# Appendix H

Water Supply Assessment

# Arica and Victory Pass Solar Projects

# WATER SUPPLY ASSESSMENT

Prepared by

**Philip Lowe, P.E., Aspen Environmental Group**

Prepared for

Clearway

**October 2020**

# Contents



# Tables

# Figures

# 1. Introduction

The objective of this report is to provide an assessment of the effects of the proposed solar projects on groundwater and surface water sources. In addition, Water Supply Assessment (WSA) pursuant to the requirements of California Senate Bill (SB) 610, for the Arica and Victory Pass Solar Projects (Projects) is included. Since NEPA requires a similar assessment to that of SB 610 this report will fulfil both needs. Sustainable Groundwater Management Act 2014 (SGMA) requires local agencies to manage basins sustainably. While this act does not apply to the federal government and its groundwater rights, it is in the governments best interests to consider the groundwater uses of the agencies and private users when evaluating sustainable use of groundwater associated with a project.

While these projects border private lands, California Environmental Quality Act will be conducted by the applicants in consultation with the California Department of Fish and Wildlife. Since NEPA requires a similar assessment to that of SB 610, this assessment provides a detailed analysis of water supply availability for the solar development projects and analyzes their potential effects on water supply availability.

# 2. Project Location and Description

The Projects, see Figures 1 and 2, would be in Riverside County, California approximately 5.5 miles east of the unincorporated community of Desert Center and north of Interstate 10 on land administered by the U.S. Department of the Interior Bureau of Land Management (BLM). The project sites are within Riverside East Solar Energy Zone (Riverside East SEZ) and a Development Focus Area, areas that are identified as appropriate for solar projects.

Each project (Victory Pass and Arica) would cover approximately 2,000 acres and consist of photovoltaic solar modules, tracker components, power inverters, transformers, an electrical collection system, one or two project substations, a shared switchyard, battery storage, access roads, and a shared gen-tie line to the existing Southern California Edison (SCE) Red Bluff Substation.

Water for construction and operations would be obtained from several potential sources, including an on-site or off-site groundwater well, or trucked from an offsite water purveyor. The Arica Project would use approximately 650 acre-feet (af) of water over an 18-month construction period, which would occur between June 2022 to December 2023, with up to 10 af per year for operations. The Victory Pass Project would also use approximately 650 af of water over a 16-month construction period, which would occur between June 2022 to October 2023, with up to 10 af per year for operations.

# 3. Water Supply Assessment including Source

These projects are subject to the California Environmental Quality Act, and would demand an amount of water equivalent to, or greater than, 150 to 250 acre feet year (AFY) during construction. SB 610 requires that a project be supported by a WSA if the conditions above are met. During construction, the Projects would use 650 af each (the majority of which (369-397 af) would be used in the second year of construction). Each would then use about 10 afy for operations. Therefore, during construction the project meets the requirements for a WSA. Projects must analyze whether the total projected water supplies determined to be available for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses. Since much of the water comes from groundwater (see Section 5), sustainable groundwater use is an important consideration. SGMA 2019 Basin Prioritization was based on the same technical process as the previous basin prioritization efforts (SIGMA 2015) with minor updates to meet changes to the statute included in the SGMA legislation. The Chuckwalla Valley Groundwater Basin, where the solar projects are located, is a low priority basin due to its low population, and low groundwater use (https://gis.water.ca.gov/app/bp-dashboard/final/ accessed 9-8-2020).

# 4. Hydrologic Overview

The Projects are located within the Chuckwalla Valley Drainage Basin of eastern Riverside County, see Figure 3. The valley is bounded by the Chuckwalla, Little Chuckwalla, and Mule Mountains on the south, the Eagle Mountains on the west, the Palen Mountains on the east, and the Coxcomb Mountains on the north. There are no perennial streams in Chuckwalla Valley. Drainage in the valley is to the Palen and Ford dry lakes located in topographic low-points. All surface water in the western portion of the valley, which includes the Projects, flows to Palen Dry Lake, located approximately 10 miles east of the community of Desert Center and roughly 0.5 miles northeast of the Arica Project. Surface water in the eastern portion of the Chuckwalla Valley flows to Ford Dry Lake, located approximately 10 miles southeast of the Palen Dry Lake.

There are no perennial streams in the Chuckwalla Valley. The local climate is arid with high summer temperatures and mild winter temperatures. Average annual precipitation in the project area, based on the gauging station at the nearby Blythe, California, airport, is 3.41 inches (USHCN, 2016, NOAA, 2020). Average summer maximum temperatures are above 100 degrees. Precipitation is seasonal.

Off-site stormwater flows affecting the Projects are primarily from the Corn Springs Wash originating in the Chuckwalla Mountains approximately five miles to the south of the project site. The Corn Springs Wash drains a watershed of approximately 44 square miles (Aspen, 2018) and enters the project area from the south. Downstream of the Chuckwalla Mountains, the Corn Springs Wash spreads over a wide alluvial fan. The alluvial fan is characterized by unconsolidated shallow flows with numerous small, unstable and shifting stream pathways that, due to the arid climate and distance from the mountains, would carry water infrequently and only after sufficient rainfall. Flow depths for the 100-year flood generated by the Corn Springs Wash would be less than one foot over most of the Projects (Westwood, 2018).

The Big Wash, generated from the Eagle Mountains and from a watershed that extends north of the Eagle and Coxcomb Mountains, flows from the north west to south east into Palen Dry Lake north of the Arica Project. It could generate 100-year flood depths as much as three feet in a small area of the extreme north end of the Arica project (based on a flood map developed in Westwood, 2018).

Springs and seeps in the area include Corn Springs, Box Spring, Crystal Spring, Old Woman Spring, Cove Spring, Mitchell Caverns Spring, Bonanza Spring, Agua Caliente Spring, Kleinfelter Spring, Von Trigger Spring, Malpais Spring, and Sunflower Spring (Aspen, 2018). All these springs are in the surrounding mountains and none are located such that they could serve as water supply for the Projects.

The Chuckwalla Valley is underlain by the Chuckwalla Valley Groundwater Basin (CVGB) described in Section 5.

# 5. Chuckwalla Valley Groundwater Basin

## 5.1 Basin Overview and Storage

The CVGB covers an area of 940 square miles in eastern Riverside County, California. The basin underlies the Palen and Chuckwalla Valleys and is bounded by consolidated rocks of the surrounding mountains. The surface watershed contributing to the area of the CVGB is 1,344 square miles (CEC, 2010), comprised of the Chuckwalla Valley (940 square miles) and the surrounding bedrock mountains (404 square miles).

Water-bearing units of the CVGB include Pliocene to Quaternary age continental deposits divided into Quaternary alluvium, the Pinto Formation, and the Bouse Formation. Bedrock is as deep as 5,000 feet below ground surface in the eastern portion of the CVGB. Wells in the vicinity of the Projects extend to depths of approximately 550 to 875 feet below ground level with water levels approximately 100 to 150 feet below ground level (Aspen, 2018, Shen, 2017). Total groundwater storage available to wells was originally estimated at 9,100,000 af, and more recently at 15,000,000 af (CDWR, 2004, CDWR, 1979). The estimate of 15,000,000 af was made by the CDWR based on multiplying specific yield times saturated thickness times basin size. Saturated thickness was obtained by subtracting the average depth to water from the average thickness of alluvial sediments, or 500 feet, whichever is smaller (CDWR, 1979). A project-specific 2013 analysis estimated the storage capacity of the Chuckwalla Valley Groundwater Basin to be about 10,000,000 af (SWRCB, 2013). The most recent Department of Water Resources 15,000,000 af estimate, is used in this analysis.

The CVGB is located within the jurisdiction of the Colorado River Basin Regional Water Quality Control Board (RWQCB) and is subject to management direction of the Water Quality Control Plan (Basin Plan) for the Colorado River Basin (Region 7). The CVGB is bordered by the Orocopia Valley groundwater basin on the west, the Palo Verde Mesa Groundwater Basin on the east, the Cadiz Valley, Rice Valley and Ward Valley Groundwater Basins on the north, and the Pinto Valley Groundwater Basin on the northwest.

### Groundwater Management

The CVGB is an unadjudicated groundwater basin. Owners of property overlying the basin have the right to pump groundwater from the basin for reasonable and beneficial use, provided that the water rights were never severed or reserved. Groundwater production in the basin is not managed by an entity and no groundwater management plan has been submitted to the California Department of Water Resources (CDWR, 2016). There is no Urban Water Management Plan for the area, and there is no Integrated Regional Water Management Plan.

## 5.2 Groundwater Trends

Groundwater levels range from the ground surface to about 400 feet below ground surface (RWQCB, 2006). Groundwater contour data from 1979 shows that CVGB groundwater moves from the north and west toward the gap between the Mule and McCoy Mountains at the southeastern end of the valley. Groundwater levels were stable up to about 1963 (CDWR, 2004). The CDWR reported total groundwater extraction of 9,100 afy in 1966.

The direction of groundwater movement is not expected to have changed since 1979, but there have been changes in groundwater levels, especially localized around areas of significant extraction. For example, data from wells within the Desert Center area show a period of water level decline from the mid-1980s through the early 1990s during periods of expanded agricultural operations when combined pumping exceeded 20,000 afy, well above historic water usage for the western portion of the basin (AECOM 2011).

The National Park Service has noted that groundwater levels throughout the CVGB appear to have been trending downward for several decades (BLM, 2012). Most wells in the CVGB have not been used for monitoring data such as groundwater level trends since the 1980s; however, several wells have been used to collect groundwater data for the past 25 years, and these data show that groundwater level trends have been fairly stable in the eastern CVGB, and rising slowly back towards pre-agricultural pumping groundwater levels in the western CVGB, while dropping slowly but steadily only in the central CVGB (Aspen, 2018). Monitoring wells installed in the eastern CVGB in 2012 by the United States Geological Survey show rising water surface levels since 2012 (USGS, 2020).

In general, well data show a relatively stable groundwater surface, interrupted locally in the past mainly by agricultural pumping. Local groundwater levels show evidence of rising after the agriculture-related drawdown of the 1980s ended, indicating that local extraction rates have not exceeded recharge.

## 5.3 Groundwater Recharge

Recharge to the CVGB occurs from subsurface inflow from other groundwater basins, infiltration of precipitation, irrigation return flow, and wastewater return. Leakage from the Colorado River Aqueduct has also been identified as a possible source of inflow.

