Water Quality in the State Water Project, 2004 and 2005

April 2009

State of California
The California Natural Resources Agency
Department of Water Resources
Division of Operations and Maintenance
Environmental Assessment Branch

Cover Photo: Pre-consolidation ponds in the western San Joaquin Valley used to facilitate near surface subsidence of alluvium in preparation for building the California Aqueduct, circa 1966. Source: DWR, Photography Section.

State of California
Arnold Schwarzenegger, Governor

The California Natural Resources Agency
Mike Chrisman, Secretary for Resources

State of California
Arnold Schwarzenegger, Governor

The California Natural Resources Agency
Mike Chrisman, Secretary for Resources

Department of Water Resources
Lester A. Snow, Director

Susan Sims
Chief Deputy Director

Kasey Schimke
Asst. Director Legislative Affairs

David Sandino
Chief Counsel

Mark W. Cowin
Deputy Director

Timothy Haines
Deputy Director

Gerald E. Johns
Deputy Director

Jim Libonati
Deputy Director

Ralph Torres
Deputy Director

Division of Operations and Maintenance
Carl Torgerson, Chief

This report was prepared under the direction of

Dave Samson
Chief, State Water Project Operations Support

and

Dean F. Messer
Chief, Environmental Assessment Branch

Written by

Barry L. Montoya ..... Staff Environmental Scientist

Acknowledgments:

Editorial service by Gretchen Goettl, Supervisor of Technical Publications, and Nikki Blomquist, Research Writer. Laboratory, field, and database management staff are acknowledged below.

Bryte Laboratory
William C. Nickels, Chief
Sidney Fong, P.H. Chemist III (Supv.)
Clint Walker, Bus. Serv. Asst
Elaine Chan, Lab. Tech.
Richard Hernandez, P.H. Chemist II
Maritza Pineda, P.H.Chemist I
Josie Quiambao, P.H. Chemist II
Pritam Thind, P.H. Staff Chemist
Allan Wong, P.H. Chemist I
Marilyn Carroll, Lab. Tech.
Matthew Hicks, P.H. Chemist I

Water Quality Section
Cindy Garcia, Chief
Austine Eke, Env. Sci.
Diane Shimzu, Env. Sci.

Oroville Field Division
Trudy Payne, WREA (Spec.)
Ron Vanscoy, WREA (Spec.)

Delta Field Division
Mike A.Taliaferro, WREA (Spec.)

San Luis Field Division
Pam Borba, Chief, Surveillance and Mont.
Bob Mattos, Water Res. Tech. II

San Joaquin Field Division
Jennifer Metcalf, Chief, Water Operations
Jaime Collado, Water Res. Tech.II

Southern Field Division
John Kemp, Chief, Water Quality Unit
Gary Faulconer, Staff Env. Sci.
Della Stephenson, Water Res. Tech. II
William Jordan, Water Res. Tech. II
Michelle Leonard, Water Res. Tech. II
Cindy Brummett, Water Res. Tech. II
Marcos Moreno, Water Res. Tech. II

Acronyms and Abbreviations

af	acre-feet
Ag	silver
Al	aluminum
As	arsenic
B	boron
Ba	barium
BPP	Banks Pumping Plant
Br	bromide
C	carbon
Ca	calcium
Cd	cadmium
cfs	cubic feet per second
C21, C29, and C41	Checks 21 to 41
Cl	chloride
CO_3	carbonate
Cr	chromium
Cu	copper
CVP	Central Valley Project
DHS	Department of Health Services
DMC	Delta-Mendota Canal
DCH	Devil Canyon headworks
DOC	dissolved organic carbon
DWR	Department of Water Resources
EC	electrical conductivity or conductance
EPA	Environmental Protection Agency
F	fluoride
Fe	iron
GPM	gallons per minute
Hg	mercury
K	potassium
meq/L	milliequivalents per liter
MCL	maximum contaminant level
maf	million acre-feet
MFL	million fibers per liter
Mg	magnesium
mg/L	milligrams per liter
Mn	manganese
MtBE	methyl *tertiary (or tert)*-butyl ether
N	nitrogen
Na	sodium
NH_4	ammonia
NO_2	nitrite
NO_3	nitrate
NTU	nephelometric turbidity unit
OFO	O'Neill Forebay outlet

P	phosphorus
pH	negative log of the hydrogen ion activity
PO_4	phosphate
SBA	South Bay Aqueduct
Se	selenium
SLC	San Luis Canal
SO_4	sulfate
SRI	Sacramento River Index
SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
TT	treatment technique
The Bureau	U. S. Bureau of Reclamation
µg/L	micrograms per liter
µmole/L	micromoles per liter
µS/cm	microseimens per centimeter
UV	ultraviolet
VSS	volatile suspended solids
KWBA	Kern Water Bank Authority
SWSD	Semitropic Water Storage District
AEWSD	Arvin-Edison Water Storage District
UVA_{254}	ultraviolet absorbance at 254 nanometers
USEPA	U.S. Environmental Protection Agency

Contents

I. Executive Summary **1**

II. Introduction **3**

III. California Aqueduct **7**

IV. San Luis Joint-Use Complex **19**

V. Southern Reservoirs **27**

VI. South Bay Aqueduct **33**

VII. North Bay Aqueduct **37**

VIII. Oroville-Thermalito Complex and Upper Feather River Reservoirs **39**

IX. Organic Chemicals **43**

X. Special Studies **47**
Groundwater Turn-ins 47

References **51**

Appendix A. Methods **53**
Monitoring Stations 53
Water Collection 53
Laboratory Methods 54

Appendix B Maximum Contaminant Levels **65**

Tables

Table 2-1. Water quality monitoring stations in the State Water Project (includes one federal Central Valley Project station on the Delta-Mendota Canal) 5

Table 3-1. Summary of major minerals and conventional parameters in the California Aqueduct, 2004 and 2005 8

Table 3-2. Disinfection byproduct precursors and ultraviolet absorbance at 254 nanometers (UVA_{254}) in the California Aqueduct, 2004 and 2005 14

Table 3-3. Summary of minor elements in the California Aqueduct, 2004 and 2005 (mg/L) 17

Table 3-4. Summary of nutrients in the California Aqueduct, 2004 and 2005 18

Table 4-1. Summary of major minerals and conventional parameters in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005 20

Table 4-2. Summary of bromide and total and dissolved organic carbon in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005 22

Table 4-3. Summary of minor elements in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005 (mg/L) 25

Table 4-4. Summary of nutrients in San Luis Reservoir, 2004 and 2005 25

Table 5-1. Summary of major minerals and conventional parameters in SWP southern reservoirs, 2004 and 2005 27

Table 5-2. Summary of bromide and dissolved and total organic carbon in SWP southern reservoirs, 2004 and 2005 30

Table 5-3. Summary of minor elements in southern SWP reservoirs, 2004 and 2005 (mg/L) 31

Table 5-4. Summary of nutrients in SWP southern reservoirs, 2004 and 2005 31

Table 6-1. Summary of major minerals and conventional parameters in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005 34

Table 6-2. Summary of disinfection byproduct precursors in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005 34
Table 6-3. Summary of minor elements in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005 (mg/L) 36
Table 6-4. Summary of nutrients in the South Bay Aqueduct, Lake Del Valle, and Lake Del Valle releases, 2004 and 2005 36
Table 7-1. Summary of water quality in the North Bay Aqueduct at Barker Slough Pumping Plant, 2004 and 2005 37
Table 8-1. Summary of major minerals and conventional parameters at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005 39
Table 8-2. Summary of minor elements at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005 (mg/L) 40
Table 9-1. Organic chemicals in the State Water Project, 2004 and 2005 (X=scans were performed) 44
Table 10-1. Groundwater turn-in volumes and flows in the California Aqueduct, 2004 (acre-feet unless noted) 47
Table 10-2. Water quality constituents-of-concern in groundwater turn-ins 48
Table 10-3. Summary table of upstream and downstream differences in constituents-of-concern between Checks 21 and 29 49
Table A-1. Water quality monitoring schedule 55
Table A-2. Analytical methods for non-organic chemical parameters 62
Table A-3. Analytical methods for organic chemicals (Con't) 64

Figures

Figure 2-1. Water quality monitoring stations in the State Water Project. Station identification numbers (e.g., KA000331) are defined in Table 2-1 and Appendix A. 4
Figure 3-1. Monthly pumping at Banks Pumping Plant (thousand acre-feet) 7
Figure 3-2. Salinity and other related parameters in the California Aqueduct at Banks Pumping Plant (BPP), O'Neill Forebay outlet (OFO), Checks 21 to 41 (C21, C29, and C41), and Devil Canyon headworks (DCH), 2004 and 2005 9
Figure 3-3. Monthly salinity and turbidity in the California Aqueduct. Turbidity values of <1 NTU were reported as zero. 10
Figure 3-4. Natural inflows to Silverwood Lake (in thousand acre-feet) and conductivity at Check 41 and Devil Canyon headworks (DCH). A decline in conductivity was observed between Check 41 and DCH due to these inflows. 11
Figure 3-5. Monthly sulfate, chloride, hardness, and alkalinity in the California Aqueduct 12
Figure 3-6. Chloride:sulfate ratios at Banks Pumping Plant, 2004 and 2005. The 1.5 seawater intrusion indicator represents the upper 99% confidence interval for this ratio in the San Joaquin River, a major source of high salt in south Delta exports besides seawater intrusion. 13
Figure 3-7. Annual average conductivity at Banks Pumping Plant, 1968 to 2005 13
Figure 3-8. Bromide and dissolved and total organic carbon in the California Aqueduct at Banks Pumping Plant (BPP), O'Neill Forebay outlet (OFO), Checks 21 to 41 (C21, C29, and C41), and Devil Canyon headworks (DCH), 2004 and 2005 14
Figure 3-9. Monthly bromide and dissolved and total organic carbon in the California Aqueduct 15
Figure 4-1. Monthly inflows to O'Neill Forebay from the California Aqueduct at Check 12 and the CVP Delta-Mendota Canal at O'Neill Pumping-Generating Plant. Also shown are releases from San Luis Reservoir at Gianelli Pumping-Generating Plant. 19
Figure 4-2. Monthly water quality in the CVP Delta-Mendota Canal near O'Neill Forebay 21

Figure 4-3. Hourly conductivity oscillations in the CVP Delta-Mendota Canal at O'Neill Forebay. Conductivity was oscillating between levels in the San Joaquin River at Vernalis and Middle River at Borden Highway. 21
Figure 4-4. Comparison of bromide, conductivity, and dissolved organic carbon between Banks Pumping Plant on the California Aqueduct and the CVP Delta-Mendota Canal near O'Neill Forebay 23
Figure 4-5. Monthly pumping into San Luis Reservoir (combined SWP and CVP) at Gianelli Pumping-Generating Plant and water quality in San Luis Reservoir at Pacheco Pumping Plant 24
Figure 5-1. Salinity and turbidity in SWP southern reservoirs. Turbidity values of <1 NTU were reported as zero. 28
Figure 5-2. Quarterly sulfate, chloride, hardness, and alkalinity in SWP southern reservoirs 29
Figure 5-3. Monthly bromide and dissolved and total organic carbon in Castaic Lake and Lake Perris 30
Figure 5-4. Monthly natural inflows to SWP southern reservoirs (thousand acre-feet) 32
Figure 6-1. Monthly pumping at South Bay Pumping Plant, natural inflows to Lake Del Valle, and releases from Lake Del Valle to the South Bay Aqueduct (thousand acre-feet) 33
Figure 6-2. Monthly water quality in the South Bay Aqueduct at Del Valle, Check 7 35
Figure 7-1. Monthly pumping in the North Bay Aqueduct at Barker Slough Pumping Plant (thousand acre-feet) 37
Figure 7-2. Monthly water quality in the North Bay Aqueduct at Barker Slough Pumping Plant 38
Figure 8-3. Summary of nutrients at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005 41
Figure 10-1. Constituents-of-concern in the California Aqueduct upstream and downstream the KWBA and SWSD turn-ins at Checks 21 and 29, respectively 49
Figure 10-2. Constituents-of-concern in the California Aqueduct upstream and downstream from the AEWSD turn-in at Checks 29 and 41, respectively 50
Figure A-1. Water quality monitoring stations in the State Water Project. The circled numbers indicate plate numbers that detail the dotted-outlined areas 56

1. Executive Summary

Water quality in the State Water Project (SWP) during 2004 and 2005 was assessed for trends and suitability as a source of drinking water. Water quality parameters included major minerals, minor elements, organic chemicals, and nutrients. Relative quality comparisons were made with existing public health standards for treated drinking water. Trend analysis focused on the effects of hydrology and operations on parameters-of-concern such as salinity, bromide, and organic carbon.

Most SWP water is exported from the southern Sacramento-San Joaquin Delta (south Delta) at Banks Pumping Plant (Banks) and conveyed down the California and South Bay aqueducts. Water quality in south Delta exports was relatively good during 2004 and 2005. Annual average conductivity was below the historic median during 2004, a below normal water year in the Sacramento Valley, and 2005, an above normal water year. Drinking water maximum contaminant levels (MCLs) for salinity, sulfate, chloride, minor elements, nutrients, and organic chemicals were not exceeded. Seawater intrusion was apparent during the second half of both years and was associated with a maximum bromide concentration of 0.38 mg/L. Dissolved organic carbon (DOC) was highest in January and February 2005, with concentrations of 8.2 and 7.1 mg/L, respectively; monthly concentrations during the rest of the two-year period were below 5 mg/L.

Further south, salinity increased in the California Aqueduct due to operations in the San Luis Joint-Use complex. Releases from San Luis Reservoir and inputs from the Central Valley Project's (CVP) Delta-Mendota Canal (DMC) contributed, in part, to higher salinities south of O'Neill Forebay. Conductivity and bromide increased between Banks and O'Neill Forebay outlet by 1% to 186% during most months of the two-year period.

Total dissolved solids (TDS) in three monthly samples from the CVP's DMC were above the recommended secondary MCL of 500 mg/L. The high-salinity water originated from the San Joaquin River with additional contributions from numerous saline point and non-point discharges on south Delta waterways flowing to the intake of the DMC. Water pumped into O'Neill Forebay from the DMC amounted to 28-31% of the total from south Delta exports during the two-year period.

Over 100,000 acre-feet of non-Project groundwater was pumped or turned into the California Aqueduct (called "turn-ins") south of O'Neill Forebay from June to December, 2004. Upstream/downstream sampling between checks 21 and 29 revealed measurable water quality changes from the largest turn-ins. Organic carbon was consistently lower at the downstream station with reductions of up to 1 mg/L. Bromide was also lower downstream of the inputs during most of the turn-in period; however, downstream concentrations of arsenic, nitrate, and sulfate were consistently higher. Conductivity was neither routinely higher nor lower at either upstream or downstream station. No drinking water MCLs were exceeded as a result of the groundwater turn-ins.

Floodwater inflows entered the San Luis Canal between December 2004 and February 2005 but were relatively minor compared to California Aqueduct flows (1% or less).

Water quality in the North Bay Aqueduct at Barker Slough Pumping Plant exhibited the typical recurrent drinking water challenges: elevated turbidity and organic carbon levels. Turbidity ranged from 24 to 130 nephelometric turbidity units (NTU) (median = 48 NTU) and DOC ranged from 2.4 to 15.9 mg/L (median = 4 mg/L). Regardless, all analyses for salinity, sulfate, chloride, nitrate, nutrients, organic chemicals, and most minor elements were below existing MCLs for these parameters in treated drinking water. The minor element manganese was above the secondary MCL of 0.05 mg/L in two samples.

The Oroville-Thermalito complex includes Lake Oroville, Thermalito Forebay, and Thermalito Afterbay. Water quality in the Oroville-Thermalito complex and upper Feather River reservoirs was characteristically excellent with less-than-detectable to low levels of minerals, nutrients, and most minor elements. Manganese was above the secondary MCL of 0.05 mg/L (0.115 mg/L) in one sample from Lake Oroville.

2. Introduction

The Department of Water Resource's (DWR) Division of Operations and Maintenance monitors water quality in the State Water Project (SWP). Water quality monitoring stations are situated on SWP storage and conveyance facilities located throughout California (Figure 2-1 and Table 2-1). The SWP monitoring program began in 1962 with exports down the South Bay Aqueduct and then expanded in 1967 with the completion of Oroville Dam and the start of exports down the California Aqueduct. Other storage and conveyance facilities monitored include the North Bay Aqueduct, Oroville-Thermalito complex, San Luis Joint-Use complex, and several reservoirs in Southern California. The SWP monitoring program incorporates both manual and automated measuring techniques to provide an ongoing assessment of water quality conditions throughout the SWP.

Discrete (or grab) water quality samples are collected at 24 routine stations and sent to DWR's Bryte Chemical Laboratory for analysis (Table 2-1). The physical and chemical analyses were first mandated in initial long-term agreements between the SWP and the water contracting agencies and districts (DWR 1965). Sampling frequency is monthly at most stations, but can vary from weekly to annually depending on location and time of year. The water quality constituents analyzed also vary between stations but typically include conventional parameters (pH, salinity, etc.), major minerals, minor elements, nutrients, and organic chemicals (see Appendix A for details). An additional 17 automated water quality monitoring stations are arrayed around the SWP to continuously measure physico-chemical conditions like conductivity, pH, temperature, and turbidity (Figure 2-1 and Table 2-1; includes one federal Central Valley Project station). SWP water quality data can be found at http://wwwomwq.water.ca.gov/.

Water quality monitoring is an important operational component of the SWP. The data generated are used to assess spatial changes, short- and long-term trends, impacts from emergencies like spills and pipe ruptures, influence of operations and hydrology, and the general suitability of SWP water for drinking water purposes as defined by public health protection standards. The data are periodically assessed and disseminated through a variety of media, including memos, network postings, conference calls, and e-mail distributions. More exhaustive assessments are included in biennial reports such as this one. Special studies are also periodically conducted to investigate the impacts of specific factors affecting SWP water quality, such as groundwater turn-ins, floodwater inflows, hydrology, and Delta hydrodynamics (select special studies and biennial reports are posted at http://wwwomwq.water.ca.gov/PublicationsPage/index.cfm).

Water quality in south Delta exports (California and South Bay aqueducts) was relatively good during 2004 and 2005. Salinity was low to moderate for most months of each year. Seawater intrusion—with the resulting elevation in salinity and bromide—was evident during the last half of both years. With the exception of two months, dissolved organic carbon in both aqueducts was 4.8 mg/L or less. North Bay Aqueduct exports exhibited relatively high levels of organic carbon and turbidity. Water quality in the Oroville-Thermalito complex and upper Feather River reservoirs was excellent, as usual, with non-detectable to low levels of minerals, nutrients, and most minor elements.

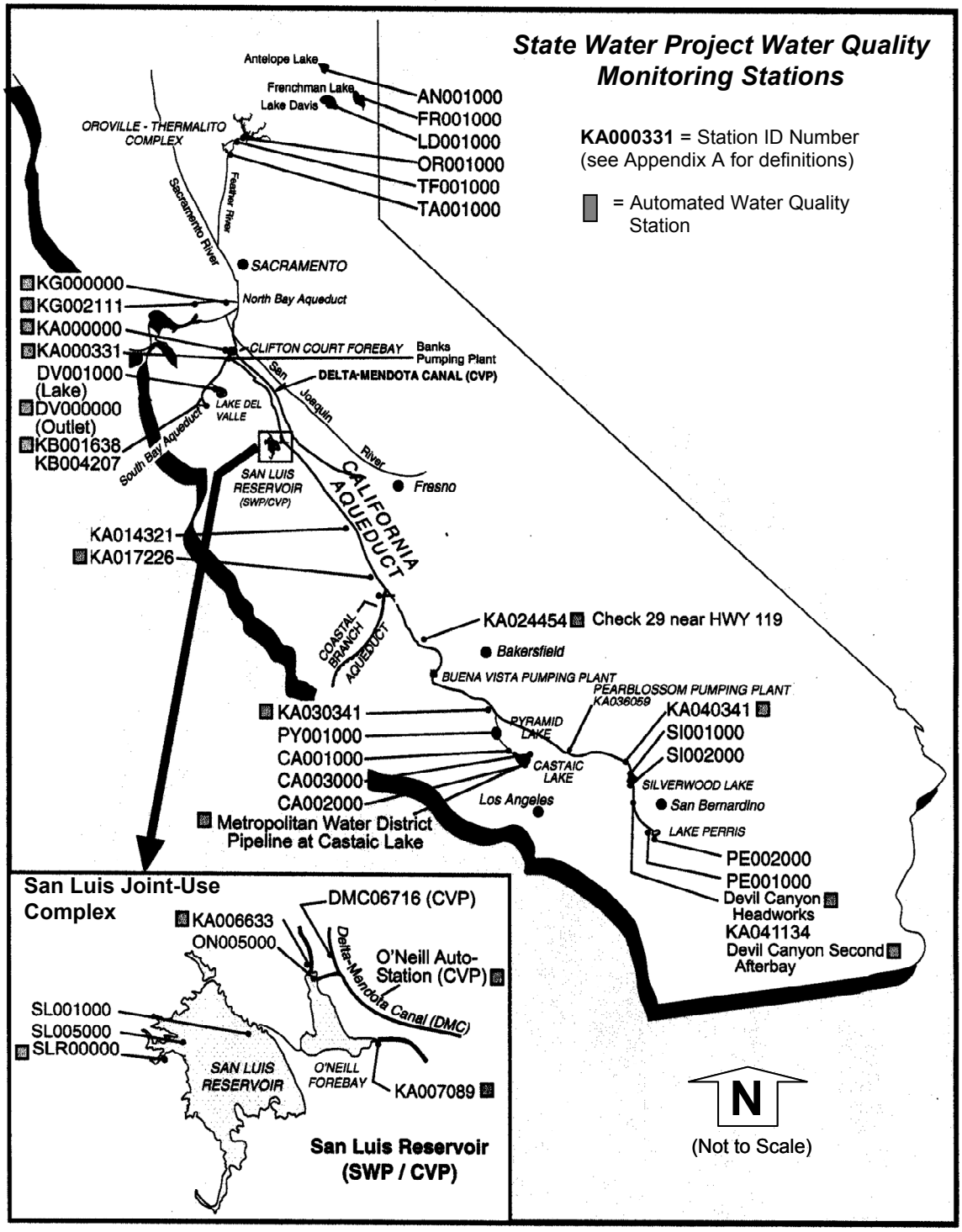

Figure 2-1. Water quality monitoring stations in the State Water Project. Station identification numbers (e.g., KA000331) are defined in Table 2-1 and Appendix A.

Table 2-1. Water quality monitoring stations in the State Water Project (includes one federal Central Valley Project station on the Delta-Mendota Canal)

Facility	Field Division	Branch/Division	Station Name	Station Code	Water Quality Station Routine Grab Samples	Water Quality Station Automated	Water Project [1/]
California Aqueduct	Delta	North San Joaquin Division	Clifton Court Forebay Gates	KA000000	X	X	SWP
			Harvey O. Banks (Banks) Pumping Plant	KA000331	X	X	|
	San Luis	San Luis Division	O'Neill Forebay Inlet (Check 12)	KA006633			SWP/CVP
			O'Neill Forebay Outlet (Check 13)	KA007089	X	X	|
			Check 18	KA014321			|
			Check 21	KA017226	X	X	|
	San Joaquin	South San Joaquin Division	Check 29	KA024454	X	X	SWP
	Southern	Tehachapi Division	Check 41 (Tehachapi Afterbay)	KA030341	X	X [2/]	|
		East Branch, Mojave Division	Check 66	KA040341	X	X	|
		East Branch, Santa Ana Division	Devil Canyon Headworks	KA041134	X	X [3/]	|
San Luis Joint-Use Complex [5/]	San Luis	San Luis Division	San Luis Reservoir, Trashracks	SL001000	X		SWP/CVP
			San Luis Reservoir, Tunnel Island	SL005000			|
			San Luis Reservoir, Pacheco Pumping Plant	SLR00000	X	X	|
			Delta-Mendota Canal	DMC06716	X	X	CVP
Southern Reservoirs		East Branch, Mojave Division	Silverwood Lake	SI001000			SWP
				SI002000	X		|
		East Branch, Santa Ana Division	Lake Perris	PE001000			|
				PE002000	X		|
				PE003000			|
		West Branch	Pyramid Lake	PY001000	X		|
				PY002000			|
				PY003000			|
			Castaic Lake	CA001000			|
				CA002000	X	X [4/]	|
				CA003000			|
South Bay Aqueduct	Delta	NA	Del Valle Check 7	KB001638	X	X	|
			Del Valle Reservoir	DV001000	X		|
			Del Valle Reservoir, Conservation Outlet Works (COW)	DV000000	X [6/]		|
			Vallecitos	KB002240		X	|
			Santa Clara Terminal Tank	KB004207			|
North Bay Aqueduct	Delta	NA	Barker Sl. Pumping Plant	KG000000	X	X	|
			Cordelia Forebay	KG002111		X	|
Oroville-Thermalito Complex and Upper Feather River Reservoirs	Oroville	Oroville Division	Lake Oroville	OR001000	X		|
			Thermalito Forebay	TF001000			|
			Thermalito Afterbay	TA001000	X		|
		Upper Feather River Division	Antelope Lake	AN001000	X		|
			Frenchman Lake	FR001000	X		|
			Lake Davis	LD001000	X		|

1/ State Water Project (SWP), federal Central Valley Project (CVP)
2/ Automated Stations at Tehachepi Forebay and Afterbay
3/ Automated Station also at Devil Canyon Second Afterbay
4/ Automated Station at Metropolitan Water District Pipeline at Castaic Dam
5/ Includes Checks 12 to 21on the California Aqueduct
6/ During Periods of Outflow

3. California Aqueduct

Water in the south Delta is pumped into the California Aqueduct at Harvey O. Banks Delta Pumping Plant. Pumping at Banks Pumping Plant totaled 3.2 million acre-feet (maf) in 2004, a below normal water year in the Sacramento Valley, and 4.0 maf in 2005, an above normal water year. Monthly pumping was generally lowest around May of each year (Figure 3-1).

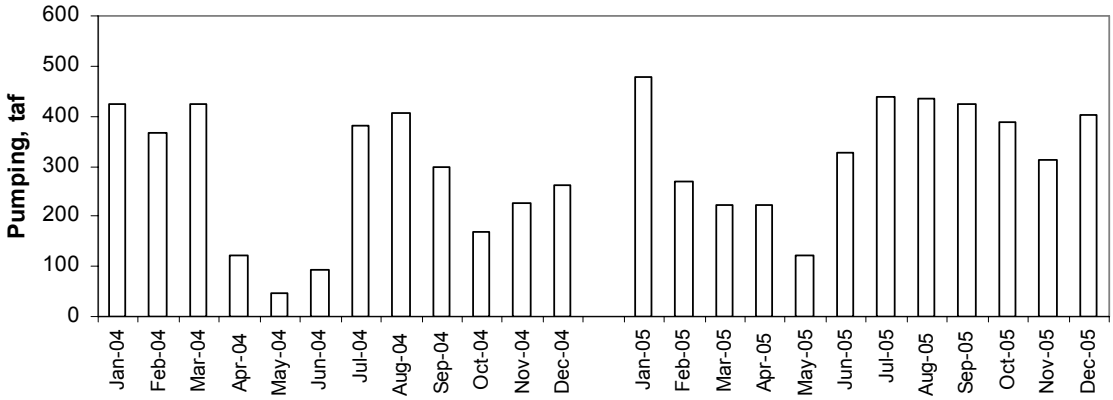

Figure 3-1. Monthly pumping at Banks Pumping Plant (thousand acre-feet)

Major minerals and conventional parameters in the California Aqueduct during 2004 and 2005 are summarized in Table 3-1. Maximum contaminant levels for salinity, sulfate, chloride, and nitrate in drinking water were not exceeded (see Appendix B for MCLs).

Monthly conductivity in the California Aqueduct ranged from 194 to 620 µS/cm and was generally lowest at Banks Pumping Plant. Median conductivity at Banks was 350 µS/cm, while at the other aqueduct stations, it ranged from 409 to 454 µS/cm (Figure 3-2). Dissolved minerals and related analyses exhibited the same general trend. Salinity in the aqueduct was highest at stations downstream from Banks due to releases from San Luis Reservoir and inputs from the Central Valley Project's (CVP's) Delta-Mendota Canal (DMC). Water from both sources enters O'Neill Forebay and is sent down the aqueduct at milepost 70.89 (O'Neill Forebay outlet). Salinity in San Luis Reservoir fluctuates within a narrow range and is oftentimes higher than at Banks largely due to:

- Reservoir filling during fall when seawater intrusion is usually prevalent
- Reservoir filling with water from the DMC, which exhibits a statistically greater salt content than exports at Banks (DWR 2004)
- Seasonal salinity declines at Banks from freshwater inflows to the Delta

Conductivity at O'Neill Forebay outlet was 1% to 78% higher (median = 19%) than at Banks in all but three monthly samples collected during the two-year period due to these combined factors.

