2020

Water Supply Assessment -Wister Solar Development Project

DRAFT – JUNE 2020

PREPARED FOR IMPERIAL COUNTY PLANNING & DEVELOPMENT SERVICES

BY DUBOSE DESIGN GROUP, INC.

1 CONTENTS

2 ACRONYMS

AB	Assembly Bill
AC	Alternating Current
AAC	All-American Canal
AF	Acre-Foot or Acre-Feet
AFY	Acre-Feet per Year
AOP	Annual Operations Plan
APN	Assessor's Parcel Number
CDPH	California Department of Public Health
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CUP	Conditional Use Permit
CU	Consumptive Use
CVWD	Coachella Valley Water District
CWC	California Water Code
DC	Direct Current
EIR	Environmental Impact Report
ET	Evapotranspiration
GenTie	Generation Intertie
ICPDS	Imperial County Planning and Development Services
IID	Imperial Irrigation District
In	Inches
IRWMP	Integrated Regional Water Management Plan
kV	Kilovolt
LAFCO	Local Agency Formation Commission
MGD	Million Gallons per Day
MW	Megawatt
MWD	Metropolitan Water District of Southern California
O&M	Operation and Maintenance
POI	Point of Interconnection
PPA	Power Purchase Agreement
PV	Photo Voltaic
RE	Renewable Energy
RPS	Renewable Portfolio Standard
SB	Senate Bill
US	United States
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
WSA	Water Supply Assessment

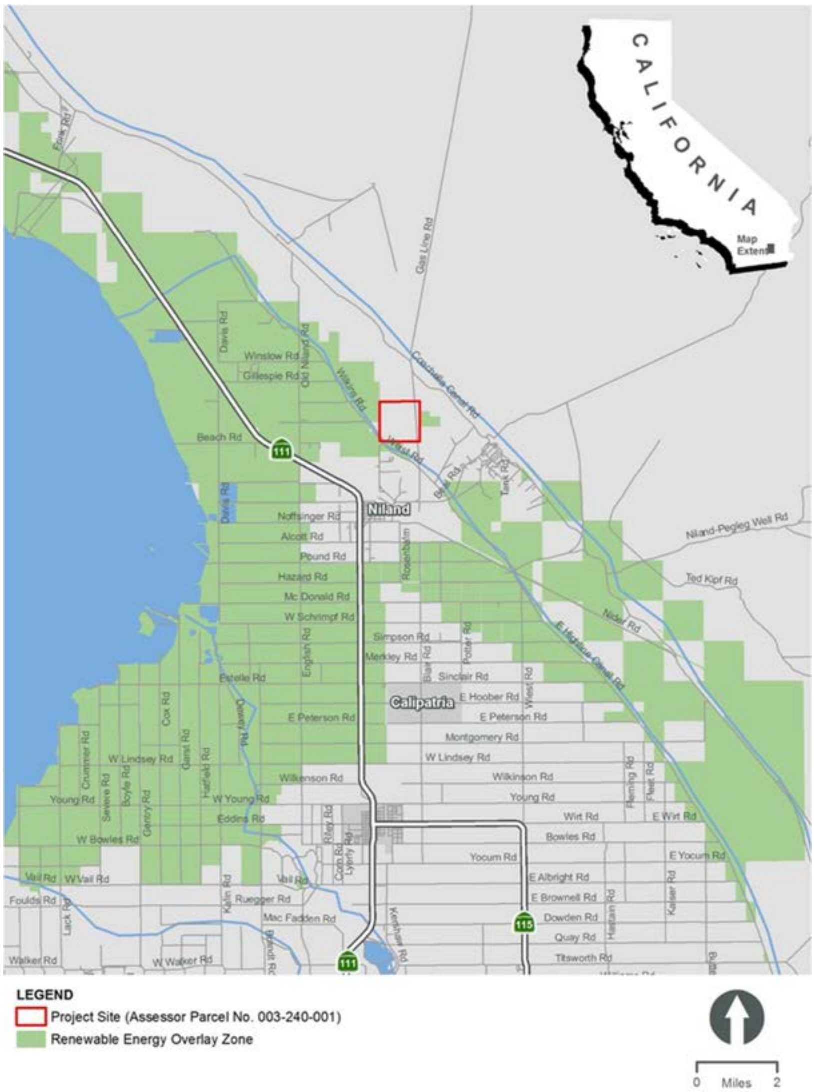
3 PURPOSE OF WATER SUPPLY ASSESSMENT & APPLICABILITY

This Water-Supply Assessment (WSA), SB 610 was prepared for the Imperial County Planning and Development Services (ICPDS) and ORNI 21, LLC (The "Applicant") by water supply experts at DuBose Design Group, Inc (DDG) for the proposed Wister Solar Energy Project ("The Project"). The proposed project consists of three primary components: 1) Solar energy generation equipment and associated facilities including a substation and access roads (herein referred to as "solar energy facility"); 2) gen-tie line that would connect the proposed on-site substation to the Point of Interconnection (POI) at the existing Imperial Irrigation District (IID) 92-kilovolt (kV) "K" line; and, 3) fiberoptic cable. California Water Code section 10912. For the purposes of this part, the following terms have the following meanings: (a) "Project" means any of the following: (5) 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 This study is a requirement of California law, specifically Senate Bill 610 (referred to as SB 610).1 SB 610 is an act that amended Section 21151.9 of the Public Resources Code, and Sections 10631, 10656, 10910, 10911, 10912, and 10915 of the California Water Code (CWC). SB 221 is an act that amended Section 11010 of the Business and Professions Code, while amending Section 65867.5 and adding Sections 66455.3 and 66473.7 to the Government Code. SB 610, which was approved by the Governor and filed with the Secretary of State on October 9, 2001, and became effective January 1, 2002, requires a lead agency, to determine that a project (as defined in CWC Section 10912) subject to California Environmental Quality Act (CEQA), to identify any public water system, or groundwater that may supply water for the project and to request the applicants to prepare a specified water supply assessment.

4 DESCRIPTION OF PROPOSED PROJECT AREA

Imperial County is in the southeast of California and borders Arizona and Mexico. The County is in an arid region and a part of the Sonoran Desert. The proposed Project is in the Imperial Valley, approximately 3 miles north of Niland, 5 miles southeast of the Salton Sea, and 4 miles east of what is known as the "Wister Unit." The Wister Unit is part of the Imperial County Wildlife Area, which is a California Department of Fish and Wildlife recreational area. The most prominent water feature in the Valley is the Salton Sea, California's largest inland surface water. Figure 1, below, shows the general location of the Project.

Figure 1 – Project Location



Niland is an unincorporated community. The Imperial Valley is characterized by high summer temperatures (> 110F) and very little precipitation. Its main industry is agriculture, which generates over $2 billion annually. The Valley has nearly 500,000 acres of agricultural land, which are typically farmed year-round and irrigated with Colorado River water. In fact, Colorado River water is the source of drinking water for most residents in the Valley. Good groundwater in the Valley is scarce. Imperial County's Code of Ordinances states, in relevant part, that "…the preservation and protection of the County's ground water resources are extremely critical… The Board of Supervisors has, therefore, determined to regulate the use, consumption and development of ground water on a County-wide basis. Further, it is the intent of the Board of Supervisors to protect the health, safety, and general welfare of the people of Imperial County by ensuring that the ground water of this County will not be polluted or contaminated. To this end, minimum requirements have been prescribed in this Ordinance for the construction, re-construction, repair, replacement, re-perforation, re-activation, operation, and destruction of a well or wells."[1] Section X of this WSA report describes in more detail the hydrologic setting for the Project.

4.1 CLIMATE FACTORS

Imperial Valley is located in the Northern Sonoran Desert, which has a subtropical desert climate characterized by hot, dry summers and mild winters. Clear and sunny conditions typically prevail, and frost is rare. The region receives 85 to 90 percent of possible sunshine each year, the highest in the United States. Winter temperatures are mild rarely dropping below 32°F, but summer temperatures are very hot, with more than 100 days over 100°F each year. The remainder of the year has a relatively mild climate with temperatures averaging in the mid-70s. The 100-year average climate characteristics are provided in Table below. Rainfall contributes around 50,000 AF of effective agricultural water per inch of rain. Most rainfall occurs from November through March; however, summer storms can be significant in some years. Annual areawide rainfall is shown in Table below. The thirty-year, 1988-2017, average annual air temperature was 74.1°F, and average annual rainfall was 2.59 inches. This record shows that while average annual rainfall has fluctuated, the 10-year average temperatures have slightly increased over the 30-year averages.[2]

Table 1: *Climate Characteristics, Imperial, CA 100-Year Record, 1918-2017*

Climate Characteristic	Annual Value
Average Precipitation (100-year record, 1918-2017)	2.96 inches (In)
Minimum Temperature, Jan 1937	16 ºF
Maximum Temperature, July 1995 & June 2017	121 ºF
Average Minimum Temperature, 1918-2017	47.9 ºF
Average Maximum Temperature, 1918-2017	98.3 ºF
Average Temperature, 1918-2017	72.9 ºF

Source: IID Imperial Weather Station Record

[1] HTTP://IMPERIALCO-CA.ELAWS.US/CODE/COOR_TITLE9_DIV21_CH1, (ORD. 1415 § 320, 2006); RETRIEVED, JUNE, 2020
2 IID WSA BOILERPLATE

Table 2: Monthly Mean Temperature (^{o}F) – Imperial, CA 10-Year, 30-Year & 100-Year (2008-2017, 1988-2017, 1918-2017)

	Jan			Feb			Mar			Apr		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
10-year	82	32	56	86	36	61	95	41	67	100	46	72
30-year	81	33	56	84	37	60	93	41	66	99	47	71
100-year	80	31	55	84	35	59	91	40	64	99	46	71

	May			Jun			Jul			Aug		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
10-year	107	53	78	115	61	87	114	69	92	114	67	91
30-year	106	54	79	113	60	86	114	68	92	113	69	92
100-year	105	52	78	113	59	86	114	68	92	113	68	91

	Sep			Oct			Nov			Dec		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
10-year	114	67	92	103	51	76	92	38	64	82	30	55
30-year	113	69	92	102	51	76	90	39	64	80	32	55
100-year	113	68	91	101	49	75	90	38	63	80	32	56

Source: IID Imperial Headquarters Station Record (Data provided by IID staff)

Table 3: Monthly Mean Rainfall (In) – Imperial, CA 10-Year, 30-Year & 100-Year (2008-2017, 1988-2017, 1918-2017)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
10-year	0.54	0.30	0.13	0.04	0.08	0.01	0.26	0.31	0.16	0.13	0.14	0.44	2.53
30-year	0.50	0.44	0.26	0.07	0.06	0.00	0.15	0.22	0.22	0.16	0.18	0.34	2.59
100-year	0.40	0.39	0.25	0.10	0.03	0.00	0.12	0.34	0.37	0.26	0.20	0.50	2.96

Source: IID WIS: CIMIS stations polygon calculation (Data provided by IID staff).

4.2 POPULATION TRENDS

The Imperial County Housing Element states, "According to the 2010 US Census, the total population of Imperial County was 174,528 in 2010, an increase of 23 percent since 2000. The population of the unincorporated county increased 15 percent over the same period, from 32,865 to 37,778. Heber was the most populated townsite in the unincorporated county, with a population of 4,275 in 2010; however, Salton City saw the most growth from 2000 to 2010. The Salton City population increased from 944 residents to 3,763, an increase of 299 percent.[3]" Refer to Table indicated below titled Population Trends identifies the unincorporated county.

The Southern California Association of Governments (SCAG) prepares a population forecast as part of its Regional Transportation Plan/Sustainable Growth Strategy. The population in the unincorporated areas of the county grew nearly 80 percent from 2010 to 2020 and another 26 percent from 2020 to 2035. Refer to Table 4 for population projections for the unincorporated county and Imperial County as a whole for 2020 and 2035."[4]

Table 4: Unincorporated Population Trend[5]

Year	2000	2010	2020	2035
Population	32,865	37,778	67,900	73,400

Imperial County Housing Element, 2013

5 WISTER SOLAR ENERGY PROJECT DESCRIPTION

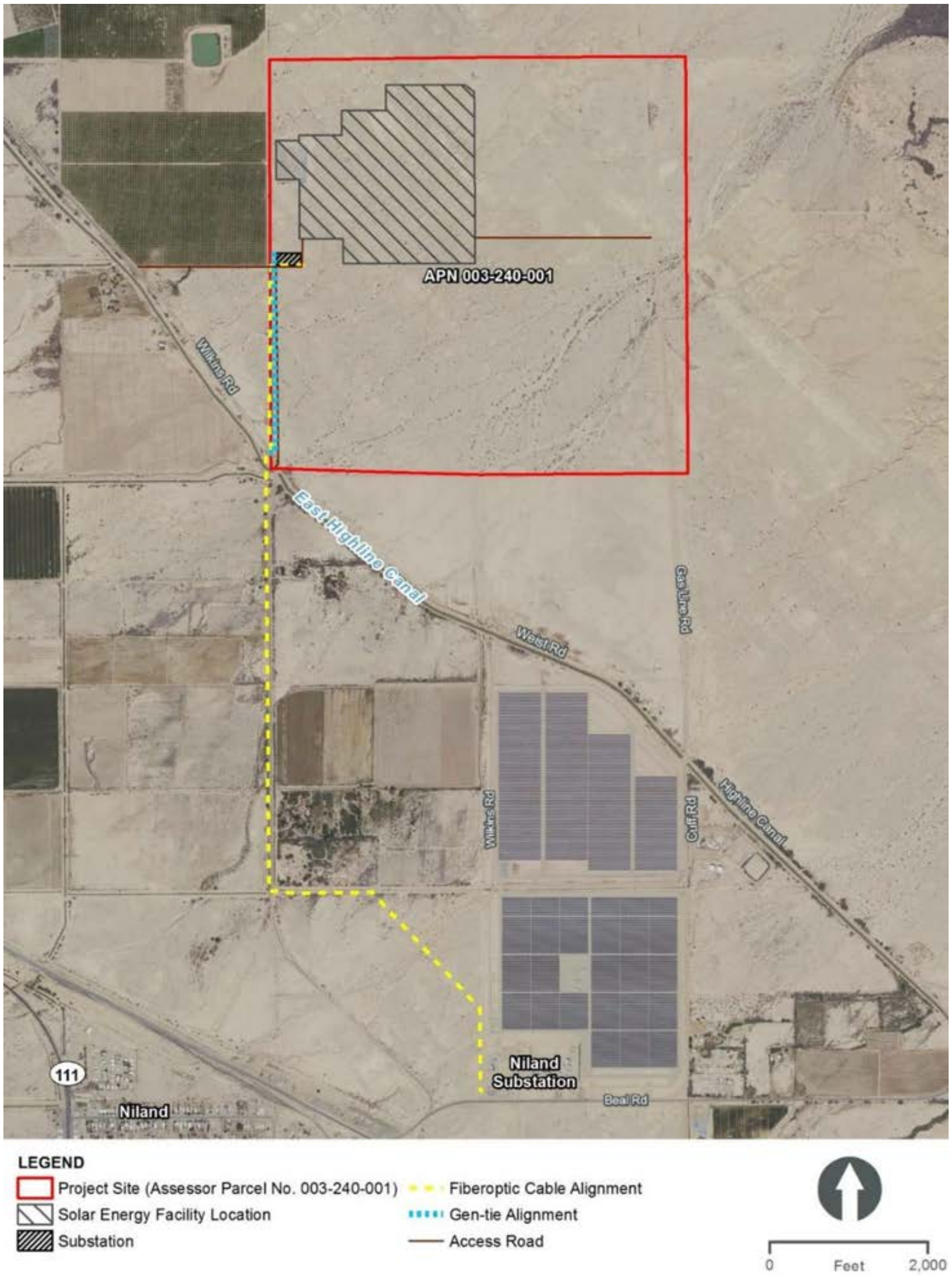
5.1 Project Location

5.1.1 Solar Energy Facility and Gen-Tie Line

The Project site is located approximately three miles north of Niland, a census-designated place, in the unincorporated area of Imperial County. The Project site is located on one parcel of land identified as Assessor's Parcel Number 003-240-001. The parcel is comprised of approximately 640 acres of land and is currently zoned Open Space/Preservation with a geothermal overlay (S-2-G). The proposed solar energy facility component of the project would be located on approximately 100 acres within the northwest portion of the larger 640-acre project site parcel. More specifically, the Project site is located east of the intersection of Wilkins Road and an unnamed county road. The project footprint (physical area where proposed project components are to be located) is generally located east of Wilkins Road, north of the East Highline Canal, and west of Gas Line Road. Figure 2, below, shows the location and alignment of key associated infrastructure.

[3] http://www.icpds.com/CMS/Media/3_ImperialCountyHE_-FINAL_9-27-13.pdf, Retrieved June, 2020
[4] http://www.icpds.com/CMS/Media/3_ImperialCountyHE_-FINAL_9-27-13.pdf, Retrieved June, 2020
[5] http://www.icpds.com/CMS/Media/3_ImperialCountyHE_-FINAL_9-27-13.pdf, Retrieved June, 2020

Figure 2: Project Location, Depicting Fiberoptic Cable Line Route & Substation



5.2 PROJECT OBJECTIVES

- Construct, operate and maintain an efficient, economic, reliable, safe and environmentally sound solar-powered electricity generating facility.
- Help meet California's Renewable Portfolio Standard (RPS) requirements, which require that by 2030, California's electric utilities are to obtain 50 percent of the electricity they supply from renewable sources.
- Generate renewable solar-generated electricity from proven technology, at a competitive cost, with low environmental impact, and deliver it to the local markets as soon as possible.
- Develop, construct, own and operate the Wister Solar Energy Facility, and ultimately sell its electricity and all renewable and environmental attributes to an electric utility purchaser under a long-term contract to meet California's RPS goals.
- Utilize a location that is in close proximity to an existing switching station and powerlines.
- Minimize and mitigate any potential impact to sensitive environmental resources within the project area.

5.3 PROJECT CHARACTERISTICS

The proposed Project involves the construction and operation of a 20-Megawatt (MW) photovoltaic (PV) solar energy facility on approximately 100 acres within APN No. 003-240-001 (privately-owned land) north of Niland. The Facility would be comprised of solar PV panels on single-axis horizontal trackers, an on-site 92-kV power substation (a.k.a. "Wister Substation"), power inverters, power transformers, and underground electrical cables. depicts the proposed site plan.

The power produced by the Facility would be conveyed to the local power grid via the on-site 92-kV substation (hereafter referred to as the "Wister Substation"), which will be tied directly to the Imperial Irrigation District's 92-kV transmission line. A gen-tie line would connect the Wister substation to the POI at the existing IID 92-kV "K" line. The Project Applicant has secured a Power Purchase Agreement (PPA) with San Diego Gas and Electric for the sale of power from the Facility.

5.3.1 Wister Substation

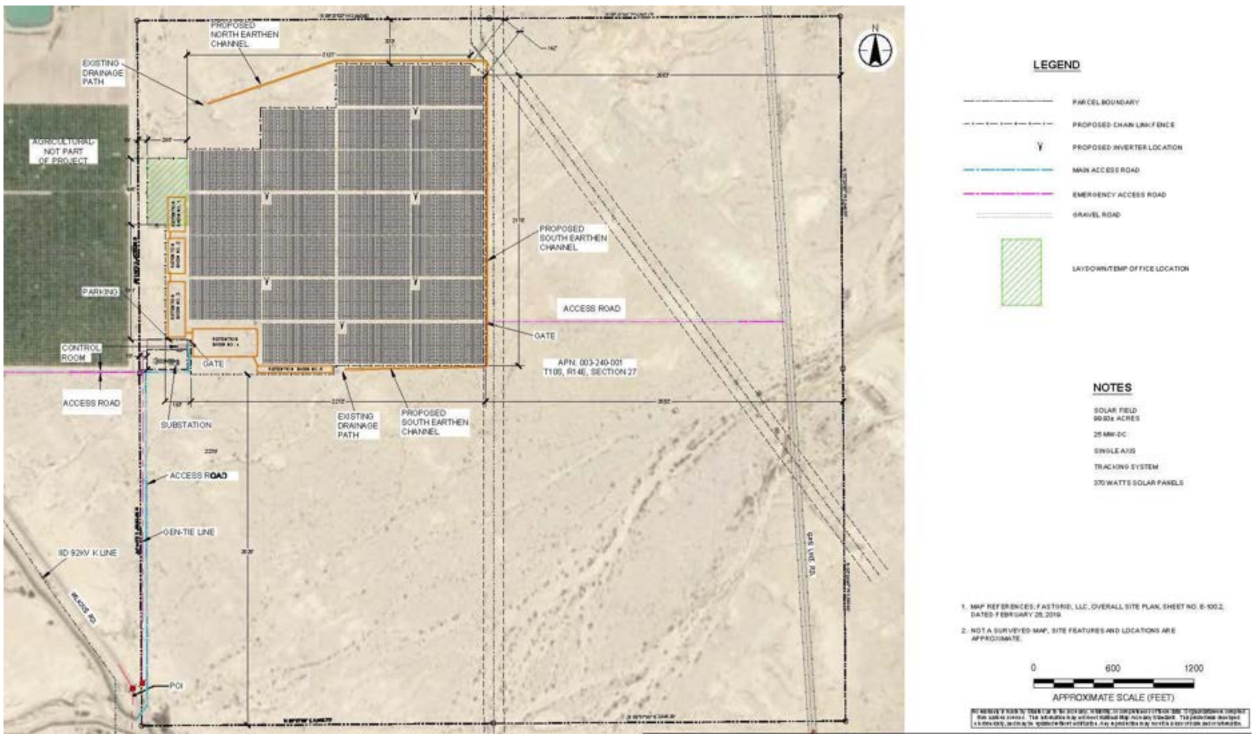
The proposed Wister Substation would be a new 92/12-kV unstaffed, automated, low-profile substation. The dimensions of the fenced substation would be approximately 300 feet by 175 feet. The enclosed substation footprint would encompass approximately 1.2 acres of the approximately 640-acre project parcel, and it will be located at the northwest quarter of the parcel, immediately southwest of the solar field. The California Building Code and the Institute of Electrical and Electronics Engineers (IEEE) 693, Recommended Practices for Seismic Design of Substations, will be followed for the substation's design, structures, and equipment.

5.3.2 Fiberoptic Cable

A proposed fiberoptic line from the proposed Wister Substation would be connected with the existing Niland Substation approximately two miles to the south, which would then be added to connect the proposed Wister Substation to the region's telecommunications system. Overall, this would provide Supervisory Control and Data

Acquisition (SCADA), protective relaying, data transmission, and telephone services for the proposed Wister Substation and associated facilities. New telecommunications equipment would be installed at the proposed Wister Substation within the Mechanical and Electrical Equipment Room (MEER). The proposed fiber optic telecommunications cable would utilize existing transmission lines to connect to the Niland Substation. The length of the proposed fiber optic telecommunications cable route would be approximately two miles. Figure 4, below, shows the preliminary site plan.

Figure 3: Site Plan



5.3.3 Gen-Tie Line

A proposed gen-tie line would connect the Wister Substation to the POI at the existing IID 92-kV "K" line. The proposed gen-tie line would originate at the proposed Wister substation and would terminate at the POI, at a distance of approximately 2,500 feet to the south-southwest. Steel poles, standing at a maximum height of 70 feet tall, will be spaced approximately every 300 feet along the route, and would support the 92-kV conductor and fiberoptic cable to the POI. Construction of the 2,500-foot gen-tie line to the POI would utilize overland travel via an all-weather improved access road along the entire route.

5.3.4 Groundwater Well

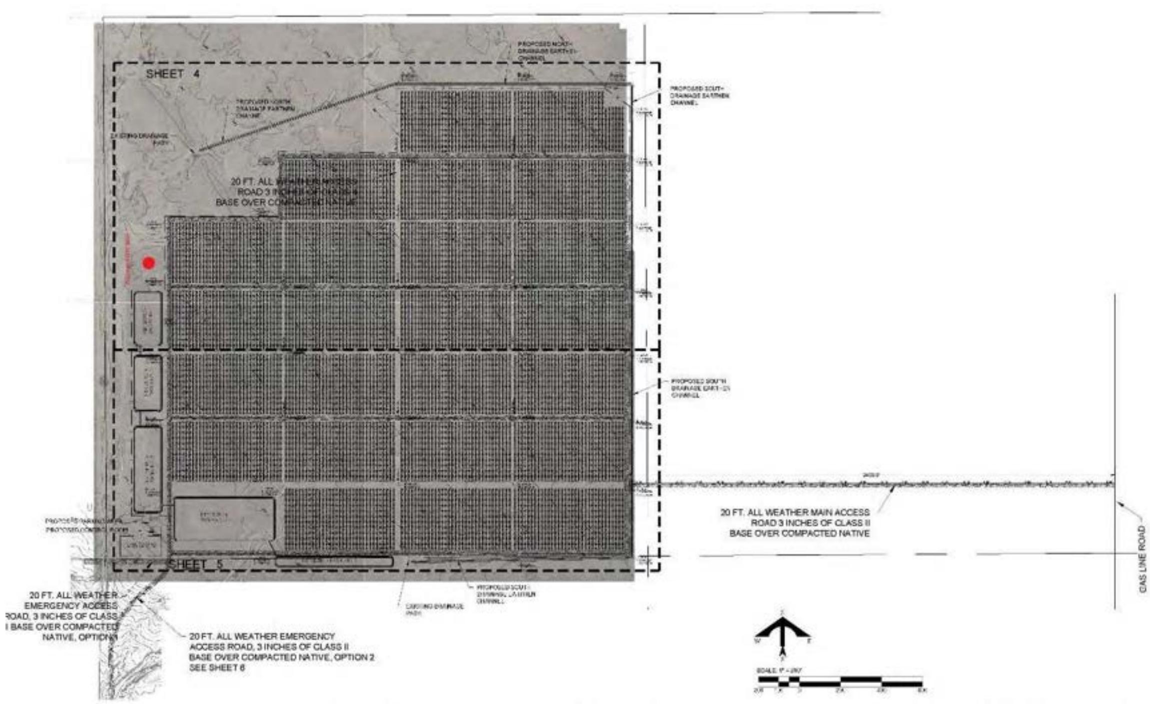
There is groundwater onsite. The proposed Project may utilize the groundwater for project construction, and potentially limited operational activities. A groundwater well would be constructed and operated on the existing geothermal well pad (and proposed Project construction staging area) located in the north-western portion of the project site, See Figure 5.

5.4 Project Construction

5.4.1 Construction Sequence

Construction activities would be sequenced and conducted in a manner that addresses storm water management and soil conservation. During construction, electrical equipment would be placed in service at the completion of each 2,500-kW power-block. The activation of the power-blocks is turned over to interconnection following the installation of transformer and interconnection equipment upgrades. This in-service timing is critical because PV panels can produce power as soon as they are exposed to sunlight, and because the large number of blocks and the amount of time needed to commission each block requires commissioning to be integrated closely with construction on a block-by-block basis.

Figure 4: Proposed Groundwater Well Location



Construction would generally occur during daylight hours, Monday through Friday. However, non- daylight work hours may be necessary to make up schedule deficiencies, or to complete critical construction activities. For example, during hot weather, it may be necessary to start work earlier to avoid pouring concrete during high ambient temperatures. If construction is to occur outside of the County's specified working hours, permission in writing will be sought at the time. Construction of the proposed project would occur in phases beginning with site preparation and grading and ending with equipment setup and commencement of commercial operations. Overall, construction would consist of three major phases over a period of approximately 6-9 months:

1. Site Preparation, which includes clearing grubbing, grading, service roads, fences, drainage, and concrete pads; (1 month)
2. PV system installation and testing, which includes installation of mounting posts, assembling the structural components, mounting the PV modules, wiring; (7 months) and

3. Site clean-up and restoration. (1 month)

Construction activities would be conducted in a manner consistent with Imperial County Codified Ordinance. Noise generating sources in Imperial County are regulated under the County of Imperial Codified Ordinances, Title 9, Division 7 (Noise Abatement and Control). Noise limits are established in Chapter 2 of this ordinance. Under Section 90702.00 of this rule, average hourly noise in residential areas is limited to 50 to 55 dB(A) from 7 AM to 10 PM, and to 45 to 50 dB(A) from 10 PM to 7 AM. The Applicant will also obtain coverage under the State Water Resources Control Board General Storm Water NPDES Permit for Construction Activities and prepare a Storm Water Pollution Prevention Plan (SWPPP) to prevent adverse water quality impacts during construction. Similarly, the Applicant will obtain the necessary permits from California Department of Fish and Wildlife should there be a need to obtain a Section 1602 Streambed Alteration Agreement during construction.

5.4.2 WORKFORCE

The on-site workforce would consist of laborers, electricians, supervisory personnel, support personnel and construction management personnel. The average number of construction workers would be approximately 50-60 people per day.

5.4.3 MATERIALS

The proposed Project would require general construction materials (i.e., concrete, wood, metal, fuel, etc.) as well as the materials necessary to construct the proposed PV arrays. Most construction waste is expected to be non-hazardous and to consist primarily of cardboard, wood pallets, copper wire, scrap steel, common trash and wood wire spools. Although field equipment used during construction activities could contain various hazardous materials (i.e., hydraulic oil, diesel fuel, grease, lubricants, solvents, adhesives, paints, etc.), these materials are not considered to be acutely hazardous and would be used in accordance with the manufacturer's specifications and all applicable regulations.

Each PV module would be constructed out of poly-crystalline silicon semiconductor material encapsulated in glass. Construction of the PV arrays will include installation of support beams, module rail assemblies, PV modules, inverters, transformers, and underground electrical cables. Concrete will be required for the footings, foundations, pads for transformers, and substation equipment. Concrete will be purchased from a local supplier and transported to the proposed project site by truck. The PCS housing the inverters will have a precast concrete base. Final concrete specifications will be determined during detailed design engineering in accordance with applicable building codes.

5.4.4 SITE PREPARATION

Project construction would include the renovation of existing dirt roads to all-weather surfaces (to meet the County standards) from Wilkins Road just south of the orchard, and a new road would be graded west from Gas Line Road and a new road graded north from the southwest corner of the parcel off Wilkins Road. Construction of the proposed project would begin with clearing of existing brush and installation of fencing around the project boundary. A 20' road of engineering-approved aggregate will surround the site within the fencing. Site preparation would be in compliance and consistent with the above-cited SWPPP.

Material and equipment staging areas would be established on-site within an approximate 4-acre area. The staging area would include an air-conditioned temporary construction office, a first-aid station and other temporary facilities including, but not limited to, sanitary facilities, worker parking, truck loading and unloading, and a designated area for assembling the support structures for the placement of PV modules. The location of the staging area would change as construction progresses throughout the project site. The project construction contractor would then survey, clear and grade road corridors in order to bring equipment, materials, and workers to the various areas under construction within the project site. Road corridors buried electrical lines, PV array locations and locations of other facilities may be flagged and staked in order to guide construction activities. In addition, water truck reloading stations would be established for dust control.

5.4.5 CONSTRUCTION WATER REQUIREMENTS

Construction of the proposed Project is anticipated to take approximately 6-9 months. from the commencement of the construction process to complete. Construction water needs would be limited to earthwork, soil conditioning, dust suppression, and compaction efforts. During construction, on-site groundwater is proposed to be utilizedwill be used. It is estimated that approximately 900,000 gallons (2.76 acre-feet [af]) of water (40,909 gallons per work day) would be required during the first phase of construction for site preparation and grading, The second phase of construction (PV system installation and testing) would take approximately 6 months and require approximately 2,130,000 gallons (6.54 af) of water (16,136 gallons per work day). Water would drop to approximately 300,000 gallons (0.92 af) (13,636 gallons per workday) of water during the last phase of the construction (clean-up and restoration). The proposed project would require a total of 3,330,000 gallons (10.22 af) of water during the construction period. To the extent necessary, non-potable water would be obtained from the Golden State Water Company's hydrant/meter near 1st Street and Memphis Street in Niland and trucked to the project site to meet construction water needs.

5.4.6 DUST SUPPRESSION

The Project would comply with all applicable air pollution control regulations. During the construction phase of the project, standard dust control measures would be used to mitigate emissions of fugitive dust. These may include watering or applying dust palliatives with low environmental toxicity to suppress dust during construction.

5.4.7 OPERATIONS AND MAINTENANCE

Once fully constructed, the proposed Project would be operated on an unstaffed basis and be monitored remotely, with periodic on-site personnel visitations for security, maintenance and system monitoring. Therefore, no full-time site personnel would be required on-site during operations, and employees would only be on-site four times per year to wash the panels.

As the project's PV arrays produce electricity passively, maintenance requirements are anticipated to be very minimal. Any required planned maintenance activities would generally consist of equipment inspection and replacement and would be scheduled to avoid peak load periods. Any unplanned maintenance would be responded to as needed, depending on the event.

Estimated annual water consumption for operation and maintenance of the proposed Project, including periodic PV module washing, would be approximately 0.81-acre feet annually (af/y). As discussed previously, the project will use groundwater from an on-site groundwater well. Alternatively, non-potable water would be obtained from the Golden State Water Company's hydrant/meter near 1st Street and Memphis Street in Niland and trucked to the Project site.

5.4.8 FACILITY DECOMMISSIONING

Solar equipment has a lifespan of approximately 20 to 25 years. At the end of the Project's operation term, the Applicant may determine that the Project should be decommissioned and deconstructed. Should the Project be decommissioned, concrete footings, foundations, and pads would be removed using heavy equipment and recycled at an off-site location. All remaining components would be removed, and all disturbed areas would be reclaimed and recontoured.

6 PREPARATION OF SB 610 ASSESSMENTS – GROUNDWATER

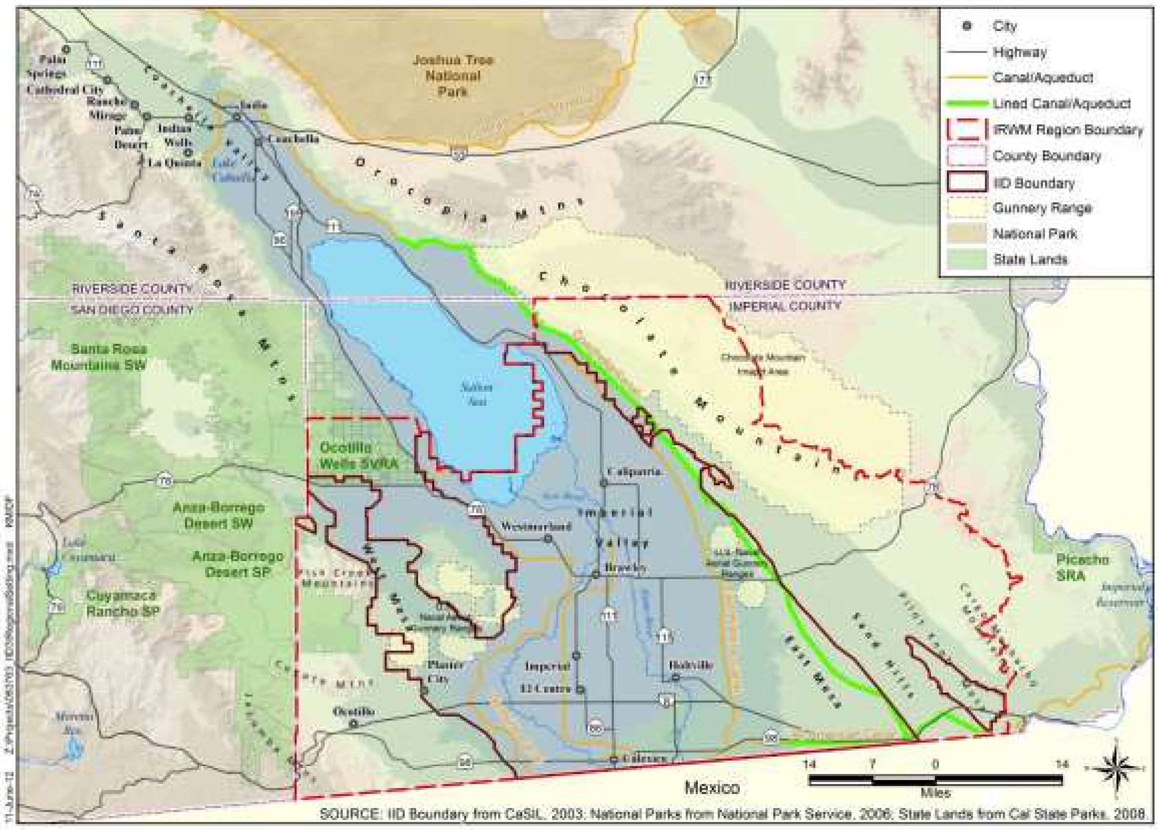
6.1 EXECUTIVE SUMMARY

6.2 IMPERIAL INTEGRATED REGIONAL WATER MANAGEMENT PLAN (OCTOBER 2012)

Imperial County has an Integrated Regional Water Management Plan (IRWMP) which was adopted in October of 2012, . As stated in the IRWMP, "…The Imperial IRWMP area lies within the Salton Trough of southern California as shown on Figure X. The Salton Trough is the dominant feature of the Colorado Desert geomorphic province of California. The trough is about 130 miles long and up to 70 miles wide, and is generally considered the northwesterly landward extension of the Gulf of California (Loeltz et al., 1975). The term Salton Basin (Basin) applies to the broad region draining directly into the Salton Sea. The Imperial Valley lies in the central part of the Basin south of the Salton Sea. Most of the IID service area overlies the area defined as the Imperial Valle. The Salton Sea is a critical component of the Pacific Flyway migratory corridor as it is an essential overwintering site for thousands of migratory waterfowl. Its marsh areas provide significant habitat for the endangered Yuma clapper rail…[6]"

[6] https://www.iid.com/water/water-supply/water-plans/imperial-integrated-regional-water-management-plan, Retrieved , June 2020

Figure 5: Imperial IRWMP Area



The IRWMP encompasses three principal physiographic and hydrologic areas: (1) the Imperial Valley which lies within the valley floor generally inside the boundaries of the Westside Main and East Highline Canals and north of the Mexico; (2) the East Mesa which is generally east of the East Highline Canal; and (3) the West Mesa generally west of the Westside Main canal. The proposed Project is in the East Mesa, which is in the southeastern portion of the Salton Basin. The IRWMP describes this area as the broad area east of the East Highline Canal and east margin of pre-historic Lake Cahuilla, and west of the Sand Hills Fault. The East Mesa is also roughly bordered by the Coachella Canal on the east and the AAC on the south. The East Mesa is an alluvial surface that slopes gently west-southwest, covered with thin veneers of wind-blown sand. The East Mesa aquifer is chiefly unconfined, homogenous, and composed of coarsegrained deposits of gravels, sands, silts, and silty clays that were deposited by the Colorado River. Faults in East Mesa (e.g., San Andreas Fault and Algodones Fault) act as partial barriers to the westward flow of groundwater from this area. The Calipatria Fault also crosses a small portion of the East Mesa along the southwest margin and also impedes the flow of groundwater out of East Mesa.

According to the IRWMP, the East Mesa has the greatest amount of available data on groundwater quality, and it includes a large number of groundwater wells. It also has a small number (12) of water supply wells, some of which are used for agricultural purposes. It has two aquifers: a shallow unconfined zone from 0 to 85 feet and a deeper semi-confined zone from 85 to 160 feet (Crandall, 1983). The aquifers were differentiated based on chemistry of their waters and the perforated interval of the particular well. The Table below provides the analysis and characterization of the water quality[7].

Table 5: East Mesa Water Quality from IRWMP

Table B-1. East Mesa Water Quality

	Zone A (85 to 160 Feet)		Zone B (0 to 85 Feet)	
Chemical Character	Sodium Chloride	15 wells	Sodium Chloride	13 wells
	Sodium Sulfate	3 wells	Sodium Sulfate	10 wells
	Sodium Bicarbonate	0 wells	Sodium Bicarbonate	6 wells
pH	Range: 7.4- 8.6	17 wells	Range: 4.3-11.2	17 wells
	Common 7.4- 8.6		Common 6.9- 9.0	
	4.3- 6.4	0 wells	4.3- 6.4	4 wells
	6.5- 7.5	1 well	6.5- 7.5	5 wells
	7.6- 8.6	16 wells	7.6- 8.6	11 wells
	8.7- 9.7	0 wells	8.7- 9.7	3 wells
	9.8-11.2	0 wells	9.8-11.2	4 wells
TDS (ppm)	Range 589-2860	17 wells	Range: 250-2620	27 wells
	Common: 750- 995	9 wells	Common: 434- 787	16 wells
	589	1 well	250	1 well
	1270	1 well	882-1413	7 wells
	1710-2860	6 wells	1750-2620	3 wells
	7112	1 well	7151	1 well
F (ppm)	Range: 0.2-1.4	10 wells	Range 0.1-1.6	22 wells
	1.9	1 well	3	1 well
B	0.26 and 0.46	2 wells	0.41	1 well

Source: Crandall, 1983

According to the IRWMP, hydraulic conductivity values for the shallow and deeper aquifers values varied from a low value of 0.5 foot per day in the central irrigated area of the to a high value of 80 feet per day in East Mesa, where sediments are highly transmissive sands and gravels. Therefore, the IRWMP concludes that on average, new wells in the East Mesa would be expected to have higher yields than those in the West Mesa[8].

