Appendix G.5

Updated Groundwater Resources Investigation Report

UPDATED DRAFT GROUNDWATER RESOURCES INVESTIGATION REPORT – FLAT CREEK WATERSHED ANALYSIS

Jacumba Community Services District, Jacumba Hot Springs, San Diego County California

Lead Agency:

County of San Diego
Planning and Development Services
5510 Overland Avenue
San Diego, California 92123
Contact: Nick Koutoufidis

Project Proponent:

Jacumba Community Services District
P.O. Box 425
Jacumba Hot Springs, California 91934
Contact: Emilio Gonzales

Prepared by:

INTERA

July 2025

This page is intentionally left blank.

Executive Summary

Following San Diego County Planning guidance, INTERA Incorporated (INTERA) has prepared this groundwater resources investigation report to examine the potential impact of the Jacumba Community Services District (JCSD) extracting additional water supply for Starlight Solar on groundwater resources of the Jacumba Valley alluvial aquifer within the Jacumba Hot Springs, California. The groundwater extracted by JCSD would be used as a non-potable supply for the construction of off-site renewable energy projects, including Starlight Solar in Boulevard, California.

JCSD is proposing the use of the Highland Center Well with potential backup water provided by the Park Well to serve as a non-potable supply for the construction of four proposed renewable energy projects. This analysis addresses potential impacts on Jacumba Valley alluvial aquifer groundwater resources due to those projects, and especially Starlight Solar, based on the production from the Highland Center Well of up to 278 acre-feet for all the projects over a period of two years with backup provided by the Park Well. The significant results of the groundwater resource investigation report are as follows:

- The proposed non-potable groundwater extraction from the Highland Center Well with backup provided by the Park Well is 139 acre-feet per year (afy), for two years for a total of 278 acre-feet for construction, or 90.6 million gallons. Operations and maintenance water supplied by the JCSD would be 5.06 afy, 4 acre-feet of which is for a renewable energy project that has already been constructed (Jacumba Solar).
- The current maximum pumping rate for the Highland Center Well and the Park Well is 174 gallons per minute (gpm) and 80 gpm, respectively. The Highland Center Well is capable of supplying JCSD future maximum non-potable water demand of 249 acre-feet of groundwater at a constant pumping rate of 154 gpm. The Park Well will be used as a backup supply to the Highland Center Well.
- The current groundwater storage in the Jacumba Valley alluvial aquifer, including the portion of the alluvial aquifer located in Mexico, is estimated to be 8,141 acre-feet based on updated groundwater level data.
- The volume of groundwater storage would not be reduced to 50% or less than the current groundwater storage in the aquifer as a result of additional pumping from the Highland Center with a backup supply provided by the Park Well based on an estimated full Jacumba Valley alluvial aquifer storage of 11,082 acre-feet and Starlight Solar and reasonable foreseeable groundwater demand of 465.4 acre-feet over the 30-year operational life of the Starlight Solar project.
- The proposed non-potable groundwater extraction of 139 afy for construction of all four projects is 6.7% of the maximum historical groundwater extracted from the Jacumba Valley alluvial aquifer estimated at 2,066 afy.
- Drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated under a 1- and 5-year scenario for the Highland Center Well and Park Well separately. The Highland Center and Park Well 1-year scenarios estimated drawdown based on the construction water demand of 139 afy. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand (5.06 afy). The total 5-year demand for all four projects would be 293.18 acre-feet spread out over 5 years, equal to 58.64 acre-feet per year or a continuous pumping rate of 36.5 gpm.
- The estimated drawdown at the nearest off-site well, Well Km, under the 1-year scenario is 1.56 feet from pumping the Highland Center Well and would be 1.56 feet from pumping the Park

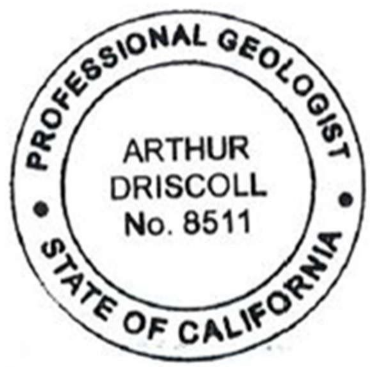
Well if used as a backup supply well. The estimated drawdown under the 5-year scenario would be 0.75 feet from pumping the Highland Center Well and 0.75 feet from pumping the Park Well if used as a backup supply well. Based on the County of San Diego well interference threshold guidance for alluvial wells, this drawdown is less than significant.

- The estimated drawdown at the nearest groundwater-dependent habitat, southern riparian forest, under the 1-year scenario is 1.53 feet from pumping the Highland Center Well and would be 1.56 feet from pumping the Park Well if used as a backup supply well. The estimated drawdown under the 5-year scenario is predicted to be 0.74 feet from pumping the Highland Center Well and 0.75 feet from pumping the Park Well if used as a backup supply well. Based on the County of San Diego groundwater-dependent habitat threshold guidance for alluvial wells, drawdown would be less than significant.
- The Highland Center Well and the Park Well are non-potable water sources; therefore, no water quality analysis was performed for this report. Groundwater from the Highland Center Well and the Park Well is suitable for non-potable use, based on historical water quality testing.
- An updated Groundwater Monitoring and Mitigation Plan (GMMP) has been prepared for the proposed groundwater extraction from the Highland Center with backup provided by the Park Well, which details thresholds for off-site well interference, groundwater in storage, and groundwater-dependent habitat. The updated GMMP provides recommendations for ongoing groundwater level monitoring and establishes groundwater thresholds for off-site well interference, groundwater in storage, and groundwater-dependent habitat.

In summary, there is sufficient non-potable water supply available from the Jacumba Valley alluvial aquifer to be supplied from JCSD’s Highland Center Well with the Park Well as backup for the construction of the four proposed renewable energy projects including Starlight Solar as documented and analyzed in this report prepared in accordance with County of San Diego guidelines.

Professional Geologist Seal

This Updated Draft Groundwater Resource Investigation Report – Flat Creek Watershed Analysis has been prepared under the direction of a professional geologist licensed in the State of California consistent with professional standards of practice.



Arthur Storer Driscoll, III (Trey)
PG No. 8511, CHG No. 936

This page is intentionally left blank.

Table of Contents

1.0 Introduction 5
1.1 Use of the Report 5
1.2 Purpose of the Report 5
1.2.1 Study Area 5
1.3 Project Description 5
1.3.1 Groundwater Supply Wells 6
1.4 Applicable Groundwater Regulations 6
2.0 Existing Conditions 9
2.1 Topographic and Hydrologic Setting 9
2.2 Climate 9
2.3 Land Use 12
2.4 Water Demand 13
2.5 Geology and Soils 14
2.5.1 Geology 14
2.5.2 Soils 15
2.6 Hydrogeologic Units 16
2.7 Hydrogeologic Inventory of Groundwater Levels 17
2.8 Water Quality 21
3.0 Water Quantity Impacts Analysis 23
3.1 50% Reduction in Groundwater Storage 23
3.1.1 Guidelines for Determining Significance 23
3.1.2 Methodology 23
3.1.3 Significance of Impacts Prior to Mitigation – Groundwater in Storage 33
3.1.4 Mitigation Measures and Design Considerations 34
3.1.5 Conclusions 34
3.2 Well Interference and Groundwater Dependent Habitat 34
3.2.1 Guidelines for Determination of Significance 34
3.2.2 Aquifer Testing Methodology 36
3.2.3 Significance of Impacts Prior to Mitigation – Well Interference and Groundwater Dependent Habitat 40
3.2.4 Mitigation Measures and Design Considerations 41
3.2.5 Conclusions 41
4.0 Water Quality Impact Analysis 42
5.0 Summary of Project Impacts and Mitigation 43
5.1 50% Reduction in Groundwater Storage 43
5.2 Well Interference 43
5.3 Groundwater-Dependent Habitat 44
5.4 Water Quality 44
5.5 Mitigation Measures 44
6.0 References 45
7.0 List of Preparers and persons and Organizations Contacted 49

List of Figures

Exhibit 2-A	Annual Precipitation Data Jacumba Rain Gauge 1963 to 2011	11
Exhibit 2-B	Jacumba Valley Alluvial Aquifer Groundwater Level Data July 1955 to December 2018	21
Figure 1	Regional Location	51
Figure 2	Vicinity Map	53
Figure 3	Hydrologic Areas	55
Figure 4	Regional Mean Annual Precipitation	57
Figure 5	Land Use	59
Figure 6	Regional Geologic Map	61
Figure 7	Soils Map	63
Figure 8	Digital Elevation Model	65
Figure 9	Wells Map	67
Figure 10	Hydrogeologic Units	69
Figure 11	Potential Groundwater Dependent Vegetation	71
Figure 12	Highland Center Well 24-hr Constant Rate Test – Highland Center Well Analysis	73
Figure 13	Park Well Analysis	75

List of Tables

Table 1-1	Existing and Proposed Renewable Energy Projects Water Demand	6
Table 2-1	Precipitation Data Recorded at Jacumba Rain Gauge	9
Table 2-2	Rain Gauges in Project Area	10
Table 2-3	CIMIS Zone 16 Reference Evapotranspiration	12
Table 2-4	Jacumba Valley Alluvial Aquifer Existing Water Demand	14
Table 2-5	Soil Units within the Flat Creek Watershed	15
Table 2-6	Jacumba Valley Well Inventory	17
Table 3-1	Jacumba Valley Alluvial Aquifer Groundwater Demand	25
Table 3-2	JCSD Non-Potable Water Demand for Starlight Solar and Reasonably Foreseeable Projects	27
Table 3-3	Well Completion Information for Constraining Alluvial Saturated Thickness	29
Table 3-4	Jacumba Valley Alluvial Aquifer 2007 and 2023 Groundwater in Storage Estimate	32
Table 3-5	Alluvial Aquifer Wells Within 0.5-Mile Radius of Extraction Wells	35
Table 3-6	Groundwater-Dependent Habitat Within 0.5-Mile Radius of Extraction Wells	36
Table 3-7	Highland Center Aquifer Test – Estimated Aquifer Hydraulic Properties	37
Table 3-8	Highland Center Well Distance Drawdown Calculations	39
Table 3-9	Park Well Distance Drawdown Calculations	40

Acronyms and Abbreviations

afy	Acre-Feet per Year
amsl	Above Mean Sea Level
APN	Assessor's Parcel Number
bgs	below ground surface
btoc	below top of casing
CIMIS	California Irrigation Management Information System
County	County of San Diego
DG	decomposed granite
DDW	Division of Drinking Water
ET	Evapotranspiration
ETo	Reference Evapotranspiration
GMMP	Groundwater Monitoring and Mitigation Plan
gpd	gallons per day
gpd/ft	gallons per day/foot
gpm	gallons per minute
IFSAR	Interferometric Synthetic Aperture Radar
INTERA	INTERA Incorporated
JCSD	Jacumba Community Servies District
MCL	Maximum Contaminant Level
O&M	operations and maintenance
PRISM	Parameter-elevation Regressions on Independent Slopes Model
µg/L	Micrograms per Liter
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

This page is intentionally left blank.

1.0 Introduction

1.1 Use of the Report

This groundwater resources investigation was prepared on behalf of Empire II, LLC by INTERA for submittal to County of San Diego (County) Planning and Development Services to satisfy groundwater resource investigation scoping requirements outlined in Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County of San Diego 2023a). This groundwater resource investigation evaluates the cumulative use by four renewable energy projects of non-potable groundwater from the Jacumba Community Services District's (JCSD) Highland Center Well with backup water supplied by JCSD's Park Well. Following County Guidelines, the evaluation includes a groundwater in-storage analysis and a 1-year and 5-year drawdown analysis of off-site well interference and groundwater-dependent habitat.

The results of this investigation should not be relied upon for use in any other groundwater use proposal subject to County review in Jacumba Hot Springs, California.

1.2 Purpose of the Report

The JCSD is located in Jacumba Hot Springs on the international border with Mexico in southeastern San Diego County, California (Figure 1). The JCSD service area is approximately 422 acres located south of Interstate 8, immediately north of the U.S./Mexico Border, and within the town of Jacumba Hot Springs (Figure 2). The Highland Center Well and the Park Well are located within the assessor's parcel number (APN) 660-140-07, located on the south side of Old Highway 80 between Heber Street and Campo Street, within Jacumba Community Park (Figure 2). JCSD owns the parcel and operates the wells. The purpose of this report is to evaluate the cumulative effects of four solar and wind projects' groundwater usage on the Jacumba Valley alluvial aquifer, with a focus on the Starlight Solar project in Boulevard, California.

1.2.1 Study Area

The study area for discussions of groundwater storage is the Quaternary alluvium, referred to as the Jacumba Valley alluvial aquifer. The study area for discussions of recharge is the Flat Creek watershed (which includes the Blue Angel Peak subwatershed, an unnamed subwatershed, and a modified version of the Walker-Carrizo Canyon subwatershed) (see Section 2.1). The study area for well interference is the 0.5-mile radius around the Highland Center Well and the Park Well.

1.3 Project Description

JCSD is proposing the use of the Highland Center Well with a potential backup supply provided by the Park Well to serve JCSD non-potable water to commercial customers. Based on foreseeable renewable energy projects, JCSD is proposing to extract 278 acre-feet of groundwater over 24 months. Construction groundwater extraction was analyzed over a period of 12 months by dividing the total proposed extraction volume by 2 to estimate the impact of one year of operational pumping. The JCSD is also proposing to supply a total of 5.06 acre-feet per year (afy) of operations and maintenance (O&M) water for these projects. Water demand for the proposed renewable energy projects and their proposed project construction duration is included in Table 1-1.

Table 1-1 Existing and Proposed Renewable Energy Projects Water Demand

Project Name	Construction Water Demand (Acre-Feet)	Construction Water Demand (Million Gallons)	Project Construction Duration (Months)	O&M Demand (Acre-Feet per Year)
Existing				
Jacumba Solar	NA	NA	NA	4[a]
Proposed				
Boulder Brush	50.03	16.30	9	0.00
Campo Wind	122.75	40.00	14	0.25
Rugged Solar	37.00	12.06	8	7.34[b]
Starlight Solar	67.9	22.13	24	0.9
TOTAL	**277.68**	**90.48**	**24**	**8.49**

Notes: O&M = Operations and maintenance. NA = Not applicable

[a] Jacumba Solar has not taken its annual allocation of O&M water since it was constructed.

[b] to be supplied by Rugged Solar Project wells

1.3.1 Groundwater Supply Wells

Both the Highland Center Well and the Park Well are non-potable supply wells screened in the Jacumba Valley alluvial aquifer. The Highland Center Well is completed to a depth of 124 feet below ground surface (bgs) with an 8.625 stainless steel casing and a screen interval of 75 to 115 feet bgs. It is estimated to have a production capacity of approximately 174 gpm based on aquifer test pumping. The Park well is completed to a depth of 124 bgs with a 4-inch PVC casing and a screened interval from 79 to 124 feet bgs. It is estimated to have a production capacity of approximately 80 gpm based on aquifer pump testing (Petra 2006, Dudek 2016c).

1.4 Applicable Groundwater Regulations

The County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County Guidelines) contain a series of significance thresholds for groundwater quantity and groundwater quality (County of San Diego 2023b). The County Guidelines contain the following guideline that, if met, would be considered a significant impact on local groundwater resources as a result of Project implementation.

To evaluate impacts on groundwater resources, a water balance analysis is typically required; the following guideline for determining significance is typically used (County of San Diego 2023b):

For proposed projects in fractured rock basins, a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction.

To evaluate off-site well interference in alluvial wells as a result of this project, the following guideline for determining significance is typically used (County of San Diego 2023b):

As an initial screening tool, offsite well interference will be considered a significant impact if after a five year projection of drawdown, the results indicate a decrease in water level of 5 feet or more in the offsite wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in offsite wells, a decrease in saturated thickness of 5% or more in the offsite wells would be considered a significant impact.

To evaluate groundwater quality impacts as a result of this project, the following guideline for determining significance is typically used (County of San Diego 2023b):

Groundwater resources for proposed projects requiring a potable water source must not exceed the Primary State or Federal Maximum Contaminant Levels (MCLs) for applicable contaminants. Proposed projects that cannot demonstrate compliance with applicable MCLs will be considered to have a significant impact. In general, projects will be required to sample water supply wells for nitrate, bacteria (fecal and total coliform), and radioactive elements. Projects may be required to sample other contaminants of potential concern depending on the geographical location within the County.

The Highland Center Well and the Park Well are non-potable water sources therefore, the above guideline for determining the significance for groundwater quality does not apply.

To evaluate impacts on groundwater-dependent habitat, the following guideline for determining significance is typically used (County of San Diego 2010):

The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historically low groundwater levels[1]*.*

The JCSD is a Water Service Agency regulated by the State Water Resources Control Board's Division of Drinking Water (DDW). Thus, JCSD is not subject to the County's Groundwater Ordinance (County of San Diego, 2013).

[1] Studies have found that groundwater elevation reductions adversely affect native plant species. Two of the referenced studies (Integrated Urban Forestry, 2001 and National Research Council, 2002) found that a permanent reduction in groundwater elevation of greater than three feet is enough to induce water stress in some riparian trees, particularly willow (Salix spp.), cottonwood (Populus spp.) and Baccharis species.

This page is intentionally left blank.

2.0 Existing Conditions

2.1 Topographic and Hydrologic Setting

The Highland Center Well and Park Well are located within the Jacumba Valley in the southeastern corner of San Diego County which has an approximate elevation of 2,804 feet above mean sea level (amsl). The topography of the Jacumba Valley is generally flat and extends south across the border with Mexico. Adjacent mountains include Round Mountain (3,367 feet amsl) to the northwest and Grey Mountain (3,780 feet amsl) to the northeast. The Valley constricts to the north where it eventually terminates at Carrizo Canyon just north of Interstate 8.

The Jacumba Valley is in the Upper Carrizo Creek Hydrologic Unit as defined by the USGS (Figure 3). The main contributing watershed to the Highland Center Well and Park Well is the Flat Creek watershed. The Flat Creek watershed does not include the Boundary Creek watershed, which is predominantly located in the United States. The Flat Creek watershed consists of approximately 52,405 acres, with 1,058 acres (2%) of the watershed located in the United States. The Flat Creek watershed ranges from 4,265 feet amsl at its headwaters along the Sierra Juarez Mountains to 2,777 feet amsl northeast of the Highland Center Well.

2.2 Climate

Jacumba experiences warm summer months and cool winters. Average temperatures vary greatly within the region. Mean maximum temperatures in the summer months reach the high-80s to low-90s (degrees Fahrenheit). Temperatures may fall below freezing in the winter, with snow levels occasionally below 2,500 feet (WRCC 2019).

Monthly precipitation records were obtained from the County of San Diego for a rain gauge previously located in Jacumba at 32°37' North latitude, 116°11' West longitude, and an elevation of 2,800 feet. The period of record available is from March 1963 until March 2011. Table 2-1 provides average monthly precipitation data, as well as the highest and lowest monthly precipitation for the Jacumba rain gauge (Allan 2013).

Table 2-1 Precipitation Data Recorded at Jacumba Rain Gauge

Month	Rainfall (inches) – 1963–2011		
	Average	***Highest/ Year***	***Lowest***
January	1.45	5.79/ 1983	0
February	1.66	10.86/ 1993	0
March	1.82	6.76/ 1998	0
April	1.45	7.13/ 1991	0
May	0.50	2.38/ 1965	0
June	0.19	2.24/ 1981	0

Table 2-1 Precipitation Data Recorded at Jacumba Rain Gauge

Month	Rainfall (inches) – 1963–2011		
	Average	*Highest/ Year*	*Lowest*
July	0.06	0.96/ 1984	0
August	0.45	3.97/ 1984	0
September	0.50	3.48/ 1992	0
October	0.37	4.58/ 1976	0
November	0.60	4.37/ 2004	0
December	0.85	3.82/ 1965	0
Year	9.64	22.16/ 1982-83	2.26

Source: Allan 2013.
Notes: Jacumba rain gauge was located at N 32°37', W 116°11', at an elevation of 2,800 feet.
a. Jacumba rain gauge was active from 1963 to 2011.
b. Lowest monthly recorded precipitation data is not available due to data gaps.

