INYO COUNTY WATER DEPARTMENT

2014-2015

ANNUAL REPORT

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SECTION 1: EXECUTIVE SUMMARY

To protect the County's environment, citizens, and economy from adverse effects caused by activities relating to the extraction and use of water resources and to seek mitigation of any existing or future adverse effects resulting from such activities.

The Water Department's efforts during 2014-2015 were directed toward our core mission of assisting in the implementation of the County's water resources policies through the Inyo/Los Angeles Long-Term Water Agreement. Our work consists of four main activities: management of LADWP water-related activities through the Inyo/Los Angeles Technical Group and Standing Committee; environmental monitoring to assess impacts of LADWP activities and compliance with Water Agreement goals; planning, monitoring, implementation, and enhancement of mitigation measures associated with the Water Agreement; and disseminating information and fostering public involvement in County water policy.

The 1997 MOU between LADWP, Inyo County, California Department of Wildlife, California State Lands Commission, the Sierra Club, and the Owens Valley Committee requires that "*DWP and the County will prepare an annual report describing environmental conditions in the Owens Valley and studies, projects, and activities conducted under the Los Angeles Agreement and this MOU.*" This requirement has customarily been fulfilled by two reports, one issued by LADWP and one issued by the Water Department. The Water Department's Annual Report is a vehicle for disseminating information about conditions and activities related to the Inyo/Los Angeles Long-Term Water Agreement. The Water Agreement contains a number of provisions for collecting and sharing data, analyzing data, managing groundwater pumping, and mitigating negative effects of LADWP water management. We strive to make this report informative broadly for those wishing an overview of conditions and trends, and also to provide detailed data and analysis for those desiring to look closely at conditions in Owens Valley. In general, this report covers the 2014-15 runoff year (April 1, 2014 through March 31, 2015), but also contains material pertaining to LADWP's planned pumping for the 2014-15 runoff year. Our Water Agreement-related data collection and analysis falls into three categories: (1) management of LADWP water-related activities through the Inyo/Los Angeles Technical Group and Standing Committee; (2) environmental monitoring to assess impacts of LADWP activities and compliance with Water Agreement goals; and (3) planning, monitoring, implementation, and enhancement of mitigation measures associated with the Water Agreement.

One area of complete agreement between LADWP and the County is that we need more snow in the Sierra Nevada and rain on the Owens Valley floor. 2012-2013 and 2013-2014 were dry, 2014-2015 was drier, and 2015-2016 promises to be drier yet. Runoff was 57% of normal runoff in 2012-2013, 54% of normal for 2013-2014, 52% of normal for 2014-2015, and is forecast to be 36% of normal for 2015-2016. If the forecast is correct, 2015-2016 will have the lowest runoff on record, and the four-year period ending in 2015-2016 will be the driest of any three consecutive years on record. The prevailing dry conditions reduce the amount of water available for export to Los Angeles and for use in Owens Valley. During 2014-2015, LADWP reported in-valley uses of 146,484 acre-feet (AF), including 43,500 AF of irrigation, 11,500 AF of stock water, 9,520 AF supplied to enhancement/mitigation projects, 7,400 AF for recreation and wildlife projects, 3,200 AF provided to Indian lands, 14,300 AF for the Lower Owens River Project, 1,600 AF for MOU Additional Mitigation Projects, and 53,700 AF for dust control at Owens Lake. During the period October 2013 through September 2014 (the most recent 12-month period that LADWP has reported to the Water Department) LADWP exported 74,578 AF from the eastern Sierra Nevada. LADWP projects that the Los Angeles Aqueduct will deliver 42,377 AF to Los Angeles during 2015-16, the lowest amount in the period 1935 to present.

The Water Agreement and Green Book include procedures to calculate a pumping limit to prevent groundwater mining to ensure no long term decline in aquifer storage. The mining calculation is a comparison of pumping and recharge for each wellfield on a water year basis (October 1st through September 31st) for a 20 water year period. The 19.5 year total of actual pumping is subtracted from 20 years of estimated recharge to arrive at an estimated April-September pumping limit for each wellfield and Owens Valley as a whole. The estimate of groundwater recharge in the Owens Valley was 109,382 AF compared to 67,765 AF of pumping for the 2014 water year, and no wellfield was in violation of the groundwater mining provision.

For 2015-16, because of successive dry years, the annual operations plan developed this April is for the six-month period from April through September 2015, and a second plan will be developed for the period October 2015 through March 2016. For the period April through September 2015, LADWP plans to pump 36,782 – 52,557 AF. The Water Department analyzed the proposed plan by reviewing existing water levels, projecting how those water levels would change based on various levels of pumping, looking at vegetation conditions. It is expected the planned levels of pumping will result in pumping for the entire 2013-14 runoff year of around 70,000 – 75,000 AF.

The Water Agreement's ON/OFF method of managing LADWP pumping wells is based on monitoring sites where vegetation cover, soil water, and depth to the water table are measured, and the vegetation's water needs are compared to the available soil water. Pumping wells are linked to a monitoring site, and if sufficient soil water is present for vegetation at a site, then wells linked to that site may be pumped. As part of the monitoring effort, each month the Water Department measures depth to groundwater and soil water at 25 monitoring sites in wellfields and 8 sites in control areas (areas unaffected by pumping). As of May 2015, six sites were in ON status, which when combined with wells exempt from ON/OFF would provide an annual pumping capacity of 128,765 AF.

The Water Department's Saltcedar Control Program focus in 2014-2015 was eradicating saltcedar in the water-spreading basins that lie just to the west of the Lower Owens River and river-riparian area. These spreading basins are a concern because they harbor mature saltcedar thickets that function as seed sources for the re-establishment of saltcedar within the LORP riparian corridor. Program staff cut and treated 100 acres in these spreading basins. Saltcedar treatment efforts over the past fifteen years have resulted in large amounts of woody slash accumulation in the LORP. Inyo County and Los Angeles reached agreement in 2012 on a slash treatment plan prepared by the Water Department. The preferred treatment method was stacking and burning slash. Following acquisition of required burn permits, in April 2012 the Water Department conducted test burns on several piles in spreading basins. The necessary equipment to provide the required water supply at burn sites was purchased during the intervening summer, and a more aggressive burn program began in the fall after burn restrictions were lifted. Approximately 50 piles of slash were burned during the 2014-15 field season. The Saltcedar Program has safely burned a total of 830 piles of slash during the past three years.

One on the roles of the Water Department is to monitor and report on the status of environmental mitigation projects in the Owens Valley. More than 62 projects, spread throughout the Valley, mitigate for a range of environmental impacts due to abandonment of irrigated agriculture and groundwater pumping in the Owens Valley. These improvements range in size from single-acre spring enhancement projects to the 78,000-acre Lower Owens River Project (LORP). The majority of these projects are described in the Water Agreement and associated 1991 EIR (titled *Water from the Owens Valley to Supply the Second Los Angeles Aqueduct*) and in the 1997 MOU (which resolved conflicts and concern over the 1991 EIR), which can be found on the Water Department website (www.inyowater.org). Highlights of 2014 included the initial irrigation of the Independence Eastside Regreening Project and the Big Pine Northeast Regreening Project. The majority of projects are being implemented successfully; however, a number of projects requiring revegetation are not meeting goals.

The Inyo County Water Department (ICWD) monitors populations of *Sidalcea covillei* (Owens Valley checkerbloom) and *Calochortus excavatus* (Inyo County star tulip) each year in accordance with the provisions of the Long Term Water Agreement. Between 1993 and 2014, ICWD monitored 24 *S. covillei* populations and 28 *C. excavatus* population. Population size estimates are based on either complete counts or sampling depending on the size of populations. Both species are perennial geophytes that can survive in a dormant state in unfavorable years. Annual population size estimates are for the non-dormant portion of the population and are thus likely underestimates of the true population size, especially in dry years.

Each year the Water Department monitors selected vegetation parcels within the valley to ensure that the Water Agreement's vegetation goals are met. The primary goal of this monitoring, according to the Green Book are to detect any *"significant decreases and changes in Owens Valley vegetation from conditions documented in 1984 to 1987"*. Vegetation live cover and species composition documented during the 1984-87 mapping effort were adopted as the baseline for comparison with each annual reinventory according to the Water Agreement. From September 1984 to Nov 1987, LADWP inventoried and mapped vegetation on 2126 vegetation parcels (223,168 acres). In the summer of 2014, the Water Department resampled 97 parcels using the line-point protocol described in the Green Book. At the valley-wide scale we evaluated plant community cover and composition in parcels affected by groundwater pumping and for parcels that were generally further east of the wellfields. At the individual parcel scale, we quantified the change in perennial vegetation cover since baseline, assessed whether the relative proportion of shrubs, grass, and herbaceous vegetation has changed compared to baseline, and quantified the temporal trends of grass and shrub proportion for each parcel. In general, wellfield parcels have been below baseline measurements while control parcels have maintained baseline conditions but in 2014 control parcel on average were below baseline perennial cover presumably owing to the ongoing drought. The 2014 reinventory data show that 58% of wellfield parcels reinventoried are below baseline perennial cover measurements. Nearly half of these parcels dropped below baseline from 2013 to 2014, following the third consecutive year of below-normal precipitation and runoff.

This Annual Report is a requirement of the 1997 MOU, which is one of the governing documents of the Inyo/Los Angeles Long-Term Water Agreement, so the focus of the Annual Report is on Water Department activities related to the LADWP and the Water Agreement. The Water Department is involved in a number of activities unrelated or indirectly related to the Water Agreement, including participation in the Inyo-Mono Integrated Regional Water Management Group, assistance to other County departments needing hydrologic analysis on projects they are working on (e.g., environmental analysis for permitting of solar, industrial, or residential developments), monitoring and management of projects permitted under Inyo County's groundwater ordinance, implementation of the Sustainable Groundwater Management Act of 2014, and development of a County-wide groundwater elevation monitoring network to meet State mandates. These activities are not covered in this Annual Report, but information on their status may be found on our web site http://www.inyowater.org.

SECTION 2: DROUGHT DEEPENS AND GROUNDWATER MANAGEMENT EMERGES

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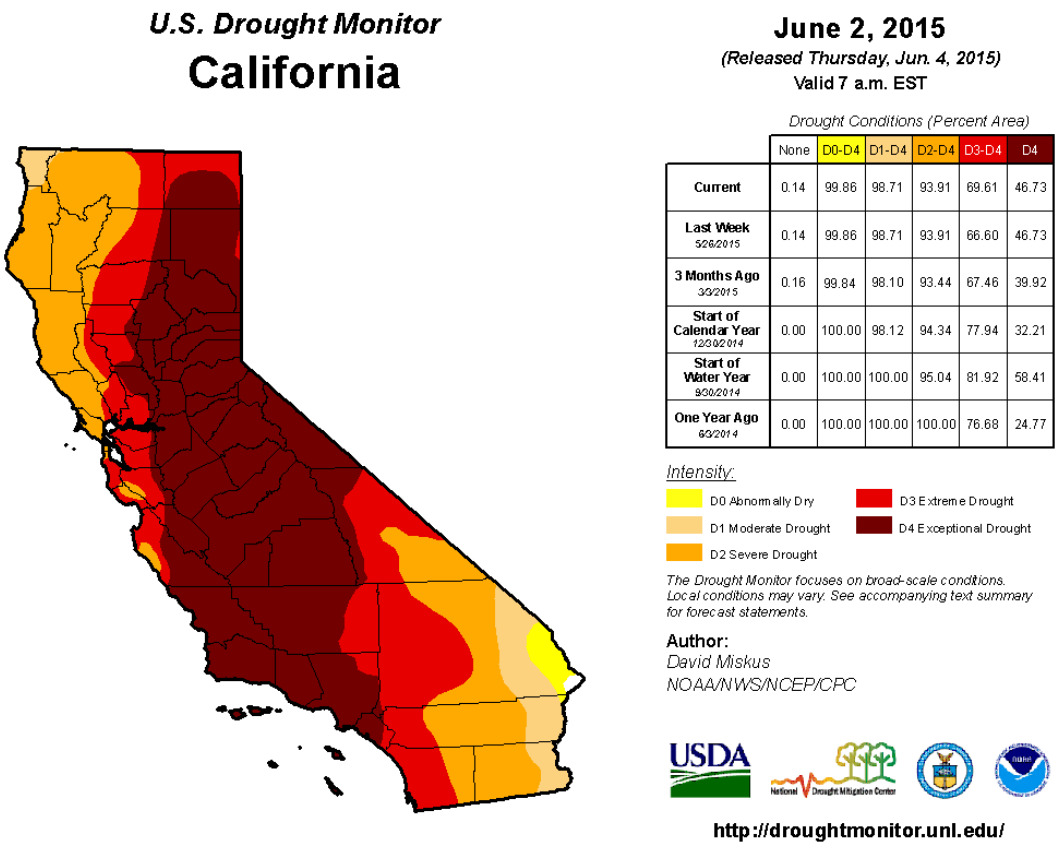
Over the past year, two events of great importance to California water management have occurred. First, a drought of historic severity, persisting since 2012, has disrupted water delivery and use throughout the State. Second, statewide legislation addressing groundwater management was adopted in fall of 2014. This Director's report summarizes regional and local drought conditions, discusses the new state groundwater management law, and provides some follow-up on activities reported in last year's Director's Report.

Drought – Statewide and Local
California and Inyo County currently have formally declared statewide and local drought emergencies. Figure 2.1 shows that drought conditions in California are severe, extreme, or exceptional throughout most of the state, as assessed by the National Drought Mitigation Center. These conditions arise from a combination of low precipitation and high temperatures. Precipitation has been low, though not without precedent (Figure 2.2), but temperatures over the past three years have been markedly higher than normal and above the gradual trend toward higher temperatures that has prevailed over the past century (Figure 2.2). Warm temperatures in January, February and March resulted in earlier than normal snowmelt, and the April 1 statewide snowpack water content was 1.4 inches of water, or 5% of the historical average. The combined effect of low precipitation and high temperatures on soil water is commonly evaluated using the Palmer Drought Severity Index (PDSI). Figure 2.2 shows that the statewide PDSI is currently at its lowest point recorded in the period 1910 to 2015.

Conditions locally in the Owens Valley mirror statewide conditions. Water planning in Owens Valley is based on what is called a 'runoff-year' beginning on April 1 and ending on the following March 31. April 1 is the date when the Sierra Nevada's snowpack historically reaches its maximum snow accumulation, and from measurements of the snowpack's water content, surface water availability can be forecast. With estimates of surface water availability in-hand, LADWP and the Water Department proceed with the annual planning process prescribed in the Inyo/Los Angeles Long-Term Water Agreement (LTWA). This planning process results in LADWP's annual operations plan.

Owens Valley runoff for the 2012, 2013, and 2014 has been 57%, 54%, and 52% of normal respectively, which is the driest three consecutive years on record since 1935.



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	98.71	93.91	69.61	46.73
Last Week 5/26/2015	0.14	99.86	98.71	93.91	66.60	46.73
3 Months Ago 3/3/2015	0.16	99.84	98.10	93.44	67.46	39.92
Start of Calendar Year 12/30/2014	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year 9/30/2014	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago 6/3/2014	0.00	100.00	100.00	100.00	76.68	24.77

Figure 2.1. California drought conditions as of June 2, 2015, provided from the National Drought Mitigation Center. Nearly half of California is in this highest level of drought designation – exceptional drought. Inyo County is mostly in extreme or exceptional drought.

Runoff-year 2014-2015, at 52%, matches the lowest runoff on record, which occurred in 1961. 2015-2016 is forecast at 36% of normal runoff, which would be by far the lowest runoff on record. For the period April 1 through September 30, 2015, runoff is expected to be 25% of normal for Owens Valley. The low runoff in 2014-2015 resulted in record low projected water exports to Los Angeles of approximately 70,000 AF. In the upcoming runoff year, exports to Los Angeles are expected to fall to approximately 42,000 AF. Since 1935, the average water export to Los Angeles has been 323,000 AF; this year's planned export is 13% of that figure.

The severe shortage of runoff strains the ability of LADWP to supply all of their water obligations in Owens Valley. This year, in the 2015-2016 Annual Operations Plan, LADWP plans to use 127,400 acre-feet (AF) in Owens Valley to supply irrigation, stockwater, enhancement/mitigation projects, recreation and wildlife projects, dust control on Owens Lake, the Lower Owens River Project (LORP), additional mitigation called for the in the 1997 MOU, and supply for tribal lands. In a normal

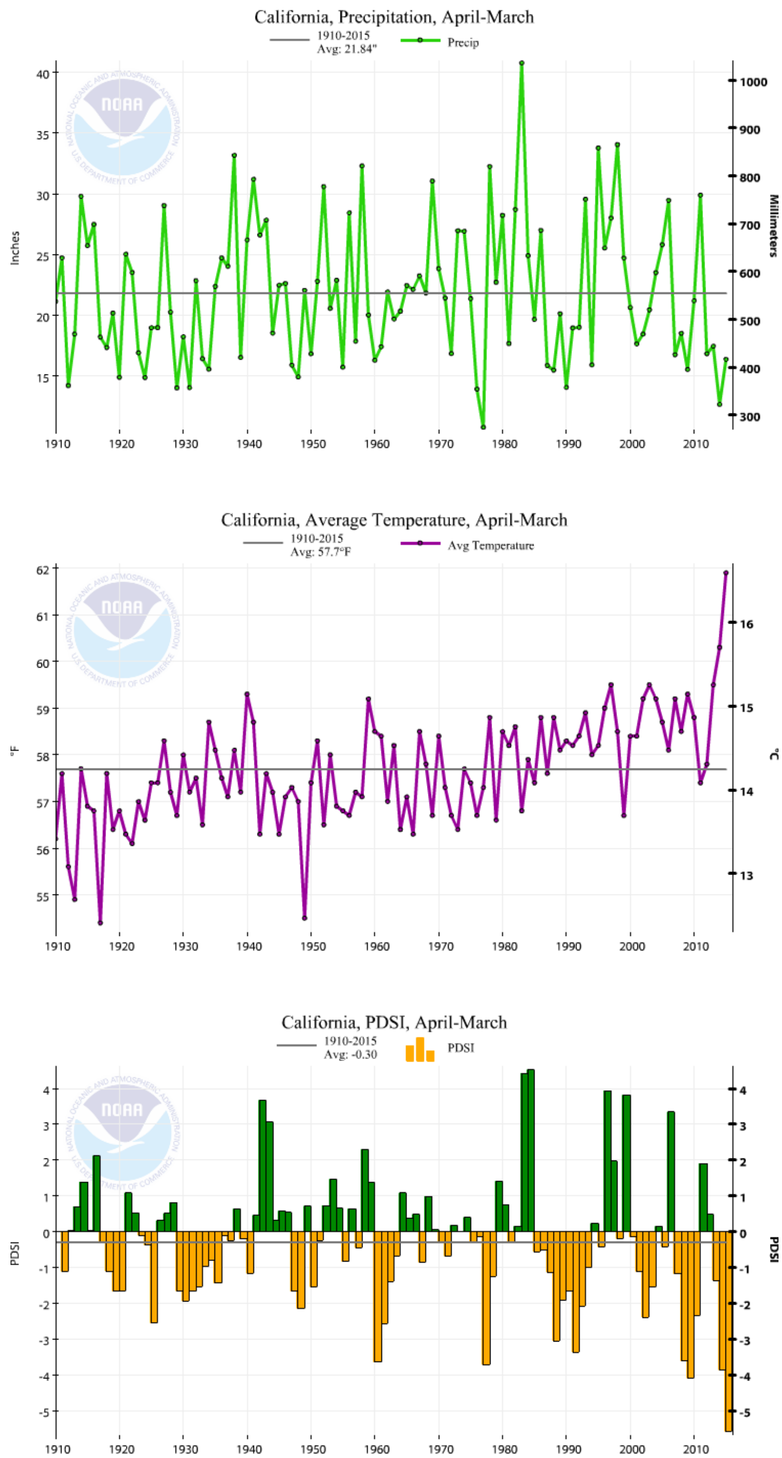


Figure 2.2. Precipitation, temperature, and Palmer Drought Severity Index (PDSI) for 1910-2015 by runoff-year. The combination of low precipitation, and high temperatures resulted in the most severe drought conditions since the Los Angeles Aqueduct was constructed. Data from the National Oceanic and Atmospheric Administration.

year, LADWP would provide 144,700 AF to in-valley uses. LADWP's Annual Operations Plan accommodates the reduction in in-valley uses mainly through reductions to irrigation. County staff has been working with LADWP to reallocate of water from other in-valley uses to irrigation. Since most other in-valley uses are slated to be maintained at near-normal levels, the Inyo/Los Angeles Standing Committee endorsed reductions to LORP water use and water use on MOU "Additional Mitigation Projects" that would save water for irrigation uses. These water savings would require concurrence of all signatories to the 1997 MOU (the MOU parties are LADWP, Inyo County, Sierra Club, Owens Valley Committee, State Department of Fish and Wildlife, and the State Lands Commission). At present, it is not clear whether the MOU parties can agree on terms to realize these water savings.

The shortage of water has had a number of negative impacts. Cattle herds on local ranches have been reduced 38% since 2012. Dozens of domestic wells have been replaced with deeper wells due to low groundwater levels. Wildfire risk is increased by dry fuels. Water-based and snow-based recreational activities such as boating, fishing, and skiing are negatively affected by low reservoir levels, meager snow packs, and shorter snow seasons. Wildlife is stressed by diminished food sources, reducing wildlife populations and driving wildlife to seek food sources in towns and residential areas. As the drought progresses into its fourth year, these problems are likely to persist or worsen.

The Sustainable Groundwater Management Act. In the fall of 2014, California adopted the Sustainable Groundwater Management Act (SGMA). This legislation requires local agencies to develop and implement groundwater management plans and grants local agencies authority to manage groundwater. If local agencies fail to implement the SGMA, then the State Water Resources Control Board will take control of groundwater management where no local agency has assumed responsibility for groundwater management.

Until the SGMA became law on January 1, 2015, California has not had a strong statewide framework for groundwater management. In California, landowners are in generally entitled to the reasonable use of groundwater on their overlying property. In contrast, California's surface water is appropriated and regulated through a state-administered statewide water rights permitting system. Except in areas where rights to groundwater were settled in court ("adjudicated"), groundwater pumping has been unregulated in California. This has resulted in areas where groundwater levels have dropped declined hundreds of feet due to groundwater pumping.

SGMA changes that, requiring local agencies to form Groundwater Sustainability Agencies (GSAs), which will be responsible for developing Groundwater Sustainability Plans (GSPs). The aim of each GSP is to manage each medium- or high-priority groundwater basin in the State sustainably, where sustainability is defined in terms of avoiding specific undesirable results within a groundwater basin. Undesirable results, as defined in the SGMA, are chronic lowering of groundwater levels, significant and unreasonable reductions in groundwater storage, significant and unreasonable seawater intrusion, significant and unreasonable degradation of water quality, significant and unreasonable land subsidence, or surface water depletions that adversely affect beneficial uses of surface water.

California has 515 groundwater basins, 127 of which are designated as medium- or high-priority (Figure 2.3). SGMA requires that these 127 basins be managed sustainably, either by local agencies developing and implementing GSPs, or, if local agencies do not form GSAs or develop and implement GSPs, the State Water Resources Control Board (SWRCB) will impose

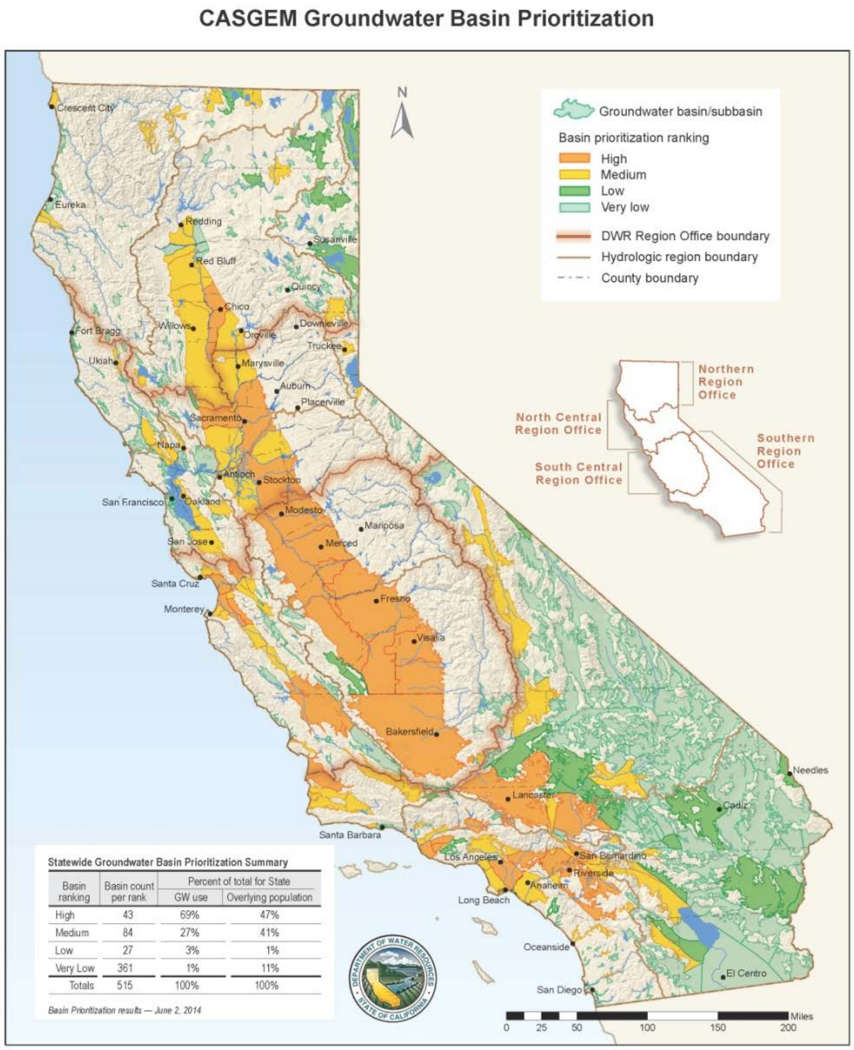


Figure 2.3. Groundwater basins in California prioritized for implementation of the Sustainable Groundwater Management Act.

an interim GSP until local agencies implement a compliant GSP. If the SWRCB implements an interim GSP, local agencies will be responsible for funding the SWRCB's preparation and implementation of the interim GSP. There are two medium priority basins in Inyo County, Owens Valley Groundwater Basin and Indian Wells Valley Groundwater Basin. Both basins are shared with other counties, Owens with Mono County and Indian Wells with Kern and San Bernardino counties.

The SGMA provides local agencies with a number of tools and authorities to implement GSPs, including the authority to require registration of groundwater wells, measure and manage extractions (including limiting extractions), require reporting, and assess of fees on extractors. GSAs in high- and medium priority basins must adopt GSP's within five years if a basin is in conditions of critical overdraft or seven years if no in a condition of critical overdraft. "Overdraft" occurs when for a long period of time (e.g., many years) groundwater is pumped at a higher rate than water is replenished to the pumped aquifer. Overdraft results in chronic long-term declines in groundwater levels. No basins in Inyo County are in critical overdraft; however, DWR is currently revising the list of critically overdrafted basins and has proposed that Indian Wells Valley Groundwater Basin be so designated.

SGMA exempts adjudicated areas from the requirements for formation of GSAs and implementation of GSPs. This exemption includes "Any groundwater basin or portion of a groundwater basin in Inyo County managed pursuant to the terms of [the Inyo/Los Angeles Long-Term Water Agreement]." Although this exemption addresses the majority of groundwater pumping in Owens Valley (i.e., that currently done by LADWP), it does not address private pumpers such and Crystal Geyser Roxane LLC's pumping for bottled water, pumping by community service districts or cities. It is presently unclear how SGMA may or may not apply to groundwater pumping on the Owens Lake playa, as LADWP has proposed to do. We are working to determine how SGMA would apply to such pumping, and how to implement SGMA in a basin that is partially adjudicated.

Because both the Owens Valley and Indian Wells Valley groundwater basins span county lines, we are discussing with our neighboring counties how to comply with SGMA in these shared basins. Implementing SGMA will be challenging for the state and local agencies, and will undoubtedly be contentious for many years to come. A lot is at stake, but this is a necessary effort for the long-term health and sustainability of California's groundwater and all that relies on it.

Following Up on Last Year's Report – Blackrock 94 Settlement. In last year's Director's Report, I discussed the terms of a settlement reached between the LADWP and Inyo County concerning vegetation conditions in the vicinity of the Black Rock Fish Hatchery. Pumping has been reduced to supply the hatchery, as per the settlement. Response to the reduced pumping rate is being monitored, and increases in water table elevation near the hatchery of up to several feet have been observed. LADWP and the County have agreed on a panel of experts from the Ecological Society of America to assist with improving the Technical Group's vegetation monitoring program, and will be meeting in Owens Valley in July to familiarize the panel with the Valley, the Water Agreement, the existing vegetation monitoring programs, and our goals and intentions for the expert panel. Finally, as prescribed in the settlement, LADWP, in consultation with the Water Department, conducted a range burn of approximately 100 acres. This winter's dry conditions prevented further range burns.

Thank you for your interest in this Inyo County Water Department Annual Report for 2014-2015. I hope it is informative and useful, and welcome any comments or suggestions you may have. I can be contacted at (760) 878-0001 or bharrington@inyocounty.us

SECTION 3: PUMPING MANAGEMENT AND GROUNDWATER CONDITIONS

2014 Operations Plan and Groundwater Conditions

LADWP prepares an operations plan each April in accordance with the Water Agreement. The plan describes runoff conditions, wellfield pumping, water uses in the Valley, and export to Los Angeles.

ICWD and LADWP each monitor groundwater levels throughout the Valley.

Groundwater pumping management for environmental protection and water supply goals is a central component of the Water Agreement. Despite the severity of the ongoing drought LADWP pumping has been less than allowed by the Water Agreement pumping provisions and has been conservative compared to operations during previous droughts. Last year pumping was approximately 66,000 ac-ft, and groundwater levels generally were stable or declined slightly. This year is the lowest predicted runoff on record and proposed pumping is approximately 73,000 ac-ft. Most of the 2015-16 increase is to supply uses in the Owens valley for environmental projects and irrigation that cannot be supplied with surface water due to extremely low Sierra Nevada snowpack and forecasted runoff.

In accordance with the Water Agreement, LADWP prepares an operations plan each April for the twelve month runoff year beginning April 1st. In the event of two consecutive dry years when actual and forecasted Owens Valley runoff for the April to September period are below normal and average less than 75 percent of normal, LADWP prepares two six-month plans. The 2014-15 runoff year qualified under the consecutive drought year provision. The first plan described operations from April 1st to September 30th, and the second plan covered October 1st to March 31st. Each plan included projected amounts for runoff, pumping, reservoir storage, water used in the Owens Valley, and water exported to Los Angeles. Also, the plans must comply with the pumping well On/Off provisions of the Agreement based on soil water and vegetation measurements. Inyo County reviews the proposed operations plans, which usually includes performing an analysis of the effects of LADWP operations on groundwater levels in the Valley. Following a Technical Group meeting to resolve concerns raised by the County, LADWP finalizes the plans.

Runoff from the Owens River watershed during the 2014-15 runoff year was forecast to be 205,900 ac-ft or 50% of normal. The actual runoff value will be available later in 2015 when the all the surface water measurements that constitute the sum have been tabulated.

Total pumping within the Owens Valley for 2014-15 was 66,372 acre-feet (ac-ft), which was slightly less than the planned pumping of 67,959 ac-ft (Table 3.1). In most wellfields, actual pumping was within 300 ac-ft

Table 3.1. Planned and LADWP actual pumping by wellfield for the 2014-15 runoff-year. Estimated minimum pumping prepared by Inyo County for sole source uses is included for reference although in an extremely dry year minimum pumping would be insufficient to supply all uses.

Wellfield	Estimated Minimum Pumping (ac-ft)	Planned Pumping (ac-ft)	Actual Pumping (ac-ft)
Laws	6,460	6,198	6,290
Bishop	10,600	11,278	10,471
Big Pine	20,400	22,080	21,633
Taboose-Aberdeen	300	7,406	7,225
Thibaut-Sawmill	8,400	8,280	8,557
Ind.-Oak	5,900	8,825	8,606
Symmes-Shepherd	1,200	1,647	1,808
Bairs-Georges	500	1,174	828
Lone Pine	775	1071	954
Total	54,335	67,959	66,372

of the planned amount except for Bishop, Big Pine and Bairs-Georges wellfields where pumping was 350-800 ac-ft less than planned. Actual pumping was greater than planned in the Thibaut-Sawmill wellfield due to operation of the backup well at the Blackrock Hatchery for three months while the repairs were completed on the primary well. The backup well has a larger instantaneous capacity than the primary well.

The effect of pumping and runoff in 2014-15 on water levels in key monitoring wells is shown in Table 3.2. The County uses data from 45 test wells to predict the effect of pumping on the water table depth (DTW). Water tables declined slightly in 30 of the 42 test wells, but the overall average was a slight rise in DTW (0.28 ft, Fig. 3.1). The average is skewed positive by four wells near the Blackrock fish hatchery in the Taboose-Aberdeen and Thibaut-Sawmill wellfields (415T, 417T, 505T, 803T). Water levels near the hatchery rose by several feet in response to the reduction in pumping at the hatchery resulting from settlement of the dispute over vegetation conditions in Blackrock 94. Water levels remain below the levels of the mid-1980's (average 1985-87) in nearly all wells.

The Water Agreement and Green Book include procedures to calculate a pumping limit to prevent groundwater mining to ensure no long term decline in aquifer storage. The mining calculation is a comparison of pumping and recharge for each wellfield on a water year basis (October 1st through September 31st) for a 20 water year period. The 19.5 year total of actual pumping is subtracted from 20 years of estimated recharge to arrive at an estimated April-September pumping limit for each wellfield and Owens Valley as a whole. The estimate of groundwater recharge in the Owens Valley from the mining calculations was approximately 109,382 ac-ft compared to 67,765 ac-ft of pumping for the 2014 water year, and no wellfield was in violation of the groundwater mining provision. The history of Owens Valley pumping and runoff are presented in Figures 3.2 and 3.3.

Table 3.2 Depth to Water (DTW) at indicator wells, April 2015. All data are in feet. A negative change indicates a water table decline; negative deviation from baseline indicates the water table is below baseline. Depths are from reference point on the test well. Baseline elevation at monitoring sites was predicted from monitoring site/indicator regression models unless the test well was present 1985-87.

Wellfield/ Monitoring Well	April 2015 DTW	Change from April 2014	Deviation from Baseline in 2015
Laws			
107T	36.44	-1.17	-12.17
436T	13.66	-0.69	-5.56
438T	16.18	-0.44	-6.58
490T	17.50	-0.83	-4.43
492T	36.53	-0.33	-3.73
795T, LW1	Dry	--	--
V001G, LW2	Dry	--	--
574T, LW3†	17.30	-0.63	-4.08
Big Pine			
425T	22.03	-0.74	-7.13
426T	17.19	-0.90	-5.62
469T	25.49	-0.12	-3.82
572T	16.05	0.97	-4.15
798T, BP1	20.42	0.26	-4.28
799T, BP2	22.47	-0.53	-4.10
567T, BP3	21.63	-1.57	-7.66
800T, BP4	20.26	-0.73	-6.72
Taboose Aberdeen			
417T	29.93	4.63	-2.96
418T	10.10	-0.30	-1.87
419T	9.07	-0.30	-2.44
421T	38.55	-0.77	-4.20
502T	12.34	-0.79	-4.85
504T	12.99	-0.48	-2.22
505T	21.85	4.39	-3.25
586T, TA4	10.43	-0.40	-2.14
801T, TA5	16.72	-0.52	-1.06
803T, TA6	11.72	4.16	-3.29
Thibaut Sawmill			
415T	14.86	10.22	3.64
507T	5.03	0.24	-0.36
806T, TS2	14.67	-0.24	-2.23
Independence Oak			
406T	5.87	-1.39	-4.30
407T	15.65	-0.12	-8.35
408T	7.03	0.30	-3.90
409T	13.19	0.83	-11.59
546T	10.85	-0.95	-7.42
809T, IO1	15.82	-0.81	-9.89
[Continued on the next page]			

Wellfield/ Monitoring Well	April 2015 DTW	Change from April 2014	Deviation from Baseline in 2015
Symmes Shepherd			
402T	12.02	-0.36	-3.99
403T	9.03	-0.47	-3.70
404T	7.01	-0.09	-3.44
447T	42.97	2.48	-21.10
510T	8.39	-0.75	-3.39
511T	9.71	-0.62	-5.08
V009G, SS1	25.14	0.92	-19.18
646T, SS2	Dry	--	---
Bairs George			
398T	6.04	0.58	0.31
400T	7.13	-0.25	-0.83

†: The new test well at LW3, 840T, tracks 574T except during active spreading on the site, and depth to water is on average 1.23 ft deeper.

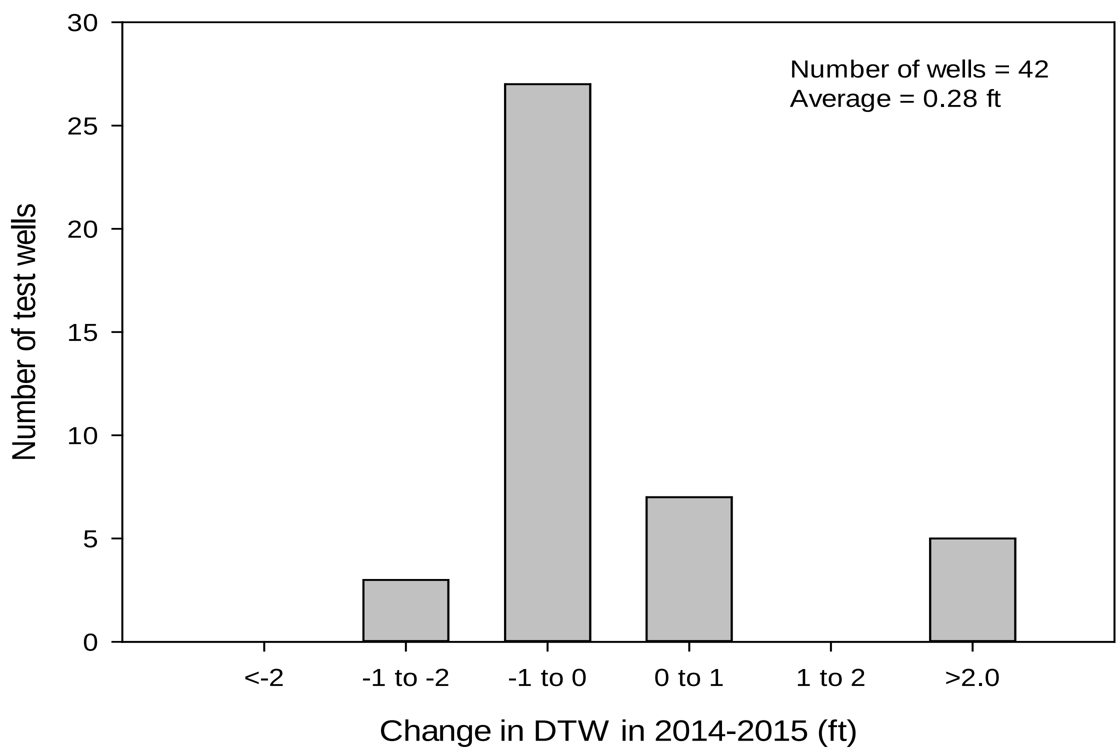


Figure 3.1. Histogram of change in DTW between April 2014 and April 2015 for 42 test wells.

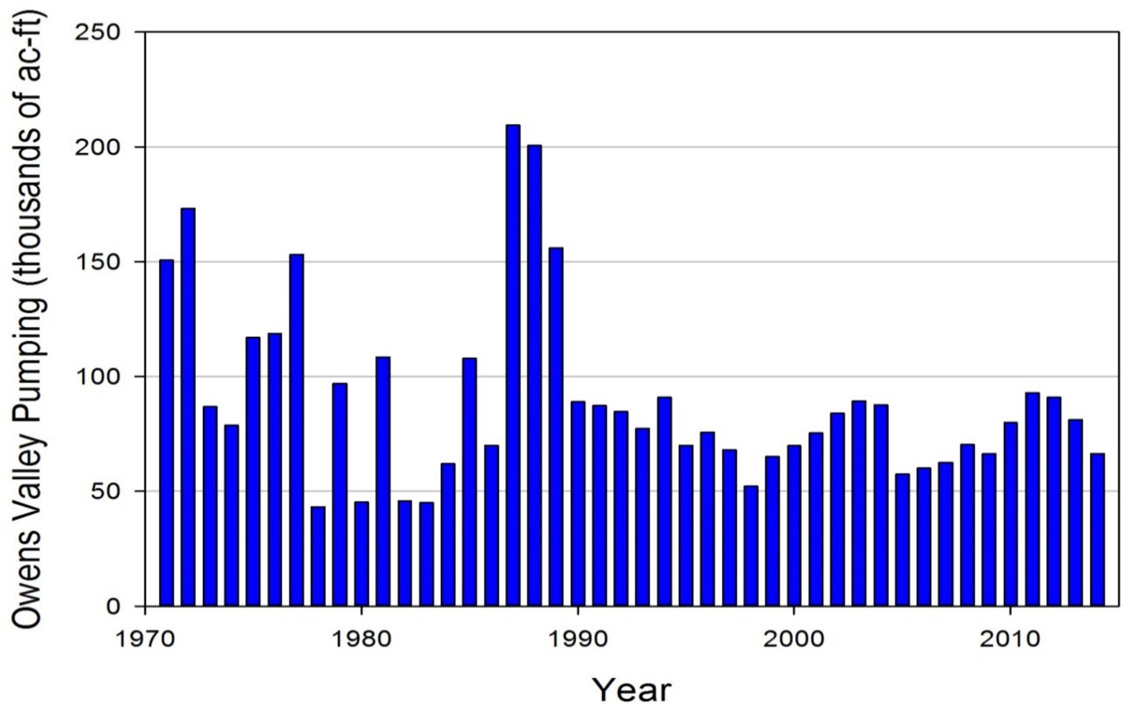


Figure 3.2. Total LADWP pumping in the Owens Valley since 1970. Values are for the runoff year (e.g. runoff year 2014 includes pumping from April 2014 through March 2015).

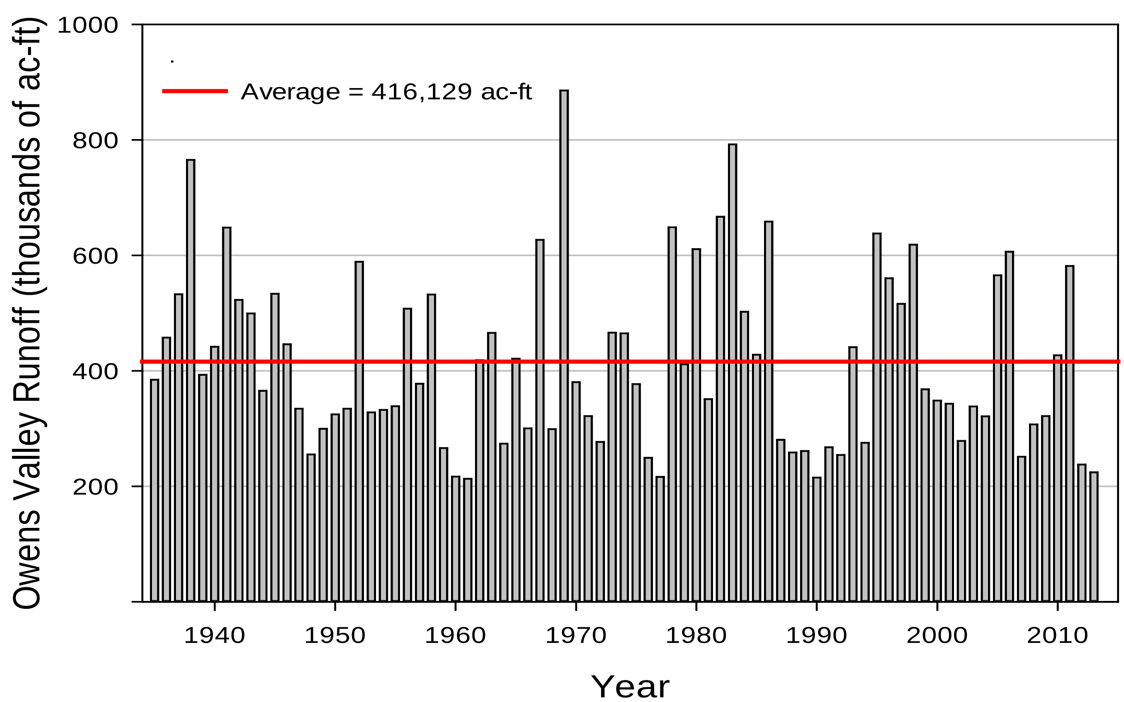


Figure 3.3. Measured Owens Valley runoff since 1935. Values are for the runoff year.

Hydrographs for the indicator wells are provided in following discussions of conditions in each wellfield; hydrographs for the permanent monitoring sites are included in the Soil Water section of this report.

Laws Wellfield

In the 1970's and 80's, pumping and irrigation and spreading from the Owens River via the McNally canals in Laws varied greatly year to year causing large fluctuations in the water table (Figures 3.4 and 3.5). This was especially true for 107T and 492T because of their proximity to the McNally canals and LADWP pumping wells. Heavy pumping and low recharge in the late 1980's caused severe declines in the water table in Laws considerably below the maximum water levels in the wellfield. Under the Water Agreement pumping has remained capacity. As a result, water levels rose, and spreading in 2005 and 2006. In 2014-15, DTW declined in all monitoring wells, and beginning in 2000, water table fluctuations have been largely driven by pumping for uses in the wellfield and by water all test holes were below baseline water levels in April 2015 (Table 3.2)

Bishop Wellfield

Groundwater pumping in the Bishop wellfield is managed differently than other wellfields due to additional legal requirements governing LADWP operations. The environmental protections and goals of the Water Agreement still apply, however. The Water Agreement requires Inyo and Los Angeles prepare an annual audit of pumping and uses on the Bishop Cone to demonstrate compliance with the Hillside Decree (the Decree itself does not contain audit procedures). The Hillside Decree is a 1940 Inyo County Superior Court stipulation and order under which LADWP pumping and water from uncapped

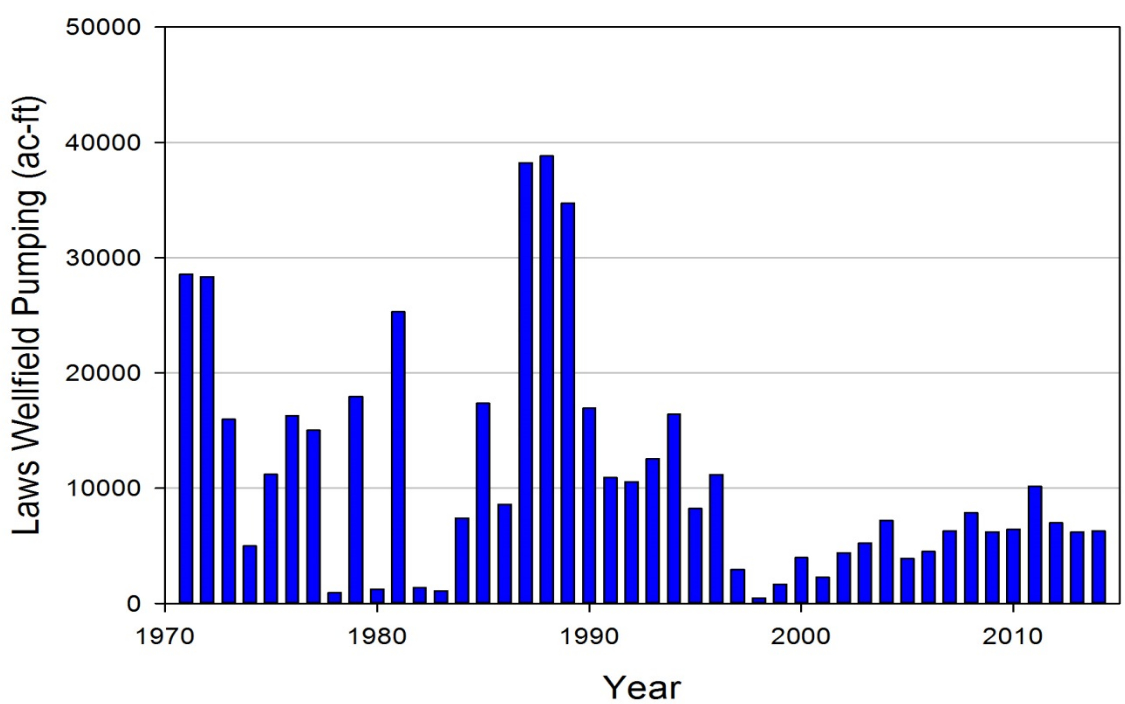


Figure 3.4. Pumping totals for the Laws wellfield.

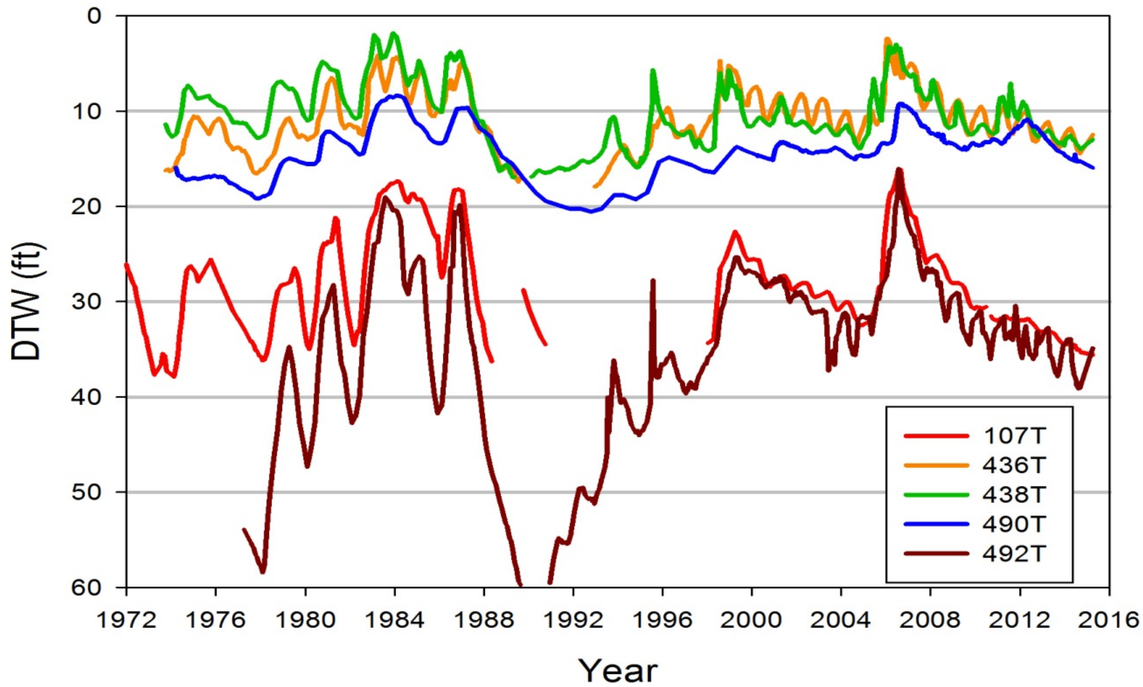


Figure 3.5. Hydrographs of indicator wells in the Laws wellfield. Well 492T is dry if DTW is below 60 ft. Missing data for well 107T reflect when the wells was dry.

flowing wells cannot exceed the annual amount of water used on LADWP owned land on the Bishop Cone. It is important to understand that the Bishop Cone Audit is not an accounting of the water balance for the groundwater aquifer. Rather, it is an accounting based on the water balance of the system of canals and ditches that convey water for irrigation. Water supplied for irrigation consists of surface water alone for some lands diverted primarily out of Bishop Creek and the Owens River (e.g. west Bishop, upstream of pumping wells). Pumped water is conveyed for irrigation using the same ditches and canals that convey surface water and most lands are supplied with combined pumped and surface water. Because it is impossible to separate surface and groundwater once they are combined in a canal or ditch, the most reliable method to assess compliance with the Hillside Decree is to compare the sum of pumping with the sum of uses. Uses in the Bishop Cone Audit are calculated as the amount of water applied to a parcel plus canal losses to transport water to the parcel minus the amount of water flowing off the parcel back into the canal system. In some cases several parcels are grouped into a single "account" and several monitoring stations are used to measure the water delivered and exiting the account. Ditch losses are estimated from flow measurements in ditches and canals. The accounts as well as the individual deliveries/uses are only included in the Bishop Cone Audit following a field inspection and Technical Group approval to ensure that appropriate monitoring is in place.

The most recent Bishop Cone Audit examined conditions for the 2013-14 runoff year. Total groundwater extraction on the

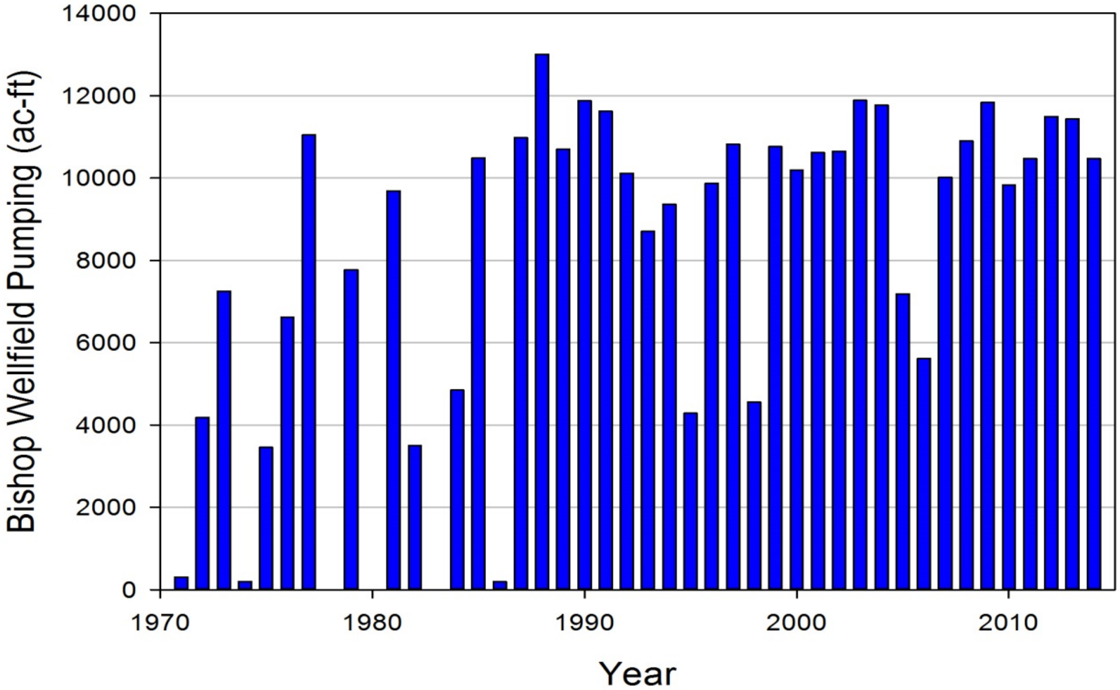


Figure 3.6. Pumping totals for the Bishop wellfield.

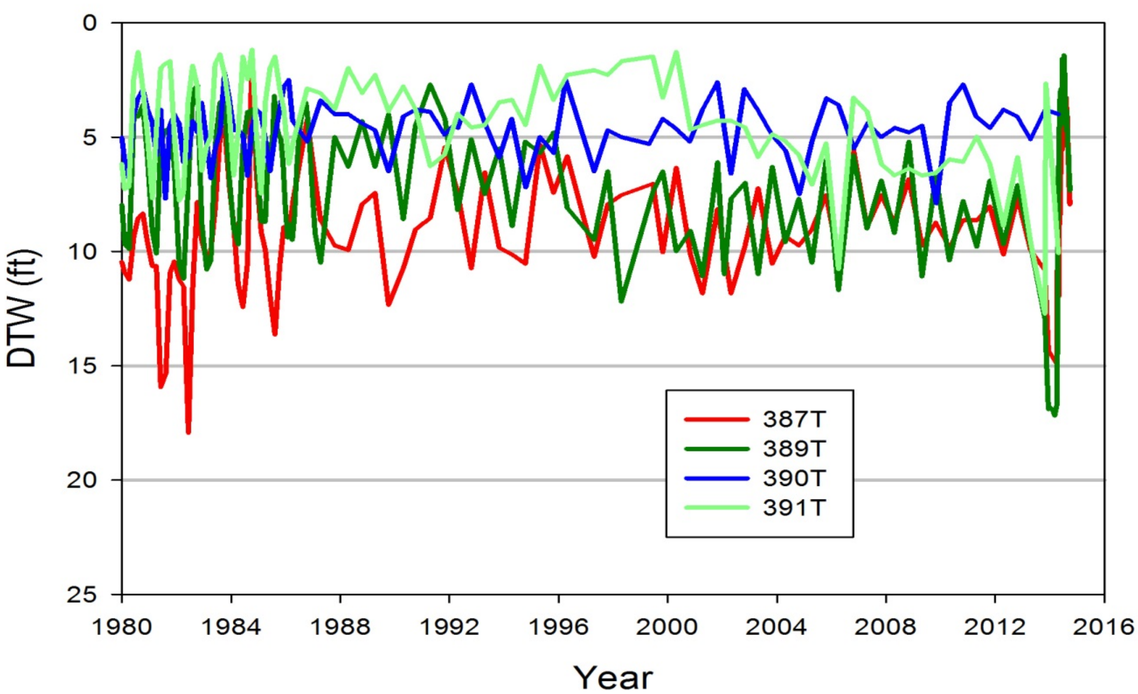


Figure 3.7. Hydrographs of selected monitoring wells in the Bishop wellfield. The wells are located in SW Bishop in a line roughly from the east end of Sunrise Drive to north of the Mclaren Lane development.

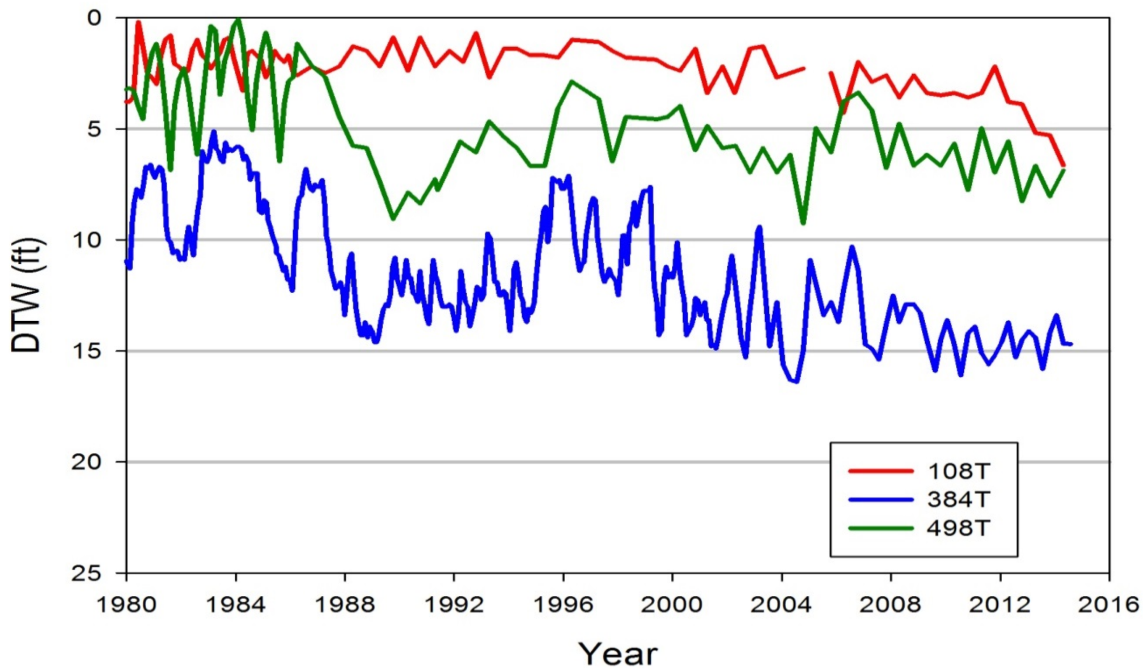


Figure 3.8. Hydrographs of selected monitoring wells in the northern part of the Bishop wellfield. The wells are located in a roughly west-east line from Brockman corner, Dixon Lane, to U.S. 6.

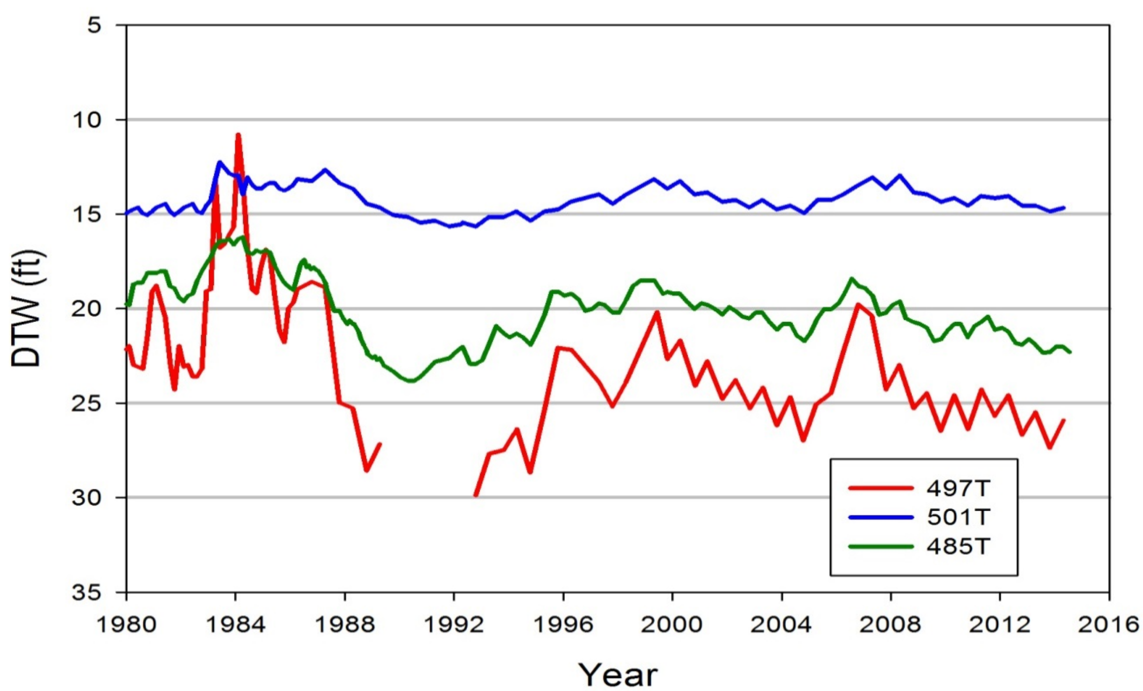


Figure 3.9. Hydrographs of selected monitoring wells in the Bishop wellfield. The wells are located in a north-south line from U.S. 6, Bishop Airport, and Warm Springs Road. The wells are separated from the Bishop pumping wells by a north-south trending series of faults.

