundwater that is accessible in significant amounts is stored in alluvial groundwater basins. These alluvial basins, which are the subject of this report, cover nearly 40 percent of the geographic area of the State (Figure 3).

This bulletin focuses on groundwater resources, but in reality groundwater and surface water are inextricably linked in the hydrologic cycle. As an example, groundwater may be recharged by spring runoff in streams, but later in the year the base flow of a stream may be provided by groundwater. So, although the land surface is a convenient division for categorizing water resources, it is a somewhat arbitrary one. It is essential that water managers recognize and account for the relationship between groundwater and surface water in their planning and operations.

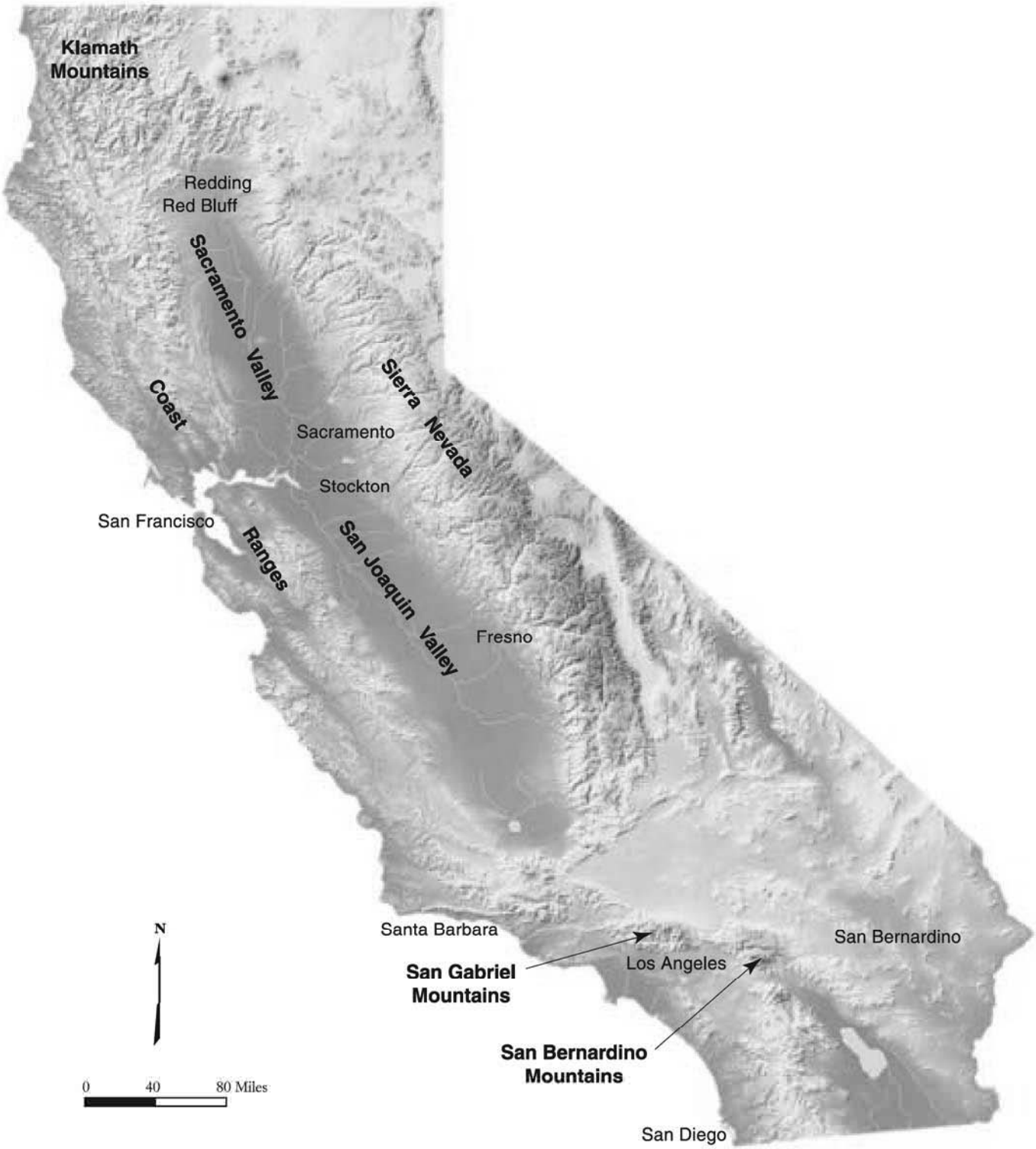

Figure 1 Shaded relief map of California

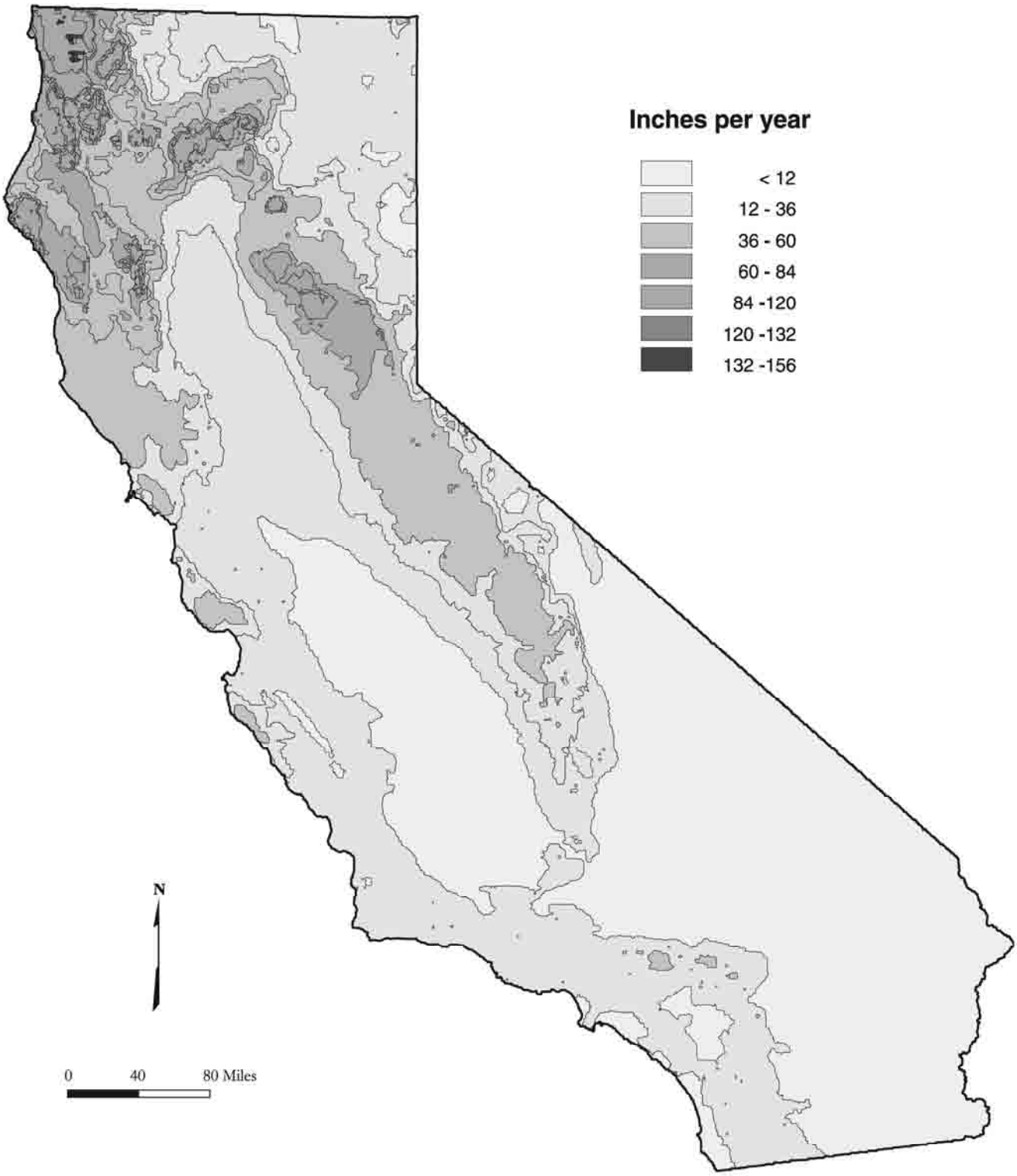

Figure 2 Mean annual precipitation in California, 1961 to 1990

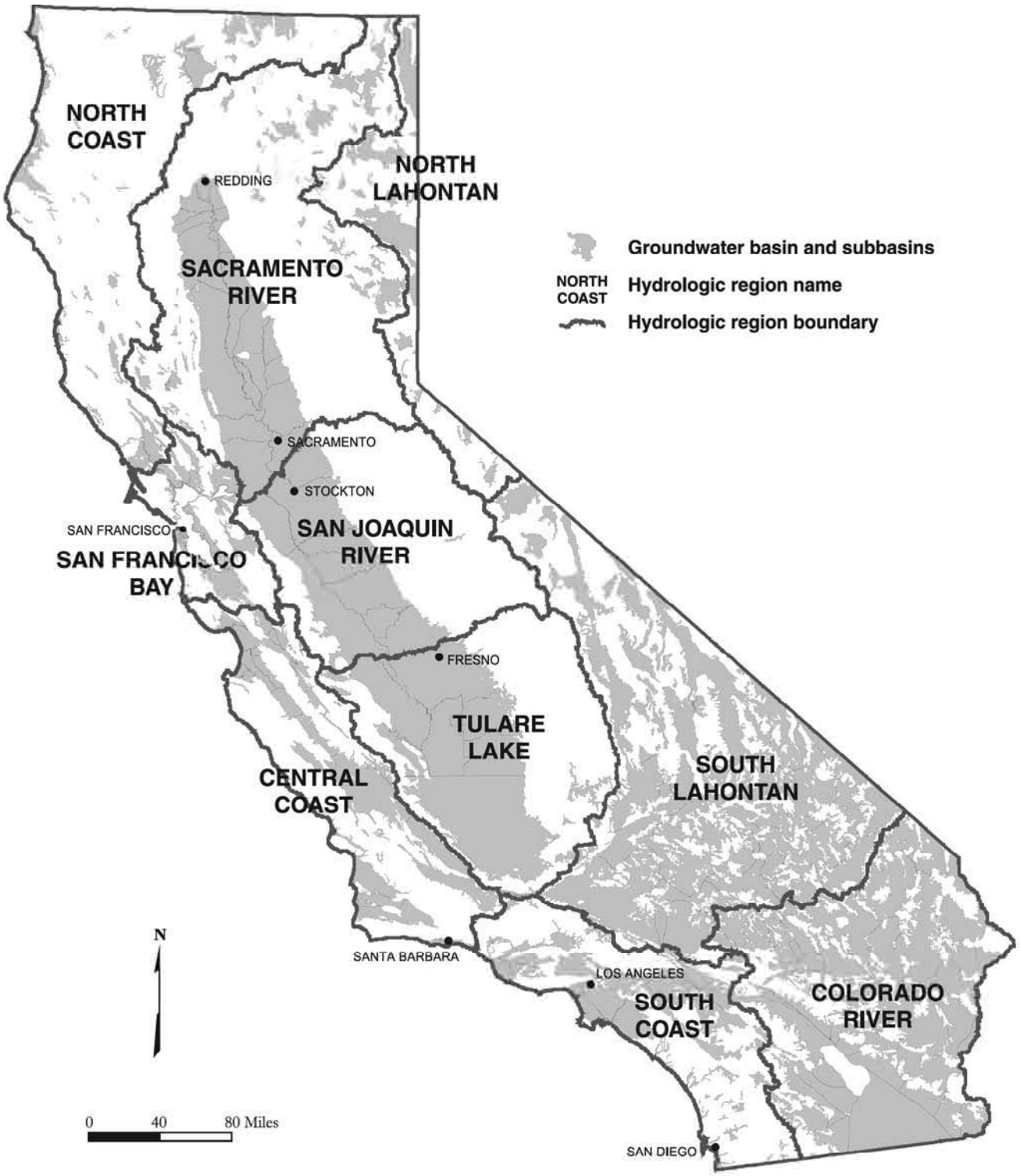

Figure 3 Groundwater basins, subbasins and hydrologic regions

California's Water Supply System

The economic success achieved in California could not have been foreseen a century ago. California's natural hydrologic system appeared too limited to support significant growth in population, industry, and agriculture. The limitations revolved around not only the relative aridity of the State, but the geographic, seasonal, and climatic variability that influence California's water supply. Approximately 70 percent of the State's average annual runoff occurs north of Sacramento, while about 75 percent of the State's urban and agricultural water needs are to the south. Most of the State's precipitation falls between October and April with half of it occurring December through February in average years. Yet, the peak demand for this water occurs in the summer months. Climatic variability includes dramatic deviations from average supply conditions by way of either droughts or flooding. In the 20th century alone, California experienced multiyear droughts in 1912–1913, 1918–1920, 1922–1924, 1929–1934, 1947–1950, 1959–1961, 1976–1977, and 1987–1992 (DWR 1998).

California has dealt with the limitations resulting from its natural hydrology and achieved its improbable growth by developing an intricate system of reservoirs, canals, and pipelines under federal, State and local projects (Figure 4). However, a significant portion of California's water supply needs is also met by groundwater. Typically, groundwater supplies about 30 percent of California's urban and agricultural uses. In dry years, groundwater use increases to about 40 percent statewide and 60% or more in some regions.

The importance of groundwater to the State's development may have been underestimated at the beginning of the 20th century. At that time, groundwater was seen largely as just a convenient resource that allowed for settlement in nearly any part of the State, given groundwater's widespread occurrence. Significant artesian flow from confined aquifers in the Central Valley allowed the early development of agriculture. When the Water Commission Act defined the allocation of surface water rights in 1914, it did not address allocation of the groundwater resource. In the 1920s, the development of the deep-well turbine pump and the increased availability of electricity led to a tremendous expansion of agriculture, which used these high-volume pumps and increased forever the significance of groundwater as a component of water supply in California.

Figure 4 Water projects in California

Box B Will Climate Change Affect California's Groundwater?

California's water storage and delivery system can be thought of as including three reservoir systems—the snowpack of the Sierra Nevada, an extensive system of dams, lakes, and conveyance systems for surface water, and finally the aquifers that store groundwater. Precipitation in the form of snow is stored in the Sierra in winter and early spring and under ideal conditions melts in a manner that allows dams to capture the water for use during California's dry season. When snow melts faster, the dams act as flood control structures to prevent high runoff from flooding lowland areas. Water storage and delivery infrastructure—dams and canals—has been designed largely around the historical snowpack, while aquifers have played a less formal and less recognized role.

What will be the effect of climate change on California's water storage system? How will groundwater basins and aquifers be affected?

The latest report of the Intergovernmental Panel on Climate Change (2001) reaffirms that climate is changing in ways that cannot be accounted for by natural variability and that "global warming" is occurring. Studies by the National Water Assessment Team for the U.S. Global Change Research Program's National Assessment of the Potential Consequences of Climate Variability and Change identify potential changes that could affect water resources systems. For California, these include higher snow levels leading to more precipitation in the form of rain, earlier runoff, a rise in sea level, and possibly larger floods. In addition to affecting the balance between storage and flood control of our reservoirs, such changes in hydrology would affect wildlands, resulting in faunal and floral displacement and resulting in changes in vegetative water consumption. These changes would also affect patterns of both irrigated and dryland farming.

A warmer, wetter winter would increase the amount of runoff available for groundwater recharge; however, this additional runoff in the winter would be occurring at a time when some basins, particularly in Northern California, are either being recharged at their maximum capacity or are already full. Conversely, reductions in spring runoff and higher evapotranspiration because of warmer temperatures could reduce the amount of water available for recharge and surface storage.

The extent to which climate will change and the impact of that change are both unknown. A reduced snowpack, coupled with increased seasonal rainfall and earlier snowmelt may require a change in the operating procedures for existing dams and conveyance facilities. Furthermore, these changes may require more active development of successful conjunctive management programs in which the aquifers are more effectively used as storage facilities. Water managers might want to evaluate their systems to better understand the existing snowpack-surface water-groundwater relationship, and identify opportunities that may exist to optimize groundwater and other storage capability under a new hydrologic regime that may result from climate change. If more water was stored in aquifers or in new or reoperated surface storage, the additional water could be used to meet water demands when the surface water supply was not adequate because of reduced snowmelt.

Recent Groundwater Development Trends

While development of California's surface water storage system has slowed significantly, groundwater development continues at a strong pace. A review of well completion reports submitted to the California Department of Water Resources (DWR) provides data on the number and type of water wells drilled in California since 1987. For the 14-year period, DWR received 127,616 well completion reports for water supply wells that were newly constructed, reconditioned, or deepened—an average of 9,115 annually[1]. Of these, 82 percent were drilled for individual domestic uses; 14 percent for irrigation; and about 4 percent for a combined group of municipal and industrial uses (Figure 5). Although domestic wells predominate, individual domestic use makes up a small proportion of total groundwater use in the State.

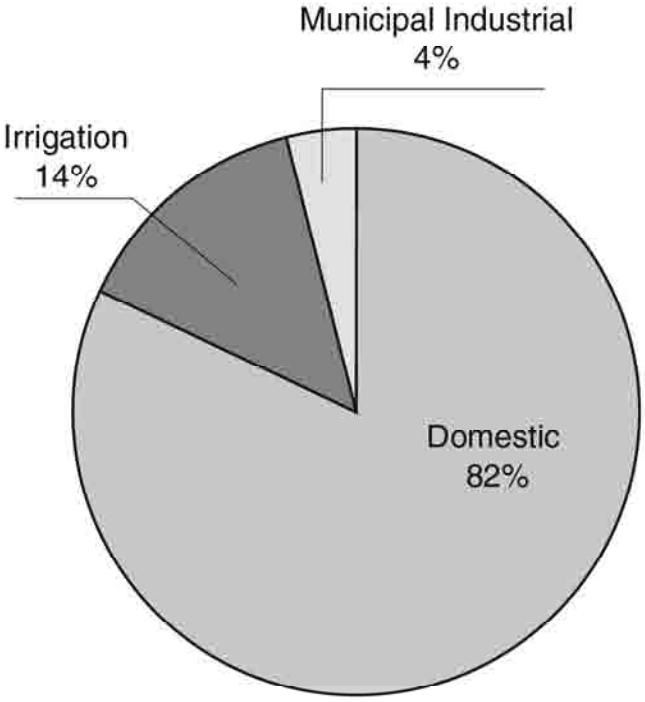

Figure 5 Well completion reports filed with DWR from 1987 through 2000

The most evident influence on the number of wells constructed is hydrologic conditions. The number of wells constructed and modified increases dramatically with drought conditions (Figure 6). The number of wells constructed and modified annually from 1987 through 1992 is more than double the annual totals for 1995 through 2000. Each year from 1987 through 1992 was classified as either dry or critically dry; water years 1995 through 2000 were either above normal or wet, based on measured unimpaired runoff in the Sacramento and San Joaquin valleys. In addition to providing an indication of the growth of groundwater development, well completion reports are a valuable source of information on groundwater basin conditions.

[1] DWR also received an average of 4,225 well completion reports for monitoring, which were not included above because they do not extract groundwater for supply purposes.

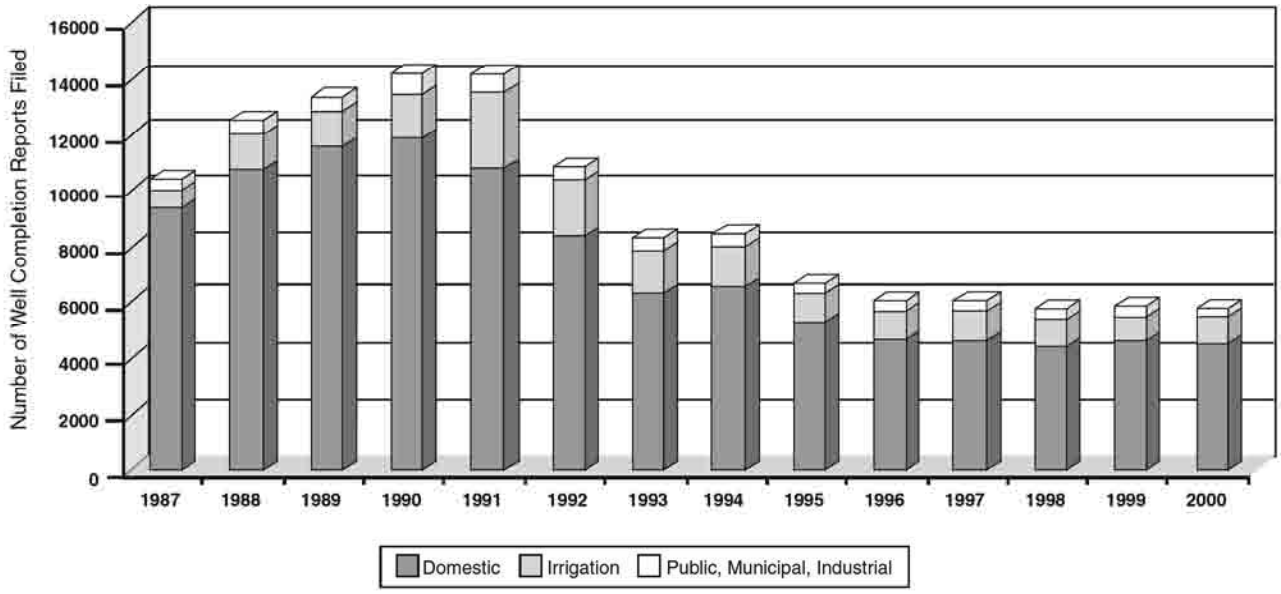

Figure 6 Well completion reports filed annually from 1987 through 2000

The Need for Groundwater Monitoring and Evaluation

Some 34 million people called California their home in the year 2000, and a population of nearly 46 million is expected by 2020. The increased population and associated commercial, industrial, and institutional growth will bring a substantially greater need for water. This need will be met in part by improved water use efficiency, opportunities to reoperate or expand California's surface water system, and increased desalination and recycling of water sources not currently considered usable. This need will also be met by storing and extracting additional groundwater. However, the sustainability of the groundwater resource, both in terms of what is currently used and future increased demand, cannot be achieved without effective groundwater management. In turn, effective groundwater management cannot be achieved without a program of groundwater data collection and evaluation.

Perhaps surprising to many, California does not have a comprehensive monitoring network for evaluating the health of its groundwater resource, including quantity and quality of groundwater. The reasons for this are many with the greatest one being that information on groundwater levels and groundwater quality is primarily obtained by drilling underground, which is relatively expensive. Given that delineated groundwater basins cover about 40 percent of the State's vast area, the cost of a dedicated monitoring network would be prohibitive. The other important reason for the lack of a comprehensive network is that, as will be discussed later in this report, groundwater is a locally controlled resource. State and federal agencies become involved only when a groundwater issue is directly related to the mission of a particular agency or if a local agency requests assistance. For these and other reasons, California lacks a cohesive, dedicated monitoring network.

Box C What about Overdraft?

Overdraft is the condition of a groundwater basin in which the amount of water withdrawn by pumping over the long term exceeds the amount of water that recharges the basin. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. Overdraft can lead to increased extraction costs, land subsidence, water quality degradation, and environmental impacts.

The California Water Plan Update, Bulletin 160-98 (DWR 1998) estimated that groundwater overdraft in California in 1995 was nearly 1.5 million acre-feet annually, with most of the overdraft occurring in the Tulare Lake, San Joaquin River, and Central Coast hydrologic regions. The regional and statewide estimates of overdraft are currently being revised for the 2003 update of Bulletin 160. While these estimates are useful from a regional and statewide planning perspective, the basin water budgets calculated for this update of Bulletin 118 clearly indicate that information is insufficient in many basins to quantify overdraft that has occurred, project future impacts on groundwater in storage, and effectively manage groundwater. Further technical discussion of overdraft is provided in Chapter 6 of this bulletin.

When DWR and other agencies involved in groundwater began to collect data in the first half of the 20th century, it quickly became evident that there were insufficient funds to install an adequate number of monitoring wells to accurately determine changes in the condition of groundwater basins. Consequently, to create a serviceable monitoring network, the agencies asked owners of irrigation or domestic wells for permission to measure water levels and to a lesser extent to monitor water quality. These have been called "wells of opportunity." In many areas, this approach has led to a network of wells that provide adequate information to gain a general understanding of conditions in the subsurface and to track changes through time. In some areas, groundwater studies were conducted and often included the construction of a monitoring well network. These studies have gradually contributed to a more detailed understanding of some of California's groundwater basins, particularly the most heavily developed basins.

Given the combination of monitoring wells of opportunity and dedicated monitoring wells, it might be assumed that an adequate monitoring network in California will eventually accumulate. However, several factors contribute to reducing the effectiveness of the monitoring network for data collection and evaluation: (1) The funding for data programs in many agencies, which was generally insufficient in the first place, has been reduced significantly. (2) When private properties change ownership, some new owners rescind permission for agency personnel to enter the property and measure the well. (3) The appropriateness of using these private wells is questionable because they are often screened over long intervals encompassing multiple aquifers in the subsurface, and in some cases construction details for the well are unknown. (4) Some wells with long-term records actually reach the end of their usefulness because the casing collapses or something falls into the well, making it unusable. In some cases, groundwater levels may drop below the well depth. (5) As water quality or water quantity conditions change, the monitoring networks may no longer be adequate to provide necessary data to manage groundwater.

The importance of long-term monitoring networks cannot be overstated. Sound groundwater management decisions require observation of trends in groundwater levels and groundwater quality. Only through these long-term evaluations can the question of sustainability of groundwater be answered. For example, this report contains a summary of groundwater contamination in public water supply wells throughout the State collected from 1994 through 2000. While this provides a "snapshot" of the suitability of the groundwater currently developed for public supply needs, it does not address sustainability of groundwater for public uses. Sustainability can only be determined by observing groundwater quality over time. If conditions worsen, local managers will need to take steps to prevent further harm to groundwater quality. Long-term groundwater records require adequate funding and staff to develop groundwater monitoring networks and to collect, summarize, and evaluate the data.

Chapter 2
Groundwater Management in California

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Groundwater management, as defined in this report, is the planned and coordinated monitoring, operation, and administration of a groundwater basin or portion of a groundwater basin with the goal of long-term sustainability of the resource. Throughout the history of water management in California, local agencies have practiced an informal type of groundwater management. For example, since the early 20th century, when excess surface water was available, some agencies intentionally recharged groundwater to augment their total water supply. In 1947, the amount of groundwater used was estimated at 9 million to 10 million acre-feet. By the beginning of the 21st century, the amount of groundwater used had increased to an estimated 15 million acre-feet. Better monitoring would provide more accurate information. This increased demand on California's groundwater resources, when coupled with estimates of population growth, has resulted in a need for more intensive groundwater management.

In 1914, California created a system of appropriating surface water rights through a permitting process (Stats 1913, ch. 586), but groundwater use has never been regulated by the State. Though the regulation of groundwater has been considered on several occasions, the California Legislature has repeatedly held that groundwater management should remain a local responsibility (Sax 2002). Although they are treated differently legally, groundwater and surface water are closely interconnected in the hydrologic cycle. Use of one resource will often affect the other, so that effective groundwater management must consider surface water supplies and uses.

Figure 7 depicts the general process by which groundwater management needs are addressed under existing law. Groundwater management needs are identified at the local water agency level and may be directly resolved at the local level. If groundwater management needs cannot be directly resolved at the local agency level, additional actions such as enactment of ordinances by local governments, passage of laws by the Legislature, or decisions by the courts may be necessary to resolve the issues. Upon implementation, local agencies evaluate program success and identify additional management needs. The State's role is to provide technical and financial assistance to local agencies for their groundwater management efforts, such as through the Local Groundwater Assistance grant program (see Chapter 4, AB 303).

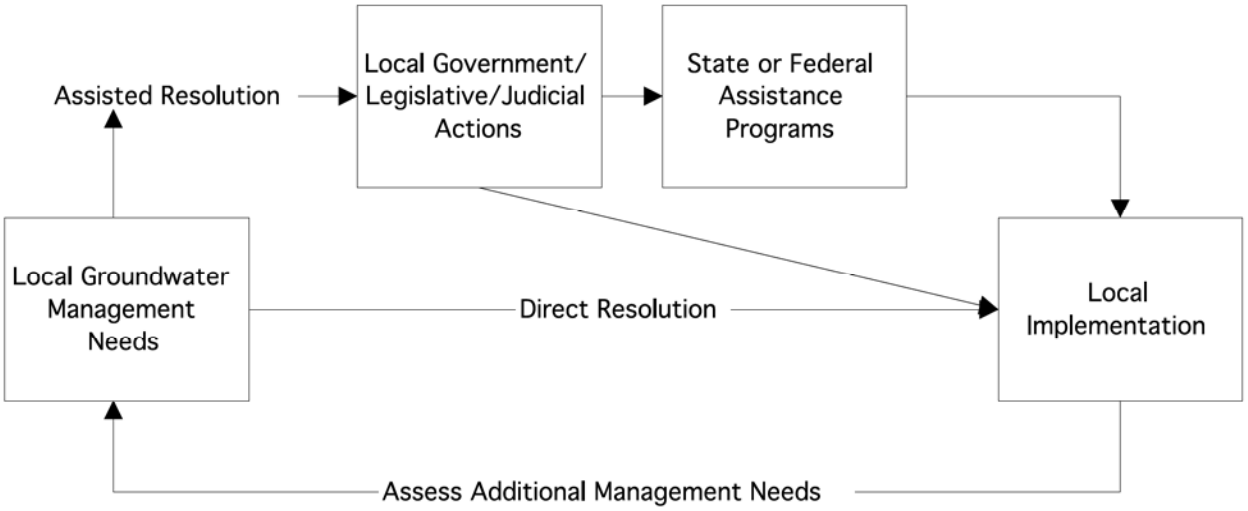


Figure 7 Process of addressing groundwater management needs in California

How Groundwater is Managed in California

There are three basic methods available for managing groundwater resources in California: (1) management by local agencies under authority granted in the California Water Code or other applicable State statutes, (2) local government groundwater ordinances or joint powers agreements, and (3) court adjudications. Table 1 shows how often each of these methods has been used, and each method is discussed briefly below. No law requires that any of these forms of management be applied in a basin. Management is often instituted after local agencies or landowners recognize a specific groundwater problem. The level of groundwater management in any basin or subbasin is often dependent on water availability and demand.

Table 1 Groundwater management methods

Method	Frequency of use[a]
Local water agencies	Undetermined number of agencies with authority to manage some aspect of groundwater under general powers associated with a particular type of district.
	Thirteen agencies with specially legislated authority to limit or regulate extraction.
	Seven agencies with adopted plans under authority from Water Code Section 10750 et seq.[b] (AB 255 of 1991).
	More than 200 agencies with adopted plans under authority from Water Code Section 10750 et seq. (AB 3030 of 1992).
Local groundwater management ordinances	Currently adopted in 27 counties.
Court adjudication	Currently decided in 19 groundwater basins, mostly in Southern California. Three more basins are in court.

a. The numbers for some methods are unknown because reporting to the California Department of Water Resources is not required.
b. Section 10750 *et seq.* was amended in 1992.

Groundwater Management through Authority Granted to Local Water Agencies

More than 20 types of local agencies are authorized by statute to provide water for various beneficial uses. Many of these agencies also have statutory authority to institute some form of groundwater management. For example, a Water Replenishment District (Water Code, § 60000 et seq.) is authorized to establish groundwater replenishment programs and collect fees for that service. A Water Conservation District (Water Code, § 75500 et seq.) can levy groundwater extraction fees. Table 2 lists these and other types of local agencies that deliver water and may have authority to institute some form of groundwater management. Most of these agencies are identified in the Water Code, but their specific authority related to groundwater management varies. The Water Code does not require that the agencies report their activities to the California Department of Water Resources (DWR).

Table 2 Local agencies with authority to deliver water for beneficial uses, which may have authority to institute groundwater management

Local agency	Authority	Number of agencies[a]
Community Services District	Gov. Code § 61000 et seq.	313
County Sanitation District	Health and Safety Code § 4700 et seq.	91
County Service Area	Gov. Code § 25210.1 et seq.	897
County Water Authority	Water Code App. 45.	30
County Water District	Water Code § 30000 et seq.	174
County Waterworks District	Water Code § 55000 et seq.	34
Flood Control and Water Conservation District	Water Code App. 38.	39
Irrigation District	Water Code § 20500 et seq.	97
Metropolitan Water District	Water Code App 109.	1
Municipal Utility District	Pub. Util. Code § 11501 et seq.	5
Municipal Water District	Water Code § 71000 et seq.	40
Public Utility District	Pub. Util. Code § 15501 et seq.	54
Reclamation District	Water Code § 50000 et seq.	152
Recreation and Park District	Pub. Resources Code § 5780 et seq.	110
Resort Improvement District	Pub. Resources Code § 13000 et seq.	-
Resource Conservation District	Pub. Resources Code § 9001 et seq.	99
Water Conservation District	Water Code App. 34; Wat. Code § 74000 et seq.	13
Water District	Water Code § 34000 et seq.	141
Water Replenishment District	Water Code § 60000 et seq.	1
Water Storage District	Water Code § 39000 et seq.	8

a. From State Controller's Office Special Districts Annual Report, 49th Edition.

Greater authority to manage groundwater has been granted to a small number of local agencies or districts created through special acts of the Legislature. For example, the Sierra Valley Groundwater Basin Act of 1980 (Water Code, App. 119) created the first two groundwater management districts in California. Currently, 13 local agencies have specific groundwater management authority as a result of being special act districts. The specific authority of each agency varies, but they can generally be grouped into two categories. Most of the agencies formed since 1980 have the authority to limit export and even control some in-basin extraction upon evidence of overdraft or the threat of overdraft. These agencies can also generally levy fees for groundwater management activities and for water supply replenishment. Agencies formed prior to 1980 do not have authority to limit extraction from a basin. However, the groundwater users in these areas are generally required to report extractions to the agency, and the agency can levy fees for groundwater management or water supply replenishment. Some of these agencies have effectively used a tiered fee

structure to discourage excessive groundwater extraction in the basin. Table 3 lists the names of special act districts with legislative authority to manage groundwater.

Table 3 Special act districts with groundwater management authority in California

District or agency	Water Code citation[a]	Year agency established in Code[b]
Desert Water Agency	App. 100	1961
Fox Canyon Groundwater Management Agency	App. 121.	1982
Honey Lake Groundwater Management District	App. 129.	1989
Long Valley Groundwater Management District	App. 119.	1980
Mendocino City Community Services District	Section 10700 et seq.	1987
Mono County Tri-Valley Groundwater Management District	App. 128.	1989
Monterey Peninsula Water Management District	App. 118.	1977
Ojai Groundwater Management Agency	App. 131.	1991
Orange County Water District	App. 40.	1933
Pajaro Valley Water Management Agency	App. 124.	1984
Santa Clara Valley Water District	App. 60.	1951
Sierra Valley Groundwater Management District	App. 119.	1980
Willow Creek Groundwater Management Agency	App. 135.	1993

a. From West's Annotated California Codes (1999 update)
b. This represents the year the agency was established in the Water Code. Specific authorities, such as those for groundwater management activities, may have been granted through later amendments.

In 1991, AB 255 (Stats. 1991, Ch. 903) was enacted authorizing local agencies overlying basins subject to critical conditions of overdraft, as defined in DWR's Bulletin 118-80, to establish programs for groundwater management within their service areas. Water Code section 10750 et seq. provided these agencies with the powers of a water replenishment district to raise revenue for facilities to manage the basin for the purposes of extraction, recharge, conveyance, and water quality. Seven local agencies adopted plans under this authority.

The provisions of AB 255 were repealed in 1992 with the passage of AB 3030 (Stats. 1992, Ch. 947). This legislation was significant in that it greatly increased the number of local agencies authorized to develop a groundwater management plan and set forth a common framework for management by local agencies throughout California. AB 3030, which is codified in Water Code section 10750 et seq., provides a systematic procedure to develop a groundwater management plan by local agencies overlying the groundwater basins defined by Bulletin 118-75 (DWR 1975) and updates. Upon adoption of a plan, these agencies could possess the same authority as a water replenishment district to "fix and collect fees and assessments for groundwater management" (Water Code, § 10754). However, the authority to fix and collect these fees and assessments is contingent on receiving a majority of votes in favor of the proposal in a local election (Water Code, § 10754.3). More than 200 agencies have adopted an AB 3030 groundwater management plan. None of these agencies is known to have exercised the authority of a Water Replenishment District.

Water Code section 10755.2 expands groundwater management opportunities by encouraging coordinated plans and by authorizing public agencies to enter into a joint powers agreement or memorandum of understanding with public or private entities that provide water service. At least 20 coordinated plans have been prepared to date involving nearly 120 agencies, including cities and private water companies.

Local Groundwater Ordinances

A second general method of managing groundwater in California is through ordinances adopted by local governments such as cities or counties. Twenty-seven counties have adopted groundwater ordinances, and others are being considered (Figure 8). The authority of counties to regulate groundwater has been challenged, but in 1995 the California Supreme Court declined to review an appeal of a lower court decision *Baldwin v. County of Tehama* (1994) that holds that State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage groundwater under their police powers. However, the precise nature and extent of the police power of cities and counties to regulate groundwater is uncertain.

The Public Policy Institute of California recently performed a study of California's water transfer market, which included a detailed investigation of the nature of groundwater ordinances by counties in California. The report found that 22 counties had adopted ordinances requiring a permit to export groundwater. In all but three cases, restricting out-of-county uses appears to be the only purpose (Hanak 2003). One ordinance, adopted recently in Glenn County (Box D, "Basin Management Objectives for Groundwater Management"), takes a comprehensive approach by establishing management objectives for the county's groundwater basins. Several other counties in Northern California are considering adopting similar management objective based ordinances.

Ordinances are mostly a recent trend in groundwater management, with 24 of the 27 ordinances enacted since 1990. Local ordinances passed during the 1990s have significantly increased the potential role of local governments in groundwater management. The intent of most ordinances has been to hold project proponents accountable for impacts that may occur as a result of proposed export projects. Because adoption of most of these ordinances is recent, their effect on local and regional groundwater management planning efforts is not yet fully known. However, it is likely that future groundwater development will take place within the constraints of local groundwater management ordinances. Table 4 lists counties with groundwater management ordinances and their key elements.

Figure 8 Counties with groundwater ordinances

Box D Basin Management Objectives for Groundwater Management

Most county groundwater management ordinances require that an export proponent prove the project will not deplete groundwater, cause groundwater quality degradation, or result in land subsidence. Although these factors could be part of any groundwater management plan, these ordinances do not require that a groundwater management plan be developed and implemented.

The only ordinance requiring development and adoption of objectives to be accomplished by management of the basin was adopted by the Glenn County Board of Supervisors in 2000. The action came after a citizens committee spent five years working with stakeholders. The process of developing a groundwater management ordinance for Glenn County began in 1995 when local landowners and county residents became concerned about plans to export groundwater or substitute groundwater for exported surface water. Control of exports was the focus of early ordinance discussions.

After long discussions and technical advice from groundwater specialists, the committee realized that goals and objectives must be identified for effective management of groundwater in the county. What did the county want to accomplish by managing groundwater within the county? What did groundwater management really mean?

The concept of establishing basin management objectives emerged (BMOs). BMOs would establish threshold values for groundwater levels, groundwater quality, and land surface subsidence. When a threshold level is reached, the rules and regulations require that groundwater extraction be adjusted or stopped to prevent exceeding the threshold.

The Glenn County Board of Supervisors has adopted BMOs, which were developed by an advisory committee, for groundwater levels throughout the county. While currently there are 17 BMOs representing the 17 management areas in the county, the goal is to begin managing the entire county in a manner that benefits each of the local agencies and their landowners, as well as landowners outside of an agency boundary. The committee is now developing BMOs for groundwater quality and land surface subsidence.

There is no single set of management objectives that will be successful in all areas. Groundwater management must be adapted to an area's political, institutional, legal, and technical constraints and opportunities. Groundwater management must be tailored to each basin or subbasin's conditions and needs. Even within a single basin, the management objectives may change as more is learned about managing the resource within that basin. Flexibility is the key, but that flexibility must operate within a framework that ensures public participation, monitoring, evaluation, feedback on management alternatives, rules and regulations, and enforcement.

Table 4 Counties with ordinances addressing groundwater management

County	Year enacted	Key elements (refer to ordinances for exemptions and other details)
Butte	1996	Export permit required (extraction & substitute pumping), Water Commission and Technical Advisory Committee, groundwater planning reports (county-wide monitoring program)
Calaveras	2002	Export permit required (extraction & substitute pumping)
Colusa	1998	Export permit required (extraction & substitute pumping)
Fresno	2000	Export permit required (extraction & substitute pumping)
Glenn	1990 rev. 2000	Water Advisory Committee and Technical Advisory Committee, basin management objectives and monitoring network, export permit required (1990)
Imperial	1996	Commission established to manage groundwater, including controlling exports (permit required), overdraft, artificial recharge, and development projects
Inyo	1998	Regulates (1) water transfers pursuant to Water Code Section 1810, (2) sales of water to the City of Los Angeles from within Inyo Co., (3) transfer or transport of water from basins within Inyo County to another basin with the County, and (4) transfers of water from basins within Inyo Co. to any area outside the County.
Kern	1998	Conditional use permit for export to areas both outside county and within watershed area of underlying aquifer in county. Only applies to southeastern drainage of Sierra Nevada and Tehachapi mountains.
Lake	1999	Export permit required (extraction & substitute pumping)
Lassen	1999	Export permit required (extraction & substitute pumping)
Madera	1999	Permit required for export, groundwater banking, and import for groundwater banking purposes to areas outside local water agencies
Mendocino	1995	Mining of groundwater regulated for new developments in Town of Mendocino
Modoc	2000	Export permit required for transfers out of basin
Mono	1988	Permit required for transfers out of basin
Monterey	1993	Water Resources Agency strictly regulates extraction facilities in zones with groundwater problems
Napa	1996	Permits for local groundwater extractions; exemptions for single parcels and agricultural use
Sacramento	1952 rev. 1985	Water Agency established to manage and protect groundwater management zones; replenishment charges
San Benito	1995	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use, injecting imported water; influence of well pumping restrictions
San Bernardino	2002	Permit required for any new groundwater well within the desert region of the county
San Diego	1991	Provides for mapping of groundwater impacted basins (defined); projects within impacted basins require groundwater investigations
San Joaquin	1996	Export permit required (extraction & substitute pumping)
Shasta	1997	Export permit required (extraction & substitute pumping)
Sierra	1998	Export permit required or for off-parcel use
Siskiyou	1998	Permit required for transfers out of basin
Tehama	1992	Mining groundwater (overdraft) for export prohibited; permit required for off-parcel use; influence of well pumping restrictions
Tuolumne	2001	Export permit required (extraction & substitute pumping)
Yolo	1996	Export permit required (extraction & substitute pumping)

Adjudicated Groundwater Basins

A third general form of groundwater management in California is court adjudication. In some California groundwater basins, as the demand for groundwater exceeded supply, landowners and other parties turned to the courts to determine how much groundwater can rightfully be extracted by each user. The courts study available data to arrive at a distribution of the groundwater that is available each year, usually based on the California law of overlying use and appropriation. This court-directed process can be lengthy and costly. As noted in Table 5, the longest adjudication took 24 years. Many of these cases have been resolved with a court-approved negotiated settlement, called a stipulated judgment. Unlike overlying and non-overlying rights to groundwater, such decisions guarantee to each party a proportionate share of the groundwater that is available each year. The intense technical focus on the groundwater supply and restrictions on groundwater extraction for all parties make adjudications one of the strongest forms of groundwater management in California.

There are 19 court adjudications for groundwater basins in California, mostly in Southern California (see Table 5). Eighteen of the adjudications were undertaken in State Superior Court and one in federal court. For each adjudicated groundwater basin, the court usually appoints a watermaster to oversee the court judgment. In 15 of these adjudications, the court judgment limits the amount of groundwater that can be extracted by all parties based on a court-determined safe yield of the basin. The basin boundaries are also defined by the court. The Santa Margarita Basin was adjudicated in federal court. That decision requires water users to report the amount of surface water and groundwater they use, but groundwater extraction is not restricted.

Most basin adjudications have resulted in either a reduction or no increase in the amount of groundwater extracted. As a result, agencies often import surface water to meet increased demand. The original court decisions provided watermasters with the authority to regulate extraction of the quantity of groundwater; however, they omitted authority to regulate extraction to protect water quality or to prevent the spread of contaminants in the groundwater. Because water quantity and water quality are inseparable, watermasters are recognizing that they must also manage groundwater quality.

Box E Adjudication of Groundwater Rights in the Raymond Basin

The first basin-wide adjudication of groundwater rights in California was in the Raymond Basin in Los Angeles County in 1949 (*Pasadena v. Alhambra*). The first water well in Raymond Basin was drilled in 1881; 20 years later, the number of operating wells grew to about 140. Because of this pumping, the City of Pasadena began spreading water in 1914 to replenish the groundwater, and during the next 10 years the city spread more than 20,000 acre-feet.

Pumping during 1930 through 1937 caused water levels to fall 30 to 50 feet in wells in Pasadena. After attempting to negotiate a reduction of pumping on a cooperative basis, the City of Pasadena, on September 23, 1937, filed a complaint in Superior Court against the City of Alhambra and 29 other pumpers to quiet title to the water rights within Raymond Basin. The court ruled that the city must amend its complaint, making defendants of all entities pumping more than 100 acre-feet per year, and that it was not a simple quiet title suit but, a general adjudication of the water rights in the basin.

In February 1939, a court used the reference procedure under the State Water Code to direct the State Division of Water Resources, Department of Public Works (predecessor to the Department of Water Resources) as referee to review all physical facts pertaining to the basin, determine the safe yield, and ascertain whether there was a surplus or an overdraft. The study took 2-1/2 years to complete and cost more than $53,000, which was paid by the parties. The resulting Report of Referee submitted to the court in July 1943 found that the annual safe yield of the basin was 21,900 acre-feet but that the actual pumping and claimed rights were 29,400 acre-feet per year.

Most parties agreed to appoint a committee of seven attorneys and engineers to work out a stipulated agreement. In 1944, the court designated the Division of Water Resources to serve as watermaster for the stipulated agreement, which all but one of the parties supported. On December 23, 1944, the judge signed the judgment that adopted the stipulation.

The stipulation provided that (1) the water was taken by each party openly, notoriously, and under a claim of right, which was asserted to be, and was adverse to each and all other parties; (2) the safe yield would be divided proportionally among the parties; and (3) each party's right to a specified proportion of the safe yield would be declared and protected. It also established an arrangement for the exchange of pumping rights among parties.

Based on the stipulation, the court adopted a program of proportionate reductions. In so doing, the court developed the doctrine of mutual prescription, whereby the rights were essentially based on the highest continual amount of pumping during the five years following the beginning of the overdraft, and under conditions of overdraft, all of the overlying and appropriative water users had acquired prescriptive rights against each other, that is, mutual prescription.*

In 1945, one party appealed the judgment, and in 1947, the District Court of Appeals reversed and remanded *Pasadena v. Alhambra*. However, on June 3, 1949, the State Supreme Court overturned the appellate court's decision and affirmed the original judgment. In 1950, the court granted a motion by the City of Pasadena that there be a review of the determination of safe yield, and in 1955, the safe yield and the total decreed rights were increased to 30,622 acre-feet per year. In 1984, watermaster responsibilities were assigned to the Raymond Basin Management Board.

*In City of Los Angeles v. City of San Fernando (1975) the California Supreme Court rejected the doctrine of mutual prescription and held that a groundwater basin should be adjudicated based on the correlative rights of overlying users and prior appropriation among non-overlying users. For further discussion, see Appendix B.

Table 5 List of adjudicated basins

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
1—Scott River Stream System	Scott River Valley; Siskiyou	1-5	1970	1980	Two local irrigation districts
2—Santa Paula Basin	Subbasin of Santa Clara River; Ventura	4-4	1991	1996	Three-person technical advisory committee from United Water CD, City of Ventura, and Santa Paula Basin Pumpers Association; www.unitedwater.org
3—Central Basin	Northeast part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1962	1965	DWR—Southern District; wwwdpla.water.ca.gov/sd/watermaster/watermaster.html
4—West Coast Basin	Southwest part of Coastal Plain of Los Angeles County Basin; Los Angeles	4-11	1946	1961	DWR—Southern District; wwwdpla.water.ca.gov/sd/watermaster/watermaster.html
5—Upper Los Angeles River Area	San Fernando Valley Basin (entire watershed); Los Angeles	4-12	1955	1979	Superior Court appointee
6—Raymond Basin	Northwest part of San Gabriel Valley Basin; Los Angeles	4-13	1937	1944	Raymond Basin Management Board
7—Main San Gabriel Basin	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13	1968	1973	Water purveyors and water districts elect a nine-member board; www.watermaster.org/
Puente Narrows, *Addendum to Main San Gabriel Basin decision*			1972	1972	Two consulting engineers
8—Puente	San Gabriel Valley Basin, excluding Raymond Basin; Los Angeles	4-13	1985	1985	Three consultants
9—Cummings Basin	Cummings Valley Basin; Kern	5-2	1966	1972	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
10—Tehachapi Basin	Tehachapi Valley West Basin and Tehachapi Valley East Basin; Kern	5-28 6-45	1966	1973	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm
11—Brite Basin	Brite Valley; Kern	5-80	1966	1970	Tehachapi-Cummings County Water District; www.tccwd.com/gwm.htm

Table 5 List of adjudicated basins (continued)

Court name	Relationship to DWR Bulletin 118 basin name; county	Basin No.	Filed in court	Final decision	Watermaster and/or website
12—Mojave Basin Area Adjudication	Lower, Middle & Upper Mojave River Valley Basins; El Mirage & Lucerne valleys; San Bernardino	6-40, 6-41, 6-42	1990	1996	Mojave Water Agency; www.mojavewater.org/mwa700.htm
13—Warren Valley Basin	Part of Warren Valley Basin; San Bernardino	7-12	1976	1977	Hi-Desert Water District; www.mojavewater.org
14—Chino Basin	Northwest part of Upper Santa Ana Valley Basin; San Bernardino and Riverside	8-2	1978	1978	Nine people, recommended by producers and appointed by the court; www.cbwm.org/
15—Cucamonga Basin	North central part of Upper Santa Ana Valley Basin; San Bernardino	8-2	1975	1978	Not yet appointed, operated as part of Chino Basin
16—San Bernardino Basin Area	Northeast part of Upper Santa Ana Basin; San Bernardino and Riverside	8-2	1963	1969	One representative each from Western Municipal Water District of Riverside County & San Bernardino Valley Municipal Water District
17—Six Basins	Six subbasins in northwest upper Santa Ana Valley; Upper & Lower Claremont Heights, Canyon, Pomona, Live Oak & Ganesha; Los Angeles. Small portions of Upper Claremont Heights and Canyon are in San Bernardino County	4-14, 8-2	1998	1998	Nine-member board representing all parties to the judgment
18—Santa Margarita River watershed	The Santa Margarita River watershed, including 3 groundwater basins: Santa Margarita Valley, Temecula Valley and Cahuilla Valley Basins; San Diego and Riverside.	9-4, 9-5, 9-6	1951	1966	U.S. District Court appointee
19—Goleta	Goleta Central Basin; judgment includes North Basin; Santa Barbara	3-16	1973	1989	No watermaster appointed; the court retains jurisdiction

How Successful Have Groundwater Management Efforts Been?

This chapter describes the opportunities for local agencies to manage their groundwater resources. Many have questioned whether these opportunities have led to an overall successful system of groundwater management throughout California. How successful groundwater management has been throughout the State is a difficult question and cannot be answered at present. While there are many examples of local agency successes (see Box F, "Managing through a Joint Powers Agreement," Box G, "Managing a Basin through Integrated Water Management," and Box H, "Managing Groundwater Using both Physical and Institutional Solutions"), there are neither mandates to prepare groundwater management plans nor reporting requirements when plans are implemented, so a comprehensive assessment of local planning efforts is not possible. Additionally, many plans have been adopted only recently, during a period of several consecutive wet years, so many of the plan components are either untested or not implemented.

At a minimum, successful groundwater management should be defined as maintaining and maximizing long-term reliability of the groundwater resource, focused on preventing significant depletion of groundwater in storage over the long term and preventing significant degradation of groundwater quality. A review of some of the groundwater management plans prepared under AB 3030 reveals that some plans are simply brief recitations about continuing the agency's existing programs. Not all agencies that enacted groundwater management plans under AB 3030 are actively implementing the plan.

Despite this apparent lack of implementation of groundwater management plans prepared under AB 3030, the bill has certainly increased interest in more effective groundwater management. With more than 200 agencies participating in plans and more than 120 of those involved in coordinated plans with other agencies, AB 3030 has resulted in a heightened awareness of groundwater management. Additionally, annual reports published by a few water agencies indicate that they are indeed moving toward better coordination throughout the basin and more effective management of all water supplies. Given the history of groundwater management in California, these seemingly small steps toward better management may actually represent giant strides forward.

More recently, financial incentives have played a large role in driving groundwater management activities. For example, under grant and loan programs resulting from Proposition 13 of 2000 (see description in Chapter 4), local agencies submitted applications proposing a total increase in annual water yield of more than 300,000 acre-feet through groundwater storage projects. Additional projects and programs would be developed with sufficient funding for feasibility and pilot studies. Unfortunately, not enough funding exists for all of the proposed projects, and many other legal and institutional barriers remain (see Box I, "Impediments to Conjunctive Management Programs in California"). It is clear, however, that further incentives would help agencies move ahead more aggressively in their groundwater management planning efforts.

Additional progress in groundwater management is reflected by passage of amendments to the Water Code (§§ 10753.4 and 10795.4 as amended, §§ 10753.7, 10753.8, and 10753.9 as amended and renumbered, and §§ 10753.1 and 10753.7 as added) through SB 1938 of 2002. The amendments require that groundwater management plans include specific components for agencies to be eligible for some public funds for groundwater projects. The provisions of SB 1938 (2001) are fully described in Chapters 3 and 4.

This evaluation of groundwater management success has not really considered ordinances and adjudications. Adjudications have been successful at maintaining the groundwater basin conditions, often restricting pumping for all basin users. In some cases, adjudication provides the necessary framework for more proactive management as well. Ordinances have successfully restricted exports from basins, but have not

Box F Managing through a Joint Powers Agreement

In 1993, representatives from business, environmental, public, and water purveyor interests formed the Sacramento Area Water Forum to develop a plan to protect the region's water resources from the effects of prolonged drought as the demand for water continues to grow. The Water Forum was founded on two co-equal objectives: (1) to provide a reliable and safe water supply for the region's economic health and planned development to the year 2030 and (2) to preserve the fishery, wildlife, recreational and aesthetic values of the lower American River.

After a six-year consensus-based process of education, analysis and negotiation, the participants signed a Water Forum agreement to meet these objectives. The agreement provides a framework for avoiding future water shortages, environmental degradation, groundwater contamination, threats to groundwater reliability, and limits to economic prosperity.

The Sacramento Groundwater Authority (SGA) was formed to fulfill a key Water Forum goal of protecting and managing the north-area groundwater basin. The SGA is a joint powers authority formed for the purpose of collectively managing the region's groundwater resources. This authority permits SGA to make contractual arrangements required to implement a conjunctive use program, and also provides potential partners with the legal and political certainty for entering into long-term agreements.

SGA's regional banking and exchange program is designed to provide long-term supply benefits for local needs, but also will have the potential to provide broader statewide benefits consistent with American River environmental needs. Water stored in Folsom Lake would be conjunctively used with groundwater in order to reduce surface water diversions in dry years and to achieve in-lieu recharge of the basin in wet years. The conjunctive use program participants include 16 water providers in northern Sacramento and southern Placer counties that serve water to more than half a million people.

Two of three implementation phases of the program are complete. In the first phase, program participants identified long-term water supply needs and conducted an inventory of existing infrastructure that could be used to implement the program. In the second phase, SGA completed two pilot banking and exchange projects, demonstrating the technical, legal, and institutional viability of a regional conjunctive use program. In the first pilot study, water agencies worked with the U.S. Bureau of Reclamation and the Sacramento Area Flood Control Agency to bank 2,100 acre-feet of groundwater, providing additional flood storage capacity in Folsom Lake. In the second pilot study, Citrus Heights and Fair Oaks water districts and the city of Sacramento extracted and used 7,143 acre-feet of groundwater, forgoing a portion of their rights to surface water, making this water available to the Environmental Water Account. The third phase of the SGA program is to further solidify the institutional framework and construct facilities to implement a full-scale regional conjunctive use program. These facilities, that will result in an average annual yield of 21,400 acre-feet, are currently under construction, funded in part by a $21.6 million grant under Proposition 13 of 2000.

Box G Managing a Basin through Integrated Water Management

Orange County Water District (OCWD) was established in 1933 by an uncodified Act (Water Code App. 40) to manage Orange County's groundwater basin and protect the Santa Ana River rights of water users of north-central Orange County. The district manages the groundwater basin, which provides as much as 75 percent of the water supply for its service area. The district strives for a groundwater-based water supply with enough reserves to provide a water supply through drought conditions. An integrated set of water management practices helps achieve this, including the use of recharge, alternative sources, and conservation.

Recharge

The Santa Ana River provides the main natural recharge source for the county's groundwater basin. Increased groundwater use and lower-than-average rainfall during the late 1980s and early 1990s forced the district to rely on an aggressive program to enhance recharge of the groundwater basin. Programs used today to optimize water use and availability include:

- Construction of levees in the river channel to increase infiltration.
- Construction of artificial recharge basins within the forebay.
- Development of an underwater basin cleaning vehicle that removes a clogging layer at the bottom of the recharge basin and extends the time between draining the basin for cleaning by a bulldozer.
- Use of storm water captured behind Prado Dam that would otherwise flow to the ocean.
- Use of imported water from the State Water Project and Colorado River.
- Injection of treated recycled water to form a seawater intrusion barrier.

Alternative Water Use and Conservation

OCWD has successfully used nontraditional sources of water to help satisfy the growing need for water in Orange County. Projects that have added to the effective supply of groundwater are:

- Use of treated recycled water for irrigation and industrial use.
- In-lieu use to reduce groundwater pumping.
- Change to low-flow toilets and showerheads.
- Participation of 70 percent of Orange County hotels and motels in water conservation programs.
- Change to more efficient computerized irrigation.

Since 1975, Water Factory 21 has provided recycled water that meets all primary and secondary drinking water standards set by the California Department of Health Services. OCWD has proposed a larger, more efficient membrane purification project called the Groundwater Replenishment System (GWRS), which is scheduled to begin operating at 70,000 acre-feet per year in 2007. By 2020 the system will annually supply 121,000 acre-feet of high quality water for recharge, for injection into the seawater intrusion barrier, and for direct industrial uses.

This facility will use a lower cost microfiltration and reverse osmosis treatment process that produces water of near distilled quality, which will help reverse the trend of rising total dissolved solids (TDS) in groundwater caused by the recharge of higher TDS-content Santa Ana River and Colorado River waters. The facility will use about half the energy required to import an equivalent amount of water to Orange County from Northern California. The GWRS will be funded, in part, by a $30 million grant under Proposition 13 of 2000.

Source: Orange County Water District

Box H Managing Groundwater using both Physical and Institutional Solutions

Four agencies share responsibility for groundwater management in Ventura County. Coordination and cooperation between these agencies focus on regular meetings, attendance at each other's board meetings, joint projects, watershed committees, and ongoing personal contacts to discuss water-related issues. The agencies and their areas of responsibility are:

- United Water Conservation District – physical solutions, monitoring, modeling, reporting, administering management plans and adjudication;
- Fox Canyon Groundwater Management Agency – pumping allocations, credits and penalties, abandoned well destruction, data for irrigation efficiency;
- County of Ventura – well permits, well construction regulations, tracking abandoned wells; and
- Calleguas Municipal Water District – groundwater storage of imported water.

In Ventura County 75% to 80% of the extracted groundwater is for agriculture; the remainder is for municipal and industrial use. Seawater intrusion into the aquifers was recognized in the 1940s and was the driving force behind a number of groundwater management projects and policies in the county's groundwater basins. As groundwater issues became more complicated at the end of the 20th century, these groundwater management projects and policies were useful in solving a number of problems.

Physical Solutions

Physical solutions substitute supplemental surface water for groundwater pumping near coastal areas, increase basin recharge, and increase the reliability of imported water. Projects include:

- Winter flood-flow storage for dry season release
- Wells and pipelines to move pumping for drinking water away from the coast
- Diversion structures to supply surface water to spreading grounds and irrigation
- Pipelines to convey surface water to coastal areas
- Las Posas Basin Aquifer Storage and Recovery project

Institutional Solutions

Institutional solutions focus on developing and implementing effective groundwater management programs, reducing pumping demands, tracking groundwater levels and water quality, managing groundwater pumping patterns, and destroying abandoned wells to prevent cross-contamination of aquifers. Solutions include:

- Creation of Fox Canyon Groundwater Management Agency (GMA), which represents each major pumping constituency
- Use of irrigation efficiency (agriculture), water conservation, and alternative sources of water (urban) to reduce pumping by 25%
- Manage outside the GMA area through an AB 3030 plan and a court adjudication
- Limit new permits for wells in specific aquifers to avoid seawater intrusion
- Creation of a program to destroy abandoned wells
- Creation of a database of historical groundwater levels and quality information collected since the 1920s
- Development of a regional groundwater flow model and a regional master plan for groundwater projects
- Creation of an irrigation weather station to assist in irrigation efficiency

Implementation of these physical and institutional management tools has resulted in the reversal of seawater intrusion in key coastal monitoring wells. These same tools are being used to mitigate saline intrusion (not seawater) in two inland basins and to reduce seasonal nitrate problems in the recharge area. Work is being expanded to help reduce loading of agricultural pesticides and nutrients. Without close coordination and cooperation of the county's water related agencies, municipalities, and landowners, it would have been very difficult to implement most of these solutions. Although such coordination takes time, the investment has paid off in solutions that help provide a sustainable water supply for all water users in Ventura County.

Source: United Water Conservation District

necessarily improved groundwater management. The primary intent of most ordinances is to ensure that proponents of projects are held accountable for potential impacts of the proposed export projects. As studies lead to a better understanding of local water resources, development of pilot export and transfer projects, with appropriate monitoring, may lead to greater certainty in managing groundwater resources. Areas managed under adjudications and ordinances will continue to develop more active management approaches. Population growth and its accompanying increased demand on the resources is a certainty. Most geographic areas in California are not immune to this growth, so strategies for more than just maintaining existing groundwater supply through extraction or export restrictions need to be implemented.

Box I Impediments to Conjunctive Management Programs in California

In 1998 the National Water Research Institute, in cooperation with the Association of Ground Water Agencies and the Metropolitan Water District of Southern California, conducted a workshop to determine the biggest impediments to implementing a cost-effective conjunctive water management program in California.

Since that time, some steps have been taken to overcome those impediments, but several important barriers remain. Workshop participants identified the 10 most significant obstacles:

1) Inability of local and regional water management governance entities to build trust, resolve differences (internally and externally), and share control.
2) Inability to match benefits and funding burdens in ways that are acceptable to all parties, including third parties.
3) Lack of sufficient federal, State, and regional financial incentives to encourage groundwater conjunctive use to meet statewide water needs.
4) Legal constraints that impede conjunctive use, regarding storage rights, basin judgments, area of origin, water rights, and indemnification.
5) Lack of statewide leadership in the planning and development of conjunctive use programs as part of comprehensive water resources plans, which recognize local, regional, and other stakeholders' interests.
6) Inability to address quality difference in "put" versus "take"; standards for injection, export, and reclaimed water; and unforeseeable future groundwater degradation.
7) Risk that water stored cannot be extracted when needed because of infrastructure, water quality or water level, politics, and institutional or contractual provisions.
8) Lack of assurances to prevent third-party impacts and assurances to increase willingness of local citizens to participate.
9) Lack of creativity in developing lasting "win-win" conjunctive use projects, agreements, and programs.
10) Supplemental suppliers and basin managers have different roles and expectations in relation to conjunctive use.

[**Editor's note**: The California Department of Water Resources' Conjunctive Water Management program has taken significant steps to overcome several of these impediments, using a combination of California Bay-Delta Authority, DWR, Proposition 13, and AB 303 funds to promote locally planned and controlled conjunctive use programs.]

Future Groundwater Management in California

Trying to predict what will happen with groundwater management in California is difficult given that actions by all of the involved groups—landowners, local governments, local, State, and federal agencies, and the courts—will continue to shape groundwater management in the future. However, the increasing population and its demands on California's water supply will accelerate the rate at which groundwater management issues become critical and require resolution. Some general conclusions are:

- Groundwater management will continue to be a local responsibility with increasing emphasis on how actions in one part of a basin impact groundwater resources throughout the basin. Regional cooperation and coordination of groundwater management activities will increase.

- As the State's population continues to grow, the increased reliance on groundwater will keep the topic of groundwater management at the forefront of legislative interest.

- Coordinated management of groundwater and surface water resources, through further development of conjunctive water management programs and projects, will become increasingly important.

- The increased reliance on groundwater in the future will necessitate a more direct link between land use planning, watershed management, floodplain management, and groundwater management plans.

- Current trends indicate that financial incentives in the form of loans and grants are increasing groundwater management planning and implementation at the local level. These successes will only continue at the current pace with increased funding to local agencies.

- Management of groundwater will increasingly include consideration of groundwater quality and groundwater quantity.

- Groundwater will be an important element in the trend toward an integrated water management approach that considers the full range of demand management and supply alternatives.

- Understanding of the relationship of groundwater and surface water and the role of groundwater in the environment will continue to grow.

Box J Managing Groundwater Quantity and Quality

When people hear the words "groundwater monitoring"' they may think either of measuring groundwater levels or of analyzing for groundwater quality. In reality, monitoring and management of groundwater quantity and groundwater quality are inseparable components of a management plan.

Although the primary focus of the California Department of Water Resources (DWR) is on groundwater quantity and the measures taken by local agencies to manage supply, management must also consider groundwater quality. Natural or anthropogenic contamination and pumping patterns that are not managed to protect groundwater quality may limit the quantity of groundwater that is available for use in a basin.

Several State programs provide useful data as well as regulatory direction on groundwater quality that managers can use in managing their groundwater supply. One program is the Drinking Water Source Assessment and Protection Program prepared by the California Department of Health Services in response to 1996 amendments to the federal Safe Drinking Water Act. The DWSAP requires water purveyors to assess sources of drinking water, develop zones indicating time of travel of groundwater, and identify potentially contaminating activities around supply wells. The goal is to ensure that the quality of drinking water sources is maintained and protected. Other useful water quality data for groundwater managers is collected by the agencies within the California Environmental Protection Agency, including the State Water Resources Control Board, Department of Pesticide Regulation and the Department of Toxic Substances Control, which are discussed in more detail in Chapter 5. Each of these agencies has a specific statutory responsibility to collect groundwater quality information and protect water quality.

Protection of Recharge Areas

Groundwater recharge areas, and the human activities that can render them unusable, are an example of the need to coordinate land use activities to protect both groundwater quality and quantity. Protection of recharge areas, whether natural or man-made, is necessary if the quantity and quality of groundwater in the aquifer are to be maintained. Existing and potential recharge areas must be protected so that they remain functional, that is they continue to provide recharge to the aquifer and they are not contaminated with chemical or microbial constituents. Land-use practices should be implemented so that neither the quantity nor quality of groundwater is reduced. A lack of protection of recharge areas could decrease the availability of usable groundwater and require the substitution of a more expensive water supply.

Many potentially contaminating activities have routinely been practiced in recharge areas, leading to the presence of contaminants in groundwater. In many areas, groundwater obtained from aquifers now requires remediation. Recent studies in some areas show that recharge areas are contaminated, but down-gradient wells are not, indicating that it is only a matter of time before contaminants in wells reach concentrations that require treatment of the groundwater.

In addition to quality impacts, urban development, consisting of pavement and buildings on former agricultural land, lining of flood control channels, and other land use changes have reduced the capacity of recharge areas to replenish groundwater, effectively reducing the safe yield of some basins.

Box J Managing Groundwater Quantity and Quality (continued)

To ensure that recharge areas continue to replenish high quality groundwater, water managers and land use planners should work together to:

- Identify recharge areas so the public and local zoning agencies are aware of the areas that need protection from paving and from contamination;
- Include recharge areas in zoning categories that eliminate the possibility of contaminants entering the subsurface;
- Standardize guidelines for pre-treatment of the recharge water, including recycled water;
- Build monitoring wells to collect data on changes in groundwater quality that may be caused by recharge; and
- Consider the functions of recharge areas in land use and development decisions.

Chapter 3

Groundwater Management Planning and Implementation

Chapter 3
Groundwater Management Planning and Implementation

The 1990s were a very important decade in the history of groundwater management in California. In 1992, the State Legislature provided an opportunity for more formal groundwater management with the passage of AB 3030 (Water Code § 10750 et seq.). More than 200 agencies have adopted an AB 3030 groundwater management plan. Additionally, 24 of the 27 counties with ordinances related to groundwater management adopted those laws during the 1990s. Plans prepared under AB 3030 certainly brought unprecedented numbers of water agencies into the groundwater management arena, and counties are now heavily involved in groundwater management, primarily through ordinances. However, many plans prepared under AB 3030 have had little or no implementation, and many counties focus primarily on limiting exports rather than on a comprehensive management program. As a result, the California Budget Act of 1999 (Stats. 1999, ch. 50), which authorized this update to Bulletin 118, directed the California Department of Water Resources (DWR) to complete several tasks, including developing criteria for evaluating groundwater management plans and developing a model groundwater management ordinance. This chapter presents the results of these directives. The intent is to provide a framework that will assist local agencies in proactively planning and implementing effective groundwater management programs.

Criteria for Evaluating Groundwater Management Plans—Required and Recommended Components

In 2002, the Legislature passed SB 1938 (Stats 2002, ch 603), which amended Water Code section 10750 et seq to require that groundwater management plans adopted by local agencies include certain components to be eligible for public funds administered by DWR for construction of groundwater projects; the statute applies to funds authorized or appropriated after September 1, 2002. In addition to the required components, DWR worked with representatives from local water agencies to develop a list of additional recommended components that are common to effective groundwater management.

Both the "required" and the "recommended" components are tools that local agencies can use either to institute a groundwater management plan for the first time or to update existing groundwater management plans. These components are discussed below and listed in Appendix C, which can be used as a checklist by local agencies to assess whether their groundwater management plans are addressing these issues.

Required Components of Local Groundwater Management Plans

As of January 1, 2003, amendments to Water Code Section 10750 et seq., resulting from the passage of SB 1938, require new groundwater management plans prepared under section 10750, commonly referred to as AB 3030 plans, to include the first component listed below.

Groundwater management plans prepared under any statutory authority must include components 2 through 7 to be eligible for the award of public funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These requirements apply to funds authorized or appropriated after September 1, 2002. Funds appropriated under Water Code section 10795 et seq. (AB 303 – Local Groundwater Assistance Fund) are specifically excluded.

1) Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan" (Water Code, § 10753.4 (b)).

2) Basin management objectives (BMOs) for the groundwater basin that is subject to the plan (Water Code, § 10753.7 (a)(1)).
3) Components relating to the monitoring and management of groundwater levels, groundwater quality, 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 (Water Code, § 10753.7 (a)(1)).
4) A plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin" (Water Code, § 10753.7 (a)(2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area" (Water Code, § 10752 (g)).
5) Adoption of monitoring protocols (Water Code, § 10753.7 (a)(4)) for the components in Water Code section 10753.7 (a)(1). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting BMOs.
6) A map showing the area of the groundwater basin as defined by DWR Bulletin 118 with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code, § 10753.7 (a)(3)).
7) For local agencies not overlying groundwater basins, plans shall be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code, § 10753.7 (a)(5)).

Recommended Components of Groundwater Management Plans

Although the seven components listed above are required only under certain conditions, they should always be considered for inclusion in any groundwater management planning process. In addition to the required components of a groundwater management plan resulting from the passage of SB 1938, it is recommended that the components listed below be included in any groundwater management plan adopted and implemented by a local managing entity. These additional components were developed in accord with the Budget Act of 1999 and with the assistance of stakeholder groups. The components should be considered and developed for specific application within the basin, subbasin, or agency service area covered by the plan. Additional components will likely be needed in specific areas. The level of detail for each component will vary from agency to agency. None of the suggested data reporting in the components should be construed to require disclosure of information that is confidential under State law. Local agencies should consider both the benefits of public dissemination of information and water supply security in developing reporting requirements.

Manage with the Guidance of an Advisory Committee

The managing entity should establish an advisory committee of interested parties that will help guide the development and implementation of the plan. The committee can benefit management in several ways. First, the committee can bring a variety of perspectives to the management team. As the intent of local groundwater management is to maintain and expand local benefits from the availability of the resource, it makes sense that the intended beneficiaries are a part of the management process. Second, the committee is free to focus on the specifics of groundwater management without being distracted by the many operational activities that the managing entity (such as a water district) must complete. Third, some parties could be negatively impacted by certain groundwater management decisions, and these actions and potential adverse impacts should be a part of the decision-making process to help reduce future conflicts. Finally, the advisory committee helps the managing entity gain the confidence of the local constituency by providing the opportunity for interested parties to participate in the management process.

Many managing entities have already elected to use advisory committees for implementation of their groundwater management plans. The composition of these committees varies widely. Some groups consist entirely of stakeholders, others add local or State government representatives or academic members as impartial third parties, and some have included consultants as technical advisers. Some plans use multiple advisory committees to manage unique subareas. Some plans appoint advisory committees with different objectives, such as one that deals with technical issues and another that deals with policy issues. There is no formula for the composition of an advisory committee because it should ultimately be based on local management needs and should include representation of diverse local interests.

The Tulare Lake Bed Coordinated Management Plan provides an example of the benefit of an advisory committee. The plan includes nine groups of participants, making coordination and communication a complicated issue. To allow for greater communication, an executive committee was established consisting of one voting member from each public agency participating in the plan and one voting member representing a combined group of private landowner plan participants. The committee administers groundwater management activities and programs for the plan (TLBWSD 2002).

Describe the Area to Be Managed under the Plan

The plan should include a description of the physical setting and characteristics of the aquifer system underlying the plan area in the context of the overall basin. The summary should also include a description of historical data, including data related to groundwater levels, groundwater quality, subsidence, and groundwater-surface water interaction; known issues of concern with respect to the above data; and a general discussion of historical and projected water demands and supplies. All of these data are critical to effective groundwater management because they demonstrate the current understanding of the system to be managed and serve as a point of departure for monitoring activities as part of plan implementation.

Create a Link Between Management Objectives and Goals and Actions of the Plan

The major goal of any groundwater management plan is to maintain a reliable supply of groundwater for long-term beneficial uses of groundwater in the area covered by the plan. The plan should clearly describe how each of the adopted management objectives helps attain that goal. Further, the plan should clearly describe how current and planned actions by the managing entity help meet the adopted management objectives. The plan will have a greater chance of success by developing an understanding of the relationship between each action, management objectives, and the goal of the groundwater management plan.

For example, prevention of contamination of groundwater from the land surface is a management objective that clearly supports the goal of groundwater sustainability. Management actions that could help support this objective include (1) educating the public through outreach programs that explain how activities at the surface ultimately impact groundwater, (2) developing wellhead protection programs or re-evaluating existing programs, (3) working with the local responsible agency to ensure that permitted wells are constructed, abandoned, and destroyed according to State well standards, (4) investigating whether local conditions necessitate higher standards than those adopted by the local permitting agency for the construction, abandonment, or destruction of wells, and (5) working with businesses engaged in practices that might impact groundwater to reduce the risks of contamination.

The concept of having a management objective is certainly not new. While many existing plans do not clearly include management objectives nor specifically identify actions to achieve objectives, some plans indirectly include these components. As an example, Eastern Municipal Water District's (EMWD) Groundwater Management Plan states that its goal includes maximizing "the use of groundwater for all beneficial uses in such a way as to lower the cost of water supply and to improve the reliability of the total

water supply for all users." To achieve this goal, EMWD has listed several issues to be addressed. One is the prevention of long-term depletion of groundwater. This can be defined as a management objective even though it is not labeled as such. Where this management objective is currently unmet in the North San Jacinto watershed portion of the plan area, EMWD has identified specific actions to achieve that objective including the reduction of groundwater extraction coupled with pursuing the construction of a pipeline to act as an alternative source of surface water for the impacted area (EMWD 2002).

Describe the Plan Monitoring Program

The groundwater management plan should include a map indicating the locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence, stream gaging, and other applicable monitoring. The groundwater management plan should summarize the type of monitoring (for example, groundwater level, groundwater quality, subsidence, streamflow, precipitation, evaporation, tidal influence), type of measurements, and the frequency of monitoring for each location. Site specific monitoring information should be included in each groundwater management plan. The plan should include the well depth, screened interval(s) and aquifer zone(s) monitored and the type of well (public, irrigation, domestic, industrial, monitoring). These components will serve as a tool for the local managing entity to assess the adequacy of the existing monitoring network in tracking the progress of plan activities.

The groundwater management plan developed for the Scotts Valley Water District (SVWD) provides a detailed description of the monitoring program in Santa Cruz County (Todd Engineers 1994) Table 6 is SVWD's monitoring table, which serves as an example of the level of detail that is useful in a plan (Todd Engineers 2003a). Figure 9 shows the locations and types of monitoring points for each monitoring site. The monitoring table specifies in detail the data available and the planned monitoring. These serve as useful tools for SVWD to visualize the types and distribution of data available for their groundwater management activities. In addition to the minimum types of monitoring, SVWD summarizes other types of data that are relevant to their groundwater management effort.

Describe Integrated Water Management Planning Efforts

Water law in California treats groundwater and surface water as two separate resources with the result that they have largely been managed separately. Such management does not represent hydrologic reality. Recently, managers of a number of resources are becoming increasingly aware of how their planning activities could impact or be impacted by the groundwater system. Because of this, the local managing entity should describe any current or planned actions to coordinate with other land use, zoning, or water management planning entities.

Integrated management is addressed in existing groundwater management plans in several ways, including conjunctively managing groundwater with surface water supplies, recharging water from municipal sewage treatment plants, and working with local planning agencies to provide comments when a project is proposed that could impact the groundwater system.

Examples of planning efforts that should be integrated with groundwater management may include watershed management, protection of recharge areas, agricultural water management, urban water management, flood management, drinking water source assessment and protection, public water system emergency and disaster response, general plans, urban development, agricultural land preservation, and environmental habitat protection or restoration. Another example that may appear insignificant is transportation infrastructure. However, local impacts on smaller aquifers could be significant when landscaping of medians and interchanges requires groundwater pumping for irrigation or when paved areas are constructed over highly permeable sediments that act as recharge zones for the underlying aquifer.

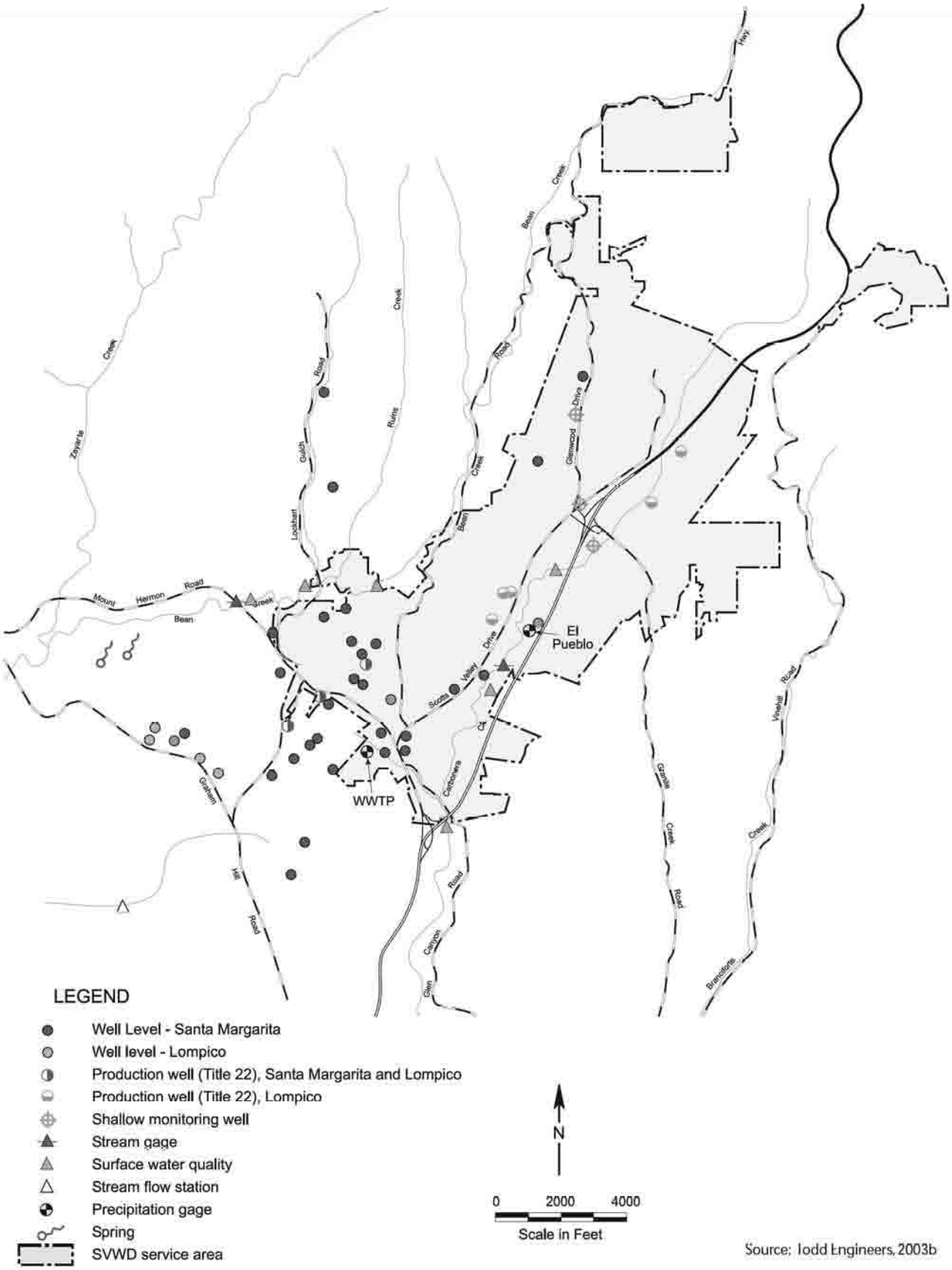
Table 6 Scotts Valley Water District's Groundwater Monitoring Plan

Monitoring type	Location	Measurement type	Date started	Frequency/ maintainer	Notes
Precipitation	El Pueblo Yard	15-minute recording	Feb-85	Daily/District, Monthly/City	Other historic gages:(1) Blair site on Granite Ck. Rd. (Jan. 1975 - Dec. 1980) (2) Hacienda Dr. (Jul. 1974 - Mar. 1979) (3) El Pueblo Yard bucket gage (Jan. 1981 - Jan. 1985)
	WWTP	5-minute recording	1990	Daily/City	
Evaporation	El Pueblo Yard	Pan	Jan-86	Daily/District	Evaporation pan raw data not compiled after July 1990
Evapotranspiration	De Laveaga Park, Santa Cruz	Automated active weather station	Sep-90	California Irrigation Management Information System/Monthly	Data available on-line through CIMIS
Streamflow	Carbonera Ck at Scotts Valley @ Cabonera Way Bridge (#111613000)	15-minute recording	Jan-85	USGS/ Daily	Other historic gages: (1) Carbonera Ck @ Santa Cruz (#11161400) 150 feet upstream from mouth (1974-1976 partial data)
	Bean Ck near Scotts Valley @ Hermon Crossing (#11160430)	15-minute recording	Dec-88	USGS/ Daily	(2) Bean Ck near Felton (#11160320) (1973-1978 partial data), low flows at same location (1983-1988)
	Eagle Creek In Henry Cowell Redwoods State Park	Bucket-Fall, Flow Meter-Spring	Mar-01	Semi-annually/ Todd Engineers	(3) Carbonera Creek @ Glen Canyon (1990-1994?)
Well Inventory	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14, 23-26, 36	Over 400 wells: location, log, type, capacity, etc. stored in GIS, and Access database	1950s	Logs from DWR maintained by Todd Engineers	
Groundwater Levels	~34 Santa Magarita aquifer and ~14 Lompico formation wells	Depth to water	1968	Quarterly/ District and cooperators	Data from over 75 wells, as early as 1968, bi-monthly 1983-1989
Pumpage	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14, 23-26, 36 District wells in production and on standby	Metered	1975	Monthly/ Scotts Valley Water District, Mt. Hermon Association, Hanson Aggregates West, San Lorenzo Valley Water District	Other historic pumpage data: Manana Woods (1988-1996 partial data)

Table 6 Scotts Valley Water District's Groundwater Monitoring Plan (continued)

Monitoring type	Location	Measurement type	Date started	Frequency/ maintainer	Notes
Groundwater Quality	T10S/R01E Sections 6-9, 16-20, 30 and T10S/R02E Sections 1,11-14,23-26, 36 District wells in production	Title 22 constituents	1963	At least semi-annual/ District and others	Data from over 80 wells, as early as 1963, monitoring frequency similar to groundwater level program
	North Scotts Valley 3 shallow monitoring wells	Metals, nitrogen species, general minerals	Mar-01	Semi-annually/ Todd Engineers	
Surface Water Quality	4 sites on Carbonera and 3 sites on Bean Creek	Grab samples - metals, nitrogen species, general minerals	Mar-01	Semi-annually/ Todd Engineers	
Wastewater Outflows	City of Scotts Valley WWTP @ Lundy Lane	Wastewater outflow volume and effluent quality	1965	Daily/City of Scotts Valley	Plant operational in 1965 (septic systems pre-1965)
Recycled Water Production	Scotts Valley WWTP	Recycled water quantity and quality	2002	At least quarterly/ WWTP	

Source: Todd Engineering 2003a



Source: Todd Engineers, 2003b

Figure 9 Scotts Valley Water District's Groundwater Management Plan monitoring locations

Box K What are Management Objectives?

Management objectives are the local managing entity's way of identifying the most important issues in meeting local resource needs; they can be seen as establishing a "value system" for the plan area. There is no fixed set of management objectives for any given plan area. Some of the more commonly recognized management objectives include the monitoring and managing of groundwater levels, groundwater quality, inelastic land subsidence, and changes in streamflow and surface water quality where they impact or are impacted by groundwater pumping. Management objectives may range from being entirely qualitative to strictly quantified.

Each management objective would have a locally determined threshold value associated with it, which can vary greatly. For example, in establishing a management objective for groundwater quality, one area may simply choose to establish an average value of total dissolved solids as the indicator of whether a management objective is met, while another agency may choose to have no constituents exceeding the maximum contaminant level for public drinking water standards. While there is great latitude in establishing management objectives, local managers should remember that the objectives should serve to support the goal of a sustainable supply for the beneficial use of the water in their particular area.

An example of an alternative management objective is Orange County Water District's (OCWD) objective of maintaining available storage space in its management area at 200,000 acre-feet. The objective does not require that groundwater elevations be fixed at any particular location, although managing to this objective would likely have the net benefit of stabilizing water levels. Groundwater storage is a dynamic value, so attempting to meet this management objective is an ongoing challenge. OCWD has implemented many management actions directly aimed at managing the basin to meet this objective.

The Deer Creek and Tule River Authority provides an excellent example of how groundwater management activities can be coordinated with other resources. The authority, in conjunction with the U.S. Bureau of Reclamation, has constructed more than 200 acres of recharge basins as part of its Deer Creek Recharge-Wildlife Enhancement Project. When available, the project takes surplus water during winter months and delivers it to the basins, which serve as winter habitat for migrating waterfowl, creating a significant environmental benefit. Most of the water also recharges into the underlying aquifer, thereby benefiting the local groundwater system.

Report on Implementation of the Plan

The managing entity should produce periodic reports—annually or at other frequencies determined by the local managing entity—summarizing groundwater basin conditions and groundwater management activities. For the period since the previous update, the reports should include:

- A summary of monitoring results, including historical trends,
- A summary of actual management actions,
- A summary, supported by monitoring results, of whether management actions are achieving progress in meeting management objectives,
- A summary of proposed management actions, and
- A summary of any plan component changes, including addition or modification of management objectives.

Unfortunately, many plans were prepared in the mid-1990s with little or no follow-up documentation of whether the plan is actually being implemented. This makes it difficult to determine what progress has been achieved in managing the groundwater resource. Periodic reports will serve as a tool for the managing entity to organize its many activities to implement the plan, act as a driving force for plan implementation, and help interested parties understand the progress made by local entities in managing their groundwater resource.

Progress reports on SVWD (Todd Engineers 2002) and EMWD (2002) groundwater management plans serve as excellent examples of the value of such an exercise. Both reports effectively portray the results of management actions: progress toward achieving objectives and specific recommendations for future management actions. An example of reporting on the modification of a management objective for water quality can be found in EMWD's 2000 Annual Report (EMWD 2001). A task force of more than 20 water suppliers and wastewater agencies, including EMWD, worked to update the Regional Water Quality Control Board's Region 5 Basin Plan objectives for nitrogen and total dissolved solids in water, effectively changing EMWD's management objectives for those constituents.

Evaluate the Plan Periodically

The managing entity and advisory committee should re-evaluate the entire plan. Periodic evaluation of the entire management plan is essential to define successes and failures under the plan and identify changes that may be needed. Additionally, re-evaluation of the plan should include assessment of changing conditions in the basin that may warrant modification of the plan or management objectives. Adjustment of components in the plan should occur on an ongoing basis if necessary. The re-evaluation of the plan should focus on determining whether the actions under the plan are meeting the management objectives and whether the management objectives are meeting the goal of sustaining the resource.

While there are several examples of existing groundwater management plans that demonstrate ongoing changes to plan activities, there are no known examples of such an approach to entirely re-evaluate an existing plan. This is likely due in part to the occurrence of several consecutive wet years in the mid- and late-1990s. The abundant surface water supplies reduced the need to actively manage groundwater supplies in many cases. More recent dry conditions and the recent passage of SB 1938 will create an excellent opportunity for managing entities to begin a re-evaluation of existing plans.

Model Groundwater Management Ordinance

As discussed in the previous chapter, ordinances are groundwater management mechanisms enacted by local governments through exercise of their police powers to protect the health and safety of their citizens. In Baldwin v. Tehama County (1994), the appellate court declared that State law does not preempt the field of groundwater management.

In the mid- to late-1990s, many counties adopted ordinances that effectively prevented export of groundwater from the county, even though none specifically prohibited export. The intent of each of these ordinances is to sustain groundwater as a viable local resource. To ensure that goal, an export project proponent is required by most of the ordinances to show that the proposed project will not cause depletion of the groundwater, degradation of groundwater quality, or subsidence before a permit to export groundwater can be issued. Although these ordinances do not specifically require threshold limits for each of these potential negative impacts, a project proponent can really only show that these negative effects will not occur if the proponent develops a groundwater management plan.

Many of these ordinances were developed in response to the plans of some agencies or landowners to export groundwater or develop a groundwater substitution project where surface water is exported and groundwater is substituted for local use. In some cases, short-term export actually took place, leading to a number of claims of negative third party impacts. Residents of some counties became concerned because no one knew how much groundwater was available for local use and how much groundwater was available for export. In short, details of the hydrology of the basin, including surface water and groundwater availability, water quality, and the interaction of surface water and groundwater were not known. This lack of detailed knowledge about the operating potential of their groundwater resources led counties to take what they viewed as protective action, which consisted of requiring a permit before anyone could export groundwater from the county.

From the perspective of DWR, groundwater should be managed in a manner that ensures long-term sustainability of the resource for beneficial uses. Those beneficial uses are to be decided by the local stakeholders within the basin. In some areas, there may be an ample supply of water, so groundwater exports or substitution projects are feasible while local beneficial uses of the water supply are maintained. In other areas, limiting exports may be necessary to maintain local beneficial uses. Such determinations can be made only after the data are collected and evaluated and the results are used to develop management objectives for the basin.

While developing both the criteria for evaluating groundwater management plans and the model groundwater management ordinance, DWR staff has borne two principles in mind. First, the goal of groundwater management, whether accomplished by a plan or by an ordinance, is to sustain and often expand a groundwater resource. Second, groundwater management, whether accomplished by a plan or by an ordinance, requires that local agencies address and resolve the same or similar issues within the boundaries of the agencies. To say it in different words, whether it is a plan or an ordinance, good groundwater management should address the same issues and problems and arrive at the same conclusions and solutions to satisfy the needs of the local area. While some areas may allow or promote exports, others may not.

As stated above, the Legislature required a model ordinance as one of the elements of this update of Bulletin 118. The model ordinance is included as Appendix D and can be used by local governments that have identified a need to adopt a groundwater management ordinance. The model is an example of what a local ordinance might include. Local conditions will require some additions, modifications, or deletions. The variety of political, institutional, legal, technical, and economic opportunities and constraints throughout California guarantees that there will be differences to which the model will have to be adapted. Local governments interested in adopting a groundwater management ordinance are encouraged to consider all components included in the model.

Water Code section 10753.7(b)(1)(A) allows an agency to participate in or consent to be subject to a groundwater management plan, a basin-wide management plan, or other integrated regional water management plan in order to meet the funding eligibility requirements that resulted from passage of SB 1938 (2001). A local government that adopts an ordinance should consider whether or not it will have local agencies that do not have their own groundwater management plan, but consent to be managed under the ordinance. If this situation is anticipated, the ordinance should include the required components described in the Water Code so State funding can be pursued.

Chapter 4

Recent Actions Related to Groundwater Management

Chapter 4
Recent Actions Related to Groundwater Management

The past few years have seen significant actions that impact groundwater management in California. Below are several examples of recent actions including legislation, ballot measures, and executive orders that show the State Legislature and the citizens of California clearly recognize the importance of groundwater and its appropriate management in meeting the present and future water supply needs of the State.

Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act of 2000 (Proposition 13)

On March 7, 2000, California voters approved a $1.97-billion general obligation bond known as the Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act (Proposition 13). Of the nearly $2 billion, $230 million was earmarked for groundwater programs. The act authorizes $200 million for grants for feasibility studies, project design, and construction of conjunctive use facilities (Water Code, § 79170 et seq.) and $30 million in loans for local agency acquisition and construction of groundwater recharge facilities and feasibility study grants for projects potentially eligible for the loan program (Water Code, § 79161 et seq.). More than $120 million have been awarded in grants and loans to local agencies in the first two years of implementation of these programs.

California Bay-Delta Record of Decision

The goal of the California Bay-Delta (formerly CALFED) program is to restore ecosystem health and improve water management in the Bay-Delta system. The program has four primary objectives:

- Provide good water quality for all beneficial uses
- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species
- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system
- Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees

The Record of Decision (ROD), released in August 2000, sets forth a 30-year plan to address ecosystem health and water supply reliability problems in the Bay-Delta system. The ROD lays out specific actions and investments over the first seven years to meet program goals. Most important, with respect to groundwater is the California Bay-Delta program's commitment to local groundwater management. The ROD states, "CALFED will work with local governments and affected stakeholders to develop legislation to strengthen AB 3030 and provide technical and financial incentives to encourage more effective basin-wide groundwater management plans…" (CALFED 2000). The ROD encourages basin management that is developed at the subbasin level so that it addresses local needs, but is coordinated at the basin-wide level so that it considers impacts to other users in the basin. The ROD also commits Bay-Delta agencies to "facilitate and fund locally supported, managed, and controlled groundwater and conjunctive use projects with a total of 500,000 acre-feet to 1 million acre-feet (maf) of additional storage capacity by 2007" (CALFED 2000).

Local Groundwater Management Assistance Act of 2000 (AB 303, Water Code Section 10795 et seq.)

The goal of the Local Groundwater Management Assistance Act is to help local agencies better understand how to manage groundwater resources effectively to ensure the safe production, quality, and proper storage of groundwater in the State. The act created the Local Groundwater Assistance Fund, which must be appropriated annually. In three years, more than $15 million in grants were awarded for 71 projects. Grants went to local agencies for groundwater studies and projects that contribute to basin and subbasin management objectives, including but not limited to groundwater monitoring and groundwater basin management. Grants are available to all geographic areas of the State. This act serves to emphasize that groundwater is recognized as an important local resource and, to the extent that groundwater is properly managed at the local level, serves to benefit all Californians.

Groundwater Quality Monitoring Act of 2001 (AB 599, Water Code Section 10780 et seq.)

Assembly Bill 599, known as the Groundwater Quality Monitoring Act of 2001, set a goal to establish comprehensive groundwater monitoring and increase the availability of information about groundwater quality to the public. The objective of the program is to highlight those basins in which contamination has occurred or is likely to occur and provide information that will allow local managers to develop programs to curtail, treat, or avoid additional contamination. The act required the State Water Resources Control Board (SWRCB), in coordination with an Interagency Task Force (ITF) and a Public Advisory Committee (PAC), to integrate existing monitoring programs and design new program elements, as necessary, to establish a comprehensive statewide groundwater quality monitoring program.

Through the ITF and PAC, the Comprehensive Groundwater Quality Monitoring Program was developed. The program will seek to:

- Accelerate the monitoring and assessment program already established by the SWRCB,
- Implement monitoring and assessment in accordance with a prioritization of basins/subbasins,
- Increase coordination and data sharing among groundwater agencies, and
- Maintain groundwater data in a single repository to provide useful access by the public while maintaining appropriate security measures.

The Comprehensive Groundwater Quality Monitoring Program is expected to provide the following key benefits:

- A common base communications medium for agencies to utilize and supply groundwater quality data at multiple levels,
- A mechanism to unite local, regional and statewide groundwater programs in a common effort,
- Better understanding of local, regional and statewide water quality issues and concerns that in turn can provide agencies at all levels with better information to deal with the concerns of consumers and consumer advocate groups,
- Groundwater agencies with trend and long-term forecasting information, essential for groundwater management plan preparation and implementation, and
- The motivation for small- and medium-sized agencies to begin or improve their own groundwater monitoring and management programs.

Water Supply Planning

Three bills enacted by the Legislature to improve water supply planning processes at the local level became effective January 1, 2002. In general, the new laws are intended to improve the assessment of water supplies during the local planning process before land use projects that depend on water are approved. The new laws require the verification of sufficient water supplies as a condition for approving developments, and they compel urban water suppliers to provide more information on the reliability of groundwater if used as a supply.

SB 221 (Bus. and Prof. Code, § 11010 as amended; Gov. Code, § 65867.5 as amended; Gov. Code, §§ 66455.3 and 66473.7) prohibits approval of subdivisions consisting of more than 500 dwelling units unless there is verification of sufficient water supplies for the project from the applicable water supplier(s). This requirement also applies to increases of 10 percent or more of service connections for public water systems with less than 500 service connections. The law defines criteria for determining "sufficient water supply," such as using normal, single-dry, and multiple-dry year hydrology and identifying the amount of water that the supplier can reasonably rely on to meet existing and future planned uses. Rights to extract additional groundwater must be substantiated if used for the project.

SB 610 (Water Code, §§ 10631, 10656, 10910, 10911, 10912, and 10915 as amended; Pub. Resources Code, § 21151.9 as amended) and AB 901 (Water Code, §§ 10610.2 and 10631 as amended; Water Code § 10634) make changes to the Urban Water Management Planning Act to require additional information in Urban Water Management Plans (UWMP) if groundwater is identified as a source available to the supplier. Required information includes a copy of any groundwater management plan adopted by the supplier, proof that the developer or agency has rights to the groundwater, a copy of the adjudication order or decree for adjudicated basins, and if not adjudicated, whether the basin has been identified as being overdrafted or projected to be overdrafted in the most current DWR publication on the basin. If the basin is in overdraft, the UWMP must include current efforts to eliminate any long-term overdraft. A key provision in SB 610 requires that any project subject to the California Environmental Quality Act supplied with water from a public water system be provided a water supply assessment, except as specified in the law. AB 901 requires the plan to include information relating to the quality of existing sources of water available to an urban water supplier over given periods and include the manner in which water quality affects water management strategies and supply reliability.

Emergency Assistance to the Klamath Basin

On May 4, 2001, the Governor proclaimed a State of Emergency in the Klamath Basin in Siskiyou and Modoc counties. The proclamation included disaster assistance of up to $5 million under authority of the State Natural Disaster Assistance Act. This assistance went directly into constructing wells to extract groundwater for use on cover crops to avoid loss of critical topsoil. The Governor's proclamation also included $1 million for a study of the Klamath River Basin to determine the long-term water supply in the California portion of the basin.

Governor's Drought Panel

The Governor's Advisory Drought Planning Panel was formed in 2000 to develop a contingency plan to address the impacts of critical water shortages in California. The panel formed with the recognition that critical water shortages may severely impact the health, welfare, and economy of California. Panel recommendations included securing funding for the Local Groundwater Management Assistance Act (described above), continued support of critical groundwater monitoring in basins with inadequate data, and the formation of a technical assistance and education program for "rural homeowners and small domestic water systems relying on self-supplied groundwater" (GADPP 2000).

Sacramento Valley Water Management Agreement

On May 22, 1995, SWRCB adopted the "Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary" (the 1995 WQCP). Following this action, SWRCB initiated a water rights hearing process with the intent of allocating responsibility for meeting the standards of the 1995 WQCP among water right holders in areas tributary to the Delta. The water rights hearing was conducted in phases with all phases being resolved with the exception of Phase 8, which involved water rights holders in the Sacramento Valley.

Proceeding with Phase 8 may have involved litigation and judicial review for years. That extended process could have resulted in adverse impacts to the environment and undermined progress on other statewide water management initiatives. To avoid the consequences of delay, the Sacramento Valley Water Users, DWR, the U.S. Bureau of Reclamation (USBR), and export water users developed the Sacramento Valley Water Management Agreement. The agreement became effective April 20, 2001. At that time SWRCB issued an order staying the Phase 8 hearing for 18 months. The parties negotiated a short-term settlement agreement that obligated DWR and USBR to continue to fully meet the Bay-Delta water quality standards while providing for the development of conjunctive use and system improvement projects by participating upstream water rights holders that would make water available to help meet water quality standards while improving the reliability of local water supplies. SWRCB has subsequently dismissed the Phase 8 proceedings, and work is being undertaken on both short-term and long-term activities included in the Sacramento Valley Water Management Agreement.

Groundwater Management Water Code Amendments

In September 2002, SB 1938 (Water Code, § 10753.4 and § 10795.4 as amended; Water Code, § 10753.7, § 10753.8 and § 10753.9 as amended and renumbered; Water Code, § 10753.1 and § 10753.7 as added) was signed into law. The act amends existing law related to groundwater management by local agencies. The law requires any public agency seeking State funds administered through DWR for the construction of groundwater projects or groundwater quality projects to prepare and implement a groundwater management plan with certain specified components. Prior to this, there were no required plan components. New requirements include establishing basin management objectives, preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management. The requirements apply to agencies that have already adopted groundwater management plans as well as agencies that do not overlie groundwater basins identified in Bulletin 118 and its updates when these agencies apply for state funds. The requirements do not apply to funds administered through the AB 303-Local Groundwater Management Assistance Act (Water Code, § 10795 et seq.) or to funds authorized or appropriated prior to September 1, 2002. Further discussion of the requirements is included in Chapter 3 and Appendix C.

Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50)

California voters approved the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50; Water Code, § 79500 et seq.) in the November 2002 elections. The initiative provides for more than $3.4 billion of funding, subject to appropriation by the Legislature, for a number of land protection and water management activities.

Several chapters of Proposition 50 allocate funds for specified water supply and water quality projects, including:

- Chapter 3 Water Security. Provides $50 million to protect State, local, and regional drinking water systems from terrorist attack or deliberate acts of destruction or degradation.

- Chapter 4 Safe Drinking Water. Provides $435 million for grants and loans for infrastructure improvements to meet safe drinking water standards.
- Chapter 5 Clean Water and Water Quality. Provides $390 million for a number of water quality and environmental improvements.
- Chapter 6 Contaminant and Salt Removal Technologies. Provides $100 million for desalination of ocean or brackish waters as well as treatment and removal of contaminants.
- Chapter 7 California Bay-Delta program. Provides $825 million for continuing implementation of all elements of the program.
- Chapter 8 Integrated Regional Water Management. Provides $500 million for many categories of water management projects that will protect communities from drought, protect and improve water quality, and reduce dependence on imported water supplies.
- Chapter 9 Colorado River. Provides $70 million for canal-lining projects necessary to reduce water use and to meet commitments related to California's allocation of water from the Colorado River.

Chapter 5

The Roles of State and Federal Agencies in California Groundwater Management

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Even though groundwater management is a local responsibility and mostly voluntary, several State and federal agencies have key roles in California groundwater management. Some of these roles may not be immediately recognized, but because they work toward the goal of maintaining a reliable groundwater supply, they are closely related to groundwater management. Some of the programs available through the California Department of Water Resources (DWR) and other agencies that assist local agencies in managing groundwater resources are described below.

Local Groundwater Management Assistance from DWR

DWR's role in groundwater management begins with the fundamental understanding that groundwater management is locally driven and management programs should respond to local needs and concerns. DWR recognizes that when groundwater is effectively managed at the local level, benefits are realized at a statewide level.

DWR has historically maintained many programs that directly benefit local groundwater management efforts including:

- Providing assistance to local agencies to assess basin hydrogeologic characteristics,
- Assisting local agencies to identify opportunities to develop additional groundwater supply,
- Monitoring groundwater levels and quality,
- Providing watermaster services for court-adjudicated basins,
- Providing standards for well construction and destruction,
- Managing the State's extensive collection of well completion reports, and
- Reviewing proposals and distributing grant funds and low-interest loans for conjunctive use projects, as well as local groundwater management and monitoring programs.

Conjunctive Water Management Program

DWR's Conjunctive Water Management Program consists of a number of integrated efforts to assist local agencies in improving groundwater management and increasing water supply reliability.

One goal of the Integrated Storage Investigations (ISI) Program, an element of the Bay-Delta program, is to increase water supply reliability statewide through the planned, coordinated management and use of groundwater and surface water resources. The effort emphasizes forming working partnerships with local agencies and stakeholders to share technical data and costs for planning and developing locally controlled and managed conjunctive water management projects.

Toward that end, the Conjunctive Water Management Program has:

- Developed a vision in which DWR would assist local agencies throughout the State so that these agencies can effectively manage groundwater resources,
- Adopted a set of working principles to ensure local planning; local control, operation, and management of conjunctive use projects; voluntary implementation of projects; and local benefits from the proposed projects,
- Executed memoranda of understanding with 30 local agency partners and provided technical and financial assistance to study groundwater basins and assess opportunities for conjunctive water management,

- Provided technical assistance in the form of groundwater monitoring, groundwater modeling, and local water management planning, as well as a review of numerous regional and statewide planning efforts on a variety of water issues, and
- Provided facilitation assistance to promote broad stakeholder involvement in regional water management planning processes.

DWR staff review proposals and distribute grants pursuant to the Local Groundwater Management Assistance Act of 2000 (AB 303). To date, DWR has awarded more than $15 million to local agencies to fund 71 projects dealing with groundwater investigation, monitoring, or management.

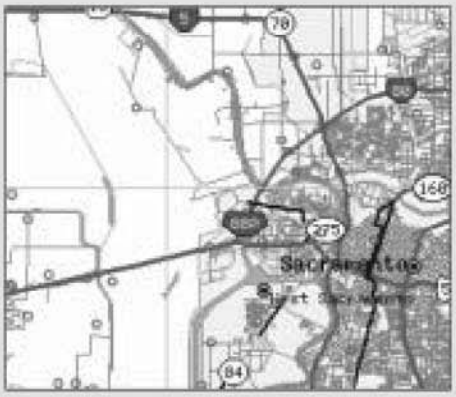
With funds provided under Proposition 13, DWR has awarded more than $170 million in loans and grants for groundwater recharge and storage studies and projects to local agencies throughout the State. Applicant estimates of the water supply reliability increases that will be realized from these projects exceeds 150 thousand acre-feet annually. Recipients of loans and grants must provide progress reports to allow an evaluation of the successes of the various programs. Figure 10 shows the distribution of loan and grant awardees throughout the State.

Both grant programs have active outreach efforts to inform and to assist agencies in preparation of applications. Selection of projects for funding relies in part on input from advisory committees composed of stakeholders from throughout the State.

Box L Providing Data:

The Internet Makes Groundwater Elevation Data Readily Accessible to the Public

In 1996, the California Department of Water Resources (DWR) began providing Internet access to groundwater level data and hydrographs for wells in groundwater basins throughout California. The website, which distributes historical data for more than 35,000 wells monitored by DWR and its many cooperators, has proven very popular, with more than 60,000 visits to date. Options include a form or map interface to locate wells with water level data and the ability to download long-term water levels for specific wells or seasonal measurements for specific areas to create groundwater contour maps. The accessibility of this data makes it a significant resource for local agencies in making sound groundwater management decisions. The address of the site is http://wdl.water.ca.gov/.



Wells can be located with a map interface. By clicking on a well, a hydrograph with the latest data available is automatically generated.

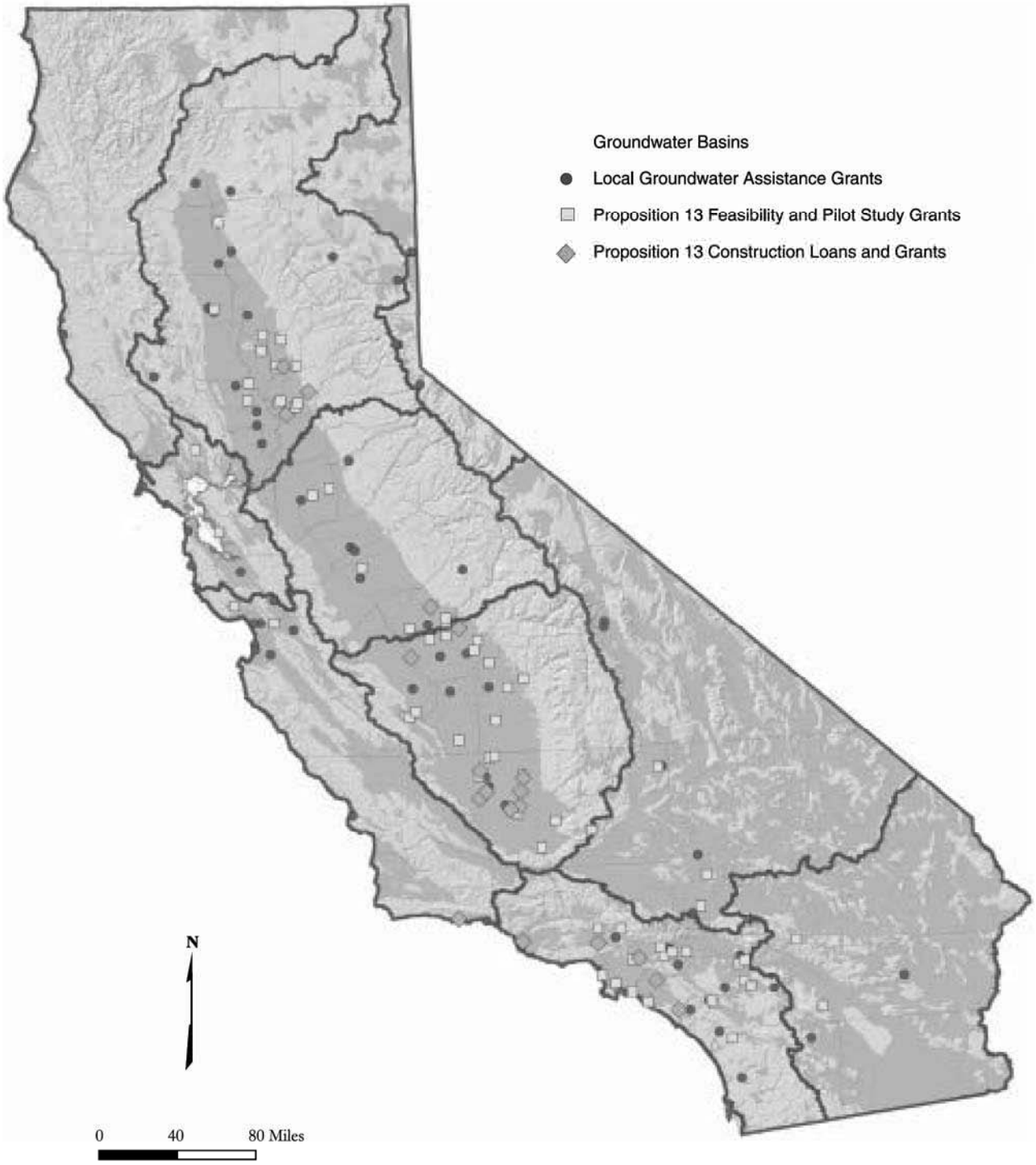


Figure 10 Broad distribution of grant and loan awardees for 2001 through 2003

Assistance from Other State and Federal Agencies

Many other State and federal agencies provide groundwater management assistance to local agencies. Some of those roles are described below. For more information on the roles of various agencies in protecting the groundwater resource, see the California Department of Health Services' Drinking Water Source Assessment and Protection Program Document (DHS 2000), California Groundwater Management (Bachman and others 1997), or the individual agency websites.

State Water Resources Control Board and Regional Water Quality Control Boards

http://www.swrcb.ca.gov The mission of the State Water Resources Control Board (SWRCB) is to ensure the highest reasonable quality of waters of the State, while allocating those waters to achieve the optimum balance of beneficial uses. In turn, the nine Regional Water Quality Control Boards (RWQCB) develop and enforce water quality objectives and implement plans to protect the beneficial uses of the State's waters, recognizing differences in climate, topography, geology, and hydrology.

SWRCB has many responsibilities regarding the protection of the groundwater resource. One of the more notable is the Groundwater Ambient Monitoring and Assessment (GAMA) Program. GAMA is a recently enacted program that will provide a comprehensive assessment of water quality in water wells throughout the state. GAMA has two main components: the California Aquifer Susceptibility (CAS) Assessment and the Voluntary Domestic Well Assessment Project.

The CAS combines age dating of water and sampling for low-level volatile organic compounds (VOCs), such as methyl tertiary-butyl ether (MTBE), to assess the relative susceptibility of all of approximately 16,000 public supply wells throughout the State. Age dating provides a general assessment of how quickly groundwater is moving through the system, while the sampling of low-level VOCs allows greater reaction time for potential remediation strategies before contaminants reach action levels. Sampling is being conducted by staff from the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory. The CAS Assessment was developed cooperatively with DHS and DWR.

The Voluntary Domestic Well Assessment Project will provide a previously unavailable sampling of water quality in domestic wells, which will assist in assessing the relative susceptibility of California's groundwater. Because water quality in individual domestic wells is unregulated, the program is voluntary and will focus, as resources permit, on specific areas of the state. Constituents to be analyzed include nitrate, total and fecal coliform bacteria, MTBE, and minerals. Additional constituents will be added in areas with known water quality problems.

Other SWRCB/RWQCB activities related to groundwater protection include developing basin plans that identify existing and potential beneficial uses of marine water, groundwater, and surface waters; regulating the discharge of waste that may affect water quality in California; monitoring of landfills and hazardous waste facilities; establishing standards for the construction and monitoring of underground storage tanks; establishing management plans for control of nonpoint source pollutants; and issuing cleanup and abatement orders that require corrective actions by the responsible party for a surface water or groundwater pollution problem or nuisance.

The Groundwater Quality Monitoring Act of 2001 (AB599, Water Code, § 10780 et seq.) required the SWRCB to develop a comprehensive monitoring program in a report to the Legislature. See Chapter 4 for details.

California Department of Health Services

http://www.dhs.ca.gov/ps/ddwem The DHS Drinking Water Program, part of the Division of Drinking Water and Environmental Management, is responsible for DHS implementation of the federal Safe Drinking Water Act, as well as California statutes and regulations related to drinking water. As part of this responsibility, DHS inspects and provides regulatory oversight of approximately 8,500 public water systems (and approximately 16,000 drinking water wells) to assure delivery of safe drinking water to all California consumers.

Public water system operators are required to regularly monitor their drinking water sources for microbiological, chemical and radiological contaminants to show that drinking water supplies meet regulatory requirements (called primary maximum contaminant levels–MCLs). Among these contaminants are approximately 80 specific inorganic and organic chemical contaminants and six radiological contaminants that reflect the natural environment as well as human activities.

Public water system operators also monitor their water for a number of other contaminants and characteristics that deal with the aesthetic properties of drinking water (known as secondary MCLs). They are also required by regulation to analyze for certain unregulated contaminants (to allow DHS to collect information on emerging contaminants, for example), and to report findings of other contaminants that may be detected during routine monitoring. The DHS water quality monitoring database contains the results of analyses since 1984. These data, collected for purposes of regulatory compliance with drinking water laws, also provide an extensive body of information on the quality of groundwater throughout the State.

California Department of Pesticide Regulation

http://www.cdpr.ca.gov/dprprograms.htm The California Department of Pesticide Regulation (DPR) protects human health and the environment by regulating pesticide sales and use and by promoting reduced-risk pest management. DPR plays a significant role in monitoring for the presence of pesticides and in preventing further contamination of the groundwater resource.

DPR conducts six types of groundwater monitoring:

1) Monitoring for pesticides on a DPR-determined Ground Water Protection List, which lists pesticides with the potential to pollute groundwater;
2) Four-section survey monitoring to verify a reported detection and to help determine if a detected pesticide resulted from legal agricultural use;
3) Areal extent monitoring to identify the extent of contaminated wells;
4) Adjacent section monitoring to identify additional areas sensitive to pesticide movement to groundwater;
5) Monitoring to repeatedly sample a network of wells to determine whether pesticide residues are declining; and
6) Special project monitoring.

When pesticides are found in groundwater, they are normally regulated in one-square mile areas identified in regulation as sensitive to groundwater pollution. These pesticides are subject to permitting by the county agricultural commissioner and to use restrictions specified in regulation. DPR maintains an extensive database of pesticide sampling in groundwater and reports a summary of annual sampling and detections to the State Legislature.

California Department of Toxic Substances Control

http://www.dtsc.ca.gov The California Department of Toxic Substances Control (DTSC) has two programs related to groundwater resources protection: the Hazardous Waste Management Program and the Site Mitigation Program. These programs are authorized under Division 20 of the California Health and Safety Code, and implementing regulations are codified in Title 22 of the California Code of Regulations.

A critical element of both programs is maintaining environmental quality and economic vitality through the protection of groundwater resources. This is accomplished through hazardous waste facility permitting and design; oversight of hazardous waste handling, removal, and disposal; oversight of remediation of hazardous substances releases; funding of emergency removal actions involving hazardous substances, including the cleanup of illegal drug labs; cleanup of abandoned hazardous waste sites; oversight of the closure of military bases; and pollution prevention.

If groundwater is threatened or impacted by a hazardous substance release, DTSC provides technical oversight for the characterization and remediation of soil and groundwater contamination. DTSC and the nine RWQCBs coordinate regulatory oversight of groundwater remediation. To ensure site-specific groundwater quality objectives are met, DTSC consults with RWQCB staff and appropriate groundwater basin plans.

Box M Improving Coordination of Groundwater Information

California's groundwater resources are addressed by an array of different State and federal agencies. Each agency approaches groundwater from a unique perspective, based on its individual statutory mandate. As a result, each agency collects different types of groundwater data and information. To facilitate the effective and efficient exchange of groundwater resource information, the State Water Resources Control Board (SWRCB) is coordinating the Groundwater Resources Information Sharing Team (GRIST), which is composed of representatives from various groundwater agencies. Agencies currently participating in GRIST are:

- State Water Resources Control Board
- Department of Health Services
- Department of Water Resources
- Department of Pesticide Regulation
- Lawrence Livermore National Laboratory
- U.S. Geological Survey

One of the tasks of the GRIST is to identify data relevant to California groundwater resources. A listing of the data, along with the appropriate agency contacts and Internet links, will be maintained by SWRCB on the Groundwater Resources Information Database. In addition, to facilitate effective information sharing and communication among stakeholders, groundwater data will be made available on the SWRCB GeoTracker system. GeoTracker is a geographic information system that provides Internet access to environmental data. The centralization of environmental data through GeoTracker will enable more in-depth geospatial and statistical analyses of groundwater data in the future. For more information about GeoTracker, visit the GeoTracker Internet site at http://geotracker.arsenautlegg.com.

California Bay-Delta Authority

http://calwater.ca.gov The California Bay-Delta program was initiated in 1994 to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Sacramento-San Joaquin Bay-Delta System. The partnership currently consists of more than 20 State and federal agencies. An important element of the program is to increase storage by developing an additional 500,000 acre-feet to 1.0 million acre-feet of groundwater storage capacity by the year 2007 (CALFED 2000).

Effective January 1, 2003, a newly formed State agency assumed responsibility for overseeing implementation of the Bay-Delta program. The California Bay-Delta Authority provides a permanent governance structure for the collaborative state-federal effort. The authority was established by enactment of Senate Bill 1653 in 2002. The legislation calls for the authority to sunset on January 1, 2006, unless federal legislation has been enacted authorizing the participation of appropriate federal agencies in the authority.

U.S. Environmental Protection Agency

http://www.epa.gov/safewater The U.S. Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water, together with states, tribes, and many partners, protects public health by ensuring safe drinking water and protecting groundwater. The EPA's role in California groundwater is primarily related to protection of the resource and comes in the form of administering several federal programs in close coordination with State agencies such as SWRCB, DHS, and DTSC.

U.S. Geological Survey

http://ca.water.usgs.gov USGS has published results of many studies of California groundwater basins. USGS maintains an extensive groundwater level and groundwater quality monitoring network and has compiled this data in a database. The California District is working on cooperative programs with local, State, and other federal agencies. The most notable programs include three regional studies of the San Joaquin-Tulare Basin, the Sacramento River Basin, and the Santa Ana River basin under the National Water Quality Assessment Program. Results were published for the San Joaquin-Tulare Basin in 1995 and the Sacramento River Basin in 2000. The Santa Ana River basin study is in progress.

U.S. Bureau of Reclamation

http://www.usbr.gov The U.S. Bureau of Reclamation (USBR) operates the Central Valley Project (CVP), an extensive network of dams, canals, and related facilities that delivers about 7 maf during normal years for agricultural, urban, and wildlife use. USBR's role with respect to groundwater is generally limited to monitoring for impacts to the groundwater systems adjacent to its CVP facilities. Through the cooperative efforts of USBR, DWR, irrigation districts, farmers, and other local entities, groundwater level data have been collected continuously since project conception in the 1930s and 1940s.

In addition to CVP monitoring, USBR monitors groundwater levels to identify potential impacts as a result of two other projects in California. That monitoring includes the Santa Ynez basin as part of the Cachuma Project on the central coast, and the Putah Creek Cone as part of the Solano Project in the southwest Sacramento Valley. Both monitoring efforts are required as part of permitting for the projects.

USBR is planning to implement a groundwater information system to collect and distribute to the public the large volume of historical groundwater level data associated with its projects.

Chapter 6

Basic Groundwater Concepts

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Basic Groundwater Concepts

This chapter presents general concepts relating to the origin, occurrence, movement, quantity, and quality of groundwater. The concepts will be useful in providing the nontechnical reader with a basic understanding of groundwater. For more experienced readers, many topics are discussed specifically as they apply to California or as the terms are used in this report. A glossary of terms is included at the end of this report. For additional reading on basic groundwater concepts see *Basic Ground-Water Hydrology* (Heath 1983).

Origin of Groundwater

Groundwater is a component of the hydrologic cycle (Figure 11), which describes locations where water may occur and the processes by which it moves or is transformed to a different phase. In simple terms, water or one of its forms—water vapor and ice—can be found at the earth's surface, in the atmosphere, or beneath the earth's surface. The hydrologic cycle is a continuum, with no beginning or end; however, it is often thought of as beginning in the oceans. Water evaporates from a surface water source such as an ocean, lake, or through transpiration from plants. The water vapor may move over the land and condense to form clouds, allowing the water to return to the earth's surface as precipitation (rain or snow). Some of the snow will end up in polar ice caps or in glaciers. Most of the rain and snowmelt will either become overland flow in channels or will infiltrate into the subsurface. Some of the infiltrated water will be transpired by plants and returned to the atmosphere, while some will cling to particles surrounding the pore spaces in the subsurface, remaining in the vadose (unsaturated) zone. The rest of the infiltrated water will move gradually under the influence of gravity into the saturated zone of the subsurface, becoming groundwater. From here, groundwater will flow toward points of discharge such as rivers, lakes, or the ocean to begin the cycle anew. This flow from recharge areas to discharge areas describes the groundwater portion of the hydrologic cycle.

The importance of groundwater in the hydrologic cycle is illustrated by considering the distribution of the world's water supply. More than 97 percent of all earth's water occurs as saline water in the oceans (Fetter 1988). Of the world's fresh water, almost 75 percent is in polar ice caps and glaciers, which leaves a very small amount of fresh water readily available for use. Groundwater accounts for nearly all of the remaining fresh water (Alley and others 1999). All of the fresh water stored in the world's rivers and lakes accounts for less than 1 percent of the world's fresh water.

Occurrence of Groundwater

Groundwater is the water occurring beneath the earth's surface that completely fills (saturates) the void space of rocks or sediment. Given that all rock has some open space (voids), groundwater can be found underlying nearly any location in the State. Several key properties help determine whether the subsurface environment will provide a significant, usable groundwater resource. Most of California's groundwater occurs in material deposited by streams, called alluvium. Alluvium consists of coarse deposits, such as sand and gravel, and finer-grained deposits such as clay and silt. The coarse and fine materials are usually coalesced in thin lenses and beds in an alluvial environment. In this environment, coarse materials such as sand and gravel deposits usually provide the best source of water and are termed aquifers; whereas, the finer-grained clay and silt deposits are relatively poor sources of water and are referred to as aquitards. California's groundwater basins usually include one or a series of alluvial aquifers with intermingled aquitards. Less frequently, groundwater basins include aquifers composed of unconsolidated marine sediments that have been flushed by fresh water. We include the marine-deposited aquifers in the discussion of alluvial aquifers in this bulletin.

