APPENDIX E

Water Supply Assessment

Prepared by

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April 2019

Water Supply Assessment

Aquamarine Solar Project
and
Gen-Tie Line

Kings and Fresno Counties, California

Prepared for:

Bert Verrips, AICP, Environmental Consulting

April 2019

Karen E. Johnson
Water Resources Planning

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CHAPTER 1 – INTRODUCTION

BACKGROUND AND PURPOSE

This Water Supply Assessment (WSA) was prepared for Bert Verrips, AICP, Environmental Consulting, the firm preparing the Initial Study/Mitigated Negative Declaration (IS/MND) for the Aquamarine Solar Project (project) on behalf of the Kings County Community Development Agency (CDA). CDA is the lead agency conducting the environmental review of the project.

The primary purpose of the WSA is to determine if there is sufficient water supply to meet the demands of the project and future water demands under normal and dry water years over the next 20 years. The WSA will be included in the IS/MND prepared for the project pursuant to the California Environmental Quality Act (CEQA). This forms the basis for an assessment of water supply sufficiency in accordance with the requirements of California Water Code §10910, *et seq.* The WSA was prepared in conformance with the requirements of Senate Bill 610 (Chapter 643, Statutes of 2001) (referred to here as SB 610). SB 610 was adopted, along with a companion measure Senate Bill 221 effective January 1, 2002, to improve the nexus between land use planning and water supply availability. Information regarding water supply availability is to be provided to local public agency decision makers prior to approval of development projects that meet or exceed specific criteria.

- A proposed residential development of more than 500 dwelling units.
- A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.
- A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space.
- A proposed hotel or motel, or both, having more than 500 rooms.
- A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area.
- A mixed-use project that includes one or more of the projects defined above.
- A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project

SB 610 was not originally clear on whether renewable energy projects are subject to SB 610 and require a WSA. However, SB 267 was signed into law on October 8, 2011, amending California's Water Law to revise the definition of "project" specified in SB 610. Under SB 267, wind and photovoltaic projects which consume less than 75 acre-feet per year (afy) of water are not considered to be a "project" under SB 610. As discussed in Chapter 2, a water demand of 205 afy may be needed for construction over two years, with an ongoing annual operational demand of 32.6 afy after construction is completed.

There is no public potable water system available or needed to serve the project. The project site is located within the boundaries of Westlands Water District (District) which provides irrigation water to users within its jurisdiction. The District does not deliver treated water for human consumption and is not considered a public water system. Water required during construction and operation of the project does not need to be treated for human consumption and will be obtained from groundwater wells and/or from the District. There is no Urban Water Management Plan (UWMP) that accounts for the project water demands because UWMPs are prepared by urban water suppliers. The District is not considered an urban water supplier and is not required to prepare an UWMP.

DESCRIPTION OF THE PROPOSED PROJECT

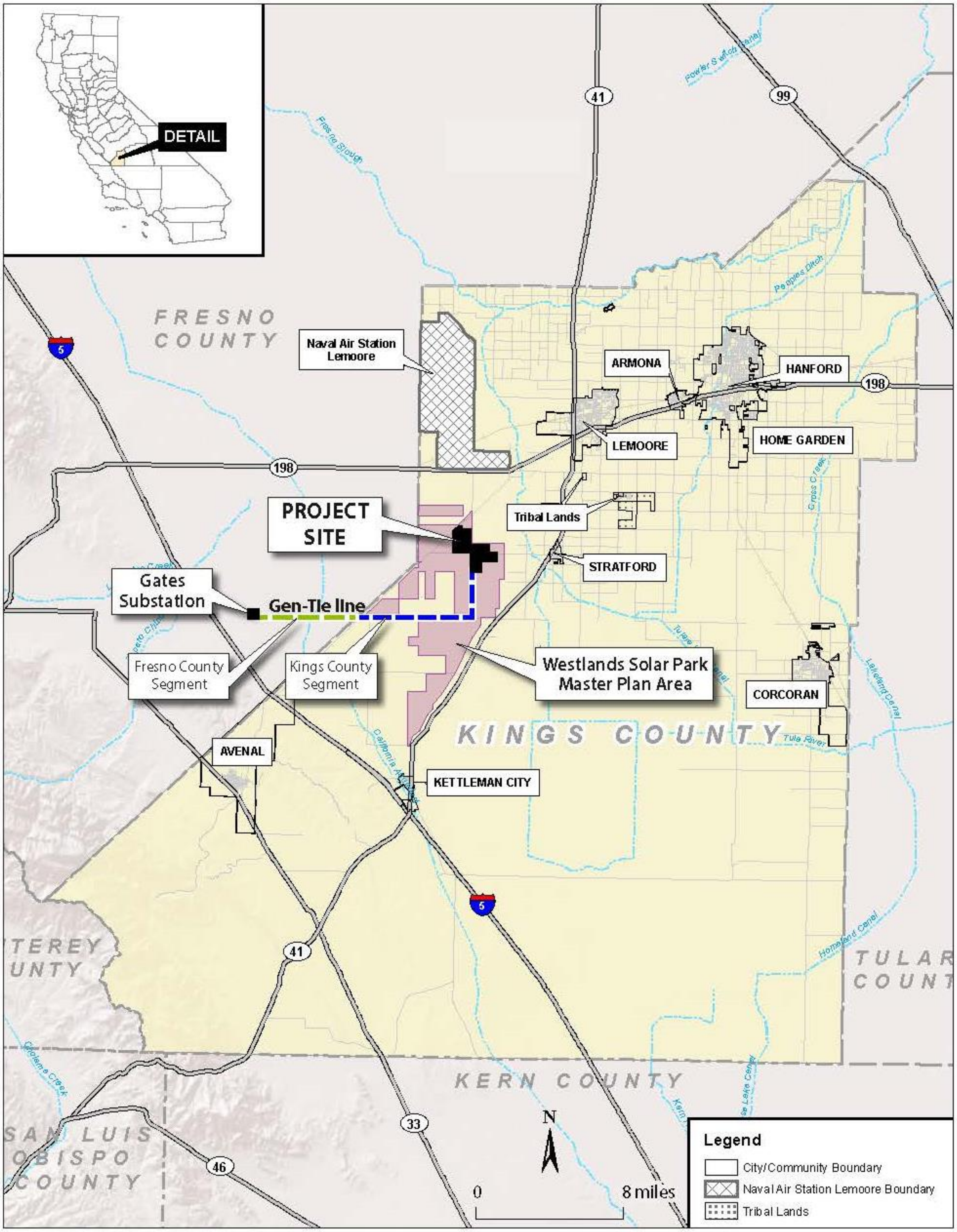

Solar panels

The Aquamarine Solar project is planned as a 250-MW solar generating facility located on a 1,825-acre site centered at the intersection of Laurel Avenue and 25th Avenue in west-central Kings County. The Aquamarine Solar project is an integral project within the Westlands Solar Park (WSP) Master Plan area which is planned for a series of large utility-scale photovoltaic (PV) solar energy generating facilities on a total area of approximately 20,900 acres. The Master Plan area is in unincorporated west-central Kings County, south of Naval Air Station Lemoore, as shown on Figure 1. The Water Supply Assessment prepared for the WSP Master Plan in 2017 is referred to in this document (WWD, 2017).

