Well W247 Replacement in Laws Wellfield

Pre-Construction Evaluation Report

Eastern Sierra Environmental Group

Water Operations Division

Los Angeles Department of Water and Power

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1. PURPOSE

The City of Los Angeles, Department of Water and Power (LADWP) is planning to drill and construct a well to replace the existing Well W247 located in Laws Wellfield, primarily to supply water to irrigate a pasture area west of Highway 6. The purpose of this report is to satisfy the requirements of Section IV.B of the Greenbook (the Technical Appendix to the Water Agreement), Guidelines for Drilling and Activating New Production Wells.

2. BACKGROUND

2.1 Introduction

LADWP plans to replace production well W247 in Laws Wellfield using the current industry standards for well construction and improve LADWP's operational flexibility in managing water resources in Owens Valley. The purpose of this report is to satisfy the requirements of Section IV.B. of the Greenbook, Guidelines for Drilling and Activating New Production Wells. According to Section VI of the Water Agreement, g "LADWP may replace existing wells and construct new wells in areas where hydrogeologic conditions are favorable".

Well W247 was constructed in 1928 to a depth of 495 feet below ground surface (bgs) to supply water for in-valley uses and the Los Angeles Aqueduct. The well casing is slotted from 28' to 470' bgs. According to the 1991 EIR, the capacity of W247 is 5.3 cfs, which has remained about the same as of recent operation in the summer of 2020. In recent years, W247 has been used primarily to supply water to the McNally Pasture

Enhancement/Mitigation Project in the summer months if the vegetation monitoring Site L1 is in ON status. When monitoring site L1 is in OFF status and Lower McNally Canal is not operating, there is no water source for the McNally Pasture Project.

2.2 Location

Laws Wellfield is located in the northern Owens Valley and is north and east of the city of Bishop. The main hydrologic features in the Laws area are Fish Slough and the McNally Canals, the latter of which supplies water from Owens River to LADWP irrigated leases and spreading areas and can convey pumped groundwater to Owens River. Figure 1 shows the location of the original W247 and the proposed location of the replacement well W247R. Similar to the existing W247, the replacement well will discharge water to the Lower McNally Canal.

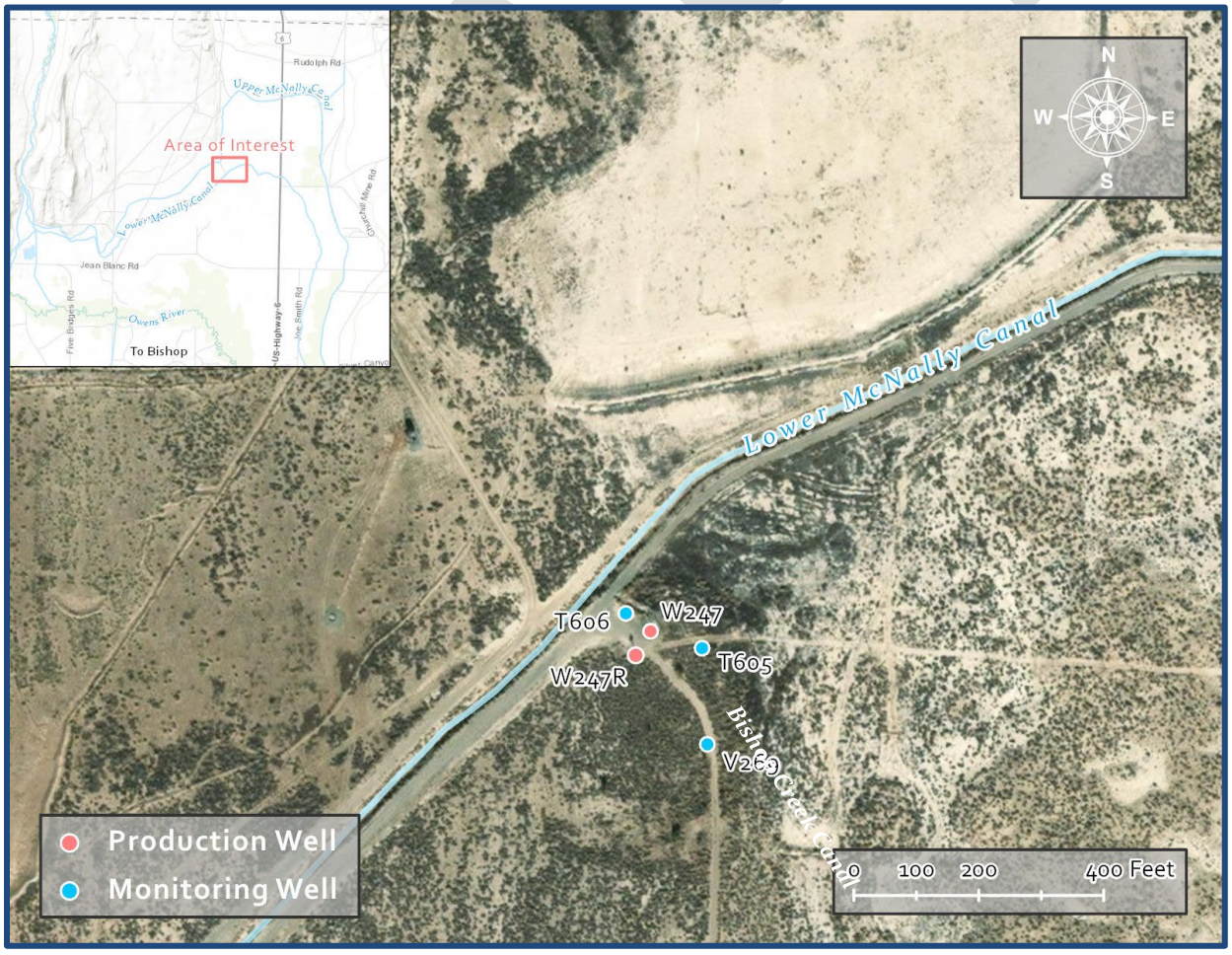

Figure 1 – Locations of existing well W247 and replacement W247R in Laws Wellfield

3. HYDROGEOLOGIC CONDITIONS

3.1 Geology

The conceptual geological framework of the Owens Valley is presented in a 1991 U.S. Geological Survey (USGS) report (Hollett, et. al., 1991). Owens Valley is a structural graben filled by debris eroded from the White and Inyo Mountains to the east and the Sierra Nevada mountain range to the west. Laws Wellfield is located at the base of the Eastern Sierra Nevada mountains, within the Volcanic Tablelands, and north and east of Bishop Wellfield. The lithology of the sediments underlying Laws Wellfield is a combination of alluvial deposits originating from the Eastern Sierra Nevada, volcanic eruptions that resulted in the Bishop Tuff formation, and fluvial/lacustrine deposits stemming from the ancestral Owens River and associated lake environment in the Bishop Basin.

