SES SOLAR ONE

In Response to CEC & BLM Data Requests Set 2: Part 2 Data Requests 142-174

Application for Certification (08-AFC-13)

December 2009

Submitted to:
Bureau of Land Management
2601 Barstow Road
Barstow, CA 92311

Submitted to:
California Energy Commission
1516 9th Street, MS 15
Sacramento, CA 95814-5504

Submitted by:
SES Solar Three, LLC
SES Solar Six, LLC

Stirling Energy Systems
4800 N. Scottsdale Road, Suite 5500
Scottsdale, AZ 85251

Tessera Solar™
power from stirling energy systems

December 4, 2009

Mr. Christopher Meyer
CEC Project Manager
Attn: Docket No. 08-AFC-13
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Mr. Jim Stobaugh
BLM Project Manager
Attn: Docket No. 08-AFC-13
Bureau of Land Management
P.O. Box 12000
Reno, NV 89520

RE: SES Solar One Project
Applicant's Responses to CEC and BLM Data Requests, Set 2, Part 2
Data Requests 142-174

Dear Mr. Meyer and Mr. Stobaugh:

Tessera Solar hereby submits the Applicant's responses to CEC and BLM Data Requests, Set 2, Part 2 (Data Requests 142-174). I certify under penalty of perjury that the foregoing is true, correct, and complete to the best of my knowledge.

Sincerely,

Camille Champion
Project Manager

TECHNICAL AREA: BIOLOGICAL RESOURCES

Data Request 142:

a) Please provide the locations and extent of localized channel grading within the ephemeral drainages and describe how the values and functions of the existing drainage will be preserved.

b) Please describe mitigation should there be a loss of the drainage's function and value.

Response:

a) The final storm water management plan has not been fully developed, however based upon the current hydrological conditions study and recommendations by the engineering firm, Huitt-Zollars, Tessera Solar is to construct a series of detention basins along the northern boundary to capture the rainfall and sediment from north of the Project as the storm water flows enter the site. The detention basins will meter the storm water flow through the site using the existing natural wash pattern. The intent is to slow the storm water flow through the site to minimize sediment transportation and erosion within the Project boundary while providing enough moisture to maintain the existing wash biological resources. Additional basins and channels will be required within the SunCatcher field to assist in the detention and sediment control process. Localized grading may occur within the site to ensure storm water capture for the interior detention basins.

A graded channel adjacent and parallel to the railroad right of way is also to be constructed to help mitigate the storm water depth along the railroad.

The sediment basins will be constructed to hold the estimated 100–year event sediment volume. The basins are designed to aid storm water management through the site and assist in the reduction of sediment transport to the railroad drainage structures, improving storm water flows through the site.

b) There should be no loss of the existing drainage's function and value. The proposed storm water management system should allow the existing plant life to be maintained and prevent storm water erosion to their root systems.

TECHNICAL AREA: SOIL AND WATER RESOURCES

BACKGROUND

SES Solar Six, LLC and SES Solar Three, LLC (Applicant) filed an Application for Certification, December 1, 2008 with California Energy Commission (CEC). According to this original filing, potential water sources evaluated for the Project included reclaimed water, surface water, ground water, and obtaining water from a service provider. The water is required for SunCatcher equipment washing, potable water, dust control water and fire protection water. Primary fugitive dust suppression during construction would use water from a proposed groundwater well(s). The Applicant estimated that 36.2 acre-feet of water would be used annually for mirror washing and domestic use. The AFC stated that additional water wells will be drilled to augment the primary water well as needed to meet peak construction water demands.

In the first set of data requests, the CEC and BLM asked Applicant for additional information on the reliability of the Solar One water supply from the ground water well(s). In considering the responses to these questions, an in-depth evaluation of the Solar One water supply options in terms of reliability, cost, and environmental impact was performed. After extensive research, the Applicant provides this additional information to present findings and to report to CEC/BLM the Applicant's research for potential sources of water for the SES Solar One Project (Project).

OVERVIEW OF RESEARCH

For this evaluation, the Applicant considered four supply options:

1. Mojave Water Agency (ground water)
2. Burlington Northern Santa Fe (reclaimed water)
3. Lavic Valley Ground Water Wells
4. Cadiz Valley Ground Water

These options are described below and summarized in Table 1.

Mojave Water Agency – After filing the Solar One AFC, the Mojave Water Agency district expressed possible interest in providing water for the project. The source of the water would be from a groundwater well through purchase of water rights from water purveyors and delivered to the project site via truck. The Project, however, is outside of the District's boundaries and therefore provides service complications for the Mojave Water Agency.

This option was explored for approximately nine months (February 2009 to October 2009), with the Applicant attending several Mojave Water Agency (MWA) board meetings to present the proposed export of water from the District to the Project site. This option raised several concerns with the watermaster and sub-advisory committees. The watermaster suggested that the Applicant pursue alternative sources for water. As such, this export via MWA is no longer a viable option.

Barstow Wastewater Treatment Facility – The Barstow Wastewater Treatment Plant is located at 2200 East Riverside Drive in Barstow California. It is operated by the Public Works Department of the City of Barstow and is approximately 15 miles west of the project site. During the time that the Applicant was exploring alternatives with MWA, MWA staff suggested that the Applicant enter into discussion with Burlington Northern Santa Fe (BNSF).

BNSF holds export rights from MWA and could supply recycled (grey) water utilizing BNSF facilities at the City of Barstow Waste Water Treatment Facility. All of the water used by the Solar One project would have been fully offset. The water would be placed on BNSF rail cars and transported to the Project Site. Use and transport of the recycled water would require approval from MWA for a change in purpose (use), and agreements with the appropriate water districts. The recycled water (grey water) would be transported outside of the District's boundaries. The Applicant pursued discussions with BNSF and MWA. After several meetings with both entities, as mentioned above, and another MWA board meeting, the export requirement from the District resulted in the same service complications as experienced with the MWA option. As a result of the watermaster's decision, this option is no longer viable.

Lavic Groundwater Basin – As discussed in the water section of the Application for Certification (page 5.5.1.2), the Project site lies within the Lavic Groundwater Basin. The basin is approximately 159 square miles and is bounded by non-water-bearing rocks of the Cady Mountains on the southwest. This water would require treatment of total dissolved solids and is considered unsuitable for domestic or irrigation use without treatment.

The AFC showed several potential locations for the development of wells. Because of permitting challenges, the test water wells will be located on private land within the Project area. Should the test wells indicate a sufficient water supply for the Project; the Applicant will initiate purchase agreements with the landowners. General locations of test wells are provided as attachment SWR-1, located behind this additional information.

The Applicant will initiate drilling the test water well(s) within the Project area in December 2009. A contractor, Mountain State Drilling, has been contracted to perform the drilling of 4 test wells within the Project boundary per CEC guidelines. If water from the Ground water Basin were used for the project, bottled water would be brought in for human consumption. The ground water source could also serve as an emergency back-up supply if required in the future.

The outcome from the test well(s) will provide additional information regarding water quantity and quality for the Project and determine if this is a viable option. The decision will be made by mid-January.

Cadiz Valley Groundwater Basin – Burlington Northern Santa Fe (BNSF) owns and operates several water wells within the Cadiz Valley Groundwater Basin approximately 60 miles east of the Project site. The water would be transported via rail or truck to the Project site.

The basin underlies Cadiz Valley which drains internally toward Cadiz Lake. Average precipitation ranges from 4 to 6 inches. An existing well has been in production for many years, currently using 1 acre foot per year. Wells in the Cadiz Valley Groundwater Basin yield as much as 167 gallons per minute (DWR 1975). Natural recharge is dominantly from percolation of surface runoff through stream beds and washes. Studies done on the groundwater in the Cadiz Valley show a recharge in the area at 2,550 to 11,200 acre/feet per year. This alternative is being pursued as a back-up plan for the Lavic Groundwater Basin and would be transported via rail or truck to the Project site. A summary and comparison of these water supply options is shown in Table 1.

Table 1
Solar One Water Supply Options

Option	Description	Type and Amount Available	Reliability of Supply	Environ. Concerns	Comment
Mojave Water Agency		Ground water		Would be fully mitigated	No longer available because project is located outside district boundaries.
City of Barstow Treatment Facility	Use of existing BNSF facilities. Requires trucking or rail to the site	Reclaimed water	Reliable supply but would require transport through facilities owned by other water districts		Option eliminated because of challenges associated with transport through facilities owned by multiple water districts; also located outside district boundaries.
Lavic Ground-Water Basin	Four test wells located on project site	Gallon per minute flow is unknown.	Unknown supply amounts to meet construction needs; sufficient flow to serve as back-up during operation; further assessment required	Potential impacts from evaporation pond; mitigate with pond design and screening	Is currently the primary option Possible back-up supply during operation
Cadiz Valley Ground Water	Requires rail or trucking to site	Ground water	Reliable	Consistent with CEC water policy; Air emissions associated with trucking water to the site	Possible back-up supply during construction and operation

STATUS OF SES SOLAR ONE PROJECT WATER SOURCE

The Applicant is actively pursuing two viable water sources for the SES Solar One project. These are:

1- Lavic Groundwater Basin: The Applicant will initiate drilling of four water wells on the project site. The Project lies within the Lavic Groundwater Basin. As wells are drilled the flow rate in gallons per minute (gpm) will be determined. If sufficient amounts of water are not supplied by the ground water well(s), a back-up source will be in place.

   As mentioned in the AFC, the water from the primary well is characterized as raw water and will require treatment to remove dissolved solids for SunCatcher mirror wash water applications. The water will be required to be demineralized to prevent mineral deposits forming on the SunCatcher mirrors. Processes available for demineralization are Reverse Osmosis (RO) and ion exchange.

2- The Applicant has had conversations with representatives from Burlington Northern Santa Fe regarding the use of water from Burlington Northern Santa Fe (BNSF) owned and operated water well within the Cadiz Valley Groundwater Basin. Data from the CA State Water Data Library shows several wells in the Cadiz Groundwater Basins. Some historical data of wells in Cadiz show that well depths were approximately 200 feet below water levels. With the recharge rate, the Project requirements would not significantly impact the wells in the area.

The Applicant believes that with these sources, the project will obtain the water to provide an appropriate quantity and quality for mirror washing. The applicant estimates that 36 acre-feet of water will be used annually for mirror washing and domestic use.

Potable water to meet plant requirements will be delivered by truck and stored in a 5,000 gallon tank in the water treatment area. This tank will be able to provide all required potable water for the operating facility for 2-3 days at which time it will need to be replenished.

All necessary environmental surveys, impact assessment, and proposed mitigation measures for these facilities will be submitted to the CEC upon completion, expected to be during the first quarter of 2010.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 143:

a) Please provide information on why those locations were selected.
b) Please provide the expected groundwater depth.
c) Please provide the expected total well depth at those locations.

Response:

a) The proposed water well locations will be located within the Project area and selected to best fit the Project needs in terms of proximity to the site facility area and location/availability of groundwater. The approximate locations of the test wells are shown on attachment SWR-1.

b) Ground Water Level Measurement Data was found on the USGS website for four existing sites with available data west of the Project location near Newberry Road at Interstate 40. The measurements suggest that the water level at these four sites ranges from 102 feet below ground level to approximately 125 feet below ground level. Based on information gathered from the USGS website, the ground water depth for pits within a 10-mile radius varies from approximately 120 feet to 200 feet below ground level. Also please refer to the table and exhibit provided in the Data Adequacy Response showing the locations of historic nearby wells and well information.

Based on information gathered from a local well drilling company (Eagle Well Drilling), the ground water depth at the Project site is expected to be 200 feet to 800 feet below ground level, depending on the well location.

c) The expected well depth at each location will be dependent on the location and depth to ground water. Based on information gathered from a local well drilling company (Eagle Well Drilling), the expected depth range is 800 to 1200 feet below ground level.

References:

USGS National Water Information System web site - Groundwater measurement data for Site Number 344927116394101, 345104116384001, 345043116393601 and 345001116381701 (see attached).

Eagle Well Drilling & Pump Services, Raymond Ward, LIC#-768952 CA, Phone 760-257-3553.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 144:

a) Please provide information on what methods will be used to construct the proposed wells.

b) Please provide detail on how the capacity of the wells to provide water to the Project will be determined.

c) Please provide the dimensions of the groundwater cone of depression that would be created by pumping the proposed well(s).

Response:

a) A well completion program will be provided to the CEC/BLM prior to the start of operations well construction. It is anticipated that results of the test wells will be provided during January, 2010.

b) The capacity of the needed wells will be determined by evaluating the volume of water needed for construction stages as well as ongoing operation and maintenance. The Project water supply needs will be compared with the results of the proposed well tests and sizing and number of wells will be determined accordingly.

c) Based on the CEC Data Adequacy Request # 53 and the response previously provided, the calculated radial zone of contribution ranges from 800 feet after 2 years to 3,200 feet (approximately 0.6 miles) after 30 years, which is the lifetime of the Project. These results suggest that pumping groundwater to meet the Project's water demand will not significantly affect the water levels at distances greater than 0.5 mile from the proposed pumping well.

References:

Eagle Well Drilling & Pump Services, Raymond Ward, LIC#-768952 CA, Phone 760-257-3553.

CEC Data Adequacy Request 53 Response Letter.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 145:

a) Please provide the results of aquifer testing in these areas showing aquifer properties and characteristics.

b) Please demonstrate the aquifer is capable of providing the volume of water needed for project construction and operation.

Response:

a) Water quality test data was obtained from the USGS website for two existing well locations near Newberry Road at Interstate 40 west of the Project site. The test data suggests that the overall water quality is sufficient for washing, cleaning and cooling purposes; however, if it is to be used for drinking, it is recommended that the Total Dissolved Solids and Arsenic Levels be verified and reduced, if needed. Based on the USGS National Water Information System, it appears a well in northeast Newberry Springs, approximately 10 miles north of the site, has a concentration of sodium of approximately 190 mg/L as measured in October, 2008. It should be noted that the water quality of the groundwater at the Project site may have significantly different quality characteristics. Final recommendations should be based on water quality tests performed at the proposed well sites.

Based on the data review letter dated June 10, 2008 prepared by URS Corporation, the groundwater quality may be poor for domestic use. The groundwater tests for nearby wells describe the groundwater as mainly sodium bicarbonate in character. The groundwater is of sodium-calcium sulfate character near Daggett and Newberry Springs. Groundwater of sodium chloride, sodium-calcium chloride, and sodium chloride-sulfate character occurs east of Troy Lake. Total Dissolved Solids concentrations range from 300 mg/l near Daggett to 2,000 mg/l near Newberry Springs (DWR, 2003).

