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COUNTY OF INYO
WATER DEPARTMENT

April 20, 2020

Mr. Clarence Martin, Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, California 93514

Subject: Proposed 6-month operational test of excess pumping capacity of Well W415

Dear Mr. Martin:

Thank you for your March 3, 2020 letter regarding the draft test procedures for well W415 near Big Pine prepared by the Water Department last December. We are pleased that staff apparently agree on the general provisions of proposed test procedures for the initial period of operation of the well.

We understand that LADWP desires to operate W415 to supply the town needs and also provide make-up water for the Big Pine Irrigation and Improvement Association (BPIIA) ditch system The Water Department and LADWP agreed previously that pumping in excess of town water needs is essentially a "new well" and subject to Section VI of the Long Term Water Agreement (LWTA) and Section IV.B of the Green Book. We also recognize that the Water Agreement, as amended by the 2002 Stipulation and Order #12908, committed LADWP to provide surface and groundwater for the BPIIA from Big Pine Creek, W341 or W415, or a new well drilled in the Bell Canyon area.

Since November 2013, LADWP has addressed concerns raised by the Water Department on the monitoring and management of 415W. These include installation of additional monitoring wells, resolving questions regarding BPIIA use and loss calculations, and mapping vegetation near the 1872 fault. Results of the test would be used to assess the adequacy of LADWP's groundwater model and determine if operation of W415 is sufficient to supply the BPIIA ditch system and thus preclude the need to install the Bell Canyon well. Ultimately, the information developed by the proposed test would assist the Technical Group design long term monitoring for the operation of W415 to ensure the goals of the Water Agreement are met.

Water Department staff will contact LADWP staff to finalize the groundwater and vegetation monitoring provisions of the draft test procedures as suggested in your letter. We believe that the Technical Group must approve the test procedures before pumping begins to substitute for Green Book On/Off provisions and to comply with LTWA, Section VI.

If you have any questions, please contact the Water Department at 878-0001.

Sincerely,

Aaron Steinwand, Director
Inyo County Water Department

Cc: Inyo Board of Supervisors
Clint Quilter, County Administrator
Inyo County Water Commission
Marshall Rudolph, County Counsel

Proposed 6-month operational test of W415 pumping capacity in excess of Big Pine town water supply requirements,

Inyo County Water Department

December 13, 2019

Background

Several documents describe the history of W415 installation and conditions in the vicinity of the well. These include: the 2003 LADWP-adopted *Mitigated Negative Declaration-Big Pine Ditch System* (BPIIA MND), the 2007 *Evaluation of the Production Well W415 Replacing W341 in West Big Pine* (Hydrologic Evaluation), the 2011 *Delineation and Classification of Vegetation within the Ten-Foot Drawdown Contours for W415* (Vegetation Delineation), and the 2013 *Establishment of a Management Area and a Monitoring Site for Pumping of Well W415 in Excess of Domestic Needs* (M&M). Well W415 was drilled by LADWP in 2001 for the purpose of replacing groundwater pumped from aging W341 used to supply the Big Pine town water system (Figure 1). W415 has a pumping capacity of 1.8 cubic-feet-per-second (cfs) which is approximately 1.1 cfs more than W341. The Inyo/LA Water Agreement, as amended by the 2002 Stipulation and Order Number 12908, committed LADWP to providing surface and groundwater for use in the BPIIA ditch system. Sources for this water would come from Big Pine Creek, W341 or W415, or a new well drilled in the Bell Canyon area. LADWP monitors BPIIA water use by comparing the inflows (diversions) to the ditch system and subtracting the outflows (returns) from the system in an annual audit. BPIIA receives a 300 acre-foot (AF) surface water credit each year. Initial ditch flows began in 2005 and have occurred spring through fall to date. Through the 2018 season, total uses exceeded the total annual credit by 1,976 AF. No groundwater has been supplied to the project. Since 2011, annual uses have exceeded the annual credit by approximately 300 AF per year which equates to 1 cfs for 150 days per year.

LADWP agreed to evaluate W415's additional pumping capacity compared with W341 under the Water Agreement's Section VI provisions for new wells (2007 Hydrologic Evaluation). These provisions include evaluating the hydrologic setting and potential impacts to vegetation and non-LADWP-owned wells caused by groundwater pumping. LADWP completed an initial Hydrologic Evaluation in 2007. This evaluation highlighted the relatively unique circumstances surrounding W415. Namely, the well is situated between two fault zones: the 1872 Owens Valley Fault Zone (1872 Fault) to the east and the Baker Fault Zone to the west. Faults in the Owens Valley typically form lateral barriers to groundwater flow due to the creation of low permeability, fault gouge material in the fault zone. These parallel north-south striking fault zones break the area west of Big Pine into three blocks with groundwater flow impeded across the faults from west to east. For simplicity, the three hydrogeologic zones will be referred to as the west block (west of the Baker Fault), the central block (between the Baker and 1872 fault; the block where W415 is located) and the east block (the Owens Valley east of the 1872 Fault where the town of Big Pine is located). Based on data from monitoring wells, significant piezometric head differences exist across the three blocks, suggesting the two major fault zones act as hydrologic barriers to groundwater flow. A local-scale, MODLFOW groundwater model (West

Big Pine Groundwater Model) was developed in 2007 to evaluate the effects of pumping in the area. The model was particularly sensitive to the estimated hydraulic conductivity across the Baker and 1872 fault zones.

