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List of Acronyms

AF	acre feet
AFC	Application for Certification
AFY	acre feet per year
amsl	above mean sea level
b	aquifer thickness
BCM	Basin Conceptual Model
bgs	below ground surface
BLM	United States Bureau of Land Management
BMPs	best management practices
CA DWR	CA Department of Water Resources
CEC	California Energy Commission
cm/sec	centimeters per second
CSU	California State University
CWA	Clean Water Act

DEHS	Department of Environmental Health Services
DEM	digital elevation model
DESCP	Drainage, Erosion, and Sediment Control Plan
ds	drawdown per log cycle
ECSZ	Eastern California Shear Zone
ft/day	feet per day
ft^2/day	square feet per day
FPLE	Florida Power and Light Energy
GHBs	general head boundaries
gpd	gallons per day
gpd/ft	gallons per day per foot
gpd/ft^2	gallons per day per square foot
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HFB	horizontal flow barrier package
HLB	Harper Lake Groundwater Basin
HTF	heat transfer fluid
HVB	Harper Valley Groundwater Basin
K	hydraulic conductivity
LGS	Layne GeoSciences
LORS	Laws, Ordinances, Regulations and Standards
lQal	lower Quaternary Alluvium
mg/L	milligrams per Liter
MRB	Mojave River Basin
MSP	Mojave Solar Project
MW	mega watt
MWA	Mojave Water Agency
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
PET	potential evapotranspiration
PG&E	Pacific Gas & Electric
pTb	non-water bearing metamorphic and granitic rocks
Q	flow rate

Qae	active eolian sand deposit of latest Holocene age
Qal	Quaternary alluvium
Qap	active playa deposit of Holocene age
Qb	Quaternary basalt
Qoa	old alluvial fan deposit of mid-early Pleistocene
Qra	recent alluvium of Holocene age
QToa	late Tertiary to early Quaternary deposits
QTof	older fan and stream deposit Pleistocene-Pliocene
QTU	undifferentiated alluvial deposits of Holocene to late Pliocene age
QTp	playa deposits
Qya	younger alluvium of Holocene to Pleistocene age
Qyf	younger alluvial an deposits of Holocene-Pleistocene
ROWD	Report of Waste Discharge
RWQCB	Regional Water Quality Control Board
S	storativity coefficient
SEGS	solar electric generating systems
SCE	Southern California Edison
T	transmissivity coefficient
t	time
t_0	time axis intercept
TDS	total dissolved solids
USGS	United States Geological Survey
uQal	upper Quaternary alluvium
WDRs	Waste Discharge Requirements
WLEs	water-limited environments
ZCTA	zip code tabulation area

5.17 Water Resources

This AFC section addresses water resources issues associated with the Mojave Solar Project (MSP). It discusses applicable Laws, Ordinances, Regulations and Standards (LORS), required permits and permit schedules, agencies involved and agency contacts, existing water resources, surface water, hydrogeology, aquifer properties, potential project environmental impacts and proposed mitigation measures.

To minimize redundancy, information related to groundwater, hydrogeology, aquifer properties, aquifer testing, groundwater geochemistry, water budgets, and groundwater modeling is presented within the Basin Conceptual Model (BCM) report. A copy of this report is attached as Appendix A. A hydrology report for the MSP was developed to analyze the surface water resources, potential storm water impacts, and proposed mitigation measures. A copy of this report is attached in Appendix K.

Information for this AFC comes from the U.S. Geological Survey (USGS), California Department of Water Resources (DWR), California Division of Mines and Geology, the Mojave Water Agency (MWA), other agencies, public-source consulting reports, and recent data acquired by Layne GeoSciences (LGS). Relevant technical reports prepared by the Mark Group (April and December, 1989) describing area hydrogeological conditions were reviewed and used as source documents when appropriate. Applicable hydrogeological data and conclusions presented in the 1987 AFC prepared by ERT Inc. for the nearby, SEGS VIII and IX were reviewed and used as source information. Inquiries were made of all agencies managing groundwater in the vicinity of the project and of local property owners.

The MSP proposes to use groundwater underlying the MSP during facility construction and operation, including cooling purposes. Based on laboratory analyses of groundwater samples collected from the active Ryken well, the expected groundwater quality will be brackish (See Table 5.17-6 and Section 5.17.2.8). Groundwater targeted for MSP supply is not potable and is unsuitable for municipal supply. The proposed use of low quality groundwater complies with applicable policies regarding water supply for power plant operation (See Section 5.17.2.12). Groundwater targeted for MSP supply has supported agricultural production in the project area in the recent past, including portions of the MSP. Historical agriculture used 6,500 to 18,000 AFY of groundwater in the vicinity of SEGS VIII and IX and the MSP; or about 2.1 AFY to 6 AFY per acre of land (land acreage for SEGS VIII and IX is about 1,280 acres and the MSP is about 1,765 acres) (See Section 5.17.2.9). Operation of the MSP requires 2,163 AFY (operation of adjacent SEGS VIII and IX requires about 1,109 AFY); or about 1.1 AFY per acre of land. The proposed use of the land for electrical power generation is a more sustainable use and has fewer environmental impacts than if the project were not to go forward and the agricultural use were to continue. The MSP's proposed groundwater use will not interfere with other designated beneficial uses in the groundwater basin. In addition, the MSP's proposed production amount and purpose of use will comply with applicable requirements of the Judgment entered in the Mojave River Basin (MRB) adjudication.

5.17.1 Laws Ordinances, Regulations and Standards

Federal, state, county and local LORS applicable to water resources are summarized and discussed in Table 5.17-1.

Table 5.17-1. LORS Applicable to Water Resources

LORS	Applicability and Requirements	Where Discussed in AFC
Federal:		
Clean Water Act (CWA) Section 402, 33 USC Section 1342; 40 CFR Parts 112, 122 through 136	The objective of the CWA (1977) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The CWA regulates both direct and indirect discharges to waters of the U.S., including storm water discharges from construction and industrial activities.	Section 5.17.1.1
State:		
California Constitution Article 10, Section 2	Prohibits waste or unreasonable use of water, regulates use and diversion of water, and requires conservation and reuse of water to the maximum extent possible.	Section 5.17.1.2 5.17.3
The Porter-Cologne Water Quality Control Act; California Water Code Division 7, Chapter 1, Section 13000 et seq.	Requires the SWRCB and the nine RWQCBs to adopt water quality criteria to protect State waters, including identification of beneficial uses, narrative and numerical water quality standards, and implementation procedures.	Section 5.17.2
Federal CWA, implemented by the State of California - California Storm Water Permitting Program: California Construction Storm Water Program, California Industrial Storm Water Program	Construction activities that disturb one or more acre are required to obtain coverage under California's General Construction Permit, which requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). Industrial activities with the potential to impact storm water discharges are required to obtain a NPDES permit for those discharges.	Section 5.17.1.2 5.17.1.4 5.17.3 5.17.4
California Water Code Division 1, Chapter 6, Article 2, Section 461	Stipulates that the primary interest of the people of the state in conservation of available water resources requires the maximum reuse of reclaimed water in the satisfaction of requirements for beneficial uses of water.	Section 5.17.2.9

LORS	Applicability and Requirements	Where Discussed in AFC
California Water Code Division 2, Part 2, Chapter 1, Article 1, Section 1200 - Water Rights	Defines water subject to appropriation through application to the State Water Resources Control Board (SWRCB) as surface water and subterranean streams flowing through known and definite channels.	Section 5.17.1.2
California Water Code Division 7, Chapter 4, Article 4, Section 13260 et seq	Requires filing with the appropriate RWQCB Report of Waste Discharge that could affect the water quality of the state, unless the requirement is waived pursuant to California Water Code section 13269 (a).	Section 5.17.1.2 5.17.1.4 5.17.4.1 5.17.4.2
California Water Code Division 7, Chapter 7, Article 7, Sections 13550, 13551, 13552.6	Requires the use of recycled water for industrial purposes subject to recycled water availability, quality, quantity, cost, and public health impacts. Prohibits use of potable domestic quality water for non-potable uses if suitable recycled water is available.	Section 5.17.2.9
California Water Code Division 7, Chapter 10, Article 3, Section 13751	Requires well completion report for constructing, altering, or destroying a water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well.	Section 5.17.1.4
State Water Resources Control Board Resolution 75-58	Encourages the use of wastewater for power plant cooling and sets an order of preference for water use for cooling purposes.	Section 5.17.2.9
California Code of Regulations, Title 23, Division 3, Chapter 9, Chapter 15	Establishes requirements for waste discharge report and requirements specifying conditions for protection of water quality. Outlines classification and siting and construction criteria for waste management units and discharges of waste to land. Provides guidance for surface impoundments and Land Treatment Units, also stipulates operational and maintenance procedures to minimize mobility of waste materials.	Section 5.17.3

LORS	Applicability and Requirements	Where Discussed in AFC
California Code of Regulations, Title 22, Division 4, Chapter 15, Articles 1, 2, 3, 4, 4.1, 4.5, 5, and 5.5, Sections 64400.80 through 64445	Requires periodic monitoring of water quality for potable water wells supplying a public water system (non-transient, non-community water systems). Regulated wells must be sampled for bacteriological quality once a month and the results submitted to the California Department of Health Services (DHS). The wells must also be monitored for inorganic chemicals once and organic chemicals quarterly during the year designated by the DHS. DHS will designate the year based on historical monitoring frequency and laboratory capacity.	Section 5.17.1.2
CEC Policy, adopted pursuant to Public Resources Code, Section 25300 et seq., 25523(a)	The CEC will approve the use of "fresh inland" water for cooling purposes by power plants only under certain circumstances. Requires submission of information to the CEC concerning proposed water resources and water quality protection in the AFC.	Section 5.17.2.9 5.17.2.10
Local:		
San Bernardino County Ordinance Code, Title 3, Division 3, Chapter 6, Domestic Water Sources and Systems, Article 3, Water Wells	Describes requirements for permitting, siting, constructing, and destroying groundwater wells. Stipulates conditions for abandonment and taking wells out of service. Describes water quality standards and requirements for the inspections of wells.	Section 5.17.3
San Bernardino County Ordinance Code, Title 3, Division 3, Chapter 8, Waste Management, Article 5, Liquid Waste Disposal	Article regards approval, permitting, and location requirements of liquid waste disposal systems.	Section 5.17.1.3
San Bernardino County Ordinance Code, Title 6, Division 3, Chapter 3, Uniform Plumbing Code	Describes installation and inspection requirements for locating disposal/leach fields, and seepage pits.	Section 5.17.1.3

5.17.1.1 Federal LORS

Clean Water Act of 1977 (including 1987 amendments) Section 402 and 402, 33 USC Section 1342; 40 CFR Parts 112, 122-136

The primary objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand, total suspended solids, oil and grease, and pH, and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The National Pollutant Discharge Elimination System (NPDES) Program (CWA §402) controls the direct discharges and storm water discharges into waters of the United States. NPDES permits contain industry-specific, technology-based limits and may also include additional water quality-based limits, and they establish pollutant-monitoring requirements. A NPDES permit may also include discharge limits based on federal or state water-quality criteria or standards. In 1987, the CWA was amended to include a program to address storm water discharges for industrial and construction activities. The Lahontan Regional Water Quality Control Board (RWQCB) administers both the NPDES and storm water discharge permits under the CWA in the project area.

According to the San Bernardino County Flood Control District, the 100-year floodplain has not been established for the Harper Dry Lake area.

5.17.1.2 State LORS

State of California Constitution Article 10, Section 2

Article 10, Section 2 of the California Constitution requires that water resources of the State be put to beneficial use to the fullest extent of which they are capable. This section prohibits the waste or unreasonable use, or unreasonable method of use or unreasonable method of diversion, of water.

Porter-Cologne Water Quality Control Act

Porter-Cologne Water Quality Control Act of 1967, Water Code Division 7, Chapter 1, Section 13000 *et seq.* requires the State Water Resources Control Board (SWRCB) and the nine RWQCBs to adopt water quality criteria to protect State waters. Those criteria include the identification of beneficial uses, narrative and numerical water quality standards, and implementation procedures. Water quality criteria for the proposed project area are contained in the Water Quality Control Plan for the Lahontan Region (Basin Plan) which was adopted in 1994 and is in the process of being amended. This plan sets numerical and/or narrative water quality standards controlling the discharge of wastes to the State's waters and land.

