

ADAMS BROADWELL JOSEPH & CARDOZO

A PROFESSIONAL CORPORATION

ATTORNEYS AT LAW

601 GATEWAY BOULEVARD, SUITE 1000
SOUTH SAN FRANCISCO, CA 94080-7037

TEL: (650) 589-1660
FAX: (650) 589-5062

tgulesserian@adamsbroadwell.com

SACRAMENTO OFFICE

520 CAPITOL MALL, SUITE 350
SACRAMENTO, CA 95814-4715

TEL: (916) 444-6201
FAX: (916) 444-6209

DANIEL L. CARDOZO
THOMAS A. ENSLOW
TANYA A. GULESSERIAN
MARC D. JOSEPH
ELIZABETH KLEBANER
RACHAEL E. KOSS
LOULENA A. MILES
ROBYN C. PURCHIA

OF COUNSEL
THOMAS R. ADAMS
ANN BROADWELL
GLORIA D. SMITH

March 8, 2010

DOCKET
08-AFC-2

DATE MAR 08 2010

RECD. MAR 09 2010

VIA OVERNIGHT MAIL

CALIFORNIA ENERGY COMMISSION

Attn: Docket No. 08-AFC-2
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512

Re: Application for Certification, Beacon Solar Energy Project, 08-AFC-2

Dear Docket Clerk:

Enclosed are an original and 12 copies of CALIFORNIA UNIONS FOR RELIABLE ENERGY REBUTTAL TESTIMONY, AMENDED SEQUENTIAL AND TOPIC EXHIBIT LISTS, AND EXHIBITS and an extra copy of this letter. Because of the size of the exhibits, rather than mailing an extra copy to be conformed and returned, we ask that you process the exhibits and provide us with a conformed copy of this letter in the envelope provided.

Thank you for your assistance with this matter.

Sincerely,

/s/

Tanya A. Gulesserian

TAG:bh
Enclosures

2162-068a

STATE OF CALIFORNIA
California Energy Commission

In the Matter of:

The Application for Certification
for the BEACON SOLAR ENERGY
PROJECT

Docket No. 08-AFC-2

CALIFORNIA UNIONS FOR RELIABLE ENERGY
REBUTTAL TESTIMONY, AMENDED SEQUENTIAL AND TOPIC
EXHIBIT LISTS, AND EXHIBITS

March 8, 2010

Tanya A. Gulesserian
Marc D. Joseph
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080
(650) 589-1660 Voice
(650) 589-5062 Facsimile
tgulesserian@adamsbroadwell.com
mdjoseph@adamsbroadwell.com

Attorneys for the CALIFORNIA
UNIONS FOR RELIABLE ENERGY

Pursuant to the Revised Notice of Prehearing Conference and Evidentiary Hearing issued February 26, 2010, Intervenor California Unions for Reliable Energy (“CURE”) provides the attached amended sequential and topic exhibit lists, Rebuttal Testimony of Matt Hagemann regarding Hazardous Materials and Waste Management, Rebuttal Testimony of Mike Bias on Biological Resources and exhibits concerning the Beacon Solar Energy Project (“Project”).

On November 12, 2009, CURE filed Testimony of Scott Cashen on Biological Resources, Testimony of Matt Hagemann on Soil Resources and Waste Management, Testimony of David Marcus on Transmission Engineering and Water Resources and Alternatives and exhibits concerning the Project.

CURE reserves the right to supplement and/or revise this testimony at any time up to and including the close of the evidentiary hearings.

Dated: March 8, 2009

Respectfully submitted,

_____/s/_____
Tanya A. Gulesserian
Marc D. Joseph
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080
(650) 589-1660 Voice
(650) 589-5062 Facsimile
tgulesserian@adamsbroadwell.com

Attorneys for the CALIFORNIA UNIONS
FOR RELIABLE ENERGY

STATE OF CALIFORNIA

Energy Resources Conservation
and Development Commission

In the Matter of:

The Application for Certification for the
BEACON SOLAR ENERGY PROJECT

Docket No. 08-AFC-2

PROOF OF SERVICE

I, Bonnie Heeley, declare that on March 8, 2010 I served and filed copies of the attached **CALIFORNIA UNIONS FOR RELIABLE ENERGY REBUTTAL TESTIMONY, AMENDED SEQUENTIAL AND TOPIC EXHIBIT LISTS, AND EXHIBITS**. 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/beacon. The document has 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 via Overnight Mail at South San Francisco, fully prepaid and addressed as provided on the Proof of Service list to those addresses NOT marked "email preferred." I also sent an original and 12 copies via Overnight Mail to the California Energy Commission Docket Office.

I declare under penalty of perjury that the foregoing is true and correct. Executed at South San Francisco, CA on March 8, 2010.

_____/s/_____
Bonnie Heeley

CALIFORNIA ENERGY COMMISSION
ATTN DOCKET NO. 08AFC2
1516 NINTH STREET MS4
SACRAMENTO, CA 95814-5512

Kristy Chew
Adviser to Commissioner Byron
California Energy Commission
1516 Ninth Street MS4
Sacramento, CA 95814-5512

SSARA HEAD, VICE PRESIDENT
AECOM ENVIRONMENT
1220 AVENIDA ACASO
CAMARILLO, CA 93012

BILL PIETRUCHA, PROJECT MGR
JARED FOSTER, P.E., MECH. ENG.
WORLEY PARSONS
2330 E. BIDWELL ST SUITE 150
FOLSOM, CA 95630

JANE LUCKHARDT
DOWNEY BRAND ATTORNEYS LLP
621 CAPITOL MALL 18TH FLR
SACRAMENTO, CA 95814

KAREN DOUGLAS
CALIFORNIA ENERGY
COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

JEFFREY D. BYRON
CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

KENNETH CELLI
CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

ERIC K. SOLORIO
CALIFORNIA ENERGY
COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

JARED BABULA
CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

Jennifer Jennings
PUBLIC ADVISER'S OFFICE
CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

S. BUSA, K.STEIN, M.RUSSELL,
D.MCCLLOUD, G.NARVAEZ
NEXTERA ENERGY RESOURCES LLC
700 UNIVERSE BLVD
JUNO BEACH, FL 33408

DIANE FELLMAN
DIRECTOR WEST REGION
NEXTERA ENERGY RESOURCES
234 VAN NESS AVENUE
SAN FRANCISCO, CA 94102

STATE OF CALIFORNIA
California Energy Commission

In the Matter of:

The Application for Certification
for the BEACON SOLAR ENERGY
PROJECT

Docket No. 08-AFC-2

AMENDED
CALIFORNIA UNIONS FOR RELIABLE ENERGY
TOPIC EXHIBIT LIST

Exhibit No.	Date	Title	Subject	Sponsor
			BIOLOGICAL RESOURCES	
600	11/12/2009	Testimony of Scott Cashen On Biological Resources	Biological Resources	Scott Cashen
601	11/11/2009	Declaration of Scott Cashen	Biological Resources	Scott Cashen
602	11/12/2009	Exhibit 1: Resume of Scott Cashen	Biological Resources	Scott Cashen
603	2003	Exhibit 2: California Department of Fish and Game. Mohave ground squirrel survey guidelines.	Biological Resources	Scott Cashen
604	1993	Exhibit 3: Gustafson JR, State of California, Department of Fish and Game. A status review of the Mohave ground squirrel.	Biological Resources	Scott Cashen
605	5/21/2008	Exhibit 4: Conference Call Agenda for May 21, 2008, BSEP CEC Proceeding 08-AFC-2.	Biological Resources	Scott Cashen
606	02/2008	Exhibit 5: AFC, Bio Tech Report: Figure 11	Biological Resources	Scott Cashen
607	1993	Exhibit 6: The California Burrowing Owl Consortium. Burrowing Owl Survey Protocol and Mitigation Guidelines	Biological Resources	Scott Cashen

608	1995	Exhibit 7: State of California, Department of Fish and Game. Staff Report on Burrowing Owl Mitigation	Biological Resources	Scott Cashen
609		Exhibit 8: AFC, Figure BR 78-1	Biological Resources	Scott Cashen
610	07/17/2009	Exhibit 9: Applicant's "Response to Select CURE Comments at CEC's Request"	Biological Resources	Scott Cashen
611	06/19/2008	Exhibit 10: Memorandum from the California Department of Fish and Game to California Energy Commission, Subject: Beacon Solar Energy Project Application for Certification	Biological Resources	Scott Cashen
632	3/8/10	Rebuttal Testimony of Michael A. Bias	Biological Resources	Michael A. Bias
633	3/8/10	Declaration of Michael A. Bias on Biological Resources	Biological Resources	Michael A. Bias
634	3/8/10	Adopted Declaration	Biological Resources	Michael A. Bias
635	3/8/10	Attachment 1: Resume of Michael A. Bias	Biological Resources	Michael A. Bias
			SOIL RESOURCES	
612	11/12/2009	Testimony of Matt Hagemann on Soil Resources and Waste Management	Soil Resources	Matt Hagemann
613	11/12/2009	Declaration of Matt Hagemann	Soil Resources	Matt Hagemann
614	11/12/2009	Attachment 1: Resume of Matt Hagemann	Soil Resources	Matt Hagemann
615	1987-2008	Attachment 2: Spill Reports – SEGS III - VII	Soil Resources	Matt Hagemann
			WATER RESOURCES	
616	11/12/2009	Testimony of David Marcus on Transmission Engineering and Water Resources and Alternatives	Water Resources	David Marcus
617	11/10/2009	Declaration of David Marcus	Water Resources	David Marcus
618	08/2009	Exhibit 1: Resume of David Marcus	Water Resources	David Marcus

623	02/01/2008	Exhibit 6: WorleyParsons: FPLE – Beacon Solar Energy Project Dry Cooling Evaluation	Water Resources	David Marcus
624	06/2009	Exhibit 7: CPUC 33% Renewables Portfolio Standard Implementation Analysis Preliminary Results	Water Resources	David Marcus
636	10/22/09	BESP FSA Soil and Water Resources and Alternatives	Water Resources	David Marcus
			WASTE MANAGEMENT	
612	11/12/2009	Testimony of Matt Hagemann on Soil Resources and Waste Management	Waste Management	Matt Hagemann
613	11/12/2009	Declaration of Matt Hagemann	Waste Management	Matt Hagemann
614	11/12/2009	Attachment 1: Resume of Matt Hagemann	Waste Management	Matt Hagemann
615	1987-2008	Attachment 2: Spill Reports – SEGS III - VII	Waste Management	Matt Hagemann
625	3/8/10	Rebuttal Testimony of Matt Hagemann on Hazardous Materials and Waste Management	Waste Management	Matt Hagemann
626	3/8/10	Declaration of Matt Hagemann	Waste Management	Matt Hagemann
627	2/23/09	Attachment 1: Hazardous Materials Business Plan, February 23, 2009, Luz Solar Partners, III-VII	Waste Management	Matt Hagemann
628	5/16/09	Attachment 2: Material Safety Data Sheet for Therminol VP-1, May 16, 2009	Waste Management	Matt Hagemann
629	11/1/05	Attachment 3: Letter from FPL Energy to RWQCB re: SEGS III HTF spill, October 21, 2005	Waste Management	Matt Hagemann
630	10/25/05	Attachment 4: Notice of Violation, Issued by San Bernardino county Fire Department to FPL Energy	Waste Management	Matt Hagemann

631	1/30/06 6/10/08	Attachment 5: Recyclable Materials Reports, FPL Energy to San Bernardino County Fire Department, 2004-2005 and 2006-2007	Waste Management	Matt Hagemann
			TRANSMISSION ENGINEERING	
616	11/12/2009	Testimony of David Marcus on Transmission Engineering and Water Resources and Alternatives	Transmission Engineering	David Marcus
617	11/10/2009	Declaration of David Marcus	Transmission Engineering	David Marcus
618	08/2009	Exhibit 1: Resume of David Marcus	Transmission Engineering	David Marcus
619	2009	Exhibit 2: LADWP Barren Ridge Renewable Transmission Project	Transmission Engineering	David Marcus
620		Exhibit 3: Projection Engineering Statement of Qualifications	Transmission Engineering	David Marcus
621		Exhibit 4: NRG SCE Filing	Transmission Engineering	David Marcus
622	11/11/2009	Exhibit 5: CEC List of Siting Cases	Transmission Engineering	David Marcus
			ALTERNATIVES	
616	11/12/2009	Testimony of David Marcus on Transmission Engineering and Water Resources and Alternatives	Alternatives	David Marcus
617	11/10/2009	Declaration of David Marcus	Alternatives	David Marcus
618	08/2009	Exhibit 1: Resume of David Marcus	Alternatives	David Marcus
623	02/01/2008	Exhibit 6: WorleyParsons: FPLE – Beacon Solar Energy Project Dry Cooling Evaluation	Alternatives	David Marcus
624	06/2009	Exhibit 7: CPUC 33% Renewables Portfolio Standard Implementation Analysis Preliminary Results	Alternatives	David Marcus
636	10/22/09	BESP FSA Soil and Water Resources and Alternatives	Alternatives	David Marcus

			HAZARDOUS MATERIALS	
625	3/8/10	Rebuttal Testimony of Matt Hagemann on Hazardous Materials and Waste Management	Hazardous Materials	Matt Hagemann
626	3/8/10	Declaration of Matt Hagemann	Hazardous Materials	Matt Hagemann
627	2/23/09	Attachment 1: Hazardous Materials Business Plan, February 23, 2009, Luz Solar Partners, III-VII.	Hazardous Materials	Matt Hagemann
628	5/16/09	Attachment 2: Material Safety Data Sheet for Therminol VP-1, May 16, 2009	Hazardous Materials	Matt Hagemann
629	11/1/05	Attachment 3: Letter from FPL Energy to RWQCB re: SEGS III HTF spill, October 21, 2005	Hazardous Materials	Matt Hagemann
630	10/25/05	Attachment 4: Notice of Violation, Issued by San Bernardino County Fire Department to FPL Energy, October 25, 2005	Hazardous Materials	Matt Hagemann
631	1/30/06 6/10/08	Attachment 5: Recyclable Materials Reports, FPL Energy to San Bernardino County Fire Department, 2004-2005 and 2006-2007	Hazardous Materials	Matt Hagemann

STATE OF CALIFORNIA
California Energy Commission

In the Matter of:

The Application for Certification
for the BEACON SOLAR ENERGY
PROJECT

Docket No. 08-AFC-2

AMENDED
CALIFORNIA UNIONS FOR RELIABLE ENERGY
SEQUENTIAL EXHIBIT LIST

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615	1987-2008	Attachment 2: Spill Reports – SEGS III - VII	Soil Resources and Waste Management	Matt Hagemann
616	11/12/2009	Testimony of David Marcus on Transmission Engineering and Water Resources and Alternatives	Water Resources, Alternatives, and Transmission Engineering	David Marcus
617	11/10/2009	Declaration of David Marcus	Water Resources, Alternatives and Transmission Engineering	David Marcus
618	08/2009	Exhibit 1: Resume of David Marcus	Water Resources, Alternatives, and Transmission Engineering	David Marcus

619	2009	Exhibit 2: LADWP Barren Ridge Renewable Transmission Project	Transmission Engineering	David Marcus
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STATE OF CALIFORNIA
California Energy Commission

In the Matter of:

The Application for Certification
for the BEACON SOLAR ENERGY
PROJECT

Docket No. 08-AFC-2

**REBUTTAL TESTIMONY OF MATT HAGEMANN
ON BEHALF OF CALIFORNIA UNIONS FOR RELIABLE ENERGY
ON HAZARDOUS MATERIALS AND WASTE MANAGEMENT
FOR THE BEACON SOLAR ENERGY PROJECT**

March 8, 2010

Tanya A. Gulesserian
Marc D. Joseph
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080
(650) 589-1660 Voice
(650) 589-5062 Facsimile
tgulesserian@adamsbroadwell.com
mdjoseph@adamsbroadwell.com

Attorneys for the CALIFORNIA
UNIONS FOR RELIABLE ENERGY

I. Introduction

I have been working for California Unions for Reliable Energy (“CURE”) as a consultant on the Application for Certification (“AFC”) for the Beacon Solar Energy Project (“Project” or “BSEP”) since the data adequacy phase. I have reviewed numerous documents and have conducted my own investigations and analyses regarding the Project’s potential environmental and health and safety impacts.

On November 12, 2009, I provided written testimony regarding numerous large spills of heat transfer fluid (“HTF”) at the Luz Solar Energy Generating Stations (“SEGS”) III through IX. The SEGS facilities are operated by the applicant for the BSEP project. The November 12, 2009 testimony was based on records obtained from the California Energy Commission (“CEC”) and on records I obtained from the Lahontan Regional Water Quality Control Board (“RWQCB”).

Following preparation of my November 12, 2009 testimony, I obtained documentation from the San Bernardino County Fire Department, the agency responsible for the management of hazardous waste at SEGS. The documentation provided additional information on the nature of the HTF spills and the response to the spills. The documentation obtained from San Bernardino County is relevant in that: (1) the piping system that will be used at BSEP is similar in design and scale and therefore, leakage of the type at the SEGS facilities should be anticipated at BSEP; and (2) the commercially available heat transfer fluid (“HTF”) used at SEGS, Therminol VP-1, is the same HTF proposed for use at BSEP.

Large leaks of HTF were considered in the BSEP AFC as follows (p. 2-23):

Larger sudden leaks are a greater concern. In order to identify and react to such leaks quickly, the Project is considering a combination of remote pressure sensing equipment and remote operating valves that would allow for isolation of large areas of the field, or possibly the entire field. Such features will be developed as part of the detail design process.

The following condition of certification is required in the FSA (p. 4.4-18):

HAZ-7 The project owner shall place an adequate number of isolation valves in the Heat transfer Fluid (HTF) pipe loops so as to be able to isolate a solar panel loop in the event of a leak of fluid. These valves shall be actuated manually and remotely. The engineering design drawings showing the number, location, and type of isolation valves shall be provided to the CPM for review and approval prior to the commencement of the solar array construction.

The effect and reliability of Condition of Certification HAZ-7 in reducing the number of leaks and the size of the leaks in a piping system at BSEP that contains 1.3 million gallons of HTF (AFC, p. 5-6-13) is unknown. Therefore, for the purposes of this rebuttal

testimony, the performance of the BESP piping facilities with regard to HTF spills is assumed to be similar to the spills which have been documented at the SEGS facilities.

HTF, or Therminol VP-1, is a mixture of 73.5% diphenyl ether and 26.5% biphenyl. According to the Hazardous Materials Business Plan prepared for the SEGS facilities, Therminol VP-1 is a hazardous material that poses acute and chronic health hazards.¹ The materials safety data sheet for Therminol VP-1 states that biphenyl is a hazardous chemical that causes health effects from chronic exposure, including:

- headache, fatigue, nausea, indigestion, abdominal pain, tremor, central and peripheral nerve damage and liver injury.²

Therefore, spills of HTF, or Therminol VP-1, may result in significant impacts to humans, wildlife and the environment.

In my November 12, 2009 testimony, I identified deficiencies in the FSA for its failure to analyze impacts from worst-case spills that should be anticipated at BESP on the basis of the spill history at SEGS. The FSA failed to consider large spills, on the order of tens of thousands of gallons, as documented at SEGS, which would likely occur at BESP and which would overwhelm the 750 cubic yard per year capacity of the Land Treatment Unit that is proposed in the FSA to treat contaminated soil. Other issues identified in my November 12, 2009 testimony include inadequate plans for groundwater monitoring at the Land Treatment Unit and at the evaporation ponds.

No response has been received that would address my November 12, 2009 testimony and all issues that were identified in that testimony remain valid. The following rebuttal testimony focuses on new information that I obtained following submittal of my November 12, 2009 testimony, namely documentation that describes the response to large volumes of spilled HTF at the SEGS facilities and the procedures used to recycle the spilled HTF for reuse in the piping system.

The following rebuttal testimony is based on the activities described above and the knowledge and experience I have acquired during more than 25 years of working on environmental issues. A summary of my education and experience is attached to my November 12, 2009 testimony.

II. Failure to Analyze Spills of Heat Transfer Fluid

The BSEP Project proposes to use parabolic mirror solar trough technology, the same technology used by the applicant at the SEGS III through IX facilities, 30 miles to the southeast (FSA, p. 4.13-10). The Beacon plant, like the SEGS facilities, would use Therminol VP-1 heat transfer fluid (HTF) to feed steam generators to produce power.

¹ Attachment 1: Hazardous Materials Business Plan, February 23, 2009, Luz Solar Partners, III-VII.

² Attachment 2: Material Safety Data Sheet for Therminol VP-1, May 16, 2009.

The FSA fails to analyze potentially significant impacts from HTF spills. The FSA only considers the need to annually treat an estimated 750 cubic yards of contaminated soil at the Land Treatment Unit (FSA, pp. 4.9-174, 4.13-10) that would result from spilled HTF. However, HTF spills involve not only contamination of underlying soil (which would be treated at the Land Treatment Unit) but also large volumes of the spilled material itself, which is found in free-standing piles on the ground surface following spills. The Applicant's testimony and the FSA both fail to mention that spills of HTF would necessitate a response to the spilled material piled atop the ground surface. The Applicant's testimony and the FSA also both fail to mention the need to treat the material on-site, in accordance with federal and local hazardous waste requirements, or to dispose of the material off-site, if necessary.

Numerous large spills have occurred at the SEGS facilities. When spilled, the HTF has a wax-like consistency at ambient temperatures and is found in a free-standing state in piles atop the ground surface. Some HTF will also seep into and contaminate underlying soil, necessitating excavation and placement in SEGS' Land Treatment Unit. BSEP proposes a similar Land Treatment Unit, which was the subject of my testimony provided on November 12, 2009.

The following spills at the SEGS facilities have been reported to the RWQCB and filed at the CEC:

HTF Release Date	HTF Released (gallons)
1 st Semester 2008	none greater than 25
27 February 2007	1,000
27 March 2007	35
16 July 2007	30,000
9 January 2006	50
15 February 2006	400
30 December 2005	50
2 May 2004	140
9 March 2004	35
6 September 2003	40
19 July 2003	60
3 May 2002	250
22 September 2001	150
16 March 2001	75
18 January 2001	300
22 May 1999	21,000
4 March 1997	50
21 December 1996	300
26 November 1996	50
27 October 1996	300-400
15 March 1996	25
1 March 1996	25
15 August 1995	50
27 November 1994	50
2 August 1994	200
28 July 1994	30

20 May 1994	35
1 September 1993	100
9 June 1993	20
29 May 1993	50
10 January 1990	Not reported
24 January 1990	100
3 February 1990	400
8 February 1990	100
12 February 1990	100
13 February 1990	400
13 February 1990	100
10 February 1989	35
23 May 1988	30
9 March 1988	25-30
10 March 1988	50-60
Discovered 22 April 1988	100-150
24 April 1988	25-30
12 January 1987	25
23 January 1987	150
28 July 1987	55
27 April 1987	25
16 November 1987	120
Between 27 February and 2 March 1987	50

Note: Spills are tabulated from documents submitted to the RWQCB (and obtained from the CEC Compliance Division) and were included as Attachment 2 to my November 12, 2009 testimony.³

Following spills, significant volumes of free-standing HTF must be vacuumed or scooped from the ground surface at the SEGS facilities. Records that I obtained from the San Bernardino County Fire Department show that massive volumes of spilled HTF are recovered from the ground surface and are sent to what is referred to as a “filtration facility”.⁴ For example, a report obtained from the County for an October 21, 2005 spill – which was not included in the files that I obtained from the CEC Compliance Division – documents cleanup that involved use of a vacuum truck to recover the free-standing HTF from atop the soil. The operation took three days to recover 7,700 gallons of the HTF which was taken to an on-site facility for recycling. The total volume of the spill was estimated to be 9,900 gallons.⁵ Since the report of the October 21, 2005 spill was not included in the files obtained from the CEC Compliance Division, I did not tabulate the 9,900-gallon spill above.

Spilled HTF at BESP will require a similar response that was not described by the BESP Applicant’s testimony or described and analyzed in the FSA. The free-standing HTF on the ground surface will need to be vacuumed or excavated prior to testing and removal of

³ Testimony of Matt Hagemann Regarding BESP (November 12, 2009).

⁴ Attachment 3: Letter from FPL Energy to RWQCB re: SEGS III HTF spill, October 21, 2005, November 1, 2005.

⁵ Ibid.

the underlying contaminated soils. Despite this fact, the BESP AFC did not include any provisions for handling free-standing HTF atop the ground surface. Other documents submitted for the Project, including the Report of Waste Discharge, also did not include provisions for handling spilled HTF.

At SEGS, the County issued a Notice of Violation for the handling and reporting of the spilled free-standing HTF that resulted from the October 21, 2005 spill.⁶ In response, the SEGS operator, implemented biannual reporting of the material that was spilled and sent to a filtration facility on the SEGS site for recycling. The reports show that during 2004 to 2005, 15,000 gallons of spilled HTF were sent to the filtration facility and that during 2006 to 2007, 18,000 gallons of spilled HTF were sent to the filtration facility.⁷ Records for 2008 and 2009 were not available from San Bernardino County at the time of my file review on December 22, 2009.

In summary, on the basis of the records I obtained from San Bernardino County, 33,000 gallons of spilled free-standing HTF required filtration at the SEGS facilities in the four-year period from 2004 to the end of 2007 to remove dirt and water for reuse in the piping system. The BESP AFC and supporting documents do not include any provisions for handling what would likely be massive volumes of spilled free-standing HTF, based on the experience at a similar facility which is operated by the applicant. The FSA for BESP only considers the need to annually treat an estimated 750 cubic yards of contaminated soil at the Land Treatment Unit (AFC, p. 4.9-174) that would result from spilled HTF. No mention of the need to vacuum the free standing HTF from the ground surface is made in the AFC, supporting documents or in the FSA.

Similarly, BESP does not include provisions for a filtration facility and therefore does not include any design specifications or treatment technologies for the removal of soil and water from the free-standing HTF. BESP also does not include any provisions for handling of the contaminated water and soil that is removed from the free-standing HTF at the filtration facility. As a result, the FSA does not evaluate a filtration facility, the potential and likely removal of soil and water from free-standing HTF, or the handling of the resulting contaminated soil and water. Finally, the FSA does not consider consistency with any Kern County permit requirements or any state or federal hazardous waste permits that may be required for the filtration facility or other aspects of handling free-standing HTF.

The Project applicant must supplement its application to the CEC to incorporate plans for a filtration facility for spilled HTF. The supplemental documentation should consider the need for county, state or federal permits to ensure the filtration facility is in compliance with all laws and regulations. The supplemental documentation must include provisions for handling the spilled free-standing HTF to ensure worker safety and proper community notification.

⁶ Attachment 4: Notice of Violation, Issued by San Bernardino County Fire Department to FPL Energy, October 25, 2005.

⁷ Attachment 5: Recyclable Materials Reports, FPL Energy to San Bernardino County Fire Department, 2004-2005 and 2006-2007.

III. Piping System is Inadequate to Contain HTF

The piping system at BESP will leak, as acknowledged by CEC staff in the FSA (p. 4.4-13):

That minor leaks in the piping system are expected to occur, is mostly due to the large number of flanged connections that, combined with the many flexible connections, will be required by the system design. The expected leaks result from the difficulty of maintaining perfect sealing in pipe couplings during the daily temperature and pressure changes that will occur during operations.

CEC staff state that leaks will be relatively minor (FSA, p. 4.4-13)

In the event that a rupture of a pipe did occur, the regularly spaced valves located throughout the solar field piping system would close to prevent continued leaks and potential fires, limiting the potential size of any leaks (see Condition of Certification Haz-7).

However, past spills at the SEGS plant, which has a similar piping design, were not apparently considered in this evaluation. The SEGS records I obtained from the CEC Compliance Division for the preparation of this testimony (as tabulated above) show 31 releases of HTF above the Comprehensive Environmental Response, Compensation, and Liability Act (“CERCLA”) reporting limit of 42 gallons. An HTF spill of 42 gallons would contain biphenyl at the CERCLA Reportable Quantity of 100 pounds. (AFC, p. 5.6-20).

The FSA fails to evaluate double walled piping, containment of spills, and other technologies that would be feasible to control or contain spills of HTF to safeguard workers, the public and the environment.

IV. Provisions for Emergency Notification are Inadequate

The AFC states only that emergency notification of spills will be reported as follows:

CERCLA prescribes that the National Response Center be notified for any release of a reportable quantity of a hazardous substance (42 USC Section 9603); notification requirements for any potentially injured parties in connection with any such release (42 USC Section 9611 (g)); and sets forth requirements for demonstration of financial responsibility in connection with the storage of hazardous substances (42 USC Section 9608(b)).

The Project will conform to these requirements by developing a Hazardous Materials Business Plan (HMBP). The administering agencies for the above authority are the EPA (Region IX), the National Response Center, and Kern

County Environmental Health Services Department. Kern County Environmental Health Services Department is a Certified Unified Program Agency (CUPA).⁸

The records at the SEGS facilities document potential violations of these and other emergency notification requirements. For example, the October 21, 2005 9,900 gallon spill was first observed on October 21, 2005 at 17:22, yet according to a document prepared by the SEGS operator, the National Response Center was not notified until October 22 at 13:15, a lag of almost 20 hours.⁹ The California Energy Commission, the California Office of Emergency Services, the Lahontan Regional Water Quality Control Board, and the Mojave Desert Air Quality Management District were subsequently notified. Please note that the operator's account of the time of National Response Center notification conflicts with records obtained from the National Response Center Website. The National Response Center Website documents the time of notification as October 22, 2005 at 16:10, which would represent a lag time of nearly 23 hours.¹⁰

The spill formed a large vapor cloud that was reported to the San Bernardino County Fire Department and the California Highway Patrol. The California Highway Patrol subsequently closed State Highway 58 as a result. Kern County Hazardous Materials Division also received calls reporting a noxious smell.¹¹

Despite community concerns and closure of a State Highway, the National Response Center, and state and other regulatory agencies were not notified until at least 20 hours had elapsed from the time of the spill. Prompt notification of the National Response Center would have ensured the best response to a spill that affected the nearby community of Kramer Junction.

Spills that exceed the required reportable quantity (for Therminol HTF spills, the reportable quantity is 42 gallons, according to the AFC, p. 5.6-20) must be reported immediately to the National Response Center under CERCLA Section 103. The lag time for reporting the spill at the SEGS facility may constitute a violation of CERCLA Section 103 reporting requirements.

Other potential reporting violations were found in documents reviewed for the preparation of this testimony. Annual spill notification reports, available online at the National Response Center Website, indicate HTF spills and spill reporting as follow:

- February 27, 2007: 1000 gallons: spill reported to have occurred at 10:50 AM and National Response Center notified at 2:42 PM

⁸ AFC, p. 5.6-3.

⁹ Attachment 3: Letter from FPL Energy to RWQCB re: SEGS III HTF spill, October 21, 2005, November 1, 2005

¹⁰ <http://www.nrc.uscg.mil/download.html>: October 21, 2005 spill is documented as incident number 777129

¹¹ Attachment 3: Letter from FPL Energy to RWQCB re: SEGS III HTF spill, October 21, 2005, November 1, 2005

- July 16, 2007: 30,000 gallons: spill reported to have occurred at 10:00 AM and National Response Center notified at 1:58 PM.¹²

Again, CERCLA 103 requires immediate reporting to the National Response Center to ensure proper emergency response. The four hour lag time in the case of the 30,000 gallon HTF spill – from the time of the spill to the time it was reported – is of particular concern because of the size of the spill and the impacts noted by the community from the 9,900 gallon spill on October 21, 2005, including a vapor cloud and closure of a state highway by the California Highway Patrol.

Other potential violations of CERCLA 103 reporting requirements may be documented by records available at the National Response Center website; however, not all incident reports that would be available online were reviewed for the preparation of this testimony.

V. Recommendations

A. Failure to Describe the Proposed Project and Failure to Analyze Significant Impacts from and Required Mitigation for Spills of Heat Transfer Fluid

The FSA fails to adequately describe the proposed Project and fails to analyze significant impacts from and required mitigation for spills of HTF. The AFC should be supplemented to incorporate plans for a filtration facility for spilled HTF. The supplemental documentation should consider the need for county, state or federal permits to ensure the filtration facility is in compliance with all laws and regulations. The AFC should be supplemented to include provisions for handling of the spilled free-standing HTF to ensure worker safety and proper community notification. Then, the CEC Staff Assessment should be revised and recirculated to the public for review.

B. Piping System is Inadequate to Contain HTF

Because there is such a high likelihood of spills at BESP, double walled piping, if feasible, or containment of the spills should be considered by the applicant in a supplement to the AFC. Then, the CEC Staff Assessment should be revised and recirculated to the public for review.

C. Provisions for Emergency Notification are Inadequate

Based on the spill history at the SEGS facilities, the AFC should be supplemented to provide explicit procedures for emergency notification following HTF spills, including the immediate notification of the National Response Center. Then, the CEC Staff Assessment should be revised and recirculated to the public for review.

¹² <http://www.nrc.uscg.mil/download.html>: February 27, 2007 spill is documented as incident number 827678; July 16, 2007 spill documented as incident number 842273

DECLARATION

I, Matt Hagemann, declare as follows:

I have reviewed the above testimony regarding the Beacon Solar Energy Project. To the best of my knowledge, all of the facts in my testimony are true and correct. To the extent that this testimony contains opinion, such opinion is my own.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief. This declaration is signed at Newport Beach, California.

Dated: 3/8/10

Signed: 



Attachment 1

Attachment 2

Attachment 3

Attachment 4

Attachment 5

DECLARATION

I, Matt Hagemann, declare as follows:

I have reviewed the above testimony regarding the Beacon Solar Energy Project. To the best of my knowledge, all of the facts in my testimony are true and correct. To the extent that this testimony contains opinion, such opinion is my own.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief. This declaration is signed at Newport Beach, California.

Dated: 3/8/10

Signed: 



Attachment 1

**CUPA**

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • PHONE: (909) 386-8401 FAX: (909) 386-8460
www.sbcfire.org

BUSINESS EMERGENCY/CONTINGENCY PLAN COVER SHEET**I. IDENTIFICATION**

FACILITY ID #

F A 0 0 0 6 1 0 2

BUSINESS NAME (Same as FACILITY NAME or DBA)

Luz Solar Partners III - VII

BUSINESS SITE ADDRESS

41100 Highway 395

CITY

Boron

ZIP CODE

93516

For Dept Use Only - Log In/Date Stamp

RECEIVED

FEB 24 2009

S.B. CO. FIRE DEPT.

II. SUBMISSION CHECKLIST*(Complete this Section if submitting an entire business emergency/contingency plan whether new or revised)*Submission Checklist ☒*Items with an '*' are considered "Inventory" under State disclosure laws*

- ☒ * Business Activities Form
- ☒ * Business Owner/Operator Identification Form
- ☒ * Supplemental Emergency Contact Page
- ☒ Emergency Response Plans and Procedures
- ☒ * Hazardous Materials Inventory Summary Form for the facility listing materials (including wastes) by item number.
- ☒ * One Hazardous Materials Inventory Form for each hazardous material (including wastes) which meet reporting criteria
- ☒ * Material Safety Data Sheets attached to the inventory form of each material not listed in Appendix I.
- ☒ * Facility map (using grid form provided) consisting of all required features including the location of each inventoried item.
- ☒ Site map (using grid form provided) consisting of all required features including surrounding facilities and areas.
- ☒ Area map - photocopied city map with location of site indicated
- ☒ Owner/Operator has signed and dated the plan and all required individual pages of the plan.
- ☒ Submit 2 copies to the Hazardous Materials Division. One is for distribution to the local fire jurisdiction.
- ☒ **Retain one copy of the business emergency/contingency at the facility.**

III. UPDATE/CERTIFICATION*(Complete this Section if submitting a partial update or re-certifying an existing Plan)*

Check the appropriate boxes below and sign the certification statement. Submit 2 copies of all update information.

- ☐ Please incorporate the following into my business emergency/contingency plan.
 - ☐ New Business Owner/Operator Identification Form
 - ☐ New Inventory Forms and new Inventory Summary Form (and maps, if affected).
 - ☐ New Supplemental Emergency Contact Page.
- ☐ Other: _____

Brief explanation of changes: _____

- ☐ There have been no changes to the inventory. In place of submitting the annual inventory, I hereby attest to all of the following:
 - The information contained in the inventory most recently submitted to the CUPA is complete, accurate and up to date.
 - There has been no change in the quantity, storage, or handling of hazardous materials (including waste) reported in the most recently submitted inventory.
 - No hazardous materials (including waste) subject to inventory requirements are being handled that are not listed on the most recently submitted inventory.
 - This certification is not being made to meet annual inventory submission requirements of EPCRA. (EPCRA requires complete annual submission)

IV. SIGNATURE*(Complete this Section for all submissions)*

Certification - Based on my inquiry of those individuals responsible for obtaining the information, I certify under penalty of law that I have personally examined and am familiar with the information submitted on this document and believe the information is true, accurate and complete.

SIGNATURE OF OWNER/OPERATOR

NAME OF SIGNER (print)

Gregg Sellers

DATE

2/23/09

NAME OF DOCUMENT PREPARER

Glen King

135

TITLE OF SIGNER (print)

Plant General Manager

ENTERED**ENTERED**
MAR 27 2009

**CUPA**

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E", San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

BUSINESS ACTIVITIES**I. FACILITY IDENTIFICATION**

FACILITY ID #	F	A	0	0	0	6	1	0	2		
BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII										EPA ID # (Hazardous Waste Only) CAL000301046	
BUSINESS ADDRESS 41100 Highway 395										CITY Boron	ZIP CODE 93516

II. ACTIVITIES DECLARATION

Does your facility...	If YES, please complete these portions of the application...	
A. HAZARDOUS MATERIALS		
1. Have onsite (for any purpose) hazardous materials at or above 55 gallons for liquids, 500 pounds for solids or 200 cubic feet for compressed gases; or the applicable Federal threshold quantity for an extremely hazardous substance; or handle radiological materials in quantities for which an emergency plan is required pursuant to 10 CFR Parts 30, 40 or 70; or handle ANY amount of Class 1 or 2 explosives; or ANY amount Category I or II pesticides.	☒ YES ☐ NO	BUSINESS EMERGENCY/CONTINGENCY PLAN (Used in place of OES Form 2730 and 2731)
2. Have extremely hazardous substances above threshold planning quantities or hazardous substances in quantities greater than 10,000 lbs (except retail gas stations up to 75,000 gallons of gasoline or 100,000 gallons of diesel fuel in upgraded USTs) or otherwise subject to EPCRA 311-312 reporting requirements.	☒ YES ☐ NO	BUSINESS EMERGENCY/CONTINGENCY PLAN (Must file annually according to EPCRA instructions to meet EPCRA SARA Title III Tier 2 reporting requirements - see instructions, pg i.)
B. REGULATED SUBSTANCES		
Have Regulated Substances stored onsite in quantities greater than the threshold quantities established by the California Accidental Release Prevention Program (CalARP)?	☒ YES ☐ NO	BUSINESS EMERGENCY/CONTINGENCY PLAN (Used in place of OES Form 2730 and 2731) CalARP REGISTRATION FORM (See Section V of BP guidelines and forms)
C. UNDERGROUND STORAGE TANKS (USTs)		
1. Own or operate underground storage tanks?	☐ YES ☒ NO	UST FACILITY UST TANK (Pages 1 and 2) (One set per tank)
2. Intend to upgrade existing or install new USTs?	☐ YES ☒ NO	UST FACILITY UST TANK (Pages 1 and 2) (One set per tank) UST INSTALLATION - CERTIFICATE OF COMPLIANCE (one page per tank)
3. Need to report closing a UST?	☐ YES ☒ NO	UST FACILITY UST TANK (Pages 1 and 2) (One set per tank) HAZARDOUS WASTE TANK CLOSURE CERTIFICATION
D. ABOVE GROUND PETROLEUM STORAGE TANKS (ASTs)		
Store greater than 1320 gallons of petroleum products (new or used) in aboveground tanks or containers?	☒ YES ☐ NO	IF YES, PREPARE AND MAINTAIN A SPILL PREVENTION CONTROL & COUNTERMEASURES PLAN (SPCC) TO ADDRESS RELEASES FROM ABOVEGROUND STORAGE OF PETROLEUM AT YOUR FACILITY.
E. HAZARDOUS WASTE		
1. Generate ANY amount of hazardous waste?	☒ YES ☐ NO	EPA ID NUMBER—provide at the top of this page BUSINESS EMERGENCY/CONTINGENCY PLAN (Used in place of OES Form 2730 and 2731)
2. Recycle more than 100 kg/month of excluded or exempted recyclable materials (per CHSC §25143.2)?	☐ YES ☒ NO	RECYCLABLE MATERIALS REPORT (Pages 1 and 2)
3. Treat hazardous waste on site?	☐ YES ☒ NO	ONSITE HAZARDOUS WASTE TRT - FACILITY ONSITE HAZARDOUS WASTE TRT - UNIT (one per unit)
4. Treatment subject to financial assurance requirements (for Permit by Rule and Conditional Authorization)?	☐ YES ☒ NO	CERTIFICATION OF FINANCIAL ASSURANCE
5. Consolidated hazardous waste generated at a remote site?	☐ YES ☒ NO	REMOTE WASTE/CONSOLIDATED SITE ANNUAL NOTIFICATION
6. Generate in any single calendar month 1,000 kilograms (kg) (2,200 pounds) or more of federal RCRA hazardous waste, or generate in any single calendar month, or accumulate at any time, 1 kg (2.2 pounds) of RCRA acute hazardous waste; or generate or accumulate at any time more than 100 kg (220 pounds) of spill cleanup materials contaminated with RCRA acute hazardous waste.	☐ YES ☒ NO	IF YES, OBTAIN FEDERAL EPA ID NUMBER, FILE BIENNIAL REPORT (EPA FORM 8700-13A/B) WITH USEPA, AND SATISFY REQUIREMENTS FOR RCRA LARGE QUANTITY GENERATOR.

**CUPA**

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • PHONE: (909) 386-8401 FAX: (909) 386-8460

BUSINESS OWNER / OPERATOR IDENTIFICATION

FACILITY ID #	F A 0 0 0 6 1 0 2	(This number is on your CUPA permit)
EFFECTIVE DATE 12/12/05	ENDING DATE	
BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII		BUSINESS PHONE (760) 762-5562
BUSINESS SITE ADDRESS 41100 Highway 395		
CITY Boron	COUNTY SAN BERNARDINO	STATE CA
D&B NUMBER	PRIMARY SIC/NAICS CODE 4911/221119	DESCRIPTION OF BUSINESS ACTIVITY FOR THIS PRIMARY SIC CODE Solar Electric Power Generation
BUSINESS OPERATOR NAME FPL Energy Operating Services, Inc.		BUSINESS OPERATOR PHONE (760) 762-5562

II. BUSINESS OWNER

OWNER NAME Luz Solar Partners III - VII	OWNER PHONE 561-304-5911
OWNER MAILING ADDRESS 700 Universe Blvd.	
CITY Juno Beach	STATE FL
ZIP CODE 33408	

III. ENVIRONMENTAL CONTACT

CONTACT NAME Glen King	CONTACT PHONE (760) 762-5562 x440
CONTACT MAILING ADDRESS 41100 Highway 395	
CITY Boron	STATE CA
ZIP CODE 92347	

- PRIMARY -**IV. EMERGENCY CONTACTS*****- SECONDARY -**

NAME Gregg Sellers	NAME Ray Salas
TITLE Plant General Manager	TITLE Production Manager
BUSINESS PHONE (760) 762-5562 x395	BUSINESS PHONE (760) 762-5562 x615
HOME PHONE (NOT CONFIDENTIAL - SEE NOTE BELOW)	HOME PHONE (NOT CONFIDENTIAL - SEE NOTE BELOW)
OTHER 24-HOUR PHONE (NOT CONFIDENTIAL - SEE NOTE BELOW)	24-HOUR PHONE (NOT CONFIDENTIAL - SEE NOTE BELOW)
PAGER/CELL #	PAGER /CELL #

*HOME PHONE NUMBERS ARE REQUIRED FOR ALL HAZARDOUS WASTE GENERATORS. IF YOU WISH TO KEEP 24-HOUR OR HOME PHONE NUMBERS CONFIDENTIAL, FILE THE CONFIDENTIAL EMERGENCY CONTACT PAGE (PAGE 3) AND LEAVE THE ABOVE 24 HR FIELDS BLANK. ALSO USE THE SEPARATE PAGE (PAGE 3) TO DESIGNATE MORE THAN 2 EMERGENCY COORDINATORS.

V. SIGNATURE

SIGNATURE OF OWNER/OPERATOR <i>Gregg Sellers</i>	NAME OF SIGNER (print) Gregg Sellers	DATE 2/23/09
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CUPA
San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

LOCALLY COLLECTED INVENTORY INFORMATION

I. FACILITY IDENTIFICATION

FACILITY ID #	F A 0 0 0 6 1 0 2	(This number is on your CUPA permit.)
BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII		
FACILITY ADDRESS 41100 Highway 395		CITY Boron

II. ADDITIONAL CONTACT & OPERATIONS INFORMATION

BUSINESS MAILING ADDRESS 41100 Highway 395	CITY Boron	STATE CA	ZIP CODE 93516
BUSINESS FAX NUMBER (760) 762-5546	BUSINESS E-MAIL		

NOTE: ALL CORRESPONDENCE, INVOICES, PERMITS, AND NOTICES WILL BE SENT TO THE ABOVE ADDRESS

Total # of Employees onsite/shift: (as reported on your most recent tax withholding forms.)	SHIFT 1 95	SHIFT 2	SHIFT 3	HOURS OF OPERATION
Total # of employees onsite involved in the operation that uses hazardous materials:			79	TAXPAYER ID NUMBER 95-4040428,95-4040461,95-4042417, 95-4048048,95-4042419
ASSESSORS PARCEL NUMBER (S) 491-151-39, 491-151-38, 491-101-16, 491-101-18, 498-171-05, 498-171-06			CROSS STREET Highway 58	
BUSINESS DESCRIPTION Electric Power Generation				
Number of Underground Storage Tanks located at this facility		0		

Does this facility:

- | | | |
|---|---|--|
| 1. Generate, handle or store any Perchlorate-containing substance or waste on site? | ☐ YES | ☒ NO |
| 2. Generate, handle or store any PCB ballasts on site?
If yes, must include PCB ballasts as hazardous waste on inventory summary and chemical description pages. | ☐ YES | ☒ NO |
| 3. Generate any amount of Universal Waste (mercury containing devices, non-empty aerosols, electronic devices, fluorescent light tubes, batteries)? | ☒ YES | ☐ NO |
| 4. Generate more than 220 pounds (100 kg) of Universal Waste within a calendar year? | ☒ YES | ☐ NO |
| 5. Generate more than 11,000 pounds (5,000 kg) of Universal Waste within a calendar year?
If yes, must obtain a federal EPA ID number and submit copy of notification to CUPA. | ☐ YES | ☒ NO |
| 6. Receive Mercury-containing Universal Waste from another Universal Waste Handler?
If yes, must include mercury-containing wastes as hazardous waste on inventory summary & chemical description pages. | ☐ YES | ☒ NO |
| 7. Process (dismantle, puncture, etc.) any Universal Wastes?
If yes, must notify DTSC of processing activity prior to operation. | ☐ YES | ☒ NO |

Provide the name(s) of all Universal Wastes handled or generated on site:
Non-empty aerosols, electronic devices, fluorescent light tubes, batteries

If you need more information, get the Managing Universal Waste fact sheet from the website of DTSC, this CUPA, or by calling our office.

Does this facility have a laboratory on site. Five water chemistry labs for water quality testing only. ☒ YES* ☐ NO

* If yes, attach a general description of the laboratory and a brief description of the type(s) and quantity of hazardous materials in the lab.

III. VULNERABLE POPULATIONS

Is there a school, hospital, or extended care facility within 1,000 ft. (straight-line distance) of this facility? ☐ YES ☒ NO

If yes, attach page with the name and address of each school hospital or extended care facility site within 1000 ft.

Date: 2/23/09



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620 South "E" Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII		
FACILITY ADDRESS 41100 Highway 395	103	CITY Boron 104
EMERGENCY RESPONSE PLANS & PROCEDURES - AGENCY NOTIFICATION POST BY PHONE		

Agency Notification: If a situation is an emergency, call 911 first. Additionally, a handler of hazardous materials is required to immediately report any release or threatened release of a hazardous material to San Bernardino County Fire Department, Hazardous Materials Division and the Governor's Office of Emergency Services. Spills exceeding federal reportable quantities require additional notification to the National Response Center. However, California statute does not limit the requirement to report to any specific quantity. **Also note that calling 911 does not meet the requirement for the handler to report a release and that the local fire department cannot make required notifications on behalf of the handler.** This CUPA requires a written report within 15 days after any reportable release or threatened release. Contact the CUPA for further guidance.

Agency

1. *Local Emergency Response Agency (if an emergency)
2. *San Bernardino County Fire Department Hazardous Materials Division
3. *State of California, Governor's Office of Emergency Services
4. National Response Center
5. Other Agencies (*Cal OSHA, Regional Board, Air Quality, as applicable*)

(* Indicates mandatory notification.)

California Energy Commission

Phone Number

911

(800) 33-TOXIC or (909) 386-8425

(800) 852-7550 or (916) 845-8911

(800) 424-8802

Agency Name
Mojave Desert AQMD

(916) 954-3936

Phone Number

(800) 635-4617

Agency Name
Lahontan Regional Water Quality Control Board

Phone Number

760-241-6583

Agency Name

Phone Number

EMERGENCY INFORMATION REQUIRED: BE PREPARED TO PROVIDE THE FOLLOWING INFORMATION

- Name & phone number of person reporting
- Name and street address of the business
- Location of the incident or threatened release
- Type of incident or threatened release
- Hazardous materials involved & physical state
- Hazards to human health and/or environment
- Actions taken or planned
- Contractor or cleanup company
- Estimate of the quantity released
- Media (soil, water, air) into which release occurred
- Precautions to take (if known)
- Time and duration of the release
- Is the chemical an extremely hazardous substance?
- Extent of injuries, if any
- Is any assistance required?

Release reporting citations (California Health and Safety Code):

§ 25501. Definitions:

(r) "Release" means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, unless permitted or authorized by a regulatory agency.

(u) "Threatened release," means a condition creating a substantial probability of harm, when the probability and potential extent of harm make it reasonably necessary to take immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment.

§ 25507(a) ... the handler or any employee, authorized representative, agent, or designee of a handler shall, upon discovery, immediately report any release or threatened release of a hazardous material to the administering agency, and to the office, in accordance with the regulations adopted pursuant to Section 25503. Each handler and any employee, authorized representative, agent, or designee of a handler shall provide all state, city, or county fire or public health or safety personnel and emergency rescue personnel with access to the handler's facilities.

See Appendix G for further citations and explanation.

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San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

BUSINESS NAME (Same as FACILITY NAME or DBA)

Luz Solar Partners III - VII

FACILITY ADDRESS

41100 Highway 395

103

CITY

Boron

104

EMERGENCY RESPONSE PLANS AND PROCEDURES

State Law requires your business to complete all sections of the Emergency Response Procedure listed below:

For each of the following, briefly describe your business's standard operating procedures relating to the release or threatened release of hazardous materials located at your facility. You may attach additional pages if necessary, but do not include copies of facility manuals unless requested to do so by this Department. You may reference manuals that are used by your facility for these procedures, but you must still give a brief description here.

EVACUATION/NOTIFICATION: Indicate location(s) where employees, customers, visitors or others on site are to evacuate in an emergency. Describe how your business will immediately notify people and evacuate the facility in the event of a release or threatened release of hazardous materials. Include the route and meeting place.

All employees have continuous access to hand held multi-channel radios for communications onsite. In case of an emergency situation, employees have been instructed to stay tuned to their normally assigned channels for general announcements. The evacuation location would generally be just outside the site's front entrance on the south side of the entrance road. The employees have been instructed to gather and remain at the evacuation location for head count and deployment.