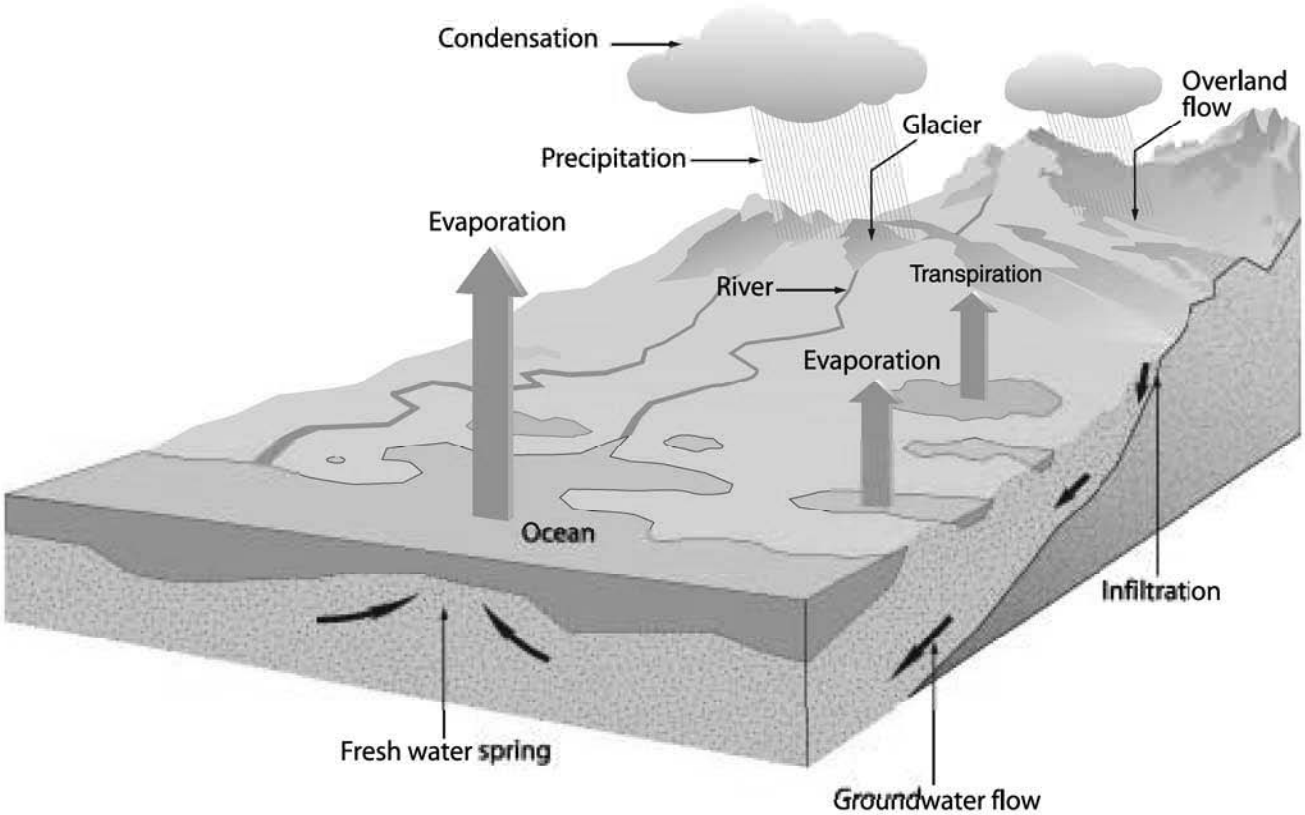

Figure 11 The Hydrologic Cycle

Although alluvial aquifers are most common in California, other groundwater development occurs in fractured crystalline rocks, fractured volcanics, and limestones. For this report, these nonalluvial areas that provide groundwater are referred to as "groundwater source areas," while the alluvial aquifers are called groundwater basins. Each of these concepts is discussed more fully below.

Groundwater and Surface Water Interconnection

Groundwater and surface water bodies are connected physically in the hydrologic cycle. For example, at some locations or at certain times of the year, water will infiltrate the bed of a stream to recharge groundwater. At other times or places, groundwater may discharge, contributing to the base flow of a stream. Changes in either the surface water or groundwater system will affect the other, so effective management requires consideration of both resources. Although this physical interconnection is well understood in general terms, details of the physical and chemical relationships are the topic of considerable research.

These details are the subject of significant recent investigations into the hyporheic zone, the zone of sand and gravel that forms the channel of a stream. As surface water flows downstream it may enter the gravels in the

Box N One Resource, Two Systems of Law

In California, two distinct legal regimes govern the appropriation of surface water and subterranean streams, and percolating groundwater. The California Water Code requires that water users taking water for beneficial use from surface watercourses and "subterranean streams flowing through known and definite channels" obtain water right permits or licenses from the State Water Resources Control Board (SWRCB) (Water Code § 1200 et seq.). Groundwater classified as percolating groundwater is not subject to the Water Code provisions concerning the appropriation of water, and a water user can take percolating groundwater without having a State-issued water right permit or license. Current Water Code section 1200 is derived from a provision in the Water Commission Act of 1913, which became effective on December 19, 1914.

The SWRCB developed a test to identify groundwater that is in a subterranean stream flowing through a known and definite channel and is therefore subject to the SWRCB's permitting authority. The physical conditions that must be present in a subterranean stream flowing in a known and definite channel are: (1) a subsurface channel must be present; (2) the channel must have relatively impermeable bed and banks; (3) the course of the channel must be known or capable of being determined by reasonable inference; and (4) groundwater must be flowing in the channel. Whether groundwater is subject to the SWRCB's permitting authority under this test is a factual determination. Water that does not fit this test is "percolating groundwater" and is not subject to the SWRCB's permitting authority.

The SWRCB has issued decisions that find that groundwater under the following streams constitutes a "subterranean stream flowing through known and definite channels" and is therefore subject to the SWRCB's permitting authority (Murphey 2003 pers com):

Los Angeles River in Los Angeles County
Sheep Creek in San Bernardino County
Mission Basin of the San Luis Rey River in San Diego County
Bonsall Basin of the San Luis Rey River in San Diego County
Pala Basin of the San Luis Rey River in San Diego County
Carmel River in Monterey County
Garrapata Creek in Monterey County
Big Sur River in Monterey County
Russian River
Chorro Creek in San Luis Obispo County
Morro Creek in San Luis Obispo County
North Fork Gualala River in Mendocino County

Contact the SWRCB, Division of Water Rights for specific stream reaches and other details of these decisions.

hyporheic zone, mix with groundwater, and re-enter the surface water in the stream channel. The effects of this interchange between surface water and groundwater can change the dissolved oxygen content, temperature, and mineral concentrations of the water. These changes may have a significant effect on aquatic and riparian biota.

Significantly, the physical and chemical interconnection of groundwater and surface water is not well represented in California's water rights system (see Box N "One Resource, Two Systems of Law").

Physical Properties That Affect Groundwater

The degree to which a body of rock or sediments will function as a groundwater resource depends on many properties, some of which are discussed here. Two of the more important physical properties to consider are porosity and hydraulic conductivity. Transmissivity is another important concept to understand when considering an aquifer's overall ability to yield significant groundwater. Throughout the discussion of these properties, keep in mind that sediment size in alluvial environments can change significantly over short distances, with a corresponding change in physical properties. Thus, while these properties are often presented as average values for a large area, one might encounter different conditions on a more localized level. Determination of these properties for a given aquifer may be based on lithologic or geophysical observations, laboratory testing, or aquifer tests with varying degrees of accuracy.

Porosity

The ratio of voids in a rock or sediment to the total volume of material is referred to as porosity and is a measure of the amount of groundwater that may be stored in the material. Figure 12 gives several examples of the types of porosity encountered in sediments and rocks. Porosity is usually expressed as a percentage and can be classified as either primary or secondary. Primary porosity refers to the voids present when the sediment or rock was initially formed. Secondary porosity refers to voids formed through fracturing or weathering of a rock or sediment after it was formed. In sediments, porosity is a function of the uniformity of grain size (sorting) and shape. Finer-grained sediments tend to have a higher porosity than coarser sediments because the finer-grained sediments generally have greater uniformity of size and because of the tabular shape and surface chemistry properties of clay particles. In crystalline rocks, porosity becomes greater with a higher degree of fracturing or weathering. As alluvial sediments become consolidated, primary porosity generally decreases due to compaction and cementation, and secondary porosity may increase as the consolidated rock is subjected to stresses that cause fracturing.

Porosity does not tell the entire story about the availability of groundwater in the subsurface. The pore spaces must also interconnect and be large enough so that water can move through the ground to be extracted from a well or discharged to a water body. The term "effective porosity" refers to the degree of interconnectedness of pore spaces. For coarse sediments, such as the sand and gravel encountered in California's alluvial groundwater basins, the effective porosity is often nearly equal to the overall porosity. In finer sediments, effective porosity may be low due to water that is tightly held in small pores. Effective porosity is generally very low in crystalline rocks that are not highly fractured or weathered.

While porosity measures the total amount of water that may be contained in void spaces, there are two related properties that are important to consider: specific yield and specific retention. Specific yield is the fractional amount of water that would drain freely from rocks or sediments due to gravity and describes the portion of the groundwater that could actually be available for extraction. The portion of groundwater that is retained either as a film on grains or in small pore spaces is called specific retention. Specific yield and specific retention of the aquifer material together equal porosity. Specific retention increases with decreasing

grain size. Table 7 shows that clays, while having among the highest porosities, make poor sources of groundwater because they yield very little water. Sand and gravel, having much lower porosity than clay, make excellent sources of groundwater because of the high specific yield, which allows the groundwater to flow to wells. Rocks such as limestone and basalt yield significant quantities of groundwater if they are well-weathered and highly fractured.

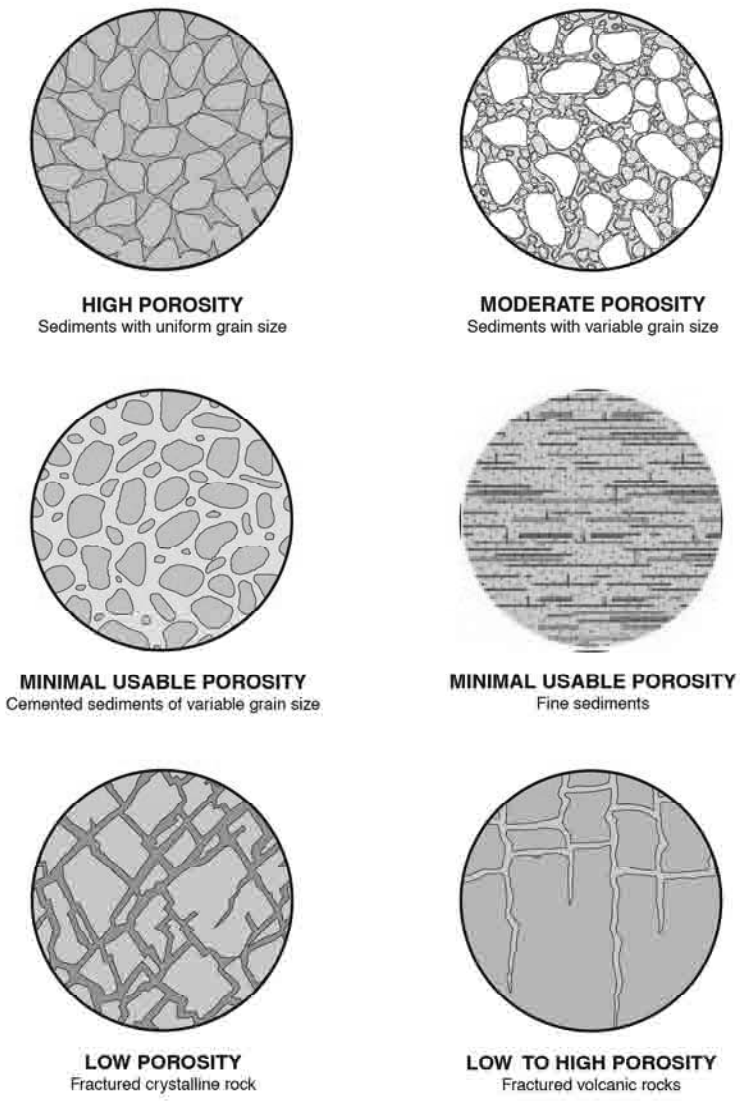

Figure 12 Examples of porosity in sediments and rocks

Table 7 Porosity (in percent) of soil and rock types

Material	Porosity	Specific yield	Specific retention
Clay	50	2	48
Sand	25	22	2
Gravel	20	19	1
Limestone	20	18	2
Sandstone (semiconsolidated)	11	6	5
Granite	0.1	0.09	0.01
Basalt (young)	11	8	3

Modified from Heath (1983)

Hydraulic Conductivity

Another major property related to understanding water movement in the subsurface is hydraulic conductivity. Hydraulic conductivity is a measure of a rock or sediment's ability to transmit water and is often used interchangeably with the term permeability. The size, shape, and interconnectedness of pore spaces affect hydraulic conductivity (Driscoll 1986).

Hydraulic conductivity is usually expressed in units of length/time: feet/day, meters/day, or gallons/day/square-foot. Hydraulic conductivity values in rocks range over many orders of magnitude from a low permeability unfractured crystalline rock at about 10^{-8} feet/day to a highly permeable well-sorted gravel at greater than 10^{4} feet/day (Heath 1983). Clays have low permeability, ranging from about 10^{-3} to 10^{-7} feet/day (Heath 1983). Figure 13 shows hydraulic conductivity ranges of selected rocks and sediments.

Transmissivity

Transmissivity is a measure of the aquifer's ability to transmit groundwater through its entire saturated thickness and relates closely to the potential yield of wells. Transmissivity is defined as the product of the hydraulic conductivity and the saturated thickness of the aquifer. It is an important property to understand because a given area could have a high value of hydraulic conductivity but a small saturated thickness, resulting in limited overall yield of groundwater.

Aquifer

An aquifer is a body of rock or sediment that yields significant amounts of groundwater to wells or springs. In many definitions, the word "significant" is replaced by "economic." Of course, either term is a matter of perspective, which has led to disagreement about what constitutes an aquifer. As discussed previously, coarse-grained sediments such as sands and gravels deposited in alluvial or marine environments tend to function as the primary aquifers in California. These alluvial aquifers are the focus of this report. Other aquifers, such as those found in volcanics, igneous intrusive rocks, and carbonate rocks are described briefly in the section Groundwater Source Areas.

Aquitard

An aquitard is a body of rock or sediment that is typically capable of storing groundwater but does not yield it in significant or economic quantities. Fine-grained sediments with low hydraulic conductivity, such as clays and silts, often function as aquitards. Aquitards are often referred to as confining layers because they retard the vertical movement of groundwater and under the right hydrogeologic conditions confine groundwater that is under pressure. Aquitards are capable of transmitting enough water to allow some flow between adjacent aquifers, and depending on the magnitude of this transfer of water, may be referred to as leaky aquitards.

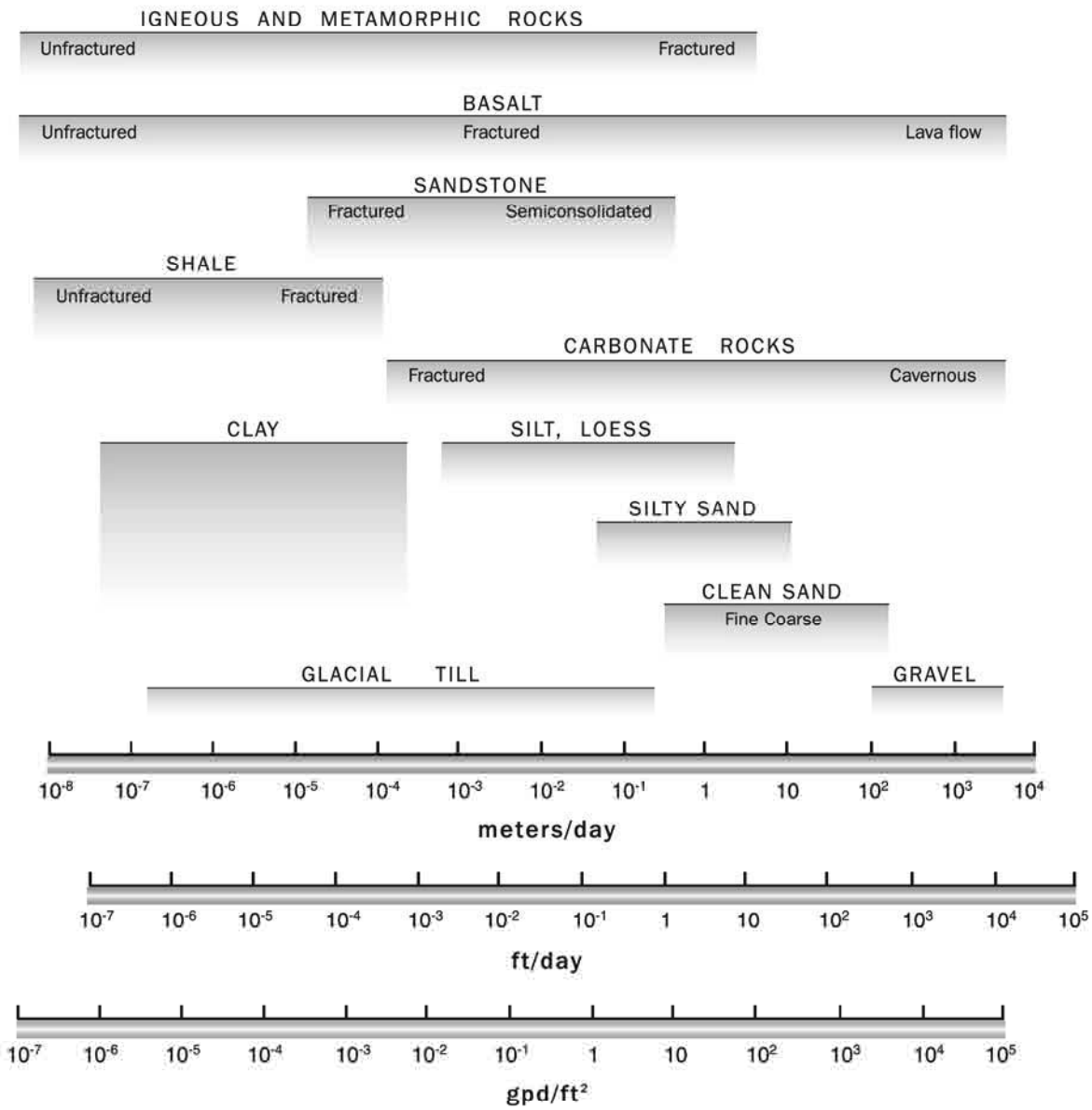

Figure 13 Hydraulic conductivity ranges of selected rocks and sediments

Unconfined and Confined Aquifers

In most depositional environments, coarser-grained deposits are interbedded with finer-grained deposits creating a series of aquifers and aquitards. When a saturated aquifer is bounded on top by an aquitard (also known as a confining layer), the aquifer is called a confined aquifer (Figure 14). Under these conditions, the water is under pressure so that it will rise above the top of the aquifer if the aquitard is penetrated by a well. The elevation to which the water rises is known as the potentiometric surface. Where an aquifer is not bounded on top by an aquitard, the aquifer is said to be unconfined. In an unconfined aquifer, the pressure on the top surface of the groundwater is equal to that of the atmosphere. This surface is known as the water table, so unconfined aquifers are often referred to as water table aquifers. The arrangement of aquifers and aquitards in the subsurface is referred to as hydrostratigraphy.

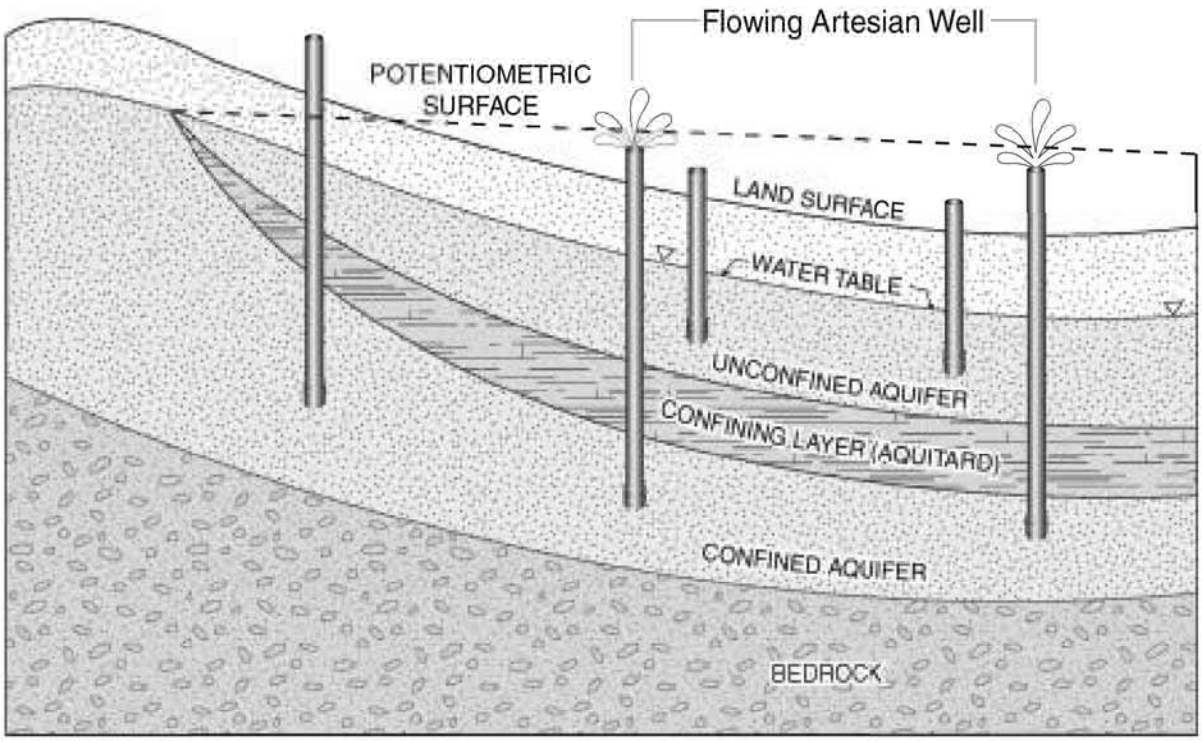

Figure 14 Interbedded aquifers with confined and unconfined conditions

With the notable exception of the Corcoran Clay of the Tulare Formation in the San Joaquin Valley and the aquitard in West Coast Basin in Los Angeles County, there are no clearly recognizable regional aquitards in California alluvial basins. Instead, due to the complexity of alluvial environments, it is the cumulative effect of multiple thin lenses of fine-grained sediments that causes increasing confinement of groundwater with increasing depth, creating what is often referred to as a semiconfined aquifer.

In some confined aquifers groundwater appears to defy gravity, but that is not the case. When a well penetrates a confined aquifer with a potentiometric surface that is higher than land surface, water will flow naturally to the surface. This is known as artesian flow, and results from pressure within the aquifer. The pressure results when the recharge area for the aquifer is at a higher elevation than the point at which discharge is occurring (Figure 14). The confining layer prevents the groundwater from returning to the surface until the confining layer is penetrated by a well. Artesian flow will discontinue as pressure in the aquifer is reduced and the potentiometric surface drops below the land surface elevation.

Groundwater Basin

A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and a definable bottom. Lateral boundaries are features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. Bottom boundaries would include rock or sediments of very low permeability if no aquifers occur below those sediments within the basin. In some cases, such as in the San Joaquin and Sacramento Valleys, the base of fresh water is considered the bottom of the groundwater basin. Table 8 is a generalized list of basin types and the features that define the basin boundaries.

Table 8 Types and boundary characteristics of groundwater basins

Characteristics of groundwater basins	
Groundwater basin	An aquifer or an aquifer system that is bounded laterally and at depth by one or more of the following features that affect groundwater flow: • Rocks or sediments of lower permeability • A geologic structure, such as a fault • Hydrologic features, such as a stream, lake, ocean, or groundwater divide
Types of basins and their boundaries	
Single simple basin	Basin surrounded on all sides by less permeable rock. Higher permeability near the periphery. Clays near the center. Unconfined around the periphery. Confined near the center. May have artesian flow near the center.
Basin open at one or more places to other basins	Many desert basins. Merged alluvial fans. Topographic ridges on fans. Includes some fault-bounded basins.
Basin open to Pacific Ocean	260 basins along the coast. Water-bearing materials extend offshore. May be in contact with sea water. Vulnerable to seawater intrusion.
Single complex basin	Basin underlain or surrounded by older water-bearing materials and water-bearing volcanics. Quantification is difficult because of unknown contacts between different rock types within the basin.
Groundwater in areas of volcanic rocks	Basin concept is less applicable in volcanic rocks. Volcanic rocks are highly variable in permeability.
Groundwater in weathered crystalline rocks (fractured hard rock)—not considered a basin	Small quantities of groundwater. Low yielding wells. Most wells are completed in the crystalline rock and rely on fractures to obtain groundwater.
Political boundaries or management area boundaries	Usually not related to hydrogeologic boundaries.Formed for convenience, usually to manage surface water storage and delivery.

Although only the upper surface of a groundwater basin can be shown on a map, the basin is three-dimensional and includes all subsurface fresh water-bearing material. These boundaries often do not extend straight down, but are dependent on the spatial distribution of geologic materials in the subsurface. In fact, in a few cases near California's coastal areas, aquifers in the subsurface are known to extend beyond the mapped surface of the basin and may actually be exposed under the ocean. Under natural conditions, fresh water flows from these aquifers into the ocean. If groundwater levels are lowered, sea water may flow into the aquifer. This has occurred in Los Angeles, Orange, Ventura, Santa Cruz and Monterey Counties, and some areas around San Francisco Bay. Depiction of a groundwater basin in three dimensions requires extensive subsurface investigation and data evaluation to delineate the basin geometry. Figure 15 is a cross-section showing how a coastal basin might appear in the subsurface.

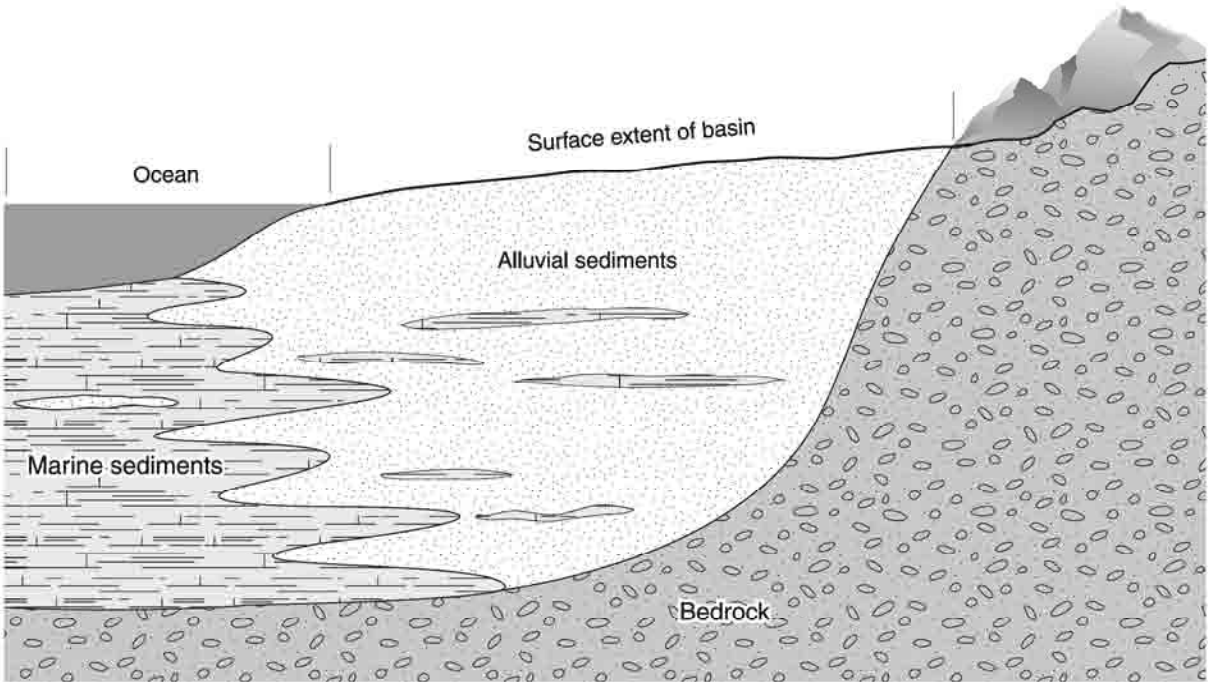

Figure 15 Groundwater basin near the coast with the aquifer extending beyond the surface basin boundary

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated. In many other basins where much less is known and understood about the basin, boundaries will probably change as a better understanding of the basin is developed. A procedure for collecting information from all the stakeholders should be developed for use statewide so that agreement on basin boundaries can be achieved.

Groundwater Subbasin

A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries (see Table 8). These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins. As the definition implies, the designation of a subbasin boundary is flexible and could change in the future. The limiting rule for a subbasin is that it should not cross over a groundwater basin boundary.

An example of a hydrologic subbasin boundary would be a river or stream that creates a groundwater divide. While hydrologic boundaries may limit groundwater flow in the shallow subsurface, data indicate significant groundwater flow may occur across the boundary at greater depths. In addition, the location of the boundary may change over time if pumping or recharge patterns change. Institutional subbasin boundaries could be based on a political boundary, such as a county line or a water agency service area, or a legally mandated boundary such as a court adjudicated basin.

Groundwater Source Areas

Groundwater in California is also found outside of alluvial groundwater basins. Igneous extrusive (volcanic), igneous intrusive, metamorphic, and sedimentary rocks are all potential sources of groundwater. These rocks often supply enough water for domestic use, but in some cases can also yield substantial quantities. In this report the term groundwater source area is used for rocks that are significant in terms of being a local groundwater source, but do not fit the category of basin or subbasin. The term is not intended to imply that groundwater actually originates in these rocks, but that it is withdrawn from rocks underlying a generally definable area. Because of the increased difficulty in defining and understanding the hydrogeologic properties of these rocks, the limited data available for the areas in which these rocks occur, and the relatively small, though rapidly growing, segment of the population served by these water supplies, they are discussed separately from groundwater basins.

Volcanics

Groundwater in volcanics can occur in fractures that result from cooling or changes in stress in the crust of the Earth, lava tubes, tree molds, weathering surfaces, and porous tuff beds. Additionally, the volcanics could overlie other deposits from an alluvial environment. Flow in the fractures may approach the same velocities as that of surface water, but there is often very limited storage potential for groundwater. The tuff beds can act similarly to alluvial aquifers.

Some of the most productive volcanic rocks in the State include the Modoc Plateau volcanics in the northeast and the Napa-Sonoma volcanics northeast of San Francisco Bay (Figure 16). Wells in Modoc Plateau volcanics are commonly reported to yield between 100 and 1,000 gallons per minute, with some yields of 4,000 gpm (Planert and Williams 1995). Bulletin 118-75 assigned identification numbers to these volcanic rocks throughout the State (for example, Modoc Plateau Recent Volcanic Areas, 1-23). The numbers led some to interpret them as being groundwater basins. In this update, the numbers corresponding to the volcanics are being retired to eliminate this confusion.

Figure 16 Significant volcanic groundwater source areas

Igneous Intrusive, Metamorphic, and Sedimentary Rocks

Groundwater in igneous intrusive, metamorphic, and consolidated sedimentary rocks occurs in fractures resulting from tectonism and expansion of the rock as overburden pressures are relieved. Groundwater is extracted from fractured rock in many of the mountainous areas of the State, such as the Sierra Nevada, the Peninsular Range, and the Coast Ranges. Rocks in these areas often yield only enough supply for individual domestic wells, stock water wells, or small community water systems. Availability of groundwater in such formations can vary widely, even over a distance of a few yards. Areas of groundwater production from consolidated rocks were not defined in previous versions of Bulletin 118 and are not included in this update.

As population grows in areas underlain by these rocks, such as the foothills of the Sierra Nevada and southern California mountains, many new wells are being built in fractured rock. However, groundwater data are often insufficient to accurately estimate the long term reliability of groundwater supplies in these areas. Additional investigation, data evaluation, and management will be needed to ensure future sustainable supplies. The Legislature recognized both the complexity of these areas and the need for management in SB 1938 (2002), which amended the Water Code to require groundwater management plans with specific components be adopted for agencies to be eligible for certain funding administered by DWR for construction of groundwater projects. Water Code section 10753.7(a)(5) states:

> Local agencies that are located in areas outside the groundwater basins delineated on the latest edition of the department's groundwater basin and subbasin map shall prepare groundwater management plans incorporating the components in this subdivision, and shall use geologic and hydrologic principles appropriate to those areas.

In carbonate sedimentary rocks such as limestone, groundwater occurs in fractures and cavities formed as a result of dissolution of the rock. Flow in the largest fractures may approach the velocities of surface water, but where these rocks occur in California there is limited storage potential for groundwater. Carbonate rocks occur mostly in Inyo County near the Nevada border (USGS 1995), in the Sierra Nevada foothills, and in some parts of the Sacramento River drainage north of Redding. The carbonates near the Nevada state border in Inyo County are part of a regional aquifer that extends northeastward into Nevada. Springs in Nevada and in the Death Valley region in California are dependent on groundwater flow in this regional aquifer. In other parts of the country, such as Florida, carbonate rocks constitute significant sources of groundwater.

Movement of Groundwater

The movement of groundwater in the subsurface is quite complex, but in simple terms it can be described as being driven by potential energy. At any point in the saturated subsurface, groundwater has a hydraulic head value that describes its potential energy, which is the combination of its elevation and pressure. In an unconfined aquifer, the water table elevation represents the hydraulic head, while in a confined aquifer the potentiometric surface represents the hydraulic head (Figure 14). Water moves in response to the difference in hydraulic head from the point of highest energy toward the lowest. On a regional scale this results in flow of groundwater from recharge areas to discharge areas. In California, pumping depressions around extraction wells often create the discharge points to which groundwater flows. Groundwater may naturally exit the subsurface by flowing into a stream, lake, or ocean, by flowing to the surface as a spring or seep, or by being transpired by plants.

The rate at which groundwater flows is dependent on the hydraulic conductivity and the rate of change of hydraulic head over some distance. In the mid-19th century, Henry Darcy found through his experiments on sand filters that the amount of flow through a porous medium is directly proportional to the difference

between hydraulic head values and inversely proportional to the horizontal distance between them (Fetter 1988). His conclusions extend to flow through aquifer materials. The difference between hydraulic heads divided by the distance between them is referred to as the hydraulic gradient. When combined with the hydraulic conductivity of the porous medium and the cross-sectional area through which the groundwater flows, Darcy's law states:

$$Q = KA(dh/dl) \quad \text{(volume/time)}$$

Where:

Q = flow discharging through a porous medium
K = hydraulic conductivity (length/time)
A = cross-sectional area (length^2)
dh = change in hydraulic head between two points (length)
dl = distance between two points (length)

This version of Darcy's law provides a volumetric flow rate. To calculate the average linear velocity at which the water flows, the result is divided by the effective porosity. The rate of movement of groundwater is very slow, usually less than 1,000 feet per year because of the great amount of friction resulting from movement through the spaces between grains of sand and gravel.

Quantity of Groundwater

Because groundwater is a precious resource, the questions of how much there is and how more can be made available are important. There are many terms and concepts associated with the quantity of groundwater available in a basin, and some controversy surrounding their definition. Some of these include groundwater storage capacity, usable storage capacity, groundwater budget, change in storage, overdraft, and safe yield. This section discusses some of the more common terms used to represent groundwater quantity in California.

Groundwater Storage Capacity

The groundwater storage capacity of an individual basin or within the entire State is one of the questions most frequently asked by private citizens, water resource planners, and politicians alike. Total storage capacity seems easy to understand. It can be seen as how much physical space is available for storing groundwater. The computation of groundwater storage capacity is quite simple if data are available: capacity is determined by multiplying the total volume of a basin by the average specific yield. The total storage capacity is constant and is dependent on the geometry and hydrogeologic characteristics of the aquifer(s) (Figure 17).

Estimates of total groundwater storage capacity in California are staggering. Previous estimates of total storage range from 850 million acre-feet (maf) to 1.3 billion acre-feet (DWR 1975, DWR 1994). However, due to incomplete information about many of the groundwater basins, there has never been an accurately quantified calculation of total storage capacity statewide. Even if such a calculation were possible, the utility of such a number is questionable because total storage capacity might lead to overly optimistic estimates of how much additional groundwater development can contribute to meeting future demands.

Total groundwater storage capacity is misleading because it only takes into account one aspect of the physical character of the basin. Many other factors limit the ultimate development potential of a groundwater basin. These limiting factors may be physical, chemical, economic, environmental, legal, and institutional (Table 9). Some of these factors, such as the economic and institutional ones, can change with time. However, there may remain significant physical and chemical constraints that will limit groundwater development.

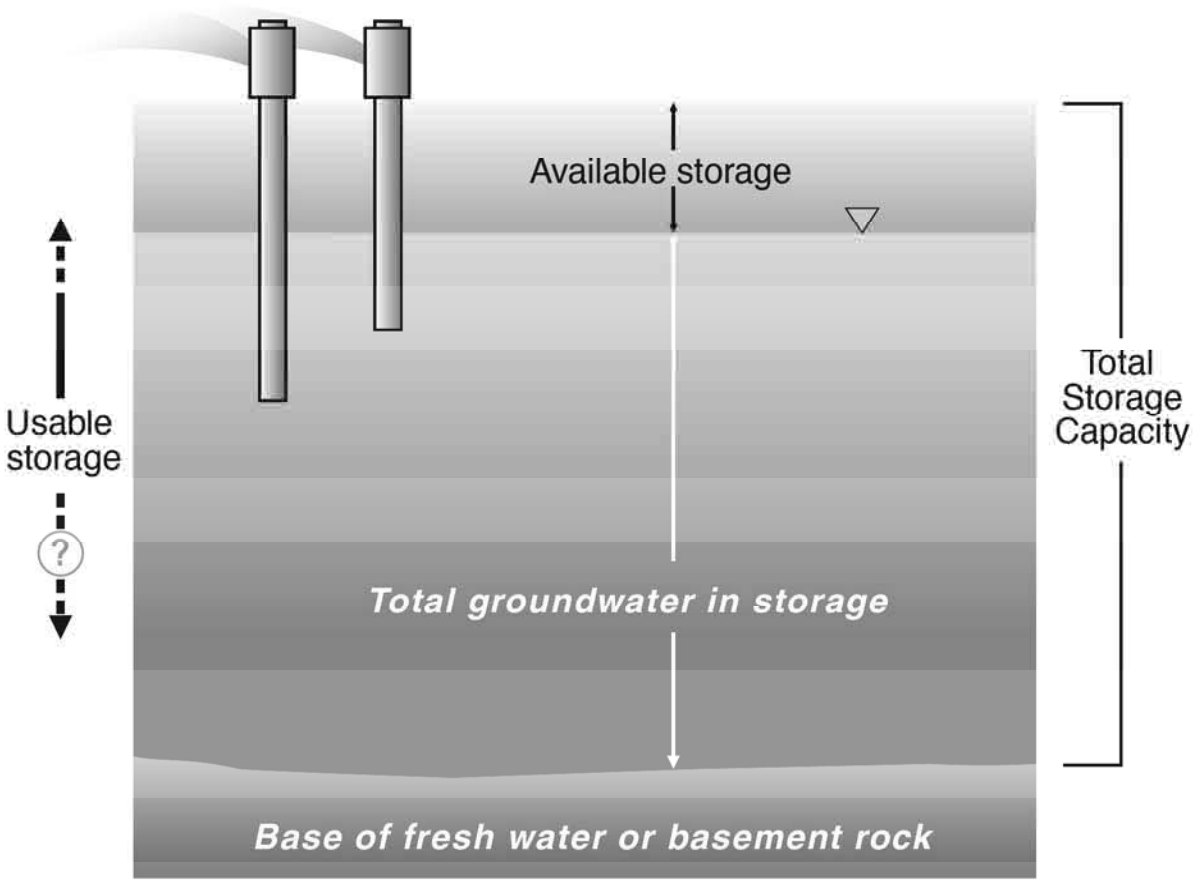

Figure 17 Schematic of total, usable, and available groundwater storage capacity

Table 9 Examples of factors that limit development of a groundwater basin

Limiting factor	Examples
Physical	Basin recharge area not adequate to sustain development; pumping too concentrated in a portion of basin; well yields too low for intended use.
Quality	Water quality not suitable for intended use; increased potential for seawater intrusion in coastal areas; upwelling of poorer quality water in deeper parts of basin.
Economic	Excessive costs associated with increased pump lifts and deepening of wells; cost of treating water if it does meet requirements for intended use.
Environmental	Need to maintain groundwater levels for wetlands, stream base flow, or other habitat.
Institutional	Local groundwater management plans or ordinances restricting use; basin adjudication; impacts on surface water rights of others.

Usable Groundwater Storage Capacity

Usable storage capacity is defined as the amount of groundwater of suitable quality that can be economically withdrawn from storage. It is typically computed as the product of the volume of the basin to some basin-specific depth that is considered economically available and the average specific yield of the basin (see Figure 17).

As more groundwater is extracted, groundwater levels may fall below some existing wells, which may then require replacement or deepening. This may be a consideration in management of the basin and will depend on the cost of replacement, the cost of pumping the water from deeper zones, and whether managers are willing to pay that cost. Other impacts that may increase the cost include subsidence and groundwater quality degradation. The usable storage may change because of changes in economic conditions.

Estimates of usable storage represent only the total volume of groundwater assumed to be usable in storage, not what would be available for sustained use on an annual basis. Previous estimates of usable groundwater storage capacity range from 143 to 450 maf (DWR 1975, DWR 1994). Unfortunately, the term "usable storage" is often used to indicate the amount of water that can be used from a basin as a source of long-term annual supply. However, the many limitations associated with total groundwater storage capacity discussed above may also apply to usable storage.

Available Groundwater Storage Capacity

Available storage capacity is defined as the volume of a basin that is unsaturated and capable of storing additional groundwater. It is typically computed as the product of the empty volume of the basin and the average specific yield of the unsaturated part of the basin (see Figure 17). The available storage capacity does not include the uppermost portion of the unsaturated zone in which saturation could cause problems such as crop root damage or increased liquefaction potential. The available storage will vary depending on the amount of groundwater taken out of storage and the recharge. The total groundwater in storage will change inversely as the available storage changes.

Available storage has often been used as a number to represent the potential for additional yield from a particular basin. Unfortunately, many of the limitations that exist in developing existing supply discussed above also limit taking advantage of available storage. Although limitations exist, looking only at available groundwater storage capacity may underestimate the potential for groundwater development. Opportunities to use groundwater already in storage and create additional storage space would be overlooked by this approach.

Groundwater Budget

A groundwater budget is an analysis of a groundwater basin's inflows and outflows to determine the change in groundwater storage. Alternatively, if the change in storage is known, the value of one of the inflows or outflows could be determined. The basic equation can be expressed as:

INFLOWS – OUTFLOWS = CHANGE IN STORAGE

Typical inflows include:

- natural recharge from precipitation;
- seepage from surface water channels;
- intentional recharge via ponds, ditches, and injection wells;
- net recharge of applied water for agricultural and other irrigation uses;
- unintentional recharge from leaky conveyance pipelines; and
- subsurface inflows from outside basin boundaries.

Outflows include:

- groundwater extraction by wells;
- groundwater discharge to surface water bodies and springs;
- evapotranspiration; and
- subsurface outflow across basin or subbasin boundaries.

Groundwater budgets can be useful tools to understand a basin, but detailed budgets are not available for most groundwater basins in California. A detailed knowledge of each budget component is necessary to obtain a good approximation of the change in storage. Absence or inaccuracy of one or more parameters can lead to an analysis that varies widely from a positive to a negative change in storage or vice versa. Since much of the data needed requires subsurface exploration and monitoring over a series of years, the collection of detailed field data is time-consuming and expensive. A management plan should develop a monitoring program as soon as possible.

Change in Groundwater Storage

As stated above, a groundwater budget is one potential way of estimating the change in storage in a basin, although it is limited by the accuracy and availability of data. There is a simpler way—by determining the average change in groundwater elevation over the basin, multiplied by the area overlying the basin and the average specific yield (or storativity in the case of a confined aquifer). The time interval over which the groundwater elevation change is determined is study specific, but annual spring-to-spring changes are commonly used. A change in storage calculation does not attempt to determine the volume of water in storage at any time interval, but rather the change from a previous period or baseline condition.

A change in storage calculation is a relatively quick way to represent trends in a basin over time. If change in storage is negligible over a representative period, the basin is in equilibrium under current use. Changes in storage calculations are more often available for a groundwater basin than groundwater budgets because water level measurements are available in many basins. Specific yield and storativity are readily estimated based on knowledge of the hydrogeologic setting and geologic materials or through aquifer pumping tests. Although simple, change in storage calculations have potential sources of error, so it is important to treat change in storage as just one of many tools in determining conditions in a groundwater basin. Well data sets must be carefully evaluated before use in these calculations. Mixing of wells constructed in confined and unconfined portions of the basin and measurement of different well sets over time can result in significant errors.

Although the change in storage calculation is a relatively quick and inexpensive method of observing changes in the groundwater system, the full groundwater budget is preferable. A detailed budget describes an understanding of the physical processes affecting storage in the basin, which the simple change in storage calculation does not. For example, the budget takes into account the relationship between the surface water and the groundwater system. If additional groundwater extraction induced additional infiltration of surface water, the calculated change in storage could be minimal. However, if the surface water is used as a source of supply downstream, the impact of reduced flows could be significant.

Overdraft

Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions (DWR 1998). Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. If overdraft continues for a number of years, significant adverse impacts may occur, including increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts.

Despite its common usage, the term overdraft has been the subject of debate for many years. Groundwater management is a local responsibility, therefore, the decision whether a basin is in a condition of overdraft is the responsibility of the local groundwater or water management agency. In some cases local agencies may choose to deliberately extract groundwater in excess of recharge in a basin (known as "groundwater mining") as part of an overall management strategy. An independent analysis of water levels in such a basin might conclude that the basin is in overdraft. In other cases, where basin management is less active or nonexistent, declining groundwater levels are not considered a problem until levels drop below the depth of many wells in the basin. As a result, overdraft may not be reported for many years after the condition began.

Water quality changes and subsidence may also indicate that a basin has been overdrafted. For example, when groundwater levels decline in coastal aquifers, seawater fills the pore spaces in the aquifer that are vacated by the groundwater, indicating that the basin is being overdrafted. Overdraft has historically led to as much as 30 feet of land subsidence in one area of the State and lesser amounts in other areas.

The word "overdraft" has been used to designate two unrelated types of water shortages. The first is "historical overdraft" similar to the type illustrated in Figure 18, which shows that ground water levels began to decline in the mid 1950s and then leveled off in the mid 1980s, indicating less groundwater extraction or more recharge. The second type of shortage is "projected overdraft" as used in the *California Water Plan Update* (DWR 1998). In reality, this is an estimate of future water shortages based on an assumed management program within the basin, including projected supply and projected demand. If water management practices change in those basins in which a water shortage is projected, the amount of projected shortage will change.

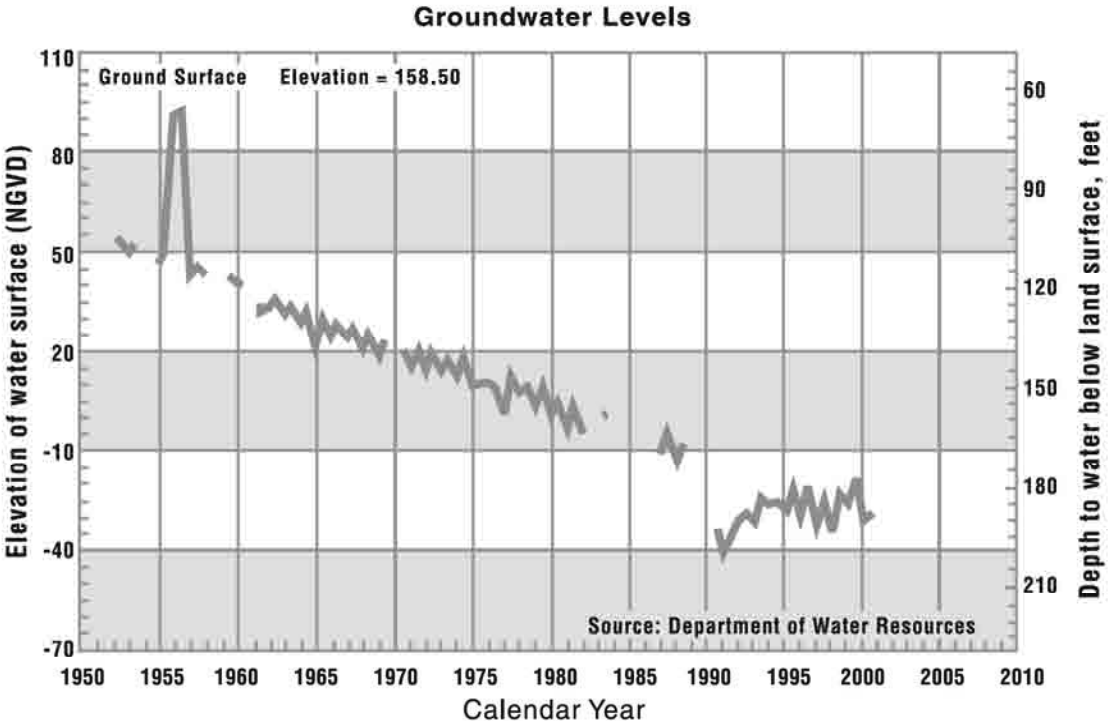

Figure 18 Hydrograph Indicating Overdraft

In some basins or subbasins, groundwater levels declined steadily over a number of years as agricultural or urban use of groundwater increased. In response, managing agencies developed surface water import projects to provide expanded water supplies to alleviate the declining groundwater levels. Increasing groundwater levels, or refilling of the aquifer, demonstrate the effectiveness of this approach in long-term water supply planning. In some areas of the State, the past overdraft is now being used to advantage. When the groundwater storage capacity that is created through historical overdraft is used in coordination with surface water supplies in a conjunctive management program, local and regional water supplies can be augmented.

In 1978 DWR was directed by the legislature to develop a definition of critical overdraft and to identify basins that were in a condition of critical overdraft (Water Code § 12924). The process that was followed and the basins that were deemed to be in a condition of critical overdraft are discussed in Box O, "Critical Conditions of Overdraft." This update to Bulletin 118 did not include similar direction from the legislature, nor funding to undertake evaluation of the State's groundwater basins to determine whether they are in a state of overdraft.

Box O Critical Conditions of Overdraft

In 1978 DWR was directed by the legislature to develop a definition of critical overdraft and to identify those basins in a critical condition of overdraft (Water Code §12924). DWR held public workshops around the state to obtain public and water managers' input on what the definition should include, and which basins were critically overdrafted. Bulletin 118-80, *Ground Water Basins in California* was published in 1980 with the results of that local input. The definition of critical overdraft is:

> *A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.*

No time is specified in the definition. Definition of the time frame is the responsibility of the local water managers, as is the definition of significant adverse impacts, which would be related to the local agency's management objectives.

Eleven basins were identified as being in a critical condition of overdraft. They are:

Pajaro Basin	Cuyama Valley Basin
Ventura Central Basin	Eastern San Joaquin County Basin
Chowchilla Basin	Madera Basin
Kings Basin	Kaweah Basin
Tulare Lake Basin	Tule Basin
Kern County Basin	

The task was not identified by the Legislature, nor was the funding for this update (2003) sufficient to consult with local water managers and fully re-evaluate the conditions of the 11 critically overdrafted basins. Funding and duration were not sufficient to evaluate additional basins with respect to conditions of critical overdraft.

If a basin lacks existing information, the cost of a thorough evaluation of overdraft conditions in a single basin could exceed $1 million. In this update of Bulletin 118, DWR has included groundwater budget information for each basin description, where available. In most cases, however, sufficient quantitative information is not available, so conditions of overdraft or critical overdraft were not reported.

While this bulletin does not specifically identify overdrafted basins (other than the 11 basins from Bulletin 118-80), the negative effects of overdraft are occurring or may occur in the future in many basins throughout the State. Declining water levels, diminishing water quality, and subsidence threaten the availability of groundwater to meet current and future demands. A thorough understanding of overdraft can help local groundwater managers minimize the impacts and take advantage of the opportunity created by available groundwater storage capacity. Local groundwater managers and DWR should seek funding and work cooperatively to evaluate the groundwater basins of the State with respect to overdraft and its potential impacts. Beginning with the most heavily used basins and relying to the extent possible on available data collected by DWR and through local groundwater management programs, current or projected conditions of critical overdraft should be identified. If local agencies take the lead in collecting and analyzing data to fully understand groundwater basin conditions, DWR can use the information to update the designations of critically overdrafted basins. This can be a cost effective approach since much of the data needed to update the overdraft designations are the same data that agencies need to effectively manage groundwater.

Safe Yield

Safe yield is defined as the amount of groundwater that can be continuously withdrawn from a basin without adverse impact. Safe yield is commonly expressed in terms of acre-feet per year. Depending on how it is applied, safe yield may be an annual average value, or may be calculated based on changed conditions each year. Although safe yield may be indicated by stable groundwater levels measured over a period of years, a detailed groundwater budget is needed to accurately estimate safe yield. Safe yield has commonly been determined in groundwater basin adjudications.

Proper application of the safe yield concept requires that the value be modified through time to reflect changing practices within the basin. One of the common misconceptions is that safe yield is a static number. That is, once it has been calculated, the amount of water can be extracted annually from the basin without any adverse impacts. An example of a situation in which this assumption could be problematic is when land use changes. In some areas, where urban development has replaced agriculture, surface pavement, storm drains, and sewers have increased runoff and dramatically reduced recharge into the basin. If extraction continued at the predetermined safe yield of the basin, water level decline and other negative impacts could occur.

Figure 19 Photograph of extensometer

An extensometer is a well with a concrete bench mark at the bottom. A pipe extends from the concrete to the land surface. If compaction of the finer sediments occurs, leading to land surface subsidence, the pipe in the well will appear to rise out of the well casing. When this movement is recorded, the data show how much the land surface has subsided.

Subsidence

When groundwater is extracted from some aquifers in sufficient quantity, compaction of the fine-grained sediments can cause subsidence of the land surface. As the groundwater level is lowered, water pressure decreases and more of the weight of the overlying sediments is supported by the sediment grains within the aquifer. If these sediments have not previously been surcharged with an equivalent load, the overlying load will compact them. Compaction decreases the porosity of the sediments and decreases the overall volume of the finer grain sediments, leading to subsidence at the land surface. While the finer sediments within the aquifer system are compacted, the usable storage capacity of the aquifer is not greatly decreased.

Data from extensometers (Figure 19) show that as groundwater levels decline in an aquifer, the land surface falls slightly. As groundwater levels rise, the land surface also rises to its original position. This component of subsidence is called elastic subsidence because it recovers. Inelastic subsidence, the second component of subsidence, is what occurs when groundwater levels decline to the point that the finer sediments are compacted. This compaction is not recoverable.

Conjunctive Management

Conjunctive management in its broadest definition is the coordinated and combined use of surface water and groundwater to increase the overall water supply of a region and improve the reliability of that supply. Conjunctive management may be implemented to meet other objectives as well, including reducing groundwater overdraft and land subsidence, protecting water quality, and improving environmental conditions. Although surface water and groundwater are sometimes considered to be separate resources, they are connected in the hydrologic cycle. By using or storing additional surface water when it is plentiful, and relying more heavily on groundwater during dry periods, conjunctive management can change the timing and location of water so it can be used more efficiently.

Although a specific project or program may be extremely complex, there are several components common to conjunctive management projects. The first is to recharge surplus surface water when it is available to increase groundwater in storage. Recharge may occur through surface spreading, by injection wells, or by reducing groundwater use by substituting surface water. The surplus surface water used for recharge may be local runoff, imported water, stored surface water, or recycled water. The second component is to reduce surface water use in dry years or dry seasons by switching to groundwater. This use of the stored groundwater may take place through direct extraction and use, pumping back to a conveyance facility, or through exchange of another water supply. A final component that should be included is an ongoing monitoring program to evaluate operations and allow water managers to respond to changes in groundwater, surface water, or environmental conditions that could violate management objectives or impact other water users.

Quality of Groundwater

All water contains dissolved constituents. Even rainwater, often described as being naturally pure, contains measurable dissolved minerals and gases. As it moves through the hydrologic cycle, water dissolves and incorporates many constituents. These include naturally occurring and man-made constituents.

Most natural minerals are harmless up to certain levels. In some cases higher mineral content is preferable to consumers for taste. For example, minerals are added to many bottled drinking waters after going through a filtration process. At some level, however, most naturally occurring constituents, along with those introduced by human activities, are considered contaminants. The point at which a given constituent is considered a contaminant varies depending on the intended use of the groundwater and the toxicity level of the constituents.

Beneficial Uses

For this report, water quality is a measure of the suitability of water for its intended use, with respect to dissolved solids and gases and suspended material. An assessment of water quality should include the investigation of the presence and concentration of any individual constituent that may limit the water's suitability for an intended use.

The SWRCB has identified 23 categories of water uses, referred to as beneficial uses. The beneficial use categories and a brief description of each are presented in Appendix E. The actual criteria that are used to evaluate water quality for each of the beneficial uses are determined by the nine Regional Water Quality Control Boards, resulting in a range of criteria for some of the uses. These criteria are published in each of the Regional Boards' Water Quality Control Plans (Basin Plans)[1].

A summary of water quality for all of the beneficial uses of groundwater is beyond the scope of this report. Instead, water quality criteria for two of the most common uses—municipal supply (referred to as public drinking water supply in this report) and agricultural supply—are described below.

Public Drinking Water Supply

Standards for maximum contaminant levels (MCLs) of constituents in drinking water are required under the federal Safe Drinking Water Act of 1974 and its updates. There are primary and secondary standards. Primary standards are developed to protect public health and are legally enforceable. Secondary standards are generally for the protection of aesthetic qualities such as taste, odor, and appearance, and cosmetic qualities, such as skin or tooth discoloration, and are generally non-enforceable guidelines. However, in California secondary standards are legally enforceable for all new drinking water systems and new sources developed by existing public water suppliers (DWR 1997). Under these primary and secondary standards, the U.S. Environmental Protection Agency regulates more than 90 contaminants, and the California Department of Health Services regulates about 100. Federal and State primary MCLs are listed in Appendix F.

Agricultural Supply

An assessment of the suitability of groundwater as a source of agricultural supply is much less straightforward than that for public water supply. An evaluation of water supply suitability for use in agriculture is difficult because the impact of an individual constituent can vary depending on many factors, including soil chemical and physical properties, crop type, drainage, and irrigation method. Elevated levels of constituents usually do not result in an area being taken entirely out of production, but may lower crop yields. Management decisions will determine appropriate land use and irrigation methods.

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[1] Digital versions of these plans are available online at http://www.swrcb.ca.gov/plnspols/index.html

There are no regulatory standards for water applied on agriculture. Criteria for crop water have been provided as guidelines. Many constituents have the potential to negatively impact agriculture, including more than a dozen trace elements (Ayers and Westcot 1985). Two constituents that are commonly considered with respect to agricultural water quality are salinity—expressed as total dissolved solids (TDS)—and boron concentrations.

Increasing salinity in irrigation water inhibits plant growth by reducing a plant's ability to absorb water through its roots (Pratt and Suarez 1996). While the impact will depend on crop type and soil conditions, it is useful to look at the TDS of the applied water as a general assessment tool. A range of values for TDS with their estimated suitability for agricultural uses is presented in Table 10. These ranges are modified from criteria developed for use in the San Joaquin Valley by the San Joaquin Valley Drainage Program. However, they are similar to values presented in Ayers and Westcot (1985).

Table 10 Range of TDS values with estimated suitability for agricultural uses

Range of TDS (mg/L)	Suitability
<500	Generally no restrictions on use
500 – 1,250	Generally slight restrictions on use
1,250 – 2,500	Generally moderate restrictions on use
>2,500	Generally severe restrictions on use

Modified from SJVDP (1990)
TDS = total dissolved solids

High levels of boron can present toxicity problems in plants by damaging leaves. The boron is absorbed through the root system and transported to the leaves. Boron then accumulates during plant transpiration, resulting in leaf burn (Ayers and Westcot 1985). Boron toxicity is highly dependent on a crop's sensitivity to the constituent. A range of values of dissolved boron in irrigation water, with their estimated suitability on various crops is presented in Table 11. These ranges are modified from Ayers and Westcot (1985).

Table 11 Range of boron concentrations with estimated suitability on various crops

Range of dissolved boron (mg/L)	Suitability
<0.5	Suitable on all but most highly boron sensitive crops
0.5 – 1.0	Suitable on most boron sensitive crops
1.0 – 2.0	Suitable on most moderately boron sensitive crops
>2.0	Suitable for only moderately to highly boron tolerant crops

Source: Modified from Ayers and Westcot 1985

Contaminant Groups

Because there are so many potential individual constituents to evaluate, researchers have often summarized contaminants into groups depending on the purpose of the study. Recognizing that there are exceptions to any classification scheme, this update considered groups according to their common sources of contamination—those naturally occurring and those caused by human activities (anthropogenic). Each of these sources includes more than one contaminant group. A listing of the contaminant groups and the individual constituents belonging to those groups, summarized in this report, is included in Appendix F.

Naturally Occurring Sources

In this report, naturally occurring sources include three primary groups: (1) inorganic constituents with primary MCLs, (2) inorganic constituents with secondary MCLs, and (3) radiological constituents. Inorganics primarily include naturally occurring minerals such as arsenic or mercury, although human activities may certainly contribute to observed concentrations. Radiological constituents include primarily naturally occurring constituents such as radon, gross alpha, and uranium. Although radioactivity is not considered a significant contaminant statewide, it can be locally important, particularly in communities in the Sierra Nevada.

Anthropogenic Sources

Anthropogenic contaminants include pesticides, volatile organic compounds (VOCs), and nitrates. Pesticides and VOCs are often grouped together into an organic contaminant group. However, separating the two gives a general idea of which contaminants are primarily from agricultural activities (pesticides) and which are primarily from industrial activities (VOCs). One notable exception to the groupings is dibromochloropropane (DBCP). Even though this compound is a VOC, DBCP is a soil fumigant and is included with pesticides. Nitrates are a surprising anthropogenic class to some observers. Nitrogen is certainly a naturally occurring inorganic constituent. However, because most nitrates are associated with agriculture (see Box P, "Focused on Nitrates: Detailed Study of a Contaminant") and nitrates are among California's leading contaminants, it is appropriate to consider them separately from inorganics.

Box P Focused on Nitrates: Detailed Study of a Contaminant

Because water has so many potential uses, the study of water quality means different things to different people. Thomas Harter, a professor at the University of California at Davis, has chosen to focus on nitrates as one of his research interests. Harter's monitoring network consists of 79 wells on 5 dairies in the San Joaquin Valley.

A common result of dairy activities is the release of nitrogen into the surroundings, which changes to nitrate in groundwater. Nitrates are notorious for their role in interfering with oxygen transport in babies, a condition commonly referred to as "blue baby syndrome." Nitrates are also of interest because more public supply wells have been closed due to nitrate contamination than from any other contaminant (Bachman and others 1997).

Harter's study has focused on two primary activities. The first is a meticulous examination of nitrogen at the surface and nitrates in the uppermost 25 feet of the subsurface. This monitoring has been ongoing since 1993, and has shown that a significant amount of nitrate can reach shallow groundwater. The second focus of the study has been to change management practices to reduce the amount of nitrogen available to reach groundwater, along with continued monitoring. This has occurred since 1998. Results of the study are better management practices that significantly reduce the amount of nitrogen available to groundwater. This will help minimize the potential adverse impacts to groundwater quality from nitrates.

Chapter 7

Inventory of California's Groundwater Information

Chapter 7
Inventory of California's Groundwater Information

The groundwater information in this chapter summarizes the available information on statewide and regional groundwater issues. For more detailed information on specific groundwater basins see the supplement to this report that is available on the California Department of Water Resources (DWR) website, http://www.waterplan.water.ca.gov/groundwater/118index.htm. See Appendix A for information on accessing individual basin descriptions and the map delineating California's groundwater basins.

Statewide Groundwater Information

There is a large amount of data available for many of the State's most heavily developed groundwater basins. Conversely, there is relatively little data available on groundwater in the undeveloped areas. The information in this report is generally limited to a compilation of the information readily available to DWR staff and may not include the most up-to-date data generated by studies that have been completed recently by water management agencies. For this reason, the collection of additional, more recent data on groundwater basins should be continued and integrated into the basin descriptions. Statewide summaries are included below.

Groundwater Basins

There are currently 431 groundwater basins delineated, underlying about 40 percent of the surface area of the State. Of those, 24 basins are subdivided into a total of 108 subbasins, giving a total of 515 distinct groundwater systems described in this report (Figure 20). Basin delineation methods are described in Appendix G. Additionally, many of the subbasin boundaries were developed or modified with public input, but little physical data. These boundaries should not be considered as precisely defining a groundwater basin boundary; the determination of whether any particular area lies within a groundwater basin boundary should be determined only after detailed local study.

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated.

Groundwater Budgets

Rather than simply providing all groundwater budget data collected during this update, the budget information was classified into one of three categories indicating the relative level of detail of information available. These categories, types A, B, and C, are discussed in Box R, "Explanation of Groundwater Data Tables." A type A budget indicates that much of the information needed to characterize the groundwater budget for the basin or subbasin was available. DWR staff did not verify these type A budgets, so DWR cannot address the accuracy of the data provided by them. Type B indicates that enough data are available to estimate the groundwater extraction to meet local water use needs. This is useful in understanding the reliance of a particular area on groundwater. Type C indicates a low level of knowledge of any of the budget components for the area.

Figure 21 depicts where these type A, B, and C budgets occur. In general, there is a greater level of understanding (type A or B) in the more heavily developed areas in terms of groundwater use. These include the Central Valley and South Coast. The lowest level of knowledge of groundwater budget data is in the southeast desert area. A discussion of groundwater use in each region is included below.

Box Q How Does the Information in This Report Relate to the Recently Enacted Laws Senate Bill 221 and Senate Bill 610 (2002)?

Recently enacted legislation requires developers of certain new housing projects to demonstrate an available water supply for that development. If a part of that proposed water supply is groundwater, urban water suppliers must provide additional information on the availability of an adequate supply of groundwater to meet the projected demand and show that they have the legal right to extract that amount of groundwater. SB 610 (2002) amended the Water Code to require, among other things, the following information (Section 10631(b)(2)):

> *For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.*

The hydrogeologic information contained in the basin descriptions that supplement this update of Bulletin 118 includes only the information that was available in California Department of Water Resources (DWR) files through reference searches and through limited contact with local agencies. Local agencies may have conducted more recent studies that have generated additional information about water budgets and aquifer characteristics. Unless the agency notified DWR, or provided a copy of the recent reports to DWR staff, that recent information has not been included in the basin descriptions. Therefore, although SB 610 refers to groundwater basins identified as overdrafted in Bulletin 118, it would be prudent for local water suppliers to evaluate the potential for overdraft of any basin included as a part of a water supply assessment.

Persons interested in collecting groundwater information in accordance with the Water Code as amended by SB 221 and SB 610 may start with the information in Bulletin 118, but should follow up by consulting the references listed for each basin and contacting local water agencies to obtain any new information that is available. Otherwise, evaluation of available groundwater resources as mandated by SB 221 and SB 610 may not be using the most complete and recent information about water budgets and aquifer characteristics.

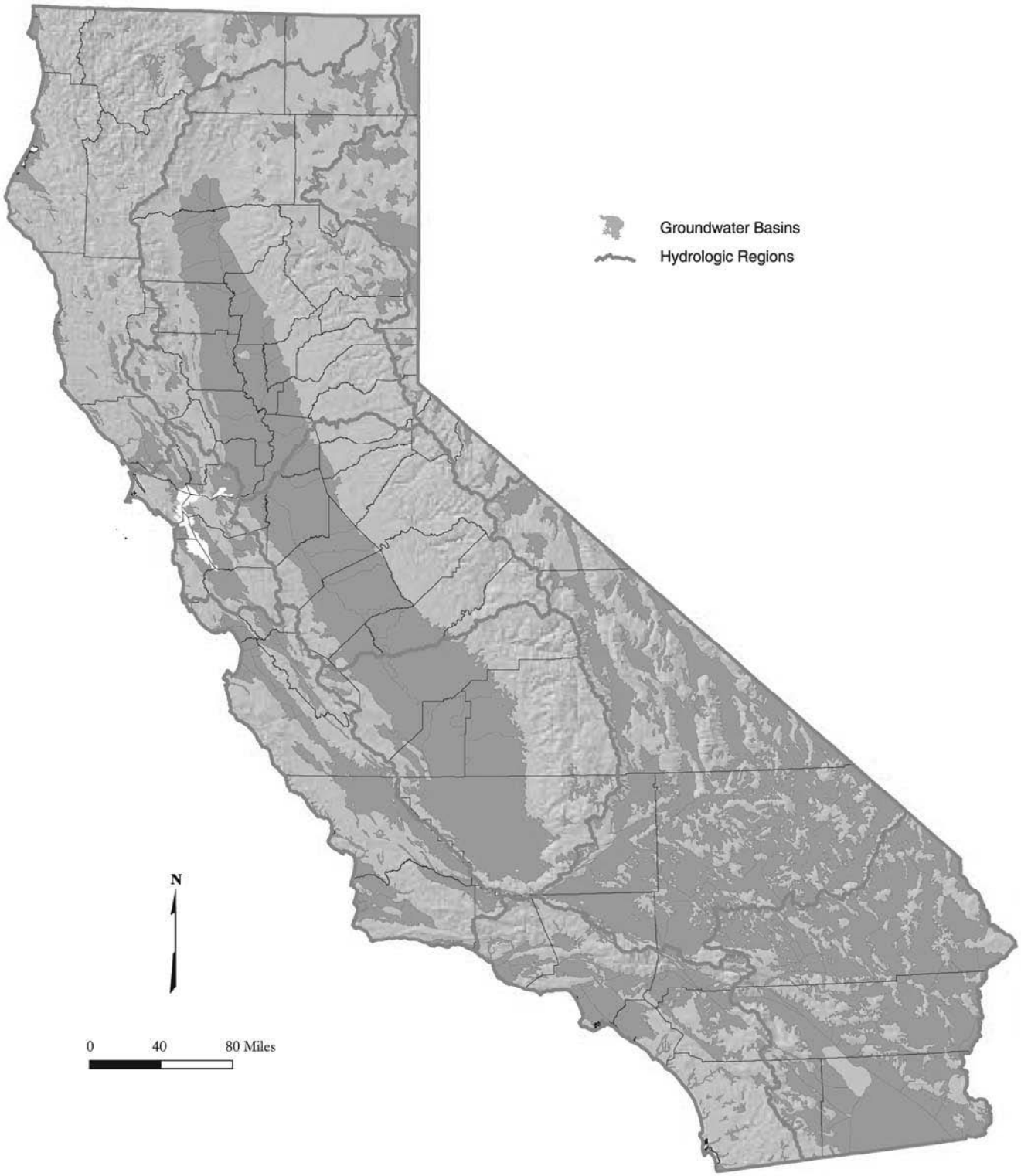

Figure 20 Groundwater basins and subbasins

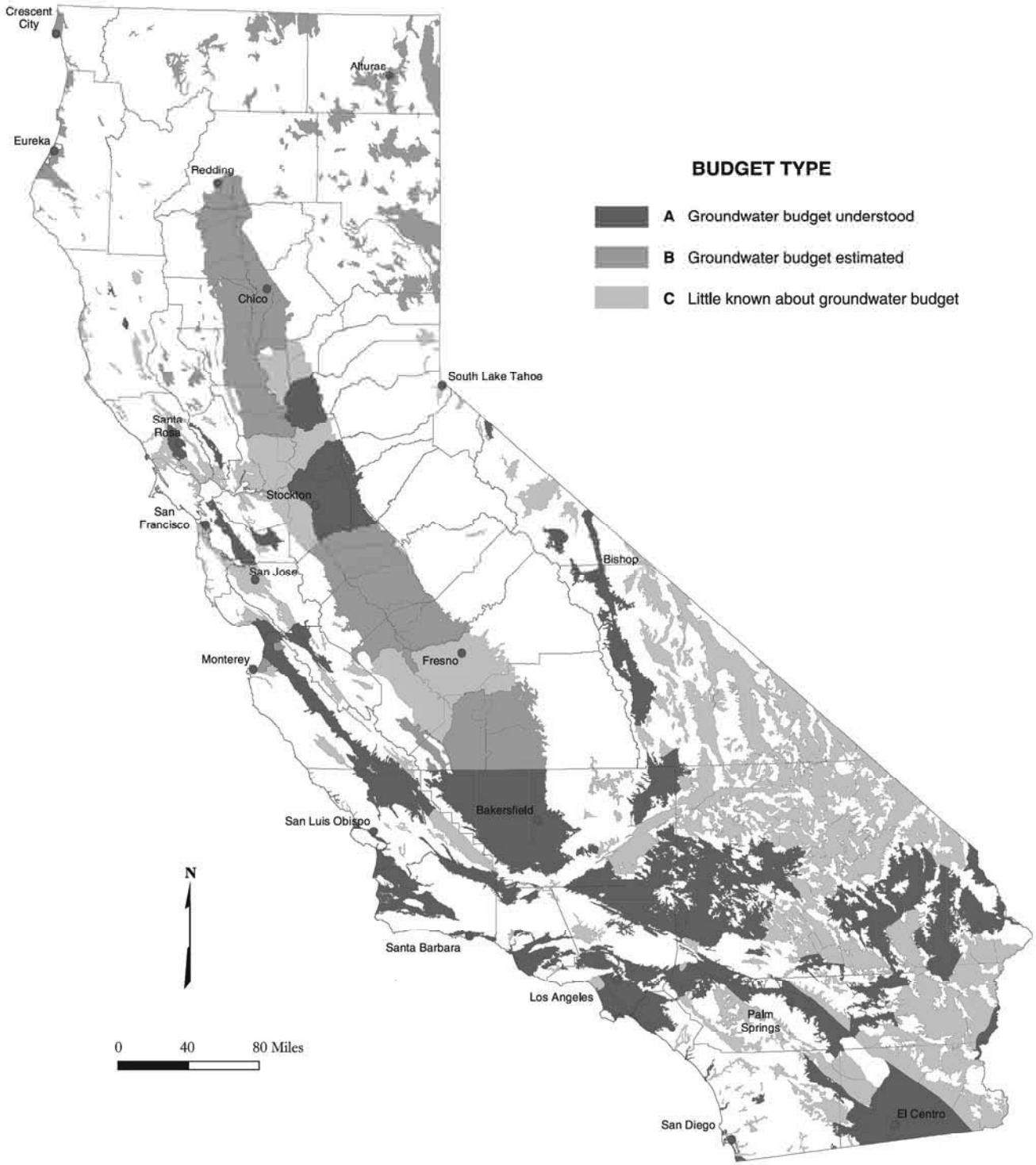

Figure 21 Basin and subbasin groundwater budget types

Box R Explanation of Groundwater Data Tables

A groundwater data table for each hydrologic region is included at the end of each hydrologic region section in Chapter 7. The tables include the following information:

Basin/Subbasin Number. The basin numbering format is x-xxx.xx. The first number in the sequence assigns the basin to one of the nine Regional Water Quality Control Board boundaries. The second number is the groundwater basin number. Any number following the decimal identifies that the groundwater basin has been further divided into subbasins. Reevaluation of available hydrogeologic information resulted in the deletion of some basins and subbasins identified in Bulletins 118-75 and 118-80. Because of this, there are some gaps in the sequence of basin numbers in this report. The methods used for developing the current groundwater basin maps are discussed in Appendix H. The names and numbers of the basins deleted, along with any comments related to their elimination are included in the appropriate region in Chapter 7. Previously unidentified groundwater basins or subbasins that were delineated during this update are assigned new identification numbers that sequentially follow the last number used in Bulletin 118-80 for groundwater basins or subbasins.

Basin or Subbasin Name. Basin names are based on published and unpublished reports, topographic maps, and local terminology. Names of more recently delineated basins or subbasins are based on the principal geographic feature, which in most cases corresponds to the name of a valley. In the case of a subbasin, its formal name should include the name of the basin (for example, Sacramento Valley Groundwater Basin, North American Subbasin). However, both locally and informally, the term subbasin is used interchangeably with basin (for example, North American Basin).

Area. The area for each basin or subbasin is presented in acres rounded to three significant figures (for example, 147,148 acres was rounded to 147,000 acres). The area describes only the upper surface or map view of a basin. The basin underlies the area and may extend beyond the surface expression (discussed in Chapter 6).

Groundwater Budget Type. The type of groundwater budget information available was classified as Type A, B, or C based on the following criteria:

Type A – indicates one of the following: (1) a groundwater budget exists for the basin or enough components from separate studies could be combined to give a general indication of the basin's groundwater budget, (2) a groundwater model exists for the basin that can be used to calculate a groundwater budget, or (3) actual groundwater extraction data exist for the basin.

Type B – indicates that a use-based estimate of groundwater extraction is calculated for the basin. The use-based estimate is determined by calculating the overall use from California Department of Water Resources land use and urban water use surveys. Known surface water supplies are then subtracted from the total demand leaving the rest of the use to be met by groundwater extraction.

Type C – indicates that there are not enough data to provide either an estimate of the basin's groundwater budget or groundwater extraction from the basin.

Well Yields. Maximum and average well yields in gallons per minute (gpm) are reported for municipal supply and agricultural wells where available. Most of the values reported are from initial tests reported during construction of the well, which may not be an accurate indication of the long-term production capacity of the wells.

Box R continued on next page

Box R Explanation of Groundwater Data Tables (continued)

Types of Monitoring. This includes monitoring of both groundwater levels and quality. "Levels" indicate the number of wells actively monitored without consideration of frequency. Most wells are monitored semi-annually, but many are monitored monthly. "Quality" indicates the number of wells monitored for various constituents; these could range from a grab sample taken for a field specific conductance measurement to a full analysis of organic and inorganic constituents. "Title 22" indicates the number of public water system wells that are actively sampled and monitored under the direction of California Department of Health Services (DHS) Title 22 Program.

Total Dissolved Solids. This category includes range and average values of total dissolved solids (TDS). This data primarily represents data from published reports. In some cases, a range of average TDS values is presented.

Active Monitoring

The summary of active monitoring includes wells that are monitored for groundwater elevation or groundwater quality within the delineated groundwater basins as of 1999. Groundwater elevation data collected by DWR and cooperators are available online at http://wdl.water.ca.gov. Most of the water quality data are for public supply wells and were provided by the California Department of Health Services (DHS). Other groundwater level and water quality monitoring activities were reported by local agencies during this update. The summary indicates that there are nearly 14,000 wells monitored for groundwater levels, 10,700[1] wells monitored under DHS water quality monitoring program, and 4,700 wells monitored for miscellaneous water quality by other agencies.

[1] These numbers include the wells in basins and subbasins only; throughout the entire state, DHS has responsibility for more than 16,000 public supply wells.

Box S What Happens When an MCL Exceedance Occurs?

All suppliers of domestic water to the public are subject to regulations adopted by the U.S. Environmental Protection Agency under the Safe Drinking Water Act (42 U.S.C. 300f et seq.) as well as by the California Department of Health Services under the California Safe Drinking Water Plan Act (Health and Safety Code §§ 116270-116750).

These regulations include primary drinking water standards that establish maximum contaminant levels (MCLs) for inorganic and organic chemicals and radioactivity. MCLs are based on health protection, technical feasibility, and economic factors.

California requires public water systems to sample their drinking water sources, analyze for regulated contaminants, and determine compliance with the MCLs on a regular basis. Sampling frequency depends on the contaminant, type of water source, and previous sampling results; frequency can range from monthly to once every nine years, or none at all if sampling is waived because the source is not vulnerable to the contaminant.

Primary MCLs are enforceable standards. In California, compliance is usually determined at the wellhead or the surface water intake. To meet water quality standards and comply with regulations, a water system with a contaminant exceeding an MCL must notify the public and remove the source from service or initiate a process and schedule to install treatment for removing the contaminant.

Notification requirements reflect the severity of the associated health risks; immediate health concerns prompt immediate notice to consumers. Violations that do not pose a significant health concern may use a less immediate notification process. In addition to consumer notification, a water system is required by statute to notify the local governing body (for example, city council or county board of supervisors) whenever a drinking water well exceeds an MCL, even if the well is taken out of service.

Detections of regulated contaminants (and certain unregulated contaminants) must also be reported to consumers in the water system's annual Consumer Confidence Report.

Groundwater Quality

The summary of water quality relied heavily on data from the DHS Title 22 water quality monitoring program. The assessment consisted of querying the DHS database for active wells that have constituents exceeding the maximum contaminant level (MCL) for drinking water. Summaries of this assessment for each of the State's hydrologic regions (HRs) are discussed in this chapter.

DHS data are the most comprehensive statewide water quality data set available, but this data set should not be used as a sole indicator of the groundwater quality in California. Data from these wells are not necessarily representative of any given basin; it only represents the quality of groundwater where a public water supply is extracted.

The Natural Resources Defense Council (NRDC 2001) issued a report that concludes California's groundwater resources face a serious long-term threat from contamination. Despite heavy reliance on groundwater, no comprehensive statewide assessments of groundwater quality were available. In response to the NRDC report, the State Water Resources Control Board (SWRCB) is planning a comprehensive assessment of the State's groundwater quality. This program is discussed in Chapter 4, in the section titled "Groundwater Quality Monitoring Act of 2001 (AB 599)."

Regional Groundwater Use

The importance of groundwater as a resource varies regionally throughout the State. For planning purposes, DWR divides California into 10 hydrologic regions (HRs), which correspond to the State's major drainage areas. HR boundaries are shown in Figure 22. A review of average water year supplies from the California Water Plan (DWR 1998) shows the importance of groundwater as a local supply for agricultural and municipal use throughout the State and in each of California's 10 HRs (Table 12 and Figure 23).

Table 12 Annual agricultural and municipal water demands met by groundwater

Hydrologic region	Total Demand Volume (TAF)	Demand met by Groundwater (TAF)	Demand met by Groundwater (%)
North Coast	1063	263	25
San Francisco Bay	1353	68	5
Central Coast	1263	1045	83
South Coast	5124	1177	23
Sacramento River	8720	2672	31
San Joaquin River	7361	2195	30
Tulare Lake	10556	4340	41
North Lahontan	568	157	28
South Lahontan	480	239	50
Colorado River	4467	337	8

Source: DWR 1998

With more than 80 percent of demand met by groundwater, the Central Coast HR is heavily reliant on groundwater to meet its local needs. The Tulare Lake and South Lahontan HRs meet more than 40 percent of their local demand from groundwater. The South Coast, North Coast, North Lahontan, San Joaquin River, and Sacramento River HRs take between 20 and 40 percent of their supply from groundwater. Groundwater is a relatively minor source of supply in the San Francisco Bay and Colorado River HRs.

Of all the groundwater extracted annually in the state, an estimated 35 percent is produced from the Tulare Lake HR. More than 70 percent of groundwater extraction occurs in the Central Valley (Tulare Lake, San Joaquin River, and Sacramento River HRs combined). Nearly 20 percent is extracted in the highly urbanized South Coast and Central Coast HRs, while less than 10 percent is extracted in the remaining five HRs combined.

Figure 22 California's 10 hydrologic regions

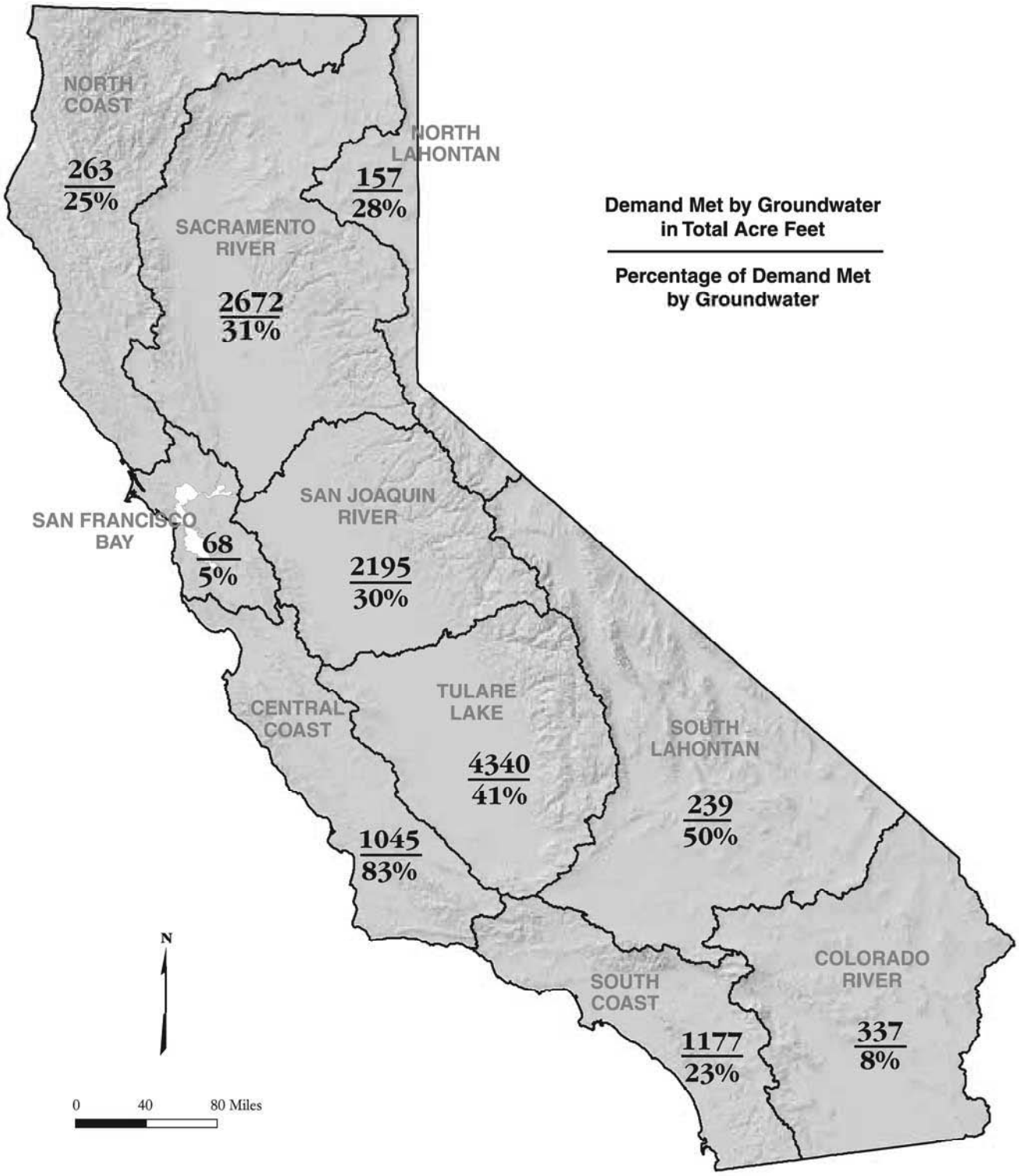

Figure 23 Agricultural and urban demand supplied by groundwater in each hydrologic region

The remainder of this chapter provides a summary of each of the 10 HRs. A basin location map for each HR is followed by a brief discussion of groundwater occurrence and groundwater conditions. A summary tabulation of groundwater information for each groundwater basin within the HR is provided. Greater detail for the data presented in these tables, including a bibliography, is provided in the individual basin/subbasin descriptions in the supplemental report (see Appendix A). Because the groundwater basin numbers are based on the boundaries of the State's nine Regional Water Quality Control Boards (RWQCB), Figure 24 shows the relationship between the Regional Board boundaries and DWR's HR boundaries.

The groundwater basin tabulations give an overview of available data. Where a basin is divided into subbasins, only the information for the subbasins is provided. The data for each subbasin generally come from different sources, so it is inappropriate to sum the data into a larger basin summary. An explanation of each of the data items presented in the summary table is provided in Box R.

Figure 24 Regional Water Quality Control Board regions and Department of Water Resources hydrologic regions

North Coast Hydrologic Region

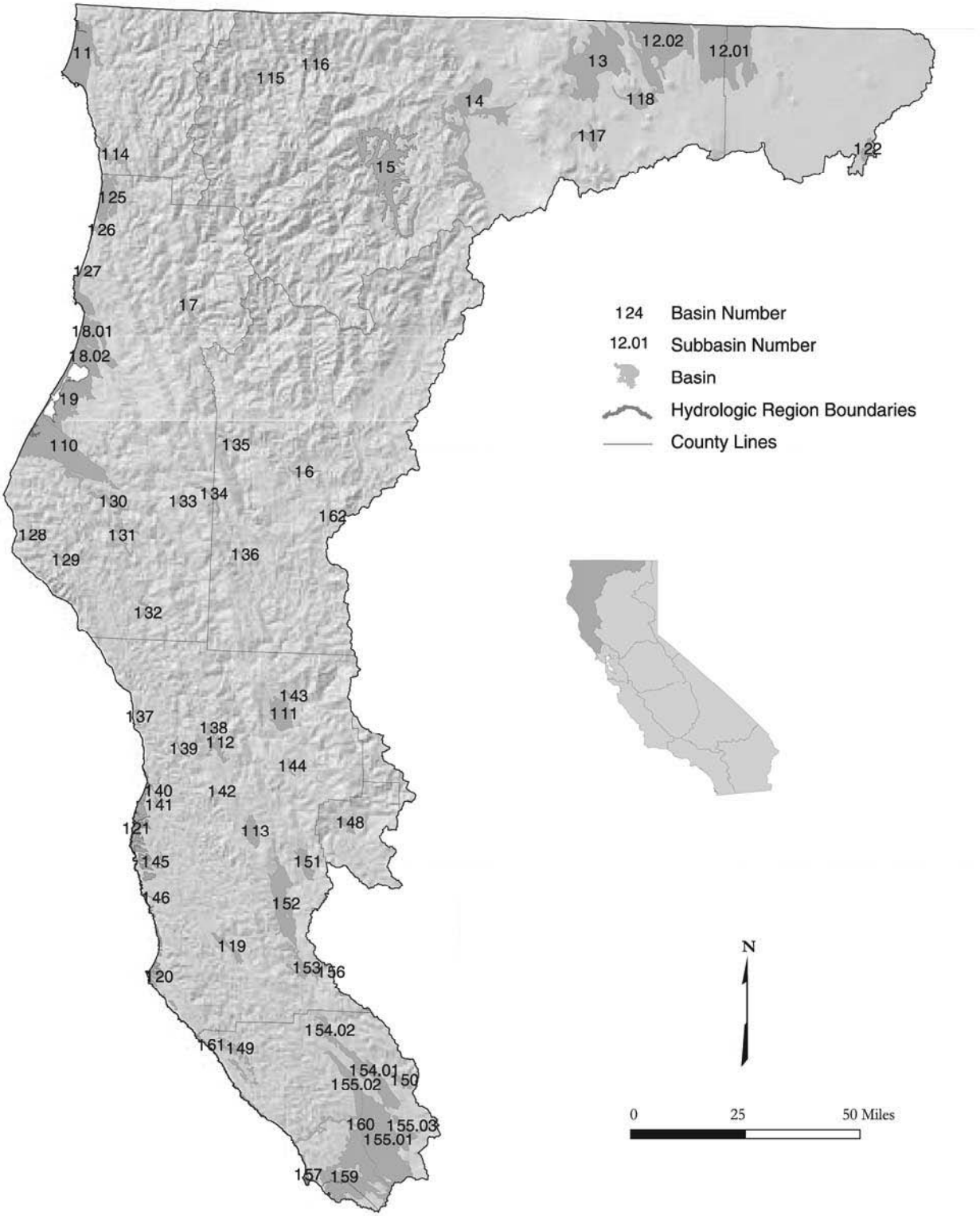

Figure 25 North Coast Hydrologic Region

Basins and Subbasins of the North Coast Hydrologic Region

Basin/subbasin	Basin name
1-1	Smith River Plain
1-2	Klamath River Valley
1-2.01	Tule Lake
1-2.02	Lower Klamath
1-3	Butte Valley
1-4	Shasta Valley
1-5	Scott River Valley
1-6	Hayfork Valley
1-7	Hoopa Valley
1-8	Mad River Valley
1-8.01	Mad River Lowland
1-8.02	Dows Prairie School Area
1-9	Eureka Plain
1-10	Eel River Valley
1-11	Covelo Round Valley
1-12	Laytonville Valley
1-13	Little Lake Valley
1-14	Lower Klamath River Valley
1-15	Happy Camp Town Area
1-16	Seiad Valley
1-17	Bray Town Area
1-18	Red Rock Valley
1-19	Anderson Valley
1-20	Garcia River Valley
1-21	Fort Bragg Terrace Area
1-22	Fairchild Swamp Valley
1-25	Prairie Creek Area
1-26	Redwood Creek Area
1-27	Big Lagoon Area
1-28	Mattole River Valley
1-29	Honeydew Town Area
1-30	Pepperwood Town Area
1-31	Weott Town Area
1-32	Garberville Town Area
1-33	Larabee Valley
1-34	Dinsmores Town Area
1-35	Hyampom Valley
1-36	Hettenshaw Valley
1-37	Cottoneva Creek Valley
1-38	Lower Laytonville Valley
1-39	Branscomb Town Area
1-40	Ten Mile River Valley
1-41	Little Valley
1-42	Sherwood Valley
1-43	Williams Valley
1-44	Eden Valley
1-45	Big River Valley
1-46	Navarro River Valley
1-48	Gravelley Valley
1-49	Annapolis Ohlson Ranch Formation Highlands
1-50	Knights Valley
1-51	Potter Valley
1-52	Ukiah Valley
1-53	Sanel Valley
1-54	Alexander Valley
1-54.01	Alexander Area
1-54.02	Cloverdale Area
1-55	Santa Rosa Valley
1-55.01	Santa Rosa Plain
1-55.02	Healdsburg Area
1-55.03	Rincon Valley
1-56	McDowell Valley
1-57	Bodega Bay Area
1-59	Wilson Grove Formation Highlands
1-60	Lower Russian River Valley
1-61	Fort Ross Terrace Deposits
1-62	Wilson Point Area

Description of the Region

The North Coast HR covers approximately 12.46 million acres (19,470 square miles) and includes all or portions of Modoc, Siskiyou, Del Norte, Trinity, Humboldt, Mendocino, Lake, and Sonoma counties (Figure 25). Small areas of Shasta, Tehama, Glenn, Colusa, and Marin counties are also within the region. Extending from the Oregon border south to Tomales Bay, the region includes portions of four geomorphic provinces. The northern Coast Range forms the portion of the region extending from the southern boundary north to the Mad River drainage and the fault contact with the metamorphic rocks of the Klamath Mountains, which continue north into Oregon. East of the Klamath terrane along the State border are the volcanic terranes of the Cascades and the Modoc Plateau. In the coastal mountains, most of the basins are along the narrow coastal strip between the Pacific Ocean and the rugged Coast Range and Klamath Mountains and along inland river valleys; alluviated basin areas are very sparse in the steep Klamath Mountains. In the volcanic terrane to the east, most of the basins are in block faulted valleys that once held Pleistocene-age lakes. The North Coast HR corresponds to the boundary of RWQCB 1. Significant geographic features include basin areas such as the Klamath River Basin, the Eureka/Arcata area, Hoopa Valley, Anderson Valley, and the Santa Rosa Plain. Other significant features include Mount Shasta, forming the southern border of Shasta Valley, and the rugged north coastal shoreline. The 1995 population of the entire region was about 606,000, with most being centered along the Pacific Coast and in the inland valleys north of the San Francisco Bay Area.

The northern mountainous portion of the region is rural and sparsely populated, primarily because of the rugged terrain. Most of the area is heavily forested. Some irrigated agriculture occurs in the narrow river valleys, but most occurs in the broader valleys on the Modoc Plateau where pasture, grain and alfalfa predominate. In the southern portion of the region, closer to urban centers, crops like wine grapes, nursery stock, orchards, and truck crops are common.

A majority of the surface water in the North Coast HR goes to environmental uses because of the "wild and scenic" designation of most of the region's rivers. Average annual precipitation ranges from 100 inches in the Smith River drainage to 29 inches in the Santa Rosa area and about 10 inches in the Klamath drainage; as a result, drought is likely to affect the Klamath Basin more than other portions of the region. Communities that are not served by the area's surface water projects also tend to experience shortages. Surface water development in the region includes the U.S. Bureau of Reclamation (USBR) Klamath Project, Humboldt Bay Municipal Water District's Ruth Lake, and U.S. Army Corps of Engineer's Russian River Project. An important factor concerning water demand in the Klamath Project area is water allocation for endangered fish species in the upper and lower basin. Surface water deliveries for agriculture in 2001, a severe drought year, were only about 20 percent of normal.

Groundwater Development

Groundwater development in the North Coast HR occurs along the coast, near the mouths of some of the region's major rivers, on the adjacent narrow marine terraces, or in the inland river valleys and basins. Reliability of these supplies varies significantly from area to area. There are 63 groundwater basins/subbasins delineated in the region, two of which are shared with Oregon. These basins underlie approximately 1.022 million acres (1,600 square miles).

Along the coast, most groundwater is developed from shallow wells installed in the sand and gravel beds of several of the region's rivers. Under California law, the water produced in these areas is considered surface water underflow. Water from Ranney collectors installed in the Klamath River, Rowdy Creek, the Smith

River, and the Mad River supply the towns of Klamath, Smith River and Crescent City in Del Norte County and most of the Humboldt Bay area in Humboldt County. Except on the Mad River, which has continuous supply via releases from Ruth Reservoir, these supplies are dependent on adequate precipitation and flows throughout the season. In drought years when streamflows are low, seawater intrusion can occur causing brackish or saline water to enter these systems. This has been a problem in the town of Klamath, which in 1995 had to obtain community water from a private well source. Toward the southern portion of the region, along the Mendocino coast, the Town of Mendocino typifies the problems related to groundwater development in the shallow marine terrace aquifers. Groundwater supply is limited by the aquifer storage capacity, and surveys done in the Town of Mendocino in the mid-1980s indicate that about 10 percent of wells go dry every year and up to 40 percent go dry during drought years.

Groundwater development in the inland coastal valleys north of the divide between the Russian and Eel Rivers is generally of limited extent. Most problems stemming from reliance on groundwater in these areas is a lack of alluvial aquifer storage capacity. Many groundwater wells rely on hydrologic connection to the rivers and streams of the valleys. The City of Rio Dell has experienced water supply problems in community wells and, as a result, recently developed plans to install a Ranney collector near the Eel River. South of the divide, in the Russian River drainage, a significant amount of groundwater development has occurred on the Santa Rosa Plain and surrounding areas. The groundwater supplies augment surface supplies from the Russian River Project.

In the north-central part of the North Coast HR, the major groundwater basins include the Klamath River Valley, Shasta Valley, Scott River Valley, and Butte Valley. The Klamath River Valley is shared with Oregon. Of these groundwater basins, Butte Valley has the most stable water supply conditions. The historical annual agricultural surface water supply has been about 20,000 acre-feet. As farming in the valley expanded from the early 1950s to the early 1990s, bringing nearly all the arable land in the valley into production, groundwater was developed to farm the additional acres. It has been estimated that current, fully developed demands are only about 80 percent of the available groundwater supply. By contrast, water supply issues in the other three basins are contingent upon pending management decisions regarding restoration of fish populations in the Klamath River and the Upper Klamath Basin system. The Endangered Species Act (ESA) fishery issues include lake level requirements for two sucker fish species and in-stream flow requirements for coho salmon and steelhead trout. Since about 1905, the Klamath Project has provided surface water to the agricultural community, which in turn has provided water to the wildlife refuges. Since the early 1990s, it has been recognized that surface water in the Klamath Project is over-allocated, but very little groundwater development had occurred. In 2001, which was a severe drought year, USBR delivered a total of about 75,000 acre-feet of water to agriculture in California, about 20 percent of normal. In the Klamath River Groundwater Basin this translated to a drought disaster, both for agriculture and the wildlife refuges. In addition, there were significant impacts for both coho salmon and sucker fisheries in the Klamath River watershed. As a result of the reduced surface water deliveries, significant groundwater development occurred, and groundwater extraction increased from an estimated 6,000 acre-feet in 1997 to roughly 60,000 acre-feet in 2001. Because of the complexity of the basin's water issues, a long-term Klamath Project Operation plan has not yet been finalized. Since 1995, USBR has issued an annual operation plan based on estimates of available supply. The Scott River Valley and Shasta Valley rely to a significant extent on surface water diversions. In most years, surface water supplies the majority of demand, and groundwater extraction supplements supply as needed depending on wet or dry conditions. Discussions are under way to develop strategies to conjunctively use surface water and groundwater to meet environmental, agricultural, and other demands.

Groundwater Quality

Groundwater quality characteristics and specific local impairments vary with regional setting within the North Coast HR. In general, seawater intrusion and nitrates in shallow aquifers are problems in the coastal groundwater basins; high total dissolved solids (TDS) content and general alkalinity are problems in the lake sediments of the Modoc Plateau basins; and iron, boron, and manganese can be problems in the inland basins of Mendocino and Sonoma counties.

Water Quality in Public Supply Wells

From 1994 through 2000, 584 public supply water wells were sampled in 32 of the 63 basins and subbasins in the North Coast HR. Analyzed samples indicate that 553 wells, or 95%, met the state primary Maximum Contaminant Levels (MCL) for drinking water. Thirty-one wells, or 5%, sampled have constituents that exceed one or more MCL. Figure 26 shows the percentage of each contaminant group that exceeded MCLs in the 31 wells.

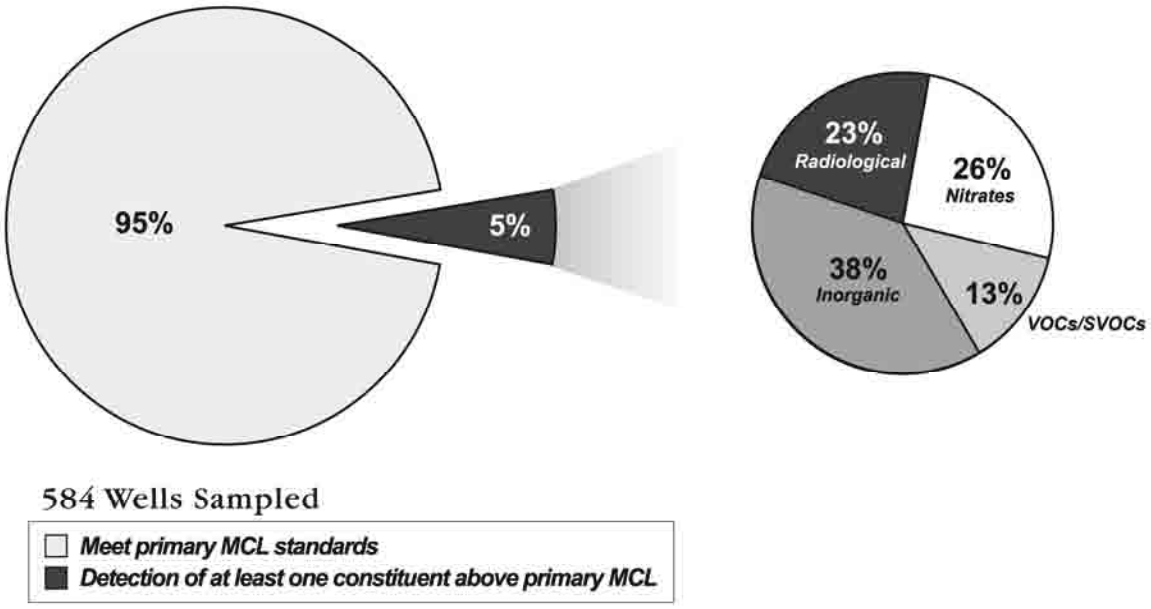

Figure 26 MCL exceedances in public supply wells in the North Coast Hydrologic Region

Table 13 lists the three most frequently occurring individual contaminants in each of the five contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 13 Most frequently occurring contaminants by contaminant group in the North Coast Hydrologic Region

Contaminant group wellsInorganics – Primary exceedance	Contaminant - # of wells Aluminum – 4	Contaminant - # of wells Arsenic – 4	Contaminant - # of 4 tied at 1
Inorganics – Secondary	Manganese – 150	Iron – 108	Copper – 2
Radiological	Radium 228 – 3	Combined RA226 + RA228 – 3	Radium 226 – 1
Nitrates	Nitrate(as NO_3) – 7	Nitrite(as N) – 1	
VOCs/SVOCs	TCE – 2	3 tied at 1 exceedance	

TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Since Bulletin 118-80 was published, RWQCB 2 boundary has been modified. This resulted in several basins being reassigned to RWQCB 1. These are listed in Table 14, along with other modifications to North Coast HR.

Table 14 Modifications since Bulletin 118-80 of groundwater basins in North Coast Hydrologic Region

Basin name	New number	Old number
McDowell Valley	1-56	2-12
Knights Valley	1-50	2-13
Potter Valley	1-51	2-14
Ukiah Valley	1-52	2-15
Sanel Valley	1-53	2-16
Alexander Valley	1-54	2-17
Santa Rosa Valley	1-55	2-18
Lower Russian River Valley	1-60	2-20
Bodega Bay Area	1-57	2-21
Modoc Plateau Recent Volcanic Area	deleted	1-23
Modoc Plateau Pleistocene Volcanic Area	deleted	1-24
Gualala River Valley	deleted	1-47
Wilson Grove Formation Highlands	1-59	2-25
Fort Ross Terrace Deposits	1-61	
Wilson Point Area	1-62	

Fort Ross Terrace Deposits (1-61) and Wilson Point Area (1-62) have been defined since B118-80 and are included in this update. Mad River Valley Groundwater Basin (1-8) has been subdivided into two subbasins. Sebastopol Merced Formation (2-25) merged into Basin 1-59 and was renamed Wilson Grove Formation Highlands.

There are a couple of deletions of groundwater basins from Bulletin 118-80. The Modoc Plateau Recent Volcanic Area (1-23) and the Modoc Plateau Pleistocene Volcanic Area (1-24) are volcanic aquifers and were not assigned basin numbers in this bulletin. These are considered to be groundwater source areas as discussed in Chapter 6. Gualala River Valley (1-47) was deleted because the State Water Resources Control Board determined the water being extracted in this area as surface water within a subterranean stream.

Table 15 North Coast 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
1-1	SMITH RIVER PLAIN	40,450	B	500	50	7	10	33	164	32 - 496
1-2	KLAMATH RIVER VALLEY									
1-2.01	UPPER KLAMATH LAKE BASIN - Tule Lake	85,930	B	3,380	1,208	40	8	5	721	140 - 2,200
1-2.02	UPPER KLAMATH LAKE BASIN - Lower Klamath	73,330	B	2,600	1,550	4	-	-	-	-
1-3	BUTTE VALLEY	79,700	B	5,000	2,358	28	13	9	310	55 - 1,110
1-4	SHASTA VALLEY	52,640	B	1,200	273	9	15	24	-	-
1-5	SCOTT RIVER VALLEY	63,900	B	3,000	794	6	10	5	258	47 - 1,510
1-6	HAYFORK VALLEY	3,300	B	200	-	-	5	-	-	-
1-7	HOOPA VALLEY	3,900	B	300	-	-	4	-	125	95 - 159
1-8	MAD RIVER VALLEY									
1-8.01	MAD RIVER VALLEY LOWLAND	25,600	B	120	72	4	9	2	184	55 - 280
1-8.02	DOWS PRAIRIE SCHOOL AREA	14,000	B	-	-	-	3	-	-	-
1-9	EUREKA PLAIN	37,400	B	1,200	-	4	4	6	177	97 - 460
1-10	EEL RIVER VALLEY	73,700	B	1,200	-	8	11	29	237	110 - 340
1-11	COVELO ROUND VALLEY	16,400	C	850	193	9	5	29	239	116 - 381
1-12	LAYTONVILLE VALLEY	5,020	A	700	7	4	3	-	149	53 - 251
1-13	LITTLE LAKE VALLEY	10,000	A	1,000	45	7	7	-	340	97 - 1,710
1-14	LOWER KLAMATH RIVER VALLEY	7,030	B	-	-	-	-	-	-	43 - 150
1-15	HAPPY CAMP TOWN AREA	2,770	B	-	-	-	-	17	-	-
1-16	SEIAD VALLEY	2,250	B	-	-	-	2	2	-	-
1-17	BRAY TOWN AREA	8,030	B	-	-	-	-	-	-	-
1-18	RED ROCK VALLEY	9,000	B	-	-	-	-	-	-	-
1-19	ANDERSON VALLEY	4,970	C	300	30	7	5	7	-	80 - 400
1-20	GARCIA RIVER VALLEY	2,240	C	-	-	-	-	-	-	-
1-21	FORT BRAGG TERRACE AREA	24,100	C	75	14	-	-	51	185	26 - 650
1-22	FAIRCHILD SWAMP VALLEY	3,300	B	-	-	-	-	-	-	-
1-25	PRAIRIE CREEK AREA	20,000	B	-	-	-	-	1	106	-
1-26	REDWOOD CREEK AREA	2,000	B	-	-	1	0	4	-	102 - 332
1-27	BIG LAGOON AREA	13,400	B	-	-	1	0	31	174	-
1-28	MATTOLE RIVER VALLEY	3,150	B	-	-	-	-	2	-	-
1-29	HONEYDEW TOWN AREA	2,370	B	-	-	-	-	1	-	-
1-30	PEPPERWOOD TOWN AREA	6,290	B	-	-	-	-	1	-	-
1-31	WEOTT TOWN AREA	3,650	B	-	-	-	-	2	-	-
1-32	GARBERVILLE TOWN AREA	2,100	B	-	-	-	-	5	-	-
1-33	LARABEE VALLEY	970	B	-	-	-	-	-	-	-
1-34	DINSMORES TOWN AREA	2,300	B	-	-	-	-	3	-	-
1-35	HYAMPOM VALLEY	1,350	B	-	-	-	-	1	-	-
1-36	HETTENSHAW VALLEY	850	B	-	-	-	-	-	-	-
1-37	COTTONEVA CREEK VALLEY	760	C	-	-	-	-	-	118	118
1-38	LOWER LAYTONVILLE VALLEY	2,150	C	-	-	-	-	-	-	-
1-39	BRANSCOMB TOWN AREA	1,320	C	-	-	-	-	-	130	80 - 179
1-40	TEN MILE RIVER VALLEY	1,490	C	-	-	-	-	-	-	-
1-41	LITTLE VALLEY	810	C	-	-	-	-	-	-	-

Table 15 North Coast Hydrologic Region groundwater data (continued)

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
1-42	SHERWOOD VALLEY	1,150	C	-	-	-	-	-	-	-
1-43	WILLIAMS VALLEY	1,640	C	-	-	-	-	-	-	-
1-44	EDEN VALLEY	1,380	C	-	-	-	-	-	140	140
1-45	BIG RIVER VALLEY	1,690	C	-	-	-	-	2	-	-
1-46	NAVARRO RIVER VALLEY	770	C	-	-	-	-	-	-	-
1-48	GRAVELLEY VALLEY	3,000	C	-	-	-	-	3	-	-
1-49	ANAPOLIS OHLSON RANCH FOR. HIGHLANDS	8,650	C	36	-	-	0	1	260	260
1-50	KNIGHTS VALLEY	4,090	C	-	-	-	-	-	-	-
1-51	POTTER VALLEY	8,240	C	100	-	2	0	1	-	140 - 395
1-52	UKIAH VALLEY									
1-53	SANEL VALLEY	5,570	C	1,250	-	5	8	6	-	174 - 306
1-54	ALEXANDER VALLEY									
1-54.01	ALEXANDER AREA									
1-54.02	CLOVERDALE AREA	6,500	C	-	500	3	-	13	-	130 - 304
1-55	SANTA ROSA VALLEY									
1-55.01	SANTA ROSA PLAIN	80,000	A	1,500	-	43	-	155	-	-
1-55.02	HEALDSBURG AREA	15,400	C	500	-	8	-	28	-	90 - 500
1-55.03	RINCON VALLEY	5,600	C	-	-	2	-	12	-	-
1-56	McDOWELL VALLEY	1,500	C	1,200	-	-	-	-	145	143 - 146
1-57	BODEGA BAY AREA	2,680	A	150	-	-	-	6	-	-
1-59	WILSON GROVE FORMATION HIGHLANDS	81,500	C	-	-	14	-	68	-	-
1-60	LOWER RUSSIAN RIVER VALLEY	6,600	C	500 +	-	1	-	32	-	120 - 210
1-61	FORT ROSS TERRACE DEPOSITS	8,490	C	75	27	-	-	13	320	230 - 380
1-62	WILSON POINT AREA	700	B	-	-	-	-	-	-	-

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

San Francisco Bay Hydrologic Region

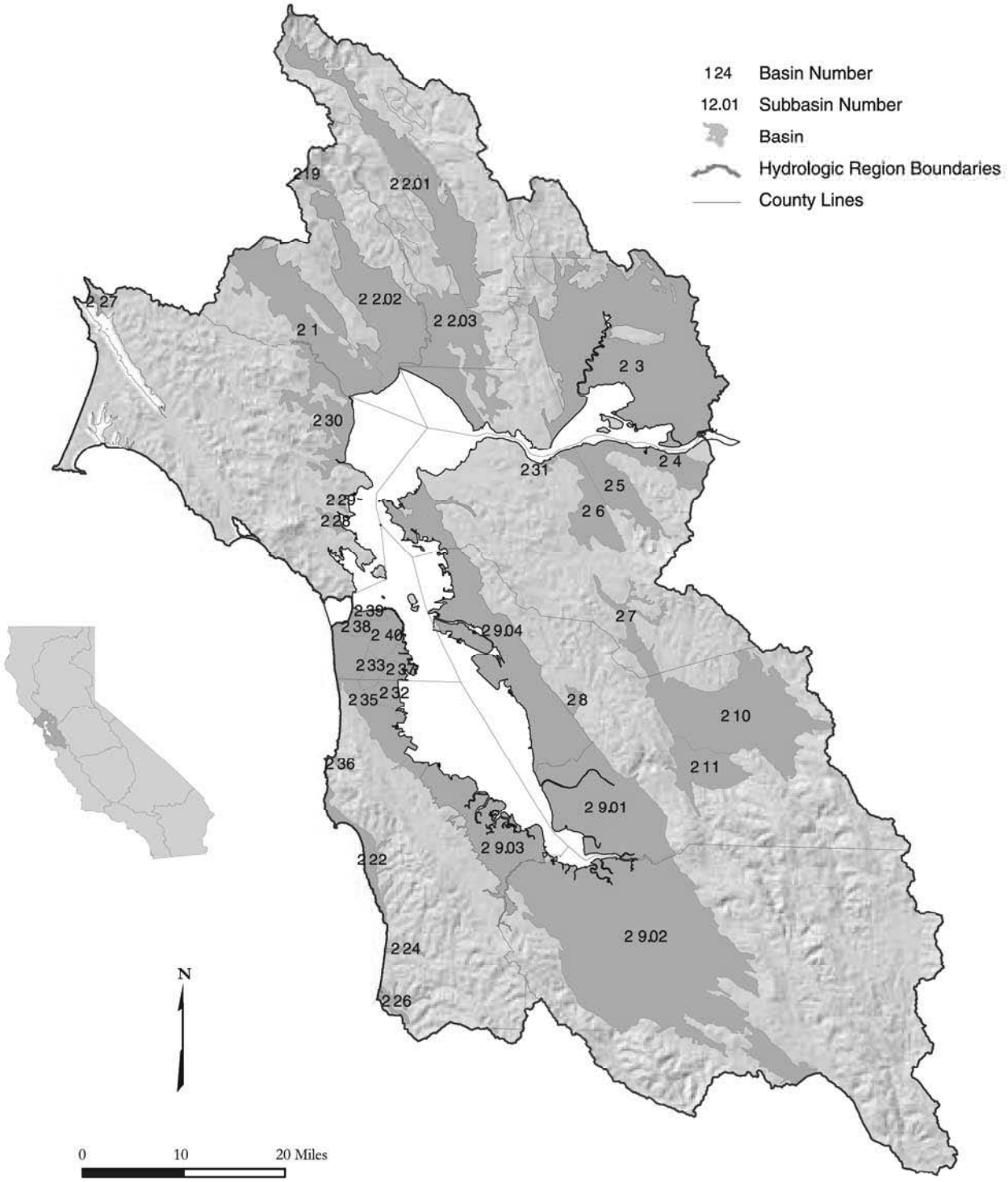

Figure 27 San Francisco Bay Hydrologic Region

Basins and Subbasins of the San Francisco Bay Hydrologic Region

Basin/subbasin	Basin name
2-1	Petaluma Valley
2-2	Napa-Sonoma Valley
2-2.01	Napa Valley
2-2.02	Sonoma Valley
2-2.03	Napa-Sonoma Lowlands
2-3	Suisun-Fairfield Valley
2-4	Pittsburg Plain
2-5	Clayton Valley
2-6	Ygnacio Valley
2-7	San Ramon Valley
2-8	Castro Valley
2-9	Santa Clara Valley
2-9.01	Niles Cone
2-9.02	Santa Clara
2-9.03	San Mateo Plain
2-9.04	East Bay Plain
2-10	Livermore Valley
2-11	Sunol Valley
2-19	Kenwood Valley
2-22	Half Moon Bay Terrace
2-24	San Gregorio Valley
2-26	Pescadero Valley
2-27	Sand Point Area
2-28	Ross Valley
2-29	San Rafael Valley
2-30	Novato Valley
2-31	Arroyo Del Hambre Valley
2-32	Visitacion Valley
2-33	Islais Valley
2-35	Merced Valley
2-36	San Pedro Valley
2-37	South San Francisco
2-38	Lobos
2-39	Marina
2-40	Downtown San Francisco

Description of the Region

The San Francisco Bay HR covers approximately 2.88 million acres (4,500 square miles) and includes all of San Francisco and portions of Marin, Sonoma, Napa, Solano, San Mateo, Santa Clara, Contra Costa, and Alameda counties (Figure 27). The region corresponds to the boundary of RWQCB 2. Significant geographic features include the Santa Clara, Napa, Sonoma, Petaluma, Suisun-Fairfield, and Livermore valleys; the Marin and San Francisco peninsulas; San Francisco, Suisun, and San Pablo bays; and the Santa Cruz Mountains, Diablo Range, Bolinas Ridge, and Vaca Mountains of the Coast Range. While being the smallest in size of the 10 HRs, the region has the second largest population in the State at about 5.8 million in 1995 (DWR 1998). Major population centers include the cities of San Francisco, San Jose and Oakland.

Groundwater Development

The region has 28 identified groundwater basins. Two of those, the Napa-Sonoma Valley and Santa Clara Valley groundwater basins, are further divided into three and four subbasins, respectively. The groundwater basins underlie approximately 896,000 acres (1,400 square miles) or about 30 percent of the entire HR.

Despite the tremendous urban development in the region, groundwater use accounts for only about 5 percent (68,000 acre-feet) of the region's estimated average water supply for agricultural and urban uses, and accounts for less than one percent of statewide groundwater uses.

In general, the freshwater-bearing aquifers are relatively thin in the smaller basins and moderately thick in the more heavily utilized basins. The more heavily utilized basins in this region include the Santa Clara Valley, Napa-Sonoma Valley, and Petaluma Valley groundwater basins. In these basins, the municipal and irrigation wells have average depths ranging from about 200 to 500 feet. Well yields in these basins range from less than 50 gallons per minute (gpm) to approximately 3,000 gpm. In the smaller basins, most municipal and irrigation wells have average well depths in the 100- to 200-foot range. Well yields in the smaller and less utilized basins are typically less than 500 gpm.

Land subsidence has been a significant problem in the Santa Clara Valley Groundwater Basin in the past. An extensive annual monitoring program has been set up within the basin to evaluate changes in an effort to maintain land subsidence at less than 0.01 feet per year (SCVWD 2001). Additionally, groundwater recharge projects have been implemented in the Santa Clara Valley to ensure that groundwater will continue to be a viable water supply in the future.

Groundwater Quality

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

The areas of high TDS (and chloride) concentrations are typically found in the region's groundwater basins that are situated close to the San Francisco Bay, such as the northern Santa Clara, southern Sonoma, Petaluma, and Napa valleys. Elevated levels of nitrate have been detected in a large percentage of private wells tested within the Coyote Subbasin and Llagas Subbasin of the Gilroy-Hollister Valley Groundwater Basin (in the Central Coast HR) located to the south of the Santa Clara Valley (SCVWD 2001). The shallow aquifer zone within the Petaluma Valley also shows persistent nitrate contamination. Groundwater with high TDS, iron, and boron levels is present in the Calistoga area of Napa Valley, and elevated boron levels in other parts of Napa Valley make the water unfit for agricultural uses. Releases of fuel hydrocarbons from leaking underground storage tanks and spills/leaks of organic solvents at industrial sites have caused minor to significant groundwater impacts in many basins throughout the region. Methyl tertiary-butyl ether (MTBE) and chlorinated solvent releases to soil and groundwater continue to be problematic. Environmental oversight for many of these sites is performed either by local city and county enforcement agencies, the RWQCB, the Department of Toxic Substances Control, and/or the U.S. Environmental Protection Agency.

Water Quality in Public Supply Wells

From 1994 through 2000, 485 public supply water wells were sampled in 18 of the 33 basins and subbasins in the San Francisco Bay HR. Analyzed samples indicate that 410 wells, or 85 percent, met the state primary MCLs for drinking water standards. Seventy-five wells, or 15 percent, have constituents that exceed one or more MCL. Figure 28 shows the percentages of each contaminant group that exceeded MCLs in the 75 wells.

Table 16 lists the three most frequently occurring contaminants in each contaminant group and the number of wells in the HR that exceeded the MCL for those contaminants.

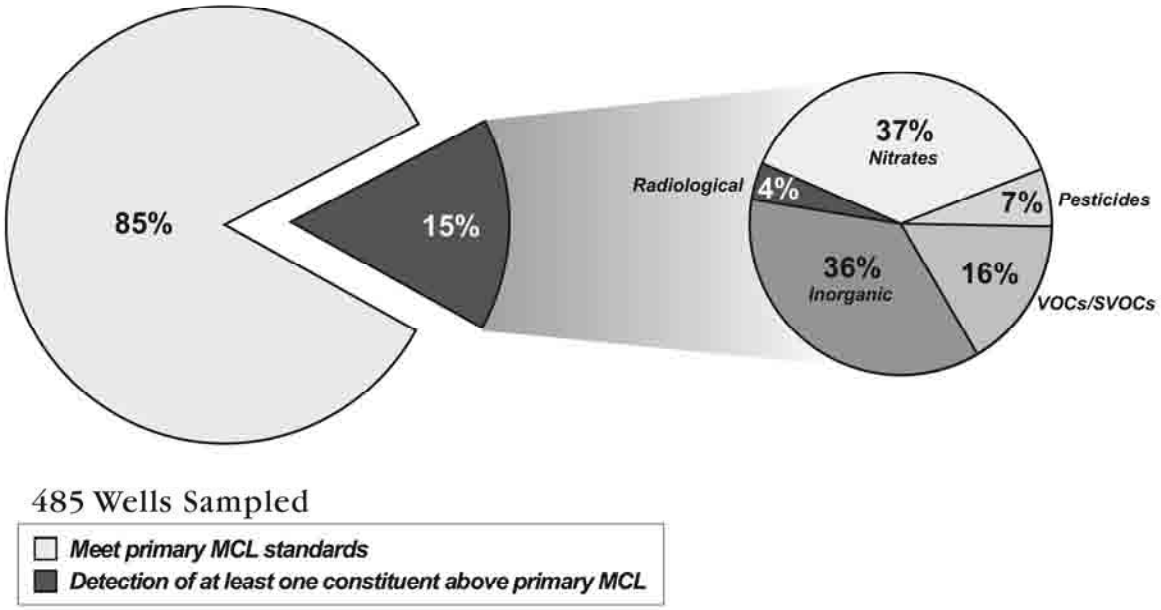

Figure 28 MCL exceedances in public supply wells in the San Francisco Bay Hydrologic Region

Table 16 Most frequently occurring contaminants by contaminant group in the San Francisco Bay Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics	Iron – 57	Manganese – 57	Fluoride – 7
Radiological	Gross Alpha – 2	Radium 226 – 1	
Nitrates	Nitrate (as NO_3) – 27	Nitrate + Nitrite – 3	Nitrite (as N) – 1
Pesticides	Di(2-Ethylhexyl)phthalate – 4	Heptachlor – 1	
VOCs/SVOCs	PCE – 4	Dichloromethane – 3	TCE– 2 Vinyl Chloride – 2

TCE = Trichloroethylene
PCE = Tetrachloroethylene
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Coumpound

Changes from Bulletin 118-80

Since Bulletin 118-80 was published, RWQCB 2 boundary has been modified. This resulted in several basins being reassigned to RWQCB 1. These are listed in Table 17.

Table 17 Modifications since Bulletin 118-80 of groundwater basins in San Francisco Bay Hydrologic Region

Basin name	New number	Old number
McDowell Valley	1-56	2-12
Knights Valley	1-50	2-13
Potter Valley	1-51	2-14
Ukiah Valley	1-52	2-15
Sanel Valley	1-53	2-16
Alexander Valley	1-54	2-17
Santa Rosa Valley	1-55	2-18
Lower Russian River Valley	1-60	2-20
Bodega Bay Area	1-57	2-21

No additional basins were assigned to the San Francisco Bay HR in this revision. However, the Santa Clara Valley Groundwater Basin (2-9) has been subdivided into four subbasins instead of two, and the Napa-Sonoma Valley Groundwater Basin is now three subbasins instead of two.

There are several deletions of groundwater basins from Bulletin 118-80. The San Francisco Sand Dune Area (2-34) was deleted when the San Francisco groundwater basins were redefined in a USGS report in the early 1990s. The Napa-Sonoma Volcanic Highlands (2-23) is a volcanic aquifer and was not assigned a basin number in this bulletin. This is considered to be a groundwater source area as discussed in Chapter 6. Bulletin 118-80 identified seven groundwater basins that were stated to differ from 118-75: Sonoma County Basin, Napa County Basin, Santa Clara County Basin, San Mateo Basin, Alameda Bay Plain Basin, Niles Cone Basin, and Livermore Basin. They were created primarily by combining several smaller basins and subbasins within individual counties. This report does not consider these seven as basins. There is no change in numbering because the basins were never assigned a basin number.

