OWENS VALLEY MONITOR

2004

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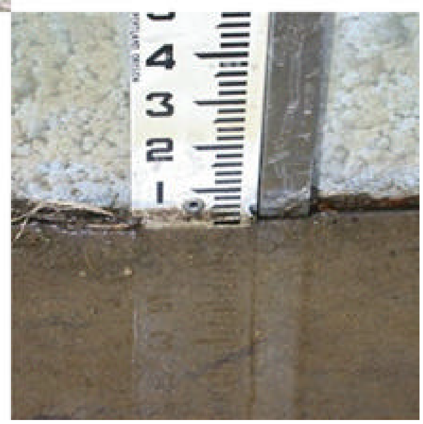
2005



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October 2005
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Owens Valley Monitor 2004-2005

The *Owens Valley Monitor* is the Inyo County Water Department's (ICWD) annual report on monitoring and other work performed by ICWD and the Los Angeles Department of Water and Power (LADWP). In accordance with the Inyo/Los Angeles water agreement, ICWD and LADWP monitor water activities in the valley and their effects on groundwater levels and vegetation. The two agencies also conduct scientific research on methods of improving water management.

This annual report was produced by the Inyo County Water Department in Bishop, California. If you would like to receive notification of the availability of future editions of the *Owens Valley Monitor*, please contact us. Our website, http://www.inyowater.org/, contains the complete text of the *Owens Valley Monitor*, plus the figures and maps are in color.

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Report on Vegetation Conditions

by Sara J. "Sally" Manning, Ph.D., Vegetation Scientist
July 13, 2005, revised October 26, 2005

In 2004, vegetation conditions in areas monitored by Inyo County Water Department (ICWD) generally showed either a pattern of holding constant relative to recent years (e.g. since 2001) or of declining.

ICWD monitors vegetation conditions throughout Owens Valley each summer. In the early 1990s, the Technical Group agreed to re-inventory plant cover and species composition in selected vegetation parcels to compare each year's conditions with the Water Agreement's baseline data. The baseline data were collected during the mid 1980s by LADWP staff. ICWD staff began collecting field data in 1991, and the program has continued since that time.

The recent elimination of ICWD seasonal staff positions (due to budget concerns) resulted in a cut back in the re-inventory work during 2003 and 2004. Ninety-six parcels were re-inventoried in 2002, but only 68 and 73 parcels were monitored in 2003 and 2004, respectively.

In addition to tracking changes since the baseline period, the re-inventory data are also analyzed for parcel water table and vegetation status with regard to the requirements of the Drought Recovery Policy (DRP). Following each summer season, data on depth to water table are obtained from ICWD hydrologists, analyses are performed, and a status report on conditions is presented to Inyo County and LA decision makers. The report on conditions through 2004 is entitled: Status of Re-Inventoried Vegetation Parcels According to the Drought Recovery Policy, 2004, by Sara J. Manning, April 27, 2005. (Available in pdf here.)

Data from 1991 through 2004 show that, in parts of most wellfields, water table and perennial vegetation have failed to recover since the 1987-1992 drought when LADWP pumped large amounts of water from Owens Valley. In terms of the DRP, of the 73 parcels re-inventoried in 2004, 29 parcels were classified as still subject to the management constraints imposed by the policy. This means that conditions have persisted below the Water Agreement baseline in these affected areas of the valley at least since 1991 (when monitoring began) and probably for a few years longer (prior to 1991).

Most of the other parcels re-inventoried in 2004 were classified either as Controls or as "Free" from the management restrictions of the DRP. Twenty parcels were designated as Controls, that is, not affected by pumping during the 1987-1992 drought. Although water tables and perennial plant cover have varied in the Control parcels since the baseline period, the range of variation in water table has been relatively small compared to the water table variation in the monitored wellfield parcels, and perennial cover in the Control parcels tends to be equal to or above baseline levels. The 21 parcels classified as "DRPfree" showed clear evidence that water tables recovered since 1992, and perennial plant cover responded to this recovery. In all cases, this "recovery" occurred during the period from 1995-2001. That is, no monitored "DRP" wellfield parcel has exhibited recovery since 2001. In addition, since 2001, many of the DRPfree parcels have exhibited declines in water table and perennial cover and some exhibited cover statistically significantly below baseline in 2004. Three additional parcels were re-inventoried in the Laws area beginning in 2003.

Because of the 14-yr gap in field data, these three parcels have not been classified according to the DRP. However, all three showed extremely low cover, significantly below baseline levels.

In addition to data collected in the field by ICWD, ICWD obtains total green plant cover estimates that are derived annually from Landsat satellite data. These data are purchased and analyzed by Dr. Andrew Elmore of Dartmouth College. During a 3-yr collaboration with ICWD scientists, Dr. Elmore and other university researchers developed a technique for assessing live plant cover throughout the valley based on a late summer satellite scene. Dr. Elmore has continued to analyze cover on an annual basis, such that ICWD has a complete late summer record of vegetation cover for 1986-2004. For ICWD's re-inventoried parcels, the Landsat-derived cover estimates were presented in Manning's 2005 report (referenced above).

The various forms of vegetation cover data have been used to study relationships between water availability and cover. To perform these analyses, best available estimates of each site's depth to water table (DTW) and cumulative annual precipitation were obtained, and relationships were examined using linear regression. Linear regression detects whether an incremental change in an environmental factor (e.g. a change in DTW) is associated with a predictable incremental change in a response factor (e.g. vegetation cover).

Despite many limitations and potential errors in the available data, some strong relationships have been detected between water availability and cover. These results are helping develop a clearer picture of the interaction between water table, precipitation, and phreatophytic plant cover in Owens Valley, and this information should be useful to water managers. Some highlights are discussed below.

The data show that, in Control areas, where water tables have fluctuated minimally during the past 19 years, plant cover does not appear to respond to the small fluctuations in DTW. In some cases, a minor correlation is detected between precipitation and cover (with cover increasing somewhat in high rainfall years) in Control areas. It is assumed that, because these sites experience a constant supply of water from the water table, the plants are not very "water-limited." Thus, when their cover varies, it is probably due to changes in other factors, such as disturbance or herbivory. Furthermore, as mentioned with regard to the field data, cover tends to remain high in Control sites.

In areas affected by pumping or by water spreading, water availability can become a constraint on vegetation cover. Analyses revealed that when management activities resulted in fluctuations in the water table (typically more than 2m during the 19-yr period), vegetation cover responded to changes in water availability. Results show that when the water table fluctuated in the root zone of the dominant Owens Valley phreatophytic species, vegetation cover was correlated with DTW. However, once the water table dropped below and stayed below root zones, further fluctuations in cover were not correlated with changes in DTW. At the point where groundwater is no longer available, total plant cover at the site is much lower than it had been when roots had access to the water table, and total plant cover begins to respond, weakly, to precipitation. (See case study for two parcels, Blackrock 99 and Blackrock 94.)

These results have implications for the parcels ICWD re-inventories. Analyses show that most of the wellfield parcels classified as "DRPfree" show a correlation between cover and change in DTW. That is, as the water table rises, cover increases, and as the water table drops, cover decreases. Groundwater levels associated with DRPfree parcels typically fluctuate within or just below the root zone, and the analyses strongly suggest that these fluctuations drive changes in cover. The relationship between DTW and cover is strongest for meadow DRPfree parcels located near the lower edge of the Sierran alluvial fans and in Laws. In contrast, for the DRP parcels, DTW typically remains below or deep within the root zone, and cover is not correlated with changes in DTW. Most DRP parcels exhibit low total cover values. Analyses often reveal that the meager cover is significantly correlated with precipitation; that is, cover increases somewhat in high rainfall years. However, the results suggest that even a very large rainfall event has little chance of returning the site cover to baseline levels and/or re-establishing functioning baseline conditions.

Case Study: Two Wellfield Parcels

Southwest of the Blackrock Fish Hatchery in the Thibaut Sawmill wellfield, parcels Blackrock 99 and Blackrock 94 are located next to each other near the toe of the Sierran alluvial fan (Figure 1, below). In 1986, LADWP mapped both parcels as alkali meadow and measured baseline perennial plant cover in parcels 94 and 99 as 41% and 48%, respectively. Blackrock 94 lies west of the aqueduct, and most of Blackrock 99 is also west; a small portion was mapped by LADWP on the east side of the aqueduct. Landsat cover estimates for both parcels are available for the entire period from 1986 (the baseline year) through 2004. In addition, relatively good quality data exist for estimating each parcel's DTW and cumulative annual precipitation each year.

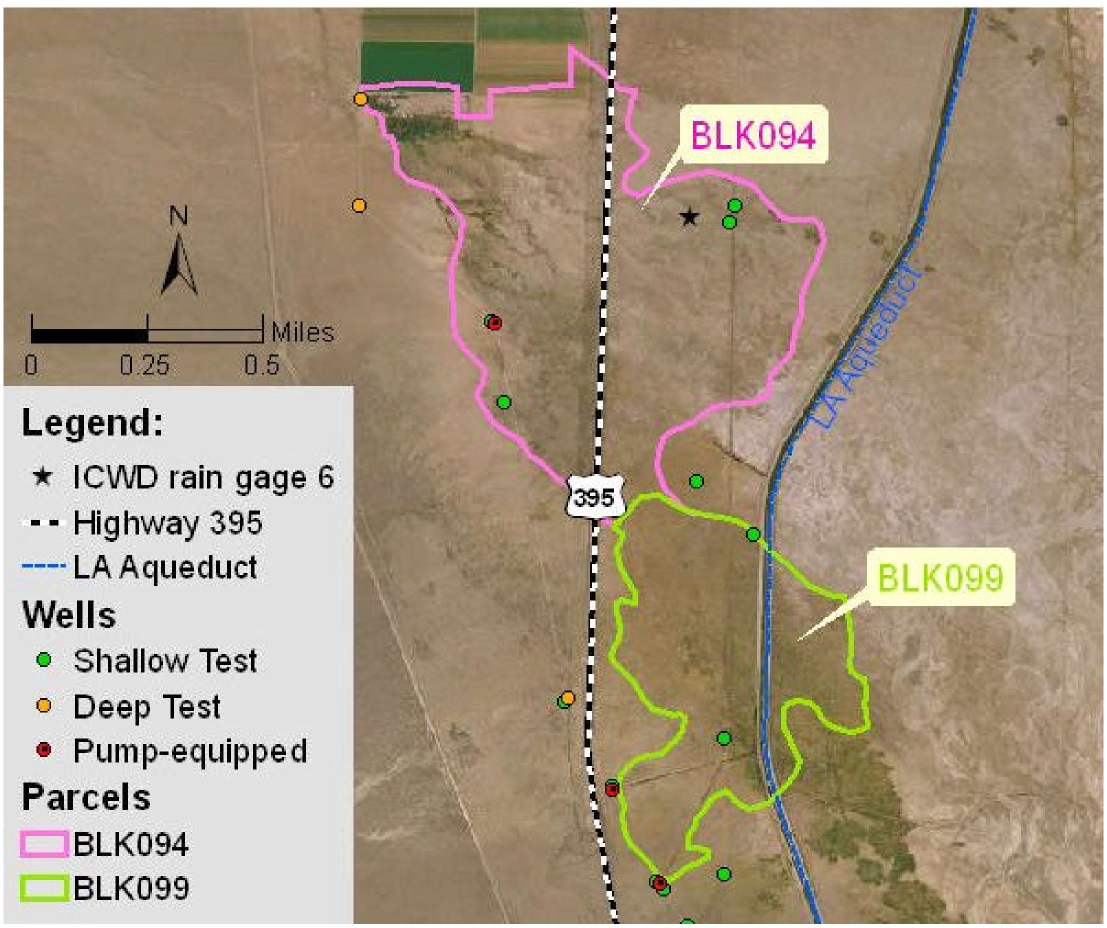


Figure 1: Features of example parcels: Blackrock 94 and 99 in Thibaut Sawmill wellfield.

Linear regression reveals that cover in Blackrock 99 (as measured in late summer each year by satellite) is correlated with DTW and that precipitation contributes no measurable influence on cover. During the period since baseline, the water table has fluctuated beneath Blackrock 99, but the average April DTW beneath this parcel has remained within reach of roots of the phreatophytic vegetation (i.e., shallower than 3m) (Figure 2, below). In contrast, the data show that, since 1988, cover in Blackrock 94 is correlated with precipitation and not with DTW. Since 1988, water tables have been below the root zone of this meadow parcel (at 4m or deeper) (Figure 3, below).

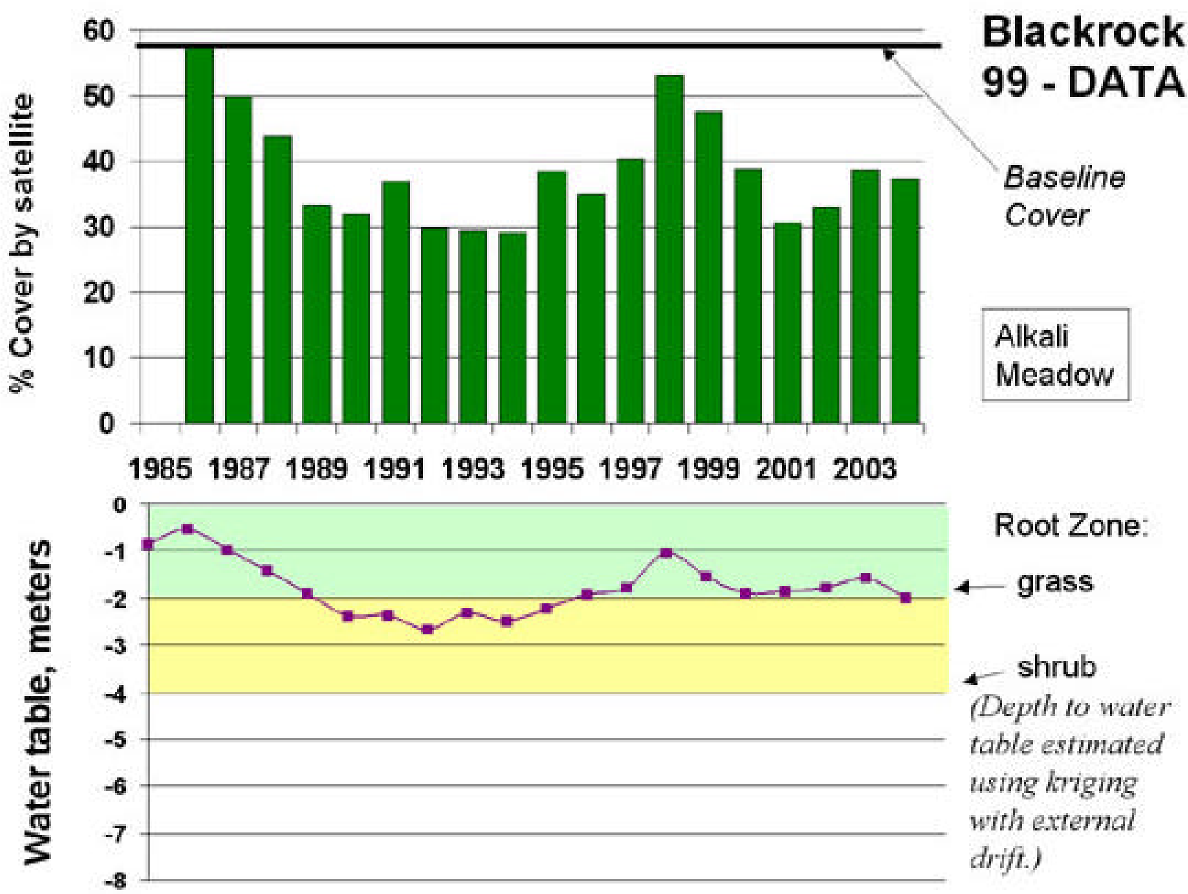


Figure 2A: Blackrock 99 - DATA. The charts above show (top) the total green plant cover measured in late summer by Landsat each year from 1986 through 2004 and (bottom) the estimated April depth to water table (DTW) beneath the parcel each April, 1985-2004. In these graphs, the data are arranged sequentially by year. The cover measured by satellite during 1986 was 58% and is highlighted by the bold line. The bottom graph shows that water table fluctuated during the 20-yr period, but did not drop below 4m. (The Green Book set root zones for management at 2m for grasses and 4m for phreatophytic shrubs. These are shown in the bottom graph by green and yellow shading.)

