WELL W379 REPLACEMENT (W379R)
BIG PINE WELLFIELD

PRE-CONSTRUCTION EVALUATION REPORT

Eastern Sierra Environmental Group

Water Operations Division

Los Angeles Department of Water and Power

May 2024

1. PURPOSE

The City of Los Angeles Department of Water and Power (LADWP) plans to drill and construct a well to replace the existing Well W379 located in Big Pine Wellfield to supply water to the same uses as the existing well. The replacement well should improve LADWP's operational flexibility and facilitate rotational pumping in the wellfield. This report's purpose is to satisfy 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

Production well W379 is among the three production wells located north of the Big Pine Town. All three wells discharge water to Big Pine Canal for enhancement and mitigation (E&M) irrigation uses. Well W379 was constructed in 1986 to a depth of 410 feet below the ground surface (feet-bgs) and is screened from 200 to 400 feet-bgs (well log included as Addendum A). In recent years, W379 has been out of commission because of damage to the screen and, as a result, sand intrusion up to about 200 feet-bgs. LADWP plans to replace production well W379 in Big Pine 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 Inyo/LA Long-Term Water Agreement (Water Agreement),

> *The Department's current groundwater pumping capacity may be increased to provide increased operational flexibility and to facilitate rotational pumping. The Department may replace existing wells and construct new wells in areas where hydrogeologic conditions are favorable, and where the operation of that well will not cause a change in vegetation that would be inconsistent with these goals and principles.*

According to the 1991 EIR, the pumping capacity of W379 is 4.3 cubic feet per second (cfs).

2.2 Geographic Setting

Big Pine Wellfield is located south of Bishop Cone in northern Owens Valley. The main hydrologic features in the Big Pine area are Big Pine Creek, Baker Creek, and Big Pine

Canal, which flow to Owens River. The Big Pine Canal supplies water from Owens River for irrigation throughout the Big Pine Wellfield, and E&M uses. The location of the existing W379 adjacent to the Big Pine Canal and the proposed location of the replacement well W379R are presented in **Figure 1**. The replacement well will be used for the same purposes as the existing well.

3. HYDROGEOLOGIC CONDITIONS

3.1 Geology

The conceptual geological framework of the Owens Valley was presented in a U.S. Geological Survey (USGS) report "Geology and Water Resources of Owens Valley, California" (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.

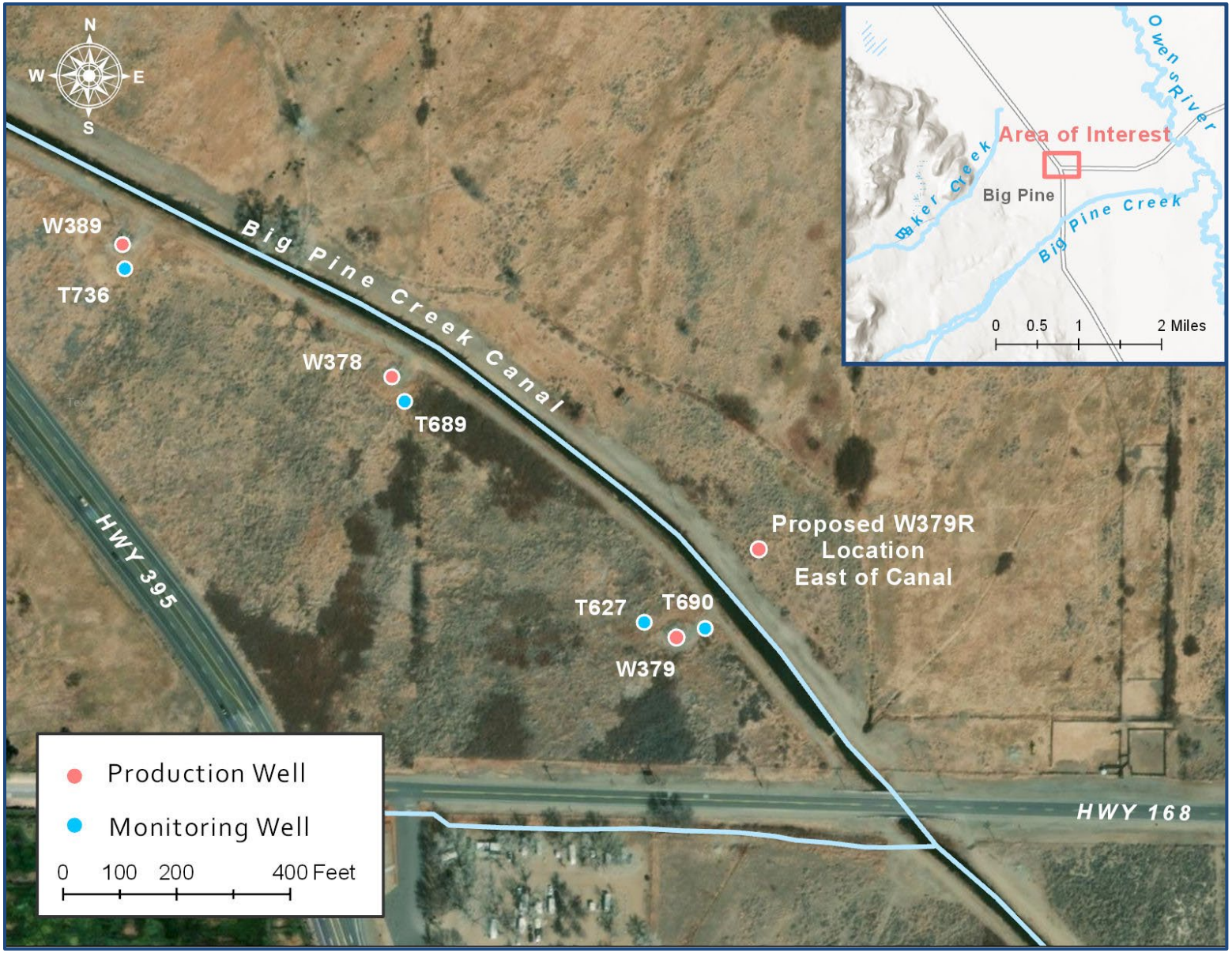

FIGURE 1 – LOCATIONS OF EXISTING WELL W379 AND REPLACEMENT W379R IN BIG PINE WELLFIELD

Lithological logs throughout the Big Pine wellfield exhibit relatively consistent coarse strata interbedded with fines, mostly in the central and eastern parts of the wellfield. The effect of the interbedded clay layers on the aquifer is semi-confinement (leaky aquifer) from approximately 100 to 200 feet-bgs.

A comparison of groundwater levels in the two nearby monitoring wells T627 and T690 exhibits the semi-confined aquifer in the vicinity of W379. T690 is completed at a depth of 55 feet-bgs with groundwater levels ranging from 5 to 15 feet-bgs. Well T627 is completed to a depth of 200 feet-bgs with groundwater levels ranging from 45 to 55 feet-bgs. The 40-foot difference in groundwater levels between these two wells indicates the possible presence of a leaky aquifer. Groundwater levels at T627 and T690, in addition to other monitoring wells throughout the wellfield, are presented in **Table 1**. They are presented in pairs of one shallow and one deep monitoring well. The locations of the monitoring wells are shown in the map in **Figure 2**.

To improve understanding of this semi-confinement, the existing W379 may be converted to a monitoring well, measuring groundwater levels in the shallow and deep aquifers.

Table 1 – Comparison of Groundwater Levels in Paired Monitoring Wells

Wellfield Area	Shallow		Deep	
	Well (depth ft-bgs)	DTW Range (ft-bgs)	Deep (depth ft-bgs)	DTW Range (ft-bgs)
North	T690 (55)	5-15	T627 (200)	45-55
South	T799 (28)	15-20	V014GA (200+)	25-30
East	T232A (20)	10-15	V295 (620)	20-25
West	T936 (150)	35-45	T937 (250)	110-120
Far South	V017GC (49)	15-30	V017GA (390)	25-50