Table 18 San Francisco Bay Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
2-1	PETALUMA VALLEY	46,100	C	100	-	16	7	24	347	58-650
2-2	NAPA-SONOMA VALLEY									
2-2.01	NAPA VALLEY	45,900	A	3,000	223	19	10	23	272	150-370
2-2.02	SONOMA VALLEY	44,700	C	1,140	516	18	9	35	321	100-550
2-2.03	NAPA-SONOMA LOWLANDS	40,500	C	300	98	0	6	9	185	50-300
2-3	SUISUN-FAIRFIELD VALLEY	133,600	C	500	200	21	17	35	410	160-740
2-4	PITTSBURG PLAIN	11,600	C	-	-	-	-	9	-	-
2-5	CLAYTON VALLEY	17,800	C	-	-	-	-	48	-	-
2-6	YGNACIO VALLEY	15,500	C	-	-	-	-	-	-	-
2-7	SAN RAMON VALLEY	7,060	C	-	-	-	-	-	-	-
2-8	CASTRO VALLEY	1,820	C	-	-	-	-	-	-	-
2-9	SANTA CLARA VALLEY									
2-9.01	NILES CONE	57,900	A	3,000	2,000	350	120	20	-	-
2-9.02	SANTA CLARA	190,000	C	-	-	-	10	234	408	200-931
2-9.03	SAN MATEO PLAIN	48,100	C	-	-	-	2	14	407	300-480
2-9.04	EAST BAY PLAIN	77,400	A	1,000	UNK	29	16	7	638	364-1,420
2-10	LIVERMORE VALLEY	69,500	A	-	-	-	-	36	-	-
2-11	SUNOL VALLEY	16,600	C	-	-	-	-	2	-	-
2-19	KENWOOD VALLEY	3,170	C	-	-	-	-	13	-	-
2-22	HALF MOON BAY TERRACE	9,150	C	-	-	5	-	9	-	-
2-24	SAN GREGORIO VALLEY	1,070	C	-	-	-	-	-	-	-
2-26	PESCADERO VALLEY	2,900	C	-	-	3	-	4	-	-
2-27	SAND POINT AREA	1,400	C	-	-	-	-	6	-	-
2-28	ROSS VALLEY	1,770	C	-	-	-	-	-	-	-
2-29	SAN RAFAEL VALLEY	880	C	-	-	-	-	-	-	-
2-30	NOVATO VALLEY	20,500	C	-	-	-	-	1	-	-
2-31	ARROYO DEL HAMBRE VALLEY	790	C	-	-	-	-	-	-	-
2-32	VISITACION VALLEY	880	C	-	-	-	-	-	-	-
2-33	ISLAIS VALLEY	1,550	C	-	-	-	-	-	-	-
2-35	MERCED VALLEY	10,400	C	-	-	-	-	10	-	-
2-36	SAN PEDRO VALLEY	880	C	-	-	-	-	-	-	-
2-37	SOUTH SAN FRANCISCO	2,170	C	-	-	-	-	-	-	-
2-38	LOBOS	2,400	A	-	-	-	-	-	-	-
2-39	MARINA	220	A	-	-	-	-	-	-	-
2-40	DOWNTOWN SAN FRANCISCO	7,600	C	-	-	-	-	-	-	-

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

Central Coast Hydrologic Region

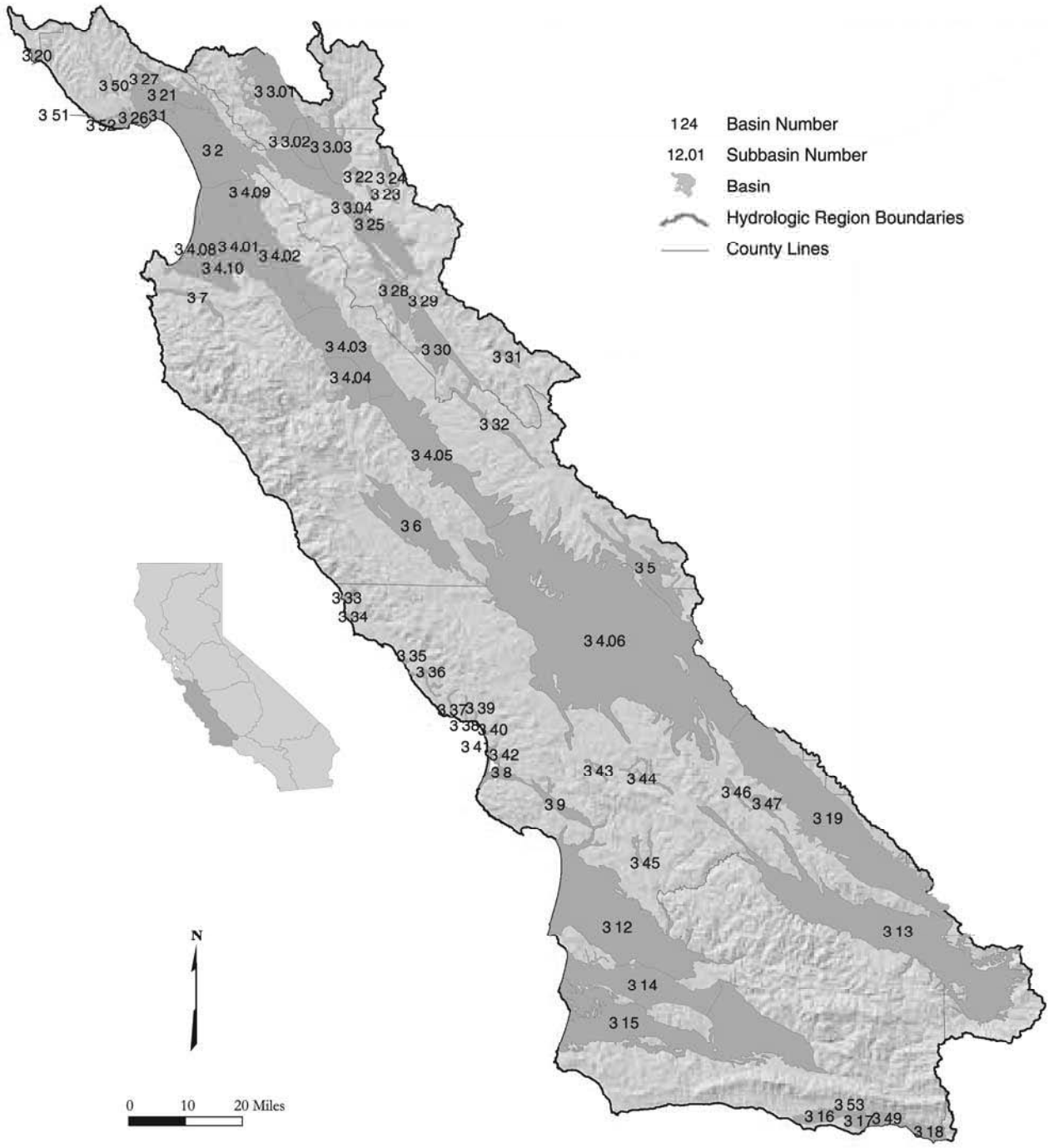

Figure 29 Central Coast Hydrologic Region

Basins and Subbasins of Central Coast Hydrologic Region

RegionBasin/ subbasin	Basin name
3-1	Soquel Valley
3-2	Pajaro Valley
3-3	Gilroy-Hollister Valley
3-3.01	Llagas Area
3-3.02	Bolsa Area
3-3.03	Hollister Area
3-3.04	San Juan Bautista Area
3-4	Salinas Valley
3-4.01	180/400 Foot Aquifer
3-4.02	East Side Aquifer
3-4.04	Forebay Aquifer
3-4.05	Upper Valley Aquifer
3-4.06	Paso Robles Area
3-4.08	Seaside Area
3-4.09	Langley Area
3-4.10	Corral de Tierra Area
3-5	Cholame Valley
3-6	Lockwood Valley
3-7	Carmel Valley
3-8	Los Osos Valley
3-9	San Luis Obispo Valley
3-12	Santa Maria River Valley
3-13	Cuyama Valley
3-14	San Antonio Creek Valley
3-15	Santa Ynez River Valley
3-16	Goleta
3-17	Santa Barbara
3-18	Carpinteria
3-19	Carrizo Plain
3-20	Ano Nuevo Area
3-21	Santa Cruz Purisima Formation
3-22	Santa Ana Valley
3-23	Upper Santa Ana Valley
3-24	Quien Sabe Valley
3-25	Tres Pinos Valley
3-26	West Santa Cruz Terrace
3-27	Scotts Valley
3-28	San Benito River Valley
3-29	Dry Lake Valley
3-30	Bitter Water Valley
3-31	Hernandez Valley
3-32	Peach Tree Valley
3-33	San Carpoforo Valley
3-34	Arroyo de la Cruz Valley

RegionBasin/ subbasin	Basin name
3-35	San Simeon Valley
3-36	Santa Rosa Valley
3-37	Villa Valley
3-38	Cayucos Valley
3-39	Old Valley
3-40	Toro Valley
3-41	Morro Valley
3-42	Chorro Valley
3-43	Rinconada Valley
3-44	Pozo Valley
3-45	Huasna Valley
3-46	Rafael Valley
3-47	Big Spring Area
3-49	Montecito
3-50	Felton Area
3-51	Majors Creek
3-52	Needle Rock Point
3-53	Foothill

Description of the Region

The Central Coast HR covers approximately 7.22 million acres (11,300 square miles) in central California (Figure 29). This HR includes all of Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara counties, most of San Benito County, and parts of San Mateo, Santa Clara, and Ventura counties. Significant geographic features include the Pajaro, Salinas, Carmel, Santa Maria, Santa Ynez, and Cuyama valleys; the coastal plain of Santa Barbara; and the Coast Range. Major drainages in the region include the Salinas, Cuyama, Santa Ynez, Santa Maria, San Antonio, San Lorenzo, San Benito, Pajaro, Nacimiento, Carmel, and Big Sur Rivers.

Population data from the 2000 Census suggest that about 1.4 million people or about 4 percent of the population of the State live in this HR. Major population centers include Santa Barbara, Santa Maria, San Luis Obispo, Gilroy, Hollister, Morgan Hill, Salinas, and Monterey.

The Central Coast HR has 50 delineated groundwater basins. Within this region, the Gilroy-Hollister Valley and Salinas Valley groundwater basins are divided into four and eight subbasins, respectively. Groundwater basins in this HR underlie about 2.390 million acres (3,740 square miles) or about one-third of the HR.

Groundwater Development

Locally, groundwater is an extremely important source of water supply. Within the region, groundwater accounted for 83 percent of the annual supply used for agricultural and urban purposes in 1995. For an average year, groundwater in the region accounts for about 8.4 percent of the statewide groundwater supply and about 1.3 percent of the total state water supply for agricultural and urban needs. In drought years, groundwater in this region is expected to account for about 7.2 percent of the statewide groundwater supply and about 1.9 percent of the total State water supply for agricultural and urban needs (DWR 1998).

Aquifers are varied and range from large extensive alluvial valleys with thick multilayered aquifers and aquitards to small inland valleys and coastal terraces. Several of the larger basins provide a dependable and drought-resistant water supply to coastal cities and farms.

Conjunctive use of surface water and groundwater is a long-standing practice in the region. Several reservoirs including Hernandez, Twitchell, Lake San Antonio, and Lake Nacimiento are operated primarily for the purpose of groundwater recharge. The concept is to maintain streamflow over a longer period than would occur without surface water storage and thus provide for increased recharge of groundwater. Seawater intrusion is a major problem throughout much of the region. In the Salinas Valley Groundwater Basin, seawater intrusion was first documented in the 1930s and has been observed more than 5 miles inland.

Groundwater Quality

Much of the groundwater in the region is characterized by calcium sulfate to calcium sodium bicarbonate sulfate water types because of marine sedimentary rock in the watersheds. Aquifers intruded by seawater are typically characterized by sodium chloride to calcium chloride, and have chloride concentrations greater than 500 mg/L. In several areas, groundwater exceeds the MCL for nitrate.

Water Quality in Public Supply Wells

From 1994 through 2000, 711 public supply water wells were sampled in 38 of the 60 basins and subbasins in the Central Coast HR. Analyzed samples indicate that 587 wells, or 83 percent, met the state primary MCLs for drinking water. One-hundred-twenty-four wells, or 17 percent, have constituents that exceed one or more MCL. Figure 30 shows the percentages of each contaminant group that exceeded MCLs in the 124 wells.

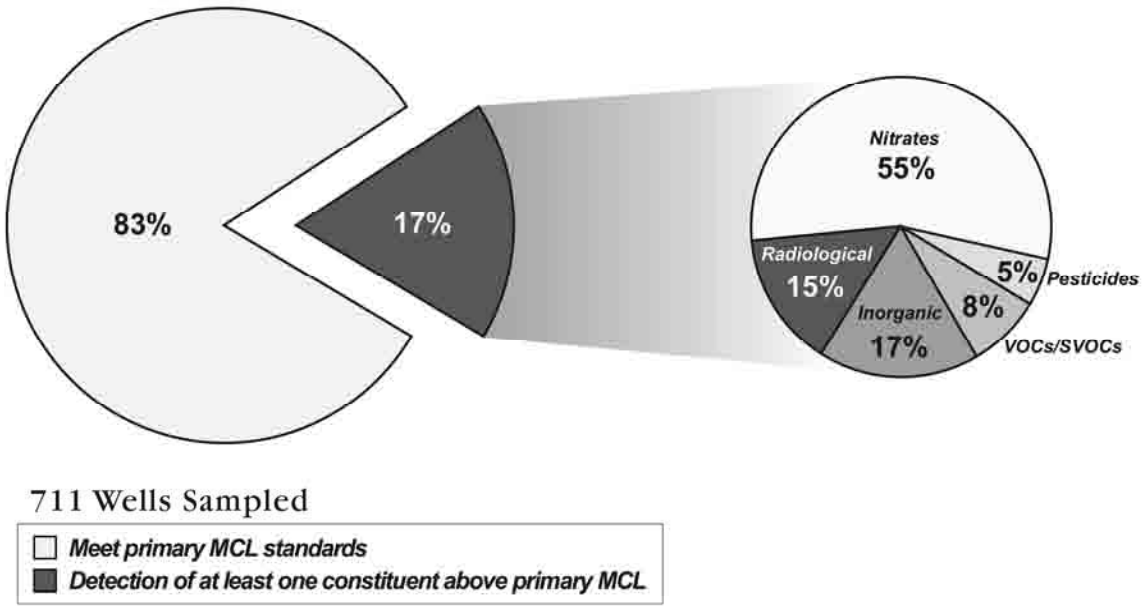

Figure 30 MCL exceedances in public supply wells in the Central Coast Hydrologic Region

Table 19 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.

Table 19 Most frequently occurring contaminants by contaminant group in the Central Coast Hydrologic Region

Contaminant group wells	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of
Inorganics – Primary	Antimony – 6	Aluminum – 4	Chromium (Total) – 4
Inorganics – Secondary	Iron – 145	Manganese – 135	TDS – 11
Radiological	Gross Alpha – 15	Radium 226 – 3	Uranium – 3
Nitrates	Nitrate (as NO_3) – 69	Nitrate + Nitrite – 24	
Pesticides	Heptachlor – 4	Di (2-Ethylhexyl) phthalate – 2	
VOCs/SVOCs	TCE – 3	3 are tied at 2 exceedances	

TCE = Trichloroethylene
VOC = Volatile Organic Compound
SVOC= Semivolatile Organic Compound

Changes from Bulletin 118-80

Four new basins have been defined since Bulletin 118-80. They are Felton Area, Majors Creek, Needle Rock Point, and Foothill groundwater basins. Additionally, new subbasins have been broken out in both the Gilroy-Hollister Valley Groundwater Basin (3-3) and the Salinas Valley Groundwater Basin (3-4) (Table 20).

Table 20 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Central Coast Hydrologic Region

Subbasin name	New number	Old number
Llagas Area	3-3.01	3-3
Bolsa Area	3-3.02	3-3
Hollister Area	3-3.03	3-3
San Juan Bautista Area	3-3.04	3-3
180/400 Foot Aquifer	3-4.01	3-4
East Side Aquifer	3-4.02	3-4
Upper Forebay Aquifer	3-4.04	3-4
Upper Valley Aquifer	3-4.05	3-4
Pismo Creek Valley Basin	3-12	3-10
Arroyo Grande Creek Basin	3-12	3-11
Careaga Sand Highlands Basin	3-12 and 3-14	3-48
Felton Area	3-50	
Majors Creek	3-51	
Needle Rock Point	3-52	
Foothill	3-53	

Pismo Creek Valley Basin (3-10) and Arroyo Grande Creek Basin (3-11) have been merged into the Santa Maria River Valley Basin (3-12). Careaga Sand Highlands Basin (3-48) has been merged into the Santa Maria River Valley Basin (3-12) and San Antonio Creek Valley Basin (3-14).

Table 21 Central Coast 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
3-1	SOQUEL VALLEY	2,500	C	1,421	665	6	6	16	482	270-990
3-2	PAJARO VALLEY	76,800	A	2,000	500	185	185	149	580-910	300-30,000
3-3	GILROY-HOLLISTER VALLEY									
3-3.01	LLAGAS AREA	55,600	C	-	-	-	-	95	-	-
3-3.02	BOLSA AREA	21,000	A	-	400	11	<11	3	-	400-1800
3-3.03	HOLLISTER AREA	32,700	A	-	400	42	<42	35	-	400-1600
3-3.04	SAN JUAN BAUTISTA AREA	74,300	A	-	400	37	<37	40	-	460-1700
3-4	SALINAS VALLEY									
3-4.01	180/400 FOOT AQUIFER	84,400	A	-	-	166	218	82	478	223-1,013
3-4.02	EAST SIDE AQUIFER	57,500	A	-	-	74	67	53	450	168-977
3-4.04	FOREBAY AQUIFER	94,100	A	-	-	89	91	35	624	300-1,100
3-4.05	UPPER VALLEY AQUIFER	98,200	A	4,000	-	36	37	17	443	140-3,700
3-4.06	PASO ROBLES AREA	597,000	A	3,300	-	183	-	58	614	165-3,868
3-4.08	SEASIDE AREA	25,900	B	3,500	1,000		7	24	400	200-900
3-4.09	LANGLEY AREA	15,400	B	1,570	450	-	-	52	-	52-348
3-4.10	CORRAL DE TIERRA AREA	22,300	C	948	450	-	3	26	-	355-679
3-5	CHOLAME VALLEY	39,800	C	3,000	1,000	1	-	1	-	-
3-6	LOCKWOOD VALLEY	59,900	C	1,500	100	-	-	9	-	-
3-7	CARMEL VALLEY	5,160	C	1,000	600	50	23	12	260-670	220-1,200
3-8	LOS OSOS VALLEY	6,990	A	700	230	-	-	10	354	78-33,700
3-9	SAN LUIS OBISPO VALLEY	12,700	A	600	300	-	-	11	583	278-1,949
3-12	SANTA MARIA RIVER VALLEY	184,000	A	2,500	1,000	286	10	108	598	139-1,200
3-13	CUYAMA VALLEY	147,000	A	4,400	1,100	17	2	8	-	206-3,905
3-14	SAN ANTONIO CREEK VALLEY	81,800	A	-	400	30	-	9	415	129-8,040
3-15	SANTA YNEZ RIVER VALLEY	204,000	A	1,300	750	163	21	76	507	400-700
3-16	GOLETA	9,210	A	800	500	49	11	17	755	617-929
3-17	SANTA BARBARA	6,160	A	625	560	75	36	5	-	217-385
3-18	CARPINTERIA	8,120	A	500	300	41	41	4	557	317-1,780
3-19	CARRIZO PLAIN	173,000	C	1,000	500	-	-	1	-	-
3-20	ANO NUEVO AREA	2,032	C	-	-	-	-	2	-	-
3-21	SANTA CRUZ PURISIMA FORMATION	40,200	C	200	20	-	-	39	440	380-560
3-22	SANTA ANA VALLEY	2,720	C	130	-	-	-	-	-	-
3-23	UPPER SANTA ANA VALLEY	1,430	C	-	-	-	-	-	-	-
3-24	QUIEN SABE VALLEY	4,710	C	122	122	-	-	-	-	-
3-25	TRES PINOS VALLEY	3,390	C	1,225	-	-	-	3	-	-
3-26	WEST SANTA CRUZ TERRACE	7,870	C	550	200	-	-	7	480	378-684
3-27	SCOTTS VALLEY	774	C	410	100-900	26	7	7	360	100-980
3-28	SAN BENITO RIVER VALLEY	24,200	C	2,000	-	-	-	3	-	-
3-29	DRY LAKE VALLEY	1,420	C	-	-	-	-	-	-	-
3-30	BITTER WATER VALLEY	32,200	C	-	-	-	-	-	-	-
3-31	HERNANDEZ VALLEY	2,860	C	160	58	-	-	-	-	-

Table 21 Central Coast Hydrologic Region groundwater data (continued)

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
3-32	PEACH TREE VALLEY	9,790	C	117	84	-	-	-	-	-
3-33	SAN CARPOFORO VALLEY	200	C	-	-	-	-	-	-	217-385
3-34	ARROYO DE LA CRUZ VALLEY	750	C	-	-	-	-	-	-	211-381
3-35	SAN SIMEON VALLEY	620	A	170	100	-	-	4	413	46-2,210
3-36	SANTA ROSA VALLEY	4,480	A	708	400	-	-	2	-	298-2,637
3-37	VILLA VALLEY	980	C	-	-	-	-	-	-	260-1,635
3-38	CAYUCOS VALLEY	530	C	166	100	-	-	-	-	815-916
3-39	OLD VALLEY	750	C	335	200	-	-	-	-	346-2,462
3-40	TORO VALLEY	721	C	500	0	-	-	-	-	458-732
3-41	MORRO VALLEY	1,200	C	442	300	-	-	6	1150	469-5,100
3-42	CHORRO VALLEY	3,200	C	700	200	-	-	6	656	60-3,606
3-43	RINCONADA VALLEY	2,580	C	0	0	-	-	-	-	-
3-44	POZO VALLEY	6,840	C	230	100	-	-	5	-	287-676
3-45	HUASNA VALLEY	4,700	C	0	0	-	-	-	-	-
3-46	RAFAEL VALLEY	2,990	C	0	0	-	-	-	-	-
3-47	BIG SPRING AREA	7,320	C	0	0	-	-	-	-	-
3-49	MONTECITO	6,270	A	1,000	750	88	2	4	700	600-1,100
3-50	FELTON AREA	1,160	C	825	244	6	-	2	-	69-400
3-51	MAJORS CREEK	364	C	50	38	-	-	-	-	-
3-52	NEEDLE ROCK POINT	480	C	450	320	-	-	-	-	-
3-53	FOOTHILL	3,120	A	-	-	-	8	7	828	554-1,118

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

South Coast Hydrologic Region

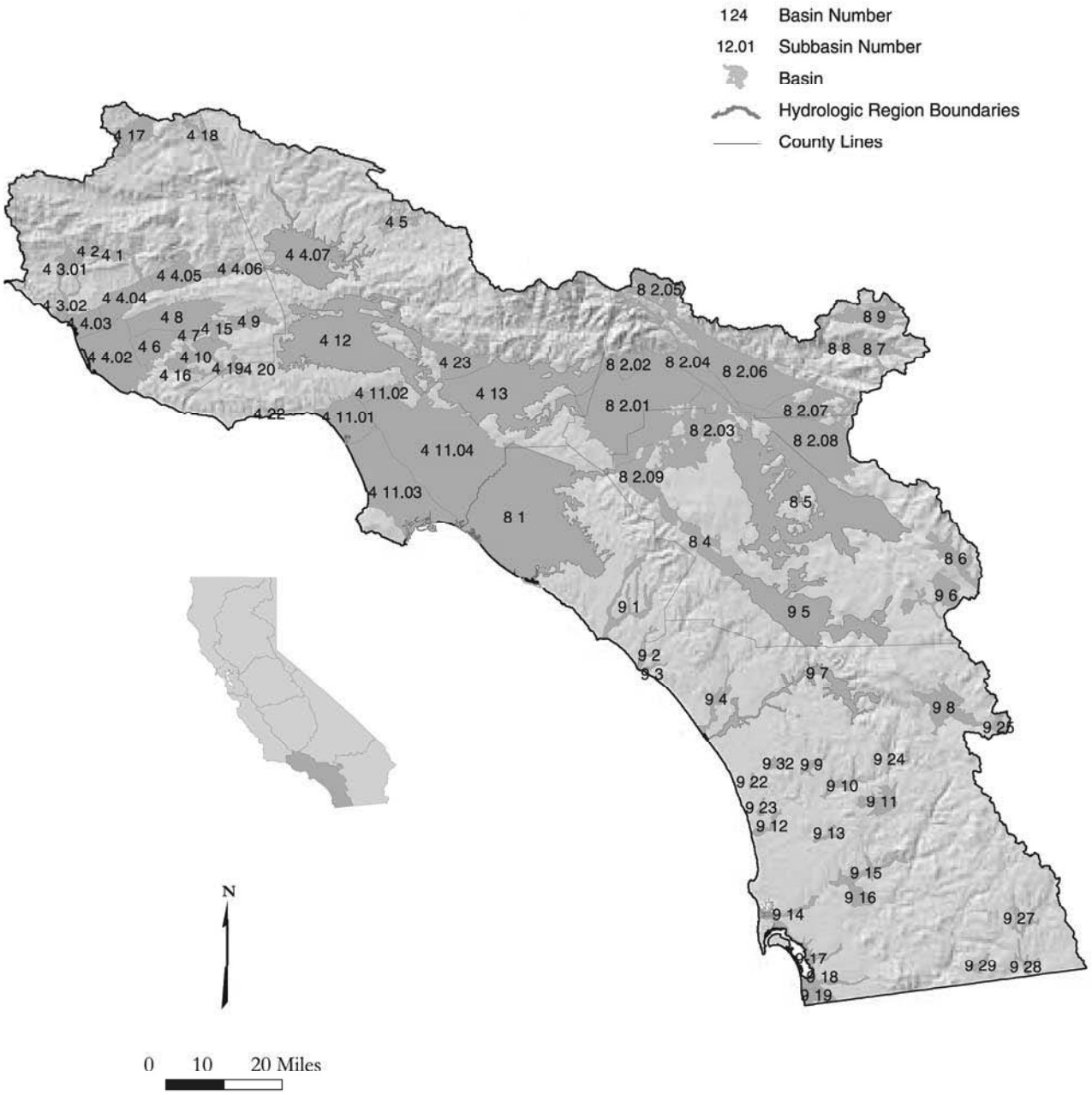

Figure 31 South Coast Hydrologic Region

Basins and Subbasins of the South Coast Hydrologic Region

Basin/subbasin	Basin name
4-1	Upper Ojai Valley
4-2	Ojai Valley
4-3	Ventura River Valley
4-3.01	Upper Ventura River
4-3.02	Lower Ventura River
4-4	Santa Clara River Valley
4-4.02	Oxnard
4-4.03	Mound
4-4.04	Santa Paula
4-4.05	Fillmore
4-4.06	Piru
4-4.07	Santa Clara River Valley East
4-5	Acton Valley
4-6	Pleasant Valley
4-7	Arroyo Santa Rosa Valley
4-8	Las Posas Valley
4-9	Simi Valley
4-10	Conejo Valley
4-11	Coastal Plain of Los Angeles
4-11.01	Santa Monica
4-11.02	Hollywood
4-11.03	West Coast
4-11.04	Central
4-12	San Fernando Valley
4-13	San Gabriel Valley
4-15	Tierre Rejada
4-16	Hidden Valley
4-17	Lockwood Valley
4-18	Hungry Valley
4-19	Thousand Oaks Area
4-20	Russell Valley
4-22	Malibu Valley
4-23	Raymond
8-1	Coastal Plain of Orange County
8-2	Upper Santa Ana Valley
8-2.01	Chino
8-2.02	Cucamonga
8-2.03	Riverside-Arlington
8-2.04	Rialto-Colton
8-2.05	Cajon
8-2.06	Bunker Hill
8-2.07	Yucaipa
8-2.08	San Timoteo
8-2.09	Temescal

Basin/subbasin	Basin name
8-4	Elsinore
8-5	San Jacinto
8-6	Hemet Lake Valley
8-7	Big Meadows Valley
8-8	Seven Oaks Valley
8-9	Bear Valley
9-1	San Juan Valley
9-2	San Mateo Valley
9-3	San Onofre Valley
9-4	Santa Margarita Valley
9-5	Temecula Valley
9-6	Coahuila Valley
9-7	San Luis Rey Valley
9-8	Warner Valley
9-9	Escondido Valley
9-10	San Pasqual Valley
9-11	Santa Maria Valley
9-12	San Dieguito Creek
9-13	Poway Valley
9-14	Mission Valley
9-15	San Diego River Valley
9-16	El Cajon Valley
9-17	Sweetwater Valley
9-18	Otay Valley
9-19	Tijuana Basin
9-22	Batiquitos Lagoon Valley
9-23	San Elijo Valley
9-24	Pamo Valley
9-25	Ranchita Town Area
9-27	Cottonwood Valley
9-28	Campo Valley
9-29	Potrero Valley
9-32	San Marcos Area

Description of the Region

The South Coast HR covers approximately 6.78 million acres (10,600 square miles) of the southern California watershed that drains to the Pacific Ocean (Figure 31). The HR is bounded on the west by the Pacific Ocean and the watershed divide near the Ventura-Santa Barbara County line. The northern boundary corresponds to the crest of the Transverse Ranges through the San Gabriel and San Bernardino mountains. The eastern boundary lies along the crest of the San Jacinto Mountains and low-lying hills of the Peninsular Range that form a drainage boundary with the Colorado River HR. The southern boundary is the international boundary with the Republic of Mexico. Significant geographic features include the coastal plain, the central Transverse Ranges, the Peninsular Ranges, and the San Fernando, San Gabriel, Santa Ana River, and Santa Clara River valleys.

The South Coast HR includes all of Orange County, most of San Diego and Los Angeles Counties, parts of Riverside, San Bernardino, and Ventura counties, and a small amount of Kern and Santa Barbara Counties. This HR is divided into Los Angeles, Santa Ana and San Diego subregions, RWQCBs 4, 8, and 9 respectively. Groundwater basins are numbered according to these subregions. Basin numbers in the Los Angeles subregion are preceded by a 4, in Santa Ana by an 8, and in San Diego by a 9. The Los Angeles subregion contains the Ventura, Santa Clara, Los Angeles, and San Gabriel River drainages, Santa Ana encompasses the Santa Ana River drainage, and San Diego includes the Santa Maria River, San Luis Rey River and the San Diego River and other drainage systems.

According to 2000 census data, about 17 million people live within the boundaries of the South Coast HR, approximately 50 percent of the population of California. Because this HR amounts to only about 7 percent of the surface area of the State, this has the highest population density of any HR in California (DWR 1998). Major population centers include the metropolitan areas surrounding Ventura, Los Angeles, San Diego, San Bernardino, and Riverside.

The South Coast HR has 56 delineated groundwater basins. Twenty-one basins are in subregion 4 (Los Angeles), eight basins in subregion 8 (Santa Ana), and 27 basins in subregion 9 (San Diego).

The Los Angeles subregion overlies 21 groundwater basins and encompasses most of Ventura and Los Angeles counties. Within this subregion, the Ventura River Valley, Santa Clara River Valley, and Coastal Plain of Los Angeles basins are divided into subbasins. The basins in the Los Angeles subregion underlie 1.01 million acres (1,580 square miles) or about 40 percent of the total surface area of the subregion.

The Santa Ana subregion overlies eight groundwater basins and encompasses most of Orange County and parts of Los Angeles, San Bernardino, and Riverside counties. The Upper Santa Ana Valley Groundwater Basin is divided into nine subbasins. Groundwater basins underlie 979,000 acres (1,520 square miles) or about 54 percent of the Santa Ana subregion.

The San Diego subregion overlies 27 groundwater basins, encompasses most of San Diego County, and includes parts of Orange and Riverside counties. Groundwater basins underlie about 277,000 acres (433 square miles) or about 11 percent of the surface of the San Diego subregion.

Overall, groundwater basins underlie about 2.27 million acres (3,530 square miles) or about 33 percent of the South Coast HR.

Groundwater Development

Groundwater has been used in the South Coast HR for well over 100 years. High demand and use of groundwater in Southern California has given rise to many disputes over management and pumping rights, with the resolution of these cases playing a large role in the establishment and clarification of water rights law in California. Raymond Groundwater Basin, located in this HR, was the first adjudicated basin in the State. Of the 16 adjudicated basins in California, 11 are in the South Coast HR. Groundwater provides about 23 percent of water demand in normal years and about 29 percent in drought years (DWR 1998).

Groundwater is found in unconfined alluvial aquifers in most of the basins of the San Diego subregion and the inland basins of the Santa Ana and Los Angeles subregions. In some larger basins, typified by those underlying the coastal plain, groundwater occurs in multiple aquifers separated by aquitards that create confined groundwater conditions. Basins range in depth from tens or hundreds of feet in smaller basins, to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this HR depending on aquifer characteristics and well location, size, and use. Some aquifers are capable of yielding thousands of gallons per minute to municipal wells.

Conjunctive Use

Conjunctive use of surface water and groundwater is a long-standing practice in the region. At present, much of the potable water used in Southern California is imported from the Colorado River and from sources in the eastern Sierra and Northern California. Several reservoirs are operated primarily for the purpose of storing surface water for domestic and irrigation use, but groundwater basins are also recharged from the outflow of some reservoirs. The concept is to maintain streamflow over a longer period of time than would occur without regulated flow and thus provide for increased recharge of groundwater basins. Most of the larger basins in this HR are highly managed, with many conjunctive use projects being developed to optimize water supply.

Coastal basins in this HR are prone to intrusion of seawater. Seawater intrusion barriers are maintained along the Los Angeles and Orange County sections of the coastal plain. In Orange County, recycled water is injected into the ground to form a mound of groundwater between the coast and the main groundwater basin. In Los Angeles County, imported and recycled water is injected to maintain a seawater intrusion barrier.

Groundwater Quality

Groundwater in basins of the Los Angeles subregion is mainly calcium sulfate and calcium bicarbonate in character. Nitrate content is elevated in some parts of the subregion. Volatile organic compounds (VOCs) have created groundwater impairments in some of the industrialized portions of the region. The San Gabriel Valley and San Fernando Valley groundwater basins both have multiple sites of contamination from VOCs. The main constituents in the contamination plumes are trichloroethylene (TCE) and tetrachloroethylene (PCE). Some of the locations have been declared federal Superfund sites. Contamination plumes containing high concentrations of TCE and PCE also occur in the Bunker Hill Subbasin of the Upper Santa Ana Valley Groundwater Basin. Some of these plumes are also designated as Superfund sites. Perchlorate is emerging as an important contaminant in several areas in the South Coast HR.

Groundwater in basins of the Santa Ana subregion is primarily calcium and sodium bicarbonate in character. Local impairments from excess nitrate or VOCs have been recognized. Groundwater and surface water in the Chino Subbasin of the Santa Ana River Valley Groundwater Basin have elevated nitrate concentrations, partly derived from a large dairy industry in that area. In Orange County, water from the Santa Ana River provides a large part of the groundwater replenishment. Wetlands maintained along the Santa Ana River near the boundary of the Upper Santa Ana River and Orange County Groundwater Basins provide effective removal of nitrate from surface water, while maintaining critical habitat for endangered species.

Groundwater in basins of the San Diego subregion has mainly calcium and sodium cations and bicarbonate and sulfate anions. Local impairments by nitrate, sulfate, and TDS are found. Camp Pendleton Marine Base, in the northwestern part of this subregion, is on the EPA National Priorities List for soil and groundwater contamination by many constituents.

Water Quality in Public Supply Wells

From 1994 through 2000, 2,342 public supply water wells were sampled in 47 of the 73 basins and subbasins in the South Coast HR. Analyzed samples indicate that 1,360 wells, or 58 percent, met the state primary MCLs for drinking water. Nine-hundred-eighty-two wells, or 42 percent, have constituents that exceed one or more MCL. Figure 32 shows the percentages of each contaminant group that exceeded MCLs in the 982 wells.

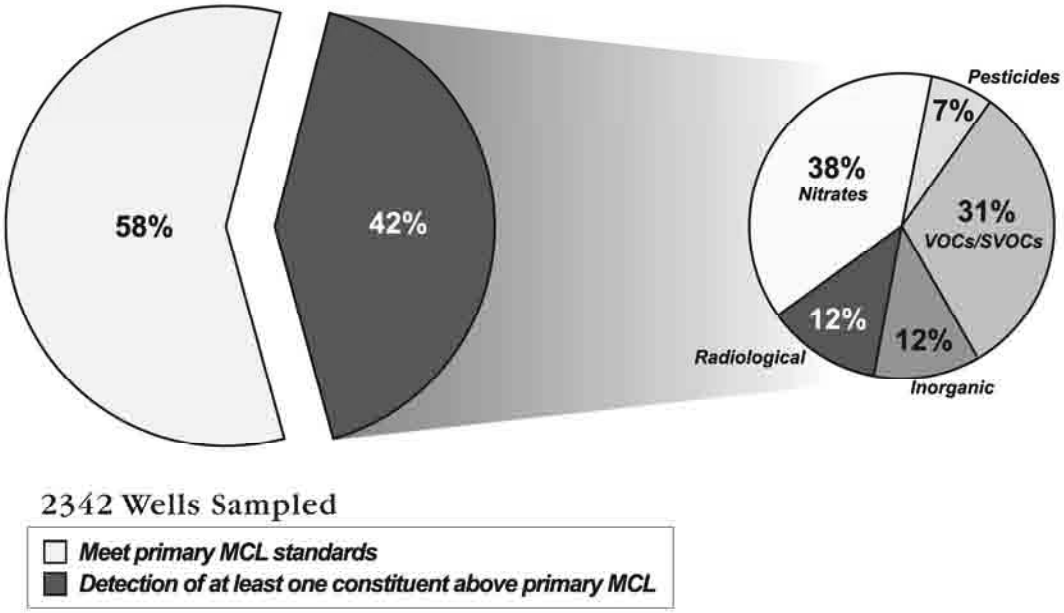

Figure 32 MCL exceedances in public supply wells in the South Coast Hydrologic Region

Table 22 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

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 23). The Cajalco Valley (8-3), Jamul Valley (9-20), Las Pulgas Valley (9-21), Pine Valley (9-26), and Tecate Valley (9-30) Groundwater Basins have been deleted in this report because they have thin deposits of alluvium and well completion reports indicate that groundwater production is from underlying fractured bedrock. The Conejo Tierra Rejada Volcanic (4-21) is a volcanic aquifer and was not assigned a basin number in this bulletin. This is considered to be groundwater source area as discussed in Chapter 6.

Table 22 Most frequently occurring contaminants by contaminant group in the South Coast Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 56	Thallium – 13	Aluminum – 12
Inorganics – Secondary	Iron – 337	Manganese – 335	TDS – 36
Radiological	Gross Alpha – 104	Uranium – 40	Radium 226 – 9 Radium 228 – 9
Nitrates	Nitrate (as NO_3) – 364	Nitrate + Nitrite – 179	Nitrate Nitrogen (NO_3-N) – 14
Pesticides	DBCP – 61	Di(2-Ethylhexyl)phthalate –5	Heptachlor – 2 EDB – 2
VOCs/SVOCs	TCE – 196	PCE – 152	1,2 Dichloroethane – 89

DBCP = Dibromochloropropane
EDB = Ethylene Dibromide
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds

The Ventura River Valley (4-3), Santa Clara River Valley (4-4), Coastal Plain of Los Angeles (4-11), and Upper Santa Ana Valley (8-2) Groundwater Basins have been divided into subbasins in this report. The extent of the San Jacinto Groundwater Basin (8-5) has been decreased because completion of Diamond Valley Reservoir has inundated the valley. Paloma Valley has been removed because well logs indicate groundwater production is solely from fractured bedrock. The Raymond Groundwater Basin (4-23) is presented as an individual basin instead of being incorporated into the San Gabriel Valley Groundwater Basin (4-13) because it is bounded by physical barriers and has been managed as a separate and individual groundwater basin for many decades. In Bulletin 118-75, groundwater basins in two different subregions were designated the Upper Santa Ana Valley Groundwater Basin (4-14 and 8-2). To alleviate this confusion, basin 4-14 has been divided, with parts of the basin incorporated into the neighboring San Gabriel Valley Groundwater Basin (4-13) and the Chino subbasin of the Upper Santa Ana Valley Groundwater Basin (8-2.01). The San Marcos Area Groundwater Basin (9-32) in central San Diego County is presented as a new basin in this report.

Table 23 Modifications since Bulletin 118-80 of groundwater basins and subbasins in South Coast Hydrologic Region

Basin/subbasin name	Number	Old number
Upper Ventura River	4-3.01	4-3
Lower Ventura River	4-3.02	4-3
Oxnard	4-4.02	4-4
Mound	4-4.03	4-4
Santa Paula	4-4.04	4-4
Fillmore	4-4.05	4-4
Piru	4-4.06	4-4
Santa Clara River Valley East	4-4.07	4-4
Santa Monica	4-11.01	4-11
Hollywood	4-11.02	4-11
West Coast	4-11.03	4-11
Central	4-11.04	4-11
Upper Santa Ana Valley	Incorporated into 8-2.01 and 4-13	4-14
Conejo-Tierra Rejada Volcanic	deleted	4-21
Raymond	4-23	4-13
Chino	8-2.01	8-2
Cucamonga	8-2.02	8-2
Riverside-Arlington	8-2.03	8-2
Rialto-Colton	8-2.04	8-2
Cajon	8-2.05	8-2
Bunker Hill	8-2.06	8-2
Yucaipa	8-2.07	8-2
San Timoteo	8-2.08	8-2
Temescal	8-2.09	8-2
Cajalco Valley	deleted	8-3
Tijuana Basin	9-19	
Jamul Valley	deleted	9-20
Las Pulgas Valley	deleted	9-21
Batiquitos Lagoon Valley	9-22	
San Elijo Valley	9-23	
Pamo Valley	9-24	
Ranchita Town Area	9-25	
Pine Valley	deleted	9-26
Cottonwood Valley	9-27	
Campo Valley	9-28	
Potrero Valley	9-29	
Tecate Valley	deleted	9-30
San Marcos Area	9-32	Not previously identified

Table 24 South Coast Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
4-1	UPPER OJAI VALLEY	3,800	A	200	50	4	-	1	707	438-1,249
4-2	OJAI VALLEY	6,830	A	600	383	24	-	22	640	450-1,140
4-3	VENTURA RIVER VALLEY									
4-3.01	UPPER VENTURA RIVER	7,410	C	-	600	17	-	18	706	500-1,240
4-3.02	LOWER VENTURA RIVER	5,300	A	-	20	-	-	2	-	760-3,000
4-4	SANTA CLARA RIVER VALLEY									
4-4.02	OXNARD	58,000	A	1,600	-	127	127	69	1,102	160-1,800
4-4.03	MOUND	14,800	A	-	700	11	11	4	1,644	1,498-1,908
4-4.04	SANTA PAULA	22,800	A	-	700	60	50	10	1,198	470-3,010
4-4.05	FILLMORE	20,800	A	2,100	700	23	-	10	1,100	800-2,400
4-4.06	PIRU	8,900	A	-	800	19	-	3	1,300	608-2,400
4-4.07	SANTA CLARA RIVER VALLEY EAST	66,200	C	-	-	-	-	62	-	-
4-5	ACTON VALLEY	8,270	A	1,000	140	-	-	7	-	-
4-6	PLEASANT VALLEY	21,600	A	-	1,000	9	-	12	1,110	597-3,490
4-7	ARROYO SANTA ROSA VALLEY	3,740	A	1,200	950	6	-	7	1,006	670-1,200
4-8	LAS POSAS VALLEY	42,200	A	750	-	-	-	24	742	338-1,700
4-9	SIMI VALLEY	12,100	A	-	394	13	-	1	-	1,580
4-10	CONEJO VALLEY	28,900	A	1,000	100	-	-	3	631	335-2,064
4-11	COASTAL PLAIN OF LOS ANGELES									
4-11.01	SANTA MONICA	32,100	C	4,700	-	-	-	12	916	729-1,156
4-11.02	HOLLYWOOD	10,500	A	-	-	5	5	1	-	526
4-11.03	WEST COAST	91,300	A	1,300	-	67	58	33	456	-
4-11.04	CENTRAL	177,000	A	11,000	1,730	302	64	294	453	200-2,500
4-12	SAN FERNANDO VALLEY	145,000	A	3,240	1,220	1398	2385	126	499	176-1,16
4-13	SAN GABRIEL VALLEY	154,000	A	4,850	1,000	67	296	259	367	90-4,288
4-15	TIERRA REJADA	4,390	A	1,200	172	4	1	-	-	619-930
4-16	HIDDEN VALLEY	2,210	C	-	-	-	-	1	453	289-743
4-17	LOCKWOOD VALLEY	21,800	A	350	25	-	-	1	-	-
4-18	HUNGRY VALLEY	5,310	C	-	28	-	-	-	<350	-
4-19	THOUSAND OAKS AREA	3,110	C	-	39	2	-	-	1,410	1,200-2,300
4-20	RUSSELL VALLEY	3,100	A	-	25	-	-	-	-	-
4-22	MALIBU VALLEY	613	C	1,060	1,030	-	-	-	-	-
4-23	RAYMOND	26,200	A	3,620	1,880	88	-	70	346	138-780
8-1	COASTAL PLAIN OF ORANGE COUNTY	224,000	A	4,500	2,500	521	411	240	475	232-661
8-2	UPPER SANTA ANA VALLEY									
8-2.01	CHINO	154,000	A	1,500	1,000	12	8	187	484	200-600
8-2.02	CUCAMONGA	9,530	C	4,400	2,115	1	1	21	-	-
8-2.03	RIVERSIDE-ARLINGTON	58,600	A	-	-	11	3	43	-	370-756
8-2.04	RIALTO-COLTON	30,100	A	5,000	545	50	5	41	337	
8-2.05	CAJON	23,200	C	200	60	-	-	5	-	-
8-2.06	BUNKER HILL	89,600	A	5,000	1,245	398	169	204	-	150-550
8-2.07	YUCAIPA	25,300	A	2,800	206	19	3	45	334	-

Table 24 South Coast Hydrologic Region groundwater data (continued)

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Active Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
8-2.08	SAN TIMOTEO	73,100	A	-	-	67	12	36	-	-
8-2.09	TEMESCAL	23,500	C	-	-	2	2	20	753	373-950
8-4	ELSINORE	25,700	C	5,400	-	1	1	18	-	
8-5	SAN JACINTO	188,000	C	-	-	150	115	56	463	160-12,000
8-6	HEMET LAKE VALLEY	16,700	C	820	196	-	-	9	-	-
8-7	BIG MEADOWS VALLEY	14,200	C	120	34	-	-	8	-	-
8-8	SEVEN OAKS VALLEY	4,080	C	-	-	-	-	1	-	-
8-9	BEAR VALLEY	19,600	A	1,000	500	57	57	52	-	-
9-1	SAN JUAN VALLEY	16,700	C	1,000	-	-	-	8	760	430-12,880
9-2	SAN MATEO VALLEY	2,990	A	-	-	-	-	5	586	490-770
9-3	SAN ONOFRE VALLEY	1,250	A	-	-	-	-	2	-	600-1,500
9-4	SANTA MARGARITA VALLEY	626	A	1,980	-	4	-	-	-	337-9,030
9-5	TEMECULA VALLEY	87,800	C	1,750	-	140	4	67	476	220-1,500
9-6	COAHUILA VALLEY	18,200	C	500	-	2	-	1	-	304-969
9-7	SAN LUIS REY VALLEY	37,000	C	2,000	500	-	-	28	1,258	530-7,060
9-8	WARNER VALLEY	24,000	C	1,800	800	-	-	4	-	263
9-9	ESCONDIDO VALLEY	2,890	C	190	50	-	-	1	-	250-5,000
9-10	SAN PASQUAL VALLEY	4,540	C	1,700	1,000	-	-	2	-	500-1,550
9-11	SANTA MARIA VALLEY	12,300	A	500	36	3	-	2	1,000	324-1,680
9-12	SAN DIEGUITO CREEK	3,560	A	1,800	700	-	-	-	-	2,000
9-13	POWAY VALLEY	2,470	C	200	100	-	-	1	-	610-1,500
9-14	MISSION VALLEY	7,350	C	-	1,000	-	-	-	-	-
9-15	SAN DIEGO RIVER VALLEY	9,890	C	2,000	-	-	-	5	-	260-2,870
9-16	EL CAJON VALLEY	7,160	C	300	50	1	-	2,340		
9-17	SWEETWATER VALLEY	5,920	C	1,500	300	7	7	9	2,114	300-50,000
9-18	OTAY VALLEY	6,830	C	1,000	185	-	-	-	-	500->2,000
9-19	TIJUANA BASIN	7,410	A	2,000	350	-	-	-	-	380-3,620
9-22	BATIQUITOS LAGOON VALLEY	741	C	-	-	-	-	-	1,280	788-2,362
9-23	SAN ELIJO VALLEY	883	C	1,800	-	-	-	-	-	1,170-5,090
9-24	PAMO VALLEY	1,500	C	-	-	-	-	-	369	279-455
9-25	RANCHITA TOWN AREA	3,130	C	125	22	-	-	-	-	283-305
9-27	COTTONWOOD VALLEY	3,850	C	-	-	-	-	1	-	-
9-28	CAMPO VALLEY	3,550	C	-	<40	-	-	4	-	800
9-29	POTRERO VALLEY	2,020	C	-	-	-	-	4	-	-
9-32	SAN MARCOS VALLEY	2,130	C	60	-	-	-	-	-	500-700

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

Sacramento River Hydrologic Region

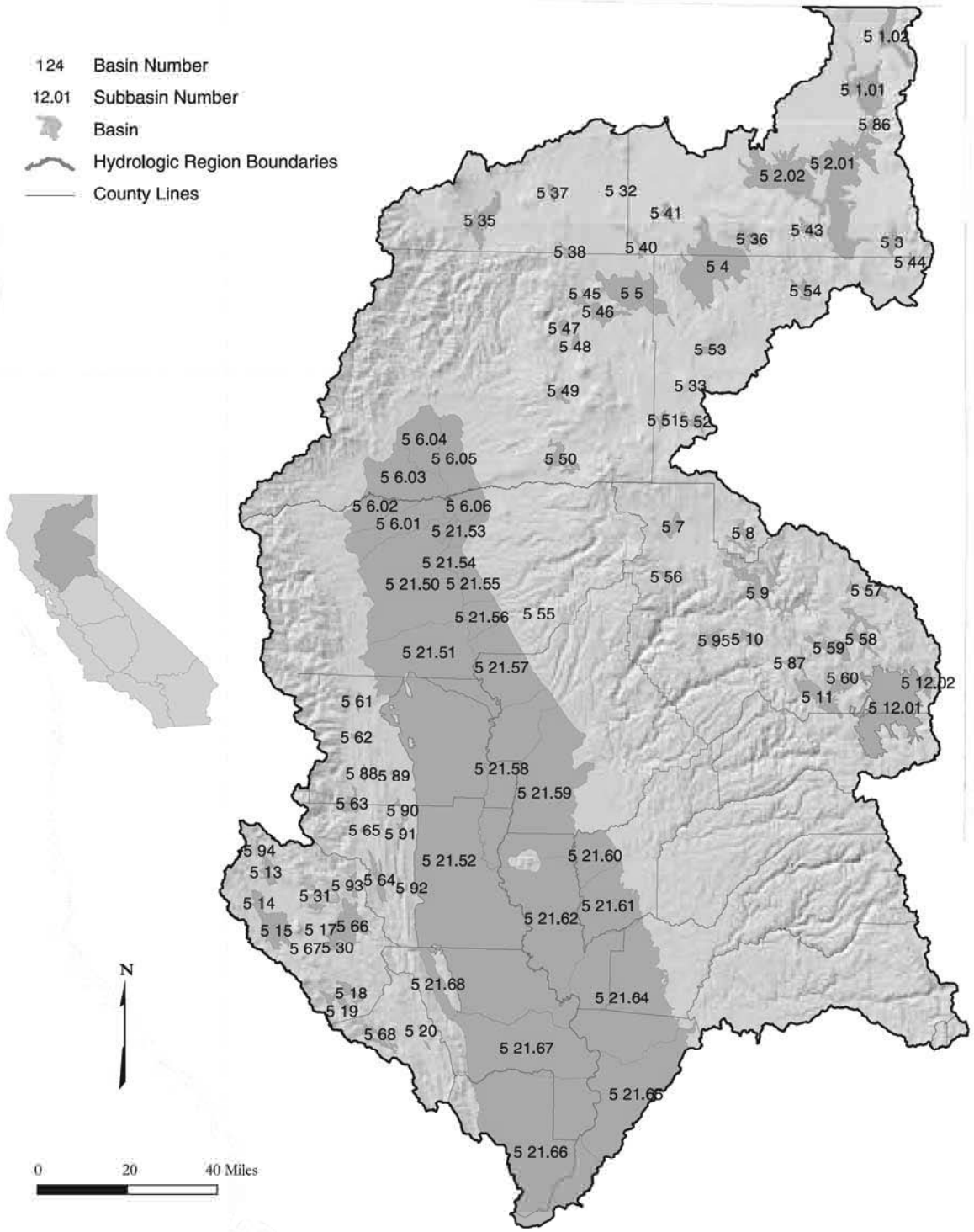

Figure 33 Sacramento River Hydrologic Region

Basins and Subbasins of the Sacramento River Hydrologic Region

Basin/subbasins	Basin name
5-1	Goose Lake Valley
5-1.01	Lower Goose Lake Valley
5-1.02	Fandango Valley
5-2	Alturas Area
5-2.01	South Fork Pitt River
5-2.02	Warm Springs Valley
5-3	Jess Valley
5-4	Big Valley
5-5	Fall River Valley
5-6	Redding Area
5-6.01	Bowman
5-6.02	Rosewood
5-6.03	Anderson
5-6.04	Enterprise
5-6.05	Millville
5-6.06	South Battle Creek
5-7	Lake Almanor Valley
5-8	Mountain Meadows Valley
5-9	Indian Valley
5-10	American Valley
5-11	Mohawk Valley
5-12	Sierra Valley
5-12.01	Sierra Valley
5-12.02	Chilcoot
5-13	Upper Lake Valley
5-14	Scotts Valley
5-15	Big Valley
5-16	High Valley
5-17	Burns Valley
5-18	Coyote Valley
5-19	Collayomi Valley
5-20	Berryessa Valley
5-21	Sacramento Valley
5-21.50	Red Bluff
5-21.51	Corning
5-21.52	Colusa
5-21.53	Bend
5-21.54	Antelope
5-21.55	Dye Creek
5-21.56	Los Molinos
5-21.57	Vina
5-21.58	West Butte
5-21.59	East Butte
5-21.60	North Yuba
5-21.61	South Yuba
5-21.62	Sutter
5-21.64	North American
5-21.65	South American
5-21.66	Solano
5-21.67	Yolo
5-21.68	Capay Valley

Basin/subbasins	Basin name
5-30	Lower Lake Valley
5-31	Long Valley
5-35	Mccloud Area
5-36	Round Valley
5-37	Toad Well Area
5-38	Pondosa Town Area
5-40	Hot Springs Valley
5-41	Egg Lake Valley
5-43	Rock Prairie Valley
5-44	Long Valley
5-45	Cayton Valley
5-46	Lake Britton Area
5-47	Goose Valley
5-48	Burney Creek Valley
5-49	Dry Burney Creek Valley
5-50	North Fork Battle Creek
5-51	Butte Creek Valley
5-52	Gray Valley
5-53	Dixie Valley
5-54	Ash Valley
5-56	Yellow Creek Valley
5-57	Last Chance Creek Valley
5-58	Clover Valley
5-59	Grizzly Valley
5-60	Humbug Valley
5-61	Chrome Town Area
5-62	Elk Creek Area
5-63	Stonyford Town Area
5-64	Bear Valley
5-65	Little Indian Valley
5-66	Clear Lake Cache Formation
5-68	Pope Valley
5-86	Joseph Creek
5-87	Middle Fork Feather River
5-88	Stony Gorge Reservoir
5-89	Squaw Flat
5-90	Funks Creek
5-91	Antelope Creek
5-92	Blanchard Valley
5-93	North Fork Cache Creek
5-94	Middle Creek
5-95	Meadow Valley

Description of the Region

The Sacramento River HR covers approximately 17.4 million acres (27,200 square miles). The region includes all or large portions of Modoc, Siskiyou, Lassen, Shasta, Tehama, Glenn, Plumas, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, Sacramento, El Dorado, Yolo, Solano, Lake, and Napa counties (Figure 33). Small areas of Alpine and Amador counties are also within the region. Geographically, the region extends south from the Modoc Plateau and Cascade Range at the Oregon border, to the Sacramento-San Joaquin Delta. The Sacramento Valley, which forms the core of the region, is bounded to the east by the crest of the Sierra Nevada and southern Cascades and to the west by the crest of the Coast Range and Klamath Mountains. Other significant features include Mount Shasta and Lassen Peak in the southern Cascades, Sutter Buttes in the south central portion of the valley, and the Sacramento River, which is the longest river system in the State of California with major tributaries the Pit, Feather, Yuba, Bear and American rivers. The region corresponds approximately to the northern half of RWQCB 5. The Sacramento metropolitan area and surrounding communities form the major population center of the region. With the exception of Redding, cities and towns to the north, while steadily increasing in size, are more rural than urban in nature, being based in major agricultural areas. The 1995 population of the entire region was 2.372 million.

The climate in the northern, high desert plateau area of the region is characterized by cold snowy winters with only moderate precipitation and hot dry summers. This area depends on adequate snowpack to provide runoff for summer supply. Annual precipitation ranges from 10 to 20 inches. Other mountainous areas in the northern and eastern portions of the region have cold wet winters with large amounts of snow, which typically provide abundant runoff for summer supplies. Annual precipitation ranges from 40 to more than 80 inches. Summers are generally mild in these areas. The Coast Range and southern Klamath Mountains receive copious amounts of precipitation, but most of the runoff flows to the coast in the North Coastal drainage. Sacramento Valley comprises the remainder of the region. At a much lower elevation than the rest of the region, the valley has mild winters with moderate precipitation. Annual precipitation varies from about 35 inches in Redding to about 18 inches in Sacramento. Summers in the valley are hot and dry.

Most of the mountainous portions of the region are heavily forested and sparsely populated. Three major national forests (Mendocino, Trinity, and Shasta) make up the majority of lands in the Coast Range, southern Klamath Mountains, and the southern Cascades; these forests and the region's rivers and lakes provide abundant recreational opportunities. In the few mountain valleys with arable land, alfalfa, grain and pasture are the predominant crops. In the foothill areas of the region, particularly adjacent to urban centers, suburban to rural housing development is occurring along major highway corridors. This development is leading to urban sprawl and is replacing the former agricultural production on those lands. In the Sacramento Valley, agriculture is the largest industry. Truck, field, orchard, and rice crops are grown on approximately 2.1 million acres. Rice represents about 23 percent of the total irrigated acreage.

The Sacramento River HR is the main water supply for much of California's urban and agricultural areas. Annual runoff in the HR averages about 22.4 maf, which is nearly one-third of the State's total natural runoff. Major water supplies in the region are provided through surface storage reservoirs. The two largest surface water projects in the region are USBR's Shasta Lake (Central Valley Project) on the upper Sacramento River and Lake Oroville (DWR's State Water Project) on the Feather River. In all, there are more than 40 major surface water reservoirs in the region. Municipal, industrial, and agricultural supplies to the region are about 8 maf, with groundwater providing about 2.5 maf of that total. Much of the remainder of the runoff goes to dedicated natural flows, which support various environmental requirements, including in-stream fishery flows and flushing flows in the Delta.

Groundwater Development

Groundwater provides about 31 percent of the water supply for urban and agricultural uses in the region, and has been developed in both the alluvial basins and the hard rock uplands and mountains. There are 88 basins/subbasins delineated in the region. These basins underlie 5.053 million acres (7,900 square miles), about 29 percent of the entire region. The reliability of the groundwater supply varies greatly. The Sacramento Valley is recognized as one of the foremost groundwater basins in the State, and wells developed in the sediments of the valley provide excellent supply to irrigation, municipal, and domestic uses. Many of the mountain valleys of the region also provide significant groundwater supplies to multiple uses.

Geologically, the Sacramento Valley is a large trough filled with sediments having variable permeabilities; as a result, wells developed in areas with coarser aquifer materials will produce larger amounts of water than wells developed in fine aquifer materials. In general, well yields are good and range from one-hundred to several thousand gallons per minute. Because surface water supplies have been so abundant in the valley, groundwater development for agriculture primarily supplement the surface supply. With the changing environmental laws and requirements, this balance is shifting to a greater reliance on groundwater, and conjunctive use of both supplies is occurring to a greater extent throughout the valley, particularly in drought years. Groundwater provides all or a portion of municipal supply in many valley towns and cities. Redding, Anderson, Chico, Marysville, Sacramento, Olivehurst, Wheatland, Willows, and Williams rely to differing degrees on groundwater. Red Bluff, Corning, Woodland, Davis, and Dixon are completely dependent on groundwater. Domestic use of groundwater varies, but in general, rural unincorporated areas rely completely on groundwater.

In the mountain valleys and basins with arable land, groundwater has been developed to supplement surface water supplies. Most of the rivers and streams of the area have adjudicated water rights that go back to the early 1900s, and diversion of surface water has historically supported agriculture. Droughts and increased competition for supply have led to significant development of groundwater for irrigation. In some basins, the fractured volcanic rock underlying the alluvial fill is the major aquifer for the area. In the rural mountain areas of the region, domestic supplies come almost entirely from groundwater. Although a few mountain communities are supplied in part by surface water, most rely on groundwater. These groundwater supplies are generally quite reliable in areas that have sufficient aquifer storage or where surface water replenishes supply throughout the year. In areas that depend on sustained runoff, water levels can be significantly depleted in drought years and many old, shallow wells can be dewatered. During 2001, an extreme drought year on the Modoc Plateau, many well owners experienced problems with water supply.

Groundwater development in the fractured rocks of the foothills of the southern Cascades and Sierra Nevada is fraught with uncertainty. Groundwater supplies from fractured rock sources are highly variable in terms of water quantity and water quality and are an uncertain source for large-scale residential development. Originally, foothill development relied on water supply from springs and river diversions with flumes and ditches for conveyance that date back to gold mining era operations. Current development is primarily based on individual private wells, and as pressures for larger scale development increase, questions about the reliability of supply need to be addressed. Many existing foothill communities have considerable experience with dry or drought year shortages. In Butte County residents in Cohasset, Forest Ranch, and Magalia have had to rely on water brought up the ridges in tanker trucks. The suggested answer has been the development of regional water supply projects. Unfortunately, the area's development pattern of small, geographically dispersed population centers does not lend itself to the kind of financial base necessary to support such projects.

Groundwater Quality

Groundwater quality in the Sacramento River HR is generally excellent. However, there are areas with local groundwater problems. Natural water quality impairments occur at the north end of the Sacramento Valley in the Redding subbasin, and along the margins of the valley and around the Sutter Buttes, where Cretaceous-age marine sedimentary rocks containing brackish to saline water are near the surface. Water from the older underlying sediments mixes with the fresh water in the younger alluvial aquifer and degrades the quality. Wells constructed in these areas typically have high TDS. Other local natural impairments are moderate levels of hydrogen sulfide in groundwater in the volcanic and geothermal areas in the western portion of the region. In the Sierra foothills, there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Human-induced impairments are generally associated with individual septic system development in shallow unconfined portions of aquifers or in fractured hard rock areas where insufficient soil depths are available to properly leach effluent before it reaches the local groundwater supply.

Water Quality in Public Supply Wells

From 1994 through 2000, 1,356 public supply water wells were sampled in 51 of the 88 basins and subbasins in the Sacramento River HR. Samples analyzed indicate that 1,282 wells, or 95 percent, met the state primary MCLs for drinking water. Seventy-four wells, or 5 percent, have constituents that exceed one or more MCL. Figure 34 shows the percentages of each contaminant group that exceeded MCLs in the 74 wells.

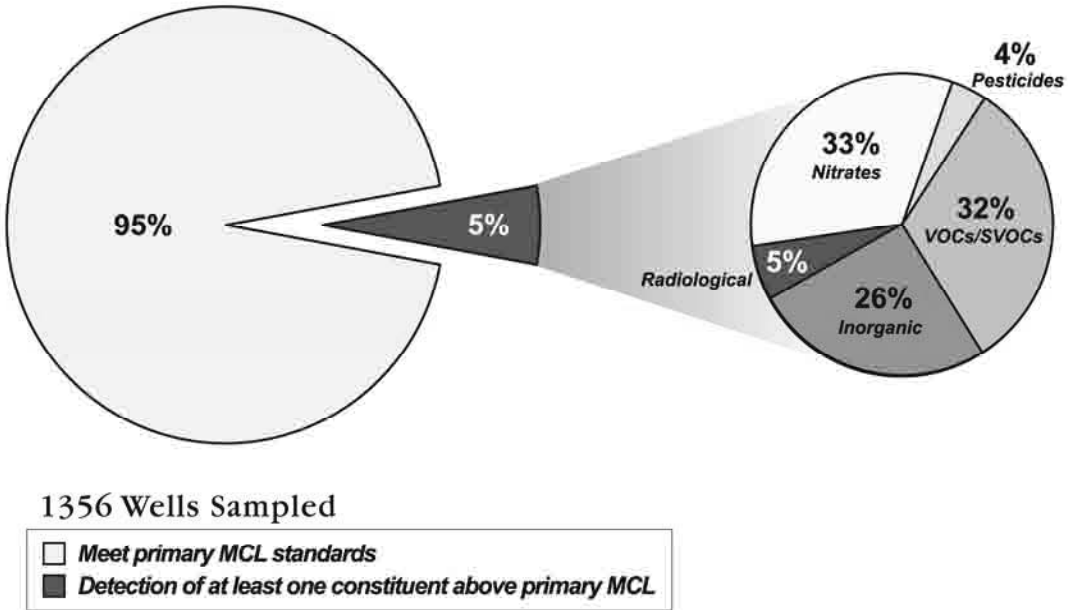

Figure 34 MCL exceedances in public supply wells in the Sacramento River Hydrologic Region

Table 25 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.

Table 25 Most frequently occurring contaminants by contaminant group in the Sacramento River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Cadmium – 4	Chromium (Total) – 3	3 tied at 2
Inorganics – Secondary	Manganese – 221	Iron – 166	Specific Conductance – 3
Radiological	Gross Alpha – 4		
Nitrates	Nitrate (as NO_3) – 22	Nitrate + Nitrite – 5	Nitrate Nitrogen (NO_3-N) – 2
Pesticides	Di(2-Ethylhexyl)phthalate – 4		
VOCs/SVOCs	PCE – 11	TCE – 7	Benzene – 4

PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Some modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report. These are listed in Table 26.

Table 26 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Sacramento River Hydrologic Region

Basin name	New number	Old number
Fandango Valley	5-1.02	5-39
Bucher Swamp Valley	deleted	5-42
Modoc Plateau Recent Volcanic Areas	deleted	5-32
Modoc Plateau Pleistocene Volcanic Areas	deleted	5-33
Mount Shasta Area	deleted	5-34
Sacramento Valley Eastside Tuscan Formation Highlands	deleted	5-55
Clear Lake Pleistocene Volcanics	deleted	5-67

No additional basins were assigned to the Sacramento River HR in this revision. However, four basins have been divided into subbasins. Goose Lake Valley Groundwater Basin (5-1) has been subdivided into two subbasins, Fandango Valley (5-39) was modified to be a subbasin of Goose Lake Valley. Redding Area Groundwater Basin has been subdivided into six subbasins, Sierra Valley Groundwater Basin has been subdivided into two subbasins, and the Sacramento Valley Groundwater Basin has been subdivided into 18 subbasins.

There are several deletions of groundwater basins from Bulletin 118-80. Bucher Swamp Valley Basin (5-42) was deleted due to a thin veneer of alluvium over rock. Modoc Plateau Recent Volcanic Areas (5-32), Modoc Plateau Pleistocene Volcanic Areas (5-33), Mount Shasta Area (5-34), Sacramento Valley Eastside Tuscan Formation Highlands (5-55), and Clear Lake Pleistocene Volcanics (5-67) are volcanic aquifers and were not assigned basin numbers in this bulletin. These are considered to be groundwater source areas as discussed in Chapter 6.

Table 27 Sacramento 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
5-1	GOOSE LAKE VALLEY									
5-1.01	LOWER GOOSE LAKE	36,000	B	-	400	9	9	-	183	68 - 528
5-1.02	FANDANGO VALLEY	18,500	B	2,000	-	3	-	-	-	-
5-2	ALTURAS AREA								357	180 - 800
5-2.01	SOUTH FORK PITT RIVER	114,000	B	5,000	1,075	9	-	8	-	-
5-2.02	WARM SPRINGS VALLEY	68,000	B	400	314	3	-	11	-	-
5-3	JESS VALLEY	6,700	B		3,000	-	-	-	-	-
5-4	BIG VALLEY	92,000	B	4,000	880	19	9	10	260	141 - 633
5-5	FALL RIVER VALLEY	54,800	B	1,500	266	16	7	3	174	115 - 232
5-6	REDDING AREA									
5-6.01	BOWMAN	85,330	B	2,000	589	8	2	13	-	70 - 247
5-6.02	ROSEWOOD	45,320	B	-	-	4	-	-	-	118 - 218
5-6.03	ANDERSON	98,500	B	1,800	46	11	10	69	194	109-320
5-6.04	ENTERPRISE	60,900	B	700	266	11	3	43	-	160 - 210
5-6.05	MILLVILLE	67,900	B	500	254	6	5	4	140	-
5-6.06	SOUTH BATTLE CREEK	32,300	B	-	-	0	0	0	360	-
5-7	LAKE ALMANOR VALLEY	7,150	B	-	-	10	4	4	105	53 - 260
5-8	MOUNTAIN MEADOWS VALLEY	8,150	B	-	-	-	-	-	-	-
5-9	INDIAN VALLEY	29,400	B	-	-	-	4	9	-	-
5-10	AMERICAN VALLEY	6,800	B	40	40		4	11	-	-
5-11	MOHAWK VALLEY	19,000	B	-	500	1	2	15	248	210 - 285
5-12	SIERRA VALLEY									
5-12.01	SIERRA VALLEY	117,700	B	1,500	640	34	15	9	312	110 - 1,620
5-12.02	CHILCOOT	7,550	B	-	-	15	-	8	-	-
5-13	UPPER LAKE VALLEY	7,260	B	900	302	12	3	6	-	-
5-14	SCOTTS VALLEY	7,320	B	1,200	171	9	1	9	158	140 - 175
5-15	BIG VALLEY	24,210	B	1,470	475	49	11	7	535	270 - 790
5-16	HIGH VALLEY	2,360	B	100	37	5	2	-	598	480 - 745
5-17	BURNS VALLEY	2,900	B	-	30	1	5	-	335	280 - 455
5-18	COYOTE VALLEY	6,530	B	800	446	6	3	3	288	175 - 390
5-19	COLLAYOMI VALLEY	6,500	B	1,000	121	10	4	3	202	150 - 255
5-20	BERRYESSA VALLEY	1,400	C	-	-	0	-	0	-	-
5-21	SACRAMENTO VALLEY									
5-21.50	RED BLUFF	266,750	B	1,200	363	30	10	56	207	120 - 500
5-21.51	CORNING	205,640	B	3,500	977	29	7	30	286	130 - 490
5-21.52	COLUSA	918,380	B	5,600	984	98	30	134	391	120 - 1,220
5-21.53	BEND	20,770	B	-	275	0	3	9		334-360
5-21.54	ANTELOPE	18,710	B	800	575	4	5	22	296	-
5-21.55	DYE CREEK	27,730	B	3,300	890	8	1	3	240	159 - 396
5-21.56	LOS MOLINOS	33,170	B	1,000	500	3	3	9	217	
5-21.57	VINA	125,640	B	3,850	1,212	23	5	69	285	48 - 543
5-21.58	WEST BUTTE	181,600	B	4,000	1,833	32	8	36	293	130 - 676

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

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
5-21.59	EAST BUTTE	265,390	B	4,500	1,019	43	4	44	235	122 - 570
5-21.60	NORTH YUBA	100,400	C	4,000	-	21	-	32	-	-
5-21.61	SOUTH YUBA	107,000	C	4,000	1,650	56	-	6	-	-
5-21.62	SUTTER	234,000	C	-	-	34	-	115	-	-
5-21.64	NORTH AMERICAN	351,000	A	-	800	121	-	339	300	150 - 1,000
5-21.65	SOUTH AMERICAN	248,000	C	-	-	105	-	247	221	24-581
5-21.66	SOLANO	425,000	C	-	-	123	23	136	427	150 - 880
5-21.67	YOLO	226,000	B	4,000+	1,000	127	20	185	880	480 - 2,060
5-21.68	CAPAY VALLEY	25,000	C	-	-	11	-	3	-	-
5-30	LOWER LAKE VALLEY	2,400	B	100	37		3	5	568	290 - 1,230
5-31	LONG VALLEY	2,600	B	100	63	-	-	-	-	-
5-35	MCCLOUD AREA	21,320	B	-	380	-	-	1	-	-
5-36	ROUND VALLEY	7,270	B	2,000	800	2				148 - 633
5-37	TOAD WELL AREA	3,360	B	-	-	-	-	-	-	-
5-38	PONDOSA TOWN AREA	2,080	B	-	-	-	-	-	-	-
5-40	HOT SPRINGS VALLEY	2,400	B	-	-	-	-	-	-	-
5-41	EGG LAKE VALLEY	4,100	B	-	20	-	-	-	-	-
5-43	ROCK PRAIRIE VALLEY	5,740	B	-	-	-	-	-	-	-
5-44	LONG VALLEY	1,090	B	-	-	-	-	-	-	-
5-45	CAYTON VALLEY	1,300	B	-	400	-	-	-	-	-
5-46	LAKE BRITTON AREA	14,060	B	-	-	-	-	2	-	-
5-47	GOOSE VALLEY	4,210	B	-	-	-	-	-	-	-
5-48	BURNEY CREEK VALLEY	2,350	B	-	-	-	-	2	-	-
5-49	DRY BURNEY CREEK VALLEY	3,070	B	-	-	-	-	-	-	-
5-50	NORTH FORK BATTLE CREEK VALLEY	12,760	B	-	-	-	-	3	-	-
5-51	BUTTE CREEK VALLEY	3,230	B	-	-	-	-	-	-	-
5-52	GRAYS VALLEY	5,440	B	-	-	-	-	-	-	-
5-53	DIXIE VALLEY	4,870	B	-	-	-	-	-	-	-
5-54	ASH VALLEY	6,010	B	3,000	2,200	-	-	-	-	-
5-56	YELLOW CREEK VALLEY	2,310	B	-	-	-	-	-	-	-
5-57	LAST CHANCE CREEK VALLEY	4,660	B	-	-	-	-	-	-	-
5-58	CLOVER VALLEY	16,780	B	-	-	-	-	-	-	-
5-59	GRIZZLY VALLEY	13,400	B	-	-	-	-	1	-	-
5-60	HUMBUG VALLEY	9,980	B	-	-	-	-	8	-	-
5-61	CHROME TOWN AREA	1,410	B	-	-	-	-	-	-	-
5-62	ELK CREEK AREA	1,440	B	-	-	-	-	-	-	-
5-63	STONYFORD TOWN AREA	6,440	B	-	-	-	-	-	-	-
5-64	BEAR VALLEY	9,100	B	-	-	-	-	-	-	-
5-65	LITTLE INDIAN VALLEY	1,270	B	-	-	-	-	-	-	-
5-66	CLEAR LAKE CACHE FORMATION	30,000	B	245	52		-	4	-	-
5-68	POPE VALLEY	7,180	C	-	-	-	-	1	-	-
5-86	JOSEPH CREEK	4,450	B	-	-	-	-		-	-

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

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
5-87	MIDDLE FORK FEATHER RIVER	4,340	B	-	-	-	-	2	-	-
5-88	STONY GORGE RESERVOIR	1,070	B	-	-	-	-	-	-	-
5-89	SQUAW FLAT	1,300	C	-	-	-	-	-	-	-
5-90	FUNKS CREEK	3,000	C	-	-	-	-	-	-	-
5-91	ANTELOPE CREEK	2,040	B	-	-	-	-	-	-	-
5-92	BLANCHARD VALLEY	2,200	B	-	-	-	-	-	-	-
5-93	NORTH FORK CACHE CREEK	3,470	C	-	-	-	-	-	-	-
5-94	MIDDLE CREEK	700	B	-	75	-	-	1	-	-
5-95	MEADOW VALLEY	5,730	B	-	-	-	-	1	-	-

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

San Joaquin River Hydrologic Region

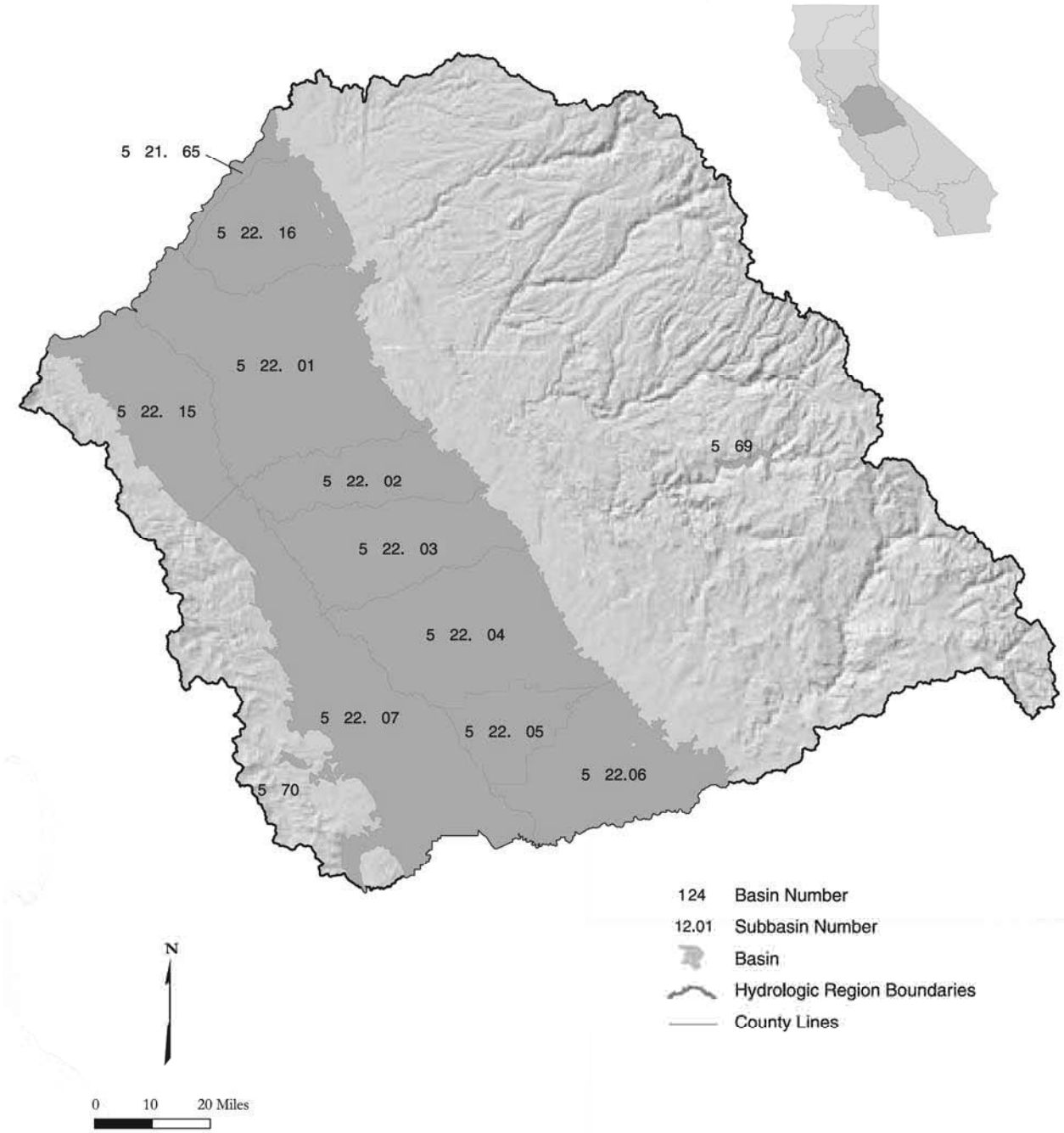

Figure 35 San Joaquin River Hydrologic Region

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.

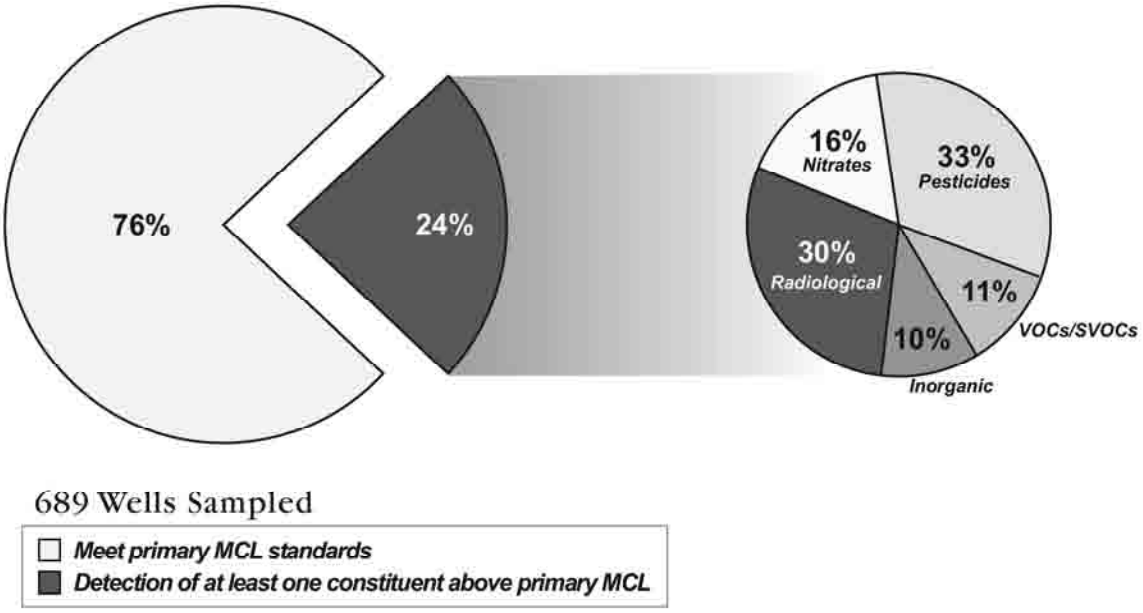

Figure 36 MCL exceedances in public supply wells in the San Joaquin River Hydrologic Region

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

Tulare Lake Hydrologic Region

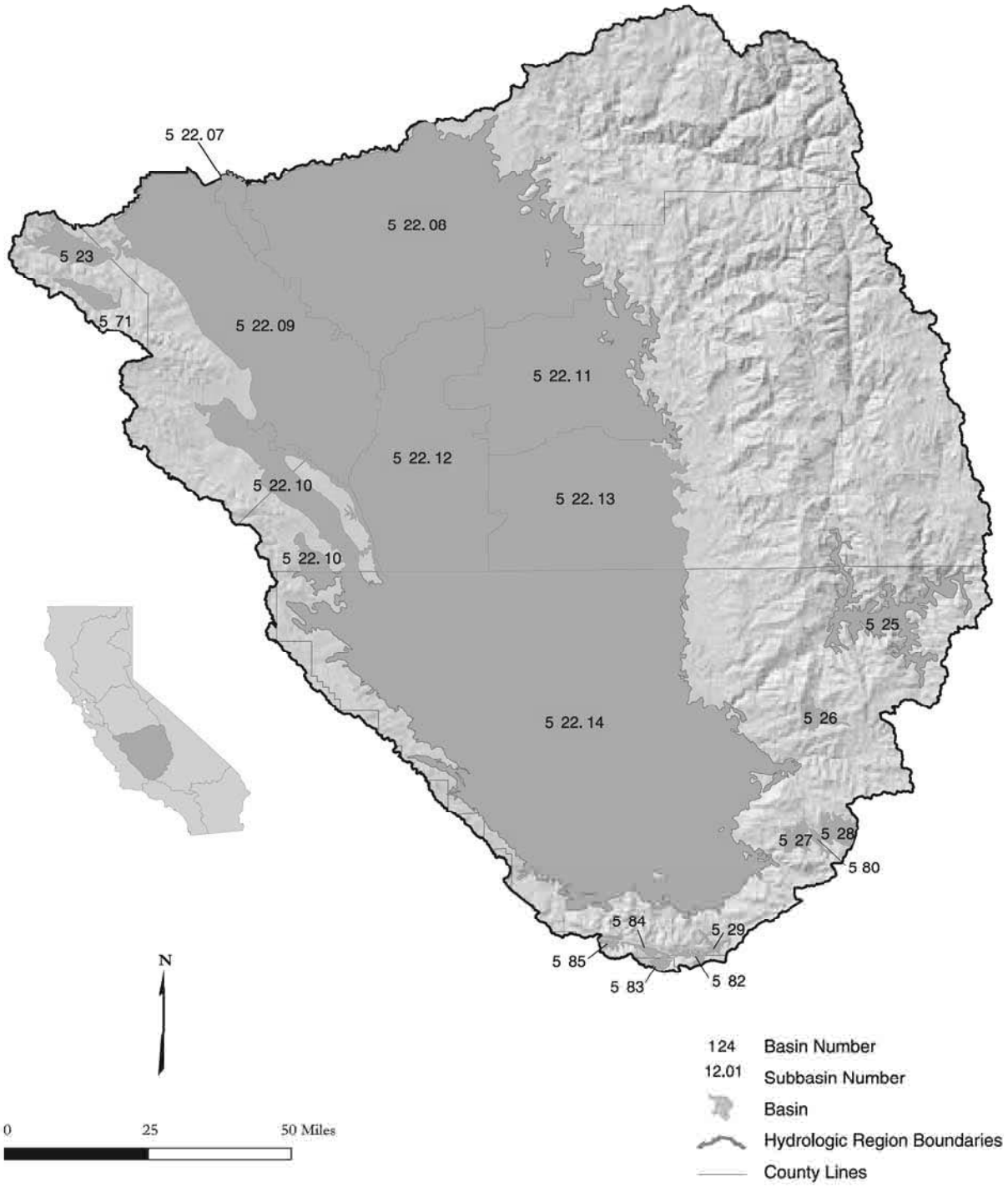

Figure 37 Tulare Lake Hydrologic Region

Basins and Subbasins of Tulare Lake Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.08	Kings
5-22.09	Westside
5-22.10	Pleasant Valley
5-22.11	Kaweah
5-22.12	Tulare Lake
5-22.13	Tule
5-22.14	Kern County
5-23	Panoche Valley
5-25	Kern River Valley
5-26	Walker Basin Creek Valley
5-27	Cummings Valley
5-28	Tehachapi Valley West
5-29	Castaic Lake Valley
5-71	Vallecitos Creek Valley
5-80	Brite Valley
5-82	Cuddy Canyon Valley
5-83	Cuddy Ranch Area
5-84	Cuddy Valley
5-85	Mil Potrero Area

Description of the Region

The Tulare Lake HR covers approximately 10.9 million acres (17,000 square miles) and includes all of Kings and Tulare counties and most of Fresno and Kern counties (Figure 37). The region corresponds to approximately the southern one-third of RWQCB 5. Significant geographic features include the southern half of the San Joaquin Valley, the Temblor Range to the west, the Tehachapi Mountains to the south, and the southern Sierra Nevada to the east. The region is home to more than 1.7 million people as of 1995 (DWR, 1998). Major population centers include Fresno, Bakersfield, and Visalia. The cities of Fresno and Visalia are entirely dependent on groundwater for their supply, with Fresno being the second largest city in the United States reliant solely on groundwater.

Groundwater Development

The region has 12 distinct groundwater basins and 7 subbasins of the San Joaquin Valley Groundwater Basin, which crosses north into the San Joaquin River HR. These basins underlie approximately 5.33 million acres (8,330 square miles) or 49 percent of the entire HR area.

Groundwater has historically been important to both urban and agricultural uses, accounting for 41 percent of the region's total annual supply and 35 percent of all groundwater use in the State. Groundwater use in the region represents about 10 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins with groundwater wells commonly exceeding 1,000 feet in depth. The maximum thickness of freshwater-bearing deposits (4,400 feet) occurs at the southern end of the San Joaquin Valley. Typical well yields in the San Joaquin Valley range from 300 gpm to 2,000 gpm with yields of 4,000 gpm possible. The smaller basins in the mountains surrounding the San Joaquin Valley have thinner aquifers and generally lower well yields averaging less than 500 gpm.

The cities of Fresno, Bakersfield, and Visalia have groundwater recharge programs to ensure that groundwater will continue to be a viable water supply in the future. Extensive groundwater recharge programs are also in place in the south valley where water districts have recharged several million acre-feet for future use and transfer through water banking programs.

The extensive use of groundwater in the San Joaquin Valley has historically caused subsidence of the land surface primarily along the west side and south end of the valley.

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 high TDS, nitrate, arsenic, and organic compounds.

The areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. High TDS content of west-side water is due to recharge of stream flow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts because of evaporation and poor drainage. In the central and west-side portions of the valley, where the Corcoran Clay confining layer exists, water quality is generally better beneath the clay than above it. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Areas of high nitrate concentrations are known to exist near the town of Shafter and other isolated areas in the San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas. Elevated arsenic levels have been reported in the Tulare Lake, Kern Lake and Buena Vista Lake bed areas. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected throughout the valley, but primarily along the east side where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is DBCP, a now-banned soil fumigant and known carcinogen once used extensively on grapes. Industrial organic contaminants include TCE, 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, 1,476 public supply water wells were sampled in 14 of the 19 groundwater basins and subbasins in the Tulare Lake HR. Evaluation of analyzed samples shows that 1,049 of the wells, or 71 percent, met the state primary MCLs for drinking water. Four-hundred-twenty-seven wells, or 29 percent, exceeded one or more MCL. Figure 38 shows the percentages of each contaminant group that exceeded MCLs in the 427 wells.

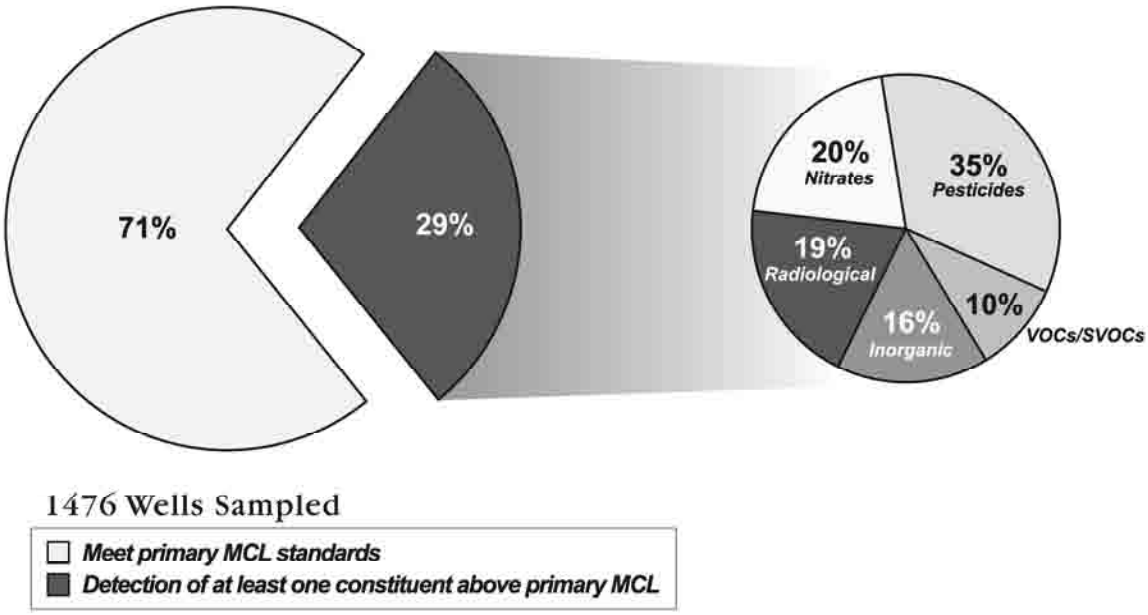

Figure 38 MCL exceedances by contaminant group in public supply wells in the Tulare Lake Hydrologic Region

Table 31 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.

Table 31 Most frequently occurring contaminants by contaminant group in the Tulare Lake Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics - Primary	Fluoride – 32	Arsenic – 16	Aluminum – 13
Inorganics - Secondary	Iron – 155	Manganese – 82	TDS – 9
Radiological	Gross Alpha – 74	Uranium – 24	Radium 228 – 8
Nitrates	Nitrate(as NO_3) – 83	Nitrate + Nitrite – 14	Nitrite(as N) – 3
Pesticides	DBCP – 130	EDB – 24	Di(2-Ethylhexyl)phthalate – 7
VOCs/SVOCs	TCE – 17	PCE – 16	Benzene – 6 MTBE – 6

DBCP = Dibromochloropropane
EDB = Ethylenedibromide
TCE = Trichloroethylene
PCE = Tetrachloroehylene
VOC = Volatile organic compound
SVOC = Semivolatile organic compound

Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. However, 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 (Table 32).

Table 32 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Tulare Lake Hydrologic Region

Subbasin name	New number	Old number
Kings	5-22.08	5-22
Westside	5-22.09	5-22
Pleasant Valley	5-22.10	5-22
Kaweah	5-22.11	5-22
Tulare Lake	5-22.12	5-22
Tule	5-22.13	5-22
Kern County	5-22.14	5-22
Squaw Valley	deleted	5-24
Cedar Grove Area	deleted	5-72
Three Rivers Area	deleted	5-73
Springville Area	deleted	5-74
Templeton Mountain Area	deleted	5-75
Manache Meadow Area	deleted	5-76
Sacator Canyon Valley	deleted	5-77
Rockhouse Meadows Valley	deleted	5-78
Inns Valley	deleted	5-79
Bear Valley	deleted	5-81

Several basins have been deleted from the Bulletin 118-80 report. In Squaw Valley (5-24) all 118 wells are completed in hard rock. Cedar Grove Area (5-72) is a narrow river valley in Kings Canyon National Park with no wells. Three Rivers Area (5-73) has a thin alluvial terrace deposit but 128 of 130 wells are completed in hard rock. Springville Area (5-74) is this strip of alluvium adjacent to Tule River and all wells are completed in hard rock. Templeton Mountain Area (5-75), Manache Meadow Area (5-76), and Sacator Canyon Valley (5-77) are all at the crest of mountains with no wells. Rockhouse Meadows Valley (5-78) is in wilderness with no wells. Inns Valley (5-79) and Bear Valley (5-81) both have all wells completed in hard rock.

Table 33 Tulare Lake 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									
5-22.08	KINGS	976,000	C	3,000	500-1,500	909	-	722	200-700	40-2000
5-22.09	WESTSIDE	640,000	C	2,000	1,100	960	-	50	520	220-35,000
5-22.10	PLEASANT VALLEY	146,000	B	3,300	-	151	-	2	1,500	1000-3000
5-22.11	KAWEAH	446,000	B	2,500	1,000-2,000	568	-	270	189	35-580
5-22.12	TULARE LAKE	524,000	B	3,000	300-1,000	241	-	86	200-600	200-40,000
5-22.13	TULE	467,000	B	3,000	-	459	-	150	256	200-30,000
5-22.14	KERN COUNTY	1,950,000	A	4,000	1,200-1,500	2,258	249	476	400-450	150-5000
5-23	PANOCHE VALLEY	33,100	C	-	-	48	-	-	1,300	394-3530
5-25	KERN RIVER VALLEY	74,000	C	3,650	350	-	-	92	378	253-480
5-26	WALKER BASIN CREEK VALLEY	7,670	C	650	-	-	-	1	-	-
5-27	CUMMINGS VALLEY	10,000	A	150	56	51	-	15	344	-
5-28	TEHACHAPI VALLEY WEST	14,800	A	1,500	454	64	-	19	315	280-365
5-29	CASTAC LAKE VALLEY	3,600	C	400	375	-	-	3	583	570-605
5-71	VALLECITOS CREEK VALLEY	15,100	C	-	-	-	-	0	-	-
5-80	BRITE VALLEY	3,170	A	500	50	-	-	-	-	-
5-82	CUDDY CANYON VALLEY	3,300	C	500	400	-	-	3	693	695
5-83	CUDDY RANCH AREA	4,200	C	300	180	-	-	4	550	480-645
5-84	CUDDY VALLEY	3,500	A	160	135	3	-	3	407	325-645
5-85	MIL POTRERO AREA	2,300	C	3,200	240	7	-	7	460	372-657

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

North Lahontan Hydrologic Region

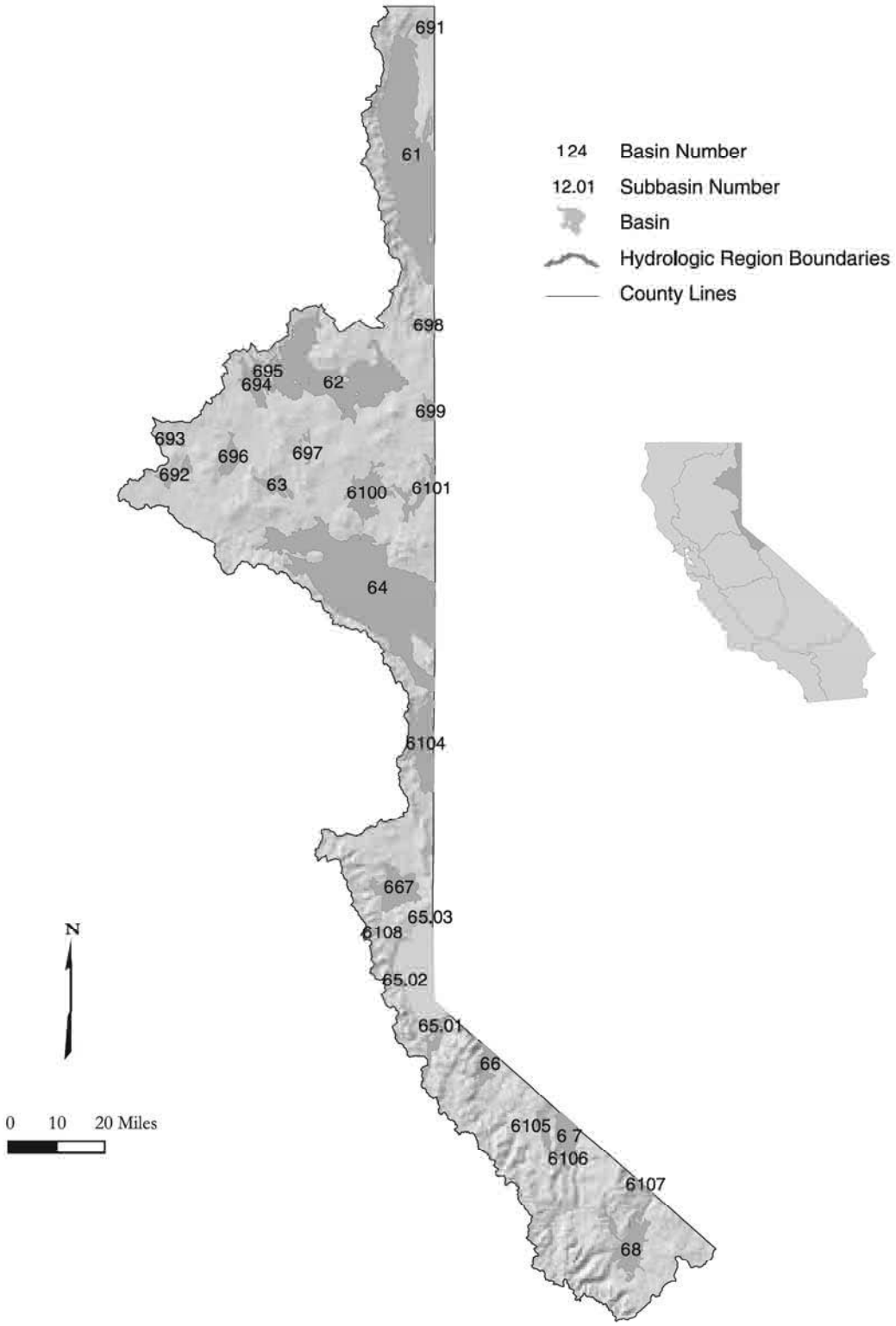

Figure 39 North Lahontan Hydrologic Region

Basins and Subbasins of the North Lahontan Hydrologic Region

Basin/subbasin	Basin name
6-1	Surprise Valley
6-2	Madeline Plains
6-3	Willow Creek Valley
6-4	Honey Lake Valley
6-5	Tahoe Valley
6-5.01	Tahoe Valley South
6-5.02	Tahoe Valley West
6-5.03	Tahoe Valley North
6-6	Carson Valley
6-7	Antelope Valley
6-8	Bridgeport Valley
6-67	Martis (Truckee) Valley
6-91	Cow Head Lake Valley
6-92	Pine Creek Valley
6-93	Harvey Valley
6-94	Grasshopper Valley
6-95	Dry Valley
6-96	Eagle Lake Area
6-97	Horse Lake Valley
6-98	Tuledad Canyon
6-99	Painters Flat
6-100	Secret Valley
6-101	Bull Flat
6-104	Long Valley
6-105	Slinkard Valley
6-106	Little Antelope Valley
6-107	Sweetwater Flat
6-108	Olympic Valley

Description of the Region

The North Lahonton HR covers approximately 3.91 million acres (6,110 square miles) and includes portions of Modoc, Lassen, Sierra, Nevada, Placer, El Dorado, Alpine, Mono, and Tuolumne counties (Figure 39). Reaching south from the Oregon border almost to Mono Lake on the east side of the Sierra, this region encompasses portions of two geomorphic provinces. From Long Valley north, most of the groundwater basins of the region were formed by basin and range block faulting near the western extent of the province. South from Long Valley, most of the basins are in the alpine valleys of the Sierra Nevada or are at the foot of the Sierra along the California-Nevada border where streams and rivers draining the eastern Sierran slopes terminate in desert sinks or lakes. The region corresponds to approximately the northern half of RWQCB 6. Significant geographic features include the Sierra Nevada, the volcanic terrane of the Modoc Plateau, Honey Lake Valley, and Lake Tahoe. The latter two areas are the major population centers in the region. The 1995 population of the entire region was about 84,000 people (DWR, 1998).

The northern portion of the region is rural and sparsely populated. Cattle ranching and associated hay cropping are the predominant land uses in addition to some pasture irrigation. Less than 4 percent of the entire region is irrigated. About 75 percent of the irrigated lands are in Modoc and Lassen counties, and most of the remainder is in Alpine and Mono counties. Much of the southern portion of the region is federally owned and managed as national forest lands where tourism and recreation constitute much of the economic base.

Much of the North Lahontan HR is chronically short of water due to the arid, high desert climate, which predominates in the region. Throughout the northern portion of the region where annual precipitation can be as low as 4 inches, runoff is typically scant and streamflows decrease rapidly during the irrigation season as the snowpack in the higher elevations melts. In the southern portion of the region, annual precipitation ranges from more than 70 inches (mostly snow in the higher elevations of the mountains) to as little as 8 inches in the low elevation valleys. In wet years, surface water can meet much of the agricultural demand, but in dry years, most of the region relies heavily on groundwater to meet water supply needs.

Groundwater Development

There are 24 groundwater basins in the region, one of which is divided into three subbasins. Thirteen of these basins are shared with Nevada and one with Oregon. These basins underlie approximately 1.03 million acres (1,610 square miles) or about 26 percent of the entire region. Although the groundwater basins were delineated based on mapped alluvial fill, much of the groundwater produced in many of them actually comes from underlying fractured rock aquifers. This is particularly true in the volcanic areas of Modoc and Lassen counties where, in many basins, volcanic flows are interstratified with lake sediments and alluvium. Wells constructed in the volcanics commonly produce large amounts of groundwater, whereas wells constructed in fine-grained lake deposits produce less. Because the thickness and lateral extent the of the hard rocks outside of the defined basin are generally not known, actual groundwater in storage in these areas is unknown.

Locally, groundwater is an important resource accounting for about 28 percent of the annual supply for agricultural and urban uses. Groundwater use in the region represents less than 1 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

In the northern portion of the region, a sizable quantity of groundwater (nearly 130,000 acre-feet) is extracted annually for agricultural and municipal purposes. Groundwater extracted from the Honey Lake Valley Basin accounts for 41,900 acre-feet of the agricultural supply and 12,000 acre-feet of the municipal supply (based on normalized data from 1990). An additional 3,100 acre-feet is extracted to meet the demands of the Honey Lake Wildlife Area, which provides habitat for several threatened species (Bald Eagle, Sandhill Crane, Bank Swallow, and Peregrine Falcon).

Well yields in the Honey Lake Valley Basin are greatest in alluvial and volcanic deposits. Wells drawing from these deposits may have yields that vary from 10 gpm to more than 2,000 gpm, but drawdown in these cases is generally high. Eight wells in the Honey Lake Wildlife Area have an average yield of between 1,260 and 2,100 gpm. Depths of completed wells in the region range from 20 to 720 feet.

The Honey Lake Valley Basin is very close to exceeding prudent perennial yield, and future development could come at the expense of water for agriculture. A 1987 agreement between DWR, the state of Nevada, and the U.S. Geological Survey resulted in a study of the groundwater flow system in eastern Honey Lake Valley. Upon conclusion of the study in September 1990, a Nevada state engineer ruled that only about 13,000 acre-feet could be safely transferred from the basin.

No major changes in water use are anticipated in the near future in the northern portion of the region. Irrigated agriculture is already constrained by economically available water supplies. A small amount of agricultural expansion is expected but only in areas that can support minor additional groundwater development. Likewise, the modest need for additional municipal and irrigation supplies can be met by minor expansion of present surface systems or by increased use of groundwater.

The principal drainages in the southern portion of the region are the Truckee, Walker and Carson rivers. Water rights in these drainages historically have been heavily contested, and allocations are limited by interstate agreements with Nevada, in-stream environmental requirements, and miscellaneous private rights holders. In the Lake Tahoe Basin, further development is strictly limited because of concerns regarding water quality in the lake. Surface water storage developed in the region's drainages provides urban and agricultural supply to the Reno/Sparks area and to the many smaller communities in the eastern Sierra and at the foot of the mountain slopes. Most communities rely on a combination of surface water and groundwater supply.

In the upper Truckee drainage, the primary groundwater basins underlie the areas around Lake Tahoe and Martis Valley, where the Town of Truckee is located. Both areas use surface water and groundwater for urban and surrounding rural domestic supplies.

Little is known about the small groundwater basins developed along the foot of the eastern Sierra. Most communities overlying these basins are along the streams and rivers flowing down the mountains, and groundwater is extracted from the underlying alluvium. Groundwater augments surface supplies for agricultural purposes and supports municipal and rural domestic supplies.

Groundwater Quality

In basins in the northern portion of the region, groundwater quality ranges widely from excellent to poor. Wells that obtain their water supply from lake deposits can have high concentrations of boron, arsenic, fluoride, nitrate, and TDS. TDS content generally increases toward the central portions of these basins where concentrations have accumulated over time. The groundwater quality along the margins of most of these basins tends to be of much better quality. There is a potential for future groundwater pollution occurring in urban/suburban areas where single-family septic systems have been installed, especially in hard rock areas. Groundwater quality in the alpine basins is good to excellent; but, as in any area where single-family septic systems have been installed, there is potential for degradation of groundwater quality.

Water Quality in Public Supply Wells

From 1994 through 2000, 169 public supply water wells were sampled in 8 of the 26 basins and subbasins in the North Lahontan HR. Evaluation of the analyzed samples indicates that 147 wells, or 87 percent, met the state primary MCLs for drinking water. Twenty-two wells, or 13 percent, have constituents that exceed one or more MCL. Figure 40 shows the percentages of each contaminant group that exceeded MCLs in the 22 wells.

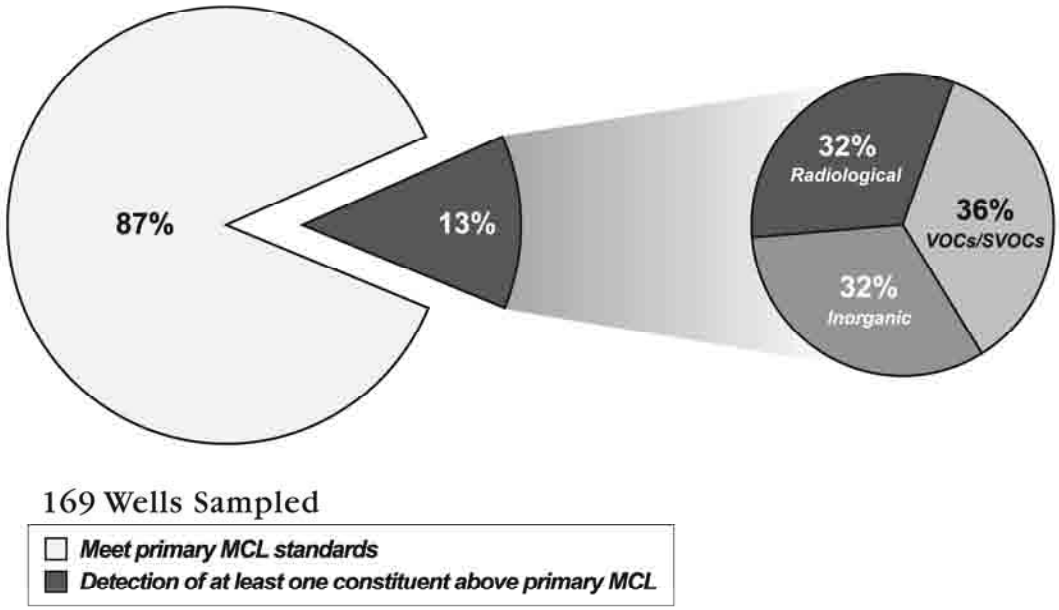

Figure 40 MCL exceedances in public supply wells in the North Lahontan Hydrologic Region

Table 34 lists the three most frequently occurring contaminants in each contaminant group and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 34 Most frequently occurring contaminants by contaminant group in the North Lahontan Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 3	Thallium – 3	3 tied at 1 exceedance
Inorganics – Secondary	Iron – 14	Manganese – 13	TDS – 1
Radiological	Gross Alpha – 7	Uranium – 5	Radium 226 – 1
VOCs/SVOCs	1,2 Dichloroethane – 8	TCE – 2	MTBE – 1

TCE = Trichloroethylene
MTBE = Methyltertiarybutylether
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. The only delineated areas removed from the list of region basins are the Recent and Pleistocene volcanic areas of the Modoc Plateau, previously numbered 6-102 and 6-103, respectively.

Table 35 North Lahontan 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
6-1	SURPRISE VALLEY	228,000	B	2,500	1,383	16	11	4	224	87 - 1,800
6-2	MADELINE PLAINS	156,150	B	-	450	2	6	-	402	81 - 1,790
6-3	WILLOW CREEK VALLEY	11,700	B	-	-	7	4	-	401	90 - 1,200
6-4	HONEY LAKE VALLEY	311,150	B	2,500	784	39	24	49	518	89 - 2,500
6-5	TAHOE VALLEY									
6-5.01	TAHOE SOUTH	14,800	C	4,000	-	6	-	54	-	59 - 206
6-5.02	TAHOE WEST	6,000	C	-	-	-	9	3	103	68 - 128
6-5.03	TAHOE VALLEY NORTH	2,000	C	900	-	-	-	-	141	-
6-6	CARSON VALLEY	10,700	C	-	-	-	-	-	-	-
6-7	ANTELOPE VALLEY	20,100	A	-	-	-	-	12	-	-
6-8	BRIDGEPORT VALLEY	32,500	C	-	-	-	-	6	-	-
6-67	MARTIS VALLEY	35,600	C	-	-	-	-	-	-	-
6-91	COW HEAD LAKE VALLEY	5,600	B	-	-	-	-	-	-	-
6-92	PINE CREEK VALLEY	9,530	B	-	-	-	-	1	-	-
6-93	HARVEY VALLEY	4,500	B	-	-	-	-	-	-	-
6-94	GRASSHOPPER VALLEY	17,670	B	-	-	-	-	-	-	-
6-95	DRY VALLEY	6,500	B	-	-	-	-	-	-	-
6-96	EAGLE LAKE AREA	-	B	-	-	-	4	4	-	-
6-97	HORSE LAKE VALLEY	3,800	B	-	-	-	-	-	-	-
6-98	TULEDAD CANYON	5,200	B	-	-	-	-	-	-	-
6-99	PAINTERS FLAT	6,400	B	-	-	-	-	-	-	-
6-100	SECRET VALLEY	33,680	B	-	-	2	2	-	-	125 - 3,200
6-101	BULL FLAT	18,100	B	-	-	-	-	-	-	-
6-104	LONG VALLEY	46,840	B	-	-	31	4		302	127 - 570
6-105	SLINKARD VALLEY	4,500	C	-	-	-	-	-	-	-
6-106	LITTLE ANTELOPE VALLEY	2,500	C	-	-	-	-	-	-	-
6-107	SWEETWATER FLAT	4,700	C	-	-	-	-	-	-	-
6-108	OLYMPIC VALLEY	700	C	600	330	-	-	2	-	-

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

South Lahontan Hydrologic Region

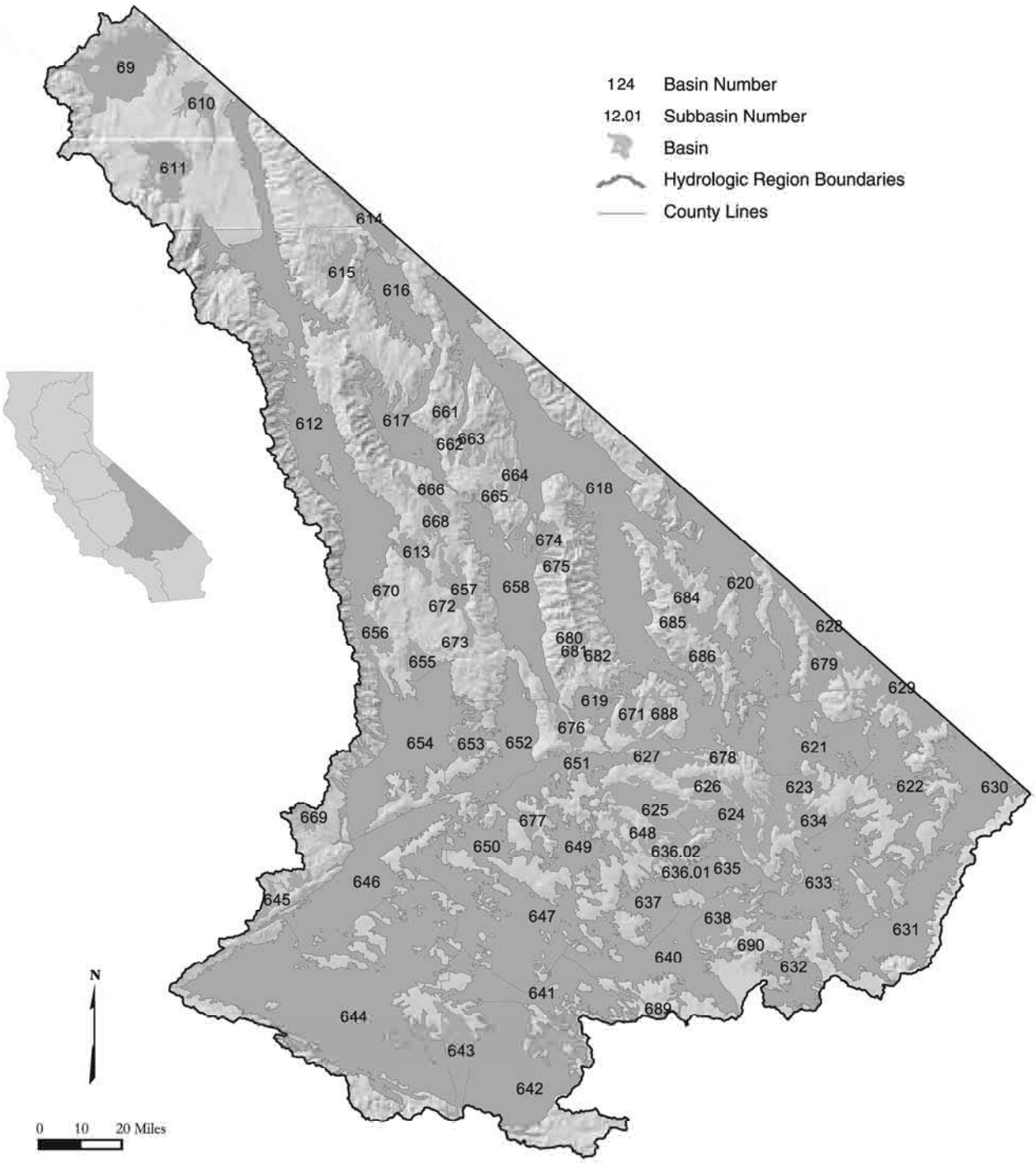

Figure 41 South Lahontan Hydrologic Region

Basins and Subbasins of the South Lahontan Hydrologic Region

Basin/subbasin	Basin name
6-9	Mono Valley
6-10	Adobe Lake Valley
6-11	Long Valley
6-12	Owens Valley
6-13	Black Springs Valley
6-14	Fish Lake Valley
6-15	Deep Springs Valley
6-16	Eureka Valley
6-17	Saline Valley
6-18	Death Valley
6-19	Wingate Valley
6-20	Middle Amargosa Valley
6-21	Lower Kingston Valley
6-22	Upper Kingston Valley
6-23	Riggs Valley
6-24	Red Pass Valley
6-25	Bicycle Valley
6-26	Avawatz Valley
6-27	Leach Valley
6-28	Pahrump Valley
6-29	Mesquite Valley
6-30	Ivanpah Valley
6-31	Kelso Valley
6-32	Broadwell Valley
6-33	Soda Lake Valley
6-34	Silver Lake Valley
6-35	Cronise Valley
6-36	Langford Valley
6-36.01	Langford Well Lake
6-36.02	Irwin
6-37	Coyote Lake Valley
6-38	Caves Canyon Valley
6-40	Lower Mojave River Valley
6-41	Middle Mojave River Valley
6-42	Upper Mojave River Valley
6-43	El Mirage Valley
6-44	Antelope Valley
6-45	Tehachapi Valley East
6-46	Fremont Valley
6-47	Harper Valley
6-48	Goldstone Valley
6-49	Superior Valley
6-50	Cuddeback Valley

Basin/subbasin	Basin name
6-51	Pilot Knob Valley
6-52	Searles Valley
6-53	Salt Wells Valley
6-54	Indian Wells Valley
6-55	Coso Valley
6-56	Rose Valley
6-57	Darwin Valley
6-58	Panamint Valley
6-61	Cameo Area
6-62	Race Track Valley
6-63	Hidden Valley
6-64	Marble Canyon Area
6-65	Cottonwood Spring Area
6-66	Lee Flat
6-68	Santa Rosa Flat
6-69	Kelso Lander Valley
6-70	Cactus Flat
6-71	Lost Lake Valley
6-72	Coles Flat
6-73	Wild Horse Mesa Area
6-74	Harrisburg Flats
6-75	Wildrose Canyon
6-76	Brown Mountain Valley
6-77	Grass Valley
6-78	Denning Spring Valley
6-79	California Valley
6-80	Middle Park Canyon
6-81	Butte Valley
6-82	Spring Canyon Valley
6-84	Greenwater Valley
6-85	Gold Valley
6-86	Rhodes Hill Area
6-88	Owl Lake Valley
6-89	Kane Wash Area
6-90	Cady Fault Area

Description of the Region

The South Lahontan HR covers approximately 21.2 million acres (33,100 square miles) in eastern California. This region includes about 21 percent of the surface area of California and both the highest (Mount Whitney) and lowest (Death Valley) surface elevations of the contiguous United States. The HR is bounded on the west by the crest of the Sierra Nevada and on the north by the watershed divide between Mono Lake and East Walker River drainages; on the east by Nevada and the south by the crest of the San Gabriel and San Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining northward. This HR includes the Owens, Mojave, and Amargosa River systems, the Mono Lake drainage system, and many other internally drained basins. Average annual precipitation is about 7.9 inches, and runoff is about 1.3 maf per year (DWR 1994).

The South Lahontan HR includes Inyo County, much of Mono and San Bernardino counties, and parts of Kern and Los Angeles counties (Figure 41). National forests, national and state parks, military bases and other public lands comprise most of the land in this region. The Los Angeles Department of Water and Power is also a major landowner in the northern part of the HR and controls rights to much of the water draining the eastern Sierra Nevada.

According to 2000 census data, the South Lahontan HR is home to about 530,000 people, or 1.6 percent of the state's population. The major population centers are in the southern part of the HR and include Palmdale, Lancaster, Victorville, Apple Valley, and Hesperia.

Groundwater Development

In this report, 76 groundwater basins are delineated in the South Lahontan HR, and the Langford Valley Groundwater Basin (6-36) is divided into two subbasins. The groundwater basins underlie about 11.60 million acres (18,100 square miles) or about 55 percent of the HR.

Most of the groundwater production is concentrated, along with the population, in basins in the southern part of this region. Groundwater provides 41 percent of water supply for agriculture and urban uses (DWR 1998). Much of this HR is public land with very low population density, within these areas there has been little groundwater development and little is known about the basins.

In most smaller basins, groundwater is found in unconfined alluvial aquifers; however, in some of the larger basins, or near dry lakes, aquifers may be separated by aquitards that cause confined groundwater conditions. Depths of the basins range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use.

Conjunctive use of surface water and groundwater is practiced in the more heavily pumped basins. Some water used in the southern part of the HR is imported from Northern California by the State Water Project. Some of this imported water is used to recharge groundwater in the Mojave River Valley basins (6-40, 6-41, and 6-42). Surface water and groundwater are exported from the South Lahontan HR to the South Coast HR by the Los Angeles Department of Water and Power.

Groundwater Quality

The chemical character of the groundwater varies throughout the region, but most often is calcium or sodium bicarbonate. Near and beneath dry lakes, sodium chloride and sodium sulfate-chloride water is common. In general, groundwater near the edges of valleys contains lower TDS content than water beneath the central part of the valleys or near dry lakes.

Drinking water standards are most often exceeded for TDS, fluoride, and boron content. The EPA lists 13 sites of contamination in this HR. Of these, three military installations in the Antelope Valley and Mojave River Valley groundwater basins are federal Superfund sites because of VOCs and other hazardous contaminants.

Water Quality in Public Supply Wells

From 1994 through 2000, 605 public supply water wells were sampled in 19 of the 77 basins and subbasins in the South Lahontan HR. Analyzed samples indicate that 506 wells, or 84 percent, met the state primary MCLs for drinking water. Ninety-nine wells, or 16 percent, have constituents that exceed one or more MCL. Figure 42 shows the percentages of each contaminant group that exceeded MCLs in the 99 wells.

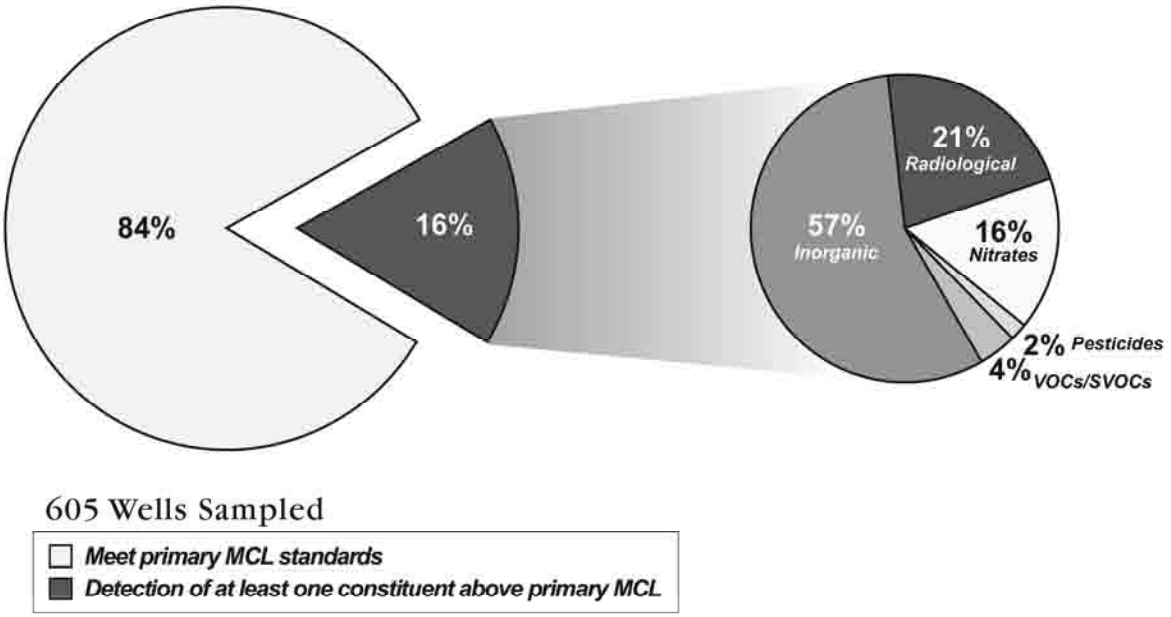

Figure 42 MCL exceedances in public supply wells in the South Lahontan Hydrologic Region

Table 36 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.

Table 36 Most frequently occurring contaminants by contaminant group in the South Lahontan Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 30	Arsenic – 19	Antimony – 5
Inorganics – Secondary	Iron – 82	Manganese – 36	Specific Conductance – 5 TDS – 5
Radiological	Gross Alpha – 18	Uranium – 7	Radium 228 – 2
Dissolved Nitrogen	Nitrate (as NO_3) – 12	Nitrate + Nitrite–6	Nitrite (as N) – 4
Pesticides	Di(2-Ethylhexyl)phthalate) – 2		
VOCs/SVOCs	MTBE – 2	TCE – 2	Carbon Tetrachloride – 2

TCE = Trichloroethylene
MTBE = Methyltertiarybutylether
VOC = Volatile Organic Compound
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 37). Langford Valley Groundwater Basin (6-36) has been divided into two subbasins. Granite Mountain Area (6-59) and Fish Slough Valley (6-60) groundwater basins have been deleted because no information was found concerning wells or groundwater in these basins or because well completion reports indicate that groundwater production is derived from fractured rocks beneath the basin. Furnace Creek Area Groundwater Basin (6-83) has been incorporated into Death Valley Groundwater Basin (6-18), and Butterbread Canyon Valley Groundwater Basin (6-87) has been incorporated into Lost Lake Valley Groundwater Basin (6-71).

Table 37 Modifications since Bulletin 118-80 of groundwater basins and subbasins in South Lahontan Hydrologic Region

Basin/subbasin name	New number	Old number
Langford Well Lake	6-36.01	6-36
Irwin	6-36.02	6-36
Troy Valley	Incorporated into 6-40 and 7-14.	6-39
Granite Mountain Area	Deleted	6-59
Fish Slough Valley	Deleted	6-60
Furnace Creek Area	Deleted – incorporated into 6-18	6-83
Butterbread Canyon Valley	Deleted – incorporated into 6-71	6-87

Troy Valley Groundwater Basin (6-39) has been split at the Pisgah fault, which is a groundwater barrier, and has been incorporated into Lower Mojave River Valley (6-40) and Lavic Valley (7-14) groundwater basins. This change incorporates part of the South Lahontan HR into a basin in the Colorado River HR[1]. The Middle Mojave River Valley Groundwater Basin (6-41) has changed boundaries along the north (Harper Valley; 6-47) and east sides (Lower Mojave River Valley; 6-40). The new boundaries are along the Camp Rock-Harper Lake fault zone, Waterman fault, and Helendale fault. Groundwater level elevations indicate that these faults are likely strong barriers to groundwater movement.

The boundary between the Upper Mojave River Valley Groundwater Basin (6-42) and the Lucerne Valley Groundwater Basin (7-19) was changed from the regional surface divide to the southern part of the Helendale fault, which is a groundwater barrier. This change incorporates part of the Colorado Desert HR into a basin in the South Lahontan HR[2].

[1] The boundaries of the hydrologic regions are defined by surface drainage patterns. In this case, faults impede groundwater flow causing it to flow beneath the surface drainage divide into the adjacent hydrologic region.
[2] See previous note.