Based on the Phase I Environmental Assessment (ESA) conducted by URS there are no known groundwater contaminants present; therefore, it is not anticipated that pumping groundwater from onsite well(s) will result in migration of groundwater contaminants. Additionally, no changes to existing physical or chemical conditions of groundwater resources are expected as a result of pumping groundwater to meet Project water needs. It appears that the Lavic Groundwater Basin is hydrologically isolated from neighboring basins: therefore, it is anticipated that water levels in neighboring basins will not be affected by pumping groundwater to meet Project water supply needs.

b) Based on the letter dated June 10, 2008 prepared by URS, the average well in the area yields approximately 770 gallons per minute. If the site wells result in 25% of the average well yield (192 gal/min) then the well may be capable of producing over 100 million gallons of water per year. Based on information provided by the Project developer, the Project will require 136 acre-feet per year (44,315,794 gallons per year) for the construction stage and 36 acre-feet per year of water for operation and maintenance. This information suggests that the proposed wells will generate a sufficient amount of water for operation and maintenance of the facility.

It should be noted that the groundwater levels and groundwater flow rates at the Project site may vary significantly. The actual groundwater level and flow rates should be verified at the proposed well sites to determine the actual amount of groundwater available.

References:

USGS National Water Information System web site - Groundwater measurement data for Site Number 344927116394101, AND 345104116384001

URS. Data review letter dated June 10, 2008 prepared by URS.

Tessera Solar provided the anticipated Project water requirement values.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 146: Please provide information and location on any known springs or seeps that may be affected by groundwater pumping at the new well locations.

Response: Based on the National Park Service web site there are no known springs or seeps within a 10-mile radius of the Project site. Review of the USGS National Water Information System and information provided by Eagle Well Drilling, it appears that there are no known springs or seeps within the area that would be affected by the groundwater pumping.

References:

National Park Service Web Site. www.nps.gov

USGS National Water Information System, http://nwis.waterdata.usgs.gov

Eagle Well Drilling & Pump Services, Raymond Ward, LIC#-768952 CA, Phone 760-257-3553.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 147: Please provide the results of groundwater modeling that shows there will be no impacts to springs and seeps or to other users or environmental resources resulting from project pumping from the new well locations.

Response: As stated in the response for Data Request 144, the anticipated radius of influence is expected to be less than 0.5 miles from the proposed well site. Information obtained from the National Park Service web site and the USGS Water Information System, discussions with the local well drilling company (Eagle Well Drilling), and review of available data suggests that there will be no impact to springs, seeps, other users, or environmental resources because the proposed well sites will be greater than 0.5 miles within the Project boundaries. The actual drawdown and groundwater cone dimensions will be verified for each proposed well location to verify that the zone of influence does not extend outside of the Project boundaries. Any adjustments will be made to ensure that the zone of influence is contained within the Project boundaries.

References:

National Park Service Web Site. www.nps.gov

USGS National Water Information System, http://nwis.waterdata.usgs.gov/

Eagle Well Drilling & Pump Services, Raymond Ward, LIC#-768952 CA, Phone 760-257-3553.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 148: Please provide information on the existing site groundwater quality and what changes to that water quality could result from project pumping.

Response: Water quality test data was obtained from the USGS website for two existing well locations near Newberry Road at Interstate 40 west of the Project site. The test data suggests that the overall water quality is sufficient for washing, cleaning and cooling purposes; however, if it is to be used for drinking, it is recommended that the Total Dissolved Solids and Arsenic Levels be verified and reduced if needed. Based on USGS National Water Information System, it appears a well in northeast Newberry Springs, approximately 10 miles north of the site, has a concentration of sodium of approximately 190 mg/L as measured in October, 2008. It should be noted that the water quality of the groundwater at the Project site may have significantly different quality characteristics and final recommendations should be based on water quality tests performed at the proposed well sites.

Based on the letter dated June 10, 2008 prepared by URS, the groundwater quality may be poor for domestic use. The groundwater tests for nearby wells describe the groundwater as mainly sodium bicarbonate in character. The groundwater is of sodium-calcium sulfate character near Daggett and Newberry Springs. Groundwater of sodium chloride, sodium-calcium chloride, and sodium chloride-sulfate character occur east of Troy Lake. Total Dissolved Solids concentrations range from 300 mg/l near Daggett to 2,000 mg/l near Newberry Springs (DWR, 2003).

Based on the Phase I Environmental Assessment (ESA) conducted by URS there are no known groundwater contaminants present; therefore, it is not anticipated that pumping groundwater from onsite well(s) will result in migration of groundwater contaminants. Additionally, no changes to existing physical or chemical conditions of groundwater resources is expected as a result of pumping groundwater to meet Project water needs. It appears that the Lavic Groundwater Basin is hydrologically isolated from neighboring basins; therefore, it is anticipated that water levels in neighboring basins will not be affected by pumping groundwater to meet Project water supply needs.

References:

USGS National Water Information System web site - Groundwater measurement data for Site Number 344927116394101, AND 345104116384001

Data review letter dated June 10, 2008 prepared by URS, Lowell Woodbury, REA, Project Geologist.

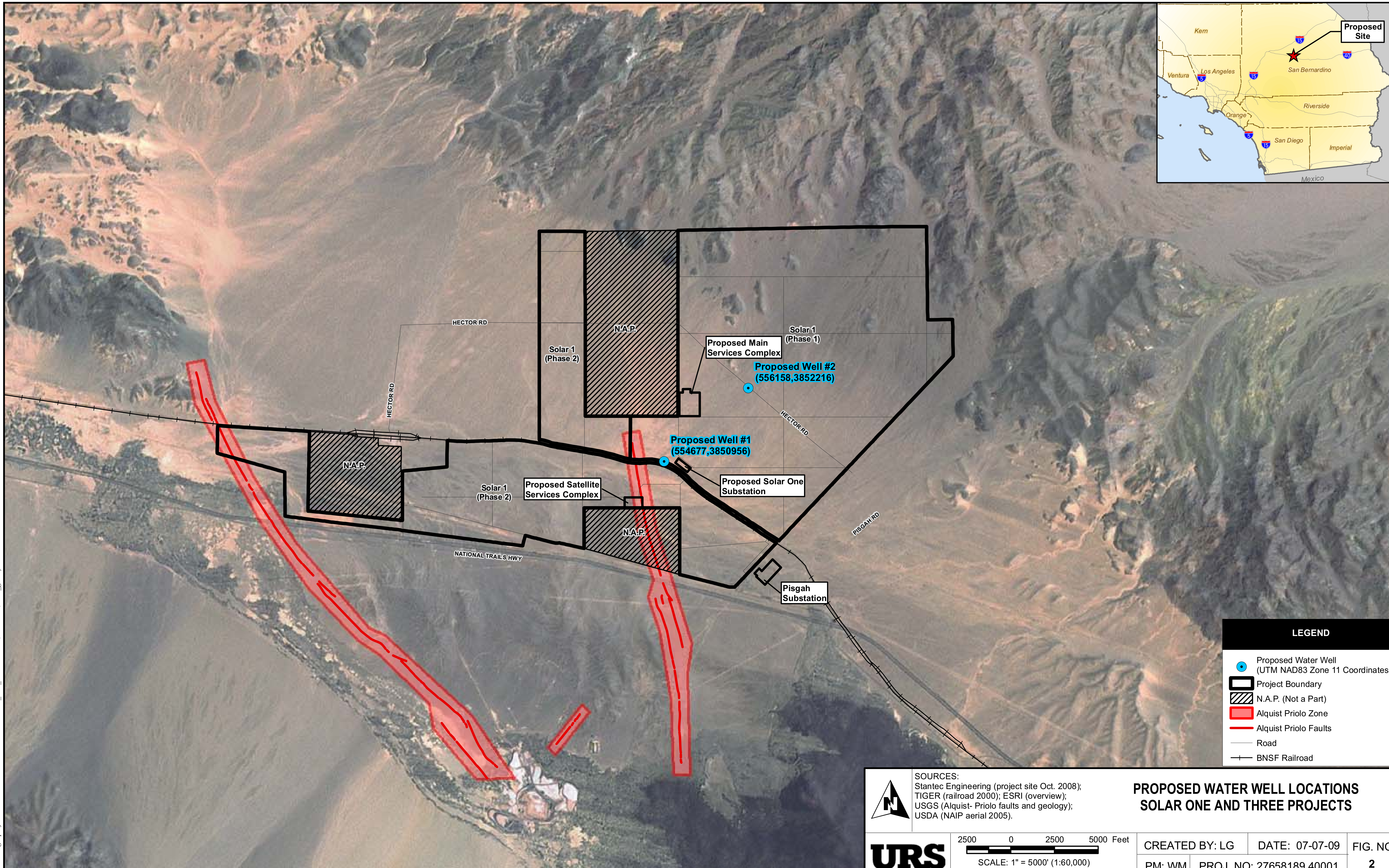
CEC Data Adequacy Request 53 Response Letter.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 149: Please provide information regarding the location, method of conveyance and distribution of the groundwater for storage, treatment and project use.

Response: Attachment SWR-1 shows the general locations of the test wells. Should the well test results indicate water availability suitable for the needs of the Project, the Applicant will provide the requested information. A water well and pump facility will be constructed for the Solar One site. The pumped groundwater is anticipated to be conveyed to an above-ground storage tank facility adjacent to the main services complex by an underground water main. A water treatment facility will be constructed near the main services complex to treat the groundwater before it is used. Water trucks will collect the water from the above-ground storage tank and distribute the water to the Project site where needed.

SWR-1



SOURCES:
Stantec Engineering (project site Oct. 2008);
TIGER (railroad 2000); ESRI (overview);
USGS (Alquist- Priolo faults and geology);
USDA (NAIP aerial 2005).

2500 0 2500 5000 Feet

SCALE: 1" = 5000' (1:60,000)
SCALE CORRECT WHEN PRINTED AT 11X17

URS

PROPOSED WATER WELL LOCATIONS SOLAR ONE AND THREE PROJECTS

CREATED BY: LG	DATE: 07-07-09	FIG. NO:
PM: WM	PROJ. NO: 27658189.40001	2

Path: G:\gis\projects\1577\27658100\mxd\Water\waterwell_locs_20090707.mxd, 07/07/09, lisa_garvey

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 150: Please provide information on how conveyance of onsite groundwater will be accomplished without creating erosion/sedimentation impacts.

Response: A Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented by the Project contractor. Appropriate erosion control measures will be put in place to prevent erosion and sedimentation impacts due to the conveyance of the onsite groundwater.

The contractor will reduce chances of erosion by avoiding excavation activities during wet weather. During construction the contractor will cover exposed piles of soil, sand or gravel, and excavated material with plastic sheeting to protect it from rain, wind, and runoff. The contractor will construct diversion dikes around the construction site to a detention basin and around the construction site to prevent erosion through the construction site.

During periodic pump testing, the pumped water will be discharged into the adjacent detention/infiltration basins, and the water will be allowed to infiltrate into the ground. Proper sandbagging will be employed to ensure that erosion of the basin floors does not occur.

During construction of the water conveyance main, proper erosion control measures will be employed to prevent erosion of excavated trenches. Sandbagging and plastic sheeting will be utilized to help prevent erosion of stock-piled dirt.

At the tank location, sandbagging will be employed to prevent erosion from discharge during water transfer from the storage tank to the distribution trucks.

References:

California Stormwater BMP Handbook, New Development and Redevelopment, Latest Edition.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 151: Please provide information on the expected quality and quantity of site generated wastewater.

Response: The mirror washing activity requires de-mineralized water in order to prevent scale build up on the mirrors degrading their reflectivity, which will lower the plant output. The Reverse Osmosis (RO) System has not been designed as the there are several possible water sources being developed for mirror washing. The estimated water demand for mirror washing water for the 850MW plant is 36 acre-feet per year. The RO System is expected to generate 9.4 acre-feet (3,063,000 gallons) of discharge into the evaporation ponds during a one-year period. The effluent could potentially contain the constituents listed in Table 1.

Table 2
Potential Effluent Constituents

Cations	Anions
Calcium (Ca)	Hydrate (OH)
Magnesium (Mg)	Carbonate (CO_3)
Sodium (Na)	Bicarbonate (HCO_3)
Potassium (K)	Sulfate (SO_4)
Iron (Fe)	Chloride (Cl)
Copper (Cu)	Nitrate (NO_3)
Barium (Ba)	Fluoride (F)
Strontium (Sr)	Phosphate (PO_4)
Aluminum (Al)	
Manganese (Mn)	
Ammonium (NH_4)	

The exact concentrations of the above substances will be determined once the water source has been identified. If the mineral content is low enough, Tessera Solar may eliminate the RO System and go directly to a de-mineralizing system significantly reducing the need for the proposed evaporation basins.

Potable water will be developed through an onsite well or be delivered in bulk to the site. Wastewater generated from the potable water supply will be processed though an onsite septic tank and leach field per County and State requirements.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 152: Please provide all information that describes how the on-site disposal method would be protective to the environment in accordance with Lahontan Regional Water Quality Control Board requirements.

Response: The Applicant will submit a Report of Waste Discharge (ROWD) and obtain Waste Discharge Requirements (WDR) from the Regional Water Quality Control Board (RWQCB), if required from the RWQCB. The evaporation ponds will be designed to comply with Title 27 requirements and ensure protection of groundwater, per RWQCB and State requirements for construction and monitoring. The Applicant is in contact with the RWQCB to finalize monitoring well locations and permitting requirements.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 153: Please provide all information regarding on-site waste water disposal that the Lahontan Regional Water Quality Control Board needs to develop Requirements of Waste Discharge.

Response: A Requirement of Waste Discharge (ROWD) will be filed with the RWQCB, if required, to apply for WDRs for the Project prior to evaporation pond operation. A complete ROWD for a lined pond typically must include the following:

- a full characterization of the wastewater chemical composition;
- a characterization of the average and peak wastewater discharge flow rates, and monthly and annual total volumes;
- a map showing the proposed pond location;
- a characterization of the geology and climatology of the site;
- design drawings showing details of the double-liner system and the leachate collection and recovery system (LCRS);
- a demonstration that the proposed liner material is compatible with the wastewater chemical composition;
- a water balance demonstrating that the pond volume is sufficient to provide at least two feet of freeboard based on the anticipated wastewater volume and evaporation/precipitation volumes;
- a demonstration that the pond will not be subject to flooding during a 100-year storm;
- a demonstration that the pond is at least 200 feet from an active fault;
- a construction quality assurance plan;
- an operation plan for waste containment;
- a plan for a vadose-zone monitoring system;
- a plan for a groundwater monitoring system, including plans to collect four independent groundwater samples (preferably over the course of a full year) from one or more onsite monitoring wells to establish a background data set prior to wastewater discharge to the pond, and plans to eventually install a minimum of three monitoring wells at locations that are up-gradient, down-gradient, and cross-gradient to the pond;
- a preliminary closure and post-closure maintenance plan; and
- financial assurance estimates for closure, post-closure maintenance, and corrective action.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 154: Please correct or clarify the information provided in that sentence.