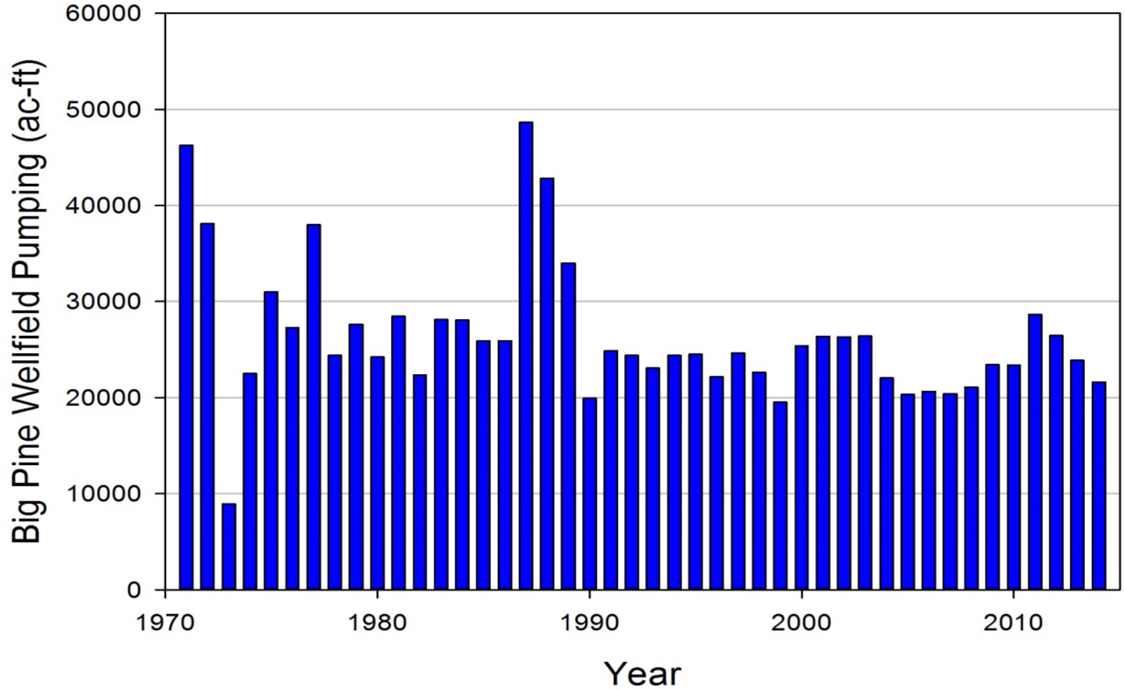


Figure 3.10. Pumping totals for the Big Pine wellfield.

Bishop Cone was 15,970 ac-ft compared with 22,765 ac-ft of recorded uses. Approximately 6,795 ac-ft of surface water was used for irrigation and not replaced in the LADWP aqueduct system with groundwater. If pumping exceeded the amount of recorded uses, all pumped water could not have been used on the Bishop Cone and LADWP would be out of compliance with the Hillside Decree. That situation has not occurred since the audit procedures were implemented as part of the Water Agreement.

Pumping in the Bishop Wellfield, also called the Bishop Cone, has been relatively constant for the past 25 years except in above normal runoff years when pumping decreased, for example 2005 and 2006 (Figure 3.6). Because of the Hillside Decree and relatively constant pumping, we do not routinely use indicator wells to analyze the annual operations plan for this wellfield. Several test wells located southwest , north, and east of the city of Bishop are presented in Figures 3.7 to 3.9. Constant pumping and consistent recharge from irrigation results in relatively stable water levels in the Bishop Cone Wellfield. Exceptions include several wells in west (387T, 388T, and 390T; Figure 3.7) and north Bishop (108T, Figure 3.9) that declined due to reduced irrigation supplied by diversions from Bishop Creek.

In 2013-14, prolonged severe drought conditions (two runoff years of very low runoff) and changes in Bishop Creek management resulted in dry ditches in the west Bishop area in the second half of the summer. LADWP relies on ditches managed by the Bishop Creek Water Users Association to convey water to irrigated pastures elsewhere on the Bishop Cone. Water levels in west Bishop typically peak after the summer irrigation season. As a result of the

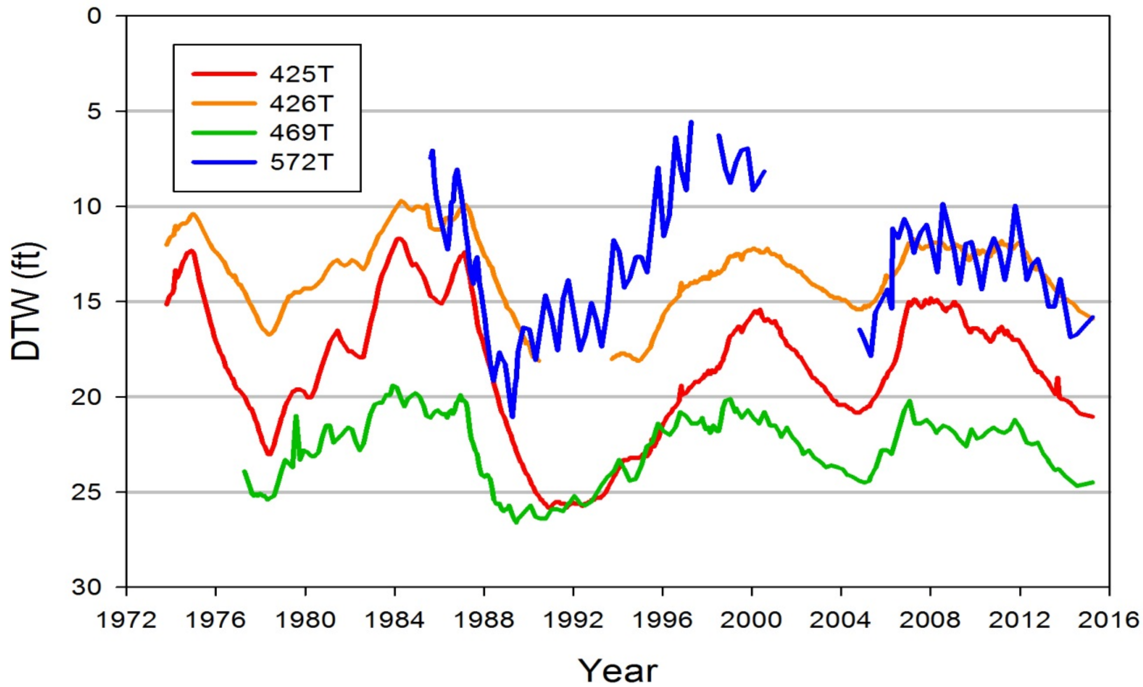


Figure 3.11. Hydrographs of indicator wells in the Big Pine wellfield. Periods of missing data for 572T occurred when the well was plugged and in need of repair.

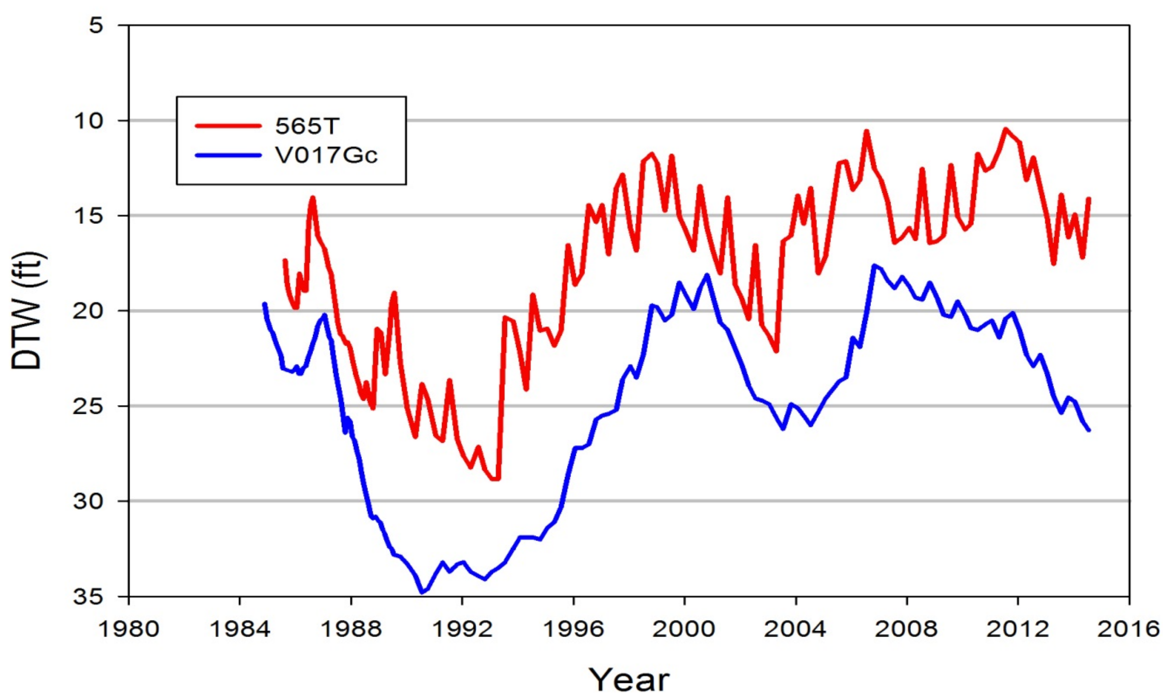


Figure 3.12. Hydrographs of monitoring wells in the southern Big Pine wellfield near pumping wells 218W and 219W.

reduced groundwater recharge locally, shallow groundwater levels dropped, in some cases to their lowest recorded levels. Ground water levels in west Bishop have recovered in 2014-15 from the decline (Figure 3.7).

Big Pine Wellfield

Pumping in the Big Pine wellfield since 1974 has been relatively large compared with other wellfields (Figure 3.10). Minimum pumping to supply uses in this wellfield include the Fish Springs Hatchery (approximately 19,500 ac-ft) and Big Pine town supply (500 ac-ft). Pumping under the Water Agreement largely has been to supply these uses. In 2014, pumping also included approximately 103 ac-ft from well 375W to replace surface water supplied to the Big Pine northeast regreening project. The ICWD did not observe any change in DTW at the nearest monitoring site (BP2) 360 m from 375W after operation of the well. The water table declined 1 inch at BP2 the following month, but such small changes are difficult to attribute to a single cause. From 2009 to 2014, wellfield pumping has been greater than the minimum for required uses, although pumping has declined slightly each year since 2011. The increase in pumping was primarily for aqueduct supply from exempt wells 218W and 219W located in the southern portion of the wellfield, west of the irrigated pastures along U.S. 395. It should be noted that most of the water pumped for the hatchery also reaches the aqueduct.

DTW in indicator and monitoring site wells in the southern of the wellfield declined slightly; water levels rose slightly in wells in the northern portion of the wellfield (572T and 798T; Figure 3.11 and Table 3.2). All wells remain between 3.8 to 7.7 ft below baseline levels in April 2015 (Table 3.2). Two test wells located just east of U.S. 395 near 218W and 219W were examined to assess possible impacts from the additional export pumping of recent years (Figure 3.12). Both V017GC and 565T are located in or adjacent to groundwater dependent vegetation. Water levels have declined in response to drought and pumping since 2012 when they were above their 1985-87 baseline. The water level in V017Gc continues to decline and the overall trend is similar to other wells in the southern Big Pine wellfield (425T, 426T Figure 3.11). V017Gc is approximately four feet below baseline. The water level decline in 2012 in 565T has stabilized, and DTW remains above baseline. This well is less than 100 m from Birch Creek and may represent local water table conditions buffered by infiltration from the creek as well as the irrigated fields across the highway.

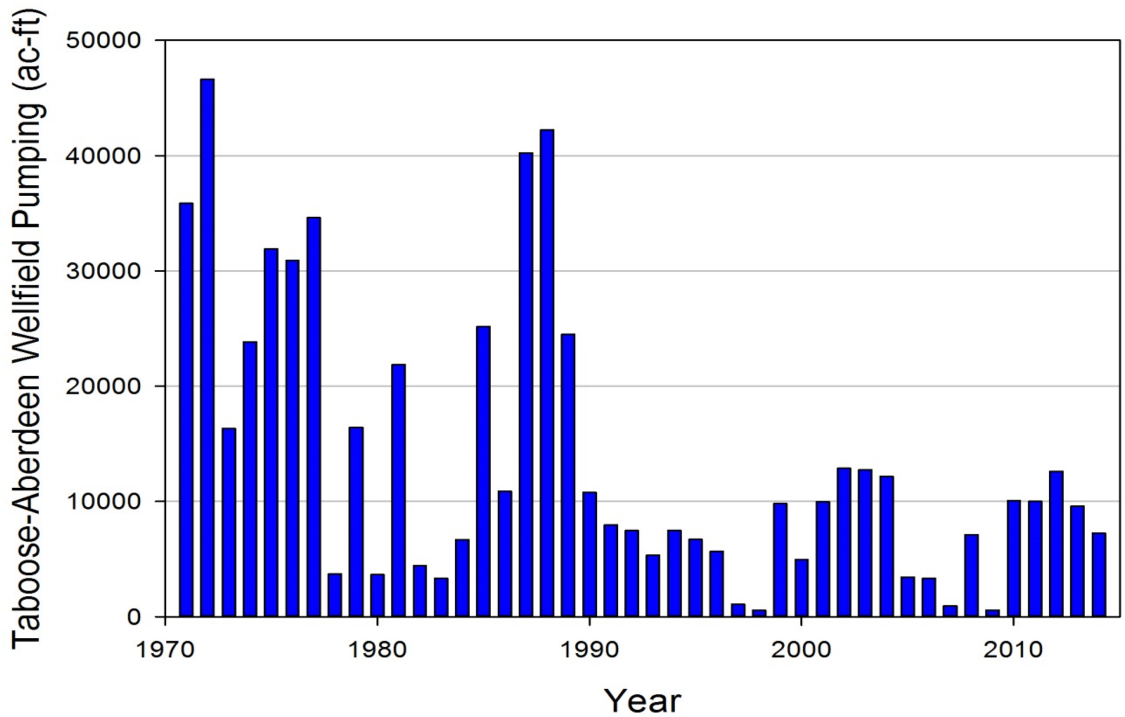


Figure 3.13 Pumping totals for the Taboose-Aberdeen wellfield.

Taboose-Aberdeen Wellfield

Pumping in the Taboose-Aberdeen Wellfield since 1990 under the Water Agreement has remained much below the wellfield capacity (Figure 3.13). Minimum pumping for this wellfield is approximately 300 ac-ft to supply one mitigation project at Big Seeley Spring, and nearly all of the pumping since 2010 has been for aqueduct supply.

Hydrographs for the indicator wells exhibit similar response to fluctuations in pumping and runoff (Figures 3.14 and 3.15). Despite the above normal runoff during 2010 and 2011, pumping also increased, and water levels were stable or declined slightly. Most of the pumping since 2012 has been from wells 349W and 118W located in the northern portion of the wellfield. Well 118W has been operated almost constantly since 2011. Data from well 587T was examined to assess the impacts of recent pumping because it is located adjacent to groundwater dependent vegetation near 118W. Water level declines in this well since 2011 have been small (Figure 3.15). Similarly, groundwater levels in 2014-2015 declined small amounts (4-9 inches) in seven out of ten indicator or monitoring site test wells (Table 3.2). Water levels in three wells in the southern portion of the wellfield increased more than four feet due to a reduction in pumping to supply the Blackrock fish hatchery. These monitoring wells were previously affected by well 370W which was granted a temporary exemption in 2013 to comply with mandatory fish flows in the Blackrock Ditch and to supplement the Blackrock Hatchery.

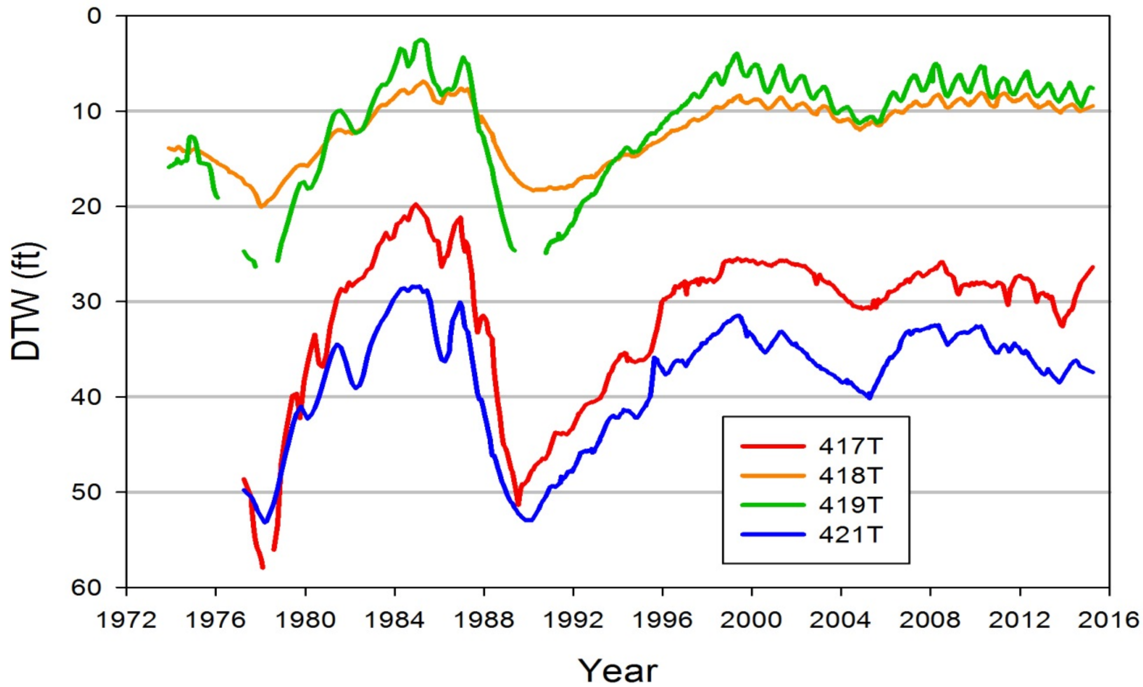


Figure 3.14. Hydrographs of indicator wells in the Taboose-Aberdeen wellfield. Periods of missing data denote when the test well was dry.

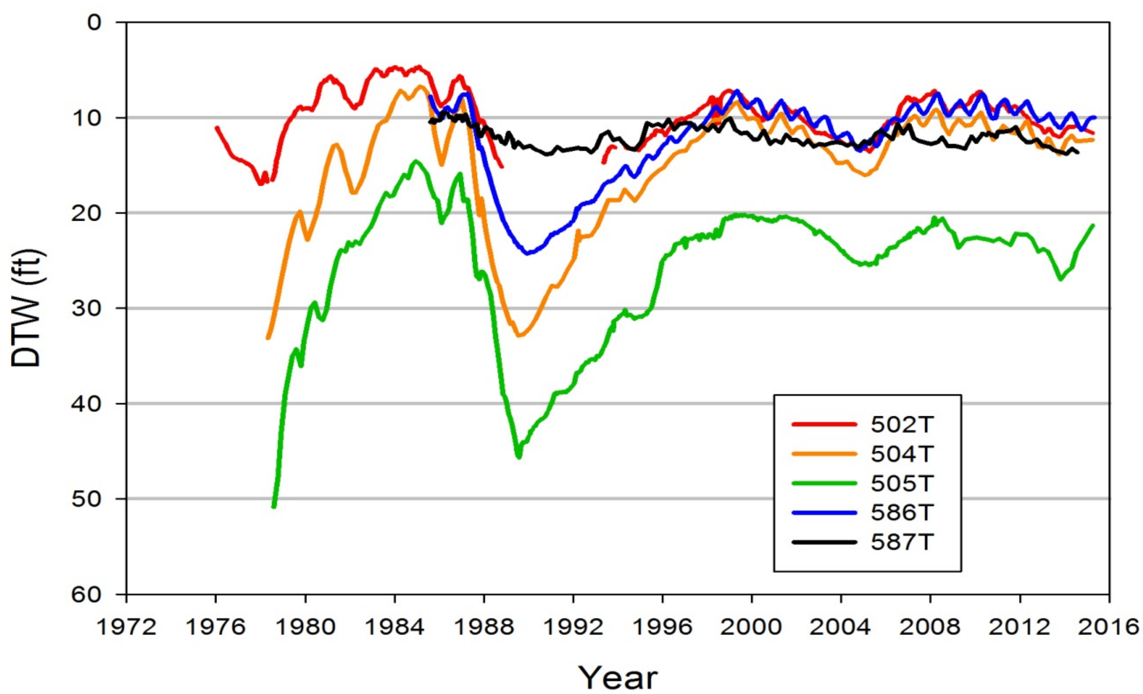


Figure 3.15. Hydrographs of indicator wells in the Taboose-Aberdeen wellfield. Periods of missing data denote when the test well was dry.

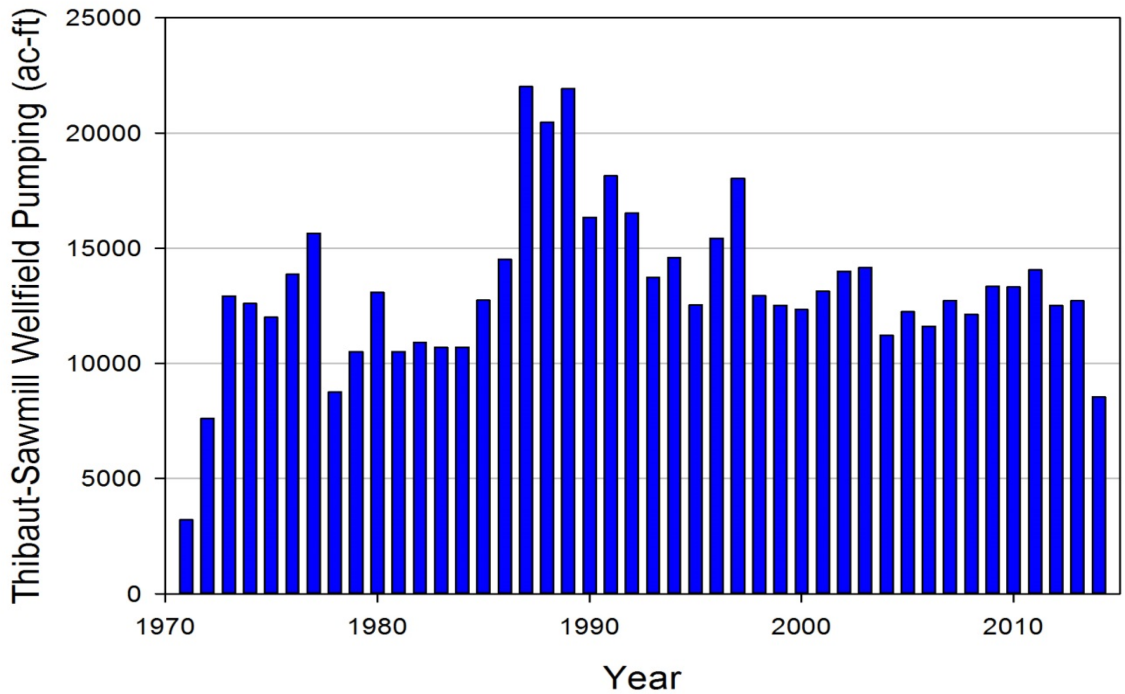


Figure 3.16. Pumping totals for the Thibaut-Sawmill wellfield.

Water levels have fully recovered from operation of 370W during that temporary exemption. Depth to water in all monitoring wells was 1-5 ft below baseline in April 2015 (Table 3.2).

Thibaut-Sawmill Wellfield

Historically, most pumping in the Thibaut-Sawmill Wellfield has been to supply approximately 12,200 ac-ft annually to the Blackrock Fish Hatchery (Figure 3.16). In 2011-12, approximately 1,800 ac-ft was pumped from this wellfield for aqueduct supply; since then, all pumping has been for hatchery or local irrigation uses. In 2014, Inyo and Los Angeles agreed to reduce hatchery pumping to approximately 8300 ac-ft. The four test wells used to track water levels in Thibaut-Sawmill exhibited different response due to local water management within the wellfield (Figure 3.17). Well 415T exhibited a substantial water level rise of over 10 ft and is 3.6 ft above the 1985-87 baseline level. Wells 413T and 414T are not used as indicator wells but they are included as examples from the southern portion of the wellfield. Both wells respond to spreading during high runoff years (e.g. 2006) and then decline gradually in response to pumping and/or reduced runoff. In 2014-2015, a downward trend since the onset of drought continued due to low runoff with a slight contribution from reduced recharge locally in the vicinity of flowing wells 103F and 104F. Recovery following the reduction in the hatchery pumping is not evident in these wells. Following nearly ten years of stable water levels, 507T began to respond in 2009 to the establishment of wetlands in the Blackrock Waterfowl Management Area. That trend

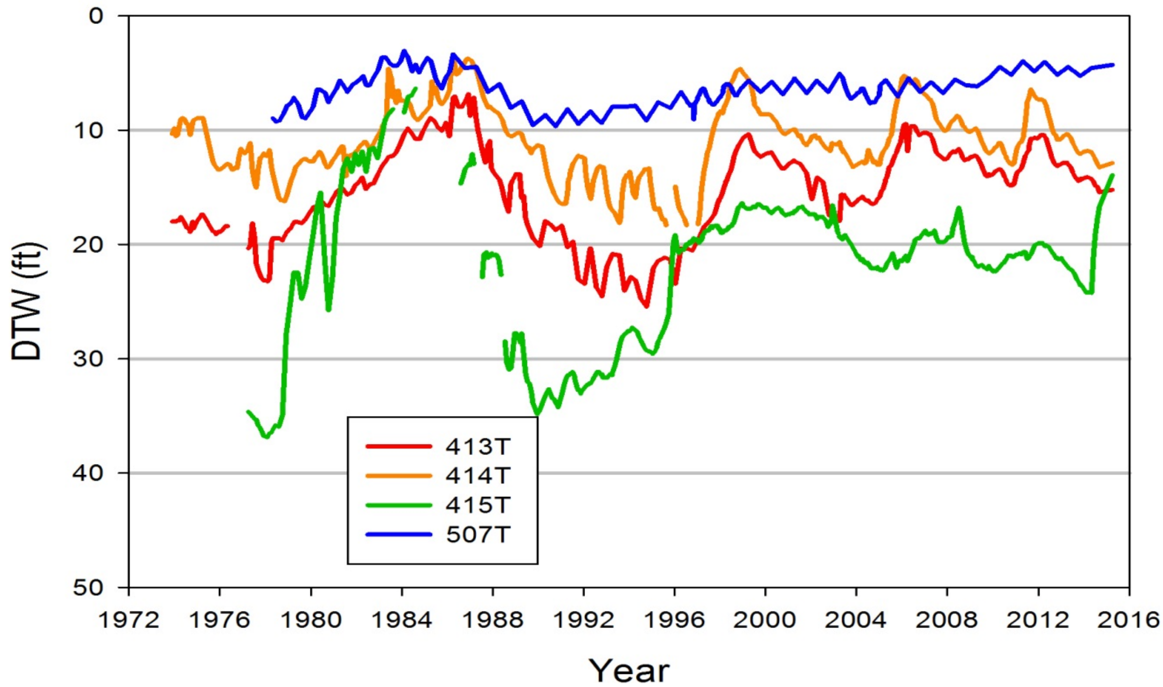


Figure 3.17. Hydrographs of selected test wells in the Thibaut-Sawmill wellfield.

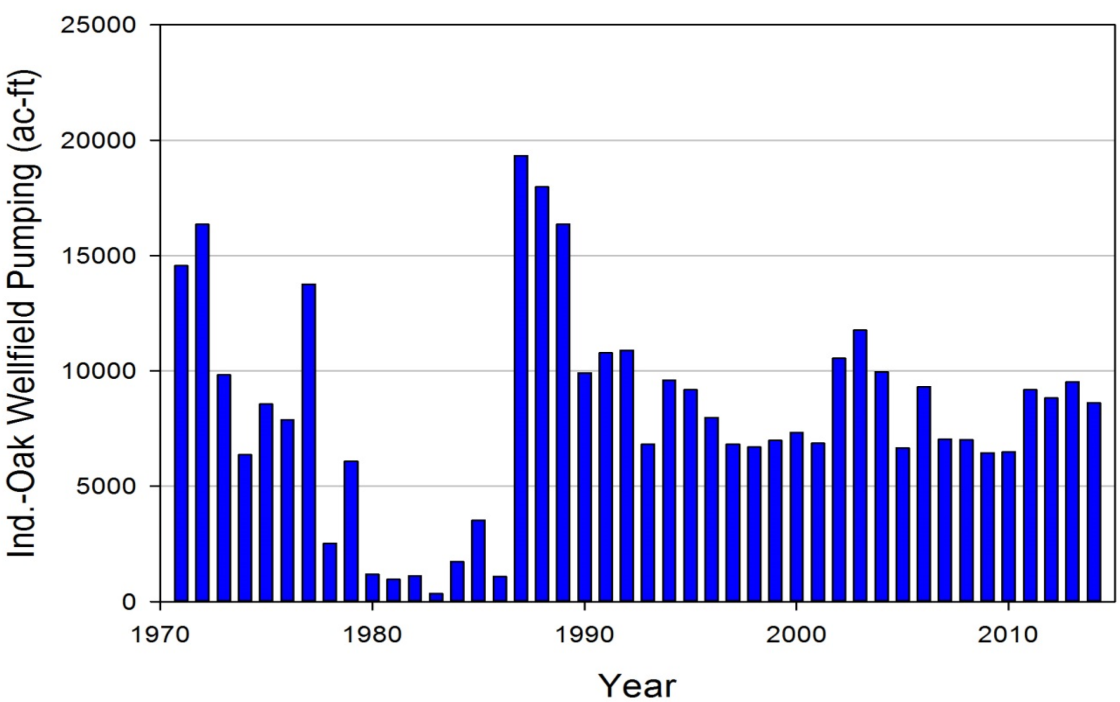


Figure 3.18. Pumping totals for the Independence-Oak wellfield.

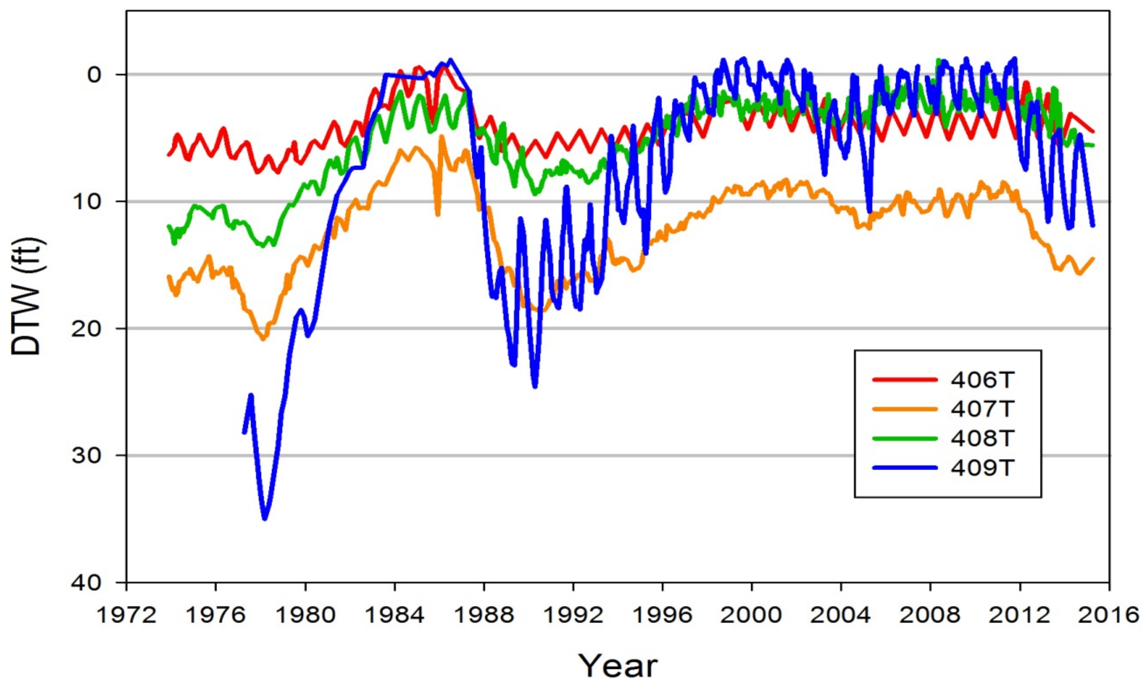


Figure 3.19. Hydrographs of selected test wells in the Independence-Oak wellfield.

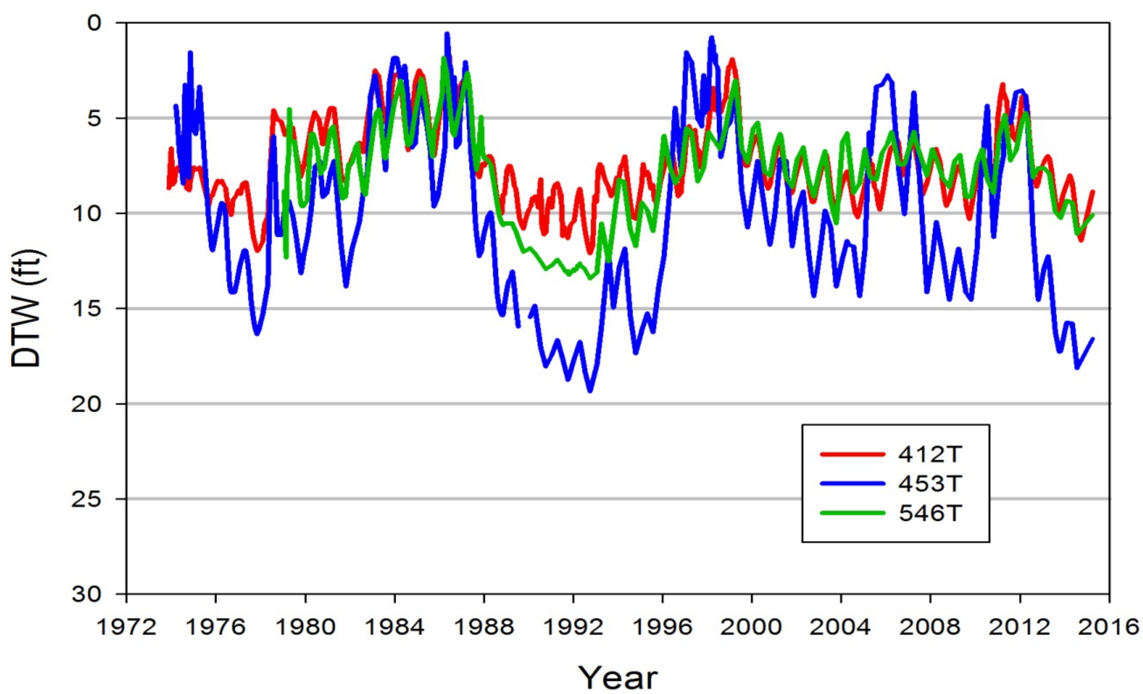


Figure 3.20. Hydrographs of selected test wells in the Independence-Oak wellfield.

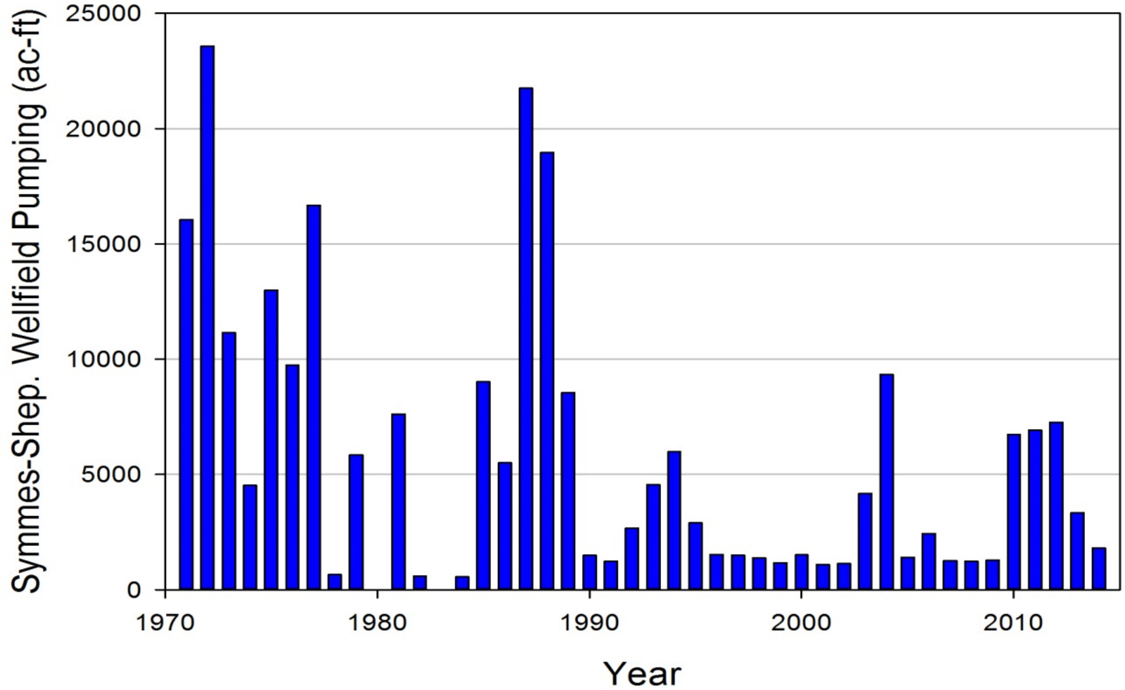


Figure 3.21. Pumping totals for the Symmes-Shepherd wellfield.

persisted through 2014-15, but is expected to reverse with the scheduled drying of the Drew Slough unit in 2015.

Independence-Oak Wellfield

Pumping in this wellfield is required to supply approximately 6,700 ac-ft annually for irrigation projects surrounding Independence and for town supply (Figure 3.18). Following four years of near minimum pumping, LADWP increased pumping to between 8, 606-9,175 each year since 2011. Pumping decreased slightly in 2014-15 compared to 2013-14. Water levels had been stable for several years in wells located in the center of the wellfield (407T, 408T, 409T), but they have declined in response to the increased pumping of the last three years. With the reduced pumping in 2014-15, water levels in these three wells stabilized (Table 3.2 and Figure 3.19). The other indicator wells located east and north of Independence exhibited declining water levels again last year (406T in Figure 3.19, and Figure 3.20). All of the indicator wells in the Independence-Oak Wellfield were below the baseline in April 2014 (Table 3.2).

Symmes-Shepherd Wellfield

In the 1970's and 80's, pumping in the Symmes-Shepherd Wellfield varied considerably (Figure 3.21). Under the Water Agreement, pumping has been reduced to approximately 1200 ac-ft to supply one mitigation project in most years; however, pumping for aqueduct supply increased considerably in the 2010, 2011, and 2012 runoff years. Pumping has declined in each of the last two years. Groundwater levels in 2014-2015 declined less than 1 foot in most wells or increased 1-2.5 ft (Table 3.2). Some test wells are buffered

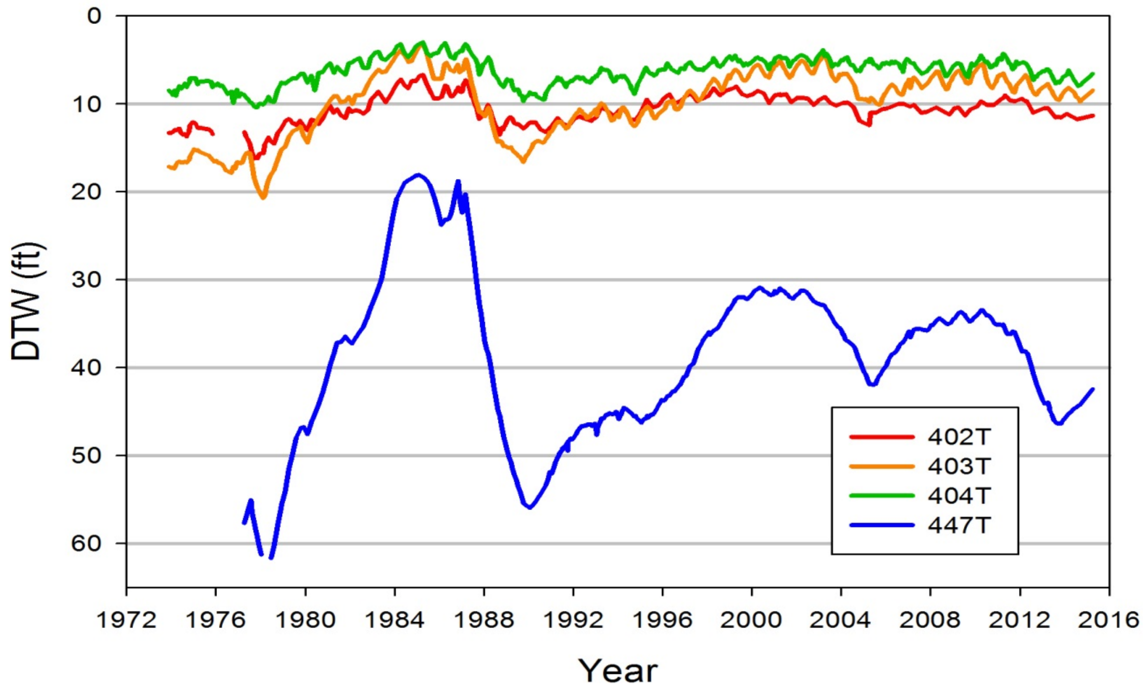


Figure 3.22. Hydrographs of indicator wells in the Symmes-Shepherd wellfield.

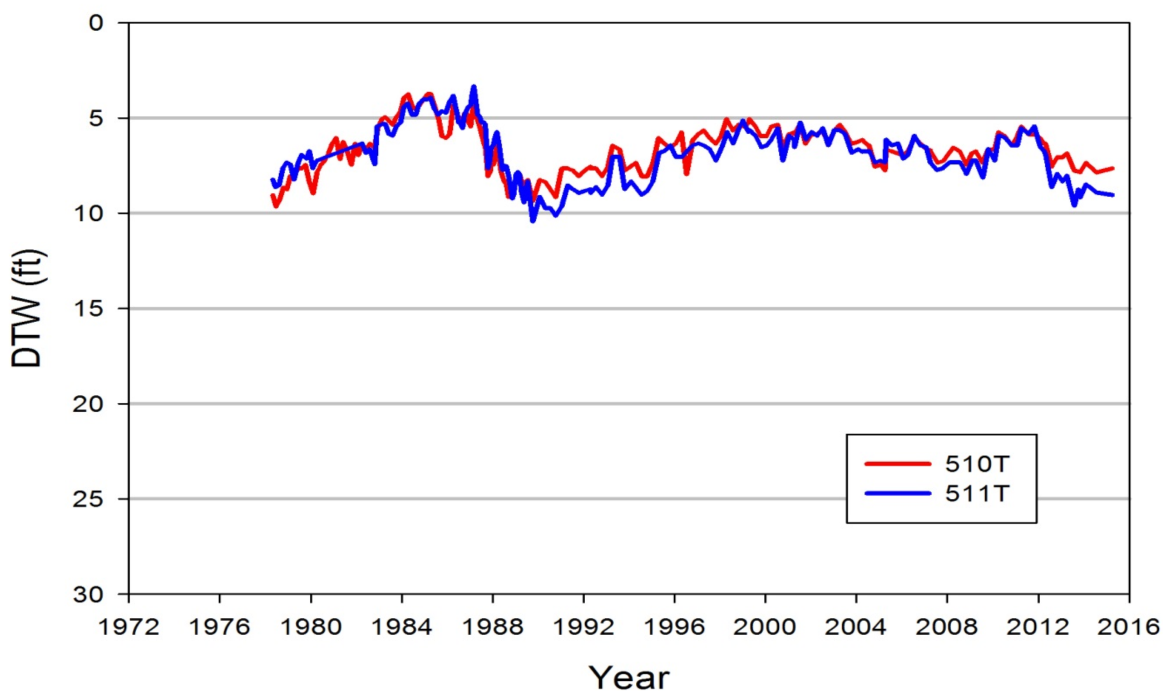


Figure 3.23. Hydrographs of indicator wells in the Symmes-Shepherd wellfield.

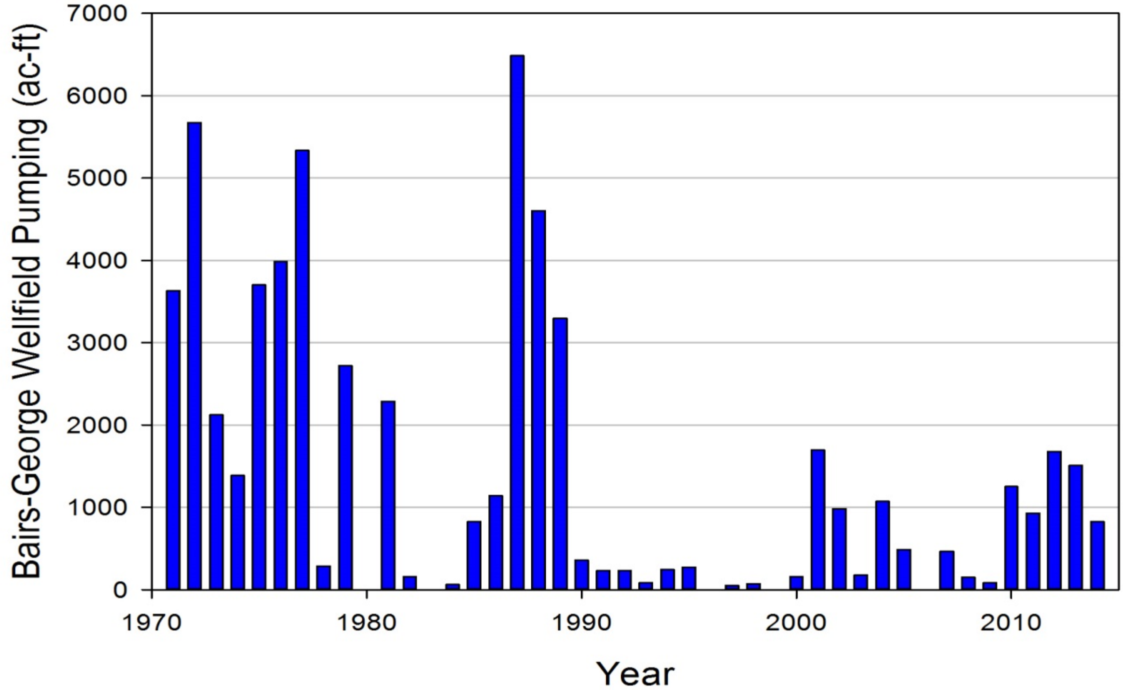


Figure 3.24. Pumping totals for the Bairs-Georges wellfield.

somewhat by their proximity to the Los Angeles Aqueduct (402T, 404T, 510T, and 511T), and water levels are relatively stable. The other test wells, 447T and V009G, are located near pumping wells in the northwestern portion of the wellfield and responded to the reduced pumping in 2014-15. Water levels in all monitoring wells were below baseline (Table 3.2).

The Bairs-Georges Wellfield

In the 1970's and 80's, pumping and water levels in the Bairs-George wellfield varied considerably (Figure 3.24), but under the Water Agreement, pumping has been reduced substantially. There are no projects supplied by groundwater in this wellfield, but in dry years one well is exempt (343W) and can be operated to supply irrigated pastures. As in other wellfields, pumping for aqueduct supply increased in 2010-2014 compared with the small amounts during the five preceding years. Since the mid 1990's groundwater levels in the two indicator test wells have been relatively stable (Figure 3.25). Water levels in 2014-2015 were stable, and one well was above baseline and the other less than 1 ft below baseline (Table 3.2).

The pumping wells are located west of the Los Angeles Aqueduct. Monitoring wells 597T and 398T (Figure 3.25) are in the immediate vicinity of the aqueduct, and well 400T is east of the aqueduct. Water table fluctuations in these wells (Figure 3.25) are buffered by the infiltration from the aqueduct although the effect of increased pumping since 2010 coupled with drought since 2012 is plainly evident in 398T and 597T.

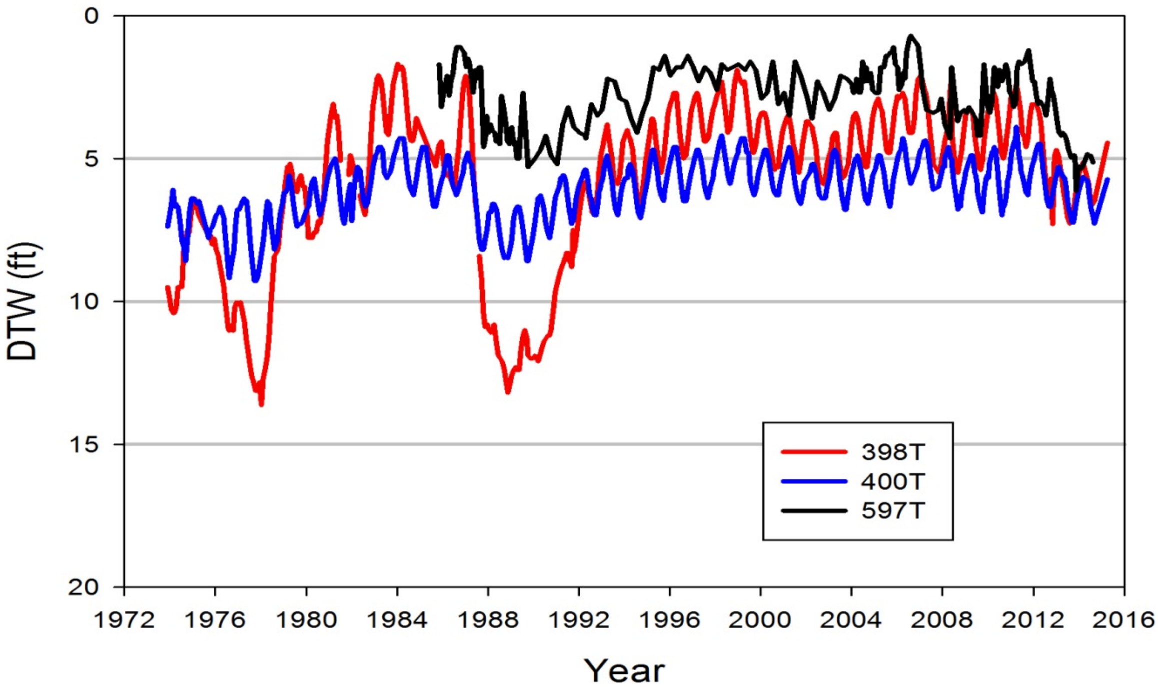


Figure 3.25. Hydrographs of indicator wells and 597T in the Bairs-Georges wellfield.

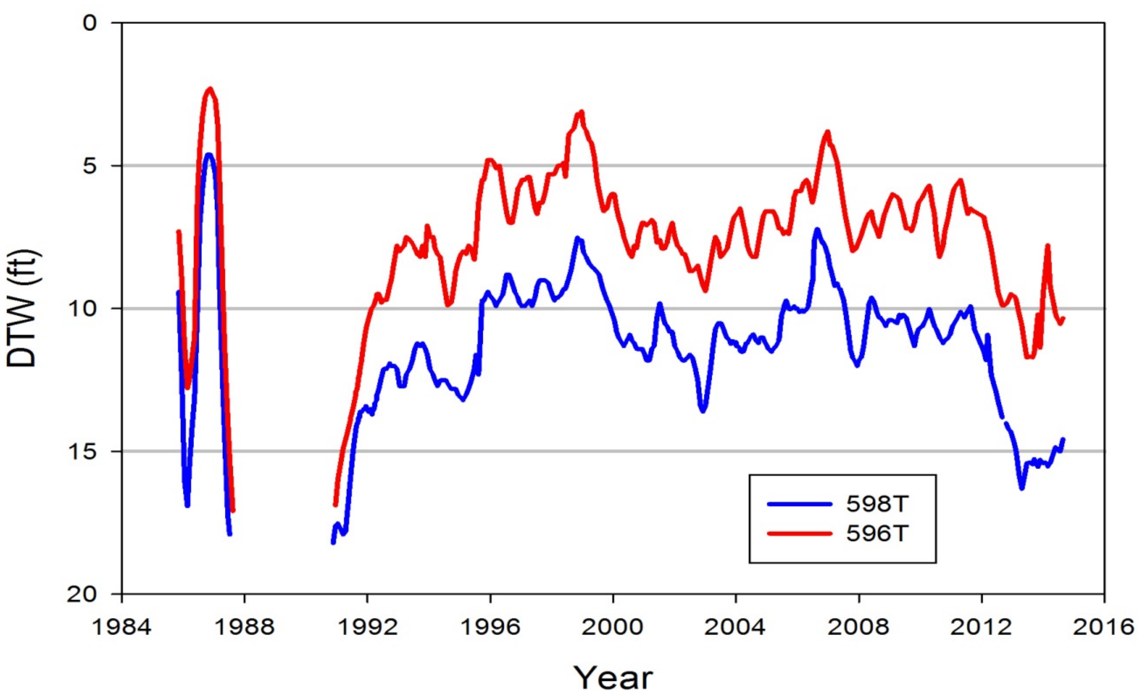


Figure 3.26. Hydrographs of selected wells in the Bairs-Georges wellfield.

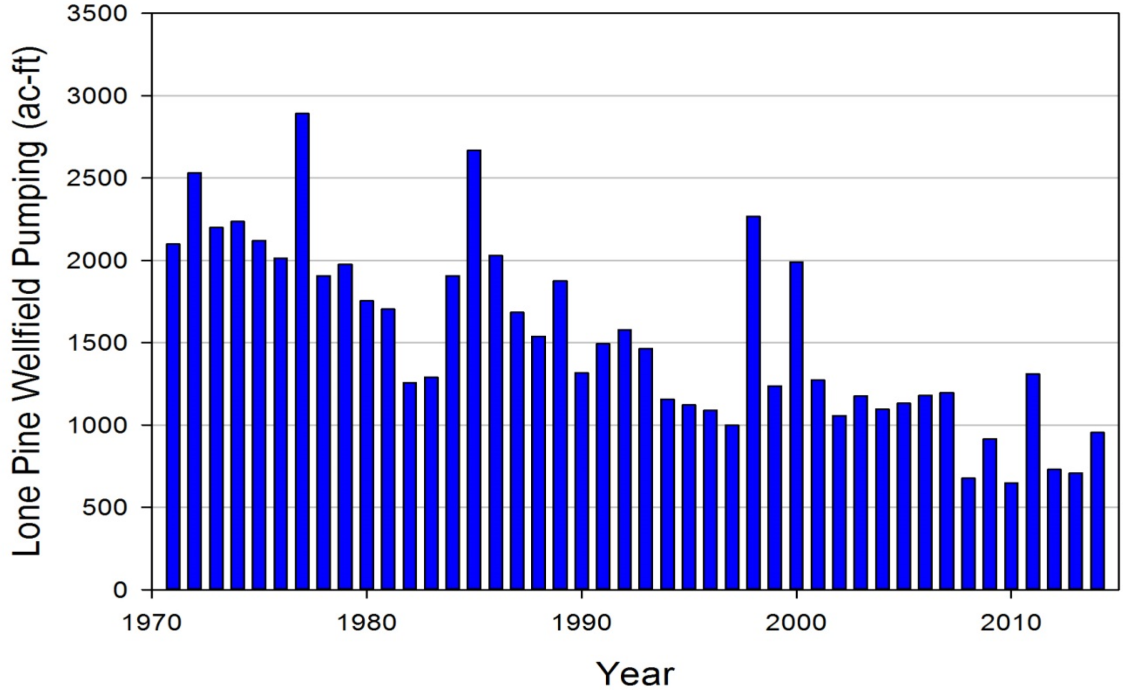


Figure 3.27. Pumping totals for the Lone Pine wellfield.

Pumping effects are less evident in 400T. Wells 598T and 596T are located west of the aqueduct, and exhibit larger fluctuations due to pumping (Figure 3.26).

The Lone Pine Wellfield

Most pumping in the Lone Pine Wellfield has been to supply the town of Lone Pine and one mitigation project (approximately 1,300 ac-ft annually). Pumping increased occasionally (e.g. 2000) to offset aqueduct water previously supplied to Diaz Lake (Figure 3.27). In 2014-15, pumping increased largely due to the operation of a new well to supply the E/M Van Norman field. The previous well (390W) degraded and production declined noticeably in 2008. The new well (425W) has capacity to fully supply the project. Because of the relatively constant pumping for sole source uses, we do not routinely use indicator wells to analyze the annual operations plan for this wellfield. Hydrographs for test wells 564T and 591T are presented in Figure 3.28 to represent water levels near the town of Lone Pine where the LADWP pumping wells are located. Monitoring well 593T and 858T are located in groundwater dependent vegetation north and south of Lone Pine, respectively. All wells exhibit seasonal fluctuations as well as water table response to decreased recharge due to drought. Pumping effects are not as evident. In early 2010, LADWP and ICWD tested a new production well, 416W installed to increase aqueduct supply. This new production well has been modified and initial tests to determine well capacity and performance have been completed. The initial operation may occur in 2015-16.

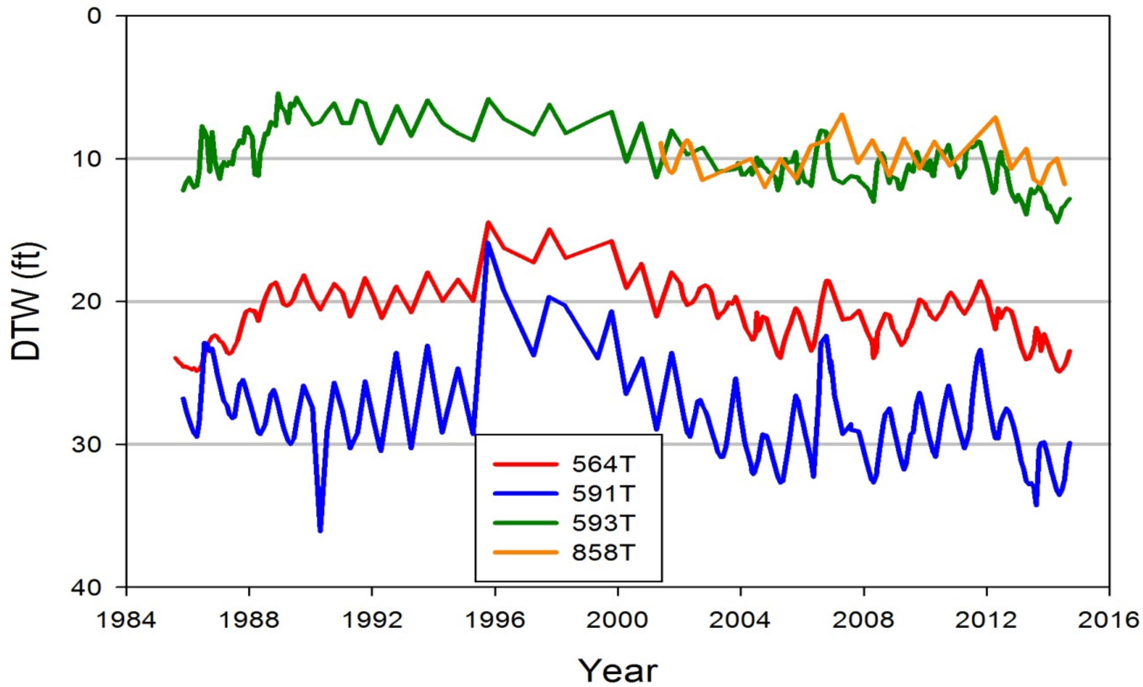


Figure 3.28. Hydrographs of selected test wells in the Lone Pine wellfield.

Shallow Groundwater Adjacent to the Lower Owens River Project (LORP)

Base flows of 40 cubic feet per second were established in the lower Owens River in the 2007-2008 runoff-year. Five periods of higher flows to promote habitat have also been released down the Owens River channel. The effect of re-watering the LORP channel on the adjacent shallow aquifer was monitored to gain information on the surface-groundwater interaction as the project was implemented (Figures 3.29 and 3.30). A selected number of test wells along with the distance from the river channel are listed in Table 3.3. Three test wells are adjacent to a previously dry reach of the river and three are adjacent to the reach south of Billy Lake previously wetted by diversions from Los Angeles aqueduct or from groundwater discharge. Shallow groundwater levels rose quickly in all wells in 2007 in response to the establishment of base flows in the Lower Owens River. The increase in shallow water levels due to the LORP has resulted in groundwater levels near or above the highest levels experienced since 1972 except for 442T. Not surprisingly, the largest increases occurred in wells adjacent to previously dry channel. Water levels have essentially reached equilibrium with the new flow regime.