### Subsurface Inflow

Groundwater in the CVGB generally flows west to east. Subsurface inflow originates from the Pinto Valley and Orocopia Valley groundwater basins, which are west of the CVGB (CDWR, 2004. BLM, 2011). The amount of inflow from the Pinto Valley and Orocopia Valley Groundwater Basins is highly uncertain, and there have been a wide range of estimates from different experts ranging from a low of 953 afy to 6,575 afy (Aspen, 2018). For purposes of this analysis, the groundwater budget uses 3,500 afy. This estimate has been used for nearby projects in the recent past (Aspen, 2018) and is approximately in the middle of the range of estimates. This analysis also applies the low estimate of 953 afy developed by the National Park Service (Aspen, 2018) to provide a probable range for the groundwater budget given the uncertainties involved.

### Recharge from Precipitation

Infiltration recharge to the CVGB by precipitation is difficult to assess due to lack of reliable data and the aridity of the area. Previous estimates have ranged from 2,060 afy to 9,448 afy (Aspen, 2018).

Generally, precipitation recharge has been estimated as a percentage of total precipitation. The CVGB receives annually about 258,000 afy total rain (CEC, 2015). The BLM estimates that 7 to 8 percent of the precipitation that falls on the bedrock mountain fronts ends up as groundwater recharge (BLM, 2012), while a smaller percentage of the valley floor precipitation makes it to the groundwater. For the CVGB, 7 to 8 percent of the precipitation that falls on the mountain fronts would be equivalent to 3 percent of the total precipitation that falls on the total CVGB watershed (BLM, 2012). The Energy Commission, using estimates of 3, 5 and 7% of total incident precipitation ending up as groundwater recharge, and overlaying isohyetal precipitation maps over the entire CVGB watershed to estimate precipitation distribution and bedrock characteristics by sector, estimated precipitation-related recharge to be 8,588, 14,313, and 20,038 afy, respectively, and recommended using 8,588 afy (about 3% of total precipitation) for a groundwater budget analysis (CEC, 2015). These results are supported by the findings of a study presented in a USGS report on groundwater recharge in the arid and semiarid southwestern United States (USGS 2007), which gave a range of approximately 3 to 7 percent of total precipitation for the Mojave Desert, depending on the amount of precipitation received. In the 2007 study by the USGS, the lower (3 percent) estimate represented years with below-average precipitation, with the higher (7 percent) estimate for above-average precipitation. The percentage changes with the amount of precipitation because most recharge occurs from runoff, and runoff is generally higher in years with greater precipitation.

For purposes of this analysis, the groundwater budget uses 8,588 afy as was used for the nearby Palen Solar Project (Aspen, 2018). This is approximately equivalent to 3 percent of the total average precipitation of 258,000 af and is supported by the USGS 2007 study for which 3 percent would represent the estimated recharge for a below-average precipitation year. The analysis herein also applies the low estimate of 2,060 afy, representing about 0.7 percent of average annual precipitation, to provide a probable range for the groundwater budget given the uncertainties involved.

### Irrigation Return Discharge

Irrigation water applied to crops within the CVGB has the potential to infiltrate to groundwater depending on the amount and method of irrigation, soils, crop type, and climate. The Energy Commission estimated irrigation return recharge as 10% of total irrigation volume as determined by a 2010 study (WorleyParsons, 2009), and determined that 800 afy would reach the CVGB (CEC, 2010). This was based on a total irrigation volume of 7,700 afy (6,400 afy for agriculture, 215 afy for aquaculture pumping, and 1,090 afy for Tamarisk Lake).

### Wastewater Return Flow

Wastewater return flow within the CVGB originates from the Chuckwalla State Prison, the Ironwood State Prison, and the Lake Tamarisk development near Desert Center (CEC, 2010, WorleyParsons, 2009). The prisons use an unlined pond to dispose of treated wastewater, and it is estimated that 795 afy infiltrates to the CVGB (WorleyParsons, 2009). Another 36 afy is estimated to originate from Lake Tamarisk, for a total of 831 afy (WorleyParsons, 2009).

### Colorado River Aqueduct

Leakage from the Colorado River Aqueduct, which runs across the western edge of the CVGB, has not been documented, but was hypothesized by the Argonne National Laboratory in a 2013 study of the Riverside East Solar Energy Zone (Argonne, 2013). Argonne estimated a 2,000 afy contribution to the CVGB from the aqueduct based on measured leakage rates from the Central Arizona Project in Arizona. Since this recharge component is not well documented, and if it does occur the use of it would require entitlement, it is not used in this analysis.

## 5.4 Groundwater Demand/Outflow

Outflow from the CVGB occurs from subsurface outflow to the Palo Verde Mesa Groundwater Basin, groundwater extraction for agriculture and other uses, and evapotranspiration from Palen Dry Lake. Outflow also occurs, or would occur, from the Projects and other existing and proposed projects.

### Subsurface Outflow

Subsurface outflow from the CVGB is to the Palo Verde Mesa Groundwater Basin and has been variously estimated as ranging from 400 afy to 1,162 afy (CEC, 2015). Argonne (Argonne, 2013), in their 2013 study of the basin, assumed zero subsurface outflow, with no justification given. Using gravity data, Wilson and Owens-Joyce (1994) found that the area through which discharge occurs is significantly more limited than previously thought due to the presence of a buried bedrock ridge, though the discharge pathway was not indicated to be completely closed. Since this discovery was made after the 1,162 afy estimate was made (which was in 1990), the lower estimate of 400 afy outflow was adopted for this study.

### Groundwater Extraction

Current and historical groundwater extraction in the CVGB includes agricultural water use, pumping for Chuckwalla and Ironwood State Prisons, pumping for the Tamarisk Lake development and golf course, domestic pumping, and a minor amount of pumping by Southern California Gas Company (CEC, 2010). The California Department of Water Resources, using data from 2005 to 2010, estimated the total amount of pumping at 4,700 afy for the entire CVGB (CDWR, 2015). Argonne (Argonne, 2013), also using California Department of Water Resources data, estimated 5,100 afy. Other recent studies have given higher estimates. Specifically, the Palen Solar Project EIS and Energy Commission staff assessment for the Palen Solar Project, both used 10,361 afy (BLM, 2011, CEC, 2015). AECOM, in a previous WSA for the Palen Solar Power Project (AECOM, 2010) estimated 5,745 to 7,415 afy, with no source given. For purposes of this analysis, the most-recent estimate of 10,361 afy is used as a reasonable upper estimate of total extraction, as was used by the BLM and Energy Commission.

The Genesis Solar Electric Plant and the First Solar Desert Sunlight Solar Farm have been recently completed in the area, and these projects will use 218 afy groundwater for operations (218 afy for Genesis, and 0.3 afy for First Solar, with the total rounded to 218). Total baseline groundwater extraction is therefore 10,579 afy for purposes of this study.

### Evapotranspiration at Palen Dry Lake

In 2009, Worley-Parsons, using hand-augur borings, found free groundwater at a depth of 8 feet below the ground surface at the Palen Dry Lake. This suggests that groundwater could be close enough to rise through capillary action and be lost through evaporation (CEC, 2015).

The Energy Commission (CEC, 2015) estimated groundwater discharge rates from the Palen Dry Lake using measured evaporation rates at Franklin Lake Playa in Death Valley, adjusted for differences in the characteristics of the two dry lakes, as a reference. The result was 0.0583 feet of evapotranspiration per month, for three months of the year. Over the 2,000-acre area thought susceptible to groundwater evapotranspiration, this amounts to 350 afy (CEC, 2015).

# 6. Groundwater Budget

The primary question to be answered in a WSA that is compliant with SB 610 requirements is:

> *Will the total projected water supply available during normal, single dry, and multiple dry water years during a 20-year projection meet the projected water demand of the proposed project, in addition to existing and planned future uses of the identified water supplies, including agricultural and manufacturing uses?*

In order to determine whether there are sufficient supplies to serve the project over the next twenty years, this section provides a baseline normal-year groundwater budget for the CVGB, based on the information provided in Section 5. This section also includes a normal-year groundwater budget assuming the Projects are in place, and a normal-year groundwater budget assuming the Projects and all known cumulative projects are in place. The same is repeated for single and multiple dry-year scenarios. The following is an explanation of water budget terms used in this document.

- A **Water Budget** is an identification, estimate, and comparison of the groundwater inputs and outputs that affect the overall trend of groundwater balance in the CVGB. Inputs such as recharge from precipitation, underflow from other groundwater basins, and other sources are compared to outputs such as loss to other groundwater basins, extractions by humans, and evapotranspiration. Total inflow minus total outflow equals change in storage.
- A **Safe Yield** is the amount of water that can be withdrawn from the groundwater basin for human use without depleting the groundwater resource. A safe yield occurs if the groundwater extractions, plus other natural outputs, do not exceed inputs. In this case, there would be no net depletion of the groundwater in storage. In this report, the safe yield is calculated for the basin as a whole.
- An **Overdraft** occurs if extractions plus other outputs exceed total inputs, in which case there will be a net loss of groundwater storage over time. In this report, an overdraft, also referred to herein as a deficit, is estimated for the CVGB basin as a whole. Long-term overdraft conditions will result in a protracted diminishment of the groundwater resource that could have effects on the environment and the sustainability of the groundwater use.

The CVGB has a lack of long-term monitoring data for performing a detailed analysis. Wells have been in only a few areas of the basin, are not well documented, and the available data are incomplete and localized. It is known that extractions were 11 afy in 1952 (CDWR, 2004), rising to about 9,100 afy in 1966 (same source), and then peaking at around 20,000 afy for agriculture in the Desert Center area, as described above, resulting in local drawdowns that have since appeared to recover.

As a result of the scarcity of available data, there is substantial uncertainty regarding some of the primary inputs to a groundwater budget. Several studies in recent years for projects such as the Projects have used the best available information do draw conclusions, summarized in Table 1. The conclusions herein are based on the same best available information and should be considered in the context of the overall uncertainty regarding the CVGB basin. Because of the uncertainties involved, the analysis uses two groundwater budgets. The first is a best estimate using data that has been widely reported and used in previous studies of this kind as described in Section 5. These adopted data are presented in Table 1. The second uses lower input estimates, also described in Section 5. Specifically, the second budget uses a recharge from precipitation estimate of 2,060 afy, and an underflow from Pinto Valley and Orocopia Valley Groundwater Basins of 953 afy. All other inflow/outflow estimates are the same for both budgets. The two together provide insight into a range of potential outcomes related to groundwater use in the CVGB.