Table 38 South Lahontan 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
6-09	MONO VALLEY	173,000	A	800	480	-	-	-	-	2060
6-10	ADOBE LAKE VALLEY	39,800	C	-	-	-	-	-	-	-
6-11	LONG VALLEY	71,800	A	250	90	20	-	5	-	-
6-12	OWENS VALLEY	661,000	A	8,100	1,870	700	7	89	-	300-450,000
6-13	BLACK SPRINGS VALLEY	30,800	C	-	-	-	-	-	-	-
6-14	FISH LAKE VALLEY	48,100	C	-	-	-	-	-	-	-
6-15	DEEP SPRINGS VALLEY	29,900	C	700	390	-	-	-	-	-
6-16	EUREKA VALLEY	129,000	C	-	-	-	-	1	-	-
6-17	SALINE VALLEY	146,000	C	-	-	-	-	-	-	-
6-18	DEATH VALLEY	921,000	C	-	-	28	-	6	-	-
6-19	WINGATE VALLEY	71,400	C	-	-		-		-	-
6-20	MIDDLE AMARGOSA VALLEY	390,000	C	3,000	2,500	2	-	4	-	-
6-21	LOWER KINGSTON VALLEY	240,000	C	-	-	-	-	-	-	-
6-22	UPPER KINGSTON VALLEY	177,000	C	24	-	-	-	5	-	-
6-23	RIGGS VALLEY	87,700	C	-	-	-	-	-	-	-
6-24	RED PASS VALLEY	96,500	C	-	-	-	-	-	-	-
6-25	BICYCLE VALLEY	89,600	C	710	-	-	12	6	618	508-810
6-26	AVAWATZ VALLEY	27,700	C	-	-	-	-	-	-	-
6-27	LEACH VALLEY	61,300	C	-	-	-	-	-	-	-
6-28	PAHRUMP VALLEY	93,100	C	300	150	-	-	-	-	-
6-29	MESQUITE VALLEY	88,400	C	1,500	1,020	-	-	-	-	-
6-30	IVANPAH VALLEY	199,000	C	600	400	-	-	9	-	-
6-31	KELSO VALLEY	255,000	C	370	290	-	-		-	-
6-32	BROADWELL VALLEY	92,100	C	-	-	-	-	1	-	-
6-33	SODA LAKE VALLEY	381,000	C	2,100	1,100	-	-	3	-	-
6-34	SILVER LAKE VALLEY	35,300	C	-	-	-	-		-	-
6-35	CRONISE VALLEY	127,000	C	600	340	-	-	-	-	-
6-36	LANGFORD VALLEY									
6-36.01	LANGFORD WELL LAKE	19,300	C	1,700	410	11	7	3	498	440-568
6-36.02	IRWIN	10,500	C	550	-	40	-	3	528	496-598
6-37	COYOTE LAKE VALLEY	88,200	A	1,740	660	5	-	-	-	300-1000
6-38	CAVES CANYON VALLEY	73,100	A	300	-	4	1	4	-	300-1000
6-40	LOWER MOJAVE RIVER VALLEY	286,000	A	2,700	770	70	21	52	300	-
6-41	MIDDLE MOJAVE RIVER VALLEY	211,000	A	4,000	1,000	74	3	14	500	-
6-42	UPPER MOJAVE RIVER VALLEY	413,000	A	5,500	1,030	120	22	153	500	1105
6-43	EL MIRAGE VALLEY	75,900	A	1,000	230	50	3	21	-	-
6-44	ANTELOPE VALLEY	1,110,000	A	7,500	286	262	10	248	300	200-800
6-45	TEHACHAPI VALLEY EAST	24,000	C	150	31	31	-	9	361	298-405
6-46	FREMONT VALLEY	2,370,000	C	4,000	500	23	-	13	596	350-100,000
6-47	HARPER VALLEY	410,000	A	3,000	725	11	3	19	-	179-2391
6-48	GOLDSTONE VALLEY	28,100	C	-	-	-	-	-	-	-
6-49	SUPERIOR VALLEY	120,000	C	450	100	-	-	-	-	-

Table 38 South Lahontan Hydrologic Region groundwater data (continued)

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
6-50	CUDDEBACK VALLEY	94,900	C	500	300	-	-	-	-	-
6-51	PILOT KNOB VALLEY	139,000	C	-	-	-	-	1	-	-
6-52	SEARLES VALLEY	197,000	C	1,000	300	-	-	-	-	-
6-53	SALT WELLS VALLEY	29,500	C	-	-	-	-	-	-	-
6-54	INDIAN WELLS VALLEY	382,000	A	3,800	815	116	20	63	312	110-1620
6-55	COSO VALLEY	25,600	C	-	-	-	-	-	-	-
6-56	ROSE VALLEY	42,500	C	-	-	-	-	1	-	-
6-57	DARWIN VALLEY	44,200	C	130	43	-	-	-	-	-
6-58	PANAMINT VALLEY	259,000	C	35	30	-	-	-	-	-
6-61	CAMEO AREA	9,310	C	-	-	-	-	-	-	-
6-62	RACE TRACK VALLEY	14,100	C	-	-	-	-	-	-	-
6-63	HIDDEN VALLEY	18,000	C	-	-	-	-	-	-	-
6-64	MARBLE CANYON AREA	10,400	C	-	-	-	-	-	-	-
6-65	COTTONWOOD SPRING AREA	3,900	C	-	-	-	-	-	-	-
6-66	LEE FLAT	20,300	C	-	-	-	-	-	-	-
6-68	SANTA ROSA FLAT	312	C	-	-	-	-	-	-	-
6-69	KELSO LANDER VALLEY	11,200	C	-	-	-	-	-	-	-
6-70	CACTUS FLAT	7,030	C	-	-	-	-	-	-	-
6-71	LOST LAKE VALLEY	23,300	C	-	-	-	-	-	-	-
6-72	COLES FLAT	2,950	C	-	-	-	-	-	-	-
6-73	WILD HORSE MESA AREA	3,320	C	-	-	-	-	-	-	-
6-74	HARRISBURG FLATS	24,900	C	-	-	-	-	1	-	-
6-75	WILDROSE CANYON	5,160	C	-	-	-	-	-	-	-
6-76	BROWN MOUNTAIN VALLEY	21,700	C	-	-	-	-	-	-	-
6-77	GRASS VALLEY	9,980	C	-	-	-	-	-	-	-
6-78	DENNING SPRING VALLEY	7,240	C	-	-	-	-	-	-	-
6-79	CALIFORNIA VALLEY	58,300	C	-	-	-	-	-	-	-
6-80	MIDDLE PARK CANYON	1,740	C	-	-	-	-	-	-	-
6-81	BUTTE VALLEY	8,810	C	-	-	-	-	-	-	-
6-82	ANVIL SPRING CANYON VALLEY	4,810	C	-	-	-	-	-	-	-
6-84	GREENWATER VALLEY	59,900	C	-	-	-	-	-	-	-
6-85	GOLD VALLEY	3,220	C	-	-	-	-	-	-	-
6-86	RHODES HILL AREA	15,600	C	-	-	-	-	-	-	-
6-88	OWL LAKE VALLEY	22,300	C	-	-	-	-	-	-	-
6-89	KANE WASH AREA	5,960	C	60	-	-	-	-	-	-
6-90	CADY FAULT AREA	7,960	C	-	-	-	-	-	-	-

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

Colorado River Hydrologic Region

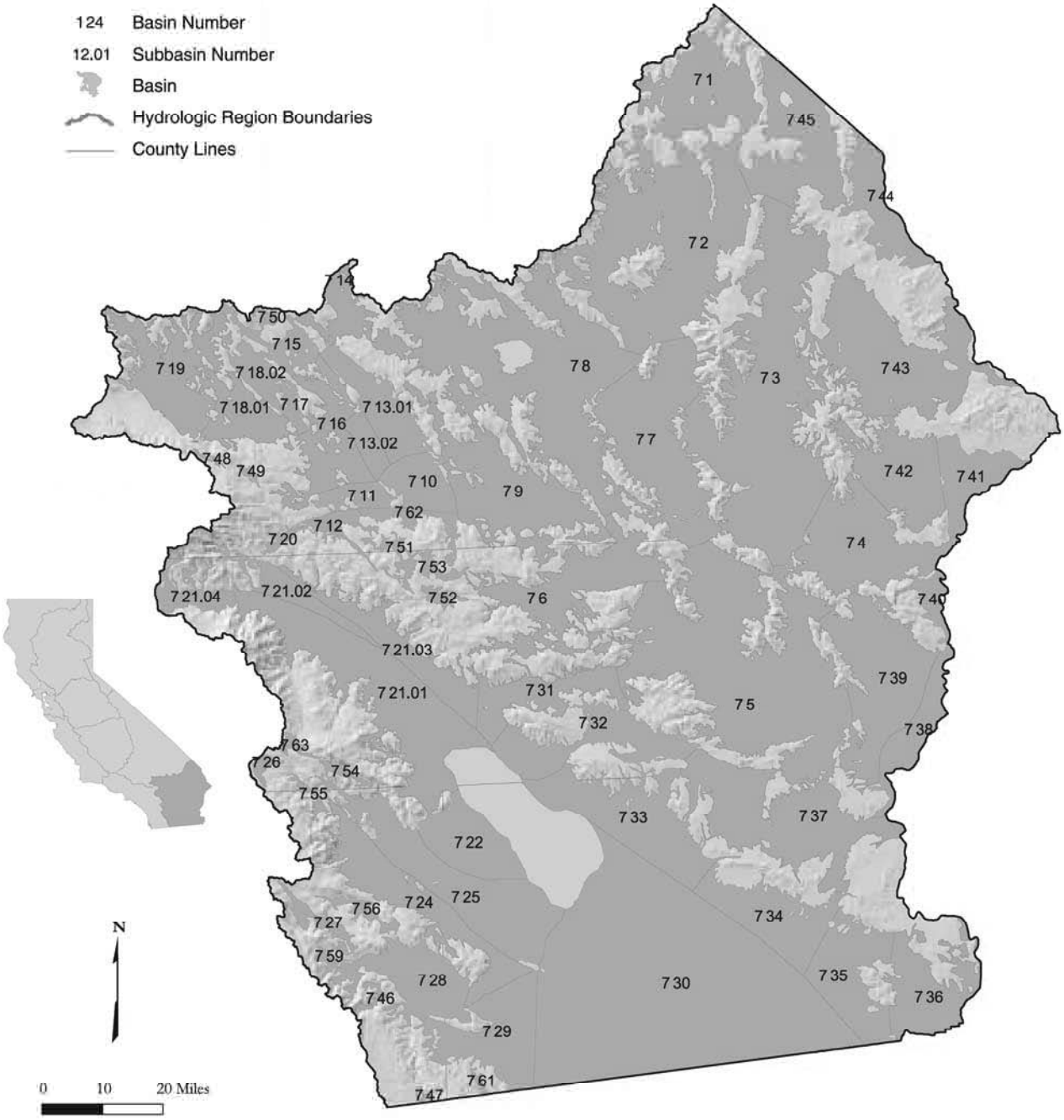

Figure 43 Colorado River Hydrologic Region

Basins and Subbasins of Colorado River Hydrologic Region

Basin/subbasin		Basin name
7-1		Lanfair Valley
7-2		Fenner Valley
7-3		Ward Valley
7-4		Rice Valley
7-5		Chuckwalla Valley
7-6		Pinto Valley
7-7		Cadiz Valley
7-8		Bristol Valley
7-9		Dale Valley
7-10		Twentynine Palms Valley
7-11		Copper Mountain Valley
7-12		Warren Valley
7-13		Deadman Valley
	7-13.01	Deadman Lake
	7-13.02	Surprise Spring
7-14		Lavic Valley
7-15		Bessemer Valley
7-16		Ames Valley
7-17		Means Valley
7-18		Johnson Valley Area
	7-18.01	Soggy Lake
	7-18.02	Upper Johnson Valley
7-19		Lucerne Valley
7-20		Morongo Valley
7-21		Coachella Valley
	7-21.01	Indio
	7-21.02	Mission Creek
	7-21.03	Desert Hot Springs
	7-21.04	San Gorgonio Pass
7-22		West Salton Sea
7-24		Borrego Valley
7-25		Ocotillo-Clark Valley
7-26		Terwilliger Valley
7-27		San Felipe Valley
7-28		Vallecito-Carrizo Valley
7-29		Coyote Wells Valley
7-30		Imperial Valley
7-31		Orocopia Valley
7-32		Chocolate Valley
7-33		East Salton Sea
7-34		Amos Valley
7-35		Ogilby Valley
7-36		Yuma Valley
7-37		Arroyo Seco Valley
7-38		Palo Verde Valley
7-39		Palo Verde Mesa
7-40		Quien Sabe Point Valley
7-41		Calzona Valley
7-42		Vidal Valley
7-43		Chemehuevi Valley
7-44		Needles Valley
7-45		Piute Valley
7-46		Canebrake Valley
7-47		Jacumba Valley
7-48		Helendale Fault Valley
7-49		Pipes Canyon Fault Valley
7-50		Iron Ridge Area
7-51		Lost Horse Valley
7-52		Pleasant Valley
7-53		Hexie Mountain Area
7-54		Buck Ridge Fault Valley
7-55		Collins Valley
7-56		Yaqui Well Area
7-59		Mason Valley
7-61		Davies Valley
7-62		Joshua Tree
7-63		Vandeventer Flat

Description of the Region

The Colorado River HR covers approximately 13 million acres (20,000 square miles) in southeastern California. It is bounded on the east by Nevada and Arizona, the south by the Republic of Mexico, the west by the Laguna, San Jacinto, and San Bernardino mountains, and the north by the New York, Providence, Granite, Old Dad, Bristol, Rodman, and Ord Mountain ranges. An average annual precipitation of 5.5 inches and average annual runoff of only 200,000 acre-feet makes this the most arid HR of California (DWR 1994). Surface runoff drains to many closed basins or to the Colorado River.

This HR includes all of Imperial, most of Riverside, much of San Bernardino, and part of San Diego counties (Figure 43). Many of the alluvial valleys in the region are underlain by groundwater aquifers that are the sole source of water for local communities.

About 533,000 people live within the Colorado River HR (DWR, 1998). The largest population centers are Palm Springs, Palm Desert, Indio, Coachella, and El Centro.

Groundwater Development

The earliest groundwater development in California may have been prehistoric water wells dug by the Cahuilla Indians in Coachella Valley of the Colorado River HR. In this report, 64 groundwater basins/subbasins are delineated in this HR. The Deadman Valley, Johnson Valley Area, and Coachella Valley groundwater basins have been divided into subbasins. Groundwater basins underlie about 8.68 million acres or about 26 percent of this HR.

In the Colorado River HR, groundwater provides about 8 percent of the water supply in normal years for agricultural and urban uses (DWR 1998). In most smaller basins, groundwater is found in unconfined alluvial aquifers. In some of the larger basins, particularly near dry lakes, aquifers may be separated by aquitards that create confined groundwater conditions. Depths of basins range from tens or hundreds of feet in smaller basins and along arms of ephemeral rivers to thousands of feet in larger basins. The thickness of aquifers varies from tens to hundreds of feet. Well yields vary in this region depending on aquifer characteristics and well location, size, and use. Some aquifers are capable of yielding thousands of gallons per minute to municipal wells.

Conjunctive use of surface water and groundwater is a long-standing practice in the region. Water is imported from the Colorado River for irrigation in Imperial, Coachella, and Palo Verde Valleys and from groundwater recharge in Coachella Valley. Water imported from Northern California is used to replenish Warren and Joshua Tree groundwater basins. Many agencies have erected systems of barriers to allow more efficient percolation of ephemeral runoff from surrounding mountains. The concept of utilizing groundwater basins in this sparsely populated HR for storing water that would be pumped during drought years is getting much attention.

Groundwater Quality

The chemical character of groundwater in the Colorado River HR is variable. Cation concentration is dominated by sodium with calcium common and magnesium appearing less often. Bicarbonate is usually the dominant anion, although sulfate and chloride waters are also common. In basins with closed drainages, water character often changes from calcium-sodium bicarbonate near the margins to sodium chloride or chloride-sulfate beneath a dry lake. It is not uncommon for concentrations of dissolved constituents to rise dramatically toward a dry lake where saturation of mineral salts is reached. An example of this is found at Bristol Valley Groundwater Basin, where the mineral halite (sodium chloride) is formed and then mined by

evaporation of groundwater in trenches in Bristol (dry) Lake. The TDS content of groundwater is high in many of the basins in this region. High fluoride content is common; sulfate content occasionally exceeds drinking water standards; and high nitrate content is common, especially in agricultural areas.

Two of the primary challenges in the Colorado River HR are overdraft in the Coachella Valley and leaking underground storage tanks. The EPA has not yet placed any contamination sites in this HR on the Superfund National Priorities List; however, one site is under consideration because of high pesticide levels.

Water Quality in Public Supply Wells

From 1994 through 2000, 314 public supply water wells were sampled in 23 of the 64 basins and subbasins in the Colorado River HR. Analyzed samples indicate that 270 wells, or 86 percent, met the state primary MCLs for drinking water standards. Forty-four wells, or 14 percent, have constituents that exceed one or more MCL. Figure 44 shows the percentages of each contaminant group that exceeded MCLs in the 44 wells.

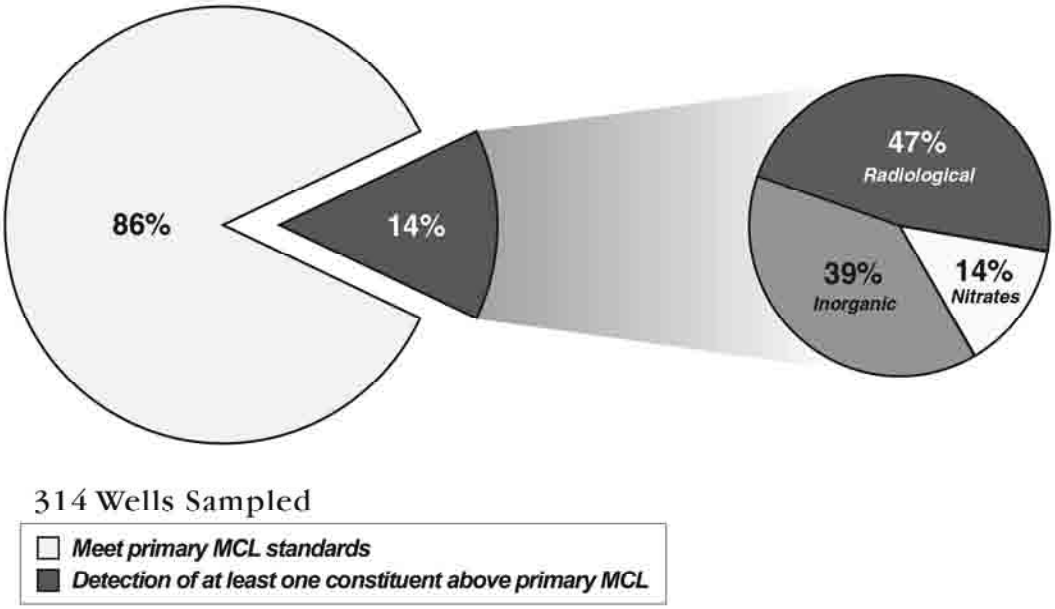

Figure 44 MCL exceedances in public supply wells in the Colorado River Hydrologic Region

Table 39 lists the three most frequently occurring contaminants in each contaminant group and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 39 Most frequently occurring contaminants by contaminant group in the Colorado River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Fluoride – 17		
Inorganics – Secondary	Iron – 38	Manganese – 26	TDS – 5
Radiological	Radium 228 – 3	Combined RA226 + RA228 – 3	Radium 226 – 1
Nitrates	Nitrate (as NO_3) – 6	Nitrate + Nitrite – 1	

Changes from Bulletin 118-80

Several modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report (Table 40). Jacumba Valley East Groundwater Basin (7-60) has been deleted because of lack of information about groundwater in this basin. The Pinyon Wash Area (7-57) and Whale Peak Area (7-58) groundwater basin names have been deleted because they are now incorporated into other larger basins. Similarly, Clark Valley (7-23) and Ocotillo Valley (7-25) groundwater basins are now the combined Ocotillo-Clark Valley Groundwater Basin (7-25). The Deadman Valley (7-13), Johnson Valley Area (7-18), and Coachella Valley (7-21) groundwater basins have been subdivided into subbasins in this report. The western boundary of Lucerne Valley Groundwater Basin (7-19) has been moved eastward from the HR boundary to the Helendale fault. Groundwater level elevations indicate that this fault is a groundwater barrier and that groundwater flows westward back under the surface divide into the Upper Mojave River Groundwater Basin (6-42). The boundary between Lucerne Valley (7-19) and Johnson Valley Area (7-18) groundwater basins is delineated in this report.

The boundaries of Twentynine Palms Valley (7-10), Copper Mountain Valley (7-11), Warren Valley (7-12), Deadman Lake (7-13), and Ames Valley (7-16) groundwater basins have been redrawn in light of newer groundwater level data. These data indicate that the Pinto Mountain fault is a groundwater barrier. Joshua Tree Groundwater Basin (7-62) is a new basin that has been delineated from parts of Copper Mountain Valley and Twentynine Palms Valley Groundwater Basins because the Pinto Mountain fault is such a strong barrier. Buck Ridge Fault Valley Groundwater Basin (7-54) was presented in Bulletin 118-80 as two unconnected deposits of water-bearing alluvium separated by outcrop of nonwater-bearing rocks. These water-bearing deposits have been designated as separate groundwater basins in this report, with the Buck Ridge Fault Valley Groundwater Basin (7-54) as the northern basin and Vandeventer Flat Groundwater Basin (7-63) presented as the southern basin.

Table 40 Modifications since Bulletin 118-80 of groundwater basins in Colorado River Hydrologic Region

Basin name	New number	Old number
Clark Valley	Delete – combined with 7-25	7-23
Ocotillo-Clark Valley	7-25 (now combined)	7-25
Pinyon Wash Area	Incorporated into 7-56	7-57
Whale Peak Area	Incorporated into 7-28	7-58
Jacumba Valley East	Deleted	7-60
Joshua Tree	7-62 (new)	
Vandeventer Flat	7-63 (new)	

Table 41 Colorado 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
7-1	LANFAIR VALLEY	157,000	C	70	16	-	-	9	515	173-2,260
7-2	FENNER VALLEY	454,000	A	200	100	-	-	4	515	173-2,260
7-3	WARD VALLEY	961,000	A	260	180	-	-	1	-	327-589
7-4	RICE VALLEY	189,000	C	65	-	-	-	-	-	-
7-5	CHUCKWALLA VALLEY	604,000	C	3,900	1,800	12	-	10	-	424
7-6	PINTO VALLEY	183,000	A	1,480	900	-	-	1	-	-
7-7	CADIZ VALLEY	270,000	C	167	66	-	-	-	400	300-3000
7-8	BRISTOL VALLEY	498,000	A	3,000	-	-	-	-		300-298,000
7-9	DALE VALLEY	213,000	C	380	275	-	-	2	-	-
7-10	TWENTYNINE PALMS VALLEY	62,400	C	3,000	540	27	-	2	640	-
7-11	COPPER MOUNTAIN VALLEY	30,300	A	2,450	250	2	-	2	-	180-214
7-12	WARREN VALLEY	17,200	A	4,000	350	27	18	17	196	129-269
7-13	DEADMAN VALLEY									
7-13.01	DEADMAN LAKE	89,200	C	2,000	-	28	3	1	-	311-985
7-13.02	SURPRISE SPRING	29,300	C	1,370	680	26	6	9	177	141-1,050
7-14	LAVIC VALLEY	102,000	C	140	80	-	-	-	-	-
7-15	BESSEMER VALLEY	39,100	C	0	-	-	-	-	-	-
7-16	AMES VALLEY	110,000	C	2,000	-	19	3	11	459	-
7-17	MEANS VALLEY	15,000	C	0	-	1	-	-	-	-
7-18	JOHNSON VALLEY AREA									
7-18.01	SOGGY LAKE	76,800	C	-	-	6	-	1	-	300-2,000
7-18.02	UPPER JOHNSON VALLEY	34,800	C	-	-	-	-	-	-	3,000
7-19	LUCERNE VALLEY	148,000	A	1,000	-	22	9	21	301	200-5,000
7-20	MORONGO VALLEY	7,240	C	600	90	-	-	5	-	-
7-21	COACHELLA VALLEY									
7-21.01	INDIO	336,000	A	1,880	650	30	-	204	300	-
7-21.02	MISSION CREEK	49,000	A	3,500	715	5	-	15	<500	-
7-21.03	DESERT HOT SPRINGS	101,000	C	2,500	985	10	-	2	-	800-1,000
7-21.04	SAN GORGONIO PASS	38,700	A	1,000	0	17	8	5	-	106-205
7-22	WEST SALTON SEA	106,000	C	540	400	v	-	-	-	-
7-24	BORREGO VALLEY	153,000	A	2,000	0	10	10	25	-	300-2,440
7-25	OCOTILLO-CLARK VALLEY	223,000	C	3,500	1,760	1	-	2	-	-
7-26	TERWILLIGER VALLEY	8,030	C	100	-	-	-	1	-	500
7-27	SAN FELIPE VALLEY	2,340	C	500	30	-	-	1	-	-
7-28	VALLECITO-CARRIZO VALLEY	122,000	C	2,500	260	-	-	1	-	-
7-29	COYOTE WELLS VALLEY	146,000	A	-	-	25	6	9	-	-
7-30	IMPERIAL VALLEY	961,000	A	1,000	-	19	-	45	1088	498-7,280
7-31	OROCOPIA VALLEY	96,500	A	210	165	0	-	1	-	-
7-32	CHOCOLATE VALLEY	130,000	C	0	0	0	-	-	-	-
7-33	EAST SALTON SEA	196,000	C	0	0	1	-	4	-	-
7-34	AMOS VALLEY	130,000	C	100	50	3	-	1	-	-
7-35	OGILBY VALLEY	134,000	C	4,000	50	27	1	3	-	-

Table 41 Colorado River Hydrologic Region groundwater data (continued)

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
7-36	YUMA VALLEY	3,780	C	100	40	59	0	15	-	-
7-37	ARROYO SECO VALLEY	258,000	C	-	-	2	0	0	-	-
7-38	PALO VERDE VALLEY	73,400	A	-	-	11	-	19	840	658-1,030
7-39	PALO VERDE MESA	226,000	C	2,750	1,650	20	-	13	-	-
7-40	QUIEN SABE POINT VALLEY	25,300	C	25	-	-	-	3	-	-
7-41	CALZONA VALLEY	81,000	C	2,340	500	0	0	0	-	
7-42	VIDAL VALLEY	138,000	C	1,800	675	-	-	1	-	-
7-43	CHEMEHUEVI VALLEY	273,000	A	0	0	1	0	1	-	-
7-44	NEEDLES VALLEY	88,400	A	1,500	980	34	-	11	-	-
7-45	PIUTE VALLEY	176,000	C	1,500	200	-	-	-	-	-
7-46	CANEBRAKE VALLEY	5,420	C	125	-	-	-	-	-	-
7-47	JACUMBA VALLEY	2,450	A	1,000	-	-	-	3		296-6,100
7-48	HELENDALE FAULT VALLEY	2,620	C	-	-	-	-	-	-	-
7-49	PIPES CANYON FAULT VALLEY	3,390	C	-	-	-	-	-	-	-
7-50	IRON RIDGE AREA	5,250	C	-	-	-	-	-	-	-
7-51	LOST HORSE VALLEY	17,300	C	-	-	-	-	-	-	-
7-52	PLEASANT VALLEY	9,670	C	-	-	-	-	-	-	-
7-53	HEXIE MOUNTAIN AREA	11,200	C	-	-	-	-	-	-	-
7-54	BUCK RIDGE FAULT VALLEY	6,930	C	-	-	-	-	-	-	-
7-55	COLLINS VALLEY	7,080	C	1,500	-	-	-	-	-	-
7-56	YAQUI WELL AREA	15,000	C	0	-	-	-	1	-	-
7-59	MASON VALLEY	5,530	C	0	0	0	0	1	-	-
7-61	DAVIES VALLEY	3,570	C	0	0	0	0	-	-	-
7-62	JOSHUA TREE	33,800	A	2,200	1,110	25	5	14	180	117-185
7-63	VANDEVENTER FLAT	6,750	C	50	17	-	-	-	-	-

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

References

References

Literature

Alley WM, Reilly TE, Franke OL. 1999. Sustainability of Ground-water Resources. Denver, CO: U.S. Geological Survey. 79 p.

Ayers RS, Westcot DW, (Food and Agriculture Organization of the United Nations). 1985. Water Quality for Agriculture. Rome: Food and Agriculture Organization of the United Nations. xii, 174 p.

Bachman SB, ... et al. 1997. California Groundwater Management. Sacramento: Groundwater Resources Association of California. xiv, 145 p.

CALFED Bay-Delta Program. 2000. Programmatic Record of Decision. http://calwater.ca.gov/Archives/GeneralArchive/RecordOfDecision2000.shtml

[DHS] California Department of Health Services. 2000. Drinking Water Source Assessment and Protection (DWSAP) Program. http://www.dhs.ca.gov/ps/ddwem/dwsap/guidance/maindocument2.htm.

[DWR] California Department of Water Resources. 1957. Lake County Investigation. Sacramento: The Department, Division of Resources Planning. Report on Bulletin 14. xiii, 169 p. Jul

[DWR] California Department of Water Resources. 1963. Northeastern Counties Ground Water Investigation. Sacramento. Bulletin 98. 2 v. Feb

[DWR] California Department of Water Resources. 1967. Evaluation of Ground Water Resources, South Bay. Sacramento: The Department, Alameda County Water District, and Santa Clara Valley Water District. Bulletin 118-1. 5 v.

[DWR] California Department of Water Resources. 1974a. Evaluation of Ground Water Resources: Livermore and Sunol Valleys. Sacramento. Bulletin 118-2. xv, 153 p.

[DWR] California Department of Water Resources. 1974b. Evaluation of Ground Water Resources: Sacramento County. Sacramento. Bulletin 118-3. xiii, 141 p.

[DWR] California Department of Water Resources. 1975a. California's Ground Water. Sacramento. Bulletin 118. x, 135 p. Sep

[DWR] California Department of Water Resources. 1975b. Evaluation of Ground Water Resources : Sonoma County. Sacramento: The Department in cooperation with County of Sonoma Water Agency. Bulletin 118-4.

[DWR] California Department of Water Resources. 1978. Evaluation of Ground Water Resources, Sacramento Valley. Sacramento: The Department and US Geological Survey. Bulletin 118-6. ix, 136 p.

[DWR] California Department of Water Resources. 1980. Ground Water Basins in California - A report to the Legislature in Response to Water Code Section 12924. Bulletin 118-80. 73 p. Jan 1980

[DWR] California Department of Water Resources. 1994. California Water Plan Update. Sacramento. Bulletin 160-94. 2 v.

[DWR] California Department of Water Resources. 1997. Compilation of Federal and State Drinking Water Standards and Criteria. The Department, Division of Local Assistance. Report on Quality Assurance Technical Document 3. Jun

[DWR] California Department of Water Resources. 1998. California Water Plan Update. Sacramento. Bulletin 160-98. 3 v.

[DWR] California Department of Water Resources. 2001. Water Facts No. 3 - Adjudicated Groundwater Basins in California. 4 p. Jan 2001

[DivWR] California Division of Water Resources. 1952. Ground Water Basins in California. Sacramento. Report Number 3, Water Quality Investigations. 44 p.

[GADPP] California Governor's Advisory Drought Planning Panel. 2000. Critical Water Shortage Contingency Plan. Sacramento: California Dept. of Water Resources. 1 v.

Driscoll FG. 1986. Groundwater and Wells. St. Paul, Minn.: Johnson Division. xv, 1089 p.

[EMWD] Eastern Municipal Water District. 2001. Groundwater Management Plan. Perris, CA.

[EMWD] Eastern Municipal Water District. 2002. Groundwater Management Plan: Progress Report. Perris, CA.

Fetter CW. 1988. Applied Hydrogeology. Columbus: Merrill Pub. Co. xvi, 592 p.

Glennon R. 2002. Water Follies: Groundwater Pumping and the Fate of America's Fresh Water. Washington, DC: Island Press. 314 p.

Heath J. 1993. Compilation of Federal and State Drinking Water Standards and Criteria. Sacramento: California Department of Water Resources. vii, 35 p.

Heath RC (North Carolina Department of Natural Resources and Community Development). 1983. Basic Ground-Water Hydrology. v, 84 p.

[NRDC] Natural Resources Defense Council. 2001. California's Contaminated Groundwater - Is the State Minding the Store? 97 p.

Plancrt M, Williams JS (US Gcological Survcy). 1995. Ground Watcr Atlas of thc Unitcd Statcs. Rcston, Va: US Geological Survey. 28 p.

[SJVDP] San Joaquin Valley Drainage Program. 1990. A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley: Final Report of the San Joaquin Valley Drainage Program. Washington, D.C.: US Dept. of the Interior Bureau of Reclamation, US Fish and Wildlife Service, and US Geological Survey. xiii, 183 p.

[SCVWD] Santa Clara Valley Water District. 2001. Santa Valley Water District Groundwater Management Plan. 67 p. Jul

Sax JL. 2002. Review of the Laws Establishing the SWRCB's Permitting Authority Over Appropriations of Groundwater Classified as Subterranean Streams and the SWRCB's Implementation of Those Laws. 92 p. 19 Jan

Solley WB, Pierce RR, Perlman HA (US Geological Survey). 1998. Estimated use of water in the United States in 1995. US Geological Survey circular; 1200. Denver, Colo: US Geological Survey. Report nr 060790075X. ix, 71 p.

[TLBWSD] Tulare Lake Basin Water Storage District. 2002. Tulare Lake Bed Coordinated Groundwater Management Plan Annual Report.

Todd Engineers. 1994. Scotts Valley Water District Groundwater Management Plan.

Todd Engineers. 2002. Scotts Valley Water District Groundwater Management Plan, 2001-2002 Annual Report; Report to Scotts Valley Water District. Jul

Todd Engineers. 2003a. Update on Autumn Groundwater Conditions and AB 303 Management Plan, Memorandum to Scotts Valley Water District. Feb

Todd Engineers. 2003b. Scotts Valley Water District Groundwater Management Plan, 2002-2003 Annual Report; Report to Scotts Valley District. Jul

[USGS] US Geological Survey. 1995. Groundwater of Lower Lake - Middletown Area, Lake County, California. Geological Survey Water Supply Paper 1297.

Personal communication

Murphey, Paul. State Water Resources Control Board, Water Rights Section. 2003. Phone call to Mary Scruggs, DWR via telephone. Aug

Glossary

Glossary

A

acre-foot (af) The volume of water necessary to cover one acre to a depth of one foot; equal to 43,560 cubic feet or 325,851 gallons.

adjudication A case that has been heard and decided by a judge. In the context of an adjudicated groundwater basin, landowners or other parties have turned to the courts to settle disputes over how much groundwater can be extracted by each party to the decision.

alluvial Of or pertaining to or composed of alluvium.

alluvium A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream or other body of running water, as a sorted or semi sorted sediment in the bed of the stream or on it's floodplain or delta, as a cone or fan at the base of a mountain slope.

anthropogenic Of human origin or resulting from human activity.

appropriative right The right to use water that is diverted or extracted by a nonriparian or nonoverlying party for nonriparian or nonoverlying uses. In California, surface water appropriative rights are subject to a statutory permitting process while groundwater appropriation is not.

aquitard A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores ground water.

aquifer A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs.

aridity A term describing a climate or region in which precipitation is so deficient in quantity or occurs so infrequently that intensive agricultural production is not possible without irrigation.

artesian aquifer A body of rock or sediment containing groundwater that is under greater than hydrostatic pressure; that is, a confined aquifer. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer.

artesian pressure Hydrostatic pressure of artesian water, often expressed in terms of pounds per square inch; or the height, in feet above the land surface, of a column of water that would be supported by the pressure.

artificial recharge The addition of water to a groundwater reservoir by human activity, such as putting surface water into dug or constructed spreading basins or injecting water through wells.

available groundwater storage capacity The volume of a groundwater basin that is unsaturated and capable of storing groundwater.

average annual runoff The average value of total annual runoff volume calculated for a selected period of record, at a specified location, such as a dam or stream gage.

average year water demand Demand for water under average hydrologic conditions for a defined level of development.

B

basin management objectives (BMOs) See management objectives

beneficial use One of many ways that water can be used either directly by people or for their overall benefit. The State Water Resources Control Board recognizes 23 types of beneficial use with water quality criteria for those uses established by the Regional Water Quality Control Boards.

borehole geophysics The general field of geophysics developed around the lowering of a variety of probes into a boring or well. Borehole logging provides additional information concerning physical, electrical, acoustic, nuclear and chemical aspects of the soils and rock encountered during drilling.

C

community water system A public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 year-long residents (DHS 2000).

confined aquifer An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself. An aquifer containing confined ground water. See artesian aquifer.

conjunctive use The coordinated and planned management of both surface and groundwater resources 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 surface water supply.

contaminant Any substance or property preventing the use or reducing the usability of the water for ordinary purposes such as drinking, preparing food, bathing washing, recreation, and cooling. Any solute or cause of change in physical properties that renders water unfit for a given use. (Generally considered synonymous with pollutant).

critical conditions of overdraft A groundwater basin in which continuation of present practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts. The definition was created after an extensive public input process during the development of the Bulletin 118-80 report.

D

deep percolation Percolation of water through the ground and beyond the lower limit of the root zone of plants into groundwater.

desalination A process that converts seawater or brackish water to fresh water or an otherwise more usable condition through removal of dissolved solids.

domestic well A water well used to supply water for the domestic needs of an individual residence or systems of four or fewer service connections.

drinking water system See public water system

drought condition Hydrologic conditions during a defined period when rainfall and runoff are much less than average.

drought year supply The average annual supply of a water development system during a defined drought period.

E

electrical conductivity (EC) The measure of the ability of water to conduct an electrical current, the magnitude of which depends on the dissolved mineral content of the water.

effective porosity The volume of voids or open spaces in alluvium and rocks that is interconnected and can transmit fluids.

environmental water Water serving environmental purposes, including instream fishery flow needs, wild and scenic river flows, water needs of fresh-water wetlands, and Bay-Delta requirements.

evapotranspiration (ET) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces.

G

groundwater basin An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.

groundwater budget A numerical accounting, the *groundwater equation*, of the recharge, discharge and changes in storage of an aquifer, part of an aquifer, or a system of aquifers.

groundwater in storage The quantity of water in the zone of saturation.

groundwater management The planned and coordinated management of a groundwater basin or portion of a groundwater basin with a goal of long-term sustainability of the resource.

groundwater management plan A comprehensive written document developed for the purpose of groundwater management and adopted by an agency having appropriate legal or statutory authority.

groundwater mining The process, deliberate or inadvertent, of extracting groundwater from a source at a rate in excess of the replenishment rate such that the groundwater level declines persistently, threatening exhaustion of the supply or at least a decline of pumping levels to uneconomic depths.

groundwater monitoring network A series of monitoring wells at appropriate locations and depths to effectively cover the area of interest. Scale and density of monitoring wells is dependent on the size and complexity of the area of interest, and the objective of monitoring.

groundwater overdraft The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.

groundwater quality See water quality

groundwater recharge facility A structure that serves to conduct surface water into the ground for the purpose of replenishing groundwater. The facility may consist of dug or constructed spreading basins, pits, ditches, furrows, streambed modifications, or injection wells.

groundwater recharge The natural or intentional infiltration of surface water into the zone of saturation.

groundwater source area An area where groundwater may be found in economically retrievable quantities outside of normally defined groundwater basins, generally referring to areas of fractured bedrock in foothill and mountainous terrain where groundwater development is based on successful well penetration through interconnecting fracture systems. Well yields are generally lower in fractured bedrock than wells within groundwater basins.

groundwater storage capacity volume of void space that can be occupied by water in a given volume of a formation, aquifer, or groundwater basin.

groundwater subbasin A subdivision of a groundwater basin created by dividing the basin using geologic and hydrologic conditions or institutional boundaries.

groundwater table The upper surface of the zone of saturation in an unconfined aquifer.

groundwater Water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

H

hazardous waste Waste that poses a present or potential danger to human beings or other organisms because it is toxic, flammable, radioactive, explosive or has some other property that produces substantial risk to life.

hydraulic barrier A barrier created by injecting fresh water to control seawater intrusion in an aquifer, or created by water injection to control migration of contaminants in an aquifer.

hydraulic conductivity A measure of the capacity for a rock or soil to transmit water; generally has the units of feet/day or cm/sec.

hydrograph A graph that shows some property of groundwater or surface water as a function of time.

hydrologic cycle The circulation of water from the ocean through the atmosphere to the land and ultimately back to the ocean.

hydrologic region A study area consisting of multiple planning subareas. California is divided into 10 hydrologic regions.

hydrostratigraphy A geologic framework consisting of a body of rock having considerable lateral extent and composing a reasonably distinct hydrologic system.

hyporheic zone The region of saturated sediments beneath and beside the active channel and that contain some proportion of surface water that was part of the flow in the surface channel and went back underground and can mix with groundwater.

I

infiltration The flow of water downward from the land surface into and through the upper soil layers.

infiltration capacity The maximum rate at which infiltration can occur under specific conditions of soil moisture.

in-lieu recharge The practice of providing surplus surface water to historic groundwater users, thereby leaving groundwater in storage for later use.

ISI Integrated Storage Investigations Program, an element of the CALFED Bay Delta initiative.

J

joint powers agreement (JPA) An agreement entered into by two or more public agencies that allows them to jointly exercise any power common to the contracting parties. The JPA is defined in Chapter 5 (commencing with Section 6500) of Division 7 of Title 1 of the California Government Code.

L

land subsidence The lowering of the natural land surface due to groundwater (or oil and gas) extraction.

leaky confining layer A low-permeability layer that can transmit water at sufficient rates to furnish some recharge from an adjacent aquifer to a well.

lithologic log A record of the lithology of the soils, sediments and/or rock encountered in a borehole from the surface to the bottom.

lithology The description of rocks, especially in hand specimen and in outcrop, on the basis of such characteristics as color, mineralogic composition, and grain size.

losing stream A stream or reach of a stream that is losing water by seepage into the ground.

M

management objectives Objectives that set forth the priorities and measurable criteria of local groundwater basin management. For example, one management objective could be to minimize degradation of groundwater quality with a criteria set that groundwater will not be degraded by more than 100 mg/l in terms of TDS.

maximum contaminant level (MCL) The highest drinking water contaminant concentration allowed under federal and State Safe Drinking Water Act regulations.

N

natural recharge Natural replenishment of an aquifer generally from snowmelt and runoff; through seepage from the surface.

nonpoint source Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients, etc., carried to lakes and streams by surface runoff.

O

operational yield An optimal amount of groundwater that should be withdrawn from an aquifer system or a groundwater basin each year. It is a dynamic quantity that must be determined from a set of alternative groundwater management decisions subject to goals, objectives, and constraints of the management plan.

ordinance A law set forth by a governmental authority.

overdraft See groundwater overdraft

overlying right Property owners above a common aquifer possess a mutual right to the reasonable and beneficial use of a groundwater resource on land overlying the aquifer from which the water is taken. Overlying rights are correlative (related to each other) and overlying users of a common water source must share the resource on a pro rata basis in times of shortage. A proper overlying use takes precedence over all non-overlying uses.

P

perched groundwater Groundwater supported by a zone of material of low permeability located above an underlying main body of groundwater.

perennial yield The maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition.

perforated interval The depth interval where slotted casing or screen is placed in a well to allow entry of water from the aquifer formation.

permeability The capability of soil or other geologic formations to transmit water. See hydraulic conductivity.

pesticide Any of a class of chemicals used for killing insects, weeds or other undesirable entities. Most commonly associated with agricultural activities, but has significant domestic use in California.

point source A specific site from which wastewater or polluted water is discharged into a water body.

pollution (of water) The alteration of the physical, chemical, or biological properties of water by the introduction of any substance into water that adversely affects any beneficial use of water.

porosity The ratio of the voids or open spaces in alluvium and rocks to the total volume of the alluvium or rock mass.

possible contaminating activity (PCA) Human activities that are actual or potential origins of contamination for a drinking water source. PCAs include sources of both microbiological and chemical contaminants that could have an adverse effect upon human health (DHS 2000).

potentiometric surface The surface to which the water in a confined aquifer will rise in a tightly cased well.

prescriptive right rights obtained through the open and notorious adverse use of another's water rights. By definition, adverse use is not use of a surplus, but the use of non-surplus water to the direct detriment of the original rights holder.

primary porosity Voids or open spaces that were present when alluvium and rocks were originally deposited or formed.

public supply well A well used as a part of a public water system.

public water system A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. (DHS 2000).

pueblo right A water right possessed by a municipality which, as a successor of a Spanish or Mexican pueblo, entitled to the beneficial use of all needed, naturally-occurring surface and groundwater of the original pueblo watershed Pueblo rights are paramount to all other claims.

R

recharge Water added to an aquifer or the process of adding water to an aquifer. Ground water recharge occurs either naturally as the net gain from precipitation, or artificially as the result of human influence. See artificial recharge.

recharge basin A surface facility constructed to infiltrate surface water into a groundwater basin.

riparian right A right to use surface water, such right derived from the fact that the land in question abuts upon the banks of streams.

runoff The volume of surface flow from an area.

S

safe yield The maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect.

salinity Generally, the concentration of mineral salts dissolved in water. Salinity may be expressed in terms of a concentration or as electrical conductivity. When describing salinity influenced by seawater, salinity often refers to the concentration of chlorides in the water. See also total dissolved solids.

saline intrusion The movement of salt water into a body of fresh water. It can occur in either surface water or groundwater bodies.

saturated zone The zone in which all interconnected openings are filled with water, usually underlying the unsaturated zone.

seawater intrusion barrier A system designed to retard, cease or repel the advancement of seawater intrusion into potable groundwater supplies along coastal portions of California. The system may be a series of specifically placed injection wells where water is injected to form a hydraulic barrier.

secondary porosity Voids in a rock formed after the rock has been deposited; not formed with the genesis of the rock, but later due to other processes. Fractures in granite and caverns in limestone are examples of secondary openings.

seepage The gradual movement of water into, through or from a porous medium. Also the loss of water by infiltration into the soil from a canal, ditches, laterals, watercourse, reservoir, storage facilities, or other body of water, or from a field.

semi-confined aquifer A semi-confined aquifer or leaky confined aquifer is an aquifer that has aquitards either above or below that allow water to leak into or out of the aquifer depending on the direction of the hydraulic gradient.

service area The geographic area served by a water agency.

specific conductance See electrical conductivity

specific retention The ratio of the volume of water a rock or sediment will retain against the pull of gravity to the total volume of the rock or sediment.

specific yield the ratio of the volume of water a rock or soil will yield by gravity drainage to the total volume of the rock or soil.

spring a location where groundwater flows naturally to the land surface or a surface water body.

stakeholders Any individual or organization that has an interest in water management activities. In the broadest sense, everyone is a stakeholder, because water sustains life. Water resources stakeholders are typically those involved in protecting, supplying, or using water for any purpose, including environmental uses, who have a vested interest in a water-related decision.

stratigraphy The science of rocks. It is concerned with the original succession and age relations of rock strata and their form, distribution, lithologic composition, fossil content, geophysical and geochemical properties—all characters and attributes of rocks as strata—and their interpretation in terms of environment and mode of origin and geologic history.

subsidence See land subsidence

subterranean stream Subterranean streams "flowing through known and definite channels" are regulated by California's surface water rights system.

surface supply Water supply obtained from streams, lakes, and reservoirs.

sustainability Of, relating to, or being a method of using a resource so that the resource is not depleted or permanently damaged.

T

total dissolved solids (TDS) a quantitative measure of the residual minerals dissolved in water that remain after evaporation of a solution. Usually expressed in milligrams per liter. See also salinity

toxic Poisonous, relating to or caused by a poison. Toxicity is determined for individual contaminants or for mixtures of contaminants as found in waste discharges.

transmissivity The product of hydraulic conductivity and aquifer thickness; a measure of a volume of water to move through an aquifer. Transmissivity generally has the units of ft^2/day or gallons per day/foot. Transmissivity is a measure of the subsurface's ability to transmit groundwater horizontally through its entire saturated thickness and affects the potential yield of wells.

transpiration An essential physiological process in which plant tissues give off water vapor to the atmosphere.

U

unconfined aquifer An aquifer which is not bounded on top by an aquitard. The upper surface of an unconfined aquifer is the water table.

underground stream Body of water flowing as a definite current in a distinct channel below the surface of the ground, usually in an area characterized by joints or fissures. Application of the term to ordinary aquifers is incorrect.

unsaturated zone The zone below the land surface in which pore space contains both water and air.

urban water management plan (UWMP) An UWMP is required for all urban water suppliers having more than 3,000 connections or supplying more than 3,000 acre-feet of water. The plans include discussions on water supply, supply reliability, water use, water conservation, and water shortage contingency and serve to assist urban water suppliers with their long-term water resources planning to ensure adequate water supplies for existing and future demands.

usable storage capacity The quantity of groundwater of acceptable quality that can be economically withdrawn from storage.

V

vadose zone See unsaturated zone

volatile organic compound (VOC) A manmade organic compound that readily vaporizes in the atmosphere. These compounds are often highly mobile in the groundwater system and are generally associated with industrial activities.

W

water quality Description of the chemical, physical, and biological characteristics of water, usually in regard to its suitability for a particular purpose or use.

water table See groundwater table

water year A continuous 12-month period for which hydrologic records are compiled and summarized. Different agencies may use different calendar periods for their water years.

watershed The land area from which water drains into a stream, river, or reservoir.

well completion report A required, confidential report detailing the construction, alteration, abandonment, or destruction of any water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well. The reports were called *Water Well Drillers' Report* prior to 1991 and are often referred to as "driller's logs." The report requirements are described in the California Water Code commencing with Section 13750.

WQCP Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary.

Metric Conversions

Quantity	To Convert from Metric Unit	To Customary Unit	Multiply Metric Unit By	To Convert to Metric Unit Multiply Customary Unit By
Length	millimeters (mm)	inches (in)	0.03937	25.4
	centimeters (cm) for snow depth	inches (in)	0.3937	2.54
	meters (m)	feet (ft)	3.2808	0.3048
	kilometers (km)	miles (mi)	0.62139	1.6093
Area	square millimeters (mm2)	square inches (in2)	0.00155	645.16
	square meters (m2)	square feet (ft2)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometers (km2)	square miles (mi2)	0.3861	2.590
Volume	liters (L)	gallons (gal)	0.26417	3.7854
	megaliters	million gallons (10*)	0.26417	3.7854
	cubic meters (m3)	cubic feet (ft3)	36.315	0.028317
	cubic meters (m3)	cubic yards (yd3)	1.308	0.76455
	cubic dekameters (dam3)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic meters per second (m3/s)	cubic feet per second (ft3/s)	35.315	0.028317
	liters per minute (L/mn)	gallons per minute (gal/mn)	0.26417	3.7854
	liters per day (L/day)	gallons per day (gal/day)	0.26417	3.7854
	megaliters per day (ML/day)	million gallons per day (mgd)	0.26417	3.7854
	cubic dekameters per day (dam3/day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lbs)	2.2046	0.45359
	megagrams (Mg)	tons (short, 2,000 lb.)	1.1023	0.90718
Velocity	meters per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (k/W)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	eet head of water	0.32456	2.989
Specific Capacity	liters per minute per meter drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per liter (mg/L)	parts per million (ppm)	1.0	1.0
Electrical Conductivity	microsiemens per centimeter (µS/cm)	micromnos per centermeter	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(1.8X°C)+32	(°F-321/18

Appendices

Appendix A
Obtaining Copies of Supplemental Material

Bulletin 118 Update 2003 includes this report and supplemental material consisting of individual basin descriptions and a GIS-compatible map of each of the delineated groundwater basins in California. The supplemental material will be updated as new information becomes available and can be viewed or downloaded at http://www.waterplan.water.ca.gov/groundwater/118index.htm

Appendix B
The Right to Use Groundwater in California

California does not have a statewide management program or statutory permitting system for groundwater. Some local agencies have adopted groundwater ordinances under their police powers, or have adopted groundwater management programs under a variety of statutory authorities.

Prior to a discussion of groundwater management, it is helpful to understand some of the laws governing the right to use groundwater in California. When the Water Commission Act of 1913 (Stats. 1913, Ch. 586) became effective in 1914, appropriative surface water rights became subject to a statutory permitting process. This appropriation procedure can be found in Water Code Section 1200 *et seq*. Groundwater classified as underflow of a surface stream, a "subterranean stream flowing through a known and definite channel," was made subject to the State permit system. However, most groundwater in California is presumed to be "percolating water," that is, water in underground basins and groundwater which has escaped from streams. This percolating water is not subject to a permitting process. As a result, most of the body of law governing groundwater use in California today has evolved through a series of court decisions beginning in the early 20th century. Key cases are listed in Table B-1, and some of the most significant are discussed below.

Table B-1 Significant court cases related to the right to use groundwater in California

Case	Issues addressed
Katz v. Walkinshaw, 141 Cal. 116 (1903)	Established Correlative Rights Doctrine. Correlative rights of overlying users, and surplus supply available for appropriation among non-overlying users.
Peabody v. City of Vallejo, 2 Cal. 2d 351 (1935)	Limited riparian rights under the reasonable and beneficial use requirement of the 1928 constitutional amendment; requirement of reasonable and beneficial use.
Pasadena v. Alhambra, 33 Cal. 2d 908 (1949)	First basin adjudication in California; established Doctrine of Mutual Prescription.
Niles Sand and Gravel Co. v. Alameda County Water District, 37 Cal. App. 3d 924 (1974)	Established right to store water underground as a servitude.
Techachapi-Cummings County Water District v. Armstrong, 49 Cal. App. 3d 992 (1975)	Modified the Mutual Prescription Doctrine articulated in Pasadena v. Alhambra. Overlying owners' water rights must be quantified on the basis of current, reasonable and beneficial need, not past use. By analogy to riparian rights, factors to be considered include: the amount of water available, the extent of ownership in the basin, and the nature of projected use.
Los Angeles v. San Fernando, 14 Cal. 3d 199 (1975)	Significantly modified Mutual Prescription Doctrine by disallowing it against public entities (Civil Code section 1007); established pueblo right above overlying owner right; established right to store imported water underground and recapture when needed above the right of overlying landowner.
Wright v. Goleta Water District, 174 Cal. App. 3d 74 (1985)	The unexercised water rights of overlying owners are protected from appropriators; notice and opportunity must be given to overlying owners to resist any interference with their rights.
Hi-Desert County Water District v. Blue Skies Country Club,	Retention of overlying right; no acquisition of prescriptive right by 23 Cal. App. 4th 1723 (1994) overlying owner.
Baldwin v. Tehama County, 31 Cal. App. 4th 166 (1994)	City and County regulation of groundwater through police power. County limitations on export upheld.
City of Barstow v. Mojave Water Agency,	Held that in considering a stipulated physical solution 23 Cal. 4th 1224 (2000) involving equitable apportionment, court must consider correlativerights of parties that did not join the stipulation.

This table modified from Bachman and others 1997

Katz v. Walkinshaw (141 Cal. 116)

In the 1903 decision, *Katz v. Walkinshaw*, the California Supreme Court rejected the English Common Law doctrine of groundwater rights and established the Doctrine of Correlative Rights. Prior to the *Katz* decision, California had followed the doctrine articulated in the 1843 English decision of *Acton v. Blundell* (12 M. & W. 324, 152 Eng. Rep. 1223), which established that landowners enjoyed absolute ownership of groundwater underneath their property. The 1903 decision rejected the English Common Law approach as unsuitable for the "natural conditions" in California, and instead established the Correlative Rights Doctrine analogous to a riparian right. Each overlying landowner was entitled to make reasonable beneficial use of groundwater with a priority equal to all other overlying users. Water in excess of the needs of the overlying owners could be pumped and used on nonoverlying lands on a first-in-time, first-in-right basis under what is known as an appropriative right. An appropriative groundwater right, unlike its surface water counterpart, is not subject to a permitting process. Where overlying owners made full use of available supplies, appropriative rights were extinguished. Where there was insufficient water to meet even the needs of the overlying owners, the court applied the Correlative Rights Doctrine to apportion the available groundwater among the overlying landowners. Figure B-1 depicts the rights to use groundwater established in *Katz v. Walkinshaw*.

City of Pasadena v. City of Alhambra (33 Cal. 2d 908)

The 1949 decision, *Pasadena v. Alhambra*, added significant complexity to the right to use groundwater in California. This decision, involving the adjudication of the Raymond Basin, established the doctrine of mutual prescription. Groundwater levels in the basin had been declining for many years by the time court action was initiated. Most substantial pumpers, both overlying and appropriators, were joined in the action. Previously, appropriators only had a right to water surplus to the needs of overlying users. However, based upon a stipulation by most of the parties, the court in *Pasadena* adopted a program of proportionate reductions. These appropriators had each effectively gained a prescriptive right, similar to that of surface water rights, in which they had taken the water in an open, notorious, and hostile manner for at least five years. Mutual prescription provided groundwater rights to both overlying users and appropriators in depleted groundwater basins by prorating their rights based on the highest continuous amount of pumping during the five years following commencement of the overdraft. All of the users in the Raymond Basin were thus entitled to extract their portion of the court-approved safe yield of the basin.

City of Los Angeles v. City of San Fernando (14 Cal. 3d 199)

In 1975, in *Los Angeles v. San Fernando*, the California Supreme Court significantly limited the Mutual Prescription Doctrine introduced in Pasadena v. Alhambra. This opinion had far-reaching impacts on both the right to use groundwater and the practice of conjunctive use of groundwater and surface water to manage a basin. The case began in 1955, when the City of Los Angeles sued the cities of San Fernando, Glendale, Burbank and other pumpers, asserting a prior right to the San Fernando Valley groundwater basins in the northern part of the City of Los Angeles. The court, relying on Civil Code Section 1007, held that public agencies and public utilities cannot lose their groundwater rights by prescription. This holding effectively ruled out any future "mutual prescription" settlements or judgments involving rights held by public entities.

With respect to the native water supply of the San Fernando Basin, the court found that the City of Los Angeles had prior rights to all of this supply pursuant to its "pueblo right." Pueblo rights are traceable to rights recognized by the Spanish crown and the Mexican government. Under the Spanish/Mexican system, water rights were held in trust by pueblos for the benefit of all of its inhabitants. Under the Treaty of Guadalupe Hidalgo executed by Mexico and the United States in 1848, the municipal successors to Spanish/Mexican pueblos retained their pueblo rights upon the cession of California. In the San Fernando decision, the court confirmed Los Angeles' pueblo right, finding it superior to the rights of all overlying landowners. While a pueblo right is rare, it is an example of the complexity of the rights to use groundwater in California.

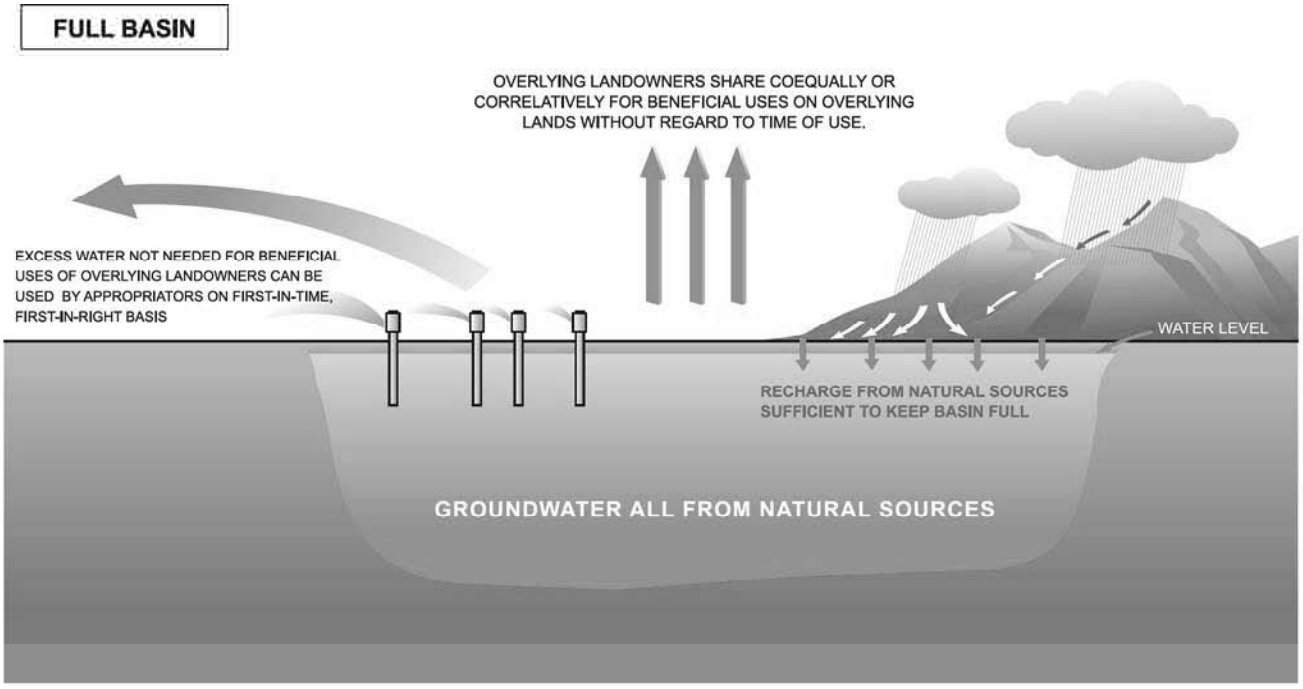

Figure B-1 Rights to groundwater use in full basin established in Katz v. Walkinshaw

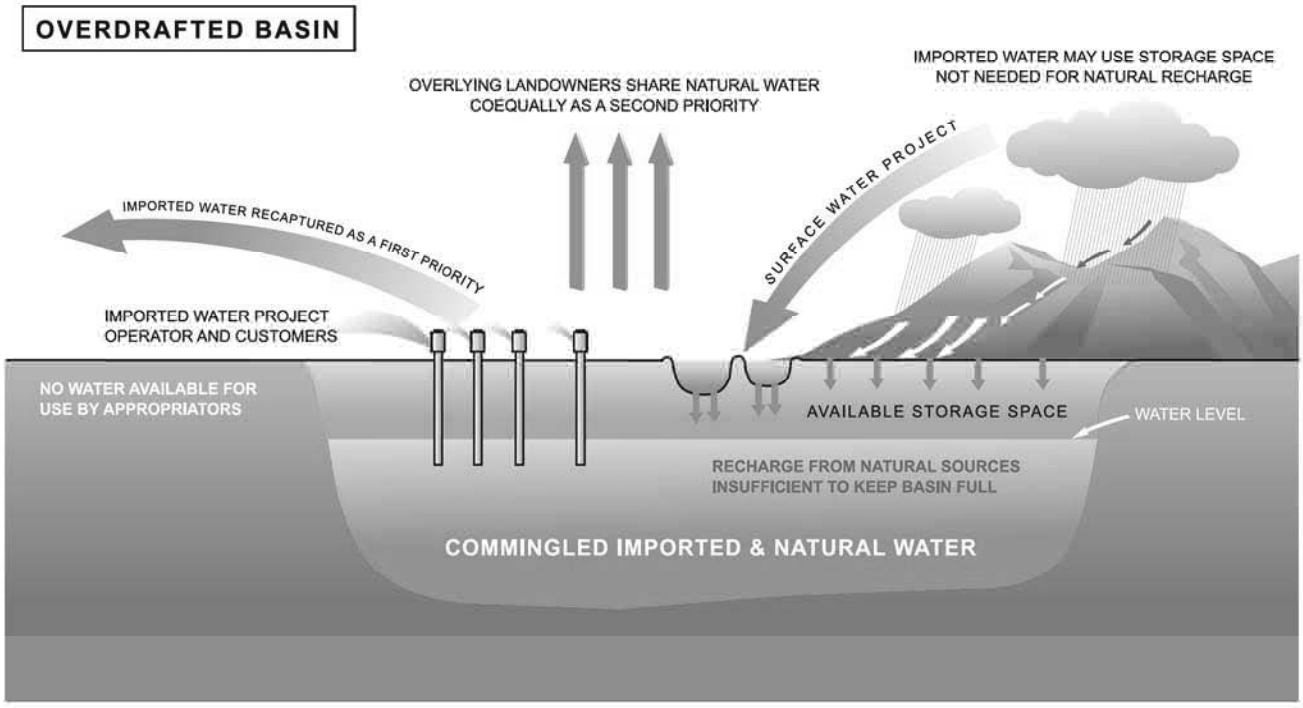

Figure B-2 Rights to groundwater use in overdrafted basin established in Los Angeles v. San Fernando

For the future of conjunctive use of groundwater basins, the court's holding with respect to the rights to available storage space in the Basin is significant. The court upheld the right of public agencies – namely the cities of San Fernando, Los Angeles, Burbank, and Glendale–to recapture the imported water they added to the Basin. The court held that the rights of the respective public agencies to recover such imported water are of equal priority to the City of Los Angeles' pueblo right, and that all such public agency rights are "prior to the rights dependent on ownership of overlying land or based solely upon appropriation of groundwater from the basin." The court remanded the case, directing the trial court to apportion the safe yield of the Basin accordingly.

The court noted that there did not appear to be any shortage of underground storage space in relation to the demand and, hence, the court did not find it necessary to determine priorities as to the future use of such space. The Judgment issued by the trial court on remand, however, provided: "To the extent of any future spreading or in lieu storage of import water or reclaimed water by Los Angeles, Glendale, Burbank or San Fernando, the party causing said water to be so stored shall have a right to extract an equivalent amount of ground water from the San Fernando Basin." Pursuant to the Judgment, a court-appointed Watermaster now manages the groundwater extraction and storage rights within the ULARA. Figure B-2 depicts the rights to use groundwater established in Los Angeles v. San Fernando in an overdrafted basin where water has been stored.

City of Barstow v. Mojave Water Agency (23 Cal. 4th 1224)

In 2000, the California Supreme Court partially overturned the 1995 adjudication of the Mojave River Basin. The trial court had approved a negotiated settlement (or stipulated agreement) that failed to include a well-by-well determination of water rights. The trial court held the negotiated settlement to be binding on all users in the basin, including some pumpers who had not agreed to the settlement. The lower court decision was based on the doctrine of "equitable apportionment," in which the available water is shared based on concepts of equity and fairness. The Court of Appeal had partially reversed the lower court, and held that the trial court did not have the authority to ignore California's traditional water rights doctrine giving overlying users a priority right to beneficial and reasonable use of the groundwater. The Court of Appeal affirmed the trial court's negotiated settlement except as it applied to two of the parties. First, the Court of Appeal reversed the holding against a non-negotiating party since the trial court had ignored that party's existing overlying water rights. Secondly, the Court of Appeal reversed the trial court's judgment as it applied to a company, where the negotiated agreement did not give the company a water-allowance equal to its actual water use. The Supreme Court affirmed the Court of Appeal decision, but reversed the judgment applying to the company's water-allowance. The Supreme Court also affirmed that the trial court could not apply the doctrine of equitable apportionment when overlying water users had already established a prior water right. The Court stated that, while the trial court could impose a physical solution (such as the negotiated settlement), the court could not simply ignore affected owners' legal water rights. Equitable apportionment, thus, remains a tool for adjudicating basin groundwater rights, but only if all parties stipulate to its use.

Appendix C
Required and Recommended Components of Local Groundwater Management Plans

Section 10750 et seq. of the Water Code, commonly referred to as Assembly Bill 3030, stipulates certain procedures that must be followed in adopting a groundwater management plan under this section.

Amendments to Section 10750 et seq. added the requirement that new groundwater management plans prepared under Section 10750 et seq. must include component 1 below (SB1938 (Stats 2002, Ch 603)).

In addition, the amendments mandate that if the agency preparing the groundwater management plan intends to apply for funding administered by the California Department of Water Resources (DWR) for groundwater or groundwater quality projects, the agency must prepare and implement a groundwater management plan that includes components 2, 3, 6, 7 and 9 below. DWR recommends that all the components below be included in any groundwater management plan to be adopted and implemented by a local managing entity.

Consideration and development of these components for the specific conditions of the basin to be managed under the plan will help to ensure effective groundwater management. In developing these criteria, DWR recognizes that the goal of a groundwater management plan and the goal of an ordinance to manage groundwater should be the same—assurance of a long-term, sustainable, reliable, good quality groundwater supply. Such efforts can benefit greatly from cooperative management within the basin or region.

None of the suggested data reporting in the components below should be construed as recommending disclosure of information that is confidential under State law.

1. Include documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan," which may include appointing a technical advisory committee (Water Code § 10753.4 (b)).
2. Include a plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin." (Water Code § 10753.7 (a)(2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area"
(Water Code § 10752 (g)).
3. Provide a map showing the area of the groundwater basin, as defined by DWR Bulletin 118, with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code § 10753.7 (a)(3)).
4. Establish an advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.
5. Describe the area to be managed under the plan, including:
    a. The physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin.

b. A summary of the availability of historical data including, but not limited to, the components in Section 7 below.

c. Issues of concern including, but not limited to, issues related to the components in Section 7 below.

d. A general discussion of historical and projected water demands and supplies.

6. Establish management objectives (MOs) for the groundwater basin that is subject to the plan. (Water Code § 10753.7 (a)(1)).

7. Include components relating to the monitoring and management of groundwater levels, groundwater quality, 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. (Water Code § 10753.7 (a)(1)). Consider additional components listed in Water Code § 10753.8 (a) through (l).

8. For each MO, describe how meeting the MO will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area, and describe existing or planned management actions to achieve MOs.

9. Adopt monitoring protocols for the components in Section 7 (Water Code § 10753.7 (a)(4)). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting MOs.

10. Describe the monitoring program, including:

    a. A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.

    b. A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, monitoring).

11. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning agencies or activities (Water Code § 10753.8 (k), (l)).

12. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s), prepared annually or at other frequencies as determined by the local management agency, should include:

    a. Summary of monitoring results, including a discussion of historical trends.

    b. Summary of management actions during the period covered by the report.

    c. A discussion, supported by monitoring results, of whether management actions are achieving progress in meeting MOs.

    d. Summary of proposed management actions for the future.

    e. Summary of any plan component changes, including addition or modification of MOs, during the period covered by the report.

    f. Summary of actions taken to coordinate with other water management and land use agencies, and other government agencies.

13. Provide for the periodic re-evaluation of the entire plan by the managing entity.

14. For local agencies not overlying groundwater basins, plans should be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code § 10753.7 (a)(5)).

Appendix D
Groundwater Management Model Ordinance

In developing this model ordinance, the California Department of Water Resources recognizes that the goal of a groundwater management plan and the goal of an ordinance to manage groundwater should be the same—assurance of a long-term, sustainable, reliable, good quality groundwater supply. Such efforts require cooperative management within the region or sub-region.

Chapter X

Groundwater Management Ordinance

Sections:

X.01 Declaration of Findings
X.02 Purpose
X.03 Declaration of Intent
X.04 Definitions
X.05 Groundwater Management Program
X.06 Management Objectives
X.07 Monitoring Program Network
X.08 Monitoring Frequency
X.09 Changes in Monitoring
X.10 Review of Technical Data
X.11 Data Dissemination
X.12 Actions when MO Noncompliance is Reported
X.13 Regional Coordination
X.14 Integrated Resource Management
X.15 Data Relating to Export and Substitution of Groundwater

X.01 Declaration of Findings - The Board finds that:

A. The protection of the groundwater resource for its use within the County is of major concern to the residents of the County for the protection of their health, welfare, and safety.
B. The reliability and sustainability of the groundwater supply for all beneficial uses are of critical importance to the economic, social, and environmental well-being of the County.
C. A lack of effective groundwater management may have significant negative impacts, including, but not limited to:
    1. Lower groundwater levels leading to additional expenses from:
        a) Increased energy consumption.
        b) The need to deepen existing wells.
        c) The need to build new wells.
        d) The need to destroy non-functioning wells.
    2. Costly damage to public roads, bridges, canals, and other structures caused by land subsidence.
    3. Reduction of surface and subsurface flows leading to the potential loss of critical riparian and wetland habitat.
    4. Degradation of groundwater quality.

D. It is essential for management purposes to adopt a monitoring program addressing groundwater levels, groundwater quality, land subsidence, and surface water flow and quality where it directly impacts or is impacted by groundwater.

X.02 Purpose - In support of the findings above, the County has determined that this groundwater management ordinance is necessary to ensure that:

A. Groundwater continues to be a reliable and sustainable resource.
B. The extraction of groundwater does not result in significant adverse economic, environmental, or social impacts.
C. Groundwater quality is protected.
D. Excessive land surface subsidence from groundwater extraction is prevented.

X.03 Declaration of Intent

A. The County intends to foster prudent groundwater management practices by establishing a policy that encourages appropriate management of the resource based on recommendations by a committee of stakeholders.
B. The County intends that its groundwater management activities occur as an open and public process that considers input from all stakeholders in the County.
C. The County intends to work cooperatively with interested local agencies to further develop and implement joint groundwater management activities.
D. The County does not intend to regulate, in any manner, the use of groundwater, except as a last resort to protect the groundwater resource.
E. The County intends to act as an enforcing agency should the local resource become threatened.
F. The County does not intend to infringe upon the rights of surface water users in the managed area.
G. The County does not intend to limit other authorized means of managing groundwater within the County.

X.04 Definitions

A. "Aquifer" means a geologic formation that stores groundwater and transmits and yields significant quantities of water to wells and springs. Significant quantity is an amount that that satisfies local needs and may range from thousands of gallons per minute to less than 5 gpm, depending on rock type and intended use.
B. "Board" means the Board of Supervisors of the County.
C. "District" means a district or municipality, located wholly or partially within the boundaries of the County, that is a purveyor of water for agricultural, domestic, or municipal use.
D. "Enforcement Agency" means the Board as the enforcement agency under this chapter.
E. "Groundwater" means all water beneath the surface of the earth below the zone of saturation, but does not include subterranean streams flowing in known and definite channels.
F. "Groundwater Basin" means an aquifer or series of aquifers with a reasonably defined lateral and vertical extent, as defined in Bulletin 118 by Department of Water Resources. "Non-basin areas" are outside defined groundwater basins and contain smaller amounts of groundwater in consolidated sediments or fractured hard rock.
G. "Groundwater Export" means the conveyance of groundwater outside of the boundaries of the County and outside of the boundaries of any district that is partially within the County.
H. "Groundwater Substitution" means the voluntary use of an available groundwater supply instead of surface water for the purposes of using the surface water outside the County and outside the boundaries of any district that is partially within the County.

I. "Land Subsidence" means the lowering of the ground surface caused by the inelastic consolidation of clay beds in the aquifer system.
J. "Management Objective"(MO) means a condition identified for each subunit to ensure that the groundwater supply is reliable and sustainable. The MOs set acceptable conditions with respect to groundwater levels, groundwater quality, inelastic land surface subsidence, and surface water flows and quality. Compliance with the MO is tracked by a monitoring program and threshold values that are adopted for each Management Objective.
K. "Recharge" means flow to groundwater storage from precipitation, and infiltration from streams, irrigation, spreading basins, injection wells, and other sources of water.
L. "Reliability" means having an available, predictable, and usable groundwater supply at any given point in time.
M. "Stakeholder" means an individual or an entity, such as a water supplier or a county resident, with a permanent interest in the availability of the groundwater resource.
N. "Subunit" means any subdivision of a groundwater basin or non-basin area in the County created for the purposes of representation of stakeholders and the establishment of local area management objectives.
O. "Sustainable" means the groundwater resource is maintained for use by residents in the basin over a prolonged period of time.
P. "Technical Advisory Committee" means a committee of persons knowledgeable in groundwater management, hydrology, and hydrogeology established for the purpose of providing technical guidance to the Water Advisory Committee.
Q. "Threshold values" mean the limits established by the WAC for groundwater levels, groundwater quality, land surface subsidence, and surface water flow and quality that are not to be exceeded if the MOs are to be met.
R. "Water Advisory Committee" (WAC) means a multimember advisory body established for the purpose of aiding the Board in providing effective management of the groundwater resources in the County, and representing all of the subunits that are identified.
S. "Water Management Entities" means any local agency, or group of agencies, authorized to manage groundwater.

X.05 Groundwater Management Program

A. The County recognizes that effective groundwater management is key to maintaining a reliable and sustainable resource. For the purposes of establishing an effective groundwater management program, the Board shall appoint a WAC to establish MOs and make recommendations to the Board to ensure that MOs are met.
B. For purposes of establishing a WAC, the groundwater basins and non-basin areas of the County will be divided into subunits based on hydrogeologic principles and institutional boundaries. These subunits shall be established by the Board based on public input to address the groundwater management needs of the County. The WAC shall consist of members that represent each subunit. Upon establishment of the subunits, the Board shall appoint a member to represent each subunit on the WAC.
C. The WAC shall have the following responsibilities to the Board:
    1. Recommend MOs for each groundwater management subunit.
    2. Recommend a groundwater monitoring network for purposes of tracking MOs.
    3. Recommend the frequency of monitoring.
    4. Propose changes in monitoring.
    5. Ensure monitoring data receive technical review.
    6. Ensure that monitoring data are made available to the public.

7. Recommend actions to resolve noncompliance with MOs.

D. For the purposes of providing technical advice to the WAC in carrying out its responsibilities, a technical advisory committee (TAC) shall be established. The TAC shall consist of local experts or a combination of local expertise and technical consultants from private and public organizations that are nominated by the WAC and approved by the Board. Individuals appointed to the TAC should be highly knowledgeable in groundwater management, hydrology, and hydrogeology. The TAC shall review technical data collected by monitoring programs within the County and advise the WAC.

X.06 Management Objectives

A. To ensure that the County maintains a reliable and sustainable groundwater supply, MOs for groundwater levels, groundwater quality, land subsidence, and surface water flow and quality shall be adopted for each subunit. Threshold values that are not to be exceeded shall be defined for each MO.

B. Compliance with the MOs will be determined by evaluation of data collected from groundwater level, groundwater quality, land subsidence, and surface water flow and quality monitoring networks. Evaluation of these data with respect to threshold values shall be the basis for determining compliance with the MOs.

C. Each WAC member shall recommend MOs for their subunit. The WAC shall develop a comprehensive set of recommendations for all subunits, and the Board shall adopt these MOs for the County. MOs may differ from subunit to subunit, but the established MOs shall be consistent with the overall goal of supply reliability for the County.

D. Groundwater management practices based on the established MOs for one subunit of the County shall not adversely impact adjacent subunits.

X.07 Monitoring Program Network

The WAC shall develop County-wide monitoring programs to collect representative data on groundwater levels, groundwater and surface water quality, land surface subsidence, and stream flow and quality. Each subunit shall propose its own monitoring program, and the WAC shall adopt a comprehensive monitoring program for the County. The data collected, showing current conditions and changes over time as a result of groundwater extraction, shall be evaluated by the WAC in consultation with the TAC. The WAC will recommend policies and actions to ensure that MOs for each subunit are met. The collection and evaluation of the data shall be based on scientifically sound principles, and shall incorporate appropriate quality assurance and quality control protocols.

A. Groundwater levels: The groundwater level monitoring network shall be proposed by the WAC and approved by the Board. The intent of the groundwater level monitoring network is to measure water levels in selected wells that can adequately determine representative conditions in the aquifer system for determination of compliance with the MOs. The network will include selected municipal, domestic, and irrigation wells owned by water districts, private parties, and municipal and industrial water suppliers. Where needed, dedicated monitoring wells may be installed. Participation by well owners will be voluntary.

B. Water Quality: The groundwater quality monitoring network shall be proposed by the WAC and approved by the Board. The intent of the groundwater quality monitoring network is to monitor selected wells that can adequately determine representative groundwater quality conditions in the aquifer system for identification of compliance with the MOs. The network will include selected municipal, domestic, and irrigation wells owned by water districts, private parties, and municipal

and industrial water suppliers. Where needed, dedicated monitoring wells may be installed. Participation by well owners will be voluntary.

C. Land Subsidence: The land subsidence program and network shall be proposed by the WAC and approved by the Board. The intent of the land subsidence monitoring is to detect land subsidence for determination of compliance with the MOs. The network may include benchmarks that are surveyed for changes in elevation throughout the County, based on the judgment of the WAC of the need for such a program.

D. Surface Water Flow and Quality: The surface water flow and quality network shall be proposed by the WAC and approved by the Board. The intent of this network is to detect changes in surface water flow or surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping for evaluation of compliance with MOs.

X.08 Monitoring Frequency

The recommended frequency of collection of data for each of the parameters listed above shall be determined by the WAC. Initially, each parameter should be measured at the frequencies outlined below, unless the WAC notes upon evaluation of existing data that more frequent monitoring or additional analyses are called for.

A. Groundwater levels should be measured at least three times during the year: one measurement prior to the period of highest groundwater use, one measurement during peak groundwater use, and one measurement following the period of highest groundwater use (approximately the months of _____, _____, and _____).

B. Groundwater quality measurements of electrical conductivity, temperature, and pH should be obtained at least twice annually during the periods of highest and lowest groundwater use (approximately the months of _____ and _____). Upon evaluation of the data, the WAC may propose analyses for other constituents.

C. Selected benchmarks in the County land subsidence monitoring network should be surveyed every five years at a minimum. These surveys should be conducted following aquifer recovery and prior to the period of highest groundwater extraction (approximately the month of_____).

D. Measurement of surface water flow and quality in areas determined to directly affect groundwater levels or quality or that are affected by groundwater pumping shall be obtained at least ___ times per month as long as there are flows in the channel.

X.09 Changes in Monitoring

If evaluation of the groundwater level, groundwater quality, land subsidence, surface water flow, or surface water quality data indicates a need for more or less frequent measurements or analyses, the WAC may propose a change in the monitoring frequency. Similarly, if evaluation of the data indicates that additional monitoring sites are necessary, the WAC may propose an additional or a reduced number of sites for data collection. The Board shall adopt these changes when supported by credible evidence.

X.10 Review of Technical Data

A. The TAC shall propose and the WAC shall adopt standard methods using scientifically sound principles for review and analysis of the collected data. The TAC will meet, as needed and requested by the WAC, to evaluate the technical data and shall report their findings at appropriate meetings of the WAC. The WAC shall meet at least __ times per month during the period of maximum groundwater use (months of _____ through _____) and quarterly during the off season (months of _____ through _____), or as necessary.

B. During the period of highest groundwater use, the WAC meetings will focus on data review and analysis with respect to compliance with the current MOs. During the period of low

groundwater use, the WAC meetings will focus on a review of compliance with MOs for the previous period of high groundwater use and consideration of the need for changes to the MOs.

X.11 Data Dissemination

The WAC, in addition to establishing methods for data collection and evaluation, shall establish methods for data storage and dissemination. The WAC shall disseminate the monitoring data and evaluation reports through public presentations and through a County-maintained groundwater Internet site. At a minimum, the WAC shall publicly present findings from the monitoring program to the Board twice annually.

X.12 Actions when MO Noncompliance is Reported

A. Action by Technical Advisory Committee. In the event that the TAC identifies an area that is not in compliance with the MOs, or if noncompliance is reported by any other means, the TAC shall report to the WAC on the regional extent and magnitude of the noncompliance. This information shall also be released to the public no later than ___ days from the time that noncompliance with MOs was identified. The TAC shall then collect all available pertinent hydrologic data, investigate possible causes for noncompliance with MOs, and recommend actions to the WAC to bring the area into compliance. These recommendations shall be made no later than ___ days after the report of noncompliance is released to the public. The TAC shall first make recommendations that focus on correcting the noncompliance through negotiations with all parties in the affected area.

B. Action by Water Advisory Committee. The WAC shall act as lead negotiator in re-establishing compliance with the MO. If negotiations with parties in the affected area do not result in timely and positive action to re-establish compliance with MOs for the basin, the WAC may recommend a plan to the Board to modify, reduce or terminate groundwater extraction in the affected area or take other necessary actions. Such a plan will be recommended to the Board only after the WAC has thoroughly reviewed the recommendations of the TAC at a public meeting. The modification, reduction, or termination of groundwater extraction in the affected area shall first be applied to wells involved in any export or substitution programs, and then to other wells if necessary. Domestic wells shall not be considered for any modification, reductions, or termination of groundwater extraction.

C. Action by Board of Supervisors. The Board of Supervisors, using its police powers, shall act as the enforcement agency for this ordinance. Any recommendation of the WAC may be appealed to the Board within __ working days.

X.13 Regional Coordination

Management decisions recommended by the WAC and adopted by the Board shall not deleteriously affect groundwater resources in any portions of groundwater basins or non-basin areas that share a common groundwater resource in adjacent counties. To accomplish this goal, the WAC shall meet and coordinate with water management entities outside the County that overlie a common groundwater basin at least twice per year once <u>prior</u> to the period of highest groundwater use and once <u>following</u> the period of highest groundwater use.

X.14 Integrated Resource Management

A. To ensure integration of planning activities within the County, the WAC shall inform County departments involved with groundwater related activities, including but not limited to Land Use or Zoning, Planning, Public Works, Utilities, and Environmental Health, of all WAC meetings and actions regarding MOs. In turn, these County departments shall take into consideration the

adopted MOs when approving development or zoning changes or construction projects that may rely on or affect groundwater quantity or quality.

B. To the greatest extent practicable, the WAC should also integrate resource management planning with other agencies within the basin. Resource activities that could benefit from integrated planning with groundwater management include, but are not limited to:
   - Groundwater management planning by other agencies—agricultural, municipal, industrial, local government
   - Watershed management plans
   - Urban water management plans
   - Management and disposal of municipal solid waste and municipal sewage
   - Drinking water source assessment and protection programs
   - Public water system emergency and disaster response plans
   - Surface water and groundwater conjunctive management programs
   - Expansion of surface and groundwater facilities
   - Water efficiency programs
   - Water recycling programs
   - Environmental habitat construction or restoration programs
   - Water quality protection programs
   - Recharge programs
   - Transportation infrastructure planning

X.15 Data Relating to Export and Substitution of Groundwater

A. Districts, persons, or contractors intending to operate a groundwater export or groundwater substitution program shall submit the following data to the WAC __ working days prior to commencing the program:
   1. A description of the project with the total amount of groundwater to be exchanged or substituted
   2. The dates over which the project will take place.
   3. A statement of the anticipated impacts of the project relative to adopted MOs.
   4. A discussion of possible contingencies in the event of MO noncompliance.
   5. A map showing the location of the wells to be used by the program.
   6. A summary of any monitoring program proposed.
   7. All required environmental documentation.

B. While the program is in operation, the following information shall be provided to the WAC at least ___ times per month:
   1. All static and pumping groundwater level measurements made in the pumping well during the period of extraction for the export or substitution program.
   2. The amount of groundwater extracted from each well per week.
   3. Static groundwater level measurements in at least __ of the most proximal wells to the project pumping wells that can be practicably monitored.

   C. All costs for providing such information to the WAC shall be borne by the project participants.

Note: Although the terms "County" and "Board" are used throughout the model ordinance for clarity, the model could be used by any local government or agency with appropriate authority or powers.

Appendix E
SWRCB Beneficial Use Designations[1]

Agricultural Supply (AGR) – Uses of water for farming, horticulture, or ranching including, but not limited to irrigation, stock watering, or support of vegetation for ranch grazing.

Aquaculture (AQUA) – Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Cold Freshwater Habitat (COLD) – Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST) – Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Freshwater Replenishment (FRSH) – Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Groundwater Recharge (GWR) – Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Hydropower Generation (POW) – Uses of water for hydropower generation.

Industrial Process Supply (PRO) – Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND) – Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Inland Saline Water Habitat (SAL) – Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Marine Habitat (MAR) – Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Migration of Aquatic Organisms (MIGR) – Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Navigation (NAV) – Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Noncontact Water Recreation (REC-2) – Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Ocean Commercial and Sport Fishing (COMM) – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

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[1] From SWRCB 2000

Preservation of Biological Habitats of Special Significance (BIOL) – Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) – Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance or plant or animal species established under State or federal law as rare, threatened or endangered.

Shellfish Harvesting (SHELL) – Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Spawning, Reproduction, and/or Early Development (SPWM) – Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Warm Freshwater Habitat (WARM) – Uses of water that support warmwater ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Wildlife Habitat (WILD) – Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Appendix F
Federal and State MCLs and Regulation Dates for Drinking Water Contaminants

Contaminant	U.S. Environmental Protection Agency		California Department of Health Services	
	MCL (mg/L)	Date[a]	MCL (mg/L)	Effective date
Inorganics				
Aluminum	0.05 to 2[b]	1/91	1 0.2[b]	2/25/89 9/8/94
Antimony	0.006	7/92	0.006	9/8/94
Arsenic	0.05 0.01	eff: 6/24/77 2001	0.05	77
Asbestos	7 MFL[c]	1/91	7 MFL[c]	9/8/94
Barium	1 2	eff: 6/24/77 1/91	1	77
Beryllium	0.004	7/92	0.004	9/8/94
Cadmium	0.010 0.005	eff: 6/24/77 1/91	0.010 0.005	77 9/8/94
Chromium	0.05 0.1	eff: 6/24/77 1/91	0.05	77
Copper	1.3[d]	6/91	1[b] 1.3[d]	77 12/11/95
Cyanide	0.2	7/92	0.2 0.15	9/8/94 6/12/03
Fluoride	4 2[b]	4/86 4/86	2	4/98
Lead	0.05[e] 0.015[d]	eff: 6/24/77 6/91	0.05[e] 0.015[d]	771 2/11/95
Mercury	0.002	eff: 6/24/77	0.002	77
Nickel	Remanded	0.1	9/8/94	
Nitrate	(as N)10	eff: 6/24/77	(as N03) 45	77
Nitrite (as N)	1	1/91	1	9/8/94
Total Nitrate/Nitrite (as N)	10	1/91	10	9/8/94
Selenium	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Thallium	0.002	7/92	0.002	9/8/94
Radionuclides				
Uranium	30 g/L	12/7/00	20 pCi/L	1/1/89
Combined radium-226 & 228	5 pCi/L	eff: 6/24/77	5 pCi/L	77
Gross Alpha particle activity	15 pCi/L	eff: 6/24/77	15 pCi/L	77
Gross Beta particle activity	dose of 4 millirem/yr	eff: 6/24/77	50 pCi/L[f]	77

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	Date[a]	California Department of Health Services MCL (mg/L)	Effective date
Strontium-90	8 pCi/L	eff: 6/24/77 now covered by Gross Beta	8 pCi/L[f]	77
Tritium	20,000 pCi/L	eff: 6/24/77 now covered by Gross Beta	20,000 pCi/L[f]	77
VOCs				
Benzene	0.005	6/87	0.001	2/25/89
Carbon Tetrachloride	0.005	6/87	0.0005	4/4/89
1,2-Dichlorobenzene	0.6	1/91	0.6	9/8/94
1,4-Dichlorobenzene	0.075	6/87	0.005	4/4/89
1,1-Dichloroethane	- -	- -	0.005	6/24/90
1,2-Dichloroethane	0.005	6/87	0.0005	4/4/89
1,1-Dichloroethylene	0.007	6/87	0.006	2/25/89
cis-1,2-Dichloroethylene	0.07	1/91	0.006	9/8/94
trans-1,2-Dichloroethylene	0.1	1/91	0.01	9/8/94
Dichloromethane	0.005	7/92	0.005	9/8/94
1,3-Dichloropropene	- -	- -	0.0005	2/25/89
1,2-Dichloropropane	0.005	1/91	0.005	6/24/90
Ethylbenzene	0.7	1/91	0.68 0.7 0.3	2/25/89 9/8/94 6/12/03
Methyl-tert-butyl ether (MTBE)	- -	- -	0.005[b] 0.013	1/7/99 5/17/00
Monochlorobenzene	0.1	1/91	0.03 0.07	2/25/89 9/8/94
Styrene	0.1	1/91	0.1	9/8/94
1,1,2,2-Tetrachloroethane	- -	- -	0.001	2/25/89
Tetrachloroethylene	0.005	1/91	0.005	5/89
Toluene	1	1/91	0.15	9/8/94
1,2,4 Trichorobenzene	0.07	7/92	0.07	9/8/94
1,1,1-Trichloroethane	0.200	6/87	0.200	2/25/89
1,1,2-Trichloroethane	0.005	7/92	0.032 0.005	4/4/89 9/8/94
Trichloroethylene	0.005	6/87	0.005	2/25/89
Trichlorofluoromethane	- -	- -	0.15	6/24/90
1,1,2-Trichloro-1,2,2- Trifluoroethane	- -	- -	1.2	6/24/90
Vinyl chloride	0.002	6/87	0.0005	4/4/89
Xylenes	10	1/91	1.750	2/25/89

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	Date[a]	California Department of Health Services MCL (mg/L)	Effective date
SVOC's				
Alachlor	0.002	1/91	0.002	9/8/94
Atrazine	0.003	1/91	0.003 0.001	4/5/89 6/12/03
Bentazon	- -	- -	0.018	4/4/89
Benzo(a) Pyrene	0.0002	7/92	0.0002	9/8/94
Carbofuran	0.04	1/91	0.018	6/24/90
Chlordane	0.002	1/91	0.0001	6/24/90
Dalapon	0.2	7/92	0.2	9/8/94
Dibromochloropropane	0.0002	1/91	0.0001 0.0002	7/26/89 5/3/91
Di(2-ethylhexyl)adipate	0.4	7/92	0.4	9/8/94
Di(2-ethylhexyl)phthalate	0.006	7/92	0.004	6/24/90
2,4-D	0.10.07	eff: 6/24/77 1/91	0.1 0.07	77 9/8/94
Dinoseb	0.007	7/92	0.007	9/8/94
Diquat	0.02	7/92	0.02	9/8/94
Endothall	0.1	7/92	0.1	9/8/94
Endrin	0.0002 0.002	eff: 6/24/77 7/92	0.0002 0.002	77 9/8/94
Ethylene Dibromide	0.00005	1/91	0.00002 0.00005	2/25/89 9/8/94
Glyphosate	0.7	7/92	0.7	6/24/90
Heptachlor	0.0004	1/91	0.00001	6/24/90
Heptachlor Epoxide	0.0002	1/91	0.00001	6/24/90
Hexachlorobenzene	0.001	7/92	0.001	9/8/94
Hexachlorocyclopentadiene	0.05	7/92	0.05	9/8/94
Lindane	0.004 0.0002	eff: 6/24/77 1/91	0.004 0.0002	77 9/8/94
Methoxychlor	0.1 0.04	eff: 6/24/77 1/91	0.1 0.04 0.03	77 9/8/94 6/12/03
Molinate	- -	- -	0.02	4/4/89
Oxamyl	0.2	7/92	0.2 0.05	9/8/94 6/12/03
Pentachlorophenol	0.001	1/91	0.001	9/8/94
Picloram	0.5	7/92	0.5	9/8/94
Polychlorinated Biphenyls	0.0005	1/91	0.0005	9/8/94
Simazine	0.004	7/92	0.010 0.004	4/4/89 9/8/94

Contaminant	U.S. Environmental Protection Agency MCL (mg/L)	Date[a]	California Department of Health Services MCL (mg/L)	Effective date
Thiobencarb	- -	- -	0.07 0.001[b]	4/4/89 4/4/89
Toxaphene	0.005 0.003	eff: 6/24/77 1/91	0.005 0.003	77 9/8/94
2,3,7,8-TCDD (Dioxin)	$3x10^{-8}$	7/92	$3x10^{-8}$	9/8/94
2,4,5-TP (Silvex)	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Disinfection Byproducts				
Total trihalomethanes	0.10 0.080	11/29/79 eff: 11/29/83 eff: 1/1/02[g]	0.10	3/14/83
Total haloacetic acids	0.060	eff: 1/1/02[g]		
Bromate	0.010	eff: 1/1/02[g]		
Chlorite	1.0	eff: 1/1/02[g]		
Treatment Technique				
Acrylamide	TT[h]	1/91	TT[h]	9/8/94
Epichlorohydrin	TT[h]	1/91	TT[h]	9/8/94

Source: http://www.dhs.ca.gov/ps/ddwem/chemicals/MCL/EPAandDHS.pdf

a. "eff." indicates the date the MCL took effect; any other date provided indicates when EPA established (that is, published) the MCL.

b. Secondary MCL.

c. MFL = million fibers per liter, with fiber length > 10 microns.

d. Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.

e. The MCL for lead was rescinded with the adoption of the regulatory action level described in footnote d.

f. MCLs are intended to ensure that exposure above 4 millirem/yr does not occur.

g. Effective for surface water systems serving more than 10,000 people; effective for all others 1/1/04.

h. TT = treatment technique, because an MCL is not feasible.

Federal and State MCLs – updated 05/23/03

Appendix G
Development of Current Groundwater Basin/Subbasin Map

This Bulletin 118 update represents the first time that groundwater basin boundaries have been released as a digital coverage. The basin boundaries for the revised groundwater basin map were primarily defined using geologic contacts and hydrogeologic barriers. Specifically the identification of the groundwater basins was initially based on the presence and areal extent of unconsolidated alluvial sediments identified on 1:250,000 scale, geologic maps published by the California Department of Conservation, Division of Mines and Geology. The identified groundwater basin areas were then further evaluated through review of relevant geologic and hydrogeologic reports and well completion reports, and using the basin definition criteria listed in Table 8. Basin boundaries that are specified in each of the court decisions has been used for the boundaries of adjudicated basins.

Well completion reports for wells present in basin areas that were identified from the geologic map were reviewed to identify the depth to the top of the water table and the top of impermeable bedrock. If there was less than 25 feet of permeable material present or if there was no groundwater present within the permeable material, the area was eliminated from the map. The well completion reports were also reviewed to determine if water supply wells located within the delineated basin area were extracting groundwater from the permeable materials underlying the area or from the bedrock beneath the permeable material. If the wells only extracted groundwater from the bedrock, the area was eliminated from the map. This resulted in the elimination of some areas identified as basins in previous Bulletin 118 publications. If there were no wells present in basin areas identified from the geologic map and no other information on the geology underlying these areas, the areas were retained in the current version of the map. Additional hydrogeologic information might or might not verify that these areas should be retained as groundwater basins.

Groundwater basins were delineated and separated from each other by the following restrictions on groundwater flow. For more detail on the types of basins and the flow boundaries of those basins, see Table 8.

Impermeable Bedrock. Impermeable bedrock with lower water yielding capacity. These include consolidated rocks of continental and marine origin and crystalline/or metamorphic rock.

Constrictions in Permeable Materials. A lower permeability material, even with openings that are filled with more permeable stream channel materials, generally forms a basin boundary for practical purposes. While groundwater may flow through the sediment-filled gaps, the flow is restricted to those gaps.

Fault. A fault that crosses permeable materials may form a barrier to groundwater movement if movement along the fault plane has created fine material that impedes groundwater movement or juxtaposed low permeability material adjacent to an aquifer. This is usually indicated by noticeable difference in water levels in wells and/or flow patterns on either side of the fault. Not all faults act as barriers to groundwater flow.

Low Permeability Zone. Areas of clay or other fine-grained material that have significant areal or vertical extent generally form a barrier to groundwater movement within the basin but do not form basin boundaries.

Groundwater Divide. A groundwater divide is generally considered a barrier to groundwater movement from one basin to another for practical purposes. Groundwater divides have noticeably divergent groundwater flow directions on either side of the divide with the water table sloping away from the divide. The location of the divide may change as water levels in either one of the basins change, making such a "divide" less useful. Such a boundary is often used for subbasins.

Adjudicated Basin Boundaries. The basin boundaries established by court order were used for all adjudicated basins. These court-decided boundaries affect the location of natural boundaries of adjoining basins. Some adjudicated basins are represented as subbasins in this bulletin.

Available reports on the geologic and hydrogeologic conditions in the delineated basin areas were also reviewed to determine if there was information that would further define the boundaries of the basin areas. This review resulted in changes to some of the basin boundaries identified in previous versions of Bulletin 118.

Several of the larger groundwater basins were further subdivided into groundwater subbasins in Bulletin 118-80 and additional large groundwater basins were subdivided during this 2003 revision. The subbasin boundaries were also primarily defined using geologic contacts and hydrogeologic divides where possible. If this was not possible, political or institutional boundaries were used.

The hydrogeologic information contained in the basin descriptions that supplement this update of Bulletin 118 includes only the information that was available in California Department of Water Resources (DWR) files through reference searches and through limited contact with local agencies. Local agencies may have conducted more recent studies that have generated additional information about water budgets and aquifer characteristics. Unless the agency notified DWR or provided a copy of the recent reports to DWR staff that recent information has not been included in the basin descriptions. Therefore, although Senate Bill 610 refers to groundwater basins identified as overdrafted in Bulletin 118, it would be prudent for local water suppliers to evaluate the potential for overdraft of any basin included as a part of a water supply assessment.

Persons interested in collecting groundwater information in accordance with the Water Code as amended by SB 221 and SB 610 may start with the information in Bulletin 118, but should follow up by consulting the references listed for each basin and contacting local water agencies to obtain any new information that is available. Otherwise, evaluation of available groundwater resources as mandated by SB 221 and SB 610 may not be using the most complete and recent information about water budgets and aquifer characteristics.

Groundwater basin and subbasin boundaries shown on the map included with this bulletin are based on evaluation of the best available information. In basins where many studies have been completed and the basin has been operated for a number of years, the basin response is fairly well understood and the boundaries are fairly well defined. Even in these basins, however, there are many unknowns and changes in boundaries may result as more information about the basin is collected and evaluated.

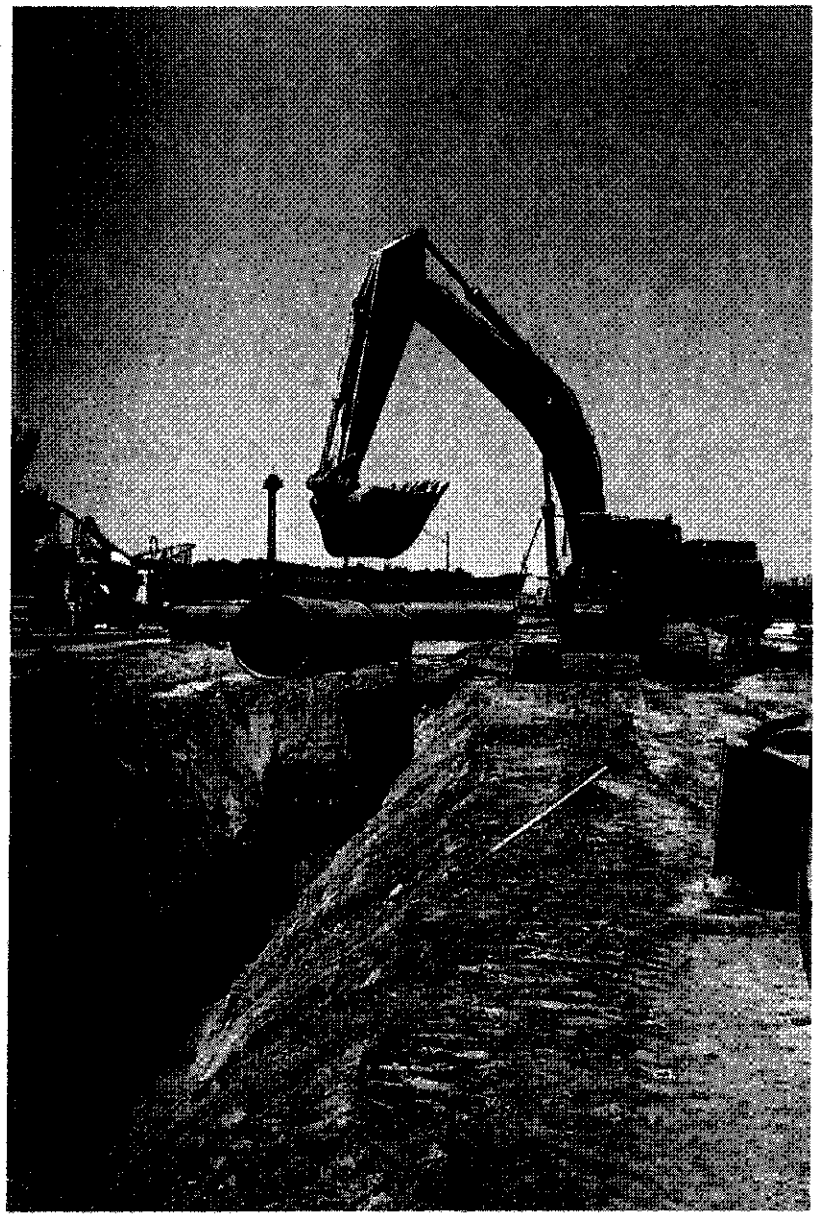
In many other basins where much less is known and understood about the basin, boundaries will probably change as a better understanding of the basin is developed. A procedure for collecting information from all the stakeholders should be developed for use statewide so that agreement on basin boundaries can be achieved.

CLWA Data Document Providing Economic Justification for Proposed Facility Capacity Fees, April 19, 2003

Castaic Lake Water Agency

Data Document

Providing Economic Justification for Proposed Facility Capacity Fees



April 19, 2003

Castaic Lake Water Agency
Memorandum

April 18, 2003

To: Board of Directors

From: Laurie Foster
Finance Officer

Subject: 2003 Data Document

Enclosed for your review is the Castaic Lake Water Agency Data Document Providing Justification for Proposed Facility Capacity Fees dated April 19, 2003. Please bring this document to the April 30, 2003 Public Hearing forming water service areas for Castaic Lake Water Agency 2003/04 and taking all necessary actions to set and fund the Agency's annual capital budget.

LAF

Enclosure

Cc (w/out enclosure): Dan Masnada, Russ Behrens

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Castaic Lake Water Agency

Data Document

Providing Economic Justification for

Proposed Facility Capacity Fees

April 2003

Report Purpose

This report provides the data concerning the estimated cost of facilities to supply water for new development, and the proposed method and basis for allocating the costs among those lands on which new development occurs, as required by Section 26.1 (c) (3) of the Castaic Water District Law. The following discussion addresses the Castaic Lake Water Agency's proposed Fiscal Year 2003/04 Facility Capacity Fee program in the context of estimated long-term costs of the Capital Improvement Program (CIP) activities of the Agency.

The CIP is a plan [within the meaning of §26.1 of the CLWA act] for the following purposes:

(1) To obtain additional facilities, works, property, improvements, and supplies of water.

(2) To increase or enlarge, as may be appropriate, its existing capacity and facilities for obtaining, importing, transporting, and delivering additional quantities of water to retail water distributors within the agency which are in need of additional water supplies.

(3) To finance or reimburse the agency for advancing the cost of acquiring facilities, works, property, improvements, and supplies of water and to allocate that cost among lands within water service areas of the agency which, by reason of new development or new construction thereon, will need new water service and will be benefited by making the additional supplies of agency water available for purchase by the retail water distributors that will supply those lands with water.

Agency water made available through CIP activities will be sold to retail water distributors who in turn, will serve Agency water to lands on which new water-utilizing development may occur as and when approved by municipal and County planning agencies. Neither the CIP nor the adoption of Facility Capacity Fees commits the Agency to proceed with any project identified in the CIP. The purpose of the CIP is to identify and estimate the cost of

projects which would be able to produce additional water supplies needed in the event new development is approved and constructed. The ultimate decision to proceed with any water supply, storage, treatment, or transmission project will depend upon growth patterns, development approvals given by city and county planning authorities, cost, and the feasibility and environmental impacts of each project. The Facility Capacity Fees contemplated herein will produce revenue only if new development actually occurs, and will not provide funding for water supply projects if no development occurs.

This report also presents background information concerning the proposed methods and basis for allocating the estimated long-term cost of Agency CIP activities to those lands which have been designated by planning agencies to accommodate new development. In addition, the report updates previous data document reports by recognizing the water demand of development which has occurred within the Agency since the adoption of the last Facility Capacity Fees.

This report is consistent with the recently submitted Urban Water Management Plan dated December 2000 which was prepared as required by State law. The Urban Water Management Plan reviews water demand and source of supply over near and long-term periods.

The Agency's water planning documents such as the Draft Integrated Water Resources Plan, Phase I dated February 8, 1998, and the Urban Water Management Plan are used as a source for the development of the Agency's CIP.

This report sets forth economic justification for the creation of revised facility capacity fee rates to fund new development's fair share of the proposed CIP activities identified and recommended by the Agency's Engineer.

Background

The proposed Facility Capacity Fee is structured to provide an identified equitable means of funding future Agency CIP activities between existing users and future development which creates new water demand. The Agency's enabling act, (West's Water Code-Appendix, Chapter 103), describes the manner in which the Agency's annual capital budget, including Facility Capacity Fees, shall be established, continued, and/or funded each year.

When the Facility Capacity Fee Program was first developed, the Agency recognized that only by reviewing and revising the data document analysis of the fee annually, would it flexibly and fairly account for and explain changing assumptions and conditions. Therefore, the program included an annual review to ensure that any difference between what had been forecast and what was actually occurring, was accounted for in later revisions and that there were accurate tracking mechanisms of the monies collected and expended in furtherance of the Agency CIP activities.

Legislation

The continuing concern regarding water supplies for new development has resulted in legislation in the form of Senate Bill No. 221 and SB 610. The legislation requires planning and permitting agencies to obtain from local water providers written verification that adequate water supplies for proposed projects are available. Since this is new legislation, the exact nature of the written verification is still uncertain. The CIP reflects a variety of projects from which the Agency can select appropriate alternatives to ensure that an adequate water supply can be made available for whatever development is approved by the city and county planning authorities.

State Water Project Reliability

The State Department of Water Resources recently published a draft report describing the State Water Project's ability to deliver the water that is requested by the State Contractors. The State is capable of providing on the average 75% of the requested amount. However, project deliveries have dropped as low as 19% in the driest years. Further, the aforementioned legislation requires assurance of water delivery under varying drought conditions. With this in mind, the Agency's Engineer has developed the CIP to provide sufficient supply, storage, and banking facilities to accommodate the worse case situation.

Projected Water Demand

The cornerstone of the Agency's CIP is to identify projects which could provide an adequate water supply under any number of future demand scenarios. The selection of appropriate projects will depend upon actual growth patterns. The CIP includes projects which would be able to accommodate the maximum anticipated water demand, as well as lesser demands which may occur. The development of the demand projections includes the following:

1. Ultimate demand based on current land use designations
2. Timing of future demand increases

3. Location of future demand increases
4. Effect of water conservation efforts to mitigate increase in demand
5. Potential use of recycled water as an additional source of water

The Agency maintains a database of every parcel within its service area. Information regarding the parcel's land use designation, projected water demand if the parcel remains vacant, and potential water use if developed, is annually updated. As the Agency service area has matured, growth patterns have changed in response to market demand and land availability. The CIP in turn has been updated to take these changes into consideration.

The Agency's computer-generated model uses information obtained from Los Angeles and Ventura County assessor records, and utilizes land use information as identified by the County assessors. For obvious reasons, the data lags actual conditions and thus the model does not reflect up-to-the-minute conditions. The model also includes estimated construction costs for various water supply, storage, treatment, and distribution projects and thus is capable of producing close approximations of actual costs. Since the process is repeated annually, it reflects current information. See Appendix A-1 for projected water demand by WSA.

Economic Climate

The last three years we have seen an economic downturn in the general economy. However, the demand for housing has resulted in a relatively stable housing market in the Santa Clarita Valley. This can be attributed to an acute demand for housing and relatively low mortgage rates. The State Department of Finance and the Southern California Association of Governments predict continued strong growth for Southern California.

The demand for housing can be demonstrated by a comparison of the median price of a detached house in the first quarter of 1999 ($289,945) to the third quarter of 2002 ($388,704). The price of an attached home in the fourth quarter of 1998 was $166,950 compared to a price of $279,990 in the third quarter of 2002.

CIP Scheduling

In accordance with standard industry practice, the Agency's CIP activities require a relatively long planning horizon. Also standard is the assumption that cycles of "boom and bust" will occur. Thus, the plan must be flexible enough to accommodate adjustments in the scheduling of projects. The Agency has an adopted policy of conservatism. **That is, the Agency will only build or acquire what it needs in such a manner as to insure that the**

Agency's water supply and facilities needs are continuously met subject to an adequate margin of safety. The policy mitigates the Agency's exposure to building facilities prematurely and having to operate underutilized facilities inefficiently. This further protects the existing user from funding the operation of facilities needed for future growth.

Policies

The Agency has two primary policies that are used as a guide in the preparation of the CIP and Facility Capacity Fees.

Fairness Policy

This policy simply states that the benefiting user pays according to the actual cost of the service. Certain facilities are required for existing as well as future users, and there are other facilities that are required only by new users. For example, changes in higher water quality standards are a benefit to existing users. Thus, the cost of providing the higher water quality is appropriately paid by existing users. The need for additional treatment capacity, on the other hand, is growth induced and thus a responsibility of the new user.

The cost of facilities benefiting both existing and future users is allocated between such uses based upon the proportional benefit. The proportional benefit is determined by taking the total capacity of the facility in terms of the number of acre-feet of annual demand it is designated to serve and allocating a share of the cost to current users reflecting the total annual demand in acre-feet of the current users who benefit from the facility. For instance, if a reservoir provides storage which is necessary to provide reliability for 5,000 acre-feet of annual demand, and the current users who will benefit from the reservoir represent 2,500 acre-feet of annual demand, then 50% of the cost of the reservoir would be allocated to current users and only 50% of the cost would be calculated into the Facility Capacity Fees for the area benefited by the reservoir reflecting the additional demand generated by future users.

Conservative Economic Policy

As previously discussed, the Agency will only build or acquire what it needs in such a manner as to insure that the Valley's water supply needs are continuously met. This policy is particularly important in the water utility industry as it is difficult to build in small increments to match growth needs on a yearly basis. On the other hand, building too soon and too

large results in excessive capital and operating costs with an insufficient number of customers to pay for the service.

Water Plan

The foundation for the Agency's proposed CIP is land use and other statistical data conforming to applicable land uses. The Agency's consultants have developed and the Agency benefits from a computerized model that catalogs all of the available land within the Agency. The model captures each parcel's existing and authorized land uses, as maintained by the Assessor and planning agencies. Potential water demands (if the lands are developed or more intensively developed) are computed using extrapolations from existing consumption data. This information enables the Agency to determine, with reasonable accuracy, the amount of water required to meet the projected needs of the Santa Clarita Valley.

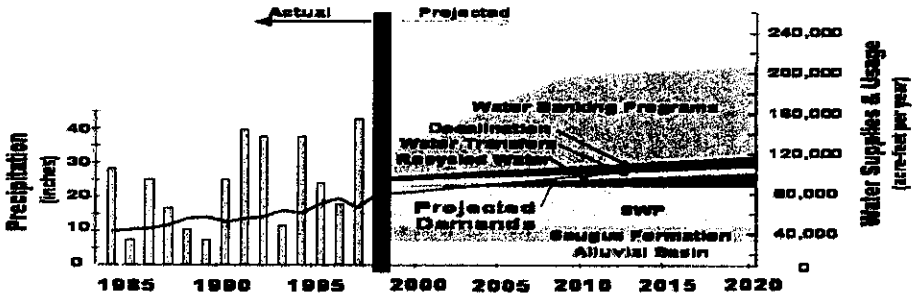
Using information obtained from the local retail purveyors, the database also contains information concerning where and when the water demand could materialize, based upon their best estimates of development. The County of Los Angeles Department of Regional Planning also supplies a report on proposed development from its development monitoring system.

Water Demand Model

This report has examined the approved land uses throughout the entire Castaic Lake Water Agency service area and the associated water demands. In this regard, a range of water demands was developed using a range of densities for specific general plan land use classifications. For the purpose of this report in determining Facility Capacity Fees, the decision was made to continue the previous practice of using the mid-range value of densities and historic water consumption.

The Draft IWRP water demand model calculated the projected future demand for the currently designated allowable land uses within the Castaic Lake Water Agency service area at approximately 175,000 acre-feet of water without conservation savings. The updated water demand for this report, with conservation, is 169,000 acre-feet. The total demand has changed slightly as a result of land use changes. However, as land is developed portions are dedicated to such uses as streets and parking lots that do not generate a water demand. Conversely, some land is developed for uses which result in a higher water use than

projected. As a result the demand at build-out is still projected to be within the ranges developed in the Draft IWRP.



As noted in the above figure, the projected water demand for 2020 is slightly more than 100,000 acre-feet, which exceeds the current reliable supply. The Agency's CIP includes additional water acquisition, recycled water, as well as water banking and storage projects to meet the future demands. These additional sources may be pursued as demand becomes more certain.

Projected Sales of Facility Capacity Fees

The financing of the Agency's Capital program is based primarily on the revenue derived from the Facilities Capacity Fees. The financial community does not consider this revenue source as stable and, as a result, is reluctant to issue a high credit rating, which, in turn, makes it difficult to secure reasonably priced bond insurance.

In 1991 the Agency issued its first bonds to begin construction of capital facilities. In order to demonstrate that the Facility Capacity Fees were a credit worthy security for the bonds, it was necessary to demonstrate exceptional conservatism in the Agency's projection of sales.

Further, the Agency had no track record of annual sales of capacity to demonstrate the reliability of strength of the building market in the Santa Clarita Valley. The Agency developed forecasts based on County general plans and development activity by the local purveyors. This, in turn, was translated into a series of scenarios projecting possible income under various economic conditions.

Based upon historical connection data and housing sales, it was determined that Facility Capacity Fee sales would be based on a reduced number from the forecasted water demand

(see Appendix A-2). This was necessary based on the financial community's concern with a variable revenue stream that was further complicated by the fact that certain development can occur that is not subject to the building permit process, thus escaping payment of the Facility Capacity Fees. In addition, landowners can develop their land using groundwater and not take any Agency water. These developments create a demand for water but they are not accountable to the Agency.

As shown in Appendix B, annual sales of capacity have been highly variably since the program was implemented. Based on the Agency's history of sales, the maintenance of cash reserves has enabled the Agency to sell a total of three bond issues all backed with insurance and a sound credit rating.

Water Conservation

The Agency has signed a memorandum of understanding with other urban water suppliers, public advocacy organizations and other interested parties. The California Urban Water Conservation Council has the responsibility for monitoring the implementation of the MOU. A major effort of this coalition is the implementation of Best Management Practices as a means of achieving water conservation goals.

There are 14 Best Management Practices. The Agency is currently involved in a pilot study for the implementation of these practices. It is anticipated that the conservation effort will reduce the water demand by approximately 10% or more.

The agency has an extensive program for the education of grade school children concerning water, its source, use and care. The Agency's conservation garden demonstrates the use of drought tolerant plants and ground covers that can be attractive while using minimum amounts of water.

Capital Improvement Program

The Agency's proposed CIP activities have been developed to fulfill the Agency's stated mission, which is to provide reliable, quality water at a reasonable cost to the Santa Clarita Valley. Thus, the proposed CIP is structured to include facilities for the treatment, storage, and transmission of water as well as the acquisition of additional water supplies. Since the State Water Project is not complete and water deliveries are variable, the proposed CIP

contains certain elements to increase reliability through a combination of additional water supplies, water banking, storage and conjunctive use.

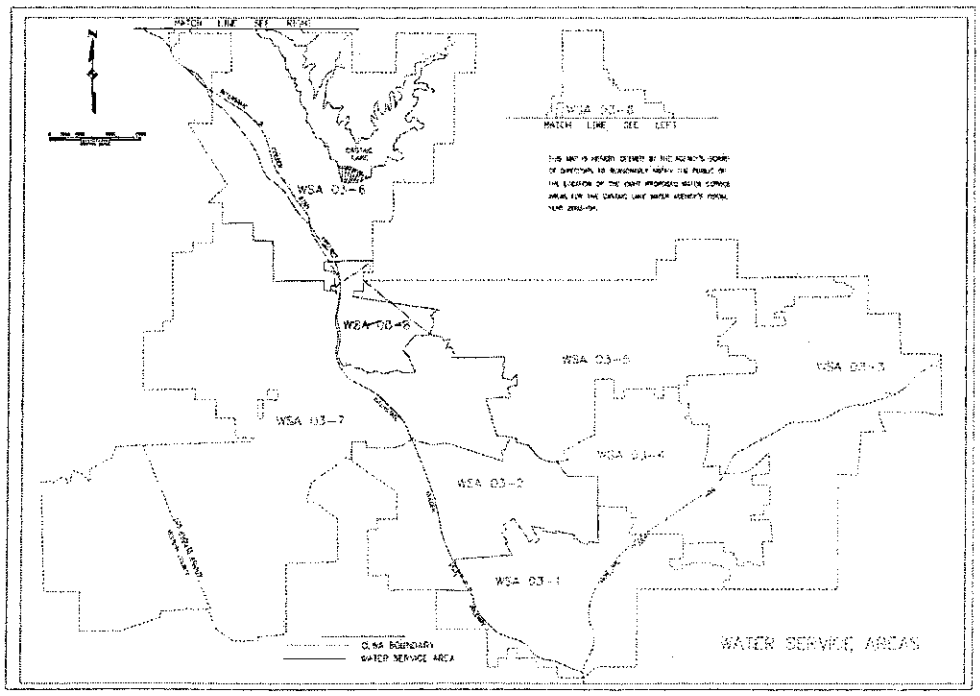
Water Service Areas

In keeping with Agency policy that the benefiting user pays, it was determined that the distribution of cost would be fairly apportioned by dividing the Agency's service area into logical hydraulic water service areas (WSAs). This enables the engineers to plan and distribute costs on a cost of service basis.

The Agency Engineer has determined that 26 specific Sub-WSAs and eight water service areas (see map below and Appendix C for an enlarged map) constitute the most practical building blocks for establishing water needs and, in turn, Agency capital facilities. Additionally, these Sub-WSAs are used in determining the areas of benefit for each capital project. These Sub-WSAs are then grouped into logical configurations to form a smaller number of WSAs and to conform to Agency policy in providing planned transmission facilities to each proposed WSA.

Multiple alternative configurations have been considered and evaluated. As a result of this evaluation, eight WSAs were established for the Agency's Capital Facility Program for Fiscal Year 1991/92. This configuration has been used every year since then, and it is proposed that the eight existing WSAs be maintained for FY 2003/04.

Water Service Areas



Water Demand by WSA

The Agency's computerized database provides water demand based on the aforementioned Sub-WSAs. The data is then analyzed to determine the Agency facilities needed for each Sub-WSA, taking into consideration the availability of local groundwater and water conservation. The net water demand is then translated into specific facilities, sizes, phasing, and cost.

Distribution of Benefits

After facility requirements are determined, costs are allocated to WSAs and then to existing or future users based on the projected benefits to be derived from the project. Each of the individual projects within the CIP are evaluated to determine from where within the Agency the project provides benefits (i.e., WSA) and who benefits from the project (existing or future users). Based on the determination of the distribution of benefits, the costs for the project are distributed accordingly. Specific details of this procedure are provided in the following section (Existing and Future User Benefits) and Appendix D.

Program Financing

Since the facilities have to be in place before development can take place, capital projects are typically debt-financed. The cost of financing is an additional cost of the program and is included as part of the project cost. In addition, portions of projects benefit existing users as well as future users. Thus, it is necessary to distribute the debt in the same manner as projects benefit (i.e., existing and future).

Agency Revenues

The Agency's authorized revenue sources are as follows:

1. Water rates
2. Facility Capacity Fees
3. Ad valorem taxes for authorized debt service
   a. State Water Project
4. Portion of 1% basic property tax levy
5. Water Standby Charges
6. Interest on investments

Existing Users Funding

Existing users could fund their portion of the Agency program through the following:

1. Portion of 1% property tax (current practice)
2. Water rates (currently not in effect)
3. Parcel charges (currently not in effect)
4. Ad valorem taxes for State Water Project (current practice)

Future Users Funding

1. Facility Capacity Fees (current practice)
2. Interest on Investments (current practice)
3. Parcel Charges (currently not in effect)
4. Portion of 1% property tax (current practice)
5. Ad valorem taxes for the State Water Project (current practice)

Existing and Future User Benefits

The allocation between existing and future users is developed based on benefits received from each facility described as follows and in Appendix D.

The existing water treatment facilities (Rio Vista and Earl Schmidt) require upgrading to meet new drinking water treatment standards issued by the State of California and United States Environmental Protection Agency. These improvements are allocated to existing users.

Emergency storage improvements included in the capital improvement plan benefit existing and future users by providing protection against short term loss of imported water supplies. Planned new storage facilities accommodate the needs of existing and future users, and costs are shared between them. This storage is provided at water treatment plant sites and along pipeline routes.

New potable water supply projects are allocated to future users and include additional potable water supplies (such as State Water Project water).

Recycled water distribution projects are allocated between existing and future users as each benefit. The development of recycled water improves the Agency's overall water supply

reliability although it will be distributed in those areas where it is most cost effective and efficient to do so.

There are two types of State Project Water reliability enhancement projects, water supply banking and Saugus aquifer wells. These projects firm up the reliability of the State Water Project water by providing an alternative supply during periods of reduced State Water Project deliveries. These projects are allocated to existing and future users.

Pipeline and pump station projects are required to convey State Water Project water to new users and all costs are allocated to future users.

Several projects (listed as System Appurtenances projects) provide improvements needed to accommodate delivery of State Water Project water and are allocated to future users.

Water treatment expansion projects are required to accommodate future users and are allocated to future users.

A description of each project included in the Draft Capital Improvement Plan (CIP) and allocation between existing and future users is provided in Appendix D. Appendix D-1 is provides a summary of the entire Draft CIP and distribution of estimated project costs among water supply, supply banking, pipeline, pump stations, storage and water treatment. Appendix D-2 provides a summary of cost allocations between existing and future users. Appendix D-3 is the projected construction schedule.

Standard Unit of Benefit

In order to distribute benefits, it is necessary to establish a "unit of benefit" that can be applied as a standard of measure. The Agency's unit measure is an **acre foot of water per year.** There is a direct nexus between the demand for an acre foot of water and the capital facilities required to supply that acre foot of water.

For example, the unit of measure for water supplies is acre feet per year. Storage is measured in acre feet and transmission is measured in acre-feet per year. Water demand is also measured in acre-feet per year. Historical consumption records for the Santa Clarita Valley indicate that the water demand for a single family dwelling ranges from 0.5 acre-feet per year to as high as 0.8 acre-feet per year based on the dwelling size and location.

Water Needs by Water Service Area

Water demands within the Agency's service area are met by both groundwater produced by retail purveyors and imported water provided by the Agency. This year recycled water will also become a source of non-potable supply to meet current and future non-potable demands. The sizing of the proposed Agency facilities is based on the demand for Agency potable and non-potable water. The additional potable and non-potable water needed to satisfy the demand was projected using a computerized water demand model as well as production records from the Agency and the four local purveyors.

Supplemental Water Needs

The Agency is now able to provide recycled water as a non-potable supply, thus augmenting the water supply to the service area. The additional water needed to satisfy the demand (referred to as supplemental water demand) was projected using a computerized water demand model as well as production records from the Agency and the four local retail purveyors.

The Agency's water demand model provides a forecast of total demand in the future for each Sub-WSA. The supplemental water demand for each Sub-WSA was determined by mathematically balancing the estimated future water demand by taking into account the configuration of the Agency and purveyor distribution systems and the potential use of recycled water. By using this mathematical approach, the optimum blend of local groundwater and supplemental water is achieved. Details of the mathematical model are set forth in Appendix E.

Water and Facility Cost Allocations

The "optimum blend" provides the hydraulic data required to size Agency water supply and treatment facilities. Projects derived from this technical process are labeled "Agency-wide" projects. The hydraulic data are used to size the transmission lines. Accordingly, these projects are labeled "WSA-specific" projects. An estimate of project cost is calculated, and the project is scheduled based on projected water demand. As a matter of Agency policy, "Agency-wide" projects include the cost of acquisition of additional water supply, water treatment facilities, and storage. "Agency-wide" projects are considered to have equal benefit regardless of geographic location within the service area.

Thus, the component of the facility capacity fee for the cost per acre foot of this portion of the CIP is the same for all WSAs regardless of location within the Agency's service area. The costs are then allocated to existing and future users. The portion which is determined to be attributable to future users becomes the "base" number for the calculation of the Facility Capacity Fee. The "base" number represents the costs of acquiring, treating, and storing an acre foot of water anywhere within the Agency service area.

As a matter of policy, "WSA-specific" projects include the cost of Agency Transmission facilities. These costs are allocated to the WSAs based on the relative benefits of a transmission project to a specific WSA. Accordingly, each WSA's share of the proposed pipeline's cost was calculated in proportion to each WSA's share of the capacity based on supplemental water demand. The resulting capital cost to convey an acre foot of water varies accordingly from WSA to WSA. The future users' benefits from the Agency's CIP was obtained (after excluding the existing users' benefits) by combining each WSA's share of the Agency-wide projects and the WSA-specific projects.

Facility Capacity Fee Calculation Methodology

As discussed earlier, each WSA's estimated water demand is expressed in acre feet per year, and is based upon combining land use codes with actual water usage from the purveyors.

Using the CIP costs and incremental water demands, the financial computer models are analyzed and mathematically calculate the cost per acre foot per WSA for "WSA-specific" transmission, and cost per acre foot for "Agency-wide" storage, banking, and treatment.

The Agency's financial model calculates these costs using a number of assumptions, including estimated future water demand (acre feet), construction inflation, general inflation, cost of borrowed money, interest earnings, and increase in assessed value. (See Appendices E and F) for a detailed explanation of the model and its method of calculation and assumptions.) Most important, the financial model also utilizes the cash flow approach to determine when funds would have to be borrowed. For the FY 2003/04 Facility Capacity Fee calculation, the financial model is based on the most recent CIP requirements and the updated forecast for water demand. The Agency generally conducts an annual review and update of the CIP as well as the Facility Capacity Fee schedule. As the area develops, there will be a shift in demand from WSA to WSA based on a number of factors such as changes in anticipated development, type of developments, etc.