Response: The sentence referenced should read, "Roadway dips will be used for major drainage patterns where the channel cross-section exceeds 8 feet in width and 3 feet in depth or exceeds 20 feet in width and 2 feet in depth."

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 155: Please describe where and how the removed sediment will be disposed.

Response: The stem-pipe risers at the culvert locations have been eliminated and are no longer part of the storm water management system. If sediment is deposited across the unpaved, surface-treated maintenance roads the sediment will be removed from the travel way and either deposited on the upstream sides, out of the floodway of the contributing drainage way, or moved to replace soil removed by scour at an onsite location. Sediment transportation through the site should be minimal based upon the initial engineering design of the sediment control basins and the detention basin on the site’s northern boundary and interior locations.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 156: Please explain why the roadway culvert design allows flows to exceed the capacity of the designed culverts.

Response: The culverts mentioned are on non-lifeline roadways and as such are designed for a 25-year event, which is a standard practice for low volume remote roadways. Lifeline roadways will be designed to accommodate the 100-year storm water flows.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 157: Please explain why the design of the roadway accounts for pavement damage following major storm events.

Response: The onsite arterials and maintenance road have at grade wash crossings and, as such, are subject to storm water damage. The acrylic polymer treatment is environmentally safe; however, it is not indestructible and will be subject to wash scour damage potential. The roadway and wash system is to be designed to minimize the scour potential, but the system can not be designed to account for all natural occurrences. The lifeline roads will be elevated and armored to further help eliminate storm water damage from the 100-year events.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 158: Please explain the collection and disposal methods to be used for removal of the damaged pavement and other roadway debris from the drainage channel.

Response: There should be no damage to lifeline roadway pavement during storm events. If such an event occurs the damaged pavement material would be collected and disposed of according to local county government requirements. Tessera Solar would like to recycle and re-use as much of the material as practical. If damage occurs to the non-lifeline roadways treated with an acrylic polymer, the treated soil can be reworked with standard roadway maintenance equipment and re-installed.

The re-working would consist of breaking down of the treated soil into reasonably sized particles, mixing those particles with additional native soil, re-applying and mixing the acrylic polymer and reconstructing the roadways damaged area.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 159: Please explain the measures proposed to address the reduction in the channels' carrying capacities of flood waters.

Response: Proposed measures to address the reduction in the channels' carrying capacities of flood waters will include periodic removal of accumulated sediment before and after storm events and through ongoing maintenance activities. Maintenance activities may include removal of accumulated sediment and disposal in onsite upland areas or areas that were subjected to scour.

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 160: Please re-evaluate and present a map showing the expected area of inundation caused by the 100-year storm that accounts for all of the SunCatcher foundations constructed in the drainage channels.

Response: Maps showing the 100-year floodplains and the SunCatcher locations are provided as parts of attachment SWR-2, located behind this response.

SWR-2

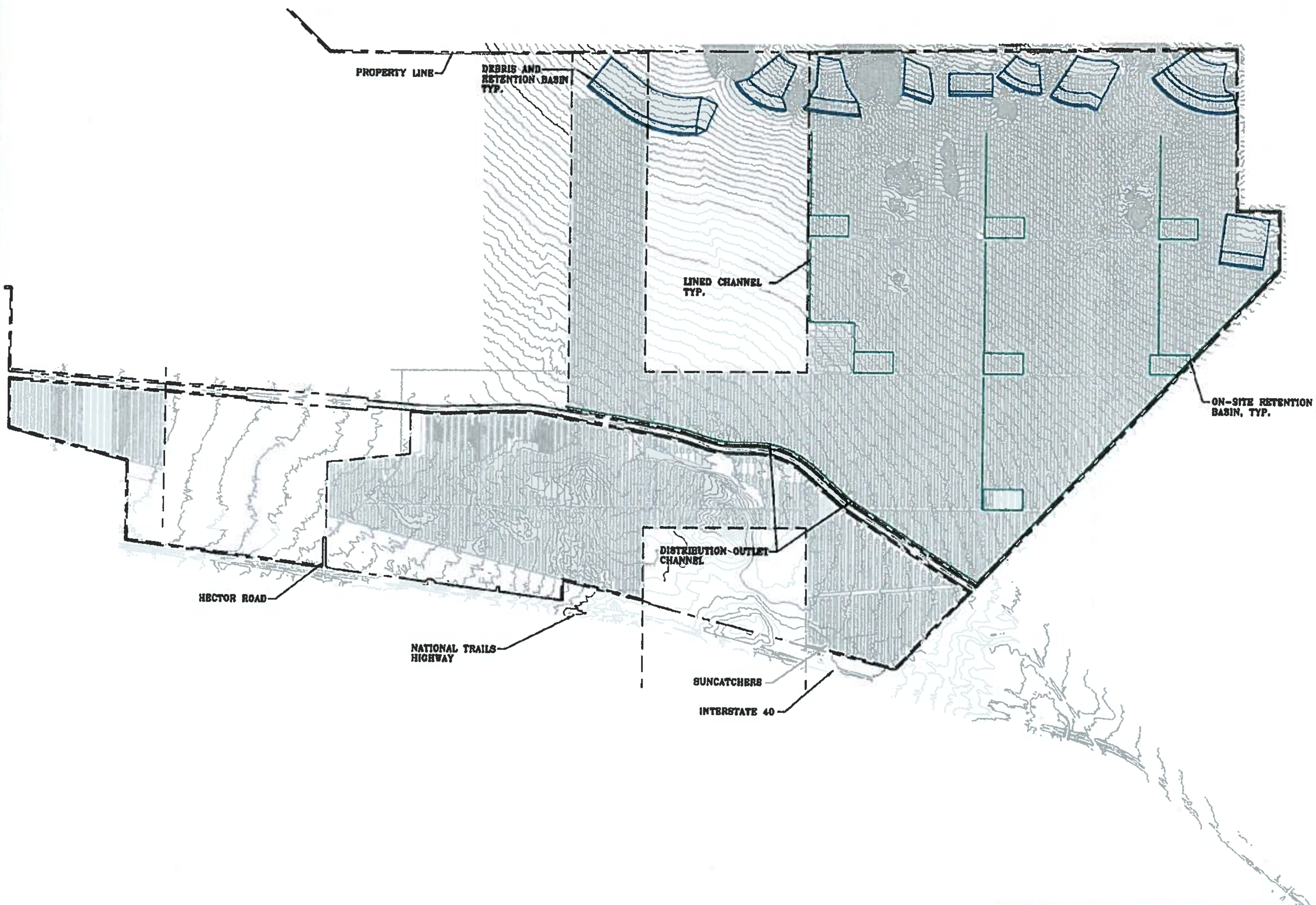


FIGURE 1
ALTERNATE 1
RETENTION OF 100-YR VOLUME

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

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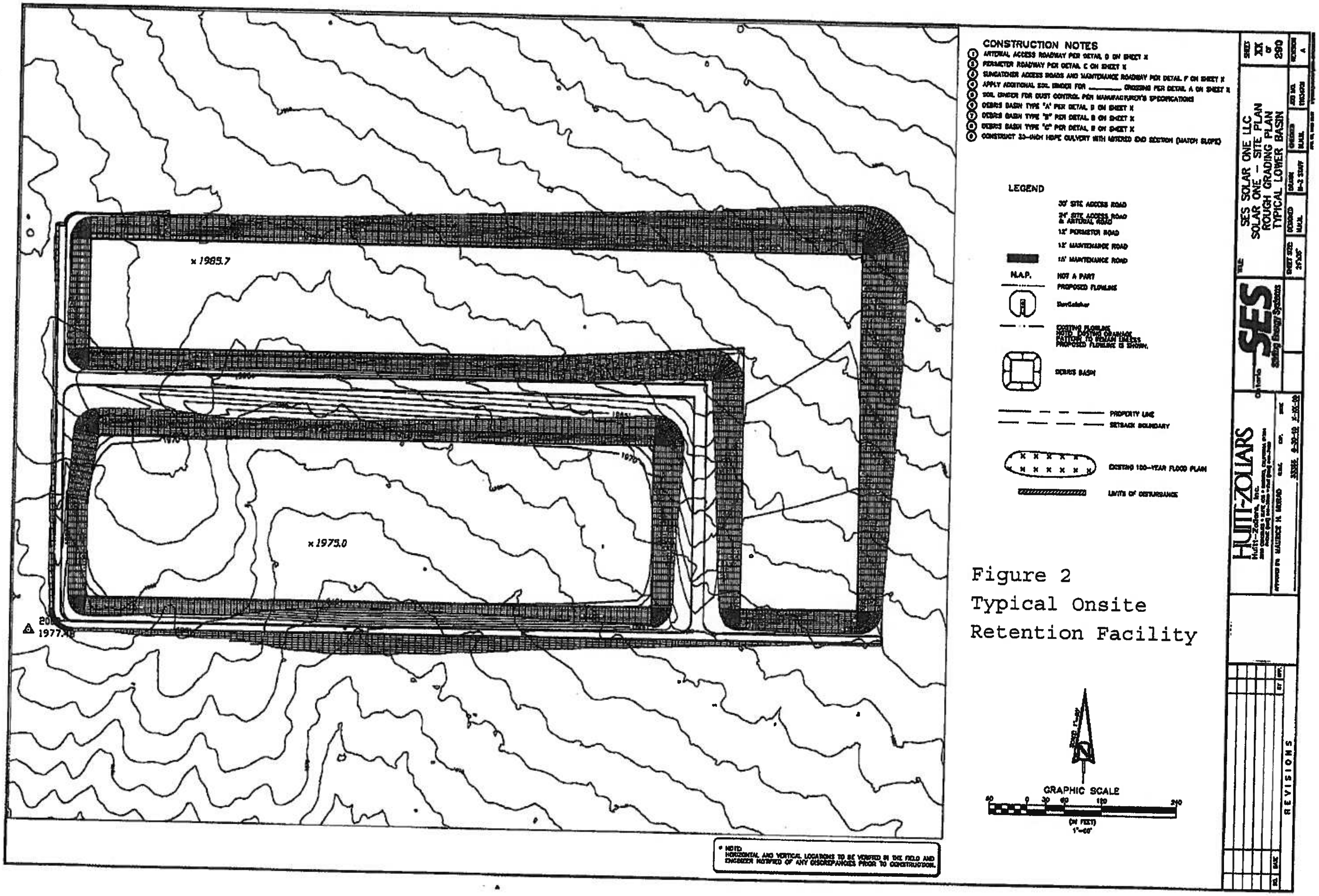

Figure 2
Typical Onsite
Retention Facility

FIGURE 3
ALTERNATE 2
RETENTION OF 100-YR VOLUME
ON-SITE RUNOFF CHANNELED

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

...\GEOPAK\DGN\LHYD_FIGURE 3.dgn 4/21/2009 7:02:43 PM

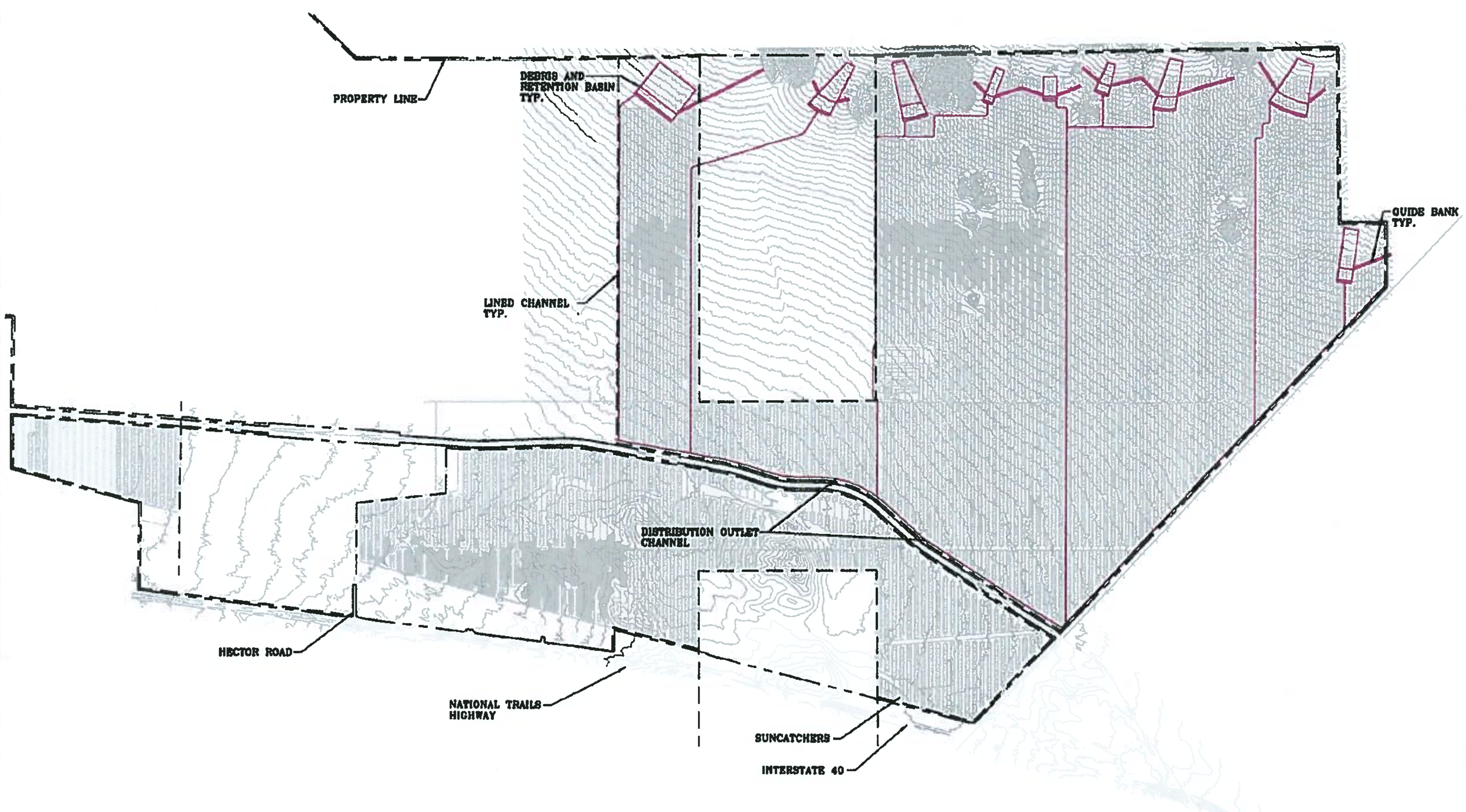

FIGURE 4
ALTERNATE 3
RELEASE OF 10-YR FLOW

HUITT-ZOLLARS
Huitt-Zollars, Inc.
3990 CONCOURS • SUITE 450 • ONTARIO, CALIFORNIA 91764
PHONE (909) 941-7799 • FAX (909) 941-7789
Ontario