PREVENTION/MITIGATION/ABATEMENT: Describe what policies and procedures your business will follow to prevent, reduce and/or remove the hazard to persons, property or the environment caused by a release or threatened release of hazardous materials and/or hazardous wastes. (✓Check those items that apply and write additional information in the space provided).

- ☒ Reduction of containers on site if not used or needed.
- ☒ Containers are properly labeled and closed when not in use.
- ☒ Compressed gas cylinders are properly secured.
- ☐ Use of monitoring system. Type: _____
- ☒ Other: _____

The emergency response plan outlines how the emergency response team (ERT) will coordinate the response to emergency situations. This mostly deals with designation of an emergency coordinator on the scene and other positions to be delegated immediately. All employees have been instructed to leave hazardous situations and call for immediate deployment of ERT members trained and equipped to handle the situation. Various ERT members have been trained in fire fighting, medical and hazardous material responses to properly address these situations.

Date: 2/23/09

Page 5

**CUPA**

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

BUSINESS NAME (Same as FACILITY NAME or DBA)

Luz Solar Partners III - VII

FACILITY ADDRESS

41100 Highway 395

103

CITY

Boron

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EMERGENCY RESPONSE PLANS AND PROCEDURES – PAGE 2

FACILITY TRAINING PLAN: Describe employee and operator training including local emergency response coordination, use of facility emergency equipment, and provisions for initial and refresher training. In addition, describe training for hazardous materials/waste handling as required by OSHA. (✓ Check those items that apply and write additional information in the space provided)

- ☒ New employee training.
- ☒ Annual training & periodic refresher courses.
- ☒ Familiarization with the Emergency Response Plans and Procedures of this Business Plan.
- ☒ Spill control equipment
- ☒ Monitoring system
- ☒ Personal Protective Equipment
- ☐ On the job training. Describe below.
- ☐ Other:

EMERGENCY PROCEDURES: Give duties of the Emergency Coordinator and how implementation of Facility Emergency Response will be accomplished. (e.g. Notification, evacuation, emergency coordination) (✓ Check those items that apply and write additional information in the space provided)

Emergency Coordinator will:

- ☒ Identify potential hazards and determine whether a release has occurred.
- ☒ Activate local emergency systems (e.g. manual shutoff devices) and take appropriate immediate actions based on level of training and the ability to act safely.
- ☒ Coordinate the notification and evacuation of employees and customers from the facility.
- ☒ Make required agency notifications and request needed assistance.
- ☒ Assist responding agencies by providing access to the facility and information about the facility.
- ☐ Other:

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EMERGENCY RESPONSE PLANS AND PROCEDURES – PAGE 3

FACILITY EMERGENCY EQUIPMENT: List facility emergency equipment on site (fire extinguisher, fire alarms, spill control equipment, SCBA, first aid kits, etc.); include test/maintenance plan. (✓ Check those items that apply and write additional information in the space provided)

Equipment	Quantity/Type	Maintenance Schedule/Frequency
☒ Fire extinguisher(s)	~500 Dry Chemical, Halon, CO2	Annual Certification, Monthly Inspection
☒ First aid kit(s)	~400	Annual Service, Monthly Inspection
☒ Fire alarm(s)	System Wide	Annual
☐ Spill control equipment		
☒ Monitoring system	~30	Annual
☒ Personal Protective Equipment	SCBA/Respirators	Monthly Inspection
☒ Emergency Response Truck	1	
☒ Fire Pumper Truck	1	
☒ HAZMAT Response Equipment		
☒ Confined Space Rescue Equipment		

FACILITY EARTHQUAKE RESPONSE: Identify areas of the facility as well as mechanical or other systems that require immediate inspection due to their vulnerability to earthquake related ground motion. (E.g. Hazardous materials or waste storage locations, vessels, piping, pipe and tank supports, valves, gauges, etc.) (✓ Check those items that apply and write additional information in the space provided)

- ☒ Chemical Storage Locations – Product and Waste
- ☒ Process vessels
- ☒ Aboveground storage tanks
- ☐ Emergency shut-off systems
- ☒ Piping and pipe supports
- ☒ Utility connections

☐ _____

☐ _____

☐ _____

☐ _____

ARRANGEMENTS/AGREEMENTS: Describe any arrangements or agreements that you have with private emergency response teams, waste haulers, disposal companies, recyclers, local hospitals, police or fire. If you have no arrangements or agreements, state that fact in the space provided. (✓ Check those items that apply and write additional information in the space provided)

- ☐ Hazardous waste hauler _____
- ☐ Emergency response team _____
- ☐ Local Hospitals _____
- ☐ Other: _____
- ☒ No arrangements or agreements at this time

Date: 2/23/09

Page 7



CUPA

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • PHONE: (909) 386-8401 FAX: (909) 386-8460

INVENTORY SUMMARY FORM (REQUIRED)**I. FACILITY IDENTIFICATION**FACILITY ID # **F A 0 0 0 6 1 0 2**

(This number is on your CUPA permit.)

BUSINESS NAME (Same as FACILITY NAME or DBA)

Luz Solar Partners III - VII

FACILITY ADDRESS

41100 Highway 395

CITY

Boron

II. INVENTORY SUMMARY

Item #	Name of Hazardous Material or Waste	Maximum Quantity	Size of Largest Container	Unit of Measure
3.	Lubricating Oil (Example Only)	555	500	Gallon
01	Therminol VP-1	600000	75000	Gallons
02	Sulfuric Acid	750000	5000	gallons
03	Sodium Hydroxide	25000	5000	gallons
04	Unleaded Gasoline	6000	5000	gallons
05	Diesel Fuel	6000	3000	gallons
06	Chemtreat CL-1491	2000	400	gallons
07	Chemtreat BL-1794	550	55	gallons
08	Chemtreat BL-1551	550	55	gallons
09	Chemtreat BL-1283	220	55	gallons
10	Sodium Hypochlorite	7500	1500	gallons
11	Acetylene	5500	285	Cu ft
12	Lead Acid Batteries	10000	460	lbs
13	Ethylene Glycol	110	55	gallons

Summarize the business plan inventory on this page. Place this summary in front of inventory section of the Business Plan. Make copies of this sheet as necessary. Reminder: You need not report hazardous materials with a maximum quantity of less than 55 gallons, 500 pounds, 200 cubic feet, or the threshold planning quantity of an extremely hazardous substance. However, hazardous wastes, Category 1 and 2 pesticides, and explosives are reportable at any quantity.

III. SIGNATURE- EPCRA Facilities MUST sign the bottom of each individual attached inventory form.

SIGNATURE OF OWNER/OPERATOR

NAME OF SIGNER (print)

Gregg Sellers

DATE

2/23/09



CUPA

San Bernardino County Fire Department • Hazardous Materials Division
620 South "E" Street, San Bernardino, CA 92415-0153 • PHONE: (909) 386-8401 FAX: (909) 386-8460

INVENTORY SUMMARY FORM (REQUIRED)**I. FACILITY IDENTIFICATION**

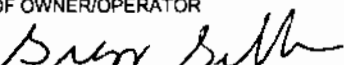
FACILITY ID #	F	A	0	0	0	6	1	0	2	(This number is on your CUPA permit)
BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII										
FACILITY ADDRESS 41100 Highway 395								CITY Boron		

II. INVENTORY SUMMARY

Item #	Name of Hazardous Material or Waste	Maximum Quantity	Size of Largest Container	Unit of Measure
3.	Lubricating Oil (Example Only)	555	500	Gallon
14	Quintolubric 822 EHC	275	55	gallons
16	Oxygen	5500	285	Cu ft
18	Nitrogen Refrigerated Liquid	24000	3000	lbs
19	Argon	5500	285	Cu ft
20	Sodium Carbonate	1000	100	lbs
22	Argon, Carbon Dioxide, Oxygen Mixture	5000	285	Cu ft
23	Safe Tame	110	55	gallons
24	Citrus Supreme	110	55	gallons
25	Ol' Number One	110	55	gallons
26	Lubricating Oils	10000	2300	gallons
27	Lubricating Greases	300	35	gallons
28	Waste Oil	10500	10000	gallons
29	Solid Waste Oil-Related Debris	540	540	Cu ft

Summarize the business plan inventory on this page. Place this summary in front of inventory section of the Business Plan. Make copies of this sheet as necessary. Reminder: You need not report hazardous materials with a maximum quantity of less than 55 gallons, 500 pounds, 200 cubic feet, or the threshold planning quantity of an extremely hazardous substance. However, hazardous wastes, Category 1 and 2 pesticides, and explosives are reportable at any quantity.

III. SIGNATURE- EPCRA Facilities MUST sign the bottom of each individual attached inventory form.

SIGNATURE OF OWNER/OPERATOR 	NAME OF SIGNER (print) Gregg Sellers	DATE 2/23/09
--	---	-----------------



I. FACILITY IDENTIFICATION

F	A	0	0	0	6	1	0	2
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(If this number is on your CUPA permit.)

Luz Solar Partners III - VII

103

CITY

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104

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III. SIGNATURE- EPCRA Facilities MUST sign the bottom of each individual attached inventory form.

NAME OF SIGNER (print)

138

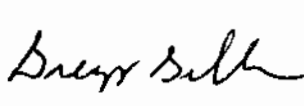
DATE _____

134

Gregg Sellers

2/23/09

San Bernardino County CUPA • HAZARDOUS MATERIALS DIVISION
620 South E Street, San Bernardino, CA 92415-0153 • (909) 366-8401 FAX (909) 366-8460

HAZARDOUS MATERIALS INVENTORY FORM - Chemical Description								☒ MATERIAL
One page per item. Indicate if material OR waste (Do <u>not</u> combine material and waste on one form)								☐ WASTE
MAKE COPIES OF THIS FORM AS NEEDED.								
ATTACH A MATERIAL SAFETY DATA SHEET (MSDS) IF THE MATERIAL IS NOT LISTED IN APPENDIX I OF THIS GUIDE.								
ITEM NUMBER 01								
FACILITY ID #		F A 0 0 0 6 1 0 2		CHEMICAL LOCATION INFORMATION				
BUSINESS NAME Luz Solar Partners III - VII				FACILITY MAP # 1		GRID COORDINATE(s) B2-H6		BLDG or AREA
BUSINESS SITE ADDRESS 41100 Highway 395, Boron, CA 93516								
CHEMICAL INFORMATION								
CHEMICAL NAME Mixture						TRADE SECRET ☒ NO Do not disclose trade secrets here. Contact this Dept for trade secret filing instructions. If EPCRA, follow EPA procedures		
COMMON NAME Therminol VP-1						EHS* ☐ YES ☒ NO		
CAS#						EHS = Extremely Hazardous Substance (Appdx B) *If EHS is "YES", all amounts MUST be in pounds		
HAZARDOUS MATERIAL TYPE (Check one item only)				RADIOACTIVE? Yes ☐ No ☒		CURIES		
☐ a. PURE ☒ b. MIXTURE ☐ c. WASTE								
PHYSICAL STATE (Check one item only)				SIZE OF LARGEST CONTAINER:				
☐ a. SOLID ☒ b. LIQUID ☐ c. GAS ☐ d. DUST				75,000				
FED HAZARD CATEGORIES								
☐ a. FIRE ☐ b. REACTIVE ☐ c. PRESSURE RELEASE ☒ d. AGUTE HEALTH ☒ e. CHRONIC HEALTH								
AVERAGE AMOUNT		550,000		MAXIMUM AMOUNT		600,000		ANNUAL WASTE AMOUNT
UNITS*		☒ a. GALLONS ☐ b. CUBIC FEET ☐ c. POUNDS ☐ d. TONS ☐ e. OTHER:		STATE WASTE CODE				
(Check one item only)				DAYS ON SITE 365				
STORAGE CONTAINER (Check all that apply)								
☒ a. ABOVEGROUND TANK ☐ b. UNDERGROUND TANK ☐ c. TANK INSIDE BUILDING ☐ d. STEEL DRUM		☐ e. PLASTIC/NONMETALLIC DRUM ☐ f. CAN ☐ g. CARBOY ☐ h. SILO ☐ i. FIBER DRUM ☐ j. BAG ☐ k. BOX ☐ l. CYLINDER ☐ m. GLASS BOTTLE ☐ n. PLASTIC BOTTLE ☐ o. TOTE BIN ☐ p. TANK WAGON ☐ q. RAIL CAR ☐ r. OTHER						
STORAGE PRESSURE		☐ a. AMBIENT ☒ b. ABOVE AMBIENT ☐ c. BELOW AMBIENT						
STORAGE TEMPERATURE		☐ a. AMBIENT ☒ b. ABOVE AMBIENT ☐ c. BELOW AMBIENT ☐ d. CRYOGENIC						
%WT	COMPOSITION (LIST ALL COMPONENTS, HAZARDOUS FIRST)				EHS		CAS #	
1. 73.5	Diphenyl Ether				☐ YES ☒ NO		101-84-8	
2. 28.5	Biphenyl				☐ YES ☒ NO		92-52-4	
3.					☐ YES ☐ NO			
4.					☐ YES ☐ NO			
5.					☐ YES ☐ NO			
If more hazardous components are present at greater than 1% by weight if non-carcinogenic or 0.1% by weight if carcinogenic, attach additional sheets								
NOTES (Trade names/synonyms or other information relevant to the substances listed) Heat Transfer Fluid					If EPCRA, Owner/Operator please sign this page 			

Date: 2/23/09

Attachment 2

Solutia Inc.

Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product name: THERMINOL® VP1 Heat transfer fluid

Reference Number: 000000000211

Date: 05/16/2009

Company Information:

United States:

Solutia Inc.
575 Maryville Center Drive, P.O. Box 66760
St. Louis, MO 63166-6760
Emergency telephone: Chemtrec: 1-800-424-9300
International Emergency telephone: Chemtrec: 703-527-3887
Non-Emergency telephone: 1-314-674-6661

Canada:

Solutia Canada Inc.
6800 St. Patrick Street
LaSalle, PQ H8N 2H3
Emergency telephone: CANUTEC: 1-613-996-6666
Non-Emergency telephone: 1-314-674-6661

Mexico:

Solutia MEXICO, S. DE R.L. DE C.V.
Prol. Paseo de la Reforma 2654
Local 501, Piso-5
Col. Lomas Altas
11950 Mexico, D.F.
Emergency telephone: SETIQ: (in Mexico) 01-800-002-1400
Non-Emergency telephone: (in Mexico) 01-55-5259-6800

Brazil:

Solutia Brazil Ltd.
Avenue Carlos Marcondes, 1200
CEP: 12241-420-São José dos Campos/SP-Brazil
Emergency telephone: 55 12 3932 7100 (PABX)
Non-Emergency telephone: 55 11 3365 1800 (PABX)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Form:	liquid
Colour:	clear to colourless
Odour:	characteristic

WARNING STATEMENTS

WARNING!
Causes eye irritation
Causes skin irritation
Causes respiratory tract irritation
Contains material which can cause liver and nerve damage

POTENTIAL HEALTH EFFECTS

Likely routes of exposure:	eye and skin contact inhalation
Eye contact:	Highly irritating to eyes.
Skin contact:	Highly irritating to skin. Prolonged or repeated skin contact may result in irritant dermatitis.
Inhalation:	Severely irritating if inhaled. No more than slightly toxic if inhaled. Significant adverse health effects are not expected to develop under normal conditions of exposure.
Ingestion:	No more than slightly toxic if swallowed. Significant adverse health effects are not expected to develop if only small amounts (less than a mouthful) are swallowed.
Signs and symptoms of overexposure:	headache fatigue nausea/vomiting indigestion abdominal pain tremors
Target organs/systems:	May cause liver damage May cause nerve damage

Refer to Section 11 for toxicological information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Components</u>	<u>CAS No.</u>	<u>Average concentration</u>	<u>Concentration range</u>	<u>Units</u>
diphenyl ether	101-84-8	73.5		%
biphenyl	92-52-4	26.5		%

4. FIRST AID MEASURES

If in eyes:	Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove any contact lenses. Get medical attention. Remove material from skin and clothing.
If on skin:	Immediately flush the area with plenty of water. Remove contaminated clothing. Wash skin gently with soap as soon as it is available. Get medical attention. Wash clothing before reuse.
If inhaled:	Remove patient to fresh air. If not breathing, give artificial respiration. If breathing is difficult give oxygen. Remove material from eyes, skin and clothing.

If swallowed: Immediate first aid is not likely to be required.
A physician or Poison Control Center can be contacted for advice.
Wash heavily contaminated clothing before reuse.

5. FIRE FIGHTING MEASURES

Fire point: 127 C

Hazardous products of combustion: carbon monoxide (CO); carbon dioxide; hydrocarbons

Extinguishing media: Water spray, foam, dry chemical, or carbon dioxide

Unusual fire and explosion hazards: None known

Fire fighting equipment: Firefighters, and others exposed, wear self-contained breathing apparatus.
Equipment should be thoroughly decontaminated after use.

Miscellaneous advice: This product is not classified as a fire-resistant heat transfer fluid.
Precautions to avoid sources of ignitions should be taken.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protection recommended in section 8.

Environmental precautions: Keep out of drains and water courses.

Methods for cleaning up: Contain large spills with dikes and transfer the material to appropriate containers for reclamation or disposal. Absorb remaining material or small spills with an inert material and then place in a chemical waste container. Flush spill area with water.

Refer to Section 13 for disposal information and Sections 14 and 15 for reportable quantity information.

7. HANDLING AND STORAGE

Handling

Avoid contact with eyes, skin and clothing.

Avoid breathing vapour or mist.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

Precautions against ignitions and fire should be taken with this product.

Heat transfer fluids are intended for INDIRECT heating purposes ONLY.

This product has not been approved for food grade use.

Emptied containers retain vapour and product residue. Observe all recommended safety precautions until container is cleaned, reconditioned or destroyed. Do not cut, drill, grind or weld on or near this container. The reuse of this material's container for non industrial purposes is prohibited and any reuse must be in consideration of the data provided in this material safety data sheet.

Storage

General: Stable under normal conditions of handling and storage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Airborne exposure limits: (ml/m3 = ppm)

THERMINOL® VP1 No specific occupational exposure limit has been established.

biphenyl ACGIH TLV: 0.2 ml/m3 ; mist ; 8-hr TWA
OSHA PEL: 0.2 ml/m3 ; 1.0 mg/m3 ; ; 8-hr TWA
Mexican OEL: 0.2 ml/m3 ; 1.5 mg/m3 ; ; 8-hr TWA
Mexican OEL: 0.6 ml/m3 ; 4 mg/m3 ; ; 15-min STEL

diphenyl ether ACGIH TLV: 1 ml/m3 ; ; 8-hr TWA
ACGIH TLV: 2 ml/m3 ; ; 15-min STEL
OSHA PEL: 1 ml/m3 ; 7 mg/m3 ; ; 8-hr TWA
Mexican OEL: 1 ml/m3 ; 7 mg/m3 ; ; 8-hr TWA
Mexican OEL: 2 ml/m3 ; 14 mg/m3 ; ; 15-min STEL

Eye protection: Wear safety goggles.
Have eye flushing equipment available.

Hand protection: Wear chemical resistant gloves.
Consult the glove/clothing manufacturer to determine the appropriate type
glove/clothing for a given application.
See Solutia Glove Facts for permeation data.

Body protection: Wear suitable protective clothing.
Consult the glove/clothing manufacturer to determine the appropriate type
glove/clothing for a given application.
Wear full protective clothing if exposed to splashes.
Wash contaminated skin promptly.
Launder contaminated clothing and clean protective equipment before reuse.
Wash thoroughly after handling.
Have safety shower available at locations where skin contact can occur.

Respiratory protection: Avoid breathing vapour or mist.
Use approved respiratory protection equipment (full facepiece recommended) when
airborne exposure limits are exceeded.
If used, full facepiece replaces the need for face shield and/or chemical goggles.
Consult the respirator manufacturer to determine the appropriate type of equipment for
a given application.
Observe respirator use limitations specified by the manufacturer.

Ventilation: Provide natural or mechanical ventilation to control exposure levels below airborne
exposure limits.
If practical, use local mechanical exhaust ventilation at sources of air contamination
such as processing equipment.

Components referred to herein may be regulated by specific Canadian provincial legislation. Please refer to exposure
limits legislated for the province in which the substance will be used.

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash point:	110 C	Pensky-Martens closed tester
	124 C	Cleveland Open Cup

Autoignition temperature:	612 C	ASTM D-2155
Density:	1.06 g/cm3 @ 25 C	
Boiling point :	257 C	
Crystallising point :	12 C	
Water solubility:	~25 mg/l	

NOTE: These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

10. STABILITY AND REACTIVITY

Conditions to avoid:	All sources of ignition.
Materials to avoid:	Contact with strong oxidizing agents.
Hazardous reactions:	Hazardous polymerization does not occur.
Hazardous decomposition products:	None known;

11. TOXICOLOGICAL INFORMATION

This product has been tested for toxicity. Results from Solutia sponsored studies or from the available public literature are described below.

Acute animal toxicity data

Oral:	LD50 , rat, 2,050 mg/kg , No more than slightly toxic
Dermal:	LD50 , rabbit, > 5,010 mg/kg , Practically nontoxic after skin application in animal studies.
Inhalation:	LC50 , rat, 2.66 mg/l , 4 h, Toxic based on animal inhalation exposure studies.
Skin irritation:	rabbit , Slightly irritating to skin., 24 h
Repeat dose toxicity:	rat, , inhalation, 13 weeks, , Produced effects on body weight, serum enzymes and/or organ weights in repeat dose studies.
Repeat dose toxicity:	rat, , gavage, 26 weeks, , Produced effects on body weight, serum enzymes and/or organ weights in repeat dose studies. Effects only observed at very high dose levels.
Target organs affected	kidneys, liver, spleen
Repeat dose toxicity:	rat, , diet, subchronic, , Repeated oral exposure produced liver and kidney changes in animal models.
Target organs affected	liver, kidneys
Developmental toxicity:	rat, gavage, , No effects on offspring observed in laboratory animals in the presence of maternal toxicity.

Mutagenicity: No genetic effects were observed in standard tests using bacterial and animal cells.

Components

Data from Solutia studies and/or the available scientific literature on the components of this material which have been identified as hazardous chemicals under the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200) or the Canadian Hazardous Products Act are discussed below.

biphenyl	Chronic exposure has been reported to cause headache, fatigue, nausea, indigestion, abdominal pain, tremor, central and peripheral nerve damage and liver injury. Slightly toxic following oral administration. Practically nontoxic after skin application in animal studies. Practically non irritating to skin (rabbit). Slightly irritating to eyes (rabbit). No mortality or signs of toxicity at the highest level achievable. Irritating to respiratory system in animal models. Produced effects on body weight, serum enzymes and/or organ weights in repeat dose studies. Produced no dermal sensitization (guinea pigs). No effects on offspring observed in laboratory animals in the presence of maternal toxicity. No genetic effects were observed in standard tests using bacterial and animal cells.
diphenyl ether	Predictive patch testing on human volunteers did not produce irritation or sensitization. Slightly toxic following oral administration. Practically nontoxic after skin application in animal studies. Slightly irritating to eyes (rabbit). Slightly irritating to skin (rabbit). Repeated exposure produced respiratory tract irritation in animal models. Repeated exposure produced eye irritation in animal models. No genetic effects were observed in standard tests using bacterial and animal cells.

12. ECOLOGICAL INFORMATION

Environmental Toxicity

Invertebrates	48 h, EC50	Water flea (<i>Daphnia magna</i>)	2.4 mg/l
Fish:	96 h, LC50	Rainbow trout (<i>Oncorhynchus mykiss</i>)	7.6 mg/l
	96 h, LC50	Fathead minnow (<i>Pimephales promelas</i>)	24 mg/l
Algae:	96 h, EC50	Algae (<i>Selenastrum capricornutum</i>)	1.3 mg/l
Biodegradation	Modified SCAS (OECD 302A) Primary degradation 99 %		

13. DISPOSAL CONSIDERATIONS

US EPA RCRA Status: This material when discarded may be a hazardous waste as that term is defined by the Resource Conservation and Recovery Act (RCRA), 40 CFR 261.24, due to its toxicity characteristic. This material should be analyzed in accordance with Method 1311 for the compound(s) below.

US EPA RCRA	D018	Compound/Characteristic:	BENZENE
-------------	------	--------------------------	---------

hazardous waste number:

Disposal considerations: Incineration

Miscellaneous advice: This product meets the criteria for a synthetic used oil under the U.S. EPA Standards for the Management of Used Oil (40 CFR 279). Those standards govern recycling and disposal in lieu of 40 CFR 260 -272 of the Federal hazardous waste program in states that have adopted these used oil regulations. Consult your attorney or appropriate regulatory official to be sure these standards have been adopted in your state. Recycle or burn in accordance with the applicable standards.
Solutia operates a used fluid return program for certain fluids under these used oil standards. Contact your Sales Representative for details.
This product should not be dumped, spilled, rinsed or washed into sewers or public waterways.

14. TRANSPORT INFORMATION

The data provided in this section is for information only. Please apply the appropriate regulations to properly classify your shipment for transportation.

US DOT

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.
biphenyl
Hazard Class: 9
Hazard Identification number: UN3082
Packing Group: Packing Group III
Transport label: Class 9
Special provisions: This material meets the definition of a marine pollutant.
Other: Applies ONLY to containers with an RQ or for shipments in bulk via water transportation.

Canadian TDG

Other: Not regulated for transport.

Reportable Quantity/Limit

US DOT RQ 100 lb *biphenyl*
Package size containing reportable amount: 377 lb

ICAO/IATA Class

Other: See DOT Information

15. REGULATORY INFORMATION

All components are in compliance with the following inventories: U.S. TSCA, EU EINECS, Canadian DSL, Australian AICS, Korean, Japanese ENCS, Phillipine PICCS, Chinese

Canadian WHMIS classification: D2(A) - Materials Causing Other Toxic Effects
D2(B) - Materials Causing Other Toxic Effects

SARA Hazard Notification:

Hazard Categories Under Title III Rules (40 CFR 370): Immediate
Delayed

Section 302 Extremely Hazardous Substances: Not applicable

Section 313 Toxic Chemical(s): biphenyl

CERCLA Reportable Quantity:

100 lbs biphenyl

For this/these chemicals, release of more than the Reportable Quantity to the environment in a 24 hour period requires notification to the National Response Center (800-424-8802 or 202-426-2675).

This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulation and the MSDS contains all the information required by the Canadian Controlled Products Regulation.

Refer to Section 11 for OSHA/HPA Hazardous Chemical(s) and Section 13 for RCRA classification.

Safety data sheet also created in accordance with Brazilian law NBR 14725

16. OTHER INFORMATION

Product use: Heat transferring agents

Reason for revision: Routine review and update

	Health	Fire	Reactivity	Additional Information
Suggested NFPA Rating	2	1	0	
Suggested HMIS Rating:	2	1	0	G

Prepared by the Solutia Hazard Communication Group. Please consult Solutia @ 314-674-6661 if further information is needed.

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SOLUTIA is a trademark of Solutia Inc.

Responsible Care® is a registered trademark of the American Chemistry Council.

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Attachment 3



FPL Energy

FPL Energy Operating Services, Inc., 41100 Highway 395, Boron, CA 93516
760-762-5562

November 1, 2005

Mr. Joe Koutsky
California Regional Water Quality Control Board
Lahontan Region
14440 Civic Dr. Suite 200
Victorville, CA 92392-2306

RECEIVED
NOV 04 2005
COUNTY FIRE DEPARTMENT
HAZARDOUS MATERIALS

Subject: SEGS III HTF Spill October 21, 2005

Dear Mr. Koutsky:

This letter is to follow-up the phone message left on your phone October 22, 2005 regarding a spill of HTF that occurred on October 21, 2005.

Release timeline and agency notifications:

October 21, 2005

17:22 SEGS III Control Room is notified by a technician of a vapor cloud that looks like it is coming from the SEGS III solar field. The Power Block Operator was dispatched to investigate.

17:25 Power block operator reported a large release in the south west quad at 52G. The release was at an HCE tube weld close to the end of the collector assembly and was spraying directly on the loop inlet isolation valve. The operator isolated the loop outlet isolation valve.

17:35 The solar field collector assemblies reached the ten degree position (standard position at the end of the day). The HTF pump was shut down and the field flow control valves were closed. Process of relieving pressure on the HTF system was begun.

17:45 West field inlet and outlet manual isolation valves were closed. Loop isolation valves on the upper terrace in the release area were isolated.

17:55 West field midline header isolation valves were closed.

18:00 Mojave Desert AQMD notified of vapor cloud that was traveling west-southwest off of the facility.

18:05 Loop inlet isolation valve for row 52 closed, stopping the release.

18:15 San Bernardino County Fire Department Communications Center called regarding reports of a vapor cloud at our facility. The fire department was informed that the release was secured and that an estimated 300 to 400 gallons were spilled and contained on the facility. An engine company from Helendale was dispatched to take a report.

18:30 California Highway Patrol, Barstow Office called regarding the release. They were informed that the release was secured and that an estimated 300 to 400 gallons were spilled and contained on the facility. The Highway

Patrol informed us that they had closed Highway 58 due to the vapor cloud. We reiterated that the release was secured and confined to our facility and they reopened Highway 58. An MSDS for the HTF was requested and furnished to the Highway Patrol. San Bernardino County Fire Department Engine Co. 4 arrived on site and were given full access to the spill area. They were also provided with an MSDS for the HTF.

20:00 Kern County Fire Department, Boron Station called reporting numerous reports to their agency of a noxious smell emitting from the direction of our facility. They informed us that they had made notification to the Kern County Fire Department HazMat Department.

22:00 Kern County HazMat called regarding the release. Site personnel discussed the properties of the HTF and how it related to the release. An MSDS was requested and sent to them.

October 22, 2005

13:15 Called the National Response Center to report the release. Site was provided with the report number of 777129. At this time the volume released was reported as 7,000 gallons. Original estimate had been done under low light conditions and looking at soil that was still very wet from rains that had occurred earlier in the week.

13:20 Called California Office of Emergency Services to report the release. Site was provided with the state control number of 05-6119.

13:36 Received a call from US Environmental Protection Agency Region 9 inquiring about any state or county personnel on site and the name of the responding officer.

13:38 Called California Energy Commission to report the release. Left a voice mail with the necessary information.

13:44 Called the Regional Water Quality Control Board to report the release. Left a voice mail with the necessary information.

13:56 Called the US Environmental Protection Agency to supply them with the requested information regarding responding officer.

14:10 Called the Mojave Desert AQMD to provide updated information regarding the release.

October 24, 2005

10:00 Kern County Fire Department Engine Co. 17 paid a visit to the facility and was given a tour of the spill area and the bioremediation facility.

Spill Clean-up

Recovery of the free-standing HTF began October 21st as soon as the release was secured. Since the soil was wet from the rain the HTF was not soaking into the ground to the extent it would on dry soil. A vacuum truck and portable evacuation trailers were used to skim the HTF off of the ground. This process continued around the clock. By Monday October 24th 7,700 gallons of HTF had been recovered and transported to the HTF filtration facility for storage and filtration.

Removal of the HTF contaminated soil began on Monday October 24th once all of the HTF liquid had been removed. The contaminated soil lies within an irregular shaped area measuring an average width of 30 feet and 418 feet long. The clean-up process has continued around the clock with approximately 200 yards of dirt moved per day through Monday, October 31st. As of Monday October 31st 950 yards of contaminated soil have been placed in the bioremediation facility and 650 yards have been placed in the landfarm facility. Currently we are

cleaning up localized contaminated areas in the spill area. Soil from this clean-up will be placed in the landfarm facility.

Soil sampling of the spill area, bioremediation facility and landfarm will be conducted November 2nd to ensure the spill area has been completely cleaned up and the bioremediation process can begin.

Currently our plans are to bioremediate all contaminated soil from this release on site. As space becomes available in the bioremediation facility soil will be moved from the landfarm to the bioremediation facility until all contaminated soil has been bioremediated. A timeline for the completion of bioremediation can not be established at this time due to the variability of the bioremediation process.

A final determination of the spill volume based on HTF levels in the SEGS III system prior to and following the incident and the volume of recovered HTF places the volume at 9,900 gallons.

Corrective action and countermeasures

Analysis of the components involved in the release revealed that the ball joint at 52G north was installed on March 17, 1999 to replace a ruptured flex hose. The two HCEs adjoining the ball joint (5N and 6N) were original Luz HCEs installed in 1986. The omega bracket which secures the ball joint/HCE to the collector assembly was found on the ground in the full deploy position. No hardware was recovered from the site (most likely disturbed during the initial clean-up activities).

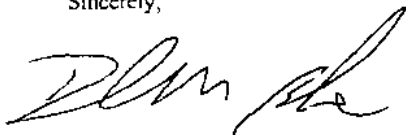
Examination of the omega bracket indicated that one of the 1/4 " bolts separated from the omega bracket allowing the omega bracket to distort and the last remaining bolt broke or worked loose allowing the support structure to separate from the ball joint and HCEs. When the collector assembly was positioned back to the east at the end of the tracking day at 17:13 the 6N HCE was bent at an acute angle causing it to separate at the weld to the 5N HCE.

Immediate corrective action has been to replace the affected HCEs and install new attachment hardware. Refresher training on solar field surveillance procedures was conducted with all solar field technicians with an emphasis on hardware inspection.

Long term countermeasures include the evaluation of replacing the existing attachment hardware consisting of a standard nut with lockwasher with a self-locking nut with lockwasher to improve the reliability of the attachment assembly. Evaluation of the omega bracket and the ball joint support designs will be conducted to explore any possibilities for reliability improvements.

If you have any questions, please contact Glen King at (760) 762-3100x231 or call me at (760) 762-5562x395.

Sincerely,



Dan Brake
Plant General Manager
Agent for Luz Solar Partners III, Ltd.

cc:
CEC - Steve Munro
SBCFD Haz. Mat. Div.
file

Attachment 4

COUNTY FIRE DEPARTMENT



COUNTY OF SAN BERNARDINO
ECONOMIC DEVELOPMENT
AND PUBLIC SERVICES GROUP

OFFICE OF THE FIRE MARSHAL
HAZARDOUS MATERIALS DIVISION
FIELD SERVICES • ENVIRONMENTAL PROTECTION
620 South "E" Street • San Bernardino, CA 92415-0153
(909) 387-4801 • Fax (909) 387-8460

PETER R. HILLS
Fire Chief
County Fire Warden

NOTICE OF VIOLATION

Violator's Name FPL Energy (Luz Solar Partners) Date 10/25/05
Mailing Address 41100 Hwy 395 Fac. Id# FA0006102
Boron CA (Kamer Jctn) APN N/A

An investigation/inspection at FPL Energy (Luz Solar Partners)
was made on 10/25, 2005. Based on conditions witnessed by the Inspector/Investigator:

THE FOLLOWING VIOLATIONS EXIST:

Calif. H&S Code § 25507(a) Failure to notify the administering
agency immediately upon discovery of a release of hazardous material.

YOU ARE HEREBY ORDERED TO COMPLY by:

Submit a comprehensive report of the occurrences that caused the
release, outline the events of the release, and the remediation process
of the release and outcome. Submit documentation for hazardous
waste tested (if any) and analytical testing thereof. Submit within 15
days of release. Notify Verbally & in writing for Active releases.
A full inspection report will be submitted to your facility in the near future.

YOU MUST COME INTO COMPLIANCE WITH THE ABOVE ORDER WITHIN 11 days OF RECEIPT OF NOTICE.

FAILURE TO COMPLY WITH ORDER MAY RESULT IN LEGAL ACTION.

If you have any questions, contact investigator at (909) 386- 8430 Monday-Friday, 8:00 a.m.-9:00 a.m.

ISSUED BY Zeigler

RECEIVED BY [Signature] 25 OCT 2005



GOVERNOR'S OFFICE OF EMERGENCY SERVICES

Hazardous Materials Spill Report

DATE: 10/22/2005 TIME: 1319	RECEIVED BY:	CONTROL#: OES - 05-6119 NRC - 777129
--	---------------------	---

1.a. PERSON NOTIFYING GOVERNOR'S OES:

1. NAME: 2. AGENCY: 3. PHONE#: 4. Ext: 5. PAG/CELL:
Luz Solar Partners #3

1.b. PERSON REPORTING SPILL (If different from above):

1. NAME: 2. AGENCY: 3. PHONE#: 4. Ext: 5. PAG/CELL:

2. SUBSTANCE TYPE:

2. a. SUBSTANCE:	b.QTY:>=<	Amount	Measure	c. TYPE:	d. OTHER:
1. VP 1 (heat transfer fluid)	=	7,000	Gal(s)	CHEMICAL	
2.	=				
3.	=				

e. DESCRIPTION: Equipment failure caused rupture allowing release.

f. CONTAINED:	g. WATER INVOLVED:	h. WATERWAY:	i. DRINKING WATER IMPACTED
Yes	No		

3. a. INCIDENT LOCATION: 41100 Hwy. 395

b. CITY: c. COUNTY: d. ZIP:
Boron San Bernardino County 93516

4. INCIDENT DESCRIPTION:

a. DATE: 10/21/2005 b. TIME (Military): 1710 c. SITE: Industrial Plant
d. INJURIES# e. FATALS #: f. EVACS #: g. CLEANUP BY:
0 0 0 Reporting Party

6. NOTIFICATION INFORMATION:

a. ON SCENE:	b. OTHER ON SCENE:	c. OTHER NOTIFIED:
		San Bernardino Co. FD, Mojave Desert AQMD

d. ADMIN. AGENCY: Kern Co. Environmental Health Services Dept e. SEC. AGENCY:

f. NOTIFICATION LIST: DOG Unit: RWQCB Unit: 6B

AA/CUPA, DFG-OSPR, DTSC, RWQCB, US EPA, USEWS
***** Control No: 05-6119 *****

Created by: Warning Center on: 10/22/2005 01:19:57 PM Last Modified by: Warning Center on: 10/22/2005 01:25:52 PM

SAN BERNARDINO COUNTY FIRE DEPARTMENT**SOURCE - FACILITY RELEASE REPORT**

SITE LOCATION: 41100 HWY 395, BORON

RECORD ID: C00011204

RELATED ID:

ACCOUNT ID: AR0006101

FACILITY INFO

FACILITY: FA0006102

FACILITY NAME: SEGS III-VII

FACILITY ADDRESS: 41100 HWY 395

CITY: BORON

STATE: CA

ZIP: 935160000

CONTACT**COMPLAINT**

COMPLAINANT: LEE/S.B. CO FD HELENDALE STN

ADDRESS:

CITY:

COUNTRY: USA

STATE:

ZIP:

WORK PHONE: 760-245-5022

EXT:

HOME PHONE:

EXT:

FAX:

EMAIL ADDRESS:

DISPOSITION

RECEIVED BY: GAIL BECKHAM

RECEIVED DATE: 10/21/2005

RECEIVED TIME: 19:53:00

ASSIGNED TO: RONNIE BROMBERG

ASSIGNED DATE: 10/28/2005

ASSIGNED TIME:

STATUS: CLOSED

PROGRAM ELEMENT:

INFORMATION**PROPERTY INFO**

PROP NAME:

BUS NAME: SEGS III-VI

ADDRESS: 41100 HWY 395

2nd ADDRESS:

CITY: BORON

STATE: CA

ZIP:

COUNTRY: USA

PHONE 1: Not Specified

EXT:

OWNER'S INFO

OWNER NAME: SEGS III-VI

BUSINESS NAME:

ADDRESS: 41100 HWY 395

2ND ADDRESS:

CITY: BORON

STATE: CA

ZIP:

HOME PHONE:

EXT:

WORK PHONE:

EXT:

LOCATION**LOCATION**

CENSUS:

DISTRICT:

LOCATION:

CITY CODE:

JURISDICTION:

PROPERTY TYPE:

INSPECTION CODE:

APN:

ER INFO (UDF)

OES NUMBER:

HOURS: 4

INCIDENT TYPE: RELEASE/ FACILITY RELATED

ENVIRONMENT TYPE: FACILITY SITE

REFERRAL AGENCY: DISTRICT ATTORNEY

REFERRAL DATE:

HAULER'S NAME:

NUMBER HOSPITALIZED:

CHEMICAL INFO 1: THERMINOL VP1 HEAT TRANSF. FLUID

CHEMICAL INFO:

AGENCY NOTIFICATION: Y

DRUG LAB:

E/R TEAM RESPONDED: Y

RESPONDING AGENCY 1: S.B. CO. FD HAZMAT
RESPONDING AGENCY 2:

REPONDER 1: GAIL BECKHAM

REPONDER 2: GREG ZEIGLER

REPONDER 3:

REPONDER 4:

RELEASED ☒ CONTAINED ☐ REMOVED ☐**SUSPECT**

PARTY NAME: UNKNOWN

DOB:

COMPANY NAME: SEGS III-VI

PHONE:

EXT:

ADDRESS: 41100 HWY 395

LICENSE NUMBER:

BORON, CA

INSPECTED/RESOLVED

EMPLOYEE: RONNIE BROMBERG

RESOLVE DATE: 10/28/2005

REQUIRES FURTHER ACTION ☐

PERMIT INFORMATION
PERMITS CURRENT? YES or NO

RECORD ID	PE	PERMIT STATUS	ISSUANCE STATUS	FROM DATE	TO DATE
PT0003457	GENERATOR - 51-100 EMPLOYEES	ACTIVE		8/1/2005	7/31/2006
PT0003458	HAZMAT HANDLER 51-100 EMPLOYEES (W/GEN PRMT)	ACTIVE		8/1/2005	7/31/2006
PT0011071	UST OWNERSHIP/OPERATING PERMIT (PER UST)	ACTIVE		8/1/2005	7/31/2006
PT0011072	UST OWNERSHIP/OPERATING PERMIT (PER UST)	ACTIVE		8/1/2005	7/31/2006
PT0011073	UST OWNERSHIP/OPERATING PERMIT (PER UST)	ACTIVE		8/1/2005	7/31/2006
PT0011074	UST OWNERSHIP/OPERATING PERMIT (PER UST)	INACTIVE		8/1/2003	7/31/2004

COMPLAINT DESCRIPTION: HELENDALE FD CALLED TO NOTIFY A RELEASE OF 300-350 GALS OF THERMINOL AT ONE OF THE SEGS AT THE FPL FACILITY

BLUE BOOK COMMENT

ENTERED BY: SANDRA NICHOLAS

ENTERED DATE: 10/28/2005

UPDATED BY:

UPDATED DATE:

ENGINE CO. OUT OF HELENDALE (SBCOFD) CALLED AND PAGED US TO NOTIFY THAT THEY HAD BEEN DISPATCHED TO A RELEASE OF WHAT WAS REPORTED TO THEM AS 300-350 GALLONS OF THERMINOL AT ONE OF THE SEGS AT THE FPL FACILITY. THEY STATED THEY WERE TOLD THAT THE RELEASE WAS CAUSED BY A MALFUNCTION OF ONE OF THE KNUCKLE UNITS ON THE MIRROR SYSTEM, CAUSING DAMAGE TO THE PIPING SYSTEM. THERE WERE NO INJURIES TO CLEANUP WOULD BE DONE BY ON SITE PERSONNEL. CONTACT WAS MIKE ROBERTSON (760) 953-1458 OF FPL. DUE TO THE FACT THAT THE INCINET SOUNDED RATHER MINOR, HM 523 DECIDED THAT RESPONSE WAS NOT NECESSARY AT THAT TIME. NOTE: THEN ENGINE CO. MADE THIS NOTIFICATION, THE FACILITY MADE NO NOTIFICATION. A FOLLOWUP CHECK ON 10/24/05 WITH OES REVEALED THAT THE RELEASE WAS REPORTED TO THEM AS 7000 GALLONS OF THERMINOL. A FACILITY VISIT TO STRAIGHTEN OUT THE ACTUAL QUANTITY RELEASED WAS REQUIRED. 10/15/05, ON SITE, IT WAS VERIFIED THAT

~7000 GALLONS WAS ACTUALLY RELEASED AND THAT IT HAD CREATED A CLOUD OVER HWY 58, CAUSING THE CHP TO SHUT DOWN THE HWY FOR A PERIOD OF TIME. ON 10/21/05, REMEDIATION/SOIL SAMPLING WAS TAKING PLACE TO BE POSSIBLY TREATED ON SITE (SOIL BIOREMEDIATION). FPL REPRESENTATIVES, GLEN KING (ENVIRONMENTAL CONTACT) AND MIKE ROBERSON (OPERATIONS COACH & ERT CHEIF) WERE INTERVIEWED AS TO WHY NO NOTIFICATION WAS MADE. THEY BOTH STATED THAT THEY WERE UNAWARE OF THE REQUIREMENT TO NOTIFY THE ADMINISTERING AGENCY IMMEDIATELY UPON DISCOVER OF A RELEASE. A SITE INSPECTION WAS CONDUCTED TO VERIFY COMPLIANCE WITH OTHER HAZARDOUS MATERIAL LAWS & REGULATIONS. AN NOV WAS ISSUED ON SITE THAT DAY FOR THE FAILURE TO NOTIFY.



San Bernardino County Fire Department

11204

Emergency Response Form

FACILITY INFO

FACILITY ID: FA0006102
FACILITY NAME: FPL - Luz Solar Partners
FACILITY ADDRESS: _____
CITY: _____ STATE: _____ ZIP: _____

CONTACT

COMPLAINT

COMPLAINANT / ER: Lee (SBC FD Helendale Sta.)
ADDRESS: _____

CITY: _____
COUNTRY: _____ STATE: _____ ZIP: _____
WORK PHONE: (760) 245-5022 EXT: _____
HOME PHONE: _____ EXT: _____
FAX: _____
EMAIL ADDRESS: _____

INFORMATION

PROPERTY INFO

PROP NAME/REP: _____
BUS NAME: FPL (Luz Solar Partners)
ADDRESS: 41100 Hwy 395
2nd ADDRESS: _____
CITY: BORON STATE: CA ZIP: 93516
COUNTRY: _____
PHONE: (760) 762-5562 EXT: _____

LOCATION

LOCATION

CENSUS: _____
DISTRICT (Inspector): _____
LOCATION (Supervisory): _____
CITY CODE: _____

ER INFO (UDF)

OES NUMBER: 05-6119 HOURS: _____
INCIDENT TYPE: FACILITY RELEASE
ENVIRONMENT TYPE: Facility Site
NUMBER HOSPITALIZED: N/A
HAULER'S NAME: N/A

COST RECOVERY

E/R TEAM RESPONDED

DRUG LAB

AGENCY NOTIFICATION

RESPONDER 1: Zeigler
RESPONDER 2: _____
RESPONDER 3: _____
RESPONDER 4: _____

REFERRAL AGENCY: _____ REFERRAL DATE: _____

RESPONDING AGENCY 1: SBC FD

RESPONDING AGENCY 2: _____

CHEMICAL INFO 1: Therminol VP1 Heat Transfer Fluid

CHEMICAL INFO 2: _____

SUSPECT

PARTY NAME: Accidental Release DOB: _____
COMPANY NAME: FPL PHONE: _____ EXT: _____
ADDRESS: _____
CITY: _____ STATE: _____ ZIP: _____ LICENSE NUMBER: _____

INSPECTED/RESOLVED

EMPLOYEE: _____ RESOLVE DATE: _____ REQUIRES FURTHER ACTION ☐

Attachment 5



CUPA

San Bernardino County Fire Department • Hazardous Materials Division
620 South 'E' Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

RECYCLABLE MATERIALS REPORT - PAGE 1
FOR EXCLUDED OR EXEMPTED MATERIALS ONLY

Page 1 of 2

FACILITY ID #	3	6	0	0	1	0	0	6	1	0	2	1	EPA ID #	CAL000301046
BUSINESS NAME (Same as FACILITY NAME or DBA) Luz Solar Partners III - VII														
BUSINESS ADDRESS 41100 Highway 395											CITY Boron		ZIP CODE 93516	
DATES OF REPORTING PERIOD				BEGINNING DATE 1/1/2004				500		ENDING DATE 12/31/2005		501		

I. TYPE OF RECYCLING ACTIVITIES*If yes, please follow instructions.*

1. Do you recycle more than 100 kg/month of excluded or exempted recyclable material at the same location at which the material was generated (onsite recycling)?	☒ YES ☐ NO 502	☒ If YES, you are both the generator and recycler. Complete one Recyclable Materials Report. Do not complete Parts II and V.
2. Do you recycle more than 100 kg/month of non-manifested, excluded recyclable materials received from an offsite location (offsite recycling)?	☐ YES ☐ NO 503	☒ If YES, you are an offsite recycler but not the generator. Complete a Recyclable Materials Report for each generator that sends you materials.

– Businesses that only send recyclable materials to an offsite recycler are not required to file this report. –

II. OFFSITE GENERATOR OF RECYCLABLE MATERIAL*Only complete when the generator is different from the recycler.*

OFFSITE GENERATOR OF RECYCLABLE MATERIAL	504	OFFSITE GENERATOR EPA ID #	505
STREET ADDRESS	506	PHONE	507
CITY	508	STATE	509
MAILING ADDRESS (IF DIFFERENT)	510	ZIP CODE	511
CITY	512	STATE	513
		ZIP CODE	514

III. CERTIFICATION SECTION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete.

SIGNATURE OF CERTIFIER 	DATE 1/30/06	515	NAME OF DOCUMENT PREPARER Glen T. King	516
NAME OF SIGNER (print) Dan Brake	517	TITLE OF SIGNER Plant General Manager	518	

**CUPA**

San Bernardino County Fire Department • Hazardous Materials Division
620 South 'E' Street, San Bernardino, CA 92415-0153 • (909) 386-8401 FAX (909) 386-8460

RECYCLABLE MATERIALS REPORT - PAGE 2
FOR EXCLUDED OR EXEMPTED MATERIALS ONLY

(One description per material recycled. Attach additional pages, if needed.)

TOTAL NUMBER OF RECYCLABLE MATERIALS 1

519

Page 2 of 2

FACILITY ID #	3	6	0	0	1	0	0	6	1	0	2	1	BUSINESS NAME (Same as FACILITY NAME or DBA)	Luz Solar Partners III - VII	3
FACILITY ADDRESS													CITY	ZIP CODE	
41100 Highway 395													Boron	93516	

IV. RECYCLABLE MATERIAL INFORMATION
A. DESCRIPTION

RECYCLABLE MATERIAL NUMBER	520	COMMON NAME OF RECYCLABLE MATERIAL	521	QUANTITY DURING TWO YEAR REPORTING PERIOD	522	UNITS	☒ a. Gallons	☐ c. Tons	523
001		Therminol VP-1		15,000		☐ b. Pounds	☐ d. Kilograms		

RECYCLABLE MATERIAL DESCRIPTION	524
Heat transfer fluid	

RECYCLING PROCESS AND BENEFICIAL USE OF RECYCLABLE MATERIAL	525
Filtration to remove dirt and water from fluid. Filtered material returned to heat collection system to be used for electrical power generation.	

AUTHORIZING PROVISION OF HSC SECTION 25143.2	526	BASIS FOR CLAIM TO AN EXCLUSION OR EXEMPTION	527
25143.2 (d)(1)		The material is a non-RCRA waste that is recycled and used at the facility where it was generated.	

B. PRODUCT AND CONSTITUENT INFORMATION: OFFSITE ONLY

Only complete if recyclable material was used to make or substitute for a product and operating pursuant to CHSC Section 25143.2(b) or (d)(5) or (6).

HAZARDOUS CONSTITUENT	HAZARDOUS CONSTITUENT		LIST FINAL PRODUCT(S) MADE FROM THIS RECYCLABLE MATERIAL AND BENEFICIAL USE OF FINAL PRODUCT(S)
	Concentration In Recyclable Material	Concentration In Final Product	
1	528	529	533
	UNITS ☐ a. percent ☐ b. ppm	UNITS ☐ a. percent ☐ b. ppm	
2	534	535	538
	UNITS ☐ a. percent ☐ b. ppm	UNITS ☐ a. percent ☐ b. ppm	
3	540	541	545
	UNITS ☐ a. percent ☐ b. ppm	UNITS ☐ a. percent ☐ b. ppm	
4	545	547	551
	UNITS ☐ a. percent ☐ b. ppm	UNITS ☐ a. percent ☐ b. ppm	

If more than four constituents are recycled, attach additional sheets using this same format.

