6-2

(189)

Staff Report

Tinemaha Reservoir, Inyo County

Recommendation to Remove Tinemaha Reservoir from the Clean Water Act Section 303(d) List of Impaired Waterbodies

California Regional Water Quality Control Board
Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150

December 2003

Contact Person:
Anne Sutherland
Engineering Geologist
Asutherland@rb6s.swrcb.ca.gov
530/542-5450

Table of Contents

Tables and Figures

1. INTRODUCTION

Section 305(b) of the Clean Water Act (CWA) mandates biennial assessment of the nation's water resources, and these water quality assessments are used to identify and list those waters which are not achieving water quality standards. The resulting list is referred to as the 303(d) list. The CWA also requires States to establish a priority ranking for these impaired waters and to develop Total Maximum Daily Loads (TMDLs). A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and it allocates pollutant loadings to point and non-point sources such that those standards will be met.

Tinemaha Reservoir was listed as impaired in 1994 due to elevated arsenic concentrations detected during 1991 water quality sampling for the *Mono Basin Water Rights Environmental Impact Report* (Jones and Stokes Assoc., 1993). The 1994 303(d) list also described the arsenic listing as a "metals" impairment (arsenic is a metalloid element). Because the arsenic detected in the reservoir is naturally occurring, the arsenic impairment listing was removed during the 2002 303(d) listing cycle. However, the reservoir owners, the Los Angeles Department of Water and Power (LADWP), routinely monitor water quality at the reservoir's outlet for various constituents, including copper. These data indicated exceedances of California Toxics Rule (CTR) aquatic life protection criteria for copper, so the "metals" impairment was refined to the more specific '"copper" designation and the reservoir remained on the 303(d) list. LADWP historically applied copper sulfate to the reservoir to control algae blooms which can impart foul taste and odor in the drinking water supply if left untreated.

As a first step in TMDL development, Regional Board and LADWP staff worked together to develop a sampling plan to determine the current concentrations of dissolved copper in the major tributary entering the reservoir and at the reservoir outlet. Following a ten-month copper sampling program, the data show that the reservoir is in compliance with water quality standards for total and dissolved copper. Therefore, Regional Board staff recommend that Tinemaha Reservoir be removed from the 303(d) list during the next listing cycle. The purpose of this report is to provide supporting data to justify the removal of the reservoir from the 303(d) list. Future copper sulfate applications to control algae will be conducted and monitored as outlined in the National Pollution Discharge Elimination System (NPDES) Aquatic Pesticides General Permit Monitoring and Reporting Program for Tinemaha Reservoir, discussed in further detail in Section 6.

2. PROJECT AREA DESCRIPTION

2.1. Location and Geography

Tinemaha Reservoir is located in the Owens Valley just east of Highway 395 in Inyo County, about 7 miles south of the town of Big Pine. Figure 1 shows the reservoir's location. The Owens Valley is characterized as high desert rangeland, with valley floor elevations ranging from 6,000 feet above mean sea level (amsl) near Mono Lake to about 3,500 feet amsl at Owens (dry) Lake. The mountains that surround the watershed rise more than 9,000 feet from the valley floor and include Mount Whitney at 14,494 feet amsl, the highest mountain in the contiguous United

States. The major river in the watershed is the Owens River, which meanders southward through the valley. The headwaters of the Owens River are in the Long Valley area, in the northern portion of the Owens River watershed.

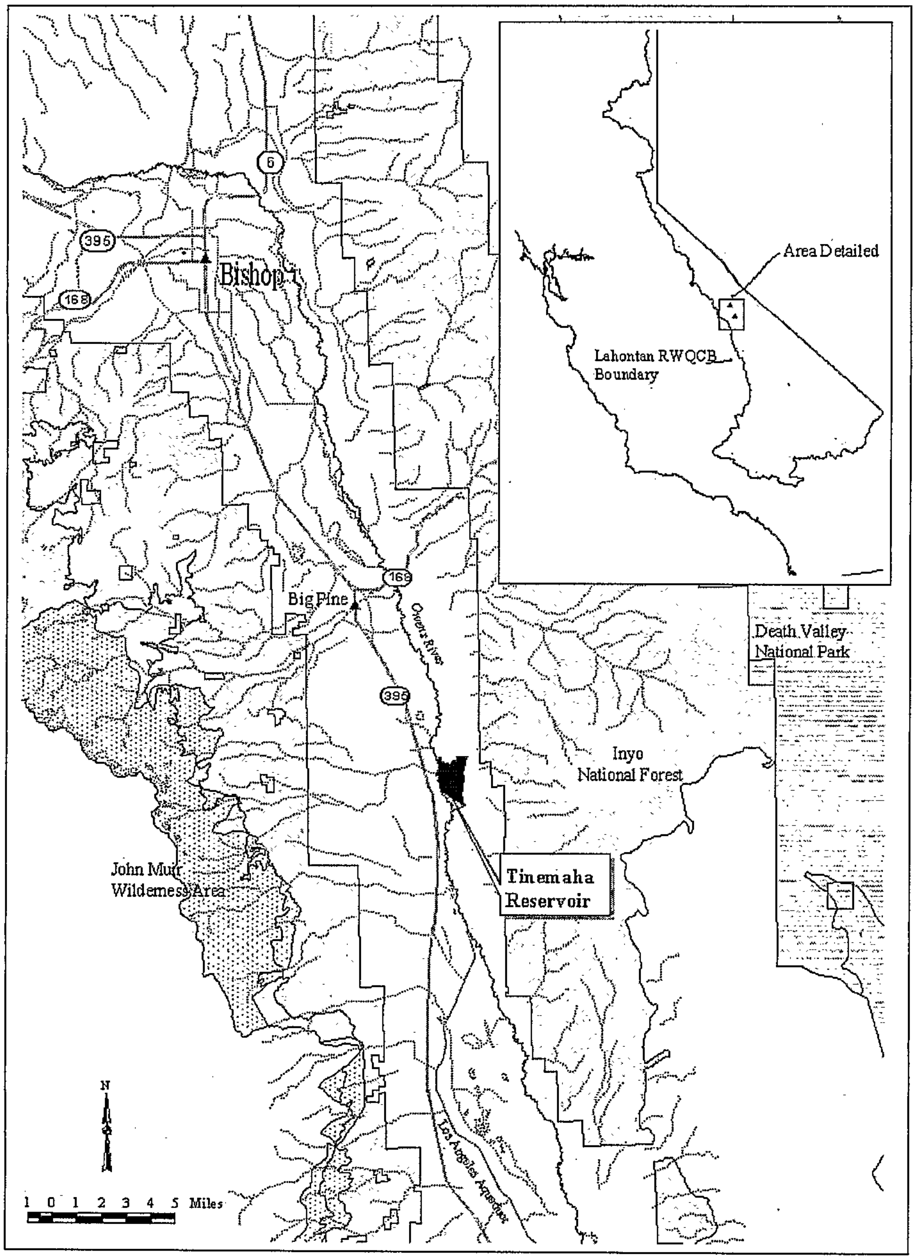

Figure 1. Tinemaha Reservoir Location Map.