[7] https://www.iid.com/water/water-supply/water-plans/imperial-integrated-regional-water-management-plan, Retrieved, June 2020.

[8] https://www.iid.com/water/water-supply/water-plans/imperial-integrated-regional-water-management-plan

The IRWMP states, "Data available in the IRWMP for wells in the East Mesa include well yields and specific capacities. Reported well yields varied from 80 to 3,000 gpm, depending on depth and location. In general, yields in excess of 900 gpm were associated with depths of 200 feet or more. Specific capacity data reported for seven wells in the East Mesa, varied from 0.8 to 85 gpm/ft. The well with the highest specific capacity was located at the junction of the AAC and Coachella Canal. Specific capacities were highest to the east, and diminished to the west. Higher specific capacities were associated with wells deeper than 200 feet (Crandall, 1983). Consistent with the overall geologic model for the Imperial IRWMP area, the highest transmissivities are associated with the East and West Mesas where aquifer formations are generally more homogenous and include a much higher proportion of coarse sands and gravels then the Imperial Valley floor, allowing groundwater to move at higher rates."[9]

The direction of groundwater movement in the East Mesa is controlled primarily by contours of groundwater level elevation; the rate of groundwater movement is proportional to the gradient or slope of the groundwater table. Groundwater levels and flow have changed with lining of the canals; therefore, two temporal sets of water level data are presented: one for 1960 representing conditions with recharge from the canals and one for 1993 after the southerly portions of the Coachella Canal was lined. Lining of portions of the AAC, generally about six miles east of the East Highline Canal to about five miles east of the Coachella Canal was not started until 2006 so neither set of maps reflect the reduction of seepage from the AAC. A portion of the AAC still contributes recharge to East Mesa. Additional details groundwater contour maps are also provided for both the East and West Mesas.

6.3 TITLE 9, DIVISION 21, WATER WELL REGULATION [DIVISION 21 ADOPTED NOVEMBER 24, 1998 (AMENDED OCTOBER 31, 2006)]

TITLE 9, DIVISION 21, WATER WELL REGILATION, DIVISION 21, § 92102.00 PERMIT(S) REQUIRED

Imperial County Ordinance XXXXX states, in relevant part, that "No person shall (1) drill a new well, (2) activate a previously drilled but unused well, (unused shall mean a well or wells that have not been used for a 12 month) period by installing pumps, motors, pressure tanks, piping, or other equipment necessary or intended to make the well operational, (3) increase the pumping capacity of a well, or (4) change the

[9] https://www.iid.com/water/water-supply/water-plans/imperial-integrated-regional-water-management-plan

use of a well, without first obtaining a Conditional Use Permit (CUP) through the County Planning & Development Services Department. The pumping capacity shall mean the "permitted amount" or in the absence of a permit the annual acreage, over 3-year period." Therefore, the Applicant would need to obtain a Conditional Use Permit from the County for the onsite well.

Additionally, Imperial County Ordinance XXXXX states that:

"(B) Well Construction Permit. No person shall dig, bore, drill, deepen, enlarge, refurbish, or destroy a water well, cathodic protection well, observation well, monitoring wells or any other excavation that intersects ground water without first obtaining a well construction permit through the Planning & Development Services Department…" The Applicant would also have to obtain a Well Construction Permit from the County.

6.3.1 TITLE 9, DIVISION 21, WATER WELL REGILATION, DIVISION 21, § 92102.05 SUSPENSION AND REVOCATION

A. Circumstances for such action: Enforcement agency may suspend or revoke any permit issued pursuant to this Ordinance, whenever it finds that the permittee has violated any of the provisions of this Ordinance, or has misrepresented any material fact in his/her application or any supporting documents for such a permit. Prior to ordering any such suspension or revocation, the enforcement agency shall give permittee an opportunity for a hearing thereon, after reasonable notice. The hearing shall be before the enforcement agency, the director, or his designated representative.

B. Consequences: No person whose permit has been suspended or revoke shall continue to perform the work for which the permit was granted until, in case of suspension, such permit has been reinstated by the enforcement agency.

C. Additional Work: Upon suspending or revoking any permit, the enforcement agency may order permittee to perform any work reasonably necessary to protect the ground water from pollution or contamination, if any work already done by permittee has left a well in such a condition as to constitute a hazard to the quality of the ground water. No permittee or person who has obtained a permit issued pursuant to this Ordinance shall fail to comply with such order

In the event the applicant be denied the Conditional Use Permit for the groundwater well, The applicant will have to take the following actions. Find another legal water source per California Water Code. The applicant will then need to submit a revised Water Supply Assessment to the Lead Agency.

This project is outside the IID's service area and therefore the IID cannot service the project with water.

6.3.2 TITLE 9, DIVISION 21, WATER WELL REGILATION, DIVISION 21, § 92103.01 REPORTS

Completion Reports: The driller shall provide the enforcement agency a completion report within 30 days of the completion of any well construction, reconstruction, or destruction job. A. Submittal of State "Report of Completion": A copy of the "Report of Completion" (Driller's well log) required by California Water Code, Section 13751, shall be submitted by the well driller to the enforcement agency within 30 days of construction or destruction of any well (except driven wells). This report shall document that the work was completed in accordance with all applicable standards and additional permit conditions. This section shall not be deemed to release any person from the requirement to file said report with the State Department of Water Resources. B. Confidentiality of Report: With the exception of the well driller's name, the date the well was drilled and the well yield, all information contained in this report shall remain "Confidential". C. Other Agency's Requirements: Nothing in this Ordinance shall be deemed to excuse any person from compliance with the provisions of California Water Code, Section 13752, relating to notices and reports of completion or any other federal, state, or local reporting regulations.

6.3.3 TITLE 9, DIVISION 21, WATER WELL REGILATION, DIVISION 21, § 92103.00 REGISTRATION OF WELL

Any person who uses a new or existing well shall first register said well with the Imperial County Planning & Development Services Department. If a well is under an active conditional use permit, the well shall be deemed to be registered. Any well that is not under an Imperial County CUP shall be registered with the Planning & Development Services Department and the State pursuant to California Water Code, Section 13750.. An application to register any well shall be filed with the Planning & Development Services Department and said application shall contain all information required upon said form.

6.3.4 TITLE 9, DIVISION 21, WATER WELL REGILATION, DIVISION 21, § 92103.02 WELL STANDARDS

Except as otherwise specified, the standards for the construction, repair, reconstruction, alteration, reactivation, operation, or abandonment of wells shall be as set forth in: A. The California Department of Water Resources Bulletin 74-81 entitled, "Water Well Standards, State of California", except as modified by subsequent supplements or revisions issued by the Department of Water Resources. Division 21 Adopted November 24, 1998 (Amended October 31, 2006) B. The California Department of Water Resources Bulletin 74-90 and any subsequent supplements or revisions issued by the Department of Water Resources. C. The following factors, to the extent necessary to avoid conditions of overdraft, subsidence, well interference, water quality degradation, or other environmental degradation: 1. The type of use or uses served. 2. The number of users served. 3. Wasteful or inefficient use. 4. Water conservation activities. 5. Reasonable need of the extractor and other affected water users. 6. The quality of groundwater. 7. The affected groundwater basin or sub-basins. 8. Environmental impact as determined through the CEQA review. 9. Any other factors that the Planning & Development Services Department reasonably believes it should consider in order to reach an equitable result within the entire County in accordance with the provisions of this Ordinance, and of California Law.

6.4 COLORADO RIVER BASIN REGION OF CALIFORNIA (BASIN PLAN) (2019)[11]

For water quality planning and protection purposes, the Project is within the Colorado River Basin Region of the California Regional Water Quality Control Board. The Water Quality Control Plan for the Colorado River Basin (Basin Plan) is the Board's master plan for water quality protection. The Basin Plan identifies the waters in the Region, theor beneficial uses, and water quality objectives to protect those uses. The Basin Plan fulfills state and federal statutory requirements for water quality planning, thereby preserving and protecting ground and surface waters of the Colorado River Basin Region. The proposed Project is in the Imperial Valley Hydrologic Unit.

6.4.1 BENEFICIAL USE DESIGNATIONS OF AQUIFERS

[11] https://www.waterboards.ca.gov/coloradoriver/water_issues/programs/basin_planning/docs/bp032014/r7_bp2019fullbp.pdf, Retrieved, June 2020

6.5 HISTORIC USE IN THE BASIN- RECORDS

The closest historical records of related to groundwater pumping on record belongs to the Western Mesquite Mines, with a ORDER R7-2014-0032, Waste Discharge Requirements And Monitoring And Reporting Program permit with the California Regional Water Quality Control Board Colorado River Basin Region. The Water Quality Control Plan for the Colorado River Basin Region of California (Basin Plan), which was adopted on November 17, 1993, and amended on November 16, 2012, designates the beneficial uses of ground and surface waters in this Region.

According to the IRWMP there is proof that farmers did use groundwater wells at one point to water crops, however there are no records on file at the County of Imperial of such permits. The majority of farmers rely on the Imperial Irrigation Districts water conveyance system for water deliveries.

The proposed well would be new and therefore has no other historical use. All water being pumped will from this proposed ground water well will be a net increase.

7 PROJECT WELL HYDRAULIC EVALUATION [13]

7.1 SURFACE WATER SYSTEM

Surface water features within 2 miles of the Proposed Well include natural drainages and manmade features including canals, laterals, IID drains and ponds/reservoirs. Natural drainages include Iris Wash and unnamed minor drainages, which convey runoff from the Chocolate Mountains to the Imperial Valley. These drainages ultimately flow towards the Salton Sea, which is the low point of the basin. All natural drainages are classified as intermittent (USFWS, 2020). Canals include the Coachella Canal and the East Highline Canal (Figure 3). Both canals deliver water from the All American Canal (AAC), located approximately 40 miles south of the Project. The Coachella Canal is located approximately 1.3 miles from the Proposed Well. The Coachella Canal was initially unlined in the Imperial Valley, which lead to water losses into the alluvial sediments. In the late 1970s, the first 49 miles of the Coachella Canal was replaced with a concrete lined channel. This end of this segment is located approximately 3.6 miles east southeast of the Proposed Well. In the mid-2000s, the remaining 36.5 miles of the Coachella Canal (including the section near the Project; see Figure 3) was replaced with a concrete lined channel, reducing seepage losses into alluvial sediments. The East Highline Canal is located approximately 0.5 miles from the Proposed Well.

[13] STANTEC STUDY

Furthermore, the East Highline Canal crosses the southwest corner of the Project (Figure 1). The East Highline Canal is unlined and likely results in seepage to alluvial sediments. The water distribution system in the Imperial Valley, near the Project, include laterals and ponds for distribution and storage, respectively, and drains to convey unused water from distribution system, farmland, and discharging groundwater to the Salton Sea (IIRWMP, 2012). The East Highline Canal is downgradient from the Project though a seepage mound in the shallow aquifer may be present upgradient of the canal, as identified along unlined sections of the AAC and Coachella Canal (Loeltz et al., 1975).

Please identify and name the closest IID Drain to the Project site.

7.2 Aquifer Extent and Properties

Aquifers in the East Salton Sea Basin include alluvial aquifers, which are present as valley fill with maximum thicknesses of at least 400 feet (Willets et al., 1954). Water bearing units include unconsolidated Quaternary alluvium and semi-consolidated Tertiary to Quaternary alluvium. The groundwater storage capacity was estimated at 360,000 acre-feet (DWR, 1975). High permeability units likely include coarse sands and gravels, where present. Aquifer extents are bounded by outcropping bedrock in the Chocolate Mountains and possibly low-permeability fault zones such as the San Andreas Fault Zone, the Banning Mission Fault, and other unnamed faults. Specific to East Mesa, aquifers in this area are generally unconfined, homogenous, and composed of sediments deposited by the Colorado River (IIWMP, 2012). A geothermal test well was previously drilled at the Project by Ormat (well 12-27) to a depth of 3401 feet bgs. The shallow groundwater system was not specifically characterized during drilling and testing. However, static temperature logs from the well may indicate the presence of an aquifer zone as shallow as 40 to 50 feet bgs. Other aquifer zones are likely present but were not identified due to the limitations of temperature logs. Geothermal properties of the test well were non-economical, and the well was abandoned. The nearest East Mesa well with a lithological log is 12S/16E-9A, which is located 9 miles to the southwest of the Proposed Well. In the 1000-foot log, 61% of the thickness is dominated by sand, 34% dominated by clay and approximately 1% dominated by sandstone. Sand and clay intervals also include silts and gravels. Coarse sands and gravels, likely having high hydraulic conductivities, are intermittently present throughout the logged sequence. The perforated interval of the well was placed at 150-1,000 feet and the static water level was recorded at 154.5 feet bgs, which is an elevation of 65.5 feet bgs. Other nearby wells with lithological logs were completed in the Imperial Valley and contain higher percentages of clay (Loeltz et al., 1975).

7.3 RECHARGE

Groundwater recharge in the East Mesa area was historically dominated by seepage from the Coachella Canal, prior to replacement with concrete lined channels in the late 1970s and mid-2000s. Prior to lining, seepage from the 36.5-mile section near the Project has been estimated at 26,000 acre-feet per year. Unlined sections of the AAC continue to recharge the East Mesa groundwater aquifer. However, the unlined section is approximately 45 miles from the Project. In the absence of canal seepage, recharge to the East Mesa aquifer from direct precipitation is estimated to be near zero (Leroy Crandall and Associates, 1983). Groundwater recharge in the Chocolate Mountains may include mountain front recharge and stream flow runoff (Tompson et al., 2008). The Lawrence Livermore National Laboratory (LLNL) groundwater model (Tompson et al., 2008) estimated that recharge from precipitation within the Imperial Valley and portions of surrounding ranges was 0.019 inches/year, which is less than 1% of precipitation. Furthermore, the LLNL model did not include additional recharge along the mountain fronts. The 2013 groundwater model, which was updated by Argonne National Laboratory (ANL; Greer et al., 2013) estimated recharge at 0.056 inches/year in Imperial Valley and 7.2 inches/year along the mountain-front area of the Chocolate Mountain. This estimate of mountain-front recharge may not be supported by the estimated precipitation rates for the Chocolate Mountains (4-6 inches/year; PRISM, 2020). In 2003, the DWR classified the East Salton Sea Basin groundwater budget type as 'C', which indicates that groundwater data is insufficient to estimate the groundwater budget or groundwater extraction (DWR, 2003)

DISCHARGE AND EXTRACTION

Discharge from the East Salton Sea Basin includes springs, discharge into irrigation drains, and extractions from wells. Spring discharge, and water losses from associated vegetation, is likely limited based on the occurrence of few springs (see Figure 3). Irrigation drains in the Imperial Valley (including the western margin of the East Salton Sea Basin) primarily return excess irrigation water to the Salton but also function to remove discharging groundwater. Water well extraction rates were last estimated in 1952 at 6 acre feet/year (DWR, 1975). Due to the lack of development in this basin, current extraction rates may be similar. However, this statement is speculative due to a lack of recent information (DWR, 2003).

7.4 GROUNDWATER LEVELS

Groundwater levels in the vicinity of the Project have been influenced by the presence of the canal systems, including the Coachella Canal, East Highline Canal, and associated laterals and drains. Seepage from the unlined Coachella Canal created a groundwater mound in the shallow alluvial aquifer of East Mesa, with water levels rising over 70 feet in some areas (Loeltz et al., 1975). Groundwater level decline in the vicinity of the Coachella Canal has been monitored since the late 1970s when the first 49 miles of the earthen canal channel was replaced with a concrete channel. United States Geological Survey (USGS) well 11S/15E-23M, which is approximately 9 miles southeast of the Proposed Well (Figure 3), shows an asymptomatic groundwater level decline from 20.68 feet bgs in 1979 to approximately 50 feet bgs at present. The water level elevations as of March 2020 were approximately 70 feet amsl. No groundwater levels have been reported along the Coachella Canal section that was lined in the late 2000s. However, a similar asymptotic decline could be expected. Groundwater levels in Imperial Valley have been historically measured at two multi-level wells located approximately 6.5 to 7.5 miles southwest of the Proposed Well (11S14E30C and 11S14E19N; Figure 3). Water levels at these locations were within 10 feet of the ground surface in 1989. The groundwater elevation at that time was approximately 215 feet bmsl. Groundwater levels in the irrigated areas have been controlled by the drain systems (IIRWMP, 2012). Current groundwater levels, although sparse, generally agree with historical groundwater elevation distributions. Groundwater elevations are higher in mountainous areas and East Mesa and decline towards Imperial Valley and the Salton Sea. This distribution of groundwater elevations suggests groundwater flow directions roughly coincide with topography. However, the flow of groundwater and distribution of groundwater levels is likely influenced by faults, which act as barriers, and changes in transmissivity.

7.5 GROUNDWATER QUALITY

Groundwater quality in the East Salton Sea Basin is generally reported as poor and not suitable for domestic, municipal, or agricultural purposes (DWR, 2004). Water types include sodium chloride and sodium sulfate. Total dissolved solids (TDS) concentrations are reported as 356 to 51,632 mg/L, whereas the National Secondary Drinking Water Regulations limit TDS to 500 mg/L. Groundwater quality is generally considered better in the vicinity of the unlined canals due to the recharge of lower TDS water. The closest well to the Proposed Well with available water quality data is located 2 miles to the west (Loeltz et al., 1975). A limited number of water quality constituents were measured in 1961, including pH (8.0), specific conductivity (19,200 µS/cm), bicarbonate (210 mg/L), chloride (6,050 mg/L), calcium-magnesium hardness (2,440 mg/L), and non-carbonate hardness 2,270 mg/L). The screened interval depth of this well is unknown.

The next closest well to the Proposed Well with available water quality data is an inactive USGS monitoring well (11S/14E-2A) located approximately 2.8 miles to the southeast (USGS, 2020). The well is located in a Basin and Range basin-fill aquifer. The total depth was 825 feet bgs, however, the depth of the screened interval is unknown. Water quality was measured in the late 1960s and early 1970s. The latest water quality sample that includes all major ions (calcium, magnesium, sodium, potassium, bicarbonate, sulfate and chloride) was collected in 1969. This sample had sodium-chloride type water and a TDS concentration of 1,760 mg/L. Furthermore, temperatures were elevated above ambient temperatures at 44.4°C.

8 PROJECT WATER DEMAND

Project Engineers estimate that the water usaged for the Project will be for construction, operational, mitigation measures and decommissioning of the Project. Water from the aquifer can be supplied to the project via the proposed well in accordance with County and State regulations. The Project is anticipated to use approximately 1.87 AFY Amortized **(see Table- 8) and associated tables below** for a summary of water usage to be supplied to the Project. The project will increase the demand for water from this water source by 100%.

Table 6: Wister Project Demands- Construction

Wister Water Project Demand		
Construction Needs		
Phases	Per Day in Gallons	ACFT/DAY
Phase 1	900,000	2.76
Phase 2 *	2,130,000	6.54
Phase 3 *	300,000	.92
Total	3,330,000	10.22

Table 7: Wister Project Demands- Operational Water Use

Wister Water Project Demand		
Operational Needs		
Phases	ACFT/YR	ACFT 30 YEAR PROJECT LIFE
Operational Water Needs, for Dust and Fire Suppression	1.37	41.1
Decommissioning Water	5	5

Table 8:Amortized Wister Project Demand

Wister Water Project Demand	
Amortized Wister Project Demand	
Phase	ACFT/YR Total for 30 Years
Construction	10.22
Operational	41.1
Decommissioning	5
Total	56.32/30=1.87 AFY

9 PROJECT SPECIFIC HYDROLOGIC EVALUATION

At the request of the Applicant, Stantec conducted a hydrological evaluation for the proposed Project. It also prepared a report with titled "Hydrological Evaluation, Wister Solar Development Project. June 8, 2020." The report presents the findings of the evaluation. This following paragraphs summarize the findings.

The Wister Solar Development Project is located within the East Salton Sea Basin, which includes the Chocolate Mountains and the northeastern margin of the Imperial Valley (Figure 2). The groundwater storage capacity of the East Salton Sea Basin was estimated at 360,000 acre-feet. Groundwater usage in the East Salton Sea Basin is limited due to generally poor water quality and limited inhabitants. Extraction rates for the East Salton Sea Basin were last estimated in 1952 at 6 acre-feet/year, which is 3% of the estimated recharge rate of 200 acre-feet/year (DWR, 1975). Limited development in the East Salton Sea

Basin suggests that current extraction rates are similar. However, a lack of recent data limits the ability update this estimate. Furthermore, surface water from the Colorado River is conveyed into the Imperial Valley through a network of canals, laterals, and reservoirs, which has further reduced the need to develop groundwater resources. Groundwater in the East Salton Sea Basin is present in alluvial aquifers at depths up to several hundred feet, and with generally high transmissivities (Montgomery Watson, 1995). At the Project, groundwater may also be present in an alluvial aquifer 40-50 feet bgs. Historically, groundwater recharge was significant in the vicinity of the earthen lined Coachella Canal. The replacement of the canal with a concrete lined channel has greatly reduced recharge to the adjacent alluvial aquifers. Near the Project, the Coachella Canal was concrete lined in the late 2000s. The East Highline Canal remains earthen-lined, which likely leads to recharge into the shallow alluvial aquifers near the Project. Recharge from precipitation is generally limited due to low precipitation rates and high evaporation potential. Recharge rates may be higher in the Chocolate Mountains due to higher precipitation rates at higher elevations (4-6 inches/year; PRISM, 2020). Recharge events are likely limited to larger storm events, which may generate runoff and seepage along ephemeral channels. Recharge rates from precipitation were estimated at 0.019 inches/year (Tompson et al., 2008). The water needs for the Project are estimated at 10.22 acre-feet for construction in the first year, 1.37 acre-feet/year for the subsequent 25 to 30 years of operation, and 5 acre-feet for decommissioning at the end of operations (Table 7). Overall, the proposed extraction for the Project are significantly lower than recharge rates in an area where groundwater usage is limited.

10 PROJECT SPECIFIC PERMITTING REQUIREMENTS

Construction activities would be sequenced and conducted in a manner that addresses storm water management and soil conservation. During construction, electrical equipment would be placed in service at the completion of each 2,500-kW power-block. The activation of the power-blocks is turned over to interconnection following the installation of transformer and interconnection equipment upgrades. This in-service timing is critical because PV panels can produce power as soon as they are exposed to sunlight, and because the large number of blocks and the amount of time needed to commission each block requires commissioning to be integrated closely with construction on a block-by-block basis.

Construction would generally occur during daylight hours, Monday through Friday. However, non- daylight work hours may be necessary to make up schedule deficiencies, or to complete critical construction activities. For example, during hot weather, it may be necessary to start work earlier to avoid pouring concrete during high ambient temperatures. If construction is to occur outside of the County's specified working hours, permission in writing will be sought at the time. Construction of the proposed project would occur in phases beginning with site preparation and grading and ending with equipment setup and commencement of commercial operations. Overall, construction would consist of three major phases over a period of approximately 6-9 months:

4. Site Preparation, which includes clearing grubbing, grading, service roads, fences, drainage, and concrete pads; (1 month)
5. PV system installation and testing, which includes installation of mounting posts, assembling the structural components, mounting the PV modules, wiring; (7 months) and
6. Site clean-up and restoration. (1 month)

Construction activities would be conducted in a manner consistent with Imperial County Codified Ordinance. Noise generating sources in Imperial County are regulated under the County of Imperial Codified Ordinances, Title 9, Division 7 (Noise Abatement and Control). Noise limits are established in Chapter 2 of this ordinance. Under Section 90702.00 of this rule, average hourly noise in residential areas is limited to 50 to 55 dB(A) from 7 AM to 10 PM, and to 45 to 50 dB(A) from 10 PM to 7 AM.

10.1 STATE PERMITS REQUIRED

The State Water Resources Control Board and the Regional Water Quality Control Board (Region 7) regulate potential water quality impacts from discharges of wastes, including storm water runoff and wastewater runoff from the site from O&M activities. The Applicant will have to obtain coverage under the State Water Resources Control Board General Storm Water NPDES Permit for Construction Activities and prepare a Storm Water Pollution Prevention Plan (SWPPP) to prevent adverse water quality impacts during construction.

The California Department of Fish and Wildlife (CDFW) is responsible for conserving, protecting, and managing California's fish, wildlife, and native plant resources. To meet this responsibility, the California Fish and Game Code (F&GC) requires that the CDFW be consulted if the proposed Project has the potential to adversely impact a stream and thereby wildlife resources that depend on a stream for continued viability (F&GC Division 2, Chapter 5, section 1600-1616). A Section 1602 Lake or Streambed Alteration Agreement may be required for the Project, should the CDFW determine that the proposed Project may do one or more of the following:

- Substantially divert or obstruct the natural flow of any river, stream or lake;
- Substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or
- Deposit debris, waste or other materials that could pass into any river, stream or lake, or
- Remove or disturb vegetation and/or habitat.

For the purposes of clarification, a stream is defined by CDFW as "a body of water that flows perennially or episodically and that is defined by the area in which water currently flows, or has flowed, over a given course during the historic hydrologic regime, and where the width of its course can reasonably be identified by physical or biological indicators." The historic hydrologic regime is defined as circa 1800 to the present (CDFW 2010). The East Highline Canal is a Water of the United States (federal jurisdiction). There may be also nearby IID Drains that are also jurisdictional waters. Therefore, the Applicant should, at a minimum, delineate jurisdictional waters that may be affected by the Project (during and post construction), and consult with CDFW to determine whether a Section 1602 Streambed Alteration Agreement is required. Also, it should also consult with the Regional Water Board to determine whether Clean Water Act Section 401 Water Quality Certification is required to prevent adverse water quality impacts as well.

11 PROJECT WATER SUPPLY

According to the Hydrological Evaluation, "The groundwater storage capacity of the East Salton Sea Basin was estimated at 360,000 acre-feet. Groundwater usage in the East Salton Sea Basin is limited due to generally poor water quality and limited inhabitants. Extraction rates for the East Salton Sea Basin were last estimated in 1952 at 6 acre-feet/year, which is 3% of the estimated recharge rate of 200 acre-feet/year (DWR, 1975).[14]" The project amortized over a 30-year term water demand is assessed at 56.32 ACFT TOTAL, divided by 30 Years equates to 1.88 ACFT/YR over 30 Years. Although the basin contains a groundwater storage capacity of 360,000 acre-feet, with the recharge rate of 200 ACFT per year it is up to the local enforcement agencies to police the amount of water allowed to the applicant. The applicant is subject to all Local, State, and Federal water laws. In sum, the aquifer beneath the site is capable of serving the water demands of the project.

[14] Hydrological Evaluation, Wister Solar development Project, June, 2020

12 SUMMARY AND CONCLUSIONS

- The proposed Project has an estimated total water demand of 56.32 AF or AFY amortized over a 30-year term). Thus, the proposed Project demand is an increase of AFY from the historical 10-year average or percent (100 %)than the historic 10-year average.
- Based on the amount of groundwater within the basin and the recharge rate of 200 acre-feet/year the project supply is able to meet the project demand of the project.
- Based on the Environmental Impact Report (EIR) prepared for this proposed Project pursuant to the CEQA, California Public Resources Code sections 21000, *et seq*., the Lead Agency hereby finds that the IID projected water supply will be sufficient to satisfy the demands of this proposed Project in addition to existing and planned future uses, including agricultural and non-agricultural uses for a 30-year Water Supply Assessment period and for the year proposed Project life.
- Permitting, The applicant is subject to all Local, State and Federal Laws during construction and operations for the Wister Solar Development Project.
- Approval of Conditional Use Permit – Groundwater Well. Pursuant to Title 9 Division 21: Water Well Regulations, §92102.00, the Applicant will be required to obtain a Conditional Use Permit for the proposed on-site groundwater well. As required by §92102.00, no person shall (1) drill a new well, (2) activate a previously drilled but unused well, (unused shall mean a well or wells that have not been used for a 12 month) period by installing pumps, motors, pressure tanks, piping, or other equipment necessary or intended to make the well operational, (3) increase the pumping capacity of a well, or (4) change the use of a well, without first obtaining a Conditional Use Permit (CUP) through the County Planning & Development Services Department.
- It is suggested that the applicant run water quality analysis for precautionary purposes.

13 WORK CITED

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7. Hydrological Evaluation, Wister Solar development Project, June, 2020

14 APPENDICES

APPENDIX A

Hydrological Evaluation

Wister Solar Development Project

June 8, 2020

Prepared for:

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Revision	Description	Author		Quality Check	
A	Internal Draft	S Smith	5/29/20	K Kohan	5/29/20
0	Client Draft	S Smith	6/1/20	K Kohan	6/2/20
1	Final	S Smith	6/8/20	K Kohan	6/8/20

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Prepared by ____________________________________

(signature)

Stanley Smith

Reviewed & Approved by ____________________________

(signature)

Kevin Kohan

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

°F	Degrees Fahrenheit
AAC	All American Canal
AFY	Acre-feet per year
amsl	Above mean sea level
ANL	Argonne National Laboratory
bmsl	Below mean sea level
DWR	California Department of Water Resources
IIRWMP	Imperial Integrated Regional Water Management Plan
LLNL	Lawrence Livermore National Laboratory
POD	Point of Diversion
Project	Wister Solar Development Project
Proposed Well	Wister Solar Development Project Proposed Water Distribution Well
Stantec	Stantec Consulting Services
TDS	Total dissolved solids

1.0 INTRODUCTION

ORNI 21, LLC (Ormat) is proposing to construct and operate the Wister Solar Development Project (Project) near the unincorporated community of Wister in Imperial County, California (**Figure 1**). The Project is located on a privately owned land parcel within the northwest quarter or Township (T) 10 South (S), Range (R) 14 East (E) Section 27, San Bernardino Meridian. The Project consists of 100 acres of solar installation with a production capacity of 20 megawatt (net), associated infrastructure, and a water distribution well. Commercial operations are anticipated to begin in 2021.

The proposed water distribution well (Proposed Well) would supply water for Project construction, operation and maintenance, and decommissioning. Water requirements are summarized in **Table 1**. Water needs for operation and maintenance include panel washing, backup dust suppression, and fire tank water.

This report describes the hydrology and water related aspects of the Project area and surrounding area. This report includes details of physiography, geologic setting, climate, land use, surface water features, groundwater features, and a hydrologic conceptualization. The extent of this report is generally limited to a two-mile radius around the proposed water distribution well. Where data were limited within a two-mile radius of the Project, information from beyond this radius was included.

Table 1 Estimated Project Water Needs

Phase	Water Usage Rate	Duration	Total Water Requirement (acre-feet)
1: Dirt Work	40,909 gallons per workday	1 month	2.76
2: Construction	16,136 gallons per workday	2-7 months	6.54
3: Reclamation	13,636 gallons per workday	1 month	0.92
Construction Total	**-**	**9 months**	**10.22**
Operation & Maintenance Total	**1.37 acre-feet/year**	**25-30 years**	**34.25-41.10**
Decommission Total	**-**	**1 month**	**5.0**
Project Total		**~26-31 years**	**49.47-56.32**

Assuming 22 construction days per month; Pre-construction water needs assumed to be negligible.

2.0 SITE DESCRIPTION

2.1 PHYSIOGRAPHY

The Project is located in the Basin and Range physiographic province, which includes inland portions of California, the majority of Nevada, and portions or Arizona, New Mexico, Oregon, Utah, Idaho, and Mexico. The Basin and Range is divided into several sub basins, which includes the Salton Trough, which contains the Project. The Salton Trough includes the Imperial Valley in the south and the Coachella Valley in the north. The Project is near the northeastern margin of the Imperial Valley, approximately 5 miles east of the Salton Sea, a saline lake located in Imperial Valley. Imperial Valley is bounded by the Coyote and Jacumba Mountains to the west, the Chocolate and Orocopia Mountains to the northeast, the Sand Hills and Cargo Muchacho Mountains to the southeast, and the United States of America and Mexico border to the south. Furthermore, the elevated margins of Imperial Valley are named West Mesa and East Mesa. The elevation of the Imperial Valley is mostly below sea level and the Project is at approximately 15 feet bmsl. The Chocolate Mountains, which are the closest mountains to the Project, have a maximum elevation of 2,877 feet amsl.

2.2 GEOLOGIC SETTING

The Salton Trough is a tectonically active pull-apart basin. The extensional tectonics results in crustal thinning and sinking. Fault systems near the Project include the San Andreas Fault Zone and Imperial Fault Zone, which are linked by the Brawley Seismic Zone. The trough has filled with sediments due to its topographically low setting and continued sinking. The overall vertical relief of the trough formation is estimated to exceed 14,000 feet, which has been caused by faulting, folding, and warping (Loeltz et al., 1975). The geology and geomorphology of the Imperial Valley was influenced by prehistoric Lake Cahuilla, including lacustrine sediments and paleo-shorelines. The adjacent Chocolate Mountains include outcrops Tertiary and older igneous and metamorphic rocks. The piedmont slope of the Chocolate Mountains, located northeast of the Project, includes poorly sorted alluvial and fluvial deposits with sparse vegetation (Loeltz et al., 1975).

2.3 CLIMATE

The Project area has a hot desert climate. Climate data was available from two nearby weather stations: Niland (0.9 miles west-northwest of the Project; NCEI 2020a) and Brawley (22 miles south of the Project; NCEI 2020b). Both sites report climate normals (1981 to 2010) with Niland reporting precipitation and Brawley reporting precipitation and temperature. Monthly average temperatures are between 54.9 to 91.6°F with minimum temperatures occurring in December and maximum temperatures occurring in August. Average annual precipitation at Niland was 2.88 inches and at Brawley was 2.78 inches. The majority of precipitation occurs from December through March.

Precipitation in the adjacent Chocolate Mountains are estimated at 4–6 inches/year (PRISM, 2020).

Table 2 Climate Normals near the Project

Period	Brawley[1)]		Niland[2)]
	Average Temperature (°F)	Precipitation (inches/year)	Precipitation (inches/year)
January	55.8	0.48	0.47
February	59.1	0.53	0.44
March	64.3	0.33	0.45
April	69.9	0.05	0.07
May	77.4	0.02	0.01
June	85.0	0.00[3)]	0.03
July	91.3	0.08	0.23
August	91.6	0.21	0.21
September	86.2	0.16	0.22
October	75.2	0.25	0.18
November	63.2	0.19	0.17
December	54.9	0.48	0.40
Annual	72.9	2.78	2.88

1) Brawley, CA US; GHCND: USC00041048; 32.9544°, -115.5581°; 100 ft bmsl; NCEI, 2020a

2) Niland, CA US; GHCND: USC00046197; 33.2775°, -115.5239°; 60 ft bmsl; NCEI, 2020b

3) non-zero value that rounds to zero

2.4 LAND AND WATER USE

Land use within 2 miles of the Proposed Well is available from the 2003 Land Use GAP dataset. A summary of land use is provided in **Table 3**. The land area in 2002 was 75.6% natural ecosystem, including Sonora Mojave, North American Warn Desert, and Inter-Mountain Basins Shale Badlands. Cultivated croplands, pasture/hay and developed areas accounted for 24% of the area and the remaining 0.5% was open water. Approximately 9.6% of land within this area is within the Chocolate Mountain Aerial Gunnery Range, which is under the jurisdiction of the United States Navy and United States Marine Corps. Comparing land use classification to recent aerial imagery indicates some in land use due to the expansion of agriculture and solar energy operations, with other land use changes possible. Cultivated croplands include areas under irrigation, likely derived from laterals from the East Highline Canal.

Site Description

Table 3 Land Use Within Two Miles of the Proposed Well

Ecosystem	Description	Percent of Area
Sonora Mojave	Creosote Bush White Bursage Desert Scrub	29.9%
	Mixed Salt Desert Scrub	13.3%
North American Warm Desert	Riparian Woodland and Shrubland	11.4%
	Wash	10.8%
	Bedrock Cliff and Outcrop	7.4%
	Pavement	1.0%
	Playa	0.4%
	Volcanic Rockland	0.1%
	Active and Stabilized Dune	0.0%*
Cultivated Cropland	-	13.5%
Pasture/Hay	-	8.5%
Developed	Low Intensity	1.5%
	Medium Intensity	0.0%*
	Open Space	0.5%
Inter-Mountain Basins Shale Badland	-	1.2%
Open Water	Fresh	0.5%

*non-zero value that rounds to zero

3.0 HYDROLOGICAL SYSTEM

The hydrologic system in the vicinity of the Project includes the East Salton Sea groundwater basin (**Figure 2** and further details in Section 3.3), which is influenced by the surface water system, which includes intermittent creeks and canal systems with associated distribution and storage systems (see Section 3.2). Surface water features and wells are shown in **Figure 3**.

3.1 PRECIPITATION AND EVAPOTRANSPIRATION

Precipitation near the Project is recorded at approximately 2.8 to 2.9 inches/year. Modeled precipitation is higher in the Chocolate Mountains at approximately 4 to 6 inches/year. Potential evapotranspiration (PET) is between 80 and 100 inches/year within 2 miles of the Proposed Well (Esri, 2015). In the Chocolate Mountains, PET is higher at 100 to 110 inches/year. High PET rates combined with low precipitation rates limits the potential for groundwater recharge. However, recharge is possible during high precipitation storm events when PET is low.

3.2 SURFACE WATER SYSTEM

Surface water features within 2 miles of the Proposed Well include natural drainages and manmade features including canals, laterals, drains and ponds/reservoirs (**Figure 3**). Natural drainages include Iris Wash and unnamed minor drainages, which convey runoff from the Chocolate Mountains to the Imperial Valley. These drainages ultimately flow towards the Salton Sea, which is the low point of the basin. All-natural drainages are classified as intermittent (USFWS, 2020). All natural drainages are classified as intermittent (USFWS, 2020).

Canals include the Coachella Canal and the East Highline Canal (**Figure 3**). Both canals deliver water from the All American Canal (AAC), located approximately 40 miles south of the Project. The Coachella Canal is located approximately 1.3 miles from the Proposed Well. The Coachella Canal was initially unlined in the Imperial Valley, which lead to water losses into the alluvial sediments. In the late 1970s, the first 49 miles of the Coachella Canal was replaced with a concrete lined channel. This end of this segment is located approximately 3.6 miles east southeast of the Proposed Well. In the mid-2000s, the remaining 36.5 miles of the Coachella Canal (including the section near the Project; see **Figure 3**) was replaced with a concrete lined channel, reducing seepage losses into alluvial sediments.

The East Highline Canal is located approximately 0.5 miles from the Proposed Well. Furthermore, the East Highline Canal crosses the southwest corner of the Project (**Figure 1**). The East Highline Canal is unlined and likely results in seepage to alluvial sediments. The water distribution system in the Imperial Valley, near the Project, include laterals and ponds for distribution and storage, respectively, and drains to convey unused water from distribution system, farmland, and discharging groundwater to the Salton Sea (IIRWMP, 2012). The East Highline Canal is downgradient from the Project though a seepage mound in the shallow aquifer may be present upgradient of the canal, as identified along unlined sections of the AAC and Coachella Canal (Loeltz et al., 1975).

3.3 GROUNDWATER SYSTEM

The Project is located in the East Salton Sea Basin (basin 7-033) (**Figure 2**). The basin occupies the northeastern margin of the Imperial Valley, including the East Mesa, and alluvial surficial deposits of the Chocolate Mountains. The basin covers 279,824 acres. Adjacent basins include Chocolate Valley to the north, Arroyo Seco Valley to the east, Amos Valley to the southeast, and Imperial Valley to the south. No groundwater basin is defined in the footprint of the Salton Sea.

3.3.1 Aquifer Extent and Properties

Aquifers in the East Salton Sea Basin include alluvial aquifers, which are present as valley fill with maximum thicknesses of at least 400 feet (Willets et al., 1954). Water bearing units include unconsolidated Quaternary alluvium and semi-consolidated Tertiary to Quaternary alluvium. The groundwater storage capacity was estimated at 360,000 acre-feet (DWR, 1975). High permeability units likely include coarse sands and gravels, where present. Aquifer extents are bounded by outcropping bedrock in the Chocolate Mountains and possibly low-permeability fault zones such as the San Andreas Fault Zone, the Banning Mission Fault, and other unnamed faults.

Specific to East Mesa, aquifers in this area are generally unconfined, homogenous, and composed of sediments deposited by the Colorado River (IIWMP, 2012).

A geothermal test well was previously drilled at the Project by Ormat (well 12-27) to a depth of 3401 feet bgs. The shallow groundwater system was not specifically characterized during drilling and testing. However, static temperature logs from the well may indicate the presence of an aquifer zone as shallow as 40 to 50 feet bgs. Other aquifer zones are likely present but were not identified due to the limitations of temperature logs. Geothermal properties of the test well were non-economical, and the well was abandoned.

The nearest East Mesa well with a lithological log is 12S/16E-9A, which is located 9 miles to the southwest of the Proposed Well (**Figure 3**). Lithological details are provided in **Table 4**. In the 1000-foot log, 61% of the thickness is dominated by sand, 34% dominated by clay and approximately 1% dominated by sandstone. Sand and clay intervals also include silts and gravels. Coarse sands and gravels, likely having high hydraulic conductivities, are intermittently present throughout the logged sequence. The perforated interval of the well was placed at 150-1,000 feet and the static water level was recorded at 154.5 feet bgs, which is an elevation of 65.5 feet bgs. Other nearby wells with lithological logs were completed in the Imperial Valley and contain higher percentages of clay (Loeltz et al., 1975).

