



# Technical Memorandum

## Lincoln Avenue Water Company (LAWC) Treatment System

### National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California

NAS710393  
NASA-JPL  
SSIC No. 9661

Final □

May 15, 2006

This technical memorandum documents the performance of the groundwater treatment system implemented at the Lincoln Avenue Water Company (LAWC) through March 2006. The treatment system was implemented as a removal action as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL). The Action Memorandum for this removal action was signed on August 23, 2004<sup>1</sup>. Table 1 is an overview of the system operations to date, which began on July 28, 2004.

**Table 1. LAW System Operational Summary (August 2004 Through March 31, 2006)**

Parameter	Units	LAWC #3	LAWC #5	Total
Total Volume of Groundwater Extracted	Acre-ft	2,119	1,180	3,299
Total Volume of Groundwater Extracted	Million gallons	690.5	384.5	1,075
Mass of Perchlorate Removed	lbs	68	15	83
Mass of Carbon Tetrachloride (CCl <sub>4</sub> ) Removed	lbs	8	14	22
Mass of Trichloroethene (TCE) Removed	lbs	7	1	8

\* Samples collected from LAW#5 have contained detectable concentrations of CCl<sub>4</sub>.

## BACKGROUND

Liquid wastes generated at JPL in the 1940s and 1950s (such as cleaning solvents, solid and liquid rocket propellants, cooling tower chemicals, and analytical laboratory chemicals) were disposed of in seepage pits, a then common and acceptable practice. Some of these wastes contained chemicals (e.g., perchlorate and chlorinated solvents containing volatile organic compounds [VOCs]) that have been found in groundwater beneath and adjacent to JPL, including groundwater extracted from two drinking water wells operated by LAW (LAWC#3 and LAW#5). Figure 1 is a location map showing JPL and the LAW production wells.

In 1981, VOCs were first detected in LAW#3 and LAW#5. By 1984, VOC concentrations were increasing and both wells were shut down. With NASA funding, LAW installed a VOC treatment facility for the wells in the early 1990s. NASA funded the ongoing operations of the plant as well. The existing VOC treatment facility consists of four 12-ft-diameter treatment vessels (Calgon Carbon Model 12 Adsorption Systems), each containing 20,000 lb of liquid-phase granular activated carbon (LGAC). The LGAC treatment facility was operated under an Operations Plan approved by the California Department of Health Services (DHS) (revised September 2002).

<sup>1</sup> NASA. 2004. *Action Memorandum for the Lincoln Avenue Water Company (LAWC), Altadena, California Associated with Groundwater Cleanup at the National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California.* August.

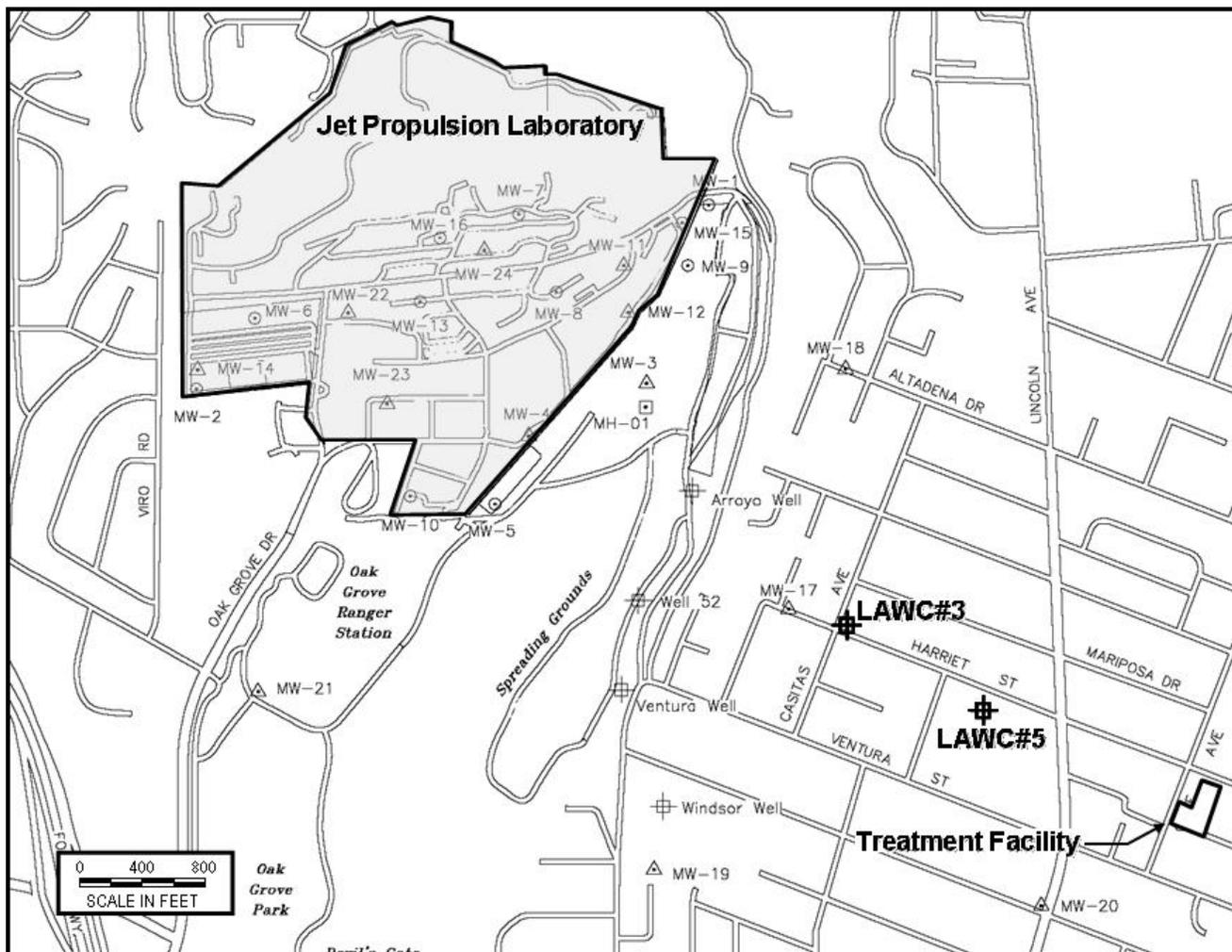
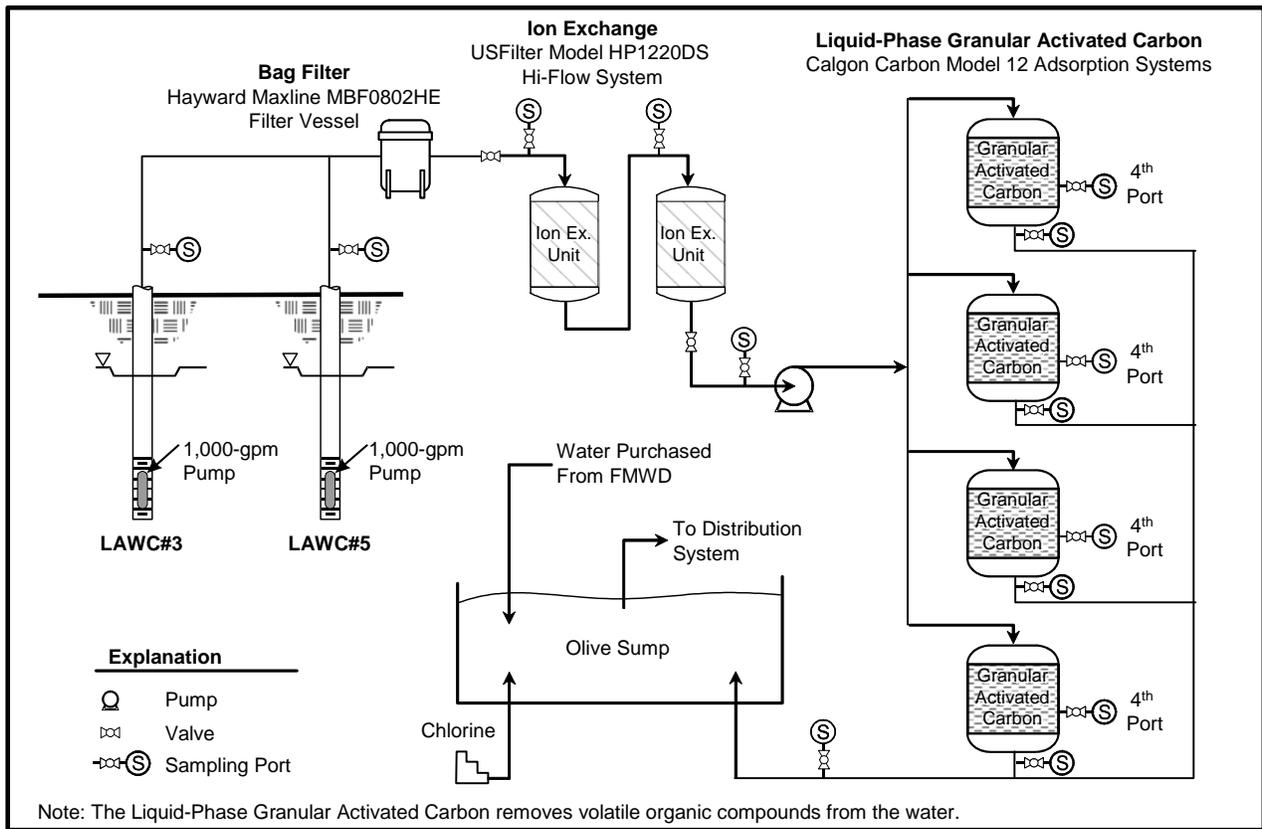


Figure 1. Location Map

Perchlorate concentrations were first detected in samples collected from the LAWC wells in 1997, when an improved analytical method, using ion chromatography, was developed to detect low levels of perchlorate. Since 1997, perchlorate concentrations in samples from the LAWC wells have ranged from less than 4 micrograms per liter ( $\mu\text{g}/\text{L}$ ) to 31.0  $\mu\text{g}/\text{L}$ . In July 2004, an ion exchange system was incorporated into the treatment train at LAWC, consisting of LGAC, chlorination, and blending with Foothill Municipal Water District (FMWD) water in the Olive Sump. Water in the Olive Sump is pumped into the distribution system for potable use by LAWC customers. A process flow diagram for this entire treatment system is provided as Figure 2.