California Storm Water Permitting Program

California Construction Storm Water Program. Construction activities that disturb one acre or more are required to obtain coverage under California's General Permit for Discharges of Storm Water Associated with Construction Activity, Water Quality Order 99-08-DWQ (General Construction Permit CAS 000002). Activities subject to permitting include clearing, grading, stockpiling, and excavation.

The General Construction Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) that specifies Best Management Practices (BMPs) that will reduce or prevent construction pollutants from leaving the site in storm water runoff and will also minimize erosion associated with the construction project. The SWPPP must contain site map(s) that show the construction site perimeter, existing and proposed structures and roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the site. Additionally, the SWPPP must describe the monitoring program to be implemented.

California Industrial Storm Water Program. Industrial activities with the potential to impact storm water discharges require a NPDES permit. In California, an Industrial Storm Water General Permit, Order 97-03-DWQ (General Industrial Permit CAS 000001) may be issued to regulate discharges associated with power generation facilities. The General Industrial Permit requires the implementation of management measures that will protect water quality. In addition, the discharger must develop and implement a SWPPP and a monitoring plan. Through the SWPPP, sources of pollutants are to be identified and the means to manage the sources to reduce storm water pollution described. The monitoring plan requires sampling of storm water discharges during the wet season and visual inspections during the dry season. A report must be submitted to the RWQCB each year by July 1 documenting the status of the program and monitoring results.

California Water Code

Division 1, Chapter 6, Article 2, Section 461. This law stipulates that the primary interest of the people of California in the conservation of all available water resources requires the maximum reuse of reclaimed water in the satisfaction of requirements for beneficial uses of water.

Division 2, Part 2, Chapter 1, Article 1, Section 1200 "Water Rights". This law classifies water in one of three categories: surface water, percolating groundwater, and "subterranean streams that flow through known and definite channels". Only surface water and subterranean stream water are within the permitting jurisdiction of the State Water Resources Control Board (SWRCB). Appropriation of those waters requires a SWRCB permit, and is subject to various permit conditions.

In establishing whether there is a condition of subterranean streams, the SWRCB uses a finding that there must be evidence of bed and banks and water flowing along a line of a surface stream (Sax 2002). Based on a review of the subsurface conditions at the Project site, there is no evidence to support that the groundwater is flowing in subterranean streams, and as such, there is no permit required for appropriation from the SWRCB.

Division 7, Chapter 4, Article 4, Section 13260 et seq. This law requires filing with the appropriate RWQCB a report of waste discharge (ROWD) that could affect the water quality of the State, unless the requirement is waived pursuant to Water Code Section 13269(a). The report shall describe the physical and chemical characteristics of the waste that could affect its potential to cause pollution or contamination. The report shall include the results of all tests required by regulations adopted by the board, any test adopted by the Department of Toxic Substances Control (DTSC) pursuant to Section 25141 of the Health and Safety Code for extractable, persistent, and bio-accumulative toxic substances in a waste or other material, and any other tests that the SWRCB or RWQCB may require.

Division 7, Chapter 7, Article 7, Section 13550. Use of recycled water is required for industrial purposes subject to recycled water being available and a number of criteria, including provisions that the quality and quantity of the recycled water are suitable for the use, the cost is reasonable, the use is not detrimental to public health, and the use will not impact downstream users or biological resources.

Division 7, Chapter 7, Article 7, Section 13551. A person or public agency, including a state agency, city, county, district, or any other political subdivision of the state, shall not use water from any source of quality suitable for potable domestic use for non-potable uses if suitable recycled water is available as provided in Section 13550.

Division 7, Chapter 7, Article 7, Section 13552.6. This law specifically identifies the use of potable domestic water for cooling towers as an unreasonable use of water within the meaning of Section 2 of Article 10 of the California Constitution, if suitable recycled water is available and the water meets the requirements set forth in Section 13550.

Division 7, Chapter 10, Article 3, Section 13751. Anyone who constructs, alters, abandons, or destroys a water well, cathodic protection well, groundwater monitoring well, or geothermal heat exchange well must file a well completion report with the DWR within 60 days from the date its construction, alteration, abandonment, or destruction is completed.

State Water Resources Control Board Resolution 75-58

On June 19, 1975, the SWRCB adopted the Water Quality Control Policy on the Use and Disposal of Inland Waters used for Power Plant Cooling. The purpose of the policy is to provide consistent statewide water quality principles and guidance for adoption of discharge requirements, and implementation actions for power plants that depend on inland waters for cooling. State policy encourages the use of wastewater for power plant cooling and sets the following order of preference for sources: 1) wastewater being discharged to the ocean; 2) ocean water; 3) brackish water from natural sources or irrigation return flows; 4) inland waste waters of low total dissolved solids (TDS); and 5) other inland waters. The criteria for the selection of water delivery options involve economic feasibility, engineering constraints such as cooling water composition and temperature and environmental considerations such as impacts on riparian habitat, groundwater levels, and surface and subsurface water quality.

California Code of Regulations

Title 23, Division 3, Chapter 9. The RWQCB must issue a report of waste discharge for discharges of waste to land pursuant to the Water Code. The report requires submittal of information regarding the proposed discharge, waste management unit design, and monitoring program. Waste Discharge Requirements (WDRs) issued by the RWQCB establish construction and monitoring requirements for the proposed discharge. The SWRCB has adopted general waste discharge requirements (97-10-DWQ) for discharge to land by small domestic wastewater treatment systems.

Title 23, Division 3, Chapter 15. This regulation outlines siting, construction and monitoring requirements for waste discharges to land for landfills, surface impoundments, land treatment units and waste piles. The chapter provides closure and post-closure maintenance and monitoring requirements for Class II designated waste facilities and surface impoundments that are applicable to the project.

Title 22, Division 4, Chapter 15, Articles 1, 2, 3, 4, 4.1, 4.5, 5, and 5.5 Water Wells, Sections 64400.80 through 64445. These regulations require monitoring for potable water wells supplying public water systems, defined as non-transient, non-community water systems (serving 25 people or more for more than six months); the project will employ about 63 workers during normal MSP operations and 73 workers during the summer months. Regulated wells must be sampled for bacteria once a month and the results submitted to the DHS. The wells must also be monitored for inorganic chemicals once and organic chemicals quarterly during the year designated by the DHS. DHS will designate the year based on historical monitoring frequency and laboratory capacity.

Public Resources Code

CEC Policy adopted pursuant to Section 25300 et seq. In the 2003 "Integrated Energy Policy Report", consistent with SWRCB Policy 75-58 and the Warren-Alquist Act, the CEC adopted a policy to approve the use of "fresh inland" water for cooling purposes by power plants only where alternative water supply sources and alternative cooling technologies are shown to be "environmentally undesirable" or "economically unsound."

Section 25523(a). The Public Resources Code provides for the inclusion of requirements in a CEC License Decision to assure protection of environmental quality and requires submission of information to the CEC concerning proposed water resources and water quality protection.

The administering agencies for the State LORS are the CEC, the SWRCB, and the Lahontan RWQCB. The project will comply with all applicable State LORS related to water use and quality during construction and operation.

5.17.1.3 Local LORS

San Bernardino County

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0631 - Permits. This ordinance requires that no person or entity, as principal agent or employee, shall dig, drill, bore, drive, reconstruct or destroy (1) a well that is or has been used to produce or inject water (2) a cathodic protection well (3) an observation well or (4) an exploration well without first filing a written application to do so with the DEHS by receiving and retaining a valid permit as provided herein.

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0636 – General Location of Water Wells. This ordinance describes requirements for the general siting of water wells. It states that it shall be unlawful for any person or entity to drill, dig, excavate, or bore any water well at any location where sources of pollution or contamination are known to exist or existed, or where otherwise substantial risk exists that water from that location may become contaminated or polluted even though the well may be properly constructed and maintained. Every well shall be located an adequate distance from all potential sources of contamination and pollution.

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0638 – Well Surface and Subsurface Construction Features. This ordinance outlines the requirements for placement of the annular seal for water supply wells. It includes guidelines for the placement of a sample spigot on the pump discharge line of any water well used as a public water supply adjacent to the pump and on the distribution side of the check valve. It further states that a check valve shall be provided on the pump discharge line adjacent to the pump for all water wells. This ordinance states that all community water supply wells and individual domestic wells shall be provided with a pipe or other effective means through which chlorine or other approved disinfecting agents may be introduced directly into the well. It requires that a master meter or other suitable measuring device shall be located at each source facility and shall accurately register the quantity of water delivered to the distribution system from all community water supply wells serving a public water supply system. This ordinance outlines the requirements of the use of an air-relief vent, if present.

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0640 – Water Quality Standards. This ordinance states that water from all new, repaired, and reconstructed community water supply wells shall be tested and meet standards for microbiological, chemical, physical, and radiological quality in accordance with California Administrative Code, Title 22, "Domestic Water Quality and Monitoring."

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0641 – Required Inspections of Wells. This ordinance requires that an inspection shall be requested of DEHS (a) at least 24 hours in advance of the filling of the annular space or conductor casing, (b) after the installation of the surface protective slab, pumping, and other required equipment, (c) and immediately before and during the destruction of a well; immediately after the well destruction, (d) and at any other time stipulated on the DEHS permit.

Ordinance Code, Title 3, Division 3, Chapter 6 - Domestic Water Sources and Systems, Article 3 – Water Wells, Section 33.0643 – Well Abandonment. This ordinance code states that if after 30 days of abandonment, the owner of an abandoned well has not declared the well to DEHS for proposed reuse per Section 33.0644, then the well shall be destroyed per Section 33.0631 of this Article. If any well is found by DEHS to be a hazard, whereby its continued existence is likely to cause damage to groundwater or to the public health and safety, DEHS shall direct the owner to destroy the well within a stated period. At the time of removal of a pump, the casing shall be provided with an adequate cap at the surface and shall be maintained so that it will not be a hazard to health or safety until such time that the abandoned well is properly sealed from the bottom to the top.

Ordinance Code, Title 3, Division 3, Chapter 8 - Waste Management, Article 5 – Liquid Waste Disposal, Section 33.0892 – Approved Liquid Waste Disposal Systems. This ordinance states that no person or entity shall install, utilize, or control the use of any liquid waste disposal system within this jurisdiction unless it is (a) a system which complies with applicable portions of the Uniform Plumbing Code as amended and adopted by this jurisdiction and complies with DEHS standards, (b) a system which has been approved by the DEHS and the building authority of this jurisdiction or (c) an alternative liquid-waste disposal system which has been approved by the DEHS, the appropriate building official of this jurisdiction, and the appropriate California Regional Water Quality Control Board as protecting water quality, public health, and safety.

Ordinance Code, Title 3, Division 3, Chapter 8 - Waste Management, Article 5 – Liquid Waste Disposal, Section 33.0893 – Permits for Alternative Liquid Waste Disposal Systems. This ordinance states that no person or entity shall install any alternative liquid-waste disposal system without first obtaining a DEHS permit to do so and paying those fees to the DEHS as are set forth in the Chapter 2 of Division 6 of Title 1 of the San Bernardino County Code.

Ordinance Code, Title 3, Division 3, Chapter 8 - Waste Management, Article 5 – Liquid Waste Disposal, Section 33.0894 – Liquid Waste Disposal System Location Requirements. This ordinance states that location requirements shall be as stated in the DEHS Standards on file with the Clerk of the Board under the date of August 1992, as the same may be amended by the DEHS from time to time and approved by the Board of Supervisors. It further states that all liquid waste disposal systems within this jurisdiction shall be installed to comply with minimum Standards unless the conditions of a DEHS-issued permit otherwise allows.

Ordinance Code, Title 6, Division 3, Chapter 3 - Uniform Plumbing Code. This code describes installation and inspection requirements for locating disposal/leach fields, and seepage pits.

5.17.1.4 Agency Contacts

Agencies that will coordinate with the CEC during the licensing process for the Project include the Lahontan RWQCB (WDRs, storm water permitting) and the County of San Bernardino Department of Environmental Health Services (water well and septic system permits). Contacts for these agencies are provided in Table 5.17-2.