Table 4 Lithological Log of 12S/16E-9A (9 Miles Southwest of the Proposed Well)

Lithology	Thickness (feet)	Depth Interval (feet)
Sand, silty, very fine, and brown clay	10	0-10
Sand, very coarse to fine, and very fine gravel	102	10-112
Clay, light-brown, and very fine silty sand	5	112-117
Sand, fine to medium, and silt	14	117-131
Clay, silty, yellow-brown	5	131-136
Sand, coarse to very coarse	15	136-151
Sand, very coarse to coarse, and very fine and larger gravel	45	151-196
Sand, fine to very coarse, and yellow-brown clay	19	196-215
Clay, yellow-brown, and fine sand	17	215-232
Sand, very fine to very coarse, and thin layers of gravel	48	232-280
Clay, yellow-brown; some light-gray clay	20	280-300
Clay, light-gray, and yellow-brown clay	40	300-340
Sand, medium to very coarse, and gravel	3	340-343
Clay, light-gray	13	343-356
Sand, fine to medium, and light-gray clay	15	356-371
Clay, silty, light-gray	13	371-384
Sand, very fine to medium, and thin layers of gray clay	33	384-417
Sand, fine to very coarse, and very fine to fine gravel	10	417-427
Sand, very fine to medium, and thin layers of gray clay	59	427-486
Clay, light-gray, and fine sand	6	486-492
Sand, silty, very fine to medium	24	492-516
Clay, light-gray	31	516-547
Sand, very fine to medium	15	547-562
Sand, very fine to medium, and light-gray clay	18	562-580
Clay, light-gray and yellow-brown	60	580-640
Sand, fine to very coarse, and light-gray clay	42	640-682
Clay, light-gray, and layers of fine to very coarse sand	30	682-712
Sandstone, very fine to medium, and fine to coarse sand	53	712-765
Clay, light-gray, and very fine to medium sandstone	17	765-782
Clay, light-gray; some yellow brown	38	782-820
Clay, gray and brown, and fine to very coarse sand	46	820-866
Sand, silty, fine to medium	61	866-927
Sand, silty, fine, and light-gray clay, in alternating layers	73	927-1,000

Source: Loeltz et al., 1975

3.3.2 Well Inventory

Only one well was identified within two miles of the Proposed Well. The well is located at 10S/14E-20N, approximately 2.0 miles west of the Proposed Well (**Figure 3**). Few details are available for this well and there are no records of construction details. However, water quality samples were collected in 1961 (see Section 3.3.8).

3.3.3 Recharge

Groundwater recharge in the East Mesa area was historically dominated by seepage from the Coachella Canal, prior to replacement with concrete lined channels in the late 1970s and mid-2000s. Prior to lining, seepage from the 36.5 mile section near the Project has been estimated at 26,000 acre-feet per year. Unlined sections of the AAC continue to recharge the East Mesa groundwater aquifer. However, the unlined section is approximately 45 miles from the Project. In the absence of canal seepage, recharge to the East Mesa aquifer from direct precipitation is estimated to be near zero (Leroy Crandall and Associates, 1983).

Groundwater recharge in the Chocolate Mountains may include mountain front recharge and stream flow runoff (Tompson et al., 2008). The Lawrence Livermore National Laboratory (LLNL) groundwater model (Tompson et al., 2008) estimated that recharge from precipitation within the Imperial Valley and portions of surrounding ranges was 0.019 inches/year, which is less than 1% of precipitation. Furthermore, the LLNL model did not include additional recharge along the mountain fronts. The 2013 groundwater model, which was updated by Argonne National Laboratory (ANL; Greer et al., 2013) estimated recharge at 0.056 inches/year in Imperial Valley and 7.2 inches/year along the mountain-front area of the Chocolate Mountain. This estimate of mountain-front recharge may not be supported by the estimated precipitation rates for the Chocolate Mountains (4-6 inches/year; PRISM, 2020).

In 2003, the DWR classified the East Salton Sea Basin groundwater budget type as ‘C’, which indicates that groundwater data is insufficient to estimate the groundwater budget or groundwater extraction (DWR, 2003).

3.3.4 Discharge and Extraction

Discharge from the East Salton Sea Basin includes springs, discharge into irrigation drains, and extractions from wells. Spring discharge, and water losses from associated vegetation, is likely limited based on the occurrence of few springs (see **Figure 3**). Irrigation drains in the Imperial Valley (including the western margin of the East Salton Sea Basin) primarily return excess irrigation water to the Salton but also function to remove discharging groundwater. Water well extraction rates were last estimated in 1952 at 6 acre-feet/year (DWR, 1975). Due to the lack of development in this basin, current extraction rates may be similar. However, this statement is speculative due to a lack of recent information (DWR, 2003).

3.3.5 Seeps and Springs

No identified springs or seepage are present within two miles of the Proposed Well. The closest identified spring is an unnamed spring located approximately 6.5 miles southeast of the Proposed Well (**Figure 3**) (USGS, 2020).

3.3.6 Underflow

Underflow seepage likely conveys water from the East Salton Sea Basin, downgradient into the Imperial Valley. The quantity of water flow between basins would require details of hydraulic gradients and transmissivities of adjoining aquifers and the impact of transmissive or impeding zones such as faults. Groundwater flow between other surrounding basins in unknown as hydraulic head and hydraulic gradient information is sparse.

3.3.7 Groundwater Levels

Groundwater levels in the vicinity of the Project have been influenced by the presence of the canal systems, including the Coachella Canal, East Highline Canal, and associated laterals and drains. Seepage from the unlined Coachella Canal created a groundwater mound in the shallow alluvial aquifer of East Mesa, with water levels rising over 70 feet in some areas (Loeltz et al., 1975).

Groundwater level decline in the vicinity of the Coachella Canal has been monitored since the late 1970s when the first 49 miles of the earthen canal channel was replaced with a concrete channel. United States Geological Survey (USGS) well 11S/15E-23M, which is approximately 9 miles southeast of the Proposed Well (**Figure 3**), shows an asymptomatic groundwater level decline from 20.68 feet bgs in 1979 to approximately 50 feet bgs at present. The water level elevations as of March 2020 were approximately 70 feet amsl. No groundwater levels have been reported along the Coachella Canal section that was lined in the late 2000s. However, a similar asymptotic decline could be expected.

Groundwater levels in Imperial Valley have been historically measured at two multi-level wells located approximately 6.5 to 7.5 miles southwest of the Proposed Well (11S14E30C and 11S14E19N; **Figure 3**). Water levels at these locations were within 10 feet of the ground surface in 1989. The groundwater elevation at that time was approximately 215 feet bmsl. Groundwater levels in the irrigated areas have been controlled by the drain systems (IIRWMP, 2012).

Current groundwater levels, although sparse, generally agree with historical groundwater elevation distributions. Groundwater elevations are higher in mountainous areas and East Mesa and decline towards Imperial Valley and the Salton Sea. This distribution of groundwater elevations suggests groundwater flow directions roughly coincide with topography. However, the flow of groundwater and distribution of groundwater levels is likely influenced by faults, which act as barriers, and changes in transmissivity.

3.3.8 Groundwater Quality

Groundwater quality in the East Salton Sea Basin is generally reported as poor and not suitable for domestic, municipal, or agricultural purposes (DWR, 2004). Water types include sodium chloride and sodium sulfate. Total dissolved solids (TDS) concentrations are reported as 356 to 51,632 mg/L, whereas the National Secondary Drinking Water Regulations limit TDS to 500 mg/L. Groundwater quality is generally considered better in the vicinity of the unlined canals due to the recharge of lower TDS water.

The closest well to the Proposed Well with available water quality data is located 2 miles to the west (Loeltz et al., 1975). A limited number of water quality constituents were measured in 1961, including pH (8.0), specific conductivity (19,200 µS/cm), bicarbonate (210 mg/L), chloride (6,050 mg/L), calcium-magnesium hardness (2,440 mg/L), and non-carbonate hardness 2,270 mg/L). The screened interval depth of this well is unknown.

The next closest well to the Proposed Well with available water quality data is an inactive USGS monitoring well (11S/14E-2A) located approximately 2.8 miles to the southeast (USGS, 2020). The well is located in a Basin and Range basin-fill aquifer. The total depth was 825 feet bgs, however, the depth of the screened interval is unknown. Water quality was measured in the late 1960s and early 1970s. The latest water quality sample that includes all major ions (calcium, magnesium, sodium, potassium, bicarbonate, sulfate and chloride) was collected in 1969. This sample had sodium-chloride type water and a TDS concentration of 1,760 mg/L. Furthermore, temperatures were elevated above ambient temperatures at 44.4°C.

3.3.9 Transmissivity and Well Yield

Well yield information for the East Salton Sea Basin is limited. The only identified value is 25 gpm at well 11S/15E-23M, located approximately 9 miles southeast of the Proposed Well (**Figure 3**) (Loeltz et al., 1975). Hydraulic properties in East Mesa were summarized in the mid-1990s (Montgomery Watson, 1995). The range of hydraulic conductivities was 32 to 1,337 feet/day, which included wells several miles southeast of the Project.

3.4 WATER RIGHTS AND POINTS OF DIVERSION

No points of diversion (POD) are identified within two miles of the Proposed Well, (California Water Boards, 2020). However, this two-mile radius includes seven laterals from the East Highline Canal, which may have associated water rights and points of diversion. The closest identified POD is 5.7 miles southwest of the Proposed Well (California Water Boards, 2020). This POD is owned by the Metropolitan Water District of Southern California and is located along the N Lateral, which originates from the East Highline Canal. More distal PODs are associated with laterals and the Alamo River.

4.0 HYDROLOGIC EVALUATION SUMMARY

The Wister Solar Development Project is located within the East Salton Sea Basin, which includes the Chocolate Mountains and the northeastern margin of the Imperial Valley (**Figure 2**). The groundwater storage capacity of the East Salton Sea Basin was estimated at 360,000 acre-feet. Groundwater usage in the East Salton Sea Basin is limited due to generally poor water quality and limited inhabitants. Extraction rates for the East Salton Sea Basin were last estimated in 1952 at 6 acre-feet/year, which is 3% of the estimated recharge rate of 200 acre-feet/year (DWR, 1975). Limited development in the East Salton Sea Basin suggests that current extraction rates are similar. However, a lack of recent data limits the ability update this estimate. Furthermore, surface water from the Colorado River is conveyed into the Imperial Valley through a network of canals, laterals, and reservoirs, which has further reduced the need to develop groundwater resources.

Groundwater in the East Salton Sea Basin is present in alluvial aquifers at depths up to several hundred feet, and with generally high transmissivities (Montgomery Watson, 1995). At the Project, groundwater may also be present in an alluvial aquifer 40-50 feet bgs. Historically, groundwater recharge was significant in the vicinity of the earthen lined Coachella Canal. The replacement of the canal with a concrete lined channel has greatly reduced recharge to the adjacent alluvial aquifers. Near the Project, the Coachella Canal was concrete lined in the late 2000s. The East Highline Canal remains earthen-lined, which likely leads to recharge into the shallow alluvial aquifers near the Project. Recharge from precipitation is generally limited due to low precipitation rates and high evaporation potential. Recharge rates may be higher in the Chocolate Mountains due to higher precipitation rates at higher elevations (4-6 inches/year; PRISM, 2020). Recharge events are likely limited to larger storm events, which may generate runoff and seepage along ephemeral channels. Recharge rates from precipitation were estimated at 0.019 inches/year (Tompson et al., 2008).

The water needs for the Project are estimated at 10.22 acre-feet for construction in the first year, 1.37 acre-feet/year for the subsequent 25 to 30 years of operation, and 5 acre-feet for decommissioning at the end of operations (**Table 1**). Overall, the proposed extraction for the Project are significantly lower than recharge rates in an area where groundwater usage is limited.

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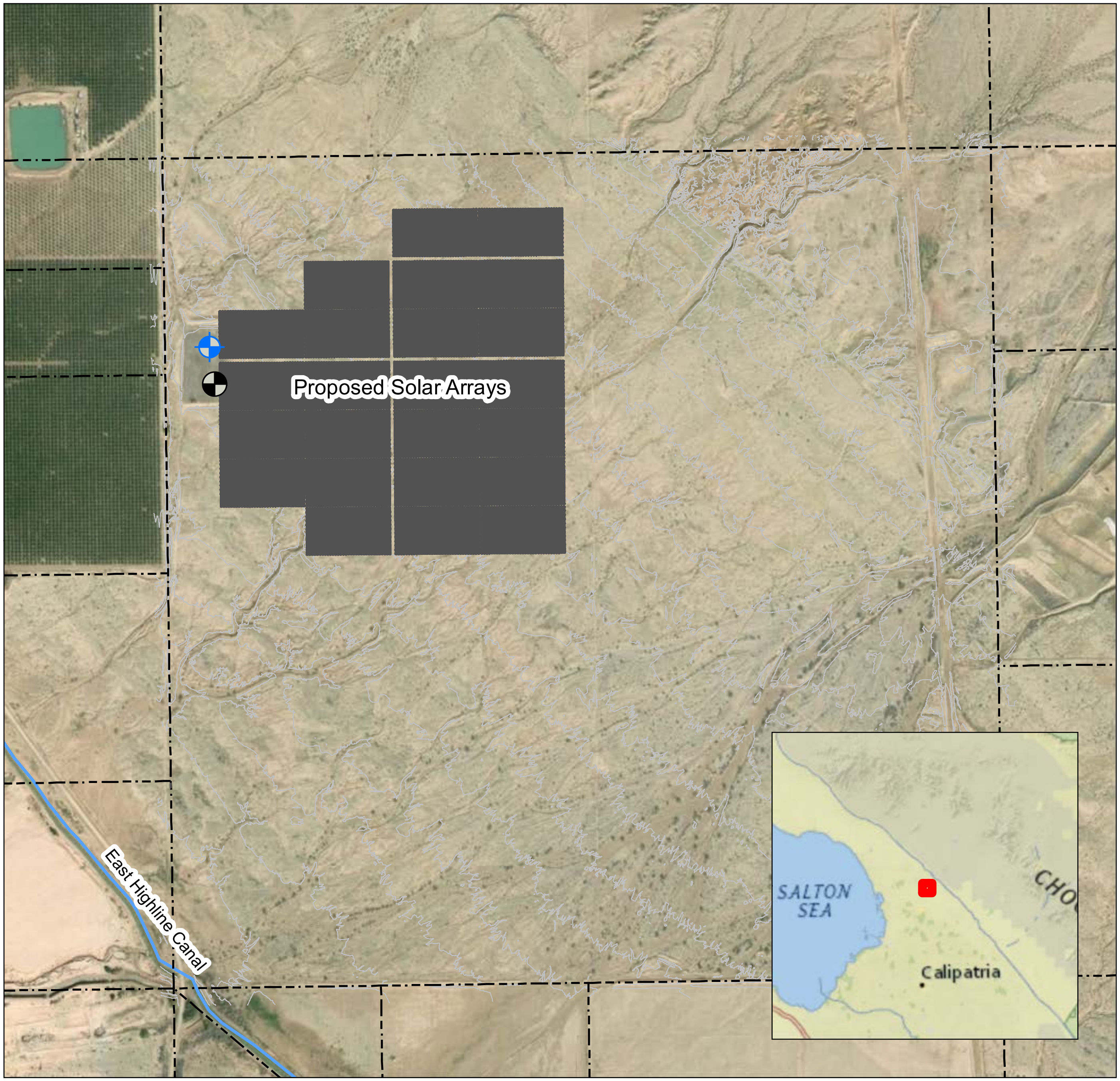
FIGURES



Stantec

Legend

- Proposed Water Distrubution Well
- Geothermal Test Well 12-27
- Property Line
- Contour-major
- Project Location

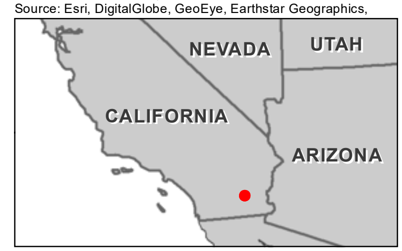
N

0 150 300 metres

(At original document size of 8.5x11)
1:11,713

Notes

1. Coordinate System: NAD 1983 UTM Zone 11N
2. Data Sources:
3. Background: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics,



Project Location
T10S, R14E, S27
Imperial County, CA

Prepared by LR on 2020-05-29
TR by SS on 2020-05-29
IR Review by KK on 2020-05-29

Client/Project
185804209 REVA
ORNI 21, LLC
Wister Solar Development Project
Hydrologic Evaluation

Figure No.
1

Title
Project Location and Overview

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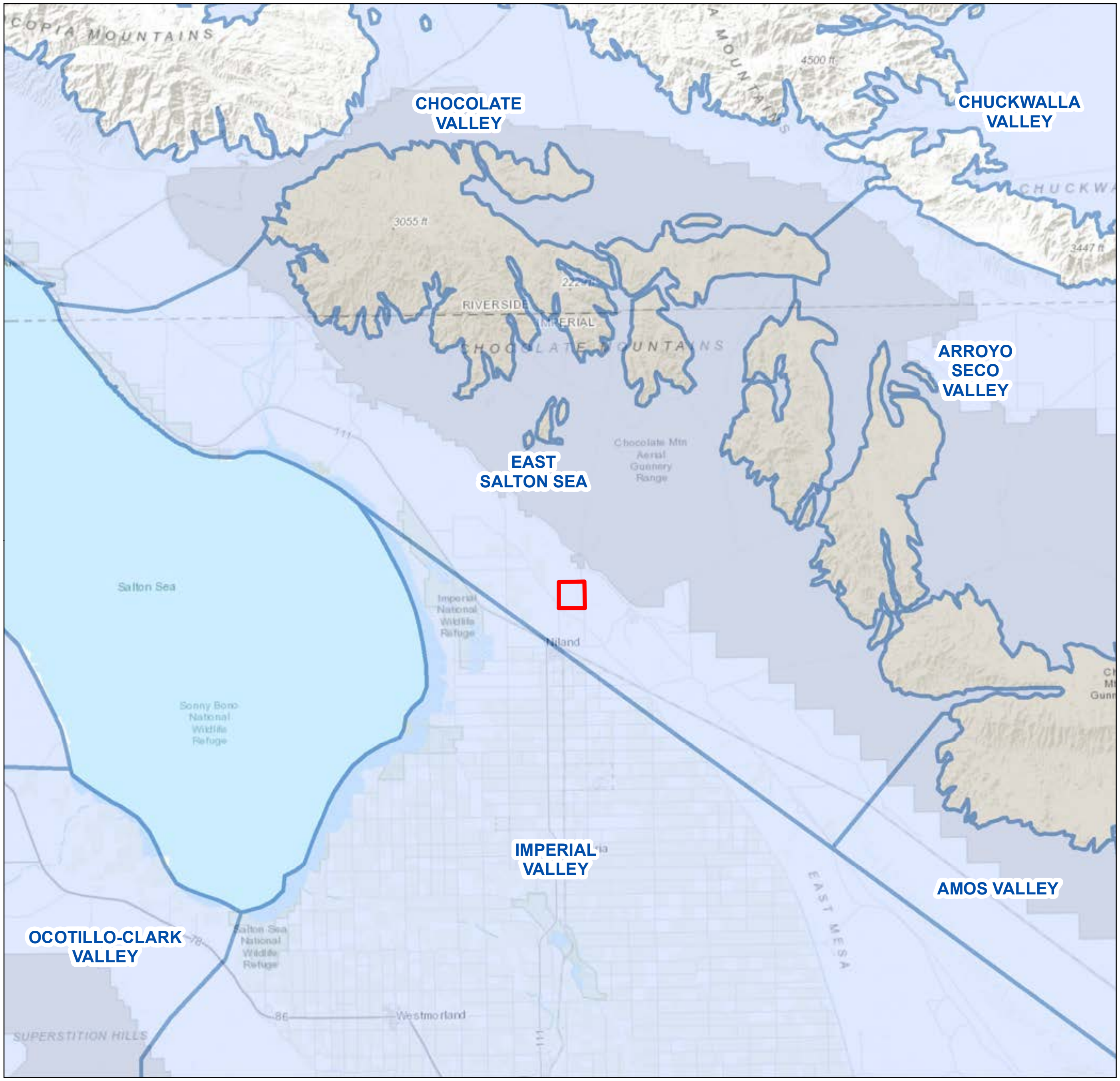


Stantec

Legend

Project Location

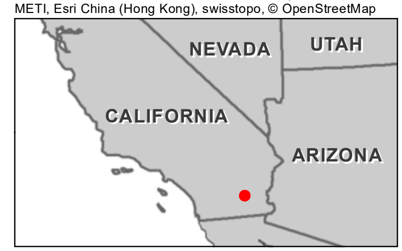
Groundwater Basin

0 4,700 9,400 metres

(At original document size of 8.5x11)
1:372,507

Notes

1. Coordinate System: NAD 1983 UTM Zone 11N
2. Data Sources:
3. Background: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap



Project Location
T10S, R14E, S27
Imperial County, CA

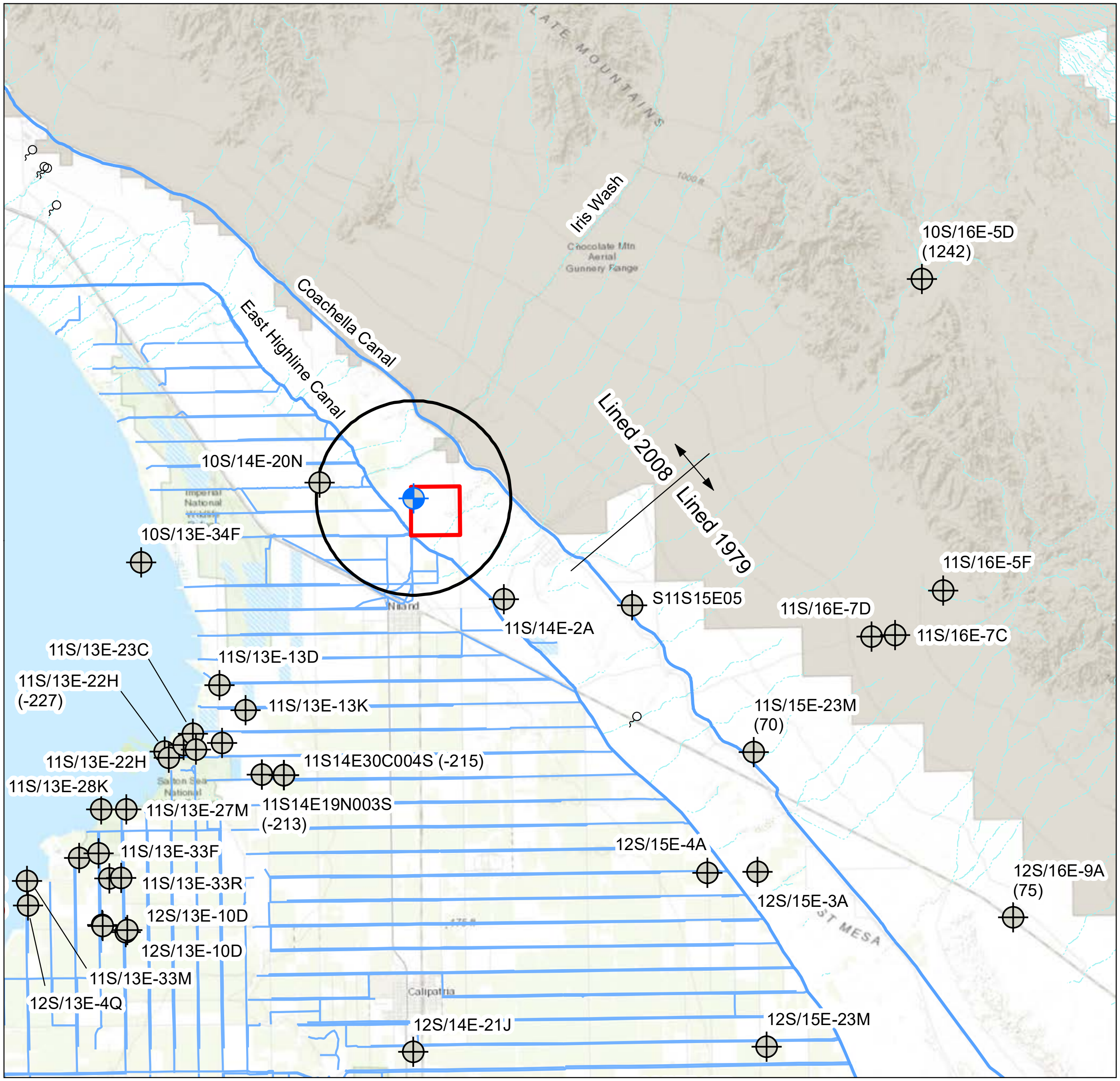
Prepared by LR on 2020-05-29
TR by SS on 2020-05-29
IR Review by KK on 2020-05-29

Client/Project
185804209 REVA
ORNI 21, LLC
Wister Solar Development Project
Hydrologic Evaluation

Figure No.
2

Title
Groundwater Basins

\\US1342-F01\workgroup\1858\active\185804156\03_data\GIS\mxd\Fig2_GW_Basins_8x11L.mxd Revised: 2020-06-08 By: stasmith



Stantec

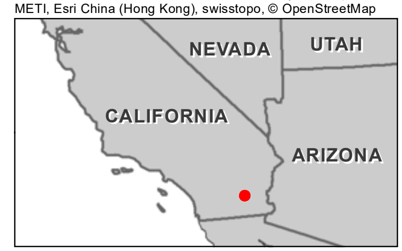
Legend

- Proposed Water Distribution Well
- Existing or Historical Well (Water Level Elevation ft amsl)
- Spring
- Canal
- Lateral
- Intermittent Creek
- Proposed Well 2-Mile Buffer
- Project Location

N

0 2,500 5,000 metres
(At original document size of 8.5x11)
1:200,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 11N
2. Data Sources:
3. Background: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap



Project Location
T10S, R14E, S27
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Prepared by LR on 2020-05-29
TR by SS on 2020-05-29
IR Review by KK on 2020-05-29

Client/Project
185804209 REVA
ORNI 21, LLC
Wister Solar Development Project
Hydrologic Evaluation

Figure No.
3

Title
Well and Water Resources Inventory

\\US1342-F01\workgroup\1858\active\185804156\03_data\GIS\mxd\Fig3_Water_Resources_8x11L_20200601.mxd Revised: 2020-06-08 By: stasmith

APPENDIX B

TITLE 9

DIVISION 21: WATER WELL REGULATIONS

CHAPTER 1: GENERAL

§ 92101.00 PURPOSE

Imperial County is an arid region located in the Southeastern portion of the State of California and the preservation and protection of the County's ground water resources are extremely critical. The Board of Supervisors hereby finds and declares that the preservation, protection and management of the groundwater within the County for the protection of domestic, commercial, agricultural, industrial, municipal, wildlife habitat, and other uses is in the public interest, that protection is necessary to ensure availability of groundwater reasonably required to meet the present and future beneficial needs of the County, and that the adoption of a system of regulation of groundwater is for the common benefit of all County water users. The Board of Supervisors has, therefore, determined to regulate the use, consumption and development of ground water on a County-wide basis. Further, it is the intent of the Board of Supervisors to protect the health, safety, and general welfare of the people of Imperial County by insuring that the ground water of this County will not be polluted or contaminated. To this end, minimum requirements have been prescribed in this Ordinance for the construction, re-construction, repair, replacement, re-perforation, re-activation, operation, and destruction of a well or wells.

§ 92101.01 DEFINITIONS

A. Cathodic Protection Well: Any artificial excavation constructed by any method for the purpose of installing equipment or facilities for the electrical protection of metallic equipment in contact with the ground.

B. Commercial Well (Small): A water well used to supply a single commercial establishment, consuming less than 10 acre feet per year ("AF/Y") of ground water.

C. Commercial Well (Large): A water well used to supply more than one (1) commercial establishment, or utilizing more than 10 AF/Y.

D. Community Water Supply Well: A water well used to supply water for domestic, commercial industrial purposes in systems subject to Chapter 7 of Part I of Division 5 of the California Health and Safety Code (Section 4010 et. seq.), i.e. more than five (5) service connections.

E. Construct, Reconstruct, (Construction, Reconstruction): To dig, drive, bore, drill, or deepen a well, or to re-perforate, remove, replace, or extend a well casing.

F. Contamination: An impairment of the quality of water to a degree that creates a hazard to the public health through poisoning or spread of disease.

G. Deep Anode Bed Well: Any cathodic protection well more than 50 feet.

H. Destruction: A proper filling and sealing of a well no longer useful so as to assure that ground water is protected and to eliminate a potential physical hazard.

I. Electrical Grounding Well: Any artificial excavation in excess of 20 feet constructed by any method for the purpose of establishing an electrical ground.

J. Enforcement Agency: An agency designated by the Board of Supervisors to administer and enforce this Ordinance. For the purpose of this Division it shall be the Planning & Development Services Department.

K. Individual Domestic Well: A water well used to supply water for domestic needs of an individual residential, utilizing less than the (10) AF/Y.

L. Modification, Repair, or Reconstruction: The deepening of a well, the re-perforation, or replacement of a well casing and all well repairs and modifications that can affect ground water quality.

M. Observation Well: A well used for monitoring or sampling the conditions of a water-bearing aquifer, such as water pressure, depth, movement or quality.

N. Permit: A Building Permit issued by the County of Imperial Planning & Development Services Department, permitting the construction, reconstruction, destruction, or abandonment of a well.

O. Person: Any person, firm, corporation, or governmental agency, to the extent authorized by law.

P. Planning Director: The Planning Director of Imperial County or his designee.

Q. Pollution: An alteration of the quality of water to a degree which unreasonably affects: (1) such waters for beneficial uses; or (2) facilities which serve such beneficial uses. Pollution may contain contamination.

R. Potable: Water generally intended for human consumption and/or meeting safe drinking water standards by State or Federal regulations.

S. Public Nuisance: The term "Public Nuisance", when applied to a well, shall mean any well which threatens to impair the quality of ground water or otherwise jeopardize the health and safety of the public.

T. Shallow Anode Bed Well: Any cathodic protection well more than 20 feet deep, but less than 50 feet deep.

U. Test or Exploratory Well: An excavation used for determining the nature of underground geological or hydrological conditions, whether by seismic safety, direct observation or any other means.

V. Well: An artificial excavation constructed by any method for the purpose of extracting water from or injecting water underground, or providing cathodic protection or electrical grounding of equipment, for making tests for observation of underground conditions, or for any other similar purposes. Wells shall include, but shall not be limited to, community water supply wells, individual domestic water wells, commercial wells, industrial wells, cathodic protection wells, electrical grounding wells, test or exploratory holes, observation wells and other wells whose regulation is necessary to accomplish purposes of this Chapter.

Wells shall not include: (1) oil and gas wells, geothermal wells, or other wells that are constructed under the jurisdiction of the State Department of Conservation, except oil wells converted to use as water wells; or (b) wells used for the purpose of de-watering excavations during construction, or stabilizing earth embankments.

CHAPTER 2: PERMITS

§ 92102.00 PERMIT(S) REQUIRED

A. Conditional Use Permit:

No person shall (1) drill a new well, (2) activate a previously drilled but unused well, (unused shall mean a well or wells that have not been used for a 12 month) period by installing pumps, motors, pressure tanks, piping, or other equipment necessary or intended to make the well operational, (3) increase the pumping capacity of a well, or (4) change the use of a well, without first obtaining a Conditional Use Permit (CUP) through the County Planning & Development Services Department.

The pumping capacity shall mean the “permitted amount” or in the absence of a permit the annual acreage, over 3 year period.

Notwithstanding the above, a CUP is not required prior to drilling the following types of wells.

1. A test/monitoring/research well where no continued water use will result. Upon completion of the tests, the well shall be sealed/abandoned in compliance with the most current edition of State Water Resources Control Board Bulletin #74-81;

2. Any new well which will replace an existing inoperable well, provided that the inoperable well is serving an existing water user and is already properly permitted through the CUP process and provided the replacement well shall be the same or smaller size, diameter, and capacity as measured by gallons per minute ("GMP") as the inoperable well. In an emergency and even if the inoperable well was not permitted, the Director may approve replacing a well provided that the replacement well meets the requirements for the last approved CUP and does not exceed 1 acre feet per year.

3. A well that is drilled by or for the Department of Fish and Game provided however that they shall register each such well with the Planning & Development Services Department.

B. Well Construction Permit. No person shall dig, bore, drill, deepen, enlarge, refurbish, or destroy a water well, cathodic protection well, observation well, monitoring wells or any other excavation that intersects ground water without first obtaining a well construction permit through the Planning & Development Services Department. As a prerequisite to applying for a water well construction permit, the Planning & Development Services Department shall first determine whether a conditional use permit is required.

§ 92102.01 APPLICATION PROCEDURES

A. Project information: The application for both a CUP and/or a Construction Permit shall be made to the Planning & Development Services Department on the forms approved or provided by the Department and shall, at a minimum, contain the following information:

1. Site Plan drawn to scale.

   a. Location of well on property.
   b. Size of property (all dimensions).
   c. Distance from well to all property lines.
   d. Distance from well to all septic/leach fields.
   e. Distance from well to all structures.
   f. All intermittent or perennial natural or artificial bodies of water or water sources.
   g. The approximate drainage pattern of the property.
   h. Other wells.
   i. Structures--surface or subsurface.

2. Location of property, Assessor's Parcel Number.
3. Name of person who will construct the well.
4. The proposed minimum and proposed maximum depth of well.
5. The proposed minimum depth and type of casings and maximum depths of perforation to be used.

   a. Pump type
   b. Size (Diameter/horsepower)
   c. gpm capacity
   d. Water pressure

6. The proposed use of well.
7. Other information as may as necessary to determine if ground water will be adequately protected.

B. Filing Fee(s): A filing fee shall be paid by the applicant. Said fee shall be as set forth in the Codified Ordinances of the County of Imperial. No filing or permit fee shall be required to abandon or destroy a well.

C. Emergency Work: In an emergency in order to maintain drinking water or agricultural supply systems as determined by the Planning Director, the following procedures shall apply:

1. Permittee shall notify the Planning & Development Services Department that an emergency exists that necessitates the immediate repair or replacement of a well or associated water system. Permittee shall provide all pertinent information as to why it is an emergency.

2. Permittee shall within 72 hours apply for and obtain all required permits.

3. Permittee will demonstrate by providing logs or other reports that all work performed was in conformance with all regulations and standards as designated herein, and will further report or correct any part of the system that does not comply with this Ordinance, other applicable laws or codes.

§ 92102.02 PERMIT CONDITIONS

A. Limitation: When the enforcement agency issues or otherwise approves a conditional use permit or well construction permit, pursuant to this ordinance, it may condition the permit in any manner necessary to carry out the purposes of this Ordinance.

B. CEQA Review: The processing of a Conditional Use Permit and/or a well construction permit shall be in compliance with the California Environmental Quality Act (CEQA) and Imperial County's Rules and Regulations to Implement CEQA, as amended.

C. Performance Bond: The enforcement agency may require such bond or other security as determined necessary to assure compliance with this Ordinance.

D. License Required: All construction, reconstruction or destruction work on wells shall be by a person/firm who possesses an active California Contractor's license in accordance with Business and Professions Code, Section 7000 et. seq.

E. Disposal of Drilling Fluids/Materials: The well driller shall be required to provide for the safe and appropriate handling and disposal of all drilling fluids or other drilling materials associated with the permitted project.

F. Abandoned Wells: As a condition to any approval for a permit for the construction or reconstruction of a well, any abandoned well(s) on the property shall be destroyed in accordance with the standards provided in this Ordinance.

G. Posting of Permit: It shall be the responsibility of the well driller to maintain a copy of the approved permit on the drilling site during all stages of construction or destruction of a well and have then available for general inspection.

H. Provide Copies: It shall be the responsibility of the well driller to maintain and provide copies to the Planning & Development Services Department, Public Works Department and Environmental Health Department of all drilling logs, testing reports and/or abandonment logs.

§ 92102.03 PERMIT DENIAL

The enforcement agency shall deny any application for a permit if, in its judgment, issuance of a permit is not in the public interest, violates health and safety concerns, or in compliance with the intent of this Ordinance.

§ 92102.04 EXPIRATION OF PERMIT

The permittee shall commence work authorized by the permit within 180 days from the effective date of issue and shall complete the work within one (1) year from date issued. The enforcement agency may grant a one-time extension for a period of up to one year if requested in writing by applicant at least 60 days prior to the expiration of the permit.

All permits that have not received a final inspection approval from the enforcement agency within one year from date of issue shall expire unless an extension is granted by the Planning & Development Services Department. If a permit has expired, no further work shall be done until a new permit is requested, approved, and issued to applicant.

§ 92102.05 SUSPENSION AND REVOCATION

A. Circumstances for such action: Enforcement agency may suspend or revoke any permit issued pursuant to this Ordinance, whenever it finds that the permittee has violated any of the provisions of this Ordinance, or has misrepresented any material fact in his/her application or any supporting documents for such a permit. Prior to ordering any such suspension or revocation, the enforcement agency shall give permittee an opportunity for a hearing thereon, after reasonable notice. The hearing shall be before the enforcement agency, the director, or his designated representative.

B. Consequences: No person whose permit has been suspended or revoke shall continue to perform the work for which the permit was granted until, in case of suspension, such permit has been reinstated by the enforcement agency.

C. Additional Work: Upon suspending or revoking any permit, the enforcement agency may order permittee to perform any work reasonably necessary to protect the ground water from pollution or contamination, if any work already done by permittee has left a well in such a condition as to constitute a hazard to the quality of the ground water. No permittee or person who has obtained a permit issued pursuant to this Ordinance shall fail to comply with such order.

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TITLE 9

DIVISION 21: WATER WELL REGULATIONS

CHAPTER 3: WELLS

§ 92103.00 REGISTRATION OF WELL

Any person who uses a new or existing well shall first register said well with the Imperial County Planning & Development Services Department. If a well is under an active conditional use permit, the well shall be deemed to be registered. Any well that is not under an Imperial County CUP shall be registered with the Planning & Development Services Department and the State pursuant to California Water Code, Section 13750..

An application to register any well shall be filed with the Planning & Development Services Department and said application shall contain all information required upon said form.

§ 92103.01 REPORTS

Completion Reports: The driller shall provide the enforcement agency a completion report within 30 days of the completion of any well construction, reconstruction, or destruction job.

A. Submittal of State "Report of Completion": A copy of the "Report of Completion" (Driller's well log) required by California Water Code, Section 13751, shall be submitted by the well driller to the enforcement agency within 30 days of construction or destruction of any well (except driven wells). This report shall document that the work was completed in accordance with all applicable standards and additional permit conditions.

   This section shall not be deemed to release any person from the requirement to file said report with the State Department of Water Resources.

B. Confidentiality of Report: With the exception of the well driller's name, the date the well was drilled and the well yield, all information contained in this report shall remain "Confidential".

C. Other Agency's Requirements: Nothing in this Ordinance shall be deemed to excuse any person from compliance with the provisions of California Water Code, Section 13752, relating to notices and reports of completion or any other federal, state, or local reporting regulations.

§ 92103.02 WELL STANDARDS

Except as otherwise specified, the standards for the construction, repair, reconstruction, alteration, reactivation, operation, or abandonment of wells shall be as set forth in:

A. The California Department of Water Resources Bulletin 74-81 entitled, "Water Well Standards, State of California", except as modified by subsequent supplements or revisions issued by the Department of Water Resources.

B. The California Department of Water Resources Bulletin 74-90 and any subsequent supplements or revisions issued by the Department of Water Resources.

C. The following factors, to the extent necessary to avoid conditions of overdraft, subsidence, well interference, water quality degradation, or other environmental degradation:

1. The type of use or uses served.

2. The number of users served.

3. Wasteful or inefficient use.

4. Water conservation activities.

5. Reasonable need of the extractor and other affected water users.

6. The quality of groundwater.

7. The affected groundwater basin or sub-basins.

8. Environmental impact as determined through the CEQA review.

9. Any other factors that the Planning & Development Services Department reasonably believes it should consider in order to reach an equitable result within the entire County in accordance with the provisions of this Ordinance, and of California Law.

§ 92103.03 VARIANCES

The enforcement agency shall have the power under the following specified conditions to grant a variance from any provision of the standards referred to above and to prescribe alternate requirements in their place. There is no appeal from a denial of a variance request, unless:

A. Special Circumstances: There must be, in a specific case, special circumstances where practical difficulties or unnecessary hardship would result from the strict interpretation enforcement of any standard. Economic expense will not be considered "unnecessary hardship".

B. Intent of Ordinance not Compromised: The granting of any variance is to be consistent with the purpose and intent of this Ordinance and State Law.

§ 92103.04 SPECIAL GROUND WATER PROTECTION

The enforcement agency may designate areas where potable ground water quality is known to exist and where a well will penetrate more than one aquifer. The enforcement agency may require in these designated areas special well seals to prevent mixing of water from several aquifers. Where an applicant proposes well construction, reconstruction, alteration, repair or construction work, in such an area, the enforcement agency may require the applicant to provide a report prepared by a registered geologist or a registered civil engineer that identifies all strata containing poor quality water and recommends the location and specification of seal or seals needed to prevent entrance of poor quality water or its mitigation into other aquifers.