In LADWP's 2007 Hydrologic Evaluation, the West Big Pine Model simulated drawdown created by pumping W415 continuously, at full capacity (1.8 cfs) for three years. The 10-foot drawdown contour created by this pumping scenario was mapped according to Greenbook Section IV.B.1.b to identify potential impacts to vegetation. According to LADWP's 2011 Vegetation Delineation report, the 2007 field work identified Type A upland and Type E black locust woodland parcels within W415's area of influence and mapped a new vegetation parcel in the vicinity of Big Pine Creek and the 1872 fault. In its 2013 M&M Plan, LADWP established photo points for monitoring potential changes to this new vegetation parcel. In 2016, LADWP drilled five new monitoring wells, and converted a former domestic supply well into a monitoring well (Figure 1). In 2019 LADWP discussed with ICWD the concept to conduct an operational test for W415.

Make-up water for the Big Pine Irrigation and Improvement Association (BPIIA).

Since 2016, ICWD staff has conducted several field visits to BPIIA ditch-system gauging stations to independently verify flow amounts. Staff also compared BPIIA ditch loss rates to similar water conveyances in the Owens Valley and concluded that LADWP's flow gauging appears accurate and that ditch-loss rates are comparable to similar conveyances in the Owens Valley.

Hydrologic Conceptual Model and Recent Hydrologic Observations

Groundwater data exists from area monitoring wells beginning in 1987 (T686 and T691) or 2001 (T844 and T845). In 2016, LADWP installed five new monitoring wells (MWs) in the vicinity of W415 and also converted a former domestic well near the Big Pine Paiute Reservation to a MW. Three of these monitoring wells were installed in the central block and three in the east block to supplement data from existing area wells. Data for new wells, T936-940, and the converted domestic well, Vwatson, begin in 2017. Figures 2-4 present groundwater elevations over time in these monitoring wells.

Groundwater elevations for existing monitoring wells T844 and T845, located in the west block, range between 4,380-4,490 feet amsl (Figure 2). There is a hydraulic head difference of several hundred feet across the Baker Fault based on a comparison of T844 and T845 with T936 and T938 located to the east. Monitoring wells T936, T938, and T940 were drilled in the central block and have groundwater elevations between 4,020-4,100 feet above mean sea level (amsl) (Figure 3). New monitoring wells T937 and T939 were drilled in the east block and have groundwater elevations between 3,870-3,950 feet amsl similar to two nearby wells,T684 and T691 (Figure 4). Based on comparisons of T936 with T937 and T940 with T939, there is a difference in hydraulic head of approximately 150 feet from the central block to the east block across the 1872 Fault.

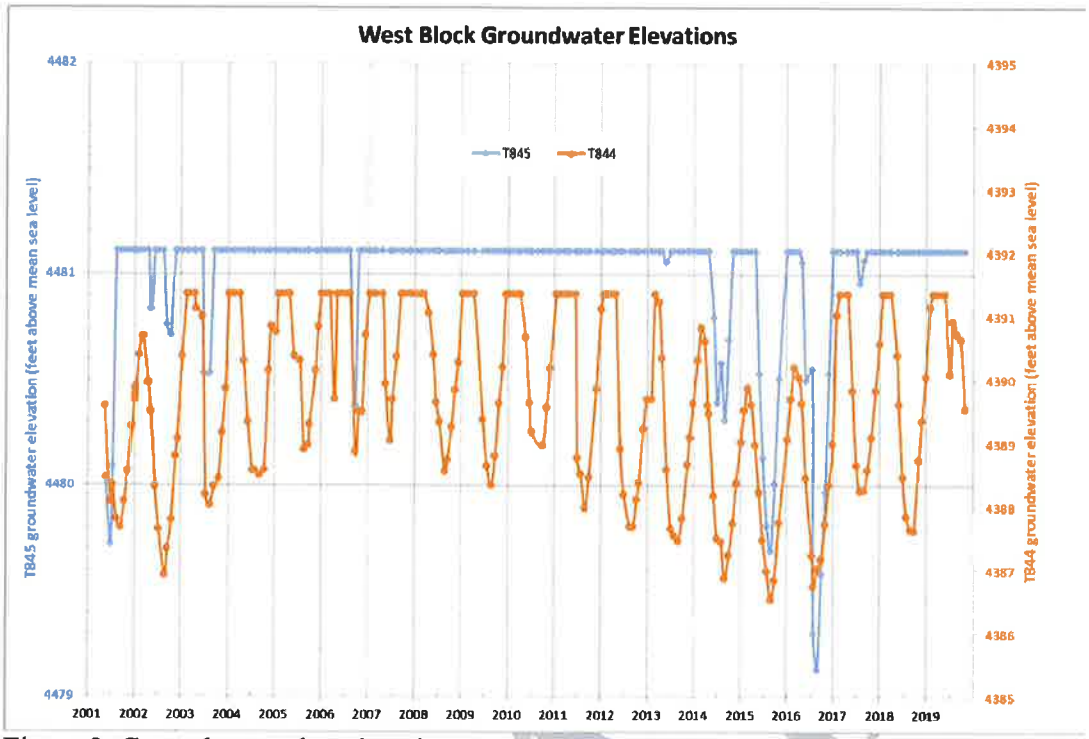


Figure 2. Groundwater elevations in West Block monitoring wells T844 and T845. T844 is artesian at approximately 4391.4 feet. T 845 is artesian at approximately 4481.1 feet.