Table 5.17-2. Water Resources Agencies and Contact Information

Contact	Phone/Email	Permits/Issue
Richard W. Booth, PG, CHg Senior Engineering Geologist Lahontan RWQCB South Lake Tahoe Office 2501 Lake Tahoe Blvd. South Lake Tahoe, CA 96150	(530) 542-5574 RBooth @waterboards.ca.gov	Waste Discharge Requirements (WDR) and Storm Water Permits
Marvyn Cerdenio Environmental Technician County of San Bernardino Department of Environmental Health Services	(909) 387-4666 lcerdenio@dph.sbcounty.gov	Groundwater Supply Well Permits

Contact	Phone/Email	Permits/Issue
385 North Arrowhead Ave., 2nd Floor San Bernardino, CA 92415-0160		
Jheri Younger Environmental Technician County of San Bernardino Department of Environmental Health Services 385 North Arrowhead Ave., 2nd Floor San Bernardino, CA 92415-0160	(909) 387-4666 jyounger@dph.sbcounty.gov	Groundwater Supply Well Permits
Hal Houser Environmental Health Specialist County of San Bernardino Department of Environmental Health Services 385 North Arrowhead Ave., 2nd Floor San Bernardino, CA 92415-0160	(909) 387-4666 hhouser@dph.sbcounty.gov	Waste Management Septic Systems
Lance Eckhart Hydrogeologist and Valerie Wiegenstein Watermaster Services Manager Mojave Water Agency 13581 John Glenn Road, Suite B Apple Valley, CA 92308	(760) 946-7015 leckhart@mojavewater.org (760) 946-7026 vwiegenstein@mojavewater.org	Water Rights, Basin Hydrogeology, Basin Adjudication Issues

5.17.1.5 Required Permits and Permit Schedule

Water resources-related permits include a WDR as part of the proposed effluent discharge to onsite evaporation ponds; per discussions with RWQCB staff (Plaziak, 2008), this WDR is expected also to cover the bioremediation unit and land farm unit associated with treatment of soil from cleanup of spills of heat transfer fluid (HTF). Storm water permits also are required for the construction and operation of the Facility. Groundwater produced from onsite wells will be used for plant cooling, other process and domestic uses, and thus, modifications to existing wells permits will be required. Wells that have previously been permitted as agricultural will be reactivated, as appropriate. Those not used to provide water for the Project or to monitor groundwater pumping will be abandoned consistent with the San Bernardino County and State requirements. Table 5.17-3 lists the water related permits that are required for the Project. This table also provides the schedule for when applications for these permits are needed.

Table 5.17-3. Required Water Resources Permits and Schedule

Permit/Approval	Schedule
WDR, Evaporation Ponds, Bioremediation Unit and Land Treatment Unit	A WDR from the Lahontan RWQCB is required for discharge of effluent to the evaporation ponds. The WDR application will be submitted after AFC submittal and the permitting process is expected to take six to nine months. Per discussions with RWQCB staff (Plaziak, 2008), one permit application will be prepared that includes the evaporation ponds, bioremediation unit and land treatment unit.
Notice of Intent (NOI) - Construction Phase Storm Water Permit	A Construction General Permit is required. A SWPPP that specifies BMPs will identify measures to reduce or prevent construction pollutants from leaving the site. The NOI will be submitted shortly prior to commencing construction. It is anticipated that the NOI will be secured within one month of submittal.
Storm Water Pollution Prevention Plan	An Industrial General permit will be required for the Project operations phase. A separate SWPPP is required that outlines The monitoring and reporting plan, along with BMPs for the Facility.
Operations Phase Storm	The permit application package will be submitted to the RWQCB
Well Permits	Prior to commencing operations, permit modifications will be required to return the wells to active usage and change their status from agricultural use to industrial. Additionally, as required, well permits will be needed should additional supply or monitor wells be installed. After AFC submittal, and upon determination of the status of the wells on the site and of their role in the Project, applications for change of status and/or re-activation will be submitted. It is anticipated that the permits will be secured shortly after the application is submitted. Wells not used for supply or to monitor pumping will be abandoned consistent with San Bernardino County and DWR requirements.
Septic System	Permitting of the septic system would be through the County of San Bernardino Department of Environmental Health Services. This will be done prior to the start of construction. It is anticipated that it would take one to two months to complete the permitting of the septic system.

5.17.1 Affected Environment

The proposed MSP is located at approximately N 35.03º / W 117.33º within the Harper Valley Groundwater Basin (HVB), a part of the Centro Sub-Basin of the Mojave River Basin (MRB). The HVB comprises about 640 square miles (410,000 acres) and includes a small portion of Kern County, with most of the basin within San Bernardino County. The HVB is centered on Harper Dry Lake, a dry lake bed with a surface elevation of about 2,025 ft above mean sea level (ft amsl); Harper Dry Lake is about 10 miles northwest of Hinkley, San Bernardino County, California (Lockhart quadrangle). The MSP is near Harper Dry Lake, as shown in Figure 5.17-1. Figure 5.17-1 shows the modified HVB, which is the domain of the numerical model (the Domain). The Domain is about 411 square miles. It is positioned within the western part of the Mojave Desert in southern California, 100 miles northeast of Los Angeles.

The Mojave Desert is characterized by barren mountain ranges and isolated hills with broad alluvial-filled valleys. The site is relatively flat with a very gentle downward slope toward Harper Dry Lake to the north-northeast. Portions of the MSP site have recently been used for agriculture purposes. Structures on the site generally consist of irrigation equipment along with active and numerous inactive water wells. Ground surface elevations within the main MSP footprint range from about 2,030 ft amsl at the northeastern edge of the site near Harper Dry Lake to about 2,100 ft amsl at the southwestern corner of the site (see Figures 5.17-2 and 5.17-3, Topography). Vegetation generally consists of sparse to moderate growth of desert plants and shrubs.

The headwaters for the Mojave River lie about 40 to 50 miles south of the Harper Dry Lake area within the high mountains of the central Transverse Ranges that were uplifted along the San Andreas Fault during the past several million years. The Mojave River channel is about 11 miles southeast of Harper Dry Lake. Recharge from surface water of the Mojave River to the HVB aquifers may be minor, possibly occurring during episodic storm flows, usually in the winter. During the rest of the year, most of the river is usually dry.

As shown in Figures 5.17-1 and 5.17-4, the Domain is about 411 square miles and includes part of the HVB, Harper Dry Lake, Kramer Junction, a southern extension to Hinkley, the Hinkley gap, and a portion of the Mojave River. In both area and shape, the Domain approximately coincides with potentiometric surface maps prepared using 1958, 1998, and 2004 source data (Harper Lake Basin Hydrogeologic Report, CSU – Fullerton and MWA, September 2007); See figures 5.17-6 through 5.17-9.

As shown in Figure 5.17-4, the Domain is drained by numerous ephemeral steams sloping toward Harper Dry Lake. The HVB has no streams discharging water out of the basin; it is a closed basin. Annual precipitation ranges from about 3 to 7 inches with highland areas of the basin receiving more precipitation and basin areas with low topography receiving less.

Quaternary lacustrine, fluvial and alluvial deposits, including unconsolidated younger alluvial fan material and unconsolidated to semi-consolidated older alluvium, can be water bearing within the basin (see Figure 5.17-5, General Geology). The fluvial deposits resulted from the ancestral Mojave River. The younger alluvium generally lies above the groundwater surface, whereas the older alluvium transects the water table (DWR, 1971).

The alluvial deposits gradually thin and become interbedded with layers of silty clay of lacustrine origin toward the middle of the basin (Bader, 1969; DWR, 1964). The older alluvium is the most important water-bearing stratum in the basin, with average well yields reported at about 725 gpm with a maximum of 3,000 gpm (DWR, 1975). Groundwater within the basin is generally unconfined, although confined conditions are found near Harper Dry Lake (DWR, 1971). Available potentiometric surface maps for the Harper Dry Lake area, based on a limited number of wells, indicate groundwater flow toward Harper Dry Lake (see Figures 5.17-6, 5.17-7, 5.17-8, 5.17-9). The total storage capacity of the HVB is estimated to be 6,975,000 acre-ft (DWR, 1975).

Water resources, their occurrence and use are complicated issues in the Mojave Desert. Groundwater within the desert provides an important resource for domestic, agriculture, commercial and industrial use and often supplements imported water from the State Water Project or Colorado River. Groundwater is a primary source of domestic water within the HVB.

The MRB was adjudicated in 1996. The Watermaster, a subdivision of the MWA, was appointed by the court to implement the terms of the Judgment entered in the adjudication. Water issues within the basin involving surface water or groundwater are managed by the MWA. For management purposes, the Judgment subdivided the Mojave River surface-water drainage basin into several subareas. The HVB is located entirely within the Centro subarea. The Mojave River is the primary source of surface water in the MRB but is not dependable for supply because significant flows occur only after intense storms. As a result, groundwater is used for agriculture and other needs.

The MSP through ownership or purchase options has rights to 10,478 AFY of groundwater (i.e. HVB / Centro Basin). These water rights consist of 9,380 AFY owned by Abengoa Solar, Inc., 224 AFY transferred in December 2008 from Jennie Most, trustee of the Most Family Trust, and an option to purchase 874 AFY from the Desert View Dairy (aka the Ryken Well). Upon obtaining ownership or purchase option, Abengoa Solar, Inc. stipulated to the Judgment entered by the court in the MRB adjudication. In accordance with the Judgment, the Watermaster adjusts production rights, requires set-asides, and recalculates assessments to account for changes in consumptive use.

Because the linear facilities (transmission line and gas pipeline) associated with the MSP will not require water as part of their operations and only minimal amounts during construction, the following discussion focuses on the MSP plant site facilities.

5.17.1.6 Climate and Precipitation

The HVB is located in the west central Mojave Desert in northwestern San Bernardino County. Average daily low and high temperatures are 32ºF to 61ºF, respectively, during January. In the summer months, however, the average diurnal temperature range is from 72ºF to 104ºF (see Graph 5.17-1). Mean annual precipitation in the basin is about 5 inches at the basin floor and about 7 inches in the surrounding highlands. Rainfall occurs largely in the winter months, with summer rainfall being rare (see Graph 2-2, Barstow Fire Station Average Monthly Precipitation). Table 5.17-4 displays the average monthly and annual minimum and maximum temperatures and total precipitation from 1980 to 2007, collected from a gauging station located at the Barstow Fire Station, about 18 miles southeast of the Project.

Average pan evaporation rate for the basin is 90 inches annually, with a maximum monthly evaporation rate of approximately 12 inches in July and a minimum monthly evaporation rate of 2.5 inches in January (National Oceanic and Atmospheric Administration, 1974). Graph 2-3, shows average monthly evapotranspiration in Barstow. According to one investigation, evaporation is considered to be negligible within the HVB, even though evaporation can occur when water ponds on dry lake surfaces or through bare-soil evaporation (Stamos et. al. 2001).

Water-limited environments (WLEs), such as the proposed MSP area, are those where the ratio between yearly precipitation and potential evapotranspiration (PET) is less than 0.75. In WLEs, recharge is generally low and PET is high.

Table 5.17-4. Barstow Fire Station, California Climate and Precipitation Summary[1] 1980 through 2007

Climate	Ave. Max. Temp. (°F)	Ave. Min. Temp. (°F)	Ave. Total Precip. (in.)
January	60.6	3.4	0.82
February	64.8	38.0	0.93
March	71.0	42.7	0.69
April	78.4	48.4	0.22
May	86.7	55.1	0.09
June	96.5	63.0	0.06
July	101.9	68.9	0.32
August	100.8	67.7	0.25
September	93.7	61.0	0.31
October	82.2	51.1	0.30
November	68.6	40.8	0.46
December	59.4	33.3	0.53
Annual[2]	80.4	50.4	4.97

[1] Source: Western Regional Climate Center, http://www.wrcc@dri.edu/ (Climate Station (040521)

[2] Refers to the annualized average of monthly temperature and precipitation values.

Key:

Ave. – Average

Max. – Maximum

Min. – Minimum

Temp. – Temperature

°F – degrees Fahrenheit

Precip. – Precipitation

in. - inches

5.17.1.7 Groundwater

Water needed for the proposed MSP will be extracted from the HVB or, more specifically, the uQal aquifer of the Domain. The CA DWR defines the HVB as positioned within the Harper Hydrologic Subunit.