Ion exchange (IX) treatment consists of a USFilter Model HP1220DS Hi-Flow System. The HP1220DS System has two 12-ft-diameter ion exchange vessels, with a nominal treatment capacity of 2,000 gpm. Each ion exchange unit contains 300 cubic feet of Rohm and Haas Amberlite™ PWA2 Strongly Basic Anion Exchange Resin, which is designed for selective removal of perchlorate from potable water. DHS issued a permit amendment on July 26, 2004 for the LAWC system, a copy of which was provided in the Technical Memorandum submitted in 2005<sup>2</sup>.

<sup>2</sup> NASA. 2005. *Technical Memorandum, Lincoln Avenue Water Company (LAWC) Treatment System, National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California.* May.



**Figure 2. Process Flow Diagram**

**LAWC#3, LAW5, AND MW-17**

Table 2 summarizes minimum and maximum carbon tetrachloride (CCl<sub>4</sub>), trichloroethene (TCE), and perchlorate concentrations detected in LAW5 and LAW5. Figures 3 and 4 are graphs of historical concentrations in extracted groundwater samples collected from LAW5 and LAW5. Trends in LAW5 indicated a general decrease in TCE concentrations and a general increase in CCl<sub>4</sub> and perchlorate concentrations. No clear trends were observed in LAW5.

NASA-JPL has a multiport monitoring well, MW-17, located less than 500 ft upgradient of LAW5 (see Figure 1). Table 2 also summarizes CCl<sub>4</sub>, TCE, and perchlorate detections in samples collected from the five sampling screens (discrete sampling intervals) of MW-17. This monitoring well serves as the best available indicator of near-future (1-2 years) concentrations that may be observed in LAW5 wells. Figures 5, 6, and 7 provide the historical concentrations of CCl<sub>4</sub>, TCE, and perchlorate in MW-17. Sampling of MW-17 (Screen 3) indicated a decreasing perchlorate concentration trend, with concentrations below 100 µg/L throughout 2005. The highest concentration detected in MW-17 (Screen 3) was 209 µg/L in July/August 2003.

**Table 2. Summary of Highest Chemical Concentrations Historically Detected**

Analyte	Units	LAW5		LAW5		MW-17 (Maximum Levels)					Regulatory Level
		Min	Max	Min	Max	S1	S2	S3	S4	S5	
CCl <sub>4</sub>	µg/L	<0.5	4.0	<0.5	1.9	<0.5	1.0	13.7	0.8	<0.5	0.5
TCE	µg/L	<0.5	20.8	<0.5	57.4	<0.5	6.2	23	15.5	16	5
Perchlorate	µg/L	<4.0	46.0	<4.0	15.0	<4.0	17	209	17	22	6

Note: MW-17 is a multiport monitoring well containing five separate sampling screens, denoted S1 through S5

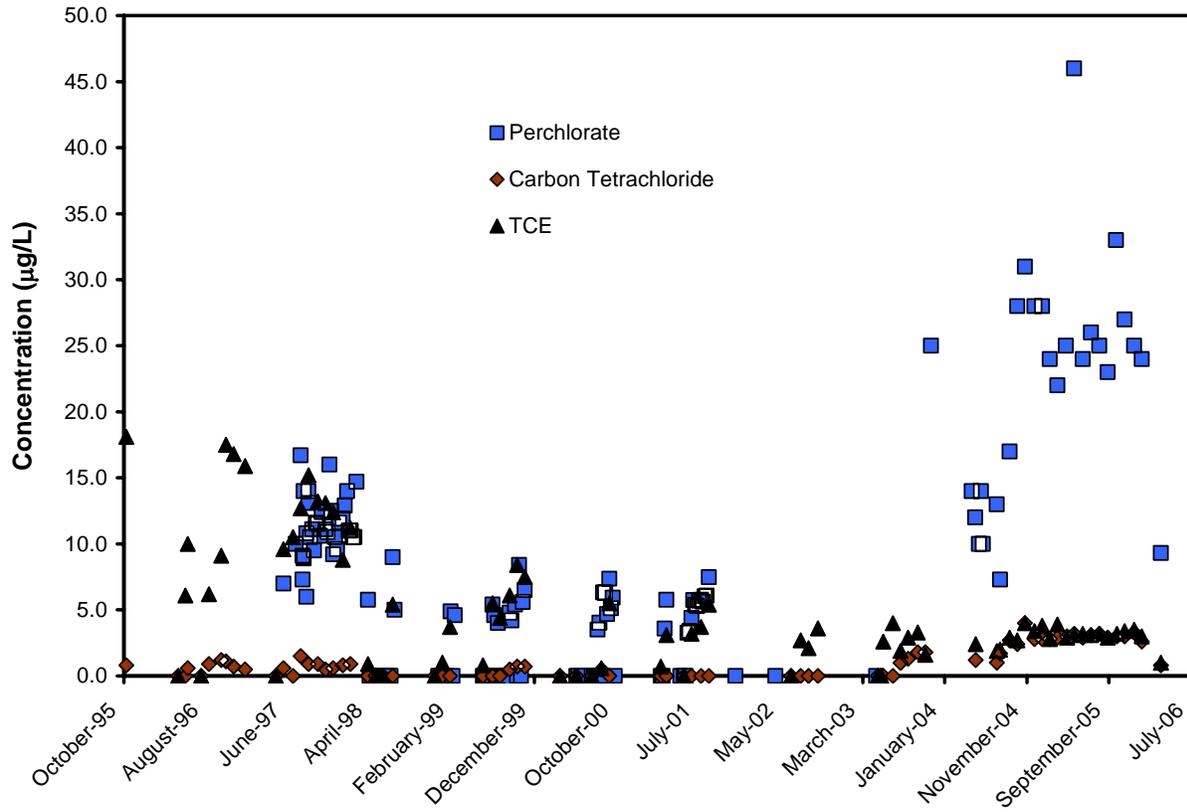


Figure 3. Historical Concentrations of CCl<sub>4</sub>, TCE, and Perchlorate in LAWC#3

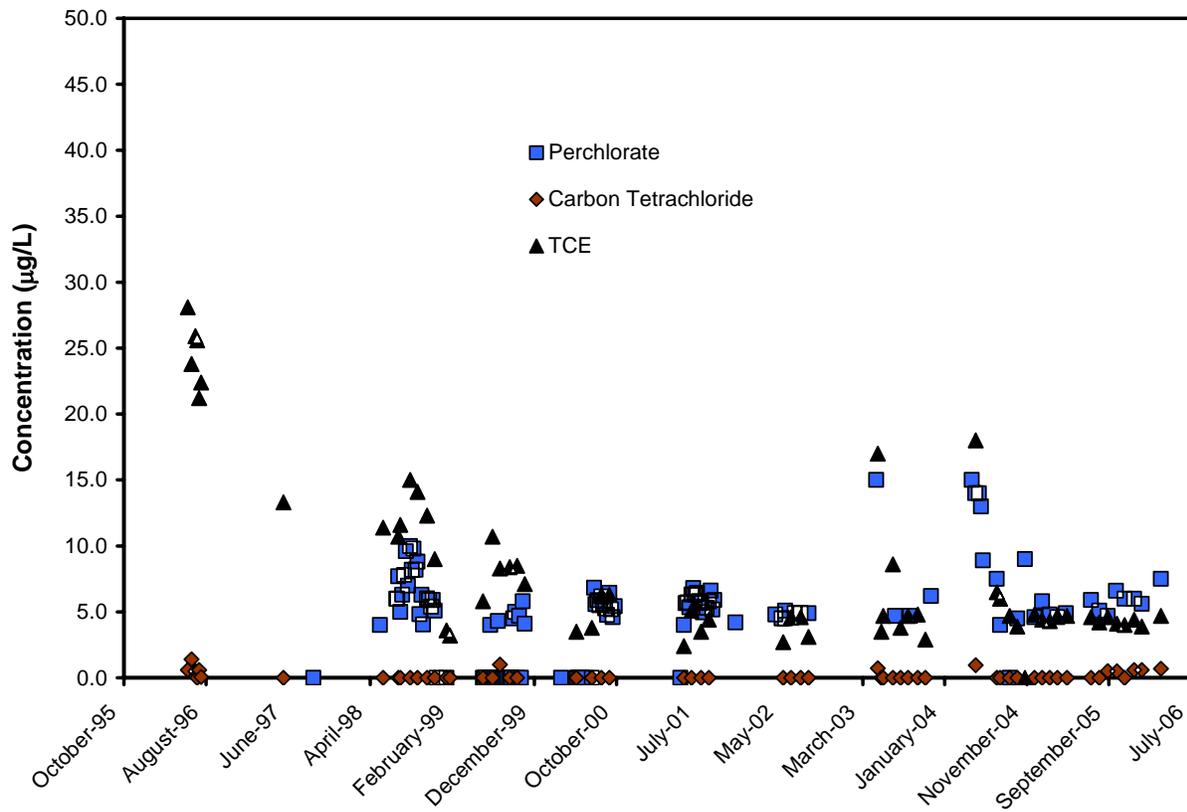


Figure 4. Historical Concentrations of CCl<sub>4</sub>, TCE, and Perchlorate in LAWC#5