**Table 1. CVGB Baseline Inflow/Outflow Summary**

| Inflow/Outflow Component | Range (afy) | Adopted for This Study (afy) | Reason for Adoption/Source |
|---|---|---|---|
| Recharge from Precipitation | +206 to +20,038 | +8,588 | 3% of total precipitation USGS (2007), BLM, (2012) |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins | +953 to +6,575 | +3,500 | Used previously for Palen and Genesis projects |
| Irrigation Return Flow | +800 | +800 | WorleyParsons (2009) |
| Wastewater Return Flow | +831 | +831 | WorleyParsons (2009) |

| Inflow/Outflow Component | Range (afy) | Adopted for This Study (afy) | Reason for Adoption/Source |
|---|---|---|---|
| Groundwater Extraction | –4,700 to –10,579 | –10,579 | Recent estimate: –10,361 (CEC, 2015) + –218 Genesis and First Solar energy projects |
| Underflow to Palo Verde Mesa Groundwater Basin | –400 | –400 | (CEC, 2015). Used lower estimate due to restricted discharge area (Wilson and Owens-Joyce, 1994) |
| Evapotranspiration at Palen Dry Lake | –350 | –350 | (CEC, 2015) estimate from Franklin Playa study. |

Inflow is depicted by a '+' sign; outflow is depicted by a '–' sign.

## 6.1 Baseline Groundwater Budget

The baseline groundwater budget is the groundwater budget for the CVGB in the absence of the project and all other known cumulative projects not already in place. For the purposes of this analysis, agricultural uses are considered as part of the baseline budget, as is the Prison Water Use, and the Genesis Solar Project. There are no manufacturing water uses in the area.

### Normal (Average) Year

Table 2 provides a baseline normal groundwater budget for the CVGB based on the adopted information presented in Sections 5.4 and 5.5 and Table 1. This budget indicates a safe yield, which is the maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect. The baseline safe yield for the CVGB is estimated at 2,390 afy (total from Table 2), meaning the basin is currently close to capacity in terms of groundwater extraction. This budget would be for a normal (average) year, in terms of precipitation and water use.

Assuming a 2,390 afy average year surplus, the CVGB would have a surplus of approximately 71,700 af at the end of the 30-year period (the life of the Clearway projects not including the 16 to 18 months of construction), meaning the groundwater basin would slowly recover from any deficits that may have been created by high agricultural pumping in the past. A 30-year period is used because that is the expected life of the project

To provide a range of values, Table 3 provides the same analysis using the lower estimates of precipitation and underflow recharge described in Section 5. This baseline budget shows the CVGB to be in deficit, with a loss of approximately 6,685 afy in the groundwater resource, meaning groundwater levels would be expected to drop as the resource is depleted over the years.

With the NPS infiltration and underflow estimates (Table 3), at the end of the 30-year period the cumulative deficit would be 200,550 af. The basin would not recover losses during that period if the NPS estimates are correct. While the amount of water within the aquifer may seem large it is old water from 9,000 to 18,000 years ago (USGS, 2013). Under a normal water year using the more conservative NPS values, cumulative deficit after 30 years is estimated at about one percent of the total estimated storage.

## Table 2. Estimated Normal Baseline Groundwater Budget for the Chuckwalla Valley Groundwater Basin

| Budget Components | Acre-Feet/Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation[1] | 8,588 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins[2] | 3,500 |
| Irrigation Return Flow[3] | 800 |
| Wastewater Return Flow[4] | 831 |
| Total Inflow | 13,719 |
| **Outflow** | |
| Groundwater Extraction[5] | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin[6] | –400 |
| Evapotranspiration at Palen Dry Lake[7] | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | 2,390 **(+0.02% of total storage)** |

1 - BLM, 2012
2 - BLM, 2012
3 - CEC, 2015
4 - WorleyParsons, 2009
5 - Based on CEC, 2015 plus extractions of Genesis Solar Electric Plant (WorleyParsons, 2009)
6 - CEC, 2010
7 - CEC, 2010

## Table 3. Estimated Normal Baseline Groundwater Budget for the Chuckwalla Valley Groundwater Basin Using Reduced Estimates of Precipitation and Subsurface Inflow

| Budget Components | Acre-Feet/Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation[1] | 2,060 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins[2] | 953 |
| Irrigation Return Flow[3] | 800 |
| Wastewater Return Flow[4] | 831 |
| Total Inflow | 4,644 |
| **Outflow** | |
| Groundwater Extraction[5] | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin[6] | –400 |
| Evapotranspiration at Palen Dry Lake[7] | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | –6,685 **(–0.04% of total storage)** |

1 - BLM, 2012
2 - BLM, 2012
3 - CEC, 2015
4 - WorleyParsons, 2009
5 - Based on CEC, 2015 plus extractions of Genesis Solar Electric Plant (WorleyParsons, 2009)
6 - CEC, 2010
7 - CEC, 2010

## Dry Year

According to SB 610 guidelines, a dry year can be considered a year with a precipitation amount that is at 10 percent probability of occurrence, meaning 10 percent of the years would be drier. A critical dry year would be a year with 3 percent probability. The historic precipitation data at Blythe, California, approximately 35 miles east of the project and at a similar elevation with similar climate, was used as a reference. Historical precipitation data for Blythe, dating from 1893 to 2014, was obtained from the United States Historical Climatology Network (USHCN, 2016). A nearby station at the Blythe Airport (NOAA, 2020) was used to supplement additional data for up to the year 2019.

The average of the annual precipitation from 1893 to 2019 at Blythe was 3.41 inches. The 10-percent probability dry year was estimated by ranking precipitation years from 1893 to 2019 from lowest to highest and giving them ranking numbers 1 to 127 with the lowest precipitation year number 1 and the highest precipitation year number 127. Dividing the ranking number by the total (127) gives a relative probability of the precipitation in any given year being less than the corresponding precipitation for the ranking number. For instance, the precipitation for Year 2009 was 1.15 inches and ranked #13. Dividing 13 by 127 and converting to percent gives 10.2%. Consequently, 1.15 inches of rain, or about 34 percent of average annual precipitation at Blythe, was considered the 10 percent probability dry year. The critical dry year was estimated in the same way and found to be approximately 0.72 inches of precipitation, or 21 percent of average precipitation (reference precipitation year 2000, ranking #4 of 127 giving 3.1 percent relative probability).

This section provides a revised baseline groundwater budget based on dry year and critical dry year conditions. The following assumptions were used:

- Recharge from precipitation is the primary factor in determining the dry year groundwater budgets. Dry years are expected to produce less recharge from precipitation, due to the fact that less runoff would generally be expected to occur in dry years, resulting in less runoff leading to infiltration. This would depend, of course, on the pattern, intensity and distribution of precipitation in a dry year, which is difficult to predict for the future. There is some evidence (USGS, 2007) that lower precipitation years may in general give a lower percentage of precipitation ending up as recharge, but the evidence is apparently not consistent, and data presented by the USGS (USGS, 2007) provides no information below 3 percent, which is the percentage used as a basis for the infiltration rate used in this analysis. Therefore, for purposes of this analysis a simplifying assumption was made that the reduction in infiltration to groundwater is in direct proportion to the reduction in precipitation. A dry year recharge is therefore estimated as 8,588 afy multiplied by 0.34 (the ratio of dry year to average year precipitation). This calculation gives 2,920 afy precipitation recharge for a dry year, and 1,803 afy for a critical dry year.
- Underflow from the Pinto Valley and Orocopia Groundwater Basins is assumed to be unaffected. Some dry-year effect could occur, especially in the case of multiple dry years, but the timing of the effect would probably be delayed, and the magnitude of the effect much reduced due to the volume of existing groundwater already in these basins.
- Irrigation return flow is assumed to be unaffected. The area is naturally very arid, and it is assumed that natural precipitation, which in normal years is infrequent, is of minor or negligible consideration in the determination of the amount of irrigation water needed yearly.
- Wastewater return flow is assumed to be unaffected for similar reasons as for irrigation
- Groundwater extraction is assumed to be unaffected by dry years for the same reasons as the irrigation return flow.
- Underflow to Palo Verde Mesa Groundwater Basin was assumed to be unaffected for the same reasons the inflow from the Pinto Valley and Orocopia Groundwater Basins was assumed to be unaffected.

- Evapotranspiration at Palen Dry Lake was assumed to be unaffected for the reason that a single dry year, or critical dry year, would result in a reduction of a maximum of 6,782 af of recharge. Given the size of the CVGB (940 square miles) a one-year reduction of this magnitude would only reduce the average groundwater level by about 0.14 inches. Evapotranspiration could be affected by a significant, long-term groundwater deficit, but for purposes of this analysis evapotranspiration was assumed to remain constant.

Tables 4 and 5 provide the assumed baseline groundwater budgets for a dry year and critical dry year. In both cases, a groundwater deficit is expected for the year, meaning groundwater withdrawals would exceed groundwater input. A dry year is expected to have a deficit of approximately 3,278 af, increasing to 4,395 af for a critical dry year.

Tables 6 and 7 provide the results of the same analysis using the reduced estimates of precipitation and underflow recharge. Each scenario, dry year and critical dry year, would have groundwater deficits, amounting to 8,045 afy and 8,312 afy, respectively.