The enforcement agency may take such other action as it determines reasonably necessary to protect the degradation of both quantity and quality of any known aquifer resulting from the installation, modification, refurbishing, construction, repair or destruction of well or from improper well operations, maintenance, and/or from excessive pumping capacity.

§ 92103.05 APPEALS

A. Any person whose application for a permit has been denied, granted conditionally, or whose permit has been suspended or revoked, may appeal said determination to the Imperial County Planning Commission, provided the appeal is in writing, within ten (10) days after any such denials, conditional granting, suspension, or revocation. Such appeal shall specify the grounds upon which it is being requested and shall be accompanied by a filing fee as set forth in the County's Codified Ordinances. The Planning Director shall set such an appeal for hearing before the Planning Commission at the earliest practicable time, and shall notify the appellant and all interested parties in writing at least ten (10) days prior to the hearing.

B. After such hearing the Planning Commission may uphold, or may reverse, wholly or in part, or may modify any such determination.

C. The decision of the Planning Commission shall be final unless it is appealed to the Board of Supervisors within ten (10) days from the date of the Planning Commission's decision.

D. Any decision made by the Board of Supervisors on an appeal from the Planning Commission shall be final.

§ 92103.06 RIGHT OF ENTRY AND INSPECTION

Representatives of the enforcement agency shall have the right to enter upon any premises at all reasonable times to make inspections and tests for the purpose of such enforcement and administration. If any such premises are occupied, the representative shall first present proper credentials and demand entry. If the same is unoccupied, the representative shall first make a reasonable effort to locate the owner or other person having charge or control of same representative shall have recourse to such remedies as are provided by law to secure entry.

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CHAPTER 4: ENFORCEMENT

§ 92104.00 ENFORCEMENT

A. Penalty: Any person who commences work for which a permit is required by this Ordinance, without first obtaining such permits and approvals, shall be required, if subsequently granted a permit, to pay double all standard permit fees. The payment of such double fee shall, however, in no way excuse compliance with this Ordinance or other applicable codes.

B. Violations is a Misdemeanor: Any person who violates any of the provisions of this Ordinance is guilty of a misdemeanor and upon conviction, thereof, shall be punishable by a fine of, not to exceed, $500.00 and/or by imprisonment in County Jail for a time not to exceed six (6) months.

C. Civil Enforcement - Nuisance

1. "Notice of Violation" Recordation: Whenever the enforcement agency determines that a well: (1) has not been completed in accordance with a well permit or the plans and specification relating thereto or (2) has been constructed without the required permit, or (3) has not been properly abandoned in accordance with the standards, the enforcement agency may record a "Notice of Violation" with the Office of the County Recorder.

2. Removal of Violation Notice: The enforcement agency shall submit a removal of the "notice of Violation" to the County Recorder when: (1) it is determined by the enforcement agency or the Board of Supervisors, after review, that no violation of this Ordinance exists; or (2) all required and corrective work has been completed and approved by the enforcement agency.

D. Remedies Cumulative: The remedies available to the County to enforce this Ordinance are in addition of any other remedies available under this Ordinance or other statute, and do not replace or supplant any other remedy, but are cumulative thereto.

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APPENDIX C

Appendix B

IID Desalination/Groundwater Development Feasibility Study

Appendix B – IID Desalination/Groundwater Development Feasibility Study

Table of Contents

Table of Figures

Tables

TECHNICAL MEMORANDUM

Subject: Desalination/Groundwater Development Feasibility Study

From: Ryan Alward, Richard Shatz (CHG 84)

Date: July 2009

Updated: July 2012

B.1 INTRODUCTION

This Technical Memorandum (TM) presents a compiled summary of the geology and occurrence of groundwater in the Imperial IRWMP area. The purpose of this TM is to summarize the hydrogeologic information that is relevant in assessing possible groundwater development and conjunctive use and banking opportunities in the area. Groundwater development and conjunctive use opportunities were identified for high water demand areas, specifically for geothermal and future municipal, commercial and industrial (MCI) development. Using local aquifer characteristics, the number of wells needed in each known geothermal resource area (K.G.R.A.) was determined along with the depths required to dispose of the desalination plant brine stream. The location of the desalination plants were picked to coincide with locations that have favorable aquifer characteristics and if possible, recharge potential. Preliminary design of well fields and recharge facilities has been conducted to evaluate whether groundwater could be a viable water supply for the area. Such opportunities are a key element under consideration as a possible means of augmenting existing water supplies for IID. This TM costs the well fields, brine injection wells and pipeline for 17 capital project alternatives.

B.2 SETTING

The Imperial IRWMP area lies within the Salton Trough of southern California as shown on Figure B-1. The Salton Trough is the dominant feature of the Colorado Desert geomorphic province of California. The trough is about 130 miles long and up to 70 miles wide, and is generally considered the northwesterly landward extension of the Gulf of California (Loeltz et al., 1975). The term Salton Basin (Basin) applies to the broad region draining directly into the Salton Sea. The Imperial Valley lies in the central part of the Basin south of the Salton Sea. Most of the IID service area overlies the area defined as the Imperial Valley.

The Basin is bounded to the west by the Coyote and Jacumba Mountains, to the northeast by the Orocopia and Chocolate Mountains, to the southeast by the Sand Hills and Cargo Muchacho

Mountains, and to the south by the U.S.-Mexican border. Other major hills and mountain ranges are shown on Figure B-1. The highest point along the Basin watershed boundary is Blue Angel Peak in the Jacumba Mountains at 4,284 feet above sea level. The lowest feature in the Basin is the surface of the Salton Sea, which lies more than 231 feet below sea level. Elevations along the Imperial Valley floor range from approximately sea level near Calexico to approximately 230 feet below sea level at the south shore of the Salton Sea to the north-northeast, a slope of approximately seven feet per mile. The Mexicali Valley is a southern extension of the same general topographic feature into Mexico. The northern Mexicali Valley is part of the Salton Basin and drains north across the U.S. border. The southern Mexicali Valley drains to the Gulf of California.

The present day Salton Sea was formed in 1905, when Colorado River water flowed through a break in an irrigation diversion structure that had been constructed along the US/Mexican border to divert the river's flow to agricultural lands in the Imperial Valley. Until that break was repaired in 1907, the uncontrolled diversions of river water drained into the Salton Basin, a closed interior basin whose lowest point is about 278 feet below mean sea level.

Historically, the Colorado River's course has changed several times. At times, the river discharged to the Gulf of California as it does today. At other times it flowed into the Salton Trough. Lake Cahuilla, the name used for any of the several prehistoric lakes to have occupied the Salton Trough, dried up some 300 years ago. In the past 2000 years, archaeological records indicate that the Colorado River headed northwest into the Salton Trough more often than it headed south into the Gulf of California (IID, 2007).

The Salton Sea is a critical component of the Pacific Flyway migratory corridor as it is an essential over-wintering site for thousands of migratory waterfowl. Its marsh areas provide significant habitat for the endangered yuma clapper rail.

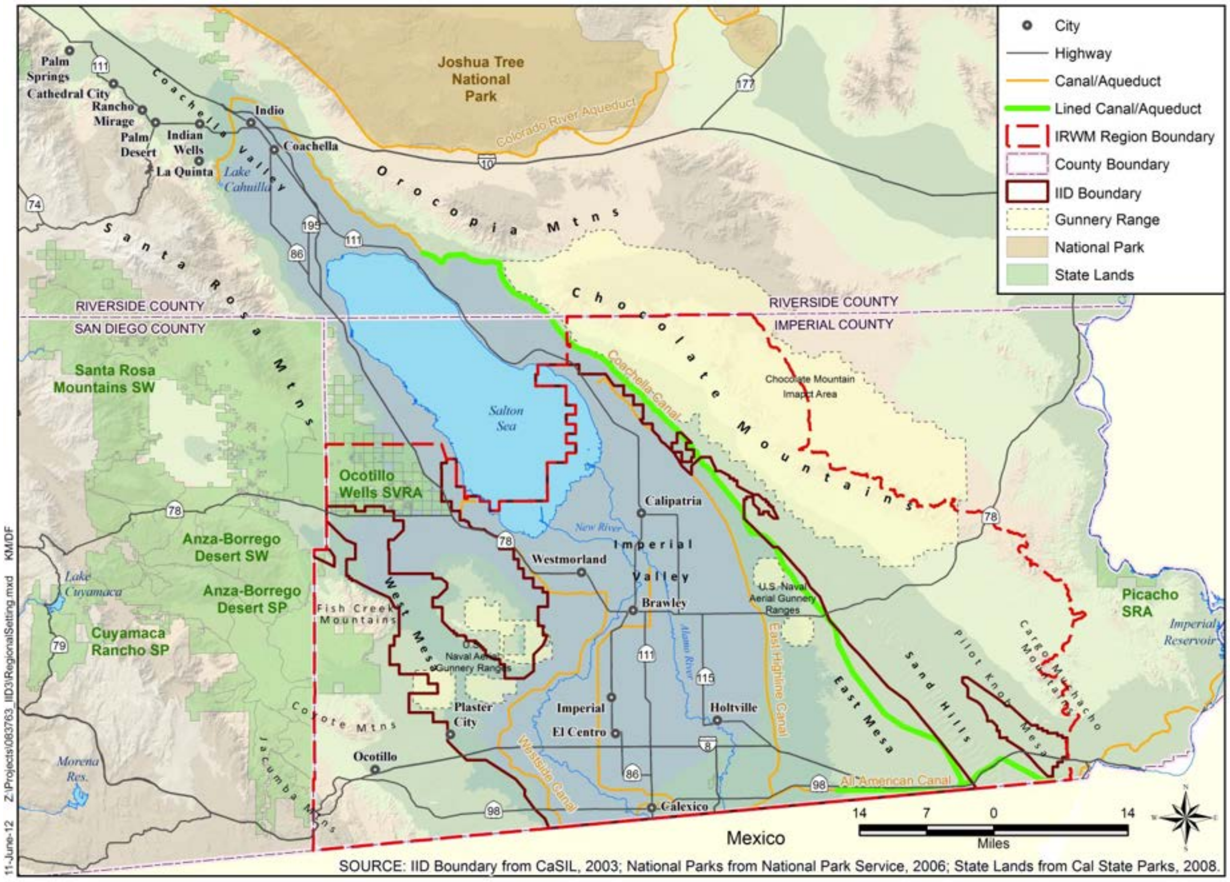

Figure B-1.Regional Setting

In general, the Imperial IRWMP area can be discussed in terms of three principal physiographic and hydrologic areas: (1) the Imperial Valley which lies within the valley floor generally inside the boundaries of the Westside Main and East Highline Canals and north of the Mexico; (2) the East Mesa which is generally east of the East Highline Canal; and (3) the West Mesa generally west of the Westside Main canal. The Ocotillo-Coyote Wells Groundwater Basin is located adjacent to the southwest corner of the West Mesa but is separated from the West Mesa by two faults which act as partial barriers to groundwater flow and is designated as a sole source aquifer (USEPA, 1996). These areas will be discussed in detail later.

B.3 CLIMATE

The Salton Basin has a typical desert climate, characterized by hot, dry summers and mild winters. Summer temperatures typically exceed 100°F, with winter low temperatures rarely dropping below 32°F. Rainfall in the Basin averages less than three inches per year, with the majority of the rainfall occurring from November through March. Total recharge to the groundwater system from precipitation within the valley was estimated to be somewhat less than 10,000 acre-feet per year

(Loeltz et al., 1975). Evaporation averages over 98 inches per year in Imperial Valley, while plant evapotranspiration is as high as 60 to 72 inches per year.

B.4 SURFACE WATER AND DRAINAGE

A generalized schematic diagram of the flow of imported surface water into and through the central Imperial Valley is shown on Figure B-2. Effectively all of the surface water coming into Imperial Valley is a result of diversions from the Colorado River. In fact, with the exception of San Felipe Creek and groundwater discharging springs to the northeast of the Salton Sea, the existence of surface water anywhere in the Basin is dependent upon the inflow of irrigation water from the Colorado River. Diversions to the Imperial Valley and lower part of the Coachella Valley are through the All-American Canal (AAC) and Coachella Canal.

Initially both the AAC and the Coachella Canal were unlined canals through the IRWMP area. A 49-mile long section of the old unlined Coachella Canal, starting at the AAC and through East Mesa, was abandoned in 1979 when a new lined canal was constructed. An additional 36.5-mile segment of the canal, continuing northward from the 1979 lining project, was lined during the Coachella Canal Lining Project which began in October 2004 and was completed in December 2006, when 26,000 acre-feet per year of conserved water began flowing to project beneficiaries. The All-American Canal Lining Project began construction in June 2007 and was completed in April 2010, when its full yield of 67,700 acre-feet per year was made available to project beneficiaries. The project lined a portion of the canal from about six miles east of the East Highline Canal to about five miles east of the Coachella Canal.

IID operates three primary branches out of the AAC to the central irrigated area of Imperial Valley. These are the East Highline, Central and Westside Main Canals. Because the Salton Basin is a closed drainage system, all surface flow not percolating into subsurface storage, evaporating or being consumed by vegetation eventually flow to the Salton Sea as part of environmental commitments. The major drainage features in the Salton Basin are the north flowing New and Alamo Rivers, San Felipe Creek, and Tule Wash. The New and Alamo Rivers, which are essentially collector drains, account for approximately 75 percent of the total surface runoff from the Imperial Valley, and nearly all of the discharge to the Salton Sea (Montgomery Watson, 1995). Both rivers cross the central area of irrigated farmland, and intercept the area's elaborate system of drains to convey water to the Salton Sea. Total flow from the New and Alamo Rivers, and the drains, into the Salton Sea between 2007 and 2011 averaged about 1.0 million acre-feet per year (MAFY) with 0.85 MAFY from Mexico.

The Imperial Valley consists of approximately 475,000 acres of irrigated and drained farmland (IID, 2012). Water is imported into the Imperial Valley via the AAC. In addition, three primary canals feed off the AAC into Imperial Valley: the Westside Main, the Central Main and East Highline canals. From these main canals, irrigation water is distributed throughout the central irrigated area via supply canals, laterals, and turnouts. The irrigated portion of the Imperial Valley also contains an extensive network of farm-gate lateral drains and subsurface tile drains. Tile drains were installed below the fields to prevent water logging of crops, and salt buildup in the clay-rich soils. The system of lateral drains and tile drains therefore determines and maintains the level of the groundwater table throughout most of the central Imperial Valley. Typically at a depth of five to seven feet, the tile drains carry subsurface water to sumps at the tail end of selected fields or discharge directly into lateral drains. The lateral drains receive both tailwater and tilewater drainage. All drain water is ultimately discharged to the Salton Sea, either directly from drainage ditches, or by way of the New and Alamo Rivers. Therefore, the vast majority of the flow in the drain system is agricultural runoff (IID, 2012).

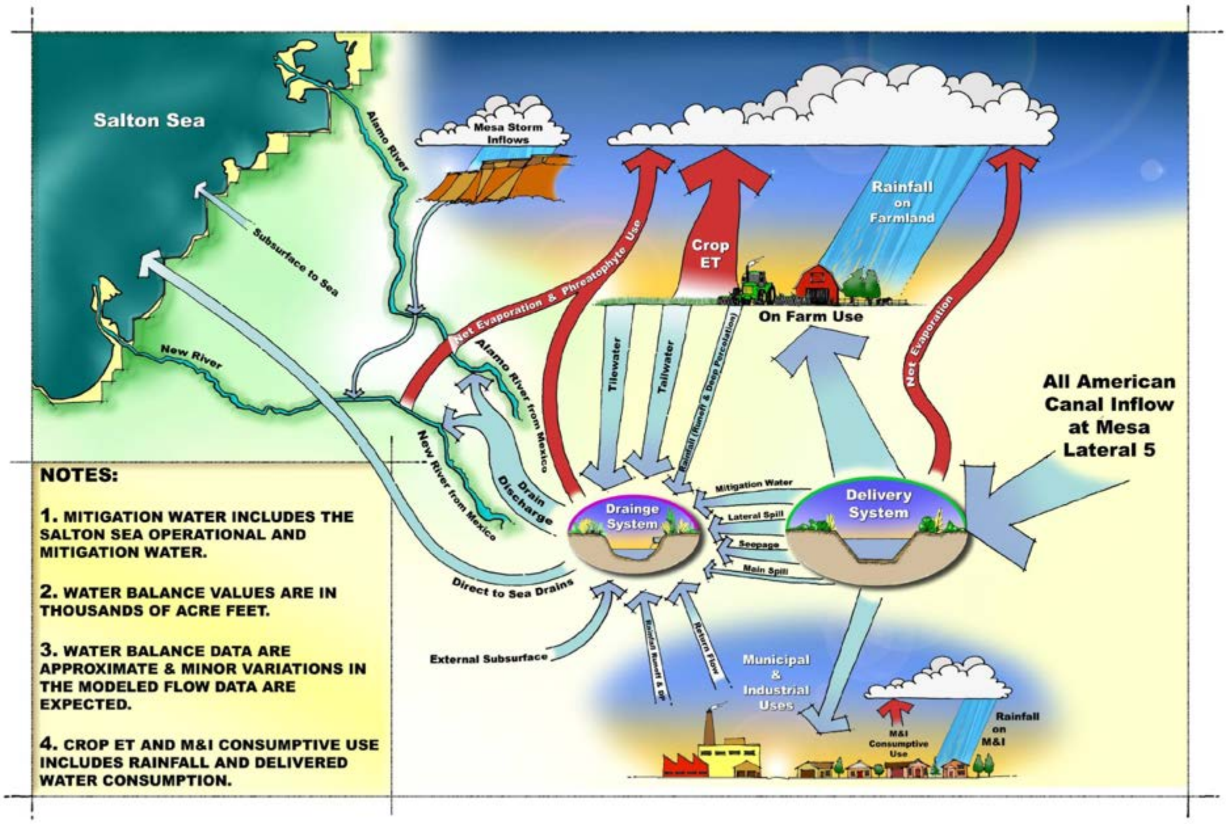

Figure B-2. Water Balance Components and Flow Paths, Imperial Valley
Source: Davids Engineering, et al., May 2007, IID Delivery System Analyses (Vol 2) Technical App. 1.b, p 2

B.5 Soil Types

Soils in the Imperial IRWMP area were mapped and described by Zimmerman (1981). As previously mentioned, the Imperial IRWMP area can be broadly viewed in terms of three different physiographic areas: the Imperial Valley, and the East and West Mesas. The ten mapped units in this survey have been grouped into two general kinds for broad interpretive purposes, as indicated on Figure B-3. A generalized map of soil types in area is provided on Figure B-4. Zimmerman (1981) identifies ten generalized soil units in the area. Consistent with the three physiographic regions above, these two groups and the map units in each group are described below.

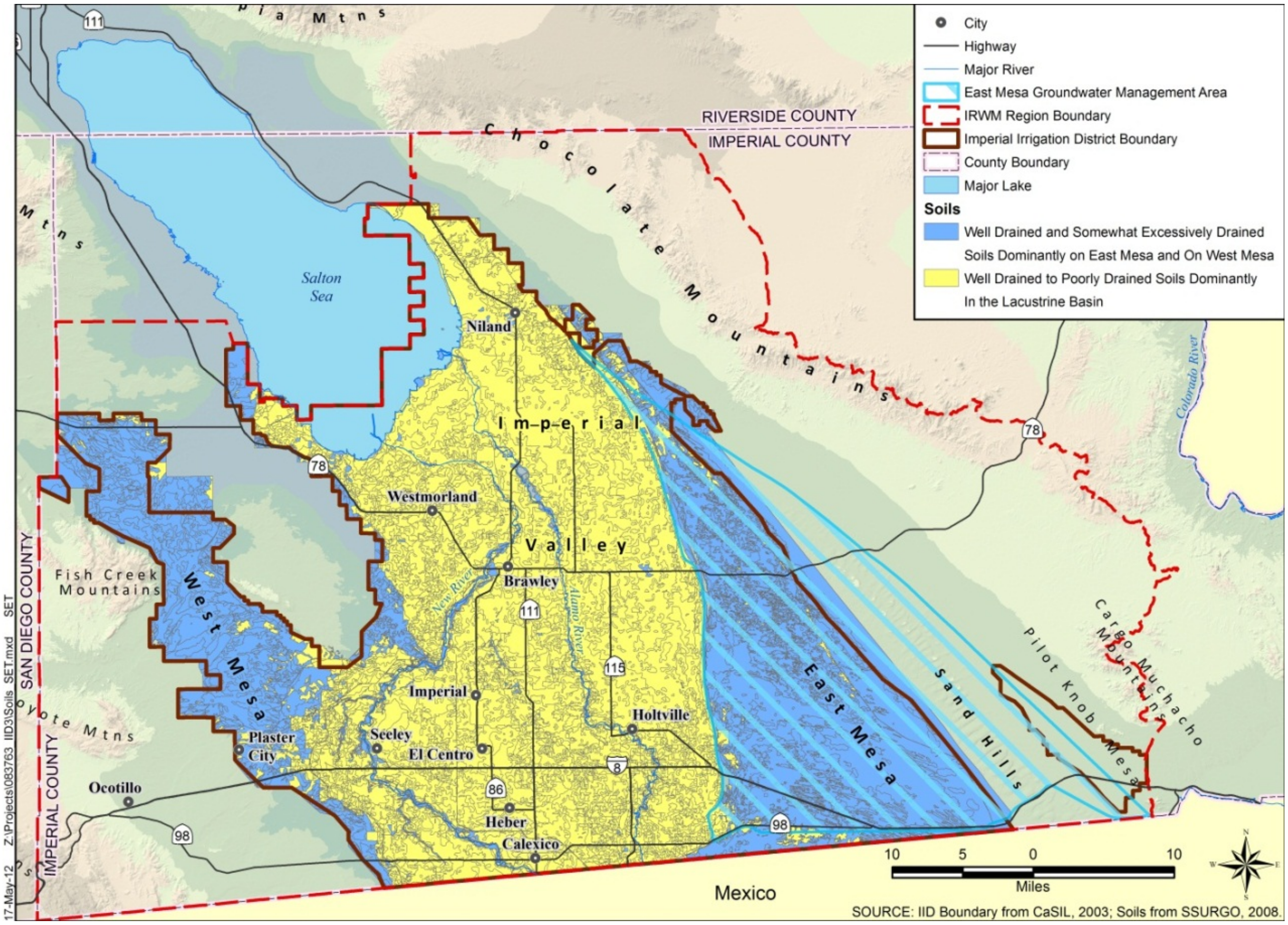

Figure B-3. Generalized Soil Types, Imperial IRWMP Area

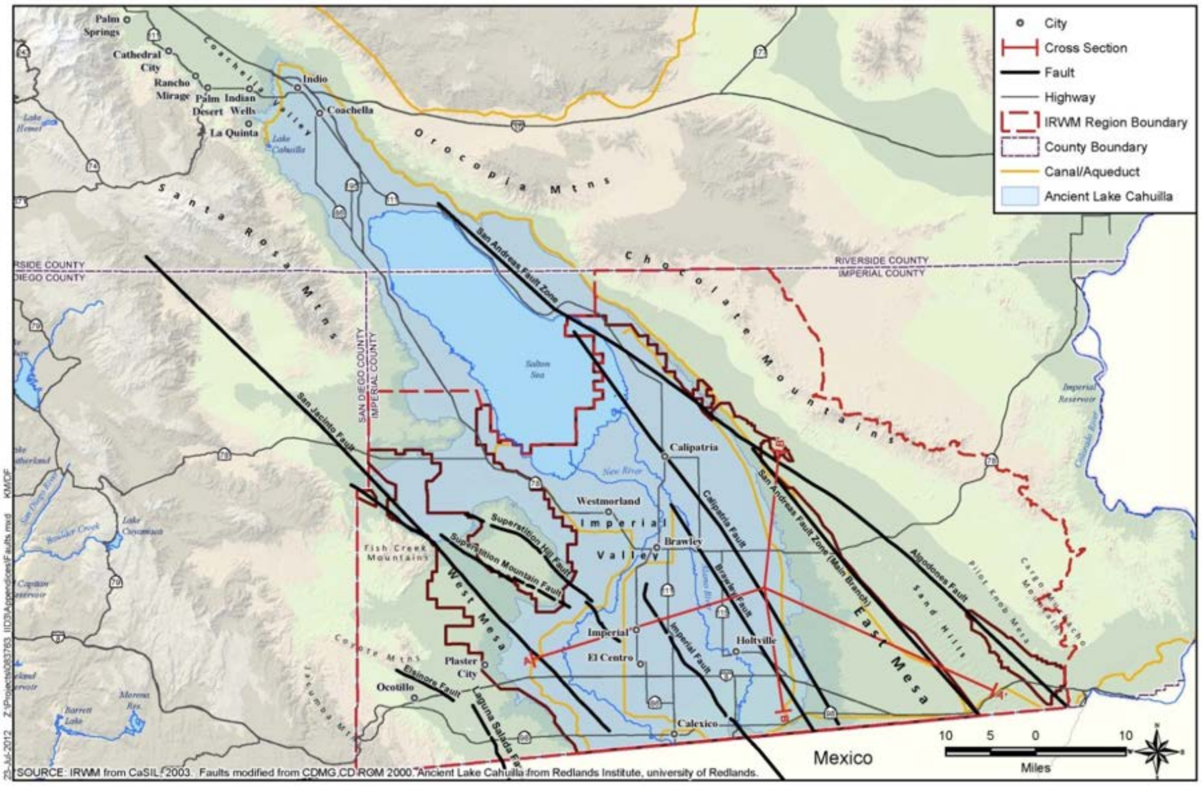

Figure B-4. Faults in Imperial Basin

Imperial Valley. Soils in this area are predominantly well drained to poorly drained soils. The soils in this group occupy the area of prehistoric Lake Cahuilla in the central valley, but also a few areas on West Mesa. The soils in this area are nearly level. Elevation is about 230 feet below sea level adjacent to the Salton Sea and about 200 feet above sea level on West Mesa. They are mainly moderately well drained to well drained, but some soils adjacent to the Salton Sea are poorly drained. A perched water table is present in most soils in the central area because of the extensive irrigation practices and underlying poorly drained clayey soils. The surface layer ranges from gravelly sand to silty clay. Soils in this group are used mainly for irrigated cropland. Although water can percolate through these soils, it typically doesn't reach the deeper aquifers because it is intercepted by the extensive network of drains.

East and West Mesas. Soils in the areas of the East and West Mesas are predominantly well drained to excessively drained and occur on the mesas adjacent to the old Lake Cahuilla lakebed. These soils have developed due to different geologic processes than the central valley area. In the East and West Mesas, sediments have been deposited not as a result of lakebed deposition, but rather chiefly as a result of stream/flood and wind processes. For these reasons, soils in the East and West Mesas are more coarse grained and hydraulically transmissive than the Central Irrigated Area. The soils in the mesas are nearly level to moderately steep, depending on location. The surface layer ranges from sand to silty clay. Soils in this group are mainly used for desert recreation or as desert wildlife habitat.

Ocotillo-Coyote Wells Groundwater Basin. Soils in the areas of the Ocotillo-Coyote Wells Groundwater Basin East and West Mesas are predominantly well drained to excessively drained

B.6 General Geologic Framework

The Salton Trough is a sediment-filled fault block bounded by the Elsinore and San Jacinto Faults on the west and the San Andreas Fault zone on the east (Loeltz et. al, 1975; Norris and Webb, 1976), as shown on Figure B-4. The trough is structurally controlled by the San Andreas Fault system, and is related to the rifting of the Baja California peninsula away from mainland Mexico. The bottom of the sediment-filled basin is thousands to tens of thousands of feet below the current ground surface (Loeltz et al., 1975). Beneath the sediments and exposed in the surrounding mountains is the basement complex which is composed of igneous, volcanic and metamorphic rocks.

The San Andreas Fault system includes numerous parallel or en-echelon faults that traverse the valley in a northwest-southeast trending manner. Related faults that are present within the trough in the central valley area include the Imperial, Brawley, and Calipatria Faults. The southern extension of the Elsinore Fault is the Laguna Salada Fault which forms the eastern boundary of the Ocotillo-Coyote Wells Groundwater Basin.

The trough has been filled with marine and non-marine sediments that overlie a pre-Tertiary bedrock complex. Up to 20,000 feet of marine and non-marine Cenozoic deposits underlie the Imperial Valley, with the thickest deposits occurring in the central part of the Imperial Valley. Non-marine sediments in the Imperial Valley include horizontally stratified lacustrine silts and clays deposited by ancient Lake Cahuilla, and alluvial sands and gravels associated with seasonal floods from the Colorado River (Loeltz et al., 1975). The known extent of Lake Cahuilla, which was present in the Basin as recently as a few hundred years ago, is shown on Figure B-4 as a light blue color.

The broad Imperial Valley area is bordered to the east and west by the East and West Mesas, respectively. These areas of the mesas represent gently sloping elevated terrains on which alluvial and wind-blown deposits of a more coarse nature have been accumulated. The West Mesa is chiefly underlain by an assemblage of alluvial fans shed from the mountain ranges to the west of the mesa. The East Mesa is primarily a relic of Colorado River flood and fan delta deposits overlain by more recent wind-blown sands. The extent of these mesas roughly coincides with the traceable shoreline of pre-historic Lake Cahuilla (Loeltz et al., 1975) and, thus, roughly defines the areas where the fine-grained, lake bed deposits give way laterally to coarser grained deposits. This general geologic model for the Basin has strong influence on the occurrence and movement of groundwater.

B.7 GROUNDWATER

This section describes the geology, aquifer characteristics and water quality in the Imperial IRWMP area.

B.7.1 Aquifers and Hydrostratigraphy

Imperial Valley. Most studies of groundwater conditions in the Imperial Valley focus exclusively on the upper 1,000 feet of water-bearing strata. Data are limited on groundwater in the area, owing to the fact that groundwater in the upper 300 feet is generally of poor quality and well yields are relatively quite low. In addition, though it exists in large quantities, historically there has been little need to investigate and develop the groundwater in the valley area due to the availability and low cost of imported Colorado River water. Studies show that groundwater in the Imperial Valley generally occurs in two water-bearing zones: (1) a shallow (0 to 300 feet), unconfined, aquifer that is bounded at depth by a low permeability clay (aquitard); and (2) a intermediate (300 to 1,500 feet), semi-confined aquifer that is bounded above by the aquitard and at depth by the older marine and non-marine sediments (Tetra Tech, 1999; Montgomery Watson, 1995). A third, deeper aquifer has been identified by some authors, and may be present at depths greater than 1,500 feet, but is likely impractical in terms of water supply resources because of its poor water quality (Durbin and Imhoff, 1993) and water temperature. The following diagrams present generalized geologic cross-sections across the Imperial Valley. The locations of the cross-section lines with respect to the valley are shown on Figure B-5. Cross-section A-A' (Figure B-6) provides an east-west profile of the sediments, and cross-section B-B' (Figure B-7) represents a north-south profile of sediments across the Imperial Valley and into East Mesa.

The cross-sections illustrate in a generalized way the horizontal stratification in the Imperial Valley and East Mesa, and the depth relationships between the water-bearing aquifers and the intervening aquitards.

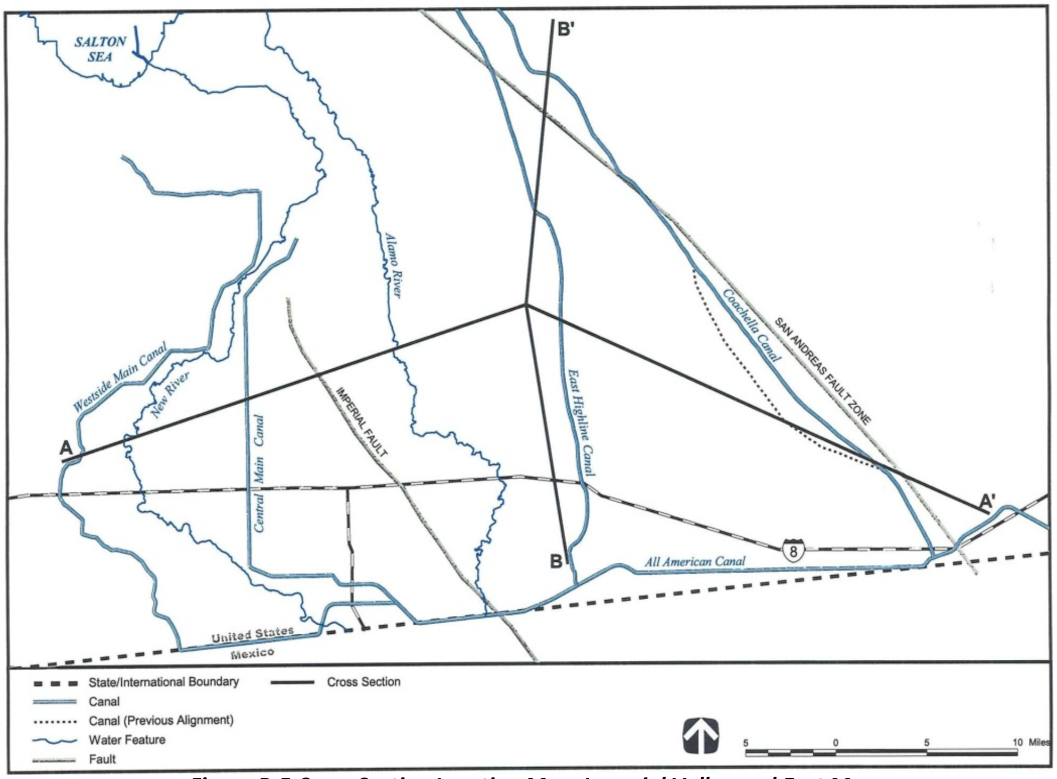

Figure B-5.Cross-Section Location Map, Imperial Valley and East Mesa

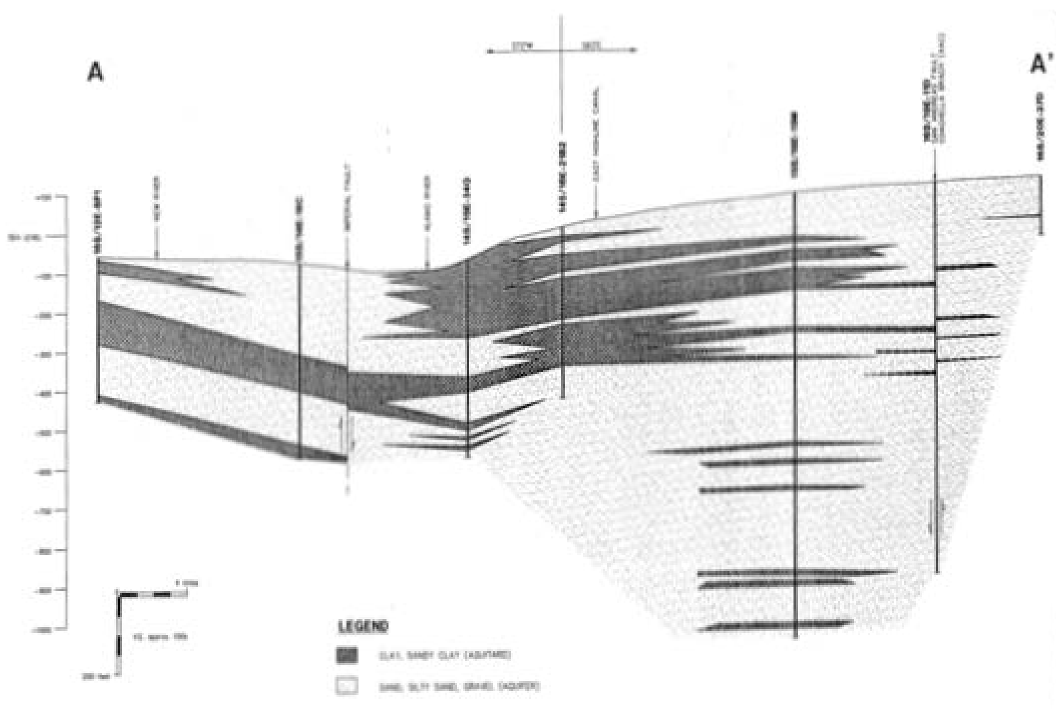

Figure B-6.Cross-section A-A'

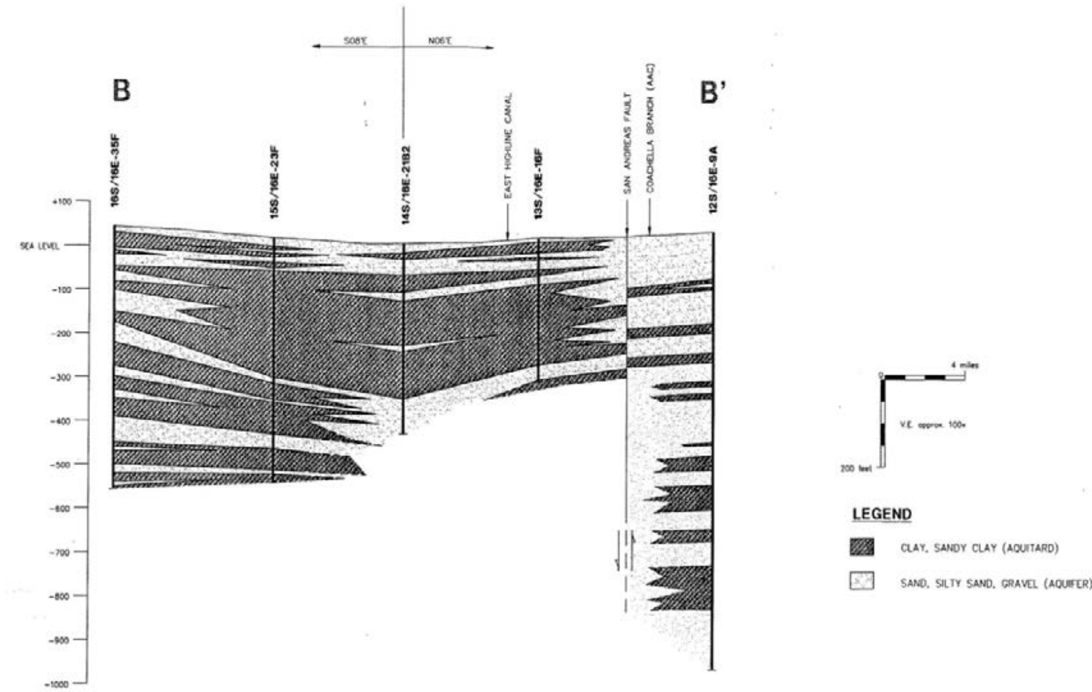

Figure B-7. Cross-section B-B’

Hydraulic communication between the upper (unconfined) and lower (semi-confined) water- bearing zones is reportedly weak, but likely varies depending on geographic location. Elevations of the base of the deeper aquifer vary from -800 feet mean sea level (MSL) in the center of the Imperial Valley to -200 feet MSL in the northeast. The upper aquifer averages 250 feet in thickness, and the deeper aquifer averages 550 feet in thickness. The aquitard separating the two water-bearing zones varies in thickness from 0 to 260 feet. This aquitard lies under the Imperial Valley but reportedly pinches out beneath East Mesa near the San Andreas Fault (and likely toward the West Mesa as well) such that only one, chiefly homogenous aquifer is present beneath the mesas. The homogeneity of the aquifer from the east to the west is interrupted by the Calipatria and the Brawley Faults. Historically, there has been up to a 10 foot head difference across the Calipatria Fault with the water levels lower on the west side of the fault (Crandall, 1983). The Brawley Fault creates about a two-foot difference in water levels, indicating that the fault is not as much of a barrier to flow as the Calipatria Fault (Crandall, 1983). The water surface gradient between the Calipatria Fault and the Brawley Fault north of the East Highline Canal have been recorded as decreasing to the northwest which indicates the flow of the water parallel to the faults, indicating the faults are at least a partial barrier to flow (Crandall, 1983).

West Mesa. The West Mesa is a somewhat loosely defined region of gently sloping desert land that lies south of the Salton Sea, west of the western shoreline of Lake Cahuilla, and east of the Coyote and Jacumba Mountains. The area includes portions of several relatively small groundwater subbasins for which little direct information is known. The exception to that is the Ocotillo-Coyote Wells Groundwater Basin, for which studies on both the quality and quantity of available groundwater exist (Bookman-Edmonston, 1996; Bookman-Edmonston, 2004). This area of West Mesa includes the area around the towns of Ocotillo and Plaster City where the U.S. Gypsum plant operates. The groundwater aquifer in the Ocotillo-Coyote Wells Groundwater Basin is characterized as unconfined, with a saturated thickness of about 400 feet and an average depth to groundwater of approximately 100 feet. The aquifer is generally homogenous and of a more coarse-grained nature than the central valley area. Thus, the data does not indicate separate water-bearing zones or intervening aquitards of any regional significance. Groundwater and surface water flow mimic the topography, flowing generally east, toward discharge areas in the Imperial Valley and Salton Sea.

Faults play a key role in the occurrence and movement of groundwater in all areas of Imperial IRWMP area. Figure B-4, shows the locations of the faults. In the West Mesa area, the Elsinore Fault and its southerly extension the Laguna Salada Fault, transect the Ocotillo-Coyote Wells Groundwater Basin act as partial barriers to the flow of groundwater out of this area toward the Imperial Valley.