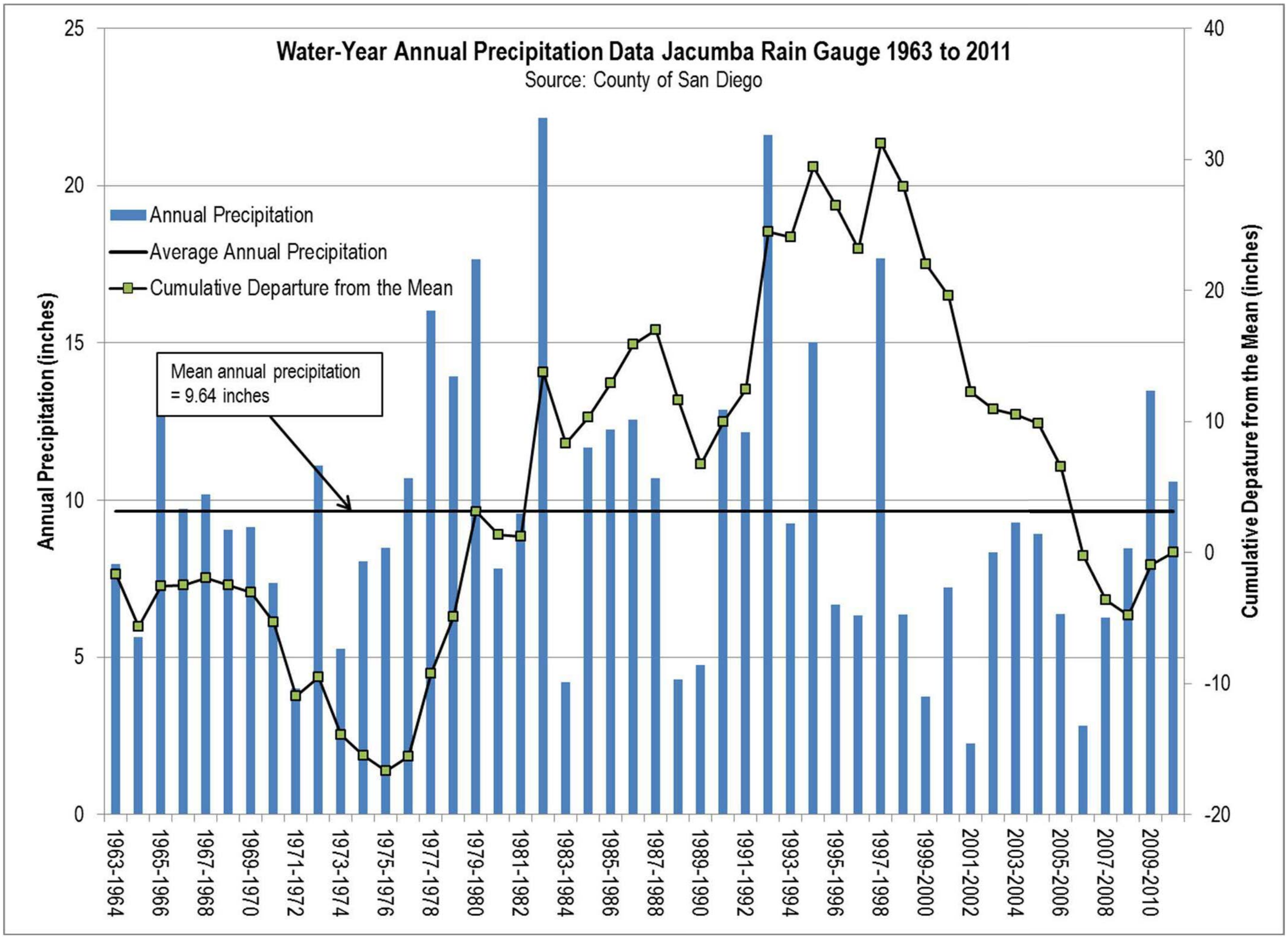
For the period between 1963 through 2011, the average annual precipitation at the Jacumba rain gauge was approximately 9.64 inches with 85% of the precipitation occurring between October and April. Annual precipitation totals at the Jacumba rain gauge vary from a high of 22.16 inches in the 1982 – 1983 water year to a low of 2.26 inches in the 2001 – 2002 water year (Exhibit 2-A).

Precipitation records from four nearby rain gauges were reviewed to determine the annual average rainfall within the vicinity of the Flat Creek watershed. The rain gauges are located in Boulevard (two stations), Tierra del Sol, and Jacumba. The location, elevation, years of operation, mean annual rainfall, and source of data are provided in Table 2-2.

Table 2-2 Rain Gauges in Project Area

Station	Location	Elevation (feet amsl)	Years of Operation	Average Annual Rainfall (inches)	Source
Boulevard 1	N 32°40', W 116°17'	3,353	1924 to 1967	14.8	NOAA
Boulevard 2	N 32°40', W 116°18'	3,600	1969 to 1994	17.0	NOAA
Tierra del Sol	N 32°39', W 116°19'	4,014	1971 to 2017	10.8	County
Jacumba	N 32°37', W 116°11'	2,800	1963 to 2011	9.64	County

The isohyetal map of annual precipitation, developed by Swenson, shows that the majority of the Flat Creek watershed receives an average of 11 inches of precipitation per year (Figure 4). The lower elevations of the watershed receive an average of 9 inches of precipitation per year. This agrees with the average precipitation calculated for the Jacumba rain gauge between 1963 and 2011. The Jacumba rain gauge was located at the lowest elevation in the Flat Creek watershed. Mean annual precipitation, as determined from the County of San Diego map entitled “Groundwater Limitations Map” on file with the Clerk of the Board of Supervisors as Document No. 195172, indicates the Flat Creek watershed within the U.S. is located within a precipitation isohyetal of 12 to 15 inches (County of San Diego 2004). The precipitation isohyets developed by Parameter-elevation Regressions on Independent Slopes Model (PRISM) also roughly concur with those developed by Swenson (Figure 4).



Notes: The station is located at N 32°37', W 116°11' at an elevation of 2,800 feet and operated from 1963 through 2011.
Source: Allan, R. B., 2013.

Exhibit 2-A Annual Precipitation Data Jacumba Rain Gauge 1963 to 2011

According to the State of California Reference Evapotranspiration Map developed by the California Irrigation Management Information System (CIMIS), the JCSD is located in Evapotranspiration Zone 16, with an average of 62.5 inches of reference evapotranspiration (ETo) per year (CIMIS 1999). Table 2-3 presents ETo by month in CIMIS Zone 16. The annual 62.5 inches of ETo is based on potential evapotranspiration (ET) from turf grass/alfalfa crops, which assumes a continuous source of moisture and does not consider summer plant dormancy.

Table 2-3 CIMIS Zone 16 Reference Evapotranspiration

Month	ETo (inches)
January	1.55
February	2.52
March	4.03
April	5.7
May	7.75
June	8.7
July	9.3
August	8.37
September	6.3
October	4.34
November	2.4
December	1.55
Year	**62.51**

Source: CIMIS 1999

2.3 Land Use

According to the San Diego County General Plan, Jacumba Hot Springs is located within the Mountain Empire Subregional Plan area (County of San Diego 2011). Land use designations within a 0.5-mile radius of the Highland Center Well include open space park or preserve, public services, communications and utilities, commercial retail, religious facility, single-family residential, spaced rural residential, road right of way, and railroad right of way. Land Use designations within a 0.5-mile radius of the Park Well include elementary school, open space park, or preserve, public services, communications and utilities, commercial retail, religious facility, single-family residential, spaced rural residential, road right of way, and railroad right of way (Figure 5). Adjacent current land uses are spaced rural residential, commercial retail, open space park or preserve, and single-family residential. The parcel on which the Highland Center Well and Park Well are located is zoned as special purpose (S-80), with land use designation of public services, and is owned by JCSD.

Current land use within the Flat Creek watershed within the country of Mexico consists primarily of vacant, undeveloped land except for the town of Jacume. The land outside Jacumba Hot Springs within the United States portion of Flat Creek watershed is predominantly undeveloped.

2.4 Water Demand

The current water demand for the Jacumba Valley alluvial aquifer includes potable demand for Jacumba Valley Ranch Water Company (formerly the Ketchum Ranch Water Company) and non-potable demand from JCSD (Table 2-4).

The Jacumba Valley Ranch Water Company is classified as a transient non-community water system. According to County Department of Environmental Health Small Drinking Water System files, seven connections—three ranch homes, two gas stations, and two fire hydrants—are part of the Jacumba Valley Ranch water system (McCullough, pers. comm. 2015). The estimated water demand for the Jacumba Valley Ranch Water Company is 5 afy. The Jacumba Valley Ranch Water Company water demand reported in 2015 of 5 afy is likely a conservative value to estimate existing conditions given the recent removal of water demand for the three ranch homes.

JCSD currently supplies potable water to 239 connections from JCSD Wells 7 and 8 located in the fractured rock aquifer. JCSD's current water usage was not made available for this report, but historical water demand and water use calculations were used to estimate current demand. Based on available data from Barrett Consulting Group (Barrett 1996), JCSD produced between 86 and 146 acre-feet annually from 1991 to 1995, averaging 116 afy. More recent production data indicates that JCSD served 26.3 million gallons (80 acre-feet) of water in 2021 and 20.2 million gallons (62 acre-feet) in 2022 meet the water demands of the potable water system and supply non-potable construction supply (Gonzalez, pers. comm. 2023). Based on the number of connections and an estimated 0.5 afy per connection, JCSD potable water demand is estimated to be 119.5 afy. This estimate roughly coincides with the average historical water demand from 1991 to 1995.

JCSD also supplies non-potable water for commercial sale. Historically, JCSD has supplied non-potable water from Well 6, a fractured rock well not screened in the Jacumba Valley alluvium. Beginning in 2016, JCSD began supplying non-potable water from the Highland Center Well and the Park Well, both screened in the Jacumba Valley alluvium. Non-potable water supply from JCSD varied based on customer demand. From February 2017 to February 2018, JCSD supplied 50.1 acre-feet from the Highland Center Well and 3.5 acre-feet from the Park Well. From February 2018 to January 2019, JCSD supplied 4 acre-feet from the Highland Center Well and 0 acre-feet from the Park Well. Maximum annual groundwater extraction from the Jacumba Valley alluvial aquifer by JCSD for non-potable water use is 53.6 afy.

Based on the County Department of Environmental Health well completion report database, no additional active wells are located within the Jacumba Valley alluvium (County of San Diego 2018). Because there is the potential for active wells to exist without proper County Department of Environmental Health permitting, this report conservatively estimates six potential domestic wells that produce groundwater from the Jacumba Valley alluvial aquifer. The estimated annual water demand for the potential domestic wells is 3 afy or 0.5 afy per well.

Agriculture located on the Jacumba Valley Ranch historically extracted most of the groundwater from the Jacumba Valley alluvial aquifer. Currently, no water is being extracted from the Jacumba Valley Ranch for these activities.

Table 2-4 Jacumba Valley Alluvial Aquifer Existing Water Demand

Groundwater Extraction Sources	Wells Names	Total Water Demand (acre-feet/year)
Jacumba Valley Ranch Water Co.	Well Km	5[a]
Jacumba Community Services District (JCSD) (potable)	Well 4	0[b]
JCSD (non-potable)	Highland Center Well, Park Well	53.6[c]
Potential Domestic Wells	Private Domestic Wells	3[d]
Total Water Demand		**61.6**

Notes:

a. Jacumba Valley Ranch Water Company has up to seven connections: three ranch homes, two gas stations, and two fire hydrants. No water demand was assigned to the fire hydrants. Water demand is estimated at approximately 1 acre-foot per connection.

b. Beginning in spring 2019, potable groundwater production from Well 4 ceased. Potable groundwater production for JCSD is sourced from Wells 7 and 8, which are located in the fractured rock aquifer.

c. Maximum demand based on meter reads from February 2017 to February 2018.

d. Not all domestic wells are currently active or known; however, a consumptive water demand of 0.5 afy has been assigned to up to six potential domestic wells.

2.5 Geology and Soils

2.5.1 Geology

Jacumba Hot Springs is located on the eastern portion of the Peninsular Range geomorphic province, which consists of northwest-oriented mountain ranges separated by northwest-trending fault-produced valleys, subparallel to faults branching from the San Andreas Fault. The regional geology of the Flat Creek watershed is depicted in Figure 6. Because much of the Project area is located south of the International Border, worldwide geologic data was used to depict geology south of the border (Garrity and Soller 2009).

The surface area of the Flat Creek watershed primarily consists of exposed Cretaceous plutonic rocks of the composite Peninsular Ranges Batholith. These plutonic rocks consist of the bedrock unit known as the tonalite of La Posta (also referred to as the La Posta Quartz Diorite) (USGS 2004). The Sierra Juarez Mountains, located on the southeastern side of the watershed in Mexico, consist of Mesozoic sedimentary rocks (Garrity and Soller 2009). Quaternary alluvium is present in low-lying areas in portions of the watershed including the Jacumba Valley (USGS 2004).

Jacumba Valley contains exposures of the Jacumba Volcanics and the Table Mountain Formation, overlain by Quaternary alluvium (Swenson 1981). Alluvial thickness in the center of Jacumba Valley is 100 to 175 feet, thinning towards the sides and ends of the valley (Swenson 1981, Dudek 2016a). The Jacumba Volcanics are encountered below the Jacumba Valley alluvium as reported in numerous boring log reports (County of San Diego 2018; CRA 2012; Petra 2006). The Table Mountain Formation underlies the Jacumba Volcanics and is described as medium- to coarse-grained sandstone and conglomerate and may reach up to 600 feet in thickness (Swenson 1981). The migmatitic schist and gneiss of the Stephenson Peak Formation outcrop just west of the valley (Swenson 1981; USGS 2004).

2.5.2 Soils

The type, areal extent, and key physical and hydrological characteristics of soils mapped on the United States side of the Flat Creek watershed were identified based on a review of soil surveys completed by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS 2018). Soil units are shown in Figure 7 and are described in Table 2-5. The permeability, specific retention, and active rooting depth of a given soil type control the percentage of precipitation that infiltrates the soil satisfies the soil moisture deficit, and is available to recharge the groundwater aquifer.

Swenson (1981) provides a map and description of soil types on the Mexico side of the Flat Creek watershed based on representative soil samples and measurements of their porosity and specific retention.

Table 2-5 Soil Units within the Flat Creek Watershed

Map Unit, Soil Name	Acres (Percent of the Flat Creek Watershed)	Parent Material	Depth to the restrictive layer (inches)	Hydrologic Group[a]	Erosion Factor[b]
Soil Identification by USDA					
AcG, Acid Igneous Rock Land	0.4 (0.001%)	Acid igneous rock	0–4	D	—
CeC, Carrizo Very Gravelly Sand, 0-9% slope	1.9 (0.004%)	Alluvium derived from mixed igneous rocks		D	0.02
InA, Indio silt loam, 0-2% slope	63.1 (0.12%0	alluvium derived from igneous rock and mica schist		B	0.55
InB, Indio silt loam, 2-5% slope	79.1 (0.15%)	alluvium derived from igneous rock and mica schist		B	0.55
IoA, Indio silt loam, saline, 0-2% slope	14.9 (0.03%)	alluvium derived from igneous rock and mica schist		B	0.55
LcE2, La Posta Loamy Coarse Sand, 5-30% slope, eroded	43.9 (0.08%)	Residuum weathered from granodiorite	27	A	0.02
MnB, Mecca coarse sandy loam, 2 – 5% slopes	12.8 (0.02%)	alluvium derived from granite		A	0.20

Table 2-5 Soil Units within the Flat Creek Watershed

Map Unit, Soil Name	Acres (Percent of the Flat Creek Watershed)	Parent Material	Depth to the restrictive layer (inches)	Hydrologic Group[a]	Erosion Factor[b]
RaC, Ramona sandy loam, 5-9% slopes	157.5 (0.30%)	alluvium derived from granite		C	0.32
RaD2, Ramona sandy loam, 9-15% slopes, eroded	6.5 (0.01%)	alluvium derived from granite		C	0.32
RkA, Reiff fine sandy loam, 0-2% slopes	171.4 (0.33%)	alluvium derived from granite		A	0.28
RsC, Rositas Loamy Coarse Sand, 2-9% slope	60.9 (0.12%)	Alluvium derived from granite		A	0.15
SrD, Sloping Gullied Land	126.3 (0.24%)			D	
SvE, Stony Land	320.4 (0.61%)	Mixed colluvium		D	
Subtotal	**1,059.1 (2.02%)**				
Soil Identification by Swenson					
W, Sandy Alluvium	7,153.0 (13.65%)			B	
X, Metamorphic and Plutonic Residuum	43,555.9 (83.11%)	Metamorphic granitic rocks		D	
Y, Volcanic residuum and Fine sand alluvium	639.1 (1.22%)			A	
Subtotal	**51,348.0 (97.98%)**				
Total Acreage	**52,407.0**				

Notes:

a. Hydrologic soil groups are used for estimating the runoff potential of soils on watersheds at the end of long-duration storms after a prior wetting and opportunity for swelling, and without the protective effect of vegetation. Soils are assigned to groups A through D in order of increasing runoff potential.

b. Erosion factor Kw indicates the susceptibility of the whole soil to sheet and rill erosion by water (estimates are modified by the presence of rock fragments). The estimates are based primarily on the percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. A range of values is given because map units are composed of several soil series.

Source: USDA 2015

2.6 Hydrogeologic Units

Boring logs were obtained for JCSD wells and select Jacumba Valley Ranch wells. The subsurface lithology within the vicinity of the Highland Center and Park Well consists of the following:

Alluvium: Alluvium up to a depth of 140 feet bgs was logged at JCSD Well 2 drilled approximately 2,200 feet east of the Park Well (Swenson 1981). The depth of alluvium at the Highland Center Well is 175 feet (Dudek 2016a). The depth of the alluvium at the Park Well is 124 feet (Petra 2006).

Jacumba Volcanics (Tv): Hard crystalline volcanic rocks form portions of the hills along the western and eastern sides of Jacumba Valley. Jacumba Volcanics have been encountered underlying the alluvium in boreholes drilled for JCSD Well 1 and the Park Well at depths of 124 feet bgs and 127 feet bgs, respectively. Jacumba Volcanics were encountered at a depth of 80 feet bgs in Chevron Service Station Well MW-9. The thickness of the Jacumba Volcanics is estimated to be up to 60 feet based on geophysical logs (Barrett 1996).

Decomposed Granite (DG): Decomposed granite (DG), ranging from 13 to 40 feet in thickness, was logged up to 80 feet bgs in JCSD Wells 6, 7, and 8 and in monitoring wells drilled approximately 1,200 feet west of the Park Well (CRA 2012).

Granitic Bedrock: The crystalline bedrock is predominantly composed of granodiorite with tonalite outcrops present throughout the Flat Creek watershed. Extensive fractures were logged up to a depth of 500 feet bgs while drilling JCSD Wells 7 and 8. Regional lineaments that trend both northwest–southeast, and west–east as depicted on the interferometric synthetic aperture radar (IFSAR) digital ortho-photography (Figure 8) also indicate extensive fracturing.

2.7 Hydrogeologic Inventory of Groundwater Levels

Published well logs were reviewed to locate wells and refine the thickness of hydrologic units present within the Jacumba Valley alluvial aquifer. Table 2-6 provides a summary of the information available from driller well logs obtained to date. Well, information has been updated based on field reconnaissance and/or historical data. Figure 9 includes the locations of select wells.

