

FINAL

**FIFTH FIVE-YEAR SUMMARY REPORT
(JANUARY 2019 THROUGH DECEMBER 2023)
(DECEMBER, 2024)**

PREPARED FOR:

Cadiz, Inc.

DECEMBER 5, 2024

PREPARED BY:

GEOSCIENCE Support Services, Inc., Ground Water Resources Development
P.O. Box 220, Claremont, CA 91711 | P: 909.451.6650 | F: 909.451.6638 | www.gssiwater.com

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Logan Wicks, PG
Senior Geohydrologist
PG No. 9580

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CADIZ, INC.

FIFTH FIVE-YEAR SUMMARY REPORT (January 2019 through December 2023)

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A	Monthly Groundwater Extraction Totals
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Acronyms, Abbreviations, and Initialisms

Abbrev.	Description
AFY	acre-feet per year
amsl	above mean sea level
BCM	Basin Characterization Model
bgs	below ground surface
CaCl	calcium chloride
Cadiz	Cadiz, Inc.
CEQA	California Environmental Quality Act
County	San Bernardino County
DRI	Desert Research Institute
DWR	California Department of Water Resources
EC	electrical conductivity
ESA	European Space Agency
FEIR	Final Environmental Impact Report
ft	foot, or feet
Geoscience	Geoscience Support Services, Inc.
gpm	gallons per minute
GPS	global positioning system
GWMP	Groundwater Monitoring Plan
GMMMP	Groundwater Management, Monitoring, and Mitigation Plan
InSAR	Interferometric Synthetic Aperture Radar
JBA	Joseph E. Bonadiman & Associates, Inc.
mg/L	milligrams per liter
MWD	Metropolitan Water District of Southern California
NaCl	sodium chloride
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
SGMA	Sustainable Groundwater Management Act
SMWD	Santa Margarita Water District
TDS	total dissolved solids
Towill	Towill, Inc.
TRE	TRE ALTAMRA Inc.
TRP	Technical Review Panel
URS	URS Consultants, Inc.
USGS	United States Geological Survey
Water Project	Cadiz Valley Water Conservation, Recovery, and Storage Project

CADIZ, INC.

FIFTH FIVE-YEAR SUMMARY REPORT (January 2019 through December 2023)

1.0 Executive Summary

This Fifth Five-Year Monitoring Report was completed in accordance with recommendations presented in the 1993 Final Environmental Impact Report (FEIR) developed by URS Consultants, Inc. (URS) for the Cadiz Valley Agricultural Development, Cadiz, Inc. (Cadiz) and required by San Bernardino County (County). In compliance with the County-approved 1993 FEIR, which requires monitoring of groundwater levels, electrical conductivity of groundwater, groundwater extraction, and changes in land surface elevation, a Groundwater Monitoring Plan (GWMP), was prepared and submitted to the County by Geoscience Support Services, Inc. (Geoscience) on July 24, 1997, which was also approved by the County Planning Department in 1997. In accordance with the GWMP and County requirements, the first two Five-Year Summary Reports have been submitted to the County for the five years prior to 2003 and 2008. A comprehensive groundwater assessment was also completed as part of the Cadiz Valley Water, Conservation, Recovery and Storage Project (Water Project) Environmental Impact Report in 2012¹, which included required monitoring data from 2008 through 2012 and was accepted as the Third Five-Year Report. Subsequently, the Fourth Five-Year Summary Report was submitted to the County in 2020 for the period from January 2013 through December 2018. This report will serve as the Fifth Five-Year Summary Report, which provides a summary, comparison, and analysis of all monitoring data collected during the period from January 2019 through December 2023.

Key findings and conclusions for the period from January 2019 through December 2023 are as follows:

- Total production increased each year from 2019 through 2022 and ranged from 2,948 to 8,068 acre-feet per year (AFY). In 2023, production decreased to 6,134 AFY. The general increase in total groundwater extraction is associated with the increase in total irrigated farming acreage.
- Variations in groundwater elevations measured in the irrigation wells are within normal ranges expected during seasonal pumping and recovery cycles.
- Groundwater elevations in most Group 1 Wells exhibit a response to increased production. However, data indicate that groundwater production of approximately 8,000 AFY in Cadiz has a negligible impact on static water levels in the aquifer immediately surrounding the wellfield. Monitoring wells outside of the wellfield and beyond the area of influence of pumping wells show

¹ Complete 2012 Water Project Final Environmental Impact Report (FEIR) available at:
<https://www.cadizwaterproject.com/public-environmental-review/>

groundwater levels have not fluctuated significantly over the long-term. As a result, fluctuations in water levels reflect natural variations in recharge (i.e. wet and dry cycles).

- No significant changes in groundwater quality were reported during the five-year reporting period. Generally, total dissolved solids (TDS) concentrations in Group 1 wells are relatively stable.
- Land surface elevation surveys were conducted in 2021, 2022, and 2023. Results from the land surface elevation surveys indicate that all NAVD88 elevations are similar to previous surveys, and no evidence of subsidence since 1997 (baseline year) has been observed.
- Based on the groundwater conditions observed during this monitoring period, irrigation pumping by the Cadiz Valley Agricultural Development has not resulted in any significant changes or adverse impacts to groundwater levels, change in storage, groundwater quality, or land surface stability.

2.0 Introduction

Cadiz, Inc. (Cadiz) is working with water agencies in Southern California to develop the Cadiz Valley Water, Conservation, Recovery and Storage Project (Water Project). The fundamental purpose of the Water Project is to conserve and recover up to 50,0000 acre-feet per year (AFY) of groundwater that would otherwise evaporate from dry lakes downgradient of the project without adverse impacts to the environment (ESA, 2012a). The Project will provide the remote and underserved communities in San Bernardino County with a necessary and reliable water supply from a wellfield south-southwest of the Fenner Gap area (Figure 1).

As part of the Water Project development process, Geoscience Support Services, Inc. (Geoscience) presents this Fifth Five-Year Summary Report (January 2019 – December 2023). This report has been prepared in compliance with the Groundwater Monitoring Plan (GWMP) submitted by Cadiz on May 1, 1997, and accepted by the San Bernardino County (County) Planning Department. The GWMP addresses groundwater monitoring requirements specified in the Final Environmental Impact Report (FEIR), entitled “Findings, Facts in Support of Findings, and Statement of Overriding Considerations Regarding Final Environmental Impact Report for Cadiz Valley Agricultural Development, County of San Bernardino” (URS, 1993).

After County approvals of the GWMP in 1997, and since 2009, Cadiz has been working with water agencies in Southern California to develop the Water Project. Santa Margarita Water District (SMWD) became the lead agency for California Environmental Quality Act (CEQA) compliance and certified the Water Project FEIR on July 31, 2012. The County approved the FEIR and the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP)² on October 1, 2012. The GMMMP outlines specific management, monitoring, and mitigation guidelines for the Water Project, including pre-operational monitoring activities. The GMMMP also provides specific significance criteria for the Water Project, which will be applied to the Cadiz Valley Agricultural Development in a transition period from the GWMP to the GMMMP. The GMMMP is intended to replace the GWMP as Cadiz transitions the use of groundwater from irrigated agriculture to the Water Project. Additionally, the Draft GMMMP Implementation Work Plan (GMMMP Addendum 1) was prepared and submitted to a technical review panel (TRP)³ for review in June 2024.

The GMMMP Implementation Work Plan supplements the GMMMP and presents the approach for implementing the Project. This Fifth Five-Year Monitoring Report is being submitted in compliance with the GWMP. However, additional monitoring features, including planned production wells and planned survey points, are shown on Figures 2 and 3, respectively, to provide an understanding of how the monitoring network discussed in this report will be expanded during the transition toward the GMMMP.

As described in previous reports, after the Water Project passed the CEQA-required FEIR, continued geologic and hydrogeologic investigations in the Fenner Valley have been undertaken to support the FEIR conclusions. Dr. Miles Kenney (2011) presented findings regarding detailed geologic mapping of the

² The updated GMMMP is available at: http://www.cadizwaterproject.com/wp-content/uploads/2015/07/V7_Appx-B1-UPDATED-GMMMP.pdf.

³ A TRP was developed for the Water Project in 2022 and includes technical representatives from County, SMWD, and a jointly selected third technical representative.

Fenner Gap area. CH2M Hill (2010) presented an updated assessment of recharge to Fenner and Orange Blossom Wash Watershed areas, as well as an assessment of evaporative discharges from Bristol and Cadiz Dry Lakes. The CH2M Hill study included measurements of evaporation at the dry lakes taken by the Desert Research Institute (DRI). Geoscience (2011) conducted detailed groundwater flow and solute transport, and subsidence modeling. These model runs assess potential impacts to groundwater levels, groundwater quality, and land subsidence that may be caused by groundwater extraction and storage during the active phase of the Water Project. Dr. David Groeneveld completed two assessments – one of potential impacts to vegetation, and a second for the potential for dust generation due to lowered groundwater levels in the vicinity of the project (Hydrobio, 2012). These assessments are included in the FEIR in Appendix E2, Fugitive Dust and Effects from Changing Water Table at Bristol and Cadiz Playas; Appendix F4, Vegetation, Groundwater Levels and Potential Impacts from Groundwater Pumping near Bristol and Cadiz Playas; and Appendix H, Hydrology Reports. These assessments represent the most up-to-date evaluation of groundwater conditions in the area. Additionally, these assessments fulfill (and exceed) the GWMP's requirement to prepare a comprehensive five-year hydrogeologic report that re-analyzes the basin (to create a comprehensive and revised monitoring plan) and establishes significance criteria. The County-approved GMMMP is based on findings from these assessments.

As per County requirements and mitigation and monitoring recommendations outlined in the FEIR, this report summarizes five-year changes in groundwater production, groundwater elevation, groundwater quality, groundwater storage and recharge, and land surface elevation.

2.1 Purpose and Scope

In accordance with the GWMP, the purpose and scope of this report is to summarize and compare monitoring data during the period from January 2019 through December 2023, including:

- Analysis of static groundwater level data over the report period and comparison to baseline⁴ conditions;
- Analysis of groundwater quality data over the report period and comparison to baseline conditions;
- Compilation and discussion of groundwater extraction data for the reporting period;
- Discussion of changes in land surface elevation, if present, for the reporting period;
- Discussion of potential impacts regarding water levels, water quality, and subsidence; and
- Presentation of updated estimates of natural groundwater recharge to the Water Project area.

In preparation for the transition from GWMP to GMMMP and GMMMP Work Plan reporting, this report includes groundwater level data from additional monitoring wells which will be used to establish an additional baseline for the Water Project.

⁴ Baseline conditions are considered to be the average conditions of water level and quality from December 1995 through December 1996.

2.2 Location of Study Area

The Cadiz Valley Agricultural Development (the study area) is in the Cadiz and Fenner Valleys, approximately 200 miles east of Los Angeles and 60 miles northeast of Twentynine Palms, within San Bernardino County, California (Figure 1). The Cadiz Valley Agricultural Development includes approximately 34,000 acres of land located between the Marble and Ship Mountains, approximately 1,145 acres of which was irrigated farmland⁵.

2.3 Monitoring Network

Monitoring conducted during the five-year reporting period (2019 – 2023) includes data inputs from the monitoring well network and the land surface survey monitoring network. The monitoring well network and the land surface survey monitoring network are shown on Figures 1, 2, and 3, and are discussed in the following subsections. The GMMMP Implementation Work Plan describes the plan to monitor additional features, as discussed in Section 2.3.3.

2.3.1 Monitoring Well Network

In compliance with the GWMP, Well 5/14-13⁶ has been designated in the Fenner Gap area to provide groundwater monitoring upgradient from Cadiz's agricultural wellfield and is part of the original GWMP monitoring network (Figure 1). As part of the transition to the GMMMP, 20 other sites are monitored quarterly for groundwater levels throughout the Gap area. Well SCE-5 has been designated as an additional monitoring well. SCE-5 was not a part of the original GWMP monitoring network but has been added to "Group 1 Wells", as discussed below. SCE-5 is in the Orange Blossom Wash, between the agricultural wellfield and Bristol Dry Lake, and will provide early indication of potential migration of groundwater with elevated levels of total dissolved solids (TDS) towards the agricultural wellfield from the area of Bristol Dry Lake. Cadiz plans to drill and construct a deeper monitoring well near SCE-5 to assist with depth-specific monitoring as part of the continued transition to the GMMMP in the near future.

"Group 1 Wells" include the seven irrigation wells (21N, 21S, 22, 27N, 27S, 28, and 33) and one monitoring well (5/14-13) originally established as part of the GWMP monitoring network (Geoscience, 1997). The monitoring network was expanded in 2012 with the creation of the GMMMP (ESA, 2012b) to include a total of 47 monitoring locations throughout the Cadiz and Fenner Valleys. Two of the original Group 1 irrigation wells – Cadiz Well 28 and Cadiz Well 27N – have been permanently taken off-line and are now strictly used for monitoring purposes (i.e., no groundwater extraction). In addition, three irrigation wells (Wells 34, 35, and 26) constructed in 2019 - 2020 have been classified as Group 1 Wells. Construction details for the three wells are provided in Table 1. During agricultural operations in late 2022, well SCE-17 appears to have been destroyed and/or buried. Efforts to locate SCE-17 are ongoing. Therefore, the monitoring network for the five-year period included a total of 50 monitoring locations. All monitoring network wells are identified in Table 1 and shown on Figures 1 and 2.

⁵ Irrigated acreage expanded from 795 to 1,145 acres during the reporting period (2019 through 2023).

⁶ Some of the monitoring wells and all of the irrigation wells are, in part, named according to their corresponding Township and Range (e.g., 5/14-13 = Township 05N Range 14E Section 13 San Bernardino Baseline and Meridian, or 21N = northern area of Section 21).

2.3.2 Land Surface Survey Monitoring Network

Joseph E. Bonadiman & Associates, Inc. (JBA) performed a baseline land surface survey of the Cadiz irrigation wells and the designated monitoring well 5/14-13 in December 1997. These baseline elevation data are presented in previous Annual Reports (e.g., Foreman, 2016). JBA conducted subsequent surveys in 1999, 2000, 2001, 2002, 2007, 2010, 2013, 2014, and 2015 to continue to monitor the study area for land subsidence. As per the GMMMP, the land subsidence monitoring program will be expanded – including the establishment of a baseline condition as part of the pre-operational monitoring activities – before groundwater pumping begins for the Water Project. As a part of this transition, a new base reference station has been established in the Marble Mountains for use in future subsidence surveys, as described in the Seventeenth Annual Report (Foreman, 2015). In addition, Cadiz established five new land subsidence control points in 2015 as part of an ongoing transition from the GWMP to the GMMMP.

Towill, Inc. (Towill) surveyed all original eight wells and the five new survey monuments in December 2016, 2017, 2018 and JBA surveyed in 2021. Land surface surveys were not conducted in 2019 and 2020 due to scheduling conflicts and the Coronavirus Disease 2019 (COVID-19). JBA surveyed the 13 survey monuments and an additional three new wells in October 2022 and December 2023. The land survey data are presented and described in Section 7.0 of this report, the Fourth Five-Year Summary Report (Geoscience, 2020), Appendix H of the FEIR (ESA, 2012a), and the Cadiz Valley Agricultural Development Annual Monitoring Reports.

2.3.3 GMMMP and GMMMP Implementation Work Plan Updates

As discussed in Section 2.1, monitoring described in the GMMMP and GMMMP Implementation Work Plan will replace GWMP monitoring when Cadiz transitions the use of groundwater from irrigated agriculture to the Water Project. The GMMMP Work Plan discusses 16 monitoring features that will provide data inputs to support Project goals during the pre-operational and operational Project phases. The pre-operational phase is one year before Project pumping begins, and the operational phase describes the 50-year project pumping period. Monitoring features include: 1) springs, 2) monitoring wells, 3) Project area monitoring well clusters, 4) Project production wells, 5) land surface surveys, 6) Interferometric Synthetic Aperture Radar (InSAR), 7) extensometers, 8) flowmeter surveys, 9) monitoring well clusters near Bristol Dry Lake, 10) monitoring well clusters near Cadiz Dry Lake, 11) geophysical surveys, 12) borehole geophysical logs, 13) salinity profiles, 14) weather stations, 15) air monitoring stations, and 16) project area vegetation.

In addition to data inputs described in Sections 2.3.1 and 2.3.2, additional monitoring data have been collected for the last nine years in preparation for the transition to the Water Project. Table 2-1 lists data inputs beyond the scope of the GWMP that have been monitored, provides the date monitoring started, and monitoring frequency.

Table 2-1. Additional Monitoring Features

Monitoring Feature	Monitoring Start Date	Frequency
Spring Monitoring	2018	Quarterly
InSAR	2015	Quarterly
Borehole Geophysics ¹	NA	NA
Weather Stations	Unknown	Continuous

Notes:

NA Not Applicable

1. Borehole geophysics are conducted during the installation of new wells and are not a routine occurrence. As a result, monitoring start and end dates are associated with individual well installation dates.

2.4 Data Sources

Production data, water quality data, and static groundwater elevation data from the irrigation and monitoring wells were used in preparation of this report. These data were collected by Cadiz and staff of Geoscience, which include State of California Professional Geologists, Certified Hydrogeologists, and Certified Engineering Geologists. Land surface elevation data were collected by staff at JBA and Towill.

3.0 Geology and Hydrogeology

A detailed description of the geology and hydrogeology of the Fenner, Orange Blossom Wash, Bristol, and Cadiz Watersheds are provided in Appendix H of the Water Project FEIR. The following is a brief summary of the geology and hydrogeology of the area in the vicinity of the Cadiz Valley Agricultural Development.

3.1 Geologic Setting

The Cadiz Valley Agricultural Development is in part of the Basin and Range province of North America, in the eastern Mojave Desert of California, within portions of the Bristol, Cadiz, and Fenner Watersheds. Geologic formations in the area are composed of a variety of bedrock, alluvial, dune, and lacustrine deposits. Bedrock is composed of igneous, metamorphic, and consolidated sedimentary rocks which include carbonates, and generally form the perimeter of the main watersheds, however large bedrock masses, such as the Clipper Mountains, also occur within the watersheds.

The Bristol and Cadiz Watersheds form a broad depression that is referred to as the Bristol Trough (Thompson, 1929; Bassett et al., 1964; Jachens and Howard, 1992). This depression formed as a result of regional fault movement and is thought to be 6 to 10 million years old (Rosen, 1989). Unconsolidated alluvial, dune, stream, aeolian, and playa lake deposits fill the Bristol Trough.

3.1.1 Stratigraphy

The geologic materials of the Bristol, Cadiz, and Fenner Watersheds are composed of three broad categories: crystalline bedrock exposed in the mountain ranges and hills, alluvial fan and valley fill sediments weathered from uplifted bedrock, and fine-grained (silt and clay) sediments and evaporite (sodium chloride (NaCl), calcium chloride (CaCl), and gypsum) deposits of the Bristol and Cadiz Dry Lakes.

The crystalline basement rocks exposed in the mountain ranges of the study area consist primarily of Precambrian granitic and metamorphic rocks locally overlain by Paleozoic sedimentary rocks. Paleozoic rocks are sandstones, shales, slates, limestones, and dolomites. These sediments and the underlying basement rocks have been faulted and folded by periods of regional tectonism. The crystalline basement rocks are generally much less permeable than alluvial deposits – yielding limited quantities of groundwater (Freiwald, 1984). However, previously conducted field investigations of the Paleozoic limestone and dolomite sections that are fractured or contain solution cavities yield large quantities of groundwater (CH2M Hill, 2010). Outcrops of these carbonate units can be found on the eastern slope of the New York Mountains, in Lanfair Valley, north of the Clipper Mountains, in the Marble Mountains, in the Ship Mountains, in the southeast end of the Bristol Mountains, in the southern Kilbeck Hills, and in the eastern Old Woman Mountains (see Kenney, 2011, and Howard, 1992, for locations of these carbonate units). The carbonate units are significant aquifers where dissolution features are present in the subsurface, such as in the Fenner Gap area (CH2M Hill, 2010). Throughout the subject area, mostly fractured crystalline basement rocks form the boundaries of the groundwater aquifer system (CH2M Hill, 2010).

In the Fenner Valley, the Paleozoic section is unconformably overlain by clastic sediments and interbedded volcanic rocks of mid-to late-Tertiary age. The Tertiary volcanic rocks consist of lava flows of basaltic to andesitic composition, and pyroclastic tuffs of rhyolitic to dacitic composition. The United States Geological Survey (USGS) reports that a shallow trap-door caldera, roughly 10 kilometers in diameter, is

centered in the eastern Woods Mountains (based on gravity and aeromagnetic anomalies). It was formed during a major eruption 15.8 million years ago, with resurgent eruptions filling the caldera with rhyolitic flows and tuffs. Dikes of similar composition are exposed in the Marble and Ship Mountains (CH2M Hill, 2010). The Tertiary sediments consist of conglomerate, fanglomerate, sandstone, siltstone, water-laid tuff, and lake sediments, which form a composite section more than 7,000 feet thick (Dibblee, 1980). The Tertiary sediments and interlayered volcanic rocks are gently dipping due to late Tertiary extensional normal faulting.

The Quaternary and late-Tertiary alluvial fill in the Bristol Trough is largely derived from Precambrian basement rocks, Paleozoic sediments, and Tertiary volcanic rocks. USGS mapped alluvial deposits exceeding 300 meters (approximately 1,000 feet) in thickness in the northern Fenner Valley. Geophysical evidence indicates this alluvial fill locally exceeds 3,500 feet in thickness beneath a portion of the southern Fenner Valley (Maas, 1994) and even greater under Bristol Valley (CH2M Hill, 2010). These alluvial sediments form one of the principal aquifers in the subject area.

The playa sediments underlying the Bristol and Cadiz Dry Lakes consist of highly saline (brine-saturated) clay, silt, fine grained sand, and evaporite deposits. The clastic sediments were deposited when stream flow and sheet flow from the surrounding alluvial fans spread onto the playas during major storm events (Gale, 1951). The evaporite deposits formed from evaporation of both surface water and groundwater that seeped into the playa sediments from the adjacent alluvial fans (Rosen, 1989).

Bristol and Cadiz Dry Lakes have static groundwater levels at or near the playa surfaces (Moyle, 1967; Rosen, 1989). Geophysical surveys of Bristol Dry Lake and Cadiz Dry Lake indicate sediments underlying the playas may extend to depths greater than 6,000 feet below ground surface (Simpson et al., 1984; Maas, 1994). These sediments have been penetrated by drill holes to depths of over 1,000 feet (Bassett et al., 1959; Rosen, 1989). Sodium chloride and/or calcium chloride are currently being recovered from trenches and brine wells on both playas. The principal recharge to the playas occurs as diffuse seepage of groundwater onto the playas from adjacent alluvial fans (Thompson, 1929; Gale, 1951; Bassett et al., 1959; Handford, 1982; Rosen, 1989).

Cadiz and Bristol Dry Lakes are locally bordered by dune deposits of fine- to medium-grained windblown sand. These Holocene deposits overlie older playa deposits of differentiated Quaternary age (Moyle, 1967). Amboy Crater, located near the western margin of Bristol Dry Lake, is a basaltic cinder cone and lava field believed to be as young as 6,000 years (Hazlett, 1992).

3.1.2 Structure

The project area is located at the eastern margin of the Eastern California Shear Zone, a broad seismically active region dominated by northwest-trending, right-lateral strike-slip faulting (Dokka and Travis, 1990). Roughly a dozen fault zones showing evidence of Quaternary movement (during the last 1.6 million years) have been identified in and adjacent to Bristol, Cadiz, and Fenner Valleys (Howard and Miller, 1992).

Cadiz Valley is underlain by two inferred, major northwest-trending faults based on gravity and magnetic data (Simpson et al., 1984). These fault zones have strike lengths of at least 25 miles and may merge to the north and northwest with extensions of the Bristol-Granite Mountains and South Bristol Mountains fault zones (Howard and Miller, 1992; see Metropolitan Water District of Southern California [MWD], 2001, for locations).

Right-lateral slip of as much as 16 miles along the Cadiz Valley fault zone has been postulated because of correlation of a distinctive Precambrian gneiss unit across the zone (Howard and Miller, 1992). Slickenside surfaces produced by fault movement and steeply dipping sediments recovered from cored drill holes beneath Cadiz Dry Lake suggest the fault zone displaces sediments of Pleistocene age (Bassett et al., 1959). Bristol Dry Lake is bordered by probable extensions of the Cadiz Valley and South Bristol Mountains fault zones to the east, and by probable extensions of the Broadwell Lake and Dry Lake fault zones to the west (Howard and Miller, 1992). Geophysical data indicate this structural depression may exceed 6,000 feet in depth (Simpson et al., 1984; Maas, 1994). Drill cores recovered from depths of more than 1,000 feet beneath Bristol Dry Lake indicate that subsidence of this basin began by Pliocene time and continues to the present (Rosen, 1989), suggesting that the area may be tectonically active.

3.1.3 Aquifer Systems

Based on available geologic, hydrologic, and geophysical data, the principal formations in the study area that can readily store and transmit groundwater (aquifers) are divided into three general units—an upper (younger) alluvial aquifer, a lower (older) alluvial aquifer, and a carbonate rock unit aquifer. However, the carbonate aquifers contain interbedded non-water bearing quartzite and shale (CH2M Hill, 2010; Geoscience, 2011).

The upper alluvial aquifer consists of Quaternary and late-Tertiary alluvial sediments, including stream-deposited sand and gravel with lesser amounts of silt (Moyle, 1967; Geoscience, 1999). The younger (upper) alluvial unit is as thick as approximately 1,000 feet in some locations (Geoscience, 1999 and 2011; CH2M Hill, 2010).

The lower alluvial aquifer consists of older sediments, including interbedded sand, gravel, silt, and clay of mid- to late-Tertiary age. Where these materials extend below the water table, they yield water freely to wells but generally may be less permeable than the upper aquifer sediments (Moyle, 1967; Geoscience, 1999; CH2M Hill, 2010). Production Well PW-1, located in Fenner Gap, draws water primarily from the upper and lower aquifers and yields 3,000 gallons per minute (gpm) with less than 20 feet of drawdown (Geoscience, 1999). The Cadiz agricultural wells draw water from the alluvial aquifers and typically yield 1,000 gpm to more than 2,000 gpm.

Based on findings from drilling in Fenner Gap, carbonate bedrock of Paleozoic age located beneath the alluvial aquifers contains groundwater and is considered a significant aquifer (Geoscience, 1999; CH2M Hill, 2010). Groundwater movement and storage in this carbonate bedrock aquifer primarily occurs in secondary porosity features (i.e., joints, faults, and dissolution cavities that have developed over time). Granite and metamorphic basement rock form the subsurface margins of the aquifer system. This basement rock is generally less permeable and typically yields smaller quantities of water to wells (Freiwald, 1984).

3.1.4 Groundwater Recharge and Flow Patterns

The primary sources of replenishment to the groundwater system in the project area include direct infiltration of precipitation (both rainfall and snowfall) in fractured bedrock exposed in mountainous terrain and infiltration of ephemeral streamflow in sand-bottomed washes – particularly in the higher elevations of the watershed. The source of much of the groundwater recharge within the regional watershed occurs at higher elevation (MWD, 2001; Davisson and Rose, 2000, USGS, 2014).

Precipitation infiltrates and moves downward to the water table. In some areas, the infiltrating water may be diverted to land surface, or groundwater may intersect buried flow barriers (i.e., bedrock or faults) which can bring the groundwater to the surface, creating a spring. Otherwise, this infiltrating water moves vertically downward where it ultimately reaches the regional groundwater system and continues to flow downgradient through principal aquifer systems. (CH2M Hill, 2010).

Groundwater occurrence in fractured bedrock of the watershed-perimeter's mountains has been known since before the turn of the twentieth century. The USGS documented the occurrence of wells and springs (referred to as "some desert watering places") throughout southeastern California and southwestern Nevada for the benefit of travelers and prospectors (Mendenhall, 1909). At least 10 wells and springs were documented in the mountains and hills around the Fenner Watershed and a number of wells were drilled into the alluvium by the Santa Fe Railroad. Another USGS study by Thompson (1929) provided additional information on more wells and springs in the study area to survey, mark, and provide protection of watering places. A more recent USGS survey of wells and springs in the area of study was conducted by Freiwald (1984). These studies provide evidence of the fractured nature of the surrounding bedrock and the continuous infiltration of precipitation and movement of water through these perimeter rocks. Although some groundwater is tapped by vegetation near the range fronts, the remainder moves slowly downgradient through Fenner Valley and Orange Blossom Wash into the Bristol and Cadiz Valleys, where it eventually discharges to Bristol and Cadiz Dry Lakes. Evaporation of groundwater and surface water from the dry lakes over the past several million years has resulted in thick deposits of salt (primarily calcium chloride and sodium chloride) and brine-saturated sediments (Rosen, 1989). Thompson (1929), Gale (1951), Bassett et al. (1959), Handford (1982), and Rosen (1989) agree that the principal source of groundwater recharge to the playas occurs as diffuse seepage of groundwater into the playa sediments from the adjacent alluvial fans.