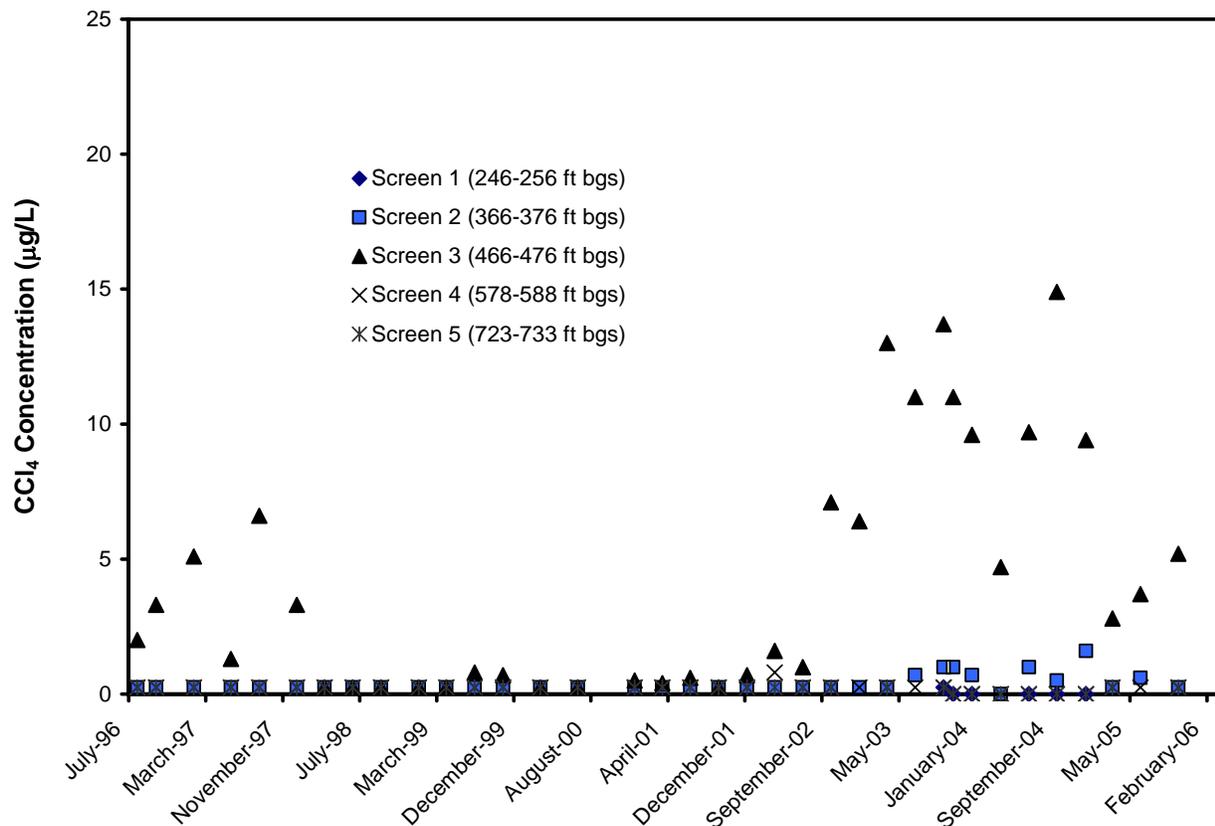


Figure 5. Historical Concentrations of CCl<sub>4</sub> in MW-17

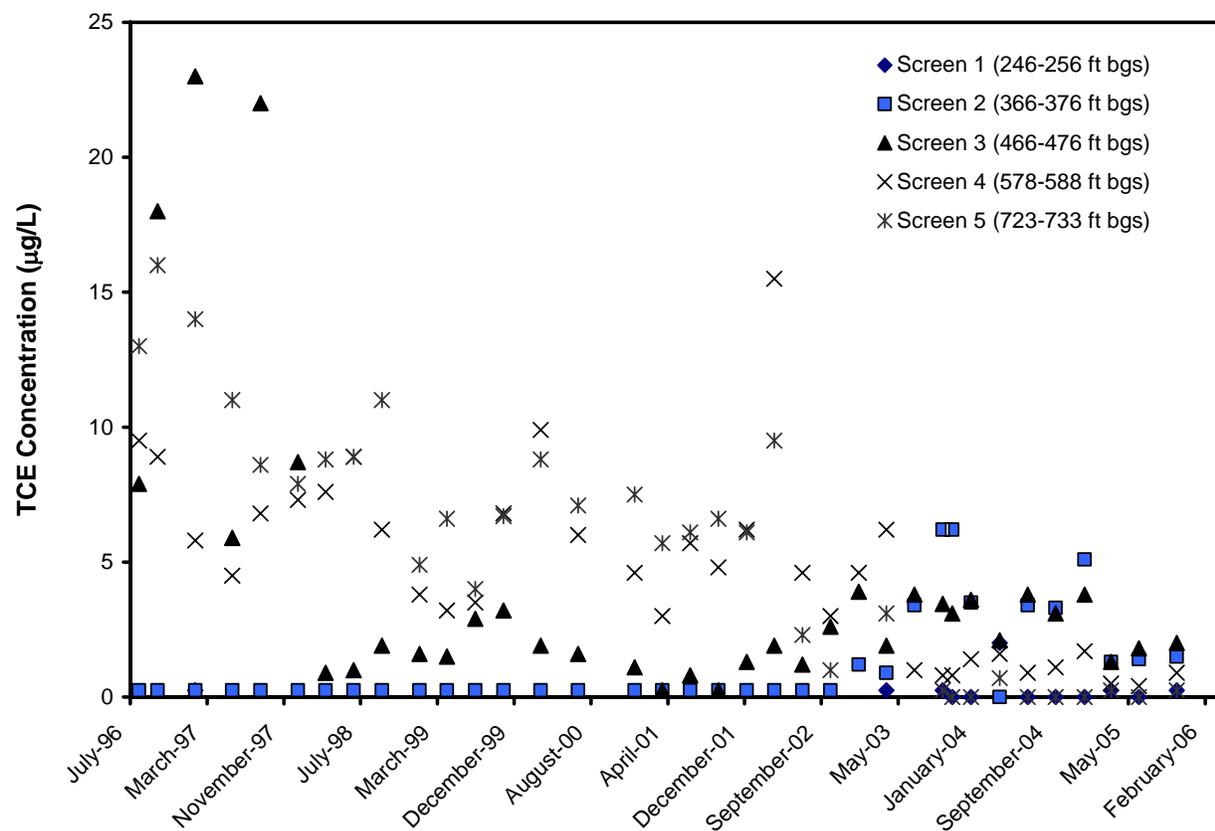
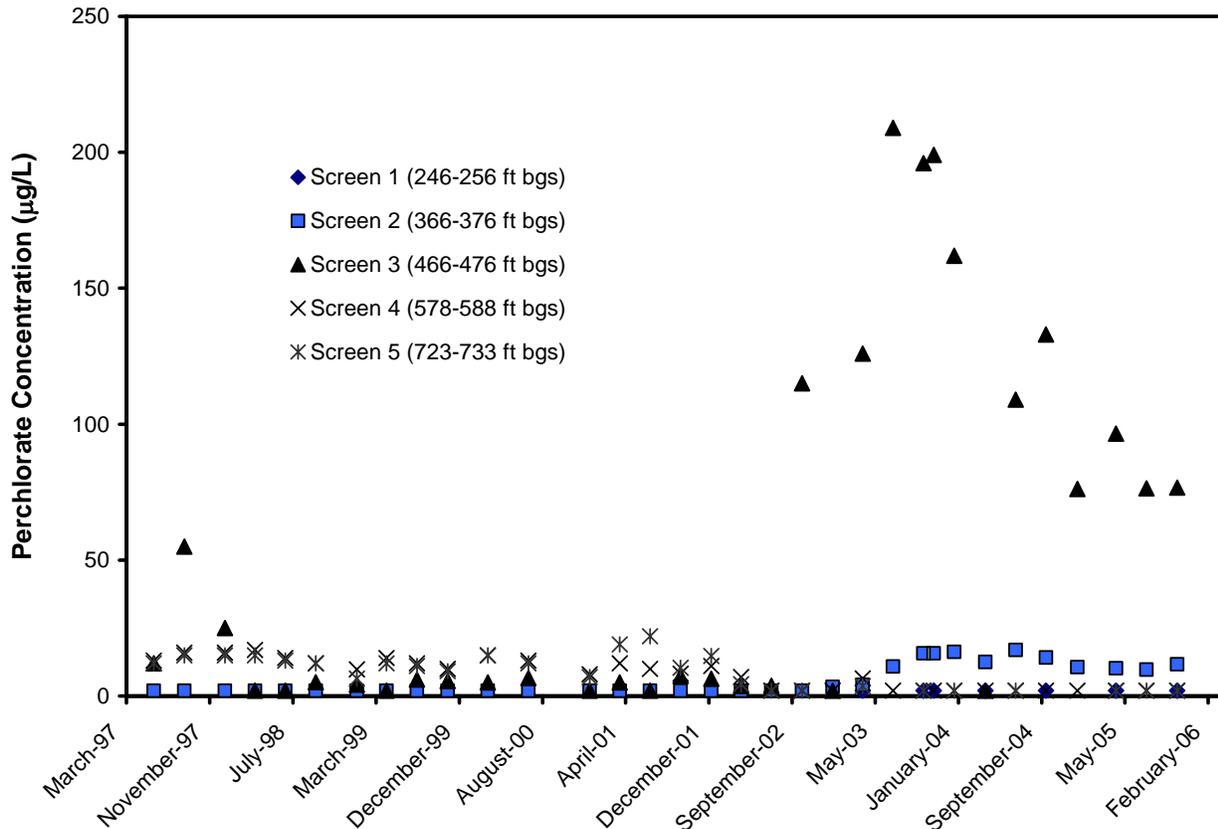


Figure 6. Historical Concentrations of TCE in MW-17



**Figure 7. Historical Concentrations of Perchlorate in MW-17**

**ROUTINE MONITORING**

Table 3 summarizes the routine monitoring schedule for the ion exchange and LGAC system. Analytical results from samples collected from LAWC#3 and LAWC#5 are presented in Figures 3 and 4, respectively.