Table 2-6 Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
Jacumba Community Services District Wells					
JCSD 1[a]	124 (1956)	43.0; 10/1955	148	120	124 (volcanic)
JCSD 2	140 (1963)	72.13; 11/1979	-	140	-
JCSD 3	79	-	-	-	-
JCSD 3A	49	-	-	49	-
JCSD 4	39	20.66; 6/26/2018	175[b]	0-39[c]	-
JCSD 5	-	-	-	-	-
JCSD 6	465 (2003)	5.50; 6/26/2018	600+	-	-
JCSD 7	518 (2008)	31.20; 6/26/2018	300+	0-10	10-23 (granitic)
JCSD 8	518 (2009)	31.02; 6/26/2018	275+	0-42	42-55 (granitic)

Table 2-6 Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
MW-3	84.5 (2007)	28.0; 3/2009	Monitor well	0-30	30-80 (granitic)
Park Well	124 (2005)	59.74; 6/26/2018	80	0-127	127 (volcanic)
Highland Center Well	125 (2016)	56.98; 6/26/2018	174	0-175	182 (granitic)
Jacumba Valley Ranch Wells					
K	102+ (1960s)	-	-	-	-
K1	110 (1950s)	42.3; 9/6/1980	-	106	-
K2	103 (1950s)	41.0; 4/1958	-	103	-
K3	117 (1950s)	8.5; 2/1996	1,000	-	-
K4	109 (1950s)	9.9; 3/1994	908	-	-
Daley Well	150 (Unknown)	39.64; 3/2023	-	-	-
Well 1	124 (Unknown)[e]	59.99; 10/2018	148	120	124 (volcanic)
Well 2	114 (2007)[e]	61.86; 3/2023	2,000[d]	113	-
Well 3	100 (2005)[e]	39.64; 3/2023	2,000[d]	112	-
Central Irrigation Well	100 (Unknown)[e]	52.71; 3/2023	-	-	-
Mid Valley Well	90.7 (Unknown)[e]	49.50; 3/2023	-	-	-
Carrizo Gorge Well	-	80.22; 7/2018	-	-	-
Ketchum Ranch Water Co. Well	150 (130 silted)	51.62; 7/2018	33.7	-	-
Test Well 1 JVR	82 (1990)	2; 5/1990	225	75	-
P-1	-	-	Monitoring well	-	-
P-2	23.72[e]	Dry; 7/30/2018	Monitoring well	-	-
P-3	30.92[e]	Dry; 7/30/2018	Monitoring well	-	-
P-4	33.71[e]	Dry; 7/30/2018	Monitoring well	-	-
P-5	27.3[e]	Dry; 7/30/2018	Monitoring well	-	-
P-6	32.26[e]	Dry; 7/30/2018	Monitoring well	-	-
P-7	38.8[e]	Dry; 7/30/2018	Monitoring well	-	-

Table 2-6 Jacumba Valley Well Inventory

Well Number	Well Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc)/date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Bedrock Depth (feet bgs)/ (Type)
P-8	39.3[e]	Dry; 7/30/2018	Monitoring well	-	-
P-9	60.17[e]	Dry; 3/18/2023	Monitoring well	-	-
Other Wells					
R1	137	-	-	-	-
R2	400	-	-	-	-
(Abandoned Well near R2)	Abandoned (1979)	-	-	-	150-492 (Sandstone)
T5		-	-	-	-
T8	-	-	-	-	-
T1	-	-	-	-	-
RM	34	-	-	-	-
Spa Well	200 (1955)	-	-	-	-
Daley Construction Well	230 (NA)	-	-	-	-
Former Chevron Service Station 20-5934					
MW-8S	50 (2007)	-	-	81.5+	-
MW8-D	80 (2007)	-	-	81.5+	-
MW-9S	50 (2007)	-	-	80	80 (Volcanics)
MW-9D	80 (2007)	-	-	80	80 (Volcanics)
MW-10	57 (2007)	-	-	50+	-
MW-11	80 (2007)	-	-	80+	-
MW-12	80 (2012)	-	-	40	40 (DG to 80.5)
MW-13	80 (2012)	-	-	81+	-
MW-14	81 (2012)	-	-	80.5+	-
B-10	(2012)	-	-	55.5+	-
B-11	(2012)	-	-	66.5+	-
B-12	(2012)	-	-	57	57 (DG to 70)

Sources: Barrett 1996; Pape 2015; Petra 2006; Swenson 1981; GRA 2012

Notes: bgs = below ground surface; btoc = below the top of the casing; gpm = gallons per minute; JCSD = Jacumba Community Services District; NA = not available; DG = decomposed granite

a. JCSD Well 1 is also referred to as JVR Well 1 and is included under both sub-headers in the table.

b. Reported pumping capacity provided by JCSD.

c. Alluvial depth based on the total depth of Well 4.

d. Pumping rate based on airlifting by the driller.

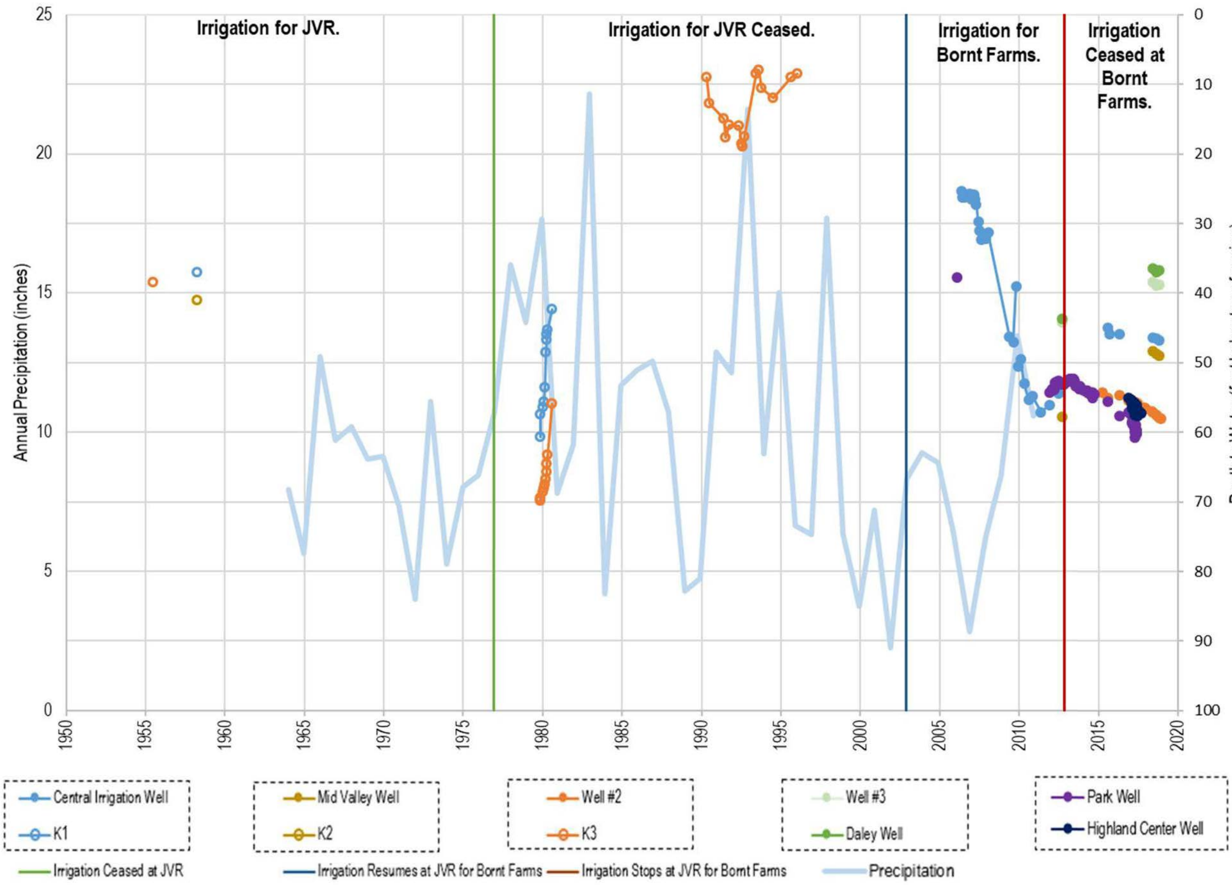
e. Based on field reconnaissance conducted in 2018 by Dudek staff and 2023 by INTERA staff.

Groundwater level data were obtained from JCSD from January 2012 through June 2018 (Devine, pers. comm. 2019; Troutt, pers. comm. 2015). Groundwater level data were also obtained from Barrett Consulting Group (1996), Peterson (2014), and Swenson (1981). Historical groundwater level data were available for Jacumba Valley as far back as 1955, but a continuous water level record was not available. Groundwater levels were periodically measured by Dudek in 2019, 2020, and 2021 and by INTERA in March 2023.

Fluctuations in groundwater levels in the Jacumba Valley alluvial aquifer result from both groundwater production and cycles of wet and dry climatic periods. Historical groundwater measurements from wells K1, K2, and K3 were used to represent trends associated with previous land use on the Project site (Exhibit 2-B). Wells K1, K2, and K3 have the closest spatial relationship to the Central Irrigation Well, Mid Valley Well, and Well 2, respectively (Figure 9).

Groundwater levels have fluctuated up to 61 feet in Well K3. When Well K3 was initially drilled in 1955, the groundwater level was 38.5 feet bgs. From 1932 to 1977, Jacumba Valley Ranch extracted on average 2,066 afy from the Jacumba Valley alluvial aquifer (Barrett 1996). Jacumba Valley Ranch pumping, in combination with lower-than-average precipitation in the late 1960s through the mid-1970s (see the declining cumulative departure from mean precipitation in Exhibit 2-A), resulted in a groundwater level decline in the Jacumba Valley alluvial aquifer (Exhibit 2-B). Irrigation of agricultural lands ceased on Jacumba Valley Ranch in approximately 1977. In 1979, the groundwater level in Well K3 was 69.9 feet bgs (more than 30 feet lower than the initial water level recorded in 1955). By 1990, groundwater levels had risen to near the surface in several Jacumba Valley alluvial aquifer wells (9 feet bgs in Well K3) because of higher recharge rates during a period of above-average precipitation in the late 1970s to mid-1980s (see the ascending cumulative departure from mean precipitation in Exhibit 2-A) and low groundwater extraction during this period.

Groundwater levels from the Central Irrigation Well declined from 2006 to 2011. This decline coincided with a lower-than-average rainfall period from 1999 to 2008 and the extraction of approximately 741 afy of groundwater by Bornt Farms. Groundwater levels began to rise after Bornt Farms ceased groundwater extraction in 2013. The current gradual declining trend in groundwater levels, shown in Well 2, can be attributed to lower-than-average rainfall years and recent extraction from JCSD non-potable wells. The groundwater level in Well 2 was measured in March 2023 at 61.86 feet below top of casing (btoc) which is about 8 feet above the historic low groundwater level observed in Well K3 in 1979, located near Well 2. Water levels have dropped almost 4 feet since 2019.



Sources: Barrett 1996; Pape 2015; Peterson 2014; Swenson 1981.
Note: Boxes outlined by dashes represent wells in similar geographical locations.

Exhibit 2-B Jacumba Valley Alluvial Aquifer Groundwater Level Data July 1955 to December 2018

2.8 Water Quality

JCSD supplies non-potable water from the Highland Center Well and the Park Well, and potable water is from JCSD Wells 7 and 8 that source water from a fractured rock aquifer west of the Jacumba Valley Groundwater Basin. Well 4 formerly was the primary potable water well from the early 1970s to 2019 and is currently a backup well. A water quality sample collected from the Highland Center Well in 2016 and 2023 had a measured total dissolved solids concentration of 400 milligrams per liter (mg/L) and 420 mg/L, respectively. A wide range of constituents, including general minerals, inorganic minerals, and volatile organic compounds, were analyzed. Laboratory results indicated that no volatile organic compounds were detected and that groundwater produced from the Highland Center Well is suitable for construction water supply (Dudek 2016a, JCSD 2023). The Park Well was initially intended for use as a potable water well; however, low concentrations of volatile organic compounds were detected during drilling. Toluene was detected at concentrations of 291 micrograms per liter (µg/L), 199 µg/L, and 520 µg/L in water quality samples collected from the Park Well in 2006 (Petra 2006). A subsequent water quality sample was collected from the Park Well on November 5, 2015. Results from the sample collected on November 5, 2015, indicated no detections above the reporting limits for all constituents analyzed, including toluene, which was previously detected in the Park Well above the drinking water maximum contaminant level of 150 µg/L. It is possible that the toluene was introduced into the Park Well as a result of drilling or from chemicals (Scothchkote™) used in splicing the submersible cable for installation of the submersible pump and motor when the well was originally tested. Toluene has been detected in other water wells after the use of Scothchkote.

Since both the Highland Center Well and the Park Well are non-potable groundwater supply wells, water quality samples were not collected for this report.

3.0 Water Quantity Impacts Analysis

This section discusses the potential impacts on local groundwater resources in terms of the County Guidelines (County of San Diego 2023a and 2023b).

3.1 50% Reduction in Groundwater Storage

To apply the County methodology for determining a 50% reduction in groundwater storage to a given well, the area of the aquifer that can be accessed by a pumping well must be defined. For this analysis, the 2,061-acre extent and variable thickness of the alluvium underlying the Jacumba Valley as defined by Swenson (1981) was used to perform the 50% reduction in storage analysis (Figure 10).

3.1.1 Guidelines for Determining Significance

The following requirement is outlined in the County Guidelines (County of San Diego 2023b):

> *For proposed projects in fractured rock basins, a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction.*

A Project-specific soil-moisture-based water balance was not performed for the Highland Center Well or the Park Well as they are screened in a sedimentary basin. Instead, an updated estimate of groundwater in storage was made based on previous work conducted by Roff and Fanzone (1994) and Swenson (1981). The estimate evaluated whether the water demands would maintain at least 50% of groundwater in storage over the 2,061-acre Jacumba Valley alluvial aquifer (mapped by Swenson 1981). Additionally, a one-time extraction of up to 139 acre-feet per year for 2 years from JCSD non-potable wells was compared to historical groundwater extraction rates from the Jacumba Valley alluvial aquifer.

3.1.2 Methodology

3.1.2.1 Groundwater Recharge

Groundwater recharge was not calculated for the Flat Creek watershed and Jacumba Valley alluvial aquifer. As such, this methodology presents a worst-case scenario that could occur during an extended drought period where no groundwater recharge occurs.

3.1.2.2 Groundwater Demand

Historical Demand: The groundwater demands of the Jacumba Valley alluvial aquifer vary with time. Historically, Jacumba Valley Ranch was the primary user of groundwater from the aquifer. Jacumba Valley Ranch produced water for irrigation of agricultural lands. From 1932 through 1977, Jacumba Valley Ranch extracted on average 2,066 afy of groundwater (Barrett 1996). Irrigation ceased on Jacumba Valley Ranch and the agricultural lands were fallowed from about 1977 until 2002. From 2002 until 2013, Bornt Farms resumed irrigation at Jacumba Valley Ranch. The water demand of Bornt Farms was reported to be more than 1 million gallons per day (Pape, pers. comm. 2015). To determine the area of active irrigated agricultural land by year, historical aerial photographs were reviewed. Between 2002 and 2013, 187 to 465 acres of the Jacumba Valley Ranch were irrigated to grow predominantly lettuce and spinach (Google Earth 2015). Assuming a crop irrigation rate of 2.14 acre-feet per acre for lettuce, the maximum annual water demand of the lettuce crop at Bornt Farms would be 995 acre-feet (Barrett 1996; U.C. Davis 2011). Other estimates state that Bornt Farms extracted 7,413 acre-feet over the farm's lifetime, or an average of 741.3 afy.

Other groundwater users include the Jacumba Valley Ranch Water Company, which has historically extracted more than 242 afy (Barrett 1996). Groundwater extraction on the Mexican side of the border has historically been estimated to be 24 afy (Barrett 1996).

Since 1985, JCSD has extracted potable water from up to four groundwater wells within its approximately 423-acre boundary (LAFCO 2013). The water system includes storage of up to 638,000 gallons. As discussed in Section 2.4, Water Demand, historical potable water demand has been documented to be between 85 and 146 afy (Barret 1996; Trout, pers. comm. 2015). Since 2019, JCSD has extracted groundwater from Wells 7 and 8, which source water from the fractured rock aquifer.

As discussed in Section 2.4, JCSD has historically supplied non-potable water for commercial sale from Well 6 (a fractured rock well not screened in the Jacumba Valley alluvium) and the Highland Center Well and Park Well (both screened in the Jacumba Valley alluvium). Non-potable water supply from JCSD varies based on customer demand. Based on meter reads from February 2017 to February 2018, JCSD supplied 50.1 acre-feet from the Highland Center Well and 3.5 acre-feet from the Park Well. Maximum annual groundwater extraction from the Jacumba Valley alluvial aquifer by JCSD for non-potable water is 53.6 afy.

Current Demand: Current groundwater demand from the Jacumba Valley alluvial aquifer includes extraction by JCSD, Jacumba Valley Ranch Water Company, and a few potential domestic well owners. The Jacumba Valley Ranch, which historically produced an excess of 2,000 afy, no longer extracts groundwater for agriculture but has obtained a Major Use permit to construct a solar energy facility (JVR Energy Park). The Jacumba Valley Ranch Water Company, which has historically extracted an excess of 242 afy, currently supplies approximately 5 afy for two gas stations and two fire hydrants (Barrett 1996; McCullough, pers. comm. 2015).

JCSD extracts non-potable groundwater from the Jacumba Valley alluvial aquifer on a limited basis. Non-potable groundwater extraction is not suitable for human use and its sale is used to defray the operating costs of the JCSD system for its residential and commercial customers. As discussed in Section 2.6, JCSD is estimated to produce approximately 119.5 afy of potable water for 239 connections from Wells 7 and 8 (fractured rock wells). In Water Year 2022, JCSD produced 7 acre-feet of non-potable water from the Highland Center Well and Park Well based on monthly data.

There may be small volumes of groundwater (less than 3 afy) extracted from domestic wells located in the residential area in Jacumba Hot Springs.

Groundwater extraction is occurring from the fractured rock aquifer by JCSD, Jacumba Hot Springs Resort, and a few domestic well users on the outskirts of town. Since the Highland Center and Park Well extract groundwater from the Jacumba Valley alluvial aquifer, groundwater extraction from the fractured rock aquifer was not included in this analysis (i.e., production from the alluvial aquifer has no effect on the potable supply from the fractured rock aquifer).

Future Demand: Future demand is expected to include JCSD non-potable demand, Jacumba Valley Ranch Water Company, JVR Energy Park, and private domestic use. Potable groundwater use from the Jacumba Valley Ranch Water Company and private domestic users is expected to be similar to current conditions over the long term.

Based on the current pumping capacity of the Highland Center and Park Wells, the maximum non-potable annual production from JCSD wells screened in the Jacumba Valley alluvial aquifer is 410 afy. This estimate is based on continuous pumping for 1 year at a maximum flow rate of 174 gpm and 80 gpm from the Highland Center Well and Park Well, respectively.

JCSD completed a manganese water treatment system for Wells 7 and 8 that currently serve all potable water demands for its customers (Dudek 2016b). This treatment system came online in 2019 and since JCSD potable water supply has been sourced from the fractured rock aquifer rather than the Jacumba Valley alluvial aquifer.

Jacumba Valley Ranch Water Company is expected to continue pumping groundwater sourced from the Jacumba Valley alluvial aquifer to supply the two gas stations.

The JVR Energy Park is anticipated to extract approximately 112 acre-feet for approximately 1 year during construction and will maintain about 10 afy of extraction during operation, and 50 acre-feet for decommissioning once the project has reached its expected lifetime (i.e., approximately 38 years). It is currently anticipated that this project will not commence construction until 2024.

The proposed renewable energy projects have an estimated O&M water demand of 1.06 afy (0.25 afy for Campo Wind, and 0.81 afy for Starlight Solar).

The JCSD is currently committed to supplying the Jacumba Solar project with up to 4 afy of non-potable water for O&M. This Jacumba Solar project has not used any O&M water from JCSD in the past six years.

Table 3-1 provides historical, current, and future water demand from the Jacumba Valley alluvial aquifer.