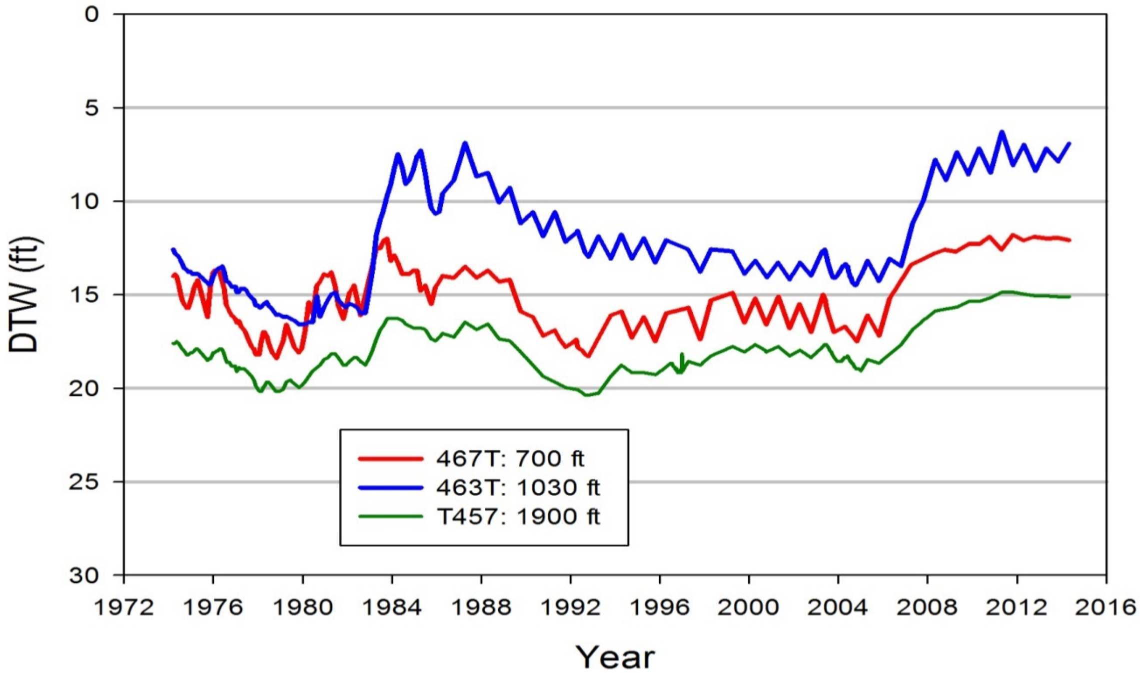


Figure 3.29. Hydrographs of selected test holes adjacent to the previously dry section of the Lower Owens River channel.

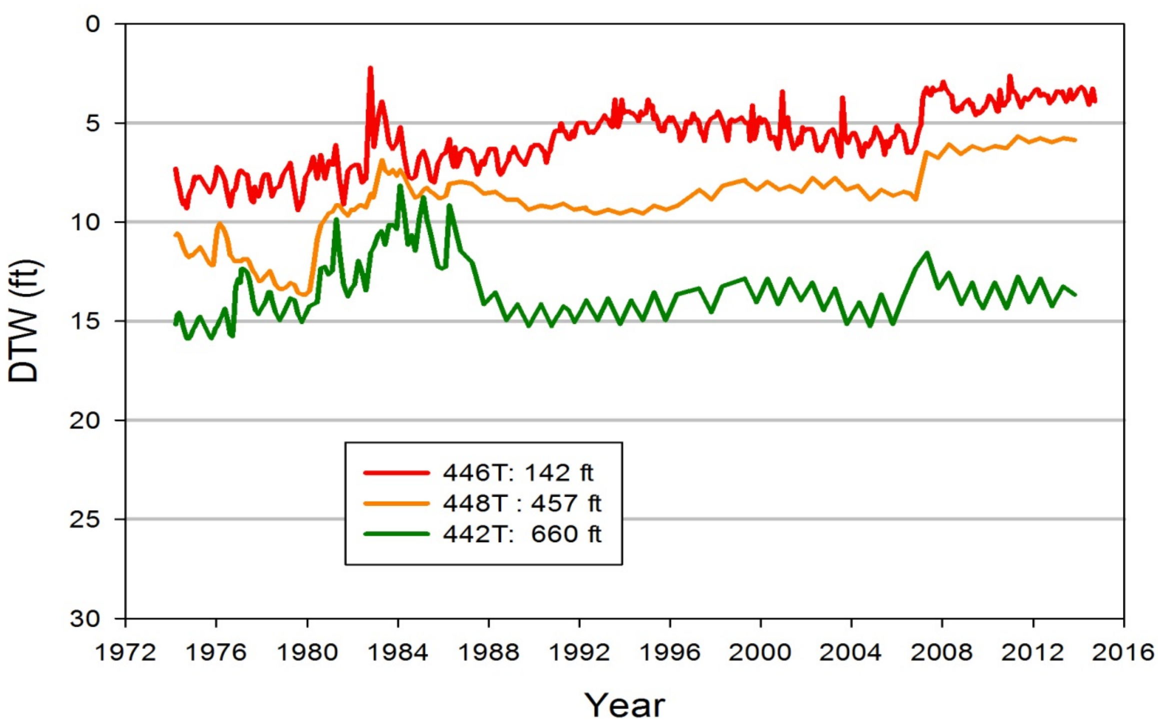


Figure 3.30. Hydrographs of selected test holes adjacent to the previously wetted section of the Lower Owens River channel.

Table 3.3. Selected shallow monitoring wells adjacent to the Lower Owens River Project.

Test Well	Pre-LORP channel condition	Distance from River Channel
		(ft)
467T	Dry	700
463T	Dry	1070
457T	Dry	1900
446T	Wet	142
448T	Wet	457
442T	Wet	660

Evaluation of 2014 DTW predictions

The Water Department routinely uses linear regression models to predict the effects of pumping on depth to water table (DTW) as part of its analysis of LADWP's annual operations plans. Periodically, we examine the accuracy of our models by comparing the predictions with DTW measurements collected the following year on April 1. The regression models were constructed from historical data for wellfield pumping, Owens Valley runoff, and current water levels. The models in Laws rely on an estimate of the diversions into the McNally canals instead of Owens Valley runoff as the variable related to groundwater recharge. For ten permanent monitoring sites, a second model was used that relies on predicted DTW in a nearby indicator well that responds similarly to pumping and runoff. The models were originally developed by Harrington (1998) and Steinwand and Harrington (2003). These reports are available on the Water Department website.

This analysis of the predictions includes uncertainty in the input variables (runoff forecast and planned pumping) as well as uncertainty in the models. Model uncertainty includes all management actions and environmental conditions not captured in the regression model e.g. atypical recharge or pumping operations near one of the test wells. In 2014-15, LADWP prepared operations plans for the April-September period and a final plan for the October-March period. The regression models operate on an annual time step and the County's analysis of LADWP's operations plan in April unavoidably included estimates of LADWP's distribution of the annual pumping amounts among wellfields. When LADWP's final proposed pumping amounts were available in October, the County revised its DTW predictions. Predictions for 43 wells made in October 2014 were examined for this report. Analysis of the October predictions isolates the evaluation of model accuracy from the uncertainty in the April estimates of annual pumping.

The predicted DTW values were based on the high pumping amount planned by LADWP in the October 2014-15 pumping plan. Wellfield pumping totals for the year were within 400 acre feet of the planned amounts in the wellfields with indicator wells; discrepancies in planned and actual pumping should be a small factor in the accuracy of model predictions. Actual and planned pumping differ

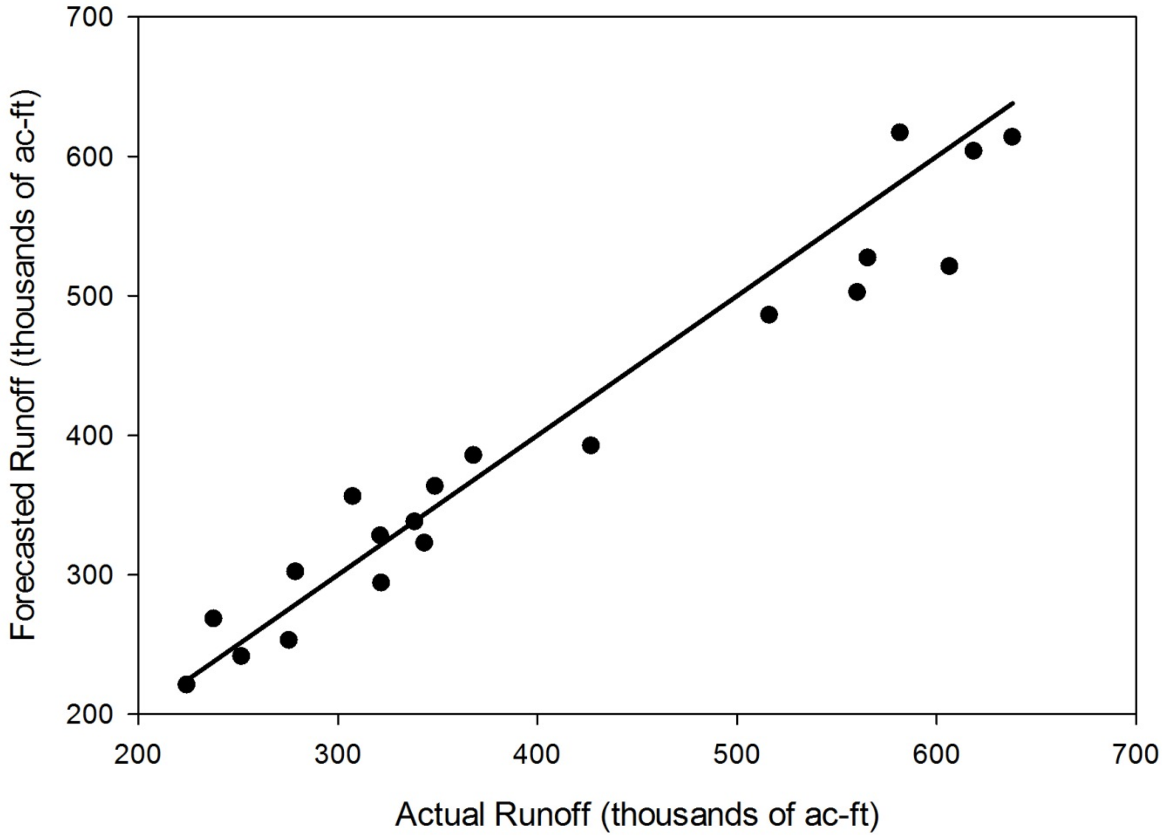


Figure 3.31. Comparison of actual and forecasted runoff 1994-2013 runoff years. During this period, LADWP has revised the method to forecast runoff, but there was no discernible trend (better or worse) in the accuracy of the forecasts over time. Runoff in 2013 is the point on the graph with the lowest actual runoff.

by more than 800 ac-ft in the Bishop wellfield, but pumping is subject to the Hillside Decree limitations and is not analyzed using indicator wells. The model predictions also rely on forecasted Owens Valley runoff and unavoidably include the uncertainty in that prediction. The LADWP runoff forecast has tracked actual runoff well since 1994 (Figure 3.31), and therefore the contribution to model uncertainty is small. The average absolute deviation is approximately 27,000 ac-ft (mean runoff is 406,372 ac-ft for the period), and on average the forecasted and actual runoff values differ by 7% of the actual value.

Model performance in 2014-15 was satisfactory and comparable to previous years. Measured and predicted change in DTW are plotted in Figure 3.32. If the models were perfect predictors, the points in Figure 3.32 would fall on the 1:1 line between the lower left and upper right quadrants. Most points were in the correct quadrant and of the 43 wells, actual and predicted DTW in 31 wells differed by less than 1 ft, and 38 differed by less than 1.5 ft. The average of the actual deviation for all monitoring wells was 1.15 ft, but the value is skewed upward by the few outliers in the TA wellfield near the Blackrock hatchery (417T,

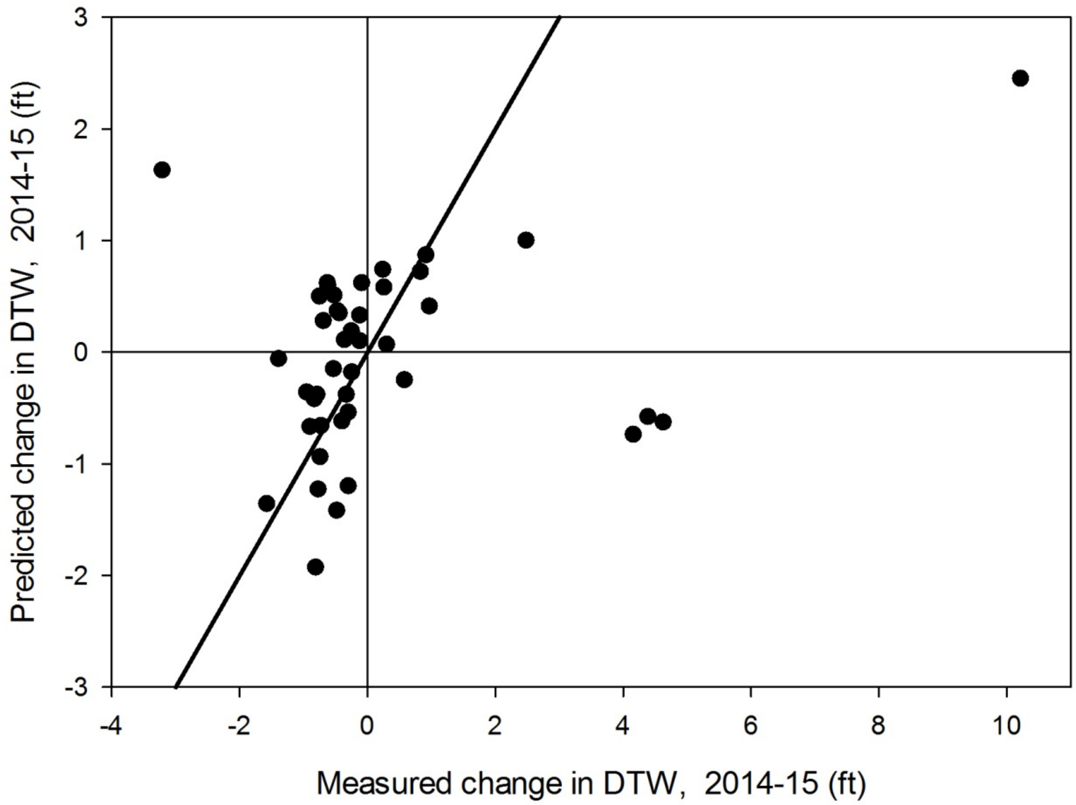


Figure 3.32. Measured and predicted change in DTW from April 2014 to April 2015 for 43 indicator wells and monitoring site wells. The solid line is the 1:1 line. Negative values denote a decline in water level.

505T, and 803T). Small declines were predicted but water levels rose substantially following reduction in hatchery pumping. Those monitoring wells are affected by the hatchery pumping, but the models do not include hatchery pumping. Without those expected outliers, the average absolute deviation was 0.85 ft which is comparable to previous years. Two other wells were outliers. The prediction for Well 415T in the Thibaut-Sawmill wellfield near the hatchery was substantially in error (7.77 ft). This was not expected although the historical data upon which the model is derived only include a single year with pumping as low as in 2014. The prediction for 107T was also in error (2.80 ft). This is the second year in a row that the water level was predicted to rise but actually declined. The DTW in 2014 and 2015 was at the extreme range (deep DTW) of historical DTW data in the model. In both cases, poor model performance may be ascribed to conditions (pumping and DTW) being at or outside the range of conditions upon which the models were based.

As mentioned previously, for ten wells, two regression models were used sequentially to predict DTW which introduced an additional source of uncertainty in predictions for those wells.

Table 3.4. Planned LADWP pumping by wellfield for April-October 2015. Minimum pumping and 2015-16 annual total estimated by Inyo County to evaluate the plan also included. The annual total estimated by Inyo was derived to evaluate the draft pumping plan. Approximately 3500 ac-ft of additional pumping was added in LADWP's final plan.

Wellfield	Estimated Minimum Pumping (ac-ft)	Planned Pumping for Apr-Sept. 2015-2016 (ac-ft)	Inyo Estimate for 2015-16 (ac-ft)
Laws	6,460	5,837-7,037	7,350
Bishop	10,600	7,306-8,806	10,800
Big Pine	20,400	10,104-12,334	22,500
Taboose-Aberdeen	300	1,423-6,203	6,855
Thibaut-Sawmill	8,400	3,996-4,246	8,300
Ind.-Oak	5,900	5,516-8,116	9,000
Symmes-Shepherd	1,200	1,181-4,111	3,140
Bairs-Georges	500	659-944	1155
Lone Pine	775	760	900
Total	54,535	36,782-52,557	70,000

The average absolute deviation for the predictions based on one model and two models were 1.15 ft and 0.92 ft, respectively. Given the similar accuracy of the two sets of wells, relying on the paired regressions was not a large source of additional uncertainty.

2015-16 Pumping Plan

LADWP issued a first half of the year operations plan for the 2015-16 runoff year on April 20, 2015. Forecasted runoff for the Owens River watershed smashed the previous record for low runoff at 148,600 ac-ft (36% of normal) and is the fourth year of record or near record drought. LADWP's plan provided a range of planned pumping for the first six months; the range between the lower and upper limit was up to several thousand acre-feet in some cases (Table 3.4). In the draft plan, projected total pumping for the entire runoff year of 2015-2016 was estimated to be 70,000 ac-ft. In the final plan pumping in the first 6 months increased 3,537 ac-ft and the annual total was represented as in the low 70,000's ac -ft. The additional planned pumping was distributed among the Big Pine, Taboose-Aberdeen, Independence, and Symmes-Shepherd wellfields. The annual planned pumping will not be known with certainty until the second pumping plan is released in October 2015.

The Water Department analyzed the effect of the operations plan on groundwater levels in the valley using regression models for several monitoring wells (Table 3.3). Most models rely on measured depth to water in April 2015, planned wellfield pumping for the entire runoff year (which this year was only an estimate), and Owens Valley runoff to predict water levels next April. For several wells, Owens Valley runoff was not a statistically significant variable in the regression model. Water levels in those wells are correlated with pumping, and the models are still useful for evaluating the pumping plan. Models in Laws use the amount of water diverted from the Owens River into the McNally canals as the variable associated with recharge. The quantity of water diverted into the McNally canals was estimated from LADWP's annual estimated spreading in Laws provided in Chapter 3 of their 2014 annual report. No spreading is planned for 2015-16 which is not unusual given the extremely low runoff forecast.

The models used by the Water Department to analyze the annual operations plan predict water levels one year in the future (e.g. April 2015 to 2016) based on annual pumping for each wellfield. The models cannot be used to analyze changes over a shorter period. However, the information provided in the pumping plan allowed the Water Department to estimate annual pumping with sufficient accuracy to apply the models. LADWP's proposed pumping for April-September ranges between 36,782 and 52,557 ac-ft. LADWP also suggested that the maximum pumping for 2015-16 will be approximately 70,000 ac-ft.

The Water Agreement and Green Book include procedures to calculate a pumping limit to prevent groundwater mining to ensure no long term decline in aquifer storage. The mining calculation is a comparison of pumping and recharge for each wellfield on a water year basis (October 1st through September 31st) for a 20 water year period. The 19.5 year total of actual pumping is subtracted from 20 years of estimated recharge to arrive at an estimated April-September pumping limit for each wellfield and Owens Valley as a whole. The preliminary recharge estimate for the 2015 water year is 82,374 ac-ft and planned pumping in each wellfield is not expected to violate the groundwater mining provision. In the Big Pine wellfield, however, pumping has exceeded recharge each of the previous four years. Pumping has been relatively constant at a high level, and the start of the deficit coincides with the onset of the severe drought. This does not constitute a violation of the groundwater mining provision, but the Water Department suggested that pumping in this wellfield be curtailed to include only sole source uses. LADWP did not reduce pumping in this wellfield; the growing deficit in the Big Pine wellfield is concerning and will be monitored carefully.

Minimum pumping for necessary uses during the fall and winter months is approximately 17,265 ac-ft. That estimate for winter pumping consists of town and hatchery supply and stockwater and environmental project supply on the Bishop Cone. It assumes there will be no extension of irrigation reliant on pumped water into October. The sum of the low range proposed summer pumping and minimum pumping during the water was 54,005 ac-ft, almost the same as the minimum annual pumping estimated by the County in past years (54,535 ac-ft). The sum of the high range of proposed pumping and the minimum pumping during the winter is approximately 66,285 ac-ft, approximately the annual total anticipated by LADWP. Actual pumping distributions among wellfields may differ from the modeled values, but the assumptions to derive the values in Table 3.3 are reasonable enough to utilize the models to evaluate LADWP's proposal. The uncertainty in how the pumping will be apportioned over the winter among wellfields with available allowable pumping is discussed below.

Minimum and proposed pumping are similar in Laws; water levels are predicted to change less than one foot (rise or fall) in all but one monitoring well in 2014-15 (Table 3.4). As discussed above, the indicator well 107T has

Table 3.5. Predicted water level changes at indicator wells and monitoring sites for estimated amounts of LADWP's annual pumping for 2015-16 and estimated minimum pumping required for sole source uses. Negative DTW values denote a decline. Baseline is the average of April water levels in 1985-87.

Wellfield Monitoring well	Predicted change in DTW: 70,000 ac-ft (ft)	Predicted change in DTW: 53,365 ac-ft (ft)	2016 predicted dev. from baseline: 70,000 ac-ft (ft)
Laws			
107T	1.82†	2.32	-10.35
436T	0.40	0.62	-5.16
438T	0.42	0.61	-6.15
490T	-0.31	-0.21	-4.74
492T	-0.76	0.02	-4.49
795T, LW1	Dry	Dry	Dry
V001G, LW2	Dry	Dry	Dry
574T	0.74	0.81	-3.35
Big Pine			
425T	-1.36	-1.04	-8.49
426T	-0.91	-0.72	-6.53
469T	-0.12	0.07	-3.94
572T	-0.58	-0.21	-4.73
798T, BP1	0.35	0.65	-3.93
799T, BP2	0.03	0.23	-4.07
567T, BP3	-1.65	-1.37	-9.31
800T, BP4	-0.99	-0.70	-7.71
Taboose Aberdeen			
417T	NA	NA	NA
418T	-0.64	-0.07	-2.51
419T, TA1	-1.38	0.00	-3.82
421T	-1.33	0.08	-5.52
502T	-0.33	0.32	-5.18
504T	-1.53	0.19	-3.75
505T	NA	NA	NA
803T, TA6	NA	NA	NA
586T, TA4	-0.62	0.54	-2.76
801T, TA5	0.67	1.00	-0.17
Thibaut Sawmill			
415T	NA	NA	NA
507T	0.68	0.73	0.32
806T, TS2	3.45	3.54	1.22
[Continued on the next page]			

Wellfield Monitoring well	Predicted change in DTW: 70,000 ac-ft (ft)	Predicted change in DTW: 53,365 ac-ft (ft)	2016 predicted dev. from baseline: 70,000 ac-ft (ft)
Independence Oak			
406T	0.15	0.54	-4.15
407T	0.30	1.41	-8.05
408T	-0.02	0.74	-3.91
409T	0.34	3.12	-11.25
546T	-0.31	0.21	-7.73
809T, IO1	-2.57	-1.72	-12.46
Symmes Shepherd			
402T	-0.10	0.15	-4.09
403T	-0.15	0.54	-3.85
404T	0.46	0.72	-2.98
510T	0.51	0.76	-2.88
511T	0.51	0.77	-4.57
447T	-1.18	0.40	-22.9
646T, SS2	Dry	Dry	Dry
V009G, SS1	0.22	1.60	-18.97
Bairs George			
398T	-0.69	-0.05	-0.38
400T	0.31	0.43	-0.52

†: *Values in this table are only significant to 0.1 ft. Extra digits are presented for transparency*

been overestimating the water table recovery in each of the last two years. It is probable that it will perform similarly this year. In Big Pine, water levels are predicted to decline 1 to 1.5 ft in most wells. At minimum pumping most wells are expected to decline. Water levels could be 0.2-0.4 ft deeper than shown in Table 3.4 if LADWP increases pumping this summer as proposed in the final Pumping Plan and/or operate wells 218W or 219W for export this winter. In Taboose-Aberdeen, water levels are predicted to decline 0.5 to 1.5 ft. At minimum pumping water levels would change little. Water levels could be 0.3-0.9 ft deeper if LADWP chooses to pump more than assumed during the winter. In the Thibaut-Sawmill wellfield, water levels are predicted to increase, largely in response to the reduction in hatchery pumping. In Independence-Oak, water levels are expected to change little. If pumping were reduced to the minimum, water levels could rise. Water levels could be 0.8 ft deeper if LADWP chooses to pump more than assumed during the winter. Water levels in Symmes-Shepherd are expected to rise slightly or decline approximately one foot. It is likely that water levels will actually be about 1 ft deeper than predicted because of the higher pumping included in the pumping plan and potential for pumping during winter for export and freeze protection. In Bair-George wellfield, water levels are expected to remain stable. It is possible that water levels may decrease an additional 1 ft if LADWP chooses to pump more than assumed during the winter.

The Water Department did not object to LADWP's operations plan given the extremely low runoff conditions, relatively low proposed pumping, and predicted stable or small DTW declines (<1.5 ft) in most wellfields. The County evaluated the annual estimated pumping contained in LADWP's draft plan (70,000). Approximately 3,500 ac-ft of additional pumping was proposed in final plan. We expect the additional pumping will cause water levels to be 0.3-1.0 deeper than shown in table 3.4 for Big Pine, Taboose-Aberdeen, Independence-Oak, Symmes-Shepherd, or Bairs-George wellfields. The predicted changes in DTW will be reanalyzed in October when the annual planned pumping is more certain. The draft and final operations plans and recommendations provided by Inyo County are available on the Water Department website.

References

Harrington, R. F., Multiple regression modeling of water table response to groundwater pumping and runoff, Inyo County Water Department report, 1998.

Steinwand, A.L, and R.F. Harrington. 2003. Simulation of water table fluctuations atpermanent monitoring sites to evaluate groundwater pumping. Report to the Inyo/LosAngeles Technical Group, February 25, 2003.

SECTION 4: SOIL WATER CONDITIONS

Introduction

The purpose for monitoring soil water and the On/Off procedures is to manage pumping to protect plant communities that require periodic access to the water table for long-term survival.

The Water Agreement established procedures to determine which LADWP pumping wells can and cannot be operated based on soil water and vegetation measurements (On/Off status). As part of the monitoring effort for the Agreement, the ICWD regularly measures depth to groundwater (DTW) and soil water content at 25 sites in wellfields and eight sites in control areas. Three of the wellfield sites are not used to determine the operational status of nearby pumping wells but are monitored to continue the data record. Each site is equipped with 1 to 6 soil water monitoring locations. Soil water measurements are collected using a neutron gauge calibrated for each site (Dickey, 1990; Steinwand, 1996).

The purpose for the On/Off procedures is to manage pumping to protect plant communities that require periodic access to the water table for long-term survival. Generally, the sites with On-status have wet soil and shallow water tables, and sites in Off-status have dry soil and deep water tables. If the avail able soil water exceeds the estimated vegetation water demand (transpiration derived from the vegetation transect leaf area index, the site can remain in On-status. LADWP pumping wells linked to On-status sites can be operated. If on July 1 or October 1, the available soil water is less than necessary to support the vegetation, the site is in Off status. Sites remain in Off status until the available soil water recovers to the amount of water required by the vegetation at the time the site went Off.

Because the On/Off status is a comparison soil water and transpiration, it sometimes is an unreliable indicator of whether groundwater conditions are adequate or whether water table recovery is necessary. To assist the evaluation of LADWP pumping proposals, the Water Department examined the DTW and soil water data to determine whether groundwater is accessible to plants at the permanent monitoring sites at the beginning of the 2015 growing season.

How well plants can access groundwater depends on the vegetation type as well as water table depth. 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 in the Water Agreement, shrub-dominated sites are assigned a root zone of 4 m (13.1 ft.); grass-dominated or mixed grass and shrub assemblages are assigned a root zone of 2 m (6.6 ft.). These approximate values are not the actual rooting depth at a particular monitoring site, but they are useful to compare with the soil depth that received recharge from groundwater.

Soil water in the root zone can be supplied by infiltration from the surface (rain or irrigation) or from contact with the water table. It is usually possible to discriminate deeper soil affected by groundwater from soil near the surface affected by infiltration based on the depth and timing of the measured changes in soil water content. Plant roots can utilize groundwater directly, and if the water table is within the root zone it is reasonable to conclude that groundwater is available. A rising water table can progressively wet the root zone from below and provide water to plants. Plant roots can also tap groundwater that is drawn into the soil above the water table by capillarity where it is held in soil pores or adsorbed to soil particles. Plant uptake during the summer depletes soil water, and when transpiration ceases in the fall, water from the moist soil above the water table will replenish the drier soil in the root zone via capillarity or through inactive plant roots even if the water table is stable or declining. This is a slow process and usually provides much less soil water recharge than a rising water table.

Results

Monitoring results for available soil water, vegetation water requirement, water table depth, and the On/Off status for all sites are presented in the figures contained at the end of this section. At the beginning of the 2014-15 runoff year, six sites were in On-status, and remained so throughout the runoff year. No sites went into On-status during the winter 2014-15. The six sites in On-status as of May, 2015 were: L2, BP4, TA5, TS2, SS1, and BG2.

Hydrographs for the permanent monitoring sites are presented in at the end of this section, and the minimum (shallowest) DTW measured during the fall and winter preceding the 2014 and 2015 growing seasons are presented in Table 4.1. The minimum DTW is a useful measurement because it is associated with the amount of groundwater recharge in the root zone before the beginning of the growing season. At most sites, the minimum DTW occurs in the spring. At sites BP1, 2, and 3 in Big Pine, the water table rises during the summer and reaches a minimum in the fall coinciding with the timing of diversions into the Big Pine canal for irrigation. For these three sites, the amount and depth of soil water recharge during the winter are related to the minimum water table depth in the fall. Of the 33 monitoring sites, TA1 and TA2 rely on a single monitoring well, and the monitoring well at SS2 was dry in 2014 and 2015 preventing evaluation of water table changes for that site. Water table changes were examined at 31 sites; 23 in wellfields and eight outside wellfields.

The water table was deeper at 20 sites in 2015 compared with 2014 (Table 4.1) although the declines in general were smaller this year than last. Groundwater pumping in 2014-15 was reduced, so generally stable water levels were expected despite the severity of the ongoing drought (see the Groundwater section of this report). The water table at control sites declined at all but TAC although the declines were small (average -0.13m or -5 inches). The water table declined at about half (13) of the wellfield sites. The average water table change in wellfields was slightly positive (0.05m or 2 inches), but the average was skewed by the large water table recovery at TA3 and TA6 due to the reduction in pumping to supply the Blackrock fish hatchery. For nearly all sites, water levels rose or declined less than 0.3m (1 ft); only BP3 and TS6 experienced declines greater than 0.5 m.

At most sites it was possible to discriminate groundwater recharge from surface infiltration because of the dry winter in 2014-15 (Tables 4.2 and 4.3). Infiltration was limited to depths within 0.3-0.5 m of the surface at most sites and resulted in negligible increase in soil water. The monitoring sites were grouped into simple categories to

Table 4.1. Minimum DTW during the fall and winter preceding the growing seasons in 2014 and 2015. Depths are in meters below ground surface. Positive values denote a rise in the water table.

Wellfield/Site	2014 DTW (m)	2015 DTW (m)	DTW Change 2014-15 (m)
Laws			
L1	8.22	Dry at 8.28	--
L2	7.45	Dry at 7.53	--
L3	5.32	5.54	-0.22
Bishop Control			
BC1	3.18	3.32	-0.14
BC2	4.53	4.60	-0.07
BC3	1.52	1.83	-0.31
Big Pine			
BP1	4.84	4.76	0.08
BP2	6.24	6.41	-0.17
BP3	5.29	6.07	-0.78
BP4	5.79	6.02	-0.23
Taboose Aberdeen			
TA1 & 2	2.11	2.27	-0.16
TA3	6.56	5.58	0.98
TA4	2.99	3.11	-0.12
TA5	4.87	5.03	-0.16
TA6	4.71	3.44	1.27
TAC	1.41	1.40	0.01
Thibaut Sawmill			
TS1	6.23	6.01	0.22
TS2	4.26	4.33	-0.07
TS3	2.41	2.91	-0.5
TS4	2.48	2.27	0.21
TS6	5.01	Dry at 5.66	--
TSC	1.14	1.32	-0.18
Independence Oak			
IO1	4.44	4.68	-0.25
IO2	10.28	9.92	0.36
IC1	0.99	1.15	-0.16
IC2	2.44	2.50	-0.06
Symmes Shepherd			
SS1	7.03	6.75	0.28
SS2	Dry @ 8.41	Dry at 8.41	--
SS3	4.33	4.32	0.01
SS4	6.47	6.56	-0.09
Bairs George			
BG2	5.59	5.35	0.24
BGC	2.87	2.97	-0.1

Table 4.2. Soil depth below ground surface replenished by groundwater in 2014-2015 at control sites. Values are provided for each monitoring location within a site. DTW was measured in the associated test well, and the values do not account for elevation differences between the well and monitoring site.

Site	Dominant plant species	Root Zone (m)	Minimum DTW (m)	Groundwater recharge depth (m)
BC1	rabbitbrush, saltbush, greasewood, alk. sacaton	4	3.32	2.9, 1.9, 2.7
BC2	rabbitbrush, saltgrass	2	4.60	<1.3†, <1.3, <1.1, 0.5
BC3	rabbitbrush, saltgrass, saltbush	2	1.83	0.3, 0.3, 0.3
TAC	saltbush, rye grass, saltgrass, alk. sacaton	2	1.40	0.5, 0.7, 0.7, 0.7
TSC	alk. sacaton, rabbitbrush, greasewood	2	1.32	0.9, 0.7, 0.9
IC1	saltbush, saltgrass, rabbitbrush	2	1.15	1.1, 0.9, 0.9
IC2	rabbitbrush, alk. sacaton	2	2.50	2.3, 2.3, >3.7
BGC	saltbush, saltgrass	4	2.97	1.1, 1.5, >3.3

†: Less than symbols (<) denote locations where both infiltration and groundwater recharge contribute to increasing soil water content above the depth indicated

summarize the connection between soil water in the root zone and the water table. Brief descriptions of the three categories and the results are given below:

1. Connected: Water table fluctuations resulted in soil water recharge in the top half of the root zone at most monitoring locations within a site. Two wellfield and six control sites were placed in this category.

2. Partially connected: Water table fluctuations resulted in soil water recharge in the bottom half of the root zone at most monitoring locations within a site. One control and three wellfield sites occur in this category. The control sites and L3, TA1, and TS3 have ample soil water stored in the soil profile.

3. Disconnected: No recharge from groundwater occurred in the root zone. Twenty wellfield sites and one control site occur in this category. The control sites and L2, BP4, TA4, TA5, IO1, SS3, and BG2 had retained soil water available to vegetation, but the water table at the beginning of the 2015 growing season is too deep to recharge the root zone. Soil at the other sites is dry.

Two sites were placed in a wetter category in 2015 compared with 2014, BC2 and TS4. In 2014-15, control site IC2 exhibited stable soil water conditions and groundwater recharge was only noticeable below the 2m root zone (Figure 4.1). Other control sites had similar or slightly drier soil conditions but all control sites still had ample retained water in the soil above the water table. At the beginning of the 2015 growing season, the water table was capable of supplying water to the root zone at five wellfield monitoring sites Figure 4.1). Twenty wellfield sites were classified as disconnected including one site added this year,TS6. Eight sites in the disconnected category still retain soil water following water table decline (L2, BP4, TA4, TS6, IO1, SS3, and BG2) or because the plant cover is low and the soil is always

Table 4.3. Soil depth below ground surface replenished by groundwater in 2012-2013 at wellfield sites. Values are provided for each monitoring location within a site unless the identification of a specific depth was uncertain. DTW was measured in the associated test well, and the values do not account for elevation differences between the well and monitoring site.

Site	Dominant plant species	Root Zone (m)	Minimum DTW (m)	Groundwater recharge depth (m)
L1	Greasewood	4	Dry at 8.28	3.5†, >3.9, 3.5†
L2	alk. sacaton, greasewood, saltbush	2	Dry at 7.53	>3.9 at all five locations
L3	alk. sacaton, saltgrass	2	5.54	0.9, >3.9, 1.1, 0.7, 1.1, 1.3
BP1	saltbush, greasewood	3	4.76	>3.7, >3.3, 2.3†, 3.7, >3.9
BP2	saltbush, rabbitbrush	4	6.41	>5.3, >3.9, >3.9
BP3	greasewood, rabbitbrush	4	6.07	>3.9, 3.1, >3.9
BP4	saltbush, greasewood	4	6.02	2.1†, >3.9, 1.9†
TA1	alk. sacaton, saltbush	2	2.27	1.3
TA2	alk. sacaton, saltbush, greasewood, rabbitbrush	2	2.27	0.9
TA3	saltbush, alk. sacaton, sagebrush	2	5.58	>3.9, 2.1†, >3.9
TA4	rabbitbrush, alk. sacaton	2	3.11	0.7†, 0.9†, >1.9
TA5	greasewood, alk. sacaton	2	5.03	
TA6	saltbush, rabbitbrush	2	3.44	3.1, 3.1, 3.1
TS1	weeds, alk. sacaton	2	6.01	>3.9 at all five locations
TS2	sagebrush, saltbush, alk. sacaton	2	4.33	3.3, >3.9, >3.3
TS3	saltgrass, alk. sacaton	2	2.91	0.7, 1.5, 1.1, 1.1, 1.1, 0.9
TS4	greasewood, alk. sacaton, saltbush, saltgrass	2	2.27	0.3†, 0.5†, 1.1, 0.9
TS6	alk. sacaton, saltbush, saltgrass	2	Dry at 5.66	>3.9
IO1	rabbitbrush, alk. sacaton, saltbush	2	4.68	1.9-2.3†, 1.7-2.1†, 1.1-2.3†
IO2	saltbush	4	9.92	>5.5, >3.9, >3.9
SS1	saltbush, greasewood	4	6.75	>5.5, >3.9, >3.9
SS2	saltbush	4	Dry at 8.41	>5.5, >3.9, >3.9
SS3	saltbush	4	4.32	>3.9, 3.3, >3.9
SS4	saltbush	4	6.56	>3.9, >3.9, >3.9
BG2	inkweed, saltbush	4	5.35	>3.9, >3.5, >3.7

†: Soil water content at these depths increases slightly during winter well above the limit of capillarity above the water table suggesting that another recharge mechanism is operating.

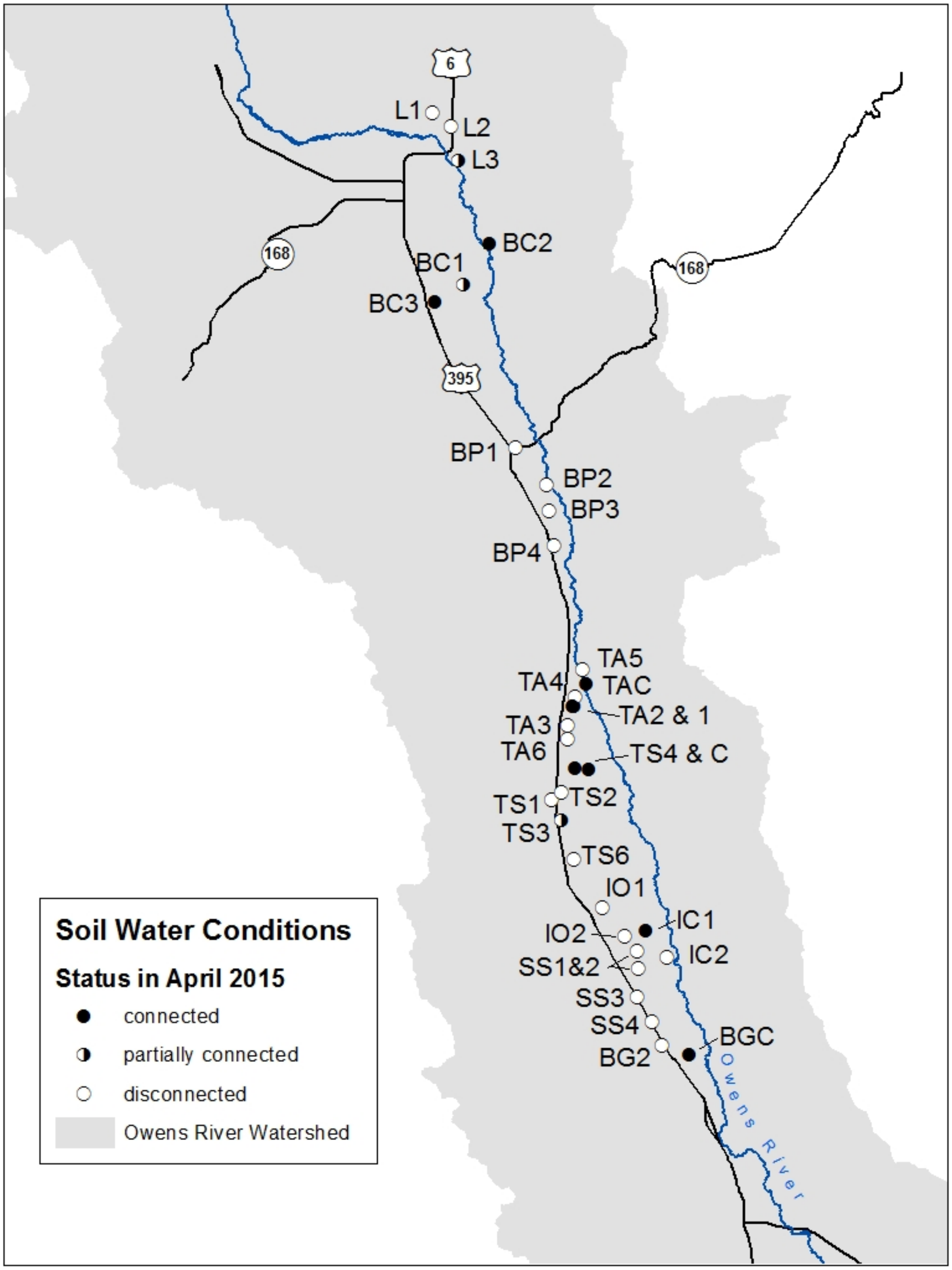


Figure 4.1. Owens Valley permanent monitoring sites and groundwater recharge classes. It is difficult to distinguish TA1 and TA2 on this map because of their proximity to one another. TA1 is partially connected; TA2 is connected.

moist (TA5). The remaining 12 sites have dry soil throughout the root zone.

As in previous years, interpretations for TA5 were atypical. Soil at this site was moist at lower depths but relatively unchanging. Plant uptake during the summer was not evident below two meters, and soil water recovery when plant uptake ceased in the fall or related to water table fluctuations was not evident. The DTW at TA5 is much below the 2m root zone, and the site was classified as disconnected as it was in 2014.

Monitoring locations at six sites, L1, BP1, BP4, TA3,TA4, TS4, and IO1 exhibited increasing soil water content at certain depths well above the water table while lower depths showed no change in water content. Simple capillary rise to recharge shallower depths while not affecting unsaturated soil just above the water table is unusual. Water can be transported during winter from wetter, deeper soil layers through plant roots to recharge dry soil at shallower depths (Horton and Hart, 1998; Jackson et al., 2000) but without additional information, assigning that cause is speculative. Regardless of the exact mechanism causing the increase in soil water, the monitoring and On/Off management was able to measure and account for that source of water.

References

Dickey, G.L. 1990. Field calibration of neutron gauges: SCS method. p. 192-201. In S.R. Harris (ed.) Irrigation and drainage. Proc. 1990 National Conference. Durango, Co., July 11-13, 1990. Am. Soc. Civil Eng., New York, NY.

Horton, J.L. and S.C. Hart. 1998. Hydraulic lift: a potentially important ecosystem process. Tree 13:232-235.

Jackson, R.B., J.S. Sperry, and T.E. Dawson. 2000. Root water uptake and transport: using physiological processes in global predictions. Trends Plant Sci. 5:482-488.

Steinwand, A.L, 1996. Protocol for Owens Valley neutron probe soil water monitoring program. Report to the Inyo/Los Angeles Technical Group, August 6, 1996.

Available Soil Water Graphs

July 1 and October 1 On/Off calculation tables for the permanent monitoring sites and graphs containing the soil-plant water balance and groundwater data and. No sites entered On status between October, 2013 and April 2014.

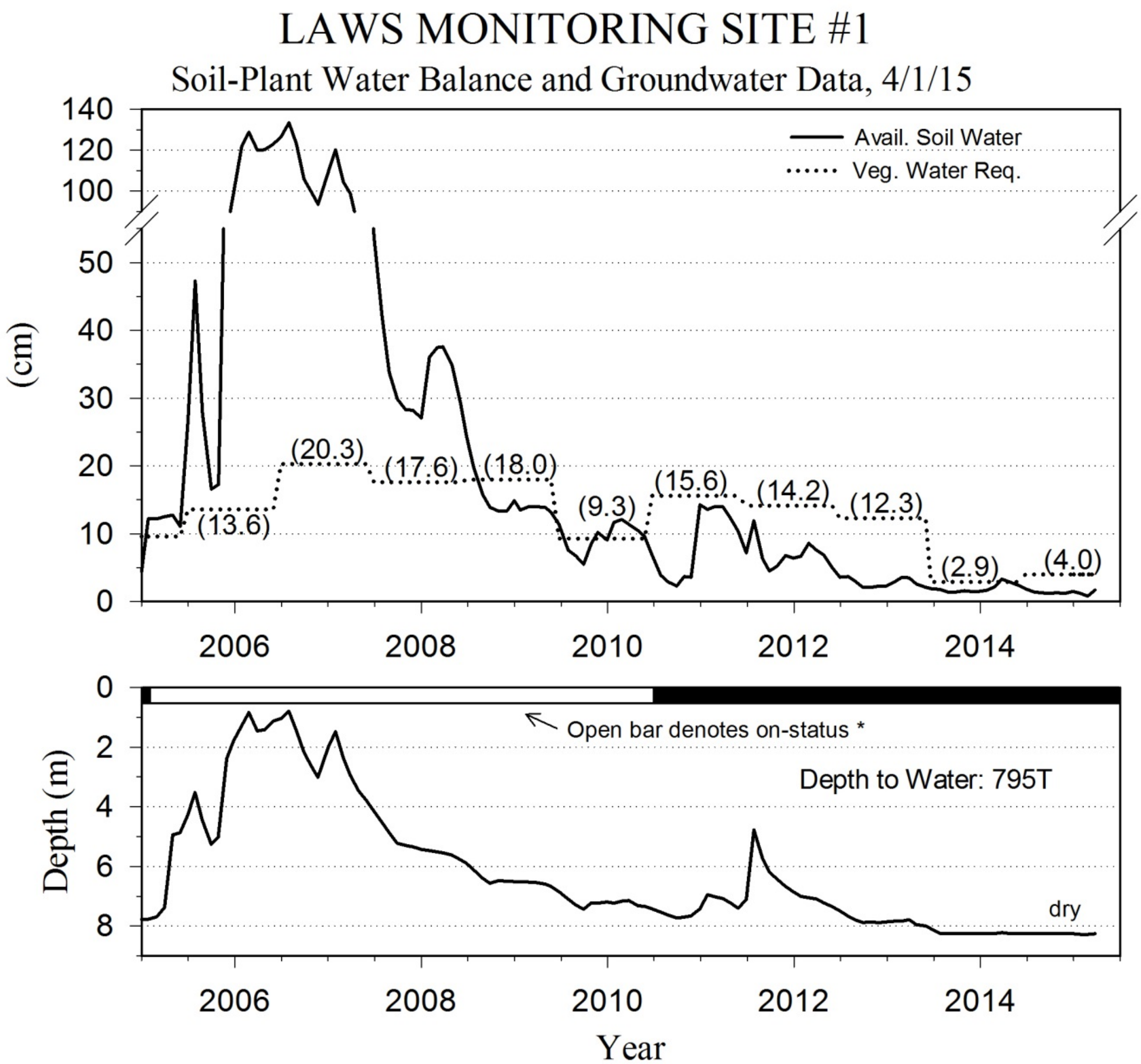
June 2014 monitoring site status and July 1 soil/vegetation water balance calculations according to Green Book, Section III.

Site	June, 2014 Status	July, 2014 Veg. Water Req./ Soil AWC for turn-on	July 2014 soil AWC	July 2014 Status	Soil AWC required. for well turn-on
		(cm)	(cm)		(cm)
L1	OFF	2.3/15.6	1.9	OFF	15.6, OFF 7-10
L2	ON	2.7/NA	12.1	ON	NA
L3	OFF	3.7/25.2	9.2	OFF	25.2, OFF 10-11
BP1	OFF	2.5/22.9	1.8	OFF	22.9†, OFF 10-97
BP2	OFF	7.2/28.4	1.5	OFF	28.4, OFF 7-98
BP3	OFF	5.3/10.6	3.1	OFF	10.6. OFF 7-12
BP4	ON	4.3/NA	41.2	ON	NA
TA3	OFF	11.6/26.0	6.6	OFF	26.0, OFF 10-11
TA4	OFF	4.8/23.3	14.4	OFF	23.3, OFF 10-11
TA5	ON	1.5/NA	21.6	ON	NA
TA6	OFF	7.3/17.6	9.4	OFF	17.6, OFF 10-11
TS1	OFF	4.0/20.4	1.5	OFF	20.4†, OFF 10-96
TS2	ON	3.3/NA	8.0	ON	NA
TS3	OFF	8.7/32.9	21.5	OFF	32.9, OFF 10-12
TS4	OFF	16.9/55.9	31.2	OFF	55.9, OFF 10-11
IO1	OFF	35.6/42.2	19.1	OFF	42.2, OFF 10-98
IO2	OFF	2.3/18.9	4.7	OFF	18.9, OFF 7-11
SS1	ON	5.8/NA	15.5	ON	NA
SS2	OFF	1.6/25.6	3.1	OFF	25.6, OFF 7-11
SS3	OFF	7.8/33.8	20.4	OFF	33.8, OFF 10-11
SS4	OFF	1.9/15.9	6.0	OFF	15.9, OFF 7-05
BG2	ON	1.4/NA	24.4	ON	NA

July 2014 monitoring site status and October 1, 2014 soil/vegetation water balance calculations according to Green Book, Section III.

Site	July 1, 2014 Status	October, 2014 Veg. Water Req./Soil AWC for turn-on	October 2014 soil AWC	+30% annual ppt.	October 1 2014 Status	Soil AWC req. for well turn-on
		(cm)	(cm)	(cm)		(cm)
L1	OFF	4.0/15.6	1.2	NA	OFF	15.6, OFF 7-10
L2	ON	4.7/NA	9.7	9.7 + 4.7 = 14.4	ON	NA
L3	OFF	6.8/25.2	7.5	NA	OFF	25.2, OFF 10-11
BP1	OFF	4.5/22.9	1.1	NA	OFF	22.9†, OFF 10-97
BP2	OFF	13.3/28.4	1.2	NA	OFF	28.4, OFF 7-98
BP3	OFF	9.4/10.6	2.6	NA	OFF	10.6. OFF 7-12
BP4	ON	7.6/NA	37.0	37.0 + 4.9 = 41.9	ON	NA
TA3	OFF	21.6/26.0	6.4	NA	OFF	26.0, OFF 10-11
TA4	OFF	8.9/23.3	13.2	NA	OFF	23.3, OFF 10-11
TA5	ON	2.7/NA	20.6	20.6 + 4.9 = 25.5	ON	NA
TA6	OFF	13.6/17.6	9.3	NA	OFF	17.6, OFF 10-11
TS1	OFF	7.4/20.4	1.4	NA	OFF	20.4†, OFF 10-96
TS2	ON	6.2/NA	6.8	6.8 + 4.4 = 11.2	ON	NA
TS3	OFF	16.0/32.9	18.1	NA	OFF	32.9, OFF 10-12
TS4	OFF	31.0/55.9	24.6	NA	OFF	55.9, OFF 10-11
IO1	OFF	66.1/42.2	12.3	NA	OFF	42.2, OFF 10-98
IO2	OFF	4.4/18.9	5.0	NA	OFF	18.9, OFF 7-11
SS1	ON	10.6/NA	12.6	12.6 + 3.9 = 16.5	ON	NA
SS2	OFF	3.0/25.6	3.4	NA	OFF	25.6, OFF 7-11
SS3	OFF	14.6/33.8	18.5	NA	OFF	33.8, OFF 10-11
SS4	OFF	3.5/15.9	11.5	NA	OFF	15.9, OFF 7-05
BG2	ON	2.5/NA	24.3	24.3 + 4.0 = 28.3	ON	NA

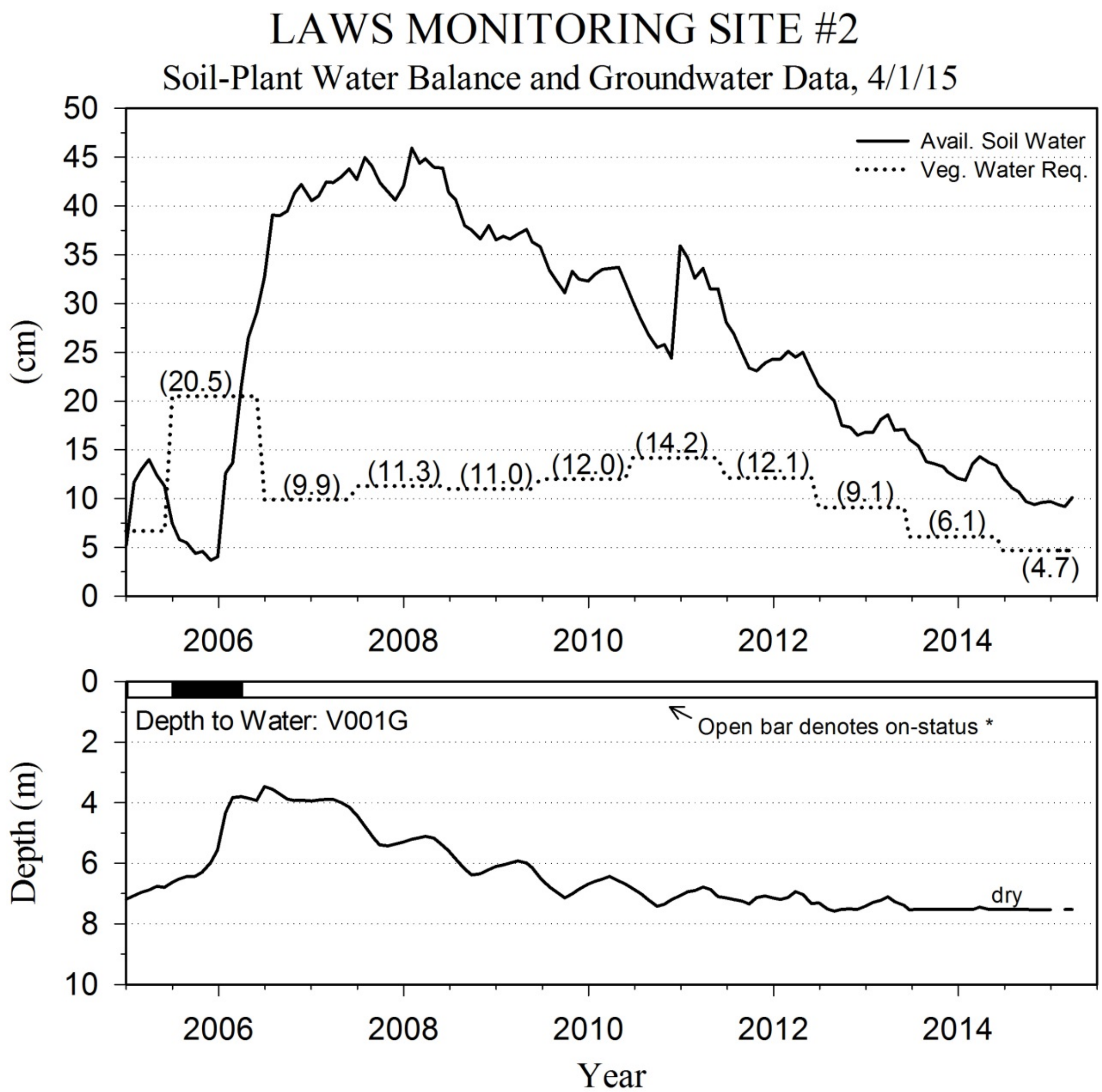
†: These values of soil water required for well turn-on were derived using calculations based on percent cover that were routinely performed in the past. The values have not been updated to conform with the Greenbook equations in section III.D.2, p. 57-59.