2.2. Waterbody Description and Water Uses

Tinemaha Reservoir is one of several reservoirs in the LADWP's Owens River/Los Angeles Aqueduct municipal supply system. It receives inflow from the Middle Owens River and Tinemaha Creek. It was constructed to provide short term-regulation of the Owens River before it's diverted into the Los Angeles Aqueduct (LAA), about 5 miles downstream of the reservoir outlet. Tinemaha Reservoir has a surface area of 2,098 acres and a drainage area of 1,915 square miles. The average depth of the reservoir at normal operating elevations ranges from three to five feet. The maximum storage is about 16,000 acre feet, although earthquake safety concerns have limited the useable storage to 10,000 acre feet in recent years.

Below Tinemaha Reservoir, flow in the Owens River continues for approximately 5 miles before nearly all the water is diverted into the unlined channel of the LAA at the Aberdeen intake. South of the intake, partial flows are maintained in the natural channel of Owens River by groundwater contributions and intermittent operational releases from the LAA. On its way to Los Angeles, water from the LAA passes through 11 power plants to supply the needs of 220,000 homes. Annual water demands in Los Angeles are about 660,000 acre-feet with an average per capita use of 150 gallons per day. About two-thirds of the City's demand is for residential uses, almost equally shared by single-family and multi-family units. About one quarter of the demand is for commercial and governmental uses, with a very small amount used by industry. The City's water demand is expected to grow to 756,000 acre-feet per year by 2015, an increase to support the projected population of 4,550,000 (LADWP, 1996).

In-valley uses of water include local municipal needs, Indian reservations, stockwater, irrigation of pastures, and cultivation of alfalfa. About 190,000 acres of the Owens Valley floor is leased by the LADWP to ranchers for grazing, and about 12,400 additional acres is leased for growing alfalfa. Several Owens Valley fish hatcheries (Fish Springs, Blackrock, and Mt. Whitney) also rely on ground and surface water for their needs. Since the early 1900's, water use in the Owens Valley has changed from meeting local needs to exporting a greater quantity of both ground and surface water.

LADWP allows fishing and float tubing on Tinemaha Reservoir; however, the use of the reservoir by the public for recreation is minimal due to the weather conditions, lack of shade and prohibitions on camping or boating.

3. WATER QUALITY STANDARDS AND 303(D) LISTING BASIS

3.1. Water Quality Standards

The 1995 Water Quality Control Plan for the Lahontan Region (Basin Plan) specifies water quality standards that are protective of beneficial uses for all waters in the Lahontan Region, including Tinemaha Reservoir. Water quality standards relevant to the copper impairment include CTR aquatic life protection criteria and Department of Health Services/US EPA primary and secondary drinking water standards. Specific water quality objectives for the Owens River at the Tinemaha Reservoir outlet are defined in the Basin Plan for total dissolved solids, chloride, sulfate, fluoride, boron, nitrogen as nitrate, total nitrogen and dissolved orthophosphate; however, they are not relevant to the copper listing.

The Basin Plan narrative water quality objective for pesticides (including copper sulfate) is applicable to all inland surface waters of the Lahontan region. It states:

"Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life."

The State Water Resources Control Board's (SWRCB) *State Implementation Policy* for the CTR contains a provision to allow a categorical exception from water quality criteria and objectives, including Basin Plan objectives such as the one outlined above, for priority pollutants for the application of aquatic pesticides. In July 2001, the SWRCB adopted a Statewide General NPDES permit for Discharge of Aquatic Pesticides, based on this categorical exemption. LADWP has applied for coverage under the General Permit, and submitted a Monitoring and Reporting Plan (MRP) which has been reviewed and approved by Regional Board staff. Details on the General Permit and MRP requirements are contained in Section 6, Monitoring/Future Actions.

The following Basin Plan narrative water quality objective for toxicity is applicable to all inland surface waters of the Lahontan Region:

"All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life."

The CTR aquatic life protection criteria are toxicity-based, and are used to implement the narrative toxicity standard. Compliance with CTR criteria is generally considered adequate to meet the narrative toxicity standard.

3.2. Beneficial Uses

According to the Basin Plan, the beneficial uses of Tinemaha Reservoir are:

- Municipal and Domestic Supply (MUN)
- Agriculture Supply (AGR)
- Groundwater Recharge (GWR)
- Water Contact Recreation (REC-1)
- Non-contact Water Recreation (REC-2)
- Commercial and Sportfishing (COMM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)

3.3. Beneficial Use Impairment

The preservation and enhancement of aquatic habitats and communities, including invertebrates, is a vital element of the COLD beneficial use. Copper sulfate applications may result in conditions toxic to benthic invertebrates and fish. Copper accumulation in the sediments and the food chain may result in negative impacts to the diversity and viability of aquatic life, impacting the reservoir's wildlife habitat and fishery.

LADWP historically has used copper sulfate in the reservoir to control algae, although the frequency of treatments have tapered off significantly in recent years and no copper was applied in 2002 or 2003. According to routine monitoring data collected by LADWP at the reservoir outlet from 1991 through 2000, twenty nine percent of the total copper samples exceeded the CTR chronic aquatic life criteria of 7.8 micrograms per liter copper (based on a median hardness value of 84 milligrams per liter calcium carbonate). Figure 2 shows historical total copper concentrations, corresponding CTR criteria, and copper sulfate application dates.

