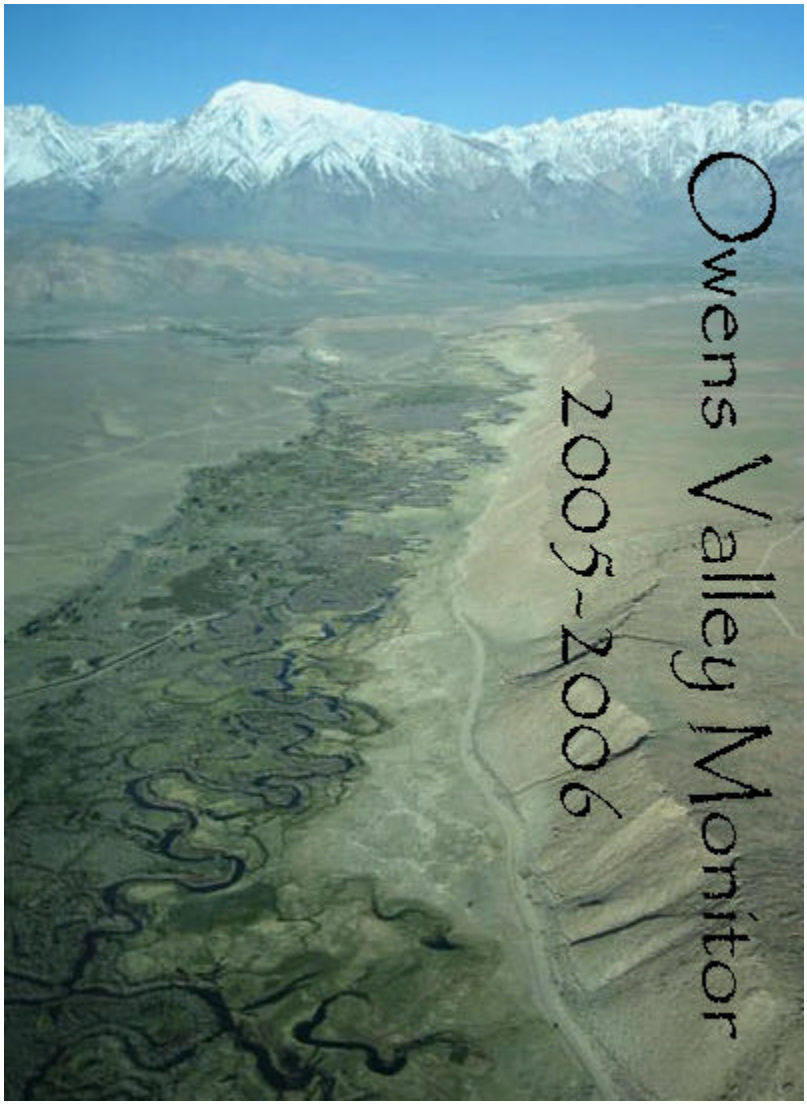

The Owens Valley Monitor is the Inyo County Water Department's (ICWD) annual report on monitoring and other work performed by ICWD and the Los Angeles Department of Water and Power (LADWP). In accordance with the Inyo/Los Angeles water agreement, ICWD and LADWP monitor water activities in the valley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

View this Owens Valley Monitor and previous Monitors at http://inyowater.org.

This annual report was produced by the Inyo County Water Department in Bishop, California, July 2006

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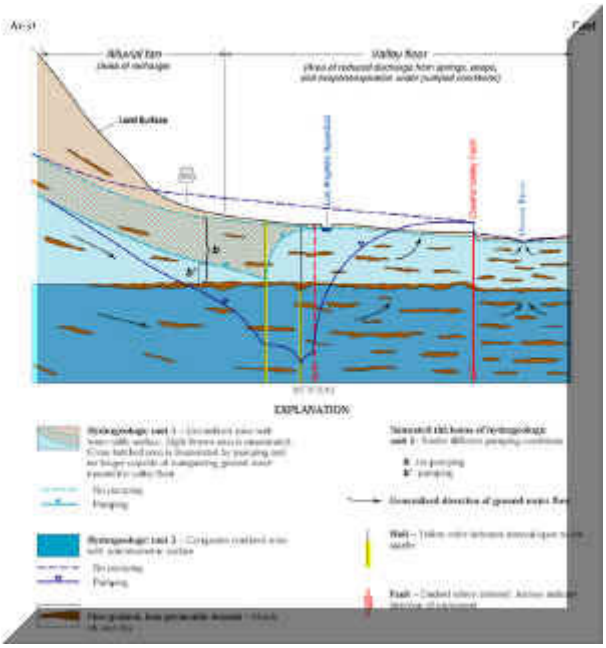
Groundwater Conditions

by Bob Harrington, Hydrologist
May, 2006

Groundwater conditions in 2005 improved due to ample recharge and restricted pumping. On August 8, 2005, Judge Lee Cooper ruled in Inyo County Superior Court that LADWP was in violation of certain court orders regarding implementation of mitigation projects associated with the Long-Term Water Agreement (LTWA) and Memorandum of Understanding. Among the sanctions imposed on LADWP by Judge Cooper were a limitation on pumping to not greater than 57,412 acre-feet per runoff year and a requirement that 16,294 acre-feet of water be spread per runoff year in the Laws area for groundwater recharge until the Court lifts the sanctions. The sanctions will be in place until LADWP establishes 40 cfs flows in the Lower Owens River. LADWP's Operations Plan for the 2005-2006 runoff year (April 2005 through March 2006) originally called for 90,000 acre-feet of pumping, however the sanctions imposed by the Superior Court forced a reduction in pumping to the court-ordered limit of 57,412 acre-feet. LADWP produced a modified Operations Plan on September 28, 2005 that reduced their planned pumping to 57,412 acre-feet. At the end of the 2005-2006 runoff year, LADWP reported that they pumped 56,765 acre-feet, and spread 24,237 acre-feet of water in Laws, of which 17,102 acre-feet was pursuant to the court order.

Conceptual diagram showing groundwater flow in the Owens Valley (Danskin, 1998);



Runoff from the 2004-2005 winter snowpack was above normal, forecasted to be 128% of normal for the Owens Valley. The depth-to-water measurements in Table 1 show that the combination of enhanced recharge due to high runoff, court-ordered recharge in Laws, and relatively low pumping as ordered by the Court resulted in a rise in water table elevation throughout the Owens Valley. The twenty-eight wells listed in Table 1 are 'indicator wells,' a small subset of LADWP's monitoring wells that have proven useful for predicting changes in the water table due to groundwater extraction and recharge. In all wellfields, water levels increased from April 2005 to April 2006; however, in all wellfields except Bairs-Georges and Laws, water levels are below the levels of the mid-1980's baseline vegetation mapping period. Noteworthy are the large increases in water table elevation in Laws due to the large amount of water spreading.

Water tables should continue to rise in 2006-2007. Forecasted runoff for the Owens Valley runoff year 2006 is 135% of normal runoff for the Owens Valley, and LADWP remains subject to the court sanctions that limited pumping during 2005-2006. In accord with the court sanctions, LADWP's Operations Plan for the 2006-2007 runoff year specifies 57,412 acre-feet of pumping and 16,294 acre-feet of water spreading in Laws. Table 2 provides LADWP's planned pumping for each wellfield. LADWP plans to have 40 cfs flowing in the Lower Owens River sometime in early-2007, which would result in the sanctions being lifted. In the event that the sanctions are lifted, LADWP may elect to modify the Operations Plan according to section V.D of the LTWA, which could result in higher pumping that currently indicated in the Operations Plan. Nonetheless, the Court-ordered restrictions on pumping and requirements for water spreading will remain in place for most of the 2006 runoff year, which should result in a general increase in water table elevations, similar to that which occurred in the 2005 runoff year.

Table 1. Depth to water (DTW) at indicator wells, April 3, 2006. All data are in feet. Baseline is the average of 1985, 1986, 1987 April water levels (as available). Negative change from April '05 indicates a declining water table; negative deviation from baseline indicates the water table is below baseline.

Well ID	DTW, April '06	DTW, April '05	Change from April '05	Baseline DTW from RP	Deviation from baseline, April '06
Bairs Georges					
398T	4.33	4.76	0.43	6.38	2.05
399T	2.69	3.41	0.72	2.96	0.27
400T	6.07	6.30	0.23	6.32	0.25
Symmes Shepherd					
401T	25.81	35.88	10.07	17.87	-7.94
402T	10.99	13.12	2.13	8.03	-2.96
510T	7.51	8.50	0.99	4.98	-2.53
403T	8.36	10.36	2.00	5.32	-3.04
404T	5.61	5.67	0.06	3.55	-2.06
511T	7.61	8.00	0.39	4.60	-3.04
447T	39.06	42.41	3.35	22.20	-16.86
Independence Oak					
407T	11.51	13.28	1.77	7.57	-3.94
406T	4.13	4.20	0.07	1.53	-2.60
408T	4.07	5.71	1.64	3.13	-0.94
546T	6.53	8.69	2.16	3.60	-2.93
412T	7.68	8.20	0.52	4.29	-3.39
Thibaut Sawmill					
413T	12.86	15.27	2.41	9.34	-3.52
415T	22.34	22.99	0.65	18.54	-3.80
507T	6.26	6.40	0.14	4.62	-1.64
Taboose Aberdeen					
417T	32.50	34.21	1.71	26.92	-5.58
418T	10.86	12.00	1.14	8.18	-2.68

419T	9.71	13.14	3.43	6.55	-3.16
421T	37.06	41.13	4.07	34.31	-2.75
502T	11.35	14.24	2.89	7.49	-3.86
504T	12.79	16.53	3.74	10.78	-2.01
505T	24.21	25.88	1.67	18.60	-5.61
Big Pine					
425T	19.46	21.48	2.02	14.89	-4.57
426T	15.02	16.53	1.51	11.57	-3.45
469T	23.97	25.42	1.45	21.73	-2.24
Laws					
107T	19.45	32.88	13.43	24.00	4.55
436T	6.02	11.38	5.36	8.40	2.38
438T	7.09	14.70	7.61	9.61	2.52
490T	14.81	16.31	1.50	13.03	-1.78
492T	25.98	33.24	7.26	32.83	6.85

Table 2. LADWP planned pumping for runoff-year 2006.

Wellfield	Pumping (acre-feet)
Lone Pine	1,231-1,566
Bairs-Georges	0
Symmes-Shepherd	1,320
Independence-Oak	7,200
Thibaut-Sawmill	13,200
Taboose-Aberdeen	2,880-4,470
Big Pine	20,400
Bishop	6,100
Laws	4,475
Total	57,412

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," which 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.

Figures 1a-c illustrate the regional water table decline from baseline to 1991 due to pumping and drought, subsequent recovery to a peak in 1999, and a subsequent decline. Red areas indicate areas of groundwater dependent vegetation where the water table is below baseline; green areas are areas above baseline. The water table change maps shown in Figures 1a-c were produced by interpolating measurements made during April of each year in several hundred LADWP shallow groundwater monitoring wells. April measurements are used because there are more data for April than any other month, and usually (though not exclusively) April is the annual maximum water level at locations where seasonal cycles in evapotranspiration mediate water levels. Although the methods used to produce these maps leave some uncertainty in the water table depth at any particular location, they provide a useful regional picture of how the water table has varied since the mid-1980's. This information is used by the Water Department to relate changes in groundwater levels to changes groundwater dependent vegetation conditions. Figure 1a shows the difference between depth to water during the baseline period (1985-1987) and depth to water in 1991. Figure 1a represents the most depressed water levels since the baseline mapping period, and extensive areas below baseline due to drought and pumping are evident. 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 2005. Figure 1c represents recent water table conditions relative to baseline water levels. LADWP production wells are generally arrayed along the western edge of the valley floor (indicted in Figures 1a-c as black dots), because situating wells on the west edge of the valley places them upslope of the LA Aqueduct in favorable aquifer material.