The annual update provides an opportunity to revise the capital needs and resulting costs in response to actual conditions. The location, size, and timing of facilities are done in accordance with District Policy. Facilities are to be available five years ahead of need. This policy precludes the construction of facilities far in advance of need, thus eliminating the cost of maintaining underutilized facilities. Further, it precludes growth inducement since the facilities are only constructed to meet the needs of authorized development. In summary, the financial model was designed to incorporate all parameters concerning the CIP, estimated water demands, and assumptions that impact the Facility Capacity Fee.

Fiscal Year 2003/04 Facility Capacity Fees

The proposed CIP in FY 2003/04 dollars is estimated at about $455 million (Appendix D). The specific amount of expenditure of capital funds will be authorized by the Board of Directors after consideration is given to a variety of physical factors and the needs of the purveyors. The proposed Facility Capacity Fees by water service area for FY 03-04 are as noted:

WSA	Charge Per Acre Foot	
	FY 1999/2000	FY 2003/04
99-1	$ 9,056	$ 8,771
99-2	$ 9,142	$ 9,336
99-3	$ 9,451	$ 12,833
99-4	$ 8,498	$ 11,479
99-5	$ 8,772	$ 9,900
99-6	$ 7,984	$ 8,213
99-7	$ 8,554	$ 9,446
99-8	$ 8,889	$ 8,856

Some of the fees are increasing and others are decreasing. The change is due to a number of factors, including the distribution of past debt and estimated imported water demands by the WSAs. The CIP likewise changed in that the acquisition of the Santa Clarita Water Company (SCWC) reduced capital needs while the re-evaluation of the State Water Project's

reliability resulted in the need to acquire more water and increase groundwater banking programs.

Apportionment of Costs and Benefits

The current CIP models were developed using a variety of sources of revenue including Facility Capacity Fees, portion of 1% property taxes, interest earnings and other miscellaneous income. Multiple models were analyzed in order to establish a proforma that would match the appropriate revenue sources with expenditures, thus complying with law and achieving the equities required by the fairness doctrine adopted by the Board of Directors.

Because of the detailed and comprehensive cash flow modeling, the appropriate WSA Facility Capacity Fees were developed to match their proportionate share of the CIP facilities attributable to growth. **That portion of the CIP that is attributable to benefits to the existing users is funded through revenue other than from Facility Capacity Fees.**

The State Water Project costs (fixed and variable) have been paid through existing voter approved ad valorem taxes for all properties within the agency's service area. The undeveloped property assessed value is $846,968,711 (5% of total assessed value) and developed property assessed value is $16,352,999,197 (95% of total assessed value) as of August 2002.

Planning Horizon

The Agency's long-range capital program consists of major water supply projects needed to supply the proposed development authorized by the appropriate planning agencies. The plan takes into consideration the following factors:

1. It includes facilities which include water acquisition, treatment, storage, and transmission pipelines
2. It utilizes cost data and timing for input into the Facility Capacity Fee model
3. It involves a time-phased program to accommodate the projected need five years in advance

The traditional approach used by the water industry is to plan infrastructure alternatives as far into the future as practical and update it as often as annually to ensure the plan will reasonably take into account changed circumstances as they occur. The Agency's CIP program is designed in a manner that allows the Agency to modify specific projects in response to changed conditions and at the same time maintain the fiscal integrity of the program. The timing and location of actual water demand has changed over the past 17-plus years and the CIP program as well as the charges have responded to these changes.

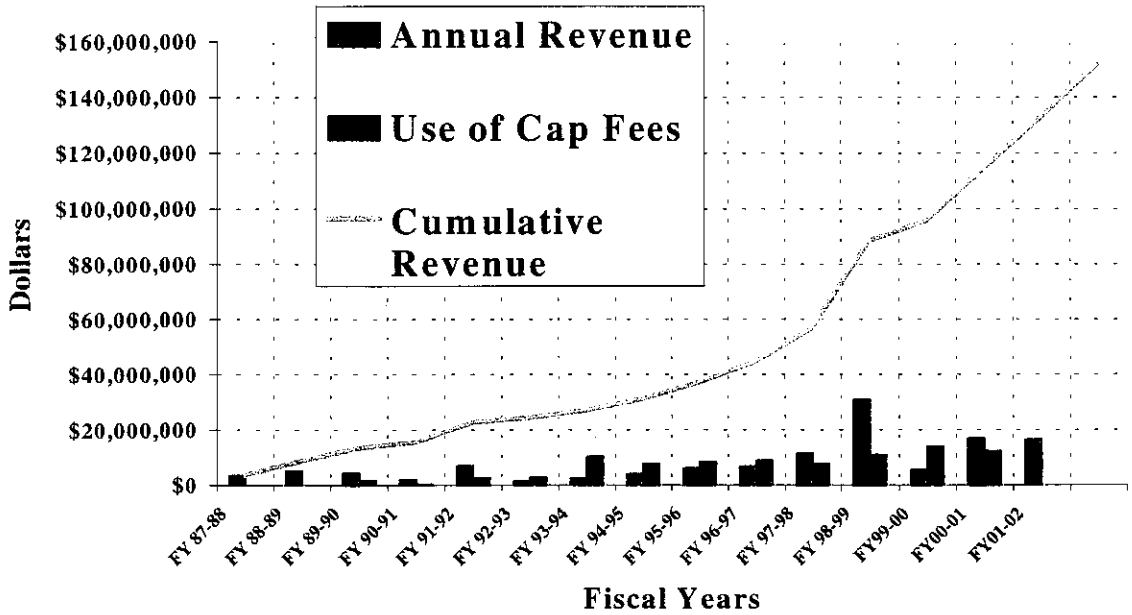
The legislature has recognized the need for long-range water planning in California as exemplified in the requirement for water agencies to provide an Urban Water Management Plan every five years. This plan takes into consideration water demands under various hydrological cycles for at least 20 or more years. Further, the legislature recently passed SB 221 and SB 610, which place greater emphasis on long-term water planning because it mandates that water purveyors provide assurance of water supplies 20 or more years into the future.

Water Supply Planning and Development in California requires very long planning horizons. For this reason the Agency has adopted a 50-year planning horizon for its planning model.

CIP Financing

Since the majority of the Agency's Capital programs are required for future needs, it was determined that the program would be debt-financed. This excludes the existing rate payer from funding growth related costs. Existing users only pay for the benefits they derive from the agency's CIP. This is in keeping with the Agency Policy of "Benefiting User Pays." In addition, water supply facilities last many generations and it would place an undue burden on existing users if the CIP were to be funded on a pay as you go basis. Debt financing allows each generation to pay for what it uses. This is also in keeping with the Agency Policy of "Benefiting User Pays." This can be best demonstrated by the history of Facility Capacity Fee Revenues.

Summary of Facility Capacity Fee Revenue



Facility Capacity Fees collected in one fiscal year may not be expended until future fiscal years. Likewise, in some years, there will not be sufficient Facility Capacity Fees collected to cover the cost of the CIP or other such expenses (such as payments on existing Agency Certificates of Participation). The financial model incorporates the impact of these timing conditions. In addition, reserve funds have been set aside to ensure the economic viability of the CIP and to provide security for the repayment of Certificates of Participation issued by the Agency to fund its CIP as described in this Data Document and in prior year Agency data documents.

Capital Replacement

The cost of system maintenance and replacement, as well as upgrades to comply with water quality regulations, is a responsibility of the existing user and as such is not funded from Facility Capacity Fees.

Summary

The foregoing program is intended to comply with the Board-adopted policies of conservatism and fairness. Conservatism will be achieved through the measured construction of those facilities necessary to maintain an advance supply of water to meet the needs of those developments authorized by the planning agencies.

Implementation of the Fairness Doctrine is accomplished through the use of a mixture of revenue sources that match the benefit to the cost. The proposed Facility Capacity Fee is calculated to fund that portion of the CIP attributable to growth-related facilities. That portion of the CIP attributable to existing users is funded by other sources.

Through the use of the aforementioned water resources, the optimization of the entire Santa Clarita Valley's water resources is achievable. Thus, the **Santa Clarita Valley is provided with reliable, quality water at a reasonable cost.**

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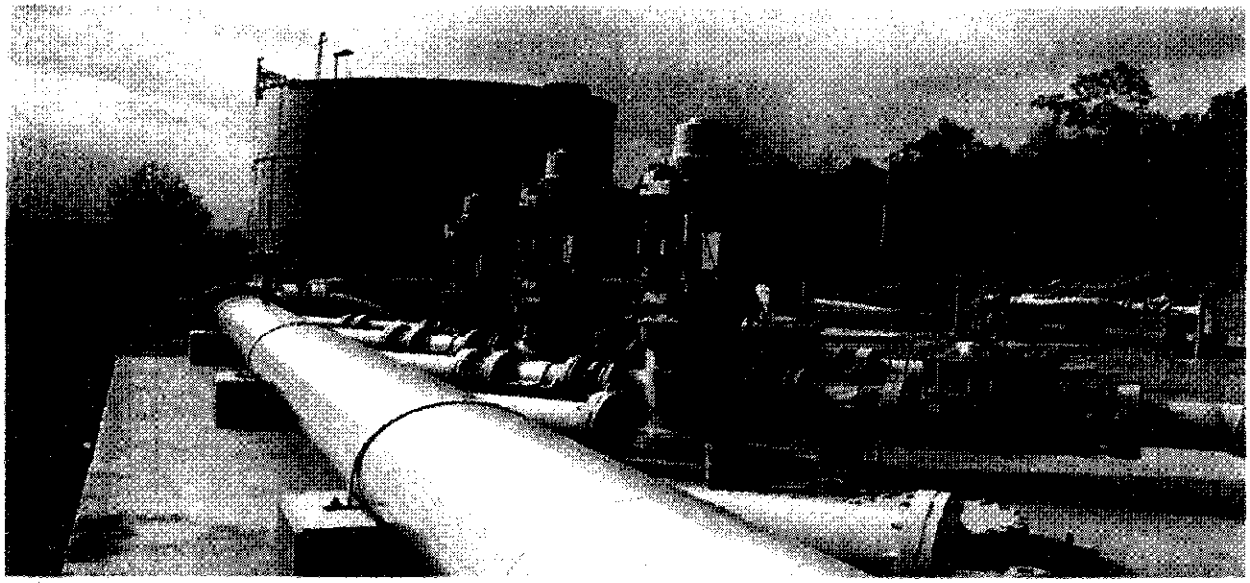
APPENDICES



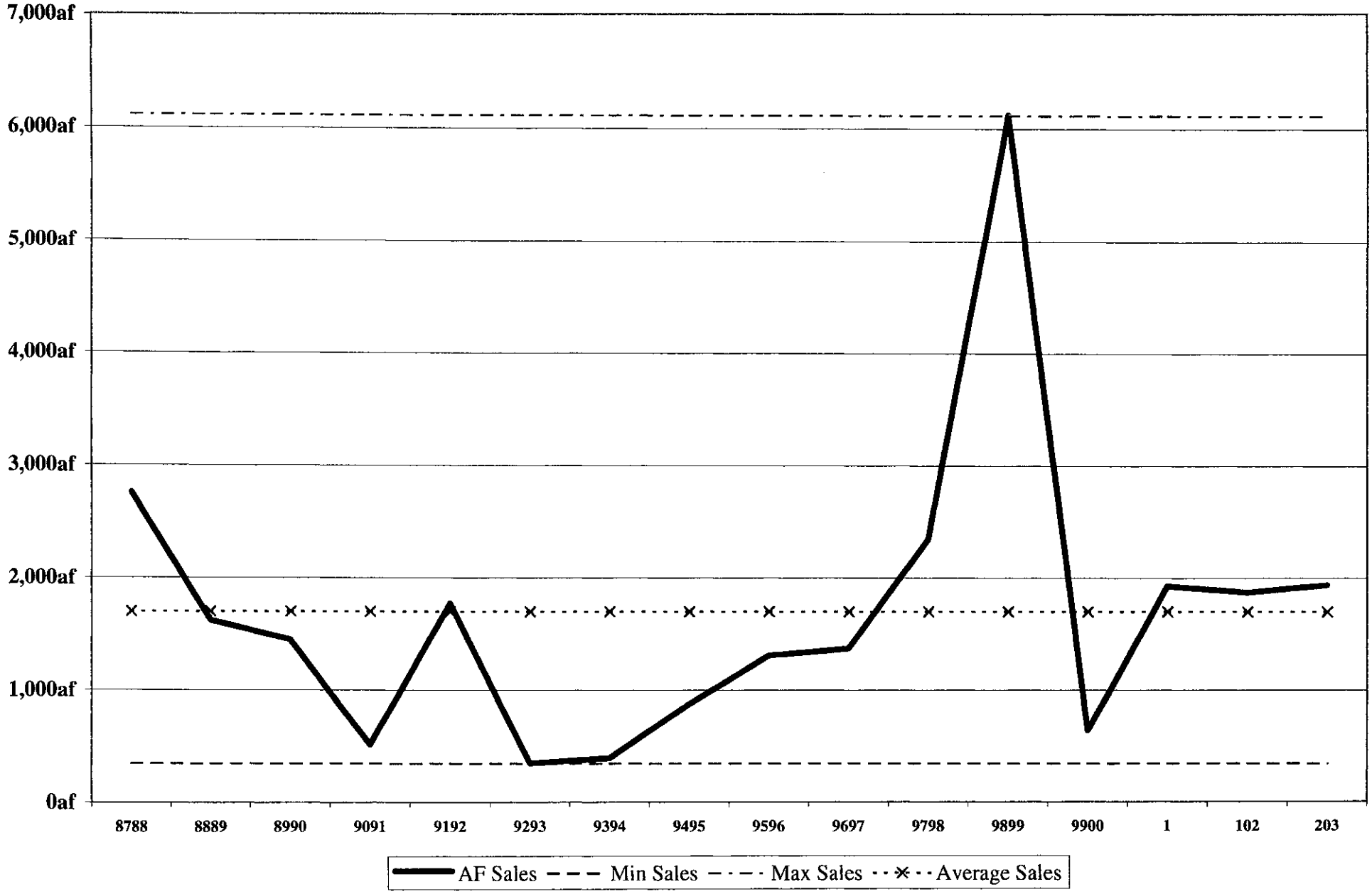
Projected Annual Increase In Water Demand in Acre-Feet

WSA	1	2	3	4	5	6	7	8	Totals
2004	331	191	597	268	425	185	1,086	14	3,096
2005	334	151	530	237	400	192	988	14	2,847
2006	345	130	492	219	381	202	931	22	2,722
2007	271	8	157	56	135	166	372	19	1,184
2008	244	7	80	27	110	164	304	20	955
2009	241	33	31	4	101	165	293	20	888
2010	215	26	24	31	76	168	236	21	797
2011	189	9	93	33	55	172	203	21	775
2012	312	16	118	97	262	246	240	28	1,320
2013	300	10	257	45	253	288	573	30	1,756
2014	286	9	243	112	239	285	541	32	1,747
2015	276	12	238	109	229	283	525	34	1,706
2016	265	17	232	106	226	278	506	37	1,666
2017	257	10	234	105	219	274	497	43	1,638
2018	249	10	234	105	219	269	491	43	1,621
2019	244	12	237	106	220	264	491	43	1,618
2020	280	12	317	146	284	285	632	46	2,003
2021	298	67	361	168	303	295	708	48	2,247
2022	304	78	382	179	320	298	743	48	2,351
2023	307	112	395	185	339	298	763	49	2,446
2024	307	137	403	189	349	296	775	49	2,506
2025	307	144	410	192	350	294	784	49	2,530
2026	306	184	415	195	356	292	792	49	2,589
2027	305	174	420	198	352	289	798	44	2,580
2028	304	155	424	200	355	286	805	17	2,547
2029	304	139	429	203	358	284	811	18	2,546
2030	304	147	434	205	317	281	818	18	2,524
2031	304	154	439	157	318	279	826	19	2,497
2032	304	162	344	163	334	277	659	20	2,263
2033	301	169	339	169	339	275	679	21	2,292
2034	302	176	351	175	346	274	698	22	2,344
2035	304	183	364	180	345	273	718	23	2,390
2036	307	190	376	186	340	272	738	24	2,433
2037	336	220	433	214	386	292	840	28	2,749
2038	298	229	449	221	398	294	868	29	2,787
2039	296	229	449	212	396	289	865	29	2,765
2040	261	229	448	212	363	285	805	29	2,631
2041	261	229	448	212	363	280	805	29	2,626
2042	261	229	447	212	363	276	805	29	2,621
2043	261	229	446	212	363	272	805	29	2,616
2044	261	229	446	212	363	200	805	29	2,544
2045	261	229	445	212	363	200	805	29	2,543
2046	261	229	445	212	363	200	805	29	2,543
2047	261	229	444	212	363	200	805	29	2,542
2048	261	229	436	212	363	200	805	29	2,534
2049	261	229	436	212	363	200	805	29	2,534
2050	174	153	201	141	242	133	537	19	1,599
Total	13,221	6,153	16,377	7,662	14,309	11,774	32,192	1,406	103,059

Projected Annual Sales in Acre-Feet

	1	2	3	4	5	6	7	8	Totals
2004	182	105	328	147	234	102	597	8	1,703
2005	184	83	292	130	220	106	544	8	1,566
2006	190	71	271	121	209	111	512	12	1,497
2007	149	4	86	31	74	91	205	11	651
2008	134	4	44	15	61	90	167	11	525
2009	133	18	17	2	56	91	161	11	489
2010	118	14	13	17	42	93	130	11	439
2011	104	5	51	18	30	94	112	12	426
2012	171	9	65	53	144	135	132	16	726
2013	165	5	142	25	139	159	315	17	966
2014	157	5	134	61	131	157	297	18	961
2015	152	7	131	60	126	156	289	19	939
2016	146	9	128	58	124	153	278	20	916
2017	141	6	129	58	120	151	273	24	901
2018	137	6	129	58	121	148	270	24	891
2019	134	7	130	59	121	145	270	24	890
2020	154	7	175	81	156	156	348	25	1,101
2021	164	37	199	93	166	162	390	26	1,236
2022	167	43	210	98	176	164	409	27	1,293
2023	169	61	217	102	186	164	419	27	1,345
2024	169	75	222	104	192	163	426	27	1,378
2025	169	79	225	106	192	162	431	27	1,392
2026	168	101	228	107	196	161	435	27	1,424
2027	168	96	231	109	194	159	439	24	1,419
2028	167	85	233	110	195	158	443	9	1,401
2029	167	77	236	111	197	156	446	10	1,400
2030	167	81	239	113	174	155	450	10	1,388
2031	167	85	241	87	175	153	454	11	1,373
2032	167	89	189	90	184	152	362	11	1,245
2033	165	93	186	93	187	151	373	12	1,260
2034	166	97	193	96	190	151	384	12	1,289
2035	167	100	200	99	190	150	395	13	1,315
2036	169	104	207	102	187	150	406	13	1,338
2037	185	121	238	118	212	160	462	15	1,512
2038	164	126	247	122	219	162	478	16	1,533
2039	163	126	247	116	218	159	476	16	1,521
2040	144	126	246	116	199	157	443	16	1,447
2041	144	126	246	116	199	154	443	16	1,444
2042	144	126	246	116	199	152	443	16	1,442
2043	144	126	246	116	199	150	443	16	1,439
2044	144	126	245	116	199	110	443	16	1,399
2045	144	126	245	116	199	110	443	16	1,399
2046	144	126	245	116	199	110	443	16	1,398
2047	144	126	244	116	199	110	443	16	1,398
2048	144	126	240	116	199	110	443	16	1,394
2049	144	126	240	116	199	110	443	16	1,394
2050	96	84	111	78	133	73	295	11	880
Total	7,271	3,383	9,006	4,212	7,867	6,472	17,702	769	56,682

Castaic Lake Water Agency
Historic Water Facilities Fee Sales (Acre Feet)



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Reiter/Lowry/Consultants

Appendix B

Table D
Castaic Lake Water Agency
FY 03/04 Capital Improvement Project Allocations

Project	Description
Water Supply Projects Projects 1 through 13 Recycled Water – Phase IB through Phase XI, Recycled water ASR project and associated environmental studies.	Cost of design and construction of the Reclaimed Water System phases as developed in the Draft Master Plan Update. Existing users pay share of project based on their share (65,490 AF – 38.75%) of the 2050 demand (168,950 AF) of the agency. Future users pay 61.24%. Projects increase system reliability. Project cost shared by all sub-WSAs.
Project 14 Additional Water Supply Purchase (40,000 AF)	Cost of acquiring additional water supply to increase level of contractual State Water Project contracts (or other water supply). Additional supply required due to recently identified reliability of current SWP contracts. Future users pay all costs and shared by all sub-WSAs.
Water Supply Banking Projects Projects 15 through 20 Water Supply Banking I, II, III and IV: Suagus Wells 1, 2, 3, and 4	Existing users pay a share of the project costs based on their share of imported water demand (36,839 AF – 36.29%) of the 2050 demand (101,520 AF). Future users allocated 63.71%. Project cost is shared by all sub-WSAs.
Pipeline/PS/Storage Projects Project 21 Honby Extension and Storage II.	Cost of design and construction of the pipeline, reservoir, and pump station. Existing users pay a share of the cost of the storage facilities based on their share of demand. Future users pay the cost of pipeline, pump station, and their share of the storage facilities. First phase of project. Storage facilities cost shared by all sub-WSAs. Pipeline and pump station cost shared by sub-WSAs 88-23, 25, 26, 33, and 36.
Project 22 Lateral Extension (Pitchess)	Cost of design and construction of pipeline from the Castaic Conduit west to the west side of Interstate 5. New pipeline to serve future users. Future users pay all project costs. Pipeline cost is shared by sub-WSAs 88-2 and 15.
Project 23 Lateral Ext. & Storage	Cost of design and construction of the Lateral Extension & Storage Project. The pipeline begins at the Newhall Parallel at the Santa Clara River and travels west into the mountains west of interstate 5. This project includes a reservoir near its terminus. Existing users pay a share of the cost of the storage facilities based on their share of demand. Future users pay cost of pipeline and their share of the storage facilities. Storage facilities cost is shared by all sub-WSAs. Pipeline

Project	Description
	cost is paid by sub-WSA 88-12 and 15.
Project 24 Honby and Newhall Parallel II (Honby Parallel)	Cost of design and construction of the Honby Parallel from RVWTP to Sand Canyon Road. Project includes pipeline, reservoir, and pump station. Existing users pay a share of the cost of the storage facilities based on their share of demand. Future users pay the cost of pipeline, pump station, and their share of the storage facilities. Storage facilities cost shared by all sub-WSAs. Pipeline and pump station costs shared by sub-WSAs 88-23, 25, 26, 33 and 36.
Project 25 Honby & Newhall Parallel III (Newhall Parallel 2)	Cost of design and construction of the pipeline. Future users pay all costs. Pipeline cost shared by sub-WSAs 88-23, 25, 26, 33, and 36.
Project 26 System Appurtenances I (CC)	Cost associated with relocation of the Castaic Conduit. Project enhances capacity of treatment system. Future users pay the entire cost. Project cost shared by all sub-WSAs.
Project 27 System Appurtenances II (MWD Cap.)	Cost associated with capacity in MWD system to deliver SWP to CLWA. Future users pay the entire cost. Project cost shared by all sub-WSAs.
Project 28 Additional Water Supply IX (SWP peaking)	Cost associated with delivery systems to deliver SWP to CLWA. Future users pay the entire cost. Project cost shared by all sub-WSAs.
Water Treatment Projects Project 29 ESFP Ozone/Contact Clarifiers/Wash-water Treatment	Cost of design and construction of Earl Schmidt Water Treatment Plant water quality upgrades needed to meet Clean Water Act. Project cost is allocated to existing users.
Project 30 Earl Schmidt Expansion 56 MGD – 1 (Treatment)	Cost of design and construction for the expansion of ESFP from 25 to 56 MGD. Future users pay the entire cost of expansion. Project cost is shared by all sub-WSAs.
Project 31 Earl Schmidt Exp. 56 MGD II (Intake Pump)	Future users will pay the entire cost for pump station improvements required to expand ESFP from 25 to 56 MGD. Total project cost is shared by all sub-WSAs.
Project 32 Earl Schmidt Storage Improvements 56 MGD III (storage)	Cost of design and construction of improvements to storage facilities at the ESFP. Existing users pay a share of the cost of the storage facilities based on their share of imported water demand (36,839 AF existing users and 101,520 AF for all

Project	Description
	users 2050). Project cost is shared by all sub-WSAs.
Project 33 Rio Vista Exp. 60 MGD (Treatment)	Cost of design and construction of expansion of RVWTP from 30 MGD to 60 MGD. Future users pay entire cost of the treatment plant expansion. Project cost is shared by all sub-WSAs.
Project 34 Rio Vista Exp. 90 MGD (Treatment)	Cost of design and construction of expansion of RVWTP from 60 MGD to 90 MGD. Future users pay the entire cost of treatment plant expansion. Project cost shared by all sub-WSAs
Project 35 Rio Vista Exp. 90 MGD (Storage)	Cost of design and construction of additional storage capacity at the RVWTP. Existing users pay for a share of the cost of the storage facilities based on their share of imported demand (36,839 AF existing users and 101,520 AF for all users in 2050). Project cost is shared by all sub-WSAs.
Project 36 Rio Vista Exp. 120 MGD (Treatment)	Cost of design and construction of expansion of RVWTP from 90 MGD to 120 MGD. Future users pay the entire cost of treatment plant expansion. Project cost shared by all sub-WSAs.
Project 37 Rio Vista Exp. 130 MGD (Treatment)	Cost of design and construction of expansion of RVWTP from 120 MGD to 130 MGD. Future users pay the entire cost of treatment plant expansion. Project cost shared by all sub-WSAs.
Projects 38, 39 and 40 Water Quality Improvements I, II and III	Cost of Improvements to the existing water treatment plants to meet changes in the State Drinking Water Act. Existing users pay entire costs.

Castaic Lake Water Agency
FY03-04 Capital Improvement Program

	Project	Total Cost	Treatment/Storage/Supply		Pipeline	
	Water Supply Projects		Percent	Cost	Percent	Cost
1	Recycled Water - Phase IB	$4,547,000	100.00%	$4,547,000	0.00%	$0
2	Recycled Water - Phase II	$10,618,000	100.00%	$10,618,000	0.00%	$0
3	Recycled Water - Phase III	$9,072,000	100.00%	$9,072,000	0.00%	$0
4	Recycled Water - Phase IV	$12,809,000	100.00%	$12,809,000	0.00%	$0
5	Recycled Water - Phase V	$1,746,000	100.00%	$1,746,000	0.00%	$0
6	Recycled Water - Phase VI	$4,718,000	100.00%	$4,718,000	0.00%	$0
7	Recycled Water - Phase VII	$9,268,000	100.00%	$9,268,000	0.00%	$0
8	Recycled Water - Phase VIII	$5,453,000	100.00%	$5,453,000	0.00%	$0
9	Recycled Water - Phase IX	$1,804,000	100.00%	$1,804,000	0.00%	$0
10	Recycled Water - Phase X	$1,783,000	100.00%	$1,783,000	0.00%	$0
11	Recycled Water - Phase XI	$762,000	100.00%	$762,000	0.00%	$0
12	Recycled Water - ASR	$8,337,000	100.00%	$8,337,000	0.00%	$0
13	Recycled Water Environmental Studies	$515,000	100.00%	$515,000	0.00%	$0
14	Additional Supply Purchase (40,000 AFY)	$60,000,000	100.00%	$60,000,000	0.00%	$0
	Subtotal	**$131,432,000**		**$131,432,000**		**$0**
	Water Supply Banking Projects					
15	Water Supply Banking I	$17,366,000	100.00%	$17,366,000	0.00%	$0
16	Water Supply Banking II	$17,366,000	100.00%	$17,366,000	0.00%	$0
17	Water Supply Banking III	$17,366,000	100.00%	$17,366,000	0.00%	$0
18	Water Supply Banking IV	$17,366,000	100.00%	$17,366,000	0.00%	$0
19	Saugus Aquifer Wells 1 and 2	$2,745,000	100.00%	$2,745,000	0.00%	$0
20	Saugus Aquifer Wells 3 and 4	$2,745,000	100.00%	$2,745,000	0.00%	$0
	Subtotal	**$74,954,000**		**$74,954,000**		**$0**
	Pipeline/PS/Storage Projects					
21	Honby Extension & Storage II	$16,366,000	20.70%	$3,388,000	79.30%	$12,978,000
22	Lateral Extension (Pitchess)	$2,138,000	0.00%	$0	100.00%	$2,138,000
23	Lateral Extension & Storage II	$12,269,000	37.96%	$4,657,000	62.04%	$7,612,000
24	Honby & Newhall Parallel II (Honby Parallel)	$24,462,000	29.84%	$7,300,000	70.16%	$17,162,000
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	$2,719,000	0.00%	$0	100.00%	$2,719,000
26	System Appurtenances I (CC)	$6,559,000	0.00%	$0	100.00%	$6,559,000
27	System Appurtenances II (MWD Cap.)	$6,898,000	0.00%	$0	100.00%	$6,898,000
28	Additional Water Supply IX (SWP Peaking)	$5,490,000	0.00%	$0	100.00%	$5,490,000
	Subtotal	**$76,901,000**		**$15,345,000**		**$61,556,000**
	Water Treatment Projects					
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	$9,762,000	100.00%	$9,762,000	0.00%	$0
30	ESFP Exp. 56 MGD I (Treatment)	$9,084,000	100.00%	$9,084,000	0.00%	$0
31	ESFP Exp. 56 MGD II (Intake Pump)	$4,944,000	100.00%	$4,944,000	0.00%	$0
32	ESFP Exp. 56 MGD III (Storage)	$19,842,000	100.00%	$19,842,000	0.00%	$0
33	Rio Vista Exp. 60 MGD	$23,683,000	100.00%	$23,683,000	0.00%	$0
34	Rio Vista Exp. 90 MGD (Treatment)	$30,699,000	100.00%	$30,699,000	0.00%	$0
35	Rio Vista Exp. 90 MGD (Storage)	$9,173,000	100.00%	$9,173,000	0.00%	$0
36	Rio Vista Exp. 120 MGD	$22,438,000	100.00%	$22,438,000	0.00%	$0
37	Rio Vista Exp. 130 MGD	$11,500,000	100.00%	$11,500,000	0.00%	$0
38	Water Quality Improvements I	$8,365,000	100.00%	$8,365,000	0.00%	$0
39	Water Quality Improvements II	$11,309,000	100.00%	$11,309,000	0.00%	$0
40	Water Quality Improvements III	$11,309,000	100.00%	$11,309,000	0.00%	$0
	Subtotal	**$172,108,000**		**$172,108,000**		**$0**
	Total Capital Improvement Program Cost	**$455,395,000**	**86.48%**	**$393,839,000**	**13.52%**	**$61,556,000**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Existing vs Future Cost Allocation

			Existing Users Share of Costs		Future Users Share of Costs	
	Project	Project Cost (2003 $)	Percent	Cost (2003)	Percent	Cost
	Water Supply Projects					
1	Recycled Water - Phase IB	$4,547,000	38.76%	$1,763,000	61.24%	$2,784,000
2	Recycled Water - Phase II	$10,618,000	38.76%	$4,116,000	61.24%	$6,502,000
3	Recycled Water - Phase III	$9,072,000	38.76%	$3,517,000	61.24%	$5,555,000
4	Recycled Water - Phase IV	$12,809,000	38.76%	$4,965,000	61.24%	$7,844,000
5	Recycled Water - Phase V	$1,746,000	38.76%	$677,000	61.24%	$1,069,000
6	Recycled Water - Phase VI	$4,718,000	38.76%	$1,829,000	61.24%	$2,889,000
7	Recycled Water - Phase VII	$9,268,000	38.76%	$3,593,000	61.24%	$5,675,000
8	Recycled Water - Phase VIII	$5,453,000	38.76%	$2,114,000	61.24%	$3,339,000
9	Recycled Water - Phase IX	$1,804,000	38.76%	$699,000	61.24%	$1,105,000
10	Recycled Water - Phase X	$1,783,000	38.76%	$691,000	61.24%	$1,092,000
11	Recycled Water - Phase XI	$762,000	38.76%	$295,000	61.24%	$467,000
12	Recycled Water - ASR	$8,337,000	38.76%	$3,232,000	61.24%	$5,105,000
13	Recycled Water Environmental Studies	$515,000	38.76%	$200,000	61.24%	$315,000
14	Additional Supply Purchase (40,000 AFY)	$60,000,000	0.00%	$0	100.00%	$60,000,000
	Subtotal	**$131,432,000**	**21.07%**	**$27,691,000**	**78.93%**	**$103,741,000**
	Water Supply Banking Projects					
15	Water Supply Banking I	$17,366,000	36.29%	$6,302,000	63.71%	$11,064,000
16	Water Supply Banking II	$17,366,000	36.29%	$6,302,000	63.71%	$11,064,000
17	Water Supply Banking III	$17,366,000	36.29%	$6,302,000	63.71%	$11,064,000
18	Water Supply Banking IV	$17,366,000	36.29%	$6,302,000	63.71%	$11,064,000
19	Saugus Aquifer Wells 1 and 2	$2,745,000	36.29%	$996,000	63.71%	$1,749,000
20	Saugus Aquifer Wells 3 and 4	$2,745,000	36.29%	$996,000	63.71%	$1,749,000
	Subtotal	**$74,954,000**	**36.29%**	**$27,200,000**	**63.71%**	**$47,754,000**
	Pipeline/PS/Storage Projects					
21	Honby Extension & Storage II	$16,366,000	7.51%	$1,229,000	92.49%	$15,137,000
22	Lateral Extension (Pitchess)	$2,138,000	0.00%	$0	100.00%	$2,138,000
23	Lateral Extension & Storage II	$12,269,000	13.77%	$1,690,000	86.23%	$10,579,000
24	Honby & Newhall Parallel II (Honby Parallel)	$24,462,000	10.83%	$2,649,000	89.17%	$21,813,000
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	$2,719,000	0.00%	$0	100.00%	$2,719,000
26	System Appurtenances I (CC)	$6,559,000	0.00%	$0	100.00%	$6,559,000
27	System Appurtenances II (MWD Cap.)	$6,898,000	0.00%	$0	100.00%	$6,898,000
28	Additional Water Supply IX (SWP Peaking)	$5,490,000	0.00%	$0	100.00%	$5,490,000
	Subtotal	**$76,901,000**	**7.24%**	**$5,568,000**	**92.76%**	**$71,333,000**
	Water Treatment Projects					
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	$9,762,000	100.00%	$9,762,000	0.00%	$0
30	ESFP Exp. 56 MGD I (Treatment)	$9,084,000	0.00%	$0	100.00%	$9,084,000
31	ESFP Exp. 56 MGD II (Intake Pump)	$4,944,000	0.00%	$0	100.00%	$4,944,000
32	ESFP Exp. 56 MGD III (Storage)	$19,842,000	36.29%	$7,200,000	63.71%	$12,642,000
33	Rio Vista Exp. 60 MGD	$23,683,000	0.00%	$0	100.00%	$23,683,000
34	Rio Vista Exp. 90 MGD (Treatment)	$30,699,000	0.00%	$0	100.00%	$30,699,000
35	Rio Vista Exp. 90 MGD (Storage)	$9,173,000	36.29%	$3,329,000	63.71%	$5,844,000
36	Rio Vista Exp. 120 MGD	$22,438,000	0.00%	$0	100.00%	$22,438,000
37	Rio Vista Exp. 130 MGD	$11,500,000	0.00%	$0	100.00%	$11,500,000
38	Water Quality Improvements I	$8,365,000	100.00%	$8,365,000	0.00%	$0
39	Water Quality Improvements II	$11,309,000	100.00%	$11,309,000	0.00%	$0
40	Water Quality Improvements III	$11,309,000	100.00%	$11,309,000	0.00%	$0
	Subtotal	**$172,108,000**	**29.79%**	**$51,274,000**	**70.21%**	**$120,834,000**
	Total Capital Improvement Program Cost	**$455,395,000**	**24.54%**	**$111,733,000**	**75.46%**	**$343,662,000**
	Existing Total Water Demand - 2003 (AFY)	65,491				
	Future Total Water Demand - 2050 (AFY)	168,950				
	Share Existing (total)	38.76%				
	Share Future (total)	61.24%				
	Existing Imported Demand (AFY)	36,839				
	Future Imported Demand (AFY)	101,520				
	Share Existing (imported)	36.29%				
	Share Future (imported)	63.71%				
	Water Banking Allocation:					
	Existing Users Requirements (AFY	36,839				
	Future Users Requirements (AFY	101,520				
	Existing Users allocatior	36.29%				
	Future Users allocatior	63.71%				

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2004	2005	2006	2007	2008	2009
	Water Supply Projects											
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004	$2,784,000					
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006	$1,950,600	$1,950,600	$2,600,800			
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007		$1,666,500	$1,666,500	$2,222,000		
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008			$2,353,200	$2,353,200	$3,137,600	
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009				$320,700	$320,700	$427,600
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010					$866,700	$866,700
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011						$1,702,500
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012						
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013						
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014						
11	Recycled Water - Phase XI	Water Supply	61.24%	$762,000	$467,000	2014						
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005	$2,297,250	$2,807,750				
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004	$315,000					
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032						
	Subtotal			**$131,432,000**	**$103,741,000**		**$7,346,850**	**$6,424,950**	**$6,620,500**	**$4,896,900**	**$4,325,000**	**$2,996,800**
	Water Supply Banking Projects											
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004	$11,064,000					
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014						
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022						
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028						
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004	$1,749,000					
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004	$1,749,000					
	Subtotal			**$74,954,000**	**$47,754,000**		**$14,562,000**	**$0**	**$0**	**$0**	**$0**	**$0**
	Pipeline/PS/Storage Projects											
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005	$7,568,500	$7,568,500				
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004	$2,138,000					
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005	$3,173,700	$7,405,300				
24	Honby & Newhall Parallel II (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017						
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005	$815,700	$1,903,300				
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005	$1,967,700	$4,591,300				
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035						
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010						
	Subtotal			**$76,901,000**	**$71,333,000**		**$15,663,600**	**$21,468,400**	**$0**	**$0**	**$0**	**$0**
	Water Treatment Projects											
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006	$0	$0	$0			
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006	$2,725,200	$2,725,200	$3,633,600			
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006	$1,483,200	$1,483,200	$1,977,600			
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006	$3,792,600	$3,792,600	$5,056,800			
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010					$4,736,600	$7,104,900
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026						
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026						
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040						
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048						
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009				$0	$0	$0
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010					$0	$0
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015						
	Subtotal			**$172,106,000**	**$120,834,000**		**$8,001,000**	**$8,001,000**	**$10,668,000**	**$0**	**$4,736,600**	**$7,104,900**
	Total Capital Improvement Program Cost			**$455,395,000**	**$343,662,000**		**$45,573,450**	**$35,894,250**	**$17,288,500**	**$4,896,900**	**$9,061,600**	**$10,101,700**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2010	2011	2012	2013	2014	2015
	Water Supply Projects											
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004						
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006						
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007						
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008						
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009						
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010	$1,155,600					
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011	$1,702,500	$2,270,000				
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012	$1,001,700	$1,001,700	$1,335,600			
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013		$331,500	$331,500	$442,000		
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014			$327,600	$327,600	$436,800	
11	Recycled Water - Phase XI	Water Supply	61.24%	$762,000	$467,000	2014			$140,100	$140,100	$186,800	
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005						
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004						
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032						
	Subtotal			**$131,432,000**	**$103,741,000**		**$3,859,800**	**$3,603,200**	**$2,134,800**	**$909,700**	**$623,600**	**$0**
	Water Supply Banking Projects											
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004						
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014					$11,064,000	
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022						
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028						
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
	Subtotal			**$74,954,000**	**$47,754,000**		**$0**	**$0**	**$0**	**$0**	**$11,064,000**	**$0**
	Pipeline/PS/Storage Projects											
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005						
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004						
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005						
24	Honby & Newhall Parallel II (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017						$4,362,600
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005						
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005						
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035						
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010	$5,490,000					
	Subtotal			**$76,901,000**	**$71,333,000**		**$5,490,000**	**$0**	**$0**	**$0**	**$0**	**$4,362,600**
	Water Treatment Projects											
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006						
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006						
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006						
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006						
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010	$11,841,500					
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026						
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026						
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040						
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048						
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009						
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010	$0					
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015				$0	$0	$0
	Subtotal			**$172,108,000**	**$120,834,000**		**$11,841,500**	**$0**	**$0**	**$0**	**$0**	**$0**
	Total Capital Improvement Program Cost			**$455,395,000**	**$343,662,000**		**$21,191,300**	**$3,603,200**	**$2,134,800**	**$909,700**	**$11,687,600**	**$4,362,600**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2016	2017	2018	2019	2020	2021	2022
	Water Supply Projects												
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004							
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006							
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007							
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008							
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009							
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010							
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011							
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012							
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013							
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014							
11	Recycled Water - Phase Xi	Water Supply	61.24%	$762,000	$467,000	2014							
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005							
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004							
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032							
	Subtotal			**$131,432,000**	**$103,741,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Supply Banking Projects												
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004							
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014							
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022							$11,064,000
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028							
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004							
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004							
	Subtotal			**$74,954,000**	**$47,754,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$11,064,000**
	Pipeline/PS/Storage Projects												
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005							
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004							
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005							
24	Honby & Newhall Parallel Ii (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017	$6,543,900	$10,906,500					
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005							
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005							
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035							
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010							
	Subtotal			**$76,901,000**	**$71,333,000**		**$6,543,900**	**$10,906,500**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Treatment Projects												
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006							
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006							
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006							
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006							
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010							
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026							
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026							
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040							
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048							
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009							
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010							
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015							
	Subtotal			**$172,108,000**	**$120,834,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Total Capital Improvement Program Cost			**$465,395,000**	**$343,662,000**		**$6,543,900**	**$10,906,500**	**$0**	**$0**	**$0**	**$0**	**$11,064,000**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2023	2024	2025	2026	2027	2028
	Water Supply Projects											
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004						
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006						
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007						
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008						
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009						
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010						
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011						
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012						
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013						
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014						
11	Recycled Water - Phase XI	Water Supply	61.24%	$762,000	$467,000	2014						
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005						
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004						
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032						
	Subtotal			**$131,432,000**	**$103,741,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Supply Banking Projects											
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004						
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014						
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022						
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028						$11,064,000
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
	Subtotal			**$74,964,000**	**$47,754,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$11,064,000**
	Pipeline/PS/Storage Projects											
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005						
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004						
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005						
24	Honby & Newhall Parallel II (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017						
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005						
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005						
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035						
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010						
	Subtotal			**$76,901,000**	**$71,333,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Treatment Projects											
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006						
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006						
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006						
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006						
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010						
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026		$6,139,800	$9,209,700	$15,349,500		
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026		$1,168,800	$1,753,200	$2,922,000		
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040						
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048						
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009						
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010						
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015						
	Subtotal			**$172,108,000**	**$120,834,000**		**$0**	**$7,308,600**	**$10,962,900**	**$18,271,500**	**$0**	**$0**
	Total Capital Improvement Program Cost			**$455,396,000**	**$343,662,000**		**$0**	**$7,308,600**	**$10,962,900**	**$18,271,500**	**$0**	**$11,064,000**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2029	2030	2031	2032	2033	2034
	Water Supply Projects											
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004						
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006						
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007						
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008						
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009						
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010						
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011						
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012						
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013						
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014						
11	Recycled Water - Phase XI	Water Supply	61.24%	$762,000	$467,000	2014						
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005						
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004						
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032				$60,000,000		
	Subtotal			**$131,432,000**	**$103,741,000**		**$0**	**$0**	**$0**	**$60,000,000**	**$0**	**$0**
	Water Supply Banking Projects											
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004						
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014						
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022						
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028						
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
	Subtotal			**$74,954,000**	**$47,754,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Pipeline/PS/Storage Projects											
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005						
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004						
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005						
24	Honby & Newhall Parallel II (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017						
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005						
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005						
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035						
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010						
	Subtotal			**$76,901,000**	**$71,333,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Treatment Projects											
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006						
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006						
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006						
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006						
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010						
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026						
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026						
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040						
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048						
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009						
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010						
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015						
	Subtotal			**$172,108,000**	**$120,834,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Total Capital Improvement Program Cost			**$455,395,000**	**$343,662,000**		**$0**	**$0**	**$0**	**$60,000,000**	**$0**	**$0**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2035	2036	2037	2038	2039	2040
	Water Supply Projects											
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004						
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006						
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007						
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008						
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009						
6	Recycled Water - Phase VI	Water Supply	61.24%	$4,718,000	$2,889,000	2010						
7	Recycled Water - Phase VII	Water Supply	61.24%	$9,268,000	$5,675,000	2011						
8	Recycled Water - Phase VIII	Water Supply	61.24%	$5,453,000	$3,339,000	2012						
9	Recycled Water - Phase IX	Water Supply	61.24%	$1,804,000	$1,105,000	2013						
10	Recycled Water - Phase X	Water Supply	61.24%	$1,783,000	$1,092,000	2014						
11	Recycled Water - Phase XI	Water Supply	61.24%	$762,000	$467,000	2014						
12	Recycled Water - ASR	Water Supply	61.24%	$8,337,000	$5,105,000	2005						
13	Recycled Water Environmental Studies	Water Supply	61.24%	$515,000	$315,000	2004						
14	Additional Supply Purchase (40,000 AFY)	Water Supply	100.00%	$60,000,000	$60,000,000	2032						
	Subtotal			**$131,432,000**	**$103,741,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Supply Banking Projects											
15	Water Supply Banking I	Water Supply	63.71%	$17,366,000	$11,064,000	2004						
16	Water Supply Banking II	Water Supply	63.71%	$17,366,000	$11,064,000	2014						
17	Water Supply Banking III	Water Supply	63.71%	$17,366,000	$11,064,000	2022						
18	Water Supply Banking IV	Water Supply	63.71%	$17,366,000	$11,064,000	2028						
19	Saugus Aquifer Wells 1 and 2	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
20	Saugus Aquifer Wells 3 and 4	Water Supply	63.71%	$2,745,000	$1,749,000	2004						
	Subtotal			**$74,954,000**	**$47,754,000**		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Pipeline/PS/Storage Projects											
21	Honby Extension & Storage II	Pipeline/PS/Storage	92.49%	$16,366,000	$15,137,000	2005						
22	Lateral Extension (Pitchess)	Pipeline	100.00%	$2,138,000	$2,138,000	2004						
23	Lateral Extension & Storage II	Pipeline/Storage	86.23%	$12,269,000	$10,579,000	2005						
24	Honby & Newhall Parallel II (Honby Parallel)	Pipeline/PS/Storage	89.17%	$24,462,000	$21,813,000	2017						
25	Honby & Newhall Parallel III (Newhall Parallel Ph 2)	Pipeline	100.00%	$2,719,000	$2,719,000	2005						
26	System Appurtenances I (CC)	Pipeline	100.00%	$6,559,000	$6,559,000	2005						
27	System Appurtenances II (MWD Cap.)	Pipeline	100.00%	$6,898,000	$6,898,000	2035	$6,898,000					
28	Additional Water Supply IX (SWP Peaking)	Pipeline	100.00%	$5,490,000	$5,490,000	2010						
	Subtotal			**$76,901,000**	**$71,333,000**		**$6,898,000**	**$0**	**$0**	**$0**	**$0**	**$0**
	Water Treatment Projects											
29	ESFP Ozone/Contact Clarifiers/Washwater Treatment	Water Treatment	0.00%	$9,762,000	$0	2006						
30	ESFP Exp. 56 MGD I (Treatment)	Water Treatment	100.00%	$9,084,000	$9,084,000	2006						
31	ESFP Exp. 56 MGD II (Intake Pump)	Water Treatment	100.00%	$4,944,000	$4,944,000	2006						
32	ESFP Exp. 56 MGD III (Storage)	Water Treatment	63.71%	$19,842,000	$12,642,000	2006						
33	Rio Vista Exp. 60 MGD	Water Treatment	100.00%	$23,683,000	$23,683,000	2010						
34	Rio Vista Exp. 90 MGD (Treatment)	Water Treatment	100.00%	$30,699,000	$30,699,000	2026						
35	Rio Vista Exp. 90 MGD (Storage)	Water Treatment	63.71%	$9,173,000	$5,844,000	2026						
36	Rio Vista Exp. 120 MGD	Water Treatment	100.00%	$22,438,000	$22,438,000	2040				$4,487,600	$6,731,400	$11,219,000
37	Rio Vista Exp. 130 MGD	Water Treatment	100.00%	$11,500,000	$11,500,000	2048						
38	Water Quality Improvements I	Water Treatment	0.00%	$8,365,000	$0	2009						
39	Water Quality Improvements II	Water Treatment	0.00%	$11,309,000	$0	2010						
40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015						
	Subtotal			**$172,108,000**	**$120,834,000**		**$0**	**$0**	**$0**	**$4,487,600**	**$6,731,400**	**$11,219,000**
	Total Capital Improvement Program Cost			**$455,395,000**	**$343,662,000**		**$6,898,000**	**$0**	**$0**	**$4,487,600**	**$6,731,400**	**$11,219,000**

Castaic Lake Water Agency
FY03-04 Capital Improvement Program
Program Schedule

	Project	Project Type	Growth Portion	Total Cost	Growth Portion of Cost	Fiscal Year Required	2048	2049	2050	Totals
	Water Supply Projects									
1	Recycled Water - Phase IB	Water Supply	61.24%	$4,547,000	$2,784,000	2004				$2,784,000
2	Recycled Water - Phase II	Water Supply	61.24%	$10,618,000	$6,502,000	2006				$6,502,000
3	Recycled Water - Phase III	Water Supply	61.24%	$9,072,000	$5,555,000	2007				$5,555,000
4	Recycled Water - Phase IV	Water Supply	61.24%	$12,809,000	$7,844,000	2008				$7,844,000
5	Recycled Water - Phase V	Water Supply	61.24%	$1,746,000	$1,069,000	2009				$1,069,000
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40	Water Quality Improvements III	Water Treatment	0.00%	$11,309,000	$0	2015				$0
	Subtotal			**$172,108,000**	**$120,834,000**		**$5,750,000**	**$0**	**$0**	**$120,834,000**
	Total Capital Improvement Program Cost			**$455,395,000**	**$343,662,000**		**$5,750,000**	**$0**	**$0**	**$343,662,000**

CASTAIC LAKE WATER AGENCY
FACILITY CAPACITY FEE
FINANCIAL MODEL

OVERVIEW

Purpose

This paper provides an explanation of how Castaic Lake Water Agency (CLWA) has developed its facility capacity fee financial model and how the fees will be used to partially pay for the Capital Improvement Program (CIP) and/or any debt incurred attributable to it. The explanation includes a description of how the factors used to calculate the facility capacity fees are derived and the basis for the assumptions used.

Long-term accurate predictions of the future are difficult, if not impossible, to make. Therefore, good financial health requires a periodic review of the fees to ensure timely response to changing conditions.

The final product of this model is an annual update of the Agency's Facility Capacity Fee (Fee) for each of its water service areas (WSAs).

Projection of Future Water Demand

The need for Capital Facilities is driven by the projected demand for water. Projected water demand has been determined, for purposes of planning capital facilities development, from a parcel database generated by the Agency using County assessor use codes. These codes reflect the uses that are currently permitted for each parcel under the planning agency's current zoning ordinances. This database is on file with the Agency. The use codes are assigned a water demand recognizing that in many cases the use code permits a range of uses and thus a range of water demand. The projected demand of all of the parcels based upon their authorized uses is determined and accumulated to derive projected future demand.

Most of the vacant land is zoned for a particular land use by one of three local planning agencies: the County of Los Angeles, County of Ventura or the City of Santa Clarita. CLWA's water demand model (including both current and future consumption) uses the

Agency's database of all vacant and improved land within its service area. All county assessor parcels within the Agency's boundaries are contained in this database. A description of many planning attributes of each parcel is maintained by the County and the City of Santa Clarita on a parcel-by-parcel basis and continually updated. The Agency's database is periodically adjusted by matching the actual water delivered by the purveyors to the parcels in the database. This information is then extrapolated to the remaining vacant parcels. This provides the Agency with an estimate of the ultimate demand based on the currently authorized land uses. Each year the process is repeated as land is developed or the use changes, giving the Agency a better indication of water demand. Because the location and nature of development depends upon many factors, water demand can change in location, timing, or quantity.

The next step is to project when these demands will materialize. With the help of the purveyors, who provide historical data, and LA County Department of Regional Planning, which supplies growth projections into the future, the time of the demand is then estimated. It is recognized that the timing projections are merely best estimates based upon data available at the time. Actual water demand may change as a result of changes in the economic climate, for example, interest rates, general economy, etc. The projection of the timing of future demand determines when various elements of the CIP will need to be commenced in order to have capacity available in time to meet demand.

The timing is critical in that early construction results in increased borrowing which in turn increases interest costs. Early construction results in lower inflated project costs as a partial offset. If facilities are not commenced at the appropriate time capacity may be unavailable at the time needed by development, with the resulting delays and costs to private entities.

Water Services Areas

This section discusses how WSAs and sub-WSAs are used in capital planning and long-range financial planning.

For each land use type, there is a range of water demand factors related to development and use of that land. Specific demand factors for each sub-WSA are developed based on

historical water use. These demand factors are applied to the vacant parcel information in the database to yield potential water demand within the Agency service area.

Development plans and other available planning documents are reviewed to determine a potential growth rate. This growth rate is merged with water demand to produce an incremental increase in total water demand over any given planning horizon for the Agency service area.

A model of the available groundwater in each sub-WSA has been developed based on purveyor information and is contained in a report entitled "2000 Urban Water Management Plan", which is on file with the Agency. The available groundwater is subtracted from total water demand to yield the requirement for imported water.

Capital Facilities

The imported water demands are then translated into Capital Facility requirements. For compliance with the Agency Act, this particular activity is conducted on a water service area basis. The capital facility requirements are estimated in a manner which considers the amount of local water that is available, the anticipated demand for imported water, and the facilities required to treat and convey imported water to service those demands. The Capital Improvement Program, prepared by Kennedy Jenks, details the facilities planned to meet future demand. The Engineering News Record Index is used in projecting the inflationary pressures on utility construction costs for facilities the construction of which is expected to be done many years in the future.

Existing versus Future Needs

The Capital Improvement Program is then further examined to determine what portion of the CIP is necessary to accommodate existing service demand versus that which is necessary to accommodate future demands. The allocation is set forth in the body of the data document. The legal basis for the Facility Capacity Fee is that it can be attributed only to those facilities that are required to serve new users. Thus, that portion of the Capital Program attributable to existing users is removed to produce capital requirements for future users only, which provides the basis for the fees.

Board Policy

In developing the Facility Capacity Fee Program, the Board established policies with regard to the sources of revenue to fund the Capital Program. Facility capacity for **future growth** (future users' share of the CIP) are funded as follows:

—A portion of 1% property tax

—Standby charges, if levied

—Interest on investments

—Capital Facility Fees

That portion of the Capital Program attributable to **existing users** is funded by:

—A portion of 1% property tax

—Standby charges, if levied

—Interest on investments

—A portion of water sales attributable to the Capital Program

—Existing ad valorem tax in excess of the 1% basic levy, which is authorized to pay the State Water Project liability of the Agency.

Basic Structure of the Model as it Relates to the Formation of the Agency's Water Service Areas

For the purposes of developing the CIP and assigning rates and charges on a cost of service approach, the Agency developed 26 sub-water service areas ("Sub-WSAs") which are aggregated into 8 water service areas ("WSAs"). (See Figure 1.) The WSAs are required by the Agency's Act, and are recorded with the State Board of Equalization as well as the County of Los Angeles. This enables the Agency to levy different water rates, standby charges, tax rates, and capital facility fees by WSA. This is a special power authorized by the Agency's Act in an effort to accommodate a rapidly growing Agency in a developing area. The cost of service approach aptly reflects the needs of the area.

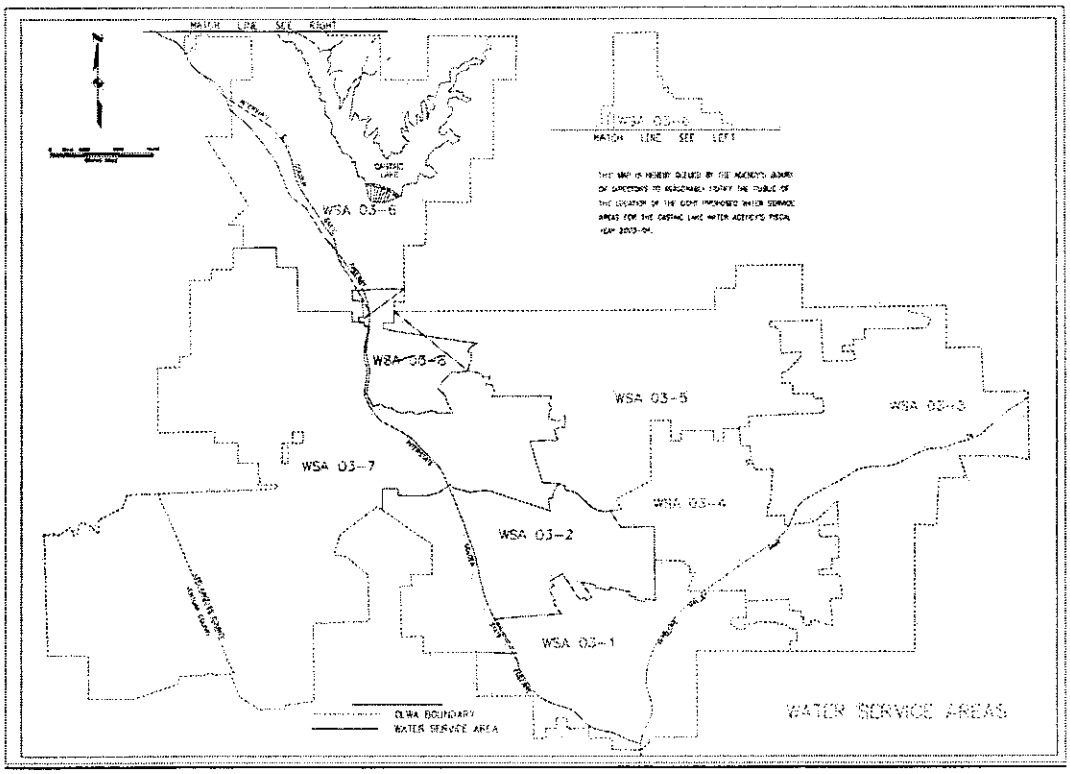


Figure 1
Water Service Area Map

Specific Benefit to WSA

The Agency's financing authority is based on a benefit assessment theory, which means that there must be an appropriate nexus between the amount of the charge and the cost of providing the benefit within each of the WSAs. The Agency Act allows the Board of Directors the flexibility to develop two or more WSAs. When the Agency was first divided into WSAs, there were four WSAs. Later, it was decided that eight would be more appropriate. Another important element is that each WSA can have its own unique set of charges, though the law does not require that the charges be different.

Agency-Wide Benefit

The Agency's CIP allocated to each WSA is based upon Board policy as follows: the cost attributable to acquire, treat and store water is considered an Agency-wide benefit, because the water is available for use in any WSA. Thus, the Fee that is derived from the calculation of these costs is applied uniformly across the entire Agency service area.

Water Service Area Specific Benefit

The transmission of the water to the various WSAs is considered to be a WSA-specific benefit. Thus, a cost of service approach is used that takes into consideration pipeline length, diameter, and other engineering parameters. The capital projects are apportioned to each of the water service areas in proportion to these mathematical relationships and then translated into a Fee for pipelines. This Fee is then aggregated with the treatment, storage, and water purchases component to create the total Facility Capacity Fee for each WSA.

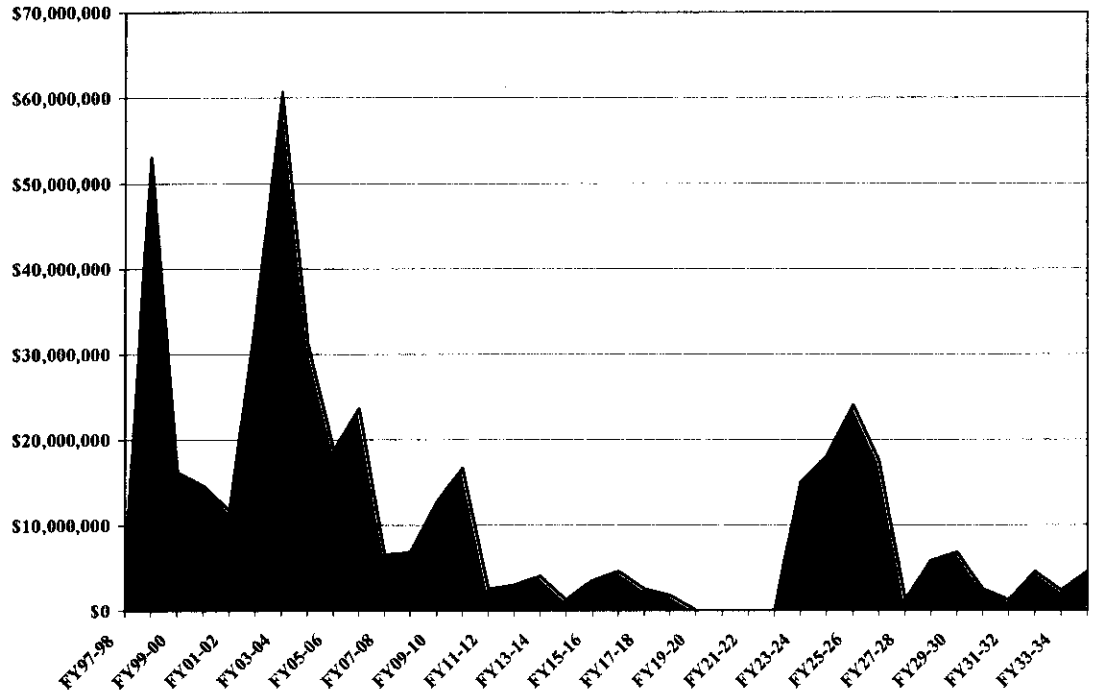
Capital Project Scheduling

The design and later construction of capital facilities are commenced approximately five years ahead of need to ensure that shortages do not occur. The rate of demand for water varies each year. While growth may be relatively small in one year, it gradually accumulates. For practical purposes, water facilities cannot be built in small increments; pipelines come in standard sizes, and it does not make economic sense to construct many parallel small pipes to respond to growing demands when one large pipeline can be planned in advance.

Therefore, Agency engineers are required to make estimates of the reasonable capacities required for the water user areas and to design pipelines appropriately. On the other hand, treatment, storage, and water supply can be more economically added by incremental units, though even these units must also be economically sized. For treatment purposes, expansion of existing treatment facilities according to staged facility enlargement plans is reasonable. Capital expenditures for the facilities projected in the CIP will take place over more than thirty (30) years, as shown in Figure 2. The expenditures under the CIP, however, are not uniformly spread; there may be years with little or no design/construction activity and then several years of intense capital outlay requirements.

Figure 2
Sample Capital Improvement Program

FACILITY CAPACITY FEE MODEL

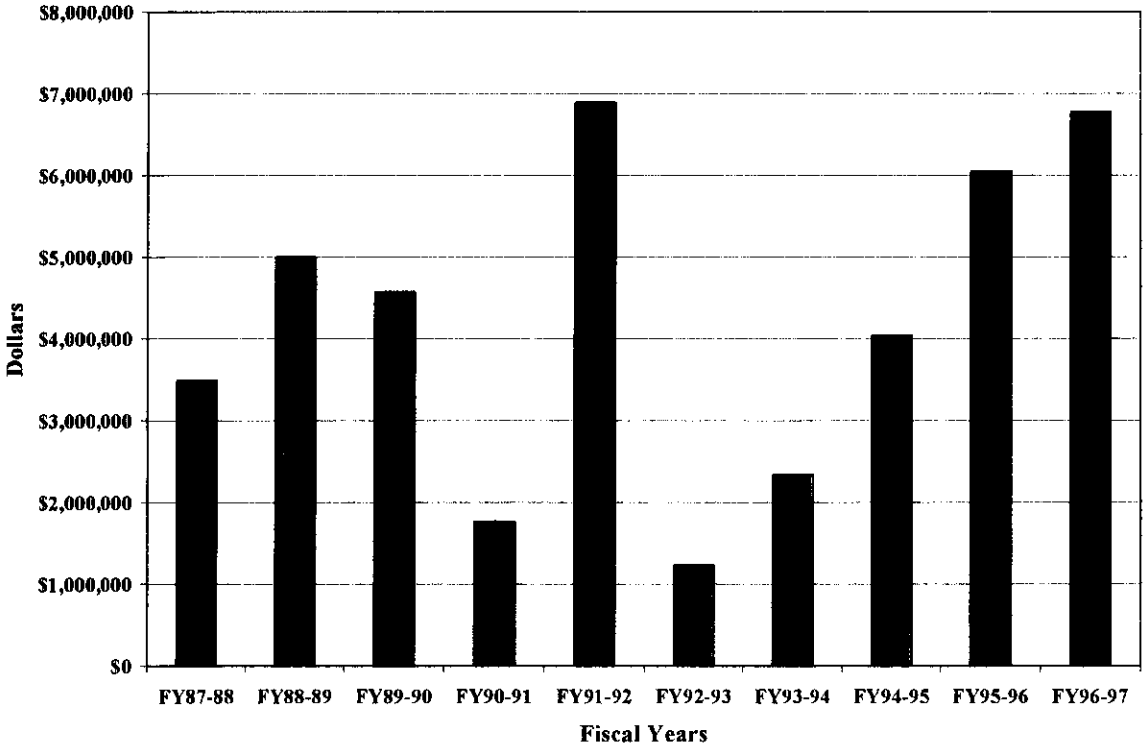


Without a systematic approach, the CIP would result in dramatic swings in fees. This would not be fair or equitable. As a result, a system was developed that recognizes the growth of the water demand compared to the requirements for capital facilities which are built in a less regular manner. Since many of the facilities are large and must be built prior to need, funds will likely not be available when needed to build these facilities. Thus, cash flow projections are developed which identify borrowing requirements and timing. With the cash outflow estimated, the next step is to consider sources of cash to offset the expense. These sources are 1% tax monies, standby charges, interest on investments, and Facility Capacity Fees.

Note that the flow of revenues is not always smooth. In recent years, 1% property tax funds have been relatively stable. However, facility capacity fees, which are a primary source of revenue for construction of facilities under the CIP, vary dramatically as the economy changes, as shown in Figure 3. The capacity fee model has to consider the above parameters

and translate them into a Fee that has a consistent long-term growth trend based upon known facts in order to avoid large changes on a year-to-year basis.

Figure 3
Facility Capacity Fee Collection History



Model Logic

The model is designed in such a way that it considers the cash demands on a year-by-year basis, and then accounts for anticipated revenues on a year-to-year basis as depicted in Figure 4. Note that there are wide discrepancies in the cash flow. Thus, it is necessary for the model to analyze how much money will be needed to cover the cumulative effect of all expenses during the study period (Figure 5). (The numbers used in Figures 4 and 5 are for illustration purposes only). Of course, cumulative revenue has to equal the cumulative expense amount although the expenses and the revenues may not match each other year by year (Figure 4). The model goes through repeated iterations to achieve the balance of cumulative revenue and expense.

Figure 4
Sample Cash Flow of Facility Capacity Fee Revenue v. Expense

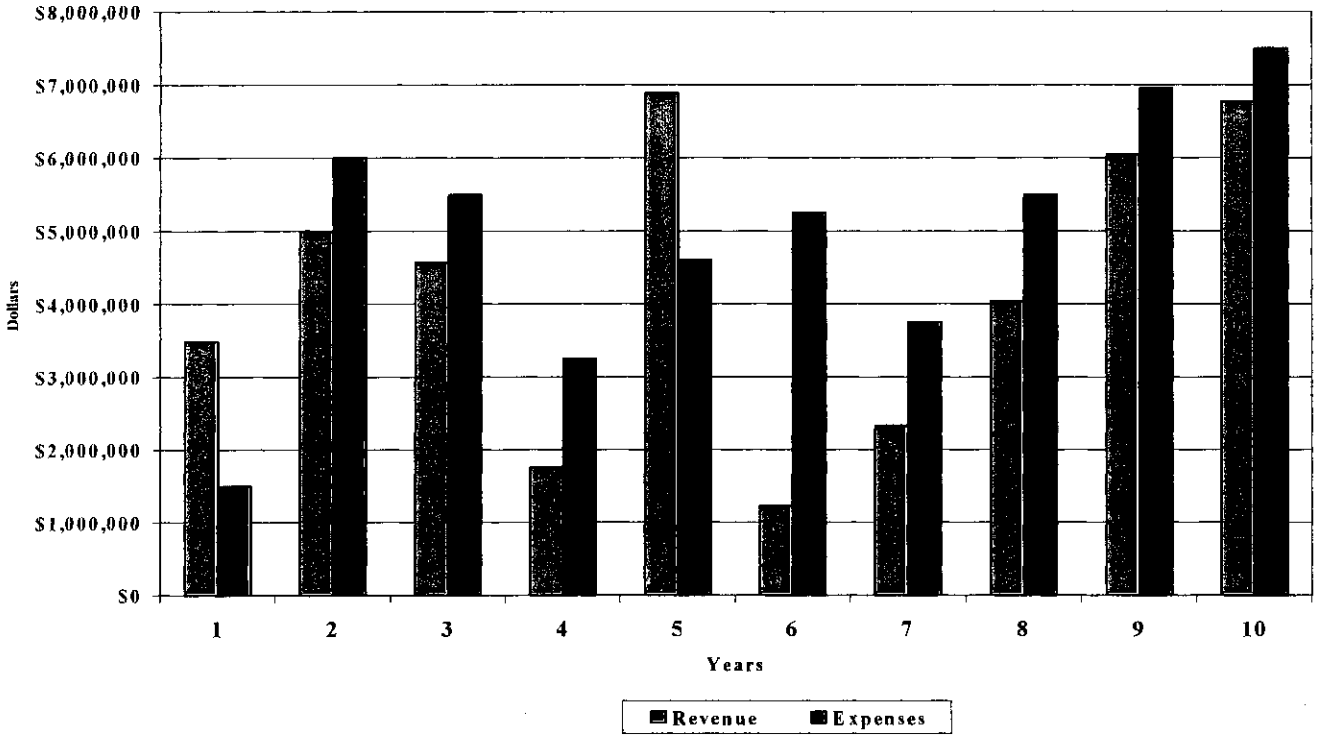
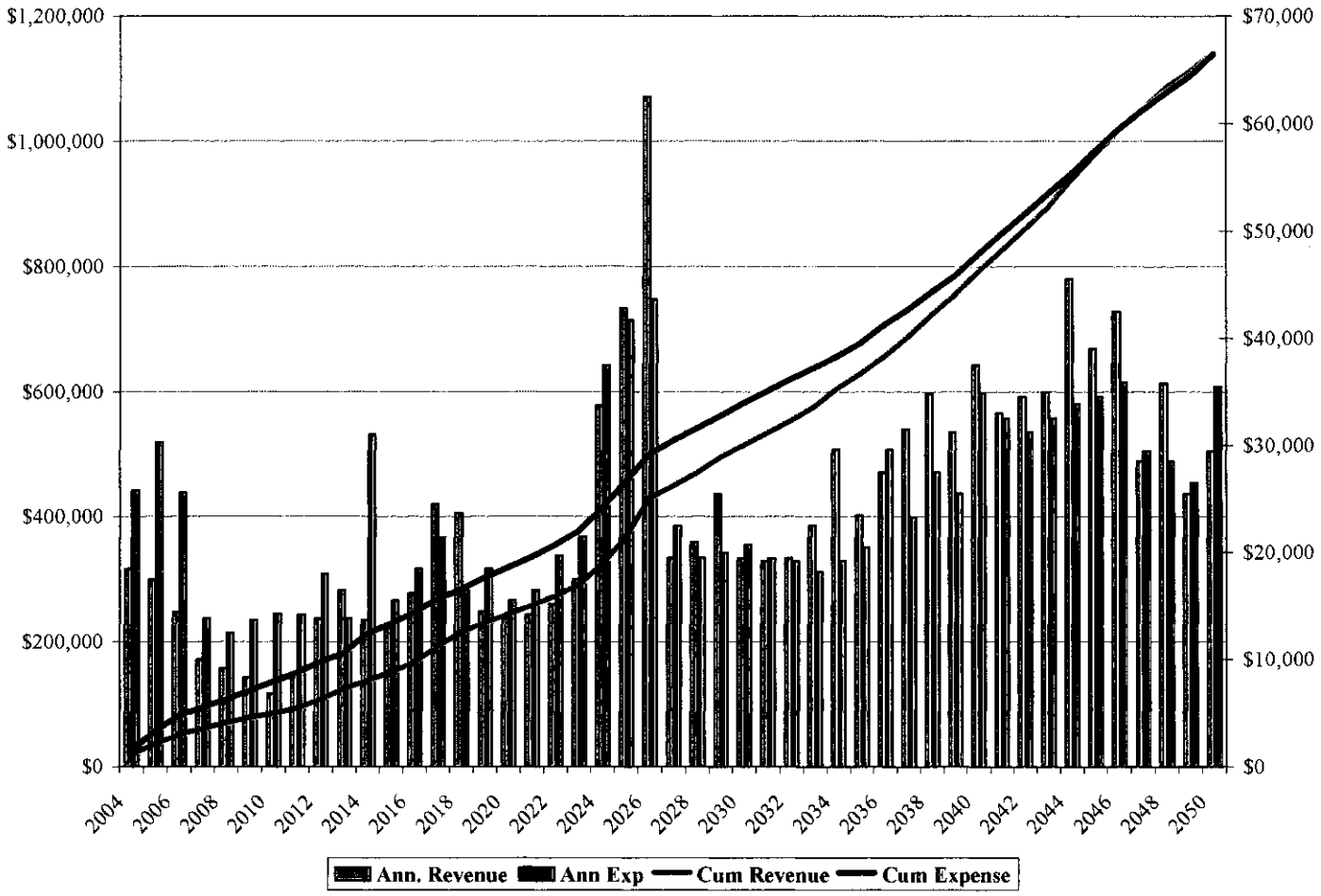


Figure 5
Example of Cumulative Revenue & Expenses



Variables/Assumptions

General

Although conceptually straightforward, the Fee calculation is mathematically complex. There are countless permutations and combinations that enter into the calculation. However, in order to obtain valid results, certain basic assumptions are made. These assumptions are examined each year to determine if they are still appropriate. The model contains many variables. For example, if the expenditures accelerate, the borrowings must be accelerated, which could mean an increase in interest cost, which adds to total costs. On the other hand, this can be offset by an increase in cash flow from the sale of Facility

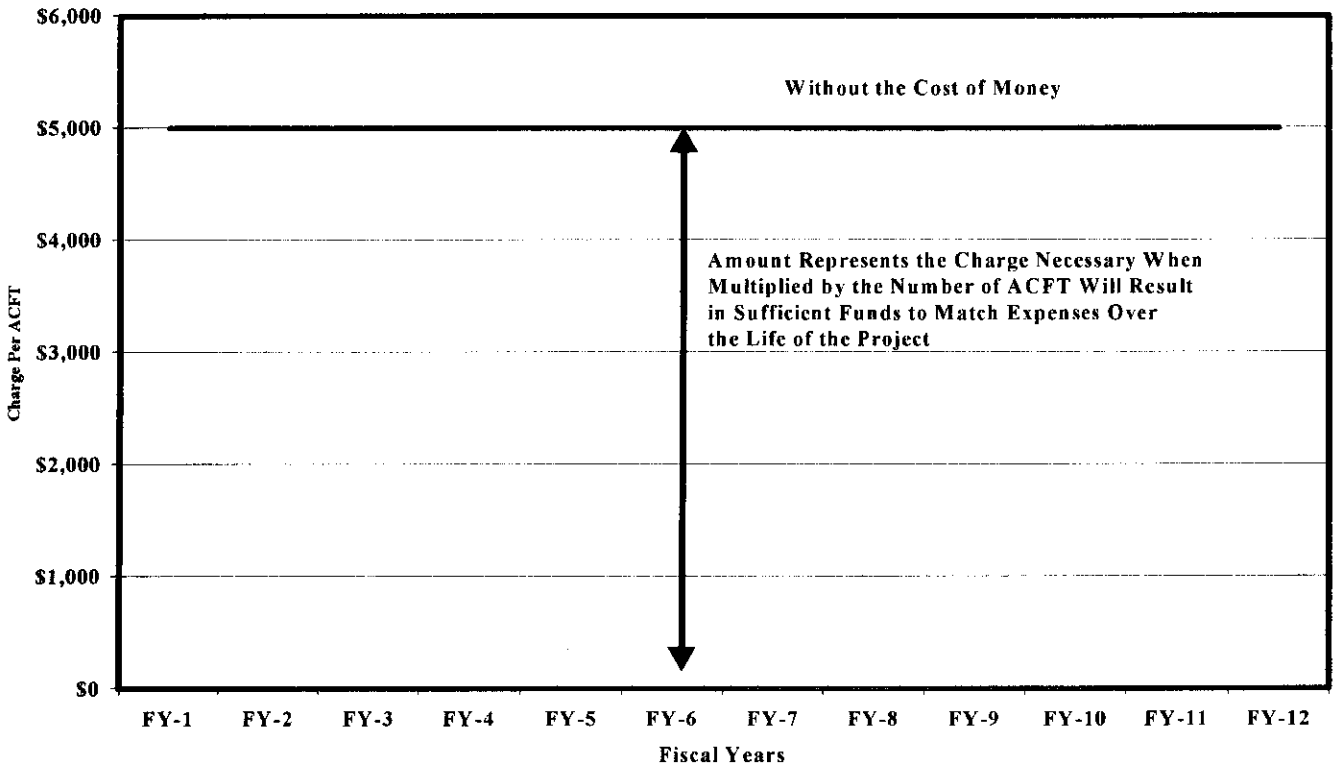
Capacity Fees and other revenue sources. This process is done on an annual basis, allowing minor adjustments and thus avoiding any abrupt changes and shortfalls in revenue. The key elements of the model are described below:

Inflation

Another major factor that is taken into consideration is the value of a dollar over time. Obviously, a dollar today is not a dollar 50 years hence. Thus, it is necessary to take into consideration the general economy or the CPI. This number is used in the model to recognize that a Fee paid today is different in value than a fee paid in 2030. Thus, it is necessary to reduce the fees in the near term recognizing that they are worth more having been paid in the early years.

Assuming no inflation and that a dollar today is worth a dollar in the future, all that would be required is a flat rate to accumulate the cash requirement as depicted in Figure 6.

Figure 6
Example of Flat Fee



Note that the connection fee rate is a horizontal line. The distance above the X-axis is sufficient so that when multiplied by the anticipated growth in sales, that volume of cash

flow will equal the volume of cash expenditures. However, costs are subject to inflation, cost of borrowing, and a CIP schedule that may vary. Thus, cash needs can dramatically change depending upon the assumptions.

Interest Income and Expense of Borrowing

The assumed interest cost for borrowing is based on the 3-year Treasury interest rate less 50 basis points, or 6.49%. The Agency invests in relatively short-term taxable paper and borrows at long-term tax-exempt rates. Since it is practically impossible to predict over 50 years what the interest rates will do the Agency determined that a prudent approach would be to use the three-year treasury rate as a guide. This approach recognizes that there are times when the Agency will earn more on interest than it pays for debt and others when it will earn less than it pays (as is the current situation). The interest cost for borrowing is based on a three-year Treasury rate less 50 basis points to approximate a high-grade tax-exempt municipal bond rate. The Agency borrows approximately every 3 to 5 years an amount expected to meet the Agency's capital needs as scheduled by the engineers.

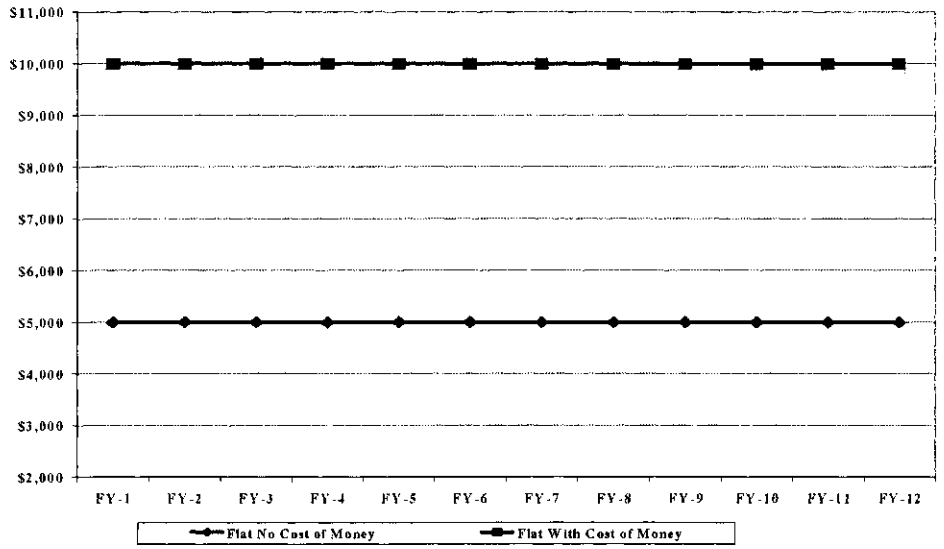
Good planning requires that capacity be available in time to meet expected demand. Since the lead time necessary to construct facilities requires that construction be commenced before fees are collected from the prospective development it is necessary for the Agency to borrow money necessary to construct facilities and then recover the cost from the Facility Capacity Fee. Interest on unspent funds is based on the current 3-year Treasury interest rate less 100 basis points, or 5.99%, to insure that the model assumes that interest earnings will be lower than borrowing costs.

It was determined that since public agencies invest over short periods of time and borrow over longer periods it was prudent to be conservative in the application of interest rates for borrowing as well as earnings. For that reason, the average interest paid and earned by the Agency was adjusted by 100 basis points to derive an interest rate to be used for calculation.

When the cost of money is added, the charge has to escalate each year to take this into account. If there is a shift in the CIP, this could result in greater or lesser cash requirements. It may also require an adjustment in the amplitude of the line, but may not necessarily change the slope, as depicted in Figure 7. If there is an unusual influx of cash in certain

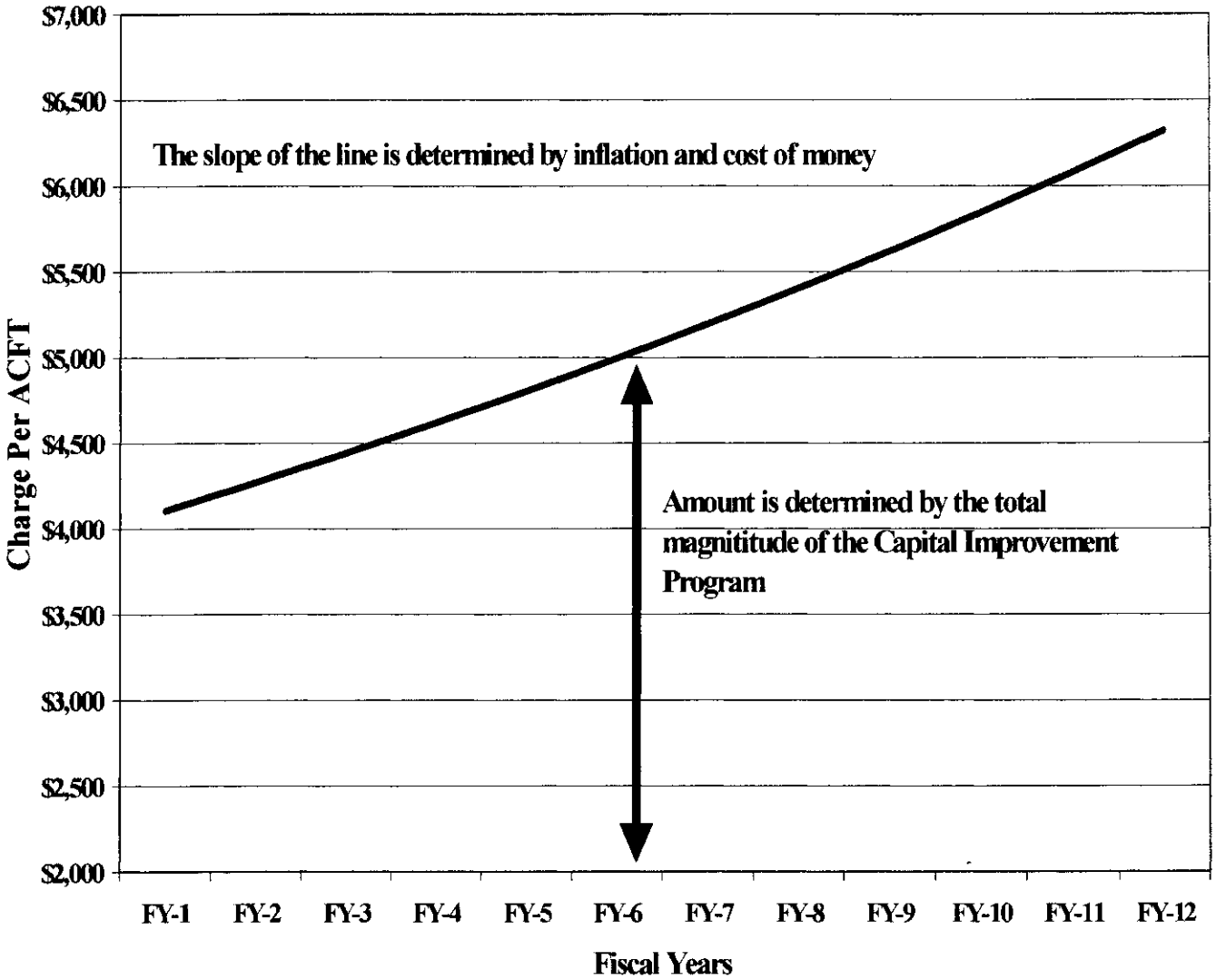
periods, it can then be reinvested, thereby increasing revenues. Thus the entire line can be shifted down, indicating a lower facility capacity fee rate, as a result of less borrowing and thus lower interest costs.

Figure 7
Facility Capacity Fee with Cost of Money



The model also has to take into consideration inflation in addition to the cost of money. As a result, the Capital Fee Schedule now takes on the appearance shown in Figure 8.

Figure 8
Facility Capacity Fee Escalated



The slope of the line takes into consideration inflation and the cost of money. The amplitude represents the magnitude or the total volume of dollars required. Each time the program is analyzed and the calculations re-run, the magnitude (the distance from the X axis) can vary as well as the slope of the line. Performing the calculations on a periodic basis minimizes changes in the rate, which could have adverse impacts on those paying the fees.

Likewise, the anticipated water demands and the facilities planned in the Capital Improvement Program are reexamined each year to determine whether changes are necessary.

Sales of Acre Feet of Capacity

The projected sale of acre feet of capacity is critical to the Agency's cash flow. The Agency has based its financial capacity to repay debt based on the revenue derived from the sale of capacity in the Agency's system, i.e. collection of facility capacity fees. Facility capacity fees are not considered by the municipal bond market to be a stable source of revenue to support bond payments, because they depend upon the progress of the housing market. It is necessary to use conservative projections of sales and demonstrate a conservative and responsible finance plan, in order to obtain a favorable bond rating. Over the past 17 years of the program the model has used 55% of projected capacity sales to calculate the capacity fee for purposes of providing sufficient revenues to support bond payments. Thus far this projection has proven to be satisfactory to the bond rating agencies as the Agency has an "A" rating. If this ever results in a potential of excess revenues, the ratio will be adjusted accordingly.

In addition to the foregoing discussion on sales it is important to point out that not all of the projected demands will be provided by the Agency. For example: there are golf courses and agricultural activities that may develop their own wells and do not require a connection to a purveyor's water system and thus are not subject to the fee. In addition there are developments that are not required to obtain building permits such as hospitals and schools. Thus, the Agency may not collect fees from these uses.

Since the fees are evaluated on a yearly basis, the Agency can adjust its sales as a percentage of demand if it is determined that more money will be collected than necessary; thus avoiding over collection.

Past Debt Allocation

As projects are built, they are removed from the CIP. However, the capital cost now has been replaced with debt. The engineers track the actual use of the proceeds of the various bond issues and allocate the debt service for each bond issue among the appropriate

benefiting cost centers such as Treatment facilities which are allocated to all WSAs , or to transmission facilities which are allocated only to the WSA(s) served by those facilities.

Unspent Bond Proceeds

If there are unspent bond proceeds, these likewise are attributed to the appropriate cost centers such as Treatment and WSA1 through WSA8. These unspent funds are an offset to projects scheduled in the program that are not yet built. The Agency currently has unspent bond proceeds because of delays in its construction program. These delays are a result of litigation and the need to prepare more environmental documentation before construction can proceed.

Allocation of 1% Property Tax

The Agency receives a portion of the 1% property tax revenue and allocates the proceeds to the future users and existing property owners based on the ratio of the assessed value of developed vs. undeveloped property. The calculation of the Facility Capacity Fee takes into account revenues available from the increment of the basic 1% property tax levy derived from undeveloped property. However, not all of the property tax revenue from undeveloped property is used to reduce the Facility Capacity Fee. Certain activities of the Agency funded with property taxes are deemed to benefit future users as well as existing users of the Agency's water system. Therefore, a portion of the property taxes on undeveloped property is used for the Agency's non-capital activities. The allocation of the Agency's tax revenue from the basic 1% levy between current uses and the CIP is based on the ratio between developed projects' assessed values (95%) and undeveloped properties' assessed values (5%). The model takes into consideration the effect of the changing ratio of developed to undeveloped property in calculating the funds available for the facility capacity program over time.

Calculation

In order to start the calculation, the model requires an initial facility capacity rate. This number is calculated by dividing the total CIP, plus financing cost including past debt, less cash sources, by the total anticipated water demand for the study period. Based on the initial rate, the model then generates a preliminary total cash revenue over the study period. If the

cash falls short, it begins a series of successive iterations until it achieves a matching of cumulative costs and revenues.

What makes this calculation complicated is that it considers cash needs on an annual basis and, if there is a cash shortfall, it takes into consideration costs attributable to borrowing this money. Each WSA effectively borrows and repays money to the Agency. The result of these borrowings and payments dictates the amount of cash required at the Agency. The Agency in turn borrows money when there is insufficient cash to cover the needs of the various WSAs.

Thus, the Facility Capacity Fee takes into account all the foregoing parameters and the cost of borrowing when it is necessary. It truly reflects the entire cost that is involved in developing and paying for a Capital Improvement Program in each WSA.

Facility Capacity Fee Calculation

A more detailed explanation of the calculation to derive the capacity fee is as follows:

A percentage of each element of the Facility Capacity Program benefiting future demand in the subject WSA is adjusted to reflect the expected change in the Construction Cost Index between now and the time of expected construction, plus the expected financing costs over the life of the financing, plus the actual cost of that percentage of facilities in place which will benefit future demand in the subject WSA, including financing costs, less estimated revenues available from property taxes collected on undeveloped property, less estimated revenues from interest on Facility Capacity Fees and tax revenues, until they are expended.

The sum of the total costs as calculated above is divided by the projected future sales in the WSA (expressed in acre feet) which will be met by the capacity of facilities planned under the CIP, and facilities currently in existence, which are of benefit to the WSA. The basic Facility Capacity Fee amount for the WSA is then adjusted to take into consideration the time value of money by reducing the fee in earlier years and increasing the fee expected to be levied in later years so that the present value of the fee in each year is equal based upon a discount rate of 4.42%.

The initial Facility Capacity Fee projected for each year is multiplied by the estimated sales of capacity (i.e. estimated facility capacity fee revenues) for each year in the future. This creates a Facility Capacity trial cash flow. This initial cash flow is then accumulated and is reduced by the accumulated annual CIP costs. The result will indicate years where there is not enough cash and other years where there is an excess. Borrowing must occur in the deficit years and the excess revenues over capital outlays may be invested to generate interest income in the surplus years. The initial Facility Capacity Fee calculation will typically result in a situation where, at the end of the build out, a WSA will either have excess cash or remaining debt. In order to minimize the projected difference between total revenues and expenses over the time period addressed in the CIP, a series of iterations must be run to adjust the initial Facility Capacity Fee either lower or higher incrementally in all time periods until a state of no excess cash and no remaining debt is reached at build out. Hundreds of iterations may occur to end up with an acceptable closing tolerance of less than 1%. Because many of the factors which go into the calculation are based on projections, estimates and assumptions regarding future growth patterns and economic conditions, the results are not guaranteed to be exact reflections of future costs and revenues. The calculations represent the Agency's best effort to set facility capacity fees based on information available today. Annual review of the capacity fees will be conducted to determine whether adjustments are necessary.

WSAs versus Agency – Model View

The Agency is the legal entity that has the authority to collect funds, spend and borrow money, and thus, for the purpose of the model, it is a "central bank". Each WSA functions as a sub-account; each has a CIP, estimated service requirements, anticipated growth and sales. Those elements that are considered Agency-wide are calculated at the Agency-wide level. The Agency-wide elements include the treatment plant, purchased water and storage. Elements which are WSA-specific (i.e., the Pipeline Capital Program), are distributed to each affected WSA. The logic previously described is also used to calculate the pipeline portion of the Facility Capacity Fee.

The very nature of the calculation is self-adjusting. As parameters change -- inflation, interest, time, sales, borrowing, value of money, amount of borrowing, increase or decrease

in CIP -- the model automatically shifts the Facility Capacity Fee projection line up or down, flatter or steeper.

Summary

The model is extremely dynamic and attempts to reflect real world conditions. It allows the Agency to make annual adjustments after reviewing past history and expected financial impacts. Further, it results in a smooth increase in connection fees that is relatively predictable over the foreseeable future.

The ultimate goal is to collect sufficient money to fund the Agency's Capital Improvement Program as well as to minimize borrowings attributable to that program in a manner that is fair, equitable and in compliance with law and Board policy.

Appendix F
Assumptions

Inflation:

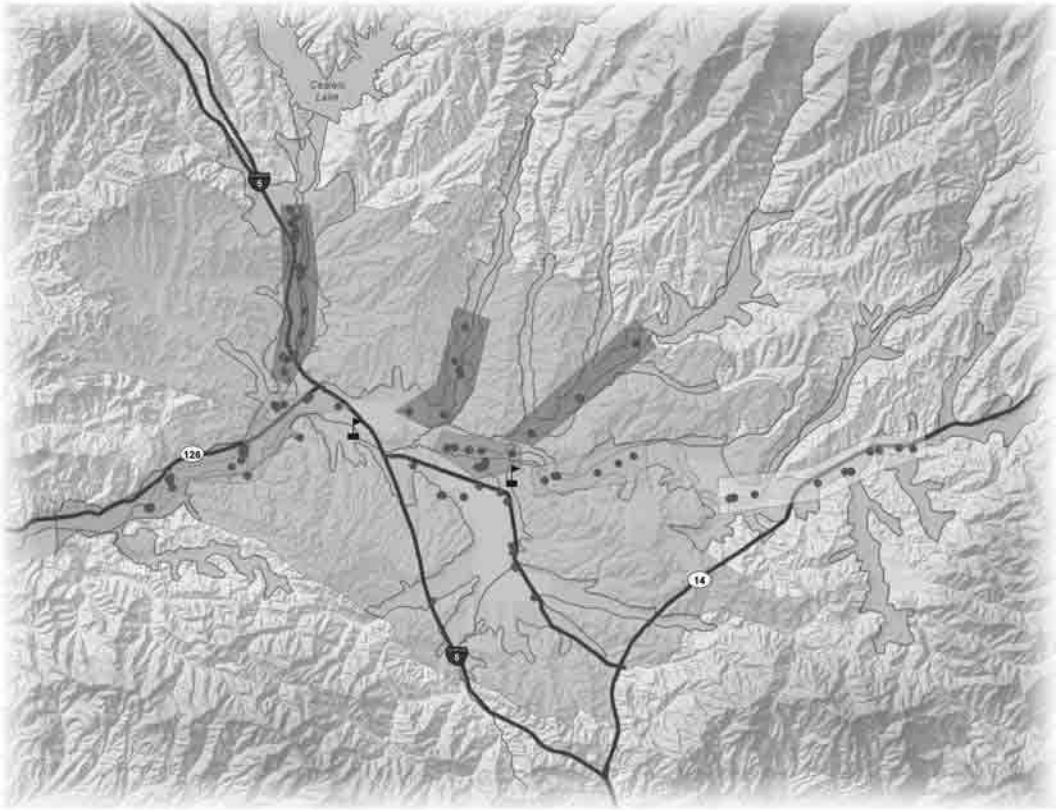
Construction Cost Index	Since 1913	4.82%
Consumer Price Index	Since 1960	4.42%

Interest:

Interest Income	1962 – 2002	5.99%
3-Year Treasury less 100 Basis Points		
Interest Expense	1962 – 2002	6.49%
3-Year Treasury less 50 Basis Points		

2004 Santa Clarita Valley Water Report, Dated May 2005

2004
Santa Clarita Valley Water Report



Castaic Lake Water Agency (CLWA)
CLWA Santa Clarita Water Division
Los Angeles County Waterworks District 36
Newhall County Water District
Valencia Water Company

May, 2005

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

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Executive Summary

This annual report, which is the seventh in a series that began in 1998, provides current information about the water requirements and water supplies of the Santa Clarita Valley. The report was prepared by Castaic Lake Water Agency (CLWA) and its Santa Clarita Water Division, Los Angeles County Waterworks District 36, Newhall County Water District, and Valencia Water Company.

The Santa Clarita Valley is served by four local retail water Purveyors: Castaic Lake Water Agency's Santa Clarita Water Division (SCWD), Los Angeles County Waterworks District 36 (LA36), Newhall County Water District (NCWD), and Valencia Water Company (VWC). The CLWA provides water from California's State Water Project (SWP) to the water Purveyors for distribution. Management from these entities and representatives from the City of Santa Clarita and the County of Los Angeles meet as required to coordinate the management of imported SWP water with local groundwater to meet water requirements in the Valley.

This report provides information about local groundwater resources, SWP water supplies, water conservation, and recycled water. The report also reviews the sufficiency and reliability of supplies in the context of existing water demand, as well as an overall outlook of water supply and demand.

In 2004, total water demands in the Santa Clarita Valley were about 87,900 acre-feet (af), of which about 82 percent (72,300 af) was for municipal use and the remaining 18 percent (15,600 af) was for agricultural and other (miscellaneous) uses. These total water demands were met by a combination of about 40,300 af from local groundwater resources (nearly 24,700 af for municipal and about 15,600 af for agricultural and other uses), about 47,200 af of SWP water, and about 450 af of recycled water.

Of the 40,300 af of total groundwater pumpage in the Valley in 2004, about 33,800 af were pumped from the Alluvium and about 6,500 af were pumped from the underlying, deeper Saugus Formation. Alluvial pumpage represented about a 200 af increase from 2003, and Saugus pumpage increased by about 2,300 af from 2003. Neither pumping volume resulted in any overall change in ongoing groundwater conditions (water levels, water quality, etc.) in either aquifer system. SWP deliveries to the Purveyors increased by 2,800 af over 2003, to 47,205 af in 2004. Water uses and supplies in 2004 are summarized in the following Table ES-1.

As discussed in the 2000 Water Report, a notable accomplishment in that year was the preparation of the Urban Water Management Plan (UWMP) for the Santa Clarita Valley. The UWMP, which is more technical and longer term in focus than this annual report, and which does not focus on recent or other historical water requirements and supplies, provides a projection of water demands through 2020. Among other details, it delineates a number of local and other groundwater supplies in conjunction with SWP water to meet those projected water demands over that time frame. It also identifies operating plans for dry periods of up to three consecutive dry years. This operating plan proposes using alternate supplies and/or development

Table ES-1
Santa Clarita Valley
Summary of 2004 Water Uses
(acre-feet)

Municipal		
State Water Project		47,205
Groundwater (Total)		24,671
Alluvium	*18,970*	
Saugus	*5,701*	
Recycled Water		448
Subtotal		**72,324**
Agriculture/Miscellaneous		
State Water Project		-
Groundwater (Total)		15,590
Alluvium	*14,787*	
Saugus	*803*	
Subtotal		**15,590**
Total		***87,914***

of future supplies from groundwater storage projects, short-term transfers, local groundwater and other supplies to offset potentially reduced deliveries of SWP water. Conjunctively, these supplies can meet demands without exceeding the operational yield of the aquifer system on a long-term basis. In litigation filed by Ventura County, The Sierra Club, and Friends of the Santa Clara River, the UWMP was upheld in April 2003 by the Kern County Superior Court as a fully legal and complete document. Notably, the Court rejected claims that population projections and associated water demand projections were underestimated, and that available water supplies were overestimated. Subsequently, however, in September 2004, the Appellate Court found that the 2000 UWMP should have addressed the time needed to implement available methodology for treatment of perchlorate contaminated groundwater, and should have described the reliability of groundwater supplies during the treatment implementation period.

As a result, the Purveyors prepared and adopted an amended 2000 Urban Water Management Plan to address three general topics: updated requirements of urban water management plans related to groundwater, as added to the Water Code since 2000; the reliability of local groundwater resources and the adequacy of groundwater supplies to meet groundwater demand without perchlorate-impacted wells; and detailed plans for the integrated control of perchlorate migration and full restoration of perchlorate-impacted water supply, scheduled for implementation by 2006. The 2000 Urban Water Management Plan **Groundwater Perchlorate Contamination Amendment and Other Amendments** was completed in January 2005 and formally submitted to the State Department of Water Resources in February 2005.

As introduced in the 2001 Water Report, a significant accomplishment in that year was the preparation and execution of a Memorandum of Understanding (MOU) between the Santa

Clarita Valley water Purveyors and the United Water Conservation District (United). United manages surface and groundwater resources in seven groundwater basins in the Lower Santa Clara River Valley Area, downstream of the Santa Clarita Valley. This regional MOU effort was born out of a willingness among the involved agencies to seek opportunities to work together and develop programs that mutually benefit the region and the communities they serve.

The MOU has initiated a collaborative and integrated approach to the following: data collection; database management; groundwater flow modeling; assessment of groundwater basin conditions, including determination of basin yield amounts; and preparation and presentation of reports, including continued annual reports such as this Water Report for current planning and consideration of development proposals, and also including less frequent but more technically detailed reports on geologic and hydrologic aspects of the overall stream-aquifer system. Integration of the Upper (Santa Clarita Valley) and Lower (United WCD) Santa Clara River databases was accomplished in 2003. Work was subsequently completed on the development and calibration of a numerical groundwater flow model of the entire Santa Clarita groundwater basin. That model will be further utilized in 2005 for evaluation of basin yield under varying management actions and hydrologic conditions.

In August 2002, the Department of Water Resources (DWR) released its Draft State Water Project Delivery Reliability Report. The report was finalized in May 2003. The report is intended to assist SWP contractors in assessing the adequacy of the SWP component of their overall supplies. The analyses contained in the report conclude that the SWP, using existing facilities and operated under current regulations, can deliver a long-term average of 76 percent of the primary contractual supply (defined as the Table A Amount) at the 2021 level of development described in the report. During infrequent dry periods deliveries are projected to be less than 50 percent, and possibly as low as 19 percent during an unusual single dry year condition that has historically occurred about once every 70 years. During very wet years, full contract amounts are available.

Significant accomplishments in 2002 and 2003 were the storing of 24,000 af of 2002 available SWP Table A water and 32,522 af of available SWP Table A water by CLWA in the Semitropic Water Storage District's groundwater banking program in Kern County. Over the subsequent ten years, this groundwater bank account will be used as an additional supply for the Santa Clarita Valley during a dry period. In accordance with the provisions of the banking agreements, CLWA can withdraw up to 50,870 af of the stored water to meet valley demands when needed.

Another notable accomplishment in water resource management in 2003 was the completion and adoption of a formal groundwater management plan. In 2001, as part of legislation authorizing CLWA to provide retail water service to individual municipal customers in addition to its ongoing wholesale water supply, Assembly Bill 134 included a requirement that CLWA prepare a groundwater management plan in accordance with the provisions of Water Code Section 10753, which was originally enacted by, and is commonly known as, Assembly Bill 3030. The general contents of that groundwater management plan were outlined in 2002, and a detailed plan was drafted in 2003 to satisfy the requirements of AB 134 and to both complement and formalize a number of existing water supply and water resource planning and management activities in the CLWA service area. Among the elements of the adopted Plan is the preparation

of groundwater management reports. The annual Water Reports, like this one, were envisioned in that Plan to continue to provide regular reporting on many of the aspects of the groundwater management plan. Other more detailed technical reports were also envisioned in the Plan to address specific aspects of basin management. The first of these technical reports, on the development and calibration of a numerical groundwater flow model, was drafted in 2003.

Due to the nature of the above-noted issues with perchlorate contamination in the basin, the primary focus of efforts in 2004 centered around those issues. Significant accomplishments included the completion of an integrated plan for restoration of impacted groundwater supply wells, treatment of groundwater for removal of perchlorate, and containment of perchlorate contamination in order to protect other wells in the basin. Closely related to the completion of that plan was the utilization of the recently developed groundwater model, after approval of the model for that purpose by the State Department of Toxic Substance Control, for analysis of the required pumping rates and resultant containment of perchlorate contamination. Embedded in the latter analysis was the basin-wide utilization of groundwater for water supply as planned in the UWMP; the resultant analysis showed, over a long-term period of typical wet/normal/dry hydrologic conditions, that both aquifer systems responded in a sustainable manner, with no depletion or degradation of the basin.

As introduced above, water supplies to meet existing water demands in the Santa Clarita Valley include groundwater from the shallow Alluvial Aquifer and from the underlying deeper Saugus Formation, SWP water, and recycled water. The following summarizes the use and condition of those water resources in the Valley in 2004.

ES.1 Alluvial Aquifer

In light of Alluvial aquifer conditions over the last 10 to 20 years, during which Alluvial pumpage has increased without long-term adverse effects on water levels or quality, the UWMP includes Alluvial pumpage in the range of 30,000 to 40,000 acre-feet per year (afy) in average/normal years, and slightly reduced pumpage (30,000 to 35,000 afy) in dry years. Pumpage from the Alluvium in 2004 was 33,800 af, and remained in the overall UWMP range as it has over the last ten years.

On a long-term basis, there is no evidence of any historic or recent trend toward permanent water level or storage decline. In general, throughout a large part of the basin, Alluvial groundwater levels have generally remained near historic highs during the last 30 years. Higher than average precipitation in late 2004 and early 2005 resulted in significant water level recovery in the eastern part of the basin, continuing the overall trend of fluctuating groundwater levels within a generally constant range over the last 30 years. These ongoing data indicate that the Alluvium is in good operating condition and can continue to support pumpage in the range included in the UWMP, as has been the case for the last decade, without adverse results (e.g., long-term water level decline or degradation of groundwater quality.)

Based on an integration of water quality records from multiple wells completed in the Alluvium, there have been historical fluctuations in groundwater quality, typically associated with variations in precipitation and streamflow. However, like groundwater levels, there has been no

long-term trend toward groundwater quality degradation; groundwater produced from the Alluvial aquifer is a viable municipal and agricultural water supply.

In 2002, as part of ongoing monitoring of wells for perchlorate contamination, perchlorate was detected in one Alluvial well located near the former Whittaker-Bermite facility. The detected concentration was slightly below the Notification Level for perchlorate (6 ug/l), and the well has been inactivated for municipal water supply. In early 2005, perchlorate was detected in a second Alluvial well, VWC's Well Q2. In response, Valencia removed the well from active service, and commissioned the preparation of an analysis and report assessing the impact of, and response to, the perchlorate contamination of that well. The Q2 Report (Luhdorff and Scalmanini, 2005) documents that the perchlorate detected in Well Q2 will not significantly impact the water supplies used to meet demand in the Santa Clarita Valley for the period of time required to respond to the contamination. The results of the Q2 analysis and Report are consistent with the analysis and conclusions in the Amended 2000 UWMP. Valencia's response plan for Well Q2 is to pursue permitting and installation of wellhead treatment by the fall of 2005, which will return the well to water supply service. All other Alluvial wells operated by the Purveyors continue to be used for municipal water supply service; those wells near the Whittaker-Bermite property are routinely sampled and perchlorate has not been detected. As detailed in the Amended 2000 UWMP and the Q2 Report, the inactivation of two Alluvial wells due to perchlorate contamination does not limit the Purveyors' ability to produce groundwater from the Alluvium in accordance with the capacities delineated in the UWMP.

The ongoing characterization and plan for control and cleanup of perchlorate initially focused on the Saugus Formation as previously reported and discussed herein. However, as a result of the detection of perchlorate in one Alluvial municipal supply well, control and cleanup actions are also being planned for the Northern Alluvium.

ES.2 Saugus Formation

For long term planning purposes, the UWMP includes pumping from the Saugus in the range of 7,500 to 15,000 afy in average/normal years; it also includes planned dry-year pumping from the Saugus of 21,000 to 35,000 afy for one to three consecutive dry years. The UWMP recognizes that such short-term pumping can be recharged during subsequent wet/normal years to allow groundwater levels and storage to recover, as it has in historical periods.

Pumpage from the Saugus Formation was about 6,500 af in 2004; on average, Saugus pumpage has been about 7,000 afy since 1980. Both rates are near the lower end of the range included in the UWMP. Detailed records are not available prior to 1980, but historical pumpage from the Saugus was quite small prior to 1960 (100 to 200 afy) and was still small in the 1960's (peak pumpage of about 3,000 afy through the mid-1960's). Historical pumpage has been as high as nearly 15,000 af in 1991, and about 12,000 afy over a four-year period in the early 1990's. These amounts are near the upper end of the range included in the UWMP. As a result of long-term relatively low pumpage from the Saugus Formation, groundwater levels in that aquifer have remained essentially constant over the last 35 to 40 years; that trend continued in 2004.

In 1997, ammonium perchlorate was discovered in four wells completed in the Saugus

Formation in the vicinity of the former Whittaker-Bermite facility located generally on the east side of the basin. All four of those impacted wells exceed the current Notification Level of 6 parts per billion set by the California Department of Health Services (DHS) and have been taken out of active water supply service (water levels in the wells continue to be monitored). All other Saugus wells owned and operated by the Purveyors are available for municipal water supply service. As part of regular operation, those wells are sampled on a routine basis and perchlorate has not been detected. However, the Purveyors have taken a cautious and prudent approach in utilizing Saugus groundwater, pending the installation of treatment facilities as part of control and cleanup of perchlorate contamination that will also restore the pumping capacity of the inactive wells. Ultimately, despite the inactivated Saugus wells, the Purveyors still have sufficient pumping capacity in other wells to meet the planned normal range of Saugus pumping in the UWMP.

Work toward the ultimate remediation of perchlorate contamination, including the restoration of impacted groundwater supply continued to progress on several integrated tracks in 2004. In February 2003, the Purveyors entered into a voluntary cleanup agreement with the State Department of Toxic Substances Control (DTSC) whereby DTSC is providing review and oversight of the activities by the Purveyors in response to the detection of perchlorate in the five impacted wells. In accordance with that agreement, the Purveyors have prepared a Work Plan for sampling of production wells, prepared a report on the results and findings of the production well sampling, prepared a draft Human Health Risk Assessment, prepared a draft Remedial Action Workplan, completed the evaluation of treatment technologies, and completed the development of the groundwater model described above. The Purveyors have also initiated a process for approval by DHS in accordance with its Policy 97-005 for restoration of water supply from "severely impaired" water sources such as the perchlorate-impacted wells. The evaluation of treatment technologies and development of the groundwater model noted above were key activities completed in 2003 and reported in 2004 for inclusion in the application for approval by DHS for the restoration of perchlorate-impacted water supply. CLWA, the Purveyors and Whittaker entered into an Interim Settlement Agreement (ISA) in 2003, wherein the parties agreed to work cooperatively for a minimum of a one-year period to further define long-term costs and reach a long-term settlement. The ISA expired in September 2004 but was extended by mutual consent of all parties until the end of January 2005. The ISA specifies that Whittaker and its insurers would reimburse certain past costs as well as ongoing costs incurred by CLWA and the Purveyors in responding to perchlorate contamination. Activities since execution of the ISA have continued on developing the elements of a remedial strategy that will entail, among other details, the pumping of two impacted wells for containment of perchlorate migration, utilization of the pumped water, after treatment, for water supply, and installation of replacement wells in non-impacted portions of the basin to restore the remainder of groundwater supply impacted by perchlorate. Activities since execution of the ISA have also involved negotiation of a long-term Settlement Agreement.

ES.3 Imported Water

CLWA's contractual Table A Amount is 95,200 af of water from the SWP. CLWA operates two water filtration plants and has a current total treatment capacity of 63.5 million gallons per day of capacity where the water is treated, filtered, and disinfected prior to being delivered to Purveyors

for distribution. CLWA has nearly completed construction that will expand the Earl Schmidt Filtration Plant from its existing rated capacity of 33.5 million gallons per day to 56 million gallons per day. Plant expansion is scheduled to come on line in mid-2005. Upon completion, CLWA will have combined treatment capacity of 86 million gallons per day.

CLWA's final allocation of Table A for 2004 was 65 percent, or 61,880 af. On December 1, 2003, the initial allocation for 2004 was announced as 35 percent. On March 1, 2004, it was raised to the final allocation of 65 percent. Utilizing SWP contract provisions, CLWA elected to "carry over" unused remaining Table A Amount into 2005.

The total available SWP supply in 2004 was 99,283 af, including 35,785 af of 2003 carryover delivered in early 2004, and 1,618 af of Article 21 water. CLWA deliveries were 47,205 af to the Purveyors and 3,776 af to the Devil's Den Ranch, with 15,522 af of the 2004 Table A Amount for potential carryover to 2005.

Late in 2003, CLWA negotiated a second groundwater banking agreement with the Semitropic Water Storage District in Kern County. CLWA delivered 32,522 af of 2003 carryover water for storage in Semitropic's program; actual delivery took place in January, February and March 2004. Over a ten-year period (until 2013), CLWA can withdraw up to 29,270 af of that stored water to meet valley demands when needed. Combined with its storage of water in 2002, CLWA now can withdraw up to 50,870 af from Semitropic to meet water demands in the Valley when needed.

SWP water deliveries are subject to reduction when dry conditions occur in Northern California. The UWMP addresses programs for enhancing water supply reliability during such occurrences. A capital improvement program funded by CLWA has been established to provide facilities and additional water supplies needed to firm up SWP water supplies during times of drought.

ES.4 Recycled Water

Recycled water service was initiated in July 2003 in accordance with CLWA's Draft Reclaimed Water System Master Plan (2002). The amount of recycled water used for irrigation purposes, at a golf course and in roadway median strips, was approximately 448 af in 2004.

ES.5 Reliability Goal

Water consumers expect that their needs are going to be met with a high degree of quality and reliability of service. To that end, CLWA and the Purveyors are in the process of establishing a water reliability policy for planning purposes sufficient to meet projected demands 95 percent of the time over each 20-year period. In the remaining 5 percent of the time, it is planned that the maximum supply shortage will be 10 percent of demand. This level is being planned based on past experience that a 10 percent water demand reduction is feasible during a drought. When a shortage occurs, water consumers typically increase their awareness of water usage and voluntarily reduce water demands. During the last drought, in the early 1990's, voluntary conservation efforts by area residents resulted in a decrease in water demand of about 20 percent per year.

For planning purposes, water supplies and facilities are added on an incremental basis and ahead of need because it would be economically imprudent to immediately, or in the short term, acquire and/or construct all the facilities and water supplies needed for the next twenty to thirty years. This would represent an unfair shift of costs from future customers to existing customers.

ES.6 Water Supply Outlook

Total demand in 2004 was consistent with the year-to-year fluctuations in demand, taking into account increases in service connections. In 2005, total water demands are expected to be about 89,000 af, generally consistent with the growth rate in the UWMP while also recognizing the cool and wet early months of the year. Of the total, municipal demand is expected to be about 73,000 af. However, record rainfall in early 2005 has depressed demand, so total annual demand may be lower. Agricultural water demands are expected to be essentially unchanged. It is expected that water demands in 2005 will continue to be met with a generally similar mix of water supplies comprised of imported SWP water, local groundwater, and recycled water.

Recycled water will continue to supply a small portion of total water demand in 2005. CLWA anticipates continuing Phase 1 of its recycled water program in 2005 to provide delivery of up to 1,700 afy of recycled water for use on large landscape areas, roadway medians and other acceptable non-potable uses. In addition, surveys conducted by CLWA indicate an interest for recycled water by existing water users as well as future development when it becomes available.

Each year, DWR determines SWP deliveries. As of April 21, 2005, the allocation of water from the SWP is 80 percent of CLWA's Table A Amount, representing 76,160 af. Combined with local groundwater from the two aquifer systems (47,500 af), small additional surface water supplies (Article 21 and Flexible Storage Account, which represent about 6,200 af combined), net carryover SWP water from 2004 (1,657 af), and recycled water (up to 1,700 af), the total available water supplies for 2005 are slightly more than 133,000 af. As a result, CLWA and the Purveyors anticipate having more than adequate supplies to meet all water demands in 2005.

In any given year, SWP supplies may be reduced due to dry weather conditions or regulatory factors. During such an occurrence, the remaining water demands are planned to be met by a combination of alternate supplies such as returning water from CLWA's accounts in the Semitropic Groundwater Storage Program, deliveries from CLWA's flexible storage account in Castaic Lake Reservoir, local groundwater pumping, short-term water exchanges, and participation in DWR dry-year water purchase programs in accordance with the Urban Water Management Plan. Due to the banking of excess 2002 and 2003 SWP water in the Semitropic Groundwater Storage Program, CLWA can draw upon its account as needed, pursuant to the terms of the banking agreement with Semitropic. The banked excess 2002 and 2003 SWP water now represents nearly 51,000 af of recoverable water for drought water supply.

Drought periods may affect available water supplies in any single year and for a duration usually not longer than three consecutive years. It is important to note that hydrologic conditions vary from region to region throughout the state. Dry conditions in Northern California affecting SWP supply may not affect local groundwater and other supplies in Southern California, and the reverse situation can also occur (as it did in 2002 and 2003). For this reason, CLWA and the

Purveyors have emphasized developing water supplies that add diversity in water supply options, especially in dry years. Diversity of supply is considered a key element of reliability, giving Valley water Purveyors the ability to draw on multiple sources of supply during dry year conditions and thereby making the Purveyors less dependent upon direct deliveries from the SWP water supplies.

I. Introduction

1.1 Background

For most residents of the Santa Clarita Valley (Valley), domestic water service is provided by four water Purveyors. They are the Castaic Lake Water Agency Santa Clarita Water Division (SCWD), Los Angeles County Waterworks District 36 (LA36), Newhall County Water District (NCWD), and Valencia Water Company (VWC). Together, the Purveyors provide water to approximately 65,000 service connections. Castaic Lake Water Agency (CLWA) draws water from Castaic Lake where it is treated, filtered, and disinfected at two treatment plants before distribution to the Purveyors. The staff of these entities meet regularly to coordinate the supply of water in the Valley. Their respective service areas are shown in Figure I-1.

Water supply for a small percentage of Valley residents is provided by individual private water supply wells. The location, construction, annual pumpage and other information about these private wells are not currently available. CLWA is currently working with private well owners to receive information about their wells for incorporation in future reports and for planning purposes. Pumping as reported herein includes an estimate of groundwater pumped from private wells; it is expected that this estimate will be refined in future reports as more information about the private wells is obtained.

Over the years, CLWA and the Purveyors have reviewed and documented the availability of water resources in the region. Past studies have assessed the condition of the local groundwater aquifers, their hydrogeologic character, aquifer storage capacity, operational yield and recharge rate, and the potential for conjunctive use of groundwater and imported water resources.

Other efforts have included developing drought contingency plans, evaluating the impact of landfills on the groundwater basin, coordinating emergency response procedures and implementing Valley-wide conservation programs. In 1985, the Purveyors prepared the area's first Urban Water Management Plan (UWMP.) Information in the plan had been coordinated among CLWA and the Purveyors so that there was general agreement about water supply and demand information for long term planning purposes. In December 2000, CLWA and the Purveyors updated the valley-wide UWMP, and that current UWMP remains the reference for projected water requirements and for municipal and agricultural water supplies in the Valley. The 2000 UWMP was amended in 2005 to specifically address the reliability of local groundwater resources and the adequacy of groundwater supplies to meet groundwater demand; the Amended 2000 UWMP also addressed the plans for integrated control of perchlorate migration and full restoration of perchlorate-impacted groundwater supply, scheduled to be implemented by 2006. The UWMP is being updated in 2005 in accordance with the California Urban Water Management Planning Act.

1.2 Purpose and Scope of the Report

The purpose of this report, which is the seventh in a series of annual water reports that began in 1998, is to provide current information about the available water supplies and demands of the Santa Clarita Valley. CLWA and the Purveyors have prepared this series of reports in response

to a request made by the Los Angeles County Board of Supervisors in 1998. This report was prepared by Castaic Lake Water Agency (CLWA) and its Santa Clarita Water Division, by Los Angeles County Waterworks District 36, by Newhall County Water District, and by Valencia Water Company. It establishes a format for providing information regarding the availability of water on an annual basis. It is intended to be a helpful resource for use by water planners and local planning agencies. This report is complemented by the more detailed UWMP for the area, which provides longer-term water supply planning over a 20-year period.

1.3 Santa Clarita Valley Water Purveyors

Castaic Lake Water Agency Santa Clarita Water Division has a service area that includes a portion of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Saugus, Canyon Country, and Newhall. Water is supplied from both groundwater and CLWA turnouts to 26,161 service connections.

Los Angeles County Waterworks District 36 has a service area that encompasses approximately 7,635 acres in the Hasley Canyon area and the unincorporated community of Val Verde. LACWWD 36 has 1,308 service connections. The District has traditionally obtained its full water supply from a connection to the CLWA's Castaic Conduit. In 2004, the District supplemented its surface water supply with groundwater purchased from the Los Angeles County Peter J. Pitchess Detention Center.

Newhall County Water District's service areas lie in four distinct geographical areas of the Santa Clarita Valley, designated as the service areas of Newhall, Pinetree, Castaic, and Tesoro. NCWD supplies water from both groundwater and CLWA turnouts to approximately 9,010 service connections.

Valencia Water Company's service area serves 28,296 service connections in a portion of the City of Santa Clarita and in the unincorporated communities of Castaic, Newhall, Saugus, Stevenson Ranch, and Valencia. VWC supplies water from both groundwater and CLWA turnouts; VWC also delivers recycled water for some non-potable uses.

1.4 The Upper Santa Clara River Hydrologic Area

The Upper Santa Clara River Hydrologic Area (HA), as defined by the California Department of Water Resources (DWR), is located almost entirely in northwestern Los Angeles County (Figure I-2). The area encompasses about 654 square miles comprised of flat valley land (about 6 percent of the total area) and hills and mountains (about 94 percent of the total area) that border the valley area. The mountains include the Santa Susana and San Gabriel Mountains to the south and the Sierra Pelona and Leibre-Sawmill Mountains to the north. Elevations range from about 800 feet on the valley floor to about 6,500 feet in the San Gabriel Mountains. The headwaters of the Santa Clara River are at an elevation of about 3,200 feet at the divide separating this hydrologic area from the Mojave Desert.

The Santa Clara River and its tributaries flow intermittently from Lang Station westward about 35 miles to Blue Cut, just west of the Los Angeles-Ventura County line, where it forms the outlet

for the Upper Santa Clara River Hydrologic Area. The principal tributaries of the upper river are Castaic Creek, San Francisquito Creek, Bouquet Creek, and the South Fork of the Santa Clara River. Additionally, the Santa Clara River receives treated wastewater discharge from the Saugus and Valencia Water Reclamation Plants, which are operated by the Sanitation Districts of Los Angeles County (Figure I-2).

The Santa Clara River traverses the Santa Clarita Valley. The mountainous area to the north of the river is dissected by long southwest draining canyons - San Francisquito, Bouquet and Mint Canyons. Castaic Lake and Lagoon are within this Sub-Area. The South Fork of the Santa Clara River, draining the mountains along the southern boundary, traverses the valley floor where it joins with the main stem of the Santa Clara River.

Beneath the Santa Clarita Valley, there are two aquifer systems that comprise the Santa Clara River Valley East Groundwater Subbasin. This groundwater basin is the source of all local groundwater used for water supply in the Santa Clarita Valley. Below Blue Cut, the Santa Clara River continues westward through Ventura County to its mouth near Oxnard. Along that route, the River traverses all or parts of six groundwater basins in Ventura County (Piru, Fillmore, Santa Paula, Oxnard Forebay, Oxnard Plain and Mound) as shown in Figure I-3.

There are two primary precipitation gages in the Santa Clarita Valley, the Newhall-Soledad 32c gage and the Newhall County Water District gage (shown in Figure I-4). The National Climatic Data Center (NCDC) and Los Angeles County Department of Public Works (LADPW) have maintained records for the Newhall-Soledad 32c gage since 1931. Newhall County Water District has maintained records for the NCWD gage since 1979. The cumulative records from these two gages correlate very closely, with the NCWD gage recording approximately 25 percent more precipitation than the Newhall-Soledad 32c gage. This is likely due to the location of the NCWD gage, which is at the base of the mountains rimming the southern edge of the Santa Clarita Valley.

The Santa Clarita Valley is characterized as having an arid climate. Intermittent periods of less-than-average precipitation are typically followed by periods of greater-than-average precipitation in a cyclical pattern, with each wetter or drier period typically lasting from one to five years. Long-term precipitation records for the Newhall-Soledad 32c gage are illustrated in Figure I-5. The long-term average precipitation is 17.90 inches (1931-2004). Figure I-5 also shows the yearly departure from mean annual precipitation. In general, periods of less-than-average precipitation are longer and more moderate than periods of greater-than-average precipitation. Recently, the periods from 1971 to 1976, 1984 to 1991 and 1999 to 2003 have been drier than average; the periods from 1977 to 1983 and 1992 to 1996 have been wetter than average. 2004 was a slightly wet year, with total precipitation of approximately 23 inches, about 5 inches above average. Wet conditions continued into early 2005; significant storm events in January 2005 produced over 13 inches of measured precipitation, or more than 70 percent of average annual precipitation in the first month of the year.

II. 2004 Water Demands and Supplies

In 2004, total water demands in the Santa Clarita Valley were 87,900 af, an increase of about 5,000 af from the previous year. Of that amount, 82 percent (72,300 af) was for municipal use and the remaining 18 percent (15,600 af) was for agricultural and other (miscellaneous) uses. These total water demands were met by a combination of 40,300 af from local groundwater resources (nearly 24,700 af for municipal and about 15,600 af for agricultural and other uses), about 47,200 af of SWP water, and 448 af of recycled water.

In 2004, the total water demand in the Santa Clarita Valley increased by slightly more than five percent from the previous year, and was approximately six percent higher than the short-term projected water demand of 83,000 af presented in last year's water report. This increase in water usage is related to an increase in the number of municipal connections served, from approximately 61,400 in 2003 to 64,800 in 2004. As presented in the 2000 UWMP, historical water use from 1985 to 1998 fluctuated notably, increasing up to 10.2 percent in hot dry years and declining by up to 3.7 percent in cool wet years. Although 2004 was a wetter-than-average year, demand per service connection remained the same as in the previous (slightly dry) year.

Tables II-1 through II-4 summarize the use of available water sources by each Purveyor to meet water demands since the importation of SWP water began in 1980. The historical distribution of water supply sources to meet cumulative municipal water demands is summarized in Table II-5; the trends in use of local groundwater and imported SWP water to meet total demand are illustrated in Figure II-1. Tables II-6 and II-7 summarize historical agricultural and miscellaneous water requirements and supplies. Finally, total water demands and supplies since 1980 are summarized in Table II-8.