In general, groundwater within the watersheds flows downgradient in the same direction as the slope of the land surface. In Fenner Valley, groundwater generally flows southward and discharges through Fenner Gap toward Bristol and Cadiz Dry Lakes. In Orange Blossom Wash, located between the Marble and Bristol Mountains, groundwater generally flows southward from the Granite Mountains into Bristol Dry Lake. (Geoscience, 1999; CH2M Hill, 2010). CH2M Hill (2012) estimated the discharge to Cadiz area to be approximately 33,890 AFY, based on measurements made by DRI (2012), extrapolated over the surface areas of Bristol and Cadiz Dry Lakes for a full year. This evaporative discharge compares well with the estimated recharge rate of 32,000 AFY (Geoscience 1995 and CH2M 2010).

4.0 Groundwater Extraction

Historically, groundwater extraction in the vicinity of the Water Project has been limited to pumping at Cadiz Valley Agricultural Development and at separate salt mining operations at Bristol and Cadiz Dry Lakes. Table 4-1 summarizes annual groundwater production from each irrigation well from 1993 through 2023, and Appendix A provides monthly production totals for each irrigation well since 1986. While individual well extraction data from 1986 through 1992 are not available, cumulative production for those years was approximately 28,130 acre-ft (an average of 4,018 AFY). Individual well extraction data for 1993 are incomplete and limited to three wells (33, 27N, and 27S), but the cumulative production was approximately 4,796 acre-ft. This production does not include extractions at the office, trailer park, and labor camp wells, which are typically just an additional few AFY.

Groundwater extraction by Cadiz was an average of approximately 5,100 AFY from 1994 to 2007 to support its agricultural operations. The annual usage was reduced in 2007 in connection with the removal of approximately 500 acres of vineyard that had reached the end of its commercial life. As a result, Cadiz pumping was limited to approximately 2,000 AFY from 2007 through 2018.

Total production increased each year from 2019 through 2022 and ranged from 2,498 to 8,068 AFY. In 2023, production decreased to 6,134 AFY. For the reporting period covered by this report (January 2019 through December 2023), the annual production average was approximately 5,094 AFY and was limited to eight Group 1 wells (see Table 4-1). The general increase in total production during the five-year reporting period (2019 – 2023) is associated with the expansion of total irrigated acreage, which increased from 795 to 1,145 acres.

Figure 4 shows annual (calendar year) groundwater production by Cadiz since 1986, which totals approximately 150,796 acre-ft. Future five-year reports will report water year (October through September) pumping data to be consistent with the reporting practices of state agencies including California Department of Water Resources (DWR) and California State Water Resources Control Board. Except for 2022 when production was approximately 8,100 acre-ft, annual pumping ranged from approximately 1,200 to 6,100 acre feet.

Additionally, Figures 5 through 14 show monthly pumping compared to static (non-pumping) or near-static (groundwater levels which may not have fully recovered from pumping conditions), and pumping groundwater levels for Group 1 Agricultural Wells during the reporting period (2019 – 2023). Sharp drawdowns in groundwater elevation during pumping are expected and not indicative of regional groundwater elevation trends. Groundwater elevations in most Group 1 Wells exhibit a response to increased production during the last five years (Figure 15). According to data collected in 2022, Cadiz groundwater production of approximately 8,000 AFY that year has a negligible long-term impact on static water levels in the aquifer surrounding the wellfield.

Table 4-1. Total Annual Groundwater Production

Year	Well 21S	Well 21N	Well 28*	Well 33	Well 27N*	Well 22	Well 27S	Well 34	Well 35	Well 26	Total
[acre-feet]											
1993	0	0	0	5	99	0	67	-	-	-	4,796**
1994	836	0	554	1,125	1,021	63	1,136	-	-	-	4,736
1995	713	948	630	1,024	1,086	285	1,282	-	-	-	5,969
1996	834	520	702	1,156	1,045	343	1,120	-	-	-	5,720
1997	882	750	511	1,062	931	289	1,038	-	-	-	5,463
1998	699	1,033	507	1,047	493	583	725	-	-	-	5,087
1999	867	1,331	366	1,097	827	731	857	-	-	-	6,076
2000	783	1,263	512	1,145	738	893	759	-	-	-	6,092
2001	825	894	400	960	590	770	797	-	-	-	5,237
2002	881	1,008	495	1,012	759	799	540	-	-	-	5,495
2003	775	1,013	404	760	711	529	904	-	-	-	5,095
2004	712	524	376	686	819	543	569	-	-	-	4,229
2005	694	551	420	765	771	612	805	-	-	-	4,618
2006	806	731	166	840	840	861	193	-	-	-	4,438
2007	581	706	65	572	899	276	489	-	-	-	3,588
2008	329	463	2	6	435	0	735	-	-	-	1,970
2009	366	584	0	502	154	62	215	-	-	-	1,882
2010	356	590	0	0	0	62	858	-	-	-	1,867
2011	482	538	0	0	0	478	842	-	-	-	2,341
2012	511	559	0	0	536	7	751	-	-	-	2,364
2013	705	674	0	0	357	0	791	-	-	-	2,526
2014	421	405	0	0	0	0	498	-	-	-	1,324
2015	522	596	0	0	0	0	260	-	-	-	1,377
2016	884	613	0	0	0	0	361	-	-	-	1,858
2017	252	504	0	8	0	102	356	-	-	-	1,223
2018	458	666	0	0	0	163	540	-	-	-	1,827
2019	623	765	0	0	0	474	637	-	-	-	2,498
2020	675	849	0	627	0	475	937	107***	24***	34***	3,717
2021	922	760	0	940	0	871	820	738	0	0	5,052
2022	871	981	0	850	0	234	790	1,453	1,696	1,194	8,068
2023	47	57	0	88	0	545	135	797	2,276	2,188	6,134

Notes:

* Wells 28 and 27N have been permanently offline starting 2009 and mid-2013, respectively.

** Individual well extraction data for 1993 are incomplete and limited to three wells (33, 27N, and 27S), but the cumulative production was approximately 4,796 acre-ft.

*** Groundwater production in 2020 at Wells 34, 35, and 26 was for aquifer testing.

5.0 Groundwater Level Conditions

Depths to static⁷ groundwater levels in Group 1 wells are measured on a monthly basis by Cadiz and Geoscience staff. In 2018 and 2019, some of the wells in the monitoring network were equipped with transducers to measure water levels several times a day as part of the ongoing transition from the GWMP to the GMMMP. Additional transducers were deployed in September 2021 to replace aging transducers and to increase the number of wells with continuous water level and specific conductivity monitoring. Water levels in all other monitoring wells are measured by Geoscience staff on a quarterly basis using both electric water level sounders and transducers. The measured depths to groundwater are converted to groundwater elevations by subtracting the depth to groundwater from the surveyed reference point elevation for each well.

5.1 Baseline Groundwater Elevations

As reported in the First Annual Report (Geoscience, 1997b), groundwater elevations in feet above mean sea level (ft amsl) were calculated by subtracting the depth to groundwater from an estimated reference point elevation for each well. Approximate reference point elevations were determined by estimating the surface elevation of each well from the USGS 7.5-minute quadrangles (Cadiz Summit, Cadiz Lake NW, Calumet Mine, and Cadiz).

More recently, in December 1997, JBA (a California licensed land surveyor) performed a survey to establish the baseline elevation of the seven agricultural wells⁸ and monitoring well 5/14-13. JBA has since resurveyed all wells and surveyed newly installed monitoring wells through 2015, as described in the Eighteenth Annual Groundwater Monitoring Report (Foreman, 2016). Five additional control points (MP1 through MP5) were added for subsidence monitoring in 2015⁹. All thirteen points have been resurveyed by Towill since 2016. This resurvey included conversion of the horizontal coordinates and vertical datum to the current NAD83 and NAVD88 datums, respectively. Table 1 presents the location coordinates and vertical elevation for wells in the monitoring system, including monitoring points.

To determine baseline groundwater level conditions for the Cadiz wellfield, historical groundwater level elevation data from November 1993 through December 1996 were evaluated. Baseline groundwater level conditions for the Cadiz wellfield have been based primarily on an average of December 1995 through December 1996 static groundwater levels. Table 2 presents a summary of these baseline groundwater levels, converted to the new datums.

5.2 Groundwater Level Trends

Irrigation and monitoring wells were grouped into six well groups based on geographic area for water level evaluation and the development of hydrographs showing measured groundwater elevations through

⁷ Static groundwater level readings are not always feasible because of crop irrigation needs. Well pumps cannot be turned off for sufficient duration to record static water levels.

⁸ Agricultural wells 21N, 21S, 22, 27N, 27S, 28, and 33 were included in the baseline elevation survey.

⁹ The 2018 subsidence report included in Appendix B provides a description of each control point.

time. Figure 1 shows the locations of the well groups and Figures 15 through 20 present hydrographs for each well group and include static and near-static water level data. Additionally, Hydrographs included in Figure 15 include static, near-static, and pumping water levels. As a result, water levels shown on the figure may be artificially low and not necessarily representative of regional conditions. Figures 21 and 22 present groundwater elevation contours for Cadiz wellfield data for fall 2019 and 2023 respectively. In general, groundwater levels in and near the Cadiz wellfield fluctuate in response to pumping and recovery cycles.

Groundwater levels in Group 1 Wells within the agricultural irrigation wellfield declined consistently in response to Cadiz pumping when pumping was increased in the 1990s to approximately 6,100 AFY (Figure 15). Groundwater level data from Well Groups 2 through 6 indicate that pumping had little to no impact on water levels outside of the agricultural irrigation wellfield during the 1990s (Figures 15 through 20). Subsequently, water levels stabilized in the late 1990s and early 2000s and recovered above baseline levels as extraction was reduced from the early 2000s through approximately 2018. In the years since 2018, water levels have declined slightly in Group 1 Wells in response to increased production. A new groundwater extraction maximum occurred in 2022 (approximately 8,100 AFY).

Table 2 provides a comparison of baseline groundwater levels (established in 1995) for Group 1 Wells to measured water level elevations in 2019 and 2023. As shown in Table 2, the baseline (1995) water level elevation for Well 21N 588.04 feet (NAVD88 datum). The maximum non-pumping water level for Well 21N was 21.92 feet lower than the baseline water level in 2019 and 6.07 feet lower than the baseline water level in 2023. The 2023 water level in Well 21N was 15.85 feet higher than the 2019 water level, indicating a rise in water level during the five-year reporting period. In contrast to water levels at Well 21N, water levels at other wells declined by a range of 7.12 to 45.70 ft during the reporting period. Groundwater levels could not be measured at one Group 1 Well (21S) in 2019 and two Group 1 Wells (21S and 27S) in 2023 due to equipment stuck in the sounding port of each well.

In 2019, groundwater levels decreased in three Group 1 Wells (21N, 27S, and 5/14-13) and increased in four Group 1 Wells (22, 27N, 28, and 33) compared to the baseline. In 2023, groundwater levels decreased in four Group 1 Wells (21N, 22, 33, and 5/14-13) and increased in two Group 1 Wells (27N and 28) compared to the baseline. Between 2019 and 2023, groundwater levels increased in one Group 1 Well (21N) and decreased in four Group 1 Wells (27N, 28, 33, and 5/14-13).

In general, groundwater levels for the five-year period appear to fluctuate slightly in response to long-term regional trends. Due to the amount of time necessary to fully recover at the end of pumping, static water level measurements in the pumping wells may be artificially lower than true static conditions. Monitoring well hydrographs for wells outside the area where groundwater was extracted (groundwater was extracted from some Group 1 Wells), especially for Group 2, 3, and 4 wells in and just north of the Fenner Gap area, suggest that groundwater levels have not fluctuated significantly over the long term (Figures 15 through 20). Groundwater elevations decreased slightly during the five-year period in three wells (HAL-1, HAL-2, and HAL-MW5) located close to salt mining operations (Figure 20). Salt mining operations include groundwater extraction and may be responsible for the decrease in water levels in the three wells.

Comparison of water level contours on Figures 21 and 22 shows groundwater elevation decreased in the vicinity of pumping wells between fall 2019 and 2023. Increased agricultural pumping during the five-year

period accounts for groundwater elevation changes near pumping wells. Groundwater elevation fluctuated less in monitoring wells located more than three miles from pumping wells, and the changes may be attributed to long-term regional trends.

6.0 Groundwater Quality Conditions

TDS concentrations in groundwater in the vicinity of the Cadiz Valley Agricultural Development irrigation wells are relatively low, with values generally around 300 milligrams per liter (mg/L). At Bristol and Cadiz Dry Lakes, evaporation of surface water and shallow groundwater concentrates dissolved salts, resulting in TDS concentrations as high as 298,000 mg/L (Shafer, 1964). In general, as groundwater moves toward the dry lakes from Fenner Gap and the surrounding mountains, it becomes more saline as "fresh" groundwater mixes with saline groundwater underlying the dry lakes. The fresh/saline groundwater interface, designated by a TDS concentration of 1,000 mg/L, is located near the margins of the two dry lakes (Figure 23). This interface location is estimated using the TDS values from wells in Group 6.

6.1 Baseline Groundwater Quality

Electrical conductivity (EC), which is directly proportional to TDS, is an additional measure of groundwater quality for the Water Project. Baseline EC measurements for Group 1 wells were collected starting in 1996 and were converted to TDS for comparison with 2019 and 2023 TDS values, as summarized in Table 6-1 below. The average 1996 baseline TDS concentrations for the Group 1 Wells range from 221 mg/L in Well 21S to 282 mg/L in Well 27N. TDS is expected to increase within the area of groundwater extraction and irrigation as time progresses (see Section 6.2 for a detailed discussion) and the increasing trend is generally observable in Table 6-1.

Table 6-1. Comparison of Baseline (1996) Calculated TDS with 2019 and 2023 TDS

Date	Well 21N	Well 21S	Well 22	Well 26 ³	Well 27N	Well 27S	Well 28	Well 33	Well 34 ³	Well 35 ³	Well SCE-5 ³	Well 5/14-13
	[mg/L]											
1996 ¹ Baseline TDS (Average)	238	221	258	-	282	257	240	223	-	-	-	261
2019 TDS ²	278	260	285	-	720	285	225	330	-	-	300	245
2023 TDS ²	300	260	290	283	635	390	225	-	265	273	315	283

Notes:

All 2019 and 2023 TDS values are laboratory reported. Results from Wells 27N, 28, 33, and 5/14-13 used a bailer to sample; values may therefore be artificially high. A low-flow pumping system was used at SCE-5 starting the third quarter of 2020.

- No Data Available

1 1st through 3rd Quarter 1996 laboratory EC values were converted to TDS and averaged for comparison.

2 If TDS was measured once in a year, the single measurement is shown. Otherwise, TDS concentrations shown are yearly averages for wells where TDS was measured multiple times in a year. Reference Table 3 for individual well TDS data.

3 These wells were incorporated into the monitoring network after establishment of 1996 Baseline TDS values.

6.2 Groundwater Quality Trends

Group 1 Wells were sampled for water quality, including TDS, during December 2018, and have been sampled quarterly from December 2019 through present. As an additional step towards GMMMP compliance, Cadiz is equipping some irrigation and monitoring wells with transducers that can continuously record EC, water level, and temperature data. It is expected that groundwater data collected

since 2012 will be used to begin to define pre-operational groundwater quality conditions for the Water Project.

Field measurements of EC and TDS were made with a portable MyronL Ultrameter II hand meter that is calibrated to standard conductivity solutions. As EC is a relative indicator of TDS concentration, actual TDS measurements are reported along with EC data as an initial transition step toward the requirements of the approved GMMMP.

Table 3 shows recent and longer-term TDS concentrations for Group 1 Wells. Additionally, Table 3 presents long-term average TDS concentrations.. TDS has remained consistently below the 500 mg/L secondary Maximum Contaminant Level (MCL) and relatively stable for drinking water in all Group 1 Wells except Well No. 27N and Well No. 33, which are discussed below. During the reporting period (2019 through 2023) all TDS concentrations were below 400 mg/L with the exception of well 27N. Figure 24 shows a Group 1 Well chemograph plot of TDS concentrations from 2013 through 2023.

As shown on Figure 24, TDS concentrations in Well 27N have varied considerably since 2013. Well 27N was taken offline and redeveloped in 2011. Problems were encountered during the redevelopment process and the well casing and screen was damaged, possibly compromising the integrity of the well, including loss of the bottom seal. A concrete plug was installed to reseal the bottom. However, it was apparent that the casing/screen required further repairs, as the well produced significant quantities of sand when in service. Well 27N was permanently taken offline mid-2013 and has only been sampled with a bailer since. It is unclear if damage to the well casing/screen may have affected the distribution of flow of groundwater vertically along the casing, resulting in some changes in groundwater quality produced by the well. TDS values at Well 27N increased steadily from 2015 to 2019 (see Figure 24). However, during the reporting period (2019 through 2023) TDS concentrations declined from approximately 800 mg/L to approximately 250 mg/L in 2022 and then reached a high of 860 in mid-2023 before declining to 350 mg/L at the end of 2023.

TDS values for Well 33 have also varied considerably since 2013. The highest TDS concentration recorded in Well 33 since 2013 was 512 mg/L in 2013. The well was sampled using multiple sampling methods including bailer and temporary pump from 2013 through 2019. TDS concentrations ranged from 308 to 512 mg/L during that time, and sampling inconsistencies may account for the wide-ranging concentrations. Well 33 was equipped with a pump and motor at the end of 2019. TDS concentrations have been below 350 mg/L during the reporting period and are within the range of TDS values for other nearby wells. The well was last sampled for TDS in October 2022.

As described in the Sixteenth Annual Report, the TDS spike observed in 2013 in Wells 33 and 27N may have been caused by leaks in irrigation system distribution piping near Well 27N and the resultant flushing of salts from the thick vadose zone to underlying groundwater near these wells (Foreman, 2014)¹⁰. Nearby irrigation wells (Wells 27S and 28) do not show an upward trend in TDS concentrations (Figure 24), so it is probable that the TDS spikes in Well 27N are due to a localized condition¹⁰ instead of a long-term trend. Well 27N was equipped with a dedicated transducer with EC recording in 2017 to help understand

¹⁰ Additionally, damage to the well during well redevelopment in 2011 (as described in Section 6.2) may have contributed to the high TDS result.

fluctuations in TDS. However, the transducer failed on August 17, 2020. The data time stamp reverted to year 1961 and recorded erroneous values. The transducer for Well 27N was replaced in September 2021. Known irrigation leaks have since been addressed but irrigation in the area of Well 27N has increased due to expanded farming operations and pumping of new wells (Wells 26, 34, and 35). Regardless, the TDS spikes in the well are anomalous and the cause needs to be investigated further. Ongoing monitoring will be used to assess the origin of TDS spikes at each well.

Monitoring Well SCE-5 is one of several existing and new monitoring wells identified in the GMMMP for the Water Project to monitor the freshwater/saline groundwater interface between Bristol Dry Lake and the Cadiz wellfield (Figure 23). Well SCE-5 was sampled in 2012, 2013, and 2015 through 2023 to monitor potential encroachment of the freshwater/saline groundwater interface toward the agricultural wellfield. As shown in Figure 24 and Table 3, TDS concentrations in groundwater at Well SCE-5 has remained stable.

As shown in Table 6-1, TDS concentrations in 2023 were higher in six Group 1 Wells (21N, 21S, 22, 27N, 27S, and 5/14-13) compared to the 1996 baseline. Increases in TDS concentrations from 1996 to 2023 were 133 mg/L or less for wells other than 27N. The average baseline to 2023 increase for wells other than 27N was approximately 58mg/L TDS. Generally, these increases are considered of little significance. TDS concentrations in 2023 were lower in one well (28) compared to the 1996 baseline. During the five-year reporting period, TDS concentrations increased in five wells (21N, 22, 27S, SCE-5, and 5/14-13), decreased in one well (27N), and did not change in two wells (21S and 28). TDS increases during the reporting period ranged from 5 to 105 mg/L. TDS decreased by 85 mg/L in Well 27N during the reporting period.

Data from the five-year reporting period (2019 – 2023) are not indicative of significant changes in regional TDS concentrations. Data from continued monitoring will be used to assess TDS trends and the potential migration of the freshwater/saline groundwater interface.

7.0 Land Surface Elevation Survey

JBA conducted a Global Positioning System (GPS) survey in December 1997 to establish a baseline elevation for each of the seven irrigation wells and monitoring well 5/14-13 to facilitate detection of changes in land surface elevation over time. Subsequent surveys were conducted in 1999, 2000, 2002, 2007, 2010, 2013 to 2015, 2017, 2018, 2021, 2022, and 2023 to assess changes in land surface elevation at the benchmark at each well. Land surface surveys were not conducted in 2019 and 2020 due to scheduling conflicts and COVID-19. These data are summarized in previous monitoring reports. The complete 2018, 2021, 2022, and 2023 survey reports can also be found in Appendix B of this report. Data from 2021 and 2023 are in Table 7-1 below.

As described in the First Five-Year Summary Report (Geoscience, 2003), no apparent land subsidence was observed during the four surveys conducted between 1997 and 2002. Because both the area of irrigated land and the amount of groundwater extraction decreased from 2003 through 2007, annual land surface elevation surveys were not conducted for that period. JBA conducted a repeat survey of land surface elevation benchmarks in December 2007. The results of this survey document that all 2007 elevations are similar to those originally measured in 1997. Land surface elevation surveys were also not conducted in 2008 and 2009 because there were no significant changes to acreage under cultivation or water use in those years. A land surface elevation survey was completed in 2010 as part of technical reporting for the Water Project, and another survey was completed in 2013. The results of these surveys are similar to the 1997 baseline measurements. Any variations observed are considered to be within expected limitations of the approach.

The land subsidence monitoring program has been and will continue to be expanded as part of the GMMMP, including establishment of a baseline condition as part of the pre-operational monitoring activities, before groundwater pumping is ramped up. As a first step in transitioning to the GMMMP, CH2M Hill (in coordination with JBA) established a new stable benchmark in the Marble Mountains and identified several existing stable benchmarks to serve as reference benchmarks for future subsidence surveys, as reported in the Seventeenth Annual Report (Foreman, 2015). In addition, five new survey control points for subsidence monitoring were added in 2015. These monitoring points are shown on Figure 3 along with the other existing monitoring points. New survey procedures were also implemented in the December 2014 survey, as described in the Seventeenth Annual Report (Foreman, 2015). The new survey procedures established benchmarks on Marble Mountain as reference points for the Cadiz subsidence surveys. The goal of the new procedures is to obtain a vertical accuracy of +/- 0.10 feet tolerance threshold.

During the 2019 through 2023 reporting period, land surface surveys were conducted by JBA in June 2021, October 2022, and December 2023. Survey results are similar to previous surveys, including a survey conducted in 2018 by Towill, Inc. Subsidence reports for land surface surveys that were conducted in 2018, 2021, 2022, and 2023 are included as Appendix B. Land surface elevation was measured at 13 sites during 2021 and 2023. Table 7-1 shows that the results from the 2021 and 2023 surveys are similar. During those years, elevation increased at eight sites (5/14-13, 21S, 22, 28, 33, MP3, MP4, and MP5) at a range of 0.003 to 0.046 ft and decreased at five sites (21N, 27N, 27S, MP1, and MP2) by a range of 0.021 to 0.107 ft (Table 7-1). As groundwater elevations have not declined significantly, it is likely that differences in year-to-year values are within the vertical accuracy of the survey capability, which may be slightly larger than the goal of +/- 0.10 feet. Future surveys will determine if these variations are anomalies or a trend.

The results of all GPS surveys of ground surface elevations suggest that no significant subsidence has occurred to date.

As part of the Sustainable Groundwater Management Act (SGMA) technical assistance, DWR contracted InSAR work to measure vertical ground surface displacement. This data was collected by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA Inc. (TRE). The data presented supports the conclusion that no land subsidence has occurred near the Cadiz wellfield. However, areas surrounding Amboy Crater National Natural Landmark at Bristol Lake appear to show positive vertical displacement.

Table 7-1. 2021 and 2023 Land Surface Elevation GPS Survey Data

Well	2021 (June)	2023 (December)	Difference
	[elevations in ft NAVD88]		
5/14-13	894.829	894.862	0.033
21N	793.370	793.349	-0.021
21S	762.935	762.964	0.029
22	813.137	813.193	0.056
27N	791.019	790.924	-0.095
27S	778.385	778.304	-0.081
28	741.113	741.117	0.004
33	729.025	729.071	0.046
MP1	612.081	611.974	-0.107
MP2	613.772	613.722	-0.050
MP3	878.944	878.947	0.003
MP4	683.632	683.637	0.005
MP5	970.557	970.584	0.027
26 ¹	-	811.786	NA
35 ¹	-	775.850	NA
34 ¹	-	760.212	NA

Notes:

1 Wells 26, 34, and 35 were first surveyed in 2022.

- Not measured

NA Not applicable

8.0 Groundwater Basin Recharge and Storage

8.1 Average Annual Recharge to Cadiz Agricultural Area

Natural replenishment of groundwater resources beneath Bristol, Cadiz and Fenner Watersheds occurs from both surface runoff and percolation of precipitation. The majority of rainfall in lower elevations (valleys) evaporates or is consumed by plants before it enters the groundwater system. Therefore, the groundwater system is primarily replenished through infiltration of precipitation at higher elevations and surface water infiltration in the sandy-bottomed washes (e.g., Orange Blossom Wash) during major storm events. Average annual precipitation in the area ranges from approximately 3.4 inches at the Amboy Station (located adjacent to Bristol Dry Lake) to 10.44 inches at the Mitchell Caverns Station (located at an elevation of 4,350 ft in the Providence Mountains). Davisson & Rose (2000) have estimated that average annual precipitation in the highest portions of the Fenner Watershed (the New York Mountains, which exceed 7,500 ft in elevation) may exceed 18 inches.

Although some of the groundwater is tapped by vegetation near the range fronts, much of the groundwater slowly moves downgradient – eventually discharging to Bristol and Cadiz Dry Lakes. Thompson (1929), Gale (1951), Bassett et al. (1959), Handford (1982), and Rosen (1989) concur that the principal discharge to the dry lakes occurs from seepage of groundwater into the lakebed sediments from adjacent alluvial deposits. This groundwater discharge to the dry lakes is ultimately lost to evaporation.

The occurrence of active groundwater replenishment within the Bristol, Cadiz, and Fenner Watershed area is supported by: 1) the existence of a regionally consistent hydraulic gradient that is based on water level measurements from more than 50 wells in the region; 2) isotopic evidence for a geologically "recent" (Holocene) age for the groundwater; and 3) relatively stable groundwater elevations recorded in wells located between Fenner Gap and Bristol Dry Lake, despite continuous groundwater pumping by the Cadiz agricultural operation for more than 33 years.

Recent estimates of average annual recharge in the Fenner Watershed include those from the USGS Basin Characterization Model (BCM) water balance model (6,873 acre-ft/yr; USGS BCM Model, 2014). However, the BCM model is a regional model developed to assess the effects of climate change and has not been validated against local data and observations. Local investigations in the Cadiz area using a combination of integrated groundwater/surface water model results and observed evaporation measurements indicate recharge at 33,885 acre-ft/yr (CH2M Hill, 2012). Using Darcy's Law to estimate underflow, the estimated recharge rate in the Cadiz area ranged from 18,000 to 32,000 acre-ft/yr (Geoscience, 1995).

8.2 Groundwater Storage in the Cadiz Agricultural Area

The volume of groundwater in storage within the aquifers in the vicinity of the Cadiz Agricultural Development is estimated to range from approximately 4 to 7 million acre-ft (Metropolitan Water District, 1999). The estimated range in storage does not include groundwater with TDS concentrations greater than 1,000 mg/L and does not include water stored in the bedrock aquifer. Monitoring well hydrographs of Well Groups 2, 3, and 4, located outside the wellfield area (especially in and north of the Fenner Gap area), suggest that groundwater levels have not fluctuated significantly over the long-term (Figures 16, 17, and 18). Therefore, overall groundwater in storage has not changed during the reporting period.