Figure 8 shows perchlorate analytical results associated with the ion exchange system. Perchlorate broke through the lead IX vessel three times during 2005, but never through the second (“lag”) IX vessel. The system was shutdown in late January 2006 to implement improvements to the manifold to prevent channeling within the IX vessels, and the system was restarted in early March 2006.

Table 4 summarizes the LGAC changeout dates and frequency based on the 4<sup>th</sup> port analytical results. Carbon tetrachloride consistently breaks through the carbon prior to other chemicals, and hence serves as the indicator chemical. Typical breakthrough occurred between 42 and 217 operating days, with an average of 115 days.

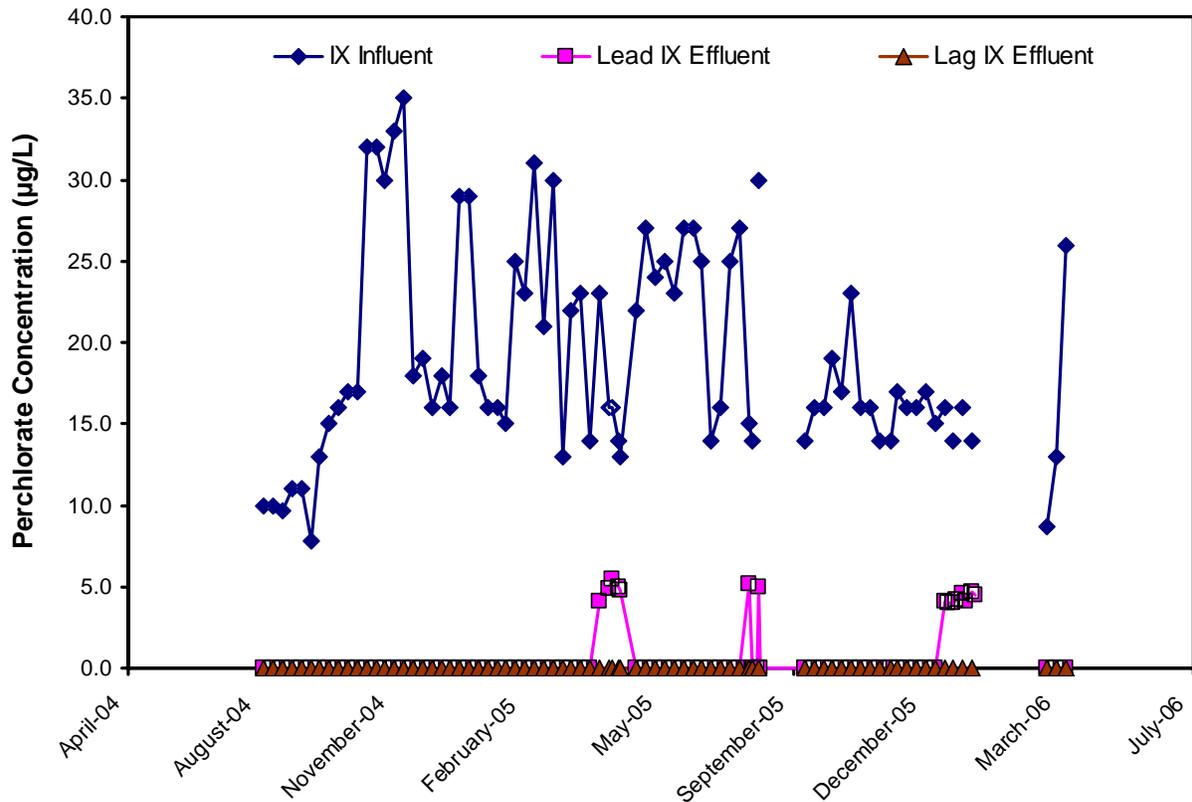
Table 5 summarizes the LGAC effluent and combined effluent sampling results. These effluent samples have not contained detectable CCl<sub>4</sub>, TCE, PCE, or perchlorate at any time since startup in July 2004, indicating the treatment system effectiveness.

**Table 3. Sampling Locations and Monitoring Schedule**

Analyte	Method	LAWC#3	LAWC#5	IX Influent	Lead IX Effluent	Lag IX Effluent	LGAC- 4 <sup>th</sup> Port <sup>(a)</sup>	LGAC-Effluent <sup>(a)</sup>	Combined Effluent
CCl <sub>4</sub>	EPA 524.2	M	M	-	-	-	W	M	M
TCE	EPA 524.2	M	M	-	-	-	W	M	M
PCE	EPA 524.2	M	M	-	-	-	W	M	M
Perchlorate	EPA 314.0	M	M	W	W	W	-	-	M
Nitrate	EPA 300.0	-	-	M	M	M	-	-	-
Total Coliform	EPA 1604	M	M	-	-	-	-	M	W
Heterotrophic Plate Count	9215B	-	-	-	-	-	-	M	W

(a) Samples collected from each of the 4 LGAC vessels  
M = Monthly; W = Weekly

Note: Sampling locations are shown on Figure 2.



**Figure 8. Ion Exchange System Performance**

**Table 4. Carbon Changeout Frequency Based on LGAC 4<sup>th</sup> Port VOC Sampling**

Description	1st Vessel	2nd Vessel	3rd Vessel	4th Vessel
Date of 1st Changeout	12/14/04	11/23/04	03/22/05	12/21/04
Date of 2nd Changeout	07/19/05	02/01/05	07/26/05	07/26/05
Days between changeouts	217	70	126	217
Date of 3rd Changeout	11/22/05	07/12/05	11/15/05	11/08/05
Days between changeouts	126	161	112	105
Date of 4th Changeout	01/03/06	11/01/05	01/20/06	01/20/06
Days between changeouts	42	112	66	73
Date of 5th Changeout		12/20/05		
Days between changeouts		49		
<b>Average days between changeouts</b>	<b>128</b>	<b>98</b>	<b>101</b>	<b>132</b>
<b>Minimum days between changeouts</b>	<b>42</b>	<b>49</b>	<b>66</b>	<b>73</b>
<b>Maximum days between changeouts</b>	<b>217</b>	<b>161</b>	<b>126</b>	<b>217</b>

(a) Changeout triggered after detection of VOCs, typically carbon tetrachloride, at the LGAC 4th Port

**Table 5. Effluent Sampling Results**

Date	LGAC Effluent VOCs <sup>(a)</sup>	Combined Effluent <sup>(b)</sup>
08/03/04	ND	ND
09/07/04	ND	ND
10/05/04	ND	ND
11/02/04	ND	ND
12/07/04	ND	ND
01/04/05	ND	ND
02/01/05	ND	ND
03/01/05	ND	ND
04/05/05	ND	ND
05/05/05	ND	ND
06/07/05	ND	ND
07/05/05	ND	ND
08/02/05	ND	ND
09/13/05	ND	ND
10/04/05	ND	ND
11/02/05	ND	ND
12/06/05	ND	ND
01/03/06	ND	ND
02/07/06	ND	ND
03/14/06	ND	ND

(a) TCE, CCl<sub>4</sub>, and PCE with detection limit of 0.5 µg/L from each of the 4 LGAC vessels effluent

(b) TCE, CCl<sub>4</sub>, and PCE with detection limit of 0.5 µg/L and perchlorate with detection limit of 4.0 µg/L

## COST SUMMARY

Table 6 summarizes the operational costs incurred between March and December 2005.

**Table 6. Operational Costs: March Through December 2005**

<b>Description</b>	<b>GAC</b>	<b>IX</b>	<b>Total</b>
Facility Inspections	\$16,577.50	\$15,707.01	\$32,284.51
Sample Analysis	\$29,397.50	\$16,106.25	\$45,503.75
Sample Collection	\$4,892.50	\$4,785.63	\$9,678.13
Maintenance	\$18,525.00	\$21,493.75	\$40,018.75
Carbon Change-Out	\$193,482.01	NA	\$193,482.01
IX Treatment Costs	NA	\$424,112.67	\$424,112.67
Associated Costs	combined	combined	\$3,327.38
Administration	\$1,385.40	\$1,431.58	\$2,816.98
Energy Costs	combined	combined	\$1,939.39
Chemical Costs	combined	combined	\$12,219.29
Support Vehicle	combined	combined	\$347.54
DHS Fees	NA	\$30,525.74	\$30,525.74
<b>Total</b>			<b>\$796,256.14</b>

## ATTACHMENTS

Attachments to this technical memorandum include the following:

- Attachment 1: Lincoln Avenue Water Company 2005 Annual Report of Operations

**ATTACHMENT 1: LINCOLN AVENUE WATER COMPANY  
2005 ANNUAL REPORT OF OPERATIONS**

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# LINCOLN AVENUE WATER COMPANY

Protecting Your Water Quality  
From The Top Down



2005  
ANNUAL REPORT OF OPERATIONS

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# Lincoln Avenue Water Company

March 9, 2006

Robert Gomperz, President  
Board of Directors  
Lincoln Avenue Water Company  
564 West Harriet Street  
Altadena, CA 91001



Dear Mr. Gomperz:

On behalf of Staff and Management of Lincoln Avenue Water Company (Lincoln), I am pleased to present the 2005 Annual Report of Operations.

The year 2005 proved to be a test of the company's commitment to continue groundwater treatment and contamination plumb containment. Last year we were faced with a number of new challenges in several phases of our water treatment operation. Our groundwater encountered an unexpected increase in the level of contamination. This in turn, caused our water quality budget along with the water quality workload to increase dramatically. As a company at the leading edge of water treatment technology, we've learned to adjust to changes.

In 2005, we received a final ruling that as a private water company, we would not receive any State or Federal financial assistance with our Ware Reservoir construction project. With no help available from government sources the company was forced to seek and secure alternative funding to make this project a reality.

Managing a drinking water agency with the water treatment complexity of Lincoln requires the recruitment and retention of qualified personnel. With certified operators in high demand throughout the industry, Lincoln not only retained but increased certification at all levels of operation.