**Table 4. Estimated Dry Year Groundwater Budget for the Chuckwalla Valley Groundwater Basin**

| Budget Components | Acre-Feet per Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation | 2,920 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins | 3,500 |
| Irrigation Return Flow | 800 |
| Wastewater Return Flow | 831 |
| Total Inflow | 8,051 |
| **Outflow** | |
| Groundwater Extraction | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin | –400 |
| Evapotranspiration at Palen Dry Lake | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | –3,278<br>**(–0.02% of total storage)** |

**Table 5. Estimated Critical Dry Year Groundwater Budget for the Chuckwalla Valley Groundwater Basin**

| Budget Components | Acre-Feet/Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation | 1,803 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins | 3,500 |
| Irrigation Return Flow | 800 |
| Wastewater Return Flow | 831 |
| Total Inflow | 6,934 |
| **Outflow** | |
| Groundwater Extraction | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin | –400 |
| Evapotranspiration at Palen Dry Lake | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | –4,395 **(–0.02% of total storage)** |

**Table 6. Estimated Dry Year Groundwater Budget for the Chuckwalla Valley Groundwater Basin Using Reduced Estimates of Precipitation and Subsurface Inflow**

| Budget Components | Acre-Feet/Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation | 700 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins | 953 |
| Irrigation Return Flow | 800 |
| Wastewater Return Flow | 831 |
| Total Inflow | 3,284 |
| **Outflow** | |
| Groundwater Extraction | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin | –400 |
| Evapotranspiration at Palen Dry Lake | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | –8,045<br>**(–0.05% of total storage)** |

**Table 7. Estimated Critical Dry Year Groundwater Budget for the Chuckwalla Valley Groundwater Basin Using Reduced Estimates of Precipitation and Subsurface Inflow**

| Budget Components | Acre-Feet/Year |
|---|---|
| **Inflow** | |
| Recharge from Precipitation | 433 |
| Underflow from Pinto Valley and Orocopia Valley Groundwater Basins | 953 |
| Irrigation Return Flow | 800 |
| Wastewater Return Flow | 831 |
| Total Inflow | 3,017 |
| **Outflow** | |
| Groundwater Extraction | –10,579 |
| Underflow to Palo Verde Mesa Groundwater Basin | –400 |
| Evapotranspiration at Palen Dry Lake | –350 |
| Total Outflow | –11,329 |
| **Budget Balance (Inflow – Outflow)** | –8,312<br>**(–0.06% of total storage)** |

## Multiple Dry Years

The Blythe precipitation data shows that in the 127 years of record from 1893 to 2019, the longest consecutive series of dry (10 percent) years on record is two. There are no consecutive critical dry years on record. A two-year string of dry years would result in a baseline groundwater deficit of twice the amount given in Table 4, or 6,556 af. A three-year string of dry years would result in a baseline groundwater deficit of 9,834 af (0.07% of total storage).

The longest consecutive series of years with below average precipitation on record at Blythe was 12 years, from 1893 to 1904. During this period the average annual rainfall was 1.42 inches, or about 42% of the overall average. This period was considered to be representative of a series of multiple dry years for the purposes of this analysis.

Table 8 presents the results of an estimated 12-year groundwater budget assuming a repeat of the 1893-1904 drought at Blythe, assuming without-project conditions. The results show that at the end of the 12-year period, the cumulative groundwater deficit would be approximately 31,486 af (0.2% of total storage). Table 9 shows the same analysis using the reduced estimates of precipitation and subsurface recharge. In that scenario, at the end of the 12-year period the cumulative groundwater deficit would be more than 94,652 af (0.6% of total storage).

**Table 8. Baseline Multiple Dry Year Groundwater Budget**

| Year | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Dry Year Reference Year | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 |
| Precipitation, in Inches | 1.75 | 2.16 | 1.84 | 1.29 | 2.84 | 1.30 |
| Precipitation as Percentage of Average | 51% | 63% | 54% | 38% | 83% | 38% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Dry Year Adjusted Recharge from Precipitation | 4,407 | 5,440 | 4,634 | 3,249 | 7,152 | 3,274 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 9,538 | 10,571 | 9,765 | 8,380 | 12,283 | 8,405 |
| Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –1,791 | –758 | –1,564 | –2,949 | 954 | –2,924 |
| Cumulative Budget Balance (Inflow – Outflow) | –1,791 | –2,549 | –4,113 | –7,062 | –6,107 | –9,031 |
| **Year** | **7** | **8** | **9** | **10** | **11** | **12** |
| Dry Year Reference Year | 1899 | 1900 | 1901 | 1902 | 1903 | 1904 |
| Precipitation, in Inches | 0.75 | 0.56 | 1.21 | 1.12 | 0.88 | 1.33 |
| Precipitation as Percentage of Average | 22% | 16% | 35% | 33% | 26% | 39% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Dry Year Adjusted Recharge from Precipitation | 1,889 | 1,410 | 3,047 | 2,821 | 2,216 | 3,350 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 7,020 | 6,541 | 8,178 | 7,952 | 7,347 | 8,481 |
| Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –4,309 | –4,788 | –3,151 | –3,377 | –3,982 | –2,848 |
| Cumulative Budget Balance (Inflow – Outflow) | –13,341 | –18,128 | –21,279 | –24,656 | –28,638 | –31,486 |

**Table 9. Baseline Multiple Dry Year Groundwater Budget Using Reduced Estimates of Precipitation and Subsurface Inflow**

| Year | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Dry Year Reference Year | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 |
| Precipitation, in Inches | 1.75 | 2.16 | 1.84 | 1.29 | 2.84 | 1.30 |
| Precipitation as Percentage of Average | 51% | 63% | 54% | 38% | 83% | 38% |
| Normal Recharge from Precipitation | 2,060 | 2,060 | 2,060 | 2,060 | 2,060 | 2,060 |
| Dry Year Adjusted Recharge from Precipitation | 1,057 | 1,305 | 1,112 | 779 | 1,716 | 785 |
| Other Groundwater Recharge (All Sources) | 2,584 | 2,584 | 2,584 | 2,584 | 2,584 | 2,584 |
| Total Groundwater Recharge | 3,641 | 3,889 | 3,696 | 3,363 | 4,300 | 3,369 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –7,688 | –7,440 | –7,633 | –7,966 | –7,029 | –7,960 |
| Cumulative Budget Balance (Inflow – Outflow) | –7,688 | –15,128 | –22,761 | –30,727 | –37,756 | –45,716 |
| **Year** | **7** | **8** | **9** | **10** | **11** | **12** |
| Dry Year Reference Year | 1899 | 1900 | 1901 | 1902 | 1903 | 1904 |
| Precipitation, in Inches | 0.75 | 0.56 | 1.21 | 1.12 | 0.88 | 1.33 |
| Precipitation as Percentage of Average | 22% | 16% | 35% | 33% | 26% | 39% |
| Normal Recharge from Precipitation | 2,060 | 2,060 | 2,060 | 2,060 | 2,060 | 2,060 |
| Dry Year Adjusted Recharge from Precipitation | 453 | 338 | 731 | 677 | 532 | 803 |
| Other Groundwater Recharge (All Sources) | 2,584 | 2,584 | 2,584 | 2,584 | 2,584 | 2,584 |
| Total Groundwater Recharge | 3,037 | 2,922 | 3,315 | 3,261 | 3,116 | 3,387 |
| Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –8,292 | –8,407 | –8,014 | –8,068 | –8,213 | –7,942 |
| Cumulative Budget Balance (Inflow – Outflow) | –54,008 | –62,415 | –70,429 | –78,497 | –86,711 | –94,652 |

## 6.2 Groundwater Budget with Arica and Victory Pass Solar Projects and Cumulative Projects

### Normal (Average) Year

All water for the project, regardless of source, would be derived from the CVGB. Total water use by the Projects will be up to 1,300 af for the 1.5-years of construction (650 af each), and up to 20 afy (10 afy each) for all subsequent 30 years (assumed) of operation, for a total of 1,900 af of water used by the project over the project life. Based on the budget balance given in Table 2, the CVGB under average-year conditions would have a cumulative surplus of 76,480 af during the same time period. The net CVGB surplus with the Projects in place would therefore be 73,783 af, or 97 percent of the surplus that would exist without the Projects. By contrast, using the reduced recharge rates for precipitation and underflow (Table 3), the 32-year deficit without the Projects would be 211,692 af, increased to 213,592 af by the Projects. The Projects would contribute about one percent to this cumulative deficit. The impact of each Project would be half of these described impacts.

For a single dry year and single critical dry year with the Projects in place, the worst-case scenario is for one of those years, dry or critical dry, to occur during the second year of construction in which total water use would be 766 af (397 af for Arica and 369 af for Victory Pass). During the second year of construction of both projects together, the CVGB annual groundwater deficit if a dry year or critical dry year occurs would be 4,044 and 5,161 af, respectively. By comparison to Tables 4 and 5, the Projects would increase the dry year deficit by 17 to 23 percent if a dry year or critical dry year occurs during the second year of construction. Assuming normal precipitation returns, this total deficit (dry year plus Project use) would be completely recovered in two to three years under both (dry and critical-dry) scenarios.

Using reduced inflow data, the single-year deficits depicted in Tables 6 and 7 are 8,045 af for dry and 8,312 af for critical dry years without the Projects. These deficits would increase to 8,811 and 9,078 afy for dry and critical dry years during the second year of construction (about a 10 percent deficit increase). Assuming normal precipitation returns after the dry year, this deficit would not be recovered during the project lifespan, with or without the project.

Cumulative projects that are projected or already constructed are listed in Table 10, with their projected water use. Water used for agriculture is not anticipated to increase so was not included in the cumulative projects. Peak agriculture in the Desert Center region occurred in 1994 with an estimated 6,100 acres under cultivation. Since then, agriculture has continued to decline with an estimated 2,100 acres under cultivation in 2016.

**Table 10. Cumulative Projects – Water Use Summary**

| Project Name | Construction Start (year) | Construction Duration (years) | Annual Construction Water Use (afy) | Annual Operational Water Use (afy) |
|---|---|---|---|---|
| Arica Solar Project | 2022–Summer | 1.5 | 397 (Second Year) | 10 |
| Victory Pass Solar Project | 2022–Summer | 1.3 | 369 (Second Year) | 10 |
| Palen Solar PV Project | 2019–October | 2.5 | 700 | 41 |
| Desert Sunlight Solar Farm | Completed | 2.2 | 600–650 | 0.3 |
| Red Bluff Substation | Completed | 2.2 | 150 | 0 |
| Eagle Mountain Gen-tie line | Completed | 1 | 6.25 | 0 |
| Eagle Mountain Pumped Storage Project[1] | 2020 | 4 | 4,456 | 2,050 |
| Desert Harvest Solar PV Project | 2019–October | 2 | 400-500 | 26–39 |
| Athos Solar Project | 2020–June | 2.5 | 200-180 | 15–40 |
| Oberon Renewable Energy Project[2] | 2022–Spring | 1.67 | 420 (Second Year) | 40 |

1 - In May 2019, FERC issued a retroactive extension of a two year extension of time to commence construction until June 2020. Under the America's Water Infrastructure Act of 2018, FERC could issue three additional two-year extensions up until June 2026. As no additional public information is known about the potential start date for construction of this Project, 2020 was assumed.