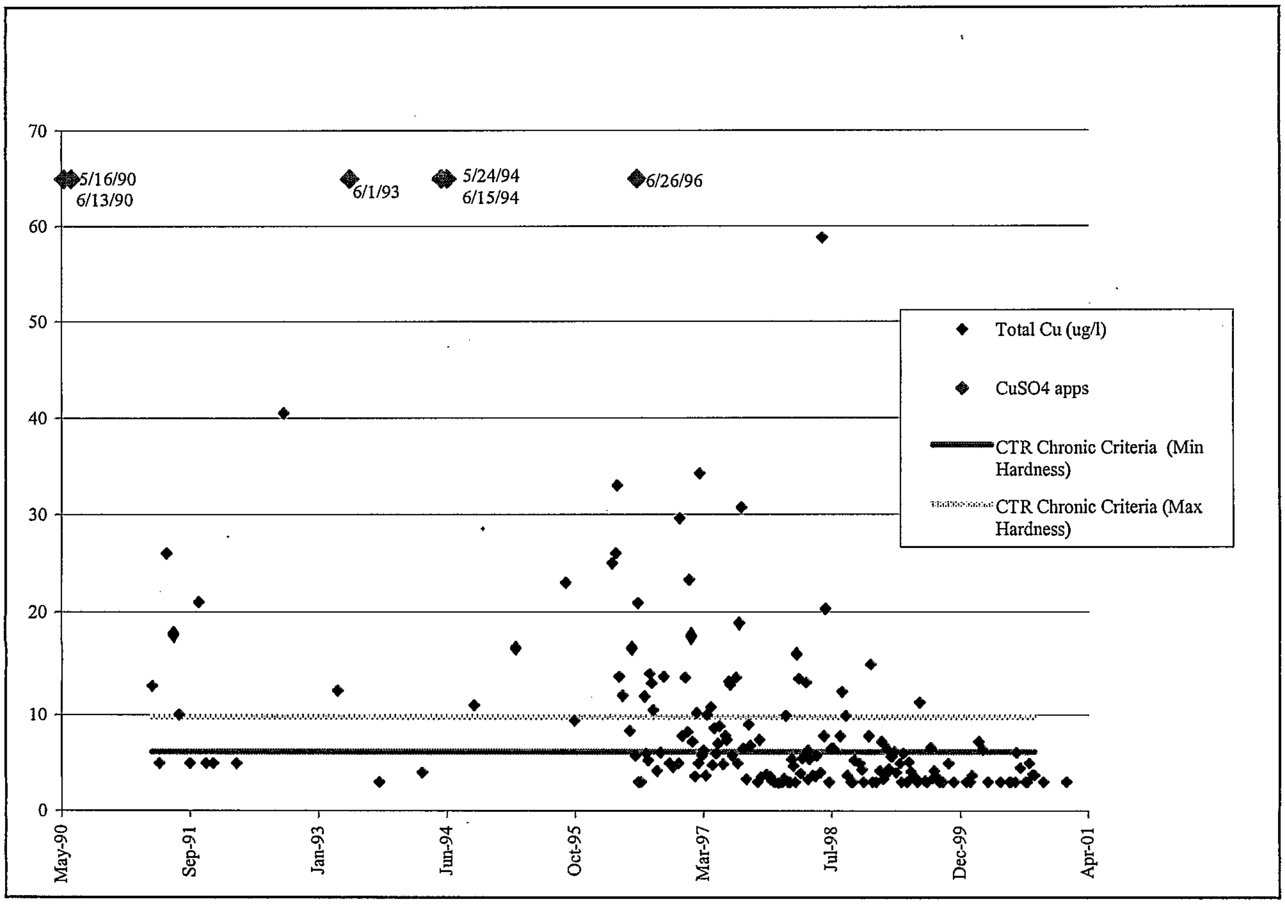

Figure 2. Historic Total Copper Concentrations, Copper Sulfate Application Dates, and CTR Chronic Copper Criteria.

4. CURRENT CONDITIONS

The first step in the TMDL process for Tinemaha Reservoir was an assessment of current dissolved copper concentrations and hardness values. Monitoring data that provided the 303(d) listing basis were expressed as total copper concentrations, with little concurrent hardness data or information regarding quality control procedures. This is problematic since the most relevant water quality objectives for copper, California Toxics Rule (CTR) aquatic life criteria, are expressed in the dissolved fraction of copper, which are typically found at lower levels than total copper concentrations. Also, low-level metals sampling should follow stringent quality control procedures during sampling and analysis to avoid sample contamination that may affect the reliability of data. Other data gaps included a lack of concurrent hardness data needed to interpret hardness-based CTR criteria.

LADWP sampled seven stations along the Owens River system from January through October 2002, as part of a "copper sources investigation", initiated in response to elevated copper concentrations detected in the LAA during the Haiwee Reservoir Copper TMDL source analysis. Sampling stations were positioned along the Owens River/LAA system from Big Pine Creek, north of Tinemaha Reservoir, to the Los Angeles Aqueduct at Cottonwood Power Plant south of the town of Lone Pine. All seven stations were sampled two times per month for total copper, temperature, pH, conductivity and alkalinity. Table 1 shows total copper concentrations measured at Stations 2 and 3, near the inlet and at the outlet of Tinemaha Reservoir.

Table 1. Total Copper Concentrations above and below Tinemaha Reservoir.

Tinemaha Reservoir Total Copper Concentrations		
Sample Date	**Station 2 Owens River above Tinemaha Res**	**Station 3 Tinemaha Res Outlet**
01/15/02	16.6* (44.3**)	ND
01/30/02	ND	ND
02/13/02	3.6	ND
02/26/02	ND	3
03/14/02	ND	ND
03/27/02	ND	ND
04/09/02	ND	ND
04/23/02	ND	ND
05/08/02	3.1	ND
05/21/02	ND	ND
06/06/02	ND	ND
06/19/02	ND	ND
07/02/02	ND	ND
07/16/02	ND	ND
08/01/02	ND	ND
08/21/02	ND	ND
09/03/02	ND	ND
09/18/02	ND	ND
10/01/02	ND	ND
10/16/02	ND	ND

Tinemaha Reservoir Total Copper Concentrations		
Sample Date	Station 2 Owens River above Tinemaha Res	Station 3 Tinemaha Res Outlet
10/29/02	ND	ND
11/07/02	ND	ND

*High concentration may be due to inadequate sample bottle preparation, which was enhanced with an additional acid wash after first sampling event when travel blanks had detectable total copper concentrations.
**Replicate Sample

To address the issue of current dissolved copper concentrations in the reservoir, beginning in August 2002, LADWP also collected dissolved copper and hardness measurements to compare with CTR hardness-based copper criteria. Sampling results indicated that dissolved copper was not detected (at a detection limit of 3 micrograms per liter) at Stations 2 and 3. Table 2 shows sampling results for these stations, hardness values, and corresponding CTR criteria.

Table 2. Dissolved Copper and Hardness Data, with Corresponding CTR Criteria.

	08/21/02	09/03/02	09/18/02	10/01/02	10/16/02	10/29/02	11/07/02
Owens River near Reservoir Inlet							
Dissolved Copper	ND*	ND	ND	ND	ND	NO DATA	ND
Hardness (mg/L CaCo3)	60.4	78.4	78.8	72.8	73	74	75.6
**CTR Chronic Criteria	5.8	7.4	7.4	6.6	7	7	7
At Reservoir Outlet							
Dissolved Copper	ND	ND	ND	ND	ND	NO DATA	ND
Hardness (mg/L CaCo3)	77.6	77.2	80.4	78.4	74	77.2	74.4
CTR Chronic Criteria	7.4	7	7.4	7.4	7	7	7

*ND = not detected at a detection limit of 3 micrograms per liter.
**CTR chronic copper criteria are the most stringent applicable criteria for copper.