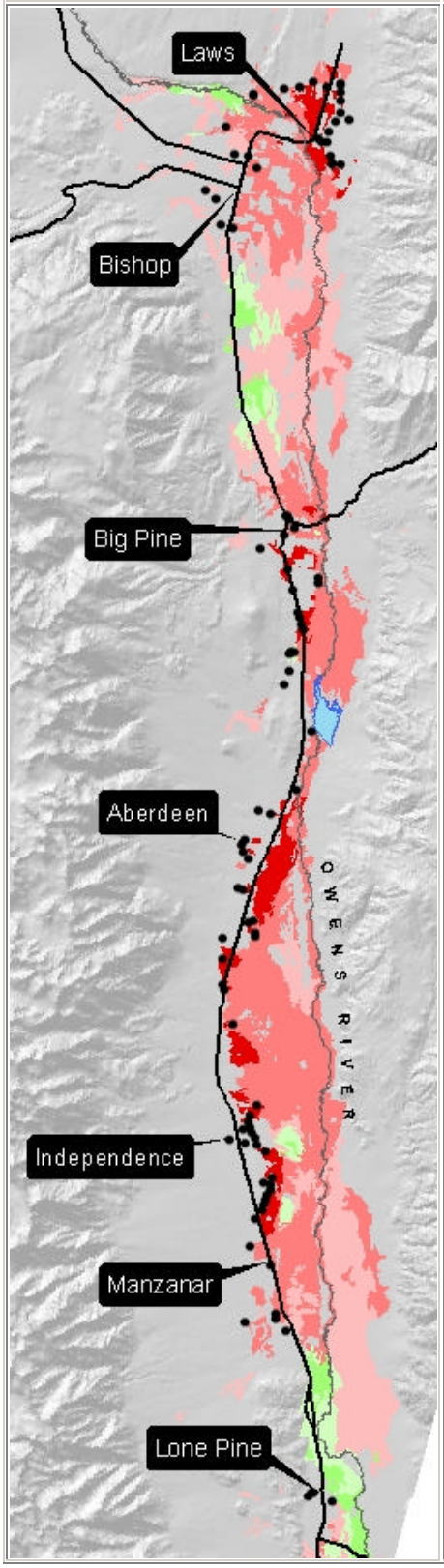
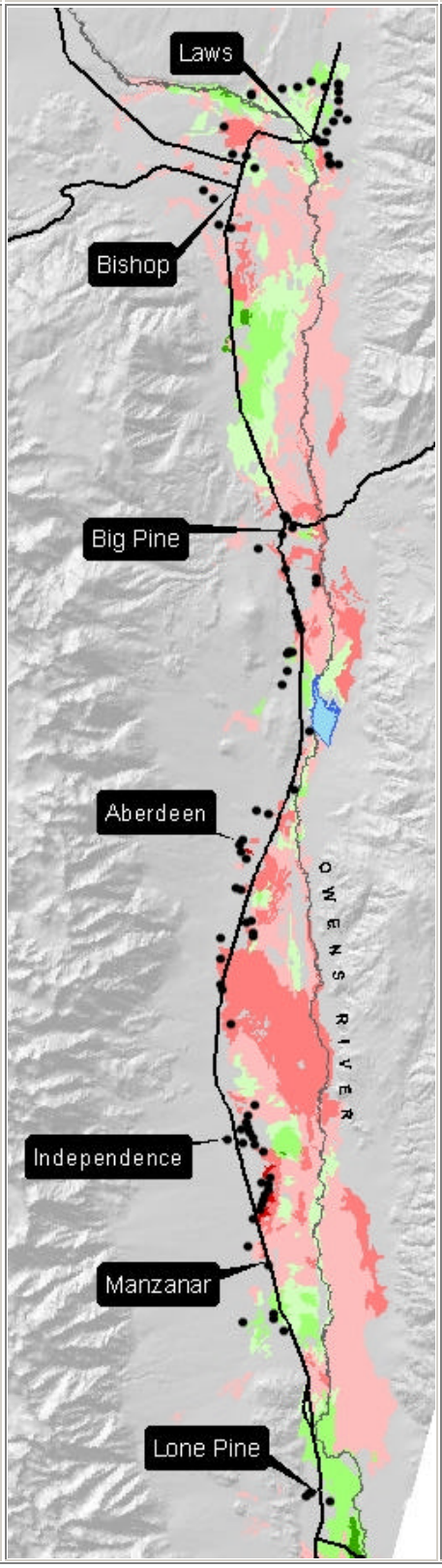
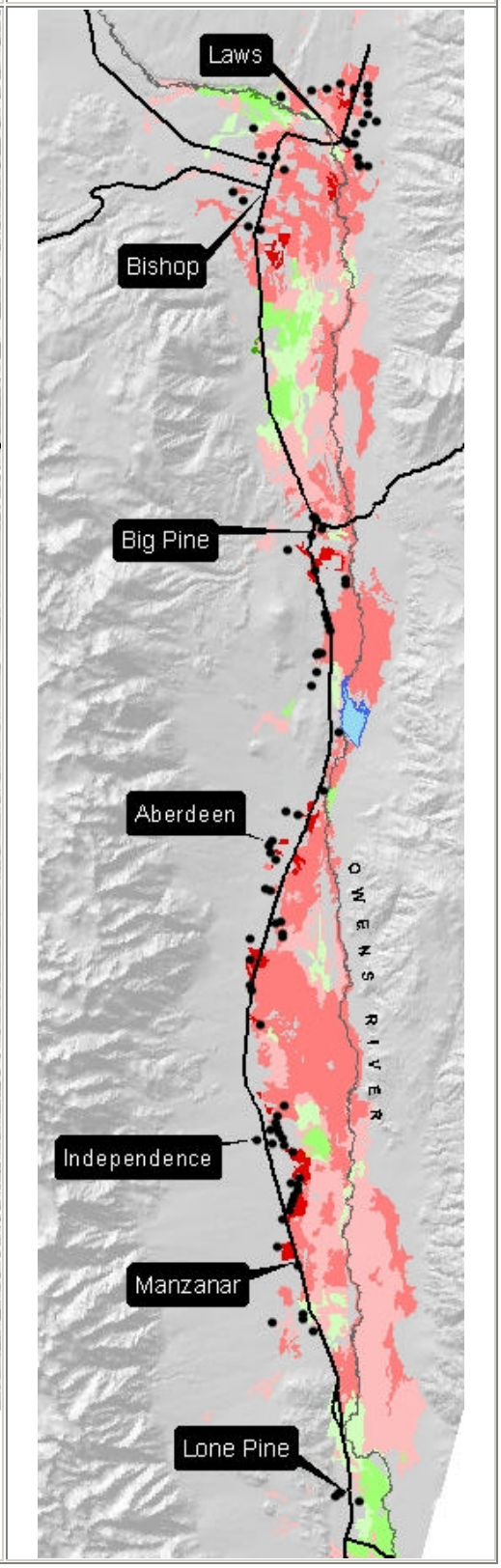
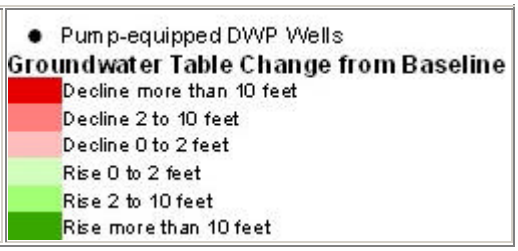
Figure 1a. Baseline to 1991	Figure 1b. Baseline to 1999	Figure 1c. Baseline to 2005
		

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 1987-1991; 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, the areas that remain the most below 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 resulted in declining water levels until 2004; high runoff during 2005 resulted in some recovery, however many areas still remain below baseline (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 forty feet below baseline between the mid-1980's and 1991 (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 reduced pumping and 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 2005-2006, which provided much needed recharge in the Laws area and produced the rise in the water table apparent in well T492.

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 3). 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).

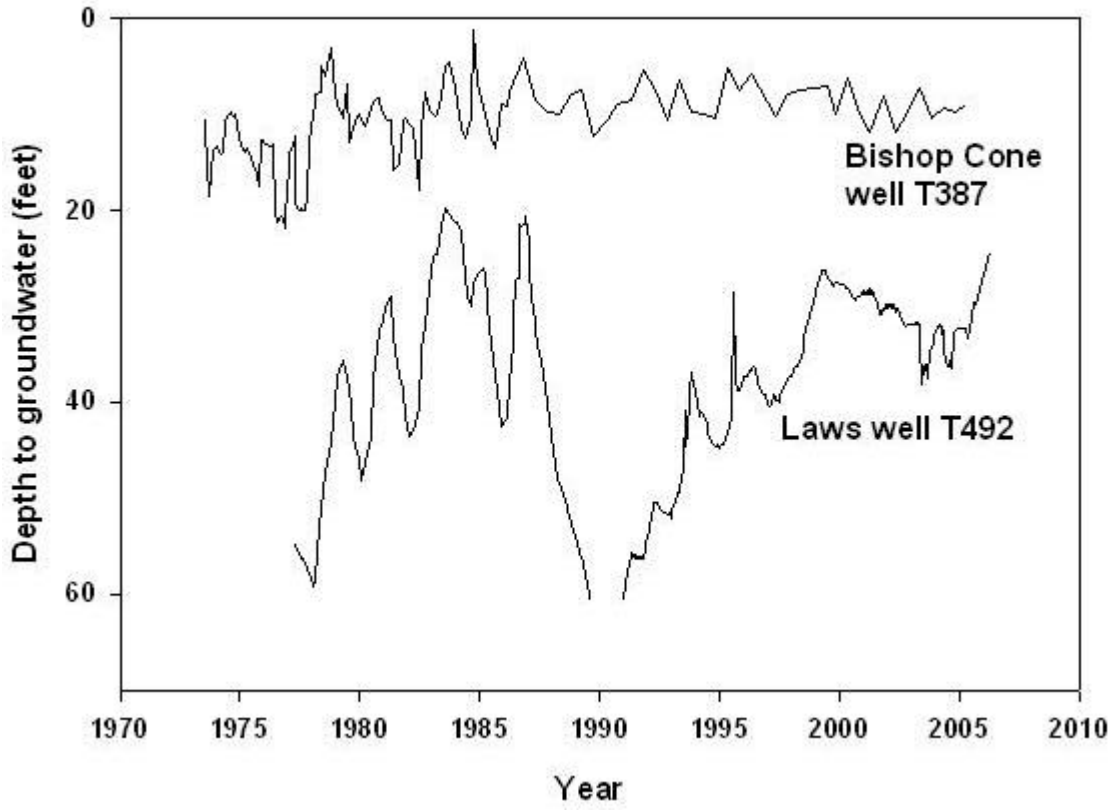


Figure 2. Water level hydrographs from a well in Laws (T492) and Bishop (T387). Water levels in Laws vary due to pumping and intermittent recharge from surface water spreading; water levels in Bishop are maintained relatively constant by the buffering effect of the network of surface water conveyances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

The Big Pine wellfield has historically been subject to high levels of groundwater pumping by LADWP for the Fish Springs Fish Hatchery. 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, a gradual decline since the late 1990's, and recovery during 2005 and 2006 (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 on the alluvial fan in the western part of this wellfield; when operated at full capacity these wells cause drawdown beneath phreatophytic vegetation on the valley floor. 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 water table in this wellfield shows large pumping-induced fluctuations where it is not buffered by surface water conveyances such as the LA Aqueduct and Blackrock Ditch.