V. DOCUMENTATION OF KNOWN MARKET (Offsite recyclers only.)

- ☐ DOCUMENTATION IS ATTACHED: Offsite recyclers must attach documentation that there was a known market for disposition of the recyclable material and any products manufactured from the recyclable material and provide a copy of this report to the Generator when the report is submitted to the CUPA. (HSC Section 25143.10(a)(3)(A).)

STATE OF CALIFORNIA
California Energy Commission

In the Matter of:

The Application for Certification
for the BEACON SOLAR ENERGY
PROJECT

Docket No. 08-AFC-2

REBUTTAL TESTIMONY OF MICHAEL BIAS
ON BEHALF OF CALIFORNIA UNIONS FOR RELIABLE ENERGY
ON BIOLOGICAL RESOURCES
FOR THE BEACON SOLAR ENERGY PROJECT

March 8, 2010

Tanya A. Gulesserian
Marc D. Joseph
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080
(650) 589-1660 Voice
(650) 589-5062 Facsimile
tgulesserian@adamsbroadwell.com
mdjoseph@adamsbroadwell.com

Attorneys for the CALIFORNIA
UNIONS FOR RELIABLE ENERGY

Introduction

I began working with the California Unions for Reliable Energy (CURE) as a consultant on the Beacon Solar Energy Project (Project) during the data adequacy phase on the Application for Certification (AFC). I have reviewed numerous documents and conducted my own investigations regarding the Project's impacts to the environment, specifically special-status wildlife and plants.

My testimony is based on the activities described above and knowledge and experience I have acquired working in the field of habitat, population, and wetland ecology since the early 1980s. A summary of my education and professional experience is attached to this testimony.

Evidence of Inadequacies of the Final Staff Assessment (FSA) to Adequately Evaluate and Mitigate Project Impacts to Special Status Wildlife

Mohave Ground Squirrel

The Mohave ground squirrel (*Spermophilus mohavensis*) is listed as Threatened under the California Endangered Species Act. California Energy Commission staff concluded that most of the 2,012-acre project site is not likely to be inhabited by the Mohave ground squirrel.¹ Staff arrived at this conclusion even though protocol-level surveys for Mohave ground squirrels were not conducted.²

The California Department of Fish and Game (CDFG) requires that protocol level surveys be conducted on proposed project sites that support desert scrub vegetation and that are within or adjacent to the Mohave ground squirrel geographic range.³ Protocol level surveys for Mohave ground squirrels consist of systematic visual surveys and up to three 5-day trapping periods.⁴ A survey is not necessary when a project proponent prefers to assume that the Mohave ground squirrel is present on the project site and applies for a California Endangered Species Act incidental-take permit (Fish and Game Code Section 2081b) requiring mitigation and compensation.⁵ The Project meets the criteria for requiring protocol level surveys; because the Project site has 429.5 acres of desert scrub vegetation type⁶ and is within the squirrel's geographic range.⁷

Despite meeting CDFG criteria for protocol level surveys, presence of Mohave ground squirrels on the Project site was based on two 1-day site visits to assess habitat during August and October 2007 by Dr. Philip Leitner.⁸ Through this assessment, Leitner concluded most of the Project site

¹ FSA, p. 4.2-35.

² FSA, p. 4.2-18.

³ CDFG. 2003. Mohave ground squirrel survey guidelines. California Department of Fish and Game, Sacramento, CA.

⁴ *Id*

⁵ *Id*

⁶ FSA, p. 4.2-9.

⁷ Leitner, P. 2008. Current status of the Mohave ground squirrel. Transactions of The Wildlife Society 44:11-29.

⁸ FAS, Appendix F, Attachment E, Mohave ground squirrel habitat assessment, December 21, 2007.

is unsuitable for Mohave ground squirrels, including the entire portion of the site located east of State Route 14.⁹ However, Leitner derived these conclusions without any scientific rigor; that is, the methods cannot be repeated by another scientist attempting to assess Mojave ground squirrel habitat on the Project site. Lacking any repeatability, the habitat assessment represents solely the opinion of Leitner's idea of what Mojave ground squirrels need to survive. Leitner provided three bases for reaching his conclusion, which is set forth in the Application for Incidental Take of Threatened and Endangered Species for the Project:

- food resources;
- demographic evidence; and,
- trapping data.¹⁰

The following discourse provides additional information related to Leitner's habitat assessment and the subsequent information presented by the applicant to the California Energy Commission.

BASIS #1: Food Resources

Leitner's first discusses that the Project site does not provide the food resources necessary to support Mohave ground squirrels. In the habitat assessment he conducted for the Project, he stated "According to the best dietary information available, Mohave ground squirrels require forage from a variety of native shrub and herbaceous species to sustain them through their active season (Leitner and Leitner 1998, 2008)." ¹¹

Leitner cites himself as the "best dietary information available;" however, several food habits studies have been conducted on the Mohave ground squirrel. Recht (1977) reported that the species of plant selected by the squirrel at any one time generally had higher water content than other available plants and, except for *Lycium*, were more abundant.¹² Further, Recht (1977) described the Mohave ground squirrel as a facultative specialist, specializing in a food resource for a short period of time but changes from one to another throughout the season.¹³ Zembal and Gall (1980) showed that Mohave ground squirrels preferred seeds from Joshua trees when available.¹⁴

In 1988 and 1989, Leitner and Leitner conducted a study at four sites in the Coso area of Inyo

⁹ *Id*

¹⁰ Beacon Solar Energy Project, Application for Incidental Take of Threatened and Endangered Species, Attachment 2; Philip Leitner, 2008 Memorandum.

¹¹ *Id*

¹² Recht, M.A. 1977. The biology of the Mohave ground squirrel, *Spermophilus mohavensis*. Ph.D. Dissert. Univ. Calif. Los Angeles. 117pp. In: Gustafson, J.R., State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County's petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

¹³ *Id*

¹⁴ Zembal, R. and C. Gall. 1980. Observations on Mohave ground squirrels, , in Inyo County, California. J. Mammal. 61(2):347-350. In: Gustafson, J.R. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County's petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

County. During the study they collected fecal samples from live-traps in which Mohave ground squirrels had been captured. On all four of the study sites, individual fecal samples tended to be dominated by a single food item.¹⁵ This led the Leitners to conclude that “[f]ood habits results and vegetation sampling indicated that MGS [Mohave ground squirrel] utilize available resources flexibly, foraging on both common and uncommon plant materials.” In addition, Gustafson (1993) reviewed numerous studies of food habits of the Mohave ground squirrel and concluded the studies have “shown that the species may follow a pattern of specialization on single food items or a pattern of individual preference...[a]bundance and water content of food items appeared to be the most important factors in food selection.”¹⁶ Thus, Leitner’s conclusion that “Mohave ground squirrels require forage from a variety of native shrub and herbaceous species to sustain them through their active season”¹⁷ is not consistent with other work on food habits of Mohave ground squirrels.

Leitner then discusses that the Project site lacks food resources for Mohave ground squirrels. Leitner reports:

“Mohave ground squirrels will eat saltbush foliage and are also known to consume small amounts of two non-native herbs: red-stemmed filaree (*Erodium cicutarium*) and Mediterranean grass (*Schismus arabicus*). These three plant species are present in the Fallow Agricultural-Disturbed Atriplex Scrub found on the Plant Site. However, there is no evidence that Mohave ground squirrels can maintain themselves on a diet made up of only these plants.”¹⁸

However, this statement is misleading as no food trial studies have ever been conducted to test the hypothesis this idea.

Gustafson (1993) summarized the results of Leitner and Leitners’ 1988 Mohave ground squirrel food habits study. At Leitners’ study site “2” the foliage of *Schismus arabicus* was a notable individual item in the diet.¹⁹ At study site “4”, Leitner and Leitner (1989) reported “boxthorn seed and saltbush (*Atriplex* sp.) leaves were also significant items in the diet here.”²⁰ However, *Schismus arabicus* and *Atriplex* sp. are two of the three plants Leitner claims **cannot** maintain Mohave ground squirrels at the Project site.

Further, Leitner’s Project habitat assessment states “[I]n a nine-year study of 754 fecal samples collected at four sites in the Coso Range of Inyo County, there was not a single case in which the diet consisted of only one or any combination of these three food items.”²¹ However, Leitner’s statement is misleading, as there were no (or very few) cases in which the diet consisted of only one food item of any type (at least between 1988 and 1991, as reported by Gustafson).²² In other words, in nine years of study, Leitner found no squirrels that consumed only one diet

¹⁵ See Gustafson. 1993.

¹⁶ *Id.*

¹⁷ *Id.*

¹⁸ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

¹⁹ See Gustafson J.R. 1993.

²⁰ *Id.*

²¹ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

²² Gustafson J.R. 1993.

item.

The Project habitat assessment then states “[c]reosote bush and scale-broom, the two shrubs found along the northern portion of the desert wash, are known to have toxic foliage. They are rarely eaten by herbivores, generally only during drought conditions when there is no other forage. Mohave ground squirrels will take small amounts of creosote bush foliage, as well as the seeds, but again this is totally inadequate to sustain them.”²³ This statement is misleading in that it seems to suggest that creosote bush and scale-broom are the only two plant species in the northern portion of the wash, and thus the wash lacks food resources. However, creosote bush and scale-broom may have been the only two *shrub* species Leitner observed during the limited amount of time he spent at the site. This is important because, in addition to shrubs, Mohave ground squirrels not only eat, but appear to prefer (a) the leaves of forbs and grasses; (b) fruits and flowers of forbs; (c) seeds of forbs, grasses, and Joshua trees; (d) fungi; and (e) arthropods.²⁴ According to the methods he reported, Leitner did not survey for any of these food resources at the Project site.^{25 26} Leitner also failed to report the potential of creosote bush and scale-broom as a food resource to Mohave ground squirrels, as evidenced by his own data.

In 1991, Leitner and Leitner again collected fecal samples from their Coso study sites. They reported “[t]he two most important food items were arthropod parts and *Opuntia* (beavertail and/or cholla cactus) seed, which together made up 70-85 percent of the relative density of each sample.”²⁷ These results were observed even though forb leaves and seeds were abundant at the sites when fecal samples were collected (i.e., squirrels were selecting arthropods and cactus over forbs).²⁸ Other researchers, and Leitner (during other years of his study), observed similar results with forbs and fruits (i.e., they constituted a large part of the diet). Therefore, Leitner’s conclusion that Mohave ground squirrels require forage from a variety of plant species seems to contradict his conclusion that squirrels could not occur within the wash because only creosote bush and scale-broom occur there. Specifically, Leitner’s own data do not support the conclusions that the Project site provides insufficient food resources to support Mohave ground squirrels.

Leitner’s statement regarding creosote bush and scale-broom is further misleading in that it implies the toxic foliage of these shrubs prevents herbivory and will only be eaten under starvation conditions. To protect against desiccation from being damaged, most desert plant have either physical or chemical defenses.²⁹ Although I am unaware of any studies that specifically have tested the effects of toxic plants on Mohave ground squirrels, most desert herbivores have adapted ways to combat a plant’s chemical defenses. These include having a relatively simple gut or consumption of only small amounts of many different (and often toxic)

²³ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

²⁴ Gustafson J.R. 1993.

²⁵ AFC, Appendix F, Attachment E, Mohave Ground Squirrel Habitat Assessment, December 21, 2007.

²⁶ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

²⁷ Gustafson JR, State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County’s petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

²⁸ *Id.*

²⁹ Willmer P, G Stone, IA Johnston. 2000. Environmental physiology of animals. Malden, MA: Blackwell Science.

foods.³⁰ Additionally, Leitner did not report that one of the fecal samples he collected in 1988 contained 45% creosote bush.

BASIS #2: Demographics

Leitner and the applicant state “demographic evidence supports the position that this type of vegetative cover [*Atriplex* scrub] is not suitable Mohave ground squirrel habitat, in that it is not capable of supporting a resident population.”³¹ Leitner then references (but does not cite) his Coso Grazing Exclosure Monitoring Study.³² Of his four Coso study sites, one was unique in that it was almost entirely composed of saltbush (*Atriplex* sp.).³³ Leitner states this *Atriplex*-dominated site was the only one of the four study sites that did not support a permanent Mohave ground squirrel population.³⁴ Specifically, he states that in 1988 only transient juveniles were captured at the site. Then, no Mohave ground squirrels were captured at the site over the next four years. However, from 1993-1996 a “few” adult Mohave ground squirrels were resident, but they were found only in a small area on the northeastern edge of the study site where the shrub diversity was highest and a few individual shrubs of species known to be important in the diet were found.³⁵

Many studies, such as the one referenced by Leitner, simply describe a particular physical state or phenomenon in time. Such studies may provide excellent descriptions³⁶ and often cursory correlations, but lack scientific rigor in that they do not test hypotheses or repeatable. Furthermore, careful consideration of the information Leitner presents would suggest his data contradict his point. In particular, the Coso study site that he states “never supported Mohave ground squirrels” was actually confirmed to have squirrels in five of the nine years of the study (albeit only juveniles were captured in 1988). Although Leitner never defined what a “resident” population consists of, some would interpret that occupancy during five of nine years is an indication of residency, especially for a rare species that is notoriously difficult to capture.³⁷

The demographic evidence that Leitner references in his Project habitat assessment does not appear in open literature (i.e., readily available), but in one or more technical reports. Technical reports are often flawed in that they (a) fail to properly cite previous studies, particularly when contrary to the conclusions or recommendations being made in the report; (b) make recommendations that are untested or unwarranted; and, (c) have not been peer reviewed.³⁸ I do not know if the reports referenced by Leitner contain one or more of these flaws because I was

³⁰ *Id.*

³¹ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

³² *Id.*

³³ *Id.*

³⁴ *Id.*

³⁵ *Id.*

³⁶ For a discussion on the types and sources of data: See Boarman WI. 2002. Threats to Desert Tortoise Populations: A Critical Review of the Literature. U.S. Geological Survey, Western Ecological Research Center. Sacramento (CA): 86 p.

³⁷ Gustafson JR, State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County’s petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

³⁸ *Id.*

unable to locate the reports. However, I was able to obtain some information from Gustafson (1993), who summarized the first four years of the study presented in Leitner's reports.

Based on Gustafson's description, the *Atriplex*-dominated site referenced by Leitner is named Site 1 ("Rose Valley").³⁹ While it appears to be true that Dr. Leitner did not capture squirrels at Site 1 from 1989 to 1991, he neglected to mention that in 1991 he did not capture squirrels at Site 4 either. He also neglected to mention that the "few" squirrels he captured at Site 1 in previous years were comparable in number to the "few" squirrels he caught at the other sites during previous years of his study.

Observational studies, such as the one conducted by Leitner, often have problems.⁴⁰ These include lack of adequate controls, insufficient sample sizes, or researcher bias in study design or interpretation.⁴¹ Leitner's study appeared to be plagued by all three of these problems. Specifically, his sample sizes were "very small";⁴² he had inconsistent and unequal sampling effort among sites and years; and his study was designed to examine the "treatment" of grazing enclosures (i.e., not vegetation types).⁴³

Finally, the applicant and Leitner have implied that the Project site's lack of winterfat (*Krascheninnikovia lanata*) and/or spiny hopsage (*Grayia spinosa*) further preclude the presence of Mohave ground squirrels.^{44 45} This presumption is not supported by the literature. Both Aardahl and Roush (1985) and Wessman (1977) had multiple study sites that were dominated by *Atriplex*, lacked winterfat and spiny hopsage, and had known occurrences of Mohave ground squirrels.^{46 47}

BASIS #3: Trapping Data

Leitner's final basis for concluding that the Project site is unsuitable for Mohave ground squirrels

³⁹ See p. 71 of Gustafson JR, State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County's petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

⁴⁰ See Boarman WI. 2002. Threats to Desert Tortoise Populations: A Critical Review of the Literature. U.S. Geological Survey, Western Ecological Research Center. Sacramento (CA): 86 p.

⁴¹ *Id.*

⁴² Gustafson JR, State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County's petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

⁴³ See *Id.*

⁴⁴ See AFC, Appendix F, Attachment E: Phil Leitner 2007 Memorandum.

⁴⁵ AFC, Incidental Take Permit Application, p. 27.

⁴⁶ Aardahl JB, P Roush. 1985. Distribution, relative density, habitat preference and seasonal activity levels of the Mohave Ground Squirrel (*Spermophilus mohavensis*) and Antelope Ground Squirrel (*Ammospermophilus leucurus*) in the western Mohave Desert, California. US Bur. of Land Manage. Rep., Calif. Desert Dist., Riverside (CA). See Appendix M of Bureau of Land Management. 2005. Final environmental impact report and statement for the West Mohave plan: a habitat conservation plan and California desert conservation area plan amendment. Moreno Valley (CA): U.S. Dept. of the Interior, Bureau of Land Management, California Desert District.

⁴⁷ Wessman EV. 1977. The distribution and habitat preferences of the Mohave ground squirrel in the southeastern portion of its range, Calif. Fish Game, Wildl. Manage. Branch. Admin. Rep. 77-5.

is that protocol trapping data support the position that monotypic stands of saltbush scrub similar to what occurs on the Project site are not likely to be occupied by Mohave ground squirrels.⁴⁸ This evidence is based on anecdotal trapping survey data provided by two other biologists who conducted trapping, but did not capture Mohave ground squirrels, at six different locations in Los Angeles and San Bernardino counties.⁴⁹ The “evidence” presented by Leitner is misleading. After reviewing records of 1,140 trapping sessions conducted over a 10-year period from 1998-2007, Leitner published a paper in which he concluded “[m]ost protocol surveys carried out in recent years have not resulted in detection of the species.”⁵⁰ Further, because no quantitative descriptors of the habitat variables were given – either for the Project site or the sites that the other researchers had trapped – we are left to believe that all sites were the same.

The California Department of Fish and Game (CDFG) requires trapping surveys at proposed development sites according to a prescribed protocol.⁵¹ As a result, the majority of the protocol trapping efforts that have been conducted in Los Angeles and San Bernardino counties have been south of State Route 58.⁵² In spite of very intensive sampling in this area, Mohave ground squirrels have been detected in only two locations. If the six trapping locations used by Leitner as evidence were south of State Route 58, one would expect that most trapping efforts south of State Route 58 failed to capture Mohave ground squirrels.

Mohave ground squirrels are difficult to capture even in locations where they are known to occur.⁵³ This phenomenon has been reported by numerous biologists including Laabs and Allaback (1991); Rempel and Clark (1990); and biologists associated with CDFG.⁵⁴ However, Leitner summarized the constraints associated with trapping data, when he published a paper that stated:

“[w]hen regional surveys or protocol trapping fail to detect Mohave ground squirrels, it is important to keep in mind that this in itself cannot be used as evidence⁵⁵ that the species is absent or that the area does not provide habitat for the species. There are a number of other circumstances that could result in lack of captures, such as locating a trapping grid in a small patch of marginal or unsuitable habitat, abundance of natural foods that reduce the attractiveness of the bait, low population density due to a series of dry years, or trapping early in the season before juveniles begin their dispersal movements. If trapping grids are not randomly sited, it is not valid to infer from a lack of captures at the grid sites that

⁴⁸ AFC, Incidental Take Permit Application, Attachment 2: Philip Leitner, 2008 Memorandum.

⁴⁹ *Id.*

⁵⁰ Leitner P. 2008. Current status of the Mohave ground squirrel. Transactions of the Western Section of the Wildlife Society 44:11-29.

⁵¹ CDFG. 2003. Mohave ground squirrel survey guidelines. California Department of Fish and Game, Sacramento, CA.

⁵² Leitner P. 2008. Current status of the Mohave ground squirrel. Transactions of the Western Section of the Wildlife Society 44:11-29.

⁵³ Gustafson JR, State of California, Department of Fish and Game. 1993. A status review of the Mohave ground squirrel (*Spermophilus mohavensis*). A report to the California Fish and Game Commission in response to Kern County’s petition to delist the Mohave ground squirrel as a Threatened Species. Nongame Bird and Mammal Section Report 93-9.

⁵⁴ *See Id.*

⁵⁵ Emphasis added.

Mohave ground squirrels are absent in the surrounding habitat. Any conclusions would apply only to the grid sites themselves. In general, the most that can be concluded from lack of captures is that the negative results provide no evidence that the species is present.”⁵⁶

Therefore, Leitner’s conclusion that protocol trapping data support the position that monotypic stands of saltbush scrub similar to what occurs on the Project site are not likely to be occupied by Mohave ground squirrels is unsupported.

Site Surveys

The California Natural Diversity Database contains nine records of Mohave ground squirrel occurrence within 16 km (10 mi) of the Project site. As such, Leitner’s conclusion that the majority of the site does not provide habitat for the species is primarily based on his field assessment. This assessment was conducted during “two field visits to the project site and surrounding habitat.”⁵⁷ During Leitner’s first visit (10 Aug 2007), he “surveyed the entire site east of State Route 14 [2,012 acres plus areas adjoining the project site to the north, east, and south] by driving dirt access roads and walking through select areas.”⁵⁸ During that time he focused on species composition and physical structure of vegetation, soil conditions, and evidence of rodent activity.⁵⁹ Based on my experience, it is unreasonable to think that 2,012 acres can be systematically surveyed in a single day while trying to document vegetation, soils, and evidence of rodent activity.

Evidence of inadequacies of the Final Staff Assessment (FSA) to Adequately Evaluate and Mitigate Project Impacts from the Rosamond and California City Recycled Water Pipeline Alternatives

17.6-Mile Natural Gas Pipeline Alignment of Rosamond and California City Recycled Water Pipeline Alternatives

Biological Resources Appendix A of the FSA describes the vegetation and wildlife resources occurring along the southern 23 miles of the 39.61-mile Rosamond Alternative water pipeline alignment. The Appendix cites that the biological resources of the northern 17.6-mile segment of the pipeline alignment were not addressed in Appendix A because they have already been assessed as part of the Project under the previously proposed natural-gas pipeline.⁶⁰ I reviewed the FSA and found no Commission Staff analysis of biological resource impacts from

⁵⁶ Leitner P. 2008. Current status of the Mohave ground squirrel. Transactions of the Western Section of the Wildlife Society 44:11-29.

⁵⁷ AFC, Appendix F, Attachment E: Phil Leitner 2007 Memorandum.

⁵⁸ Dr. Leitner reportedly spent his second visit west of State Route 14. See AFC, Appendix F, Attachment E: Phil Leitner 2007 Memorandum.

⁵⁹ *Id.*

⁶⁰ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. 4.2-127.

construction or operation of the California City water pipeline alternative described in FSA⁶¹, which was assessed as part of the Project under the previously proposed natural-gas pipeline. However, the referenced biological resource assessment was not conducted by CEC Staff and only consisted of the following:

“A natural gas pipeline will be constructed from California City to the solar block along California City Boulevard, Neuralia Road, and an existing dirt road that accesses the eastern edge of the plant site. This approximately 17.6-mile pipeline will occur entirely within the disturbed and developed shoulders of the existing roads and will avoid native habitat. Approximately 60.0 acres of disturbed habitat will be temporarily disturbed for the natural gas pipeline.”⁶²

A preliminary evaluation of the proposed 17.6-mile natural gas pipeline was performed by car on November 13, 2007 by EDAW biologist Lyndon Quon for the Project applicant. During this survey, the width of the right-of-way (road shoulder) and surrounding vegetation was noted.⁶³ This 2007 driving survey was apparently the only special-status plant and wildlife survey conducted along the 17.6 mile natural gas pipeline alignment. Although the 17.6-mile pipeline alignment transects habitats known for the Mohave desert tortoise, the western burrowing owl, and the Mohave ground squirrel, no surveys – protocol-level or otherwise – were conducted for these species along the pipeline alignment.^{64 65 66} As such, no analysis of impacts or mitigation for any project impacts was prepared.

Further, although the FSA lists several special-status plant species (e.g., CNPS 1B) that have moderate to high potential to occur along the 17.6-mile natural gas pipeline alignment⁶⁷, no special-status plant surveys were conducted.

23-Mile Alignment of Rosamond Recycled Water Pipeline Alternatives

As with the 17.6-mile pipeline alignment, the remaining 23-mile alignment also transects habitats known for the Mohave desert tortoise, the western burrowing owl, and the Mohave ground squirrel. However, no protocol-level surveys were conducted for these species along the pipeline alignment.^{68 69 70} Instead,

⁶¹ FSA, Alternatives, pp. 6-1 to 6-20 and appendices.

⁶² Beacon Solar Energy Project Biological Technical Report, p. 55.

⁶³ Beacon Solar Energy Project Biological Technical Report, p. 19.

⁶⁴ See U.S. Fish and Wildlife Service (USFWS). 1992. Field Survey Protocol for Any Non-Federal Action That May Occur within the Range of the Desert Tortoise.

⁶⁵ See California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. April 1993.

⁶⁶ CDFG. 2003. Mohave ground squirrel survey guidelines. California Department of Fish and Game, Sacramento, CA.

⁶⁷ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. 4.2-147-150.

⁶⁸ See U.S. Fish and Wildlife Service (USFWS). 1992. Field Survey Protocol for Any Non-Federal Action That May Occur within the Range of the Desert Tortoise.

⁶⁹ See California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. April 1993.

“Wildlife biologist Richard Anderson conducted a habitat assessment for desert tortoise (*Gopherus agassizii*) and Mohave ground squirrel (*Spermophilus mohavensis*) and other special status wildlife species on July 19 and 20, 2009. This wildlife reconnaissance survey was conducted during daylight and consisted of slowly driving the route several times, and included the same 2000-ft wide, 23-mile long Study Area described above. The biologist stopped often and investigated the surrounding area on foot. During these driving surveys the biologist observed and documented wildlife and habitat quality. Habitat quality was documented out to 1000 feet on either side of the pipeline alignment.”⁷¹

The applicant’s Biological Technical Report provides a description of project-related impacts to vegetation communities and special status plant and wildlife species may be either directly or indirectly impacted by a project. Direct and indirect impacts may be either permanent or temporary in nature, and need to be mitigated accordingly. These impact categories are defined below.⁷²

- Direct: Any alteration, disturbance, or destruction of biological resources that would result from Project-related activities is considered a direct impact. Examples include clearing vegetation, encroaching into wetlands, diverting natural surface water flows, and the loss of individual species and/or their habitats.⁷³
- Indirect: As a result of Project-related activities, biological resources may also be affected in a manner that is not direct. Examples include elevated noise and dust levels, soil compaction, increased human activity, decreased water quality, and the introduction of invasive wildlife (domestic cats and dogs) and plants.⁷⁴
- Permanent: All impacts that result in the long-term or irreversible removal of biological resources are considered permanent. Examples include constructing a building or permanent road on an area containing biological resources.⁷⁵
- Temporary: Any impacts considered to have reversible effects on biological resources can be viewed as temporary. Examples include the generation of fugitive dust during construction; or removing vegetation for underground pipeline trenching activities and either allowing the natural vegetation to recolonize or actively revegetating the impact area. Surface disturbance that removes vegetation and disturbs the soil is considered a long-term temporary impact because of

⁷⁰ CDFG. 2003. Mohave ground squirrel survey guidelines. California Department of Fish and Game, Sacramento, CA.

⁷¹ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. 4.2-128.

⁷² Beacon Solar Energy Project Biological Technical Report, p. 51.

⁷³ *Id.*

⁷⁴ *Id.*

⁷⁵ *Id.*

slow natural recovery in arid ecosystems. Therefore, all such impacts in the survey area are considered permanent.⁷⁶

Impacts to special-status wildlife species were assessed along the 23-mile portion of the Rosamond alignment based on wildlife habitat quality rated in the field as poor, fair, good or excellent with the focus on desert tortoise and Mohave ground squirrel habitat requirements. It was assumed that habitat suitable for desert tortoises was suitable for Mohave ground squirrels. It was additionally assumed that some habitat too fragmented for desert tortoises could be viable Mohave ground squirrel habitat. Polygons of each habitat category within the Study Area were mapped in the field on high resolution digital orthophotos. The habitat polygons delineated in the field were digitized with ArcGIS Desktop 9.3.1, and acreages of each habitat category impacted by the Rosamond pipeline were calculated ArcMap toolbox, as described above.⁷⁷

Although the Rosamond pipeline alignment study area encompasses 5,987 acres⁷⁸, project impact to plant communities was estimated only to be 92.36 acres.⁷⁹ This calculation incorporates only direct construction impacts to plant communities and does not incorporate any temporary or indirect project impacts (as described above) to desert tortoise, Mohave ground squirrel, or burrowing owls. Thus calculation greatly underestimates Project impacts to these special-status wildlife species because the calculation is based solely on the construction footprint and not on the indirect impacts of the project, which may extend beyond 1,000 feet from the construction.⁸⁰

As with the 17.6-mile natural gas pipeline alignment, the FSA lists several special-status plant species (e.g., CNPS 1B) that have moderate to high potential to occur along the Rosamond alignment.⁸¹ However, no special-status plant surveys were conducted. Instead, due to survey timing, many annual and perennial herbs encountered could not be identified to the species level, or to a level necessary to detect rare plant taxa, if present. Therefore, special-status plant assessment along the Rosamond alignment was limited to an assessment of the habitat suitability for special-status species with known occurrences in the west Mohave region.⁸² From this general assessment, the FSA concluded that “No federal-listed [plant] species have the potential to occur within the Study Area.”⁸³ This was a spurious conclusion, as it was made without appropriately-timed surveys. Because rare plants are often only identifiable and detectable on a particular site at certain times of the year, i.e., following early spring rain events, appropriately-

⁷⁶ *Id.*

⁷⁷ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. 4.2-129.

⁷⁸ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. Table 1. p. 4.2-136.

⁷⁹ *Id.* Table 4. p.4.2-156.

⁸⁰ See U.S. Fish and Wildlife Service (USFWS). 1992. Field Survey Protocol for Any Non-Federal Action That May Occur within the Range of the Desert Tortoise.

⁸¹ Final Staff Assessment, Beacon Solar Energy Project, Application for Certification, Biological Resources Appendix A. 4.2-147-150.

⁸² *Id.* 4.2-130.

⁸³ *Id.* 4.2-146.

timed surveys for rare plants are critical to assess occurrence. If surveys are not conducted at proper times of the year for a specific plant, presence may not be detected.

Conclusions

Neither the applicant nor Staff conducted protocol or other surveys to evaluate presence and index abundance of Mohave ground squirrels on the Project site, the transmission line corridor, along the pipeline routes, or in areas where other direct, indirect and cumulative impacts may occur. Occurrence of Mohave ground squirrels on the Project site was assessed based on the opinion of a Mohave ground squirrel researcher and not on repeatable and, hence, verifiable scientific methods. As such, evaluating the conclusions of this researcher and actually determining if Mohave ground squirrels do occur or not occur on the Project site can still only be assessed through properly-timed protocol-level surveys. Since these surveys have not been conducted, the applicant's conclusions have not been verified. Thus, Staff's conclusions are not based on scientific evidence.

Additionally, protocol-level special-status plant and wildlife surveys were not conducted at all along the 17.6-mile natural gas pipeline alignment of the Rosamond water pipeline alternative. As such, any project-related impacts to these species cannot be assessed.

Lastly, protocol-level special-status plant and wildlife surveys were not conducted along the 23-mile Rosamond pipeline alignment. Instead, presence was erroneously assessed through untested correlation with habitat assessments conducted in the field. As such, proposed compensation for project-related impacts to Mohave ground squirrels, desert tortoise, and burrowing owls is grossly underestimated. Further, project-related impacts could not be evaluated at all for rare plants because presence was evaluated without appropriately-timed surveys.

Without valid level plant and wildlife species surveys, accurate and scientifically-sound compensation for project-related impacts to the environment from the Project will not be realized. As presented, the FSA fails to comply with major components of the California Endangered Species Act as well as the federal Endangered Species Act.

DECLARATION OF
MICHAEL BIAS

I, Michael Bias, declare as follows:

1. I am President and Principal Ecologist of Ecosystem Restoration Sciences, Inc.
2. I hold a Doctorate degree in Wildland Resources Science. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.
4. I prepared the testimony attached hereto and incorporated herein by reference relating to the biological resource impacts of the Beacon Solar Energy Project.
5. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.
5. I am personally familiar with the facts and conclusions related in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: BMAR 10

Signed: Michael A Bias

At: TWIN BRIDGES, MT

DECLARATION OF
MICHAEL BIAS

I, Michael Bias, declare as follows:

1. I am President and Principal Ecologist of Ecosystem Restoration Sciences, Inc.
2. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.
3. I am adopting the testimony of Scott Cashen on biological resources for the Beacon Solar Energy Project based on my independent analysis and my professional experience and knowledge.
4. It is my professional opinion that the prepared testimony is valid and accurate with respect to the issue(s) addressed therein.
5. I am personally familiar with the facts and conclusions related in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 5 MARCH 10

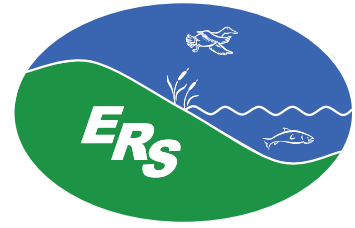
Signed: 

At: TWIN BRIDGES, MT.

MICHAEL A. BIAS

Principal Ecologist

Ecosystem Restoration Sciences, Inc.
PO Box 177
Twin Bridges, MT 59754
406-925-2276



Michael Bias, Ph.D. serves as President and Principal Ecologist of Ecosystem Restoration Sciences, Inc. Dr. Bias is currently serving as the Executive Director for the Big Hole River Foundation, Inc., based out of Butte, Montana. Dr. Bias has extensive experience with State and Federal Threatened and Endangered species, waterfowl, and wetlands restoration. His professional expertise includes wildlife habitat and population ecology. He has published papers on spotted owl ecology, wetlands, and ecological restoration in *The Journal of Wildlife Management*, *Journal of Raptor Research*, *Southwestern Naturalist*, and *Transactions of the Western Section of the Wildlife Society*.

Education

Ph.D. Wildland Resource Science, May 1994. Dissertation title: Ecology of the salt marsh harvest mouse in San Pablo Bay.

Department of Forestry and Resource Science, University of California, Berkeley, CA.

M.S. Wildlife Management, May 1989. Thesis title: Habitat use by California spotted owls in the central Sierra Nevada.

Department of Wildlife, Humboldt State University, Arcata, CA.

B.S. Wildlife Science, May 1984, Unity College, Unity, ME.

Publications

Bias, M.A. and M.L. Morrison. 2006. Habitat selection of the salt marsh harvest mouse and sympatric rodent species. *Journal of Wildlife Management* 70(3):732-742.

Hulst, M.D., L.S. Hall, M.L. Morrison, and M.A. Bias. 2001. Assessing salt marsh harvest mouse movements during high tides, San Pablo Bay, California. *Transactions of the Western Section of the Wildlife Society* 37:88-89.

Bias, M.A. and M.L. Morrison. 1999. Movements and home range of salt marsh harvest mice. *The Southwestern Naturalist* 44(3): 348-353.

_____ and J.M. Payne. 1997. Agriculture and wildlife in California's Central Valley: mutually exclusive or win-win? p.47-57. in: J. Schaack and S.S. Anderson, eds. *Water for Agriculture and Wildlife and the*

Environment, Win-Win Opportunities. Proceedings from the 1996 USCID wetlands seminar. Bismarck, ND, June 27-29, 1996. U.S. Committee on Irrigation and Drainage. Denver, CO. 323pp.

_____ and _____. 1996. Integrating wildlife habitat into agricultural enterprises. 3pp. in: Proceedings of the 48th Annual Conference of the California Weed Science Society. California Weed Science Society, Fremont, CA.

Payne, J.M., M.A. Bias, and R.G. Kempka. 1996. VALLEY CARE: Bringing conservation and agriculture together in California's Central Valley. p.79-88. in: W. Lockeretz, ed. 1996. Environmental Enhancement Through Agriculture: Proceedings of a Conference. Tufts University, Boston, MA. 343pp.

Bias, M.A., N.L. Breuner, and M.L. Morrison. 1992. House mice as indicators of marking effects on salt marsh harvest mice. Transactions of the Western Section of The Wildlife Society 28:34-37.

_____ and R.J. Gutierrez. 1992. Habitat associations of California spotted owls in the central Sierra Nevada. Journal of Wildlife Management 56:584-595.

Thraillkill, J. and M.A. Bias. 1989. Diets of breeding and nonbreeding California spotted owls. Journal of Raptor Research 23(2):39-41.

Grants

CALFED Bay-Delta Program, Ecological monitoring of the Tolay Creek and Cullinan Ranch tidal wetland restoration projects in the north San Francisco Bay, 2001, Grant funds \$593,931.

North American Wetlands Conservation Act, Suisun Marsh: Lower Joice Island acquisition and Enhancement, California, 2000, Grant funds \$660,000.

North American Wetlands Conservation Act, San Pablo Bay Tidal Wetlands Habitat Restoration Project, California, 1999, Grant funds \$997,300.

CALFED Bay-Delta Program, Cullinan Ranch Tidal Marsh Restoration Project, 1998, Grant funds \$368,500.

CALFED Bay-Delta Program, Tolay Creek Restoration Project, 1998, Grant funds \$283,000.

Central Valley Project Improvement Act (b) (22), A proposal for Ducks Unlimited's Valley CARE Program to administer CVPIA (b) (22) funds in the Central Valley, 1998, Grant funds \$682,970.

California Wildlife Conservation Board - Inland Wetlands Program, Suisun Marsh Waterfowl Production Enhancement Project, 1998, Grant funds \$120,000.

North American Wetlands Conservation Act, Suisun Marsh: Enhancement and Restoration, 1997, Grant funds \$999,940.

Central Valley Project Improvement Act (b) (22), A proposal for Ducks Unlimited's Valley CARE Program to administer CVPIA (b) (22) funds in the Central Valley, 1997, Grant funds \$582,791.

North American Wetlands Conservation Act, Grasslands Ecological Area: Enhancement and Restoration, 1996, Grant funds \$1,434,174.

National Fish and Wildlife Foundation, VALLEY CARE III: Wetlands and Farming, 1996, Grant funds \$200,000.

Other Publications

Bias, M.A. 2008. Indigenous Big Hole grayling denied protection. Northwest Flyfishing. March/April 2008. 10(2): 30-31.

_____. 2001. Ecology and conservation of the salt marsh harvest mouse. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 8pp.

_____. 1997. Ecology and conservation of the chinook salmon in the Central Valley. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 12pp.

_____, M.A. Wolder, and P.E. Schmidt. 1997. Disturbance as a component of waterfowl habitat quality. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 12pp.

Wrysiniski, J.E., J.D. Garr, and M.A. Bias. 1995. Rice straw decomposition and development of seasonal waterbird habitat on rice fields. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 8pp.

Harrell, W.C., S.F. Burton, and M.A. Bias. 1995. Enhancing agricultural fields for waterfowl. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 8pp.

Bias, M.A. 1995. Wildlife resources of the Central Valley, California: important wetland-associated mammals. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 8pp.

Burton, S.F., M.A. Bias, and S.E. Staelgraeve. 1995. Livestock grazing for wetland and waterfowl management. Valley Habitats: A Technical Guidance Series for Private Land Managers in California's Central Valley. Ducks Unlimited, Sacramento, CA. 8pp.

Presentations

Anderson, M.L., K. Owens, and M.A. Bias. 2008. Rural stakeholders and Arctic grayling (*Thymallus arcticus*) management in the Big Hole River Watershed, Montana, USA. Oral presentation at the 5th World Fisheries Congress, held October 20-24, 2008 in Yokohama, Japan.

Bias, M.A. 2008. Perspectives on not listing the fluvial Arctic grayling. Ennis Fly Fishing Festival. Madison River Foundation. August 2008.

_____. 2008. Perspectives on not listing the fluvial Arctic grayling. Arctic Grayling Recovery Group, Annual Meeting. March 2008.

_____. 2007. The Big Hole River: can fly fishing, conservation, and agriculture coexist? Federation of Flyfishers 2007 International Fly Fishing Show & Conclave Livingston Montana, July 31 - August 4

_____, Woo, I., J. Y. Takekawa, S. Demers, and G. T. Downard . 2003. EFFECT OF TIDAL MARSH RESTORATION ON SALT MARSH HARVEST MICE: THE NEED FOR INDICES OF HABITAT QUALITY. Calfed Bay Delta Science Conference. January. Sacramento, CA.

Woo, I., J. Y. Takekawa, M.A. Bias, S. Demers, G. T. Downard, and F.A. Reid . 2003. TIDAL MARSH RESTORATION: TRANSITIONAL HABITATS AND AVIAN RESPONSE TO MUDFLAT FORMATION ON TOLAY CREEK, SAN PABLO BAY. Calfed Bay Delta Science Conference. January. Sacramento, CA.

Emerson, S.J., M.A. Bias, G.T. Downard, and J.Y. Takekawa. 2001. Biophysical Monitoring of a Tidal Salt Marsh Rehabilitation in the San Francisco Pablo Bay Estuary. Society of Wetland Scientists Annual Meeting. May. Chicago, IL.

Downard, G.T., J.Y. Takekawa, M.A. Bias, S.J.Emerson, and L. Vicencio. 2000. Biophysical Monitoring of Wetland Restoration and Rehabilitation Projects in San Pablo Bay. Calfed Bay Delta Science Conference. 3-5 October. Sacramento, CA.

Hulst, M., L.S. Hall, M.L. Morrison, and M.A. Bias. 2000. Salt marsh harvest mouse (*Reithrodontomys raviventris*) habitat use at San Pablo Bay, California. 2000 Annual Conference. The Wildlife Society Western Section. Riverside, CA. January.

Bias, M.A., R.E. Laird, J.Y. Takekawa, M. Eagan, M. Hulst, and L. Vicencio. 1999. Easier said than done: Lessons learned from a tidal restoration in San Pablo Bay. Society for Ecological Restoration. San Francisco, CA. September.

Bias, M.A. 1999. Habitat type conversion and the recovery of the salt marsh harvest mouse. The Wildlife Society - Western Section Annual Conference. Monterey, CA. 21-23 January 1999.

_____ and H. Andree. 1999. Evaluating newsletter and technical guidance publications using reader surveys. The Wildlife Society - Western Section Annual Conference. Monterey, CA. 21-23 January 1999.

Schmidt, P.E., J.D.Garr, J.H. Hobbs, and M.A. Bias. 1999. Monitoring of waterbirds on flooded post-harvest small grain fields in California's Central Valley. The Wildlife Society - Western Section Annual Conference. Monterey, CA. 21-23 January 1999.

Hobbs, J.H., and M.A. Bias. 1999. Monitoring waterbird response to restored and enhanced wetlands. The Wildlife Society - Western Section Annual Conference. Monterey, CA. 21-23 January 1999.

Reid, F.A., R.G. Kempka, M.A. Bias, J.E. Hill, S.M. Brouder, G. Wylie, and J.H. Day. 1997. Assessing the challenge for waterfowl habitat in the rice landscape of the Sacramento Valley. First North American Duck Symposium. Baton Rouge, LA. 12-16 February 1997.

Bias, M.A. and T. R. Underwood. 1996. Phragmites control in the Suisun Marsh. 1996 California Department of Fish and Game Pesticide Applicators Seminar. Fish Camp, CA. March 1996.

_____. 1996. Using agricultural land for wildlife habitat. 1996 California Department of Fish and Game Pesticide Applicators Seminar. Fish Camp, CA. March 1996.

_____ and J.M. Payne. 1996. Integrating wildlife habitat into agricultural enterprises. 48th Annual Conference of the California Weed Science Society. Sacramento, CA.

Payne, J.M., M.A. Bias, and R.G. Kempka. 1995. VALLEY CARE: Bringing conservation and agriculture together in California's Central Valley. Conference on Environmental Enhancement Through Agriculture. Tufts University, Boston, MA.

Bias, M.A. 1995. Effects of winter flooding on waterfowl harvest. California Department of Fish and Game - U.S. Fish and Wildlife Service Coordination Meeting. Sacramento, CA. May 1995.

_____ and J. Day. 1995. Wildlife use of flooded rice fields. Western Aquatic Plant Management Society, 14th Annual Meeting. March 1995.

_____. 1995. The effects of non-native vegetation on waterfowl. 1995 California Department of Fish and Game Pesticide Applicators Seminar. Modesto, CA. March 1995.

_____, W.C. Harrell, J.D. Garr, S.F. Burton, and J.M. Payne. 1995. Ducks Unlimited in the Central Valley: more than ducks. The Wildlife Society - Western Section Annual Conference. Rohnert Park, CA. February 1995.

_____. 1995. Ecology of the Sacramento-San Joaquin Delta. Twelfth Annual California Farm Conference. Sacramento, CA. February 1995.

_____ and J. Takekawa. 1995. Salt marsh harvest mouse on Mare Island. From Top Secret to Top Attraction: Conference on Mare Island's Natural and Cultural Attractions. Mare Island Naval Shipyard, Vallejo, CA. February 1995.

_____. 1995. How to avoid trouble: wetland habitats. Annual Conference of the California Farm Water Coalition, Sacramento, CA. January 1995.

_____ and M.L. Morrison. 1992. Movements of salt marsh harvest mice determined from radio telemetry. American Society of Mammalogists, Seventy-second Annual Meeting. Salt Lake City, UT. June 1992.

_____, N.L. Breuner, and M.L. Morrison. 1992. House mice as indicators of marking effects on salt marsh harvest mice. The Wildlife Society - Western Section Annual Conference. San Diego, CA. February 1992.

_____, M.L. Morrison, and S.D. Kovach. 1991. Ecology of the salt marsh harvest mouse on Mare Island, Vallejo, California. The Wildlife Society - Western Section Annual Conference. Sacramento, CA. February 1991.

_____. 1989. Call response behavior of the California spotted owl in the central Sierra Nevada. Cooper Ornithological Society, 59th Annual Meeting. Moscow, ID. June 1989.

_____ and R.J. Gutierrez. 1987. Population ecology of the California spotted owl in the central Sierra Nevada. 105th Stated Meeting of the American Ornithologists' Union. San Francisco, CA. August 1987.

Professional Experience

Executive Director. Started with the Big Hole River Foundation, Inc. out of Butte, Montana as Executive Director in March 2006. Responsible for project management and delivery, client and agency liaison, technical support, preparation of proposals and contracts, marketing, and preparation of reports.
Big Hole River Foundation, Inc. 03/06-present.

Principal Ecologist. Founded Ecosystem Restoration Sciences in May 2001. Responsible for project management and delivery, client and agency liaison, technical support, preparation of proposals and contracts, marketing, and preparation of environmental documents.
Ecosystem Restoration Sciences, Inc. 06/01-present.

Principal Ecologist. Founded the Center for Wildlands Ecology in January 2006. Responsible for research projects, management, preparation of proposals and contracts, and preparation of scientific reports and papers.
Center for Wildlands Ecology, Inc. 06/01-08/08.

Senior Restoration Ecologist. Responsible for project management, client and agency liaison, technical support, preparation of proposals and contracts, marketing, and preparation of environmental documents.
ECORP Consulting, Inc. 06/99-06/01.

Adjunct Professor. Serve on graduate committees and direct graduate students on wetland and wildlife ecology aspects of their research. Lecture on wetland and wildlife ecology.
Department of Biological Sciences, California State University, Sacramento. 09/98-present.

Regional Biologist II/Special Projects Coordinator. Under the newly expanded Valley/Bay CARE Program, became responsible for coordinating, managing, and delivering larger habitat development projects for Valley/Bay CARE, those in excess of \$100,000 or involving multiple partners. Coordinated and directed the monitoring and evaluation efforts of habitat development projects in the Central Valley, Suisun Marsh, and San Francisco Bay area. Evaluations included biological review of proposals and projects, and development of protocols to evaluate ecosystem function response. Continued and expanded grant and report writing for the Valley/Bay CARE Program. Contributed to Valley/Bay CARE publications. Immediate supervisor to 1 Project Biologist and 3 temporary Biologists.

Ducks Unlimited, Inc. 08/98-06/99.

Regional Biologist II. Coordinated all aspects of Ducks Unlimited's Valley CARE Program. In 1996, the Program became integrated with Ducks Unlimited's traditional conservation program of wetland restoration and enhancement on public lands. During 1997, we intensified our efforts to include the San Francisco Bay area. Continued and expanded my role writing grants and reports for the Program. Responsible for developing, initiating, and delivering wetland enhancement and restoration projects throughout the Central Valley and Bay area. Responsible for producing "Valley Habitats," a technical guidance series for private land managers in California's Central Valley and our Valley CARE Newsletter. Immediate supervisor to 3 Project Biologists and up to 3 temporary Biologists.

Ducks Unlimited, Inc. 04/96-08/98.

Regional Biologist. Responsible for all field-related aspects of Valley CARE, Ducks Unlimited's private land program in California's Central Valley. Assist the Director of the Private Lands with administrative details of implementing Valley CARE, for example writing grants and reports. Responsible for developing, initiating, and delivering wetland enhancement and restoration projects throughout the Central Valley. Responsible for producing "Valley Habitats," a technical guidance series for private land managers in California's Central Valley. Responsible for familiarity with all water and fish related issues concerning Ducks Unlimited in California. Responsible for writing monthly articles for our Valley CARE newsletter. Immediate supervisor to 3 Project Biologists.

Ducks Unlimited, Inc. 03/94-04/96.

Project Leader. Ph.D. Dissertation work. Conducted a study to evaluate the effectiveness of wetland habitat improvement projects on the ecology of the salt marsh harvest mouse and other small mammals at Mare Island Naval Shipyard, Vallejo, California. Study primarily consisted of capture-recapture techniques to estimate demographic parameters and assess habitat use of salt marsh harvest mice. Extensive small mammal trapping, radio-telemetry, vegetation sampling, and data analysis skills were required. Research was funded by Mare Island Naval Shipyard. Supervised >10 persons. Responsible for quarterly and annual reports.

University of California, Berkeley, CA. 04/89-03/94.

Consulting Biologist. Conducted an Endangered Species survey to document presence of salt marsh harvest mice at Naval Security Group Activity, Skaggs Island, California.

Western Division Naval Facilities Engineering Command, San Bruno, CA. 08/90-09/90.

Graduate Student Instructor. Taught the discussion section of Wildlife Ecology (FRM170). Lectured on important topics covered in Lecture. Presented lectures when the professor was absent.

University of California, Berkeley, CA. 08/92-12/92.

Graduate Student Instructor. Taught two lab sections of North American Wildlife: Identification and Conservation (FRM171) each Fall semester. Lectured on identification and natural history of North American birds and mammals. Presented lectures when the professor was absent. Prepared and graded lab exams.

University of California, Berkeley, CA. 08/91-12/91, 08/92-12/92.

Consulting Biologist. Conducted an endangered species survey to obtain population estimates of the salt marsh harvest mice within three marshes at the mouth of San Rafael Canal, California.

BioSystems Analysis, Tiburon, CA. 08/90-09/90.

Wildlife Biologist. Located spotted owls using radio-telemetry techniques and entered location data into computers. Responsible for locating, capturing, banding, and attaching radio transmitters to northern spotted owls.

USDA - Forest Service, Redwood Science Laboratory, Arcata, CA. 10/88-4/89.

Wildlife Technician. Assisted a Ph.D. student from the University of California, Berkeley for one week on a vertebrate ecology study of oak woodlands. Conducted small mammal trapping and time-restraint searches for reptiles and amphibians.

University of California, Berkeley, Berkeley, CA. 9/88-9/88.

Project Leader. M.S. Thesis project. Designed and conducted a study of habitat use by California spotted owls in the central Sierra Nevada. Responsible for design of study, data collection and analysis, and publication of results. Job related skills included knowledge of vegetation sampling, multivariate analysis of data, and locating spotted owls, nests and young. Supervised 4 persons.

Research funded by the U.S. Forest Service, Pacific Southwest Forest and Range Experimental Station, Fresno, CA. 6/87-10/88.