9.0 Conclusions

Key findings and conclusions for the analysis of data collected from the Cadiz Valley Agricultural Development project area over the five-year period between January 2019 and December 2023:

- Total groundwater production increased each year from 2019 through 2022 and ranged from 2,948 to 8,068 AFY. In 2023, production decreased to 6,134 AFY. The general increase in total groundwater extraction during the five-year reporting period is associated with the increase in total irrigated farming acreage, which increased from 795 to 1,145 acres.
- Variations in groundwater elevations measured in the irrigation wells are within normal ranges expected during seasonal pumping and recovery cycles. Generally, groundwater levels are slightly below baseline levels in Cadiz irrigation wells as a result of increased groundwater extraction.
- Groundwater elevations in most Group 1 Wells exhibit a response to increased production. However, data indicate that groundwater production of approximately 8,000 AFY in Cadiz has a negligible impact on static water levels in the aquifer immediately surrounding the wellfield. Monitoring wells outside of the wellfield and beyond the area of influence of pumping wells show groundwater levels have not fluctuated significantly over the long-term. As a result, fluctuations in water levels reflect natural variations in recharge (i.e. wet and dry cycles).
- No significant changes in groundwater quality were reported during the five-year reporting period. Generally, TDS concentrations in Group 1 wells are relatively stable. High TDS concentrations in samples collected from Wells 27N and 33 are anomalous and additional investigations are required to better assess localized TDS concentrations in the two wells.
- Land surface elevation surveys were conducted in 2021, 2022, and 2023. Results from the land surface elevation surveys indicate that all NAVD88 elevations are similar to previous surveys, and no evidence of subsidence since 1997 (baseline year) has been observed. Variations observed between surveys are considered to be within expected limitations of the approach.
- Based on the groundwater conditions observed during this monitoring period, irrigation pumping by the Cadiz Valley Agricultural Development has not resulted in any significant changes or adverse impacts to groundwater levels, change in storage, groundwater quality, or land surface stability.

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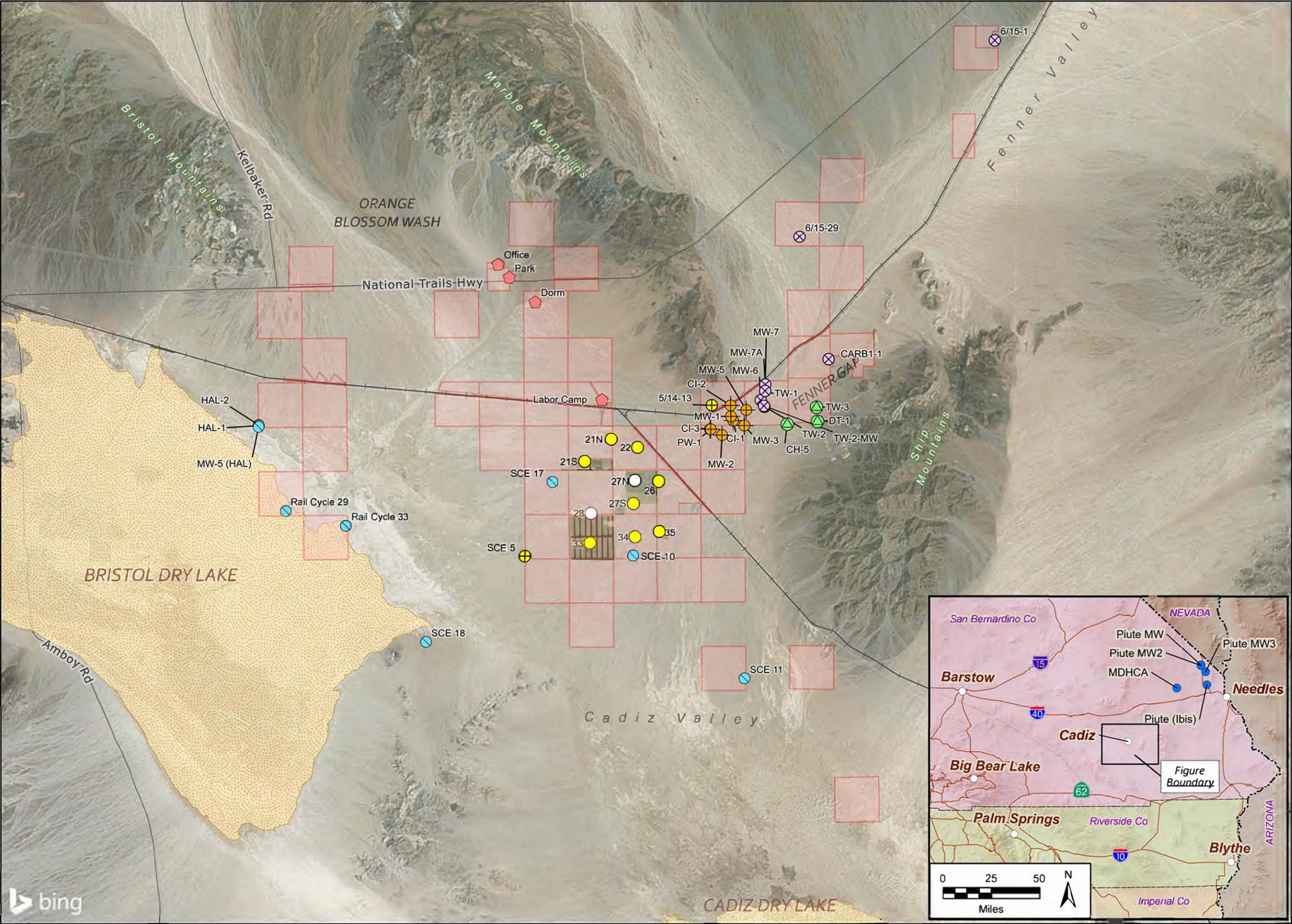
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Figures

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EXPLANATION

Well Location and Hydrograph Group

Group 1

- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively

Group 2

- ⊗ Group 2

Group 3

- ⊕ Group 3

Group 4

- ⊕ Group 4

Group 5

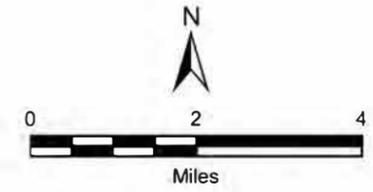
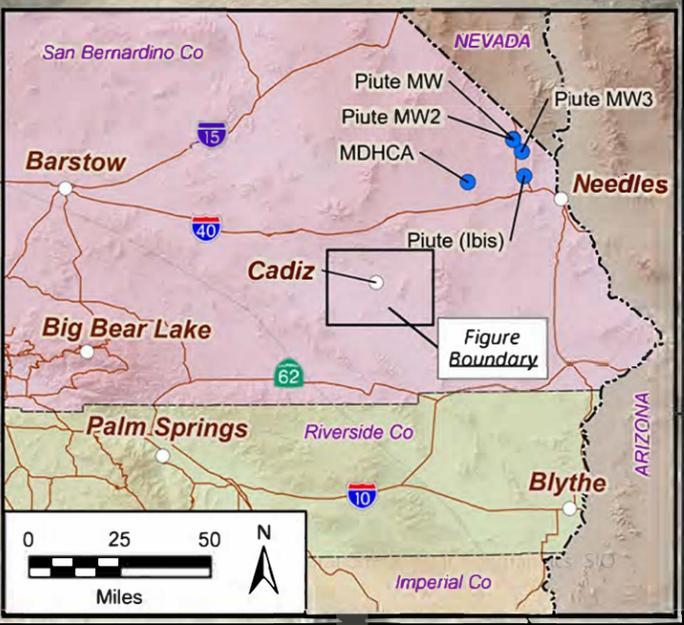
- ⊕ Group 5

Group 6

- ⊕ Group 6

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a). Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

- Groundwater Elevation Measuring Point
- Cadiz-Owned Land
- Dry Lake

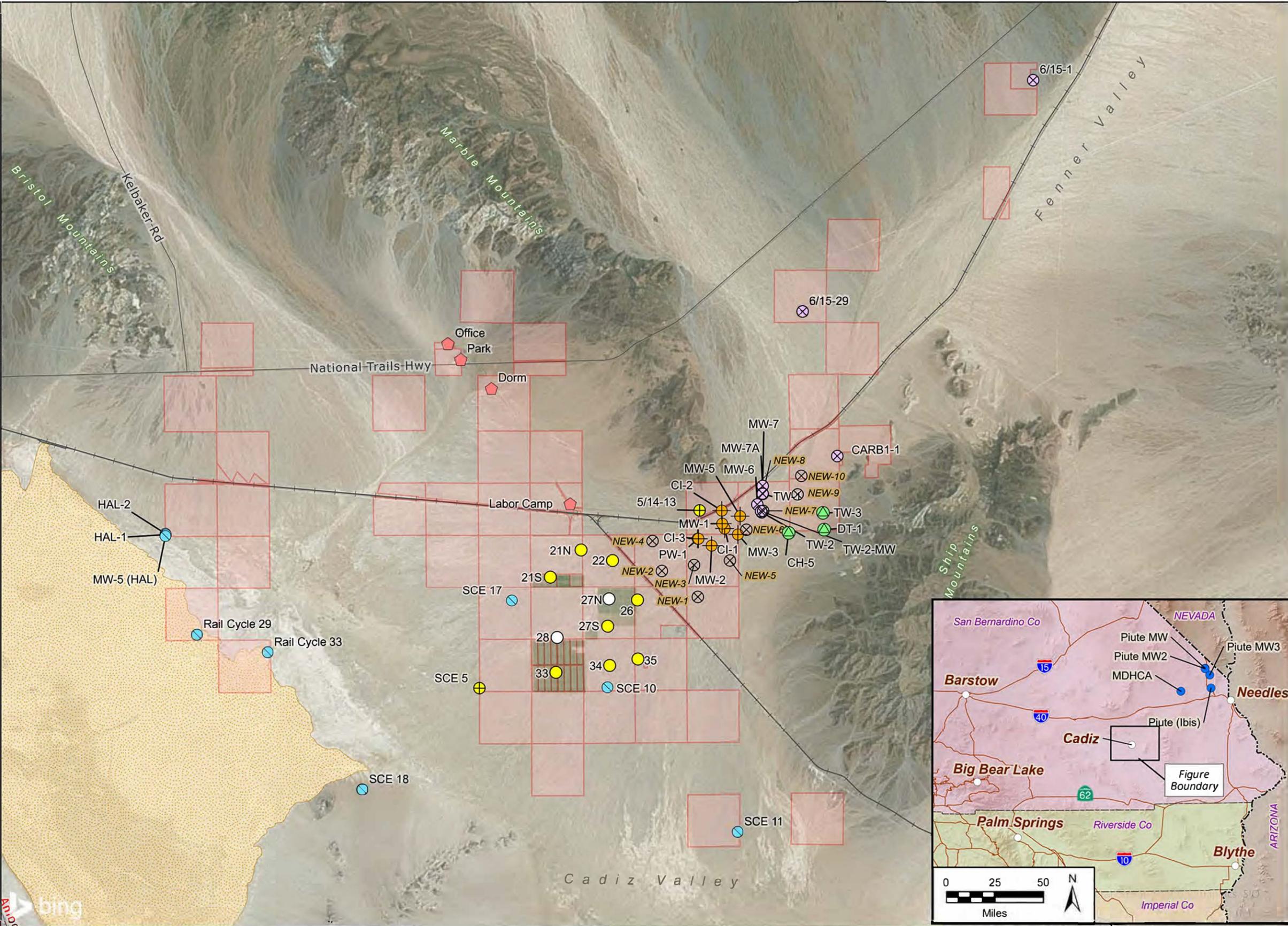


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CADIZ AGRICULTURAL WELLFIELD AND MONITORING NETWORK

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EXPLANATION

- ⊗ Planned Production Well

Well Location and Hydrograph Group

Group 1

- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively

Group 2

- ⊗

Group 3

- ⊕

Group 4

- ⊕

Group 5

- ⊕

Group 6

- ⊕

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a). Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

- Groundwater Elevation Measuring Point
- ▭ Cadiz-Owned Land
- Bristol Dry Lake

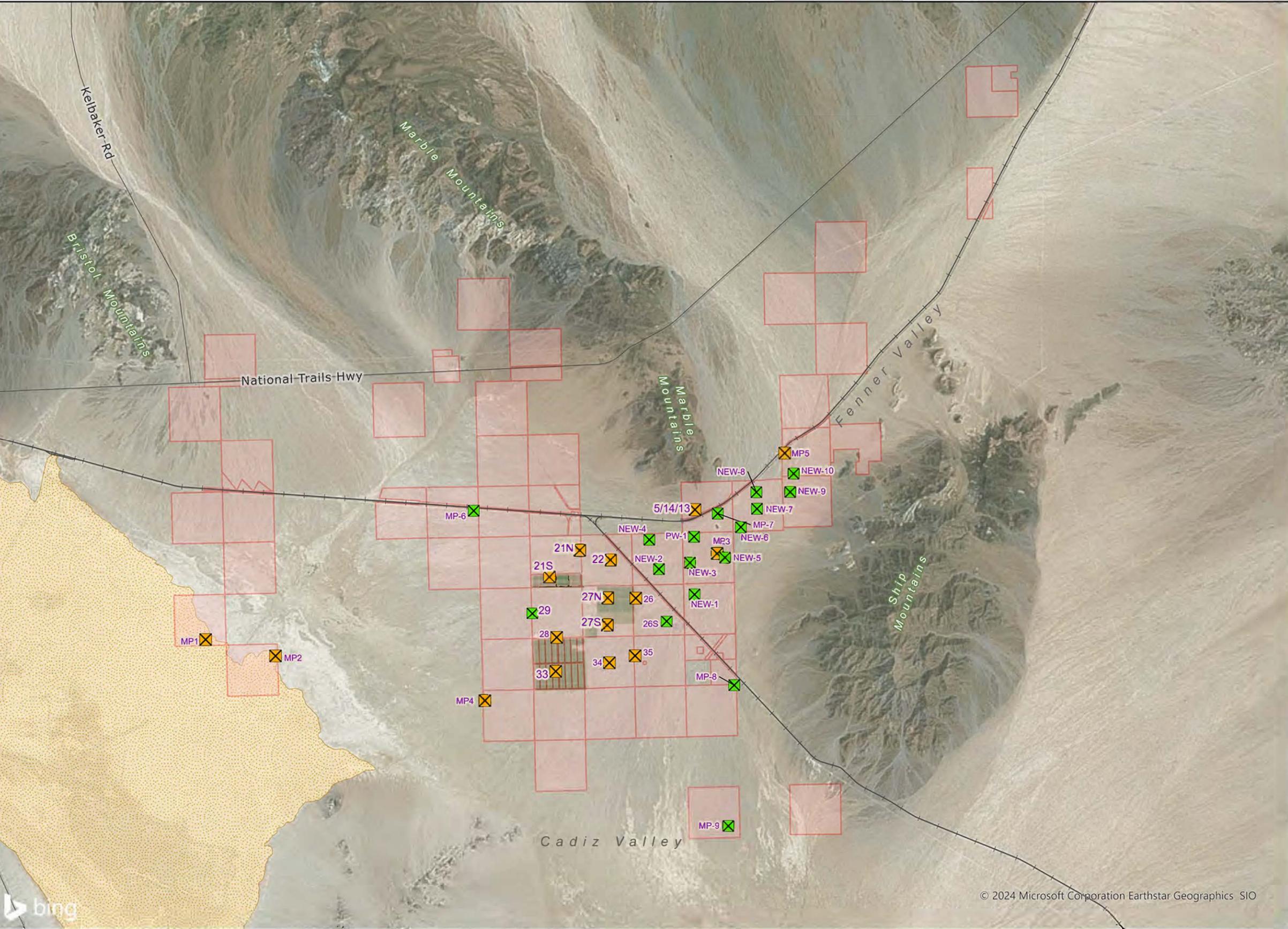
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**PROPOSED MONITORING POINTS
(GROUNDWATER ELEVATION)**

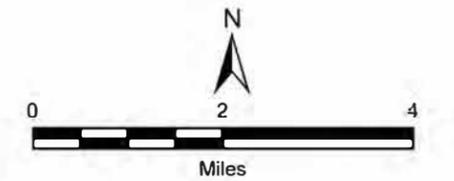
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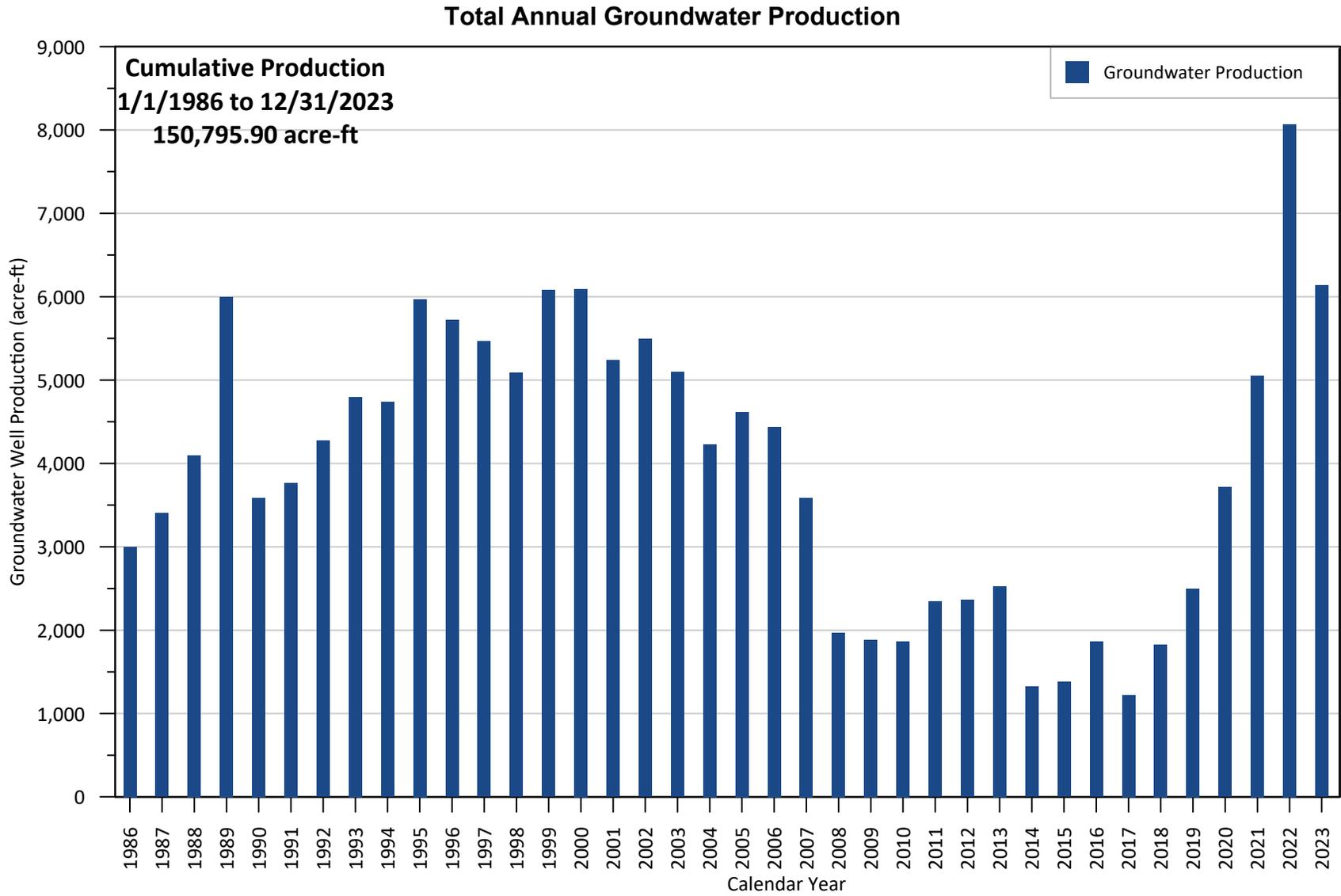
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-  Planned Survey Point
-  Cadiz-Owned Land
-  Bristol Dry Lake