Table II-1
Water Supplies for Los Angeles County Waterworks District 36
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	-	-	**0**
1981	0	-	-	**0**
1982	145	-	-	**145**
1983	207	-	-	**207**
1984	240	-	-	**240**
1985	272	-	-	**272**
1986	342	-	-	**342**
1987	361	-	-	**361**
1988	434	-	-	**434**
1989	457	-	-	**457**
1990	513	-	-	**513**
1991	435	-	-	**435**
1992	421	-	-	**421**
1993	465	-	-	**465**
1994	453	-	-	**453**
1995	477	-	-	**477**
1996	533	-	-	**533**
1997	785	-	-	**785**
1998	578	-	-	**578**
1999	654	-	-	**654**
2000	800	-	-	**800**
2001	907	-	-	**907**
2002	1,069	-	-	**1,069**
2003	1,175	-	-	**1,175**
2004	854	380	-	**1,234**

Groundwater purchased from Los Angeles County Honor Farm

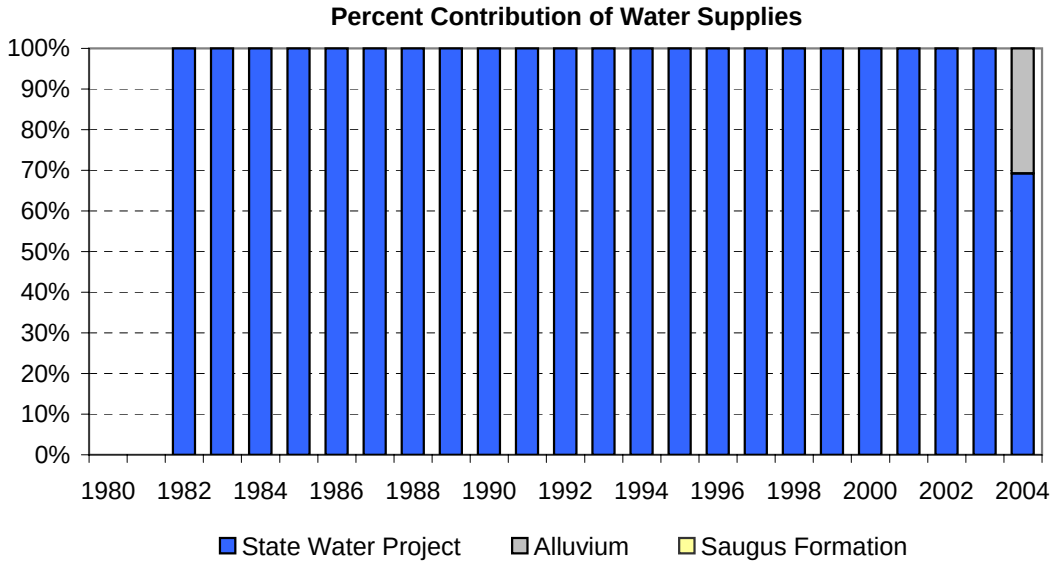


Table II-2
Water Supplies for Newhall County Water District
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	1,170	2,363	**3,533**
1981	0	1,350	2,621	**3,971**
1982	0	1,178	2,672	**3,850**
1983	0	1,147	2,787	**3,934**
1984	0	1,549	2,955	**4,504**
1985	0	1,644	3,255	**4,899**
1986	0	1,842	3,548	**5,390**
1987	22	2,127	3,657	**5,806**
1988	142	2,283	4,041	**6,466**
1989	428	2,367	4,688	**7,483**
1990	796	1,936	4,746	**7,478**
1991	675	1,864	4,994	**7,533**
1992	802	1,994	5,160	**7,956**
1993	1,075	1,977	5,068	**8,120**
1994	906	2,225	5,103	**8,234**
1995	1,305	1,675	4,775	**7,755**
1996	1,213	1,803	4,871	**7,887**
1997	1,324	2,309	5,168	**8,801**
1998	1,769	1,761	4,557	**8,087**
1999	5,050	1,676	2,622	**9,348**
2000	6,024	1,508	2,186	**9,718**
2001	5,452	1,641	2,432	**9,525**
2002	5,986	981	3,395	**10,362**
2003	6,572	1,266	2,513	**10,351**
2004	5,896	1,582	3,739	**11,217**

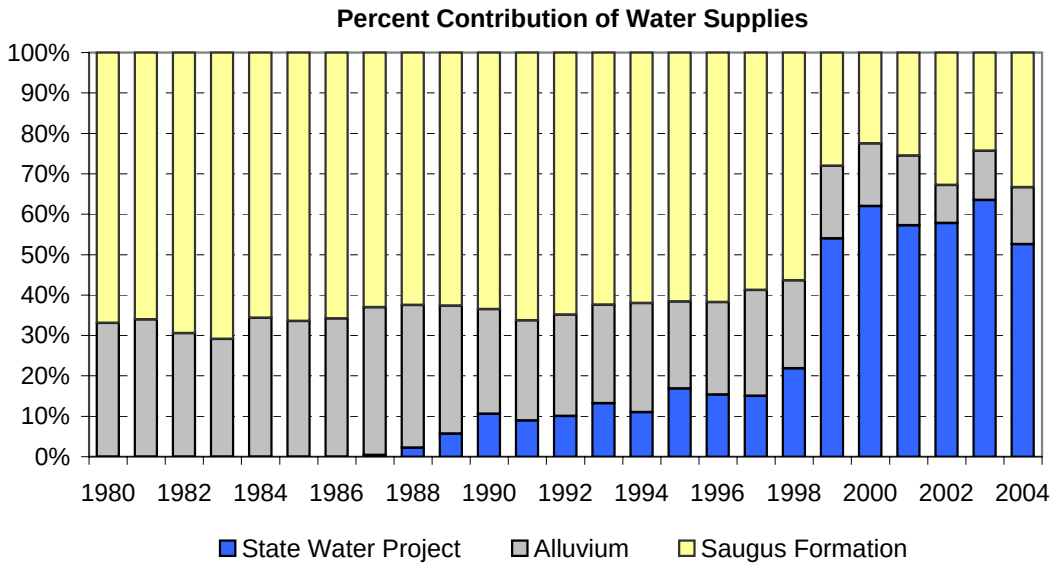


Table II-3
Water Supplies for CLWA Santa Clarita Water Division
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	1,125	9,460	0	**10,585**
1981	4,602	7,109	0	**11,711**
1982	6,454	4,091	0	**10,545**
1983	5,214	4,269	0	**9,483**
1984	6,616	6,057	0	**12,673**
1985	6,910	6,242	0	**13,152**
1986	8,366	5,409	0	**13,775**
1987	9,712	5,582	0	**15,294**
1988	11,430	5,079	63	**16,572**
1989	12,790	5,785	0	**18,575**
1990	12,480	5,983	40	**18,503**
1991	6,158	5,593	4,781	**16,532**
1992	6,350	8,288	2,913	**17,551**
1993	3,429	12,016	2,901	**18,346**
1994	5,052	10,996	3,863	**19,911**
1995	7,955	10,217	1,726	**19,898**
1996	9,385	10,445	2,176	**22,006**
1997	10,120	11,268	1,068	**22,456**
1998	8,893	11,426	0	**20,319**
1999	10,772	13,741	0	**24,513**
2000	13,751	11,529	0	**25,280**
2001	15,648	9,896	0	**25,544**
2002	18,921	9,513	0	**28,434**
2003	20,668	6,424	0	**27,092**
2004	22,045	7,146	0	**29,191**

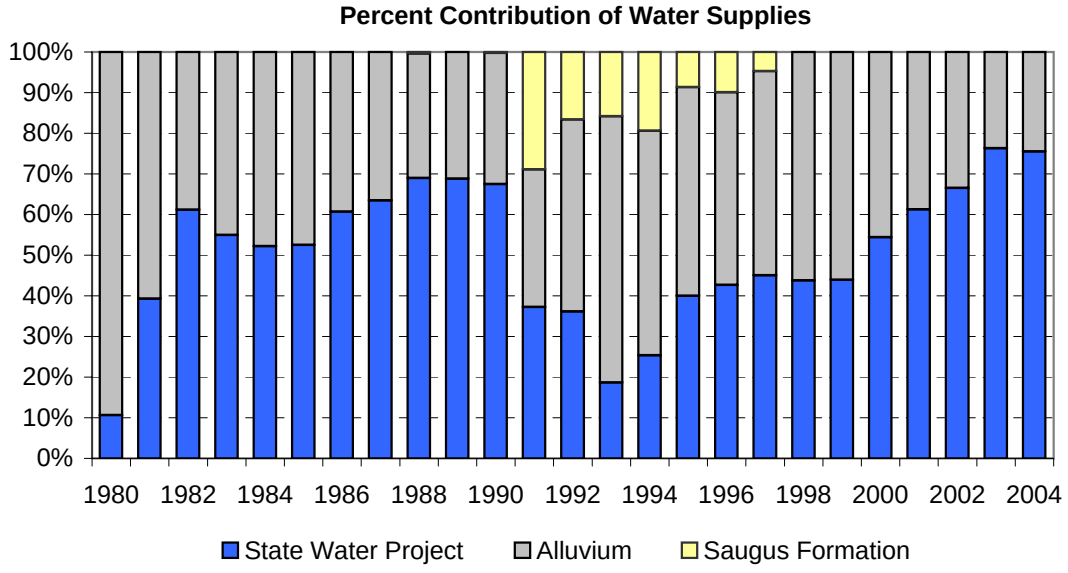


Table II-4
Water Supplies for Valencia Water Company
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	0	5,995	2,206	-	**8,201**
1981	1,214	5,597	2,329	-	**9,140**
1982	3,060	3,415	897	-	**7,372**
1983	3,764	3,387	611	-	**7,762**
1984	4,140	4,975	854	-	**9,969**
1985	4,641	4,633	885	-	**10,159**
1986	5,051	5,167	1,427	-	**11,645**
1987	6,190	4,921	1,305	-	**12,416**
1988	7,027	4,835	2,300	-	**14,162**
1989	7,943	5,826	2,529	-	**16,298**
1990	7,824	5,232	3,516	-	**16,572**
1991	700	9,951	4,642	-	**15,293**
1992	6,338	6,615	2,385	-	**15,338**
1993	8,424	5,815	2,182	-	**16,421**
1994	7,978	6,847	2,565	-	**17,390**
1995	7,259	8,698	1,586	-	**17,543**
1996	6,962	12,433	326	-	**19,721**
1997	9,919	11,696	516	-	**22,131**
1998	9,014	10,711	149	-	**19,874**
1999	10,806	11,823	106	-	**22,735**
2000	12,004	12,179	1,007	-	**25,190**
2001	13,362	10,518	835	-	**24,715**
2002	15,792	11,603	965	-	**28,360**
2003	16,004	11,707	1,068	700	**29,479**
2004	18,410	9,862	1,962	448	**30,682**

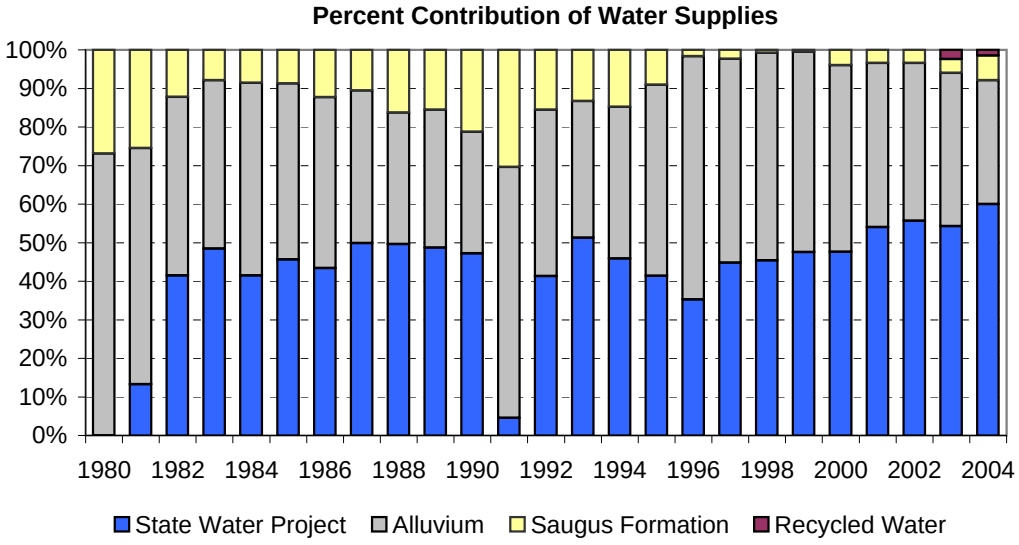


Table II-5
Total Water Supplies for Municipal Purveyors*
(Acre-Feet)

* includes LACWD 36, NCWD, SCWD and VWC

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	1,125	16,625	4,569	-	**22,319**
1981	5,816	14,056	4,950	-	**24,822**
1982	9,659	8,684	3,569	-	**21,912**
1983	9,185	8,803	3,398	-	**21,386**
1984	10,996	12,581	3,809	-	**27,386**
1985	11,823	12,519	4,140	-	**28,482**
1986	13,759	12,418	4,975	-	**31,152**
1987	16,285	12,630	4,962	-	**33,877**
1988	19,033	12,197	6,404	-	**37,634**
1989	21,618	13,978	7,217	-	**42,813**
1990	21,613	13,151	8,302	-	**43,066**
1991	7,968	17,408	14,417	-	**39,793**
1992	13,911	16,897	10,458	-	**41,266**
1993	13,393	19,808	10,151	-	**43,352**
1994	14,389	20,068	11,531	-	**45,988**
1995	16,996	20,590	8,087	-	**45,673**
1996	18,093	24,681	7,373	-	**50,147**
1997	22,148	25,273	6,752	-	**54,173**
1998	20,254	23,898	4,706	-	**48,858**
1999	27,282	27,240	2,728	-	**57,250**
2000	32,579	25,216	3,193	-	**60,988**
2001	35,369	22,055	3,267	-	**60,691**
2002	41,768	22,097	4,360	-	**68,225**
2003	44,419	19,397	3,581	700	**68,097**
2004	47,205	18,970	5,701	448	**72,324**

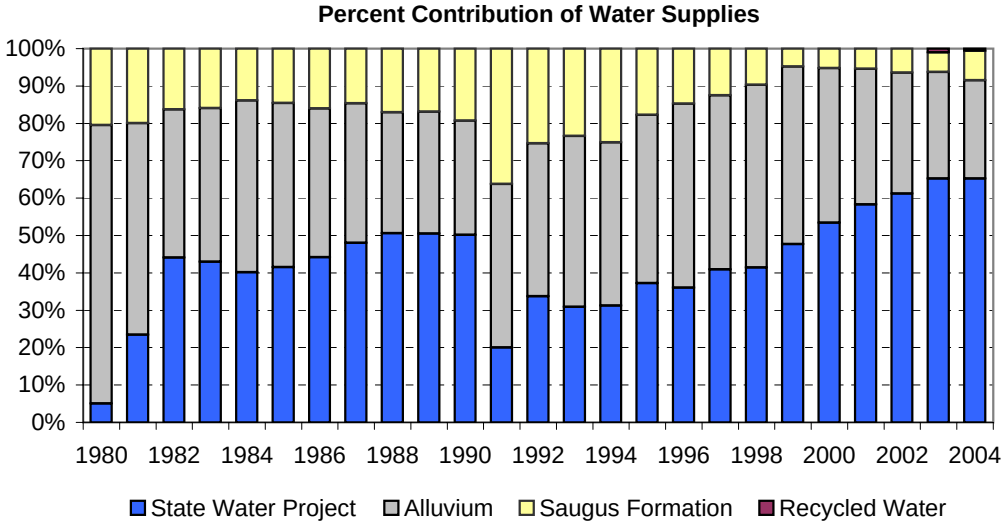


Table II-6
Water Supplies for Agriculture and Miscellaneous Uses
(Acre-Feet)

	Newhall Land and Farming			***Los Angeles County Honor Farm***			***Irrigation, Golf Courses and Miscellaneous Uses***		
Year	*Alluvium*	*Saugus Formation*	**Total**	*Alluvium*	*State Water Project*	**Total**	*Alluvium* [1]	*Saugus Formation* [2]	**Total**
1980	11,331	20	**11,351**	3,000	0	**3,000**	500	0	**500**
1981	13,237	20	**13,257**	3,000	0	**3,000**	500	0	**500**
1982	9,684	20	**9,704**	3,000	0	**3,000**	500	501	**1,001**
1983	7,983	20	**8,003**	3,000	0	**3,000**	500	434	**934**
1984	11,237	20	**11,257**	3,000	0	**3,000**	500	620	**1,120**
1985	9,328	20	**9,348**	3,000	0	**3,000**	500	555	**1,055**
1986	8,287	20	**8,307**	3,000	0	**3,000**	500	490	**990**
1987	6,512	20	**6,532**	3,000	0	**3,000**	500	579	**1,079**
1988	5,951	20	**5,971**	3,000	0	**3,000**	500	504	**1,004**
1989	6,243	20	**6,263**	3,000	0	**3,000**	500	522	**1,022**
1990	8,225	20	**8,245**	2,000	0	**2,000**	500	539	**1,039**
1991	7,039	20	**7,059**	2,240	0	**2,240**	500	480	**980**
1992	8,938	20	**8,958**	1,256	987	**2,243**	500	446	**946**
1993	8,020	20	**8,040**	1,798	443	**2,241**	500	439	**939**
1994	10,606	20	**10,626**	1,959	311	**2,270**	500	474	**974**
1995	11,174	20	**11,194**	2,200	6	**2,206**	500	453	**953**
1996	12,020	266	**12,286**	1,237	780	**2,017**	500	547	**1,047**
1997	12,826	445	**13,271**	1,000	1,067	**2,067**	500	548	**1,048**
1998	10,250	426	**10,676**	2,000	12	**2,012**	500	423	**923**
1999	13,824	479	**14,303**	1,842	20	**1,862**	500	509	**1,009**
2000	11,857	374	**12,231**	1,644	3	**1,647**	932	513	**1,445**
2001	12,661	300	**12,961**	1,604	0	**1,604**	953	573	**1,526**
2002	13,514	211	**13,725**	1,602	0	**1,602**	890	589	**1,479**
2003	10,999	122	**11,121**	2,273	0	**2,273**	909	504	**1,413**
2004	10,991	268	**11,259**	2,725	0	**2,725**	1,071	535	**1,606**

1. Robinson Ranch Golf Course irrigation and estimated private pumping.
2. Valencia Country Club and Vista Valencia Golf Course irrigation.

Table II-7
Total Water Supplies for Agriculture and Miscellaneous Uses
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	14,831	20	**14,851**
1981	0	16,737	20	**16,757**
1982	0	13,184	521	**13,705**
1983	0	11,483	454	**11,937**
1984	0	14,737	640	**15,377**
1985	0	12,828	575	**13,403**
1986	0	11,787	510	**12,297**
1987	0	10,012	599	**10,611**
1988	0	9,451	524	**9,975**
1989	0	9,743	542	**10,285**
1990	0	10,725	559	**11,284**
1991	0	9,779	500	**10,279**
1992	987	10,694	466	**12,147**
1993	443	10,318	459	**11,220**
1994	311	13,065	494	**13,870**
1995	6	13,874	473	**14,353**
1996	780	13,757	813	**15,350**
1997	1,067	14,326	993	**16,386**
1998	12	12,750	849	**13,611**
1999	20	16,166	988	**17,174**
2000	3	14,433	887	**15,323**
2001	0	15,218	873	**16,091**
2002	0	16,006	800	**16,806**
2003	0	14,181	626	**14,807**
2004	0	14,787	803	**15,590**

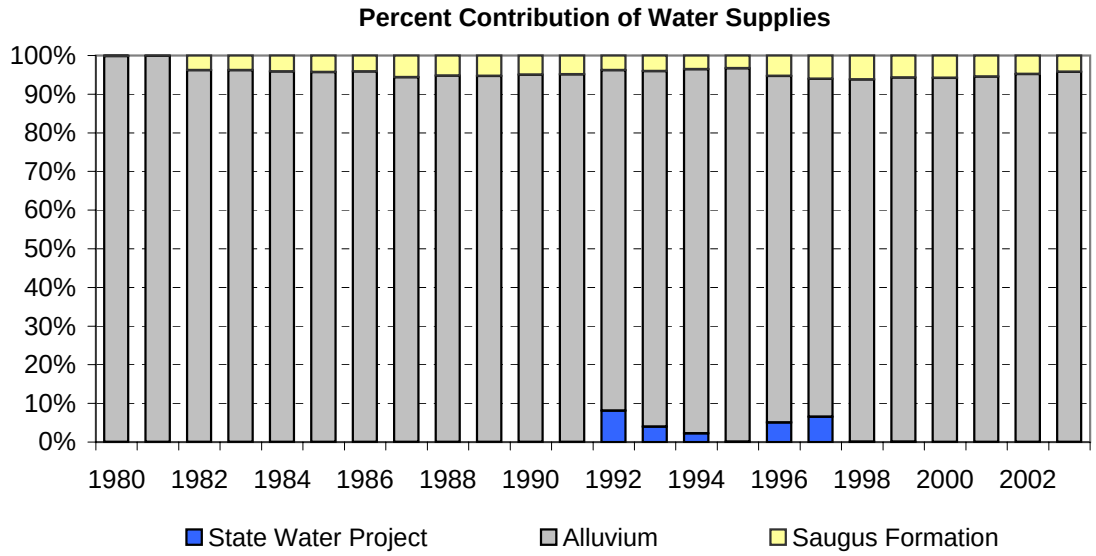
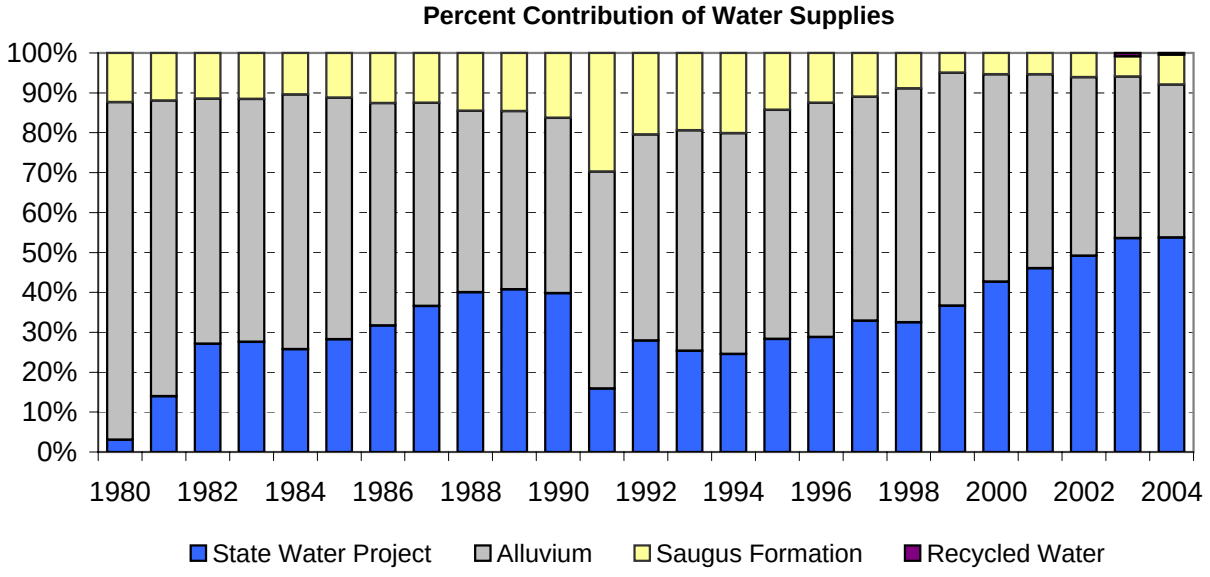


Table II-8
Total Water Supplies for Municipal, Agriculture and Miscellaneous
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	1,125	31,456	4,589	-	**37,170**
1981	5,816	30,793	4,970	-	**41,579**
1982	9,659	21,868	4,090	-	**35,617**
1983	9,185	20,286	3,852	-	**33,323**
1984	10,996	27,318	4,449	-	**42,763**
1985	11,823	25,347	4,715	-	**41,885**
1986	13,759	24,205	5,485	-	**43,449**
1987	16,285	22,642	5,561	-	**44,488**
1988	19,033	21,648	6,928	-	**47,609**
1989	21,618	23,721	7,759	-	**53,098**
1990	21,613	23,876	8,861	-	**54,350**
1991	7,968	27,187	14,917	-	**50,072**
1992	14,898	27,591	10,924	-	**53,413**
1993	13,836	30,126	10,610	-	**54,572**
1994	14,700	33,133	12,025	-	**59,858**
1995	17,002	34,464	8,560	-	**60,026**
1996	18,873	38,438	8,186	-	**65,497**
1997	23,215	39,599	7,745	-	**70,559**
1998	20,266	36,648	5,555	-	**62,469**
1999	27,302	43,406	3,716	-	**74,424**
2000	32,582	39,649	4,080	-	**76,311**
2001	35,369	37,273	4,140	-	**76,782**
2002	41,768	38,103	5,160	-	**85,031**
2003	44,419	33,577	4,207	700	**82,904**
2004	47,205	33,757	6,503	448	**87,914**



III. Water Supplies

Prior to 1980, local groundwater extracted from the Alluvium and the Saugus Formation was the sole source of water supply in the Santa Clarita Valley. Since 1980, local groundwater supplies have been supplemented with imported SWP water supplies. In 2003, those water supplies began to be augmented by the initiation of deliveries from CLWA's recycled water program. Ongoing expansion of this program is anticipated to increase the recycled water supply. This section describes the groundwater resources of the Santa Clarita Valley, SWP water supplies, and CLWA's recycled water program.

3.1 Santa Clara River Valley Groundwater Basin – East Subbasin

The groundwater basin generally beneath the Santa Clarita Valley, identified in the State Department of Water Resources' Bulletin 118 as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin No. 4-4.07), is comprised of two aquifer systems. The Alluvium generally underlies the Santa Clara River and its several tributaries, and the Saugus Formation underlies practically the entire Upper Santa Clara River area. There are also some scattered outcrops of Terrace deposits in the basin that likely have the capacity to contain limited amounts of groundwater. However, since these deposits are located in limited areas that are situated at elevations above the regional water table and are also of limited thickness, they are of no practical significance as aquifers and have consequently not been developed for any significant water supply. The mapped extent of the Santa Clara River Valley East Subbasin in DWR Bulletin 118 and its relationship to the extent of the CLWA service area are illustrated in Figure III-1. The subbasin boundary approximately coincides with the outer extent of the Alluvium and Saugus Formation.

A 2001 Update Report on both the Alluvium and Saugus Formation Aquifers (Slade, 2002), which updated analyses and interpretation of hydrogeologic conditions from earlier reports (Slade, 1986 and 1988), included extensive detail on major aspects of the groundwater basin. Notable parts of the Update Report include:

- Description of the extensive additional data available since the original Alluvium and Saugus Formation reports were prepared in 1986 and 1988, respectively;
- Organization of historic data into a Geographic Information System (GIS) database;
- Description of the overall groundwater basin in conformance with that being mapped by the State Department of Water Resources;
- Analysis of historical groundwater levels and production, and conclusions that there have been no conditions that would be illustrative of groundwater overdraft;
- Suggestion that utilization of operational yield (as opposed to perennial yield) as a basis for managing groundwater production would be more applicable in this basin to reflect fluctuating utilization of groundwater in conjunction with imported SWP water;

- Conclusion that operational yield of the Alluvium would typically be as included in the UWMP: 30,000 to 40,000 afy for wet and normal rainfall years, with an expected reduction into the range of 30,000 to 35,000 afy in dry years;

- Conclusion that operational yield of the Saugus Formation could also be as included in the UWMP: in the range of 7,500 to 15,000 afy on a long-term basis, with short-term increases during dry periods into a range of 15,000 to 25,000 afy, and to 35,000 afy if dry conditions continue.

In 2004, as part of analyzing the restoration of perchlorate-impacted groundwater supply, a numerical groundwater flow model was utilized to analyze the response of the groundwater basin to long-term operation at the operational yields noted above. Resultant projections of groundwater levels, groundwater storage, and surface water flows showed the basin to respond in a long-term sustainable manner, with no chronic depletion of groundwater levels, storage, or stream flows (CH2M Hill, 2004).

3.2 Alluvium – General

The Alluvial aquifer system, of Quaternary to Holocene (Recent) geologic age, consists primarily of stream channel and flood plain deposits of the Santa Clara River and its tributaries. The Alluvium is deepest along the center of the present river channel, with a maximum thickness of about 200 feet near the area known as Saugus. It thins toward the flanks of the adjoining hills and toward the eastern and western boundaries of the basin and, in the tributaries, becomes a mere veneer in their upper reaches. The spatial extent of the Alluvium throughout the basin is illustrated in Figure III-1.

Groundwater generally moves toward the outlet of the basin, which is also the outlet of the Upper Santa Clara River HA. Thus, groundwater movement in the Alluvium beneath the tributaries is toward their confluence with the Santa Clara River and then westward in the Alluvium. From about Castaic Junction to Blue Cut, the Alluvium thins and narrows. This configuration forces groundwater to rise, keeping the depth to water at or close to the land surface. As discussed in more detail below, the general groundwater flow direction has remained unchanged whether groundwater levels are high or intermittently depressed. The San Gabriel and Holser faults traverse the basin but neither fault measurably affects groundwater levels or flows in the Alluvium.

Alluvial wells are distributed throughout the basin along the Santa Clara River and its southwest draining tributaries. Figure III-2 illustrates the location of the Purveyor-operated Alluvial wells and other Alluvial wells considered in this water report. The Alluvium is the most permeable of the local aquifer units. Based on well yields and aquifer testing, estimated transmissivity values of 50,000 to 500,000 gallons per day per foot have been reported for the Alluvium, with the higher values where the Alluvium is thickest in the center of the valley and generally west of Bouquet Canyon. The amount of groundwater in storage in the Alluvium can vary considerably because of the effects of recharge, discharge, and pumping from the aquifer. The maximum storage capacity of the Alluvium has been estimated to be 240,000 acre-feet (af).

Consistent with the 2001 Update Report and the UWMP, the current management practice of the Purveyors is to maximize use of the Alluvium because of the aquifer's ability to store and produce good quality water on a sustainable basis, and because the Alluvium is capable of rapid recovery of water levels and storage in wet periods. As with many groundwater basins, it is possible to intermittently exceed a long-term average yield for one or more years without long-term adverse effects. Higher pumpage for short periods may temporarily lower groundwater storage and related water levels, as has been the case in the Alluvium several times since the 1930's. However, subsequent decreases in pumpage limit the amount of water level decline, and normal to wet-period recharge result in a rapid return of groundwater levels to historic highs. Historical groundwater data collected from the Alluvium over many hydrologic cycles provide assurance that groundwater elevations, if locally lowered, recover in average or wet years following dry periods during which the groundwater elevations have declined. Such water level response to rainfall is a significant characteristic of permeable, porous, alluvial aquifer systems that occur within large watersheds. In light of these historical observations, complemented by the results of the recently developed groundwater flow model, there is ongoing confidence that groundwater can continue to be a sustainable source of water supply at the rates of pumping described in the 2001 Update Report and in the 2000 UWMP.

Long-term adverse impacts to the Alluvium could occur if the amount of water extracted from the aquifer exceeds the amount of water that recharges the aquifer over an extended period. However, the quantity and quality of water in the Alluvium and pumpage from the Alluvium are routinely monitored, and no long-term adverse impacts are evident. However, the Purveyors have identified cooperative measures to be taken if needed, to ensure sustained use of the aquifer. Such measures include but are not limited to the continuation of conjunctive use of imported SWP surface water with local groundwater, artificial recharge of the aquifer with local runoff or other surface water supplies, financial incentives discouraging extractions above a selected limit, and expanded use of other alternative supplies such as recycled water.

3.2.1 Alluvium – Historical and Current Conditions

Total pumpage from the Alluvium in 2004 was about 33,800 af, essentially the same as the preceding year with an increase of about 200 af. Of the total Alluvial pumpage in 2004, about 56 percent (19,000 af) was for municipal water supply, and the balance, about 44 percent (14,800 af), was for agriculture and other (minor) miscellaneous uses.

Alluvial pumpage has been recorded beginning in the mid-1940's, and consistently since 1980. When pumpage records are unavailable, data have been approximated to obtain a continuous historic record (Figure III-3). Alluvial pumpage from private wells, estimated to be at most 500 afy, has been included in the total Alluvial pumpage. Over the last two decades, since the inception of SWP deliveries in 1980, total pumpage from the Alluvium has ranged from a low of about 20,000 afy (in 1983) to slightly more than 43,000 afy (in 1999). Agricultural pumpage remained stable from the mid-1940's through about 1960, generally ranging from 33,000 to 37,000 afy, with annual pumpage as high as 41,000 af. From 1960 through the late 1970's, agricultural pumpage declined in a nearly linear trend, and has fluctuated slightly since then, between approximately 10,000 and 16,000 afy. As agricultural pumpage declined, municipal

pumpage from the Alluvium increased from less than 4,000 afy in the 1950's to approximately 17,000 afy in 1980. Beginning in 1980 with the importation of SWP water, municipal pumpage from the Alluvium declined to about 12,500 afy and remained stable throughout the 1980's. Municipal pumpage has subsequently increased to the current range of approximately 20,000 to 25,000 afy. Overall, there has been a change in municipal/agricultural pumping distribution since 1980, toward a slightly higher fraction for municipal water supply (from about 50 percent to nearly 60 percent of Alluvial pumpage), which reflects the general land use changes in the area.

Historical estimates (Slade, 1986, 2002; Amended 2000 UWMP; CH2M Hill, 2004) have suggested and shown that the operational yield of the Alluvium is from 30,000 to 40,000 afy in average and wet years, and in the range of 30,000 to 35,000 afy in dry years. On a long-term basis since the importation of SWP water, total Alluvial pumpage has been about 30,500 afy (31,300 af in years with less-than-average precipitation, and 29,400 af in years with greater-than-average precipitation). These averages are at the lower end of the range of operational yield of the Alluvium.

Groundwater levels in various parts of the basin have historically exhibited different responses to both pumpage and climatic fluctuations. During the last 20 to 30 years, in essentially all the alluvial portions of the basin, groundwater levels have fluctuated from near the ground surface when the basin is full, to as much as 100 feet lower during intermittent dry periods of reduced recharge. Figure III-2 groups the Alluvial wells into areas with similar groundwater level fluctuations. Figures III-4 and III-5 present historical groundwater levels organized into hydrograph form (groundwater elevation vs. time) for four areas throughout the basin. The other areas shown in Figure III-2 exhibit groundwater level responses that are similar to those in these four areas.

The 'Mint Canyon' area is located at the far eastern end of the groundwater basin along the Santa Clara River. In this area, the Alluvium is shallower than in the westerly parts of the basin; consequently, the area has historically exhibited the most dramatic responses to climatic fluctuations. The 'Above Saugus WRP' and 'Bouquet Canyon' areas generally exhibit groundwater level responses that are similar to those in the 'Mint Canyon' area. As described and discussed above, the Alluvium has historically experienced a number of alternating wet and dry hydrologic conditions (Figures III-4 and III-5) during which groundwater level declines are followed by returns to historic highs. Since the Alluvium is thinner to the east, the resulting groundwater fluctuations are most dramatic in this area, up to 75 to 100 feet. When water levels are low, well yields and pumping capacities in this area can be impacted. The affected Purveyors respond by increasing use of Saugus Formation and imported (SWP) supplies, as shown in Table II-8. The Purveyors also shift a fraction of the Alluvial pumpage that would normally be supplied by 'Mint Canyon' area wells to areas further west, where well yields and pumping capacities remain fairly constant because of smaller groundwater level fluctuations. As shown in Figure III-6, the Purveyors decreased total Alluvial pumpage from the 'Mint Canyon' area steadily from 2000 through 2003, and offset these decreases by increasing pumpage in the 'Below Saugus WRP' and 'Below Valencia WRP' areas. This allowed the Purveyors to maximize the available supply from the Alluvium during dry periods to best meet demand. In spite of a continued period of below-average precipitation from 1999 to 2003, groundwater

levels in the ‘Mint Canyon’ area ceased to decline in 2002 and 2003. This is illustrative of the Purveyor’s integrated use of surface water and groundwater to maintain local groundwater resources within their overall yield during dryer than average periods.

The ‘Below Saugus WRP’ area is located along the Santa Clara River immediately downstream of the Saugus Water Reclamation Plant. The ‘San Francisquito Canyon’ area generally exhibits groundwater level responses that are similar to those in the ‘Below Saugus WRP’ area. In this middle part of the basin, historical groundwater levels were lower in the 1950's and 60's than current levels. The historically lower groundwater levels were likely a result of the higher agricultural pumpage of the 1950's before the importation of SWP water. Increased return flows to the river from treated wastewater discharge have also more recently augmented groundwater recharge. Groundwater levels in this area notably recovered as pumpage declined through the 1960's and 1970's. They have subsequently sustained generally high levels for much of the last 30 years, with three dry-period exceptions: mid-1970's, late 1980's to early 1990's, and the late 1990’s to early 2000’s. Recoveries to previous high groundwater levels followed both of the short dry-period declines in the 1970's and 1990's. Most recently, groundwater levels have recovered significantly following a wetter-than-average year in 2004 and heavy precipitation in January 2005, indicating that the groundwater level decline that occurred from 1999-2004 also represented a temporary dry-period decline.

The ‘Castaic Valley’ area is located along Castaic Creek below Castaic Lake. In that area, groundwater levels have remained fairly constant, with slight responses to climatic fluctuations, since the 1950’s.

The ‘Below Valencia’ WRP area is located along the Santa Clara River downstream of the Valencia Water Reclamation Plant, and receives recharge from the treated wastewater discharged from the Valencia WRP to the Santa Clara River. Groundwater levels in this area exhibit slight, if any, response to climatic fluctuations, and have remained fairly constant since the 1950’s despite, over the last 20 years, a notable increase in pumping in that area.

As previously mentioned, it is possible to intermittently utilize some water from storage in the aquifer, such as has historically been the case in the eastern part of the basin. This results in temporarily lower groundwater levels, which subsequently recover during periods of reduced pumpage or higher than average precipitation. Records of groundwater levels, pumpage and precipitation suggest that declines and subsequent rises in groundwater levels are influenced more by fluctuations in the availability of water for recharge than by pumpage. When less water is available for recharge, during periods of lower-than-average precipitation and streamflow, groundwater levels decline even when pumpage remains constant. Conversely, when an abundance of water is available for recharge because of wet conditions, pumpage can increase significantly without affecting groundwater levels.

During the period from 1984 through 1991, which experienced eight consecutive years of lower than average precipitation (with one average year in the middle), pumpage from the Alluvium averaged 24,000 afy, well below the dry-year operational yield. During this same period, water levels declined over 80 feet in the eastern part of the basin. Subsequently, from 1992 to 1996, when precipitation was generally higher than average, groundwater levels recovered to and

maintained historic highs, despite a steady increase in annual pumpage. From 1999 to 2003, precipitation was again generally lower than average but average pumping from the Alluvium had increased to about 38,400 afy; as a result, during that period, groundwater levels again declined in some areas. Annual pumpage from the Alluvium has now decreased from 2000 to present, and is currently within the operational yield. The previous annual report stated that it was likely that groundwater levels would not return to historic highs until a period of higher-than-average precipitation occurred. As mentioned above, early 2005 data indicates that groundwater levels have already recovered significantly (approaching historic highs) in response to very high precipitation and runoff in January.

In summary, depending on the period of available data, all the history of groundwater levels in the Alluvium show the same general picture: recent (last 30 years) groundwater levels have exhibited historic highs; in some locations, there are intermittent dry-period declines (and an associated use of some groundwater from storage) followed by wet-period recoveries (and associated refilling of storage space). On a long-term basis, whether over the last 23 years since importation of supplemental SWP water, or over the last 40 to 50 years (since the 1950's - 60's), the Alluvium shows no signs of water level-related overdraft, i.e., no trend toward decreasing water levels and storage. Consequently, pumpage from the Alluvium has been and continues to be within the operational yield of that aquifer.

3.3 Saugus Formation – General

Late Pleistocene older Alluvium, known as terrace deposits, is elevated along the Santa Clara River to form terraces and mesas. These terrace deposits define the extent of the Saugus Formation in the groundwater basin. Because they are elevated, they usually lie above the regional water table and act as areas of infiltration and percolation to the underlying formation.

The Saugus Formation, of Pliocene to Pleistocene geologic age, has traditionally been divided into two stratigraphic units: the lowermost, geologically older Sunshine Ranch member, which is of mixed marine to terrestrial (non-marine) origin; and the overlying, or upper, portion of the Formation which is entirely terrestrial in origin. The Sunshine Ranch Member of the Saugus Formation has a maximum thickness of about 3,000 to 3,500 feet in the central part of the valley; however, due to its marine origin and fine-grained nature, it is not considered to be a viable source of groundwater for municipal or other water supply. Above the Sunshine Ranch Member, the Saugus Formation is coarser grained, consisting mainly of lenticular beds of sandstone and conglomerate that are interbedded with lesser amounts of sandy mudstone, which were deposited in stream channels, flood plains, and alluvial fans by one or more ancestral drainage systems in the valley. The sand and gravel units that represent aquifer materials in the upper part of the Saugus Formation are generally located between depths of about 300 and 2,500 feet. The spatial extent of the Saugus Formation throughout the basin is illustrated in Figure III-1.

While much thicker and more spatially extensive throughout the basin when compared to the Alluvium, and while significant in terms of groundwater storage and individual well capacity, the Saugus Formation has typically lower values of transmissivity, in the range of 80,000 to 160,000 gpd/ft, with the higher values in the upper portions of the Formation. The storage capacity of the Saugus has most recently been estimated to be 1.65 million acre-feet between

depths of 300 feet and approximately 2,500 feet (to the base of the Saugus, or to the base of fresh water if shallower than 2,500 feet). Groundwater in the Saugus Formation generally moves north along the South Fork of the Santa Clara River, towards the Santa Clara River and the outlet of the basin. Saugus wells operated by the Purveyors (shown in Figure III-7) are located in the southern portion of the basin, south of the Santa Clara River.

For long term planning purposes, the UWMP includes pumping from the Saugus in the range of 7,500 to 15,000 afy in average/normal years, a conservative estimate in light of historical estimates of potential recharge to the Saugus, complemented by observations of high groundwater levels in the overlying Alluvium over the last 30 years. The UWMP also includes planned dry-year pumping from the Saugus of 15,000 to 35,000 afy for one to three consecutive dry years, when shortages to CLWA's SWP water supplies could occur. Such high pumping would be followed by periods of lower pumpage (the 7,500 to 15,000 afy in average/normal years as noted above) in order to allow recharge to recover water levels and storage in the Saugus. Maintaining the substantial volume of water in the Saugus Formation is an important strategy to help maintain water supplies in the Santa Clarita Valley during drought periods.

3.3.1 Saugus Formation – Historical and Current Conditions

Total pumpage from the Saugus in 2004 was 6,500 af, an increase of about 2,300 af from the preceding year. Of the total Saugus pumpage in 2004, most (5,700 af) was for municipal water supply, and the balance (800 af) was for agricultural and other (minor) uses. The majority of pumpage from the Saugus (an average of about 90% of total Saugus pumpage) is for municipal supply. Groundwater pumpage from the Saugus peaked in the early 1990's and then steadily declined through the remainder of that decade. Saugus pumpage has subsequently increased gradually since 1999.

Historical pumpage records for the Saugus formation are limited prior to 1980, but suggest that pumpage from the Saugus was minimal at that time. When pumpage records are unavailable, data have been approximated to obtain a continuous historic record (Figure III-8). There was essentially no pumping from the Saugus prior to 1960 (on the order of about 100 af in most years, beginning in 1948). Some increased pumping for agricultural water supply (about 900 af) began in about 1962. The largest amount of agricultural pumping from the Saugus was during the mid-1960's, when annual pumpage was about 3,000 af. Agricultural pumping from the Saugus declined to near zero by the late 1970's, but has generally ranged from 500 to 1,000 afy since 1982. There was no Saugus pumpage for municipal supply in the early 1960's; post-1980 data suggests that municipal pumping from the Saugus began in the 1970's, and reached nearly 5,000 afy by 1980-81.

Historical estimates and recent analyses (Slade, 1988, 2002; Amended 2000 UWMP; CH2M Hill, 2004) have suggested and shown that the operational yield of the Saugus Formation is in the range of 7,500 to 15,000 afy in average years, with an increase to up to 35,000 afy in multiple dry-year periods. On a long-term average basis since the importation of SWP water, total pumpage from the Saugus Formation has ranged from a low of about 3,700 afy (in 1999) to a high of nearly 15,000 afy (in 1991); average pumpage from 1980 to present has been about 6,700 afy. These pumping rates are within, and generally at the lower end of the range of the

operational yield of the Saugus Formation.

Unlike the Alluvium, which has an abundance of wells with extensive water level records, the water level data for the Saugus Formation are limited by the distribution of the wells in this Formation and the periods of record. The wells that do have water level records extending back to the mid-1960's indicate that groundwater levels in the Saugus Formation were highest in the mid-1980's and are currently higher than they were in the mid-1960's (Figure III-9). Based on these data, there is no evidence of any historic or recent trend toward permanent water level or storage decline.

Records of groundwater levels, pumpage and precipitation suggest that declines and subsequent rises in groundwater levels in the Saugus Formation are more influenced by pumpage than by climatic fluctuations. Water levels in wells in the Saugus Formation are highly dependent on pumping in the respective well. In contrast to the Alluvium, where pumpage is fairly evenly distributed among a number of wells in a given area, there are fewer active wells in the Saugus Formation, and pumping at one well can create a localized pumping depression that is evident in groundwater level hydrographs. Water levels in the Saugus Formation also exhibit stronger seasonal (pumping) fluctuations over a year than in the Alluvium (generally more than 20 feet in active Saugus wells, as opposed to generally less than ten feet in Alluvial wells). These responses to pumping are characteristic of the lower transmissivity of the Saugus Formation.

During the period from 1985 through 1991, which experienced consecutive years of lower-than-average precipitation (with one average year in the middle), pumpage from the Saugus increased from 4,700 afy to nearly 15,000 afy, and groundwater levels declined more than 100 feet in some cases. However, the subsequent rise in water levels at an individual well depended on pumping at that well. For example (as illustrated in Figure III-9), pumping of Saugus wells declined dramatically beginning between 1993 and 1995, and water levels in individual wells subsequently rose when pumping decreased. From 1999 to 2003, water levels in the Saugus were stable and exhibited very slight, if any, response to less-than-average precipitation. The amount of pumpage from Saugus wells in 2004 was about the same as in 1997 and 1998, and groundwater levels were also about the same as in those years. A slight pumping depression is evident around active wells. Water levels in the Saugus remain at or above historic averages, and there is no trend toward a sustained decline in Saugus water levels or storage that would be indicative of overdraft.

Consistent with the 2001 Update Report and the UWMP, and consistent with the recently modeled basin response to UWMP pumping, the current management practice of the Purveyors is to maintain water levels in the Saugus Formation so this supply is available during drought periods, when available Alluvial groundwater and SWP supplies are anticipated to decrease. The period of increased pumpage during the late 1980's and early 1990's is a good example of this management strategy. Most notably, in 1991, when SWP deliveries were substantially reduced, increased pumpage from the Saugus made up almost half of the decrease in SWP deliveries. This increased Saugus pumpage resulted in short-term declining water levels reflecting the use of stored water. However, the water levels subsequently rose when pumpage declined, reflecting recovery of storage capacity of the Saugus Formation.

3.4 Imported Water

CLWA obtains water supplies from the SWP, which is managed by DWR. CLWA is one of 29 contractors holding long-term SWP contracts with the State of California DWR. SWP water originates from rainfall and snowmelt in northern and central California. Runoff is stored in Lake Oroville, which is the project's largest storage facility. The water is then released from Lake Oroville down the Feather River to the Sacramento River and the Sacramento-San Joaquin Delta. Water is diverted from the Delta into the Clifton Court Forebay, and then pumped into the 444-mile long California Aqueduct. SWP water is temporarily stored in San Luis Reservoir, which is jointly operated by DWR and the U.S. Bureau of Reclamation. Prior to delivery to CLWA, SWP supplies are stored in Castaic Lake, located at the end of the West Branch of the California Aqueduct.

CLWA's service area covers approximately 195 square miles (124,800 acres), including the entire City of Santa Clarita and the surrounding unincorporated communities. CLWA obtains SWP water from the upper reservoir at Castaic Lake. The water is treated, filtered and disinfected at CLWA's Earl Schmidt Filtration Plant and Rio Vista Water Treatment Plant. CLWA has a current capacity to treat a total of 63.5 million gallons per day. CLWA has nearly completed construction that will expand the Earl Schmidt Filtration Plant from its existing rated capacity of 33.5 million gallons per day to 56 million gallons per day. Plant expansion is scheduled to come on line in mid-2005. CLWA will then have combined treatment capacity of 86 million gallons per day. Treated water is delivered from the treatment plants by gravity flow to each of the four Purveyors through a distribution network of pipelines and turnouts. At present, CLWA delivers water to the four Purveyors through 11 turnouts.

In 2004, CLWA fulfilled the following major accomplishments in order to enhance, preserve, and strengthen the quality and reliability of existing and future supplies:

- Delivered approximately 32,000 af of SWP water to be banked in the Semitropic groundwater banking program;
- Continued construction for expansion of the Earl Schmidt Filtration Plant from 33.5 mgd to 56 mgd;
- Continued implementation of various water supply programs recommended in the Amended 2000 UWMP;
- Amended the 2000 UWMP to reflect updated information about perchlorate contamination;
- Continued implementation of the water conservation Best Management Practices, as recommended in the UWMP;
- Continued work under the Interim Settlement Agreement toward a possible long-term settlement that will accomplish containment of perchlorate and restoration of perchlorate-impacted water supply wells and associated cost recovery;
- Continued cooperative effort with the U.S. Army Corps of Engineers for characterization studies of the former Whittaker-Bermite site and in a task force effort with the City of Santa Clarita, local legislators, and state agencies to affect the cleanup and remediation of all aspects of the former Whittaker-Bermite site, including the perchlorate groundwater contamination;

- Obtained $700,000 in Federal funding for continued analysis of perchlorate contamination and $500,000 for expansion of recycled water system;
- Continued recycled water service.

3.4.1 State Water Project Table A Supplies

Each SWP contractor has a specified water supply amount shown in Table A of its contract that currently totals approximately 4.1 million af. The term of the contract is through 2035 and is renewable after that year. Although the SWP has not been fully completed, the SWP can deliver all of the 4.1 million af of Table A Amounts during very wet years.

CLWA has a contractual Table A Amount of 95,200 af per year of water from SWP. The original contract for 23,000 af was signed in 1960 and the Table A Amount was later increased to 41,500 af. CLWA increased its Table A Amount to its current level of 95,200 af by purchasing 12,700 af from Devil's Den Water District in 1988 and acquiring 41,000 af in 1999 from Kern County Water Agency and its member district, the Wheeler Ridge-Maricopa Water Storage District (WRMWSD).

CLWA acquired the 41,000 af from WRMWSD by way of a Table A water transfer agreement executed in March 1999. CLWA prepared an environmental impact report (EIR) to address the environmental consequences of the transfer agreement. The environmental review for the project by CLWA was the subject of litigation in Los Angeles Superior Court. CLWA prevailed in the EIR litigation at the trial court; however, the project opponents (Friends of the Santa Clara River) filed an appeal.

In January 2002, the Court of Appeal issued a decision ordering the Superior Court to decertify the EIR for the transfer agreement on the grounds that it had tiered off of another EIR that had been subsequently decertified in other litigation. In doing so, however, the Court of Appeal also examined all of the plantiffs' other arguments, found them to be without merit, and held that, if the tiering problem had not arisen, it would have affirmed the earlier trial court judgment upholding the EIR.

The Court of Appeal did not invalidate any portion of the completed 41,000 afy transfer agreement. Instead, the Court directed the trial court to vacate certification of the EIR, and to retain jurisdiction until CLWA corrects the tiering technicality by preparing a new EIR. In September 2002, the Los Angeles Superior Court refused to prohibit CLWA from using the 41,000 af of Table A water while a new EIR is being prepared. The Superior Court decision on remand was appealed by Friends of the Santa Clara River to the appellate court in January 2003. In December 2003, the appellate court denied any relief to Friends and affirmed the trial court's ruling.

The new EIR was released for public review and comment in April 2004. It was subsequently certified by the CLWA Board of Directors on December 23, 2004. On January 24, 2005, separate lawsuits challenging the environmental review for this same project were filed by California Water Impact Network and Planning and Conservation League in the Ventura County

Superior Court. Hearings on motions to transfer the cases to the Los Angeles Superior Court are pending.

CLWA's final allocation of Table A for 2004 was 65 percent, or 61,880 af. On December 1, 2003, the initial allocation for 2004 was announced as 35 percent. On March 1, 2004, it was raised to the final allocation of 65 percent. Utilizing SWP contract provisions, CLWA elected to "carry over" unused remaining Table A Amount into 2005. As of April 21, 2005, CLWA's allocation of Table A for 2005 is 80 percent, or 76,160 af.

As shown in Table III-1, due to the 65 percent allocation, CLWA had excess SWP water in 2004. As DWR increased the allocation through the year, and due to a total of 35,785 af of carryover from 2003 and 1,618 af of Article 21 water, the total available SWP supply in 2004 was 99,283 af. CLWA deliveries were 47,205 af to the Purveyors and 3,776 af to Devil's Den Ranch, with 15,522 af of the 2004 Table A Amount for potential carryover to 2005.

As noted above, CLWA had slightly more than 35,000 af of excess Table A water in 2003, which it elected to carry over to 2004. The CLWA Board of Directors instructed staff to search out possibilities for storing the excess water in a groundwater banking program. An agreement was reached with the Semitropic Water Storage District in Kern County, and 32,522 af were banked in Semitropic's 2003 groundwater bank account. Of that amount, CLWA can withdraw up to 29,270 af as a short-term dry year supply over the next ten years (until 2013). Combined with 24,000 af banked in Semitropic's 2002 account, of which 21,600 af can be withdrawn, CLWA now has a total of 50,870 af of short-term dry year supply available for extraction from groundwater storage in Kern County.

3.4.2 Imported Water Supply Reliability

In May 2003 the Department of Water Resources finalized its State Water Project Delivery Reliability Report. This report is intended to assist SWP contractors in assessing the adequacy of the SWP component of their overall supplies.

The Reliability Report is based on a computer model commonly known as CALSIM II, which calculates SWP delivery probabilities under different hydrologic year types, based on long-term historical data and a variety of operating parameters. The analyses contained in the report conclude the SWP, using existing facilities and operated under current regulations, can deliver an average of 76 percent of the primary contractual supply (defined as the Table A Amount) at the 2021B level of development described in the report. During infrequent dry periods, deliveries are projected to be less than 50 percent, and possibly as low as 19 percent during an unusual single dry year condition that historically occurs about once every 70 years. During very wet years, full contract amounts are available.

The report will be updated with new information and calculations of delivery reliability every two years. The report is available on-line at *http://swpdelivery.water.ca.gov/*.

Some of the most significant opportunities for meeting the future water supply needs of the Santa Clarita Valley are from supplies available from the SWP. In the resource planning process of the

Table III-1
2004 CLWA State Water Project Supply and Demand Schedule
(acre-feet)

Supply		
Net 2003 Carryover to 2004 [1]		3,263
CLWA 2004 Final Allocation [2]		61,880
Article 21 Water		1,618
Total 2004 SWP Supply [1]		**66,761**
Demand		
Purveyor Deliveries (Total)		47,205
CLWA SCWD	*22,045*	
Valencia Water Company	*18,410*	
Newhall County Water District	*5,896*	
Los Angeles County WWD 36	*854*	
CLWA/ Purveyor Metering		258
Devils Den Ranch		3,776
2004 Table A Carryover to 2005 [3]		15,522
Total 2004 SWP Demand [4]		**66,761**

1. Total Carryover from 2003 was 35,785 af, resulting in a total 2004 SWP supply of 99,283 af; of that amount, 32,522 af were banked in Semitropic WSD, leaving a net carryover of 3,263 af.

2. Final 2004 allocation was 65% of contractual Table A amount of 95,200 acre-feet, which progressed as follows:

Initial allocation (Dec. 1, 2003)	35%
Allocation increase (Jan. 15, 2004)	50%
Final allocation (March 1, 2004)	65%

3. Total excess 2004 SWP supply; of that amount, 13,865 af spilled in early 2005 at San Luis Reservoir, leaving a net carryover of 1,657 af.

4. Includes total 2004 Table A carryover.

SWP, there are a number of complex issues facing delivery of CLWA's Table A Amount of 95,200 af. These factors include annual hydrologic conditions, environmental requirements, and evolving policies in the Bay-Delta. However, there are a number of programs and approaches that improve reliability of SWP water supplies.

Groundwater banking and conjunctive use offer significant opportunities to improve water supply reliability for CLWA. Groundwater banking is the process of storing available supplies of water during wet years in groundwater basins. Conjunctive use is the coordinated operation of multiple water supplies to achieve improved supply reliability. During wet periods, additional surface water supplies from the SWP can be used to recharge a local groundwater basin and then recovered for delivery during dry periods. In 2002 and 2003 CLWA took advantage of such a program on a short-term basis (10 years or less) by placing 24,000 af of available 2002 Table A water and 32,522 af of 2003 Table A water in the Semitropic Water Storage District's Groundwater Banking Program. Over the next ten years, CLWA can withdraw up to 50,870 af of that stored water to meet valley demands when needed. The Amended 2000 UWMP Supplement includes additional information about these and other programs.

3.5 Water Quality – General

Water delivered by the Purveyors consistently meets drinking water standards set by the Environmental Protection Agency (EPA) and the California Department of Health Services (DHS). The Purveyors in turn supply this safe and potable water to their customers. An annual Consumer Confidence Report is provided to all Santa Clarita Valley residents who receive water from one of the four water retailers. In that report, there is detailed information about the results of quality testing of the groundwater and treated SWP water supplied to the residents of the Santa Clarita Valley during 2004.

Water quality regulations are constantly changing as contaminants that are typically not found in drinking water are being discovered, and new standards are adopted. In addition, existing water quality standards are becoming more stringent in terms of allowable levels in drinking water. In light of these changes, several constituents of particular interest are discussed in more detail below.

<u>Total Trihalomethanes</u>
In 2002, the United States Environmental Protection Agency implemented the new Disinfectants and Disinfection Byproducts Rule. In part, this rule establishes a new MCL of 80 ug/L (based on an annual running average) for Total Trihalomethanes (TTHM). TTHMs are a byproduct that is created when free chlorine is used as a means for disinfection. In December 2004, as part of regular quarterly TTHM monitoring, Newhall CWD detected TTHM concentrations that resulted in the running annual average TTHM concentrations to slightly exceed the MCL of 80 parts per billion (ppb) in its Pinetree and Tesoro service areas. The respective running average annual TTHM concentrations for the fourth quarter 2004 were 82.6 ppb and 80.8 ppb. In August 2004, Los Angeles County WWD 36 reported its running annual average TTHM concentration to also exceed the MCL, in that case at 88 ppb. To address potential TTHM formation in the future, CLWA and the Purveyors are implementing an alternative method of disinfection (i.e., chloramination) to be able to maintain compliance with the new rule and future regulations

relating to disinfection byproducts.

Arsenic

The United States Environmental Protection Agency has revised the Federal MCL for arsenic from 50 ug/L to 10 ug/L. Compliance with the Federal standard is not required until 2006. In April 2004, the Office of Environmental and Health Hazard Assessment (OEHHA) finalized a new Public Health Goal (PHG) for arsenic at 4 parts per trillion (ppt). State Health and Safety Code required DHS to establish a new MCL for arsenic by June 30, 2004. Because the PHG was not available until April of that year, the process for establishing the new arsenic MCL has been delayed. DHS has not made public a revised schedule for the MCL process. Historically, naturally occurring arsenic has been detected at concentrations of less than 5 ug/L in a few local groundwater supplies, and at concentrations of less than 3 ug/L in SWP water supplies. Most groundwater wells in the valley have non-detectable (less than 2 ug/L) concentrations of arsenic.

Perchlorate

Perchlorate has been a water quality concern in the Valley since 1997 when it was originally detected in four Saugus wells operated by the Purveyors in the eastern part of the Saugus Formation, near the former Whittaker-Bermite facility. In late 2002, perchlorate was detected in a fifth municipal well, in this case an Alluvial well also located near the former Whittaker-Bermite site. In early 2005, perchlorate was detected in a second Alluvial well near the former Whittaker-Bermite site. The six perchlorate-impacted wells have been removed from active water supply service. The Purveyors are continuing to test for perchlorate in all of their active Alluvial and Saugus wells. The current DHS Notification Level for perchlorate is 6 micrograms per liter (ug/l). DHS currently anticipates proposing a Maximum Contaminant Level (MCL) for perchlorate in 2005.

In the meantime, the impacted Purveyors (CLWA, SCWD, NCWD, and VWC) and CLWA are developing a plan for a water treatment process to restore the impacted pumping capacity as soon as possible. The plan for restoring “severely impaired” water sources such as the perchlorate-impacted wells must comply with the provisions of the State Department of Health Services’ (DHS) Policy Memo 97-005. Work on the documentation required by Policy Memo 97-005 continued in 2004 on interrelated fronts: 1) development of a pumping plan for restoration of some perchlorate-impacted groundwater supply by installing treatment at two impacted wells, together with a plan for construction of replacement wells to restore the balance of impacted groundwater supply; 2) analysis of the capture zones around wells to contain further migration of perchlorate and protect non-impacted wells; 3) analysis of overall groundwater reliability during the period before restoration of impacted supply, currently scheduled for 2006; and 4) analysis of overall groundwater resource sustainability under long-term pumping that would both contain perchlorate migration and meet municipal and agricultural water requirements in accordance with the UWMP.

Pilot studies of an ion exchange treatment system and two biological treatment systems were completed in 2003; the results of those studies were the basis for selection of ion exchange as the treatment process for removal of perchlorate from groundwater pumped for control of perchlorate migration in the aquifer system.

The numerical groundwater flow model was originally envisioned as a tool for analysis of basin-wide water supply and management issues. In addition to that use, which is ongoing, the model was initially approved by regulatory agencies in 2003 and formally approved in 2004 for use in evaluating the effectiveness of pumping on the extraction of contaminants and the control of contaminant migration in the affected aquifers. The initial use of the model in 2003 was to evaluate the effectiveness of pumping at capacities equivalent to replacement of the perchlorate-impacted wells. In 2004, the model was used to simulate long-term aquifer response to basin-wide pumping in accordance with the operational plans in the UWMP; included in that analysis was the selective pumping of impacted wells, with treatment, for a combination of restoring some impacted water supply and controlling perchlorate migration. The results, derived from simulation over a 78-year period that includes a range of wet/normal/dry hydrologic conditions, showed the aquifer system to be sustained with no long-term adverse conditions such as groundwater level decline, groundwater storage depletion, or depletion of surface stream flows. The modeled results also showed that the pumping of selected impacted wells for water supply, with treatment, will contain the migration of perchlorate and thus provide a level of protection against contamination of additional downgradient wells. The modeling results and the evaluation of treatment alternatives are being submitted to DHS for its approval of a program to restore the impacted water supply in accordance with its Policy Memo 97-005.

The development and implementation of a cleanup plan for the Whittaker-Bermite site and the impacted groundwater is being coordinated among CLWA, the impacted Purveyors, the State Department of Toxic Substance Control (DTSC), and U.S. Army Corps of Engineers. DTSC is the lead agency responsible for regulatory oversight of the Whittaker-Bermite site. In February 2003, DTSC and the impacted Purveyors entered into a voluntary cleanup agreement entitled *Environmental Oversight Agreement*. Under the Agreement, DTSC is providing review and oversight of the response activities being undertaken by the impacted Purveyors related to the detection of perchlorate in the five impacted wells. Under the Agreement's Scope of Work, the impacted Purveyors have prepared a Work Plan for sampling the production wells, prepared a report in the results and findings of the production well sampling, prepared a draft Human Health Risk Assessment, prepared a draft Remedial Action Workplan, completed the evaluation of treatment technologies, and completed the development of the groundwater model described above.

In 2000, CLWA and the impacted Purveyors had filed a lawsuit against Whittaker Corporation (the former owner of the contaminated property) and Santa Clarita LLC and Remediation Financial, Inc. (the current owners). The lawsuit seeks to have the defendants pay all necessary costs of response, removal of the contaminant, remedial action costs, and any liabilities or damages associated with the contamination. In late summer 2003, CLWA, the Purveyors and Whittaker entered into an Interim Settlement Agreement (ISA) wherein the parties agreed to work cooperatively for a minimum of a one-year period to further define long-term costs and reach a long-term settlement. The ISA expired in September 2004 but was extended by mutual consent of all parties until the end of January 2005. The ISA specifies that Whittaker and its insurers would reimburse certain past costs as well as ongoing costs incurred by CLWA and the Purveyors in responding to perchlorate contamination. Activities since execution of the ISA have continued on developing the elements of a remedial strategy that will entail, among other details, the pumping of two impacted wells for containment of perchlorate migration, utilization

of the pumped water, after treatment, for water supply, and installation of replacement wells in non-impacted portions of the basin to restore the remainder of groundwater supply impacted by perchlorate. Activities since execution of the ISA have also involved negotiation of a long-term Settlement Agreement.

3.5.1 Groundwater Quality – Alluvium

Groundwater quality is, of course, a key factor in assessing the Alluvial aquifer as a municipal and agricultural water supply. Groundwater quality details related to drinking water standards are discussed below. In terms of the aquifer system, however, there is no convenient long-term record of water quality, i.e. water quality data in one or more single wells that span several decades and continue to the present. Thus, in order to examine a long-term record of water quality in the Alluvium, one approach is to integrate individual records from several wells completed in the same aquifer materials and in close proximity to each other. Several such integrated records are illustrated in Figures III-10 and III-11, which show trends in groundwater quality for the 'Above Saugus WRP', 'Below Saugus WRP', 'Bouquet Canyon' and 'Castaic Creek' areas. Specific conductance (or Electrical Conductivity, EC) was chosen to represent water quality because it is generally a good indicator of overall trends in water quality, and because the records for this parameter are the most comprehensive. Based on these records of groundwater quality, wells within the Alluvium have experienced historical fluctuations in EC, which correlate with fluctuations of individual constituents that contribute to EC. The limited historic water quality data indicate that on a long-term basis, there has not been a notable trend and specifically, there has not been a decline in water quality within the Alluvium.

Specific conductance within the Alluvium exhibits a westward gradient, corresponding with the direction of groundwater flow in the Alluvium, which is also westward. EC is lowest in the easternmost portion of the basin, and highest in the west. Water quality in the Alluvium generally exhibits an inverse correlation with precipitation and streamflow, with a stronger correlation in the easternmost portion of the basin where groundwater levels fluctuate the most. Wet periods have produced substantial recharge of higher quality (low EC) water and dry periods have resulted in the notable declines in water levels described above, with a corresponding increase in EC (and individual contributing constituents) in the deeper parts of the Alluvium.

In the 'Above Saugus WRP' area, EC correlates strongly and inversely with precipitation and streamflow, showing an increase during periods of lower-than-average precipitation and a decrease during periods of higher-than-average precipitation. There is inadequate data for this area to determine the relationship of current levels of EC with long-term historic trends. The limited historic data from other areas indicate that, despite the recent increase, overall levels of EC around 1960 were higher than current levels. Water quality in the 'Mint Canyon' area is similar to that in the 'Above Saugus WRP' area.

Water quality in the 'Below Saugus WRP' area has also historically exhibited noticeable inverse fluctuations with precipitation and streamflow. Limited data from the early 1960's indicates that the recent increases (since 2001) in levels of EC in this area have not resulted in measured historic highs. EC in this area has experienced similar increases to those in the 'Above Saugus WRP' area, and is currently within the same range. This is an indication that the recent increase

in EC in the 'Below Saugus WRP' area may not be a result of salt loading from recharge of treated wastewater discharged to the Santa Clara River from the Saugus Water Reclamation Plant.

In the 'Bouquet Canyon' area, water quality appears to have generally improved since the 1950's and 1960's, and has remained fairly stable for the last thirty years. The 'San Francisquito Canyon' area has exhibited similarly consistent water quality.

Fluctuations in water quality in the 'Castaic Creek' area have been recorded since the 1950's, but there has been no long-term change in overall level of EC. Levels of EC generally declined in the 1990's, and limited recent data indicates that levels may be increasing, but are still below historic highs. Water quality in the 'Below Valencia WRP' area is similar to that in the 'Castaic Creek' area; however, no water quality data within the last 25 years is available for this area.

Throughout the Alluvium, measurements of EC have generally been made about every three years, as is typically required for public water supply wells. While this frequency is adequate to determine long-term trends and fluctuations in EC, it is not sufficient to identify the timing of the water quality response to wet or dry conditions. Occasional more frequent measurements of EC indicate that in the central to eastern portions of the basin there is a lag time in water quality response to precipitation, and levels of EC do not appear to decline substantially until there are at least two consecutive years of higher-than-average precipitation. The last such instance was in 1992 to 1993, which corresponded to the last significant decline in EC. It is likely that levels of EC will not decline substantially until a period of consecutive years of higher-than-average precipitation occurs. Monthly data collected by VWC in 2004 show that EC levels declined gradually during the year. Analysis of water quality data to be collected in 2005 may provide a better understanding of the correlation between groundwater levels and water quality within the Alluvium, and allow for better characterization of the Alluvial water quality response to precipitation.

Specific conductance throughout the Alluvium is currently below the Secondary (aesthetic) Upper Maximum Contaminant Level of 1600 μmhos/cm. The presence of long-term consistent water quality patterns, although intermittently affected by wet and dry cycles, supports the conclusion that the Alluvial aquifer is a viable ongoing water supply source in terms of groundwater quality.

As discussed above, in 2002, one Alluvial well located near the former Whittaker-Bermite facility was inactivated for municipal water supply due to detection of perchlorate slightly below the Notification Level. In early 2005, perchlorate was detected in a second Alluvial well, VWC's Well Q2. In response, Valencia removed the well from active service, and commissioned the preparation of an analysis and report assessing the impact of, and response to, the perchlorate contamination of that well. The Q2 Report (Luhdorff and Scalmanini, 2005) documents that the perchlorate detected in Well Q2 will not significantly impact the water supplies used to meet demand in the Santa Clarita Valley for the period of time required to respond to the contamination. The results of the Q2 analysis and Report are consistent with the analysis and conclusions in the Amended 2000 UWMP. Valencia's response plan for Well Q2 is to pursue permitting and installation of wellhead treatment by the fall of 2005, which will return

the well to water supply service. All other Alluvial wells operated by the Purveyors continue to be used for municipal water supply service. Those Alluvial wells near the Whittaker-Bermite property are routinely sampled and perchlorate has not been detected. As detailed in the Amended 2000 UWMP and the Q2 Report, the inactivation of two Alluvial wells due to perchlorate contamination does not limit the Purveyors' ability to produce groundwater from the Alluvium in accordance with the capacities delineated in the UWMP. The characterization and plan for control and cleanup of perchlorate, initially focused on the Saugus Formation due to the contamination and resultant inactivation of four Saugus wells in 1997, includes the Alluvial aquifer as well.

3.5.2 Groundwater Quality – Saugus Formation

As discussed above for the Alluvium, groundwater quality in the Saugus Formation is a key factor in assessing that aquifer as a municipal and agricultural water supply. As with groundwater level data, long-term Saugus groundwater quality data are not sufficiently extensive (few wells) to permit any sort of basin-wide analysis or assessment of pumping-related impacts on quality. As with the Alluvium, specific conductance (EC) has been chosen as an indicator of overall water quality, and records have been combined to produce a long-term depiction of water quality within the Saugus Formation (Figure III-12). Water quality in the Saugus Formation has not historically exhibited the precipitation-related fluctuations seen in the Alluvium. Based on the historical record over the last 50 years, groundwater quality in the Saugus has exhibited a slight overall increase in EC. More recently, several wells within the Saugus Formation have exhibited an additional increase in EC similar to that seen in the Alluvium. This is possibly a result of recharge to the Saugus Formation from the Alluvium. In 2004, monthly data collected by VWC for two Saugus wells shows that the overall level of EC remained fairly stable during the year. Levels of EC in the Saugus Formation remain below the Secondary (aesthetic) Upper Maximum Contaminant Level for EC. Groundwater quality within the Saugus will continue to be monitored to ensure that degradation that presents concern relative to the long-term viability of the Saugus as an agricultural or municipal water supply does not occur.

As previously noted, in 1997, ammonium perchlorate was discovered in four Saugus wells located generally on the east side of the basin in the vicinity of the former Whittaker-Bermite facility. All four impacted wells were removed from active water supply service, and are expected to remain inactive until the extent of contamination is fully characterized and appropriate treatment facilities are installed for contaminant control and removal. The other Saugus wells owned and operated by the Purveyors continue to be sampled on a routine basis and have not detected perchlorate.

The Amended 2000 UWMP specifically addressed the adequacy of groundwater supply in light of the inactivation of the four impacted Saugus wells; and it addressed the plan and schedule for restoration of perchlorate-impacted wells, including the protection of existing non-impacted wells. The Amended 2000 UWMP analysis showed that the inactivation of the impacted wells does not constrain the ability to meet the groundwater component of water supply through the scheduled period for restoration, through 2006. The same analysis showed that the restoration of pumping capacity, with treatment to meet drinking water standards, will effectively contain perchlorate migration and protect downgradient wells from perchlorate impacts.

3.5.3 Imported Water Quality

CLWA operates two water treatment plants, the Earl Schmidt Filtration Plant located near Castaic Lake and the Rio Vista Water Treatment Plant located in Saugus. CLWA produces water that meets drinking water standards set by EPA and DHS. SWP water has different aesthetic characteristics than groundwater with hardness (as CaCO3) ranging from 130 to 170 milligrams per liter (mg/L) and TDS of approximately 280 to 314 mg/L.

3.6 Recycled Water

Recycled water is available from two existing water reclamation plants operated by the Sanitation Districts of Los Angeles County. In 1993, CLWA prepared a draft Reclaimed Water System Master Plan that outlined a multi-phase program to deliver recycled water in the Valley. CLWA has completed environmental review on the construction of Phase I of the project, which will deliver 1,700 afy of water. Deliveries of recycled water began in 2003 for irrigation water supply at a golf course and in roadway median strips. In 2004, recycled water deliveries were 448 af.

Surveys conducted by CLWA indicate an interest for recycled water by existing water users as well as future development when it becomes available. The Purveyors encourage and support the use of recycled water to help augment and drought proof existing supplies. Overall, the program is expected to ultimately reclaim up to 17,000 af of treated (tertiary) wastewater suitable for reuse on golf courses, landscaping and other non-potable uses, as set forth in the UWMP.

In October 2004, CLWA began California Environmental Quality Act (CEQA) analysis of the Recycled Water Master Plan (2002). This analysis will result in a Program Environmental Impact Report covering the various options for a recycled water system outlined in the Master Plan. A Notice of Preparation was released for public review in April 2005.

3.7 Santa Clara River

As noted above, a significant accomplishment in 2001 was the preparation and execution of a Memorandum of Understanding (MOU) between the Santa Clarita Valley Purveyors and the United Water Conservation District, which manages surface and groundwater resources in seven groundwater basins in the Lower Santa Clara River Valley Area. The MOU initiates a collaborative and integrated approach to data collection; database management; groundwater flow modeling; assessment of groundwater basin conditions, including determination of basin yield amounts; and preparation and presentation of reports, including continued annual reports such as this one for current planning and consideration of development proposals, and also including more technically detailed reports on geologic and hydrologic aspects of the overall stream-aquifer system. Meetings of the MOU participants have continued, and integration of the Upper (Santa Clarita Valley) and Lower (United WCD) Santa Clara River databases has been accomplished. In 2002, work commenced on the development and calibration of a numerical groundwater flow model of the entire Santa Clarita groundwater basin; model development and calibration was completed in 2003 and reported in early 2004. The model has been used as

described above for assessing the effectiveness of various scenarios to restore pumping capacity impacted by perchlorate contamination by pumping and treating groundwater for water supply while simultaneously controlling the migration of contaminated groundwater. In 2005, it is planned to utilize the model for ongoing evaluation of basin yield under varying management actions and hydrologic conditions.

On occasion, issues have been raised about whether use and management of groundwater in the Santa Clarita Valley have adversely impacted surface water flows into Ventura County. The long-term history of groundwater levels in the western and central part of the basin, as illustrated in Figures III-4 and III-5, suggests that groundwater has not been lowered in such a way as to induce infiltration from the river. Long-term stream flow data gauged near the County line shows notably higher flows from the Santa Clarita Valley into the uppermost downstream basin, the Piru Basin, over the last 30 to 35 years, as illustrated in Figure III-13.

IV. Summary of 2004 Water Supply and 2005 Outlook

As reported herein, total water demands in the Santa Clarita Valley were 87,900 af in 2004. This represented an increase of slightly more than five percent from total demand in 2003. Of the total demand, about 72,300 af was for municipal water supply, and the balance (15,600 af) was for agricultural and other minor uses. As also discussed herein, the total demand in 2004 was met by a combination of local groundwater and imported SWP water, both within their respective operational yields and contractual Table A Amounts respectively, and by a small amount of recycled water.

The demand in 2004 was greater than the short-term projected demand that was estimated in the 2003 Water Report and it was also greater than the demand estimated in the UWMP. For illustration, historical water use from 1980 through 2003 is plotted in Figure IV-1; also shown with that historical record are the projected total water demands in the UWMP through 2020. As discussed in the 2000 UWMP, the year-to-year fluctuations in historical water demand range from about three percent below to about ten percent above the projection, primarily related to growth, that would describe the long-term historical trend in the Valley's total water demand. The primary factor causing the year-to-year fluctuations is weather. In the short term, drier years result in higher water demand. Extended drier periods, however, have resulted in decreased demand due to conservation and water shortage awareness. The decline in water demand at the end of the 1987-92 drought is a good example of such reduced demand. Ultimately, however, it would appear that the growth rate in the Santa Clarita Valley over the last three years has exceeded the rate estimated in the 2000 UWMP. Over the same time, the average rate of water use per service has remained nearly constant. The combination of a nearly constant unit water demand and a greater number of services has resulted in municipal water demand increasing over the last five years at a slightly higher rate than was estimated in the UWMP in 2000. Projected water demands will be updated in the 2005 UWMP currently in preparation.

For short-term planning, recognizing the continuation of recent higher-than-originally-estimated growth, and significantly above-normal precipitation in early 2005, water demand in 2005 is projected to be about 89,000 af. It is expected that both municipal and agricultural water demands in 2005 will be met with a generally similar mix of water supplies as in previous years, notably local groundwater and imported SWP water, complemented by recycled water that will continue to supply a small fraction of total water demand.

As of April 21, 2005, the allocation of water from the SWP is 80 percent of CLWA's Table A Amount, or 76,160 af. Combined with local groundwater from the two aquifer systems (47,500 af), small additional surface water supplies (Article 21 and Flexible Storage Account, which represent about 6,200 af combined), net carryover SWP water from 2004 (1,657 af), and recycled water (up to 1,700 af), the total available water supplies for 2005 are slightly more than 133,000. Consequently, CLWA and the Purveyors anticipate having more than adequate supplies to meet all water demands in 2005. A summary of projected 2005 water supply and demands is presented in Table IV-1.

Table IV-1
2005 Water Supply and Demand
(acre-feet)

Projected 2005 Demand [1]		**89,000**
Available Water Supplies		
Local Groundwater		47,500
Alluvial Aquifer [2]	*40,000*	
Saugus Formation [3]	*7,500*	
Imported Water		84,101
Table A Amount [4]	*76,160*	
Article 21 Water Program for 2005 [5]	*1,600*	
Net Carryover from 2004 [6]	*1,657*	
CLWA Flexible Storage Account [7]	*4,684*	
Recycled Water		1,700
Total Available 2005 Supplies		**133,301**
Dry Year Supplies [8]		
Semitropic Groundwater Storage Bank		50,870
2002 Account	*21,600*	
2003 Account	*29,270*	
Total Supplemental Dry Year Supplies		**50,870**

1. Refer to the Amended 2000 UWMP for long-term projections of supply and demand. The projected 2005 water demand is based on recent actual water demands, with adjustment for significantly wet conditions in early 2005.

2. The Alluvium represents 30,000 – 40,000 afy of available supply under wet-normal conditions, and 30,000 – 35,000 afy under dry conditions. Available supply in 2005 is shown to be the average/wet range due to significantly above-average precipitation in late 2004 and early 2005.

3. The Saugus represents 7,500 – 15,000 afy of available water supply under non-drought conditions, and up to 35,000 afy under increasingly dry conditions. Available supply in 2005 is shown to be limited to very wet conditions; no short-term increase in Saugus pumping is required or shown for 2005 water supply.

4. CLWA's SWP Table A amount is 95,200 af. The 2005 allocation, as of April 21, 2005, is 80 percent (76,160 af).

5. Through March 2005. Article 21 Water Program refers to a provision in the SWP contract for delivering water that is available in addition to CLWA's Table A allocation. This water is typically available only for a limited time from January through March, as hydrologic and SWP storage conditions allow.

6. Total excess 2004 SWP supply was 15,522 af; of that amount, 13,865 af spilled in early 2005 at San Luis Reservoir, leaving a net carryover delivery of 1,657 af.

7. CLWA can directly utilize up to 4,684 af of storage capacity in Castaic Lake.

8. Recoverable portion of 24,000 af and 32,522 af of excess in 2002 and 2003 Table A water banked in Semitropic WSD, respectively. Does not include other reliability measures available to CLWA and the retail water Purveyors. These measures include short-term exchanges, participation in DWR's dry-year water purchase programs, local dry-year supply programs and other planned groundwater storage programs. Refer to the Amended 2000 UWMP for more information on these and other programs.

In addition to the preceding, it is noteworthy that, while not required to meet projected demand in 2005, a total of nearly 51,000 af of recoverable water has been stored in a Kern County groundwater storage bank account for dry-year deliveries.

A significant number of local projects are part of an overall program currently funded by CLWA to provide facilities needed to firm up imported water supplies during times of drought. These involve water conservation, surface and groundwater storage, water transfers and exchanges, water recycling, additional short-term pumping from the Saugus Formation, and increasing CLWA's imported supply. This overall strategy is designed to meet increasing water demands while assuring a reasonable degree of supply reliability.

The Purveyors strive to provide a blend of groundwater and imported water to area residents to ensure consistent quality and reliability of service. The actual blend of imported water and groundwater in any given year and location in the valley is an operational decision and varies over time due to source availability and operational capacity of Purveyor and CLWA facilities. The goal is to conjunctively use the available water resources so that the overall reliability of water supply is maximized.

Dry-year periods may affect available water supplies in any single year and for a duration usually not longer than three consecutive years. It is important to note that hydrologic conditions vary from region to region throughout the state. Dry conditions in Northern California affecting SWP supply may not affect local groundwater and other supplies in Southern California, and vice versa.

For this reason, CLWA and the Purveyors have emphasized developing water supplies that add diversity allowing water supply options especially in dry years. Diversity of supply is considered a key element of reliability, giving the Purveyors the ability to draw on multiple sources of supply during dry-year conditions and thereby making the Purveyors' water deliveries more reliable. As a result of this advance planning, no water shortages are anticipated in CLWA's service area for the foreseeable future.

For long-term planning purposes, water supplies and facilities are added on an incremental basis and ahead of need. It would be economically to immediately, or in the short term, acquire all the facilities and water supplies needed for the next twenty to thirty years. This would represent an unfair shift of costs from future customers to existing customers.

There are many ongoing efforts to produce an adequate and reliable supply of good quality water for Valley residents. Water consumers expect that their needs are going to be met with a high degree of reliability and quality of service. To that end, CLWA and the Purveyors are in the process of establishing a water reliability policy for planning purposes sufficient to meet projected demands 95 percent of the time over each 20-year period. In the remaining 5 percent of the time, it is assumed that the maximum allowable supply shortage will be 10 percent of overall demand.

This shortage level is being recommended because a 10 percent water demand reduction is feasible during a drought based on past experience. When a shortage occurs, water consumers

typically increase their awareness of water usage and voluntarily reduce water demands. During the 1987–1992 drought, voluntary conservation efforts by area residents resulted in a decrease in water demand of about 20 percent per year.

V. Water Conservation

The California Urban Water Conservation Council (CUWCC) was formed in 1991 through the Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California. The urban water conservation BMPs included in the MOU are intended to reduce California's long-term urban water demands. The BMPs are currently implemented by the signatories to the MOU on a voluntary basis. However, the CalFed Bay-Delta Program has included mandatory implementation of the BMPs and certification of water use efficiency programs in its final Environmental Impact Statement/Report and Record of Decision. This certification requirement would take effect after enabling legislation is passed and would apply to any agency subject to the Urban Water Management Planning Act that is located in the CalFed solution area. In addition, the BMPs are specified as part of the Urban Water Management Planning Act.

CLWA signed the urban MOU in 2001 on behalf of its wholesale service area. Since then, CLWA has instituted implementation of BMP 2 (Residential Plumbing Retrofits) and BMP 14 (Residential ULFT Replacement Programs). NCWD signed the MOU in 2002 on behalf of its own retail service area. As a separate MOU signer and due to its role as a retailer, NCWD is committed to implementing additional BMPs that are feasible and applicable in its service area. Efforts are made to coordinate with CLWA and the other purveyors wherever possible to maximize efficiency and ensure the cost effectiveness of NCWD's conservation program.

Water conservation can achieve a number of goals, such as:

- Meeting legal mandates
- Reducing average annual potable water demands
- Reducing sewer flows
- Reducing demands during peak sessions
- Meeting drought restrictions

In coordination with the Purveyors in its service area, CLWA has been implementing the following urban water conservation Best Management Practices (BMPs) (which pertain to wholesalers) for several years:

BMP 3	System Water Audits, Leak Detection and Repair
BMP 7	Public Information Programs
BMP 8	School Education
BMP 10	Wholesale Agency Programs
BMP 11	Conservation Pricing
BMP 12	Water Conservation Coordinator
BMP 13	Water Waste Prohibition (Implementation during last drought)

CLWA and the Purveyors have been implementing the listed BMPs valley-wide since 2002. In addition, interior plumbing code changes that have been in effect since 1992, as well as changes in lot size and reduction in exterior square footage of new housing and commercial developments, have begun to impact overall demand in the Valley. The valley's water suppliers will continue to monitor water demand trends through time to assess which factors are accounting for the reduction, and to attempt to quantify them.

VI. References

California Department of Water Resources, **The California Water Plan Update,** Bulletin 160-98, 1998.

California Department of Water Resources, **Final State Water Project Delivery Reliability Report, 2002**, May 2003.

Castaic Lake Water Agency (CLWA), CLWA Santa Clarita Water Division, Newhall County Water District, and Valencia Water Company, **Groundwater Perchlorate Contamination Amendment and Other Amendments, 2000 Urban Water Management Plan,** January 2005, including Black and Veatch, Reiter/Lowry/Consultants, and SA Associates **Urban Water Management Plan Update, 2000**, Castaic Lake Water Agency, Newhall County Water District, Santa Clarita Water Company, and Valencia Water Company.

CH2M Hill, **Evaluation of Historical and Projected Future Flows to Ventura County Resulting From Importation of State Project Water to the Santa Clara River Watershed,** July, 1998.

CH2M Hill **Evaluation of Historical and Projected Future Flows to Ventura County Resulting From Importation of State Project Water to the Santa Clara River Watershed**, Update 2001.

CH2M Hill **Regional Groundwater Flow Model for the Santa Clarita Valley, Model Development and Calibration**, April, 2004.

CH2M Hill, **Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property, Santa Clarita,** California, Prepared in support of the 97-005 Permit Application, December 2004.

Kennedy/Jenks Consultants, Draft Report, **Recycled Water Master Plan,** Castaic Lake Water Agency, May 2002

Luhdorff and Scalmanini, Consulting Engineers, **Santa Clarita Valley Water Report 2003**, prepared for Castaic Lake Water Agency, Los Angeles County Waterworks District 36, Santa Clarita Water Division of CLWA, Valencia Water Company, May 2004.

Luhdorff and Scalmanini, Consulting Engineers, **Impact and Response to Perchlorate Contamination, Valencia Water Company Well Q2**, prepared for Valencia Water Company, April 2005.

Richard C. Slade & Associates, LLC, **2001 Update Report, Hydrogeologic Conditions in the Alluvial and Saugus Formation Aquifer Systems**, prepared for Santa Clarita Valley Water Purveyors, July 2002.

Slade, R. C., **Hydrogeologic Assessment of the Saugus Formation in the Santa Clara Valley of Los Angeles County, California,** vols. I and II, prepared for Castaic Lake Water Agency, 1988.

Slade, R. C., **Hydrogeologic Investigation of Perennial Yield and Artificial Recharge Potential of the Alluvial Sediments in the Santa Clarita River Valley of Los Angeles County, California**, vols. I and II, prepared for Upper Santa Clara Water Committee, 1986.

United Water Conservation District, Groundwater Department, **Surface and Groundwater Conditions Report, Year 2000 Supplement,** September 2001.

Valencia Water Company, **Water Management Program,** 2001.

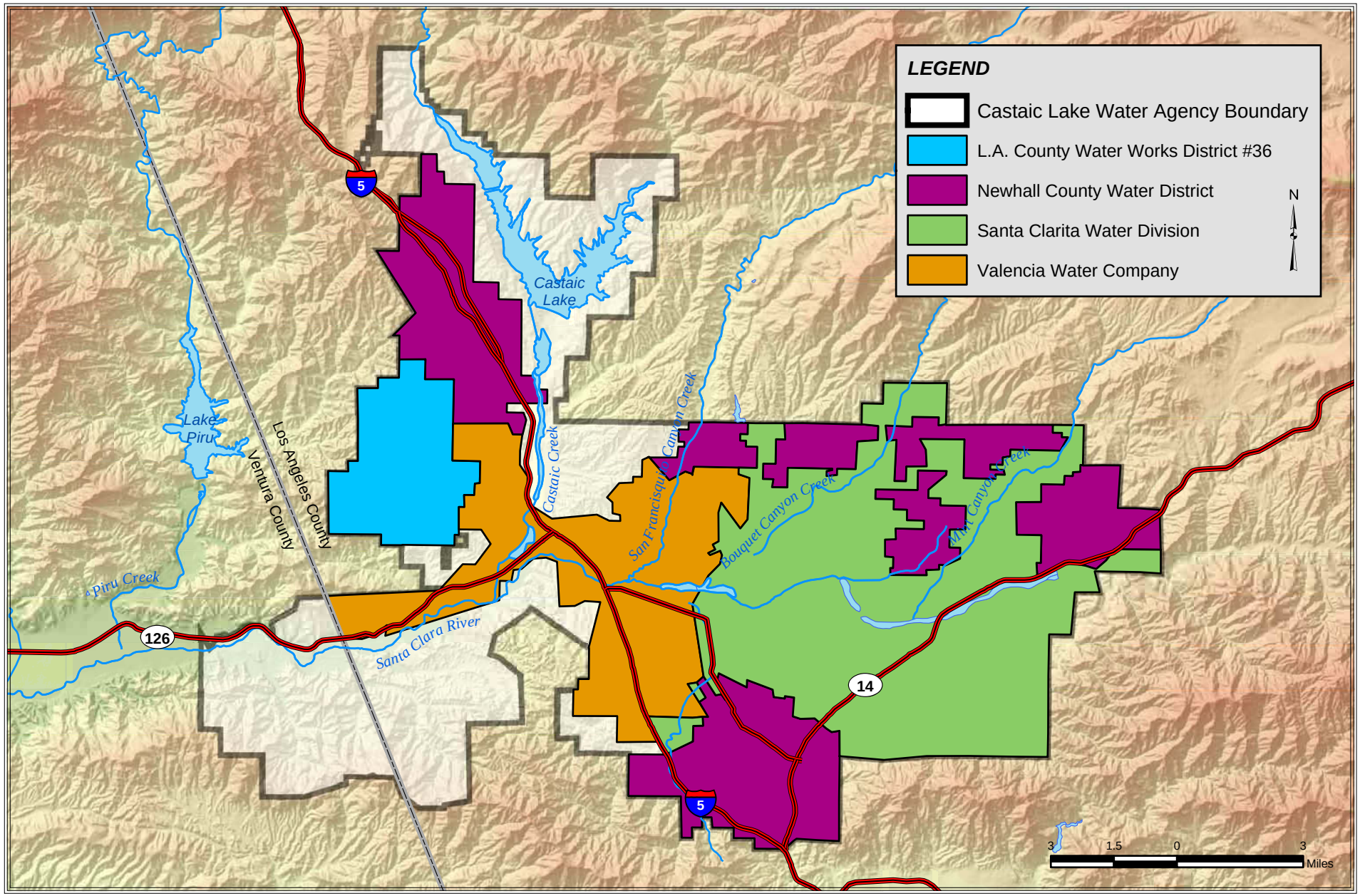


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Figure I-1
CLWA and Purveyor Service Areas

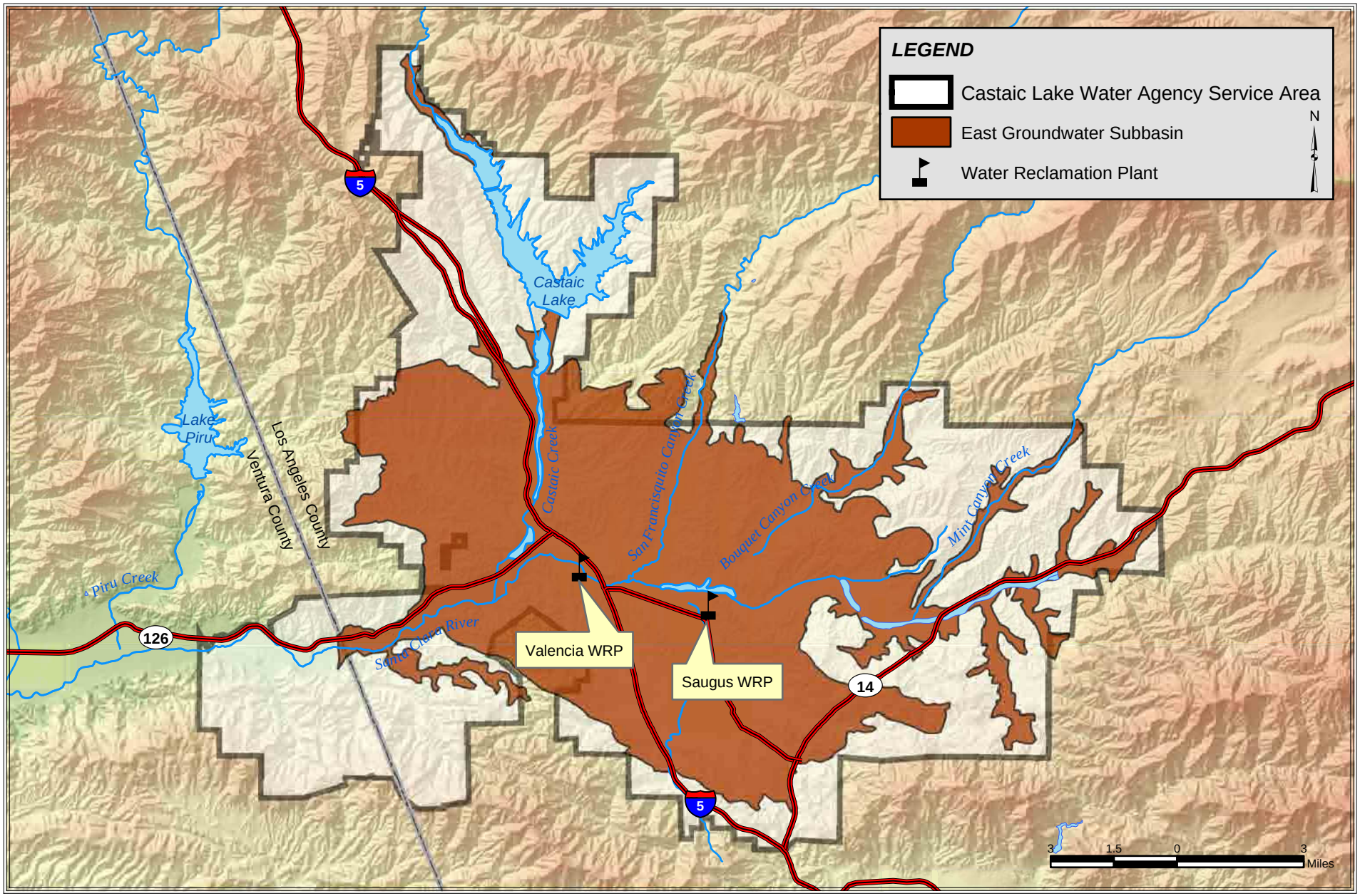

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Figure I-2
Santa Clara River Valley
East Groundwater Subbasin

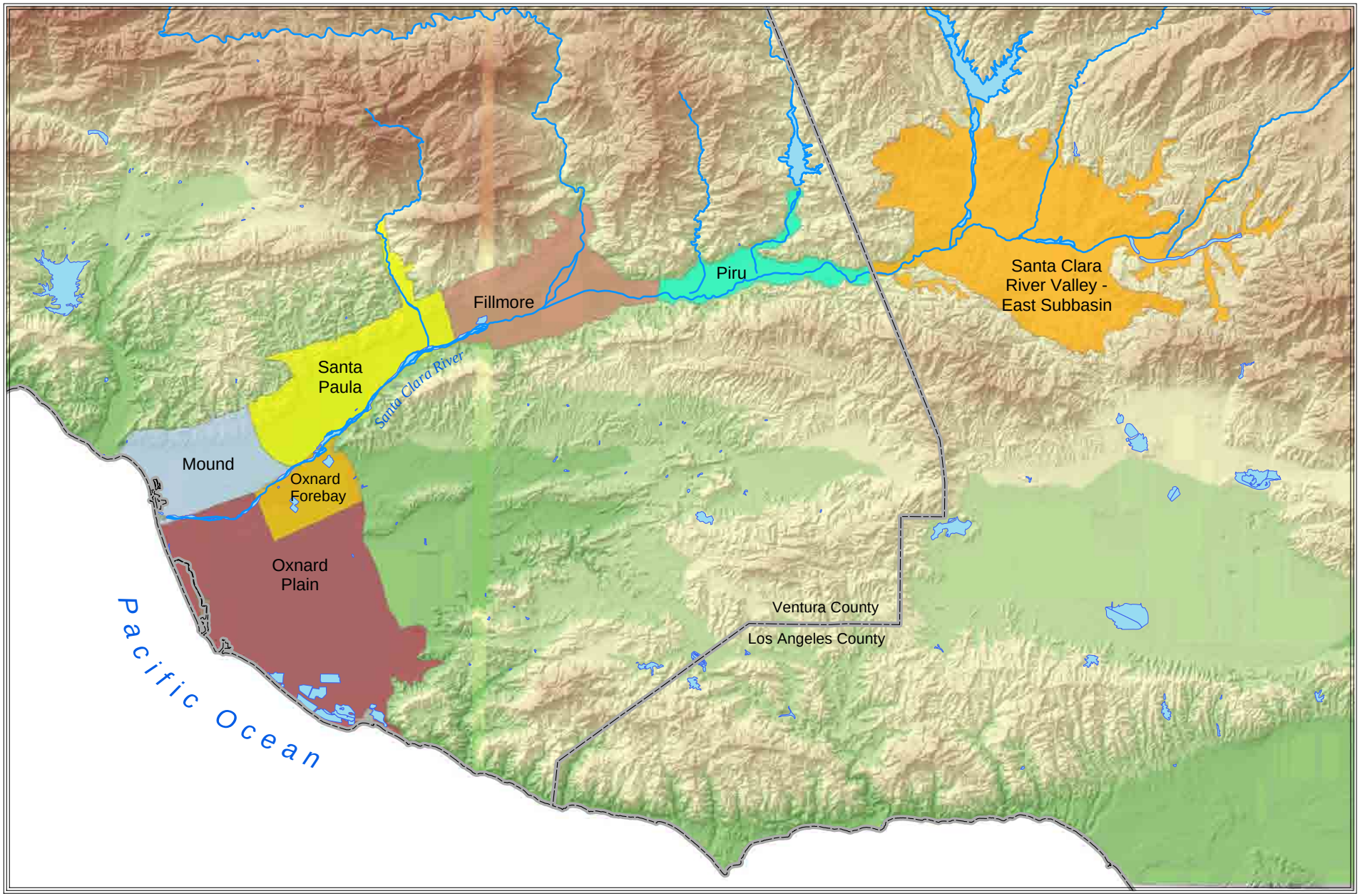

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Figure I-3
Upper and Lower Santa Clara River Basins

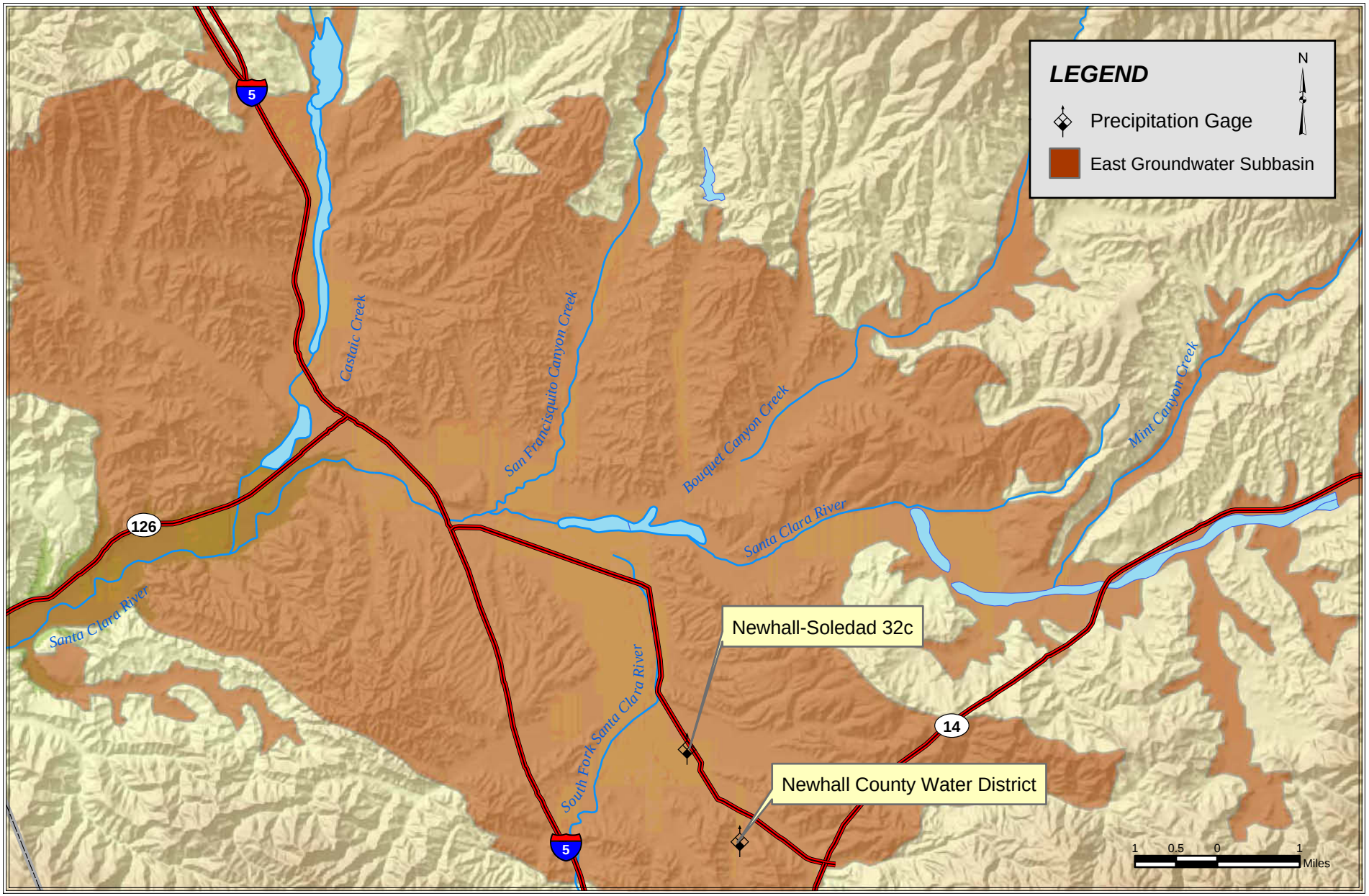

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Figure I-4
Precipitation Gage Locations
Santa Clara River Valley, East Groundwater Subbasin

Annual Precipitation and Departure from Mean Annual Precipitation
Santa Clara River Valley, East Groundwater Subbasin
(Newhall-Soledad 32c Gage)

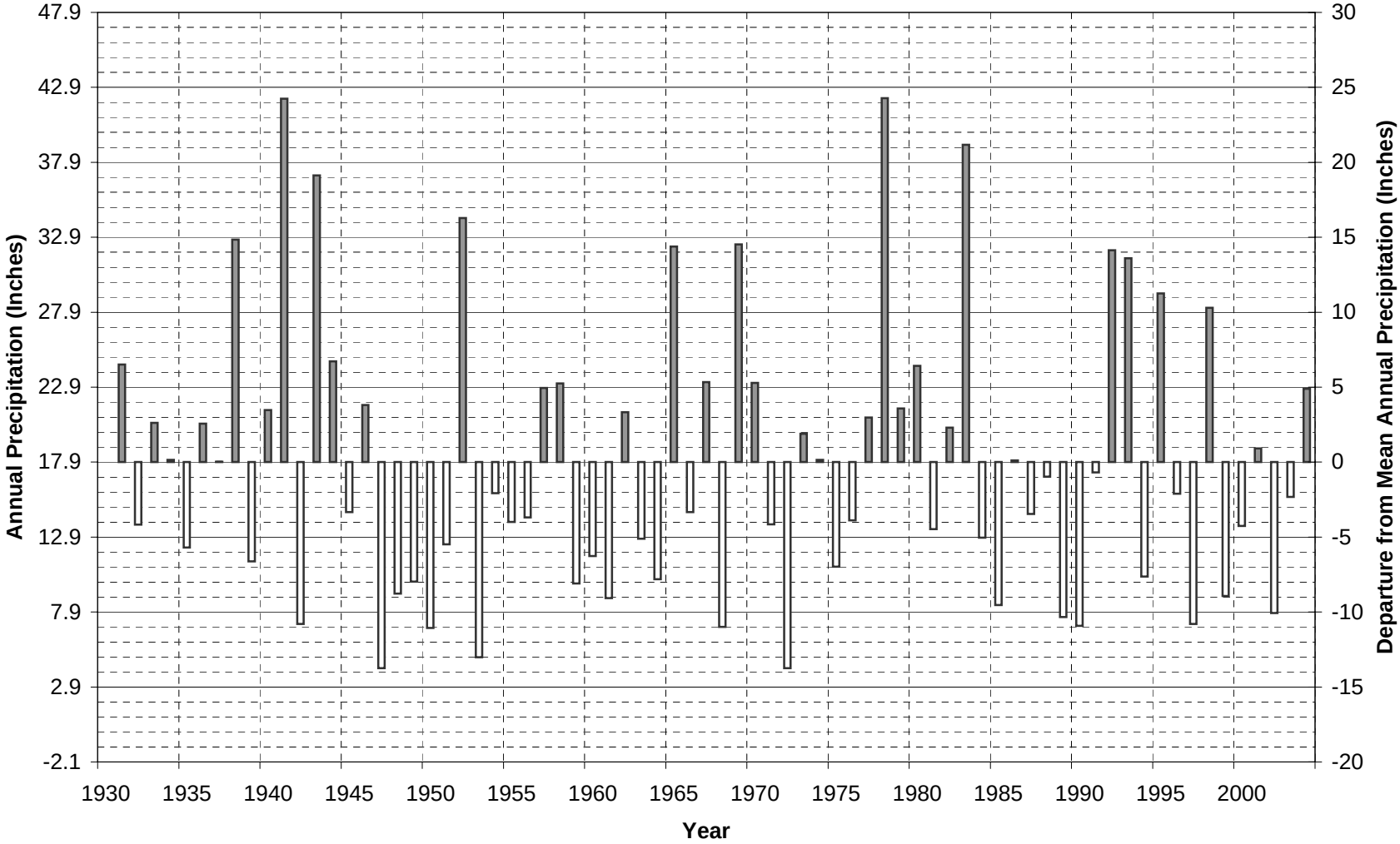

Figure I-5

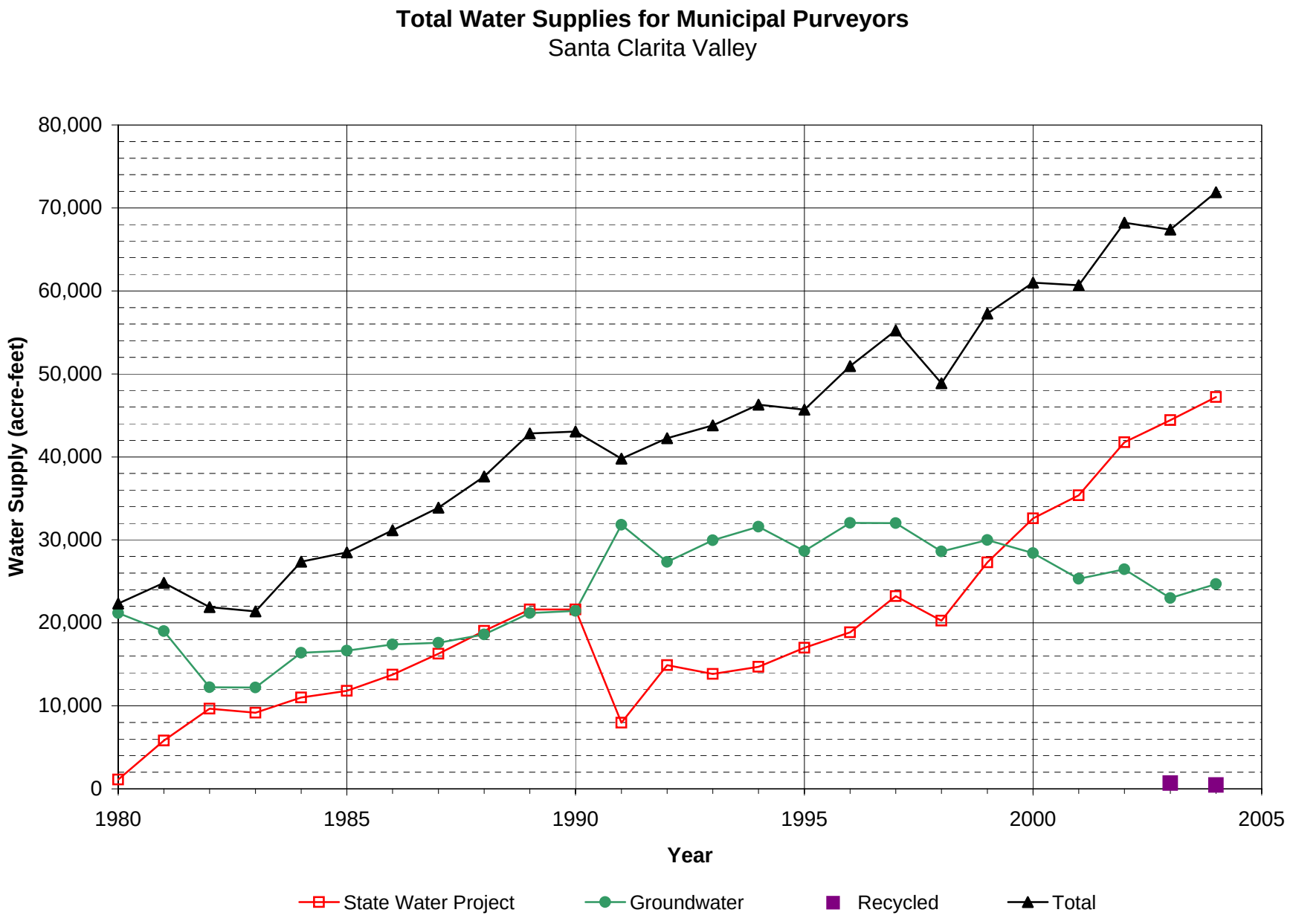
Total Water Supplies for Municipal Purveyors
Santa Clarita Valley
Water Supply (acre-feet)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1985
1990
1995
2000
2005
Year
State Water Project
Groundwater
Recycled
Total

Figure II-1

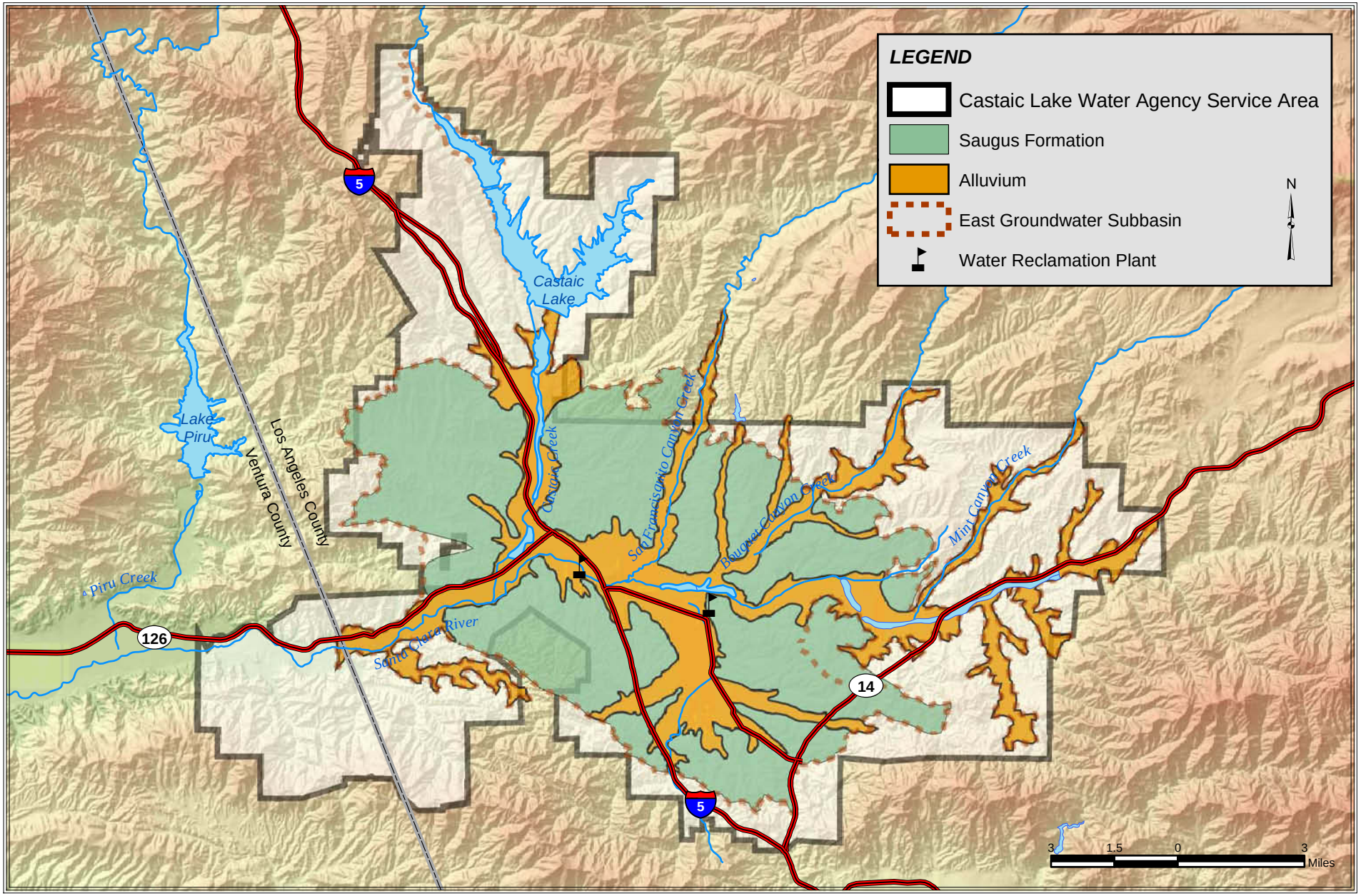

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Figure III-1
Alluvium and Saugus Formation
Santa Clara River Valley East Groundwater Subbasin

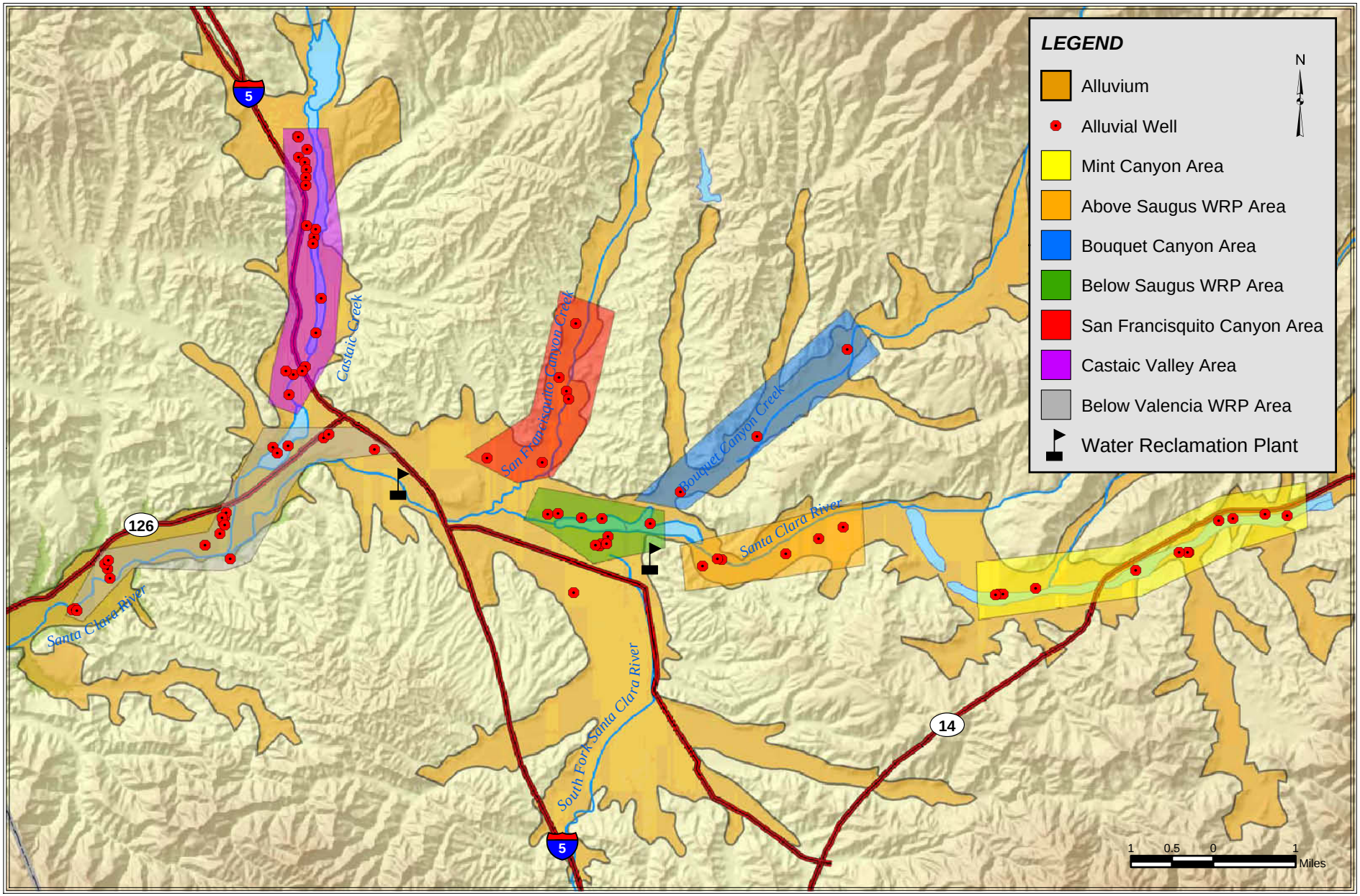

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Figure III-2
Alluvial Well Locations By Area
Santa Clara River Valley, East Groundwater Subbasin

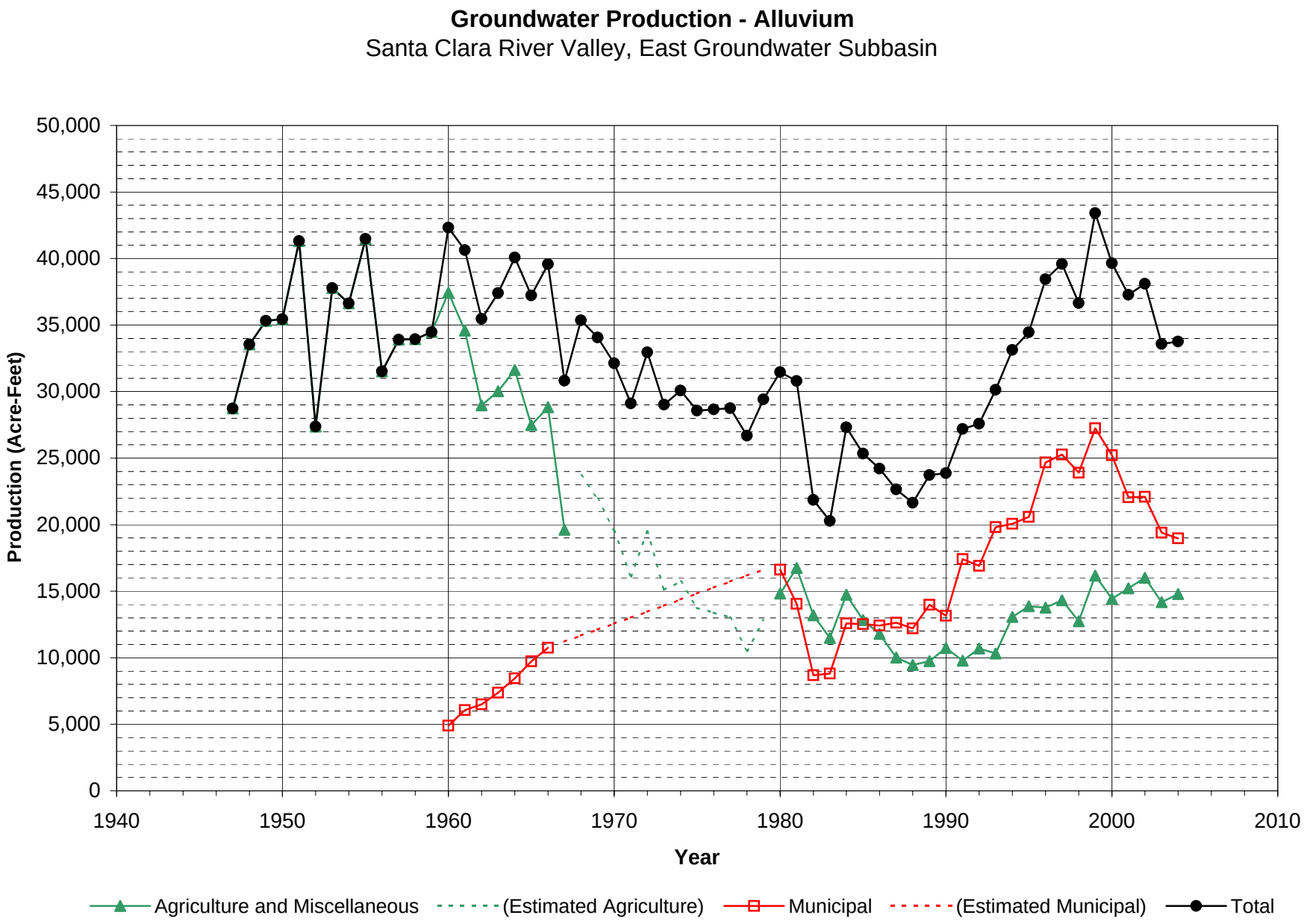
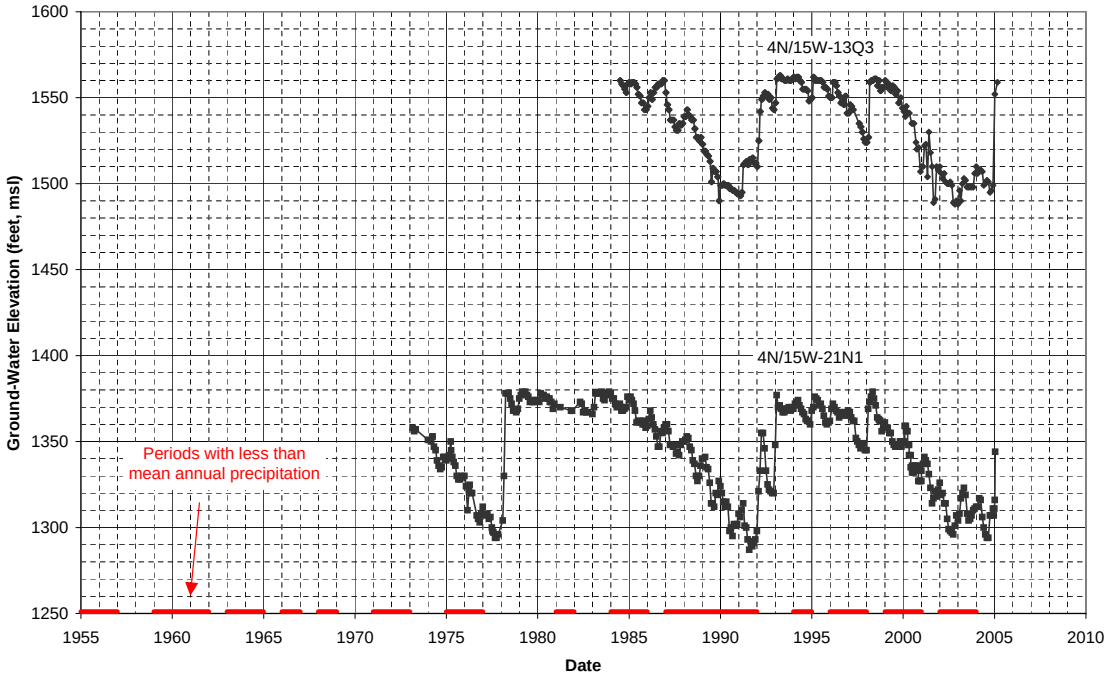

Groundwater Production - Alluvium
Santa Clara River Valley, East Groundwater Subbasin
Production (Acre-Feet)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
Agriculture and Miscellaneous
(Estimated Agriculture)
Municipal
(Estimated Municipal)
Total

Figure III-3

Groundwater Elevation for 'Mint Canyon' Area Alluvial Wells
(lowest and highest for area shown)



Groundwater Elevation for 'Below Saugus WRP' Area Alluvial Wells
(lowest and highest for area shown)