Project Leader. Conducted a study to estimate specific demographic parameters of California spotted owls in the central Sierra Nevada. This study was conducted concurrently with the habitat study. Responsible for implementing the study design, data collection and analysis, and written reports and presentations. Job related skills included expertise in locating, capture and banding of spotted owls, livetrapping and handling of small mammals, and use of computer facilities for data analysis. Supervised 2 persons. *Research was funded by the California Department of Fish and Game, Sacramento, CA. 6/86-12/87.*

Instructor. Co-taught 4, 2-day intensive workshops on monitoring, survey, and capture techniques of spotted owls. Workshop participants were primarily federal and state agency personnel. Lectured on basic spotted owl ecology. Followed U.S. Forest Service spotted owl monitoring guidelines.

Natural Resources Institute, Humboldt State University, Arcata, CA. 4/86, 4/87.

Wildlife Technician. Worked at hunter check stations collecting white-tailed deer and black bear morphological data (sex, age, weight, antler measurements, and lactation). Was selected for the "search method" which required collecting data from hunting camps, meat cutters, and private residences. Responsible for state vehicles and property.

Maine Department of Inland Fisheries and Wildlife, Bangor, ME. 10/84-11/84.

Guide. Conducted tours through the Fort Peck hydroelectric facilities. Presented informative talks on all aspects of the hydroelectric facility and reservoir. Advised visitors on the rules of the recreation area.

U.S. Army Corps of Engineers, Ft. Peck, MT. 5/84-9/84.

Research Assistant. Collected vegetation data for a winter food habits and nutrition study of white-tailed deer. Determined winter food habits from plant epidermal cell identification in deer feces. Used the micro-Kjeldahl process for crude protein analysis of fecal material. Also was a teaching assistant for *Wildlife Techniques class (see below).*

Unity College, Unity, ME. 1/83-5/84.

Teaching Assistant. Prepared labs, field exercises, and tutored students in Wildlife Techniques class. Conducted and graded lab problem sets.
Unity College, Unity, ME. 9/82-12/82.

Hatchery Assistant. Prepared raceways for hatchery-reared landlocked salmon. Responsible for care and feeding of fish in hatchery and raceways. Assisted in stocking programs. Became familiar with relevant aspects of fish culture.
Casco Fish Hatchery, Casco, ME. 6/82-9/82.

Research Assistant. Collected white-tailed deer pellet groups for winter food habits and parasitic nematode analysis. Assisted with prescribed burns, collected pre- and post-burn soil samples.
Unity College, Unity, ME. 9/81-6/82.

Wildlife Technician. Sampled vegetation for a white-tailed deer wintering habitat study. Sampled vegetation along transect lines in two deer wintering areas. Used the collected data for my Senior Internship paper.
Maine Department of Inland Fisheries and Wildlife, Augusta, ME. 6/81-9/81.

Ecology Tutor. Was asked to tutor students in Ecology lab and lectures because of high academic achievement in this class during the previous semester. Corrected and graded lab problem sets.
Unity College, Unity, ME. 2/81-6/81.

Special Accomplishments

Referee for the Journal of Wildlife Management and The Wildlife Society Bulletin.
Inducted into the Choy Li Fut Kung Fu Federation, Jiang Men City, China, September 1998.
Black Sash, Eastern Ways Gung-Fu. December 1997.
Graduate: Dale Carnegie Course, October 1997.
Graduate: The Guide School, Clearwater House on Hat Creek, May 1997.
Completed U.S. Army Corps of Engineers Wetland Delineation Certification Training Program, September 1996.
Featured on the Discovery cable channel show "Invention" for my radio telemetry work on the salt marsh harvest mouse. First broadcast 11 November 1992.
Elvada Trautmann Estate Scholarship, 1986-1987.
Ida C. Koran Scholarship, academic achievement, 1983-1984.
Maine State Incentive Scholarship, 1983-1984.
President's Choice Scholarship, academic achievement, 1982-1983.
National Dean's List, 1981.

Volunteer And Other Work

Fly Fishing Guide. Self-employed as a fly fishing guide and outfitter. Guided clients in Montana and Idaho 1997-present.

Fly Fishing Guide/Instructor. Fly fishing guide for Hyde Outfitters, Idaho Falls, Idaho. Also, Entomology Instructor for Hyde Outfitters Guide School. May 2000 – September 2007.

Member. Acquisition and restoration committee, San Francisco Bay Joint Venture. 1998-2005.

Member. Implementation committee, San Francisco Bay Joint Venture. 1996-1998.

Member. Technical committee, Central Valley Habitat Joint Venture. 1996-1999.

Chairperson. Chair of the Agriculture and Wildlife Enhancement Committee (AWEC) for the Central Valley Habitat Joint Venture (CVHJV) for the North American Waterfowl Management Plan. 1996-1997.

Committee member. Worked on and assisted with several local Ducks Unlimited Chapter's fund-raising dinners. 1989-1995.

Volunteer. Assisted with various tasks at the Annual Meeting of the Cooper Ornithological Society, Sacramento, CA, 1993.

February 2010.

**BEACON SOLAR ENERGY PROJECT
(08-AFC-2)
FINAL STAFF ASSESSMENT**

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SOIL AND WATER RESOURCES

Casey Weaver, P.G., Vince Geronimo, P.E., John L. Fio, and Michael N. DiFilippo

SUMMARY OF CONCLUSIONS

As proposed, the project does not comply with all LORS and existing water policies. A summary of staff conclusions is presented below.

- Ownership of, and the potential for the Beacon Solar Energy Project (BSEP) to use, groundwater underlying the site is disputed and undetermined.
- The proposed use of high quality fresh groundwater for power plant cooling is in conflict with State Water Resources Control Board and Energy Commission policies.
- There is no compelling evidence that using the lowest quality water supply reasonably available (recycled wastewater produced by Rosamond Community Services District and/ or California City) would be environmentally undesirable or economically unsound.
- There is no compelling evidence that alternative cooling technologies (specifically dry cooling) would be environmentally undesirable or economically unsound.
- There is general uncertainty in hydrogeologic conditions and future groundwater levels. Modeling shows that under a conservative set of assumptions there is potential for significant drawdown that could impact nearby wells. Monitoring and mitigation for impacts should be required if the applicant is permitted to use groundwater for power plant cooling.
- The project site is bisected by a mapped FEMA Special Flood Hazard Area (SFHA). The applicant is proposing to construct a diversion channel to reroute the design discharge of 28,000 cubic feet per second around the project site and reduce flood impacts to less than significant levels. The project owner is required to follow the FEMA CLOMR/LOMR application process to remap the SFHA around the solar field.
- The diversion channel may require sediment removal to maintain channel capacity for the design discharge. Sediment removal and other maintenance activities should be the responsibility of BSEP in perpetuity.
- Implementation of Best Management Practices during BSEP construction in accordance with effective Storm Water Pollution Prevention Plans and a Drainage, Sedimentation and Erosion Control Plan would avoid significant adverse effects that could otherwise result in significant transport of sediments or contaminants from the site by wind or water erosion.
- The proposed use of a partial Zero-Liquid-Discharge system to recycle waste water is consistent with state water use and conservation policies.

INTRODUCTION

This section analyzes potential impacts to soil and water resources from the construction and operation of the Beacon Solar Energy (BSEP) project. The analysis specifically focuses on the potential for BSEP to:

- cause accelerated wind or water erosion and increased sedimentation;
- exacerbate flood hazards in the vicinity of the project;
- adversely affect surface or groundwater supplies;
- degrade surface water or groundwater quality; and
- comply with all applicable laws, ordinances, regulations, and standards (LORS) and state policies.

Where the potential for significant adverse impacts are identified, staff has proposed mitigation measures to reduce the significance of the impact, if possible, and has recommended conditions of certification.

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

The following federal, state, and local environmental Laws, Ordinances, Regulations, and Standards (LORS) are applicable to the BSEP. BSEP's compliance with LORS ensures the most appropriate use and management of both soil and water resources. The requirements of these LORS are intended to protect human health and the environment.

Soil & Water Table 1
Laws, Ordinances, Regulations, and Standards

Federal LORS	
Clean Water Act (33 U.S.C. Section 1251 et seq.)	The Clean Water Act (33 USC § 1257 et seq.) requires states to set standards to protect water quality, which includes regulation of storm water and wastewater discharges during construction and operation of a facility. California established its regulations to comply with the Clean Water Act under the Porter-Cologne Water Quality Control Act of 1967. The Clean Water Act also establishes protection of navigable waters through Section 401. Section 401 certification through the Army Corps of Engineers and Regional Water Quality Control Board (RWQCB) is required if there are potential impacts to surface waters of the State and/or Waters of the United States, such as perennial and ephemeral drainages, streams, washes, ponds, pools, and wetlands. Section 401 requires impacts to these waters to be quantified and mitigated.
Resource Conservation and Recovery Act	The Resource Conservation Recovery Act (RCRA) of 1976 (40 CFR Part 260 et seq.) seeks to prevent surface and groundwater contamination, sets guidelines for determining hazardous wastes, and identifies proper methods for handling and disposing of those wastes.
Title 44 of the Code of Federal Regulations (44 CFR) Part 65	44 CFR contains the basic policies and procedures of the Federal Emergency Management Agency (FEMA) for adoption of rules. Part 65 - Identification and mapping of special hazard areas requires development in areas identified as a FEMA Special Flood Hazard Area to meet the requirements of Title 44 of the Federal Code of Regulations (44CFR)
State LORS	
California Constitution, Article X, Section 2	This section requires that the water resources of the State be put to beneficial use to the fullest extent possible and states that the waste, unreasonable use or unreasonable method of use of water is prohibited.
The Porter-Cologne Water Quality Control Act of 1967, Water Code Sec 13000 et seq.	Requires the State Water Resources Control Board (SWRCB) and the nine RWQCBs to adopt water quality criteria to protect state waters. Those regulations require that the RWQCBs issue Waste Discharge Requirements specifying conditions for protection of water quality as applicable.
California Water Code (CWC) Section 13146	Requires that state offices, departments and boards in carrying out activities, which affect water quality, shall comply with state policy for water quality control unless otherwise directed or authorized by statute, in which case they shall indicate to the SWRCB in writing their authority for not complying with such policy.
California Water Code Section 13551	Requires the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare.

Recycling Act of 1991 (Water Code 13575 et. seq)	States that retail water suppliers, recycled water producers, and wholesalers should promote the substitution of recycled water for potable and imported water in order to maximize the appropriate cost-effective use of recycled water.
SWRCB Water Quality Order 99-08	The SWRCB regulates storm water discharges associated with construction projects affecting areas greater than or equal to 1 acre to protect state waters. Under Order 99-08, the SWRCB has issued a National Pollutant Discharge Elimination System (NPDES) General Permit for storm water discharges associated with construction activity for which applicants can qualify if they meet the criteria and upon preparing and implementing an acceptable SWPPP and notifying the SWRCB with a Notice of Intent.
California Code of Regulations, Title 22, Division 4, Chapter 15	This Chapter specifies Primary and Secondary Drinking Water Standards in terms of Maximum Contaminant Levels (MCLs). These MCLs include total dissolved solids (TDS) ranging from a recommended level of 500 milligrams per liter (mg/l), an upper level of 1,000 mg/l and a short term level of 1,500 mg/l. Other water quality MCLs are also specified, in addition to MCLS specified for heavy metals and chemical compounds.
California Code of Regulations, Title 23, Division 3, Chapter 15	This Chapter requires the Regional Board to issue Waste Discharge Requirements specifying conditions for protection of water quality as applicable.
California Code of Regulations, Title 23, Division 3, Chapter 30	This Chapter requires the submission of analytical test results and other monitoring information electronically over the internet to the SWRCB's Geotracker data base.
California Water Code Section 13260	Requires filing with the appropriate Regional Board a report of waste discharge that could affect the water quality of the state, unless the requirement is waived pursuant to Water Code section 13269.
The California Safe Drinking Water and Toxic Enforcement Act	The California Health & Safety Code Section 25249.5 et seq. prohibits actions contaminating drinking water with chemicals known to cause cancer or possessing reproductive toxicity. The RWQCB administers the requirements of the Act.
Local LORS	
Kern County Ordinance Code, Title 4, Chapter 14.08 – Water Supply Systems	Regulates permitting, siting, construction and destruction of groundwater wells.
Kern County Environmental Health Services Department, Chapter II, Section 602, Sewage Disposal by Individual Soil Absorption Systems	Regulates construction of on-site sewage disposal systems.

Kern County Uniform Plumbing Code, Chapter 17	Regulates installation and requires inspection for locating disposal/leach fields and seepage pits.
Kern County Division Four, Standards for Drainage	Provides standards for drainage of waters generated by storms, springs, or other sources that should be mitigated so as to provide reasonable levels of protection for life and property, and the maintenance of necessary access to property or passage of the traveling public on the public highways.
Kern County Code Of Building Regulations Chapter 17.48 Floodplain Management	Regulates development of projects in special flood hazard areas. These regulations are designed to comply with the National Flood Insurance Program regulations.
State Policies and Guidance	
State Water Resources Control Board (SWRCB) Resolution No. 09-11	State Water Resources Control Board Resolution 09-11 encourages and promotes use of recycled water to replace the use of potable water for non-potable purposes. The policy supports the sustainable use of surface water and groundwater and encourages the use of recycled water where this water is not being put to other beneficial uses. The policy provides for a streamlined permitting process for recycled water use with local Regional Water Quality Control Boards.
SWRCB Resolution No. 75-58	The principal policy of the SWRCB that addresses the specific siting of energy facilities is the Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Power Plant Cooling (adopted by the Board on June 19, 1976, by Resolution 75-58). This policy states that use of fresh inland waters should only be used for power plant cooling if other sources or other methods of cooling would be environmentally undesirable or economically unsound.
2003 Integrated Energy Policy Report (IEPR)	In this report, consistent with SWRCB Policy 75-58 and the Warren-Alquist Act, the Energy Commission adopted a policy stating the Commission will approve the use of fresh water for cooling purposes by power plants only where alternative water supply sources and alternative cooling technologies are shown to be "environmentally undesirable" or "economically unsound."

REGIONAL SETTING

The BSEP would be located in an unincorporated part of eastern Kern County within the Fremont Valley near California City. Fremont Valley is in the northwestern portion of the Mojave Desert where water resources are extremely limited.

REGIONAL WATER RESOURCES

The Fremont Valley Groundwater Basin is located in the South Lahontan Hydrologic Region of the Mojave Desert (DWR 2003). Within the desert environment of the South Lahontan Hydrologic Region (Region), the occurrence and use of water resources are complicated issues. In this Region, groundwater often supplements imported State Water Project or Colorado River water for domestic, agricultural, commercial and industrial water uses. The Region includes approximately 33,100 square miles and is bounded on the west by the crest of the Sierra Nevada; on the north by the watershed divide between Mono Lake and East Walker River drainages; on the east by the California-Nevada border; and on the south by the crest of the San Gabriel, the San

Bernardino mountains and the divide between watersheds draining south toward the Colorado River and those draining to the north. The South Lahontan Hydrologic Region includes the Owens, Mojave, and Amargosa River systems, the Mono Lake drainage system and numerous other internally drained basins.

The South Lahontan Hydrologic Region is subdivided into 76 groundwater basins, one of which is the Fremont Valley Groundwater Basin (RWQCB 1994). The BSEP and surrounding area is underlain by the Fremont Valley Groundwater Basin.

Surface water in the Fremont Valley originates in the surrounding mountains and flows toward Koehn Lake, a dry lake or playa, which is located approximately six miles northeast of the BSEP site. Most of the surface water infiltrates into the alluvium-filled valley and any surface flow that does not infiltrate or evaporate, discharges to Koehn Lake. Koehn Lake is a highly saline wet playa. The playa is a flat, vegetation-free area located at the lowest part of the undrained desert basin. There is no surface water outflow from the Fremont Valley due to low precipitation rates, high soil infiltration rates, high evapotranspiration rates and the topographic low of Koehn Lake.

Fremont Valley Groundwater Basin

The Fremont Valley Groundwater Basin is divided into six sub-basins: California City, Koehn, Chaffee, Gloster, Oak Creek, and Willow Springs (BS 2008a, Figure 5.17-1). The sub-basins are typically separated by faults that form partial barriers to groundwater movement (Bloyd 1967, Koehler 1977, Saint-Armand 1991).

The primary source of water to the Fremont Valley is surface water infiltration and potentially underflow from the Antelope Valley (Muroc sub-basin) located to the southwest (SAMDA 1997). Groundwater recharge resulting from precipitation on the valley floor is considered minimal because direct rainfall is significantly less than the potential evapotranspiration rate and potential soil moisture retention. In portions of the basin where development has occurred, used water may return to the basin's aquifer through discharge of septic systems, and by inefficient irrigation practices.

Koehn Sub-basin

The BSEP is located within the Koehn sub-basin of the Fremont Valley Groundwater Basin. The Koehn sub-basin is bounded by the California City sub-basin to the southeast, the Chaffee sub-basin to the south and the Oak Creek sub-basin to the southwest (BS 2008a, Figure 5.17-1). The physical boundaries of the Koehn sub-basin include the Randsburg-Mojave Fault and Rand Mountains to the south; the El Paso Mountains to the north; the Sierra Nevada Mountains to the west; and the confluence of the El Paso and Rand Mountains to the northeast (Weir et al. 1965, Bloyd 1967, DWR 1968, Moyle et. al., 1985, DWR 2003).

Subsurface alluvial deposits in the Koehn Lake sub-basin vary in thickness between approximately 400 feet thick to over 1,700 feet thick and consist of variable mixtures of sand and gravel with interspersed, non-continuous clay lenses. Depth to groundwater also varies throughout the sub-basin and ranges from more than 300 feet deep away from Koehn Lake to as shallow as approximately 14 feet deep in the immediate vicinity of the lake.

Large scale alfalfa farming began within the sub-basin in the mid-1950's and extended through the mid 1980s. During this time, groundwater pumping lowered the water table several hundred feet, which formed a large groundwater depression and caused land subsidence within the sub-basin. Due to the lowered groundwater elevation, pumping costs increased to a point that farming was no longer profitable and most farming operations ceased (SAMDA 1997).

Groundwater quality in the Koehn sub-basin varies spatially in relationship to Koehn Lake. In the southwest portion of the sub-basin, water quality is of sodium bicarbonate or calcium-sodium bicarbonate types (DWR 2003). Due to evaporative concentration of salts, Total Dissolved Solids (TDS) concentrations increase and water quality decreases toward Koehn Lake. Beneath Koehn Lake, the TDS concentration of the groundwater is as high as 100,000 mg/L (Dockter, 1979; DWR, 2003). Southwest of the lake bed, and near the proposed BSEP site, typical TDS concentrations are reportedly about 500 mg/L.

PROJECT SITE AND VICINITY SETTING

As proposed, the BSEP would be a concentrated thermal solar electric generating facility constructed on an approximately 2,012-acre site in eastern Kern County, California. The project would have a nominal electrical output of 250 megawatts (MW).

BSEP is designed to use a wet cooling tower for power plant cooling. Water for cooling tower makeup, process water makeup, and other industrial uses such as mirror washing, would be supplied from onsite groundwater wells, which also would supply water for employee use (e.g., drinking, showers, sinks, and toilets).

SURFACE WATER

There are three main watersheds that contribute surface water flow in the BSEP site vicinity. These watersheds are the Pine Tree Creek Watershed, Jawbone Creek Watershed and an unnamed watershed located adjacent to the Pine Tree Creek Watershed. Discussion of these watersheds is presented below. Pine Tree Creek, a dry desert wash, that trends from the south-southwest to the north-northeast through the center of the site. The channel is mapped as a 100-year special flood hazard area by the Federal Emergency Management Agency (FEMA) where it crosses the site. The applicant proposes to fill the existing creek channel and reroute Pine Tree Creek around the south and east periphery of the solar facility.

Pine Tree Creek Watershed

Pine Tree Creek originates from the Pine Tree Canyon where the Sierra Nevada Mountain Range becomes the Tehachapi Mountains, west of the BSEP site. The Pine Tree Creek headwaters are located at Cache Peak. Pine Tree Creek descends the flanks of the mountains, forms an alluvial fan, traverses the project site and ultimately discharges to Koehn Lake. The topographical apex of the Pine Tree Creek alluvial fan is located at the mouth of Pine Tree Canyon and was formed from sediment washing out from the canyon. This alluvial fan is evident from topographic and aerial maps reviewed by staff. The alluvial fan is crossed by two Los Angeles Department of Water and Power aqueducts, State Route -14 (SR-14) about a mile downstream from the apex, and the

Southern Pacific Rail Road (SPRR). An existing six cell 8-foot by 8-foot Reinforced Concrete Box (RCB) culvert passes Pine Tree Canyon flows under SR-14. Downstream of the SPRR, the channel confluences with the Barren Ridge drainage from the south and continues northeasterly toward the BSEP site.

A large portion of the southern half of the Pine Tree Creek watershed includes the sub-watershed area east of Barren Ridge. From a high elevation of approximately 4,200 feet, runoff comes down from the ridge through several small drainage swales to the alluvial area west of SR-14. An engineered drainage ditch along the west side of SR-14 collects the watershed runoff and routes it to a double barrel 8-foot by 6-foot RCB at SR-14. The flow past SR-14 continues northeasterly, beneath the SPRR tracks, and continues along its historic alignment. This sub-watershed eventually confluences with Pine Tree Creek in the alluvial flats about 1,000 feet east of SPRR. Downstream of this location, the channel enters the BSEP property.

The area east of Chuckwalla Mountain drains from an elevation of 4,900 feet toward the BSEP site. Runoff from Chuckwalla Mountain travels through several distributaries before being cut off by SR-14. SR-14 has several existing culverts to convey flows to the east side of the road and past SPRR. Drainage channels are formed downstream of these crossings and are eventually diverted north through ditches outside of the BSEP property boundaries (BS 2008a), apparently deflecting what appears to be the natural drainage path of these channels away from the site.

In the AFC (BS 2008a), the applicant has identified a smaller tributary area located along the BSEP western property boundary between Pine Creek Canyon and the Chuckwalla drainage area (Sheds 1S & 3S). The applicant has identified this "shed" as a nearly 1.5 square-mile basin that currently drains across the site after crossing through an existing SPRR culvert. This drainage area becomes a regulated Water of the State as it crosses the BSEP property.

Jawbone Creek Watershed

The Jawbone Creek Watershed drains several canyons located in the Tehachapi Mountains. These canyons experience climatic conditions similar to Pine Tree Canyon. The names of these canyons are, from south to north, Alphie Canyon, Cottonwood Creek Canyon, Water Canyon, Jawbone Canyon and Red Rock Canyon.

Jawbone Canyon ends at the base of the mountainous and canyon areas. Jawbone Creek leaves the canyon at this location and drains to SR-14 and then to SPRR on the alluvial flats. At the SPRR tracks, the FEMA flood mapping shows a split in Jawbone Creek flow condition. One path leads to the north, and the other south toward the BSEP site. The southern channel bends easterly before reaching the northernmost BSEP property boundary. FEMA delineates this reach as a Special Flood Hazard Area (SFHA); Zone AE, Base Flood Elevations determined. The SFHA is nearly one-mile wide at this location north of the site. The Jawbone Creek flood hazard is not mapped within the BSEP property boundary but is located immediately to the north where the creek flows easterly toward the Honda Proving Center and eventually to Koehn Lake, nearly 6 miles downstream from the site. Near the BSEP site, the watershed area for Jawbone Creek is roughly 280 square miles.

Unnamed Watershed (Adjacent to Pine Tree Creek Watershed)

The unnamed watershed is located immediately east of Pine Tree Creek watershed on the Fremont Valley alluvial plain. The watershed has an area of roughly 8-square-miles and drains across the site to Jawbone Creek at nearly the same location as the confluence of Pine Tree Creek and Jawbone Creek.

SOILS

The majority of project facilities would be located on soil units that have rapid permeability and negligible to low runoff potential (**Soil & Water Table 2**). The exceptions are areas underlain by the Rosamond clay loams, which have moderate runoff potential. The runoff designation for Cajon loamy sand is low, and the designation for Rosamond clay loam is moderate. In contrast, the Cajon loamy sand has rapid permeability whereas the Rosamond clay loam has a moderate to moderately slow permeability.

Soil & Water Table 2
Soil Types Potentially Affected & Characteristics

Primary Soil Name	Slope Class	Water Erosion Potential	Wind Erosion Potential	Permeability (in/hr)	Shrink-Swell Potential
Cajon Loamy Sand	0 -15%	Slight to Moderate	High	Rapid	Low
Cajon Gravelly Loamy Sand	0 to 15 %	High	High	Rapid	Low
Garlock Loamy Sand	2 to 9 %	Moderate	Moderate	Rapid	Low
Rosamond Clay Loam, Saline-Alkali	0 to 2 %	Moderate	Moderate	Moderate to Moderately Slow	Low to Moderate
Rosamond Clay Loam	0 to 2 %	Moderate	Moderate	Moderate to Moderately Slow	Low to Moderate

Source: U.S. Department of Agriculture's Soil Conservation Service Soil Survey of Kern County, California, Southeastern Part (1981)

BSEP site soils would be subject to wind and water erosion during facility construction and operation activities. Only two soil types would be affected by grading and excavation activities; Cajon loamy sand and Rosamond clay loam. The soils on the project site have a moderate to high hazard for wind erosion.

CLIMATE

The BSEP site is situated in the northwestern portion of the Mojave Desert. The climate in the Mojave Desert is dry and arid and characterized by low precipitation. The region experiences a wide variation in temperature, with very hot summer months (an average maximum temperature of 104 °F occurring in July) and cold dry winters (average minimum temperature of 28 °F occurring in December). Annual precipitation in the Mojave Desert ranges from three inches to six inches (U.S. Department of Agriculture 1981). **Soil & Water Table 3** displays the average monthly and annual minimum and

maximum temperatures and total annual precipitation from 1971 to 2000. This data was collected from a gauging station in Cantil (Station 041488), located about one mile north of the Project (BSEP 2008a).

Soil & Water Table 3
Cantil, California Climate and Precipitation Summary¹ 1971 through 2000

Climate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual ²
Ave Max Temp (°F)	58.9	65.6	71.5	76.2	86.5	97.7	104.3	102.1	93.1	80.2	64.1	58.0	80.1
Ave Min Temp (°F)	28.9	33.9	40.8	46.1	55.0	63.8	69.2	67.1	57.1	44.1	34.7	28.2	47.5
Ave Total Precip (in)	0.71	0.48	0.33	0.09	0.15	0.05	0.10	0.12	0.05	0.06	0.43	0.54	3.05

¹ Source – Western Regional Climate Center, <http://www.wrcc.dri.edu/> (Climate Station 041488 – Cantil)

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

In the lee (downwind side) of the Tehachapi Range, precipitation in the site vicinity averages 3 to 6 inches a year, but is extremely variable. Snow and winter rains result from North Pacific cyclonic storms. Snowfall is infrequent and considered insignificant for staff's review. The remainder of precipitation comes from intense, local thunderstorms and summer tropical storms (FEMA 2008). Local thunderstorms are usually associated with convective (the vertical transport of heat and moisture in the atmosphere) activities and normally occur in the summer. The summer convective storms (thunderstorms) are generally dominant in the southern desert area (West 2007).

STORM WATER

The existing storm water flow across the project site is from southwest to northeast and occurs as sheet flow or shallow flooding. Pine Tree Creek, a dry wash that conveys flash flood flows, bisects the site. The applicant plans to construct the solar power plant on ten individually elevated cut and fill pads or planar "cells". The site grading slopes southwest to the northeast to direct storm induced sheet flow into transverse intercept trenches that convey collected runoff into proposed onsite retention basins. Following settlement of suspended sediments and attenuation of peak flows in the retention basins or supplemental detention basins, the collected storm water would percolate or evaporate within 48 hours following the precipitation event. Plans provided in the June 2009 project Design Refinements (DB 2009r) indicate that the easternmost retention ponds will be outfitted with stand pipes and subsurface drainage pipes that will convey flows that exceed pond capacity to an outlet in the rerouted Pine Tree Creek Channel. BSEP's Storm Water Pollution Prevention Plan (SWPPP) and the Drainage Erosion and Sediment Control Plan (DESCP) establish methods of when and how to control and manage storm water flow as it reaches the project, flows across the project, and then leaves the project. Draft plans have been prepared for both the construction and operational phases of the project.

The proposed diversion channel construction would precede excavation and filling of Pine Tree Creek, within the limits of the effective SFHA. Once constructed, the diversion channel would route flood flows around the southern and eastern sides of the project, allowing construction and grading improvements in the existing Pine Tree Creek

floodplain. Following diversion channel construction, the applicant would submit an application for a Letter of Map Revision (LOMR) to FEMA to revise the effective SFHA. Subsequently, the proposed power block would not be located within a FEMA designated floodplain.

In order to comply with the Energy Commission's "in lieu permit" authority established under the Warren-Alquist Act, staff has coordinated joint environmental review with other agencies such as the U.S. Fish and Wildlife Service, California Department of Fish and Game (CDFG), Lahontan Regional Water Quality Control Board (RWQCB) and Kern County. As part of this coordinated review, the applicant submitted a copy of their Conceptual Drainage Study (CDS), which addressed the BSEP's initial storm water plan, to the CDFG, as part of an application for a Streambed Alteration Agreement. Lahontan Regional Water Quality Control Board (LRWQCB) and Kern County also received copies of the CDS for review and comment. These agencies have taken an active role in the certification process. Comments from these agencies provided influence on BSEP's updated site drainage plan, as described in the Project Design Refinements (DB 2009r). Staff recognizes the value of these agency comments and refers to them in the discussion of project impacts, below.

PROJECT WATER SUPPLY

In the AFC and subsequent submittals, the applicant proposes to use high quality fresh groundwater from onsite wells during construction (primarily during grading) and for operations phase water needs (primarily evaporative cooling). Based on information provided in the Project Design Refinements (DB 2009r), the project would consume approximately 1,388 acre-feet per year (AFY) of high quality fresh groundwater. Ownership of site groundwater rights is disputed according to letters submitted by Mr. John Musick and the applicant.

The proposed use of fresh groundwater for power plant cooling is inconsistent with SWRCB and Energy Commission water policies. Given the inconsistency with these policies, staff researched and identified alternative water supplies that could be considered for use in power plant cooling. Staff has identified degraded groundwater in the vicinity of Koehn Lake and recycled municipal wastewater produced by Rosamond Community Services District and California City as possible alternative water supplies. These supplies are briefly discussed below and further analyzed in the LORS Compliance section and Alternatives section of this FSA.

Results of groundwater monitoring conducted by the United States Geological Survey and the California Department of Water Resources since 1955 indicate that groundwater in the vicinity of Koehn Lake contains elevated concentrations of Total Dissolved Solids (TDS). Staff considers groundwater with elevated TDS to be degraded. Power plant use of this degraded groundwater would comply with Energy Commission and State Water Resources Control Board (SWRCB) policies by using the most degraded water available.

Rosamond Community Services District (RCSD) and California City treat municipal wastewater (sewage) at their wastewater treatment plants, providing high quality recycled waste water suitable for industrial use. Both entities have indicated their

willingness and ability to provide BSEP with this recycled wastewater (CofC 2009 b & c, RCSD 2009 a-d). Similar to degraded groundwater, use of recycled wastewater for power plant operations would comply with Energy Commission and SWRCB policies by using the most degraded water available.

Construction Water Use

The AFC states that initially, water requirements would be significant for the first five months as the site is prepared and rough grading conducted (BS2008a). During grading, the AFC indicates that water usage would be between 5 million and 10 million gallons per day (gpd), five days per week for a total period of 22 days per month for five months (or 110 days). Under the above assumptions, between approximately 7,000 and 14,000 gallons per minute (gpm) of water would be required daily from seven wells to support initial construction activities.

**Soil & Water Table 4
Proposed Annual Construction Water Demands**

Average Daily Use (gallons)	Maximum Daily Use (gallons)	Initial Construction Activities Use (gallons)	Water Supply Source	Delivery Method
1.6 million (5 AF)	10 million (30.7 AF)	1.1 billion (3,375.77 AF)	On-site Groundwater	Existing On-site Wells

Source: BS 2008a

Following the initial five-month grading period, water would be used primarily for dust suppression and used in the construction of the solar field, power block and other site buildings and hydrostatic testing of the facility's pressure vessels and piping. Site construction water use is expected to consume between 10,000 and 400,000 gpd for the remaining 22 months.

In the AFC, the applicant proposed to meet site pre-watering, grading and normal construction activity (e.g., mixing concrete, dust control) water requirements using water supplied from existing onsite wells equipped with temporary pumps.

The AFC states that during construction, potable water use would be limited to drinking water provided in bottles. Waterless portable facilities would be used for sanitary needs.

Operations Water Use

The applicant proposes to use onsite high quality fresh groundwater for all operation water needs. In the project AFC the applicant initially estimated annual maximum water use to be 1,600 AFY. Now with the addition of the partial ZLD, the applicant estimates that 1,388 AF of water would be consumed annually for power plant operation and potable water needs. The onsite well field would include three wells for redundancy should one or more of the onsite wells fail.

A raw water storage tank with a capacity of 2,840,000 gallons capacity would hold 2,480,000 gallons of water for plant operations (a water supply sufficient to cover an 18-hour interruption) and 360,000 gallons of raw water dedicated to the plant's fire protection water system. The water would be treated with a biocide (sodium hypochlorite) prior to storage. There also would be a treated water tank with a capacity of 2,350,000 gallons for raw make-up water in the cooling towers and as support for domestic water use. Plant process water would be treated via ion exchange to reduce scale-forming concentrations entering the cooling water system. In addition, a 150,000-gallon tank would be utilized to store de-mineralized water, and an 80,000-gallon capacity storage tank would be used for neutralization of water treatment wastewater.

During plant operation, the estimated annual potable water demand is 8 AFY. With minimal treatment, groundwater from onsite wells could meet the potable water demands of the BSEP operations workforce. No other source of potable water has been identified by the applicant.

WASTEWATER

Construction Wastewater

During construction, water would be used for one-time hydrostatic testing of pipelines and pressure vessels. The applicant estimates that approximately 360,000 gallons of water will be used for hydrostatic testing. This water will be reused to the extent feasible in accordance with applicable regulations. In addition to hydrostatic test water, a small amount of wastewater will be generated during equipment and vehicle washing. Water that cannot be reused will be discharged to on-site evaporation ponds.

Operation Wastewater

Wastewater generated during power plant operation would be segregated in two separate collection systems, one for industrial streams (including the cooling tower blowdown and raw water treatment effluent) and the other for sanitary waste.

Industrial Wastewater

The industrial wastewater system would collect blowdown from the Solar Steam Generator (SSG), circulating cooling water blowdown, chemical feed area drains, general plant drains and wastewater from the demineralization system and deliver the collected waste to the cooling tower basin.

For disposal of the collected wastewater, the applicant initially proposed to use three double-lined evaporation ponds, each with a nominal surface area of 8.3 acres, for a total of 25 acres. In a March 2009 supplement to the AFC, the applicant redesigned the three evaporation ponds to have a nominal surface area of 40 acres (AECOM 2009c). Then, subsequent to the March 2009 submittal, the applicant redesigned the disposal of the industrial wastewater to include a partial Zero Liquid Discharge (ZLD) system (DB 2009r). The partial ZLD would concentrate the wastewater, liberating some treated

water for industrial reuse and concentrating the remaining wastewater into a smaller volume of high TDS slurry. BSEP now proposes to dispose of the smaller volume of the high TDS slurry into three, 2 acre evaporation ponds, for a combined pond area of 6 acres.

The evaporation ponds are designed with a base layer consisting of either a geosynthetic clay layer or a layer 2 feet thick of onsite soil material with a hydraulic conductivity of less than 1×10^{-6} centimeters per second, covered with a 40-mil high density polyethylene (HDPE) liner, that would be covered with an interstitial leak detection and removal system consisting of a geomembrane geonet and collection piping, in turn covered by a 60 mil HDPE liner covered with a hard surface/protective layer with granular fill/free draining sub-base. Multiple ponds are planned to allow plant operations to continue in the event that a pond needs to be taken out of service for maintenance and/or waste removal.

Sanitary Wastewater (septic)

The proposed sanitary wastewater system would collect wastewater from sinks, toilets, and other sanitary facilities and discharge those fluids to an onsite septic system. This sanitary wastewater system will be located in the power block area of the power plant site.

ASSESSMENT OF IMPACTS AND DISCUSSION OF MITIGATION

This section provides an evaluation of the expected direct, indirect, and cumulative significant impacts to soil and water resources caused by project construction, operation, and maintenance. Staff's analysis consists of a brief description of the project's potential impacts, and application of threshold criteria to determine whether or not the impact is significant. If the impact is significant, then staff provides a summary of the applicant's proposed mitigation and a discussion of the adequacy of the proposed mitigation. If necessary, staff presents additional or alternative mitigation measures which appear at the end of the Soil & Water Resources section as specific Conditions of Certification. The objective of identifying mitigation measures is to reduce potentially significant environmental impacts to a less than significant level.

METHOD AND THRESHOLD FOR DETERMINING SIGNIFICANCE

To evaluate if significant impacts to soil or water resources would occur, staff assessed:

- Whether the project would violate water quality standards or waste discharge requirements.
- Whether the project substantially depletes groundwater supplies or interferes with groundwater recharge such that there is a net deficit in aquifer volume
- Lowering of the local groundwater table level in nearby pre-existing wells to a level that fails to support permitted existing or planned land uses.
- Whether the project substantially alters existing site or area drainage patterns, including the alteration of stream or river courses, or substantially increases the rate or amount of surface runoff in a manner that results in on- or off-site flooding or substantial erosion or siltation.

- Whether the project would create or contribute runoff water that exceeds existing or planned storm water-drainage system capacity or provides substantial additional sources of polluted runoff.
- Whether the project would place structures within a 100-year flood hazard area and impede or redirect flood flows.
- Whether the project would lower groundwater levels such that protected species or habitats are affected.
- Whether the project would substantially degrade surface water or groundwater quality.

The significance thresholds for soil and water resources are discussed in the analysis below.

DIRECT/INDIRECT ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Project Water Use

Four existing water supply wells (nos. 41, 42, 49 and 63), are proposed to supply water for the operation of the project. The four existing wells are located in the central and southwestern portion of the proposed plant site, and would be used on a rotating basis. When not in use, the offline wells would provide backup for each other in the event of outages or maintenance. Pumping test data provided by ENSR (BS 2008a) has shown water supply wells on the plant site have the capacity to meet BSEP water supply requirements of 3,403 gpm (DB 2009r).

Construction

The AFC stated that, initially, water demand for the project would be significant through the first five months of site preparation and rough grading. Rough grading was estimated to involve moving 5.16 million cubic yards of soil (BS2008a). During initial grading, the applicant estimates that water usage would be between 5 million and 10 million gallons per day (gpd); five days per week for a total period of 22 days per month for five months or 110 days. This initial grading could consume as much as 1.1 billion gallons or 3,376 AF of water (BS 2008a). However, it appears that the applicant did not account for the volume of soil that would be cut and placed as compacted fill during construction of the rerouted Pine Tree Creek Channel. The excavation of the channel will require the removal and relocation of an additional volume of approximately 3.1 million cubic yards of soil (totaling approximately 8.3 million cubic yards of soil). Assuming the same ratio of water to soil used for determining water usage for rough grading (5.16 million cubic yards/3,376 AF), excavation of the rerouted channel will require an additional 2,028 AF of water during construction, for a total of 5,404 AF of water required for rough grading.

Following the five-month long initial grading period, water use is expected to decrease to a rate of approximately 400,000 gpd for a period of 21 months or 462 days. According to the AFC, this decreased construction water use could consume as much as 185 million gallons or 567 AF.

Staff's review of the applicant's geotechnical report indicates that, to attain maximum relative compaction of site soils, the soil must contain 10.7% water by weight. To properly compact 8.3 million cubic yards of soil, it would take approximately 548 AF of water. In addition, the revised design includes the mixing and placement of approximately 249,000 cubic yards of soil cement which would require approximately 55 AF of water.

Potable water demands during construction would be minimal. The applicant proposes to use bottled water to supply drinking water for the construction workforce. Portable facilities would be used for sanitary needs and operate without water. Staff concludes that there would not be significant adverse environmental impacts associated with this potable water supply.



Combining the water use requirements discussed above, staff estimates project construction water use will exceed 6,574 AF. The estimated water requirement is substantially greater than the 3,378 AF presented in the AFC (BS 2008a).

Staff also notes the applicant has indicated groundwater would be used for dust control during grading activities. The applicant's estimated silt content of site soils is approximately 7.5%. This number was used in the applicant's determination of the volume of water required for dust suppression and is reflected in the revised volume discussed above. However, staff's review of the applicant's geotechnical report indicates that silt content of site soils ranges from 5-79%, with an average (19 samples) silt content of 30.4%. This observation indicates that approximately 23% more fine grain material exists in site soils than was presented in the AFC. Staff considers this additional fine grain material will require a volume of water commensurate with the increased silt content to adequately suppress dust during construction. Therefore, staff believes dust suppression will require a volume of water 23% higher than that described above. Using the information provided above, staff believes that project construction will require 8,086 AF.

The additional construction water use will increase drawdown in wells beneath and near the site. The drawdowns are likely short-term however, and after 30-years of project operations, the simulated effect on long-term drawdown is an increase in drawdown of about 1 foot or less. The greater construction water use could alter staff findings (i.e., the number of wells experiencing drawdown may increase), but the conclusions regarding impacts will likely not change substantially. Drawdown from combined construction and operational water use is discussed in detail below under the Groundwater Impacts section.

Groundwater Storage

The volume of groundwater stored in a basin can vary over time because of changes in water inflow and outflow. Groundwater storage and well water levels increase when inflow exceeds outflow. Conversely, groundwater storage and water levels decrease when inflow is less than outflow. Significant adverse impacts can occur when groundwater storage conditions are in a state of perpetual decline, causing increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts (DWR, 2003).

Staff obtained well water levels from DWR and the USGS, constructed hydrographs and inserted the hydrographs into a map showing the Fremont Groundwater Basin (**Soil & Water-Figure 1**). In **Soil & Water-Figure 1**, simulated water levels from the applicant's groundwater-flow model are also shown with observed water levels. The discussion of simulated water levels is provided in **Soil and Water Resources-Appendix B**.

Observed water levels show variable responses to pumping. Water level declines generally first appeared in the 1950s and accelerated during the 1970s due to increased agriculture production. The lowering of the groundwater table caused an increase in pumping costs which affected farming profits resulting in decreased agriculture production (SAMDA 2008). Accordingly, agricultural groundwater consumption in the Koehn Lake Sub-basin decreased dramatically during the late 1980s and 1990s.

For the past 10 to 15 years, groundwater levels have been partially recovering in most wells monitored in the Koehn Sub-basin. The observed water level increase indicates groundwater storage is likely increasing in parts of the Koehn Sub-basin as groundwater flows from surrounding sub-basins to refill the historical depression left over from historical agricultural consumption. In contrast, water levels in other parts of the Fremont Valley continue to decline indicating groundwater storage continues to decrease in most of the remaining areas in the Fremont Valley Groundwater Basin (California City, Chaffee, and Gloster Sub-basins). The decline in water levels is due in part to groundwater outflow from these surrounding Sub-basins into the Koehn Sub-basin and groundwater consumption rates that exceed the rate of groundwater recharge.

From the observed water level data shown in **Soil & Water- Figure 1**, staff prepared **Soil & Water Table 6**. **Soil & Water Table 6** shows historical maximum water levels, historical minimum water levels, most recent water levels (generally observed in 2008), the calculated change between maximum and recent water levels, and the average annual water level recovery trend (generally the water level trend recorded during the period 1986-2006)¹. The 1986-2006 period is utilized because it generally represents the time between maximum historical drawdown due to agricultural pumping and the subsequent recovery period after pumping was dramatically curtailed. In 2008, the water levels in almost one-half of the Koehn Sub-basin wells monitored were more than 40 feet below their historical maximums. Hence, water levels remain significantly lower than they were prior to consumption by agriculture during the 1970s and early 1980s. Since 1985, water levels in nine of 14 Koehn sub-basin wells showed statistically significant water level increases that range from 0.03 to 5.8 feet per year; two of the wells showed statistically significant downward trends of about 0.5 feet per year, and the trends in the remaining three wells (two downward and one upward) were not statistically significant. The greatest observed water level increases are for wells located

¹ Water level trends were calculated from observations recorded during the recovery period that began after about 1985. Because of gaps in measured water level data or well operations that continued beyond 1985, the trends in some wells are necessarily calculated after 1985. For example, the observed recovery in wells 30S/38E-31C and 29S/39E-33K1 began after 1995, so the trends in these wells were calculated for the period beginning in 1996. Staff employed the Mann-Kendall test to determine statistically significant trends (95% confidence level) and the Sen's nonparametric estimator of slope to determine the water level change per unit time. For each well, the test first determined the slope of water level plotted versus time, then tested whether the slope was significantly non-zero at the 95% confidence level.

within the historical pumping centers (former agricultural areas). The observed water level changes are generally consistent with reduced pumping and subsequent groundwater storage recovery in the Koehn Sub-basin. In contrast, water levels in most Fremont Valley wells located south of the Koehn Sub-basin (10 of 13) indicate statistically significant long-term declines ranging from -0.02 to -9.1 feet per year. These observations are consistent with continued pumping and storage declines in the California City, Chaffee and Gloster Sub-basins of the Fremont Valley.

Soil and Water Table 6
Reported Fremont Valley Basin and Antelope Valley Basin Water Levels

Well Number	Historical Maximum GWE		Historical Minimum GWE		2008 GWE		Change (2008 Maximum)	Recover Trend (ft/yr)		
	Year	Elevation	Year	Elevation	Year	Elevation		$\alpha = 0.05$		
								Years	Observed	Simulated
KOEHN SUB-BASIN OF FREMONT VALLEY										
29S39E33K001 M	1958	1919	1996	1797	2008	1863	-56	1996-2006	5.8	-1.4
30S37E13C001 M	1978	2025	1998	2009	2008	2011	-14	1986-2006	(-0.1)	1.2
30S37E27H002 M	1973	1869	1984	1788	2008	1849	-20	1985-2006	2.4	4.9
30S37E34H002 M	2003	1841	1984	1778	2007	1838	---	1986-2005	(2.0)	2.7
30S37E36G001 M	1929	1950	1995	1831	2008	1847	-103	1985-2006	0.6	4.8
30S37E36N001 M	1953	1948	1976	1744	2008	1844	-104	1993-2006	3.3	5.3
30S38E03K002 M	1996	1881	1977	1842	2008	1880	-1	1985-2006	0.03	-0.8
30S38E04D002 M	1979	1905	2007	1897	2007	1897	---	1996-2006	(-0.1)	1.0
30S38E24F001 M	1953	1928	2008	1893	2008	1893	-35	1985-2006	-0.4	-1.0
30S38E30P001 M	1958	1933	1977	1822	2008	1844	-89	1985-2006	0.8	3.7
30S38E30Q001 M	1958	1942	1982	1893	2008	1901	-41	1985-2006	-0.5	3.7
30S38E31C001 M	1986	1844	1961	1794	2008	1844	0	1995-2006	2.6	4.6
31S37E04J001 M*	1974	1920	1986	1700	1999	1779	---	1986-2004	5.4	1.4
31S37E04Q001 M*	1974	1948	1985	1685	2008	1819	-129	1985-2006	5.6	1.4

CALIFORNIA CITY, CHAFFEE and GLOSTER SUB-BASINS OF FREMONT VALLEY										
11N11W07A00 1S	1958	2426	2008	2417	2008	2417	-9	1986-2006	-0.1	---
11N11W09A00 1S	1956	2425	2008	2416	2008	2416	-9	1986-2006	-0.1	---
11N12W22F002 S	2008	2423	1974	2403	2008	2423	0	1985-2006	0.3	---
11N13W19C00 1S	1983	3429	1992	3253	2008	3270	-159	1992-2006	-9.1	---
11N13W29M00 1S	1984	3072	2008	3006	2008	3006	-66	1993-2006	-3.9	---
12N12W35R00 1S	1957	2427	2008	2417	2008	2417	-10	1985-2006	-0.1	---
31S37E33H001 M	1956	2110	1990	2058	2008	2064	-46	1985-2006	0.2	-0.6
31S37E35N001 M	1953	2089	1969	2053	2008	2066	-23	1985-2006	0.2	-0.7
31S38E18P001 M	1917	2085	1983	2076	2008	2077	-8	1986-2006	-0.02	---
32S36E35D001 M	1957	2428	2008	2417	2008	2417	-11	1986-2006	-0.1	---
32S37E11N001 M	1953	2107	1992	2078	2008	2078	-29	1986-2006	-0.3	---
32S37E12M001 M	1970	2108	2008	2100	2008	2100	-8	1986-2006	-0.2	---
32S37E26N001 M	1970	2095	2007	2054	2008	2060	-35	1986-2006	-1.2	---
NORTH MUROC SUB-BASIN OF ANTELOPE VALLEY										
10N09W10B00 1S	1991	2183	2007	2176	2007	2176	---	1991-2005	-0.4	---
11N10W12F001 S	1967	2179	2000	2153	2002	2157	---	1985-2002	-0.6	---

Data from: DWR, Groundwater Level Data, March 2009

Trends in parentheses are not significant at the alpha = 0.05 level.

* On-site well

According to DWR (1998) groundwater overdraft occurs when the water withdrawn by pumping exceeds recharge over a period of years during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. The Fremont Valley Basin exhibits these characteristics of overdraft. Historical water levels show a continuous decline over a period of 20 to 30 years, and 2008 water levels in some wells were more than 100 feet below historical highs and therefore, have not fully recovered.

Volumetric Water Budget

In their Conceptual Hydrogeologic Model, ENSR (BS 2008a) estimated a water budget for the Fremont Valley groundwater basin. There is uncertainty in the water budget components, and assumptions employed in previous budget assessments have provided variable results. Staff developed a water budget approach, reviewed and summarized previous budget study results, and assessed the results to provide insight into the above water level trends.

Fremont Valley Groundwater Basin

Soil & Water- FIGURE 2 summarizes the primary water inflow and outflow components in the Fremont Valley Groundwater Basin.

Conservation of mass requires inflows and outflows balance as represented by Equation (1):

$$R + GW_i = W + LD + GW_o + \Delta S \quad (1);$$

where,

- ΔS is the change in groundwater storage;
- R is groundwater **recharge** from all possible sources (the net result of percolation of rainfall, infiltration of surface water runoff from surrounding mountains and foothills, applied irrigation water, and so forth, less the consumptive use of water by evaporation, native plants and agriculture);
- GW_i is **subsurface** inflow from the adjoining Antelope Valley Groundwater Basin;
- GW_o is **subsurface** outflow to the adjoining Antelope Valley Groundwater Basin;
- W is **groundwater** extraction by Fremont Valley wells; and,
- LD is **groundwater** discharge to Koehn Lake.

Equation (1) is rearranged to solve for ΔS :

$$\Delta S = R + GW_i - GW_o - W - LD \quad (2).$$

A positive value for ΔS indicates inflow is greater than outflow, and storage and water levels increase. Conversely, a negative value for ΔS indicates inflow is less than outflow, and storage and water levels decrease.

In the Fremont Valley Basin, under pre- and early development conditions, groundwater extraction by wells and the long-term groundwater storage changes was zero. Constant storage volume is represented by long-term stable (constant) water levels and gradients. Koehn Lake was the only significant natural discharge feature in the basin, and any other subsurface outflows were negligible. Hence, under pre- and early development conditions, Equation (1) is reduced and (re-arranged) to represent a balance between inflows and outflows:

$$R + GW_i = LD \quad (3).$$

GSI/water (1993) calculated the potential amount of groundwater discharge into Koehn Lake in the absence of pumping wells at about 18,000 AF/yr. The only significant subsurface inflow was from the Antelope Valley Basin, which reportedly occurs through a gap in the bedrock located southeast of California City. Durbin (1978) estimated this flow at a rate of about 1,000 AF/yr, and Leighton and Phillips (2003) later refined the estimate to consider water level declines occurring in both the Antelope Valley and Fremont Valley basins. Leighton and Phillips (2003) concluded the inflow from Antelope Valley decreased from about 500 AF/yr in 1958 to 200 AF/yr by 1995. These studies suggest long-term, average annual Fremont Valley recharge under pre- and early development conditions ranged from about 17,000 to 17,500 AF/yr, which is at the lower end of the broad range of average annual recharge rates estimated by GSI/water (1993) (4,200 to 42,000 AF/yr).