5. SAMPLING METHODS AND QUALITY CONTROL/QUALITY ASSURANCE

5.1. Bottle Preparation

Copper samples were collected in high density polyethylene (HDPE) bottles prepared in LADWP's Water Quality Laboratory for metals analysis. Samples bottles were acid washed, rinsed in tap water, and rinsed twice from the Lab's reverse osmosis (RO) treatment unit. Sample bottles were then oven-dried and stored in enclosed cabinets.

5.2. Sampling Procedures

Samples were collected from as near the middle of the stream as possible at a depth of two feet below the water surface. All samples were grab samples, collected using a "sample pole" which holds the sample bottle directly, to reduce the possibility of contamination. Sampling personnel wore talc-free latex gloves for sample collection and handling. "Clean" sampling techniques for trace metals sampling were used to the extent practicable.

5.3. Travel Blanks and Duplicate Samples

Two travel blanks for copper using copper sample bottles and RO water were prepared prior to leaving the lab. Travel blanks accompanied all copper samples bottles and were handled the same way. An additional copper sample (duplicate) was collected from one randomly selected sample site during each event.

5.4. Sample Analysis

All samples were transported to the LADWP lab within 24 hours of collection and logged into the Lab's Information Management System. All samples were accompanied by a Chain of Custody form. Samples were analyzed in the lab, which is accredited by the California Department of Health Services (DOHS) under the Environmental Laboratory Accreditation Program (ELAP). Total and dissolved copper samples were analyzed using Method 3113B from Standard Methods on a Perkin-Elmer Model 4100 atomic adsorption furnace with a detection limit of 3 micrograms per liter.

5.5. Atomic Adsorption Furnace Calibration and Data Validation

The furnace was calibrated for each batch of copper samples as follows:

- A calibration curve is created using lab-prepared known copper concentrations.
- The calibration curve is checked using commercially prepared copper standards.
- The results from the commercially prepared copper standard are compared against another commercially prepared standard from a different source.
- A reagent blank is analyzed to ensure that the reagents and sample preservatives are free from contamination.
- A spiked sample is prepared and analyzed to determine percent recovery.
- All samples, blanks, and duplicate samples are analyzed twice.
- All analytical results are reviewed by the analyst.
- All reviewed analytical results are validated by the lab supervisor staff.

(LADWP, 2001).

6. MONITORING PLAN AND FUTURE ACTIONS

In July 2001, the State Water Resources Control Board (SWRCB) adopted an NPDES permit for Discharge of Aquatic Pesticides (General Permit No. CAG990003). The General Permit was developed on an emergency basis to provide coverage for broad categories of aquatic pesticide use as a result of the Ninth Circuit Court's Talent decision (Headwaters, Inc. v. Talent Irrigation District, 2001), which required that discharges of pollutants from the use of aquatic pesticides require coverage under an NPDES permit.

The permit grants a categorical exception from the water quality criteria and objectives for priority pollutants for the application of aquatic pesticides. This exception is short-term (including seasonal) and applies only during and following the use of aquatic pesticides. Any impacts on beneficial uses must be temporary in nature and must allow for full restoration of pre-project water quality and protection of beneficial uses. Effluent limitations are narrative and include requirements to implement appropriate best management practices and comply with all pesticide label requirements. Coverage is available to "public entities" for resource or pest management, based on the provisions of the SWRCB's State Implementation Policy of the CTR.

The General Permit's Monitoring and Reporting Program (MRP) requires that dischargers submit a monthly report to the appropriate RWQCB documenting specific information regarding each aquatic pesticide use site. The discharger must also submit an annual report which summarizes the objectives of the MRP, results, and interpretation of data. LADWP applied for coverage under the General Permit and submitted an MRP in 2002, specifically for copper sulfate applications in Tinemaha Reservoir. The approved MRP includes extensive pre- and post-copper sulfate application water sampling, reporting, and language to trigger future water column and/or sediment toxicity testing, depending on frequency of copper sulfate treatments.

LADWP have submitted the required monthly and annual Pesticide Use Reports, which show that no copper sulfate was applied to the reservoir since 2002 or 2003.

7. RECOMMENDATION

Based on the information summarized in this report, Regional Board staff believe it is appropriate to remove Tinemaha Reservoir from the CWA Section 303(d) list of impaired waterbodies during the next 303(d) listing cycle, which is currently scheduled for June 2004.

8. REFERENCES

Los Angeles Department of Water and Power, *Unidentified Copper Sources Investigation Study Plan*, December, 2001.

------------*Water Supply Fact Sheet,* 1996. Available at http://www.ladwp.com/water/supply/facts/index.htm.

Jones and Stokes Associates, *Mono Basin Environmental Impact Report*, May 1993. Chapters 3 A, 3B, Appendix T.

Department of Water and Power the City of Los Angeles

March 14, 2003

Mr. Harold J. Singer
California Regional Water Quality Control Board
Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Dear Mr. Singer

Subject: Los Angeles Aqueduct Copper Source Survey Final Report Addendum

In a letter dated December 12, 2002 to the Lahontan Regional Water Quality Control Board, the Los Angeles Department of Water and Power submitted the final report for an investigation of unidentified copper sources in the Los Angeles Aqueduct. At the time the final report was submitted, the test results from samples collected on December 4, 2002 in the Owens River below Big Pine Creek and at the Tinemaha Reservoir outlet were still pending.

The physical/chemical data for December 4 are appended to Table 1 (attached), which presents all of the water quality data collected during the investigation. Flow data for the same period are shown in Table 2 (attached).

The December 4 water quality data are consistent with the earlier finding that Tinemaha Reservoir is unimpaired by copper and should be removed from the 303(d) list of impaired water bodies. During the course of the investigation, the concentration of dissolved copper in the Owens River below Big Pine Creek and at the Tinemaha Reservoir outlet was always less than the 3 µg/L detection limit. This detection limit is well below the acute and chronic toxicity thresholds for copper.

If you have any comments or questions or require additional information please call Brian White at 213 367-3419.