3.2 Hydrology

3.2.1 Groundwater

Groundwater in Laws Wellfield resides mostly in the alluvial and valley fill that consists of debris flows and fluvial material originating from mountain canyons. Groundwater in Laws Wellfield flows generally in the southerly direction from the recharge areas north, east, and mainly west of the wellfield. The McNally Canals are a primary source of recharge for Laws Wellfield. Overall, this wellfield receives low recharge (median of 11,000 AF over the last two decades) compared with other wellfields because of its distance from the Sierra mountain front, except when the McNally Canals are operated in wet and very wet years.

A review of the driller's logs for existing wells in Laws Wellfield and previous studies indicates the existence of shallow and deep aquifer zones separated by lower permeability materials. MWH (2005) summarized several stratigraphic trends as listed below:

- Volcanic tuff tends to thin toward the south and east.

- Relatively thick clay units appear to underlie the central portion of Laws Wellfield between approximately 3,200 and 3,600 feet above mean sea level (amsl)
- Above 3,600 feet amsl, sand and gravel deposits are predominant with interbeds of lenticular clay layers.
- Clay deposits tend to be thickest in the lowest-lying areas. These low-lying areas may be related to the presence of alkaline lakes as hypothesized by Hollett et. al. (1991).
- The Volcanic Tablelands to the north of Laws Wellfield consist mainly of the welded tuff member of Bishop Tuff. Gilbert (1938) describes Bishop Tuff as pumice and welded ash that originated from the Long Valley Caldera eruption.

Hydrogeologic characteristics of the area's aquifers were estimated in previous studies using data from pumping tests conducted on existing wells. The calculated transmissivities ranged from 1,200 to 120,000 ft^2/day. Lower transmissivities are found in lacustrine deposits near the valley center (MWH, 2005). Hollett et. al, (1991) estimated that vertical hydraulic conductivity of the confining clays in the valley ranges from 0.002 to 0.00083 ft/day. Storage coefficients (storativity) derived from Laws and Bishop area aquifer pumping tests range from 2.6×10^{-12} (which is an outlier, the next lowest value at a different well is 7.3×10^{-5}) to 0.24 [dimensionless].

Currently, LADWP has 15 production wells in Laws Wellfield. Table 1 lists the total annual pumping volume from five wells in the vicinity of W247 since the 1971 runoff year (ROY). Annual pumping volume from all 15 production wells and wells that have been replaced since the 1971 ROY are presented in Table A of the Appendix. As shown in Table 1, total groundwater pumping in Laws Wellfield has ranged generally between 1 and 10 thousand acre-feet per year since 1991, the start of the Water Agreement. In addition to LADWP wells shown in Figure 2, there are several relatively shallow private and community domestic supply wells in Laws Wellfield, but none in the vicinity of W247. In recent years, LADWP has replaced well W365 with well W424 and well W243 with well W426. Well W426 is not pump-equipped yet.

Figure 2 – Production wells in Laws Wellfield

Table 1 – Groundwater pumping from wells in the vicinity of W247, west of Hwy 6 and total Laws Wellfield Pumping (AF/year)

Runoff Year	W246	W247	W248	W249	W398	Total Wellfield
1971	1,219	560	1,855	1,124		
1972	2,086	2,901	3,183	3,033		
1973	1,061	1,644	1,516	1,619		
1974	0	0	0	0		4,990
1975	1	125	99	83		11,202
1976	0	0	0	0		16,285
1977	5	1	1	3		15,038
1978	0	0	0	0		945
1979	682	1,609	1,220	1,116		17,933
1980	0	10	0	0		1,251
1981	1,467	3,169	2,680	2,382		25,313
1982	21	48	45	41		1,388
1983	0	2	0	0		1,113
1984	0	0	0	128		7,403
1985	364	947	710	852		17,369
1986	372	1,455	731	654		8,600
1987	1,742	3,009	3,422	3,012		38,241
1988	1,639	3,262	2,962	2,611		38,841
1989	1,288	3,062	2,604	2,521		34,757
1990	0	578	2	0		16,929
1991	0	385	0	1		10,940
1992		359	0	0	0	10,560
1993		1,760	1,585	1,334	0	12,560
1994		1,818	1,675	1,368	1,008	16,410
1995		581	1,638	1,282	136	8,244
1996		535	799	0	0	11,187
1997		538	0	0	0	2,951
1998		426	0	0	0	483
1999		382	0	0	0	1,674
2000		318	0	0	0	3,975
2001		438	0	0	0	2,298
2002		404	0	0	0	4,395
2003		329	0	0	0	5,245
2004		281	0	0	0	7,202
2005		464	0	0	0	3,909
2006		0	513	736	0	4,507
2007		451	0	0	0	6,288
2008		787	0	0	0	7,883
2009		745	0	0	0	6,226
2010		0	0	0	0	6,431
2011		0	0	0	0	10,158
2012		0	0	0	0	6,616
2013		0	0	0	0	6,108
2014		0	0	0	0	6,292
2015		0	0	0	0	5,742
2016		0	0	0	0	6,017
2017		0	0	0	0	2,283
2018		953	980	1,030	0	12,184
2019		0	233	1,241	0	5,878
2020		942	19	1,077	0	9,650
1991-2020 Average	Offline	430	248	269	41	6,810

Gray cell indicates well was either offline or not yet constructed

3.2.2 Surface Water

The main water features in Laws Wellfield include Owens River, McNally Canals, and Fish Slough, which recharge the groundwater aquifer. Owens River, which flows from northwest to the southeast of the wellfield, is considered the southern and the western boundary of the wellfield. The weather station at LADWP's Bishop Yard is the closest station to Laws Wellfield with long-term average precipitation (from 1971 to 2020 ROYs) of 6.0 inches per year, slightly higher than the average precipitation of 5.8 inches per year in Owens Valley.

Table 2 lists the major surface water flow gauges and their associated flows in Laws Wellfield. The locations of the flow gauges are presented in Figure 3. In general, Laws Wellfield receives a low volume of recharge water in its creeks and ditches. It should be noted that LADWP operates McNally Canals based on operational needs and typically in wet and very wet years to spread water in Laws Wellfield.