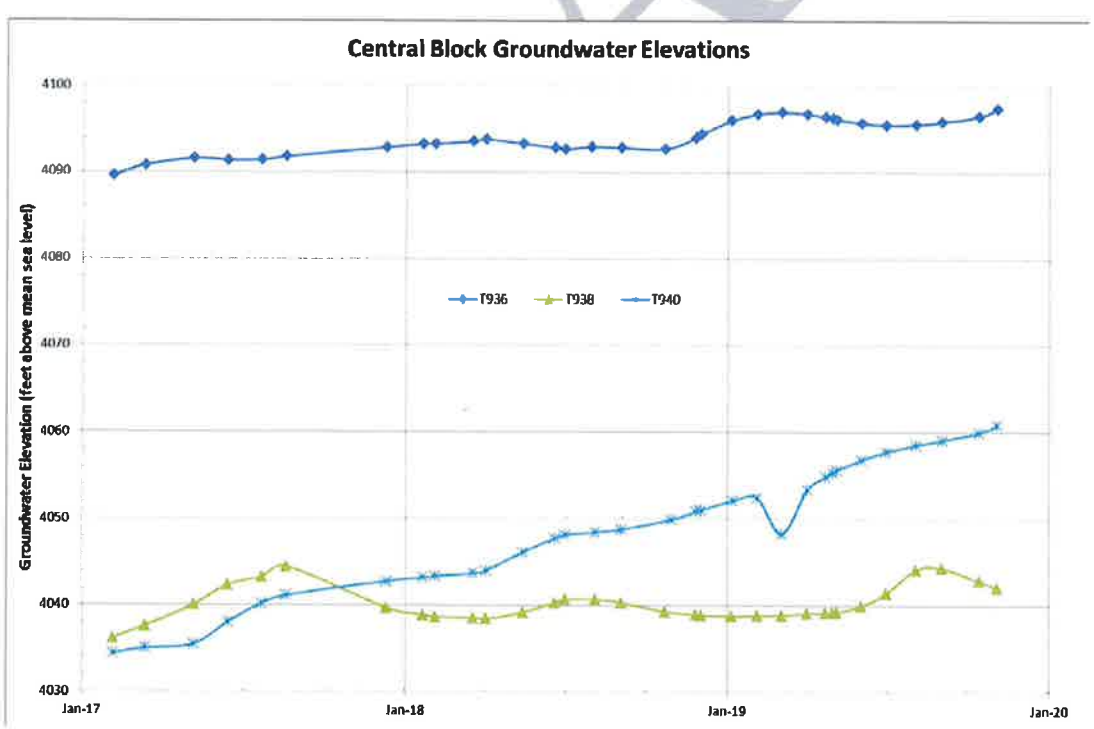


Figure 3. Groundwater elevations in Central Block monitoring wells T936, T938, T940.

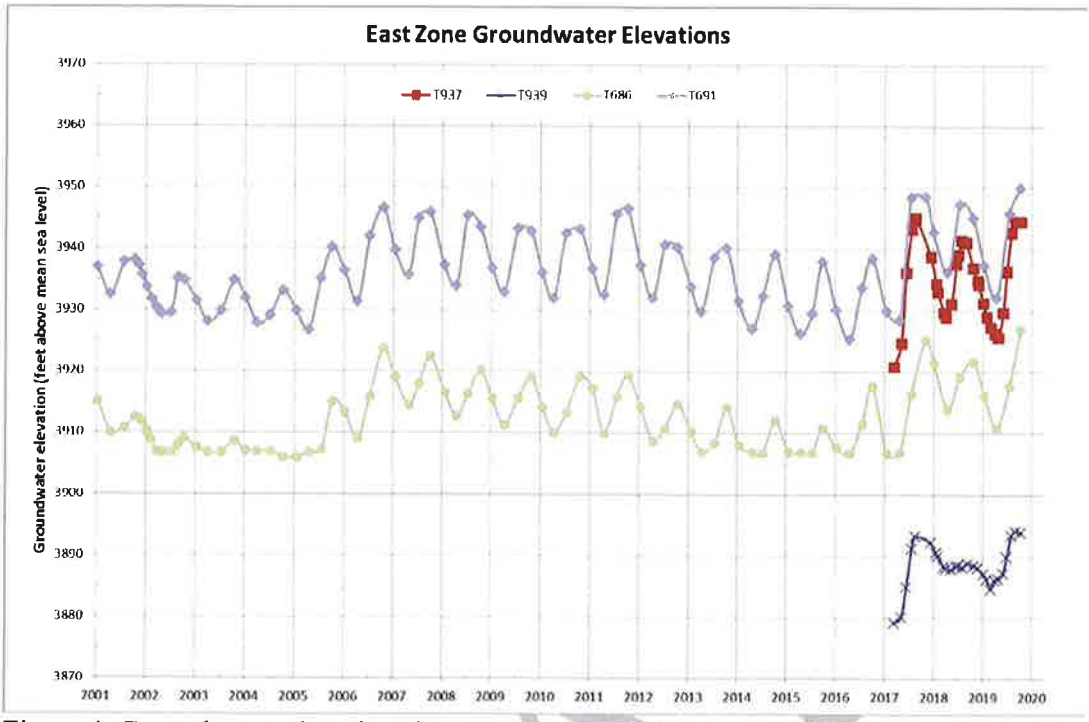


Figure 4. Groundwater elevations in East Zone monitoring wells T686, T691, T937 and T939.