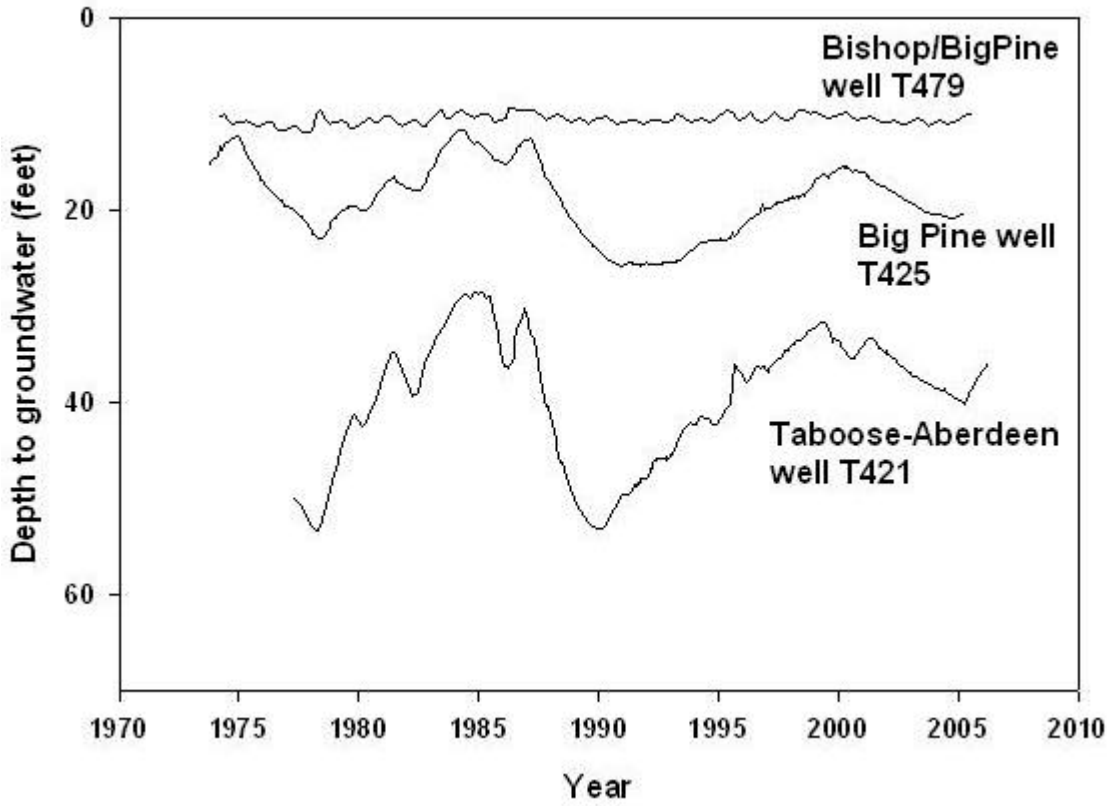


Figure 3. Water level hydrographs from a well between Bishop and Big Pine (T479), a well south of Big Pine (T425), and a well in the Taboose-Aberdeen wellfield (T421). T479 is far from pumping wells, whereas T425 and T421 are affected by pumping.

The Independence-Oak wellfield is subject to sustained pumping due to a large number of wells that are 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 amount of water pumped from the Symmes-Shepherd wellfield has varied greatly. 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 and subsequent recovery was observed in well T401 due to the operation of well W075 (Figure 4). Following the cessation of pumping from W075 in April 2005, T401 has partially recovered.

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).

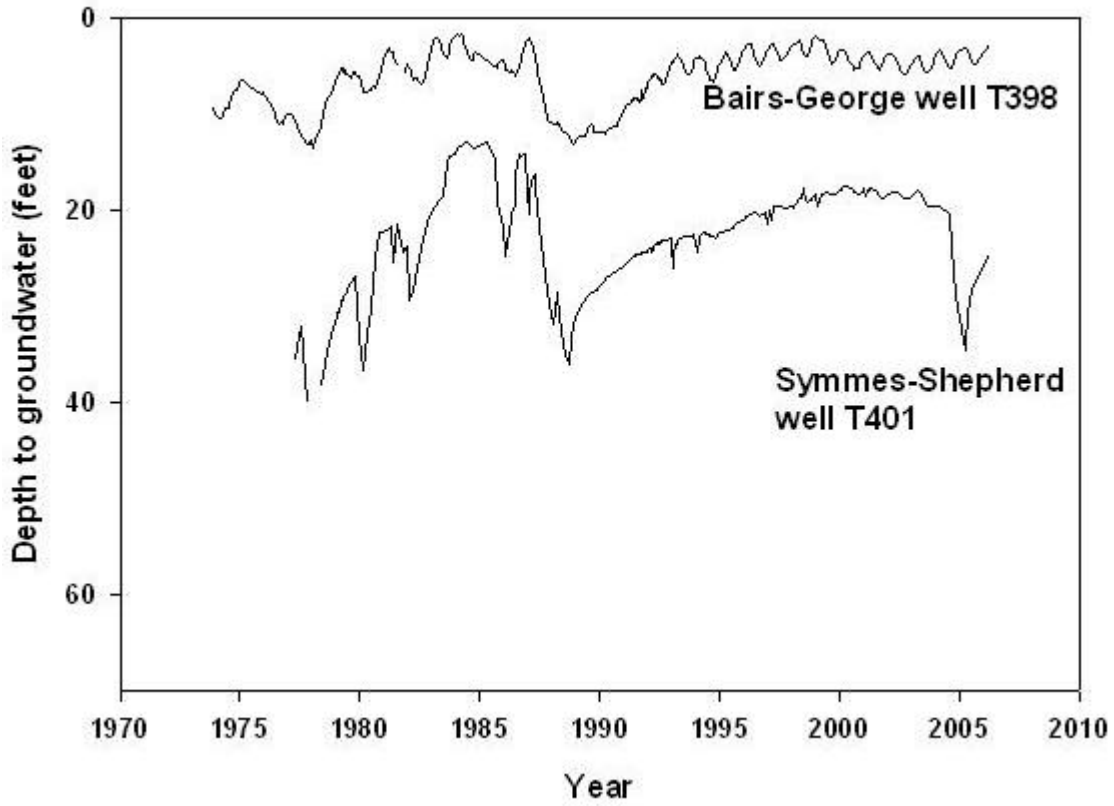


Figure 4. Water level hydrographs from a well in the Symmes-Shepherd wellfield (T401) and a well in the Bair-George wellfield (T398). The steep decline in T401 in 2004 was due to the operation of well W075.

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

Precipitation

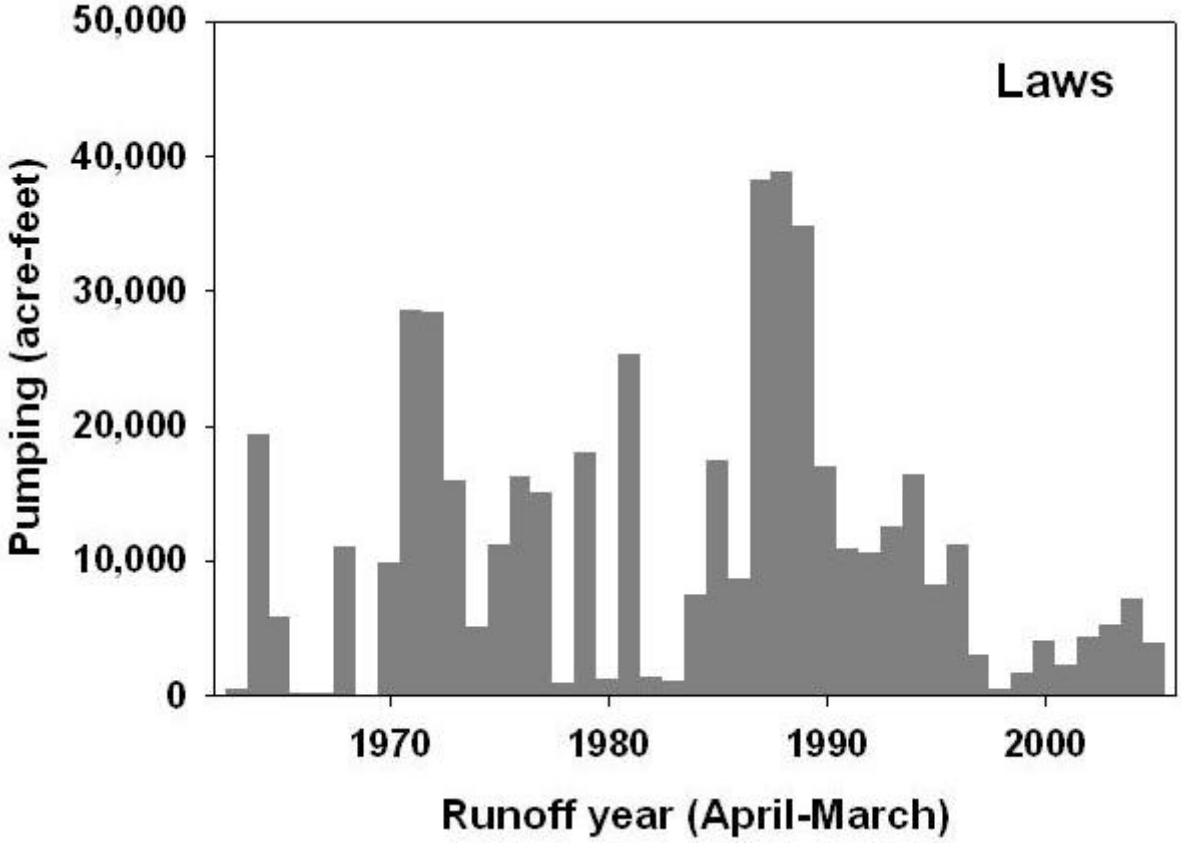
Inyo County Water Department has collected precipitation data at seven rain gauges in Owens Valley since 1993. Precipitation totals for Water Department rain gauges appear in Table 1. For the 2005 water year (beginning October 1, 2004, and ending September 30, 2005), precipitation measured at the gauges averaged 9.2 inches, making the 2005 water year the wettest in our short period of record.

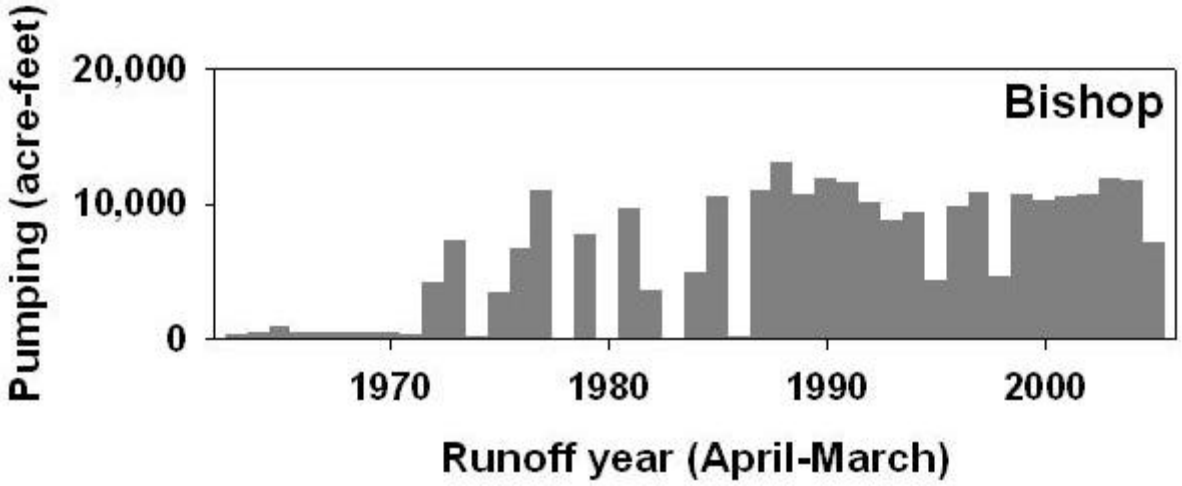
Table 1. Precipitation (in inches) measured in ICWD rain gauges by water year (October 1 of the previous year through September 30 of the year noted).