Table 3-1. Summary of major minerals and conventional parameters in the California Aqueduct, 2004 and 2005

Station Name	Station Number	Major Minerals	Units	Median	Low	High	Sample Size	Conventional Parameters	Units	Median	Low	High	Sample Size
Clifton Court Forebay gates	KA000000	Alkalinity	mg/L as CaCO3	69	41	87	24	Conductivity	µS/cm	359	194	566	24
Banks Pumping Plant	KA000331			70	41	84	25			350	196	567	25
O'Neill Forebay Outlet	KA007089			73	44	85	23			409	221	615	23
Check 21	KA017226			77	43	89	27			433	218	620	27
Check 29	KA024454			76	55	89	26			454	291	609	26
Check 41	KA030341			75	42	93	24			424	203	592	24
Devil Canyon Headworks	KA041134			75	60	84	25			432	307	597	25
Clifton Court Forebay gates	KA000000	Calcium	mg/L	16	11	30	24	Hardness	mg/L as CaCO3	85	48	141	24
Banks Pumping Plant	KA000331			17	11	30	25			85	48	141	25
O'Neill Forebay Outlet	KA007089			20	12	31	23			99	55	143	23
Check 21	KA017226			19	12	30	27			102	55	141	27
Check 29	KA024454			21	15	30	26			99	66	141	26
Check 41	KA030341			21	11	30	24			99	48	141	24
Devil Canyon Headworks	KA041134			21	16	27	25			100	73	125	25
Clifton Court Forebay gates	KA000000	Chloride	mg/L	48	20	118	24	pH	pH units	6.6	6.4	8.2	24
Banks Pumping Plant	KA000331			49	16	120	25			6.7	6.3	8.2	25
O'Neill Forebay Outlet	KA007089			61	24	120	23			7.0	6.4	8.3	23
Check 21	KA017226			66	24	124	27			6.9	6.4	8.3	27
Check 29	KA024454			64	36	110	26			7.1	6.4	8.3	26
Check 41	KA030341			62	22	113	24			7.0	6.3	8.3	24
Devil Canyon Headworks	KA041134			60	36	105	25			7.0	6.2	8.3	25
Clifton Court Forebay gates	KA000000	Magnesium	mg/L	11	5	16	24	TDS	mg/L	202	115	319	25
Banks Pumping Plant	KA000331			10	5	16	25			204	108	322	25
O'Neill Forebay Outlet	KA007089			12	6	16	23			242	124	348	24
Check 21	KA017226			12	6	17	27			251	124	368	27
Check 29	KA024454			12	7	16	26			253	161	355	26
Check 41	KA030341			12	5	16	24			245	118	326	24
Devil Canyon Headworks	KA041134			12	8	15	25			240	173	348	24
Clifton Court Forebay gates	KA000000	Nitrate	mg/L as N03	2.1	0.6	7	24	TSS	mg/L	10	2	34	25
Banks Pumping Plant	KA000331			2.0	0.5	6.9	25			9	<1	28	24
O'Neill Forebay Outlet	KA007089			3.0	0.6	6.8	23			4	<1	11	23
Check 21	KA017226			2.7	0.8	7.1	27			4	<1	15	24
Check 29	KA024454			2.8	1.1	7.7	26			8	2	24	25
Check 41	KA030341			2.9	1.5	6.7	24			8	1	45	24
Devil Canyon Headworks	KA041134			3.1	1.5	6.3	25			<1	<1	10	9
Clifton Court Forebay gates	KA000000	Sodium	mg/L	36	18	71	24	Turbidity	NTU	10	3	20	25
Banks Pumping Plant	KA000331			37	16	72	25			11	5	70	25
O'Neill Forebay Outlet	KA007089			44	21	76	23			5	2	23	23
Check 21	KA017226			46	21	80	27			6	2	18	28
Check 29	KA024454			46	28	73	26			6	3	24	25
Check 41	KA030341			44	19	73	24			7	2	36	24
Devil Canyon Headworks	KA041134			45	29	69	25			2	<1	167	25
Clifton Court Forebay gates	KA000000	Sulfate	mg/L	25	14	67	24	VSS	mg/L	2	<1	6	25
Banks Pumping Plant	KA000331			26	15	77	25			2	<1	9	24
O'Neill Forebay Outlet	KA007089			39	18	77	23			2	<1	4	23
Check 21	KA017226			38	20	72	27			2	<1	4	25
Check 29	KA024454			38	20	72	26			2	<1	5	24
Check 41	KA030341			38	19	66	24			2	<1	7	24
Devil Canyon Headworks	KA041134			37	24	58	25			<1	<1	2	9

Turbidity in the aqueduct ranged between <1 and 36 NTU with one exception: turbidity was 167 NTU at Devil Canyon headworks in October 2004 (Figure 3-3). The sample was collected on October 20, the same day that natural inflows to Silverwood Lake peaked at 2,481 af. Devil Canyon headworks is located on the San Bernardino Tunnel, which is a pipeline that conveys water from Silverwood Lake to Devil Canyon Afterbay. Natural inflows to Silverwood Lake are often near zero during the month of October, but a local storm generated watershed runoff from Miller, Cleghorn, and Sawpit creeks that increased from 1 af on October 18, 2004, to 2,481 af on October 20; this is when the elevated turbidity was measured at Devil Canyon headworks. This indicates a first flush event, which is when the first major storm event of the rainy season flushes the watershed of deposits built up during the summer months and transports more erosional material downstream than similar storm events do later in the rainy season.

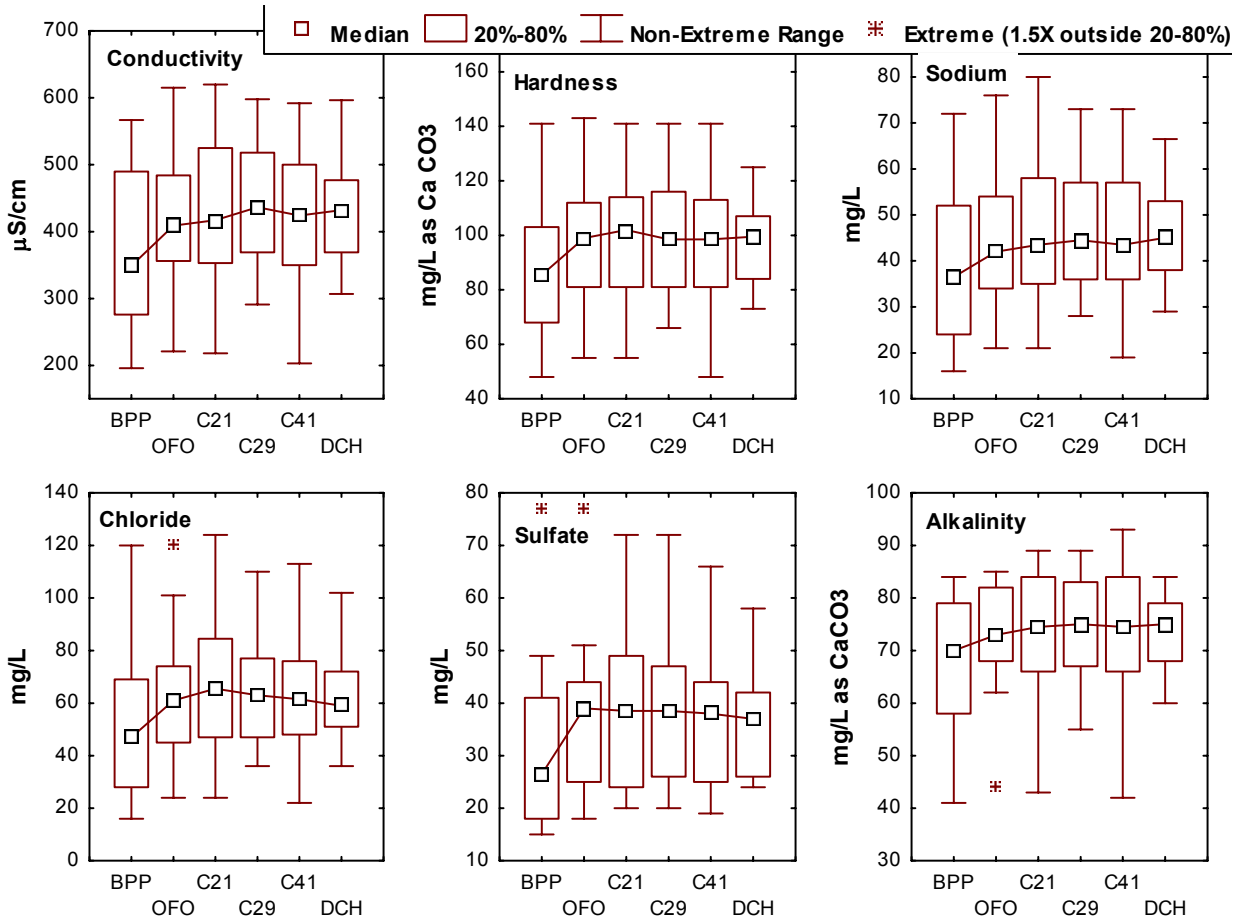

Figure 3-2. Salinity and other related parameters in the California Aqueduct at Banks Pumping Plant (BPP), O'Neill Forebay outlet (OFO), Checks 21 to 41 (C21, C29, and C41), and Devil Canyon headworks (DCH), 2004 and 2005

Natural inflows to Silverwood Lake increased again in early 2005, resulting in a decrease in salinity and related dissolved parameters at Devil Canyon headworks. Inflows increased to 8,701 af on January 9, 2005, corresponding with a decline in conductivity that reached a minimum of 152 µS/cm on January 11 (Figure 3-4). Conductivity upstream at Check 41 ranged between 500 and 620 µS/cm over the same period (Figure 3-4). Natural inflows to Silverwood Lake totaled 32,977 af in January 2005 and reduced downstream conductivity at Devil Canyon headworks by as much as 75%.

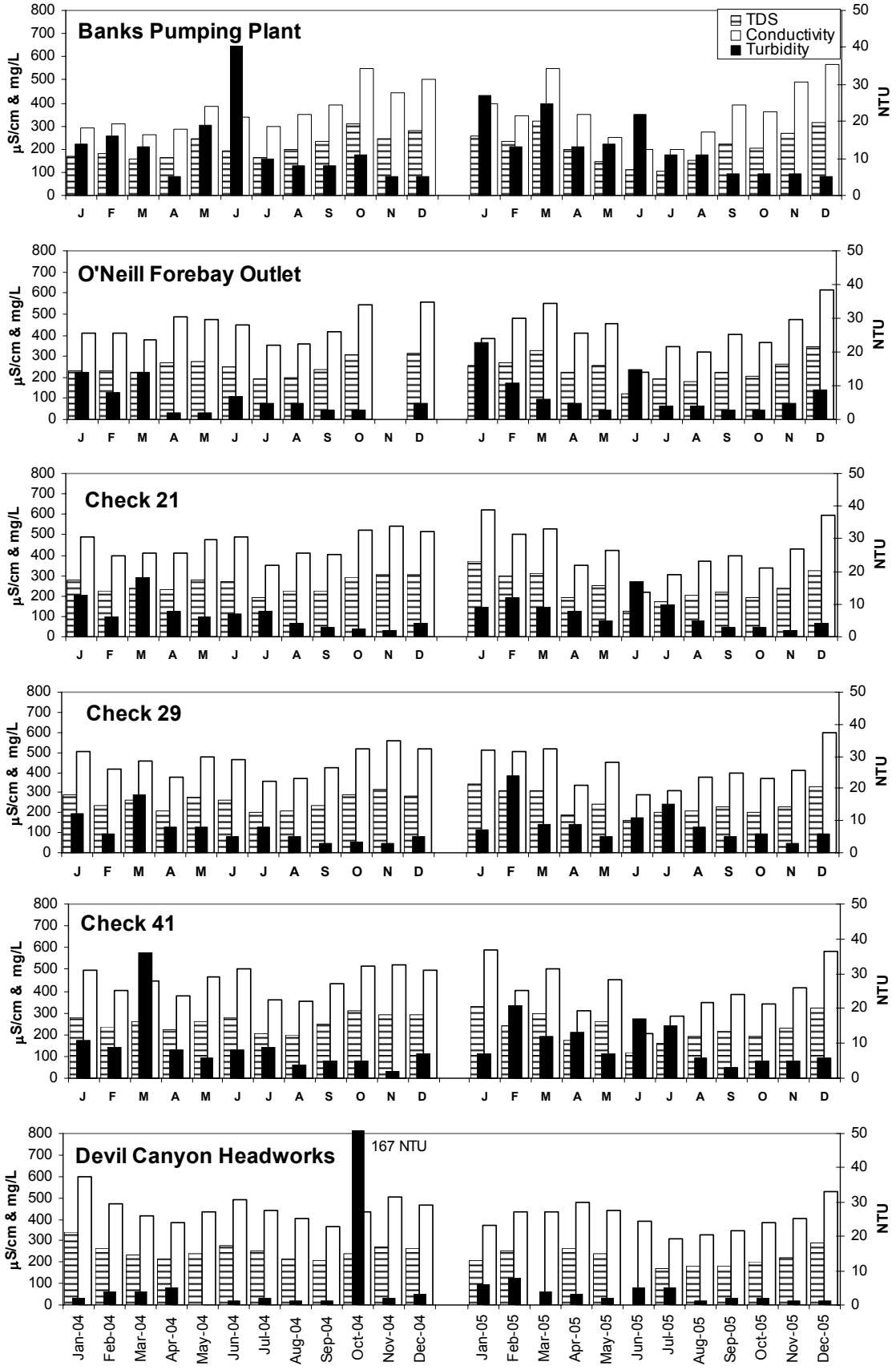

Figure 3-3. Monthly salinity and turbidity in the California Aqueduct. Turbidity values of <1 NTU were reported as zero.

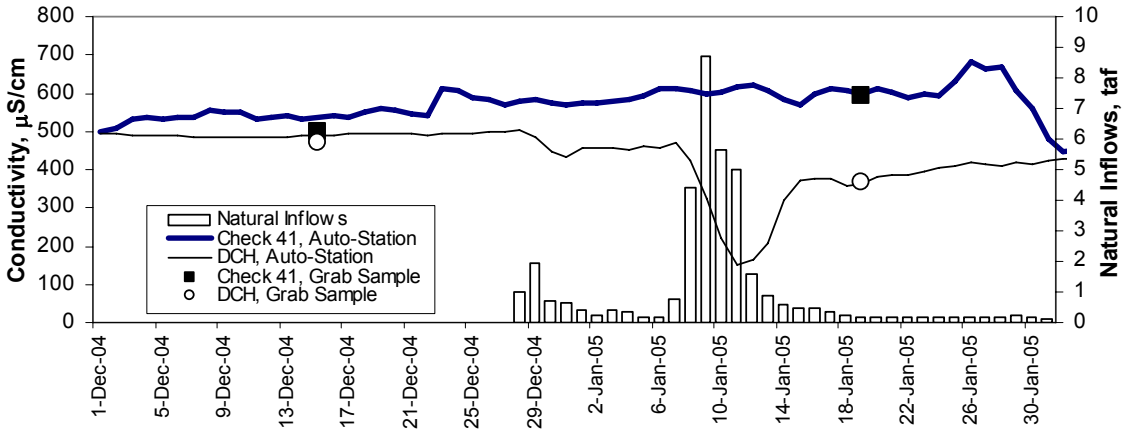

Figure 3-4. Natural inflows to Silverwood Lake (in thousand acre-feet) and conductivity at Check 41 and Devil Canyon headworks (DCH). A decline in conductivity was observed between Check 41 and DCH due to these inflows.

Figure 3-5 shows chloride at Banks Pumping Plant increased relative to sulfate towards the end of each year, which is an indication of seawater intrusion. Seawater intrusion from the Francisco Bay (or influence from waters with seawater-like characteristics) is evident when the chloride:sulfate ratio exceeds about 1.5. Pure seawater exhibits a chloride:sulfate ratio of seven and can dramatically alter the mineralogical balance of freshwater even in very small amounts. Seawater intrusion was evident at Banks during 12 months of the two-year period (Figure 3-6).

Annual average conductivity at Banks Pumping Plant was 367 µS/cm for 2004 and 364 µS/cm for 2005. Both averages were below the long-term historical median extending back to 1968, the first full year of California Aqueduct operations (Figure 3-7). The annual average for 2004 is relatively good considering that unimpaired runoff that year was classified as below normal in the Sacramento Valley and dry in the San Joaquin Valley.

Bromide, dissolved organic carbon (DOC), total organic carbon (TOC), and ultraviolet absorbance at 254 nanometers (UVA_{254}) in the aqueduct are summarized in Table 3-2. Bromide at all stations ranged from 0.05 to 0.43 mg/L and was least variable at Devil Canyon headworks (Figures 3-8 and 3-9). Similar to other salt-related parameters, bromide concentrations were lowest at Banks Pumping Plant. As discussed, salinity often increases at stations downstream of Banks starting at O'Neill Forebay outlet due, in part, to releases from San Luis Reservoir and inputs from the DMC. Bromide was 5% to 186% higher at O'Neill Forebay outlet than at Banks during 17 of the 23 months sampled during the two-year period (median = 38%). During the other six months, these differences ranged from 0% to -17%.

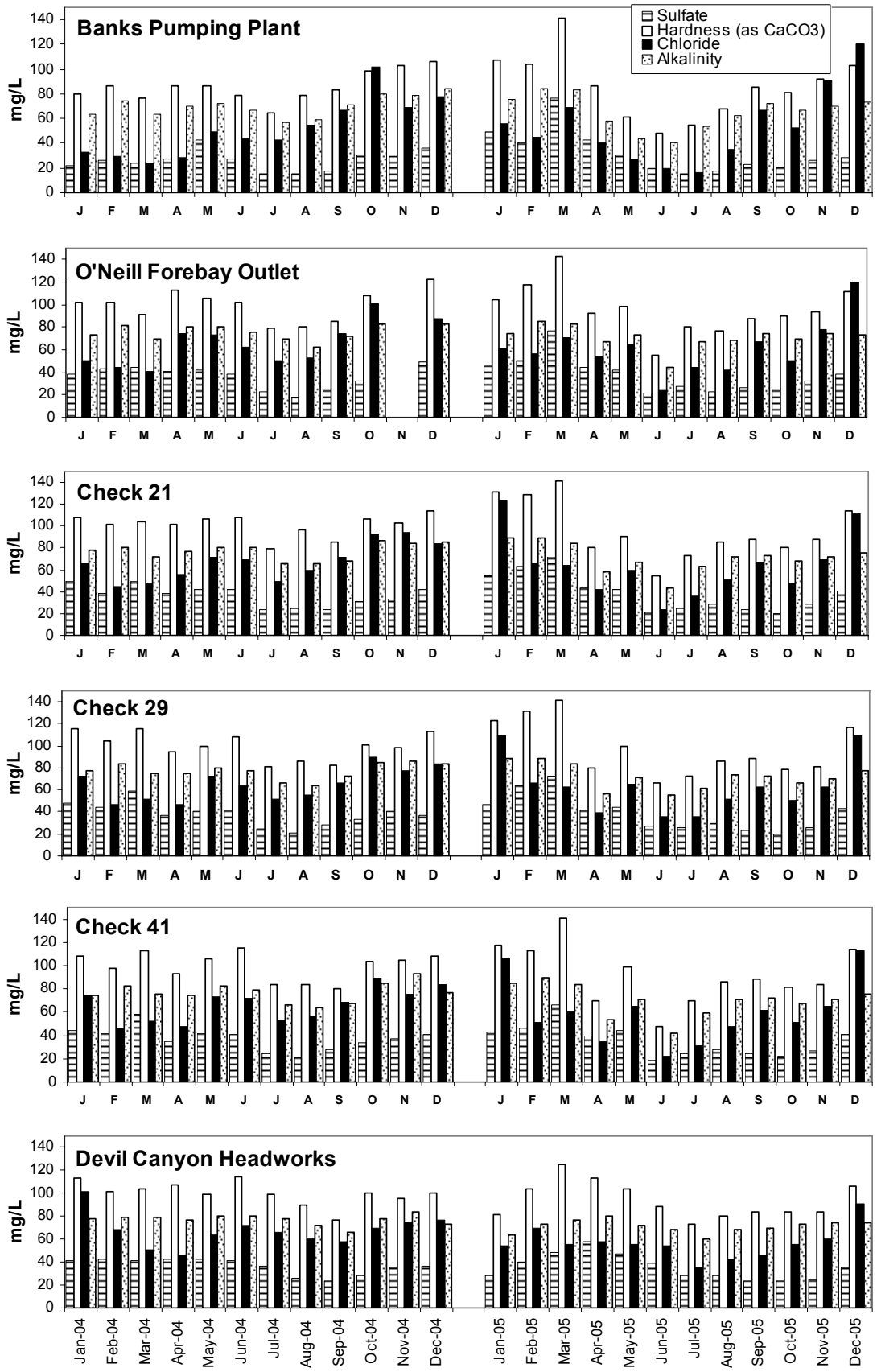

Figure 3-5. Monthly sulfate, chloride, hardness, and alkalinity in the California Aqueduct

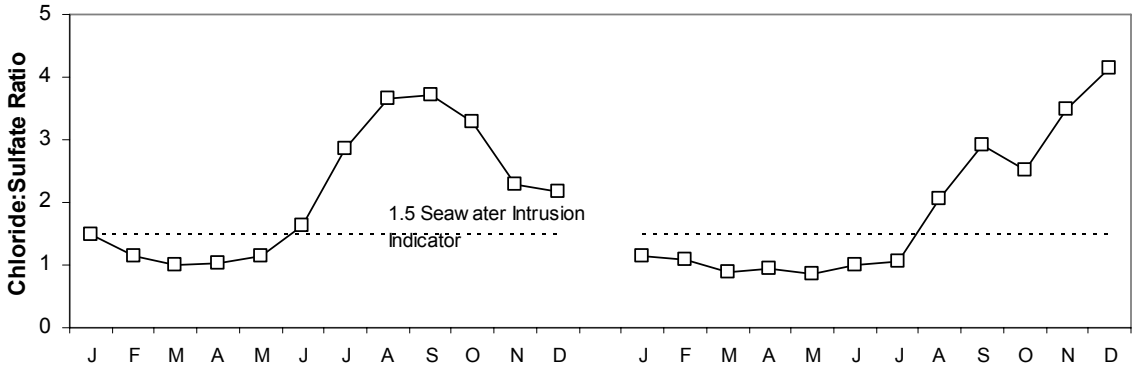

Figure 3-6. Chloride:sulfate ratios at Banks Pumping Plant, 2004 and 2005. The 1.5 seawater intrusion indicator represents the upper 99% confidence interval for this ratio in the San Joaquin River, a major source of high salt in south Delta exports besides seawater intrusion.

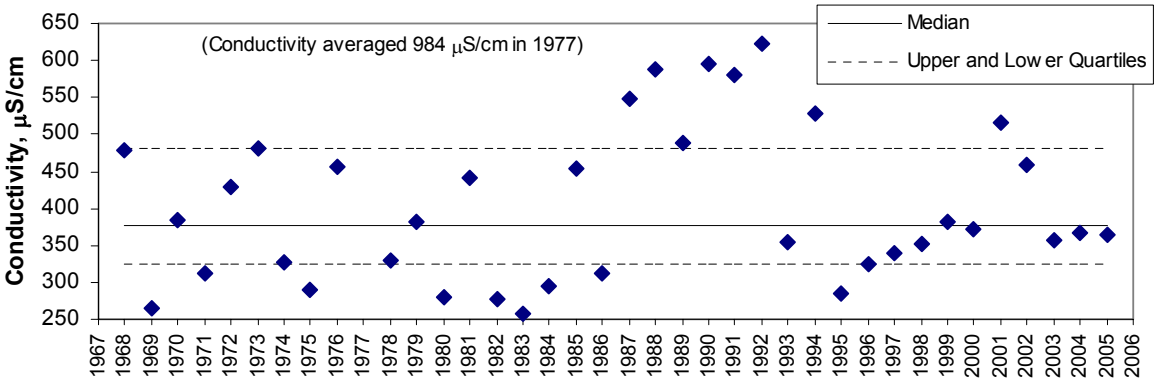

Figure 3-7. Annual average conductivity at Banks Pumping Plant, 1968 to 2005

Median DOC and TOC at all aqueduct stations ranged narrowly between 2.8 and 3.2 mg/L (Table 3-2 and Figure 3-8). Organic carbon was highest during winter of both years at most stations (Figure 3-9). The peak DOC concentration of 8.2 mg/L measured at Banks Pumping Plant in January 2005 originated from a first flush event in the San Joaquin River (DWR in prep.). The elevated TOC relative to DOC at Devil Canyon headworks in October 2004 was related to a spike in turbidity (and associated particulate organic matter) as a result of rainfall runoff from the watershed surrounding Silverwood Lake (see previous discussion on turbidity). Concentration differences between DOC and TOC in the California Aqueduct are most likely to be widest when the associated turbidity is greater than about 15 NTU (DWR 2005).

Unlike dissolved salts, DOC concentration differences between Banks and O'Neill Forebay outlet were not that great (Figure 3-8). Although DOC at O'Neill Forebay outlet was higher than at Banks during a majority of months (16 of 23), the percentage increases were relatively subdued (3% to 26%) compared to those for conductivity and bromide. One major underlying factor for these lower percentages is that organic carbon between Banks and the DMC is not statistically different like that of salinity.

Table 3-2. Disinfection byproduct precursors and ultraviolet absorbance at 254 nanometers (UVA_{254}) in the California Aqueduct, 2004 and 2005

Station Name	Station Number		Units	Median	Low	High	Sample Size
Clifton Court Forebay	KA000000	Bromide	mg/L	0.17	0.05	0.37	16
Banks Pumping Plant	KA000331			0.13	0.05	0.38	25
O'Neill Forebay Outlet	KA007089			0.17	0.07	0.37	23
Check 21	KA017226			0.18	0.07	0.43	27
Check 29	KA024454			0.18	0.10	0.35	26
Check 41	KA030341			0.17	0.07	0.35	24
Devil Canyon Headworks	KA041134			0.18	0.10	0.32	25
Clifton Court Forebay	KA000000	DOC	mg/L as C	3.0	2.2	7.8	24
Banks Pumping Plant	KA000331			2.9	2.2	8.2	54
O'Neill Forebay Outlet	KA007089			3.0	2.4	7.9	49
Check 21	KA017226			3.4	2.4	7.1	27
Check 29	KA024454			3.0	2.3	7.1	26
Check 41	KA030341			3.3	0.5	7.0	25
Devil Canyon Headworks	KA041134			3.3	2.5	5.5	25
Clifton Court Forebay	KA000000	TOC	mg/L as C	3.2	2.1	8.0	24
Banks Pumping Plant	KA000331			3.1	2.2	8.4	53
O'Neill Forebay Outlet	KA007089			3.2	2.3	8.0	49
Check 21	KA017226			3.4	2.3	6.9	27
Check 29	KA024454			3.2	2.3	7.5	25
Check 41	KA030341			3.4	1.7	7.4	25
Devil Canyon Headworks	KA041134			3.4	2.2	8.6	25
Clifton Court Forebay	KA000000	UVA_{254}	Absorbance/cm	NA			
Banks Pumping Plant	KA000331			0.103	0.065	0.287	24
O'Neill Forebay Outlet	KA007089			0.106	0.064	0.277	23
Check 21	KA017226			NA			
Check 29	KA024454			NA			
Check 41	KA030341			0.098	0.06	0.239	25
Devil Canyon Headworks	KA041134			0.100	0.068	0.193	25

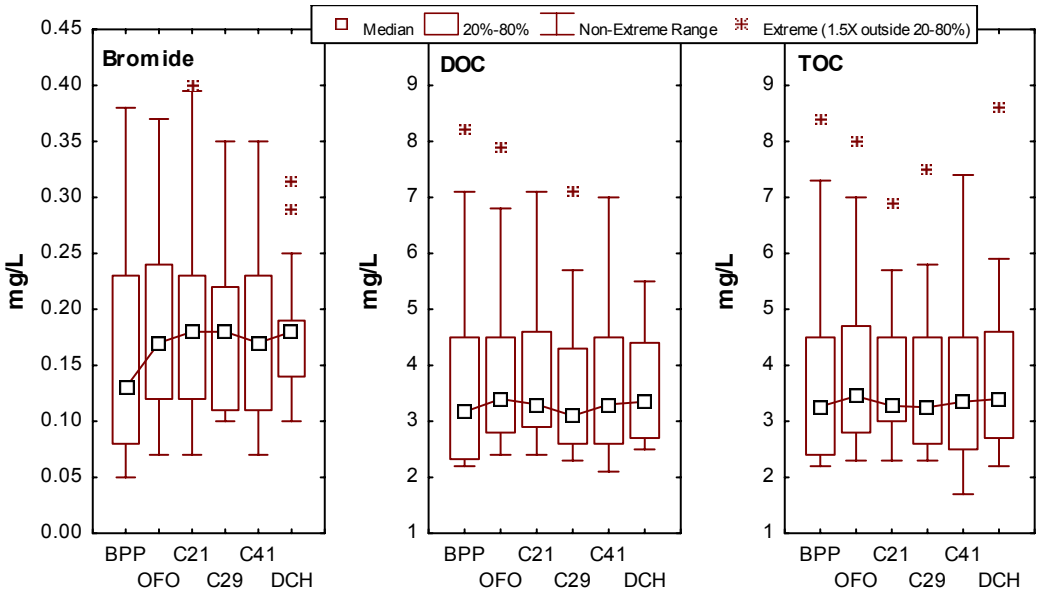

Figure 3-8. Bromide and dissolved and total organic carbon in the California Aqueduct at Banks Pumping Plant (BPP), O'Neill Forebay outlet (OFO), Checks 21 to 41 (C21, C29, and C41), and Devil Canyon headworks (DCH), 2004 and 2005

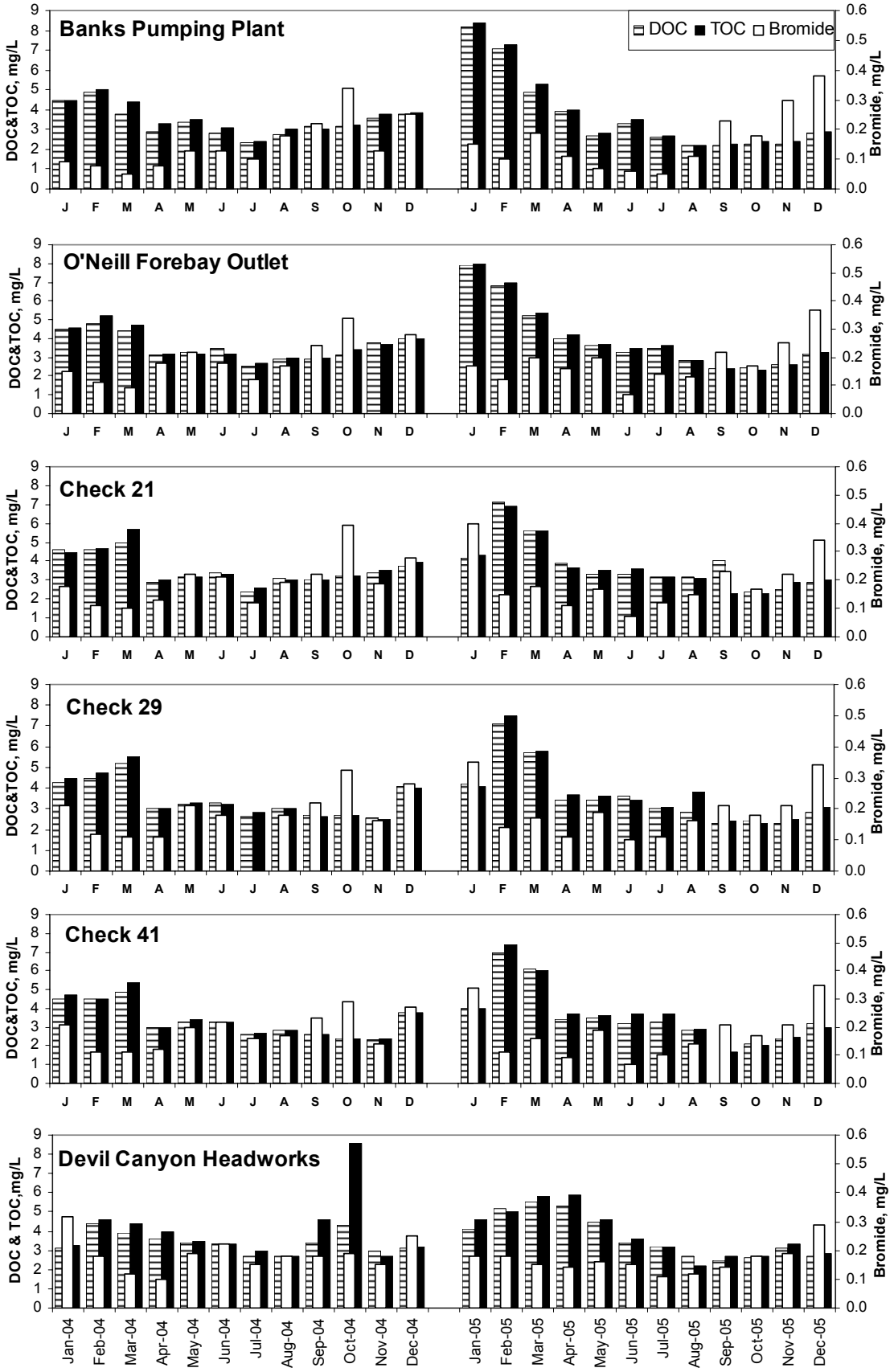

Figure 3-9. Monthly bromide and dissolved and total organic carbon in the California Aqueduct

More than 100,000 af of non-Project groundwater was conveyed into the California Aqueduct (termed groundwater "turn-ins") south of O'Neill Forebay during June to December, 2004. Around 75% of the total volume came from Kern Water Bank Authority (KWBA) and Semitropic Water Storage District (SWSD), with the remainder originating from Arvin-Edison Water Storage District (AEWSD). Although each source exhibited unique water quality characteristics, all were low in organic carbon, with concentrations ranging around 1 mg/L.