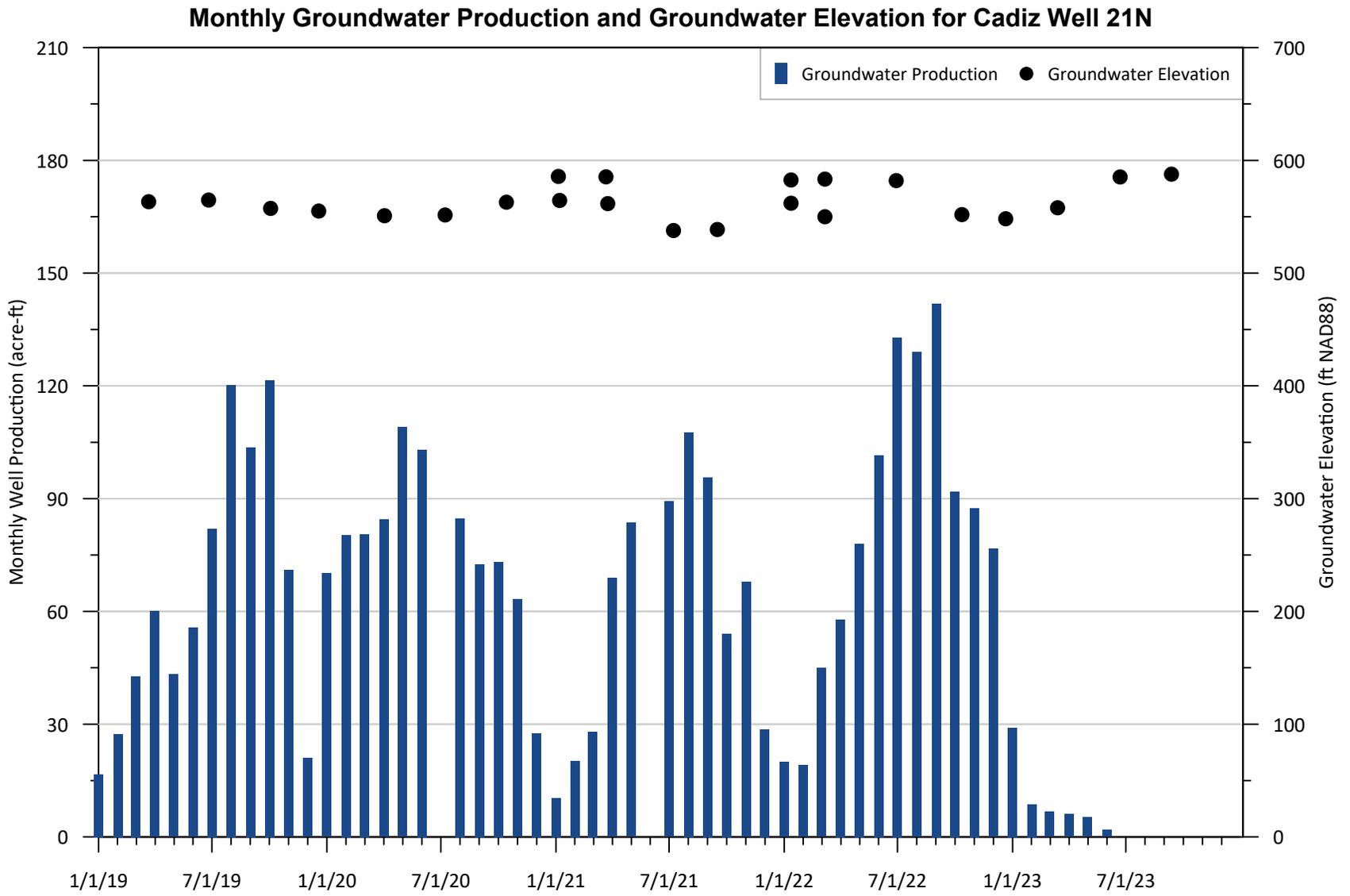


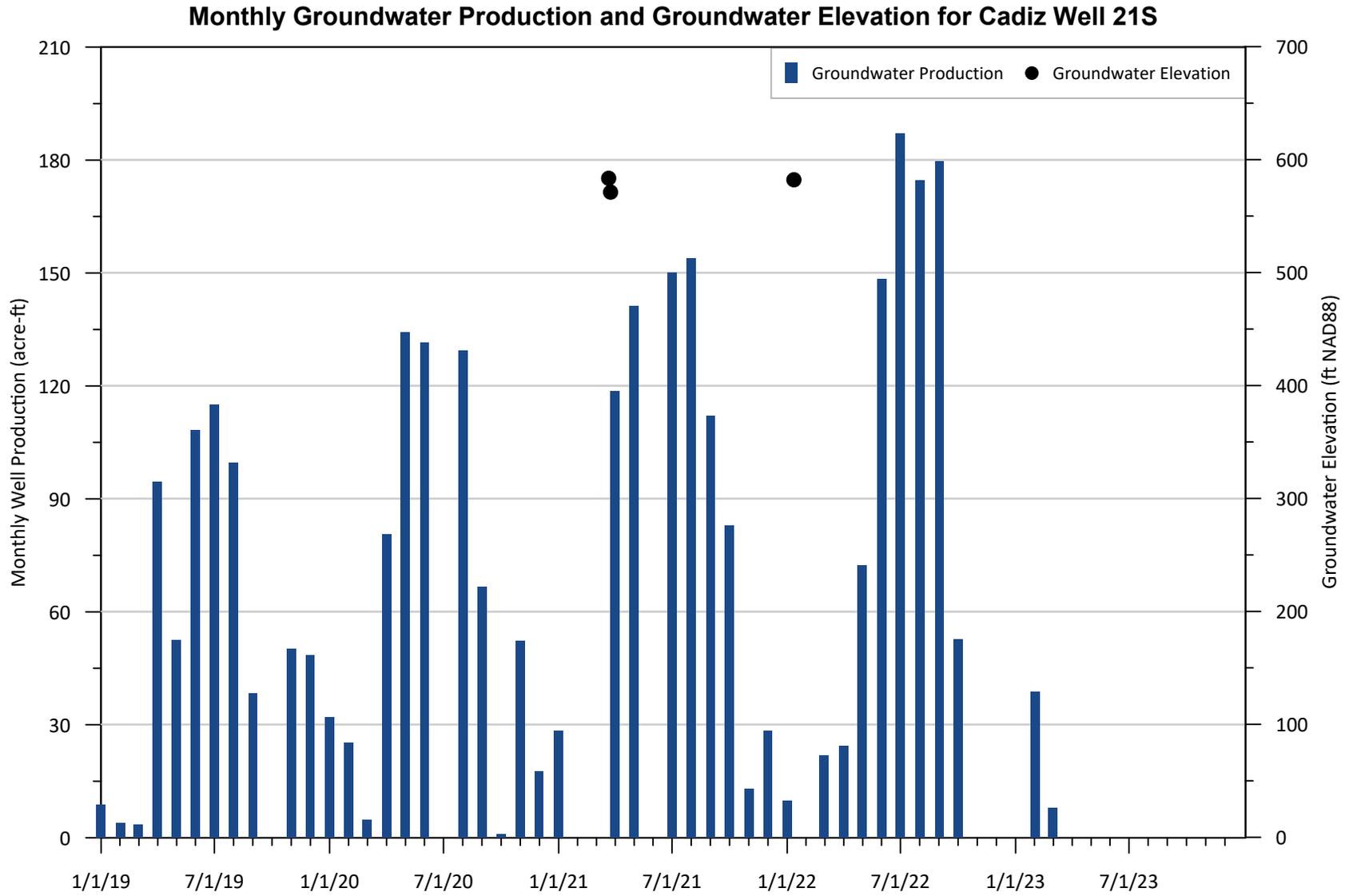
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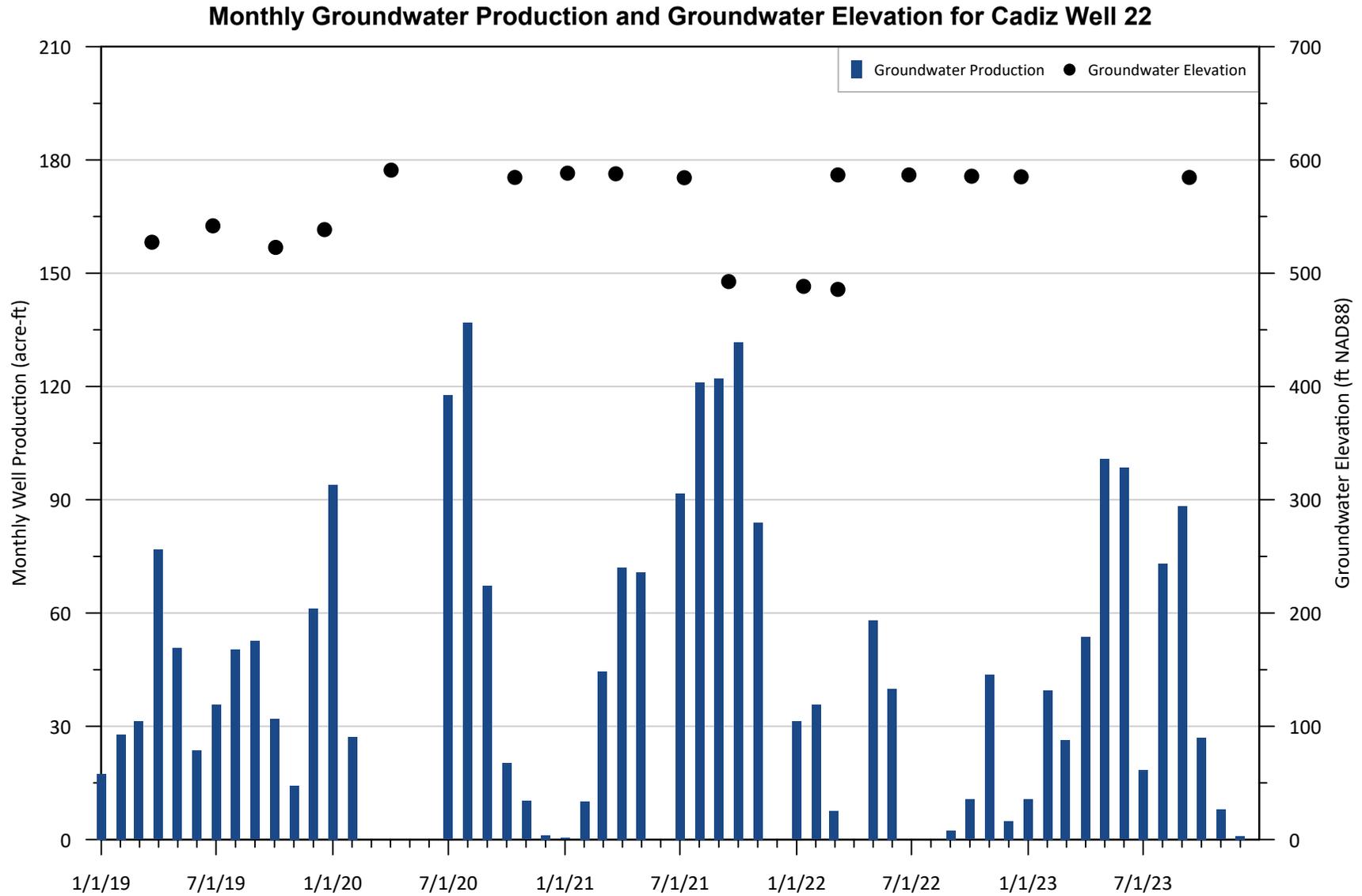
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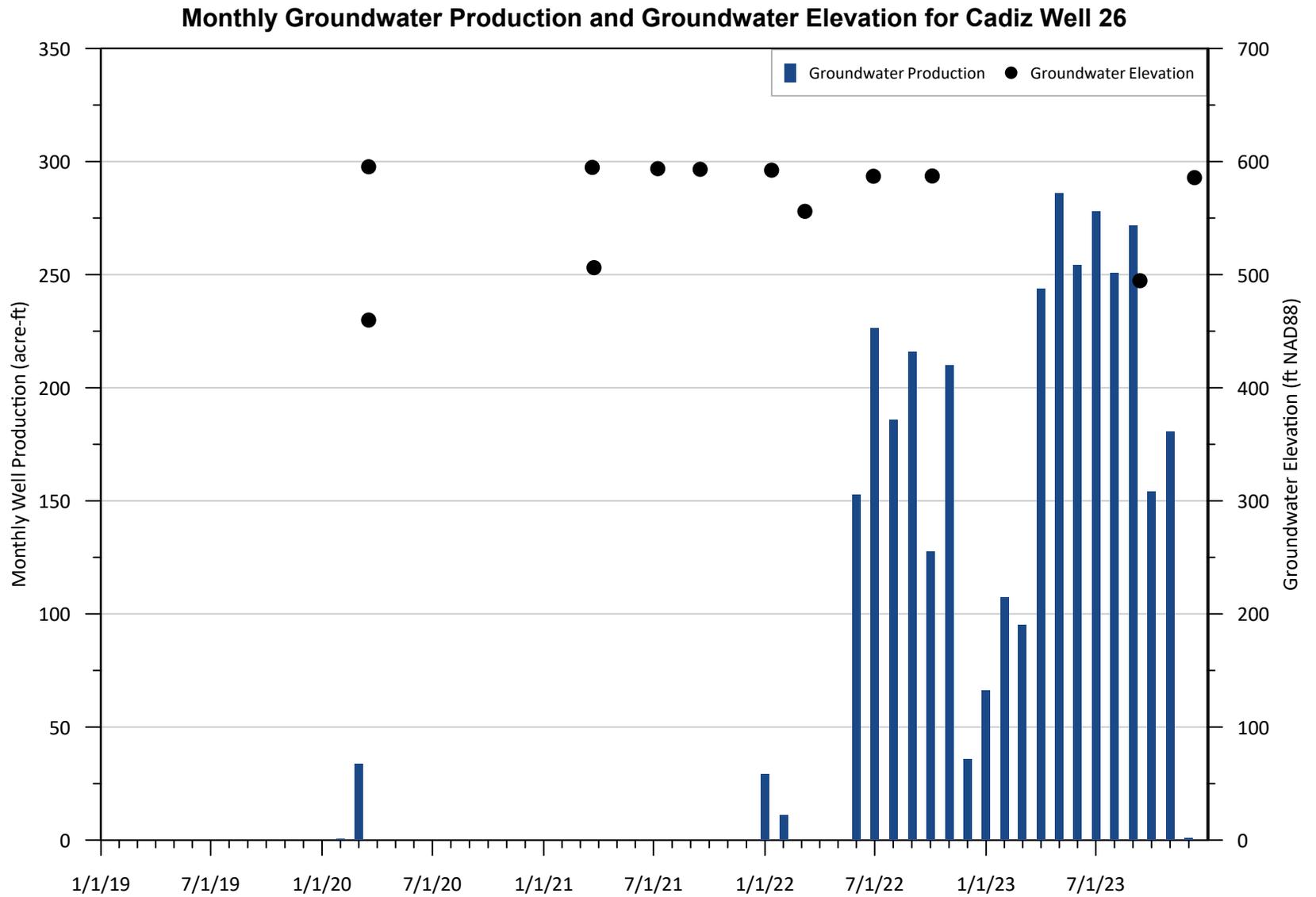
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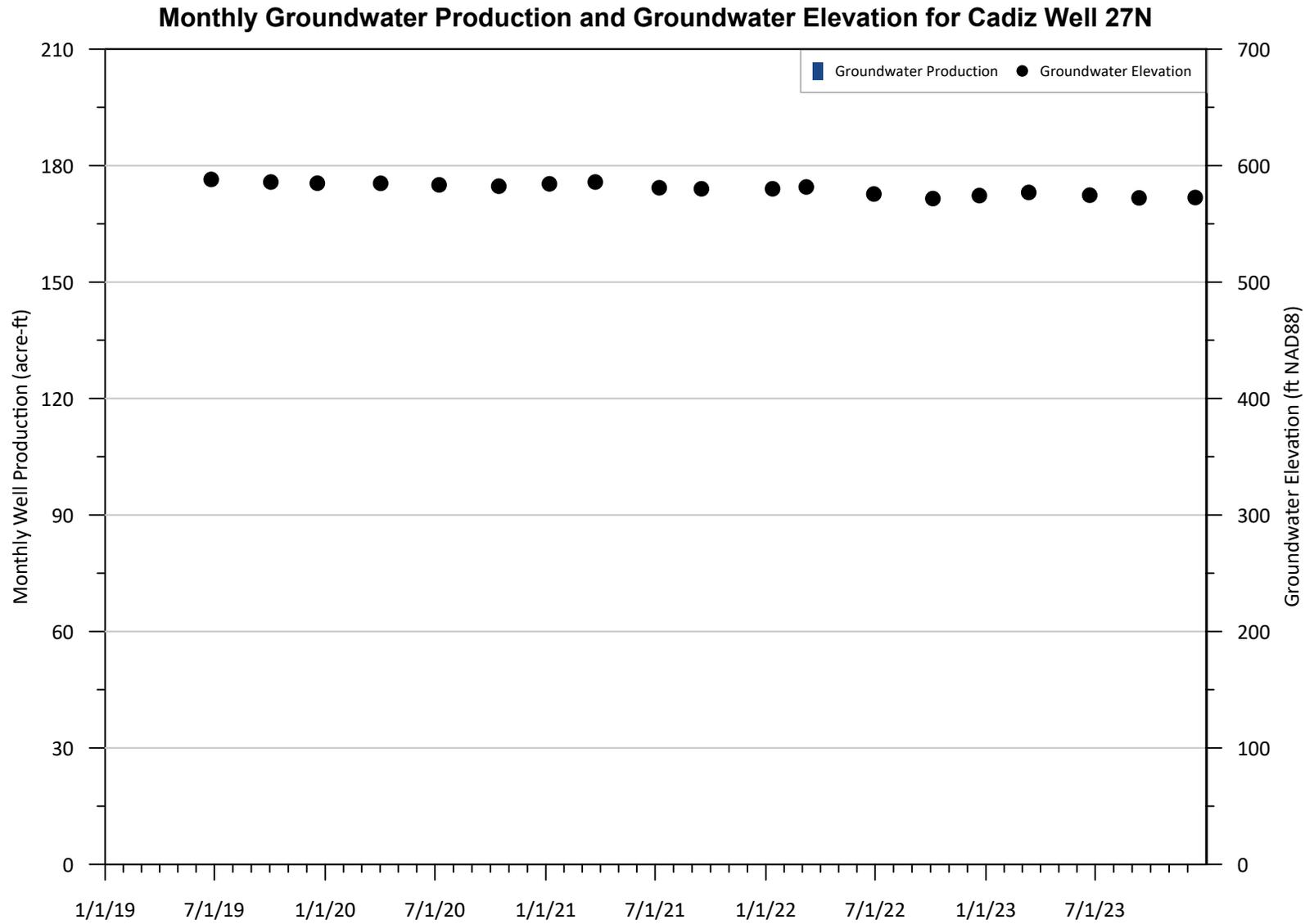