Groundwater levels in the east block (Owens Valley floor) display notable seasonality (range of 10-20 feet annually) with shallowest groundwater during the fall after the irrigation and runoff season. Groundwater levels in the west block also exhibit seasonality (range of 2-4 feet annually) but with levels shallowest in spring before summer evapotranspiration demand peaks. In the central block, northernmost well T938 has annual groundwater fluctuations of 5-10 feet with shallowest levels in the late summer/fall. Groundwater levels in central block well T936, located between Bell Canyon and Big Pine Creek, has an annual pattern with shallowest groundwater in spring and with pumping stress evident in mid-summer. Overall, groundwater levels have trended upward in T936, rising 8 feet since 2017. Groundwater levels in central block well T940, the southern-most well, have had a multi-year rise of approximately 25 feet since 2017.

In the west block shallow groundwater is supported by seepage from surface flows in Big Pine Creek, Baker Creek, the Giroux ditch and irrigation, and by groundwater flow from the west impeded by the Baker Fault zone. Evapotranspiration demand is evident in T844 water levels within the west block and in surface water discharge flowing east to Bell Canyon and Baker Creek areas. In the central block groundwater depth ranges between 35 and 110 feet. Water levels are supported by seepage from Big Pine Creek, Baker Creek, the Rossi Ditch, and Bell Canyon surface flow. Surface water discharges from the central block to the east block via groundwater seepage across the exposed 1872 fault scarp. In the area of Big Pine, water levels are relatively deeper (80-130 feet) compared with lower areas of the valley floor to the east. The east block is affected by numerous surface water inputs, ET demand, pumping stress, and is characterized by general west to east and north to south groundwater flow.

There are three potential concerns associated with W415 pumping. The first concern is that pumping stress in the central block will communicate across the Baker Fault zone lowering shallow groundwater levels in the west block and impacting groundwater dependent vegetation. Due to the large difference in head across this fault zone, this scenario is unlikely, but monitoring T844 and T845 will determine if groundwater levels are being affected by additional pumping of W415.

The second concern is that pumping stress from W415 in the central block will communicate across the 1872 Fault at depth, causing water table drawdown that would affect phreatophytic vegetation or domestic wells in the east block. Groundwater east of the 1872 fault ranges from 40 feet bgs in the immediate proximity to Big Pine Creek to 130 feet bgs further north and south away from the creek. Groundwater levels in the east block are primarily below phreatophytic root zones and are affected by numerous other influences, including surface water flow and management, pumping, irrigation, and regional groundwater flow patterns. Due to the large head difference across this fault zone, it is unlikely that an additional 1 cfs of pumping will significantly affect groundwater levels in the east block, but monitoring wells T937, T686, T691and Vwatson will detect if this is occurring.

Finally, because pumping from W415 will occur in a relatively small fault block with limited recharge sources, drawdown caused by W415 pumping could have a larger area of influence in the central block as compared to other Owens Valley locations. Substantially lowering groundwater levels in the central bock could potentially lead to a reduction in shallow groundwater discharge to springs and seeps along the crest of the 1872 Fault or at other areas in the central block where groundwater flow is restricted by subsidiary north-south striking faults. A combination of groundwater monitoring at T936, T938 and T940 and vegetation monitoring at select locations will be implemented.

Recent Vegetation Observations and Monitoring

ICWD has identified several locations for vegetation monitoring including areas in the west and central blocks and along the 1872 fault scarp. Pumping in these blocks has been minimal or relatively constant and vegetation fluctuations largely controlled by fire and drought. We suggest conducting vegetation monitoring that combines satellite imagery-based monitoring, along with supplementary photo points and field monitoring to verify any potential changes in remotely sensed vegetation indices in areas where vegetation is potentially affected by groundwater declines. Satellite imagery-derived spectral ratios such as the Normalized Difference Vegetation Index (NDVI) will be used to monitor vegetation for specific areas with reference to the area's historical range of variability over the 36-year history. The lowest NDVI values over the Landsat history for parcels in the vicinity are coincident with drought or wildfire years. If NDVI levels drop below a threshold near historic lows, additional field monitoring will be conducted to perform ground truth and to determine the cause of vegetation decline.

Parcels recommended to be monitored with the NDVI historical range of variability method include BGP119, 122, 123, 124, 125 in the west block; portions of parcels BGP 115, 116, 117, 118, 126, 127 in the central block; and BGP114 and the Type E black locust woodland (Holland

code 76100) along the 1872 fault scarp. Photo points and transects will be established within these parcels in spring 2020.

In the west block, seepage from Big Pine Creek, Baker Creek, and Giroux ditch along with groundwater discharge support riparian and meadow vegetation in parcels BGP 119, 122, 123, 124 and 125 including rare plant sites. This area burned in 2007. In the central block, surface water dependent riparian vegetation along Bell Canyon, Little and Big Pine creeks and potential groundwater-dependent vegetation in parcels BGP 117/118 are of interest (locust trees along unnamed faults near Baker Cr. road). These areas were also partially burned in the 2012 and 2014 fires. Along the 1872 Fault, parcel BGP 114 and the 2007 LADWP-mapped black locust woodland parcel contain groundwater dependent vegetation. Parcel BGP114 contains tree willow (*Salix laevigata*, *Salix goodingii*) and cottonwood (*Populous fremontii*), and likely receives groundwater discharge across the 1872 fault. This parcel was partially burned in 2014.

In the spring of 2020, permanent line-point intercept transects with 3 height classes (low vegetation less than 1m, mid-story 1-3m, canopy greater than 3m) will be used to characterize the existing vegetation community composition within BGP 114 and other parcels or areas needing compositional characterization. If satellite-detected NDVI values drops below the threshold value for the given area, these transects would be revisited to verify any change in vegetation cover and to quantify changes in vegetation composition. Photo points would also be established to qualitatively monitor vegetation and revisited if NDVI reference values are exceeded.