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells- 247, 248, 249, 398

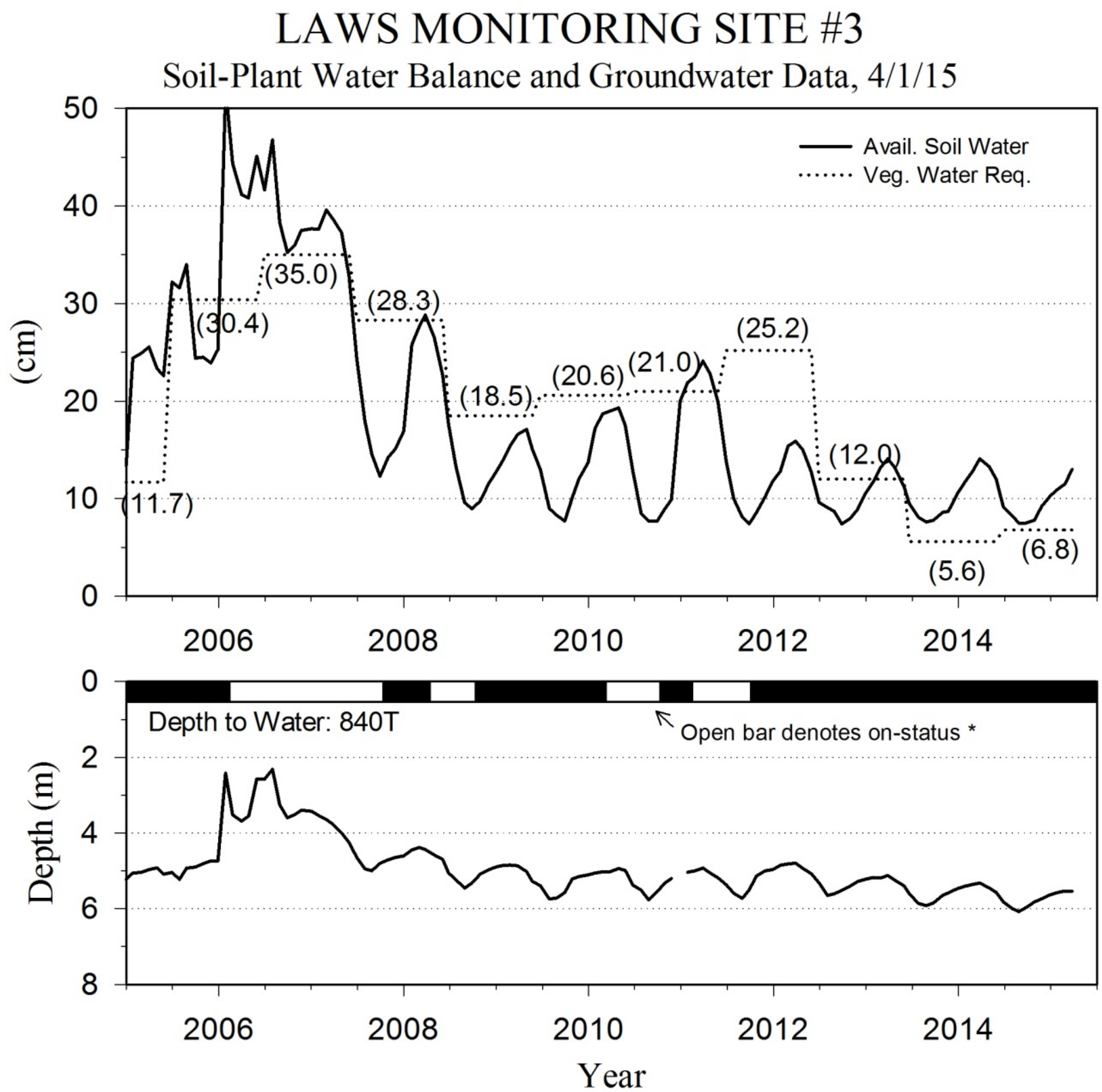
Soil water required for turn on (15.6 cm)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 236, 239, 243, 244

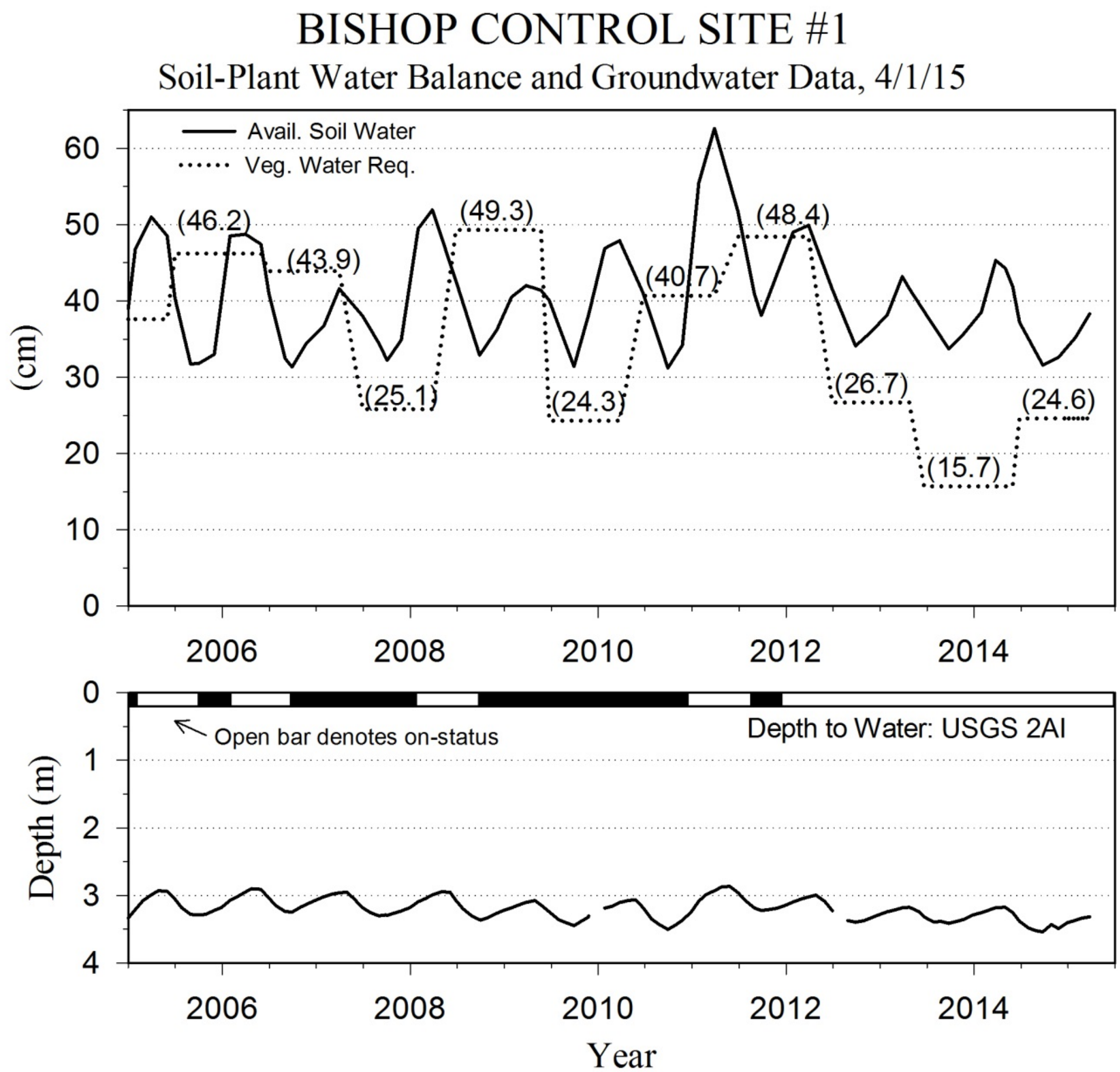
Soil water required for turn on (--)



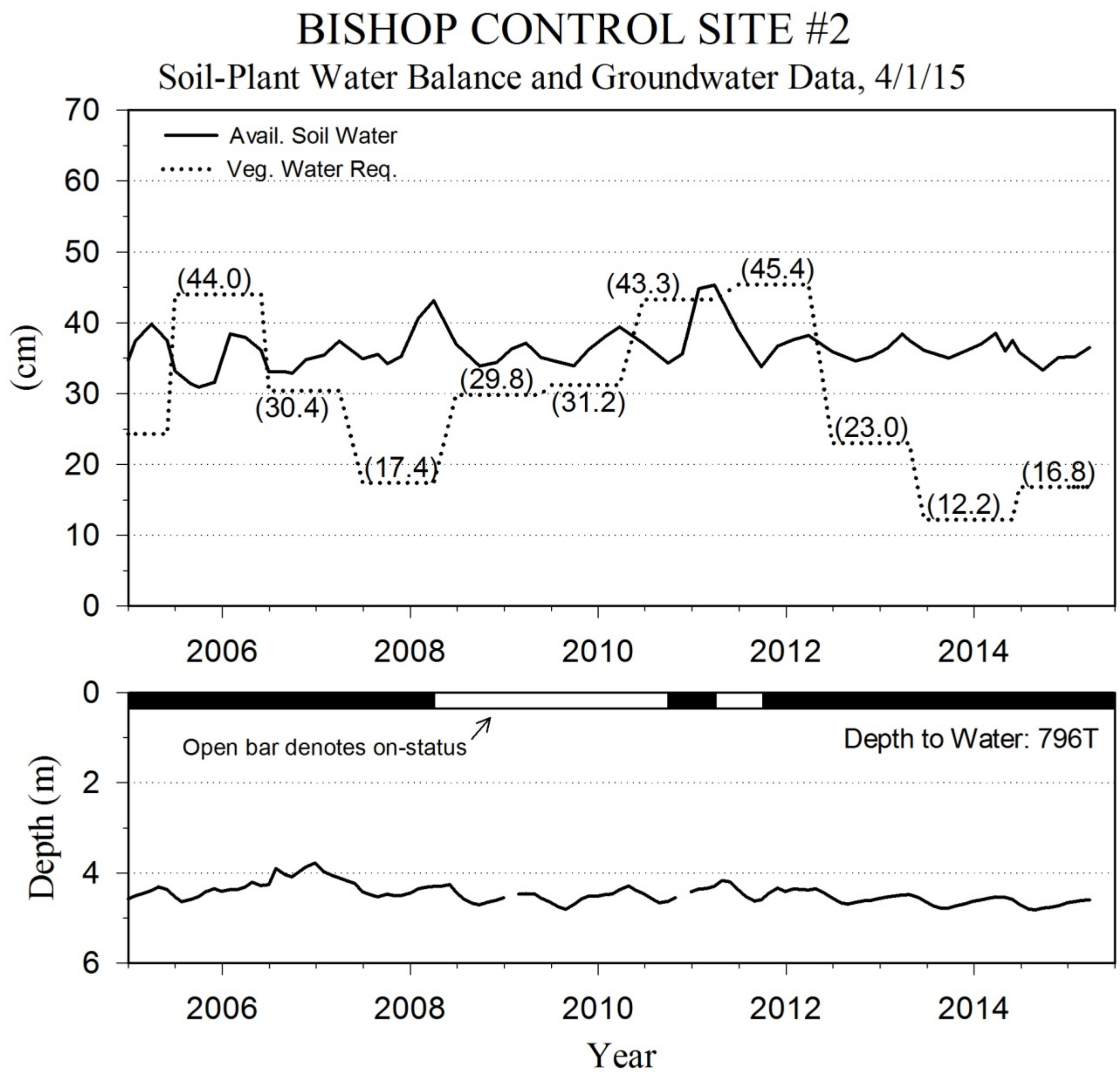
* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 240, 241, 399, 376, 377

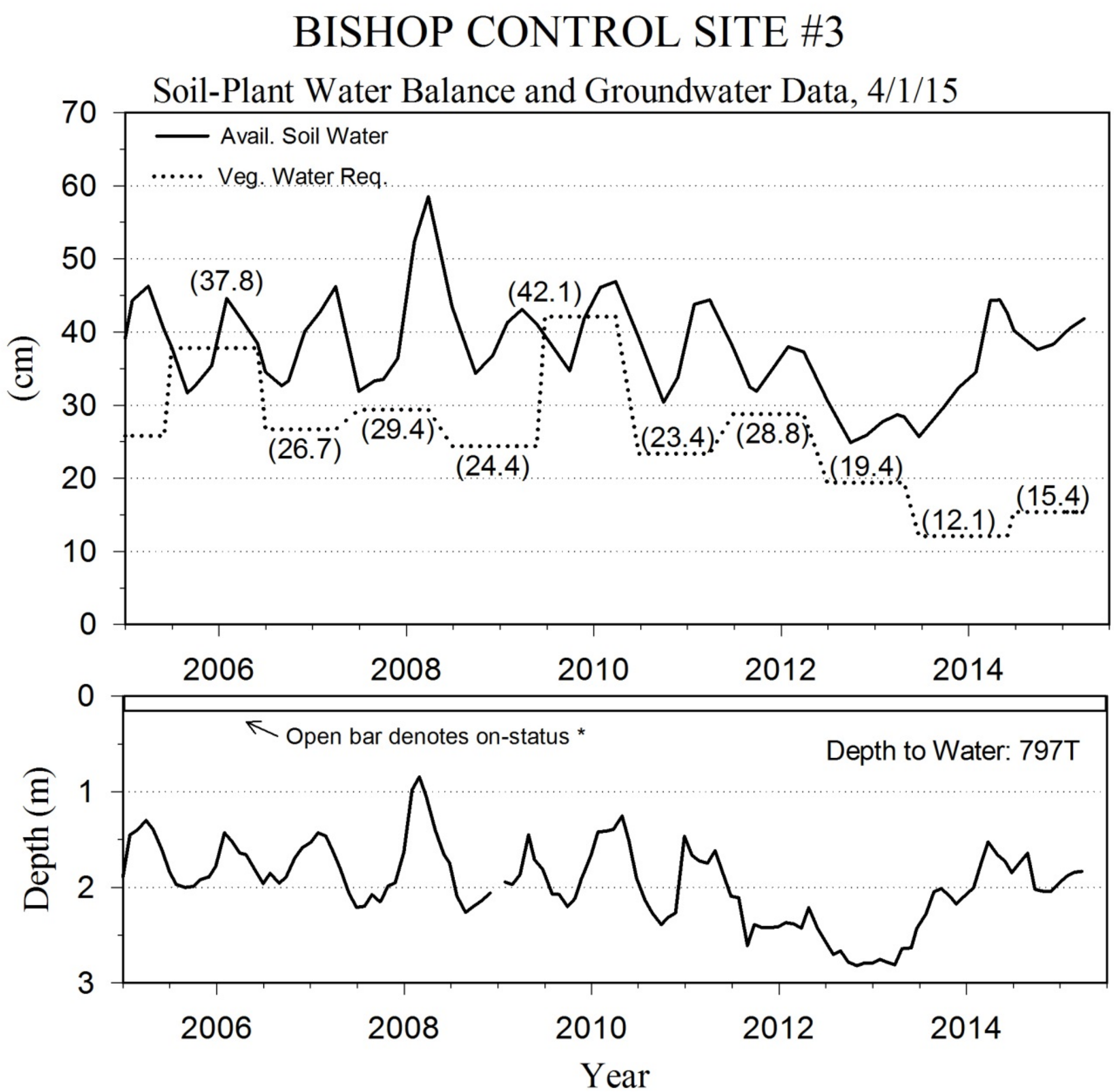
Soil water required for turn on (25.2 cm)



*On/off according to the Green Book Section III values for Veg. Water Req.
Soil water required for turn on (--)

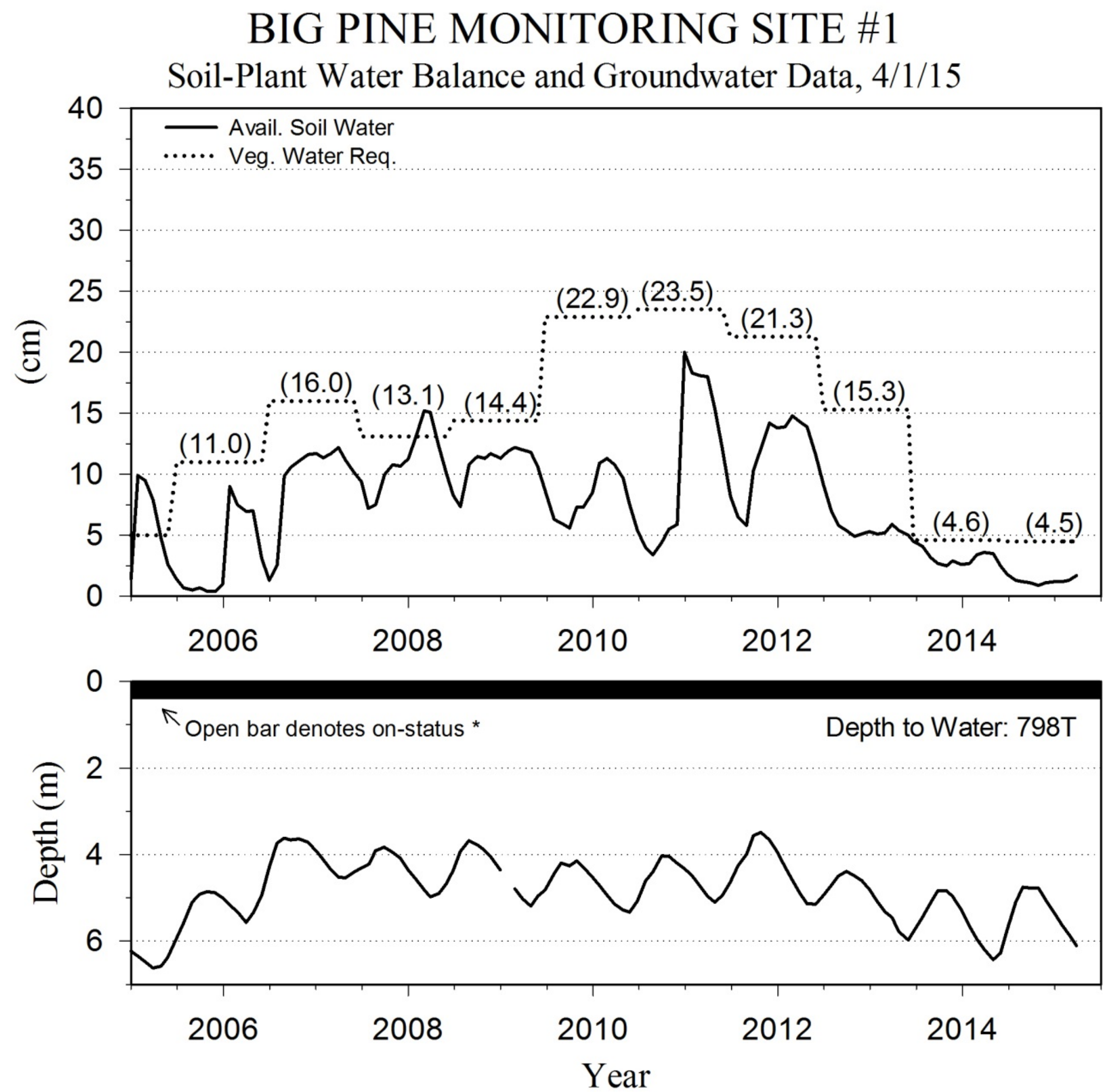


*On/off according to the Green Book Section III values for Veg. Water Req.
Soil water required for turn on (--)



*On/off according to the Green Book Section III values for Veg. Water Req.

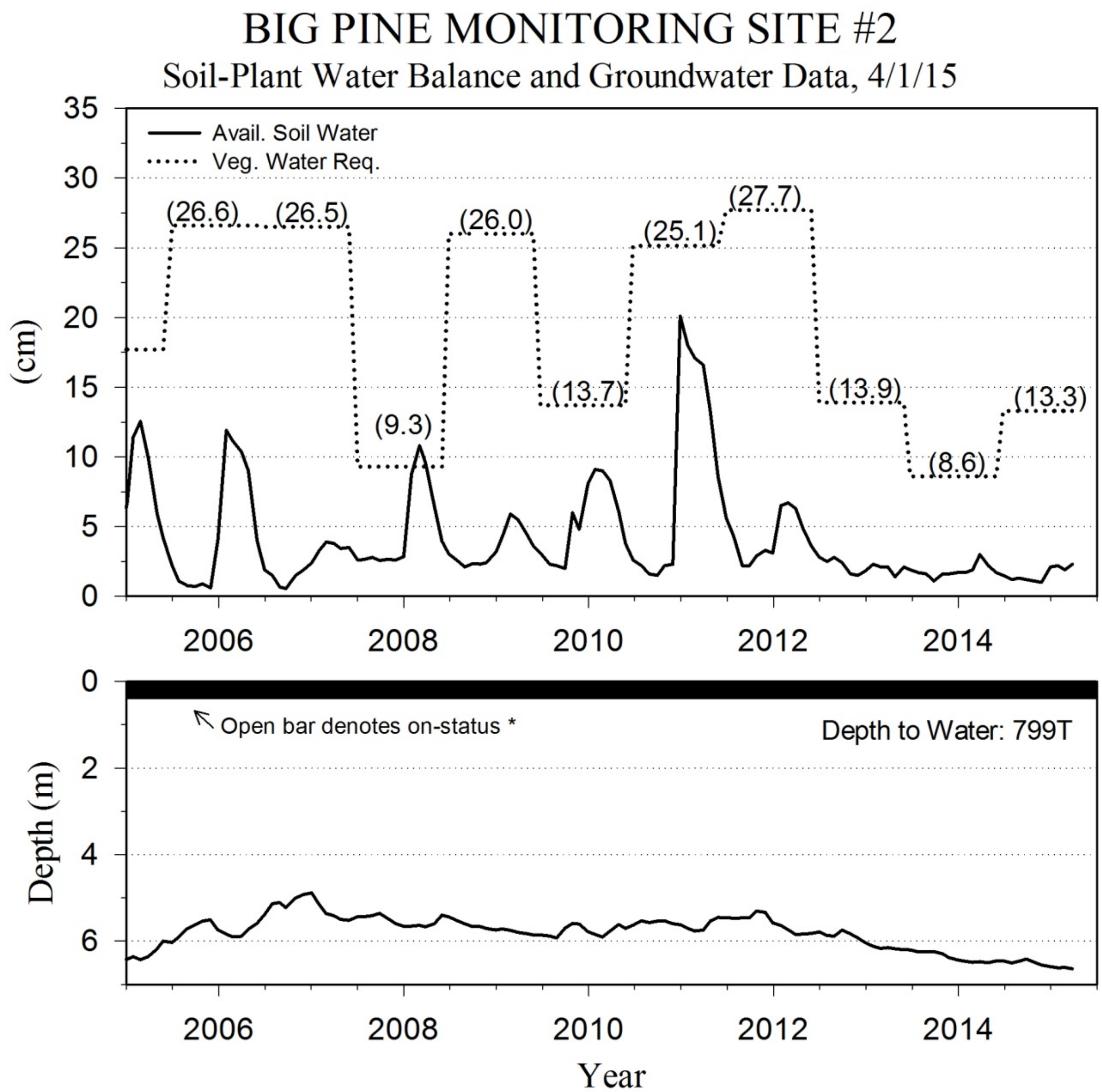
Soil water required for turn on (--)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 210, 378, 379, 389

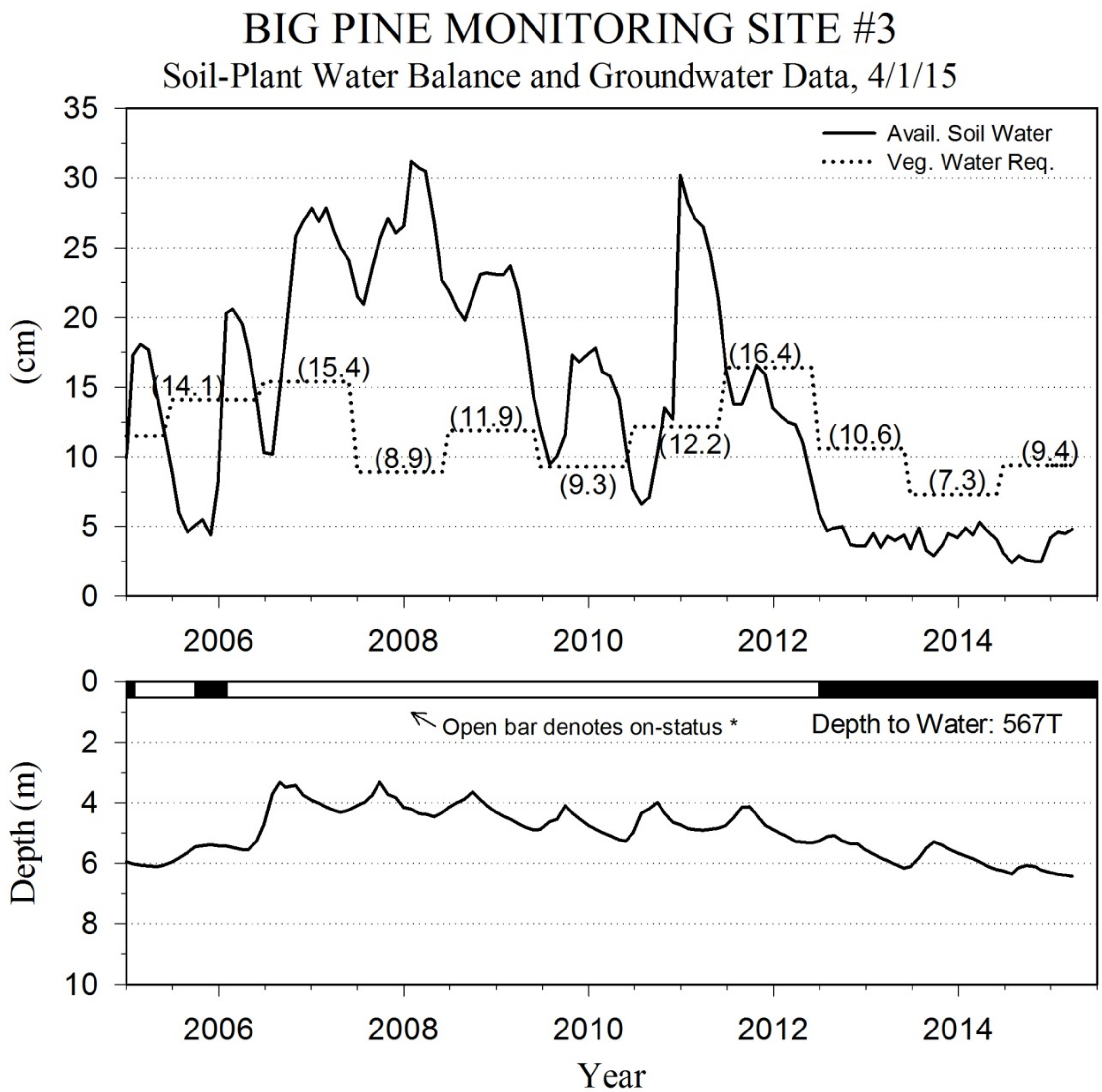
Soil water required for turn on (22.9 cm)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 220, 229, 374, 375

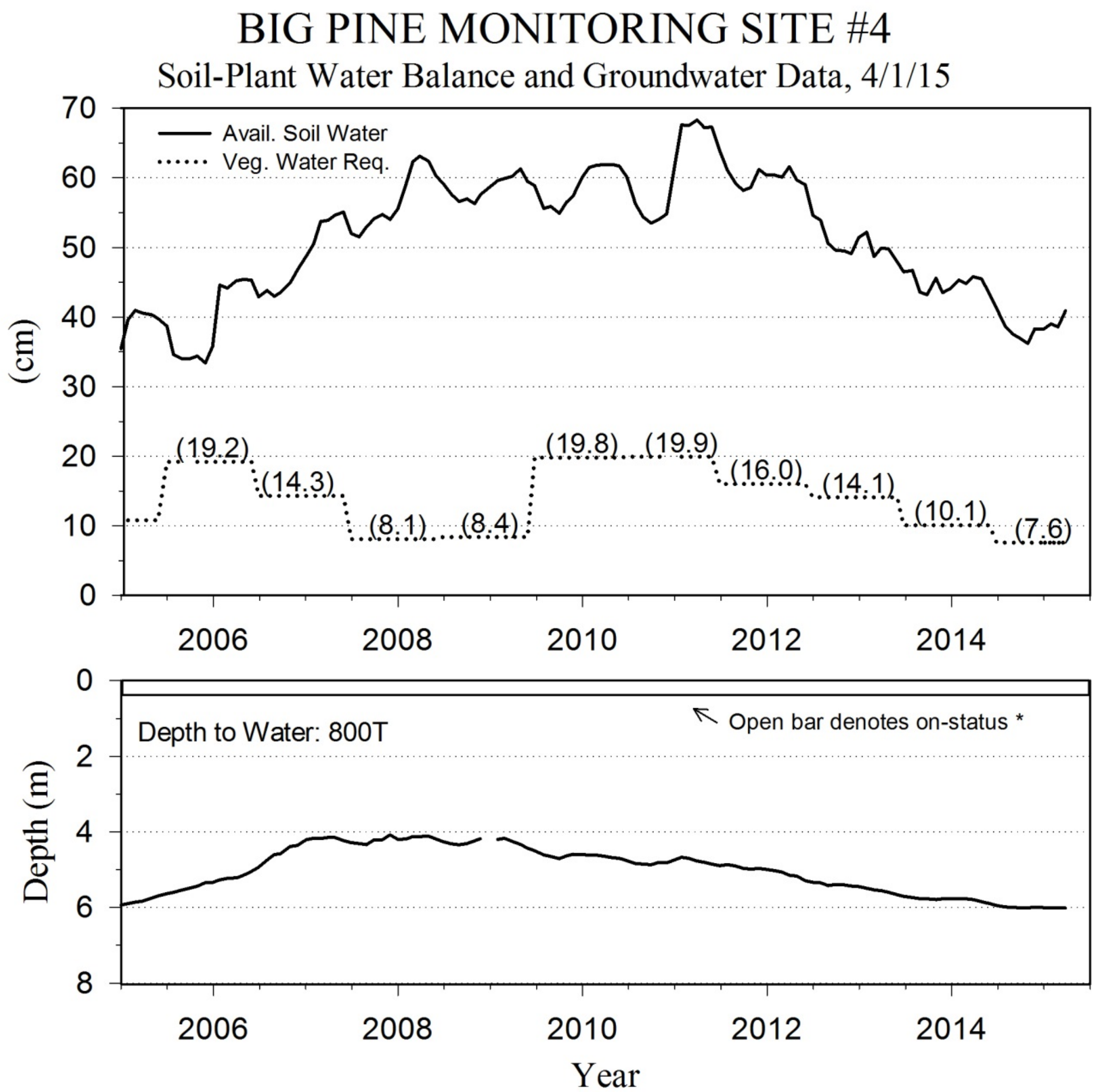
Soil water required for turn on (28.4 cm)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 222, 223, 231, 232

Soil water required for turn on (10.6 cm)



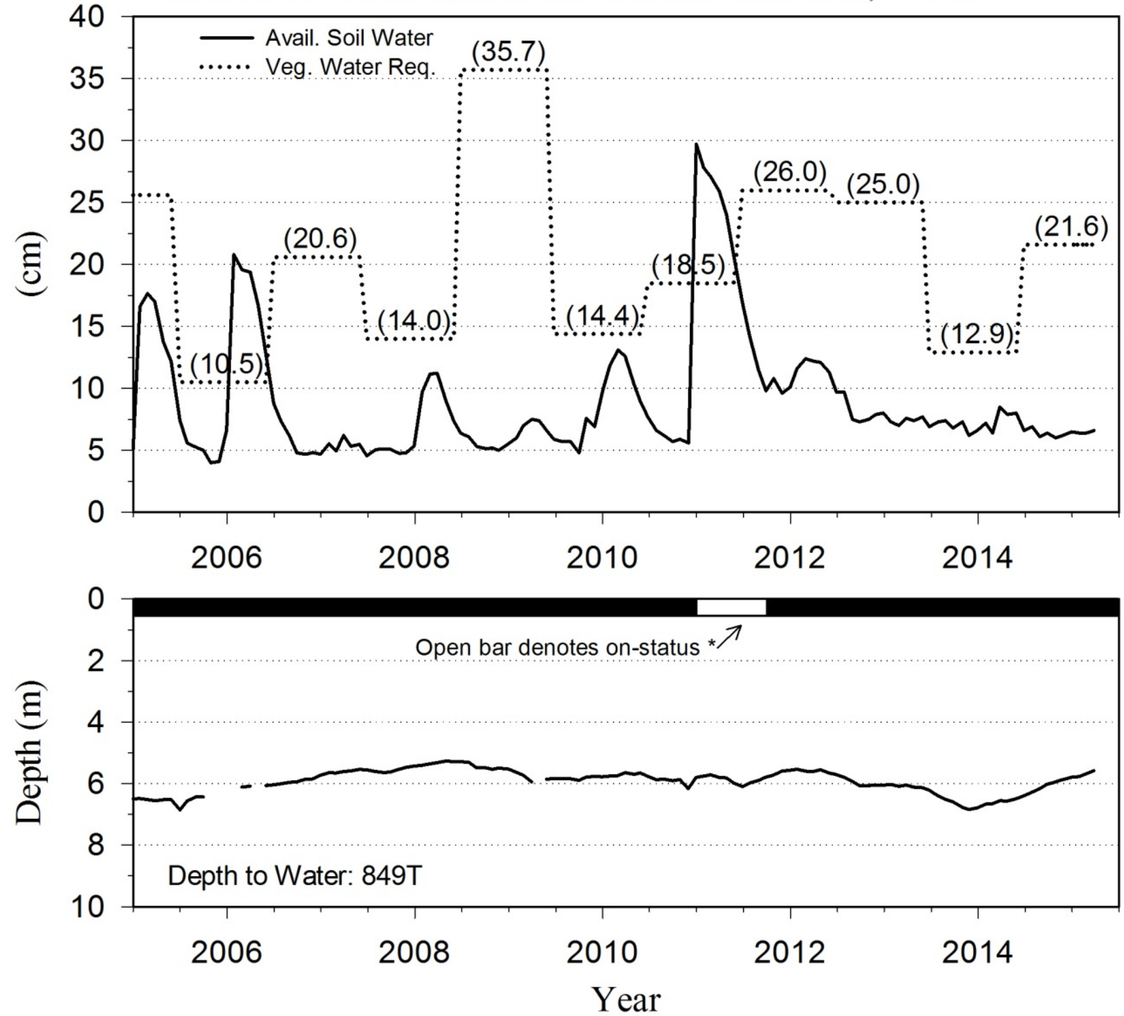
* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping well - 331

Soil water required for turn on (--)

TABOOSE/ABERDEEN MONITORING SITE #3

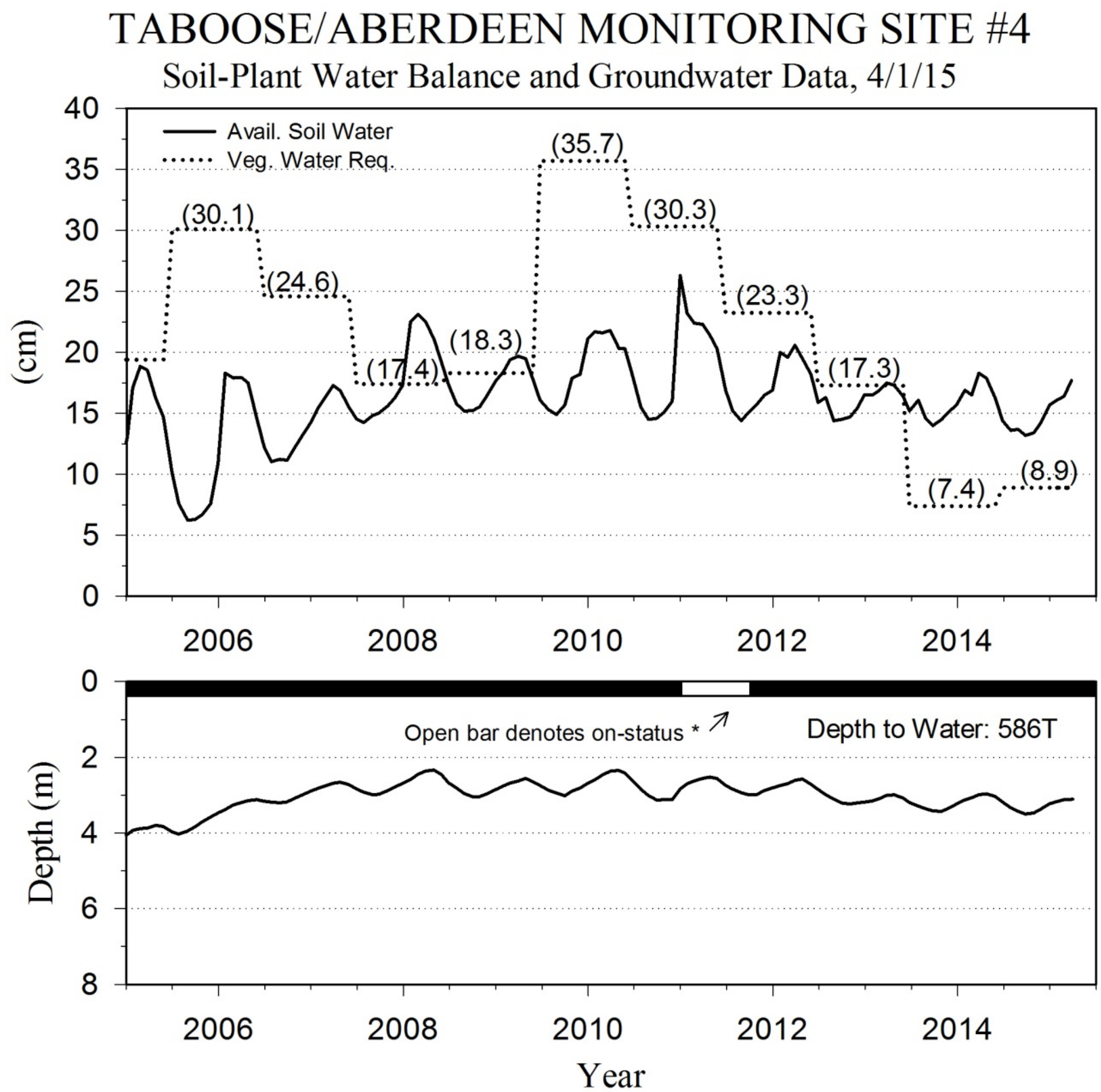
Soil-Plant Water Balance and Groundwater Data, 4/1/15



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 106, 110, 111, 114

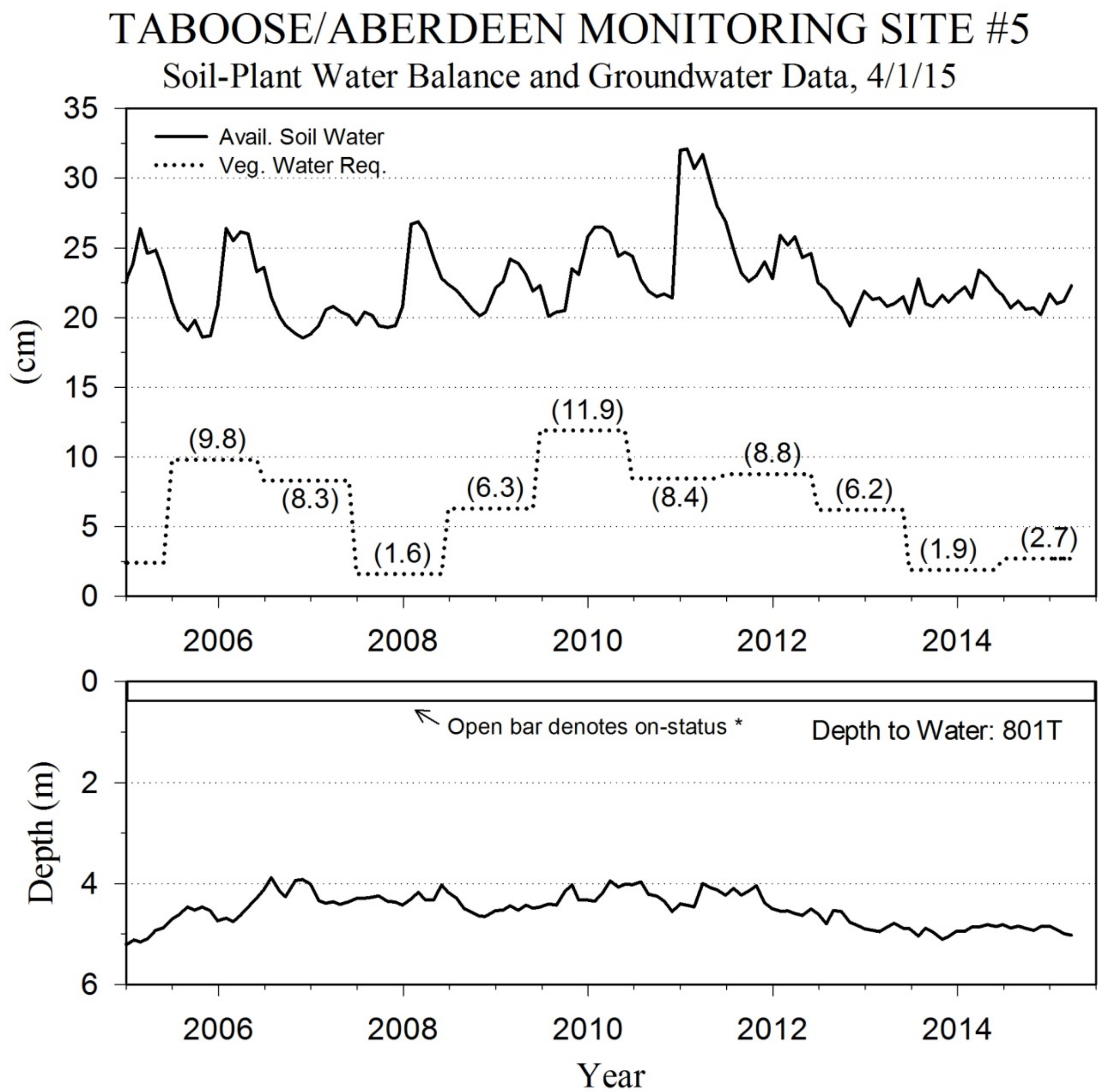
Soil water required for turn on (26.0 cm)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 342, 347

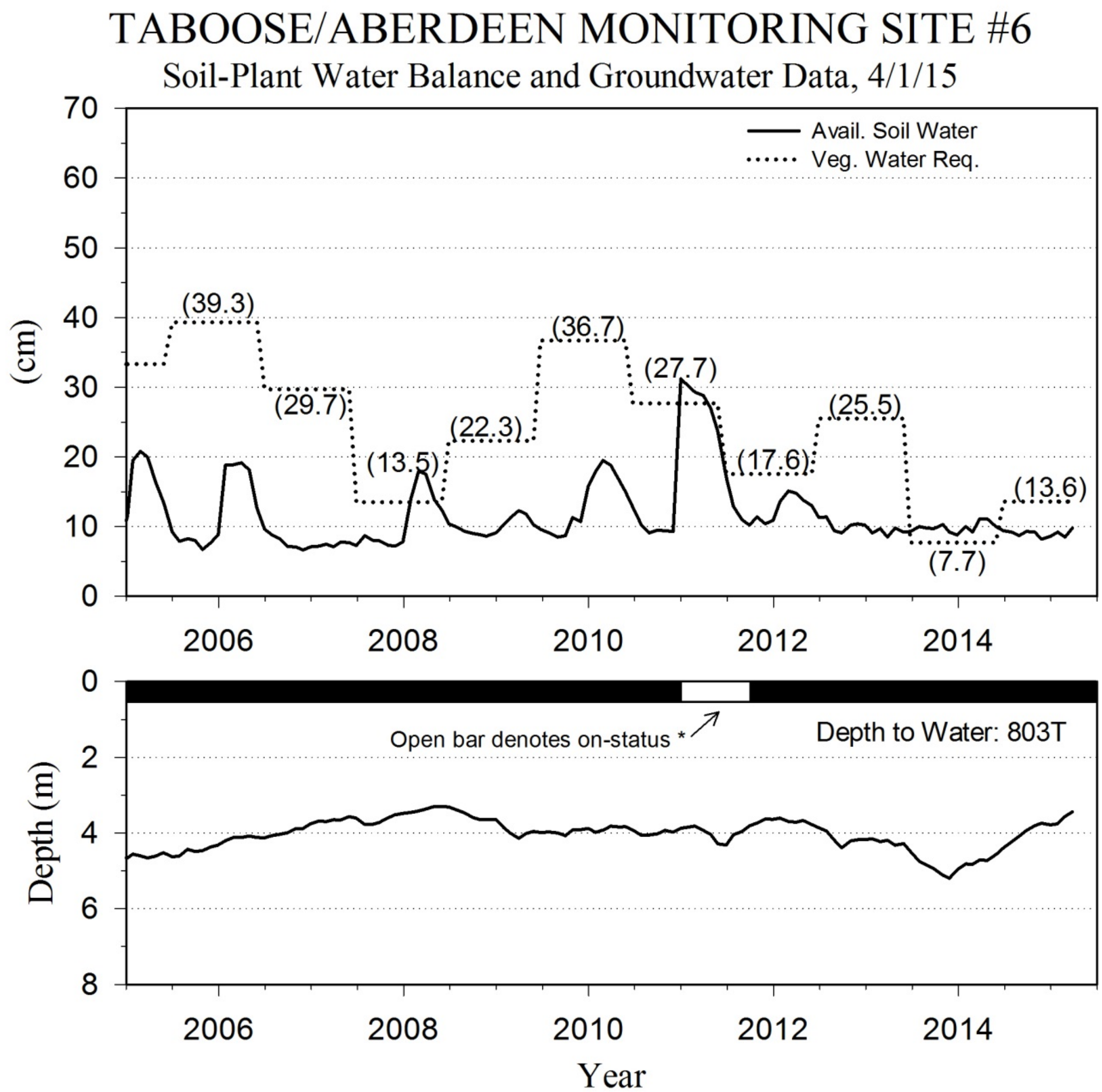
Soil water required for turn on (23.3 cm)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III value for Veg. Water Req.

Linked pumping well - 349

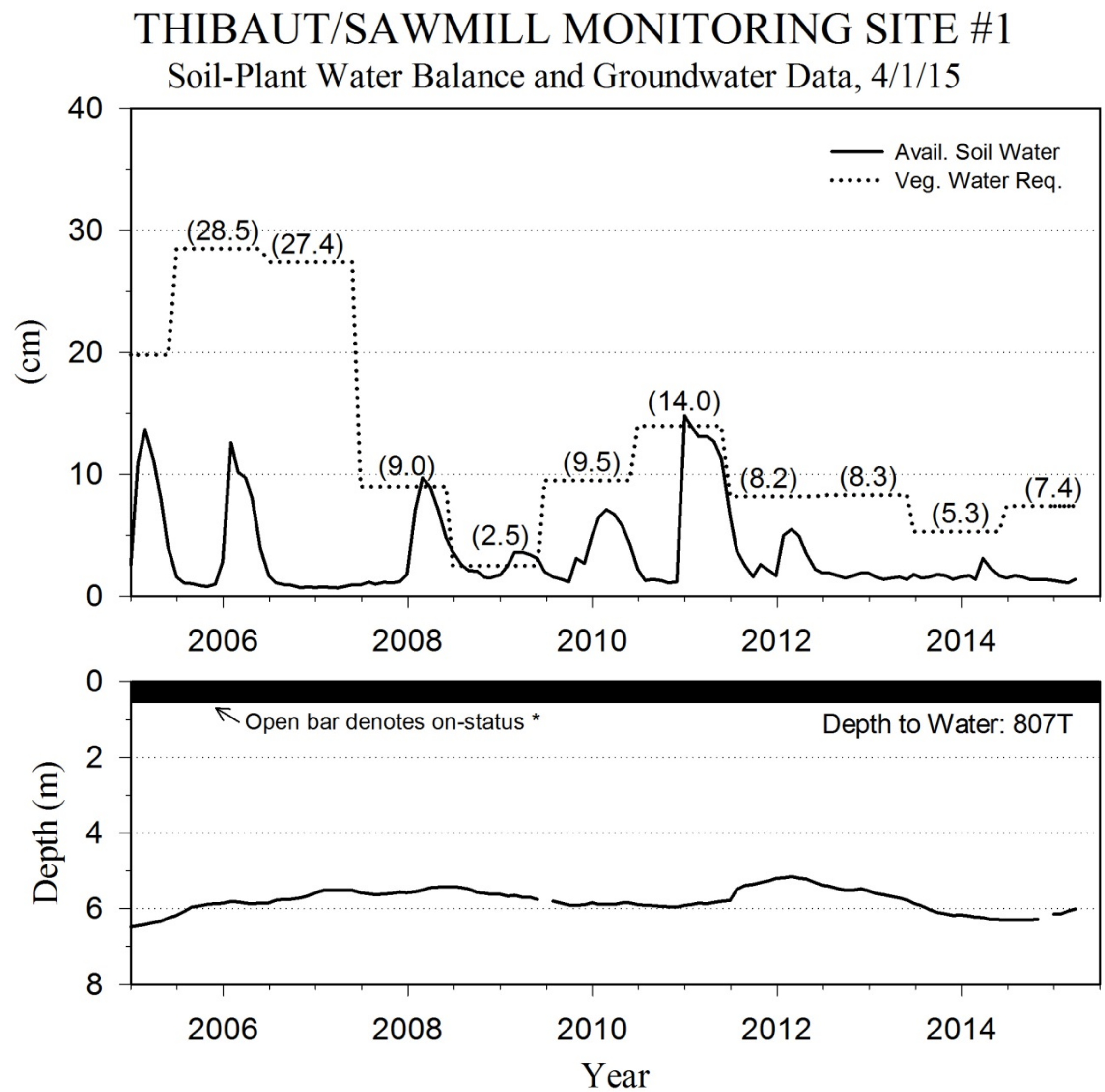
Soil water required for turn on (--)



* Wells not necessarily operated when in on-status. On\off according to Green Book Section III values for Veg. Water Req.

Linked pumping wells - 109, 370

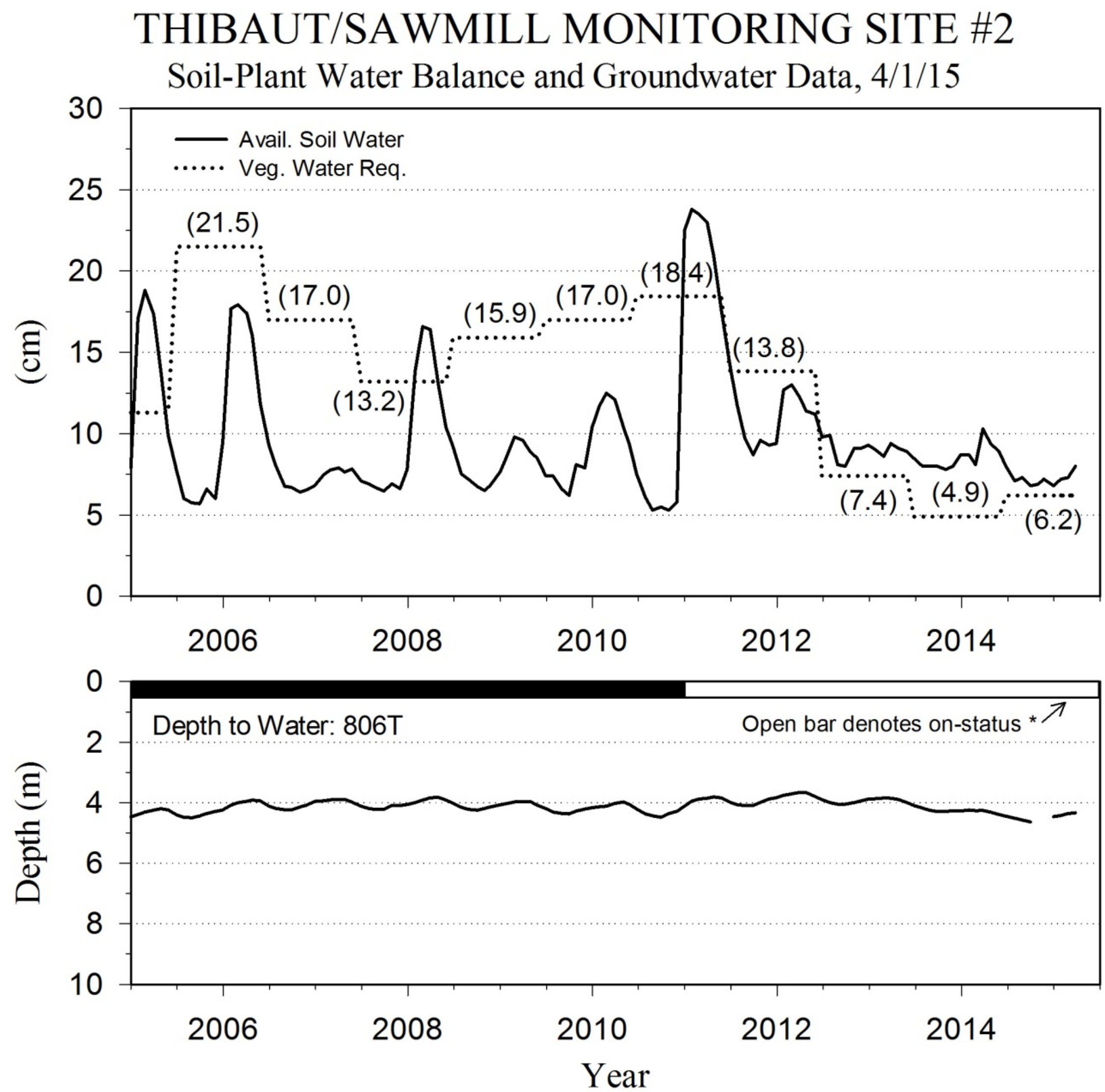
Soil water required for turn on (17.6 cm)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping well - 159

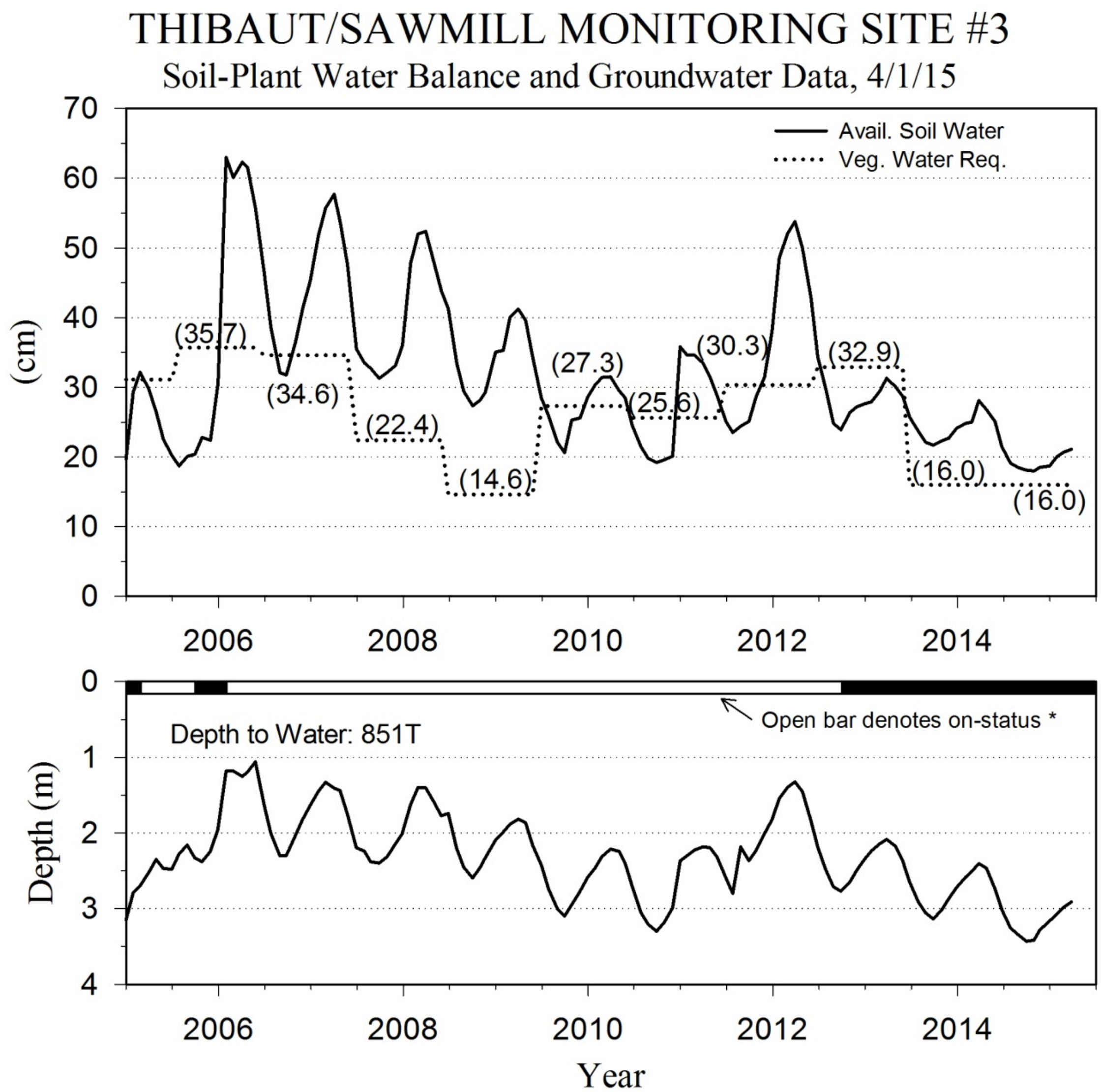
Soil water required for turn on (20.4 cm)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping well - 155

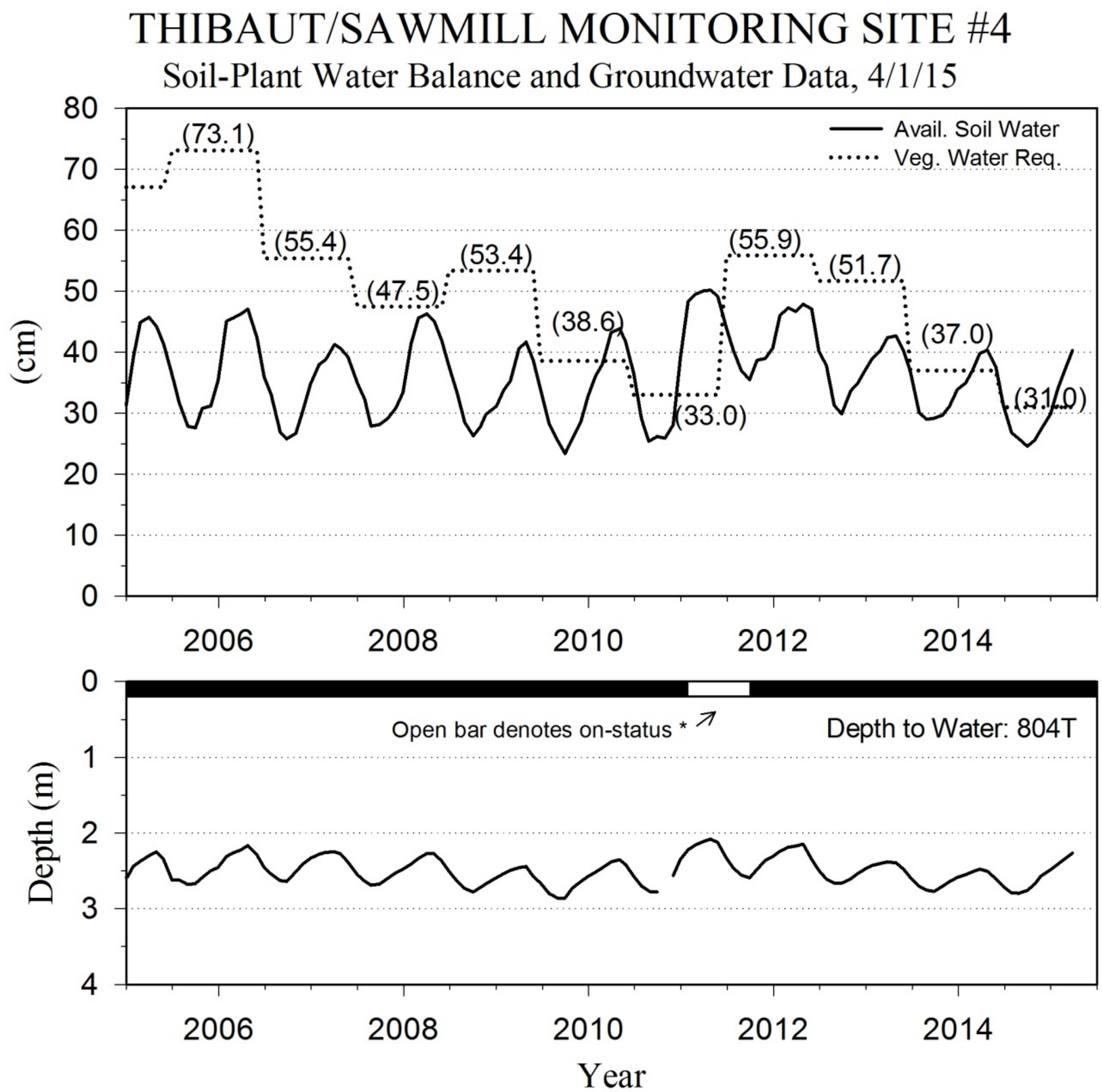
Soil water required for turn on (--)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 103, 104, 382

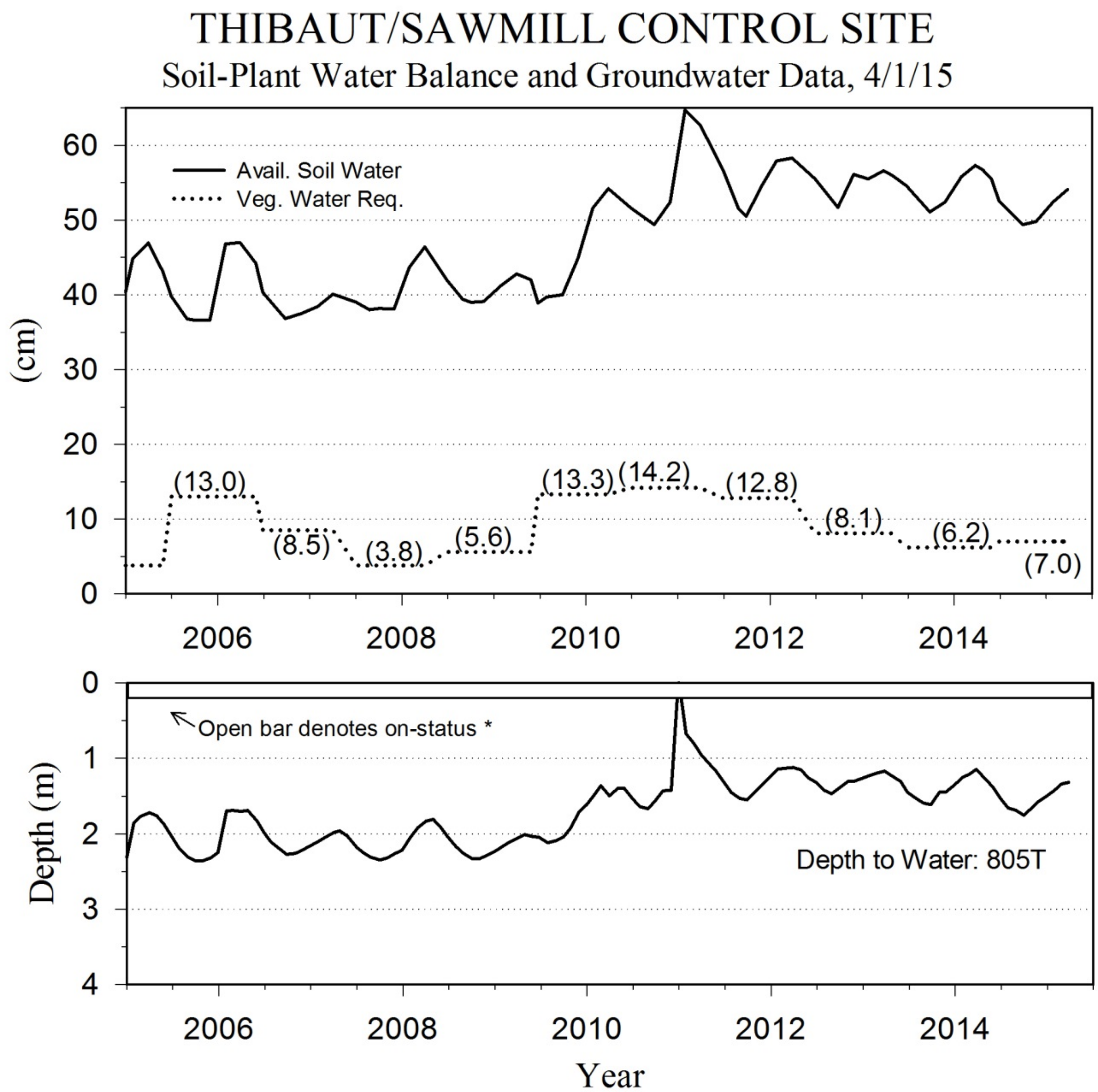
Soil water required for turn on (32.9 cm)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 380, 381

Soil water required for turn on (55.9 cm)

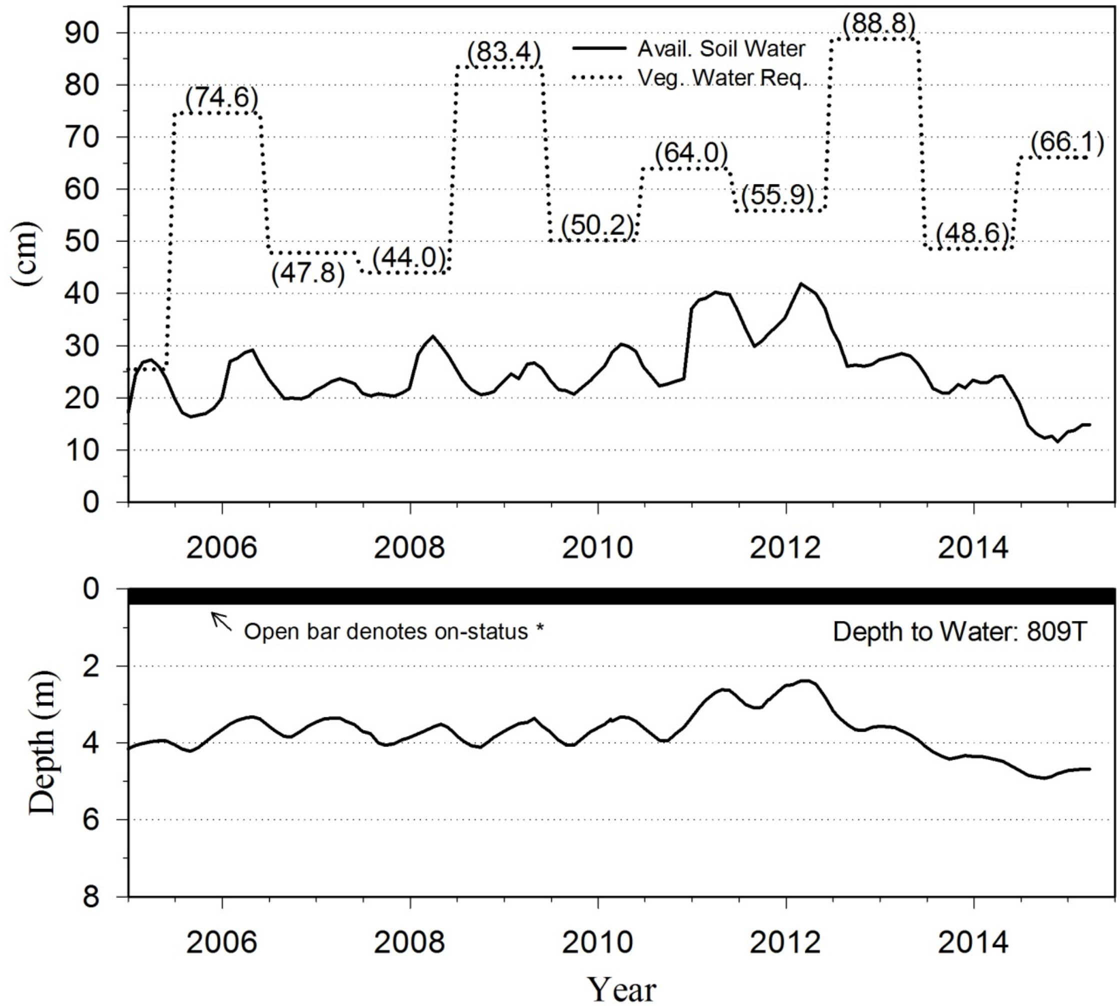


* On\off according to the Green Book Section III values for Veg. Water Req.