The project site is within the Westlands Competitive Renewable Energy Zone (CREZ) as identified through the Renewable Energy Transmission Initiative (RETI). As shown on Figure 1, the plan area is generally located south of SR-198, west of SR-41, and east of the Fresno County line. Almost half (9,800 acres) of the WSP Master Plan area has been retired from irrigated agricultural uses while the remaining irrigated lands (11,100 acres) purchase water from the District and/or pump groundwater.

The proposed project also includes the construction of a 15-mile transmission generation-interconnection tie lines (gen-ties) extending from the Aquamarine Solar project site to the Gates Substation in Fresno County to the west. This gen-tie line was also included in the WSP Master Plan which plans for two 230-kV generation-interconnection tie-lines (gen-ties) which will deliver solar-generated power to the California grid at Gates Substation.

The Westlands Solar Park Master Plan provides a planning framework for the comprehensive and orderly development of renewable solar energy resources within the WWD CREZ. The total peak generating capacity of the project is estimated to be approximately 2,000 megawatts (MW) based on current solar PV technology and collection systems. The Program EIR on the Westlands Solar Park Master Plan and Gen-Tie Corridors Plan was certified by the Westlands Water District Board of Directors on January 16, 2018. The Program EIR was prepared in coordination with the Kings County Community Development Agency staff, who plan to use the Program EIR as a first tier CEQA document in the preparation of subsequent MNDs prepared on individual solar projects proposed within the WSP Master Plan area.



Source: Kings County Community Development Agency

Map Source: Bert Verrips, AICP, Environmental Consulting

Regional Location
Figure 1

The development of Westlands Solar Park is planned to occur through the incremental installation of individual solar projects privately developed over a 12 year period from 2019 through 2030. The Aquamarine Solar project represents the first major solar project to be constructed within the WSP Master Plan area.

The Aquamarine Solar project will largely consist of solar modules mounted on a series of horizontal single-axis trackers to be oriented in north-south rows which will rotate the solar arrays in an east-west direction. The solar modules generate direct current (DC) power and the electricity travels via underground cables to inverters to be converted to alternating current (AC) power. Since the solar facilities will not have permanent on-site staff, wastewater generated by workers visiting the solar facilities for maintenance activities will be held in septic tanks that will be regularly serviced by a private septic pumping contractor, with the collected wastewater disposed of at an approved wastewater treatment facility in the area.

Chapter 2 of this WSA provides a discussion of future project water demands and historical site demands. Water supply information is provided in Chapter 3. The comparison of water demands with supplies and the reliability of supplies is provided in Chapter 4 followed by the sufficiency findings in Chapter 5.

CHAPTER 2 – WATER DEMANDS

The regional climatic characteristics are summarized along with projected project water demands and current water production requirements for the site.

CLIMATIC CONDITIONS

The project area is in the semi-arid San Joaquin Valley. Temperatures during the summer are hot, frequently exceeding 100 degrees Fahrenheit. Cool winters occasionally fall below freezing. Average maximum and minimum temperatures are presented in Table 1 for the closest station which is near Kettleman City. The growing season is long with most rainfall occurring between November and April. As presented in Table 1, the average annual precipitation is 6.6 inches. With climate change, the State Department of Water Resources (DWR) expects a reduced snowpack, spring runoff shifting to earlier in the year, more frequent and extreme dry periods, and shorter winters.

Table 1. Climate Data[1]

Month	Average Maximum Temperature (F)	Average Minimum Temperature (F)	Average Precipitation (inches)
January	55.2	35.2	1.38
February	62.1	39.7	1.18
March	68.1	42.9	0.82
April	74.3	47.2	0.69
May	84.4	54.5	0.31
June	93.0	61.7	0.06
July	100.1	68.0	0.01
August	98.6	66.5	0.03
September	92.1	60.7	0.09
October	80.6	52.0	0.27
November	67.1	41.8	0.72
December	56.1	35.7	1.08
Annual	**77.6**	**50.5**	**6.64**

Source: Temperature and precipitation from Kettleman City, Ca #044534, Western Regional Climate Center for period of record February 1955 through June 2016. (WRCC, 2018)

PROJECT WATER DEMANDS

Water demands for the Aquamarine Solar project consist of temporary construction demands over a two year period and long term operational demands for washing the solar modules and controlling site vegetation.

Construction Water Use

The highest water demands are associated with construction in preparing the site for the solar arrays and trenching for conduit. During this earthwork phase of construction, non-potable water will be used for dust control. Based on past experience with similar solar projects, each acre of construction area will require 0.2 acre-feet of water during construction, as presented in Table 2.

Table 2. Water Demand Factors

Activity	Water Use	Unit
Construction – Dust Control		
Aquamarine Solar Project Area	0.2	af/acre
Gen-Tie Line	0.2	af/acre
Operations		
Panel Washing	38,999	gal/MW/yr
Sheep Grazing	728	gal/MW/yr
General Operations	2,000	gal/MW/yr
Total Operational Demands	41,727	gal/MW/yr

Source: Bert Verrips, AICP, Environmental Consulting, 2019.

The 250-MW project will occupy a total site area of 1,825 acres resulting in total construction water demand of 365 acre-feet spread over two years. This is an average of 182.5 afy for the solar project. Construction demands are presented in Table 3.

Construction of the gen-tie line would involve a total ground disturbance area of 227 acres (at the transmission tower sites, staging area, and pulling/tensioning sites). At a water application rate of 0.2 af/acre, the total water required for dust control during gen-tie line construction would be 45.4 acre-feet, with an annual average of 22.7 afy. Total average annual construction demands during the two year period for the solar project and the gen-tie line are approximately 205 afy.