Due to differing hydrologic and vegetation conditions encountered in each fault-bounded block and varying levels of disturbances such as wildlife throughout the management area, the vegetation thresholds will be unique relative to each area's natural range of variability including response to previous disturbances. ICWD recommends an NDVI monitoring threshold for BGP 114 be set at 0.3. NDVI values have been greater than this threshold in years without wildfire or drought. Values below this threshold are unlikely to be reached due to low runoff alone (Figure 4). Similarly, ICWD recommends an NDVI monitoring threshold for Type E BGP 119 (Figure 5) and Type D BGP122 (Figure 6) be set at 0.46, just above the 2013-2015 drought-induced NDVI lows. If successful, ICWD proposes to use this monitoring and threshold method both during the operational test and long-term pumping of W415's non-exempt pumping capacity.

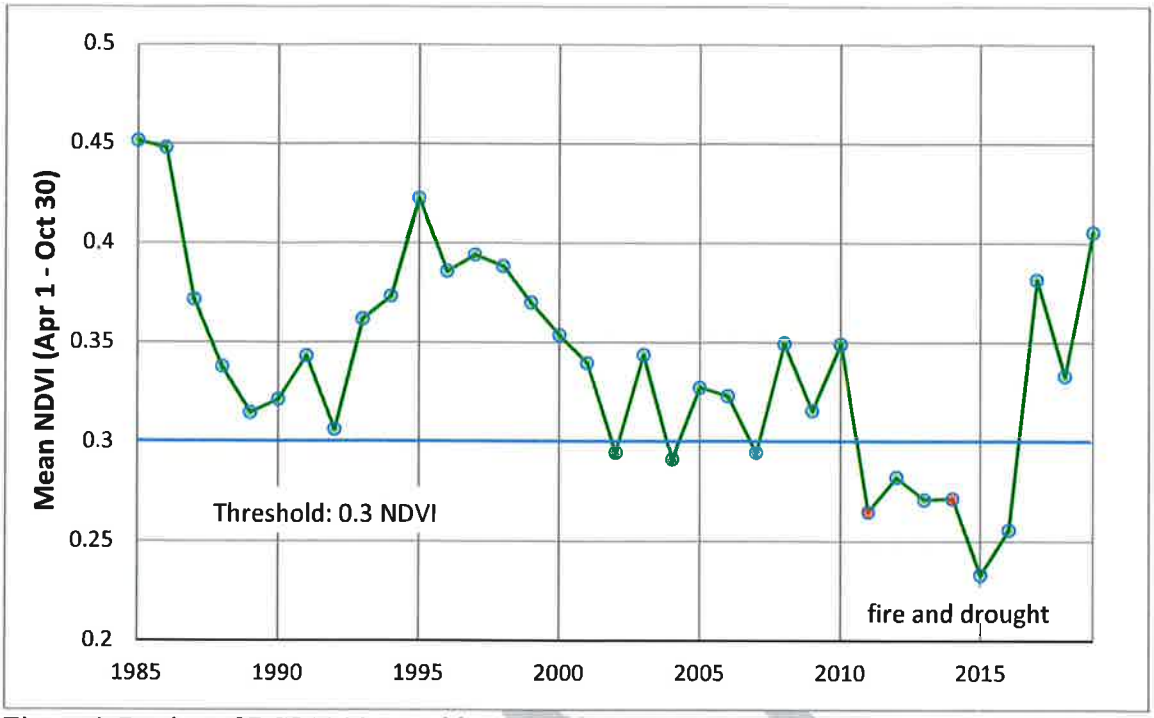


Figure 4. Portion of BGP114 NDVI history. Reference NDVI 0.3 set above values associated with effects of wildfire and multi-year drought.