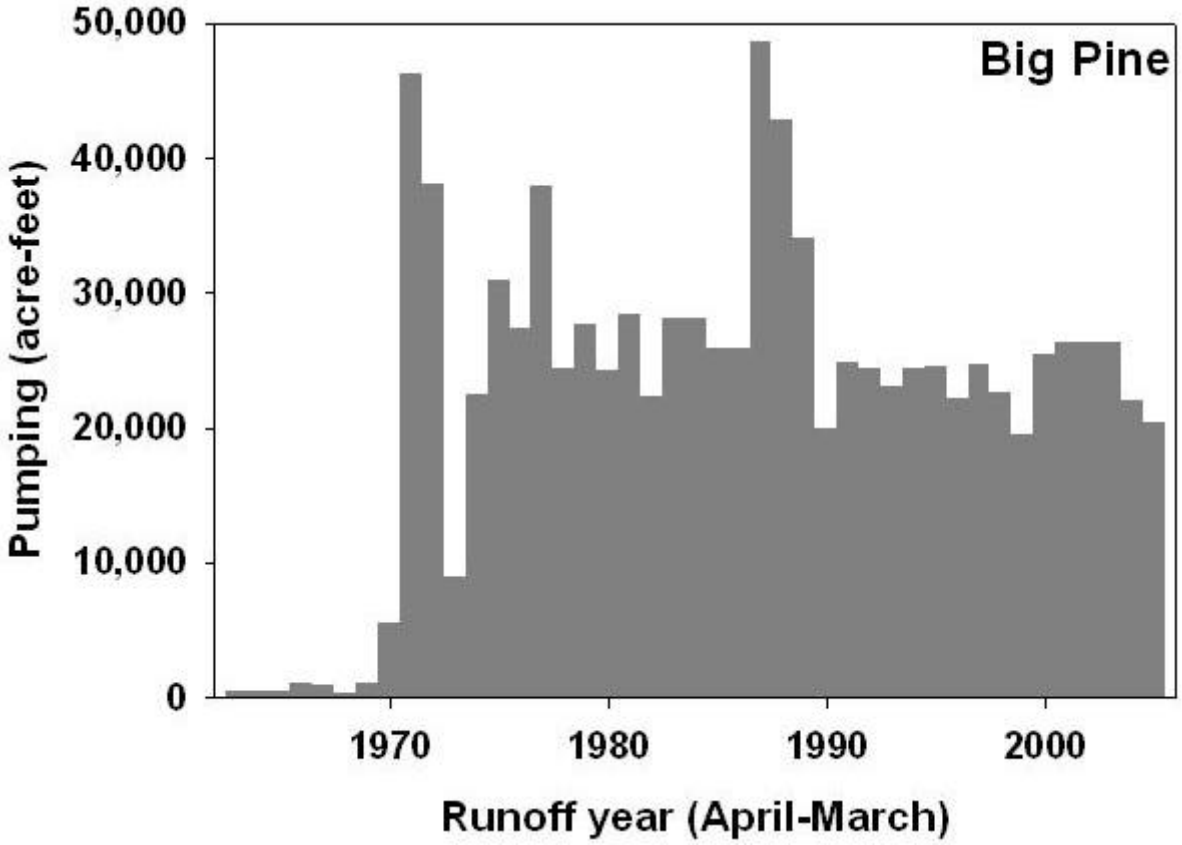
Gauge	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
RG-1, east of Fish Slough	5.94	3.40	7.60	4.51	4.66	6.09	1.82	1.32	2.26	0.86	5.41	2.75	8.65
RG-2, near Laws	6.29	3.62	7.80	4.55	4.91	7.34	2.50	1.73	3.27	1.28	5.49	2.96	11.13
RG-3, 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	9.96
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	9.35
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	7.94
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	11.38
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	5.88
Rain Gage 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**	**9.18**
Avg. 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**	**7.74**
percent in winter	98.70	56.70	86.60	88.80	73.00	74.00	73.90	65.70	79.90	90.40	92.70	92.40	84.30

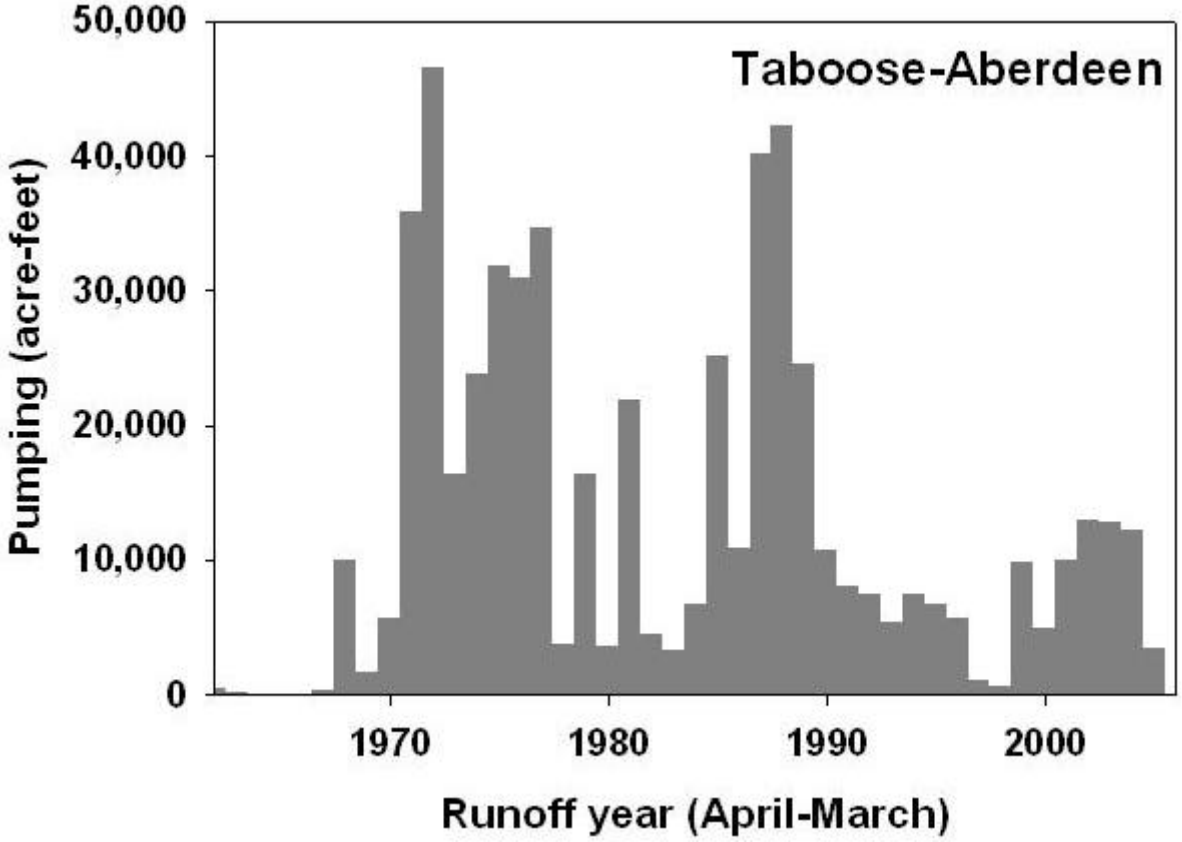
Wellfield Pumping

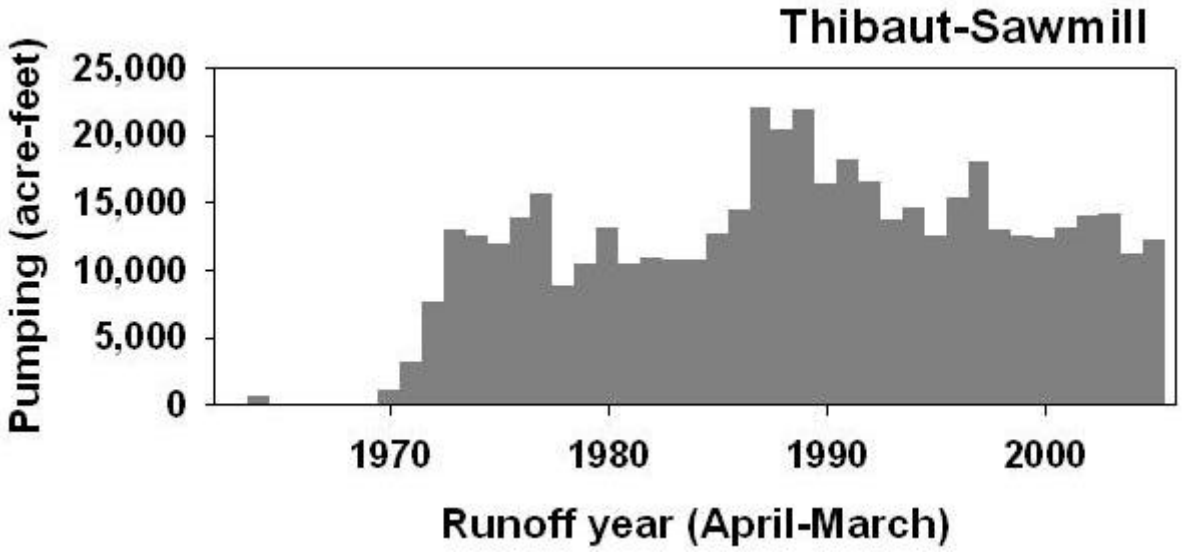
Below are graphs showing groundwater pumping by wellfield for Runoff Years 1960-2005 in acre-feet. The 'Y' axes on the graphs are a constant scale, providing an accurate comparison of pumping between the various wellfields. A Runoff Year is April of any given year through the following March.