Table 3. Project Water Demands

Activity	Water Use[1]	Unit
Construction		
Aquamarine Solar Project		
Construction Demands (0.2 af/acre)	365	acre-feet
Gen-Tie Line		
Construction Demands (0.2 af/acre)		
Kings County Segment (125 acres)	25.0	acre-feet
Fresno County Segment (102 acres)	20.4	acre-feet
Operations		
2021 Buildout Operational Demands (41,727 gal/MW/yr)	10,431,750	gal/yr
	32	afy

[1] Based on water demand factors from Table 2. Construction demands are total demands over two years, not annual demands.

The water supply for construction needs will be obtained from existing agricultural wells on or near the project site. Operational water use is discussed below. Supplies are described in Chapter 3.

Operational Water Use

Maintenance will primarily consist of washing the PV modules about four times each year to remove accumulated dust from panel surfaces to maintain efficiency. Light duty trucks with tow-behind trailers with small water tanks will transport the water; workers spray to wet the panel surfaces then squeegee the panels dry. In addition to panel washing, sheep will be grazing the site for approximately five months during the first half of each year to keep site vegetation under control. An additional demand is for general operations and maintenance (e.g., equipment washing, hand washing, and other non-sanitary uses).

Water demand unit factors associated with operations are presented in Table 2. The panel washing unit factor is based on 1/8 of a gallon per square foot of panel or module, with module size of 20.87 square feet, and a total of 934,332 modules. Four washing per year will use approximately 9,749,755 gallons, or 38,999 gallons per MW per year.

Sheep grazing would take place in the westerly 872 acres of the project site in order to maintain agricultural productivity on lands subject to Williamson Act contracts. The sheep grazing estimates within a portion of the project area are based on 0.5 sheep per acre, on 804 net acres (872 acres minus 7.8 percent unvegetated area within the solar facility), for a total of 402 sheep. With sheep grazing five months (151 days), at 3 gallons per day per sheep, equals 453 gallons per sheep per year. Thus the total water required for the 402 sheep is 182,106 gallons per year or 728 gallons per MW per year. The demand for general operations and maintenance is estimated to be 2,000 gallons per MW per year.

Combined, the total annual water consumption for operations is 41,727 gallons per MW per year. Applying these factors to the total 250 MW capacity of the completed project, total operational water demands will be 10.43 million gallons per year or 32.00 afy, as presented in Table 3. Overall, annual water demands are not anticipated to vary based on climatic conditions.

The water supply for ongoing operations will be provided by Westlands Water District. The District has a distribution system of laterals that convey surface water directly from the San Luis Canal/California Aqueduct. District water supplies are from several sources, as discussed in the following chapter.

Maximum Water Demands During Construction

Given the two year construction period, the average annual demand for the construction of the Aquamarine Solar project will be 182.5 acre-feet. For purposes of this analysis, it is assumed that the gen-tie line will be constructed over the same two-year period, with 45.4 acre-feet of water required for construction of the gen-tie line divided equally between the two construction years, or 22.7 afy. Thus the total maximum annual water demand from construction of the Aquamarine Solar project and the gen-tie line will be 205.2 acre-feet, rounded to 205 afy.

HISTORICAL WATER PRODUCTION

Under current conditions, approximately 872 acres within the Aquamarine Solar project site is irrigated with District water and groundwater, while 953 acres of District-owned lands is not irrigated. The District-owned lands are not irrigated due to poor drainage and water quality issues, resulting in lands left fallowed or used for non-irrigated low-yield agricultural production (tilled, seeded, and harvested for winter wheat and oats) utilizing precipitation only. There are agricultural wells and irrigation canals within the Aquamarine Solar project site; however, historical and current groundwater pumping quantities on project lands are not available. Assuming a typical application rate for croplands of 2.5 acre-feet per acre per year (af/ac/yr) applied to the approximately 872 acres of private lands being irrigated, existing water demands on the project site are approximately 2,180 afy. This demand is met with District water and groundwater pumping; the quantities of each vary annually depending on surface water availability.

CHAPTER 3 – WATER SUPPLIES

Water for project construction needs will be provided by wells proximate to each Westlands Solar Park solar facility. Upon completion, water for ongoing operational water supplies will be provided by the District through its water pipeline system from imported surface water sources. This section discusses water supplies currently used on project lands, surface water and groundwater available to the project, District supply conditions, water management activities, and reliability of project supplies.