Organic carbon in the aqueduct was consistently lower downstream of KWBA and SWSD with decreases of up to 1 mg/L between Check 21 (upstream station) and Check 29 (downstream station). However, arsenic, nitrate, and sulfate were consistently higher downstream of the turn-ins. Conductivity was neither consistently higher nor lower at either station. Changes in aqueduct water quality due to AEWSD between checks 29 and 41 were less substantial or not discernable due to low inflow volumes relative to aqueduct flow. A more detailed analysis is presented in the Special Studies section.

Non-Project floodwaters also entered the aqueduct between O'Neill Forebay outlet and Check 21 (the San Luis Canal). These inflows originate as rainfall runoff from agricultural or undeveloped lands west of the San Luis Canal. Inflow volumes totaled 151 af, 1,161 af, and 159 af during December 2004, January 2005, and February 2005, respectively. Although floodwater inflows can affect water quality in the aqueduct (for example, increased salinity and turbidity), the floodwater volumes were relatively small compared to aqueduct flows. Floodwater inflows made up 1% or less of aqueduct flows during the three-month period.

Minor elements and nutrients in the aqueduct are summarized in Tables 3-3 and 3-4. All analyses were below MCLs for drinking water, with the exception of aluminum. Aluminum was detected above the federal secondary MCL range of 0.05 to 0.2 mg/L in one sample from O'Neill Forebay outlet (0.115 mg/L). The MCL for aluminum was established to address drinking water aesthetics, not public health (DHS 2005). Noticeable effects of aluminum above the secondary MCL can be an objectionable coloration (USEPA 1992).

Table 3-3. Summary of minor elements in the California Aqueduct, 2004 and 2005 (mg/L)

Station Name	Station Number	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size
Banks Pumping Plant	KA000331	Aluminum		< 0.01	< 0.01	24	Chromium +3	0.002	< 0.001	0.003	25	Nickel	0.001	< 0.001	0.002	25
O'Neill Forebay Outlet	KA007089		1/	< 0.01	0.115	2		0.002	0.001	0.004	23		0.001	0.001	0.003	23
Check 21	KA017226		NA					0.002	< 0.001	0.004	27		0.001	0.001	0.003	24
Check 29	KA024454			< 0.01	< 0.01	26		0.002	< 0.001	0.004	26		0.001	0.001	0.003	26
Check 41	KA030341		1/	< 0.01	0.017	24		0.002	0.001	0.004	24		0.001	0.001	0.002	24
Devil Canyon Headworks	KA041134		2/	< 0.01	0.038	25		0.002	0.001	0.004	25		0.001	0.001	0.002	25
Banks Pumping Plant	KA000331	Antimony		< 0.001	< 0.001	25	Copper	0.002	< 0.001	0.005	25	Selenium	0.001	< 0.001	0.002	25
O'Neill Forebay Outlet	KA007089			< 0.001	< 0.001	23		0.002	0.001	0.005	23		0.001	< 0.001	0.002	23
Check 21	KA017226			< 0.001	< 0.001	24		0.002	0.001	0.009	27		0.001	< 0.001	0.002	27
Check 29	KA024454			< 0.001	< 0.001	26		0.002	0.001	0.003	26		0.001	< 0.001	0.002	26
Check 41	KA030341		NA					0.002	0.001	0.003	24		0.001	< 0.001	0.002	22
Devil Canyon Headworks	KA041134		NA					0.002	0.002	0.008	25		0.001	< 0.001	0.002	22
Banks Pumping Plant	KA000331	Arsenic	0.002	0.001	0.003	25	Fluoride	< 0.1	< 0.1	0.1	25	Silver		< 0.001	< 0.001	24
O'Neill Forebay Outlet	KA007089		0.002	0.002	0.003	23		< 0.1	< 0.1	0.1	24		NA			
Check 21	KA017226		0.002	0.002	0.004	27		< 0.1	< 0.1	0.1	27		NA			
Check 29	KA024454		0.002	0.002	0.004	27		< 0.1	< 0.1	0.2	26			< 0.001	< 0.001	26
Check 41	KA030341		0.002	0.002	0.004	24		< 0.1	< 0.1	0.1	24			< 0.001	< 0.001	24
Devil Canyon Headworks	KA041134		0.002	0.001	0.004	25		< 0.1	< 0.1	0.1	24			< 0.001	< 0.001	25
Banks Pumping Plant	KA000331	Barium		< 0.05	< 0.05	24	Iron	0.009	< 0.001	0.075	25	Thallium	NA			
O'Neill Forebay Outlet	KA007089			< 0.05	< 0.05	2		0.01	< 0.001	0.114	23		NA			
Check 21	KA017226		NA					0.008	< 0.001	0.068	27			< 0.001	< 0.001	2
Check 29	KA024454			< 0.05	< 0.05	26		0.0055	< 0.001	0.043	26		NA			
Check 41	KA030341			< 0.05	< 0.05	24		0.0045	< 0.001	0.044	24		NA			
Devil Canyon Headworks	KA041134			< 0.05	< 0.05	25		0.005	< 0.001	0.028	25		NA			
Banks Pumping Plant	KA000331	Beryllium		< 0.001	< 0.001	25	Lead		< 0.001	< 0.001	25	Zinc		< 0.005	< 0.005	25
O'Neill Forebay Outlet	KA007089			< 0.001	< 0.001	23			< 0.001	< 0.001	23			< 0.005	< 0.005	23
Check 21	KA017226			< 0.001	< 0.001	24		1/	< 0.001	0.001	27		1/	< 0.005	0.01	27
Check 29	KA024454			< 0.001	< 0.001	26			< 0.001	< 0.001	26		1/	< 0.005	0.005	26
Check 41	KA030341			< 0.001	< 0.001	24			< 0.001	< 0.001	24		1/	< 0.005	0.005	24
Devil Canyon Headworks	KA041134			< 0.001	< 0.001	25			< 0.001	< 0.001	25		4/	< 0.005	0.023	25
Banks Pumping Plant	KA000331	Boron	0.1	0.1	1	25	Manganese	0.013	0.005	0.036	25					
O'Neill Forebay Outlet	KA007089		0.2	0.1	0.4	23		0.006	0.005	0.013	23					
Check 21	KA017226		0.2	0.1	0.3	27		< 0.005	< 0.005	0.008	27					
Check 29	KA024454		0.15	<0.1	0.3	26			< 0.005	< 0.005	26					
Check 41	KA030341		0.2	<'0.1	0.3	24			< 0.005	< 0.005	24					
Devil Canyon Headworks	KA041134		0.2	<'0.1	0.3	25		< 0.005	< 0.005	0.097	25					
Banks Pumping Plant	KA000331	Cadmium		< 0.001	< 0.001	24	Mercury		< 0.0002	< 0.0002	25					
O'Neill Forebay Outlet	KA007089			< 0.001	< 0.001	2			< 0.0002	< 0.0002	2					
Check 21	KA017226		NA					NA								
Check 29	KA024454			< 0.001	< 0.001	26			< 0.0002	< 0.0002	26					
Check 41	KA030341			< 0.001	< 0.001	24			< 0.0002	< 0.0002	25					
Devil Canyon Headworks	KA041134		1/	< 0.001	0.004	25		3/	< 0.0002	0.0007	25					

1/ One positive detection

2/ Six positive detections (0.012 to 0.038 mg/L)

3/ Two positive detections (0.0002 and 0.0007 mg/L)

4/ Five positive detections (0.005 to 0.023 mg/L)

Table 3-4. Summary of nutrients in the California Aqueduct, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Banks Pumping Plant	KA000331	Ammonia	mg/L as N	0.05	0.02	0.15	25
O'Neill Forebay Outlet	KA007089			0.02	0.01	0.12	18
Check 21	KA017226			0.01	0.01	0.08	24
Check 29	KA024454			0.01	0.01	0.04	19
Check 41	KA030341			0.01	0.01	0.05	24
Devil Canyon Headworks	KA041134			0.02	0.01	0.07	25
Banks Pumping Plant	KA000331	Nitrite+Nitrate	mg/L as N	0.50	0.16	1.5	25
O'Neill Forebay Outlet	KA007089			0.60	0.18	1.5	18
Check 21	KA017226			0.67	0.26	1.5	24
Check 29	KA024454			0.56	0.27	1.7	19
Check 41	KA030341			0.68	0.31	1.6	24
Devil Canyon Headworks	KA041134			0.72	0.28	1.4	25
Banks Pumping Plant	KA000331	Ortho-Phosphate	mg/L as P	0.06	0.03	0.16	22
O'Neill Forebay Outlet	KA007089			0.08	0.06	0.12	12
Check 21	KA017226			0.07	0.06	0.13	23
Check 29	KA024454				0.04	0.15	2
Check 41	KA030341			0.08	0.04	0.12	24
Devil Canyon Headworks	KA041134			0.05	0.04	0.11	23
Banks Pumping Plant	KA000331	Total Kjeldahl Nitrogen	mg/L as N	0.4	0.1	1.0	25
O'Neill Forebay Outlet	KA007089			0.3	0.2	1.0	18
Check 21	KA017226			0.3	0.2	0.7	24
Check 29	KA024454			0.3	0.2	1.4	19
Check 41	KA030341			0.3	0.1	0.9	24
Devil Canyon Headworks	KA041134			0.4	0.2	1.0	25
Banks Pumping Plant	KA000331	Total Phosphorus	mg/L	0.10	0.06	0.28	25
O'Neill Forebay Outlet	KA007089			0.10	0.07	0.21	18
Check 21	KA017226			0.10	0.06	0.19	24
Check 29	KA024454			0.09	0.06	0.22	19
Check 41	KA030341			0.10	0.04	0.22	24
Devil Canyon Headworks	KA041134			0.10	0.07	0.46	25

4. San Luis Joint-Use Complex

The San Luis Joint-Use complex includes O'Neill Forebay, San Luis Reservoir, and the San Luis Canal, which is a stretch of the California Aqueduct extending 101 miles from O'Neill Forebay outlet to Check 21 (see inset in Figure 2-1). The facilities are operated to deliver water to both State and federal water contractors. Water from O'Neill Forebay is pumped into San Luis Reservoir generally during fall and winter. Releases from San Luis Reservoir augment water supplies during spring and summer when downstream demand is highest. South Delta exports enter O'Neill Forebay from the California Aqueduct at Check 12 or from the Central Valley Project's (CVP's) Delta-Mendota Canal (DMC) at O'Neill Pumping-Generating Plant.

Inflow to O'Neill Forebay from the California Aqueduct at Check 12 totaled 3.042 million acre-feet (maf) in 2004 and 3.842 maf in 2005. Monthly flow at Check 12 was generally highest during winter and summer of both years (Figure 4-1).

Annual pumpage from the DMC into O'Neill Forebay at O'Neill Pumping-Generating Plant was 1.334 maf in 2004 and 1.475 maf in 2005. Pumpage from the DMC accounted for 28% and 31% of the total inflow to O'Neill Forebay from south Delta exports during 2004 and 2005, respectively. Releases from San Luis Reservoir during both years were generally greatest from April to August and lowest during the months of December to March (Figure 4-1).

Major minerals and conventional parameters in the DMC near O'Neill Forebay and San Luis Reservoir during 2004 and 2005 are summarized in Table 4-1. Maximum Contaminant Levels for sulfate, chloride, and nitrate in treated drinking water were not exceeded (MCLs are listed in Appendix B).

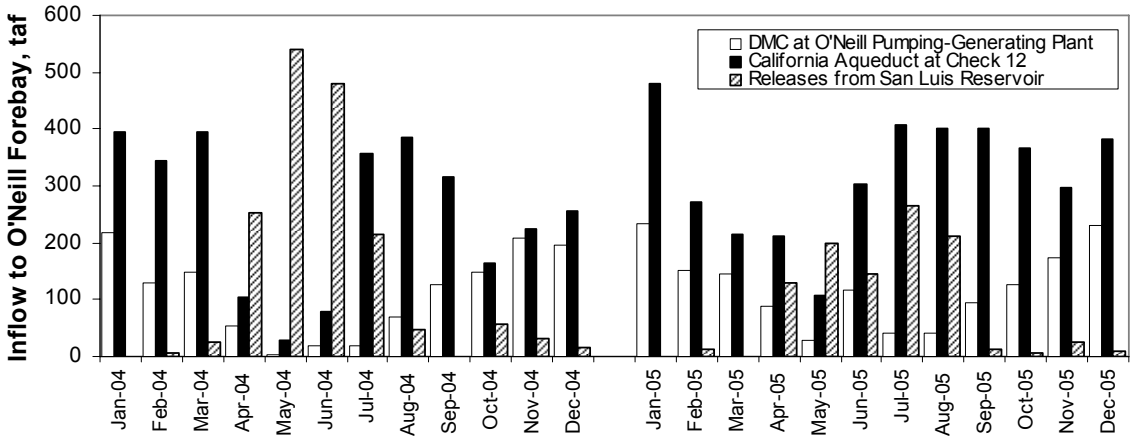

Figure 4-1. Monthly inflows to O'Neill Forebay from the California Aqueduct at Check 12 and the CVP Delta-Mendota Canal at O'Neill Pumping-Generating Plant. Also shown are releases from San Luis Reservoir at Gianelli Pumping-Generating Plant.

Table 4-1. Summary of major minerals and conventional parameters in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005

Station Name	Station Number	Major Minerals	Units	Median	Low	High	Sample Size	Conventional Parameters	Units	Median	Low	High	Sample Size
CVP Delta-Mendota Canal	DMC06716	Alkalinity	mg/L as CaCO3	75	39	140	24	Conductivity	uS/cm	450	182	1,150	24
San Luis Reservoir, Pacheco PP	SL000000			81	77	93	24			494	441	524	24
San Luis Reservoir, Dam Trashracks	SL001000			85	78	92	19			494	441	529	19
CVP Delta-Mendota Canal	DMC06716	Calcium	mg/L	20	11	50	24	Hardness	mg/L as CaCO3	102.5	44	236	24
San Luis Reservoir, Pacheco PP	SL000000			22	19	25	24			108	97	124	24
San Luis Reservoir, Dam Trashracks	SL001000			22	19	24	19			113	97	122	19
CVP Delta-Mendota Canal	DMC06716	Chloride	mg/L	63.5	17	165	24	pH	pH units	6.7	6.4	8.4	24
San Luis Reservoir, Pacheco PP	SL000000			77	70	89	24			6.9	6.3	8.9	24
San Luis Reservoir, Dam Trashracks	SL001000			78	68	87	19			7.4	6.4	9.1	19
CVP Delta-Mendota Canal	DMC06716	Magnesium	mg/L	12	4	27	24	TDS	mg/L	261	108	654	24
San Luis Reservoir, Pacheco PP	SL000000			13	12	15	24			280	265	301	26
San Luis Reservoir, Dam Trashracks	SL001000			13.5	12	15	19			282	259	292	23
CVP Delta-Mendota Canal	DMC06716	Nitrate	mg/L as N03	2.9	1.4	9.8	24	Turbidity	NTU	12	8	48	24
San Luis Reservoir, Pacheco PP	SL000000			3.3	0.5	4.7	24			2	1	5	25
San Luis Reservoir, Dam Trashracks	SL001000			2.7	0.2	4.6	19			2	<1	5	20
CVP Delta-Mendota Canal	DMC06716	Sodium	mg/L	48	16	131	24						
San Luis Reservoir, Pacheco PP	SL000000			52	49	59	24						
San Luis Reservoir, Dam Trashracks	SL001000			54	48	60	19						
CVP Delta-Mendota Canal	DMC06716	Sulfate	mg/L	40	17	166	24						
San Luis Reservoir, Pacheco PP	SL000000			41	35	43	24						
San Luis Reservoir, Dam Trashracks	SL001000			41	35	45	19						

The recommended secondary MCL for total dissolved solids (TDS) of 500 mg/L was exceeded in DMC samples collected during January, February, and March, 2004 (Figure 4-2). The recommended secondary MCL for conductivity of 900 µS/cm was exceeded in two of the same three monthly samples. Conductivity data from continuous automated monitoring stations reveals that the saline water originated from the San Joaquin River. Figure 4-3 shows hourly conductivity in the DMC near O'Neill Forebay, the San Joaquin River at Vernalis, and Middle River at Borden Highway. Conductivity in the DMC was oscillating hourly between levels in the San Joaquin and Middle Rivers. Water from these two sources fluctuates in and out of the south Delta export zone with tide. The San Joaquin and Middle Rivers are two major source waters immediately upstream from the C. W. "Bill" Jones (formerly Tracy) Pumping Plant. The San Joaquin River can flow directly to Jones Pumping Plant from the east via Grant Line Canal and/or south Old River. Water from Middle River can flow to Jones Pumping Plant from the north via Victoria Canal and (north) Old River (DWR 2004). Grab samples from the DMC during the winter months of 2004 (when the TDS MCLs were exceeded) were unintentionally collected at the specific time of day when higher-salinity water from the San Joaquin River was present.

Conductivity oscillations in the DMC are most prominent during December to March when the south Delta temporary barriers are not in place. The oscillations are readily apparent because conductivity between cross Delta flow (represented in Figure 4-3 by Middle River) and the San Joaquin River is usually distinct. Peak conductivity levels in the DMC are often higher than in the San Joaquin River at Vernalis due to the numerous saline point, non-point, and groundwater sources that are situated on the waterways between Vernalis and Jones Pumping Plant (DWR 2007b). Salt augmentation by these sources can be seen in Figure 4-3: hourly conductivity peaks in the DMC were as much as 300 µS/cm higher than levels in the San Joaquin River.

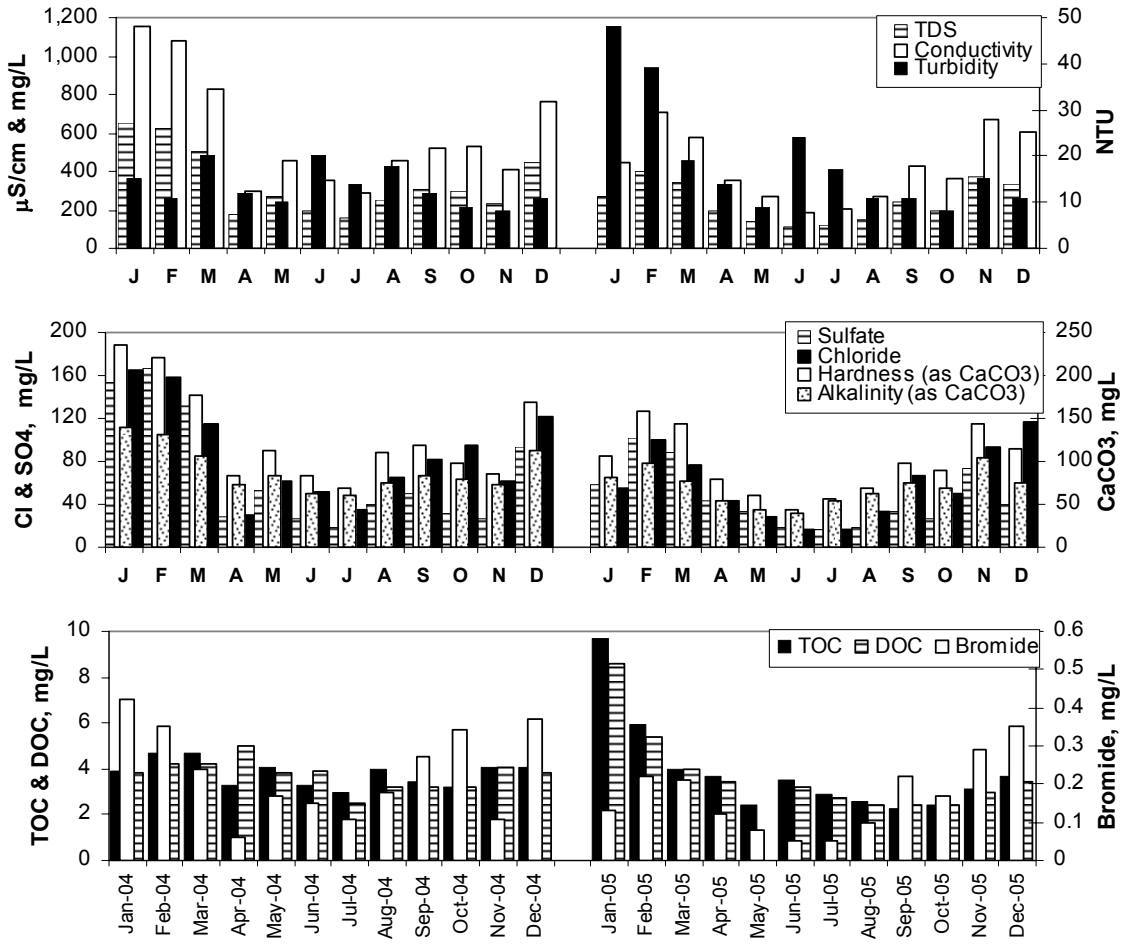

Figure 4-2. Monthly water quality in the CVP Delta-Mendota Canal near O'Neill Forebay

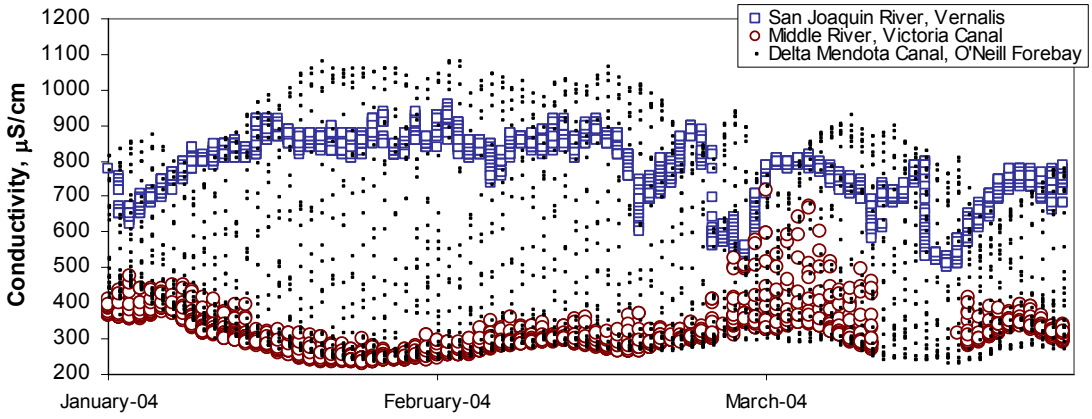

Figure 4-3. Hourly conductivity oscillations in the CVP Delta-Mendota Canal at O'Neill Forebay. Conductivity was oscillating between levels in the San Joaquin River at Vernalis and Middle River at Borden Highway.

Disinfection byproduct precursors in the DMC and San Luis Reservoir are summarized in Table 4-2. Bromide in the DMC ranged from 0.05 to 0.42 mg/L and was generally highest during certain fall and winter months (Figure 4-2). The maximum bromide concentration of 0.42 mg/L in the DMC was slightly higher than the maximum detected at Banks Pumping Plant (0.38 mg/L). The widest bromide (as well as conductivity) concentration

disparities between these two stations were in January, February, and March, 2004 (Figure 4-4). As discussed, the DMC samples collected during those months captured water from the San Joaquin River which was not the case for samples from Banks that captured water largely from cross Delta flow.

Table 4-2. Summary of bromide and total and dissolved organic carbon in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
CVP Delta-Mendota Canal	DMC06716	Bromide	mg/L	0.175	0.05	0.42	24
San Luis Reservoir, Pacheco PP	SL000000			0.22	0.14	0.29	24
San Luis Reservoir, Dam Trashracks	SL001000			0.23	0.13	0.27	19
CVP Delta-Mendota Canal	DMC06716	DOC	mg/L as C	3.6	2.4	8.6	24
San Luis Reservoir, Pacheco PP	SL000000			3.5	3.0	4.7	21
San Luis Reservoir, Dam Trashracks	SL001000			NA			
CVP Delta-Mendota Canal	DMC06716	TOC	mg/L as C	3.6	2.3	9.7	24
San Luis Reservoir, Pacheco PP	SL000000			3.7	3.2	4.5	21
San Luis Reservoir, Dam Trashracks	SL001000			NA			

Organic carbon (TOC and DOC) in the DMC ranged from 2.3 to 9.7 mg/L and was highest in January 2005 with a peak DOC of 8.6 mg/L, just above the maximum detected at Banks Pumping Plant (8.2 mg/L) the same month (Table 4-2 and Figures 4-2 and 4-4). Water collected at both stations that month originated from a first flush event in the San Joaquin River flowing directly to the export sites via south Old River and/or Grant Line Canal (DWR in prep.). The following month (February 2005), DOC dropped to 5.4 mg/L in the DMC but remained relatively high at Banks (7.1 mg/L) (Figure 4-4). Water in the February sample at Banks originated from cross Delta flow while water in the DMC sample the same month originated from the San Joaquin River. Elevated DOC levels in the San Joaquin River during January 2005 had declined by 3.2 mg/L when the February sample was collected from the DMC. Therefore, the San Joaquin River was the source of the high DOC in samples from both stations in January 2005, but was the source of the lower DOC concentration in the DMC sample collected the following month.