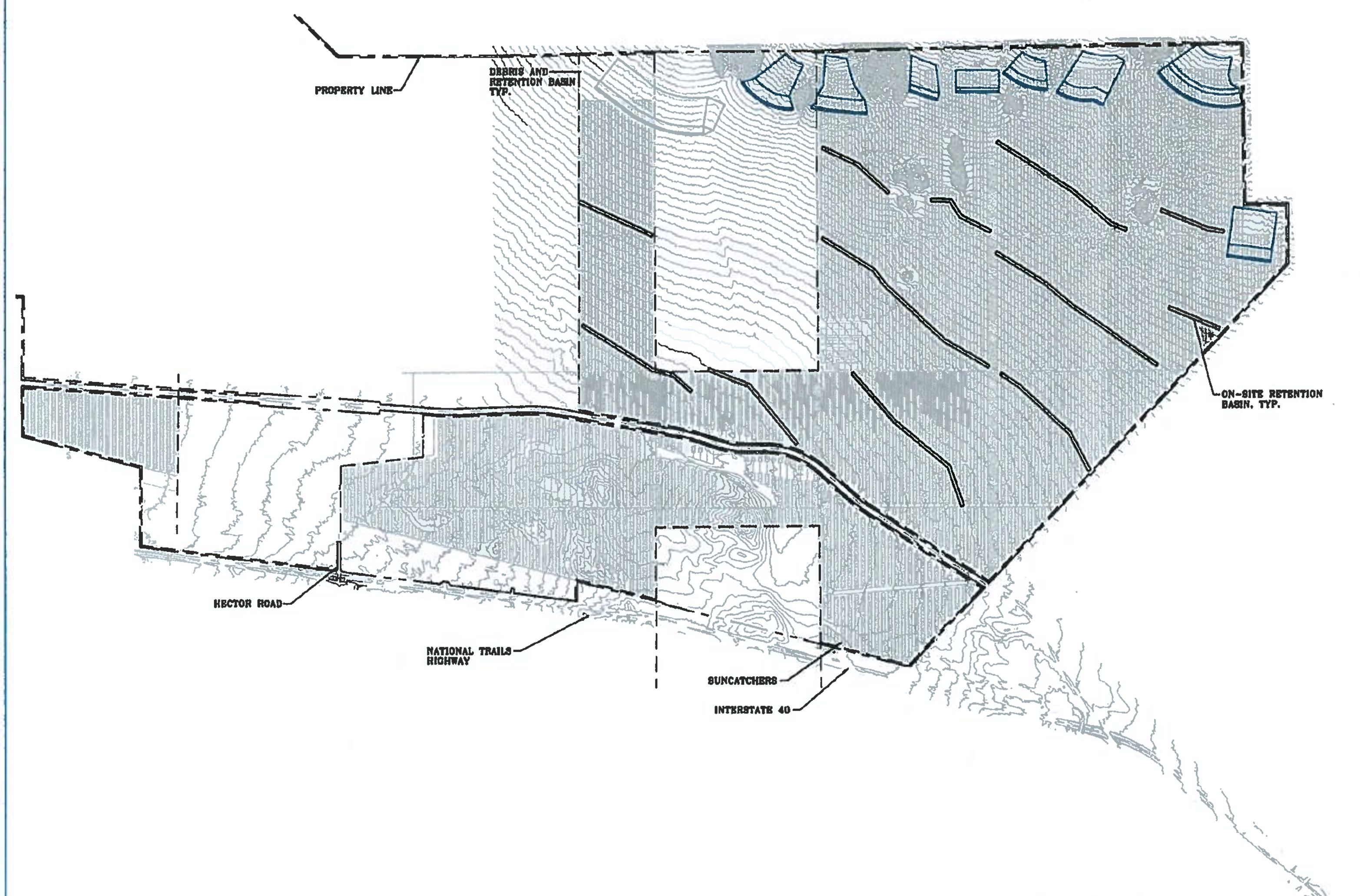

FIGURE 5
ALTERNATE 4
ON-SITE LINEAR RETENTION BASINS

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

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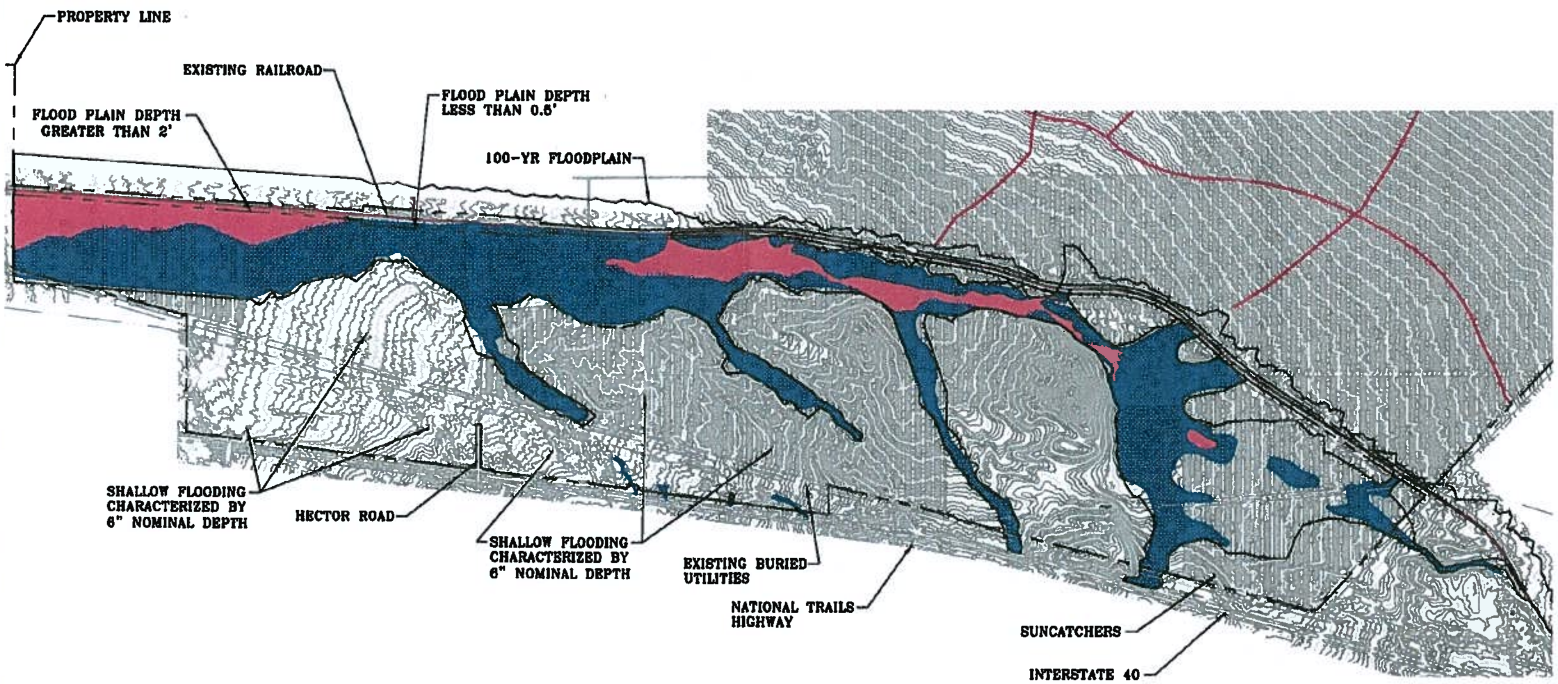

FIGURE 6
EXISTING FLOODPLAIN DEPTH
(SOUTH OF RAILROAD)

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

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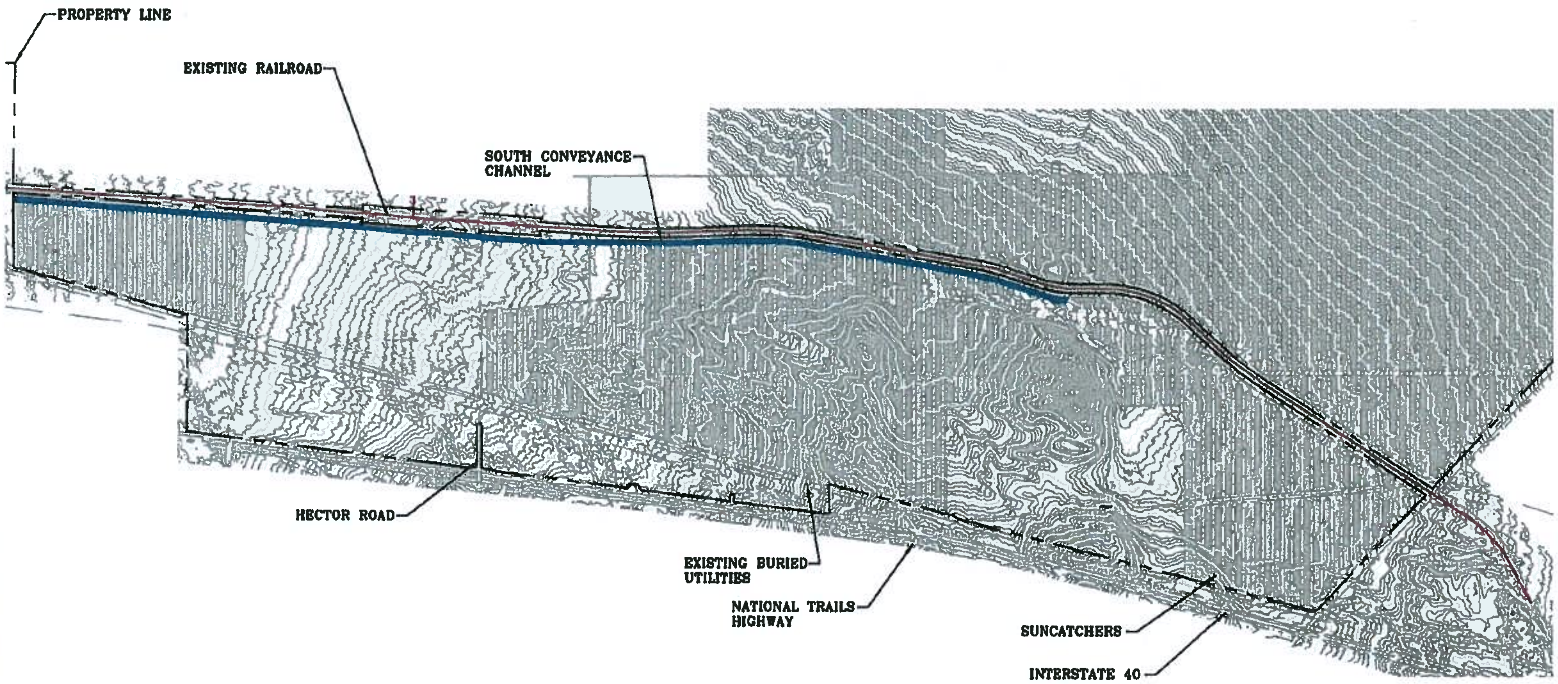
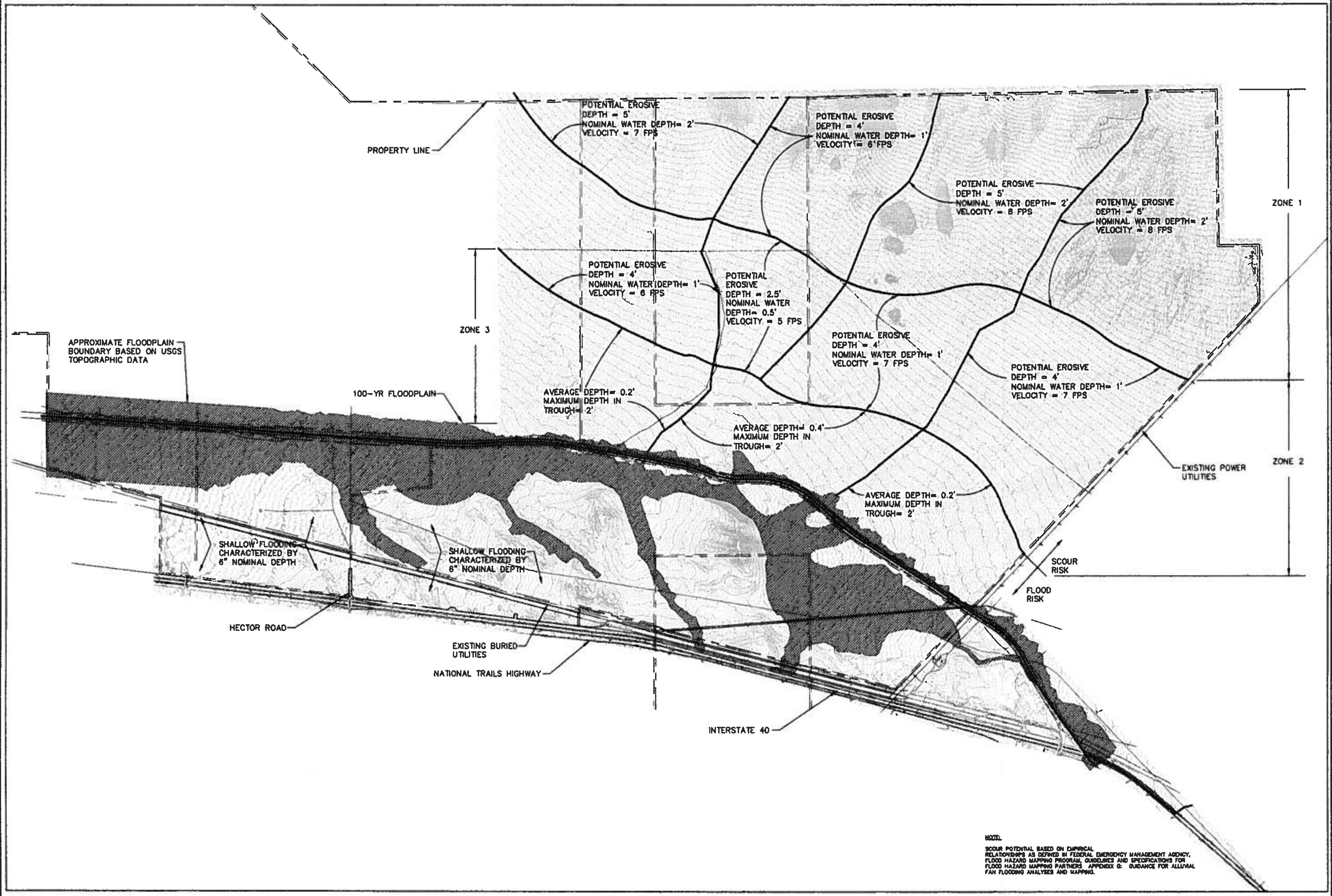