Sincerely

Susan M. Damron

Susan M. Damron
Manager Wastewater Quality

BNW: bdc

TAL 1 - Physical/Chemical Data											
	1/15/2002	1/30/2002	2/13/2002	2/26/2002	3/14/2002	3/27/2002	4/9/2002	4/23/2002	5/8/2002	5/21/2002	6/6/2002
Big Pine Creek at Highway 395											
Total Copper ug/L (replicate)	**96.8**	**ND (ND)**	**ND**	**ND**	**ND**	**ND**	**ND (ND)**	**ND**	**ND**	**ND (ND)**	**ND**
Temperature °C	2.5	0.5	3.1	6.6	6.4	12.6	17.5	16.1	7.3	12.0	12.2
pH	7.90	No Data	7.63	6.52	7.69	7.94	7.28	7.92	8.19	8.23	8.25
Alkalinity mg/L as $CaCO_3$	40.0	41.0	39.0	37.5	39.0	No Data	32.0	33.5	26.0	20.0	16.5
Specific Conductance E.C.	100	104	106	102	101	No Data	78	78	63	48	40.0
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	3.7	3.89	4.69	6.51
Owens River below Big Pine Creek											
Total Copper ug/L (replicate)	**16.6 (44.3)**	**ND**	**3.6**	**ND**	**ND**	**ND**	**ND**	**ND**	**3.1**	**ND**	**ND**
Dissolved Copper ug/L											
Temperature °C	4.1	0.5	5.4	8.5	9.4	14.6	20.1	18.6	12.1	16.3	19.0
pH	8.25	No Data	7.84	7.55	7.92	8.15	7.68	7.97	8.32	7.82	8.14
Alkalinity mg/L as $CaCO_3$	104.0	109.0	115.5	108.0	113.0	110.0	128.0	134.5	150.5	138.0	117.5
Total Hardness as CaCO3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Specific Conductance E.C.	313	320	330	319	337	324	360	371	393	367	313
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	9.05	35.8	19.7	15.20
Tinemaha Reservoir Outlet											
Total Copper ug/L (replicate)	**ND**	**ND**	**ND**	**3.0**	**ND (ND)**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Dissolved Copper ug/L											
Temperature °C	4.6	0.5	6.0	8.5	10.0	12.3	19.3	18.0	13.0	16.5	21.8
pH	8.38	No Data	8.22	7.42	8.79	8.85	7.96	8.30	8.61	7.68	8.44
Alkalinity mg/L as $CaCO_3$	115.0	109.5	111.5	110.5	116.0	118.0	126.5	135.0	144.0	138.0	120.0
Total Hardness as CaCO3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Specific Conductance E.C.	307	313	313	313	322	328	342	357	387	371	314
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	6.03	15.4	12.9	4.48
LA Aqueduct at Black Rock Gate											
Total Copper ug/L (replicate)	**14.9**	**ND**	**ND (ND)**	**3.1**	**ND**	**ND**	**ND**	**ND (9.6)**	**3.3**	**ND**	**ND**
Temperature °C	5.8	2.0	7.0	10.6	12.6	14.4	19.7	21.9	14.0	16.6	21.8
pH	8.15	No Data	7.91	7.39	7.97	8.44	7.67	8.07	8.41	7.90	8.10
Alkalinity mg/L as $CaCO_3$	125.0	126.5	120.0	127.0	96.5	127.0	133.0	146.5	150.5	146.0	128.0
Specific Conductance E.C.	333	347	329	346	276	346	371	390	396	393	330
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	6.59	16.1	18.4	7.72
LA Aqueduct at Mazourka Canyon Road											
Total Copper ug/L (replicate)	**33.9**	**ND**	**ND**	**98.3**	**4.3**	**3.7 (ND)**	**ND**	**ND**	**ND (ND)**	**ND**	**ND (ND)**
Temperature °C	5.9	2.5	7.0	12.4	10.7	13.2	19.6	22.5	14.4	17.1	21.7
pH	8.19	No Data	8.00	7.48	8.24	8.36	7.50	7.93	8.34	7.81	8.18
Alkalinity mg/L as $CaCO_3$	114.0	122.0	120.5	121.5	137.5	126.0	131.0	138.5	144.0	140.0	123.5
Specific Conductance E.C.	327	339	332	338	391	344	357	378	394	371	325
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LA Aqueduct at Alabama Gates											
Total Copper ug/L (replicate)	**5.8**	**ND**	**ND**	**3.2**	**5.0**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Temperature °C	5.4	2.5	7.1	11.7	11.3	12.8	18.9	23.7	14.8	16.8	21.9
pH	8.32	No Data	8.04	7.52	8.56	8.51	7.52	8.02	8.39	7.72	8.18
Alkalinity mg/L as $CaCO_3$	122.0	122.0	124.0	121.0	144.0	120.0	130.0	139.5	142.0	136.0	116.5
Specific Conductance E.C.	329	340	341	335	388	332	352	374	386	381	311
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	8.43	23.5	32.6	8.58
LA Aqueduct at Cottonwood Creek											
Total Copper ug/L (replicate)	**28.5**	**No Sample**	**ND**	***48.8 (20.9)***	**ND**	**3.5**	**ND**	**ND**	**3.0**	**ND**	**ND**
Temperature °C	5.4	No Data	8.5	13.2	12.0	12.7	17.7	28.7	15.9	15.5	22.1
pH	8.59	No Data	8.15	7.75	8.79	8.54	7.71	8.08	8.42	7.74	8.26
Alkalinity mg/L as $CaCO_3$	113.0	No Data	119.0	119.0	131.5	115.5	129.0	129.0	140.0	131.0	110.5
Specific Conductance E.C.	315	No Data	327	327	347	322	363	347	389	381	287
Turbidity NTU	NA	NA	NA	NA	NA	NA	NA	6.7	28.6	27	7.27
Travel Blank 1 Total Copper (ug/L)	**3.1**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Travel Blank 2 Total Copper (ug/L)	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Travel Blank 3 Dissolved Copper (ug/L)											