Hourly conductivity oscillations observed in the DMC during February 2005 were an indication that organic carbon was also oscillating hourly. For instance, based on the DOC concentration differences between Banks and the DMC, DOC in the DMC was oscillating hourly between 5 and 7 mg/L around the day the February 2005 sample was collected, reflecting hourly composition changes alternating between cross Delta flow and the San Joaquin River.

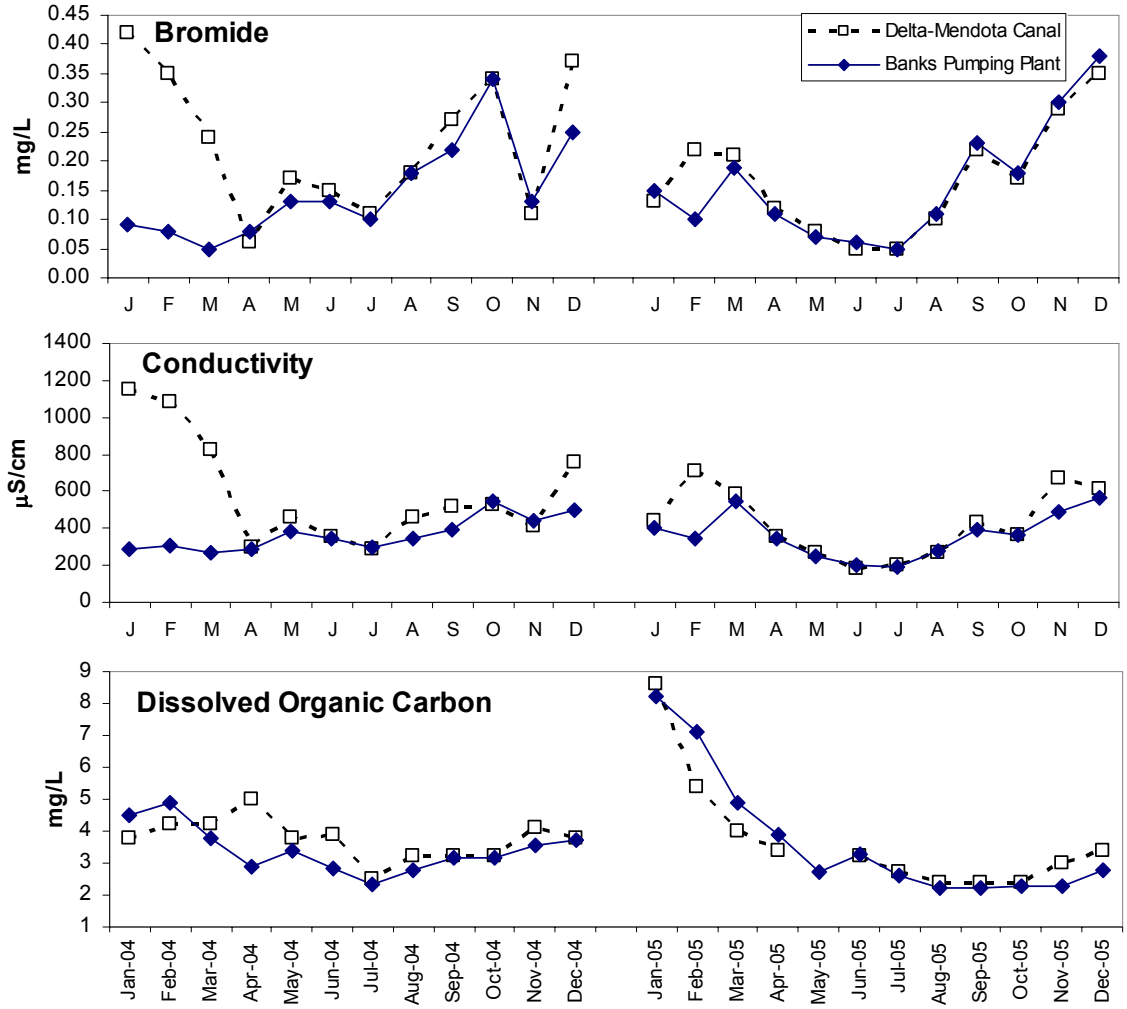

Figure 4-4. Comparison of bromide, conductivity, and dissolved organic carbon between Banks Pumping Plant on the California Aqueduct and the CVP Delta-Mendota Canal near O'Neill Forebay

Monthly salinity and related dissolved parameters in San Luis Reservoir fluctuated within a narrow range (Table 4-1 and Figure 4-5). Organic carbon in San Luis Reservoir ranged between 3 and 4.7 mg/L. An increase of 1.2 mg/L in reservoir DOC between December 2004 and February 2005 overlapped a period of reservoir filling and elevated organic carbon concentrations in south Delta exports (Figure 4-5).

Minor elements and nutrients in San Luis Reservoir and the DMC are summarized in Tables 4-3 and 4-4. Existing MCLs for these parameters in treated drinking water were not exceeded.

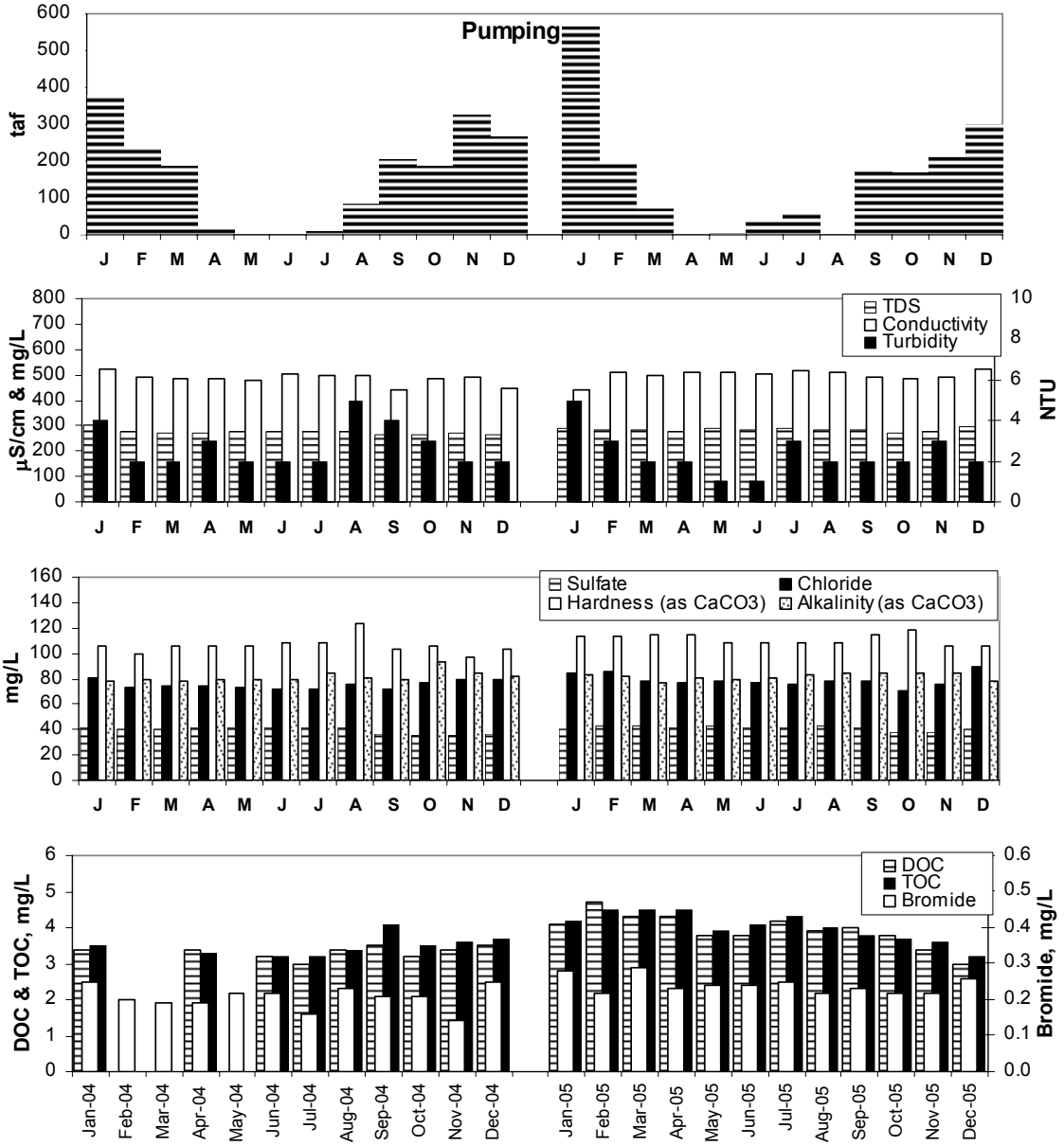

Figure 4-5. Monthly pumping into San Luis Reservoir (combined SWP and CVP) at Gianelli Pumping-Generating Plant and water quality in San Luis Reservoir at Pacheco Pumping Plant

Table 4-3. Summary of minor elements in the CVP Delta-Mendota Canal and San Luis Reservoir, 2004 and 2005 (mg/L)

Station Name	Station Number	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size
CVP Delta-Mendota Canal	DMC06716	Aluminum	NA				Cadmium	NA				Manganese	3/	< 0.005	0.012	24
San Luis Reservoir, Pacheco PP	SL000000		NA					NA					6/	< 0.005	0.1	24
San Luis Reservoir, Dam Trashracks	SL001000			<0.01	<0.01	19		1/	<0.001	0.002	19			< 0.005	< 0.005	19
CVP Delta-Mendota Canal	DMC06716	Antimony		<0.001	<0.001	24	Chromium +3	0.002	< 0.001	0.004	24	Mercury	NA			
San Luis Reservoir, Pacheco PP	SL000000			<0.001	<0.001	17		0.003	0.001	0.005	24		NA			
San Luis Reservoir, Dam Trashracks	SL001000			<0.001	<0.001	19		0.002	0.002	0.004	19			<0.0002	<0.0002	19
CVP Delta-Mendota Canal	DMC06716	Arsenic	0.002	0.001	0.003	24	Copper	0.002	0.001	0.003	24	Nickel	0.001	0.001	0.003	24
San Luis Reservoir, Pacheco PP	SL000000		0.003	0.002	0.004	24		0.003	0.002	0.005	24		0.001	0.001	0.002	17
San Luis Reservoir, Dam Trashracks	SL001000		0.003	0.002	0.004	19		0.002	0.001	0.002	19		0.001	0.001	0.002	19
CVP Delta-Mendota Canal	DMC06716	Barium	NA				Fluoride	2/	< 0.1	0.1	24	Selenium	0.001	0.001	0.003	24
San Luis Reservoir, Pacheco PP	SL000000		NA					4/	< 0.1	0.1	24		0.001	<0.001	0.002	24
San Luis Reservoir, Dam Trashracks	SL001000			<0.05	<0.05	19		3/	< 0.1	0.1	19		0.001	0.001	0.002	19
CVP Delta-Mendota Canal	DMC06716	Beryllium		< 0.001	< 0.001	24	Iron	0.005	< 0.001	0.056	24	Silver	NA			
San Luis Reservoir, Pacheco PP	SL000000			< 0.001	< 0.001	17		5/	0.005	0.032	24		NA			
San Luis Reservoir, Dam Trashracks	SL001000			< 0.001	< 0.001	19		3/	< 0.001	0.009	19			< 0.001	< 0.001	19
CVP Delta-Mendota Canal	DMC06716	Boron	0.2	<'0.1	0.6	24	Lead		< 0.001	< 0.001	24	Zinc	1/	< 0.005	0.015	24
San Luis Reservoir, Pacheco PP	SL000000		0.2	0.1	0.2	24			< 0.001	< 0.001	24			< 0.005	< 0.005	24
San Luis Reservoir, Dam Trashracks	SL001000		0.2	0.1	0.2	19			< 0.001	< 0.001	19		1/	< 0.005	0.014	19

1/ One positive detection
2/ Six positive detections
3/ Three positive detections
4/ Two positive detections
5/ Eight positive detections
6/ Four positive detections

Table 4-4. Summary of nutrients in San Luis Reservoir, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
San Luis Reservoir, Pacheco PP	SL000000	Ammonia	mg/L as N	<0.01	<0.01	0.02	24
		Nitrate + Nitrite	mg/L as N	0.795	0.12	1	24
		Ortho-Phosphate	mg/L as P	0.09	0.06	0.12	24
		Total Kjeldahl Nitrogen	mg/L as N	0.3	0.1	1.7	24
		Total Phosphorus	mg/L	0.1	0.07	0.16	24
San Luis Reservoir, Dam Trashracks	SL001000	Ammonia	mg/L as N	0.01	<0.01	0.12	24
		Nitrate + Nitrite	mg/L as N	0.605	0.04	1	24
		Ortho-Phosphate	mg/L as P	0.07	0.04	0.1	23
		Total Kjeldahl Nitrogen	mg/L as N	0.4	0.2	1	24
		Total Phosphorus	mg/L	0.09	0.05	0.36	24

5. Southern Reservoirs

Major minerals and conventional parameters in SWP southern reservoirs during 2004 and 2005 are summarized in Table 5-1. Maximum Contaminant Levels for salinity, sulfate, chloride, and nitrate in drinking water were not exceeded. Salinity and dissolved minerals were most variable in Silverwood and Pyramid lakes during both years with conductivity ranging from 323 to 486 µS/cm and chloride ranging from 39 to 79 mg/L (Figures 5-1 and 5-2). Conductivity was consistently highest in Lake Perris ranging between 549 and 667 µS/cm.

Table 5-1. Summary of major minerals and conventional parameters in SWP southern reservoirs, 2004 and 2005

Station Name	Station Number	Major Minerals	Units	Median	Low	High	Sample Size	Conventional Parameters	Units	Median	Low	High	Sample Size
Pyramid Lake	PY001000	Alkalinity	mg/L as CaCO3	79	70	81	8	Conductivity	uS/cm	416	323	464	8
Castaic Lake	CA002000			90	77	112	11			476	416	504	12
Silverwood Lake	SI002000			74	68	82	8			423	326	486	8
Lake Perris	PE002000			106	97	117	11			581	549	667	14
Pyramid Lake	PY001000	Calcium	mg/L	21	17	28	8	Hardness	mg/L as CaCO3	97	82	119	8
Castaic Lake	CA002000			25	21	39	12			112	102	159	12
Silverwood Lake	SI002000			21	17	22	8			98	82	104	8
Lake Perris	PE002000			27	24	29	14			128	113	142	14
Pyramid Lake	PY001000	Chloride	mg/L	55	39	67	8	pH	pH units	7.3	6.3	8.4	8
Castaic Lake	CA002000			47	45	71	8			7.9	6.6	8.9	11
Silverwood Lake	SI002000			61	42	79	8			7.2	6.4	8.3	8
Lake Perris	PE002000			92	82	102	8			8.1	6.8	8.8	11
Pyramid Lake	PY001000	Magnesium	mg/L	11	9	13	8	TDS	mg/L	245	186	279	8
Castaic Lake	CA002000			13	12	15	12			275	255	381	8
Silverwood Lake	SI002000			12	9	13	8			239	188	268	11
Lake Perris	PE002000			15	13	17	14			315	292	375	8
Pyramid Lake	PY001000	Nitrate	mg/L as N03	2.05	0.6	3.5	8	Turbidity	NTU	3	<1	7	7
Castaic Lake	CA002000			1.7	<0.1	2.6	8			2	<1	17	11
Silverwood Lake	SI002000			3.0	1.4	5.7	8			2	<1	7	10
Lake Perris	PE002000			0.05	<0.1	1.2	8			1	<1	82	13
Pyramid Lake	PY001000	Sodium	mg/L	41	30	48	8						
Castaic Lake	CA002000			41	39	50	8						
Silverwood Lake	SI002000			45	31	61	8						
Lake Perris	PE002000			64	58	75	8						
Pyramid Lake	PY001000	Sulfate	mg/L	34	24	64	8						
Castaic Lake	CA002000			48	41	89	8						
Silverwood Lake	SI002000			35	25	48	8						
Lake Perris	PE002000			48	46	50	8						

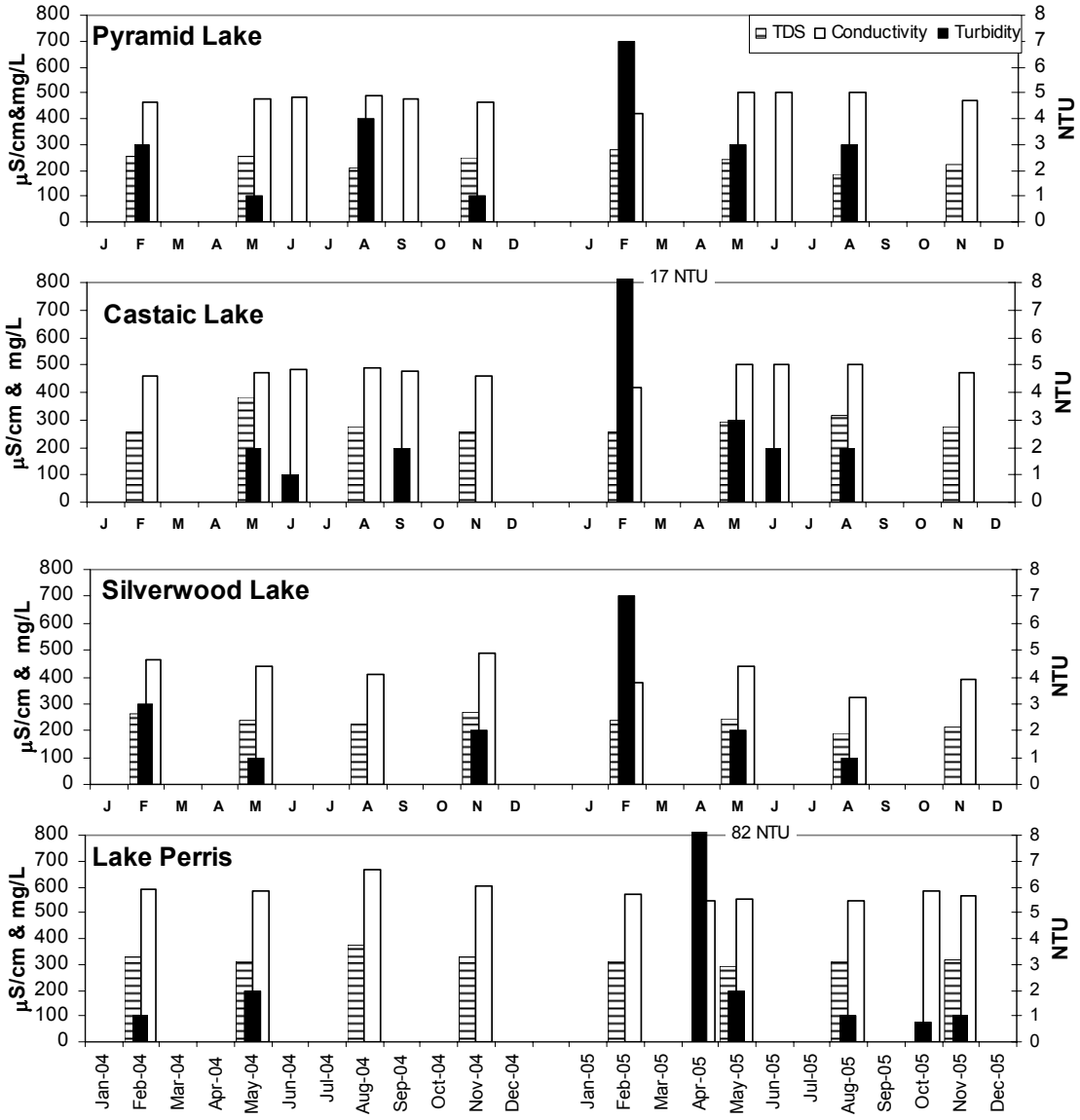

Figure 5-1. Salinity and turbidity in SWP southern reservoirs. Turbidity values of <1 NTU were reported as zero.

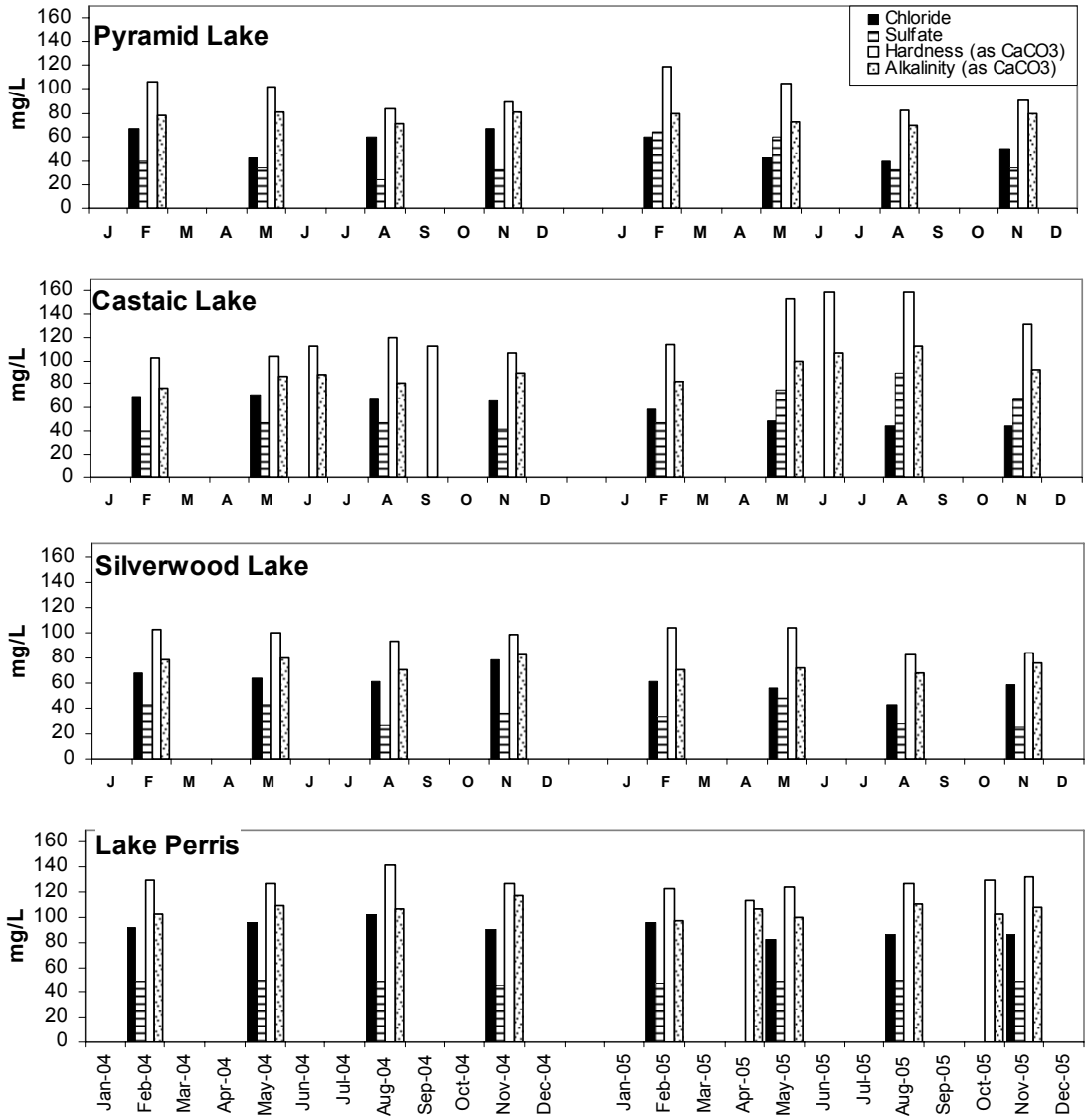

Figure 5-2. Quarterly sulfate, chloride, hardness, and alkalinity in SWP southern reservoirs

Disinfection byproduct precursors in SWP southern reservoirs are summarized in Table 5-2. Bromide in all four reservoirs ranged between 0.09 and 0.34 mg/L. Organic carbon was generally highest during the summer months in Castaic Lake, while monthly trends in Lake Perris were not well defined (Figure 5-3).

Minor elements and nutrients in SWP southern reservoirs are summarized in Tables 5-3 and 5-4. Existing MCLs for these parameters in treated drinking water were not exceeded.

Table 5-2. Summary of bromide and dissolved and total organic carbon in SWP southern reservoirs, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Pyramid Lake	PY001000	Bromide	mg/L	0.15	0.09	0.28	20
Castaic Lake	CA002000			0.18	0.14	0.32	24
Silverwood Lake	SI002000			0.17	0.10	0.32	21
Lake Perris	PE002000			0.30	0.16	0.34	24
Lake Perris	PE002000	DOC	mg/L as C	4.2	2.6	5.0	24
Castaic Lake	CA002000			3.2	2.2	4.2	24
Lake Perris	PE002000	TOC	mg/L as C	4.1	3.4	5.5	24
Castaic Lake	CA002000			3.3	2.4	4.2	24

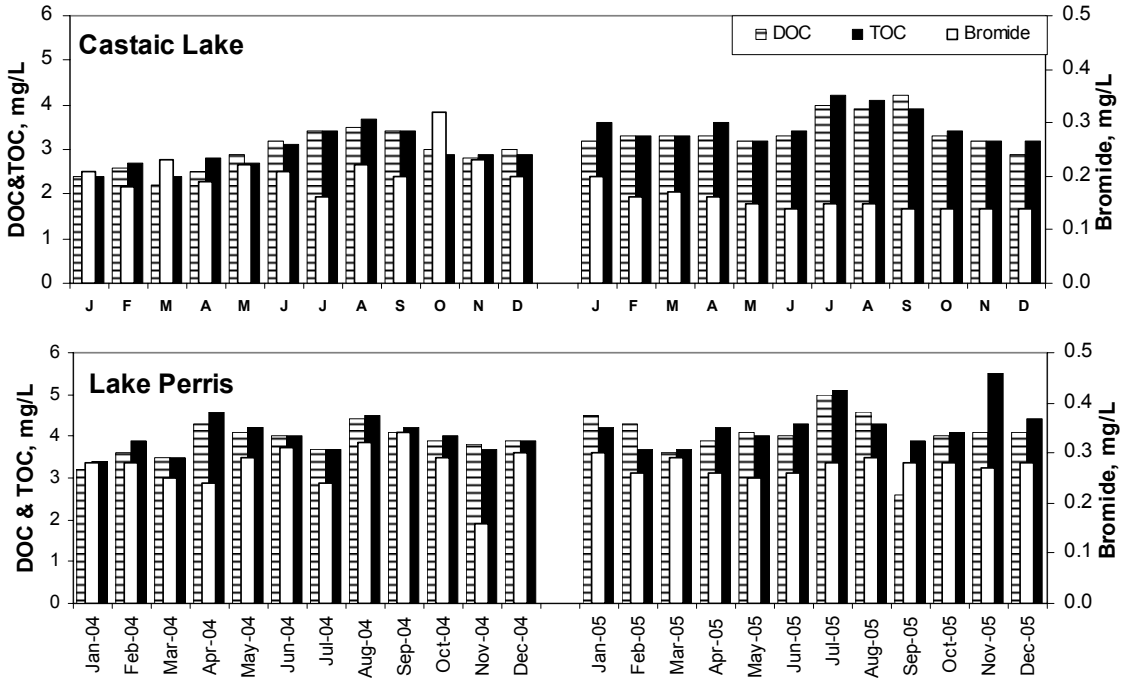

Figure 5-3. Monthly bromide and dissolved and total organic carbon in Castaic Lake and Lake Perris

Table 5-3. Summary of minor elements in SWP southern reservoirs, 2004 and 2005 (mg/L)

Station Name	Station Number	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size
Pyramid Lake	PY001000	Aluminum	1/	< 0.01	0.037	8	Cadmium		< 0.001	< 0.001	8	Manganese		< 0.005	< 0.005	8
Castaic Lake	CA002000			< 0.01	< 0.01	8			< 0.001	< 0.001	8			< 0.005	< 0.005	8
Silverwood Lake	SI002000		2/	0.01	0.014	8			< 0.001	< 0.001	8		3/	<0.005	0.03	8
Lake Perris	PE002000		1/	< 0.01	0.01	8			< 0.001	< 0.001	8		4/	<0.005	0.021	8
Pyramid Lake	PY001000	Antimony	NA				Chromium +3	0.002	0.001	0.003	8	Mercury		< 0.0002	< 0.0002	8
Castaic Lake	CA002000		NA					0.002	0.001	0.003	8			< 0.0002	< 0.0002	8
Silverwood Lake	SI002000		NA					0.002	<0.001	0.004	8			< 0.0002	< 0.0002	8
Lake Perris	PE002000		NA					0.002	0.002	0.003	8			< 0.0002	< 0.0002	8
Pyramid Lake	PY001000	Arsenic	0.0025	0.002	0.004	8	Copper	0.003	0.002	0.004	8	Nickel	0.001	0.001	0.002	8
Castaic Lake	CA002000		0.002	0.002	0.003	8		0.004	0.002	0.015	22		0.001	0.001	0.002	8
Silverwood Lake	SI002000		0.002	0.002	0.004	8		0.002	0.002	0.004	8		0.001	0.001	0.002	8
Lake Perris	PE002000		0.002	0.002	0.003	8		0.004	0.002	0.015	31			0.001	0.001	8
Pyramid Lake	PY001000	Barium		< 0.05	< 0.05	8	Fluoride	0.1	<0.1	0.2	8	Selenium	0.001	< 0.001	0.002	7
Castaic Lake	CA002000			< 0.05	< 0.05	8		0.15	<0.1	0.2	8		0.001	0.001	0.002	7
Silverwood Lake	SI002000			< 0.05	< 0.05	8		1/	<0.1	0.1	8		0.001	< 0.001	0.002	7
Lake Perris	PE002000		1/	< 0.05	0.051	8		0.1	<0.1	0.2	8		0.001	< 0.001	0.003	7
Pyramid Lake	PY001000	Beryllium		< 0.001	< 0.001	8	Iron	1/	< 0.005	0.046	8	Silver		< 0.001	< 0.001	8
Castaic Lake	CA002000			< 0.001	< 0.001	8		1/	< 0.005	0.006	8			< 0.001	< 0.001	8
Silverwood Lake	SI002000			< 0.001	< 0.001	8		3/	0.005	0.026	8			< 0.001	< 0.001	8
Lake Perris	PE002000			< 0.001	< 0.001	8		2/	< 0.005	0.011	8			< 0.001	< 0.001	8
Pyramid Lake	PY001000	Boron	0.2	0.1	0.2	8	Lead		< 0.001	< 0.001	8	Zinc	2/	< 0.005	0.007	8
Castaic Lake	CA002000			0.2	0.2	8			< 0.001	< 0.001	8		2/	< 0.005	0.01	8
Silverwood Lake	SI002000		0.15	0.1	0.4	8			< 0.001	< 0.001	8			< 0.005	< 0.005	8
Lake Perris	PE002000			0.2	0.2	8			< 0.001	< 0.001	8			< 0.005	< 0.005	8

1/ One positive dectection
2/ Two positive detections
3/ Three positive detections
4/ Four positive detections

Table 5-4. Summary of nutrients in SWP southern reservoirs, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Pyramid Lake	PY001000	Ammonia	mg/L as N	< 0.01	< 0.01	0.07	23
Castaic Lake	CA002000			< 0.01	< 0.01	0.05	24
Silverwood Lake	SI002000			0.02	< 0.01	0.06	24
Lake Perris	PE002000			< 0.01	< 0.01	0.09	24
Pyramid Lake	PY001000	Nitrite+Nitrate	mg/L as N	0.58	0.13	0.88	23
Castaic Lake	CA002000			0.43	<0.01	0.61	24
Silverwood Lake	SI002000			0.73	0.31	1.40	24
Lake Perris	PE002000			0.01	<0.01	0.42	24
Pyramid Lake	PY001000	Ortho-phosphate	mg/L as P	0.06	0.04	0.07	23
Castaic Lake	CA002000			0.03	0.01	0.07	24
Silverwood Lake	SI002000			0.08	0.06	0.10	24
Lake Perris	PE002000			< 0.01	<0.01	0.03	23
Pyramid Lake	PY001000	Total Kjeldahl Nitrogen	mg/L as N	0.30	0.10	0.60	23
Castaic Lake	CA002000			0.30	0.10	0.40	24
Silverwood Lake	SI002000			0.40	0.20	4.4	24
Lake Perris	PE002000			0.40	0.40	0.90	24
Pyramid Lake	PY001000	Total Phosphorus	mg/L	0.08	0.04	0.10	23
Castaic Lake	CA002000			0.04	0.01	0.10	24
Silverwood Lake	SI002000			0.09	0.07	0.43	24
Lake Perris	PE002000			0.02	0.01	0.06	24

Natural inflows to Silverwood, Pyramid, and Castaic Lakes were greatest during the first few months of 2005 (Figure 5-4). Natural inflows to Silverwood Lake were 15,062 af in 2004 and 70,254 af in 2005, respectively accounting for 1.4% and 7.1% of the total (natural + Project). Natural inflows to Pyramid Lake were 13,016 af in 2004 and 158,093 af in 2005, respectively accounting for 1.5% and 24% of the total (natural + Project [generation at William E. Warne Powerplant]). Natural inflows to Castaic Lake and Elderberry Forebay totaled 5,369 af in 2004 and 132,948 af in 2005.