Table 3-1 Jacumba Valley Alluvial Aquifer Groundwater Demand

	Historical Water Demand (afy)	Current Water Demand (afy)	Future Demand with JCSD Non-potable Demand(afy)	Future Maximum Demand (afy)	Future Demand During O&M (afy)
Jacumba Valley Ranch (Jacumba Valley Ranch; Bornt Farms; JVR Energy Park)	2,066; 741–995	0	-	141.4[i]	11 [a]
Jacumba Valley Ranch Water Company	242	5	5	5	5
Private Domestic	3	3	3	3	3
JCSD (Potable)	80–146[c]	0	0[d]	0[d]	0

Table 3-1 Jacumba Valley Alluvial Aquifer Groundwater Demand

	Historical Water Demand (afy)	Current Water Demand (afy)	Future Demand with JCSD Non-potable Demand(afy)	Future Maximum Demand (afy)	Future Demand During O&M (afy)
JCSD (Non-Potable)	53.6	7[e]	249	410[f]	5.06[g]
Total Estimated Water Demand	**2,212[h]**	**15**	**257**	**559.4**	**24.06**

Source: Barrett 1996; Dudek 2015; Troutt, pers. comm. 2015, JCSD 2023
Notes: afy = acre-feet per year; JCSD = Jacumba Community Services District

a. O&M demand for JVR is proposed to be 11 afy.
b. Not all domestic wells are currently active or known; however, a consumptive water demand of 0.5 afy has been assigned to up to six potential domestic wells.
c. JCSD Wells 1 and 2 supplied all potable demands for the town of Jacumba Hot Springs until JCSD Wells 3 and 4 were drilled in the early 1970s.
d. Future JCSD potable water demand will be supplied from Wells 7 and 8, completed in the fractured rock aquifer.
e. Assumes current groundwater demand based on metered data from Water Year 2022.
f. Assumes maximum groundwater extraction based on tested well yields from the Highland Center Well and the Park Well.
g. Total assumes 0.25 afy for Campo Wind, 4 afy for Jacumba Solar, and 0.81 afy for Starlight Solar.
h. Assumes maximum concurrent water demand from JCSD potable demand and Jacumba Valley Ranch.
i. Future maximum demand includes a one-time demand for the construction of the JVR Energy Park of 141.4 acre-feet.

Historically, groundwater demand from the Jacumba Valley alluvial aquifer has been estimated to be upwards of 2,066 afy. A drastic reduction in groundwater production has occurred since agriculture irrigation ceased on Jacumba Valley Ranch. The current groundwater demand from the Jacumba Valley alluvial aquifer is estimated to be 15 afy. The proposed future water demand of 278 acre-feet for over 24 months would be extracted from the Highland Center Well with backup provided by the Park Well. Totaling the current use of 15 acre-feet and the one-year construction water demand of 139 acre-feet, the proposed demand would result in a one-year extraction amount of 153 acre-feet from the Jacumba Valley alluvial aquifer.

The future probable maximum non-potable groundwater demand for JCSD wells is estimated based on Starlight project demand and reasonably foreseeable projects to evaluate potential impacts pursuant to CEQA. Table 3-2 provides annual water demand estimates for the Starlight Solar project including construction, O&M and decommissioning over the expected life of the project. The total non-potable JCSD water demand for the Starlight Solar project and reasonably foreseeable projects over a 35-year period is 489.6 acre-feet.

Table 3-2 JCSD Non-Potable Water Demand for Starlight Solar and Reasonably Foreseeable Projects

Year	Starlight		Jacumba Solar[1]	Rugged[2]	Boulder Brush[3]	Campo Wind[4]		Total Water Demand by Year
	Construction	Operation & Decommissioning	Operation & Decommissioning	Construction	Construction	Construction	Operation & Decommissioning	
	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	
1	14.8	0	4	0	0	0	0	19
2	0	0.2	4	37	0	0	0	41
3	35.40	0.2	4	0	50.03	0	0	90
4	17.70	0.2	4	0	0	122.75	0	145
5	0	0.9	4	0	0	0	0.25	5
6	0	0.9	4	0	0	0	0.25	5
7	0	0.9	4	0	0	0	0.25	5
8	0	0.9	4	0	0	0	0.25	5
9	0	0.9	4	0	0	0	0.25	5
10	0	0.9	4	0	0	0	0.25	5
11	0	0.9	4	0	0	0	0.25	5
12	0	0.9	4	0	0	0	0.25	5
13	0	0.9	4	0	0	0	0.25	5
14	0	0.9	4	0	0	0	0.25	5
15	0	0.9	4	0	0	0	0.25	5
16	0	0.9	4	0	0	0	0.25	5
17	0	0.9	4	0	0	0	0.25	5
18	0	0.9	4	0	0	0	0.25	5
19	0	0.9	4	0	0	0	0.25	5
20	0	0.9	4	0	0	0	0.25	5
21	0	0.9	4	0	0	0	0.25	5
22	0	0.9	4	0	0	0	0.25	5
23	0	0.9	4	0	0	0	0.25	5
24	0	0.9	4	0	0	0	0.25	5
25	0	0.9	4	0	0	0	0.25	5

Year	Starlight		Jacumba Solar[1]	Rugged[2]	Boulder Brush[3]	Campo Wind[4]		Total Water Demand by Year
	Construction	Operation & Decommissioning	Operation & Decommissioning	Construction	Construction	Construction	Operation & Decommissioning	
	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	Acre-Feet	
26	0	0.9	4	0	0	0	0.25	5
27	0	0.9	4	0	0	0	0.25	5
28	0	0.9	4	0	0	0	0.25	5
29	0	0.9	4	0	0	0	0.25	5
30	0	0.9	4	0	0	0	0.25	5
31	0	0.9	50	0	0	0	0.25	51
32	0	0.9	0	0	0	0	0.25	1
33	0	0.9	0	0	0	0	0.25	1
34	0	0.9	0	0	0	0	0.25	1
35	0	6.6	0	0	0	0	0.25	5
Total	**67.9**	**34.2**	**170.0**	**37.0**	**50.0**	**122.8**	**7.8**	**489.6**

Notes:

1. Jacumba Solar estimates 4 AFY for O&M and 50 AFY for decommissioning. To date, Jacumba Solar has taken no water for O&M as the project has not elected to implement panel washing.
2. Rugged would use water for construction only with O&M water supplied from on-site wells at the Rugged/Rough Acres Ranch site.
3. Boulder Brush includes water demand for construction only.
4. Campo Wind has identified additional water supply sources including on-site wells at Campo Band of Diegueño Mission Indians Reservation. Not all water may be supplied by JCSD for the Campo Wind Project.

3.1.2.3 Groundwater in Storage

Groundwater in storage was calculated using estimates of the saturated aquifer thickness underlying the 2,060-acre area of the Jacumba Valley alluvial aquifer, as mapped by Swenson (1981). Aquifer thickness was updated from the Swenson groundwater storage compartments (A through E) with available well-completion information. The saturated thickness of the aquifer system has been estimated for three periods based on groundwater levels measured in 2007, 2018, and 2023. The well completion information used to constrain aquifer thickness is provided in Table 3-3. For compartments with multiple wells and groundwater level measurements, values were averaged to represent a non-uniform saturated aquifer thickness. In all cases, the average saturated thickness used to define groundwater in storage (Table 3-4) was less than the measured saturated thickness at each well (Table 3-3). For compartments in which no wells were located, groundwater levels were extrapolated from the nearest well (Table 3-4). Groundwater storage compartments and their representative wells are depicted in Figure 10. The specific yield was estimated based on historical and recent aquifer test analyses.

Table 3-3 Well Completion Information for Constraining Alluvial Saturated Thickness

Common Well Name	Source or County of San Diego Well Record Identification	Aquifer Thickness (feet)	Depth to Groundwater/ (feet below ground surface)	Depth to Groundwater Measurement Date	Saturated Thickness (feet)	Swenson Compartment (Swenson 1981)
JVR – Carrizo Creek	Lwel 6933	55	—	—	—	A
Leighton B-12	Leighton 1991a	20	—	—	—	A
Well 3	Lwel 16419	89	39.64	3/18/2023	50.26	C
Well 2	Lwel 1815	113	61.86	3/18/2023	55.27	C
Test Hole	Lwel 20450	100	—	—	—	C
Leighton B-2	Leighton 1991a	25	—	—	—	C
Central Irrigation Well	—	—	49.50	3/18/2023	—	C
Mid-Valley Well	—	—	52.71	3/18/2023	—	C
Well 1	—	124	57.87, destroyed	12/11/2018	—	D
J2	Swenson 1981	120	—	—		D
Test Hole	Lwel 17922	108	—	—	—	D
Southwest Irrigation	Lwel 18031	86	—	—	—	D
Test Hole	Lwel 20411	150	—	—	—	D
Highland Center Well	Lwel 001506	175	57.61	3/18/2023	118.02	E
Park Well	—	—	60.05	3/18/2023	—	E

INTERA

Table 3-3 Well Completion Information for Constraining Alluvial Saturated Thickness

Common Well Name	Source or County of San Diego Well Record Identification	Aquifer Thickness (feet)	Depth to Groundwater/ (feet below ground surface)	Depth to Groundwater Measurement Date	Saturated Thickness (feet)	Swenson Compartment (Swenson 1981)
J3	Swenson 1981	60	—	—	—	E
J4	Swenson 1981	50	—	—	—	E
Gas Station Well	CRA 2007	81.5+	47.52	6/28/2007	33.98+	E

Notes: — = no information is available

Aquifer Hydraulic Characteristics

Previous estimates of specific yield for the Jacumba Valley alluvial aquifer were made by Swenson (1981) and calculated from aquifer testing performed by Barrett (1996). The specific yield associated with the alluvium was conservatively estimated by Swenson (1981) to be between 5% and 10%. Barrett (1996) estimated the specific yield to be 25% based on aquifer testing of Well K4, Test Well No. 1, and Well Km.

Storativity (storage coefficient) was recently calculated for two wells screened in the Jacumba Valley alluvial aquifer based on two constant-rate aquifer tests located on the Jacumba Valley Ranch (Dudek 2019a). The storage coefficient from one well (Well 2), located in compartment D, ranged from 0.008 to 0.028. The storage coefficient from another well (Well 3), located in compartment C, was 0.2349 (Geosyntec 2012). Since the aquifer tests were conducted in the unconfined aquifer, the calculated storage coefficient is equivalent to the specific yield (Driscoll 1986). Values for the storage coefficient for unconfined aquifers range from 0.01 to 0.30 (Driscoll 1986). The calculated storage coefficients from the well located on the Jacumba Valley Ranch (Well 2 and Well 3) aquifer tests fall within this range.

Based on aquifer test analysis performed on wells on the Jacumba Valley Ranch within the Jacumba Valley alluvial aquifer, the specific yield ranges from 0.8% to 24%, with a mean value of 12% (Dudek 2019a, Geosyntec 2012). To provide a conservative estimate, a specific yield value of 10% was used for this analysis to calculate groundwater in storage.

The groundwater in storage estimate calculated by INTERA in 2023 was used for this analysis and the calculation methods are described here. Saturated thickness was calculated by subtracting the average alluvial thickness from recent depth to groundwater measurements recorded in 2023. The saturated thickness for each compartment was then multiplied by the compartment's acreage and the 10% specific yield value to determine the groundwater in storage by compartment. Based on these calculations, the current groundwater in storage within the Jacumba Valley alluvial aquifer is estimated to be 8,639 acre-feet (Table 3-4)[2]. This is a reduction of groundwater in storage of 3,232 acre-feet since 2007 (202.0 afy). The reduction in groundwater storage is attributed to high groundwater production

[2] The estimate of 8,639 acre-feet of groundwater in storage in 2023 for the Jacumba Valley alluvial aquifer is an updated estimate based on available data, including well logs, water levels, and aquifer properties estimated by pump testing. The 2018 estimate was 9,005 acre-feet using similar methodology. The estimated storage in the Jacumba Valley alluvial aquifer may be revised again as additional data is acquired.

that occurred on Bornt Farms from prior to 2007 to 2014 and below-average precipitation and some groundwater production from the Jacumba Valley alluvial aquifer from 2014 to 2023.

In comparison, groundwater in storage was estimated to range from 9,600 to 16,000 acre-feet by Roff and Fanzone (1994), and from 3,200 to 6,400 acre-feet by Swenson (1981).

Proposed groundwater production from the Highland Center Well with backup provided by the Park Well would be 278 acre-feet over the period of 24 months or approximately 139 acre-feet for 1 year. Assuming no recharge to the aquifer, this would reduce groundwater in storage by 3.2% (for the full 278 acre-feet), which is substantially less than the 50% reduction in storage criteria. The estimated future demand from the aquifer with other groundwater users, including JCSD non-potable use from the Highland Center with backup provided by the Park Well, is 257 acre-feet, or a 2.9% reduction in estimated groundwater in storage. The estimated future maximum extraction by all known sources from the Jacumba Valley alluvial aquifer is 559.4 acre-feet or a 6.5% reduction in estimated groundwater in storage.

Table 3-4 Jacumba Valley Alluvial Aquifer 2007 and 2023 Groundwater in Storage Estimate

Alluvial Aquifer Compartments*	Area (acres)	Leighton Alluvial Thickness (1991) (feet)	Average Alluvial Thickness (feet)	Depth to Water 2007 (feet bgs)	Depth to Water 2023 (feet bgs)	Average Saturated Thickness 2007(feet)	Average Saturated Thickness 2023 (feet)	Specific Yield (unitless)	Storage 2007 (acre-feet)	Storage 2023 (acre-feet)
A	297.80	50+	37.5	25.14	39.64	12.36	0	0.10	297.80	0.00
B	260.28	50+	50	25.14	39.64	24.86	10.36	0.10	260.28	108.47
C	2120.11	120+	81.75	22.7	44.57	59.05	37.18	0.10	2549.66	1633.69
D	7484.91	100+	117	47.87	61.86	69.13	55.14	0.10	7484.91	5,970.17
E	919.26	80+	95.0	31.34	47.16	63.67	47.84	0.10	1232.62	926.18
Total Groundwater in Storage (rounded acre-feet)									**11,870**	**8,639**

* **Compartment Details:**

A Aquifer thickness is estimated from an average alluvial thickness observed in well log Lwel 6933 and B-12 (Leighton 1991a). Depth to water extrapolated from Well 3 (Lwel 16419)

B Aquifer thickness defined by Leighton 1991a. Depth to water extrapolated from Well #3 (Lwel 16419)

C Aquifer thickness estimated from Well 3 (Lwel 16419), Well 2 (Lwel 1814), Test Hole (L well 20450), and Leighton B-7 (Leighton 1991a). Depth to water averaged from Well 3 and Central Irrigation Well.

D Aquifer thickness estimated from Well J2 (Swenson 1981), Test Holes (Lwell 17922 and 201411), and the Southwest Irrigation Well (Lwell 18031). Depth to water estimated from Well 2 in 2023.

E Aquifer thickness estimated from the Highland Center Well (Lwell 001506), and Wells J3 and J4 (Swenson 1981). Depth to water estimated from an average of the Gas Station Well in 2021, JCSD-4 in 2023, Park Well in 2023, and JVR Well Km in 2022.

3.1.2.4 Long-Term Groundwater Availability (Sustainability)

Long-term groundwater availability was evaluated in the context of the currently available groundwater in storage, historical groundwater levels, and water demand. The volume of groundwater in storage varies depending on the rate of recharge and the volume of water pumped from storage (water demand). Sustainable groundwater availability is less than the historical average groundwater production rate of 2,066 afy from 1932 to 1977. This is observed during dry periods when the Jacumba Valley experienced groundwater overdraft, as indicated by declining groundwater levels in the alluvial aquifer wells (Exhibit 2-B). Pumping by Jacumba Valley Ranch between 2003 and 2013 also resulted in groundwater level declines in the alluvial aquifer. Bornt Farms grew lettuce and spinach on up to 465 acres, year-round, with an estimated maximum extraction rate of 995 acre-feet per year (Barrett 1996; UC Davis 2011). Due to Bornt Farms' irrigation and below-average precipitation recorded in the contributing watersheds over the past twenty years, the water demands exceeded available recharge, resulting in a groundwater level decline (Exhibit 2-B). Several years of drought and limited non-potable extraction by JCSD likely contributed to the current groundwater level decline.

The JCSD proposes to supply 278 acre-feet of non-potable groundwater from the Highland Center Well with backup provided by the Park Well over a period of 24 months which equals 139 acre-feet per year. This one-time use of groundwater for construction is approximately 6.7% of the estimated historical annual maximum groundwater extracted from the Jacumba Valley alluvial aquifer.

The future maximum groundwater extraction from all sources in the Jacumba Valley alluvial aquifer is estimated to be 559.4 acre-feet for one year, which is 27% of the estimated historical annual maximum groundwater extraction in the Jacumba Valley alluvial aquifer. This maximum groundwater extraction amount would be a one-time demand during the construction of various renewable energy projects.

3.1.3 Significance of Impacts Prior to Mitigation – Groundwater in Storage

The results of the analysis show that historical groundwater extraction rates of 995 to 2,066 afy resulted in groundwater overdraft during dry climatic periods such as those experienced from 1963 to 1976 and 1998 through 2008. Between 1955 and 1978, in conjunction with high pumping rates and low recharge rates, groundwater levels in the Jacumba Valley alluvial aquifer decreased by approximately 30 feet. The groundwater overdraft and storage reduction observed in the Jacumba Valley alluvial aquifer between 1938 and 1978 was alleviated, however, by 1993 when groundwater levels recovered to within 8 feet of the land surface at Well K3 (Exhibit 2-B). These data show that aquifer recharge is as important as groundwater withdrawal for maintaining adequate storage in the aquifer. Groundwater recharge is not included in the methodology to evaluate a worst-case scenario during a drought period with little to no recharge to the Jacumba Valley alluvial aquifer.

The groundwater extraction from the Highland Center Well with backup provided by the Park Well of 278 acre-feet over 24 months is equivalent to 6.7% of the total estimated maximum annual production of 2,066 afy from the entire Jacumba Valley alluvial aquifer. Assuming no recharge to the aquifer, this proposed groundwater extraction amount from the Highland Center Well and Park would reduce groundwater in storage by 1.5% annually for two years. The estimated total maximum groundwater extraction from the Jacumba Valley alluvial aquifer is 545.5 acre-feet or 6.7% of the estimated groundwater in storage.

3.1.4 Mitigation Measures and Design Considerations

Actual conditions during groundwater extraction for the Highland Center Well with backup provided by the Park Well may vary from the above analysis. The existing Groundwater Monitoring and Mitigation Plan (GMMP) has been updated to ensure that pumping does not significantly impact existing well users. The GMMP provides for monitoring the duration and rate of Project pumping to document the total volume of groundwater extracted. The GMMP also provides for monitoring groundwater levels from Project pumping and monitoring wells.

3.1.5 Conclusions

The proposed Project would have a less-than-significant impact on groundwater in storage, as defined by the County Guidelines (County of San Diego 2007). The proposed groundwater extraction amount of 278 acre-feet over approximately two years from the Highland Center Well with backup provided from the Park Well would equate to a 2.9% reduction in estimated groundwater storage. This value is far less than the County's determination of significance criteria of 50%.

Total estimated groundwater extraction from the Jacumba Valley alluvial aquifer, including the maximum production from JCSD non-potable wells and all proposed projects would reduce estimated groundwater in storage by 6.5% and would be 27% of the estimated historical maximum groundwater extraction.

3.2 Well Interference and Groundwater Dependent Habitat

3.2.1 Guidelines for Determination of Significance

3.2.1.1 Well Interference

The following significant impact requirements are outlined in the County of San Diego Guidelines (County of San Diego 2023b):

> ***Alluvial Well:*** *As an initial screening tool, off-site well interference will be considered a significant impact if after a five-year projection of drawdown, the results indicate a decrease in water level of 5 feet or more in the off-site wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in off-site wells, a decrease in saturated thickness of 5% or more in the off-site wells would be considered a significant impact.*

According to the County Groundwater Geologist, the primary author of the County of San Diego Guidelines, the intent of the above guideline was to cover projects that have continual ongoing water uses that remain static over time (Bennett, pers. comm. 2015). Historically, this has been the case for most groundwater-dependent projects processed by the County. The JCSD, however, proposes to use variable quantities of water, with intensive pumping over short periods. The intensive pumping during short periods may cause direct well interference impacts. Therefore, to evaluate the potential impacts of short-term pumping of groundwater, the County Groundwater Geologist has requested a short-term drawdown analysis, in addition to the 5-year projection of drawdown, to evaluate the potential impacts from operating at the highest rate of pumping (Bennett, pers. comm. 2015).