In the Fremont Valley Basin, the number of wells and extraction rates increased over time and consumed increasing quantities of groundwater. When outflow eventually exceeded recharge, the storage volume and well water levels declined. **Soil & Water Table 7** summarizes the limited available water budget information provided by previous hydrologic studies for these periods.

Soil & Water Table 7
Fremont Valley Basin Water Budget (All Units In AF/yr).

	ΔS	R	$GW_i - GW_o$	W	LD
Early Development	0	17,000 to 17,500 ^a	1000 ^b to 500 ^c	0	18,000 ^d
1958-1976	?	?	400 ^c	?	?
1977-1984	?	?	300 ^c	?	?
1985-1997	10,400 to 15,300 ^e	4,200 to 42,000 ^d	200 ^f	?	?
1998-2007	?	4,200 to 42,000 ^d	100 ^f	?	0 ^g

a) Calculated using Equation (3).

b) Durbin (1978).

c) Leighton and Phillips (2003).

d) GSI/water (1993).

e) EarthSat (1997).

f) Projected from simulated annual trend reported by Leighton and Phillips (2003).

g) BSEP (2009).

Determination of annual groundwater recharge of the Fremont Valley Basin is uncertain, and inflow from the Antelope Valley Basin has been declining with time. Water budget estimates seem to indicate that basin-wide groundwater storage began to increase during the mid-1980's. In contrast, the data reported in **Soil & Water Table 6** indicate rising water levels and groundwater storage increases continued in some parts of the basin, whereas water levels and groundwater storage appeared to have declined in other basin areas. The net volumetric storage change for the Fremont Valley Basin during the 1998-2007 periods has not been estimated, and groundwater-flow modeling completed by the project applicant focused primarily on one sub-basin (the Koehn sub-basin). Considerable uncertainty therefore exists on the relationships between changes in groundwater consumption within individual sub-basins and the overall water balance for the entire Fremont Valley Basin.

Koehn Groundwater Sub-Basin

A budget approach also applies to the Koehn Sub-basin (**Soil & Water Figure 3**):

$$\Delta S^k = R^k + GW_i^k - GW_o^k - W^k - LD \quad (4).$$

The terms in Equation (4) are similar to Equation (1); however, the components are distinguished by a superscript "k" to clarify they apply specifically to the Koehn Sub-basin. The primary outflow is to Koehn Lake, and conceivably water could flow in or out between the adjoining Oak Creek, Chaffee, and California City sub-basins. Under pre- and early development conditions, any subsurface flow was away from these sub-basins into the Koehn Sub-basin. All water inflow to the Koehn Sub-basin ultimately discharged to Koehn Lake. However, with variable extraction well locations and groundwater consumption rates, the gradients between sub-basins would likely change and conceivably, if drawdown was great enough, gradients could reverse between sub-basins resulting in a net loss of groundwater from the Koehn Sub-basin.

In the Koehn Sub-basin, the number of wells and extraction rates increased with time, consuming greater quantities of groundwater. Several investigations estimated the historical changes in groundwater storage. Koehler (1977) utilized observed water level changes in wells during the period 1958-1976 to estimate the storage change within an area generally coinciding with the Koehn Sub-basin. EarthSat (SAMDA 2008) also utilized water level changes to estimate storage changes during the period 1985-1997 for seven Fremont Valley Basin subareas; the combined area of five subareas generally coincide with the Koehn Sub-basin. ESI (ESI2009) reported the results from a numerical groundwater-flow model of the Koehn Sub-basin, and the model simulated annual storage changes during the period 1958-2007.

Soil & Water Table 8 summarizes Koehn Sub-basin water budget estimates. For the past two decades, the budget data indicate groundwater storage has generally increased by about 10,000 to 15,000 AF/yr. The Koehn Sub-basin is 146,500 acres in area (Bloyd, 1967), and if the estimated storage increases are applied uniformly across the sub-basin and we assume a specific yield of 0.11, this water volume corresponds to average annual water level increases ranging from about 0.6 to 0.9 foot per year. Water level increases of this magnitude are consistent with the lower end of observed trends

depicted in **Soil & Water- Figure 1** and summarized in **Soil & Water Table 6**. The exceptions include (1) water levels in wells located near major historical pumping centers, which exhibit a more rapid water level rise due to subsurface inflow from adjacent areas; and, (2) wells that show declining water level trends.

Soil & Water Table 8
Water Budget Estimates For The Koehn Sub-Basin (All Units In AF/yr).

	Source	ΔS^k	R^k	$GW^k_i - GW^k_o$	W^k	LD^k
Early Development	Equation (4)	0	---	---	0	18,000
1958-1976	Koehler (1977)	-21,800	700	9,500	32,000	n.c.
	ESI (2009)	-20,100	15,600	1,600	31,100	6,200
1977-1984	ESI (2009)	-23,900	15,600	1,300	40,800	0
1985-1997	EarthSat (1997)	9,700 to 14,800	---	---	---	---
	ESI (2009)	-4,100	15,500	1,200	20,800	0
1998-2007	ESI (2009)	11,700	15,500	1,100	4,900	0

n.c. is "not calculated".

In the Koehn Sub-basin, increasing water levels are the result of recharge from infiltration of rainfall runoff, groundwater inflow from adjacent sub-basins, and subsurface inflows partially re-filling the depression created by historical pumping.

Well Interference

All operating wells within a groundwater basin contribute toward a lowering of water levels at other well locations. The overlap of drawdown among two or more wells is "well interference", and is significant when it results in a loss of yield or exposes the well screen. The magnitude of drawdown impact is controlled by five factors: (1) the rate of pumping; (2) the duration of pumping; (3) the depth of the well screens (water-intake depth of well); (4) aquifer parameters (hydraulic conductivity and specific yield, which are determined by the aquifer materials); and, (5) aquifer boundary conditions. A loss of yield is appreciable if the interference renders an existing nearby well incapable of meeting 1) maximum daily demand, 2) dry-season demand, or 3) annual demand.

Loss of Yield

The maximum theoretical well yield is the pumping rate supplied by a well without lowering the water level in the well below the pump intake (Freeze & Cherry, 1979). Typically, pump intakes are located near the top of the screened interval because it is

desirable to keep the screen submerged under water; submerging the well screen can minimize chemical clogging and physical deterioration of the well screen (Driscoll, 1995).

Assuming unconfined groundwater conditions, the theoretical relationship between groundwater elevations, aquifer conductivity, well diameter, and discharge at a steady rate Q is described by Equation (1):

$$Q = \pi K (H^2 - h^2) / \ln(R/r) \quad (1)$$

where:

Q is the constant well discharge rate, in ft³/day;

K is the hydraulic conductivity of the aquifer, in ft/day;

H is the groundwater elevation at a distance R from the well, both in ft;

h is the groundwater elevation in the well, in ft;

r is the radius of the well, in ft; and,

π is a constant and equal to the ratio of a circle's circumference to diameter (approximately 3.1416).

Equation (1) assumes (a) groundwater is unconfined; (b) the aquifer is horizontal, infinite and of constant thickness; (c) the water bearing materials are homogeneous and isotropic; and, (d) the groundwater elevation is everywhere uniform prior to pumping (Driscoll, 1995).

Equation (1) indicates the theoretical discharge rate is determined primarily by the hydraulic conductivity and groundwater elevations, and owing to the logarithmic function much less on the distance " R " and well diameter " r ". Employing Equation (1) for a specified well-groundwater system (i.e., fixed hydraulic conductivity, well diameter, and groundwater elevation in the well) Equation (1) is re-arranged to solve for the proportional change in discharge [Equation (2)].

$$(Q_1 - Q_2) / Q_1 = (H_1^2 - H_2^2) / (H_1^2 - h^2) \quad (2)$$

where:

Q_1 and Q_2 are constant well discharge rates corresponding to groundwater elevations H_1 and H_2 ;

H_1 and H_2 are groundwater elevations at a point located the distance R outside the well borehole; and,

h is the groundwater elevation in the well and assumed to be approximately the same for both pumping rates.

Equation (2) indicates the percent change in well discharge is related to the difference in drawdown caused by the well interference. The conductivity, well radius, and distance R are all constant for a given well and therefore, cancel each other in the calculation.

Physical Damage

Exposure of neighboring well screens represents the potential for physical damage to a well. A reasonable threshold of significance is if the project causes static water levels (when the pump is off) at wells to fall below the average depth to the top of the well screen. The average top-of-screen depth may be an appropriate benchmark because it would be unreasonable for the shallowest well in a basin to constrain the use of basin storage by all users. In practice, some wells may have static water levels that are already below the top of the screen. In this case, a small amount of additional drawdown would be of little consequence because the risk of screen collapse due to corrosion is already present. At other wells, pumping water levels (when the pump is on) can be below the top of the screen. Corrosion is not usually a high risk in these situations, and a small increment of additional drawdown would presumably not substantially increase the likelihood for damage to occur. Accordingly, the impact of additional drawdown is considered significant only if static water levels above the screen are caused to fall below the top of the screen because of project pumping.

Staff reviewed the well construction information for water supply wells reported by the applicant (Appendix J of the AFC) and in classified well driller reports provided by the California Department of Water Resources. The well construction data indicate an average well depth of about 480 feet, and the top of the well perforations start at an average depth of 210 feet below land surface. In March of 2008, the average reported depth to water in wells was 200 feet below land surface (standard deviation of 100 feet). Hence, average water depths are within ten feet or more of average well perforation depths.

Thresholds to Determine Significant Impact

For average conditions in the Fremont Valley, the water table is located about 10 feet above the well perforations. Equation (2) indicates a 10 feet decrease in average depth to water, which corresponds to a lowering of the water table to the top of the well screen, results in a 9-percent reduction in theoretical maximum well yield. One threshold therefore could be limiting drawdown to 10 feet below existing conditions. Drawdown of static water levels greater than 10 feet may expose the well screens, making them susceptible to potential corrosion and damage.

Groundwater Impacts

The applicant developed a two-dimensional groundwater-flow model of the Koehn Sub-basin to evaluate potential project-related pumping impacts. Staff's evaluation and conclusions regarding the model are provided in **SOIL and WATER-Appendix B**. In summary, the model appears properly constructed, adequately represents the applicant's stated and/or implied assumptions regarding groundwater-flow conditions, and uses an accepted computer code. All model simulations appear to meet appropriate mass balance errors and head closure criterion.

However, these supportive findings do not necessarily indicate the model accurately simulates historical water levels at all locations or reliably predicts future water level changes due to proposed project pumping. For example, staff compared simulated and observed water level recoveries and noted that at nine locations, the directions of the

trends agree but the simulated recovery rate was usually greater than observed. Additionally, at seven locations simulated and observed water level trends are opposite in direction. At some of these locations, the model simulated increasing water levels when in reality observed water levels are decreasing. At other locations, simulated water levels are decreasing whereas observed water levels are increasing. These findings illustrate that the model is a simplification of the real world system and there likely exist conceptual deficiencies (i.e., important processes may be neglected in the model) and uncertainty in defined stresses (inflows and outflows like recharge and pumping rates are poorly understood). The model results submitted by the Applicant can likely provide useful insight into the probable cause and effect relationships between recharge and pumping, but the accuracy of the results is uncertain and should be interpreted with caution.

The aquifer parameter values and most boundary conditions specified in the model appear generally consistent with the conceptual groundwater system described in previous reports. However, staff's review of published modeling studies and data provided by the project applicant indicate two boundary conditions may actually be different than specified in the model. These conditions are subsurface inflow from the Antelope Valley to the Fremont Valley Basin, and the timing and magnitude of discharge to Koehn Lake. No assessment of model sensitivity to these boundary conditions is reported. It appears to staff that the model also neglects to include historical agricultural return flows, which is a potentially important historical recharge process. Sensitivity testing by the applicant included agricultural return flows with a 10-year delay and the results appeared to significantly alter the timing and magnitude of simulated water level changes. At the end of their "verification" model run, the simulated water levels at some locations were 30 to 50 feet higher in 2007 than their corresponding model run that did not consider return flows.

The applicant reported additional model simulations that considered the sensitivity of model results to uncertainty in aquifer parameters (hydraulic conductivity and storage coefficient), fault hydraulic characteristics, and recharge. The sensitivity test results provided a range in possible simulated Koehn Sub-basin responses to project groundwater pumping and help represent the uncertainty in sub-basin hydrogeologic conditions.

Staff considered the applicant's model and simulation results as part of their evaluation of potential groundwater impacts. Environmental Simulations, Inc. (ESI 2009) modeled the 5-month construction water use scenario to assess pumping effects. The groundwater model simulation assumed seven wells pump continuously during the five-month period at about 5 million to 10 million gpd. This construction scenario pumping was then followed by 30 years of project pumping operations. For project operations, the initial water use estimate of 1,600 AFY of pumping was simulated for a continuous 30-year period (ESI 2009).

Substantial interference with groundwater recharge or depletion of aquifer volume and lowering of the local groundwater table level are considered significant negative impacts. Potential recharge interferences can refer to how a project alters the volume and rate of water percolating into the subsurface and replenishing the aquifer. In the Fremont Valley, recharge from rainfall infiltration on the valley floor is assumed

negligible, so the project itself is not expected to interfere substantially with recharge from rainfall infiltration. Mountain front recharge and recharge from runoff infiltration into stream beds are assumed to continue at historical rates unaltered by the project. The applicant's groundwater-flow modeling results provide insight into project pumping impacts to groundwater supplies.

Soil & Water Figure 4 shows the historical cumulative change in groundwater storage simulated by the applicant's groundwater-flow model for their "verification" run and predicted future storage changes both with and without proposed project pumping. Simulated historical conditions indicated that past agricultural pumping consumed almost 640,000 AF of groundwater storage and since about 1995, simulated storage in the Koehn sub-basin has slowly but steadily recovered at a rate of about 5,300 AF/yr. Even with the proposed project, simulated storage continues to increase but at a slower rate (4,600 AF/yr). After 30 years of simulated project pumping, simulated groundwater storage in the Koehn sub-basin is about 21,000 AF lower than without project pumping.

ESI (ESI2009) also reported the predicted impacts to water levels at 24 well locations within and near the project site. They defined these impacts as the difference between simulated future water levels in the year 2040 with and without project pumping. ESI (ESI2009) also considered the uncertainty in aquifer conditions and report simulated impacts for a range in aquifer conditions defined by the assumed uncertainty in model input. Staff utilized this information to calculate the drawdown in order to compare model results with the thresholds and determine the significance of the impacts. Staff calculated the drawdown by subtracting the simulated water level at the end of 2007 (current conditions) from the predicted water levels in 2040. The calculated drawdowns are summarized below in **Soil & Water Table 9**.

In **Soil & Water Table 9**, positive drawdown indicates simulated future water levels decrease relative to 2007 because of simulated project pumping. Conversely, negative drawdown indicates simulated future water levels increase relative to 2007 water levels (i.e., simulated water levels continue to increase even with project pumping).

Soil & Water Table 9
Maximum Thresholds and Simulated Impacts from Project Pumping.

Well	Distance to Pumping Well (miles)	Threshold (feet)	Simulated Drawdown (feet)			
			Zero Recharge ^a	Base ^b	Sensitivity Tests	
					Maximum Drawdown	Test Name
Pumping Well 63	0.0	10	33.4	-40	-30	K x 0.5
31S37E08C001M	0.6	10	30.0	-43	-36	K x 0.5
31S37E05M01	0.9	10	31.6	-44	-37	K x 0.5
Pumping Well 48	1.0	10	28.3	-44	-38	K x 0.5
31S37E10A01	1.9	10	-11.0	-48	-42	No Cantil Fault
30S37E34H02	2.7	10	24.1	-43	-40	K x 0.5
31S37E14L01	3.0	10	-11.7	-47	-42	No Cantil Fault
30S37E27H002M	3.4	10	24.3	-41	-39	K x 0.5
31S37E30F001M	3.6	10	-2.0	-23	-18	No Cantil Fault
Well 24	4.1	10	-7.9	-46	-43	No Cantil Fault
31S38E06E001M	4.2	10	-9.4	-45	-42	No Cantil Fault
30S37E36G001M	4.3	10	15.1	-44	-43	K x 0.5
31S37E33H001M	4.5	10	9.5	-2	0	No Cantil Fault
31S37E35N001M	5.3	10	9.8	-1	1	No Cantil Fault
30S37E24J001M	5.4	10	11.8	-35	-34	Sy x 0.5
30S38E32D03	5.6	10	-10.9	-40	-38	No Cantil Fault
30S38E19K01	5.9	10	9.1	-33	-32	Sy x 0.5
30S38E03K002M	10.2	10	6.3	-25	-24	Sy x 0.5
30S38E24F001M	10.2	10	-6.3	-19	-18	K x 2
29S39E32E001M	13.6	10	13.5	-22	-22	Sy x 0.5
30S39E08A001M	13.7	10	4.5	-7	-6	K x 2
29S39N29N01	13.9	10	14.8	-22	-22	Sy x 0.5
29S39E33K001M	14.9	10	8.5	-7	-6	K x 2
29S39E28H001M	15.8	10	18.1	-20	-19	K x 2, Sy x 0.5

a) ESI (2009) reported simulated impacts in their Table 4 assuming Zero Recharge (no mountain front recharge or rainfall runoff infiltration), and defined the impact as the predicted water level in 2010 minus the predicted water level in 2040 with project pumping. Negative values indicate that simulated water levels in 2040 are greater than in 2010 (i.e., simulated water levels continue to increase even with project pumping and no mountain front recharge or rainfall runoff infiltration). Positive values indicate water levels decrease because of project pumping and reduced recharge.

b) Drawdown calculated as the simulated 2007 water level minus the simulated 2040 water level with project pumping. Negative values indicate that simulated water levels in 2040 are greater than in 2007 (i.e., simulated water levels continue to increase even with project pumping).

The maximum simulated drawdown utilizing the "base" model ranges from -1 foot to almost -50 feet. Although water levels are lowered by project pumping relative to water levels without project pumping, negative drawdown indicates water levels are higher at the end of the pumping period than in 2007. Therefore, the maximum thresholds are not exceeded utilizing the "base" model, and maximum well yields are expected to increase relative to current conditions as a result of the simulated water level rise.

Sensitivity tests considered potential effects of uncertainty in aquifer parameters, faults, and recharge. The effects are variable between tests and at different well locations, but the conclusions generally agree with the base model run results. On average, reducing hydraulic conductivity and specific yield increases the magnitude of simulated

drawdown, whereas increasing hydraulic conductivity, specific yield, or removing the Cantil Valley Fault decreases the simulated drawdown. In all but two wells, the drawdown is negative indicating simulated future water levels are greater than simulated 2007 levels. Because of the continued simulated water level rise, thresholds are not exceeded at these wells. In the two wells with non-negative drawdown, simulated drawdown is zero and one foot, which are both below the thresholds and indicate no significant impact.

For the "Zero Recharge" analysis, the simulated drawdown without mountain front recharge or infiltration of storm run-off represents the extreme case where Koehn sub-basin groundwater storage changes are due solely to subsurface inflow from adjacent sub-basins (about 1,100 AF/yr) and outflow by pumpage (4,900 AF/yr of pre-existing pumpage shown in **Soil & Water Table 8** and the approximately 1,600 AF/yr additional new pumping for the project). The simulated drawdown at seven locations is negative, indicating that water levels continue to rise in some areas even without future recharge. On the average, the decrease in groundwater recharge reduces the simulated recovery rates by 1.2 ft/yr (almost 30%). The continued increase of water levels is therefore, due partially from groundwater already in storage, and on average 70% of the simulated recovery in these areas is due to the re-distribution of water in storage. In the remaining wells, simulated water levels decrease from about four to more than 33 feet. In 11 wells, the simulated drawdown is greater than 10 feet indicating a significant reduction in theoretical well yield and exposure of the well screens.

About 30% of estimated average annual recharge is currently extracted and consumed by pumping wells in the Koehn sub-basin (**Soil & Water Table 8**), and proposed project pumping represents consumption of an additional 10% of estimated annual recharge (a combined total consumption of 40%). The estimated volumetric water budget for the sub-basin suggests groundwater storage is increasing by 11,700 acre-feet per year, but the increase is not uniform and observed water level declines in some areas indicate groundwater discharge may exceed recharge at least locally (**Soil & Water Table 6**). The applicant's groundwater-flow modeling results indicate observed upward water level trends is not entirely due to the addition of new water from rainfall recharge, but instead is groundwater already in the sub-basin moving into water table depressions created by historical agricultural consumption. In addition, simulated upward water-level trends based on the applicant's recharge values in **Soil & Water Table 6** can be greater than observed water level trends (see **Soil & Water Table 6** and **Soil & Water Figure 1 in Appendix B**). These findings indicate uncertainty in estimated recharge, and under assumed worst case conditions (no mountain front recharge or infiltration of storm run-off) potentially significant negative impacts to existing wells near the project site may occur.

The applicant's conclusions regarding insignificant impacts resulting from project groundwater use rely substantially on Koehn Sub-basin water levels continuing to increase into the future. Staff confirmed historical water level increases in most parts of the Koehn Sub-basin. However, in some areas, the model-simulated recovery is substantially greater than observed (for example, the actual water levels observed in some wells have been somewhat stable for the past 5-years or more but the model simulates a substantial water level increase). In other areas, the recovery is supplied primarily by water already in the basin (the re-distribution of existing water in response

to historical agricultural groundwater use). Finally, the simulated water level rise in some areas is contrary to observed, and real world water levels are actually declining. Simulated drawdown from the applicant's model may therefore be optimistic (represent the minimum potential to impact groundwater resources), at least in some areas, whereas the "Zero Recharge" test may be overly conservative (represent the maximum drawdown), at least over the long-term period of 30-years. The actual potential for the project to impact the groundwater resource and existing wells likely falls within a range bounded by these two scenarios (the Base and Zero Recharge simulations).

Because of general uncertainty in hydrogeologic conditions and future groundwater levels, the applicant proposes to mitigate potential negative impacts to wells by forming a Koehn sub-basin groundwater monitoring committee. The purpose for the committee is to implement data collection activities and track actual changes in groundwater levels or quality in wells near the proposed power plant. The committee will include representatives from California City, the community of Cantil, Rancho Seco, Honda, and the project applicant (Beacon Solar LLC). The committee will oversee development of a monitoring well network; establish base line (pre-project conditions); and, routinely collect, archive, and analyze water level and water quality data.

Data collection and routine monitoring is necessary to manage groundwater resources. It will be critical for groundwater monitoring activities to identify and quantify future water level changes and the relationships between groundwater use and recharge in order to quantify project impacts that may occur. To ensure there are no impacts to groundwater resources, staff recommends the applicant be required to comply with Condition of Certification SOIL&WATER – 1 which would require the applicant to form a groundwater management committee, implement a monitoring program to evaluate groundwater basin conditions, and provide recommendations to staff regarding the need for and scope of mitigation necessary for any impacted wells.

Water Quality

In the southwestern portion of the Koehn sub-basin, groundwater is classified as sodium bicarbonate or calcium-sodium bicarbonate and contains TDS concentrations ranging from 350 ppm to 450 ppm (DWR 2003). Monitoring of BSEP site wells by USGS and DWR since 1955 demonstrate that groundwater beneath the site is of high quality with TDS concentrations ranging between 350 ppm and 564 ppm (BS2008a). Near the end of site aquifer testing conducted in 2007, three groundwater samples were collected from onsite wells (BS2008a). Evaluation of laboratory analyses conducted on those samples indicate that site groundwater is fresh and with minimal treatment, suitable for drinking.

Groundwater within the Koehn sub-basin varies in quality in relation to its proximity to Koehn Lake. Koehn Lake is hydraulically connected to groundwater in the basin and is reportedly the only significant natural discharge feature in the Koehn sub-basin. The natural discharge of Koehn Lake is through evaporation, which leaves behind (concentrates) salts previously contained in the groundwater. As Koehn Lake is

approached, TDS concentrations in groundwater increase thereby, decreasing groundwater quality. Groundwater samples collected from wells adjacent to Koehn Lake have contained TDS concentrations exceeding 100,000 ppm (Dockter 1979, DWR 2003).

Saint-Armand (1991) suggested that "farming had so lowered the water table that brackish water from Koehn Dry Lake may migrate westward into the pumping depression near Cantil..." Similarly, Koehler (1977), indicated that because the groundwater gradient is from Koehn Lake toward the pumping depression, which was located near the proposed BSEP site, saline water under Koehn Lake poses a potential threat to the fresh water supply.

Significant pumping west of the lake bed can therefore, potentially change eastward sloping hydraulic gradients, causing them to reverse and induce groundwater flow from east to west. As a result, saline groundwater associated with the lake bed can migrate and co-mingle with the relatively higher quality fresh water. Staff analyzed the project's proposed use of groundwater to determine if it could degrade the quality of regional or local surface water or groundwater supplies.

Staff reviewed water quality data presented by the applicant that was compiled from DWR and USGS records obtained from well-water samples collected during various periods between 1955 and 2007(DB2008t). The data indicate variations in concentrations of TDS in groundwater samples collected from representative wells during this time. However, these data do not indicate a discernible trend that would indicate migration of high TDS groundwater within the Koehn Lake Sub-basin caused by water extraction at the BSEP site during the period of heavy agricultural pumping (1977 to 1984). During this time of heavy agricultural pumping, groundwater was extracted from the site at volumes between 12,000 and 17,000 AFY (SAMDA 2008a). Additionally, surrounding landowners were also pumping heavily causing a significant decline in water levels (SAMDA 2008a). This heavy agricultural pumping was more than 10 times greater than that proposed by the applicant (1,388 AFY). Based on substantial historic pumping levels and corresponding lack of data indicating that relatively high salinity groundwater migrated toward the pumping depression during that period, the withdrawal of 1,388 AFY of groundwater from beneath the site is not expected to induce high salinity groundwater near Koehn Lake to migrate westward, toward the site, and significantly impact local groundwater quality.

Applicant's Groundwater Mitigation Plan

The applicant has proposed a Groundwater Mitigation Plan to address potential impacts to groundwater resources. The program would consist of four components which are discussed below.

1. Partial Zero Liquid Discharge System (ZLD)

The applicant has redesigned their project (DB 2009r) to include ZLD. They indicate the use of this technology would reduce their water use up to 200 AFY. This reduction in water use has been included in the applicant's current estimated water use of 1,388 AFY. Staff analysis of potential groundwater impacts discussed above includes consideration of this revised water use estimate.

2. Incorporating Low Impact Development (LID)

The applicant has redesigned their project (DB 2009r) to incorporate LID practices into the facility layout and design. Staff does not believe the applicant's proposed storm water management design is consistent with LID. The goal of LID is to maintain the function and value of the natural drainage system while minimizing the risk of accelerated soil erosion and increased storm water runoff, while enhancing or maintaining groundwater recharge. The applicant did not provide sufficient information to quantify what change in groundwater recharge could be achieved with this design when compared to the no project condition.

3. Tamarisk Removal Program

The Tamarisk Removal Program is designed to provide benefits to both groundwater and biological resources. The applicant would establish an endowment fund and a program that would include research, stakeholder coordination, mapping, removal, and monitoring. Water savings estimates have been provided but it appears there is insufficient data currently available to identify where there is significant growth of Tamarisk in the Fremont Valley. Since the removal potential is unknown it is not possible to estimate what water savings could be considered in a groundwater impact analysis.

4. Groundwater Monitoring

The applicant has proposed a groundwater monitoring program in response to staff's analysis in the PSA. Staff has included this program in Appendix I and used it as the basis for development of Condition of Certification **SOIL&WATER – 1**.

In summary, staff believes the analysis of groundwater impacts above has adequately addressed the quantifiable savings described in the applicant's groundwater mitigation plan. It is possible additional benefits can be achieved through an LID approach to design and a Tamarisk Removal program but insufficient information was provided to evaluate the potential for mitigation of any impacts.

Wastewater

Construction Wastewater

During construction, water would be used for one-time hydrostatic testing of pipelines and pressure vessels. In addition to hydrostatic test water, a small amount of wastewater will be generated during equipment and vehicle washing. The applicant estimates that approximately 360,000 gallons of water will be used for hydrostatic testing. This water will be reused to the extent feasible in accordance with applicable regulations. Water that cannot be reused will be discharged to the evaporation ponds. As currently designed (6 acres of surface area), the evaporation ponds have enough capacity to contain all of the 360,000 gallons of hydrostatic test water. The discharge of any wastewater during construction must comply with Condition of Certification **SOIL & WATER – 4**, and the Requirements of Waste Discharge presented in **Soil and Water Appendices E, F, and G**.

Operation Wastewater

Wastewater generated from the project operation would include cooling tower blow down, sanitary wastewater, and storm water. The applicant proposes two separate wastewater collection systems for BSEP operation. The water-balance diagrams provided in the AFC (BS 2008a), show the expected wastewater streams and flow rates for the project under summer (representing peak usage) and annualized conditions.

The first wastewater collection system is the process wastewater system. The process wastewater system is proposed to collect all onsite wastewater generated from operation of the plant. Process water wastes, including cooling tower blowdown and waste streams from the neutralization tank would be conveyed to a partial zero liquid discharge (ZLD) system and disposed to lined, onsite evaporation ponds. The peak summer discharge is designed at a rate of 52 gallons per minute (gpm) and an annual discharge is designed at a rate of 44 gpm.

Three potential water sources with different water chemistries have been identified for use by BSEP. These three sources are 1) site groundwater, 2) recycled wastewater obtained from the city of Rosamond and/or California City and 3) degraded groundwater located in the vicinity of Koehn Lake. Concentration of TDS in the site groundwater and the recycled water are very similar (approximately 500 ppm). TDS in groundwater near Koehn Lake exceeds 1,000 ppm. Employing the partial ZLD, the wastewater discharging to the evaporation ponds will have a TDS concentration of approximately 70,000 ppm if site groundwater or recycled wastewater is the water source, and approximately 111,000 ppm if the degraded groundwater is the water source. Due to the elevated concentration of TDS, this wastewater is considered a Class II designated waste. In order to accommodate this flow, three evaporation ponds will be required, each with a nominal surface area of two acres, for a total surface area of six acres.

The ponds would be designed with an average depth of eight feet, which allows for two feet of freeboard, three feet of wastewater and three feet of accumulated solids. Because the wastewater is considered a Class II designated waste, the ponds must be designed to contain precipitation resulting from a 1,000 year, 24 hour storm (**Soil & Water Appendix F**). For safety and operational purposes, the ponds will be cleaned when three feet of precipitated solids are accumulated in the base of the ponds.

Multiple ponds are planned to allow plant operations to continue in the event that a pond needs to be taken out of service (e.g., needed maintenance or solids removal). Each pond will have enough surface area so that the evaporation rate exceeds the cooling tower blowdown rate at maximum design conditions and at annual average conditions.

As designed, the pond liner system would consist of a 60 mil high density polyethylene (HDPE) primary liner and a minimum 40 mil HDPE secondary liner. Between the liners is a synthetic drainage geonet that is used as part of the leachate collection and removal system (LCRS). There will be a hard surface protective layer on top of the 60 mil HDPE, which will consist of a non-woven geotextile, one-foot thick granular fill/free

draining, material and a one-foot thick hard surface such as roller-compacted concrete. The hard surface provides protection against accidental damage to the HDPE from falling objects, varying climatic conditions and worker activities during cleanout and maintenance.

BSEP estimates that precipitated solids would accumulate to a thickness of three feet in the ponds every 4.5 years if site groundwater or recycled wastewater is the water source, and approximately 3.8 years if the degraded groundwater is the water source. Once the solids accumulate to a thickness of three feet, the evaporative residue would be removed. BSEP estimates that 150,000,000 pounds of residue will be generated in the ponds over a thirty year period if site groundwater or recycled wastewater is the water source, and approximately 300,000,000 pounds of residue will be generated in the ponds over a thirty year period if the degraded groundwater is the water source (DB 2009r).

Evaporation pond monitoring would be required to detect the presence of liquid and/or constituents of concern emanating from the ponds in accordance with the Requirements of Waste Discharge established by the LRWQCB and presented in **SOIL & WATER Appendices E, F and H**. As proposed, the leak detection monitoring program for the facility consists of monitoring the LCRS, lysimeters, and monitoring wells for the presence of liquid and/or constituents of concern (BS2008a). The LCRS would be monitored to detect accidental liner failure. BSEP proposes to use several existing onsite water supply wells to detect groundwater impacts from accidental pond discharge. Constituents of concern would include chloride, sodium, sulfate, TDS, biphenyl, diphenyl oxide, potassium, selenium, and phosphate (BS 2008a). Staff believes there would be no significant surface water or groundwater contamination resulting from wastewater discharge if the applicant complies with Conditions of Certification **SOIL&WATER - 3. SOIL & WATER -3** would require the applicant to comply with the Requirements of Waste Discharge presented in **Appendices E, F, G and H**.

The second proposed wastewater-collection system is the sanitary system. The sanitary system would collect wastewater from sinks, toilets, and other sanitary facilities for discharge to an onsite septic sewer system and leach field. Design and construction of the on-site waste disposal system would be completed in accordance with Kern County Environmental Health Services Department, Sewage Disposal by Individual Soil Absorption Systems requirements. In order to comply with Kern County on-site sewage disposal requirements, staff recommends that the sanitary wastewater system be constructed in accordance with Condition of Certification **SOIL&WATER - 2**.

Soil Erosion Potential by Water and Wind

Construction

Construction activities can adversely impact soil resources including increased soil erosion, soil compaction, loss of soil productivity, and disturbance of soils crucial for supporting vegetation and water dependant habitats. Activities that expose and disturb the soil leave soil particles vulnerable to detachment by wind and water. Soil erosion results in the loss of topsoil and increased sediment loading to nearby receiving waters.

The magnitude, extent, and duration of those impacts would depend on several factors, including the proximity of the BSEP site to surface water, the soil types affected, and the method, duration, and time of year of construction activities. Prolonged periods of precipitation, or high intensity and short duration runoff events coupled with earth disturbance activities can result in on-site erosion. In addition, high winds during grading and excavation activities can result in wind borne erosion leading to increased particulate emissions that adversely affect air quality.

The BSEP site would be subject to wind and water erosion during construction. Project construction would be completed over a 26-month period (BS 2008a). The total site grading would be significant, with up to 20 feet of cuts and fills, excavation of a diversion channel to reroute Pine Tree Creek and filling the existing Pine Tree Creek channel, amounting to approximately 8,300,000 cubic yards of soil being moved. The earthwork would consist of primarily cut and fill grading with excavation for foundations and underground systems. The Pine Tree Creek engineered diversion channel would require nearly 3.1 million cubic yards of soil material to be cut.

A draft project grading plan and SWPPP has been prepared by the applicant that includes Best Management Practices (BMPs) for wind and water erosion control during project construction. The implementation of appropriate erosion control measures would help conserve soil resources, maintain water quality, prevent accelerated soil loss, and protect air quality. The erosion and sedimentation control measures include: applying water to the roads in active construction and laydown areas; controlling speed on unpaved surfaces; placing gravel in entrance ways; use of straw bales, silt fences, and earthen berms to control runoff; restoration of native plant communities by natural revegetation, seeding and transplanting, and application of soil bonding and weighting agents. During grading work, soil would also be stabilized by maintaining sufficient water content to make it resistant to weathering and erosion by wind and water. Silt fences would be placed at adequate spacing perpendicular to the drainage path and generally oriented in a northwest to southeast direction to trap sediment before it can migrate.

Given the low frequency of precipitation and storm water runoff BMPs implemented during construction should limit potential soil loss from water erosion caused by on-site precipitation events. As outlined in the preliminary DESCP, BMPs would include temporary erosion control methods such as the use of crushed rock, silt fences and fiber rolls. The potential for soil loss by water erosion was estimated by ENSR (March 2008) for pre-development, construction, and post-development conditions. Under current conditions, the soil loss was estimated to be about one ton per year. As described above and in the DESCP, without implementation of control measures and BMPs, construction activities would increase the potential for soil loss. Estimated soil loss during the construction period is about 150 tons per year (BS2008a). Although the expected infiltration rate at the site is rapid, BMPs would include the following:

- Local soil berms and a retention area would be constructed to contain storm water runoff.
- During site grading, clearing and grubbing would be confined to only those areas needed for facility construction as indicated in the conceptual grading plan.

- Temporary erosion controls including crushed rock, silt fences and fiber rolls would be used as needed to minimize erosion in active grading areas. Soil stockpiles would be covered prior to forecasted storm events and during windy conditions. Fiber rolls or gravel bags would be placed around the perimeter of the stockpiles to further minimize the potential for runoff.
- The applicant indicated that as a BMP, water would be used to control dust and would be applied at a rate so as to minimize runoff. Staff recommends that the applicant utilize CPM- approved dust palliatives and other dust control BMPs including soil binders or weighting agents to minimize water use during construction to the extent possible.

BMPs would be applied and repaired as soon as erosion is evident and as soon as possible. Temporary erosion control measures would be implemented as needed to control erosion. Temporary sediment control materials would be maintained onsite throughout the life of the project to respond as needed to unforeseen rain or emergencies.

In the absence of proper BMPs and due to the soil type, the project earthwork could cause significant fugitive dust and erosion. As shown in **Soil and Water Table 2**, the predominant surface soil condition on the proposed BSEP site is fine to gravelly sand with a water erosion potential of slight to moderate. The surface textures of these gravelly areas have a slight potential for wind erosion and those areas with a finer component have a high potential for wind erosion (NRCS 2008). However, with implementation of BMPs identified by the applicant in the AFC and proposed in Condition of Certification **SOIL&WATER-3**, significant soil erosion and subsequent sedimentation would be avoided. Overall, staff believes the applicant has identified a reasonable plan and sequence for implementing BMPs that would avoid significant adverse erosion and sedimentation impacts resulting from precipitation runoff. Staff concludes that through the proper application of BMPs as proposed by these conditions of certification, the impact to soil resources from water and wind erosion during construction would be reduced to a level that is less than significant.

Staff has also analyzed the potential impacts from construction of the alternative recycled water supply pipelines from Rosamond Community Services District and California City. The applicant did not include these linears in the draft project grading plan and SWPPP. For delivery of this water from Rosamond, construction would require a 40-mile long underground pipeline extending from the community of Rosamond to the BSEP site. The southern 23 mile portion of the Rosamond Alternative water pipeline alignment would be constructed almost entirely within existing road beds and shoulders. The alignment is mostly along improved gravel and dirt roads in rural-residential and undeveloped areas, on the disturbed road shoulder of Sierra Highway, and on the paved road bed of Rosamond Boulevard. The northern 17 mile portion would be constructed in the existing roadbed and shoulder of Neuralia Road. The pipeline alignment crosses two forks of Cache Creek, an ephemeral drainage, and 12 smaller unnamed ephemeral drainages. All features, including Cache Creek, are isolated waters with no direct connection to a perennial stream or other navigable waters or permanent water source such as a lake or spring, and are unlikely to qualify as jurisdictional features subject to regulation under the federal Clean Water Act. Only Cache Creek

would be considered a waters of the state because the other ephemeral drainages are not characterized by a defined bed and bank within the pipeline alignment right-of-way. To reduce construction related erosion and sedimentation impacts to less than significant, the applicant would be required to comply with Condition of Certification **SOIL & WATER-5** for installation of this pipeline.

For delivery of recycled waste water from California City, construction of a 12-mile long underground pipeline extending from California City to the BSEP site would be required. The California City Alternative water pipeline alignment would be constructed almost entirely within existing road beds and shoulders. The alignment is mostly along the disturbed road shoulder of paved Mendiburu and Neuralia Roads. To reduce construction related erosion and sedimentation impacts to less than significant, the applicant would be required to comply with Condition of Certification **SOIL & WATER-5** for installation of this pipeline.

Staff believes that the conceptual Best Management Practices (BMPs) for wind and water erosion control presented in the draft grading plan and SWPPP could also be applied to the pipeline alignments and would be sufficient to address significant adverse erosion and sedimentation impacts resulting from precipitation runoff. To ensure grading and drainage plans are developed that specifically address potential impacts from pipeline construction, staff recommends the applicant be required to comply with Conditions of Certification **SOIL & WATER-3** and **SOIL & WATER-5**. Condition of Certification **SOIL & WATER-3** would require the applicant to develop a SWPPP that would include identifying and implementing BMP's for construction of the pipelines. Condition of Certification **SOIL & WATER-5** would require the applicant to develop and implement a DESCP that would include designs and plans for implementation of soil and water erosion mitigation measures for construction of either pipeline alternative.

Operation

The applicant has proposed permanent erosion control measures to mitigate potential soil erosion and subsequent sedimentation impacts resulting from precipitation runoff during operation of BSEP. During operation, areas not covered by foundations, paving, or the solar array would be treated with soil stabilizers. BSEP has not fully described the durability of these soil stabilizers to withstand adverse weather conditions, and their susceptibility to vehicular traffic. These erosion control measures would be included in the Requirements for Waste Discharge presented in **Soil and Water Appendix F** and required by staff in Condition of Certification **SOIL&WATER – 4**. With implementation of the requirements, staff does not believe there would be significant impacts to soil resources during operation of BSEP.

Staff is concerned that the finish grade soil stabilization treatments may cause a reduction in infiltration and requests that the applicant assess potential impacts related to storm water runoff from treated soils or mitigate for additional surface runoff. Broad application of soil treatments would affect the soils ability to infiltrate rainwater. Less infiltration means more runoff. The applicant referenced the September/October 2003, Journal of Hydrologic Engineering article: "Hydrologic Impacts of Disturbed Lands Treated with Dust Suppressants." The study presents research on changes in hydrologic characteristics of disturbed land surfaces treated with dust suppressants.

The study reports the percent change in runoff from eleven different dust suppressant tests. Tests show disturbed lands treated with dust suppressants can cause minor increases to runoff or increase runoff 300% to 400%.

Staff recommends that the applicant comply with Air Quality Condition of Certification AQ-SC3 to apply dust suppressant compounds as necessary. The applicant would apply the dust suppressants per manufacturer's specifications and rely on data from the manufacturer or studies that examine the change to the runoff characteristics of the disturbed soil. The applicant would be required to describe its findings in the Drainage, Erosion, and Sediment Control Plan (DESCP). Site imperviousness, used for determining runoff as well as sizing onsite retention basins, would account for changes to the runoff characteristics. Staff is requiring that the applicant provide these calculations in the DESCP, a requirement of Condition of Certification **SOIL & WATER-5**. Condition of Certification **SOIL & WATER-5** requires the project owner to obtain Compliance Project Manager (CPM) approval of the site-specific final DESCP that addresses storm water project elements including site runoff, retention, detention (if necessary), and BMPs to protect soil and water resources for the operation phase of the project.

BSEP storm water may encounter soil or chemicals deleterious to aquatic and terrestrial plant and wildlife. Staff reviewed the applicant's conceptual BMPs for managing potentially harmful storm water to check that the measures would protect water quality. Potentially significant water quality impacts could occur during operations if contaminated or hazardous materials used during operations were to contact storm water and drain offsite. BSEP would alter natural storm water drainages and use BMPs to reduce potentially significant impacts related to concentrated drainage and ensuing soil erosion and sediment transport offsite. Recognizing these potential impacts, the applicant has prepared a draft industrial SWPPP required by the general WDR for industrial activity. Condition of Certification **SOIL&WATER - 4** requires the project owner obtain Compliance Project Manager (CPM) approval and implement the final industrial SWPPP and monitoring plan. Condition of Certification **SOIL&WATER - 4** requires that BSEP comply with the conditions of the Requirements for Waste Discharge (**Soil and Water Appendix F**), for discharges of storm water associated with industrial activity.

Temporary and permanent disturbances associated with construction and operation of the proposed project would cause accelerated wind- and water-induced erosion. However, staff has concluded that with the implementation of proposed mitigation measures, the construction and operation SWPPPs, and Condition of Certification **SOIL&WATER-5** that the project would not contribute significantly to cumulative erosion and sedimentation impacts. Staff recommends that BSEP develop a site specific DESCP that addresses all project storm water elements as part of this Condition of Certification to ensure protection of water quality and soil resources during construction and operation of the project. This condition of certification requires the applicant to provide Kern County a copy of the DESCP for their review and comment. The project owner would also be required to obtain CPM approval of the DESCP.

Storm Water

Construction Storm Water

The BSEP site would be located primarily in a former agricultural field with areas having sparse scrub and brush. During site construction, several site conditions would potentially contribute to significant erosion following a significant rainfall event. Some of these construction related site conditions include the large volume of earth graded, the long duration of the construction period, and soil properties that have a high to moderate potential for water erosion. Construction storm water drainage patterns may concentrate runoff in areas that are not properly protected with BMPs causing erosion of soils and sediment discharge offsite and possibly into surface waters. Potentially significant impacts to water quality could occur during construction, excavation, and grading activities if contaminated or hazardous soil or materials used during construction were to contact storm water runoff and drain offsite.

Staff reviewed the BSEP Conceptual Drainage Plan provided in the AFC (BS 2008a) and the Project Design Refinements (DB 2009r) which evaluated storm water runoff for pre-developed conditions onsite and offsite and post-development (operations) conditions at the site. BSEP development would increase site runoff volume because of increased impervious areas or other changes to the site's soil infiltration capacity. Drainage system improvements also reduce the time of concentration of the storm water runoff and may increase peak runoff rates without proper attenuation measures.

Potentially significant impacts to soils resulting from soil erosion would occur in areas not protected with BMPs for construction. Recognizing these potential impacts, the applicant has prepared a draft SWPPP, required by the general WDR, for construction activity. Condition of Certification **SOIL&WATER-3** would require the applicant to comply with the requirements of the WDR for discharges of storm water associated with construction activity. With implementation of the permit requirements and Condition of Certification **SOIL&WATER-3**, staff does not believe there would be significant erosion or sedimentation impacts due to storm water runoff, for on and offsite discharges, during construction.

Construction of the BSEP would add impervious areas to the site, causing an increase in storm water runoff. Drainage and erosion control measures that create a separate storm drainage system for the power plant are proposed. BSEP proposes soil treatments, such as soil stabilizers or sprayed water to resist weathering and wind erosion. BSEP's draft construction SWPPP provides conceptual plans for construction related erosion and drainage control measures (BS 2008a). The draft construction SWPPP includes BMPs for properly storing and containing hazardous materials used, and hazardous waste generated, during the course of construction. Staff concludes that proper application of BMPs in accordance with the conditions of certification would reduce to less than significant levels, the storm water impacts to water quality and soil and water resources. Staff also concludes that with implementation of onsite retention, site improvements would not increase the runoff volume or increase peak flood levels downstream.

Storm Water Management During Operations

Staff reviewed the applicant's hydrologic calculations in the Conceptual Drainage Study (CDS) and the Project Design Refinements (DB 2009r) to evaluate the offsite areas tributary to the BSEP site and the proposed onsite storm water management plan. Storm water from offsite areas historically flow toward and across the site via Pine Tree Creek, small drainage swales, or over land as shallow flooding. As proposed, the BSEP project would alter historic storm water flow paths and change typical runoff patterns from the property. **SOIL and WATER - Appendix C** presents a detailed discussion of staff's review of BSEP's storm water plan and watershed-scale assessment of Pine Tree Creek floodwaters. In this section, staff summarizes the potential erosion and sedimentation hazards resulting from onsite precipitation runoff during project operation, and separately addresses onsite storm water impacts and potential impacts related to the Pine Tree Creek diversion.

Site development would result in the formation of ten individual, gently northward-sloping, planar "cells". The applicant has designed ten onsite drainage ditches at the downslope (northern) edge of each cell to collect rainfall runoff and nuisance water runoff originating from site maintenance activities. The ditches would flow from west to east, carrying runoff from each "cell". The applicant sized the ditches for high intensity short duration rainfall with flow velocities three to four feet per second. Ditch flow depths would not be greater than one foot deep. These shallow ditches would have no design freeboard.

The BSEP Retention Methodology chapter of their Conceptual Retention and Grading Study (DB 2009r) provided the engineering design methods proposed by the applicant to size retention basins and detention basins, if necessary, per Kern County requirements. BSEP's retention basin sizing methods introduced in the Project Design Refinements respond to staff and agency comments seeking to percolate and evaporate storm water and prevent undetained discharges. The applicant would construct a network of retention and drainage features to maintain pre-development peak flows from the site. The onsite retention basins, sized for the Intermediate Storm Design Discharge (ISDD) five-day storm event, addresses Lahontan RWQCB and CDFG comments and Kern County requirements for storm water discharges from industrial use areas. Based on the methods proposed by the applicant, staff believes that storm water runoff from the site as well as potential nuisance flows from plant operation and maintenance would not cause significant impacts to the receiving waters with implementation of the Conditions of Certification **SOIL&WATER-4 and -5**. Mitigation required to reduce potential surface water and groundwater contamination impacts to less than significant from discharges of hazardous substances or plant contact storm water are written in Condition of Certification **SOIL&WATER-4**. Staff believes that BSEP would avoid significant degradation to receiving waters during operations caused by storm water during plant operation by implementing these two Conditions of Certification.

The retention basins proposed by the applicant are terminal storm water facilities that would have a 48-hour drawdown. Staff understands this design satisfies the Kern County requirements to infiltrate and/or evaporate within seven days. Staff expects sediment to build up after sediment-laden inflow dissipates or windblown sand

accumulates in the basins. Maintenance and sediment removal may be difficult for basins located directly within the solar field. Staff concludes that the 12 to 18 inches deep retention basins would require monitoring and close inspection to initiate prompt sediment removal activities. It is not clear to staff that the retention basins are adequately sized. Typical sediment volumes are 20% of the total retention volume. It appears that adequate design would require additional storage volume to accommodate accumulated sediments. Staff recommends that these refinements to the design of the retention basins be incorporated into the final DESCP as part of compliance with Condition of Certification **SOIL&WATER -5**.

Staff believes the terrain, originating from the Chuckwalla Mountains west of BSEP, slopes toward the BSEP site and may have historically drained to the site. An offsite drainage ditch currently diverts the offsite tributary area away from the site to the north. In the PSA, staff requested that the applicant provide an adequate routing assessment of the ditch to assess its capacity and flow path and assure the adjacent property owners are not impacted by BSEP diverting storm water away from the BSEP property. Maintenance of this ditch may be required to ensure peak flood flows are routed away from the solar field. The DESCP, requisite for Condition of Certification **SOIL&WATER - 5**, requires that the applicant identify activities and procedures needed to maintain capacity for this offsite ditch to avoid future potential flood related impacts.

In the PSA, staff made requests to the applicant to revise the Conceptual Drainage Study (CDS) to address several concerns about the methods used to meet local storm water management guidelines. The applicant submitted its revised Project Design Refinements (DB 2009r) that overhauled the original Conceptual Drainage Study storm water management plan. Many of staff's concerns were resolved while some issues have not been fully addressed, including the affect of soil stabilizers on the infiltration capacity, impervious area for developed conditions, hydrologic calculations for tributary areas, overflow risks for onsite drainage ditches, and the BSEP contingency plan for potential discharges of hazardous substances in contact with storm water from the industrial site.

Staff finds the current methods proposed by the applicant in the revised Project Design Refinements (DB 2009r), are adequate for developing the onsite, storm water management plan. If implemented as proposed, staff believes the storm water management, including proposed retention basins, would protect the site from erosion and downstream areas from sedimentation and degradation by deleterious materials. However, other issues noted by staff and identified above have not been addressed as part of the design refinements. Condition of Certification **SOIL&WATER-5** requires that the applicant develop a DESCP that addresses these staff comments. Staff believes that if BSEP complies with these conditions, there would not be significant erosion or sedimentation impacts due to onsite storm water runoff.