TABLE 1 - Physical/Chemical Data

	6/19/2002	7/2/2002	7/16/2002	8/1/2002	8/21/2002	9/3/2002	9/18/2002	10/1/2002	10/16/2002	10/29/2002	11/7/2002	12/4/2002
Big Pine Creek at Highway 395												
Total Copper ug/L (replicate)	7.3	ND (ND)	ND(ND)	ND	ND	ND	ND	ND (ND)	ND	ND (ND)		
Temperature °C	12.6	18	18.1	14.9	13.3	15.8	11.9	10.7	7.5	9.5		
pH	8.11	7.1	7.38	7.38	8.12	8.6	7.74	7.16	7.06	8.37		
Alkalinity mg/L as $CaCO_3$	15.0	13.5	No Data	17.5	20.5	23.0	24.0	28.0	32.0	No Data		
Specific Conductance E.C.	34.0	28.0	No Data	34.0	38.8	45.5	55.5	64.4	76.0	No Data		
Turbidity NTU	4.43	3.64	2.42	2.29	1.52	1.48	2.15	4.07	2.34	2.06		
Owens River below Big Pine Creek												
Total Copper ug/L (replicate)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Copper ug/L	NA	NA	NA	ND	ND	ND	ND	ND	ND	No Data	ND	ND
Temperature °C	19.3	22.9	25.0	20.6	19.1	21.4	16.4	14.7	10.7	12.1	No Data	5.2
pH	8.18	7.87	7.73	7.8	8.25	7.18	8.46	7.69	7.73	8.01	No Data	8.22
Alkalinity mg/L as $CaCO_3$	119.0	128.0	No Data	145.0	144.0	142.0	136.0	136.0	131.0	No Data	124.0	114.0
Total Hardness as CaCO3	NA	NA	NA	NA	80.4	78.4	78.8	72.8	73.0	74.0	75.6	84.0
Specific Conductance E.C.	320	334	No Data	379	378	377	364	364	351	No Data	334	334
Turbidity NTU	11.90	9.93	8.52	13.70	8.80	5.53	1.39	8.13	8.04	5.12	NoData	4.72
Tinemaha Reservoir Outlet												
Total Copper ug/L (replicate)	ND(ND)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Copper ug/L	NA	NA	NA	ND	ND	ND	ND	ND	ND	No Data	ND	ND
Temperature °C	21.3	24.0	25.0	21.2	17.7	22.0	16.6	14.6	13.1	12.1	8.8	6.1
pH	8.84	8.04	8.12	7.33	8.42	7.09	8.22	8.07	8.04	8.13	8.43	8.36
Alkalinity mg/L as $CaCO_3$	115.0	122.0	No Data	142.0	142.0	135.0	136.0	134.0	130.0	No Data	125.0	117.0
Total Hardness as CaCO3	NA	NA	NA	NA	77.6	77.2	80.4	76.4	74.0	77.2	74.4	91.6
Specific Conductance E.C.	300	311	No Data	363	368	352	358	362	348	No Data	334	333
Turbidity NTU	13.60	13.40	8.60	13.00	12.80	16.60	18.10	13.50	3.46	12.10	3.71	6.56
LA Aqueduct at Black Rock Gate												
Total Copper ug/L (replicate)	ND	ND	ND	ND	3.5	ND	ND(ND)	ND	ND	ND		
Temperature °C	21.7	23.9	26.5	22.2	18.2	21.5	17.4	15.5	11.9	13.7		
pH	8.30	7.97	7.89	7.75	8.24	7.43	8.17	7.84	7.72	7.88		
Alkalinity mg/L as $CaCO_3$	119.0	126.0	No Data	146.0	146.0	146.0	148.0	140.0	137.0	No Data		
Specific Conductance E.C.	321	322	No Data	373	380	379	389	377	366	No Data		
Turbidity NTU	8.59	13.00	8.96	11.60	13.70	9.01	10.40	8.44	6.00	5.61		
LA Aqueduct at Mazourka Canyon Road												
Total Copper ug/L (replicate)	ND	ND	ND	ND	ND(ND)	ND	ND	ND	ND	ND		
Temperature °C	21.1	25.1	24.7	21.9	18.8	22.6	16.2	15.5	13.9	14.0		
pH	8.17	7.67	7.79	7.13	8.31	7.15	8.23	7.62	7.66	7.79		
Alkalinity mg/L as $CaCO_3$	114.0	119.0	No Data	144.0	144.0	142.0	140.0	144.0	132.0	No Data		
Specific Conductance E.C.	361	308	No Data	368	373	374	373	368	360	No Data		
Turbidity NTU	10.20	12.30	8.95	10.00	11.30	7.20	8.91	7.63	7.82	4.71		
LA Aqueduct at Alabama Gates												
Total Copper ug/L (replicate)	ND	3.5	ND	ND	ND	ND	ND	ND	ND	ND		
Temperature °C	20.7	24.4	25.1	24.0	19.9	24.0	16.9	15.0	13.4	13.4		
pH	8.3	7.77	7.63	7.19	8.27	7.5	8.3	7.69	8.11	7.85		
Alkalinity mg/L as $CaCO_3$	112.0	118.0	No Data	143.0	142.0	142.0	141.0	143.0	132.0	No Data		
Specific Conductance E.C.	293	305	No Data	364	372	372	369	370	354	No Data		
Turbidity NTU	9.8	11.7	7.83	9.34	9.2	6.16	6.78	6.19	7.82	5.4		
LA Aqueduct at Cottonwood Creek												
Total Copper ug/L (replicate)	ND	ND	ND	ND (ND)	ND	ND (ND)	ND	ND	ND (ND)	ND		
Temperature °C	21.5	23.6	25.6	23.0	20.4	24.1	18.7	16.1	14.7	13.2		
pH	8.41	8.19	8.04	7.66	8.62	8.05	8.79	7.67	8.15	8.51		
Alkalinity mg/L as $CaCO_3$	107.0	112.0	No Data	140.0	142.0	143.0	140.0	133.0	129.0	No Data		
Specific Conductance E.C.	281	292	No Data	355	366	362	364	359	347	No Data		
Turbidity NTU	9.4	11.3	8.52	7.27	8	6.38	4	5.87	6.63	3.71		
Travel Blank 1 Total Copper (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Travel Blank 2 Total Copper (ug/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Travel Blank 3 Dissolved Copper (ug/L)				ND	ND	ND	ND	ND	ND		ND	ND