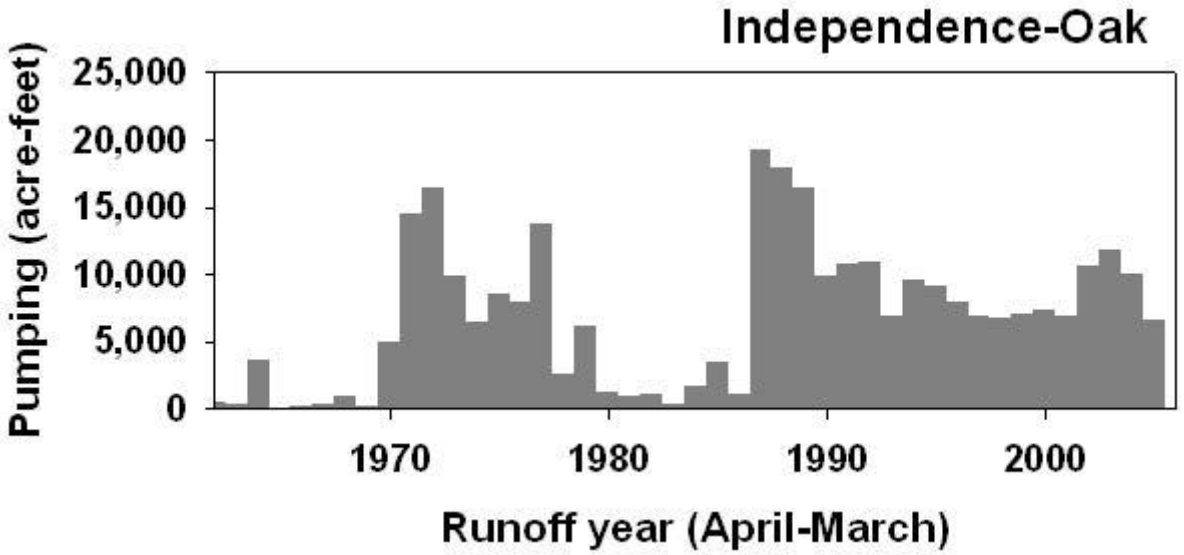


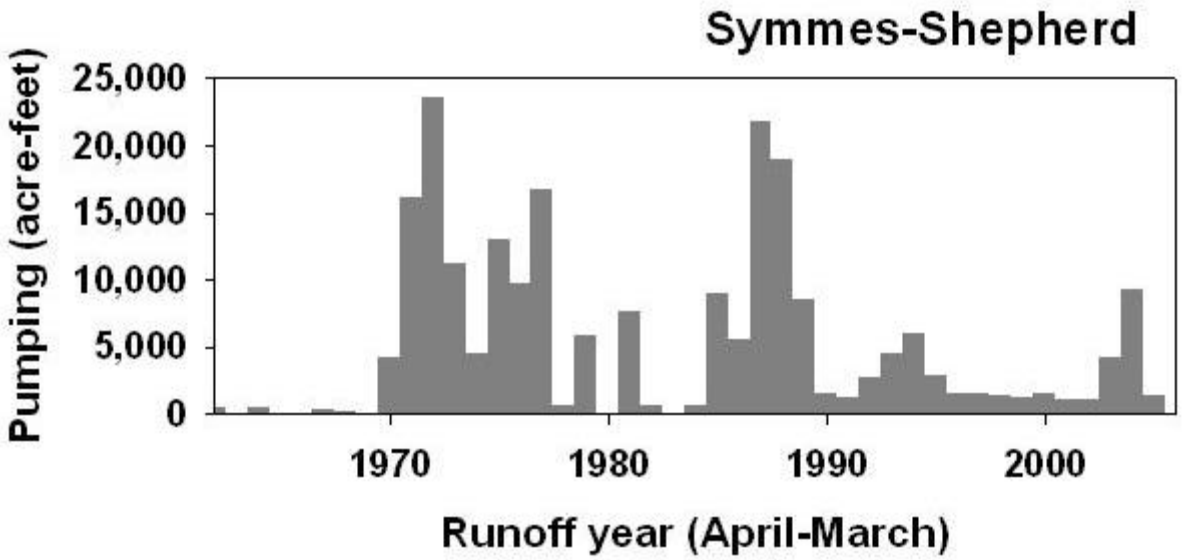


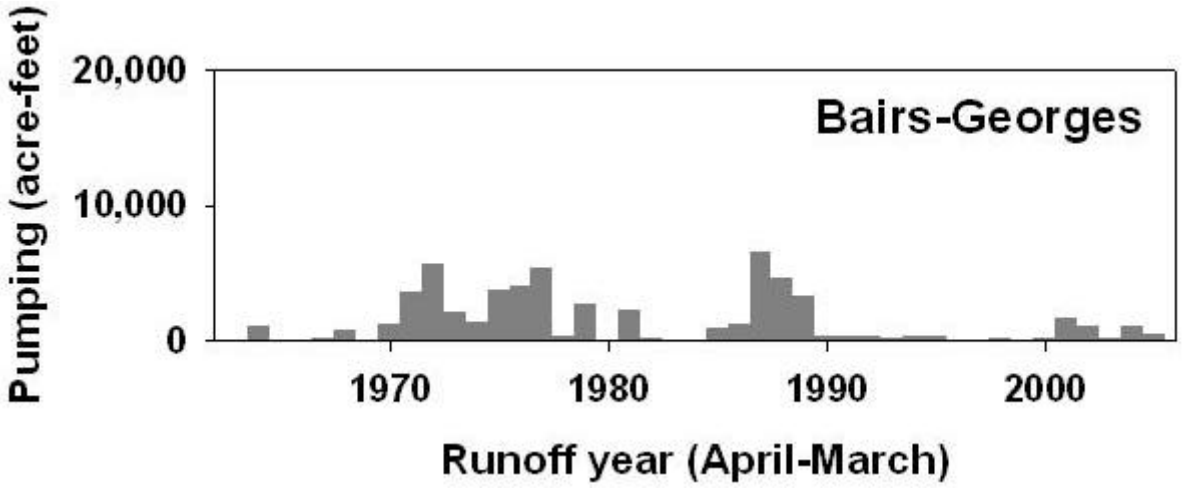

Big Pine
Pumping (acre-feet)
50,000
40,000
30,000
20,000
10,000
0
1970
1980
1990
2000
Runoff year (April-March)

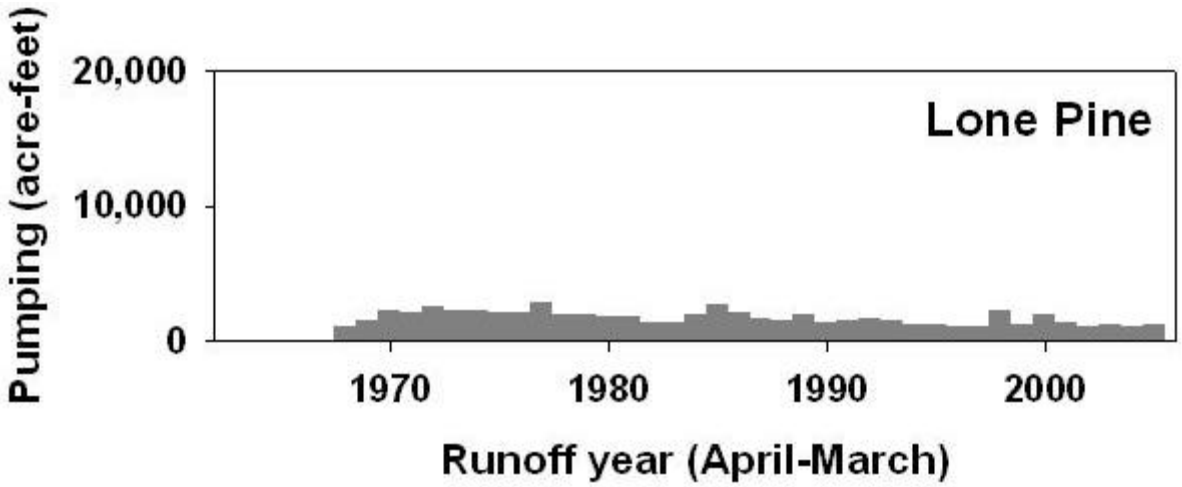

Taboose-Aberdeen
Pumping (acre-feet)
50,000
40,000
30,000
20,000
10,000
0
1970
1980
1990
2000
Runoff year (April-March)


Thibaut-Sawmill
Pumping (acre-feet)
25,000
20,000
15,000
10,000
5,000
0
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)


Pumping (acre-feet)
20,000
10,000
0
Bairs-Georges
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)

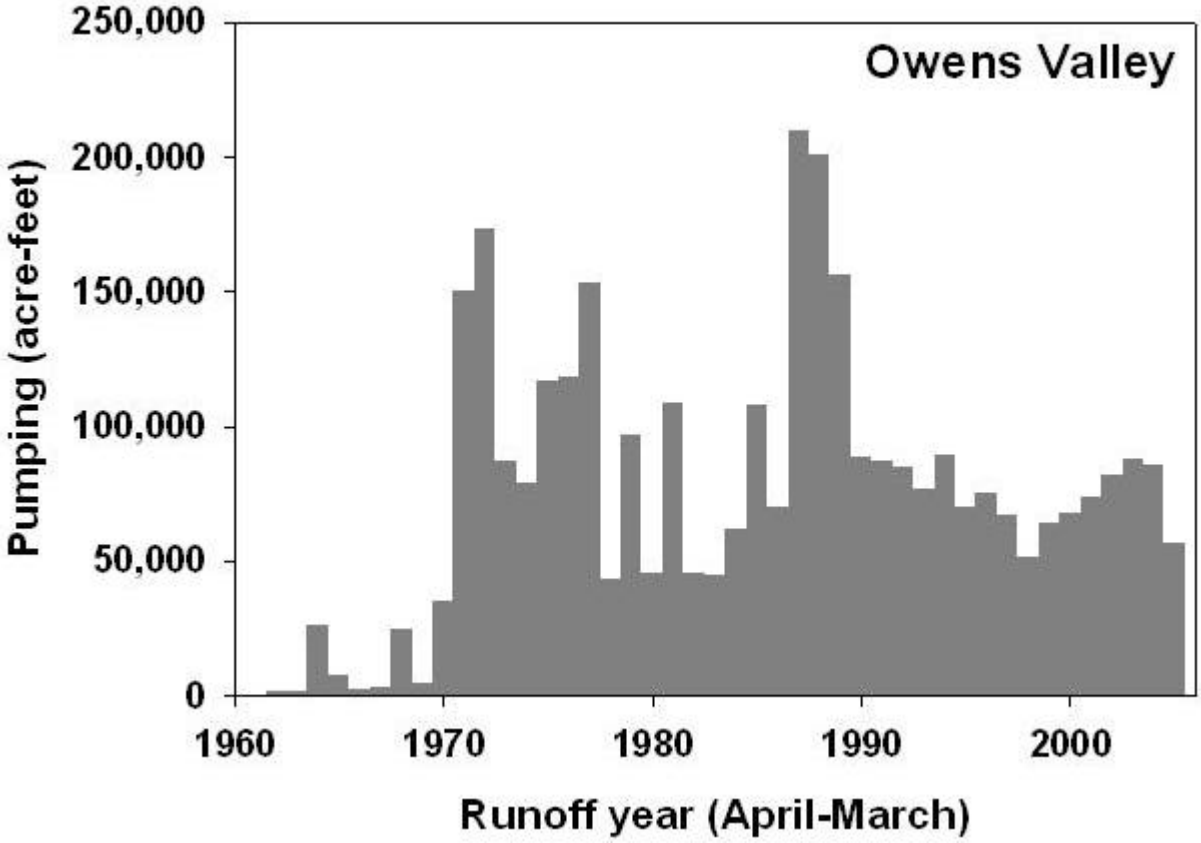
Valley-wide Pumping

Groundwater Pumping by wellfield, Runoff Year 2005 (acre-feet)*

LAWS	3,909
BISHOP CONE	7,183
BIG PINE	20,315
TABOOSE-ABERDEEN	3,422
THIBAUT-SAWMILL	12,248
INDEPENDENCE-OAK	6,657
SYMMES-SHEPHERD	1,414
BAIRS-GEORGES	486
LONE PINE	1,141
Total	**56,775**

DWP Pumping Well W410, north of Dixon Lane, Bishop

Below is a graph showing Owens Valley groundwater pumping by Runoff Year from 1960-2005



*Runoff Year 2005 is April 2005 through March 2006

2005 Vegetation Conditions

Status of Groundwater Dependent Vegetation with Regard to the Drought Recovery Policy
by Sally Manning, Vegetation Scientist, May 2006

The Inyo County Water Department (ICWD) continues to monitor vegetation conditions to identify and evaluate changes that may be caused by water table fluctuations. During 2005, ICWD staff collected data on 70 vegetation parcels that, since the late 1990s, have been monitored to track progress in achieving the goals of the Drought Recovery Policy (DRP). To assess vegetation conditions in these parcels, ICWD compares data collected in the field during the current year with data collected by LADWP during the baseline vegetation inventory and mapping period (1984-87, exact time dependent on location in the valley). Both ICWD and LADWP employed the "line-point" transect technique to characterize parcel vegetation. However, because ICWD aims to achieve an unbiased representation of current vegetation cover and species composition throughout the entire area of the vegetation parcel, ICWD randomly locates the transects using a sophisticated GIS application in conjunction with GPS, and ICWD runs several more transects than were employed by LADWP during the mid 1980s.

ICWD devised criteria for annually classifying parcel status with regard to the DRP (see for example, Inyo County Water Department staff 1999; Manning 2002; Manning 2006). The criteria incorporate the critical components of the DRP, which calls for an evaluation of water table depth, degree of water table recovery, soil moisture and type, vegetation conditions, and information on vegetation recovery, prior to establishing each year's annual pumping program. The goal of the DRP was to recover enough water within the phreatophytic root zone to protect the vegetation and avoid decreases and changes. Each year, ICWD collects data, then analyzes its data along with other available data to assess conditions with regard to DRP guidelines. For each vegetation parcel, current vegetation conditions and recovery to baseline perennial cover levels are assessed. ICWD uses LADWP data on depth to water table to derive an estimate of average water table depth beneath each parcel as well as degree of water table recovery to levels which occurred during the baseline period. Soil water content is measured many times per year at the 33 permanent monitoring sites in the valley. These measurements have provided insights into the mechanisms by which the quantity of water necessary for vegetation health is replenished from rising water tables and, to a lesser extent, precipitation. However, it is not possible to quantify available soil water at the much larger vegetation parcel scale. Because the DRP calls for recovery of soil water within the vegetation root zones -- 2m for grass-dominated and 4m for shrub-dominated parcels -- depth to water table, degree of water table recovery, and evidence of vegetation recovery (i.e., an increase in perennial cover) in conjunction with measured water table recovery are used as a surrogate for assessing the amount of water available to parcel plants.

The 70 parcels monitored in 2005 were all originally characterized as being dominated by groundwater dependent species. After applying the DRP criteria, each was classified into one of the following DRP categories:

LOCATION	STATUS	DEFINITION
Outside of wellfield	Control	Not affected by pumping during the 1987-1992 drought
Inside of wellfield	DRP	Affected by pumping during the 1987-1992 drought and still not recovered in terms of water table and total perennial plant cover
	DRPfree	Affected by pumping during the 1987-1992 drought, but judged to have recovered in 1996 or after in terms of water table and perennial plant cover

Between 1995 and 2001, conditions in some wellfield parcels met the criteria ICWD devised for release from management constraints of the DRP. Since 2001, however, water tables have generally

declined beneath Owens Valley wellfields, and as a result, no additional parcels have been designated DRPfree in recent years. As of 2005, 29 of the 70 monitored parcels were still assigned to the DRP category (that is, never recovered); 21 were DRPfree; and 20 of the 70 served as Control parcels.