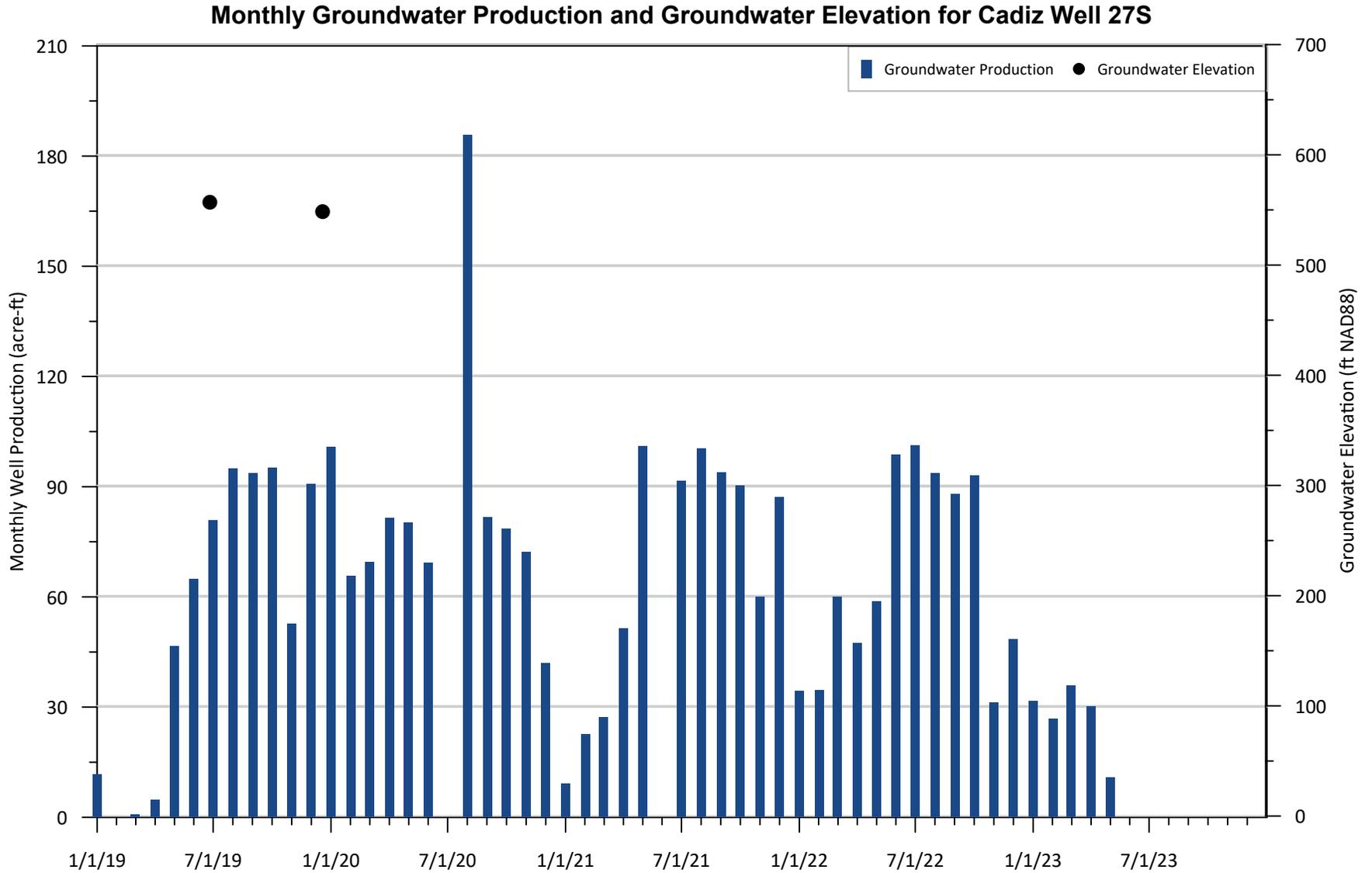


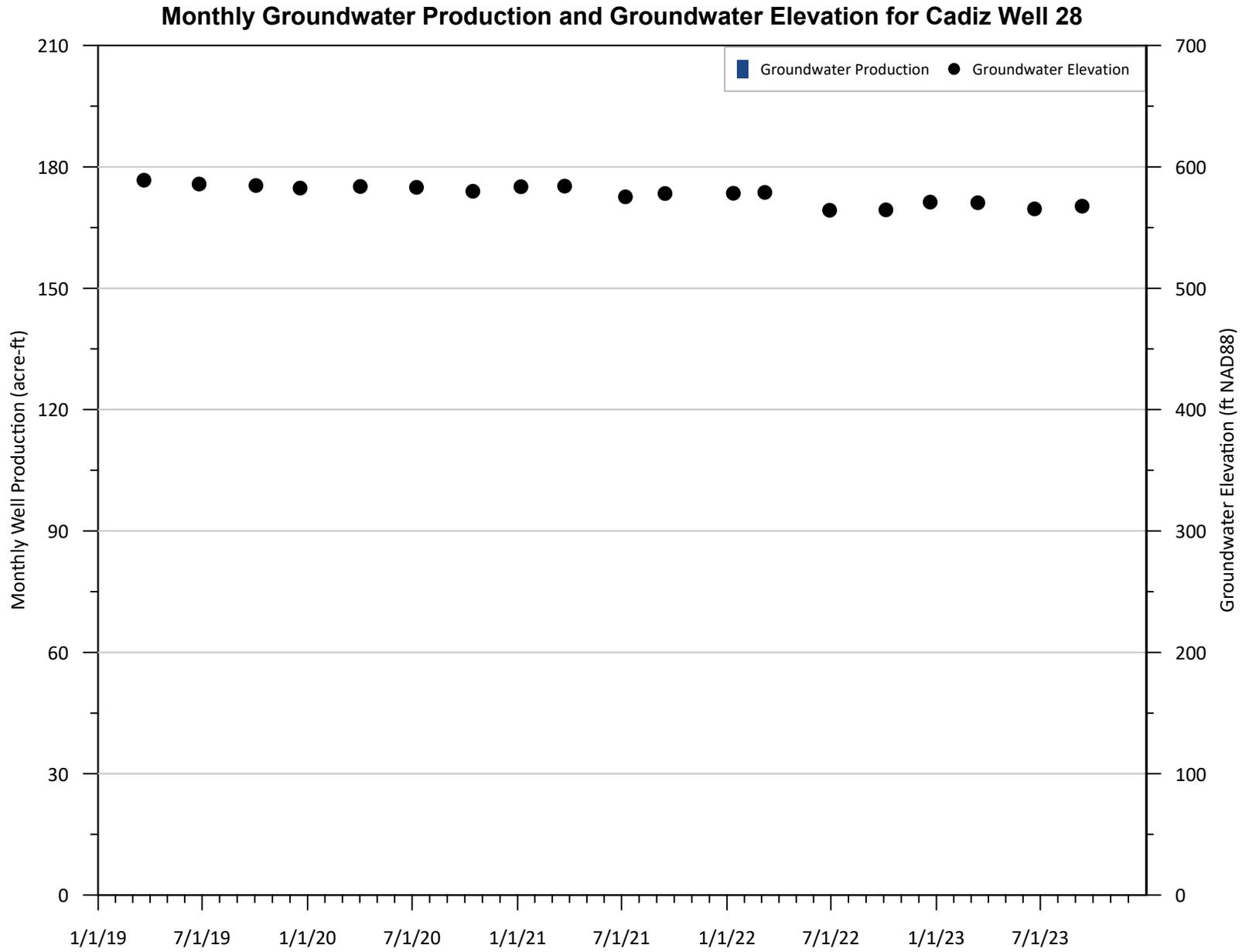


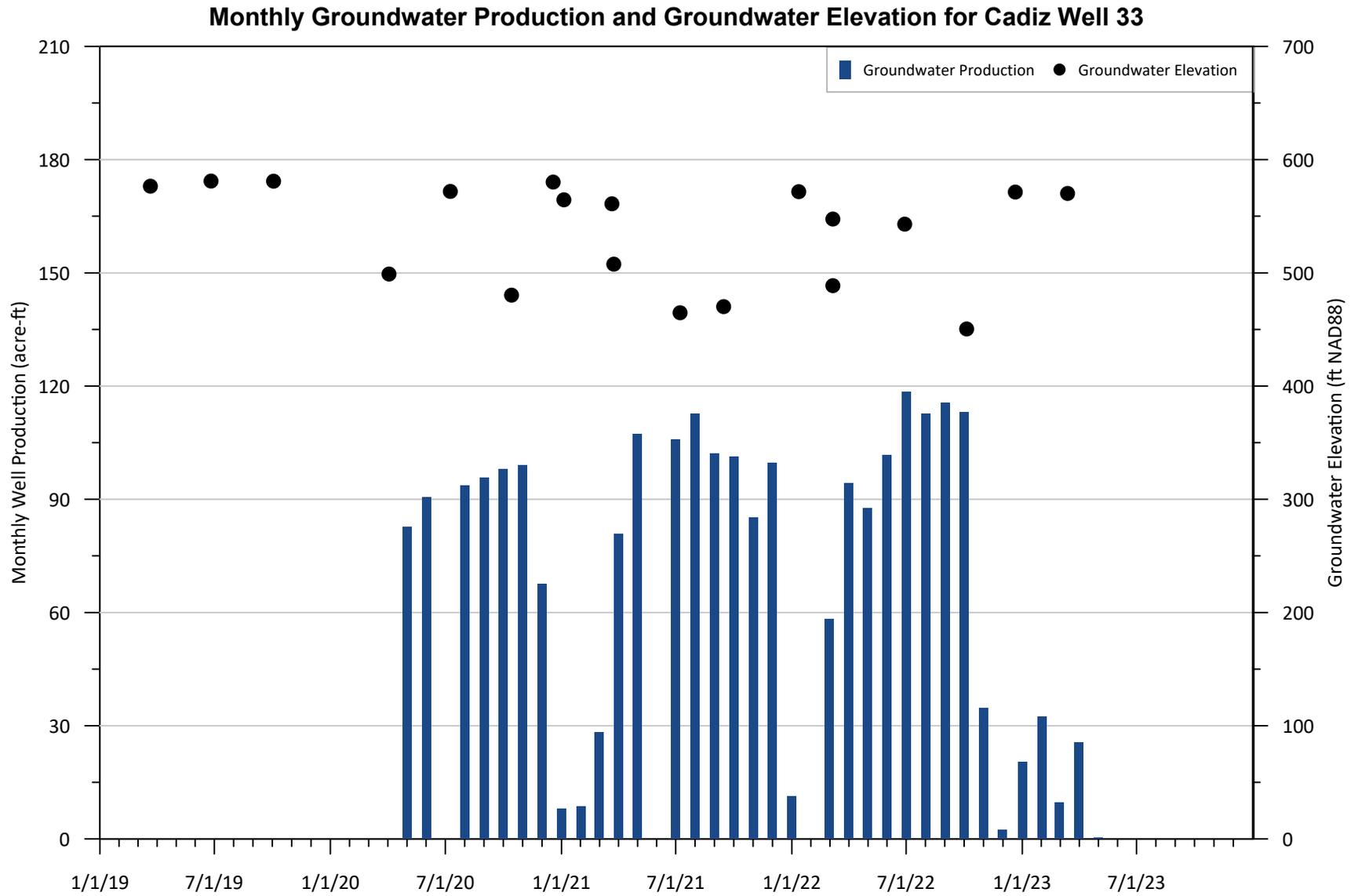




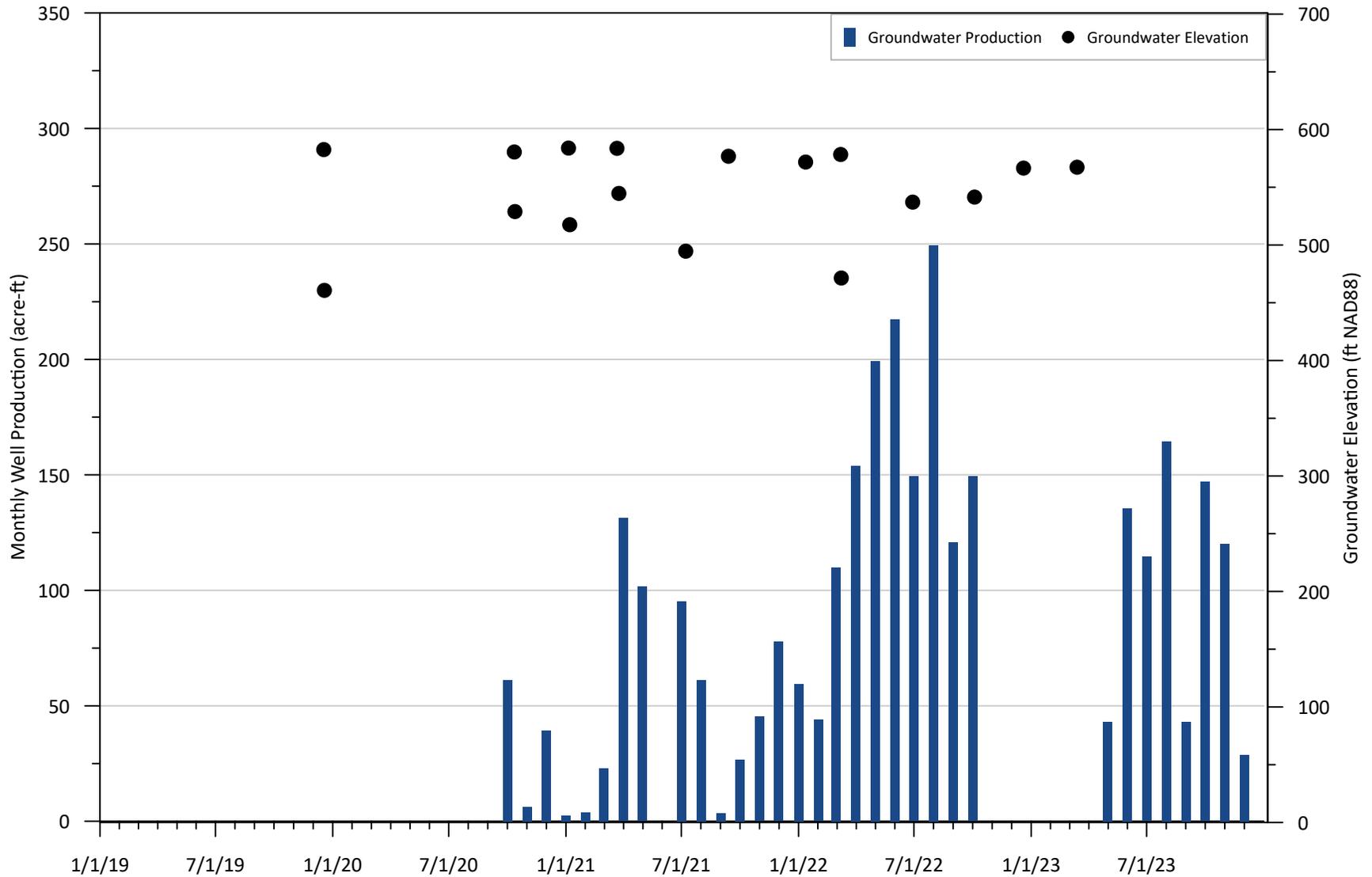


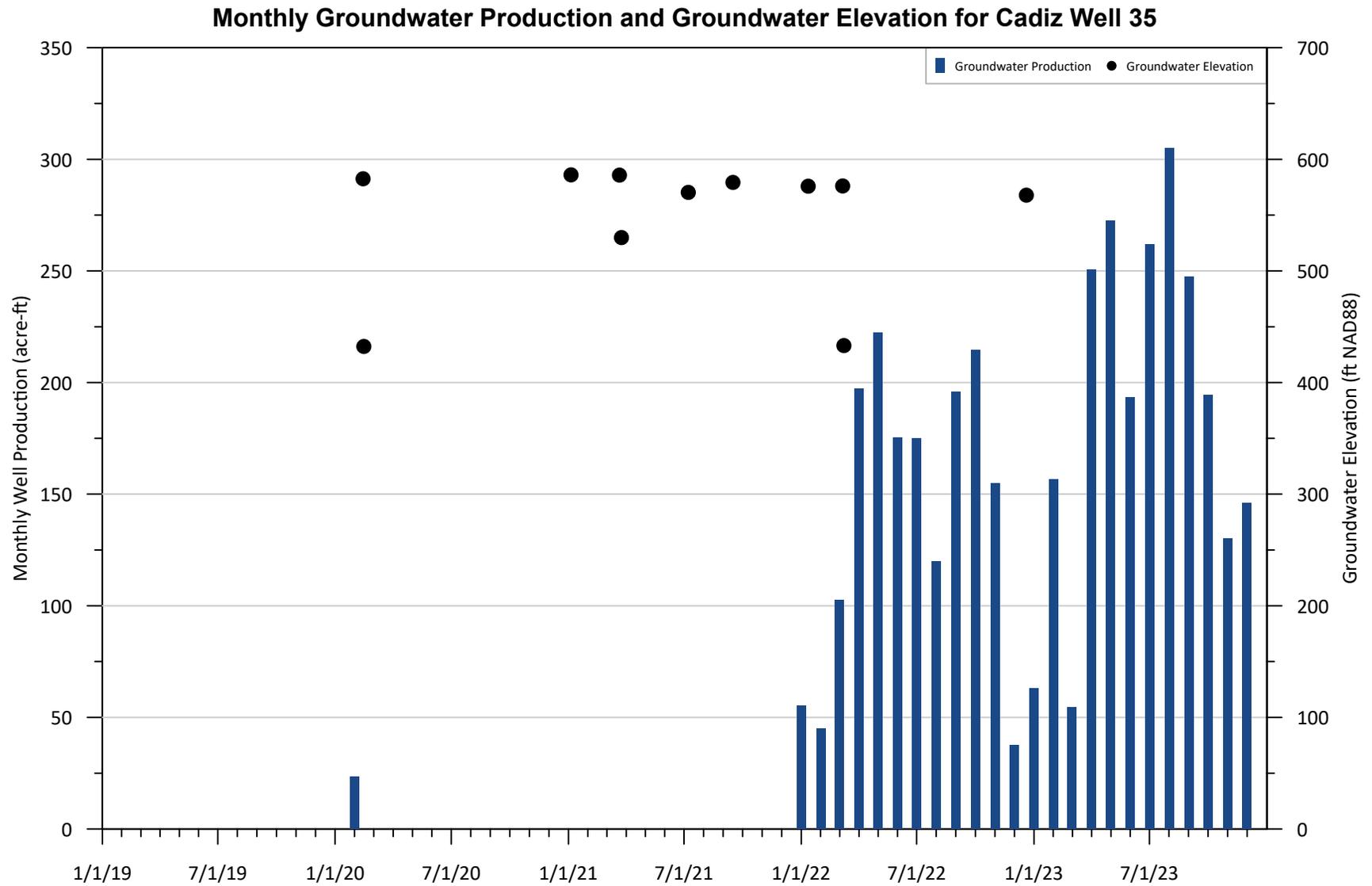






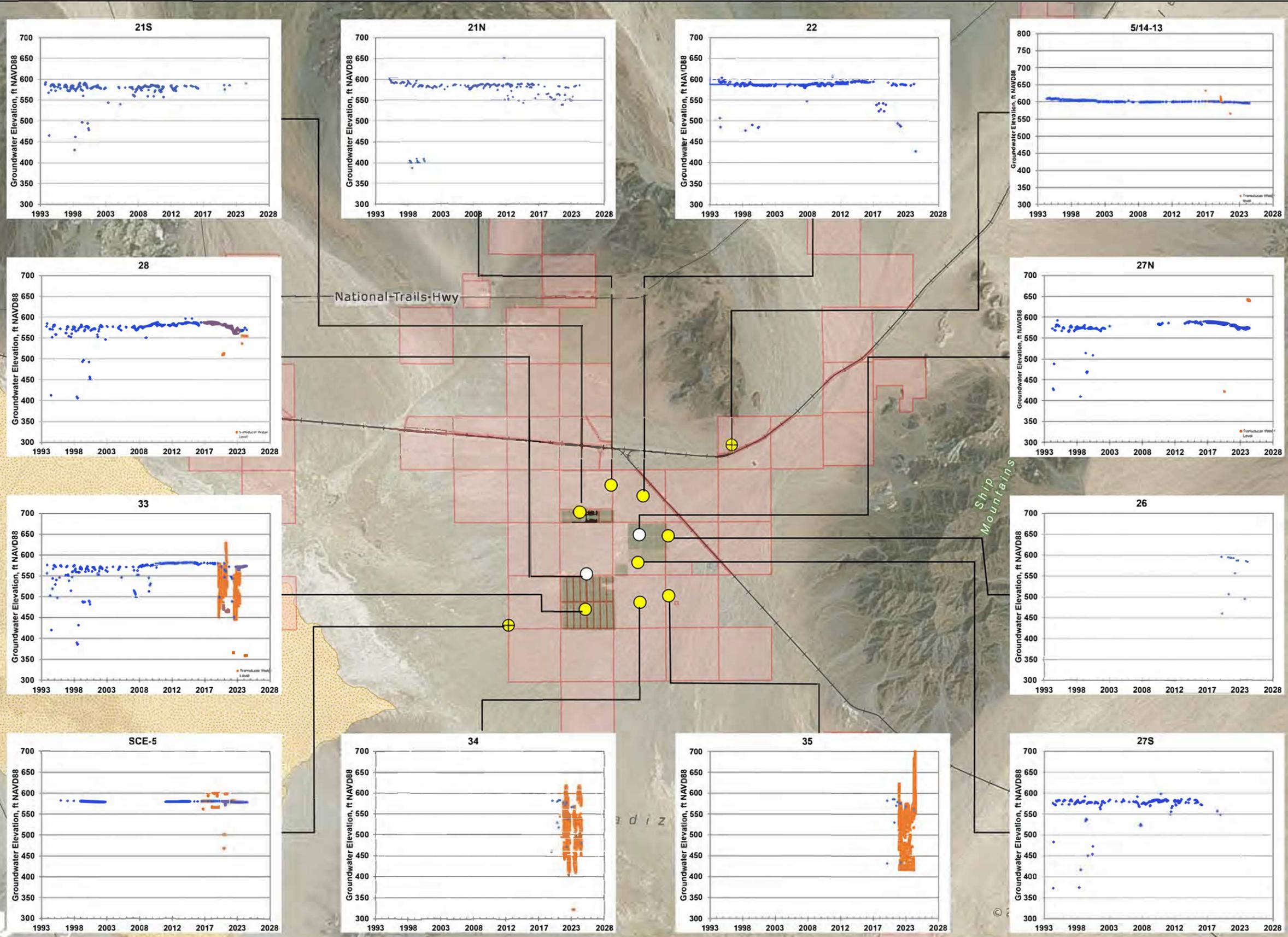
Monthly Groundwater Production and Groundwater Elevation for Cadiz Well 34





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EXPLANATION

Well Location of Hydrograph Group 1

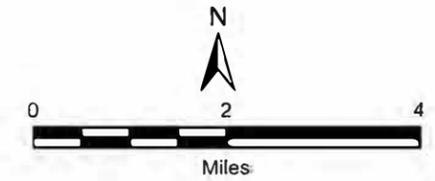
- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a).

- Cadiz-Owned Land
- Bristol Dry Lake

Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement

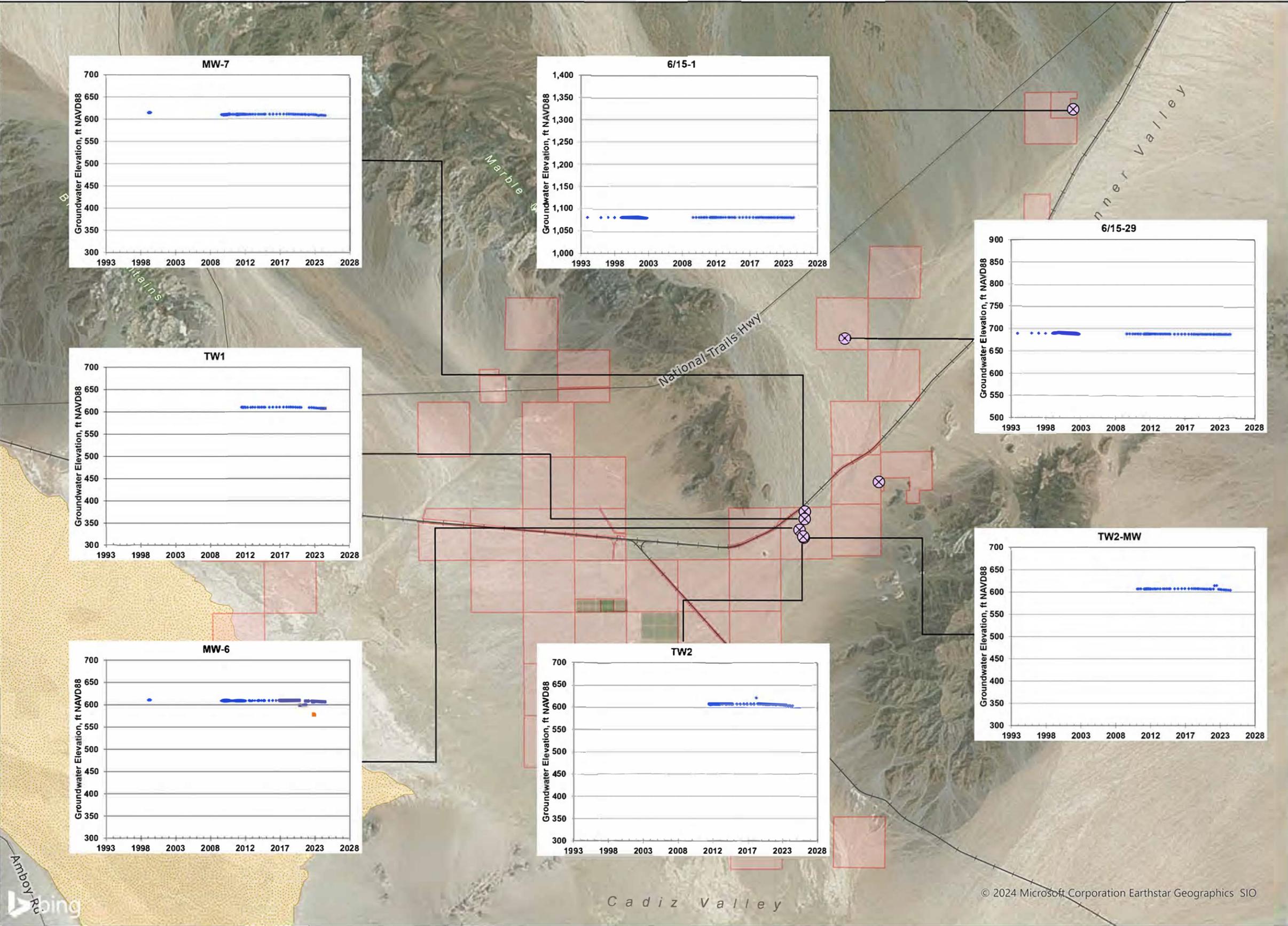


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HYDROGRAPHS GROUP 1

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EXPLANATION

⊗ Well Location of Hydrograph Group 2

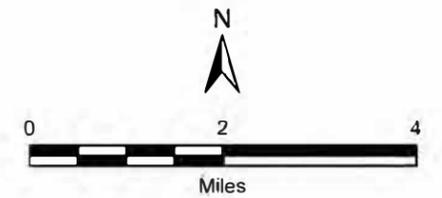
Note: Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA. 2012b).

▭ Cadiz-Owned Land

🟡 Bristol Dry Lake

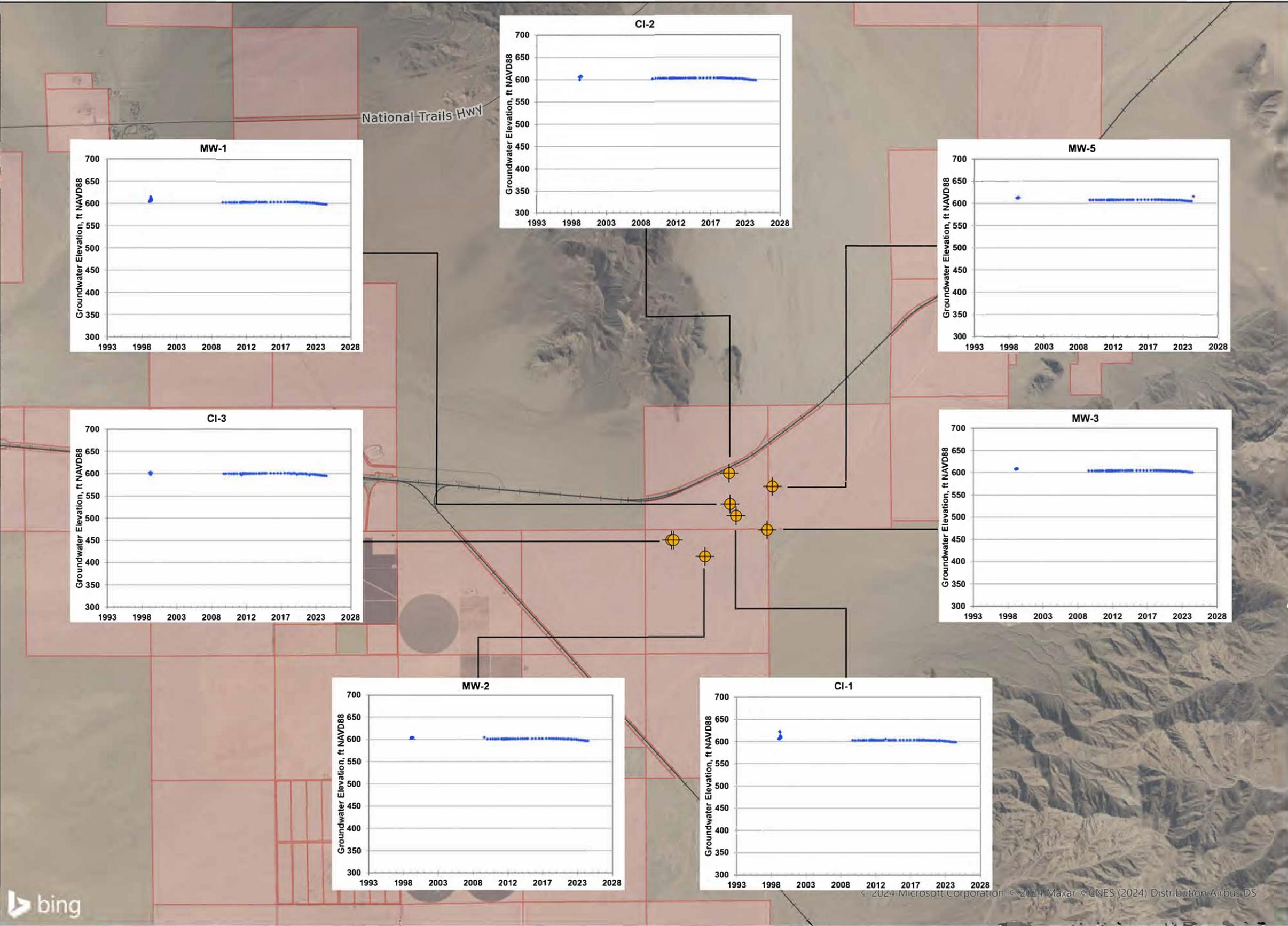
Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement



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HYDROGRAPHS GROUP 2



EXPLANATION

- Well Location of Hydrograph Group 3

Note: Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

- Cadiz-Owned Land
- Bristol Dry Lake

Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement

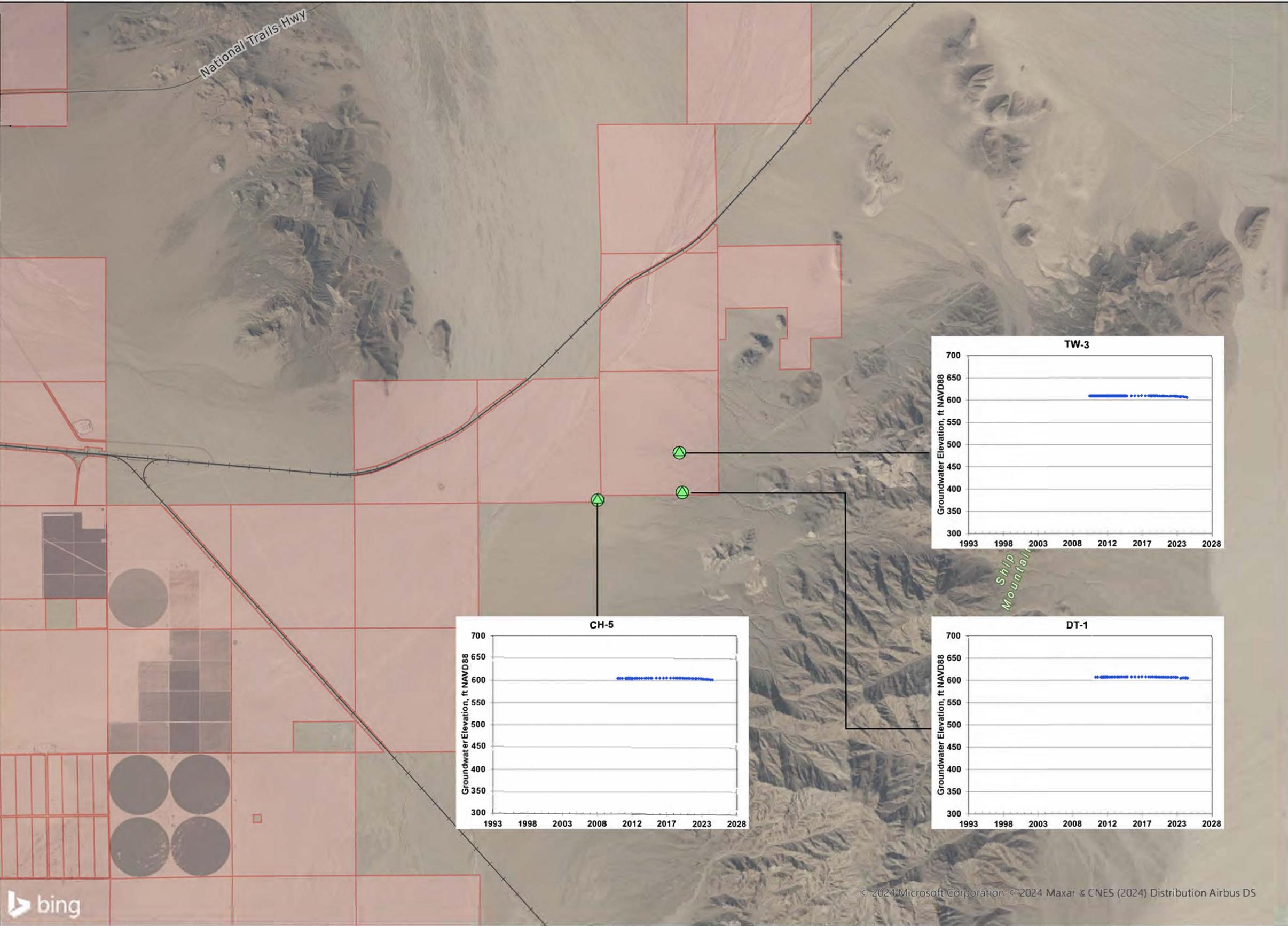
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HYDROGRAPHS GROUP 3

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EXPLANATION

Well Location of Hydrograph Group 4

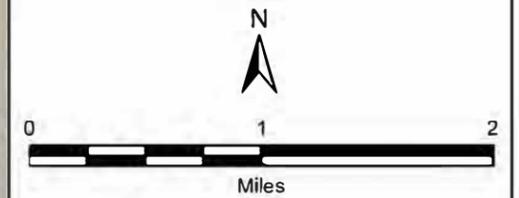
Note: Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA. 2012b).

Cadiz-Owned Land

Bristol Dry Lake

Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement



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HYDROGRAPHS GROUP 4

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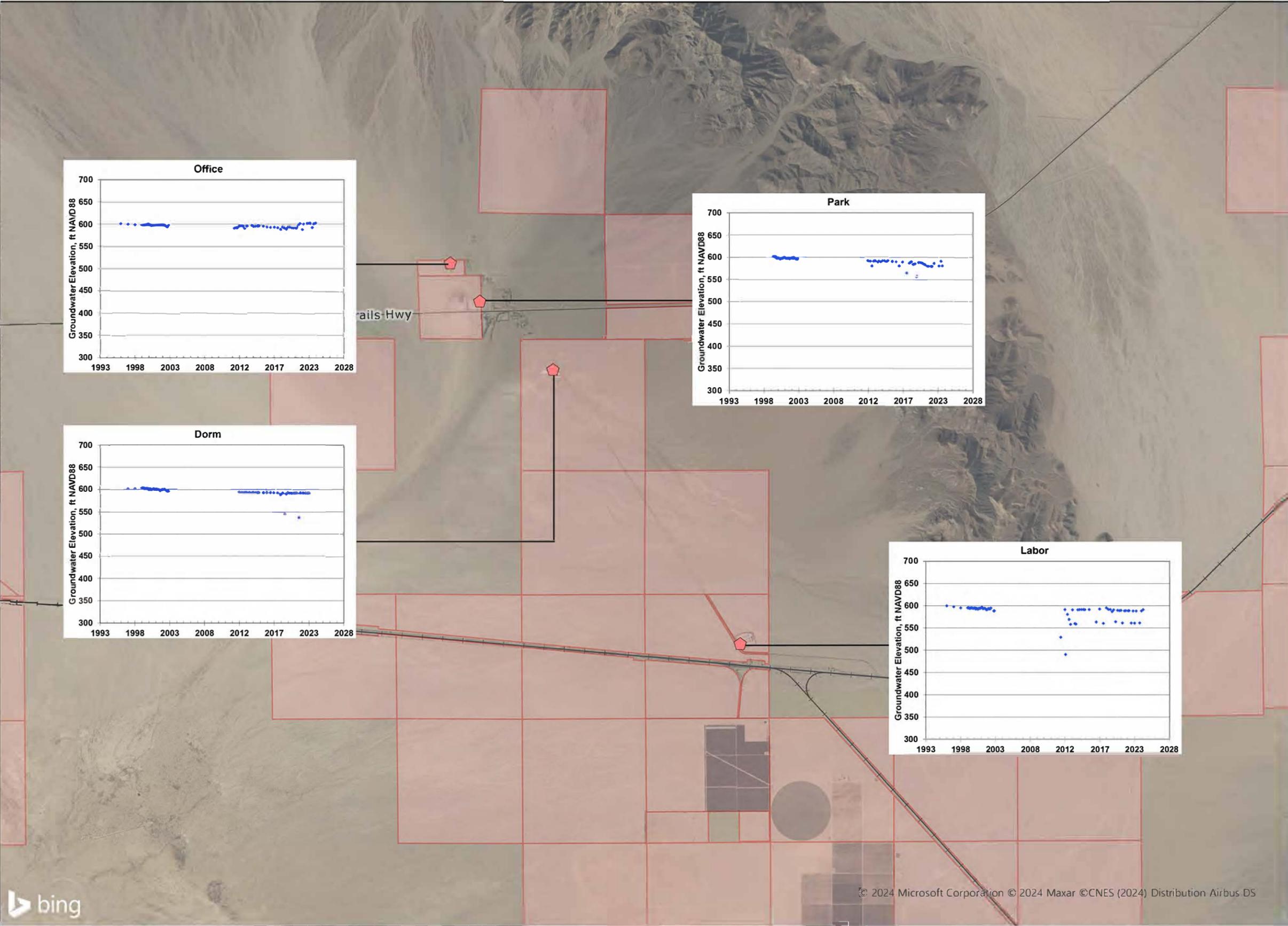


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CADIZ, INC.

CADIZ VALLEY AGRICULTURAL DEVELOPMENT - FIFTH FIVE-YEAR SUMMARY REPORT (JANUARY 2019 - DECEMBER 2023)

FIGURE 18



EXPLANATION

- Well Location of Hydrograph Group 5

Note: Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA. 2012b).

- Cadiz-Owned Land
- Bristol Dry Lake

Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement

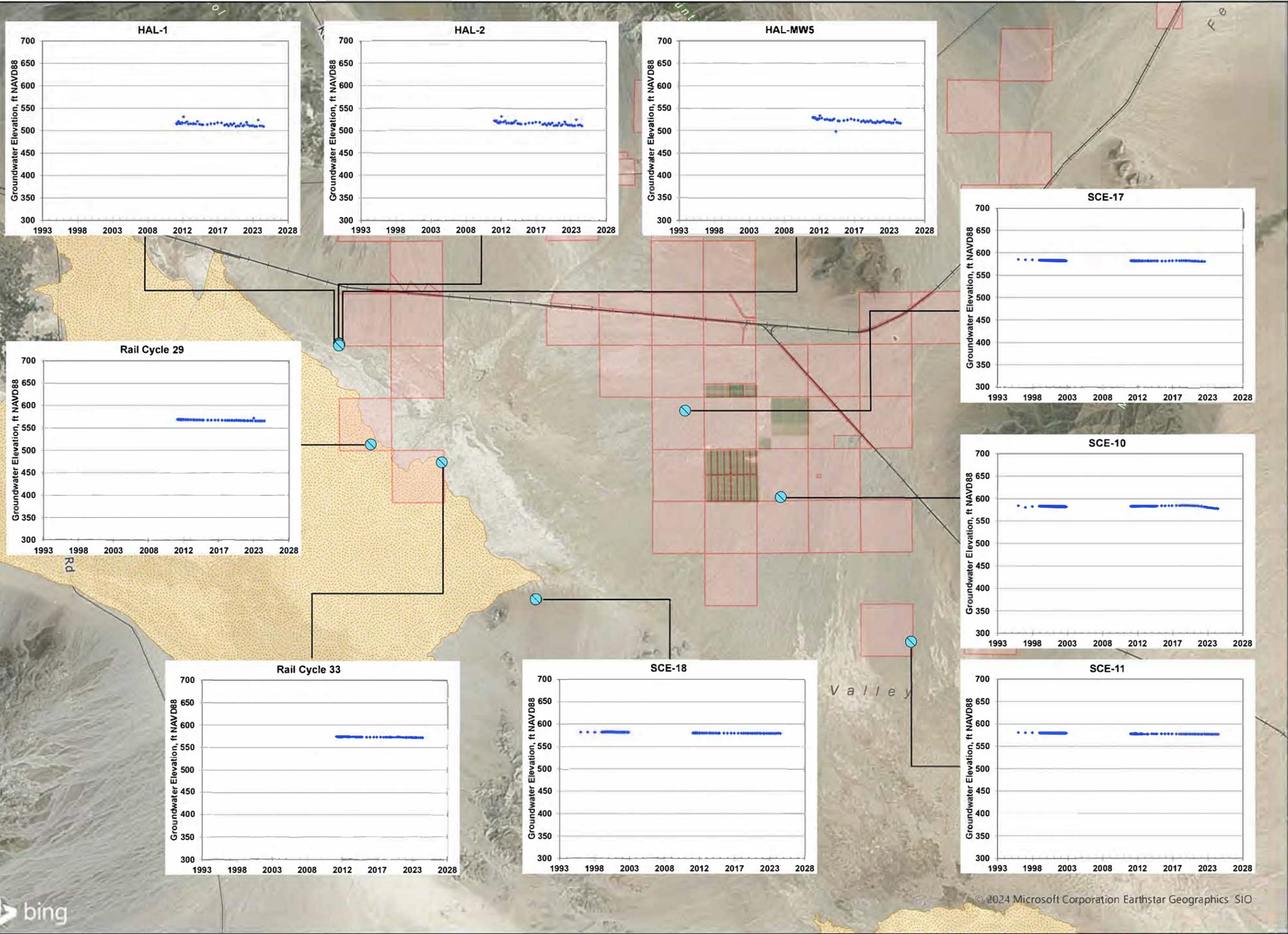
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EXPLANATION

- Well Location of Hydrograph Group 6

Note: Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

- Cadiz-Owned Land
- Bristol Dry Lake

Hydrograph Legend

- Manual Water Level Measurement
- Transducer Water Level Measurement

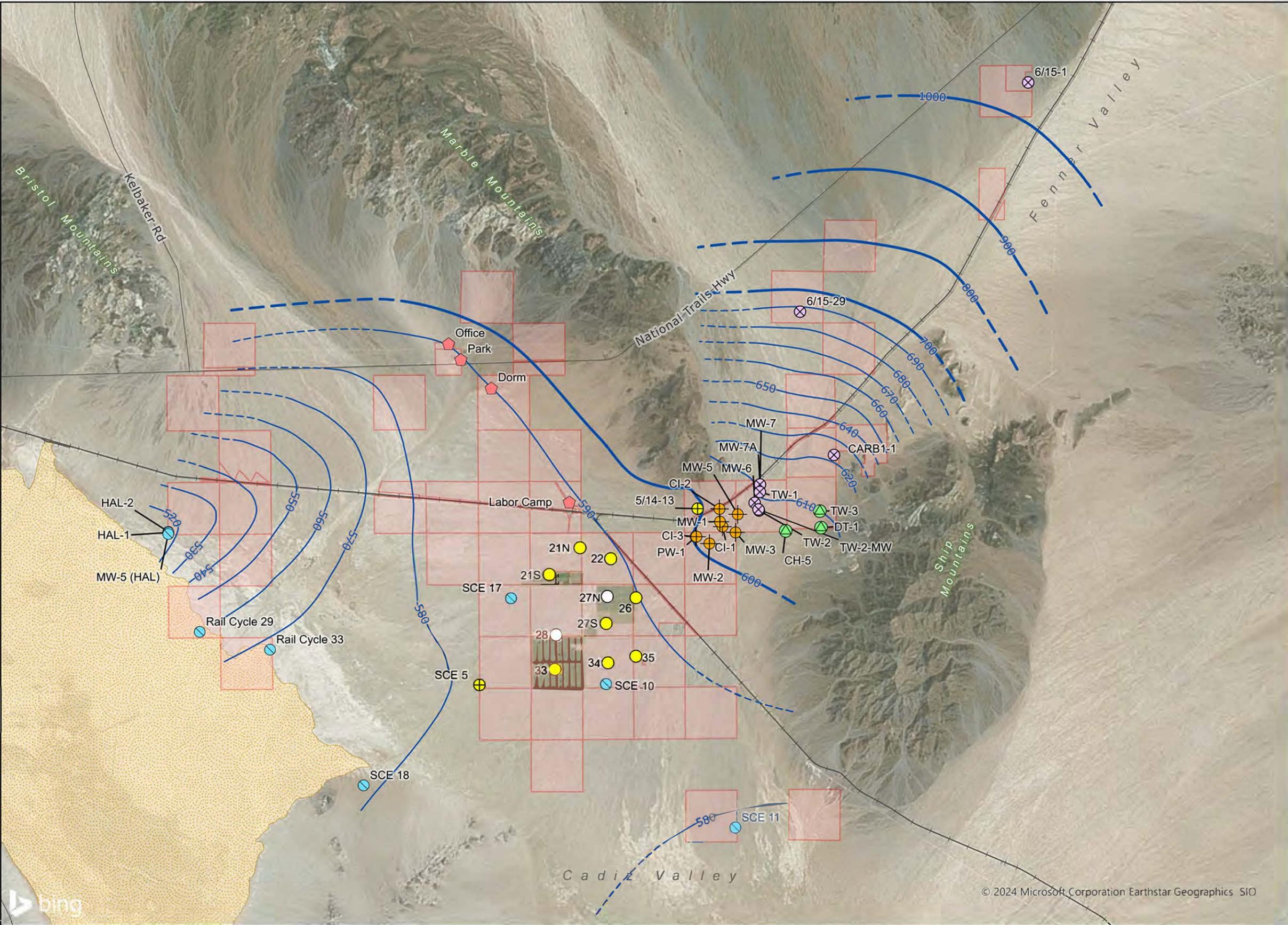
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HYDROGRAPHS GROUP 6