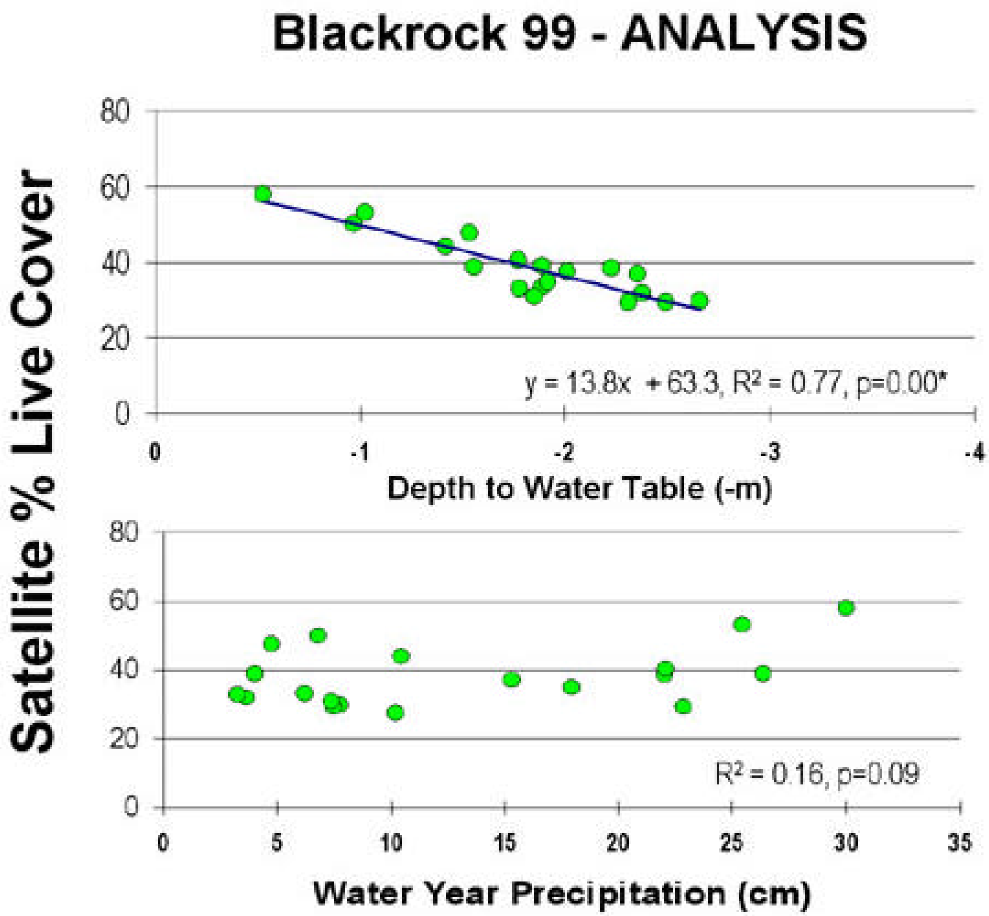


Figure 2B: Blackrock 99 - ANALYSIS. In these graphs, Landsat cover for Blackrock 99 was rearranged and graphed based on increasing depth to water (top) and increasing precipitation (bottom). The relationship between cover and DTW was analyzed using linear regression, and a significant correlation resulted (p = 0.00). The significant result is shown by the line drawn through the data points and the equation in the bottom corner of the graph. These results indicate that as water table declined in this parcel, cover also declined (and as water table increased, cover increased). The coefficient of determination is R2 = 0.77; this means that fluctuation in April DTW accounted for 77% of the change in the cover data. When cover was compared with precipitation, no significant relationship was detected by linear regression (p = 0.09). Therefore, the analysis did not reveal a relationship between changes in amount of precipitation and changes in vegetation cover in Blackrock 99.

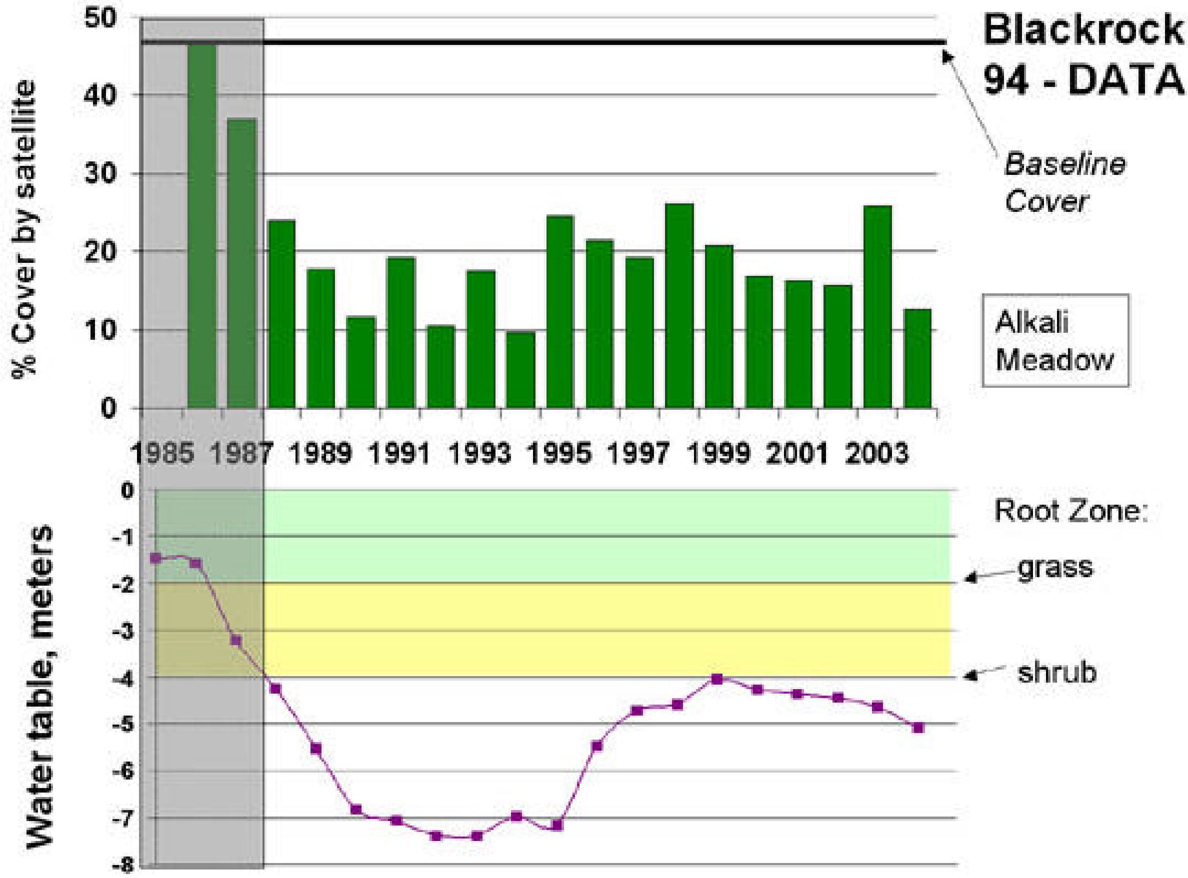


Figure 3A: Blackrock 94 - DATA. The charts above show (top) the total green plant cover measured in late summer by Landsat each year from 1986 through 2004 and (bottom) the estimated April depth to water table beneath the parcel each April, 1985-2004. In these graphs, the data are arranged sequentially by year. The cover measured by satellite during 1986 was 47% and is highlighted by the bold line. The bottom graph shows that water table fluctuated considerably during the 20-yr period. By April 1988, the water table was below the 4m root zone, and according to these estimates, it remained below 4m through 2004. For the analysis, cover and DTW data for years when the water table was in the root zone were omitted (the omitted data are shown by the gray shading).

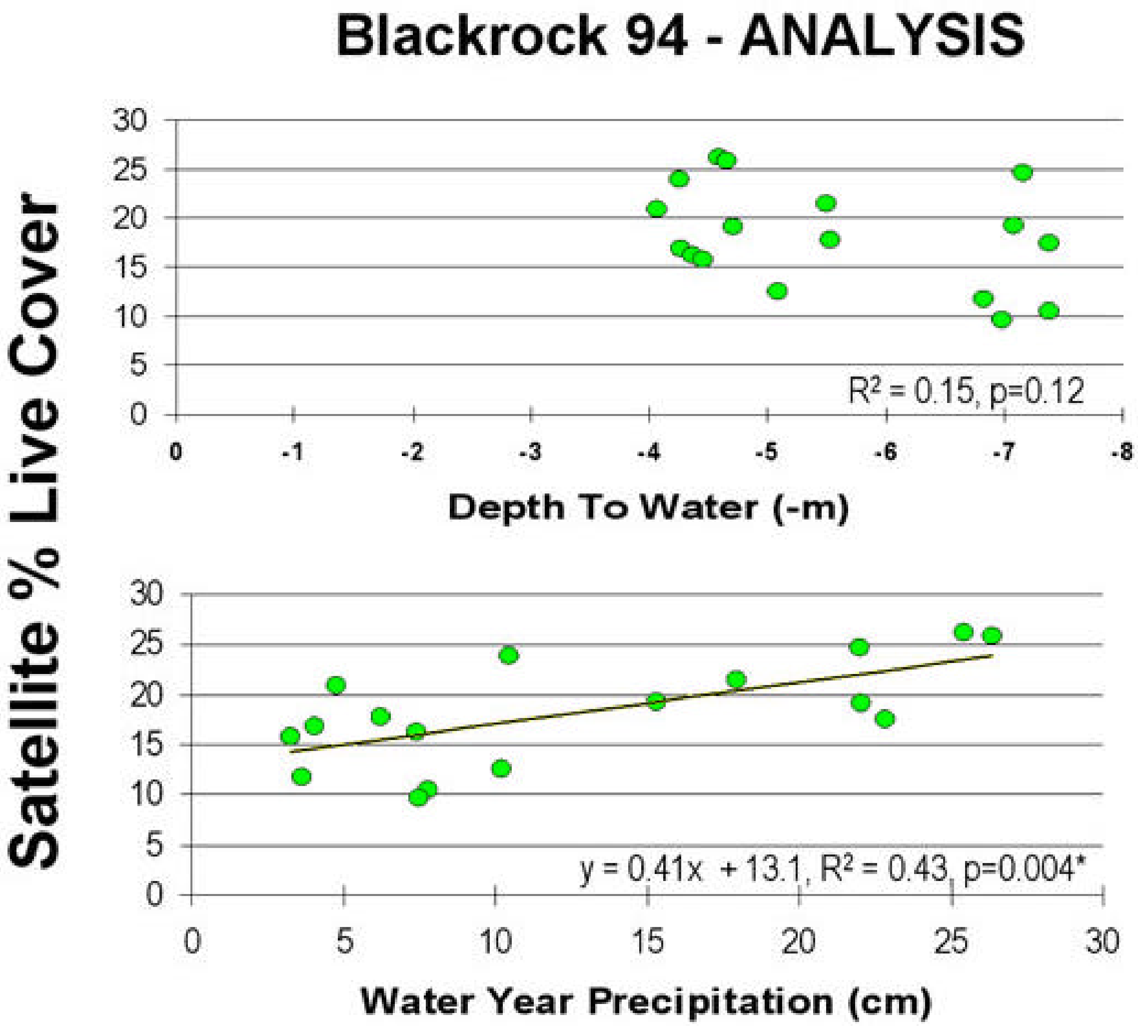


Figure 3B: Blackrock 94 - ANALYSIS. For this analysis, only data from 1988 onward were used. By eliminating 1986 and 1987, the analysis focuses on the roles of water table and precipitation in situations when the water table is below the management root zone. In these graphs, 1988-2004 Landsat cover for Blackrock 94 was rearranged and graphed based on increasing depth to water (top) and increasing precipitation (bottom). Linear regression did not detect a significant correlation between water table and vegetation cover ($p = 0.12$). Although the water table variation 1988-2004 went from 4m to nearly 8m, the pattern of vegetation change was not correlated with these large fluctuations (top graph). However, when cover was compared with precipitation, a statistically significant relationship was detected by linear regression ($p = 0.004$) (bottom graph). The analysis shows that, once the water table is below the root zone, precipitation may influence cover. In this example, fluctuation in annual precipitation amounts accounts for 43% of the change in the cover data. It is noteworthy that, without the presence of groundwater in the root zone, the highest cover achieved 1988-2004 was 26%, thus well below the 1986 baseline value of 47%. In fact, the regression result indicates that, with an Owens Valley average rainfall of about 14 cm, approximately 18% cover can be sustained at this site.

2004-2005 Groundwater Pumping

by Chris Howard, GIS/LAN Coordinator
July 2005

Inyo County and LADWP disagreed on pumping for 2004-2005, unable to reach consensus. LADWP's Final Operations Plan, received June 21, 2004, reported planned maximum groundwater pumping of 92,000 acre-feet for April 1, 2004 – March 31, 2005. Actual pumping for the period was 85,803. Table 1 shows planned and actual pumping for 2004-2005 by wellfield and summarized valley-wide. Although Owens Valley-wide actual groundwater pumping (85,803) was below planned pumping (92,000), three wellfield pumped more than planned: Bairs-Georges, Symmes-Sheperd, and Laws.

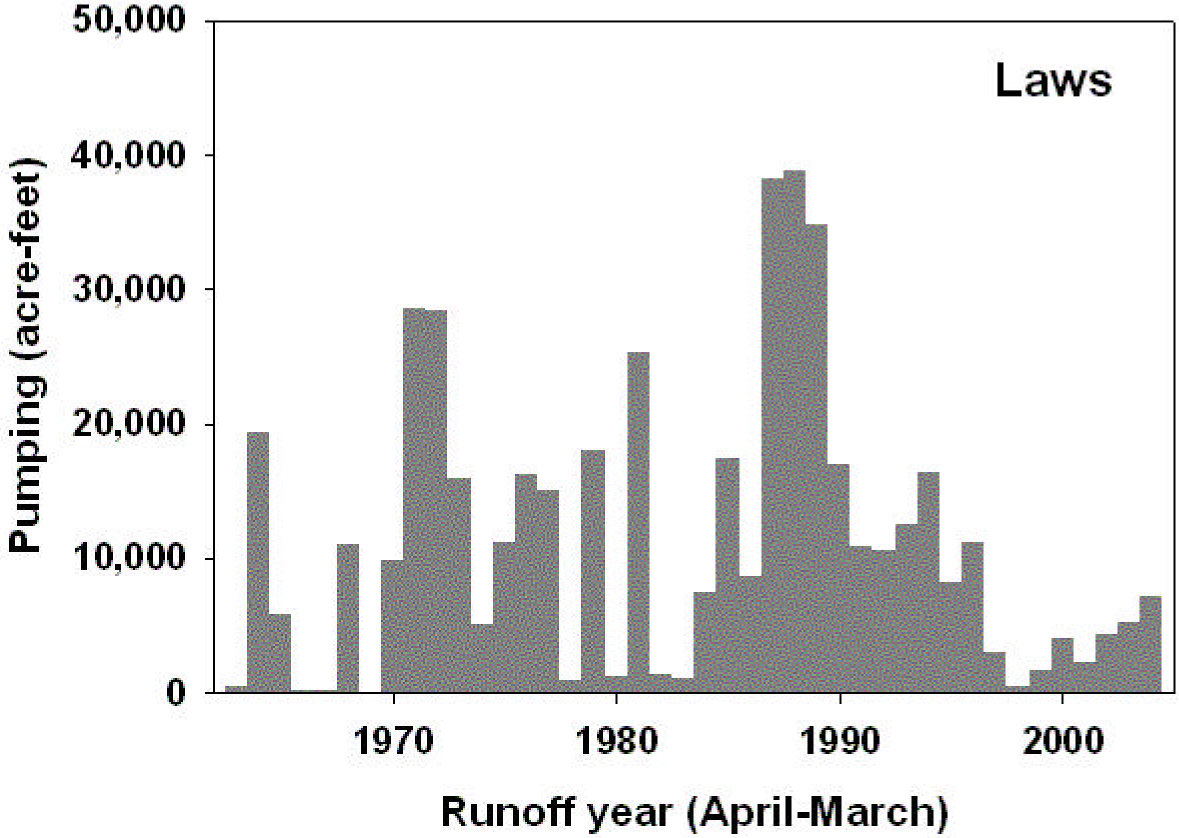
Table 1. LADWP Owens Valley planned and actual groundwater pumping in acre-feet for runoff year 2004-2005. (Source: LADWP)

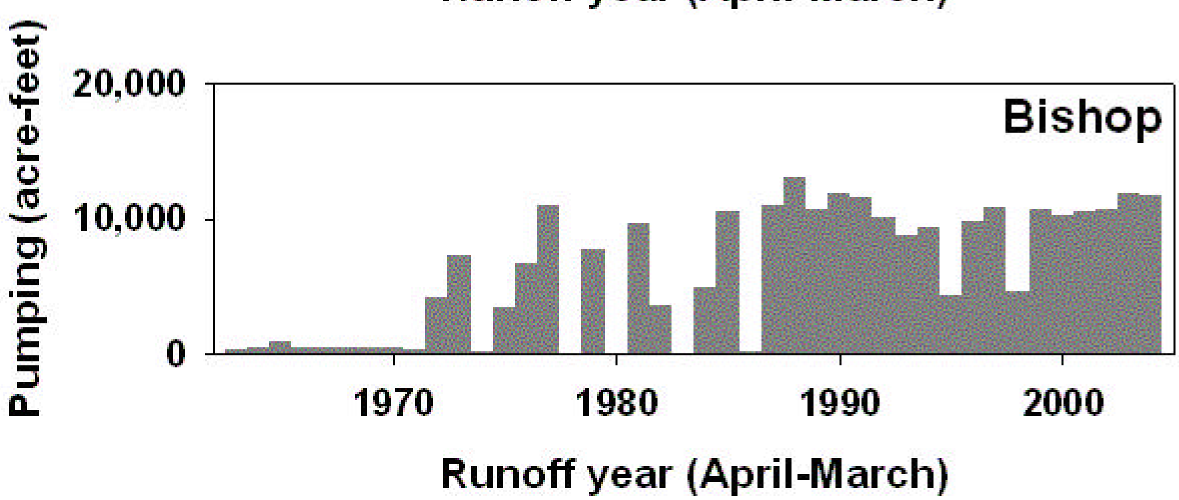
Wellfield	**Planned Pumping**	**Actual Pumping**
Lone Pine	1,550	1,096
Bairs-Georges	970	1,071
Symmes-Sheperd	7,500 - 9,150	9,332
Independence-Oak	10,000 - 11,700	9,943
Thibaut-Sawmill	13,800	11,218
Taboose-Aberdeen	12,580	12,147
Big Pine	23,400 - 26,750	22,046
Bishop	12,000	11,748
Laws	6,850	7,202
Total (Owens Valley-wide)	**92,000**	**85,803**