Total perennial plant cover in the 70 parcels was calculated for 2005 and compared with baseline levels. Perennial cover is evaluated with regard to precipitation and water table conditions. During the 2005 water year, valley floor precipitation exceeded average (see related article). From 2004 to 2005, water tables generally rose somewhat in Control areas but remained stable or declined in wellfield areas. Average perennial cover relative to baseline is graphed in Figure 1.

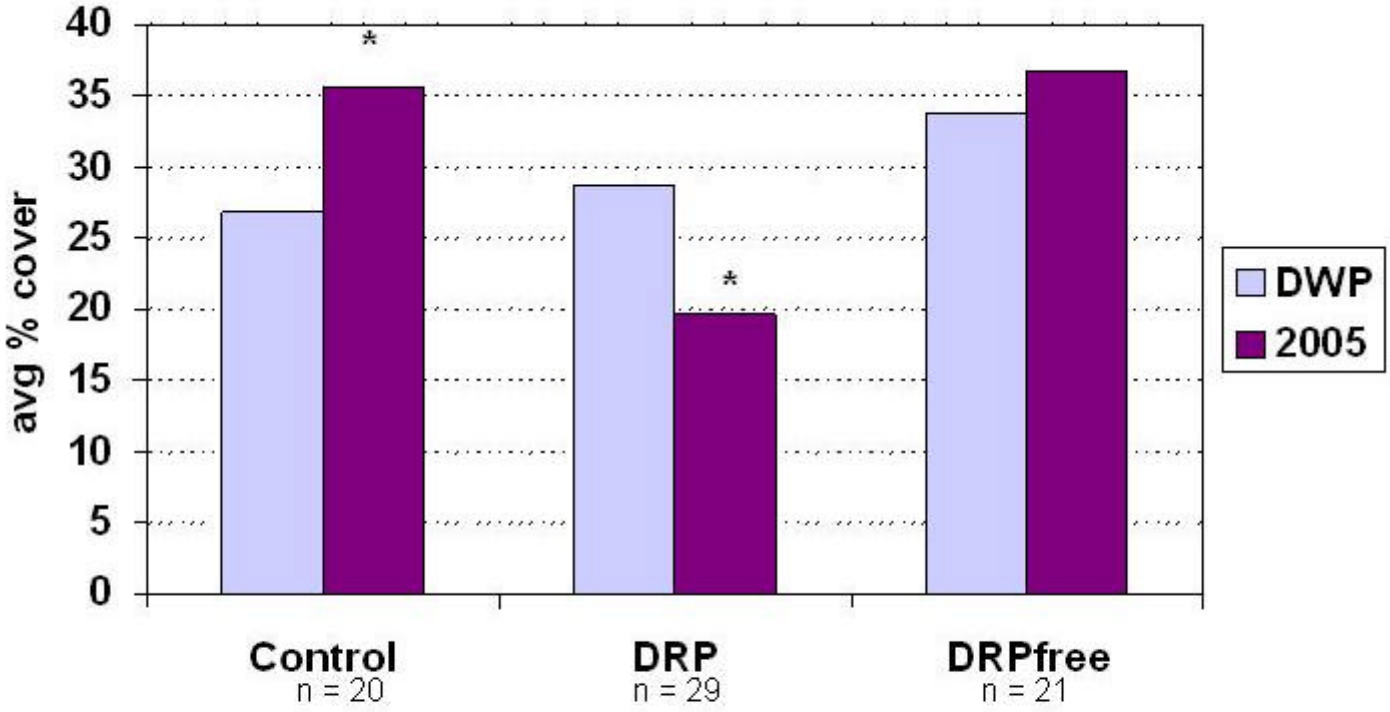


Figure 1. Average perennial cover during the baseline period versus 2005 for 20 Control, 29 DRP and 21 DRPfree parcels. Asterisk shows a statistically significant change ($p<=0.05$) between baseline and 2005 according to a dependent t-test.

Within the three groups, results for 2005 were consistent with cover trends since 1991 and with expected vegetation responses to changes in hydrologic conditions.

Control Group. Average cover in the Control parcels exceeded baseline levels in 2005 (Figure 1). Over the period from 1985 - 2005, water tables have fluctuated minimally beneath Control parcels (Figure 2a). ICWD transect data, collected 1991-2005, have shown that, on average, perennial cover in Control parcels equals or exceeds baseline levels, and the years in which cover exceeds baseline are high-precipitation years.

DRP Group. Water tables beneath the DRP parcels were drawn down during the 1987-1992 drought. Since that time, water tables beneath these parcels have failed to fully recover (Figure 2b). ICWD

transect data, collected 1991-2005, have shown that, on average, perennial cover in DRP parcels remains significantly below baseline levels in most years. In 1995 and 1998, two high-precipitation years, perennial cover averaged for the DRP parcels equaled baseline, but in 2005 (a high precipitation year), average perennial cover for the DRP group was significantly below baseline (Figure 1). Unlike the Control group, cover in the DRP parcels has never exceeded baseline during the period ICWD has been monitoring.

DRPfree Group. Water tables beneath the DRPfree group of parcels declined during the 1987-1992 period, and, on average, made a brief recovery to baseline levels during the mid-late 1990s (Figure 2c). Since about 2000, water tables have been declining beneath these parcels. From 1998-2001, average perennial cover in the DRPfree group exceeded baseline levels. Thus, in those years, cover trend in the DRPfree parcels mimicked the pattern of the Control group relative to baseline. However, in 2002, a dry year, average perennial cover in the DRPfree group dropped significantly below baseline whereas the Control group average cover equaled baseline. Since 2001, perennial cover in the DRPfree group has been below or equal to baseline. In 2005, a wet year, average cover in the DRPfree group was statistically indistinguishable from baseline (Figure 1).

A more detailed analysis of parcel conditions, and data for each monitored parcel, can be found in "Status of re-inventoried vegetation parcels according to the Drought Recovery Policy, 2005" by Sara J. Manning, May 9, 2006.

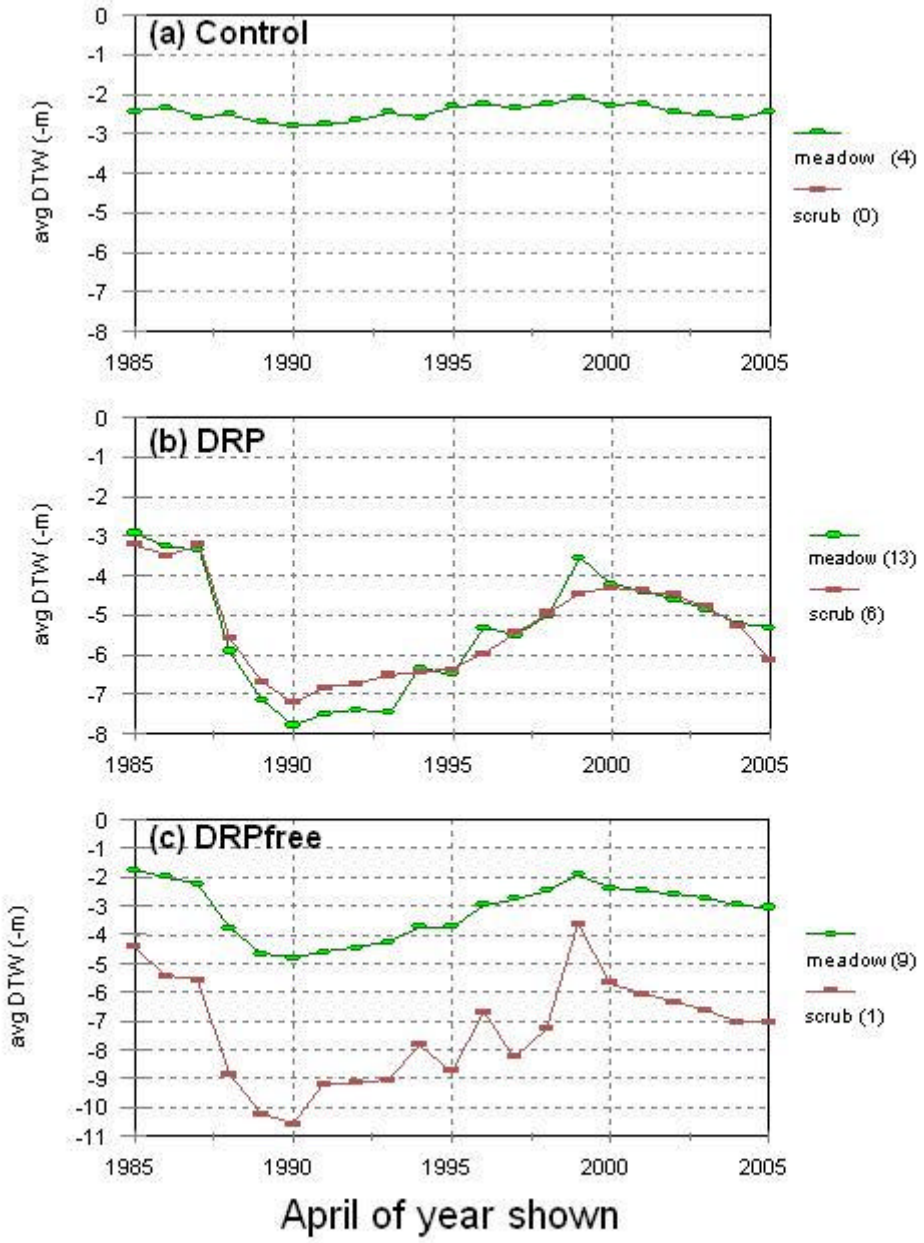


Figure 2. Parcel-scale depth to water (DTW) estimates were judged reliable all years for some of the parcels ICWD monitored in 2005 (see Harrington 2003; Manning 2006). For those parcels with sufficient reliable data, parcel DTW values were averaged for all parcels within the management groups (Control, DRP, and DRPfree) and within vegetation type (meadow or scrub). The number of parcels in each group is shown in parentheses. Failure of the DRP group to achieve full water table recovery since the baseline period may account for the finding that perennial vegetation cover was significantly below baseline in 2005 (Figure 1), even though 2005 was a high precipitation year for Owens Valley. The agreed upon rooting zone for meadow is 2m, and for scrub, it is 4m.

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Vegetation Conversion from Meadow to Scrub

by Sally Manning, Vegetation Scientist, May 17, 2006

Management of water resources according to the Water Agreement is supposed to be performed in a manner that avoids causing vegetation classified as type C to degrade into vegetation that could be classified as type B (or A). Stated more simply, a change in vegetation from grass-dominated meadow to shrub-dominated "scrub" is considered to be a significant adverse change if it results from inappropriate management of Owens Valley water resources. Recently, an analysis of vegetation data collected by the Inyo County Water Department (ICWD) revealed that conversion from meadow to scrub had occurred or was in the process of occurring in many parts of Owens Valley. The analysis also showed that actual conversion and higher rates of conversion were occurring in wellfields, especially wellfield areas where water tables and perennial plant cover had not recovered to baseline levels since the 1984-87 baseline period (see related article). An analysis of shrub conversion is documented in "Conversion of reinventoried parcels from meadow to scrub" by Sara J. Manning, January 9, 2006. Here, a synopsis is presented.

Determining whether a parcel should be categorized as "meadow" or "scrub" requires some definitions of terms. The LADWP comprehensive baseline inventory and mapping of vegetation, which took place 1984-87, distinguished meadow, scrub, and an intermediate plant community type identified as "shrub-meadow." Meadow and shrub-meadow were typically classified as type C (phreatophytic meadow), and parcels dominated by phreatophytic shrubs but with little or no grass cover were typically classified as type B. An investigation into the original baseline transect data showed that a threshold between type C meadow and type B scrub could be quantified. A clear dividing line between type C meadow and type B scrub occurred when the proportion of shrubs within a parcel, relative to the total cover of grasses plus shrubs, equaled or exceeded 0.8. If one were to view the vegetation from above, at a shrub proportion of 0.8, one would see that, of the area covered with living plants, 20% would be grass and 80% would be shrub. Shrubs actually "dominate" the parcel when a proportion of 0.5 is exceeded, but to cross the line from meadow through shrub-meadow into scrub, the shrub proportion (according to the baseline data) needs to be 0.8.