East Mesa. East Mesa is located in the southeastern portion of the Salton Basin, and is described as the broad area east of the East Highline Canal and east margin of pre-historic Lake Cahuilla, and west of the Sand Hills Fault. The Sand Hills Fault (also named the Algodones Fault), an easterly splay of the San Andreas Fault system, is mapped as bordering the east side of the Sand Hills (Loeltz et. al., 1975). The East Mesa is also roughly bordered by the Coachella Canal on the east and the AAC on the south. The East Mesa is an alluvial surface that slopes gently west-southwest, covered with thin veneers of wind-blown sand. The East Mesa aquifer is chiefly unconfined, homogenous, and composed of coarse-grained deposits of gravels, sands, silts, and silty clays that were deposited by the Colorado River.

In East Mesa, the San Andreas Fault zone includes a main branch along the west margin of the Sand Hills, and an easterly splay identified as the Algodones Fault (Loeltz et. al., 1975). These faults act as partial barriers to the westward flow of groundwater from this area. The Calipatria Fault also crosses a small portion of the East Mesa along the southwest margin and also impedes the flow of groundwater out of East Mesa.

B.8 Aquifer Recharge and Discharge

In the Imperial Valley, recharge to the groundwater reservoir by subsurface inflow from tributary areas is small compared with recharge from the imported Colorado River water. Total recharge to the groundwater system from precipitation within the valley was estimated to be somewhat less than 10,000 acre-feet per year (Loeltz et al., 1975). However, Montgomery Watson (1995) cites a more likely recharge rate of 0.02 inch per year for the Ocotillo area, which equates to approximately 800 acre-feet of recharge per year, over the 500,000 acres of un-irrigated land in the West Mesa. Major sources of groundwater discharge from Imperial Valley aquifers include groundwater discharging directly into the New and Alamo Rivers, pumping in Mexicali Valley to the south, intercepted shallow groundwater from the agricultural fields by drains and the extensive tile drain network, and subsurface discharge into the Salton Sea. Phreatophytes also remove groundwater by evapotranspiration in areas where the groundwater table is shallow, especially in the rivers and drains and by wetlands (Tetra Tech, 1999). Artesian groundwater conditions exist in the Imperial Valley, primarily east of the Alamo River in a band extending roughly from Holtville in the south to Calipatria in the north.

In the West Mesa area, recharge to the aquifer is from two sources: precipitation falling directly on the area and percolation of stream runoff from the Coyote and Jacumba Mountains to the west. Sources of discharge in the West Mesa include pumpage by U.S. Gypsum, limited urban water use into the town of Ocotillo, and subsurface outflow across the Elsinore/Laguna Salada faults and toward Mexico (Bookman- Edmonston, 1996).

In the East Mesa, the source of water supply recharge to the groundwater aquifer was from canal seepage from the old unlined Coachella Canal and the AAC. However, recharge has essentially ceased when portions of unlined Coachella Canal were lined in 1979. Although portions of the AAC were lined between 2006 and 2010, the project did not complete lining of the canal completely through the East Mesa area, so some recharge from the canal to the mesa still continues. Due to the arid conditions, virtually no direct precipitation reaches the groundwater aquifer in the East Mesa (Crandall, 1983). Groundwater from the East Mesa is discharged at ground surface in springs and in the subsurface into Imperial Valley aquifers. Discharge of groundwater onto ground surface in springs occurs at areas of shallow groundwater along the AAC. In these areas, where wetlands have been created from canal seepage, discharged groundwater consumptive use is mainly attributable to evapotranspiration by phreatophytes and surface evaporation. Subsurface outflow in the East Mesa occurs toward the Imperial Valley, toward Mexico, and into a portion of the East Highline Canal.

B.8.1 Aquifer Storage

The storage capacity of the Imperial Valley has been estimated at approximately 14 MAF of water (CDWR, 1975). Available aquifer storage within the East Mesa in between the East Highline Canal and the old unlined Coachella Canal is estimated to be one (1) MAF (USBR, 1988). The aquifer storage potential of the West Mesa has not been quantified; however, aquifer conditions in the area appear favorable for storage of water. However, it will be more difficult to supply the water to the West Mesa area as there are no canals along the topographical higher areas where permeable sediments are present.

B.8.2 Groundwater Quality

The Imperial Valley contains a large area of poor quality groundwater that is generally regarded as unsuitable for domestic or irrigation use without treatment. The chemical quality of groundwater differs greatly from place to place, and salinity is the primary water quality issue. Total dissolved solids (TDS) range from several hundreds to more than 10,000 milligrams per liter (mg/L). Generally, Ocotillo-Coyote Wells Groundwater Basin sole source aquifers, which receive recharge from precipitation on the Jacumba Mountains, contains only a few hundred mg/L of dissolved solids. Beneath East Mesa the water quality is moderate to poor and has been locally influence by seepage from the old unlined reaches of the Coachella Canal and AAC.

In Imperial Valley, concentrations of nitrate and fluoride higher than the concentration recommended for drinking water are common. High concentrations of sulfate may also be present. Concentrations of boron are typically higher than those recommended for certain agricultural crops. Selenium, also a constituent of concern in the Imperial Valley drains, is thought to be a principally imported contaminant from the Colorado River supply.

In the Imperial IRWMP area, water quality was interpreted to define the areal and vertical distribution of salt within the aquifers (Durbin and Imhoff, 1993). TDS concentrations were summarized for three distinct water-bearing zones, shallow (80' to 300'), intermediate (300' to 1,500') and deep (>1,500') as shown on Figure B-8 through Figure B-10, respectively. The shallow aquifer contains highly variable water quality ranging from about 800 to over 10,000 mg/L TDS. Relatively consistent water quality is present in the shallow aquifer beneath East Mesa ranging from about 800 to 2,200 mg/L TDS. The intermediate aquifer beneath the Imperial Valley contains water that is fairly uniform averaging about 2,200 mg/L, while the deep aquifer contains more uniform the poorest quality water.

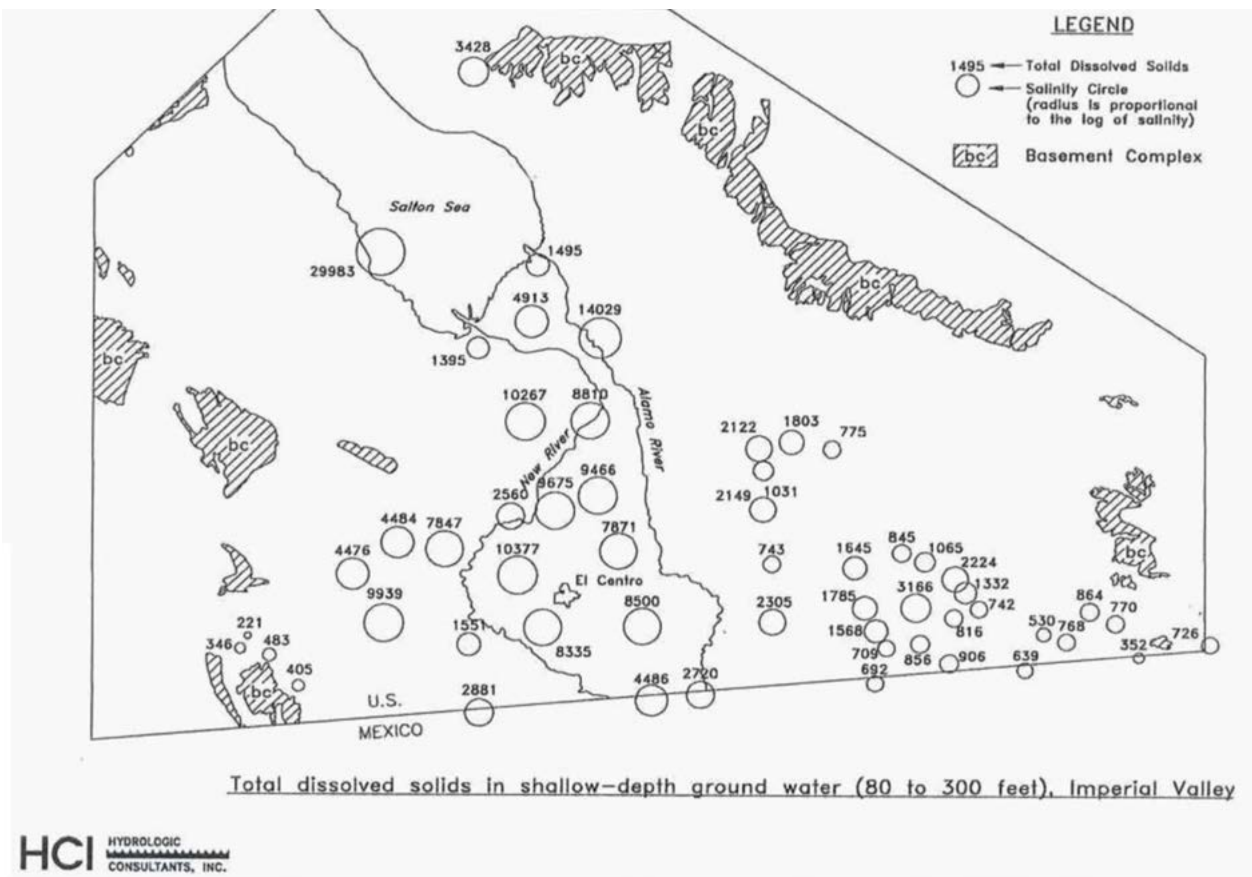

Figure B-8.Shallow Aquifer Water Quality

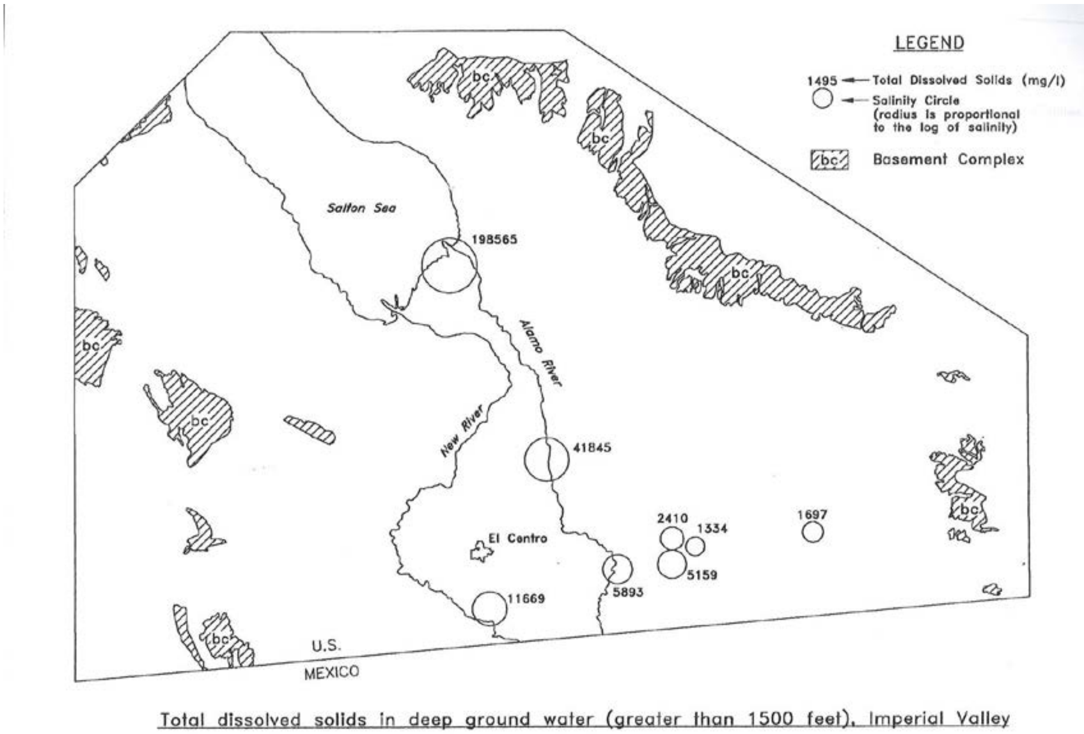

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Figure B-9. Shallow Aquifer Water Quality

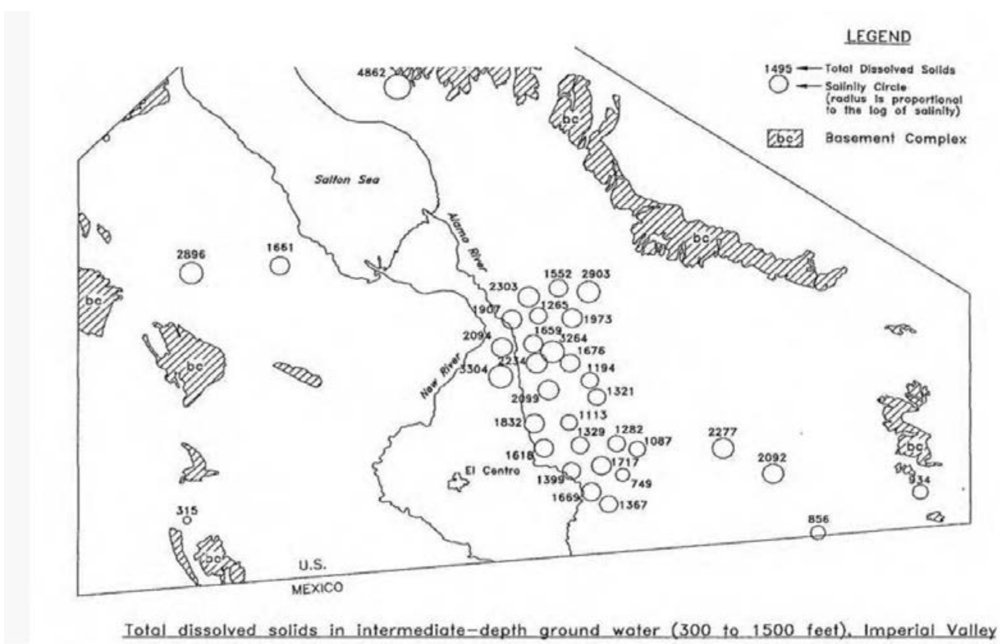

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Figure B-10.Intermediate Aquifer Water Quality

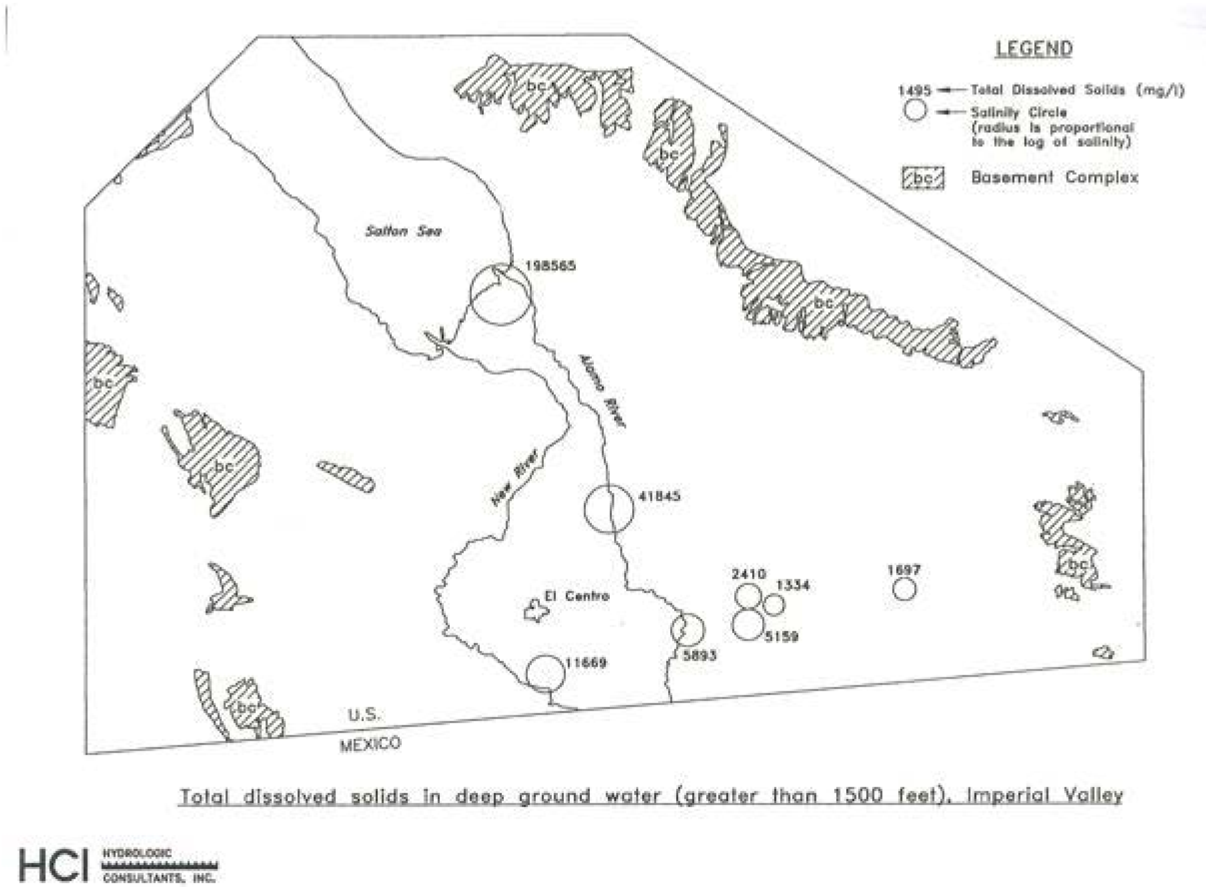

Figure B-11.Deep Aquifer Water Quality

Additional water quality investigations were performed in the East and West Mesas that refine the previous regional studies. In the West Mesa, groundwater is pumped for industrial use at the U.S. Gypsum plant at Plaster City. The quality of the groundwater pumped in this area is reportedly good. In addition, the U.S. Geological Survey has conducted water quality sampling in the Ocotillo-Coyote Wells Groundwater Basin since 1977 (Bookman-Edmonston, 1996). Water quality data for this sole source aquifer suggest average TDS concentrations range from 300 to 400 mg/L due to recharge being derived from precipitation on the adjacent Jacumba mountains. As previously discussed, the Elsinore-Laguna Salada fault complex comprises a partial barrier to the flow from east to west of groundwater from the Ocotillo-Coyote Wells Groundwater Basin to West Mesa. TDS concentrations are notably higher on the east side of the faults (i.e., toward the Imperial Valley), ranging up to 15,000 mg/L in some wells. On the east side of the faults, shallow wells have higher TDS concentrations than deeper wells, indicating that poorer quality groundwater overlies better quality.

The greatest amount of available data on groundwater quality pertains to the East Mesa area. While there is little to no permanent groundwater pumping, the East Mesa area includes a large number of wells and has been the subject of investigation for possible groundwater development and banking for several decades. There are oil and gas exploration wells, geothermal wells, test holes, monitoring wells associated with canal seepage from the AAC and Coachella Canal, and a small number (12) of water supply wells, some of which are used for agricultural purposes. The majority of the wells are located in the southern portion of the East Mesa area, along the AAC. Two aquifers were identified in the area: a shallow unconfined zone from 0 to 85 feet and a deeper *semi*-confined zone from 85 to 160 feet (Crandall, 1983). The two water-bearing zones were differentiated based on chemical character, pH, TDS, and the perforated interval of the particular well. Overall, the median TDS is slightly higher in the shallow aquifer than in the deeper aquifer, and the water in the deeper aquifer contains water (sodium bicarbonate in character) from a different source. Table B-1 provides the analysis and characterization of the water quality.[1]

1

Table B-1. East Mesa Water Quality

	Zone A (85 to 160 Feet)		Zone B (0 to 85 Feet)	
Chemical Character	Sodium Chloride	15 wells	Sodium Chloride	13 wells
	Sodium Sulfate	3 wells	Sodium Sulfate	10 wells
	Sodium Bicarbonate	0 wells	Sodium Bicarbonate	6 wells
pH	Range: 7.4- 8.6	17 wells	Range: 4.3-11.2	17 wells
	Common 7.4- 8.6		Common 6.9- 9.0	
	4.3- 6.4	0 wells	4.3- 6.4	4 wells
	6.5- 7.5	1 well	6.5- 7.5	5 wells
	7.6- 8.6	16 wells	7.6- 8.6	11 wells
	8.7- 9.7	0 wells	8.7- 9.7	3 wells
	9.8-11.2	0 wells	9.8-11.2	4 wells
TDS (ppm)	Range 589-2860	17 wells	Range: 250-2620	27 wells
	Common: 750- 995	9 wells	Common: 434- 787	16 wells
	589	1 well	250	1 well
	1270	1 well	882-1413	7 wells
	1710-2860	6 wells	1750-2620	3 wells
	7112	1 well	7151	1 well
F (ppm)	Range: 0.2-1.4	10 wells	Range 0.1-1.6	22 wells
	1.9	1 well	3	1 well
B	0.26 and 0.46	2 wells	0.41	1 well

Source: Crandall, 1983

Groundwater Temperature

Along with varying TDS, local groundwater also has varying temperatures. Geothermal heat in the Imperial Valley and the East Mesa is used to generate geothermal energy. Figure B-11 shows the Known Geothermal Resource Areas (K.G.R.A). The California Department of Conservation Division of Oil, Gas & Geothermal (DOGGR) has temperature logs for wells within the K.G.R.A.s. Several of these temperature logs were gathered and used to estimate the groundwater temperature that can be expected in different portions of the Imperial Valley. The data for the East Mesa is confidential so temperatures were estimated from the available logs for the shallow and intermediate aquifers in the Imperial Valley and extrapolated into areas where the information was not available.

Beneath the East Brawley K.G.R.A., the shallow water temperature has been reported as 90 degrees Fahrenheit (°F) (USBR, 1992). A log for a well in the East Brawley K.G.R.A. indicated that temperature ranged from 170 °F at 1,000 feet below ground surface (bgs) to 288 °F at 2,000 feet bgs. The temperature above 1,000 feet bgs was not recorded due to the sensitivity of the temperature probe but is likely cooler at shallower depths.

A temperature of 170°F was assumed for the entire East Mesa aquifer due to the similar aquifer depth and proximity to wells in the East Brawley K.G.R.A.

Groundwater temperature for the Heber K.G.R.A. was estimated using a temperature log from the HGU well 109. The temperature at 250 feet bgs was 178 °F, which is the depth of the shallow aquifer; and 308 °F at 1,500 feet bgs for the intermediate aquifer. Heber K.G.R.A. has the highest temperatures in the region for the shallow and intermediate aquifers.

Groundwater temperature for the Salton Sea K.G.R.A. was estimated using a log from the Megamax 4 well. At 300 feet bgs, at the base of the shallow aquifer, the temperature was recorded as 94 °F. The intermediate aquifer, with a depth of about 1,500 feet bgs, has a temperature recorded of 145 °F.

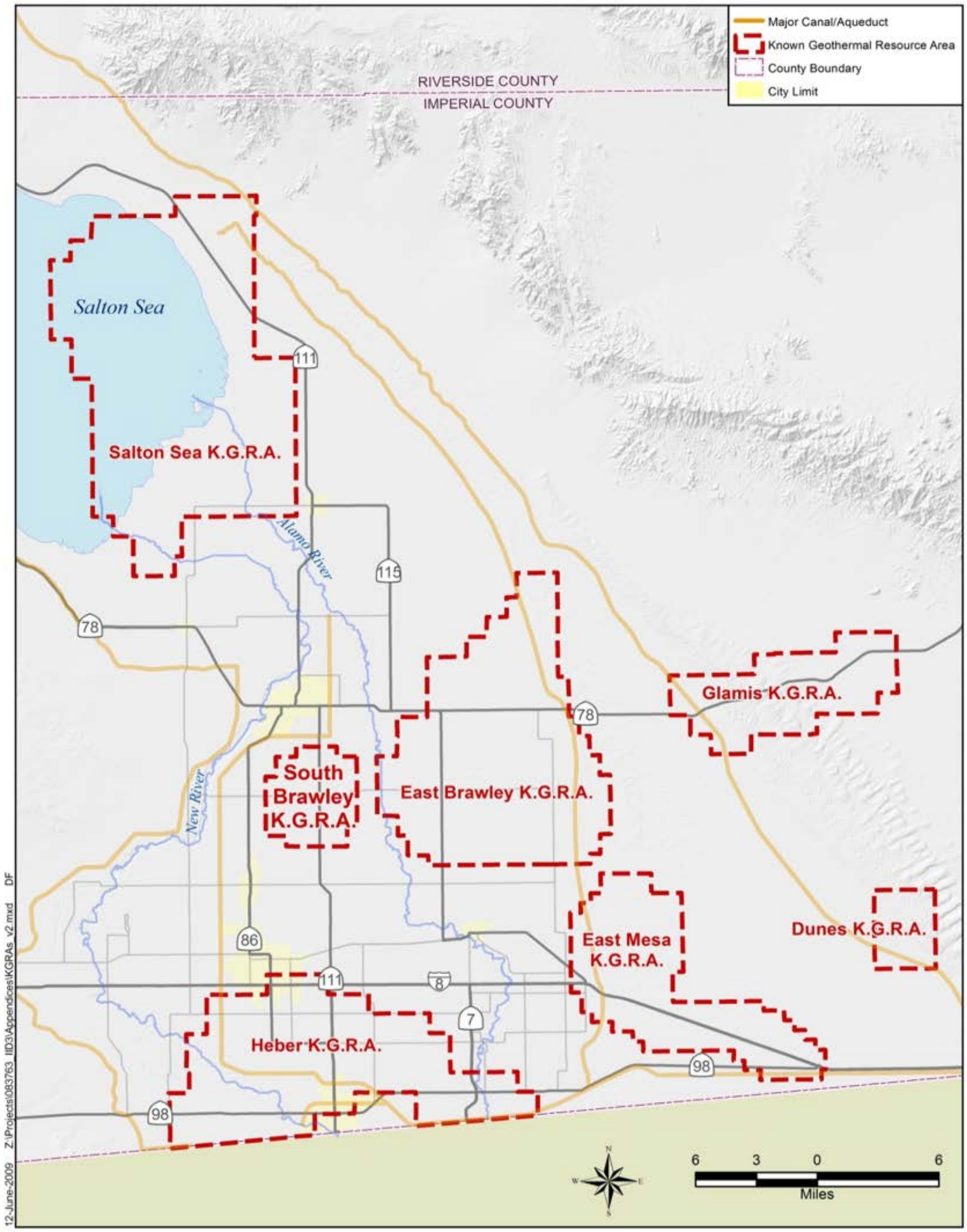

Figure B-12.Known Geothermal Resource Areas

B.9 AQUIFER HYDRAULIC CHARACTERISTICS

Aquifer hydraulic characteristics are present in terms of hydraulic conductivity, transmissivity and specific yield or storativity. The hydraulic conductivity is the rate at which water can move through a permeable medium and the units of Length/Time. Transmissivity is the ability of an aquifer to transmit water. The capacity of aquifer to transmit groundwater under pressure, expressed as a quantity of water, at the prevailing temperature, transmitted horizontally in a given period of time through a vertical strip of a given width of the fully saturated thickness of the aquifer, under a hydraulic gradient of one with unit of Length squared/Time or by multiplying these values by 7.48 to obtain units of gallons per day per foot. The transmissivity is equal to the hydraulic conductivity times the thickness of the aquifer. Porosity is the voids or open spaces in sediments that can be filled with water, frequently expressed ratio of the volume of open space to the total sediment volume, and is expressed as a percentage.

Storativity is the volume of water released from storage in an aquifer in a vertical column of one foot-square when the water surface in a confined aquifer (potentiometric surface) declines 1 foot. In an unconfined aquifer the storativity is approximately equal to specific yield.

Another common term used during evaluations of wells is specific capacity, which simply divides the gallons per minute (gpm) divided by the drawdown (static water level – pumping water level). Specific capacity units are gpm/foot (gpm/ft). The higher the number the better the well and indicates the sediments are more highly transmissive. The values range from less than 1 to 150 gpm/ft.

Several sources of data exist that provide information on the hydraulic parameters of aquifers in the Imperial IRWMP area. Areal distribution of aquifer transmissivity values derived from pumping tests, which typically provide high quality data, is shown on Figure B-12 (Tetra Tech, 1999). Unfortunately the data was not organized by aquifer. The highest aquifer transmisivities are found in the East and West Mesas, and the lowest are within the Imperial Valley.

Transmissivity values varied from 200 square feet/day in the Imperial Valley, to 100,000 square feet/day in East Mesa.

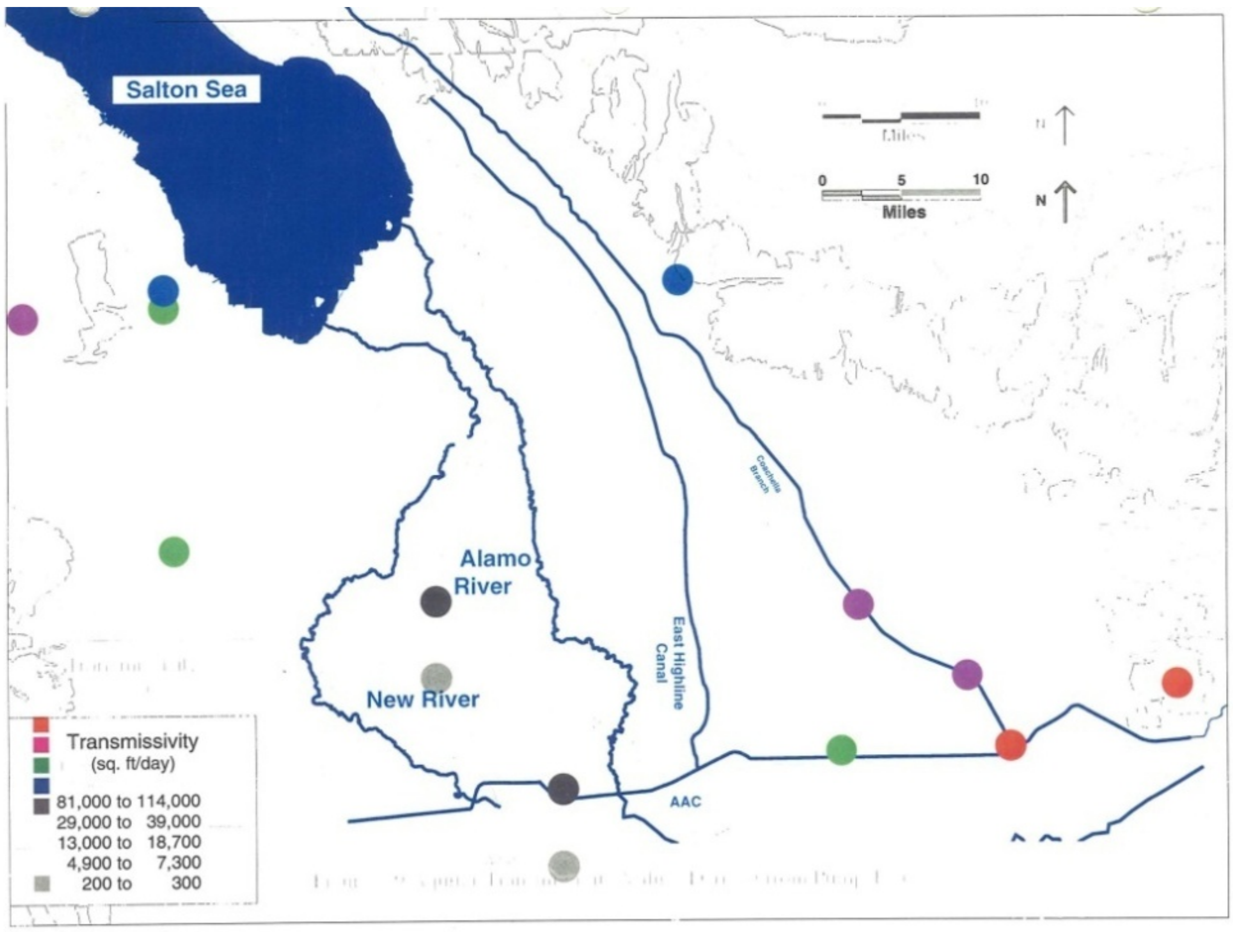

Figure B-14.Areal Distribution of Aquifer Transmissivities

Hydraulic conductivity values for the shallow and deeper aquifers were initially estimated using transmissivity data from the Imperial County Groundwater Model report (Montgomery Watson, 1995). Aquifer hydraulic conductivity values varied from a low value of 0.5 foot per day in the central irrigated area of the Basin where the previously described low conductivity lake bed sediments dominate, to a high value of 80 feet per day in East Mesa, where sediments are highly transmissive sands and gravels. Values for the Sand Hills, east of East Mesa, are 50 feet per day. Areas lacking data are assumed to have a hydraulic conductivity value of 30 feet per day for locations east of the pre-historic Lake Cahuilla shoreline (see Figure B-4) and 0.5 feet per day for locations west of the pre-historic Lake Cahuilla shoreline. Thus, based on the data presented; on average, new wells in the East Mesa would be expected to have higher yields than those in the West Mesa. Montgomery Watson (1995) presents a summary of hydraulic characteristics in various areas of the Imperial Valley. This is reproduced on Table B-2 below:

Table B-2. Summary of Hydraulic Characteristics

Area	Transmissivity (gpd/ft)	Transmissivity (sq ft/day)	Hydraulic Conductivity (ft/day)	Specific Yield
Imperial Valley	1,700 - 2,200	227 - 294	0.67 - 0.94	
East Mesa	140,000 - 50,000	18,717 - 113,636	32 - 1,337	
Sand Hills	62,000 - 590,000	8,289 - 78,887	9.7 - 401	
Ocotillo-Coyote Wells Groundwater Basin	10,000 - 82,000	1,336 - 10,963		0.04 - 0.15

Source: Montgomery Watson (1995)

Beyond those data cited above, Crandall (1983) provides data on estimated specific yield for the East Mesa aquifer. The range of values reported by Crandall varied from about 4 percent near the East Highline Canal, to 25 percent which occurs in areas along the Coachella Canal and AAC. The average specific yield for the East Mesa area was listed as 21 percent. Consistent with the geologic model described previously, specific yields decrease closer to the valley floor in proximity to the pre-historic Cahuilla Lake bed deposits. Higher values found elsewhere in the area are associated with coarser grained deposits of wind-blown origin.

Well logs obtained from the CDWR were used to evaluate depth specific aquifer characteristics. Aquifer characteristics were estimated from pumping test information contained on some of the logs; however, because the results are based on a single well the quality of the estimate is moderate. Table B-3 shows the aquifer characteristics by aquifer and generalized areas. The results show that East Brawley K.G.R.A. and East Mesa K.G.R.A. intermediate aquifers have the highest transmissivity and hydraulic conductivities. The aquifers in these locations will be able to supply greater quantities of water more sustainably than the Salton Sea or Heber K.G.R.A.s.

Table B-3. Aquifer Hydraulic Parameters

K.G.R.A.	Depth (feet)	Transmissivity (gpd/ft)	Hydraulic Conductivity (ft/day)	Storativity	TDS (mg/L)	Water Temprature (F)
Shallow Aquifer						
East Brawley [4]	80-300	10,000	13	0.01	1576 [7]	90
Heber [4]	80-300	10,000	13	0.01	3603 [7]	178
Salton Sea [4]	80-300	10,000	13	0.01	1500 [8]	94
Intermediate Aquifer						
East Brawley [6]	200-900 [2]	250,000	71	0.0001	1886 [7]	170-288 [11]
Heber [3,5]	300-1500	120,000	25	0.0001	1478 [9]	308
Salton Sea [3]	300-1500	60,000	25	0.0001	3200 [10]	94-145
East Mesa [1]	200-900 [2]	250,000	47	0.0001	1584 [7]	170

Notes:
LeRoy Crandall and Associates [1]
Assumed aquifer thickness form Cross -Sections A and B [2]
Hydraulic Conductivity assumed 25 ft/day and Transmissivity was backsolved [3]
Transmissivity Estimated from CDWR Paper 486-K [4]
Aquifer thickness averaged from CDWR well logs and CDWR Paper 486-K [5]
East side of Calipatria Fault and assumed sediments similar to that of East Mesa [6]
TDS is average for the well field area [7]
TDS only one measruement available in the area [8]
TDS Value is average from available vaues along Alamo River and East of Heber [9]
TDS Value from Niel at NCRS for Alamo River Flows [10]
From 1000 to 2000 feet depth [11]

Other data available for wells in the East Mesa include well yields and specific capacities. Reported well yields varied from 80 to 3,000 gpm, depending on depth and location. In general, yields in excess of 900 gpm were associated with depths of 200 feet or more. Specific capacity data reported for seven wells in the East Mesa, varied from 0.8 to 85 gpm/ft. The well with the highest specific capacity was located at the junction of the AAC and Coachella Canal. Specific capacities were highest to the east, and diminished to the west. Higher specific capacities were associated with wells deeper than 200 feet (Crandall, 1983).

Consistent with the overall geologic model for the Imperial IRWMP area, the highest transmissivities are associated with the East and West Mesas where aquifer formations are generally more homogenous and include a much higher proportion of coarse sands and gravels then the Imperial Valley floor, allowing groundwater to move at higher rates.

B.10 GROUNDWATER LEVELS AND MOVEMENT

The direction of groundwater movement is controlled primarily by contours of groundwater level elevation; the rate of groundwater movement is proportional to the gradient or slope of the groundwater table. Groundwater levels and flow have changed with lining of the canals; therefore, two temporal sets of water level data are presented: one for 1960 representing conditions with recharge from the canals and one for 1993 after the southerly portions of the Coachella Canal was lined. Lining of portions of the AAC, generally about six miles east of the East Highline Canal to about five miles east of the Coachella Canal was not started until 2006 so neither set of maps reflect the reduction of seepage from the AAC. A portion of the AAC still contributes recharge to East Mesa. Additional details groundwater contour maps are also provided for both the East and West Mesas.

B.10.1 Imperial IRWMP Area Historic Groundwater Levels (1960 Data)

Published water level contours are available for 1965 for Imperial IRWMP area (Loeltz et al., 1975) and 1960 for the East Mesa (USBR, 1994). A composite water level contour map of the area based on the 1960 and 1965 data is presented on Figure B-13. The dashed water level contours east of the Salton Sea area reflect limited data for this area.

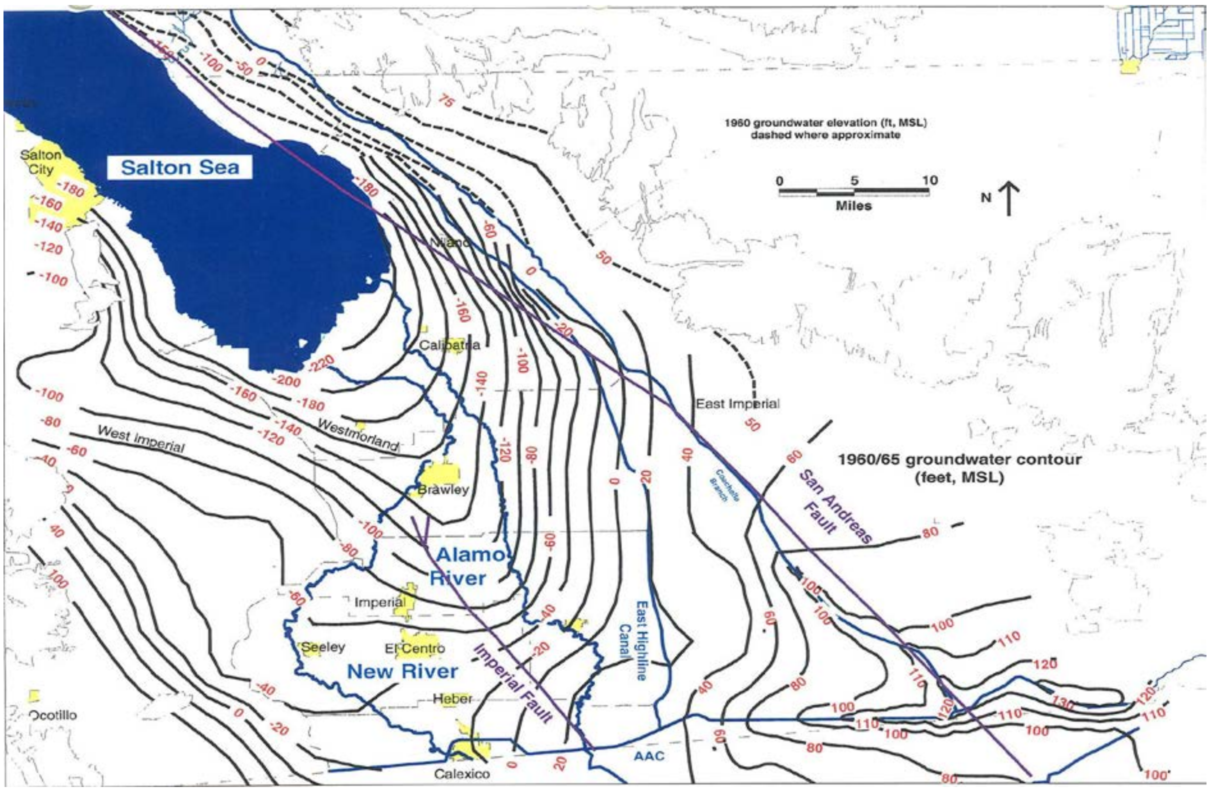

Figure B-15.Groundwater Contour Map, 1960/65 Data

The groundwater contours show a broad groundwater mound in the East Mesa area, from east of the San Andreas Fault and continuing to the East Highline Canal. This mound is associated with seepage recharge from unlined portions of the AAC beginning with its construction in the 1940s. The groundwater mound also extends northwest along the unlined Coachella Canal due to seepage recharge. Between the canals, the direction of movement is west-northwestward; but south of the AAC, the flow direction is into Mexico. East of the Coachella Canal, the flow direction is northward for the first 20 miles, but further north, gradually swings to the west. East of the San Andreas Fault zone, groundwater reportedly flows north and east toward the Colorado River.