TABLE 1 - Physical/Chemical Data

	6/19/2002	7/2/2002	7/16/2002	8/1/2002	8/21/2002	9/3/2002	9/18/2002	10/1/2002	10/16/2002	10/29/2002	11/7/2002	12/4/2002
Big Pine Creek at Highway 395												
Total Copper ug/L (replicate)	**7.3**	**ND (ND)**	**ND(ND)**	**ND**	**ND**	**ND**	**ND**	**ND (ND)**	**ND**	**ND (ND)**		
Temperature °C	12.6	18	18.1	14.9	13.3	15.8	11.9	10.7	7.5	9.5		
pH	8.11	7.1	7.38	7.38	8.12	8.6	7.74	7.16	7.06	8.37		
Alkalinity mg/L as $CaCO_3$	15.0	13.5	No Data	17.5	20.5	23.0	24.0	28.0	32.0	No Data		
Specific Conductance E.C.	34.0	28.0	No Data	34.0	38.8	45.5	55.5	64.4	76.0	No Data		
Turbidity NTU	4.43	3.64	2.42	2.29	1.52	1.48	2.15	4.07	2.34	2.06		
Owens River below Big Pine Creek												
Total Copper ug/L (replicate)	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Dissolved Copper ug/L	NA	NA	NA	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	No Data	**ND**	**ND**
Temperature °C	19.3	22.9	25.0	20.6	19.1	21.4	16.4	14.7	10.7	12.1	No Data	5.2
pH	8.16	7.87	7.73	7.8	8.25	7.18	8.46	7.69	7.73	8.01	No Data	8.22
Alkalinity mg/L as $CaCO_3$	119.0	128.0	No Data	145.0	144.0	142.0	136.0	136.0	131.0	No Data	124.0	114.0
Total Hardness as CaCO3	NA	NA	NA	NA	80.4	78.4	78.8	72.8	73.0	74.0	75.6	84.0
Specific Conductance E.C.	320	334	No Data	379	378	377	364	364	351	No Data	394	394
Turbidity NTU	11.90	9.93	8.52	13.70	8.60	5.53	1.39	8.13	8.04	5.12	NoData	4.72
Tinemaha Reservoir Outlet												
Total Copper ug/L (replicate)	**ND(ND)**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Dissolved Copper ug/L	NA	NA	NA	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	No Data	**ND**	**ND**
Temperature °C	21.3	24.0	25.0	21.2	17.7	22.0	16.6	14.6	13.1	12.1	8.8	6.1
pH	8.84	8.04	8.12	7.33	8.42	7.09	8.22	8.07	8.04	8.13	8.43	8.36
Alkalinity mg/L as $CaCO_3$	115.0	122.0	No Data	142.0	142.0	135.0	136.0	134.0	130.0	No Data	125.0	117.0
Total Hardness as CaCO3	NA	NA	NA	NA	77.6	77.2	80.4	78.4	74.0	77.2	74.4	91.6
Specific Conductance E.C.	300	311	No Data	363	368	352	358	362	348	No Data	334	333
Turbidity NTU	13.80	13.40	8.60	13.00	12.80	16.60	18.10	13.50	3.46	12.10	3.71	6.56
LA Aqueduct at Black Rock Gate												
Total Copper ug/L (replicate)	**ND**	**ND**	**ND**	**ND**	**3.6**	**ND**	**ND(ND)**	**ND**	**ND**	**ND**		
Temperature °C	21.7	23.9	26.5	22.2	18.2	21.5	17.4	15.5	11.9	13.7		
pH	8.30	7.97	7.69	7.75	8.24	7.43	8.17	7.84	7.72	7.88		
Alkalinity mg/L as $CaCO_3$	119.0	126.0	No Data	146.0	146.0	146.0	146.0	140.0	137.0	No Data		
Specific Conductance E.C.	321	322	No Data	373	380	379	389	377	366	No Data		
Turbidity NTU	8.59	13.00	8.96	11.60	13.70	9.01	10.40	8.44	6.00	5.61		
LA Aqueduct at Mazourka Canyon Road												
Total Copper ug/L (replicate)	**ND**	**ND**	**ND**	**ND**	**ND(ND)**	**ND**	**ND**	**ND**	**ND**	**ND**		
Temperature °C	21.1	25.1	24.7	21.9	18.8	22.5	16.2	15.5	13.9	14.0		
pH	8.17	7.87	7.79	7.13	8.31	7.15	8.23	7.62	7.66	7.79		
Alkalinity mg/L as $CaCO_3$	114.0	119.0	No Data	144.0	144.0	142.0	140.0	144.0	132.0	No Data		
Specific Conductance E.C.	361	308	No Data	368	373	374	373	368	360	No Data		
Turbidity NTU	10.20	12.30	8.95	10.00	11.30	7.20	8.91	7.63	7.82	4.71		
LA Aqueduct at Alabama Gates												
Total Copper ug/L (replicate)	**ND**	**3.6**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**		
Temperature °C	20.7	24.4	25.1	24.0	19.9	24.0	16.9	15.0	13.4	13.4		
pH	8.3	7.77	7.63	7.19	8.27	7.5	8.3	7.69	8.11	7.85		
Alkalinity mg/L as $CaCO_3$	112.0	118.0	No Data	143.0	142.0	142.0	141.0	143.0	132.0	No Data		
Specific Conductance E.C.	293	305	No Data	364	372	372	369	370	354	No Data		
Turbidity NTU	9.8	11.7	7.83	9.34	9.2	6.16	6.78	6.19	7.82	5.4		
LA Aqueduct at Cottonwood Creek												
Total Copper ug/L (replicate)	**ND**	**ND**	**ND**	**ND (ND)**	**ND**	**ND (ND)**	**ND**	**ND**	**ND (ND)**	**ND**		
Temperature °C	21.5	23.6	25.6	23.0	20.4	24.1	18.7	16.1	14.7	13.2		
pH	8.41	8.19	8.04	7.86	8.62	8.05	8.79	7.67	8.15	8.51		
Alkalinity mg/L as $CaCO_3$	107.0	112.0	No Data	140.0	142.0	143.0	140.0	133.0	129.0	No Data		
Specific Conductance E.C.	281	292	No Data	355	366	362	364	359	347	No Data		
Turbidity NTU	9.4	11.3	8.52	7.27	8	6.38	4	5.87	6.63	3.71		
Travel Blank 1 Total Copper (ug/L)	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Travel Blank 2 Total Copper (ug/L)	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
Travel Blank 3 Dissolved Copper (ug/L)				**ND**	**ND**	**ND**	**ND**	**ND**	**ND**		**ND**	**ND**

TABLE 2 - OWENS VALLEY FLOW DATA (CFS)

Owens River Below Big Pine Creek

YEAR	MONTH	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20	DAY21	DAY22	DAY23	DAY24	DAY25	DAY26	DAY27	DAY28	DAY29	DAY30	DAY31
2002	1	303	299	297	297	296	266	249	248	255	258	252	246	249	247	245	239	235	240	236	237	237	237	231	228	235	243	244	242	242	231	231
2002	2	240	237	231	231	233	233	239	220	199	203	202	200	198	201	205	191	177	175	172	172	171	182	195	194	195	198	200	200	0	0	0
2002	3	196	197	181	163	153	153	152	151	148	145	147	152	156	160	158	158	159	162	165	172	165	157	155	146	145	146	149	147	149	158	153
2002	4	148	152	156	167	174	163	164	165	170	173	166	168	169	173	177	180	181	196	186	177	178	176	176	177	179	179	175	177	200	224	0
2002	5	294	367	434	479	428	346	343	365	381	372	370	389	389	379	381	386	413	455	461	460	464	439	429	426	426	441	457	453	455	465	467
2002	6	479	475	454	418	409	422	451	442	436	436	436	413	411	376	368	369	366	369	368	365	372	372	357	365	386	395	391	420	445	452	0
2002	7	459	450	443	445	445	437	433	430	408	404	407	441	446	417	417	416	415	417	422	418	415	408	398	399	406	408	423	424	418	417	424
2002	8	422	422	417	416	418	407	404	402	395	393	391	387	388	388	380	380	385	389	385	354	335	332	331	306	254	203	198	191	186	181	177
2002	9	177	175	168	165	165	161	168	190	193	200	203	203	200	200	198	197	213	236	236	243	241	248	242	235	237	227	234	247	252	255	0
2002	10	259	266	268	271	269	272	271	265	261	262	264	266	270	268	266	274	270	261	259	261	265	268	266	246	211	206	208	208	207	207	210
2002	11	209	219	210	209	218	216	182	198	271	265	211	199	190	187	187	196	199	199	199	199	199	199	199	199	198	193	193	193	196	196	0
2002	12	192	197	202	194	194	193	206	217	203	194	191	191	192	193	194	203	237	225	211	209	209	210	207	201	199	200	200	201	200	200	201