Groundwater hydraulic information for the HVB has been obtained from readily available literature sources, existing and historical water wells, historical gas exploratory wells, available geophysical surveys, historical and newly prepared geologic cross sections, and quantitative hydraulic values derived from historical and newly performed aquifer pumping tests. Relevant information includes groundwater elevations, groundwater flow patterns, recharge, sinks, aquifer thickness, identification of aquitards, aquifer transmissivity and the aquifer storage coefficient. To minimize redundancy, information related to groundwater, hydrogeology, aquifer properties, aquifer testing, groundwater geochemistry, water budgets, and groundwater modeling is presented within the Basin Conceptual Model (BCM) report. A copy of this report is included as Appendix A.

5.17.1.8 Hydrogeology

The Mojave River does not typically flow and is usually dry. In the vicinity of Hinkley, rare flow within the river channel is from west to east and occurs from infrequent rain events during high precipitation years. In historic high-precipitation years, most recently in early 2005, the river flowed into the Silver Lake playa, a northern subbasin of Lake Mojave. The Mojave River channel is about 11 miles southeast of the proposed MSP. Recharge from the Mojave River to the HVB aquifers may be minor, possibly occurring during episodic storm flows, usually in the winter. During the rest of the year, most of the river is usually dry.

Harper Dry Lake, along with Lake Manix and Lake Mojave to the east, are part of a series of formerly interconnected basins. During much of the wetter Pleistocene epoch (10,000 to approximately 1.8 million years ago), these basins were connected by the ancestral Mojave River. In the late Pleistocene, after breaching Lake Manix basin, Lake Mojave episodically discharged northward into Death Valley (Reheis, et al, 2007). Today, the ground surface at Harper Dry Lake is about 2,025 ft amsl (see Figures 5.17-2 and 5.17-3). Thomas W. Dibblee recorded historic shorelines of Harper Lake as high as 2,160 ft amsl (Reynolds and Reynolds, 1994). BCM Figure 2-2 shows the maximum historical Harper Lake shoreline.

The combination of re-working of basin sediments by the Mojave River with active shedding of sediments from the alluvial fans coming off of the Rand Mountains, the Black Mountains and other basin perimeter highlands likely resulted in a complex distribution of well-sorted and poorly sorted deposits. Additional geologic controls that further increased the distribution complexity of sediment grain sizes and degree of sorting resulted from the continuing regional tectonic activity.

The HVB itself is a significant structure, and basin geometry controls groundwater flow. As an example, the HVB perimeter coincides with a groundwater divide caused by a bedrock structure consistent with a conventional basin shape.

The Domain is within the Mojave Block, one of the most tectonically active regions of the United States (Reheis et al, 2007). The geologic structure within the Domain is discussed in more detail within the BCM report, Appendix A. BCM Figure 1-12, shows southern California faults.

Geologic cross sections originally presented in the Hydrogeologic Assessment Report associated with permit application for the nearby SEGSs VIII and IX indicate a laterally extensive subsurface basalt flow positioned within the alluvium aquifer (The Mark Group, April 1989). The Black Mountain Basalt flow is about 75 to 200 feet thick, and although its continuity is undetermined due to limited investigation, it is likely present beneath a portion of Hinkley Gap, Harper Dry Lake, SEGs VIII and IX, and the proposed MSP. The impact of extensive volcanism upon sediment distribution, groundwater quality, general groundwater flow patterns, groundwater inflow into the Domain, and aquifer transmissivity, is not well understood within the Domain, especially in the vicinity of the HVB perimeter and including portions of the Hinkley Gap.

Primary depositional environments for water producing sediments in the project area of Harper Dry Lake are lacustrine / pluvial, potentially extending laterally to a maximum ground surface elevation of 2,160 ft amsl on the basis of recorded historic shorelines (refer to BCM Figure 2-2). The nominal surface elevation of Harper Dry Lake is 2,025 ft amsl. Fluvial deposits and reworked lacustrine sediment from the ancestral Mojave River are present beneath the project area. Due to limited subsurface information, elevations of these Pleistocene-age lacustrine / fluvial sediment contacts are undefined.

Depth to groundwater beneath the proposed MSP footprint is about 125 to 145 ft bgs. Quaternary lacustrine and alluvial deposits, including unconsolidated younger fan material and unconsolidated to semi-consolidated older alluvium, can be water bearing within the basin (see Figure 5.17-5). The alluvial deposits gradually thin and become interbedded with layers of silty clay of lacustrine origin toward the middle of the basin (Bader, 1969; DWR, 1964). The older alluvium is the most important water-bearing stratum in the basin, with average well yields reported at about 725 gpm with a maximum of 3,000 gpm (CA DWR, 1975). Groundwater within the basin is generally unconfined, although confined conditions are found near Harper Dry Lake (DWR, 1971). The total storage capacity of the HVB is estimated to be 6,975,000 acre-ft (DWR, 1975).

In the vicinity of Harper Dry Lake and beneath the proposed MSP, a basalt flow (or flows), identified as the Black Mountain Basalt flow of early Pleistocene age is present within the playa / lacustrine deposits and the fluvial deposits from the ancestral Mojave River. In other areas, the basalt may rest directly on Tertiary sandstone or pre-Tertiary bedrock units. Depth to the top of the basalt is variable. Beneath the project area, the expected depth to it is about 500 ft bgs, with variable thickness of about 75 to 200 ft. Where free of fractures, the basalt layer functions as an aquitard. Due to limited subsurface information, the extent and continuity of the basalt layer have been estimated based on review of driller's logs, available geologic cross sections, and interpretation of recent magnetotelluric data. Figure 5.17-16 shows the interpreted perimeter of the Black Mountain Basalt. See Appendix A, BCM Appendix H, Geophysical Investigations, for more information.

Pleistocene age unconsolidated sediment from lacustrine / pluvial depositional processes along with sediment from fluvial / reworked lacustrine environments likely continues beneath the basalt layer to bedrock. In the MSP footprint area, the depth to bedrock is estimated at 900 to 1,000 ft bgs (Ebbs, 2007). Because of compaction and potential cementation, hydraulic conductivity is estimated to be 75 percent reduced within the unconsolidated sediment below 1,100 ft amsl.

Within the Domain but outside of the depositional influence of ancestral Harper Lake (i.e., ground surface elevation of 2,160 ft amsl), the primary depositional environment for water-producing sediment is alluvial fan and fluvial. These sediments extend to bedrock and likely become more compacted below about 1,100 ft amsl. The geologic history of deposits within the Domain was obtained through review of available technical literature and lithologic data and is discussed in greater detail within the BCM Report, Appendix A.

5.17.1.9 Groundwater Occurrence and Flow

Within the MRB, the HVB, and the Domain, two aquifers are recognized by the USGS and by the MWA. They are commonly identified as the Floodplain and Regional Aquifers. The Regional Aquifer is also known as the Qal Aquifer. These aquifers are hydraulically connected. Since the Mojave River is a losing stream, underflow is from the Floodplain Aquifer to the Regional Aquifer. Transmissivity is significantly larger within the Floodplain Aquifer than within the Regional Aquifer. Nonetheless, relatively large yields (≥ 1,000 gpm) have been documented from water wells completed within the Regional Aquifer near Harper Dry Lake. The proposed MSP will use groundwater produced from the upper portion of the Regional Aquifer, the uQal.

Groundwater within the Regional Aquifer is subdivided into the uQal and the lQal in areas where subsurface basalt flows are present. In Domain areas where the basalt layer is not present, the aquifer is identified as the Qal aquifer.

The early Pleistocene-age Black Mountain Basalt flow is beneath portions of Harper Dry Lake and the project area. In the project area, the basalt is likely positioned within the aquifer at about 500 ft bgs, with variable thickness ranging from about 75 to 200 ft. Where it is free of fractures, the basalt layer functions as an aquitard. Due to limited subsurface information, the perimeter positions and continuity of the basalt layer are unknown. Refer to BCM Report Section 4.5.11, Basalt Mountain Basalt Discussion, Appendix A.

In the vicinity of the proposed MSP, the potentiometric surface for the uQal Aquifer is about 1,904 ft amsl (see Figure 5.17-9, Potentiometric Surface 2008) and depth to groundwater is about 143 ft bgs. Thickness of the uQal aquifer beneath the proposed MSP is about 300 to 400 ft. Due to the lack of wells completed within the lQal, the associated potentiometric surface is undocumented. Thickness of the lQal is also undocumented. Groundwater flows from the Domain perimeter toward Harper Dry Lake and flow rates vary as a function of time and position.

Perched groundwater was documented west of Harper Dry Lake (The Mark Group, April 7, 1987). Depth to groundwater within shallow geotechnical soil borings was recorded as 9 to 26 ft bgs. Based on these groundwater elevations flow is toward the Harper Dry Lake wetlands from these soil-boring locations. The 1987 report concluded that applied irrigation water was the source of the observed perched water. Perched groundwater within the Harper Dry Lake area is not considered a significant influence to groundwater flow within the Domain. However, it could influence uQal water quality if the perched water leaked downward through improperly abandoned wells.

Outcrops of igneous, metamorphic and sedimentary rock within the Domain (see Figure 5.17-5) are areas of no flow. Hydraulic conductivity within these rock ridges and hills is low, and they are considered an aquiclude.

Water levels within the HVB vary from approximately ground surface near Harper Dry Lake (perched water) to nearly 300 ft bgs 10 miles west of the proposed MSP near Kramer Junction. Refer to Figures 5.17-6 through 5.17-9 showing historical potentiometric surface maps. Comparison of historical groundwater elevations, hydraulic gradients, and direction of flow are discussed in greater detail with the BCM Report, Appendix A.

The basement rock (see Figure 5.17-10) is a no-flow boundary. Hydraulic conductivity within the basement rock is low and it is considered an aquiclude.

Aquifer properties relevant to understanding groundwater flow are transmissivity (T), aquifer thickness (b), and the storage coefficient (S). T and S values are obtained by processing aquifer pumping test data, and when test data are not available, T and S values may be estimated from literature sources. The T value is the product of hydraulic conductivity (K) and b. Aquifer thickness is obtained from driller's logs or from geophysical data interpretations. Based on well logs, the bottom of the uQal Aquifer within the proposed MSP is at a nominal elevation of about 1,600 ft amsl, providing a b value of about 300 ft.

The BCM Report (Appendix A) discusses tests conducted between August 14 and 25, 2008 involving pumping of the Ryken Well. The Ryken Well is located within the MSP footprint (Figure 5.17-22). The objective of the pumping tests was to provide hydraulic information needed to evaluate the feasibility of using groundwater pumped from the upper Quaternary alluvium as MSP process water. The potentiometric surface under static conditions at the Ryken Well is about 1,904 ft amsl. Aquifer testing showed a maximum of 37 feet of drawdown in the Ryken Well (i.e., the Ryken Well) after 7 days of continuous pumping at a rate of 1,143 gpm. The saturated thickness of the uQal aquifer at the Ryken Well is about 267 feet. BCM Graphs 2-4 through 2-14 show hydraulic head change due to various pumping sources. Pumping test results are summarized below.

- For unconsolidated aquifer sediment above 1,100 ft amsl, excluding flood plain sediment, LGS recommends application of hydraulic conductivity of 843 gallons per day per square foot (gpd/ft^2) or 0.039 centimeters per second (cm/sec), unless subsurface data or depositional environment interpretations indicate otherwise.
- For aquifer sediment below 1,100 ft amsl, excluding flood plain sediment, LGS recommends application of hydraulic conductivity of 210 gpd/ft^2 (0.00975 cm/sec), unless subsurface data indicate otherwise.
- In aquifer areas inside the ancestral Harper Dry Lake footprint, LGS recommends application of a Storativity coefficient value of 0.003, unless subsurface data or depositional interpretations indicate otherwise.
- In aquifer areas outside the ancestral Harper Dry Lake footprint (i.e., no clay layers present providing aquifer confinement), LGS recommends application of a Storativity coefficient value of 0.12, unless subsurface data or depositional interpretations indicate otherwise.

Refer to the BCM Report, Appendix A for additional discussion regarding aquifer properties.

Faults within the Domain (see Figure 5.17-5) can affect groundwater flow. These faults control the surface exposures of the bedrock materials adjacent to the basin and contributed to the formation of Harper Dry Lake. They may restrict groundwater flow and create subsurface compartments with hydraulic qualities different from those of adjacent areas. Generally, quantitative hydraulic conductivity data within fault zones are unavailable.