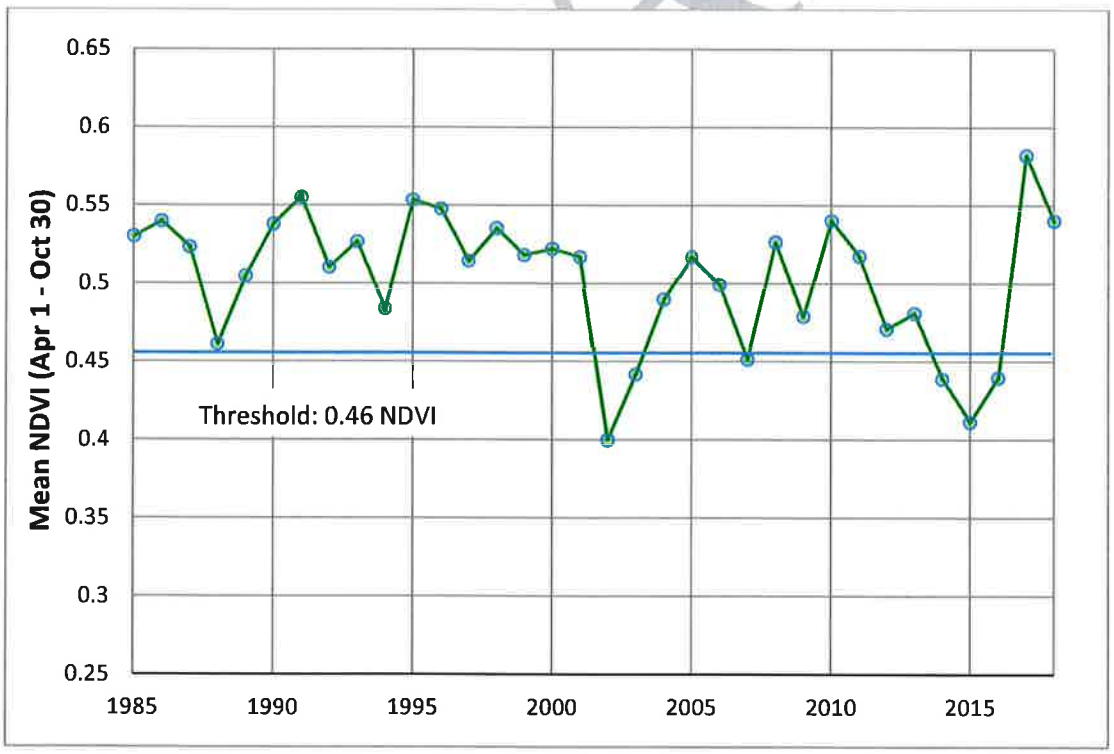


Figure 5. BGP 119 NDVI history. Reference NDVI = 0.46, set above values associated with effects of wildfire and multi-year drought.

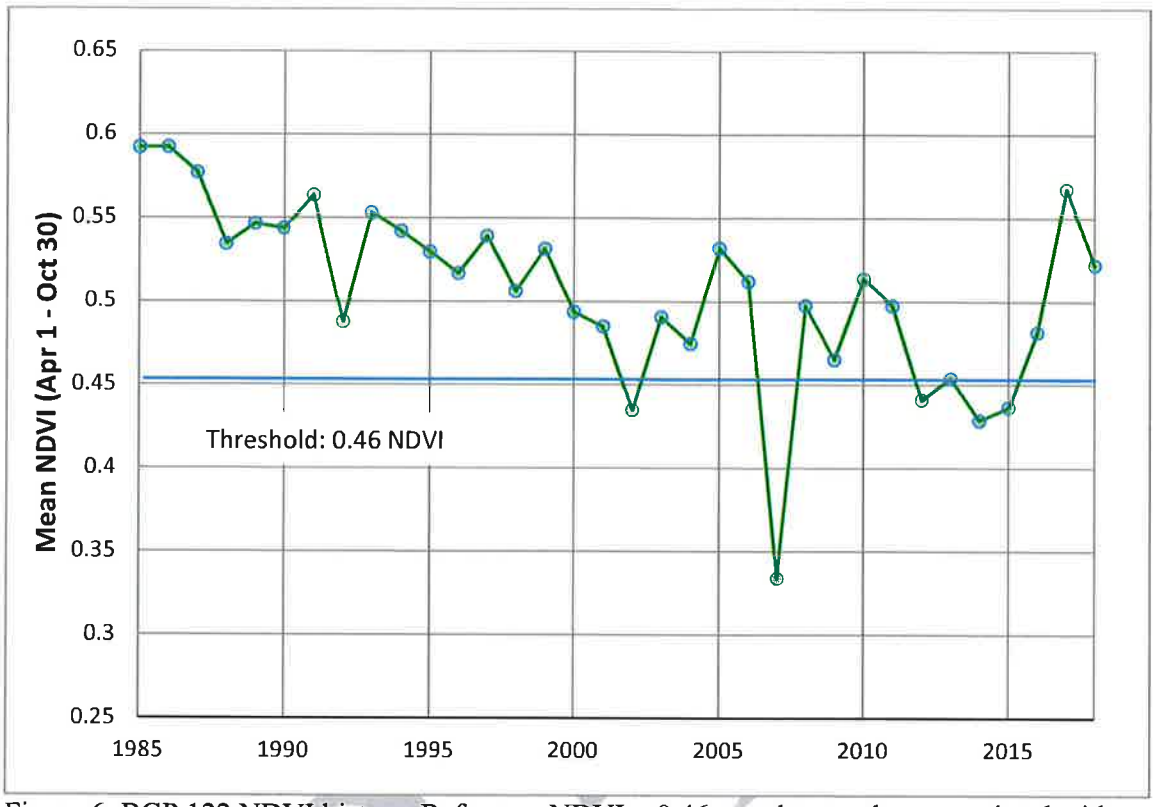


Figure 6. BGP 122 NDVI history. Reference NDVI = 0.46, set above values associated with effects of wildfire and multi-year drought.

Proposed W415 Operational Test and Associated Monitoring.

A proposed operations test would pump W415 at maximum capacity (1.8 cfs) for up to 6 months to test the effectiveness of the fault zones as hydraulic barriers, to examine the effects of various boundary conditions on drawdown in the central block, and to generate sufficient data for use in groundwater model calibration. At the completion of the operations test, data would be used to update the West Big Pine Model and to simulate the effects of potential long-term W415 pumping scenarios.

ICWD staff agrees with LADWP's overall assessment that the 1872 Fault to the east and the Baker Fault to the west will focus drawdown from W415 to the area between the faults. This assessment is supported by the significant groundwater elevation differences measured across each fault zone. However, similar to the conclusions reached in recent studies at Owens Lake, the permeability of high-angle faults relative to lateral flow is a critical factor controlling the effect of pumping on resources across the fault. The initial testing and hydrologic monitoring for W415 should be aimed at detecting the degree to which drawdown does or does not propagate across the faults to potentially affect resources outside of the fault-bounded area, such as

groundwater-dependent vegetation in the Baker Creek area to the west, vegetation along the 1872 Fault scarp to the east, and wells on the Big Pine Paiute Tribe Reservation to the east.