Based on staff's hydrologic analyses (see **SOIL and WATER - Appendix C**), staff concludes that BSEP's design discharge of 28,000 cfs for Pine Tree Creek is reasonable. This discharge rate establishes the design discharge threshold for the Pine Tree Creek diversion channel basis- of -design. As part of the requirements of Condition of Certification **SOIL&WATER-6**, the project owner would be required to show evidence that, as related to the required CLOMR, Kern County and FEMA have accepted the

calculations and methods used to determine the design discharge. The threshold for significance in this case is the peak design discharge for the 1% annual chance flood (Base Flood). The hydrology study and design discharge must meet FEMA's standards for determining the base flood discharge. As part of the CLOMR approval process, FEMA would review the hydrologic analyses and report on the reasonableness of BSEP's design discharge to meet the 1-percent annual chance flood standard. Condition of Certification **SOIL&WATER-6** also requires BSEP to develop peak flood flow estimates for the 10%, 2%, and 0.2% annual chance flood events using methods acceptable to FEMA.

Since the initial submission of the AFC, the applicant has presented several diversion channel design iterations to staff for review. Staff's most recent review is of the plan provided in the Project Design Refinements (DB 2009r). Staff assessed the potential for this most recent plan to cause impacts related to flooding. Staff's technical review comments are included in **Soil and Water- Appendix C**. Staff provided specific design criteria in the PSA that was meant to guide the applicant into developing the basis-of-design for the diversion channel. In the PSA, staff identified appropriate federal, state and local guidelines and specifications for the applicant that provide design objectives for engineered channels. Staff used these criteria to examine the applicant's flood management plan and to provide comment on the limitations and thresholds of the plan to avoid potential impacts.

CDFG and Lahontan RWQCB provided written comments on the original diversion channel design. Their continued participation in public meetings has resulted in numerous follow-on questions and comments about the design of the diversion channel. The agencies want assurances that the project minimizes environmental impacts, mitigates unavoidable impacts, and restores elements of the natural character of the existing Pine Tree Creek wash. CDFG provided these recommendations to the applicant in response to the BSEP application for a Streambed Alteration Agreement (CDFG, 2009).

Geomorphic Assessment of Pine Tree Creek

Restoring or recreating similar biological functions and values and beneficial uses of Pine Tree Creek, requires an understanding of the geomorphic and hydrological processes found in the natural channel. Staff and the resources agencies identified this link and recommended that the applicant conduct a geomorphic assessment of the diversion channel to identify its potential to meet these criteria. Staff's desktop geomorphic assessment and field reconnaissance focused on sediment erosion, deposition and transport for the natural and proposed engineered channel. Staff used standard geomorphological assessment methods to understand the processes that influence the channel's morphology and sustain its biological characteristics. The geomorphic assessment of Pine Tree Creek is discussed in **Soil and Water - Appendix C**.

In the PSA, staff requested that BSEP use a fluvial geomorphologist with expertise in arid system channel design to conduct a geomorphic study of the Pine Tree Creek drainage. Staff asked that the geomorphic study address the following key issues:

1. Discuss the stability of existing Pine Tree Creek, as it pertains to active alluvial fan morphology, debris flows, erosion, sediment movement and deposition, and channel migration.
2. Selection of an appropriate reference reach (similar watershed characteristics, hydrology, and sediment) to help predict the channel's geomorphic response.
3. Sediment transport analysis that includes the following:
 - a. Grain size distributions from Pine Tree Canyon sediment samples and samples taken within the channel on the alluvial fan.
 - b. A discussion of Pine Tree Creek watershed as a potential source of sediment, the active erosional and depositional conditions of the existing channel, the sediment transport capacity of the existing channel and proposed diversion channel, and the proposed sediment load and flux anticipated with the proposed channel.
 - c. Recommendations for applying bulking factors to the base flood flow.
 - d. Provide a discussion of anticipated maintenance requirements and measures that would improve opportunities for successful mitigation.
4. Low flow channel design for the ultimate diversion channel.

BSEP responded with a sediment transport analysis and concise geomorphic assessment that relied heavily on three aerial photographs taken in 1952, 1983, and 2007. Staff's technical comments on the BSEP Preliminary Sediment Transport Study and Geomorphic Assessment are discussed in **Soil and Water - Appendix C**.

Several of the key issues identified in the PSA and listed above, were not addressed in the Project Design Refinements (DB2009r). The anticipated geomorphic response of the diversion channel was ultimately determined in concert with staff's impact assessment. Staff's conclusions provide the impetus to establish the significance criteria to assess potential impacts related to the diversion channel and its ability to sustain the biological and geomorphological characteristics required for successful mitigation. Staff believes that the channel must be slightly aggradational to recreate the geomorphic function of the natural channel. In an engineered flood control channel, this requires a sufficient understanding of sediment delivery to and transport through the proposed channel. Too much sediment deposition would reduce flood capacity or require a significant effort to maintain the system to avoid significant flood impacts caused by insufficient channel conveyance capacity. Maintenance activities would conversely disturb mitigation efforts to restore biological resources.

Staff concludes that a slightly aggradational channel would provide protection against scour and erosion by maintaining a sediment source that can mobilize throughout the engineered channel. Sediment transport analyses using sensitivity tests on likely scenarios or input variables (sediment delivery, in-channel sediment sources, flow duration, discharge, transport methods, etc.) reduces the uncertainty of the computer simulation. Computer modeling provides the basis for identifying thresholds of significance that factor into the final design. The primary goal for developing a reliable sediment transport model is to update and finalize design criteria that characterize the channel's flood management function. Staff believes that with the engineered channel designed to be slightly aggradational, a braided channel would be developed that can erode the deposited sediment, widen within the banks of the engineered channel, lose sediment transport capacity and deposit excess sediment in a positive feedback loop. This process is typical of the alluvial fan geomorphology present in the existing Pine Tree Creek wash. Staff believes that, with sufficient analyses, the final design could result in the bed of the diversion channel supporting similar biological, hydrologic, and geomorphic functions of the existing channel.

In anticipation of a slightly aggradational channel, staff is requiring Condition of Certification **SOIL&WATER-7**. This Condition of Certification directs the applicant to establish a publicly held, and BSEP funded, maintenance district that would identify and monitor key channel indicators, inspect the channel after rainfall-runoff events, conduct periodic inspections, make repairs, and adaptively manage sediment to maintain flood capacity for the design discharge. All calculations supporting the final diversion channel design, including sediment transport modeling results, would be presented in the Engineer's Report as required in Condition of Certification **SOIL&WATER-13** and Condition of Certification **SOIL&WATER-15**. Staff believes the additional Conditions of Certification set forth in **SOIL&WATER-7** and **SOIL&WATER-5** would reduce potential flood impacts and risk, attributable to sediment, to less than significant levels. Staff also concludes that the implementation of these Soil & Water Resources Conditions of Certification, in concert with Conditions of Certification **BIO-7** and **BIO-18**, BSEP would have the least impact possible to native plant communities and wildlife habitat.

Flooding

The existing Pine Tree Creek flood hazard is identified in the effective Digital Flood Insurance Rate Map for Kern County. The special flood hazard area (SFHA) is mapped "Zone A" which is a result of approximate methods used to delineate an area with a high potential for flooding (FEMA 2008). Immediately downstream of the site, Pine Tree Creek joins Jawbone Creek. Jawbone Creek is mapped Zone AE with Base Flood Elevations (BFE) determined. The applicant's proposed plan to divert Pine Tree Creek entails a point of diversion, a new alignment, and a connection back to the Pine Tree Creek near the confluence with Jawbone Creek. The proposed diversion channel would result in a change to the FEMA SFHA.

Changes to the FEMA SFHA would require a Conditional Letter of Map Revision (CLOMR) to address LORS and comply with the Kern County Floodplain Management Ordinance. The existing and proposed conditions analyses would be required as part of

the FEMA CLOMR process to evaluate the project's affect on the SFHA. Because the site is mapped with a Zone A SFHA, BSEP would be required to follow Zone A map revision requirements described in *Managing Floodplain Development in Approximate Zone A Areas, A Guide for Obtaining and Developing Base (100-Year) Flood Elevations* (FEMA, 1995). The primary requirements would be to not increase flood hazards on neighboring properties and match the post-conditions floodplain to the approximate SFHA limits upstream and downstream of the BSEP site.

Historic Floods

Staff conducted research on historic flood events near the BSEP to recognize the potential flood hazards associated with desert hydrology (See **Soil and Water - Appendix C**). Two significant rainfall-runoff events occurred in Pine Tree Canyon during 1961 and 1997. **Soil and Water - Figure C1** illustrates these historic rainfall-runoff events occurred above predicted peak discharges for analogous watersheds. In fact, the Red Rock Canyon storm plotted well above the 100-year peak discharge regression analysis yet was identified as only a 50-year event. Staff recognizes that stream gauge estimates measure runoff and sediment in the flow. Sediment can increase clear water flow estimates by as much as 200% (See **Soil and Water - Appendix C**). In desert streams, it is also common for the peak flows to decrease in a downstream direction, especially after leaving the mountains (USGS, 1997a) where flows may flood the plains, infiltrate and attenuate the peak discharge.

One Percent Risk Flow

According to Kern County's Division Four Standards for Drainage, the One Percent Risk Flow is the flow on the alluvial fan based upon the joint probability of the flow distribution at the fan apex and the probability of occurring at the development site. The analyses submitted by the applicant have reasonably shown that the One Percent Risk Flow is equal to the design discharge of 28,000 cfs. Based on staff's geomorphic assessment (**Soil and Water - Appendix C**), it appears that the active channel immediately upstream of the point of diversion at the property line does not have the capacity to contain 28,000 cfs without flowing out of bank (see **Soil & Water Figure C2**). Based on the applicant's hydraulic model results and staff's analysis, the flood inundation area upstream of the site is within the active Pine Tree Creek channel and its floodplain. Staff has concluded that shallow flooding would flow onto the BSEP site along most of the southern property boundary during a one percent risk flood.

Existing Flood Hazards

The effective Digital Flood Insurance Rate Map for Kern County identifies Pine Tree Creek as an existing flood hazard. The special flood hazard area is mapped "Zone A" which is a result of approximate methods used to delineate an area with a high potential for flooding (FEMA 2008). Immediately downstream of the site, Pine Tree Creek joins Jawbone Creek. Jawbone Creek is mapped Zone AE with Base Flood Elevations (BFE) determined. The applicant's proposed plan to divert Pine Tree Creek entails a point of diversion, a realigned engineered channel, and a connection back to Pine Tree Creek near its confluence with Jawbone Creek. The proposed diversion channel would result in a change to the FEMA SFHA.

The proposed diversion channel would completely change the flood flow regime from shallow flooding across the site to concentrated flow that the applicant proposes to return to shallow flooding as the flood exits the property. To address this concern, staff requested numerous engineering studies in the PSA that provide the breadth needed to examine potential flood-related impacts related to the proposed channel diversion. The results of these studies also provide the basis for staff's recommended mitigation. Staff focused on the BSEP hydrologic and hydraulic studies and computer models prepared for this project.

Based on staff's analyses of the One Percent Risk Flow, staff estimates that roughly 4,000 cfs would be "contained" in the natural channel at the planned point of diversion. Discharges exceeding this capacity would sheet flow overland toward the BSEP. Staff approximated the flow path because actual flow paths are uncertain. Staff found that the out of bank discharge would cause shallow flooding across the BSEP property from the south toward the northeast.

The effective Pine Tree Creek SFHA delineated on the Digital Flood Insurance Rate Map (DFIRM), for Kern County does not show a shallow flooding hazard. Requests to FEMA to revise inaccurate SFHA's require an assessment of the existing flood hazards. BSEP studied the existing conditions flood hazards in the Project Design Refinements (DB 2009r) and subsequently revised the analyses to extend upstream and downstream of the site. Staff concludes that the methods used were appropriate.

Using the design discharge of 28,000 cfs, BSEP conducted hydrodynamic modeling simulations to determine the existing flood path. BSEP's delineation of the design discharge confirms staff's recognition of shallow flooding. BSEP extended the existing conditions analyses a significant distance upstream and downstream necessary to test the impacts caused by site improvements. Staff could not be certain that BSEP modified the existing conditions model for the portion of the reach affected by development but this is typical practice. Evaluation of the existing and proposed conditions model results immediately outside of the property boundary provides the basis for assessing potentially significant flood impacts.

Open Channel Hydraulics Study of the Diversion Channel

Staff reviewed the methods and computer models used by the applicant to establish the basis of design for the proposed Pine Tree Creek diversion channel. Development of the basis of design relied on hydrologic and hydraulic analyses for the existing and proposed conditions. Staff commented on the basis of design and associated studies in **Soil and Water - Appendix C**. Staff concluded that the applicant has developed the appropriate analyses to study the diversion channel in the Project Design Refinements (DB 2009r). Staff considers the engineering design drawings submitted for the diversion channel are "conceptual" and have concluded that additional information and final design drawings are required for staff to determine if the project mitigates the effects of the design discharge. Staff concludes that refinements to the computer models are necessary to adapt the conceptual design to final design. Staff's technical review conclusions (**Soil and Water - Appendix C**) have resulted in a series of Conditions of Certifications **SOIL & WATER -10** through **-17** to address these final design deficiencies.

Staff used the results of the hydraulic analyses to assess the adequacy of the proposed channel design and its structural elements. Staff concluded that the resulting design discharge velocity, depth, shear, and Froude Number are high when compared to the anticipated channel stability thresholds of the proposed earthen channel. High velocities and deep concentrated flow tend to increase shear stresses on the channel, which result in a greater potential for failure. Staff reviewed the preliminary diversion channel design and proposed measures to protect the channel from failure. Staff recognizes that many of the specific channel elements (grade control, energy dissipaters, bank protection, etc.) require complete knowledge of the system constraints and hydraulic response. Staff recognizes that the BSEP engineer is ultimately responsible for designing the channel such that the banks and bed of the channel resist the hydraulic forces of the design discharge. Staff recommends that the applicant rely on the results of the hydraulic models to refine the final engineering design criteria for grade control and bank protection. Conditions of Certifications **SOIL & WATER -10** through **-17** specify the analytical requirements needed for BSEP to reach final design for the diversion channel and its structural elements. Staff believes that compliance with these Conditions of Certification would provide sufficient evidence that the project mitigates the effects of the design discharge and would protect BSEP and adjacent properties from significant flood related impacts.

As of the date of this FSA, several important structural design elements have not reached a final selection or a final level of design including levees, grade control structures, soil cement bank protection, and the structural diversion that would account for upstream shallow floods. These engineered channel elements have influence over several areas of concern including flood carrying capacity and mitigation. Staff believes that these final design elements are necessary to assess whether the diversion channel would function properly and avoid flood-related impacts caused by a catastrophic failure of the drainage infrastructure. Staff recommends the applicant be required to comply with Condition of Certification **SOIL&WATER-9** for final design review and approval. Condition of Certification **SOIL&WATER-9** would require the applicant prepare preliminary (30%) design drawings for the channel and include typical channel cross section dimensions, typical details for all structural elements needed to protect the channel from erosion, and a grading plan for proposed conditions that ties into existing topography or solar field grading. The 30% design drawings would be submitted to FEMA showing the proposed drainage infrastructure, the existing or pre-developed floodplain limits and the proposed floodplain limits following channel construction, as required in Condition of Certification **SOIL&WATER-6**. Staff's conditions of certification include these requirements where appropriate so that the project would avoid or mitigate potential flood impacts related to poorly designed channel elements. Staff believes that when the applicant complies with these conditions of certification, there would not be significant flood-related impacts attributable to the diversion channel for peak discharges less than 28,000 cfs.

The applicant reported that the diversion channel water surface profile is contained below the existing grade and would not require levees. Staff could not definitively confirm this statement given the materials provided for review. Staff reviewed the AutoCAD file with preliminary grade contours but the electronic drawing did not include existing site and adjacent offsite topography, needed to determine if a levee is required. The HEC-RAS model cross sections did not extend beyond the top of bank to show the

tie-in with the existing ground elevations. Staff recommends that the height of the banks above the water surface profile provide adequate freeboard. Chapter X of the Kern County's Division Four Standards for Drainage dictates the freeboard and super elevation criteria for constructed channel design. Should the final elevation of the top of bank be higher than the adjacent existing topography or proposed grade then the applicant would design the embankment, or levee, in accordance with the latest revision of the Corps of Engineers Design and Construction of Levees, Engineer Manual, EM1110-2-1913, per Kern County standards. Staff's Condition of Certification **SOIL&WATER-13** requires compliance with Kern County Division Four standards should levees be required to mitigate the potential flood impacts of the design discharge.

BSEP Hydraulic Analysis

To develop a defensible basis of design, the applicant developed several computer models that simulated the existing Pine Tree Creek wash and the diversion channel hydraulics and reported their findings in the Project Design Refinements (DB 2009r). Staff reviewed these computer models and analyses to determine if the diversion channel would discharge the one percent risk flow in a manner, as close as possible, to the existing conditions flow pattern in accordance with Kern County Division Four, Standards for Drainage, Chapter IV. Staff provided a technical discussion in **Soil and Water - Appendix C**. Staff's hydraulic analyses review focused on model applicability/selection, model setup, hydraulic methods and calculations, assumptions, and how the model results apply to the basis of design. Staff's review of the existing conditions model sought to understand the extent of the design flow shallow flooding. Staff's review of the proposed conditions model was to understand if the proposed diversion channel has the capacity for the design discharge.

Staff reviewed two two-dimensional hydraulic models simulating the existing Pine Tree Creek Wash at BSEP: a MIKE-21 model and a FEMA approved FLO-2D hydrodynamic model. BSEP also developed a HEC-RAS model for the existing wash that staff did not review. The MIKE-21 model was a cursory investigation by the applicant. The FLO-2D was a detailed simulation of the design discharge. The hydraulic model allows shallow flooding across a defined topographic boundary. The model results provided a detailed assessment of the existing Pine Tree Creek flood hazards upstream, onsite, and immediately downstream of the property. The model results produce important spatial measurements of depth and velocity and limits of flooding.

Pine Tree Creek, Diversion Channel – Outfall

Flood hazard mapping is the customary format for communicating flood risk. These maps can be approximate or studied using detailed methods that improve the accuracy and identification of the flood hazard. BSEP's engineered channel design requires a significant amount of iterative analyses to assess its potential to cause significant impacts. The pre- and post-conditions engineering analyses results can be compared and are important for determining the significance of a flood impact. Staff compared the pre- and post-conditions flood hazards mapping to determine areas at risk for flooding. Staff also examined the analyses results and flow characteristics at the downstream property boundary for increases in the flow per unit length to assess the danger potential for adults and children to cross safely through the shallow flooding and to

assess downstream changes within the floodway. The safety determination is velocity multiplied by depth, which is essentially the same as the flow per unit length. When the product of velocity and depth increases above four, there is an increased risk to people in the path of the flood. Staff has borrowed this standard method from Maricopa County, AZ (Maricopa 2009a) in an effort to assess potential impacts caused by a change to the SFHA.

Staff concluded that the outflow profile along the northern property line shows a significant reduction in the extent of shallow flooding leaving the site. The revised flood mapping would shorten the width of the design discharge flood by nearly one-mile. The proposed shallow flood path shows a slight increase in the concentration of flows toward the east, as was to be expected. The increased concentration causes slight increases to the flow per unit length that would occur in areas already greater than four. Staff believes these higher rates for the proposed condition do not increase flood risks beyond those found in the existing condition.

To assess downstream changes within the floodway, staff referred to the National Flood Insurance Program (NFIP) criteria 44CFR 65.13c (5) that requires an engineering analyses that includes studying the effect of the project on flood hazards, including velocity and depth of floodwaters. Additionally, CCR, Title 23. Waters Division 1.5, Article 3, Section 221 restrictions use in a floodway since the flood hazard in a designated floodway is usually very great due to greater depth and higher velocity of flood flow. Staff reviewed the BSEP diversion channel to determine if changes to the floodway would result in use restrictions downstream of the site.

Based on the location and alignment of the proposed diversion channel outfall, staff concludes that the proposed flood hazard boundary would not tie into the existing SFHA shown on the effective DFIRM immediately downstream of the site. BSEP's existing conditions flood hazard mapping would provide the basis for changing the effective DFIRM maps. Because Pine Tree Creek ends shortly to the north of BSEP, staff recommended that BSEP extend the hydraulic analysis downstream to Jawbone Creek (CEC 2009n). The applicant's current analyses do not use the effective base flood elevations determined for Jawbone Creek downstream of BSEP. Staff's recommendation would result in a continuous detailed study from the mouth of Pine Tree Creek to a sufficient distance upstream of the site and allow for an adequate assessment of the proposed project. Staff concludes that the applicant has not sufficiently addressed the downstream mapping constraints and is requiring as part of Condition of Certification **SOIL&WATER-6** that BSEP provide sufficient flood hazard mapping that meet FEMA's requirements. Compliance with this Condition of Certification would provide sufficient evidence that BSEP's proposed change to the SFHA has adequately addressed FEMA's map revision requirements in accordance with the Kern County Floodplain Management Ordinance. Staff recognizes that BSEP would submit the revised preliminary mapping to FEMA for review as part of the CLOMR application. Staff recognizes that FEMA requires this mapping as part of their review process. Compliance with Condition of Certification **SOIL&WATER-6** would provide sufficient evidence that BSEP has addressed the potential flood impacts to adjacent and downstream properties.

Diversion Channel – Point of Diversion

Staff interprets, from the applicant's submittals, that the "point of diversion" is the location where the centerline of the proposed engineered channel intercepts the Pine Tree Creek Wash thalweg (low flow channel centerline). The actual extent of the hydraulic diversion, needed to route the design discharge from the natural channel and floodplain to the engineered channel, covers a much broader area along the southernmost property line. Staff defines the "diversion" as the total transition from natural channel (assumed to be the unaffected cross section at the property line) to the location of the engineered channel cross section that conveys the full design discharge. Staff believes this wide-to-narrow hydraulic diversion area, immediately adjacent to the neighboring property to the south, creates a significant design challenge that BSEP has not addressed. While it may be possible to engineer the transition, the applicant has not presented an adequate plan or analyses for staff's engineering and environmental impact review. Staff's conclusions in **Soil and Water - Appendix C** resulted in development of several conditions of certification that relate to the final design deficiencies that must be refined and verified with staff to ensure the project adequately reduces potential impacts to less than significant (See Conditions of Certification **SOIL & WATER -10** through **-17**). In addition to requests made in the PSA, staff asked about this unique transition during the July 2009 workshop. CDFG expressed concern on this transition in their comments dated February 19, 2009. To date, the applicant has not provided sufficient design details to show that the diversion can divert the design discharge without increasing flood hazards.

The drop into the diversion channel presents a significant hydraulic constriction for the design discharge. The most prominent change across this transition is the large change in bed elevation from the existing channel to the engineered channel bottom. The applicant has shown on their grading plan that the vertical distance between natural and design invert is over 25 feet.

The transition would also require a 90 degree change in flow direction. Staff estimated that the engineered channel as proposed is shown having a 600 foot radius when joined with the natural channel. Kern County requires that the minimum centerline radius for curves in constructed channels be three times the top width of the design water surface. The top width of the design discharge in the engineered channel is approximately 270 feet, which would require an 810 foot radius to meet Kern County design guidelines. Staff recommends that the curvature of the transition be analyzed as part of the overall diversion design. Ultimately, the applicant must show that the selected design radius for the channel transition functions hydraulically without increasing potential flood hazards on adjacent property or to the solar field site. Staff is requiring compliance with Condition of Certification **SOIL&WATER-6** and Conditions of Certification **SOIL&WATER-9** through **-17**, that require the applicant to comply with FEMA NFIP regulations and Kern County design standards. The natural channel floodplain as it crosses the BSEP property boundary is well over 3,000 feet wide. At the point of diversion, the natural channel would likely contain the most concentrated flow but far less than the design discharge. The remainder of the design discharge would spread out across the floodplain as it enters the site boundary. This presents a significant problem for the engineered channel in terms of routing the natural floodplain through the point of diversion. Because site improvements would only take place onsite, BSEP will

need to account for the full extent of the existing channel's floodplain in the final design of the diversion. The applicant has not shown that the diversion channel is capable of capturing the entire design discharge. Staff is concerned that the proposed engineered channel grading does not extend to the west sufficiently to capture the design discharge (left bank) floodplain.

Staff has concluded that the diversion channel poses a potential flood hazard to neighboring properties if it is not properly designed, constructed, and protected against the design discharge flood. An inadequate design could also affect the natural characteristics of the upstream wash especially since the channel upstream from BSEP appears to be actively migrating. The diversion channel point of diversion would fix the bed elevation at the property line and may restrict natural channel morphology upstream of the site. To reduce the risk of impacts to adjacent upstream properties and natural Pine Tree Creek wash, staff is requiring that the applicant respond to these design challenges and present a comprehensive, engineered plan for the diversion channel as part of the requirements of Conditions of Certification **SOIL&WATER-6** and **SOIL&WATER-9**. Staff is requiring these conditions to address CDFG technical comments and to satisfy conditions described in Condition of Certification **BIO-18**. Staff believes that with implementation of these conditions, the risk of flooding during the design discharge flood would be lowered. The reduced risk of flooding mitigates to less than significant the potential flood impacts related to the diversion channel.

SFHA Revisions / CLOMR Requirements

Staff reviewed the existing Pine Tree Creek flood hazard analyses and the proposed conditions analyses that form the basis for determining impacts related to the proposed change to the SFHA. Staff recommends that these analyses become the engineering backup, required as part of a CLOMR application to FEMA. The applicant would coordinate with Kern County prior to making a submittal to FEMA. Kern County would review and comment on the study's conformance with the County's Floodplain Management Ordinance. The applicant would provide staff with a copy of the final CLOMR application and any county comments. Staff is requiring Condition of Certification **SOIL&WATER- 6** to ensure that the proposed revision to the FEMA regulated floodplain meets the minimum floodplain management criteria of Kern County and the NFIP. Staff recognizes that FEMA's pre-development review typically results in conditions in the approved CLOMR. In order to address LORS, staff recommends the applicant be required to comply with the conditions in the CLOMR. Condition of Certification **SOIL&WATER- 6** would ensure the applicant has received an approved FEMA CLOMR for the project prior to site mobilization and is following the guidance from FEMA to avoid potentially significant flood impacts caused by the planned BSEP flood control facilities.

As currently presented, it appears that the Pine Tree Creek existing conditions analyses and "corrected effective" flood hazard mapping would redefine the FEMA effective flood hazard. This change, if accepted by FEMA, would show adjacent properties within the SFHA. This change would initiate a notice from FEMA stating that the effective DFIRM maps could change based on detailed engineering analyses. Because the map update is associated with a proposed project, FEMA would not issue a notice until they have completed their review of the proposed project. The corrected effective maps would

form the basis for determining the change in location of the flood area boundaries caused by the BSEP project. The applicant must demonstrate that the proposed Pine Tree Creek re-alignment would not increase flood hazards to neighboring properties, using the corrected effective maps as the basis for change. Adjacent properties impacted by the proposed project would require notification from the applicant that the proposed BSEP would affect current flood hazards. To ensure the County's standards are met, staff is recommending, as part of Condition of Certification **SOIL&WATER- 6**, that the applicant follow design guidelines described in Kern County Division Four, Standards for Drainage and notify adjacent property owners who are shown to be affected by the proposed change to the corrected effective flood hazard mapping. To avoid significant flood impacts to adjacent properties, the applicant would be required to submit copies of these notices and acknowledgment letters from the property owners as part of the FEMA CLOMR process.

Staff requires that the BSEP's flood management plan and CLOMR request removal of the solar field from the proposed conditions SFHA as defined by the design discharge. Base Flood Elevations (BFEs), determined as part of the final analyses, would be below the adjacent grade of the solar field. Mapped floodways, if required by FEMA or recommended by Kern County, would remain entirely within the channelized reach of the diversion channel. Given the uncertainty of precipitation and the difficulty defining the flood hazard on alluvial fans, portions of the site might be prone to shallow flooding from events greater than the one percent annual chance flood. FEMA may request that the 500-year peak discharge be determined and mapped. Staff recommends that the solar field remain completely free from flooding up to the design discharge. If the proposed solar field is included in the 500-year flood-prone area (Zone X, 500-year flood), all new construction must (i) be designed (or modified) and adequately anchored to prevent floatation, collapse, or lateral movement, (ii) be constructed with materials resistant to flood damage, (iii) be constructed by methods and practices that minimize flood damages, and (iv) be constructed with electrical, heating, ventilation, plumbing, and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding [44 CFR 60.3(a)(3)].

Diversion Channel – Maintenance District

The applicant would be responsible for the diversion channel maintenance. Currently the County of Kern does not have a Flood Control District in place, which could serve as the maintenance entity. The applicant would therefore be required to form a new Maintenance District as part of the project or find an entity that would be willing to conduct maintenance in perpetuity. Staff recommends **SOIL&WATER- 7**, which would require BSEP to develop a public Maintenance District, in perpetuity, to manage the diversion channel maintenance and avoid significant flooding or soil erosion related impacts from diverting Pine Tree Creek wash.

Maintenance District - Channel Maintenance Program

Following creation of the Maintenance District, the applicant would coordinate with the public entity and the Maintenance District supervisor to develop and implement a Channel Maintenance Program that provides long-term guidance to the Maintenance District to implement routine channel maintenance projects and comply with conditions

of certification in a feasible and environmentally-sensitive manner. The Channel Maintenance Program would be a process and policy document prepared by the project owner, reviewed by the CPM and the public entity, and adopted by the Maintenance District as required in Condition of Certification **SOIL&WATER- 8. Soil and Water Appendix J** describes the purpose, objectives and applicability of the requirements for the BSEP Maintenance District's Channel Maintenance Program. Staff is requiring as part of Condition of Certification **SOIL&WATER- 8** that the Channel Maintenance Program provide long-term guidance to the applicant and Maintenance District to implement routine channel maintenance projects and comply with BSEP's related biological (**BIO-18**) and flood protection (**SOIL&WATER-5** and **SOIL&WATER-6**) conditions of certification. Condition of Certification **SOIL&WATER- 8** requires verification that the Maintenance District has adopted the Channel Maintenance Program and that the applicant will implement the measures identified in the program. The main goals of the Channel Maintenance Program would be to maintain the diversion channel to meet its original design to provide flood protection, support BSEP mitigation, protect wildlife habitat and movement/migration, and maintain groundwater recharge. Compliance with Condition of Certification **SOIL&WATER- 8** would significantly reduce the long-term risk of flooding and improve the success of the desert wash mitigation. In **Soil and Water Appendix J**, staff provides a summary of related programmatic documentation required for implementation of the Channel Maintenance Program. Additional operation and maintenance plan guidance for proposed flood control measures on areas subject to alluvial fan flooding are specified under 44 CFR 65.10 (c) and (d).

Letter of Map Revision (LOMR)

As soon as practicable, but not later than six months after construction of the diversion channel, the applicant would notify FEMA of the changes by submitting technical or scientific data as part of a Letter of Map Revision (LOMR) request, in accordance with 44 CFR 65.3. A LOMR is required after physical changes to the floodplain have changed the flood hazard information shown on the effective DFIRM. The appropriate portions of the MT-2 application forms package, titled Revisions to National Flood Insurance Program Maps (FEMA Form 81-89 Series), applicable fees, and the required supporting information, must accompany the request. Staff has recommended Condition of Certification **SOIL&WATER-6** to ensure the project owner complies with the conditions established by FEMA in the CLOMR and reports to FEMA that the project has been completed as stated in the CLOMR. Significant variations to the design require prior approval from FEMA. Full compliance with this condition requires CPM notification of the approved FEMA LOMR. The LOMR would provide evidence that the applicant has adequately identified flood hazards associated with the project and has mitigated adverse flood impacts to the solar field and adjacent properties in accordance with the Kern County Floodplain Management Ordinance.

Geotechnical Investigation for Final Design

Staff requested additional information related to onsite soil characteristics in the PSA. BSEP partially responded to staff's requests. Staff requested the studies as part of the development for the basis of design. Staff was concerned that the soils may not support large grade control structures (which could lead to several more, smaller, grade control structures), or that the soil stability would require a more conservative hydraulic

response. Staff requested data regarding the nature, distribution, strength of existing soils, and conclusions and recommendations for grading procedures. Subsequent to the July workshop, staff has relied on the Geotechnical Report (BS2008a) to assess the soil characteristics. Staff examined soil boring logs for subsurface soils at various locations near the engineered channel but none at the exact locations planned for grade control. The report did not discuss the stability of the diversion channel slopes under hydrostatic and hydraulic loading. The applicant acknowledged that these soil characteristics are important for final design and that the applicant's engineers would investigate these conditions during final design.

Based on staff's technical review, staff has concluded that a geotechnical investigation is required of the applicant for final design of the structural elements of the diversion channel to ensure flood-related impacts are mitigated or lowered to less than significant. Staff is requiring Condition of Certification **SOIL & WATER -13** to analyze the stability of onsite soils. Compliance with this Condition of Certification would provide sufficient evidence that the proposed diversion channel grade control structures would not fail under design discharge hydraulic and hydrostatic load conditions.

CUMULATIVE IMPACTS AND MITIGATION

Cumulative impacts represent impacts that are created because of construction and operation of the proposed project in combination with impacts from other past, present, or reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time in the same area.

Construction and operation of the proposed project would result in both temporary and permanent changes at the project site. These changes could incrementally increase local soil erosion and storm water runoff. Potential project related soil erosion and increased sedimentation resulting from storm water runoff could be reduced to a level of insignificance through implementation of the applicant's proposed mitigation measures/BMPs and project DESCP; implementation of the SWPPPs for the Construction and Industrial Activities; and compliance with all applicable erosion and storm water management LORS.

Staff estimates that the initial construction water use could exceed 7,500 AF in the first 5 months of the construction period. Subsequent construction water use could consume as much as approximately 185 million gallons or 567 AF over the last 21 months of the construction period. Combined, the volume of water used for construction of the BSEP could exceed 8,086 AF over a 26-month period.

Project operations are anticipated to consume an annual average of 1,388 AFY of groundwater. Staff estimates that, as proposed, construction and operation of the project would consume approximately 50,000 acre feet of high quality fresh groundwater water, during the 30-year life of the project.

The AFC notes the population and quantity of groundwater consumed in the adjacent California City sub-basin is projected to increase over the next decade. Increased groundwater consumption by existing users or future new users would decrease the storage recovery rate and conceivably cause a net groundwater storage reduction. Long-term groundwater storage declines could negatively impact water users by increasing pumping lifts and potentially negatively impacting the primary potable water supply of the Fremont Valley.

Stetson Engineers Inc. indicated that the California City population will rise to 33,226 by 2025 (CofC 2009a). Concomitantly, California City's demand for water may increase from about 4,500 acre-feet (2007) to as great as 12,655 acre-feet in 2025. The City's water supply is a mix of local groundwater and surface water purchased from the State Water Project. During the period 2000-2007, the average water supply was comprised of 83-percent local groundwater and 17-percent imported surface water (CofC 2009a). Under worse case conditions (no surface water and maximum water demand increase), groundwater extraction by California City could increase from almost 3,100 acre-feet in 2007 to 12,655 acre-feet in 2025 (a more than tripling of groundwater use to almost 9,600 acre-feet per year).

California City extracts groundwater from the California City Sub-basin of the Fremont Valley Groundwater Basin, which is hydraulically connected to the Koehn sub-basin. Observed water levels in the California City area are declining in most wells and indicate current groundwater consumption levels exceed recharge (**Soil & Water Table 6**). An increase in groundwater consumption is therefore expected to exasperate the decline in water levels already observed.

The Koehn Sub-basin is separated from the California City Sub-basin by the Randsburg-Mojave Fault. Groundwater currently flows across the fault from the California City Sub-basin to the Koehn Sub-basin. However, increased groundwater consumption and declining water levels in the California City Sub-basin will change hydraulic gradients between sub-basins, and if drawdown is great enough, the gradients could reverse resulting in a net loss of groundwater from the Koehn Sub-basin. No quantitative information is readily available to assess the relationships between groundwater level decline in the California City Sub-basin and potential groundwater level and storage changes in the Koehn Lake Sub-basin. Staff expects this impact to be insignificant during the operation life of the BSEP based on the following.

The conductivity across the Randsburg-Mojave Fault estimated by the ground-water flow model is 0.00197 feet per day, which is almost six orders of magnitude lower than the representative conductivity of water-bearing deposits in the basin (20 to 40 feet per day). Hence, groundwater in the California City Sub-basin is only partially connected to groundwater in the Koehn Sub-basin.

On average, groundwater levels in the California City Sub-basin (about 2,070 feet above mean sea level) are more than 200 feet greater than water levels in the southern portion of the Koehn Sub-basin (about 1,850 feet above mean sea level) (see **Soil &**

Water Table 6). The observed water level declines in the California City Sub-basin are fairly modest (most are less than 1 foot per year), and under current water use conditions would require 200 years or more to fall from 2,070 to 1,850 feet above mean sea level.

Because of general uncertainty in hydrogeologic conditions and future groundwater levels, the applicant proposes to mitigate potential negative impacts to wells by forming a groundwater monitoring committee. As part of **SOIL&WATER – 1**, staff recommends the scope of this groundwater monitoring program be expanded to include both the Koehn and California City sub-basins. The monitoring effort will require monitoring water levels in California City wells and assessing potential changes in subsurface flow between sub-basins. This effort is necessary to isolate direct impacts on Koehn sub-basin water levels due to BSEP water use and potential cumulative impacts as a result of regional changes in water use and groundwater storage conditions.

Potential cumulative impacts to high quality fresh groundwater resources resulting from use by BSEP for power plant cooling can be avoided by using a degraded water source such as that available in the vicinity of Koehn Lake, recycled wastewater obtained from the City of Rosamond and California City or by employing a different cooling technology such as dry cooling (see **Soil and Water - Appendix D** and **ALTERNATIVES** section of this document). Further analysis of alternative degraded groundwater and recycled wastewater supplies is presented under the Energy Commission and SWRCB water policy in the LORS section below.

COMPLIANCE WITH LORS

Staff has reviewed the LORS and policies presented in **Soil & Water Table 1**. A discussion of selected LORS and policies is presented below.

Code of Federal Regulations Title 44

Staff has determined that the Beacon Solar project would be required to comply with local flood management ordinances (Kern County Floodplain Management Ordinance) and submit an application to FEMA for a Letter of Map Revision (LOMR). Rules regarding data requirements and procedures for obtaining LOMRs are outlined in Title 44, Chapter I, Part 65, Code of Federal Regulations. Staff is requiring Conditions of Certification **SOIL & WATER-6** to ensure Beacon Solar would comply with the local and federal requirements.

Article X Section 2 of the California Constitution, SWRCB Resolution 75-58 and Energy Commission's 2003 Integrated Energy Policy Report

LORS and water policies applicable to this project stem from, among other things, Article X, section 2 of the California Constitution, which declares that *"the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented..."* In order to better define what "unreasonable use" means in terms of power plant cooling, the SWRCB issued Resolution 75-58, *"Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Power Plant Cooling"* (Resolution 75-58). It sets forth, in priority order, a list of preferable water sources for power plant cooling as follows: (1) wastewater

being discharged to the ocean, (2) ocean, (3) brackish water from natural sources or irrigation return flow, (4) inland wastewaters of low TDS, and (5) other inland waters. The resolution also states that fresh inland waters should only be used for power plant cooling if other sources or other methods of cooling would be environmentally undesirable or economically unsound. Since adopting Resolution 75-58 in 1976, the SWRCB has more recently confirmed the ongoing applicability of its policy for cooling of modern power plants and clarified a basic principle by stating, *"The policy requires that the lowest quality cooling water reasonably available from both a technical and economic standpoint should be utilized as the source water for any evaporative cooling process utilized at these facilities"* (SWRCB 2002a).

Based, in part, on the State Constitution and SWRCB Policy 75-58, the Energy Commission adopted its own policy for water conservation in the cooling of power plants. The Energy Commission's 2003 IEPR specifies that *"the Energy Commission would approve the use of fresh water for cooling purposes by power plants which it licenses only where alternative water supply sources and alternative cooling technologies are shown to be 'environmentally undesirable' or 'economically unsound'"*.

The applicant proposes to use high quality fresh groundwater for power plant construction (primarily dust suppression and grading) and operation (primarily power plant cooling). Use of high quality fresh groundwater for power plant cooling is in direct conflict with Energy Commission and SWRCB policies concerning water use. Staff believes that the use of high quality fresh groundwater for power plant construction and operation is an unreasonable use of this valuable resource and should be prohibited.

Proposed Water Source is Considered Fresh Inland Water

The examination of alternative water supplies and technologies begins with a determination of whether a project will use fresh water for cooling. The IEPR itself does not define what constitutes fresh water. Resolution 75-58, upon which the IEPR water policy is based, defines fresh inland waters as *"those inland waters which are suitable for use as a source of domestic, municipal, or agricultural water supply..."* (State Water Resources Control Board Resolution 75-58, p. 3.) Thus, fresh water is not given a narrow definition but is broadly defined by how it is used, evincing an intent to be as inclusive as possible. The groundwater proposed to be used by BSEP meets the definition of fresh inland water under Resolution 75-58 because it is used for agricultural and domestic use in the area.

Another indication of the suitability of this water as a domestic source is its compliance with the Drinking Water Standards found in Title 22 of the California Code of Regulations. BSEP proposes to use site groundwater that has a TDS of 470 - 550 mg/l (BS 2008a). This TDS level is well within the secondary maximum contaminant level (MCL) for TDS in drinking water of 1000 mg/l and below or near the recommended limit of 500 mg/l (Cal. Code Regs., tit. 22, §§ 64431, 64449). Secondary MCLs are based on aesthetics and intended to protect odor, taste and appearance. Exceeding these levels does not restrict the use of this water for drinking.

Resolution 75-58 is clearly intended to broadly protect beneficial uses of the State's water resources. In this vein, the SWRCB states that *"in considering issuance of a permit or license to appropriate water for power plant cooling, the Board will consider*

the reasonableness of the proposed water use when compared with other present and future needs for the water source and when viewed in the context of alternative water sources that could be used for the purpose" (Resolution 75-58, pgs. 5 & 6). Although no appropriative right is at issue in this case, increasing groundwater demands in this region of the state dictate that the Energy Commission consider the reasonableness of allowing BSEP to use groundwater of a quality suitable for domestic use when a source of lower quality is available.

Availability of an Alternative Water Supply

In accordance with CEQA guidelines, (Article 1, section 15002), staff evaluated whether there were any feasible alternative water supplies and/or cooling technologies that would meet the needs of the project. As discussed above in the Project Water Supply section, staff identified three alternative water supplies that could be used as a project water supply. In addition, staff identified a cooling technology that does not require water. Below, staff has identified and analyzed the technical merits of these alternatives. In addition, the economic feasibility of these alternatives is discussed in **Soil & Water Appendix D** and the **Alternatives** section of this FSA.

Alternative Degraded Groundwater Supply

California Code of Regulations (CCR), Title 23, Division 3, Chapter 15, specifies Primary and Secondary Drinking Water Standards in terms of Maximum Contaminant Levels (MCLs). These MCLs include total dissolved solids (TDS) ranging from a recommended level of 500 mg/L or less to an upper level of 1,000 mg/L. Staff considered groundwater with TDS concentrations greater than or equal to 1,000 mg/L or more degraded relative to potential drinking water supplies. Groundwater TDS concentrations greater than or equal to 1,000 mg/L are therefore preferred as potential water supplies for power plant use because they comply with State Board and Energy Commission water use policies.

Staff reviewed previous studies describing hydrogeologic conditions and groundwater quality in the Koehn sub-basin, confidential boring logs for wells constructed near Koehn Lake (where available), and well location information from Kern County Environmental Health Services Department Resource Management Agency to identify potential alternative water supplies for the BSEP. Based on this information, relatively high salinity groundwater appears to occur along the base of the El Paso Mountains, generally within a mile of the trace of the Garlock fault and adjacent to and beneath the Koehn Lake bed.

Well driller logs indicate that subsurface materials (soils) northwest, west and southwest of Koehn Lake are comprised primarily of coarse-grained sand and gravel sequences to depths of at least 600 feet; the coarse-grained deposits can include fine-grained clayey sand and clay interbeds of variable thickness. The predominantly coarse-grained materials generally produce copious amounts of water and are conducive to high well production rates.

Driller logs from 8 wells located west of Koehn Lake (T30S R38E, Sections 17, 18 and 20) indicate reported pumping rates that range from 2,000 to 4,050 gallons per minute (gpm). These pumping rates, if sustainable, are similar to wells located at the BSEP site (1,770 to 2,000 gpm) and therefore assumed sufficient to meet the water needs of the proposed project. However, geochemical data is not available for the water produced by these wells and there is uncertainty in the expected quality of this potential alternative water supply.

Staff conducted a field reconnaissance to locate existing wells in the area of this potential alternative supply. Located wells were photographed and GPS coordinates recorded. As part of the reconnaissance effort, staff also assessed the operational status and possible suitability of the wells for potential power plant supply. Well owners were contacted, permission to access the wells requested and additional information obtained. Accessible wells were sampled in accordance with standard sampling procedures. Due to State budgetary restraints, the Applicant's consultant (AECOM) performed the groundwater sampling program by collecting well-water samples in the target area. The samples were submitted to a State-certified laboratory (CalScience Environmental Laboratories, Inc.), and the Applicant shared this information with CEC staff for independent analysis. A summary of the results of the groundwater sampling effort are presented in **Soil and Water Table 5** below.

Soil and Water Table 5
General Water Chemistry of Groundwater Samples
Degraded Groundwater Sampling Program

Well Number		Arciero #33	Well 52	Well 57	Well 58	Well 59	Well 61	Well 63
Date Sampled		8/5/2009	8/6/2009	8/6/2009	8/6/2009	8/6/2009	8/7/2009	8/7/2009
	Depth to Water feet-bgs ²	253.7	NM ⁹	NM ⁹	NM ⁹	NM ⁹	NM ⁹	NM ⁹
Lab Analytical and Field Measured ¹ Data	TDS ³ (mg/L)	1420	522	516	1210	895	482	514
	Fluoride	0.20	--	--	0.32	--	--	--
	Chloride	220	--	--	470	--	--	--
	Nitrite	<0.10	--	--	<0.10	--	--	--
	Nitrate	1.2	--	--	<0.10	--	--	--
	Sulfate	530	--	--	150	--	--	--
	Gross Alpha ⁴	3.79	--	--	0.00	--	--	--
	pH	7.43	7.51	7.5	--	6.93	7.93	7.3
	Turbidity ⁵	35	0	0	--	0	0	0
	ORP ⁶	137	-37	-36	--	-48	92	119
	EC ⁷	0.22	82.8	84.1	--	0.145	69.4	74.1
	DO ⁸	4.3	4.4	1.7	--	3.2	4.4	2.6

Notes:

1. pH, Turbidity, ORP, EC, and DO were measured in the field with a Horiba.
 2. bgs = below ground surface
 3. TDS = Total Dissolved Solids (milligrams per liter)
 4. Gross Alpha = Radionuclides (pico Curies per liter)
 5. Turbidity is measured in NTUs
 6. ORP = Oxidation-reduction potential (milliVolts)
 7. EC = Electric Conductivity (micromhos per centimeter)
 8. DO = Dissolved oxygen
 9. NM = Not measured. Well had a pump on it that did not allow the water level meter to be dropped down the well.
 - Analysis not run
- Bold Values** Bold values indicate TDS results exceeding 1,000 mg/L.

Evaluation of the test results indicate that an area of relatively high salinity groundwater (groundwater with TDS concentrations equal to or greater than 1,000 mg/L) occurs approximately 5 miles to the northeast of the BSEP site (Arciero Ranch well #33, which was a former high capacity agriculture well). A water sample from another well (#58 in **Soil and Water Table 5**) also had TDS concentrations greater than 1,000 mg/L. In the past, well 58 provided an agricultural water supply and its large casing diameter (20 inches) suggest it was likely a high producing well. Driller logs for wells constructed in this portion of the Koehn sub-basin report well pumping rates greater than 2,000 gpm, and these wells presumably can meet BSEP water requirements.

Based on staff's review of existing information and on the well sampling program discussed above, staff believes that a viable source of degraded groundwater exists in the BSEP site vicinity that could be developed for project use. Although the specific site

where degraded groundwater is available in sufficient volume has not been identified, staff believes it is likely available and could be further investigated. If this alternative is selected, BSEP would have to provide additional information on project design and alignment of conveyance facilities so potential environmental impacts can be analyzed, and provide a copy of an agreement that would allow BSEP access to pump and use groundwater from this area. Additionally, BSEP would need to assess the groundwater storage and water level changes that could occur as a result of moving the project's pumping center to an alternative site.

Alternative Recycled Wastewater Supply

Rosamond Community Services District (RCSD) and California City have offered to supply BSEP with tertiary treated recycled wastewater that meets California Code of Regulations, Title 22 requirements. In addition to meeting Title 22 requirements, results of analytical testing of recycled wastewater produced at RCSD and California City indicates their recycled wastewater contains 548 ppm and 590 ppm TDS, respectively. The recycled wastewater is chemically similar to site groundwater and would be suitable for use by BSEP with minor changes to BSEP's original design. Further, use of recycled wastewater complies with SWRCB and Energy Commission policies and is encouraged for use by both agencies. Staff considers the use of recycled wastewater to be a preferred alternative to using site groundwater for power plant construction and operation.

Rosamond Community Services District Recycled Wastewater

The Rosamond Community Services District has expressed their willingness to provide 1,456 acre-feet per year of Title 22 tertiary treated waste water to the BSEP for a period of 30 years (Rosamond 2009a-d). Delivery of this water would require construction of a 40 mile long underground pipeline extending from the community of Rosamond to the BSEP site. Staff considers RCSD's recycled wastewater to be a reasonable alternative to the proposed use of fresh groundwater.

If the Energy Commission requires the use of recycled water from RCSD, staff recommends the applicant be required to comply with Condition of Certification **SOIL&WATER - 18**. This condition would require the applicant to enter into a long term purchase agreement for delivery of recycled water to the project and comply with CCR Title 17 and Title 22 requirements for the use of recycled water. Staff also recommends the applicant be required to comply with **SOIL&WATER - 19** which would require the applicant to meter recycled water delivery and report project use in accordance with Title 20 section 1304.

California City Recycled Wastewater

California City has expressed their willingness to provide 1,424 acre-feet per year of Title 22 tertiary treated waste water to the BSEP for a period of 30 years (CofC 2009b &c). Delivery of this water would require construction of a 12-mile underground pipeline extending from California City to the BSEP site. Staff considers California City's recycled wastewater to be a reasonable alternative to the proposed use of fresh groundwater.

If the Energy Commission requires the use of recycled water from California City, staff notes that additional environmental analysis of potential impacts would be required. BSEP would have to provide information on the project design and alignment. If this alternative is selected staff would still recommend that BSEP be required to comply with Condition of Certification **SOIL&WATER -18**. This condition would require the applicant to enter into a long term purchase agreement for delivery of recycled water to the project and comply with CCR Title 17 and Title 22 requirements for the use of recycled water. Staff would also recommend the applicant be required to comply with Condition of Certification **SOIL&WATER - 19** which would require the applicant to meter recycled water delivery and report project use in accordance with Title 20 section 1304.

Dry Cooling

Staff evaluated three Air Cooled Condenser (ACC) dry cooling alternatives presented by the applicant (BS2008a). A summary of the cooling system comparisons is presented in **Soil & Water APPENDIX D, Table D6** and in the **Alternatives** section.

Staff believes that if this dry cooling alternative is selected and the dry cooling equipment is located within the current site footprint, no additional analysis of potential environmental impacts related to soil and water resources would be required. Dry cooling would significantly reduce the volume of process wastewater generated, possibly eliminating the need for a partial ZLD and reducing the volume of wastewater disposed to evaporation ponds. Potential impacts related to stormwater runoff and disposal of other process wastewater would be addressed by the current design proposed by BSEP and mitigation recommended by staff in the Conditions of Certification.