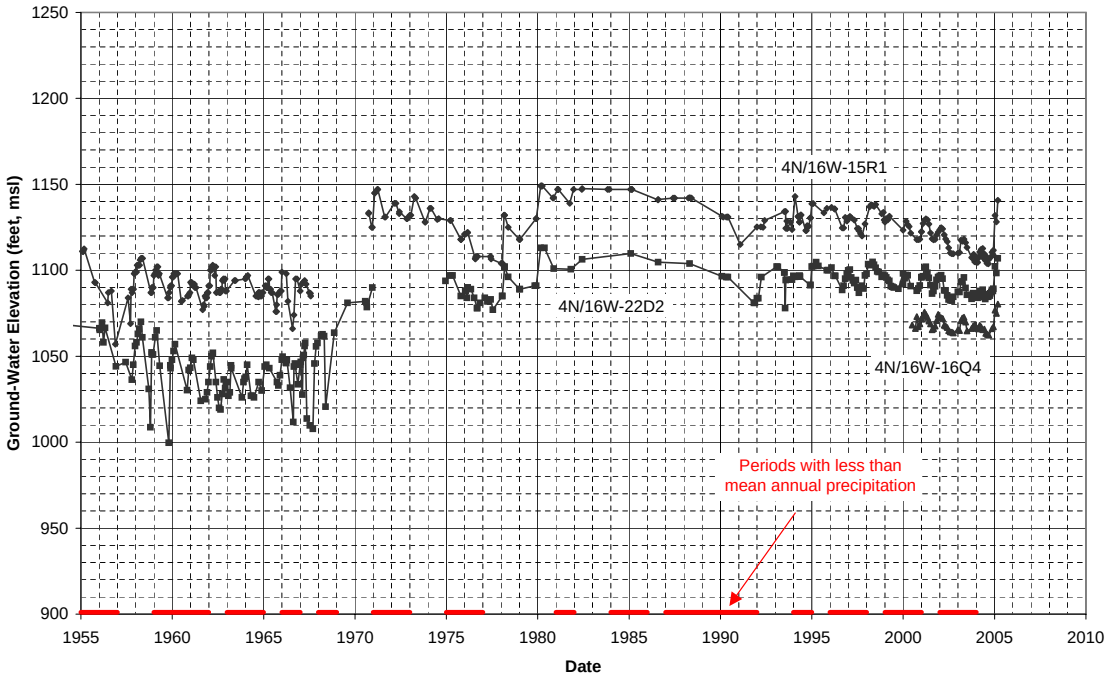
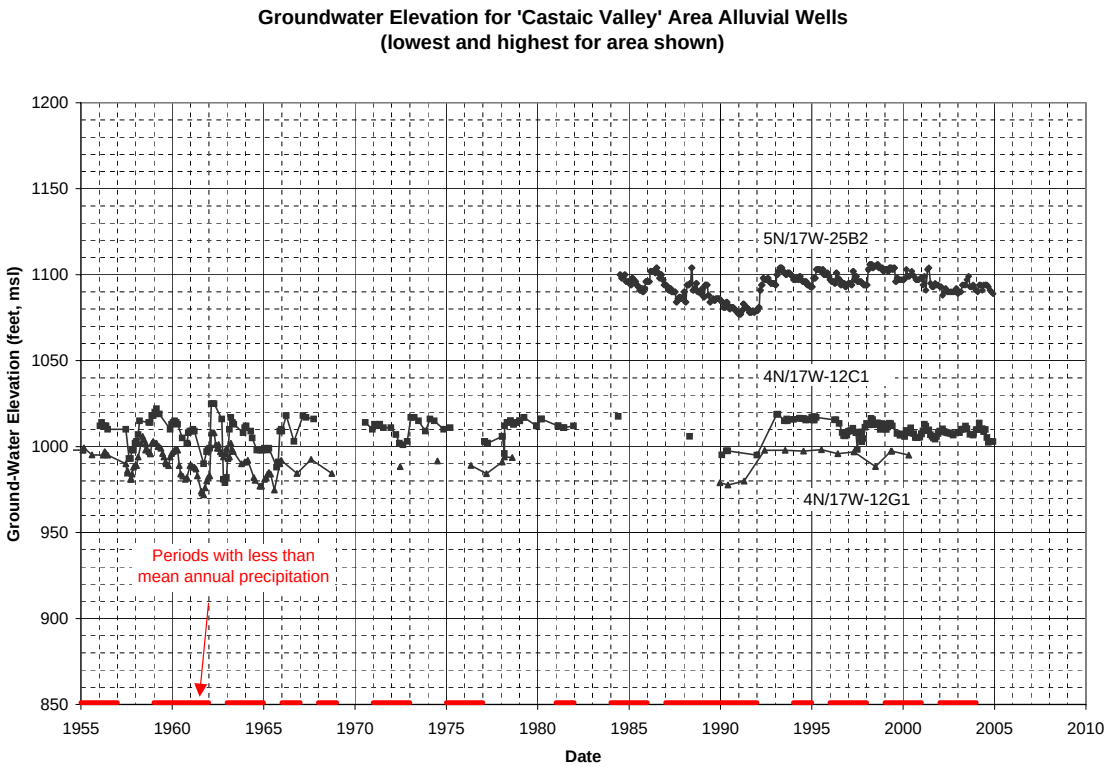


Figure III-4


Groundwater Elevation for 'Castaic Valley' Area Alluvial Wells
(lowest and highest for area shown)
Ground-Water Elevation (feet, msl)
Date
5N/17W-25B2
4N/17W-12C1
4N/17W-12G1
Periods with less than
mean annual precipitation

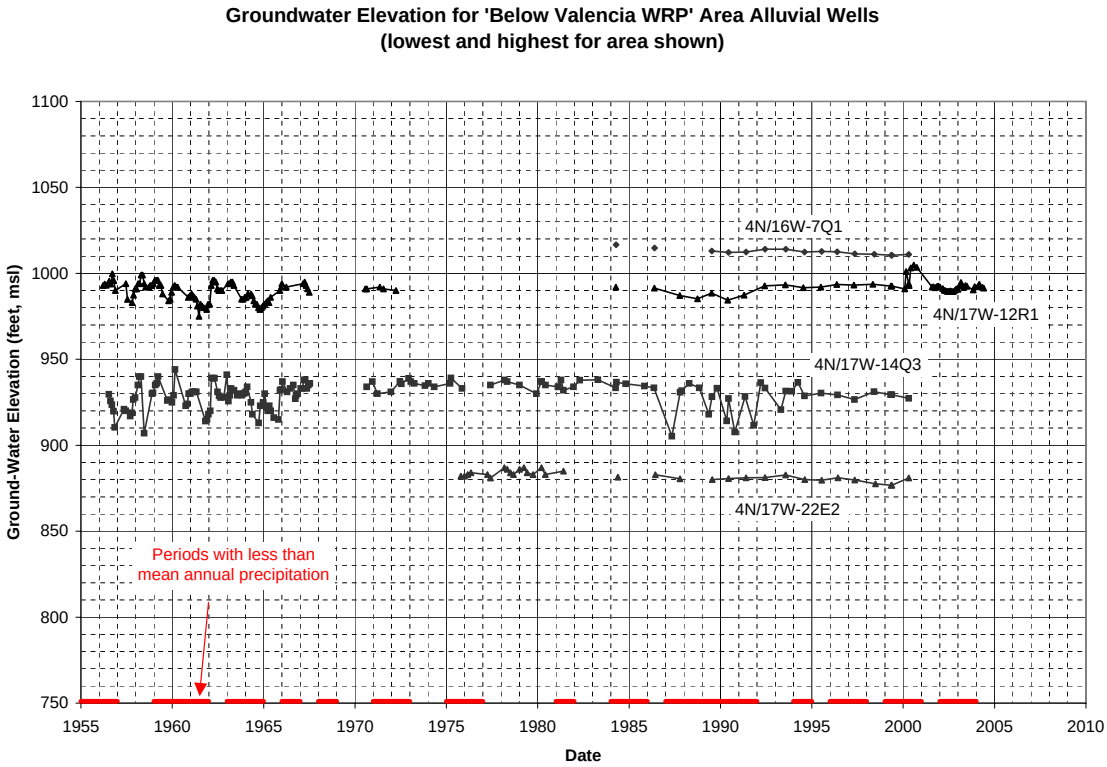

Groundwater Elevation for 'Below Valencia WRP' Area Alluvial Wells
(lowest and highest for area shown)
Ground-Water Elevation (feet, msl)
Date
4N/16W-7Q1
4N/17W-12R1
4N/17W-14Q3
4N/17W-22E2
Periods with less than
mean annual precipitation

Figure III-5

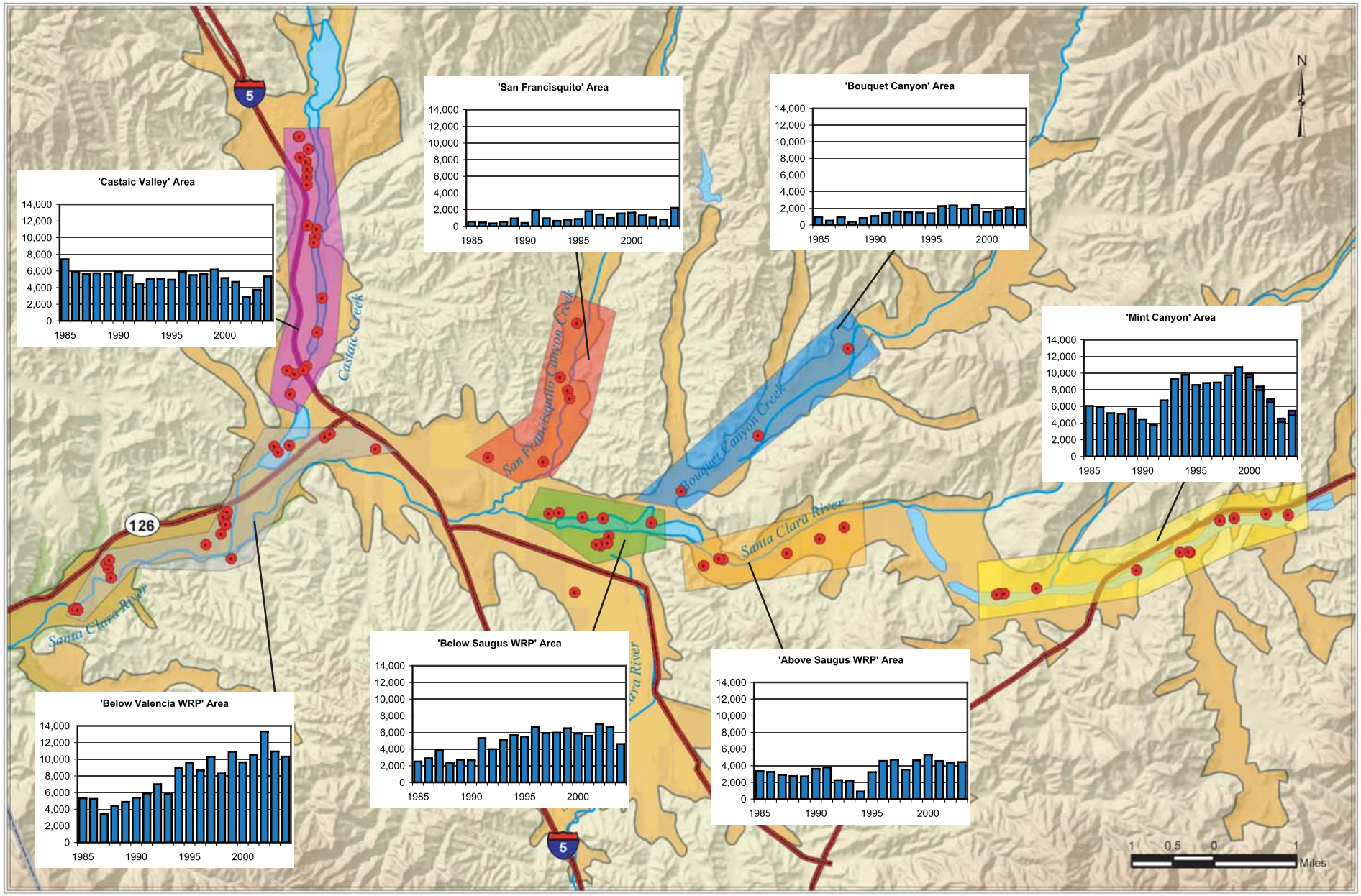


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Figure III-6
Annual Groundwater Production from Alluvium by Area (Acre-feet)
Santa Clara River Valley, East Groundwater Subbasin

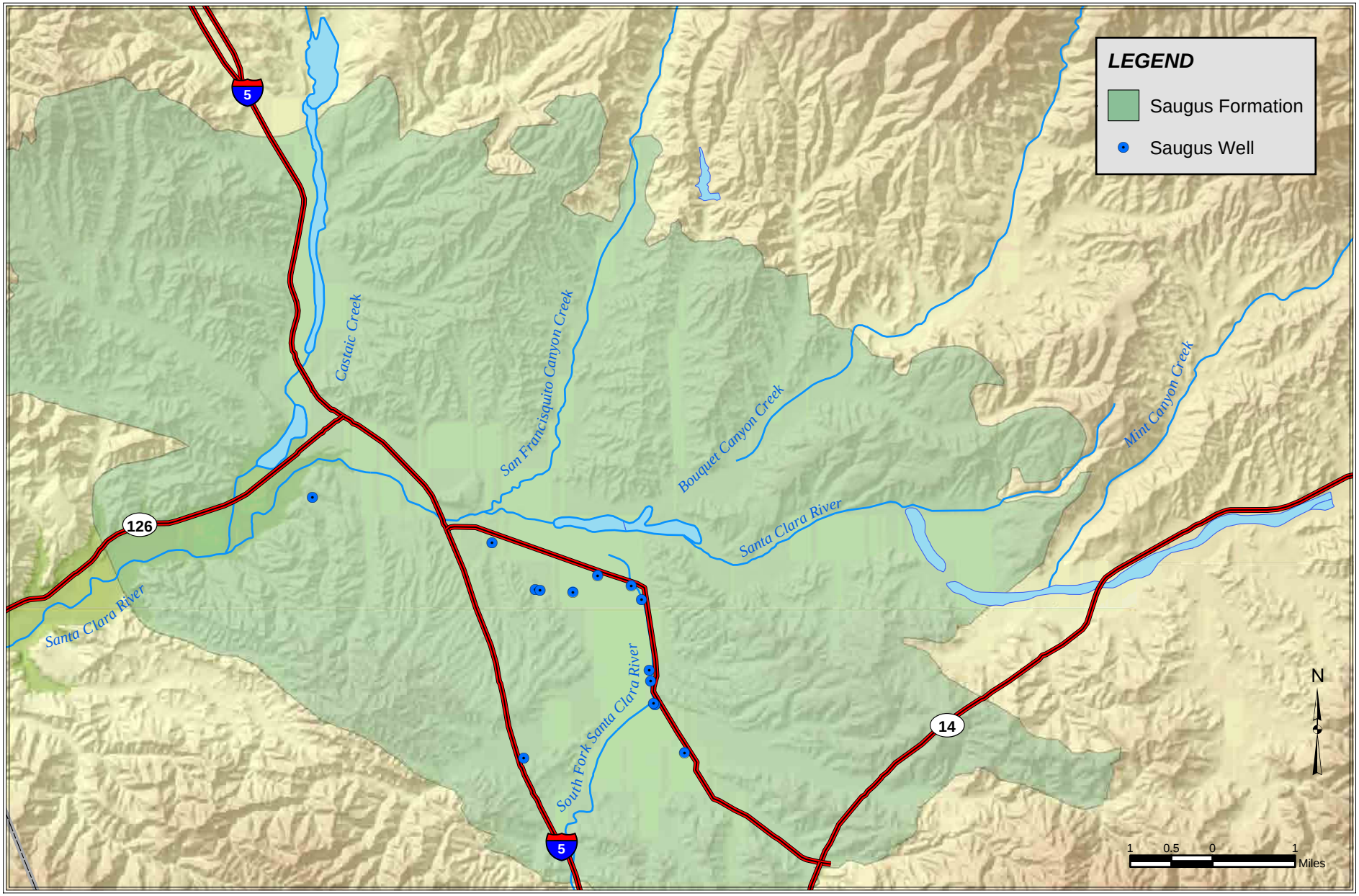

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Figure III-7
Saugus Well Locations
Santa Clara River Valley, East Groundwater Subbasin

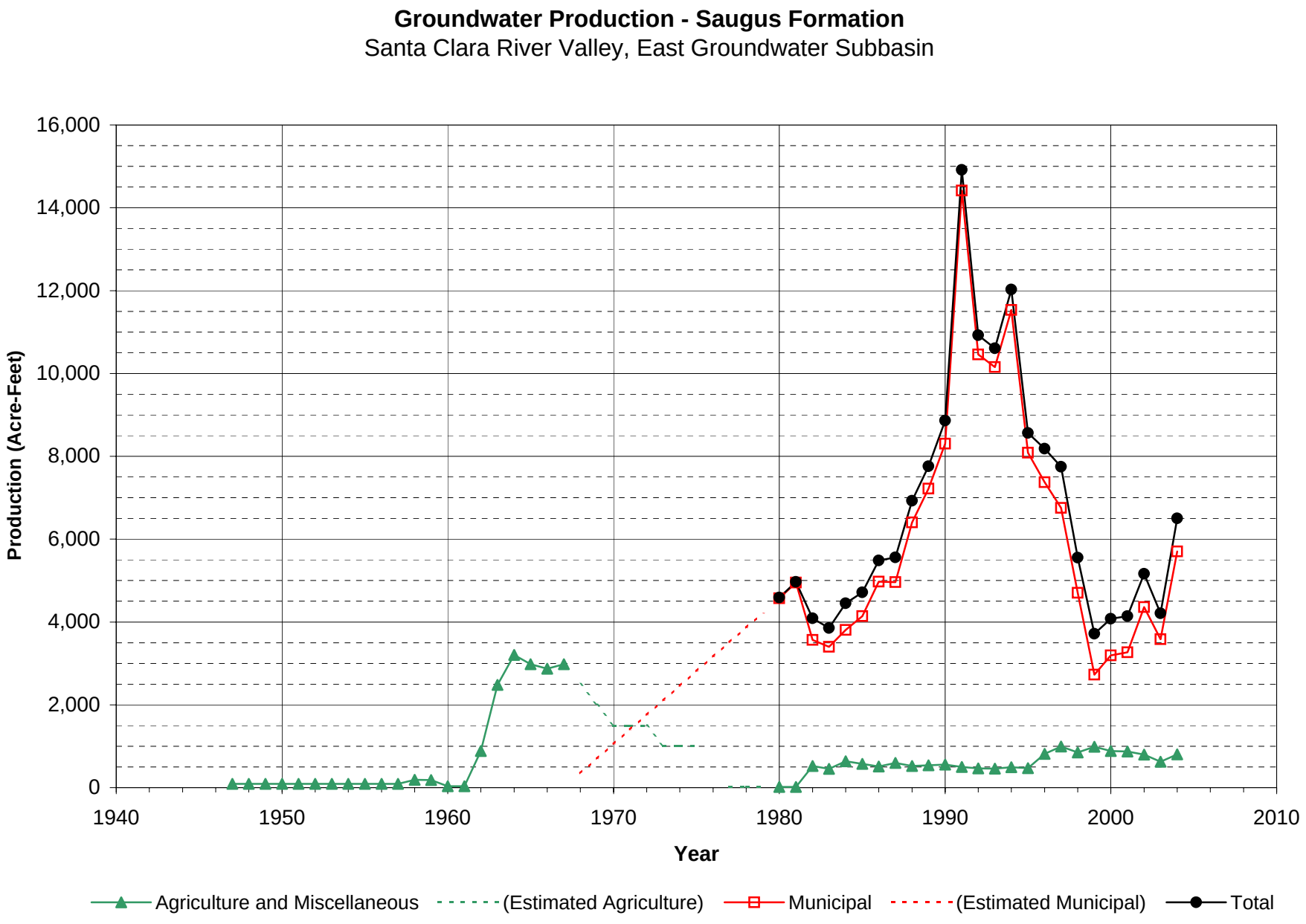
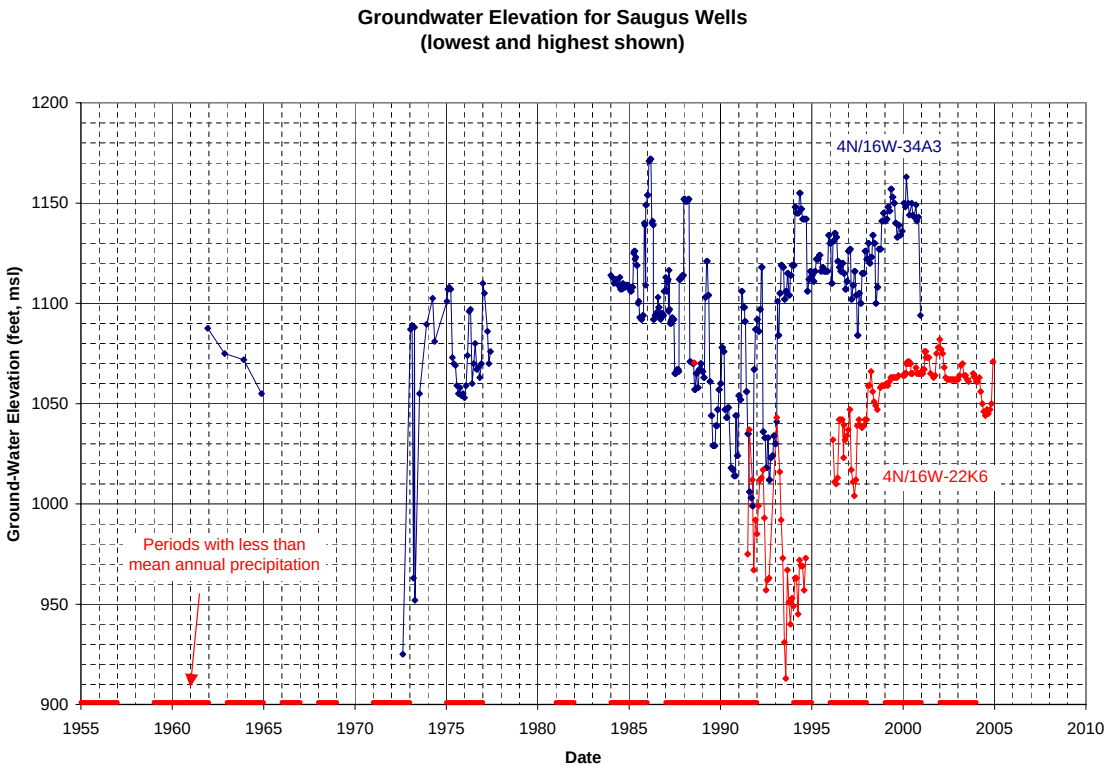

Groundwater Production - Saugus Formation
Santa Clara River Valley, East Groundwater Subbasin
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Production (Acre-Feet)
1940
1950
1960
1970
1980
1990
2000
2010
Year
Agriculture and Miscellaneous
(Estimated Agriculture)
Municipal
(Estimated Municipal)
Total

Figure III-8


Groundwater Elevation for Saugus Wells
(lowest and highest shown)
Ground-Water Elevation (feet, msl)
Date
4N/16W-34A3
4N/16W-22K6
Periods with less than
mean annual precipitation
1200
1150
1100
1050
1000
950
900
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

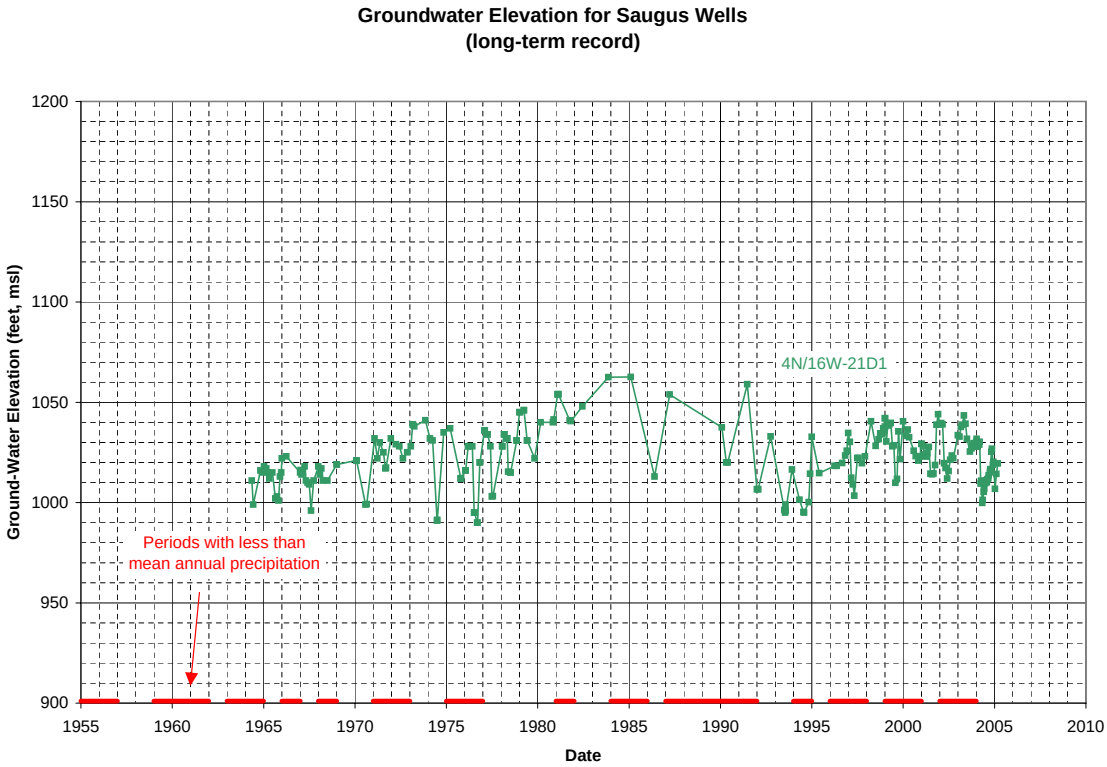
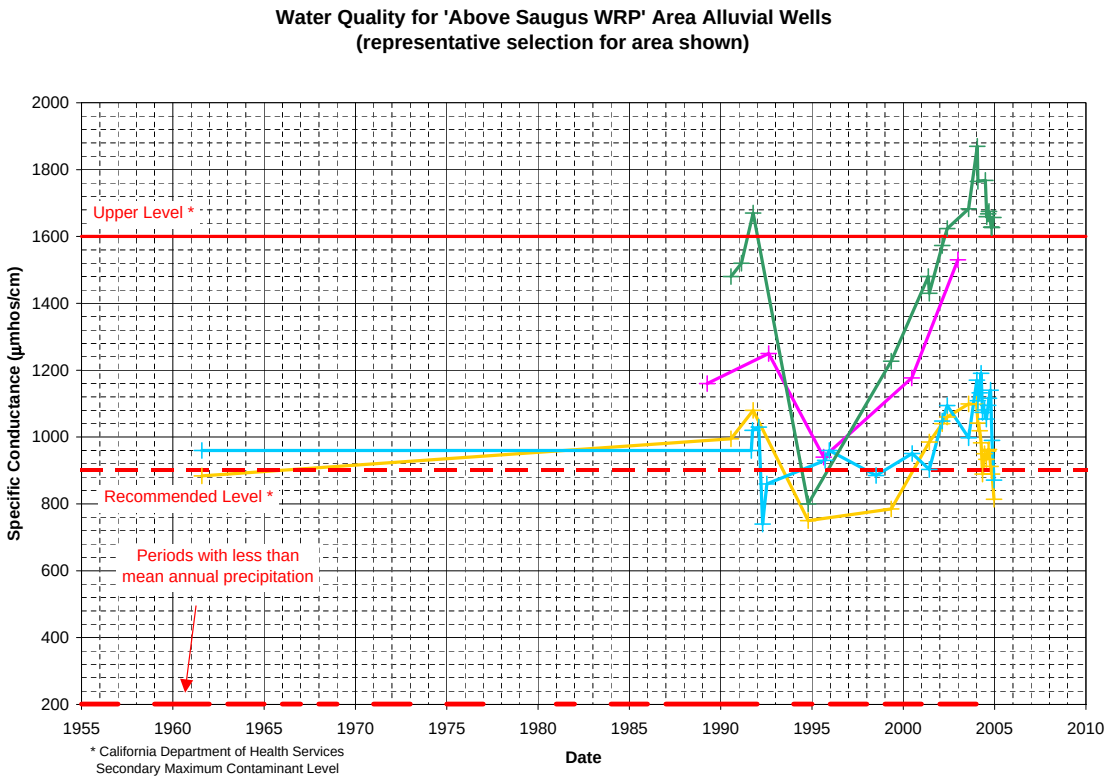

Groundwater Elevation for Saugus Wells
(long-term record)
Ground-Water Elevation (feet, msl)
Date
4N/16W-21D1
Periods with less than
mean annual precipitation
1200
1150
1100
1050
1000
950
900
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

Figure III-9



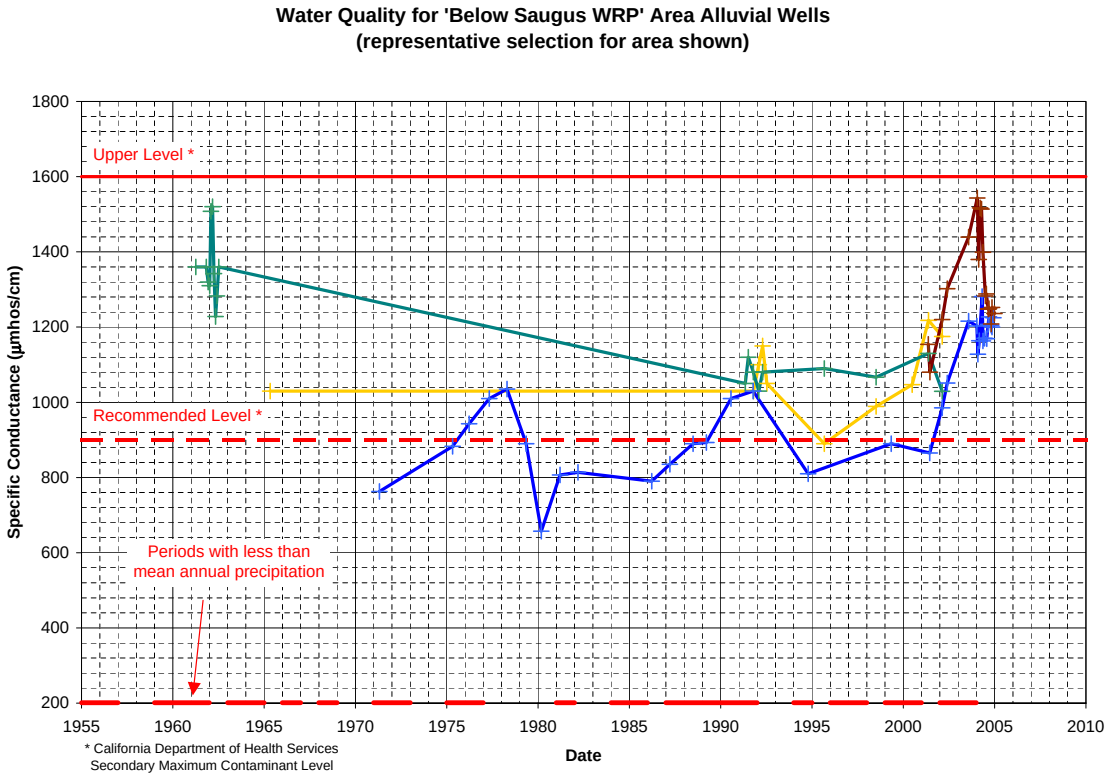
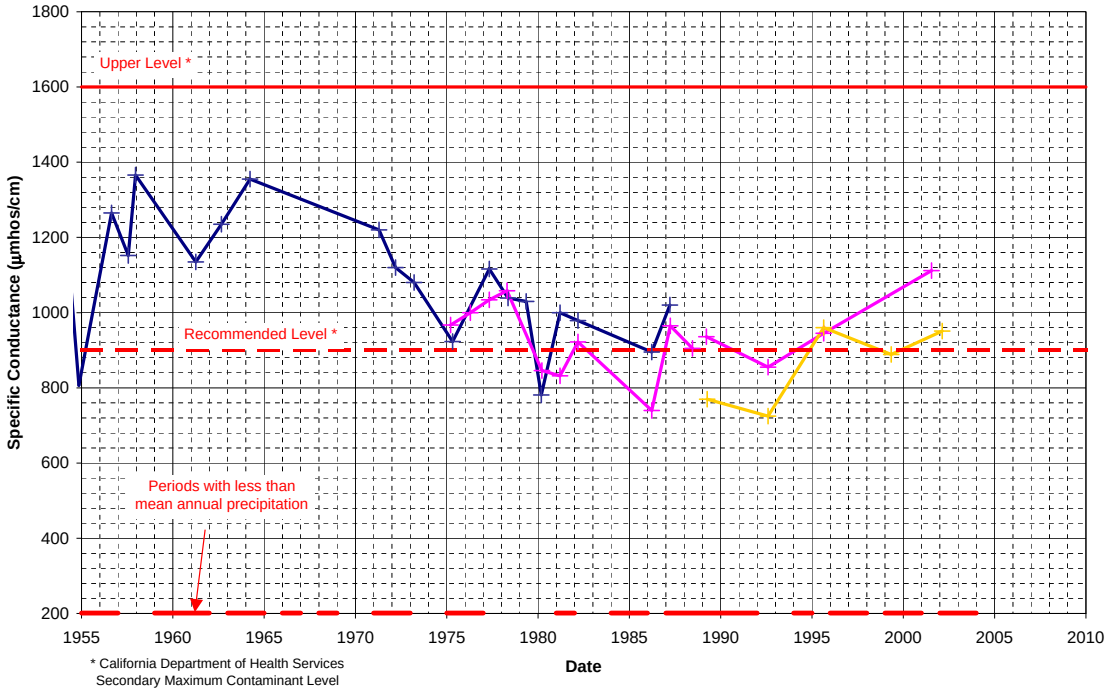


Figure III-10

Water Quality for 'Bouquet Canyon' Area Alluvial Wells
(representative selection for area shown)



Water Quality for 'Castaic Creek' Area Alluvial Wells
(representative selection for area shown)

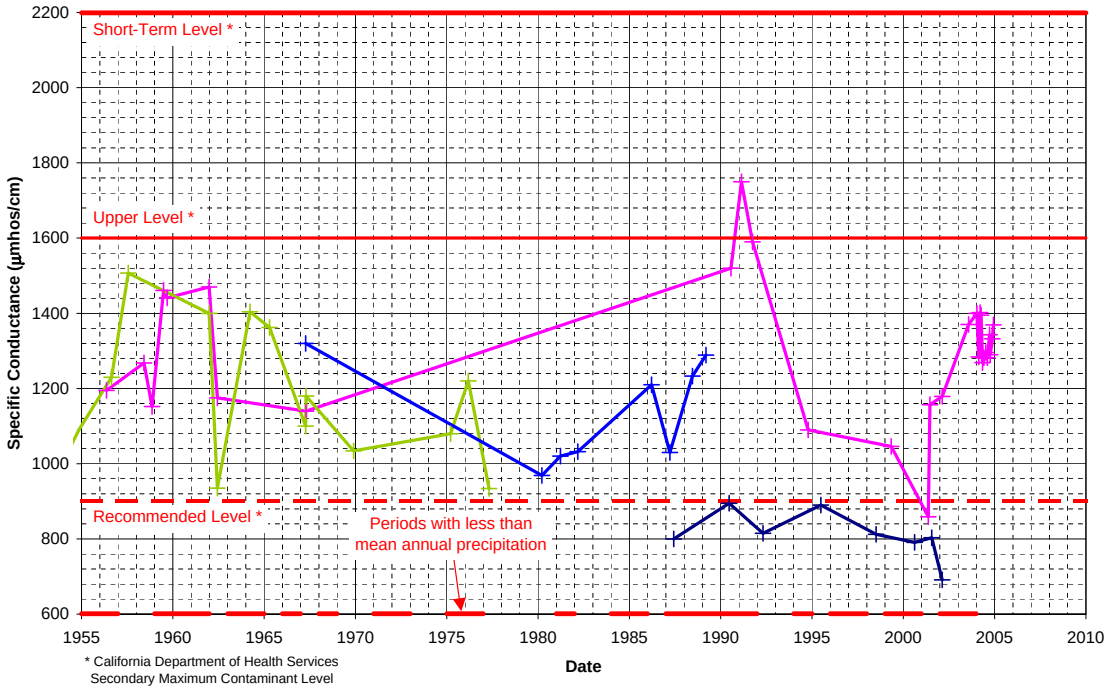
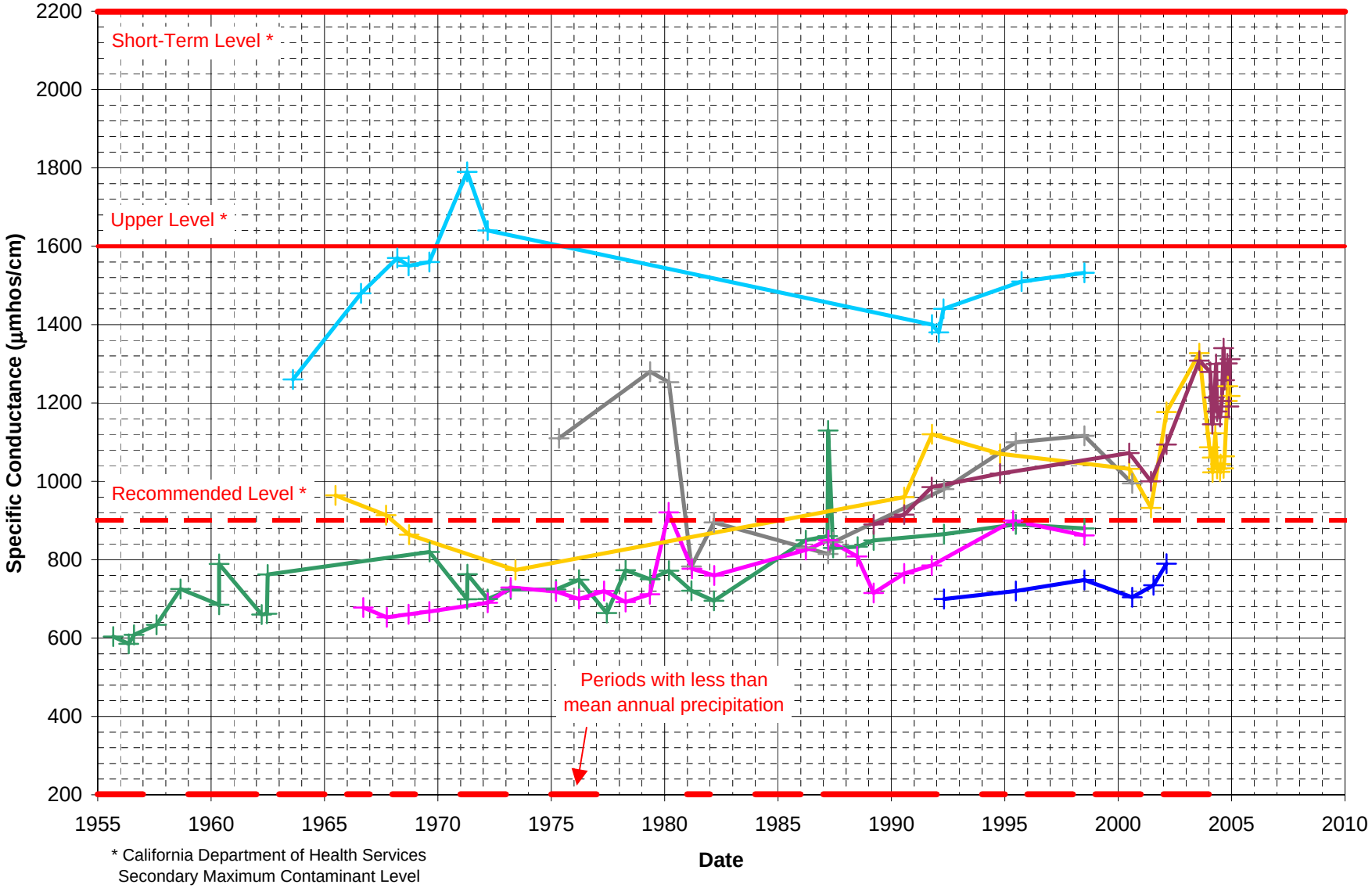


Figure III-11

Water Quality for Saugus Wells
(representative selection shown)



* California Department of Health Services
Secondary Maximum Contaminant Level

Figure III-12

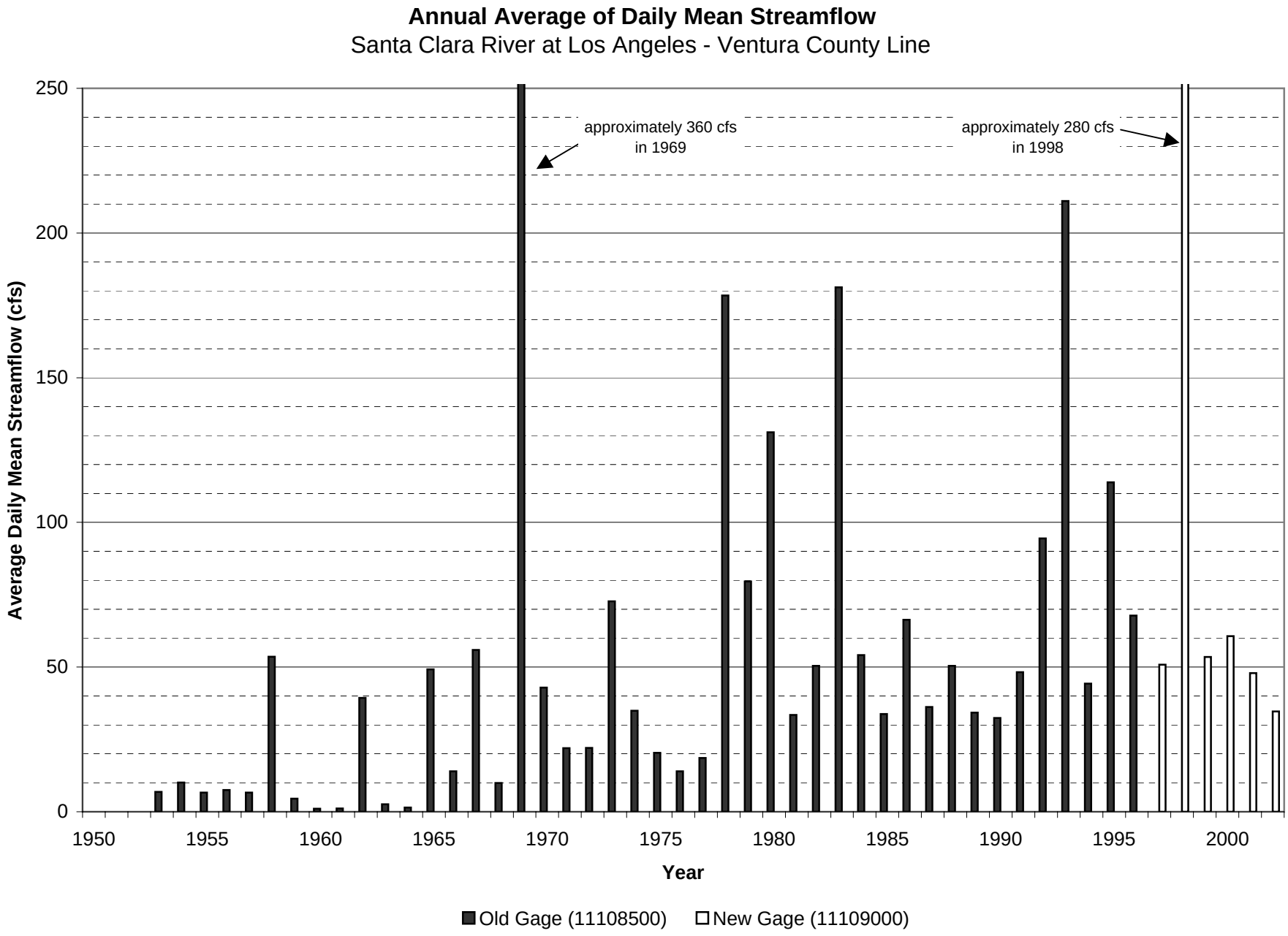


Figure III-13

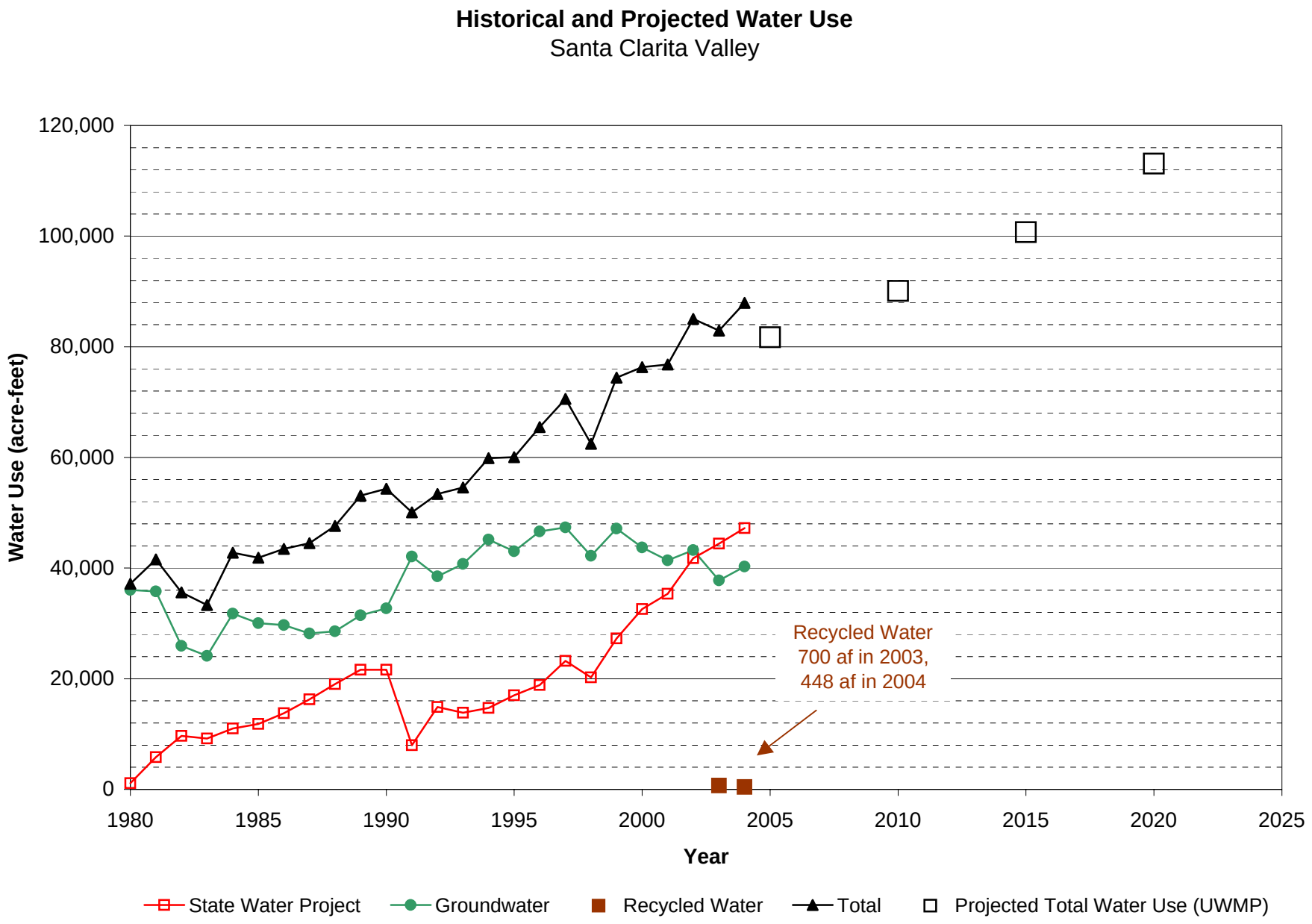

Historical and Projected Water Use
Santa Clarita Valley
Water Use (acre-feet)
120,000
100,000
80,000
60,000
40,000
20,000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
Year
Recycled Water
700 af in 2003,
448 af in 2004
State Water Project
Groundwater
Recycled Water
Total
Projected Total Water Use (UWMP)

Figure IV-1

2005 Santa Clarita Valley Water Report, Dated April 2006

2005
Santa Clarita Valley Water Report

Castaic Lake Water Agency (CLWA)
CLWA Santa Clarita Water Division
Los Angeles County Waterworks District 36
Newhall County Water District
Valencia Water Company

April, 2006

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Executive Summary

This annual report, which is the eighth in a series that began in 1998, provides current information about the water requirements and water supplies of the Santa Clarita Valley. The report was prepared for Castaic Lake Water Agency (CLWA) and its Santa Clarita Water Division, Los Angeles County Waterworks District 36, Newhall County Water District, and Valencia Water Company.

The Santa Clarita Valley is served by four local retail water Purveyors: Castaic Lake Water Agency's Santa Clarita Water Division (SCWD), Los Angeles County Waterworks District 36 (LA36), Newhall County Water District (NCWD), and Valencia Water Company (VWC). The CLWA provides water from California's State Water Project (SWP) to the water Purveyors for distribution. Management from these entities and representatives from the City of Santa Clarita and the County of Los Angeles meet as required to coordinate the management of imported SWP water with local groundwater, now augmented by recycled water, to meet water requirements in the Valley.

This report provides information about local groundwater resources, SWP water supplies, water conservation, and recycled water. The report reviews the sufficiency and reliability of supplies in the context of existing water demand, with focus on actual conditions in 2005, and it provides a short-term outlook of water supply and demand for 2006.

In 2005, total water demands in the Santa Clarita Valley were about 83,600 acre-feet (af), of which about 85 percent (70,800 af) was for municipal use and the remainder (12,800 af) was for agricultural and other (miscellaneous) uses, including individual domestic uses. Total demand in 2005 was about five percent lower than in 2004, and about nine percent lower than had been estimated in the previous Water Report, all attributable to the significantly wet conditions that prevailed through winter and spring in the Valley. These total water demands were met by a combination of about 45,100 af from local groundwater resources (nearly 32,300 af for municipal and about 12,800 af for agricultural and other uses), about 38,000 af of SWP water, and about 450 af of recycled water.

Of the 45,100 af of total groundwater pumpage in the Valley in 2005, about 38,700 af were pumped from the Alluvium and slightly less than 6,500 af were pumped from the underlying, deeper Saugus Formation. Alluvial pumpage represented about a 5,000 af increase from 2004, and Saugus pumpage was essentially unchanged from 2004. Neither pumping volume resulted in any overall change in ongoing groundwater conditions (water levels, water quality, etc.) in either aquifer system. SWP deliveries to the Purveyors decreased by about 9,000 af from the previous year, again primarily as a result of decreased water demand due to significantly wet conditions in the early part of the year. Water uses and supplies in 2005 are summarized in the following Table ES-1.

Table ES-1
Santa Clarita Valley
Summary of 2005 Water Supplies and Uses
(acre-feet)

Municipal		
State Water Project		38,034
Groundwater (Total)		32,316
Alluvium	*26,368*	
Saugus	*5,948*	
Recycled Water		438
Subtotal		**70,788**
Agriculture/Miscellaneous		
State Water Project		-
Groundwater (Total)		12,785
Alluvium	*12,280*	
Saugus	*505*	
Subtotal		**12,785**
Total		***83,573***

In accordance with the California Urban Water Management Planning Act, the Valley-wide UWMP was updated in 2005 to extend projected water demands through 2030, and to describe the combination of local groundwater, imported water supplies from the State Water Project, local recycled water supplies, and planned other water supplies to meet the existing and projected water demands in the Valley. The 2005 UWMP describes the reliability of local groundwater resources and the adequacy of groundwater supplies to meet groundwater demand, including consideration of the impacts of perchlorate contamination on several municipal water supply wells. The 2005 UWMP also describes the plans and ongoing work for integrated control of perchlorate migration and full restoration of perchlorate-impacted groundwater supply.

Notable details about each component of water supply in the Valley, and about the water supply outlook for 2006, include the following.

ES.1 Alluvial Aquifer

The groundwater operating plan in the UWMP includes Alluvial pumpage in the range of 30,000 to 40,000 acre-feet per year (afy) in average/normal years, and slightly reduced pumpage (30,000 to 35,000 afy) in dry years. Pumpage from the Alluvium was 38,700 af in 2005, and remained in the overall UWMP range as it has over the last ten years.

On a long-term basis, there is no evidence of any historic or recent trend toward permanent water level or storage decline. In general, throughout a large part of the basin, Alluvial groundwater levels have generally remained near historic highs during the last 30 years. Higher than average precipitation in late 2004 and 2005 resulted in significant water level recovery in the eastern part of the basin, continuing the overall trend of fluctuating groundwater levels within a generally constant range over the last 30 years. These ongoing data indicate that the Alluvium remains in good operating condition and can continue to support pumpage in the range included in the UWMP, as has been the case for the last decade, without adverse results (e.g., long-term water level decline or degradation of groundwater quality.)

Based on an integration of water quality records from multiple wells completed in the Alluvium, there have been historical fluctuations in groundwater quality, typically associated with variations in precipitation and streamflow. However, like groundwater levels, there has been no long-term trend toward groundwater quality degradation; groundwater produced from the Alluvial aquifer remains a viable municipal and agricultural water supply.

In 2002, as part of ongoing monitoring of wells for perchlorate contamination, perchlorate was detected in one Alluvial well located near the former Whittaker-Bermite facility. The detected concentration was slightly below the Notification Level for perchlorate (6 ug/l), and the well has been inactivated for municipal water supply since the detection of perchlorate. In early 2005, perchlorate was detected in a second Alluvial well, VWC's Well Q2. In response, Valencia removed the well from active service, and commissioned the preparation of an analysis and report assessing the impact of, and response to, the perchlorate contamination of that well. Valencia's response plan for Well Q2 was to pursue permitting and installation of wellhead treatment by the fall of 2005, all of which was successfully completed with the return of the well to water supply service in October 2005. All other Alluvial wells operated by the Purveyors continue to be used for municipal water supply service; those wells near the Whittaker-Bermite property are routinely sampled and perchlorate has not been detected. As detailed in the 2005 UWMP and the Q2 Report, the inactivation of either of the Alluvial wells due to perchlorate contamination does not limit the Purveyors' ability to produce groundwater from the Alluvium in accordance with the groundwater operating plan in the UWMP.

The ongoing characterization and plan for control and cleanup of perchlorate in the Valley has focused on the Saugus Formation. In addition, however, on-site cleanup and control activities also extended to the initiation of soil cleanup on one part of the Whittaker-Bermite site, and the initiation of pump and treatment action in the Northern Alluvium.

ES.2 Saugus Formation

The groundwater operating plan in the UWMP includes pumping from the Saugus in the range of 7,500 to 15,000 afy in average/normal years; it also includes planned dry-year pumping from the Saugus of 21,000 to 35,000 afy for one to three consecutive dry years. The UWMP recognizes that such short-term pumping can be recharged during subsequent wet/normal years to allow groundwater levels and storage to recover, as it has in historical periods.

Pumpage from the Saugus Formation was slightly less than 6,500 af in 2005; on average, Saugus pumpage has been about 7,000 afy since 1980. Both rates are near the lower end of the range included in the UWMP. As a result of long-term relatively low pumpage from the Saugus Formation, groundwater levels in that aquifer have remained essentially constant over the last 35 to 40 years; that trend continued in 2005.

In 1997, ammonium perchlorate was discovered in four wells completed in the Saugus Formation in the vicinity of the former Whittaker-Bermite facility located generally toward the east, on the south side of the basin. All four of those impacted wells remain out of active supply service. All other Saugus wells owned and operated by the Purveyors are available for municipal water supply service. As part of regular operation, those wells are sampled on a routine basis and perchlorate has not been detected. Despite the inactivated Saugus wells, the Purveyors still have sufficient pumping capacity in other wells to meet the planned normal range of Saugus pumping in the UWMP.

Work toward the ultimate remediation of perchlorate contamination, including the restoration of impacted groundwater supply continued to progress in 2005, with focus on permitting of a jointly developed plan "pump and treat" contaminated water from two wells to stop migration of the contaminant plume, and to deliver treated water to partially replace impacted well capacity. Environmental review of the project was completed with adoption of a Mitigated Negative Declaration in September. The Final Interim Remedial Action Plan was completed and approved by the State Department of Toxic Substances Control in December. Construction of facilities and pipelines necessary to implement the pump and treat program and to also restore inactivated well capacity is anticipated to commence in the fall of 2006.

ES.3 Imported Water

CLWA's contractual Table A Amount is 95,200 af of water from the SWP. CLWA operates two water filtration plants and has a current total treatment capacity of 86 million gallons per day of capacity where the water is treated, filtered, and disinfected prior to being delivered to Purveyors for distribution. Included in the total CLWA treatment plant capacity is the expansion of its Earl Schmidt Filtration Plant, which was completed in 2005 and added 22.5 mgd of capacity.

CLWA's final allocation of Table A for 2005 was 90 percent, or 85,680 af. On December 1, 2004, the initial allocation for 2005 was announced as 40 percent. On May 27, 2005, it was raised to the final allocation of 90 percent. Utilizing SWP contract provisions, CLWA elected to "carry over" unused remaining Table A Amount into 2006.

The total available SWP supply in 2005 was 88,382 af, including 2,702 af of 2004 carryover delivered in early 2005. CLWA deliveries were 38,034 af to the Purveyors and 20,000 af to the Rosedale-Rio Bravo Water Storage District's Storage and Recovery Program, with 31,377 af of the 2005 Table A Amount for potential carryover to 2006.

CLWA has two groundwater banking agreements with the Semitropic Water Storage District in Kern County. In accordance with those agreements, over a ten-year period (until 2012/13), CLWA can withdraw up to 50,870 af of water that it stored in 2002 and 2003 to meet Valley

demands when needed. In addition to the banking in Semitropic, CLWA finalized an agreement with the Rosedale-Rio Bravo Water Storage District in 2005, and banked 20,000 af of surplus Table A Amount in Rosedale-Rio Bravo's Water Storage and Recovery Program in 2005. In accordance with the provisions of that agreement, CLWA can withdraw up to 17,800 of that water to meet Valley water demands when needed.

Since SWP water deliveries are subject to reduction when dry conditions occur in Northern California, the UWMP includes programs, like the Semitropic and Rosedale-Rio Bravo programs, for enhancing water supply reliability during such occurrences. A capital improvement program funded by CLWA has been established to provide facilities and additional water supplies needed to firm up SWP water supplies during times of drought.

ES.4 Recycled Water

Recycled water service was initiated in July 2003 in accordance with CLWA's Draft Reclaimed Water System Master Plan (2002). The amount of recycled water used for irrigation purposes, at a golf course and in roadway median strips, was approximately 450 af in 2005.

ES.5 Water Supply Outlook

In 2006, total water demands are expected to be about 91,500 af, consistent with the growth rate and related water demand projections in the UWMP. It is expected that water demands in 2006 will continue to be met with a generally similar mix of water supplies comprised of imported SWP water, local groundwater, and recycled water.

As of March 23, 2006, the allocation of water from the SWP is 80 percent of CLWA's Table A Amount, representing 76,160 af. Combined with local groundwater from the two aquifer systems (42,500 af), total Flexible Storage Account (6,060 af), net carryover SWP water from 2005 (3,718 af), and recycled water (500 af), the total available water supplies for 2006 are nearly 129,000 af. As a result, CLWA and the Purveyors anticipate having more than adequate supplies to meet all water demands in 2006.

In any given year, SWP supplies may be reduced due to dry weather conditions or regulatory factors. During such an occurrence, the remaining water demands are planned to be met by a combination of alternate supplies such as returning water from CLWA's accounts in the Semitropic Groundwater Storage Program and the Rosedale-Rio Bravo Water Storage District's Banking Program, deliveries from CLWA's flexible storage account in Castaic Lake Reservoir, local groundwater pumping, short-term water exchanges, and participation in DWR dry-year water purchase programs in accordance with the Urban Water Management Plan. Due to the banking of excess 2002 and 2003 SWP water in the Semitropic Groundwater Storage Program, and banking CLWA can draw upon its account as needed, pursuant to the terms of the banking agreements. The banked excess 2002 and 2003 SWP water in Semitropic now represents nearly 51,000 af of recoverable water for drought water supply, and the banked excess 2005 SWP water in Rosedale-Rio Bravo now represents an additional 17,800 af of recoverable water for drought water supply.

Drought periods may affect available water supplies in any single year and for a duration usually not longer than three consecutive years. It is important to note that hydrologic conditions vary from region to region throughout the state. Dry conditions in Northern California affecting SWP supply may not affect local groundwater and other supplies in Southern California, and the reverse situation can also occur (as it did in 2002 and 2003). For this reason, CLWA and the Purveyors have emphasized developing water supplies that add diversity in water supply options, especially in dry years. Diversity of supply is considered a key element of reliability, giving Valley water Purveyors the ability to draw on multiple sources of supply during dry year conditions and thereby making the Purveyors less dependent upon direct deliveries from the SWP water supplies.

I. Introduction

1.1 Background

For most residents of the Santa Clarita Valley (Valley), domestic water service is provided by four retail water Purveyors. They are the Castaic Lake Water Agency Santa Clarita Water Division (SCWD), Los Angeles County Waterworks District 36 (LA36), Newhall County Water District (NCWD), and Valencia Water Company (VWC). Together, the Purveyors provide water to approximately 66,000 service connections. Castaic Lake Water Agency (CLWA) contracts for State Water Project water from Castaic Lake where it is treated, filtered, and disinfected at two treatment plants before distribution to the Purveyors. The staff of these entities meet regularly to coordinate the supply of water in the Valley. Their respective service areas are shown in Figure I-1.

Water supply for a small percentage of Valley residents is provided by individual private water supply wells. The locations, construction details, annual pumpage and other information about these private wells are not currently available. CLWA is currently working with private well owners to receive information about their wells for incorporation in future reports and for planning purposes. Pumping as reported herein includes an estimate of groundwater pumped from private wells; it is expected that this estimate will be refined in future reports as more information about the private wells is obtained.

In addition to municipal and individual private water uses in the Valley, there remains an agricultural water demand that is predominately dependent on local groundwater for its water supply. Accordingly, ongoing agricultural water requirements and the use of local groundwater to meet those requirements are considered in analyses and reports on water supplies such as this report.

Over the years, CLWA and the Purveyors have reviewed and documented the availability of water supplies to meet all water requirements in the Valley. Those reports have also addressed the status of water resources in the region. Past studies have assessed the condition of the local groundwater aquifers, their hydrogeologic character, aquifer storage capacity, operational yield and recharge rate, groundwater quality and contamination, and the potential for conjunctive use of groundwater and imported water resources.

Other efforts have included developing drought contingency plans, evaluating the impact of landfills on the groundwater basin, coordinating emergency response procedures and implementing Valley-wide conservation programs. In 1985, the Purveyors prepared the area's first Urban Water Management Plan (UWMP.) Information in the plan had been coordinated among CLWA and the Purveyors to provide accurate, comprehensive and consistent water supply and demand information for long term planning purposes. In accordance with the California Urban Water Management Planning Act, the Valley-wide UWMP was updated in 2005 to extend projected water demands through 2030, and to describe the combination of local groundwater, imported water supplies from the State Water Project, local recycled water supplies, and planned other water supplies to meet the existing and projected water demands in

the Valley. The 2005 UWMP describes the reliability of local groundwater resources and the adequacy of groundwater supplies to meet groundwater demand, including consideration of the impacts of perchlorate contamination on several municipal water supply wells. The 2005 UWMP also describes the plans and ongoing work for integrated control of perchlorate migration and full restoration of perchlorate-impacted groundwater supply.[1]

1.2 Purpose and Scope of the Report

The purpose of this report, which is the eighth in a series of annual water reports that began in 1998, is to provide current information about the available water supplies and demands of the Santa Clarita Valley. CLWA and the Purveyors have prepared this series of reports in response to a request made by the Los Angeles County Board of Supervisors in 1998. This report was prepared for Castaic Lake Water Agency (CLWA) and its Santa Clarita Water Division, for Los Angeles County Waterworks District 36, for Newhall County Water District, and for Valencia Water Company. It continues a format for providing information regarding water uses and the availability of water supplies on an annual basis. It is intended to be a helpful resource for use by water planners and local planning agencies. This report is complemented by the more detailed UWMP for the area, which provides longer-term water supply planning over a 25-year period.

1.3 Santa Clarita Valley Water Purveyors

As introduced above, four retail water Purveyors provide water service to most residents of the Santa Clarita Valley. Brief summary descriptions of those four Purveyors are as follows.

Castaic Lake Water Agency Santa Clarita Water Division has a service area that includes a portion of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Saugus, Canyon Country, and Newhall. Water is supplied from both groundwater and CLWA turnouts to nearly 27,000 service connections.

Los Angeles County Waterworks District 36 has a service area that encompasses approximately 7,635 acres in the Hasley Canyon area and the unincorporated community of Val Verde. LACWWD 36 has 1,320 service connections. The District has traditionally obtained its full water supply from a connection to the CLWA's Castaic Conduit. In 2005, as it had in 2004, the District supplemented its surface water supply with groundwater purchased from the Los Angeles County Peter J. Pitchess Detention Center.

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[1] The 2005 UWMP was challenged in a lawsuit filed in early 2006 by the California Water Impact Network and the Friends of the Santa Clara River, ultimately seeking a mandate that the approval of the UWMP by CLWA and the Purveyors be invalidated. Allegations in the lawsuit include claims that the 2005 UWMP ignored or failed to adequately address cumulative impacts of urbanization on groundwater recharge and on habitat; the impacts of private well use, a number of water quality issues, the timely remediation of perchlorate contamination, and the inability to utilize existing groundwater for Newhall Ranch water supply. Additional allegations include an overstatement of surface water reliability from the State Water Project, uncertainty of 41,000 af of CLWA's SWP Table A Amount, erroneous reliance on 24,000 af of banked groundwater, erroneous reliance on "paper water" in DWR's SWP Delivery Reliability Report, and failure to address known, foreseeable declines in SWP deliveries due to global warming. The 2005 UWMP remains valid unless affected by a future judgment or order of the court. The Purveyors believe the lawsuit is without merit, and will vigorously defend the plan in court.

Newhall County Water District's service area includes portions of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Newhall, Canyon Country, Saugus, and Castaic. NCWD supplies water from both groundwater and CLWA turnouts to approximately 9,200 service connections.

Valencia Water Company's service area serves about 28,800 service connections in a portion of the City of Santa Clarita and in the unincorporated communities of Castaic, Newhall, Saugus, Stevenson Ranch, and Valencia. VWC supplies water from both groundwater and CLWA turnouts; VWC also delivers recycled water for some non-potable uses.

1.4 The Upper Santa Clara River Hydrologic Area

The Upper Santa Clara River Hydrologic Area (HA), as defined by the California Department of Water Resources (DWR), is located almost entirely in northwestern Los Angeles County (Figure I-2). The area encompasses about 654 square miles comprised of flat valley land (about 6 percent of the total area) and hills and mountains (about 94 percent of the total area) that border the valley area. The mountains include the Santa Susana and San Gabriel Mountains to the south and the Sierra Pelona and Leibre-Sawmill Mountains to the north. Elevations range from about 800 feet on the valley floor to about 6,500 feet in the San Gabriel Mountains. The headwaters of the Santa Clara River are at an elevation of about 3,200 feet at the divide separating this hydrologic area from the Mojave Desert.

The Santa Clara River and its tributaries flow intermittently from Lang Station westward about 35 miles to Blue Cut, just west of the Los Angeles-Ventura County line, where it forms the outlet for the Upper Santa Clara River Hydrologic Area. The principal tributaries of the upper river are Castaic Creek, San Francisquito Creek, Bouquet Creek, and the South Fork of the Santa Clara River. Additionally, the Santa Clara River receives treated wastewater discharge from the Saugus and Valencia Water Reclamation Plants, which are operated by the Sanitation Districts of Los Angeles County (Figure I-2).

The Santa Clara River traverses the Santa Clarita Valley. The mountainous area to the north of the river is dissected by long southwest draining canyons - San Francisquito, Bouquet and Mint Canyons. Castaic Lake and Lagoon are within this Sub-Area. The South Fork of the Santa Clara River, draining the mountains along the southern boundary, traverses the valley floor where it joins with the main stem of the Santa Clara River.

Beneath the Santa Clarita Valley, there are two aquifer systems that comprise the Santa Clara River Valley East Groundwater Subbasin. This groundwater basin is the source of essentially all local groundwater used for water supply in the Santa Clarita Valley. Below Blue Cut, the Santa Clara River continues westward through Ventura County to its mouth near Oxnard. Along that route, the River traverses all or parts of six groundwater basins in Ventura County (Piru, Fillmore, Santa Paula, Oxnard Forebay, Oxnard Plain and Mound) as shown in Figure I-3.

There are two primary precipitation gages in the Santa Clarita Valley, the Newhall-Soledad 32c gage and the Newhall County Water District gage (shown in Figure I-4). The National Climatic

Data Center (NCDC) and Los Angeles County Department of Public Works (LADPW) have maintained records for the Newhall-Soledad 32c gage since 1931. Newhall County Water District has maintained records for the NCWD gage since 1979. The cumulative records from these two gages correlate very closely, with the NCWD gage recording approximately 25 percent more precipitation than the Newhall-Soledad 32c gage. This is likely due to the location of the NCWD gage, which is at the base of the mountains rimming the southern edge of the Santa Clarita Valley.

The Santa Clarita Valley is characterized as having an arid climate. Intermittent periods of less-than-average precipitation are typically followed by periods of greater-than-average precipitation in a cyclical pattern, with each wetter or drier period typically lasting from one to five years. Long-term precipitation records for the Newhall-Soledad 32c gage are illustrated in Figure I-5. The long-term average precipitation is 18.16 inches (1931-2005). Figure I-5 also shows the yearly departure from mean annual precipitation. In general, periods of less-than-average precipitation are longer and more moderate than periods of greater-than-average precipitation. Recently, the periods from 1971 to 1976, 1984 to 1991 and 1999 to 2003 have been drier than average; the periods from 1977 to 1983 and 1992 to 1996 have been wetter than average. 2004 was a slightly wet year, with total precipitation of approximately 23 inches, about 5 inches above average. Wet conditions that began in late 2004 continued into early 2005. Significant storm events in January 2005 produced over 13 inches of measured precipitation, or more than 70 percent of average annual precipitation in the first month of the year. Significant storm events continued in February, resulting in nearly 17 inches of additional measured precipitation, or nearly 100 percent of average annual precipitation in February alone. In total, 2005 had about 37 inches of measured precipitation, or slightly more than 200 percent of long-term average precipitation.

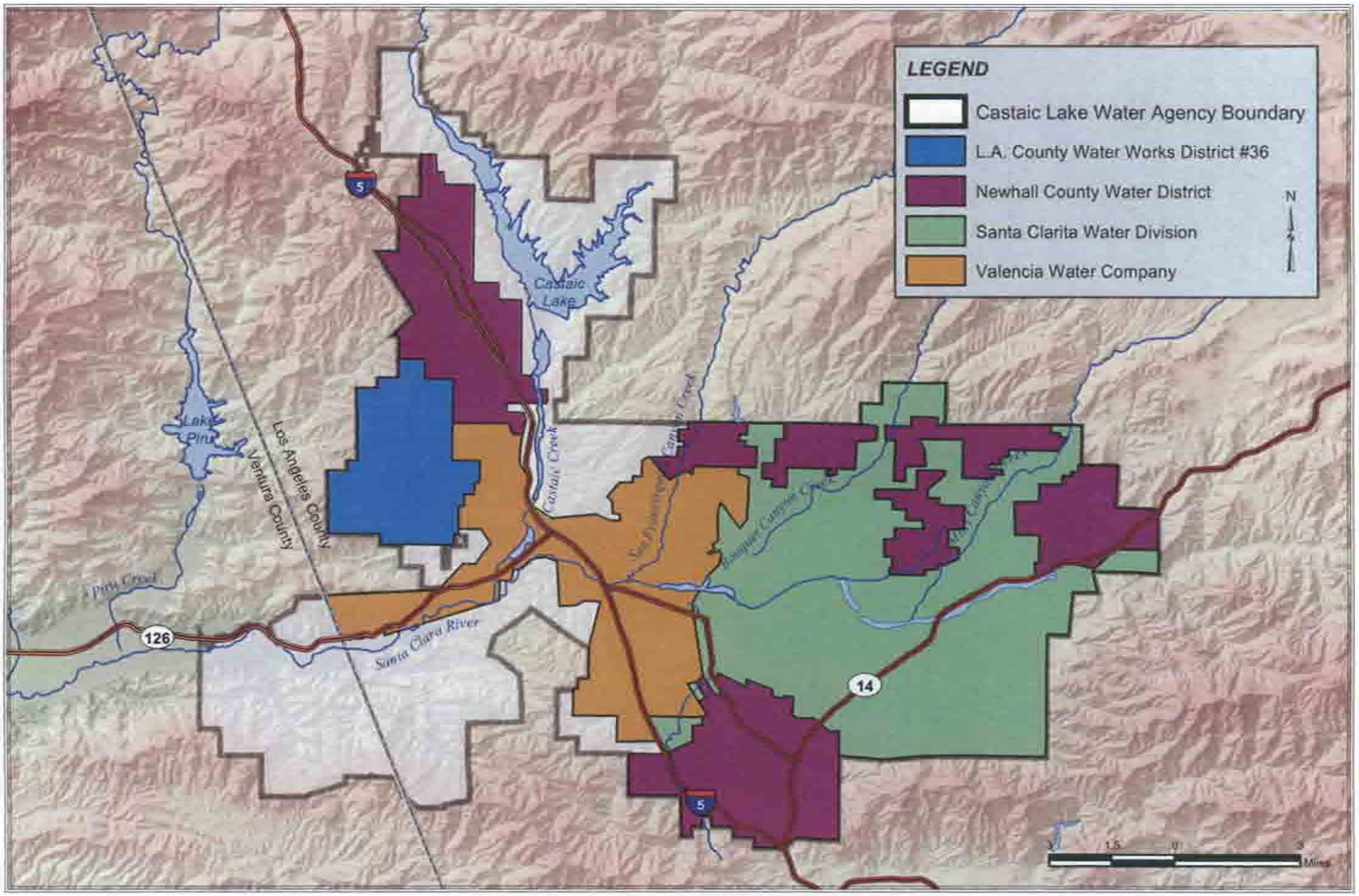

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Figure I-1
CLWA and Purveyor Service Areas

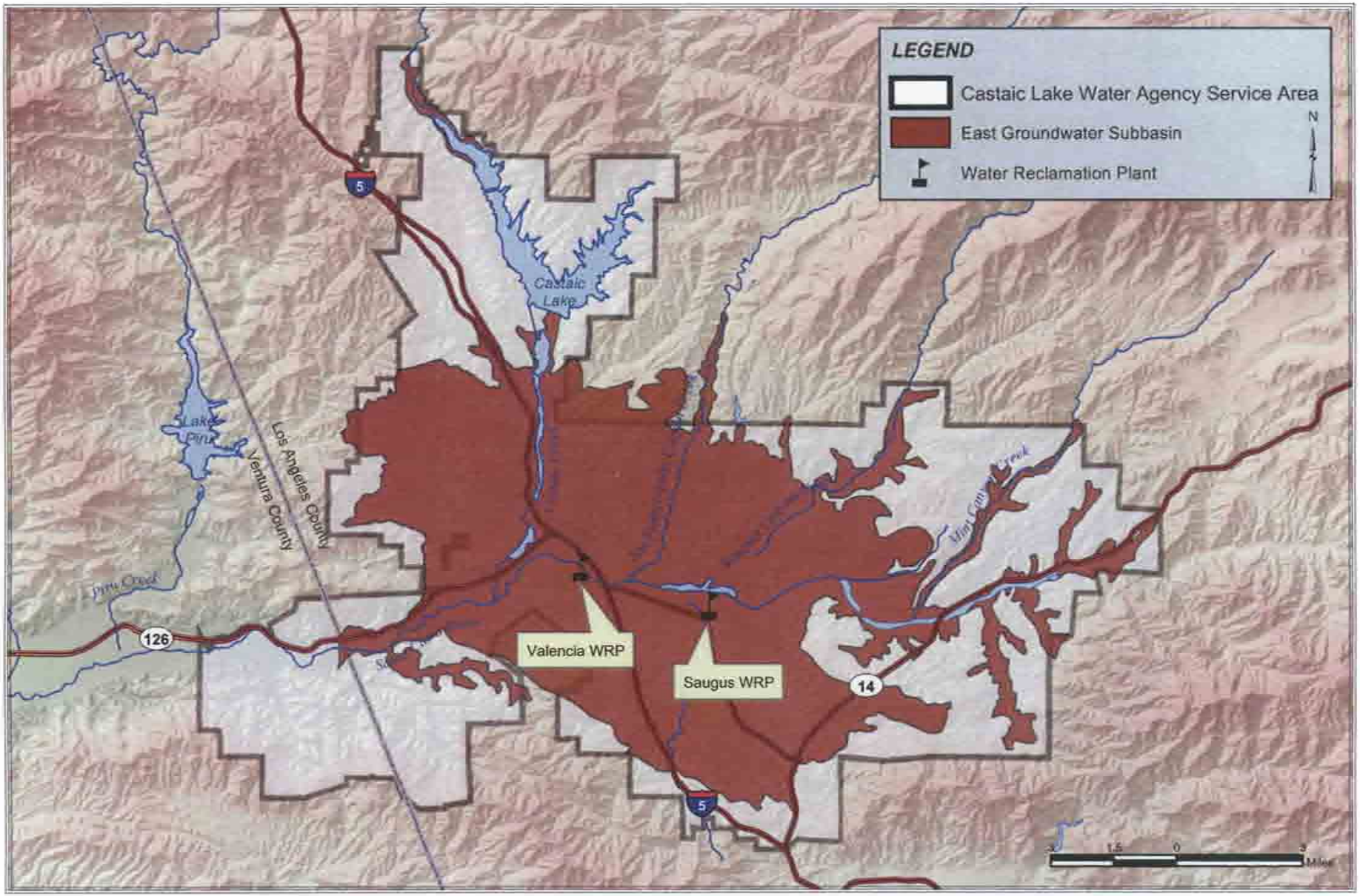

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Figure I-2
Santa Clara River Valley
East Groundwater Subbasin

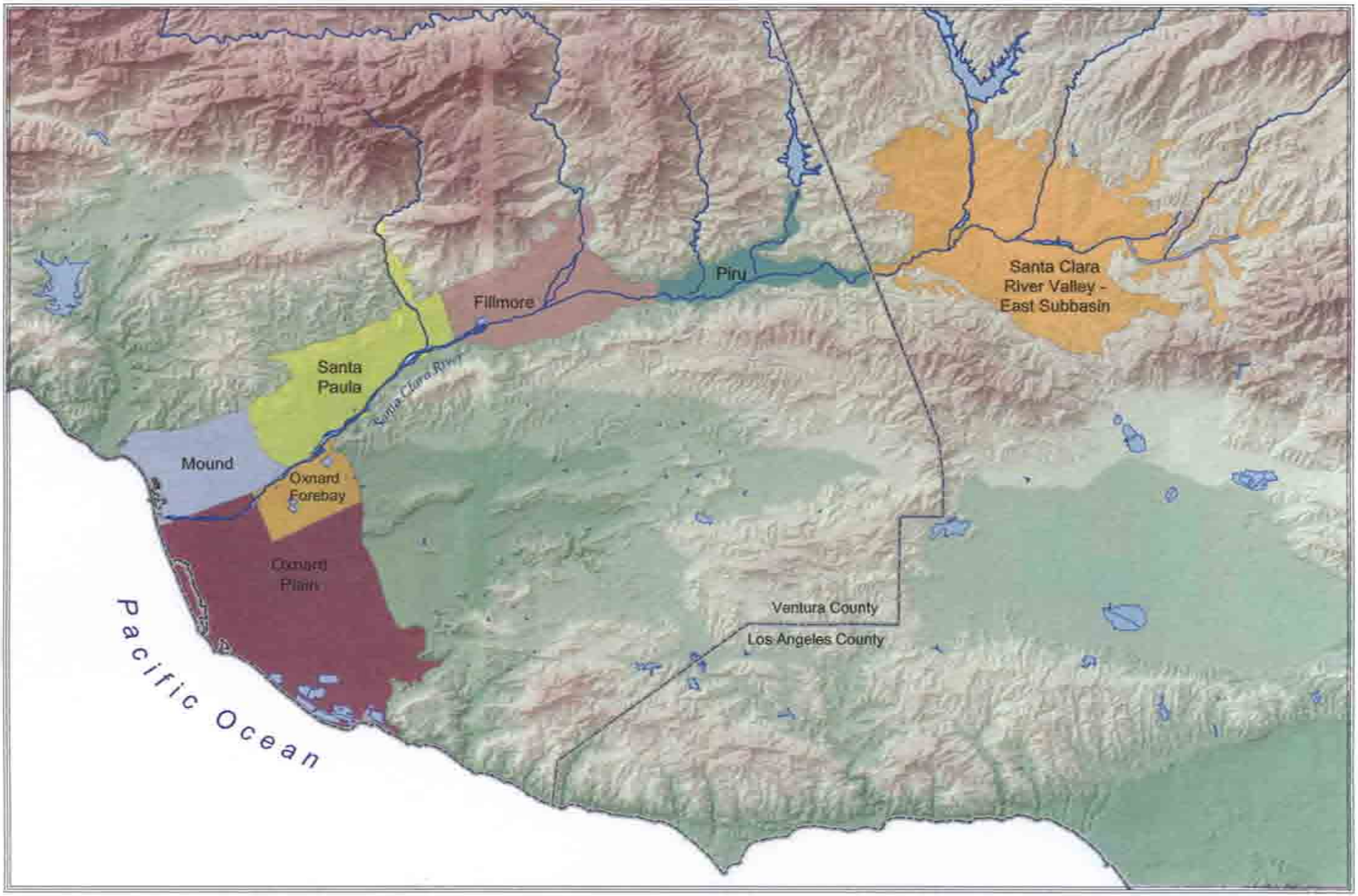

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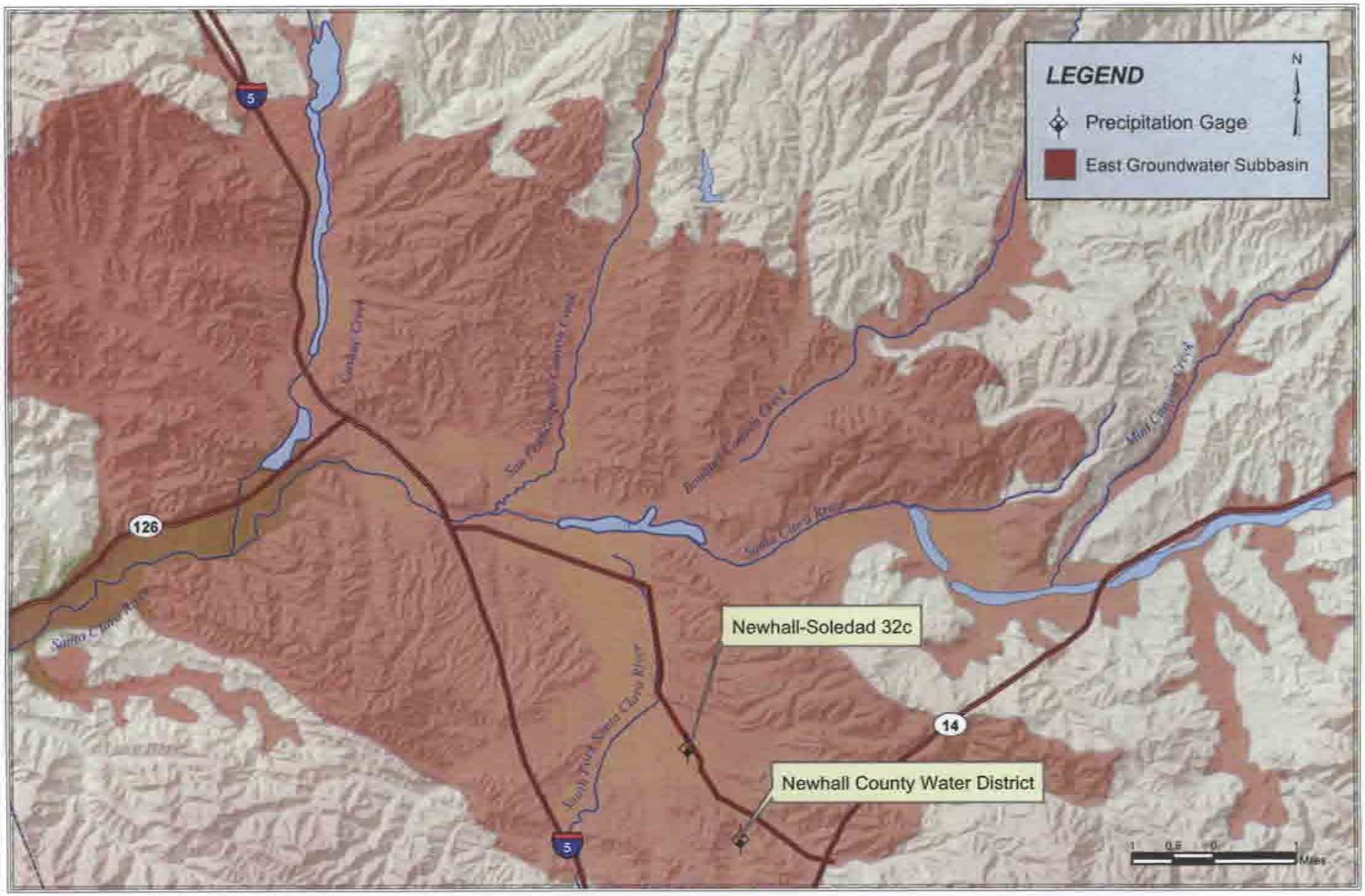
Figure I-3
Upper and Lower Santa Clara River Basins



LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Figure I-4
Precipitation Gage Locations
Santa Clara River Valley, East Groundwater Subbasin

Annual Precipitation and Departure from Mean Annual Precipitation
Santa Clara River Valley, East Groundwater Subbasin
(Newhall-Soledad 32c Gage)

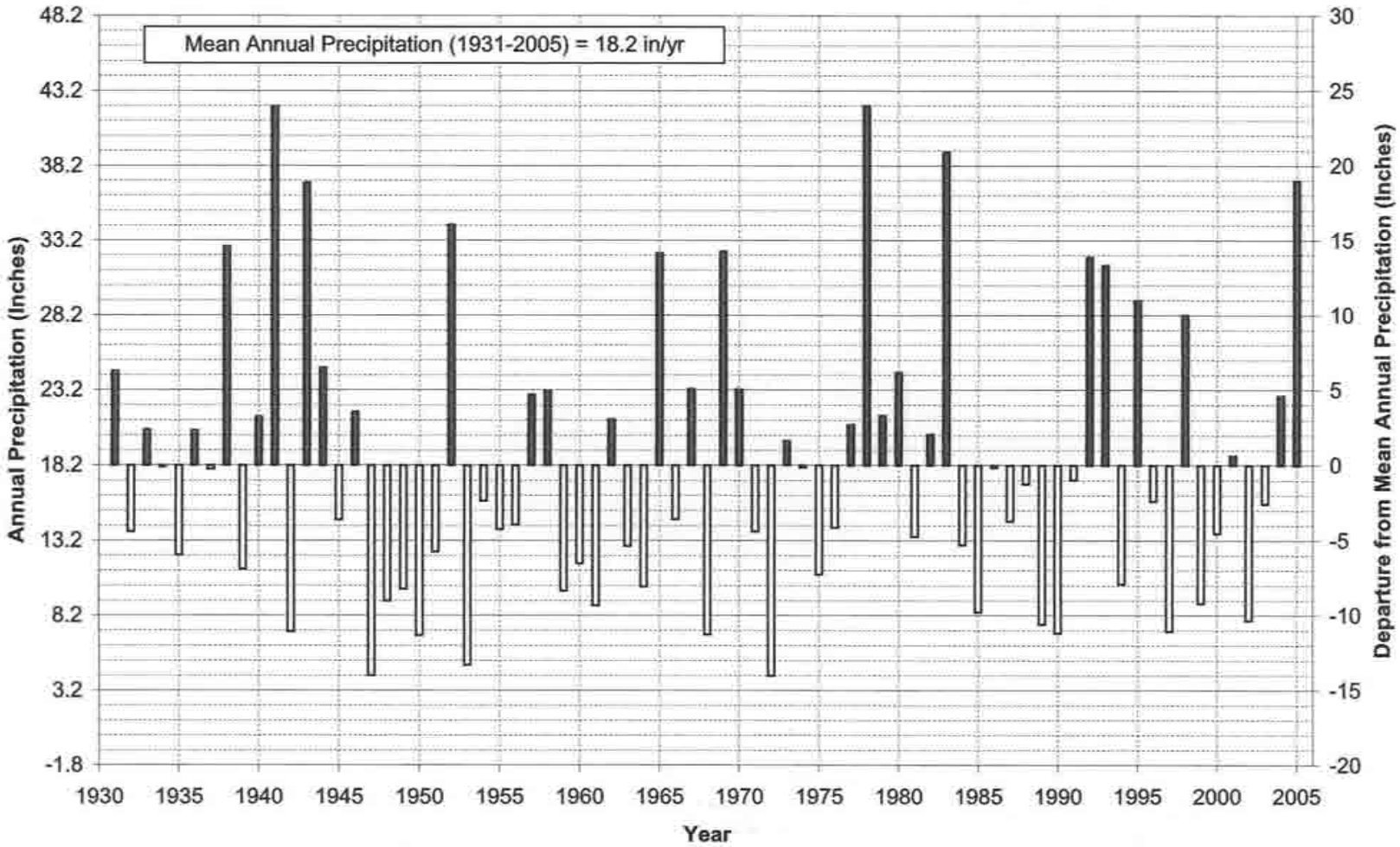


Figure I-5

II. 2005 Water Demands and Supplies

In 2005, total water demands in the Santa Clarita Valley were 83,600 af, a decrease of about 4,400 af from the previous year. Of the total water demand, 85 percent (70,800 af) was for municipal use and the remaining 15 percent (12,800 af) was for agricultural and other (miscellaneous) uses, including individual domestic uses. These total water demands were met by a combination of 45,100 af from local groundwater resources (nearly 32,300 af for municipal and about 12,800 af for agricultural and other uses), about 38,000 af of SWP water, and 438 af of recycled water.

Compared to the previous year, the total water demand in the Santa Clarita Valley decreased by about five percent in 2005. Actual water use in 2005 was also about nine percent lower than the short-term projected water requirement of about 89,000 acre-feet presented in last year's Water Report. The decrease in water use in 2005 was despite an increase of about 1,500 municipal service connections, from 64,800 in 2004 to 66,300 in 2005. The magnitude of decreased water use in 2005, which resulted from the significantly wet winter of 2004-05, was consistent with the analysis of weather impacts on water usage in the 2005 Urban Water Management Plan. As summarized in that Plan, examination of historical water use patterns in the Valley since 1980, when State Water Project deliveries began, show that weather variations have influenced water use by nine to ten percent of normal, or average, use. In hotter, dry years, water demands have been as much as nine percent higher than normal while in cooler, wet years, water demands have been as much as ten percent less than normal. In summary, the extended and significantly wet conditions in early 2005 resulted in a water demand decrease that, over the entire calendar year, was about equal to the largest historical single-year decrease from normal water demands over the last 25 years.

The uses of local and imported water supplies to meet municipal water requirements since 1980, when the importation of SWP water began, are summarized in Table II-1. Water supply utilization by each individual municipal Purveyor is tabulated in Tables II-2 through II-5 for the same period of time.

Water supply utilization for all agricultural and other non-municipal uses is summarized in Table II-6 and tabulated by three categories of agricultural and other users in Table II-7.

Water supply utilization for all uses in the Santa Clarita Valley, again for the period 1980 to present, is summarized in Table II-8. The trends in utilization of local groundwater and imported SWP water, complemented by the recent addition of recycled water, are graphically illustrated in Figure II-1. As can be seen by inspection of Table II-8 and Figure II-1, total water use in the Valley has nearly linearly increased over the last 25 years, with some weather-related fluctuations in certain years. The resultant increase in total water demand, since the inception of supplemental SWP importation, has been from about 37,000 acre-feet in 1980 to the mid-80,000 acre-feet per year range over the last four years. As can also be seen by inspection of Table II-8 and Figure II-1, that increase in water demand has essentially all been met with increasing importation of SWP water; groundwater pumping has remained close to constant, particularly within a very narrow range over the last 15 years.

Table II-1
Water Supply Utilization by Municipal Purveyors*
(Acre-Feet)

* includes CLWA-SCWD, LACWD 36, NCWD and VWC

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	1,125	16,625	4,569	-	**22,319**
1981	5,816	14,056	4,950	-	**24,822**
1982	9,659	8,684	3,569	-	**21,912**
1983	9,185	8,803	3,398	-	**21,386**
1984	10,996	12,581	3,809	-	**27,386**
1985	11,823	12,519	4,140	-	**28,482**
1986	13,759	12,418	4,975	-	**31,152**
1987	16,285	12,630	4,962	-	**33,877**
1988	19,033	12,197	6,404	-	**37,634**
1989	21,618	13,978	7,217	-	**42,813**
1990	21,613	13,151	8,302	-	**43,066**
1991	7,968	17,408	14,417	-	**39,793**
1992	13,911	16,897	10,458	-	**41,266**
1993	13,393	19,808	10,151	-	**43,352**
1994	14,389	20,068	11,531	-	**45,988**
1995	16,996	20,590	8,087	-	**45,673**
1996	18,093	24,681	7,373	-	**50,147**
1997	22,148	25,273	6,752	-	**54,173**
1998	20,254	23,898	4,706	-	**48,858**
1999	27,282	27,240	2,728	-	**57,250**
2000	32,579	25,216	3,193	-	**60,988**
2001	35,369	22,055	3,267	-	**60,691**
2002	41,768	22,097	4,360	-	**68,225**
2003	44,419	19,397	3,581	700	**68,097**
2004	47,205	18,970	5,701	448	**72,324**
2005	38,034	26,368	5,948	438	**70,788**

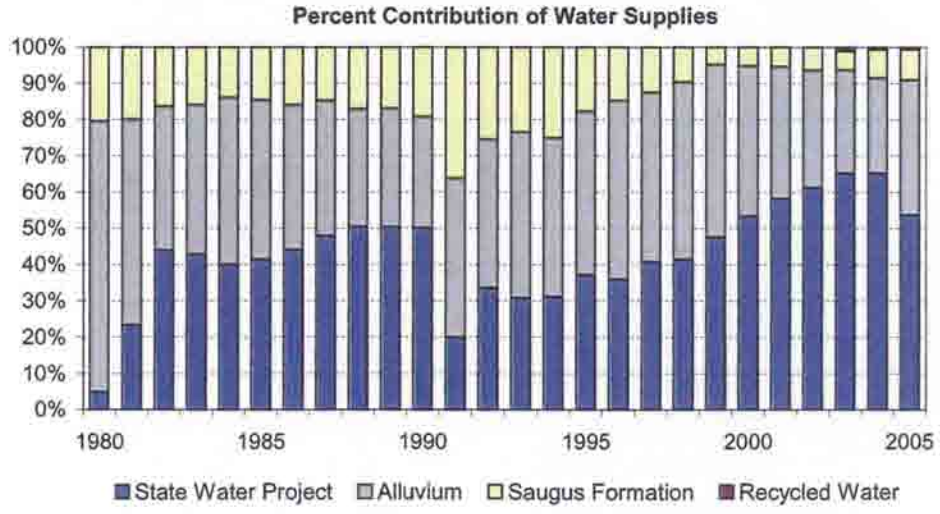


Table II-2
Water Supply Utilization by CLWA Santa Clarita Water Division
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	1,125	9,460	0	**10,585**
1981	4,602	7,109	0	**11,711**
1982	6,454	4,091	0	**10,545**
1983	5,214	4,269	0	**9,483**
1984	6,616	6,057	0	**12,673**
1985	6,910	6,242	0	**13,152**
1986	8,366	5,409	0	**13,775**
1987	9,712	5,582	0	**15,294**
1988	11,430	5,079	63	**16,572**
1989	12,790	5,785	0	**18,575**
1990	12,480	5,983	40	**18,503**
1991	6,158	5,593	4,781	**16,532**
1992	6,350	8,288	2,913	**17,551**
1993	3,429	12,016	2,901	**18,346**
1994	5,052	10,996	3,863	**19,911**
1995	7,955	10,217	1,726	**19,898**
1996	9,385	10,445	2,176	**22,006**
1997	10,120	11,268	1,068	**22,456**
1998	8,893	11,426	0	**20,319**
1999	10,772	13,741	0	**24,513**
2000	13,751	11,529	0	**25,280**
2001	15,648	9,896	0	**25,544**
2002	18,921	9,513	0	**28,434**
2003	20,668	6,424	0	**27,092**
2004	22,045	7,146	0	**29,191**
2005	16,513	12,408	0	**28,921**

Percent Contribution of Water Supplies

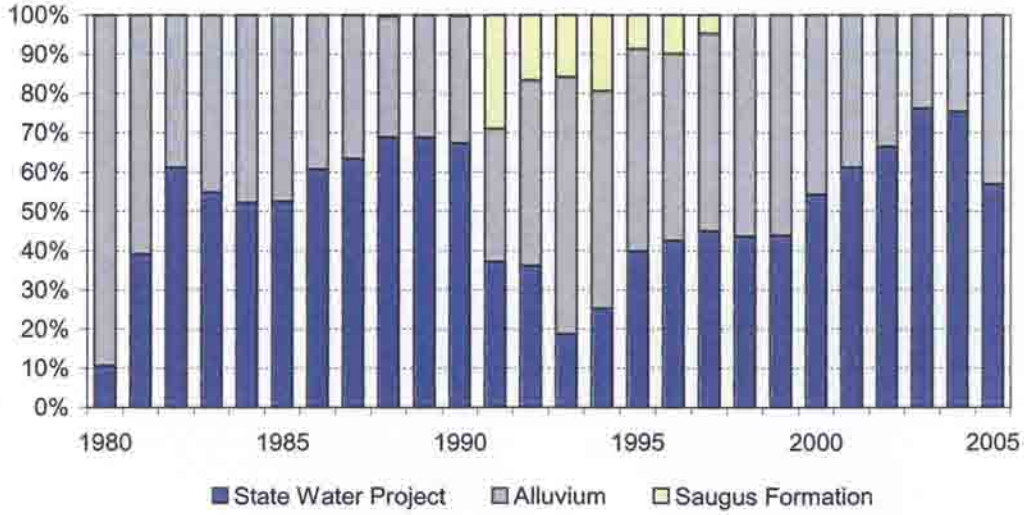


Table II-3
Water Supply Utilization by Los Angeles County Waterworks District 36
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	-	-	**0**
1981	0	-	-	**0**
1982	145	-	-	**145**
1983	207	-	-	**207**
1984	240	-	-	**240**
1985	272	-	-	**272**
1986	342	-	-	**342**
1987	361	-	-	**361**
1988	434	-	-	**434**
1989	457	-	-	**457**
1990	513	-	-	**513**
1991	435	-	-	**435**
1992	421	-	-	**421**
1993	465	-	-	**465**
1994	453	-	-	**453**
1995	477	-	-	**477**
1996	533	-	-	**533**
1997	785	-	-	**785**
1998	578	-	-	**578**
1999	654	-	-	**654**
2000	800	-	-	**800**
2001	907	-	-	**907**
2002	1,069	-	-	**1,069**
2003	1,175	-	-	**1,175**
2004	854	380	-	**1,234**
2005	857	343	-	**1,200**

Groundwater purchased from Los Angeles County Honor Farm

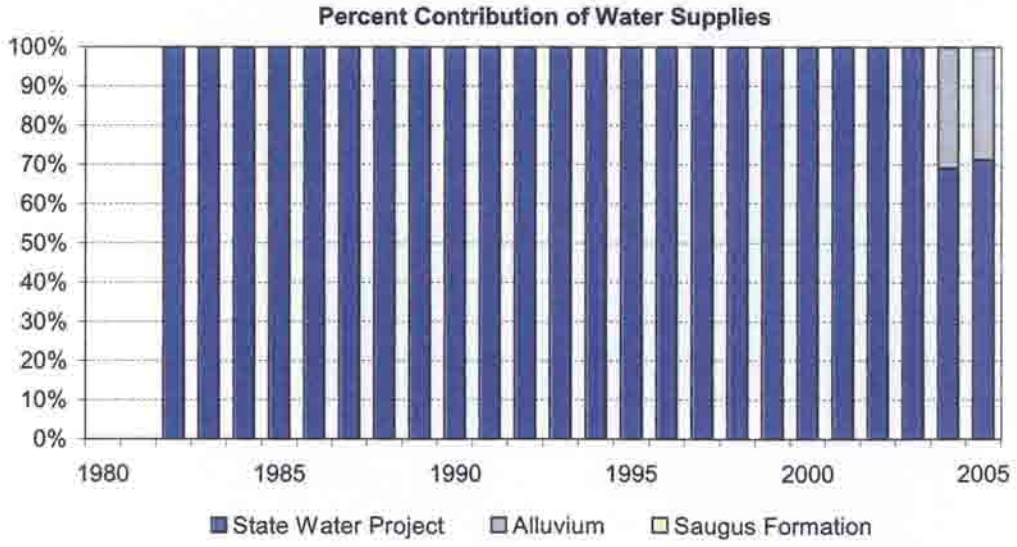


Table II-4
Water Supply Utilization by Newhall County Water District
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	1,170	2,363	**3,533**
1981	0	1,350	2,621	**3,971**
1982	0	1,178	2,672	**3,850**
1983	0	1,147	2,787	**3,934**
1984	0	1,549	2,955	**4,504**
1985	0	1,644	3,255	**4,899**
1986	0	1,842	3,548	**5,390**
1987	22	2,127	3,657	**5,806**
1988	142	2,283	4,041	**6,466**
1989	428	2,367	4,688	**7,483**
1990	796	1,936	4,746	**7,478**
1991	675	1,864	4,994	**7,533**
1992	802	1,994	5,160	**7,956**
1993	1,075	1,977	5,068	**8,120**
1994	906	2,225	5,103	**8,234**
1995	1,305	1,675	4,775	**7,755**
1996	1,213	1,803	4,871	**7,887**
1997	1,324	2,309	5,168	**8,801**
1998	1,769	1,761	4,557	**8,087**
1999	5,050	1,676	2,622	**9,348**
2000	6,024	1,508	2,186	**9,718**
2001	5,452	1,641	2,432	**9,525**
2002	5,986	981	3,395	**10,362**
2003	6,572	1,266	2,513	**10,351**
2004	5,896	1,582	3,739	**11,217**
2005	5,932	1,389	3,435	**10,756**

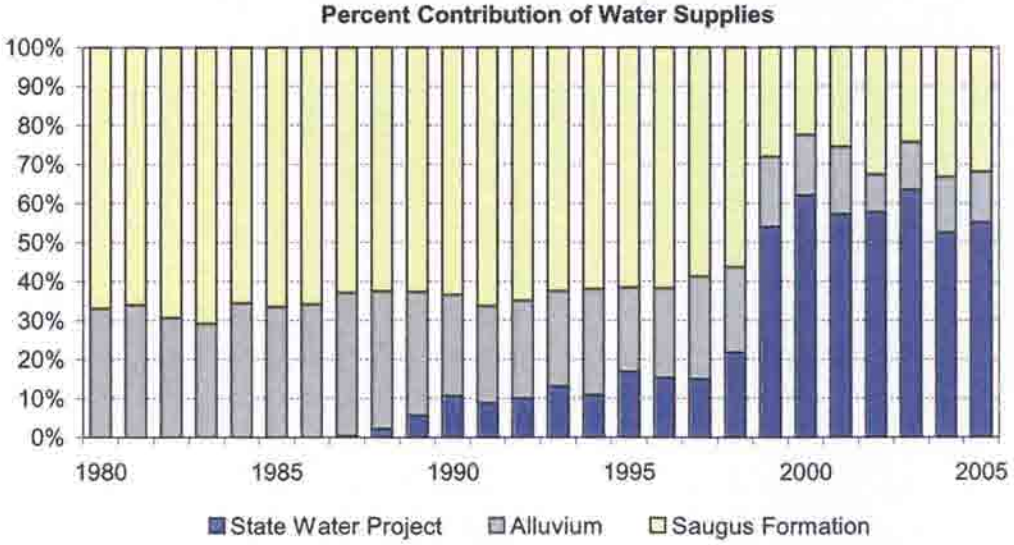


Table II-5
Water Supply Utilization by Valencia Water Company
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	0	5,995	2,206	-	**8,201**
1981	1,214	5,597	2,329	-	**9,140**
1982	3,060	3,415	897	-	**7,372**
1983	3,764	3,387	611	-	**7,762**
1984	4,140	4,975	854	-	**9,969**
1985	4,641	4,633	885	-	**10,159**
1986	5,051	5,167	1,427	-	**11,645**
1987	6,190	4,921	1,305	-	**12,416**
1988	7,027	4,835	2,300	-	**14,162**
1989	7,943	5,826	2,529	-	**16,298**
1990	7,824	5,232	3,516	-	**16,572**
1991	700	9,951	4,642	-	**15,293**
1992	6,338	6,615	2,385	-	**15,338**
1993	8,424	5,815	2,182	-	**16,421**
1994	7,978	6,847	2,565	-	**17,390**
1995	7,259	8,698	1,586	-	**17,543**
1996	6,962	12,433	326	-	**19,721**
1997	9,919	11,696	516	-	**22,131**
1998	9,014	10,711	149	-	**19,874**
1999	10,806	11,823	106	-	**22,735**
2000	12,004	12,179	1,007	-	**25,190**
2001	13,362	10,518	835	-	**24,715**
2002	15,792	11,603	965	-	**28,360**
2003	16,004	11,707	1,068	700	**29,479**
2004	18,410	9,862	1,962	448	**30,682**
2005	14,732	12,228	2,513	438	**29,911**

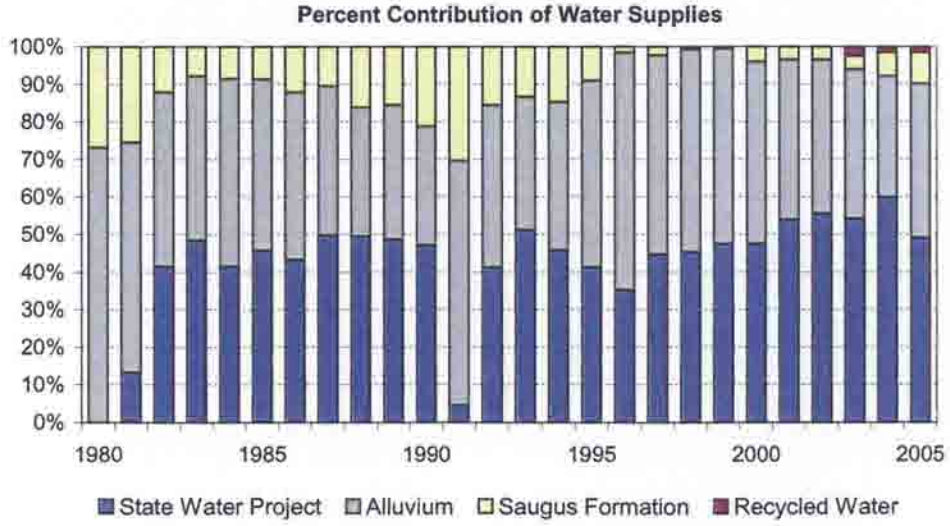


Table II-6
Water Supply Utilization for Agricultural and Other Uses
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	0	14,831	20	**14,851**
1981	0	16,737	20	**16,757**
1982	0	13,184	521	**13,705**
1983	0	11,483	454	**11,937**
1984	0	14,737	640	**15,377**
1985	0	12,828	575	**13,403**
1986	0	11,787	510	**12,297**
1987	0	10,012	599	**10,611**
1988	0	9,451	524	**9,975**
1989	0	9,743	542	**10,285**
1990	0	10,725	559	**11,284**
1991	0	9,779	500	**10,279**
1992	987	10,694	466	**12,147**
1993	443	10,318	459	**11,220**
1994	311	13,065	494	**13,870**
1995	6	13,874	473	**14,353**
1996	780	13,757	813	**15,350**
1997	1,067	14,326	993	**16,386**
1998	12	12,750	849	**13,611**
1999	20	16,166	988	**17,174**
2000	3	14,433	887	**15,323**
2001	0	15,218	873	**16,091**
2002	0	16,006	800	**16,806**
2003	0	14,181	626	**14,807**
2004	0	14,787	803	**15,590**
2005	0	12,280	505	**12,785**

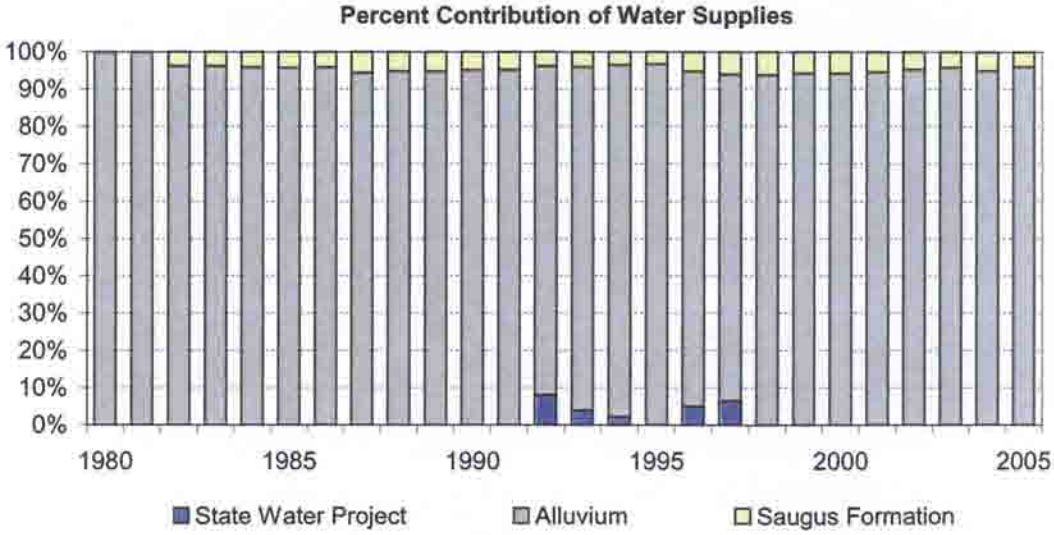


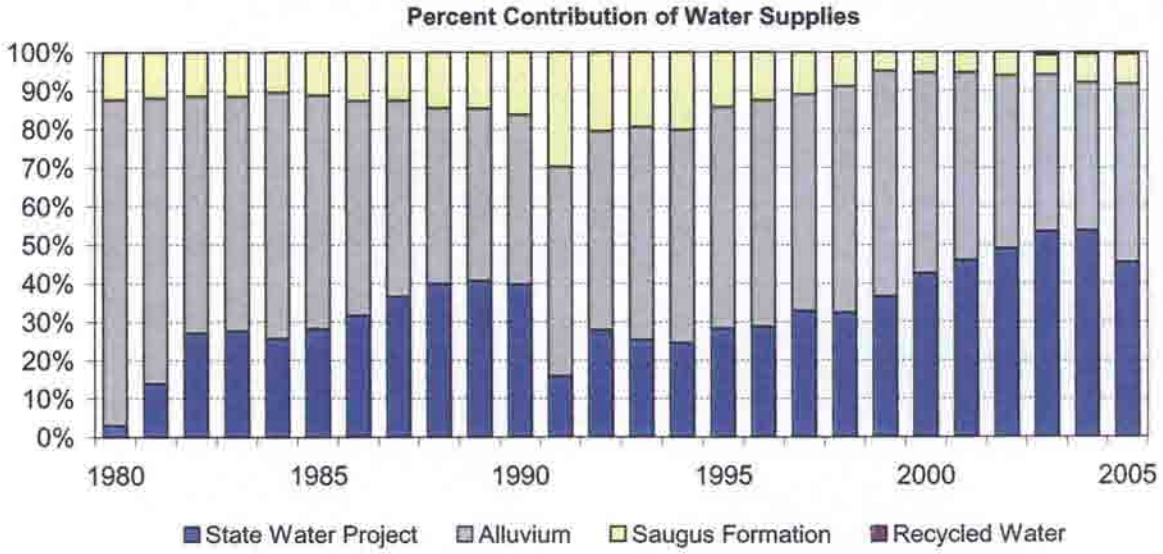
Table II-7
Individual Water Supply Utilization by Agricultural and Other Users
(Acre-Feet)

	Newhall Land and Farming			Los Angeles County Honor Farm			Small Private Domestic, Irrigation and Golf Courses Uses		
Year	Alluvium	Saugus Formation	Total	Alluvium	State Water Project	Total	Alluvium [1]	Saugus Formation [2]	Total
1980	11,331	20	**11,351**	3,000	0	**3,000**	500	0	**500**
1981	13,237	20	**13,257**	3,000	0	**3,000**	500	0	**500**
1982	9,684	20	**9,704**	3,000	0	**3,000**	500	501	**1,001**
1983	7,983	20	**8,003**	3,000	0	**3,000**	500	434	**934**
1984	11,237	20	**11,257**	3,000	0	**3,000**	500	620	**1,120**
1985	9,328	20	**9,348**	3,000	0	**3,000**	500	555	**1,055**
1986	8,287	20	**8,307**	3,000	0	**3,000**	500	490	**990**
1987	6,512	20	**6,532**	3,000	0	**3,000**	500	579	**1,079**
1988	5,951	20	**5,971**	3,000	0	**3,000**	500	504	**1,004**
1989	6,243	20	**6,263**	3,000	0	**3,000**	500	522	**1,022**
1990	8,225	20	**8,245**	2,000	0	**2,000**	500	539	**1,039**
1991	7,039	20	**7,059**	2,240	0	**2,240**	500	480	**980**
1992	8,938	20	**8,958**	1,256	987	**2,243**	500	446	**946**
1993	8,020	20	**8,040**	1,798	443	**2,241**	500	439	**939**
1994	10,606	20	**10,626**	1,959	311	**2,270**	500	474	**974**
1995	11,174	20	**11,194**	2,200	6	**2,206**	500	453	**953**
1996	12,020	266	**12,286**	1,237	780	**2,017**	500	547	**1,047**
1997	12,826	445	**13,271**	1,000	1,067	**2,067**	500	548	**1,048**
1998	10,250	426	**10,676**	2,000	12	**2,012**	500	423	**923**
1999	13,824	479	**14,303**	1,842	20	**1,862**	500	509	**1,009**
2000	11,857	374	**12,231**	1,644	3	**1,647**	932	513	**1,445**
2001	12,661	300	**12,961**	1,604	0	**1,604**	953	573	**1,526**
2002	13,514	211	**13,725**	1,602	0	**1,602**	890	589	**1,479**
2003	10,999	122	**11,121**	2,273	0	**2,273**	909	504	**1,413**
2004	10,991	268	**11,259**	2,725	0	**2,725**	1,071	535	**1,606**
2005	8,648	6	**8,654**	2,499	0	**2,499**	1,133	499	**1,632**

1. Robinson Ranch Golf Course irrigation and estimated private pumping.
2. Valencia Country Club and Vista Valencia Golf Course irrigation.

Table II-8
Total Water Supply Utilization for Municipal, Agricultural and Other Uses
(Acre-Feet)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	1,125	31,456	4,589	-	**37,170**
1981	5,816	30,793	4,970	-	**41,579**
1982	9,659	21,868	4,090	-	**35,617**
1983	9,185	20,286	3,852	-	**33,323**
1984	10,996	27,318	4,449	-	**42,763**
1985	11,823	25,347	4,715	-	**41,885**
1986	13,759	24,205	5,485	-	**43,449**
1987	16,285	22,642	5,561	-	**44,488**
1988	19,033	21,648	6,928	-	**47,609**
1989	21,618	23,721	7,759	-	**53,098**
1990	21,613	23,876	8,861	-	**54,350**
1991	7,968	27,187	14,917	-	**50,072**
1992	14,898	27,591	10,924	-	**53,413**
1993	13,836	30,126	10,610	-	**54,572**
1994	14,700	33,133	12,025	-	**59,858**
1995	17,002	34,464	8,560	-	**60,026**
1996	18,873	38,438	8,186	-	**65,497**
1997	23,215	39,599	7,745	-	**70,559**
1998	20,266	36,648	5,555	-	**62,469**
1999	27,302	43,406	3,716	-	**74,424**
2000	32,582	39,649	4,080	-	**76,311**
2001	35,369	37,273	4,140	-	**76,782**
2002	41,768	38,103	5,160	-	**85,031**
2003	44,419	33,577	4,207	700	**82,904**
2004	47,205	33,757	6,503	448	**87,913**
2005	38,034	38,648	6,453	438	**83,573**



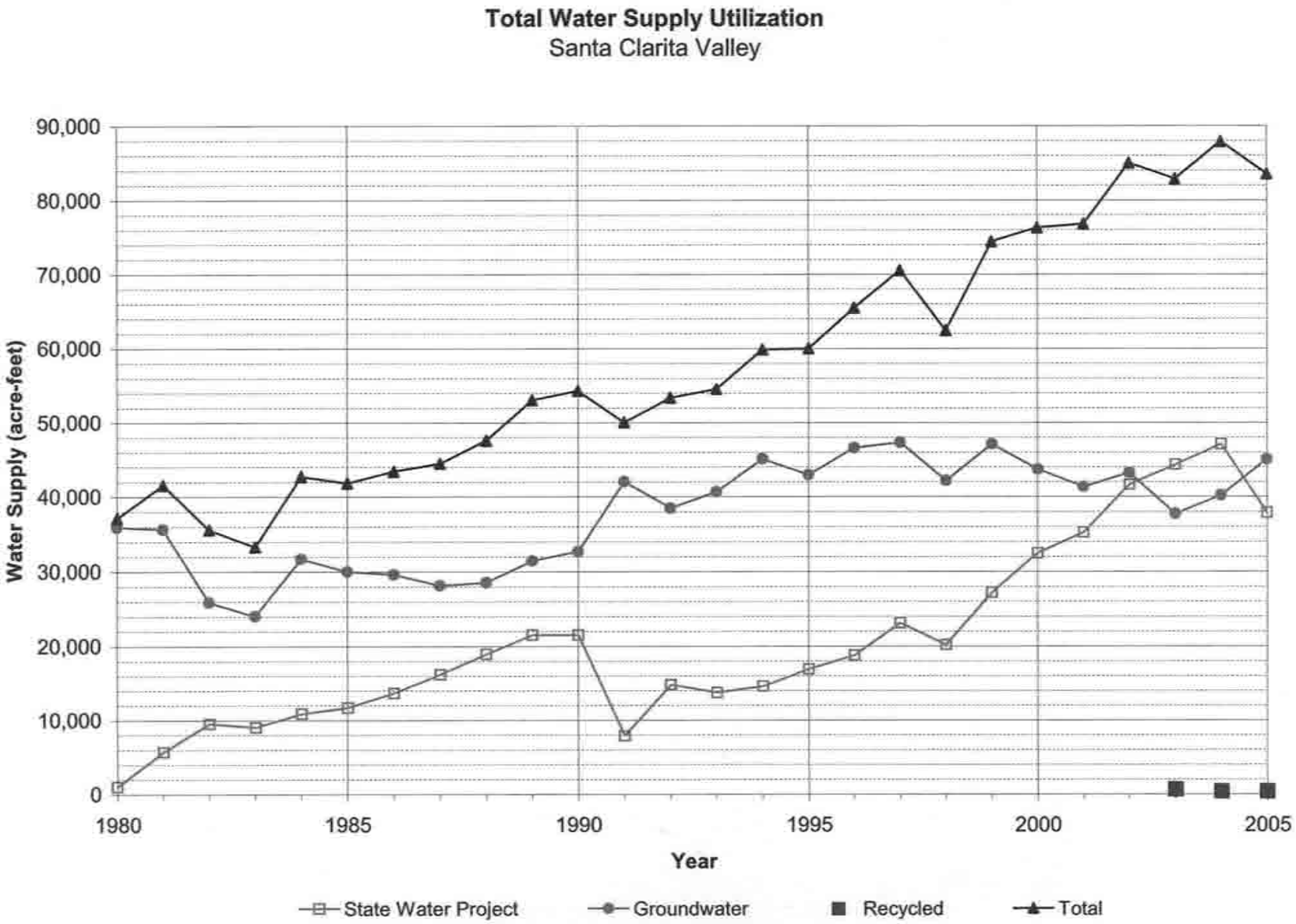

Total Water Supply Utilization
Santa Clarita Valley
Water Supply (acre-feet)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1985
1990
1995
2000
2005
Year
State Water Project
Groundwater
Recycled
Total

Figure II-1

III. Water Supplies

Prior to 1980, local groundwater extracted from the Alluvium and the Saugus Formation was the sole source of water supply in the Santa Clarita Valley. Since 1980, local groundwater supplies have been supplemented with imported SWP water supplies. Those water supplies were further augmented by the initiation of deliveries from CLWA's recycled water program in 2003. This section describes the groundwater resources of the Santa Clarita Valley, SWP water supplies, and CLWA's recycled water program.

3.1 Santa Clara River Valley Groundwater Basin – East Subbasin

The groundwater basin generally beneath the Santa Clarita Valley, identified in the State Department of Water Resources' Bulletin 118 as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin No. 4-4.07), is comprised of two aquifer systems. The Alluvium generally underlies the Santa Clara River and its several tributaries, and the Saugus Formation underlies practically the entire Upper Santa Clara River area. The mapped extent of the Santa Clara River Valley East Subbasin in DWR Bulletin 118 and its relationship to the extent of the CLWA service area are illustrated in Figure III-1. The subbasin boundary approximately coincides with the outer extent of the Alluvium and Saugus Formation.

A 2001 Update Report on both the Alluvium and Saugus Formation Aquifers (Slade, 2002), which updated analyses and interpretation of hydrogeologic conditions from earlier reports (Slade, 1986 and 1988), included extensive detail on major aspects of the groundwater basin. Notable parts of the Update Report relative to water supply include:

- Analysis of historical groundwater levels and production indicates that there have been no conditions that would be illustrative of groundwater overdraft;

- Utilization of operational yield (as opposed to perennial yield) as a basis for managing groundwater production would be more applicable in this basin to reflect fluctuating utilization of groundwater in conjunction with imported SWP water;

- Operational yield of the Alluvium would be 30,000 to 40,000 afy for wet and normal rainfall years, with an expected reduction into the range of 30,000 to 35,000 afy in dry years;

- Operational yield of the Saugus Formation would be in the range of 7,500 to 15,000 afy on a long-term basis, with short-term increases during dry periods into a range of 15,000 to 25,000 afy, and to 35,000 afy if dry conditions continue.

In 2004, as part of analyzing the restoration of perchlorate-impacted groundwater supply in the Valley, a numerical groundwater flow model was developed and calibrated for use in analyzing the response of the groundwater basin to long-term operation at the operational yields noted above, with focus on perchlorate extraction and the control of perchlorate migration in the basin. Subsequently, in 2005, the groundwater flow model was utilized to specifically analyze the sustainability of groundwater supplies in both the Alluvium and the Saugus Formation through a

long-term (78 year) hydrologic period that was selected to examine groundwater basin response to variations in pumping in accordance with the operating plan. Resultant projections of groundwater levels, groundwater storage, and surface water flows showed the basin to respond in a long-term sustainable manner, with no chronic depletion of groundwater levels, storage, or stream flows. The primary findings of the Basin Yield Report on the preceding work (CH2M Hill and LSCE, 2005), which also assessed current basin conditions based on historical data utilized in the model, included:

- The groundwater basin has historically been, and continues to be, in good operating condition and not in overdraft conditions, as indicated by historical data.

- The groundwater plan is sustainable over varying hydrologic conditions, because it is feasible to intermittently exceed a long-term average yield for one or more years without creating long-term adverse impacts to the groundwater system and the Santa Clara River.

- The groundwater operating plan for the Alluvium and the Saugus Formation can be used for long-term water supply planning purposes. In particular, although increased pumping from the Saugus Formation during dry periods can be expected to cause short-term declines in groundwater levels, it is not projected to cause permanent declines in groundwater discharges or streamflow. Additionally, Saugus groundwater levels will rapidly recover to pre-drought conditions.

- The strategy around which the groundwater operating plan was designed (maximizing the use of Alluvial Aquifer and imported water during years of normal or above-normal availability of these supplies, while limiting the use of the Saugus Formation during these periods, then temporarily increasing Saugus pumping during years when SWP supplies are significantly reduced because of drought conditions) is viable on a long-term basis.

- The historical observations of basin conditions and the model simulations together support the historical and ongoing confidence that groundwater can continue to be a sustainable source of water supply under the groundwater operating plan.

3.2 Alluvium – General

The spatial extent of the aquifers used for groundwater supply in the Valley, the Alluvium and the Saugus Formation, are illustrated in Figure III-1. Geologic descriptions and hydrogeologic details related to both aquifers are included in several other technical reports including Slade (1986, 1988 & 2002), CH2M Hill (2005) and LSCE (2005), and in the 2005 Urban Water Management Plan.

Consistent with the 2001 Update Report (Slade), the 2005 Basin Yield Report (CH2M Hill and LSCE), and the 2005 UWMP, the management practice of the Purveyors continues to be to utilize the Alluvium in accordance with the groundwater operating plan, 30,000 to 40,000 afy in wet and normal years, with possible reduction to 30,000 to 35,000 afy in dry years. Such operation will maximize use of the Alluvium because of the aquifer's ability to store and produce good quality water on a sustainable basis, and because the Alluvium is capable of rapid recovery

of water levels and storage in wet periods. As with many groundwater basins, it is possible to intermittently exceed a long-term average yield for one or more years without long-term adverse effects. Higher pumpage for short periods may temporarily lower groundwater storage and related water levels, as has been the case in the Alluvium several times since the 1930's. However, subsequent decreases in pumpage limit the amount of water level decline, and normal to wet-period recharge result in a rapid return of groundwater levels to historic highs. Historical groundwater data collected from the Alluvium over numerous hydrologic cycles continue to provide assurance that groundwater elevations, if locally lowered during dry periods, recover in subsequent average or wet years. Such water level response to rainfall is a significant characteristic of permeable, porous, alluvial aquifer systems that occur within large watersheds. In light of these historical observations, complemented by the long-term sustainability analysis using the numerical groundwater flow model, there is ongoing confidence that groundwater will continue to be a sustainable source of water supply at the rates of pumping described in the Basin Yield Report, now incorporated in the 2005 UWMP.

Long-term adverse impacts to the Alluvium could occur if the amount of water extracted from the aquifer were to exceed the amount of water that recharges the aquifer over an extended period. However, the quantity and quality of water in the Alluvium and pumpage from the Alluvium are routinely monitored, and no long-term adverse impacts have ever been evident. Ultimately, the Purveyors have identified cooperative measures to be taken, if needed, to ensure sustained use of the aquifer. Such measures include but are not limited to the continuation of conjunctive use of imported SWP surface water with local groundwater, artificial recharge of the aquifer with local runoff or other surface water supplies, financial incentives discouraging extractions above a selected limit, expanded use of other alternative supplies such as recycled water, and expanded implementation of demand-side management, including conservation.

3.2.1 Alluvium – Historical and Current Conditions

Total pumpage from the Alluvium in 2005 was about 38,700 af, an increase of nearly 5,000 af from the preceding year. Total Alluvium pumping thus remains within the groundwater operating plan range. Of the total Alluvial pumpage in 2005, about 68 percent (26,400 af) was for municipal water supply, and the balance, about 12,300 af, was for agriculture and other smaller uses, including individual domestic uses. In a longer-term context, there has been a change in municipal/agricultural pumping distribution since SWP deliveries began in 1980, toward a slightly higher fraction for municipal water supply (from about 50 percent to more than 60 percent of Alluvial pumpage), which reflects the general land use changes in the area. Ultimately, on a long-term average basis since the importation of SWP water, total Alluvial pumpage has been slightly less than 31,000 afy, which is at the lower end of the range of operational yield of the Alluvium. The overall historic record of Alluvial pumping is illustrated in Figure III-2.