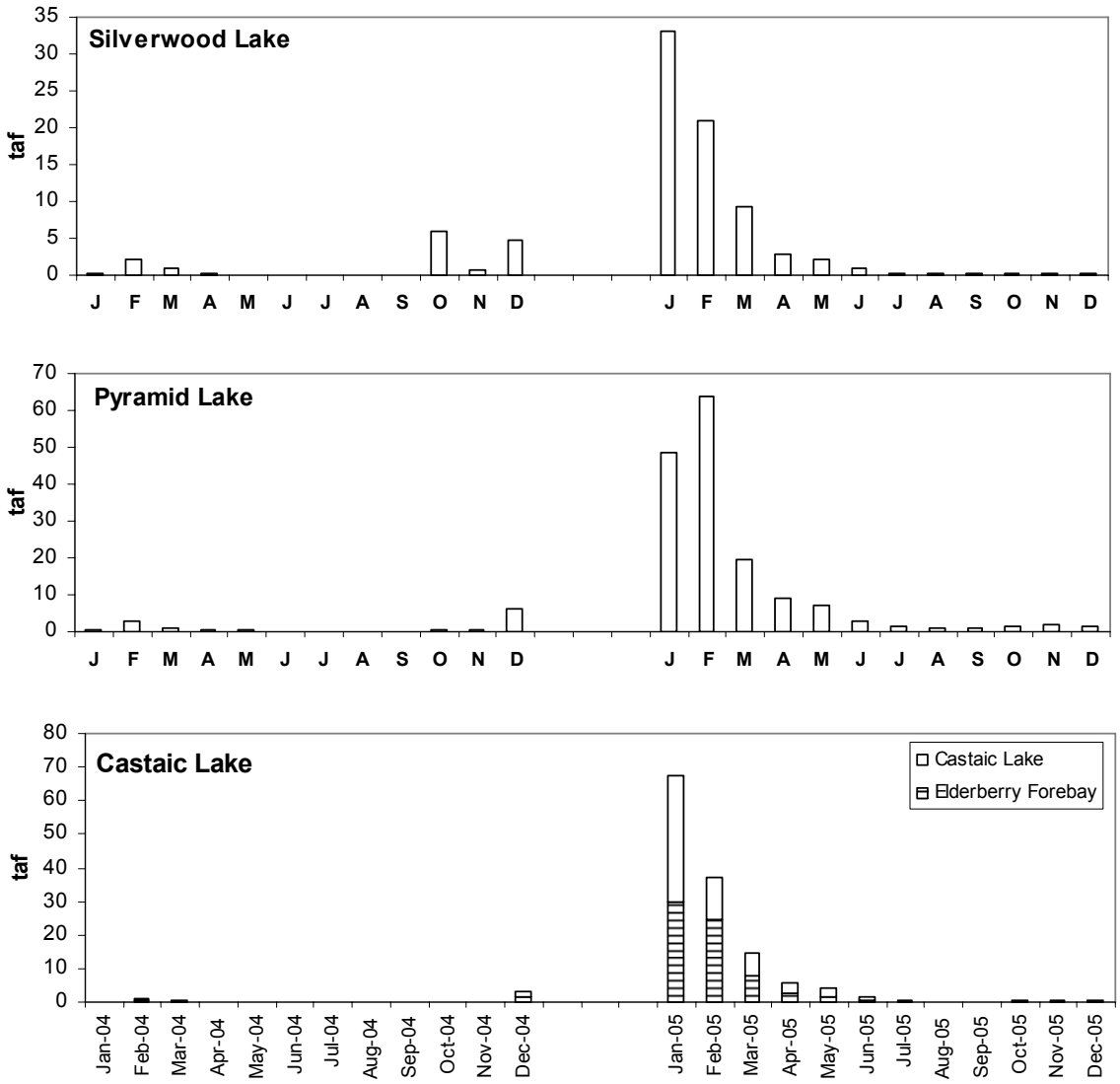

Figure 5-4. Monthly natural inflows to SWP southern reservoirs (thousand acre-feet)

6. South Bay Aqueduct

Pumpage at South Bay Pumping Plant totaled 121,728 af in 2004 and 107,841 af in 2005, respectively comprising 3.8% and 2.7% of the total pumpage at Banks Pumping Plant. Pumpage at South Bay Pumping Plant was erroneously reported as 10% of that at Banks in the 2002-03 biennial water quality report (DWR 2007a). Percentages were actually 3.1% for 2002 and 5.8% for 2003. Monthly pumping during 2004-05 was generally lowest during winter and fall (Figure 6-1).

Natural inflows to Lake Del Valle totaled 15,295 af in 2004 and 30,275 af in 2005 and were generally highest during winter of both years (Figure 6-1). Natural inflows accounted for 11.2% of the total volume conveyed into the South Bay Aqueduct system (natural inflows + pumpage at South Bay Pumping Plant) during 2004 and 21.9% during 2005. Monthly releases from Lake Del Valle to the South Bay Aqueduct ranged from zero to 7,605 af during the two-year period (Figure 6-1).

Major minerals, conventional parameters, and disinfection byproduct precursors in the South Bay Aqueduct and Lake Del Valle releases during 2004 and 2005 are summarized in Tables 6-1 and 6-2. Maximum Contaminant Levels for salinity, chloride, nitrate, and sulfate in drinking water were not exceeded.

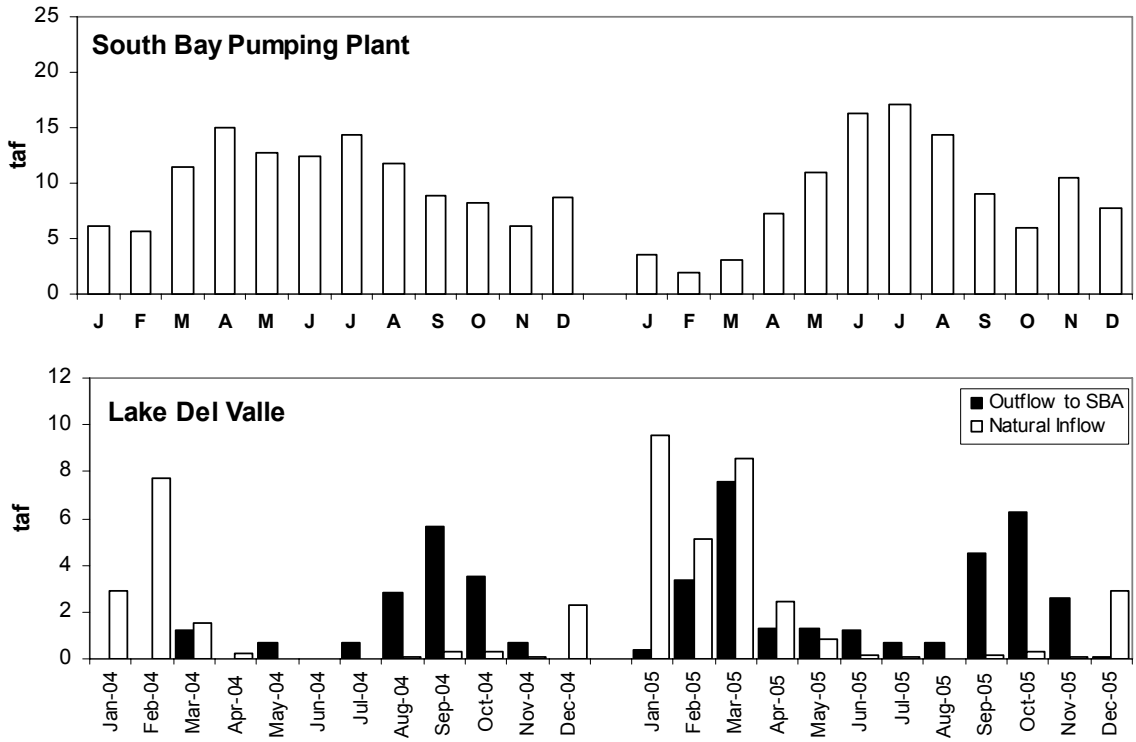

Figure 6-1. Monthly pumping at South Bay Pumping Plant, natural inflows to Lake Del Valle, and releases from Lake Del Valle to the South Bay Aqueduct (thousand acre-feet)

Table 6-1. Summary of major minerals and conventional parameters in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005

Station Name	Station Number	Major Minerals	Units	Median	Low	High	Sample Size	Conventional Parameters	Units	Median	Low	High	Sample Size
Del Valle Check 7	KB001638	Alkalinity	mg/L as CaCO3	69	42	96	24	Conductivity	uS/cm	353	194	573	24
Del Valle Outlet	DV000000			134	124	144	10			363	334	414	10
Santa Clara Terminal Tank	KB004207			96	59	111	11			363	267	579	11
Del Valle Check 7	KB001638	Calcium	mg/L	17	12	30	24	Hardness	mg/L as CaCO3	86	55	137	24
Del Valle Outlet	DV000000			31	29	34	10			147	145	167	10
Santa Clara Terminal Tank	KB004207			22	15	32	11			113	70	150	11
Del Valle Check 7	KB001638	Chloride	mg/L	48	16	111	24	pH	pH units	7.0	6.4	8.8	24
Del Valle Outlet	DV000000			17	10	23	10			7.3	6.6	8.1	10
Santa Clara Terminal Tank	KB004207			39	26	112	11			7.0	6.7	8.1	11
Del Valle Check 7	KB001638	Magnesium	mg/L	10	6	16	24	TDS	mg/L	197	110	328	24
Del Valle Outlet	DV000000			17	17	20	10			216	191	233	10
Santa Clara Terminal Tank	KB004207			14	8	17	11			208	157	325	11
Del Valle Check 7	KB001638	Nitrate	mg/L as N03	1.65	0.1	7.4	24	TSS	mg/L	8	<1	26	24
Del Valle Outlet	DV000000			0.3	<0.1	1	10			2.5	<1	14	10
Santa Clara Terminal Tank	KB004207			1.35	0.3	3.9	11			5	<1	7	11
Del Valle Check 7	KB001638	Sodium	mg/L	37	16	77	24	Turbidity	NTU	8	2	22	24
Del Valle Outlet	DV000000			19	14	25	10			3.5	1	11	10
Santa Clara Terminal Tank	KB004207			30	24	67	11			5	1	10	11
Del Valle Check 7	KB001638	Sulfate	mg/L	26	15	69	24	VSS	mg/L	2	<1	6	24
Del Valle Outlet	DV000000			33	28	38	10			0.5	<1	6	10
Santa Clara Terminal Tank	KB004207			30	23	50	11			2	<1	5	11

Table 6-2. Summary of disinfection byproduct precursors in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Del Valle Check 7	KB001638	Bromide	mg/L	0.11	0.05	0.37	24
Del Valle Outlet	DV000000			0.04	0.02	0.06	10
Del Valle Check 7	KB001638	DOC	mg/L as C	3.2	2.3	7.4	24
Del Valle Outlet	DV000000			4.1	3.8	5	10
Del Valle Check 7	KB001638	TOC	mg/L as C	3.3	2.4	7.7	24
Del Valle Outlet	DV000000			4.2	3.8	5	10
Del Valle Check 7	KB001638	UVA_{254}	cm^{-1}		0.168	0.179	2
Del Valle Outlet	DV000000			0.113	0.092	0.129	7

Salinity, turbidity, certain major minerals, and disinfection byproduct precursors at Del Valle Check 7 are shown in Figure 6-2. Trends for dissolved parameters were similar to those observed at Banks Pumping Plant. Seawater intrusion was apparent during the last five to seven months of each year as evidenced by chloride:sulfate ratios above 1.5 (see details in the California Aqueduct Section). Dissolved organic carbon was highest during winter of both years.

Minor elements and nutrients in the South Bay Aqueduct and Lake Del Valle are summarized in Tables 6-3 and 6-4. Existing MCLs for these parameters in treated drinking water were not exceeded.

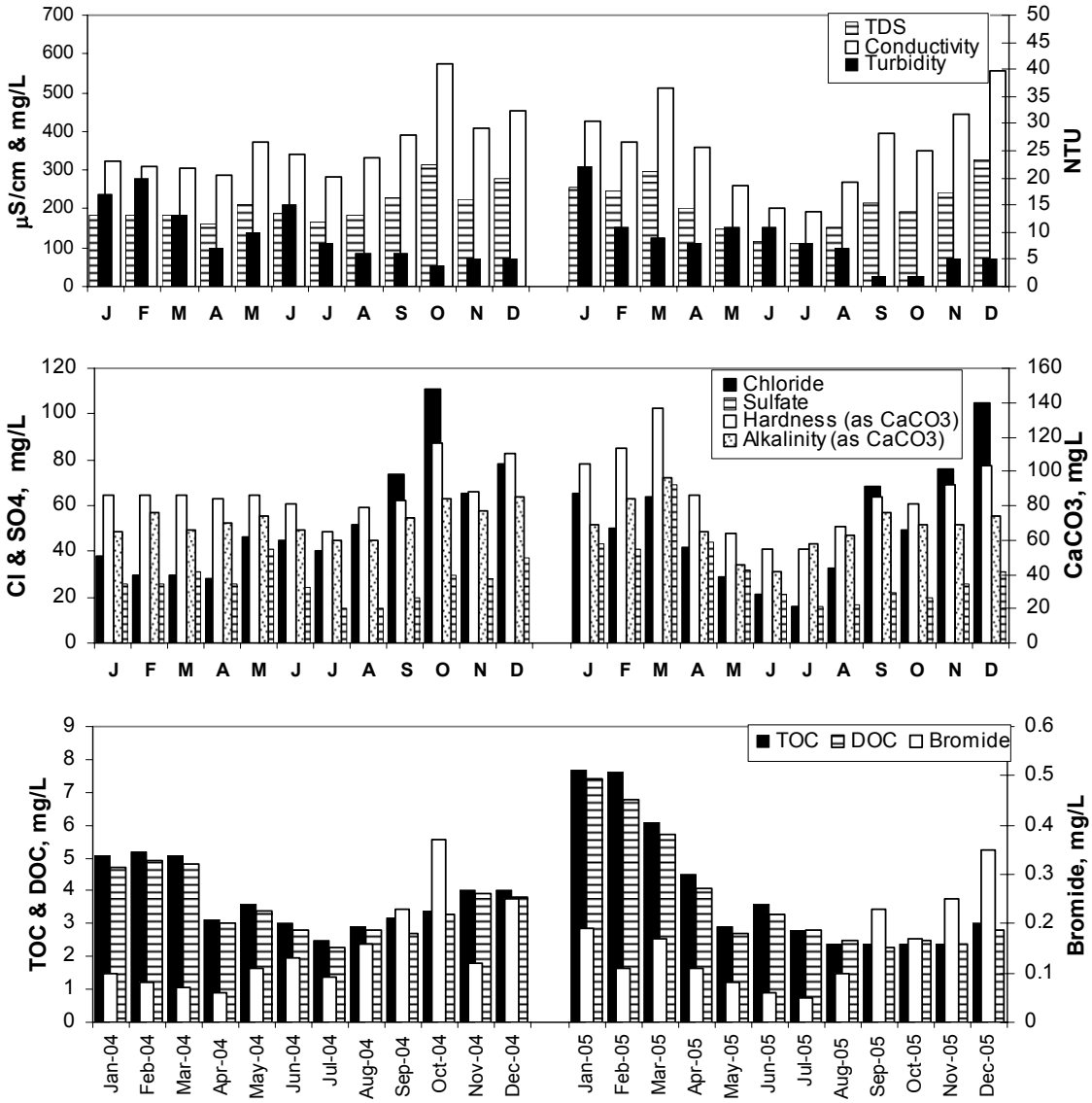

Figure 6-2. Monthly water quality in the South Bay Aqueduct at Del Valle, Check 7

Table 6-3. Summary of minor elements in the South Bay Aqueduct and Lake Del Valle releases, 2004 and 2005 (mg/L)

Station Name	Station Number	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size
Del Valle Check 7	KB001638	Aluminum		< 0.01	< 0.01	23	Cadmium		< 0.001	< 0.001	23	Manganese	4/	< 0.005	0.012	24
Del Valle Outlet	DV000000			< 0.01	< 0.01	10			< 0.001	< 0.001	10		3/	< 0.005	0.011	10
Santa Clara Terminal Tank	KB004207			< 0.01	< 0.01	11			< 0.001	< 0.001	11		5/	< 0.005	0.009	11
Del Valle Check 7	KB001638	Antimony		< 0.001	< 0.001	24	Chromium +3	0.002	<0.001	0.003	24	Mercury		< 0.0002	< 0.0002	24
Del Valle Outlet	DV000000			< 0.001	< 0.001	10		0.001	0.001	0.002	10			< 0.0002	< 0.0002	10
Santa Clara Terminal Tank	KB004207		1/	< 0.001	0.002	11		0.002	<0.001	0.003	11			< 0.0002	< 0.0002	11
Del Valle Check 7	KB001638	Arsenic	0.002	0.001	0.003	24	Copper	0.002	0.001	0.021	24	Nickel	0.001	<0.001	0.002	24
Del Valle Outlet	DV000000		0.002	0.001	0.003	10		0.002	0.002	0.003	10		0.002	<0.001	0.002	10
Santa Clara Terminal Tank	KB004207		0.002	0.001	0.003	11		0.003	0.002	0.008	11		0.001	0.001	0.002	11
Del Valle Check 7	KB001638	Barium		< 0.05	< 0.05	23	Fluoride	1/	< 0.1	0.1	25	Selenium	0.001	<0.001	0.002	24
Del Valle Outlet	DV000000		0.06	0.05	0.071	10		2/	< 0.1	0.1	10			< 0.001	< 0.001	10
Santa Clara Terminal Tank	KB004207		1/	< 0.05	0.051	11		1/	< 0.1	0.1	11		6/	0.001	0.002	11
Del Valle Check 7	KB001638	Beryllium		< 0.001	< 0.001	24	Iron	0.0115	<0.005	0.051	24	Silver		< 0.001	< 0.001	23
Del Valle Outlet	DV000000			< 0.001	< 0.001	10		1/	< 0.005	0.008	10			< 0.001	< 0.001	10
Santa Clara Terminal Tank	KB004207			< 0.001	< 0.001	11		0.0113	0.005	0.028	11			< 0.001	< 0.001	11
Del Valle Check 7	KB001638	Boron	0.1	<0.1	0.3	24	Lead		< 0.001	< 0.001	24	Zinc	7/	< 0.005	0.01	24
Del Valle Outlet	DV000000			0.2	0.2	10			< 0.001	< 0.001	10		0.088	0.022	0.26	10
Santa Clara Terminal Tank	KB004207		0.1	0.1	0.3	11			< 0.001	< 0.001	11		0.007	< 0.005	0.013	11

1/ One positive detection 3/ Two positive detections 5/ Three positive detections 7/ Six positive detections
2/ Five positive detections 4/ Nine positive detections 6/ Four positive detections

Table 6-4. Summary of nutrients in the South Bay Aqueduct, Lake Del Valle, and Lake Del Valle releases, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Del Valle Check 7	KB001638	Ammonia	mg/L as N		0.01	0.06	24
Lake Del Valle	DV001000			1/	< 0.01	0.07	19
Del Valle Outlet	DV000000				< 0.01	< 0.01	10
Del Valle Check 7	KB001638	Nitrite+Nitrate	mg/L as N		0.03	1.6	24
Lake Del Valle	DV001000			2/	< 0.01	0.19	19
Del Valle Outlet	DV000000			0.065	< 0.01	0.23	10
Del Valle Check 7	KB001638	Total Kjeldahl Nitrogen	mg/L as N	0.4	0.1	0.8	24
Lake Del Valle	DV001000			0.3	0.2	0.5	19
Del Valle Outlet	DV000000			0.3	0.2	0.4	10
Del Valle Check 7	KB001638	Ortho-phosphate	mg/L as P	0.05	0.03	0.12	22
Lake Del Valle	DV001000			3/	< 0.01	0.02	17
Del Valle Outlet	DV000000			4/	< 0.01	0.02	9
Del Valle Check 7	KB001638	Total Phosphorus	mg/L	0.09	0.05	0.22	24
Lake Del Valle	DV001000			0.01	<0.01	0.04	18
Del Valle Outlet	DV000000			0.01	<0.01	0.03	10

1/ Two positive detections 3/ Four positive detections
2/ Seven positive detections 4/ Two positive detections

7. North Bay Aqueduct

Pumpage to the North Bay Aqueduct at Barker Slough Pumping Plant totaled 53,317 af in 2004 and 46,424 af in 2005. Monthly pumping was generally lowest during winter to early spring of both years (Figure 7-1).

Water quality at Barker Slough Pumping Plant is summarized in Table 7-1. Salinity, chloride, sulfate, and nitrate were below their respective drinking water MCLs. The minor element manganese was above the secondary MCL of 0.05 mg/L in two samples collected in February and May, 2005 (0.089 and 0.559 mg/L, respectively).

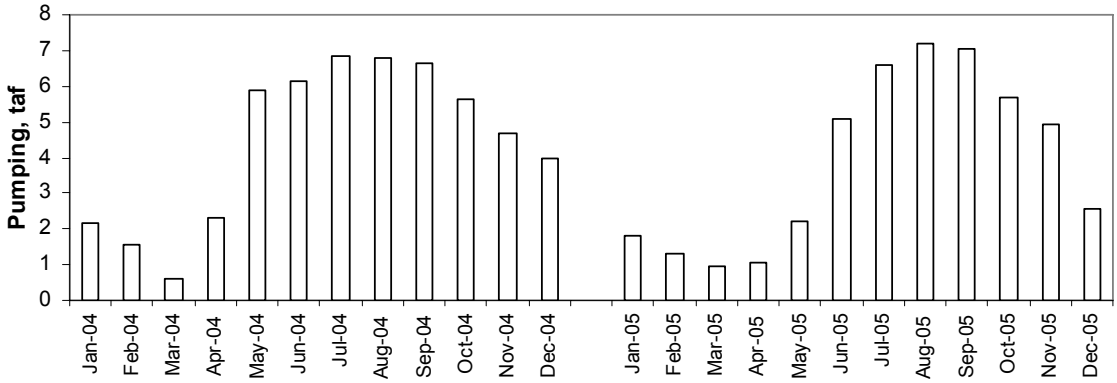

Figure 7-1. Monthly pumping in the North Bay Aqueduct at Barker Slough Pumping Plant (thousand acre-feet)

Table 7-1. Summary of water quality in the North Bay Aqueduct at Barker Slough Pumping Plant, 2004 and 2005

Parameter	Units	Median	Low	High	Sample Size	Parameter	Units	Median	Low	High	Sample Size
Major Minerals						**Minor Elements (Cont.)**					
Alkalinity	mg/L as CaCO3	89	48	163	23	Barium	mg/L	1/	< 0.05	0.066	22
Calcium	mg/L	16	6	26	23	Beryllium	mg/L		< 0.001	< 0.001	23
Chloride	mg/L	19	6	44	23	Boron	mg/L	0.1	<0.1	0.4	23
Magnesium	mg/L	12	5	25	23	Cadmium	mg/L		< 0.001	< 0.001	22
Nitrate	mg/L as NO3	1	0.4	2.9	23	Chromium +3	mg/L	0.001	<0.001	0.003	23
Sodium	mg/L	21	15	52	23	Copper	mg/L	0.002	0.001	0.005	23
Sulfate	mg/L	19	6	49	23	Fluoride	mg/L	2/	< 0.1	0.1	23
Conventional Parameters						Iron	mg/L	0.09	0.005	0.232	23
Conductivity	uS/cm	274	136	533	23	Lead	mg/L		< 0.001	< 0.001	23
Hardness	mg/L as CaCO3	89	36	168	23	Manganese	mg/L	0.017	<0.005	0.559	23
pH	pH units	6.9	6.4	8.2	23	Mercury	mg/L		< 0.0002	< 0.0002	23
TDS	mg/L	163	94	304	24	Nickel	mg/L	0.02	0.001	0.007	23
TSS	mg/L	40	15	134	23	Selenium	mg/L	3/	< 0.001	0.001	23
Turbidity	NTU	48	24	130	23	Silver	mg/L		< 0.001	< 0.001	22
VSS	mg/L	6	2	20	23	Zinc	mg/L		< 0.005	< 0.005	23
Disinfection Byproduct Precursors						**Nutrients**					
Bromide	mg/L	0.04	<0.01	0.09	23	Ammonia	mg/L as N	0.02	0.01	0.21	23
DOC	mg/L as C	3.95	2.4	15.9	24	Nitrate + Nitrite	mg/L as N	0.22	0.09	0.61	23
TOC	mg/L as C	4.2	2.7	17.3	23	Ortho-phosphate	mg/L as P	0.12	0.06	0.25	22
UVA 254	Absorbance/cm	0.123	0.071	0.661	23	Total Kjeldahl Nitrogen	mg/L as N	0.5	0.3	2	23
Minor Elements						Total Phosphorus	mg/L	0.21	0.1	0.63	23
Aluminum	mg/L	1/	< 0.01	0.027	22						
Antimony	mg/L		< 0.001	< 0.001	23						
Arsenic	mg/L	0.02	0.002	0.003	23						

1/ Three positive detections
2/ Ten positive detections
3/ Three positive detections

Turbidity was relatively high during most of the two-year period with a range of 24 to 130 nephelometric turbidity units (NTU) and a median of 48 NTU (Figure 7-2). Salinity and certain dissolved minerals reached seasonal peak concentrations in April 2004 and May 2005. Dissolved organic carbon ranged from 2.4 to 15.9 mg/L with a median of 3.95 mg/L and was highest (>5mg/L) during the first few months of each year.