Soil water required for turn on (--)

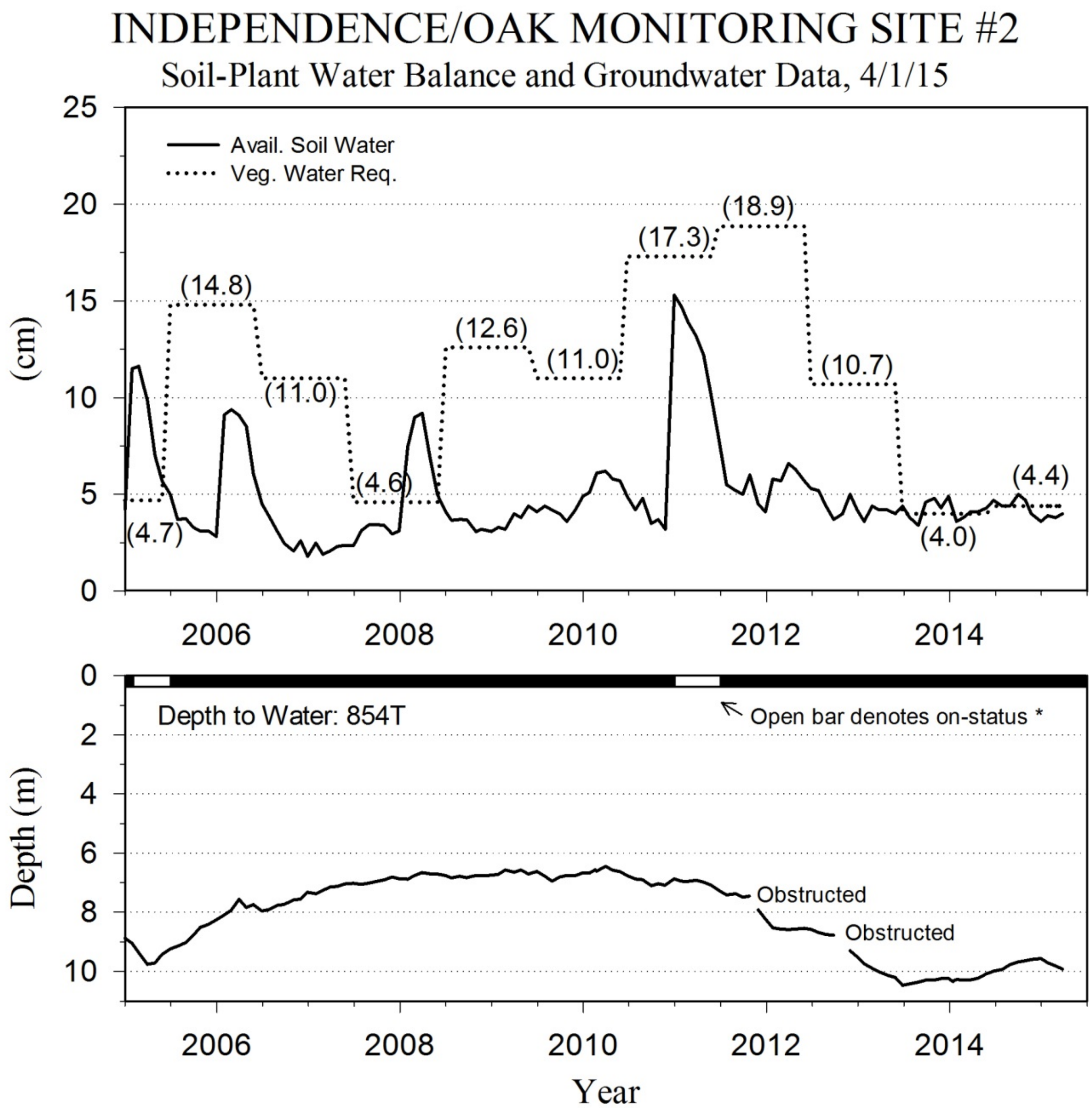
INDEPENDENCE/OAK MONITORING SITE #1

Soil-Plant Water Balance and Groundwater Data, 4/1/15



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.
Linked pumping wells - 61, 391, 400

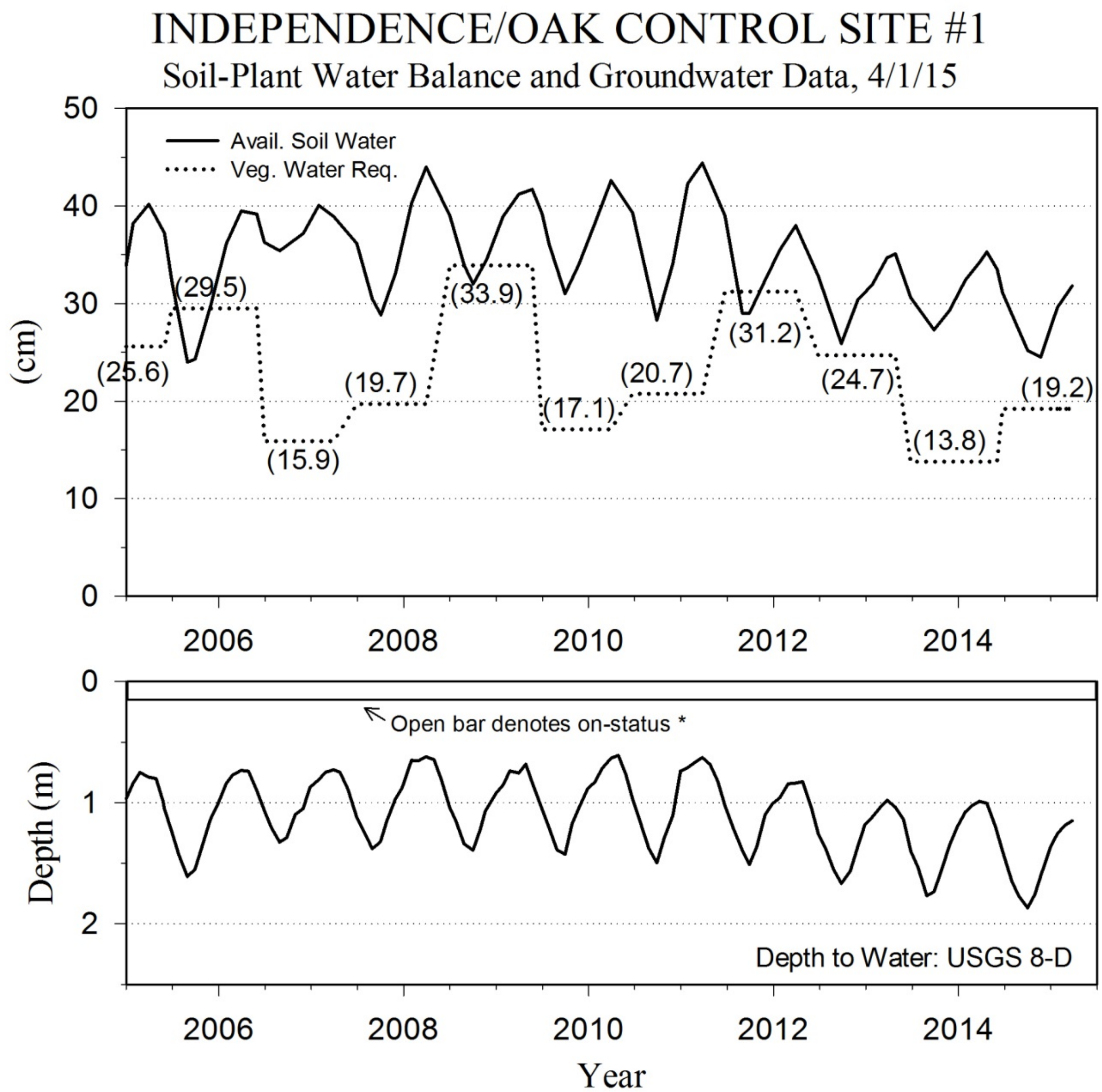
Soil water required for turn on (42.2 cm)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

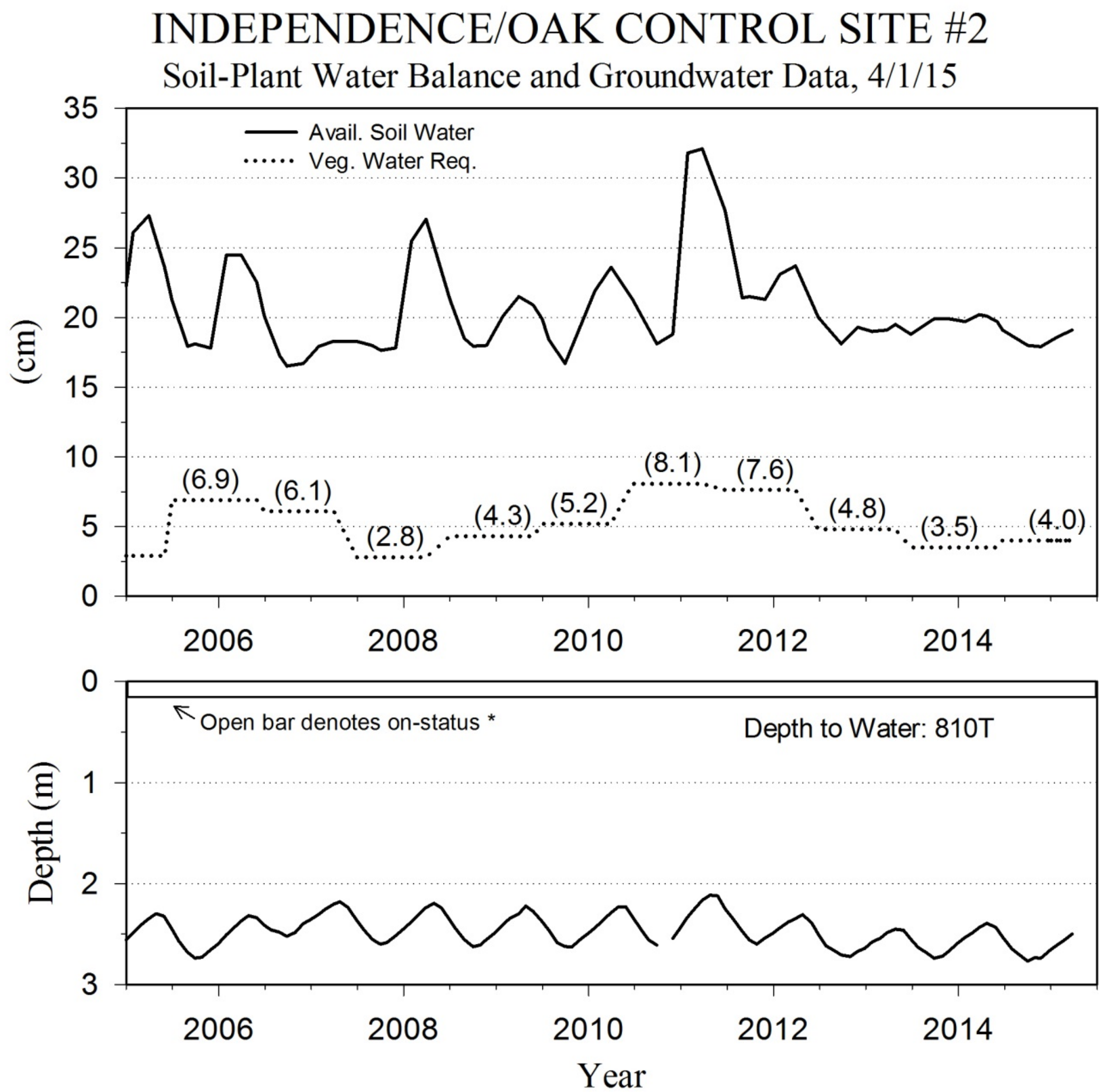
Linked pumping well - 63

Soil water required for turn on (18.9 cm)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Soil water required for turn on (--)

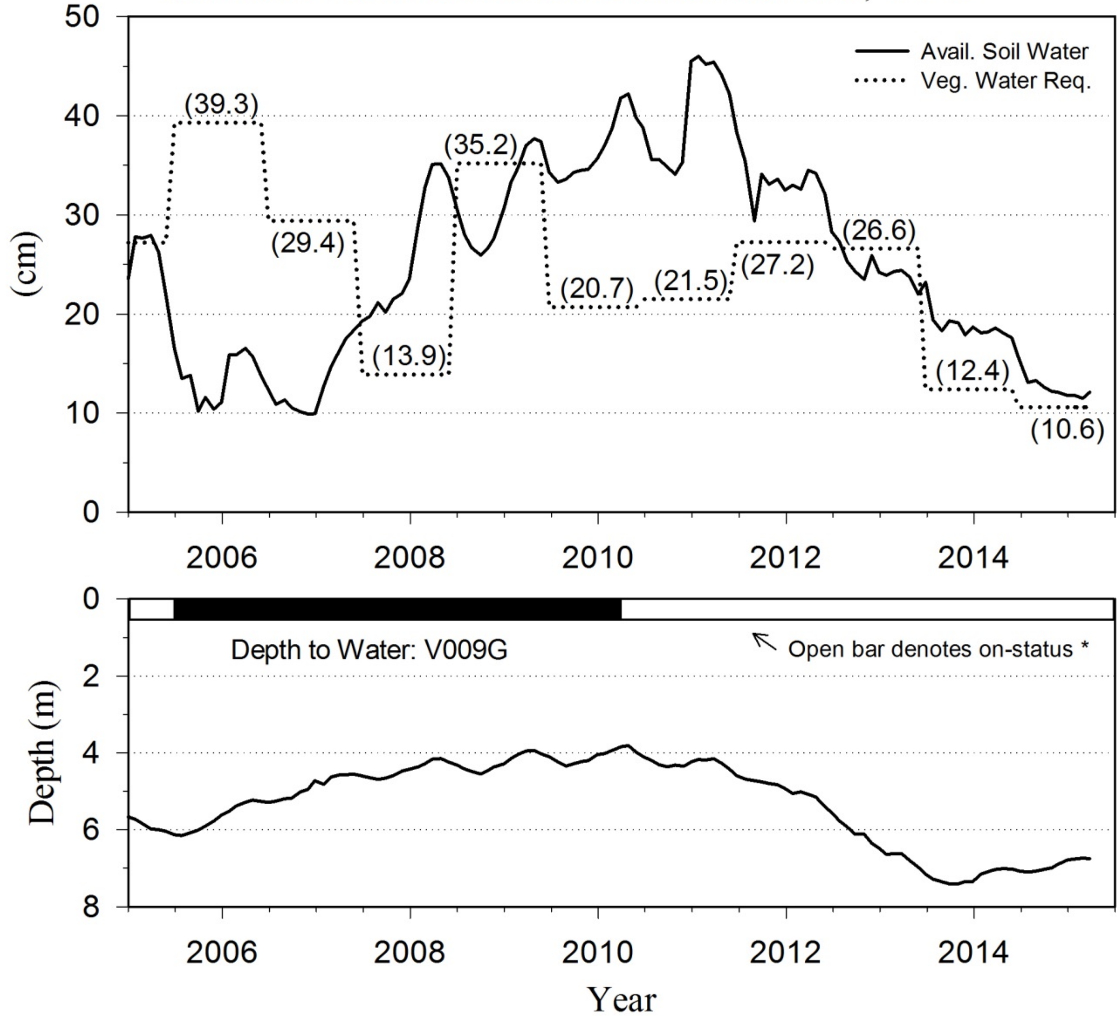


* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Soil water required for turn on (--)

SYMMES/SHEPHERD MONITORING SITE #1

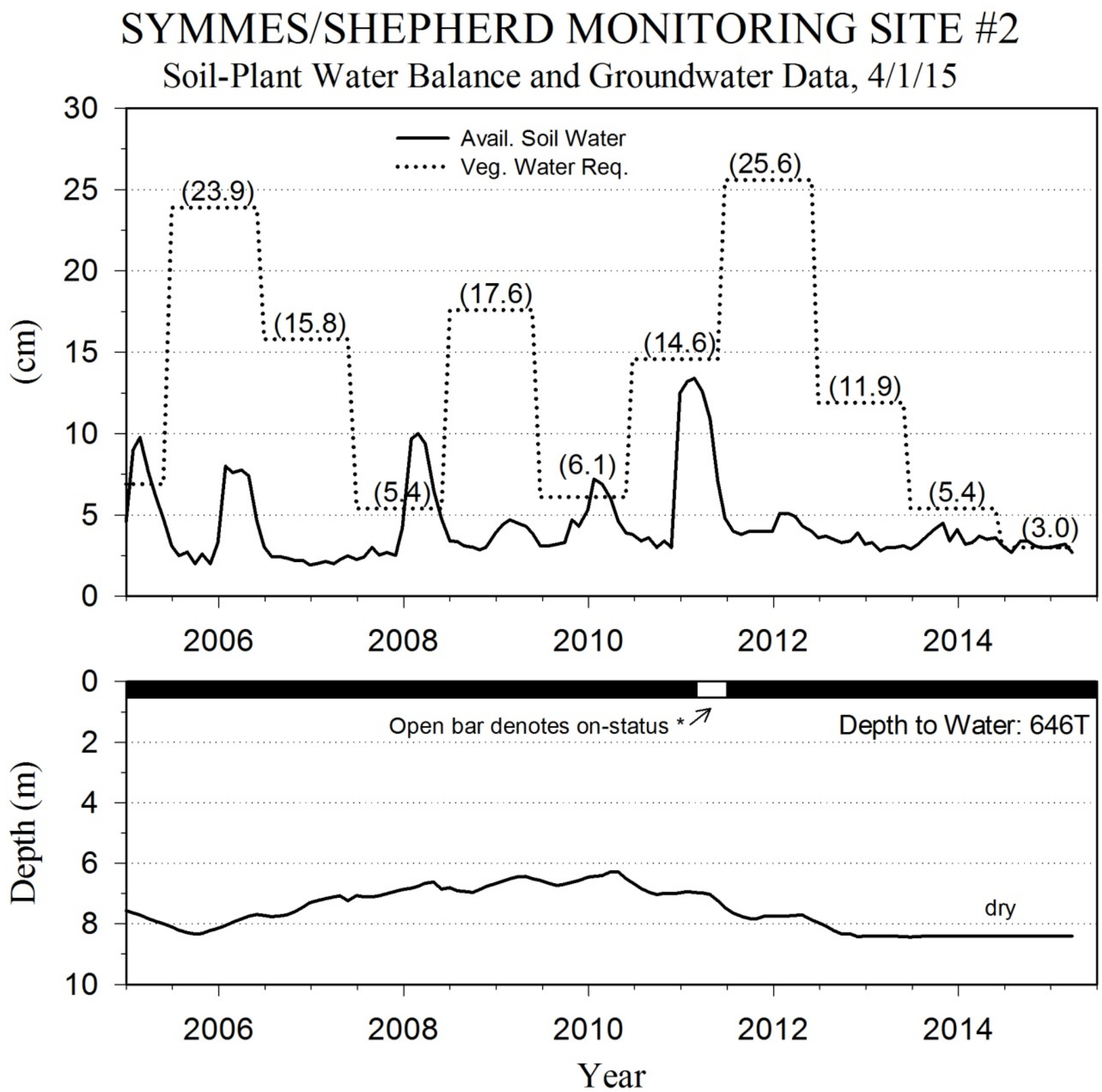
Soil-Plant Water Balance and Groundwater Data, 4/1/15



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 69, 392, 393

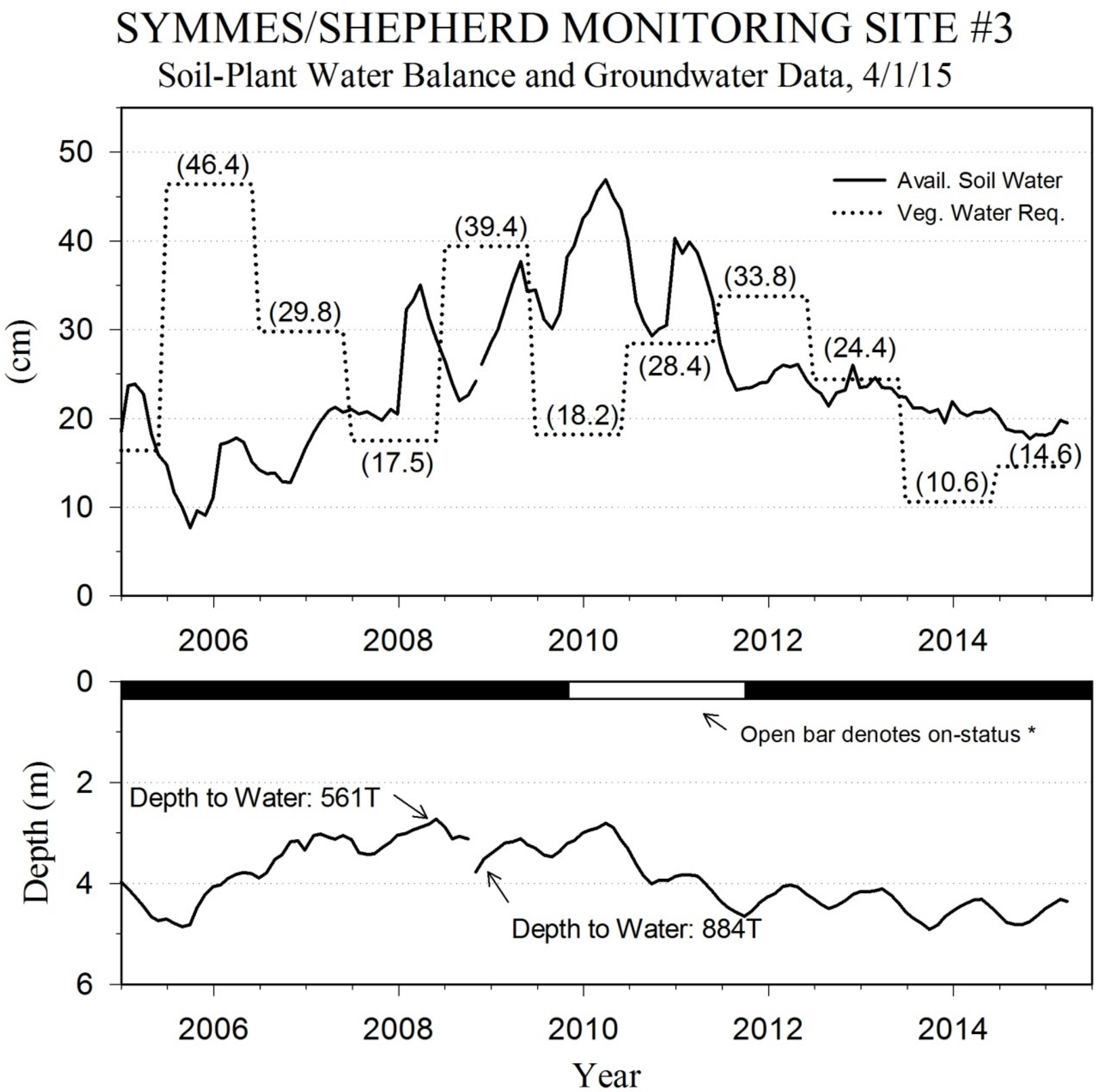
Soil water required for turn on (--)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 74, 394, 395

Soil water required for turn on (25.6 cm)

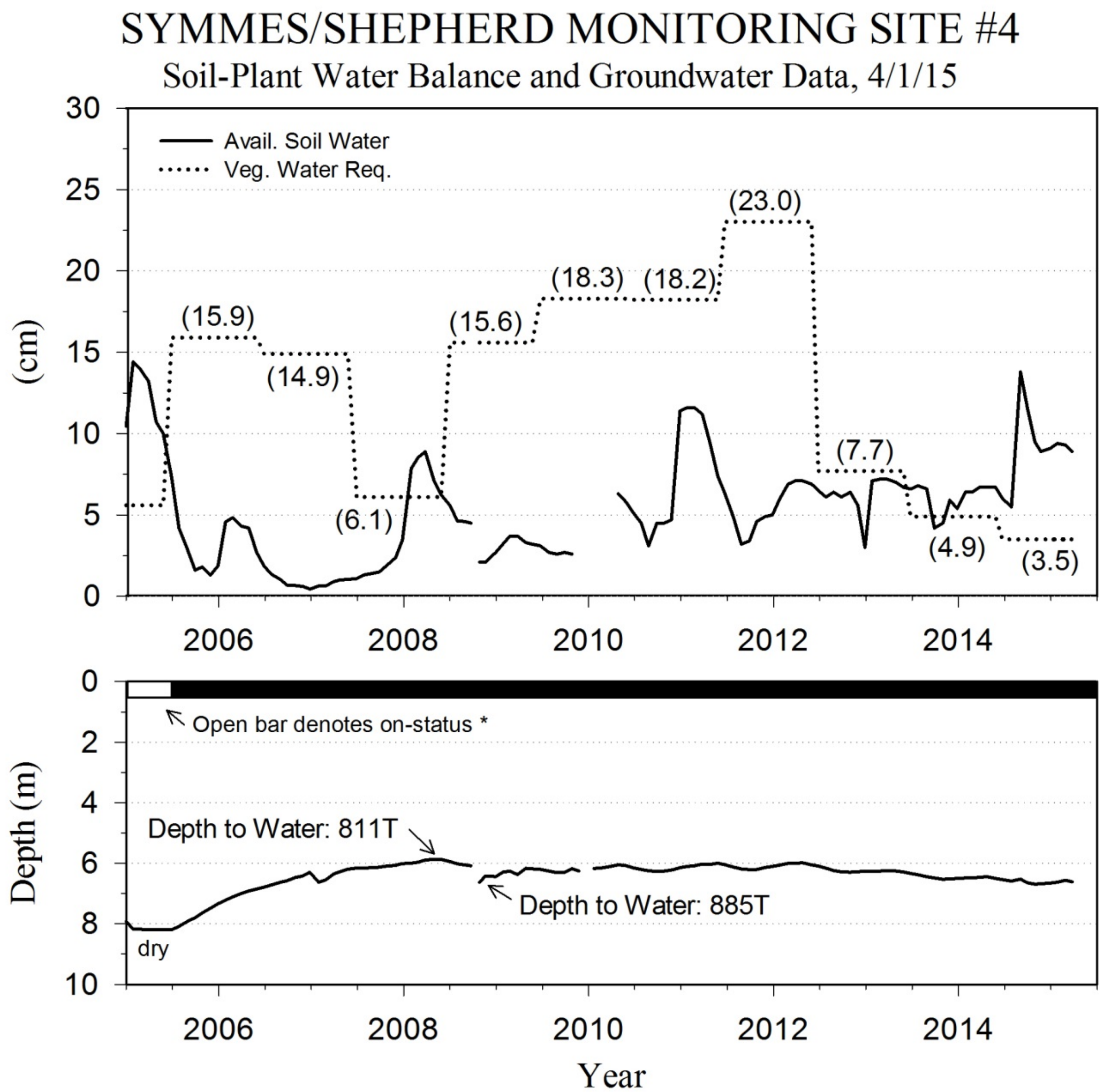


* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 92, 396

Soil water required for turn on (33.8 cm)

New soil water monitoring locations established Dec 1, 2008

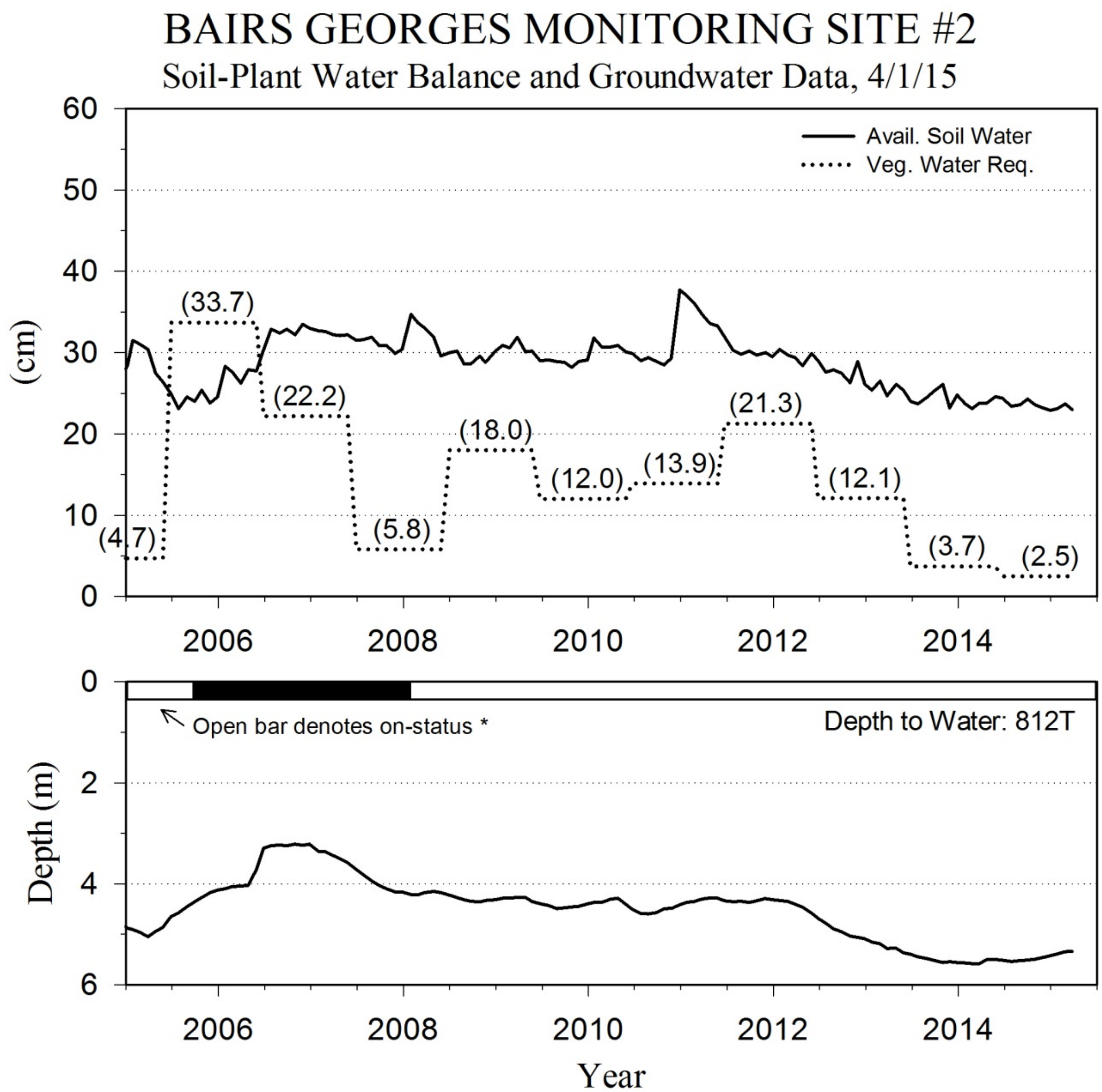


* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 75, 345

Soil water required for turn on (15.9 cm)

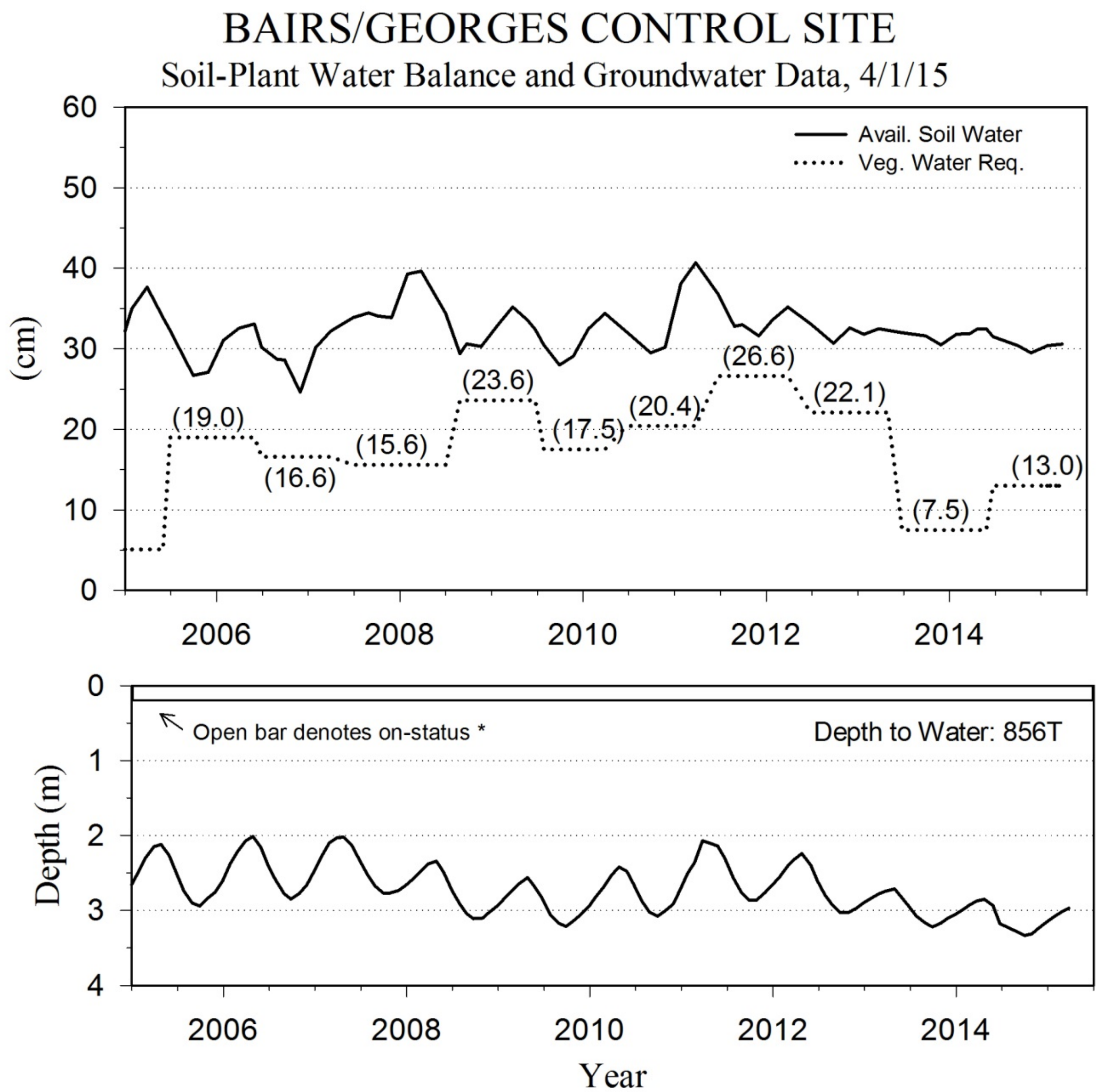
New soil water monitoring locations established Nov 1, 2008 and May 1, 2010



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Linked pumping wells - 76, 403, 343, 348

Soil water required for turn on (--)



* Wells not necessarily operated when in on-status. On\off according to the Green Book Section III values for Veg. Water Req.

Soil water required for turn on (--)

SECTION 5: VEGETATION CONDITIONS

Zach Nelson, Vegetation Scientist

A primary goal of the Water Agreement is to manage groundwater and surface water while maintaining healthy groundwater-dependent plant communities in the Owens Valley.

This section presents an analysis of the 2014 vegetation conditions

Abstract

A primary goal of the Long Term Water Agreement between Inyo County and Los Angeles Department of Water and Power is to manage groundwater and surface water while maintaining healthy groundwater-dependent vegetation communities found in the Owens Valley. Each year the Inyo County Water Department monitors selected vegetation parcels within the valley to ensure that these goals are met. This report provides estimates for: (1) changes in vegetation cover and composition for parcels influenced by pumping (wellfield parcels) and parcels not influenced by pumping (control parcels), and (2) changes in cover over time for individual vegetation parcels. In general, wellfield parcels have been below baseline measurements while control parcels have maintained baseline conditions but in 2014 control parcel on average were below baseline perennial cover presumably owing to the ongoing drought. The 2014 reinventory data show that 58% of wellfield parcels reinventoried are below baseline perennial cover measurements. Nearly half of these parcels dropped below baseline from 2013 to 2014, following the third consecutive year of below-normal precipitation and runoff.

Introduction

This report presents an analysis of the 2014 vegetation conditions measured by the Inyo County Line Point Transect (hereafter LPT) Monitoring Program. Each year, the Inyo County Water Department monitors vegetation conditions on the floor of the Owens Valley. The purpose of this monitoring is to detect any *"SIGNIFICANT DECREASES AND CHANGES IN OWENS VALLEY VEGETATION FROM CONDITIONS DOCUMENTED IN 1984 TO 1987"*. Vegetation live cover and species composition documented during the 1984-87 mapping effort were adopted as the baseline from which current conditions are compared.

The technical appendix to the Agreement (Green Book) details certain decreases and changes in vegetation community types that must be avoided under the Agreement. Baseline vegetation communities in which evapotranspiration exceeds precipitation were classified as Types B, C, and D. These phreatophytic communities are dependent on shallow groundwater to maintain plant populations, as precipitation alone is inadequate to meet transpiration water demand required by species in these locations (Sorensen *et al.* 1991, Steinwand *et al.* 2006).

For these parcels, according to the Green Book, *"THE GOAL IS TO MANAGE GROUNDWATER PUMPING AND SURFACE WATER MANAGEMENT PRACTICES SO AS TO AVOID CAUSING SIGNIFICANT DECREASES IN LIVE VEGETATION COVER"* and to prevent a significant amount of vegetation from changing to a *"VEGETATION TYPE THAT PRECEDES IT ALPHABETICALLY" (FOR EXAMPLE, TYPE C MEADOW CHANGING TO TYPE B, SHRUB MEADOW, OR TYPE B CHANGING TO TYPE A, NON-GROUNDWATER DEPENDENT VEGETATION).*

To determine whether significant decreases and/or changes in vegetation have occurred, three criteria need to be met that are described in the Green Book: (1) measurability of vegetation change, (2) attributability of vegetation change to LADWP groundwater pumping or surface water management and (3) degree of significance defined by the magnitude, extent, duration and permanency of the change along with other factors including air quality, human health, impact to species of concern, etc. In the Green Book, the term "measurability" is synonymous with statistical significance. The primary objective of the vegetation annual report is to evaluate the statistical significance (measurability) of vegetation change compared to baseline, however significance levels (i.e. Type I error rates) and sample sizes were not specified in the Green Book nor were specific statistical tests specified. The second criterion, evaluating whether a statistically significant change in vegetation is caused by water management (attributability), is beyond the scope of this report owing to the need for a comprehensive analysis on a case by case basis for each vegetation parcel. Another source of confusion may arise with the third criterion which is the "degree or significance" of environmental change. For this criterion to be met, statistical significance is necessary but not sufficient. As described above, there are several other factors in addition to statistical significance that must be demonstrated to evaluate the degree of significance for the third criterion. For an example of a an evaluation of all three criteria for an individual parcel, see the report "Analysis of Conditions in Vegetation Parcel Blackrock 94" and the various reports associated with the arbitration concerning this vegetation parcel (available at www.inyowater.org).

A large proportion of groundwater-dependent parcels were mapped during baseline as Type C alkali meadows (61%), and the Agreement seeks to prevent these meadows from changing to shrub-dominated communities (Type B), a change that can be associated with increased depth to groundwater. Alkali meadows are of special concern because small increases in depth to groundwater can decouple the groundwater from the root zone of grass species (Naumberg *et al.* 1996, Elmore *et al.* 2006). Alkali meadow comprises 0.1% of the vegetation community types in California and 80% of alkali meadow communities are located within the Owens Valley (Davis *et al.* 1998). Local management of these ecosystems influences the likelihood these ecosystems persist within California in a changing environment.

Vegetation change across the Owens Valley was evaluated at both the valley scale and for each of 97 individual parcels sampled in 2014. First, at the valley-wide scale we evaluated perennial plant cover and composition in parcels affected by groundwater pumping and for parcels that were relatively unaffected by groundwater pumping during the period of maximum pumping rate (1987-1993). Second, we assessed whether perennial plant cover differed over time for locations influenced by pumping compared to locations not influenced by groundwater pumping. Third, we quantitatively assessed the divergence of these groups of parcels from the baseline cover values recorded from 1984 to 1987. Fourth, we assessed whether vegetation composition in wellfield or control groups had changed from baseline values. Lastly, for individual parcels, we (a) quantified the magnitude of change in perennial vegetation cover over the twenty-three year reinventory period, (b) assessed whether the relative proportion of woody vegetation (hereafter shrub), gramminoid vegetation (hereafter grass) and non-gramminoid herbaceous vegetation (hereafter herb) has changed compared to baseline and (c), quantified the temporal trends of vegetation composition for each parcel.

Evaluation of LADWP transect locations

The inventory of vegetation in the Owens Valley conducted from 1984 to 1987 by LADWP was set as a legal baseline for vegetation cover and composition as part of the LTWA. However, the baseline data set (1984-1987) did not include the precise locations of transects precluding a repeated measures design for a monitoring program.

ICWD began its vegetation monitoring program in 1991 and LADWP began its program in 2004. The primary difference between the programs is that ICWD re-randomized transect locations within parcels each year (1991-2014) to guard against inadvertently entrenching a systematic bias in the reinventory data. LADWP selected permanent transect locations to monitor each year (2004-2014) so that the effect of transect differences could be statistically controlled, isolating the actual inter-annual change in vegetation from variability solely due to transect location.

Currently, ICWD and LADWP are tasked with implementing a single vegetation monitoring program for the 2015 growing season that provides data amenable to an unbiased statistical comparison to baseline samples while also amenable to quantifying trends in vegetation change with a high degree of precision and accuracy. The uncertainty in a potential bias of permanent transect locations has been a key barrier to implementing a single vegetation monitoring program in the past. But if permanent transect locations can be demonstrated to be unbiased, (a) statistical comparisons to baseline using the means and variance are justified and (b) the gains in precision in quantifying vegetation change by controlling for transect identity would be an advantage in elucidating causes of vegetation change.

The potential bias of permanently located samples has remained an unanswerable hypothetical owing to the infeasibility of exhaustively sampling each parcel to approximate the true parcel cover. Here we use a 28-year time-series of remotely sensed vegetation using Landsat TM data processed with a spectral mixture analysis yielding a fractional photosynthetic vegetation value. From this data, the parcel average vegetation cover can be calculated and compared to the mean of the values extracted from transect coordinates yielding the sample error for each year in the time series. This approach allows for an assessment of potential systematic sample bias associated with the spatial locations of the permanent transects based on the heterogeneity of within-parcel vegetation cover.

Methods

The Owens Valley is located in east-central California, entirely within Inyo County. The valley is bounded by the Sierra Nevada to the west and the White/Inyo Mountains to the east. Runoff from the Sierra Nevada maintains a shallow water table in the valley that historically supported phreatophytic vegetation communities including alkali meadow, Nevada saltbush meadow and rabbitbrush meadow. Perennial grasses dominate the alkali meadow vegetation communities, while shrubs and grasses co-dominate mixed meadows (Manning, 1997).

From September 1984 to Nov 1987, LADWP inventoried and mapped vegetation on 2126 vegetation parcels (223,168 acres). Many of these parcels are characterized by nonphreatophytic plant communities or are distant from pumped areas. In the summer of

2014, ICWD resampled 97 parcels using the line point protocol described in the Greenbook (a complete list is contained in Appendix 1). Parcels were initially selected based on meeting one or more of the following criteria: (1) parcel contained a permanent monitoring site; (2) baseline data was collected for the parcel; (3) parcel was in close proximity to a pumping well; (4) information of past and current land use for parcel was available; (5) parcel was representative of one of the plant communities originally mapped during baseline; (6) soil characterization was available for the parcel; (7) characterization of the landscape position was available for the parcel (Manning 1994). The average size of these vegetation parcels in which sampling was conducted was 88.1 acres (range 13.5-565.2 acres) and the total acreage of all parcels combined was 9,690.9 acres. Between 14 and 36 transects were sampled in each vegetation parcel in 2014. Randomized transect locations were generated in ArcGIS 10.2 software (ESRI 1995-2011).

Criteria for Control or Wellfield Groups

Parcels were classified as either control or wellfield based on criteria derived from groundwater drawdown during the period of maximum pumping rate that occurred between 1987 and 1993. Two water table estimation methods were used to provide numerical criteria for these parcel classifications: (1) ordinary kriging, a geostatistical approach that relies on the spatial correlation structure of the test well data for weighting in order to interpolate groundwater depth for an entire parcel, and (2) groundwater-flow modeling estimates of groundwater drawdown contours shown on the baseline maps (Danskin 1998, Agreement Exhibit A: Management Maps, Harrington and Howard 2000, Harrington 2003). Parcels were designated as either wellfield or control depending on whether drawdown estimates from both kriged test well data and groundwater modeling were above or below critical values. Parcels were assigned wellfield status if (1) kriged DTW estimates exceeded 1-m water-table drawdown and (2) they were located at sites corresponding to modeled drawdown contours greater than 10 ft. Parcels were assigned control status if (1) kriged DTW estimates were less than 1-m and (2) they were located at sites corresponding to modeled drawdown contours less than 10 ft. If the kriged DTW estimates were not reliable owing to inadequate test well coverage near vegetation parcels (Harrington 2003), then the groundwater-flow model estimate of the 10-ft drawdown contour was used as the sole criteria to designate parcels as either wellfield or control. An exception to the above criteria was applied to parcels associated with drawdown contours greater than 10-ft yet located near a surface water source (specifically, a canal, sewer pond, creek, river, or a ground water seepage source) that would lessen local drawdown effects—these parcels were classified as control. Some parcels assigned the wellfield designation currently have higher water tables than during 1987 to 1993, but they retain the wellfield designation owing to their proximity to pumping wells.

Statistical Analyses

Changes in vegetation cover and composition from baseline were evaluated at the valley-wide scale via comparisons of parcel groups (wellfield vs. control) and at the individual parcel scale using multi-year transect data for each parcel.

All statistical analyses were performed using R Version 3.1.1 (R Core Team 2014). The following R packages were used: ‘plyr’ (Wickham 2011), ‘reshape’ (Wickham 2007), ‘multcomp’ (Hothorn et al. 2008), ‘nlme’ (Pinheiro *et al.* 2013), and ‘car’ (Fox and Weisberg 2011). Statistical significance was declared at the $\alpha = 0.05$ level; however the County recognizes the arbitrary dichotomization of the p scale is more an accident of history rather than a defensible cut point to base inference upon. As such, absolute p-values are considered along with effect sizes. Cover values are rounded to the nearest integer in reporting.

Analysis Variables

At the transect level, the data represent the counts of vegetation cover 'hits' from a 50-m line-point-intercept transect sampled every 0.5 m yielding 100 possible hits per transect. Perennial cover was chosen for analysis because annual species are not dependent on ground water. Perennial cover was further categorized by the life-form categories grass, herb, and shrub.

In order to analyze the changes in the composition of total perennial cover, the proportion of shrub, herb and grass cover in comparison to total perennial cover was calculated at the transect level. Transect data are summarized for each year using the arithmetic average, creating a history of cover over time for each parcel. Other measurements taken each year at the parcel level include depth to water (DTW) and fraction of photosynthetic vegetation cover derived from spectral mixture analysis (SMA) of LANDSAT TM imagery data (Elmore 2001). Kriged DTW estimates for reinventoried vegetation parcels were not available for 2014 during the writing of this report. An updating of the kriging procedure including decisions on which test wells to include has been an ongoing project in 2014-2015 and estimates should be available in 2015. SMA values were not available for 2011-2014 due to discontinuation of Landsat 7 data use in previous years. However Landsat 8 data is now available and a new LANDSAT TM data processing tool is being developed for ICWD which will be available in summer 2015.

A change profile for each parcel in the continuous parcel data was computed as the change in mean perennial cover for each reinventory year from baseline perennial cover. Each parcel is classified by its Holland type and by its status as either wellfield or control.

Analysis Data Sets

The number of parcels sampled each year as well as the number of transects sampled per parcel has varied due to fluctuations in annual staffing. Thus, some parcels have varying numbers of transects sampled across time. Other parcels have not been sampled continuously during the entire monitoring period. In 2014, 97 parcels were sampled. For determinations of change from baseline, several subsets of the entire data set were used as follows:

Parcels missing baseline transect data (*n* = 11): The set of parcels resampled in 2014 for which baseline transect data is unavailable.

1. Full transect data (*n* = 86): The set of parcels with transect data from both the current year (2014) and at least one associated transect conducted during the baseline monitoring period (1985-1987). These parcels were further identified as belonging to the control or wellfield parcel group.
    a. Wellfield (*n* = 53)
    b. Control (*n* = 33)
2. Continuous parcel data (*n* = 36): The subset of full transect data that was sampled in every year from 1992 to the present. The year 1992 was chosen for the continuous parcel data because the sample size was greater than the set of parcels sampled each year from 1991 to the present. The baseline year was assigned to the nominal value of 1986 for these data. These data were further identified as either control or wellfield and by alkali meadow.
    a. Wellfield (*n* = 24)
        i. Continuous transect data – alkali meadow wellfield (*n* = 15)
    b. Control (*n* = 12)
        i. Continuous transect data – alkali meadow control (*n* = 10)
3. Regression data set (*n* = 100): The subset of full transect data with at least 10 years of data including the nominal baseline year. This set also includes parcels that were not sampled in 2014 if

the time series contained at least 10 years of data.

a. Wellfield (n = 63)
b. Control (n = 37)

Analysis of parcel groups: wellfield vs. control

MANOVA was used to assess whether there was a difference in level or shape of the change profile over time between wellfield and control parcels. This allowed a direct evaluation of the effects of parcel status (wellfield or control) and time (1992-2014) on changes from baseline. The change profile was defined as the difference between the mean annual cover for each year and baseline. To allow for arbitrary changes in variance from year to year, and also for arbitrary dependence between errors from year to year, a fully unstructured correlation matrix was used. To avoid confounding the evaluation of change over time with the potential effects of varying the sample size between years, analyses were performed only on the continuous parcel data and on the alkali meadows subset of the continuous parcel data. Model fit was assessed using graphical analysis of residuals.

To assess directly whether there was a change from baseline across parcels in mean perennial cover or mean grass cover, a paired t-test was used. Tests were performed using the full parcel data. Wellfield and control parcels were analyzed separately.

Analysis of covariance (ANCOVA) was used to assess whether there were differences in the linear trend of total perennial, grass cover, herb cover and shrub cover wellfield and control parcels. This analysis was performed using the continuous parcel data (1986, 1992-2014 = 24 years). The grouping variable was parcel status (wellfield or control), and the continuous variable was cover regressed on time. Linear trends were subsequently estimated using simple linear regression. Model fit was assessed using graphical analysis of residuals.

Individual parcel analyses

To evaluate in which parcels and in which year(s) total perennial cover has significantly differed from baseline, Welch's t-test for unequal variance was used to evaluate significant changes compared to baseline for each year that the parcel was sampled. Weighted ANOVA with Dunnet's method for multiple comparisons has been used for these comparisons in the past; however, Welch's t-test is appropriate and there is no need to correct for multiple comparisons in a monitoring context when the comparison is always the most recent sample estimate vs. the baseline value (ICWD Annual report 2014, p. 172). This method could only be used for parcels in which baseline data contained more than one transect. The results were grouped into three categories: significantly below baseline, no difference from baseline, and significantly above baseline.

To assess whether composition had changed within each vegetation parcel, a regression of shrub proportion (shrub cover/total perennial cover), grass proportion, and herb proportion over time was performed for all parcels in the full transect data with at least 10 years of vegetation data including baseline (regression data set).

Evaluation of LADWP transect locations

Landsat TM data was processed with a linear spectral mixture analysis (SMA) to derive a gridded (30-m spatial resolution) fractional photosynthetic vegetation cover for the Owens Valley (Elmore 2000). The time-series of SMA cover and live vegetation cover measured on the ground with line-point-intercept transects track the same inter-annual cycles suggesting SMA cover useful to serve as a proxy to evaluate sample error of permanent transect locations. The Landsat TM scenes were acquired in late summer/early fall to remove the signal from annuals that were assumed to have senesced by fall, leaving the signal from perennial species in the SMA cover value. The gridded SMA cover has a spatial resolution of 30 m and the time-series 1984-2011 was used.

Certain unvegetated features (i.e. roads, aqueduct) bisect some parcels and these areas were masked out before the datasets were constructed. The Los Angeles aqueduct was digitized roughly down the center and was buffered by 40 m in each direction perpendicular to the feature to exclude this unvegetated infrastructure. Highway 395 was buffered by 25 m on each side of both north bound and south bound lanes creating an approximate 90-m width exclusion buffer. Undeveloped and surface roads were buffered by 10-m in either direction. The masked area features were rasterized to 5 m and these features were assigned the value "1". No data values were assigned the value zero.

SMA datasets were resampled to 5 m so the features could be extracted at the 5 m resolution. The `Set Null` tool was used to set the masked area to 'no data' based on the conditional statement "VALUE" = 1; in grid cells where the statement was false, the values of the 'false raster' (SMA annual imagery) values were assigned. This resulted in a resampled SMA time-series at 5-m resolution with roads and aqueduct features assigned a 'no data' value.

The ‘zonal statistics as table’ tool in ArcGIS spatial analyst extension was used to compute the known parcel average for each year, 1984 to 2011, for the 136 vegetation parcels that LADWP measures. The `extract multi values to points` tool was used to create the sample dataset of the cell values associated with LADWP transect locations from 1984-2011.

The `bearing distance to line` tool in Data Management Tools was used to map each transects' orientation. The `Feature vertices to points` was used to create a transect end point feature that was then merged with the start point feature. The spatial analyst tool `extract multi-values to points` was used to acquire grid cell values at each start and end point. These values were averaged to represent the remotely sensed vegetation cover at transect locations.

The sample error was computed for each parcel in each year as the difference between the sample mean and known mean. The average sample error across each parcel's time series was classified as, `Good` (absolute mean sample error less than 5%), `Fair` (absolute mean sample error less than 10%) or `Unsatisfactory` (absolute mean sample error greater than 10%).

A linear regression was fit to each parcel's time-series having the form:

$$K = \beta_o + \beta_1 S + \epsilon$$

Where K is the known mean of the SMA grid cell values in each parcel, S is the mean of the SMA cover at permanent transect locations, β_o is the intercept, β_1 is the slope and ϵ is the model error term. The slope was analyzed to evaluate whether the sample error was stable over time, meaning the processes that influence the temporal dynamics of vegetation are adequately represented by the sample. This was of interest when the average sample error was unsatisfactory. The sample error was considered stable if the 95% confidence interval of β_1 encompassed one. Slopes significantly different than one suggest the sample error is unstable, meaning either key processes were not represented by the sample or the model error term and 95% confidence interval was small, rendering trivial deviations from a slope of one significant.

Results

Analysis of Parcel Groups: Wellfield vs. Control

Comparison of change profiles between wellfield and control groups–MANOVA results

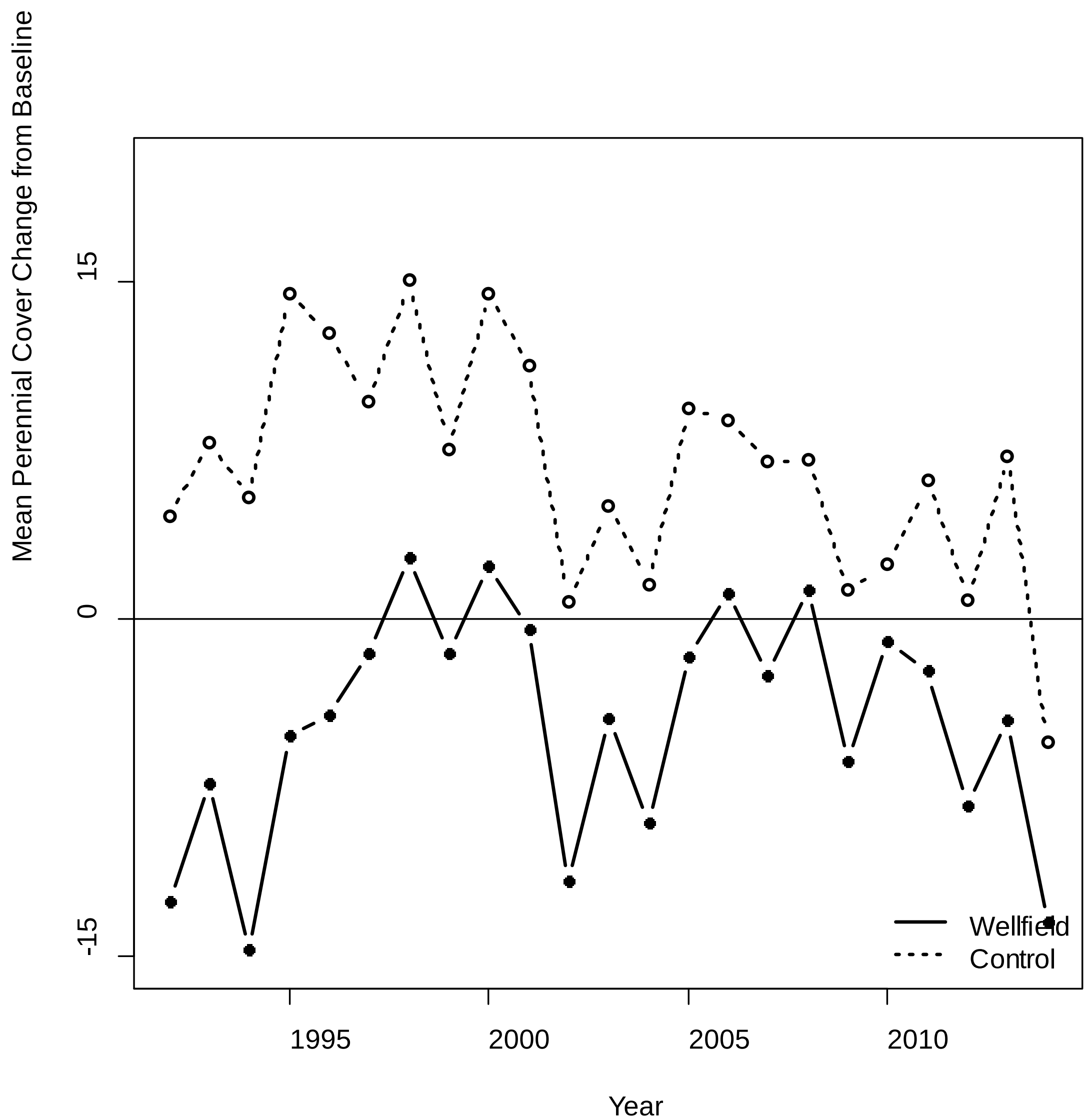


Figure 5.1a. The mean change from baseline of mean perennial cover for all parcels sampled each year between 1992 and 2014 (n = 36).

Figure 5.1a-b displays the change profiles for wellfield and control parcels that were continuously sampled, as well as for the alkali meadow subset of these parcels.Figure 5.2 breaks out the overall cover by each lifeform category.

The change from baseline of mean perennial cover of wellfield parcels (*n* = 24) differed from the change from baseline of mean perennial cover of control parcels (*n* = 12) (*n* = 23 yrs (1992-2014), *p* = 0.01998, Figure 5.1a). Inter-annual trends or the shape of the change profile in the two groups have been similar during the reinventory period, thus the significant difference is attributable to the level of the difference between the change profiles. In 2014 both groups dropped below baseline.