According to one investigation, evaporation is negligible within the HVB. Evaporation can occur when water ponds on dry lake surfaces or through bare-soil evaporation (Stamos et. al. 2001). Depth to non-perched groundwater beneath Harper Dry Lake is estimated at about 125 ft bgs (see Figure 5.17-9). Moisture within sediment beneath the playa surface likely derives from infrequent precipitation events rather than a hypothetical 125-ft-thick capillary fringe. A dry, white, mineral crust covers the Harper Dry Lake playa, decreasing evaporation of moisture within near-surface lacustrine sediment. This mineral crust dissolves during precipitation events and reforms as the playa surface water rapidly evaporates.

Large historical pumping rates from wells near Harper Dry Lake did not affect water levels in the northeast portion of the HVB (CSU / MWA, 2007). Underflow from the Middle Mojave River Valley Groundwater Basin into the HVB is independent of groundwater pumping at the proposed MSP or in the general vicinity of Harper Dry Lake.

The Harper Dry Lake area is the single natural groundwater sink within the HVB. Significant historical agriculture pumping occurred in the Harper Dry Lake area. In response to elimination of most agriculture pumping, the potentiometric surface is slowly recovering or rising (see Figure 5.17-23).

In current times, groundwater production within the HVB mostly occurs due to pumping near Harper Dry Lake. Primary categories of groundwater production include the FPLE SEGS VIII and IX and the Ryken irrigation well (Desert View Dairy),

Since the adjudication, consumption of water within the HVB has dropped by nearly 50 percent (MWA 2007). The MWA Watermaster has tracked and estimated annual water production for the HVB. Verified water production for the water year 2005-06 was 3,429 AFY (MWA 2007).

5.17.1.10 Recharge to the Harper Lake Water Basin

Within the MRB, the HVB, and the Domain, recharge to alluvial aquifers occurs by the following sources:

- Storm runoff from the highlands that enters ephemeral streams with eventual percolation to the underling aquifer;
- Precipitation falling on the basin floor;
- Precipitation falling on the surrounding mountain areas that percolates into bedrock with eventual flow into the basin; and
- Groundwater underflow from basins adjacent to the HVB.

Over the long term, recharge to alluvial aquifers due to precipitation within the HVB is approximately equal to precipitation source recharge to the Domain. Percolation of rainwater into the 100,800 acres of hills surrounding the HVB with eventual flow into the basin is about 300 AFY (The Mark Group, April 7, 1987). Stable isotope tests show that recharge in desert environments varies from 0.34 to 0.51 percent of precipitation (Stone, 1986). Rainwater falling onto the 297,200-acre HVB floor and providing aquifer recharge is estimated at 420 AFY. Precipitation falling on the surrounding mountain areas that percolates into bedrock with eventual flow into the basin is estimated by the CA DWR as 550 AFY or about 1 percent of annual precipitation falling on those highland areas (CA DWR, 1967).

Although additional gaps within the perimeter bedrock structure likely exist, information is currently not available to support underflow estimates within HVB perimeter areas other than the Hinkley gap. Refer to Figure 5.17-13 showing relatively low potential for underflow through the Lynx Cat-Iron Mountains gap. Description and evaluation of underflow into the HVB is discussed in greater detail within the BCM Report, Appendix A.

Table 5.17-5 summarizes recharge estimates to the HVB alluvial aquifers:

Table 5.17-5. Recharge Estimate

	AFY
Precipitation falling on the basin floor	420 (1)
Precipitation falling on the surrounding highlands	300 (1)
Runoff from the highlands that enters ephemeral streams	550 (1)
Hinkley Gap underflow	2,100 (2)
Recharge of indeterminate origin	3,160 (3)
Total	6,530

(1) Refer to BCM Report Section 4.6.3, Recharge to the Domain. Sources include The Mark Group, April 7, 1987;CA DWR, 1967

(2) Underflow through gap on west side of Red Hill (aka Hinkley Gap). Refer to Table 8, CSU and MWA, September 2007; average of four underflow estimates; excludes the two lowest estimates (basis: MWA 1983 estimate superseded in 2007 report and DWR 1967 no underflow location specified)

(3) Derived from numerical model water balance, BCM Report (Appendix A)

Identifying underflow recharge to the HVB, a basin described as closed because of bedrock structure, is of interest. As previously discussed, underflow recharge to the HVB from the Middle Mojave River Valley Groundwater Basin has been identified, contrary to the closed-basin model. Underflow from adjacent basins through other potential gaps in the HVB perimeter bedrock has not been investigated.

Geochemical analyses are commonly employed in the identification of recharge. Understanding salinization mechanisms may assist in HVB underflow investigation. Chloride and sulfate are the primary anions contributing to salinity in HVB waters. For water sampled at the Hinkley and Ryken Wells, the ratio of Cl to SO_4 is about 2:1 with increased anion concentrations. At the well east of Harper Dry Lake, the ratio of Cl to SO_4 is about 1:1 with decreased anion concentrations. Different ratios of Cl to SO_4 between the Hinkley and Ryken wells as compared to the well east of Harper Dry Lake suggest different recharge sources. Significantly decreased anion concentrations at the well east of Harper Dry Lake indicate recharge other than through the Hinkley gap. Recharge from adjacent Superior Valley beneath Quaternary basalt flows as suggested by the CA DWR is a possibility (CA DWR 1975). Although gypsum deposits often are the source of dissolved sulfate in groundwater, gypsum deposit(s) have not been identified within the HVB or Domain. Concentration patterns discussed above are readily apparent on Graph 5.17-4 (chloride vs. sulfate).

Due to the significant reduction of agriculture groundwater production over the past 20 to 30 years, the potentiometric surface within the Domain is recovering to a higher elevation, especially in the vicinity of the proposed MSP (Figure 5.17-23).

5.17.1.11 Domain Groundwater Geochemistry

Concentration of dissolved salts in groundwater in a desert environment is usually higher than elsewhere. Most of the dissolved salts are present in concentrations that are generally not hazardous but create poor taste and residue problems such as pipe scaling and sink staining. From cursory analysis, the irrigation wells in Harper Valley show TDS concentrations ranging from approximately 400 to 5500 mg/L. Shallow perched water within about 20 ft bgs, especially near Harper Dry Lake, is very high in salts because of evaporation of irrigation runoff. This zone with perched groundwater is typically avoided and not screened during well construction but may be a source of poor quality recharge to the water table. Water quality appears to vary with depth beneath the area.

Groundwater quality within the HVB is generally marginal to inferior for irrigation and domestic uses because concentrations of boron, fluoride, and sodium are elevated (Figure 5.17-24). General groundwater quality information for the HVB is summarized below (DWR 1964):

- Reports from the west side indicate uneven mixtures of sodium, chloride, bicarbonate, and sulfate, with TDS content as high as 2,390 mg/L; elevated concentrations of fluoride, boron and sulfate have been reported.
- The southern side is of calcium-sodium sulfate character with high sulfate, boron, and TDS concentrations.
- The northern side is of sodium sulfate-bicarbonate character with relatively high concentrations of sodium, fluoride, and boron.
- The eastern side (i.e., proposed MSP) is of a sulfate-chloride character, with chloride ranging from about 500 mg/L to 2400 mg/L and sulfate ranging from 350 mg/L to

about 600 mg/L; boron and iron concentrations also tend to be elevated; reports of TDS ranged from about 1600 mg/L to 5500 mg/L.

- Groundwater targeted as the make-up water for cooling electricity generation equipment at the proposed MSP is not potable and would require treatment prior to drinking.

Advisory information regarding general groundwater quality for the proposed MSP area is summarized below:

- Groundwater TDS concentrations appear to increase as distance from the well to the present-day playa decreases;
- Perched groundwater caused by historical and current agriculture irrigation may be common in the proposed MSP area. Agricultural source perched water often contains elevated TDS concentrations. Improperly designed / constructed wells, both abandoned and active, provide a vertical conduit between perched groundwater and the uQal Aquifer;
- Proper well design / construction eliminates vertical connections between perched groundwater and the uQal Aquifer and thereby reduces the TDS concentration of produced groundwater;
- Destruction procedures are available to eliminate vertical hydraulic connections at abandoned wells and thereby reduce the TDS concentration of produced groundwater.

Within the HVB, groundwater quality is variable. Concentrations of major cations and anions were graphed from water samples collected in 1990, 1992, 2000, 2002, and 2008 (Ryken Well only). Refer to BCM Report Section 4.8.1 for discussion of a series of Stiff diagrams (see Appendix A, BCM Graphs 2-21 through 2-28).

5.17.1.12 Hinkley Area Groundwater Quality

BCM Report Section 4.8.3 (see Appendix A) discusses the impact to groundwater quality of a historical release of hexavalent chromium from a Pacific Gas & Electric Company compressor station at 35863 Fairview Road, Hinkley. Status of the affected groundwater and potential impact to the proposed MSP is summarized below.

This historical release created a groundwater plume containing detectable hexavalent chromium concentrations exceeding the California Maximum Contaminant Level for drinking water of 50 µg/L. The plume of affected groundwater extends about 2 miles to the north of the compressor station and is about 1.3 miles wide (CA RWQCB Lahontan Region, Resolution No. R6V-2008-0013). PG&E monitors groundwater quality across the affected site and off-site areas by use of a comprehensive groundwater monitoring well network on a bi-monthly, quarterly, and semi-annual basis depending on well locations (CA RWQCB Lahontan Region, Resolution No. R6V-2008-0013). Groundwater flow is to the north-northwest in the project area (CA RWQCB Lahontan Region, Resolution No. R6V-2008-0013). The site is subject to various RWQCB orders, including a Cleanup and Abatement Order requiring PG&E to conduct cleanup of chromium in groundwater in a manner that does not threaten to create nuisance conditions (CA RWQCB Lahontan Region, Resolution No. R6V-2008-0013). PG&E proposes extraction and management of groundwater, as well as in-situ treatment, to reduce contamination in the groundwater and contain plume migration.

LGS interpreted aquifer pumping test data collected from the MSP area near Harper Dry Lake. The distance from the proposed MSP water production wells to the northern, leading edge of the affected groundwater plume in the Hinkley Valley is about 10 miles. This distance is too large for future water production by the proposed MSP to influence contaminated groundwater in the Hinkley Valley.

5.17.1.13 MSP Geochemistry

Coincident with an aquifer pumping test at the active Ryken Well (see Figure 5.17-22), groundwater samples were collected and analyzed by Test America analytical laboratories for Title 22 parameters to evaluate potential water quality change due to pumping. Sample S-1 was collected early in the pumping test period on August 14, 2008. Sample S-2 was collected about 1 hour before the pump was turned off on August 25. Water pumping during this period was continuous at a rate of about 1,143 gpm. Additionally, groundwater from the Ryken well was sampled on November 26 and analyzed for supplemental parameters to assist with water treatment equipment design.

Groundwater from the Wetlands Supply Well (see Figure 5.17-22) was analyzed by Test America analytical laboratories for Title 22 parameters and supplemental parameters to assist with water treatment equipment design. This sample was collected on November 5, 2008 after the Well was pumped for a minimum of 20 minutes at a rate of about 1,150 gpm.

The laboratory reports are included within Appendix E of the BCM Report (see Appendix A). The entire laboratory data set was organized into tables (see Appendix A, BCM Report Appendix C). Tests for Silt Density Index and free chlorine are performed in the field at the wellhead. Table 5.17-6 summarizes water quality in the two wells.