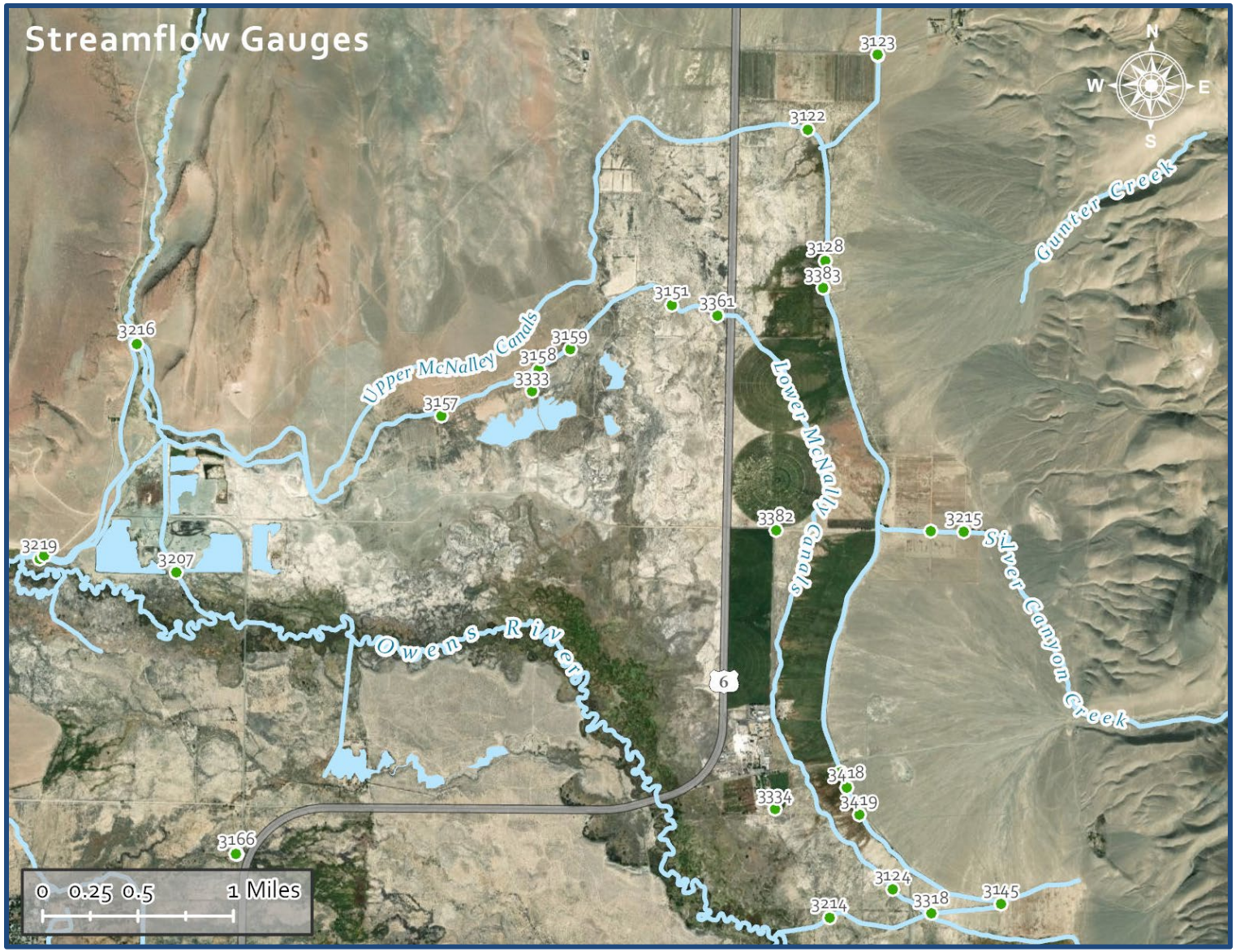

Figure 3 – Streamflow gauges in Laws Wellfield (3211 is upstream Silver Canyon Ck.)

Table 2 – Flow measurements in main Laws area measuring stations

Station ID	Station Name	Volume [AF/year] 1991-2020 ROY Average
3207	Fish Slough *At Owens River*	3,372
3216	Fish Slough *At L.A. Station #2*	3,863
3124	Lower McNally Canal *Return #5*	1,115
3157	Lower McNally Canal *Div. #5*	378
3158	Lower McNally Canal *Div. #7*	376
3159	Lower McNally Canal *Div. #8*	462
3151	Lower McNally Canal *Div. #12*	477
3219	Lower McNally Canal *At O.V.P.A. Station*	3,347
3361	Lower McNally Canal *Div. #13*	36
3122	Upper McNally Canal *Above W245*	2,739
3149	Upper McNally Canal *Div. #9*	60
3218	Upper McNally Canal *At O.V.P.A. Station*	4,688
3418	Upper McNally Canal *Div. #9A*	784
3419	Upper McNally Canal *Div. #9B*	533
3123	Coldwater Canyon Creek *Sprinkler Diversion*	147
3212	Coldwater Canyon Creek At End of Pipeline	392
3130	Silver Canyon Creek *Revegetation Pump Plant*	211
3211	Silver Canyon Creek *At Base of Mountains Station #2*	999
3215	Silver Canyon Creek Above W365	409
3383	W245 *Irrigation Div. E&M*	39
3128	W387 *Irrigation Div. E&M*	73
3145	Laws Ditch *Below Upper McNally Canal*	2,119
3318	Laws Ditch *Div. to Lower McNally Canal*	960
3382	Laws Pilot System	1,297
3430	Laws Pilot 94 & 95	40

4 ENVIRONMENTAL RESOURCES

4.1 Vegetation in the Vicinity of the Replacement Well

Vegetation parcels in the Laws area were inventoried from 1987 and later classified according to the Water Agreement based on water use with designations of Type A to Type E. Vegetation parcels in the vicinity of W247 are presented in Figure 4. According to the Green Book, Section II.A.2, “parcel boundary lines were transferred to orthophoto quadrangles at 1:24,000 scale. The final maps overlay the USGS 7.5-minute quads.”