FIGURE 7
SOUTH CONVEYANCE CHANNEL

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

...\GEOPAK\DGN\LHYD_FIGURE 7.dgn 4/22/2009 1:14:02 AM



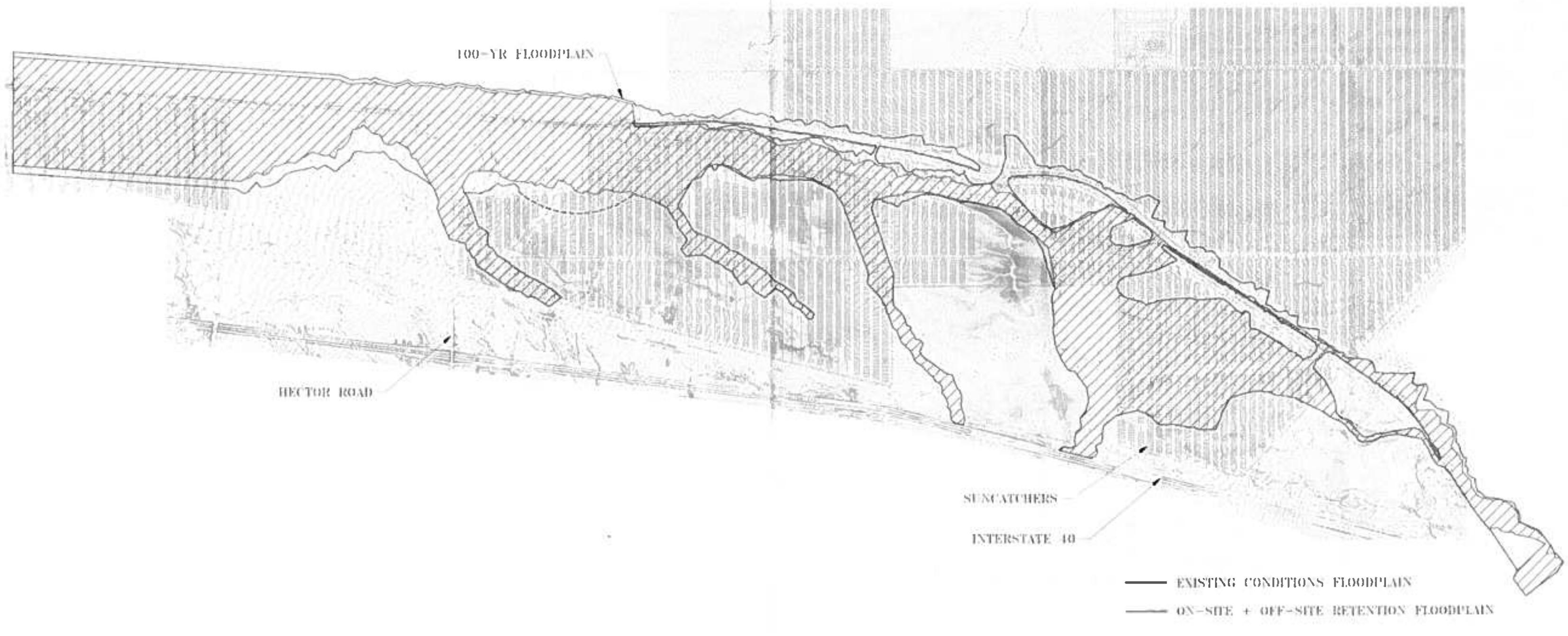
SCOUR/FLOOD RISK MAP
EXISTING CONDITIONS

SOLAR ONE
COUNTY OF SAN BERNARDINO

SCALE: = 1" = 1000'

HUITT-ZOLLARS

SHEET 1



FLOODPLAIN COMPARISON MAP
SOLAR ONE
COUNTY OF SAN BERNARDINO

SCALE: 1" = 1000'

HUITT-ZOLLARS
Huitt-Zollars, Inc.
Ontario

TECHNICAL AREA: SOIL AND WATER RESOURCES

Data Request 161: Please provide the analysis used to determine adequate SunCatcher foundation depth to account for expected drainage scour.

Response: The majority of the SunCatcher units will be supported by single metal pipe foundations that are hydraulically driven into the ground. These foundations are expected to be approximately 16 feet long and 24 inches in diameter. Shallow drilled pier concrete foundations, approximately 36 inches in diameter, embedded into rock a minimum socketed depth of six feet would be used for hard and rock-like ground conditions. Expected scour at the SunCatcher unit foundations is approximately three to five feet during a 100-year storm event. SunCatcher foundations/supports will be designed as appropriate to withstand this anticipated scour depth.

TECHNICAL AREA: VISUAL RESOURCES

Data Request 162: Please describe any conditions under which the heated face of the PCUs might be visible to viewers.

Response: The PCU apertures may be seen both directly and indirectly. Directly, the aperture can only be seen from 22 to 90 degrees on each side of the dish. From the front of the dish, they are blocked by the PCU. From the back of the dish, they are blocked by the mirrors. Indirectly, the aperture can be seen only from the front side of the dish where the image of the aperture can be reflected by the mirrors.

Ghanbari and Diver [Ghanbari, C.M. and Diver, R.B. (1994), Glint Hazard Assessment, Sandia National Laboratories Internal Memo, April 21, 1994.] is provided as attachment VIS-1. The report developed a mathematical model to investigate the maximum viewing time of diffuse reflections from a dish receiver aperture plate. The results showed that diffusely reflected radiation from the receiver did not pose hazards for retinal thermal damage, retinal photochemical injury, or infrared radiation damage.

Furthermore, in 24 years of Dish Stirling operations there have been no reported injuries from looking at the apertures. Additionally, 10 SunCatchers and other similar concentrating solar devices operate on an Air Force base, without incident or complaint.

SolarPACES 2009, Berlin, Germany, September 15-18, 2009

HAZARD ANALYSES OF GLINT AND GLARE FROM CONCENTRATING SOLAR POWER PLANTS

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Abstract

Because of the increased interest in deploying concentrating solar power systems, glint and glare from concentrating solar collectors and receivers is receiving increased attention as a potential hazard or distraction for motorists, pilots, and pedestrians. This paper provides a summary of previous analyses to evaluate glint and glare from concentrating solar power plants. In addition, a review of the physiology, optics, and damage mechanisms associated with ocular radiation is provided. A summary of safety metrics and standards is also compiled from the literature to evaluate the potential hazards of calculated irradiances from glint and glare. Previous safety metrics have focused on prevention of permanent eye damage (e.g., retinal burn). New metrics are introduced in this paper for temporary flash blindness, which can occur at irradiance values several orders of magnitude lower than the irradiance values required for irreversible eye damage.

Keywords: glint, glare, retinal irradiation, retinal burn, flash blindness

1. Introduction

Assessment of the potential hazards of glint and glare from concentrating solar power plants is an important requirement to ensure public safety. Glint is defined as a momentary flash of light, while glare is defined as a more continuous source of excessive brightness relative to the ambient lighting. Hazards from glint and glare from concentrating solar power plants include the potential for permanent eye injury (e.g., retinal burn) and temporary disability or distractions (e.g., flash blindness), which may impact people working nearby, pilots flying overhead, or motorists driving alongside the site.

Applications and certifications for solar thermal power plants often require an assessment of “visual resources” at the site, but these requirements typically focus on aesthetic qualities and standards. Certifications also require an evaluation of general health and safety issues associated with the site, but rigorous and uniform treatment of glint and glare are lacking. The purpose of this paper is to summarize previous analyses and provide general assessment methods that can be used to evaluate potential hazards of glint and glare for all of the primary concentrating solar power (CSP) technologies: (1) power tower systems, (2) linear concentrator systems (e.g., parabolic troughs, linear Fresnel), and (3) dish/engine systems.

2. Review of Previous Assessments

The following sections summarize previous assessments that were conducted to evaluate potential glint and glare hazards from power towers, linear receivers, and dish collector systems. Figure 1, Figure 2, and Figure 3 show photographs of observed specular and diffuse reflections from these different types of systems.

2.1 Power Towers

Brumleve [1],[2] provided some of the earliest analyses of eye hazards associated with central receiver technologies. Analytical models were developed to assess light intensities and hazardous ranges of single and multiple coincident heliostat beams at ground level and in the air space above a central receiver facility at Sandia National Laboratories in Albuquerque, New Mexico. Distances were calculated to ensure safe retinal irradiance levels (based on work from Sliney and Freasier [3]), and results showed that retinal irradiance from single heliostat beams exceeded the safe limits only within a short range (up to 40 m) within the focal distance of the heliostat. For heliostats with focal distances greater than 270 m, the safe retinal limits were never exceeded. The safe number of multiple coincident beams was also calculated as a function of distance, focal length, and projected area density of the multiple collectors on the retina. Based on these analyses, exclusion zones (restricted areas) and beam control techniques were recommended to minimize the potential hazards from single and multiple heliostat beams during operation.

Brumleve [2] also used video techniques during helicopter flyovers and at ground level to determine retinal irradiance, image size, and receiver brightness for the 10 MW_e solar thermal central receiver pilot plant in Barstow, California. Safe limits were not exceeded in the airspace above an altitude of ~240 m, which is the lowest allowable altitude for aircraft near the 91-m tall receiver tower. It was also found that the receiver was not bright enough to constitute an eye hazard during momentary viewing.

The probability of multiple heliostat beams randomly crossing in the airspace above the proposed Ivanpah Solar Electric Generating System in California was calculated in an application submitted to the California Energy Commission [4]. In the application, they showed that the probability of a sufficient number of heliostat beams (8) crossing at the same point to exceed safety limits at an altitude of 1000 m was infinitesimally small.

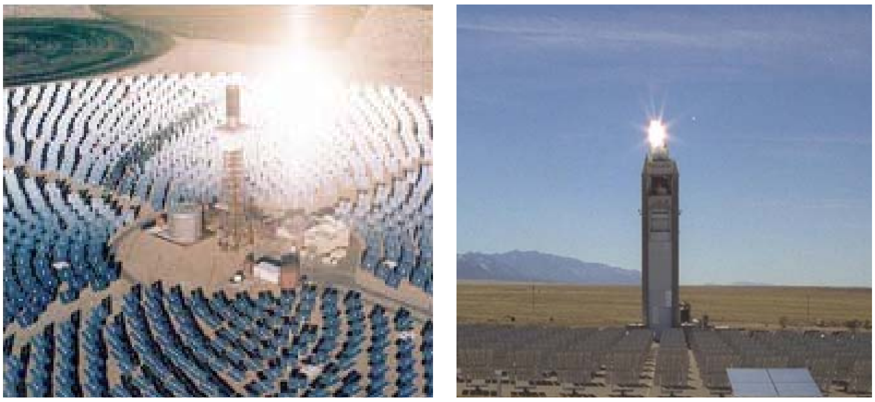

Figure 1. Left: Specular reflections from heliostats at Solar One (10 MW_e Power Tower, Daggett, CA). Right: Diffuse reflections from receiver panel (National Solar Thermal Test Facility, SNL, NM).

2.2 Linear Concentrators

Glint and glare analyses have been performed for the proposed Carrizo Energy Solar Farm in San Luis Obispo County, California, which consists of nearly 200 lines of compact linear Fresnel reflector systems [5]. Diffuse reflection from the receiver pipes and spillage intensity from the reflectors were evaluated. Results showed that unsafe beam intensities could be posed to pedestrians within ~18 m of the perimeter fence; therefore, privacy slats in the perimeter fence were proposed. Other scenarios associated with reflected light were not found to be likely hazards.

An application for certification of the Victorville 2 Hybrid Power Project [6] included a letter from the California Department of Transportation, Division of Aeronautics, that conducted flyovers of existing parabolic trough plants at Kramer Junction and Harper Lake in Southern California. The glare and flash was found to be similar to the reflection over a smooth water surface. In addition, a letter from the chief operating officer of the Kramer Junction facility stated that the observed reflections originated primarily from the receiver tubes and that the glare has not been a distraction to pilots in nearly 20 years of operation.

A recent application for certification of the San Joaquin Solar 1 & 2 project submitted to the California Energy commission included a glint and glare analysis for their proposed parabolic trough plant [7]. The analysis evaluated the diffuse reflection from the receiver pipes (heat collection elements), and they concluded that the diffusely reflected sunlight from the receiver pipes would be 150 times less than the intensity of the sun and therefore not a hazard. The beam intensity caused by specular reflection from the mirrors was also considered to evaluate potential glare when the parabolic troughs were being rotated from stow position to tracking position. Results showed that the beam intensity could be unsafe for pedestrians within 60 feet from the plant perimeter (although details of the calculations and metrics were not provided), so privacy slats in the perimeter fence were recommended.

Figure 2. Specular and diffuse reflections from linear receiver tube (left) and trough field (aerial view, right) at Kramer Junction (150 MW_e Parabolic Trough, Mojave Desert, CA).

2.3 Dish/Engines

A qualitative glint and glare analysis of dish/engine systems for the SES Solar Two Project was conducted as part of the application for certification that claimed that distracting, blinding, or hazardous glint or glare effects should not be a problem [8]. However, detailed analyses of the potential for hazardous reflections during off-axis positions (e.g., during stowing, start-up, or abnormal operations) was not performed.

Ghanbari and Diver [9] developed a mathematical model to investigate the maximum viewing time of diffuse reflections from a dish receiver aperture plate (see Appendix). The maximum viewing time was based on exposure limits for optical radiation published by the American Conference of Governmental Industrial Hygienists (ACGIH) [10]. Their results showed that diffusely reflected radiation from the receiver did not pose hazards for retinal thermal damage, retinal photochemical injury, and infrared radiation damage.

In 1980, Sliney evaluated hazards of the reflected sunlight from the point-focus collectors at the JPL/Edwards test site [11]. He first analyzed the hazards from viewing the sun directly and concluded that the natural blink response of 0.1 – 0.2 seconds is adequate to protect viewers from thermal retinal and photochemical injury. However, prolonged staring at the sun when it is high in the sky or viewing it, unfiltered, through a magnifier such as binoculars or telescopes will result in thermal retinal damage. He then analyzed viewing of reflected sunlight from a point-focus collector. Sliney concluded that if an observer is less than one focal length away from a single facet on a point-focus collector, even for short exposures, injury could occur. However, when a dish is tracking the sun, it is virtually impossible for anyone, worker or observer, to be less than one focal length for any one facet. The situation that is of greater concern is when the dish is not tracking the sun but is in an off-axis position that could still reflect sunlight onto a worker or observer. In these cases, however, the reflected sunlight would not emanate from the entire dish, but rather from an individual facet, and observers would not be exposed to reflections that are more dangerous than the sun itself.