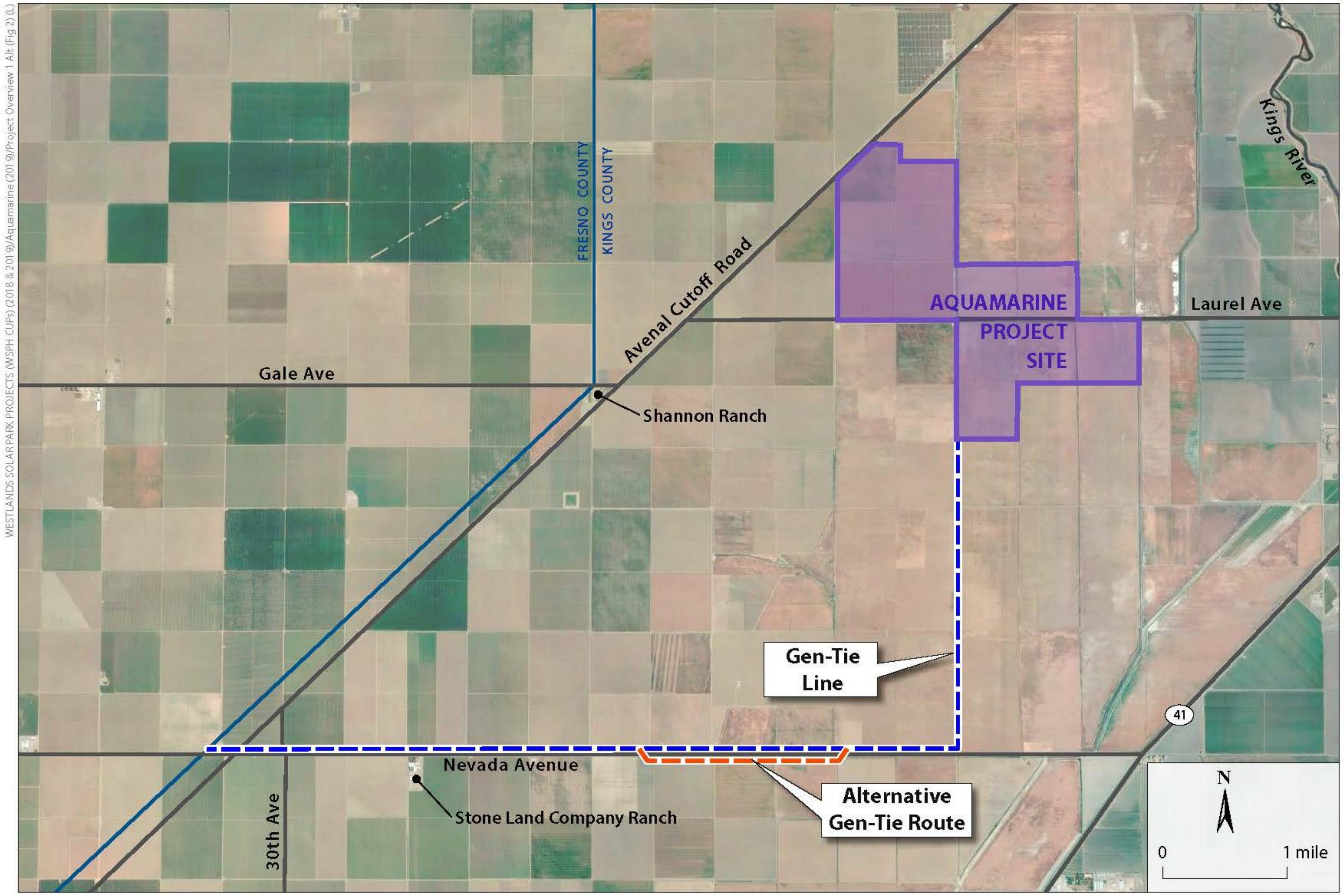
CURRENT WATER USE

As discussed in Chapter 2, existing agricultural water demands within the Aquamarine Solar project site are estimated to be approximately 2,180 afy. Agricultural water supplies for irrigated lands within the project site (approximately 872 acres) are currently provided by the District and groundwater pumping from on-site wells. The groundwater supply is untreated non-potable water for crop irrigation; there are no sources of potable domestic water within the master plan area. The remaining approximately 953 acres within the project site are not irrigated.

SURFACE WATER SUPPLIES

The Aquamarine Solar project site, shown in Figure 2, lies entirely within the boundaries of the District. The WWD was formed in 1952 to serve agricultural water users on the west side of the San Joaquin Valley and has a service area of 610,000 acres, of which 44,000 acres is retired, non-irrigated farmland. The total volume of water required for the entire irrigable area of 568,000 acres within WWD is about 1.5 million acre-feet (WWD 2016a). Upon completion of the San Luis Canal by the U.S. Bureau of Reclamation (USBR) in 1968, WWD began receiving deliveries of Central Valley Project (CVP) water from the Delta. Water is delivered from the Sacramento River-San Joaquin River Delta during winter months and is stored in the San Luis Reservoir. Water is then delivered to District growers through the San Luis Canal and the Coalinga Canal. Once it leaves the federal project canals, water is delivered through approximately 1,030 miles of pipeline.

Westlands' annual water entitlement from the USBR's Central Valley Project is 1,193,000 acre-feet, or about 300,000 acre-feet less than irrigation needs. Thus Westlands' surface water supply entitlement of CVP water is short even when 100 percent of the Contract water is available. Some of the difference is made up by well water from the lower aquifer and water transfers (the latter averaging 150,000 acre-feet per year). Under the terms of a 2015 settlement agreement between WWD and the U.S. Department of Justice, WWD's annual water deliveries are capped at 895,000 acre-feet. Thus the annual shortfalls of water supply will be approximately 500,000 acre-feet per year, assuming full delivery of surface water and annual transfers of 150,000 acre-feet per year.



Source: Google Earth, 2018

Map Source: Bert Verrips, AICP, Environmental Consulting

Project Overview

Figure 2

The west side of the San Joaquin Valley was among the last areas in the Central Valley to receive imported water from the Delta and thus has a lower priority to receive contract water from the federal CVP. The south of Delta contractors suffer disproportionately during drought conditions when water deliveries are curtailed. For example, as presented in Table 4, during the last ten years between 2009 and 2018, WWD received its full 100 percent contract entitlement in only one year - 2017. In eight of those 10 years, WWD received water allocations that were 45 percent or less than its contract entitlement. The average annual water allocation received during that 10 year period was about 385,000 acre-feet, or 32 percent of the contract entitlement.

The District augments CVP contract water with other supplies such as flood flows from the San Joaquin and Kings rivers when available; these seasonal supplies are made available to the District as they flow into the Mendota Pool. Water transfers have become an important component in the District supply portfolio. Transfers and other purchases are included in Table 4 as Additional District Supply. Transfers from other water districts are pursued each year to supplement contract deliveries. For example, water year 2011-12 saw a total of 115,615 acre-feet transferred into the District with 1,440 acre-feet transferred out. The amount of groundwater pumped from the basin in any given year is typically inversely proportional to the availability of surface water supplies; this is evident for dry water years 2013 through 2015, as shown in Table 4.

REGIONAL GROUNDWATER SUPPLY

The District does not supply groundwater to District growers nor does it regulate the use of groundwater. Growers within the District service area augment District deliveries with pumped groundwater to meet irrigation needs. The Westlands Solar Park plan area overlies the Westside Subbasin (5-22.09) of the San Joaquin Valley Basin within the Tulare Lake Hydrologic Region. Although the District collects some pumping data, the lack of a complete database of extraction data and replenishment rates within the subbasin makes it difficult to estimate baseline conditions regarding water supply availability. This is a common problem in the San Joaquin Valley as the majority of water usage is associated with individual agricultural water users with a lack of consistent groundwater monitoring and reporting programs. Where data are not available to make quantitative estimates of water availability and reliability, reasonable assumptions are made here based on information and data that are available.

Subbasin Characteristics

The Tulare Lake Hydrologic Region covers approximately 17,000 square miles including all of Kings and Tulare counties, and most of Fresno and Kern counties. Significant geographic features include the Temblor Range to the west, the Tehachapi Mountains to the south and the southern Sierra Nevada to the east. The Kings, Kaweah, Tule, and Kern Rivers drain the southern portion of the valley internally towards the Tulare drainage basin.