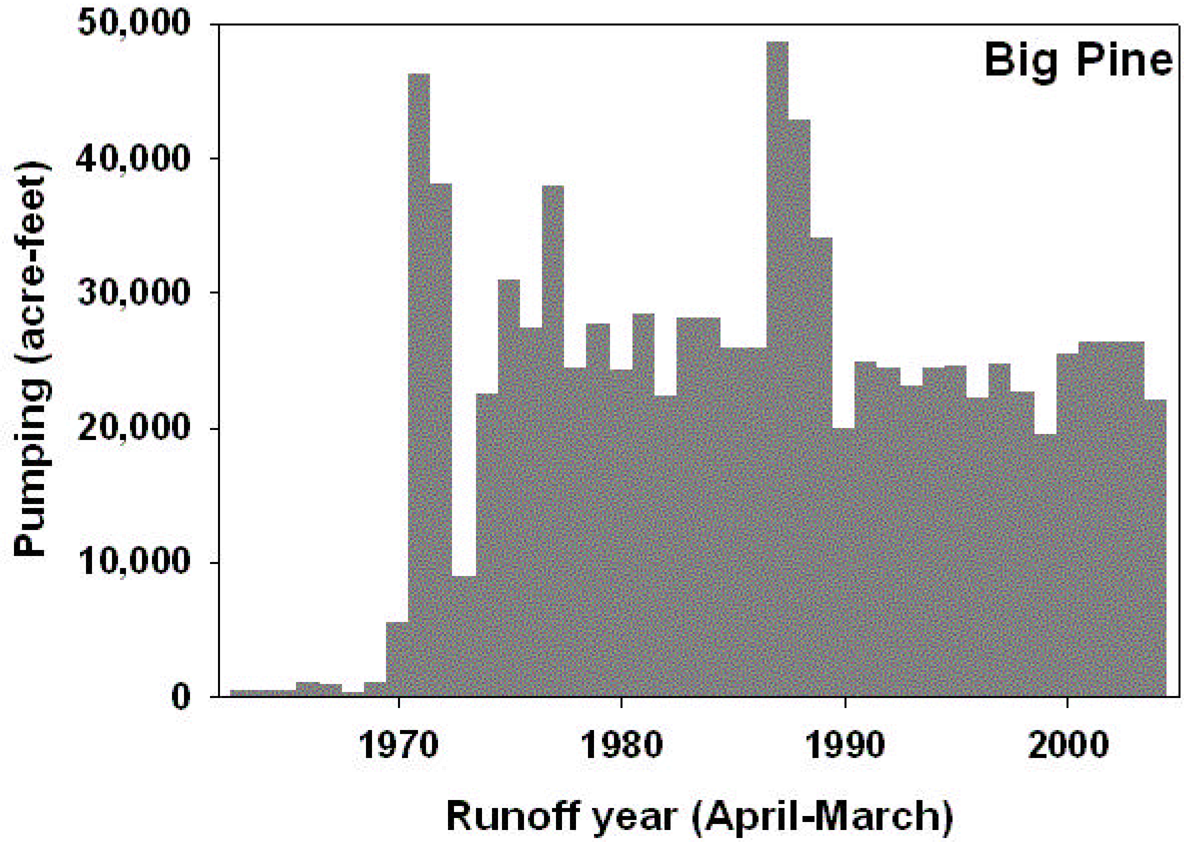
Historic Pumping

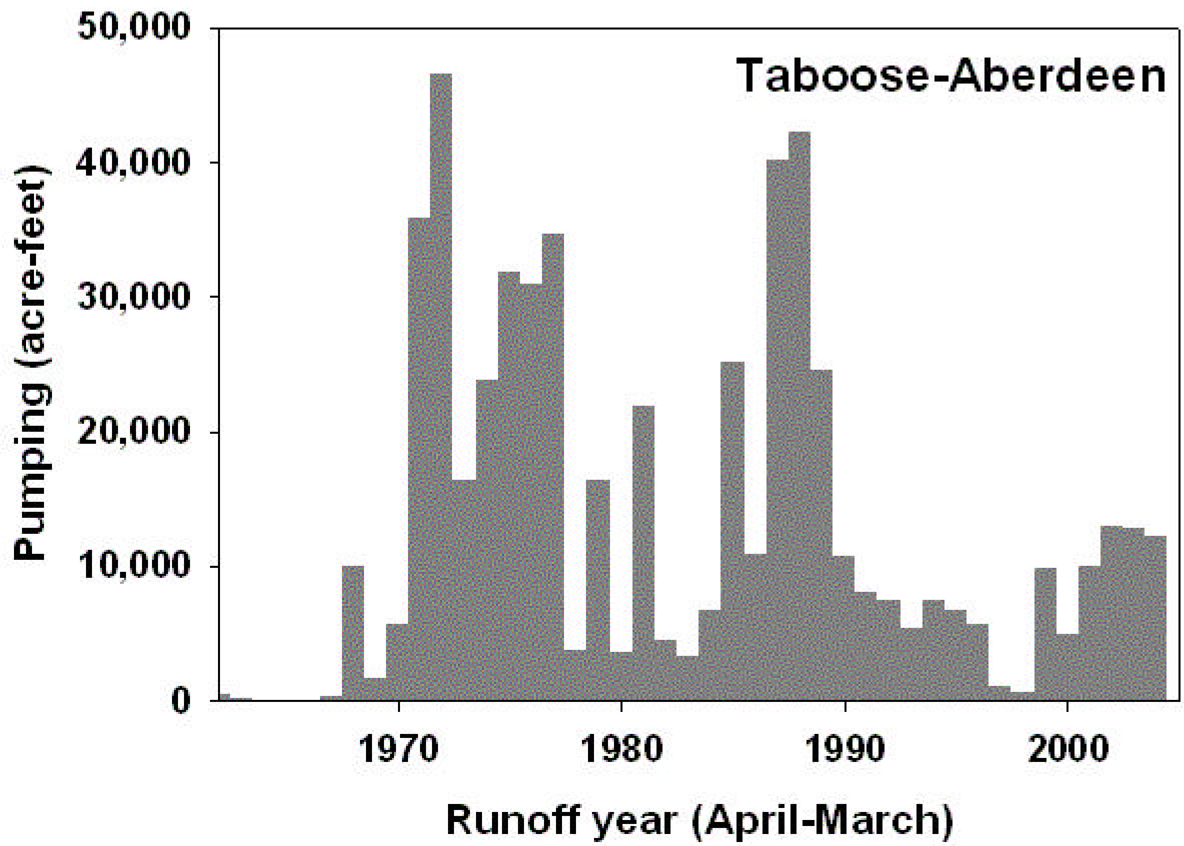
by Bob Harrington, Hydrologist
September 2005

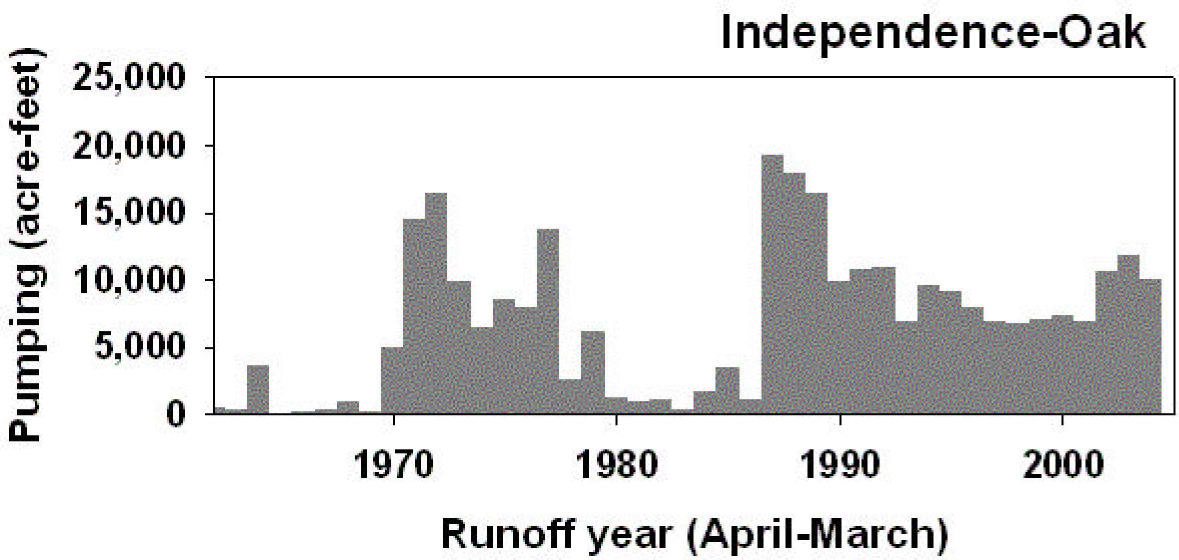
Owens Valley wellfield pumping for Runoff Years 1964 through 2004, in acre-feet. A Runoff is defined as April 1 of said year through March 31 of the following year.

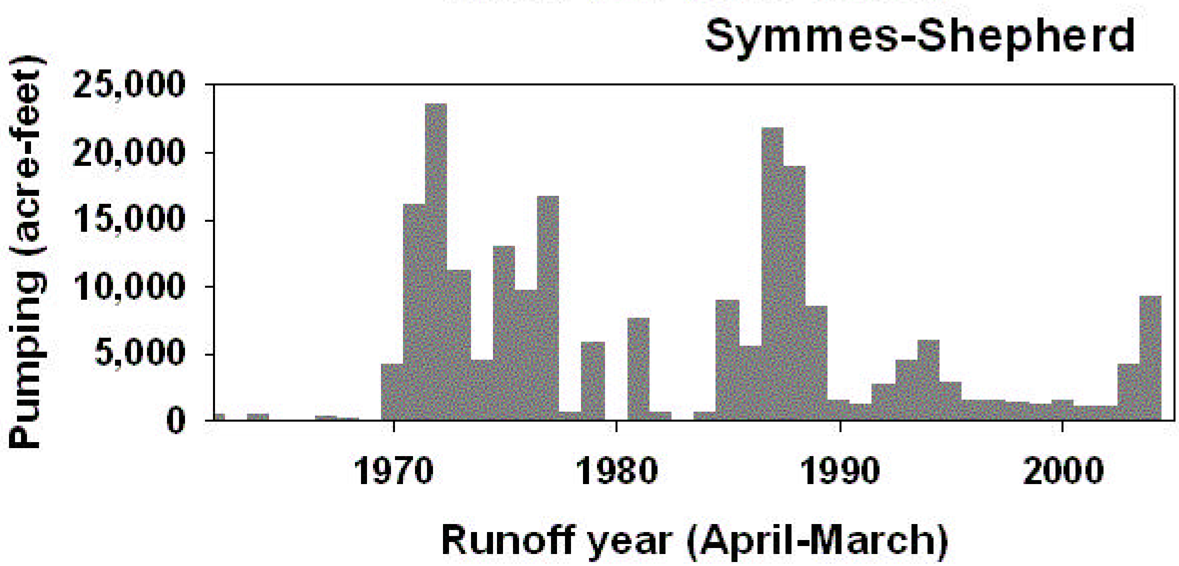


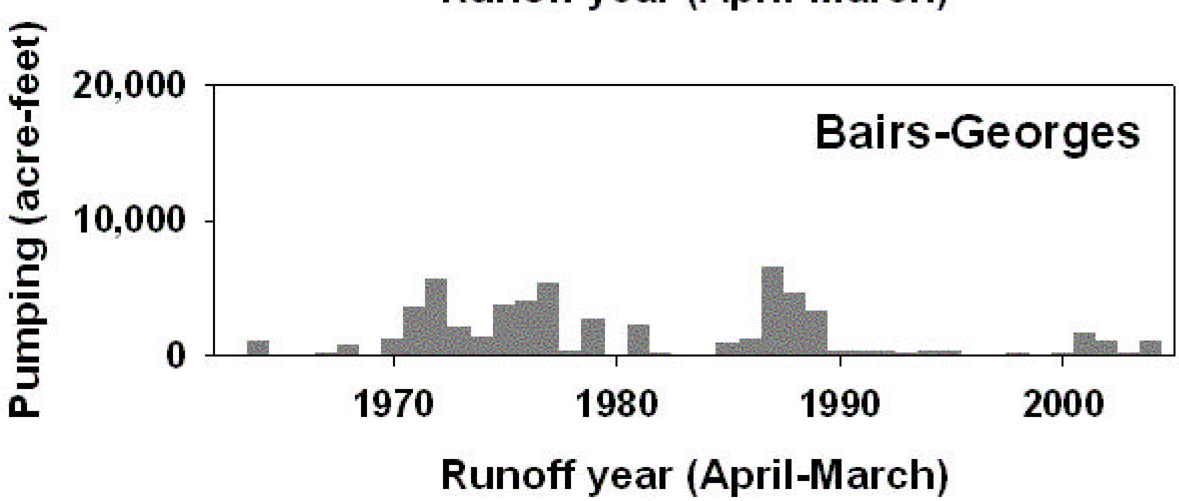


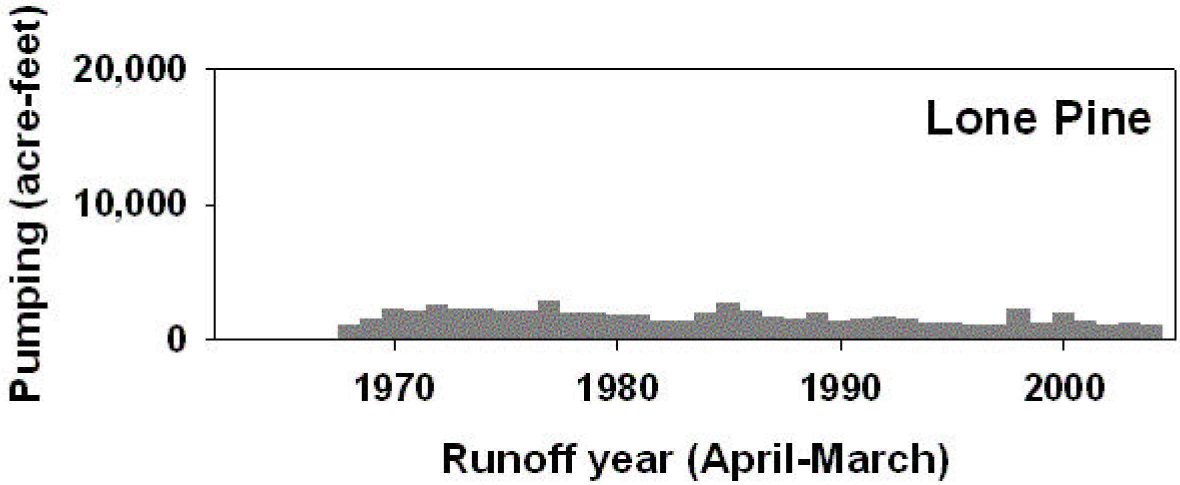

Big Pine
50,000
40,000
30,000
20,000
10,000
0
Pumping (acre-feet)
1970
1980
1990
2000
Runoff year (April-March)


Taboose-Aberdeen
50,000
40,000
30,000
20,000
10,000
0
Pumping (acre-feet)
1970
1980
1990
2000
Runoff year (April-March)


Independence-Oak
Pumping (acre-feet)
25,000
20,000
15,000
10,000
5,000
0
1970
1980
1990
2000
Runoff year (April-March)


Symmes-Shepherd
Pumping (acre-feet)
25,000
20,000
15,000
10,000
5,000
0
1970
1980
1990
2000
Runoff year (April-March)


Bairs-Georges
Pumping (acre-feet)
20,000
10,000
0
1970
1980
1990
2000
Runoff year (April-March)


Pumping (acre-feet)
20,000
10,000
0
Lone Pine
1970
1980
1990
2000
Runoff year (April-March)

Bishop Cone Audit

Randy Jackson Senior County Hydrologist
Inyo County Water Department
Report 2005-1
June 30, 2005

INTRODUCTION

The Bishop Cone audit is an annual accounting of Los Angeles Department of Water and Power's (LADWP) groundwater extraction and water usage on Los Angeles-owned lands on the Bishop Cone. Section VII.A of the Inyo County/Los Angeles long-term groundwater management agreement provides that, "Before the Department may increase groundwater pumping above present levels, or construct any new wells on the [Bishop] Cone, the Technical Group must agree on a method for determining the exact amount of water annually used on Los Angeles-owned lands on the Cone. The agreed upon method shall be based on a jointly conducted audit of such water uses." (See Appendix A of this report for Section VII.A of the Inyo County/Los Angeles long-term groundwater management agreement).

At its October 17, 1995 meeting, the Technical Group agreed to recommend to the Inyo County/Los Angeles Standing Committee the description of a Bishop Cone audit procedure to be incorporated into the Green Book. That audit procedure is attached (See Appendix A of this report for section IV.D of the Green Book). The Green Book is the technical appendix to the long-term agreement. The Inyo County/Los Angeles Standing Committee adopted the procedure on November 7, 1996 as section IV.D of the Green Book.

WATER USES ON LADWP-OWNED LAND ON THE BISHOP CONE

Section IV.D.1.a. of the Green Book states, "For the purposes of the Bishop Cone audit, water usage on Los Angeles-owned land on the Bishop Cone is defined as the quantity of water supplied to such land, including conveyance losses, less any return flow to the aqueduct system" (See Appendix A). Table 1, below, is a compilation of water usage in acre-feet (AF) on LADWP-owned land on the Bishop Cone for the runoff years of 2003-2004 and 2004-2005.