Potential well interference impacts caused by groundwater extraction from the Highland Center Well with backup provided from the Park Well were evaluated over a 0.5-mile radius from the well. Table 3-5 lists off-site wells within a 0.5-mile radius of the Highland Center and Park Well.

Table 3-5 Alluvial Aquifer Wells Within 0.5-Mile Radius of Extraction Wells

Well Name	Use	Distance from the Highland Center Well (feet)	Distance from the Park Well (feet)
Gas Station Well	Monitoring	966	505
Well Km	Small Water System	1,553	1,567
JCSD Well 4	Public/Potable/Stand-by	2,585	2,128
Border Patrol Well	Federal/Inactive	2,316	2,637

3.2.1.2 Groundwater-Dependent Habitat

Guideline 4.2.C from the County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements: Biological Resources defines the following threshold for determining a significant impact on riparian habitat or a sensitive natural community (County of San Diego 2010):

> *The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from the historical low groundwater levels.*

Potential groundwater-dependent habitats present near the Highland Center Well and Park Well are depicted in Figure 11. The location and type of groundwater-dependent habitat were reviewed based on two sources; (1) the Ecological Vegetation Communities’ data set, and (2) biological field surveys conducted by Dudek biologist for the JVR Energy Park project located adjacent to the Highland Center and Park Well (SanGIS 2017; Dudek 2019b). Both data sets were used to identify the nearest potential groundwater-dependent habitat to the Highland Center Well and Park Well (Table 3-6). The nearest groundwater-dependent habitat to the Highland Center Well and Park Well is a southern riparian forest located 1,720 and 1,570 feet north, respectively.

The southern riparian forest is a broad description of riparian forest habitat that cannot be differentiated into a more distinct type of riparian forest habitat. These habitats are found along streams and rivers. The characteristic plant species are the California sycamore (Platanus racemosa), cottonwood (Populus spp.), and other wetland plants (Oberbauer 2008).

INTERA

Table 3-6 Groundwater-Dependent Habitat Within 0.5-Mile Radius of Extraction Wells

Well Name	Source	Distance from the Highland Center Well (feet)	Distance from the Park Well (feet)
Southern Riparian Forest	SanGIS	1,720	1,570

Notes: SanGIS = San Diego Geographical Information Source.

3.2.2 Aquifer Testing Methodology

The following sections describe the procedures followed during the aquifer testing of the Highland Center Well. The purpose of the aquifer tests was to obtain an approximate long-term production rate for the well and to estimate aquifer properties for distance drawdown calculations.

3.2.2.1 Well Test Description

Highland Center Well: A 24-hour constant rate aquifer test was performed at the Highland Center Well by Fain Drilling and Pump Company on October 12, 2016, at an average pumping rate of 174.2 gpm.

3.2.2.2 Well Test Analysis

After 24 hours of continuous groundwater extraction, the observed groundwater level drawdown was 24.66 feet at the Highland Center Well (pumping well) and approximately 1.85 feet in the Park Well (observation well, located 483 feet away). Drawdowns in the Highland Center Well and the Park Well are shown in Figures 12 and 13, respectively.

Transmissivity: Aquifer transmissivity (the rate at which water flows through a vertical strip of the aquifer 1-foot wide and extending through the full saturated thickness, under a hydraulic gradient of 1 or 100%) is calculated using the Cooper–Jacob approximation to the Theis equation (Cooper and Jacob 1953) as follows:

$$\boldsymbol{T} = \frac{\mathbf{2.303}\boldsymbol{Q}}{\mathbf{4}\boldsymbol{\pi}\boldsymbol{\Delta s}}$$

where

$\boldsymbol{T}$ = transmissivity (feet^2/day) [multiply by 7.48 to get units of gpd/foot]
$\boldsymbol{Q}$ = average pumping rate (feet^3/day) [multiply gpm by 192.5]
$\boldsymbol{\pi}$ = pi (3.14)
$\Delta \boldsymbol{s}$ = difference in drawdown over one log cycle (feet)

The transmissivity (T) calculated by performing the Cooper-Jacob approximation to the Theis equation, using data collected in the pumping well, is 748 square feet per day (ft^2/day) or 5,599 gpd/ft (Figure 12). The transmissivity calculated by performing the Cooper-Jacob approximation to the Theis equation, using data collected in the observation well is 10,242.8 ft^2/day or 76,616.1 gpd/ft (Figure 13).

Storativity: The aquifer coefficient of storage (also called storativity) is the volume of water released from storage per unit decline in hydraulic head in the aquifer per unit area of the aquifer. Due to well losses and the inefficiency of the pumping well, an observation well is required to calculate the

INTERA

coefficient of storage. The coefficient of storage from the aquifer test was estimated using the Cooper-Jacob approximation to the Theis non-equilibrium flow equation (Cooper and Jacob 1953) as follows:

$$S = \frac{2.25Tt_0}{r^2}$$

where

S = Coefficient of Storage (dimensionless)
T = transmissivity (feet2/day)
t_0 = intercept with the x-axis, time (days)
r = distance to the observation well (feet)

The coefficient of storage calculated at Park Well was 0.0000185 (1.85x10-5) (Figure 13).

AQTESOLV Analysis: Aquifer properties were also calculated using AQTESOLV. The transmissivity values obtained from the Cooper-Jacob and Theis equations using data from 60 to 600 minutes since the start of pumping are 11,060 ft^2/day and 8,598.9 ft^2/day in the Park Well. These values were obtained using an aquifer saturated thickness (b) equivalent to 40 feet (the saturated thickness of the screened interval of the Highland Center Well). The hydraulic conductivity values calculated by dividing transmissivity by aquifer thickness (K=T/b) ranged from 276.5 ft/day to 215 ft/day. The storativity values estimated using data collected in the Park Well ranged from 0.00001959 (1.959x10-5) using the Cooper-Jacob method and 0.00007532 (7.532x10-5) using the Theis method. Table 3-7 shows the range of aquifer properties and residual statistics obtained from the AQTESOLV curve matching of drawdown data at the Park Well from the Highland Center Well aquifer test. AQTESOLV results are included in Appendix A.

Table 3-7 Highland Center Aquifer Test – Estimated Aquifer Hydraulic Properties

Solution Method	Estimated Aquifer Hydraulic Estimates			Residual Statistics
	Transmissivity (feet^2/day)	Hydraulic Conductivity (feet/day)	Storativity (dimensionless)	The sum of Squares (feet^2)
Park Well (Observation Well)				
Cooper-Jacob (Manual)	10,242.80	256	0.0000185	-
Cooper-Jacob (AQTESOLV)	11,060	276.5	0.00001959	0.2048
Theis (AQTESOLV)	8,598.9	215	0.00007532	2.093
Average (AQTESOLV)	**9,829**	**245.75**	**0.00004745**	**-**

Note: Dash (-) = Data not available or not applicable.

An estimated transmissivity of 10,242.80 ft^2/day and storativity of 0.0000185 (1.85x10-5) were used for distance drawdown calculations. Data were verified by computing transmissivity and storativity in AQTESOLV. The average transmissivity and storativity values estimated by fitting the Cooper-Jacob and Theis methods to the drawdown data in the Park Well using AQTESOLV are 9,829 ft2/day and 0.00004745 (4.745x10-5), respectively.

Distance Drawdown: Manually estimated aquifer hydraulic properties (transmissivity and storativity) calculated by using the Cooper-Jacob approximation of the Theis equation were used for distance drawdown calculations. An estimate of groundwater drawdown at the nearest off-site wells and groundwater-dependent habitat, induced by pumping after 1 year and 5 years, was estimated using the Cooper-Jacob approximation of the Theis equation (Kruseman and de Ridder 2000):

$$s = \frac{2.3Q}{4\pi T} log \frac{2.25Tt}{r^2S}$$

where

s = predicted drawdown (feet)
Q = average pumping rate (feet^3/day)
T = transmissivity (feet^2/day)
t = time (days)
r = distance from pumping well (feet)
S = coefficient of storage (dimensionless)

The solution assumes that the aquifer is infinite and that no recharge occurs during the forecast period.

Distance drawdown calculations were performed separately at select distances from the Highland Center Well and the Park Well. Calculations assume that the wells will not be pumped together at the same time. The Highland Center Well is capable of supplying JCSD future maximum non-potable water demand of 249 acre-feet of groundwater at a constant pumping rate of 154 gpm for one year. The Park Well will provide backup water supply. The maximum groundwater demand that can be extracted from the Park Well, based on the current maximum pumping rate, is 129 acre-feet per year, or 80 gpm for one year.

For the Highland Center Well, drawdown at the nearest off-site well and potential groundwater-dependent habitat were estimated after 1-year and 5-year scenarios. The 1-year scenario estimates drawdown based on the construction water demand of 278 acre-feet over a 24-month period, which equals 139 acre-feet for one year. The 5-year scenario estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand with other contractually obligated JCSD non-potable supply (5.06 afy). The total 5-year demand would be 293.18 acre-feet spread out over 5 years, equal to 58.64 acre-feet per year or a continuous 36.5 gpm.

For the Park Well, drawdown at the nearest off-site well and potential groundwater-dependent habitat were estimated after 1-year and 5-year scenarios. The 1-year scenario estimates drawdown based on the construction water demand of over one year, equal to 139 acre-feet. The 5-year scenario estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand with other estimated JCSD non-potable supply (5.06 afy). The total 5-year demand would be 293.2 acre-feet spread out over 5 years, equal to 58.64 acre-feet per year or a continuous 36.5 gpm.

Highland Center Well Drawdown: The closest active off-site well to the Highland Center Well is Well Km, owned by the Jacumba Valley Ranch Water Company, located 1,553 feet to the north (Figure 11). The projected drawdown at Well Km after 1 year of construction groundwater extraction at a constant rate of 86 gpm is 1.56 feet. The total estimated drawdown at Well Km for the 5-year scenario is predicted to be 0.75 feet.

The closest groundwater-dependent habitat to the Highland Center Well is the southern riparian forest located 1,720 feet to the north (Figure 11). The projected drawdown at the nearest groundwater-dependent habitat after 1 year of construction groundwater extraction at a constant rate of 86 gpm is 1.53 feet. The total estimated drawdown at the southern riparian forest for the 5-years scenario is predicted to be 0.74 feet.

Table 3-8 summarizes the projected drawdown at select distances from the Highland Center Well.

Table 3-8 Highland Center Well Distance Drawdown Calculations

Nearest Off-site Well or Groundwater-Dependent Habitat	Distance from Pumping Well (feet)	End Year 1 Drawdown (feet)[a]	u[b]	End Year 5 Drawdown (feet)[a]	u[b]
-	25	2.62	7.73E-10	1.20	1.55E-10
-	50	2.44	3.09E-09	1.12	6.19E-10
-	60	2.40	4.45E-09	1.10	8.91E-10
-	100	2.27	1.24E-08	1.05	2.47E-09
-	250	2.03	7.73E-08	0.95	1.55E-10
-	500	1.85	3.09E-07	0.87	6.19E-08
Gas Station	966	1.68	1.15E-06	0.80	2.31E-07
-	1,000	1.67	1.24E-06	0.80	2.47E-07
-	1,500	1.57	2.78E-06	0.75	5.57E-07
Well Km	1,553	1.56	2.98E-06	0.75	5.97E-07
Southern Riparian Forest	1,720	1.53	3.66E-06	0.74	7.32E-07
JVR Well 2	1,987	1.50	4.88E-06	0.72	9.77E-07
-	2,000	1.50	4.95E-06	0.72	9.90E-07
Border Patrol Well	2,316	1.46	6.64E-06	0.71	1.33E-06
JCSD Well 4	2,585	1.43	8.27E-06	0.69	1.65E-06

Notes: Dash (-) = Data not available or not applicable.

a. Amortized 1-year and 5-year production rates 86 gpm and 36.5 gpm, respectively.

b. u valid if sufficiently small ($u < 0.05$) Driscoll 2003.

Park Well: The closest off-site well to the Park Well is Well Km, owned by the Jacumba Valley Ranch Water Company, located 1,567 feet to the north (Figure 11). The projected drawdown at Well Km after 1 year of construction groundwater extraction at a constant rate of 86 gpm is 1.56 feet. The total estimated drawdown at Well Km for the 5-year scenario at a constant pumping rate of 36.5 gpm is predicted to be 0.75 feet.

The closest groundwater-dependent habitat to the Park Well is the southern riparian forest located 1,570 feet to the north (Figure 11). The projected drawdown at the nearest groundwater-dependent habitat after 1 year of construction groundwater extraction at a constant rate of 86 gpm is 1.56 feet. The total estimated drawdown at the southern riparian forest for the 5-years scenario at a constant pumping rate of 36.5 gpm is predicted to be 0.75 feet.

Table 3-9 summarizes the projected drawdown at select distances from the Park Well.

Table 3-9 Park Well Distance Drawdown Calculations

Nearest Off-site Well or Groundwater Dependent Habitat	Distance from Pumping Well (feet)	*End Year 1 Drawdown (feet)*	*u[b]*	*End Year 5 Drawdown (feet)*	*u[b]*
-	25	2.62	7.73E-10	1.20	1.55E-10
-	50	2.44	3.09E-09	1.12	6.19E-10
-	60	2.40	4.45E-09	1.10	8.91E-10
-	100	2.27	1.24E-08	1.05	2.47E-09
-	250	2.03	7.73E-08	0.95	1.55E-08
-	500	1.85	3.09E-07	0.87	6.19E-08
Gas Station Well	505	1.85	3.15E-07	0.87	6.31E-08
-	1,000	1.67	1.24E-06	0.80	2.47E-07
-	1,500	1.57	2.78E-06	0.75	5.57E-07
Well Km	1,567	1.56	3.04E-06	0.75	6.08E-07
Southern Riparian Forest	1,570	1.56	3.05E-06	0.75	6.1E-07
JVR Well 4	2,128	1.48	5.60E-06	0.72	1.12E-06
JVR Well 2	2,450	1.44	7.43E-06	0.70	1.49E-06
Border Patrol	2,637	1.42	8.60E-06	0.69	1.72E-06

Notes: Dash (-) = Data not available or not applicable.

a. Amortized 1-year and 5-year production rates 86 gpm and 36.5 gpm, respectively.

b. u valid if sufficiently small ($u < 0.05$) Driscoll 2003.

3.2.3 Significance of Impacts Prior to Mitigation – Well Interference and Groundwater Dependent Habitat

Drawdown at the nearest off-site well and potential groundwater-dependent habitat was estimated under 1-year and 5-year scenarios for the Highland Center Well and Park Well separately. The Highland Center 1-year scenario estimated drawdown based on the construction water demand of 139 acre-feet extracted from the Highland Center Well for one year. The Park Well 1-year scenario also estimated drawdown based on the construction water demand of 139 acre-feet. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand (5.06 afy). The total 5-year demand would be 293.2 acre-feet spread out over 5 years, equal to 58.6 acre-feet per year or a continuous 36.5 gpm.

To assess the potential for groundwater extraction to draw down the groundwater table to the detriment of nearby groundwater-dependent habitat, or to cause well interference, projected drawdown within a 0.5-mile radius of the Highland Center Well and the Park Well was estimated using the Cooper-Jacob equations. Pumping scenarios of 1 year and 5 years were used to calculate the potential long-term impacts on nearby groundwater-dependent habitats and off-site production wells.

Drawdown at the closest off-site groundwater well (Well Km) to the Highland Center Well under the 1-year 5-year scenario is predicted to be 1.56 feet and 0.75 feet, respectively. The projected drawdown at the closest groundwater-dependent habitat to Highland Center Well, southern riparian forest, located approximately 1,720 feet to the north, under the 1-year and 5-year scenario is predicted to be 1.53 feet and 0.74 feet, respectively.

Drawdown at the closest off-site groundwater well (Well Km) to the Park Well under the 1-year and 5-year scenarios is predicted to be 1.56 feet and 0.75 feet, respectively. The projected drawdown at the closest groundwater-dependent habitat to Park Well, located approximately 1,570 feet to the north, under the 1- and 5-year scenarios is predicted to be 1.56 feet and 0.75 feet, respectively.

The estimated drawdown from both the Highland Center Well and the Park Well at the nearest off-site well, Well Km, is less than the County threshold of significance of a decrease in groundwater level of 5 feet or more for an alluvial well.

The estimated drawdown from both the Highland Center Well and the Park Well at the groundwater-dependent habitat, southern riparian forest, is less than the County threshold of significance of a decrease in groundwater level of 3 feet below the historical low.

3.2.4 Mitigation Measures and Design Considerations

As the above analysis is based on available site data and well testing, monitoring will be conducted to verify that groundwater levels remain stable at accessible off-site wells. An updated GMMP, which details the updated establishment of groundwater thresholds for off-site well interference and groundwater-dependent habitat, has been prepared for off-site water supply.

3.2.5 Conclusions

The analysis above indicates that the potential for groundwater extraction for four renewable energy projects, including Starlight Solar, from the Highland Center Well with backup provided by the Park Well to impact off-site wells or nearby groundwater-dependent habitat is anticipated to be less-than-significant. This analysis is based on a separate drawdown estimate for the Highland Center Well and the Park Well and assumed that each well will not be pumped during the same time. For safe measures, groundwater-level monitoring would be performed in several wells to record groundwater levels during groundwater extraction. An updated GMMP detailing groundwater thresholds for off-site well interference and groundwater-dependent habitat has been prepared. An annual review of groundwater-level data would be conducted by a Professional Geologist or Engineer licensed in the State of California to evaluate long-term impacts.

4.0 Water Quality Impact Analysis

The JCSD does not propose to supply groundwater as a potable water source; therefore, no water quality impact analysis was conducted.

5.0 Summary of Project Impacts and Mitigation

5.1 50% Reduction in Groundwater Storage

As discussed in Section 3.1, a soil moisture-based water balance was not performed for the Highland Center Well or the Park Well. Instead, a 1-year non-potable extraction volume of up to 139 acre-feet was compared to historical, ongoing, and future estimated groundwater extraction rates from the Jacumba Valley alluvial aquifer and updated estimates of groundwater in storage originally made by Roff and Franzone (1994) and Swenson (1981).

The analysis evaluates whether the proposed water demands alone and with maximum estimated groundwater use from other users in the aquifer would maintain at least 50% groundwater in storage over the 2,060-acre Jacumba Valley alluvial aquifer. The proposed groundwater extraction amount of 139 acre-feet for approximately one year from the Highland Center Well with backup provided from the Park Well would equate to a 1.5% reduction in estimated groundwater storage and would be 6.7% of the estimated historical maximum groundwater extraction. Total estimated groundwater extraction from the Jacumba Valley alluvial aquifer, including the maximum production from JCSD non-potable wells and all proposed projects, would reduce estimated groundwater in storage by 6.9% and would be 27% of the estimated historical maximum groundwater extraction.

The analysis indicates that the volume of groundwater in storage remains above the 50% significance threshold provided groundwater level monitoring thresholds be placed on groundwater extraction. Since JCSD groundwater extraction will not exceed the 50% reduction in groundwater storage threshold and other cumulative groundwater demands will be met, groundwater impacts to storage will be less than significant.

5.2 Well Interference

As presented in Section 3.2, the nearest off-site well to the Highland Center Well and the Park Well is Well Km. Well, interference was estimated under 1-year and 5-year scenarios for each well. The Highland Center Well 1-year scenario estimated drawdown based on the construction water demand of 139 acre-feet extracted from the Highland Center Well for one year. The Park Well 1-year scenario also estimated drawdown based on the construction water demand of 139 acre-feet. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand with other contractually obligated JCSD non-potable supply (5.06 afy), equal to 293.2 acre-feet over 5 years.