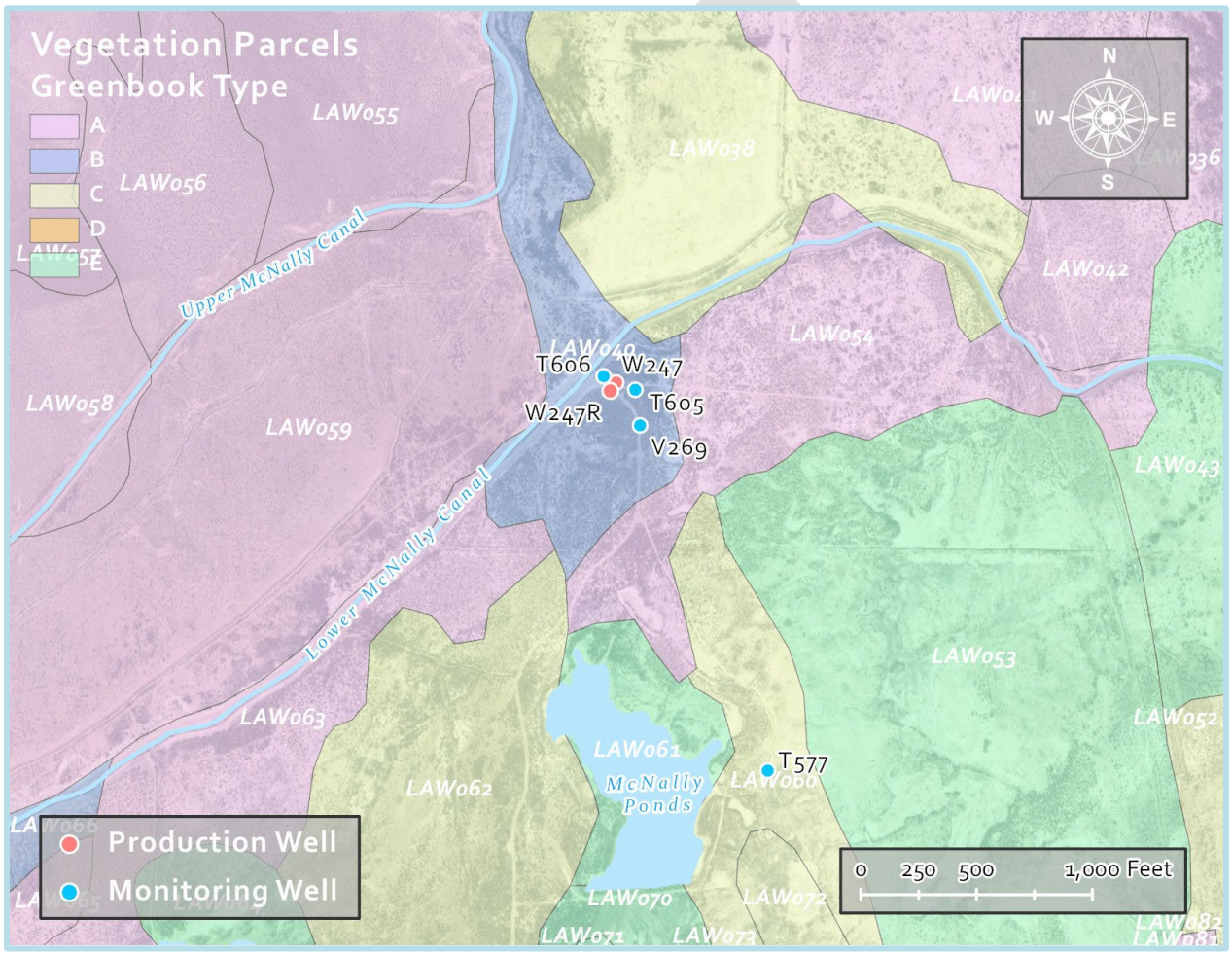

Figure 4 – Vegetation parcel in Laws Wellfield in the vicinity of W247

4.2 Springs, Seeps, Flowing Wells

Although parts of the deep semi-confined aquifer are under artesian head, there are no flowing wells in Laws Wellfield. A number of flowing wells exist adjacent to Owens River but because they are located just west of Owens River, they are considered in Bishop Wellfield.

5. CONSTRUCTION AND TESTING

5.1 New Well Design

An exploratory borehole for W247R will be drilled to approximately 700 feet bgs. The total depth and screen length of the replacement wells will be determined using lithologic and geophysical logs. The preliminary design of W247R with a screen interval of 350 to 700 feet bgs is shown in Figure 5. This screen depth ensures that W247R will draw water mainly from the deep aquifer. The replacement well will be equipped with an 18-inch diameter casing and screen using High Strength/Low Alloy material.

Current industry standards for well drilling and design are incorporated in plans for the installation of the well. These plans include using a mud rotary method for drilling and using a pre-fabricated casing and screen, along with placing a properly sized filter pack in the annular space between the screen and borehole wall. The appropriate screen slot size will be determined considering the soil samples from the zone where the well screen will be installed. The annular space between the casing and borehole, above the filter pack to the ground surface will be filled with cement seal to ensure that groundwater is protected from potential surface contamination.

The initial pumping capacity of W247R is expected to be approximately 4.0 - 5.0 cfs. Analysis of the data from the 24-hour pumping test will be used to determine the actual pumping capacity of this well. It is also understood that the pumping capacity of W247R will decrease over time.