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EXPLANATION

400 Fall 2019 Groundwater Elevation Contours

Well Location and Hydrograph Group

Group 1

- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively
- ⊗ Group 2
- ⊕ Group 3
- ⊕ Group 4
- ⊕ Group 5
- ⊕ Group 6

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a). Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

- Cadiz-Owned Land
- Bristol Dry Lake

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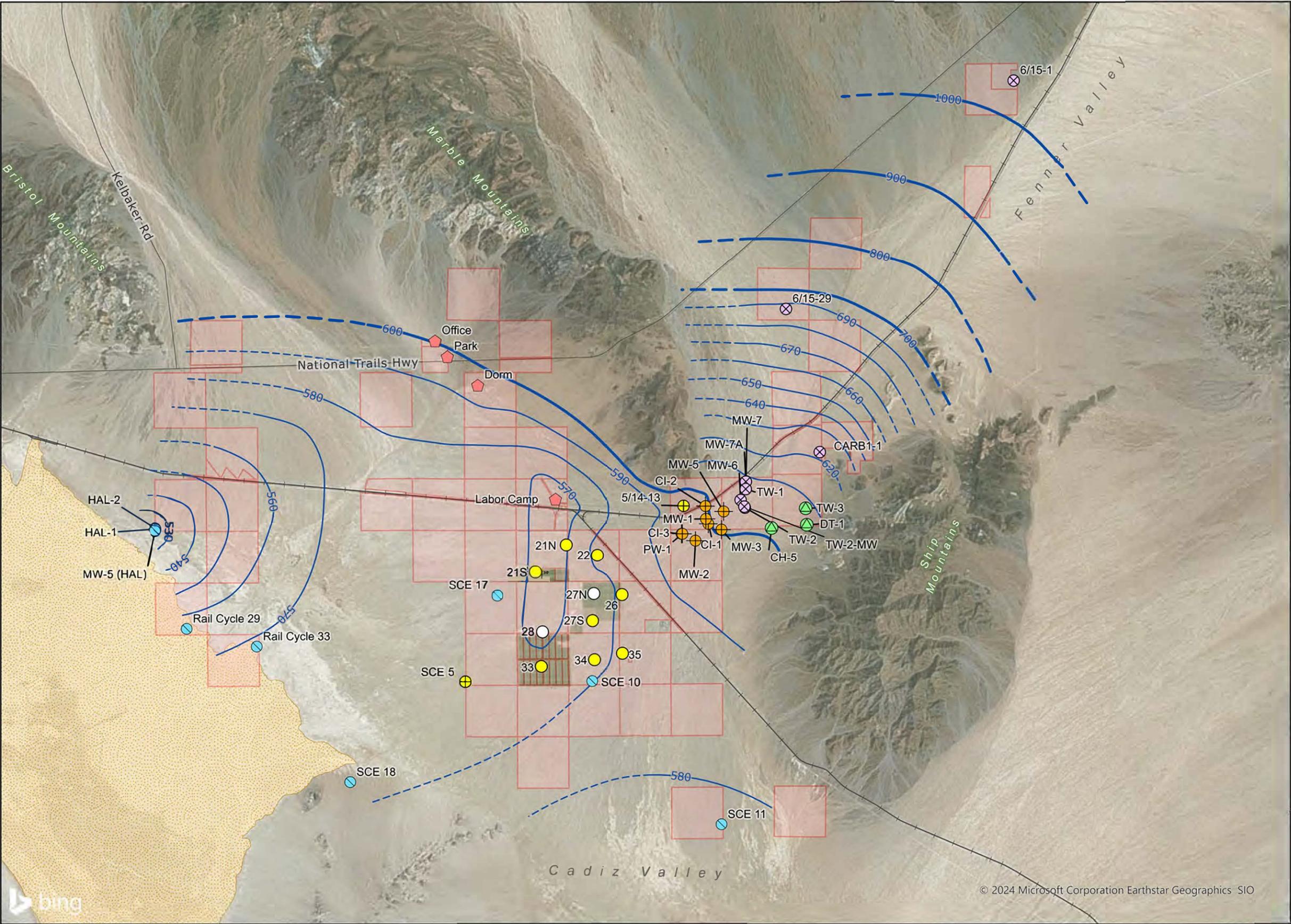
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GROUNDWATER ELEVATION CONTOURS - FALL 2019

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EXPLANATION

400 Fall 2023 Groundwater Elevation Contours

Well Location and Hydrograph Group

Group 1

- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively
- ⊗ Group 2
- ⊕ Group 3
- ⊗ Group 4
- ⊕ Group 5
- ⊗ Group 6

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a). Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

Cadiz-Owned Land

Bristol Dry Lake

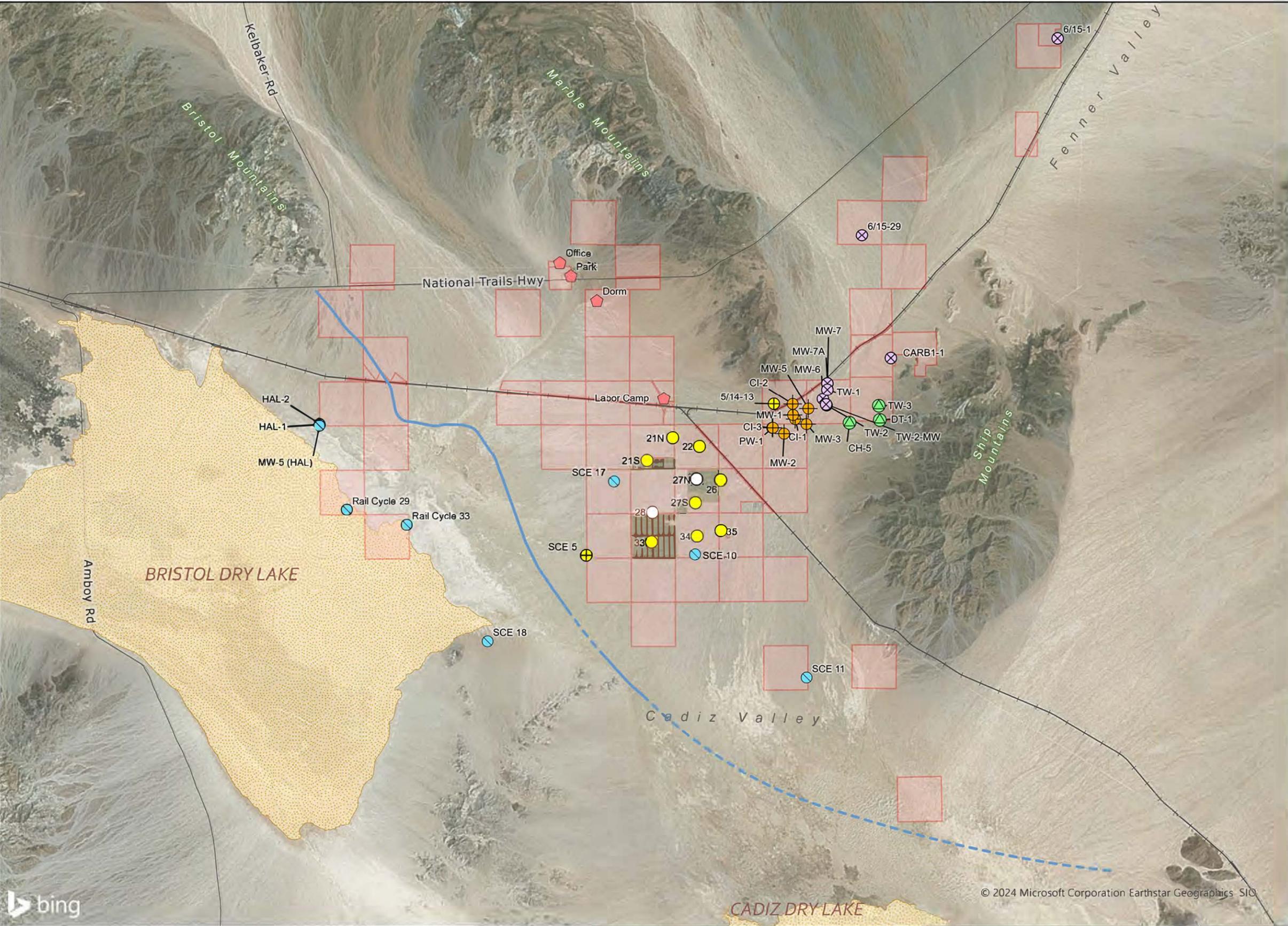
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GROUNDWATER ELEVATION CONTOURS - FALL 2023

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EXPLANATION

— Freshwater / Saline Water Interface (as of August 2021) (TDS = 1,000 mg/L)

Well Location and Hydrograph Group

Group 1

- Agricultural Well
- ⊕ Monitoring Well
- Agricultural Well Permanently Offline And Used As Wellfield Monitoring Well Exclusively

Group 2

- ⊗

Group 3

- ⊕

Group 4

- ⊕

Group 5

- ⬠

Group 6

- ⊕

Note: Group 1 includes wells in the original mon. network established in the Groundwater Monitoring Plan (GWMP) (Geoscience, 1997a). Groups 2 through 6 include wells in the extended mon. network established in the Groundwater Management, Monitoring, and Mitigation Plan (GMMMP) (ESA, 2012b).

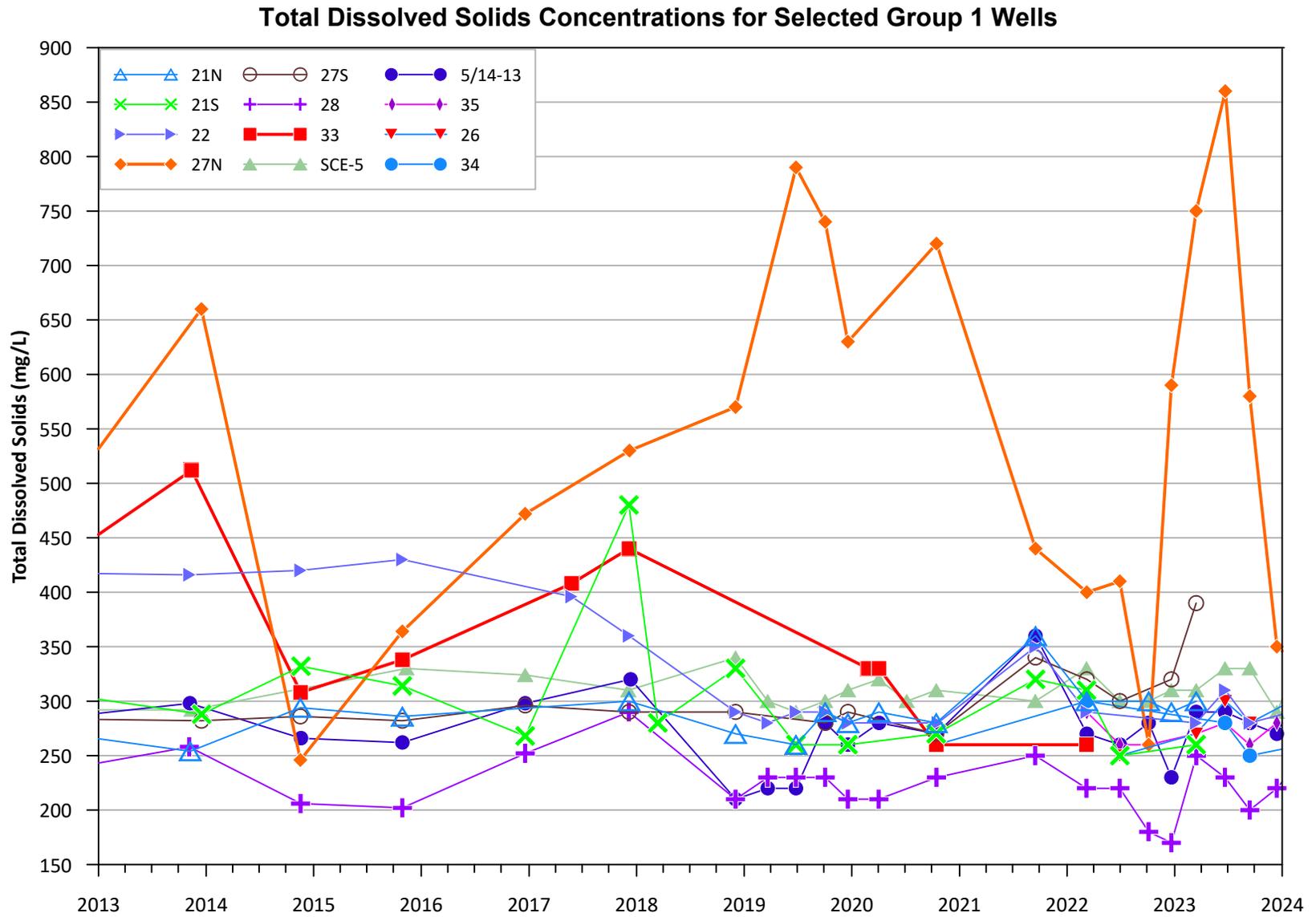
■ Cadiz-Owned Land

○ Dry Lake

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FRESHWATER / SALINE WATER INTERFACE



Tables

Production and Monitoring Well Construction Details

Well Designation	Year Completed	Coordinates (NAD83)		Ground Surface Elevation (ft msl)	Drilling Method	Borehole Diameter (inches)	Conductor Depth (ft bgs) (Diameter)	Total Borehole Depth (ft bgs)	Cased Depth (ft bgs) (Diameter)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal Interval (ft bgs)
		Latitude	Longitude									
TW-1 (Alluvium Section)	2009	34° 31' 38"	115° 26' 55"	940.04	Mud Rotary (to 455 ft) Dual Tube (to 1,002 ft)	24 (to 50 ft) 17.5 (to 461 ft) 9.5 (to 1,022 ft)	50' (18-inch)	1,022	455 (10")	355 - 440	335 - 445	0 - 335
TW-1 (Carbonate Section Open Borehole)	"	"	"	"	"	"	"	"	"	455 - 1,002	"	"
TW-2	2009	34° 31' 12"	115° 26' 56"	921.29	Flooded Reverse (to 798 ft) Dual Tube (to 1,380 ft)	42 (to 35 ft) 32 (to 340 ft) 17.5 (to 798 ft) 9.5 (to 1,160 ft) 5.25 (to 1,380 ft)	35' (32-inch) 340' (24-inch)	1,380	799 (10")	340 - 779	0 - 785 ⁽¹⁾	0 - 340
TW-2 (post May 2011)	2011	"	"	"	Dual Rotary (redrilled 870 - 1160 ft)	"	"	1,160	10" to 799 8" to 1,004	340 - 779 869 - 992	"	"
TW2-MW	2010	34° 31' 13"	115° 26' 56"	921.87	Dual Tube (to 740 ft)	5.25 (to 740 ft)	-	740	720	600 - 700	575 - 740	0 - 575
TW-3	2010	34° 31' 11"	115° 25' 41"	1,055.73	Dual Tube (to 960 ft) Rock Core (to 1,942 ft)	6 (to 85 ft) 5.25 (to 960 ft) 3.5 (to 1,230 ft) 2.75 (to 1,942 ft)	-	1,942	522	502 - 522	472 - 1,774	0 - 472
CH-5	2010	34° 30' 51"	115° 26' 23"	975.34	Dual Tube (to 349 ft) Rock Core (to 1,191 ft)	6 (to 55 ft) 5.25 (to 349 ft) 3.5 (to 1,191 ft)	-	1,191	438 (1.5")	338 - 438	55 - 1,191	0-55
DT-1	2011	34° 30' 54"	115° 25' 40"	1079.74	Dual Tube (to 1,500 ft)	30 (to 42 ft) 20 (to 935 ft) 12 (to 1,285 ft) 6.5 (to 1,500 ft)	38' (24-inch) 935' (12-inch)	1,500	980	935 - 975	895 - 900	0-895
PW-1	1999	34° 30' 46"	115° 28' 13"	875.72	Mud Rotary	36 (to 30 ft) 26 (to 830)	30' (30-inch)	830	820	300 - 800	50 - 830	0-50
5\14-13¹	1905	34° 31' 14"	115° 28' 11"	894.86	Unknown	Unknown	Unknown	592	590 (5-inch)	280 - 590	Unknown	Unknown
6\15-1¹	1994	34° 38' 23"	115° 21' 22"	1,374.68	Unknown	Unknown	Unknown	799	500 (5-inch)	300 - 793	Unknown	Unknown
6\15-29¹	1994	34° 34' 33"	115° 26' 04"	1,136.99	Unknown	Unknown	Unknown	809	809 (5-inch)	305 - 809	Unknown	Unknown
CI-1	1999	34° 30' 56"	115° 27' 41"	896.96	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 320 ft)	Unknown	320	310 (2")	250 - 310	200 - 320	0 - 20
CI-2	1998	34° 31' 14"	115° 27' 44"	904.77	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 690 ft)	Unknown	690	420 (2")	300 - 420	250 - 420	0 - 20
CI-3	1998	34° 30' 46"	115° 28' 14"	876.43	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 800)	Unknown	800	500 (2")	300 - 500	250 - 500	0 - 20
MW-1	1999	34° 31' 01"	115° 27' 44"	897.02	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 500)	Unknown	500	400 (2")	300 - 400	250 - 400	0 - 20
MW-2	1999	34° 30' 39"	115° 27' 57"	877.30	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 400)	Unknown	400	400 (2")	300 - 400	250 - 400	0 - 20
MW-3	1999	34° 30' 50"	115° 27' 25"	897.57	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 550)	Unknown	550	400 (2")	300 - 400	250 - 400	0 - 20
MW-5	1999	34° 31' 08"	115° 27' 22"	913.30	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 400)	Unknown	400	400 (2")	300 - 400	250 - 400	0 - 20
MW-6	1999	34° 31' 20"	115° 27' 01"	928.77	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 800)	Unknown	400	400 (2")	300 - 400	250 - 400	0 - 20
MW-7	1999	34° 31' 38"	115° 26' 54"	940.57	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 600)	Unknown	600	600 (2")	500 - 600	265 - 600	0 - 30
MW-7a	1999	"	"	"	Track mounted rotary drilling rig	12.25 (to 20 ft) 6.5 (to 600)	Unknown	600	400 (1")	300 - 400	265 - 600	0 - 30
SCE 5²	Unknown	34° 28' 18"	115° 32' 37"	686.84	Unknown	Unknown	Unknown	Unknown	137 (1.5-inch)	49 - 135	Unknown	Unknown

Production and Monitoring Well Construction Details

Well Designation	Year Completed	Coordinates (NAD83)		Ground Surface Elevation (ft msl)	Drilling Method	Borehole Diameter (inches)	Conductor Depth (ft bgs) (Diameter)	Total Borehole Depth (ft bgs)	Cased Depth (ft bgs) (Diameter)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal Interval (ft bgs)
		Latitude	Longitude									
SCE 10 ²	Unknown	34° 28' 22"	115° 29' 59"	748.84	Unknown	Unknown	Unknown	Unknown	178 (1.5-inch)	47 - 176	Unknown	Unknown
SCE 11 ²	Unknown	34° 25' 51"	115° 27' 25"	672.4	Unknown	Unknown	Unknown	Unknown	120 (1.5-inch)	84 - 117	Unknown	Unknown
SCE 17 ²	Unknown	34° 29' 55"	115° 31' 58"	731.99	Unknown	Unknown	Unknown	Unknown	158 (1.5-inch)	148 - 156	Unknown	Unknown
SCE 18 ²	Unknown	34° 26' 37"	115° 34' 59"	631.13	Unknown	Unknown	Unknown	Unknown	79 (1.5-inch)	69 - 79	Unknown	Unknown
21N ¹	1995	34° 30' 36"	115° 30' 35"	793.47	Unknown	42 (to 50 ft) 26 (to 928 ft)	50' (30-inch)	920	920 (16-inch)	250 - 490 570 - 900	250 - 900	0 - 50
21S ¹	1984	34° 30' 09"	115° 31' 13"	763.03	Unknown	28	40' (30-inch)	790	790 (16-inch)	348 - 778	Unknown	Unknown
22 ¹	1994	34° 30' 25"	115° 29' 57"	813.18	Unknown	26	60'	894	890 (16-inch)	320 - 400 580 - 630 670 - 710 740 - 880	Unknown	Unknown
26 ^{1,3}	2020	34°29' 82"	115°29' 43"	813.00	Mud Rotary	34 (50-270ft) 28 (270-1,000ft)	50 (36-inch)	1000	980 (18-inch)	390 - 430 480 - 565 640 - 690 725 - 960	250 - 1,000	0 - 250
27N ¹	1989	34° 29' 46"	115° 30' 02"	790.94	Unknown	28	40' (30-inch)	800	800 (16-inch)	360 - 760	Unknown	Unknown
27S ¹	1989	34° 29' 19"	115° 30' 04"	778.40	Unknown	28	40' (30-inch)	990	990 (16-inch)	400 - 900	Unknown	Unknown
28 ¹	1987	34° 29' 07"	115° 31' 06"	741.21	Unknown	28	40' (30-inch)	800	800 (16-inch)	400 - 800	Unknown	Unknown
33 ¹	1984	34° 28' 32"	115° 31' 09"	729.13	Unknown	28	40' (30-inch)	790	790 (16-inch)	355 - 776	Unknown	Unknown
34 ^{1,3}	2019	34°28' 27"	115°30' 94"	760.00	Mud Rotary	28	50 (36-inch)	1140	1,120 (18-inch)	400 - 470 500 - 1,100	196 - 1,140	0 - 196
35 ^{1,3}	2020	34°28' 54"	115°29' 00"	777.00	Mud Rotary	28	50 (36-inch)	850	830 (18-inch)	420 - 560 580 - 810	200 - 850	0 - 250
Labor Camp	Unknown	34° 31' 24"	115° 30' 50"	785.74	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Office	Unknown	34° 34' 03"	115° 33' 15"	736.64	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Dorm	Unknown	34° 33' 18"	115° 32' 23"	711.49	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Park	Unknown	34° 33' 47"	115° 33' 00"	721.09	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Piute (Ibis)	Unknown	34° 56' 31"	114° 47' 33"	1,457.89	Unknown	26	50	924	860	290 - 840	0 - 860	0 - 50
Piute MW ^{3,4}	Unknown	35° 5' 23"	114° 50' 38.6"	2,025	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Piute MW2 ^{3,4}	Unknown	35° 5' 12.5"	114° 50' 38.5"	2010	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Piute MW3 ^{3,4}	Unknown	35° 3' 29"	114° 48' 21"	2,087	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
MDHCA ^{3,4}	1992	34° 55' 14"	115° 4' 0.7"	2593	Unknown	Unknown	Unknown	Unknown	900 (8-inch)	Unknown	Unknown	Unknown
HAL 1 ^{3,4}	Unknown	34° 30' 53.9"	115° 38' 58.7"	621	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
HAL 2 ^{3,4}	Unknown	34° 30' 54.3"	115°38' 59.6"	621	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
MW5 (HAL) ^{3,4}	Unknown	34° 30' 52.3"	115° 38' 59.8"	618	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
RC 29 ^{3,4}	Unknown	34° 29' 13"	115°38' 21.9"	616	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
RC 33 ^{3,4}	Unknown	34° 28' 54"	115° 36' 55.4"	616	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Notes:
 1. Township/ Range and Section used for well names (ex., 5/14-13 = Township 05N Range 14E Section 13 San Bernardino Baseline Meridian, or 21N = northern area of Section 21) Latitude/Longitude UnkownD83; elevation data UnkownVD88.
 2. Screened Interval Determined from Video Log of Wells - May 2013 ft = foot/feet
 3. Well has not been surveyed yet, elevation was approximated using Google Earth.
 4. Well has not been surveyed yet, latitude/longitude was approximated using Google Earth.
 ft bgs = feet below ground surface
 ft msl = feet (relative to) mean sea level

Fifth Five-Year Summary Report (January 2019 - December 2023)

2019 and 2023 Groundwater Elevations Compared to Baseline

Well	Baseline Value ¹ (ft NAVD88)	Maximum Non-pumping GW Level for 2019 (ft NAVD88)	Difference (2019 Max Level from Baseline) (ft NAVD88)	Maximum Non-pumping GW Level for 2023 (ft NAVD88)	Difference (2023 Max Level from Baseline, ft)	Difference (Between 2019 and 2023, ft)
21N ²	588.04	566.12	-21.92	581.97	-6.07	15.85
21S ³	584.47	NA	NA	NA	NA	NA
22 ⁴	589.63	591.56	1.93	584.44	-5.19	-7.12
27N	570.01	623.86	53.85	578.16	8.15	-45.70
27S ⁵	575.23	556.93	-18.30	NA	NA	NA
28	568.71	588.94	20.23	570.43	1.72	-18.51
33	574.12	581.03	6.91	573.01	-1.11	-8.02
5/14-13	606.31	601.29	-5.02	593.53	-12.78	-7.76

Note: Positive values indicate groundwater level rise relative to Baseline levels

1. Baseline groundwater level conditions for the Cadiz wellfield have been based primarily on an average of December 1995 through December 1996 static groundwater levels.
2. Groundwater Measurements were collected during pumping during 2023. As a result, the maximum non-pumping GW level shown for 2019 is from June 9, 2022.
3. Groundwater level measurements were not collected in 2019 or 2023 due to sounding port issues.
4. Groundwater measurements were collected at Well 22 while the well was pumping in 2019, and a reliable static water level was not obtained. As a result, the static water level measurement shown is from April 4, 2020.
5. Groundwater level measurements were not collected in 2023 due to sounding port issues.