The 0.8 threshold was applied to the data from meadow parcels monitored in 2005. It was determined that, of the 50 type C meadow parcels, 12 had converted to scrub in 2005 (or before) because the proportion of shrubs equaled or exceeded 0.8. An additional 12 meadow parcels showed a statistically significant trend in increasing proportion of shrubs over time, but by 2005 had not yet crossed the threshold. Nearly all meadow parcels showed a higher proportion of shrubs in 2005 relative to baseline.

Water management practices since the mid 1980s can account for the conversion from meadow to scrub. Only one Control parcel (unaffected by groundwater pumping during 1987-92 drought) showed a conversion from type C to type B between the baseline period and 2005 (Table 1). This parcel, PLC106, has faulty baseline data: All available information strongly suggests the parcel existed as a type B scrub during the baseline period, not a type C meadow as assigned by LADWP in the parcel's final baseline classification. In contrast, more than 40% of the parcels still subject to the management constraints of the Drought Recovery Policy (DRP, see related article) converted from meadow to scrub, and they had an overall higher annual rate of increase in shrub proportion. A few wellfield parcels classified as generally recovered from the 1987-1992 drought (i.e., "DRPfree" = free from the constraints of the DRP) had converted from type C to type B. Overall, results for DRPfree parcels were somewhat intermediate between results for Controls vs results for DRP parcels (Table 1).

Table 1. Some summary statistics for type C meadow parcels (meadow and shrub-meadow, combined) monitored in 2005 and their conversion to type B scrub as of 2005.

characteristic	Control	DRP	DRPfree
# type C meadow parcels	15	18	17
# (of above) meadow parcels with shrub proportion > 0.8 in 2005	1*	8	3
# meadow parcels with shrub proportion > 0.5 in 2005 (includes above)	7	14	5
# meadow parcels with significant increasing trend in shrub proportion	4	11	5
avg. predicted yr for above to cross 0.8 meadow/scrub threshold	2076	2004	2034
# meadow parcels showing decline in shrub prop btw baseline and 2005	3	4	2

* = Parcel PLC106 (see text)

Overall, the results of this analysis suggest that withdrawal of the water table without subsequent full water table recovery greatly accelerates the conversion of meadow to scrub. To avoid causing the accelerated rate of conversion within wellfield meadow parcels, management to allow full recovery of water tables to grass root zones is probably required.

The occurrence of wildfire was also examined to the extent allowed by this data set. Fire often kills shrubs. When a meadow parcel with a high water table burns, the existing perennial, native grasses resprout soon after the burn, but it typically takes many years for shrubs to re-establish to pre-burn levels. When sites without access to the water table burn, vegetation cover is lost, and non-native annual weeds or other non groundwater dependent species may subsequently invade the site. Therefore, periodic burning has the effect of limiting shrub encroachment in relatively healthy meadow sites, but it can have devastating consequences for sites where hydrologic conditions have been altered. Of the 68 parcels evaluated in this investigation, it was found that 12 had burned in the past two decades. Using this approximation, it could be estimated that a parcel has a chance of burning once about every 115 years. If the fire frequency rate is on the order of 115 years, it is unlikely that Control parcels, at the conversion rates calculated here, will achieve complete conversion, because the shrub cover is likely to be set back by fire long before the 0.8 threshold is reached. If vegetation in a wellfield parcel burns while it has access to the water table, it might show recovery to more meadow-like conditions. However, if the parcel has converted or is on the verge of converting to scrub, and access to the water table is minimal or negligible, fire will probably convert the parcel to bare ground and/or a sparse cover of non groundwater dependent species. In summary, fire may promote maintenance of type C meadow when the site's hydrology has not been compromised. In contrast, a meadow site without adequate water table conditions is at risk of being permanently destroyed should a fire occur.

Saltcedar Control Update

by Brian Cashore, Project Manager

In its eighth season of cutting tamarisk in the Lower Owens River channel, Inyo County Water Department's Saltcedar Crew reached the shore of Owens Lake. While more saltcedar work lies ahead in the delta and other Owens Valley sites, it's worth pausing to reflect on the Saltcedar Program's number one priority: The Lower Owens River Channel. The channel contained the densest and most extensive populations of Owens Valley saltcedar. These dated back to 1969, when El Niño water spreading activities created conditions highly favorable to the opportunistic homestead tamarisks growing in the valley at that time.

This season's ten-person crew began at river-mile 27, south of Mazourka Canyon Road, in November and finished at mile 55, at the pump-back station, in March. Field conditions varied from thick walls of saltcedar to open, riverside meadows that required long strolls carrying our chainsaws and other equipment. The largest concentration of trees were encountered below Alabama Gates. Some of the largest saltcedars cut in the valley were growing in this area. More off-river trees remain there for future crew work.

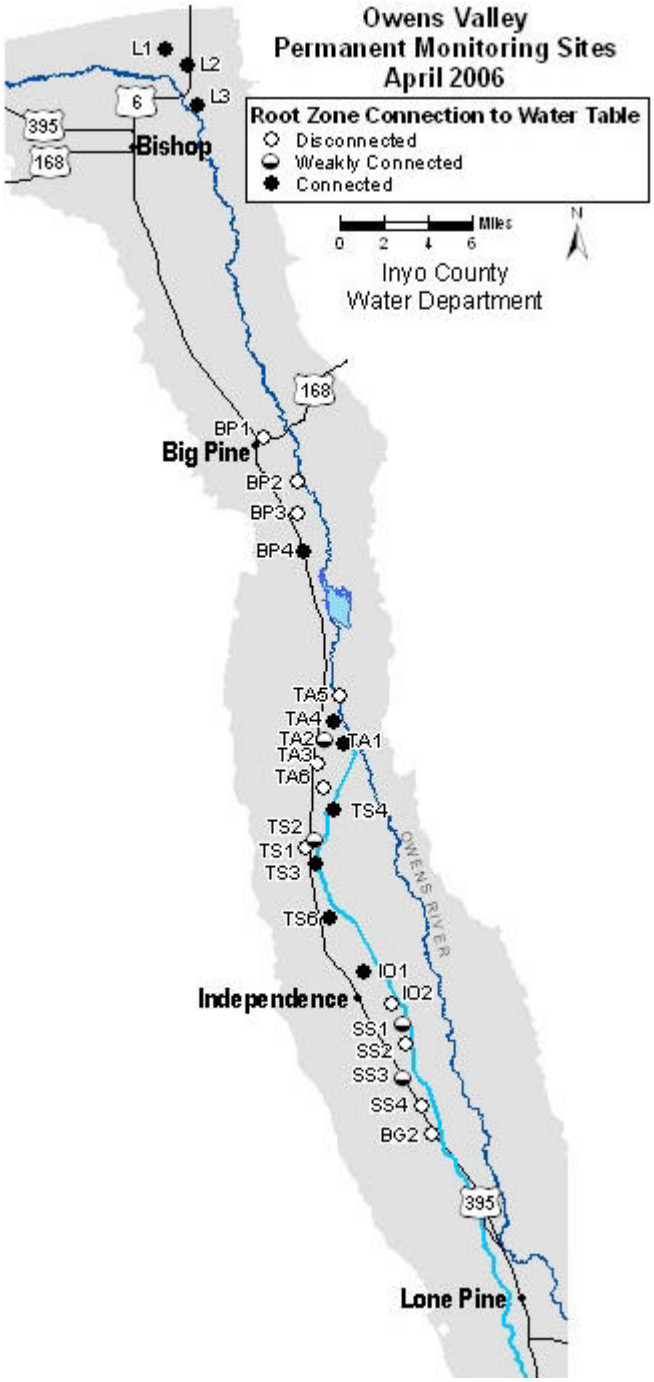
This season marks the last of our California Wildlife Conservation Board grant funding that has been supporting the program since 2002. Matching funds from LADWP will keep the saltcedar program moving in the near future. Additional grants will be necessary to continue a valley-wide program. Other than maintenance and follow-up monitoring of Lower Owens River work sites, future saltcedar control activity will be focused on tributaries, nearby seed sources, and spreading-basin populations. Different tools and strategies such as biocontrol and mechanical techniques may be incorporated into the control of upland, non-riparian saltcedar populations.

The 'Blue Crew' 2005-2006:

Soil Water Conditions

by Aaron Steinwand, Soil Scientist

The Water Agreement established procedures to determine which LADWP pumping wells can be operated based on soil water and vegetation measurements. Staff from ICWD regularly 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. Seven sites changed from On to Off status in July and October 2005. The large number of sites changing to Off-status is not unusual during a period of declining water tables and following a winter with ample rainfall on the valley floor. In October, only three sites were in On-status, the lowest number since the Green Book program was initiated in late 1989. These three sites along with the wells not subject to the Green Book management had an annual pumping capacity of approximately 110,500 ac-ft. Four sites entered On-status during the winter 2005-06 due to the combination of water spreading, above-average precipitation, and rising water table. Annual pumping capacity allowed by the Green Book in May, 2006 was approximately 137,000 ac-ft.



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 based on an incomplete accounting of the components of the soil water balance, however. 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 identify the monitoring sites where the root zone is connected with the water table to give a clearer picture of the conditions underground that are affected by pumping. We rely on both 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. For 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 (2 m); shrub sites are assigned a root zone of 13.1 feet (4 m).

The wellfield monitoring sites (including three that are monitored but not used for pumping management) were grouped into simple categories to summarize the connection between the root zone and the water table. Brief descriptions of the three categories are given below. Nearly all wellfield sites have an intermediate zone where soil water contents change very little that separates lower depths affected by water table from upper depths affected by infiltration. Infiltration for several sites often extends to about 40 inches (1 m) deep which is the middle of the root zone in grass-dominated sites. In years like 2005-06 with above normal precipitation and rising water tables, it can be difficult to identify the source of water when infiltration and capillarity above the water table overlap. Most sites in the coupled and weakly connected category have relatively moist soil throughout the profile at the beginning of the 2006 growing season.

1. Disconnected: No recharge from lower depths is occurring in the root zone. Eleven sites occur in this category. Sites TA5 and BG2 have retained soil water available to plants. 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. Three sites occur in this category.
3. Connected: Water table fluctuations cause soil water changes in the top half of the root zone. Ten sites occur in this category. Water spreading in Laws and Thibaut-Sawmill wellfields in particular produced sufficient water table rise to wet the soil at several monitoring sites into the upper parts of the root zone.

The above average runoff and associated water spreading along with greatly decreased pumping in 2005-06 caused water table increase at all but two monitoring sites. Consequently, the number of sites where soil water responds to water table fluctuations has increased. As of May 2006, the water table was supplying water to the root zone at fourteen monitoring sites located in wellfields (see map). This compares to about eight sites last year. Soil water at eleven sites did not increase at depth after plant transpiration ceased in the fall 2005 and/or did not respond to rising water tables during the winter suggesting that the water table and root zone were disconnected.

Status of Mitigation Measures

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.