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, the projected drawdown at Well Km under the 1-year scenario is estimated to be 1.56 feet from pumping the Highland Center Well and 1.56 feet from pumping the Park Well. The total estimated drawdown under the 5-year scenario for the Highland Center Well and the Park Well is 0.75 and 0.75 feet, respectively.

These results indicate that drawdown is not predicted to exceed the County well interference threshold of significance of a decrease in groundwater level of 5 feet or more in off-site alluvial wells (County of San Diego 2007).

5.3 Groundwater-Dependent Habitat

As presented in Section 3.2, the potential groundwater-dependent habitat includes a southern riparian forest located approximately 1,720 feet north of the Highland Center Well and 1,570 feet north of the Park Well.

Drawdown at potential groundwater-dependent habitat was estimated under a 1- and 5-year scenario for each well. The Highland Center Well 1-year scenario estimated drawdown based on the construction water demand of 139 acre-feet extracted from the Highland Center Well for one year. The Park Well 1-year scenario also estimated drawdown based on the 1-year construction demand of 139 acre-feet. The 5-year scenario, used for both the Highland Center Well and Park Well, estimates drawdown based on the combined total of construction water demand (278 acre-feet) and 3 years of O&M demand (5.06 afy), equal to 293.2 acre-feet over 5 years.

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, the projected drawdown at the southern riparian forest under the 1-year scenario is 1.53 feet from pumping the Highland Center Well and 1.56 feet from pumping the Park Well. The total estimated drawdown under the 5-year scenario is predicted to be 0.75 feet from pumping the Highland Center Well and 0.75 feet from pumping the Park Well.

These results indicate that drawdown is not predicted to exceed the County groundwater-dependent habitat threshold of significance of a decrease in groundwater level of 3 feet or more from historically low groundwater levels (County of San Diego 2010).

Additionally, groundwater levels within the Jacumba Valley alluvial aquifer are not currently at the lowest recorded level (Exhibit 2-B). Groundwater levels are about 10 feet higher than the historically low groundwater level in the Jacumba Valley alluvial aquifer (Exhibit 2-B). Groundwater production from the Highland Center Well or the Park Well is unlikely to draw down the groundwater table to the detriment of groundwater-dependent habitat, and impacts are anticipated to be less than significant.

5.4 Water Quality

The JCSD does not propose to supply groundwater as a potable water source; therefore, no water quality impact analysis was conducted.

5.5 Mitigation Measures

Monitoring will be in place during production from the Highland Center Well and the Park Well to verify that impacts to groundwater storage, well interference, and groundwater-dependent habitat do not occur. An updated GMMP detailing groundwater level thresholds for off-site well interference and groundwater-dependent habitat has been prepared.

6.0 References

Allan, R.B. 2013. Unpublished precipitation data from Jacumba and Tierra del Sol rain gauges. Personal communication from R. Allan (County of San Diego Flood Control). September 13, 2013.

Barrett (Barrett Consulting Group). 1996. Hydrogeological Investigation, Proposed Jacumba Valley Ranch Development, Jacumba, San Diego County, California. Prepared for Jacumba Valley Ranch. October 18, 1995.

Bennett, Jim. 2015. Discussion of Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources. Relayed to Trey Driscoll (Dudek).

CIMIS (California Irrigation Management Information System). 1999. “ETo Zones Map.” CIMIS. 1999. Accessed August 2013. http://www.cimis.water.ca.gov/ cimis/cimiSatEtoZones.jsp.

Cooper, H.H., Jr., and C.E. Jacob. 1953. “A Generalized Graphical Method of Evaluating Formation Constraints and Summarizing Well Field History.” U.S. Department of the Interior, Geological Survey, Water Resources Division, Groundwater Branch. January 1953.

County of San Diego. 2004. Groundwater Limitations Map. On file with the Clerk of the Board of Supervisors as Document No. 195172. April 2, 2004.

County of San Diego. 2010. County of San Diego, Guidelines for Determining Significance and Report Format and Content Requirements: Biological Resources. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. Fourth Revision. September 15, 2010.

County of San Diego. 2011. San Diego County General Plan: A Plan for Growth, Conservation, and Sustainability. Mountain Empire Subregional Plan. Adopted August 3, 2011.

County of San Diego. 2018. Department of Environmental Health. Environmental Health Document Search. Accessed 2018. https://www.sandiegocounty.gov/content/sdc/ deh/doclibrary/.

County of San Diego. 2023a. County of San Diego Report Format and Content Requirements: Groundwater Resources. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. First Revision. September 27, 2023.

County of San Diego. 2023b. County of San Diego Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. First Revision. September 27, 2023.

CRA (Conestoga-Rovers and Associates). 2007. Well Completion Report Former Chevron Service Station 20-5934, Old Highway 80 & Railroad Street, Jacumba, California. Case No. H29832-002. July 18, 2007.

CRA. 2012. Monitoring Well Installation and Soil Boring Report Former Chevron Service Station 44485 Old Highway 80, Jacumba, California. Case No. H29832-002. May 1, 2012.

Garrity, C.P., and D.R. Soller. 2009. Database of the Geologic Map of North America; adapted from the map by J.C. Reed, Jr. and others (2005): U.S. Geological Survey Data Series 424. https://pubs.usgs.gov/ds/424/.

Google Earth. 2015. Aerial Photography Imagery. August 28, 2015.

Devine, B. 2019. Jacumba Community Services District Service Connections. Personal communication from B. Devine (General Manager Jacumba Community Services District).

Driscoll, Fletcher G. 1986. Groundwater and Wells. St Paul, Minn: Johnson Division.

Dudek. 2016a. Draft Highland Center Well Completion Report. Prepared for Jacumba Community Services District. November 2016.

Dudek. 2016b. Final Preliminary Engineering Report Proposed Domestic Water Supply Project – Manganese Treatment System Water Supply Wells No. 7 and 8, Photovoltaic Array and Pipeline Replacement Prepared for the Jacumba Community Services District and U.S. Department of Agriculture – Rural Development. August 2016.

Dudek. 2016c. Unpublished aquifer test results, Park Well. Test was conducted on October 7, 2016.

Dudek. 2019a. Draft Groundwater Resources Investigation Report JVR Energy Park. Prepared for JVR Energy Park LLC

Dudek. 2019b. Draft Biological Resources Technical Report for the JVR Energy Park. Prepared for JVR Energy Park LLC.

DWR and UCCE (University of California Cooperative Extension). 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California, The Landscape Coefficient

Method and WUCOLS III. Accessed August 2013. http://www.water.ca.gov/ wateruseefficiency/docs/ wucols00.pdf.

EnviroMatrix Analytical. 2015. "Jacumba Park Monitoring Well." Results of Analysis of Samples. November 18, 2015.

Geosyntec. 2012. Jacumba Valley Ranch Property Well #3 Aquifer Test Report, Jacumba, CA. November 2012.

JCSD (Jacumba Community Services District). 2023. Title 22 Water Quality Sampling Results for the Highland Center Well. September 28, 2023.

LAFCO (Local Agency Formation Commission). 2013. Independent and Dependent Districts. Jacumba Community Services District. Updated September 16, 2013. http://www.sdlafco.org/images/Profiles/Profile_CSD_Jacumba.pdf.

McCullough, Jamelle. 2015. Jacumba Valley Ranch Water Company Connection Information. Personal communication from Jamelle McCullough (County of San Diego Department of Environmental Health, Small Drinking Water Systems). April 8, 2015.

NRCS (National Resource Conservation Service). 2018. Plant Database. Accessed December 2018. http://plants.usda.gov/java/.

Oberbauer, T., M. Kelly, and J. Buegge. 2008. Draft Vegetation Communities of San Diego County. Based on "Preliminary Descriptions of the Terrestrial Natural Communities of California," by R.F. Holland, Ph.D., October 1986. March 2008.

Petra Environmental Division (Petra). 2006. Well Installation, Testing, and Sampling Report Jacumba Community Services District. 44465 Old Highway 80, Jacumba, California. June 30, 2006.

Roff, D.F., and J.G. Franzone. 1994. Proposed Final Report, Hydrogeological Investigation, Proposed Jacumba Valley Ranch Development, Jacumba, San Diego County, California. Leighton and Associates Inc. 19 p.

Swenson, G.A. 1981. Master's Thesis San Diego State University – The Groundwater Hydrology of Jacumba Valley, California, and Baja California.

SanGIS (San Diego Geographic Information Source). 2018. Vegetation Information in the San Diego Region. Shapefile. Accessed 2018.

Troutt, D. 2015. JCSD Groundwater Production and Water Level Data. Personal communication from D. Troutt (Former General Manager of Jacumba Community Services District). January 12, 2015.

U.C. Davis (University of California at Davis, Vegetable Research and Information Center). 2011. "Iceberg Lettuce Production in California." Publication 7215. 2011.

USDA (U.S. Department of Agriculture). 2015. National Resource Conservation Service, Custom Soil Resource Report for San Diego County Area, California, based on San Diego County Survey Area, Version 6, December 17, 2007. Accessed March 2015. http://websoilsurvey.nrcs.usda.gov.

USGS (U.S. Geological Service). 1962. Theory of Aquifer Tests, Groundwater Hydraulics. Geological Survey Water-Supply Paper No. 1536-E. Prepared by J.G. Ferris, D.B. Knowles, R.H. Brown, and R.W. Stallman. Denver, Colorado: USGS.

USGS (U.S. Geological Survey). 2004. "Preliminary Geologic Map of the El Cajon 30' x 60' Quadrangle, Southern California." Version 1.0. 1:100,000. Compiled by V.R. Todd.

WRCC (Western Regional Climate Center). 2019. "Period of Record General Climate Summary—Temperature: Campo, California." WRCC. Accessed September 2019. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1424.

7.0 List of Preparers and persons and Organizations Contacted

This report was prepared by INTERA Principal Hydrogeologist Trey Driscoll, PG, CHG, and INTERA Senior Hydrogeologist Ryan Alward. Graphics were provided by Erik Fox. Emilio Gonzales, Jacumba Community Services District, assisted with background information and data.

This page is intentionally left blank.

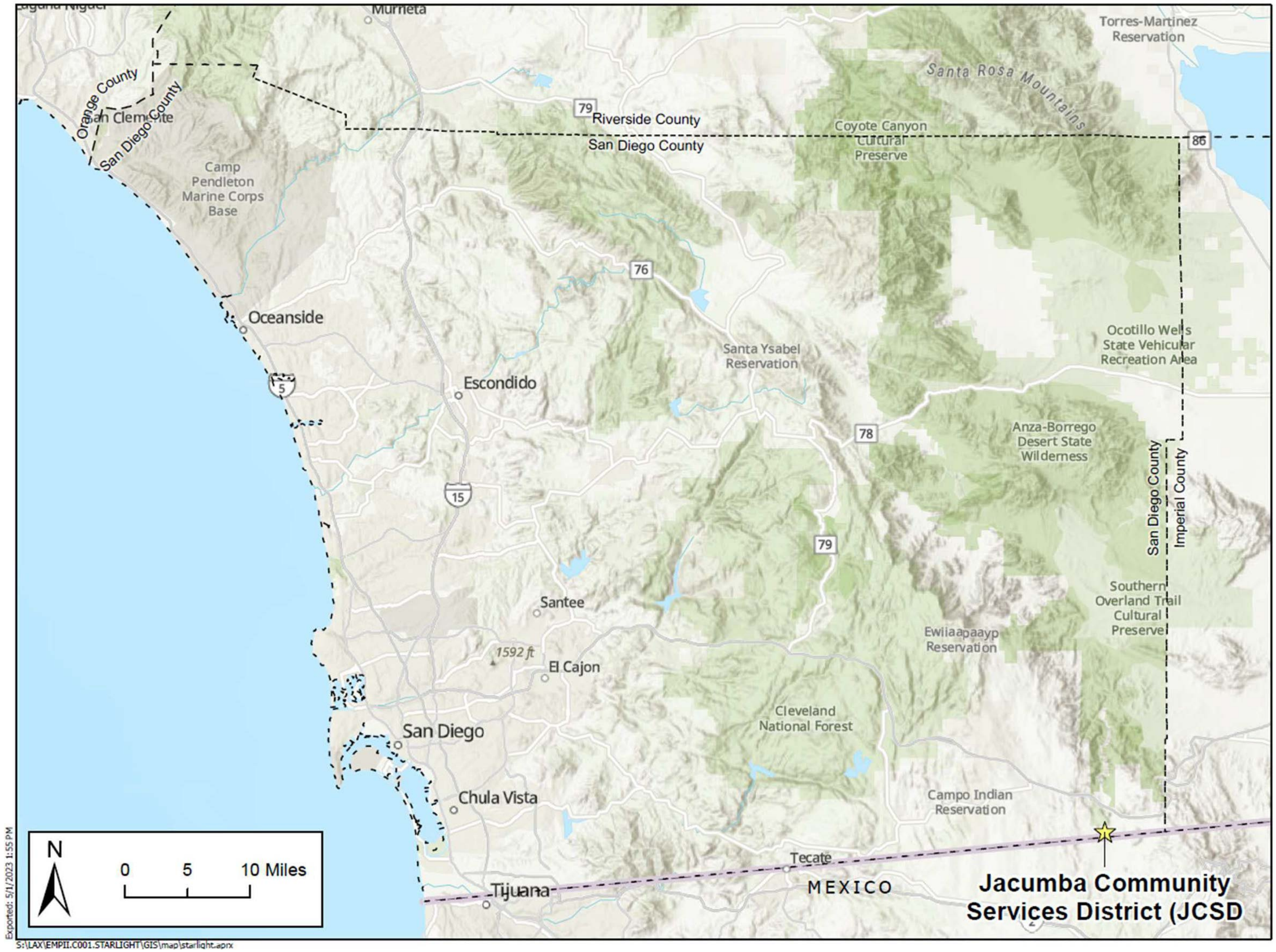


Figure 1 Regional Location

This page is intentionally left blank.

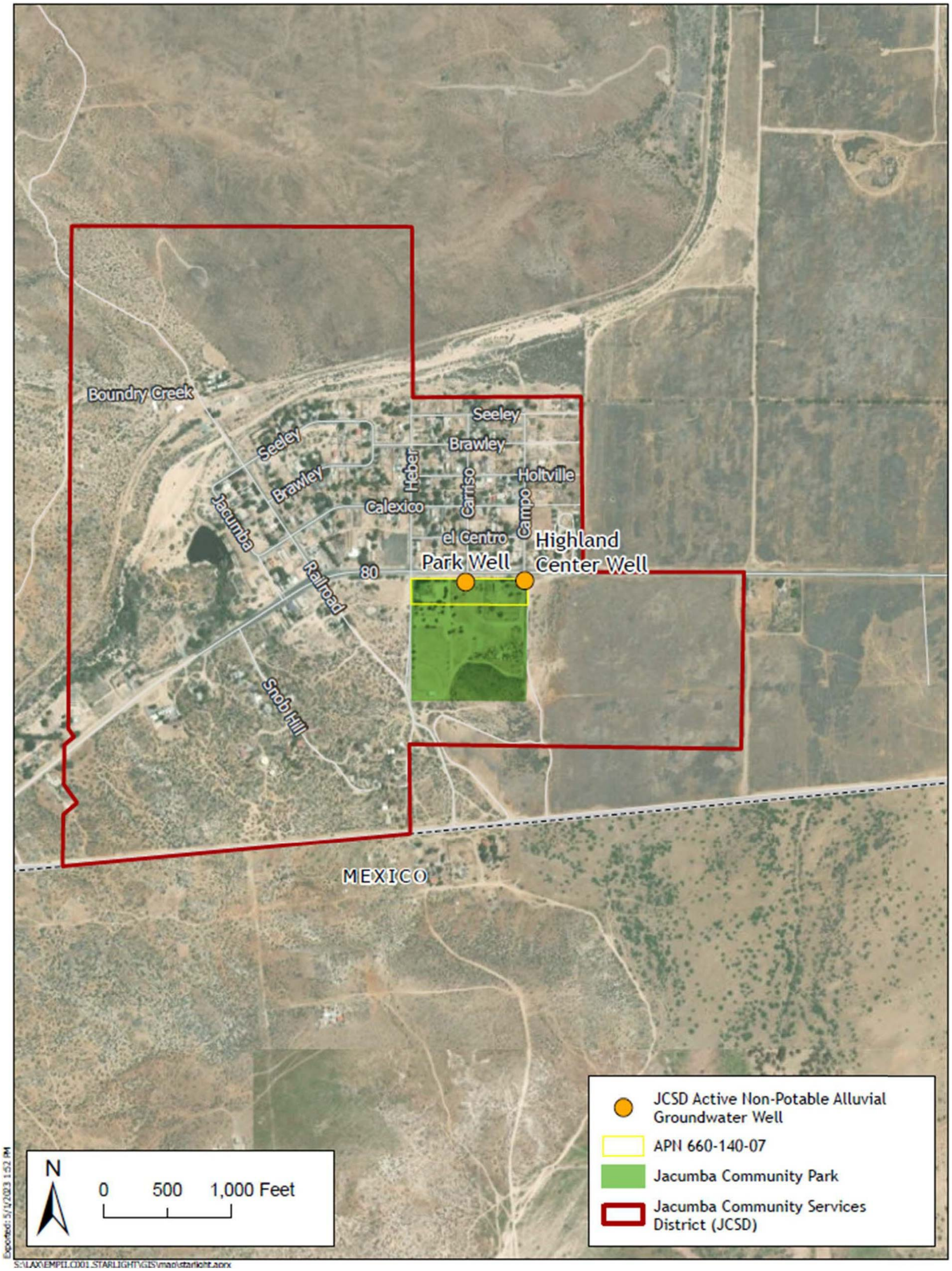


Figure 2 Vicinity Map

This page is intentionally left blank.

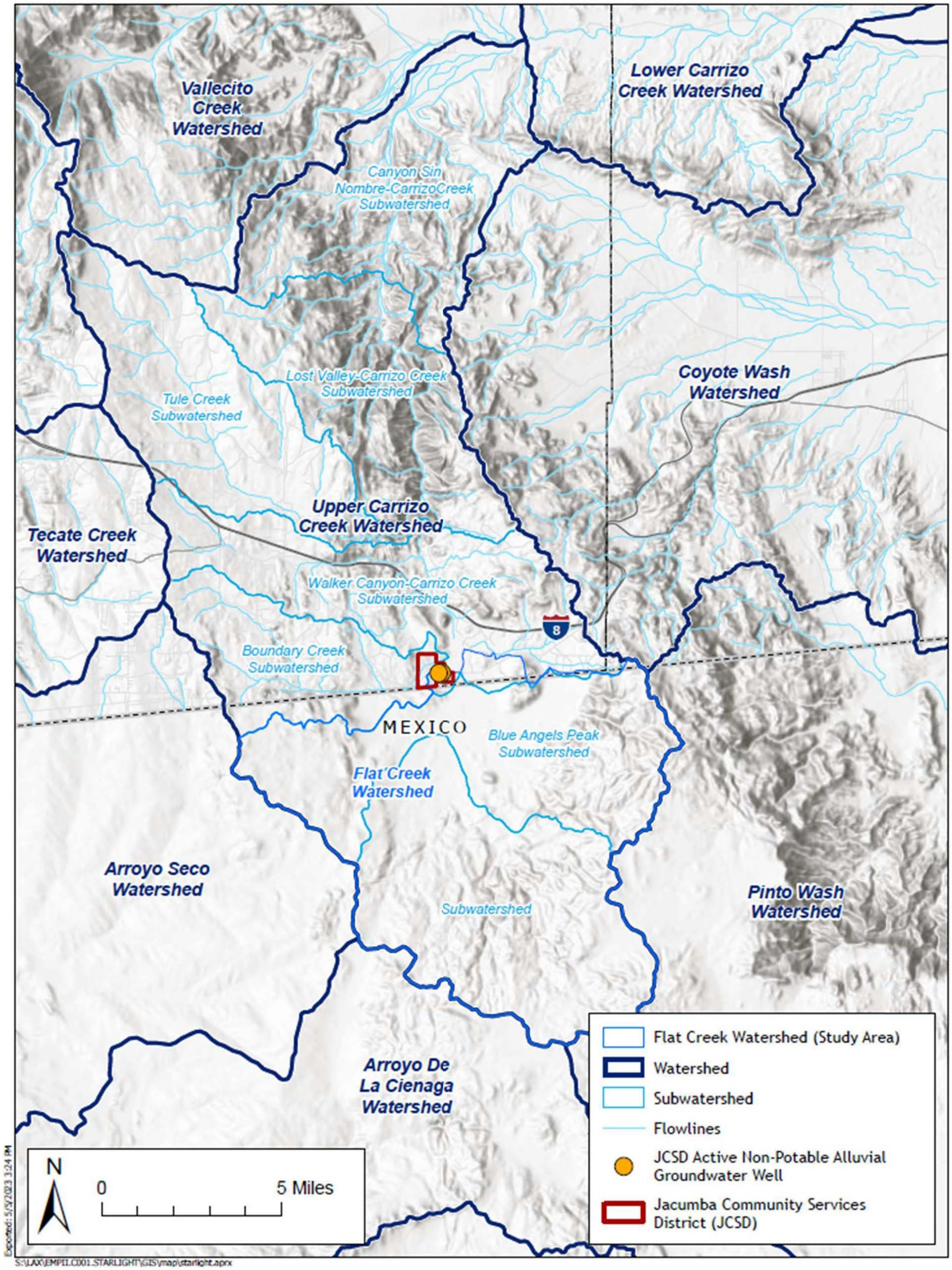


Figure 3 Hydrologic Areas

This page is intentionally left blank.