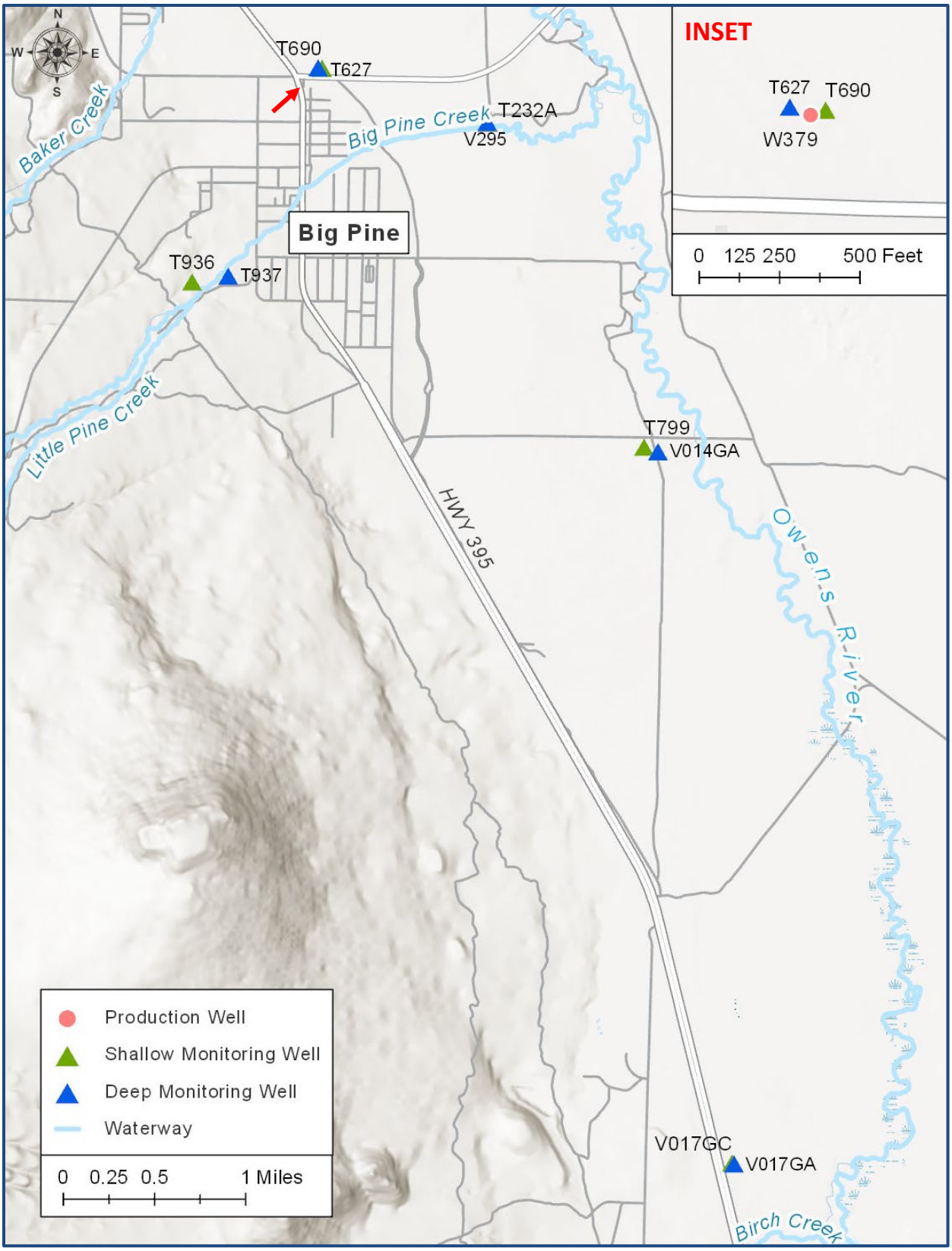

FIGURE 2 – SHALLOW AND DEEP AQUIFER MONITORING WELLS IN BIG PINE WELLFIELD

3.2 Hydrology

3.2.1 Groundwater

Groundwater in Big Pine Wellfield resides mostly in the alluvial and valley fill that consists of debris flows and fluvial material originating from mountain canyons. Groundwater in the wellfield generally flows southward from the recharge areas north, east, and mainly west of the wellfield. The Big Pine Creek is the primary source of recharge for the Big Pine Wellfield. Overall, this wellfield receives a moderate amount of recharge (median of 21,000 AF over the last two decades) compared to other wellfields.

A review of the driller's logs for existing wells in Big Pine Wellfield indicates relatively consistent sand and gravel strata. Additionally, groundwater levels at T627 and T690 indicate the presence of leaky aquifer conditions in the vicinity of W379, as described in the previous section. Hollett et al. (1991) estimated vertical hydraulic conductivity of the confining clays in the valley ranges from 0.002 to 0.00083 ft/day.

Currently, LADWP has 19 production wells in Big Pine Wellfield, four of which were operational during the 2021 runoff year (RY). The locations of these production wells are presented in the map in **Figure 3**. The historical annual pumping volume of wells within a 1-mile radius of W379R and the total wellfield annual pumping volume since the 1971 RY are listed in **Table 2**. As listed in the table, groundwater pumping in Big Pine Wellfield has ranged generally between 15 and 26 thousand acre-feet per year (AFY) since 1991, when the Water Agreement was implemented. In addition to the LADWP wells shown in **Figure 3**, there are several relatively deep private, tribal, and community domestic supply wells in Big Pine Wellfield, but none are located in the immediate vicinity of W379. The Big Pine Paiute Reservation uses production wells for domestic purposes but not much information on the well construction and pumping history is available publicly.

FIGURE 3 – LADWP PRODUCTION WELLS IN THE VICINITY OF W379 IN BIG PINE WELLFIELD

TABLE 2 – GROUNDWATER PUMPING FROM WELLS IN THE VICINITY OF W379 IN BIG PINE WELLFIELD (AFY)

Runoff Year	W210	W352	W378	W379	W389	Big Pine Area
1971	902					45,781
1972	1,555	102				38,120
1973	21	48				8,943
1974	0	166				22,506
1975	9	546				30,998
1976	180	561				27,306
1977	964	1,385				38,001
1978	0	851				24,418
1979	0	729				27,639
1980	0	0				24,211
1981	0	1,055				28,462
1982	26	53				22,351
1983	0	506				28,119
1984	0	1				28,067
1985	0	51				25,911
1986	0	412				25,934
1987	664	192	3,000	2,933	3,000	48,663
1988	1,535	190	1,465	885	1,465	42,817
1989	173	58	102	175	102	34,027
1990	0	230	13	0	13	19,908
1991	0	41	0	39	0	24,880
1992	0	0	0	0	0	24,400
1993	0	74	3	3	3	23,061
1994	0	7	2	2	2	24,388
1995		1	1,201	1,360	1,201	24,511
1996		239	0	0	0	22,152
1997		46	536	624	536	24,654
1999		203	0	0	0	22,645
1999		1	0	0	0	19,512
2000		2	0	0	0	25,378
2001		41	2	0	2	26,397
2002		2	0	0	0	26,318
2003		6	0	0	0	26,400
2004		15	0	0	0	22,045
2005		23	0	0	0	20,316
2006		4	0	0	0	20,657
2007		5	0	0	0	20,406
2008		7	0	0	0	21,073

Runoff Year	W210	W352	W378	W379	W389	Big Pine Area
2009		6	0	0	0	23,427
2010		19	0	0	0	23,413
2011		11	0	0	0	28,654
2012		5	0	0	0	26,452
2013		15	0	0	0	23,871
2014		2	0	0	0	21,635
2015		1	0	0	0	20,578
2016		28	0	0	0	23,598
2017		9	0	0	0	21,705
2018		21	0	0	0	23,065
2019		74	0	0	0	19,821
2020		26	0	0	0	14,573
2021		26	0	0	0	16,490
2022		24	0	0	0	16,445
1992-2022 Average	0	31	58	66	58	22,591

Note: Gray cells indicate well were offline

3.2.2 Surface Water

The main water features in Big Pine Wellfield include Owens River, Tinemaha Reservoir, Big Pine Creek, Baker Creek, and Big Pine Canal, which recharge the groundwater aquifer. The weather station at LADWP's Big Pine Powerhouse Weather Yard is the closest station to W379, with long-term average precipitation (from 1991 to 2022 hydro years) of 9.0 inches per year, higher than the historical average precipitation in the Owens Valley.

The major flow gauges and their associated flows in Big Pine Wellfield are listed in **Table 3**. The locations of the flow gauges are presented in the **Figure 4** map. Some of the flow gauges listed in **Table 3** are outside of the area presented in the map in **Figure 4**. Big Pine Wellfield receives the second-highest volume of water in its creeks and ditches.

FIGURE 4 – KEY STREAMFLOW GAUGES IN BIG PINE WELLFIELD NEAR W379

TABLE 3 – FLOW MEASUREMENTS IN KEY BIG PINE AREA STREAMFLOW GAUGES

Station ID	Station Name	Volume [AFY] Average 1991-2022 RY
2046	Fuller Ck *At Forest Service Boundary*	37
2051	Little Pine Ck *At McMurry Rd*	756
2052	Big Pine Ck *At USGS Station*	25,755
2062	Red Mountain Ck *At Forest Service Boundary*	2,605
2063	Birch Ck *Above Mill Site*	5,510
2064	Baker Ck A*t L.A. Station*	5,144
2065	Tinemaha Ck *At Forest Service Boundary*	5,363
2066	Owens River *Below Big Pine Ck*	245,102
2091	Malone Springs *At Pipeline Exit*	130
2106	Big Pine Canal	11,788
2167	Klondike Lake *Waterfowl Diversion*	99

4. ENVIRONMENTAL RESOURCES

4.1 Vegetation in the Vicinity of the Replacement Well

Vegetation parcels in the Big Pine 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 W379 are presented in **Figure 5**. 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." Once installed the replacement production well would be in the immediate vicinity of Type B, C, and E vegetation parcels. However, generally, there is little to no effect on shallow groundwater levels from operating the intermediate aquifer screened, existing W379. Likewise, operating the deeper replacement well W379R would have little to no effect on groundwater-dependent vegetation.