Figure 3. Left: Specular reflections from stowed parabolic dish collectors. Right: Diffuse light emanating from dish receiver aperture. (National Solar Thermal Test Facility, SNL, NM)

2.4 Discussion of Previous Analyses

In the previous analyses of glint and glare for concentrating solar thermal power plants, permanent eye damage was used as the metric to determine safe retinal irradiance values. The safe retinal irradiance thresholds were based on retinal burn tests performed on rabbits [3]. In the next section, additional metrics are discussed, including temporary flash blindness. Data from past research on flash blindness and recovery times from after-image disability are reviewed to provide additional quantitative metrics that may be used for glint and glare evaluations of concentrating solar thermal power plants.

3. Ocular Irradiation and Safety Metrics

3.1 Anatomy of the Eye

Figure 4 shows an illustration of the human eye and how an image is projected onto the retina. Light rays enter through the cornea and pass through the pupil, which can vary in aperture size from 2 – 3 mm for a sunlight-adapted eye to 7 – 8 mm for a dark-adapted eye. The rays pass through the lens and converge at a nodal point behind the lens. The image is then inverted and projected onto the retina, a distance approximately 1.7 cm behind the nodal point in healthy eyes.

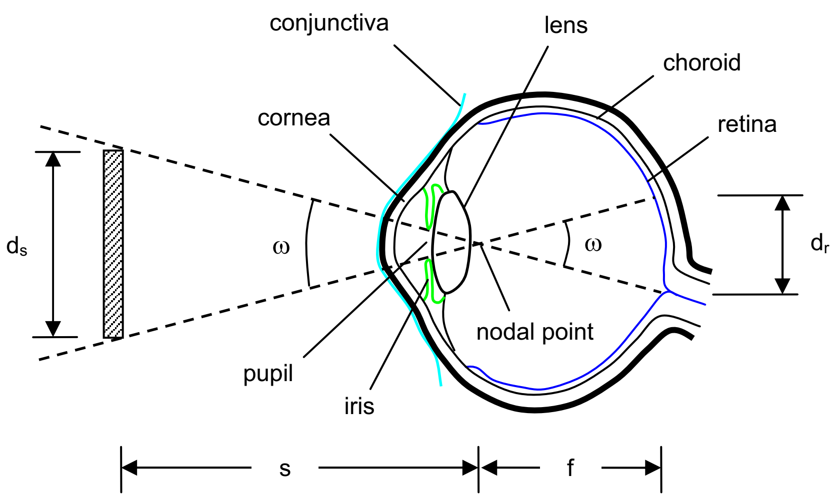

Figure 4. Image projected onto the retina of a human eye.

Potential damage to the eye depends on a number of factors including the source radiance, source angle (size and distance to eye), duration of exposure, and wavelength. The spectral distribution of sunlight is heavily weighted in the visible bandwidth (400 – 700 nm), but the eye can pass wavelengths between 400 and 1400 nm to the retina. The lens of the eye is a strong absorber of wavelengths less than 400 nm [3]. At lower wavelengths, UV-B and UV-C radiation are absorbed in the cornea and conjunctiva, and sufficient doses can cause keratoconjunctivitis (welder's flash) and photokeratitis (snow blindness) [3],[12]. Solar retinitis and eclipse blindness are caused primarily by photochemical damage (rather than thermal injury) in the visible spectrum between 380 and 580 nm. Between 580 and 1400 nm, photothermal damage predominates over photochemical damage. Because the blink response of the eye is rapid (0.15 – 0.2 s) [3], exposure to reflected sunlight is expected to be short in duration.

3.2 Retinal Irradiance

The retinal irradiance (power per unit area) can be calculated from the total power entering the pupil and the retinal image area. The area projected onto the retina (assuming circular images) can be determined from the source angle (ω), which can be calculated from the source size (d_s) and distance (s), and the focal length (f), as follows (refer to Figure 4):

$$d_r = f\,\omega$$

$$\text{where } \omega = d_s / s \qquad (1)$$

Eq. (1) assumes that the arc and the chord of a circle are the same for small angles. At a source angle, ω, of 60°, the error in d_r is ~5%. If the irradiance at a plane in front of the cornea, E_c (W/m^2), is known, the power entering the pupil can be calculated as the product of the irradiance and the pupil area (the diameter of the pupil, d_p, adjusted to sunlight is ~2 mm). The power is then divided by the retinal image area and multiplied by a transmission coefficient, τ (~0.5 [11]), for the ocular media (to account for absorption of radiation within the eye before it reaches the retina) to yield the following expression for the retinal irradiance:

$$E_r = E_c \left(\frac{d_p^2}{d_r^2} \right) \tau \qquad (2)$$

If the source radiance, L (W/m^2/sr) is known, the corneal irradiance in Eq. (2) can be determined by multiplying the radiance by the subtended solid angle of the source, Ω (sr):

$$E_c = L\Omega = L\frac{A_s}{s^2} \approx L\left(\frac{\pi}{4}\omega^2 \right) \qquad (3)$$

and the retinal irradiance can be calculated directly from the radiance as follows:

$$E_r = \frac{\pi L \tau}{4} \left(\frac{d_p}{f} \right)^2 \qquad (4)$$

It should be noted that Brumleve [1] includes an additional coefficient (ν) to account for the fraction of solar irradiance between 400 and 1400 nm, but this has been included in the transmission coefficient, τ, above. As an example, the retinal irradiance caused by viewing the sun directly can be calculated using Eqs. (1) and (2) with E_c = 0.1 W/cm^2, d_p = 0.002 m, f = 0.017 m, ω = 0.0093 rad, and τ = 0.5, which yields a retinal irradiance, E_r, of ~8 W/cm^2. Note that the retinal irradiance is significantly higher than the irradiance at the entrance of the eye. For applications involving images of the sun, the retinal irradiance can be converted to corneal irradiance using Eqs. (1) and (2) with d_p = 0.002 m, f = 0.017 m, ω = 0.0093 rad (sun shape), and τ = 0.5, yielding the following approximate relation: $E_c = 0.0125E_r$.

3.3 Safety Metrics

Safety metrics relevant to optical radiation and the prevention of permanent eye damage are reviewed and presented in this section. In addition, previous studies pertaining to flash blindness are also presented since temporary flash blindness is potentially hazardous to motorists or pilots. Other consequences from glint and glare such as discomfort and distraction have been evaluated in the literature [13],[14], but the subjective impacts of discomfort and distraction glare are not considered in this paper.

3.3.1 Safe Retinal Irradiance Values from Retinal Burn Data

Sliney and Freasier [3] presented maximum permissible retinal irradiance levels (W/cm^2) based on retinal burn data using rabbits. Brumleve [1] used this data to develop a convenient metric for safe retinal irradiance, E_{rs} (W/cm^2) based on retinal image size, d_r (m), assuming circular images and a 0.15 second exposure (typical blink response):

$$E_{rs} = \frac{0.002}{d_r} \quad \text{for } d_r < 0.002 \text{ m}$$

$$E_{rs} = 1 \quad \text{for } d_r \geq 0.002 \text{ m} \tag{5}$$

Eq. (5) has been used by several analyses of glint and glare for concentrating solar thermal power plants [4],[5],[7]. However, the calculated safe retinal irradiance value that was used in these analyses is based on specific properties of a heliostat (e.g., reflectivity, beam divergence) reported by Brumleve [2] that may not be generally applicable to other collector systems. The safe retinal irradiance value for viewing the sun directly can be calculated using Eq. (5) and the subtended angle of the sun (~9.3 mrad) to calculate the retinal image diameter. The safe retinal irradiance value is 12.7 W/cm^2, which is about 1.6 times greater than the retinal irradiance experienced from viewing the sun directly (~8 W/cm^2). Note that the retinal irradiance is greater than the corneal irradiance (or "irradiance at the eye") because of the smaller image area projected onto the retina (relative to the pupil size). The equivalent safe corneal irradiance for a subtended angle of 9.3 mrad is 0.16 W/cm^2 or 1600 W/m^2.

3.3.2 ANSI 2000 Standard

More recently, Delori et al. [15] provide a concise formulation and summary of the American National Standards Institute (ANSI) Z136.1-2000 Standard for the protection of the human eye from laser exposure. They note that the recommended exposure limits for lasers and broadband sources (such as the sun) are not substantially different. Delori et al. [15] present maximum permissible power levels entering the pupil as a function of exposure duration, wavelength, and source angle. For brief exposures (0.15 – 0.2 s), Table 3 in Delori et al. [15] provides the following expression for the maximum permissible power level, MP (W):

$$MP = 6.93\text{x}10^{-4}\, C_T\, C_E\, P^{-1}\, t^{-0.25} \tag{6}$$

where C_T is a function of wavelength (ranges between 1 and 40 at wavelengths between 400 and 1400 nm), C_E is a function of the source angle (6.2 for an angle of 9.3 mrad subtended by the sun), P is a pupil factor that is a function of exposure time and wavelength (ranges between 1.8 and ~1 for wavelengths between 400 and 1400 nm), and t is the exposure time (s). Using solar-radiance spectrally weighted values for the coefficients provided by Delori et al. [15] and an assumed exposure duration of 0.15 seconds yields a maximum permissible power at the pupil of ~0.008 W and maximum retinal irradiance of ~40 W/cm^2 for direct viewing of the sun (which corresponds to a safe corneal irradiance of ~0.5 W/cm^2 or 5000 W/m^2). This value is about three times greater than the safe retinal irradiance values proposed by Brumleve [1],[2] for direct viewing of the sun. The difference is probably due to several factors including the use of different factors of safety (up to an order of magnitude or more) in the calculations.

3.3.3 ACGIH Threshold Limit Values

Spectrally weighted exposure limits for optical radiation have also been published by the American Conference of Governmental Industrial Hygienist (ACGIH) [10]. These limits are called Threshold Limit Values (TLVs) and are calculated from spectrally weighted radiometric values of radiance or irradiance. TLVs are evaluated for (1) retinal thermal damage, (2) photochemical injury from chronic blue light exposure, (3) and infrared radiation damage.

3.3.4 Flash Blindness

Flash blindness results from bleaching of retinal visual pigments caused by bright (high luminance) sources of light. Photometric units are used to characterize the levels of brightness (or luminance) (lumens/m^2/sr) or illuminance (lumens/m^2) that cause flash blindness. Most people have experienced flash blindness after viewing a flash bulb from a camera or a bright light in a darkened room. A number of tests were performed by the U.S. Air Force to assess the visual recovery times for individuals exposed to bright flashes of light, primarily to determine how long it would take for pilots to read their instrument panels after being exposed to illumination from nuclear blasts [16],[17]. These studies found that visual recovery times ranged from 4 – 12 seconds for illuminance values ranging from ~650 – 1,100 lumens/m^2. For light emitted within the solar spectrum, this corresponds to approximately 7 – 11 W/m^2 of solar irradiance at the eye.

Additional tests were performed by Saur and Dobrash [18] to determine visual recovery times of individuals after being exposed to simulated sun reflections. They found that recovery times ranged from 0.8 – 2.7 seconds for illuminance values ranging from 120 – 280 lumens/m^2. Based on the solar spectrum, this is equivalent to approximately 1 – 3 W/m^2 of solar irradiance at the eye.

From these data, it appears that a solar irradiance on the order of 1 – 10 W/m^2 or 1×10^{-4} – 1×10^{-3} W/cm^2 at the eye is sufficient to cause temporary flash blindness. Assuming that this solar irradiance originates from an image that subtends a similar angle to the sun (9.3 mrad) with d_p = 0.002 m, f = 0.017 m, and τ = 0.5, the minimal retinal irradiance values that can cause flash blindness is ~0.01 – 0.1 W/cm^2. Comparing these solar irradiance values against the metrics used for calculating irreversible eye damage (e.g., Eqs. (5) or (6)) shows that flash blindness can occur at irradiances that are several orders of magnitude less than the irradiance metrics used for irreversible eye damage.

3.3.5 Summary of Safety Metrics

Figure 5 summarizes the safe irradiance values and flash blindness metrics discussed above for a 0.15 s exposure. As the subtended source angle increases, the safe retinal irradiance threshold decreases because of the increased size of the retinal image area, and, hence, increased energy applied to the retina. The metrics proposed by Brumleve [1] for safe retinal irradiances appear to be more conservative relative to the other standards plotted. The potential for flash blindness shown in the plot was based on corneal irradiance values of 1×10^{-4} – 1×10^{-3} W/cm^2 from the above studies, and the retinal irradiance was then determined using Eqs. (1) and (2) with d_p = 0.002 m, f = 0.017 m, and τ = 0.5 (the average retinal irradiance was plotted and the error bars represent the maximum and minimum values). The plotted retinal irradiance values for potential flash blindness appear reasonable when compared to retinal irradiance values of several common sources of light reported by Sliney and Freasier [3]: incandescent bulb (~10^{-4} W/cm^2), pyrotechnic flare (~10^{-3} W/cm^2), tungsten filament (~10^{-2} W/cm^2). Depending on the subtended source angle, the retinal irradiance that causes flash blindness can be 2 – 4 orders of magnitude less than the safe retinal irradiance metrics to prevent irreversible //eye damage.