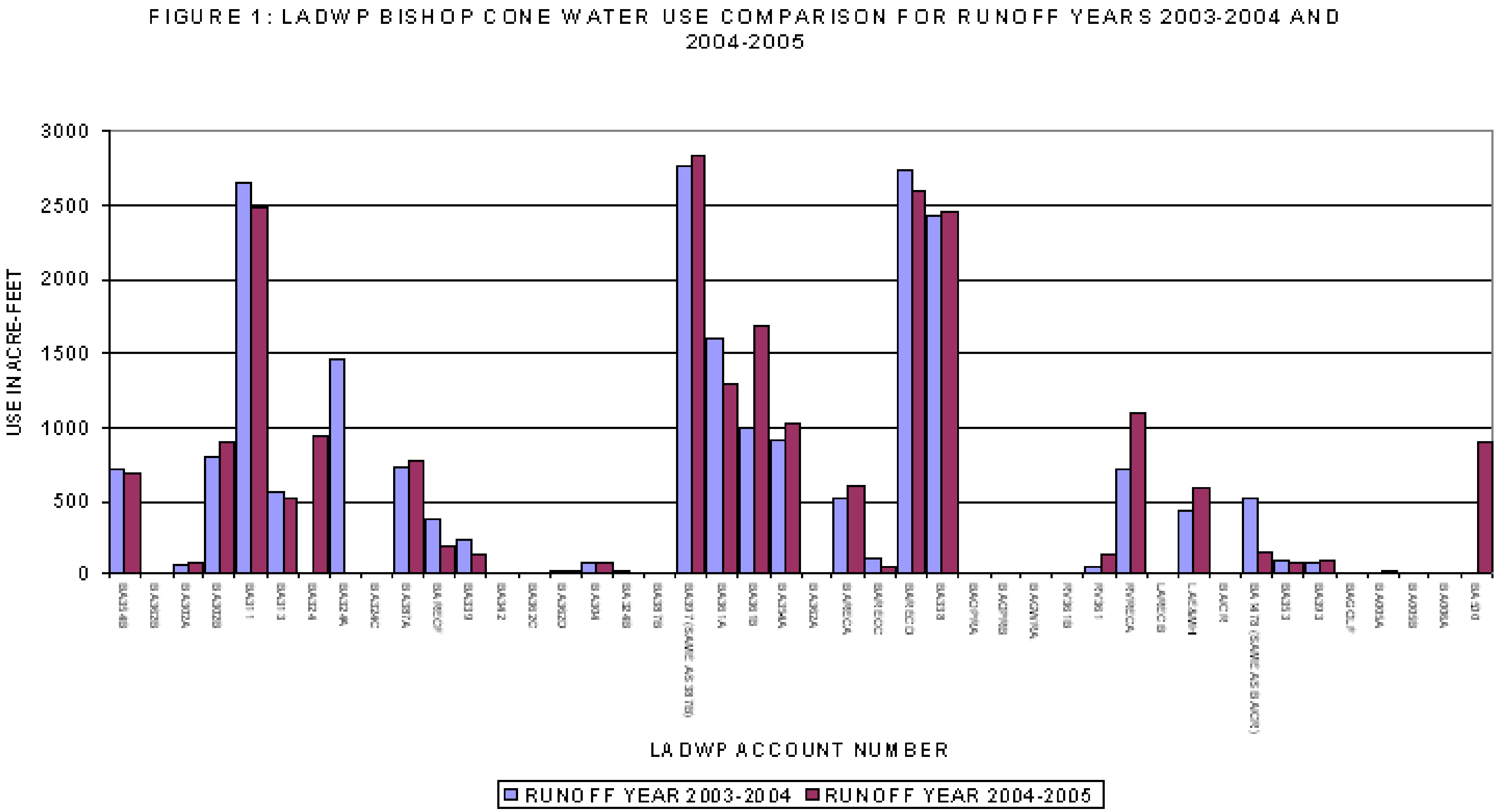
TABLE 1. WATER USES ON LOS ANGELES-OWNED LAND ON THE BISHOP CONE.

LADWP ACCOUNT NUMBER	RUNOFF YEAR 2003-2004 (AF)	RUNOFF YEAR 2004-2005 (AF)
BA354B or BA362B	718.00	684.00
BA302A	66.00	83.00
BA302B	803.48	890.53
BA311	2,661.07	2,479.82
BA313	563.77	518.69
BA324	NO ACCOUNT	940.24
BA324A	1,460.64	NO DATA
BA324C	NO DATA	NO DATA
BA387A	730.00	775.00

BARECF	376.85	198.69
BA339	232.54	136.28
BA342	NO DATA	NO DATA
BA362C	NO DATA	NO DATA
BA362D		26.40
BA304	85.00	84.00
BA324B	29.03	NO DATA
BA387B	NO DATA	NO DATA
BA397 (SAME AS BA387B-NEW LEASE HOLDER)	2,757.09	2,832.48
BA361A	1,602.14	1,287.83
BA361B	1,001.66	1,683.09
BA354A or 362A	908.00	>1,021.00
BARECA	520.00	596.00
BARECC	103.00	55.00
BARECD	2,744.00	2,603.00
BA338	2,430.37	2,450.66
BAOPRA	0.00	0.00
BAOPRB	0.00	0.00
BAGWRA	NO DATA	NO DATA
RV361	56.02	129.55
RV361B	NO DATA	NO DATA
RVRECA	708.00	1,088.00
LARECB	NO DATA	NO DATA
LAE&MH	433.00	591.00
BAICR	NO DATA	NO DATA
BA1478 (SAME AS BAICR-NEW LEASE HOLDER)	510.25	148.79
BA353	94.00	92.00
BA393	76.00	96.00
BA500		892.68
*2BAGOLF	0.00	0.00*2
*2BA005A	0.00	32.00*2
*2BA005B	0.00	00.00*2
*2BA006A	0.00	00.00*2
TOTAL	21,697.88	22,415.73

*1 A runoff year is defined as starting April 1st and ending March 31st of the following year.
*2 Accounts were first listed in the 2002-2003 runoff year. The accounts (BAGOLF, BA005A, BA005B and BA006A) are active water use accounts, but in the past have been denied by Inyo for lack of measuring devices. A device has been installed at BA005A this runoff year. Devices have not yet been installed at accounts BA006A, BAGOLF and BA005B). NO DATA -The Account was not active, no data was reported. 0.00-The account was active, no use was reported, data was 0.00 acre-feet.
*3 New accounts, field inspection performed and accounts credited.

Figure 1, below, is a bar graph comparing water use in LADWP account numbers on the Bishop Cone for runoff years 2003-2004 and 2004-2005. In general, there was an increase in water use, on most accounts from runoff years 2003-2004 to 2004-2005 as well as an overall total increase in water use of 886.95 acre-feet. Three of the new accounts first reported in 2002-2003 have reported uses in



2004-2005 (See Table 1, BA005A, BA005B and BA006A). An additional measuring device has been installed to measure water use associated with account BA005A. The Parashall Flume was inspected on June 17, 2005. The reported use for this account was credited. No additional measurement devices were installed for Accounts BA005B and BA006A and as a result no credit for reported uses was granted for these accounts this runoff year. A field inspection was performed on BA324 and BA500 and reported uses were credited.

TOTAL LADWP GROUNDWATER EXTRACTION ON LADWP-OWNED LAND ON THE BISHOP CONE FOR RUNOFF YEARS 2002-2003 AND 2003-2004

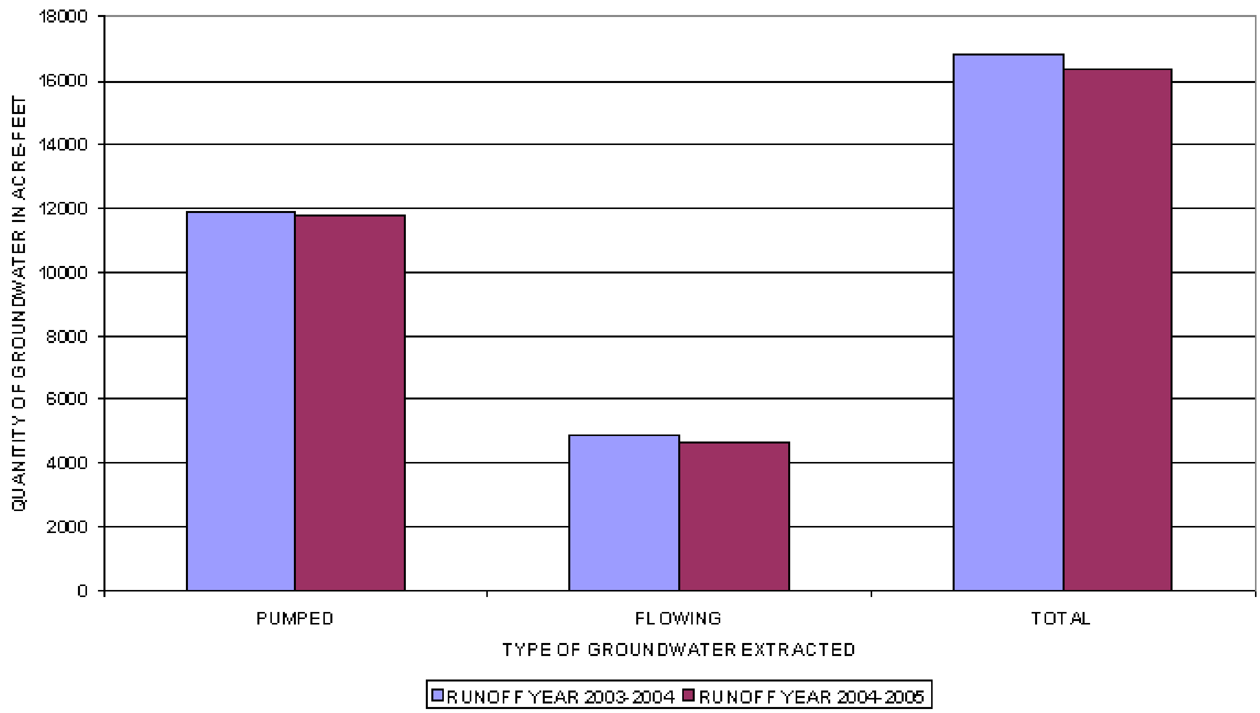
Section IV.D.1.d of the Green Book states, "Total groundwater extraction by LADWP will be compared with corrected water usage on the Bishop Cone for the runoff year. Total groundwater extraction is defined as the sum of all groundwater pumped by LADWP plus the amount of artesian water that flowed out of LADWP uncapped wells on the Bishop Cone during the runoff year."

Total groundwater LADWP extraction and groundwater extraction classified as flowing and pumped groundwater in acre-feet, on the Bishop Cone for the runoff years of 2003-2004 and 2004-2005, are shown in Table 2, below.

TABLE 2. TYPE OF GROUNDWATER EXTRACTION ON LADWP LANDS ON THE BISHOP CONE		
TYPE OF GROUNDWATER	RUNOFF YEAR 2003-2004 (AF)	RUNOFF YEAR 2004-2005 (AF)
PUMPED	11,884.00	11,748.00
FLOWING	4,919.00	4,623.00
TOTAL	16,803.00	16,371.00

Total groundwater extraction and groundwater extraction classified as flowing and pumped groundwater in acre-feet on LADWP-owned land on the Bishop Cone are shown in a bar chart in Figure 2, below.

FIGURE 2: TYPE OF LADWP GROUNDWATER AND TOTAL GROUNDWATER EXTRACTION ON THE BISHOP CONE FOR RUNOFF YEARS 2003-2004 AND 2004-2005



COMPLIANCE WITH THE INYO COUNTY/LOS ANGELES LONG-TERM GROUNDWATER MANAGEMENT AGREEMENT

The Inyo County/Los Angeles long-term groundwater management agreement provides that, during any runoff year, total groundwater extraction by LADWP on the Bishop Cone shall not exceed water usage on Los Angeles-owned land on the Cone. Table 3, below, shows that LADWP was within compliance with the above provision for runoff years 2003-2004 and 2004-2005.

TABLE 3. LADWP USES IN COMPARISON TO LADWP GROUNDWATER EXTRACTION ON THE BISHOP CONE.

	RUNOFF YEAR 2003-2004(AF)	RUNOFF YEAR 2004-2005(AF)
TOTAL USES	21,697.88	22,415.73
TOTAL GROUNDWATER EXTRACTION	16,803.00	16,371.00

Groundwater Conditions

by Bob Harrington, Hydrologist
September 2005

When LADWP inventoried Owens Valley vegetation from 1984 through 1987, water tables were generally high throughout the valley because of a series of wet years (1982-86) and relatively low groundwater pumping. The vegetation mapped during 1984 through 1987, which became the baseline for management under the Inyo/Los Angeles Water Agreement (LTWA), reflected the high water table prevalent at that time. Following the inventory, during the first three years of a six-year drought, LADWP pumped large amounts of groundwater: approximately 210,000 acre-feet (1987), 200,000 acre-feet (1988), and 155,000 acre-feet (1989). In response to the stress of groundwater pumping, water tables declined in most wellfields to substantially below the plant root zones, and as a result, native groundwater-dependent vegetation declined.

In 1990, in recognition of the decline in water tables and vegetation, the Inyo/Los Angeles Standing Committee adopted the "Drought Recovery Policy." The policy requires that groundwater pumping be managed in a conservative manner to allow substantial recovery of water tables, soil moisture, and vegetation. Since then, LADWP's pumping has been lower than the pumping of the late-1980's. In response to both lower pumping and several high runoff years, water tables rose during the 1990's.

Figure 1a shows the difference between depth to water during the baseline period (1985-1987) and depth to water in areas of groundwater-dependent vegetation in 1992, the last of six consecutive dry years. Figure 1a represents the most depressed water levels since the baseline mapping period. Figure 1b shows the difference between baseline water levels and April 1999 levels. Figure 1b represents the highest water levels since the baseline mapping period. Figure 1c shows the difference between baseline levels and April 2004. Figure 1c represents recent water table conditions relative to baseline water levels. Figures 1a-c illustrate the decline from baseline from 1986 to 1992 due to pumping and drought, subsequent recovery to a peak in 1999, and a subsequent decline. Red areas indicate areas where the water table is below baseline; green areas are areas above baseline. LADWP production wells are generally arrayed along the western edge of the valley floor (indicted in figures 1a-c as blue circles), because this location situates the wells upslope of the LA Aqueduct. Figures 1a-c were developed by interpolating depth to water measurements from several hundred shallow groundwater monitoring wells throughout the Owens Valley. These maps showing how depth to water has changed over time in areas of groundwater dependent vegetation are used by the Water Department to relate changes in groundwater levels to changes in vegetation conditions.

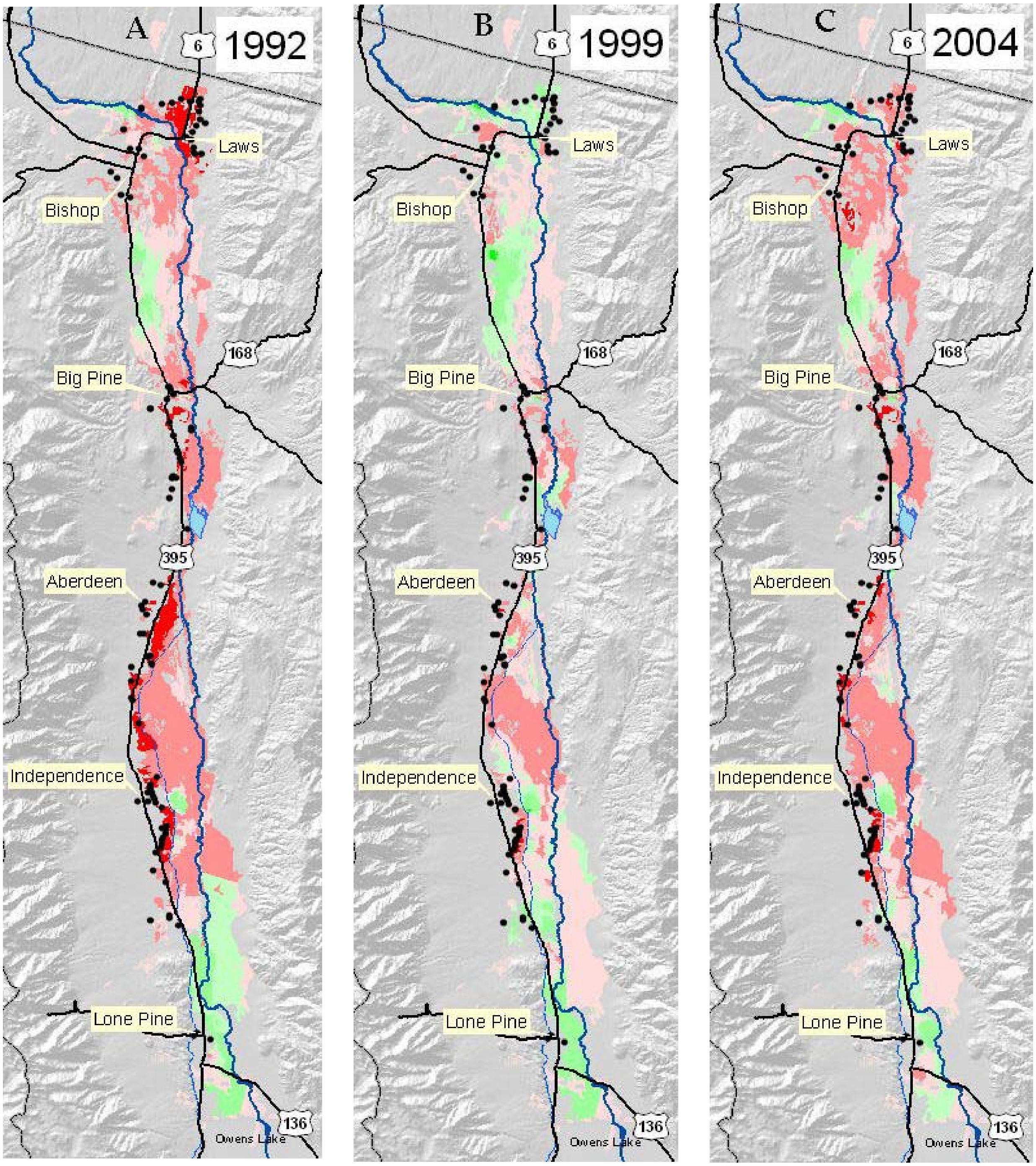
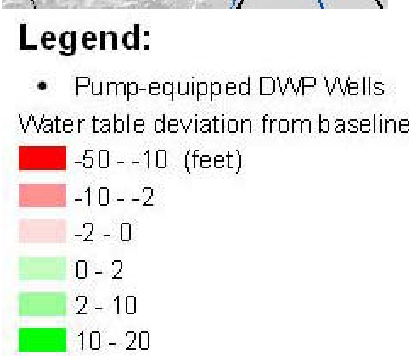


Figure 1a-c. Depth to water deviation from baseline water levels (feet) in areas of groundwater dependent vegetation. Red indicates areas where the water table is below baseline. Figure 1a represents the deepest water tables during the drought of 1987-1992; 1b shows the how the water table recovered during the mid to late 1990's, but remained below baseline in some areas; Figure 1c shows how the water table has declined since its high point in 1b.