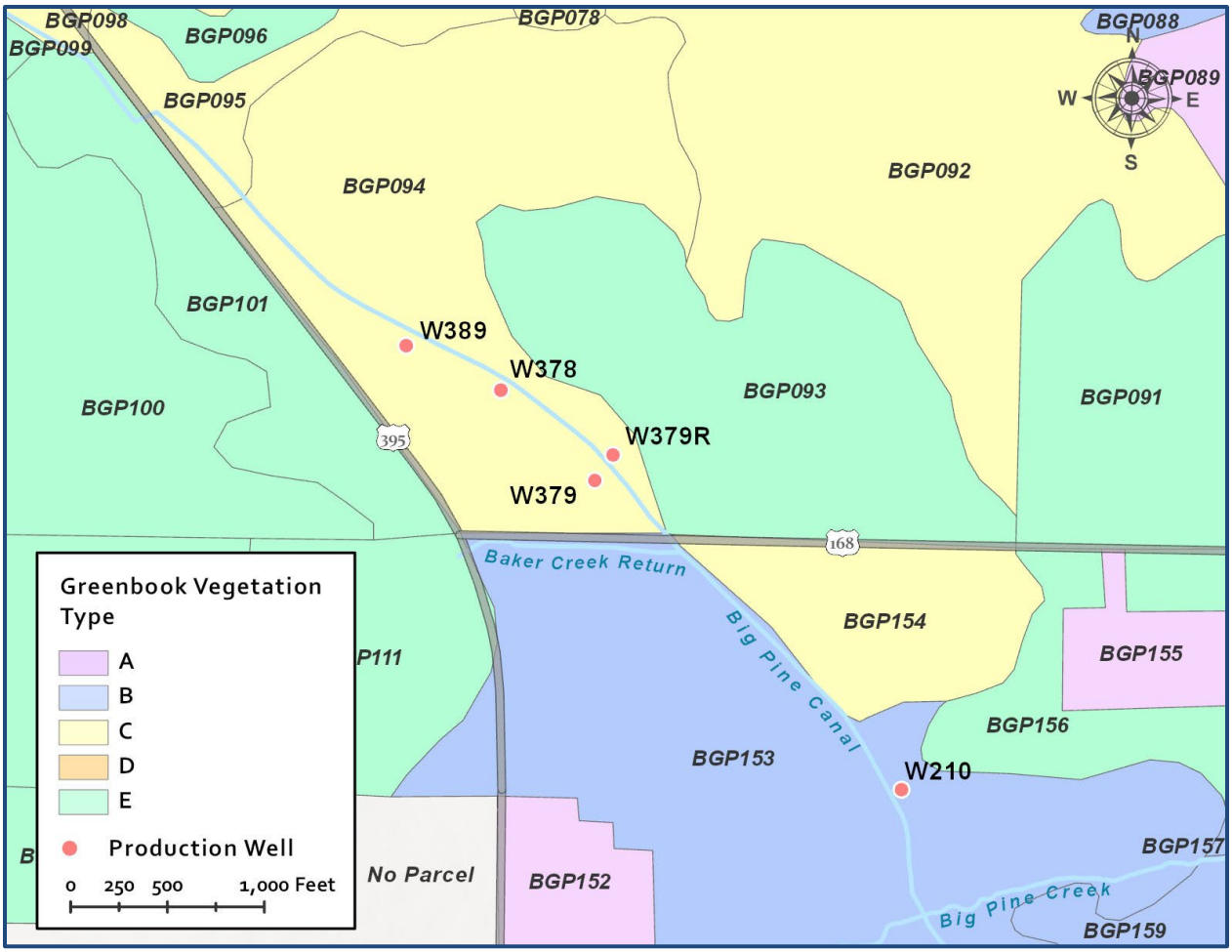

FIGURE 5 – VEGETATION PARCEL IN BIG PINE WELLFIELD IN THE VICINITY OF W379

4.2 Springs, Seeps, Flowing Wells

Although parts of the deep semi-confined aquifer are under artesian condition, there are few known springs or flowing wells in Big Pine Wellfield. Fish Spring located south of town has been dry since the hatchery supply wells were operating in the late 1960s. Uhlmeyer Spring (DWP22) is a seep located at the base of the White Mountains approximately 3 miles east of the location of the planned replacement well. This spring is well outside the zone of influence from simulating W379R operation, which is described in Section 6 of this report. Furthermore, the spring is likely fed by runoff from the western flank of the White Mountains and seeps to the surface due to a hydrogeologic boundary at an elevation of approximately 4,050 ft-amsl. The planned replacement well, at an approximate elevation of 3,960 ft-amsl, will be screened and draw water from below a 65 ft deep aquitard. Provided this elevation differential with the

boundary and distance from the replacement well, no effect from operating W379R is expected on Uhlmeyer Spring. The nearest flowing well to the planned production well, F121, is over 7 miles to the north in Bishop Cone, outside the zone of influence of W379R.

4.3 Non-LADWP Wells

There are a few private wells in the town of Big Pine that provide water for domestic and irrigation purposes. The Big Pine Reservation supply well is located south of town, approximately 1.4 miles southwest of W379. No data on the depth, diameter, or pumping record of the Big Pine Reservation supply well is available. V874 supplies water to Steward Ranch, approximately 3 miles east of W379R. Two other wells exist on the Steward Ranch property, but have not been operated in decades. The Steward Ranch well is screened from approximately 180 to 400 feet-bgs, which is considered screened below the shallow aquifer. The non-LADWP wells typically have smaller diameters and shallower depths, drawing water from the shallow aquifer and, therefore, are affected primarily by changes in groundwater levels in the shallow aquifer. Because the shallow aquifer is recharged primarily by the infiltration of water from excess irrigation water, the creeks, and ditches running throughout Big Pine area, changes in ditch operations could potentially affect groundwater levels in private and community supply wells. The locations of known non-LADWP wells in the vicinity of W379 based on available data from the California State Department of Water Resources (DWR) are presented in **Figure 6**. Based on the available data, there are no non-LADWP within 3,600 feet of the planned production well W379R.

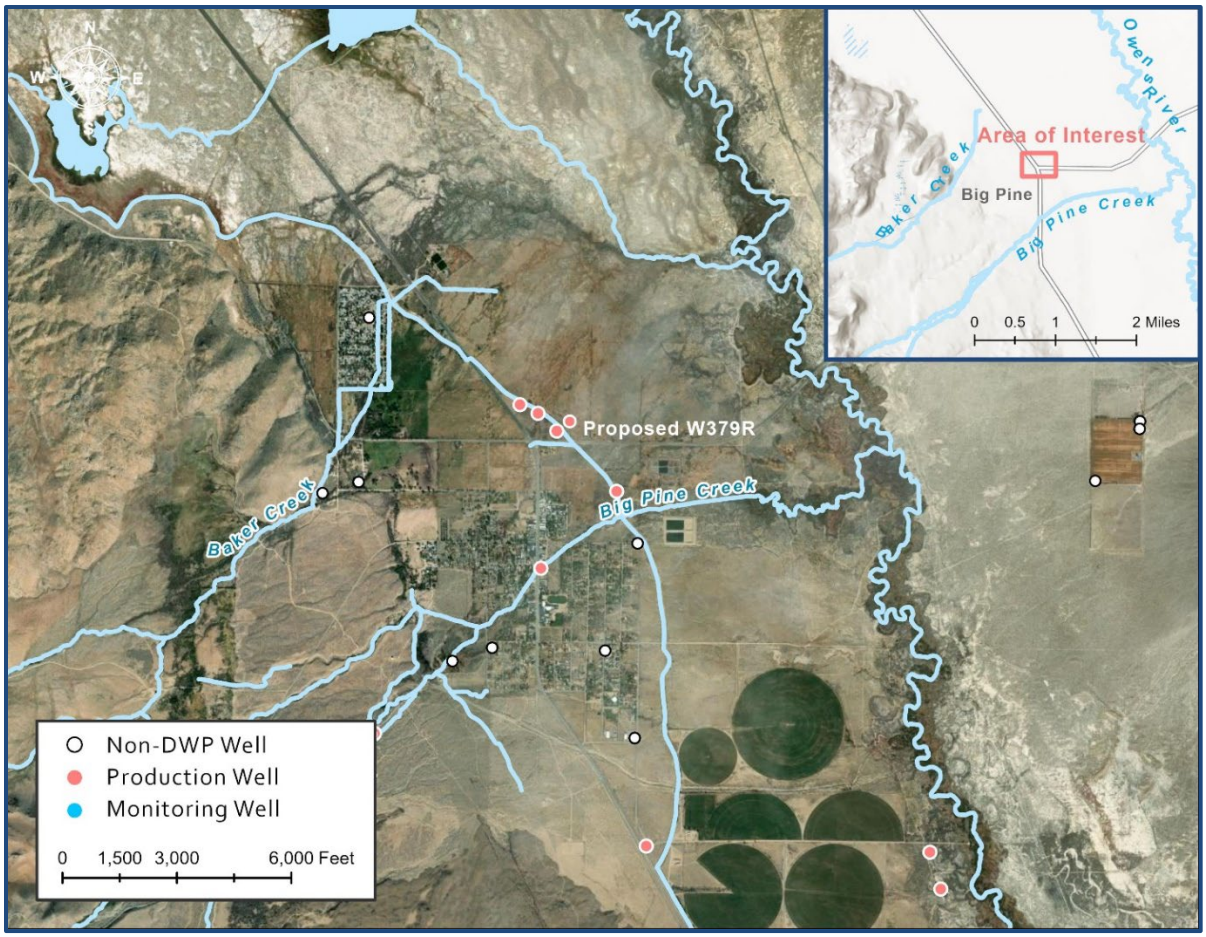

FIGURE 6 – NON-DWP WELLS IN THE VICINITY OF LOCATION OF PROPOSED W379R

5. CONSTRUCTION AND TESTING

5.1 New Well Design

To minimize potential effects of operating the replacement well on vegetation depending on water from the shallow aquifer, W379R will be screened below the semi-confinement separating shallow and deep aquifers in the Big Pine area. An exploratory borehole for W379R will be drilled to approximately 700 feet-bgs. The final depth and screen zone of the replacement well will be determined after reviewing the lithologic and geophysical logs of the borehole. The preliminary design of W379R with a screen interval from 350 to 700 feet-bgs is presented in **Figure 7**. This screen depth should ensure that W379R will primarily draw water from the deep aquifer. The zone above the screen will be sealed to the ground surface. The replacement well will be constructed with an 18-inch diameter casing and screen using high-strength/low-alloy steel. Using an 18-inch diameter screen and casing is the current industry standard for municipal wells and allows easier well and pump maintenance.