The continuing increase in the region's population has placed a major demand on our limited drinking water supply. To help meet our drinking water needs everyone will be asked to practice more efficient water conservation. Water managers will have to find more creative ways to store available water in our regional groundwater aquifer to meet the demand during periods of drought. Lincoln is doing its part to help the region meet its current and future water needs with the construction of an Aquifer Storage and Recovery (ASR) well facility. By storing surplus water when available we add to our local supply for use in the future.

Managing a \$4 million annual operating budget and facing an annual increase in the cost of imported water requires strong leadership and sound financial planning. The staff at Lincoln has proven it can meet these requirements. We now look forward to a new year with new challenges.

Lincoln Avenue Water Company will continue to fulfill the mission of providing high quality, reliable water service to our customers at the lowest possible cost. We will continue to provide to our customers the best management practice from The Top Down.

Sincerely,  
Lincoln Avenue Water Company

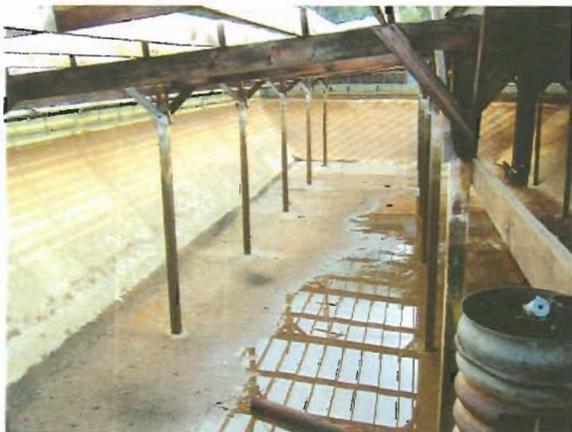
  
Robert J Hayward  
General Manager



### *Ware Reservoir Construction Project*

Following two years of planning and having overcome major funding obstacles, construction work at the Ware Reservoir site has begun. Faced with limited funding options from the inception and maintaining a commitment to not pass on a major rate increase to our customers, Lincoln's Board and management took on the challenge of completing this project using alternative resources.

As a non-profit private company, every attempt to secure State or Federal funding assistance ended up to no avail. Faced with this limitation, the Company turned to its local banking partner, Citizens Business Bank. By working with our bank, we were able to structure a construction loan agreement with acceptable terms and conditions which allowed the Company to proceed with the project without a major rate increase.





A view of the old Ware Reservoir interior during demolition. This reservoir has been in service since the early 1900's. It was originally an irrigation reservoir retrofitted to store potable water in 1937.



An over head view of the construction site. A temporary tank will be used to serve the Ware zone with adequate water service until the project is completed. The new reservoir will double the storage capacity for this zone.



Cover: Lincoln's Board of Directors breaking ground at the new Ware Reservoir site. (From left to right: Richard Fiedler, John Clairday, Robert Gomperz, Lawrence Duncan and Lester Allen.)



Lincoln's Board of Directors inspect the construction plans at the Ware Reservoir site with General Manager, Robert Hayward.

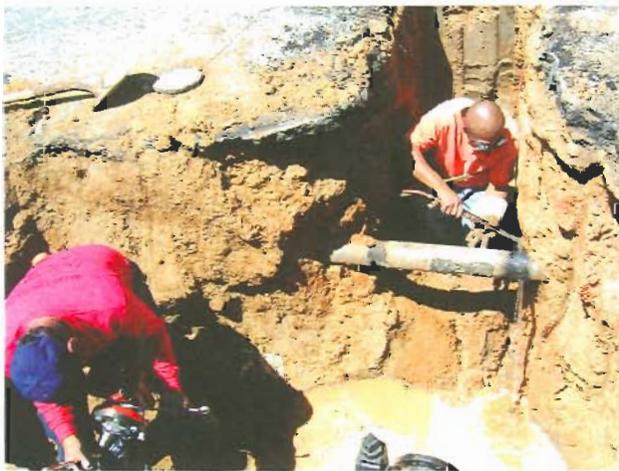


Chaney Trail Pipeline Replacement Project



### *Long Term Capital Improvement/ Pipeline Replacement Projects*

We are committed to the continued upgrade of our 100 year old distribution system and infrastructure. Each year, we continue to replace old deteriorated undersize pipes with new larger water mains. By doing so, we reduce leaks and improve fire flow protection to meet current code requirement. In 2005, such projects included the replacement of over 1,100 linear feet of aged pipe on Chaney Trail and Fair Oaks Avenue.



Fair Oaks Pipeline Replacement Project

### *Team Work Between Neighboring Agencies*

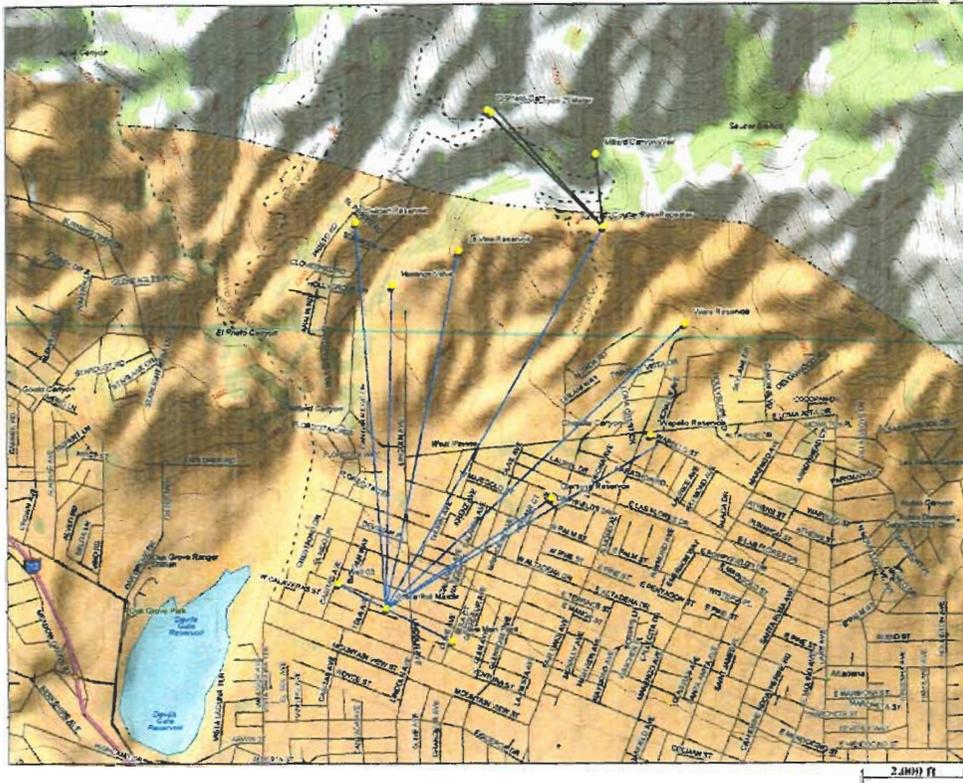
Lincoln Avenue Water Company and the City of Pasadena (Pasadena) has a long history of assisting each other in the efficient management of our local water resources. We have an agreement in place at this time to pump, treat and deliver to Pasadena their excess Arroyo Seco groundwater rights that they are currently unable to produce. As a means of facilitating this process, a new larger pipeline has been installed on North Fair Oaks Avenue. This new line will allow Lincoln to transmit treated water back to the Pasadena system through our Fair Oaks Avenue/Calaveras Street interconnection in a much more efficient manner. A history of team work has proven to be a continued benefit to both agencies.



### *Aquifer Storage and Recovery (ASR) Well Conversion for Dry Years Storage*

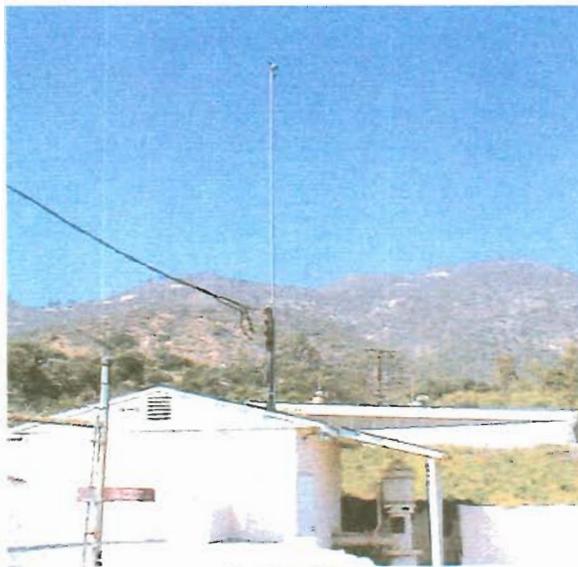
Lincoln is participating in the Metropolitan Water District's (MWD) Dry Year Storage Program. The program calls for MWD member agencies and sub-agencies to store excess surface water in the basin via injection well during wet years for extraction during dry years. One such well is currently under construction at Lincoln. Water will be stored when available and produced to supplement local supply during drought years. Injecting water in the Monk Hill Basin aquifer also creates an artificial barrier which will help slow the migration of contamination from the Jet Propulsion Laboratory site. Lincoln's #5 well has been modified to function as an ASR injection-extraction well.





### *Supervisory Control and Data Acquisition (SCADA)/ Security System Upgrade*

As required by the Bioterrorism Act of 2002, Lincoln completed a Bioterrorism Vulnerability Assessment (VA) review in 2004. The review final report recommended that Lincoln make certain upgrades to the distribution system including the SCADA system and security system. Lincoln has completed the first phase of implementing these upgrades by detailing the scope of work involved in this major project. When completed, the fully automated system will allow greater security control at remote facilities by detecting, alarming and recording intrusion with video surveillance in real time that can be viewed from a central or remote location.



Radio site survey performed to test the feasibility and quality of a proposed wireless Broadband Ethernet system.