For the alkali meadow parcel group sampled each year during this same time period (1992-2014), the general pattern and level of

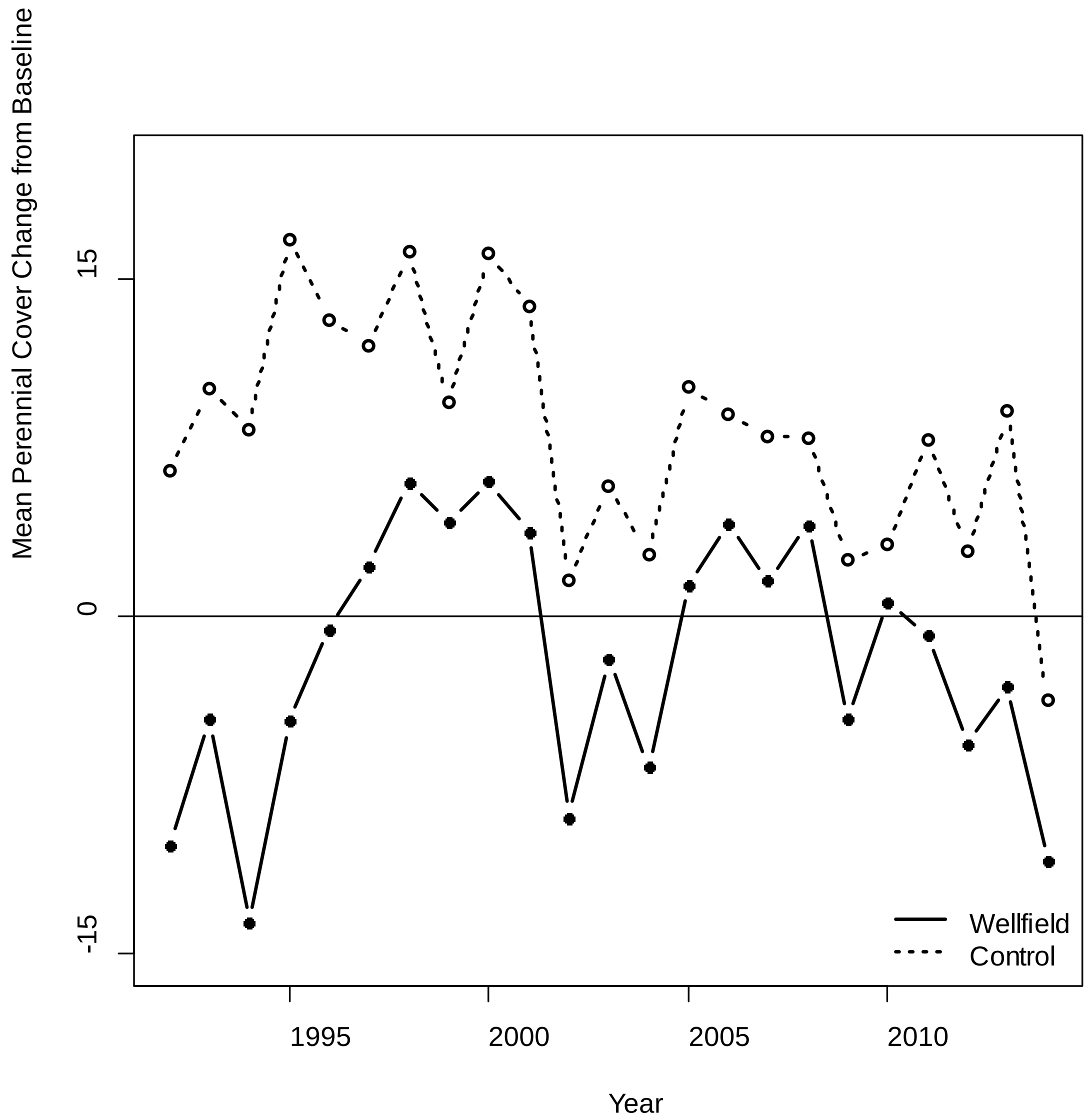


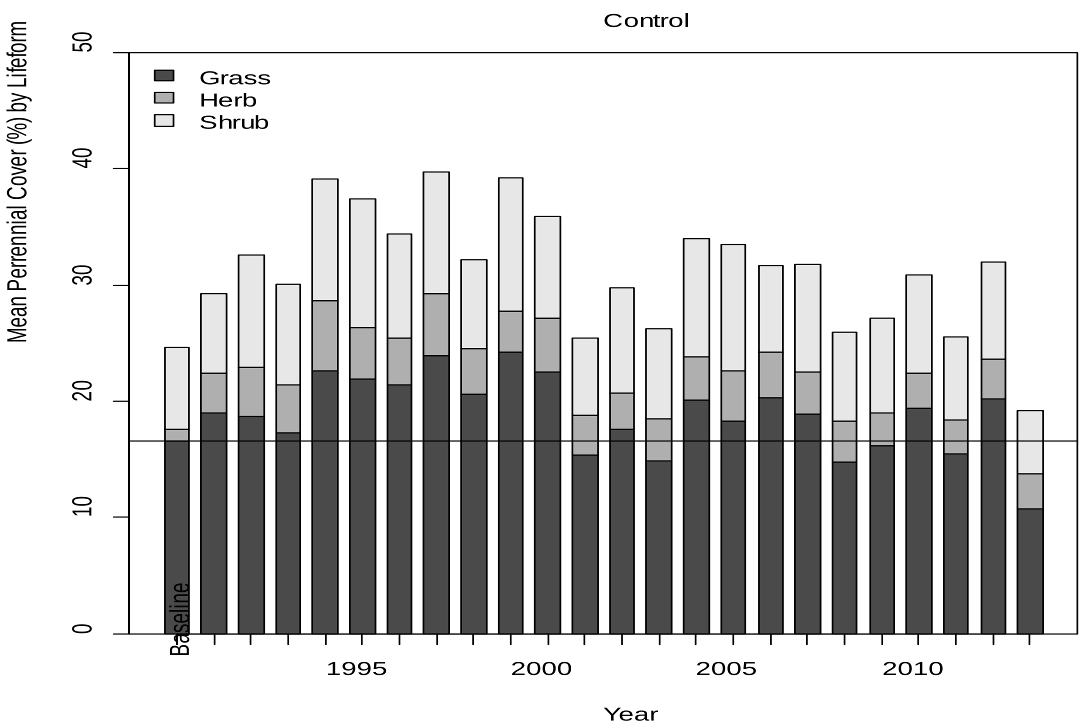
Figure 5.1b. The mean change from baseline of mean perennial cover for the alkaline meadow parcels sampled each year between 1992 and 2014 (n = 25).

difference were similar; however, the comparison between wellfield (n = 15) and control (n = 10) parcels was not significant (n = 22 yrs, p = 0.6822, Figure 5.1b).

<u>Difference between baseline and 2014 cover in wellfield and control parcel groups</u>

Mean perennial cover in wellfield parcels calculated from the 2014 full transect data set (n = 97) was 17%, compared to 32% mean baseline cover (n = 53, p < 0.0001, Figure. 5.3). Mean perennial cover in control parcels calculated from the full data set in 2014 was 22%, compared to 30% mean baseline cover (n = 33, p = 0.0014, Figure 5.3).

In 2014, mean perennial grass cover in wellfield parcels calculated from the full transect data set was 8%, compared to 20% mean baseline grass cover (n = 53, p < 0.0001, Figure 5.3). Mean perennial grass cover in control parcels calculated from the full data set



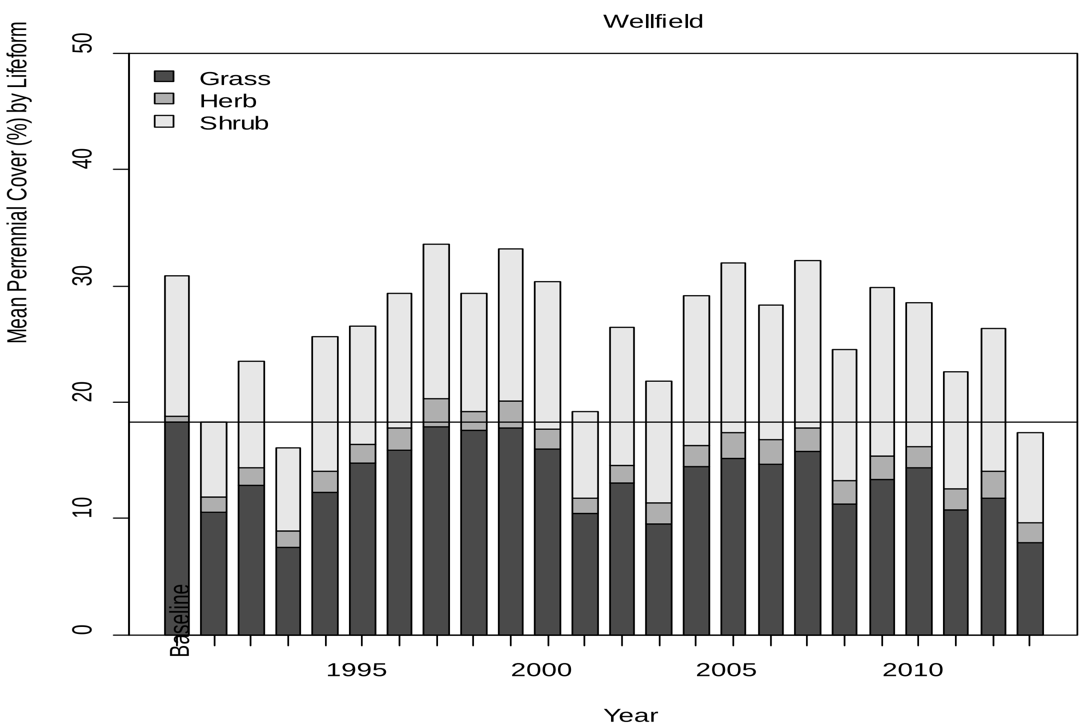
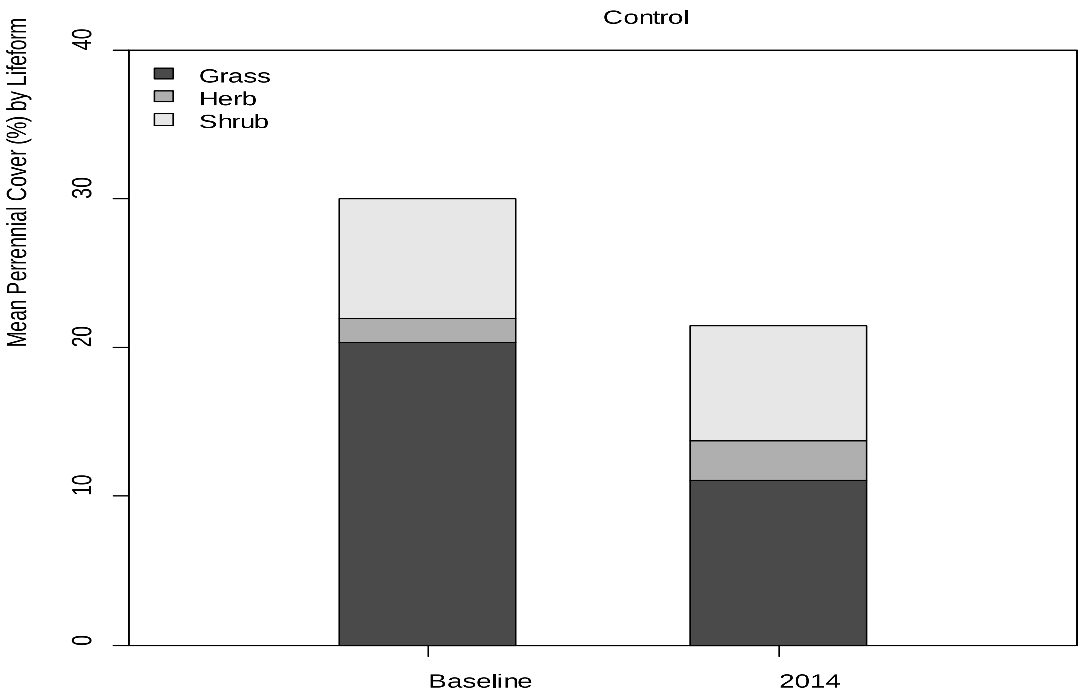


Figure 5.2. Time profile of grass, herb and shrub cover for baseline and each reinventory year for control and wellfield parcels sampled each year between 1992 and 2014 (n = 24 wellfield parcels, n = 12 control parcels, n = 24 yrs including nominal baseline year). Horizontal line shows the mean baseline grass cover value.



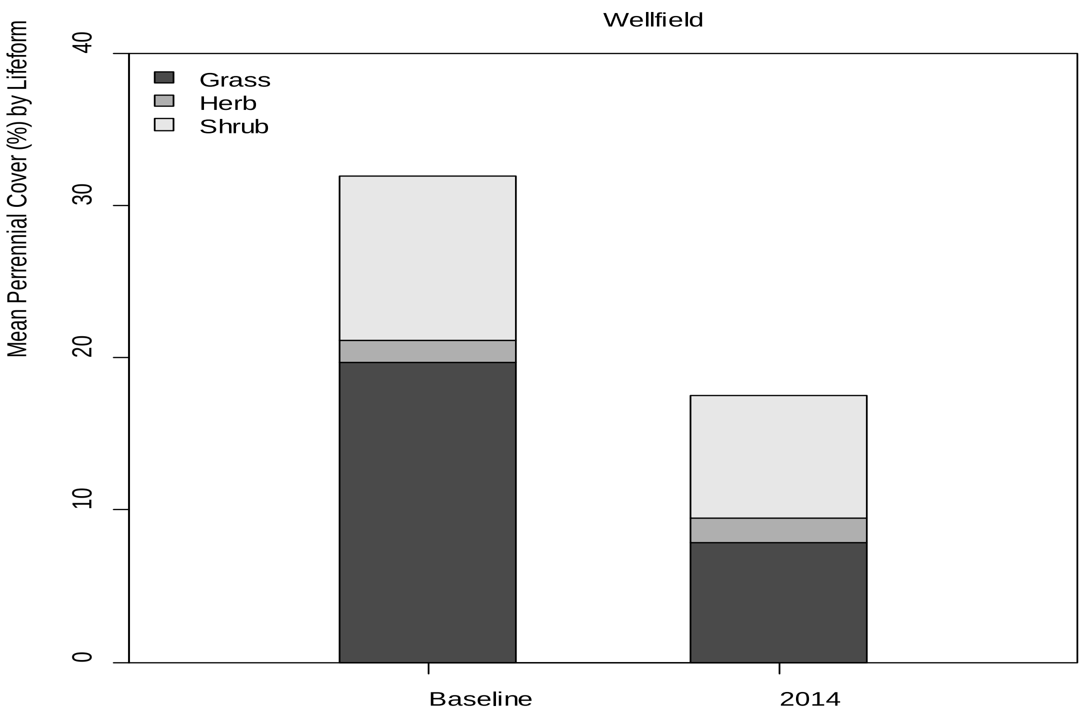


Figure 5.3. Mean perennial cover partitioned by lifeform for baseline and 2014 calculated for all parcels sampled in 2014 that have baseline transect data (n = 33 for control parcels, n = 53 for wellfield parcels).

in 2014 was 11%, compared to 20% mean baseline grass cover (n = 36, p = 0.0015, Figure 5.3).

Differences in rates of composition change for wellfield vs. control groups

Formal tests for difference in slope using analysis of covariance (ANCOVA) over time (n = 24 years) between control and wellfield parcel groups were not significant for total perennial cover (p = 0.25) or grass cover (p = 0.67). Herb cover (p=0.09) and shrub cover (p = 0.08) approached significance at alpha 0.05. Parcel-level responses in opposing directions within groups yield wide variance when aggregated at this level.

Composition change for wellfield and control groups

Using the 24-yr continuous dataset (1992-2014) (n = 24 wellfield parcels, n = 12 control parcels), simple linear regression was used to graphically illustrate linear trends in plant functional groups over time (Figure 5.4a-d). Mean total perennial cover in wellfield parcels was above 30% during baseline and below 20% in 2014, but the slope over time was flat owing to the variability between baseline and 2014. Control parcel cover during baseline was about 25% and all years following were above this level except 2014 when it dropped below 20% cover. Grass cover has declined in both wellfield and control parcels; the primary decline in wellfield parcels was in the early 1990's but grass cover in 2014 nearly declined below the lowest grass cover on record in 1994 (Figure 5.4). The largest decline in grass cover at control parcels was between 2013 and 2014 with about a 10% decline. Wellfield herbaceous perennial cover has increased over time but represents a small component of overall cover (less than 3%).

Individual Parcel Analysis

In 2014, perennial cover in 31 out of 53 sampled wellfield parcels (58%) with baseline transect data were significantly below baseline (Figures 5.5-5.9 and Appendix 2). Nearly half (14 out of 31) of these parcels dropped below baseline in 2014. There are eight parcels that have been below baseline for three years, five parcels that have been below baseline for the last 6-8 years, and 4 parcels that have been below baseline for 14 years or more (Figure 5.10).

Individual parcel changes in shrub and grass proportion

Shrub proportion in 49 of 100 parcels (regression data set, n = 63 wellfield, n = 37 control) was significantly correlated with time (Appendix 3). Seven of these 49 parcels had significantly decreasing shrub proportion and 42 parcels had significantly increasing shrub proportion (Appendix A). Twenty-five of the 42 parcels that showed increasing shrub proportion over time were wellfield parcels while 17 were control parcels.

Grass proportion in 46 of 100 parcels was significantly correlated with time (Appendix 3). Thirty-nine of these 46 parcels had significantly decreasing grass proportion and seven parcels had significantly increasing grass proportion (Appendix A). Twenty-five of the 46 parcels that showed decreasing grass proportions over time were wellfield parcels while 14 were control parcels.

Herb proportion in 12 of 100 parcels was significantly correlated with time (Appendix 3). Ten of these 13 parcels had significantly increasing herb proportion and two parcels had significantly decreasing herb proportion (Appendix 3). Eight of the 10 parcels that showed increasing herb proportion over time were wellfield parcels while two were control parcels.

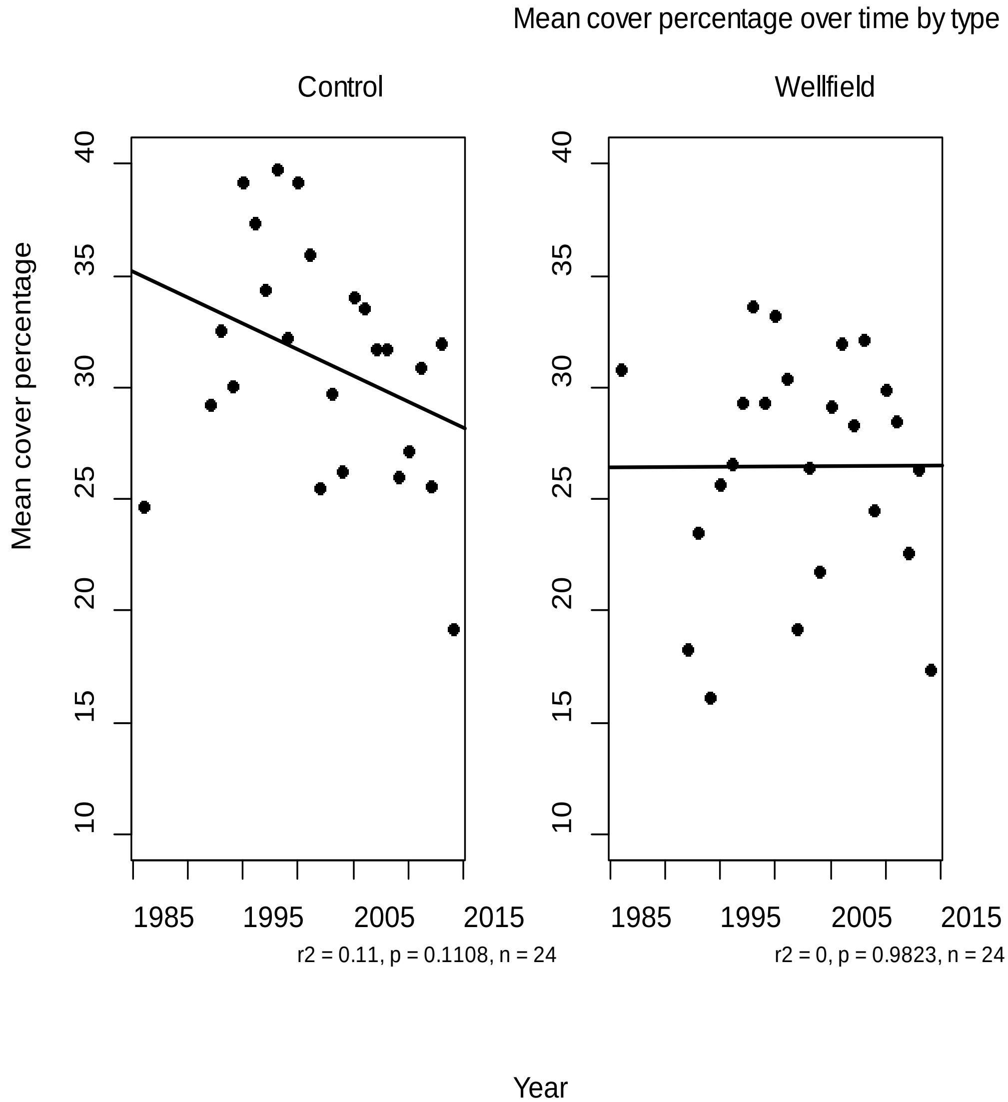


Figure 5.4a. Total cover over time in wellfield and control parcels computed from parcels in the continuous transect data set (n = 24 wellfield parcels, 12 control parcels, n = 24 years including nominal baseline year).

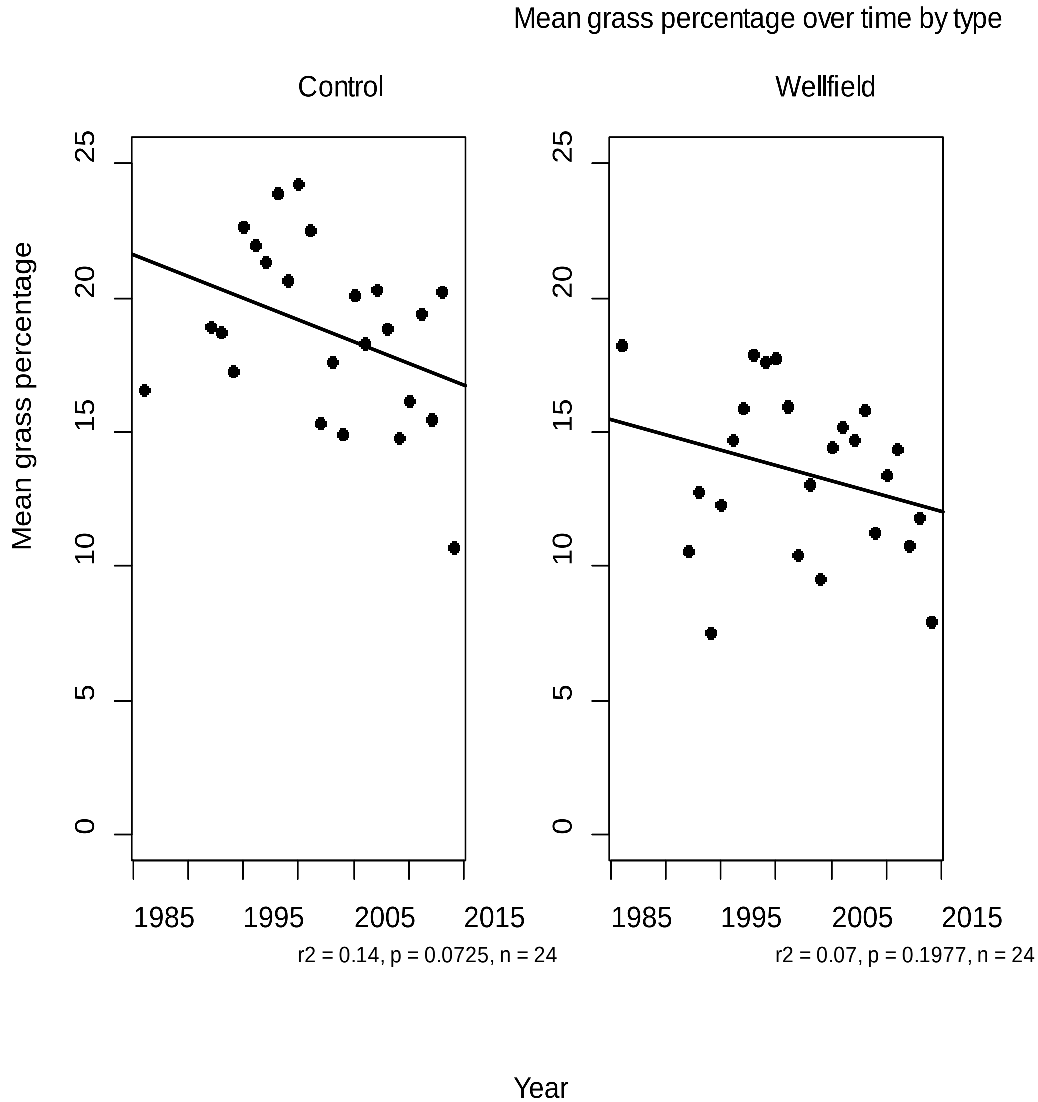


Figure 5.4b. Grass cover, over time in wellfield and control parcels computed from parcels in the continuous transect data set (n = 24 wellfield parcels, 12 control parcels, n = 24 years including nominal baseline year).

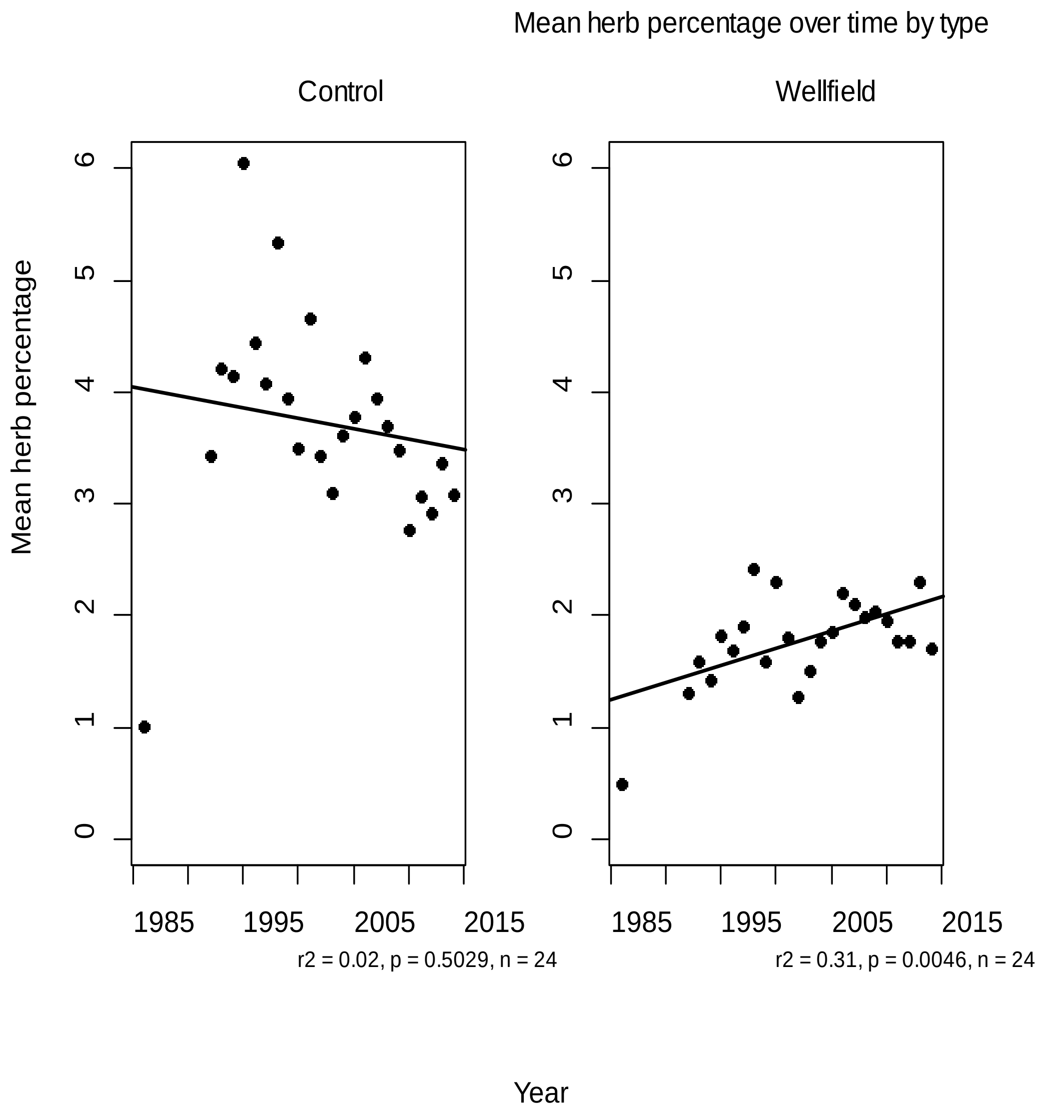


Figure 5.4c. Herbaceous cover over time in wellfield and control parcels computed from parcels in the continuous transect data set (n = 24 wellfield parcels, 12 control parcels, n = 24 years including nominal baseline year).

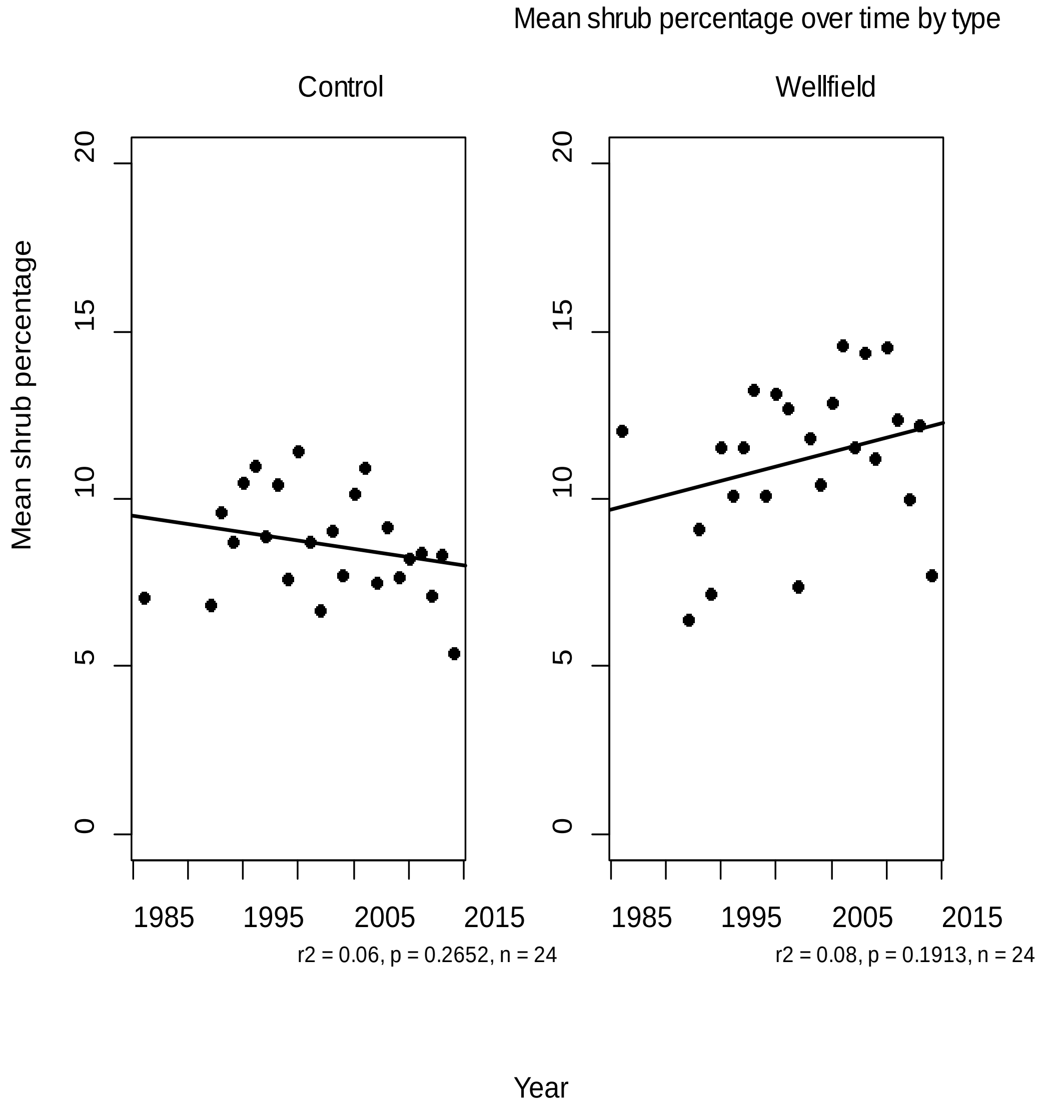


Figure 5.4d. Shrub cover over time in wellfield and control parcels computed from parcels in the continuous transect data set (n = 24 wellfield parcels, 12 control parcels, n = 24 years including nominal baseline year).

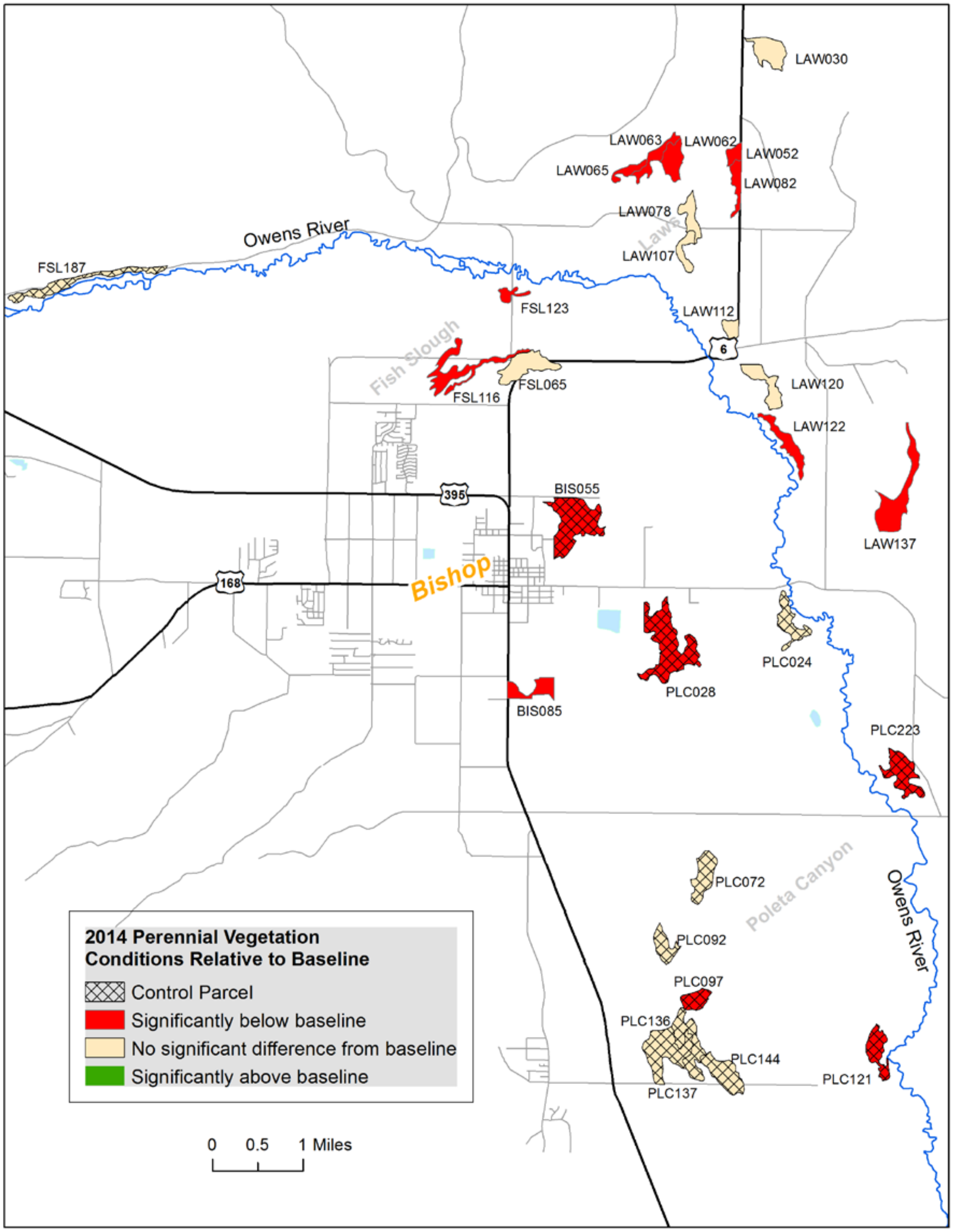


Figure 5.5. Parcels in the Bishop wellfield area color-coded by degree of change from baseline perennial cover based on Welch's unequal variances t-test comparing baseline to 2014 data.

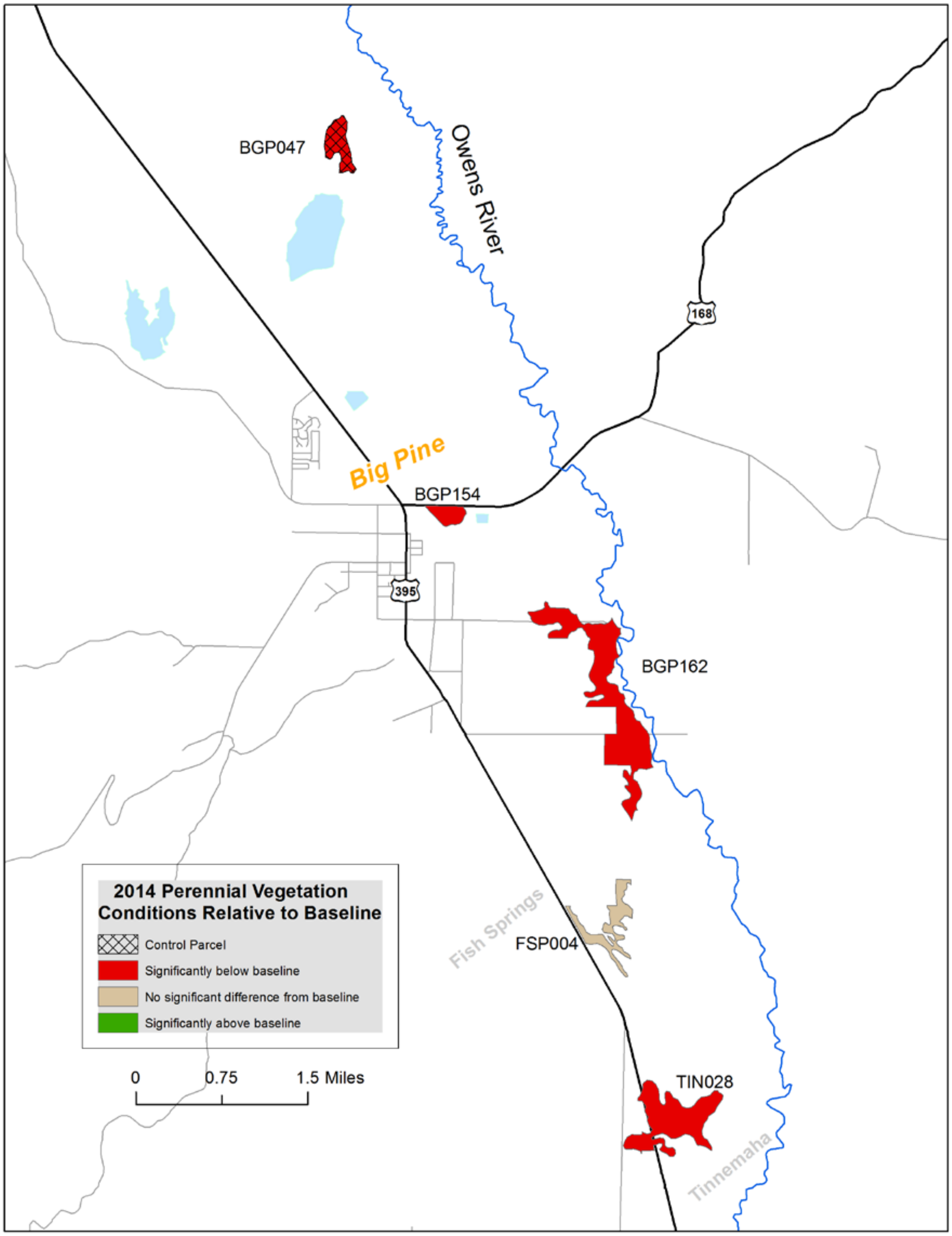


Figure 5.6. Parcels in the Big Pine wellfield area color-coded by degree of change from baseline perennial cover based on Welch's unequal variances t-test comparing baseline to 2014 data.

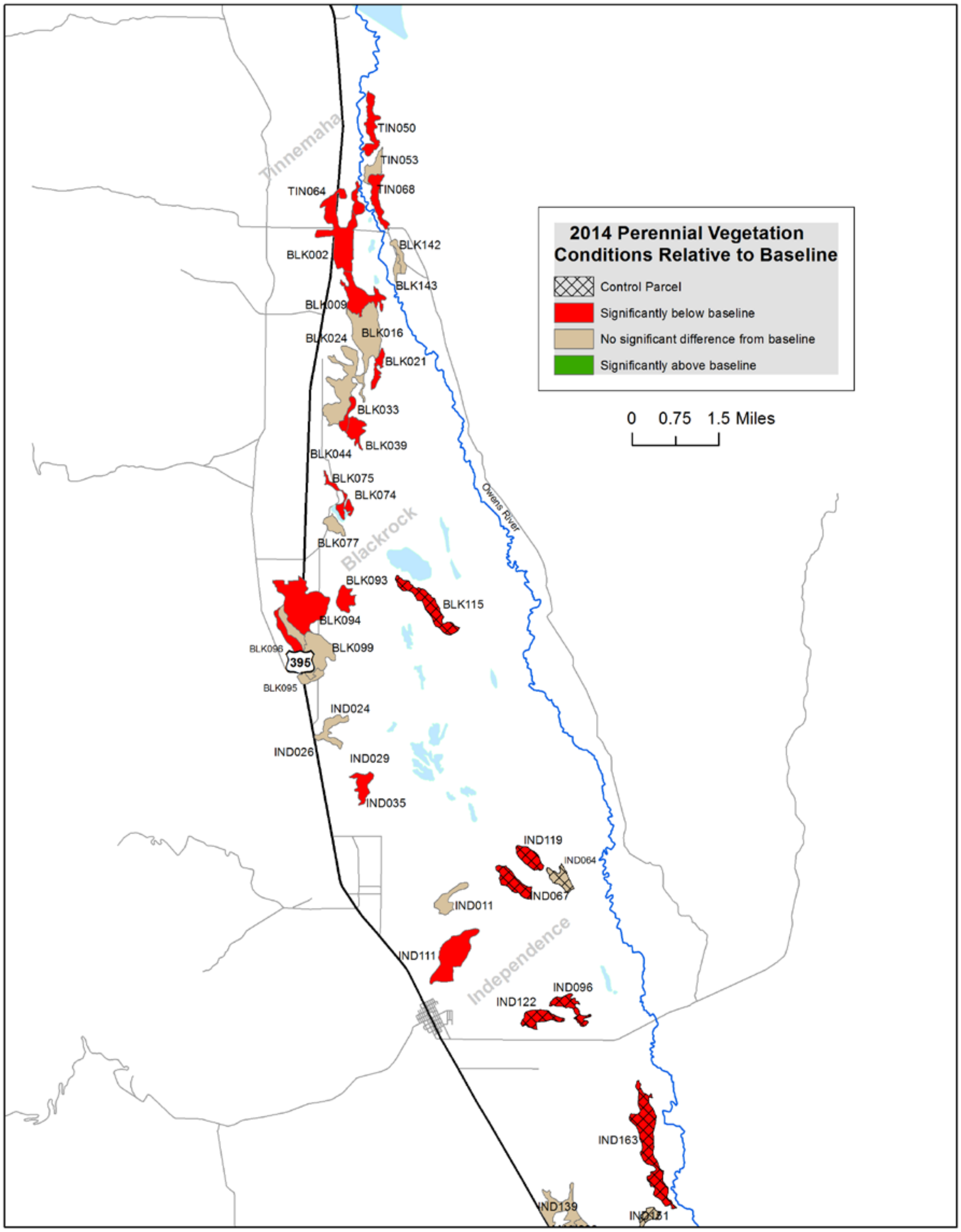


Figure 5.7. Parcels in the Taboose-Aberdeen and Thibaut-Sawmill wellfield areas color-coded by degree of change from baseline perennial cover based on Welch's unequal variances t-test comparing baseline to 2014 data.

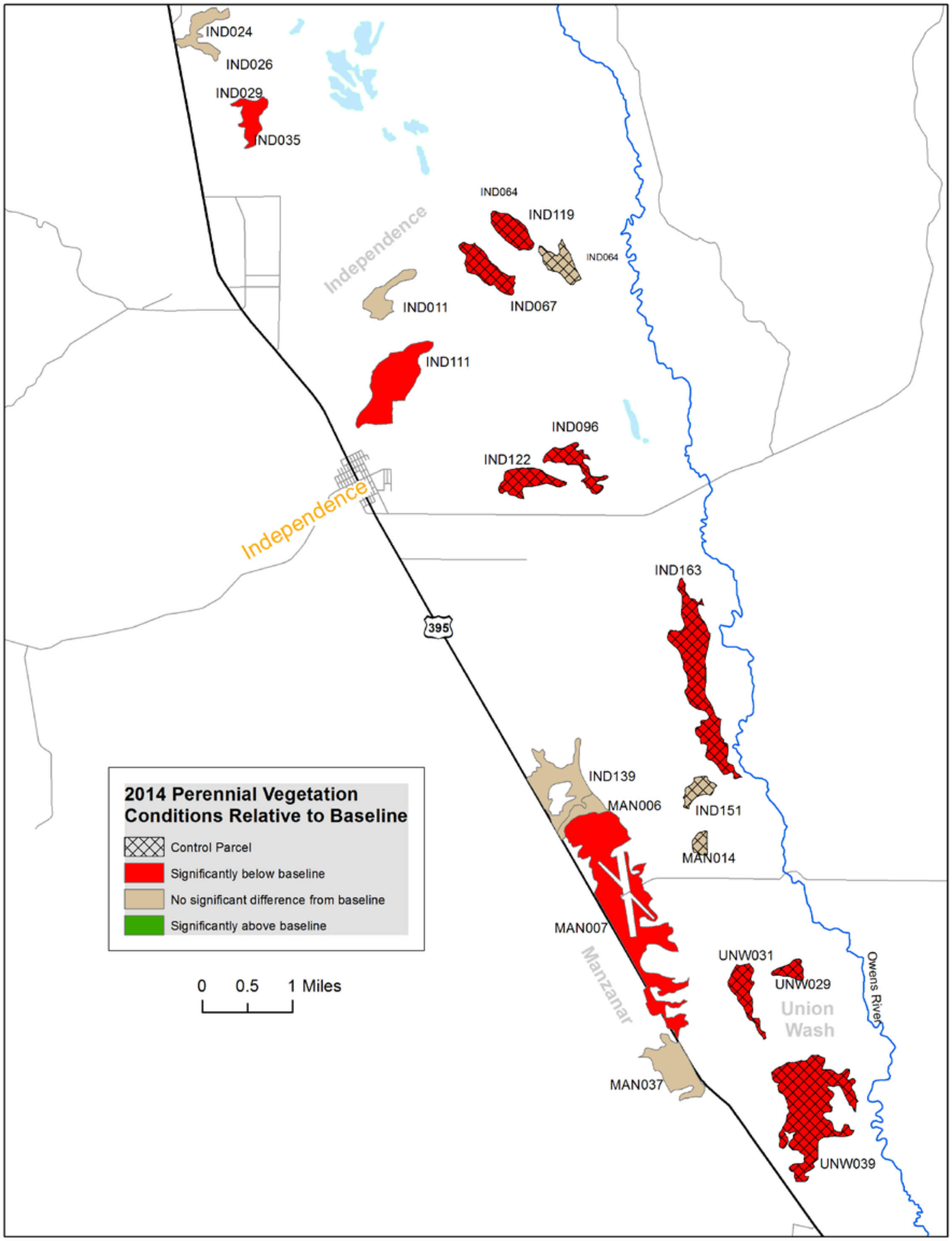


Figure 5.8. Parcels in the Independence-Oak, Symmes-Shepard and Bairs-George wellfield, color-coded by degree of change from baseline perennial cover based on Welch's unequal variances t-test comparing baseline to 2014 data.

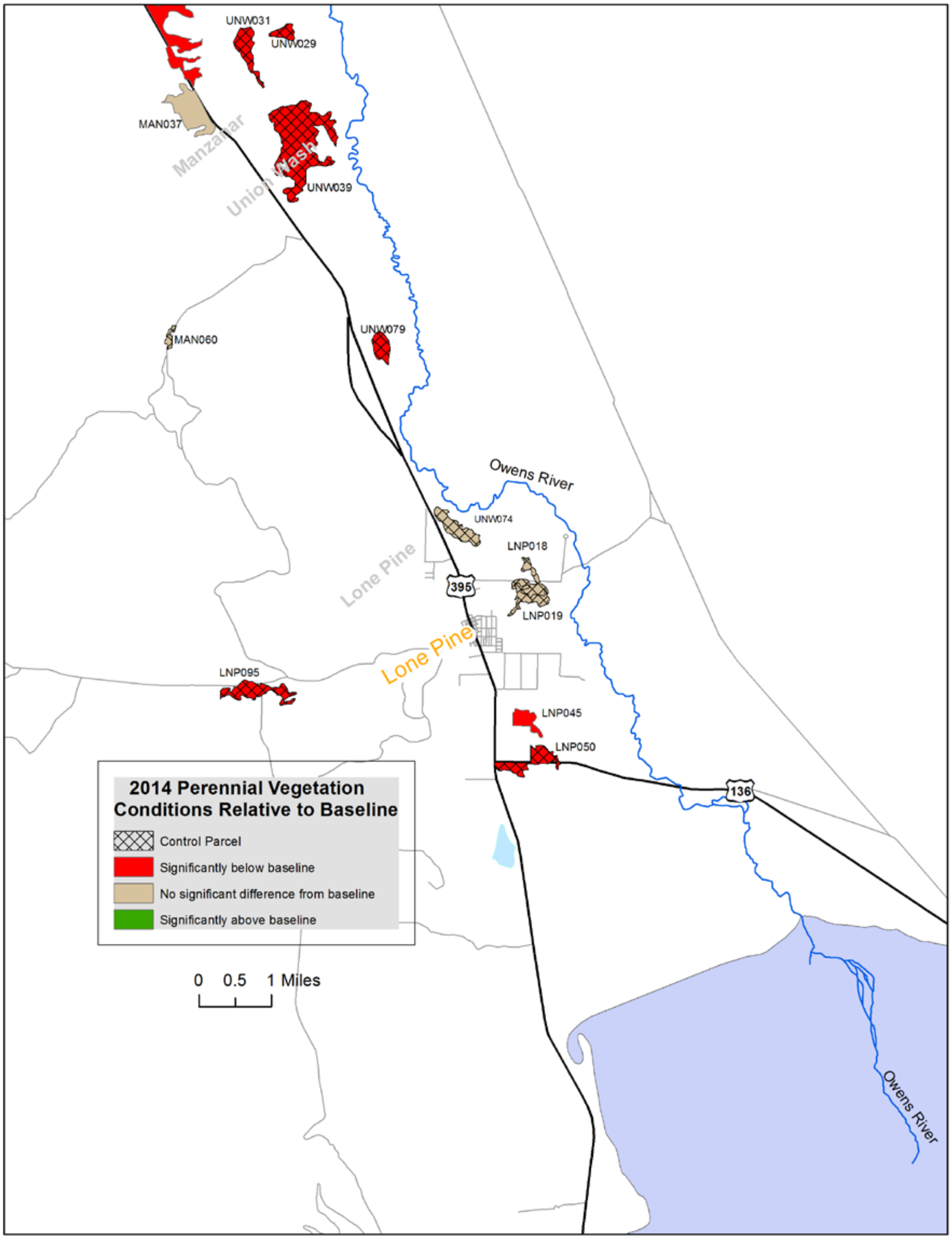


Figure 5.9. Parcels in the Lone Pine wellfield color-coded by degree of change from baseline perennial cover based on Welch's unequal variances t-test comparing baseline to 2014 data.

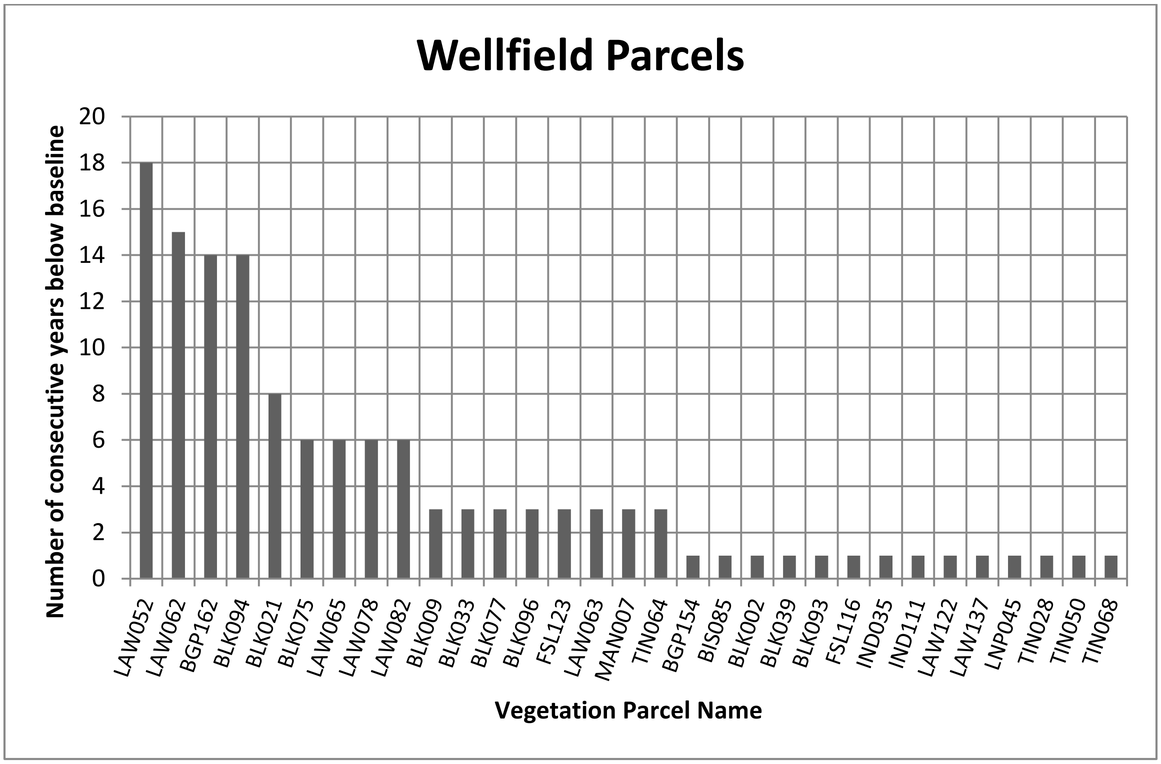


Figure 5.10. Number of consecutive years below baseline prior to and including 2014 for wellfield parcels. Statistical significance was determined based on Welch's unequal variances t-test with significance declared at α = 0.05.

Evaluation of LADWP Permanent Transect Locations

Based on mean sample errors from each parcel's time series, there were 126 good samples, 8 fair samples and 2 unsatisfactory samples out of 136 parcels evaluated (Table 5.1). For the 10 fair and unsatisfactory samples 7 were overestimates and 3 were underestimates (Table 5.2). Out of 7 overestimates, 6 had unstable error and out of the 3 underestimates, 2 had unstable error (Table 5.3). The mean sample error reported for each parcel is included in Appendix 4.

Table 5.1. Overall adequacy of sample error.

Sample adequacy	# parcels
Fair	8
Good	126
Unsatisfactory	2

Table 5.2. Sample adequacy and direction of bias for 'fair' and 'unsatisfactory' mean sample errors.

Sample adequacy	Over or Under	# parcels
Fair	Overestimate	5
Fair	Underestimate	3
Unsatisfactory	Overestimate	2

Table 5.3. Sample adequacy, direction of bias and sample error stability for 'fair' and 'unsatisfactory' mean sample errors.

Sample adequacy	Over or Under	stability of sample error	# parcels
Fair	Overestimate	Stable sample error	1
Fair	Overestimate	Unstable sample error	4
Fair	Underestimate	Stable sample error	1
Fair	Underestimate	Unstable sample error	2
Unsatisfactory	Overestimate	Unstable sample error	2

Discussion

There have been statistically significant changes in cover and composition at the wellfield group level and at the level of individual parcels. The majority of the individual parcels that had statistically significant change were from the wellfield group

Analysis of Parcel Groups: Wellfield vs. Control

Comparison of change profiles between wellfield and control groups

The change from baseline of mean perennial cover of wellfield parcels from 1992-2014 differed significantly from the change from baseline of mean perennial cover of control parcels. The finding of statistical significance for this test could in theory be due to either shape or level differences between the change profile of wellfield and control parcels. The shape of the change profile was quite similar for both parcel groups and thus the significance may be interpreted as being due to differences in overall level, with the wellfield group change from baseline, significantly below that of the control group.

Difference in 2014 vs. baseline cover for wellfield and control groups

Total perennial cover in 2014 for the wellfield group was 14.4% lower than baseline and grass cover was 11.8% below baseline (n=53). Total perennial cover for the control parcel group in 2014 was 8.5% below baseline and grass cover was 9.2% below baseline.

Composition change for wellfield and control group

Using the continuous data set, simple linear regression showed shrub and herb cover in wellfield parcels increased significantly and grass cover decreased (Figure 5.4). Control parcels showed a decreasing trend in grass cover also with 2014 being an influential data point associated with the third year of consecutive drought and the lowest value recorded for control parcels since 1994 for this subset of parcels (Figure 5.4).

Individual Parcel Analysis

Difference in 2014 vs. baseline cover for individual parcels

Maps of all parcels sampled in 2014 and the comparison with baseline are shown in Figures 5.5 to 5.9. Figure 5.10 shows four parcels that have been statistically below baseline for the past 14 consecutive years or more. The causes of cover decline in one of these four parcels, BLK094, was the subject of several years of analysis by Technical group members and a dispute resolution process; and ultimately a management resolution was agreed upon that included reduced pumping in the vicinity and off-site prescribed burns intended to reduce woody vegetation with the aim of maintaining higher gramminoid cover. The post-baseline decline in cover for LAW052 and LAW062 and other LAWS parcels is likely symptomatic of the reduction of water conveyance through the McNally Canals and constant pumping for irrigation.

The 2014 reinventory data show that 58% of wellfield parcels reinventoried are below baseline perennial cover measurements. Nearly half of these parcels dropped below baseline from 2013 to 2014, following the third consecutive year of below-normal precipitation and runoff. Following this trend, below normal precipitation again in winter of 2014-2015 could further exacerbate declines in vegetation.

Dominant species in these meadow communities require more water than is available via precipitation and obtain needed water within a zone of soil that is saturated with groundwater, or immediately above this zone in the capillary fringe. Reduction in water table beyond a maximum rooting depth of 2-2.5 m is incompatible with shallow-rooted species of meadow ecosystems (Elmore et al. 2006). With water-table decline, establishment and dominance of deep-rooted woody species over herbaceous species is predicted based on deeper rooting depth of shrubs (Stromberg et al. 1996; Cooper et al. 2006; Trammell et al. 2008; Goedhart and Pataki, 2010). In alkali soils, reductions in the groundwater table reduce dissolved salt content that accumulates via wicking to the surface via capillary action (Cooper et al. 2006; Patten et al. 2008). In addition to a lack of salt replenishment to the soil surface with water table reductions, subsequent precipitation events further leach remaining salts to deeper horizons. The consequent decreases in soil salt content could increase site-suitability for non-halophytic species (Patten et al. 2008) and reduce site-suitability for halophytes (plants adapted to saline environments). *Distichlis spicata*, or saltgrass, a native halophytic dominant of alkali meadow, could be expected to decrease in distribution and abundance in association with both decreases in the groundwater table and consequent decreases in soil-surface salt content. To allow long-term persistence of meadow ecosystems and alkali meadow in particular, water management in the Owens Valley requires maintenance of a shallow saturated zone of soil necessary to maintain populations of meadow species.

Trends in individual parcel composition change

The decrease in grass cover and increase in shrub cover in the wellfield parcels is consistent with the causal link between water table reductions beyond the 2 to 2.5-m grass root zone, favoring deeper-rooted woody species. In some control parcels, however, shrub cover also increased and grass cover decreased. Since control parcels are outside the influence of ground-water pumping, the mechanism underlying this effect could be due to altered water management, or disturbance regimes (i.e. grazing, fire, and drought) or a combination of these factors influencing local population demographic rates and succession to increased dominance of woody vegetation (Brown and Archer 1999, Van Auken 2000, Berlow *et al.* 2002, Eldridge *et al.* 2011).

For parcels influenced by groundwater management, repeated drawdown below the maximum rooting depth of grasses may result in establishment and dominance of shrubs. Depending on the degree of grass decline, water table management alone may be inadequate to recover the former grass component without additional management such as prescribed fire and reseeding. Land and water management practices, including reduced pumping in impacted areas, in combination with water spreading, prescribed burning (to reduce woody vegetation) and revegetation of alkali meadow species where appropriate may allow recovery of ground-water dependent meadows at sites already transitioning to

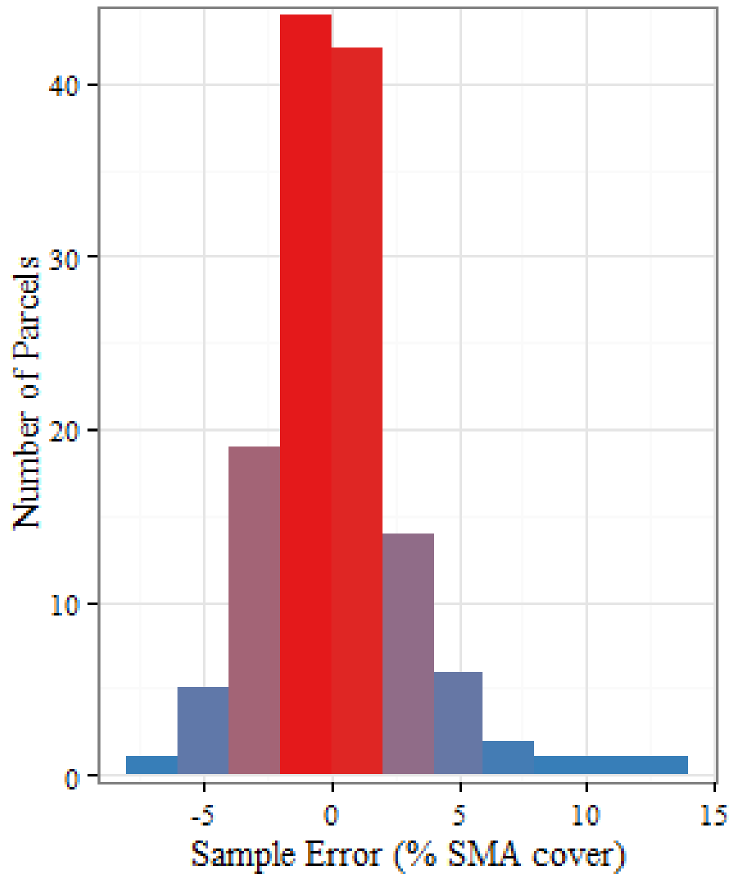


Figure 5.11. Sample error distribution associated with LADWP's transect locations at 136 vegetation parcels.

woody-dominated communities. Lack of action in arresting these transitions during early warning signs of composition shifts, will require more intensive action later on with the likelihood of success shrinking rapidly as the local species pool is reduced.