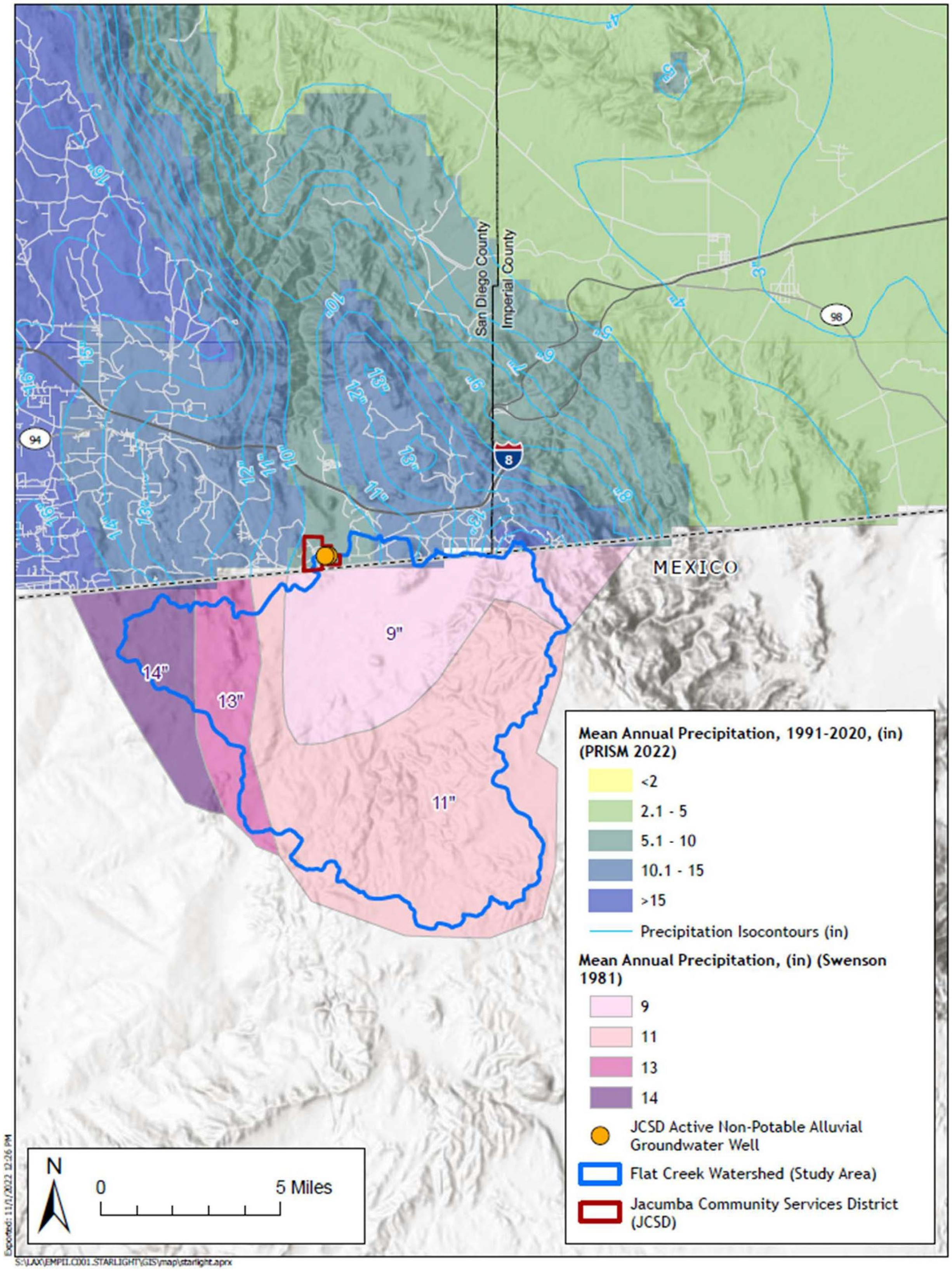


Figure 4 Regional Mean Annual Precipitation

This page is intentionally left blank.

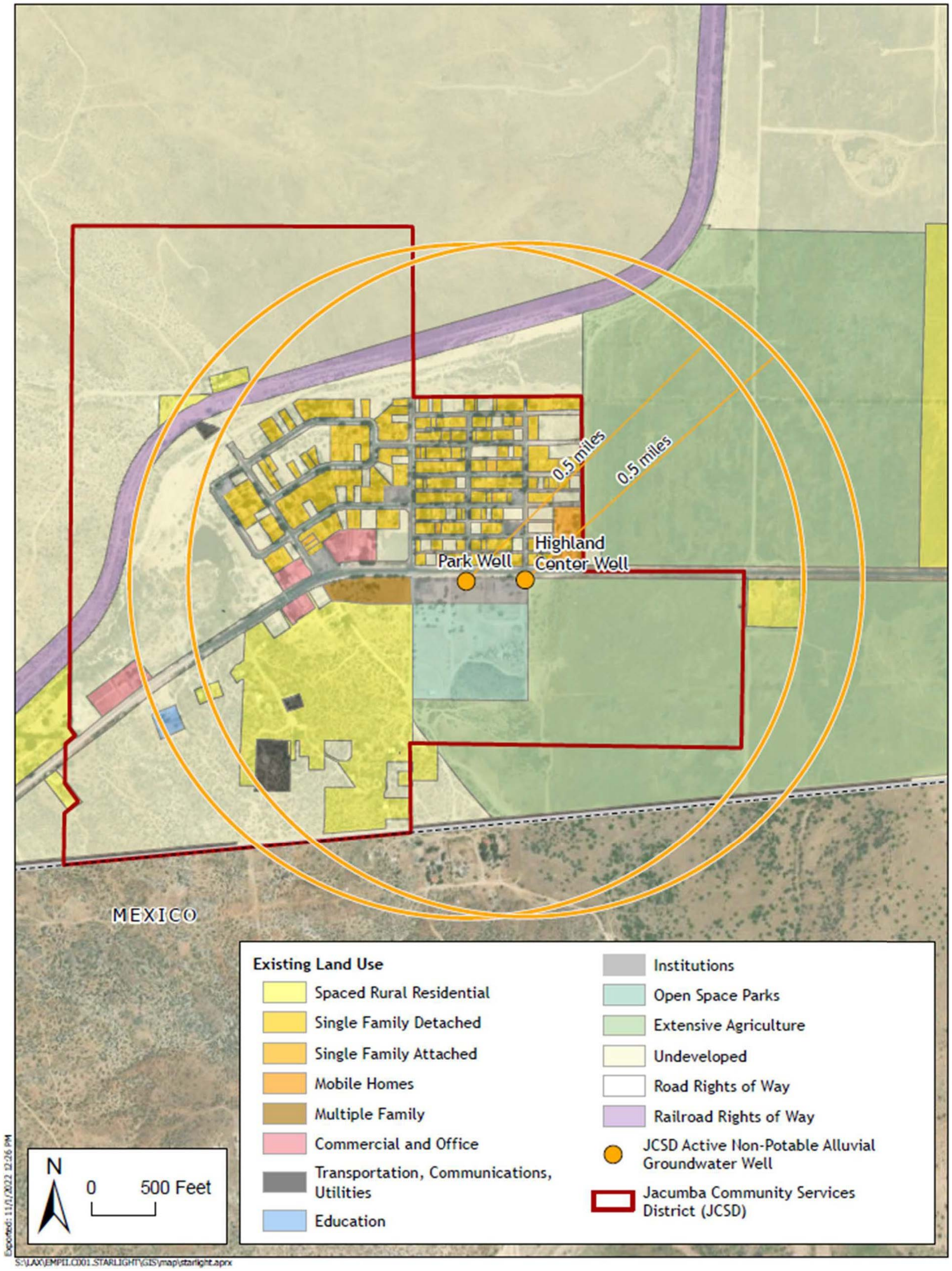


Figure 5 Land Use

This page is intentionally left blank.

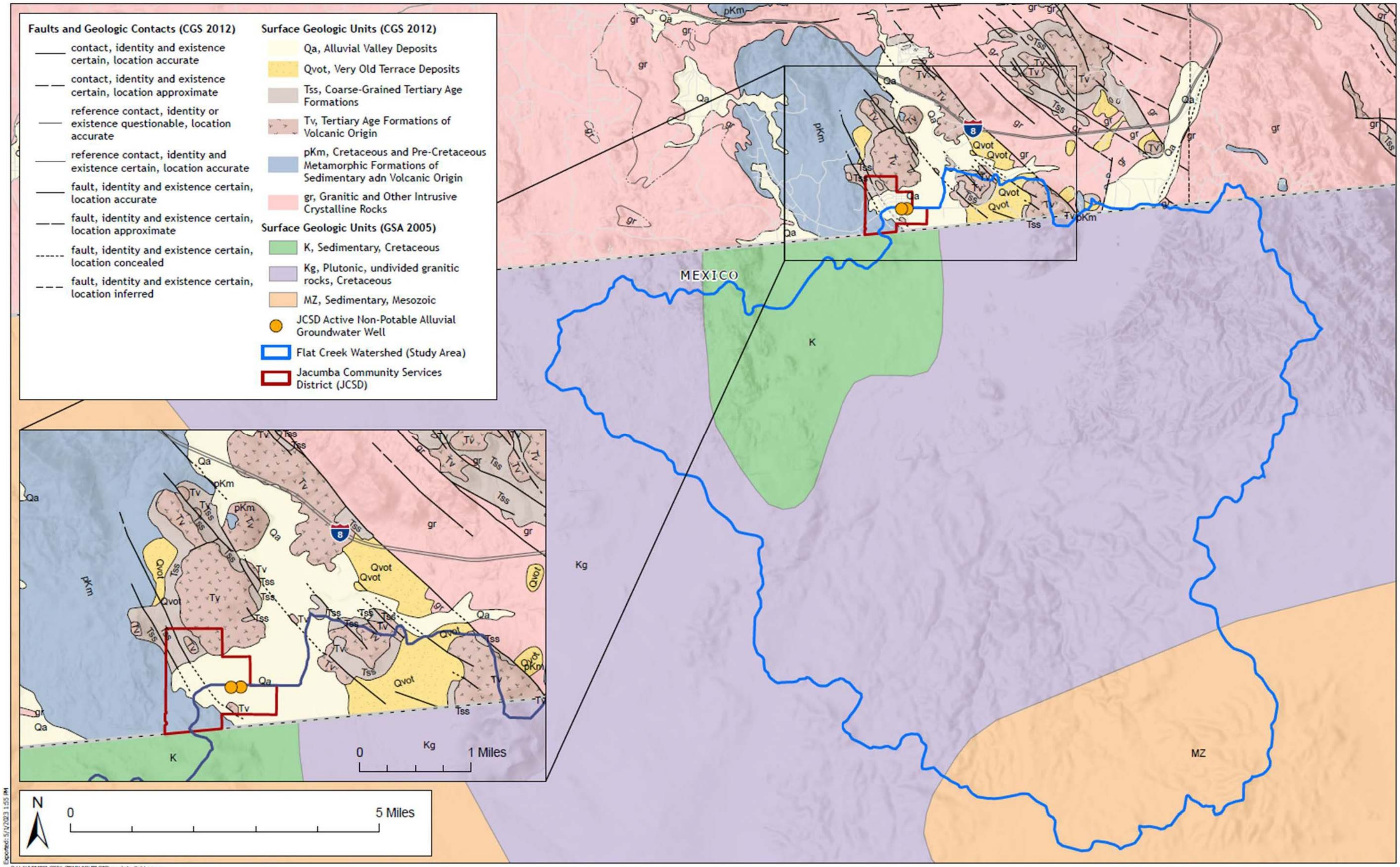


Figure 6 Regional Geologic Map

This page is intentionally left blank.

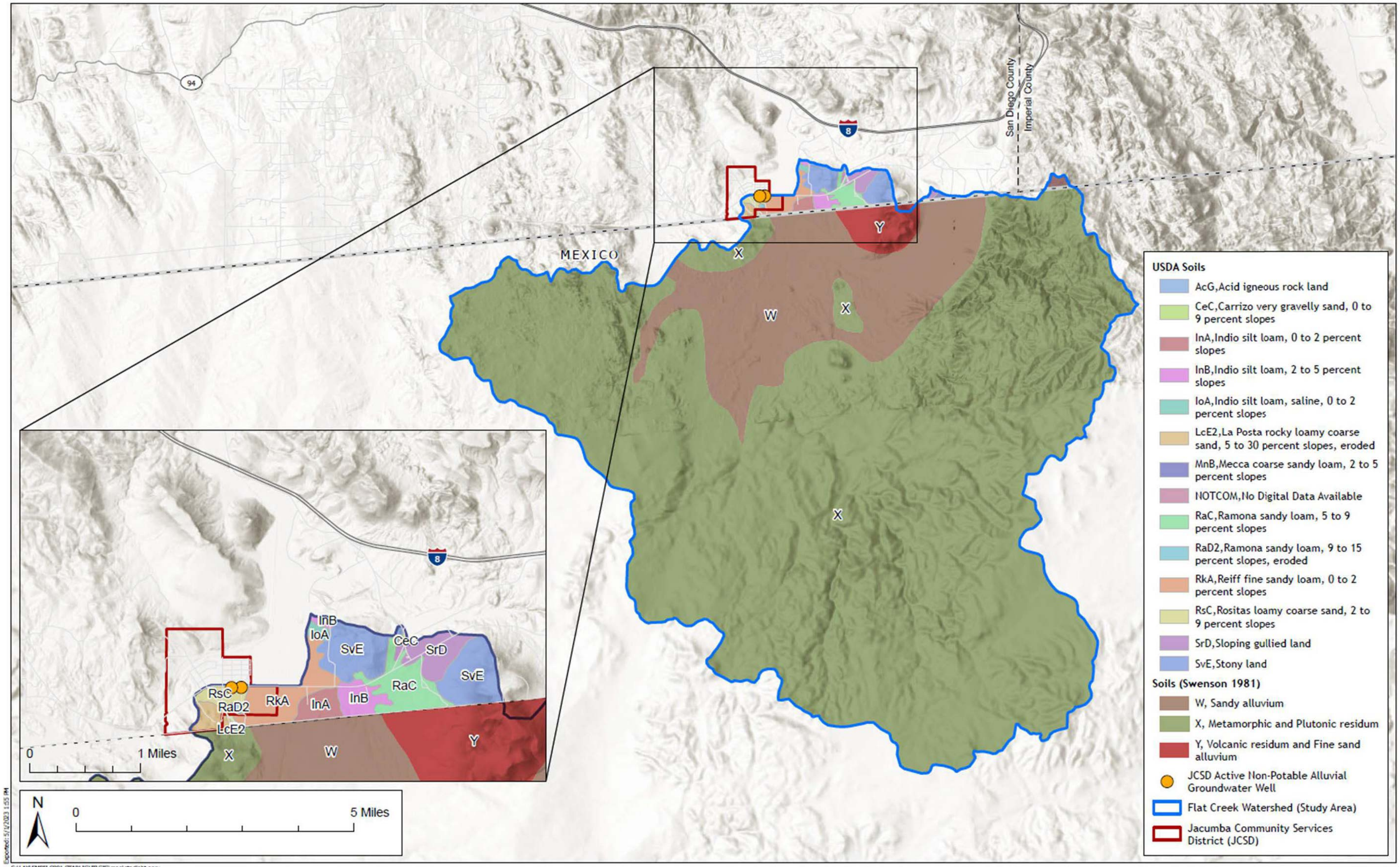


Figure 7 Soils Map

This page is intentionally left blank.

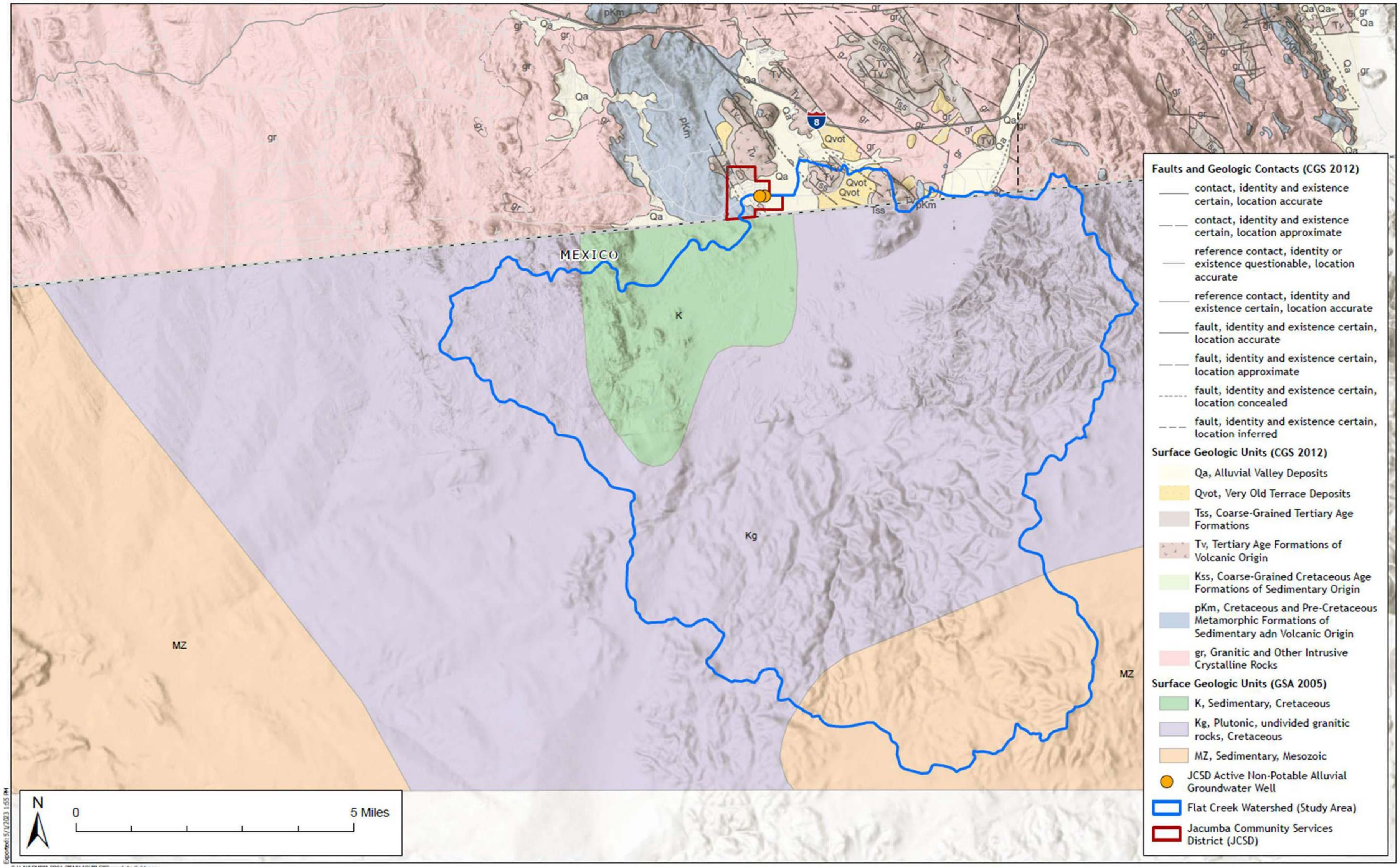


Figure 8 Digital Elevation Model

This page is intentionally left blank.