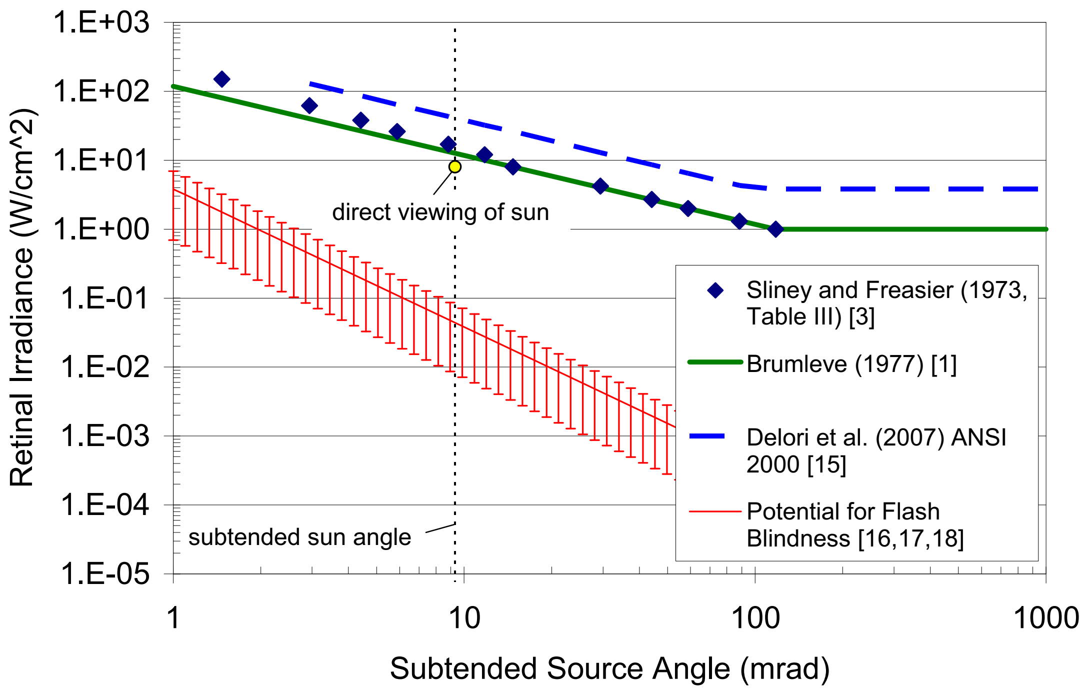

Figure 5. Retinal irradiance metrics as a function of subtended source angle for 0.15 s exposure (typical blink response time). Sliney and Freasier [3], Brumleve [1], and Delori et al. [15] provide safe retinal irradiance values to prevent irreversible eye damage. The range of retinal irradiances that can induce flash blindness is from several data sources [16], [17], [18].

4. Summary and Conclusions

This paper has presented methods to evaluate potential glint and glare hazards from specularly and diffusely reflected sunlight from concentrating solar collectors. First, a review of previous data and standards was performed to summarize metrics used to determine safe retinal irradiances as a function of subtended source angle (or retinal image size). These metrics were all based on preventing permanent eye damage, so a new metric that represents the potential for temporary flash blindness was introduced. The potential for temporary flash blindness can occur at irradiances several orders of magnitude lower than irradiances required for irreversible eye damage. Analytical models were then derived to calculate irradiances from both specular and diffuse sources. In addition, an example of irradiance calculations using a ray-tracing computational model was presented.

The methods and equations presented in this paper can be used to calculate irradiances from various concentrating solar collector systems (e.g., heliostats, dishes, troughs, receivers). These calculated irradiances can then be used to calculate the retinal irradiance using equations in Section 3.2. Finally, the calculated retinal irradiance can be compared against the safe retinal irradiance metrics provided in Section 3.3 to evaluate potential glint and glare hazards. Based on the configurations and operation of the various concentrating solar technologies, potential glint and glare hazards that should be considered include the following:

- Power Towers
    - Specular reflections from heliostats when they are moving from stowed to tracking positions, in standby mode, or are not focused on the receiver
    - Diffuse reflections from the receiver
- Linear Collectors
    - Specular reflections from the mirrors when they are moving from stowed to tracking and from specular reflections off the ends of the trough or mirrors when the sun has a low

elevation angle (e.g., reflections from the north end of a north-south field when the sun is low in the southern horizon).
    - Diffuse and specular reflections from receiver tubes
- Dish/Engine Systems
    - Specular reflections from mirror facets when the dish is off-axis (e.g., moving from stow to tracking)
    - Diffuse reflections from the receiver aperture

The impact of multiple coincident beams (i.e., from adjacent collectors or receivers) was not considered in this study. Brumleve (pp. 27-32) [1] provides a discussion of the impact of multiple sources that can be used together with the results of this study. In general, multiple sources can increase the retinal image size. In addition, the retinal irradiance may or may not increase depending on whether the projected retinal images overlap, which depends on the positions of the sources relative to the observer. For example, if two beams enter the eye but do not overlap, the affected retinal image area is increased, but the irradiance (W/cm^2) is the same as that from a single beam. If the two beam are nearly coincident and form a coalesced image on the retina, the retinal image size is about the same but the irradiance increases.

Acknowledgments

The authors would like to thank Jim Adams from the California Energy Commission and Bill Kanemoto for pointing us to information relevant to glint and glare assessments in various applications for certification (AFCs) of concentrating solar power plants. We also thank Chuck Andraka and Brian Myer for their insights and discussions regarding glint, optics, and imaging.

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TECHNICAL AREA: VISUAL RESOURCES

Data Request 163: Please provide the expected luminance of the face of a PCU in photometric terms (candela per square meter).

Response: When the system is running, the geometry of the PCU receiver is such that most of the light reflected off the mirrors is trapped inside of the receiver. A small amount of light does escape and this light can be seen by observers. The luminance of the PCU has not been measured in candela per square meter, but in the past 24 years, there have been no reported injuries from workers or visitors.

TECHNICAL AREA: VISUAL RESOURCES

Data Request 164: Please describe the maximum possible luminance of the mirror surfaces of a unit due to diffuse reflection in candela per square meter.

Response: The mirrors are highly specular. The five percent of energy not reflected by the mirrors is absorbed by the mirrors and is therefore not visible. The luminance in the visible spectrum from this effect is zero candela per square meter.

TECHNICAL AREA: VISUAL RESOURCES

Data Request 165: Please characterize the times of day in which the entire mirror surface would be visible to a) eastbound motorists on I-40, b) westbound motorists on I-40, c) BNSF staff, d) and train passengers. This description may be described in terms of representative seasonal days, e.g., solstices and equinox.

Response: If the motorists or train passengers turn their heads, the mirrors will be visible in both directions every day that the dishes are in operation. They would not be visible at night when the dishes are in night stow position.

TECHNICAL AREA: VISUAL RESOURCES

Data Request 166: Please describe the potential luminance of the off-axis focal point created in the transition from cloud-cover to full solar brightness and indicate the safe viewing distance for passing aircraft.

Response: By definition, the luminance of a source is not changed by focusing, optics, or distance. The luminance of the sun is the same if you look at it from anywhere on Earth, from any other planet, or from the focal point of a SunCatcher.

The irradiance of direct reflections from the SunCatcher decreases with distance. They are presented in Table 2, below. For comparison, the sun on a bright day typically has an irradiance of 1.000kW/m^2. Please also see the Glint and Glare Study submitted as part of the response to CEC and BLM Data Request 120.

Table 3
Irradiance of Reflected Light

Distance from Dish (ft)	Irradiance of Reflected Light Assuming Nominal Focal Distance (kW/m^2)	Irradiance of Reflected Light Assuming a Worst case Focal Distance of 100 ft (kW/m^2)
Boundary of Plant (60 ft)	0.009	0.444
Nearest Shoulder of Roadway (460 ft)	0.004	0.147

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 167: Please provide information on the size of the oil tank associated with the solar Stirling engines.

Response: The oil tank associated with the Stirling engines will hold four quarts of oil.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 168: Please provide information on any proposed oil storage tanks or storage systems that will be used to refill and maintain SunCatcher oil tanks.

Response: PCU engine oil will be stored in four 150-gallon capacity double-walled storage tanks on site in accordance with good engineering practices and applicable laws, ordinances, regulations, and standards. Two tanks will store oil recovered from the PCU's while it is waiting to be filtered for re-use in the engine. The filtered oil will be stored in two additional tanks.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 169: Please provide information on the best management practices used to contain oil leakage from around the oil tanks.

Response: Routine inspections would be performed to check for external corrosion and structure failure and spills or overflows due to operator error. Additionally, workers will receive appropriate training to minimize operator error. A Hazardous Materials Business Plan (HMBP), which outlines hazardous materials handling, storage, spill response, and reporting procedures, will be prepared before construction activities. If a spill or release of hazardous materials should occur during operations, the spill area will be bermed or controlled as quickly as practical to minimize the footprint of the spill. Finally, catch pans will be placed under equipment/hose connections to catch potential spills during fueling and servicing.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 170: Please explain if the project will or will not require a Spill Prevention, Control and Countermeasure Plan.

Response: The Lahontan RWQCB will require a Spill Prevention, Control and Countermeasure Plan. The San Bernardino Fire Department, Hazardous Material Division has requested notification for the above-ground gasoline fuel storage tank, as well as a Business Emergency/Contingency Plan.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 171: If a Spill Prevention, Control and Countermeasure Plan is required please provide a copy to staff.

Response: The California Environmental Protection Agency guidelines for the preparation of a Spill Prevention Control and Countermeasure (SPCC) plan, which the Applicant will follow, are provided as attachment WASTE-1. According to discussion with Richard Booth at the Lanhontan RWQCB, the plan will not be required until the site is in the process of being constructed. At the time of construction, the contact information and actual operations personnel will have been identified and the specific elements, other than the 5,000-gallon above-ground fuel tank, will have been identified. Richard Booth also noted the enforcing agency would be the San Bernardino Fire Department, Hazardous Material Division. Dwayne Pianalto with the San Bernardino County Fire Department provided the attached required documentation.

WASTE-1

San Bernardino Co. CUPA
620 South "E" Street
San Bernardino, CA 92415
Tel: (909) 386-8401
Fax: (909) 386-8460
www.sbcfire.org

Aboveground Storage Tank Facility Statement
Notification/Change in Status

I. Facility/Business Information

Facility CUPA ID# 1	Facility Name 3	Owner Name 111	
FA			

Facility Address 103		Owner Mailing Address 113		
City 104	Zip Code 105	City 114	State 115	Zip Code 116
Contact Name 117a	Contact Phone 118a	Owner Phone 112	NAICS Code 107	

Contact Email 119a	Does the facility have an SPCC plan? 920 (see directions on reverse) ☐ Yes ☐ No	If yes, date of last SPCC Plan Revision/Review:
If the facility does not have an SPCC plan, is it in progress? ☐ Yes ☐ No		If yes, expected completion date:

II. Total Facility Capacity in gallons

Facility's total aboveground petroleum product storage tank **capacity** for all tanks/containers/equipment/systems greater than or equal to 55 gallons (see directions on reverse)

921 TOTAL CAPACITY ____ gal

III. Tank Details – Include each aboveground tank that contains a petroleum product or other type of oil (including mineral, animal, or vegetable oils). Attach additional pages should your facility have more tanks.

922 Tank ID# (e.g. 1, 2, 3, etc.)	923 Contents (Gas, Diesel, etc.)	924 Capacity (In gallons)	925 Tank Location (Describe location)	926 Year Installed	927 Tank type:	928 Secondary Containment
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No
					☐Steel ☐Fiberglass/Plastic ☐Other (please describe)	☐Yes ☐ No

IV. Signature

I certify under penalty of law that the information submitted is accurate and complete to the best of my knowledge.

Signature of owner or tank facility operator	Printed name of owner or tank facility operator 136	Date (M/d/yyyy) 134

Aboveground Storage Tank Facility Statement

1. FACILITY CUPA ID NUMBER – This number is found on your CUPA permit.
3. FACILITY NAME - Enter the name of the business, facility or DBA for this site.
103. FACILITY ADDRESS - Enter the street address where the aboveground storage tank facility is located. No post office box numbers are allowed. This information must provide a means to geographically locate the facility.
104. CITY - Enter the city or unincorporated area in which the aboveground storage tank facility is located.
105. ZIP CODE - Enter the zip code of aboveground storage tank facility. The extra 4 digit zip may also be added.
107. NAICS CODE – Enter the primary North American Industrial Classification System code number (6 digit) or Standard Industrial Classification Code (4 digit) for primary business activity.
111. BUSINESS OWNER NAME - Enter name of business owner. If a corporation, enter the name of the corporation.
113. BUSINESS OWNER MAILING ADDRESS - Enter the owner's mailing address if different from business site address.
112. OWNER PHONE - Enter the business owner's phone number, area code first, and any extension.
114. BUSINESS OWNER CITY - Enter the name of the city for the owner's mailing address.
115. OWNER STATE - Enter the 2 character state abbreviation for the owner's mailing address.
116. BUSINESS OWNER ZIP CODE - Enter the zip code for the owner's address. The extra 4 digit zip may also be added.
117a. CONTACT NAME - Enter the name of the person who receives Aboveground Storage Tank correspondence.
118a. CONTACT PHONE - Enter the phone number, area code first, and any extension.
119a. CONTACT EMAIL – Enter the email address of the contact in 117a, if the contact has one
920. DOES THE FACILITY HAVE AN SPCC PLAN – Check the box. A Spill Prevention, Control, and Countermeasure (SPCC) Plan is a carefully thought-out plan, prepared in accordance with the guidelines contained in U.S. Environmental Protection Agency's Web site at http://www.epa.gov/oilspill/spcc.htm. This plan discusses procedures, methods, and equipment in place at the facility to prevent discharges of petroleum from reaching navigable waters. A complete copy of the SPCC plan must be maintained on site.
921 TOTAL FACILITY CAPACITY – Enter the facility's total aboveground storage tank capacity (in gallons) of petroleum products and other oils (such as mineral, animal, and vegetable oils). Aboveground storage tank means a tank that has the capacity to store 55 gallons or more of petroleum and that is substantially or totally above the surface of the ground. Total gallons may be tabulated individually or cumulatively; container size could be an aboveground tank, 55-gallon drums, or tanks and drums. For example, a facility may have petroleum products stored only in 55-gallon drums, but if there are 24 drums, then the total capacity is 1,320 gallons and the facility would qualify as a tank facility. Or a facility may have three 240-gallon aboveground tanks containing petroleum products and eleven 55-gallon drums of petroleum products and still qualify as a tank facility. Enter the total **capacity** and not the amount actually stored. The entire 2,000 gallons of an aboveground storage tank with a capacity of 2,000 gallons would be counted even if the tank never actually contained more than 1,000 gallons.
922 TANK ID# - Enter a unique tank identification number. You may create your own numbering system. (You don't need to assign numbers for 55-gallon drums.)
923. CONTENTS - Enter the contents (e.g. DIESEL, GASOLINE, WASTE OIL, etc.) of the aboveground storage tank.
924. CAPACITY – Enter the aboveground storage tank's capacity (in gallons).
925 TANK LOCATION – Enter general location (e.g. EAST, WEST, NORTH, SOUTH) of the tank at your facility.
926 YEAR INSTALLED – Enter the year the aboveground storage tank was installed.
927. TANK TYPE - Check the construction type or enter the material used to construct the aboveground storage tank. If the petroleum product is contained in a "non-tank" container such as oil-filled operational, process, or electrical equipment, indicate that under "Other." The aggregate amount of petroleum products contained in 55-gallon drums can be entered on one line, with "Other" marked as the tank type and "55-gallon drums" given as the tank description.
928. SECONDARY CONTAINMENT – Check the appropriate box if the tank has secondary containment.
136. APPLICANT NAME – Print or type the full name of the person signing the form.
134. DATE – Enter the date (M/d/yyyy) the form was signed.