Table 5.17-6. Summary of Water Quality Samples from the Ryken and Wetlands Supply Wells

Parameter	Ryken Well S-1	Ryken Well S-2	Ryken Well S-3	Wetlands Supply Well	Units
Sample Date	8-14-08	8-25-08	11-26-08	11-5-08	
GENERAL:					
Conductivity	2,600	2,400	NA	8200	µmhos/cm
Total Dissolved Solids	1,700	1,500	NA	5500	mg/L
Hardness	320	310	NA	920	mg/L
Color	<1	< 1	< 1	< 1	PCU

Parameter	Ryken Well S-1	Ryken Well S-2	Ryken Well S-3	Wetlands Supply Well	Units
Sample Date	8-14-08	8-25-08	11-26-08	11-5-08	
Sulfate	330	260	NA	930	mg/l
Ammonium (NH_4)	NA	NA	< 0.6	< 0.6	mg/l
pH	7.35	7.35	7.30	7.27	
Field Temperature	24	24	25	23.5	°C
Turbidity	<0.10	<0.10	NA	<0.10	NTU
Silt Density Index	NA	NA	-.07/-.03/-.04	NA	
Free Chlorine (Cl_2)	NA	NA	0.05	0.01	mg/l
Total Suspended Solids	NA	NA	< 10	< 10	mg/l

CATIONS/ANIONS:					
Potassium (K)	6.5	8.2	NA	7.9	mg/l
Iron (total)	<0.040	<0.040	NA	0.25	mg/l
Iron (Fe^{+2})	NA	NA	< 0.10	< 0.10	mg/L
Sodium (Na)	400	370	NA	1400	mg/l
Magnesium (Mg)	17	15	NA	59	mg/l
Calcium (Ca)	98	100	NA	270	mg/l
Chloride (Cl)	690	580	NA	2400	mg/l
Nitrate Nitrogen (N)	3.0	1.6	NA	11	mg/l
Phosphate (PO_4)	NA	NA	NA	0.15	mg/l
Bicarbonate(as $CaCO_3$)	140	120	NA	130	mg/l
Fluoride (F)	0.64	0.56	NA	0.98	mg/l

CATIONS/ANIONS:					
Alkalinity (as $CaCO_3$)	140	120	NA	130	mg/l
Sulfate (SO_4)	350	260	NA	930	mg/l
Silica (SiO_2) (by EPA 6010B)	NA	NA	20	NA	mg/L
Silica (SiO_2) (by EPA 200.7)	NA	NA	43	35	mg/l
Chromium VI	<0.0010	0.0047	NA	<0.0010	mg/l
METALS:					
Barium (Ba)	28	34	NA	37	µg/l
Strontium (Sr)	NA	NA	2.5	8.3	µg/l
Lead (Pb)	< 1.0	< 1.0	NA	3.4	µg/l
Arsenic (As)	9.1	9.7	NA	5.5	µg/l
Aluminum (Al)	< 10	< 10	NA	<20	µg/l
Chromium (Cr)	3.4	4.8	NA	<4.0	µg/l
Cadmium (Cd)	< 1.0	< 1.0	NA	<2.0	µg/l
Selenium (Se)	5.3	5.0	NA	13	µg/l
Zinc (Zn)	< 20	< 20	NA	<40	µg/l
Mercury (Hg)	<0.00020	<0.00020	NA	<0.00020	µg/l
Manganese (Mn)	1.3	< 1.0	NA	2.5	µg/l
Copper (Cu)	7.1	2.2	NA	7.1	µg/l
Silver (Ag)	< 1.0	< 1.0	NA	<2.0	µg/l
Nickel (Ni)	< 2.0	< 2.0	NA	<4.0	µg/l
Uranium (U)	8.0	5.0	NA	15	pCi/L

CATIONS/ANIONS:					
ORGANICS/ DISSOLVED GASES:					
TOC	NA	NA	0.76	0.47	mg/l
BOD5	NA	NA	< 2.0	< 2.0	mg/l
CO_2	NA	NA	3.5	18	mg/l
NA = Not available					

Based on laboratory analyses of groundwater samples collected at the active Ryken well, the groundwater at the MSP is expected to be brackish. The groundwater is brackish because the TDS and chloride concentrations are elevated. The Ryken well currently supplies irrigation water to an alfalfa field and has done so for approximately the last 30 years. Due to the Ryken well operational history / duration, water quality, specifically TDS concentrations, from groundwater pumped by proposed MSP production wells is expected to be similar to water quality from the Ryken well (see Table 5.17-6). The TDS concentration of groundwater produced by active and nearby SEGS VIII and IX wells has been stable and is similar to TDS concentrations measured at the Ryken well. TDS and chloride concentrations from groundwater wells sampled in the vicinity of the proposed MSP from years 2005 to 2008 are shown on Figure 5.17-24.

Because of the high transmissivity of the uQal aquifer, prolonged extraction for MSP supply water should not cause an increase in TDS concentration and deterioration in quality by drawing in water of higher salinity from an expanded pumping depression reaching below Harper Dry Lake. Similarly, the proposed pumping of groundwater to supply the MSP is not expected to alter TDS concentrations by inducing additional migration of underflow from the floodplain aquifer of the Mojave River. An indicator of water quality stability during groundwater production is the historical and current production of groundwater with TDS concentrations capable of supporting alfalfa crops. As indicated in Table 5.17-6 groundwater quality stability was observed over a seven day pumping period at the Ryken well. LGS does not expect groundwater production during MSP construction and operation to significantly impact groundwater quality.

5.17.1.14 Historical Groundwater Use

Historical groundwater use in the Harper Dry Lake area has been for irrigated agriculture, primarily alfalfa and similar forage crops. This water has been withdrawn from the uQal aquifer. Irrigation return water escaping evapotranspiration and percolating to shallow perched zones contributes moisture required by native plants. Because of the relatively low density of native plants within the desert environment of the Domain, irrigation return water that percolates and recharges the uQal and Qal aquifers is estimated at 50 percent of the water pumped for irrigation.

Historic water well pumping data could not be obtained from the CA DWR because no records were kept. Historic use can best be estimated by assuming that approximately 5

AF were applied for each agriculture production acre each year (MWA, 1983). According to the Mark Group (April 1989), annual agricultural production in the Harper Valley area has varied from 1,800 acres in 1953 to 2,300 acres in 1955 and 2,500 acres in 1968. Annual production ranged from 2,000 to 2,500 acres from 1968 to 1983. Annual production from 1984 to 1988 was approximately 1,500 acres. On the basis of an average pumping value of 5 acre-ft/acre, about 6,500 to 18,000 AFY of groundwater has been used for historical agriculture production in the vicinity of the existing FPLE SEGS VIII and IX and the proposed MSP or about 2.1 AFY to 6 AFY per acre of land (land acreage for SEGS VIII and IX is about 1,280 acres and the MSP is about 1,765 acres). An unknown portion of this water (drain waters) may have recharged the shallow, perched groundwater system near a wetlands area in the southwest part of Harper Dry Lake.

Water level decline due to agricultural pumping from 1953 to 1986 varied from 80 ft at the center of the former Lockhart Ranch to 20 ft in the area of Black's Ranch (The Mark Group, April 1989). A drop in water level of this magnitude without recovery indicates that groundwater extraction in the Harper Dry Lake area has historically exceeded recharge.

The historic water levels show a hydraulic cone of depression centered at the agricultural activities immediately west and south of Harper Dry Lake. The volume of dewatered sediments within this historical cone of depression represented approximately 94,300 acre-ft of depleted groundwater storage, assuming a storage coefficient of 0.12 (The Mark Group, April 1989).

5.17.1.15 Current Groundwater Use

Current groundwater use within the HVB is shown on Table 5.17-7.

Table 5.17-7. Current HVB Output Estimate

	AFY
Existing SEGS VIII and IX	1,109 (1)
Desert View Dairy alfalfa field (aka the Ryken Well) off Lockhart Road	707 (1)
Residential water	430 (2)
Total:	2,246

(1) Highest usage on record in the last 5 years (Mojave Basin Area Watermaster, 2008).

(2) Based on a total population estimate of 1,915 with a consumption rate of 200 Gallons per person per day (CA DWR, 1967) from homes in the Lockhart / Harper Lake community and from residential properties in and around Hinkley.

A total of 278 water supply wells shown in Figure 5.17-4 was field verified by LGS. Wells within the Domain were identified from a search of DWR, MWA, and USGS database information. A field survey was conducted to identify the wells' location, assess operational status, and evaluate their use. The field survey consisted of walking or driving county roads and conducting and interviewing property owners as access would allow. Many of the historic wells could not be located. If access or an interview could not be secured, well status was evaluated from the nearest road and/or remote imaging. Many of these wells are nonfunctional but have not been abandoned or destroyed in accordance with county regulations. In some cases, although the well could be identified, its operational status could not be determined because the land could not be accessed.

A San Bernardino County parcels base map dated July 11, 2008, was obtained from the Assessor's office. Water well locations identified from the field survey were linked to property owners by use of the County parcels base map. CA DWR Well Completion Report Request Forms were mailed to 118 property owners. Permission to access Well Completion Reports was granted by current owners for 31 wells or 11 percent. Of these, the CA DWR found 9 Well Completion Reports, or 3 percent of all wells, in their files.

Available information for water supply wells located within ½-mile radius of the MSP is summarized in Table 5.17-6 and shown in BCM Report Figure 4-1 (see Appendix A). Nearby residential and production wells are shown on Figure 5.17-18.

Table 5.17-8. Well Completion Details: Water Supply Wells within a ½ Mile Radius of the MSP

State Well Number	Common Name	Top of Well Measuring Pt. Elevation (ft amsl)	Well TD (ft bgs)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Specific Capacity (gpm/ft)
	Well "J"	2,060	NA	NA	NA	NA
11N04W28E01S	NA	2,030	NA	NA	NA	NA
11N04W28N01S	NA	2,040	350	NA	NA	NA
11N04W28N03S	NA	2,044	NA	NA	NA	NA
11N04W29J02S	NA	2,046	NA	NA	NA	NA
11N04W29N01S	NA	2,061	NA	NA	NA	NA
11N04W29P01S	33544	2,056	410	180	410	36.5
11N04W29Q01S	NA	2,055	NA	NA	NA	NA
11N04W29Q02S	NA	2,046	NA	NA	NA	NA
11N04W29R01S	NA	2,045	303	NA	NA	NA
11N04W29R02S	E0001406	2,046	NA	NA	NA	NA
11N04W32A01S	NA	2,044	NA	NA	NA	NA
11N04W32A02S	NA	2,060	NA	NA	NA	NA
11N04W32C02S	NA	2,069	NA	NA	NA	NA
11N04W32C05S	NA	2,069	NA	NA	NA	NA
11N04W32D01S	NA	2,075	500	NA	NA	NA
11N04W32F01S	NA	2,080	225	NA	NA	NA
11N04W32F02S	NA	2,081	NA	NA	NA	NA
11N04W32F03S	NA	2,081	NA	NA	NA	NA

State Well Number	Common Name	Top of Well Measuring Pt. Elevation (ft amsl)	Well TD (ft bgs)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Specific Capacity (gpm/ft)
11N04W32F06S	NA	2,081	NA	NA	NA	NA
11N04W32F07S	NA	2,082	NA	NA	NA	NA
11N04W33B01S	37009	2,050	435	154	435	37.6
11N04W33C01S	NA	2,051	NA	NA	NA	NA
11N04W33D01S	NA	2,050	NA	NA	NA	NA
11N04W33F01S	37794	2,055	448	220	445	NA
11N04W33G01S	NA	2,059	310	NA	NA	NA
11N04W33G02S	37799	2,050	460	170	457	25.5
11N04W33G03S	37796	2,050	446	160	425	33.8

Key:
tt amsl – feet above mean sea level
ttbgs = feet above ground surface
gpm/ft = gallons per minute per foot of drawdown
NA = data not provided for available in either CADWR or USGS database

5.17.1.16 Surface Water

The single surface water feature in the project area is a lacustrine marsh located at the southwestern edge of Harper Dry Lake less than 1 mile north of the proposed MSP. This marsh is also known as the Harper Dry Lake Wetlands. This semi-perennial marsh has had maximum dimensions of about 2 miles long and 0.25 miles wide. In the past, the area received its water supply from surface water and agricultural runoff. With significant decline in Harper Dry Lake area agriculture, the marsh has been maintained with groundwater pumped by the BLM from a former irrigation well now owned by Mojave Solar LLC.

The ephemeral Mojave River, shown in Figure 15.17-4 is the southeast boundary of the Domain. Infrequent storms with significant precipitation result in Mojave River flow.

The surface area of the HVB encompasses approximately 640 square miles. The watershed area tributary to Harper Dry Lake is approximately 738 square miles. The ephemeral drainages within the tributary watershed flow from adjacent mountain highlands to the central part of the basin at Harper Dry Lake. Recharge to alluvial aquifers due to storm flow within the ephemeral streams is discussed within the BCM Report (see Appendix A, BCM Section 4.6.3, Recharge to Domain).