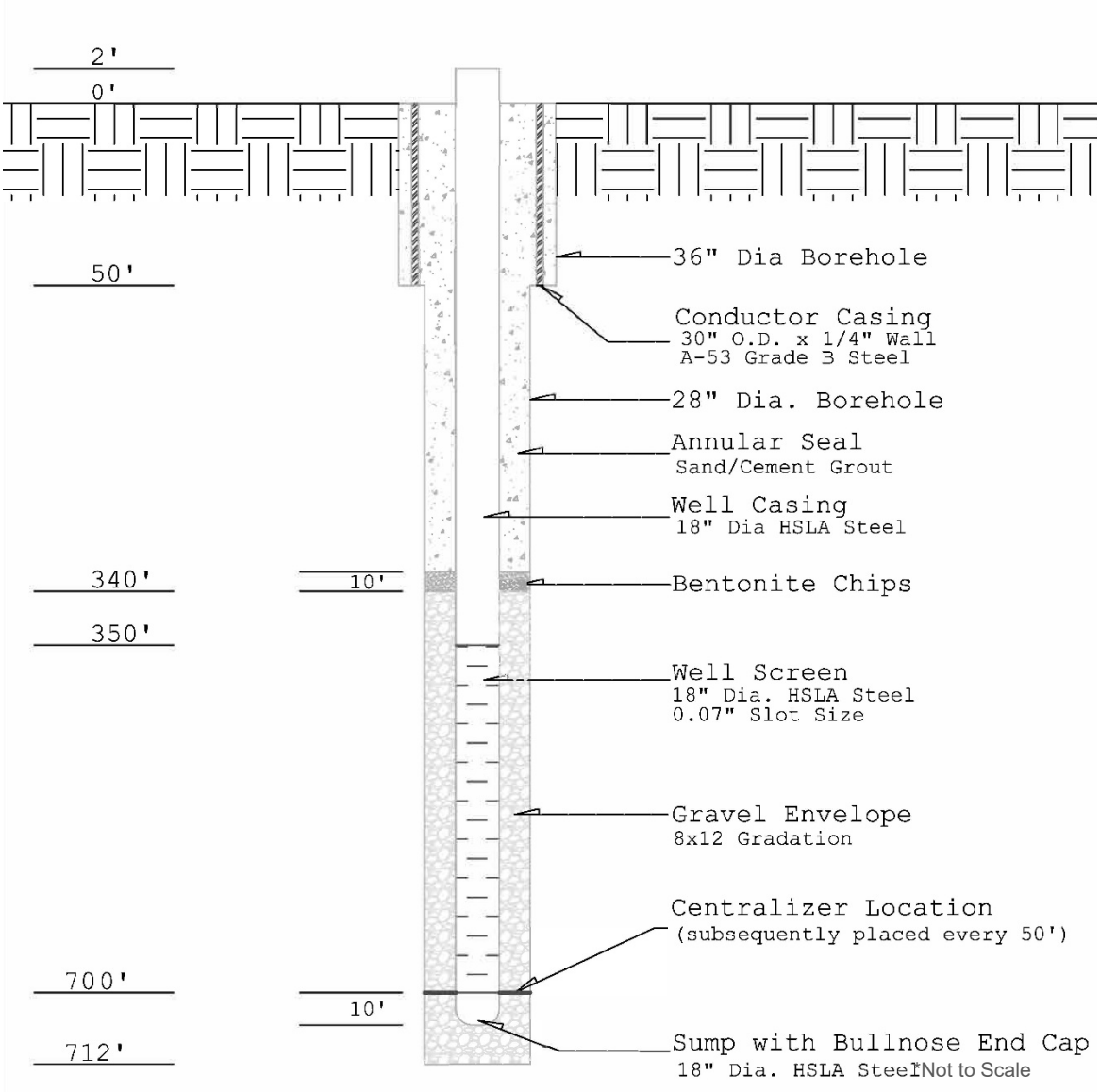

Figure 5 – Preliminary design for W247R in Laws Wellfield

5.2 Aquifer Test

Following the installation of W247R, the contractor will perform a step-drawdown test with up to four steps of increasing pumping rates and a 24-hour constant rate pumping test while collecting groundwater level data from the pumping well and nearby shallow and deep monitoring wells. Data from the pumping tests will be used to estimate aquifer characteristics in the vicinity of this location. Monitoring data will also be used to estimate the pumping capacity of the replacement well. However, similar to any other pumping wells, the pumping capacity of W247R is expected to reduce over time.

6 POTENTIAL IMPACTS ON GROUNDWATER-DEPENDENT RESOURCES

6.1 Well Operation Simulations

A groundwater flow model developed for the Bishop/Laws Wellfields by MWH Americas, Inc., was utilized to estimate the effect of operating the proposed replacement well W247R on the shallow aquifer groundwater levels. This MODFLOW-based groundwater model includes three layers, simulating the shallow, intermediate, and deep aquifer with a uniform cell size of 500 feet by 500 feet. The original well W247 is primarily slotted in the shallow, intermediate, and deep aquifer zones (layers 1, 2, and 3). Replacement well W247R is planned to be primarily screened in the deep aquifer zone (layer 3).

When operable and vegetation monitoring Site LA1 is in ON status according to the Green Book procedure, LADWP operates W247 as needed to supply water for the Laws area uses and for aqueduct supply. According to the 1991 EIR, the well had an operational capacity of 5.3 cfs, which still holds generally true as of the summer of 2020. Therefore, to determine the relative effect of pumping W247 compared with that of W247R, the simulated drawdowns resulting from pumping the existing W247 at an average rate of 5.3 cfs and the replacement well W247R at an average rate of 5.3 cfs were compared for one year of operation.

The resulting one-year pumping simulation drawdown contours of groundwater levels in the shallow aquifer are presented in Figures 6 to 8. Based on the contour maps, it is evident that pumping W247R results in significantly less drawdown in shallow aquifer groundwater levels than that of W247. The drawdown simulation for W247R resulted in about 8 feet or less of drawdown, whereas the simulation for the original W247 resulted in about 28 feet in the shallow aquifer zone in the vicinity of the well site.

*Figure 6 – Drawdown contours of groundwater levels in the shallow aquifer from pumping original **W247** at 5.3 cfs for one year*

*Figure 7 – Drawdown contours of groundwater levels in the shallow aquifer from pumping replacement well **W247R** at 5.3 cfs for one year*

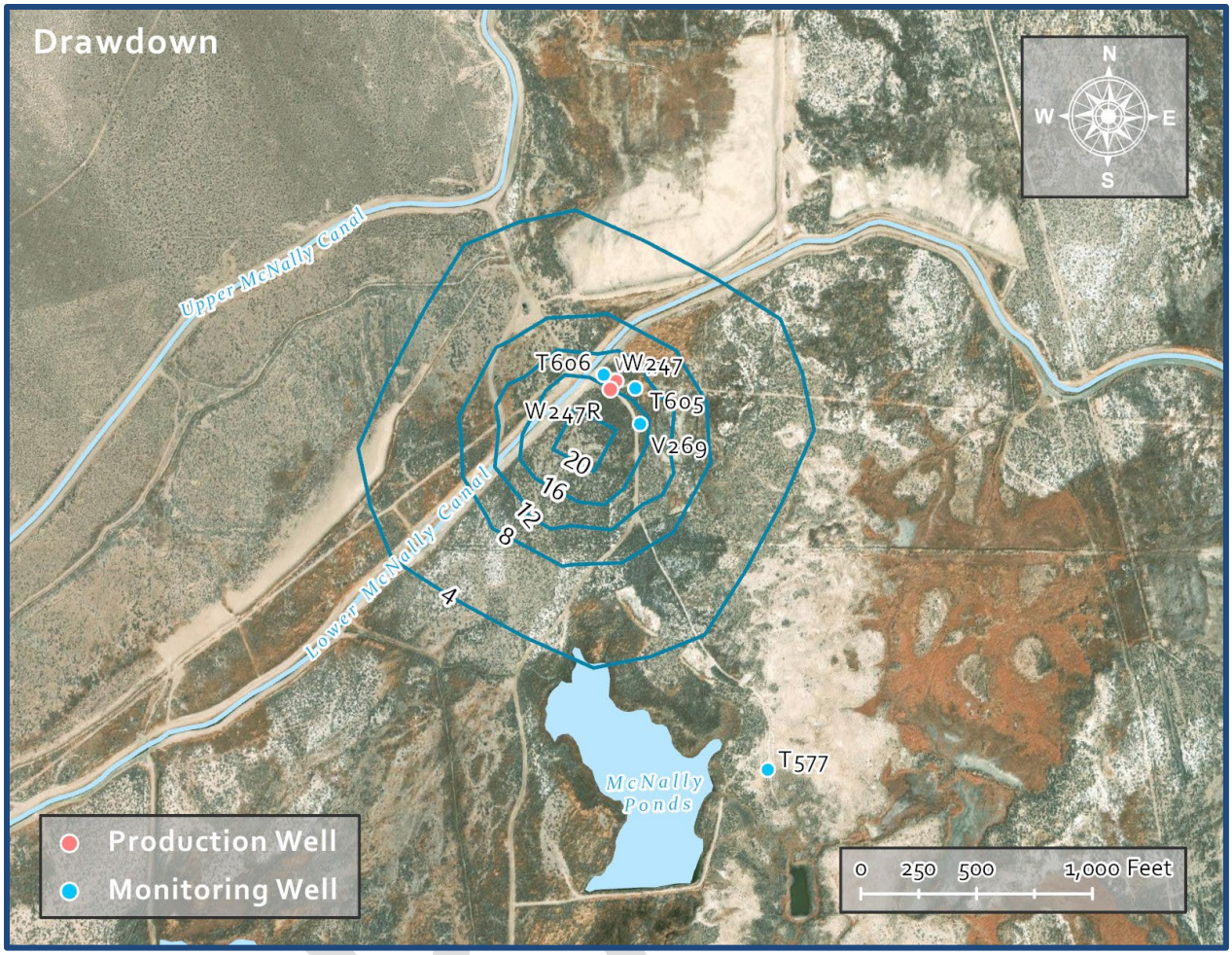

Figure 8 – Difference in shallow aquifer groundwater levels when operating W247 and W247R for one year, indicating less drawdown by W247R

Once W247R is drilled and data from the 24-hour pumping test are analyzed, the calculated aquifer characteristics from the tests will be used to update and re-calibrate the Bishop/Laws groundwater model in the area near W247R. This updated model should yield an improved understanding of aquifer characteristics and produce a more realistic effect of pumping on groundwater levels in the shallow aquifer.