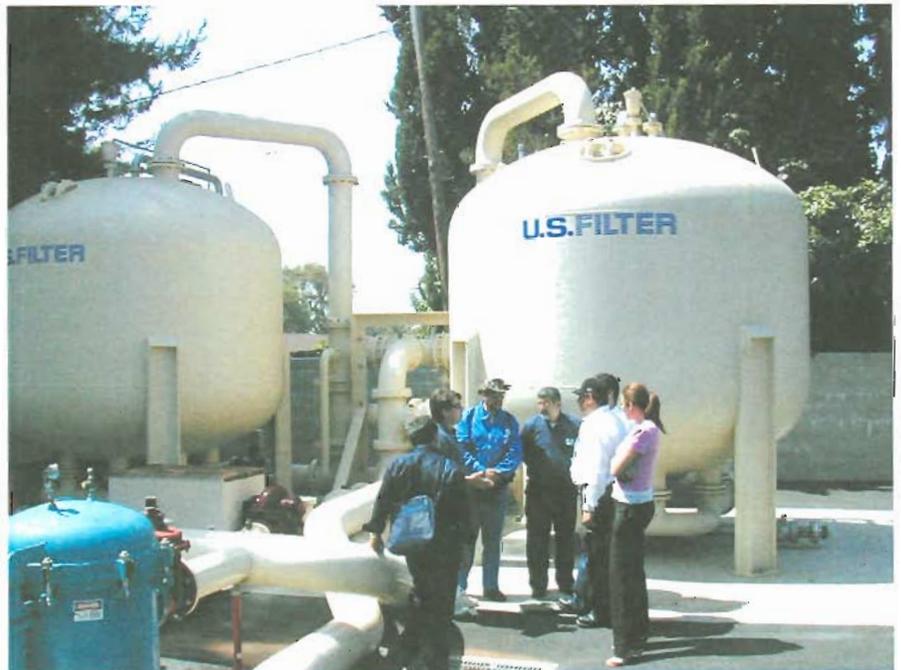


In May 2005, government officials from the State of Israel toured our treatment facility to learn more about advanced perchlorate treatment.

*\*\*\*International Recognition\*\*\**  
*Visitors from Afar Toured our State-of-the-Art*  
*Groundwater Treatment Facility*

Our state-of-the-art Ion Exchange Perchlorate Treatment Facility operating in conjunction with our Liquid Phase Granular Activated Carbon (GAC) Groundwater Treatment Facility made news around the world. We entertained visitors from as far away as Israel and as close as Mexico. These visitors were interested in learning more about the advanced technology and operation of our plant. Since the start-up of our expanded treatment system in July 2004, Lincoln has treated over 3,000 acre feet or 1 billion gallons of water. The entire Raymond Basin benefits from the continued operation of this plant.

In July 2005, officials from Mexico accompanied by NASA officials discussed the operation and technology of our plant for possible use in their environmental remediation work.



## *Lincoln Hosted a Meeting of ACWA Region 8 Members*



Lincoln's Board Member, Mr. Robert Gomperz welcomed everyone to the meeting and tour.

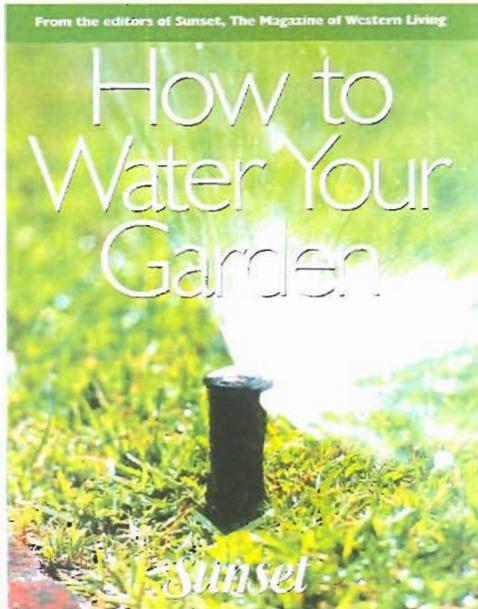
In April 2005, Lincoln hosted a meeting of the Association of California Water Agencies (ACWA), the largest and oldest state water association. A panel of experts including a senior environmental specialist from the Metropolitan Water District was on hand to discuss perchlorate treatment and why it is important. Officials from the City of Pasadena, NASA, JPL and other local water agencies also attended the meeting and toured the facility.



Also in attendance, City of Pasadena District 1 Councilmember Joyce Streater. Her district has also been impacted by groundwater contamination.



ACWA Region 8 members and local officials were in attendance.



## *Water Conservation is Always in Style*

Lincoln continues to offer its customers water conservation ideas and better tools to help save water. The Ultra Low Flush Toilet Retrofit Rebate Program (ULFT) and Residential High Efficiency Clothes Washer Rebate Program (HECW) continued to be available at our office. These programs are offered in partnership with the Metropolitan Water District of Southern California. Since the inception of the ULFT rebate program in May 1999 and the HECW rebate program in May 2002, Lincoln has returned over \$17,000 to our customers in the form of water bill rebates. The water saving sample brochures below are available at our office or for more information on water conservation, please visit [www.bewaterwise.com](http://www.bewaterwise.com).



**WATER SALES AND PRODUCTION FOR 2005  
IN ACRE FEET**

MONTH	IMPORTED	WELLS	LOCAL SURFACE	TOTAL PRODUCTION	SALES	RAIN FALL
January	2.10	180.88	12.63	195.61	132.60	20.26
February	0.00	133.80	47.48	181.28	124.43	16.30
March	0.00	129.21	86.51	215.72	97.49	3.14
April	24.13	215.76	83.20	323.09	140.50	0.85
May	166.04	116.56	85.67	368.27	178.77	0.61
June	191.92	122.44	76.12	390.48	248.33	0.00
July	191.55	226.98	44.15	462.68	265.53	0.00
August	268.63	113.84	26.79	409.26	323.60	0.00
September	184.80	163.87	18.89	367.56	293.85	0.38
October	130.66	199.34	18.34	348.34	236.77	4.18
November	100.72	191.26	18.33	310.31	172.79	0.31
December	27.01	270.08	18.51	315.60	180.05	0.29
<b>TOTAL</b>	<b>1287.56</b>	<b>2064.02</b>	<b>536.62</b>	<b>3888.20</b>	<b>2394.71</b>	<b>46.32</b>

**PUMPED FROM WELLS**

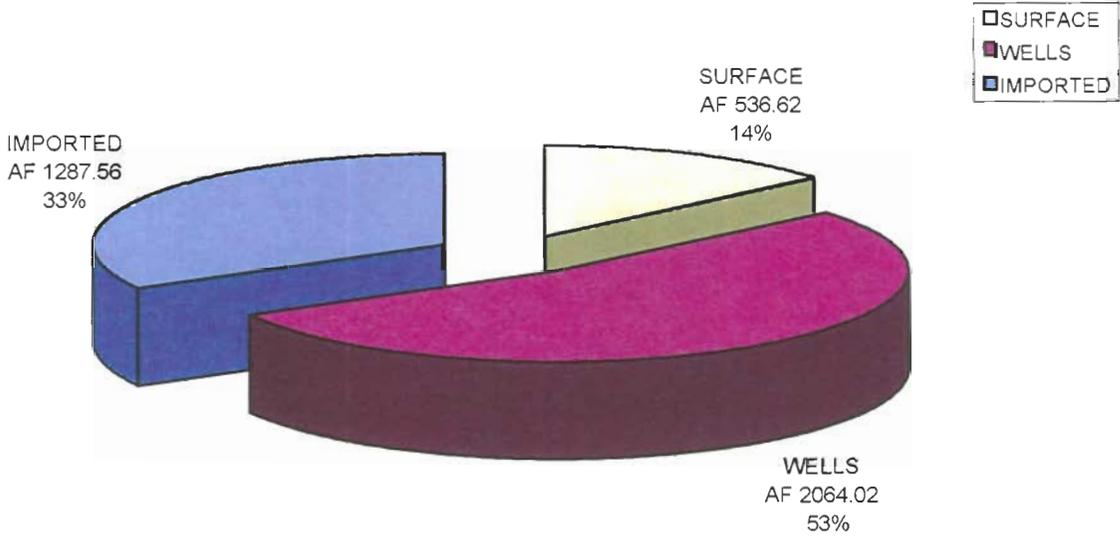
WELL #3	1372.59
WELL #5	691.43
<b>TOTAL</b>	<b>2064.02</b>

Total Production	3888.20
<b>Delivered to Pasadena (lease agreement)</b>	<b>-1141.25</b>
Production for Lincoln	2746.95
Total Sales	2394.71
Non-Sales Production*	352.24 or 9%

\***Non-Sales Production** is water loss due to disinfection requirements, leaks on mains, evaporation from reservoirs, faulty meters, un-metered water for irrigation at Company sites, flushing of dead ends, pipeline ditch compaction, fire fighting, fire training, etc. Lincoln's non-sale production water continues to be below the national average for systems of our age.

The Company's groundwater consists of 567 acre feet annual decreed right plus spread credit from mountain run-off, and available leased groundwater..