Areas of greatest water table decline in Figure 1a coincide with the locations of highest groundwater extraction along the western edge of the valley floor. In Figure 1b, many of areas that remain furthest from recovery to baseline are also near areas where the greatest amount of pumping has occurred. Comparison of Figures 1a and 1b shows that some areas recovered during the 1990's in response to high recharge and pumping managed under the Drought Recovery Policy; however, areas near centers of pumping remain below baseline levels. Since 1999, low recharge due to low runoff and a steady increase in pumping has resulted in declining water levels, evidenced by more areas below baseline in 2004 than in 1999 (Figure 1c).

In the Laws area, north of Bishop, the water table responds dramatically to pumping and recharge from the McNally canals (e.g., well T492 in Figure 2). Water tables declined to over four feet below baseline between the mid-1980's and 1992 (Figure 1a). However, in 1999, several monitoring wells in the area were at baseline or above (Figure 1b). These high water table levels were the result of recharge induced by LADWP's operation of the McNally canals and water spreading in the Laws area during the summer of 1998, resulting in the water table rising over 10 feet in some wells. Water levels in the Laws area declined since 1999 in response to pumping and low recharge. Water was again diverted from the Owens River into the McNally canals in March of 2005, which will provide much needed recharge in the Laws area. LADWP's Annual Operations Plan for 2005-2006 called for pumping 12,350 af in Laws, however a recent court order has reduced LADWP's pumping and required spreading of 16,294 acre-feet of in the Laws wellfield for groundwater recharge. This will result in significant increases in the water table in Laws.

Pumping on the Bishop Cone and recharge from the extensive network of surface water conveyances balance to stable water levels in west Bishop (e.g. well T387 in Figure 2). Water tables in the area between Bishop and Big Pine are relatively stable due to the absence of pumping stress (e.g. T479 in Figure 2).

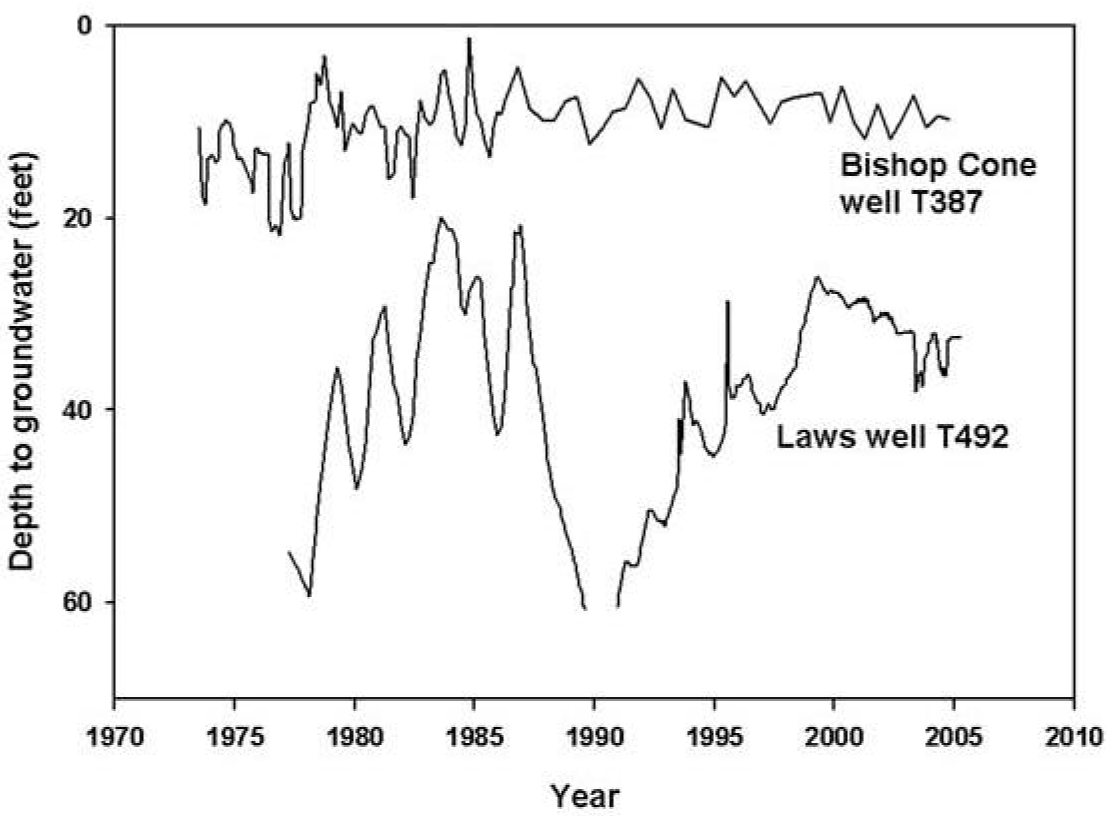


Figure 2. Water level hydrographs from a well in Laws (T492) and Bishop (T387). Water levels in Laws vary due to pumping and intermittent recharge from surface water spreading; water levels in Bishop are maintained relatively constant by the buffering effect of the network of surface water conveyances in the Bishop area.

The Big Pine wellfield has historically been subject to high levels of groundwater pumping by LADWP. Water table hydrographs near Big Pine show a typical pattern of a mid-1980's maximum, rapid decline in the late-1980's, gradual recovery to a level below the maximum level, and a gradual decline since the late 1990's (e.g. well T425 in Figure 3).

The Taboose-Aberdeen wellfield has undergone intermittent stress when wells have been operated during droughts. Some of LADWP's highest capacity wells are located in this wellfield. Water table hydrographs in this wellfield reflect large, pumping induced fluctuations (e.g., well T421 in Figure 3).

The Thibaut-Sawmill wellfield is subject to a constant pumping stress due to the Blackrock Fish Hatchery, plus additional stress from pumping for the LA Aqueduct. The shallow water table in this wellfield shows large pumping-induced fluctuations where it is not buffered by surface water conveyances (e.g., LA Aqueduct, Blackrock Ditch).

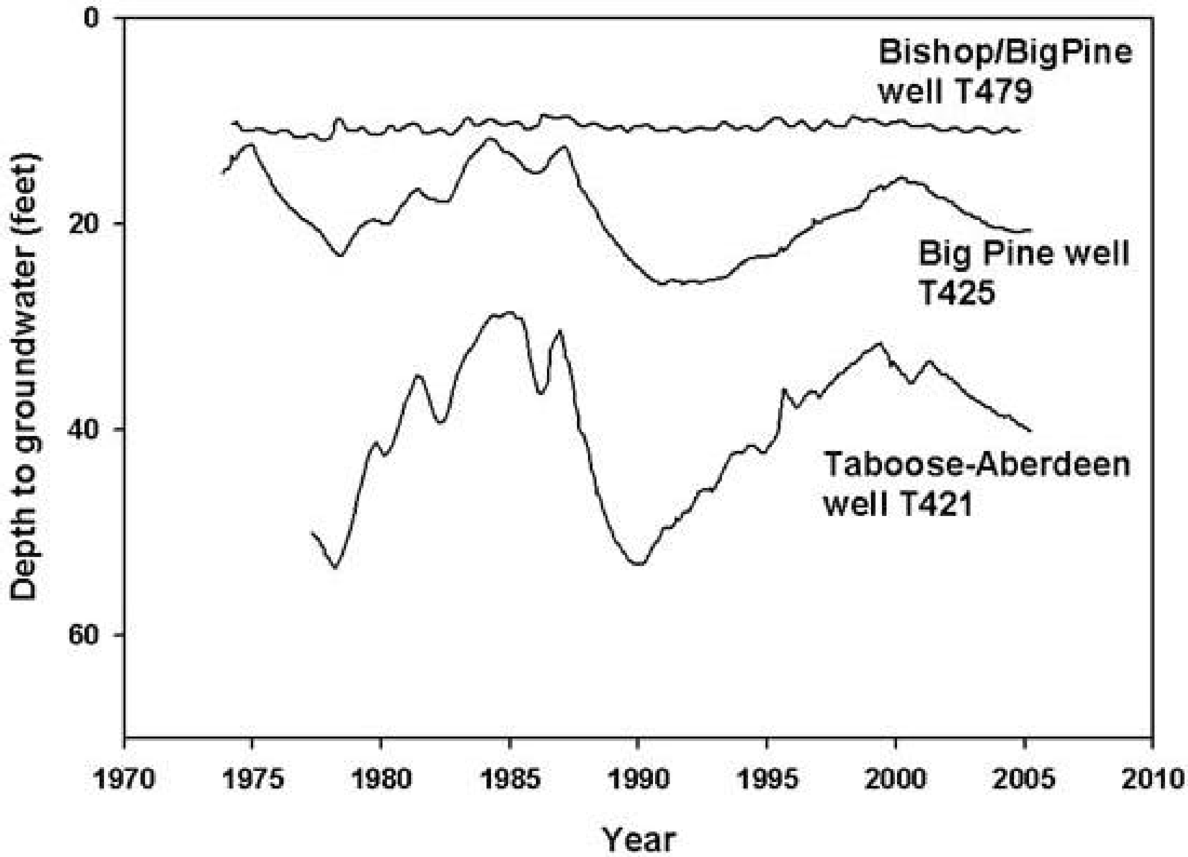


Figure 3. Water level hydrographs from a well between Bishop and Big Pine (T479), a well south of Big Pine (T425), and a well in the Taboose-Aberdeen wellfield (T421). T479 is far from pumping wells, whereas T425 and T421 are affected by pumping.

The Independence-Oak wellfield is subject to sustained pumping due to a large number of wells that area exempt from the on-off provisions of the LTWA. As a result, the water table in the Independence area is depressed below baseline.

Pumping in the Independence-Oak wellfield also impacts the northern portion of the Symmes-Shepherd wellfield. The Symmes-Shepherd wellfield has seen large variability in the amount of water pumped. After nearly a decade of relatively modest pumping, pumping in this wellfield increased in 2003, resulting in a pumping-induced decline in the water table. A recent pumping induced decline was observed in well T401 due to the operation of well W075 (Figure 4).

The Bairs-Georges wellfield has a small pumping capacity, and has been pumped little in the past fifteen years, resulting in water levels fluctuating around their baseline levels (e.g., well T398 in Figure 4).

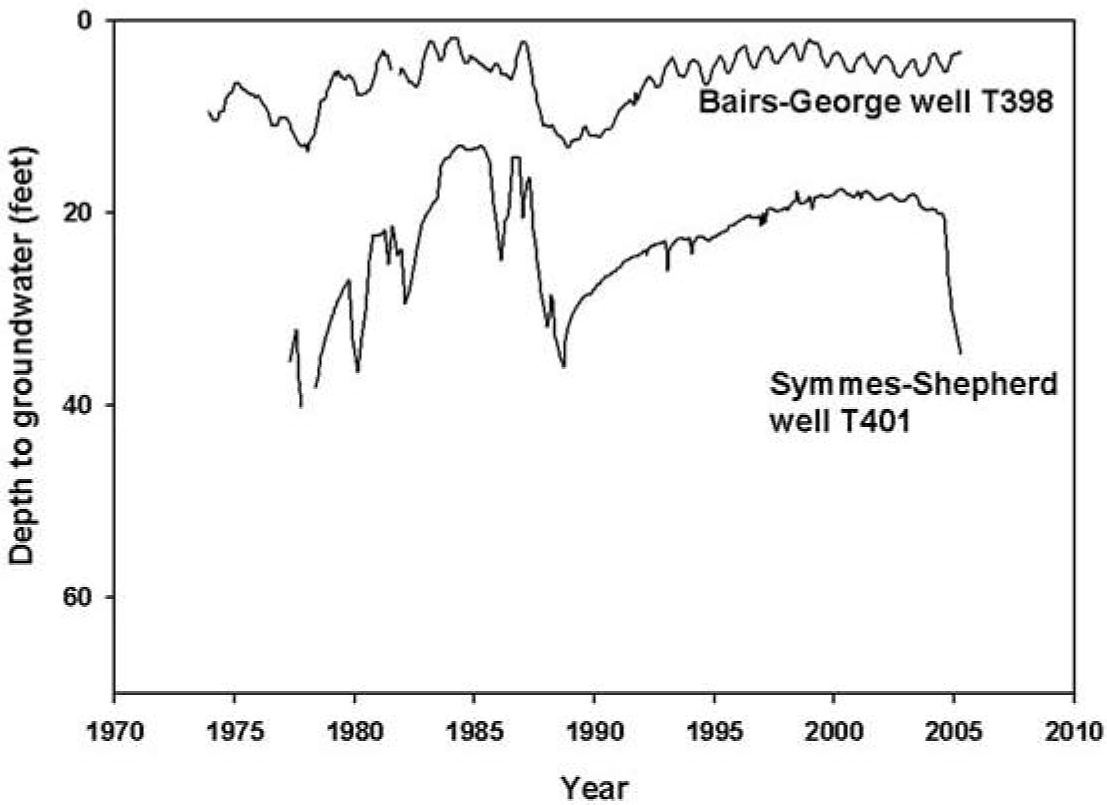


Figure 4. Water level hydrographs from a well in the Symmes-Shepherd wellfield (T401) and a well in the Bair-George wellfield (T398). The steep decline in T401 in 2004 was due to the operation of well W075.

Pumping in the Lone Pine wellfield has primarily been for town supply, Diaz Lake, and an irrigation enhancement/mitigation project east of town, thought LADWP has constructed a new production well west of town on Lone Pine Creek to supply the LA Aqueduct. LADWP and the County are currently developing a process and plan for testing this wells and implementing management to protect groundwater dependent natural resources and non-LADWP wells.

The recent court order curtailing LADWP's pumping in the Owens Valley to 57,412 af per runoff year for this year and the next is a reduction in pumping stress the last several years; since the baseline period of the mid-1980's, only one year's pumping (1998) has been below this level. Unless runoff conditions are very poor (i.e., light winter snow pack in the Sierra Nevada), this reduced pumping should result in increases in water table elevation.

Development of Water Table Based Management of Groundwater Pumping

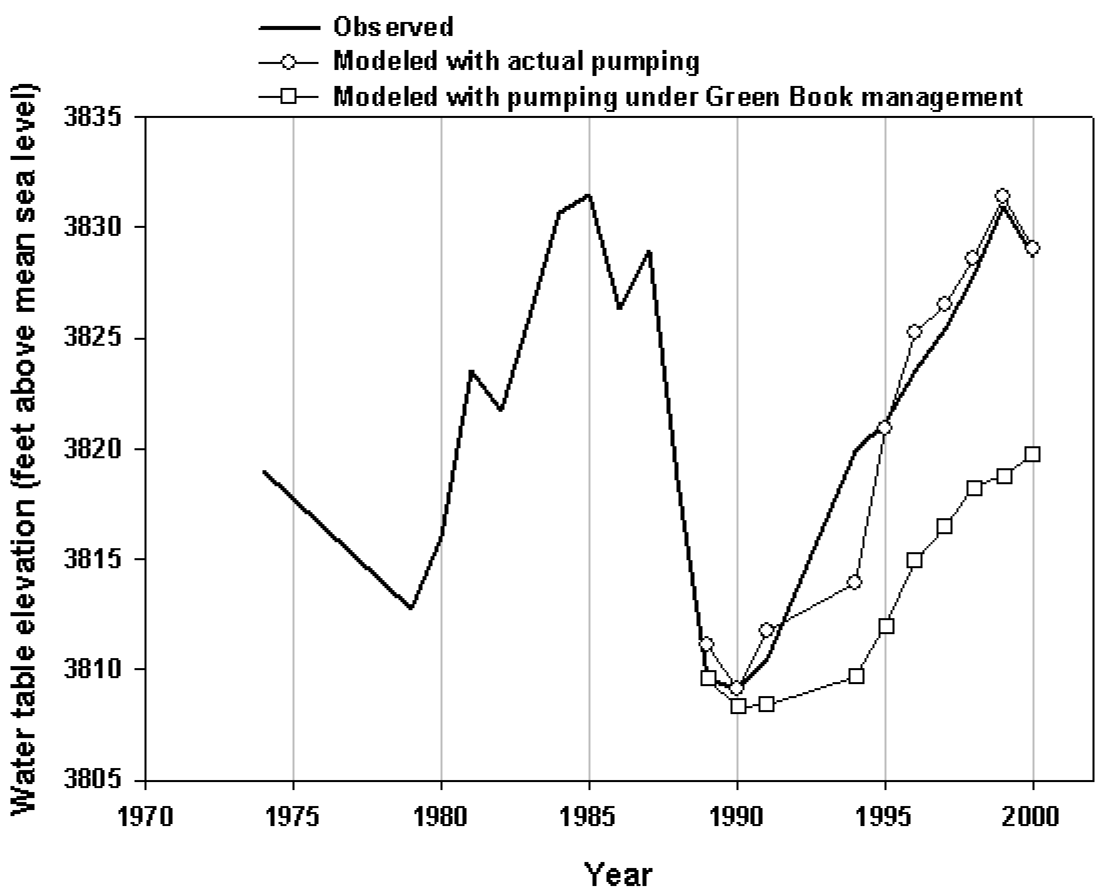
R. Harrington, Hydrologist
A. Steinwand, Soil Scientist
October 2005

Mary Austin aptly called the Owens Valley 'The Land of Little Rain' - about six inches of precipitation falls on the valley floor each year, an amount typical for a desert - yet the floor of the Owens Valley supports large areas of vegetation that require more water than the meager amount that falls as precipitation. These plants survive by getting most of their water from groundwater - water that percolates through the sand, gravel, and clay that fills the valley. Areas of groundwater-dependent vegetation can exist because groundwater flows from areas of groundwater recharge, such as the mountain front of the Sierra Nevada, to the arid valley floor. The depth of the water table beneath groundwater-dependent vegetation affects the availability of water to the vegetation - if the water table is too deep, water is not accessible to the plants' roots.