Evaluation of LADWP Permanent Transect Locations

This study removed one obstacle to developing a cooperative vegetation monitoring program between LADWP and ICWD. The potential bias of permanently located samples was shown to be negligible when considered in aggregate, with most sample errors (92%) within 5% of the calculated known mean (Figure 5.11). The eight parcels with mean sample error between 5-10% and the two parcels with sample errors between 10-13% cover will be evaluated further; but for the interim, the County is satisfied that the spatial locations of the transects provide adequate estimates of parcel mean vegetation cover; and the County will cooperatively measure vegetation cover at these transects with LADWP in 2015 as an interim program.

A panel of ecologists selected by the Ecological Society of American will evaluate the monitoring programs in July 2015. Their individual recommendations will address the broader issue of whether the monitoring program can be improved to better disentangle the causes of vegetation change. Ultimately, the design of the monitoring program is not intended to only estimate annual vegetation cover but rather to answer what level of vegetation change is attributable to groundwater pumping and associated groundwater levels. The Inyo/LA technical group will update the cooperative monitoring program in part based on the panel's recommendations.

Conclusions

Vegetation conditions following the 2014-monitoring season can be summarized by four main findings. First, during the time period 1992-2013, the change profile of the wellfield parcel group was different from the control parcel group, with the decrease in wellfield group cover below that of the control group. Second, overall perennial cover and grass cover in 2014 for both wellfield and control parcel groups was significantly below baseline. Third, within the wellfield parcel group, the relative proportion of shrub cover has significantly increased. Finally at the individual parcel level of analysis, 31 out of 56 (58%) wellfield parcels were significantly below their baseline cover values.

Acknowledgments

Field data collection was conducted by a dedicated field crew during the reinventory period covered in this report (1991-2014). Jerry Zatorski managed the logistics of field data collection, scheduling and data management. Meredith Jabis and Jerome Braun developed some of the R scripts for analysis. Andrew Elmore provided the spectral mixture analysis on Landsat TM data. LADWP provided georeferenced transect data used in the evaluation of sample error associated with their permanent transect locations.

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Section 5 Appendices

Appendices are on the Water Department's web site: http://www.inyowater.org in the section containing Inyo County Water Department Annual Reports.

Appendix 1. Parcels sampled in 2014. Column headings indicate: baseline management *type (A,B,C,D,E), plant community* type based on Holland (1986), and *location* based on proximity to production wells.

Appendix 2. Figures 1-169 show mean perennial vegetation cover plotted over time for the 169 vegetation parcels sampled since 1991 using the Green Book Line Point monitoring program, and SMA average cover data (through 2011), and depth to water (through 2010). Asterisks depict years that perennial cover is significantly different from the baseline period (sampled between 1984 and 1987) using Welch's t-test for unequal variances. Thirteen parcels do not have raw baseline transect data and thus could not be analyzed with statistics based on the variance. In these cases, the baseline cover value is shown without error bars.

Appendix 3. Grass, shrub, and herb proportion regressed against time in parcels with baseline transect data and at least 10 years of line point data. Columns indicate: wellfield or control parcel status, *W/C*; sample size*, n*; coefficient of determination, R^2; p-value, *p*; slope parameter estimate, *slope*; upper and lower 95% confidence interval for the slope parameter, *95% Confidence Interval*; direction (positive or negative) of the relationship, *Slope direction*. Bold text in p-value column, indicates significant regressions at $\alpha = 0.05$. Rows were sorted by grass slope direction to highlight changes in grass proportion.

Appendix 4. Mean sample error of LADWP transect locations for each parcel (n=136).

SECTION 6: CONDITION OF SELECTED POPULATIONS OF RARE PLANTS SIDALCIA COVILLEI AND CALOCHORTUS EXCAVATUS OWENS VALLEY, 2014

The Long Term Water Agreement requires management of rare species to be consistent with applicable laws. The ICWD monitors populations of two plant species that could potentially be affected by groundwater pumping.

Abstract

The Inyo County Water Department (ICWD) monitors populations of *Sidalcea covillei* (Owens Valley checkerbloom) and *Calochortus excavatus* (Inyo County star tulip) each year in accordance with the provisions of the Long Term Water Agreement. Between 1993 and 2014, ICWD monitored 24 *S. covillei* populations and 28 *C. excavatus* population. Population size estimates are based on either complete counts or sampling depending on the size of populations. Both species are perennial geophytes that can survive in a dormant state in unfavorable years. Annual population size estimates are for the non-dormant portion of the population and are thus likely underestimates of the true population size, especially in dry years. A combination of water table depth, grazing, and heterospecific competition, likely influences the above-ground vegetative growth, investment in reproductive structures and the relative proportion of bulb dormancy in any given year. These factors were qualitatively recorded but were not directly measured by ICWD in 2014.IntroductionIntroduction

The Green Book requires monitoring of rare plant populations in the Owens Valley. This report contains an update of the status of the populations sampled by the Inyo County Water Department in 2014. Two species of rare plants have been monitored between 1993 and 2014; the Owens Valley checkerbloom, *Sidalcea covillei* (SICO), and Inyo County star tulip, *Calochortus excavatus* (CAEX). Both species are geophytes and can persist in a dormant state below the soil surface during unfavorable periods (i.e. drought). SICO is listed as endangered by the state of California, and is a US Fish and Wildlife species of concern. Both species are listed under CNPS List 1B.1 (rare, threatened, or endangered in CA and elsewhere). The Water Department has monitored, in total, up to 24 SICO populations and up to 28 CAEX populations.

Characteristics of SICO

SICO occurs from about 1100 - 1300 m elevation in alkali meadows that are periodically wet from nearby streams, springs or groundwater in the Owens Valley. SICO's carbohydrate-rich roots allow it to survive dry periods but continuously dry periods are incompatible with population maintenance. SICO grows to 20-60 cm. The leaves are fleshy and waxy in texture. The inflorescence is an open panicle of several flowers.

Figure 6.1. Sidalcea covillei (Owens Valley Checkerbloom). Photo by Inyo County Staff.

Figure 6.2. Calochortus excavatus (Inyo County Star Tulip). Photo by Inyo County Staff.

The leaves and flower sepals are coated in tiny branching hairs According to Halford (1994), SICO population demographics are influenced by annual precipitation, timing and intensity of cattle grazing, competition with shrubs and rhizomatous grass species, and activities that influence surface and groundwater sources. Owens Valley checkerbloom flowers from April through June.

Characteristics of CAEX

CAEX is endemic to Inyo and Mono Counties and ranges between 1300 - 2000 m. According to USFWS (1998). *CAEX* reproduces by seed and by offset bulbils from the main bulb. The seeds of *Calochortus* are relatively large and lack obvious adaptations for long-distance dispersal. Plants may persist up to ten years. The relative proportion of carbohydrate storage in below-ground bulbs and above-ground tissues is likely dependent on the antecedent water regime and life stage. In dry years, CAEX can remain dormant in bulb form. The presence of a dormant seedbank is unknown.

Methods

ICWD sampled 11 SICO populations and 27 CAEX populations within the Owens Valley in 2014. The number of sites monitored for population estimates is determined by staffing levels in May and early June.

Calochortus Sampling

Currently there are 58 known sites supporting CAEX being monitored, all of which are in the Owens Valley in Inyo County. The Water Department monitors 27 CAEX populations annually, LADWP monitors approximately six populations and the Bureau of Land Management monitors eight populations. The 27 populations monitored by the Water Department are located on land owned by LADWP. Individual CAEX plants were counted using walking grids located within previously mapped population boundaries.

Sidalcea Sampling

SICO populations were sampled by first mapping known population locations into polygons and then either sampling individuals via randomly located quadrats, or via hand counts of flagged individuals within mapped sub-populations. Polygon boundaries were marked with flags and mapped by walking the perimeter with a GPS unit. Quadrats (approximately 1m^2) were randomly sampled within the polygon. Locations of quadrats were selected using a random bearing and a random number of paces (i.e. three sets of random paces were generated: 1-20, 1-30, 1-40 for small vs. larger polygons). The number of quadrats sampled increased with the size of the polygon; 10 was the minimum number of quadrats sampled.

Qualitative Site Condition Score

In a qualitative assessment, four factors were each given a score and the sum of these qualitative scores was then assigned to the overall site score. The factors included: the level of grazing (i.e. none (3), light(2), moderate(1), heavy(0)), abundance of invasive species (none (3), few (2), many(1)), apparent available soil moisture(saturated(3), moderately wet(2), slightly wet(1), dry(0)) and rare plant vigor (robust(3), good(2), poor(1)) were recorded at each site. These values for each of the four factors were summed to derive the qualitative overall site quality score for each site (i.e. excellent (10-12), good (8-9), fair (6-7), or poor (2-5)). The qualitative site condition score was not analyzed in this year's report in relation to population size estimates owing the qualitative nature. Quantitative environmental variables will be explored for analysis in the 2015 report.

Results and Discussion

Population estimates are sampled differently for the two rare species monitored. Because the population dynamics and life history of SICO allows for larger population sizes, population estimates are determined from sampling. Therefore, greater variance between years may be expected in SICO population estimates when compared with smaller population numbers present in the CAEX populations which allow for individual counts. For low density sites, lack of detection is not unexpected in dry years.

Of the 11 SICO populations sampled in 2014 (Table 6.1), six were below the long-term average while five sites increased above the long term average (1993-2013). The average decrease was 20,294 individuals and the average increase was 5,959 individuals. The accuracy of the sampling estimates has not been quantified and should be a priority in the future depending on the use of the population estimates for management.

Of the 27 CAEX populations sampled in 2014 (Table 6.2), 25 sites were below the average computed from 1993-2013. On average 2014 population estimates were below the long-term average by 80 individuals.

In dry years, dormancy is common in bulbiferous perennials and above-ground detection is expected to be lower than in wet years.

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Table 6.1. SICO population estimates during the period 1993-2013.

site	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
S-UNW-NW-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9059
S-BGP-SE-01	NA	NA	181	221	350	520	625	586	754	918	921	872	834	808	715	503	350	NA	400	682	2345	699
S-BIS-NE-01a	NA	0	2000	500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	110	93	120
S-BIS-NE-03	22275	59999	77355	89502	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	80	4630	3444	2721	9070	NA
S-BIS-NE-04	NA	600	9731	5545	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	323	378	257	9	NA
S-BIS-NE-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	5	5	2	2	2	0	0	1	0	0	0
S-FSL-SE-01	NA	35	200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	61	45	51
S-FSL-SE-02	150	115000	90974	NA	69743	NA	41275	42351	39938	NA	NA	NA	NA	NA	NA	NA	5000	NA	18829	17300	NA	25843
S-FSL-SE-03	106	67	171	131	129	152	223	94	113	53	75	44	72	91	70	44	0	14	8	1	0	0
S-FSL-SW-02	5000	41239	51002	20196	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1200	20655	19568	22924	53777	29973
S-IND-NW-01	826	17356	10126	9674	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-IND-NW-02	1800	2976	3657	10676	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	62	NA	NA	NA
S-IND-NW-03	66600	124714	169367	74003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	97343	NA	NA	NA
S-IND-NW-04	64388	156288	84653	25149	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11285	NA	NA	NA
S-IND-SE-01	NA	46457	78817	64299	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11101	NA	NA	NA
S-IND-SE-02	2000	2400	72156	27901	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9716	NA	NA	NA
S-LAW-SW-01	35000	NA	28668	12868	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28582	24909	9278	NA	NA
S-LAW-SW-02	NA	NA	97452	43438	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	33144	NA	NA
S-LAW-SW-03	0	12	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-LAW-SW-04	NA	10	NA	2	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	0	0	NA
S-MAN-NE-01	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-PLC-NW-01	3000	NA	19396	8652	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3000	NA	6633	4663	9405	5348
S-PLC-SW-02	NA	1100	1496	1582	1476	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	803	507	677	50
S-PLC-SW-03	NA	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	335	758	149
S-PLC-SW-04	92155	68126	198418	141568	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8000	NA	57590	57279	NA	NA

Table 6.2. CAEX population estimates during the period 1993-2014.

site	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
C-IND-NW-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1974	13	6
C-BGP-NW-03	0	2	5	1	2	4	4	0	4	0	2	0	0	1	0	1	0	0	2	0	0	0
C-BIS-NE-01	0	NA	NA	33	30	74	67	82	43	53	36	0	28	34	5	6	0	2	11	0	12	7
C-BIS-NE-02	NA	97	400	200	18	100	150	167	592	4	673	6	681	575	177	1162	0	61	165	2	0	1
C-BLK-NW-01	12	33	42	31	6	3	7	14	10	0	19	16	34	42	6	30	10	39	21	18	0	9
C-BLK-NW-02	0	0	69	9	3	10	0	0	14	0	51	0	39	19	0	49	7	14	6	12	0	3
C-BLK-NW-03	78	0	315	19	100	200	41	54	124	21	348	30	186	40	54	213	62	183	62	22	0	2
C-BLK-NW-04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	166	296	18	567	34	350	135	107	8	50
C-BLK-SW-02	NA	NA	NA	NA	NA	NA	8	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35	57	31	10
C-BLK-SW-04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17	15	5	20
C-BLK-SW-05	NA	NA	NA	NA	7	16	2	0	4	1	6	0	8	8	1	8	1	7	3	0	0	0
C-BLK-SW-06	15	0	0	57	45	2	19	6	88	65	173	7	77	95	51	37	1	14	6	0	0	0
C-BLK-SW-07	NA	NA	NA	NA	NA	50	NA	44	84	96	296	82	290	457	76	183	23	276	265	40	11	32
C-BLK-SW-09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	852	662	399	780	174	626	516	533	568	474
C-FSL-SE-02	55	1	380	150	50	100	248	689	548	90	368	90	321	130	171	320	5	155	92	11	12	36
C-IND-NE-01	18	6	58	21	25	21	17	10	6	23	18	5	8	15	18	26	6	13	8	12	4	2
C-IND-NW-02	72	46	50	104	45	100	133	98	27	13	103	7	140	112	143	68	1	NA	5	29	1	1
C-IND-NW-03	282	31	500	450	400	250	NA	687	658	991	1124	85	837	203	927	1227	68	94	38	257	190	375
C-IND-NW-04	105	77	180	200	111	92	114	236	432	340	286	214	408	262	167	269	145	NA	198	389	541	317
C-IND-SE-01	26	152	91	80	220	116	208	177	699	337	388	392	128	181	234	64	15	51	62	195	27	41
C-IND-SE-03	NA	NA	NA	2	1	NA	NA	0	0	0	NA	0	0	NA	0	0	NA	NA	NA	NA	NA	NA
C-LAW-SW-01	15	1	56	55	50	17	64	76	45	20	13	7	16	86	26	59	6	42	55	4	2	8
C-LAW-SW-02	NA	NA	36	7	2	15	17	3	1	0	3	2	17	8	5	4	3	2	0	1	0	0
C-LAW-SW-03	1	0	21	3	4	15	6	5	6	5	8	4	17	6	5	14	4	3	11	3	3	2
C-PLC-NW-01	NA	NA	NA	NA	NA	NA	NA	NA	NA	345	1081	255	661	191	170	1616	505	448	141	60	222	287
C-PLC-SW-02	120	26	450	32	14	23	0	0	1	0	2	0	260	99	0	355	2	380	151	0	0	0
C-PLC-SW-03	NA	200	400	92	90	90	100	318	627	527	1643	81	1502	506	263	1793	361	1220	814	81	36	357
C-PLC-SW-04	13	0	118	17	1	47	17	3	19	0	6	0	10	14	0	43	2	28	26	1	0	1

SECTION 7: SALTCEDAR CONTROL

The goal of the Saltcedar Control Program is to eliminate existing saltcedar stands and prevent the spread of saltcedar throughout the Lower Owens River and associated wetlands to support habitat recovery

The goal of the Saltcedar Control Program is to eliminate existing saltcedar stands and prevent the spread of saltcedar throughout the Lower Owens River and associated wetlands to support the habitat restoration that is occurring in the LORP. This section of the 2014-15 ICWD Annual Report briefly describes work completed from October 2014 to March 2015. A more complete description of the progress of the saltcedar program is contained in the Lower Owens River Annual Report.

Program Background

Saltcedar (Tamarix ramosissima) is an invasive non-native shrub or tree that can grow to 25 feet and live up to 100 years. Given favorable conditions, a tree can grow 10 to 12 feet in one season. Saltcedar competes with native vegetation and degrades wildlife habitat. Its presence in the southern Owens Valley has the potential to interfere with the LORP goals of establishing a healthy, functioning Lower Owens River riverine-riparian ecosystem.

References to the importance of managing saltcedar can be found in documents that guide the saltcedar program and the LORP:

- The LORP Monitoring, Adaptive Management, and Reporting Plan (MAMP), notes that saltcedar may increase in some areas of the river because of seed distribution with stream flows. The MAMP states that the potential risk of infecting new areas with saltcedar is considered a significant threat in all management areas

- The 1997 Memorandum of Understanding (MOU), between Inyo County, City of Los Angeles, Sierra Club, Owens Valley Committee, CA Dept. of Fish and Game and California State Lands Commission, expresses that saltcedar reinfestation in the LORP area would compromise the goal of controlling deleterious species whose "presence within the Planning Area interferes with the achievement of the goals of the LORP" (1997 MOU B. 4)

- Parties to the Inyo/Los Angeles Long-Term Water Agreement (LTWA) recognized that even with annual control efforts saltcedar might never be fully eradicated, but that ongoing and aggressive efforts to remove saltcedar will be required. (Sec. XIV. A).

Project Management and Staff

The Saltcedar Control Program was created by the Agreement and is administered by the Inyo County Water Department. The Saltcedar Project Manager oversees the project and work crews consisting of eight employees and one shared full-time county employee (Figure 7.1). In addition, the California Department of Forestry and Fire Protection (Cal Fire) has provided work crews to assist in efforts to cut saltcedar and remove slash. In 2014-2015, the field season began in October and concluded in mid-March.

The Saltcedar Control Program uses chainsaws, brushcutters, herbicides, and fire to treat and control saltcedar and saltcedar slash in the Owens Valley.

Work Accomplished

In 2014, work focused on eradicating saltcedar in the water-spreading basins that lie just to the west of the Lower Owens River and river-riparian area. These spreading basins are a concern because they harbor mature saltcedar thickets that function as seed sources for the re-establishment of saltcedar within the LORP riparian corridor. Program staff cut and treated 100 acres in these spreading basins (Figure 5.2).

Surveying the river to locate and remove saltcedar is an annual and ongoing activity by ICWD and LADWP staff. Treating saltcedar in the LORP riparian area and especially new established plants is a priority of the Saltcedar program. At various times during the cutting season over the winter, crews worked along the river to treat resprouts and pull seedlings recorded the previous summer along the 106 miles of LORP river bank and floodplain. In addition, many mature plants that were discovered in the process of clearing the river were also treated.

Extensive saltcedar treatment in recent years has resulted in large amounts of woody slash accumulation in the LORP. Inyo County and Los Angeles reached agreement in 2012 on a slash treatment plan prepared by the ICWD. The preferred treatment method was stacking and burning slash. Following acquisition of required burn permits, in April 2012 the ICWD conducted test burns on several piles in spreading basins. The necessary equipment to provide the required water supply at burn sites was purchased during the intervening summer, and a more aggressive burn program began in the fall after burn restrictions were lifted. Approximately 50 piles of slash were burned during the 2014-15 field season by the Saltcedar Program crews and CalFire. The number of piles (50) burned during the 2014-15 field season was significantly less than the previous year due to numerous windy days which made for unsafe burning conditions. The Saltcedar Program has safely burned a total of 830 piles of slash during the past three years.

Funding

Funding for the Saltcedar program comes from the Water Agreement and a grant from the California Wildlife Conservation Board (WCB). The Water Agreement provided $69,481. The Inyo County Water Department was awarded a new grant from the WCB for $385,000 in December 2011. LADWP has assisted the County in its efforts to renew the WCB grant and matched the grant fulfilling their obligation under the 2004 Stipulation and Order to match up to $1,500,000 of any grant funds obtained by the County.
In addition, LADWP provided the annual funding required by the Water Agreement. The 2014-15 program relied on these funding sources.

Figure 7.1. The 2014-15 ICWD Saltcedar crew.

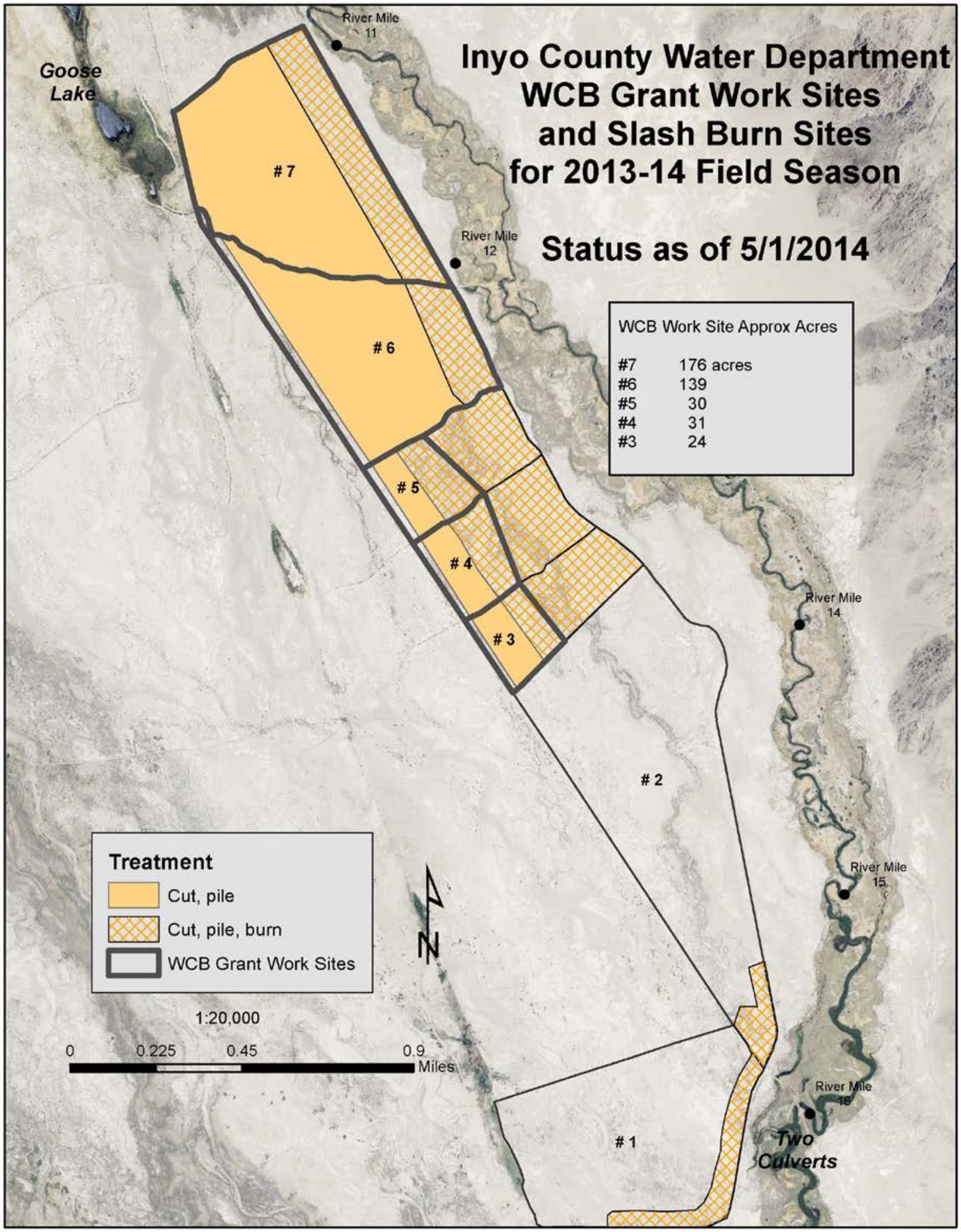

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Figure 7.2. Saltcedar areas treated during 2014-2015.

SECTION 8: MITIGATION

Introduction

The Inyo County Water Department monitors and reports on the staus of environmental mitigation projects in the owens Valley.

Inyo County is also a partne in funding and implementing the Lower Owens River Project.

One on the roles of the Inyo County Water Department (ICWD) is to monitor and report on the status of environmental mitigation projects in the Owens Valley. More than 62 projects, spread throughout the Valley, mitigate for a range of environmental impacts due to abandonment of irrigated agriculture and groundwater pumping in the Owens Valley. These improvements range in size from single-acre spring projects to the 78,000-acre Lower Owens River Project (LORP). The majority of these projects are described in the Water Agreement and associated 1991 EIR (*Water from the Owens Valley to Supply the Second Los Angeles Aqueduct*), and in the 1997 MOU (*Resolving conflicts and concern over the 1991 EIR*), which can be found on the ICWD website (www.inyowater.org).

ICWD participates in the development of new projects, evaluates the effectiveness of ongoing mitigation, and oversees modifications of existing projects that have been changed by the Inyo/LADWP Standing Committee or the courts.

This report provides background and status on all mitigation projects. Special attention is given to projects that are being actively managed, those that are just being implemented, those that are not meeting management goals, and projects in need of plan revisions.

This section is divided into three parts:

Background information on the mitigation projects, including project origins and the impact for which mitigation is being provided.

Projects that require special attention, or those that have changed status during the reporting period.

A table of all the projects described in the 1991 EIR and MOU. Information found here includes the project origin, impact being addressed, management prescription, development stage, and project status.

Mitigation Projects Origins and Background

The Los Angeles Department of Water and Power (LADWP) is legally obligated to implement mitigation projects to enhance recreation, diversify land use, improve or create habitat for wildlife and vegetation, and mitigate for a range of impacts in the Owens Valley. Descriptions of mitigation projects are found in the collection of documents that govern the activities of the LADWP in the Owens Valley. These documents were developed over time and include the 1991 Long Term Water Agreement and associated EIR, the 1997 MOU, and other court stipulations and orders.

Although the environment of the Owens Valley had begun to suffer the effects of large-scale water diversions to supply water to Los Angeles Aqueduct beginning in 1913, all of the mitigation projects described in this report mitigate for impacts after 1970 that resulted from the operation of the second Los Angeles Aqueduct. These mitigation projects will to a certain degree repair, restore and compensate for adverse impacts from the operation of the second aqueduct.

More than 58,000 acres of groundwater dependent vegetation is found in the Owens Valley. Between 1970 and 1990, increased groundwater pumping, and the resulting fluctuations in groundwater table, has had a significant effect on more than 1,000 acres; 655 acres of groundwater dependent vegetation has entirely died-off. Most of the mitigation projects include goals to improve vegetation in the Owens Valley.

Mitigation Alternatives

With respect to mitigation, the Water Agreement generally follows the framework of the California Environmental Quality Act (CEQA), which allows several alternative forms of mitigation. These are generally considered in sequence (i.e., with preference given to avoidance first and compensation last). These actions include:

- **Avoiding the impact altogether by not taking a certain action or parts of an action.**
  Local example: Well on/off provisions. When soil water and projected contribution from precipitation is inadequate to maintain vegetation, wells are not operated.

- **Minimizing impact by limiting the degree or magnitude of the action and its implementation.**
  Local example: Shutting down pumping wells, as was done at Five Bridges when groundwater drawdown degraded nearby vegetation.

- **Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.**
  Local example: Revegetation and regreening projects, which compensate for the effects of the abandonment of irrigated agriculture leading to areas of blowing dust and dirt.

- **Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action. Local example: Salt cedar control, ongoing irrigation of fields**

- **Compensating for the impact by replacing or providing substitute resources or environments.**
  Local example: Lower Owens River Project, civic projects, recreational facilities, habitat enhancement projects, and fish hatcheries

Origin of Mitigation Efforts

Mitigation planning, development, and implementation are ongoing activities that are undertaken cooperatively with LADWP; however, the majority of mitigation projects in the Owens Valley were developed by the two parties during three discrete periods of time in response to judgments or potential legal and administrative actions:

Environmental Projects (EP), 1970-1984

Between 1970 and 1984, LADWP committed about 10,000 acre-feet of water annually to implement twelve environmental projects. The primary purpose of these projects was to restore habitat that had been negatively affected or lost due to water gathering. These areas may have exhibited vegetation changes, or reduction in wildlife using a particular habitat. The goal was to provide a regular water supply to habitats such as ponds, lakes, sloughs, springs, and the Lower Owens River (LOR). Objectives differed between the projects, depending on the type of the impact that had occurred, but the overall goal of the environmental projects was to improve wildlife, forage, fisheries, and public recreation facilities.

In many instances it was impractical to mitigate at the original impact site, or the affected area was not well defined, or the impact was sporadic. In these cases a project was constructed at a site that would best accommodate the goals of the mitigation.

- **Farmer's Ponds**: Water is provided each fall to offer habitat for migrating waterfowl; two miles north of Bishop.
- **Buckley Ponds:** Water is provided for a warm-water fishery and waterfowl area; three miles southeast of Bishop.
- **Saunders Pond:** Water is provided to a warm-water fishery and waterfowl area; five miles southeast of Bishop.
- **Mill Pond:** Water is provided to a pond at a recreation area, either by creek flow or a well at the site; four miles northwest of Bishop; five miles west northwest of Bishop.
- **Klondike Lake:** Water is provided for permanent wildlife habitat area now incorporated in Klondike Lake E/M Project; 2 mile north of Big Pine.
- **Tule Elk Field:** Water is provided to irrigate a pasture heavily used in summer by tule elk; between U.S. Highway 395 and Tinemaha Reservoir.
- **Seely Spring:** Maintained by an LADWP well adjacent to Owens River to provide waterfowl and shorebird habitat larger than had existed at Seeley Spring; two miles south of Tinemaha Reservoir.
- **Calvert Slough:** Water is provided to maintain habitat; small pond and marsh area near LADWP Aqueduct Intake.
- **Little Blackrock Spring:** Water is diverted from ditch to maintain wetland area at original spring site; west of the aqueduct intake.
- **Lone Pine Pond:** Water is provided by natural seep or spring flow in river with supplemental releases from Alabama Gates (now incorporated in the Lower Owens River E/M Project); north of Lone Pine Narrow Gauge Road.
- **Lower Owens River:** Water releases began in 1975 to provide year-long minimal flows along the lower Owens River, as well as releases to Twin Lakes, Billy Lake, and Thibaut Ponds. The goal is to maintain waterfowl, marsh, shorebird,

and upland gamebird habitat, as well as provide for a warm-water fishery. The project has now been replaced by the Lower Owens River E/M Project, which provides water to all of the formerly dry stretch of the Owens River; the 78,000 acre project site is located east of the towns of Aberdeen, Independence, and Lone Pine.

- **Diaz Lake:** A supplemental water supply is provided to Diaz Lake recreational area. The accounting of water supplied to this project has been revised as part of the MOU 1600 ac-ft. projects described below. The lake is three miles south of Lone Pine.

Enhancement/Mitigation Projects 1985-1991

The Enhancement Mitigation (E/M) projects are environmental projects that were implemented prior to adoption of the 1991 EIR. The Water Agreement required that all E/M project continue. Some of these projects were included in the 1991 EIR as mitigation for impacts due to LADWP's water gathering activities. The amount of water allocated to these projects, along with the water used is reported in Table 8.1.

These projects addressed a number of environmental impacts and filled community needs. Projects include the revegetation of abandoned agricultural lands and lands that experienced vegetation loss due to groundwater pumping, delivery of water for public parks, improved wildlife habitat, and a partial rewatering of the lower Owens River. For each project, specific goals and objectives were established and environmental documentation was prepared in accordance with CEQA.

- **Millpond Recreation Area Project:** Located west of Bishop, was the first E/M measure to be completed. Since October 1985, funds have been provided to operate the recreation area's sprinkler irrigation system that waters 18 acres of the community park, including two softball fields.
- **Shepherd Creek Alfalfa Lands Project:** Revegetated 198 acres of abandoned cropland adjacent to U.S. Highway 395 with sprinkler-irrigated alfalfa and windbreak trees. The property between Lone Pine and Independence had only sparse annual vegetation since 1976, and was a source of blowing dust creating a traffic hazard.
- **Klondike Lake Project:** Previously, the 160-acre lake located north of Big Pine had been filled only during above-normal runoff years. Now, less than 1,700 af of water maintains the lake year-round. Benefits include nesting and feeding areas for waterfowl, and recreation including skiing, windsurfing, and other water sports in summer months. Due to the shape and size of the Klondike lakebed, the full volume of water (2,200 af) allocated to the project was more than the lake required, so the project was modified to permanently reduce the water allotment. The balance of this unused water allocation was apportioned the Big Pine Ditch System and the Klondike South Shore Habitat Area.
- **Laws Historical Museum Project:** Provides a regular water supply to improve the native vegetation on a 21-acre parcel, provide for irrigated pasture on 15 acres, and establish windbreak trees, all adjacent to the museum.
- **640 acres near Laws:** Revegetate with non-groundwater dependent native plants (potential project that would require Standing Committee approval to implement).

Figure 8.1. Lone Pine Woodlot (July 2012). The community woodlots in Lone Pine and Independence are in need of thinning and replanting.

- **Laws-Poleta Native Pasture Project:** Provides water for irrigation of 220 acres of sparsely vegetated land to reestablish native vegetation on abandoned pasturelands and increase livestock grazing capabilities.
- **McNally Ponds and Pasture:** Provides a regular water supply to existing ephemeral ponds (60 acres) in the Laws area to create waterfowl habitat, and to provide spring and summer irrigation to enhance and maintain existing vegetation on 300 acres of pastureland.
- **Independence Pasture Lands/and Spring Field Projects:** Provides approximately 910 acres of abandoned croplands and sparsely vegetated land with irrigation to create native pasturelands and provide water to native vegetation. Flood irrigation converted sparsely vegetated land east of Independence into productive native pasture. The project mitigated a source of blowing dust and stabilized soil previously affected by severe wind erosion.
- **Lone Pine Riparian Park:** Provides a continuous water supply to a ditch running through Russell Spainhower Park then easterly to supply water to Lone Pine Woodlot and Richards and Van Norman Fields projects.
- **Van Norman Field (160 acres) and Richards Field (160 acres):** Provides surface and pumped water to establish pastureland and increase livestock grazing capabilities on abandoned agricultural land.
- **Lone Pine Sports Complex:** At the request of the community, portions of the Lo-Inyo Elementary School and vacant LADWP property were converted to an outdoor sports complex consisting of baseball fields, soccer fields, and related parking, picnic and park areas.
- **Independence and Lone Pine Woodlots:** Two irrigated projects in Lone Pine and Independence provide a greenbelt and are harvested as sustainable source of firewood for those in need.
- **Independence Roadside Rest:** This project consisted of planting shade and windbreak trees and grass, installation of an irrigation system, and placement of picnic table on a 1/2-acre site south of the town of Independence. The project is an aesthetic improvement over the previously blighted area.
- **Eastern California Museum:** This project enhanced the appearance of the Eastern California Museum grounds in Independence. It consisted of a small

Table 8.1. Water Supplied to E/M Projects 2004-2015 (from values provided in LADWP's Owens Valley Report).

Water Supplied to Enhancement/Mitigation Projects 2004-2015 in acre-feet (source LADWP Annual Owens Valley Reports)

		Runoff Year													
Project	**Normal Year Water Supply (EIR)**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**11-Year Average *Supplied***	**11-Year *Actual***	**11-Year EIR Total**
McNallyLaws/Poleta Native Pasture Lands	660	1,682	1,269	1,241	1,396	1,320	1,764	1,267	2,306	1,460	1,149	1,376	**1,475**	**16,230**	**7,260**
McNally Ponds	4,000	0	1,522	1,491	0	0	0	368	857	0	0	0	**385**	**4,238**	**44,000**
Laws Historical Museum	150	32	59	99	147	63	131	152	105	138	112	119	**105**	**1,157**	**1,650**
Klondike Lake	1,700	1,278	1,203	314	1,201	1,195	1,169	1,195	1,086	1,144	1,515	1,600	**1,173**	**12,900**	**18,700**
Big Pine NE Regreening	150	0	0	0	0	0	0	0	0	0	0	103	**9**	**103**	**1,650**
Independence Pasture Land	2,350	2,489	3,330	2,785	3,272	2,588	1,962	2,397	2,545	2,324	1,852	1,932	**2,498**	**27,476**	**25,850**
Independence Springfield	1,500	280	519	1,850	1,962	1,554	1,530	1,356	1,136	1,188	958	1,427	**1,251**	**13,760**	**16,500**
Independence Ditch System	725	451	356	359	380	515	446	497	496	165	129	343	**376**	**4,137**	**7,975**
Independence Woodlot	120	276	190	226	237	335	220	569	175	334	150	186	**263**	**2,898**	**1,320**
Independence East Regreening	150	0	0	0	0	0	0	0	0	0	0	63	**6**	**63**	**1,650**
Shepherd Creek Alfalfa Lands	990	1,072	1,152	1,206	1,100	1,183	1,166	1,212	1,073	1,019	884	980	**1,095**	**12,047**	**10,890**
Lone Pine Park/Richards Field	1,230	916	1,085	870	570	1,012	1,037	1,037	1,194	481	416	429	**822**	**9,047**	**13,530**
Lone Pine Woodlot	120	76	100	120	78	51	58	123	120	156	70	74	**93**	**1,026**	**1,320**
Lone Pine Van Norman Field	480	337	474	512	306	28	147	102	116	97	79	343	**231**	**2,541**	**5,280**
Lone Pine Regreening	95	238	180	107	232	228	283	257	298	223	216	233	**227**	**2,495**	**1,045**
Total	**14,420**	**9,127**	**11,439**	**11,180**	**10,881**	**10,072**	**9,913**	**10,532**	**11,507**	**8,729**	**7,530**	**9,208**	**10,011**	**110,118**	**158,620**

[1] **Scoped at 2,200, but in 2004 reduced to 1,500 af**

pond, trees, expanded lawn areas, and installation of an irrigation system.

- **Town Regreening Projects:** Three projects designed to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the towns of Big Pine, Independence, and Lone Pine. Lone Pine has been implemented; Big Pine and Independence should come into operation in 2014.
- **Lower Owens River Rewatering E/M Project:** This project provided up to 18,000 AFY of continuous flow of water in the previously dry (1913-1986) portion of the river channel, creating a warm water fishery and wildlife habitat in the southern Owens Valley. The project also supplies water to five small lakes along the river route providing improved waterfowl habitat in the region. This project has been superseded by the Lower Owens River Project, which was fully implemented in December 2006.
- **Hines Springs:** Create 1-2 acres of aquatic, riparian, and marshland habitats. Project will serve as a research project on how to reestablish a damaged aquatic habitat.

Enhancement Mitigation Water Use (Table 8.1)

In 2014-2015, the total water supplied E/M projects was 9,280 acre-feet. This is 36% less water than would be applied based on the total normal year water allocation described in the 1991 EIR (14,420 acre-feet). This figure also includes, for the first time, water provided to two recently implemented projects;

Independence Eastside Regreening, and Big Pine NE Regreening.

Most of the difference between the allocation and the supply can be attributed to having not supplied the McNally Ponds in the Laws area. These ponds have not received their full 1,500 acre-foot allocation since 2006-2007, and have only received water four times in the past 11 years. The McNally Ponds situation is described in more depth in Section II of this report.

Additional Mitigation Projects, 1997 MOU and 2004 Amended Stipulation and Order

The 1997 MOU identifies *Additional Commitments* that include studies, evaluations and commitments to specific issues (Section III.A). One of the issues brought forward in the MOU in Section III.A.3. is *Additional Mitigation* that requires a total of 1,600 acre-feet of water per year to be supplied by Los Angeles Department of Water and Power (LADWP). This water is to be used for the implementation of on-site mitigation measures at Hines Springs that were identified in the 1991 EIR and on-site or off-site mitigation that is in addition to the mitigation measures identified in the EIR for impacts at Fish Springs, Big and Little Seely Springs and Big and Little Blackrock Springs.

- **Yellow-Billed Cuckoo (YBC) Enhancement Mitigation Project:** These projects located near Big Pine on Baker Creek and Hogback Creek near Lone Pine were designed to enhance vegetation conditions and direct land management actions to enlarge and enhance existing YBC habitat.
- **1600 acre-feet of water:** Commits 1600 acre-feet of water at seven sites. The initial project recommended by the MOU consultant was replaced by seven projects prepared by an Ad Hoc group of Inyo, LADWP, and CFG staff, local lessees, and representatives of the Owens Valley Committee and the Sierra Club. A report describing these projects can be found on the ICWD website.

Current Project Status

This portion of the report describes the current status of projects implemented under the Water Agreement. Particular attention is given to large projects that are underway or recently implemented. The ICWD has raised concerns that some projects are not fully implemented or not meeting project goals. These projects include McNally Ponds, Lower Owens River Project, MOU Additional Mitigation Projects, and many of the revegetation projects.

McNally Ponds

Since the Water Agreement and EIR were completed in 1991, water was supplied to the 60 acre McNally ponds during the waterfowl season (September through January) only seven times in the past 24 years (Table 8.2).

The CEQA document adopted for the McNally Ponds and Native Pasture E/M Project (Project) describes the project as: Approximately 60 acres of ponds located south of the Lower McNally Canal and west of U.S. Highway 6 will be provided water annually during the waterfowl season September through January. Water will be diverted through existing ditches and headgates from the Lower McNally Canal. Approximately 300 acres of native pasture will be provided water from existing diversion from the Lower McNally Canal during the growing season April through September.

Water supply

The Project was originally planned to be supplied by diversion from the Owens River

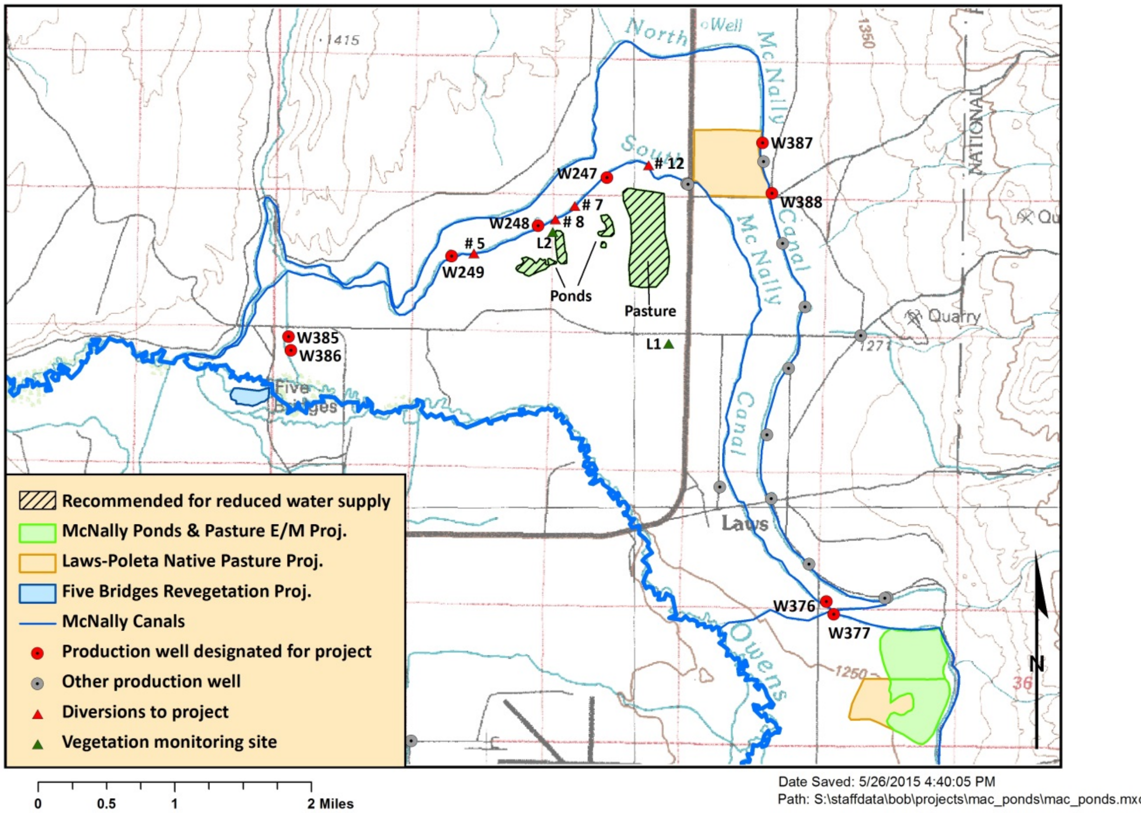

Figure 8.2. Laws area E/M projects, related production wells, and diversions relevant to the portion of the project west of U.S. Highway 6. The McNally Ponds Project consists of two components, irrigated pasture southeast of Laws, and irrigated pasture and waterfowl ponds west of U.S. Highway 6.

through the Lower McNally Canal, with Well W249 as an alternative supply, and that the water used by the Project would be made up by a new well or wells located south of the Laws return ditch. These new wells were constructed and designated W376 and W377 (see Figure 8.2). They have been operated sporadically to supply the southeastern part of the project. The CEQA analysis for this project was done in combination with the Laws-Poleta Native Pasture Project (also shown on Figure 8.2). The CEQA document described additional wells located at the gravel plant west of Five Bridges Road to supply replacement water for river water diverted to the western portion of the project. These wells were designated W385 and W386.

The 1991 EIR identified that wells W385 and W386 caused adverse impacts to native vegetation that are subject to mitigation, shown in Figure 8.2 as the Five Bridges Revegetation Project. W385 and W386 have not been operated since the early-1990s because of these negative impacts. LADWP has recently installed liners in W385 and W386 to reduce the effects of the wells on the shallow aquifer, but the Technical Group has not completed testing of efficacy of the liners.

The CEQA document for the Project also identified two new wells along the Upper McNally Canal to supply the pastures at the

Table 8.2. Total water supplied to McNally Ponds via lower McNally diversions 5, 7, and 8 for the months September through January. Values derived from LADWP totals and means database. Water supply values contained in LADWP annual reports also are presented. The amount of water originally expected to be supplied was 1500 ac-ft as described in Standing Committee scoping documents for the project.

Runoff year	Totals and Means (acre-feet)
1991	0
1992	0
1993	1,738
1994	0
1995	1,531
1996	495
1997	0
1998	1,550
1999	0
2000	0
2001	0
2002	0
2003	0
2004	0
2005	2,142
2006	900
2007	0
2008	0
2009	0
2010	365
2011	957
2012	0
2013	0
2014	0

southeastern portion of the McNally Ponds Project and the adjoining Laws-Poleta Native Pasture Project. These wells were designated W387 and W388, and were never linked to an on/off monitoring site, nor were they exempted from on/off by the Technical Group. W387 and W388 have been run annually to supply irrigation water in the E/M projects in the southeastern part of Laws via the Upper McNally Canal. Additionally, other wells along the Lower McNally Canal have been used to supply the project, either when in on-status or when they were exempted from the Water Agreement's on/off well management provisions under the 2007-2009 Interim Management Plan. During periods of high runoff the McNally Ponds were supplied with water from the Owens River via the Lower McNally Canal.

Figure 8.3. Well 249 is in Off status.

In summary:

1. Wells situated such that they could provide water directly to the Project (wells W247, W248, and W249) are linked to monitoring site L1, which is in off-status (Figure 8.3).
2. Wells designated for provided make-up water from water diverted from the Owens River are not currently equipped for pumping, and the effects of the recent modifications to these wells have not been evaluated by the Technical Group (wells W385 and W386).
3. Diverting water from the Owens River into the Lower McNally Canal to supply the project would incur significant conveyance losses, making less water available for use elsewhere.

Supplying the project during drought

Severe drought conditions exist in Owens Valley and throughout California. The April 1 runoff forecast for the 2014-2015 runoff-year was for 57% of normal. The prior two runoff years had been respectively 54%, and 52% of normal, constituting the lowest runoff on record for any two consecutive years. It is recognized that successive dry years could result in insufficient water to meet all in-valley water needs. The Water Agreement Section IV.A allows that, "…the Department shall provide water to any enhancement/mitigation projects added since 1981-1982, unless the Inyo County Board of Supervisors and the Department agree to reduce or eliminate such water supply." In 2014, the Department did not seek agreement with the County and did not supply the water to the project.

It is feasible to supply the southeastern portion of the project with pumped water (see Figure 8.2). LADWP and Inyo County staff has met on multiple occasions, both in the office and out in the field to begin to work through this process. Initial investigation involved identifying individual project water supplies, learning how water is conveyed to or through a project and how flow is measured. Also to be evaluated is the effectiveness of each of these projects as mitigation. Now staffs are now working to develop proposals that can be considered by the Technical Group. Once these proposals are developed, the following is suggested (Greg James, May 1999) as the procedure to modify or discontinue a mitigation measure:

1. If the Technical Group agrees to recommend a modification or discontinuation of an enhancement/mitigation project which is identified as a mitigation measure, the Technical Group should submit to the Standing Committee sufficient information to enable the Standing Committee to determine:
    a. That the proposed change will not have a new or adverse effect on the environment. In support of this conclusion the Technical Group should

probably submit an initial study, together with any documentation required by CEQA, or a statement setting forth the reasons why no CEQA document is required.

b. That the proposed change may cause a new or adverse effect on the environment, but with mitigation, the new or adverse effect will be mitigated to less than significant. The Technical Group should submit to the Standing Committee an initial study, together with either a mitigated negative declaration, or if necessary, an EIR. (The entity proposing the change in the mitigation measure [either the County or LADWP] should have the responsibility for preparing any necessary CEQA documentation.)

c. That, the enhancement/mitigation project, as modified, will continue to reduce the identified adverse effect of the project to a level which is less than significant, and/or

d. That, with the implementation of a new (or substitute) mitigation measure, the identified adverse effect of the project will continue to be reduced to a level which is less than significant.

e. That, with the modification of the mitigation measure, and/or with the implementation of a new (or substitute) mitigation measure, mitigation will be provided at a level equal or greater than the level of mitigation provided by the mitigation measure without modification.

2. If the Standing Committee makes the required findings, the Standing Committee may approve the modification or discontinuation of the mitigation measure.

Following consideration by the Technical Group and approval by the Standing Committee any proposed change in project would require the following actions:

1. CEQA Review
2. Adoption of CEQA by the Los Angeles Board of Water and Power Commissioners
3. Approval of a proposed amendment to the Water Agreement by the Los Angeles Board of Water and Power Commissioners
4. Submission of a recommendation from the Inyo County Water Commission (the Water Commission acts as the County's CEQA agency for purposes of projects arising out of the Water Agreement) to the Inyo County Board of Supervisors as to whether the County should adopt CEQA
5. Adoption of CEQA by the Inyo County Board of Supervisors
6. Approval of a proposed amendment to the Water Agreement by the Inyo County Board of Supervisors
7. Approval of an amendment to the Water Agreement by the Inyo County Superior Court
8. Determination by the Los Angeles Board of Water and Power Commissioners that the proposed modification of the Enhancement/Mitigation Project, will continue to provide mitigation equal to

the mitigation that would be provided if the project were not modified

9. Agreement by the Inyo County Board of Supervisors and LADWP, acting through the Standing Committee, to approve the proposed modification to the Enhancement/ Mitigation Project

Lower Owens River Project (LORP)

Environmental monitoring of the LORP is continuing to provide information used by scientists and project managers to evaluate project conditions and make adjustments to management when required. We have found that by many measures the LORP is a success, but in this 6th year of monitoring it is still too early to state that the goals of the LORP are on track to being fully met.

As in previous years, LORP monitoring activities were carried out in all management units (River-Riparian System, Blackrock Waterfowl Management Area, Off-River Lakes and Ponds, and the Delta Habitat Area). Work on the LORP in fiscal year 2014-15 conducted by LADWP and Inyo County included:

- Maintenance activity such as cleaning sediment accumulations and obstructions from water measurement facilities, ditch maintenance, fence repairs, and adjustments to flow control structures.
- Hydrologic monitoring and analysis of river baseflows and seasonal habitat flows, the ponded area of the Blackrock Waterfowl Management Area (BWMA), the level of the Off-River Lakes and Ponds, and baseflows, pulse flows, and seasonal habitat flows to the Owens River Delta.
- Biological and water quality monitoring included water temperature and dissolved oxygen monitoring, rapid assessment survey (RAS), avian census, and range monitoring. Not all monitoring tasks are conducted every year. A list of monitoring by year can be found in the LORP Adaptive Management and Reporting Plan, which can be found on the ICWD website: http://www.inyowater.org/LORP/DOCUMENTS/LORP_MonitoringAdaptiveManagementPlan_042808.pdf
- Rangeland monitoring included irrigated pasture condition scoring and utilization trends. Woody species recruitment monitoring was added in September 2010 in order to assess potential livestock influences on regeneration of desirable woody species
- Other work included saltcedar control, weed abatement, and mosquito control

Complete observations from the 2014 field studies are found in the 2014 LORP Annual Report, which can be found on the ICWD website (www.inyowater.org).

Summary of 2014 LORP Observations

The development of the LORP ecosystem has been monitored since water was reintroduced into the Owens River in December 2006. Based on this monitoring the mitigation project is not at this point trending toward meeting goals. Water quality issues, lack of woody recruitment, and emergent vegetation encroachment are challenging the project.

Water quality concerns

The late July 2013 monsoonal storm event that caused flash flooding and led to the unplanned release of a large flow from the Alabama Gates into the lower stretch of the Lower Owens River resulted in a substantial fish kill. From that experience and other observations of fish stress in 2010, it appears that it is not possible to maintain river water quality under the restrictions of the current hydrograph. The balance between carbon

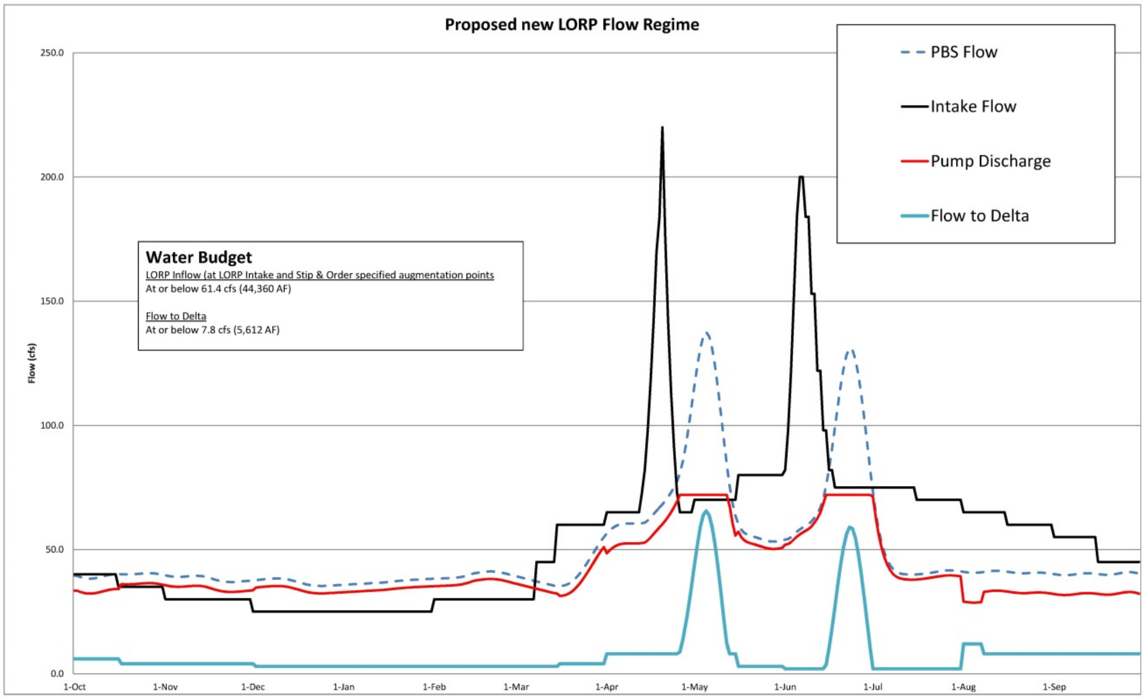

Figure 8.4 Proposed hydrograph to improve water quality. Includes an additional pulse flow in late April and flows below 40 cfs over winter months.

created and stored in the river, and carbon that can effectively be removed from the system are out of balance and cannot be easily equalized by flow modifications within the bounds of the stipulated flow (40-200 cfs). The amount of flow needed to effectively move muck out of the river may also deplete the water of dissolved oxygen, endangering the fishery.

LADWP staff has proposed a new hydrograph designed to improve water quality (Figure 8.4). It is expected that flows larger and smaller than those stipulated will be required. Parties to the MOU have being asked to allow revisions to the stipulation and order to allow for more appropriate flow management. This would include allowing the Pumpback Station (PBS) discharge capacity to increase from 50 cfs to a maximum of 110 cfs, and allowing baseflows above or below 40 cfs at times. All parties to the MOU, except for the Owens Valley Committee (who oppose raising the PBS capacity), have agreed to make these changes.

Emergent vegetation encroachment

The dominance of cattails and bulrush (collectively referred to here, and in other places, as tules) along the waterline is a concern. Although tules are an expected natural feature in wetted areas of the Owens Valley, and are in many ways are beneficial, it was not expected that tules would dominate the LORP as they have. Tules influence riparian development, changing river flows, limiting certain habitat development. They have become a major impediment to river recreation and in some areas tules are encroaching in on range forage. Inyo County and LADWP staffs,

Figure 8.5. Drew Slough.

along with the MOU consultants are discussing ways in which tules might be best managed

Woody recruitment

The goal of developing a Lower Owen River riparian canopy suitable for supporting canopy dependent habitat indicator species still remains elusive; recruitment of tree willow in the riparian area is occurring, but very slowly and in limited areas. During the 2014 Rapid Assessment Survey (a 10 day 200 mile survey in August walked along the edge of all wetted features in the LORP), tree willows seedlings or juveniles were found at eight sites, down from 46 sites in 2013, and the lowest number since the survey began in 2007. Additionally, no cottonwood recruitment was recorded this year (only a few cottonwood recruits have been discovered since the beginning of the project).

It's unclear if there is a relationship between the size of the Seasonal Habitat Flow (SHF) and woody recruitment (for more information, see the Rapid Assessment section of the 2013 LORP Annual Report). The SHF, which somewhat mimics high spring flows, was seen by project consultants as the primary tool for encouraging recruitment.

The volunteer group Friends of the Inyo has plans to experiment with pole planting willow and cottonwood beginning in 2015.

LORP Seasonal Habitat Flow and Blackrock Waterfowl MA Flooded Acreage

With the Owens Valley runoff forecast to be 50% of normal, no seasonal habitat flow was released, and the flooded acreage in the Blackrock Waterfowl Management Area was set at 250 acres, which is the minimum allowed in the LORP management plan. All water was held in Drew Slough (Figure 8.5).

The Drew Slough is to maintain about 50% open water, but in 2014 60% of the wetted area was filled in by tules. In 2015 Drew slough will be drained and burned, and the water sent into the Winterton unit.

LORP Recreational Use Plan (RUP)

It is anticipated that the LORP will become a popular recreation area that will appeal to those who enjoy hiking, biking, bird watching, wildlife viewing, hunting and fishing and other outdoor activities. Increasing visitor use is expected each year for the first 10-15 years of the project.

A RUP will provide a mechanism to comprehensively identify resource-appropriate recreational opportunities and evaluate these in relation to: environmental and habitat objectives of the LORP; maintenance of warm water fishery, LADWP operations, cultural resources, cattle grazing and other agricultural activities. The LORP RUP will address community concerns that cultural resources and working landscapes be protected (Figure 8.6). The development of the RUP has involved extensive public and stakeholder review. From this input, three options were presented

Figure 8.6. Unsafe recreation at Mazourka Canyon LORP flow measuring station.

to Inyo County Board to help narrow the scope of the project. With the Board instructions, a draft RUP was written and released to public in February 2012. A final preferred plan was presented to the Inyo County Board of Supervisors and the Inyo/Los Angeles Standing Committee in February 2013. Both bodies recommended that the plan proceed to a final design stage with environmental review. The County is pursuing grants to complete the plan.

LORP Summit

A LORP Summit was convened July 29-30, 2014, to inform the MOU parties and stakeholders about progress of the project, which is about half-way through its 15 year term, and present possible solutions to some of the project's challenges.

The first day, a series of eight technical presentations were made by LADWP and Inyo staff. These described the current status of specific conditions in the project area. As well, rancher Scott Kemp presented some of his observations. The second day was mostly spent in the field, in the project area.

The presentations in summary:

Flow Management – Eric Tillemans (LADWP) presented the hydrologic state of the river; emphasizing that the restrictions on the pumpback station capacity require careful flow monitoring to maintain the stipulated 40 cubic feet per second (cfs) flow. He indicated that the three main challenges to meeting the mandated flow requirements; the requirements leave little room for error; water losses are spatially and temporally variable; and flow travel-time from intake to pumpback station are considerable. He pointed out that LADWP has not once been out of compliance with flow requirement since the beginning of the project.