Calvert Slough Mitigation Measure, April 28, 2006 (at right)

	Mitigation	Mitigation Measure	2005 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.	This project consists of two pastures. One pasture is adjacent to and east of Hwy. 6 (160 acres). In the past, only the eastern half of this pasture has been effectively irrigated. The other pasture SE of Laws (60 acres) has not appeared to be fully irrigated in the past. Plant cover was poor, grasses were mainly limited to ditches, and weeds were prevalent. Management of the lease for these pastures changed recently, thus a site visit will be conducted in 2006 to assess plant cover. LADWP did not separate the water use for this project from the McNally pasture projects for 2005-2006 runoff year, therefore combined water use reported for the Laws/Poleta native pastures and the McNally pastures was 1,269 acre-feet in the 2005 runoff year.
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.	This project consists of ponds, a 100 acre native pasture east of the ponds, and two pastures (100 acres each) SE of the Laws museum. Ponds west of Hwy 6 received 1,522 acre-feet of water in runoff year 2005. LADWP has reported that management of this project includes supplying water to the ponds only when water is diverted from the Owens River to the McNally Canals. This management

			change has not been discussed with or approved by the Standing Committee. The 100-acre pasture had poor cover at the time of a field visit in 2004. Pastures on the east side of the river are completed and provide good grass cover. LADWP reported in 2005 that the water supply to this project and the Laws/Poleta project cannot be separated.
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 of this potential 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. Portions of the mitigation plan are being implemented; however, management changes have been made to some provisions without Technical Group approval. Providing a regular supply of surface water to the site has increased cover in some areas. The area north of the river appears to have declined in cover and requires attention. This area was not addressed in the mitigation plan.
5	**Farmers Pond**	Provide wet habitat by maintaining operation of seasonal pond.	Implemented and ongoing. Water supply for runoff year 2004 was 596 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 study plot in 2001 in lieu of planting container plants as required in the Mitigation Plan. Results of the study were provided in Nov. 2003. In 2005, LADWP reported they expanded and planted the drip irrigation study plots. No report of the extent, species, seed source, or methods has been provided. In 2002, LADWP's contractor conducted an additional revegetation study. LADWP reported in 2005, "the results of these studies were utilized to move forward with larger scale revegetation efforts at this site." The project area has decreased in size due to the irrigation project in Laws.
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.	In progress. LADWP reported irrigation would begin in the summer or autumn of 2006.
8	**Laws area**	Monitor and reduce groundwater pumping where suspected impacts have occurred. Mitigate according to the Agreement, if necessary.	The 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 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.
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 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.
12	**Millpond Recreation Area**	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.
14	**120 acres near Bishop**	Revegetate with non-groundwater dependent native vegetation.	In progress but behind schedule. Fencing has been installed. The Mitigation Plan provided for the implementation of test plots if vegetation did not naturally increase. Monitoring results between 1999 and 2003 showed little to no increase in perennial vegetation. Therefore, the Technical Group should have developed test plots in 2004 to develop effective revegetation methods. Instead, LADWP contracted with MWH for studies 2002. In 2004, LADWP reported, "a drip irrigation system is being designed for this site" and that implementation of revegetation will commence one year after the projects at Big Pine 160 and Independence 123 are fully implemented and operating properly." No timeline is provided.
15	**Saunders Pond**	Provide wet habitat by maintaining operation of year-round pond.	Implemented and ongoing, although an operations plan needs to be developed.
16	**Klondike Lake**	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; however several management issues have not been addressed. The Technical Group began test water releases to the South Shore Habitat Area in 2005. LADWP installed a water delivery system and measuring device for the habitat area. It appears that it may not be possible to provide the allotted 200 acre-feet of water to the habitat area. The lake water allotment is not fully supplied every year and it is not clear how this impacts the habitat area water supply. ICWD would like lake levels reported to the Technical

			Group to assure that agreed upon levels are met. In addition, ICWD is concerned that LADWP's rechannelization of Lyman Ditch in 2004 may adversely affect the project's native pastures adjacent to the ditch. Water supply in the 2005 runoff year was reported by LADWP as 1,203 acre-feet.
17	**Big Pine Northeast Regreening E/M (30 acres)**	Manage pumping in accordance with the Agreement and establish irrigated crop.	Not implemented. CEQA requirements have not been completed although LADWP reports that an archaeological survey has been conducted. The Technical Group has not completed mitigation plans for the site. ICWD revisions to LADWP's plan were sent 6/22/05.
18	**Big Pine Ditch System**	Establish/restore ditch system through Big Pine.	Implementation in progress. LADWP reports they have a contract to drill a new well in Bell Canyon to supply the project; however, the Technical Group has not been developing the evaluation criteria necessary prior to constructing the well.
19	**20 acres near Big Pine E/M**	Establish an irrigated crop while continuing the activity that caused the impact.	Not implemented and behind schedule. The Technical Group has not agreed on a plan or schedule although the MOU required that these be completed in 1998. Rather, LADWP has stated that "this potential E/M project will not be implemented at this time" because water supplied to E/M projects exceeds the amount pumped from E/M wells. LADWP has reported in their annual report (2006), "the plan is to fence the area in 2006-27 to … encourage natural revegetation. If this area does not revegetate naturally, it will be included with LADWP's ongoing revegetation efforts."
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. The Technical Group should have implemented test plots in 2001. LADWP's contractor implemented a revegetation study in 2002. The Mitigation Plan scheduled revegetation efforts to be expanded in 2006. LADWP reports that results of revegetation studies will be used to implement larger scale revegetation efforts but no schedule is provided.
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 did not provide a water-spreading plan for the Big Pine Wellfield in their annual operations plan. Therefore, It is not clear whether the groundwater mining limits provided by the Agreement are being met.

23	**Fish Springs**	CDFG fish hatchery and the LORP serve as compensatory mitigation.	Hatchery is in place and implementation of the LORP has been initiated. Hatchery water use for runoff year 2004-2005 was 18,832 acre-feet.
24	**Tule Elk Field**	Provide water in summer to field used by tule elk.	Ongoing, although LADWP has decreased the water supply to this project.
25	**Big and Little Seely**	Provide wet habitat for waterfowl and shorebirds by maintaining operation of a year-round pond.	Ongoing, although an operations plan is needed.
26	**Calvert Slough**	Maintain small pond and marsh.	LADWP reported that water would be provided to Calvert Slough in runoff year 2004 after seven years of not receiving water. It is not known whether LADWP plans to supply water in runoff year 2005.
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.	In process. A final mitigation plan was received mid-May 2006; however, implementation may be delayed. An ad hoc group is working with LADWP and ICWD to develop project plans.
28	**80 acres (Taboose/Hines Spring area).**	Manage pumping and revegetate with native species.	In progress. The entire impact area consists of 3 sites that total approx. 115 acres. Implementation at one site (Hines Spring South) had been delayed because it is dependent on plans for mitigating Hines Spring. This area is approx. 100 acres. Tin 54 is 0.3 acres. 108 alkali sacaton plants were planted in 1999. A drip irrigation system was installed and utilized every growing season although irrigation was reduced in 2004. Irrigation plans for the 2006-growing season are unknown. Past monitoring results demonstrate high survival of planted grasses thus far; however, the site vegetative cover decreased 0.9% between baseline, measured in 1999, prior to planting the alkali sacaton, and 2004. Perennial native vegetation cover was measured as 3.3% in 2004 far below the site goal of 33% cover. Because cover decreased and is below the site goal, transects will be run again in 2007. Blk 16E is 7.2 acres. Transects run in 2005 resulted in higher perennial native vegetation, 8.4%, compared to 1999, 5.4%; however, s
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 the water supply ditch, the Goodale Bypass Ditch, 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 and implementation of the LORP has been initiated. Water use was 9,670 acre-feet in runoff year 2004.

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 serves as compensatory mitigation. Project implementation began in Jan. 2006.
32	**Independence Pasturelands E/M (610 acres)**	Develop and irrigate pasture or alfalfa fields.	The acreage of this project was changed from 610 to 470 acres without discussion or approval from the Standing Committee. LADWP decreased the water allotment from 1,825 acre-feet/year to 1,493 acre-feet/year. However, they report that water use in runoff year 2004 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 needs to be developed.
34	**Independence East Side Regreening E/M (30 acres)**	Manage pumping and establish irrigated crop.	Not implemented. LADWP has completed the CEQA process for the project; however, the County is considering a new well location. A mitigation plan for the project has not been completed. Comments on a draft mitigation plan was sent to LADWP on 6/22/06. Recently, LADWP stated that the well is out to bid and that regreening will be implemented on 2/3 of the area to accommodate a potential sports complex in the future.
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 2005 was 190 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 20050 was 519 acre-feet.
37	**Additional 40 acres w/in springfield**	Revegetate with native pasture.	Not implemented. The MOU required a plan and schedule by 1998; however these requirements have 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 115.2 acres. Ind 123 (28.4 acres) did not have test plots implemented in 2002 as scheduled in the Mitigation Plan. 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. Ind 131 (73.2 acres) had a Technical Group approved study implemented in Dec. 2001. A final report from the consultant was received in March 2004. LADWP's contractor, MWH, conducted additional test plots in 2002. The mitigation plan schedule provides that a plan for the entire site will be developed in 2007 and implemented in 2008.
39	**Shepherd Creek Alfalfa Field E/M (200 acres)**	Manage pumping and establish irrigated crop on approx. 200 acres	Implemented and ongoing on approximately 195 acres. LADWP reports that water supply for runoff year 2005 was 1,152 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.	In August 2004, LADWP reported that data from transects run in the potential mitigation area showed an increase in vegetation cover from 18%, baseline, to 44% and thus no expansion of the Shepherd Creek E/M Project was necessary. The Technical Group has not discussed this determination.
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 spring dependent vegetation.
42	**Lone Pine Ponds**	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 reported a combined water supply of 180 acre-feet for the Lone Pine "East" and "West" regreening projects for runoff year 2005.
44	**Lone Pine West Side Regreening E/M (7 acres)**	Revegetate and provide irrigation.	Implemented and ongoing. LADWP reported a combined water supply of 180 acre-feet for the Lone Pine "East" and "West" regreening projects for runoff year 2005.
45	**Lone Pine Woodlot E/M (12 acres)**	Create irrigated pasture or alfalfa field.	Implemented and ongoing; however, management may have been modified without Standing Committee approval. . LADWP informed the Water Dept. in August 2004 that the project would no longer receive water during the non-irrigation season as practiced in the past. The project is currently managed by IMACA; however,an operation plan is needed based on management guidelines agreed to by Inyo and LADWP. LADWP reports water use was 100 acre-feet for runoff year 2005.
46	**Richards Field E/M (189 acres)**	Create irrigated pasture or alfalfa field.	Implemented and ongoing; however, management may have been modified without Standing Committee approval.

			LADWP informed the Water Dept. in August 2004 that the project would no longer receive water during the non-irrigation season as practiced in the past. Water to this project is not measured separately from the park supply. LADWP reports 2005 runoff year water use was 1,085 acre-feet for the park and the field.
47	**Van Norman Field E/M (160 acres)**	Create irrigated pasture.	Implemented and ongoing. 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 474 acre-feet in runoff year 2005.
48	**Diaz Lake**	Provide supplemental water to recreation area and create wet habitat.	Ongoing, however, an operations plan needs to be developed.
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 due to drought conditions. LADWP reports the water supply in runoff year 2005-2006 was 7,566 acre-feet. The LORP willsubsume this E/M project.
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	CEQA documentation was completed in Dec. 2005 andproject implementation began in Jan. 2006. A supplemental draft EIR for the brine pool transition area was released in Dec. 2005.
51	**Meadow/riparian vegetation dependent on agricultural tailwater**	LORP to serve as compensatory mitigation.	The LORP serves as compensatory mitigation. See LORP status above.
52	**Salt Cedar Control Program**	Implement salt cedar control program in accordance with the Agreement.	Ongoing, program implemented in 1998. Approx. 28 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 the areas impacted by water spreading due to insufficient funding. Continuation of the salt cedar control program is dependent upon obtaining funding beyond that provided by LADWP.
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 flow or vegetation at springs and seeps. Ecosystem Sciences 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 adequacy of the draft to Ecosystem

			Sciences. No revisions to the inventory were ever made.
55	**Springs/Seeps**	Monitor and maintain vegetation to avoid significant change or decrease as provided in the Agreement and the Green Book.	See status of named springs above.

Mitigation Measure Problems

Numbers in parentheses refer to project numbers in the mitigation status table.
by Irene Yamashita, Revegetation Project Coordinator

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

Big Pine Northeast Regreening Project - mitigation not implemented

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. Thus, a revised schedule for implementation of mitigation is necessary.
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. Although the project received water in 2005, no water had been provided for the previous 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 EIR 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 EIR 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 was intended to provide baseline data that could be used in future monitoring. ICWD has provided extensive comments to Ecosystem Sciences

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. 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 or Water Agreement provisions not in compliance.	
Laws-Poleta native pastures (1)	This project has two pastures. Neither pasture has been effectively irrigated in the past; however, management is now under a new lessee. Pasture cover will be monitored.
Big Pine general (22)	It is not known whether LADWP will exceeded the groundwater mining limit in the Big Pine wellfield during the 2006 runoff year because a spreading plan has not been provided to the Technical Group.
Van Norman Field E/M (45)	A portion of the project is not capable of being flood irrigated due to the site topography.