Zero Liquid Discharge Technology

With respect to wastewater, the Energy Commission's 2003 IEPR specifies that "the Energy Commission will require zero liquid discharge technologies (ZLD) unless such technologies are shown to be 'environmentally undesirable' or 'economically unsound.'" As discussed above under process wastewater impacts, the applicant initially proposed to dispose of process wastewater in lined evaporation ponds that would encompass an area of approximately 43 acres.

Based on information provided in the Project Design Refinements (DB2009r), the applicant now proposes to use a partial ZLD system. The partial ZLD system would concentrate brine wastewater to a maximum concentration between 70,000 to 111,000 mg/L TDS depending on which water source is used. The concentrated brine wastewater would then be conveyed to three evaporation ponds (each pond occupying 2 acres), for a combined disposal area of 6 acres. This proposed design would significantly reduce the area needed for brine disposal. Condition of certification **SOIL&WATER - 4** would require BSEP to mitigate any potential impacts related to operation and maintenance of the evaporation ponds. Staff believes the use of the partial ZLD system would be consistent with Energy Commission policy.

CONCLUSIONS

As proposed, the project does not comply with all LORS and existing water policies. A summary of staff conclusions is presented below.

- Ownership of, and the potential for the Beacon Solar Energy Project (BSEP) to use, groundwater underlying the site is disputed and undetermined.
- The proposed use of high quality fresh groundwater for power plant cooling is in conflict with State Water Resources Control Board and Energy Commission policies.
- There is no compelling evidence that using the lowest quality water supply reasonably available (recycled wastewater produced by Rosamond Community Services District and/ or California City) would be environmentally undesirable or economically unsound.
- There is no compelling evidence that alternative cooling technologies (specifically dry cooling) would be environmentally undesirable or economically unsound.
- There is general uncertainty in hydrogeologic conditions and future groundwater levels. Modeling shows that under a conservative set of assumptions there is potential for significant drawdown that could impact nearby wells. Monitoring and mitigation for impacts should be required if the applicant is permitted to use groundwater for power plant cooling.
- The project site is bisected by a mapped FEMA Special Flood Hazard Area (SFHA). The applicant is proposing to construct a diversion channel to reroute the design discharge of 28,000 cubic feet per second around the project site and reduce flood impacts to less than significant levels. The project owner is required to follow the FEMA CLOMR/LOMR application process to remap the SFHA around the solar field.
- The diversion channel may require sediment removal to maintain channel capacity for the design discharge. Sediment removal and other maintenance activities should be the responsibility of BSEP in perpetuity.
- Implementation of Best Management Practices during BSEP construction in accordance with effective Storm Water Pollution Prevention Plans and a Drainage, Sedimentation and Erosion Control Plan would avoid significant adverse effects that could otherwise result in significant transport of sediments or contaminants from the site by wind or water erosion.
- The proposed use of a partial Zero-Liquid-Discharge system to recycle waste water concentrate waste is consistent with state water use and conservation policies.

PUBLIC AND AGENCY COMMENTS ON THE PRELIMINARY STAFF ASSESSMENT

California Regional Water Quality Control Board, Lahontan Region (LRWQCB) Comments:

The drainages affected by the Project are waters of the State, as defined by California Water Code section 13050, and are subject to State requirements in accordance with Water Code section 13260. Therefore, the requirements for

construction and industrial storm water management will be issued in the form of proposed Waste Discharge Requirements that will be incorporated in the Energy Commission's certification process.

STAFF RESPONSE:

See Condition of Certification **SOIL & WATER -3** and **Appendices E, F, G and H** for Waste Discharge and Storm Water Requirements

LRWQCB Comment:

The discussion of construction wastewater streams on page 4.9-23 appears to be incomplete. The only wastewater stream discussed is a one time hydrostatic testing of pipelines and pressure vessels. Please evaluate construction activities to determine if all waste streams have been identified, e.g., vehicle washdown.

STAFF RESPONSE:

See discussion of Construction Wastewater above.

Comments from Intervener California Unions for Reliable Energy (CURE):

The applicant's proposal to use potable water for power plant cooling poses a significant impact to water resources under CEQA and is inconsistent with applicable laws, ordinances, regulations, and standards ("LORS").² In addition, the Project's proposed use of onsite groundwater poses a significant impact to the water levels and storage volumes of the potable water supply, and could significantly impact nearby potable water wells.³ Thus, the Project's proposed use of wet cooling results in numerous significant impacts under CEQA.

STAFF RESPONSE:

See Assessment of Impacts and Discussion of Mitigation and Compliance with LORS within this section and the Alternatives section of the FSA.

CURE Comment:

The proposed use of potable water for power plant cooling also conflicts with State Water Resources Control Board and Energy Commission policies. The applicant's proposal is inconsistent with SWRCB Policy 75-58 as LORS in the area of soil and water resources. This policy prohibits the use of potable water for power plant cooling unless other sources or other methods of cooling are environmentally undesirable or economically unsound. Compliance with SWRCB Policy 75-58 is wholly consistent with the Commission's practices in past siting proceedings and decisions in which the Commission has identified and relied upon Policy 75-58 as LORS.⁴

² PSA, pp. 4.2-37, 4.9-49.

³ PSA, p. 4.9-50.

⁴ See, e.g., Commission Siting Decision for the Delta Energy Center (98-AFC-3), Appx. A: LORS, at p. 30; Commission Decision for the Pittsburg District Energy Facility (98-AFC-1), Appx. A: LORS, at p. 44; Commission Decision for the Luz Engineering Corporation SEGS (87-AFC-1), Condition 8.

The applicant's proposed use of potable water for power plant cooling is also inconsistent with Energy Commission policy. The Commission has an established policy regarding the use of fresh water for power plant cooling. The Energy Commission's 2003 Integrated Energy Policy Report states that the Commission will approve the use of fresh water for power plant cooling "only where alternative water supply sources and alternative cooling technologies are shown to be 'environmentally undesirable' or 'economically unsound.'"⁵ The Commission defines "economically undesirable" as "having a significant adverse environmental impact," and "economically unsound" as "economically or otherwise infeasible."⁶

The impacts posed by the Project's proposed use of potable water for power plant cooling must be mitigated. Mitigation measures must be designed to minimize, reduce, or avoid an identified environmental impact or to rectify or compensate for that impact.⁷ We propose that the CEC adopt dry cooling as mitigation for these impacts. Dry cooling completely eliminates the need for evaporation ponds, avoiding significant impacts to migratory birds and desert tortoise from the ponds. In addition, dry cooling avoids the Project's impact to groundwater and local wells. Finally, dry cooling avoids the Project's conflicts with LORS.

STAFF RESPONSE:

Staff has proposed a number of alternatives to onsite groundwater use. See Assessment of Impacts and Discussion of Mitigation and **LORS Compliance** sections above. Also see the **Alternatives** section of the FSA.

CURE Comment:

The PSA includes increased costs for larger cooling pond acreage than proposed by the applicant. It is not clear whether either the PSA or the applicant have included costs associated with mitigating the harm and risks to avian life from the cooling ponds, and mitigating the surface disturbance caused by building the cooling ponds.

In addition, neither the PSA nor the AFC appear to have fully considered possibilities for reoptimizing other aspects of power block design to take into account differences between wet and dry cooling. Since the plant design has presumably already been optimized for the proposed wet cooling system, any such changes should have the effect of reducing the net cost of dry cooling.

STAFF RESPONSE:

Staff believes dry cooling is feasible. See the **LORS Compliance** section above and the **Alternatives** section of the FSA.

⁵ 2003 Integrated Energy Policy Report, California Energy Commission, December 2003, Docket No. 02-IEP-1, Pub. No. 100-03-019.

⁶ *Id.*

⁷ CEQA Guidelines, § 15370.

CURE Comment:

CURE made a number of comments which generally pointed out that at the time of the Preliminary Staff Assessment some information about the design and function of the re-routed wash were not yet developed.

STAFF RESPONSE:

The Soil and Water Resources section contains a more complete analysis of the re-routed wash (diversion channel) as the applicant has submitted additional information since the publication of the Preliminary Staff Assessment. See Operations Storm Water section above and the detailed discussion of the re-routed wash in **Appendix C. Conditions of Certification SOIL & WATER -9 through -17** are proposed by staff to address current deficiencies in the final design of the re-routed wash.

CURE Comment:

The groundwater monitoring system, as proposed, is inadequate and would unlikely detect releases of hazardous waste to groundwater. Groundwater monitoring wells must be placed at the point of compliance, defined as the "vertical surface located at the hydraulically downgradient limit of the Unit that extends through the uppermost aquifer underlying the Unit."⁸ The point of compliance is further defined as follows:

If the facility contains contiguous Units and monitoring along a shared boundary would impair the integrity of a containment or structural feature of any of the Units, the Point of Compliance may be located at the hydraulically downgradient limit of an area described by an imaginary line along the outer boundary of the contiguous Units. This provision only applies to contiguous Units that have operated or have received all permits necessary for construction and operation before 7-1-91.⁹

The locations of the proposed detection groundwater monitoring wells in the ROWD do not conform to the cited regulatory requirements. According to water level contours provided in the ROWD, only one detection monitoring well (MW-1) is located at what would be downgradient of the land treatment unit.¹⁰ Water level contours are plotted in Figure 1-11 at a scale of 1 inch = approximately 2000 feet. However, this scale is inadequate for determining groundwater flow direction in the vicinity of the land treatment unit. A figure at a scale appropriate for determining flow direction (DTSC specifies 1 inch = 200 feet¹¹) and adequacy of detection well placement should be included in the PSA.

⁸ 27 Cal. Code Regs. § 20405(a).

⁹ 27 Cal. Code Regs. § 20405(b).

¹⁰ ROWD, Appendix I, Figure 1-11.

¹¹ http://www.dtsc.ca.gov/SiteCleanup/upload/SMP_Report-Hydrogeologic_Char_Data.pdf

Two additional detection monitoring wells (MW-2 and 3) are identified in Figure 4-1 at the northern and eastern margin of a boundary that would encompass the evaporation ponds. No upgradient detection monitoring well is identified in Figure 4-1. The ROWD states that the point of compliance after operations at the site commence will be defined by the extraction wells (Well 63 and Well 49).¹² From Figure 1-11, Well 63 was measured to be approximately 1000 feet northeast (and downgradient according to "predicted drawdown contours") from the northeastern-most evaporation pond and nearly 3000 feet downgradient from the Land Treatment Unit.

Point of compliance monitoring wells, as defined in the CCR, must be located at the margin of the regulated units, not at the distances specified in the ROWD which, in some cases, are more than a half-mile downgradient of the regulated unit. The PSA completely ignores this issue and potentially significant impacts from hazards on the Project site. The PSA should be revised and recirculated accordingly.

STAFF RESPONSE:

The Requirements for Waste Disposal presented in the attached Appendices provide appropriate groundwater monitoring requirements. See Soil and Water Resources - **APPENDIX H, MONITORING AND REPORTING PROGRAM for GROUNDWATER (THREE SURFACE IMPOUNDMENTS AND A LAND TREATMENT UNIT)**.

CURE Comment:

In the ROWD, Detection Monitoring Program, diphenyl oxide and biphenyl oxide are listed as annual monitoring parameters and are to be monitored with a reporting limit goal of 500 ug/L each.¹³ However, in a review of cleanup programs for biphenyl and diphenyl oxide, we found cleanup goals for groundwater at a site in Washington as follows:

- Biphenyl: 230 ug/L; and
- Diphenyl oxide: 410 ug/L.¹⁴

¹² ROWD, Appendix I, p. 3-4.

¹³ ROWD, Appendix G, Table 4-4.

¹⁴ http://www.ecy.wa.gov/programs/tcp/sites/emerald_kal/Kalama%20Consent%20Decree%20-%20Exhibit%20B%20Part%202.pdf

COC	Groundwater Cleanup Level (µg/L)	K _{oc} (mg/g)	K _d (mg/g)	Henry's Law Constant (dimensionless)	Unsaturated Zone Soil Concentration (mg/kg)
Benzene	1.2	62	0.062	0.228	0.00676
Toluene	2,000	140	0.14	0.272	14.5
Benzoic Acid	24,590	0.6	0.0006	6.31E-05	99
Biphenyl	230	1,072	1.072	0.016	5.9
Bis(2-ethylhexyl) phthalate	1.8	111,123	111,123	4.18E-06	4.01
Diphenyl Oxide	410	1,655	1.655	0.0089	15.2
Phenol	2,560	28	0.028	1.63E-05	11.7
UCF	0.001		mg/µg		
DF (unsaturated)	20				
Theta w (unsaturated)	0.3				
Theta air (unsaturated)	0.13				
soil bulk density	1.5		kg/L		
fraction of organic carbon	0.001				

Given that the cleanup goals are lower than the monitoring reporting limits, the PSA should evaluate the reporting limits to ensure protection of beneficial uses.

STAFF RESPONSE:

The Requirements for Waste Disposal presented in the attached Appendices provide the appropriate groundwater monitoring requirements. See **Soil and Water - APPENDIX H, MONITORING AND REPORTING PROGRAM for GROUNDWATER (THREE SURFACE IMPOUNDMENTS AND A LAND TREATMENT UNIT)**. These Requirements were developed in consultation with the Lahontan Regional Water Quality Control Board (LRWQCB). Regarding determination of reporting limits, staff and LRWQCB concluded that Biphenyl Oxide is a solid at normal environmental temperatures (melting point 158 degrees F), it has a very low solubility in water (0.0004 g/100 ml), and due to the great depth to groundwater at the site, the site's arid climate, the design of the Title 27 waste containment units, the applicant's spill response plan, etc., the migration of biphenyl oxide and diphenyl oxide to groundwater is unlikely. The detection limit of biphenyl and diphenyl was set at 500 ug/L because that is the test method detection limit and it is also the concentration that is applied at the other solar facilities using heat transfer fluid within the Lahontan Region.

CURE Comment:

Selenium concentrations have been estimated by the applicant to be discharged to the evaporation ponds from the following individual source terms at the following concentrations:

- Mean well water concentration: 0.39 ppb (0.00039 ppm);
- Cooling tower blowdown: 0.6 ppb (0.0006 ppm); and

- Ion exchange regeneration: 4.5 ppb (0.0045 ppm).¹⁵

Selenium, in the food chain, is a compound that undergoes bioconcentration, bioaccumulation, and biomagnification as trophic levels increase. In aquatic organisms, including waterfowl, adverse effects include loss of equilibrium, neurological disorders, liver damage, reproductive failure, reduced growth, reduced movement rate, chromosomal aberrations, reduced hemoglobin, increased white blood cell count, and necrosis of the ovaries.

Discharge of selenium is subject to the California Toxics Rule which establishes a water quality criterion for selenium of 5 ppb. Selenium concentrations in wastewater have been limited by California regulatory agencies to concentrations as low as 4 ppb, as demonstrated by the following examples:

- The California Regional Water Quality Control Board ("RWQCB"), Central Valley Region, required the City of Davis to limit selenium discharge in effluent to a weekly average of 5 ppb.¹⁶
- The RWQCB, Colorado River Basin Region, required the City of El Centro to limit selenium discharge in effluent to a monthly average of 4 ppb.¹⁷
- The City of Davis 2001 National Pollutant Discharge Elimination System ("NPDES") permit limits selenium discharge in effluent to a four-day average of 5 ppb and to a one-hour maximum of 20 ppb.¹⁸

The RWQCB would, via a NPDES permit, make specific requirements regarding selenium. The PSA proposes a condition for certification that "the project owner shall comply with the requirements of the general NPDES permit for discharges of storm water associated with industrial activity."¹⁹ However, the PSA fails to discuss the likely requirement of such a permit and how these discharge requirements would be met in wastewater discharged to the ponds upon evaporation as selenium concentrations increase. Thus, the PSA must be revised accordingly.

STAFF RESPONSE:

See **Soil and Water Appendix E, F, G and H** for Waste Discharge Requirements for selenium and other materials.

CURE Comment:

The applicant has estimated the selenium concentration in surface water to be discharged into the evaporation ponds at 0.0028 ppm (mg/L) (2.8 ppb)²⁰ and 0.0027

¹⁵ Beacon's Response to Staff's Data Request No. 125.

¹⁶ R5-2008-0601 City of Davis http://www.swrcb.ca.gov/rwqcb5/board_decisions/adopted_orders/yolo/r5-2008-0601_enf.pdf

¹⁷ R7-2006-0075 City of El Centro
http://www.swrcb.ca.gov/rwqcb7/board_decisions/adopted_orders/orders/2006/06_0075.pdf

¹⁸ City of Davis DPDES http://cityofdavis.org/pw/water/pdfs/VVExecSumm_Website.pdf

¹⁹ PSA Condition of Certification Soil & Water-4, pp. 4.9-52-53.

²⁰ July 16, 2008 Response to Staff's Data Requests, p. BR-7.
http://www.energy.ca.gov/sitingcases/beacon/documents/applicant/2008-07-16_DATA_RESPONSES_1-70_TN-47078.PDF

ppm (2.7 ppb).²¹ The applicant has also estimated selenium concentrations to be discharged to the evaporation ponds from the following individual source terms at the following concentrations:

- Mean well water concentration: 0.39 ppb (0.00039 ppm)
- Cooling tower blowdown: 0.6 ppb (0.0006 ppm)
- Ion exchange regeneration: 4.5 ppb (0.0045 ppm)²²

However, the applicant does not provide any explanations of how these numbers were derived. Thus, the PSA should address whether the assumptions are valid and whether potentially significant impacts related to selenium concentrations have been adequately analyzed and mitigated.

STAFF RESPONSE:

See **Soil and Water Appendix E, F, G and H** for Waste Discharge Requirements for selenium and other materials.

Kern County Planning Department Comments:

The proposed project has incorporated into its design a flood control channel which will re-route the flows from Pine Tree Creek around the solar energy plant site. Pine Tree Creek has been mapped by the Federal Emergency Management Agency (FEMA) as a Special Flood Hazard Area (SFHA), Zone A. In order to construct the proposed flood control facility, the applicant will be required to obtain a Conditional Letter of Map Revision (CLOMR) from FEMA prior to construction.

As part of the CLOMR application the applicant must identify a public entity which will be responsible for channel maintenance. Currently the County of Kern does not have a Flood Control District in place which could serve as the maintenance entity. The applicant would therefore be required to either form a District as part of the project or find an entity outside.

STAFF RESPONSE:

See Condition of Certification **SOIL & WATER - 6** which requires the applicant to obtain approval from FEMA to change the SFHA and Condition of Certification **SOIL & WATER - 7** which requires the applicant to set up or fund a public maintenance entity.

California Department of Fish and Game (DFG) Comments:

The Soil and Water Resources section of the PSA discusses the option of using lower quality water, such as brackish water near Koehn Lake, as opposed to potable water, and states that there is no compelling evidence that using this water would be environmentally undesirable. However, if this lower quality water

²¹http://www.energy.ca.gov/sitingcases/beacon/documents/applicant/data_response_set_02/8.%20Water%20Resources%20Data%20Response%20Set%202.pdf

²² Beacon's Response to Staff's Data Request No. 125.

is used in a wet cooling scenario, where evaporation ponds are necessary, because of higher salinity, and/or higher levels of different trace elements of concern (Se), potential impacts to migratory birds posed by evaporation ponds could be more significant than those considered in the PSA, depending on how the water is treated prior to use and disposal into the evaporation ponds. However, if lower quality water is used in a dry cooling or zero liquid discharge scenario where evaporation pond will not be necessary, or if the water is treated such that constituents of concern are removed prior to discharge into the evaporation ponds, we encourage the use of lower quality water.

STAFF RESPONSE:

Staff has proposed a number of feasible alternatives to onsite groundwater use. See the **LORS Compliance** section above and **Alternatives** section of this FSA.

DFG COMMENT:

A January 26, 2009 letter to the Energy Commission, the California Department of Fish and Game provided comments on the applicant's AFC and provisions for the Streambed Alteration Agreement (SAA) (CDFG, 2009). Related to Soil and Water Resources, the California DFG requested several specific revisions to the site design, including:

1. A hydrologic analyses report that evaluates the potential impacts to the existing FEMA designated 100-year floodplain and potential impacts to areas upstream and downstream of the property;
2. Revised storm water management plan to require all site storm water runoff to be directed into retention ponds and avoid discharge to Waters of the State.
3. A requirement that the applicant reconsider placement of rock lining of the channel's low flow.

STAFF RESPONSE:

Staff concurs with California DFG's request and has asked the applicant to meet Conditions of Certification **SOIL & WATER-5, -6, & -7, -8, and BIO-18** that would examine the current channel design and recommend the most appropriate design elements for the channel that respond to the SAA provisions. Staff also concurs with the CDFG comments above and have required BSEP to prepare a DESCP and CLOMR that address impacts related to the SFHA, include retention basins, and remove rock placed in the channel bed with the exception of the toe rock intended to protect the channel banks from lateral migration of the streambed.

Staff have also reviewed the CDFG provisions included in the January 26th letter. These provisions require the Project Owner to:

1. Provide a set of near final engineering plans and drawings, and notify the CDFG of the construction start date.

2. Determine limitations to the annual construction schedule in an effort to protect nesting birds.
3. Direct all site storm water runoff away from Waters of the State by utilizing retention ponds.
4. Avoid use of materials hazardous to aquatic life, wildlife, and desert habitat for project related activities that have the potential for contaminating the soil and/or entering the Waters of the State. Hazardous materials may include but are not limited to: chemicals used to clean solar panels, cooling system wastewater, herbicides and pesticides, raw cement, concrete washings, asphalt, paint, coating materials, and oil or petroleum based products. Hazardous material placed in areas where they may enter Waters of the State will be removed immediately.
5. Prepare a hydrologic (and hydraulic) analyses of the re-routed stream to determine if the proposed structures and other constructed features will be properly engineered, installed and maintained to assure resistance to washout, and to erosion of the stream bed, stream banks and/or fill (upstream and downstream), and that they will not cause long-term changes in water flows that adversely modify the existing streambed bank contours (upstream and downstream) or increase sediment deposition.
6. Thoroughly analyze the existing FEMA designated 100-year floodplain to identify impacts (upstream and downstream) of the site.
7. Ensure the diversion channel design would be constructed and maintained to avoid barriers to wildlife movement, or cause an avoidance reaction. (Barriers may include channel features such as in-stream grade control or structural elements of bank protection).
8. Develop an engineered plan and submit to the CDFG for review for the construction laydown area which would describe protective structures, procedures for moving equipment, fuels and materials, and plan for conveyance of runoff during a rainfall event.
9. Construct a diversion channel before altering the historic Pine Tree Creek flow path.

The project owner would also be required to notify CDFG when activities covered by the provisions of the Streambed Alteration Agreement have been completed. Staff have integrated these CDFG comments and provisions into our analyses and conclusions for the BSEP site's ability to reduce impacts to less than significant levels.

PROPOSED CONDITIONS OF CERTIFICATION

SOIL&WATER-1: If the Energy Commission approves the use of site groundwater for power plant construction and/or operation, the project owner shall be

limited to using no more than 1,388 AFY. The project owner shall also develop and implement a groundwater impact monitoring and mitigation program. The monitoring and mitigation program shall be consistent with the intent of **Soil and Water APPENDIX I**, attached to this FSA. The primary objective for the monitoring is to establish pre-construction and project related water level trends that can be quantitatively compared against observed and simulated trends near the project pumping wells, at the property boundary, and near potentially impacted existing wells. Specifically, the project owner shall do all of the following:

- A. Prior to construction,
 - 1. Create the Fremont Valley Groundwater Monitoring Committee, in accordance with provisions set forth in **Soil and Water Appendix I**, to provide for land owner protection and include stakeholder participation in evaluation of project impacts. The monitoring committee's function will be to implement and oversee the groundwater monitoring program and to confer with the CPM to verify that there are no unacceptable impacts, as discussed in the Groundwater Impacts section of this FSA, to groundwater levels or to water quality in water supply wells adjacent to the BSEP.
 - 2. Identify and secure access to the wells predicted by the "Zero Recharge" simulation run (see Groundwater Impacts section of this FSA), to allow monitoring of groundwater levels and quality of those wells. Any new wells within the potentially impacted area not previously identified shall also be included in the monitoring network. Abandoned wells, or wells no longer in use, that are accessible and provide reliable water level data shall also be included as part of the monitoring network.
 - 3. In addition to the Zero Recharge wells discussed above, identify and include all available wells between the BSEP site and California City, in both the Koehn and California City sub-basins, into the monitoring network. Inclusion of these wells into the monitoring network is necessary to assess potential changes in hydraulic gradients and subsurface flow between sub-basins.
 - 4. At least 30-days prior to project construction, accessible abandoned or unused wells within the monitoring network shall be instrumented with recorders to track groundwater levels during project construction. The water level recorders shall continuously collect and store the data every four hours and shall be serviced at least quarterly.
 - 5. Obtain all historic water level and water quality data for each water supply well where access to monitor groundwater conditions has been obtained. Additionally, obtain well construction information (completion depth, well screen depth interval, and pump intake depth), historic well performance data, including pumping and non-pumping water levels, and pump specifications for each of those wells.

6. Update the groundwater data presented in the AFC with all new information obtained from the wells where access to monitor groundwater conditions has been obtained.
7. Prepare time series graphs for water level and total dissolved solids (TDS) concentrations data for each well where information is available.
8. Perform statistical trend analysis using Mann-Kendall Trend Test and Sen's Slope Estimator for water levels and the TDS data to statistically analyze the data. Determine the significance of an apparent trend and estimate the magnitude of that trend.
9. Collect groundwater levels from the off-site and on-site wells and collect and analyze groundwater samples for TDS concentrations to provide baseline groundwater levels and TDS concentrations for both on-site and off-site wells. Groundwater samples shall be analyzed for TDS by a California Certified Analytical Laboratory in accordance with Standard Methods 2540C.
10. Map TDS data and groundwater levels within the Koehn Sub-basin from the groundwater data collected prior to construction. Update trend plots and statistical analyses, as data is available.

B. During Construction:

1. Collect water levels and TDS concentrations within the monitoring network on a quarterly basis throughout the construction period, and at the end of the construction period. The continuous monitoring discussed in item A.4, above shall continue a minimum of 30-days after completion of project construction. Perform statistical trend analysis using Mann-Kendall Trend Test and Sen's Slope Estimator for water levels and the TDS data to statistically analyze the data. Determine the significance of an apparent trend and estimate the magnitude of that trend.

C. During Operation:

1. On a quarterly basis for the first five years of operation, collect water level measurements and TDS data from the wells identified in the groundwater monitoring program to evaluate operational influence from the project. Quarterly operational parameters (i.e., pumping rate) of the water supply wells shall be monitored. Additionally, quarterly groundwater-use in the Koehn sub-basin shall be estimated and the values submitted to the Fremont Valley Basin Groundwater Monitoring Committee for evaluation and consultation with the CPM.
2. On an annual basis, perform statistical trend analyses using Mann-Kendall Trend Test and Sen's Slope Estimator for water levels and the TDS data to statistically analyze the data. The significance of an apparent trend shall be determined and the magnitude of that trend estimated. Based on the results of the statistical trend analyses, the project owner shall determine if the project pumping has induced a drawdown in the water supply at a level of ten feet or more below the baseline trend.

3. If water levels have been lowered below pre-site operational trends, and monitoring data provided by the project owner show these water level changes are different from background trends and are caused by project pumping, then the project owner shall provide mitigation to the well owner(s). Mitigation shall be provided if the CPM's inspection of the well monitoring data confirms changes to water levels and water level trends relative to measured pre-project water levels, and the well yield has been lowered by project pumping. The type and extent of mitigation shall be determined by the amount of water level decline and site specific well construction and water use characteristics. The mitigation of impacts will be determined as follows:
- a. If project pumping has lowered water levels and increased pumping lifts, increased energy costs shall be calculated in accordance with item **SOIL & WATER-11** above. Payment or reimbursement for the increased costs shall be provided at the option of the affected well owner.
 - b. If groundwater monitoring data indicate project pumping has lowered water levels below the top of the well screen, and the well yield is shown to have decreased by 10-percent or more of the initial yield, compensation shall be provided for the diagnosis and maintenance to treat and remove encrustation from the well screen. Reimbursement shall be provided at an amount equal to the customary local cost of performing the necessary diagnosis and maintenance for well screen encrustation. Should well yield reductions be reoccurring, the project owner shall provide payment or reimbursement for either periodic maintenance throughout the life of the project or, if treatment is anticipated to be required more frequently than every 3-5 years, replacement of the well.
 - c. If project pumping has lowered water levels to significantly impact well yield or cause casing collapse, payment or reimbursement of an amount equal to the cost of deepening or replacing the well shall be provided to accommodate these effects. Payment or reimbursement shall be at an amount equal to the customary local cost of deepening the existing well or constructing a new well. The demand for water, which determines the required well yield, shall be determined on a per well basis using well owner interviews and field verification of property conditions and water requirements compiled as part of the pre-project well reconnaissance. Well yield shall be considered significantly impacted if it is incapable of meeting 150-percent of the well owner's maximum daily demand, dry-season demand, or annual demand – assuming the pre-project well yield documented by the initial well reconnaissance met or exceeded these yield levels. For already low-yielding wells identified prior to project construction, a reduction due solely to project pumping of 10-percent or more below the pre-project yield shall be considered a significant impact. The contribution of project pumping to observed decreases in observed well yield shall be determined using the groundwater monitoring data collected.
 - d. Electrical cost reimbursement – If the pumping water level falls below a depth of 10 feet from an average of the baseline measurements, the well owner shall be compensated by the project owner for the additional electrical costs commensurate with the additional lift required to pump. The water level in the

well will be assessed relative to the pumping rate established during the pre-site development period.

- e. Where it is determined by the CPM that the project owner shall reimburse a private well owner for increased energy costs, the project owner shall calculate the compensation owed to the owner of any impacted well as described below.

Increased cost for energy

= change in lift/total system head x total energy consumption x costs/unit of energy

Where:

change in lift (ft)

= calculated change in water level in the well resulting from project

total system head (ft)

= elevation head + discharge pressure head

elevation head (ft)

= difference in elevation between wellhead discharge pressure gauge and water level in well during pumping.

discharge pressure head (ft) = pressure at wellhead discharge gauge (psi) X 2.31

- f. The project owner shall notify all owners of the impacted wells within one month of the CPM approval of the compensation analysis for increased energy costs.
- g. Compensation shall be provided on either a one-time lump-sum basis, or on an annual basis, as described below:

Annual Compensation: Compensation provided on an annual basis shall be calculated prospectively for each year by estimating energy costs that will be incurred to provide the additional lift required as a result of the project. With the permission of the impacted well owner, the project owner shall provide energy meters for each well or well field affected by the project. The impacted well owner to receive compensation must provide documentation of energy consumption in the form of meter readings or other verification of fuel consumption. For each year after the first year of operation, the project owner shall include an adjustment for any deviations between projected and actual energy costs for the previous calendar year.

One-Time Lump-Sum Compensation: Compensation provided on a one-time lump-sum basis shall be based on a well-interference analysis, assuming the maximum project-pumping rate of 20.8 AFY. Compensation associated with increased pumping lift for the life of the project shall be estimated as a lump sum payment using the following criterion:

- The current cost of energy to the affected party considering time of use or tiers of energy cost applicable to the party's billing of electricity from the utility providing electric service, or a reasonable equivalent if the party independently generates their electricity;
- An annual inflation factor for energy cost of 3 percent; and

- A net present value determination assuming a term of 30 years and a discount rate of 9 percent.
- h. Pump lowering – In the event that groundwater is lowered to an extent where pumps are exposed but well screens remain submerged the pumps shall be lowered to maintain production in the well. All costs associated with lowering pumps shall be borne by the project owner.
 - i. Deepening of wells – If the groundwater is lowered enough that well screens are exposed, pump lowering is not an option. In this case, the wells shall be deepened or new wells constructed. All costs associated with deepening existing wells or constructing new wells shall be borne by the project owner.
4. After the first five-year operational and monitoring period, the CPM, after consultation with the Fremont Valley Basin Groundwater Monitoring Committee, shall evaluate the data and determine if the monitoring program water level measurements and TDS sampling frequencies should be revised or eliminated. Revision or elimination of any monitoring program elements shall be based on the consistency of the data collected. The determination of whether the monitoring program should be revised or eliminated shall be made by the CPM after consultation with the Fremont Valley Basin Groundwater Monitoring Committee.
 5. At the end of every subsequent five-year monitoring period, the collected data shall be evaluated by the CPM after consultation with the Fremont Valley Basin Groundwater Monitoring Committee and the CPM shall determine if the sampling frequency and TDS sampling should be revised or eliminated.
 6. Comply with Condition of Certification **SOIL & WATER -19**, which requires metering of water used for power plant construction and operation.
 7. During the life of the project, the project owner shall provide to the CPM and Fremont Valley Basin Groundwater Monitoring Committee, all monitoring reports, complaints, studies and other relevant data within 10 days of being received by the project owner.

Verification: The project owner shall do all of the following:

1. At least 60 days prior to start of construction, the project owner shall submit to the CPM a list identifying the members of the Fremont Valley Basin Groundwater Monitoring Committee and each member's written agreement to participate in accordance with the Committee's stated purpose and function and assist the project owner in implementing the groundwater monitoring program.
2. At least 30 days prior to project construction, the project owner shall submit to the CPM, a comprehensive report presenting all the data and information required in items **SOIL & WATER – 1.A.2** through **-1.A.9**.

The project owner shall submit to the CPM all calculations and assumptions made in development of the report data and interpretations, along with any agreement or dissenting opinions voiced by Committee members or local well owners on the data, calculations and assumptions used in development of the report.

3. During project construction, the project owner shall submit to the CPM quarterly reports presenting all the data and information required in items **SOIL & WATER – 1.B.1** through **-1.B.2**.

The project owner shall submit to the CPM all calculations and assumptions made in development of the report data and interpretations, along with any agreement or dissenting opinions voiced by Committee members or local well owners on the data, calculations, and assumptions used in development of the report.

4. No later than 60 days prior to project operation, the project owner shall provide to the CPM for review and approval, documentation showing that any mitigation to private well owners during project construction was satisfied, based on the requirements of the property owner as determined by the CPM.
5. During project operation, the project owner shall submit to the CPM, applicable quarterly and annual reports presenting all the data and information required in items **SOIL & WATER – 1.C.1** through **-1.C.7**.

The project owner shall submit to the CPM all calculations and assumptions made in development of report data and interpretations, along with any agreement or dissenting opinions voiced by Committee members or local well owners on the data, calculations, and assumptions used in development of any reports.

6. The project owner shall provide mitigation as described in **SOIL & WATER- 1.C.3**, if the CPM's inspection of the monitoring information confirms changes to water levels and water level trends relative to measured pre-project water levels, and well yield has been lowered by project pumping. The type and extent of mitigation shall be determined by the amount of water level decline and site specific well construction and water use characteristics. The mitigation of impacts will be determined as set forth in **SOIL & WATER-1.C.3**.
7. If mitigation includes monetary compensation, the project owner shall provide documentation to the CPM that compensation payments have been made by March 31 of each year of project operation or, if lump-sum payment is selected, payment is made by March 31 following the first year of operation only. Within 30 days after compensation is paid, the project owner shall submit to the CPM a compliance report describing compensation for increased energy costs necessary to comply with the provisions of this condition.

After the first five year operational and monitoring period, the project owner shall submit a 5 year monitoring report to the Fremont Valley Basin Groundwater Monitoring Committee and to the CPM that submits all monitoring data collected and provides a summary of the findings. After consultation with the Fremont Valley Basin Groundwater Monitoring Committee, the CPM will determine if the water level measurements and TDS sampling frequencies should be revised or eliminated.

SOIL&WATER-2: The project owner will comply with the requirements of the Kern County Environmental Health Services Department, regarding sanitary waste disposal facilities such as septic systems and leach fields.

Verification: The project owner will submit all necessary information and the appropriate fee to the county of Kern to ensure that the project has complied with the county's sanitary waste disposal facilities requirements. A written assessment prepared by Kern County of the project's compliance with these requirements must be submitted to the CPM for review and approval 30-days prior to the start of power plant operation.

SOIL&WATER-3: The project owner shall comply with the Waste Discharge Requirements for discharge of storm water associated with construction activity that are presented in **Soil and Water Appendices E, F, G and H** and submit the appropriate compliance fee to the LRWQCB. The project owner shall develop, obtain compliance project manager (CPM) approval of, and implement a Storm Water Pollution Prevention Plan (SWPPP) for the construction of the BSEP site, laydown area, and all linear facilities.

Verification: At least 60 days prior to site mobilization, the project owner shall submit to the CPM and LRWQCB, a copy of the construction SWPPP for review and CPM approval prior to site mobilization. The project owner shall also submit to the CPM evidence of payment to LRWQCB of the appropriate compliance fee. The project owner shall retain a copy of the SWPPP on site. The project owner shall submit to the CPM copies of all correspondence between the project owner and the LRWQCB regarding the Waste Discharge Requirements for the discharge of storm water associated with construction activity within 10 days of its receipt or submittal.

SOIL&WATER-4: The project owner shall comply with the requirements of the Waste Discharge Requirements in **Soil and Water Appendices E, F, G and H**, for discharges of process water and storm water associated with industrial activity. The project owner shall develop, obtain CPM approval of, and implement an industrial SWPPP for the operation of the project.

Verification: At least 60 days prior to commercial operation, the project owner shall submit to the CPM a copy of the industrial SWPPP for operation of the project for review and approval prior to commercial operation. The project owner shall retain a copy on site. The project owner shall submit copies to the CPM of all correspondence between the project owner and the LRWQCB regarding the Requirements of Waste Discharge of process water and storm water associated with industrial activity within 10 days of its receipt or submittal. Copies of correspondence shall include the Notice of Intent sent by the project owner to the SWRCB.

SOIL&WATER-5: Prior to site mobilization, the project owner shall obtain CPM approval for a site specific DESCP that ensures protection of water quality and soil resources of the project site and all linear facilities for both the construction and operation phases of the project. This plan shall address appropriate methods and actions, both temporary and permanent, for the protection of water quality and soil resources, demonstrate no increase in off-site flooding potential, and identify all

storm water monitoring and maintenance activities. The project owner shall complete all necessary engineering plans, reports, and documents necessary for Kern County to conduct a review of the proposed project and provide its written evaluation as to whether the proposed grading, drainage improvements, diversion channel design, and flood management activities comply with all county requirements. The project owner shall ensure compliance with all county standards and requirements for grading, erosion control, and flooding for the life of the project. The plan shall be consistent with the grading and drainage plan as required by Condition of Certification **CIVIL-1**, and with requirements described in Condition of Certification **BIO-18**. The DESCP shall contain the following elements:

- ***Vicinity Map*** – A map shall be provided indicating the location of all project elements with depictions of all significant geographic features to include watercourses, washes, irrigation and drainage canals, major utilities, and sensitive areas, such as Waters of the State.
- ***Site Delineation*** – The site and all project elements shall be delineated showing boundary lines of all construction areas and the location of all existing and proposed structures, underground utilities, roads, and drainage facilities. Adjacent property owners shall be identified on the plan maps. All maps shall be presented at a legible scale
- ***Drainage*** – The DESCP shall include the following elements suitable for submittal to FEMA as part of compliance with Condition of Certification **SOIL&WATER-6**:
 - a. **Topography** – Topography for offsite areas are required to define the existing upstream tributary areas to the site and downstream to provide enough definition to map the existing Pine Tree Creek flood hazard. Spot elevations shall be required where relatively flat conditions exist.
 - b. **Proposed Grade** – Proposed grade contours shall be shown at a scale appropriate for delineation of onsite sub-basins, drainage ditches, pond contours, diversion channel, and tie-ins to the existing topography.
 - c. **Hydrology** - Existing and proposed hydrologic calculations for on-site areas and offsite areas that drain to the site; include maps showing the drainage area boundaries and sizes in acres, topography and typical overland flow directions, and show all existing, interim, and proposed drainage infrastructure and their intended direction of flow.
 - d. **Hydraulics** - Provide hydraulic calculations to support the selection and sizing of the onsite drainage network, retention facilities and best management practices (BMPs). Design

calculations and the results of the hydraulic backwater model for the Pine Tree Creek diversion channel shall be included.

- e. Channel Stabilization Plan – The Project Owner shall present methods to mitigate for adverse hydraulic conditions (high velocities, high shear stress, Froude Numbers greater than 0.8) in the proposed diversion channel. Channel plan and profile maps showing water surface elevations, channel slope, bank protection, channel stabilization elements. Channel bank elevations shall also be identified.

Watercourses and Critical Areas – The DESCP shall show the location of all nearby watercourses including washes, irrigation and drainage canals, and drainage ditches, and shall indicate the proximity of those features to the construction site. Maps shall identify high hazard flood prone areas:

- a. FEMA Regulated Special Flood Hazard Areas (Effective floodplain from DFIRM) shall be shown on site as well as upstream and downstream within 2,000 feet from the BSEP property boundary;
 - b. Existing Conditions 100-year Floodplain – Shall be continuous with the effective floodplain; and
 - c. Proposed (Revised) Conditions 100-year Floodplain – Shall be continuous with the effective floodplain.
- **Clearing and Grading** – The plan shall provide a delineation of all areas to be cleared of vegetation and areas to be preserved. The plan shall provide elevations, slopes, locations, and extent of all proposed grading as shown by contours, cross sections, cut/fill depths or other means. The locations of any disposal areas, fills, or other special features shall also be shown. Proposed contours shall tie into existing topography. The DESCP shall include a statement of the quantities of material excavated at the site, whether such excavations or fill is temporary or permanent, and the amount of such material to be imported or exported or a statement explaining that there would be no clearing and/or grading conducted for each element of the project. Areas of no disturbance shall be properly identified and delineated on the plan maps.
 - **Project Schedule** – The DESCP shall identify on the topographic site map the location of the site-specific BMPs to be employed during each phase of construction (initial grading, project element and diversion channel excavation, and construction, and final grading/stabilization). The project schedule shall identify the construction sequence for the Pine Tree Creek diversion channel. Separate BMP implementation schedules shall be provided for each project element for each phase of construction.

- **Best Management Practices** – The DESCP shall show the location, timing, and maintenance schedule of all erosion- and sediment-control BMPs to be used prior to initial grading, during project element excavation and construction, during final grading/stabilization, and after construction. BMPs shall include measures designed to control dust and stabilize construction access roads and entrances. The maintenance schedule shall include post-construction maintenance of treatment-control BMPs, including application of soil stabilizers, applied to disturbed areas following construction.
- **Erosion Control Drawings** – The erosion-control drawings and narrative shall be designed, stamped and sealed by a professional engineer (PE) or a Certified Professional in Erosion and Sediment Control (CPESC).
- **Agency Comments** – The DESCP shall include copies of recommendations, conditions, and provisions from Kern County, CDFG, and LRWQCB.
- **Monitoring Plan** – Monitoring activities shall include routine measurement of the volume of accumulated sediment in the onsite drainage ditches, storm water retention basins, and the diversion channel.

Additional monitoring requirements shall be presented in a Desert Wash Mitigation and Monitoring Plan as discussed in Condition of Certification BIO-18.

- **Maintenance Plan** – The maintenance plan shall identify activities and procedures needed to maintain capacity within all onsite drainage ditches, and the drainage ditch that currently diverts flow along the western property boundary. Channel maintenance may include BMP repairs, bank stabilization, debris removal, grade control, and revegetation. The maintenance plan shall support the objectives of the revegetation plan and mitigation effort. Maintenance activities must also include removal of accumulated sediment from all retention basins when an average depth of 0.5 feet of sediment has accumulated in the retention basin. The maintenance plan shall be developed in accordance with the activities and procedures identified for the Pine Tree Creek diversion channel as part of compliance with Condition of Certification **SOIL&WATER-7** and **SOIL&WATER-8**.

Verification: The project owner shall do all of the following:

1. No later than 90 days prior to start of site mobilization, the project owner shall submit a copy of the DESCP to Kern County and the LRWQCB for review and comment. A copy shall be submitted to the CPM no later than 60 days prior to the start of site mobilization for review and approval. The CPM shall consider comments received from both Kern County and LRWQCB.

2. During construction, the project owner shall provide an analysis in the monthly compliance report on the effectiveness of the drainage-, erosion- and sediment-control measures and the results of monitoring and maintenance activities.
3. Once operational, the project owner shall provide in the annual compliance report information on the results of storm water BMP monitoring and maintenance activities.
4. Provide the CPM with two (2) copies of all monitoring or other reports required for compliance with Kern County, CDFG, and LRWQCB.
5. Provide Kern County, LRWQCB and the CPM with quarterly maintenance activity reports for all onsite drainage ditches and the drainage ditch that currently diverts flow along the western property boundary. These reports shall also provide an account of any significant runoff event and will describe channel performance.

SOIL&WATER-6: In accordance with Kern County's Floodplain Management Ordinance and 44 CFR 65.12, the project owner shall prepare all necessary engineering plans and documents to support a Conditional Letter of Map Revision (CLOMR) application submittal to FEMA. The project shall not commence construction in the SFHA until Kern County receives from FEMA an approved CLOMR. Following construction, the Project Owner shall prepare all necessary documents required for a final Letter of Map Revision (LOMR). The project owner shall use FEMA's Guidelines and Specifications for Mapping Partners for guidance. The project owner shall:

- a. Prepare hydrologic analyses to estimate the 10-, 2-, 1-, and 0.2-percent annual chance flood events for the Pine Tree Creek watershed. The analyses shall be conducted using numerical models approved by FEMA;
- b. Prepare preliminary (30%) design drawings for the channel, include typical channel cross section dimensions, typical details for all structural elements needed to protect the channel from erosion, and a grading plan for proposed conditions that ties into existing topography;
- c. Conduct hydraulic analyses for existing and proposed conditions. Plot the water surface and energy grade line profile for the constructed channel. Tie the proposed conditions water surface elevation profile into the water surface profile from the existing hydraulic model upstream and downstream of the site;
- d. Prepare flood hazard mapping for the existing and proposed conditions. Floodplain mapping shall tie-into the upstream and downstream special flood hazard mapping shown on the effective DFIRM;

- e. Provide notification to all adjacent property owners, impacted by the proposed change to the SFHA;
- f. Complete the necessary FEMA MT-2 application forms package and pay all applicable CLOMR review fees. The submittal shall be certified by a California-licensed professional engineer; and
- g. Address all FEMA review comments as needed to receive an approved CLOMR.

Prior to mobilization, the Project Owner shall receive confirmation from Kern County that FEMA has issued a CLOMR for the BSEP. The Project Owner shall address all "conditions" in the CLOMR during project construction. No later than six months after the end of construction, the project owner, through a request from Kern County, must notify FEMA of the changes in accordance with 44 CFR 65.3. The Project Owner shall submit the following technical or scientific data as part of a Letter of Map Revision (LOMR) request:

- h. Conduct an As-Built survey of the completed construction;
- i. Update the Proposed Conditions Model to reflect the As-Built Revised Conditions and delineate the resulting flood hazards;
- j. Complete the necessary FEMA MT-2 application forms package and pay all applicable LOMR review fees. The submittal shall be certified by a California-licensed professional engineer;
- k. Address all FEMA review comments as needed to receive approval of the LOMR; and
- l. Notify the CPM of the approved LOMR.

Verification: The project owner shall do all of the following:

1. Submit a copy of the draft application for a CLOMR, to include all backup calculations and the preliminary design drawings, to the CPM 60 days prior to sending the request to FEMA.
2. No later than thirty (30) days after receiving notification from FEMA that all required CLOMR or LOMR documents have been received by FEMA, the Project Owner shall notify the CPM that the project is currently being reviewed by FEMA. During the review process, the project owner shall submit all correspondence between FEMA and project owner's engineer representative responsible for addressing FEMA's comments.
3. Prior to construction activity within the effective SFHA the Project Owner shall provide a copy of the CLOMR to the CPM for verification.
4. Following construction of the channel improvements, the Project Owner shall complete an As-built survey of the improvements, update the hydraulic model, and

prepare a final submittal, to include forms and fees, for a FEMA LOMR request. The Project Owner shall submit a copy of the completed LOMR submittal to the CPM and Kern County for review.

5. No later than thirty (30) days after receiving notification from FEMA that the LOMR has been issued to Kern County the project owner shall submit a copy of the LOMR to the CPM for verification.

SOIL&WATER-7: The project owner shall coordinate with a public entity to establish a BSEP Maintenance District. The project owner shall be responsible for maintaining the integrity, engineering design, and design discharge capacity of the rerouted Pine Tree Creek channel. The maintenance district shall be formed with consideration of all appropriate Waste Discharge requirements presented in **Soil and Water Appendices E through H**. The project owner shall also ensure that the BSEP Maintenance District manages utility crossings of the rerouted Pine Tree Creek channel. The Project Owner shall develop the Maintenance District according to the stream alteration agreement as described in the Biological Resources section and in accordance with Condition of Certification **BIO-18**. Funding for the maintenance district shall be provided by the project owner in perpetuity. The project owner shall ensure the following duties are performed:

1. In coordination with the public entity, develop and supervise the implementation of a Channel Maintenance Program in accordance with conditions of certification;
2. Consult with the Maintenance District Manager on the preparation of the Biological Resources Mitigation Implementation and Monitoring Plan (BRMIMP);
3. Be available to coordinate with the Designated Biologist on mitigation, monitoring, and other biological resources compliance efforts, particularly in areas requiring avoidance or containing sensitive biological resources, such as special-status species or their habitat, as they relate to maintenance district responsibilities;
4. Notify the CPM of any non-compliance with conditions of certification related to the maintenance district;
5. Respond directly to inquiries of the CPM regarding the maintenance district or the Channel Maintenance Program;
6. Maintain written records of the tasks specified above and those included in the Channel Maintenance Program. Summaries of these records shall be provided to the CPM, as required, per the conditions of certification;
7. Train the Maintenance District personnel as appropriate, and ensure their familiarity with the Channel Maintenance Program;

8. Manage utility crossings at the Diversion Channel;
9. Develop the Maintenance District's CIP Plan and manage the available funds;
10. Be available to coordinate with the public entity during emergency repairs conducted by the Maintenance District;
11. Report to the CPM and the public entity annually the Maintenance District's available funds and annual costs each year since the District was created.

Verification: Prior to receiving a FEMA approved CLOMR, required as a part of Condition of Certification **SOIL & WATER -6**, the Project Owner shall receive written consent from a public entity allowing BSEP to create a special maintenance district. The project owner shall provide a copy of the final Maintenance Agreement to the CPM for approval and shall include a detailed discussion of the funding mechanism for the Channel Maintenance Program and Capital Improvement Projects. The maintenance agreement shall report the name and contact information of the Maintenance District supervisor.

SOIL&WATER-8: Following creation of the Maintenance District, the project owner shall coordinate with the public entity and the Maintenance District supervisor to develop and implement a Channel Maintenance Program that provides long-term guidance to the Maintenance District to implement routine channel maintenance projects and comply with conditions of certification in a feasible and environmentally-sensitive manner. The Channel Maintenance Program will be a process and policy document prepared by the project owner, reviewed by the CPM and the public entity, and adopted by the Maintenance District.

The project owner is responsible for implementing a Channel Maintenance Program as presented in **Soil and Water APPENDIX J**, attached to this FSA. The Channel Maintenance Program shall be developed in consultation with the Maintenance District and the public entity and shall include the following:

1. **Purpose and Objectives** – establishes the main goals of the Program, of indefinite length, to maintain the diversion channel to meet its original design to provide flood protection, support BSEP mitigation, protect wildlife habitat and movement/ migration, and maintain groundwater recharge.
2. **Application and Use** - The channel maintenance work area is defined as the BSEP engineered channel, typically extending to the top of bank, include access roads, and any adjacent property that BSEP or the District owns or holds an easement for access and maintenance. The Program would include Pine Tree Creek maintenance as needed to protect the BSEP facilities.