Current industry standards for well drilling and design are incorporated in plans for the installation of the well W379R. These plans include using a mud rotary method for drilling, a pre-fabricated casing and screen, and placing a properly sized filter pack in the annular space between the screen and the borehole wall. The appropriate screen slot size will be determined by performing a sieve analysis. The annular space between the casing and borehole, above the filter pack to the ground surface, will be sealed with cement grout and bentonite chips to ensure that groundwater is protected from potential surface contamination and the well is not drawing water from the shallow aquifer. After construction, the production well will be developed by removing the drilling mud from the casing, swabbing and airlifting the screen zone, and pumping/surging. The development will be complete once the discharge water is clear and turbidity is below 10 NTU.

The initial pumping capacity of W379R should be approximately 4.0 - 5.0 cfs. Analysis of the data from the well development and the planned aquifer test will be used to determine the actual pumping capacity of W379R. It is also expected that the pumping capacity of W379R will decrease over time, which is typical for all water supply wells.

If the pumping capacity of the well is higher than that of the existing well, the replacement well will be equipped with a pump with the same or lower pumping capacity than that of the one it is replacing.

The Technical Group will develop a monitoring plan in a multi-phased adaptive approach to minimize potential effects on nearby environmental resources, including vegetation, private wells, flowing wells, and springs. The monitoring plan phases include 1) preparing a draft monitoring plan before installing the replacement well for the Technical Group's consideration, 2) revising and updating the draft plan utilizing aquifer test data analysis and results of model simulations after recalibrating the Big Pine Wellfield model, and 3) developing a long-term operation plan to protect nearby non-LADWP wells after an initial first season of operation.

The first-phased draft monitoring plan is attached to this report, which will be considered by the Technical Group before the aquifer testing of the replacement well. The second phase updated plan will be utilized during the first season of operating the replacement well

After activation of the replacement well W379R, the existing well W379 will be either abandoned or converted to a deep monitoring well during the following round of LADWP's contractor fieldwork.

5.2 Aquifer Test

Once the replacement well W379R is installed, the contractor will place a temporary pump in the well for pumping development and conducting a step-drawdown test with up to four steps. The step drawdown test data and analysis will determine the appropriate pumping rate during the constant-rate aquifer test. The aquifer test will include pumping for a minimum of 24 hours, but will continue for 48 and up to 72 hours if the water levels in the designated monitoring well or wells have not stabilized. Appropriate portions of the monitoring plan will be implemented during the aquifer test.

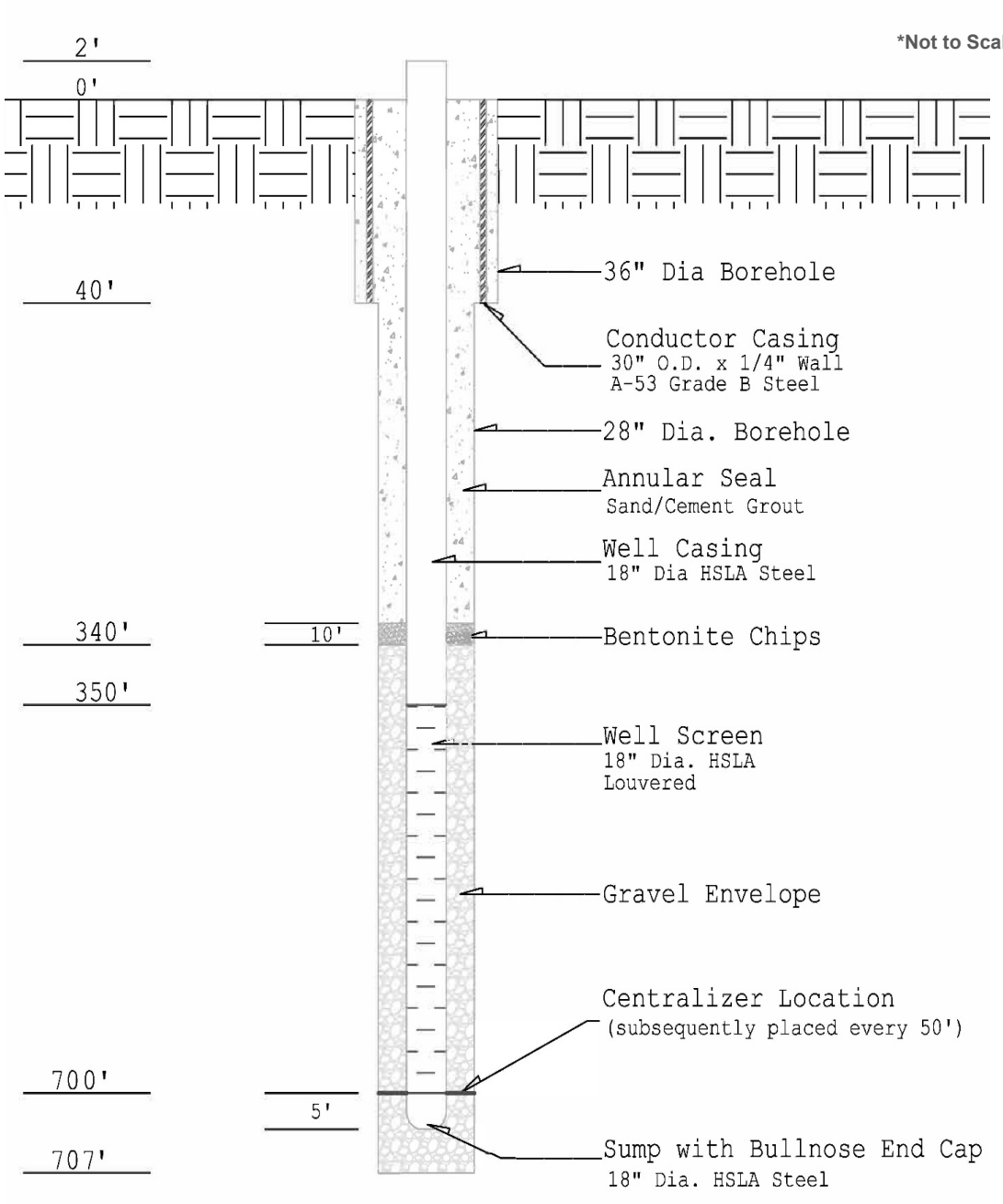

FIGURE 7 - PRELIMINARY DESIGN FOR W379R IN BIG PINE WELLFIELD

6. POTENTIAL IMPACTS ON GROUNDWATER-DEPENDENT RESOURCES

6.1 Well Operation Simulations

A groundwater flow model that was developed for the Big Pine Wellfield by MWH Americas, Inc. (now Stantec Consulting) was utilized to estimate the effect of operating

the proposed replacement well W379R on the shallow aquifer groundwater levels. This MODFLOW-based groundwater model represents the groundwater aquifer in four model layers, simulating the shallow, intermediate, and deep aquifer with a uniform cell size of 500 feet by 500 feet. The Big Pine model was recently updated in 2023. Documentation on the initial and boundary conditions of the current model update are described in the Big Pine Groundwater Model Update: Model Documentation Report (Stantec, 2023). Data to be gathered from the planned aquifer test of W379R will be used to improve the predictability of the model. The existing well W379 is primarily screened in the intermediate aquifer zones (layers 2 and 3). Replacement well W379R is planned to be primarily screened in the deep aquifer zone (layer 4). According to the 1991 EIR, the well had an operational capacity of 4.3 cfs. To determine the relative effect of pumping W379 and W379R, the simulated drawdown resulting from pumping W379 at an average rate of 4.3 cfs and the W379R at the same average pumping rate for one nearly average runoff year of operation were compared.

The resulting one-year pumping simulated drawdown contours of groundwater levels in the shallow, intermediate, and deep aquifers are presented in **Figures 8 to 10**. The resulting one-year pumping simulation of W379R resulted in less drawdown in the shallow aquifer (about 4 feet less within a 500-foot radius), and more in both the intermediate and deep aquifers (about 10 and 6 feet more, respectively, within a 500-foot radius), compared to the original W379R. Simulation of the one-year operation in a nearly average runoff year was used in all previous new and replacement wells as part of the pre-construction evaluation reports to estimate the effect of operating the new well on nearby resources.