According to the San Bernardino County Flood Control District, the 100-year floodplain has not been mapped for the Harper Dry Lake area.

5.17.1.17 MSP Water Supply, Use, and Wastewater

Groundwater targeted as the make-up water for cooling electricity generation equipment at the proposed MSP is not potable, is unsuitable for municipal use, and will require treatment prior to its use for MSP cooling and drinking. Water from the eastern side of the HVB including the project area, is of a sulfate-chloride character with chloride concentrations ranging from about 500 mg/L to 2400 mg/L and sulfate concentrations ranging from 350 mg/L to about 600 mg/L; boron and iron concentrations also tend to be elevated; reported TDS concentrations ranged from about 1600 mg/L to 5500 mg/L. This TDS concentration range places the source water into the brackish category. The chemical character of the groundwater available from wells on or near the site is of marginal quality for domestic and agricultural use; however, it can be treated economically using a reverse osmosis system.

This low quality groundwater supply complies with the policy set forth by the SWRCB in Resolution 75-58 because "brackish water from natural sources or irrigation return flow" is preferred as a water source for power plant cooling over both inland wastewaters of low TDS and other inland waters. In addition, the CEC's 2003 IEPR provides that "the Energy Commission will approve the use of fresh water for cooling purposes by power plants which it licenses only where alternative water supply sources and alternative cooling technologies are shown to be 'environmentally undesirable' or 'economically unsound'." The MSP complies with this policy because it is not proposing to use fresh water for cooling purposes. Rather, brackish groundwater will be used for power plant cooling and for all other power plant needs. Therefore, the MSP's proposed water source meets applicable state water policies.

Although showing that alternative water supply sources are "environmentally undesirable" or "economically unsound" is only necessary when fresh water use is proposed, the use of recycled water for the MSP as an alternative to groundwater has been considered and rejected. Wastewater in the quantities required is not produced at the site and would have to be transported approximately 30 miles from the Barstow area. The scope of such a construction project (Metcalf & Eddy, 2008) renders it economically infeasible and additional analysis of its environmental impacts would likely be problematic as well. A discussion of alternative cooling technologies and waste discharge is provided in Section 4.0, Alternatives.

Operation of the 250 MW electricity generation facilities is expected to require 2,163 AFY of water for 30 years. This proposed use of HVB groundwater consumes less water than historical agriculture (alfalfa) irrigation. About 6,500 to 18,000 AFY of groundwater has been used for historical agriculture in the vicinity of the existing FPLE SEGS VIII and IX and the proposed MSP (see BLM Report, Section 4.9.1); or about 2.1 AFY to 6 AFY per acre of land (land acreage for SEGS VIII and IX is about 1,280 acres and the MSP is about 1,765 acres). Operation of the MSP requires 2,163 AFY (operation of adjacent SEGS VIII and IX requires about 1,109 AFY); or about 1.1 AFY per acre of land. The proposed use of the land for electrical power generation is a more sustainable use and has fewer environmental impacts than if the project were not to go forward and the agricultural use were to continue.

Figure 5.17-19 shows two wells, one production well and one backup well, on the north end of each of the two proposed MSP power blocks. Supply water between power blocks is not interconnected and each power block has water treatment equipment dedicated to a well pair. To meet the production demand, each well will be designed for a peak capacity of 1,172 gpm. The required annual average water production (i.e., 2,163 AFY) has been normalized to a constant and continuous flow rate of 670 gpm from each of the two power blocks based on water production 24 hours per day and seven days per week.

LGS used WinFlow version 3, developed by Environmental Simulations, Inc., to simulate the impact to neighboring property due to water production from two on-site wells. The predictive simulation lasted 30 years and assumed that each of two production wells was pumped continuously at 670 gpm. A flow rate of 670 gpm from two wells, 24 hours per day for one year is equivalent to 2,163 AFY. Predicted hydraulic interference (drawdown) for MSP operation as a result of 30 years of constant pumping is shown in Figure 5.17-21. Maximum estimated hydraulic interference at positions off the MSP footprint and at a radial distance of 0.5 miles from production wells PW-1a and PW-2b is 5.2 feet. Maximum estimated on-site drawdown during MSP operations is shown on Figure 5.17-21 at 11.3 feet. Pumping levels (or maximum on-site drawdown) from WinFlow simulations are underestimated, since well losses are not considered. Therefore, maximum onsite drawdown predictions should be doubled to account for well losses.

Available data indicate sufficient quantity of groundwater in storage within the Domain under current conditions to supply the water requirements needed by the proposed MSP for its anticipated 30-year life. Additionally, an evaluation of Domain groundwater inputs and outputs indicates MSP groundwater use will not exceed the water budget. Refer to BCM Tables 4-3a and 4-3b, Appendix A. Available aquifer testing data indicate water supply requirements can be met from two properly constructed wells within the MSP property (see Figure 5.17-19).

The MSP through ownership or purchase options has rights to 10,478 AFY of groundwater in the HVB (i.e. Centro Basin). These water rights consist of 9,380 AFY owned by Abengoa Solar, Inc., 224 AFY transferred in December 2008 from Jennie Most, trustee of the Most Family Trust, and an option to purchase 874 AFY from the Desert View Dairy (aka the Ryken Well). Upon obtaining ownership or purchase option, Abengoa Solar, Inc. stipulated to the Judgment entered by the court in the MRB adjudication. In accordance with the Judgment, the Watermaster adjusts production rights, requires set-asides, and recalculates assessments to account for changes in consumptive use. The MSP's proposed production amount and purpose of use will comply with applicable requirements of the Judgment entered in the MRB adjudication and with the Watermaster's administration of the Judgment.

On-site storm runoff flows within the power island areas will be intercepted, treated to remove possible pollutants, and recycled as plant cooling water.

Refer to Figure 5.17-17 showing the water balance for waste water treatment with the proposed wet cooling alternative as a process schematic. Wastewater streams include mirror washing water and cooling tower blowdown.

5.17.1.18 Numerical Groundwater Flow Model

Refer to the BCM Report, Appendix I for the Numerical Groundwater Flow Model Report. The results are summarized in this section.

A calibrated numerical groundwater flow model utilizing MODFLOW within Groundwater Vistas software has been constructed for the Domain. The model was constructed based on information presented in the BCM Report. Examples include recently acquired geophysical data pertaining to the Black Mountain basalt layer geometry, recently acquired aquifer parameters obtained from pumping-test data, and historical gravity-based mapping for the top of the basement elevation within the Domain. Additional information related to basin geometry and described within the BCM Report (Appendix A) was incorporated into the model and improved its function.

Model calibration using a steady-state process focused on matching pre-development potentiometric surface data sets available from the 1920s and 1930s. This is similar to the approach adopted by the USGS in calibrating their Mojave River Basin Model (Stamos et al., 2001).

Groundwater underflow from the Floodplain Aquifer associated with the Mojave River provides recharge to the HVB. Sufficient recharge to the HVB appears to be available for the MSP. Due to a surplus water balance predicted by the model, aquifer recovery (see Figure 5.17-23) during MSP operation is expected to continue. LGS does not expect groundwater production for MSP operation to increase underflow from adjacent groundwater basins. Simulation results of the pumping test (i.e., the Ryken Well) and groundwater pumping required for the MSP construction/operation periods using MODFLOW and WinFlow (2D model) are consistent.

5.17.2 Environmental Impacts

Environmental impacts due to use of groundwater pumped from the uQal Aquifer as the MSP water supply source may be considered significant if the following impacts resulted:

- Substantial depletion of groundwater resources and interference with local wells;
- Substantial interference with groundwater recharge; or
- Use of water in a wasteful manner.

Project water quality or erosion/flooding-related impacts may be considered significant if the MSP resulted in the following:

- Degradation of groundwater quality;
- Discharge into surface waters resulting in alteration of surface water quality; or
- Substantial erosion or flooding off the site.

The direct effects of the MSP on local water resources are those associated with using groundwater for construction, specifically for demands during site grading, and with the plant's process water needs. No surface water will be used.

5.17.2.1 Construction

Water Use

Currently, construction plans are to clear and grade the MSP site with heavy equipment to provide a terraced site with gentle northerly and easterly sloping grades on each terrace. The preliminary cut and fill volume is estimated to be 4.2 million cubic yards. The cut and fill will be balanced and there are no plans to import fill material during general grading operations. Because of the amount of soil and vegetation affected by grading activities, substantial water erosion control and dust control measures will be required to minimize offsite impacts. Overall, the MSP will result in disturbance of approximately 1,765 acres at the project site. A construction phase SWPPP and DESCP to meet CEC requirements will include a series of management controls and BMPs to minimize erosion and impacts to drainage.

Construction of the MSP is expected to require 26 months. During MSP construction, water production is needed for potable water use and non-potable water use, including mass grading, dust suppression, sewage and fire protection. Construction phase water usage is estimated to be between 59,800 and 1,766,050 gallons per day.

During MSP construction water will be produced from three wells, including one well at each of the power blocks and the Ryken Well.

Water usage for the construction period is expected to proceed along the following schedule:

- Month 1 through 6 – 1,766,050 gallons per day (gpd),
- Month 7 through 26 – 59,800 to 61,750 gpd.

Following the initial grading period of six months, groundwater usage will drop dramatically with daily rates ranging from 59,800 to 61,750 gpd. This period of usage is about 3.4 percent of the groundwater usage during the grading period and water usage and effects on surrounding wells and groundwater quality will be less significant.

Potential impacts to neighboring property (see Figure 5.17-18) due to construction phase water production from three on-site wells has been simulated using WinFlow, v. 3, developed by Environmental Simulations, Inc. The predictive simulation lasted 26 months and assumed that each of the three production wells was pumped continuously at 410 gpm. A flow rate of 410 gpm from three wells, 24 hours per day is equivalent to 1,766,050 gallons per day. Simulations based on this rate will result in maximum hydraulic interference estimates.

Hydraulic interference resulting from 26 months of continuous pumping at 410 gpm from each of the three production wells is shown on Figure 5.17-20. Maximum estimated hydraulic interference at positions off the MSP footprint and at a radial distance of 0.5 miles from production wells PW-1a, PW-2b and the Ryken Well is five feet. This interference to potential offsite wells located as close as 0.5 miles from the MSP supply wells is insignificant. LGS does not expect groundwater production during MSP construction to significantly impact water levels at neighboring wells. Based on interpretations of 2D modeling simulations, the uQal Aquifer shows minimal sensitivity (with regard to hydraulic head) to relatively small changes in the discharge rate (+- 20 AFY). Simulation results of groundwater pumping required for the MSP construction period using MODFLOW (refer to Appendix A) are consistent with WinFlow results.

Maximum estimated on-site drawdown during construction is about nine feet, as shown on Figure 5.17-20. Pumping levels (or maximum on-site drawdown) are under estimated by WinFlow simulations, since well losses are not considered. Therefore, predictions of maximum onsite drawdown should be increased to account for well losses. A doubling of the maximum onsite drawdown predicted by the WinFlow simulations should be sufficient.

Water Quality

Water quality impacts could result from releases of chemicals used during construction, such as motor oil, fuel, and solvents. These chemicals can potentially contaminate surface waters during heavy storm events, or affect groundwater through infiltration. Mitigation measures are in place to prevent spills of chemicals, as well as to respond to spills should they occur. The SWPPP and DESCP will require storm water BMPs and temporary erosion control measures, including revegetation, dust suppression, and construction of berms and ditches, which will prevent accelerated soil erosion or dust generation. Adhering to proper material handling procedures and complying with the SWPPP will ensure that construction-related water quality impacts are not significant.

Because of the high transmissivity of the uQal aquifer, prolonged extraction for MSP supply water should not cause an increase in TDS concentration or deterioration in quality by drawing in water of higher salinity from an expanded pumping depression reaching below Harper Dry Lake. Similarly, the proposed pumping of groundwater to supply the MSP during construction is not expected to induce additional migration of Mojave River underflow. About 6,500 to 18,000 AFY of groundwater have been used for historical agriculture production in the vicinity of the existing FPLE SEGS VIII and IX and the proposed MSP as compared to the 2,163 AFY needed during operation of the MSP. Refer to Section 5.17.2.6, Domain Groundwater Geochemistry, for additional groundwater quality discussion and an evaluation of groundwater quality stability from seven days of pumping at the Ryken Well. LGS does not expect groundwater production during MSP construction to significantly impact groundwater quality.