Table 4. Westlands Water District Water Supplies

District Water Supply							
Water Year	CVP Allocation %	Net CVP (AF)	Groundwater (AF)	Water User Acquired (AF)	Additional District Supply (AF)	Total Supply (AF)	Fallowed Acres
1988	100%	1,150,000	160,000	7,657	97,712	1,415,369	45,632
1989	100%	1,035,369	175,000	20,530	99,549	1,330,448	64,579
1990	50%	625,196	300,000	18,502	(2,223)	941,475	52,544
1991	27%	229,666	600,000	22,943	77,399	930,008	125,082
1992	27%	208,668	600,000	42,623	100,861	952,152	112,718
1993	54%	682,833	225,000	152,520	82,511	1,142,864	90,413
1994	43%	458,281	325,000	56,541	108,083	947,905	75,732
1995	100%	1,021,719	150,000	57,840	121,747	1,351,306	43,528
1996	95%	994,935	50,000	92,953	172,609	1,310,497	26,754
1997	90%	968,408	30,000	94,908	261,085	1,354,401	35,554
1998	100%	945,115	15,000	54,205	162,684	1,177,004	33,481
1999	70%	806,040	60,000	178,632	111,144	1,155,816	37,206
2000	65%	695,693	225,000	198,294	133,314	1,252,301	46,748
2001	49%	611,267	215,000	75,592	135,039	1,036,898	73,802
2002	70%	776,526	205,000	106,043	64,040	1,151,609	94,557
2003	75%	863,150	160,000	107,958	32,518	1,163,626	76,654
2004	70%	800,704	210,000	96,872	44,407	1,151,983	70,367
2005	85%	996,147	75,000	20,776	98,347	1,190,270	66,804
2006	100%	1,076,461	25,000	45,936	38,079	1,185,476	54,944
2007	50%	647,864	310,000	87,554	61,466	1,106,884	96,409
2008	40%	347,222	460,000	85,421	102,862	995,505	99,663
2009	10%	202,991	480,000	68,070	70,149	821,210	156,239
2010	45%	590,059	140,000	71,296	79,242	880,597	131,339
2011	80%	876,910	45,000	60,380	191,686	1,173,976	59,514
2012	40%	405,451	355,000	111,154	123,636	995,241	112,755
2013	20%	188,448	638,000	101,413	143,962	1,071,823	131,848
2014	0%	98,573	655,000	59,714	26,382	839,669	220,053
2015	0%	82,429	660,000	51,134	34,600	828,163	218,112
2016	5%	9,204	612,000	72,154	174,374	867,732	179,784
2017	100%	911,307	54,000	(50,009)	174,490	1,089,788	146,275
2018*	40%	479,958	370,000	75,000	130,000	1,054,958	160,000

Definitions: *Estimated

Water Year - March 1 to February 28

CVP Allocation - Final CVP water supply allocation for the year (100% = 1,150,000 AF)+(Reassignment = 46,948 AF)

Net CVP - CVP Allocation adjusted for carry over and rescheduled losses

Groundwater - Total groundwater pumped (see District's Deep Groundwater Report)

Water User Aquired - Private Landowner water transfers

Additional District Supply - Surplus water, supplemental supplies, and other adjustments.

Fallowed Acres - Agricultural land out of production

Source: WWD, 2018

The Westside Subbasin is primarily located in Fresno County; a portion – including the entire Westlands Solar Park plan area – is in Kings County. The subbasin encompasses a surface area of approximately 640,000 acres within the San Joaquin Valley. The Westside Subbasin is located between the Coast Range foothills on the west and the San Joaquin River drainage and Fresno Slough to the east. To the southwest is the Pleasant Valley Groundwater Subbasin, and to the west are Tertiary marine sediments of the Coast Ranges. To the north and northeast is the Delta-Mendota Groundwater Subbasin, and to the east and southeast are the Kings and Tulare Lake Groundwater subbasins, also subbasins of the San Joaquin Valley Basin.

The aquifer system comprising the Westside Subbasin consists of unconsolidated continental deposits of Tertiary and Quaternary age. These deposits form an unconfined to semi-confined upper aquifer and a confined lower aquifer. These aquifers are separated by an aquitard named the Corcoran Clay member of the Tulare Formation. The unconfined to semi-confined aquifer (upper zone) above the Corcoran Clay includes younger alluvium, older alluvium, and part of the Tulare Formation. These deposits consist of highly lenticular, poorly sorted clay, silt, and sand intercalated with occasional beds of well-sorted fine to medium grained sand. This clay layer ranges in thickness from 20 to 200 feet, underlies most of the District, and has extensive wells penetrating the clay which allows partial interaction between the zones (DWR, 2006). The depth to the top of the Corcoran Clay varies from approximately 500 feet to 850 feet (WWD, 2014). The confined aquifer (lower zone) consists of the lower part of the Tulare Formation and possibly the uppermost part of the San Joaquin Formation. This unit is composed of lenticular beds of silty clay, clay, silt, and sand interbedded with occasional strata of well-sorted sand. Brackish or saline water underlies the usable groundwater in the lower zone (DWR, 2006). Well yields are good with an average of 1,100 gallons per minute (gpm) and a maximum of 2,000 gpm (DWR, 2003a).

Flood basin deposits along the eastern subbasin have caused near surface soils to drain poorly thus restricting the downward movement of percolating water. This causes agriculturally applied water to build up as shallow water in the near surface zone. Areas prone to this buildup are often referred to as drainage problem areas (DWR, 2006).

Water quality in the lower water bearing zone varies. Typically, water quality varies with depth with poorer quality existing at the upper and lower limits of the aquifer and the optimum quality somewhere between. The upper limit of the aquifer is the base of the Corcoran Clay with the USGS identifying the lower limit as the base of the fresh groundwater. The quality of the groundwater below the base of fresh water can exceed 2,000 milligrams per liter (mg/L) total dissolved solids (TDS) which is too high for irrigating crops; the subbasin averages 520 mg/L TDS. In addition to high TDS, this subbasin can also contain selenium and boron that may affect usability as irrigation water.