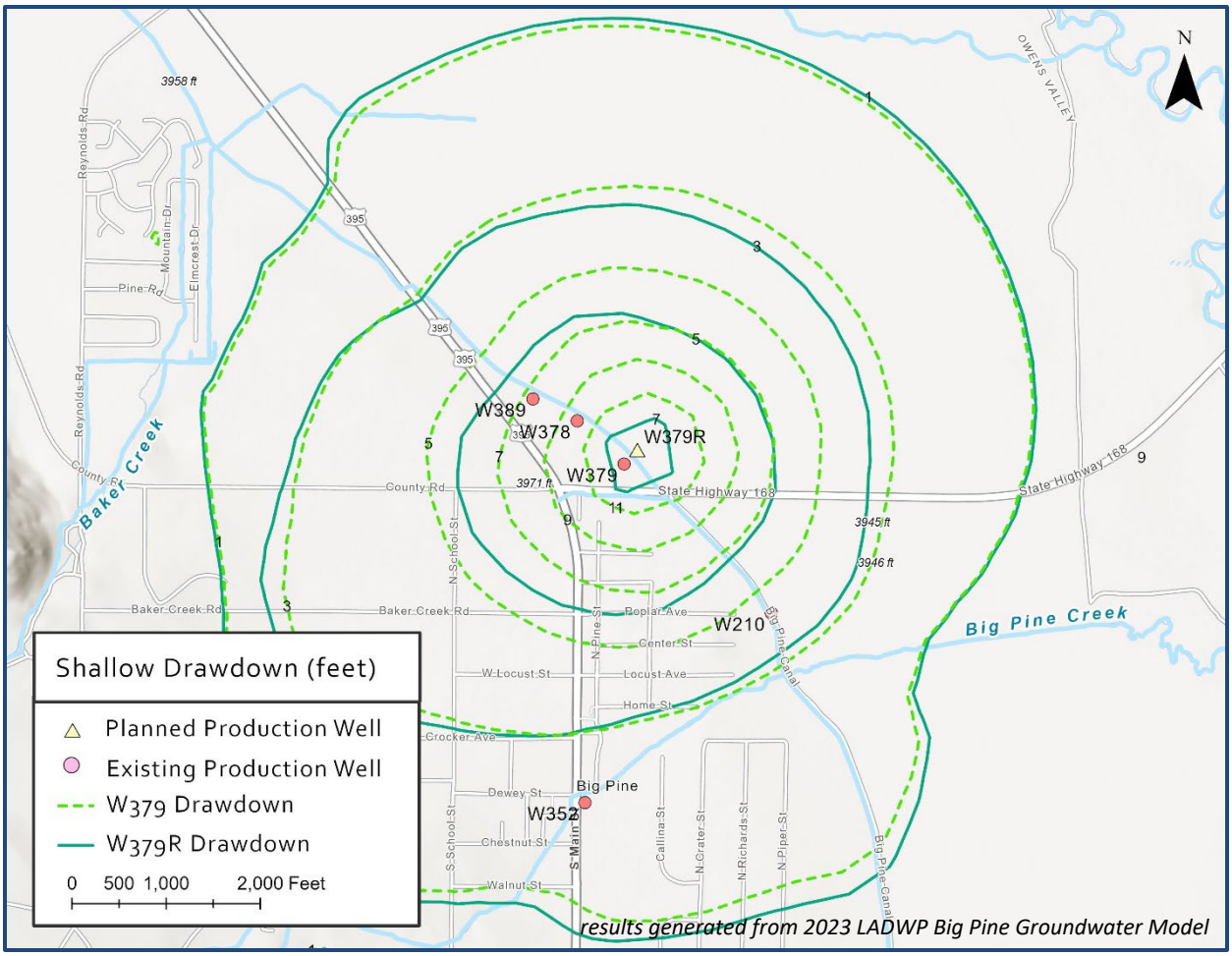

FIGURE 8 - SHALLOW AQUIFER **GROUNDWATER DRAWDOWN (FT) FROM OPERATING EXISTING W379 AND REPLACEMENT W379R AT 4.3 CFS FOR ONE YEAR**

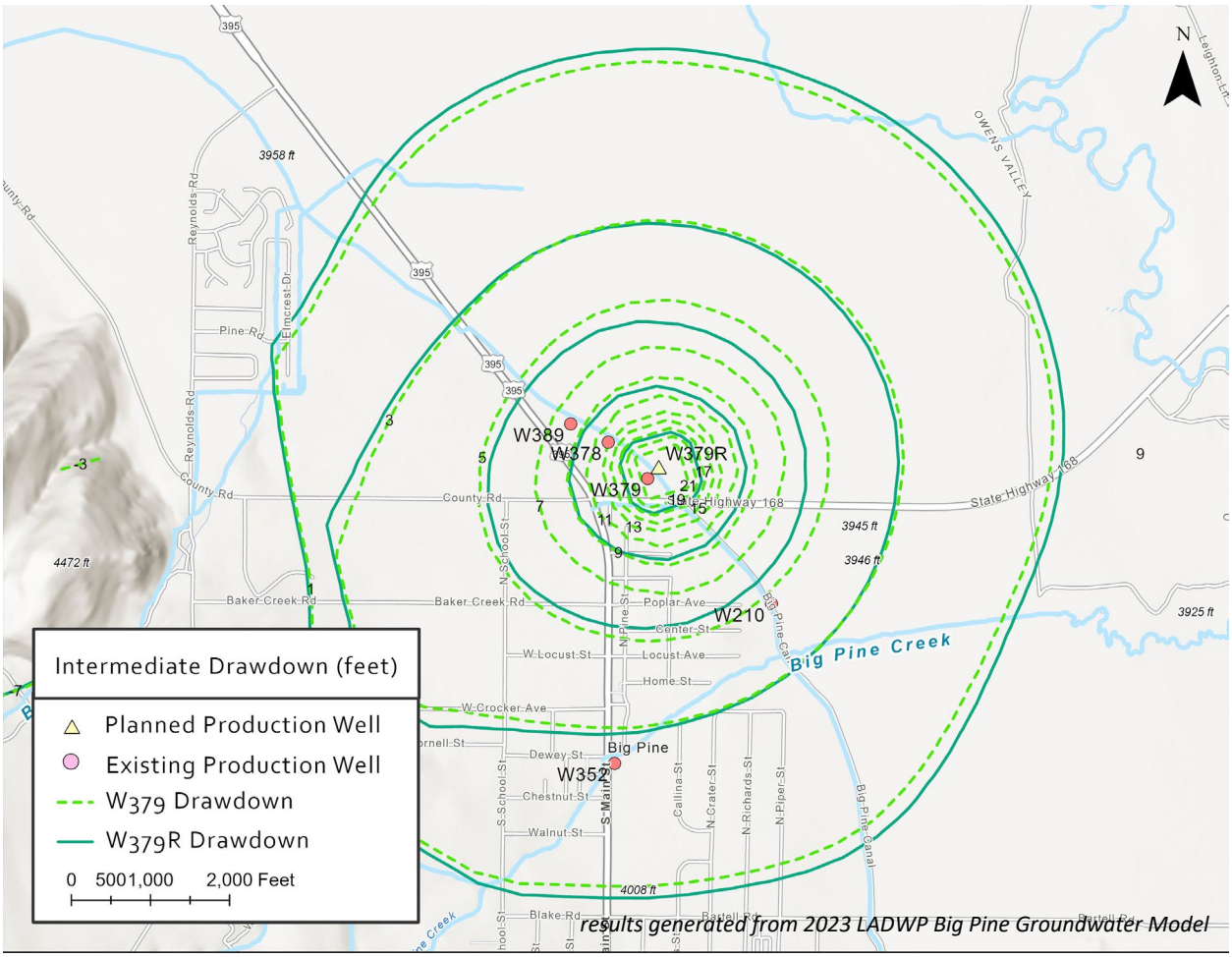

FIGURE 9 - INTERMEDIATE AQUIFER **GROUNDWATER DRAWDOWN (FT) FROM OPERATING EXISTING W379 AND REPLACEMENT W379R AT 4.3 CFS FOR ONE YEAR**