A central goal of the Long-Term Water Agreement (LTWA) is that LADWP groundwater wells will be managed to avoid harming groundwater dependent vegetation. The mechanism specified in the Green Book (the technical appendix to the LTWA) for managing groundwater wells uses 22 vegetation and soil moisture monitoring sites located from Laws to George Creek, near Manzanar, to determine if sufficient soil moisture is present in the plant root zone to sustain the plants at the site. Each monitoring site has a number of nearby LADWP production wells associated with it. If the soil moisture is sufficient, the associated wells can be operated; if the soil moisture is insufficient, the associated wells are not operated to allow the soil moisture to be replenished from the water table. A flaw in this management strategy is that pumping can lower the water table to levels far below the root zone before soil moisture is depleted to the point where wells are turned off. By the time soil moisture is depleted, even if pumping stops, the water table may not recover in time to prevent vegetation harm. In the early-1990's, the Inyo/Los Angeles Standing Committee adopted the Drought Recovery Policy, in recognition of the need to promote water table and soil moisture recovery in order to achieve the vegetation protection goals of the LTWA. The Drought Recovery Policy resulted in less groundwater pumping than would have occurred under the management mechanism specified in the Green Book.

To remedy the deficiencies in the soil-moisture-based management strategy, the Water Department has examined the possibility of managing pumping based on the level of the water table. In two reports produced by the Water Department, it was shown that (1) if groundwater had been pumped during the 1990's to the maximum amount allowed under the Green Book's well management mechanism, water table recovery would have been substantially less than the recovery achieved under the Drought Recovery Policy, and (2) the probability of recovery to water table targets within three years was low for many monitoring sites because the initial water table was below the target level, and because of the infrequency of large recharge years. The primary tools for carrying out these evaluations were regression models, which are mathematical models based on the relationship between water table fluctuations, pumping amounts, and amounts of groundwater recharge. The model results are expressed as probabilities of recovery to water table targets because of the uncertainty in amounts of future runoff. These reports are available on the Water Department's web site.

In the first report, Water Table Fluctuations Resulting from Management Under the Drought Recovery Policy and the Green Book, 1989 to 2000, by Aaron Steinwand and Robert Harrington, the amount of pumping that would have been allowable under Green Book management was applied to the regression models to estimate how the water table would have responded had pumping been managed under the Green Book from 1989 through 2000. Figure 1 shows the observed hydrograph for well 419T, a shallow monitoring well near the LA Aqueduct intake east of Aberdeen. Also shown is the modeled hydrograph for the amount of pumping that actually occurred under the Drought Recovery Policy, and the modeled hydrograph for the amount of pumping that could have occurred under the Green Book well management mechanism. It is apparent that water levels in this area would have been about 10 feet lower under the Green Book management. It is also apparent that the model reproduces the observed hydrograph fairly accurately.



Shown above is the observed water table elevation, modeled water table under the amount of pumping that actually occurred, and modeled water table under the amount of pumping that could have occurred under Green Book management at well 419T, a shallow monitoring well east of Aberdeen near the LA Aqueduct intake. The modeled segment of the hydrograph starts in 1989, when the Long-Term Water Agreement first took effect. When the amount of pumping that actually occurred is applied to the model (circles), the model does a reasonably accurate job of reproducing the water table recovery that actually occurred. The model shows that the amount of pumping allowed under the Green Book (squares) would have resulted in a significantly lower water table than actually occurred.

In the second report, Simulation of Water Table Fluctuations at Permanent Monitoring Sites to Evaluate Groundwater Pumping, by Aaron Steinwand and Robert Harrington, the regression models were used to evaluate the probability that the water table would achieve water table targets. First, water table targets were developed for monitoring sites based on the rooting depth, soil moisture data, or historical water levels at the site, and then water levels were simulated to determine the probability of recovery to the target water level for each monitoring site. For most sites, unless the water table was near the target level, the probability of recovery was low even at minimum pumping for a three-year duration. Simulations were also done to determine the level at which water tables would stabilize with many years of average runoff and reduced levels of pumping. In these model runs, the only pumping conducted was for uses such as fish hatcheries, irrigation that can't be supplied by other sources, and supply for towns. These simulations showed that at many sites, the water level stabilizes at levels deeper than the water table target, highlighting the importance of high runoff events in producing water levels comparable to the mid-1980's.

These modeling efforts show the need for revising the procedures in the Green Book, yet many hurdles remain in the development of water table based management of groundwater pumping. The water table targets described above were based variously on water levels during the mid-1980's and on the root zones described in the Green Book; it is not certain these targets will actually achieve the vegetation goals of the LTWA. Furthermore, to base management on water table fluctuations, it's necessary to know how long various groundwater dependent plant communities can tolerate disconnection from the water table.

For groundwater dependent vegetation in the Owens Valley, groundwater pumping results in a land of less than little rain, because pumping-induced reductions in groundwater levels threaten to remove the main source of water for these vegetation communities. Basing management of groundwater pumping directly on water table fluctuations would provide a more reliable strategy of managing groundwater pumping to achieve the LTWA's vegetation goals.

The USGS Groundwater Model for the Owens Valley

by Bob Harrington, Hydrologist
August 2005

In a 19th century decision regarding groundwater rights, the Ohio Supreme Court decreed that "Because the existence, origin, movement, and course of such waters, and the causes which govern and direct their movements are so secret, occult, and concealed that any attempt to administer any set of legal rules in respect to them would be involved in hopeless uncertainty, and therefore would be practically impossible." Since then, much has been learned about the physical processes affecting groundwater, and there now exist methods that allow for the evaluation of the movement of groundwater. Among the most useful of the modern tools for evaluating groundwater levels and flows are groundwater flow models.

Groundwater levels respond to inputs and withdrawals of water from the groundwater system. For example, when it rains on the valley floor or when springtime snowmelt runoff percolates into the alluvial fans flanking the Sierra Nevada, water levels rise. Groundwater withdrawals, such as pumping of groundwater or water use by plants, cause groundwater levels to decline. The balance of inputs and withdrawals determines whether groundwater levels rise or fall, much like the balance of deposits and withdrawals determines whether a bank account rises or falls. The nature of the response of the groundwater system to inputs and withdrawals is determined by the groundwater flow properties of the materials that the groundwater moves through. For example, water flows more readily through sand and gravel than through clay, so a groundwater pumping well will preferentially withdraw water from sand and gravel layers rather than clay layers.

In order to make sense of all the inputs, withdrawals, and flow properties in a groundwater flow system, hydrologists use a groundwater flow model to simulate the water levels and movement of groundwater. Groundwater flow models are computerized renditions of groundwater flow systems, incorporating the basic physical principles of groundwater flow and information about the inputs, withdrawals, and flow properties of the particular groundwater system under study. Computer simulations of environmental systems can never completely capture the complexity of the real world, and therefore are never perfectly accurate. Though we have some information from monitoring of flows and from tests done on wells, we never have complete or exact knowledge of what the inputs, withdrawals, and flow properties of a groundwater system really are. Design of groundwater models necessitates a certain amount of guesswork about how the groundwater system works, and the results generated by the model have to be interpreted with consideration of the assumptions and uncertainties included in the model design.

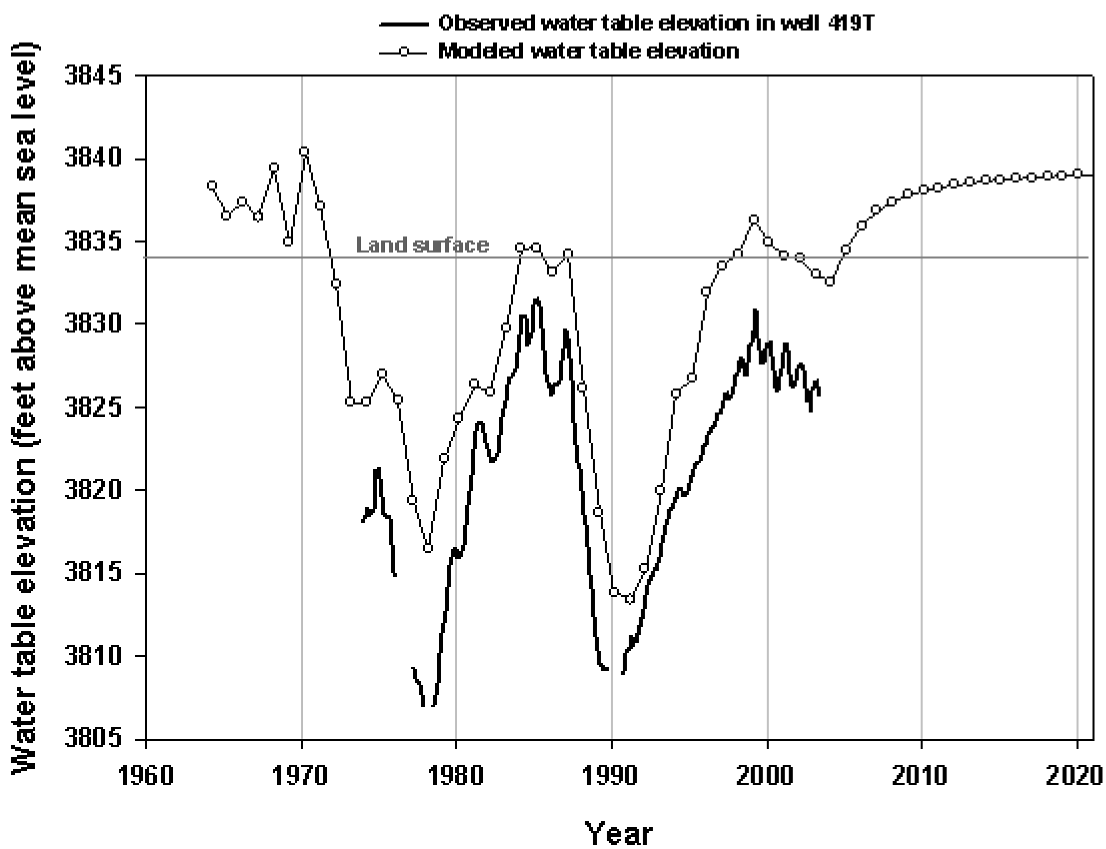


Figure 1: Shown above are modeled and observed hydrographs of well 419T. Well 419T is located east of Aberdeen near the LA Aqueduct intake. Its observed hydrograph, the thick line, shows water table fluctuations that are typical of the past thirty years in the Owens Valley: a depressed water table during the late 1970's, a peak in the mid-1980's, a rapid decline in the early-1990's, followed by gradual recovery to a peak in the late-1990's, followed by a gradual decline. The missing parts of the observed hydrograph are due to the well being dry. The modeled hydrograph, the thin line with circles, is consistently offset a few feet higher than the observed hydrograph, but the modeled year-to-year changes correspond closely to the observations. Thus, at well 419T, while the model produces water levels that are erroneous by a few feet, it reproduces the response to pumping stresses and recharge quite faithfully. The errors are present for two reasons: first, the model is an imperfect and approximate representation of reality, and second, the model represents average water levels over a 2000 by 2000 foot square, which need not be exactly the same as at the location of well 419T.

The period from 2003 to 2020 was modeled using mean runoff conditions and no pumping. Notice that the water table is intermittently modeled as being above the land surface - this is not entirely unrealistic, as this area was formerly the site of significant groundwater discharge (the presently dry vent of Hines Spring is located nearby). Rather than ponding to the depths indicated by the modeled hydrograph, the emerging groundwater would flow down-slope in the many sloughs and channels in the area forming shallow ponds and wetlands.

As part of a joint Inyo County/LADWP cooperative study, the U.S. Geological Survey (USGS) constructed a groundwater model for the Owens Valley in the 1980's for the purpose of examining different groundwater management scenarios. This model simulated the groundwater system for the period 1963 through 1988. Inyo County, working with LADWP and the USGS, has recently completed an update of the USGS model to make it into a tool for evaluating current and future groundwater levels. Tasks completed as part of the update of the USGS model include extending the range of the model out to the year 2020, implementing a more detailed accounting of the groundwater inputs and withdrawals, and examination of five scenarios designed to verify that the model was performing correctly. Figure 1 compares the USGS model's prediction of water table elevation to observations in a shallow monitoring well (well 419T) near the LA Aqueduct intake, a few miles east of Aberdeen. Though the model does not exactly reproduce the observed water table elevations, clearly the model provides us with a general prediction about how the water table responds to hydrologic stresses. The results of the update generally strengthen the conclusions from the initial model development effort:

- The primary influence on water levels in most areas of the Valley is groundwater pumping.
- The time frame for the groundwater system to respond to regional stresses is five to ten years. This means that there is a time-lag of as much as a decade before the groundwater system completely responds to a change in natural conditions, such as the amount of runoff, or a change in management, such as a change in pumping.
- Pumping is a relatively short-term and localized effect, whereas recharge from runoff is a relatively diffuse and long-term effect.

The updated model promises to be a valuable tool for both Inyo County and LADWP. The effects of a proposed annual pumping plan, a proposed well or well test, or a change in the volume of runoff can be evaluated using this model. Additionally, retrospective questions, such as what has been the effect of the Drought Recovery Policy, or alternative futures, such as what would be the effect of stopping groundwater pumping (Figure 1), can be analyzed. Groundwater science has progressed since the 19th century, and no longer is the movement of groundwater considered "secret, occult, and concealed;" groundwater flow modeling is a key tool in the analysis of groundwater movement in the Owens Valley.

Precipitation

by Sally Manning, Vegetation Scientist
July 2005

Inyo County Water Department has collected precipitation data at seven rain gauges in Owens Valley since 1993. Precipitation totals for Water Department rain gauges appear in Table 1. For the 2004 water year (beginning October 1, 2003, and ending September 30, 2004), precipitation measured at the gauges averaged 3.1 inches, and 92% of the precipitation fell between October 1 and April 15, prior to the 2004 growing season.

Table 1. Precipitation (in inches) measured in ICWD rain gauges by water year (October 1 of the previous year through September 30 of the year noted).

Rain Gauge	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
RG-1, east of Fish Slough	5.94	3.40	7.60	4.51	4.66	6.09	1.82	1.32	2.26	0.86	5.41	2.75
RG-2, near Laws	6.29	3.62	7.80	4.55	4.91	7.32	2.50	1.73	3.27	1.28	5.49	2.96
RG-3, southeast of Bishop	7.21	4.34	8.87	4.29	6.85	9.98	2.39	2.93	4.63	1.24	6.57	3.59
RG-4, south of Big Pine	8.29	4.24	9.76	6.85	8.33	8.99	1.83	2.56	3.34	1.59	7.23	4.09
RG-5, near Goose Lake	6.83	2.15	7.07	5.64	7.02	7.47	1.98	0.80	2.46	0.75	7.47	2.58
RG-6, near Blackrock	9.00	2.95	8.67	7.07	8.68	10.01	1.88	1.59	2.91	1.28	10.38	4.01
RG-7, west of Union Wash	5.00	1.61	4.88	2.14	4.35	5.06	1.61	1.54	3.91	0.51	5.62	1.77
Water Year Average	**6.94**	**3.19**	**7.81**	**5.01**	**6.40**	**7.85**	**2.00**	**1.78**	**3.25**	**1.07**	**6.88**	**3.11**
Average precipitation occurring Oct 1 - Apr 15 ("Winter")	6.85	1.81	6.76	4.45	4.67	5.81	1.48	1.17	2.60	0.97	6.38	2.87
percent in winter	*98.7*	*56.7*	*86.6*	*88.8*	*73.0*	*74.0*	*73.9*	*65.7*	*79.9*	*90.4*	*92.7*	*92.4*

Soil Water Conditions

by Aaron Steinwand, Soil Scientist
August 2005

The Water Agreement established procedures to determine which LADWP pumping wells can be operated based on soil water and vegetation measurements. Staff from ICWD routinely monitors depth to groundwater and soil water content at 25 sites in wellfields and eight sites in control areas. Data from 22 wellfield sites visited each month are used to determine the operational status (On or Off) of nearby pumping wells. In October 2004, six sites were in On-status. Three sites entered On-status following December/January rains and another in February due to precipitation and rising water table. Four sites went into Off status on July 1, 2005.

The purpose for the On/Off procedures is to manage pumping to protect plant communities that require periodic connection to the water table for long-term survival. Generally the sites with On-status have wet soil and shallow water tables, and the Off-status sites have dry soil and deep water tables. The On/Off determination is affected by several other factors, and sometimes On-status sites are those with a deep water table and low plant cover. Conversely, a site with adequate water table depth may be in Off-status if the water table occurs just below the root zone and plant cover is high.

We determine which monitoring sites are connected with the water table to give a clearer picture of the conditions underground that are affected by pumping. We rely on soil water and groundwater data because the water table depth necessary to provide water to the plant roots depends on the soil characteristics as well as water table depth.