6.2 Potential Effects on Vegetation

The contours of drawdown were superimposed on the Bishop area vegetation parcel map and are presented in Figures 9 to 11 for the one-year pumping scenario.

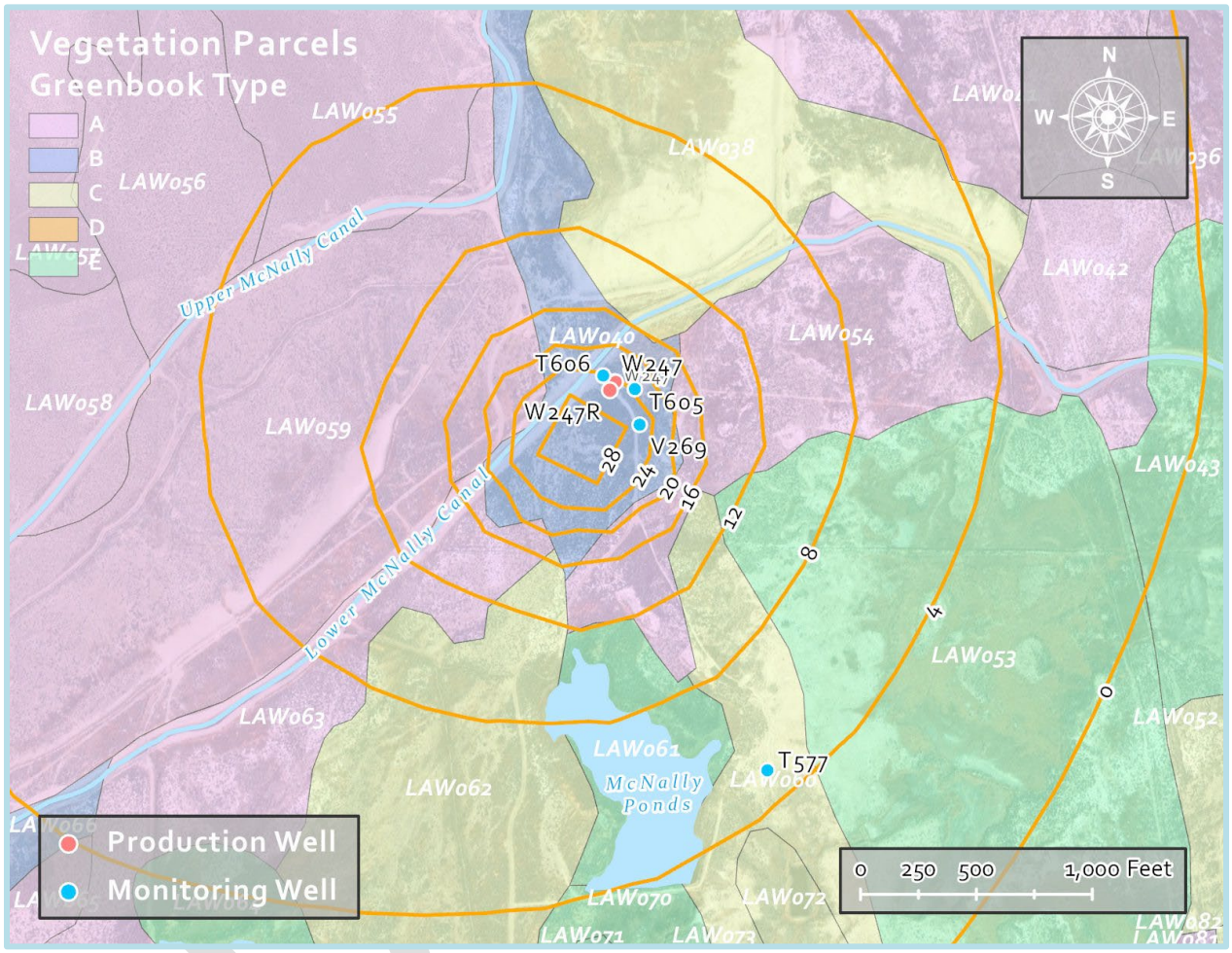

*Figure 9 – Vegetation parcels and drawdown contours in the shallow aquifer from pumping original **W247** at 5.3 cfs for one year*