Groundwater Level Trends

As shown in Table 5, groundwater levels were generally at their lowest levels in the late 1960's prior to the importation of surface water. The CVP began delivering surface water to the San Luis Unit in 1967-68. Water levels gradually increased to a maximum in about 1987-88, falling briefly during the 1976-77 drought and again during the 1987-92 drought. 1998 water levels recovered nearly to the 1987-88 levels

Table 5. Groundwater Use and Elevation Change in Westlands Water District

Crop[1] Year	Pumped AF	Elevation FT	Elevation Change FT	Crop Year	Pumped AF	Elevation FT	Elevation Change FT
1956	964,000	-65	-13	1986	145,000	71	8
1957	928,000	-56	9	1987	159,000	89	18
1958	884,000	-29	27	1988	160,000	64	-25
1959	912,000	-77	-48	1989	175,000	63	-1
1960	872,000	-81	-4	1990	300,000	9	-54
1961	824,000	-96	-15	1991	600,000	-32	-41
1962	920,000			1992	600,000	-62	-30
1963	883,000			1993	225,000	1	63
1964	913,000			1994	325,000	-51	-52
1965	822,000			1995	150,000	27	78
1966	924,000	-134		1996	50,000	49	22
1967	875,000	-156	-22	1997	30,000	63	14
1968	596,000	-135	21	1998	15,000	63	0
1969	592,000	-120	15	1999	20,000	65	2
1970	460,000	-100	20	2000	225,000	43	-22
1971	377,000	-93	7	2001	215,000	25	-18
1972		-54	39	2002	205,000	22	-3
1973		-37	17	2003	160,000	30	8
1974	96,000	-22	15	2004	210,000	24	-6
1975	111,000	-11	11	2005	75,000	56	32
1976	97,000	-2	9	2006	15,000	77	21
1977	472,000	-99	-97	2007	310,000	35	-42
1978	159,000	-4	95	2008	460,000	-11	-46
1979	140,000	-13	-9	2009	480,000	-31	-20
1980	106,000	4	17	2010	140,000	9	40
1981	99,000	11	7	2011	45,000	49	40
1982	105,000	32	21	2012[2]	355,000	1	-48
1983	31,000	56	24	2013	638,000	-58	-59
1984	73,000	61	5	2014	655,000	-76	-18
1985	228,000	63	2	2015	660,000	-120	-44

Source: WWD, 2016b.
[1] Crop year is from October 1 of previous year to September 30 of current year.
[2] Starting with 2012, groundwater pumped is for Water Year (March 1 through February 28)

after a series of wet years. Recharge is primarily from seepage of Coast Range streams along the west side of the subbasin (approximately 30,000 to 40,000 afy) and deep percolation of surface irrigation. Secondary recharge to the upper aquifer (approximately 20,000 to 30,000 afy) and lower aquifer (150,000 to 200,000 afy) occurred from areas to the east and northeast as subsurface flows. WWD estimated the average deep percolation between 1978 and 1996 was 244,000 afy and applied groundwater between 1978 and 1997 was 193,000 afy (DWR, 2006; WWD, 2015).

According to DWR's draft designation, the Westside Subbasin is considered a critically overdrafted basin. This designation was recently identified as a part of the Sustainable Groundwater Management Act of

2014 (SGMA) and Groundwater Sustainability Plan (GSP) process and was based on significant, on-going, and irreversible subsidence which was about 0.4 feet per year between 2007 and 2011 (DWR, 2015b). Basins in critical overdraft must develop a GSP by 2020. As the primary water purveyor in the Westside Subbasin, Westlands Water District is the designated Groundwater Sustainability Agency (GSA) for the subbasin, and is currently in the process of developing the GSP for the subbasin. The plans and progress toward meeting the sustainability goal of achieving sustainable groundwater management within 20 years of implementation of the GSP, will be evaluated every five years. Other actions to manage the subbasin are described later in this chapter.

Aquifer's Ability to Recover

The reduction of CVP water and other surface supplies to the District over time has resulted in the construction of many new wells by farmers to obtain water to make up for the shortfall. There were 605 wells constructed within the District between 2000 and 2015. The total number of operational wells within the District in 2014 was 792 and 124 non-operational wells. Most of the information provided here on District groundwater conditions was obtained from the District's 2015 Deep Groundwater Report (WWD, 2016b) and 2012 Water Management Plan (WWD, 2013a).

As presented in Table 5, prior to the delivery of CVP water into the District, the annual groundwater pumping ranged from 822,000 to 964,000 acre-feet during the period of 1953 to 1968. The majority of this pumping was from the aquifer below the Corcoran Clay causing the sub-Corcoran piezometric groundwater surface (groundwater surface) to reach the lowest recorded average elevation of 156 feet below mean sea level in 1967. The U.S. Geological Survey concluded that extraction of large quantities of groundwater prior to CVP deliveries resulted in compaction of water bearing sediments and caused land subsidence ranging from 1 to 24 feet between 1926 and 1972.

After CVP water deliveries began in 1968, the groundwater surface rose steadily until reaching 89 feet above mean sea level in 1987, the highest average elevation on record dating back to the early 1940's. The only exception during this period was in 1977 when a drought and drastic reduction of CVP deliveries resulted in groundwater pumping of approximately 472,000 acre-feet and an accompanying drop in the groundwater surface elevation of approximately 97 feet.

During the early 1990's, groundwater pumping increased due to reduced CVP water supplies due to drought and regulatory actions. Groundwater pumping reached an estimated 600,000 acre-feet annually during 1991 and 1992 when the District received only 25 percent of its contractual entitlement of CVP water. This increased pumping caused the groundwater surface to decline to 62 feet below mean sea level, the lowest elevation since 1977. DWR estimated the amount of subsidence since 1983 to be almost two feet in some areas of the District, with most of that subsidence occurring since 1989.

Based on data presented in Table 4 and Table 5, during 2011 to 2015, CVP allocations averaged 28 percent (320,771 acre-feet), total groundwater pumped was 2,353,000 acre-feet, and the groundwater surface elevation decreased 129 feet. The CVP allocations for 2014 and 2015 water year were 0 percent for both years and with the accompanying increase in groundwater pumped (655,000 acre-feet and

660,000 acre-feet, respectively), the groundwater surface decreased 62 feet over the two-year period to an average elevation of 120 feet below mean sea level.

In the project vicinity, the depth to the top of the Corcoran Clay in the project vicinity is approximately 650 to 700 feet. The elevation of the base of fresh groundwater is approximately -2200 feet mean sea level (WWD, 2015b).

Sustainable Yield

Estimates of annual sustainable yield or perennial yield of the subbasin (i.e., the annual amount of groundwater that can be extracted without lowering groundwater levels over the long term) are currently being developed by WWD through its development of a Groundwater Sustainability Plan under the Sustainable Groundwater Management Act. Once the sustainable yield number is determined, the yield per acre will vary somewhat throughout WWD depending on localized hydrogeology. However, as indicated in Tables 4 and 5 for 2013 through 2015, under drought conditions WWD groundwater withdrawals (data tables only include WWD data as growers who rely solely on groundwater are not included here) result in progressive lowering of the groundwater table, indicating exceedance of the sustainable yield of the groundwater resource.