Groundwater levels in various parts of the basin have historically exhibited different responses to both pumpage and climatic fluctuations. During the last 20 to 30 years, depending on location, Alluvial groundwater levels have remained nearly constant (generally toward the western end of the basin), or have fluctuated from near the ground surface when the basin is full, to as much as 100 feet lower during intermittent dry periods of reduced recharge (generally toward the eastern

end of the basin). For illustration of the various groundwater level conditions, the Alluvial wells have been grouped into areas with similar groundwater level patterns as illustrated in Figure III-3. Figures III-4 and III-5 present historical groundwater levels organized into hydrograph form (groundwater elevation vs. time) for four areas throughout the basin. The other areas shown in Figure III-2 exhibit groundwater level responses that are similar to those in these four areas.

The 'Mint Canyon' area, located at the far eastern end of the groundwater basin, and the nearby 'Above Saugus WRP' and 'Bouquet Canyon' areas generally exhibit similar groundwater level responses. Those parts of the Alluvium have historically experienced a number of alternating wet and dry hydrologic conditions (Figures III-4 and III-5) during which groundwater level declines have been followed by returns to historic highs. When water levels are low, well yields and pumping capacities in this area can be impacted. The affected Purveyors respond by increasing use of Saugus Formation and imported (SWP) supplies, as shown in Table II-8. The Purveyors also shift a fraction of the Alluvial pumpage that would normally be supplied by 'Mint Canyon' area wells to areas further west, where well yields and pumping capacities remain fairly constant because of smaller groundwater level fluctuations. As shown in Figure III-6, the Purveyors decreased total Alluvial pumpage from the 'Mint Canyon' area steadily from 2000 through 2003, and correspondingly increased pumpage in the 'Below Saugus WRP' and 'Below Valencia WRP' areas. In spite of a continued period of below-average precipitation from 1999 to 2003, that progressive decrease in pumping resulted in a cessation of groundwater level decline in the 'Mint Canyon' area in 2002 and 2003. Subsequently, wet conditions in late 2004, continuing into 2005, resulted in full recovery of groundwater storage. With such high groundwater levels, pumping in the 'Mint Canyon' area was increased in 2005, with no significant change in groundwater levels as a result.

The 'Below Saugus WRP' area (Figure III-4), along the Santa Clara River immediately downstream of the Saugus Water Reclamation Plant, and the 'San Francisquito Canyon' area generally exhibit similar groundwater levels. In this middle part of the basin, historical groundwater levels were lower in the 1950's and 60's than current levels. Groundwater levels in this area notably recovered as pumpage declined through the 1960's and 1970's. They have subsequently sustained generally high levels for much of the last 30 years, with three dry-period exceptions: mid-1970's, late 1980's to early 1990's, and the late 1990's to early 2000's. Recoveries to previous high groundwater levels followed both of the short dry-period declines in the 1970's and 1990's. Most recently, groundwater levels have recovered significantly following a wetter-than-average year in 2004 and significantly wet 2005, indicating that the groundwater level decline that occurred from 1999-2004 also represented a temporary dry-period decline.

The 'Castaic Valley' area is located along Castaic Creek below Castaic Lake. In that area, groundwater levels have remained fairly constant, with slight responses to climatic fluctuations, since the 1950's (Figure III-5).

The 'Below Valencia' WRP area is located along the Santa Clara River downstream of the Valencia Water Reclamation Plant, where discharges of treated effluent from the Valencia WRP to the Santa Clara River contribute to groundwater recharge. Groundwater levels in this area exhibit slight, if any, response to climatic fluctuations, and have remained fairly constant since

the 1950's despite, over the last 20 years, a notable increase in pumping in that area (Figure III-5 and III-6).

In summary, depending on the period of available data, all the history of groundwater levels in the Alluvium show the same general picture: recent (last 30 years) groundwater levels have exhibited historic highs; in some locations, there are intermittent dry-period declines (and an associated use of some groundwater from storage) followed by wet-period recoveries (and associated refilling of storage space). On a long-term basis, whether over the last 26 years since importation of supplemental SWP water, or over the last 40 to 50 years (since the 1950's - 60's), the Alluvium shows no signs of water level-related overdraft, i.e., no trend toward decreasing water levels and storage. Consequently, pumpage from the Alluvium has been and continues to be sustainable within the operational yield of that aquifer.

3.3 Saugus Formation – General

Saugus wells operated by the Purveyors are located in the southern portion of the basin south of the Santa Clara River (Figure III-7). Consistent with the 2001 Update Report (Slade) and the 2005 Basin Yield Report (CH2M Hill and LSCE), the management practice of the Purveyors is to utilize the Saugus in accordance with the groundwater operating plan, in the range of 7,500 to 15,000 afy in average/normal years, and planned dry-year pumping of 15,000 to 35,000 afy for one to three consecutive dry years, when shortages to CLWA's SWP water supplies could occur. Such high pumping would be followed by periods of lower pumpage (the 7,500 to 15,000 afy in average/normal years as noted above) in order to allow recharge to recover water levels and storage in the Saugus. Maintaining the substantial volume of water in the Saugus Formation is an important strategy to help maintain water supplies in the Santa Clarita Valley during drought periods.

3.3.1 Saugus Formation – Historical and Current Conditions

Total pumpage from the Saugus in 2005 was slightly less than 6,500 af, essentially the same as in the preceding year. Of the total Saugus pumpage in 2005, most (nearly 6,000 af) was for municipal water supply, and the balance (500 af) was for agricultural and other irrigation uses. Groundwater pumpage from the Saugus peaked in the early 1990's and then steadily declined through the remainder of that decade. Since then, Saugus pumpage has been in the range of about 4,000 to 6,500 afy. On a long-term average basis since the importation of SWP water, total pumpage from the Saugus Formation has ranged from a low of about 3,700 afy (in 1999) to a high of nearly 15,000 afy (in 1991); average pumpage from 1980 to present has been about 6,700 afy. These pumping rates remain well within, and generally at the lower end of the range of operational yield of the Saugus Formation. The overall historic record of Saugus pumping is illustrated in Figure III-8.

Unlike the Alluvium, which has an abundance of wells with extensive water level records, the water level data for the Saugus Formation are limited by the distribution of the wells in this Formation and the periods of record. The wells that do have water level records extending back to the mid-1960's indicate that groundwater levels in the Saugus Formation were highest in the mid-1980's and are currently higher than they were in the mid-1960's (Figure III-9). Based on

these data, there is no evidence of any historic or recent trend toward permanent water level or storage decline.

Consistent with the 2001 Update Report (Slade), the 2005 Basin Yield Report (CH2M Hill and LSCE), and the 2005 UWMP, the management practice of the Purveyors continues to be to maintain groundwater storage and associated water levels in the Saugus Formation so that supply is available during drought periods, when Alluvial pumping might be reduced and SWP supplies could be decreased. The period of increased pumpage during the late 1980's and early 1990's is a good example of this management strategy. Most notably, in 1991, when SWP deliveries were substantially reduced, increased pumpage from the Saugus made up almost half of the decrease in SWP deliveries. This increased Saugus pumpage resulted in short-term declining water levels reflecting the use of stored water. However, the water levels subsequently rose when pumpage declined, reflecting recovery of storage capacity of the Saugus Formation.

3.4 Imported Water

CLWA obtains water supplies from the SWP, which is owned and operated by the California Department of Water Resources (DWR). CLWA is one of 29 contractors holding long-term SWP contracts with DWR. SWP water originates as rainfall and snowmelt in northern and central California. Runoff is stored in Lake Oroville, which is the project's largest storage facility. The water is then released from Lake Oroville down the Feather River to the Sacramento River and the Sacramento-San Joaquin Delta. Water is diverted from the Delta into the Clifton Court Forebay, and then pumped into the 444-mile long California Aqueduct. SWP water is temporarily stored in San Luis Reservoir, which is jointly operated by DWR and the U.S. Bureau of Reclamation. Prior to delivery to CLWA, SWP supplies are stored in Castaic Lake, located at the end of the West Branch of the California Aqueduct.

CLWA's service area covers approximately 195 square miles (124,800 acres), including the entire City of Santa Clarita and surrounding unincorporated communities. CLWA obtains SWP water from a SWP terminal reservoir, Castaic Lake. The water is treated, filtered and disinfected at CLWA's Earl Schmidt Filtration Plant and Rio Vista Water Treatment Plant, which have a combined treatment capacity of 86 million gallons per day. Treated water is delivered from the treatment plants by gravity flow to each of the four Purveyors through a distribution network of pipelines and turnouts. At present, CLWA delivers water to the four Purveyors through 18 turnouts.

In 2005, CLWA fulfilled the following major accomplishments in order to enhance, preserve, and strengthen the quality and reliability of existing and future supplies:

- Completed expansion of the Earl Schmidt Filtration Plant from 33.5 mgd to 56 mgd;
- Progressed on construction of the Sand Canyon Pipeline and Reservoir;
- Completed construction of the Pitchess Pipeline;
- Adopted the 2005 Urban Water Management Plan;
- Initiated participation in a long-term water banking program with Rosedale-Rio Bravo Water Storage District and delivered 20,000 af of water into storage, as recommended in the UWMP;

- Obtained the right to utilize 1,376 af of flexible storage in Castaic Lake through an agreement with Ventura County SWP contractors;
- Continued implementation of various water supply programs recommended in the UWMP;
- Continued implementation of the AB 3030 Groundwater Management Plan;
- Continued implementation of the water conservation Best Management Practices;
- Continued cooperative effort with the U.S. Army Corps of Engineers for characterization studies of the former Whittaker-Bermite site and in a task force effort with the City of Santa Clarita, local legislators, and state agencies to effect the clean-up and remediation of all aspects of the former Whittaker-Bermite site, including the perchlorate groundwater contamination;
- Continued work on the design and construction of facilities for restoration of groundwater supply wells impacted by perchlorate contamination;
- Continued recycled water service.

3.4.1 State Water Project Table A Supplies

Each SWP contractor has a specified water supply amount shown in Table A of its contract that currently totals approximately 4.1 million af. The term of the contract is through 2035 and is renewable after that year. Although the SWP has not been fully completed, the SWP can deliver all of the 4.1 million af of Table A Amounts during very wet years.

CLWA has a contractual Table A Amount of 95,200 af per year of water from SWP.[2] CLWA's final allocation of Table A Amount for 2005 was 90 percent, or 85,680 af. On December 1, 2004, the initial allocation for 2004 was announced as 40 percent. On January 14, 2005, it was

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[2] 41,000 af of CLWA's 95,200 af Table A Amount was acquired from the Wheeler Ridge-Maricopa Water Storage District by way of a Table A water transfer agreement executed in March 1999. CLWA prepared an environmental impact report (EIR) to address the environmental consequences of the transfer agreement. The environmental review for the project by CLWA was the subject of litigation in Los Angeles Superior Court. CLWA prevailed in the EIR litigation at the trial court; however, the project opponents (Friends of the Santa Clara River) filed an appeal.

In January 2002, the Court of Appeal issued a decision ordering the Superior Court to decertify the EIR for the transfer agreement on the grounds that it had tiered off of another EIR that had been subsequently decertified in other litigation. In doing so, however, the Court of Appeal also examined all of the plantiffs' other arguments, found them to be without merit, and held that, if the tiering problem had not arisen, it would have affirmed the earlier trial court judgment upholding the EIR.

The Court of Appeal did not invalidate any portion of the completed 41,000 afy transfer agreement. Instead, the Court directed the trial court to vacate certification of the EIR, and to retain jurisdiction until CLWA corrects the tiering technicality by preparing a new EIR. In September 2002, the Los Angeles Superior Court refused to prohibit CLWA from using the 41,000 af of Table A water while a new EIR is being prepared. The Superior Court decision on remand was appealed by Friends of the Santa Clara River to the appellate court in January 2003. In December 2003, the appellate court denied any relief to Friends and affirmed the trial court's ruling.

The revised EIR was released for public review and comment in April 2004. It was subsequently certified by the CLWA Board of Directors on December 23, 2004. On January 24, 2005, separate lawsuits challenging the environmental review for this same project were filed by California Water Impact Network and Planning and Conservation League in the Ventura County Superior Court.

raised to 60 percent. On April 21, 2005 the allocation was raised to 80 percent. On May 27, 2005, it was raised to the final allocation of 90 percent. Utilizing SWP contract provisions, CLWA elected to "carry over" unused remaining Table A Amount into 2006.

CLWA also has access to 4,684 af of "flexible storage" in Castaic Lake. In addition, during 2005 CLWA negotiated an agreement with the Ventura County SWP contractors to allow CLWA to utilize their flexible storage account of 1,376 af. This provides total flexible storage of 6,060 af, which is maintained in Castaic Lake for use in a future dry period or an emergency. This amount was available in 2005, but was not utilized due to wet conditions statewide.

As shown in Table III-1, due to the 90 percent allocation, CLWA had excess SWP water in 2005. As DWR increased the allocation through the year, and due to a total of 2,702 af of carryover from 2004, the total available SWP supply in 2005 was 88,382 af. CLWA deliveries were 38,034 af to the Purveyors, and 20,000 af to its Rosedale-Rio Bravo Banking Program, leaving more than 31,000 af of Table A Amount available for carryover to 2006. Portions of the carryover water from 2004 and 2005 were utilized for local deliveries to the Purveyors, as well as Rosedale-Rio Bravo banking program deliveries; the remainder reverted to overall SWP use, and was allocated among all SWP contractors.

In 2005 CLWA completed an agreement to participate in a long-term water banking program with Rosedale-Rio Bravo Water Storage District in Kern County and delivered 20,000 af of Table A Amount water into storage. This long-term program will allow the storage of 100,000 af at any one time, and will provide significant dry year reliability for the Santa Clarita Valley.

As described in earlier Water Reports, agreements were reached in 2002 and 2004 with the Semitropic Water Storage District in Kern County for groundwater banking purposes. CLWA banked portions of its allocated 2002 and 2003 SWP Table A Amounts in Semitropic and, as a result, has short-term dry year supply available for extraction from that groundwater storage in Kern County until 2012/13.

3.4.2 Imported Water Supply Reliability

In May 2003 the Department of Water Resources finalized its State Water Project Delivery Reliability Report. This report is intended to assist SWP contractors in assessing the adequacy of the SWP component of their overall supplies. The report is updated with new information and calculations of delivery reliability every two years, and an updated draft was provided to the SWP Contractors in May 2005 for use in producing their 2005 UWMPs. A discussion of the Reliability Report, as well as the most significant opportunities for meeting the future water supply needs of the Santa Clarita Valley, is provided in the 2005 UWMP.

Groundwater banking and conjunctive use offer significant opportunities to improve water supply reliability for CLWA. Groundwater banking is the process of storing available supplies of water during wet years in groundwater basins. Conjunctive use is the coordinated operation of multiple water supplies to achieve improved supply reliability. During wet periods, additional surface water supplies from the SWP can be used to recharge a local groundwater basin and then recovered for delivery during dry periods.

Table III-1
2005 CLWA State Water Project Supply and Disposition
(acre-feet)

Supply		
Net 2004 Carryover to 2005 [1]		2,702
CLWA 2005 Final Allocation [2]		85,680
Total 2005 SWP Supply		**88,382**
Disposition		
Purveyor Deliveries (Total)		38,034
CLWA SCWD	*16,513*	
Valencia Water Company	*14,732*	
Newhall County Water District	*5,932*	
Los Angeles County WWD 36	*857*	
CLWA/DWR/Purveyor Metering[3]		(1,029)
Rosedale – Rio Bravo WSD Storage Program		20,000
2005 Table A Carryover to 2006[4]		31,377
Total 2005 SWP Disposition [4]		**88,382**

1. Amount used by CLWA, based on final DWR delivery accounting; total 2004 carryover was 15,522 af.

2. Final 2005 allocation was 90% of contractual Table A amount of 95,200 acre-feet, which progressed as follows:
   Initial allocation (Dec. 1, 2004) 40%
   Allocation increase (Jan. 14, 2005) 60%
   Allocation increase (Apr. 21, 2005) 80%
   Final allocation (May 27, 2005) 90%
   Does not include 2,451 af of Article 21 water used at CLWA's Devil's Den Ranch in Kern and Kings Counties.

3. Reflects meter reading differences and meter outage in 2005 winter storms.

4. Total 2005 Table A carryover to 2006.

As previously described, CLWA entered into two 10-year agreements with Semitropic Water Storage District to bank water for subsequent use in dry years. During that period, CLWA can withdraw up to 50,870 af of 2002 and 2003 SWP Table A water that it stored in Semitropic to meet Valley demands when needed.[3]

As also previously described, CLWA's long-term water banking program with Rosedale-Rio Bravo Water Storage District in Kern County provides significant dry year reliability for the Santa Clarita Valley.

3.5 Water Quality – General

Water delivered by the Purveyors consistently meets drinking water standards set by the Environmental Protection Agency (EPA) and the California Department of Health Services (DHS). An annual Consumer Confidence Report is provided to all Santa Clarita Valley residents who receive water from one of the four water retailers. There is detailed information in that report, about the results of quality testing of the groundwater and treated SWP water supplied to the residents of the Santa Clarita Valley during 2004.

Water quality regulations are constantly changing as contaminants that are typically not found in drinking water are being discovered, and new standards are adopted. In addition, existing water quality standards are becoming more stringent in terms of allowable levels in drinking water. In light of these changes, several constituents of particular interest are discussed in more detail below.

Total Trihalomethanes

In 2002, the United States Environmental Protection Agency implemented the new Disinfectants and Disinfection Byproducts Rule. In part, this rule establishes a new MCL of 80 ug/L (based on an annual running average) for Total Trihalomethanes (TTHM). TTHMs are a byproduct that is created when free chlorine is used as a means for disinfection. To address potential TTHM formation, CLWA and the Purveyors implemented an alternative method of disinfection, chloramination, in 2005 to be able to maintain compliance with the new rule and future regulations relating to disinfection byproducts. TTHM concentrations have remained significantly below the MCL since implementation of alternative disinfection.

Perchlorate

Perchlorate has been a water quality concern in the Valley since 1997 when it was originally detected in four Saugus wells operated by the Purveyors in the eastern part of the Saugus Formation, near the former Whittaker-Bermite facility. In late 2002, perchlorate was detected in a fifth municipal well, in this case an Alluvial well also located near the former Whittaker-Bermite site. In early 2005, perchlorate was detected in a second Alluvial well near the former Whittaker-Bermite site. The six perchlorate-impacted wells were removed from active water supply service after detection of perchlorate. One of the Alluviual wells was returned to active water supply service, with treatment, in late 2005 as discussed below; the other impacted wells remain out of service. The 2005 UWMP specifically addressed the adequacy of groundwater

[3] Legal challenges to the 2002 banking program with Semitropic were resolved by the appellate court in favor of CLWA on all issues. It is expected the that appellate court decision should become final before July 2006.

supply in light of the inactivation of the impacted Alluvial and Saugus wells; and it addressed the plan and schedule for restoration of perchlorate-impacted wells, including the protection of existing non-impacted wells. As summarized in the 2005 UWMP, the inactivation of the impacted wells does not constrain the ability to meet the groundwater component of water supply in the Valley.

The Purveyors are continuing to test for perchlorate in all of their active Alluvial and Saugus wells at risk. The current DHS Notification Level for perchlorate is 6 micrograms per liter (ug/l). DHS had anticipated proposing a Maximum Contaminant Level (MCL) for perchlorate in 2005; the State Department of Finance is apparently considering the economic impact of several alternative MCL concentrations between 4 and 25.6 ug/l.

In 2005, the impacted Purveyors (SCWD, NCWD, and VWC) and CLWA continued working toward implementation of a jointly developed plan that will combine pumping from two of the impacted wells and a water treatment process to restore the impacted pumping capacity and control the migration of contamination in the aquifer. The plan for restoring "severely impaired" water sources such as the perchlorate-impacted wells must comply with the provisions of the State Department of Health Services' (DHS) Policy Memo 97-005. Work on the documentation required by Policy Memo 97-005 continued in 2005 such that DHS approval is anticipated by early fall, 2006.

The development and implementation of a cleanup plan for the Whittaker-Bermite site and the impacted groundwater is being coordinated among CLWA, the impacted Purveyors, the State Department of Toxic Substance Control (DTSC), and U.S. Army Corps of Engineers. DTSC is the lead agency responsible for regulatory oversight of the Whittaker-Bermite site. In February 2003, DTSC and the impacted Purveyors entered into a voluntary cleanup agreement entitled *Environmental Oversight Agreement*. Under the Agreement, DTSC is providing review and oversight of the response activities being undertaken by the Purveyors related to the detection of perchlorate in the impacted wells. Under the Agreement's Scope of Work, the impacted Purveyors have prepared a Work Plan for sampling the production wells, prepared a report in the results and findings of the production well sampling, prepared a draft Human Health Risk Assessment, prepared a draft Remedial Action Workplan, completed the evaluation of treatment technologies, and completed an analysis to show the integrated effectiveness of a project to restore impacted pumping capacity, extract perchlorate for treatment, and control the migration of perchlorate in the Saugus Formation. Environmental review of that project was completed in September with adoption of a mitigated Negative Declaration. The Final Interim Remedial Action Plan (IRAP) for containment and extraction of perchlorate was completed and approved by DTSC in December. Construction of facilities and pipelines necessary to implement the pump and treat program and to also restore inactivated well capacity is anticipated to commence in the fall of 2006. On the Whittaker-Bermite site, notable accomplishments in 2005 included startup of soil remediation activities in operating unit subareas, and initiation of groundwater pump and treat operations in the Northern Alluvium.

As noted above, perchlorate was detected in a second Alluvial well, VWC's Well Q2, in early 2005. In response, Valencia removed the well from active service, and commissioned the preparation of an analysis and report assessing the impact of, and response to, the perchlorate

contamination of that well. The Q2 Report (LSCE, 2005) documented that the temporary inactivation of Well Q2 would not significantly impact the water supplies used to meet demand in the Santa Clarita Valley for the period of time required to respond to the contamination. The results of the Q2 analysis and Report are consistent with the analysis and conclusions in the UWMP. Valencia's response plan for Well Q2 was to pursue permitting and installation of wellhead treatment through the summer of 2005, and to then return the well to water supply service. That work was successfully completed, with wellhead treatment installed by September, and Well Q2 was returned to active water supply service in October.

In 2000, CLWA and the impacted Purveyors had filed a lawsuit against Whittaker Corporation (the former owner of the contaminated property) and Santa Clarita LLC and Remediation Financial, Inc. (the current owners). The lawsuit seeks to have defendants pay all necessary costs of response, removal of the contaminant, remedial action costs, and any liabilities or damages associated with the contamination. Although an Interim Settlement Agreement expired in January 2005, the parties, under California Department of Toxic Substances oversight, jointly developed a plan in 2005 to "pump and treat" contaminated water from two of the Purveyors' impacted wells to stop migration of the contaminant plume. Also during the year, the parties continued negotiations intended to achieve a long term settlement to the litigation; as of March 2006 the negotiations are ongoing.

3.5.1 Groundwater Quality – Alluvium

Groundwater quality is, of course, a key factor in assessing the Alluvial aquifer as a municipal and agricultural water supply. Groundwater quality details and long-term conditions, examined by integration of individual records from several wells completed in the same aquifer materials and in close proximity to each other, have been discussed in previous Annual Water Reports and, most recently, in the 2005 UWMP. There were no changes in groundwater quality in 2005 that would change any of the fluctuations, trends, or other groundwater quality conditions as illustrated in Figures III-10 and III-11. In summary, those conditions include: no long-term overall trend, and most notably no long-term decline in Alluvial groundwater quality; a general groundwater quality "gradient" from east to west, with lowest dissolved mineral content to the east, increasing in a westerly direction; and periodic fluctuations in some parts of the basin, where groundwater quality has inversely varied with precipitation and stream flow. Those variations are typically characterized by increased mineral concentrations through dry, lower stream flow, and lower recharge conditions, followed by lower mineral concentrations through wetter, higher stream flow, higher recharge conditions.

The presence of long-term consistent water quality patterns, although intermittently affected by wet and dry cycles, supports the conclusion that the Alluvial aquifer remains a viable ongoing water supply source in terms of groundwater quality.

3.5.2 Groundwater Quality – Saugus Formation

As discussed above for the Alluvium, groundwater quality is a key factor in also assessing the Saugus Formation as a municipal and agricultural water supply. As with groundwater level data, long-term Saugus groundwater quality data are not sufficiently extensive to permit any sort of

basin-wide analysis or assessment of pumping-related impacts on quality. However, integration of individual records from several wells has been used to examine general water quality trends. Based on those records, water quality in the Saugus Formation has not historically exhibited the precipitation-related fluctuations seen in the Alluvium. Based on available data over the last 50 years, groundwater quality in the Saugus has exhibited a slight overall increase in dissolved mineral content as illustrated in Figure III-12. More recently, several wells within the Saugus Formation have exhibited an additional increase in dissolved mineral content, similar to short-term changes in the Alluvium, possibly as a result of recharge to the Saugus Formation from the Alluvium. Dissolved mineral concentrations in the Saugus Formation remain below the Secondary (aesthetic) Upper Maximum Contaminant Level. Groundwater quality within the Saugus will continue to be monitored to ensure that degradation to the long-term viability of the Saugus as an agricultural or municipal water supply does not occur.

3.5.3 Imported Water Quality

CLWA operates two water treatment plants, the Earl Schmidt Filtration Plant located near Castaic Lake and the Rio Vista Water Treatment Plant located in Saugus. CLWA produces water that meets drinking water standards set by the U.S. EPA and California DHS. SWP water has different aesthetic characteristics than groundwater with lower dissolved mineral concentrations (total dissolved solids) of approximately 280 to 314 mg/L, and lower hardness (as calcium carbonate) of 130 to 170 mg/l.

3.6 Recycled Water

Recycled water is available from two existing water reclamation plants operated by the Sanitation Districts of Los Angeles County. In 1993, CLWA prepared a draft Reclaimed Water System Master Plan that outlined a multi-phase program to deliver recycled water in the Valley. CLWA has completed environmental review on the construction of Phase I of the project, which will deliver 1,700 afy of water. Deliveries of recycled water began in 2003 for irrigation water supply at a golf course and in roadway median strips. In 2005, recycled water deliveries were 438 af.

Surveys conducted by CLWA indicate an interest for recycled water by existing water users as well as future development when it becomes available. In 2002, CLWA produced an updated Draft Recycled Water Master Plan. Overall, the program is expected to ultimately reclaim up to 17,000 af of treated (tertiary) wastewater suitable for reuse on golf courses, landscaping and other non-potable uses, as set forth in the UWMP.

CLWA has initiated California Environmental Quality Act (CEQA) analysis of the Recycled Water Master Plan (2002). This analysis will result in a Program Environmental Impact Report covering the various options for a recycled water system outlined in the Master Plan. A Notice of Preparation was released for public review in April 2005. The EIR is expected to be finalized by September 2006.

3.7 Santa Clara River

A significant accomplishment in 2001 was the preparation and execution of a Memorandum of Understanding (MOU) between the Santa Clarita Valley Purveyors and the United Water Conservation District, which manages surface and groundwater resources in seven groundwater basins in the Lower Santa Clara River Valley Area. The MOU initiated a collaborative and integrated approach to data collection; database management; groundwater flow modeling; assessment of groundwater basin conditions, including determination of basin yield amounts; and preparation and presentation of reports, including continued annual reports such as this one for current planning and consideration of development proposals, and also including more technically detailed reports on geologic and hydrologic aspects of the overall stream-aquifer system. Meetings of the MOU participants have continued, and integration of the Upper (Santa Clarita Valley) and Lower (United WCD) Santa Clara River databases has been accomplished. As discussed above, a numerical groundwater flow model of the entire Santa Clarita groundwater basin was developed and calibrated in 2002-2004. Subsequent to its initial use in 2004 for assessing the effectiveness of various scenarios to restore pumping capacity impacted by perchlorate contamination by pumping and treating groundwater for water supply while simultaneously controlling the migration of contaminated groundwater, the model was used in 2005 for evaluation of basin yield under varying management actions and hydrologic conditions. The results completed the determination of sustainable operating yield values for both the Alluvium and the Saugus Formation, which are now incorporated in the 2005 UWMP.

On occasion, issues have been raised about whether use and management of groundwater in the Santa Clarita Valley have adversely impacted surface water flows into Ventura County. Part of the groundwater modeling work has addressed the surface water flow question as well as groundwater levels and storage. While the sustainability of groundwater has logically derived primarily from projected long-term stability of groundwater levels and storage, it has also derived in part from modeled simulations of surface water flows and the lack of stream flow depletion by groundwater pumping. In addition, the long-term history of groundwater levels in the western and central part of the basin, as illustrated in Figures III-4 and III-5, supports the modeled analysis and suggests that groundwater has not been lowered in such a way as to induce infiltration from the river and thus impact surface water flows. Finally, long-term stream flow data gauged near the County line show notably higher flows from the Santa Clarita Valley into the uppermost downstream basin, the Piru Basin, over the last 30 to 35 years, as illustrated in Figure III-13.

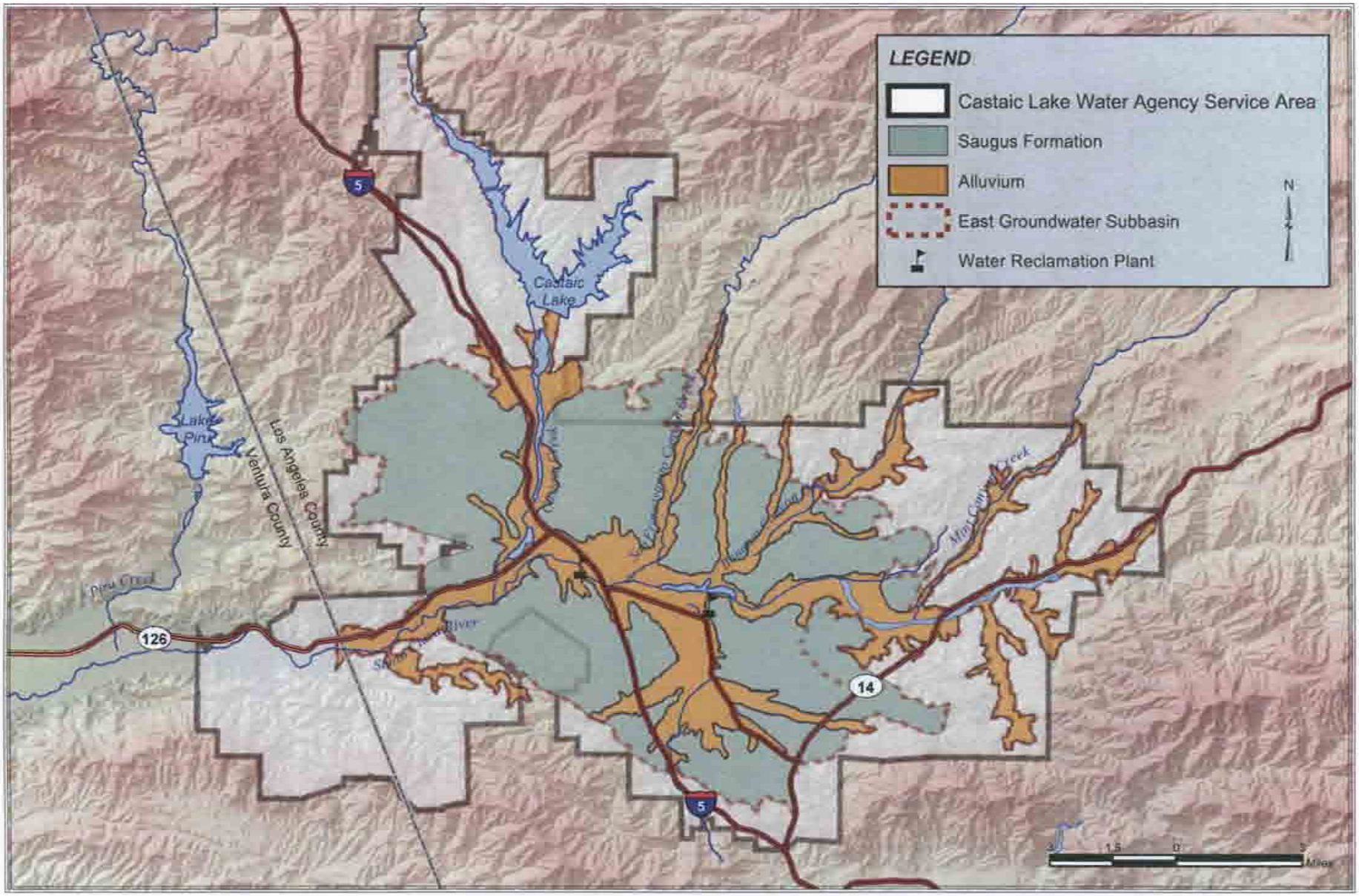

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Figure III-1
Alluvium and Saugus Formation
Santa Clara River Valley East Groundwater Subbasin

IV. Summary of 2005 Water Supply and 2006 Outlook

As reported herein, total water demands in the Santa Clarita Valley were 83,600 af in 2005. This represented a decrease of about five percent from total demand in 2004. Of the total demand in 2005, about 70,800 af was for municipal water supply, and the balance (12,800 af) was for agricultural and other uses, including individual domestic uses. As also discussed herein, the total demand in 2005 was met by a combination of local groundwater and imported SWP water, each within its respective operational yield and contractual Table A Amount, and by a small amount of recycled water.

The water demand in 2005 was less than the short-term projected demand that was estimated in the 2004 Water Report and it was also less than the demand estimated in the UWMP. For illustration, historical water use from 1980 through 2005 is plotted in Figure IV-1; also shown with that historical record are the projected total water demands in the UWMP through 2030. As discussed in the 2005 UWMP, the year-to-year fluctuations in historical water demand range from about ten percent below to about nine percent above the average or "normal" projection that would describe the long-term historical trend in the Valley's total water demand. The primary factor causing the year-to-year fluctuations is weather. In the short term, wetter years have typically resulted in decreased water demand, and drier years have typically resulted in higher water demand. Extended drier periods, however, have resulted in decreases in demand due to conservation and water shortage awareness. The decline in water demand toward the end of the 1987-92 drought is a good example of such reduced demand.

For short-term planning, recognizing the continuation of growth and near normal precipitation in early 2006, water demand in 2006 is projected to be consistent with the projections in the 2005 UWMP, or about 91,500 af. It is expected that both municipal and agricultural water demands in 2006 will be met with a generally similar mix of water supplies as in previous years, notably local groundwater and imported SWP water, complemented by recycled water that will continue to supply a small fraction of total water demand.

As of March 23, 2006, the allocation of water from the SWP in 2006 is 80 percent of CLWA's Table A Amount, or 76,160 af. Combined with local groundwater from the two aquifer systems (42,500 af), total Flexible Storage Account water (6,060 af), net carryover SWP water from 2005 (3,718 af), and recycled water (500 af), the total available water supplies for 2006 are nearly 129,000 af. Consequently, CLWA and the Purveyors anticipate having more than adequate supplies to meet all water demands in 2006. Projected 2006 water supplies and demand are summarized in Table IV-1.

Recognizing the projected surplus of supply in 2006, CLWA intends to bank an additional 20,000 af in its Rosedale-Rio Bravo WSD Banking Program in 2006.

In addition to the preceding, it is noteworthy that, while not required to meet projected demand in 2006, a total of nearly 51,000 af of recoverable water has been stored in the Semitropic Groundwater Storage Bank in Kern County. Another 17,800 af of recoverable water has been stored in a long-term water banking program with Rosedale Rio Bravo Water Storage District,

Table IV-1
2006 Water Supply and Demand
(acre-feet)

Projected 2006 Demand [1]		**91,500**
Available Water Supplies		
Local Groundwater		42,500
Alluvial Aquifer [2]	*35,000*	
Saugus Formation [3]	*7,500*	
Imported Water		85,938
Table A Amount [4]	*76,160*	
Net Carryover from 2005 [5]	*3,718*	
Flexible Storage Account (CLWA) [6]	*4,684*	
Flexible Storage Account (Ventura County) [6]	*1,376*	
Recycled Water		500
Total Available 2006 Supplies		**128,938**
Dry Year Supplies [7]		
Semitropic Groundwater Storage Bank		50,870
2002 Account	*21,600*	
2003 Account	*29,270*	
Rosedale-Rio Bravo Groundwater Storage Bank		17,800
Total Supplemental Dry Year Supplies		**68,670**

1. Interpolated from 2005 and 2010 projections in UWMP.

2. The Alluvium represents 30,000 – 40,000 afy of available supply under wet-normal conditions, and 30,000 – 35,000 afy under dry conditions. Available supply in 2006 is shown to be mid-range for average/wet conditions.

3. The Saugus represents 7,500 – 15,000 afy of available water supply under non-drought conditions, and up to 35,000 afy under increasingly dry conditions. Available supply in 2006 is shown to be limited to very wet conditions; no short-term increase in Saugus pumping is required or shown for 2006 water supply.

4. CLWA's SWP Table A amount is 95,200 af. The 2006 allocation, as of March 23, 2006 is 80 percent (76,160 af).

5. Amount used by CLWA, including 1,450 af banked in Rosedale-Rio Bravo WSD; total carryover was 31,377 af.

6. CLWA can directly utilize up to 4,684 af of storage capacity in Castaic Lake. By agreement in 2005, CLWA can also utilize 1,376 af of Ventura County SWP contractors' flexible storage capacity in Castaic Lake.

7. Does not include other reliability measures available to CLWA and the retail water Purveyors. These measures include short-term exchanges, participation in DWR's dry-year water purchase programs, local dry-year supply programs and other future groundwater storage programs.

also in Kern County. Total recoverable water in Kern County storage banks is now more than 68,000 af. However, that component of overall water supply is separately reflected in Table IV-1 because it is intended for dry-year supply and will not be used for 2006 water supply.

A significant number of local projects are part of an overall program currently funded by CLWA to provide facilities needed to firm up imported water supplies during times of drought. These involve water conservation, surface and groundwater storage, water transfers and exchanges, water recycling, additional short-term pumping from the Saugus Formation, and increasing CLWA's imported supply. This overall strategy is designed to meet increasing water demands while assuring a reasonable degree of supply reliability.

The Purveyors strive to provide a blend of groundwater and imported water to area residents to ensure consistent quality and reliability of service. The actual blend of imported water and groundwater in any given year and location in the Valley is an operational decision and varies over time due to source availability and operational capacity of Purveyor and CLWA facilities. The goal is to conjunctively use the available water resources so that the overall reliability of water supply is maximized.

Dry periods may affect available water supplies in any single year and for a duration usually not longer than three consecutive years. It is important to note that hydrologic conditions vary from region to region throughout the state. Dry conditions in Northern California affecting SWP supply may not affect local groundwater and other supplies in Southern California, and vice versa.

For this reason, CLWA and the Purveyors have emphasized developing water supplies that add diversity to water supply options especially in dry years. Diversity of supply is considered a key element of reliability, giving the Purveyors the ability to draw on multiple sources of supply during dry-year conditions and thereby making the Purveyors' water deliveries more reliable. As a result of this advance planning, no water shortages are anticipated in CLWA's service area for the foreseeable future.

For long-term planning purposes, water supplies and facilities are added on an incremental basis and ahead of need. It would be economically unsound to immediately, or in the short term, acquire all the facilities and water supplies needed for the next twenty to thirty years. This would unfairly burden existing customers with costs that should be borne by future customers. There are many ongoing efforts to produce an adequate and reliable supply of good quality water for Valley residents. Water consumers expect that their needs will continue to be met with a high degree of reliability and quality of service. To that end, CLWA's and the Purveyors' stated reliability goal is to deliver a reliable and high quality water supply for their customers, even during dry periods. Based on conservative water supply and demand assumptions contained in the 2005 UWMP over the next 25 years, in combination with conservation of non-essential demand during certain dry years, CLWA and the Purveyors believe implementing their water plan will successfully achieve this goal.

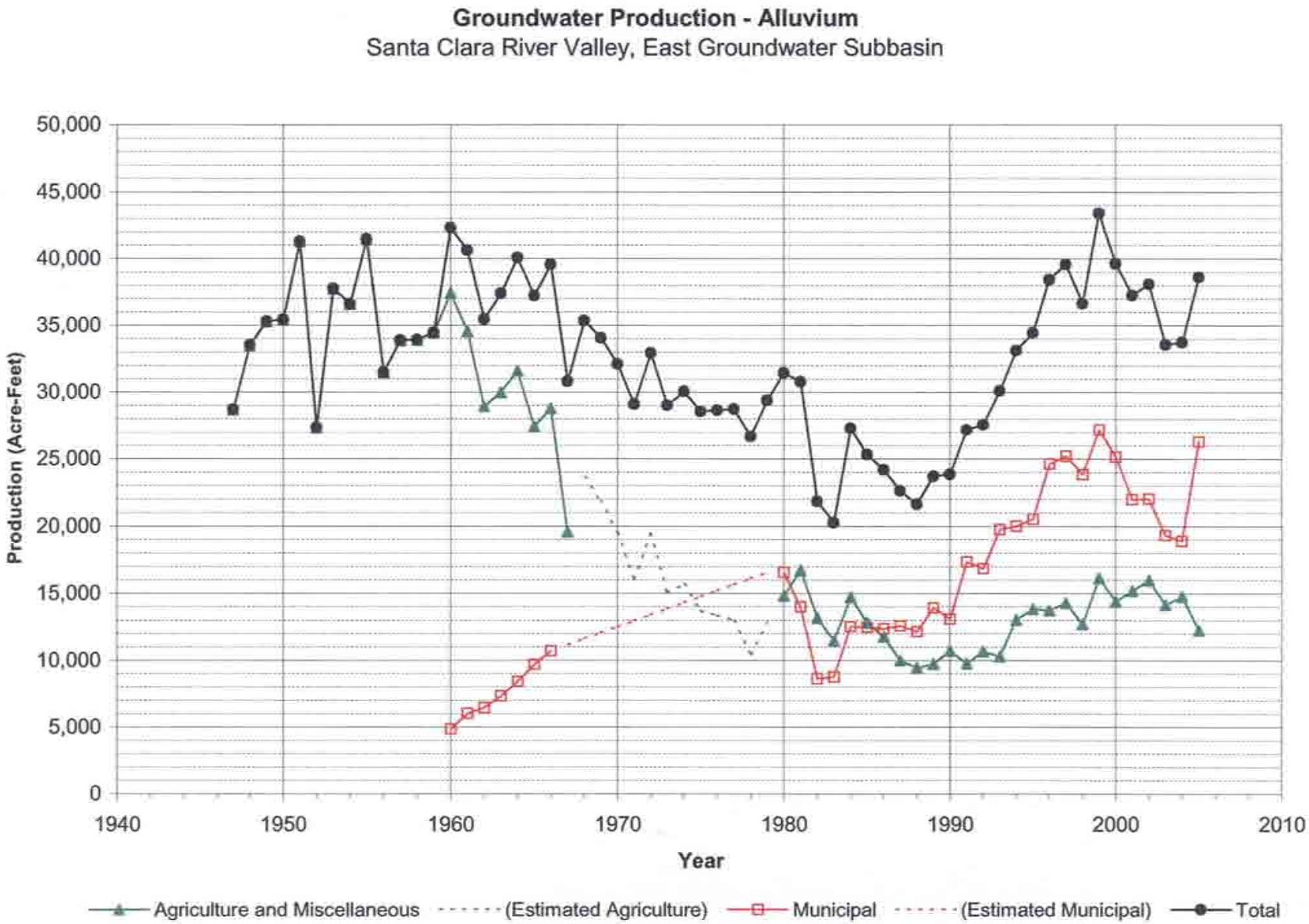
Groundwater Production - Alluvium
Santa Clara River Valley, East Groundwater Subbasin
Production (Acre-Feet)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
Agriculture and Miscellaneous
(Estimated Agriculture)
Municipal
(Estimated Municipal)
Total

Figure III-2

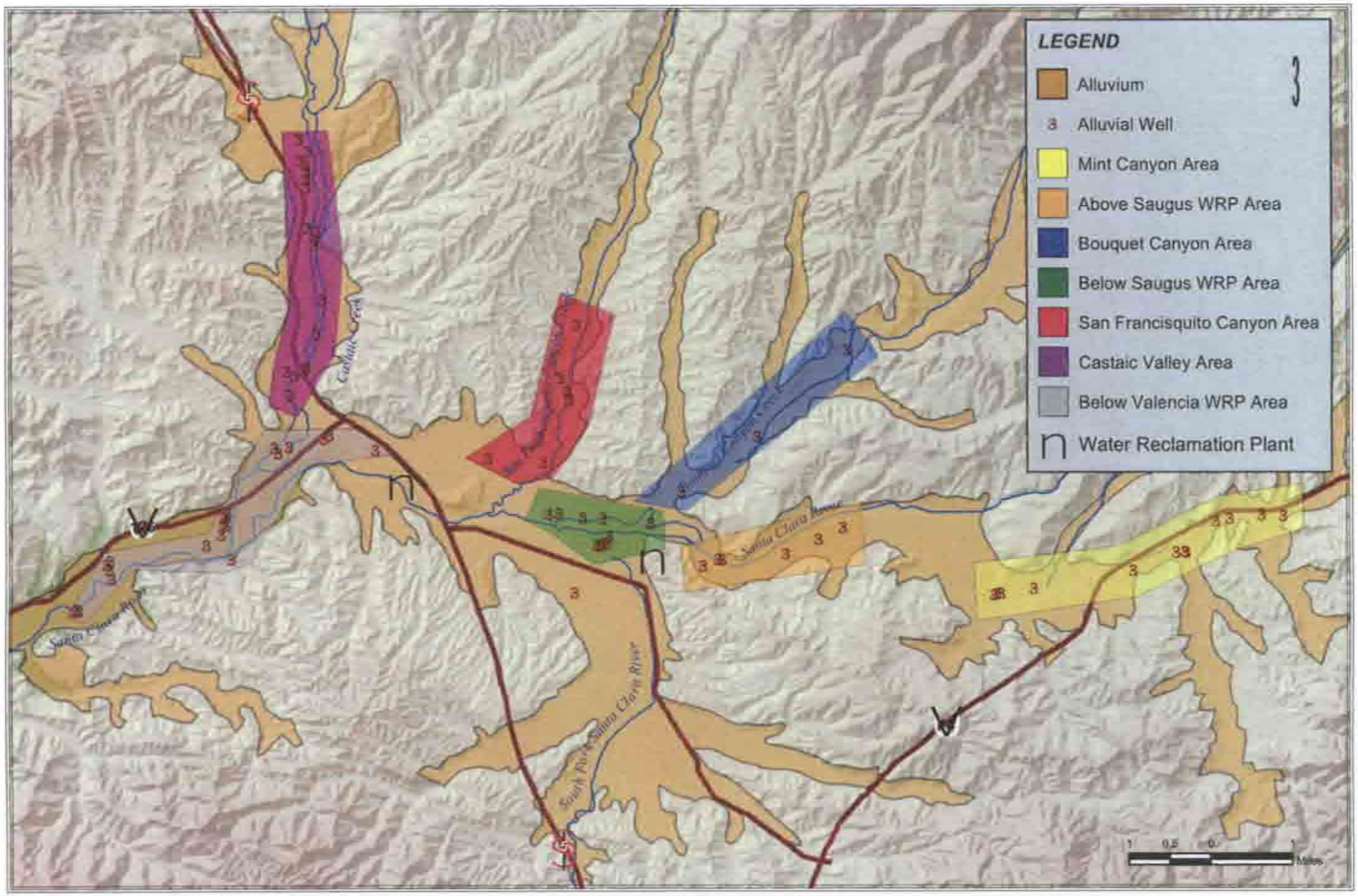

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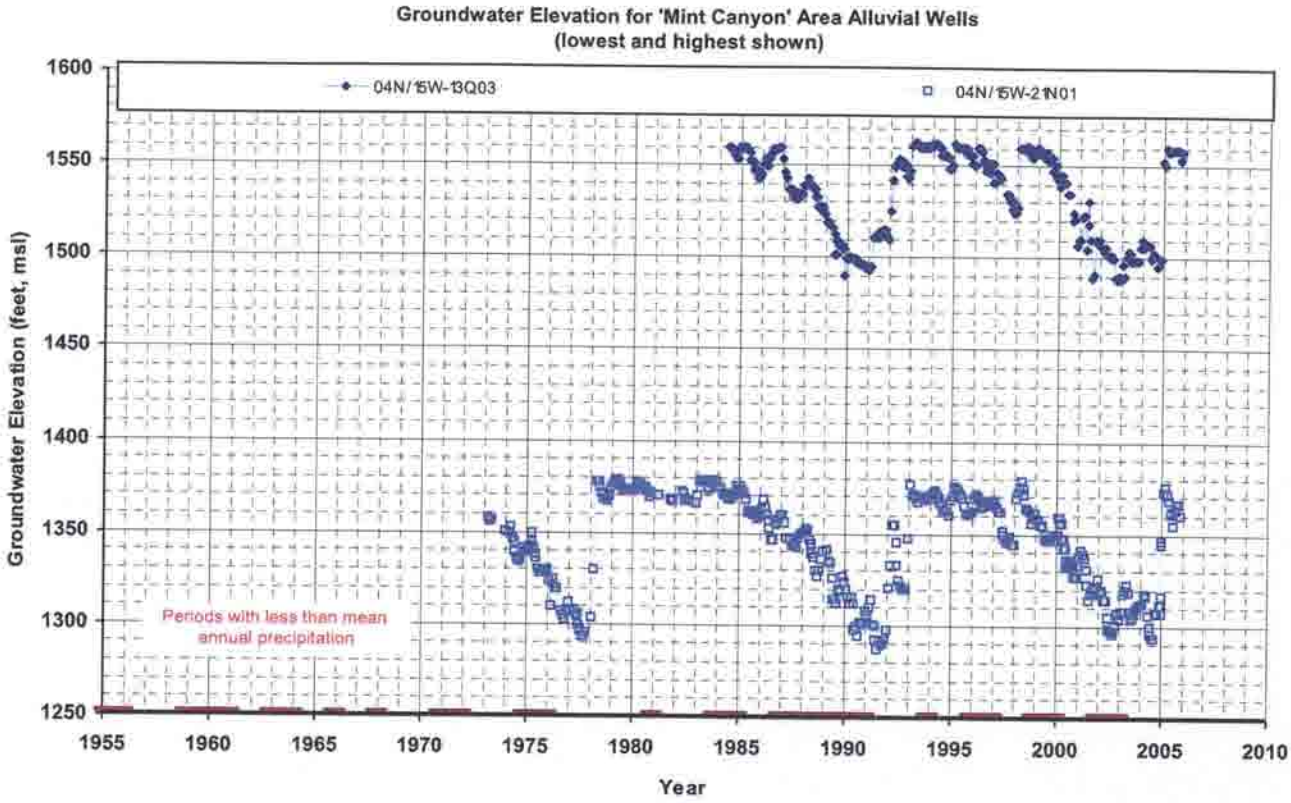
Figure III-3
Alluvial Well Locations By Area
Santa Clara River Valley, East Groundwater Subbasin


Groundwater Elevation for 'Mint Canyon' Area Alluvial Wells
(lowest and highest shown)
04N/15W-13Q03
04N/15W-21N01
Groundwater Elevation (feet, msl)
1600
1550
1500
1450
1400
1350
1300
1250
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

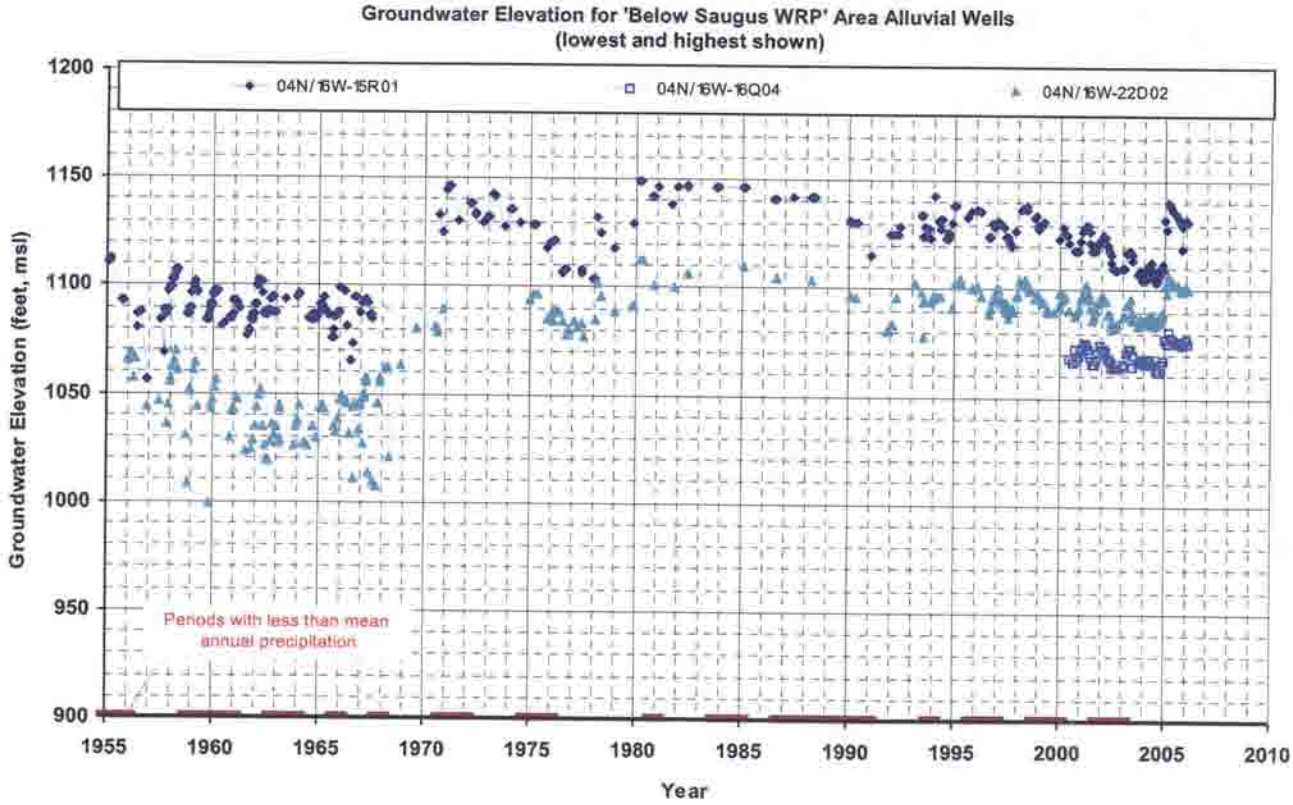
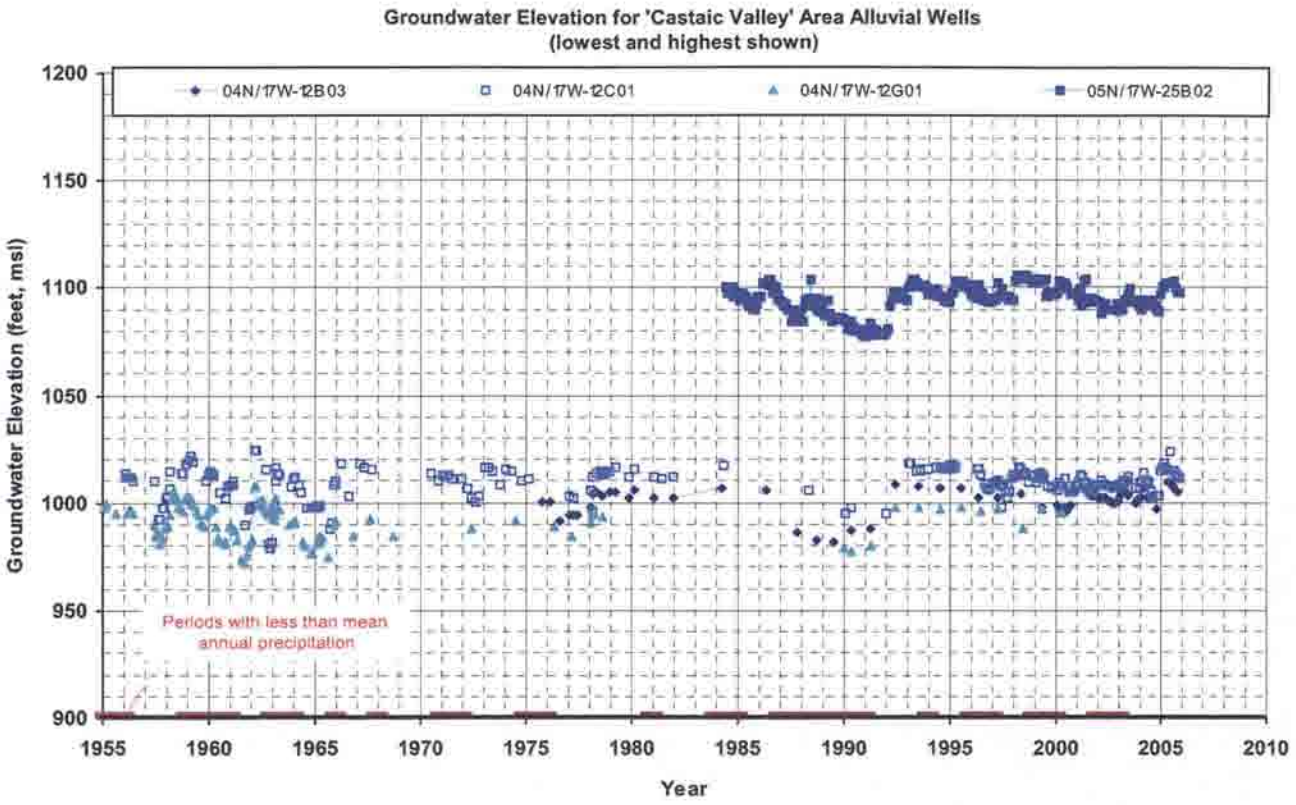

Groundwater Elevation for 'Below Saugus WRP' Area Alluvial Wells
(lowest and highest shown)
04N/16W-15R01
04N/16W-16Q04
04N/16W-22D02
Groundwater Elevation (feet, msl)
1200
1150
1100
1050
1000
950
900
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

Figure III-4


Groundwater Elevation for 'Castaic Valley' Area Alluvial Wells
(lowest and highest shown)
04N/17W-12B03
04N/17W-12C01
04N/17W-12G01
05N/17W-25B02
Groundwater Elevation (feet, msl)
1200
1150
1100
1050
1000
950
900
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

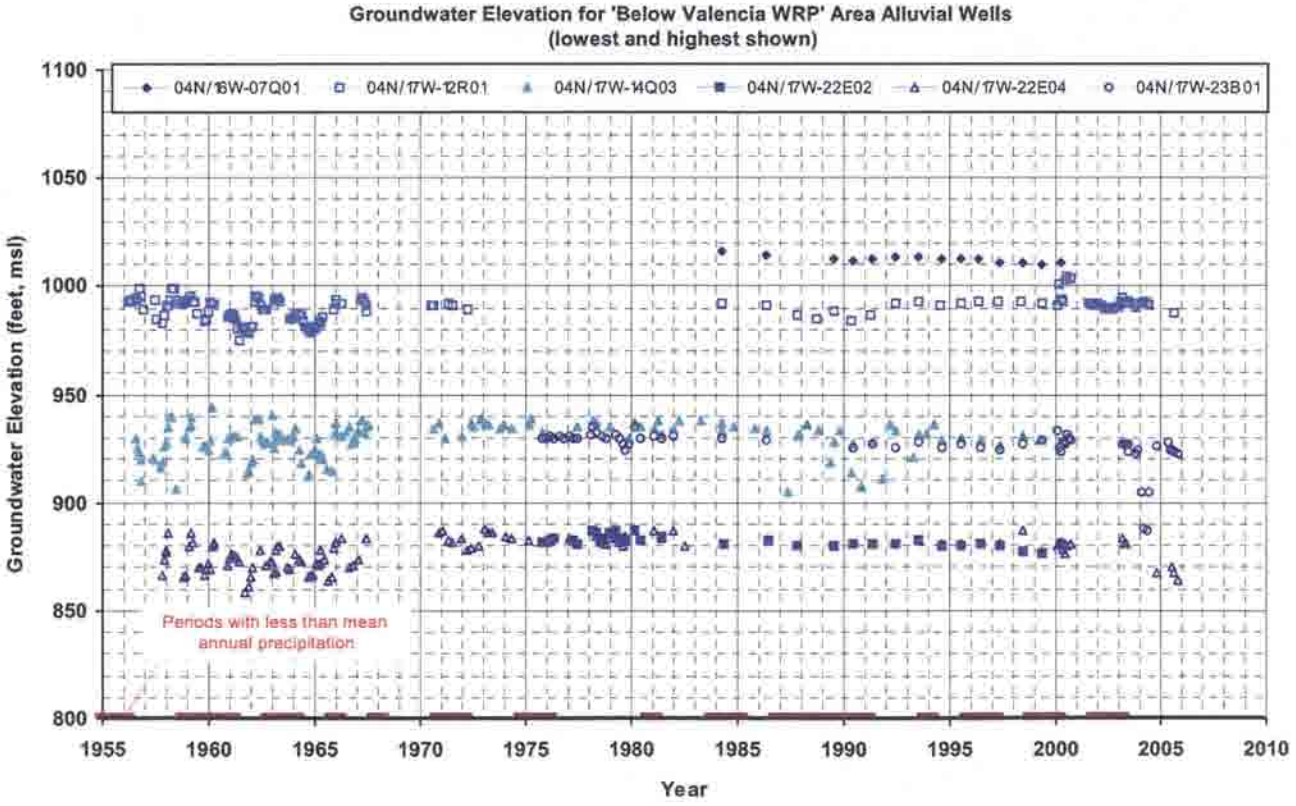

Groundwater Elevation for 'Below Valencia WRP' Area Alluvial Wells
(lowest and highest shown)
04N/16W-07Q01
04N/17W-12R01
04N/17W-14Q03
04N/17W-22E02
04N/17W-22E04
04N/17W-23B01
Groundwater Elevation (feet, msl)
1100
1050
1000
950
900
850
800
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

Figure III-5

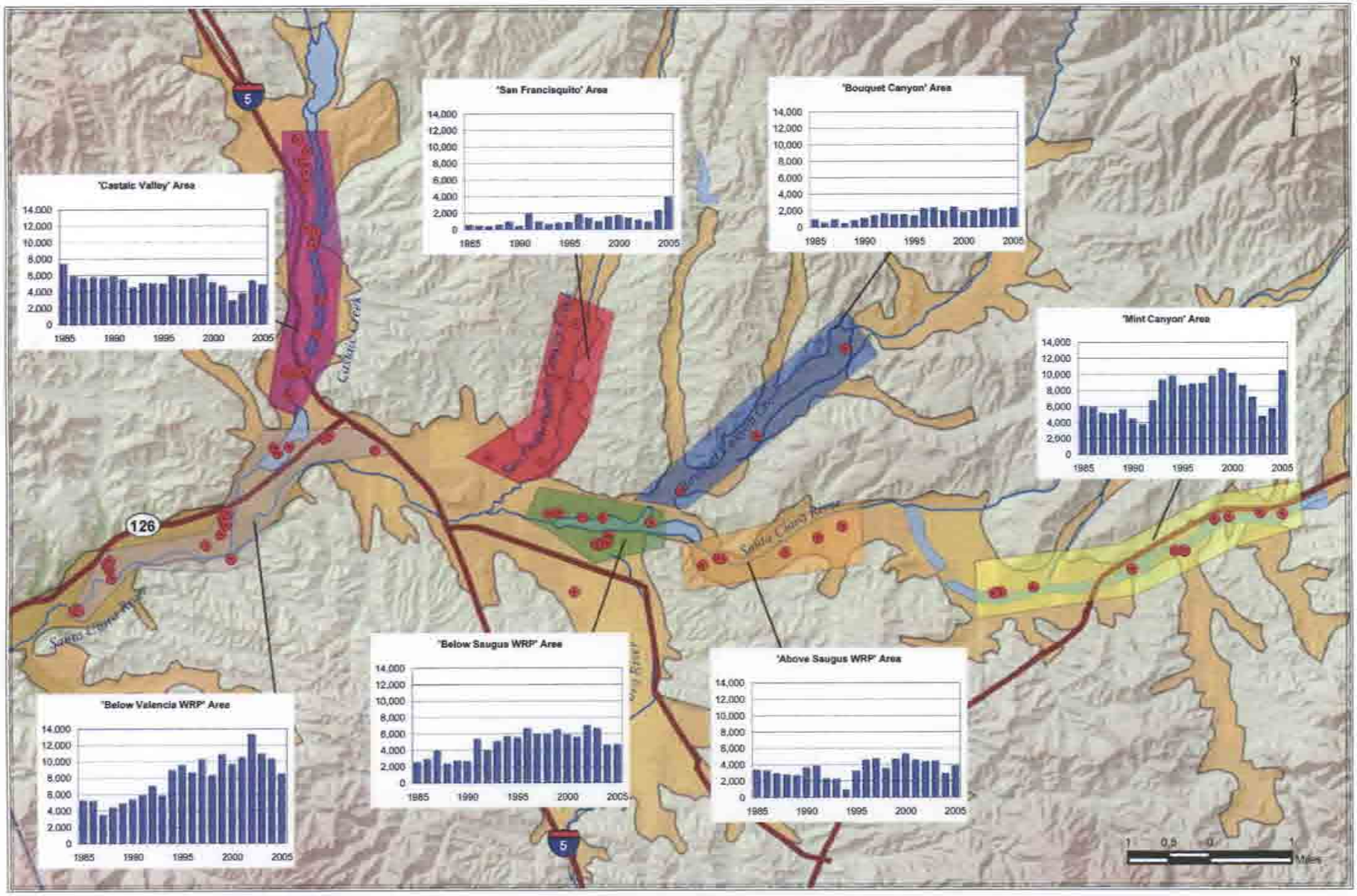


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Figure III-6
Annual Groundwater Production from Alluvium by Area (Acre-feet)
Santa Clara River Valley, East Groundwater Subbasin

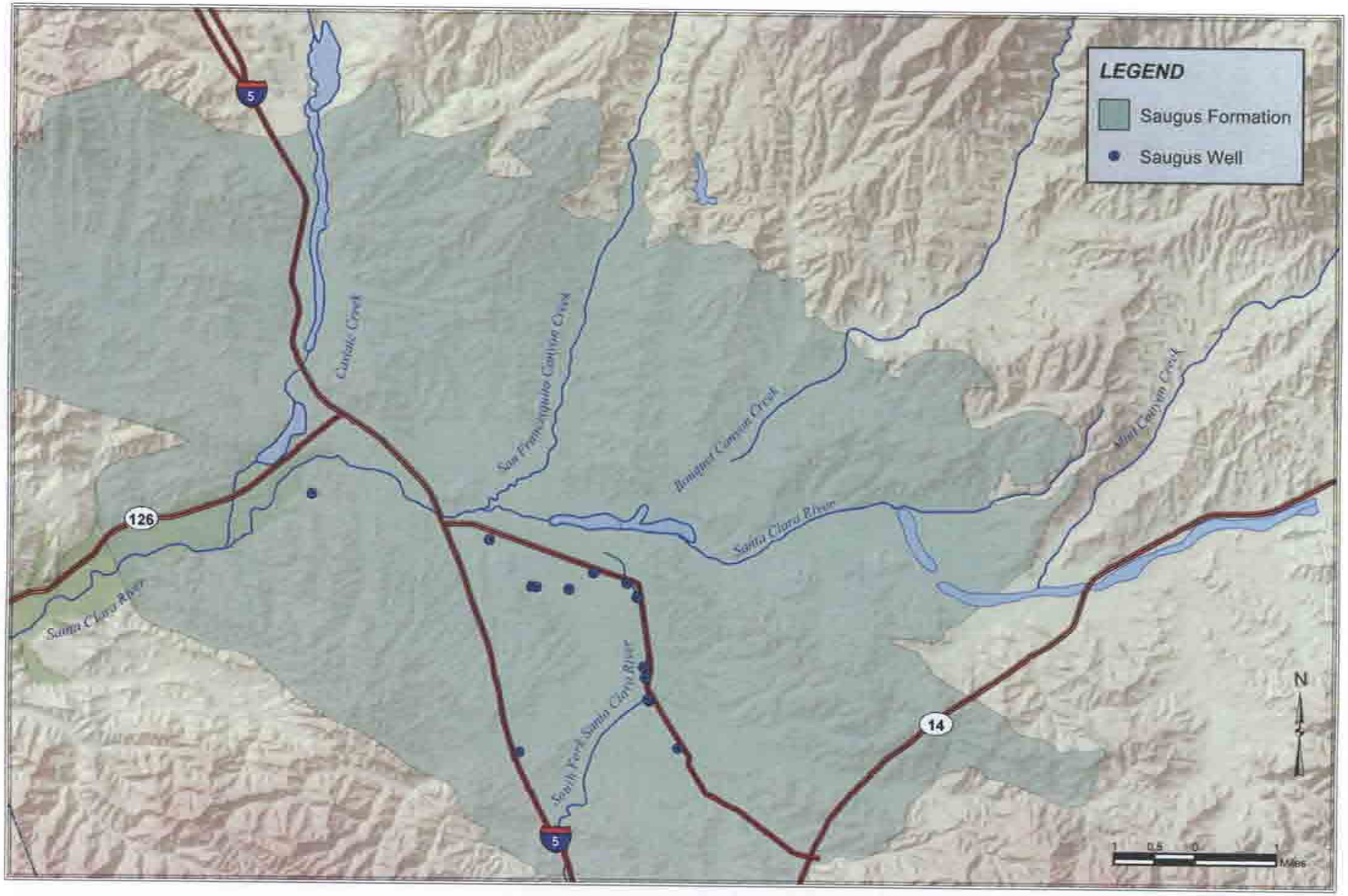

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Figure III-7
Saugus Well Locations
Santa Clara River Valley, East Groundwater Subbasin

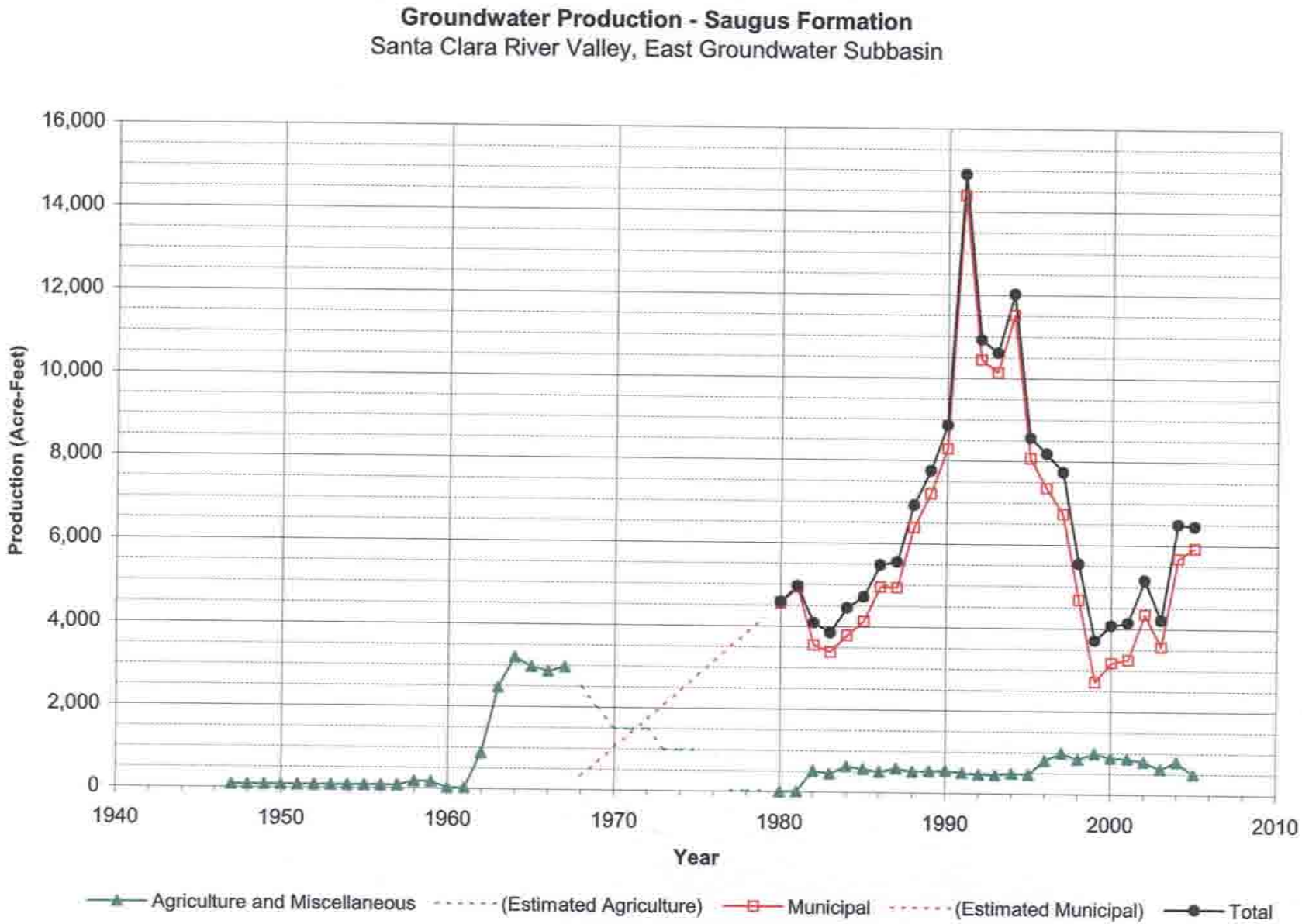
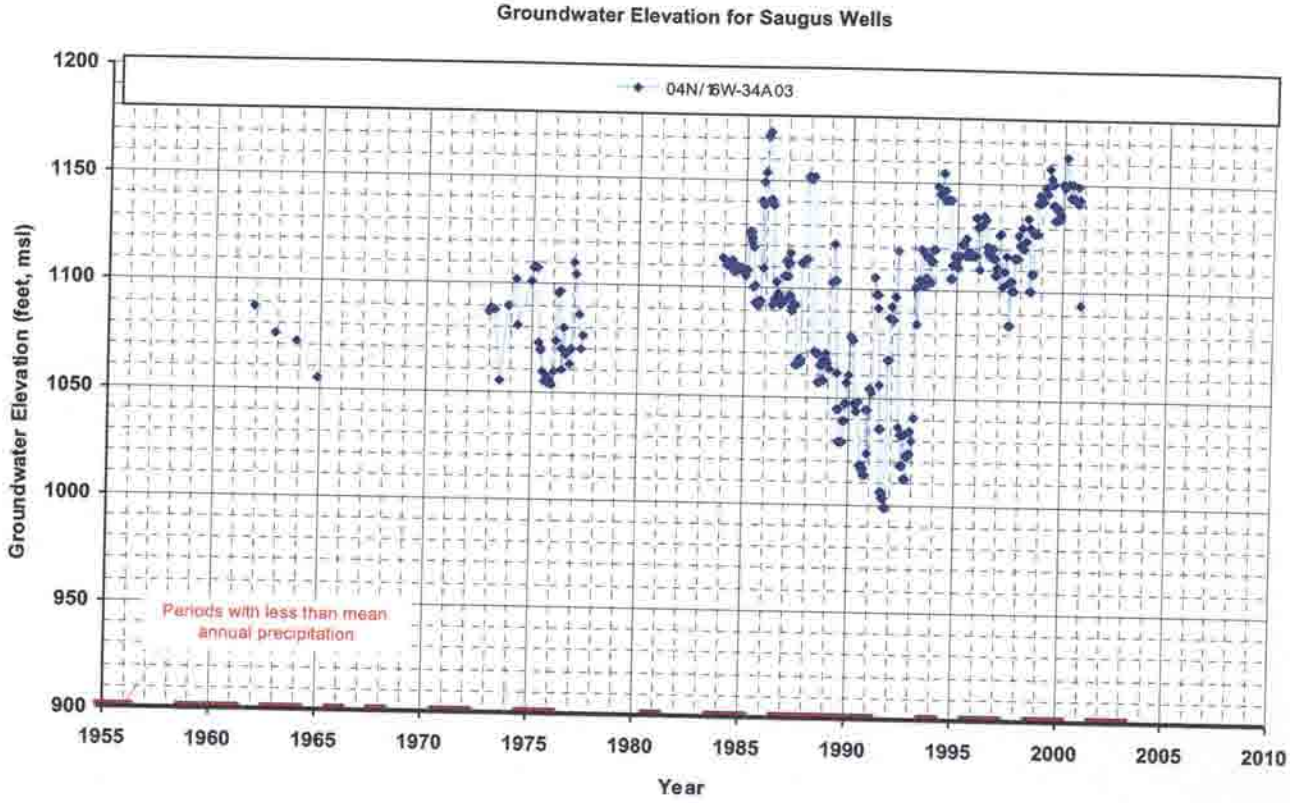

Groundwater Production - Saugus Formation
Santa Clara River Valley, East Groundwater Subbasin
Production (Acre-Feet)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1940
1950
1960
1970
1980
1990
2000
2010
Year
Agriculture and Miscellaneous
(Estimated Agriculture)
Municipal
(Estimated Municipal)
Total

Figure III-8


Groundwater Elevation for Saugus Wells
04N/16W-34A03
Groundwater Elevation (feet, msl)
1200
1150
1100
1050
1000
950
900
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

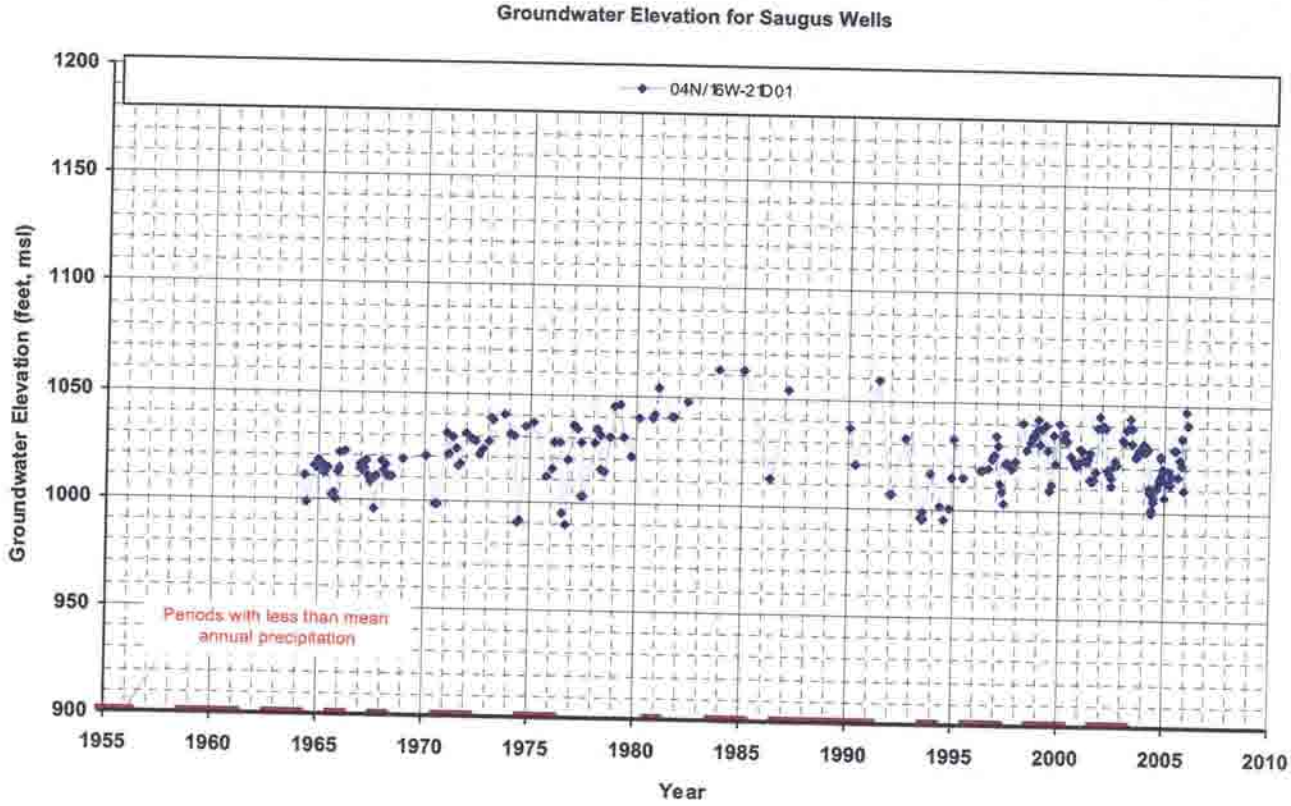
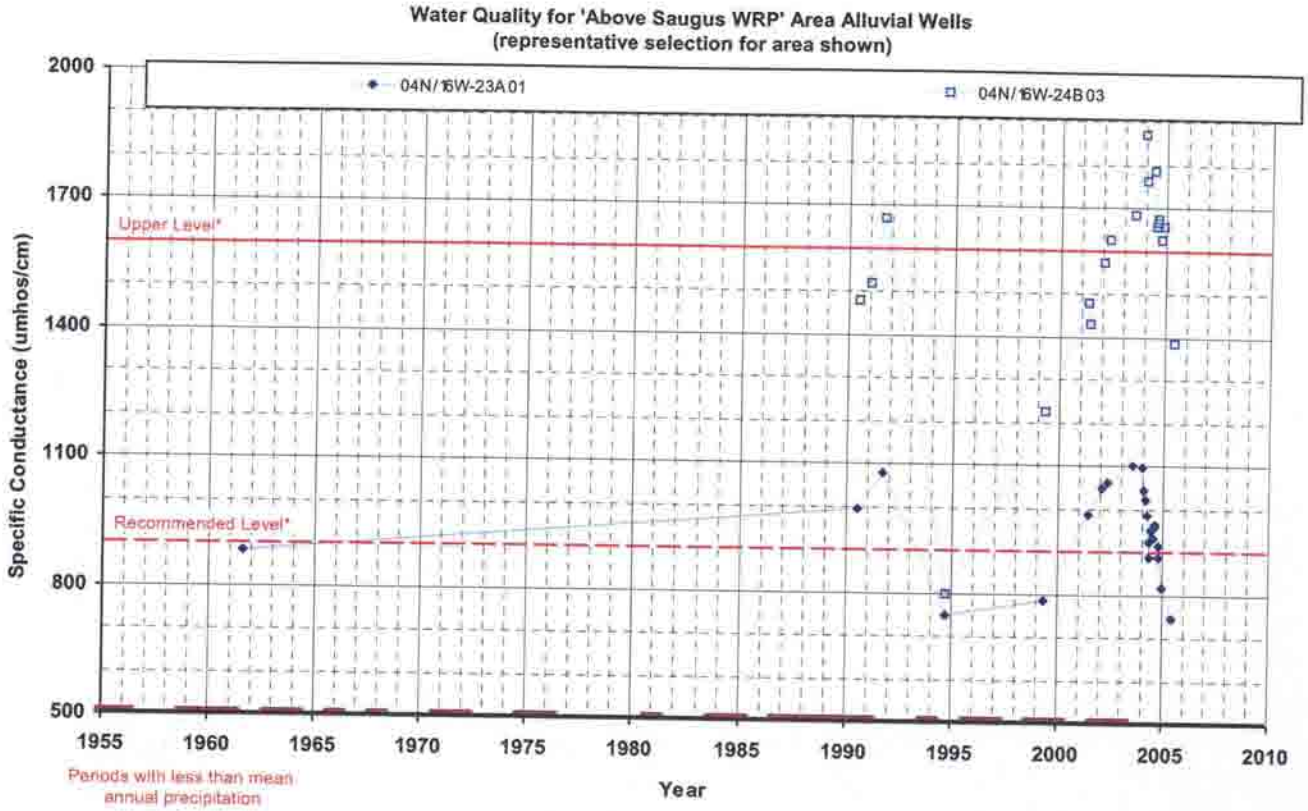
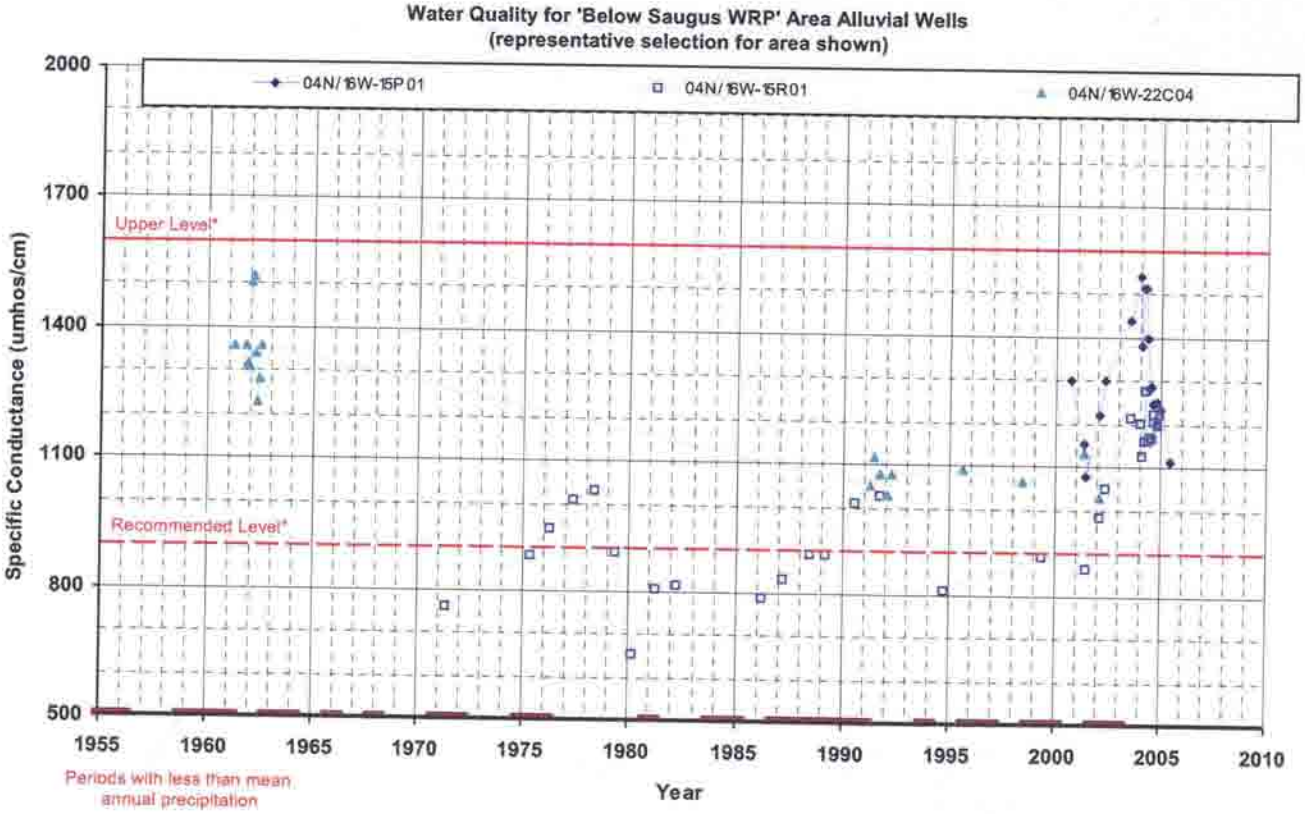

Groundwater Elevation for Saugus Wells
04N/16W-21D01
Groundwater Elevation (feet, msl)
1200
1150
1100
1050
1000
950
900
Periods with less than mean annual precipitation
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

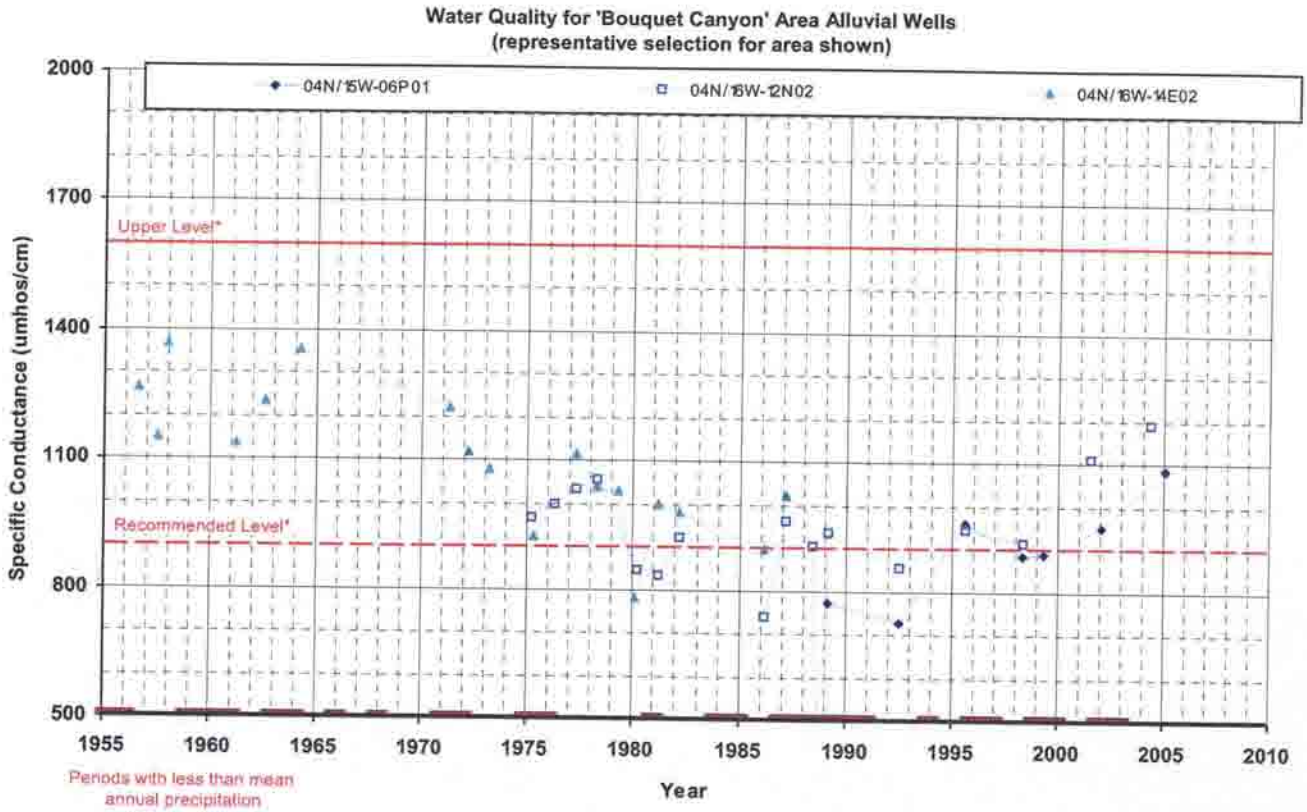
Figure III-9

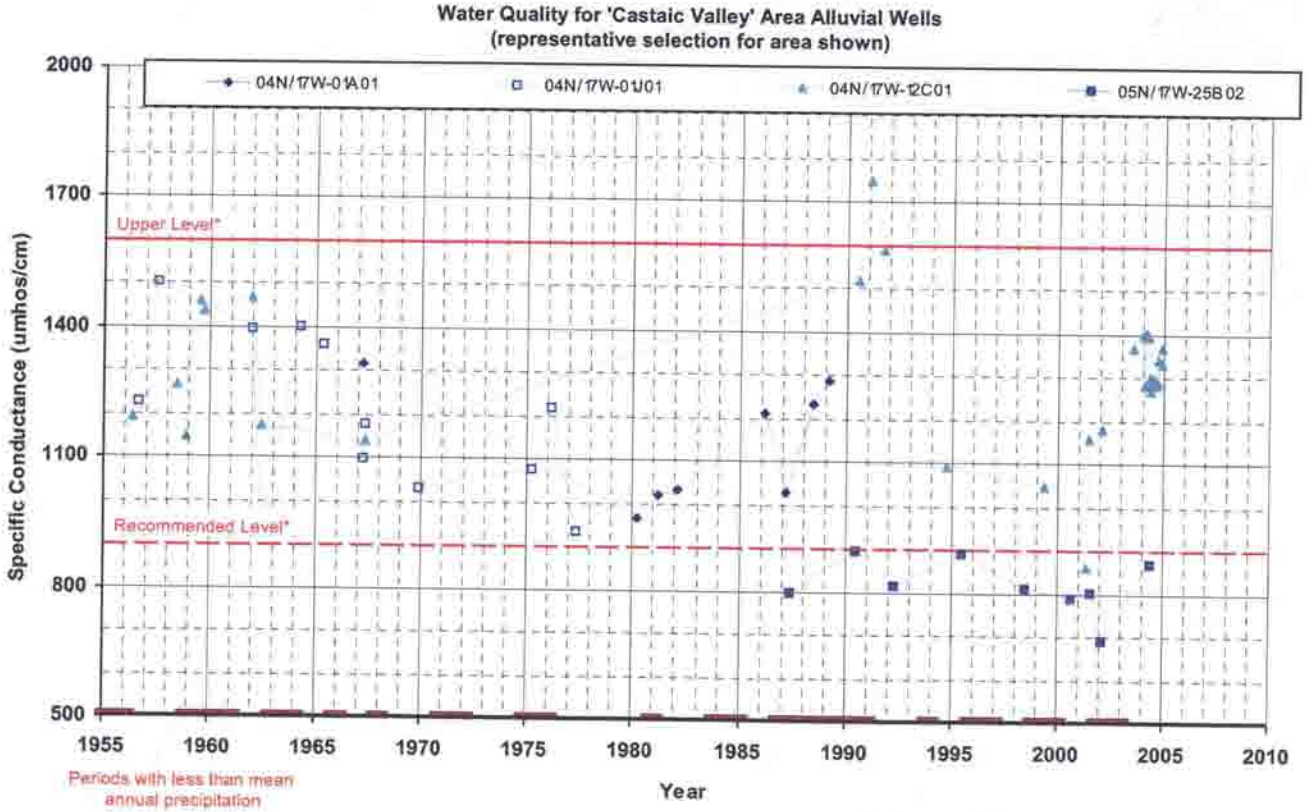




*California Department of Health Services Secondary Maximum Contaminant Level

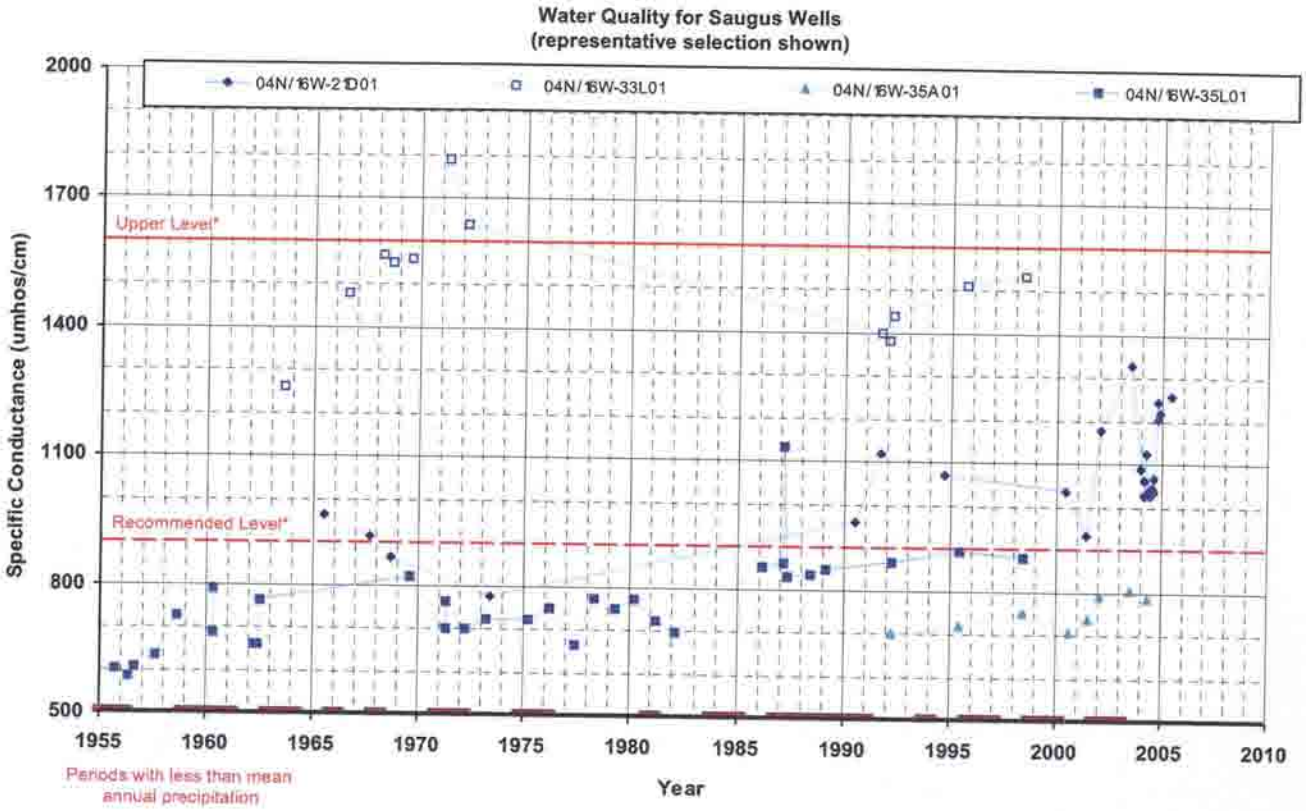
Figure III-10





*California Department of Health Services Secondary Maximum Contaminant Level

Figure III-11



*California Department of Health Services Secondary Maximum Contaminant Level

Figure III-12

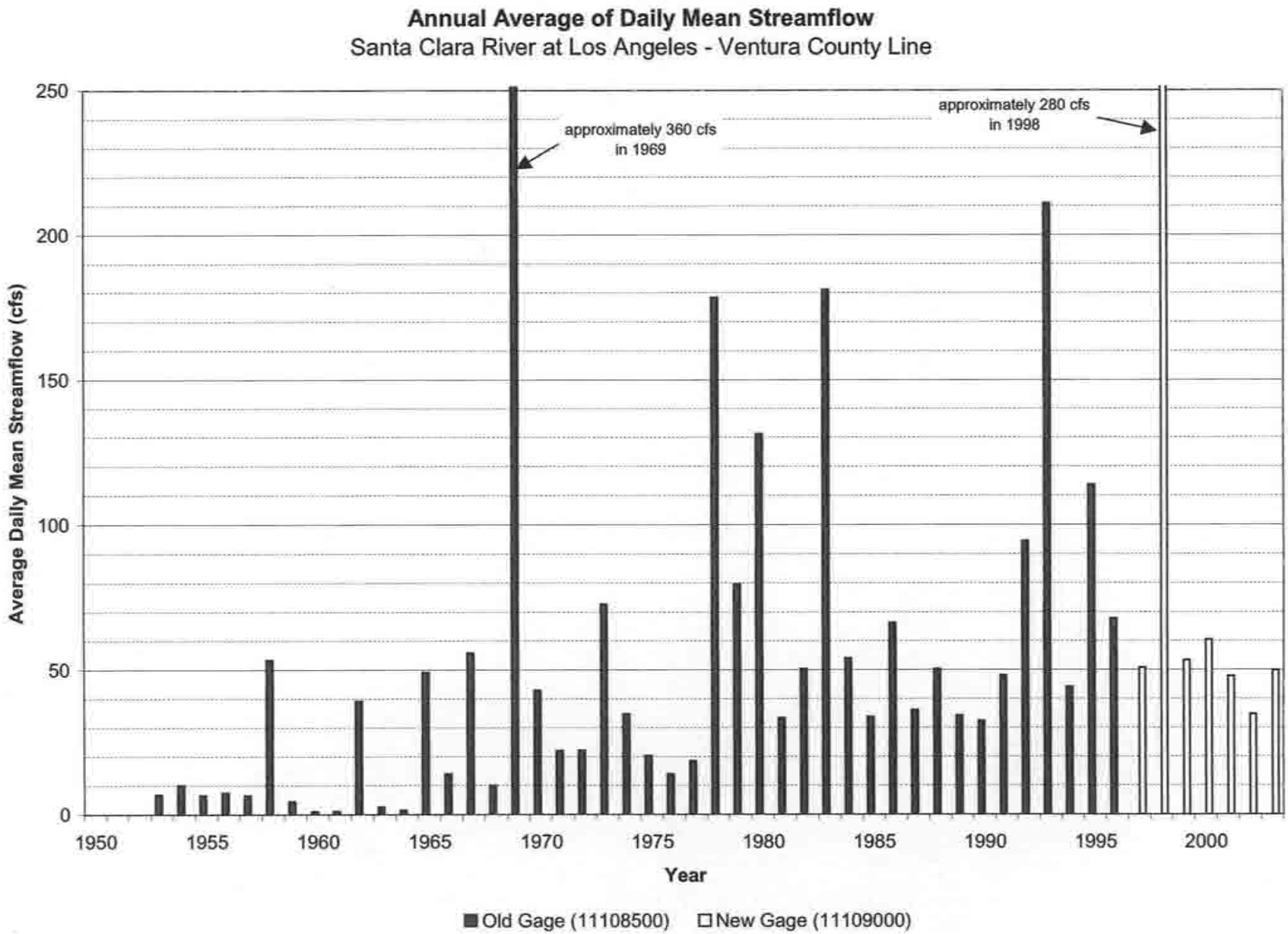


Figure III-13

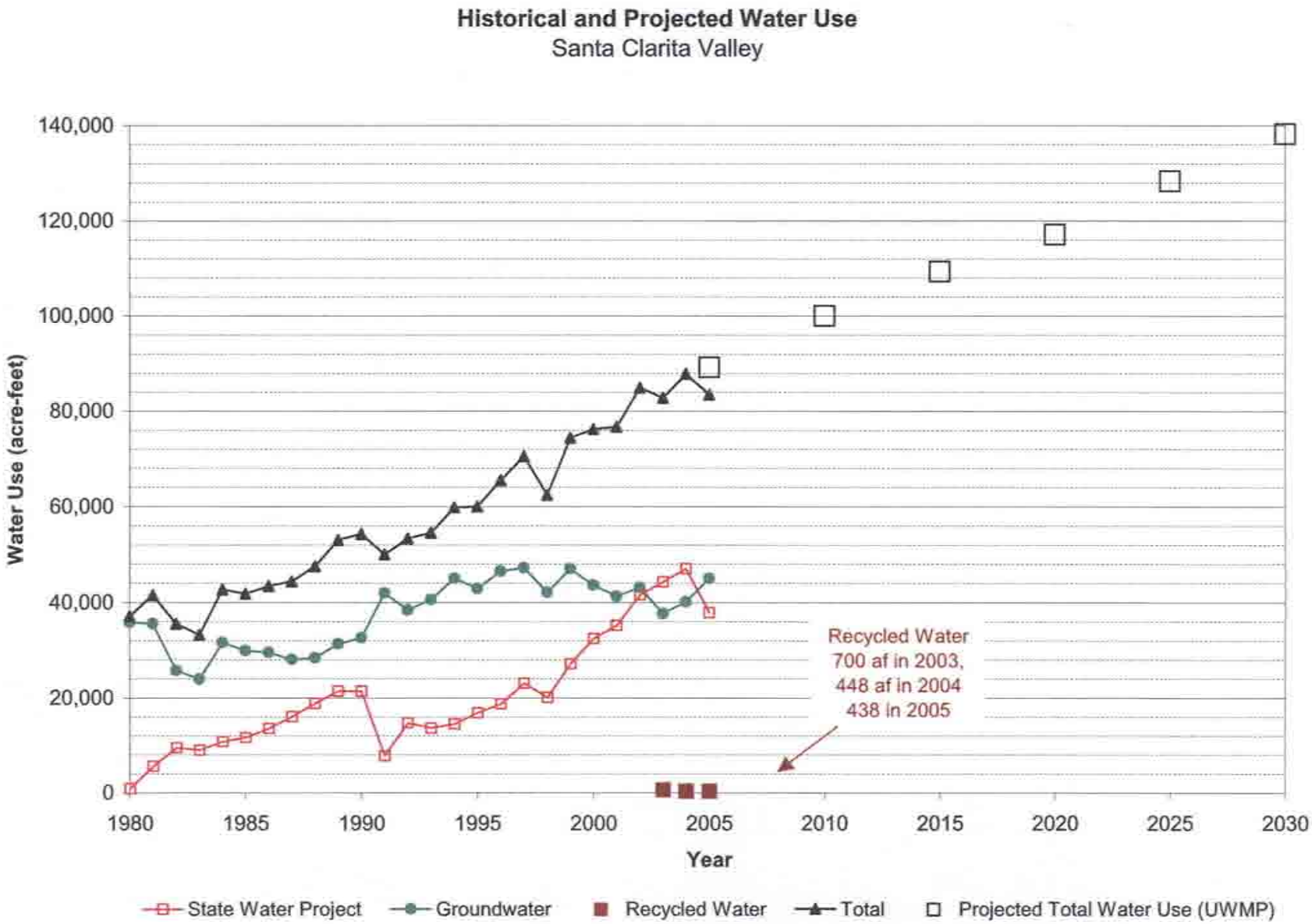

Historical and Projected Water Use
Santa Clarita Valley
Water Use (acre-feet)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
Year
Recycled Water
700 af in 2003,
448 af in 2004
438 in 2005
State Water Project
Groundwater
Recycled Water
Total
Projected Total Water Use (UWMP)

Figure IV-1

V. Water Conservation

The California Urban Water Conservation Council (CUWCC) was formed in 1991 through the Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California. The urban water conservation Best Management Practices (BMPs) included in the MOU are intended to reduce California's long-term urban water demands. While the BMPs are currently implemented by the MOU signatories on a voluntary basis, they are specified as part of the Demand Management Measures section of the Urban Water Management Planning Act.

Water conservation can achieve a number of goals, such as:

- Meeting legal mandates
- Reducing average annual potable water demands
- Reducing sewer flows
- Reducing demands during peak seasons
- Meeting drought restrictions

CLWA signed the urban MOU in 2001 on behalf of its wholesale service area, and pledged to implement several BMPs at a wholesale support level (listed below). NCWD signed the MOU in 2002 on behalf of its own retail service area. As a separate MOU signatory and due to its role as a retailer, NCWD is committed to implementing all BMPs that are feasible and applicable in its service area. Efforts are made to coordinate with CLWA and the other Purveyors wherever possible to maximize efficiency and ensure the cost effectiveness of NCWD's conservation program.

In coordination with the Purveyors, CLWA has been implementing the following BMPs (which pertain to wholesalers) for several years (some prior to signing the MOU in 2001):

BMP 3	System Water Audits, Leak Detection and Repair
BMP 7	Public Information Programs
BMP 8	School Education Programs
BMP 10	Wholesale Agency Programs
BMP 11	Conservation Pricing
BMP 12	Water Conservation Coordinator
BMP 13	Water Waste Prohibition (implementation during last drought)

CLWA and the Purveyors have been implementing these BMPs valley-wide. Since 2001, CLWA has also instituted implementation of BMP 2 (Residential Plumbing Retrofits) and BMP 14 (Residential ULFT Replacement Programs) on behalf of the Purveyors.

NCWD has initiated implementation of the remaining BMPs that are specific to retail water suppliers:

BMP 1	Water survey programs for single-family residential and multi-family residential customers
BMP 3	System water audits, leak detection and repair

BMP 4	Metering with commodity rates for all new connections and retrofit of existing connections
BMP 5	Large landscape conservation programs and incentives
BMP 6	High-efficiency clothes washing machine financial incentive programs
BMP 9	Conservation programs for commercial, industrial, and institutional (CII) accounts
BMP 11	Conservation pricing
BMP 12	Conservation coordinator
BMP 13	Water waste prohibition

Reports to the CUWCC on BMP implementation by CLWA and the Purveyors were included in the 2005 UWMP.

Additional savings are occurring Valley-wide due to state interior plumbing code requirements that have been in effect since 1992, as well as due to changes in lot size and reduction in exterior square footage of new housing and commercial developments. These have begun to impact overall demand in the Valley. The Valley's water suppliers continue to monitor water demand trends through time to assess those factors that are accounting for the reduction, and to attempt to quantify them.

VI. References

California Department of Water Resources, **The California Water Plan Update,** Bulletin 160-98, 1998.

California Department of Water Resources, **Final State Water Project Delivery Reliability Report, 2002**, May 2003.

California Department of Water Resources, **California's Groundwater**, Bulletin 118 – Update 2003, October 2003

Castaic Lake Water Agency (CLWA), CLWA Santa Clarita Water Division, Newhall County Water District, and Valencia Water Company, **Groundwater Perchlorate Contamination Amendment and Other Amendments, 2000 Urban Water Management Plan,** January 2005, including Black and Veatch, Reiter/Lowry/Consultants, and SA Associates **Urban Water Management Plan Update, 2000**, Castaic Lake Water Agency, Newhall County Water District, Santa Clarita Water Company, and Valencia Water Company.

Castaic Lake Water Agency (CLWA), CLWA Santa Clarita Water Division, Newhall County Water District, and Valencia Water Company, **2005 Urban Water Management Plan**, Los Angeles County Waterworks District No. 36, Cooperating Agency, November 2005.

CH2M Hill, **Evaluation of Historical and Projected Future Flows to Ventura County Resulting From Importation of State Project Water to the Santa Clara River Watershed,** July, 1998.

CH2M Hill **Evaluation of Historical and Projected Future Flows to Ventura County Resulting From Importation of State Project Water to the Santa Clara River Watershed**, Update 2001.

CH2M Hill **Regional Groundwater Flow Model for the Santa Clarita Valley, Model Development and Calibration**, April, 2004.

CH2M Hill, **Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property, Santa Clarita,** California, Prepared in support of the 97-005 Permit Application, December 2004.

CH2M Hill, Technical Memorandum, **Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California,** August 2005.

CH2M Hill and Luhdorff & Scalmanini, Consulting Engineers, **Analysis of Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California**, August 2005.

Kennedy/Jenks Consultants, Draft Report, **Recycled Water Master Plan,** Castaic Lake Water Agency, May 2002.

Luhdorff and Scalmanini, Consulting Engineers, **2004 Santa Clarita Valley Water Report**, prepared for Castaic Lake Water Agency, CLWA Santa Clarita Water Division, Los Angeles County Waterworks District 36, Newhall County Water District, and Valencia Water Company, May 2005.

Luhdorff and Scalmanini, Consulting Engineers, **Impact and Response to Perchlorate Contamination, Valencia Water Company Well Q2**, prepared for Valencia Water Company, April 2005.

Richard C. Slade & Associates, LLC, **2001 Update Report, Hydrogeologic Conditions in the Alluvial and Saugus Formation Aquifer Systems**, prepared for Santa Clarita Valley Water Purveyors, July 2002.

Slade, R. C., **Hydrogeologic Assessment of the Saugus Formation in the Santa Clara Valley of Los Angeles County, California,** Vols. I and II, prepared for Castaic Lake Water Agency, 1988.

Slade, R. C., **Hydrogeologic Investigation of Perennial Yield and Artificial Recharge Potential of the Alluvial Sediments in the Santa Clarita River Valley of Los Angeles County, California**, Vols. I and II, prepared for Upper Santa Clara Water Committee, 1986.

United Water Conservation District, Groundwater Department, **Surface and Groundwater Conditions Report, Year 2000 Supplement,** September 2001.

Valencia Water Company, **Water Management Program,** 2001.

Results of Laboratory Testing of Valencia Water Company Wells

Valencia Water Company
California Department of Health Services Drinking Water Standards, Title 22
Wells E-14, E-15, E-16, E-17

Primary Standards:
Inorganic Chemicals

Parameter	MCL	DLR	Units	E-14	E-15	E-16	E-17
Aluminum	1000	50	µg/l	ND	ND	ND	ND
Antimony	6	6	µg/l	ND	ND	ND	ND
Arsenic	50	2	µg/l	ND	ND	ND	ND
Barium	1000	100	µg/l	ND	ND	ND	ND
Beryllium	4	1	µg/l	ND	ND	ND	ND
Cadmium	5	1	µg/l	ND	ND	ND	ND
Chromium (Total)	50	10	µg/l	ND	ND	ND	ND
Fluoride	2	0.1	mg/L	0.89	0.9	0.89	0.83
Lead	50	5	µg/l	ND	ND	ND	ND
Mercury	2	1	µg/l	ND	ND	ND	ND
Nickel	100	10	µg/l	ND	ND	ND	ND
Nitrate (as NO3)	45	2	mg/L	11	14.2	16.8	16.8
Nitrite (as N)	1000	400	µg/l	ND	ND	ND	ND
Nitrate + Nitrite (as N)	10000	400	µg/l	2500	3200	3800	3800
Selenium	50	5	µg/l	ND	ND	ND	ND
Thallium	2	1	µg/l	ND	ND	ND	ND

Regulated Organic Chemicals

Parameter	MCL	DLR	Units	E-14	E-15	E-16	E-17
Volatile Organic Chemicals (VOC's)	variable	variable	µg/l	ND	ND	ND	ND
Synthetic Organic Chemicals (SOC's)	variable	variable	µg/l	ND	ND	ND	ND

Secondary Standards:

Parameter	MCL	DLR	Units	E-14	E-15	E-16	E-17
Apparent Color	15	NA	Units	<3	3	3	3
Chloride	250-500-600	NA	mg/L	75	88	89	74
Copper	1000	50	µg/l	ND	ND	ND	ND
Iron	300	100	µg/l	ND	ND	ND	ND
Manganese	50	20	µg/l	ND	ND	ND	ND
MBAS (foaming agents)	0.5	NA	mg/L	ND	ND	ND	ND
Odor	3	1	units (TON)	1	4	3	1
pH	6.5 - 8.5	NA	units	7.5	7.7	7.3	7.4
Silver	100	10	µg/l	ND	ND	ND	ND
Specific Conductance (E.C.)	900-1600-2,200	NA	umho/cm	1240	1290	1390	1360
Sulfate	250-500-600	0.5	mg/L	340	330	340	340
Total Dissolved Solids (TDS)	500-1000-1500	NA	mg/L	900	890	950	960
Turbidity	5	NA	NTU	0.4	0.9	0.2	0.3
Zinc	5000	50	µg/l	ND	ND	ND	ND

Valencia Water Company
California Department of Health Services Drinking Water Standards, Title 22
Wells E-14, E-15, E-16, E-17

Unregulated / Other Chemicals

Parameter	Notification Level	DLR	Units	E-14	E-15	E-16	E-17
Alkalinity	NA	NA	mg/L	230	215	244	254
Bicarbonate (as HCO3)	NA	NA	mg/L	280	262	298	310
Calcium	NA	NA	mg/L	130	120	120	130
Carbonate (as CO3)	NA	NA	mg/L	0.575	0.853	0.386	0.506
Carbon dioxide	NA	NA	µg/l	17700	10500	29900	24700
Hardness (Total as CaCO3)	NA	NA	mg/L	514	481	489	535
Hydroxide	NA	NA	mg/L	0.005	0.009	0.003	0.004
Magnesium	NA	NA	mg/L	46	46	44	51
Potassium	NA	NA	mg/L	4.2	4	3.9	4.4
Sodium	NA	NA	mg/L	100	100	110	110
Total Anions	NA	NA	meq/L	14	13.9	14.8	14.6
Total Cations	NA	NA	meq/L	14.7	14.1	14.7	15.6
Boron	1000	100	µg/l	430	480	460	470
Chromium, hexavalent	NA	1	µg/l	ND	ND	ND	ND
Dichlorodifluoromethane (Freon 12)	100	0.5	µg/l	ND	ND	ND	ND
Ethyl Tert-Butyl Ether (ETBE)	NA	3	µg/l	ND	ND	ND	ND
Langelier Index (25C)	NA	NA	none	0.62	0.75	0.41	0.56
Perchlorate	6	4	µg/l	ND	ND	ND	ND
Tert-Amyl Methyl Ether (TAME)	NA	3	µg/l	ND	ND	ND	ND
Tert-Butyl Alcohol (TBA)	12	2	µg/l	ND	ND	ND	ND
1,2,3-Trichloropropane (1,2,3-TCP)	0.005	0.005	µg/l	ND	ND	ND	ND
Vanadium	50	3	µg/l	ND	ND	ND	ND

Notes: Thiobencarb is listed as both an SOC and a Secondary Standard. The results for thiobencarb are included under SOC results.
MTBE is listed as both a VOC and a Secondary Standard. The results for MTBE are included under VOC results.
Aluminum is considered both a Primary and Secondary Standard. The results for aluminum are listed under Primary Standards.
2,3,7,8 -TCDD is an SOC. The results are attached.
EDB-DBCP are SOC's. They were run separately for E-16. Results are attached to E-16 file.
Alkalinity was run separately for E-14. Results are attached to E-14 file.

CH2MHill Memorandum, Effect of Urbanization on Aquifer Recharge in the Santa Clarita Valley, February 22, 2004

Effect of Urbanization on Aquifer Recharge in the Santa Clarita Valley

TO: Tom Worthington/Impact Sciences, Inc.

FROM: John Porcello/CH2M HILL

DATE: February 22, 2004

Introduction

In a groundwater basin, the effect of urbanization on recharge to underlying groundwater is dependent on land uses, water uses, vegetative cover, and geologic conditions. Groundwater recharge from undeveloped lands occurs from precipitation alone, whereas areas that are developed for agricultural or urban land uses receive both precipitation and irrigation of vegetative cover. In an urban area, groundwater recharge occurs directly beneath irrigated lands and in drainages whose bottoms are not paved or cemented. This memorandum discusses the general effects of urbanization on groundwater recharge and the specific effects in the Santa Clarita Valley.

Summary of Findings

In the Santa Clarita Valley, stormwater runoff finds its way to the Santa Clara River and its tributaries, whose channels are predominantly natural and consist of vegetation and coarse-grained sediments (rather than concrete). The stormwater that flows across paved lands in the Santa Clarita Valley is routed to stormwater detention basins and to the river channels, where the porous nature of the sands and gravels forming the streambeds allow for significant infiltration to occur to the underlying groundwater.

Increased urbanization in the Valley has resulted in the irrigation of previously undeveloped lands. The effect of irrigation is to maintain higher soil moisture levels during the summer than would exist if no irrigation were occurring. Consequently, a greater percentage of the fall/winter precipitation recharges groundwater beneath irrigated land parcels than beneath undeveloped land parcels. In addition, urbanization in the Santa Clarita Valley has occurred in part because of the importation of State Water Project (SWP) water, which began in 1980. SWP water use has increased steadily, reaching nearly 44,500 acre-feet (AF) in 2003. Two-thirds of this water is used outdoors, and a portion of this water eventually infiltrates to groundwater. The other one-third is used indoors and is subsequently routed to local water reclamation plants (WRPs) and then to the Santa Clara River (after treatment). A portion of this water flows downstream out of the basin, and a portion infiltrates to groundwater.

Records show that groundwater levels and the amount of groundwater in storage were similar in both the late 1990s and the early 1980s, despite a significant increase in the

urbanized area during these two decades. This long-term stability of groundwater levels is attributed in part to the significant volume of natural recharge that occurs in the streambeds, which do not contain paved, urban land areas. On a long-term historical basis, groundwater pumping volumes have not increased due to urbanization, compared with pumping volumes during the 1950s and 1960s when water was used primarily for agriculture. Also, the importation of SWP water is another process that contributes to recharge in the Valley. In summary, urbanization has been accompanied by long-term stability in pumping and groundwater levels, plus the addition of imported SWP water to the Valley, which together have not reduced recharge to groundwater, nor depleted the amount of groundwater that is in storage within the Valley.

Effect of Pavement on Recharge Beneath Specific Land Parcels

The amount of paved cover on the ground affects the degree to which rainfall and outdoor-applied urban water will be able to infiltrate to groundwater. In heavily industrialized areas with high percentages of paved cover, such as exist in portions of the Los Angeles Basin, less rainfall recharge will occur than if the land is in an undeveloped condition. Furthermore, if the bottoms of rivers and other drainages are paved, then the majority of stormwater generated during a rainfall event will be unable to infiltrate to groundwater. In contrast, the amount of recharge to groundwater will be greater in urbanized areas, such as the Santa Clarita Valley, that have natural soils in the bottoms of rivers and local drainages or that have lower percentages of paved cover on the developed areas lying outside the principal drainages. In these areas, the outdoor use of water for irrigation landscape vegetation or agricultural lands can notably increase the amount of groundwater recharge, particularly if the outdoor water is imported from outside the local groundwater basin. This is discussed further below.

Effect of Vegetative Cover and Water Use

From the 1930s through the 1960s, H.F. Blaney and other researchers at the U.S. Department of Agriculture performed numerous studies to measure the amount of infiltration to groundwater that occurs beneath undeveloped lands and irrigated farmlands, and the differences in recharge rates for different types of native vegetation and crops. In California, these studies included a 1933 study by Blaney in Ventura County, a 1963 study by Blaney and others in the Lompoc Uplands, studies by the U.S. Geological Survey and various consultants in the Montecito and Carpenteria groundwater basins, and a groundwater basin study by Santa Barbara County[1] that incorporated the results of these earlier studies.

Together, these studies concluded that deep percolation to groundwater from undeveloped lands occurs only during years of average or above-average precipitation. This occurs because:

1. Southern California's rainfall is highly seasonal in nature, whereupon most rainfall occurs during the relatively cool period November through March, when plant water

[1] See Santa Barbara County Water Agency, December 15, 1977. *Report on Adequacy of the Groundwater Basins of Santa Barbara County.*

requirements are low, and little, if any, rainfall occurs during the remaining (and warmer months) when plant water requirements increase.

2. During the summer, when little or no rainfall occurs, the native vegetation extracts the residual moisture that is present in the soil, which substantially decreases the soil moisture within the root zone of the vegetation. At the end of the dry season, soil moisture levels on undeveloped lands are below the soil's field capacity, which is the amount of moisture that must be present in the soil before free drainage of water can occur below the rooting zone of the native vegetation.

3. When the seasonal rains arrive, the incident rainfall that is not consumed by plants and does not become stormwater runoff must first raise the soil moisture level to the soil's field capacity before any groundwater recharge will occur. The various studies indicate that about 17 inches/year of rainfall is necessary to raise the soil moisture to the field capacity on an undeveloped parcel of land. This is similar to the average annual rainfall in the Santa Clarita Valley and in other lowland coastal and near-coastal valleys in southern California.

On irrigated lands, irrigation occurs during several months of the year, with the exact duration depending on the amount and timing of rainfall and also the crops or type of urban landscaping being irrigated. The principal effect of converting undeveloped land to land that receives agricultural or urban irrigation is to increase the amount of water that is applied to the land during the low-rainfall months. This application of water to the vegetative cover on the surface of the developed land parcel results in the maintenance of higher soil moisture levels during the warm, dry months than would occur without development. This has three effects:

1. Because irrigation will generally be performed in a manner that maintains the health of the vegetative cover, enough water will be applied to maintain the soil moisture at, or close to, the field capacity of the soil. This in turn will allow some deep percolation to occur from the irrigation water itself.

2. When the rainy season begins, because irrigation has maintained soil moisture at or near field capacity, less of the initial rainfall entering the root zone needs to be stored in the soil (to meet soil moisture deficits) beneath an irrigated parcel than in the case of an undeveloped parcel. Therefore, a greater percentage of the initial rainfall and annual rainfall will be able to infiltrate to groundwater. The southern California studies estimated that irrigated land parcels would allow rainfall infiltration to occur in years when annual rainfall is at least 10.5 inches/year. This threshold rainfall value is 6.5 inches less than the threshold rainfall value that the studies estimated to be necessary for generating groundwater recharge beneath undeveloped land parcels.

3. Because the majority of irrigation occurs during the dry (low-rainfall) months, the total annual recharge to groundwater from irrigated developed lands is the sum of: (a) the deep percolation arising from irrigation (during the low-rainfall months); and (b) rainfall (during the months when less irrigation is occurring). Therefore, groundwater recharge beneath developed lands is greater and occurs for a longer period of time each year than in the case of undeveloped lands where no irrigation is occurring.

Historical Observations of Groundwater Conditions in the Santa Clarita Valley

The findings of the studies described above for other groundwater basins in southern California are consistent with observations that have been made in the Santa Clarita Valley, which are based on long-term water level records, water budget analyses, and groundwater modeling. Based on a month-by-month calibration to a 20-year record of historical water level records (throughout the Valley) and stream gaging records (at the Los Angeles – Ventura County line), the model simulates 10 percent of the applied outdoor water as being available for recharge to groundwater in retail and residential areas, with greater percentages infiltrating beneath golf courses and agricultural lands. This is consistent with a 1980 study by DWR of the groundwater resources of the Santee and El Monte hydrologic subareas of San Diego County. In that study, which was performed to evaluate reclaimed water use plans, DWR concluded that approximately 20 percent of the applied outdoor water in municipal areas infiltrates to the water table, with the remaining 80 percent going to evapotranspiration and direct evaporation. DWR also concluded that there would likely be no significant change in these percentages as urbanization continues.[2]

In the Santa Clarita Valley, as in any urbanized area, urbanization increases the paved area and can increase the magnitude and intensity of stormwater runoff from paved land areas. In the Santa Clarita Valley, this stormwater runoff will find its way to the Santa Clara River and its tributaries, whose channels are predominantly natural and consist of vegetation and coarse-grained sediments (rather than concrete). The stormwater that flows across paved lands in the Santa Clarita Valley is routed to stormwater detention basins and to the river channels, where the porous nature of the sands and gravels forming the streambeds allow for significant infiltration to occur to the underlying groundwater. Consequently, for a developed land parcel, the water that runs off of the paved portion of the land parcel will infiltrate to groundwater from a detention basin or a riverbed, rather than infiltrating onsite.

Riverbed infiltration is a significant percentage of total recharge in the Santa Clarita Valley in any given year. Streamflow records and the model calibration process together demonstrate that year-to-year fluctuations in total recharge in the Valley arise not just from year-to-year variations in incident rainfall within the Valley, but also from year-to-year variations in streamflows in the Santa Clara River and its tributaries. Because the areas contributing flow to the rivers are located both within and outside of the Valley, the recharge that occurs from riverbeds is a significant source of groundwater recharge within the Valley.

Evidence that stormwater infiltration to groundwater is not significantly decreased by urbanization comes from long-term water level records at wells completed in the Alluvial aquifer. These records show that groundwater levels and the amount of groundwater in storage were similar in both the late 1990s and the early 1980s, despite a significant increase in the urbanized area during these two decades. This long-term stability is attributed in part to the significant volume of natural recharge that occurs in the streambeds, which do not contain paved, urban land areas. Also, groundwater pumping volumes have not increased

[2] See State of California, Department of Water Resources, Southern District. August 1984, *San Diego County Cooperative Ground Water Studies: Reclaimed Water Use, Phase II*. Pages 40-41.

due to urbanization, compared with pumping volumes during the 1950s and 1960s when water was used primarily for agriculture. Additionally, beginning in 1980, water was imported into the Santa Clarita Valley from the State Water Project (SWP) for urban use, with SWP water use reaching nearly 30,000 acre-feet per year (AF/yr) by the end of the 1990s, and progressively increasing from about 32,500 AF in 2000 to nearly 44,500 AF in 2003. Because two-thirds of the total urban water demand is used outdoors, a substantial portion of the imported SWP water has been and continues to be applied to urban landscaping, thereby increasing the amount of recharge to groundwater. The remaining urban water is used indoors, and is subsequently routed to local water reclamation plants (WRPs) and then to the Santa Clara River (after treatment). A portion of this water flows downstream out of the basin, and a portion infiltrates to groundwater.

In summary, urbanization has been accompanied by long-term stability in pumping and groundwater levels, plus the addition of imported SWP water to the Valley, which together have not reduced recharge to groundwater, nor depleted the amount of groundwater that is in storage within the Valley.