Initial testing and monitoring should also be aimed at quantifying the drawdown within the central block and avoiding potential effects to phreatophytic or riparian vegetation in this area. Data from the test should be used to refine hydrologic properties such as transmissivity, storage coefficients, and seepage rates in the central block to update and calibrate the West Big Pine model.

The primary monitoring wells for the test will be T936-T940, Vwatson, T844, T845, T686 and T691. Wells T844 and T845 should be modified to measure artesian head, if necessary (e.g., casing extended or capped and equipped with valves for pressure readings). Where possible, these wells should be equipped with data-logging pressure transducers set to record at 6-hour intervals. Existing LADWP flow monitoring in the area (Big Pine Creek 2052, Little Big Pine Creek 2051, Giroux Ditch 2049, Baker Creek 2064, Rossi Ditch 2007, etc.) is adequate and should continue. Visual observations of Bell Canyon flow at Glacier Lodge Road should also be made during the test.

Groundwater Triggers Levels for 6-Month Operational Test.

In order to protect phreatophytic vegetation and non-LADWP wells, the following hydrologic triggers are proposed for the 6-month operational test. If a trigger is reached, pumping above town supply demands would stop, monitoring for recovery would begin, and groundwater model update and calibration would be completed. Utilizing the trigger levels for the initial operation of W415 will be limited only to the six-month pumping test period. This monitoring and management plan is neither an endorsement nor a limitation on the use of trigger levels for future testing and management of pumping operation of W415.

A number of hydrologic factors can affect groundwater levels, including variations in recharge, surface flow, irrigation, pumping, ET demand, seismic events, etc. ICWD recommends setting groundwater triggers that are within the historic range of depth-to-water measured in area monitoring wells. Triggers should consider current DTWs, potential annual deviations caused by runoff/recharge variance, and potential impacts to sensitive resources. The goal of the triggers is to allow a responsible pumping test to proceed without impacting sensitive resources. Although a uniform system for setting triggers is preferred, the differing hydrologic and resource conditions encountered in each fault-bounded block dictate customization while adhering to the primary goal.

In the west block, groundwater levels in both T844 and T845 declined during the severe, 2012-2016 drought when runoff was less than 60% of the long-term average for four consecutive years. Groundwater levels in these wells recovered to historic norms in 2017 in part due to abnormally high runoff.

Groundwater in T844 is currently (November 2019) 0.15 feet below ground surface (feet bgs) but has been as deep as 2.2, 2.8, and 3.2 feet bgs, respectively, during the 2013-2015 summers. No significant or permanent impacts to vegetation were observed from these runoff driven

declines in groundwater levels as evidenced by the NDVI history of parcel BGP122, which encompasses much of the west block vegetation and which shows post drought recovery (Figure 6). ICWD recommends a trigger for T844 set at 2.8 feet bgs, corresponding to GWE of 4386.9 feet amsl. This trigger would keep water levels within the rooting depth of alkali meadow phreatophytes (including rare plant species), within the natural range of variability, and is unlikely to be exceeded due to a single year of abnormally low runoff.

Groundwater in T845 is currently (November 2019) artesian, but dropped to 0.6 feet bgs in 2016 (the final year of the drought). No significant or permanent impacts to vegetation were observed from this natural decline in groundwater levels as evidenced by the NDVI history of parcel BGP122 showing post-drought recovery. ICWD recommends a trigger for T845 set at 0 feet bgs (2015 low), corresponding to a GWE of 4479.7 feet amsl. This trigger would keep water levels within the rooting depth of alkali meadow phreatophytes (including rare plant species), within the natural range of variability, and is unlikely to be exceeded due to a single year of abnormally low runoff.