Tinemaha Reservoir Outlet

YEAR	MONTH	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20	DAY21	DAY22	DAY23	DAY24	DAY25	DAY26	DAY27	DAY28	DAY29	DAY30	DAY31
2002	1	302	302	302	302	302	302	302	302	301	300	300	300	300	300	300	300	300	279	253	251	251	251	251	251	251	250	251	251	251	250	253
2002	2	253	253	253	253	253	253	253	251	249	249	249	249	249	250	251	249	249	248	247	246	281	297	297	298	297	296	264	248	0	0	0
2002	3	229	201	201	184	98.5	47.6	43.9	42.9	43	41.9	37.9	32	31.6	31.5	31.8	31.8	31.8	30.2	28.6	28.9	27.2	26.7	53.4	112	208	252	251	251	252	252	253
2002	4	249	247	246	248	249	250	251	250	248	247	247	245	247	248	225	202	202	202	202	202	202	202	201	200	201	200	201	201	200	229	0
2002	5	289	340	388	404	406	402	400	401	401	401	399	398	403	406	404	403	403	403	403	405	404	402	404	405	406	405	406	406	408	406	406
2002	6	404	406	406	404	405	405	443	456	456	454	453	452	451	452	456	455	453	450	457	427	407	407	405	404	404	404	403	402	403	403	0
2002	7	405	406	405	439	454	454	454	454	454	453	451	452	453	454	453	453	452	453	452	452	449	451	452	448	416	402	401	402	404	404	405
2002	8	404	403	404	403	402	402	402	401	401	401	403	404	402	404	405	403	402	402	401	399	367	320	306	305	268	251	252	250	252	250	216
2002	9	201	200	200	200	202	201	201	203	204	205	206	203	202	203	204	208	207	208	204	203	202	201	203	205	207	202	201	203	204	206	0
2002	10	204	236	251	253	252	250	250	251	251	251	251	252	252	252	253	253	252	251	251	251	250	250	250	251	252	252	223	201	202	202	202
2002	11	202	201	200	200	200	200	201	201	203	201	201	201	229	251	250	249	250	250	250	250	250	250	251	251	250	248	247	244	249	252	0
2002	12	253	253	253	253	253	220	203	203	203	203	203	203	203	203	203	203	203	203	203	229	257	257	255	253	253	253	253	253	253	253	253

Los Angeles Aqueduct at Alabama Gates

YEAR	MONTH	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20	DAY21	DAY22	DAY23	DAY24	DAY25	DAY26	DAY27	DAY28	DAY29	DAY30	DAY31
2002	1	371	368	367	370	369	369	369	369	372	365	365	365	366	364	365	361	360	361	337	316	317	317	313	314	317	318	324	318	317	316	313
2002	2	320	324	322	324	322	323	324	324	318	317	318	320	309	308	307	312	331	322	319	319	320	353	369	369	368	368	366	336	0	0	0
2002	3	320	300	274	273	249	185	149	137	135	136	132	117	103	103	102	103	102	101	99.2	98.1	95.6	93.1	107	115	171	252	299	310	313	316	316
2002	4	310	300	299	300	300	306	307	307	305	301	298	297	296	301	303	278	266	264	261	254	249	255	256	252	262	257	257	257	264	268	0
2002	5	292	344	395	439	456	460	457	453	459	465	464	464	462	465	470	474	476	479	489	491	486	482	476	471	467	467	465	466	465	469	471
2002	6	474	480	484	482	482	499	523	567	571	562	540	530	525	534	542	545	545	541	536	544	512	490	480	475	470	466	464	460	457	460	0
2002	7	461	460	460	458	487	499	499	495	492	491	491	491	493	494	493	490	483	486	491	488	485	486	468	486	479	449	433	432	433	433	432
2002	8	431	430	431	430	427	427	425	424	423	422	419	420	421	424	423	424	421	417	417	415	407	387	348	324	318	286	268	270	270	272	268
2002	9	243	232	229	227	226	222	219	220	220	221	224	228	225	224	221	226	227	229	229	230	228	224	222	219	221	221	221	223	225	227	0
2002	10	233	268	286	289	290	291	291	292	292	296	297	297	296	296	298	297	296	296	293	298	301	301	299	300	305	305	273	257	257	258	257
2002	11	258	260	262	262	265	256	268	309	414	303	287	283	300	328	317	314	312	313	312	312	310	312	313	310	313	305	307	303	310	313	0
2002	12	315	314	313	313	312	310	277	262	261	261	262	263	262	261	270	272	291	278	270	275	308	327	322	320	321	324	325	321	337	326	329

Los Angeles Aqueduct at Cottonwood Gates

YEAR	MONTH	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20	DAY21	DAY22	DAY23	DAY24	DAY25	DAY26	DAY27	DAY28	DAY29	DAY30	DAY31
2002	1	336	336	372	375	374	375	374	375	363	358	360	361	360	356	367	344	338	331	316	291	287	302	286	285	286	287	317	299	285	267	288
2002	2	304	315	304	312	307	313	315	315	305	292	305	298	291	291	299	305	317	306	301	301	301	323	347	345	338	332	329	308	0	0	0
2002	3	293	289	232	223	221	172	113	98.4	91.7	52.1	0	0	0	0	0	0	0	0	0	0	0	0	63.2	85	109	195	254	268	271	274	284
2002	4	278	257	236	241	245	256	263	263	265	262	267	267	260	268	274	252	236	216	220	212	207	213	208	207	209	211	213	211	205	218	0
2002	5	233	291	332	380	405	416	408	404	400	406	402	407	409	408	413	417	429	430	429	443	438	442	427	412	407	408	415	425	428	433	431
2002	6	444	454	458	453	449	471	469	500	508	486	472	458	462	458	520	551	553	548	541	550	532	441	427	414	446	486	478	464	398	401	0
2002	7	428	459	417	412	425	451	451	447	442	443	451	459	463	464	464	463	455	452	440	438	434	430	441	480	475	443	401	360	357	388	418
2002	8	406	382	379	377	376	378	370	366	365	368	378	367	345	330	326	326	342	339	338	341	335	317	274	253	249	224	208	210	206	203	206
2002	9	185	166	158	156	152	147	141	136	134	149	168	183	178	169	165	165	169	176	169	171	175	167	171	175	170	169	168	183	171	161	0
2002	10	164	204	236	242	258	259	241	231	233	244	250	258	258	255	261	267	264	263	267	269	269	268	261	263	276	278	263	228	217	216	221
2002	11	232	240	240	237	233	234	242	308	430	320	278	281	278	318	316	310	309	311	313	311	313	307	311	310	308	298	302	300	302	309	0
2002	12	308	309	303	300	296	294	281	252	231	181	189	194	205	236	251	259	287	272	268	255	262	276	285	289	291	294	296	299	300	303	306