GW groundwater

NA Not applicable

TDS Concentration Data

Well Name	21N	21S	22	26	27N ¹	27S	28 ¹	33 ²	34	35	SCE-5 ³	5/14-13 ⁴
Parameter	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)				
Date Sampled												
11/5/2013	-	-	-	-	-	-	258	-	-	-	-	-
11/6/2013	-	-	416	-	-	-	-	-	-	-	-	-
11/7/2013	-	-	-	-	-	-	-	-	-	-	-	298
11/8/2013	254	-	-	-	-	-	-	-	-	-	-	-
11/13/2013	-	-	-	-	-	-	-	512	-	-	292	-
12/16/2013	-	-	-	-	660	282	-	-	-	-	-	-
12/17/2013	-	288	-	-	-	-	-	-	-	-	-	-
11/17/2014	294	-	-	-	246	286	-	-	-	-	-	-
11/18/2014	-	-	420	-	-	-	206	308	-	-	-	-
11/19/2014	-	332	-	-	-	-	-	-	-	-	-	266
10/29/2015	286	314	430	-	364	282	202	338	-	-	-	262
11/12/2015	-	-	-	-	-	-	-	-	-	-	330	-
12/19/2016	-	268	-	-	472	296	252	-	-	-	324	298
5/25/2017	-	-	396	-	-	-	-	408	-	-	-	-
12/4/2017	-	-	-	-	-	-	-	-	-	-	310	-
12/6/2017	300	480	360	-	-	290	290	440	-	-	-	-
12/8/2017	-	-	-	-	530	-	-	-	-	-	-	-
12/12/2017	-	-	-	-	-	-	-	-	-	-	-	320
3/14/2018	-	280	-	-	-	-	-	-	-	-	-	-
12/3/2018	270	330	290	-	570	290	210	-	-	-	-	-
3/22/2019	-	-	280	-	-	-	230	-	-	-	300	220
6/26/2019	260	260	290	-	790	-	230	-	-	-	290	220
10/3/2019	290	-	290	-	740	280	230	-	-	-	300	280
12/19/2019	280	260	280	-	630	290	210	330	-	-	310	260
4/2/2020	290	370	-	300	680	300	210	330	-	270	320	280
7/8/2020	290	260	280	-	730	290	220	-	-	-	300	250
10/14/2020	280	270	280	-	720	270	230	260	260	-	310	270
1/7/2021	250	290	300	-	540	300	220	330	260	-	260	280
3/25/2021	280	290	260	270	380	280	200	250	250	260	310	270
7/8/2021	290	250	290	-	390	290	210	240	270	-	300	270
9/16/2021	360	320	350	-	440	340	250	300	-	-	300	360
1/12/2022	290	-	290	300	370	300	230	-	290	300	300	310
3/9/2022	300	310	290	-	400	320	220	260	300	290	330	270
6/29/2022	-	250	-	250	410	300	220	-	-	260	300	260
10/5/2022	300	260	-	270	440	290	180	270	260	260	300	280
12/21/2022	290	-	-	-	590	320	170	-	-	-	310	230
3/15/2023	300	260	280	270	750	390	-	-	-	270	310	290
3/16/2023	-	-	-	-	-	-	250	-	-	-	-	-
6/21/2023	-	-	-	300	-	-	230	-	280	280	330	290
6/22/2023	-	-	310	-	860	-	-	-	-	-	-	-

Well Name	21N	21S	22	26	27N ¹	27S	28 ¹	33 ²	34	35	SCE-5 ³	5/14-13 ⁴
Parameter	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)				
Date Sampled												
9/13/2023	-	-	280	280	580	-	200	-	250	260	330	280
9/14/2023	-	-	-	-	-	-	-	-	-	-	-	-
12/12/2023	-	-	-	-	-	-	-	-	-	-	-	-
12/14/2023	-	-	-	-	350	-	220	-	-	280	290	270
Average TDS Value	287.7	297.1	317.2	280.0	545.3	299.3	222.2	326.9	268.9	273.0	306.5	275.4

Note: All TDS values are derived from laboratory analysis

1. Sampled with bailer after 2012

2. Sampled with bailer in 2014, and on December 19, 2019. Sampled with temporary pump in 2013 and 2017. Equipped with a pump and motor at the end of 2019.

3. Sampled with low-flow pumping system

Appendix A: Monthly Groundwater Extraction Totals

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
1993	11/1/1993	0.00	0.00	0.00	52.20	67.18	0.00	5.49			
1993	12/1/1993	0.00	0.00	0.00	46.30	0.00	0.00	0.00			
1994	1/1/1994	0.00	0.23	0.00	40.35	24.96	18.13	4.81			
1994	2/1/1994	0.00	0.00	0.00	20.25	53.03	44.59	36.89			
1994	3/1/1994	0.00	6.59	0.00	70.65	110.54	42.82	100.26			
1994	4/1/1994	0.00	92.47	0.00	126.90	203.41	28.85	167.78			
1994	5/1/1994	0.00	171.72	0.00	196.95	237.11	0.91	189.02			
1994	6/1/1994	0.00	190.18	0.00	208.50	202.09	116.94	177.15			
1994	7/1/1994	0.00	221.41	0.00	217.95	162.82	104.22	151.62			
1994	8/1/1994	0.00	38.61	7.05	137.40	26.99	108.03	156.47			
1994	9/1/1994	0.00	21.17	21.46	1.94	30.60	65.13	94.35			
1994	10/1/1994	0.00	14.72	13.73	0.00	1.18	12.38	41.49			
1994	11/1/1994	0.00	0.00	11.49	0.00	30.42	0.00	4.77			
1994	12/1/1994	0.00	79.21	9.71	0.00	53.24	12.20	0.00			
1995	1/1/1995	0.00	0.00	4.06	0.00	22.04	8.81	0.00			
1995	2/1/1995	0.00	19.81	13.16	22.57	84.72	54.18	54.51			
1995	3/1/1995	0.00	45.04	18.86	62.70	102.23	61.89	90.92			
1995	4/1/1995	136.55	82.34	21.20	73.20	107.39	55.65	100.61			
1995	5/1/1995	133.62	110.44	36.95	152.45	199.42	115.45	211.69			
1995	6/1/1995	204.91	177.47	39.29	151.78	187.78	124.10	347.74			
1995	7/1/1995	38.79	157.95	31.82	140.11	147.75	88.26	0.00			
1995	8/1/1995	106.49	58.44	34.63	144.52	111.56	59.84	108.43			
1995	9/1/1995	123.01	45.37	37.52	140.44	106.21	48.33	88.09			
1995	10/1/1995	123.79	16.55	31.77	117.52	94.06	10.71	22.11			
1995	11/1/1995	53.30	0.00	12.80	34.99	67.13	3.26	0.00			
1995	12/1/1995	27.72	0.00	3.17	45.34	51.26	0.00	0.00			
1996	1/1/1996	20.71	16.28	9.42	54.92	20.99	32.11	1.70			
1996	2/1/1996	33.26	39.63	17.84	64.65	0.00	51.41	68.42			
1996	3/1/1996	88.45	87.95	35.16	98.39	59.26	83.70	159.20			
1996	4/1/1996	54.34	148.20	36.88	106.50	139.28	97.15	187.71			
1996	5/1/1996	101.20	163.83	41.16	134.51	177.93	104.59	195.33			
1996	6/1/1996	119.54	161.71	37.30	151.18	185.21	106.73	189.67			
1996	7/1/1996	84.65	126.36	40.96	130.02	185.22	95.12	192.62			
1996	8/1/1996	1.63	34.52	42.18	102.41	106.06	60.51	70.73			
1996	9/1/1996	12.73	32.51	35.59	93.76	141.74	50.41	60.99			
1996	10/1/1996	2.53	18.73	31.55	74.36	49.54	16.68	23.36			
1996	11/1/1996	0.02	3.10	6.77	4.32	36.42	2.57	4.08			
1996	12/1/1996	0.64	1.60	7.95	30.33	18.34	1.15	1.85			
1997	1/1/1997	0.49	35.09	7.40	7.23	33.71	0.00	29.72			
1997	2/1/1997	0.00	59.09	9.91	14.98	47.99	0.00	62.53			
1997	3/1/1997	67.42	70.99	24.58	93.20	64.13	30.20	82.05			
1997	4/1/1997	19.65	132.65	33.02	116.35	117.63	84.59	154.95			
1997	5/1/1997	64.46	135.58	41.22	128.73	145.81	93.77	203.96			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
1997	6/1/1997	209.91	177.31	39.13	104.53	147.91	97.83	192.44			
1997	7/1/1997	187.32	119.98	39.37	129.02	128.38	92.84	165.59			
1997	8/1/1997	92.87	80.70	37.19	116.51	122.62	50.68	92.25			
1997	9/1/1997	62.71	50.90	25.47	79.68	75.25	35.03	57.84			
1997	10/1/1997	17.66	10.41	25.07	83.17	92.78	12.08	20.68			
1997	11/1/1997	11.43	3.59	5.39	24.70	24.70	6.19	0.00			
1997	12/1/1997	15.68	5.67	1.12	32.83	37.27	7.94	0.00			
1998	1/1/1998	5.60	24.63	-	27.13	34.87	13.85	13.77			
1998	2/1/1998	1.68	8.52	-	18.22	23.85	11.24	24.93			
1998	3/1/1998	31.05	42.71	18.24	42.87	44.30	31.95	46.35			
1998	4/1/1998	70.25	63.08	46.92	55.99	59.60	48.02	98.24			
1998	5/1/1998	196.46	100.50	59.78	63.59	53.27	94.79	189.75			
1998	6/1/1998	195.12	143.44	97.20	2.82	92.59	96.67	181.67			
1998	7/1/1998	229.04	124.27	108.56	54.35	113.66	95.53	183.41			
1998	8/1/1998	194.23	95.39	93.15	71.10	95.59	63.15	163.74			
1998	9/1/1998	48.20	38.89	88.99	62.89	73.44	11.21	69.25			
1998	10/1/1998	17.90	29.74	44.48	55.02	61.55	20.14	60.98			
1998	11/1/1998	23.35	9.30	15.02	18.43	26.68	14.57	6.44			
1998	12/1/1998	19.94	18.97	10.35	20.09	45.91	6.34	8.21			
1999	1/1/1999	11.79	6.67	2.98	25.75	36.12	0.00	11.90			
1999	2/1/1999	27.07	17.46	1.87	24.83	35.37	0.00	38.34			
1999	3/1/1999	56.57	36.52	0.91	43.30	59.96	1.61	70.15			
1999	4/1/1999	180.78	127.97	50.36	46.82	73.55	53.42	139.27			
1999	5/1/1999	182.42	136.65	74.15	103.00	142.16	92.19	176.28			
1999	6/1/1999	198.16	167.99	138.63	111.81	122.66	92.83	159.98			
1999	7/1/1999	197.98	138.23	147.64	117.74	108.69	89.29	167.67			
1999	8/1/1999	199.31	106.12	114.27	110.50	107.22	9.13	169.82			
1999	9/1/1999	146.11	72.95	42.22	96.43	87.03	4.70	123.98			
1999	10/1/1999	99.48	43.35	44.24	56.11	54.75	6.32	40.05			
1999	11/1/1999	22.91	8.04	75.63	58.52	11.52	2.58	0.00			
1999	12/1/1999	8.90	5.23	38.30	31.84	17.61	13.72	0.00			
2000	1/1/2000	10.45	12.16	29.37	26.62	7.57	20.29	0.00			
2000	2/1/2000	48.61	23.90	47.06	11.22	19.00	8.81	33.88			
2000	3/1/2000	85.45	38.61	40.88	38.94	41.34	19.10	86.36			
2000	4/1/2000	116.71	74.38	70.94	62.07	57.17	37.46	131.28			
2000	5/1/2000	165.85	119.46	115.47	54.79	96.30	71.23	176.19			
2000	6/1/2000	184.27	161.30	124.79	91.70	123.10	189.29	178.46			
2000	7/1/2000	186.65	139.46	99.34	112.59	116.70	61.12	183.68			
2000	8/1/2000	181.25	82.82	138.78	127.92	101.28	24.02	166.70			
2000	9/1/2000	157.14	73.38	104.44	83.45	80.90	24.73	130.59			
2000	10/1/2000	101.52	32.95	87.21	68.20	59.71	50.08	1.70			
2000	11/1/2000	16.13	16.16	29.83	29.07	22.12	5.80	33.33			
2000	12/1/2000	8.82	8.53	4.54	30.99	33.34	0.00	22.77			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2001	1/1/2001	23.50	20.59	23.42	24.91	33.02	0.00	33.74			
2001	2/1/2001	60.17	66.71	28.66	28.22	50.94	29.92	70.54			
2001	3/1/2001	62.39	74.65	38.38	24.68	55.26	42.40	79.97			
2001	4/1/2001	82.98	81.72	47.80	35.11	69.60	61.26	103.13			
2001	5/1/2001	130.03	144.10	107.64	76.31	110.98	55.80	146.05			
2001	6/1/2001	169.23	157.16	147.96	109.00	128.71	76.51	160.87			
2001	7/1/2001	164.90	101.47	126.60	98.24	107.20	61.46	149.52			
2001	8/1/2001	53.48	50.85	97.79	74.49	91.09	20.50	63.58			
2001	9/1/2001	52.57	40.62	79.14	65.42	63.80	18.76	53.92			
2001	10/1/2001	63.24	54.42	38.50	32.96	34.40	14.99	55.19			
2001	11/1/2001	18.18	27.47	10.04	20.77	30.33	7.56	36.88			
2001	12/1/2001	13.64	5.33	24.47	0.00	22.05	10.37	6.64			
2002	1/1/2002	NA	7.07	15.13	9.47	22.72	0.87	10.02			
2002	2/1/2002	47.13	27.16	0.00	26.12	25.31	0.00	38.02			
2002	3/1/2002	57.57	49.96	8.27	30.71	31.47	0.00	53.30			
2002	4/1/2002	89.44	73.69	17.36	47.19	41.60	0.03	74.16			
2002	5/1/2002	216.11	186.40	228.51	219.07	203.18	164.65	162.14			
2002	6/1/2002	177.80	146.93	129.62	91.35	97.71	79.63	149.22			
2002	7/1/2002	160.89	143.01	134.76	107.71	95.80	83.33	156.70			
2002	8/1/2002	170.83	95.68	103.49	80.59	22.64	69.38	141.70			
2002	9/1/2002	70.04	76.51	71.36	70.79	0.00	42.49	125.10			
2002	10/1/2002	12.20	59.13	59.34	48.19	0.00	43.52	78.08			
2002	11/1/2002	5.81	15.87	31.39	27.38	0.00	11.16	24.05			
2002	12/1/2002	NA	NA	NA	NA	NA	NA	NA			
2003	1/1/2003	3.62	2.82	26.78	23.11	0.00	6.12	10.06			
2003	2/1/2003	6.69	19.89	14.57	18.26	3.11	13.60	21.38			
2003	3/1/2003	53.86	43.47	16.35	10.13	20.96	24.15	43.69			
2003	4/1/2003	84.19	66.36	24.20	41.51	83.03	38.51	72.95			
2003	5/1/2003	178.31	134.26	67.26	108.64	190.42	76.42	140.26			
2003	6/1/2003	173.96	138.26	113.85	132.42	181.12	78.70	132.08			
2003	7/1/2003	186.94	129.53	120.74	120.00	202.84	80.50	134.18			
2003	8/1/2003	140.70	98.02	105.94	101.40	64.87	55.59	99.61			
2003	9/1/2003	102.23	75.98	18.93	73.88	56.86	30.13	83.62			
2003	10/1/2003	42.20	55.73	19.12	30.82	58.86	0.00	22.12			
2003	11/1/2003	17.73	4.78	0.79	21.93	17.64	0.00	0.00			
2003	12/1/2003	22.42	5.42	0.00	29.38	24.43	0.00	0.00			
2004	1/1/2004	27.26	22.69	2.50	29.33	20.87	0.00	0.00			
2004	2/1/2004	16.11	20.77	0.00	19.03	19.37	0.00	0.00			
2004	3/1/2004	48.59	61.11	9.37	44.13	59.85	14.77	32.02			
2004	4/1/2004	40.10	166.76	23.32	39.29	67.82	41.91	17.15			
2004	5/1/2004	63.50	84.98	23.83	80.18	92.20	54.72	98.30			
2004	6/1/2004	74.80	99.23	49.94	69.60	110.01	64.03	116.57			
2004	7/1/2004	71.71	83.26	100.94	142.27	110.74	30.90	111.84			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2004	8/1/2004	56.15	65.27	118.64	147.80	88.44	75.18	135.14			
2004	9/1/2004	79.83	75.76	114.58	126.51	0.00	56.65	104.98			
2004	10/1/2004	30.05	29.52	51.91	62.46	0.00	21.55	35.18			
2004	11/1/2004	8.44	2.60	26.73	31.80	0.00	11.76	33.66			
2004	12/1/2004	7.30	0.00	20.94	26.53	0.00	4.62	1.43			
2005	1/1/2005	1.82	8.72	10.09	8.94	0.00	1.96	5.34			
2005	2/1/2005	0.54	16.30	1.50	0.00	0.00	6.35	8.44			
2005	3/1/2005	29.86	45.71	5.49	12.78	13.55	25.77	48.09			
2005	4/1/2005	34.55	53.28	15.18	17.54	42.85	30.50	57.68			
2005	5/1/2005	80.43	41.18	48.75	63.76	94.92	57.95	102.61			
2005	6/1/2005	82.04	178.02	127.06	128.65	156.93	80.48	135.70			
2005	7/1/2005	78.33	165.09	131.88	122.15	188.54	78.78	140.03			
2005	8/1/2005	64.62	101.12	57.07	129.46	190.25	75.80	141.23			
2005	9/1/2005	33.14	51.61	51.52	130.18	101.04	47.09	89.51			
2005	10/1/2005	18.57	24.75	102.51	93.71	16.29	12.43	30.54			
2005	11/1/2005	122.23	8.67	34.14	34.43	0.43	2.77	5.76			
2005	12/1/2005	5.25	0.00	26.59	29.24	0.00	0.00	0.00			
2006	1/1/2006	6.13	6.51	26.34	31.66	0.00	0.93	3.71			
2006	2/1/2006	20.71	29.14	22.65	13.46	0.00	0.00	23.21			
2006	3/1/2006	25.80	36.60	29.60	30.51	21.98	0.00	43.81			
2006	4/1/2006	29.92	41.91	26.92	33.51	26.68	7.64	85.76			
2006	5/1/2006	68.94	99.73	69.94	88.81	70.91	44.14	61.95			
2006	6/1/2006	120.04	133.80	106.38	119.88	65.96	67.60	134.44			
2006	7/1/2006	142.57	117.91	109.09	127.03	6.97	40.37	146.28			
2006	8/1/2006	157.45	128.63	112.85	129.03	0.00	0.00	137.55			
2006	9/1/2006	145.14	118.58	111.31	89.41	0.00	0.00	102.89			
2006	10/1/2006	14.49	62.37	109.39	38.11	0.00	0.00	66.26			
2006	11/1/2006	0.00	31.21	109.79	105.89	0.00	5.21	29.88			
2006	12/1/2006	0.00	0.00	26.77	32.77	0.00	0.00	4.70			
2007	1/1/2007	24.40	2.94	16.96	33.13	4.60	0.00	5.73			
2007	2/1/2007	1.05	26.50	0.00	25.62	23.20	0.00	9.75			
2007	3/1/2007	0.00	43.59	25.71	33.25	23.66	0.00	4.22			
2007	4/1/2007	199.89	98.27	39.79	53.23	2.96	29.54	48.34			
2007	5/1/2007	61.86	63.48	65.69	79.82	112.22	35.14	93.99			
2007	6/1/2007	99.20	85.15	109.95	103.76	100.18	0.00	130.51			
2007	7/1/2007	108.00	86.82	0.00	68.61	99.64	0.00	130.24			
2007	8/1/2007	87.77	69.99	0.00	147.46	88.98	0.00	33.58			
2007	9/1/2007	64.67	50.75	0.00	105.62	33.20	0.00	62.45			
2007	10/1/2007	26.80	33.89	0.00	95.51	0.00	0.00	36.91			
2007	11/1/2007	15.63	18.66	0.00	102.64	0.00	0.00	16.28			
2007	12/1/2007	16.52	1.23	17.79	50.47	0.14	0.00	0.00			
2008	1/1/2008	12.00	2.00	0.00	15.98	28.00	0.00	0.00			
2008	2/1/2008	11.39	12.87	0.00	7.96	22.27	0.00	0.00			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2008	3/1/2008	24.75	20.78	0.00	0.00	63.91	0.00	0.00			
2008	4/1/2008	48.11	43.59	0.00	1.04	76.24	0.00	0.00			
2008	5/1/2008	51.01	46.48	0.00	42.19	59.92	0.00	0.00			
2008	6/1/2008	99.67	67.43	0.00	78.41	99.78	0.85	0.00			
2008	7/1/2008	85.80	51.04	0.00	86.37	119.49	1.03	0.00			
2008	8/1/2008	32.60	22.82	0.00	56.54	79.99	0.35	1.88			
2008	9/1/2008	39.92	26.93	0.00	49.70	68.95	0.00	1.47			
2008	10/1/2008	35.67	23.80	0.00	57.17	55.43	0.00	1.78			
2008	11/1/2008	13.77	8.43	0.00	25.83	40.21	0.00	0.50			
2008	12/1/2008	7.93	2.58	0.00	13.99	20.94	0.00	0.00			
2009	1/1/2009	6.72	2.61	0.00	17.53	11.17	0.00	0.00			
2009	2/1/2009	21.60	5.54	0.00	6.95	14.01	0.00	0.00			
2009	3/1/2009	22.62	29.02	0.00	52.17	39.73	0.00	0.00			
2009	4/1/2009	44.76	42.93	0.00	57.43	59.58	0.00	11.26			
2009	5/1/2009	62.22	53.02	3.25	19.80	60.63	0.00	26.94			
2009	6/1/2009	66.22	77.82	8.61	0.00	0.00	0.00	77.65			
2009	7/1/2009	157.58	106.07	13.11	0.00	0.00	0.00	120.32			
2009	8/1/2009	65.77	48.95	12.99	0.00	0.00	0.00	108.03			
2009	9/1/2009	42.57	0.00	11.51	0.00	0.00	0.00	98.21			
2009	10/1/2009	47.94	0.00	6.99	0.00	0.00	0.00	59.67			
2009	11/1/2009	33.32	0.00	3.80	0.00	17.51	0.00	0.00			
2009	12/1/2009	12.66	0.00	1.29	0.00	12.19	0.00	0.00			
2010	1/1/2010	5.17	0.00	0.74	0.00	31.51	0.00	0.00			
2010	2/1/2010	8.76	0.00	3.67	0.00	55.91	0.00	0.00			
2010	3/1/2010	37.33	0.00	2.56	0.00	11.38	0.00	0.00			
2010	4/1/2010	49.36	1.31	3.00	0.00	0.00	0.00	0.00			
2010	5/1/2010	42.14	78.87	4.69	0.00	43.43	0.00	0.00			
2010	6/1/2010	142.82	122.48	10.92	0.00	123.51	0.00	0.00			
2010	7/1/2010	129.54	87.18	11.13	0.00	130.77	0.00	0.00			
2010	8/1/2010	59.90	22.37	11.57	0.00	121.11	0.00	0.00			
2010	9/1/2010	50.08	18.62	10.06	0.00	111.15	0.00	0.00			
2010	10/1/2010	37.30	16.25	3.81	0.00	134.52	0.00	0.00			
2010	11/1/2010	22.72	9.12	0.00	0.00	63.93	0.00	0.00			
2010	12/1/2010	5.30	0.00	0.13	0.00	30.94	0.00	0.00			
2011	1/1/2011	17.00	0.00	0.00	0.00	8.54	0.00	0.00			
2011	2/1/2011	18.54	4.42	0.00	0.00	47.07	0.00	0.00			
2011	3/1/2011	19.07	24.60	0.00	0.00	38.91	0.00	0.00			
2011	4/1/2011	30.90	37.20	0.00	0.00	57.73	0.00	0.00			
2011	5/1/2011	54.84	87.42	0.00	0.00	92.85	0.00	0.00			
2011	6/1/2011	105.07	123.30	0.00	0.00	150.71	0.00	0.00			
2011	7/1/2011	113.00	106.73	80.45	0.00	120.58	0.00	0.00			
2011	8/1/2011	73.35	55.41	139.28	0.00	102.67	0.00	0.00			
2011	9/1/2011	40.82	33.03	126.11	0.00	92.31	0.00	0.00			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2011	10/1/2011	34.22	0.00	73.06	0.00	72.37	0.00	0.00			
2011	11/1/2011	19.47	10.35	42.91	0.00	40.34	0.00	0.00			
2011	12/1/2011	11.99	0.00	16.32	0.00	17.97	0.00	0.00			
2012	1/1/2012	16.15	0.00	0.00	0.00	0.00	0.00	0.00			
2012	2/1/2012	13.30	18.43	6.79	0.00	33.65	0.00	0.00			
2012	3/1/2012	23.88	0.00	0.00	0.00	53.24	0.00	0.00			
2012	4/1/2012	23.38	25.73	0.00	0.00	50.50	0.00	0.00			
2012	5/1/2012	52.07	111.95	0.00	81.10	71.76	0.00	0.00			
2012	6/1/2012	58.97	140.00	0.00	97.90	109.59	0.00	0.00			
2012	7/1/2012	68.92	82.82	0.00	100.43	112.84	0.00	0.00			
2012	8/1/2012	129.71	41.58	0.00	112.65	118.47	0.00	0.00			
2012	9/1/2012	86.46	65.38	0.00	100.34	109.10	0.00	0.00			
2012	10/1/2012	48.21	25.40	0.00	37.68	51.13	0.00	0.00			
2012	11/1/2012	25.53	0.00	0.00	0.00	31.56	0.00	0.00			
2012	12/1/2012	12.69	0.00	0.00	6.21	8.85	0.00	0.00			
2013	1/1/2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
2013	2/1/2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
2013	3/1/2013	62.15	61.83	0.00	290.77	84.89	0.00	0.00			
2013	4/1/2013	53.20	62.80	0.00	33.51	57.53	0.00	0.00			
2013	5/1/2013	63.14	84.23	0.00	29.88	68.26	0.00	0.00			
2013	6/1/2013	71.53	129.09	0.00	3.30	99.26	0.00	0.00			
2013	7/1/2013	118.70	90.35	0.00	0.00	123.91	0.00	0.00			
2013	8/1/2013	130.08	43.84	0.00	0.00	130.87	0.00	0.00			
2013	9/1/2013	95.95	98.03	0.00	0.00	110.66	0.00	0.00			
2013	10/1/2013	35.27	64.42	0.00	0.00	89.73	0.00	0.00			
2013	11/1/2013	19.02	68.12	0.00	0.00	11.22	0.00	0.00			
2013	12/1/2013	24.50	1.90	0.00	0.00	14.54	0.00	0.00			
2014	1/1/2014	21.68	3.27	0.00	0.00	16.10	0.00	0.00			
2014	2/1/2014	27.96	7.63	0.00	0.00	15.95	0.00	0.00			
2014	3/1/2014	36.18	11.99	0.00	0.00	28.00	0.00	0.00			
2014	4/1/2014	36.09	33.87	0.00	0.00	55.90	0.00	0.00			
2014	5/1/2014	37.70	33.87	0.00	0.00	56.50	0.00	0.00			
2014	6/1/2014	35.32	36.25	0.00	0.00	56.75	0.00	0.00			
2014	7/1/2014	59.17	100.76	0.00	0.00	65.23	0.00	0.00			
2014	8/1/2014	59.61	85.37	0.00	0.00	61.30	0.00	0.00			
2014	9/1/2014	39.14	43.13	0.00	0.00	46.73	0.00	0.00			
2014	10/1/2014	27.92	39.00	0.00	0.00	52.98	0.00	0.00			
2014	11/1/2014	6.47	25.79	0.00	0.00	26.59	0.00	0.00			
2014	12/1/2014	17.82	0.00	0.00	0.00	15.79	0.00	0.00			
2015	1/1/2015	23.05	3.71	0.00	0.00	15.34	0.00	0.00			
2015	2/1/2015	29.97	3.29	0.00	0.00	10.34	0.00	0.00			
2015	3/1/2015	41.22	5.06	0.00	0.00	16.23	0.00	0.00			
2015	4/1/2015	27.86	27.84	0.00	0.00	12.32	0.00	0.00			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2015	5/1/2015	44.95	50.77	0.00	0.00	15.50	0.00	0.00			
2015	6/1/2015	49.73	86.90	0.00	0.00	21.80	0.00	0.00			
2015	7/1/2015	64.99	74.67	0.00	0.00	29.71	0.00	0.00			
2015	8/1/2015	90.78	40.22	0.00	0.00	39.81	0.00	0.00			
2015	9/1/2015	100.53	132.76	0.00	0.00	37.58	0.00	0.00			
2015	10/1/2015	68.83	52.26	0.00	0.00	30.10	0.00	0.00			
2015	11/1/2015	27.08	35.62	0.00	0.00	17.04	0.00	0.00			
2015	12/1/2015	26.78	8.91	0.00	0.00	13.94	0.00	0.00			
2016	1/1/2016	20.30	39.29	0.00	0.00	8.92	0.00	0.00			
2016	2/1/2016	31.99	63.06	0.00	0.00	14.72	0.00	0.00			
2016	3/1/2016	24.24	59.57	0.00	0.00	10.55	0.00	0.00			
2016	4/1/2016	47.46	100.01	0.00	0.00	0.00	0.00	0.00			
2016	5/1/2016	57.71	110.51	0.00	0.00	64.46	0.00	0.00			
2016	6/1/2016	77.66	112.34	0.00	0.00	42.99	0.00	0.00			
2016	7/1/2016	91.36	102.97	0.00	0.00	47.25	0.00	0.00			
2016	8/1/2016	102.20	81.23	0.00	0.00	51.42	0.00	0.00			
2016	9/1/2016	37.23	101.08	0.00	0.00	48.81	0.00	0.00			
2016	10/1/2016	113.49	6.66	0.00	0.00	35.78	0.00	0.00			
2016	11/1/2016	9.25	76.62	0.00	0.00	18.30	0.00	0.00			
2016	12/1/2016	0.00	30.72	0.00	0.00	17.84	0.00	0.00			
2017	1/1/2017	0.00	7.54	0.00	0.00	5.87	0.00	0.00			
2017	2/1/2017	0.00	17.42	0.00	0.00	7.66	0.00	0.00			
2017	3/1/2017	0.00	32.58	0.00	0.00	21.57	0.00	0.00			
2017	4/1/2017	21.29	24.14	0.00	0.00	23.85	0.00	0.00			
2017	5/1/2017	52.40	0.00	6.10	0.00	32.61	0.00	8.10			
2017	6/1/2017	86.83	0.00	0.00	0.00	50.82	0.00	0.00			
2017	7/1/2017	37.61	94.07	0.00	0.00	70.92	0.00	0.00			
2017	8/1/2017	43.73	70.55	8.38	0.00	49.21	0.00	0.00			
2017	9/1/2017	96.12	5.98	66.85	0.00	0.00	0.00	0.00			
2017	10/1/2017	78.87	0.00	9.50	0.00	37.18	0.00	0.00			
2017	11/1/2017	50.58	0.00	11.48	0.00	23.81	0.00	0.00			
2017	12/1/2017	36.24	0.00	0.00	0.00	32.96	0.00	0.00			
2018	1/1/2018	18.08	0.00	0.00	0.00	16.76	0.00	0.00			
2018	2/1/2018	24.80	0.00	0.00	0.00	18.72	0.00	0.00			
2018	3/1/2018	3.59	49.38	15.14	0.00	14.67	0.00	0.00			
2018	4/1/2018	83.32	0.00	2.85	0.00	25.66	0.00	0.00			
2018	5/1/2018	87.74	0.00	0.00	0.00	48.95	0.00	0.00			
2018	6/1/2018	61.25	63.60	11.58	0.00	75.12	0.00	0.00			
2018	7/1/2018	100.51	81.73	35.82	0.00	91.36	0.00	0.00			
2018	8/1/2018	94.06	97.74	28.87	0.00	89.19	0.00	0.00			
2018	9/1/2018	86.05	102.71	26.44	0.00	79.99	0.00	0.00			
2018	10/1/2018	42.50	39.67	12.54	0.00	42.90	0.00	0.00			
2018	11/1/2018	46.46	13.32	11.03	0.00	25.29	0.00	0.00			