WESTLANDS WATER DISTRICT SUPPLY CONDITIONS

The District has stated it will provide PV solar projects an operational water supply of up to 5.0 afy per quarter section (160 acres) (which equals 0.03125 af/ac/yr or 57.05 afy for the 1,825-acre Aquamarine Solar site). Total operational demands of 32.6 afy from Table 3 equates to 2.86 afy per ¼ section (0.01788 af/ac/yr), well within WWD's maximum annual allowance.

Because of recurring dry years and the possibility of a drought during the construction period, pumping in excess of the sustainable yield may continue in the Westside Subbasin. However, such conditions would occur regardless of the proposed project; water levels in the Westside Subbasin have historically generally recovered from periods of heavy pumping during drought years, indicating that overdraft conditions do not persist when the import of surface water returns to non-drought quantities. However, DWR designated the subbasin as critically overdrafted primarily because of the related subsidence effects of overpumping. Although the District has been able to meet its municipal and industrial untreated water demands in the past, in the event that the District cannot provide the project water supply, water can be obtained from the same local wells that were used for construction water demands.

WATER MANAGEMENT AGENCIES AND ACTIVITIES

The majority of the Westside Subbasin is in Fresno County, extending south into Kings County. The Westside Subbasin is almost entirely within the District service area.

Westlands Water District

With the a total irrigation requirement of 1.5 million afy, and with WWD's CVP contract water amount recently reduced to a maximum 895,000 afy (with actual surface water deliveries recently averaging far less), the District must allocate water to its growers, even in the wettest years. To adapt to ongoing supply shortages and shallow groundwater drainage issues which are detrimental to regional groundwater quality, the District funds education and technology, enabling growers to effectively utilize water allotments through efficiencies. The District surveys the static water levels in the wells and the water quality and quantity of pumped groundwater as part of its Water Management Plan.

A key component of the District's Water Management Plan is water conservation. This program consists of the following elements.

- Irrigation Guide for water requirements per crop
- Water Conservation and Management Handbook
- Workshops and meeting on water management information
- Technical assistance and conservation computer programs
- Meter repair and updated program
- Groundwater monitoring
- Pump efficiency tests
- Conjunctive use of supplies
- Irrigation System Improvement Program
- Satellite imagery purchased about once every two weeks

The Sustainable Groundwater Management Act requires that all medium to critically over-drafted subbasins identified by DWR be managed by a groundwater sustainability agency. The GSA is responsible for locally managing the groundwater subbasin through the development and implementation a Groundwater Sustainability Plan. As the primary water purveyor in the DWR-designated critically overdrafted Westside Subbasin, WWD is serving as the GSA for the subbasin, effective November 1, 2016. Under SGMA, WWD is required to submit a Groundwater Sustainability Plan by January 31, 2020 to demonstrate how the groundwater resources will be sustainably managed. WWD is currently in the process of developing the GSA for the Westside Subbasin.

Fresno Area Regional Groundwater Management Plan

The Fresno County Groundwater Management Plan was updated in 2006. Although the study area is primarily within the Kings Subbasin which does not extend to the WSP site, its activities will improve the management of the Westside Subbasin and it demonstrates active efforts towards increased supply reliability in the region. The regional groundwater management group of nine agencies and one private water company that prepared the plan is implementing activities to improve water resources management and reporting annually. Activities include: groundwater level monitoring, groundwater quality monitoring, land surface subsidence monitoring, and surface water monitoring on an ongoing basis. These agencies are constantly making improvements to improve groundwater recharge, increase water conservation and education savings, pursue groundwater banking, increase recycled water usage to reduce potable consumption, and other activities.

WATER SUPPLY RELIABILITY

SB 610 requires the consideration of supply availability under varying climatic conditions including normal water years and dry years. Reasonable assumptions can be made regarding availability and reliability under normal year and dry year scenarios based on available data and information for the project.

Groundwater Supply Reliability

During single and multiple dry years when less CVP contract water is available, the District relies more on local groundwater resources, resulting in a temporary drawdown of the aquifer. As demonstrated, historically the basin generally recovers from these times of increased pumping when surface water availability is restored; however, there is some concern regarding subsidence reducing the overall capacity of the aquifer, particularly on the west side of the subbasin.

In addition, reducing the current amount of groundwater pumping within the Westlands Solar Park plan area will increase availability of Westside Subbasin groundwater supplies for management, improve water quality, and not exacerbate subsidence. For the construction of the Westlands Solar Park solar projects, groundwater in this unadjudicated basin is considered available and reliable under normal water years, a single dry water year, and multiple dry years, as shown in Table 6.

Aquamarine Solar project and gen-tie line’s combined temporary demands of 205 afy (during the two year construction period) and 32 afy (operational use after project completion) would introduce a less intensive water demand on 872 acres of the site which is currently pumping some portion of the overall 2,180 afy irrigation demand. Of the 953 acres of fallowed (or dry farmed) District-owned land, the Westlands Solar Park solar projects would temporarily represent a more intensive use of the land by applying water for dust control during construction (whereas no water is applied to this area currently). The net result for the entire 1,825-acre project site is a reduction in water demands from 2,180 afy to a maximum of 205 afy during construction and 32 afy for operations after buildout. Based on the information provided in this WSA, the maximum annual demand during construction of 205 afy is not expected to result in adverse water supply reliability impacts; in fact, the change in land use will result in a beneficial impact to the Westside Subbasin by reducing the amount of groundwater pumped.

Westlands Water District Supply Reliability

The amount of CVP contract water received by the District during any given year varies depending on climatic and hydrologic conditions, Delta constraints, and other factors. The District augments the contract water with transfers and other purchased supplies, and growers augment surface supplies through increased groundwater pumpage. During operation of the project, the long term water demand of 32 afy for operational uses such as panel cleaning and vegetation management by sheep grazing would be met using water provided by WWD.