Groundwater moves from the recharge areas east and west of Imperial Valley, toward the axis of the valley, and converges upon the New and Alamo Rivers respectively, which discharge to the Salton Sea. The overall direction of flow of groundwater in the area based on the 1960 data is presented on Figure B-14. Historically, artesian groundwater conditions have been quite common between the East Highline Canal and the Alamo River, but artesian conditions do not extend west of the Alamo River. This suggests that the Alamo River may be a more significant source of discharge from the upper aquifer than the New River in the central valley area.

As illustrated in Figure B-14, flow directions are westward along the AAC between the Coachella Canal and the Alamo River, then northwest to north between the Alamo and New River. Flow direction below the AAC is to the south into Mexico east of the Coachella Canal, but then turns southwest between the Coachella Canal and the East Highline Canal. Apparent flow direction is to the northwest in western Imperial Valley near the West Mesa and to the southwest east of the Salton Sea, as flow from both these areas converges towards the Salton Sea. Flow direction in East Mesa is west to northwest, although it was also locally influenced by the presence of the groundwater mound under the former unlined Coachella Canal. Groundwater flow east of the San Andreas Fault system is to the north.

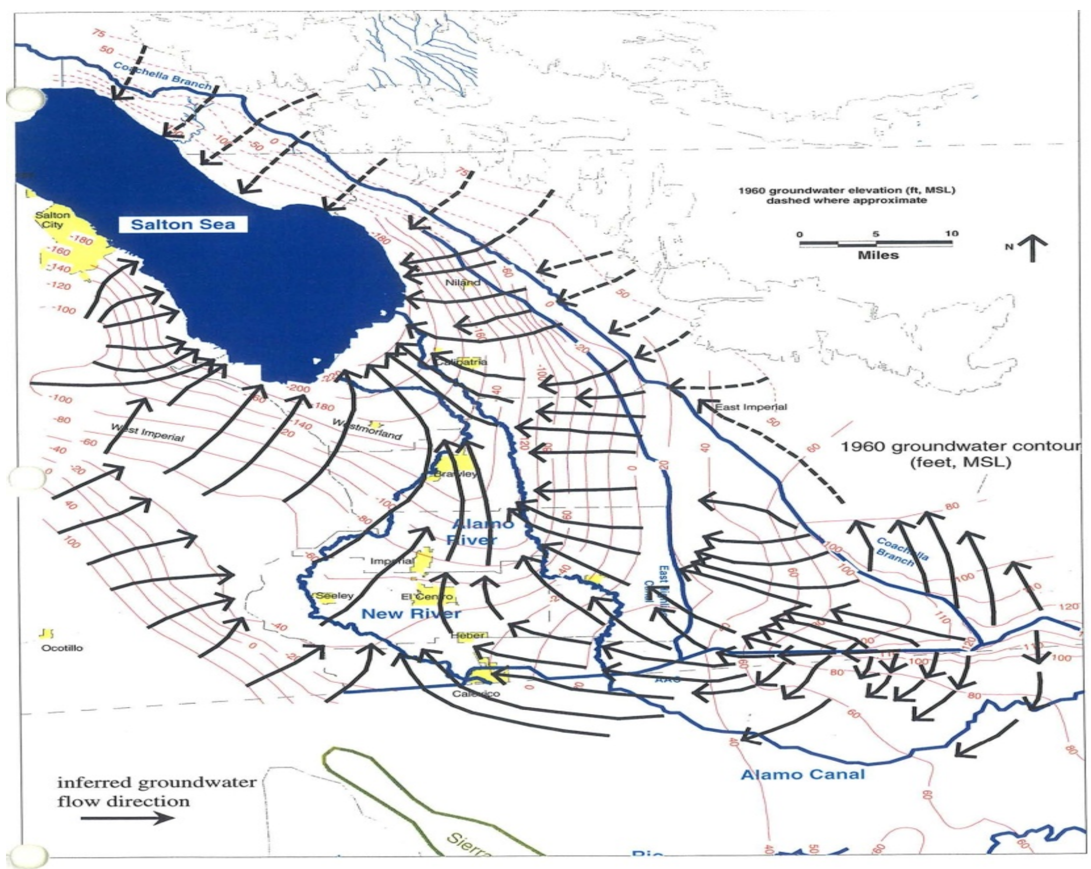

Figure B-16.Regional Groundwater Flow Map, 1960

Groundwater levels adjacent to the canal in the East Mesa area have varied significantly over time, primarily in response to seepage of imported Colorado River water. These canals have had the most significant impact on water levels in the study area. In the irrigated Imperial Valley groundwater levels have remained essentially the same for many decades, due to the existence of the tile drain network and the New and Alamo Rivers, which act as regional drains and control groundwater levels.

Many East Mesa wells have seasonal trends in the water levels, with highest water levels in March and the lowest water levels in September. The seasonal trends appear strongest near the AAC below Drop 1, although they can also be observed in East Mesa. These seasonal trends are thought to be associated with variations in canal leakage prior to lining of the canal.

B.10.2 Imperial IRWMP Area Recent Groundwater Levels (1993 Data)

Groundwater levels for the Imperial IRWMP area, based on 1993 data, are shown on Figure B-15. The 1993 time period represents the most recent period with comprehensive data of the entire area, including the Mexicali Valley, and it also is a time period that should accurately represent present day water levels in the East Mesa and Imperial Valley (Tetra Tech, 1999). The decline in the water table in East Mesa, due to the lining of the first 49 miles of the Coachella Canal, began in 1980 and stabilized in the early 1990s. A similar affect should be expected in the southern margin of East Mesa upon completion of the lining for the AAC in 2010.

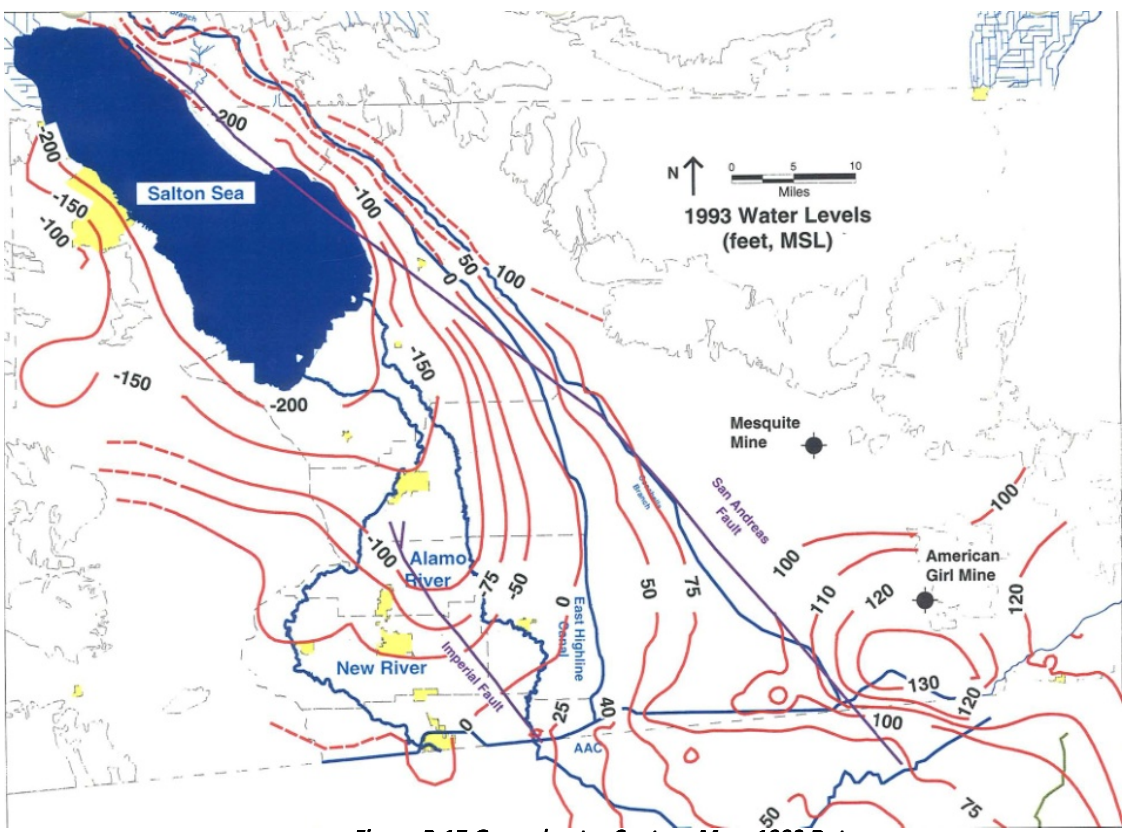

Figure B-17.Groundwater Contour Map, 1993 Data

As can be seen on Figure B-15, groundwater contours are generally unchanged from the 1960s data in the Imperial Valley, the area east of the Salton Sea, Mexicali Valley, and the East Mesa area adjacent to the AAC. However, the water table declined significantly along the first 49 miles of the Coachella Canal due to its 1979 lining. This has resulted in a more northerly flow direction into East Mesa near Drop 1 of the AAC. In general, the water levels along the AAC are similar to the 1960 conditions because AAC seepage was not controlled by water level elevations near Drop 1 on the AAC. It is expected further decreases in groundwater levels will occur after the completion of addition lining of the ACC in 2010.

B.10.3 West Mesa

Groundwater levels beneath West Mesa, as show on Figure B-14, show the groundwater flow direction beneath West Mesa is from the southwest to the northeast toward the Salton Sea.

Groundwater levels in the Ocotillo-Coyote Wells Groundwater Basin west of the West Mesa area are measured by the USGS. The most recent (1995) water level elevation data are shown on the groundwater contour map in Figure B-16. This map shows the groundwater slopes (and therefore moves) southwesterly through the Ocotillo-Coyote Wells Groundwater Basin, from areas of recharge in the Coyote and Jacumba Mountains, to areas of discharge in Mexico and across the Elsinore/Laguna Salada Faults. The data also reveal the difference in groundwater elevations from one side to the other of the Elsinore/Laguna Salada Faults, reflect the fact that these faults are an impediment to the movement of groundwater into West Mesa.

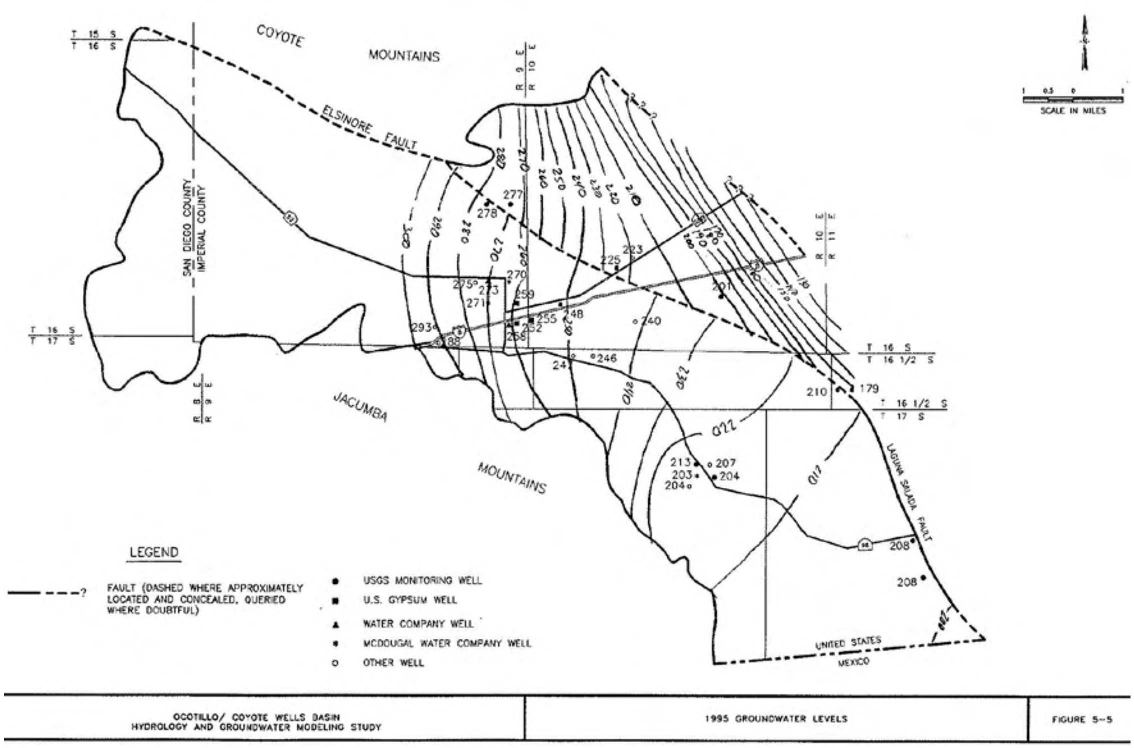

Figure B-18.West Mesa Groundwater Contour Map, 1995 Data

B.10.4 East Mesa

As previously described, the East Mesa includes the roughly triangular area southwest of the San Andreas Fault, north of the Mexican border, and east of the East Highline canal (shoreline of ancient Lake Cahuilla) as shown on Figure B-4. Recharge to the East Mesa is almost entirely a result of historic seepage from unlined portions of the AAC and Coachella Canal. The movement of groundwater in areas of the East Mesa is, therefore, reflective of these sources of recharge. Little data are available on the existence and continuity of clayey lake beds and aquitards in the East Mesa; and, as described previously, groundwater occurs under unconfined conditions in most areas. Figure B-17 presents a groundwater contour map of the East Mesa based on 1982 data, shortly after the lining of the Coachella Canal in 1979 but before ACC lining project in 2006 (USBR, 1988). As shown in Figure B-17 groundwater in the southern part of East Mesa, near the ACC, generally flows north-northwesterly. In the more northern portions of East Mesa flows are in a more westerly direction toward the East Highline Canal and the Imperial Valley.

As previously mentioned, several significant faults in the area alter and restrict the flow of groundwater flow from east to west, into the Imperial Valley. These are, from west to east, the Brawley, Calipatria, San Andreas (main branch), and Algodones/Sand Hills Faults. Crandall (1983) reports that water levels are offset across both the Brawley and Calipatria faults, indicating they may be partial barriers to the flow of groundwater from East Mesa into the Imperial Valley. To the east, the Sand Hills (also known as the Algodones Dunes) lie between the San Andreas and Algodones Faults. This area may provide a favorable structural zone in which groundwater recharge and recovery activities can be considered.

B.11 GROUNDWATER VELOCITY

Data was reviewed that presents approximate groundwater flow rates, based on the slope of the water table, the aquifer hydraulic conductivity, and the aquifer effective porosity. Groundwater velocity in the permeable East Mesa sands and gravels is estimated to be 450 feet per year using a gradient of 0.001 foot per foot (ft/ft), a hydraulic conductivity of 250 feet per day and an effective porosity of 20 percent. In contrast, groundwater velocity in the semi-permeable pre-historic Lake Cahuilla sediments beneath the Imperial Valley is estimated to be only 10 feet per year using a gradient of 0.004 ft/ft, a hydraulic conductivity of 0.5 foot per day, and an effective porosity of 8 percent. In addition to the major differences in groundwater flow rates between the East Mesa and the Imperial Valley, smaller groundwater flow rate variations occur due to variability in the gradient and hydraulic conductivity within each area (Bureau of Reclamation, 1987; Tetra Tech, 1999; Crandall, 1983).

B.12 Recovery and Artificial Recharge Potential

The potential for artificial recharge and recovery varies greatly between the Imperial Valley, West and East Mesas due to the permeability of the sediments and the ability to convey water to the recharge areas. A discussion for each area is provided below.

B.12.1 Imperial Valley

The Imperial Valley has limited potential for conjunctive use or banking opportunities. The Imperial Valley is underlain by at least two regional aquifers. The upper aquifer is about 200 feet thick and may contain about 0.8 million AF poor quality of water (see Figure B-8). The aquifers for the most part are relatively thin sand beds. Groundwater levels are near ground surface (10 to 15 bgs) indicating the aquifer is full. Recovery of water could be by wells or drains, but they are hampered low transmissive sediments, poor and highly variable quality water as shown on B-8, and other impacts such as land subsidence.

Since irrigation began in the valley, recharge to the aquifer is from percolation of applied water not captured by the drain system; therefore, no recharge facilities would need to be constructed.

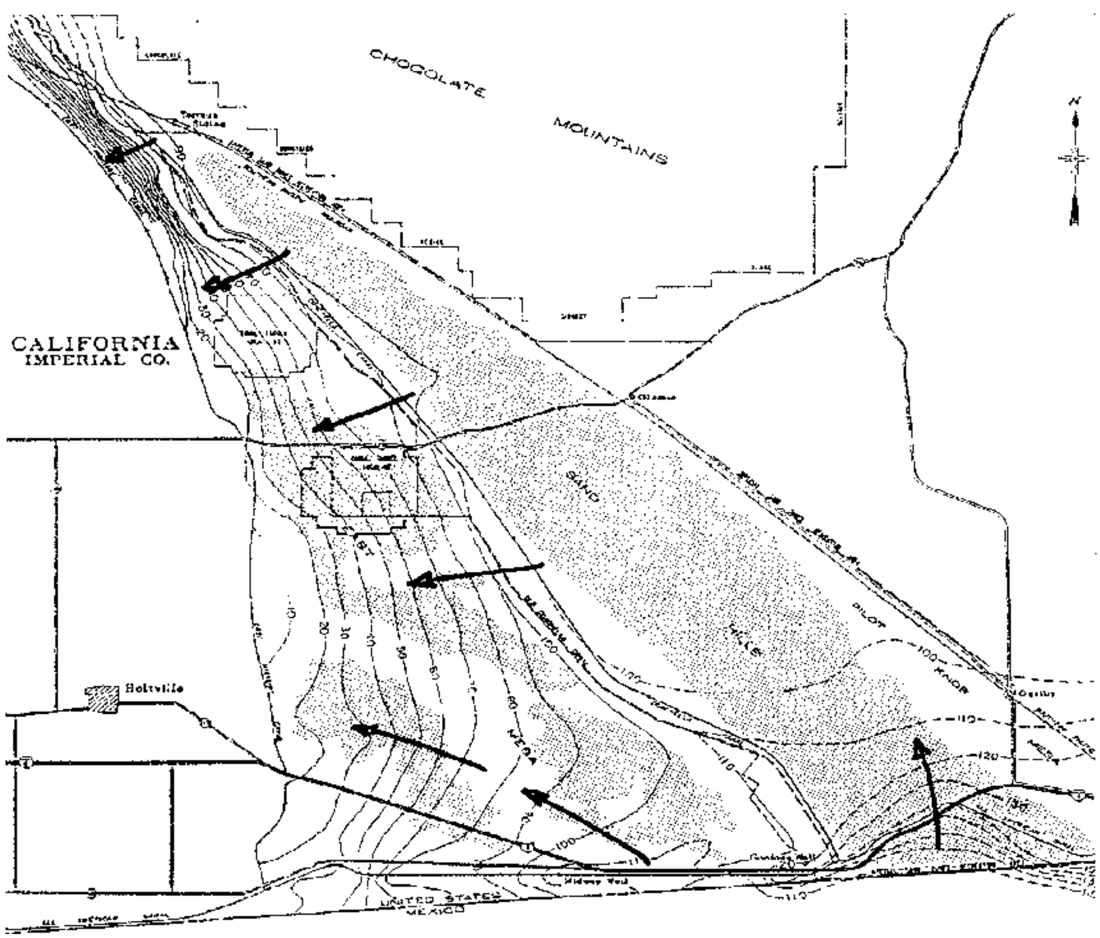

Figure B-19.East Mesa Groundwater Contour Map, 1982 Data

The intermediate aquifer, beneath the Imperial Valley is about 600 feet thick and may contain about 24 million AF of water. There are relatively thick sand beds which could be favorable for developing high capacity wells. The salinity of the groundwater ranges from about 700 to 3,330 mg/L, which makes treatment of the water feasible. The full extent of the aquifer is unknown and its hydraulic interconnection to the upper aquifer is poorly understood. Geologic information is insufficient to ascertain the source area for recharge to the intermediate aquifer. It could be from the overlying upper aquifer to the south in Mexico, or to from the East Mesa area west of the San Andreas Fault. If recharge to the intermediate aquifer comes from the East Mesa area and the water can cross the Calipatria Fault, which is at least a partial barrier to groundwater flow, then it is possible that an artificial recharge project through unlined portions of the old Coachella Canal could be an effective conjunctive use project for the intermediate aquifer. Because of its large storage and areal extent, relatively consistent water quality, and apparent ability to convey water to high capacity wells, the intermediate aquifer could possibly be a conjunctive use target. However, with the high degree of uncertainty in the recharge, this aquifer should not be considered for a conjunctive use project.

B.12.2 West Mesa

Constraints to groundwater banking activities in the West Mesa include the potential conflicts with the U.S. Gypsum operation, sole source aquifer designation for Ocotillo-Coyote Wells Groundwater Basin and maintaining the recharged water for use by IID. However, recharge water in the West Mesa is a possibility. The mountain front areas along the west side of mesa include portions of several small groundwater basins identified by CDWR. Most of the basins in this area include a small number of highly productive wells, reflective of the more permeable aquifers that underlie this area. Aquifer materials and hydraulic characteristics are highly favorable for recharge of water to the subsurface, and subsequent recovery. Water quality is generally good, and might not require treatment prior to use. Areas that warrant further investigation are near the Carrizo Wash or Palm Canyon.

B.12.3 East Mesa

The East Mesa area is the most favorable for an aquifer storage and recovery operation. The concept of storing and recovering Colorado River water during IID underruns in the East Mesa and has been the subject of investigation by both IID and the USBR since the mid-1980s.

In 1989, a recharge study using a portion of the old unlined Coachella Canal just south of the Glamis K.G.R.A and west of the San Andreas Fault, diverted an average of 80 cfs (17,000 AF) of water into the canal for 3.5 months proving the sediments are favorable for a recharge facility (USBR, 1992). The recharged water raised the water table by about 15 feet near the canal, but only raised the piezometric head in the semi-confined intermediate aquifer by about 3 feet. USBR postulated the piezometric head in the intermediate aquifer was raised due to the overburden of the recharged mound of water in the shallow aquifer applying great pressure to the intermediate aquifer. Most likely the confining layer separating the two aquifers is not a significant barrier to groundwater flow and that by pumping from the intermediate aquifer could induce recharged water to enter the intermediate aquifer where the aquifers have a higher transmissive capacity and potential for developing high yielding wells. Additional testing is needed.

The upper and intermediate aquifers beneath East Mesa are highly permeable. Groundwater in storage beneath the East Mesa west of the San Andreas fault in just the upper aquifer is estimated to be about 1.5 million AF. The aquifers are generally full and may need to be pumped to create storage for recharged water. The aquifers are favorable for development of high capacity wells, and water is generally of good quality, with TDS ranging from 500 to 1,000 mg/L, (see Figure B-8 and Figure B-10).

B.13 CONJUNCTIVE USE FACILITY CONCEPTUAL DESIGNS

This section presents conceptual designs for using groundwater as the source of supply and groundwater recharge facilities.

New water supply will be needed to support future development of geothermal plants in each of the K.G.R.A.s and other Municipal, Commercial and Industrial (MCI) development. The water could also be used by agriculture to augment supplies when a potential annual overrun is projected.

Development of groundwater supply wells and well fields, was evaluated as a source to supply water to each of the K.G.R.A.s. Imperial Valley groundwater quality is generally of moderate to poor quality in the aquifers and would require treatment. The shallow aquifer has the most variable concentrations ranging from 800 to over 10,000 mg/L. The intermediate aquifer has the most consistent salt concentrations ranging from about 800 to 2,220 mg/L. Generally better quality water is present beneath East Mesa due to historic recharge from the unlined canals. Desalination plants would be required and the brine associated with the treatment will require disposal.

Extraction of groundwater in the desert environment would eventually deplete the resource if the aquifers were not recharged. Selection of the well pumping capacity and the well field locations were based on the ability to recharge the aquifers either from deep percolation of agricultural applied water or by replenishing the water through groundwater recharge. Conceptual well fields were not located between closely spaced parallel faults due to their potential to be barriers to groundwater flow, limited storage capacity, and the potential lack of recharge that could lead to subsidence and ground fissuring. The well locations were further constrained by geologic hazards and other design constraints.

B.14 GEOLOGIC HAZARDS AND DESIGN CONSTRAINTS

The Imperial region lies in one of the most seismically active areas in the United States. Several geologic hazards face the region including earthquakes, liquefaction, sieches, flooding due to breaching of canals, and subsidence.

B.14.1 Earthquakes

Near the K.G.R.A.s, major active and potentially active faults trend in a northwestern direction. Figure B-18 shows the location of these faults. The San Andreas and the Imperial faults are active. The Brawly and Calipatria Faults are classified as potentially active according to the California Geological Survey. Near the active and potentially active faults the potential for surface displacement and cracking is high.

The potential for shaking is high near the K.G.R.A.s. Facilities should be designed to within the appropriate level of shaking and to the extent possible be set back as far as possible from the faults. Where distribution pipelines cross faults they will be subject to shearing.

B.15 LIQUEFACTION

Liquefaction may occur during an earthquake where saturated soils are shaken and the geologic media become buoyant in the groundwater and structures can sink or sag due to the decrease in the soil's structural integrity. Potential for liquefaction is low beneath East Mesa, but increases to the west where the potential is moderate to high, due to irrigation that may cause perched water above the pre-historic Lake Cahuilla clayey lakebed deposits.

Groundwater pumping could locally decrease the potential for liquefaction by lowering groundwater levels.

B.16 SIECHES

When an earthquake occurs in a location near a large body of water a sieche can occur. A sieche is a large wave in an inland body of water that can cause flooding and damage nearby structures. A strong earthquake could create a sieche from either the Salton Sea or in the canals. Although sieches have not been reported, the potential is moderate to high.

B.17 FLOODING

Imperial Valley and even East Mesa are at risk for flooding were canals to be sheared and offset due to fault activity. A significant surface rupture of one or multiple canals could flood portions of the Imperial Valley. Potential for flooding is moderate to high. Facilities located down gradient of the major canals should be designed to withstand flooding though elevation of structures or inclusion of diversion measures to redirect water away from the facilities.

B.18 SUBSIDENCE

Two inches of naturally occurring subsidence annually are centered at the middle of the Salton Sea. The two inches of subsidence decreases radially outward from the Salton Sea. Near the Mexican border the natural subsidence is essentially zero (Imperial County, 2006).

Imperial Valley has a dense irrigation network of canals and laterals that supply water throughout the valley. This network relies on canal grades to gravity feed the water throughout the system. Subsidence can cause the ground surface to sink or sag damaging or changing the grade on infrastructure.

Subsidence may also be induced by removing more water from the aquifer than can be replaced naturally or by injection. Imperial Valley's geothermal wells remove steam and water from below the deep aquifer. In some cases water is injected back into the zones where water was removed and aid to mitigate potential subsidence. Subsidence has been detected in the Salton Sea K.G.R.A.

Potential for subsidence as a result of groundwater pumping is high in the Imperial Valley and low to moderate in the East Mesa area. Geotechnical investigations will be required for foundation designs to withstand settlement due to subsidence and how potential subsidence would affect existing infrastructure, canals, drains, and bridges. Pipelines should be constructed with flexible materials or incorporate expansion joints.

B.19 Corrosive Soils

Data was gathered on 28 soil types that are common in the Imperial Valley and East Mesa showed that some soil types can be corrosive to steel and concrete. The risk of corrosion to both concrete and steel were reported as either low, moderate, or high (NRCS *http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx*). Of the 28 soils from the soil survey all 28 had a high rating for being corrosive to steel. Of the 28 soil types, 13 were considered low, 13 were considered moderate, 1 was considered high, and 1 was not rated for corrosiveness to concrete.

To withstand the corrosive soils, pipelines should be constructed with polyvinylchloride or high density polyethylene. Depending on the location, special mixtures of concrete may be required for foundations.

B.20 Colorado River Effects

The Colorado River is located about 50 miles to the east of the Imperial IRWMP area. An accounting surface method was developed in the 1990s by the U.S. Geologic Survey, in corporation with the Bureau of Reclamation to identify wells outside of the flood plain of the lower Colorado River that yield water that will be replaced by water from the river. This method was needed to identify which wells require an entitlement for diversion of water from the Colorado River and need to be included in accounting for consumptive use of Colorado River water as outlined in the Consolidated Decree of the

United States Supreme Court in Arizona v. California. The method is based on the concept of a river aquifer and an accounting surface within the river aquifer. The study area includes the valley adjacent to the lower Colorado River and parts of some adjacent valleys in Arizona, California, Nevada, and Utah and extends from the east end of Lake Mead south to the southerly international boundary with Mexico. Contours for the original accounting surface were hand drawn based on the shape of the aquifer, water-surface elevations in the Colorado River and drainage ditches, and hydrologic judgment.

This method for determining well impacts to the Colorado River was published in the Federal Register for the Department of the Interior on July 16, 2008, but was not formalized. It indicated that if static water levels in wells are equal to or the elevation of water in the Colorado River it is assumed that water from the wells is coming from Colorado River. The elevations of the river were projected into areas surrounding the river to create the accounting surface. The accounting surface extended into portions of East Mesa (Scientific Investigations Report 2008-5113, USGS 2008).

In 2008, the USGS published another method for assessing whether wells deplete groundwater that would otherwise recharge the Colorado River aquifers. They developed a superposition model that simulates the percentage of water depleted from the river (Scientific Investigations Report 2008-5189, USGS 2008). The assumption is that when a well is initially pumped, virtually all the water comes from groundwater storage; but over time, as the cone of depression grows, the percentage of water from the river or other recharge sources increases. The southeastern portion of the East Mesa has been designated as having a potential to deplete water in the Colorado River as shown on Figure B-18 as the Depletion Model Area. The Dunes K.G.R.A. is adjacent to and overlaps the proposed depletion area.

B.21 ENDANGERED SPECIES

Endangered and threatened species are present in the Region. The endangered species habitat areas were mapped to the extent possible to highlight areas that were excluded as desalination plant and well field locations. These locations are illustrated on Figure B-18. Most of the Glamis and Dunes K.G.R.A.s are occupied by endangered species.

B.22 SEEPAGE RECOVERY SYSTEM

IID has installed a Seepage Recovery (SR) system to collect seepage from the East Highline Canal and the ACC as part of the system efficiency conversation. Water collected by the SR system interceptors is protected. About 13,000 AFY has been recovered from the East Highline Canal SR system and about 25,000 AFY has been recovered from the ACC SR system. Well fields for the desalination plants should be designed to minimize drawdown along the SR system so they will not collect water that would have been otherwise collected through SR system.

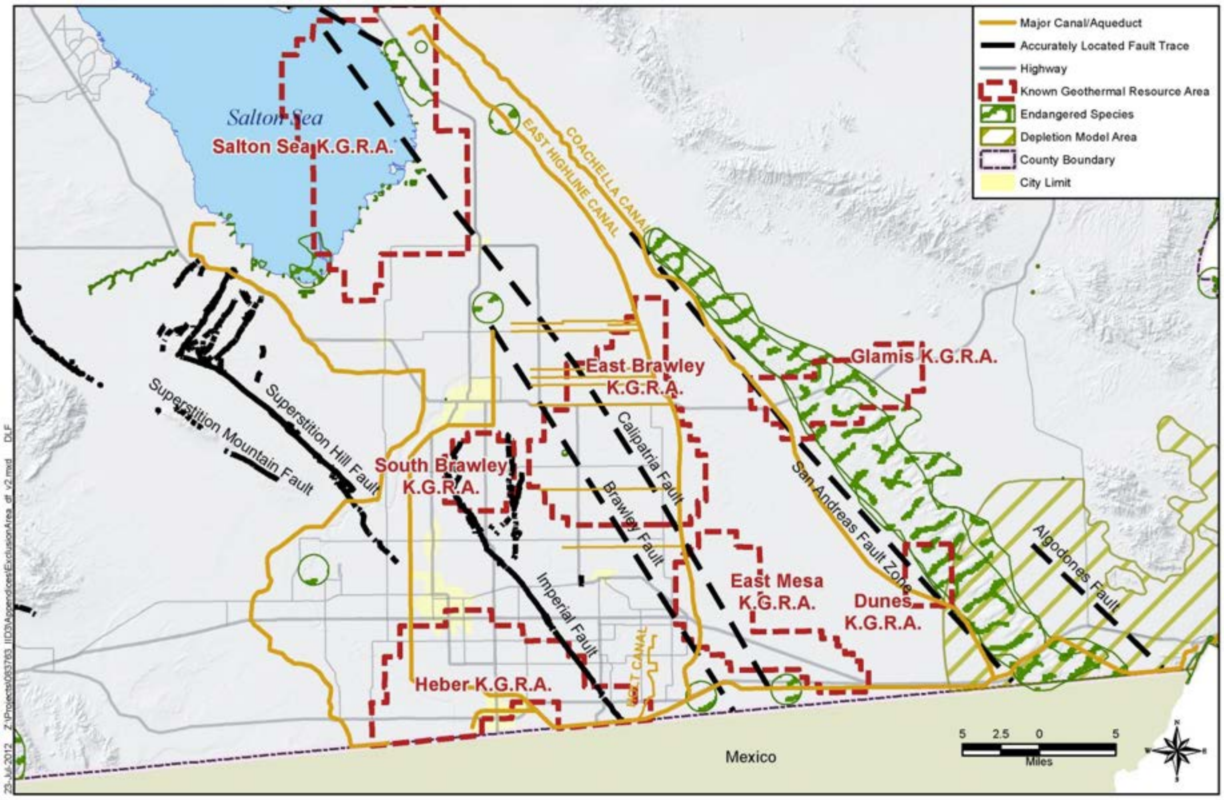

Figure B-20.Exclusion Zones

B.23 WELL FIELD CONCEPTUAL DESIGNS

Preliminary designs for well fields were developed to supply 5,000 AFY, 25,000 AFY, and 50,000 AFY of groundwater to the East Brawley, East Mesa, Heber, and Salton Sea K.G.R.A.s. Attachment A contains conceptual sketches of the well fields along with the raw and finished water distribution systems. Because the water will need to be treated, the amount of groundwater pumped had to be increased as the treatment plants will operate with 75 percent efficiency. Using the 75 percent efficiency, the wells will need to produce 6,600 AFY, 33,300 AFY, and 66,600 AFY.

Aquifer characteristics listed in Table B-3 for each K.G.R.A. were used to determine the potential well pumping rate over the 30 year life of the project. A Theis analysis of the potential well fields was conducted assuming the wells are arranged in a grid shape. Spacing between wells was initially estimated to limit well interference to about 10 feet. Analysis predicted the average drawdown expected due to pumping of the well field. These estimations were used to determine if the drawdown would exceed the thickness of the aquifers or in the case of the intermediate aquifer to maintain groundwater levels above the confining bed. The number of wells and their pumping rates were then adjusted to select the optimum number of wells. The number of wells and their production rates for each proposed well field by K.G.R.A. are summarized in Table B-4.

Table B-4. Wells Required for Each Well Field Based on K.G.R.A.s

K.G.R.A.	Plant Capacity (AFY)	Aquifer	Well Depth (feet)	Tranmissivity (gpd/ft)	Hydraulic Conductivity (ft/day)	75% Efficency Water Needed (AFY)	GPM per Year	Pumping Rate (gpm)	Number of Wells
East Brawley	**5,000**	Shallow	80-300	10,000	13	6,667	4,133	100	41
	25,000	Shallow	80-300	10,000	13	33,333	20,665	100	207
	50,000	Shallow	80-300	10,000	13	66,667	41,331	100	413
	5,000	Intermediate	200-900	250,000	71	6,667	4,133	2000	2
	25,000	Intermediate	200-900	250,000	71	33,333	20,665	2000	11
	50,000	Intermediate	200-900	250,000	71	66,667	41,331	2000	21
Heber	**5,000**	Shallow	80-300	10,000	13	6,667	4,133	100	41
	25,000	Shallow	80-300	10,000	13	33,333	20,665	100	207
	50,000	Shallow	80-300	10,000	13	66,667	41,331	100	413
	5,000	Intermediate	300-1500	120,000	25	6,667	4,133	350	12
	25,000	Intermediate	300-1500	120,000	25	33,333	20,665	350	59
	50,000	Intermediate	300-1500	120,000	25	66,667	41,331	350	118
Salton Sea	**5,000**	Shallow	80-300	10,000	13	6,667	4,133	200	21
	25,000	Shallow	80-300	10,000	13	33,333	20,665	200	103
	50,000	Shallow	80-300	10,000	13	66,667	41,331	200	207
	5,000	Intermediate	300-1500	60,000	25	6,667	4,133	350	12
	25,000	Intermediate	300-1500	60,000	25	33,333	20,665	350	59
	50,000	Intermediate	300-1500	60,000	25	66,667	41,331	350	118
East Mesa	**5,000**	Intermediate	200-900	250,000	47	6,667	4,133	2000	2
	25,000	Intermediate	200-900	250,000	47	33,333	20,665	2000	10
	50,000	Intermediate	200-900	250,000	47	66,667	41,331	2000	21

Note: Pumping Rate assumes pumping 365 per year for 24 hours/day

The aquifers beneath the K.G.R.A.s have varying salt concentrations and groundwater temperatures. Table B-3 summarizes aquifer quality and temperatures associated by aquifer and each K.G.R.A.

The aquifers likely have a broad regional extent and may extend to the valley edges. However, groundwater flow may be blocked by faults, which would limit recharge. The Calipatria and Brawley Faults are considered at least partial barriers to flow on the east side of the Imperial Valley. Well fields for the East Brawley, East Mesa, and Salton Sea K.G.R.A.s were positioned east of these faults so that water recharged near the Coachella Canal would reach the well fields.

The Dunes and Glamis K.G.R.A.s were not evaluated, because most of their areas are occupied by endangered species and their proximity to the proposed Colorado River depletion surface.

B.24 SOUTH BRAWLEY WELL FIELD

Developing groundwater as a source of supply for the South Brawley K.G.R.A. (including the Keystone development area) was considered and then abandoned due to the area being located between two branches of the Imperial Fault. Where faults are closely spaced, they may create small compartments that have limited recharge and can be easily dewatered, which could result in subsidence and ground fissuring. Therefore, a well field within the K.G.R.A. was not planned. Groundwater supply to this area could be from a well field in the East Brawley K.G.R.A., as described below. Water could be conveyed west to the South Brawley K.G.R.A. and the Keystone development area using either pipelines or existing IID canal infrastructure; however, not in high periods of agricultural demands. Attachment A, Figures A-1 through A-6, contains conceptual well field layouts for feasible alternatives in the South Brawley/Keystone areas.

B.25 EAST BRAWLEY WELL FIELD

Conceptual well field designs were developed to supply water to the East Brawley K.G.R.A. These designs would also apply to serve the South Brawley K.G.R.A., but the water would have to be conveyed to that demand area. Well field designs were prepared to produce 5,000

AFY, 25,000 AFY, and 50,000 AFY after treatment as shown in Figures A-7 through A-10. The well fields were located east of the Calipatria Fault to receive recharge from percolation basins potentially located in the old unlined Coachella Canal, on private land not managed by Bureau of Land Management (BLM). The K.G.R.A. generally overlies lakebed deposits which pinches out to the east where the recharge facilities are planned. Therefore recharge facilities located in the old unlined Coachella Canal could replenish water in either the shallow or intermediate aquifers.

Both the shallow and intermediate aquifers were evaluated for development of the well field. The characteristics for each aquifer are presented in Table B-3. The intermediate aquifer is more favorable for development, because it is thicker and has a corresponding higher capacity to transmit water than the shallow aquifer. Flow rates from each well were selected to prevent dewatering of the aquifer. Estimated pumping rates per well for the shallow aquifer is 100 gpm and 2,000 gpm for the intermediate aquifer.

Table B-4 lists the number of wells required to provide 5,000 AFY, 25,000 AFY, and 50,000 AFY. Development of the shallow aquifer is not feasible because between 40 and 400 wells would have to be constructed in comparison to the intermediate aquifer which will only require construction of 2 to 21 wells. Attachment A, Figures A-7 and A-8, contains conceptual well field layouts for feasible alternatives in the East Brawley K.G.R.A.

Two pumping wells could be constructed to supply 5,000 AFY of water from the intermediate aquifer. The pumping would reduce the water surface elevation by about 35 feet over the 30 year project lifespan.