2 - This information was calculated based on acreage of project and general solar development assumptions. Annual construction water use is for Year 2 of construction. Total construction water use would be approximately 450 af.

Table 10 shows that the Projects contribute a little less than one percent of the total cumulative operational extractions, long-term. The Eagle Mountain Pumped Storage Project would use nearly 10 times the operational groundwater of all other cumulative projects combined.

Table 11 provides a 33-year (starting from the date of this analysis and assuming the Projects are in place for 30 years) groundwater budget projection for average years with Projects and all cumulative projects in place and assuming the Projects begin using water in the summer (mid-year), 2022. Only those cumulative projects that would withdraw groundwater during the assumed 2020 to 2053 period of analysis are included. Assuming an average precipitation year, there would be an initial groundwater overdraft of up to 11,527.5 af in the year 2024. The groundwater basin would then begin to slowly recover. By the end of the 30-year period of Arica and Victory Pass Solar Project operations, the cumulative groundwater deficit would be approximately –6,896.2 af (approximately 0.05% of total CVGB storage). Without the Arica and Victory Pass Solar Projects and all other cumulative projects in place, there would be a surplus of 81,260 af at the end of the 30-year period (Approximately 0.5% of total CVGB storage).

The same analysis using reduced infiltration and underflow estimates results in a total cumulative-project deficit of about 315,446 af (2.1% of total storage), to which the Arica and Victory Pass Solar Projects would contribute about 0.6 percent, or 1,900 af. Using these inflow estimates, the CVGB would not recover the overdraft with or without the Arica and Victory Pass Solar Projects.

**Table 11. 30-Year Projected CVGB Groundwater Budget for Solar Energy Projects Plus Cumulative Projects Using Adopted Precipitation and Underflow Recharge Estimates**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028* | 2053* |
|---|---|---|---|---|---|---|---|---|---|---|
| Arica Solar Project | 0.0 | 0.0 | 253.0 | 397.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Victory Pass Solar Project | 0.0 | 0.0 | 284.0 | 369.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Palen Solar PV Project | 700.0 | 700.0 | 390.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 |
| Desert Sunlight Solar Farm | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Eagle Mountain Pumped Storage Project | 0.0 | 4,456.0 | 4,456.0 | 4,456.0 | 4,456.0 | 2,050.0 | 2,050.0 | 2,050.0 | 2,050.0 | 2,050.0 |
| Desert Harvest Solar PV Project | 500.0 | 500.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 |
| Athos Solar Project | 200.0 | 200.0 | 120.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 | 39.0 |
| Oberon Renewable Energy Project | 0.0 | 0.0 | 280.0 | 420.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| **Total Used** | 1,400.3 | 5,856.3 | 5,822.3 | 5,762.3 | 4,636.3 | 2,230.3 | 2,230.3 | 2,230.3 | 2,230.3 | 2,230.3 |
| **CVGB Baseline Surplus** | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 | 2,390.0 |
| **CVGB Surplus Minus Total Use** | 989.7 | –3,466.3 | –3,432.3 | –3,372.3 | –2,246.3 | 159.7 | 159.7 | 159.7 | 159.7 | 159.7 |
| **Cumulative CVGB Surplus/Deficit** | 989.7 | –2,476.6 | –5,908.9 | –9,281.2 | –11,527.5 | –11,367.8 | –11,208.1 | –11,048.4 | –10,888.7 | –6,896.2 |

* All years between 2025 and 2053 have the same total water use of 2,241.3 afy. The CVGB baseline surplus is assumed to be the same (2,390 afy) for all those years. Consequently, in each of those years, which are not shown in the table, the cumulative CVGB deficit is reduced by 2,390 – 2,241.3 = 148.7 afy.

Note: This table begins in the year 2020 as this is the year this report was prepared. The 30-year time period is assumed to begin when the Arica and Victory Pass Solar Projects begin operations at the end of 2023.

## Multiple Dry Years

Table 12 provides a summary of the multiple dry year analysis using the same methods as described for Table 11, and assuming the Projects plus all cumulative projects are in place. At the end of the 12-year period representing the longest consecutive series of years with below average precipitation on record at Blythe, the cumulative groundwater deficit would be 67,780 af (0.5% of total storage). The Projects would contribute 1,500 af, about 2.1 percent, to this deficit. The same analysis using the reduced estimates of recharge and outflow result in a cumulative deficit of 130,946 af (0.9% of total storage). The Projects would cause about 1.1 percent of this deficit.

The rainfall record shows that a series of dry years has been followed by a series of years with above-average rainfall. To assess the probable effect of this over the 30-year life of the project, a 30-year running average analysis was made of the 127 years of record. This analysis, including the 30-year multiple-dry-year baseline calculation, is summarized in Tables 13 through 15.

The driest 30-year period was the period beginning in 1893 and ending in 1922. Average annual rainfall during this period was 3.05 inches, or about 89% of normal. Table 13 shows that if a repeat of this 30-year period occurs under current (no project) conditions, at the end of the 30-year period the CVGB would have a surplus of 44,274 af assuming adopted rainfall and infiltration conditions. The worst year of the drought-induced deficit in the CVGB would be the twelfth year (Year 2033 in Table 13), in which the total deficit would be 31,486 af. Recovery would then begin with total recovery by 2042, and as noted, there would be a groundwater surplus of 44,274 af by the end of 30 years. Using reduced recharge data, the same analysis results in a continually-increasing groundwater deficit ending at 207,129 af after 30 years.

The same analysis with the Projects in place but no other cumulative project gives similar results as the without-project condition, with total groundwater recovery occurring by 2043, and recovery to a surplus of 42,411 af at the end of 30 years. Using reduced recharge data, the same analysis, with the Projects in place, results in a continually-increasing groundwater deficit ending at 208,992 af after 30 years.

Table 14 provides the cumulative-project analysis. With all cumulative projects in place, the greatest CVGB deficit would occur in year 16 (assumed project year 2037) with a total deficit of 70,692 af, after which recovery would begin, but full recovery would not occur during the 30-year period. The CVGB would end the period with a 32,165-af deficit. Using reduced recharge data, the 30-year deficit would be 283,568 af.

**Table 12. Multiple Dry Year Groundwater Budget Analysis with the Arica and Victory Pass Solar Projects and All Cumulative Projects in Place, Assuming Adopted Recharge and Inflow Estimates**

| **Assumed Project Year** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** |
|---|---|---|---|---|---|---|
| **Dry Precipitation Reference Year** | **1893** | **1894** | **1895** | **1896** | **1897** | **1898** |
| Precipitation, in Inches | 1.75 | 2.16 | 1.84 | 1.29 | 2.84 | 1.30 |
| Precipitation as Percentage of Average | 51% | 63% | 54% | 38% | 83% | 38% |
| Normal Recharge from Precipitation, in Acre Feet | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Dry Year Adjusted Recharge from Precipitation, in Acre Feet | 4,407 | 5,440 | 4,634 | 3,249 | 7,152 | 3,274 |
| Other Groundwater Recharge (All Sources), in Acre Feet | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge, in Acre Feet | 9,538 | 10,571 | 9,765 | 8,380 | 12,283 | 8,405 |
| Baseline Groundwater Outflow, in Acre Feet | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Cumulative Project Groundwater Use, in Acre Feet | -5,822 | -5,762 | -4,636 | -2,230 | -2,230 | -2,230 |
| Total Groundwater Outflow, in Acre Feet | –17,151 | –17,091 | –15,965 | –13,559 | –13,559 | –13,559 |
| Budget Balance (Recharge + Outflow), in Acre Feet | –7,613 | –6,520 | –6,200 | –5,179 | –1,276 | –5,154 |
| **Cumulative Budget Balance, in Acre Feet** | **–7,613** | **–14,133** | **–20,334** | **–25,513** | **–26,789** | **–31,943** |
| **Assumed Project Year** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** |
| **Dry Precipitation Reference Year** | **1899** | **1900** | **1901** | **1902** | **1903** | **1904** |
| Precipitation, in Inches | 0.75 | 0.56 | 1.21 | 1.12 | 0.88 | 1.33 |
| Precipitation as Percentage of Average | 22% | 16% | 35% | 33% | 26% | 39% |
| Normal Recharge from Precipitation, in Acre Feet | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Dry Year Adjusted Recharge from Precipitation, in Acre Feet | 1,889 | 1,410 | 3,047 | 2,821 | 2,216 | 3,350 |
| Other Groundwater Recharge (All Sources), in Acre Feet | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge, in Acre Feet | 7,020 | 6,541 | 8,178 | 7,952 | 7,347 | 8,481 |
| Baseline Groundwater Outflow, in Acre Feet | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Cumulative Project Groundwater Use, in Acre Feet | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 |
| Total Groundwater Outflow, in Acre Feet | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 |
| Budget Balance (Recharge + Outflow), in Acre Feet | –6,539 | –7,018 | –5,381 | –5,608 | –6,212 | –5,079 |
| **Cumulative Budget Balance, in Acre Feet** | **–38,483** | **–45,501** | **–50,882** | **–56,489** | **–62,701** | **–67,780** |