Table 6. Westlands Solar Park Supplies and Demands (afy)

	2015	2020	2025	2030	2035	2040
Normal Year Construction						
Groundwater Supply [1]	209	209	209	209	209	209
WWD Supply	0	0	0	0	0	0
Construction Demand [2]	*0*	*205*	*0*	*0*	*0*	*0*
Normal Year Operations						
Groundwater Supply	0	0	0	0	0	0
WWD Supply [3]	57	57	57	57	57	57
Operations Demand [2]	*0*	*32*	*32*	*32*	*32*	*32*
Single Dry Year Construction						
Groundwater Supply [1]	209	209	209	209	209	209
WWD Supply	0	0	0	0	0	0
Construction Demand [2]	*0*	*205*	*0*	*0*	*0*	*0*
Single Dry Year Operations						
Groundwater Supply	0	0	0	0	0	0
WWD Supply [3]	57	57	57	57	57	57
Operations Demand [2]	*0*	*32*	*32*	*32*	*32*	*32*
Multiple Dry Year Construction (Year 1, 2, 3)						
Groundwater Supply [1]	209	209	209	209	209	209
WWD Supply	0	0	0	0	0	0
Construction Demand [2]	*0*	*205*	*0*	*0*	*0*	*0*
Multiple Dry Year Operations (Year 1, 2, 3)						
Groundwater Supply	0	0	0	0	0	0
WWD Supply [3]	57	57	57	57	57	57
Operations Demand [2]	*0*	*32*	*32*	*32*	*32*	*32*

[1] Pending WWD's development of sustainable yield estimates through its ongoing Groundwater Sustainability Plan efforts, this analysis presumes a sustainable yield of 0.24 af/ac/yr (based on a conservatively low estimate of 135,000 afy sustainable yield for the 568,000 irrigable acres within Westlands Water District) (WWD 2017). This is applied to 872 currently irrigated acres within the Aquamarine Solar project area. This low-side estimate of sustainable yield provides a reasonable worst-case baseline for purposes of this WSA.
[2] From Table 3 rounded.
[3] WWD can provide up to 5.0 afy per 160 acres from its CVP allocation augmented with other purchases and groundwater (WWD, 2017). Assumes total project area of 1,825 acres equals 57.03 or 57 afy rounded.

The District does not have a municipal and industrial (M&I) supply contract with USBR, but it does exercise provisions in its agricultural water service contract for supplying water for incidental agricultural water. These purposes include M&I water use for industrial and commercial operations, single family dwellings, and farm housing. Thus, WWD delivers untreated water to communities of

Coalinga, Heron, and other M&I users. The WWD rules and regulations recognize solar facilities as an M&I use and therefore has a higher priority for CVP allocations. During dry years for example, a higher percentage is allocated to M&I than to agricultural uses (e.g., during 2014 the CVP had a 25 percent allocation for M&I versus 0 percent for agriculture).

WWD manages its supplies for long term supply reliability. It augments CVP contract water with local and purchased surface waters, which are supplemented by groundwater pumping by growers, as presented in Table 4, and WWD encourages the fallowing of lands during shortages. Based on the information provided in this WSA, WWD water supplies to meet the operational demand of 32 afy and a temporary construction demand averaging 205 afy for each of the two years of construction under normal water years, a single dry water year, and multiple dry years, are considered available and reliable, as shown in Table 6.

Approximately 209 afy of water supplies from groundwater are assumed to be available to meet the construction and operational demands based on an estimated sustainable yield of the basin (to be updated upon completion of the GSP) of 0.24 af/ac/yr (WWD, 2017). If for some reason District surface water supplies are not available when needed, groundwater would be pumped from local agricultural wells and trucked to the site for panel washing and sheep grazing.

In summary, sufficient water supply is available to meet Westlands Solar Park construction and operational demands under normal, dry, and multiple dry year climatic conditions. Westlands Solar Park would result in significantly less groundwater pumping of the Westside Subbasin during construction, and no groundwater pumping during solar facility operations after full buildout.

OTHER PLANNED USES

Other planned uses in the Westside Subbasin consist almost entirely of other solar PV generation facilities. Currently, there are 16 completed or partially completed solar projects in the Kings County and Fresno County portions of the subbasin, plus an additional 13 solar projects with pending or approved conditional use permit (CUP) applications at the counties. The total land area covered by these other projects is approximately 27,889 acres, with a total generating capacity of 2,997 MW. Based on an average construction water demand rate of 0.2 acre-feet/acre, these other projects would consume a total of 5,578 acre-feet during construction.

It is assumed that all construction water would be obtained from local groundwater sources within the subbasin, and it is expected that construction of each acre of solar project would take less than one year. The consumption rate of 0.2 af/ac/yr would not exceed the presumed groundwater sustainable yield of 0.24 af/ac/yr of the groundwater basin. Upon completion, operational water demands would be approximately 0.01754 af/ac/yr. It is assumed that operational water for the other solar projects would be obtained from groundwater sources within the subbasin. These operational water demands would be well below the presumed sustainable yield for the groundwater basin.

In summary, neither the short-term construction of the other planned projects within the subbasin, nor the long-term operational water demands from each project, would be likely to exceed the sustainable yield of the groundwater basin. Therefore, the construction and operational water demands for the other planned projects in the subbasin could be met from existing groundwater sources without contributing to overdraft of the subbasin.

CHAPTER 4 – CONCLUSIONS

SUFFICIENCY FINDINGS

A lack of specific data for project site groundwater usage and replenishment rates (e.g., a water budget) makes it difficult to quantify baseline conditions regarding groundwater supply availability. However, an analysis of the ability of the groundwater basin (based on District subbasin data) to meet projected temporary construction water demands of Aquamarine Solar Project was based on other factors. One consideration is that the solar projects have rights to a reasonable use of groundwater supply from the groundwater basin they overlie and that the peak construction demands are substantially less than the presumed sustainable groundwater yield on a per acre basis. Another consideration is that the projected annual construction and operational demands for the Aquamarine Solar project and gen-tie line (205.2 afy for construction, and 32 afy for operations) will be significantly lower than current total agricultural water demands within the project site (2,180 afy).

The WWD CVP allocation is only about 50 percent reliable on average, but this supply is augmented with other sources, particularly during dry years. The groundwater basin available to individual landowners within WWD is in critical overdraft. However a reduction in agricultural water demands due to the solar projects will result in increased water supply reliability for other agricultural users within the District.

With consideration of these variables and conditions, it is concluded that groundwater supplies from the Westside Subbasin will meet construction demands for the Aquamarine Solar project and gen-tie line during the two year construction period, in addition to the demand of existing and other planned future uses. District water supplies will meet projected operational water demands for the Aquamarine Solar project over a 20 year planning horizon, in addition to the demand of existing and other planned future uses. No supply deficiencies are expected in normal, dry, and multiple dry years for the proposed project. This WSA was prepared in compliance with the California Water Code, as amended by SB 610.

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