2005  
Water Production  
By Source



Wells	2064.02 AF
Surface	536.62 AF
Imported	<u>1287.56 AF</u>
Total Production	3888.20 AF

**ENERGY COST BY PUMPING STATIONS AND WELLS  
2001-2005**

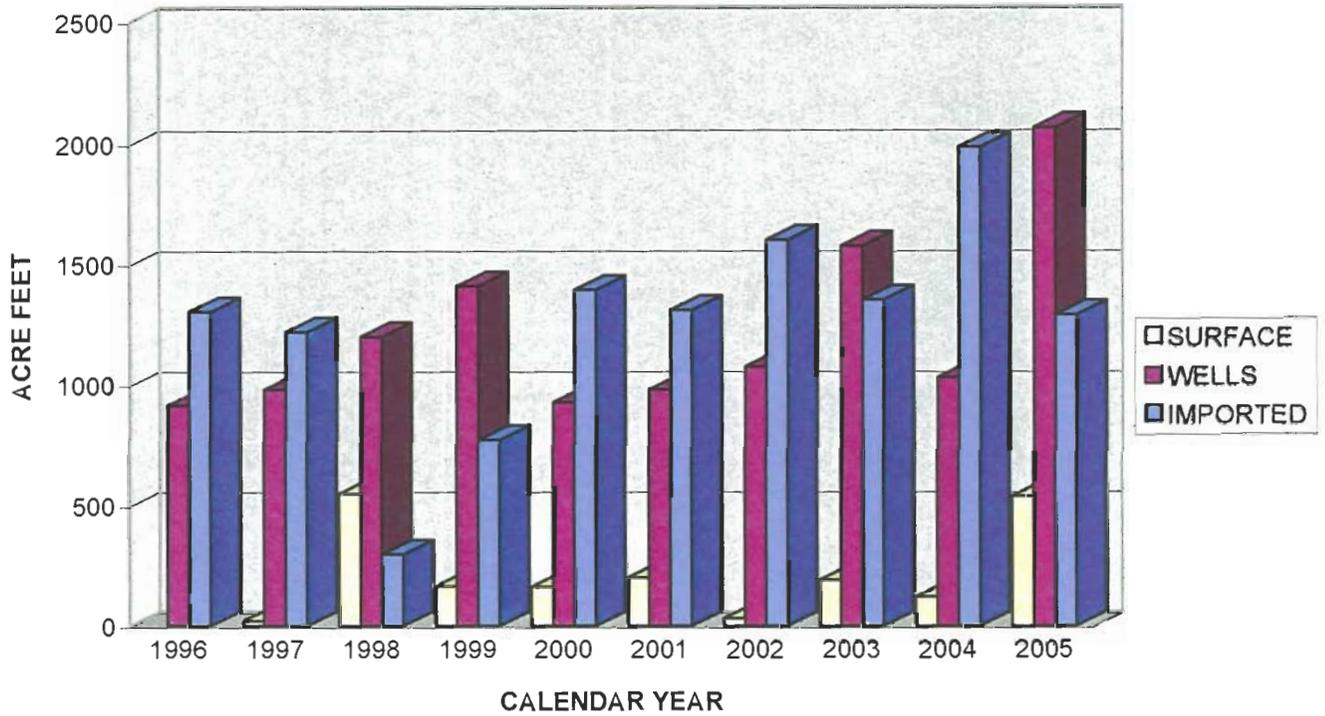
PUMPING STATIONS & WELLS	2005 ANNUAL ENERGY COST COST/AF	2004 ANNUAL ENERGY COST COST/AF	2003 ANNUAL ENERGY COST COST/AF	2002 ANNUAL ENERGY COST COST/AF	2001 ANNUAL ENERGY COST COST/AF
Well #3 <i>(Pump to Main Plant)</i>	\$60,306 \$43.94	\$32,507 \$52.47	\$34,763 \$44.76	\$28,610 \$55.54	\$29,748 \$63.37
Well #5 <i>(Pump to Main Plant)</i>	47,500 68.70	27,478 66.82	45,475 57.02	38,595 68.99	34,909 68.26
Main Plant <i>(Pump to Glenrose Resv.)</i>	143,152 42.71	90,805 30.12	82,677 28.27	86,581 32.38	74,361 32.47
Glenrose Reservoir <i>(Pump to Wapello Resv.)</i>	35,256 10.52	47,043 15.60	46,403 15.87	53,177 19.89	41,624 18.18
Wapello Reservoir <i>(Pump to Ware &amp; La Vina &amp; Swigart Resv.)</i>	46,929 34.99	56,206 31.55	59,776 33.72	65,576 47.71	51,932 50.69
Ware Reservoir <i>(Pump to Coulter Resv.)</i>	9,402 89.91	16,737 58.70	19,221 54.32	28,819 55.76	22,895 52.44
TOTAL ANNUAL ENERGY COST	\$342,545	\$270,776	\$288,315	\$301,358	\$255,469

**ANNUAL PRODUCTION IN ACRE FEET  
1996-2005**

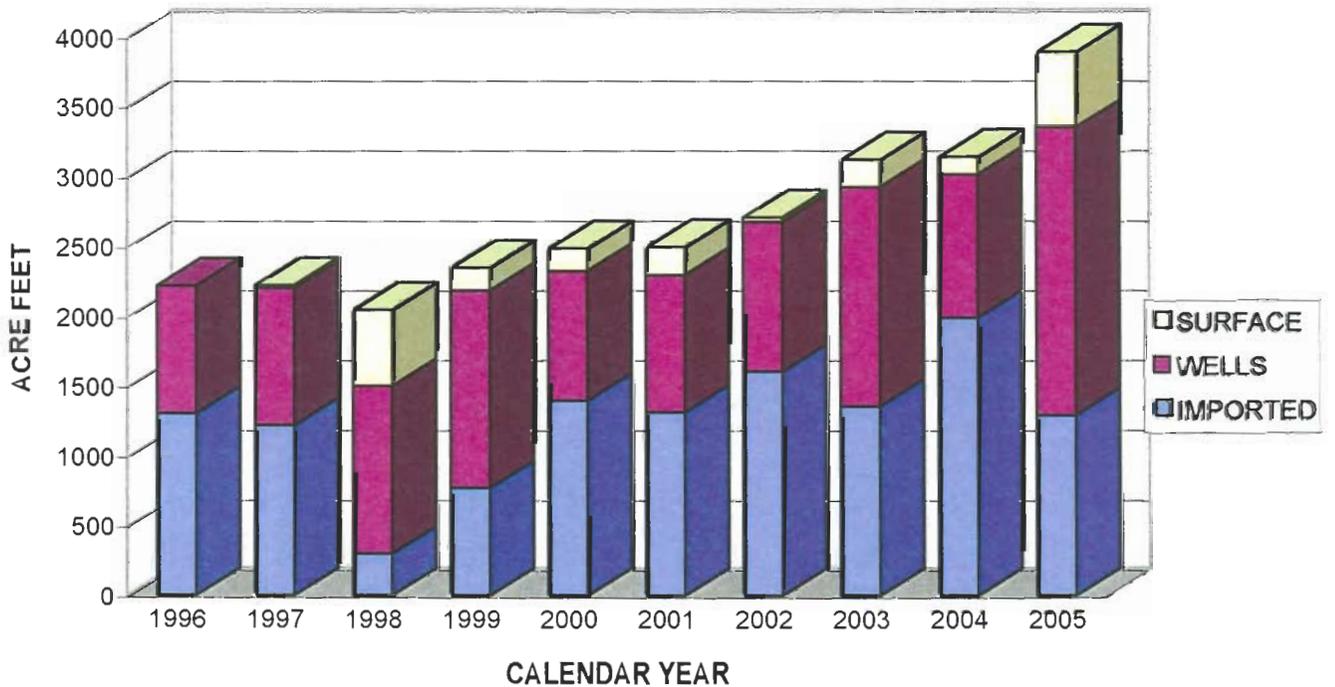
<b>CALENDAR YEAR</b>	<b>WELL #3</b>	<b>WELL #5</b>	<b>SURFACE*</b>	<b>IMPORTED</b>	<b>TOTAL PRODUCTION</b>	<b>LESS PASADENA DELIVERY</b>	<b>ACTUAL PRODUCTION (LINCOLN)</b>
2005	1372.6	691.4	536.6	1287.6	3888.2	1141.3	2746.9
2004	619.5	411.2	121.9	1984.1	3136.7	322.7	2814.0
2003	776.6	797.5	190.7	1350.4	3115.2	403.4	2771.8
2002	515.1	559.4	30.8	1599.4	2704.7		2704.7
2001	469.4	511.4	201.3	1309.3	2491.4		2491.4
2000	385.4	541.3	164.0	1392.4	2483.1		2483.1
1999	760.5	647.7	166.1	770.4	2344.7		2344.7
1998	573.9	624.7	547.1	298.3	2044.0		2044.0
1997	960.3	0.6	19.6	1218.9	2199.4		2199.4
1996	695.2	218.6		1302.8	2216.6		2216.6

\* Surface Water Treatment Plant start-up November 1997.