Surface water within the Domain is limited to a small wetlands area in the south portion of Harper Dry Lake (north of the Wetlands Well). Refer to Section 5.17.2.11, Surface Water, for additional surface water discussion. The MSP will not discharge water or wastewater to the wetlands. LGS does not expect surface water to be significantly altered due to MSP construction.

Drainage

Site grading activities will be ongoing for the first six months of the construction schedule. During this time the site will be divided into areas and grading will proceed from one area to the next until the entire site grading has been completed. Drainage channels to intercept off-site runoff from storm events that may occur will be constructed around the

Project site at the beginning of grading activities. During grading procedures, site drainage will be managed according to the BMP's provided in the construction SWPPP and the DESCP will be employed to minimize erosion and manage storm water runoff. Though infiltration at the site is expected to be rapid, mitigation measures will include local soil berms within the collector fields to contain storm runoff water during construction. Temporary erosion controls including crushed rock, silt fences, and fiber rolls will be used to minimize erosion in active grading areas. Additionally, water will be used to control fugitive dust emissions and will be applied at a rate so as to minimize runoff.

Activities and products that have the potential to contaminate groundwater and surface water will be properly stored and used in a manner consistent with the approved grading plan, SWPPP, and DESCP. Good house keeping and prompt removal of spills and leaks will be implemented to minimize storm water contact with contaminated materials. With the implementation of BMP's and procedures and protocols provided in the DESCP, it is anticipated that during construction, drainage and erosion control measures will adequately protect surface and groundwater resources and impacts will be less than significant.

5.17.2.2 Operation

Water Use

The Project proposes to use a wet cooling tower for power plant cooling. Water for cooling tower makeup, process water makeup, and other industrial uses such as mirror washing will be supplied from selected onsite groundwater wells. Water from the onsite wells also will be used to supply potable water for employees (e.g., drinking, showers, sinks, toilets). Operation of the 250 MW electricity generation facility is expected to require 2,163 AFY of water (includes 10 AFY for potable water) for an anticipated 30 years. Figure 5.17-19 shows two wells, a production well and a backup well, located on the north ends of each of the two proposed MSP power blocks. Supply water between power blocks will not be interconnected and each power block will have dedicated water treatment equipment. To meet the production demand, each well will be designed for a peak capacity of 1,172 gpm. The required annual water production (i.e., to support 2,163 AFY) has been normalized to a constant flow rate of 670 gpm from each of the two power blocks based on water production 24 hours per day and seven days per week.

Potential impacts to neighboring property due to water production from two on-site wells has been simulated using WinFlow, v. 3, developed by Environmental Simulations, Inc. The predictive simulation lasted 30 years and assumed that each of two production wells was pumped continuously at 670 gpm. A flow rate of 670 gpm from two wells, 24 hours per day for one year is equivalent to 2,163 AFY. Predicted hydraulic interference (drawdown) is shown in Figure 5.17-21. This interference to potential offsite wells located as close as 0.5 miles from the MSP supply wells is insignificant. LGS does not expect groundwater production during MSP operations to significantly impact water levels at neighboring wells. Based on interpretations of 2D modeling simulations, the uQal aquifer shows minimal sensitivity (with regard to hydraulic head) to relatively small change in the discharge rate (+-20 AFY).

Hydraulic interference resulting from 30 years of continuous pumping from two production wells at a rate of 670 gpm at each well is shown on Figure 5.17-21. Maximum estimated hydraulic interference at positions off the MSP footprint and at a radial distance of 0.5 miles from production wells PW-1a and PW-2b is 5.2 feet.

Maximum estimated on-site drawdown during MSP operations is 11.3 ft as shown on Figure 5.17-21. Pumping levels (or maximum on-site drawdown) are under estimated by WinFlow simulations since well losses are not considered. Therefore, predictions of maximum onsite drawdown predictions should be increased to account for well losses. A doubling of the maximum onsite drawdown predicted by the WinFlow simulations should be sufficient.

Based on the estimated solar energy and plant operating profile, approximately 2,163 AFY of water will be used by the MSP (includes 10 AFY needed for water treated to potable standards). Monthly water usage is projected to follow the monthly schedule shown in Table 5.17-9. Refer to BCM Tables 4-3a and 4-3b, Appendix A.

Table 5.17-9. Estimated Monthly Water Usage

Month	Approximate Water Usage Acre-Feet (gpm)[1]	Month	Approximate Water Usage Acre-Feet (gpm)[1]
January	55.27 (404)	July	291.66 (2,129)
February	78.35 (633)	August	272.81 (1,992)
March	150.99 (1,102)	September	240.65 (1,815)
April	230.28 (1,737)	October	135.35 (988)
May	278.72 (2,035)	November	80.10 (604)
June	289.16 (2,181)	December	59.66 (436)

[1]The estimated groundwater usage in gallons per minute (gpm) is based on average daily consumption.

The maximum groundwater production rate for which the wells will be designed to pump is approximately 1,099 gpm (or 2,198 gpm for two production wells).

As indicated in the above schedule, estimates of water usage during the months of April through September range from between 1,737 and 2,181 gpm. During the winter months of October through March, the flow rate is significantly reduced, to between 404 gpm (January) and 988 gpm (October). The maximum groundwater production rate for which each well will be designed to pump is approximately 1,099 gpm (or 2,198 gpm for two production wells). The average flow rate normalized for the entire year is about 670 gpm for each well (or 1,340 gpm from two production wells). These flow rate estimates are conservative since they do not take into account MSP water storage capacity.

Water Quality

Water quality impacts could result from releases of chemicals used during MSP operation, such as motor oil, fuel, and solvents. These chemicals can potentially contaminate surface waters during heavy storm events, or affect groundwater through infiltration. Mitigation measures are in place to prevent spills of chemicals, as well as to respond to spills should they occur. The SWPPP and DESCP will require storm water BMPs and temporary erosion control measures, including revegetation, dust suppression, and construction of beams and ditches, which will prevent accelerated soil erosion or dust generation. Adhering to proper material handling procedures and complying with the SWPPP will ensure that construction-related water quality impacts are not significant.

Because of the high transmissivity of the uQal aquifer, prolonged extraction for MSP supply water should not cause an increase in TDS concentration and deterioration in quality by drawing in water of higher salinity from an expanded pumping depression reaching below Harper Dry Lake. Similarly, the proposed pumping of groundwater to supply the MSP during operation is not expected to induce additional migration of Mojave River underflow. About 6,500 to 18,000 AFY of groundwater have been used for historical agriculture production in the vicinity of the existing FPLE SEGS VIII and X and the proposed MSP as compared to the 2,163 AFY needed during operation of the MSP. Refer to Section 5.17.2.6, Domain Groundwater Geochemistry, for additional groundwater quality discussion and an evaluation of groundwater quality stability based on seven days of pumping at the Ryken Well. LGS does not expect groundwater production during MSP construction to significantly impact groundwater quality.

Surface water within the Domain is limited to a small wetlands area in the south portion of Harper Dry Lake (north of the Wetlands Well). Refer to Section 5.17.2.11, Surface Water, for additional surface water discussion. The MSP will not discharge water or wastewater to the wetlands. LGS does not expect surface water to be significantly altered due to operation of the MSP.

Drainage and Flood Control

The project site slopes from the southwest towards the northeast at grades of approximately one percent. The 100-year floodplain has not been mapped for the Harper Dry Lake area. Storm runoff flow, in the form of sheet flow, across the Project site will be intercepted as it enters the site, conveyed around the Project, and returned to its historical flow location and parameters as it flows into Harper Dry Lake. Off-site storm runoff flow around the Project will be isolated from on-site flows within the Project. Sheet flow within the solar field will be managed through the construction of internal drainage facilities designed to capture storm water and allow it to percolate and evaporate within the fields. The power islands will drain as sheet flow away from equipment foundations. On-site storm runoff flows within the power island areas will be intercepted, treated to remove possible pollutants, and recycled as plant cooling water. Local area containments will be provided around certain locations, such as oil-filled transformers and chemical storage areas. The water from the power islands and from other plant drains will be sent to on-site oil-water separators and then added to the plant cooling water.

A hydrology study was conducted to provide a preliminary design of surface water drainage storm water management structures, and to design drainage structures to convey runoff around the plant site, (Appendix K). The drainage channel along the upstream (southern) plant boundary was designed for flows up to 14,800 cfs. The recommended outlet structure of the channel consists of a "spreading ground" encompassing approximately 30 acres and designed to transition storm runoff from a concentrated flow to sheet flow to match the historical nature of runoff flow even during a 100-year storm event. The channel outfall will be located in the northeastern portion of the Project adjacent to Harper Dry Lake.

A comprehensive system of controls including operation of "year-round" BMPs will be used to manage storm water runoff and to control sediment and erosion. The controls will be detailed in the SWPPP and DESCP (Appendix K1) prepared for the Project and are summarized below:

- Initially, grading will proceed in a systematic manner in those areas needed for site construction and operation of the MSP. Undisturbed areas will remain so until being actively graded.
- Berms will be used along slopes or check structures to control sediment loss and erosion. As indicated for the storm channel sections, rip-rap gabions or other erosion control measures will be used to minimize scour and erosion.
- Roads and paved areas will be kept free of dust, dirt, and visible soil materials. A stabilized construction entrance/exit shall be constructed and maintained. Stabilized construction roadways will be utilized throughout the project site and maintained throughout the construction period. Water will be used to control fugitive dust emissions and applied as to minimize and control water runoff.
- BMPs will be applied and repaired as soon as erosion is evident and as soon as possible. Temporary erosion control measures will be implemented as needed to control erosion. Temporary sediment control materials will be maintained onsite throughout the term of the project so as to respond as needed to unforeseen rain or emergencies.

With the implementation of BMPs, it is anticipated that the Project will effectively provide a management program to minimize impacts to drainage and/or control potential flood conditions.

5.17.2.3 Cumulative Impacts

Cumulative water resources impacts are areas with multiple proposed or existing individual projects and that when considered cumulatively, a potential impact to water resources may occur. Projects with overlapping construction schedules and/or operations collectively could result in a demand for water that cannot be met by the project area water supply resources or could result in water quality impacts to surface or groundwater resources. The existing FPLE SEGSs VIII and IX present a potential cumulative impact.

As discussed, the MSP proposes to use groundwater as the primary water source during construction and operation. Refer to BCM Section 4.9.3, where pre and post MSP water budgets for the HVB are presented. Groundwater consumption from FPLE SEGS VIII and IX operations has been accounted for within these Water Budgets. Therefore, the MSP is not expected to contribute to a significant cumulative groundwater supply impact causing the water budget for the HVB to be exceeded.

The cumulative impacts on surface water quality associated with the MSP are not expected to be significant. Area projects, including the MSP, would each be required to comply with the requirements of the California Storm Water Permitting Program.

5.17.3 Mitigation Measures

5.17.3.1 Construction

WTR-1 Prior to beginning any clearing, grading or excavation activities associated with construction of the Project, the Applicant will prepare an approved construction phase SWPPP as required under the General Storm water Construction Activity Permit and a DESCP to meet CEC requirements.

WTR-2 The Applicant will obtain final WDRs issued by the Lahontan RWQCB for the Project's proposed wastewater discharge.

WTR-3 The Applicant will obtain permits for construction of a septic system prior to construction of the plant. A copy of the permits will be provided to the CEC CPM 60 days prior to the beginning of construction activities.

WTR-4 The Applicant will revise and reclassify well permits from San Bernardino County for those wells that will be used to monitor groundwater and provide water supply to the Project. Proposed MSP water wells require well permits from the County. Those wells not being used will be destroyed consistent with San Bernardino County requirements.

5.17.1.1 Operation

WTR-5 Prior to commercial operation, the Applicant, as required under the General Industrial Activity Storm Water Permit, will develop and implement an operations phase SWPPP.

WTR-6 The Applicant will record on a monthly basis the amount of groundwater pumped by the project. This information will be supplied to the CEC and San Bernardino County Water Agency.

WTR-7 The Applicant will measure groundwater levels in the onsite monitoring wells on a monthly basis for the first six months following the project start up and thereafter on a quarterly basis and submit periodic monitoring reports to the CEC.

5.17.4 References

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