Ten wells would be required to produce 25,000 AFY from the intermediate aquifer. The water surface would be lowered by an average of 92 feet over the 30-year project lifespan.

Twenty-one wells would be needed to produce 50,000 AFY. The average groundwater surface would decline by about 172 feet in the center of the well field over the 30-year life of the project. The drawdown would diminish away from the well field.

Conjunctively managing the groundwater levels through recharge would reduce the drawdown of the aquifer. Management of the groundwater could lower the groundwater surface in the shallow aquifer, depending upon the interconnectedness of the shallow aquifer to the intermediate aquifer. The insert on Figure A-8 shows where potential recharge facilities on the old unlined Coachella Canal could be located to conjunctively manage surface water and groundwater and create a water bank. Groundwater levels could be lowered below the root zone which could benefit local agricultural users and would reduce the potential for liquefaction. Management of recharge and pumping would be required to reduce the potential for subsidence associated with pumping.

B.26 EAST MESA WELL FIELD

Due to the land limitations and the lack of demand in the area, a 5,000 AFY plant is recommended for this area. Well fields were designed for the East Mesa K.G.R.A. for both the shallow and intermediate aquifers. Most of the East Mesa K.G.R.A. is BLM-managed land. The small portion of the K.G.R.A. that does not belong to BLM is between the Calipatria and Brawley Faults and was not considered because they are partial barriers to groundwater flow and could limit recharge of the aquifers. The 5,000 AFY well field could be positioned on existing geothermal plant leases whereas the 25,000 AFY and 50,000 AFY well fields would need to be on land acquired from BLM, which could require lengthy negotiations.

Aquifer characteristics for the East Mesa well field are assumed to be similar to the East Brawley well field; therefore, the number of wells is similar. Based on the analysis for the East Brawley K.G.R.A., the shallow aquifer was not considered for development. Table B-4 provides information for the number of wells needed, their depths and their production capacities. For the 5,000 AFY well field only two wells would be needed. Locally the wells would lower the water surface by about 35 feet over the 30-year project lifespan. If the well field is to produce 25,000 AFY, 10 pumping wells would need to be constructed. The water surface locally would be lowered an average of 92 feet over the 30-year project lifespan. For a 50,000 AFY well field, 21 wells would be needed. The average groundwater surface would decline by about 172 feet in the center of the well field over the 30-year life of the project. The drawdown would diminish away from the well field. Attachment A, Figures A- 11 to A-13, contains conceptual well field layouts for feasible alternatives in the East Mesa K.G.R.A.

Pumping effects could be offset by recharge in the unlined old Coachella Canal recharging potentially both the shallow and intermediate aquifers. Management of the recharge and pumping would be needed to reduce the potential for subsidence associated pumping.

B.27 SALTON SEA WELL FIELD

The well field designs were prepared to produce after treatment, 5,000 AFY, 25,000 AFY, and 50,000 AFY from the shallow and intermediate aquifers. Well fields were located east of the Calipatria Fault to be able to receive recharge from percolation basins potentially located in the unlined old Coachella Canal. It is estimated that the shallow aquifer is from 80 feet bgs to 300 feet bgs with about 100 feet of the sediments consisting of sandy sediments. Although the intermediate aquifer is located between 300 and 1,500 feet, it only likely contains about 300 feet of sandy sediments which can readily convey water to a well. Because of the thinner sequence of coarse grained sediments, the transmissivity is lower than in the East Brawley K.G.R.A.

Well field designs showed the number of wells required would range from 12 to over 200 wells. Table B-4 (page 40) lists the number of wells by aquifer and production capacity. Well fields for producing about 5,000 AFY could be developed by using either the shallow or intermediate aquifers. Production of 25,000 AFY and 50,000 AFY from wells is not reasonable.

The shallow aquifer could produce 5,000 AFY with 21 wells pumping at a rate of 200 gpm each. Over the 30-year project lifespan it is estimated that there will be about an average of 190 feet of drawdown which will not be below the base of the aquifer.

The intermediate aquifer could also be utilized to produce 5,000 AFY with 12 wells pumping at about 350 gpm. Over the 30-year project lifespan it is estimated that there will be about an average of 83 feet of drawdown.

Pumping of the shallow aquifer has the additional benefit to agriculture and communities by locally lowering groundwater levels below the root zone and by reducing the potential for liquefaction. Although a greater number of wells would be required than if pumping from the intermediate aquifer, wells constructed into the shallow aquifer would be less costly to construct. Construction of a well field in the shallow aquifer is a preferred option for this K.G.R.A. Attachment A, Figure A-16, contains a conceptual well field layout for a 5,000 AFY facility in the Salton Sea – K.G.R.A.

Pumping effects could be offset by recharge in the unlined portions of the old Coachella Canal recharging potentially both the shallow and intermediate aquifers. Management of the recharge and pumping would be needed to reduce the potential for subsidence associated pumping.

B.28 HEBER WELL FIELD

A 5,000 AFY, 25,000 AFY, and 50,000 AFY well field was evaluated for the Heber K.G.R.A. The evaluation considered extraction of water from both the shallow and intermediate aquifers. The ability of the aquifers to transmit water is lower in this area and therefore a larger number of wells were required. Table B-4 lists the aquifer characteristics and the number of wells required. The number of wells ranged from 12 to over 400. Only the 5,000 AFY well field was reasonable, requiring 12 wells to produce from the intermediate aquifer. Wells have been estimated to produce 350 gpm each and the aquifer has about 650 feet of saturated sediments. Pumping of the wells would locally lower the piezometric surface head in the semi-confined aquifer by about 44 feet over the 30-year project lifespan. Attachment A, Figure A-17, contains a conceptual well field layout for the 5,000 AFY facility in the Heber K.G.R.A.

Recharge to the intermediate aquifer in this area could occur from percolation of water applied for agriculture which has migrated through the shallow aquifer and the weakly confining clay bed. No dedicated recharge facilities are planned. Additional testing will be needed to confirm source of water is either vertically from the shallow aquifer or from Mexico. Pumping would need to be designed to limit pumping affects to groundwater in Mexico.

B.29 CONCEPTUAL GROUNDWATER STORAGE BANKING FACILITIES FOR WELL FIELDS

Groundwater recharge facilities constructed within the unlined old Coachella Canal can be used for conjunctive use and to mitigate pumping effects for the East Brawley, East Mesa, and Salton Sea K.G.R.A.s. The groundwater gradient is to the west and would provide recharge to replenish water extracted by the well fields constructed east of the Calipatria Fault. Groundwater banking within the East Mesa will provide a method of storing water during under run years when excess water would be available. Historically, under run volumes for IID have ranged from 15,000 acre-feet to over 250,000 acre-feet and could be placed into storage.

A 15-mile long section of the old unlined Coachella Canal west of the San Andreas Fault and south of the Glamis K.G.R.A. was abandoned when the lined canal was constructed. The unlined Coachella Canal has the ability to recharge about 10,000 AFY per mile of unlined canal (USBR, 1992). If all of the unlined portions were used, about 150,000 AFY could be recharged.

Conceptually the old unlined canal will need to be modified to serve as a recharge facility. A turnout would have to be constructed to divert water from the lined Coachella Canal into the unlined canal. Under run water could be allowed to flow into the unlined canal saturating whatever length of the unlined canal until the ideal volume of water percolates. This approach limits the potential environmental impacts. However, along portions of the unlined canal layer of clay, 1 to 1.5 feet thick, was installed into the canal to reduce percolation losses. Removal of the clay layer would increase percolation rates. The sediments could be used to create intermediate berms in the canal confine the recharge water to highly permeable soil sections and reduce evaporation. Spillways could be constructed in the intermediate berms to allow excess water to spill into the adjacent basin, depending upon the amount of water available. This will allow for a compartmentalized series of recharge basins for greater infiltration and less evaporation. To keep the recharge near the well fields, modifying any favorable two-mile long section of the old unlined Coachella Canal could provide capacity to percolate 20,000 AFY to 40,000 AFY.

Constraints to the recharge facilities include ownership and management of the canal area by the BLM, existence of sensitive habitats, and ability to obtain easements and rights-of- way. A land exchange could overcome some of the potential constraints. The possibility for the land exchanges should be researched to determine the feasibility of such exchanges.

B.30 RIVER AND TILE DRAIN SOURCE WATER CONCEPTUAL DESIGN

Water in the Alamo and New Rivers contain tailwater from the irrigated areas within the Imperial Valley and some of the water in the rivers could be reused. About 2.6 MAFY quantity of water is applied to irrigate agriculture and for MCI use within the Imperial Valley. About 30 percent of the water delivered for irrigation is percolated through the soil and captured by tile drains or becomes tailwater that is conveyed by a vast drainage system to the Alamo and New Rivers, which convey the water to the Salton Sea. In 2011, the tilewater and tailwater amounted to 830 AF. The irrigated areas could possibly be considered a recharge area. As such, no recharge facilities would have to be constructed. Because the water gravity drains to the rivers no wells would be required. After 2017, the tailwater can be considered a water supply source to the desalination plants. However, possible environmental complications need to be considered.

Water can be retrieved from large drains or the water could be pumped from the Alamo River to be used as source water for the desalination plants. The quantity of water available from these sources to use for desalination is greater than the amount needed to supply 50,000 AFY of new water. Refer to Appendix G for the analysis of available water from the Alamo River and the various drains. This concept could be used as a source of supply to the South Brawley and Salton Sea K.G.R.A.s as shown on Figures A-4 and A-14, contained in Attachment A.

B.31 CONCEPTUAL BRINE DISPOSAL

The desalination process produces brine that will need to be disposed. It has been assumed that 25 percent of the raw water delivered to the treatment plant will become brine. The brine could be disposed of by either injecting it through wells into deeper aquifers, which begin about 1,500 feet below ground surface, or it can be pumped into evaporation ponds at the ground surface.

There are two choices for the use of injection wells. Either new injection wells will be constructed for the disposal or, if possible, existing injection wells that are operated by the local geothermal power plants may be utilized.

Should new injection wells be elected to be constructed for brine disposal their number, injection rates, and depths will have to be confirmed. Assuming the injection wells can dispose of about 2,000 gpm the number of injection wells ranges from one to five depending on the size of the well field.

B.32 CAPITAL PROJECT ALTERNATIVES

Seventeen desalination (desal) alternatives were developed to compare the combination of different source water, distribution system, and recharge elements. Table B-5 summarizes the alternatives, their components, and whether they are feasible or not. Each alternative is summarized below by their K.G.R.A. locations. The costs to develop and operate each alternative were developed and are reported in Appendix N and summarized in Table 12-5. Figure B-11 shows the general locations of each K.G.R.A..

Table B-5. Drawdown and Feasibility of Alternatives

K.G.R.A.	Alternative Designation	Plant Capacity (AFY)	Aquifer	Pumping Rate (gpm)	Number of Wells	30-Year Drawdown (ft)	Banking (Y/N)	Recommended (Y/N)
South Brawley	1	**50,000**	Intermediate	2000	21	172	N	N
	2	**50,000**	Intermediate	2000	21	172	Y	Y
	3	**50,000**	Intermediate	2000	21	172	Y	Y
	4	**50,000**	N/A	N/A	0	N/A	N	Y
	5	**25,000**	Intermediate	2000	11	92	Y	N
	6	**25,000**	Intermediate	2000	11	92	N	N
East Brawley	7	**25,000**	Intermediate	2000	11	92	N	Y
	8	**25,000**	Intermediate	2000	11	92	Y	Y
	9	**25,000**	Intermediate	2000	11	92	Y	Y
	10	**5,000**	Intermediate	2000	2	35	Y	Y
East Mesa	11	**25,000**	Intermediate	2000	10	92	N	Y
	12	**25,000**	Intermediate	2000	10	92	Y	Y
	13	**5,000**	Intermediate	2000	2	35	N	Y
Salton Sea	14	**50,000**	N/A	N/A	0	N/A	N	Y
	15	**50,000**	N/A	N/A	0	N/A	N	Y
	16	**5,000**	Shallow	200	21	190	N	Y
Heber	17	**5,000**	Intermediate	350	12	44	N	Y

Note: Pumping Rate assumes pumping 365 per year for 24 hours/day
N/A = Not applicable

B.33 SOUTH BRAWLEY K.G.R.A – KEYSTONE AREA

Desal Alternative 1: 50,000 AFY Keystone Desalination with Well Field. This alternative is represented in Figure A-1 and was created to test the feasibility of pumping 50,000 AFY of groundwater for the desalination plant without the mitigation effects of groundwater recharge. The new water from this alternative would be used to for IID irrigation purposes.

Desal Alternative 2: 50,000 AFY Keystone Desalination with Well Field and Groundwater Recharge. This alternative builds on Desal Alternative 1 and is represented in Figure A-2. It

highlights the use of groundwater to supply the desalination plant and use recharge in an unlined portion of the Coachella Canal to mitigate for groundwater pumping. The location of the planned recharge facilities is located in the inset on Figure A-2.

Desal Alternative 3: 50,000 AFY Keystone Desalination with Well Field, Groundwater Recharge and MCI Distribution. This alternative is the same as Desal Alternative 2 and adds the conveyance of new water to be used for MCI purposes. Figure A-3 represents this alternative.

Desal Alternative 4: 50,000 AFY Keystone Desalination with water from the Alamo River water. The use of surface water does not require a dedicated groundwater recharge facility and will not have the additional annual operations and maintenance costs of a well field. A pump lift station would be required to take water from the river and take it into the treatment plant. Figure A-4 represents this alternative.

Desal Alternative 5: 25,000 AFY Keystone Desalination with Well Field, Groundwater Recharge and Evaporation Ponds. This alternative was created to test the feasibility of using evaporation ponds to dispose of the brine stream. Figure A-5 shows a potential location of the evaporation ponds and the disposal and land costs have been estimated.

Desal Alternative 6: 25,000 AFY Keystone Desalination with Well Field. This alternative was developed to determine if pumping 25,000 AFY would have a low enough groundwater impact to supply the desalination plant without using groundwater recharge in the unlined Coachella Canal and is represented by Figure A-6.

B.34 East Brawley K.G.R.A.

Desal Alternative 7: 25,000 AFY East Brawley Desalination with Well Field. This alternative is represented in Figure A-7 and was created to test the feasibility of pumping 25,000 AFY of groundwater for the desalination plant without the mitigation effects of groundwater recharge. The new water from this alternative would be used for IID irrigation purposes.

Desal Alternative 8: 25,000 AFY East Brawley Desalination with Well Field and Groundwater Recharge. This alternative builds on Desal Alternative 7 and is represented in Figure A-8. It highlights the use of groundwater to supply the desalination plant and use recharge in a portion of the old unlined Coachella Canal to mitigate for groundwater pumping. The location of the planned recharge facilities is located in the inset on Figure A-8.

Desal Alternative 9: 25,000 AFY East Brawley Desalination with Well Field and Groundwater Recharge and MCI Distribution. This alternative is the same as Desal Alternative 8 and adds the conveyance of new water to be used for MCI purposes. Figure A-9 represents this alternative.

Desal Alternative 10: 5,000 AFY East Brawley Desalination with Well Field. This alternative represented in Figure A-10 uses groundwater for the desalination plant without the use of recharge. The new water from this alternative would be used for IID irrigation purposes.

B.35 EAST MESA K.G.R.A.

Desal Alternative 11: 25,000 AFY East Mesa Desalination with Well Field and Industrial Distribution system to the nearby K.G.R.A.. This alternative was developed to determine if pumping 25,000 AFY would have a low enough impact to supply the desalination plant with groundwater without using groundwater recharge in the unlined Coachella Canal and is represented by Figure A-11. The new water from this alternative would be used for IID irrigation purposes and industrial distribution.

Desal Alternative 12: 25,000 AFY East Mesa Desalination with Well Field and Groundwater Recharge and Industrial Distribution. This alternative builds on Desal Alternative 11 and is represented in Figure A-12. It highlights the use of groundwater to supply the desalination plant and use recharge an unlined portion of the Coachella Canal to mitigate for groundwater pumping. The location of the planned recharge facilities is located in the inset on Figure A-12. The new water from this alternative would be used for IID irrigation purposes and industrial distribution.

Desal Alternative 13: 5,000 AFY East Mesa Desalination with Well Field and Industrial Distribution. This alternative represented in Figure A-13 uses groundwater for the desalination plant without the use of recharge. The new water from this alternative would be used by local geothermal plants.

B.36 SOUTH SALTON SEA K.G.R.A.

Desal Alternative 14: 50,000 AFY South Salton Sea Desalination with Alamo River water. Using the river as the source water is a way to recover the tilewater and tailwater. This alternative does not impact groundwater through pumping the aquifers. The alternative is presented in Figure A-14. The new water from this alternative would be used by local geothermal plants.

Desal Alternative 15: 50,000 AFY South Salton Sea Desalination with Alamo River Water and MCI Distribution system pipeline. This alternative uses the same concept as Desal Alternative 14 with the addition of conveyance of new water to water treatment plants for municipal users and to the geothermal plants. This alternative is represented in Figure A-15.

B.37 South Salton Sea K.G.R.A. – East

Desal Alternative 16: 5,000 AFY South Salton Sea – East Desalination with Well Field. This alternative represented in Figure A-16 uses groundwater for the desalination plant without the use of recharge. The new water from this alternative would be used by local geothermal plants.

B.38 Heber K.G.R.A.

Desal Alternative 17: 5,000 AFY Heber Desalination with Well Field with M & I Distribution. This alternative represented in Figure A-17 uses groundwater for the desalination plant without the use of recharge. The new water from this alternative would be used for irrigation purposes and new MCI purposes.

B.39 Recommendations

Limited data was available and was interpolated to prepare the conceptual well fields, recharge facilities and brine disposal injection wells. Validation of the assumptions is needed before proceeding to preliminary designs. We recommend the following initial activities:

1. Discuss use of the old unlined canal as a recharge facility with the landowner.
2. Acquire additional information is needed to verify the assumptions and interpretations of the well production capacities, salt concentrations, and temperature of the water in the aquifers used in the analysis.
3. Drill a large diameter pilot production well into the intermediate aquifer in the East Brawley K.G.R.A. to confirm its production capacity and to allow use of existing monitoring wells during production testing to confirm the interconnectedness of the intermediate aquifer to the sediments beneath the unlined canal.
4. Install one nested piezometer on the west side of the Calipatria Fault to assess the effect of the fault during pumping.
5. Excavate several potholes within the unlined canal to resolve whether there is a clay liner and whether its removal could enhance the percolation rates.
6. Drill additional test wells in the other K.G.R.A.s to confirm the production capacity of the wells along with the temperature and salinity with depth.
7. Enter into preliminary discussions with geothermal power plant operators as to whether they would be willing to accept and dispose of the brine water.

Upon completion of this work, refine the previously developed Imperial County Groundwater Model to more accurately predict the effects of the well field pumping in conjunction with recharge in the unlined canal.

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Attachment A

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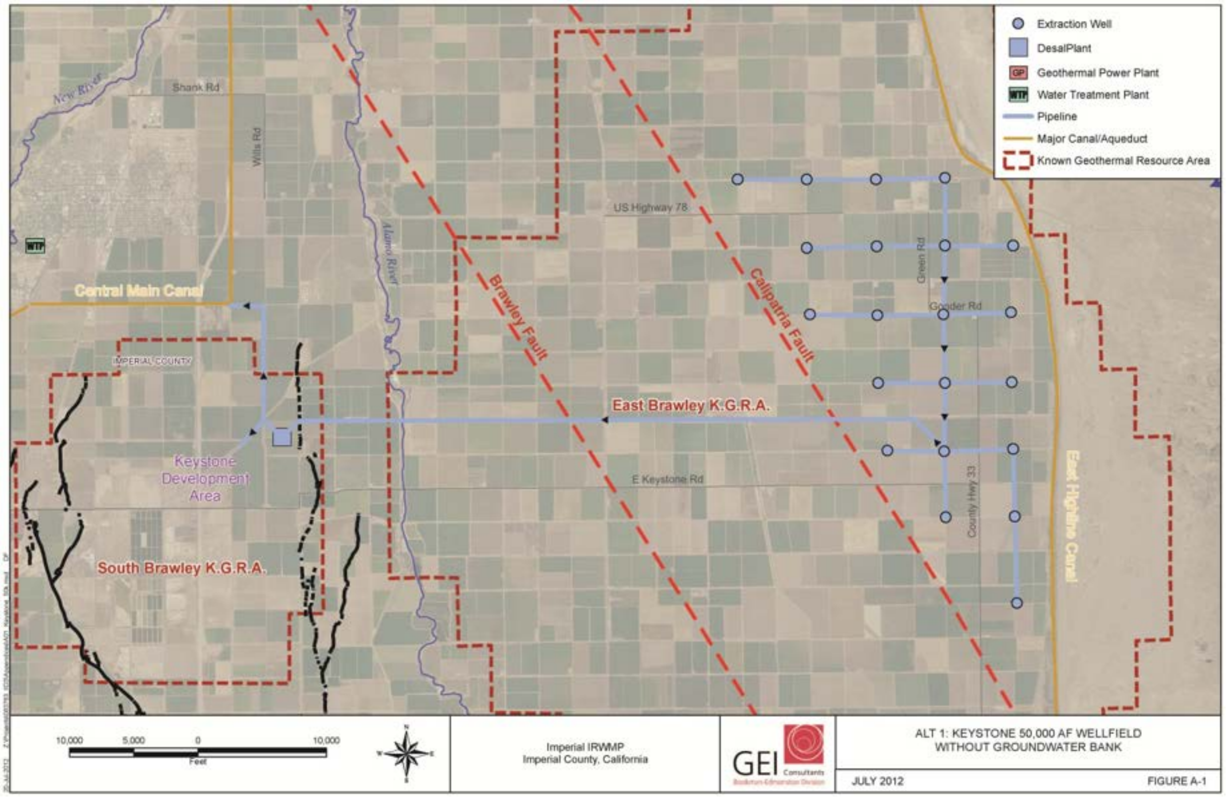
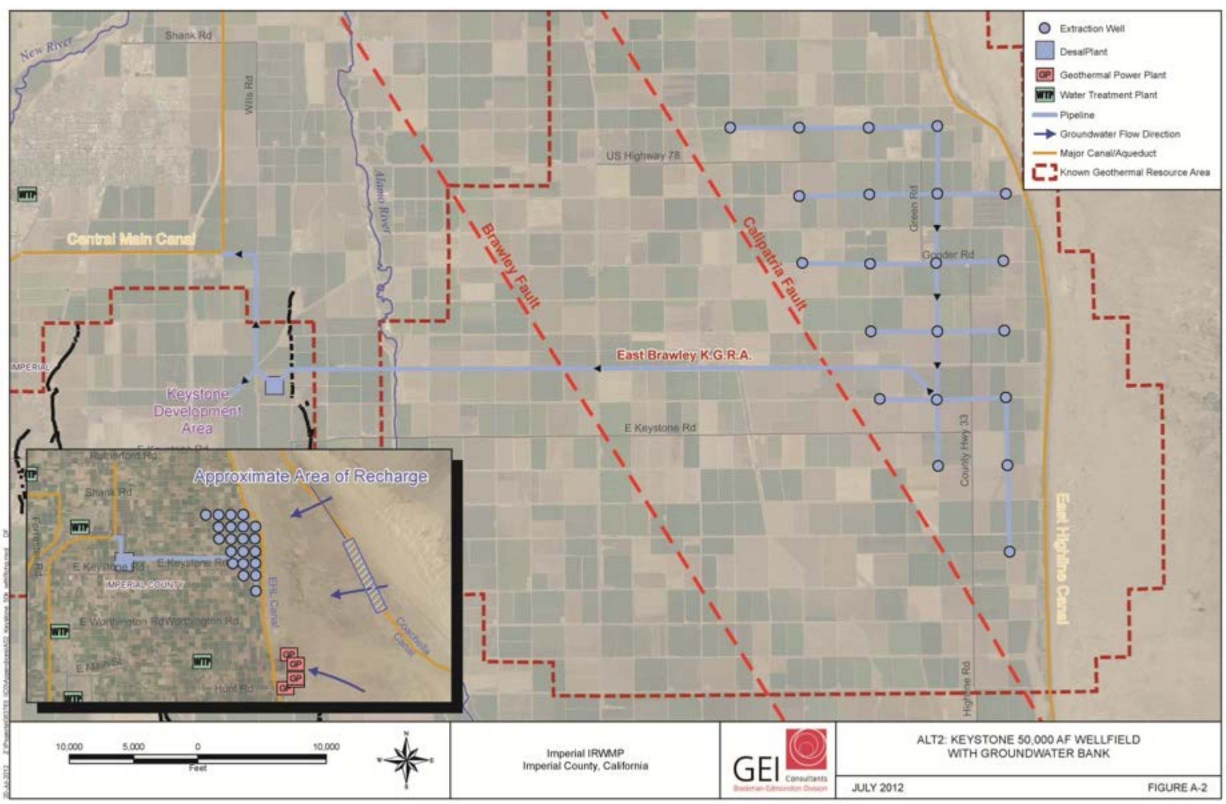
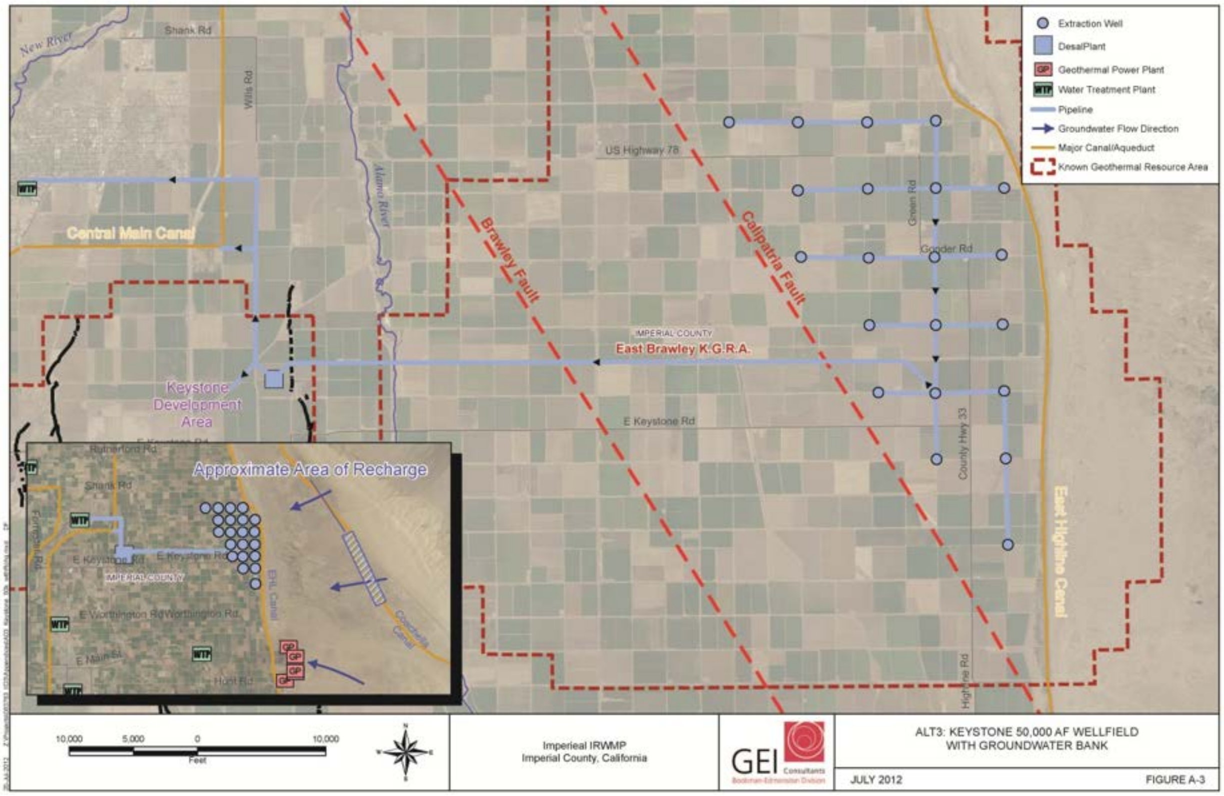
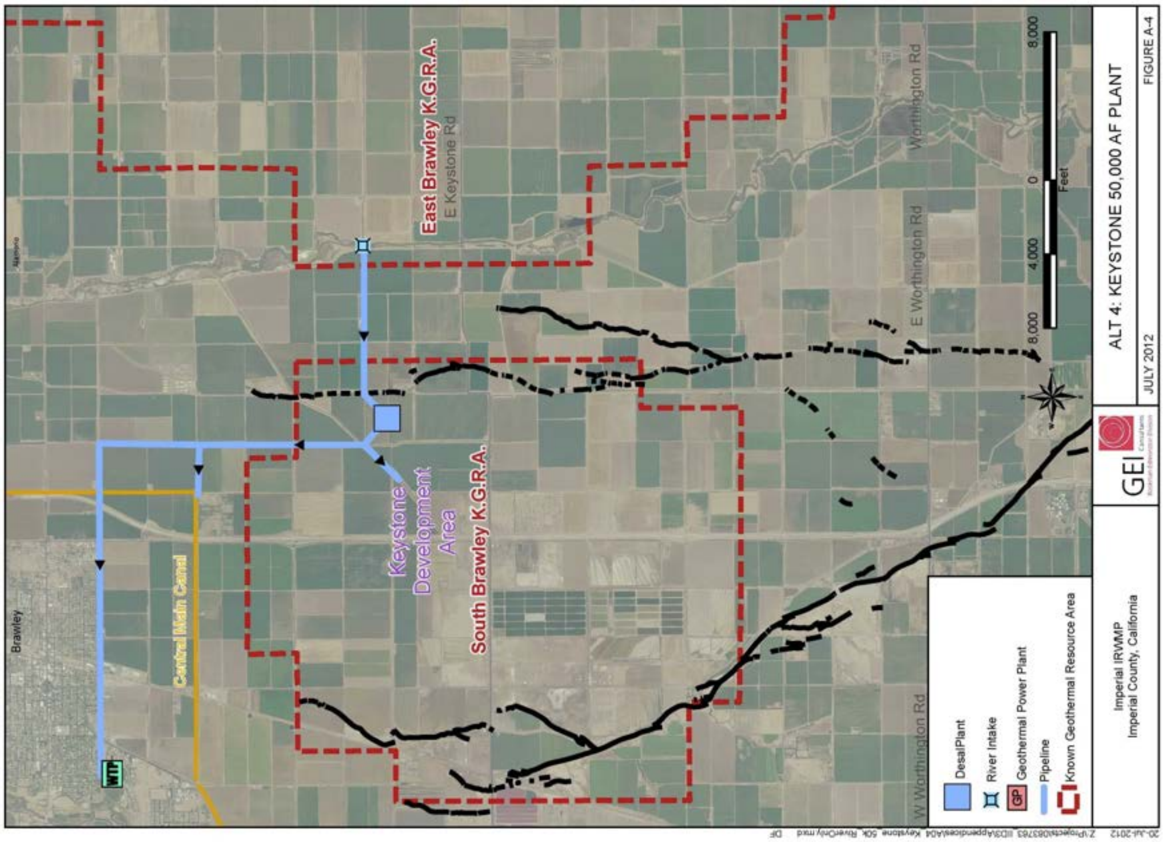
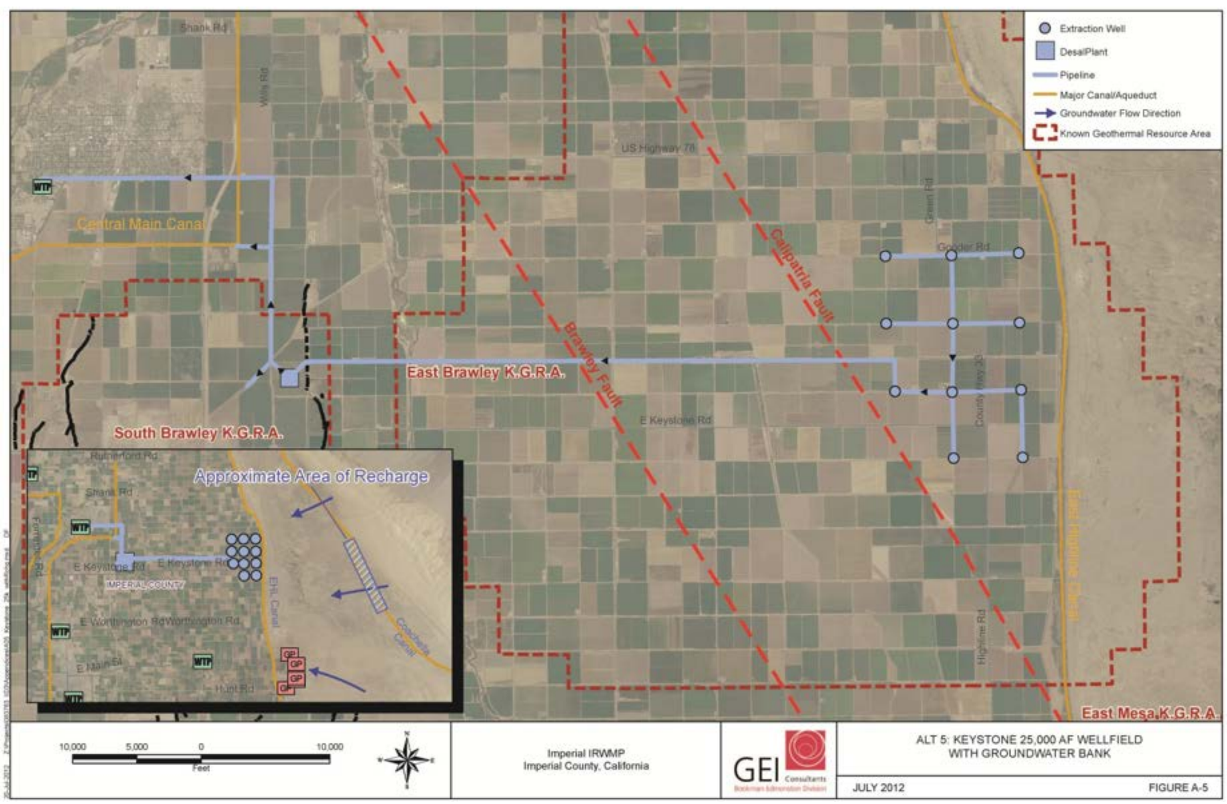
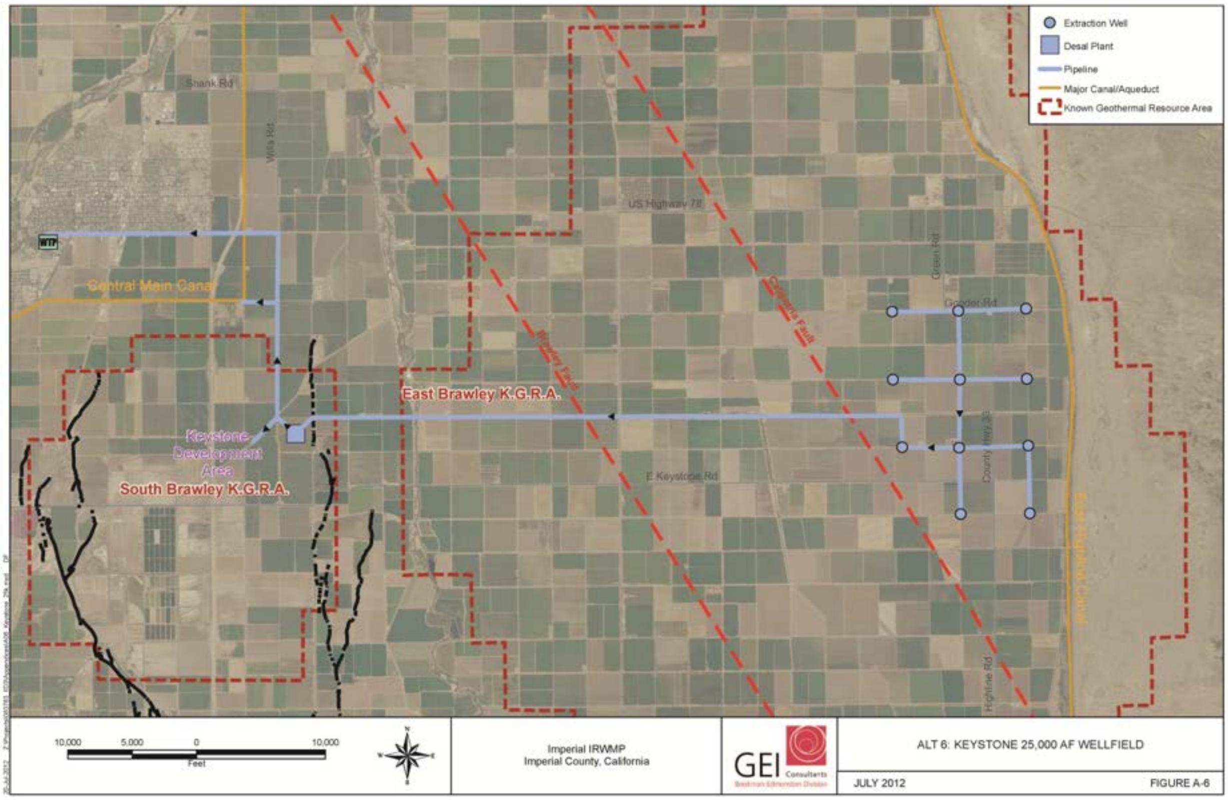

Extraction Well
DesalPlant
Geothermal Power Plant
Water Treatment Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
New River
Shank Rd
Wills Rd
Alamo River
US Highway 78
Brawley Fault
Calipatria Fault
Green Rd
Gonder Rd
Central Main Canal
IMPERIAL COUNTY
East Brawley K.G.R.A.
Keystone Development Area
E Keystone Rd
County Hwy 33
East Highline Canal
South Brawley K.G.R.A.
10,000 5,000 0 10,000
Feet
Imperial IRWMP
Imperial County, California
GEI Consultants
ALT 1: KEYSTONE 50,000 AF WELLFIELD WITHOUT GROUNDWATER BANK
JULY 2012
FIGURE A-1

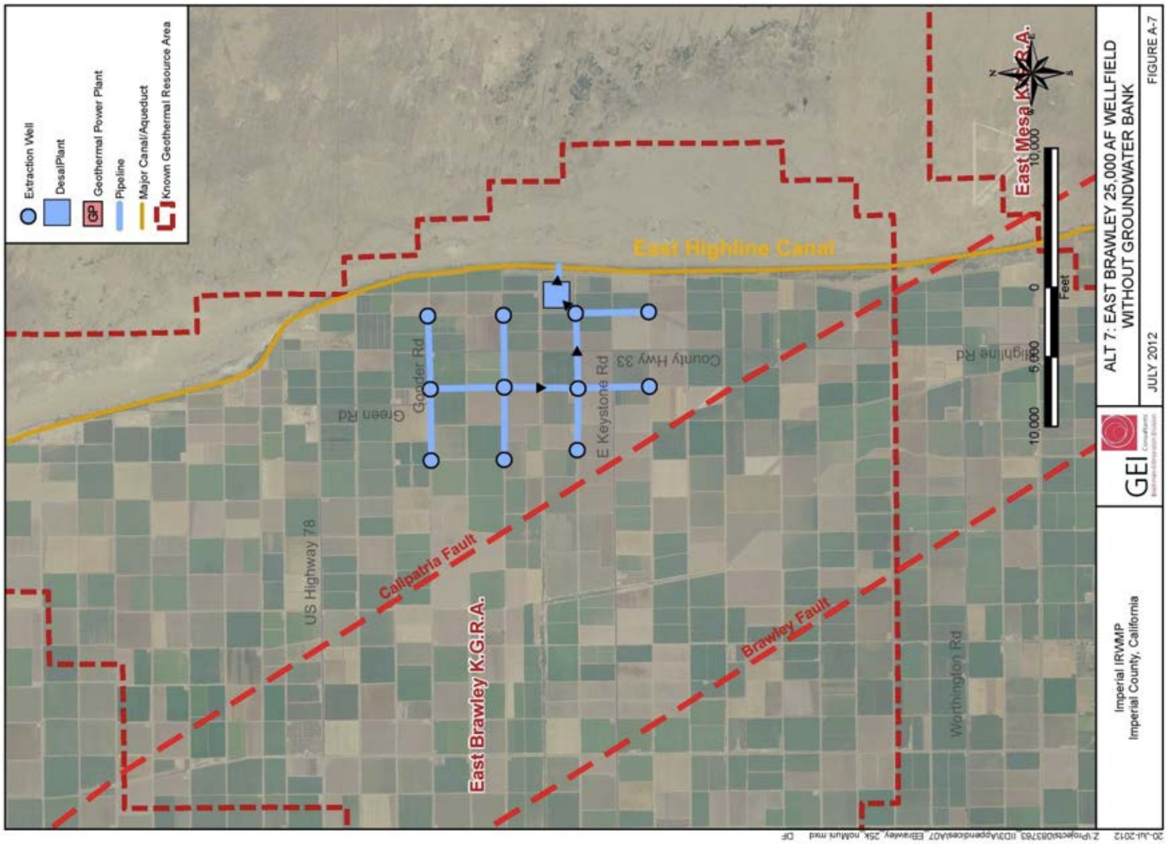

Extraction Well
DesalPlant
Geothermal Power Plant
Water Treatment Plant
Pipeline
Groundwater Flow Direction
Major Canal/Aqueduct
Known Geothermal Resource Area
New River
Shank Rd
Wills Rd
Alamo River
US Highway 78
Brawley Fault
Calipatria Fault
Green Rd
Gonder Rd
Central Main Canal
East Brawley K.G.R.A.
Keystone Development Area
E Keystone Rd
County Hwy 33
Highline Rd
East Highline Canal
Approximate Area of Recharge
Coachella Canal
10,000 5,000 0 10,000
Feet
Imperial IRWMP
Imperial County, California
GEI Consultants
ALT2: KEYSTONE 50,000 AF WELLFIELD WITH GROUNDWATER BANK
JULY 2012
FIGURE A-2