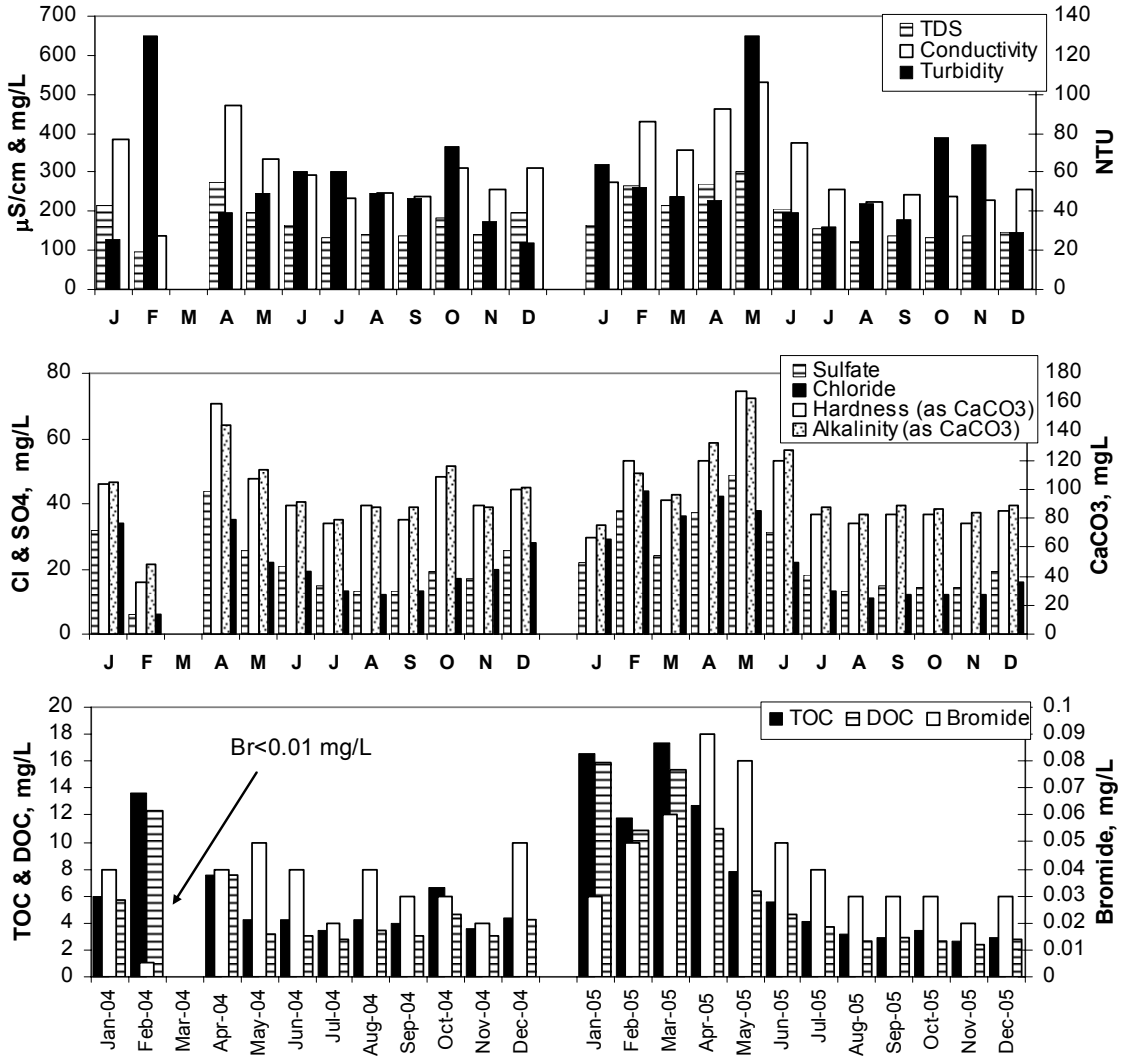

Figure 7-2. Monthly water quality in the North Bay Aqueduct at Barker Slough Pumping Plant

8. Oroville-Thermalito Complex and Upper Feather River Reservoirs

The Oroville-Thermalito complex includes Lake Oroville, Thermalito Forebay, and Thermalito Afterbay. Water quality in the Oroville-Thermalito complex and upper Feather River reservoirs during 2004 and 2005 is summarized in Tables 8-1 to 8-3. Water quality was characteristically excellent with less-than-detectable to low levels of minerals, most minor elements, and nutrients. Existing MCLs for salinity, chloride, sulfate, nitrate, and nutrients in treated drinking water were not exceeded. One sample from Lake Oroville in September 2004 contained manganese above the secondary MCL of 0.05 mg/L (0.116 mg/L).

Table 8-1. Summary of major minerals and conventional parameters at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005

Station Name	Station Number	Major Minerals	Units	Median	Low	High	Sample Size	Conventional Parameters	Units	Median	Low	High	Sample Size
Antelope Lake	AN001000	Alkalinity	mg/L as CaCO3		37	39	2	Conductivity	µS/cm		75	77	2
Lake Davis	LD001000				41	42	2				79	84	2
Lake Oroville	OR001000			44	41	50	12			90	82	100	12
Thermalito Forebay	TF001000				37	39	2				76	86	2
Thermalito Afterbay	TA001000			40	36	51	24			82	76	147	24
Antelope Lake	AN001000	Calcium	mg/L		7	8	2	Hardness	mg/L as CaCO3		26	28	2
Lake Davis	LD001000				8	8	2				32	32	2
Lake Oroville	OR001000			9	8	10	12			39	36	41	12
Thermalito Forebay	TF001000				7	8	2				30	36	2
Thermalito Afterbay	TA001000			8	7	9	24			36	30	39	25
Antelope Lake	AN001000	Chloride	mg/L		< 1	< 1	2	pH	pH units		6.6	6.6	2
Lake Davis	LD001000				< 1	< 1	2				6.7	6.8	2
Lake Oroville	OR001000				1	1	12			6.7	6.3	8.2	12
Thermalito Forebay	TF001000				< 1	< 1	2				6.5	6.6	2
Thermalito Afterbay	TA001000			1	< 1	1	24			6.6	6.2	8.1	24
Antelope Lake	AN001000	Magnesium	mg/L		2	2	2	TDS	mg/L		52	54	2
Lake Davis	LD001000				3	3	2				48	56	2
Lake Oroville	OR001000				4	4	12			55	52	64	12
Thermalito Forebay	TF001000				3	4	2				51	54	2
Thermalito Afterbay	TA001000			4	3	4	24			52	44	106	24
Antelope Lake	AN001000	Nitrate	mg/L as N03		< 0.1	0.6	2	TSS	mg/L	NA			
Lake Davis	LD001000				< 0.1	< 0.1	2			NA			
Lake Oroville	OR001000				< 0.1	< 0.1	12			0.5	<1	4	12
Thermalito Forebay	TF001000				< 0.1	0.5	2				<1	7	2
Thermalito Afterbay	TA001000			1/	< 0.1	0.1	24			4	<1	8	19
Antelope Lake	AN001000	Sodium	mg/L		4	5	2	Turbidity	NTU		1	3	2
Lake Davis	LD001000				4	4	2				2	2	2
Lake Oroville	OR001000			4	3	4	12			< 1	< 1	2	12
Thermalito Forebay	TF001000				3	3	2				1	10	2
Thermalito Afterbay	TA001000			3	3	4	24			2.5	1	7	24
Antelope Lake	AN001000	Sulfate	mg/L		< 1	< 1	2	VSS	mg/L	NA			
Lake Davis	LD001000				< 1	< 1	2			NA			
Lake Oroville	OR001000				2	2	12			1	< 1	5	12
Thermalito Forebay	TF001000				2	2	2				< 1	3	2
Thermalito Afterbay	TA001000				2	2	24			2	< 1	6	19

1/ One positive detection

Table 8-2. Summary of minor elements at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005 (mg/L)

Station Name	Station Number	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size	Minor Element	Median	Low	High	Sample Size
Antelope Lake	AN001000	Aluminum		< 0.01	< 0.01	2	Cadmium		<'0.001	0.001	2	Manganese		<'0.005	0.011	2
Lake Davis	LD001000			< 0.01	< 0.01	2			< 0.001	< 0.001	2			0.012	0.013	2
Lake Oroville	OR001000		1/	< 0.01	0.011	12			< 0.001	< 0.001	12		4/	< 0.005	0.116	12
Thermalito Forebay	TF001000			< 0.01	< 0.01	2			< 0.001	< 0.001	2			< 0.005	< 0.005	2
Thermalito Afterbay	TA001000			< 0.01	< 0.01	23			< 0.001	< 0.001	23			< 0.005	< 0.005	24
Antelope Lake	AN001000	Antimony		< 0.001	< 0.001	2	Chromium +3		< 0.001	0.001	2	Mercury		< 0.0002	< 0.0002	2
Lake Davis	LD001000			< 0.001	< 0.001	2			< 0.001	< 0.001	2			< 0.0002	< 0.0002	2
Lake Oroville	OR001000			< 0.001	< 0.001	12			< 0.001	< 0.001	12			< 0.0002	< 0.0002	12
Thermalito Forebay	TF001000		NA						< 0.001	< 0.001	2			< 0.0002	< 0.0002	2
Thermalito Afterbay	TA001000			< 0.001	< 0.001	16			< 0.001	< 0.001	24			< 0.0002	< 0.0002	23
Antelope Lake	AN001000	Arsenic		< 0.001	< 0.001	2	Copper		< 0.001	0.001	2	Nickel		< 0.001	< 0.001	2
Lake Davis	LD001000			< 0.001	< 0.001	2			< 0.001	0.001	2			< 0.001	< 0.001	2
Lake Oroville	OR001000			< 0.001	< 0.001	12			< 0.001	< 0.001	12			< 0.001	< 0.001	12
Thermalito Forebay	TF001000			< 0.001	< 0.001	2			< 0.001	< 0.001	2			0.001		1
Thermalito Afterbay	TA001000			< 0.001	< 0.001	24		2/	< 0.001	0.002	24			< 0.001	< 0.001	20
Antelope Lake	AN001000	Barium		< 0.05	< 0.05	2	Fluoride		< 0.1	< 0.1	2	Selenium		< 0.001	< 0.001	2
Lake Davis	LD001000			< 0.05	< 0.05	2			< 0.1	< 0.1	2			< 0.001	< 0.001	2
Lake Oroville	OR001000			< 0.05	< 0.05	12			< 0.1	< 0.1	12			< 0.001	< 0.001	12
Thermalito Forebay	TF001000			< 0.05	< 0.05	2			< 0.1	< 0.1	2			< 0.001		1
Thermalito Afterbay	TA001000			< 0.05	< 0.05	23			< 0.1	< 0.1	24			< 0.001	< 0.001	24
Antelope Lake	AN001000	Beryllium		< 0.001	< 0.001	2	Iron		0.024	0.048	2	Silver		< 0.001	< 0.001	2
Lake Davis	LD001000			< 0.001	< 0.001	2			0.007	0.019	2			< 0.001	< 0.001	2
Lake Oroville	OR001000			< 0.001	< 0.001	12		1/	< 0.005	0.012	12			< 0.001	< 0.001	12
Thermalito Forebay	TF001000			< 0.001		1			0.008	0.009	2			< 0.001	< 0.001	2
Thermalito Afterbay	TA001000			< 0.001	< 0.001	20		3/	< 0.005	0.014	24			< 0.001	< 0.001	23
Antelope Lake	AN001000	Boron		< 0.1	< 0.1	3	Lead		< 0.001	< 0.001	2	Zinc		< 0.005	< 0.005	2
Lake Davis	LD001000			< 0.1	< 0.1	2			< 0.001	< 0.001	2			< 0.005	< 0.005	2
Lake Oroville	OR001000			< 0.1	< 0.1	12			< 0.001	< 0.001	12			< 0.005	< 0.005	12
Thermalito Forebay	TF001000			< 0.1	< 0.1	2			< 0.001	< 0.001	2			< 0.005	< 0.005	2
Thermalito Afterbay	TA001000			< 0.1	< 0.1	24			< 0.001	< 0.001	24			< 0.005	< 0.005	24

1/ Two positive detections
2/ Five positive detections
3/ Eight positive detections
4/ One positive detection

Figure 8-3. Summary of nutrients at SWP stations in the Oroville-Thermalito complex and upper Feather River reservoirs, 2004 and 2005

Station Name	Station Number	Parameter	Units	Median	Low	High	Sample Size
Antelope Lake	AN001000	Ammonia	mg/L as N		< 0.01	< 0.01	2
Lake Davis	LD001000				< 0.01	< 0.01	2
Lake Oroville	OR001000				< 0.01	< 0.01	16
Thermalito Afterbay	TA001000				< 0.01	< 0.01	24
Antelope Lake	AN001000	Nitrite +Nitrate	mg/L as N		< 0.01	< 0.01	2
Lake Davis	LD001000				< 0.01	< 0.01	2
Lake Oroville	OR001000				< 0.01	< 0.01	16
Thermalito Afterbay	TA001000			1/	< 0.01	0.04	24
Antelope Lake	AN001000	Ortho-Phosphate	mg/L as P		< 0.01		1
Lake Davis	LD001000				< 0.01		1
Lake Oroville	OR001000			2/	< 0.01	0.01	16
Thermalito Afterbay	TA001000			2/	< 0.01	0.01	24
Antelope Lake	AN001000	Total Kjeldahl Nitrogen	mg/L as N		0.1	0.2	2
Lake Davis	LD001000				0.3	0.4	2
Lake Oroville	OR001000			0.1	<0.1	0.2	16
Thermalito Afterbay	TA001000			0.1	<0.1	0.3	24
Antelope Lake	AN001000	Total Phosphorus	mg/L		< 0.01	0.01	2
Lake Davis	LD001000				< 0.01	0.02	2
Lake Oroville	OR001000			3/	< 0.01	0.02	16
Thermalito Afterbay	TA001000			0.01	< 0.01	0.02	24

1/ Ten positive detections
2/ One positive detection
3/ Five positive detections

9. Organic Chemicals

Organic chemicals are monitored throughout the SWP in March, June, and September of each year. Chemical scans include carbamate pesticides, chlorinated organic pesticides, chlorinated phenoxy herbicides, sulfur pesticides, glyphosate, phosphorus/nitrogen pesticides, and purgeable (volatile) organics. Specific chemicals analyzed in each scan are listed in Appendix A, Table A-3. Sampling stations, chemical scans, and any positive detections are listed in Table 9-1.

Volatile organic chemicals (including the gas additive methyl *tert*-butyl ether, MtBE) were analyzed monthly during 2004 and 2005 at Banks Pumping Plant, the South Bay Aqueduct at Del Valle Check 7, Lake Del Valle, and the North Bay Aqueduct at Barker Slough Pumping Plant. Toluene was the only volatile organic chemical detected during the two-year period. One sample from Banks Pumping Plant and two from Lake Del Valle contained toluene at the reporting limit of 0.5 µg/L, below the State MCL of 150 µg/L. No MtBE was detected in any of the samples.

Five herbicides were detected in and around the SWP during 2004 and 2005. Simazine was present in the California Aqueduct at several stations during June 2004 and March and June 2005. Simazine concentrations ranged between 0.02 and 0.2 µg/L, below the drinking water MCL of 4 µg/L. Simazine was also detected at Barker Slough Pumping Plant during March and June 2005 and in the DMC during March 2005 with concentrations ranging from 0.02 to 0.24 µg/L. The herbicide 2,4-D was detected in the DMC and all aqueduct stations during September of both years. Concentrations ranged from 0.1 to 0.3 µg/L and were well below the MCL for 2,4-D of 70 µg/L. Diuron was detected in the DMC and at all aqueduct stations during June 2004 and March 2005 with concentrations ranging between 0.3 and 1.7 µg/L (no MCL exists for diuron). A metolachlor concentration of 0.1 µg/L was detected at several aqueduct stations and Barker Slough Pumping Plant during June 2005 (no MCL exists). Trifluralin was present at two stations in the aqueduct during June 2004 and at Barker Slough Pumping Plant during June 2005 (no MCL exists).

The insecticide diazinon was detected in two samples from the California Aqueduct during June 2004 (no MCL exists).

Table 9-1. Organic chemicals in the State Water Project, 2004 and 2005 (X=scans were performed)

					EPA Method # Scan 1/							µg/L					
Facility	Station	Lake Depth, M	Year	Date	531.1	608	615	Sulfur Pest.	547	614	502.2	2,4-D	Chlorpyrifos	Diuron	Metolachlor	Simazine	Other Compounds
California Aqueduct																	
	Banks Pumping Plant		2004	1/21/2004							X						
				2/18/2004							X						
				3/17/2004	X	X	X	X	X	X	X						
				4/21/2004							X						
				5/19/2004							X						
				6/10/2004	X	X	X	X	X	X	X						
				6/16/2004	X	X	X	X	X	X	X			0.3			Trifluralin (0.01µg/L)
				7/21/2004							X						
				8/18/2004							X						
				9/15/2004	X	X	X	X	X	X	X	0.2					
				10/20/2004							X						
				11/17/2004							X						Toluene (0.5 µg/L)
				12/15/2004							X						
			2005	1/19/2005							X						
				2/16/2005							X						
				3/16/2005	X	X	X	X	X	X	X		0.03	0.68		0.11	
				4/20/2005							X						
				5/18/2005							X						
				6/15/2005	X	X	X	X	X	X	X				0.1		
				7/20/2005							X						
				8/17/2005							X						
				9/21/2005	X	X	X	X	X	X	X	0.3					
				10/19/2005							X						
				11/16/2005							X						
				12/14/2005							X						
	O'Neill Forebay Outlet		2004	6/16/2004	X	X	X	X	X	X	X			0.55		0.04	
				9/15/2004	X	X	X	X	X	X	X	0.1					
			2005	3/16/2005	X	X	X	X	X	X	X		0.02	0.88		0.13	
				6/14/2005	X	X	X	X	X	X	X				0.1		
				9/21/2005	X	X	X	X	X	X	X	0.2					
	Check 21		2004	3/16/2004	X	X	X		X	X	X						
				6/15/2004	X	X	X		X	X	X			0.35		0.06	
				9/14/2004	X	X	X		X	X	X	0.1					
			2005	3/15/2005	X	X	X		X	X	X			0.78		0.12	
				6/14/2005	X	X	X		X	X	X				0.1	0.02	
				9/20/2005	X	X	X		X	X	X	0.1					
	Check 29		2004	6/15/2004	X	X	X	X	X	X				0.59	0.1	0.05	Diazinon (0.01 µg/L)
				9/13/2004	X	X	X	X	X	X		0.1					
			2005	3/15/2005	X	X	X	X	X	X	X			0.82		0.15	
				6/21/2005	X	X	X	X	X	X	X				0.1	0.03	
				9/20/2005	X	X	X	X	X	X	X		0.01				
	Check 41		2004	3/17/2004	X	X	X	X	X	X	X						
				6/16/2004	X	X	X	X	X	X	X			0.57			Trifluralin (0.01µg/L), Diazinon (0.01 µg/L)
				9/15/2004	X	X	X	X	X	X	X						
			2005	3/16/2005	X	X	X	X	X	X	X			1.4		0.2	
				6/15/2005	X	X	X	X	X	X	X				0.1	0.02	
				9/21/2005	X	X	X	X	X	X	X		0.05				
	Devil Canyon Headworks		2004	1/7/2004	X	X	X	X	X	X	X			0.61			
				3/17/2004	X	X	X	X	X	X	X						
				6/16/2004	X	X	X	X	X	X	X			0.31		0.03	
				9/15/2004	X	X	X	X	X	X	X	0.1					
			2005	3/16/2005	X	X	X	X	X	X	X			1.7		0.2	
				6/15/2005	X	X	X	X	X	X	X					0.05	
				9/21/2005	X	X	X	X	X	X	X						
	Lake Perris, Outlet, PE002000	3	2004	1/20/2004	X	X	X	X	X	X							
		10			X	X	X	X	X	X							
CVP Delta Mendota Canal																	
	DMC06716		2004	3/17/2004	X	X	X	X	X	X	X						
				6/16/2004	X	X	X	X	X	X	X			0.55			
				9/15/2004	X	X	X	X	X	X	X	0.3					
			2005	3/16/2005	X	X	X	X	X	X	X			0.48		0.05	
				6/14/2005	X	X	X	X	X	X	X						
				9/21/2005	X	X	X	X	X	X	X	0.2					

Table 9-1 (Con't)

					EPA Method # Scan 1/						µg/L					
Facility	Station	Lake Depth, M	Year	Date	531.1	608	615	Sulfur Pest.	547	614	502.2	2,4-D	Chlorpyrifos	Diuron	Metolachlor	Simazine	Other Compounds
South Bay Aqueduct																	
	Del Valle Check 7		2004	1/20/2004							X						
				2/17/2004							X						
				3/15/2004							X						
				4/20/2004							X						
				5/19/2004							X						
				6/15/2004							X						
				7/19/2004							X						
				8/17/2004							X						
				9/13/2004							X						
				10/19/2004							X						
				11/15/2004							X						
				12/13/2004							X						
			2005	1/17/2005							X						
				2/14/2005							X						
				3/14/2005							X						
				4/18/2005							X						
				5/17/2005							X						
				6/13/2005							X						
				7/18/2005							X						
				8/15/2005							X						
				9/19/2005							X						
				10/18/2005							X						
				11/14/2005							X						
				12/12/2005							X						
	Lake Del Valle Outlet (COW), DV000000		2004	3/16/2004							X						
				8/17/2004							X						
				10/19/2004							X						
			2005	2/15/2005							X						
				3/15/2005							X						
				4/18/2005							X						
				5/17/2005							X						
				9/19/2005							X						
				10/18/2005							X						
	Lake Del Valle, DV010000	1	2004	1/20/2004							X						
		4									X						
		8									X						
		0.5		2/17/2004							X						
		4									X						
		8									X						
		0.5		3/16/2004							X						
		4									X						
		8									X						
		1		4/19/2004							X						
		4									X						
		8									X						
		1		6/14/2004							X						
		4									X						
		8									X						
		1		7/19/2004							X						
		4									X						
		8									X						
		1		8/16/2004							X						
		4									X						
		8									X						
		1		9/14/2004							X						Toluene (0.5 µg/L)
		4									X						Toluene (0.5 µg/L)
		1		11/16/2004							X						
		4									X						
		1		12/14/2004							X						
		4									X						
		8									X						

Table 9-1 (Con't).

					EPA Method # Scan 1/							µg/L					
Facility	**Station**	**Lake Depth, M**	**Year**	**Date**	**531.1**	**608**	**615**	**Sulfur Pest.**	**547**	**614**	**502.2**	**2,4-D**	**Chlorpyrifos**	**Diuron**	**Metolachlor**	**Simazine**	**Other Compounds**
	Lake Del Valle, DV010000 (Con't)	1	2005	1/18/2005							X						
		4									X						
		8									X						
		1		3/15/2005							X						
		1		4/19/2005							X						
		4									X						
		8									X						
		1		6/14/2005							X						
		4									X						
		8									X						
		1		7/19/2005							X						
		4									X						
		8									X						
		1		8/15/2005							X						
		4									X						
		8									X						
		1		9/20/2005							X						
		4									X						
		8									X						
		1		11/20/2005							X						
		4									X						
		8									X						
		1		12/13/2005							X						
		4									X						
		8									X						
North Bay Aqueduct																	
	Barker Slough Pumping Plant		2004	1/21/2004							X						
				2/18/2004							X						
				4/21/2004							X						
				5/19/2004							X						
				6/15/2004	X	X	X	X	X	X	X			0.34			
				7/21/2004							X						
				8/18/2004							X						
				9/15/2004	X	X	X	X	X	X	X						
				10/20/2004							X						
				11/17/2004							X						
				12/15/2004							X						
			2005	1/19/2005							X						
				2/16/2005							X						
				3/16/2005	X	X	X	X	X	X	X					0.24	
				4/20/2005							X						
				5/18/2005							X						
				6/15/2005	X	X	X	X	X	X	X				0.1	0.02	Trifluralin (0.01µg/L)
				7/20/2005							X						
				8/17/2005							X						
				9/21/2005	X	X	X	X	X	X	X						
				10/19/2005							X						
				11/16/2005							X						
				12/14/2005							X						

1/ 531.1: Carbamate Pesticides; 608: Chlorinated Organic Pesticides; 615: Chlorinated Phenoxy Acid Herbicides;
Sulfur Pest.: DWR Sulfur Pesticides; 547: Glyphosate; 614: Phosphorus/Nitrogen Pesticides;
502.2: Volatile Organics (Purgeable Organics).

10. Special Studies

Groundwater Turn-ins

Over 100,000 af of non-Project groundwater was turned or pumped into the California Aqueduct between June and December, 2004. Around 75% of the total volume came from Kern Water Bank Authority (KWBA) and Semitropic Water Storage District (SWSD), with the rest inputted by Arvin-Edison Water Storage District (AEWSD) (Table 10-1). The turn-ins (groundwater inputs) are located on the aqueduct at mileposts 238, 209, and 277, respectively. Turn-ins to the aqueduct from KWBA and SWSD made up between 4% and 19% of the monthly flow at Check 29. Smaller inputs from AEWSD further downstream made up 0.9% to 4.2% of the monthly volume pumped at Edmonston Pumping Plant (Table 10-1).

Table 10-1. Groundwater turn-in volumes and flows in the California Aqueduct, 2004 (acre-feet unless noted)

Month	Check 21	SWSD	KWBA	Check 29	% of Aqueduct Flow a/	AEWSD	Check 41	% of Aqueduct Flow b/	Total Turn-in
June	342,120			207,335	0	1,664	181,917	0.9	1,664
July	384,530			228,154	0	1,982	204,626	1.0	1,982
August	311,988		8,841	218,675	4	2,829	204,653	1.4	11,670
September	214,312	8,965	15,249	200,396	12	5,098	195,604	2.6	29,312
October	153,684	12,501	16,483	154,711	19	4,293	154,112	2.8	33,277
November	110,422	6,602	8,226	115,347	13	4,957	118,938	4.2	19,785
December	169,736			173,846	0	4,689	178,054	2.6	4,689
Total		28,068	48,799			25,512			102,379
% of Total turn-in		27.4	47.7			24.9			

a/ The product of 100 and (SWSD+KWBA)/Check 29 flow ratio.
b/ The product of 100 and AEWSD/Check 41 flow ratio.

Water quality constituents-of-concern in the turn-ins are shown in Table 10-2. Total and dissolved organic carbon concentrations in all three turn-ins were around 1 mg/L. Bromide was relatively low in KWBA and AEWSD with concentrations of 0.17 and 0.10 mg/L, respectively. Bromide in SWSD declined from 0.58 mg/L in September to 0.14 mg/L in November. During the same two-month period (September 13 to November 12), arsenic in SWSD declined from 0.018 to 0.012 mg/L. Other parameters such as nitrate and sulfate were below their respective MCLs in all three turn-ins.

Table 10-2. Water quality constituents-of-concern in groundwater turn-ins

		Concentration (mg/L unless stated otherwise)									
	Date	As	Br	Cond. (µS/cm)	Cr+6	DOC	TOC	NO3	SO4	TDS	U (pCi/L)
Source	MCL 1/	0.010	none	900 2/	none	none	none	45	250 2/	500 2/	20
KWBA	8/17/2004	0.002	0.17	467	0.0011	0.8	0.8	9.3	47	263	12.4 to 13.1
AEWSD	6/22/2004	0.004	0.10	356	0.0027	0.9	1	7.9	25	195.5	1.08 to 1.22
SWSD	9/13/2004	0.018	0.58	758	0.0041	0.9	1.1	4.8	103	436	
	9/27/2004	0.013	0.49	714		1.2		6.4	89	395	
	10/4/2004	0.014	0.44								
	10/12/2004	0.016									
	10/18/2004	0.013	0.30								
	10/26/2004	0.013	0.16								
	11/4/2004	0.013	0.19								
	11/8/2004	0.013	0.17								
	11/12/2004	0.012	0.14								

1/ Primary Maximum Contaminant Level unless otherwise specified.
2/ Recommended Secondary MCL

Constituents-of-concern in the California Aqueduct upstream (Check 21) and downstream (Check 29) of KWBA and SWSD are graphed in Figure 10-1. The figure shows DOC and TOC were consistently lower at the downstream station during the turn-in period from mid-August to mid-November (horizontal arrow in Figure 10-1). Alternately, arsenic, nitrate, and sulfate were consistently higher at Check 29 than Check 21. Conductivity and TDS were not consistently higher or lower at either station during the turn-in period.

Concentration differences between upstream/downstream sample pairs are in Table 10-3. Bromide averaged 0.033 mg/L lower at Check 29 than Check 21 when the KWBA and SWSD turn-ins were active. The average decline in DOC and TOC was 0.53 and 0.64 mg/L, respectively. The average increase in aqueduct nitrate (0.88 mg/L) and sulfate (3.33 mg/L) was relatively minor compared to the respective MCLs of 45 and 250 mg/L. In four sample pairs, arsenic was higher at Check 29 by 0.001 mg/L, and in the other two, upstream/downstream concentrations were the same. The maximum arsenic concentration of 0.004 mg/L at Check 29 was below the drinking water MCL of 0.01 mg/L.

The AEWSD turn-in, which is located between checks 29 and 41, appeared to reduce DOC and TOC to a small extent during months when the turn-in was active (Figure 10-2). Nitrate and TDS increased slightly between stations during most months. For the other constituents-of-concern, concentrations were not consistently higher or lower between stations.