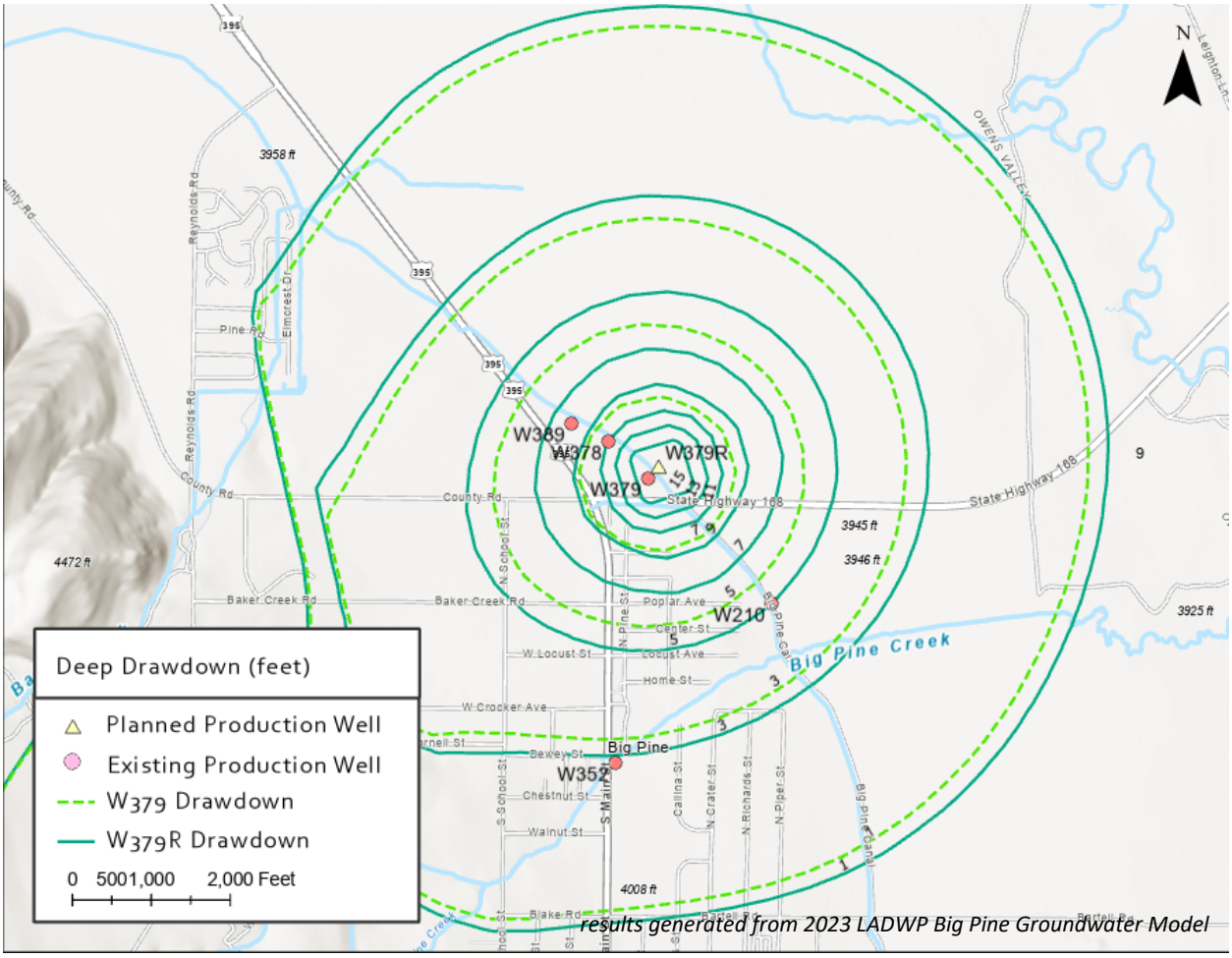

FIGURE 10 - DEEP AQUIFER **GROUNDWATER DRAWDOWN (FT) FROM OPERATING EXISTING W379 AND REPLACEMENT W379R AT 4.3 CFS FOR ONE YEAR**

Once W379R is drilled and data from an aquifer test are analyzed, the calculated aquifer characteristics from the tests will be used to update and re-calibrate the Big Pine groundwater model in the area near W379R. This updated model should improve the understanding of aquifer characteristics and produce a more realistic effect of pumping on groundwater levels. Using the updated model, multiple-year pumping scenarios during various runoff conditions can be simulated.

6.2 Potential Effects on Vegetation

The simulations of the one-year of operation of the existing and replacement wells W379 and W379R result in a similar effect on the shallow aquifer water levels. Therefore, no additional potential effect from operating the replacement of W379 on groundwater-dependent vegetation is expected.

6.3 Potential Effects on non-LADWP wells

As the nearest non-LADWP well is approximately 3,600 feet away from the proposed production well, no effects are expected from operating W379R on non-LADWP wells in the Big Pine Area. The nearest non-LADWP wells within a 2-mile radius of W379R are screened generally shallow with screens higher than 165 feet-bgs.

7. OPERATION

The pump, motor, and related equipment will be designed and installed in the well using the results from the analysis of the data collected during the aquifer tests and the calculated pumping capacity. Operation of W379R, similar to W379, will be subject to the ON/OFF protocols of the Water Agreement as described in Section 2.1 of this report. The operation of W379R will be controlled by the vegetation monitoring site BP1.

According to the Water Agreement, the Technical Group is responsible for developing and implementing a monitoring plan during the initial operation of new wells. The monitoring plan will include both hydrologic and vegetation monitoring. The goal of the initial operation is to determine the potential long-term effects of operating the well. A draft monitoring plan for the first season of W379R operation is attached. The applicable portions of the draft monitoring plan will be implemented during the aquifer test by the contractor. The monitoring plan will be updated using the findings from the aquifer test data analysis and modeling effort. After the completion of the initial operation phase of W379R, the regular operation of this well will be included in LADWP's annual operation plan for Owens Valley. The operation of W379R will provide operational flexibility in Big Pine Wellfield water management.

8. ENVIRONMENTAL ASSESSMENT

Well W379R will replace and be located adjacent to the existing well W379. The well will extract water from the intermediate and deep aquifers and water will be used for the same purposes as the well it is replacing. Computer model simulations show that the operation of the replacement well should have minimal effect on groundwater levels in the shallow aquifer that supports vegetation. Therefore, no further impact on nearby vegetation is expected from the operation of the replacement well. Additional assessment will not be conducted for the replacement well W379R, and LADWP will file a Notice of Exemption under Class 2 of the California Environmental Quality Act with the Inyo County Recorder's Office. A Class 2 exemption consists of replacing or reconstructing existing structures and facilities where the new structure will be located on

the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.

9. REFERENCES

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Well W379R - Replacement for W379

Big Pine Wellfield, Owens Valley

Monitoring Plan

For

First Season of Operation

Eastern Sierra Environmental Group

Water Operations Division

Los Angeles Department of Water and Power

May 2024

1. PURPOSE

The City of Los Angeles Department of Water and Power (LADWP) plans to drill and construct a well to replace the existing Well W379 located in Big Pine Wellfield. The replacement well will supply water for the same uses as the existing well. This monitoring plan satisfies the requirement of Section VI of the Inyo County/Los Angeles Water Agreement and Section IV.B of the Greenbook (the Technical Appendix to the Water Agreement), Guidelines for Drilling and Activating New Production Wells. This document describes the monitoring program for the first season of operating the W379 replacement well (W379R).

2. BACKGROUND

2.1 Location

Production well W379 is among the three production wells located in the Big Pine Wellfield, north of Big Pine Town. All three wells discharge water to Big Pine Canal for enhancement and mitigation (E&M) irrigation uses. This production well has been out of commission due to severe sanding problems. **Figure 1** shows the location of the existing W379 adjacent to the Big Pine Canal and the proposed location of W379R. The replacement well will be used for the same purposes as the existing well. LADWP plans to drill W379R using the current industry standards for well construction and improve LADWP's operational flexibility in managing water resources in Owens Valley.

2.2 Water Agreement

The purpose of this monitoring plan is to describe the monitoring program during the first season of operating W379R. According to Section VI of the Inyo/LA Long-Term Water Agreement (Water Agreement),

> *During this initial period of operation, the Technical Group shall monitor water levels and vegetation conditions in accordance with a jointly developed monitoring program. Additional wells may be installed by the Department in the area if operation of the initial well indicates no impacts that would be inconsistent with these goals and principles. Monitoring wells shall be installed as necessary to evaluate any potential effects of the operation of the new well or wells not owned by the Department.*

The applicable components of the monitoring plan can be implemented during the aquifer testing following the installation of the production well.

Phases

The monitoring plan for the planned replacement well W379R will be developed in a multi-phased adaptive approach to minimize potential effects on nearby environmental resources, including vegetation, private wells, flowing wells, and springs. The phases in the development and updating of the monitoring plan include:

1) Preparing a draft monitoring plan before installation of the replacement well,
2) Revising and updating the plan based on aquifer test data analysis, including pumping tests, and results of model simulations after recalibrating the Big Pine Wellfield Model, and
3) Developing a long-term operation plan to protect nearby non-LADWP wells after the first season of operation.

This report represents the first-phase draft monitoring plan, which will be considered by the Technical Group before the initial aquifer testing of the replacement well. The second-phase updated monitoring plan will be utilized during the first season of operating the replacement well.

3. AQUIFER TEST

Once the replacement well W379R is installed, the contractor will place a temporary pump in the well for developing and conducting a step drawdown test with up to four steps. The step drawdown test data and analysis will determine the appropriate pumping rate during the constant-rate aquifer test. The aquifer test will consist of pumping for a minimum of 24 hours but will continue for 48 and up to 72 hours if the water levels in the designated monitoring well or wells have not stabilized.

To ensure groundwater level measurements are not affected by the operation of other nearby wells, production wells W378 and W389 will not be operated for at least one week before to one week after the completion of the aquifer testing. The pumping well and the monitoring wells listed in **Table 1** will be monitored either manually or automatically utilizing pressure transducers. If monitoring is performed manually, the measurement frequency will be 1, 2, 3, 5, 10, 15, 20, 25, 30, 40, 50, and 60 minutes after the start of the pump and every half hour afterward. The same measurement frequency will be implemented during the recovery period for at least 2 hours after pumping stops. If the groundwater measurements are performed using a pressure

transducer, the measurement frequency will be set to every 5 minutes. Both manual and automatic groundwater measurements will be conducted in the pumping well.

COMPONENTS OF THE MONITORING PLAN

During the first season of operation, the monitoring plan will include hydrologic and vegetation monitoring.

4.1 Hydrologic Monitoring

Hydrologic monitoring will include groundwater and surface water monitoring. The groundwater monitoring will include shallow and deep aquifer wells that could respond to W379R pumping.