For example, the capillary rise above the water table in a silty soil is much greater than in a sandy soil. At the same water table depth, the plants may have access to groundwater if the soil is silty, but not if it is sandy. How well plant roots can take up groundwater also depends on the type of vegetation. In similar soils, a shallower water table is necessary to supply groundwater to grasses than shrubs because of the shallower roots of the grasses. For management purposes, grass-dominated monitoring sites are assigned a root zone of 6.6 feet; shrub sites are assigned a root zone of 13.1 feet.

The wellfield monitoring sites (including three monitored but not used for pumping management) were grouped into three categories to summarize the connection between the root zone and the water table. Brief descriptions of the three categories are given below.

1. **Disconnected**: No recharge from lower depths is occurring in the root zone. This is primarily observed during winter or in response to rising water. Seventeen sites occur in this category. Sites L2, TA1, TA5, TS2, and IO1 have retained soil water available to plants that is taken up during the summers of 2004 and 2005. Soil at the other sites is dry except at shallow depths affected by rain.
2. **Weakly connected**: Water table fluctuations cause soil water changes in the bottom half of the root zone. Five sites occur in this category, and four (L1, TA2, TS3, TS6) have a considerable amount of retained soil water. TA4 has little retained water and the amount of recharge from below is very small.
3. **Connected**: Water table fluctuations cause soil water changes in the top half of the root zone. Three sites occur in this category.

The relatively low runoff and increased pumping from 2003 and 2004 caused water table and soil water decline at most monitoring sites from the relatively shallow water table conditions in 1999-00. Consequently, the number of sites where soil water responds to water table fluctuations has decreased. As of July 2005, the water table was supplying water to the root zone at eight monitoring sites located in wellfields (see map). This compares to about 20 sites with groundwater recharging the root zone in 2000. Soil water at slightly more than half of the sites (17) did not increase at depth after plant transpiration ceased in the fall 2004 and/or did not respond to water table increases over the following winter suggesting that the water table and root zone are disconnected.

Saltcedar

by Brian Cashore, Saltcedar Control Coordinator
July 2005

After seven years of cutting tamarisk on the lower Owens River, one learns not to look too far downstream. There is usually more than enough brush to stay occupied within a cowpie's throw of the parking spot for the day. Not that there aren't unexpected surprises: that charging cow protecting the just born calf, the early morning river crossings " ya, the ice is thick, it'll hold you" (nope), the unexplainable military operations going on overhead, all are in a days work for the saltcedar crew. As we work our way south, branch by branch, towards the delta at Owens Lake, the miles along the river channel accumulate slow and steady.

In recent years, we've had the benefit of funds from the California Wildlife Conservation Board. Matching funds from LADWP keep the sawdust flying as well. The combined funding sources keep the program moving forward as well as allowing for year-round monitoring and follow-up maintenance, a key component to long-term control.

In the last year, our seven-person crew worked through thick side channels and off-river ditches to return to the main channel, where flowing water and native trees added diversity and challenge. As we move downstream below Mazourka Canyon Road, the dense saltcedar populations give way to patches until the next "tami-jungle" near the Alabama Gates north of Lone Pine.

The work on tamarisk-eating beetles continues and it is anticipated that the newest arrivals, climate and latitude specific insects, will begin to affect saltcedar regionally as in other western U.S. locations.

Even though we can see Owens Lake now when we park each day, we know its' really best to focus on what's around the next river bend.

Cooperative Studies

In the late 1980's, Inyo County and Los Angeles developed the techniques for groundwater and vegetation management that became the basis for the Inyo/Los Angeles water agreement and its technical appendix, the Green Book. At the time, it was recognized that there would be a need for continuing research and cooperative studies to achieve the goals of the agreement. Consequently, the agreement was designed to be flexible to allow adoption of improved techniques.

The following are summaries of seven cooperative studies being developed or conducted by the Inyo/Los Angeles Technical Group. The full study proposals can be accessed by clicking the individual study titles.

1. Development of Hydrological Modeling Tools Robert Harrington, ICWD; Saeed Jorat, LADWP Approved by the Standing Committee, May 11, 2000. The purpose of this study is to improve hydrological models developed by previous cooperative studies to evaluate the impact of groundwater pumping, weather variations, surface water management, and other hydrologic changes on groundwater levels. Because groundwater modeling is the only method for consistent interpretation of groundwater data and evaluation of management options, this task is a prerequisite to fulfill the monitoring and technical goals of the Water Agreement. Inyo County and LADWP want to jointly develop a common set of modeling tools so that methods and analyses are understood and accessible to each agency.
2. Evapotranspiration from Groundwater-Dependent Plant Communities: Comparison of Micrometeorological Measurements and Vegetation-based Measurements Robert Harrington, Aaron Steinwand, ICWD; Paula Hubbard, David Martin, LADWP Approved by Standing Committee, March 23, 2000. Completed – report on website
3. Characterization of Confining Layer Hydrologic Conductivity and Storage Properties in the Owens Valley Randy Jackson, ICWD; Saeed Jorat, LADWP Approved by Standing Committee March 23, 2000. The purpose of this study is to determine confining layer hydrologic properties to assist groundwater modeling efforts (study #1) and to improve the management of wells sealed to the deep aquifer. Pumping from deep aquifers potentially could be managed differently than the Green Book methods. Without information to be developed by this study, however, the magnitude and timing of the water table drawdown from pumping deep aquifers are difficult to predict, complicating any assessment of the effects of different pumping scenarios. A stepwise approach is proposed, starting with analysis of existing data and progressing to low and high intensity field projects, if necessary.
4. Shallow and Deep Groundwater Geochemistry and the Source of Spring and Seep Water in the Owens Valley Aaron Steinwand, Randy Jackson, ICWD; Saeed Jorat, Paula Hubbard, LADWP Approved by Standing Committee Completed – report on website
5. Application of Canonical Community Ordination (CANOCO) to Assess Vegetation

Change
Sally Manning, ICWD; David Martin, LADWP
Approved by Standing Committee March 23, 2000.
This study proposed to apply complex statistical techniques to an extensive dataset of vegetation measurements collected by ICWD vegetation staff to quantify the importance of several environmental factors, such as water table fluctuations, influencing vegetation changes observed in the last decade. Since 2000, the principal investigators have worked independently to investigate factors influencing Owens Valley vegetation change. After working with the data at hand, Dr. Manning has determined that it would be preferable to substitute multiple linear regression as the analytical method. Results of analyses performed to date have been documented in written reports, presented by Dr. Manning at conferences and other presentations, and incorporated into manuscripts.

6. Inventory and Classification of Riparian Vegetation in the Owens Valley for Use in Future Monitoring
Sally Manning, ICWD; David Martin, LADWP; and unnamed consultant
Approved by Standing Committee March 23, 2000.
The objective of this study is to inventory, map, and classify riparian (Type D) vegetation on Los Angeles-owned land in Owens Valley to improve monitoring and management of these areas. This study was suggested in the Green Book (the technical appendix to the Water Agreement) but has not been completed. The Standing Committee agreed at its March 23, 2000, meeting that this work will be conducted by a consultant selected jointly by ICWD and LADWP, and the contract will be managed by LADWP. Work was to begin in March 2001. At present, LADWP is reviewing a draft request for proposals and a tentative map outlining of areas to be inventoried.

7. Development of a Demographic Model for Nevada saltbush (*Atriplex torreyi*)
Sally Manning, ICWD; David Martin, LADWP, Consultant to be funded by LADWP
Approved by Standing Committee March 23, 2000.
The purpose of this study is to use existing data for Nevada saltbush collected by ICWD vegetation staff to develop a model that could allow researchers and managers to make predictions about future population trends of this species. Nevada saltbush is a native shrub that commonly invades meadows subjected to pumping. It has the potential to out-compete grass species and change the character of the plant community in a way not allowed under the Water Agreement. It is unclear whether, once begun, saltbush invasion can be halted and whether existing saltbush-dominated communities are sustainable. A consultant to assist with the modeling work has not been selected. Since 2000, the principal investigators have worked independently on this study. Water Department staff continue to collect field data annually, and Dr. Manning recently completed a preliminary report analyzing the fate of some saltbush recruits.

Mitigation Status

by Irene Yamashita, Revegetation Project Coordinator

The 1991 EIR provided 55 mitigation projects, listed below. In addition there are eight Enhancement/Mitigation (E/M) projects that are not mitigation measures. The status of each project is summarized in the table below.

Additionally, "Problem" mitigation measures that require attention from the Technical Group, the Standing Committee or both are listed here.

	Mitigation Name	Mitigation Measure	Status
1	**Laws/Poleta Native Pasture E/M (220 acres)**	Annually provide water to approx. 220 acres in two locations to enhance and maintain existing vegetation and increase livestock grazing capacities while continuing the activity that caused the impact.	One pasture is adjacent to and east of Hwy. 6 (160 acres, parcel 44). Only the eastern half of the pasture has been effectively irrigated. Water use for this pasture in the 2004-2005 runoff year has not been reported by LADWP (see McNally Ponds and Pasture E/M project below.) The native pasture SE of Laws (60 acres, parcel 138) does not appear to be fully irrigated. Plant cover is poor, grasses are mainly limited to ditches and weeds are prevalent. LADWP reports that they cannot separate this project's water supply from contiguous irrigated parcels.
2	**McNally Ponds and Native Pasture E/M (348 acres)**	Create waterfowl habitat by annually filling ponds Sept. – Jan. Enhance and maintain vegetation and increase livestock grazing capacities by irrigating 100 acres of native vegetation and ~200 acres of native pasture.	In the past, the Inyo Board of Supervisors has approved water reductions due to drought conditions. LADWP currently describes the water supply to the ponds as provided only when water is diverted from the Owens River to the McNally canals. The adjacent 100 acre pasture has poor cover with some patches of good grass cover. Pond water supply for runoff year 2004-05 was 0 acre-feet. Pastures on the east side of the river (200 acres) maintain good grass cover. LADWP reports it is not possible to separate water

			supply to this project from the Laws/Poleta water supply project. Thus uses for both projects were 1,682 acre-feet for the 2004-05 runoff year.
3	**640 acres near Laws**	Standing Committee to consider revegetating with non-groundwater dependent native plants and continuing the activity that caused impact.	The Standing Committee has not evaluated the need for mitigation of this area. Further, the expansion of the Desert Aggregates gravel mine operation includes 174 acres in the western part this potential mitigation site.
4	**300 acres Five Bridges area**	Manage pumping to restore water table levels, supply surface water, and restore meadow and riparian vegetation through active revegetation efforts. Inyo and LA are responsible for plan development and implementation.	In progress. Several activities have taken place in the Five Bridges area, but the Technical Group has not evaluated nor approved management changes to the mitigation plan. Providing surface water to the site has increased cover in some areas. The area north of the river that was originally in the impact area appears to have declined in cover and requires attention but his area was not addressed in the mitigation plan. In March 2005, LADWP informed the Water Department that limited grazing in some exclosures had resumed. The Technical Group needs to agree on a revised mitigation plan for the Five Bridges area.
5	**Farmers Pond**	Provide wet habitat by maintaining operation of seasonal pond.	Implemented and ongoing. Water supplied for runoff year 2004-2005 was 520 acre-feet.
6	**140 acres near Laws**	Native plant revegetation. As a result of the Laws reirrigation Mitigated Negative Declaration (MND) approx. 32 acres will be converted to flood irrigated pasture.	The Technical Group implemented a 10-acre study plot in 2001 in lieu of initiating the planting of container plants as required in the Mitigation Plan. Results of the study were available in Nov. 2003. In 2005, LADWP reported that they have expanded and planted the drip irrigation plots. No reporting of extent, species, seed source, or methods has been provided. LADWP informed the

			County they would run W376 during 2004 and 2005 growing seasons to supply the drip lines (less than 2 acre-feet in 2004). The mitigation project area has decreased in size due to the Laws reirrigation MND. LADWP's contractor conducted a revegetation study at the site. No results from that study have been provided to the Water Dept.
7	**Laws Museum Pastures E/M (21 & 15 acres)**	Enhance the museum grounds by irrigating pastures east and west of the museum. This project was revised in the Laws reirrigation MND.	Not completed. Both museum pastures had a tall dense cover of weedy species at the time of a site visit (9/2/04). LADWP reported water use in runoff year 2004-05 was 32 acre-feet. They also report that the sprinkler system to fully irrigate both pastures will be operable in 2005.
8	**Laws area**	Monitor and reduce groundwater pumping where suspected impacts have occurred. Mitigate according to the Agreement, if necessary.	County and LADWP are in disagreement over groundwater pumping and the need to operate the McNally canals to avoid impacts to vegetation. Monitoring of select vegetation parcels is ongoing.
9	**Bishop Cone groundwater levels**	Establish new monitoring sites prior to increased pumping.	Not implemented. Inyo County provided an outline to LADWP in June 2004 for evaluating additional monitoring and management of wells on the Bishop Cone. LADWP has not responded to this letter.
10	**Bishop Cone flowing wells**	Monitor flow rates from flowing wells and associated vegetation.	Not implemented. Inyo County provided to LADWP in June 2004 an outline of a plan designed to monitor and manage LADWP's increased pumping of wells on the Bishop Cone. LADWP has not responded to this letter.
11	**Bishop Cone groundwater dependent vegetation**	Monitor new and existing sites such that pumping would be managed to avoid significant adverse impacts to the environment	Not implemented. Inyo County provided to LADWP in June 2004 an outline of a plan designed to monitor and manage LADWP's increased pumping of wells on the

			Bishop Cone. LADWP has not responded to this letter.
12	**Millpond Recreation Area E/M**	Pay for costs of running well to provide water to pond and thus create wet habitat.	Implemented and ongoing.
13	**Buckley Ponds**	Provide habitat for warm-water fishery and waterfowl by maintaining a year-round pond.	Implemented and ongoing, although an operations plan needs to be developed. Water supply to Buckley Ponds, Duck Pond, and Saunders Pond in runoff year 2004-2005 was 2,744 acre-feet.
14	**120 acres near Bishop**	Revegetate with non-groundwater dependent native vegetation.	In progress but behind schedule. Fencing to eliminate disturbance has been installed. The Mitigation Plan (MP) provided that test plots would be implemented if the area did not demonstrate vegetation recovery. Vegetation cover was re-sampled in 2003 to compare with 1999 baseline cover. Results showed little to no change. The MP requires the Technical Group to develop test plots by 2004 to determine effective methods to re-establish native vegetation. In addition, the MP provided that revegetation efforts would be expanded in 2009, five years after implementation of test plots. LADWP's contractor conducted studies on the site. Methods and results from the study have not been available. LADWP reported in May 2004 that "a drip irrigation system is being designed for this site" and that implementation at the Bishop site will commence one year after the projects at Big Pine 160 and Independence 123 are fully implemented and operating properly; however, no schedule was provided.
15	**Saunders Pond**	Provide wet habitat by maintaining operation of year-round pond.	Implemented and ongoing, although an operations plan is needed.

16	**Klondike Lake E/M**	Improve waterfowl habitat and provide recreation in the Big Pine area. The Big Pine Ditch MND (2004) reduced the water supply to 1700 acre-feet, provided maintenance of native pasture and wetland habitats adjacent to Lyman ditch, and committed LADWP to maintain a described a lake level. Up to 200 acre-feet/year would be used for a native habitat area.	Providing water to the lake is ongoing. LADWP reports runoff year 2004-2005 water use was 1,278 acre-feet. The Technical Group is developing plans for test water releases in summer 2005.To insure that the lake elevation levels are being met, the Water Dept. recommends a reporting procedure should be incorporated into this project. In addition, the Water Dept. believes that LADWP's rechannelization and altered management of Lyman Ditch may adversely affect the adjacent native pastures included in the project description.
17	**Big Pine Northeast Regreening E/M (30 acres)**	Manage pumping in accordance with the Agreement and establish irrigated crop.	Behind schedule. A plan and schedule should have been developed in 1998.The Technical Group is currently developing these requirements.
18	**Big Pine Ditch System**	Establish/restore ditch system through Big Pine.	Partially implemented. A portion of the ditch system will be running in spring of 2005.
19	**20 acres near Big Pine E/M**	Establish an irrigated crop while continuing the activity that caused the impact.	Behind schedule. The MOU required a plan and schedule by 1998; however this has not been completed. The draft EIR stated that if permanent irrigation was deemed infeasible then a revegetation program would be implemented. However, the final EIR stated that a cultivated crop supplied with pumped or surface water would be implemented. LADWP has stated that, because there is an imbalance between E/M project uses and E/M pumping it is currently not feasible to implement this project. Thus, the Water Dept. recommends that the Technical Group decide whether the final EIR was in error and make a determination regarding the feasibility of permanent irrigation

			at the project site.
20	**160 acres near Big Pine**	Revegetate with non-groundwater dependent native species while continuing the activity that caused the impact.	Behind schedule. The site has been fenced to reduce disturbances. The Technical Group should have implemented test plots in 2001. LADWP's contractor implemented a revegetation study in 2001. Reports describing methods and results have not been provided to the Water Dept. The Mitigation Plan scheduled revegetation efforts to be expanded in 2006.
21	**Steward Ranch**	Compensation agreement with ranch owner.	Mitigation agreement is in place.
22	**Big Pine general**	Valley-wide mitigation by Agreement management provisions.	LADWP exceeded groundwater mining pumping amounts in the Big Pine wellfield during the 2004 – 2005 runoff year. Groundwater mining limits are provided for by the Agreement.
23	**Fish Springs**	CDFG fish hatchery and the LORP serve as compensatory mitigation.	Hatchery is in place. The LORP project is behind schedule. LADWP has approved their LORP EIR. The EPA is preparing an EIS. County approval is pending completion of the EIS. * LADWP did not report water use for runoff year 2004-05.
24	**Tule Elk Field**	Provide water in summer to field used by tule elk.	The water supply to this project has been reduced since 2002.LADWP did not inform the County that water management changes would be implemented.
25	**Big and Little Seely**	Provide wet habitat for waterfowl and shorebirds by maintaining operation of a year-round pond.	Implemented and ongoing, although an operations plan is needed.
26	**Calvert Slough**	Maintain small pond and marsh.	This project has not been receiving a regular water supply since 1998. LADWP reported that low flows in the creek do not allow supplying the project because of high ditch losses and the "off" status of the two wells upstream of the project. No water was supplied to this project for seven years