**Table 13. 30-Year Projected CVGB Groundwater Budget in Acre Feet for Baseline (No Project) Conditions Using Adopted Precipitation and Underflow Recharge Estimates and Assuming a Repeat of the Driest 30 Years on Record at Blythe**

| **Assumed Project Year** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Precipitation Reference Year** | **1893** | **1894** | **1895** | **1896** | **1897** | **1898** | **1899** | **1900** | **1901** | **1902** |
| Rainfall, in Inches | 1.75 | 2.16 | 1.84 | 1.29 | 2.84 | 1.3 | 0.75 | 0.56 | 1.21 | 1.12 |
| Precipitation as Percentage of Average | 51% | 63% | 54% | 38% | 83% | 38% | 22% | 16% | 35% | 33% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Adjusted Recharge from Precipitation | 4,407 | 5,440 | 4,634 | 3,249 | 7,152 | 3,274 | 1,889 | 1,410 | 3,047 | 2,821 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 9,538 | 10,571 | 9,765 | 8,380 | 12,283 | 8,405 | 7,020 | 6,541 | 8,178 | 7,952 |
| Non-Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Total Groundwater Outflow | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –1,791 | –758 | –1,564 | –2,949 | 954 | –2,924 | –4,309 | –4,788 | –3,151 | –3,377 |
| Cumulative Budget Balance (Inflow – Outflow) | –1,791 | –2,549 | –4,113 | –7,062 | –6,107 | –9,031 | –13,341 | –18,128 | –21,279 | –24,656 |
| **Year** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** |
| **Precipitation Reference Year** | **1903** | **1904** | **1905** | **1906** | **1907** | **1908** | **1909** | **1910** | **1911** | **1912** |
| Rainfall, in Inches | 0.88 | 1.33 | 4.29 | 2.55 | 2.18 | 3.21 | 5.51 | 4.66 | 3.58 | 4.44 |
| Precipitation as Percentage of Average | 26% | 39% | 126% | 75% | 64% | 94% | 162% | 137% | 105% | 130% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Adjusted Recharge from Precipitation | 2,216 | 3,350 | 10,804 | 6,422 | 5,490 | 8,084 | 13,877 | 11,736 | 9,016 | 11,182 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 7,347 | 8,481 | 15,935 | 11,553 | 10,621 | 13,215 | 19,008 | 16,867 | 14,147 | 16,313 |
| Non-Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Total Groundwater Outflow | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | –3,982 | –2,848 | 4,606 | 224 | –708 | 1,886 | 7,679 | 5,538 | 2,818 | 4,984 |
| Cumulative Budget Balance (Inflow – Outflow) | –28,638 | –31,486 | –26,880 | –26,656 | –27,364 | –25,477 | –17,799 | –12,261 | –9,442 | –4,458 |
| **Year** | **2042** | **2043** | **2044** | **2045** | **2046** | **2047** | **2048** | **2049** | **2050** | **2051** |
| **Precipitation Reference Year** | **1913** | **1914** | **1915** | **1916** | **1917** | **1918** | **1919** | **1920** | **1921** | **1922** |
| Rainfall, in Inches | 4.8 | 5.82 | 3.88 | 3.64 | 1.82 | 6.64 | 3.66 | 4.51 | 7.08 | 2.11 |
| Precipitation as Percentage of Average | 141% | 171% | 114% | 107% | 53% | 195% | 107% | 132% | 208% | 62% |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Adjusted Recharge from Precipitation | 12,089 | 14,658 | 9,772 | 9,167 | 4,584 | 16,723 | 9,218 | 11,358 | 17,831 | 5,314 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 17,220 | 19,789 | 14,903 | 14,298 | 9,715 | 21,854 | 14,349 | 16,489 | 22,962 | 10,445 |
| Non-Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Total Groundwater Outflow | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Budget Balance (Inflow – Outflow) | 5,891 | 8,460 | 3,574 | 2,969 | –1,614 | 10,525 | 3,020 | 5,160 | 11,633 | –884 |
| Cumulative Budget Balance (Inflow – Outflow) | 1,432 | 9,892 | 13,466 | 16,435 | 14,820 | 25,345 | 28,365 | 33,525 | 45,158 | 44,274 |

**Table 14. 30-Year Projected CVGB Groundwater Budget in Acre Feet Using Adopted Precipitation and Underflow Recharge Estimates and Assuming a Repeat of the Driest 30 Years on Record at Blythe, with all Cumulative Projects in Place**

| **Year** | **2022** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | **2031** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Precipitation Reference Year** | **1893** | **1894** | **1895** | **1896** | **1897** | **1898** | **1899** | **1900** | **1901** | **1902** |
| Rainfall, in Inches | 1.75 | 2.16 | 1.84 | 1.29 | 2.84 | 1.3 | 0.75 | 0.56 | 1.21 | 1.12 |
| Precipitation as Percentage of Average | 51% | 63% | 54% | 38% | 83% | 38% | 22% | 16% | 35% | 33% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Adjusted Recharge from Precipitation | 4,407 | 5,440 | 4,634 | 3,249 | 7,152 | 3,274 | 1,889 | 1,410 | 3,047 | 2,821 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 9,538 | 10,571 | 9,765 | 8,380 | 12,283 | 8,405 | 7,020 | 6,541 | 8,178 | 7,952 |
| Non–Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Project Groundwater Outflow (All Cumulative Projects) | –5,822 | –5,762 | –4,636 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 |
| Total Groundwater Outflow | –17,151 | –17,091 | –15,965 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 |
| Budget Balance (Inflow – Outflow) | –7,613 | –6,520 | –6,200 | –5,179 | –1,276 | –5,154 | –6,539 | –7,018 | –5,381 | –5,608 |
| Cumulative Budget Balance (Inflow – Outflow) | **–7,613** | **–14,133** | **–20,334** | **–25,513** | **–26,789** | **–31,943** | **–38,483** | **–45,501** | **–50,882** | **–56,489** |
| **Year** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** |
| **Precipitation Reference Year** | **1903** | **1904** | **1905** | **1906** | **1907** | **1908** | **1909** | **1910** | **1911** | **1912** |
| Rainfall, in Inches | 0.88 | 1.33 | 4.29 | 2.55 | 2.18 | 3.21 | 5.51 | 4.66 | 3.58 | 4.44 |
| Precipitation as Percentage of Average | 26% | 39% | 126% | 75% | 64% | 94% | 162% | 137% | 105% | 130% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Adjusted Recharge from Precipitation | 2,216 | 3,350 | 10,804 | 6,422 | 5,490 | 8,084 | 13,877 | 11,736 | 9,016 | 11,182 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 7,347 | 8,481 | 15,935 | 11,553 | 10,621 | 13,215 | 19,008 | 16,867 | 14,147 | 16,313 |
| Non–Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Project Groundwater Outflow (All Cumulative Projects) | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 |
| Total Groundwater Outflow | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 |
| Budget Balance (Inflow – Outflow) | –6,212 | –5,079 | 2,376 | –2,006 | –2,938 | –344 | 5,448 | 3,308 | 588 | 2,754 |
| Cumulative Budget Balance (Inflow – Outflow) | **–62,701** | **–67,780** | **–65,404** | **–67,410** | **–70,348** | **–70,692** | **–65,244** | **–61,936** | **–61,348** | **–58,594** |
| **Year** | **2042** | **2043** | **2044** | **2045** | **2046** | **2047** | **2048** | **2049** | **2050** | **2051** |
| **Precipitation Reference Year** | **1913** | **1914** | **1915** | **1916** | **1917** | **1918** | **1919** | **1920** | **1921** | **1922** |
| Rainfall, in Inches | 4.8 | 5.82 | 3.88 | 3.64 | 1.82 | 6.64 | 3.66 | 4.51 | 7.08 | 2.11 |
| Precipitation as Percentage of Average | 141% | 171% | 114% | 107% | 53% | 195% | 107% | 132% | 208% | 62% |
| Normal Recharge from Precipitation | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 | 8,588 |
| Adjusted Recharge from Precipitation | 12,089 | 14,658 | 9,772 | 9,167 | 4,584 | 16,723 | 9,218 | 11,358 | 17,831 | 5,314 |
| Other Groundwater Recharge (All Sources) | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 | 5,131 |
| Total Groundwater Recharge | 17,220 | 19,789 | 14,903 | 14,298 | 9,715 | 21,854 | 14,349 | 16,489 | 22,962 | 10,445 |
| Non–Project Groundwater Outflow (All Sources) | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 | –11,329 |
| Project Groundwater Outflow (All Cumulative Projects) | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 | –2,230 |
| Total Groundwater Outflow | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 | –13,559 |
| Budget Balance (Inflow – Outflow) | 3,660 | 6,229 | 1,343 | 739 | –3,845 | 8,294 | 789 | 2,930 | 9,403 | –3,114 |
| Cumulative Budget Balance (Inflow – Outflow) | **–54,934** | **–48,705** | **–47,361** | **–46,622** | **–50,467** | **–42,173** | **–41,383** | **–38,453** | **–29,051** | **–32,165** |

# 7. Analysis Summary and Conclusions

The following provides a summary of the results of the analysis presented above.

- Table 2 shows that under normal precipitation conditions and using precipitation recharge and the adopted subsurface inflow recharge estimates, the CVGB would have a baseline surplus of approximately 2,390 afy, which means there could be a sustainable yield of groundwater extraction across the basin in that amount. Table 3, based on lower precipitation and subsurface inflow estimates available in the literature, shows that the CVGB could already be in an overdraft condition of 6,685 afy, and is and will continue to lose groundwater unless current pumping is curtailed. In this case, any additional extractions would increase the overdraft unless replaced by additional inflow.
- Tables 4 through 7 show that there will be a groundwater deficit in dry years and critical dry years (10 percent and 3 percent probability) under current conditions. The magnitude of the deficit depends on the recharge input assumptions.
- Tables 8 and 9 show that under current extraction conditions a repeat of the worst sustained drought on record at Blythe, 12 years of below-average precipitation, will likely result in cumulative groundwater overdrafts of 31,612 af to 94,682 af. Unless compensated by subsequent high-precipitation years, this would likely become a new baseline groundwater level. This cumulative overdraft would represent roughly 0.2 percent to 0.6 percent of the total groundwater in the basin[1].
- Under normal conditions, the addition of the Projects to the existing condition would not create an overdraft in the CVGB, assuming adopted recharge estimates, and would have little effect on the cumulative surplus that is expected. Assuming reduced recharge estimates, the Projects would contribute about 1 percent to a 30-year projected overdraft.
- Table 11 shows that with all cumulative projects in place, and using adopted recharge estimates, the CVGB would suffer an initial overdraft of about 11,527.5 af in 2024, due to the higher use of water during project construction, and then begin to recover. In other words, after construction is complete, operation water use will be slightly less than the safe yield estimate of 2,390 afy. Long-term cumulative operational use is estimated at 2,230.3 afy, to which the Projects would contribute about 0.9 percent (about 0.45 percent for each of the Projects). The Projects contribution would have little effect on the rate of groundwater use or recovery. At the end of 30 years, the total cumulative deficit would be about 6,896 af.
- Using reduced recharge estimates the CVGB, now in overdraft, would be in more severe overdraft with cumulative projects in place, resulting in a cumulative 30-year overdraft of 315,446 af.
- Table 12 shows that under a repeat of the multiple dry year scenario based on the 1893 to 1904 drought, cumulative projects would exacerbate the cumulative overdraft shown in Table 8. With projects in place and adopted recharge estimates, the cumulative overdraft would be 67,780 af to which the Projects would contribute about 2.1 percent. Using reduced recharge estimates, there would be a cumulative overdraft of 130,946 af at the end of the drought, to which the Projects would contribute about 1.1 percent.