APPLICANT SIGNATURE – The application form must be signed in the space provided.

Attachment 1
Spill Prevention Control and Countermeasure Plan Requirements
U.S. Code of Federal Regulations, Title 40, Part 112

PREPARE SPCC PLAN

Prepare a Spill Prevention Control and Countermeasure (SPCC) plan in accordance with U.S. Code of Federal Regulations, Title 40, Part 112 (40CFR112).

i. Prepare an SPCC plan in accordance with good engineering practices. *(40 C.F.R. § 112.7)*
ii. The SPCC plan must have the full approval of management at a level of authority to commit the necessary resources to fully implement the SPCC plan. *(40 C.F.R. § 112.7)*
iii. You must prepare the SPCC plan in writing. *(40 C.F.R. §§ 112.3 and 112.7)*
iv. If you do not follow the sequence specified in this section for the SPCC plan, you must prepare an equivalent SPCC plan that meets all of the applicable requirements listed in this part, and you must supplement it with a section cross-referencing the location of requirements listed in this part and the equivalent requirements in the other prevention plan. *(40 C.F.R. § 112.7)*
v. If the SPCC plan calls for additional facilities or procedures, methods, or equipment not yet fully operational, you must discuss these items in separate paragraphs, and must explain separately the details of installation and operational start-up. *(40 C.F.R. § 112.7)*
vi. Include a discussion of your facility's conformance with the requirements listed in this part. *(40 C.F.R. § 112.7(a)(1))*
vii. Comply with all applicable requirements listed in this part.

    1. Your SPCC plan may deviate from the requirements in paragraphs (g), (h)(2) and (3), and (i) of this section and the requirements in subparts B and C of this part, except the secondary containment requirements in paragraphs (c) and (h)(1) of this section, and sections 112.8(c)(2),112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11),112.13(c)(2), and 112.14(c), where applicable to a specific facility, if you provide equivalent environmental protection by some other means of spill prevention, control, or countermeasure. *(40 C.F.R. § 112.7(a)(2))*
    2. Where your SPCC plan does not conform to the applicable requirements in paragraphs (g), (h)(2) and (3), and (i) of this section, or the requirements of subparts B and C of this part, except the secondary containment requirements in paragraphs (c) and (h)(1) of this section, and sections 112.8(c)(2), 112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11), 112.13(c)(2), and 112.14(c), you must state the reasons for nonconformance in your SPCC plan and describe in detail alternate methods and how you will achieve equivalent environmental protection. If the Regional Administrator determines that the measures described in your SPCC plan do not provide equivalent environmental protection, he may require that you amend your SPCC plan, following the procedures in sections 112.4(d) and (e). *(40 C.F.R. § 112.7(a)(2))*

viii. Describe in your SPCC plan the physical layout of the facility and include a facility diagram, which must mark the location and contents of each container. *(40 C.F.R. § 112.7(a)(3))*

    1. The facility diagram must include completely buried tanks that are otherwise exempted from the requirements of this part under section 112.1(d)(4). *(40 C.F.R. § 112.7(a)(3))*
    2. The facility diagram must also include all transfer stations and connecting pipes. *(40 C.F.R. § 112.7(a)(3))*

ix. You must also address in your SPCC plan:

1. The type of oil in each container and its storage capacity; *(40 C.F.R. § 112.7(a)(3)(i))*
2. Discharge prevention measures including procedures for routine handling of products (loading, unloading, and facility transfers, etc.); *(40 C.F.R. § 112.7(a)(3)(i))*
3. Discharge or drainage controls such as secondary containment around containers and other structures, equipment, and procedures for the control of a discharge; *(40 C.F.R. § 112.7(a)(3)(ii))*
4. Countermeasures for discharge discovery, response, and cleanup (both the facility's capability and those that might be required of a contractor); *(40 C.F.R. § 112.7(a)(3)(iii))*
5. Methods of disposal of recovered materials in accordance with applicable legal requirements; and *(40 C.F.R. § 112.7(a)(3)(iv))*
6. Contact list and phone numbers for the facility response coordinator, National Response Center, cleanup contractors with whom you have an agreement for response, and all appropriate federal, state, and local agencies who must be contacted in case of a discharge as described in section 112.1(b). *(40 C.F.R. § 112.7(a)(3)(v))*

x. Provide information and procedures in your SPCC plan to enable a person reporting a discharge as described in section 112.1(b) to relate information on the exact address or location and phone number of the facility; the date and time of the discharge, the type of material discharged; estimates of the total quantity discharged; estimates of the quantity discharged as described in section 112.1(b); the source of the discharge; a description of all affected media; the cause of the discharge; any damages or injuries caused by the discharge; actions being used to stop, remove, and mitigate the effects of the discharge; whether an evacuation may be needed; and, the names of individuals and/or organizations who have also been contacted. *(40 C.F.R. § 112.7(a)(4))*

xi. Organize portions of the SPCC plan describing procedures you will use when a discharge occurs in a way that will make them readily usable in an emergency, and include appropriate supporting material as appendices. *(40 C.F.R. § 112.7(a)(5))*

xii. Where experience indicates a reasonable potential for equipment failure (such as loading or unloading equipment, tank overflow, rupture, or leakage, or any other equipment known to be a source of a discharge), include in your SPCC plan a prediction of the direction, rate of flow, and total quantity of oil which could be discharged from the facility as a result of each type of major equipment failure. *(40 C.F.R. § 112.7(b))*

xiii. Provide appropriate containment and/or diversionary structures or equipment to prevent a discharge as described in section 112.1(b). *(40 C.F.R. § 112.7(b))*

1. The entire containment system, including walls and floor, must be capable of containing oil and must be constructed so that any discharge from a primary containment system, such as a tank or pipe, will not escape the containment system before cleanup occurs. *(40 C.F.R. § 112.7(c))*
2. At a minimum, you must use one of the following prevention systems or its equivalent:

    a. For onshore facilities:

    i.) Dikes, berms, or retaining walls sufficiently impervious to contain oil; *(40 C.F.R. § 112.7(c)(1)(i))*
    ii.) Curbing; *(40 C.F.R. § 112.7(c)(1)(ii))*
    iii.) Culverting, gutters, or other drainage systems; *(40 C.F.R. § 112.7(c)(1)(iii))*
    iv.) Weirs, booms, or other barriers; *(40 C.F.R. § 112.7(c)(1)(iv))*
    v.) Spill diversion ponds; *(40 C.F.R. § 112.7(c)(1)(v))*
    vi.) Retention ponds; or *(40 C.F.R. § 112.7(c)(1)(vi))*
    vii.) Sorbent materials. *(40 C.F.R. § 112.7(c)(1)(vii))*

b. For offshore facilities:

i.) Curbing or drip pans; or *(40 C.F.R. § 112.7(c)(2)(i))*
ii.) Sumps and collection systems. *(40 C.F.R. § 112.7(c)(2)(ii))*

xiv. If you determine that the installation of any of the structures or pieces of equipment listed in paragraphs (c) and (h)(1) of this section, and sections 112.8(c)(2), 112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11), 112.13(c)(2), and 112.14(c) to prevent a discharge as described in section 112.1(b) from any onshore or offshore facility is not practicable, you must clearly explain in your SPCC plan why such measures are not practicable; *(40 C.F.R. § 112.7(d))*

1. For bulk storage containers, conduct both periodic integrity testing of the containers and periodic integrity and leak testing of the valves and piping; and, unless you have submitted a response plan under section 112.20, provide in your SPCC plan the following:

   a. An oil spill contingency plan following the provisions of part 109 of this chapter. *(40 C.F.R. § 112.7(d)(1))*
   b. A written commitment of man power, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful. *(40 C.F.R. § 112.7(d)(2))*

CONDUCT PERIODIC INSPECTIONS

Conduct periodic inspections to assure compliance with 40CFR112 (inspections, tests, and records).

i. Conduct inspections and tests required by this part in accordance with written procedures that you or the certifying engineer develop for the facility. *(40 C.F.R. § 112.7(e))*

   1. You must keep these written procedures and a record of the inspections and tests, signed by the appropriate supervisor or inspector, with the SPCC plan for a period of three years. *(40 C.F.R. § 112.7(e))*
   2. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph. *(40 C.F.R. § 112.7(e))*

IMPLEMENT SPCC PLAN

Implement SPCC plan in compliance with 40CFR112.

i. *Personnel, training, and discharge prevention procedures.*

   1. At a minimum, train your oil-handling personnel in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC plan. *(40 C.F.R. § 112.7(f)(1))*
   2. Designate a person at each applicable facility who is accountable for discharge prevention and who reports to facility management. *(40 C.F.R. § 112.7(f)(2))*
   3. Schedule and conduct discharge prevention briefings for your oil-handling personnel at least once a year to assure adequate understanding of the SPCC plan for that facility. Such briefings must highlight and describe known discharges as described in section 112.1(b) or failures, malfunctioning components, and any recently developed precautionary measures. *(40 C.F.R. § 112.7(f)(3))*

ii. *Security (excluding oil production facilities).*

1. Fully fence each facility handling, processing, or storing oil, and lock and/or guard entrance gates when the facility is not in production or is unattended. *(40 C.F.R. § 112.7(g)(1))*
2. Ensure that the master flow and drain valves and any other valves permitting direct outward flow of the container's contents to the surface have adequate security measures so that they remain in the closed position when in non-operating or non-standby status. *(40 C.F.R. § 112.7(g)(2))*
3. Lock the starter control on each oil pump in the "off" position and locate it at a site accessible only to authorized personnel when the pump is in a non-operating or non-standby status. *(40 C.F.R. § 112.7(g)(3))*
4. Securely cap or blank-flange the loading/unloading connections of oil pipelines or facility piping when not in service or when in standby service for an extended time. This security practice also applies to piping that is emptied of liquid content either by draining or by inert gas pressure. *(40 C.F.R. § 112.7(g)(4))*
5. Provide facility lighting commensurate with the type and location of the facility that will assist in the:

    a. Discovery of discharges occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel (the general public, local police, etc.); and *(40 C.F.R. § 112.7(g)(5)(i))*
    b. Prevention of discharges occurring through acts of vandalism. *(40 C.F.R. § 112.7(g)(5)(ii))*

iii. Facility tank car and tank truck loading/unloading rack (excluding offshore facilities). *(40 C.F.R. § 112.7(h)(1))*

1. Where loading/un-loading area drainage does not flow into a catchment basin or treatment facility designed to handle discharges, use a quick drainage system for tank car or tank truck loading and unloading areas. *(40 C.F.R. § 112.7(h)(1))*
2. You must design any containment system to hold at least the maximum capacity of any single compartment of a tank car or tank truck loaded or unloaded at the facility. *(40 C.F.R. § 112.7(h)(1))*
3. Provide an interlocked warning light or physical barrier system, warning signs, wheel chocks, or vehicle break interlock system in loading/un-loading areas to prevent vehicles from departing before complete disconnection of flexible or fixed oil transfer lines. *(40 C.F.R. § 112.7(h)(2))*
4. Prior to filling and departure of any tank car or tank truck, closely inspect for discharges the lowermost drain and all outlets of such vehicles, and if necessary, ensure that they are tightened, adjusted, or replaced to prevent liquid discharge while in transit. *(40 C.F.R. § 112.7(h)(3))*

iv. If a field-constructed aboveground container undergoes a repair, alteration, reconstruction, or a change in service that might affect the risk of a discharge or failure due to brittle fracture or other catastrophe, or has discharged oil or failed due to brittle fracture failure or other catastrophe, than evaluate the container for risk of discharge or failure due to brittle fracture or other catastrophe, and as necessary, take appropriate action. *(40 C.F.R. § 112.7(i))*

v. In addition to the minimal prevention standards listed under this section, include in your SPCC plan a complete discussion of conformance with the applicable requirements and other effective discharge prevention and containment procedures listed in this part or any applicable more stringent State rules, regulations, and guidelines. *(40 C.F.R. § 112.7(j))*

FOR MORE INFORMATION

For additional information, visit U.S. Environmental Protection Agency's Web site at http://www.epa.gov/oilspill/spcc.htm.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 172: Please list and quantify any waste streams expected from the construction and decommissioning of the SunCatcher assembly buildings.

Response: The assembly buildings are portable buildings that will be removed from the site after construction. The waste stream table presented in the AFC (Table 5.14-2) includes the construction of the assembly buildings. It is anticipated that the Project will generate and dispose of approximately 780 cubic yards of waste. The waste will consist of foundation materials, lumber, crating, cardboard, and other materials.

The mechanical and electrical systems will be skid-mounted for easy relocation. There will be utilities associated with the buildings that will be unassembled and moved, and there may be some wastes associated with that removal. There will be concrete pads under the buildings that will remain after the buildings are removed. Decommissioning and removing the Assembly buildings will generate approximately 80 cubic yards of waste, consisting of surplus packing materials, lumber, cardboard, lighting, gaskets and wiring.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 173: Please list and quantify any waste streams expected from the construction of the substation.

Response: Construction of the substation will generate and dispose of an estimated 1,050 cubic yards of waste. The waste will consist of foundation materials, lumber, crating, cardboard, and other materials. This information is contained in AFC Table 5.14-2, Summary of Construction Waste Streams and Management Methods.

TECHNICAL AREA: WASTE MANAGEMENT

Data Request 174: Please discuss how these wastes will be managed and disposed.

Response: During construction, recyclable and non-recyclable wastes will be separated and stored in dumpsters until they are removed from the site. Approved commercial waste disposal firms will haul and dispose of non-recyclable construction debris in a landfill approved for construction waste. The management methods are further described in AFC Table 5.14-2, Summary of Construction Waste Streams and Management Methods.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION
For the SES SOLAR ONE PROJECT

Docket No. 08-AFC-13

PROOF OF SERVICE

(Revised 12/2/09)

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*indicates change

DECLARATION OF SERVICE

I Corinne Lytle , declare that on December 4, 2009 I served and filed copies of the attached Applicant's Responses to CEC and BLM Data Requests, Set 2, Part 2. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: [www.energy.ca.gov/sitingcases/solarone].

The documents have been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

FOR SERVICE TO ALL OTHER PARTIES:

_____ sent electronically to all email addresses on the Proof of Service list;

_____ by personal delivery or by depositing in the United States mail at ____________ with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list above to those addresses NOT marked "email preferred."

AND

FOR FILING WITH THE ENERGY COMMISSION:

_____ sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (*preferred method*);

OR

_____ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 08-AFC-13
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct.

original signed by

____

Corinne Lytle

*indicates change