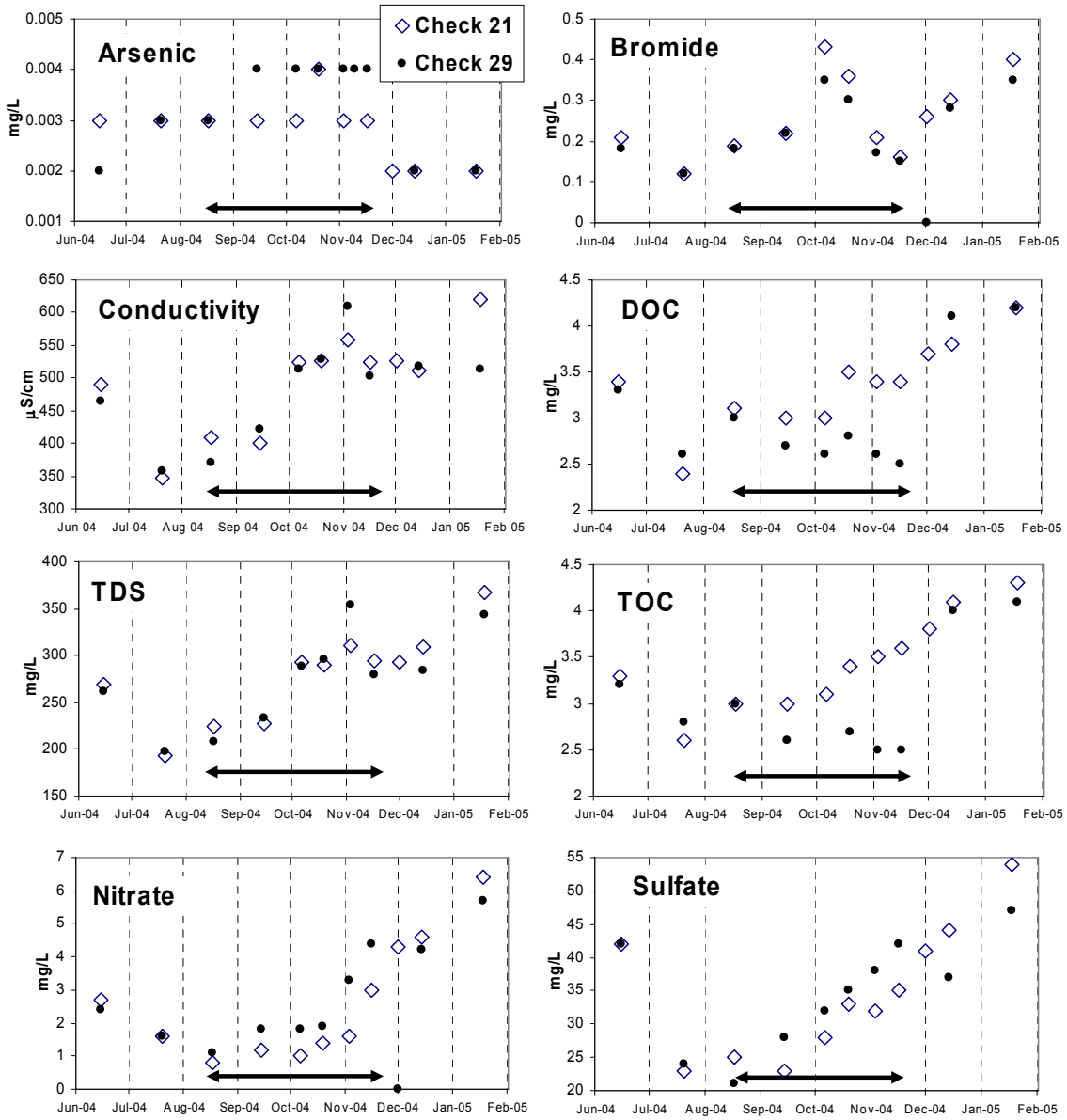

Figure 10-1. Constituents-of-concern in the California Aqueduct upstream and downstream the KWBA and SWSD turn-ins at checks 21 and 29, respectively

Table 10-3. Summary table of upstream and downstream differences in constituents-of-concern between checks 21 and 29

	Concentration Range		Check 29 minus Check 21				
Parameter (mg/L)	Check 21	Check 29	Range	Positive	Negative	Zero	Average
Arsenic	0.003-0.004	0.003-0.004	0.000 to 0.001	4	0	2	0.001
Bromide	0.16-0.43	0.15-0.35	-0.08 to 0.00	0	5	1	-0.033
Conductivity, µS/cm	401-559	371-609	-38 to 50	3	3	0	0.167
TDS	225-310	208-354	-17 to 44	3	3	0	3.33
DOC	3.1-3.5	2.5-3.0	-0.9 to -0.1	0	6	0	-0.53
TOC	3.0-3.6	2.5-3.0	-1 to 0.00	0	4	1	-0.64
Nitrate	0.8-1.6	0.3-1.7	0.3 to 1.7	6	0	0	0.88
Sulfate	23-33	21-42	-4 to 7	5	1	0	3.33

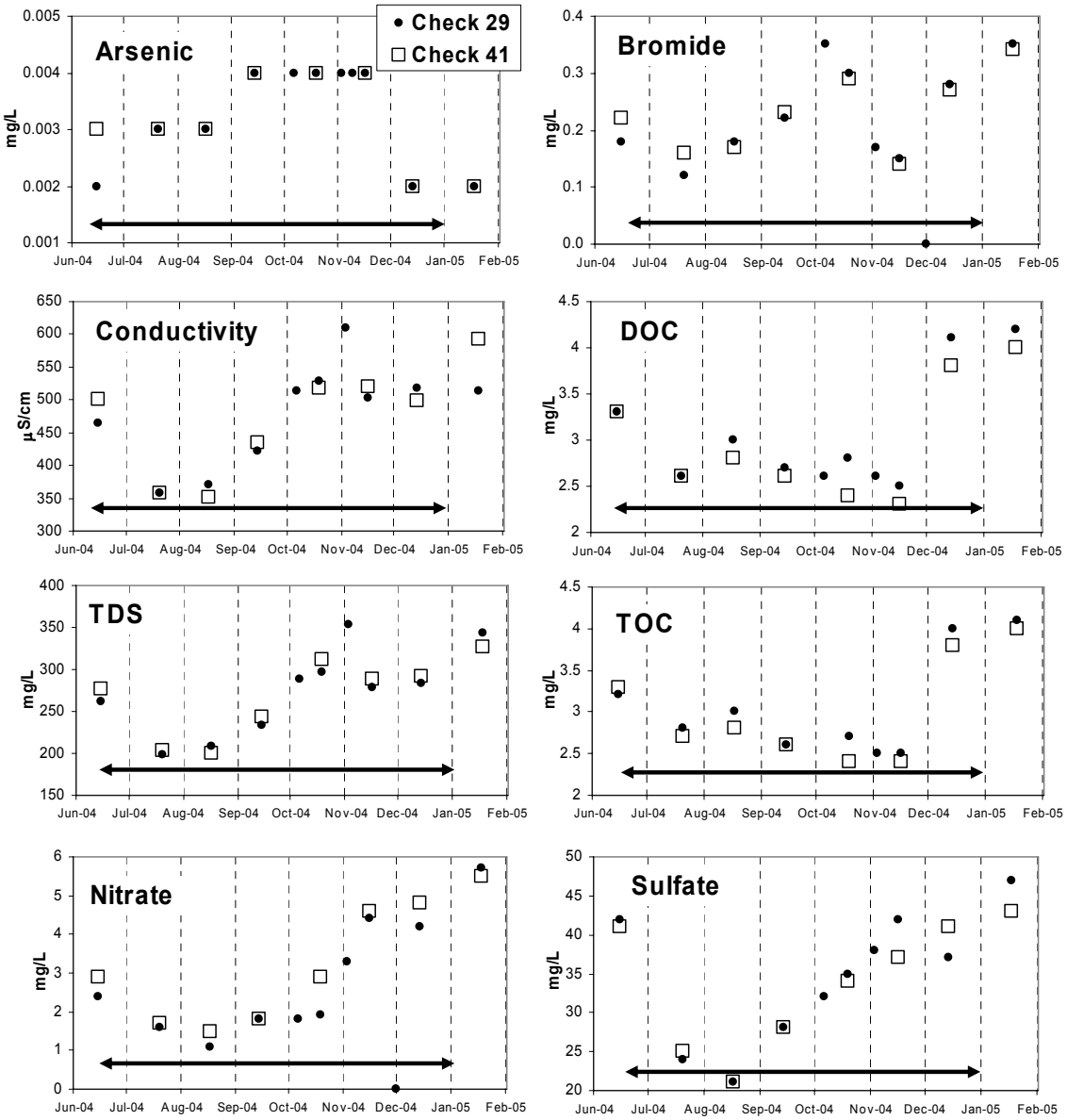

Figure 10-2. Constituents-of-concern in the California Aqueduct upstream and downstream from the AEWSD turn-in at checks 29 and 41, respectively

References

APHA (American Public Health Association), AWWA (American Water Works Association), and WEF (Water Environment Federation). 1995. *Standard Methods for the Examination of Water and Wastewater, 18th Edition.* American Public Health Association, Washington, D.C.

DHS (Department of Health Services). 2005. *Drinking Water Notification Level for Manganese.* California Department of Health Services. February 22. Downloaded on February 2006 from: http://www.dhs.ca.gov/ps/ddwem/chemicals/ manganese/notificationlevel.htm.

DWR (Department of Water Resources). 2007a. *Water Quality in the State Water Project, 2002 and 2003*. Division of Operations and Maintenance, Environmental Assessment Branch. Sacramento, California. July.

—— . 2007b. *Sources of Salinity in the South Sacramento-San Joaquin Delta.* Memorandum report from Barry Montoya, Staff Environmental Scientist, to Dean F. Messer, Environmental Program Manager. Division of Operations and Maintenance, Environmental Assessment Branch. Sacramento, California. May 30.

—— . 2005. *Factors Affecting Total Organic Carbon and Trihalomethane Formation Potential in Exports from the South Sacramento-San Joaquin Delta and Down the California Aqueduct.* Division of Operations and Maintenance, Environmental Assessment Branch. Sacramento, California. October.

—— . 2004. *Factors Affecting the Composition and Salinity of Exports from the South Sacramento-San Joaquin Delta.* Memorandum report from Barry Montoya, Staff Environmental Scientist, to Dan Peterson, Environmental Program Manager. Division of Operations and Maintenance, Environmental Assessment Branch. Sacramento, California. February.

—— . 1965. *The California State Water Project. Water Supply Contracts.* Bulletin No. 141. November.

—— . In prep. *Hydrological and Operational Factors Controlling the Composition and Water Quality of Exports from the Southern Sacramento-San Joaquin Delta, 2004 and 2005*.

USEPA (U. S. Environmental Protection Agency). 1983. *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79-020. Rev. March.

—— . USEPA. 1992. *Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals.* Ground Water and Drinking Water. EPA 810/K-92-001. July. Accessed February 2006 from http://www.epa.gov/safewater/ consumer/2ndstandards.html.

Appendix A. Methods

Monitoring Stations

Water quality monitoring stations are situated on SWP storage and conveyance facilities located throughout California (Table A-1, Figure A-1, and Plates 1 to 5). Water quality samples are collected on or around the third Wednesday of each month. Automated water quality monitoring stations continuously measure several physico-chemical parameters such as conductivity, temperature, and turbidity at multiple locations throughout the SWP.

Water Collection

Water quality sampling, preservation, and transportation protocols are followed as per EPA 1983 and *Standard Methods for the Examination of Water and Wastewater* (APHA et al. 1995). Monitoring protocols for the SWP water quality program are documented in O&M's *Water Quality Field Manual for the State Water Project,* DWR, Environmental Assessment Branch, May 2006. The specifics are briefly described here.

Several field techniques are employed to collect water samples depending on station including use of acrylic Van Dorn Beta samplers with polypropylene stoppers, hand-dipped bottles, stainless steel buckets for organics, or plastic buckets for metals. At stations with automated stations, samples are collected directly from the circulation system. Water is drained from a system valve for 2 to 3 minutes before sample bottles are filled. The circulation piping is PVC and the submerged pump forces 3 to 5 GPM through the system. Automated water quality monitoring stations usually draw water from a depth of about 3 meters. At all other stations, water samples are collected from just below the surface.

Sample filtration is usually performed in the field with a peristaltic pump. A segment of Masterflex® platinum-cured polypropylene tubing is connected to a Pall Gelman AcroPak™ 0.45 micron filter capsule. One capsule is used for all filtered samples, including the filtered field blanks. Filtration of samples is conducted on a clean surface: Clean plastic wrapping is spread out on the sampling bench prior to filtration. Items set on this surface include sample bottles, filter tubing, preservatives, and filter capsules.

Precautions are taken in the field to eliminate sample contamination including the use of "clean" sampling boxes for storage and transport of items used in the collection and filtration process. Clean items include unused filter cartridges, unused sample bottles, filter tubing, and unused baggies. Clean boxes include coolers with hinged tops or polyethylene security containers with flip lids.

Filtered and unfiltered field blanks are prepared using de-ionized water prior to processing the environmental samples. Minor elements analyzed in field blanks include aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, silver, and zinc. A travel blank of de-ionized water is provided by the lab along

with the purgeable organics vials. Once the samples are collected and filtered, they are immediately placed in a cooler with ice and transported to the lab within 24 hours.

Laboratory Methods

Analytical work is performed by DWR's Bryte Chemical Laboratory using the methods shown in Tables A-2 and A-3. As required for environmental laboratory accreditation (ELA Program) in California, Bryte Laboratory filed a Quality Assurance Plan with the California Department of Health Services. The plan covers items required for lab accreditation, such as organization and responsibility, laboratory sample procedures and identification, analytical methods, internal quality control checks, and corrective actions. Internal quality control checks include duplicates, reference standards, and control charts. Details of this plan can be found in *Bryte Chemical Laboratory Quality Assurance Manual*, May 2006 (http://www.wq.water.ca.gov/docs/bryte_pubs/Bryte_QA_Manual_2006.pdf).

Table A-1. Water quality monitoring schedule

Waterbody or Facility	Station Name or Description	Station I.D.	Sampling Frequency 1/											
							Organics							
			Project Standard 2/	Nutrients	Bromide	Iron and Manganese	Chlorinated Organics	Organo-Phosphorus Pesticides	Herbicides	Carbamates	Purgeable Organics	Tot. & Dis. Organic Carbon	UV 254	Automated Monitoring Station
California Aqueduct	Clifton Court Forebay	KA000000	M		M							M		X
	Banks Pumping Plant	KA000331	M	M	M		T	T	T	T	T	M	M	X
	O'Neill Forebay Outlet	KA007089	M		M		T	T	T	T	T	M	M	X
	Check 21	KA017226	M	M	M		T	T	T	T	T	M		X
	Check 29	KA024454	M		M		T	T	T	T	T	M		X
	Check 41	KA030341	M	M	M		T	T	T	T	T	M	M	X
	Check 66	KA040341	Q											X
	Devil Canyon Headworks	KA041134	M	M	M		T	T	T	T	T	M		X
Joint Use Facilities and the DMC	San Luis Res., Trashracks	SL001000												
	San Luis Res., Tunnel Island	SL005000												
	San Luis Res., Pacheco PP	SLR00000	M	M	M							M		X
	CVP Delta Mendota Canal	DMC06716	M		M		T	T	T	T	T	M		
SWP Lakes in Southern California	Pyramid Lake	PY001000	Q	M	Q									
		PY002000												
		PY003000												
	Castaic Lake	CA001000												
		CA002000	Q	M	Q							Q		X
		CA003000												
	Silverwood Lake	SI001000												
		SI002000	Q	M	Q							Q		
	Lake Perris	PE001000												
		PE002000	Q	M	Q							Q		
		PE003000												X
South Bay Aqueduct	Del Valle Check 7	KB001638	M	M	M							M		X
	Del Valle Reservoir	DV001000		M										
	Del Valle Res. Outlet	DV000000	M1	M1	M1							M1		
	Santa Clara Terminal Tank	KB004207												X
North Bay Aqueduct	Barker Sl. Pumping Plant	KG000000	M	M	M		T	T	T	T	T	M4	M4	X
	Cordelia Forebay	KG002111	Q											
Feather River Watershed	Antelope Lake	AN001000	A	A		M3								
	Frenchman Lake	FR001000	A	A										
	Lake Davis	LD001000	A	A		M2								
	Lake Oroville	OR001000		M										
	Thermalito Forebay	TF001000	Q											
	Thermalito Afterbay	TA001000	M	M	Q									

1/ Sampling Frequency : A=Annual Q=Quarterly Q1=Feb, May, Aug-Dec M=Monthly M1=Monthly When Flowing
M2=Apr-Nov M3=May-Sep M4=Weekly in Winter else Monthly, T=Mar, Jun, Sep,

2/ Project Standard: Arsenic, Chromium, Copper, Iron, Lead, Manganese, Selenium, Zinc, Calcium, Magnesium, Sodium, Alkalinity, Sulfate, Chloride, Fluoride, Boron, Nitrate, Dissolved Solids, Turbidity, and Conductivity Barium, Berillium, Cadmium, Aluminum, Mercury, Nickel, and Silver.

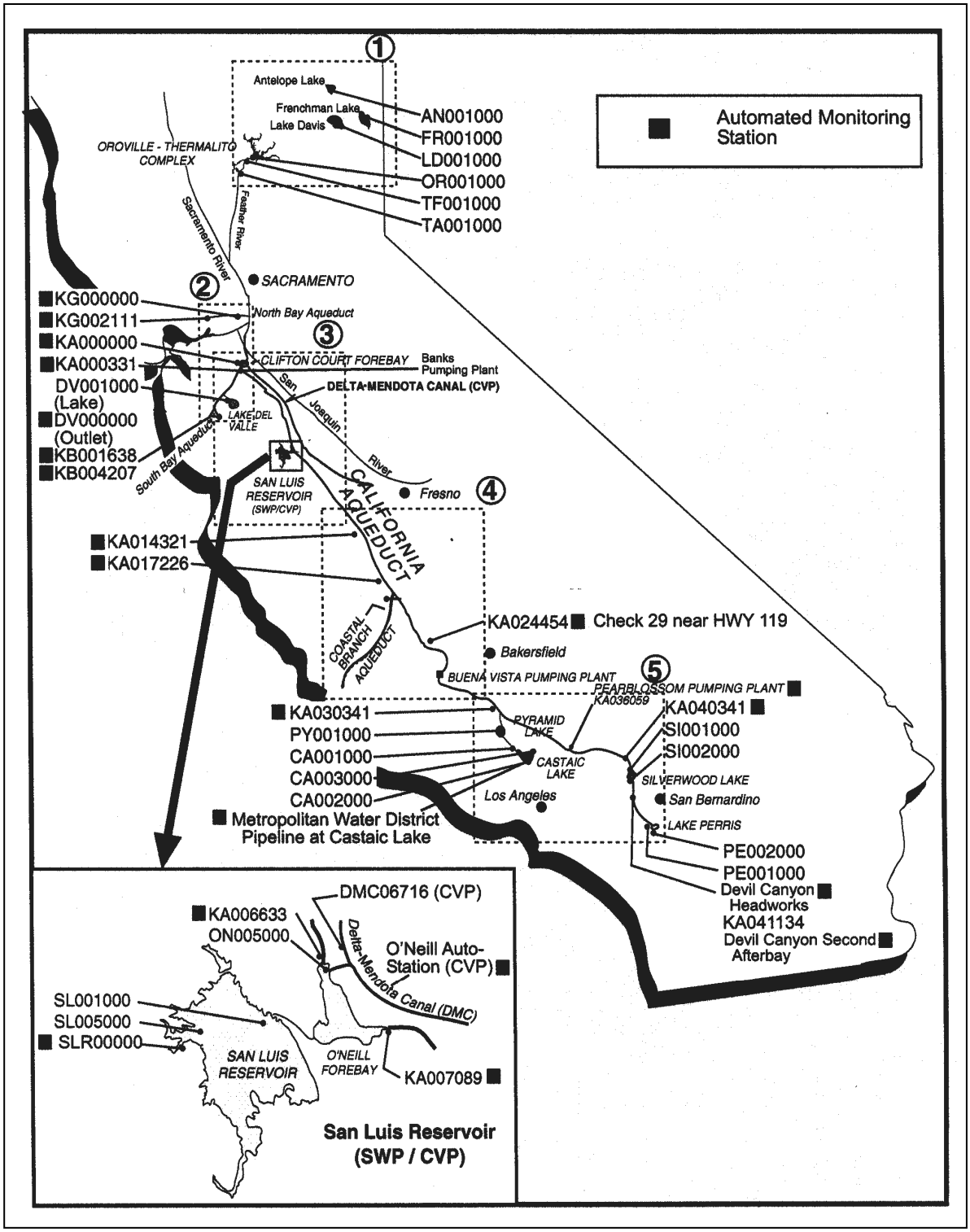

Figure A-1. Water quality monitoring stations in the State Water Project. The circled numbers indicate plate numbers that detail the dotted-outlined areas.

Plate 1. Water quality monitoring stations in the Oroville-Thermalito complex and upper Feather River lakes

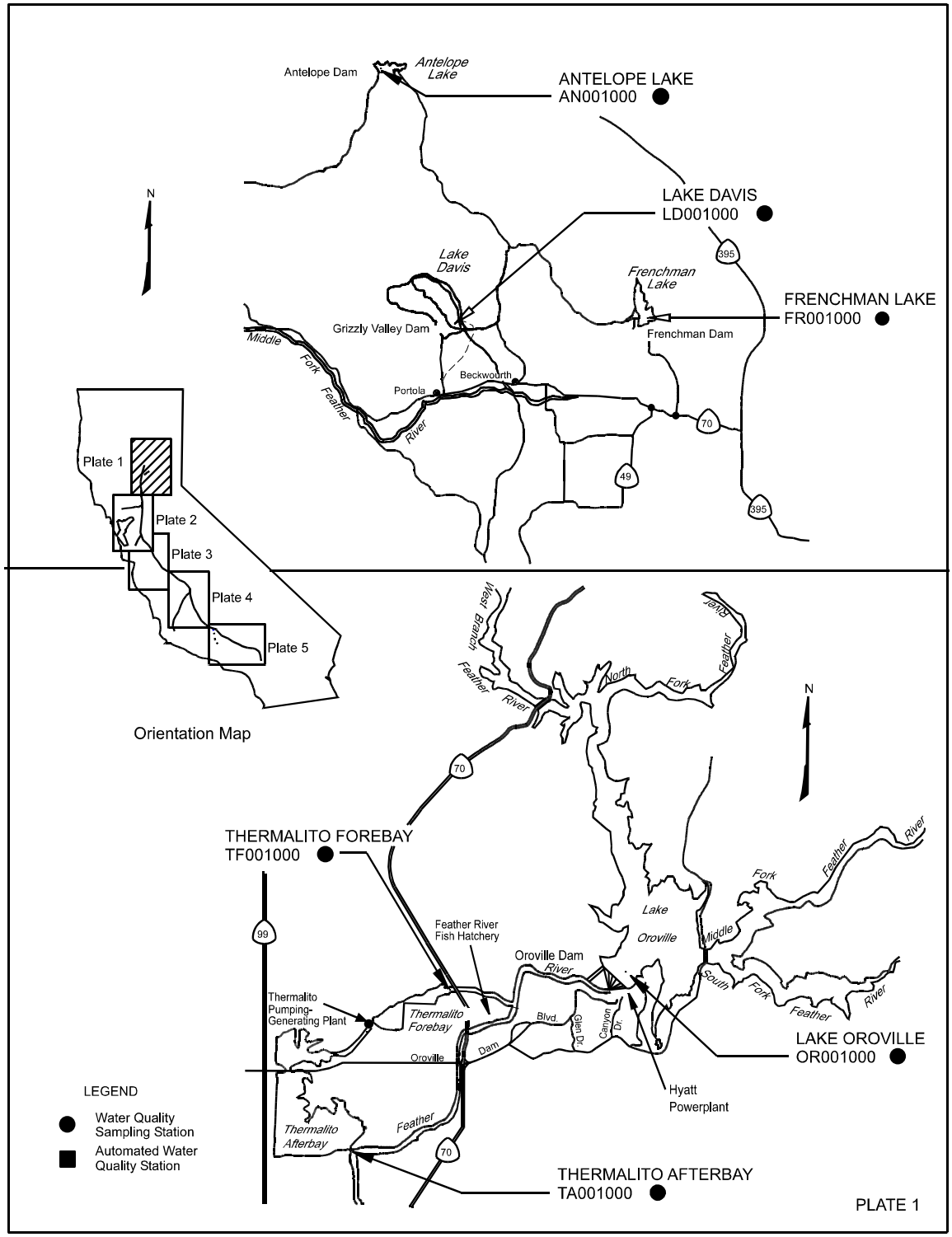

Plate 2. Water quality monitoring stations in the North and South Bay Aqueducts

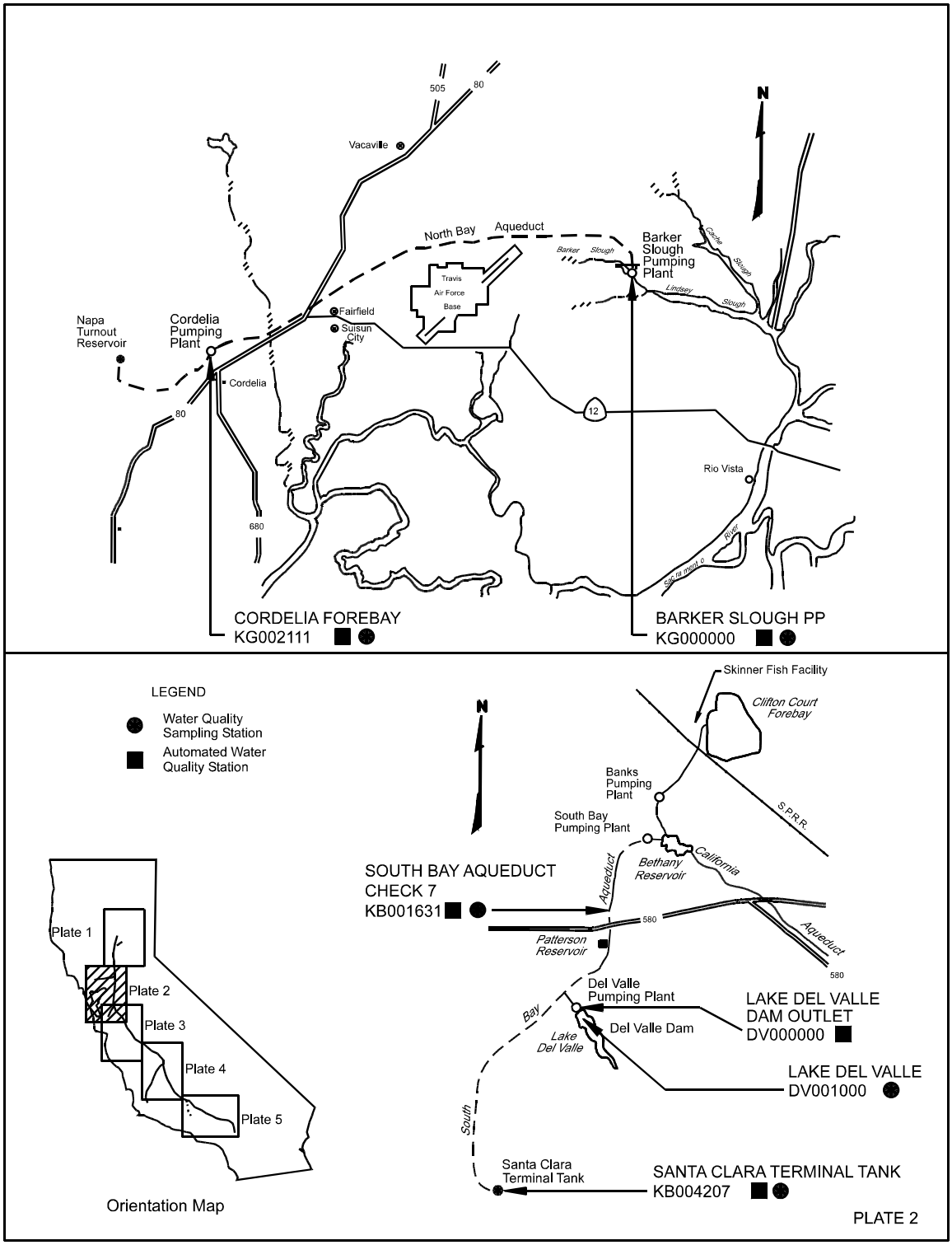

Plate 3. Water quality monitoring stations in the California Aqueduct from Clifton Court Forebay to Cantua Creek and the CVP Delta-Mendota Canal at O'Neill Forebay