[1] For comparison purposes, using the reduced groundwater storage amount (10,000,000 AF), cumulative overdraft would represent roughly 0.3 percent to 0.9 percent of the total groundwater in the basin.

## Groundwater Budget Reliability Considerations

The groundwater budgets presented in this WSA are based on assumptions that could affect the reliability of the budget projections. These assumptions are based on the best available data from the sources cited in this document. The following is a discussion of these assumptions, and other considerations, and their implications on the groundwater budgets.

Recharge from precipitation is an important component of the groundwater budget, and alone can make a difference to whether the groundwater basin is in a condition of surplus or overdraft. The amount of recharge from precipitation is difficult to estimate. The estimate used in this analysis, 8,588 afy, represents 3% of the total average annual precipitation on the CVGB watershed, and is considered a reasonable estimate of the reported recharge range from previous studies. The overall groundwater budget is very sensitive to the precipitation input. For instance, if the recharge by precipitation is as low as 2.4% of total annual precipitation (6,198 afy), the baseline groundwater budget would give a net budget balance of zero, and all project scenarios presented above would result in a groundwater deficit. If recharge from precipitation is as high as 6% of total rainfall, which is within the probable range of recharge estimated by the USGS (USGS, 2007) and Energy Commission (CEC, 2015), there would be no groundwater deficit in any year under the cumulative scenario except under the lower subsurface inflow estimates used in this report as a likely lower boundary of inflow, for which the 30-year cumulative deficit would be only about 25,000 af (less than 0.2 percent of total storage).

Although the lower CVGB recharge estimates were used in this analysis to illustrate a possible worst-case estimate showing the CVGB currently in deficit, recent short-term (2012 to 2018) groundwater monitoring information from the USGS (USGS, 2020) indicate that groundwater levels in the eastern portion of the CVGB may be stable or slightly rising, which could indicate that the CVGB is not currently in overdraft and the adopted recharge estimates may be more accurate than the reduced recharge estimates.

Precipitation reliability could be uncertain should there be shifts in the future climate of the area.

All other groundwater budget input parameters are best estimates subject to uncertainty. The cumulative project list includes projects that are still under consideration and which could be altered or cancelled in the future. Other projects could be proposed, and projects could use other water sources than the CVGB. Changes in future projects could have substantial effects on the groundwater budget.

## Conclusions

It is determined that the Projects, either as two separate projects or as a single project, can draw anticipated water needs from the CVGB without resulting in an overdraft of the groundwater basin under normal (average precipitation) conditions using adopted higher inflow rates. The normal-year baseline groundwater budget for the CVGB shows a surplus of 2,390 af, which is more than the total yearly need for construction by the Projects, and far more than the annual operating water needs. However, this water may be needed for other purposes so water conservation where possible is encouraged. The total 30-year projected water use of the Projects is less than the annual baseline water surplus for the CVGB. Monitoring of groundwater is limited in the basin and thus tracking changes in groundwater levels will be difficult.

The multiple dry year analysis shows that a repeat of the longest consecutive dry period on record the cumulative projects would result in a total groundwater deficit of approximately 0.5% of total CVGB storage. A similar analysis using the driest 30-years on record shows that after the initial very-dry period groundwater would begin to recover but with cumulative projects in place full recovery would not occur during that time and the CVGB would end with a 32,165-af deficit (about 0.2% of total storage).

# References

AECOM. 2011. Desert Sunlight Solar Farm Project: Response to Public Comments Regarding Potential Relationship Between Groundwater Pumping Levels and Impacts to the Colorado River. Appendix O – Accounting Surface Technical Memorandum. Prepared for Bureau of Land Management, Palm Springs–South Coast Field Office. January 5. [online]: http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/ palmsprings/desert_sunlight.Par.92719.File.dat/Desert%20Sunlight%20FEIS%20appendix%20N-O.pdf. Accessed July 25, 2016.

_____. 2010. Water Supply Assessment, Palen Solar Power Project, Riverside County, California. California Energy Commission.

Argonne (Argonne National Laboratory). 2013, A Groundwater Model to Assess Water Resource Impacts at the Riverside East Solar Energy Zone. Environmental Science Division, U.S. Department of Energy, Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN. ANL/EVS/R-13/8.

Aspen (Aspen Environmental Group). 2018. Palen Solar Project Water Supply Assessment. Appendix G. Final Supplemental Environmental Impact Statement/Environmental Impact Report/Land Use Plan Amendment. Index No. BLM/CA/PL-2017/012+1793+2050, CA State Clearinghouse No. 2011054002

BLM (Bureau of Land Management). 2012. Desert Harvest Solar Project Final Environmental Impact Statement and Proposed California Desert Conservation Area Plan Amendment. United States Department of the Interior Bureau of Land Management, Palm Springs– South Coast Field Office, Palm Springs, CA. CACA-49491.

_____. 2011. Plan Amendment Final EIS for the Palen Solar Power Project. United States Department of the Interior Bureau of Land Management, Palm Springs–South Coast Field Office, Palm Springs, CA. DOI Control No. FES 11-06.

CDWR (California Department of Water Resources). 2016. Groundwater Information Center Interactive Map Application.

_____. 2015. California's Groundwater Update 2013. A Compilation of Enhanced Content for California Water Plan Update 2013. Colorado River Hydrologic Region.

_____. 2004. Chuckwalla Valley Groundwater Basin Description. California's Groundwater Bulletin 118.

_____. 1979. Sources of Powerplant Cooling Water in the Desert Area of Southern California – Reconnaissance Study. Bulletin 91-24.

CEC (California Energy Commission). 2015. Palen Solar Power Project Revised Staff Assessment Part II. CEC-700-2010-007-REV-PT2, Docket Number 09-AFC-07.

_____. 2010. ECE Pump Storage Presentation. Eagle Mountain Pumped Storage Project. Docket Number 15-MISC-05.

NOAA (National Oceanic and Atmospheric Administration). 2020. Global Summary of the Year Station Details Blyth ASOS, CA, US. [online]: https://www.ncdc.noaa.gov/cdo-web/datasets/GSOY/stations/GHCND:USW00023158/detail. Accessed May 1, 2020.

RWQCB (California Regional Water Quality Control Board). 2006. Water Quality Control Plan, Colorado River Basin, Region 7.

ECEC (Eagle Crest Energy Company). 2008. Eagle Mountain Pumped Storage Project Draft License Application Exhibit E, Volume 1, Public Information. Submitted to Federal Energy Regulatory Commission.

FERC (Federal Energy Regulatory Commission). 2014. Order Issuing Original License, Eagle Crest Energy Company, Project No. 13123-002. June 19, 2014.

SWRCB (State Water Resources Control Board). 2013. Eagle Mountain Pumped Storage Project FERC 13123 Final Environmental Impact Report July 2013. https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/eagle_mountain_pumped_ferc13123/eir/vol2/em_feir_3_3.pdf. Accessed September 30, 2020.

USGS (United States Geological Survey). 2013. R.R. Everett, A.A. Brown, and G.A. Smith. Chuckwalla Valley Multiple-well Monitoring Site, Chuckwalla Valley, Riverside County, California Open-File Report 2013–1221.October 2013

USGS (United States Geological Survey). 2020. Groundwater Levels for California. [online]: https://nwis.waterdata.usgs.gov/ca/nwis/gwlevels/?site_no=333527114511901, https://nwis.waterdata.usgs.gov/ca/nwis/gwlevels/?site_no=333527114511902, https://nwis.waterdata.usgs.gov/ca/nwis/gwlevels/?site_no=333527114511903. Accessed May 1, 2020.

_____. 2007. Ground-Water Recharge in the Arid and Semiarid Southwestern United States. Professional Paper 1703.

USHCN (U.S. Historical Climatology Network). 2016. Monthly Data Site 040924. BLYTHE, California. [online]: https://www.ncdc.noaa.gov/cdo-web/datasets/GSOY/stations/GHCND:USC00040924/detail. Accessed June 30, 2016.

Westwood (Westwood Professional Services). 2018. Preliminary Hydrology Study for Athos Solar Project. Prepared for Intersect Power, LLC, 2 Embarcadero Center, 7th Floor, San Francisco, CA 94111. Prepared by Westwood Professional Services, 12701 Whitewater Drive, Suite 300, Minnetonka, MN 55343.

Wilson, Richard P., and Owen-Joyce, Sandra J. 1994. Method to Identify Wells That Yield Water That Will Be Replaced by Colorado River Water in Arizona, California, Nevada, and Utah. U.S. Geological Survey Water-Resources Investigations Report 94-4005.

WorleyParsons. 2009. Groundwater Resources Investigation Genesis Solar Energy Project, Riverside County, California WorleyParsons Infrastructure and Environment, 2330 East Bidwell St, Suite 150, Folsom, CA.