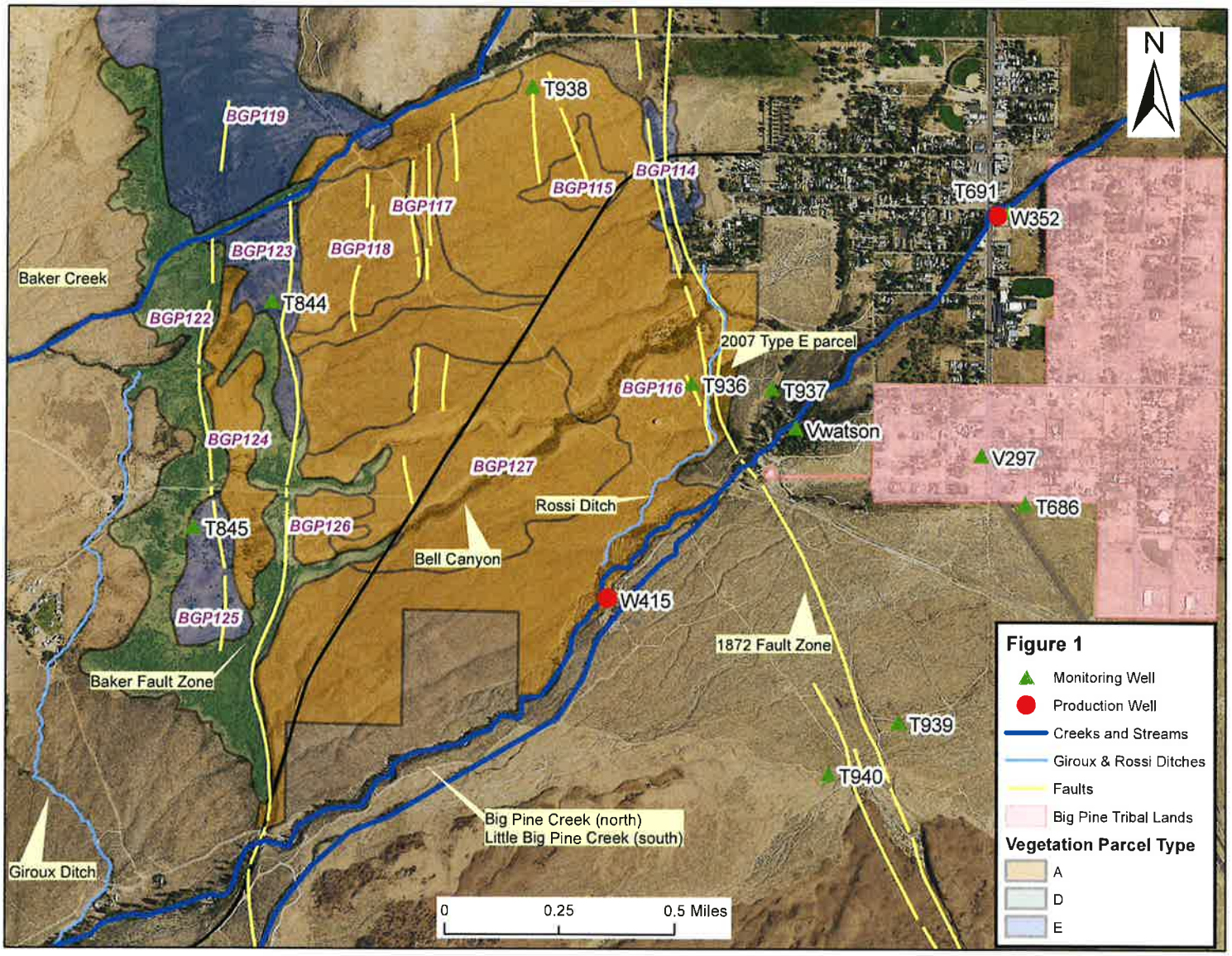
Groundwater levels in all three monitoring wells in the central block have risen since the first measurements were recorded in February 2017, presumably responding to increased recharge from 2017 through 2019. Monitoring well T936 is located between W415 and parcel BGP114's groundwater dependent vegetation along the 1872 Fault scarp and will provide an upgradient trigger to protect this vegetation. As noted previously, the riparian vegetation along this portion of the 1872 seepage face was altered by fires in 2012 and 2014, but phreatophytic vegetation persisted through the drought as evidenced by the NDVI history for a portion of BGP114. Groundwater in T936 is currently (November 2019) 37.7 feet bgs and was 45.5 feet bgs in February 2017. ICWD recommends a trigger for T936 set at 42.3 feet bgs (2018 low), corresponding to a GWE of 4092.7. This trigger would keep water levels within the natural range of variability, at or above the surface elevation of the 1872 seepage face, and is unlikely to be exceeded due to a single year of abnormally low runoff.

Groundwater levels in the east block display relatively large seasonal variability (10-20 feet annually) but have risen from summer 2016 lows due the ensuing favorable runoff years. Groundwater levels in the east block are well below phreatophytic vegetation rooting depths; therefore, the most sensitive resource to consider is non-LADWP-owned production wells. Monitoring well T937 is located across the 1872 Fault from T936, is closer to W415 pumping than Big Pine Paiute Reservation Wells, and is north of Big Pine Creek. Monitoring well T686 is located further east of T937, south of Big Pine Creek, and down gradient from T937. These two monitoring wells bracket Big Pine Paiute Tribal wells. For the past three years, groundwater levels in T937 have closely paralleled nearby east block monitoring wells T686 and T691. These are existing monitoring wells with more than 30 years of data. Groundwater levels in T686 and T691 during their seasonal low in April 2019 were similar to annual lows during the 2006-2012 time period.

ICWD recommends a trigger for T686 set at 98.8 feet bgs equal to the 2013 low in the second year of the drought and corresponding to a GWE of 3906.9 feet amsl. This trigger would keep water levels within the natural range of variability and is unlikely to be exceeded due to a single year of abnormally low runoff. ICWD recommends a trigger for T937 set at 126.2 feet bgs equal

to four feet below the 2019 low and corresponding to a GWE of 3921.6 feet amsl. This trigger would keep water levels within the natural range of variability and is unlikely to be exceeded due to a single year of abnormally low runoff.

If possible, domestic supply wells on the Big Pine Paiute Reservation (wells V021N, V022N, and V299) could be monitored during the initial operation of W415. Other monitoring wells and baseline data may be available if the Big Pine Paiute Tribe is agreeable to sharing such data. However, several monitoring wells (T691, T686, Vwatson, and T937) provide representative hydrologic data in this area.


N
T938
BGP119
BGP114
BGP115
BGP117
T691
W352
BGP123
BGP118
Baker Creek
T844
BGP122
2007 Type E parcel
BGP116
T936
T937
Vwatson
BGP124
BGP127
V297
Rossi Ditch
T686
T845
BGP126
Bell Canyon
W415
BGP125
1872 Fault Zone
Baker Fault Zone
T939
T940
Big Pine Creek (north)
Little Big Pine Creek (south)
Giroux Ditch
0
0.25
0.5 Miles
Figure 1
Monitoring Well
Production Well
Creeks and Streams
Giroux & Rossi Ditches
Faults
Big Pine Tribal Lands
Vegetation Parcel Type
A
D
E