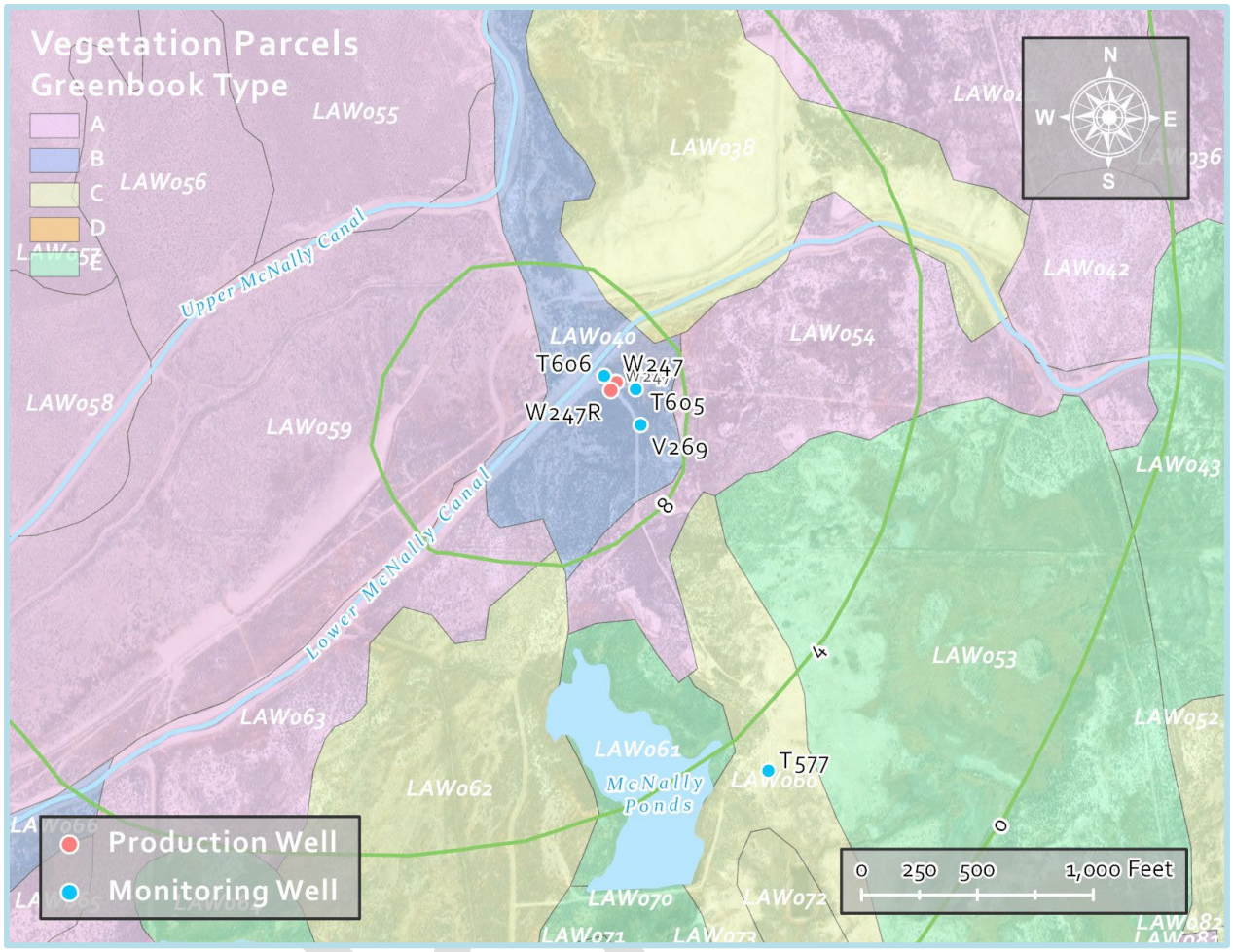

*Figure 10 – Vegetation parcels and drawdown contours in the shallow aquifer from pumping **W247R** at 5.3 cfs for one year*

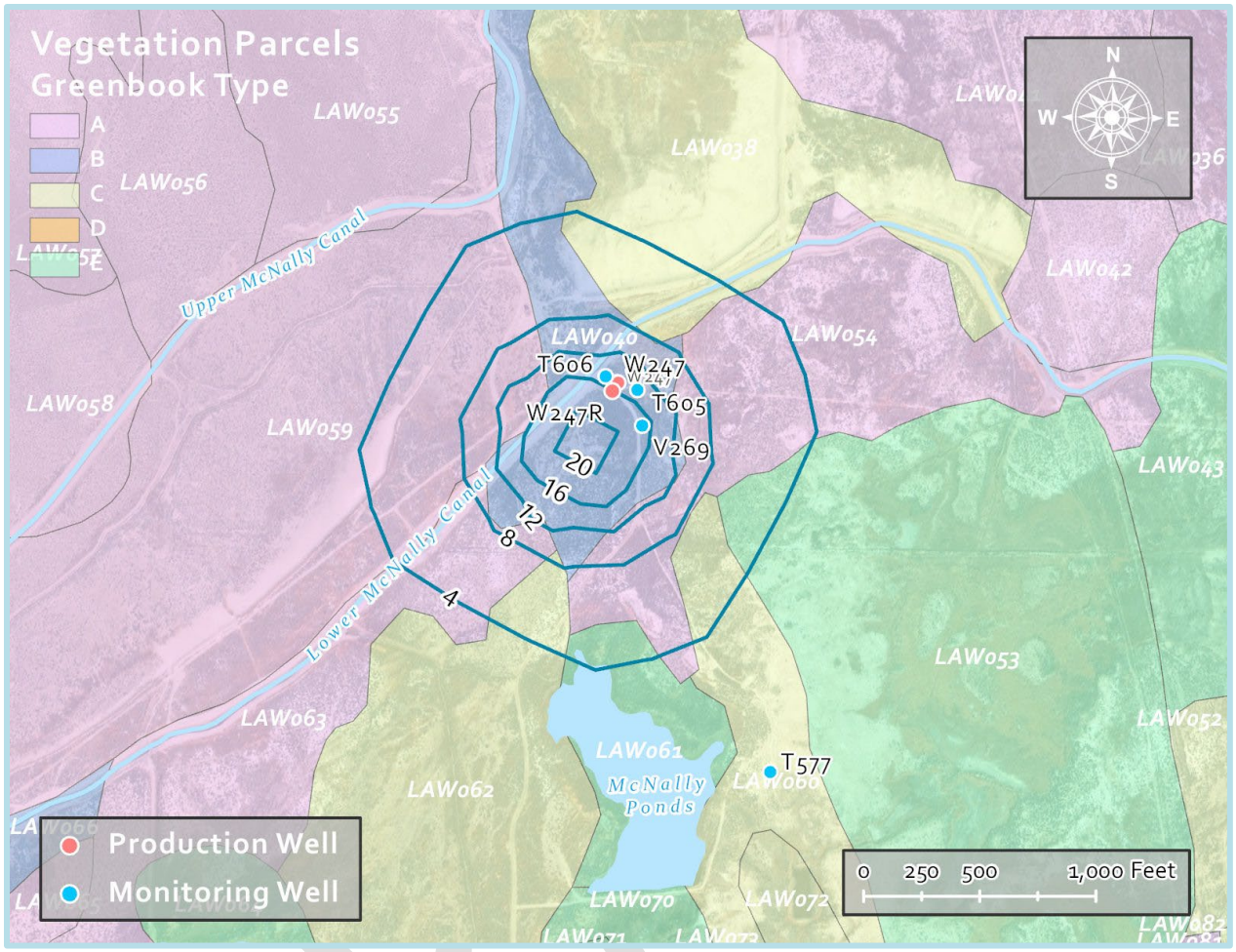

Figure 11 – Vegetation parcels and contours of the difference in shallow aquifer groundwater levels between the one-year pumping simulations of W247 and W247R, indicating less drawdown by W247R

7. OPERATION

Using the results of the analysis of the data collected during the pumping tests and the calculated pumping capacity, pump equipment will be designed and installed in the well. Operation of W247R is subject to the ON/OFF protocols of the Water Agreement as described in Section 2.1 of this report. The operation of W247 is controlled by the vegetation monitoring site L1. As a sole source of water for the McNally Pasture E/M Project, the Inyo/ LA Technical Group may exempt W247 only for supplying water to the McNally Pasture project.

According to the Water Agreement, the Technical Group is responsible for developing and implementing a monitoring plan during the initial operation. The monitoring plan will include both hydrologic and vegetation monitoring. The goal of the initial operation is to determine the potential long-term impacts of operating the well.