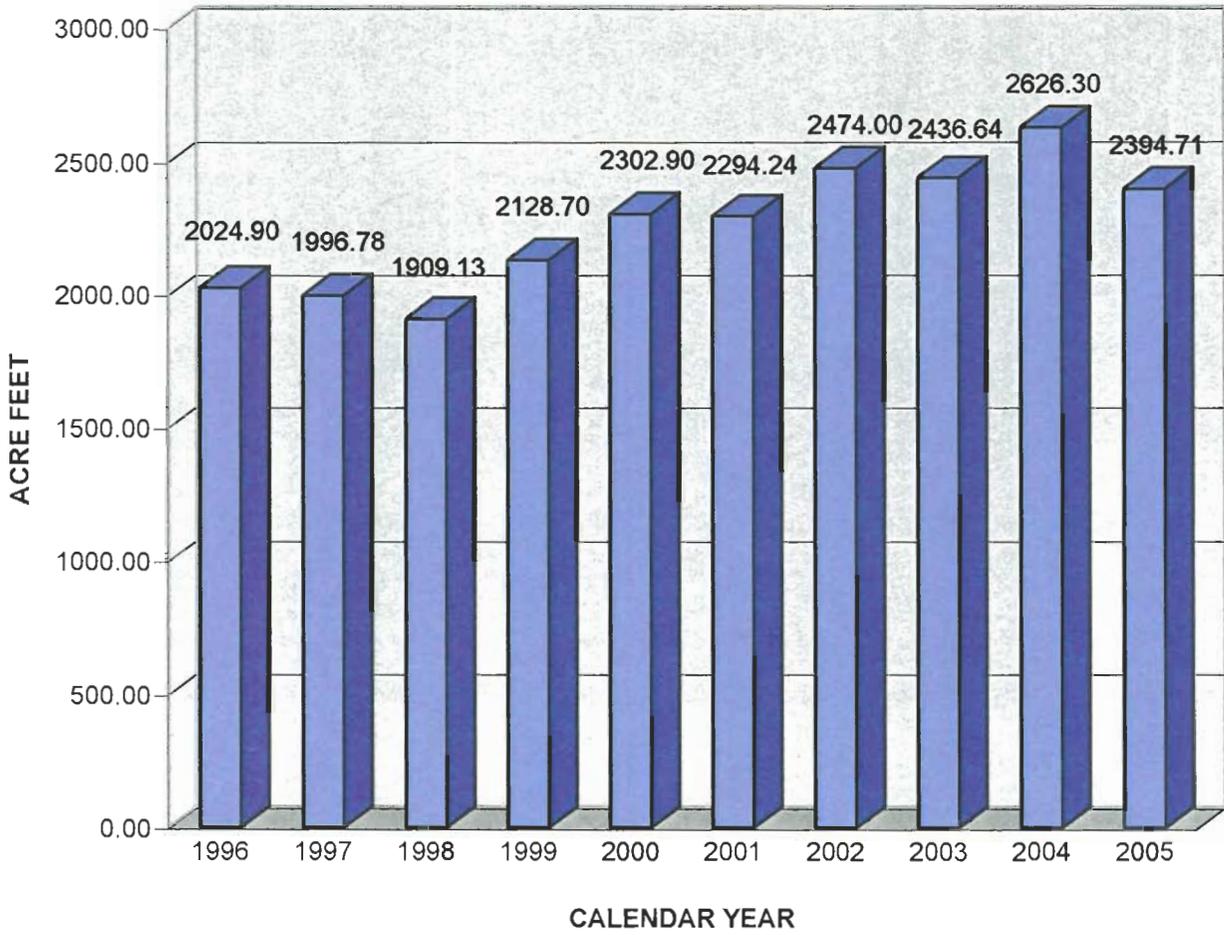
### ANNUAL PRODUCTION BY SOURCE - SURFACE, WELLS & IMPORTED



### TOTAL ANNUAL PRODUCTION - SURFACE, WELLS & IMPORTED



### ANNUAL WATER SALES IN ACRE FEET 1996 - 2005



## METERS AND SERVICE CONNECTIONS

New service connection installed in 2005	3
Meter replacement in 2005	86
Total number of service connections in 2005	4443
2005 average consumption per meter per day - Residential	434 gal.
2005 average consumption per meter per day - Commercial	1855 gal.
2005 average consumption per capita per day - Residential	124 gal.

## TOTAL NUMBER OF METERS BY SIZE

5/8"	3225
3/4"	807
1"	319
1½"	21
2"	61
3"	5
4"	5
<b>TOTAL</b>	<b>4443</b>

**WELL PRODUCTION CAPACITY**

Well #3 (drilled 1924)	900 GPM
Well #5 (drilled 1971)	1100 GPM

**TOTAL OF ALL DISTRIBUTION LINES IN LINEAR FEET**

Distribution System	287,163
Pumping Lines	18,128
<b>TOTAL</b>	<b>305,291</b> <b>or 57.8 miles</b>

## TOTAL ANNUAL CANYON WATER BASIN RE-CHARGE IN ACRE FEET

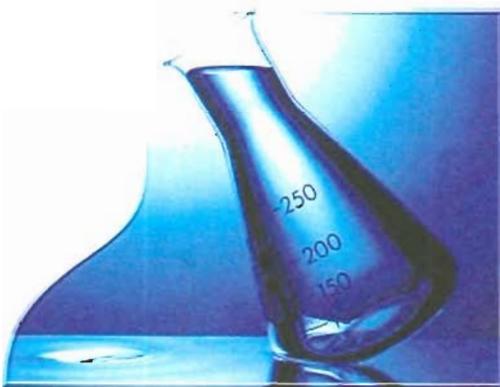
### CANYON WATER BASIN RE-CHARGE

Millard	110.80
Swigart	891.86
El Prieto	6.93
Millard/La Vina*	255.26
TOTAL	1264.85

\*Maximum allowable spread credit for Millard/La Vina is 0.65 CFS.

All canyon water that flows to the spreading basin is metered with an allowable extraction based on Raymond Basin Management Board percolation calculations.

### WATER QUALITY



Lincoln Avenue Water Company is required by the State of California Department of Health Services (DHS) to take distribution system wide water quality samples which include bacteriological, total trihalomethanes, volatile organic compounds, general physical, general mineral and inorganics, along with other scheduled analyses. Lincoln's system was in compliance with DHS water quality standards at all time during 2005.

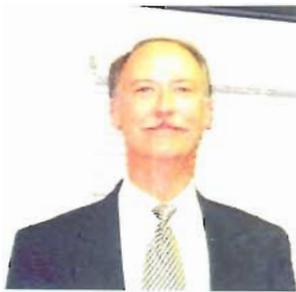
**BOARD OF DIRECTORS  
FOR THE YEAR 2005**



**ROBERT J. GOMPERZ**

**PRESIDENT**

Robert J. Gomperz has been a Board member since 1990. He is retired from the Metropolitan Water District of Southern California where he coordinated various communications programs to the public about Metropolitan's programs and policies. Mr. Gomperz has been a public relations professional for more than three decades. He has a degree in Management from the University of Redlands. Prior to joining Metropolitan, he was Pasadena City College's Public Information Director for 12 years. He owns and operates Foto-Buster which is located on Altadena Dr., near Lake Avenue. Mr. Gomperz is also an elected member of the Foothill Municipal Water District, representing a portion of Altadena.



**JOHN C. CLAIRDAY**

**VICE PRESIDENT**

John C. Clairday, a graduate of the University of Southern California and Loyola Law School, has served on the Board since 1993. A former public high school teacher, Mr. Clairday presently works as an attorney for the Metropolitan Water District of Southern California. As a member of the General Counsel's Office, Mr. Clairday works closely with Metropolitan's Board and staff and represents the District before various administrative and regulatory agencies.



**LAWRENCE W. DUNCAN**

**1ST VICE PRESIDENT**

Lawrence W. Duncan is a retired textile industry supervisor and a 38-year Altadena resident. Mr. Duncan is entering his fifth year as a member of the Lincoln Board and also serves as the Company's Community Liaison Officer.



**LESTER ALLEN**

**TREASURER**

Lester Allen, a retired Water Supervisor for the City of Pasadena Department of Water and Power, has served on Lincoln Avenue's Board for 26 years. Mr. Allen brings many years of waterworks experience to the Company.



**RICHARD P. FIEDLER**

**ASSISTANT SECRETARY**

Richard P. Fiedler, a graduate of the University of Southern California with a bachelor's degree in Mechanical Engineering and bachelor's and master's degrees in Chemical Engineering, brings with him over 40 years of experience in the water industry. For the last 33 years, he has been the owner of F & F Industries and Process Systems Inc., located in West Altadena. Mr. Fiedler has served on the Board since 1993. His wide range of experience as well as his engineering and professional associations is a valuable asset to the Company.

# Office Staff



Maria Roxanna Autran, Office Supervisor and Bookkeeper has over 20 years of service to the company.



Jennifer Betancourt, Customer Service Representative and Water Conservation Coordinator joined the company in 2003.



Vannessa Grant, Customer Service Representative and Administrative Assistant is the newest member of the office staff.



Anne Asavavimol, Water Quality Coordinator and Assistant Supervisor is a senior employee with over 15 years of service.

# Field Staff



Jack Harms, Water Quality Supervisor preparing to check chlorine residuals from distribution system sampling sites.



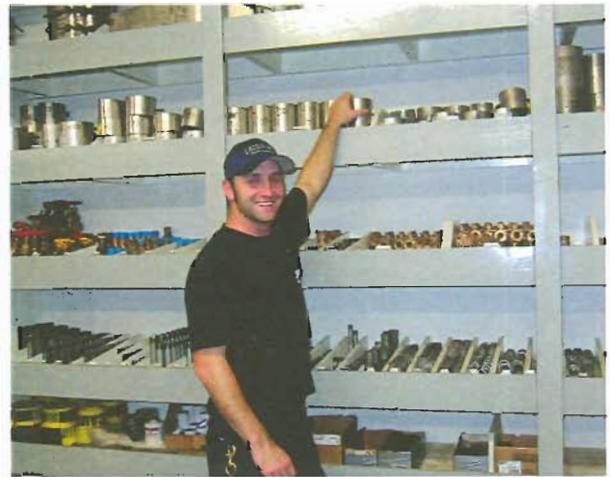
Asia Smith, Water Distribution Supervisor checks the telemetry system before starting his routine inspection of the distribution system, treatment plants, and reservoir sites.



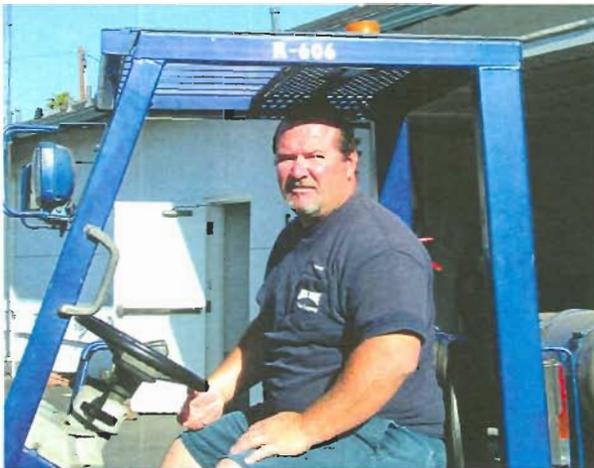
Bobby Valdez, Senior Field Representative inspects Olive Avenue booster station.



George Salazar, Senior Field Representative and Cross Connection Control Specialist reviewing plans for a future pipeline replacement project.



Mike Cotter, Field Representative inspecting and organizing inventory.



David Arden, Field Representative unloads a delivery of water meters and other waterworks materials.