Avian Indicator Species – Debbie House (LADWP) pointed out improvements in avian habitat indicator species (HIS) are not well represented in the LORP. The majority of the HIS require stands of trees in which to breed, and improvements will not likely occur until that habitat suitable for these species develops. She suggested we should consider reevaluating the HIS list, and add species that are more prevalent, and thus better indicators of habitat change. She also presented that the Delta Habitat Area may be receiving more water than needed, and as a result marsh is replacing meadow habitat, and suggested that habitat conditions in the delta could be improved by cutting down the amount of water sent to the delta during the summer, eliminating winter pulse flows, and broaden and flatten the fall and spring pulse flows.

Geomorphic Fluvial State – Sherm Jensen (LADWP) provided background on the physical differences in the six river reaches between the river intake and the pumpback station. Before the project was implemented, when it was being planned, projections were made of how the river would behave once flows were reestablished -- some of these were quite accurate, others were far off. He discussed that the lower section of river is aggrading (i.e., material is accumulating), which is leading to increases in tules, increases in travel-time, increases in water lost, impacts to water quality, and impacts on established and establishing riparian vegetation (Figure 8.7). This situation, he explained, is conducive to creating a wetland not a river. Scott Kemp noted that beaver moved in around his pastures in 1980 or 1990, which he feels led to blockage of the lower river.

Figure 8.7. One of the effects of an aggrading river in the Islands area is the lateral spread of water. Where this is occurring the result can be the conversion of pasture and willow to tule marsh.

Riparian Condition/Woody Recruitment – John Hays (LADWP) presented evidence that the recruitment of willow and cottonwood has been insignificant, and that the prescribed flows in the river, which were designed to promote tree recruitment, may be having the opposite effect by encouraging tules, which compete for suitable habitat. As well, the normal seasonal variation of flow released from the intake may be drowning newly established tree seedlings. In the summer, 90 cfs releases at the intake are needed to maintain 40 cfs at the pumpback station and these high flows can drown seedlings that established during lower flows released in the spring.

Tule Condition/ Control – David Livingston (LADWP) offered two primary management methods for controlling emergent vegetation—passive and active. He presented information from literature and experiments that indicate that tules in the Lower Owens River cannot be controlled simply by altering flows, because the river cannot be manipulated to significantly increase depth or velocity sufficient to control tules. He discussed the feasibility of herbicide, mechanical removal, and biological controls.

Water Quality – Larry Freilich (ICWD) pointed out that it was not unexpected that poor water quality would be the norm in the river. He referred to the LORP EIR, which listed only two immitigable impacts, both related to water quality, and both unavoidable: that in the area downstream of Mazourka Canyon Road, baseflows and SHFs could degrade water quality and kill fish. He illustrated how water temperature and flow relate to changes in dissolved oxygen levels, which when low can kill fish and other aquatic organisms.

Fishery – Jason Morgan (LADWP) showed data that suggests that the Lower Owens River is a productive warm water fishery. He showed data from the 2014 creel census (i.e., data from fishermen) that the fishery had recovered from the fish kill of July 2013. He concluded from these and other data that the warm water fishery is resilient and self-sustaining.

An Alternative Flow Regime – Eric Tillemans (LADWP) presented a hypothetical hydrograph for the river. Instead of maintaining a strict 40 cfs flow with an annual SHF, the proposed hydrograph contains two peak flows, one in the spring to move organic material through the system and another in early summer to promote recruitment of woody riparian vegetation. Flows in the winter would be reduced to approximately 25 cfs to recoup additional water used for the additional pulse flow.

Effect of the LORP on Ranching – Scott Kemp pointed out that the islands reach where he ranches was once a diverse habitat, with extensive woodlands and ample pastureland. Now, he explained, the area has been ruined by tules, encroaching throughout his islands lease. He believes that if the river were trained through the area the result would be better habitat and better forage. He reported that the tule infestation appears to be moving upstream.

Most of the second day was spent in the field. The group travelled from the pumpback station up to the river intake and saw first-hand the successes and significant challenges that were discussed in the previous day's presentations. It was an informative trip with a dozen scientists, a few lawyers, the LORP lessees, and the MOU representatives, all engaged in conversation.

Much of what was seen on the tour reinforced the view that tules were a dominating force in wetted areas. Other than the Owens Valley Committee (OVC), there was agreement among the parties that tules were limiting habitat development in the riverine riparian system, and that methods to control tules should be further investigated. OVC wasn't opposed to experiments in tule control, but they were more willing to accept a tule filled river and tule swamp in the Islands area as a desired condition. Scott Kemp pointed to tree snags in the middle of the islands to make a point that before the project much of this swamp had been woodland and much more diverse.

Stops were made to look at an area that was improved by a range burn, another to see a LORP flow measuring station, and a visit was made to Drew Slough in the Blackrock Waterfowl Management Area (BWMA). Debbie House and John Hays discussed changes to water management in the BWMA that would both improve waterfowl habitat and control tule growth.

Figure 8.8. New flow in Hines Spring, Aberdeen Ditch, a 1600 acre-foot project. Porous rock below bed has required m/oving the point of discharge hundreds of feet down channel from the original outfall.

The final conversation among parties involved a discussion of next steps. It was decided that the group would revisit the agreement to lift the pumpback station restrictions and flow requirements and develop an agreement to increase the pumpback station capacity for a limited time, the Water Department agreed to produce a summary analysis report of all water quality studies done on the river to date. LADWP agreed to prepare a Delta and BWMA plan to improve habitat in these areas. LADWP will investigate engineering options to move water more efficiently through the islands. LADWP was tasked with developing an improved hydrograph that can be used to improve water quality.

MOU Additional Mitigation Projects

(AMP)The 1997 MOU commits LADWP to implement additional mitigation that provides a total 1,600 acre-feet of water per year, spread out among eight projects. These projects mitigate for impacts due to the loss of springs

Table 8.3. Amount of water applied to 1,600 acre-foot projects relative to target in 2014-2015. The sum of the deficit, 321 acre-feet, was applied to Warren Lake.

Project	**Deficit**
Freeman Creek	0
Hines Spring, Well 355	-33 af
Hine Spring, Aberdeen Ditch	-81 af
North of Mazourka Canyon Road	-153 af
Homestead	-26 af
W 368	-26 af
Diaz Lake	-2 af

including Fish Springs, Big and Little Seely Springs, and Big and Little Blackrock Springs.

On-site mitigation measures were developed at Hines Spring (Figures 8.8 and 8.9) and the balance of the water was allocated other projects in the Owens Valley. The projects are described in the report, *Additional Mitigation Projects Developed by the MOU Ad Hoc Group* (www.inyowater.org).

These projects which were fully implemented in March 2012 include: The two *Hines Springs* projects, consisting of a surface-water fed channel off the Aberdeen Ditch, and a pumped water (Well 355) which creates ponded water for cattle and tule marsh habitat; *Freeman Creek*, where water is being diverted back into ancestral washes to support a riparian corridor and pasture; *North of Mazourka* Canyon Road project, where a new flowing well augments supply from an older well to create spring and seep habitat and provide stock water; the *Homestead* project southeast of Independence, which relies on a new flowing well to create a short flowing channel and a one-acre pond; the *Well 368* project includes a new artesian well to augment water for an existing Owens Valley Pupfish refuge. In addition, to these biological projects, *Diaz Lake* will be supplied a secure amount of water, which reduces the amount of water pumped by Inyo County to supply the lake. The annual balance of 1,600 af not used by the other projects will be used at *Warren Lake* to enhance shorebird and wildlife habitat.

Annual water commitments are as follows: Freeman Creek (215 af), Hines Spring Well 355 (240 af), Hines Spring Aberdeen Ditch, (145 af), North of Mazourka Canyon Road (300 af), Homestead (300 af), Well 368 (150 af), and Diaz Lake (up to 250 af). If the sum of water applied to these projects is less than 1,600 af, Warren Lake receives the balance. In 2014-15, the project water deficit was 325 af. Warren Lake received 325 af in make-up water, which was put out from October-December 2014 and February-March 2015 (Table 8.3).

Figure 8.9. The reinforced outfall at at Hines Spring, Well 355, a 1600 acre-foot project.

Revegetation projects in the 1991 EIR and Irrigation in the Laws Area (ILA) MND

Revegetation projects mitigate for environmental damages due to groundwater pumping and/or discontinuation of agriculture (Figure 8.10). A mitigation plan for these projects dates back to August 1999 (www.inyowater.org).

It is frequently quoted that active revegetation is a slow process, which may require a decade or more to achieve, but despite well over a decade of research and considerable experimentation, the majority of these projects have not met goals.

LADWP reported in 2012-13 that only four of sixteen revegetation parcels have met required cover and composition goals (Table 8.4). None of the abandoned agricultural revegetation projects are near meeting targeted goals. To date, the only revegetation efforts to have succeeded were those that came back naturally once the water table was allowed to recover. In these instances no improvements other than fencing and the elimination of grazing were needed.

The majority of the revegetation projects require some form of irrigation to support transplanted stock (irrigation will be discontinued once plant cover and composition meets goals for a parcel, and those goals can be sustained unirrigated for a specified period of time). However, most of these projects are not supplied adequate irrigation and as a result have not achieved revegetation goals.

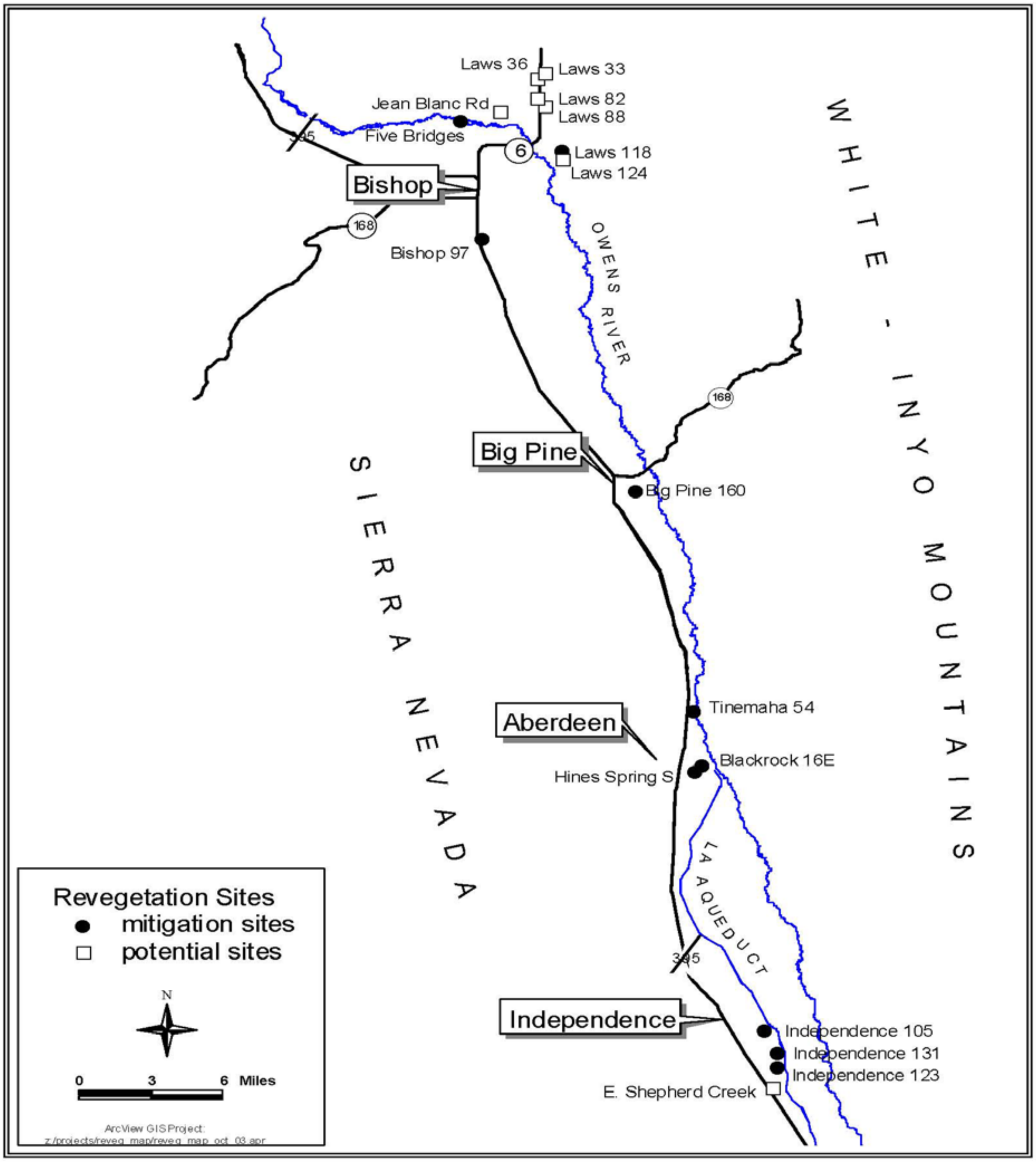

Figure 8.10. Locations of revegetation projects in the Owens Valley described in the 1991 EIR.

Table 8.4: Status of revegetation projects.

Guiding Document	Project name	Acres	Impact[2]	Met goal	Percent Live Native Cover: Goal %	Percent Live Native Cover: Reported %	Number of Species: Goal	Number of Species: Reported
91 EIR/97 MOU	LAWS 118	107	ABAG	NO	11.5	2.0 [4]	11	Not reported
91 EIR/97 MOU	BISHOP 97	124	ABAG	NO	15.0	4.8 [4]	12	Not reported
91 EIR/97 MOU	FIVE BRIDGES	300	GP	NO	60.0	47.0/74.0 (2 sites)	4	5/6 (2 sites)
91 EIR/97 MOU	BIG PINE 160	211	ABAG	NO	17.7	3.0 [4]	10	Not reported
91 EIR/97 MOU	TINEMAHA 54	0.4	GP	NO	33.0	2.1 [4]	3	Not reported
91 EIR/97 MOU	BLACKROCK 16E	7.5	GP	YES	34.0	37.0	6	14
91 EIR/97 MOU	HINES SOUTH[2]	9.0[4]	GP	NO	33.0	–	TBD	–
91 EIR/97 MOU	INDEPENDENCE 105	42	GP	YES	25.0	>25.0	4	>4
91 EIR/97 MOU	INDEPENDENCE 123	42	GP	YES	17.0	>17.0	4	>4
91 EIR/97 MOU	INDEPENDENCE 131 N	23	GP	YES	17.0	16.2 [4]	4	5
91 EIR/97 MOU	INDEPENDENCE 131 S	50	GP	NO	17.0	6.2 [4]	4	Not reported
ILA*	LAWS 90	94	ABAG	NO	10.0	Not surveyed	10	Not surveyed
ILA	LAWS 94	47	ABAG	NO	10.0	Not surveyed	10	Not surveyed
ILA	LAWS 95	44	ABAG	NO	10.0	Not surveyed	10	Not surveyed
ILA	LAWS 118/129	50	ABAG	NO	10.0	Not surveyed	8	Not surveyed
ILA	LAWS 27 (SEED FARM)	118	ABAG	NO	10.0	Not surveyed	8	Not surveyed

YES	Met Goals - Project Complete
YES	Determined by LADWP to have met goals in 2012
NO	Not meeting goals

*ILA, Irrigation in the Laws Area MND

[1] 32 acres removed for irrigation

[2] Abandoned agriculture, lands removed from agriculture (ABAG); increased groundwater pumping (GP)

[3] Surveyed August 2012

4 Scoped at 11.5 acres. Fenced. No active revegetation planned

Figure 8.11. Dust emissions are a still a concern at LAWS 129/118 (April 2015). LADWP has been experimenting with bark mulch and straw bales to control dust pollution.

Figure 8.12. Dust coming off the seed farm neat the community of Rudolph.

Members of the public, Inyo County Water Commission, the ICWD, and other agencies have voiced concern about the lack of progress, especially in the Laws area, where after nine years little revegetation has occurred and blowing dust from these parcel continues to impact the property and health of nearby residents (Figures 8.11 and 8.12) .

Beginning in 2013 LADWP has been steadily increasing the amount of effort they are putting into the ILA projects. As of 2014, a dedicated revegetation manager is overseeing the planting and irrigation, which seems to be improving the project's implementation. Irrigation has been installed in all parcels and thousands of plants are being installed. Transplants that have not established are being removed and replaced with new plants when stock is available. Once the crews are finished planting the ILA parcels they plan to begin work on the EIR revegetation projects.

Revegetation Mitigation Projects Described in the 1991 EIR

The 1991 EIR identified mitigation for lands that were made barren due to increased groundwater pumping, or the abandonment of agriculture. The 1997 MOU, which supplements the 1991 EIR, describes the goals for the revegetation projects:

> *The content of the mitigation plans will be in accordance with the EIR, which provides that on-site mitigation will be accomplished through revegetation with native Owens Valley species and through establishment of irrigation. The mitigation plans may include schedules for conducting research and testing revegetation techniques.*
>
> *As reliable methods are developed for large-scale revegetation applicable to the different characteristics of the affected areas, the initial revegetation goals contained in the EIR, or in the initial plan, for each site will be refined or modified as necessary. In refining or modifying the revegetation goals for the affected areas, a preference will be given to revegetation that will restore the area to vegetation conditions similar to those that previously existed. If this cannot be feasibly and reliably accomplished because of the characteristics of the area, or for other reasons, the next preference will be to establish perennial vegetation comparable to that in nearby areas. If this is not feasible, revegetation with other native Owens Valley species will be the preferred goal.*

Beginning in 1991, studies and test plots were used to examine various methods that could be used to effectively and efficiently revegetate arid lands. Based on these studies and experiments, revegetation plans called for in the 1997 MOU and Long-Term Water Agreement (LTWA) were released in August 1999. The plans are titled, *Revegetation Plan for Impacts Identified in the LADWP, Inyo County EIR for Groundwater Management* and can be found on the ICWD website.

All the revegetation projects were fenced in 1999 to eliminate disturbances. Experimental techniques were tried at plots within some sites to test various methods of revegetation with the goal of developing techniques that could be applied to all projects. Sites were prioritized according to the difficulty of the project and threat of continued degradation. At sites where natural recruitment was taking place, passive techniques--simply fencing the land--was all that was called for. At the most disturbed sites where top-soil had eroded, it was established through studies that systematic irrigation would be required to cultivate native perennial transplants.

Figure 8.13. Ten thousand native plants put out at LAWS 129/118 revegetation project (April 2015). Plantings are staked in cages.

The status of these projects is as follows:

- **Laws 118**: LADWP reported that in 2013 a drip irrigation system was installed that covers much of the parcel) in 2011, 18 acres were drill seeded (Figure 8.13). In 2012 a buried drip irrigation line was installed, and a new fence was constructed. The site was found to have 2% cover when surveyed in 2012, so the parcel is not meeting cover goals. LADWP reports that they likely plant this parcel in 2015, which is after they have completed planting Laws parcels 90, 94, 95, and 129. The Irrigation in the Laws MND (2003) specifies that 32 acres of parcel 118 is to be flood irrigated to create and maintain native pasture; however this section has not been irrigated. LADWP is working with the lessee to get water onto the land.
- **Bishop 97**: approximately 35 acres were drill seeded in 2011, and a buried drip system was installed on approximately 16 acres. This parcel has 4.8% native perennial cover. The goal for this project is 15% cover. As of 2014, it doesn't appear that seeding has improved cover.
- **Five Bridges**: Water was release from C Drain three times during the growing season. Water spread was assessed visually. Permanent transects and photo points were monitored, and weed control continued. LADWP is not following the approved mitigation plan for Five Bridges, which requires flood irrigation from high flows from the

Owens River. A revised plan for this project had been circulated, but has not been approved by the Technical Group. Under LADWP's current management, the percent of native perennial cover and composition of that cover, as measure by LADWP, varies quite a bit from year to year, but generally the cover has been in decline during the past eight years, which was recorded in LADWP's annual report. ICWD has requested that LADWP apply water earlier in the growing season for rare plants in the area. In 2014, the first water of the season will be released at the end of May.

- **Big Pine 160**: About 20 acres were drill seeded in 2011. LADWP is still evaluating a water source and designing an irrigation supply. Transects conducted in August 2012 found 3% native perennial cover. Additional drill seeding was accomplished in 2014.
- **Tinemaha 54**: No work has been reported by LADWP. This parcel is not meeting cover and composition goals. A 2012 survey found 2.14% cover.
- **Blackrock 16E**: The site has attained cover and composition goals, and no work was reported.
- **Hines South**: This project has not been implemented. Planning was to begin after the Hines Spring projects were completed in March 2012. Although the Hines Springs projects were implemented by deadline they are not fully performing as designed due to the character of the soils at the site. A decision was made to delay planning for three years in order to allow an assessment of the Hines Spring project. It is expected that planning will be completed by March 2015.
- **Independence 105** and **Independence 123**: It is reported that these sites have attained cover and composition goals.
- **Independence 131N**: This parcel was surveyed in the summer of 2012 and transects show that vegetation cover was 16.2%, which is just below the required 17% vegetation cover goal; however, the revegetation plan allows that when cover is 90% of the stated goal it is considered rehabilitated.
- **Independence 131S**: approximately 21 acres were drill seeded. LADWP reported in 2011 that buried drip irrigation was to be installed in 2012.

The 1999 mitigation plan for these revegetation projects provides that, "After seven years, these overall goals should be reexamined to assess whether they are realistic or need revision. Assessment will include the level of effort expended on the project and a statistical evaluation of the status of the cover and composition of desirable and weedy species". It has been 13 years and no reevaluation has taken place.

Irrigation in the Laws Area MND (ILA), Revegetation Projects (233 acres)

These revegetation projects are the result of the reclassification of some of the formerly irrigated land in the Laws area. In the 1990's the Laws Ranch agricultural fields were supplied irrigation water for pasture and alfalfa until a dispute between the lessee and LADWP ended with the lessee abandoning the field. LADWP did not continue irrigation, topsoil was lost and the fallow ground became a major source of blowing dust.

In order for the Laws Ranch to be efficiently irrigated, Inyo County and LADWP agreed to redesignate these formally irrigated parcels from Type E (lands supplied with water) to Type A (vegetation that can survive on available precipitation). In trade, certain parcels in the Laws area were reclassified Type E, so that an equivalent acreage remained irrigated.

Three parcels in the Laws area that had been irrigated farmland will be revegetated:

Laws 90 (101 acres), Laws 95 (46 acres), and Laws 129 (47 acres). Another two Laws parcels, which are mapped as abandoned agricultural land, Laws 94 (40 acres) and a portion of Laws 118 (18 acres) surrounding Laws 129 will also be planted.

The mitigation plan for the Irrigation Project in the Laws Area, MND, entitled, *Revegetation Plan for Lands Removed from Irrigation Laws Parcels 90, 95, and 129 and Abandoned Agricultural Land Parcel 94* was released in 2003 (www.inyowater.org). The plan describes restoring native perennial cover that closely approximates the vegetative cover and species composition of nearby parcels with similar ecological site descriptions. All parcels are to be irrigated until the project is complete; when, after two years of having discontinued irrigation and other activities, the prescribed cover and composition is maintained.

The plan provides specific goals for total vegetative cover, species composition, and a project schedule. The cover and composition goals are: a minimum 10% cover of native perennial vegetation composed of 10 native perennial species at Laws 90, 94, 95, and 8 native perennial species in Laws 129/118 by 2013.

LADWP reports that the planting on all of the Laws parcels will be complete by 2014-15, but has not provided a revised plan and schedule that describes when project goals are expect to be met. The Plan for the Irrigation Project in the Laws Area requires that beginning in 2010, if revegetation is not on schedule, the annual report is to be expanded. The Water Department has asked LADWP to provide the expanded report and a new timeline. Inyo County is working with LADWP to revise the plan, which should be completed in 2014. The revised Plan will be submitted to the Technical Group for review and approval. The Irrigation Project in the Laws Area, MND will be amended with the revised plan.

Although LADWP is years behind schedule, they are making a concerted effort to accelerate work on these projects. They have two greenhouses for propagating native transplants, which allows them to place thousands of deep-rooted transplants at buried drip emitters in the project parcels. New drip irrigation systems had being installed, or expanded to allow for additional plantings in 2014.

While progress on these projects is evident, the Water Department still has concerns that these projects will not meet the Plan's cover and composition goals. Plants, including perennial grasses, are being placed at water emitters on a grid with 10 foot grid spacing. Even if all transplants survived (as of 2011, it appeared that less than 60% survived), and each individual plant attained a full canopy, plants placed with such a large spacing would be unlikely to attain a 10% cover. LADWP suggests that cover will expand with new recruitment, but there is little evidence that recruitment is occurring in the Laws parcels. As well, LADWP is not monitoring survivorship, and has not committed to replacing transplants that have died.

Another concern is competition for resources by weedy species, primarily tumbleweed (*Salsola tragus*), which covers much of the land in these parcels. Weeds are taking advantage of moist soils at the drip emitters and competing with transplants. Under the mitigation plan, Salsola is not a species LADWP is required to treat, but without management, many of the new transplants will be needlessly lost. In 2014, LADWP began experimenting with mulches to control weeds, and wind fences and hay bales were installed to control windblown dust.

Two parcels identified from mitigation in the Irrigation in the Laws Area MND, totaling 162 acres, have not been implemented. The 32 acre portion of Laws 118 that is to be converted to irrigated pasture has not received water, and Laws 50, which has been the subject of complaints from The Great Basin Unified Air Pollution Control District, has yet to be fully implemented.

Table 8.5. Species Cover and Composition at Five Bridges, recorded by LADWP 2003-2014 (values in red are below project goals). Values are in % cover.

Transect	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
L4 Cover	59	61	68	61	52	47	39	47	21	13	9
L4 Comp.	5	4	4	4	5	5	5	5	5	5	4
L5 Cover	78	89	93	70	74	43	61	74	68	34	34
L5 Comp.	6	7	7	7	6	7	6	6	6	6	6

Figure 8.14. Panoramic view of Five Bridges vegetation cover in impacted area (April 2015).

Five Bridges

In 1988, approximately 300 acre of vegetation in the Five Bridges area, located about 3.5 miles north of Bishop, was observed to have died off or was in decline. The impact was attributed to local groundwater pumping and the effects of drought. A mitigation plan for the site was developed in 2002, but the Technical Group never approved it. The mitigation goals are to restore the area to a complex of vegetation communities with similar species composition and cover as existed prior to impact. The goal will be attained when alkali meadows have live cover of 60% that is composed of four perennial species and riparian areas attain live cover of 90% composed of four perennial species. In the unadopted plan, these goals were to be attained at the end of the 2007 growing season. Five Bridges is presently managed using controlled burns, grazing restrictions, weed control, and water spreading (Figures 8.14 and 8.15)

Beginning in 2004, LADWP's Annual Owens Valley Report provides transect results from two alkali meadow sites (Table 8.5). Since 2004, species composition goals have been met; however, vegetation cover in these same areas has varied greatly over time. Of interest is survey data that show a general decline in alkali meadow vegetation cover at the two reported permanent transect sites. Transect L4 had met, or nearly met, required cover only during the first four years in which project data had been reported, but for the last five years cover has greatly declined. The most recent figures for transect L4 and L5, reported in 2014, show a dramatic decline in cover compared to previous years. In 1989 cover at L4 was 3.9% and L5 was 15.9%.

In light of the declining trends seen in this project, Inyo County has requested that the mitigation plan for the project be reviewed and revised. LADWP has not responded to this request.

Figure 8.15. Cattle grazing in impacted area at Five Bridges (April 2015).

Figure 8.16. Newly watered section of South Shore Shorebird and Shorebird Habitat, with Klondike Lake in the background.

Klondike Lake, South Shore Waterfowl Habitat Area (SSHA)

Klondike South Shore Habitat Area is to be provided 200 acre-feet of water per year for the purpose of creating and maintaining an open-water habitat for waterfowl and a shallow-flooded habitat for shorebirds.

LADWP had encountered problems conveying the assigned volume of water between Klondike Lake and the adjoining SSHA. There is very little gradient between the lake and the SSHA, so that less than half the water allocation could be supplied in most yearsIn 2012 an addition water gate was opened between the lake and habitat area, and water delivered to the site was reported to be 200 af in 2011-13. However, in 2014 LADWP did not meet their obligation; only 54 acre-feet was released to the wetlands.

Encroachment by emergent vegetation in the project area is a concern (Figure 8.16). Tules have largely displaced open water habitat in much of the project area that was first flooded. With the switch in the primary water delivery point, new areas of open water have developed and are being used by shorebirds and waterfowl, off-setting the loss of open water elsewhere in the project area. In 2014 the areas most infested with tules was disked. Neither the County nor the CADFW was consulted before the Department took this action.

Figure 8.17. Sprinkler irrigation installation.

Independence Eastside and Big Pine NE Regreening, and Van Norman Field Projects

Independence Eastside Regreening (30 acres)

This project, which mitigates for impacts due to groundwater pumping and surface water diversions, consists of constructing a new water supply well in the town of Independence and irrigating approximately 30 acres immediately north of Market St. and east of Clay St.

From 2002 to 2008, the project underwent several rounds of review and consideration by Inyo County. In April 2009, the Standing Committee revised the scope of the project to allow sprinkler irrigation and relocate the well to the east to reduce pump noise at neighboring residences. The change in scope also allowed for an onsite stable and corral.

The Technical Group had evaluated and approved the new well at the site and by September 2012 LADWP had drilled the new well, and selected a lessee.

The area was fenced beginning in the winter of 2013 and “No Public Access” signs have been posted. The project area had been a popular pedestrian route from town to the fields to the east. Independence residents asked the LADWP to allow continued access and LADWP accommodated this by relocating the north fence line.

A number of mature trees were left within the project boundary.

The sprinkler irrigation system was installed in April 2014 (Figure 8.17), and the area was planted with a pasture mix by the lessee in 2014-2015.

Big Pine Northeast Regreening (30 acres)

The Inyo County/ LADWP Technical Group approved an amended mitigation plan in the spring of 2010. The Big Pine Canal was identified as a source of project water. Replacement water up to 150 AFY will be supplied by Well 375. The effect of pumping Well 375 to supply this project has been modeled and water drawdown is expected to be insignificant, with no effect to vegetation or neighboring wells. Pumped throughout the irrigation season, at 150 AFY, the model predicted a groundwater decline of less than 0.2 feet.

The new project scope allows for sprinkler irrigation or flood irrigation. The original project description anticipated flood irrigation. Sprinklers were installed, which will reduce the project’s water demand from 150 AFY to 90 AFY.

LADWP had completed a Negative Declaration (ND) in November 2011 and began work to identify a lessee and build project infrastructure, but in April 2012 the Owens Valley Committee, Sierra Club, and Big Pine Paiute Tribe filed a legal challenged on the grounds that an EIR was required. In November 2012 the court ruled that LADWP’s original CEQA document, the 1991 EIR, described the project and that a ND was adequate for the project to proceed.

The site was prepared beginning in the winter of 2013, and the Irrigation was installed in March and April 2014 (Figure 8.18). The parcel has been planted with pasture mix by the lessee.

Figure 8.18. Big Pine Northeast Regreening (April 9, 2014).

Mitigation Table (projects arranged north to south)

This table contains general information about each project, including its origin, description, impact mitigated, plan, development stage and status as of April 2015.

The *Mitigation Origin* column lists the project starting point and any subsequent consideration of the project over time. Many of the Enhancement Mitigation projects (E/M) that were implemented prior to the 1991 EIR were continued. Some of the pre 1985 Environmental Projects (EP) identified as mitigation in the EIR. The Impact Number, if provided, is from Section 7 of the 1991 EIR, and associates the mitigation measure with the pre-project setting and type of environmental impact being mitigated; it also describes the significance of the environmental impact. Non-E/M projects were largely developed in response to an impact that occurred subsequent to the EIR. Some non-E/M projects provide substitute mitigation, or mitigation not specific to an impact identified in the 1991 EIR.

The *Impact* column summarizes the environmental impact being mitigated. The *Prescription* column describes the activities and goals from the associated mitigation plan or other agreement. The project's state of development, relative to the project's goals, is reported in the *Development Stage* column. The *Status* column summarizes recent project activity.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
Laws/Poleta Native Pasture (north and southeast of Laws) (216 acres)	E/M 1985-1990[1] 1991 Owens Valley EIR Impact No. 10-16	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought.	Annually provide water to approx. 216 acres in two locations to enhance and maintain existing vegetation and increase livestock grazing capacities while continuing the activity that caused the impact. (First implemented 1988).	Implemented and ongoing.	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. LADWP had reported that they couldn't separate this project's water accounting from adjacent irrigated parcels. LADWP reports these projects were supplied a combined 1,376 acre-feet in 2014-15.
McNally Ponds and Native Pasture (348 acres)	E/M 1985-1990 1991 Owens Valley EIR Impact No. 10-18	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing, and drought.	Create waterfowl habitat by annually filling ponds Sept-Jan. Enhance and maintain vegetation and increase livestock grazing capacities by irrigating 107 acres of native vegetation and ~200 acres of native pasture. (First implemented 1986-1987).	Implemented and ongoing This project and Laws Poleta Native Pasture received no water in 2014-15	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 low patchy grass cover. The other pasture located 1 ½ miles SE of Laws (200 acres) was irrigated and maintaining grass cover. During the 2014-15 runoff year, neither the ponds or pond-adjacent pasture received any water. In 2013-14, to compensate for not irrigating the ponds pasture, approximately 100 acres of pasture adjacent to Bishop Creek Canal was irrigated. This was not done again in 2014-15.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
640 acre potential revegetation near Laws	E/M 1985-1990 1991 EIR Impact No. 10-18	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought.	Standing Committee to consider revegetating with non-groundwater dependent native plants and continuing the activity that caused impact.	In progress	The Standing Committee has not evaluated the need for mitigation of this area. Desert Aggregates expanded gravel mine operation includes at least 174 acres in the western part this potential mitigation site.
Five Bridges area revegetation (300 acres)	1991 Owens Valley EIR Impact No. 10-12	Between 1987 and 1988, two wells in the Five Bridges area that were pumped to supply water to enhancement mitigation projects contributed to a lowering of the water table under riparian and meadow areas along Owens River. Approximately 300 acres of vegetation were affected, and within this area, approximately 36 acres lost all vegetation due to a wildfire. EIR v1 (10-58)	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	Water has been spread over the affected area since 1988. By the summer of 1990, revegetation of native species had begun on approximately 80 percent of the affected area. LADWP and Inyo County had been developing a plan to revegetate the entire affected area with riparian and meadow vegetation. The planning effort stalled in 2003 and has not proceeded beyond a draft that has not been implemented. 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 draft mitigation plan. In March 2005, LADWP informed the Water Department that limited grazing in some enclosures had resumed. The project is affected by a widely fluctuating water table, invasive

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					weeds, and irregular water deliveries. The Technical Group needs to develop a final mitigation plan for the area. In April 2015 herds of cattle were observed in the area eating what little vegetation was available.
Farmers Pond	EP 1970-1984 1991 EIR Impact No. 10-18	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought.	Water provided in fall of each year to offer increased habitat for migrating waterfowl; two miles north of Bishop.	Implemented and ongoing	Implemented and ongoing
Revegetation near Laws (160 acres)	Non-E/M Project 1991 EIR Impact No. 10-18	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought. EIR v1 (10-66)	Native plant revegetation. Mitigated Negative Declaration (MND) allows approx. 32 acres to be converted to flood irrigated pasture.	Incomplete	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. The mitigation project area has decreased in size due to the Laws Irrigation MND.
Laws Museum Pastures (21 and 15 acres)	E/M 1985-1990 1991 EIR Impact No. 10-18	Significant adverse vegetation decrease and change have occurred in the Laws area due to a combination of factors, including abandoned agriculture, groundwater pumping, water spreading in wet years, livestock grazing, and drought.	Enhance the museum grounds by irrigating pastures east and west of the museum. This project was revised in the Laws reirrigation MND.	Implemented and ongoing	Both museum pastures had a cover of weedy species in the recent past, but seem to be improving. The condition of project and irrigation system will be monitored. LADWP reports that the project was supplied 119 acre-feet of water in 2014-15

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					Inyo and LA will examine this project during the E/M Evaluation study underway
Laws area	1991 EIR Impact No. 10-18	Significant adverse vegetation decreases and changes have occurred in the Laws area due to a combination of factors, including abandoned agriculture, groundwater pumping, water spreading in wet years, livestock grazing, and drought.	Monitor and reduce groundwater pumping where suspected impacts have occurred. Mitigate according to the Agreement, if necessary.	Incomplete	County and LADWP are in disagreement over the need to operate the McNally canals to avoid impacts to vegetation. Monitoring of select vegetation parcels is ongoing.
Millpond Recreation Area	EP 1970-1984; E/M 1985-1990	Non-specific compensation.	Pay for electricity used to run a well to provide water to pond and wetland habitat.	Implemented and ongoing	Implemented and ongoing.
Buckley Ponds	EP 1970-1984 1991 EIR Impact No. 11-1	Non-specific compensation.	Provide habitat for warm-water fishery and waterfowl by maintaining a year-round pond.	Implemented and ongoing	Implemented and ongoing.
Bishop Area Revegetation Project (Bishop 97, 120 acres)	Non-E/M Project 1991 EIR Impact No. 10-16	Non-specific compensation.	Revegetate with non-groundwater dependent native vegetation.	In progress	In progress, but behind schedule. LADWP estimates that successful revegetation could take a decade or longer. Fencing to eliminate disturbance has been installed. The Mitigation Plan (MP) provided that test plots would be implemented if the

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					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. Another survey is planned for 2012. The MP provides that revegetation efforts would be expanded in 2009, five years after implementation of test plots. In 2011-12 drip irrigation was expanded and about 2,180 containerized plants were planted. The parcel was surveyed in 2012 and found to have attained a 4.8% native perennial cover.
Saunders Pond	EP 1970-1984	Non-specific compensation.	Provide wet habitat by maintaining operation of year-round pond.	Implemented and ongoing	Implemented and ongoing.
Klondike Lake	EP 1970-1984; E/M 1985-1990 1991 EIR Impact No. 11-1	Non-specific compensation.	Improve waterfowl habitat and provide recreation in the Big Pine area. The Big Pine Ditch MND (2004) reduced the water supply to 1,700 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. (First implemented 1987).	In progress .	Motorized recreation on the lake has been limited to prevent the introduction of the freshwater quagga mussel. LADWP reports runoff year 2014-15 water use was 1,600 acre-feet. Inyo and LA will examine this project during the E/M Evaluation study underway

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
Klondike South Shore Waterfowl Management Area (160 acres)	1991 EIR Impact No. 11-1 Addition to Klondike Lake project 2005	Compensation for the inability to supply water to the Klondike Lake Project.	When initiated, the Klondike Lake Project was expected to use 2,200 AF, but the project requires less than 1,500 AF. South Shore project was initiated to create waterfowl habitat just south of the lake with water that could not be delivered to Klondike Lake. Two hundred AF was allocated for this purpose.	In progress	The elevation between the Lake and the Project is minimal and sediment in the water conveyance limited flow to the project. A new water gate was installed and from the 2011-12 runoff year to present, a full 200 af allocation was supplied. With the use of the new water gate new habitat has been created and is being used by desired species; however the original project area receives little water and is almost completely tule chocked. A habitat management plan needs to be prepared for this project. It has been the practice of LADWP to release water to the project area during waterfowl migration season, usually beginning releases in late winter, but as of April 2013 water had not been supplied to the project.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
Big Pine Northeast Regreening (30 acres)	E/M 1985-1990 1991 EIR Impact No. 10-19	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Manage pumping in accordance with the Agreement and establish irrigated crop.	In progress	The Inyo County/ LADWP Technical Group approved an amended mitigation plan in the spring of 2010. Modifications include a change in water source. The Big Pine Canal will serve as a source of project water. Replacement water, (equal to or less than 150 AFY) will be supplied by Well 375. The new project scope allows sprinkler irrigation as well as flood irrigation. It is estimated that sprinklers will reduce the project's water use from 150 AFY to 90 AFY. In April 2012, a lawsuit seeking to declare the ND inadequate and asking that a full EIR be developed was presented. The Court found that the CEQA document was appropriate and the case was dismissed in 2013. The IC Water Commission toured this project and others in the Big Pine area in September 2013. The project area has been fenced, sprinkler irrigation installed. The project was supplied 103 acre-feet. Though initially weedy, desirable pasture species are becoming dominant.
Big Pine Ditch	Non-E/M	Non-specific compensation.	Establish/restore ditch system through	Implemented	This project was completed in the

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
System	Project 1991 EIR Impact No. 10-19		Big Pine.	and ongoing	summer of 2010, and provides water to 85% of Big Pine residents. The IC Water Commission toured this project and others in the Big Pine area in September 2013.
Big Pine Revegetation (East Big Pine) (20 acres)	E/M 1985-1990 1991 EIR Impact No. 10-19	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	This is an undefined potential enhancement/mitigation (E/M) project that will become a native plant site if permanent irrigation is infeasible Establish an irrigated crop while continuing the activity that caused the impact.	Incomplete and ongoing	Portion of parcel 160 to west of BP Canal. LADWP reports "The site was fenced in 2007 to eliminate disturbances and encourage natural revegetation. If this area does not revegetate naturally, it will be included with LADWP's ongoing revegetation efforts." The IC Water Commission was shown this project and others in the Big Pine area in September 2013. LADWP reports that they drill seeded 3.2 acres in February of 2014. The County is looking into the possibility of using reclaimed water supplied by the Big Pine Community Service District as a source of irrigation water for this project.
Revegetation near Big Pine (Big Pine 160) (160 acres)	Non-E/M Project	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Revegetate with non-groundwater dependent native species while continuing the activity that caused the impact.	Incomplete and ongoing	LADWP reports, "The site has been fenced. Permanent transects were run in 2006. In the spring of 2011 approximately 20 acres were drill seeded with locally collected seed." Transects run in August 2012 show 3% native perennial cover. LADWP reports that they drill seeded 28 acres in

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					February of 2014. The native seed was installed in time for a 1.35" rain event. The IC Water Commission saw this project and others in the Big Pine area in September 2013. The County is looking into the possibility of using reclaimed water supplied by the Big Pine Community Service District as a source of irrigation water for this project.
Steward Ranch	Non-E/M Project 1991 Owens Valley EIR Impact No. 9-14	Compensation for loss of well.	Compensation agreement with ranch owner.	Implemented and ongoing	Mitigation agreement is in place.
Fish Springs Hatchery	EP 1970-1984; Non-E/M Project 1991 Owens Valley EIR Impact No. 10-14	CDFG fish hatchery and the LORP serve as compensatory mitigation.	No on-site mitigation will be implemented at Fish Springs, however, the CDFG fish hatcheries at these locations serve as mitigation of a compensatory nature by producing fish that are stocked throughout Inyo County.	Implemented and Ongoing	Implemented
Tule Elk Field	EP 1970-1984	Non-specific compensation.	Provide water in summer to field used by tule elk between U.S. Highway 395 and Tinemaha Reservoir.	Implemented and ongoing	The water supply to this project has been reduced since 2002. ICWD does not agree the project allocation is sufficient in all years to meet project

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					goals.
Big and Little Seely	EP 1970-1984 1991 Owens Valley EIR Impact No. 10-14	Non-specific compensation.	Maintained by LADWP well adjacent to Owens River to provide year-round waterfowl and shorebird habitat larger than had existed at Seeley Spring Two miles south of Tinemaha Reservoir LADWP well number 349, discharges water into a pond approximately one acre in size. This pond provides a temporary resting place for waterfowl and shorebirds when the pumps are operating or Big Seely Spring is flowing. Riparian vegetation has become established around this pond. (eir v1, 10-62)	Implemented and ongoing	Implemented and ongoing.
Calvert Slough	EP 1970-1984	Non-specific compensation.	Water provided to maintain habitat for a small pond and marsh area near LADWP Aqueduct Intake.	Inactive	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).
Hines Spring (1,600 af project)	E/M 1985-1990; 1997 MOU; 204 and 2010	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland	The Hines Spring vent and its surroundings will receive on-site mitigation. Water will be supplied to the area from an existing, but unused,	In progress	The initial concept, to provide water at the spring vent, proved impractical. MOU Parties entered into an ad hoc process and agreed to build two

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	Stipulation and order. 1991 EIR Impact No. 10-11	vegetation is lost.	LADWP well at the site. As a result, approximately one to two acres will either have ponded water or riparian vegetation. Hines Spring will serve as a research project on how to re-establish a damaged aquatic habitat and surrounding marshland. Riparian trees and a selection of riparian herbaceous species will be planted on the banks. The area will be fenced. (EIR) v.1 10-62)		projects at the spring site; 1) water from Well 355 now supplies water to a small pond used by livestock. The solar power source designed to power Well 355 would be insufficient, so the project was modified to include a new above-ground power line to the project; 2) Aberdeen Ditch. A 2700' pipeline now supplies water to a ditch just to southeast of the former spring that will be used by livestock.
Taboose/Hines Spring – Blackrock Areas Revegetation Project (80 acres)	Non-E/M Project 1991 EIR Impact No. 10-11	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	Manage pumping and revegetate with native species. These lands will not be permanently irrigated, but will be revegetated with native Owens Valley vegetation not requiring irrigation except during initial establishment.	In progress	This mitigation measure consists of 3 sites that total approx. 115 acres. Hines Spring. A mitigation plan and schedule for will be developed by March 8, 2015; 3 years after the Hines Spring mitigation project had been completed. Tin 54 (0.3 acres) 108 alkali sacaton plants were planted in 1999. A drip irrigation system has been utilized. Blk 16E 7.2 acres. LADWP reports that based on 2010 transects the project has attained the cover and composition goals in the revegetation plan. The cover goal is 35%
Little Blackrock Springs	EP 1970-	Ground water pumping has lowered depth to water to a level where	LADWP will continue to supply water from Division Creek to the site of the	Implemented	An operations plan is needed. LADWP had reported that the Goodale Bypass

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	1984 1991 EIR Impact No. 10-14	springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	former pond at Little Blackrock Springs, to maintain marsh vegetation at this site will thus be maintained.	and ongoing	Ditch that supplies the project normally runs all year at less than 1 cfs, providing approx. 700 acre feet a year.
Big Blackrock Springs	Non-E/M Project 1991 EIR Impact No. 10-14	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	No on-site mitigation will be implemented at Big Blackrock Springs; however, the CDFG fish hatcheries at these locations serve as mitigation of a compensatory nature by producing fish that are stocked throughout Inyo County.	Implemented and ongoing ICWD calculates runoff year 2009-10 water use was 13,354 acre-feet	The fish hatchery is in place.
Thibaut/Sawmill marsh habitat	Non-E/M Project 1991 EIR Impact No. 10-20	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	The Blackrock Waterfowl component of the LORP will provide compensatory and some on-site mitigation. Vegetation impacts will be mitigated under the Agreement.	Implemented and ongoing	Implemented under the LORP.
Independence Pasture Lands (610 acres)	E/M 1985-1990 1991 EIR Impact No. 12-1	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Develop and irrigate pasture or alfalfa fields (first implemented 1987-1988).	Implemented and ongoing	Site topography prevents flood irrigation from reaching some portions of the project. LADWP reports runoff year 2014-15 water use was 1,932 af.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
Billy Lake	EP 1970-1984 1991 EIR Impact No. 11-1	Non-specific compensation.	Maintain wet habitat to provide waterfowl habitat in the region.	Implemented and ongoing	Included in the LORP. Billy lake is managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as an Off River Lake.
Independence East Side Regreening (30 acres)	E/M 1985-1990 1991 EIR Impact No. 12-1	Regreening projects implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the towns of Big Pine, Independence, and Lone Pine. Water is supplied from LADWP to promote and maintain vegetation.	Manage pumping and establish irrigated crop.	In Progress	The Technical Group evaluated and approved a new well at the site, and CEQA was completed. LADWP has drilled the new well and put out a request for proposals to identify a lessee. Pasture was established on the site in 2014. Initially weedy, desirable pasture is increasing in cover.
Independence Woodlot (21 acres)	E/M 1985-1990 1991 EIR Impact No. 10-13	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Create irrigated crop.	Implemented and ongoing	Lone Pine FFA is managing the project, with some wood going to Independence residents and other wood being sold in Lone Pine to support FFA activities. An operations plan is needed based on management guidelines agreed to by Inyo Co. and LADWP. The project was supplied 186 af water during 2014-15.
Independence Springfield (283 acres)	E/M 1985-1990 1991 EIR	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture	Manage pumping and establish native pasture or alfalfa (first implemented 1988).	Implemented and ongoing	40 acres were identified as still requiring mitigation. Water supply during runoff year 2014-15 was 1,427

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	Impact No. 12-1	lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.			acre-feet.
Additional regreening w/in Independence Springfield (40 acres)	E/M 1985-1990 1991 EIR Impact No. 12-1	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Revegetate with native pasture.	Not Implemented	LADWP in their 2014 annual report said they are "currently planning to irrigate an additional 40; however LADWP staff claim that, an internal review of the projects in the Independence area found that the Independence Springfield is approximately 300 acres in area and has an irrigation allotment of approximately 1,500 acre-feet per year, which meets the goals of the project."
Symmes/Shepherd wellfield revegetation (60 acres)	Non-E/M Project 1991 EIR Impact No. 10-13	Increased groundwater pumping from wells in the Symmes-Shepherd area has caused a substantial reduction of vegetation cover in approximately 60 acres in three areas immediately to the east of the pumping wells. The affected vegetation was previously supplied by shallow groundwater and surface seeps. EIR v1 (10-59)	A revegetation program will be implemented for these effected areas utilizing native vegetation of the type that that has died off. Water may be spread as necessary in these areas to accomplish the revegetation. EIR v1 (10-59)		Two of the four sites included in 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. LADWP in 2011 reports that goals have been attained. Ind 131, north and south. (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

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					revegetation studies, and reports on methods and results from this effort have not been made available. The schedule in the Mitigation Plan called for expanding revegetation efforts for Ind 123 and 131 in 2007. LADWP reports in 2011 that the north plot is not attaining goals. Transects will be run in 2012. The south plot was drilled with native seed in 2011. Transects will be run in 2012. 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 has attained prescribed cover and composition goals.
Shepherd Creek Alfalfa Field (200 Acre)	E/M 1985-1990 1991 EIR Impact No. 12-1	Dust mitigation	Manage pumping and establish irrigated crop on approx (first implemented 1986).	Implemented and ongoing	Alfalfa planted and maintained on approx. 185 acres. LADWP reports that water supply for runoff year 2014-15 was 980 af.
Expand Shepherd Creek Alfalfa (60 acres)	E/M 1985-1990 1991 EIR	Dust mitigation	Expand E/M project to east of Hwy 395 if vegetation cover in that area remains sparse.		The Technical Group does not have mitigation or monitoring plans for this mitigation measure. LADWP has

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	Impact No. 12-1				conducted vegetation transects and concluded that vegetation cover has increased from baseline and thus the mitigation is not necessary.
Reinhackle Spring	Non-E/M Project 1991 EIR Impact No. 16-11	Increased groundwater pumping has periodically reduced the flow from Reinhackle Spring. This spring is the source of water for a large pasture area and supports many large tree willows. EIR v1 (10-61)	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.	Under investigation	A 2004 study concluded that the water flowing from Reinhackle Spring is similar in composition to aqueduct water and not similar to the deep aquifer samples or up-gradient shallow aquifer wells. Testing to monitor the effect of pumping conducted May 2010 to April 2011. Data from these tests are being analyzed. A draft management plan is under consideration by the Technical Group.
Lone Pine Ponds	EP 1970-1984; E/M 1985-1990 1991 EIR Impact No. 11-1	Non-specific compensation.	Wildlife enhancement. Similar to Buckley Ponds and Saunders Pond; water provided by natural seep or spring flow in river with supplemental releases from Alabama Gates (now incorporated in lower Owens River E/M Project); north of Lone Pine Station.	Implemented and ongoing	Included in the LORP. The Lone Pine Ponds are managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as a component of the River-Riverine system.
Lone Pine East Side Regreening (11 acres)	E/M 1985-1990 1991 EIR	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town.	Create irrigated pasture.	Implemented and ongoing	Pasture appears to be receiving water and is in good condition. LADWP does not break out water use for this

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	Impact No. 10-16	Water is supplied from LADWP to promote and maintain vegetation.			project.
Lone Pine Woodlot (12 acres)	E/M 1985-1990 1991 EIR Impact No. 10-16	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Revegetate and provide irrigation.	Implemented and ongoing	Lone Pine FFA irrigates the woodlot and distributes wood according to plan developed by the Technical Group LADWP reports water use was 74 af for runoff year 2014-15. The project needs at least 100 af. Many of the trees, especially the black locust look to be in poor condition. The trees need thinning and new trees need to be planted on the west side of the parcel. In spring 2015, LADWP use a tractor to clear out weeds in the rows.
Richards Field (189 acres)	E/M 1985-1990 1991 EIR Impact No. 10-16	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Create irrigated pasture or alfalfa field (first implemented 1987).	Implemented and ongoing	This project had 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 water use for Richards Field and Lone Pine Park was 429 af for runoff year 2014-15.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
Van Norman Field (160 acres)	E/M 1985-1990 1991 EIR Impact No. 10-16	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Create irrigated pasture or alfalfa field.	Implemented and ongoing	LADWP reports water use was 79 acre-feet for runoff year 2013-14. The project is allocated 480 afy, but the parcel's irregular topography, and the sanding in of the on-site well, limits its ability to receive its full allocation. A replacement well was drilled in the fall of 2012 and began production in April 2014. The new well is located in a position that should allow the establishment of additional acres of pasture. In 2013, as part of an E/M evaluation, Inyo County and LADWP agreed to expand the project to include irrigating an adjacent 10 acre parcel operated as a school farm by Lone Pine High School. On April 29, 2014 the Standing Committee agreed to The Standing Committee agreed to: "Modify the Van Norman Field Enhancement/Mitigation (E/M) Project by adding approximately ten acres of the Lone Pine High School Farm to the Van Norman Field E/M Project. The total acreage of the modified Van Norman Field E/M Project will be approximately 170 acres. The approximately ten additional acres will be irrigated pasture. The total annual water supply

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
					for the project will remain at 480 acre-feet per year, which will result in an annual water distribution within the project boundaries of approximately 2.8 acre-feet per acre.” The parcel, including the LP school farm, was supplied 343 af in 2014-15
Lone Pine West Side Regreening (7 acres)	E/M 1985-1990 1991 EIR Impact No. 10-16	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Create irrigated pasture.	Implemented and ongoing	Pasture looks to be in good condition. LADWP reports water use was 233 af for runoff year 2014-15.
Diaz Lake	EP 1970-1984	Non-specific compensation.	Provide supplemental water to recreation area and create wet habitat.	Implemented and ongoing	Under the Additional Mitigation project description, Diaz Lake will be supplied a secure source of water, which reduces dependence on water pumped by Inyo County up to 250 afy. LADWP’s lease with Inyo County (Lease No. 1494, in effect until June 30, 2015) has been updated to reflect these additional water supply commitments and accounting requirements of this project agreed to by LADWP.
Lower Owens Rewatering Project	E/M 1985-1990 1991 EIR Impact No.	The Lower Owens Rewatering Project was initiated in 1986 by the LADWP and Inyo County to improve habitat for shorebirds, waterfowl, and fish in	Re-water the Owens River to create wet habitat for wildlife. Project includes off-river lakes and ponds. Under the project, 18,000 acre-feet of	Replaced	Superseded by the LORP. Billy lake is managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as an Off River Lake.

Project	Mitigation Origin	Impact	Prescription	Development Stage	Status
	10-14	the river corridor and at the Delta. The project was one of 25 Enhancement/Mitigation Projects jointly implemented between 1985 and 1990.	water per year were to be released from the Blackrock Spillgate to maintain continuous flow in the Lower Owens River from the Blackrock area to the Owens River Delta (first implemented, step 1, 1986).		
Lower Owens River Project	1991 DEIR; MOU 1997 1991 EIR Impact No. 10-14	The LORP is a in-kind compensatory mitigation for impacts related to LADWP's groundwater pumping that are difficult to quantify or mitigate directly such as the drying up of springs, seeps and loss of wetlands.	The Lower Owens River Project settles more than 24 years of litigation between the Department and Inyo County over groundwater pumping and water exports. The project is intended to mitigate for a host of lost environmental values in the reach of the Owens River from the Los Angeles Aqueduct Intake to Owens Lake, and associated springs and seeps and off-river lakes and ponds. 64 miles of the Owens River channel will be rewatered. The project includes the Delta Habitat Area, Off-river Lakes and Ponds, and a 1500 acre Blackrock Waterfowl Management Area	Implemented and ongoing	Project implemented. In December 2006, when a 40 cfs baseflow was established. A permanent base flow of 40 cfs was established on February, 20, 2007. In February 2008, Los Angeles initiated the first seasonal habitat flow. Adaptive management requires ongoing monitoring, which is described in the Monitoring, Adaptive Management, and Reporting Plan. Additional information about the status of the LORP can be found at www.inyowater.org.
Meadow/riparian vegetation dependent on agricultural tailwater	1991 EIR Impact No. 10-14	Decrease in irrigated land resulted in reduction or withdrawal of tailwater and associated loss of dependent vegetation.	LORP serves as compensatory mitigation.	Replaced	LORP serves as compensatory mitigation.

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Salt Cedar Control Program	1991 EIR Impact No. 10-6	Between 1970 and 1990, LADWP continued to spread surplus water in wet years in the spreading areas created by the dikes east of Independence between the aqueduct and the river. This activity increased soil moisture and water table, but also fostered conditions favorable to the spread of salt cedar, which was established prior to 1970. (91 EIR)	Implement salt cedar control program in accordance with the Agreement.	Ongoing implemented	The program also monitors and maintains cleared areas. The current program is focused on clearing saltcedar thickets in water spreading basin adjacent to the Lower Owens River and burning slash. In 2014-15, workers cut 100 acres, burned about 50 slash piles, and treated 106 miles of Owens River bank and floodplain.
Irrigated fields, including Cartago and Olancha	1991 EIR Impact No. 10-16	Decrease in irrigated land resulted in reduction or withdrawal of tailwater and associated loss of dependant vegetation.	Continue irrigation practices since 1981-82 and thereafter.		Ongoing. Irrigated lands are not directly monitored; lessees are relied upon to indicate if there are changes in water for irrigation.
Fish Springs, Big and Little Seely, and Big and Little Blackrock	1991 EIR Impact No. 10-14	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	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 developed an inventory of springs and seeps. According to the MOU, the inventory should provide baseline data adequate for monitoring change.

[1] DEIR, V1 (p. 5-19)

[2] DEIR, V1 (p. 5-20)

[3] Last status report Oct 2008

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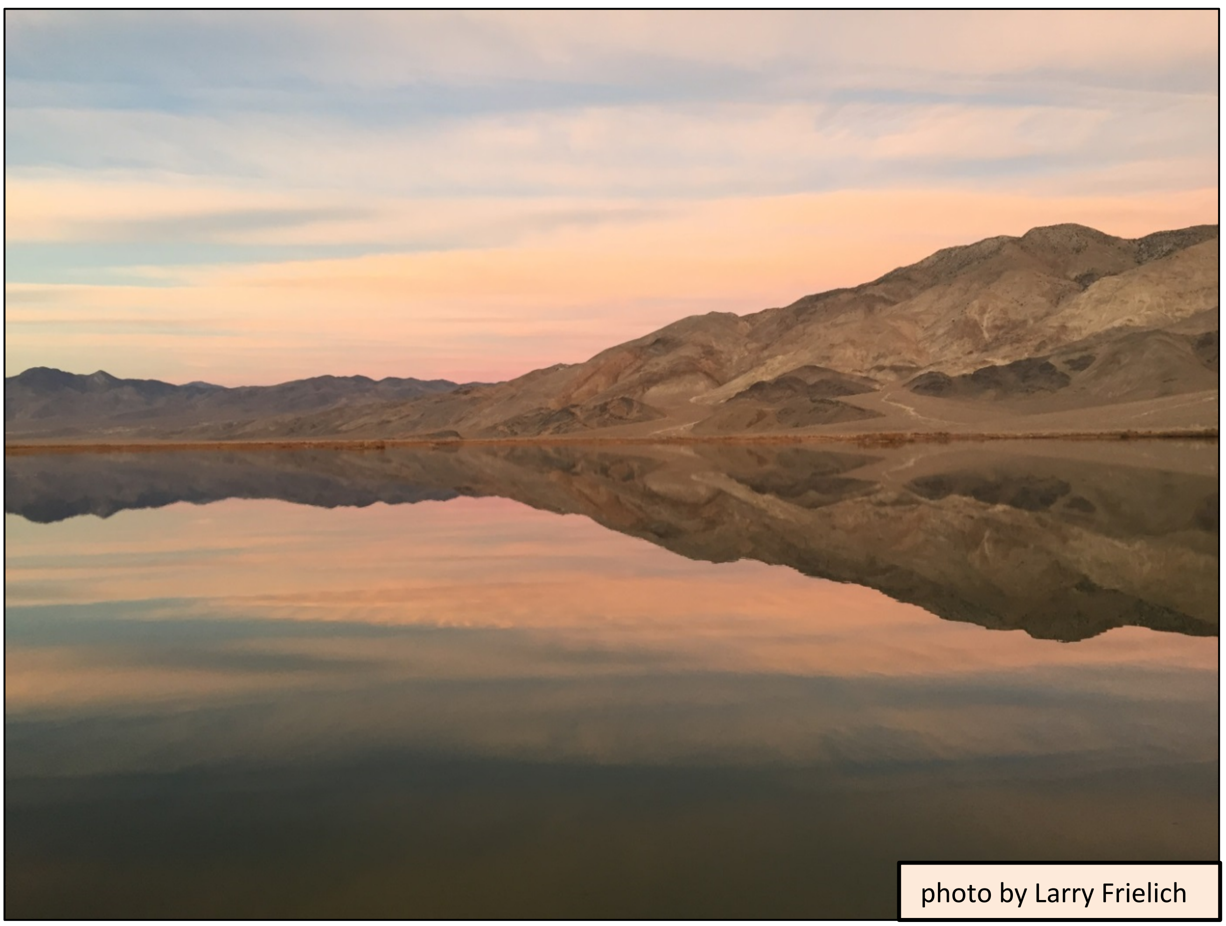

photo by Larry Frielich