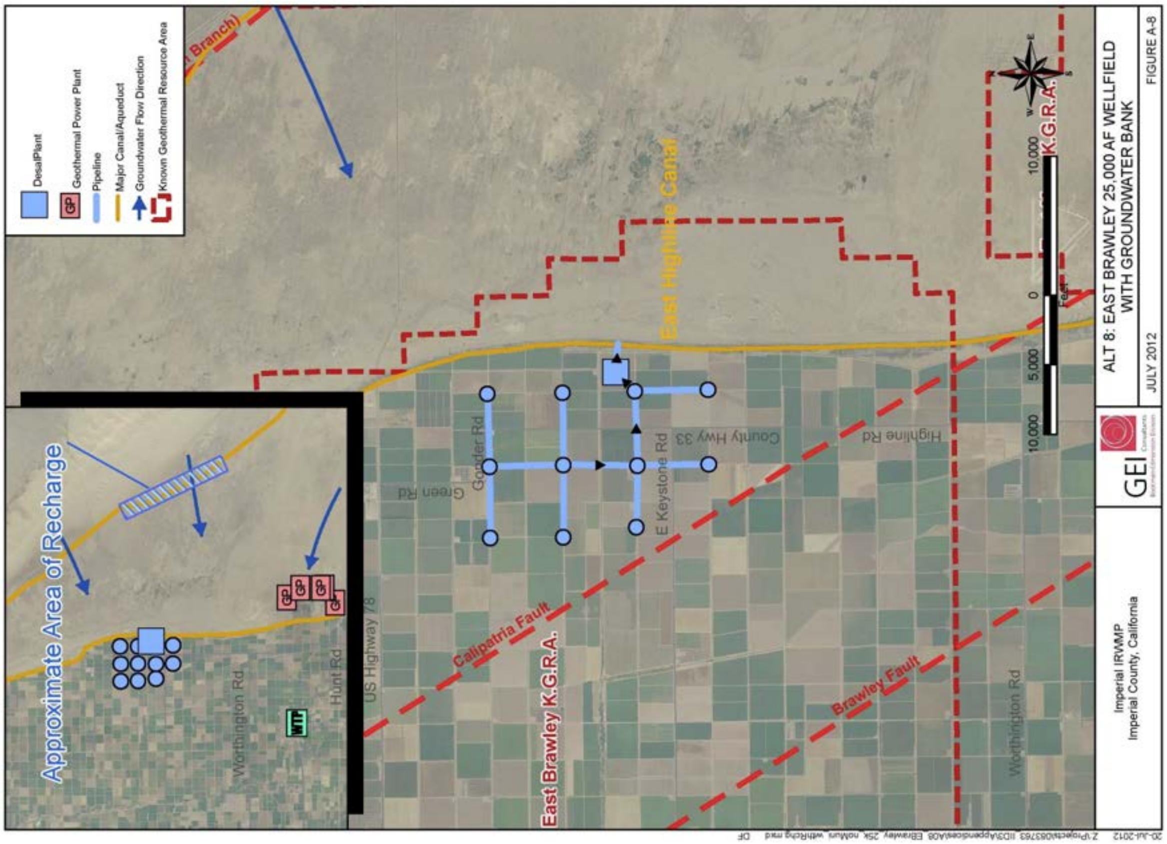

Extraction Well
DesalPlant
Geothermal Power Plant
Water Treatment Plant
Pipeline
Groundwater Flow Direction
Major Canal/Aqueduct
Known Geothermal Resource Area
New River
Shank Rd
Wills Rd
Alamo River
US Highway 78
Brawley Fault
Calipatria Fault
Central Main Canal
Green Rd
Gonder Rd
IMPERIAL COUNTY
East Brawley K.G.R.A.
Keystone Development Area
E Keystone Rd
County Hwy 33
East Highline Canal
Highline Rd
Approximate Area of Recharge
E Worthington Rd
E Main St
Hunt Rd
Coachella Canal
10,000
5,000
0
10,000
Feet
Impereal IRWMP
Imperial County, California
GEI Consultants
ALT3: KEYSTONE 50,000 AF WELLFIELD
WITH GROUNDWATER BANK
JULY 2012
FIGURE A-3

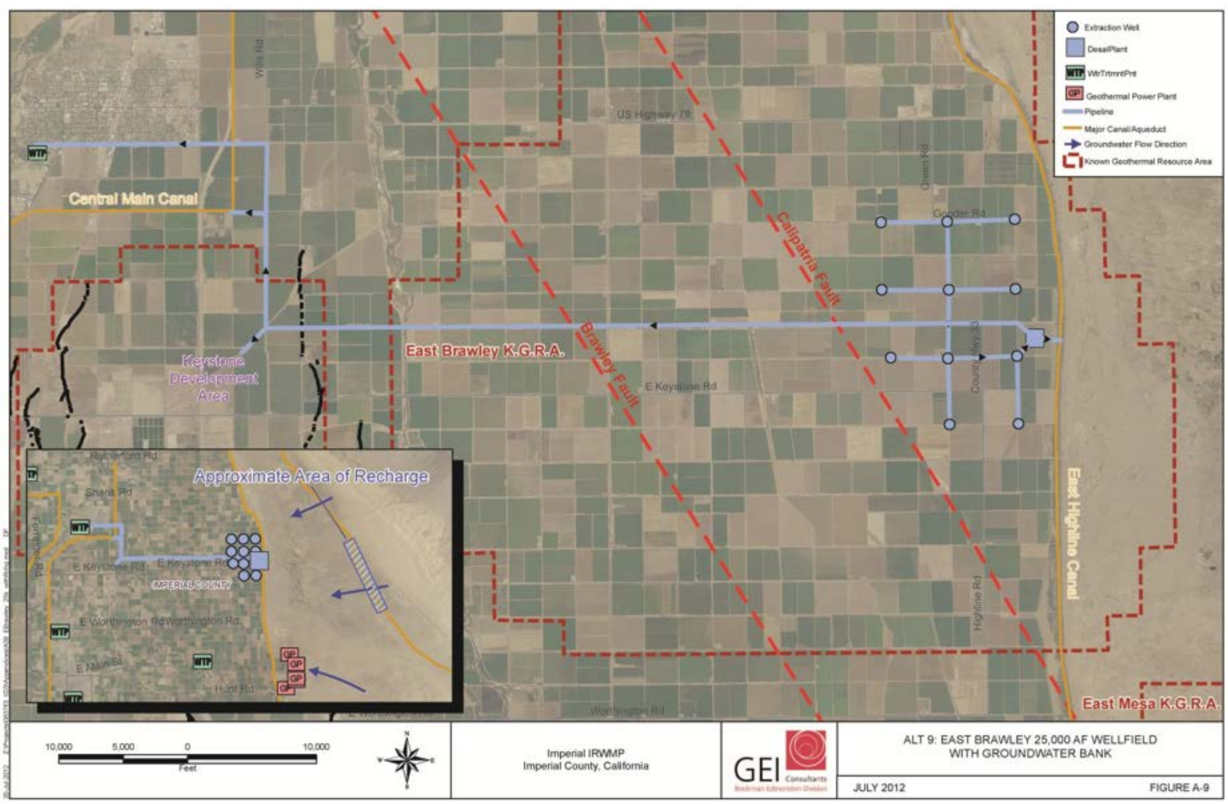

ALT 4: KEYSTONE 50,000 AF PLANT
FIGURE A-4
JULY 2012
Imperial IRWMP
Imperial County, California
DesalPlant
River Intake
Geothermal Power Plant
Pipeline
Known Geothermal Resource Area
East Brawley K.G.R.A.
E Keystone Rd
Keystone Development Area
South Brawley K.G.R.A.
Central Main Canal
Brawley
Worthington Rd
E Worthington Rd
W Worthington Rd
Feet

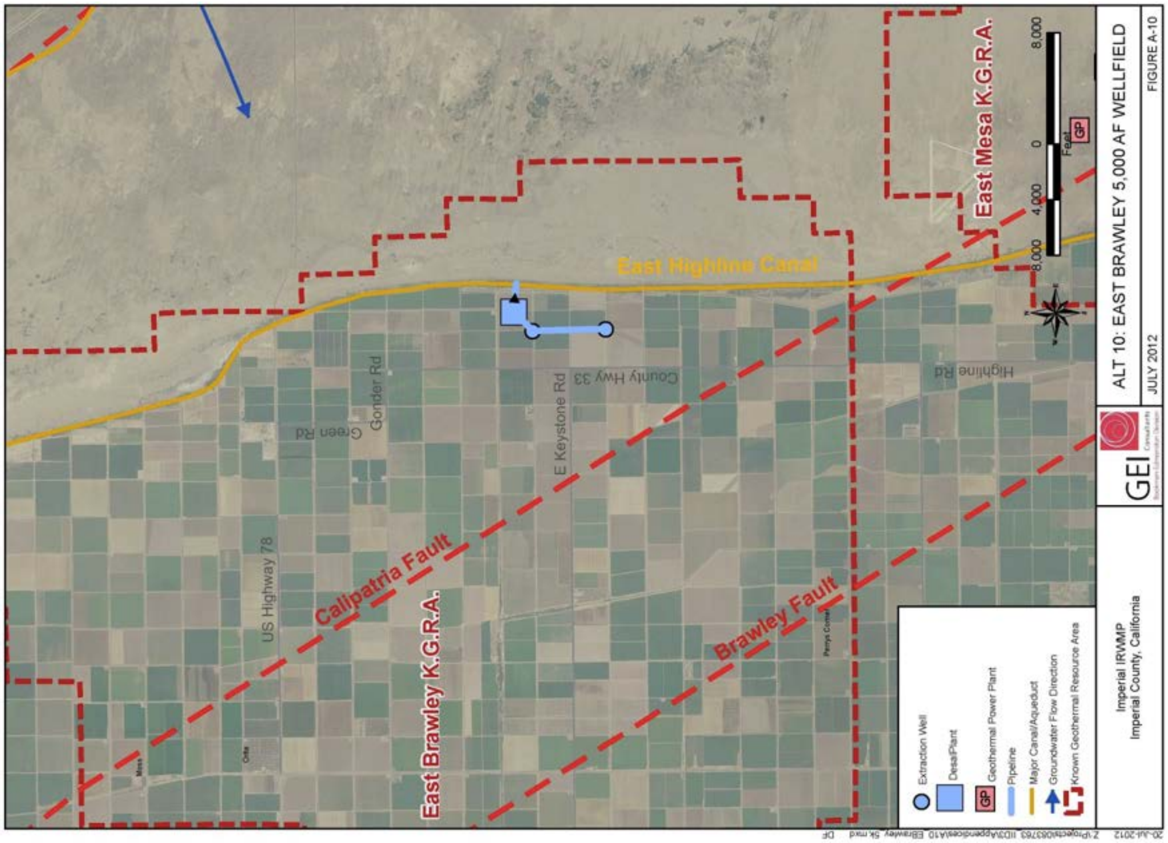

Extraction Well
DesalPlant
Pipeline
Major Canal/Aqueduct
Groundwater Flow Direction
Known Geothermal Resource Area
Central Main Canal
US Highway 78
East Brawley K.G.R.A.
South Brawley K.G.R.A.
Brawley Fault
Calipatria Fault
E Keystone Rd
Approximate Area of Recharge
East Mesa K.G.R.A.
Imperial IRWMP
Imperial County, California
ALT 5: KEYSTONE 25,000 AF WELLFIELD WITH GROUNDWATER BANK
JULY 2012
FIGURE A-5
Feet

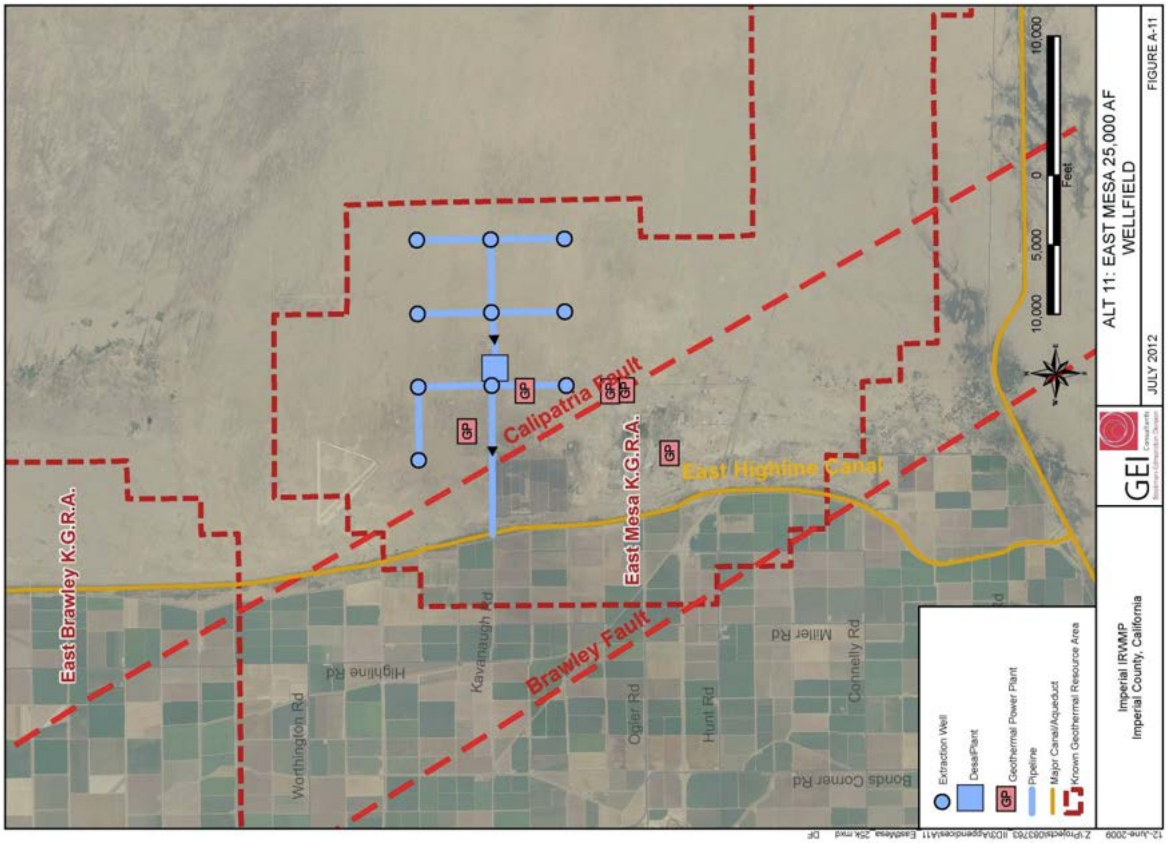

Extraction Well
Desal Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
Shank Rd
Wills Rd
US Highway 78
Central Main Canal
East Brawley K.G.R.A.
Keystone Development Area
South Brawley K.G.R.A.
E Keystone Rd
Highline Rd
10,000
5,000
0
10,000
Feet
Imperial IRWMP
Imperial County, California
GEI Consultants
ALT 6: KEYSTONE 25,000 AF WELLFIELD
JULY 2012
FIGURE A-6

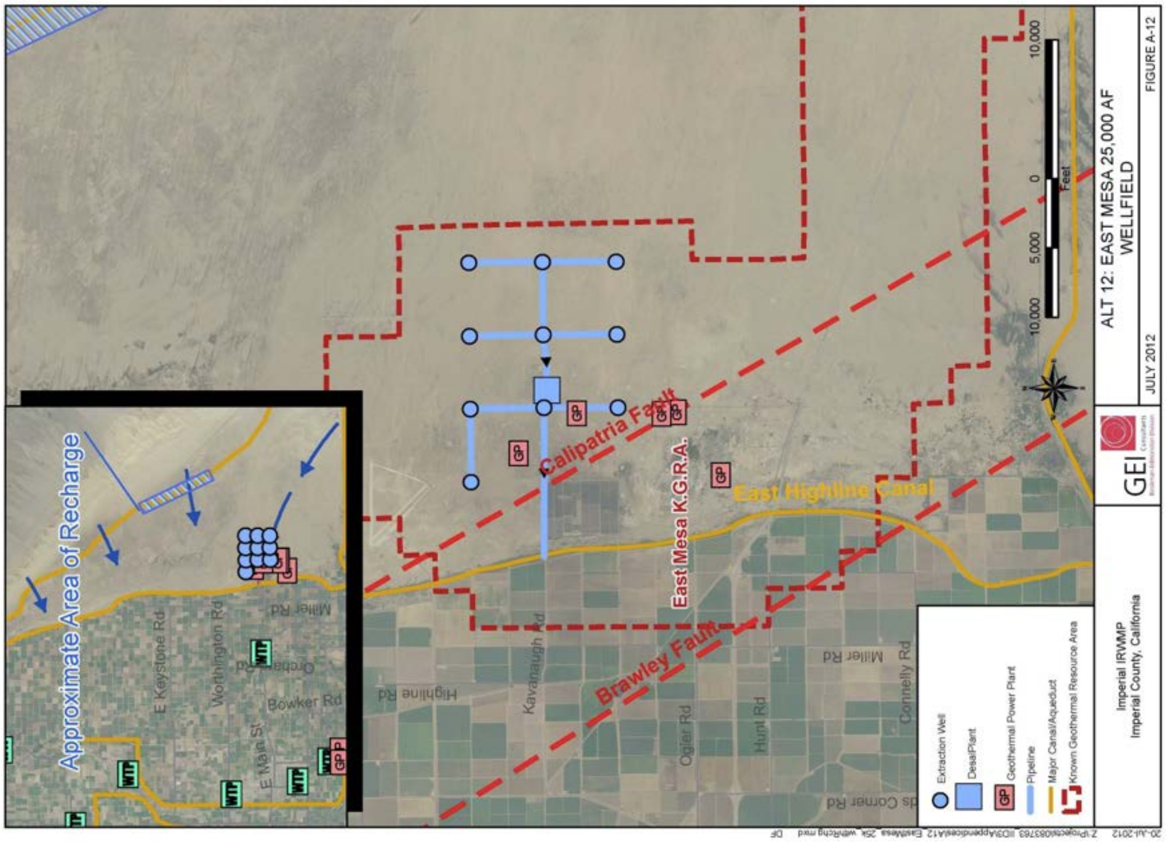

Extraction Well
Desal Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
East Highline Canal
East Mesa K.G.R.A.
Highline Rd
County Hwy 33
E Keystone Rd
Gonder Rd
Green Rd
US Highway 78
Calipatria Fault
East Brawley K.G.R.A.
Brawley Fault
Worthington Rd
10,000 5,000 0 10,000
Feet
ALT 7: EAST BRAWLEY 25,000 AF WELLFIELD WITHOUT GROUNDWATER BANK
JULY 2012
FIGURE A-7
GEI Consultants
Imperial IRWMP
Imperial County, California

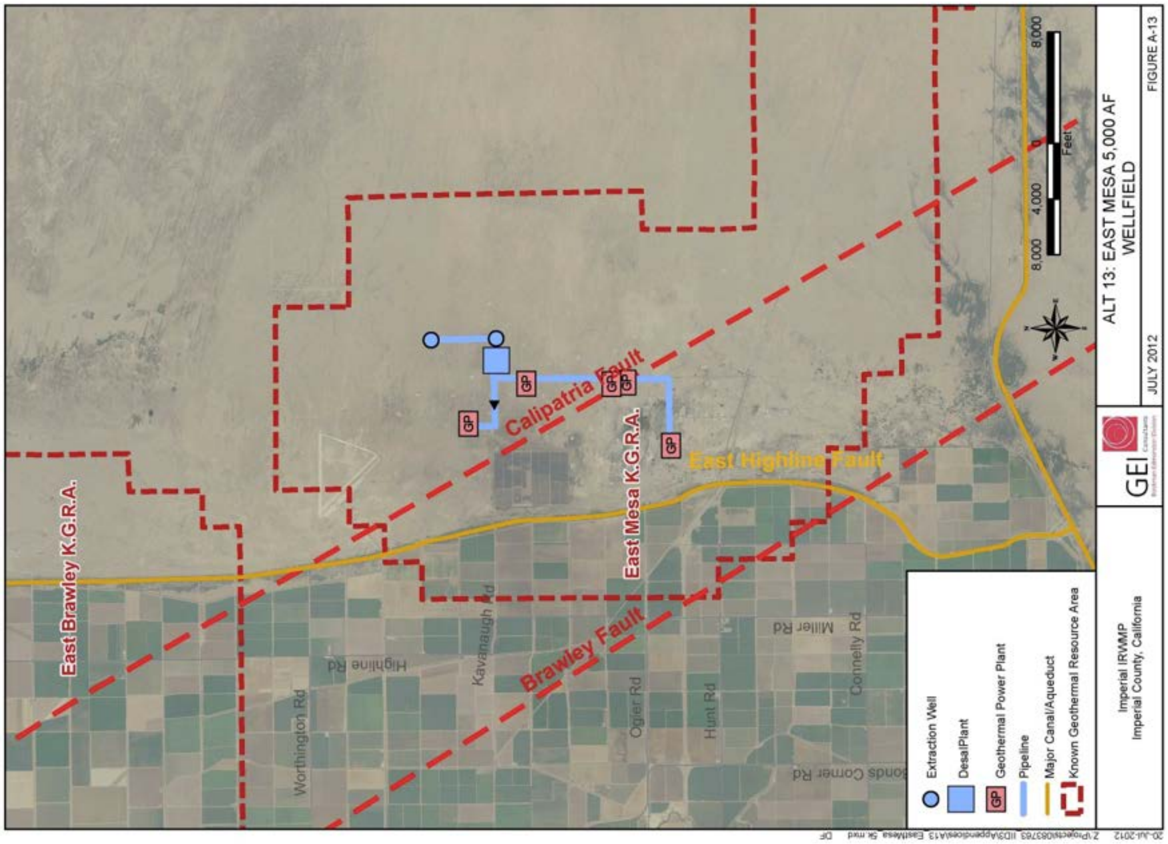

DesalPlant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Groundwater Flow Direction
Known Geothermal Resource Area
Approximate Area of Recharge
Worthington Rd
Hunt Rd
US Highway 78
East Highline Canal
Calipatria Fault
Brawley Fault
East Brawley K.G.R.A.
K.G.R.A.
Gonder Rd
Green Rd
E Keystone Rd
County Hwy 33
Highline Rd
10,000
5,000
0
10,000
Feet
Imperial IRWMP
Imperial County, California
ALT 8: EAST BRAWLEY 25,000 AF WELLFIELD
WITH GROUNDWATER BANK
JULY 2012
FIGURE A-8

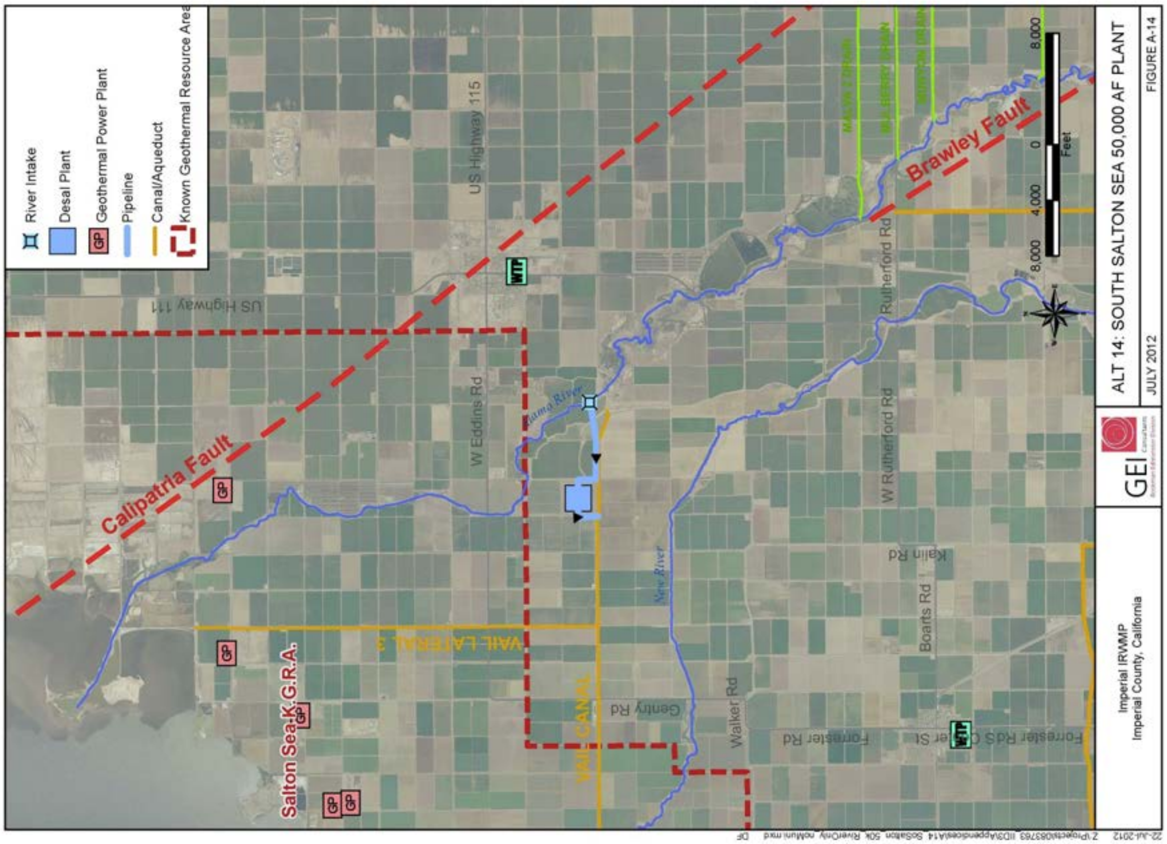

Extraction Well
DesalPlant
WtrTrtmntPnt
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Groundwater Flow Direction
Known Geothermal Resource Area
Central Main Canal
US Highway 78
Calipatria Fault
Brawley Fault
East Brawley K.G.R.A.
Keystone Development Area
E Keystone Rd
Gonder Rd
Green Rd
Highline Rd
East Highline Canal
East Mesa K.G.R.A.
Worthington Rd
Approximate Area of Recharge
10,000
5,000
0
10,000
Feet
Imperial IRWMP
Imperial County, California
ALT 9: EAST BRAWLEY 25,000 AF WELLFIELD
WITH GROUNDWATER BANK
JULY 2012
FIGURE A-9

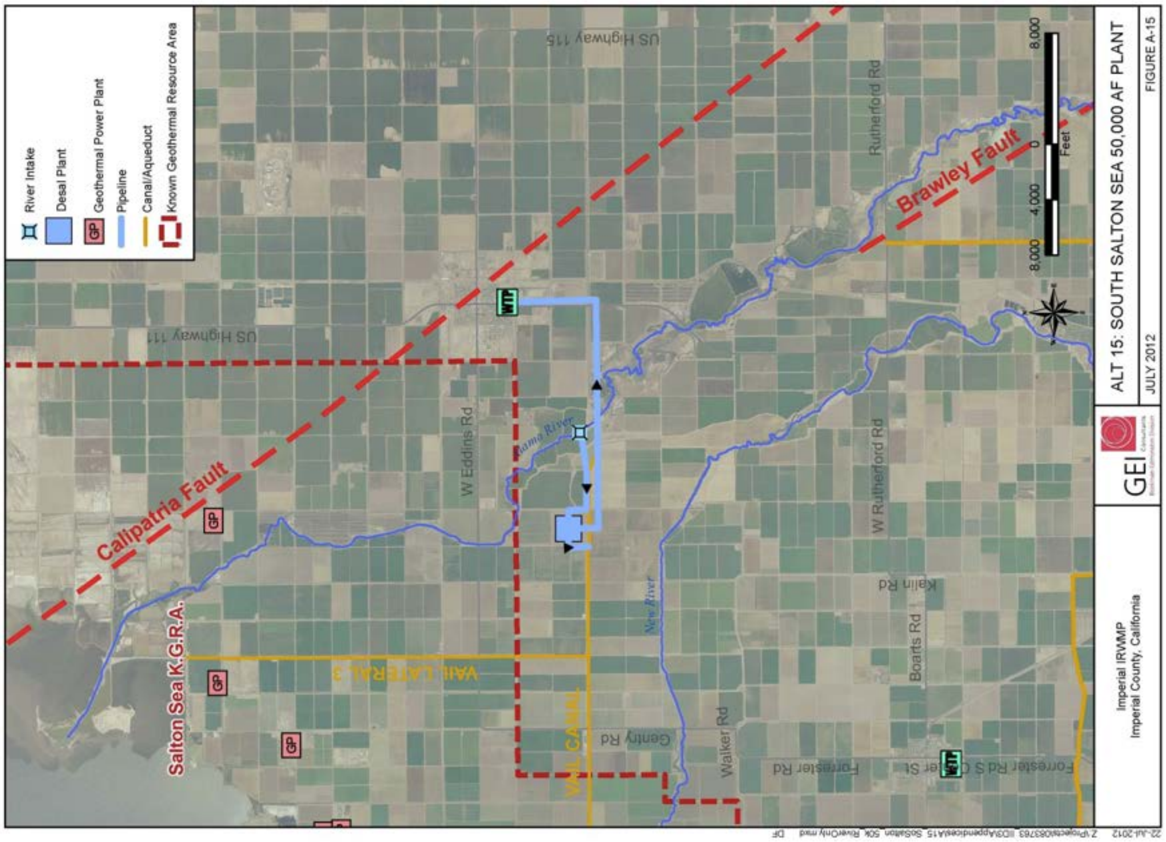

ALT 10: EAST BRAWLEY 5,000 AF WELLFIELD
JULY 2012
FIGURE A-10
Imperial IRWMP
Imperial County, California
Extraction Well
Desal/Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Groundwater Flow Direction
Known Geothermal Resource Area
8,000
4,000
0
8,000
Feet
GP
East Highline Canal
East Mesa K.G.R.A.
East Brawley K.G.R.A.
Calipatria Fault
Brawley Fault
US Highway 78
Green Rd
Gonder Rd
E Keystone Rd
County Hwy 33
Highline Rd

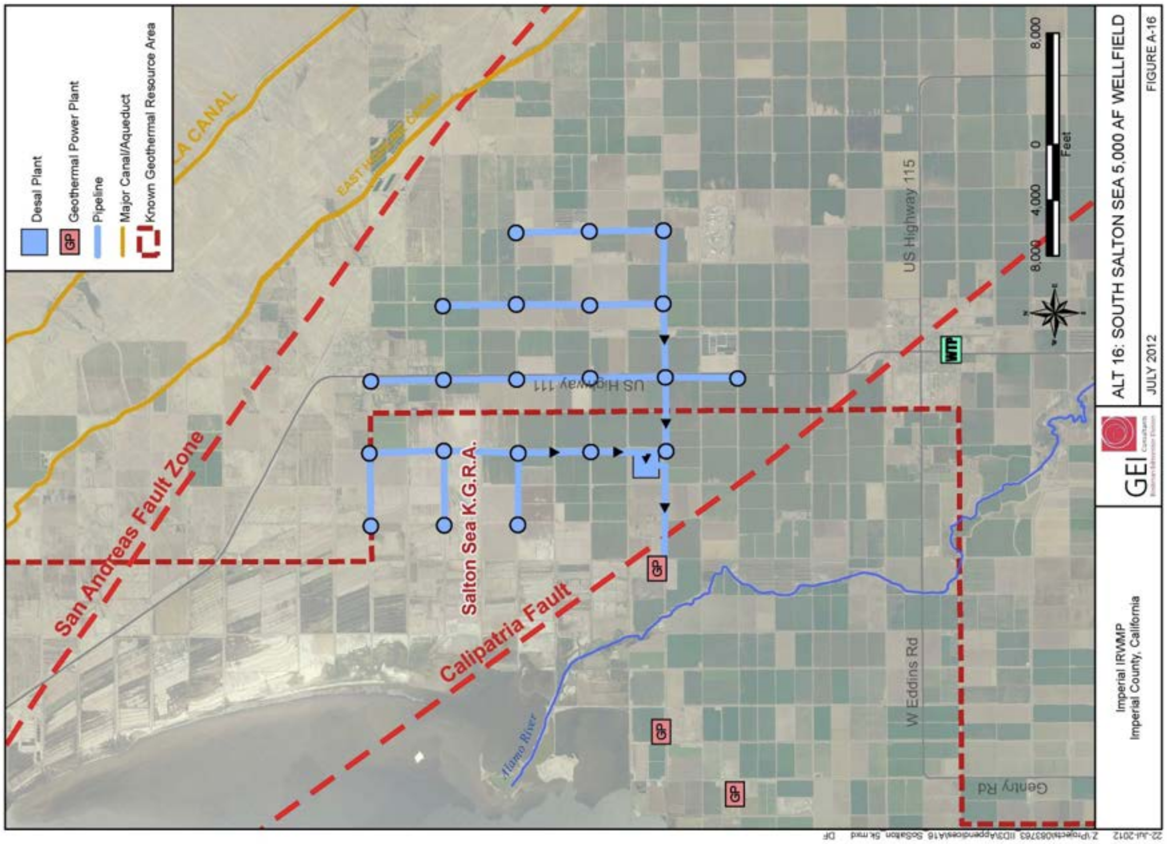

ALT 11: EAST MESA 25,000 AF WELLFIELD
FIGURE A-11
JULY 2012
Imperial IRWMP
Imperial County, California
GEI
Extraction Well
Desal Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
10,000
5,000
0
10,000
Feet
Calipatria Fault
Brawley Fault
East Highline Canal
East Mesa K.G.R.A.
East Brawley K.G.R.A.
Highline Rd
Worthington Rd
Kavanaugh Rd
Ogier Rd
Hunt Rd
Miller Rd
Connelly Rd
Bonds Corner Rd
GP

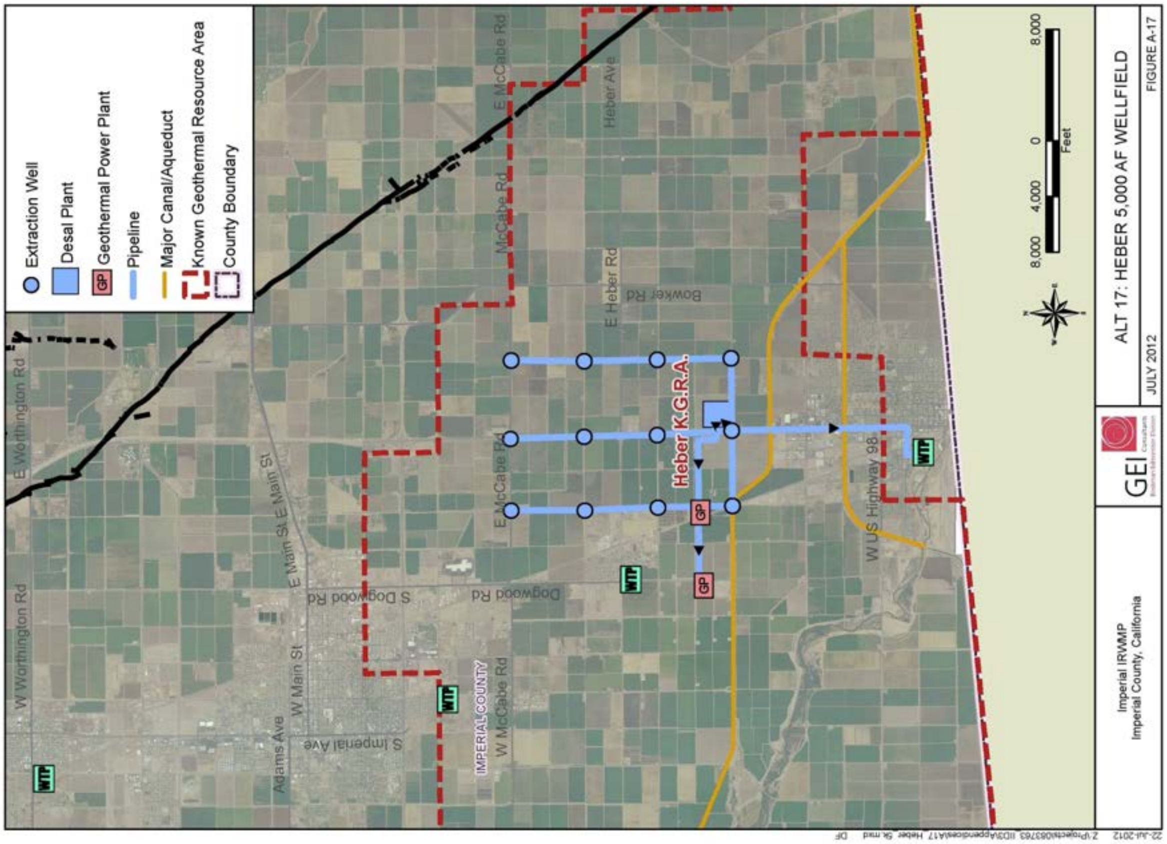

ALT 12: EAST MESA 25,000 AF WELLFIELD
FIGURE A-12
JULY 2012
Imperial IRWMP
Imperial County, California
GEI Consultants
Extraction Well
Desal Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
10,000
5,000
0
10,000
Feet
Calipatria Fault
Brawley Fault
East Highline Canal
East Mesa K.G.R.A.
Approximate Area of Recharge
Miller Rd
Highline Rd
Kavanaugh Rd
Ogler Rd
Hunt Rd
Donnelly Rd
Worthington Rd
E Keystone Rd
Bowker Rd
E Main St
GP
WTP


ALT 13: EAST MESA 5,000 AF
WELLFIELD
JULY 2012
FIGURE A-13
Imperial IRWMP
Imperial County, California
Extraction Well
DesalPlant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
Feet
8,000
4,000
0
8,000
Calipatria Fault
Brawley Fault
East Highline Fault
East Brawley K.G.R.A.
East Mesa K.G.R.A.
Highline Rd
Kavanaugh Rd
Worthington Rd
Ogier Rd
Hunt Rd
Miller Rd
Connelly Rd


River Intake
Desal Plant
Geothermal Power Plant
Pipeline
Canal/Aqueduct
Known Geothermal Resource Area
Calipatria Fault
Brawley Fault
Salton Sea K.G.R.A.
US Highway 111
US Highway 115
W Eddins Rd
Alamo River
New River
VAIL LATERAL 5
VAIL CANAL
Gentry Rd
Walker Rd
Forrester Rd
W Rutherford Rd
Rutherford Rd
Kalin Rd
Boarts Rd
8,000
4,000
0
Feet
ALT 14: SOUTH SALTON SEA 50,000 AF PLANT
FIGURE A-14
JULY 2012
GEI Consultants
Imperial IRWMP
Imperial County, California


River Intake
Desal Plant
Geothermal Power Plant
Pipeline
Canal/Aqueduct
Known Geothermal Resource Area
ALT 15: SOUTH SALTON SEA 50,000 AF PLANT
FIGURE A-15
JULY 2012
Imperial IRWMP
Imperial County, California
GEI
Calipatria Fault
Brawley Fault
Salton Sea K.G.R.A.
US Highway 111
US Highway 115
W Eddins Rd
VAIL LATERAL 3
VAIL CANAL
Gentry Rd
Walker Rd
Forrester Rd
New River
Alamo River
W Rutherford Rd
Rutherford Rd
Kalin Rd
Boarts Rd
Feet
8,000
4,000
0
8,000


Desal Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
San Andreas Fault Zone
Salton Sea K.G.R.A.
Calipatria Fault
US Highway 111
US Highway 115
W Eddins Rd
Gentry Rd
Alamo River
GP
WTP
8,000 4,000 0 8,000
Feet
ALT 16: SOUTH SALTON SEA 5,000 AF WELLFIELD
JULY 2012
FIGURE A-16
GEI Consultants
Imperial IRWMP
Imperial County, California


Extraction Well
Desal Plant
Geothermal Power Plant
Pipeline
Major Canal/Aqueduct
Known Geothermal Resource Area
County Boundary
Heber K.G.R.A.
IMPERIAL COUNTY
E Worthington Rd
W Worthington Rd
E McCabe Rd
McCabe Rd
W McCabe Rd
Heber Ave
E Heber Rd
Bowker Rd
Dogwood Rd
S Dogwood Rd
E Main St
W Main St
Adams Ave
S Imperial Ave
W US Highway 98
8,000
4,000
0
8,000
Feet
ALT 17: HEBER 5,000 AF WELLFIELD
FIGURE A-17
JULY 2012
Imperial IRWMP
Imperial County, California

IMPERIAL IRWMP

INTEGRATED REGIONAL WATER MANAGEMENT PLAN

GEI Consultants