# Figures

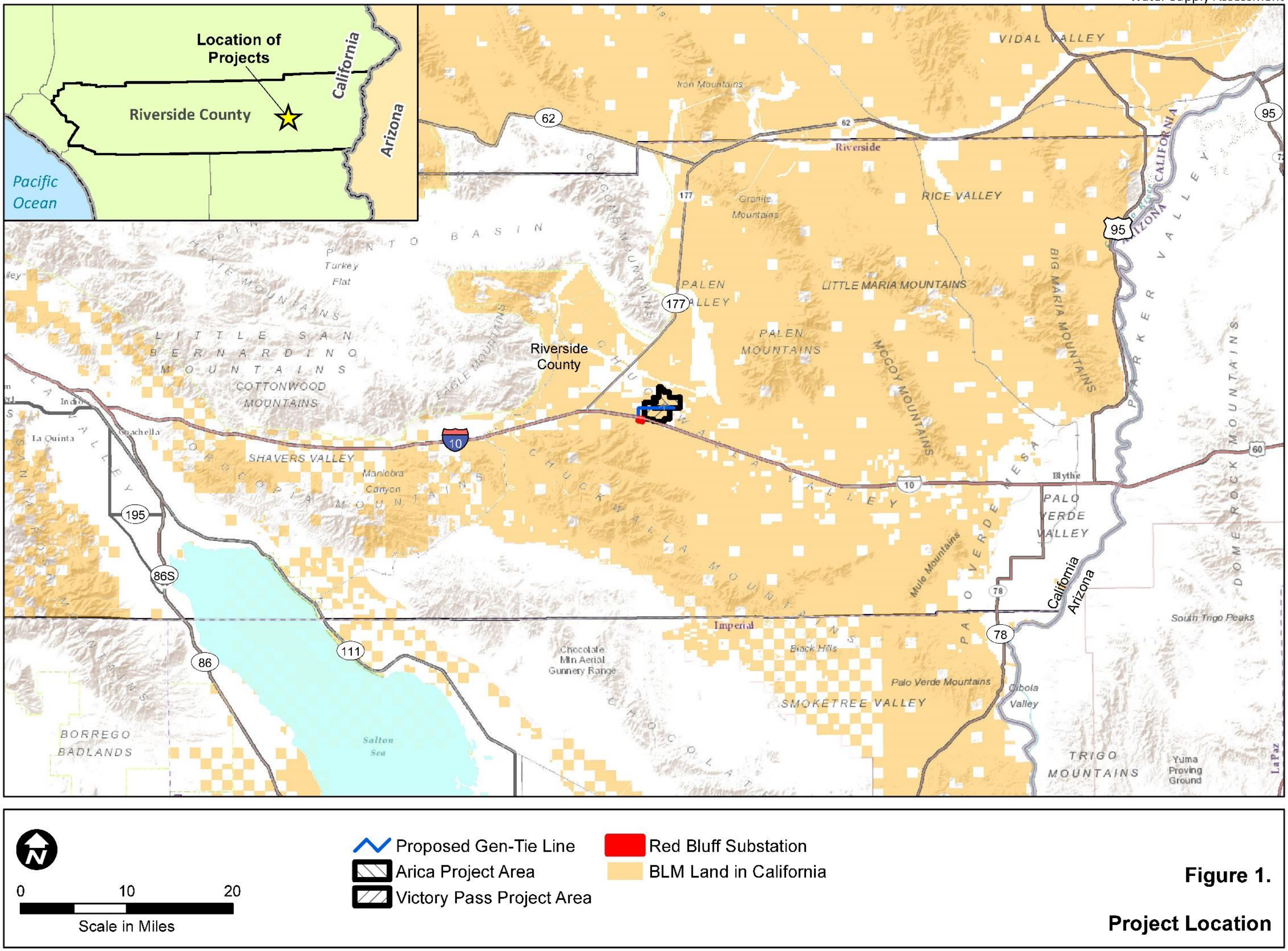


**Figure 1.**

**Project Location**

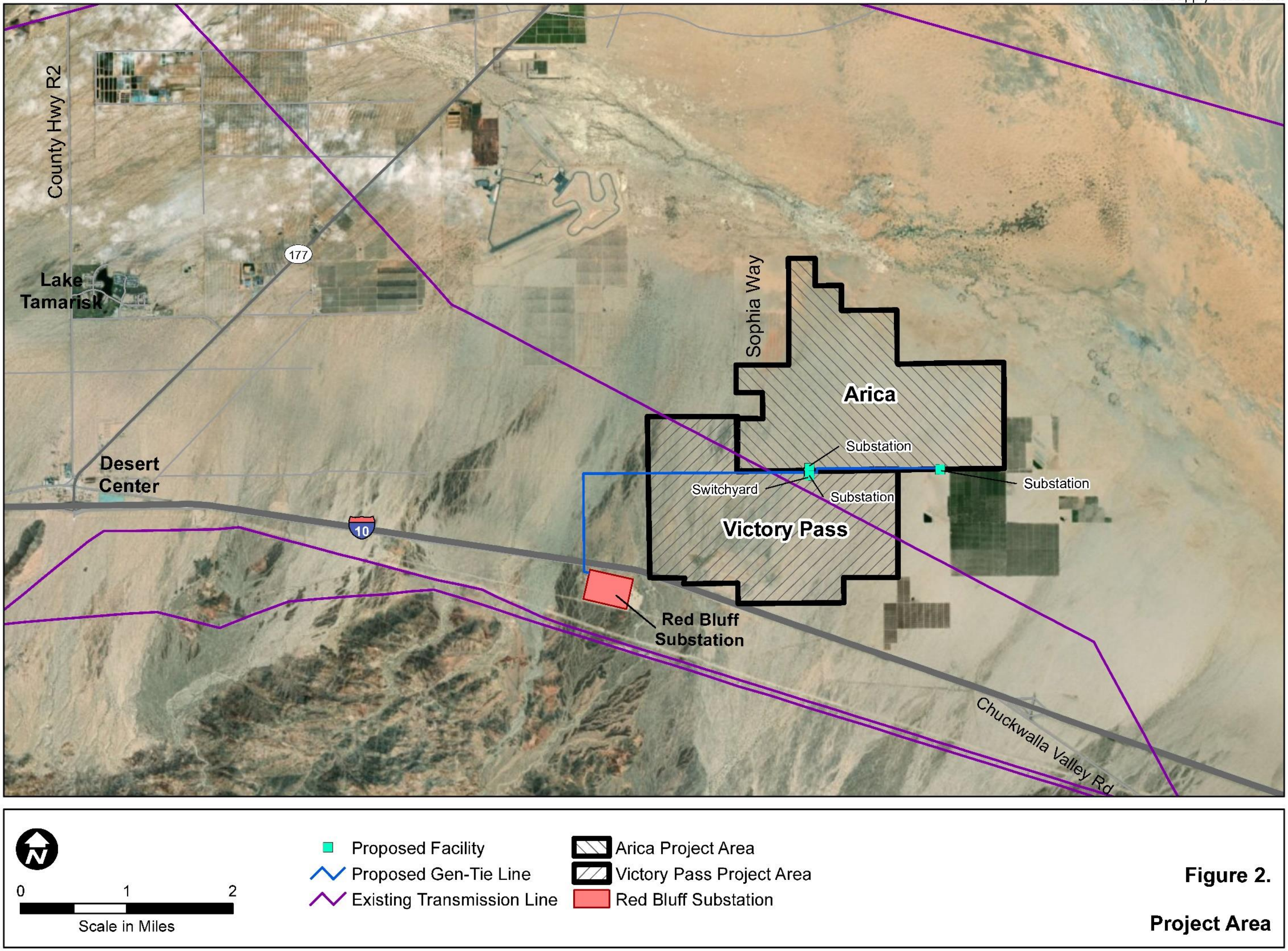


**Figure 2.**

**Project Area**

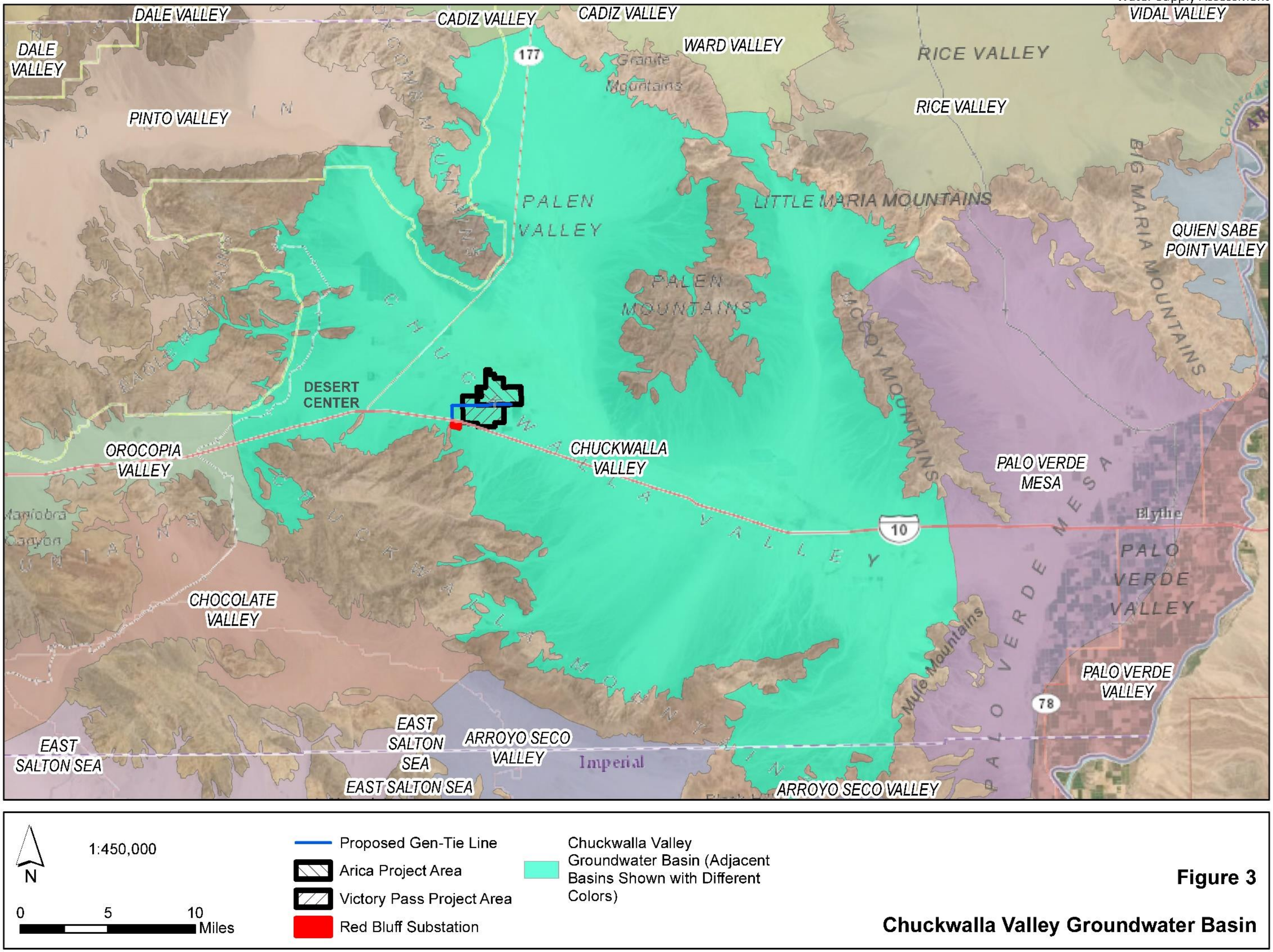


**Figure 3**

**Chuckwalla Valley Groundwater Basin**