			(1998-2004).
27	**Hines Spring**	Create 1-2 acres of aquatic, riparian, and marshland habitats. Project will serve as a restoration research project. Also, manage pumping according to the Agreement.	A revised work plan and schedule were approved by Inyo and LA to complete a mitigation plan for Hines Spring. Development of the mitigation plan is in progress and should be completed in 2005.
28	**80 acres (Taboose/Hines Spring area).**	Manage pumping and revegetate with native species.	In progress. This mitigation measure consists of 3 sites that total approx. 115 acres. A mitigation plan and schedule for one site (Hines Spring S.) will be developed 3 years after the Hines Spring mitigation project is completed. Tin 54 – 0.3 acres.108 alkali sacaton plants were planted in 1999. A drip irrigation system has been utilized; irrigation amounts were reduced in 2004. Monitoring results demonstrate high grass survival. Baseline cover in 1999, prior to planting was 4.2%. Vegetation cover was 3.3% in 2004. The site goal is 33% cover. Although cover remains far below the site goal, more time will be given for the planted grasses to grow before developing additional revegetation plans. Transects will be run again in 2007. Blk 16E – 7.2 acres. Transects run in 2002 had higher perennial native vegetation compared to 1999, therefore no active revegetation plans are being considered. Vegetation cover increased from 5.4% to 12.2%.Transects will be run again in 2005 to track whether the vegetation cover is trending towards the goal of 35%.
29	**Little Blackrock Spring**	Water provided to maintain wet area at original spring site.	Implemented and ongoing, although an operations plan is needed. LADWP reports that the Goodale Bypass Ditch that supplies the project normally runs all year at less than 1 cfs.

			providing approx. 700 acre feet a year.
30	**Big Blackrock Springs**	CDFG fish hatchery and the LORP serve as compensatory mitigation.	The fish hatchery is in place. The LORP project is behind schedule; see LORP project, no. 50 below. * LADWP has not reported water use for the 2004-05 runoff year.
31	**Thibaut/Sawmill marsh habitat**	The Blackrock Waterfowl component of the LORP will provide compensatory and some on-site mitigation. Vegetation impacts will be mitigated under the Agreement.	The LORP project is behind schedule. See LORP project below, no. 50.*
32	**Independence Pasturelands E/M (610 acres)**	Develop and irrigate pasture or alfalfa fields.	The acreage of this project declined from 610 to 470 acres without approval from the Standing Committee. LADWP has revised the water allotment from 1,825 acre-feet/year to 1,493. They report that water use in runoff year 2004-05 was 2,489 acre-feet. Site topography prevents flood irrigation from reaching some portions of the project.
33	**Billy Lake**	Maintain wet habitat.	Implemented and ongoing, although an operations plan is needed.
34	**Independence East Side Regreening E/M (30 acres)**	Manage pumping and establish irrigated crop.	Not implemented. LADWP plans to submit a MND to their board for approval in 2005.The project requires that the Technical Group meet Green Book provisions for developing a new well and mitigation plan.
35	**Independence Woodlot E/M (21 acres)**	Create irrigated crop.	Implemented and ongoing, IMACA has been managing the project since 1997. An operations plan is needed based on management guidelines agreed to by Inyo Co. and LADWP. LADWP reports that water supply during runoff year 2004-05 was 276 acre- feet.

36	**Independence Springfield E/M (283 acres)**	Manage pumping and establish native pasture or alfalfa.	Implemented and ongoing. As noted below, approx. 40 acres were identified as still requiring mitigation. Water supply during runoff year 2004-05 was 280 acre-feet.
37	**Additional 40 acres w/in springfield**	Revegetate with native pasture.	The MOU required a plan and schedule by 1998; however this has not been completed.
38	**60 acres in S/S well field**	Manage pumping according to the Agreement and supply water to restore vegetation to natural composition and cover through active revegetation efforts.	One of the 3 sites that comprise this mitigation measure is behind schedule. The 3 sites total approx. 115.2 acres. Ind 123 (28.4 acres) did not have test plots implemented in 2002 as scheduled in the Mitigation Plan. Ind 131 (73.2 acres). The Technical Group implemented revegetation test plots in Dec. 2001. A final report from the consultant was received in Nov. 2003. LADWP's consultant conducted additional revegetation studies, and reports on methods and results from this effort have not been made available. LADWP informed the County that well 392 would be used during the 2004-growing season to supply a drip system with approx. 2 acre-feet. The schedule in the Mitigation Plan called for expanding revegetation efforts for Ind 123 and 131 in 2007. Ind 105 (13.6 acres) cover data increased from 1999 to 2001, thus no active revegetation activities are planned. The initial cover of 8.1% increased to 13.5%.The goal for the site is 17% perennial native cover. The site will be re-sampled in 2006 to re-evaluate progress.
39	**Shepherd Creek Alfalfa Field E/M**	Manage pumping and establish irrigated crop on approx. 200 acres	Implemented and ongoing, alfalfa planted and maintained on approx. 185 acres. LADWP reports that water supply for runoff year 2004-05 was 1,072 acre-feet.

40	**Expand Shepherd Creek Alfalfa E/M (60 acres)**	Expand E/M project to east of Hwy 395 if vegetation cover in that area remains sparse.	The Technical Group does not have a mitigation or monitoring plan for this mitigation measure. LADWP has conducted vegetation transects and concluded that vegetation cover has increased from baseline and thus the mitigation is not necessary.
41	**Reinhackle Spring**	Manage groundwater pumping to avoid reductions in flow and monitor and maintain vegetation to avoid significant change or decrease as provided in the Agreement and the Green Book.	Not implemented. The Technical Group has not developed a plan for monitoring the flows and vegetation dependent on the spring flows.
42	**Lone Pine Ponds E/M**	Maintain wet habitat.	Implemented and ongoing. This project will be included as part of the off-river lakes and ponds in the LORP.
43	**Lone Pine East Side Regreening E/M (11 acres)**	Create irrigated pasture.	Implemented and ongoing. LADWP did not report water use for this project in runoff year 2004-05.
44	**Lone Pine Woodlot E/M (12 acres)**	Revegetate and provide irrigation.	Implemented and ongoing; however management has been modified without Standing Committee approval. During the non-irrigation season, water normally flows to the project after flowing through Lone Pine Riparian Park. LADWP informed the Water Dept. that the project will no longer receive water during the non-irrigation season. This project is currently managed by IMACA. An operation plan is needed based on management guidelines agreed to by Inyo and LADWP. LADWP reports water use was 76 acre-feet for runoff year 2004-05.
45	**Richards Field E/M (189 acres)**	Create irrigated pasture or alfalfa field.	This project has been modified without Standing Committee approval. During the non-irrigation season, water normally flows to the project after flowing through Lone Pine Riparian Park.

			LADWP informed the Water Dept. that the project will no longer receive water during the non-irrigation season. Water to this project is not measured separately from the park supply. LADWP reports runoff year water use was 916 acre-feet for the park and field.
46	**Van Norman Field E/M (160 acres)**	Create irrigated pasture or alfalfa field.	Implemented and ongoing although a portion of the project is not capable of being irrigated due to the site topography. Inyo recommends an evaluation of this portion of the project. LADWP reports water use was 337 acre-feet in runoff year 2004-05.
47	**Lone Pine West Side Regreening (7 acres)**	Create irrigated pasture.	Implemented and ongoing. LADWP did not report water use for runoff year 2004-05.
48	**Diaz Lake**	Provide supplemental water to recreation area and create wet habitat.	Implemented and ongoing although an operations plan is needed.
49	**Lower Owens Rewatering Project E/M**	Re-water the Owens River to create wet habitat for wildlife. Project includes off-river lakes and ponds	Project water supply reduced in 1991 to present due to drought conditions. Flows between Blackrock and Billy Lake have been discontinued. The Lower Owens River Project will incorporate this project. LADWP reports water use for runoff year 2004-05 was 8,910 acre-feet.
50	**Lower Owens River Project**	Re-water approx. 60 miles of the Owens River channel. The project includes the delta habitat area, off-river lakes and ponds, and a 1500 acre waterfowl habitat	Project implementation pending approval of the EIR/EIS. The LORP project is behind schedule. LADWP has approved their EIR. The EPA and LADWP's contractor is preparing an EIS. County approval is pending completion of the EIS.*
51	**Meadow/riparian vegetation dependent on agricultural tailwater**	LORP to serve as compensatory mitigation.	The LORP project is behind schedule. LADWP has approved their EIR. The EPA is preparing an EIS. County approval is pending completion of the EIS.*

52	**Salt Cedar Control Program**	Implement salt cedar control program in accordance with the Agreement.	Ongoing, program implemented in 1998. Approx. 23 mi. of the Owens River floodplain south of the aqueduct intake has been cleared of saltcedar. The program also monitors and maintains cleared areas. The current program will not address areas impacted by water spreading due to insufficient funding.
53	**Irrigated fields, including Cartago and Olancha**	Continue irrigation practices since 1981-82 and thereafter.	Ongoing. Irrigated lands are not directly monitored; instead, lessees are relied upon to indicate if there are changes in water for irrigation.
54	**Fish Springs, Big and Little Seely, and Big and Little Blackrock**	Monitor and maintain vegetation to avoid significant change or decrease as provided in the Agreement and the Green Book.	The Technical Group does not have a plan for monitoring flows or vegetation at springs and seeps. Ecosystem Sciences has completed a draft inventory of springs and seeps. According to the MOU, the inventory should provide baseline data adequate for monitoring change. ICWD provided extensive comments on the draft to Ecosystem Sciences.
55	**Springs/Seeps**	Monitor and maintain vegetation to avoid significant change or decrease as provided in the Agreement and the Green Book.	The Technical Group does not have a plan for monitoring flows or vegetation at springs and seeps. Ecosystem Sciences has completed a draft inventory of springs and seeps. According to the MOU, the inventory should provide baseline data adequate for monitoring change. ICWD provided extensive comments on the draft to Ecosystem Sciences.

* In September 2005, the County agreed to forego EPA funding, therefore an EIS for the LORP is no longer required. However, an EIR on the project still needs to be approved by the Inyo County Board of Supervisors. (See Inyo's letter to EPA, Sept. 20, 2005 and Settlement between Inyo and Los Angles, Sept. 13, 2005.)

Status of Non-mitigation E/M projects

1	Independence Ditch	Completed

2	Eastern California Museum	Completed
3	Independence Roadside Rest Area	Completed
4	Manzanar Tree Pruning	Completed
5	North Lone Pine Cleanup	Completed
6	Lone Pine Riparian Park	Completed
7	Lone Pine Sports Complex	Completed
8	Tree Planting along Public Roadways	Completed

Problems with Mitigation Implementation

Numbers in parentheses refer to project numbers in the mitigation status table.

Problem: Changes made to project description, project management, or both without Standing Committee approval.	
McNally ponds and native pasture (2)	LADWP has changed this project from one in which annual water deliveries were provided to one in which water is provided intermittently. The project description provides for an annual water supply to the ponds, 60 acres, and three pastures. LADWP's pond management description in their annual report is different from the project description. They report that water will only be supplied when water is diverted from the Owens River to the McNally canals. In addition the 100-acre pasture is poorly vegetated. This may be a result of decreased water supply and the difficulties of spreading water over natural topography. However, it is not clear how much water this project receives. The pastures SE of the Laws museum, consisting of 200 acres total, are well irrigated.
300 acres at Five Bridges (4)	LADWP has carried out activities at Five Bridges that differ from the agreed upon Mitigation Plan.
140 acres near Laws (6)	The mitigation plan is not being implemented as required in the Mitigation Plan. The Technical Group chose this site for implementing a 10-acre study plot in 2001 in lieu of initiating the planting of container plants. In addition, the size and configuration of the site has changed due to the Laws reirrigation project.
Klondike Lake (16)	Current management of Lyman Ditch may be adversely affecting the native pastures that are protected according to the project description.
Tule Elk Field (24)	Water deliveries to this wildlife enhancement project were reduced beginning in 2002. As a result, vegetation cover has been decreasing.
Independence Pasturelands (32)	The acreage of this project has decreased from 610 acres in the project description to 470 acres. LADWP reported in their annual report that the reduction is due to "lease boundaries, vegetation, and other surface features." Accordingly, the water supplies were revised by LADWP to

	1,493 acre-feet/yr. from 1,825 acre-feet/yr.
Potential Expansion of Shepherd Creek Alfalfa (40)	A mitigation or monitoring plan for this mitigation measure has not been developed by the Technical Group. LADWP conducted vegetation transects and concluded that vegetation cover has increased from baseline and thus the mitigation measure is not necessary.
Richards Field (45)	During the non-irrigation season, water normally flows to the project after flowing through Lone Pine Riparian Park. LADWP informed the Water Dept. that water will no longer be delivered to the project during the non-irrigation season.
Lone Pine Woodlot (44)	During the non-irrigation season, water normally flows to the project after flowing through Lone Pine Riparian Park. LADWP informed the Water Dept. that water will no longer be delivered to the project during the non-irrigation season.
Calvert Slough (26)	This project provides water to maintain a pond and marsh area. LADWP reported that low flows in the creek do not allow supplying the project because of high ditch losses and the "off" status of the two wells upstream of the project. No water has been supplied to this project for seven years.

Problem: Mitigation not implemented	
640 acres near Laws (3)	The Standing Committee has not evaluated the need for mitigating this potential site. Further, the expansion of the gravel plant to the west now includes 174 acres of this potential mitigation site.
Bishop Cone impacts to groundwater levels (9)	The FEIR anticipated increased pumping from the Bishop Cone, and recent data show pumping has increased. Inyo County sent a letter to LADWP in June 2004 containing a proposed outline for evaluating additional monitoring and management of wells on the Bishop Cone. LADWP has not responded to this letter.
Bishop Cone impacts to flowing wells (10)	Inyo County sent a letter to LADWP in June 2004 containing a proposed outline for evaluating additional monitoring and management of wells on the Bishop Cone. LADWP has not responded to this letter.
Bishop Cone impacts to groundwater dependent vegetation (11)	Inyo County sent a letter to LADWP in June 2004 containing a proposed outline for evaluating additional monitoring and management of wells on the Bishop Cone. LADWP has not responded to this letter.
Big Pine NE regreening (17)	The Technical Group has not developed a plan for this mitigation measure although the MOU required that a mitigation plan and implementation schedule be developed in 1998.
20 acres east of Big Pine (19)	No plan or schedule for this project has been developed although the MOU required that a plan and schedule be developed in 1998.The 1991 FEIR stated that a cultivated crop supplied with pumped or surface water would be established. LADWP has stated that because there is an imbalance between E/M project uses and E/M pumping it is currently

	not feasible to implement this project.
40 acres within Independence Springfield (37)	This mitigation measure does not have a mitigation plan and schedule. The MOU required a plan and schedule to be completed in 1998.
Monitoring of seeps and springs (55)	The Technical Group is not monitoring springs and seeps. Ecosystem Sciences has completed a draft inventory of springs and seeps. The inventory should provide baseline data that could be used in future monitoring. ICWD has provided extensive comments to Ecosystem Sciences
30 acres east of Independence (34)	This mitigation measure does not have a plan and schedule. A mitigation plan and schedule should have been completed in 1998. LADWP will submit a Mitigated Negative Declaration on this project to their board for approval; however the Technical Group must complete Green Book procedures for drilling a new well and for developing a mitigation plan.
Lower Owens River Project (50)	LADWP has approved their EIR. EPA is preparing an EIS. County approval is pending completion of the EIS

Problem: Implementation of mitigation plan provisions behind schedule	
Laws 140 (6)	In lieu of initiating the revegetation planting of container plants as required in the Mitigation Plan, the Technical Group initiated a 10-acre study in 2001. Results of the study were provided in Nov. 2003. The Mitigation Plan intent to move forward with revegetating the entire site has not occurred. The mitigation project size and configuration has changed due to the Laws reirrigation project.
Big Pine 160 acres (20)	The Technical Group has not implemented test plots scheduled for 2001 in the Mitigation Plan. However, LADWP contracted with MWH to implement test plots in 2001. Reports describing methods and results have not been made available. The Mitigation Plan required that revegetation efforts would be expanded in 2006.
Independence 123 (only a portion of the 60 acres in the SS wellfield) (38)	Revegetation test plots were to be implemented by the Technical Group at this site in 2002, but they were not.
120 acres near Bishop (14)	The Mitigation Plan provided that test plots would be implemented if the area did not demonstrate vegetation recovery. A comparison of cover between 2003 and 1999 baseline cover showed little to no change. The Technical Group has not developed and implemented test plots.

Problem: Effectiveness of mitigation is inadequate and thus management should be re-evaluated	
Laws-Poleta	This project has two pastures. One, 160 acres, is effectively irrigated on half the

native pastures (1)	parcel. The remainder is mainly barren. This pasture received approx. half the water supply allotted in the 2001-2002 runoff year. The second pasture is also only partially irrigated due to its topography. The water supply to this project is not reported to the Water Dept.
Big Pine general (22)	LADWP exceeded the groundwater mining limit in the Big Pine wellfield during the 2004-2005 runoff year. Groundwater mining protections are provided for in the water Agreement.
Van Norman Field E/M (45)	A portion of the project is not capable of being flood irrigated due to the site topography.