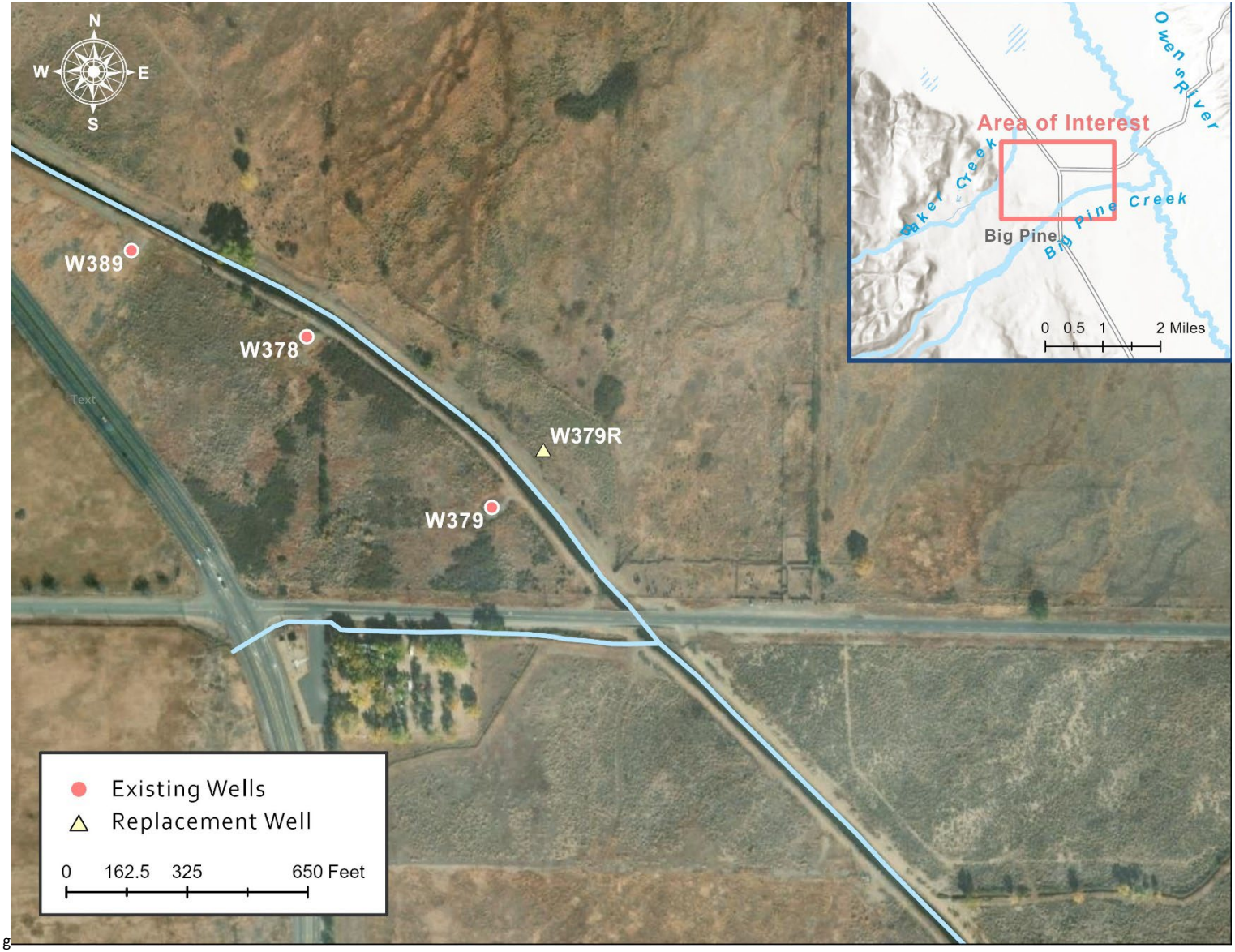

Figure 1 – Locations of existing well W379 and replacement W379R in Big Pine Wellfield

4.1.1 Groundwater Monitoring

A review of lithological and geophysical logs of wells near W379 indicates a likely semi-confined aquifer in the northern Big Pine area. **Table 1** lists and **Figure 2** shows locations of representative shallow and deep wells that will be monitored during the first season of W379R operation.

Table 1 – Monitoring wells to be monitored during the aquifer testing and the initial season of operation

Well Number	Depth (feet)	Direction	Distance (feet)
T572	21 - Shallow	East	2,500
T627	200+ - Deep	West	250
T689	55 - Shallow	Northwest	750
T690	55 - Shallow	West	200
T691	100 - Shallow	South	3,600
T736	350 - Deep	Northwest	1,300
T936	110 - Shallow	Southwest	7,200
T937	252 - Deep	Southwest	6,500
V013N	92 - Shallow	West	3,000
V210	360 - Deep	Southeast	2,100
V295	620 - Deep	Southeast	5,000

4.1.2 Surface Water Monitoring

None of the surface water features are expected to be affected by W379R operation. LADWP conducts regular flow monitoring of the surface water features near W379R. Therefore, no additional monitoring of surface water features is planned.

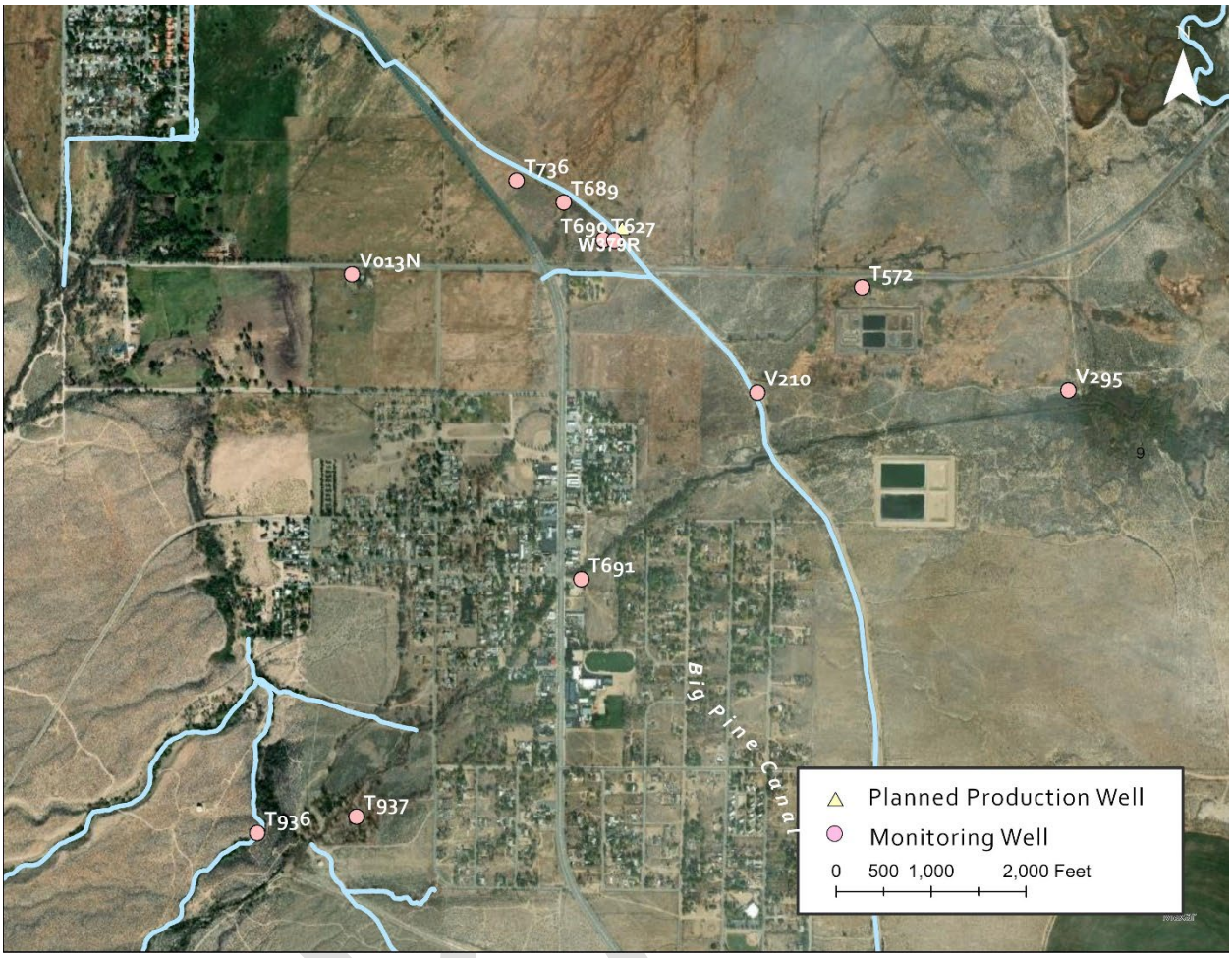

Figure 2 - Monitoring locations for the first season of W379R operation

4.2 Vegetation Monitoring

Vegetation parcels in the vicinity of W379R, including types B, C, and E vegetation are shown in **Figure 3**. Given the planned deep screen zone for W379R, and the preliminary results of groundwater modeling, operating W379R is not expected to affect the groundwater levels in the shallow aquifer supporting vegetation.

As part of vegetation monitoring during the first season of W379R operation, the Normalized Difference Vegetation Index (NDVI) derived from remote sensing data from Sentinel and Landsat satellites will be utilized to compare the health of nearby vegetation parcels BGP078. BGP086, BGP092, BGP094, BGP095, BGP154, BGP221, BGP088, BGP153, BGP157, and BGP159 before and after the completion of the first season of W379R operation. LADWP and ICWD staff will continue the annual monitoring of the vegetation parcel BGP094 utilizing line point transects.