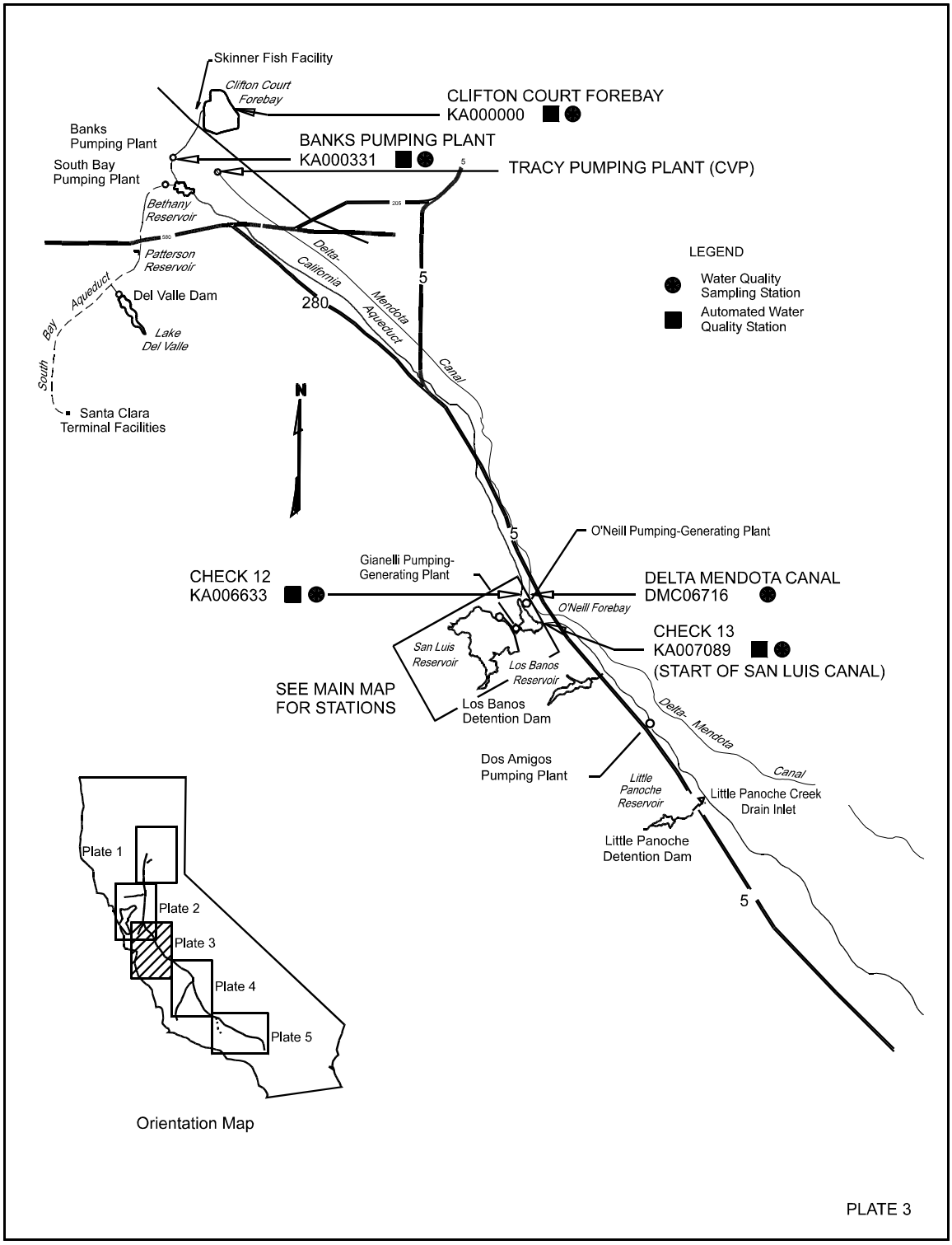

Plate 4. Water quality monitoring stations in the California Aqueduct from Cantua Creek to Edmonston Pumping Plant

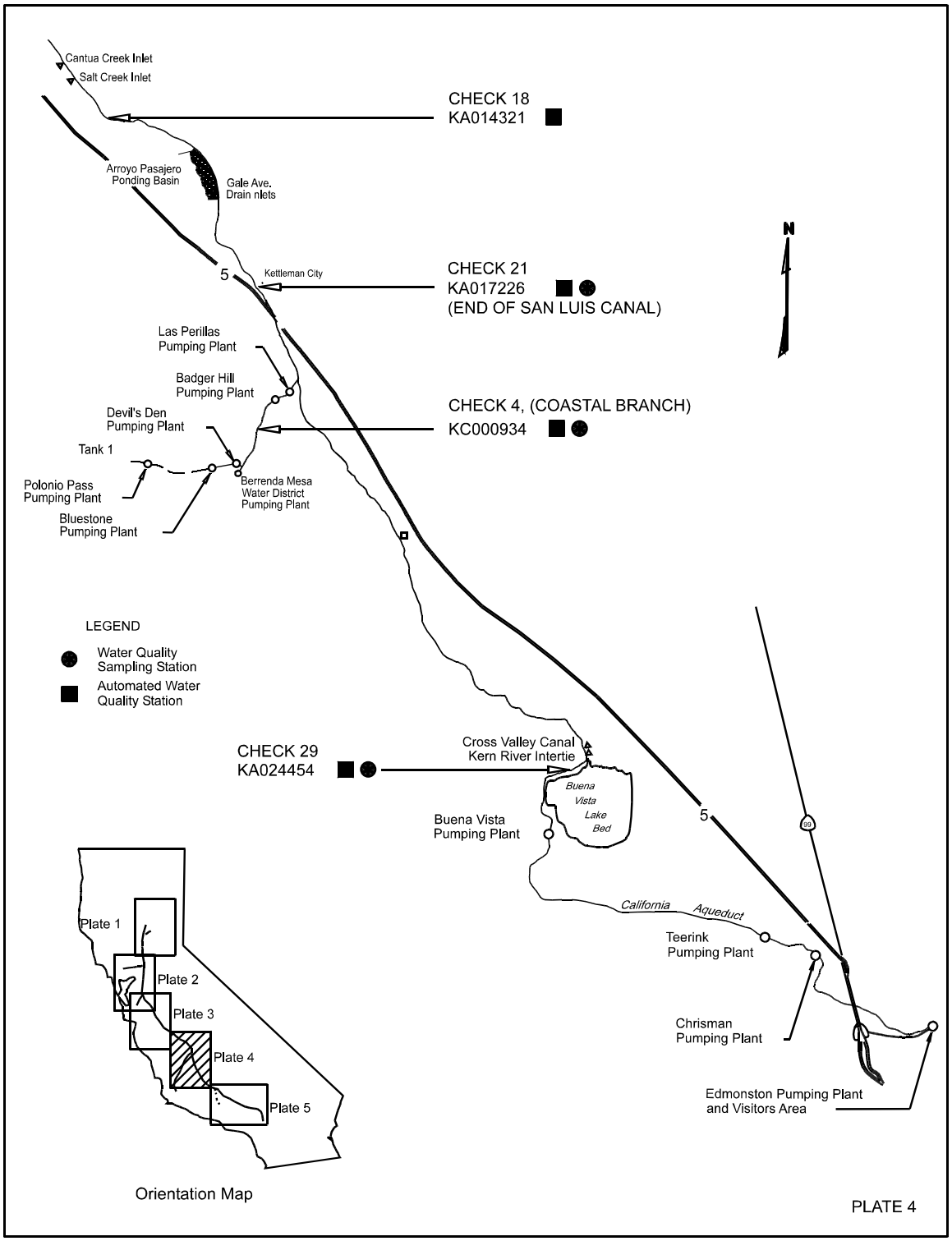

Plate 5. Water quality monitoring stations in the East and West Branches of the California Aqueduct and SWP southern reservoirs

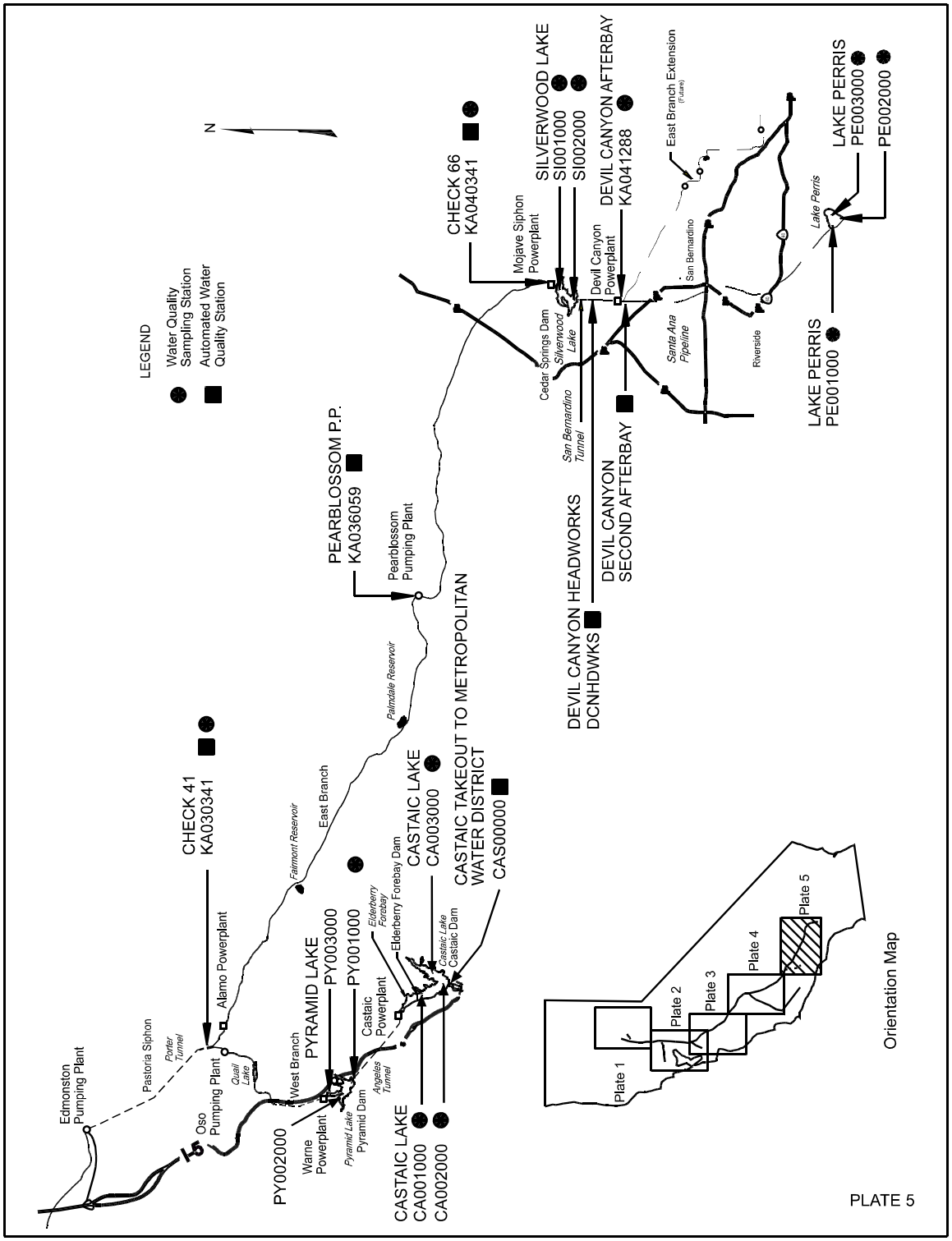

Table A-2. Analytical methods for non-organic chemical parameters

Analyte	Method Title	Reporting Limit	Units	MethodName
Alkalinity	Alkalinity	1	mg/L as CaCO3	Std Method 2320 B
Conductance (EC)	Electrical Conductivity (EC)	1	µS/cm	Std Method 2510-B
Dissolved Aluminum	ICP/MS Trace Elements (Dissolved)	0.01	mg/L	EPA 200.8 (D)
Dissolved Ammonia	Ammonia, Nitrogen (Dissolved)	0.01	mg/L as N	EPA 350.1
Dissolved Antimony	ICP/MS Trace Elements (Dissolved)	0.005	mg/L	EPA 200.8 (D)
Dissolved Arsenic	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Barium	ICP/MS Trace Elements (Dissolved)	0.050	mg/L	EPA 200.8 (D)
Dissolved Beryllium	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Boron	ICP Metals and Trace Elements (Dissolved)	0.100	mg/L	EPA 200.7 (D)
Dissolved Bromide	Inorganic Anions 28d hold	0.01	mg/L	EPA 300.0 28d Hold
Dissolved Cadmium	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Calcium	ICP Metals and Trace Elements (Dissolved)	1	mg/L	EPA 200.7 (D)
Dissolved Chloride	Inorganic Anions 28d hold	1	mg/L	EPA 300.0 28d Hold
Dissolved Chromium	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Chromium, hexavalent (Cr6+)	Chromium, Hexavalent by Ion Chromatography	0.001	mg/L	EPA 218.6
Dissolved Copper	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Fluoride	Inorganic Anions 28d hold	0.1	mg/L	EPA 300.0 28d Hold
Dissolved Iron	ICP/MS Trace Elements (Dissolved)	0.005	mg/L	EPA 200.8 (D)
Dissolved Lead	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Magnesium	ICP Metals and Trace Elements (Dissolved)	1	mg/L	EPA 200.7 (D)
Dissolved Manganese	ICP/MS Trace Elements (Dissolved)	0.005	mg/L	EPA 200.8 (D)
Dissolved Mercury	Mercury by EPA Method 200.8 (Dissovled)	0.0002	mg/L	EPA 200.8 (Hg Dissolved)
Dissolved Nickel	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Nitrate	Nitrate, Ortho Phosphate 48hr Hold	0.1	mg/L	EPA 300.0 48 hr (N03, OP)
Dissolved Nitrite + Nitrate	Nitrite, Nitrate (DWR Modified) (Dissolved)	0.01	mg/L as N	Std Method 4500-NO3-F Modified
Dissolved Organic Carbon	Organic Carbon (Dissolved) by Wet Oxidation	0.1	mg/L as C	EPA 415.1 (D) Ox
Dissolved Ortho-phosphate	Ortho-phosphate (Dissolved)	0.01	mg/L as P	Std Method 4500-P, F
Dissolved Selenium	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Silver	ICP/MS Trace Elements (Dissolved)	0.001	mg/L	EPA 200.8 (D)
Dissolved Sodium	ICP Metals and Trace Elements (Dissolved)	1	mg/L	EPA 200.7 (D)
Dissolved Sulfate	Inorganic Anions 28d hold	1	mg/L	EPA 300.0 28d Hold
Dissolved Zinc	ICP/MS Trace Elements (Dissolved)	0.005	mg/L	EPA 200.8 (D)
Hardness	Hardness By Calculation	1	mg/L as CaCO3	Std Method 2340 B
Total Dissolved Solids	Total Dissolved Solids (TDS)	1	mg/L	Std Method 2540-C
Total Kjeldahl Nitrogen	Kjeldahl Nitrogen	0.1	mg/L as N	EPA 351.2
Total Organic Carbon	Organic Carbon (Total) by Combustion	0.5	mg/L as C	EPA 415.1 (T) Cmbst
Total Organic Carbon	Organic Carbon (Total) by Wet Oxidation	0.1	mg/L as C	EPA 415.1 (T) Ox
Total Phosphorus	Phosphorus (Total)	0.01	mg/L	EPA 365.4
Total Suspended Solids	Total Suspended Solids	1	mg/L	EPA 160.2
Turbidity	Turbidity	1	N.T.U.	EPA 180.1
UV Absorbance @254nm	UVA	0.001	absorbance/cm	Std Method 5910B
Volatile Suspended Solids	Volatile Suspended Solids	1	mg/L	EPA 160.4

Table A-3. Analytical methods for organic chemicals

Method Title	Analyte	Reporting Limit	Units	Method Name
Carbamate Pesticides	3-Hydroxycarbofuran	2	µg/L	EPA 531.1
	Aldicarb	2	µg/L	EPA 531.1
	Aldicarb sulfone	2	µg/L	EPA 531.1
	Aldicarb sulfoxide	2	µg/L	EPA 531.1
	Carbaryl	2	µg/L	EPA 531.1
	Carbofuran	2	µg/L	EPA 531.1
	Formetanate hydrochloride	100	µg/L	EPA 531.1
	Methiocarb	4	µg/L	EPA 531.1
	Methomyl	2	µg/L	EPA 531.1
	Oxamyl	2	µg/L	EPA 531.1
Chlorinated Organic Pesticides	Alachlor	0.05	µg/L	EPA 608
	Aldrin	0.01	µg/L	EPA 608
	Atrazine	0.02	µg/L	EPA 608
	BHC-alpha	0.01	µg/L	EPA 608
	BHC-beta	0.01	µg/L	EPA 608
	BHC-delta	0.01	µg/L	EPA 608
	BHC-gamma (Lindane)	0.01	µg/L	EPA 608
	Captan	0.02	µg/L	EPA 608
	Chlordane	0.05	µg/L	EPA 608
	Chlorothalonil	0.01	µg/L	EPA 608
	Chlorpropham	0.02	µg/L	EPA 608
	Chlorpyrifos	0.01	µg/L	EPA 608
	Cyanazine	0.3	µg/L	EPA 608
	Dacthal (DCPA)	0.01	µg/L	EPA 608
	Dichloran	0.01	µg/L	EPA 608
	Dicofol	0.05	µg/L	EPA 608
	Dieldrin	0.01	µg/L	EPA 608
	Diuron	0.25	µg/L	EPA 608
	Endosulfan sulfate	0.02	µg/L	EPA 608
	Endosulfan-I	0.01	µg/L	EPA 608
	Endosulfan-II	0.01	µg/L	EPA 608
	Endrin	0.01	µg/L	EPA 608
	Endrin aldehyde	0.01	µg/L	EPA 608
	Heptachlor	0.01	µg/L	EPA 608
	Heptachlor epoxide	0.01	µg/L	EPA 608
	Methoxychlor	0.05	µg/L	EPA 608
	Metolachlor	0.2	µg/L	EPA 608
	Oxyfluorfen	0.2	µg/L	EPA 608
	p,p'-DDD	0.01	µg/L	EPA 608
	p,p'-DDE	0.01	µg/L	EPA 608
	p,p'-DDT	0.05	µg/L	EPA 608
	PCB-1016	0.1	µg/L	EPA 608
	PCB-1221	0.1	µg/L	EPA 608
	PCB-1232	0.1	µg/L	EPA 608
	PCB-1242	0.1	µg/L	EPA 608
	PCB-1248	0.1	µg/L	EPA 608
	PCB-1254	0.1	µg/L	EPA 608
	PCB-1260	0.1	µg/L	EPA 608
	Pentachloronitrobenzene (PCNB)	0.01	µg/L	EPA 608
	Simazine	0.02	µg/L	EPA 608
	Thiobencarb	0.02	µg/L	EPA 608
	Toxaphene	0.4	µg/L	EPA 608
Chlorinated Phenoxy Acid Herbicides	2,4,5-T	0.1	µg/L	EPA 615
	2,4,5-TP (Silvex)	0.1	µg/L	EPA 615
	2,4-D	0.1	µg/L	EPA 615
	2,4-DB	0.1	µg/L	EPA 615
	Dacthal (DCPA)	0.1	µg/L	EPA 615
	Dicamba	0.1	µg/L	EPA 615
	Dichlorprop	0.1	µg/L	EPA 615
	Dinoseb (DNPB)	0.1	µg/L	EPA 615
	MCPA	0.1	µg/L	EPA 615
	MCPP	0.1	µg/L	EPA 615
	Pentachlorophenol (PCP)	0.1	µg/L	EPA 615
	Picloram	0.1	µg/L	EPA 615
	Triclopyr	0.1	µg/L	EPA 615
DWR Sulfur Pesticides	Propargite	1	µg/L	DWR Sulfur Pesticides
Glyphosate	Aminomethylphosphonic Acid (AMPA)	100	µg/L	EPA 547
Glyphosate	Glyphosate	100	µg/L	EPA 547
Phosphorus / Nitrogen Pesticides	Azinphos methyl (Guthion)	0.05	µg/L	EPA 614
	Benfluralin	0.01	µg/L	EPA 614
	Bromacil	1	µg/L	EPA 614
	Carbophenothion (Trithion)	0.02	µg/L	EPA 614
	Chlorpyrifos	0.01	µg/L	EPA 614
	Cyanazine	0.3	µg/L	EPA 614
	Demeton (Demeton O + Demeton S)	0.02	µg/L	EPA 614
	Diazinon	0.01	µg/L	EPA 614
	Dimethoate	0.01	µg/L	EPA 614
	Disulfoton	0.01	µg/L	EPA 614
	Ethion	0.01	µg/L	EPA 614
	Malathion	0.01	µg/L	EPA 614
	Methidathion	0.02	µg/L	EPA 614
	Mevinphos	0.01	µg/L	EPA 614
	Naled	0.02	µg/L	EPA 614
	Napropamide	5	µg/L	EPA 614
	Norflurazon	5	µg/L	EPA 614
	Parathion (Ethyl)	0.01	µg/L	EPA 614
	Parathion, Methyl	0.01	µg/L	EPA 614
	Pendimethalin	5	µg/L	EPA 614
	Phorate	0.01	µg/L	EPA 614
	Phosalone	0.02	µg/L	EPA 614
	Phosmet	0.02	µg/L	EPA 614

Table A-3. Analytical methods for organic chemicals (Con't)

Method Title	Analyte	Reporting Limit	Units	Method Name
	Profenofos	0.01	µg/L	EPA 614
	Prometryn	0.05	µg/L	EPA 614
	Propetamphos	0.1	µg/L	EPA 614
	s,s,s-Tributyl Phosphorotrithioate (DEF)	0.01	µg/L	EPA 614
	Trifluralin	0.01	µg/L	EPA 614
Volatile Organics in Water (Purgeable Organics)	1,1,1,2-Tetrachloroethane	0.5	µg/L	EPA 502.2
	1,1,1-Trichloroethane	0.5	µg/L	EPA 502.2
	1,1,2,2-Tetrachloroethane	0.5	µg/L	EPA 502.2
	1,1,2-Trichloroethane	0.5	µg/L	EPA 502.2
	1,1-Dichloroethane	0.5	µg/L	EPA 502.2
	1,1-Dichloroethene	0.5	µg/L	EPA 502.2
	1,1-Dichloropropene	0.5	µg/L	EPA 502.2
	1,2,3-Trichlorobenzene	0.5	µg/L	EPA 502.2
	1,2,3-Trichloropropane	0.5	µg/L	EPA 502.2
	1,2,4-Trichlorobenzene	0.5	µg/L	EPA 502.2
	1,2,4-Trimethylbenzene	0.5	µg/L	EPA 502.2
	1,2-Dibromo-3-chloropropane (DBCP)	0.5	µg/L	EPA 502.2
	1,2-Dibromoethane	0.5	µg/L	EPA 502.2
	1,2-Dichlorobenzene	0.5	µg/L	EPA 502.2
	1,2-Dichloroethane	0.5	µg/L	EPA 502.2
	1,2-Dichloropropane	0.5	µg/L	EPA 502.2
	1,3,5-Trimethylbenzene	0.5	µg/L	EPA 502.2
	1,3-Dichlorobenzene	0.5	µg/L	EPA 502.2
	1,3-Dichloropropane	0.5	µg/L	EPA 502.2
	1,4-Dichlorobenzene	0.5	µg/L	EPA 502.2
	2,2-Dichloropropane	0.5	µg/L	EPA 502.2
	2-Chlorotoluene	0.5	µg/L	EPA 502.2
	4-Chlorotoluene	0.5	µg/L	EPA 502.2
	4-Isopropyltoluene	0.5	µg/L	EPA 502.2
	Benzene	0.5	µg/L	EPA 502.2
	Bromobenzene	0.5	µg/L	EPA 502.2
	Bromochloromethane	0.5	µg/L	EPA 502.2
	Bromodichloromethane	0.5	µg/L	EPA 502.2
	Bromoform	0.5	µg/L	EPA 502.2
	Bromomethane	0.5	µg/L	EPA 502.2
	Carbon tetrachloride	0.5	µg/L	EPA 502.2
	Chlorobenzene	0.5	µg/L	EPA 502.2
	Chloroethane	0.5	µg/L	EPA 502.2
	Chloroform	0.5	µg/L	EPA 502.2
	Chloromethane	0.5	µg/L	EPA 502.2
	cis-1,2-Dichloroethene	0.5	µg/L	EPA 502.2
	cis-1,3-Dichloropropene	0.5	µg/L	EPA 502.2
	Dibromochloromethane	0.5	µg/L	EPA 502.2
	Dibromomethane	0.5	µg/L	EPA 502.2
	Dichlorodifluoromethane	0.5	µg/L	EPA 502.2
	Ethyl benzene	0.5	µg/L	EPA 502.2
	Hexachlorobutadiene	0.5	µg/L	EPA 502.2
	Isopropylbenzene	0.5	µg/L	EPA 502.2
	m + p Xylene	0.5	µg/L	EPA 502.2
	Methyl tert-butyl ether (MTBE)	1	µg/L	EPA 502.2
	Methylene chloride	0.5	µg/L	EPA 502.2
	Naphthalene	0.5	µg/L	EPA 502.2
	n-Butylbenzene	0.5	µg/L	EPA 502.2
	n-Propylbenzene	0.5	µg/L	EPA 502.2
	o-Xylene	0.5	µg/L	EPA 502.2
	sec-Butylbenzene	0.5	µg/L	EPA 502.2
	Styrene	0.5	µg/L	EPA 502.2
	tert-Butylbenzene	0.5	µg/L	EPA 502.2
	Tetrachloroethene	0.5	µg/L	EPA 502.2
	Toluene	0.5	µg/L	EPA 502.2
	trans-1,2-Dichloroethene	0.5	µg/L	EPA 502.2
	trans-1,3-Dichloropropene	0.5	µg/L	EPA 502.2
	Trichloroethene	0.5	µg/L	EPA 502.2
	Trichlorofluoromethane	0.5	µg/L	EPA 502.2
	Vinyl chloride	0.5	µg/L	EPA 502.2

Appendix B. Maximum Contaminant Levels

(http://www.cdph.ca.gov/certlic/drinkingwater/Pages/default.aspx, Feb 2009)

MAXIMUM CONTAMINANT LEVELS AND REGULATORY DATES FOR DRINKING WATER
U.S. EPA VS CALIFORNIA
NOVEMBER 2008

Contaminant	U.S. EPA		California	
	MCL (mg/L)	**Date**[a]	**MCL** (mg/L)	**Effective Date**
Inorganics				
Aluminum	0.05 to 0.2[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 0.010	eff: 6/24/77 eff: 1/23/06	0.05 0.010	77 11/28/08
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]	77 12/11/95
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
Perchlorate	-	-	0.006	10/18/07
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 ug/L	12/7/00	20 pCi/L 20 pCi/L	1/1/89 6/11/06
Combined Radium - 226+228	5 pCi/L	eff: 6/24/77	5 pCi/L 5 pCi/L	77 6/11/06
Gross Alpha particle activity (excluding radon & uranium)	15 pCi/L	eff: 6/24/77	15 pCi/L 15 pCi/L	77 6/11/06
Gross Beta particle activity	4 millirem/yr	eff: 6/24/77	50 pCi/L[f] 4 millirem/yr	77 6/11/06
Strontium-90	8 pCi/L	eff: 6/24/77 now covered by Gross Beta	8 pCi/L[f] 8 pCi/L[f]	77 6/11/06
Tritium	20,000 pCi/L	eff: 6/24/77 now covered by Gross Beta	20,000 pCi/L[f] 20,000 pCi/L[f]	77 6/11/06

Appendix B (Con't)

Contaminant	U.S. EPA		California	
	MCL (mg/L)	**Date**[a]	**MCL** (mg/L)	**Effective Date**
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 Trichlorobenzene	0.07	7/92	0.07 0.005	9/8/94 6/12/03
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

Appendix B (Con't)

Contaminant	U.S. EPA		California	
	MCL (mg/L)	Date[a]	MCL (mg/L)	Effective Date
SOCS				
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	0.1 0.07	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
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

Appendix B (Con't)

Contaminant	U.S. EPA		California	
	MCL (mg/L)	**Date**[a]	**MCL** (mg/L)	**Effective Date**
Disinfection Byproducts				
Total Trihalomethanes	0.100 0.080	11/29/79 eff: 11/29/83 eff: 1/1/02 [g]	0.100 0.080	3/14/83 6/17/06
Haloacetic acids (five)	0.060	eff: 1/1/02 [g]	0.060	6/17/06
Bromate	0.010	eff: 1/1/02 [g]	0.010	6/17/06
Chlorite	1.0	eff: 1/1/02 [g]	1.0	6/17/06
Treatment Technique				
Acrylamide	TT[h]	1/91	TT[h]	9/8/94
Epichlorohydrin	TT[h]	1/91	TT[h]	9/8/94

a. "eff." indicates the date the MCL took effect; any other date provided indicates when USEPA established (i.e., 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. Gross beta MCL is 4 millirem/year annual dose equivalent to the total body or any internal organ; Sr-90 MCL = 4 millirem/year to bone marrow; tritium MCL = 4 millirem/year to total body
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.

Secondary Maximum Contaminant Levels
Effective September 27, 2006

"Consumer Acceptance ~~Limits~~ Contaminant Levels"

Constituents	*Maximum Contaminant Levels/Units*
Aluminum	0.2 mg/L
Color	15 Units
Copper	1.0 mg/L
~~Corrosivity~~	~~Non-corrosive~~
Foaming Agents (MBAS)	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Methyl-*tert*-butyl ether (MTBE)	0.005 mg/L
Odor—Threshold	3 Units
Silver	0.1 mg/L
Thiobencarb	0.001 mg/L
Turbidity	5 Units
Zinc	5.0 mg/L

Appendix B (Con't)

	Maximum Contaminant Level Ranges		
Constituent, Units	*Recommended*	*Upper*	*Short Term*
Total Dissolved Solids, mg/L	500	1,000	1,500
or			
Specific Conductance, ~~micromhos~~ µS/cm	900	1,600	2,200
Chloride, mg/L	250	500	600
Sulfate, mg/L	250	500	600