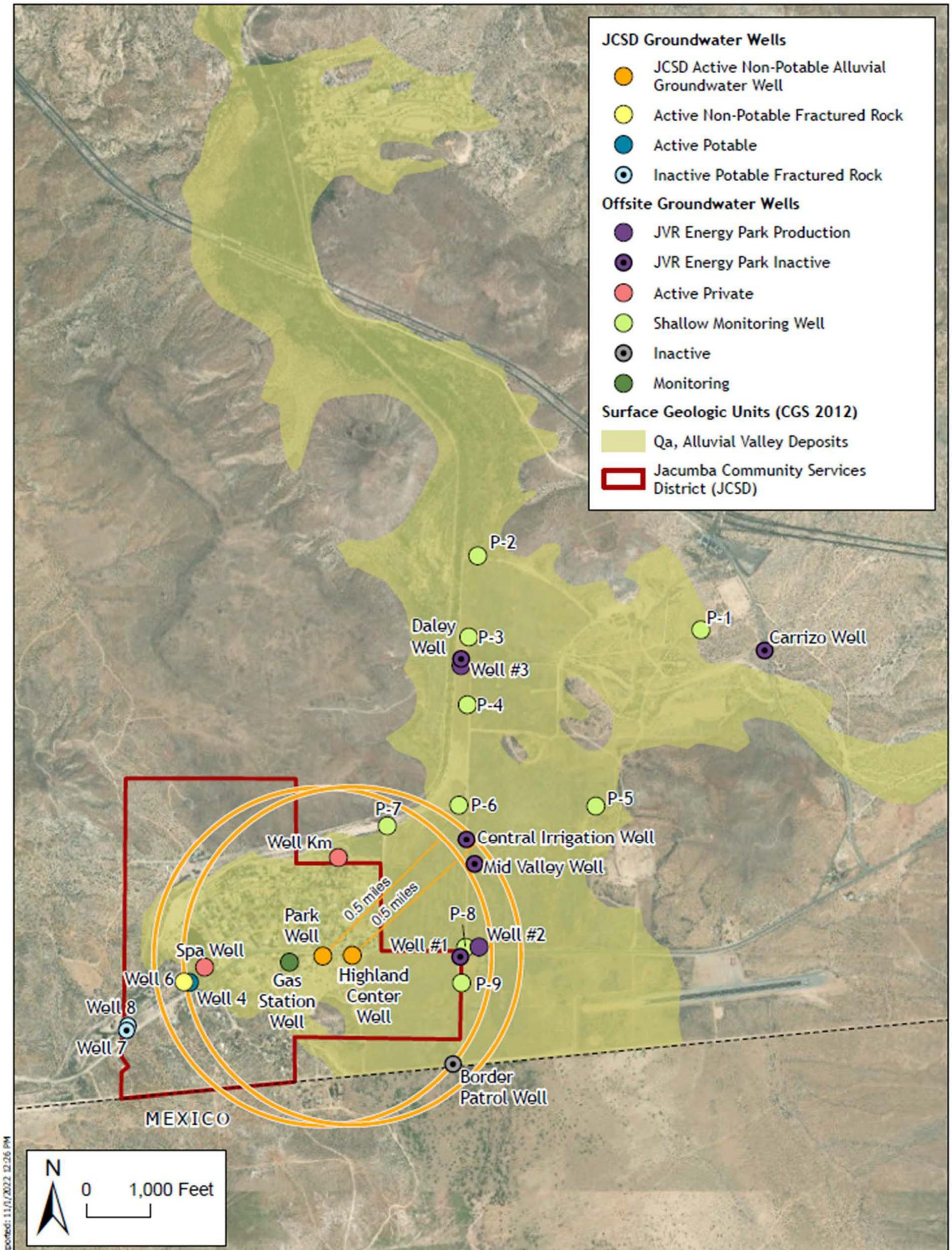


Figure 9 Wells Map

This page is intentionally left blank.

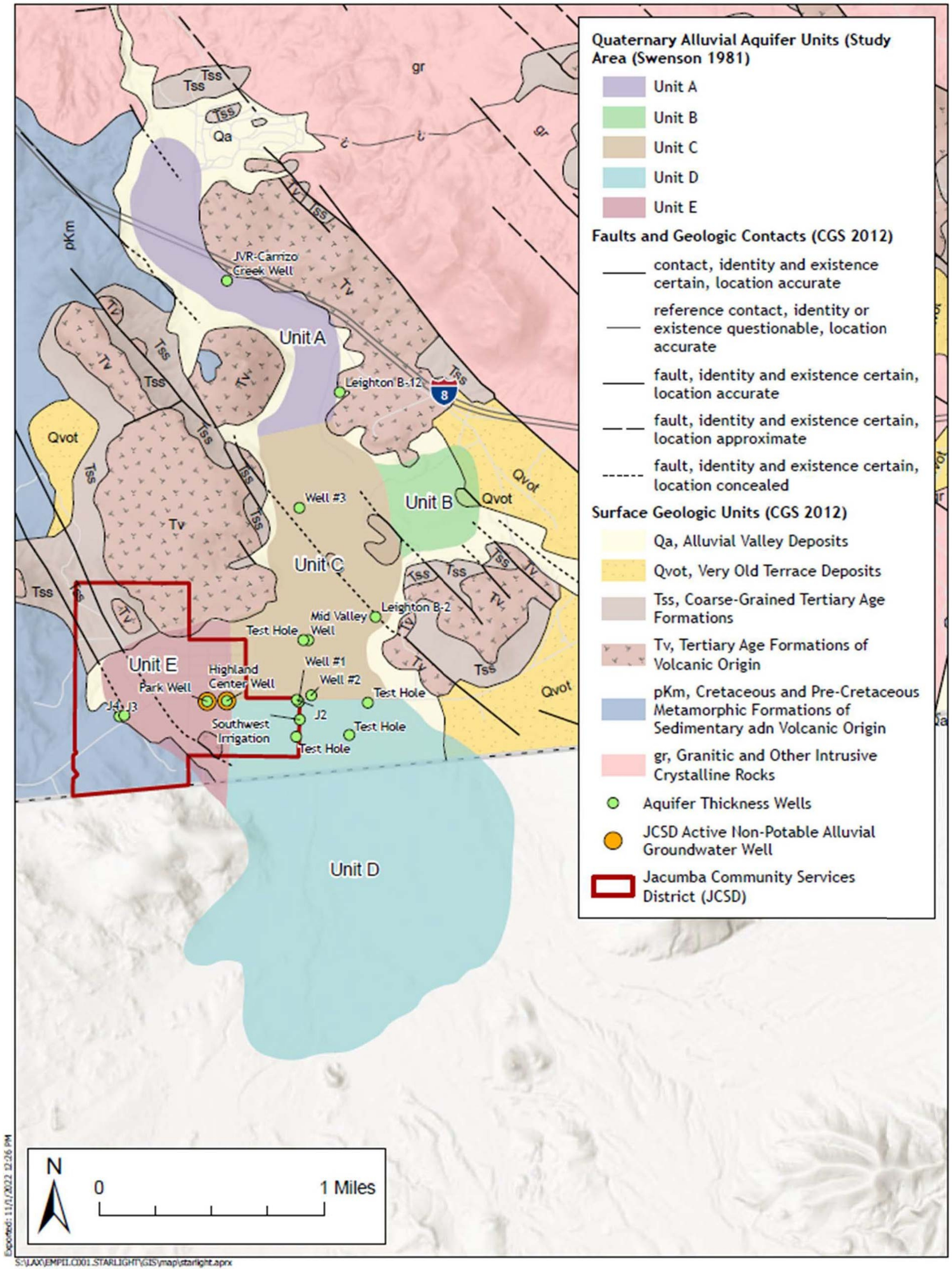


Figure 10 Hydrogeologic Units

This page is intentionally left blank.

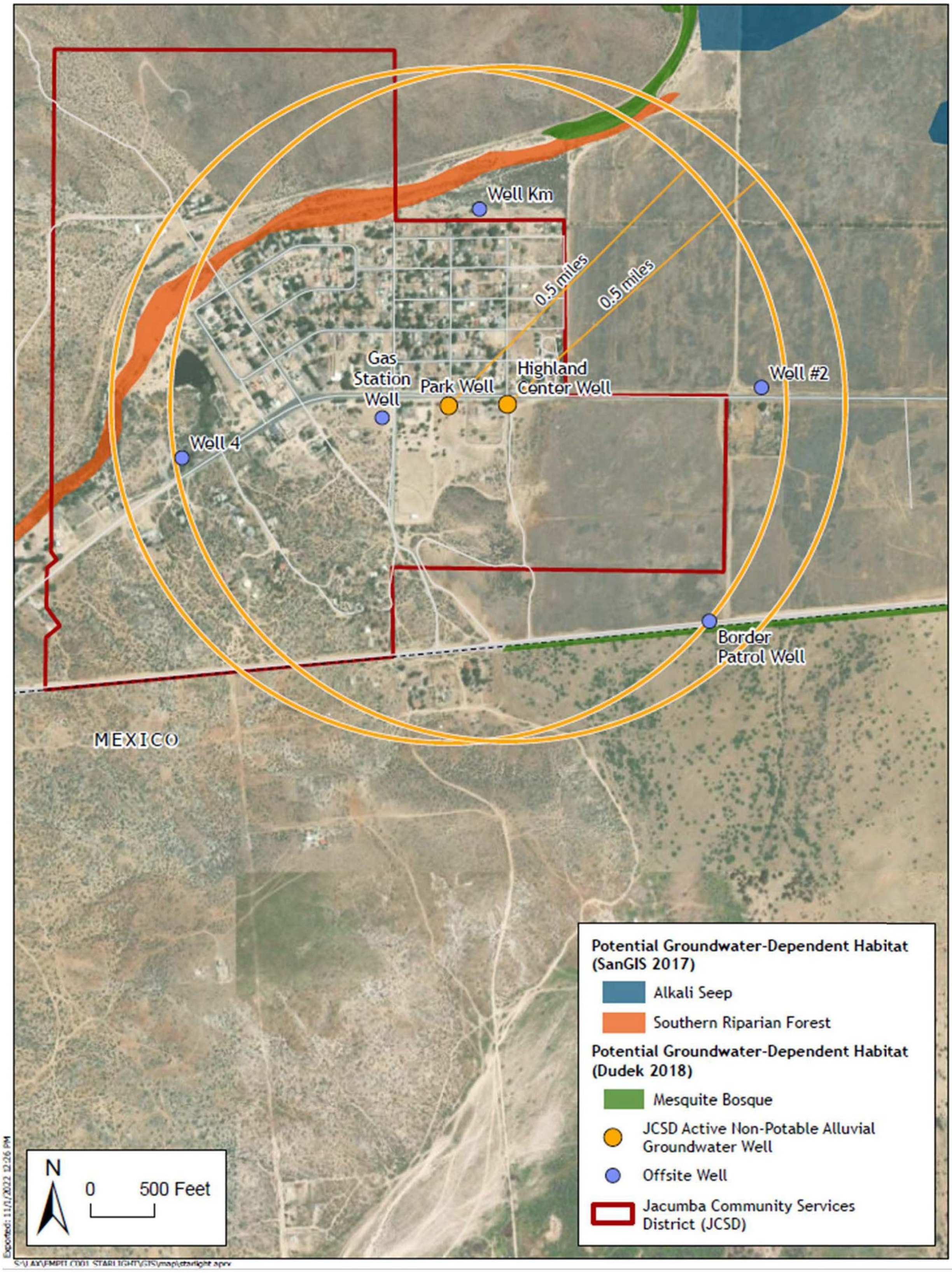


Figure 11 Potential Groundwater Dependent Vegetation

This page is intentionally left blank.

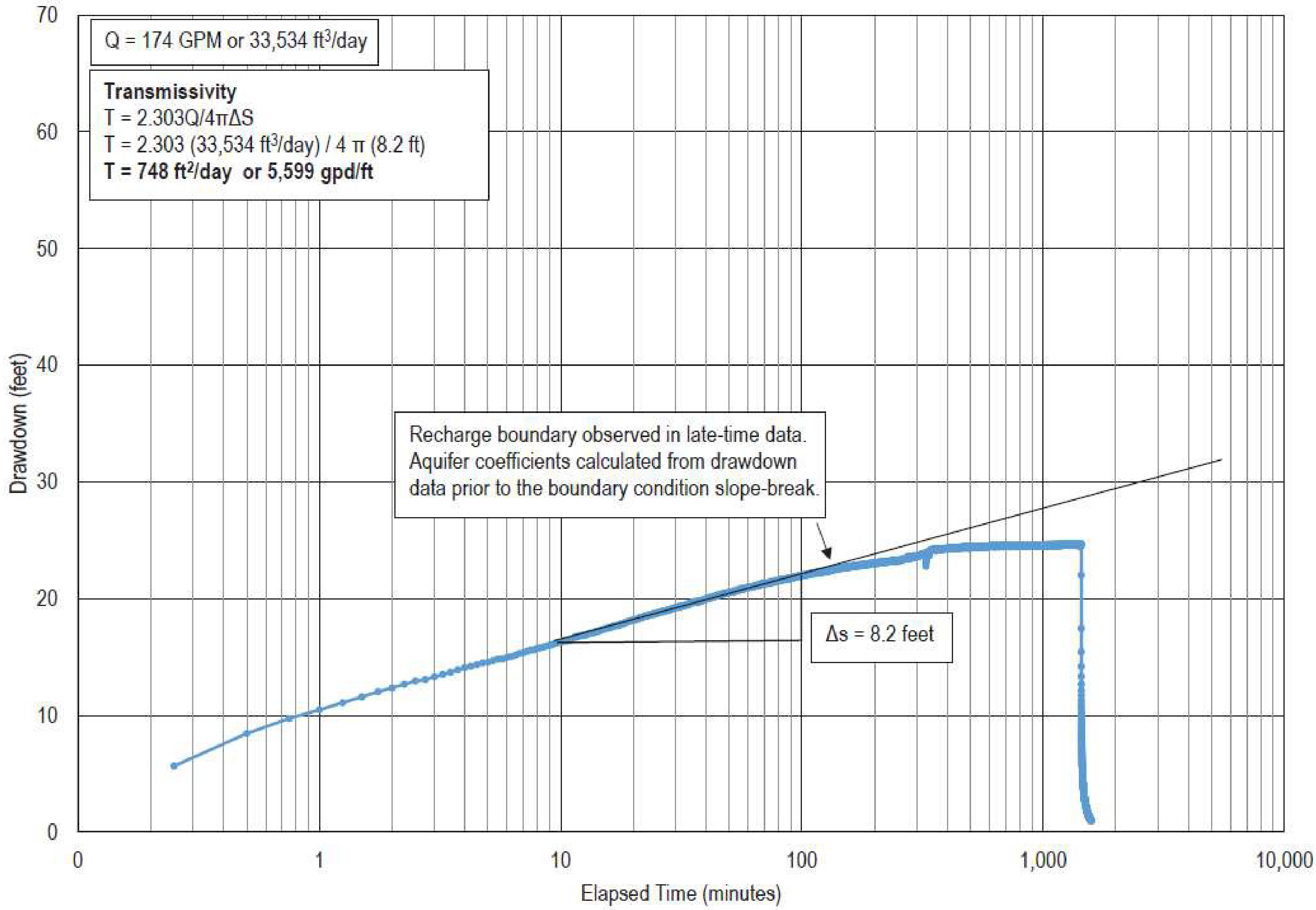


Figure 12 Highland Center Well 24-hr Constant Rate Test – Highland Center Well Analysis

This page is intentionally left blank

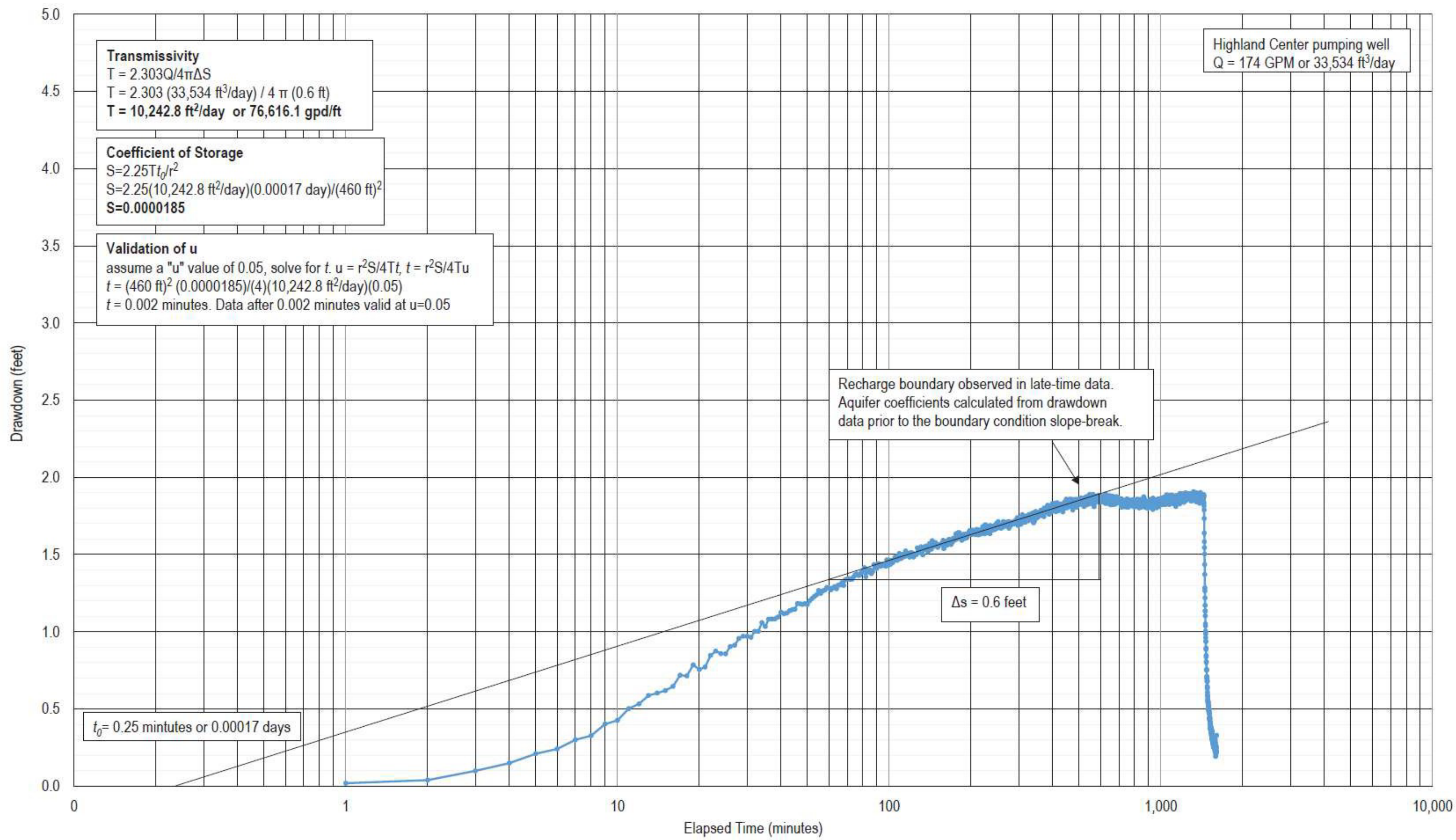


Figure 13 Park Well Analysis

This page is intentionally left blank