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2018	12/1/2018	18.01	10.17	18.27	0.00	11.32	0.00	0.00			
2019	1/1/2019	16.60	8.83	17.37	0.00	11.75	0.00	0.00			
2019	2/1/2019	27.41	3.90	27.83	0.00	0.00	0.00	0.00			
2019	3/1/2019	42.69	3.54	31.28	0.00	0.77	0.00	0.00			
2019	4/1/2019	60.00	94.55	76.78	0.00	4.73	0.00	0.00			
2019	5/1/2019	43.21	52.52	50.72	0.00	46.59	0.00	0.00			
2019	6/1/2019	55.61	108.23	23.73	0.00	64.91	0.00	0.00			
2019	7/1/2019	81.98	115.05	35.66	0.00	80.80	0.00	0.00			
2019	8/1/2019	120.25	99.61	50.33	0.00	94.92	0.00	0.00			
2019	9/1/2019	103.67	38.43	52.56	0.00	93.66	0.00	0.00			
2019	10/1/2019	121.53	0.00	32.03	0.00	95.04	0.00	0.00			
2019	11/1/2019	70.98	50.11	14.22	0.00	52.75	0.00	0.00			
2019	12/1/2019	20.93	48.38	61.19	0.00	90.75	0.00	0.00			
2020	1/1/2020	70.15	32.02	93.87	0.00	100.78	0.00	0.00		0.00	
2020	2/1/2020	80.34	25.25	27.24	0.00	65.67	0.00	0.00		23.52	0.61
2020	3/1/2020	80.59	4.68	0.00	0.00	69.51	0.00	0.00		0.00	33.66
2020	4/1/2020	84.39	80.50	0.00	0.00	81.48	0.00	0.00	0.00	0.00	
2020	5/1/2020	108.95	134.35	0.00	0.00	80.16	0.00	82.58	0.00	0.00	
2020	6/1/2020	103.02	131.52	0.00	0.00	69.30	0.00	90.44	0.00	0.00	
2020	7/1/2020	0.00	0.00	117.66	0.00	0.00	0.00	0.00	0.00	0.00	
2020	8/1/2020	84.70	129.43	136.88	0.00	185.70	0.00	93.67	0.00	0.00	
2020	9/1/2020	72.55	66.62	67.21	0.00	81.76	0.00	95.67	0.00	0.00	
2020	10/1/2020	73.22	0.91	20.39	0.00	78.47	0.00	98.04	61.24	0.00	
2020	11/1/2020	63.19	52.17	10.20	0.00	72.18	0.00	99.00	6.33	0.00	
2020	12/1/2020	27.62	17.58	1.07	0.00	41.86	0.00	67.46	39.27	0.00	
2021	1/1/2021	10.31	28.45	0.40	0.00	9.24	0.00	7.89	2.59	0.00	0.00
2021	2/1/2021	20.19	0.00	10.18	0.00	22.62	0.00	8.61	3.91	0.00	0.00
2021	3/1/2021	28.05	0.00	44.52	0.00	27.22	0.00	28.22	22.98	0.00	0.00
2021	4/1/2021	68.93	118.67	72.13	0.00	51.50	0.00	80.84	131.23	0.00	0.00
2021	5/1/2021	83.60	141.14	70.73	0.00	100.97	0.00	107.29	101.56	0.00	0.00
2021	6/1/2021	106.37	93.42	122.49	0.00	84.92	0.00	100.73	165.97	0.00	0.00
2021	7/1/2021	89.21	150.00	91.64	0.00	91.64	0.00	105.91	95.31	0.00	0.00
2021	8/1/2021	107.63	154.00	121.08	0.00	100.48	0.00	112.59	61.20	0.00	0.00
2021	9/1/2021	95.63	112.00	122.13	0.00	93.88	0.00	102.18	3.50	0.00	0.00
2021	10/1/2021	54.01	83.00	131.77	0.00	90.23	0.00	101.31	26.69	0.00	0.00
2021	11/1/2021	67.79	13.00	83.90	0.00	60.09	0.00	85.17	45.38	0.00	0.00
2021	12/1/2021	28.60	28.36	0.00	0.00	87.22	0.00	99.55	77.64	0.00	0.00
2022	1/1/2022	19.87	9.84	31.28	0.00	34.49	0.00	11.26	59.54	55.33	29.08
2022	2/1/2022	19.04	0.00	35.64	0.00	34.56	0.00	0.00	43.95	45.15	10.85
2022	3/1/2022	44.89	21.90	7.64	0.00	59.94	0.00	58.29	109.97	102.50	0.00
2022	4/1/2022	57.83	24.50	0.00	0.00	47.32	0.00	94.30	153.88	197.39	0.00
2022	5/1/2022	78.05	72.40	58.14	0.00	58.83	0.00	87.67	199.37	222.41	0.00
2022	6/1/2022	101.60	148.30	39.89	0.00	98.70	0.00	101.70	217.42	175.36	152.71

Monthly Irrigation Well Groundwater Production											
Year	Month	Well 21N	Well 21S	Well 22	Well 27N*	Well 27S	Well 28	Well 33	Well 34	Well 35	Well 26
2022	7/1/2022	132.82	187.00	0.00	0.00	101.27	0.00	118.46	149.30	175.04	226.40
2022	8/1/2022	128.92	174.60	0.00	0.00	93.72	0.00	112.66	249.34	119.99	185.71
2022	9/1/2022	141.87	179.59	2.40	0.00	88.02	0.00	115.58	120.67	196.03	215.77
2022	10/1/2022	91.88	52.70	10.60	0.00	92.96	0.00	113.09	149.30	214.46	127.58
2022	11/1/2022	87.43	0.00	43.66	0.00	31.18	0.00	34.59	0.00	155.01	210.06
2022	12/1/2022	76.69	0.00	4.87	0.00	48.52	0.00	2.32	0.00	37.55	35.85
2023	1/1/2023	29.00	0.00	10.71	0.00	31.66	0.00	20.46	0.00	63.07	66.10
2023	2/1/2023	8.68	38.70	39.51	0.00	26.88	0.00	32.40	0.00	156.82	107.44
2023	3/1/2023	6.67	7.90	26.32	0.00	35.88	0.00	9.68	0.00	54.63	95.10
2023	4/1/2023	6.04	0.00	53.73	0.00	30.20	0.00	25.48	0.00	250.50	243.78
2023	5/1/2023	5.16	0.00	100.87	0.00	10.80	0.00	0.23	42.99	272.48	285.86
2023	6/1/2023	1.80	0.00	98.43	0.00	0.00	0.00	0.00	135.54	193.30	254.31
2023	7/1/2023	0.00	0.00	18.47	0.00	0.00	0.00	0.00	114.62	261.81	277.90
2023	8/1/2023	0.00	0.00	73.13	0.00	0.00	0.00	0.00	164.55	305.16	250.58
2023	9/1/2023	0.00	0.00	88.26	0.00	0.00	0.00	0.00	43.01	247.66	271.66
2023	10/1/2023	0.00	0.00	26.92	0.00	0.00	0.00	0.00	146.88	194.59	154.15
2023	11/1/2023	0.00	0.00	7.92	0.00	0.00	0.00	0.00	120.25	130.05	180.54
2023	12/1/2023	0.00	0.00	1.00	0.00	0.00	0.00	0.00	28.75	146.09	1.00

Appendix B: Land Surface Elevation Survey Reports for 2018, 2021, 2022, and 2023

Subsidence Monitor Survey Report

prepared by: Towill, Inc.

for: Cadiz, Inc.

December 10, 2018

1.0 Introduction

The purpose of this project is to establish horizontal and vertical control values on 13 subsidence monitoring locations associated with the Cadiz Pipeline in San Bernardino County, California.

2.0 Field Survey Operations

2.1 Field Equipment

Trimble GNSS Receivers with internal antennae were used for all GPS Observations.

Trimble Geodetic Receivers, R10

Serial Numbers: 5433475779, 5430473783

2.2 Survey Team and Dates

Date of Survey: December 3-5, 2018

Field Survey Members: Oliver Rocha, Certified Party Chief – Local 12
Alex Schlangen, Apprentice – Local 12

2.3 GPS Processing and Adjustment Software

Trimble's Trimble Business Center Software v4.00 was utilized for all data processing and least squares network adjustments.

3.0 Horizontal and Vertical Control Surveys

3.1 Primary Control

The primary control values utilized for the monitoring well survey were taken from the CH2MHill "Report on Establishing and Monitoring Survey Monuments in the Cadiz Valley, California" dated May 2015. These values include:

Station Name	Northing	Easting	Elevation
MARBLE BM	2023673.689	7323716.382	963.397
PBB 12 USGS	2038964.266	7318487.888	1280.408
Z 1308	2036442.464	7315249.324	1099.525

3.1.1 Horizontal Coordinate Datum

The horizontal datum for the resultant coordinate values is the North American Datum of 1983 (NAD83, 2011.0 Epoch).



3.1.2 Vertical Datum

Elevations established in this survey are North American Vertical Datum of 1988 (NAVD88, Geoid12A) based upon the value published for MARBLE BM.

3.1.3 Units of Measure

Units of measure for this survey are US Survey Feet.

4.0 Primary Control Procedures and Adjustments

4.1 Primary Controls

GPS Real Time Kinematic surveys were performed to verify the position and elevation of MARBLE BM in comparison to the other project bench marks, Z 1308 and PBB 12 USGS.

4.1.1 Primary Control Constraints

Control surveys completed confirmed horizontally and vertically to the primary controls provided by the client.

BM NUMBER	DIFF. NORTH	DIFF. EAST	DIFF. ELEV.
PBB 12	0.022	0.022	0.002
Z 1308	0.015	0.067	-0.035

4.1.2 Field Methods

Real Time Kinematic GPS methods were utilized to position and elevate the primary control. A minimum of 4-minutes of GPS data was collected at least two separate times on different days at each monitoring well location.

4.1.3 Data Processing and Comparison

The GPS data sets collected were downloaded daily and processed through Trimble baseline processing software. The Real Time Kinematic baselines for each measurement were reviewed. In addition, the data was reviewed and the resulting values compared to the May 2015 values. This comparison is based on utilizing MARBLE BM as the horizontal and vertical constraint. The following tables illustrate the measured values and the differences in data sets:



Results for Measurement #1

WELL NUMBER	MEASURE 1						
	NORTH	EAST	ELEV	DATE	TIME	SATS.	PDOP
5/14-13	2021446.843	7323740.959	894.856	12/3/2018	3:31:23 PM	14	1.463
21N	2017242.060	7311758.242	793.368	12/3/2018	3:09:02 PM	16	1.351
21S	2014440.506	7308662.988	762.971	12/4/2018	10:58:44 AM	17	1.349
22	2016211.523	7314994.086	813.107	12/4/2018	12:22:58 PM	16	1.388
27N	2012283.246	7314707.336	790.910	12/4/2018	12:13:31 PM	16	1.583
27S	2009515.074	7314616.661	778.355	12/4/2018	12:01:58 PM	15	1.926
28	2008178.187	7309388.482	741.115	12/4/2018	11:11:40 AM	17	1.356
33	2004655.788	7309287.950	729.054	12/4/2018	11:25:19 AM	17	1.385
MP1	2007954.448	7272935.594	611.884	12/3/2018	2:16:03 PM	13	1.715
MP2	2006251.211	7280193.280	613.715	12/3/2018	2:28:22 PM	15	1.485
MP3	2016868.780	7326083.132	878.937	12/4/2018	1:02:17 PM	18	1.428
MP4	2001630.764	7301909.678	683.548	12/4/2018	11:42:44 AM	16	1.566
MP5	2027229.717	7333049.646	970.558	12/4/2018	1:20:42 PM	17	1.423

Results for Measurement #2

WELL NUMBER	MEASURE 2						
	NORTH	EAST	ELEV	DATE	TIME	SATS.	PDOP
5/14-13	2021446.854	7323740.947	894.860	12/4/2018	1:37:54 PM	17	1.322
21N	2017242.054	7311758.247	793.369	12/4/2018	12:33:18 PM	16	1.376
21S	2014440.539	7308662.989	763.007	12/5/2018	9:20:11 AM	14	1.639
22	2016211.489	7314994.110	813.132	12/5/2018	10:34:14 AM	17	1.216
27N	2012283.218	7314707.336	790.924	12/5/2018	10:24:08 AM	16	1.200
27S	2009515.089	7314616.695	778.341	12/5/2018	10:15:43 AM	15	1.644
28	2008178.162	7309388.477	741.170	12/5/2018	9:30:47 AM	14	1.809
33	2004655.779	7309287.942	729.053	12/5/2018	9:40:15 AM	14	1.732
MP1	2007954.383	7272935.626	611.876	12/4/2018	9:45:12 AM	14	1.808
MP2	2006251.179	7280193.263	613.647	12/4/2018	10:00:15 AM	14	1.556
MP3	2016868.760	7326083.123	878.960	12/5/2018	10:53:49 AM	18	1.295
MP4	2001630.703	7301909.683	683.580	12/5/2018	9:56:35 AM	14	1.581
MP5	2027229.721	7333049.630	970.535	12/5/2018	11:11:44 AM	18	1.323



Difference between Measurement #1 and Measurement #2

WELL NUMBER	DIFF.NORTH M1 V M2	DIFF.EAST M1 V M2	DIFF.ELEV. M1 V M2
5/14-13	-0.011	0.012	-0.004
21N	0.006	-0.005	-0.001
21S	-0.033	-0.001	-0.036
22	0.034	-0.024	-0.025
27N	0.028	0.000	-0.014
27S	-0.015	-0.034	0.014
28	0.025	0.005	-0.055
33	0.009	0.008	0.001
MP1	0.065	-0.032	0.008
MP2	0.032	0.017	0.068
MP3	0.020	0.009	-0.023
MP4	0.061	-0.005	-0.032
MP5	-0.004	0.016	0.023

Difference between the average of Measurement #1 and #2 and the May 2015 Survey

WELL NUMBER	DIFF. NORTH	DIFF. EAST	DIFF. ELEV.
5/14-13	-0.003	-0.009	0.029
21N	0.018	0.033	0.036
21S	-0.007	0.000	0.010
22	-0.017	-0.011	0.010
27N	-0.004	-0.023	0.008
27S	0.040	0.002	0.005
28	0.026	-0.007	0.045
33	-0.003	-0.004	-0.016
MP1	-0.028	-0.038	-0.152
MP2	0.005	-0.036	-0.115
MP3	0.006	-0.007	-0.011
MP4	0.040	-0.005	-0.071
MP5	0.014	0.012	-0.032

A complete Listing of State Plane coordinate values are attached under the Appendices 5.1.



5.0 Appendix

5.1 Final Control Values

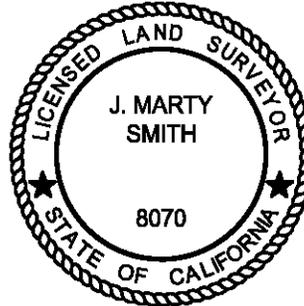
5.2 Field Notes

6.0 Surveyor's Statement

This report represents a survey made by me or under my direct supervision in December 2018.



J. Marty Smith, PLS
Dated: December 10, 2018





APPENDIX 5.1

Final Coordinate Values



CADIZ PIPELINE

MONITOR SURVEY COORDINATE VALUES

SURVEYED DECEMBER 2018

Horizontal Datum: NAD83 (2011.0 Epoch)

Projection: CCS83, Zone 5

Vertical Datum: NAVD88 (Geoid 12A) base on MARBLE Bench Mark

WELL	DESCRIPTION	MEASUREMENT 1 & 2 AVERAGE		
		NORTHING	EASTING	ELEVATION
		US SURVEY FEET		
5/14/2013	2" Brass Disk in Conc.Pad	2021446.865	7323740.954	894.852
21N	2" Brass Disk in Conc.Pad	2017242.075	7311758.255	793.343
21S	2" Brass Disk in Conc.Pad	2014440.499	7308663.01	762.889
22	2" Brass Disk in Conc.Pad	2016211.537	7314994.098	813.102
27N	2" Brass Disk in Conc.Pad	2012283.247	7314707.354	790.887
27S	2" Brass Disk in Conc.Pad	2009515.092	7314616.679	778.331
28	2" Brass Disk in Conc.Pad	2008178.14	7309388.483	741.053
33	2" Brass Disk in Conc.Pad	2004655.786	7309287.96	728.963
MP1	2" Brass Disk in Square Well	2007954.423	7272935.631	611.919
MP2	2" Brass Disk in Square Well	2006251.195	7280193.263	613.662
MP3	2" Brass Disk in Conc.Pad	2016868.776	7326083.132	878.939
MP4	2" Brass Disk in Square Well	2001630.728	7301909.696	683.507
MP5	2" Brass Disk in Conc.Pad	2027229.722	7333049.645	970.531
PBB 12M	BM-3 1/2"Brass Disk	2038964.276	7318487.908	1280.431
Z 1308M	BM-3 1/2"Brass Disk	2036442.479	7315249.356	1099.522
MARBLE BM	BM-2"Brass Disk	2023673.689	7323716.382	963.397



APPENDIX 5.2

Field Notes

July 29, 2021

Cadiz
Attn: Lesley Thornburg
1701 Clinton Street, Suite 212
Los Angeles, CA 90026



Re: June 2021 Subsidence Survey

Purpose: Establish horizontal and vertical values on 13 monitoring locations.

Field Equipment: Trimble GNSS R8 Receivers.

Office Software: Trimble Business Center v5.50.

Primary Control: Towill Subsidence Report dated December 10, 2018.

Horizontal Datum: North American Datum of 1983 (NAD83, 2011.0 Epoch).

Vertical Datum: North American Vertical Datum of 1988 (NAVD88, Geoid18 Conus).

Units: US Survey Feet.

Real Time Kinematic GPS methods were utilized to position and elevate the primary control. The GPS data sets collected were downloaded daily and processed through Trimble Business Center processing software. The Real Time Kinematic baselines for each measurement were reviewed. Survey data was reviewed and the resulting values compared to the December 2018 values. This comparison is based on utilizing MARBLE BM as the horizontal and vertical constraint.

80 Years

of Professional Experience

234 North Arrowhead Avenue, San Bernardino, CA 92408

Joseph E. Bonadiman & Associates, Inc.
Engineers • Surveyors • Planning • G.I.S.
Tel. (909) 885-3806 • Fax (909) 381-1721
www.bonadiman.com

Well	Towill 2018	Bonadiman 2021	DIFFERENCE
5/14/13	894.852'	894.829'	-0.023'
21N	793.343'	793.370'	+0.027'
21S	762.889'	762.935'	+0.046'
22	813.102'	813.137'	+0.035'
27N	790.887'	791.019'	+0.132'
27S	778.331'	778.385'	+0.054'
28	741.053'	741.133'	+0.080'
33	728.963'	729.025'	+0.062'
MP1	611.919'	612.081'	+0.162'
MP2	613.662'	613.772'	+0.110'
MP3	878.939'	878.944'	+0.005'
MP4	683.507'	683.632'	+0.125'
MP5	970.531'	970.557'	+0.026'

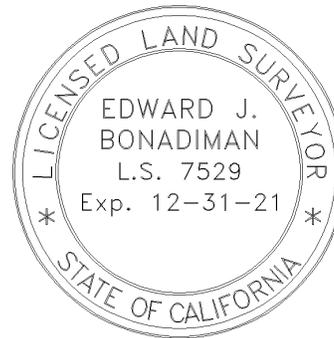
This report represents a survey made by me or under my direct supervision in June 2021.

Should you have any additional questions and/or comments relative to the subject matter contained herein, please feel free to contact the undersigned at (909) 885-3806, Ex 132.

Sincerely,



Edward J. Bonadiman, PLS 7529
President





Joseph E. Bonadiman, P.E. (1903 – 1990)
Charles F. Bonadiman, L.S. (1898 – 1986)
Joseph S.C. Bonadiman, P.E. (1932 – 2013)

October 12, 2022

Cadiz
Attn: Lesley Thornburg
1701 Clinton Street, Suite 212
Los Angeles, CA 90026

Re: October 2022 Subsidence Survey

Purpose: Establish horizontal and vertical values on 16 monitoring locations.

Field Equipment: Trimble GNSS 12 & 12i Receivers

Office Software: Trimble Business Center v5.60

Primary Control: Joseph E. Bonadiman & Associates Inc. Subsidence Report dated July 29, 2021

Horizontal Datum: North American Datum of 1983 (NAD83, 2010.0 Epoch)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88, Geoid18 Conus)

Units: US Survey Feet.

Real Time Kinematic GPS methods were utilized to position and elevate the primary control. The GPS data sets collected were downloaded daily and processed through Trimble Business Center processing software. The Real Time Kinematic baselines for each measurement were reviewed. Survey data was reviewed, and the resulting values compared to the July 2021 values. This comparison is based on utilizing MARBLE BM as the horizontal and vertical constraint.

81 Years

of Professional Experience

234 North Arrowhead Avenue, San Bernardino, CA 92408

Joseph E. Bonadiman & Associates, Inc.
Engineers • Surveyors • Planning • G.I.S.
Tel. (909) 885-3806 • Fax (909) 381-1721
www.bonadiman.com

Well	Bonadiman 2021	Bonadiman 2022	DIFFERENCE
5/14/13	894.829'	894.825'	-0.004'
21N	793.370'	793.376'	+0.006'
21S	762.935'	762.991'	+0.056'
22	813.137'	813.112'	-0.025'
27N	791.019'	790.930'	-0.089'
27S	778.385'	778.289'	-0.096'
28	741.133'	741.048'	-0.085'
33	729.025'	729.015'	-0.010''
MP1	612.081'	611.971'	-0.110'
MP2	613.772'	613.735'	-0.037'
MP3	878.944'	878.940'	-0.004'
MP4	683.632'	683.544'	-0.088'
MP5	970.557'	970.667'	+0.110'
26	N/A	811.767'	0.000'
35	N/A	775.798'	0.000'
34	N/A	760.146'	0.000'

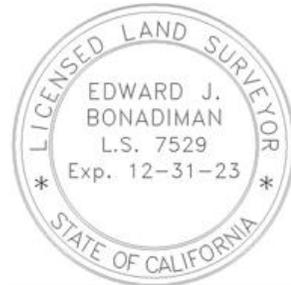
This report represents a survey made by me or under my direct supervision in October 2022.

Should you have any additional questions and/or comments relative to the subject matter contained herein, please feel free to contact the undersigned at (909) 885-3806, Ex 132.

Sincerely,



Edward J. Bonadiman, PLS 7529
President





Joseph E. Bonadiman, P.E. (1903 – 1990)
Charles F. Bonadiman, L.S. (1898 – 1986)
Joseph S.C. Bonadiman, P.E. (1932 – 2013)

January 2, 2024

Cadiz Inc.
Attn: Lesley Thornburg
1701 Clinton Street, Suite 212
Los Angeles, CA 90026

Re: December 2023 Subsidence Survey

Purpose: Establish Vertical Values on 16 Monitoring Locations.

Field Equipment: Trimble GNSS 12 & 12i Receivers

Office Software: Trimble Business Center v2023.10

Primary Control: Joseph E. Bonadiman & Associates Inc. Subsidence Report dated October 12, 2022

Horizontal Datum: North American Datum of 1983 (NAD83, 2010.0 Epoch)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88, Geoid18 Conus)

Units: US Survey Feet.

Real Time Kinematic GPS methods were utilized to position and elevate the primary control. The GPS data sets collected were downloaded daily and processed through Trimble Business Center processing software. The Real Time Kinematic baselines for each measurement were reviewed. Survey data was reviewed, and the resulting values compared to the October 2022 values. This comparison is based on utilizing MARBLE BM as the horizontal and vertical constraint.

83 Years

of Professional Experience

234 North Arrowhead Avenue, San Bernardino, CA 92408

Joseph E. Bonadiman & Associates, Inc.
Engineers • Surveyors • Planning • G.I.S.
Tel. (909) 885-3806 • Fax (909) 381-1721
www.bonadiman.com

Well	Bonadiman 2022	Bonadiman 2023	DIFFERENCE
5/14/13	894.825'	894.862'	+0.037'
21N	793.376'	793.349'	-0.027'
21S	762.991'	762.964'	-0.027'
22	813.112'	813.193'	+0.081'
27N	790.930'	790.924'	-0.006'
27S	778.289'	778.304'	+0.015'
28	741.048'	741.117'	+0.069'
33	729.015'	729.071'	+0.056'
MP1	611.971'	611.974'	+0.003'
MP2	613.735'	613.722'	-0.013'
MP3	878.940'	878.947'	+0.007'
MP4	683.544'	683.637'	+0.093'
MP5	970.667'	970.584'	-0.083'
26	811.767'	811.786'	+0.019'
35	775.798'	775.850'	+0.052'
34	760.146'	760.212'	+0.066'

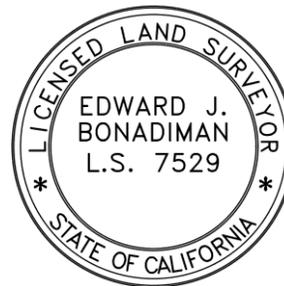
This report represents a survey made by me or under my direct supervision in December 2023.

Should you have any additional questions and/or comments relative to the subject matter contained herein, please feel free to contact the undersigned at (909) 885-3806, Ex 132.

Sincerely,



Edward J. Bonadiman, PLS 7529
President





GEOSCIENCE

P.O. Box 220, Claremont, CA 91711

P: 909.451.6650 | F: 909.451.6638 | www.gssiwater.com