After the completion of the initial operation phase of W247R, the regular operation of this well will be included in LADWP's annual operation plan for Owens Valley.

8. ENVIRONMENTAL ASSESSMENT

Well W247R will replace an existing infrastructure and will be located adjacent to the existing well. The well will pump from the deeper aquifer and pumped water will be used for the same purposes as the well it is replacing. Computer simulations show that the operation of the replacement well will have less effect on the groundwater levels in the shallow aquifer that support vegetation than the existing well. Therefore, no further impact to nearby vegetation is expected from the operation of the replacement well. Additional assessment will not be conducted for the replacement well W247R and LADWP plans to prepare a Notice of Exemption under the California Environmental Quality Act with Inyo County Recorder's Office.

9. REFERENCES

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Los Angeles Department of Water and Power and County of Inyo, Water from the Owens Valley to Supply the Second Los Angeles Aqueduct, Draft Environmental Impact Report, Vol. 1, SCH #89080705, September 1990. Final EIR 1991.

MWH Americas, Inc., Bishop Local Management Model - Technical Memorandum 2-2, 2005.

Appendix Table A – Groundwater pumping from LADWP wells in Laws Wellfield (AF/year)

Runoff Year	W236	W239	W240	W241	W242	W243	W244	W245	W246	W247	W248	W249	W365	W385	W386	W398	W399	Total
1971	1,506	908	1,213	925	1,194	463	1,166	1,272	1,219	560	1,855	1,124						13,405
1972	2,802	2,325	2,277	1,668	793	1,810	2,111	2,156	2,086	2,901	3,183	3,033						27,145
1973	1,762	1,487	626	483	551	989	1,349	1,532	1,061	1,644	1,516	1,619						14,619
1974	680	379	80	413	482	548	499	636	0	0	0	0						3,717
1975	1,322	1,060	1,217	1,365	1,082	1,337	415	1,946	1	125	99	83						10,052
1976	2,688	2,439	2,262	1,550	683	1,521	1,868	2,297	0	0	0	0						15,308
1977	2,312	2,008	1,582	1,204	840	1,946	2,001	1,804	5	1	1	3	1,311					15,018
1978	0	0	0	0	0	0	0	0	0	0	0	0	907					907
1979	1,796	1,639	1,488	1,186	931	1,649	1,482	1,374	682	1,609	1,220	1,116	1,726					17,898
1980	0	0	0	0	0	0	0	0	0	10	0	0	1,218					1,228
1981	2,015	1,888	1,807	1,448	1,031	2,020	1,878	1,723	1,467	3,169	2,680	2,382	1,775					25,283
1982	0	0	27	21	15	54	54	84	21	48	45	41	946					1,356
1983	0	1	0	1	0	0	0	0	0	2	0	0	1,085					1,089
1984	969	836	713	569	404	662	984	847	0	0	0	128	1,265					7,377
1985	2,134	2,052	1,745	1,036	972	1,957	1,847	1,693	364	947	710	852	1,030					17,339
1986	712	618	532	404	322	592	407	431	372	1,455	731	654	1,343					8,573
1987	2,506	2,218	1,940	1,307	830	2,009	552	1,256	1,742	3,009	3,422	3,012	1,360	1,148	1,817			28,128
1988	2,542	2,377	1,969	1,054	817	2,044	937	1,172	1,639	3,262	2,962	2,611	1,245	2,525	3,248			30,404
1989	1,969	2,255	1,710	762	933	1,814	1,995	915	1,288	3,062	2,604	2,521	1,172	0	63			23,063
1990	726	751	1,032	546	519	567	634	687	0	578	2	0	581	0	0			6,623
1991	1	0	882	500	392	0	0	602	0	385	0	1	739	3	2			3,507
1992	31	0	886	435		18	0	433		359	0	0	502	0	0	0	380	3,044
1993	1	1	705	646		0	0	312		1,760	1,585	1,334	2	1,344	754	0	475	8,919
1994	1	2	1,487	725		1	1	818		1,818	1,675	1,368	1	0	0	1,008	541	9,446
1995	244	171	0	0		152	11	74		581	1,638	1,282	87	1	1	136	0	4,378
1996	0	0	0	0		0	0	0		535	799	0	0	0	0	0	0	1,334
1997	0	0	0	0		0	0	0		538	0	0	0	0	0	0	33	571

Runoff Year	W236	W239	W240	W241	W242	W243	W244	W245	W246	W247	W248	W249	W365	W385	W386	W398	W399	Total
1998	0	0	0	0		0	0	0		426	0	0	0	0	0	0	0	426
1999	0	0	0	0		0	0	133		382	0	0	0	0	0	0	14	529
2000	0	0	0	0		0	0	487		318	0	0	597	0	0	0	0	1,402
2001	0	0	0	2		0	0	290		438	0	0	236	0	0	0	0	966
2002	0	0	0	0		0	0	413		404	0	0	1,624	0	0	0	0	2,441
2003	1,626	959	0	0		0	869	120		329	0	0	836	0	0	0	0	4,739
2004	1,293	732	0	0		0	1,019	389		281	0	0	512	0	0	0	0	4,226
2005	1,021	50	0	0		0	135	81		464	0	0	449	0	0	0	0	2,200
2006	1,293	0	0	0		0	0	130		0	513	736	466	0	0	0	6	3,144
2007	1,107	0	0	0		0	0	622		451	0	0	543	0	0	0	17	2,740
2008	962	0	0	0		0	7	668		787	0	0	732	1	0	0	18	3,175
2009	1,066	0	0	0		0	432	442		745	0	0	609	0	0	0	3	3,297
2010	993	197	0	0		0	579	687		0	0	0	673	0	0	0	0	3,129
2011	2,175	1,321	503	0		0	1,526	562		0	0	0	350	0	0	0	12	6,449
2012	1,371	917	51	57		0	418	521		0	0	0	199	0	0	0	43	3,578
2013	1,315	546	0	0		0	551	507		0	0	0	496	0	0	0	10	3,427
2014	1,160	492	0	0		0	579	255		0	0	0	286	0	0	0	5	2,781
2015	1,023	746	0	0		0	368	330		0	0	0	0	1	0	0	24	2,496
2016	1,040	946	0	0		0	511	60		0	0	0	0	0	0	0	26	2,585
2017	1,104	6.015	0	0		0	0	0		0	0	0	0	0	0	0	54	1,165
2018	686	918	920	821		0	657	610		953	980	1,030	0	0	0	0	29	7,609
2019	1,188	184	492	132			80	61		0	233	1,241	0	463	0	0	86	4,164
2020	307	1,101	479	453			878	496		942	19	1,077	0	0			38	5,789
1991-2019 Average	700	310	213	126	Offline	6	287	337	Offline	430	248	269	331	60	26	41	63	3,483

Table excludes domestic supply and enhancement/mitigation pumping wells

Gray cell indicates well was either offline or not yet constructed