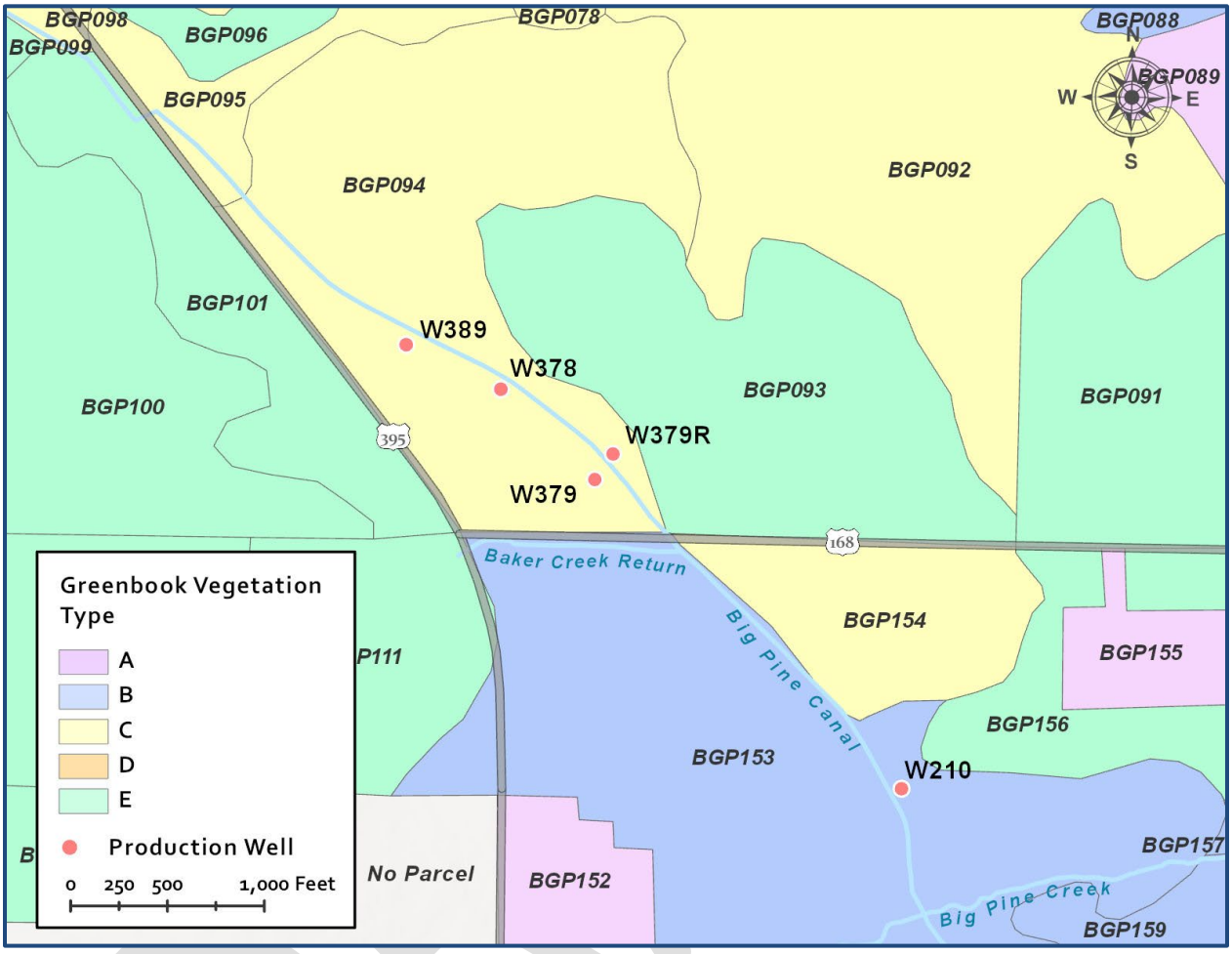

Figure 3 – Vegetation parcel in Big Pine Wellfield in the vicinity of W379

4.3 Springs, Seeps, Flowing Wells

The nearest flowing well to the planned production well, F121, is over 7 miles to the north in Bishop Cone, outside the zone of influence of W379R. Fish Spring located south of town has been dry since the hatchery supply wells were operating in the late 1960s. Uhlmeyer Spring (DWP22) is located at the base of the White Mountains approximately 3 miles east of the location of the planned replacement well. The artesian nature of F121 and the spring indicate they are hydrogeologically distinct from the W379R deep aquifer. Additionally, both are well outside the zone of influence from W379R operation, therefore monitoring is not planned for these resources. No known flowing wells or springs exist in the Big Pine Wellfield, and therefore, no monitoring of

these types of groundwater-dependent resources is planned during the first season of W379R operation.

4.4 Non-LADWP Wells

A few non-LADWP wells in the town of Big Pine area provide water for domestic purposes. The Big Pine Reservation supply well/wells are located south of town, approximately 1.4 miles southwest of the planned location of W379R, but no information on the construction, pumping capacity, or historic pumping is available. The locations of known non-LADWP wells in the vicinity of the planned location of W379R based on available data from the California State Department of Water Resources (DWR) are presented in **Figure 4.** Based on the available data, there are no non-LADWP wells within 3,500 feet of the replacement well W379R, and no impact from pumping W379R is expected. If access is granted by the owners, LADWP staff will monitor nearby non-LADWP wells before and after the first season of W379R operation.

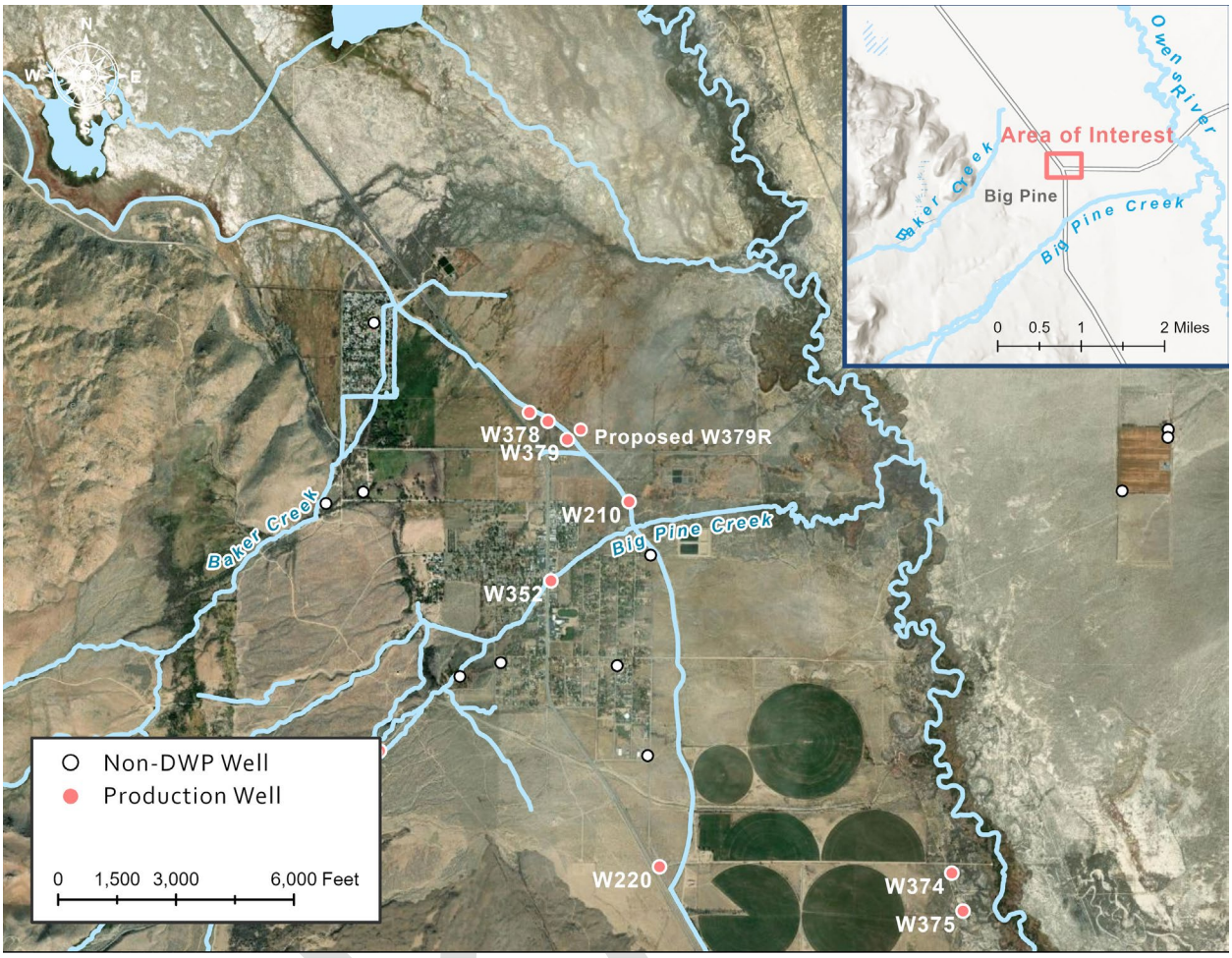

Figure 4 – Non-LADWP and LADWP Production Wells in the Big Pine Area