3. Channel Maintenance Activities

- a. **Sediment Removal** - sediment is removed when it: (1) reduces the diversion channel effective flood capacity, to less than the design discharge, (2) prevents appurtenant hydraulic structures from functioning as intended, and (3) becomes a permanent, non-erodible barrier to instream flows.
- b. **Vegetation Management** - manage vegetation in and adjacent to the diversion channel to maintain the biological functions and values proposed in the mitigation. Vegetation management shall include control of invasive or nonnative vegetation as prescribed in Condition of Certification **BIO-18**.
- c. **Bank Protection and Grade Control Repairs** - Bank protection and grade control structure repairs involve any action by the District to repair eroding banks, incising toes, scoured channel beds, as well as preventative erosion protection. The District would implement instream repairs when the problem (1) causes or could cause significant damage to BSEP, adjacent property, or the structural elements of the diversion channel, (2) is a public safety concern, (3) negatively affects groundwater recharge, or (4) negatively affects the mitigation vegetation, habitat, or species of concern.
- d. **Routine Channel Maintenance** - trash removal and associated debris to maintain channel design capacity; repair and installation of fences, gates and signs; grading and other repairs to restore the original contour of access roads and levees (if applicable); and removal of flow obstructions at BSEP storm drain outfalls.
- e. **Channel Maintenance Program** – Exclusions including: emergency repair and CIP.

4. Related Programmatic Documentation – CPM will review and approve the Channel Maintenance Program programmatic documentation. Maintenance activities shall comply with the stream alteration agreement provisions and requirements for channel maintenance activities consistent with California's endangered species protection regulations and with NFIP regulations.

5. Channel Maintenance Process Overview

- a. **Program Development and Documentation** – This documentation provides the permitting requirements for channel maintenance work in accordance with the conditions of certification for individual routine maintenance of the engineered channel without having to perform separate CEQA review or obtain permits.

- b. **Maintenance Guidelines** - based on two concepts: (1) the maintenance standard and (2) the acceptable maintenance condition, and applies to sediment removal, vegetation management, trash and debris collection, blockage removal, fence repairs, and access road maintenance.
 - c. **Implementation** – Sets Maintenance Guidelines for vegetation and sediment management. BSEP's vegetation management activities are established in Condition of Certification **BIO-18**. Maintenance Guidelines for sediment removal provide information on the allowable depth of sediment for the engineered channel that would continue to provide design discharge protection. The final determination on allowable sediment accumulation will be studied by the applicant as part of compliance with Condition of Certification **SOIL&WATER-7**.
 - d. **Reporting** – CPM requires the following reports to be submitted each year as part of the ACR:
 - i. Channel Maintenance Work Plan - Describes the planned "major" maintenance activities and extent of work to be accomplished; and
 - ii. Channel Maintenance Program Annual Report - Specifies which maintenance activities were completed during the year including type of work, location, and measure of the activity (e.g. cubic yards of sediment removed).
 - iii. A report describing "Lessons Learned" to evaluate the effectiveness of both resource protection and maintenance methods used throughout the year.
6. **Resource Protection Policies** - establishes policies to ensure that resources would be protected to the fullest extent feasible during routine channel maintenance activities. Policies would be developed to guide decision-making for channel maintenance activities. BMPs shall be developed to implement these policies.

Verification: Following creation of the Maintenance District and at least 60 days prior to the start of any project-related site disturbance activities, the project owner shall coordinate with public entity and the Maintenance District supervisor to develop the Channel Maintenance Program. The project owner shall submit two copies of the programmatic documentation, describing the proposed Channel Maintenance Program, to the CPM (for review and approval). The Project Owner shall provide written notification from the Maintenance District that they plan to adopt and implement the measures identified in the approved Channel Maintenance Program. The project owner shall:

1. In coordination with the public entity and the Maintenance District staff, develop and supervise the implementation of a Channel Maintenance Program in accordance with conditions of certification;

2. Ensure the BSEP Construction and Operation Managers receive training on the Channel Maintenance Program and coordinate with the Maintenance District staff;
3. Coordinate with the Maintenance District staff to develop Maintenance Guidelines;
4. Coordinate with the Maintenance District staff to develop annual and project specific Channel Maintenance Work Plans; and
5. As part of the BSEP Annual Compliance Report to the CPM, submit a Channel Maintenance Program Annual Report specifying which maintenance activities were completed during the year including type of work, location, and measure of the activity (e.g. cubic yards of sediment removed).

SOIL&WATER-9: The project owner shall submit two (2) copies of the 30-percent, 60-percent and 90-percent design drawings for the diversion channel to the CPM for review and comment. The project owner shall prepare a set of design specifications to supplement the 90-percent design drawings. Plans, specifications, computations and other data shall be prepared by persons properly authorized by the State of California. If the 60-percent plans or 90-percent plans and specifications do not comply with the appropriate Conditions of Certification, the necessary changes or revisions to the plans shall be made by the project owner. If the CPM finds that the work described in the plans and specifications conform to the Conditions of Certifications in the Energy Commission Decision and other pertinent LORS, then the project owner shall submit two (2) copies of the 100-percent set for CPM approval. All design drawings must be submitted on bound or stapled 24" x 36" size paper.

Verification: The project owner shall prepare preliminary (30-percent) diversion channel design drawings for CPM review and comment. The preliminary design drawings shall be submitted as required in the verification for Condition of Certification

SOIL&WATER-6. The project owner shall submit two (2) copies of the 60-percent and 90-percent (with specifications) design drawings to the CPM for review and comment. No later than 30 days after publication of the Energy Commission Decision, the 60-percent set of design drawings shall be submitted to the CPM for review and comment in consultation with CDFG and Kern County. The project owner shall submit the 90-percent design drawings to the CPM after the person who originally drew the plan or their duly authorized agent addresses the CPM's 60-percent submittal comments and required changes directed by FEMA during the CLOMR review. The 100-percent design drawings and specifications (construction documents), shall be signed and sealed by a Registered Professional Engineer in the State of California, are to be submitted as the final, approved set of construction documents prior to site mobilization.

SOIL&WATER-10: The project owner shall comply with the Kern County Division Four Standards for Drainage to estimate an appropriate imperviousness value to apply to onsite storm water runoff and retention basin analyses. Retention basin sizing shall take into account the effects of dust suppressants on infiltration. The applicant shall assess all offsite

drainage areas tributary to the site in the hydrologic study. Runoff from tributaries mapped as a water of the state shall not be piped.

Verification: The project owner shall do the following:

1. Estimate an appropriate imperviousness for the BSEP developed conditions site. Submit a description of the methods used to calculate imperviousness to the CPM for approval at least 60 days prior to submitting the DESCP.
2. Prepare a hydrologic study to estimate the peak flood flows to the BSEP site for two offsite watersheds that drain toward the BSEP: A) the 8.0 square-mile drainage area east of the Barren Ridge watershed and B) the 1.5 square-mile area draining the Chuckwalla Mountains. Submit the hydrologic analysis results to the CPM as part of the DESCP, required as part of Condition of Certification **SOIL&WATER-5**.
3. Provide the open channel design across the solar field for undetained runoff originating from the offsite tributary west of BSEP. Provide the CPM with evidence that a maintenance easement is established for the channel.

SOIL&WATER-11: The Kern County Division Four Standards for Drainage and 44CFR Part 65 require that projects on alluvial fans study the potential for debris flow and sediment movement using engineering methods acceptable to FEMA. The project owner shall analyze the potential for sediment to influence the Pine Tree Creek design discharge. The final analyses shall be reported in the hydrology section of the DESCP, required as part of Condition of Certification **SOIL&WATER-5**.

Verification: The project owner shall submit all calculations necessary for determining a bulking factor to the CPM for review and approval 30-days prior to submittal of the CLOMR application required in Condition of Certification

SOIL&WATER-6. After FEMA has issued a CLOMR, the final hydrologic analyses with bulking factor applied, if required by the CPM, shall be applied to the diversion channel design discharge.

SOIL&WATER-12: The project owner shall comply with the Kern County Standards for Drainage, Chapter IV and provide engineering analyses and design details for the transition where the diversion channel intercepts the natural channel. The project owner shall provide engineering analyses showing that the shallow flooding along uncertain paths from the south will not cause diversion channel bank failure from lateral overtopping. The project owner shall submit a proposed- conditions grading plan as evidence to show the diversion channel will capture shallow flooding along the left bank (looking downstream) of the natural wash.

Verification: The project owner shall complete the engineering analyses, design, and grading for the transition from the natural channel to the proposed diversion channel to intercept the design discharge along the southern property boundary. The engineered design for this transition shall be provided to the CPM for review and approval at the same time the 30 percent design drawings are submitted to the CPM as required in Condition of Certification **SOIL&WATER-6**. The project owner shall also provide final design details for the transition in the 60 percent and 90 percent design

drawings to the CPM for approval as required in Condition of Certification **SOIL&WATER-9**.

SOIL&WATER-13: The project owner shall complete the hydraulic analyses and final basis of design for the diversion channel, upstream- and downstream-transitions, bank protection, levees (if applicable), and grade control structures using hydraulic criteria for flood velocity, depth, Froude Number, and shear stress appropriate for the anticipated channel stability thresholds. These thresholds are based on the Kern County Division Four Standards for Drainage, Chapter X, where applicable. The value of the Froude Number between grade control structures shall be less than 0.8. Channel design elements not in compliance with Kern County Division Four standards will require a written variance from the County. All grade control structure stilling basins shall be designed with weep drains to prevent perched groundwater conditions and promote groundwater recharge. The project owner shall also be responsible for a geotechnical investigation to test the soils as necessary for final design of the grade control structures and bank stabilization measures. The results of the hydraulic analyses and the geotechnical investigations shall be presented in an Engineer's Report that accompanies each iterative stage of final design (30-percent, 60-percent and 90-percent as required in Condition of Certification **SOIL&WATER-9**).

Verification: At each iterative stage of final design (30-percent, 60-percent and 90) the project owner shall submit an Engineer's Report that includes the hydraulic analyses and geotechnical investigation results for the diversion channel to the CPM for review and approval. All design variances approved by Kern County shall be provided to the CPM.

SOIL&WATER-14: The project owner shall design the diversion channel to avoid soil cement lining on the bed of the channel between grade control structures to address resource agency comments. The project owner shall install bank toe protection along the entire length of the diversion channel to protect the banks from under-cutting, channel migration, and local erosion.

Verification: The project owner shall provide channel design drawings to the CPM for review and approval. The channel design drawings shall show the cross section detail for the bank toe protection measures, the longitudinal extent of the bank treatment with linear dimensions, and the area of the exposed diversion channel bed between each grade control structure. The design drawings shall be submitted with each verification requirement in Condition of Certification **SOIL&WATER-9**.

SOIL&WATER-15: The project owner shall complete a proposed-conditions sediment transport analyses to determine the final channel slope for the diversion channel that provides a slightly aggradational system that is predicted to result in a braided low flow channel.

Verification: The project owner shall provide to the CPM for review and approval a proposed-conditions sediment transport analyses that predicts an aggradational system for the final diversion channel design. The sediment transport analyses shall be submitted to the CPM at the same time as the engineer's report, required in Condition of Certification **SOIL&WATER-13**.

SOIL&WATER-16: The project owner, in accordance with Kern County Division Four Standards for Drainage, Chapter IV, shall provide engineering analyses or evidence showing that the diversion channel structural design elements will provide protection from hazards associated with the possible relocation of the Pine Tree Creek wash upstream of BSEP project boundaries.

Verification: The project owner shall provide engineering analyses or evidence to the CPM showing that the BSEP flood control facilities will provide protection from hazards associated with the relocation of Pine Tree Creek upstream from the site.

SOIL&WATER-17: The project owner shall stockpile topsoil excavated from the Pine Tree Creek wash separately. The topsoil material shall be used to backfill the energy dissipaters or stilling basins planned as part of each grade control structure. This requirement is in consistent with Condition of Certification **BIO-18**.

Verification: Following construction of the grade control structures and after FEMA approves the CLOMR, the project owner shall use the stockpiled topsoil from the existing Pine Tree Creek wash excavation to backfill the grade control structure stilling basins up to the height of the sill.

SOIL&WATER-18: The project owner shall provide the CPM two copies of the executed Recycled Water Purchase Agreement (agreement) with the recycled waste water purveyor for the long-term supply (30 – 35 years) of disinfected tertiary recycled water to the BSEP. The agreement shall specify a delivery rate to meet BSEP's maximum operation requirements and all terms and costs for the delivery and use of recycled water at the BSEP. The BSEP shall not connect to the new recycled water pipeline without the final agreement in place and submitted to the CPM. The project owner shall comply with the requirements of Title 22 and Title 17 of the California Code of Regulations and section 13523 of the California Water Code.

Verification: No later than 60 days prior to the connection to the recycled water pipeline, the project owner shall submit two copies of the executed agreement for the supply and on-site use of disinfected tertiary recycled water at the BSEP. The agreement shall specify that the recycled waste water purveyor can deliver recycled water at a maximum rate up to 900-gpm and will provide the BSEP a minimum of 1,424-AFY.

The project owner shall submit to the CPM a signed agreement between the applicant and the recycled waste water purveyor for the long-term supply of disinfected tertiary

recycled water from the recycled wastewater purveyors treatment plant to the BSEP for industrial and landscape irrigation purposes.

The project owner shall submit to the CPM a copy of the Producer/User Water Recycling Requirements, the recycled wastewater criteria, the Engineering Report, and the Cross Connection Inspection and Approval report prior to the connection to the disinfected tertiary recycled wastewater pipeline.

SOIL&WATER-19: Prior to the use of groundwater or recycled wastewater for operation of the BSEP, the project owner shall install and maintain metering devices as part of the water supply and distribution system to monitor and record in gallons per day the volume of water supplied to the BSEP. The metering devices shall be operational for the life of the project. An annual summary of daily water use by the BSEP, differentiating between potable, recycled wastewater or groundwater, shall be submitted to the CPM in the annual compliance report.

Verification: At least 60 days prior to use of any water source for BSEP operation, the project owner shall submit to the CPM evidence that metering devices have been installed and are operational on the water pipelines serving the project. The project owner shall provide a report on the servicing, testing, and calibration of the metering devices in the annual compliance report.

The project owner shall submit a water use summary report to the CPM in the annual compliance report for the life of the project. The annual summary report shall be based on volume of water used and shall distinguish recorded daily use of potable and recycled water. Included in the annual summary of water use, the project owner shall submit copies of meter records from the potable water and recycled water supplies documenting the volume of water supplied over the previous year. The report shall include calculated monthly range, monthly average, and annual use by the project in both gallons per day and acre-feet. After the first year and for subsequent years, this information shall also include the yearly range and yearly average potable and recycled water used by the project.

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SOIL AND WATER RESOURCES - APPENDIX A

ACRONYMS USED IN THE SOIL AND WATER RESOURCES SECTION

AF	acre-feet
AFY	acre-feet per year
BFE	Base Flood Elevation
BMP	Best Management Practices
BSEP	Beacon Solar Energy Plant
CalTrans	California Department of Transportation
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CPM	Compliance Project Manager
CLOMR	Conditional Letter of Map Revision
CSDD	Capitol Storm Design Discharge
CVWD	Coachella Valley Water District
CWA	Clean Water Act
CWC	California Water Code
DESCP	Drainage, Erosion, and Sediment Control Plan
DFIRM	Digital Flood Insurance Rate Map
DTSC	Department of Toxic Substances Control
DWA	Desert Water Agency
DWR	Department of Water Resources
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FIRMS	Flood Insurance Rate Maps
FSA	Final Staff Assessment
gpd	Gallons per day
gpm	gallons per minute
IEPR	Integrated Energy Policy Report
KCWA	Kern County Water Agency
LORS	laws, ordinances, regulations, and standards
mg/l	milligrams per liter
MW	megawatt
MWD	Metropolitan Water District of Southern California
NFIP	National Flood Insurance Program
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Services
NWS	National Weather Service
NOAA	National Oceanic and Atmospheric Administration
Porter-Cologne	Porter-Cologne Water Quality Control Act
PSA	Preliminary Staff Assessment
RCRA	Resource Conservation and Recovery Act

RWQCB	Regional Water Quality Control Board
SFHA	Special Flood Hazard Area
SPRR	Southern Pacific Railroad
SSG	Solar Steam Generator
STG	Steam Turbine Generator
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WQMP	Water Quality Management Plan
WSP	Water Supply Plan
WWTP	wastewater treatment plant
ZLD	zero liquid discharge

Soil And Water Resources - Appendix B

OVERVIEW OF MODELING APPROACH AND KOEHN LAKE SUB-BASIN MODEL REVIEW

The proposed Beacon Solar site is located in the Koehn sub-basin, which is part of the larger Fremont Valley Groundwater Basin located in the Mojave Desert and northeast of Antelope Valley, southeastern California. Environmental Simulations, Inc. (BS 2008a) developed a two-dimensional groundwater-flow model of the Koehn sub-basin to evaluate potential pumping impacts as part of the proposed Beacon Solar Energy Project (herein referred to as the "Koehn sub-basin model" or "the model"). Based on staff comments, they completed sensitivity testing with the model in October of 2008, and then refined the conceptual model and model calibration in May 2009 (many of the sensitivity tests were updated using the refined model). The updated model was employed to simulate groundwater level changes in response to pumping from extraction wells for plant construction (5-month simulation) and plant operation (30-year simulation). This appendix assesses model construction, assumptions, parameters, calibration, sensitivities, and simulated results from the May 2009 modeling effort (ESI 2009).²³

BACKGROUND ON GROUNDWATER-FLOW MODELING

The process of numerical groundwater-flow modeling involves first developing a conceptual model of the physical system and then applying a mathematical model to represent it quantitatively. A conceptual model is a clear, qualitative description of the natural system and its operation including water sources (recharge), flow directions, and sinks (discharge). The conceptual model of the Koehn sub-basin is based largely on the work of Koehler 1977, and was summarized by ENSR in the Application for Certification (BS 2008a).

A mathematical model utilizes equations to simulate the physical processes described by the conceptual model. The potential complexity of processes and variety of boundary conditions require numerical procedures to determine an approximate solution to the mathematical groundwater-flow equations. The Koehn sub-basin model utilizes the numerical mathematical model MODFLOW 2000 (Harbaugh2000), which is an updated version of the U.S. Geological Survey's groundwater-flow model MODFLOW.

²³ The terms "verification" and "validation" are often used interchangeably in hydrologic modeling. Some consider a "valid" groundwater-flow model as meaning it has been adequately demonstrated that the model simulates the cause and effect relationships within a specific groundwater basin. For example, the model adequately simulates the magnitude and distribution of water level changes in response to a change in recharge and pumpage. This type of validation is typically accomplished by conducting a post audit after the modeling study is completed. A post audit assesses whether conditions predicted by the model is confirmed by new field data that has been collected. This type of validation is beyond the scope of our evaluation; rather, we instead consider a "valid" model as a model constructed with an accepted computer code, reasonable parameter values supported by field data, and appropriately defined and implemented boundary conditions. An application is "valid" when all simulations meet typical measures of numerical accuracy (i.e., acceptable mass balance errors and groundwater-level closure criterion) and considers the potential sensitivity of model results to uncertainty in the input parameters.

MODFLOW was originally published and distributed in the 1980's, and is widely accepted and used and verified to produce numerically stable solutions (AndersonWoessner1992).

In applying models to real world groundwater-flow systems, errors can potentially arise from the following sources:

- Conceptual deficiencies (i.e., erroneous basin geometry, incorrect boundary conditions, neglecting important processes, including inappropriate processes, and so forth),
- Numerical deficiencies from errors associated with the equation solvers. These errors introduce problems with computational accuracy and precision, and
- Inadequacies in parameterization (water transmitting and storage properties) and poorly defined stresses (inflows and outflows like recharge and pumping).

The most common errors in model construction are attributed to conceptual deficiencies, inadequate parameterization and poorly defined stresses. The focus of this assessment is: (1) the modeling approach employed to simulate pumping impacts; (2) the assumptions, parameter values, and boundary conditions incorporated into model construction; and, (3) the simulation results and their inherent sensitivity to uncertainty in model input.

CONCEPTUAL MODEL

The Koehn sub-basin is bounded by low permeability rocks and faults, which act as partial barriers to water movement and limit the exchange of groundwater between adjoining sub-basins of the Fremont Valley Groundwater Basin. In the south, the Koehn sub-basin is bounded by the Rand Mountains and Randsburg-Mojave Fault; to the east by the confluence of the El Paso and Rand Mountains; to the north by the El Paso Mountains and Sierra Nevada; and, to the west by the Oak Creek sub-basin. The Koehn sub-basin is further divided by the Cantil Valley Fault and the Garlock Fault. The Cantil Valley Fault is the most hydrologically significant because it acts as a partial barrier to ground-water movement and effectively splits the Koehn sub-basin into two halves that are only partially connected (Koehler 1977).

In the Koehn sub-basin, percolation of runoff from the mountains and possibly subsurface inflow from the Antelope Valley are the primary sources of groundwater recharge (See **SOIL & WATER FIGURE 3**). Under pre- and early area-development conditions, groundwater flow was from the sub-basin boundaries inward toward Koehn Lake, which is the lowest point within the sub-basin and is the primary natural discharge feature. Since the 1950's, evapotranspiration of groundwater extracted by wells increased and this consumptive use reportedly peaked at almost 60,000 acre-feet per year in the mid- 1970's (Koehler 1977). These groundwater extractions resulted in substantial groundwater storage reductions in the sub-basin. During the 1980's, groundwater extractions largely ceased and groundwater levels and storage volumes have since somewhat continuously increased (SAMDA 1997; BS 2008a). The water level increase is localized recovery from substantial past pumping drawdown, where the

recovery is lateral inflow from other parts of the sub-basin, and continued water additions from mountain front recharge and infiltration of storm water runoff (recharge).

MODEL CONSTRUCTION

ASSUMPTIONS

We reviewed ENSR's modeling assumptions and found that most are generally consistent with published descriptions of the conceptual model for the Koehn sub-basin and the objectives specified for the numerical groundwater-flow model. The assumptions used in the model included:

- Groundwater in the Koehn Lake sub-basin is unconfined;
- For modeling purposes, vertical groundwater flow in the saturated zone is ignored and the Koehn Lake sub-basin was represented as a two-dimensional system where flow is exclusively in the horizontal (x-y) plane;
- Faults act as partial barriers to groundwater flow, and are represented in the model as thin, vertical, low-permeability geologic features located at the boundary between two adjacent finite-difference cells;
- Groundwater recharge is primarily from mountain-front recharge and infiltration of storm-runoff into stream beds; and,
- Aquifer compaction and land subsidence is neglected because water levels in the sub-basin have been increasing, and Earth Satellite Corporation (SAMDA1997), concluded the likelihood of subsidence due to groundwater extraction at the proposed project site was small owing to a relative lack of significant clay layers beneath the water table and unconfined groundwater conditions.
- The model simulations are assumed to converge when the residuals in hydraulic head and volumetric fluxes meet a water level closure criterion of 0.001 foot and mass balance error criterion of less than 0.1 percent.

Staff's review of relevant published modeling studies and data provided by the project applicant indicate uncertainty in simulated conditions and therefore some modeling assumptions may be incorrect. The relevant assumptions include two simulated boundary conditions (Antelope Valley inflow and discharge to Koehn Lake, recharge processes, aquifer parameters (hydraulic conductivity and storage coefficients), and water density effects.

- Groundwater inflow across the southern boundary is assumed to decrease from 1,000 acre-feet per year in 1958 to 200 acre-feet per year in 2007 and beyond. Although the magnitude of flux into the Fremont Valley is generally consistent with previous modeling studies completed by the USGS, staff concluded the likelihood of this water reaching the southern model boundary and contributing inflow to the Koehn Sub-basin is questionable. This is discussed in greater detail below under "*Boundary Conditions-Constant Flux*";

- The model employs drain cells to simulate groundwater discharge from Koehn Lake. The simulated discharge ceases by 1976, which staff concluded may disagree with hydrogeologic conditions. This is discussed in greater detail below under "*Boundary Conditions-Fixed Head*";
- The magnitude, distribution, and timing of recharge may be influenced by agricultural return flows and unsaturated zone thickness. This process is not considered by the project applicant's model, although one of the sensitivity tests conducted on the model considers delayed recharge from return flows. The potential consequences of this potential conceptual difference is discussed in greater detail below under "*Recharge and Pumping*";
- The model assumes that water removed from storage is discharged instantaneously with decline in head, and the storage coefficients do not vary with time. However, staff's review of pumping test results and modeling analyses reported by the project applicant suggest a time-delay in the dewatering response to water level declines, and therefore storage coefficients may not be constant but instead vary with time. This deficiency is discussed in greater detail below under "*Storage Coefficient*"; and,
- The groundwater-flow model (MODFLOW) simulates vertical and horizontal groundwater movement of constant-density groundwater in saturated sediments. However, density differences can influence hydraulic conditions and flow near and beneath Koehn Lake.

PARAMETERS

The two aquifer properties specified in the model are hydraulic conductivity and storage coefficient (specific yield). Hydraulic conductivity is a measure of the rate of flow through a strip of aquifer of unit height and width under a unit hydraulic gradient. The storage coefficient is the volume of water an aquifer releases or takes into storage per unit surface area per unit change in groundwater level.

Hydraulic Conductivity

Hydraulic conductivity is a measure of the aquifer's ability to transmit water. There is almost always uncertainty in the magnitude and distribution of hydraulic conductivity owing to the inherent uncertainty of natural heterogeneous systems.

The initial modeled hydraulic conductivity distribution was based largely on Koehler (Koehler 1977), with refinements based on model calibration to short-term aquifer tests and various water level records in wells during the period 1958 to 2007 (BS 2008a). Koehler approximated transmissivity from specific capacity²⁴ data, from which hydraulic conductivity was calculated using an assumed saturated aquifer thickness. The conductivity values inferred from Koehler's transmissivity estimates range from 11.5 to almost 31 feet per day (ft/day) (DB 2008t).

In the Koehn sub-basin model, the calibrated conductivity values range from 0.11 to 68.8 ft/day. Except for the lowest conductivity values (0.11 to 0.52 ft/day), the remaining

²⁴ Specific capacity is the yield of water from a well, typically in gallons per minute, divided by the associated water level drawdown, in feet. Specific capacity is influenced by the pumping rate, duration of pumping, well construction, well age, and other factors.

calibrated values (20.0 to 68.8 ft/day) are within about 50-percent of the values inferred from Koehler's transmissivity estimates (11.5 to 31 ft/day), and are generally similar to unconfined aquifer zone conductivity values reported by Leighton (2003), for the nearby Antelope Valley Groundwater Basin (2 to 30 ft/day). However, the spatial distribution of calibrated conductivity values in the Koehn sub-basin model are reversed from Koehler's estimate; the calibrated hydraulic conductivity values north of the Cantil Fault (20 ft/day) are approximately one-half the calibrated conductivity values south of the Fault (43.3 ft/day).

ENSR (DB 2008t) acknowledge model conductivity values south of the Cantil Fault are greater than estimated from Koehler's (1977) transmissivity results. They reasoned that uncertainty in aquifer thickness and specific capacity data could explain the differences. ENSR (DB2008t) concluded that model results may be more reliable than Koehler's results because they represent values averaged over a greater basin area than specific capacity data from individual wells. However, staff's experience with groundwater flow models indicates that calibrated conductivity values are often coupled to specified stresses, and therefore uncertainty in the magnitude and distribution of simulated pumping and recharge influence modeled hydraulic conductivity. The AFC (BS 2008a) reports that modeled pumping and recharge are only approximate values. Therefore, because of the coupling between conductivity and specified stresses, staff concluded the reliability of the calibrated hydraulic conductivity is also only approximate.

The two largest conductivity zones represent the area north and south of the Cantil Valley Fault (conductivity zones 1 and 2, respectively, as reported by ENSR, BS2008a). The modeled hydraulic conductivity distribution is uniform and continuous throughout these zones, except for the area beneath Koehn Lake. The modeled conductivity north and south of the lakebed is 20.0 and 43.5 ft/d, respectively, whereas the modeled conductivity beneath the lakebed is 15.3 ft/d (a reduction of 24- to 65-percent, respectively). The hydraulic conductivity reduction beneath the lakebed is generally consistent with the sub-basin's geologic description provided in the AFC (BS2008a) indicating that sediment texture fines towards the lake and that five deep borings in the lake bed found predominantly clay sediments to a depth of 515 ft below ground surface. Specifically, five deep borings in the lakebed reported by the USGS (Docker1979) encountered 100- to 92-percent clay (average percent clay of 97-percent), whereas confidential well reports provided to staff for wells located one to two miles west and south of the lakebed encountered less clay (average percent clay of 19-percent). These reported observations confirm that that hydraulic conductivity is not uniform but decreases with the increased fining of sediment texture beneath the lakebed. Based on average clay content (97-percent), the expected conductivity beneath the lake bed could be even lower than 15.3 ft/d. A greater conductivity contrast between predominantly coarse and fine grained deposits may influence temporal trends in the magnitude and rate of simulated water level changes and groundwater discharge to the lake (groundwater discharge to Koehn Lake is discussed in detail below under "*Boundary Conditions*").

The lowest calibrated model-conductivity values are located beneath the northern portion of the proposed project site (0.11 ft/d), and beneath the eastern end of the modeled valley (0.40 to 0.52 ft/d). Model calibration to short term pumping test data was used to determine site specific conductivity values, and the low values beneath the

proposed project site seem to correspond to areas mapped by Earth Satellite Corporation (SAMDA 2008) as having significant surficial clay deposits and more frequent and thicker clay lenses with depth. In the eastern end of the valley, no specific capacity or aquifer test data is provided to confirm the lower calibrated conductivity values that were reportedly necessary to simulate high water levels in the area (BS 2008a). A map showing model-calibration target locations (DB 2009o, Figure 2) shows three wells utilized as match points to calibrate the low conductivity values modeled in the eastern end of the valley.

Due to uncertainty in hydraulic conductivity, the model simulations reported by ENSR consider a range in hydraulic conductivity. Uncertainty was considered by conducting parallel simulations that uniformly multiplied hydraulic conductivity values by factors of 0.5 and 2.0 (DB 2009o).

Storage Coefficient

The storage coefficient relates the volume of water released per unit area of aquifer to a unit decline in head. In an unconfined aquifer, the storage coefficient is represented by the specific yield. Koehler estimated a specific yield for the Koehn sub-basin of 0.11 based on well-driller logs, which is the value employed in the model.

Similar to hydraulic conductivity, there is uncertainty in the magnitude and distribution of specified yield. The model assumes that the water removed from storage is discharged instantaneously with a decline in water level, and the specific yield is constant and does not vary with time. Pumping test data analyses conducted with the model and reported by ENSR (BS 2008a) indicate short-term storage coefficients of about 10^{-3} for most of the model area and 10^{-4} for the central part of the project site. These storage coefficient values were determined from short-term tests (several days) and are substantially lower than the specific yield employed in the model (0.11). The applicant concluded the small storage coefficients indicated semi-confined to confined aquifer conditions, which is inconsistent with the conceptual model (the sub-basin is considered an unconfined aquifer system). Alternatively, the small storage coefficients from multi-day pumping tests may indicate groundwater releases slowly from storage as water levels decline. The delay in yield would indicate storage changes are not instantaneous, but instead are a time-dependent process, and significant time may be required to drain the water from storage between sediment grains at amounts that are consistent with the specific yield.

If the pumping test results indeed reflect delayed yield, the assumption that storage releases instantaneously is probably reasonable for long-term simulations (i.e., simulations that consider water level changes over a 30-year period). However, the simulated water level response to shorter pumping periods (i.e., simulations that consider water level changes over a period of several days or weeks) can be underestimated using the specific yield. ESI (DB 2009o) reported a sensitivity test conducted using the lower storage coefficients to maximize local impacts from the 5-month construction period; the lower storage coefficient resulted in an additional 5 feet of simulated water level decline at the end of the construction period.

Due to uncertainty in the storage coefficient, the model simulations reported by ESI consider a range in specific yield. The uncertainty was considered by conducting parallel simulations that multiply specific yield values by factors of 0.5 and 2.0 (DB 2009o).

Faults

The Horizontal Flow Barrier Package simulates the hydrologic effects of internal faulting within the Koehn sub-basin. It represents faults as thin, vertical, low-permeability geologic features located at the boundary between two adjacent finite-difference cells. The parameter representing the fault is its hydraulic characteristic, in units of per day (day^{-1}); the hydraulic characteristic is the barrier hydraulic conductivity (ft/day) divided by its width (ft).

In the Koehn sub-basin model, four faults are simulated (the Garlock, Cantil Valley, Randsburg-Mojave, and Muroc Faults). With the exception of the Garlock Fault, the calibrated hydraulic characteristics range from about 4×10^{-5} to $2 \times 10^{-3} \text{ day}^{-1}$, which is generally similar to the range in unconfined zone fault hydraulic characteristics reported by Leighton for their model of the Antelope Valley (1.0×10^{-5} to $4.0 \times 10^{-3} \text{ day}^{-1}$). The calibrated hydraulic characteristic for the Garlock Fault is considerably higher than the other three faults (1.0 day^{-1}).

Due to uncertainty in fault hydraulic characteristics, ESI (DB 2009o) reported model simulations that tested model sensitivity to faults by reporting a simulation that removed the Cantil Valley Fault.

BOUNDARY CONDITIONS

The model utilizes three types of boundary conditions: free-surface, constant-flux, and fixed-head (general-head and drain).

Free-Surface

The free-surface boundary condition simulates the water table, which intercepts recharge and subsequently rises and falls in response to simulated recharge and pumping. The model does not explicitly simulate the contribution of irrigation return flows to the magnitude and distribution of recharge, and does not consider potential delays in the timing of irrigation return flows owing to the thick unsaturated zone. These issues are discussed below beneath the heading "*Recharge and Pumping*".

Constant-Flux

Groundwater flow across the southern boundary is specified as 1,000 acre-feet per year in 1958 and decreases linearly to 200 acre-feet per year in 2007. In the future, the specified inflow is assumed constant at 200 acre-feet per year. ENSR (BS2008a) cites Durbin (1978) as the source for a specified inflow of 1,000 AF/yr. Leighton reported that the gradient from the Antelope Basin to the Fremont Basin has not been constant over time, and therefore subsurface inflow to the Koehn sub-basin is not constant over time. Leighton reported that subsurface inflow to the Fremont Basin was about 5,400 AF/yr in 1958, and declined to 200 AF/yr by 1995. If this trend continued after 1995, the inflow probably declined to a value significantly less than 200 AF/yr by 2007.

Durbin 1978 represented subsurface flow from Antelope Valley into the Fremont Basin through a gap in the bedrock located southeast of California City (a gap in the bedrock located at the northwest corner of the north Muroc groundwater sub-basin). However, staff's review of Koehn sub-basin model boundaries indicate the model introduces this inflow at a location northwest of California City. **Soil & Water- Figure 1** shows water levels in the California City Sub-basin of the Freemont Valley and the North Muroc Sub-basin of the Antelope Valley are declining (note the observed water level trends in wells 32S/37E-11N1, -12M1, and -26N1). Hence, staff concluded that subsurface flow entering the model southeast of California City, if any, is probably captured, at least partially, by extraction wells in the California City Sub-basin prior to reaching the model boundary located northwest of California City. No information was provided by the project applicant to assess the sensitivity of model results to the magnitude of specified inflow from the North Muroc Sub-basin.

Fixed-Head

Two types of fixed-head boundaries are employed in the model: a general-head boundary along the eastern edge of the model simulates subsurface inflow across the Muroc Fault, and a drain boundary that simulates groundwater discharge to Koehn Lake.

General Head Boundary

The general-head boundary assumes the exchange of water across the Muroc Fault is proportional to the difference between a specified external water level west of the Fault (presumably located within the Chaffee sub-basin) and the model-calculated water levels in the adjacent portion of the California City sub-basin. The external water level is specified at 2,430 feet above mean sea level. The proportionality constant (the general head boundary conductance) represents the effective hydraulic conductivity across the fault and between the two sub-basins, and the distance to the specified external water level. Because the specified external water levels are maintained constant, they assume water levels within the Chaffee sub-basin are stable and simulated flow across the Muroc Fault is solely dependent on model-calculated water levels in the California City and Koehn sub-basins. Based on the model output listing file (ESI2009), simulated flow across the Muroc Fault increases from 704 AF/yr in 1959, to 709 AF/yr in 2007.

Drain Boundary

Groundwater discharge from Koehn Lake is the primary discharge mechanism under pre- and early-development conditions. Groundwater discharge across the lake bed is simulated using drain boundaries, which assume leakage to the drain is proportional to the difference between model-calculated groundwater levels and the specified drain elevation. The drain elevation is considered equal to lake bed elevation, and averages 1,893 feet (ranges from 1,888 to 1,900). The proportionality constant, or drain conductance, is determined by the properties of the interface between the lake bed and deeper groundwater system. The model uses an assumed value of 1 foot per day for the drain conductance (the information source or calibration effort undertaken to estimate this value is not reported).

As justification for employing drain cells, ESI (DB 2009o) cites a USGS modeling study of the Death Valley flow system that also employed drain cells to simulate groundwater

discharge to playa lakes. The USGS approach is significantly different from the Koehn Sub-basin model because it specified drain elevations substantially less than land surface elevation. In the USGS model, the drain elevation is set almost 33 feet below the lowest land-surface elevation, which was assumed a reasonable depth below which evapotranspiration would not occur (the extinction depth) and to represent springs located in land-surface depressions (Faunt2004).

Staff notes there is variability in approaches employed to represent groundwater discharge from bare soil and playa lakes. The USGS Mohave Desert Model (Stamos 2001) employed drains to simulate dry lake evaporation. Similar to the Koehn Sub-basin model, the Mohave Desert Model set drain elevations equal to the average elevation of the lakebed surface and calibrated conductance values ranged from 0.001 to 1.0 ft²/day. The USGS Antelope Valley Model (Leighton 2003) employed MODFLOW's Evapotranspiration Package to simulate both bare-soil evaporation and transpiration by phreatophytes. The annual maximum evapotranspiration rate was specified when the water table was at land surface and decreased linearly to zero when the water table reached a depth of 10 feet below land surface (the extinction depth).

In the "verification" run (DB 2009o), simulated drain flow (groundwater discharge to Koehn Lake) ceases after 1975. No tests are reported that assess the sensitivity of simulated discharge to drain elevation, conductance and proposed project pumping. Several pieces of evidence indicate groundwater may have continued to discharge to Koehn Lake bed under present day (2008) conditions, which would be contrary to the "verification" run.

- Potentiometric maps prepared by Earth Satellite Corporation for 1985 and 1997 (SAMDA1997, Figures F.2 and F.3, respectively) continued to show groundwater gradients toward Koehn Lake. Groundwater gradients toward Koehn Lake could be indicative of groundwater discharge from the lakebed. Alternatively, the project applicant believes most of the water migrating toward Koehn Lake is replenishing storage depleted by historical pumping, and no significant discharge is occurring from the lakebed. In the future, as water levels in the Koehn Sub-basin continue to recover, groundwater will again discharge from the lakebed.
- There is no groundwater level data for beneath the lakebed, and groundwater storage increases beneath Koehn Lake is inconsistent with observed water levels near the lakebed (**Soil & Water – Figure 1**). In March 2008, the water level in 30S/38E-24F01 corresponded to an elevation of 1,893 feet, which is equal to the average lakebed elevation. The water levels in this well have been declining since 1985 at an annual rate of -0.4 ft/year. In March 2008, the water level in 30S/38E-3K02 corresponded to an elevation of 1,880 feet, which is 8 feet lower than the minimum average lakebed elevation (1880 feet). The water levels in this well have been slowly rising since 1985 at an annual rate of only 0.03 ft/year. Lastly, on July 8 2009 staff visited the lakebed south of 30S/38E-3K02 and noted areas of standing water beneath the salt crust. The standing water could be the surface expression of a shallow water table, or it could be the remains of ponded surface water from past runoff events. Without additional data, conclusions regarding the source of standing water are speculative.

- A drain elevation equal to the lakebed surface may ignore potential groundwater discharge to the atmosphere from a shallow water table. Detailed evapotranspiration studies in Death Valley indicate average annual groundwater discharge from dry, salt encrusted and bare-soil playa lakebeds at 0.13 to 0.15 foot per year, respectively (DeMeo2003). The water table underlying these areas ranged from 5 to 10 feet of land surface. If these Death Valley estimates are applied to the Koehn Lake bed, which has an area of about 7,300 acres, the annual evaporation rate from the dry salt encrusted and bare-soil lakebed could be 950 to 1,095 acre-feet per year. These evaporation rates represent about 6-percent of the simulated, average annual water inflow to the Koehn Sub-basin and more than 20-percent of the average simulated pumpage during 1998-2007 (about 4,900 acre-feet per year).
- Substantial variations in water salinity and density near and beneath Koehn Lake contribute to uncertainty in groundwater-flow and potential discharge from the lake. Historical water quality data for samples collected below and adjacent to the lakebed indicate groundwater can be high in dissolved solids concentrations. Dockter1979 reported water samples collected 300 to 400 feet beneath the lakebed having TDS concentrations ranging from 1,430 to 110,000 mg/L. Koehler 1977 cited samples from a well located on the northwest side of the lake having TDS concentrations ranging from 68,800 to 101,000 mg/L (30S/38E-3B1). ENSR-2008 documented several additional wells near the lake having substantial TDS concentrations; 30S/38E-5R3 (59,500 mg/L in 1976), 30S/38E-24F1 (13,100 mg/L in 1953), and 30S/38E-32D1/D3 (5,700 mg/L in 1953). On July 9 2009, staff measured the electrical conductivity of a grab sample from 30S/38E-K02 at 113,000 $\mu\text{S}/\text{cm}$, indicating TDS concentrations of approximately 79,000 mg/L. For comparison, seawater is about 35,000 mg/L (Hem-1985). Without correcting for the salt-density effects, comparisons between groundwater elevations, hydraulic gradients, and flow directions can be erroneous.

RECHARGE AND PUMPING

Simulated 1958-2007 average, annual recharge from mountain-front recharge and infiltration of storm-runoff into streambeds is almost 15,600 AF/yr. This recharge rate was estimated from previous studies (Koehler, 1977; Bloyd, 1967; Welch 2007) and an analysis of historical precipitation and run-off potential (BS2008a). ENSR concluded mountain-front recharge and infiltration of storm-runoff into stream beds could range from 3,000 to 22,000 AF/yr. In addition to mountain-front recharge and storm-runoff infiltration, simulated subsurface inflows across the Muroc Fault and Antelope Valley is 700 and 600 acre-feet per year, respectively. Total simulated average inflow to the Koehn Sub-basin is therefore almost 26,900 acre-feet per year.

During the period 1958 to 2007, simulated annual pumping rates range from 3,357 to 66,115 AF/yr. During the period 1960 to 1976, historical annual pumping rates are based on the Koehler annual consumptive use estimates. After 1976, annual pumping rates included estimated domestic, industrial, and agricultural water uses (agricultural pumping was estimated from irrigated land areas identified by field surveys and aerial photographs). Neither the assumptions and calculations employed to derive the pumping values nor their uncertainty is reported and estimated.

The model relies substantially on Koehler-reported annual consumptive use estimates for simulated pumping rates. Koehler defined consumptive use as being equivalent to evapotranspiration, which is not the same as the applied water or pumpage. Water application rates are usually greater than consumptive use rates because some of the applied water is lost to deep percolation past the plant roots, evaporates from bare surfaces, and so forth. Leighton estimated that 30-percent of the applied irrigation water in the Antelope Valley is not available to the plant and becomes deep percolation to the groundwater system.

The principal crop grown in the Fremont Valley was alfalfa, and Koehler employed a "consumptive use" rate of 6.2 feet per year (ft/yr). Koehler's consumptive use rate is higher than plant water use rates reported for alfalfa grown in similar areas. Leighton cited studies that estimated the consumptive use rate for alfalfa in desert areas at 4.8 ft/yr, and a corresponding water application rate for alfalfa of 6.6 ft/yr.

If the Koehler "consumptive use" estimates in fact represent plant water use, then the volume of water extracted and applied (total pumpage) was substantially greater than 6.2 ft/yr. Conversely, if the Koehler "consumptive use" estimates actually represent the water applied (total pumpage), then a substantial proportion of the 6.2 ft/yr of applied water (approximately 30-percent) probably percolated past the crop roots and was returned to groundwater storage (agricultural return flow). In either case, based on this information staff concluded that potentially important processes (agricultural return flows) and the relationships between total pumpage and groundwater recharge may not be considered by the model.

Staff recognizes it could be argued that the Koehn sub-basin is a one-layer model, and the appropriate input to evaluate is the difference between total pumpage and return flows (net pumpage), which is essentially the water consumed by the plants. However, the analysis of Leighton indicates there is a time lag between when water is applied and when it reaches the water table. Specifically, they employed a 10-year delay for agricultural return flows to percolate through the thick unsaturated zone and reach the water table. Including this time delay will alter the time-series of net pumpage in the model. ESI (ESI2009) conducted a sensitivity test in which "agricultural return flows were added with a 10-year lag". The locations where the return flow is introduced into the model are not identified. After including agricultural return flows, the simulated hydrographs show significant changes in the timing of drawdown and recovery as well as the magnitude of the water levels at the end of the "verification" model run (simulated water levels at some locations were 30 to 50 feet higher in 2007 than the corresponding model run without including the return flows).

CALIBRATION

The purpose of calibration is to establish that the model reproduces observed real-world groundwater levels and flows. During model calibration, model parameters like hydraulic conductivity and storage coefficient are systematically adjusted in an attempt to improve the match between simulated and observed groundwater levels and flows. The result is an improved description of the magnitude and distribution of hydraulic conductivity and storage coefficient in the groundwater system.

All calibrated models are influenced by uncertainty because we cannot define the distribution of parameters like hydraulic conductivity and storage coefficient exactly. There is also uncertainty in the definition of boundary conditions, and uncertainty in the magnitude, distribution and timing of stresses like recharge and pumpage. For these reasons, a sensitivity analysis is performed to assess and quantify the effect of uncertainty on model calibration and predicted water levels simulated by the model. The model simulations reported by ESI (DB 2009o) included calibration sensitivity tests conducted on hydraulic conductivity (multiplied by factors between 0.5 and 2.0), storage coefficient (specific yield multiplied by factors between 0.1 and 10.0), recharge (multiplied by a factor between 0.5 and 10.0), and fault conductance (the conductances of four faults multiplied by factors ranging from 0.1 and 10.0). Additionally, sensitivity tests were included for conductivity, specific yield, faults (removal of Cantil Valley Fault), and agricultural return flows to test their influence on simulated water level changes owing to proposed project pumping.

RESULTS

CALIBRATION

The revised model data input files for the historical calibration run were received from ESI in June 2009, and we ran the model in DOS using executable files obtained from the U.S. Geological Survey's Water Resource Divisions website (MODFLOW Version 1.15.00, 8/6/2004). The model as provided converged in all time-steps.

The revised calibrated historical model, referred to as the "verification" run by ESI (DB 2009o) indicates that since 1996 groundwater storage has been increasing at an average annual rate of almost 10,830 AF/yr. Accordingly, simulated groundwater levels have also steadily increased in most wells through the end of the simulation in 2007.

Staff compared the simulated and observed water level recoveries plotted in **Soil & Water- Figure 1** and summarized the results below in **Soil & Water- Table B1**. While ESI (DB 2009o) assessed model calibration and the "verification" using a statistical comparison of the difference between simulated and observed water levels, their assessment did not consider a comparison between observed and simulated water level trends. At nine of the 16 locations in **Soil & Water- Figure 1**, the directions of the simulated and observed water level trends agree. Specifically, the model simulated increasing water levels at eight locations where observed water levels are also increasing (however, the simulated recovery rate at most of the locations was greater than observed). Similarly, the model simulated decreasing water levels at one location where observed water levels are also decreasing. At the remaining seven well locations, the simulated and observed trends were opposite in direction. In other words, the model simulated increasing water levels where observed water levels are decreasing, or the model simulated decreasing water levels where observed water levels are increasing. The specific discrepancies are summarized as follows.

- Two wells are located north of the Garlock Fault (30/37E-4D2 and -13C1), and simulated water levels increased 1.0 to 1.2 ft/yr whereas observed water levels decreased 0.1 ft/yr.

- Two wells are located south of the Randsburg-Mojave Fault (31S/37E-33H1 and -35N1), and simulated water levels decreased 0.6 to 0.7 ft/yr whereas observed water levels increased 0.2 ft/yr.
- One well is located east of Koehn Lake (29S/39E-33K1), and simulated water levels decreased 1.4 ft/yr but observed water levels increased 5.8 ft/yr.
- One well is located west of Koehn Lake and approximately mid-way between the lakebed and proposed project site (30S/38E-30Q1). Simulated water levels increased 3.7 ft/yr but observed water levels decreased 0.5 ft/yr. It is noteworthy that this well is located near two other wells (30S/38E-30P1 and -31C1) where simulated and observed water level trends agree and are both upwards. However, the simulated recovery rate at these two locations is approximately 2 to 4 times greater than observed.
- One well is located near the north shoreline of Koehn Lake (30S/38E-3K2), and simulated water levels at this location decreased 0.8 ft/yr but observed water levels were approximately flat (the calculated trend is 0.03 ft/yr).

Staff noted the water level data reported by ESI (DB 2009o) for some wells are incomplete and appear to be missing observations reported by the USGS after approximately 1999. The missing data reveal water level trends that are quite different from the trends simulated by the model. For example, observed water levels in wells 30S/37E-27H2 and -38G1 both show flat trends after 1999 relative to the upward trends simulated by the model for the same locations. Similarly, observed water levels in 29S/39E-33K1 continued to rise after 1999 whereas simulated water levels show a steady decline beginning around 1975.

Soil & Water Table B1
Observed and Simulated Water Level Trends, Koehn Sub-basin Model

Well Number	Recovery Trend (ft/year)				
	Years	Observed <i>alpha</i> = 0.05	Simulated	Simulated/ Observed	Simulated (without mountain front and infiltration recharge)
KOEHN SUB-BASIN OF FREEMONT VALLEY					
29S39E33K001M	1996-2006	5.8	-1.4	Opposite	-2.9
30S37E13C001M	1986-2006	(-0.1)	1.2	Opposite	-0.7
30S37E27H002M	1985-2006	2.4	4.9	2.0	3.6
30S37E34H002M	1986-2005	(2.0)	2.7	1.4	0.9
30S37E36G001M	1985-2006	0.6	4.8	8.0	3.5
30S37E36N001M	1993-2006	3.3	5.3	1.6	4.5
30S38E03K002M	1985-2006	0.03	-0.8	Opposite	-2.1
30S38E04D002M	1996-2006	(-0.1)	1.0	Opposite	-0.7
30S38E24F001M	1985-2006	-0.4	-1.0	2.5	-2.2
30S38E30P001M	1985-2006	0.8	3.7	4.6	2.4
30S38E30Q001M	1985-2006	-0.5	3.7	Opposite	2.4
30S38E31C001M	1995-2006	2.6	4.6	1.8	3.7
31S37E04J001M*	1986-2004	5.4	1.4	0.3	-0.6
31S37E04Q001M*	1985-2006	5.6	1.4	0.3	-0.5
CALIFORNIA CITY SUB-BASIN OF FREEMONT VALLEY					
31S37E33H001M	1985-2006	0.2	-0.6	Opposite	-1.1
31S37E35N001M	1985-2006	0.2	-0.7	Opposite	-1.1

Parentheses indicate calculated trend is statistically insignificant at the 95-percent confidence interval

The simulated recovery rate is sensitive to the net difference between recharge and pumpage (net recharge). Net recharge can decrease because of a decrease in mountain-front recharge and/or storm-runoff infiltration, an increase in groundwater consumption by pumpage, and/or increased discharge from Koehn Lake. Reducing net recharge decreases the simulated rate of water level rise. Staff tested "verification" run sensitivity to net recharge by eliminating mountain-front recharge and storm-runoff infiltration. Without mountain-front recharge and runoff infiltration, the model continued to simulate rising water levels at seven well locations. On the average, the resulting decrease in groundwater inflow reduced the simulated recovery rates from 4.2 to 3.0 ft/yr – an average decrease of 1.2 ft/yr (almost 30 percent). The continued inflow causing the water levels to rise is therefore from groundwater storage. Hence, on the average 70-percent of the simulated recovery in some model areas is from the re-distribution of groundwater in storage.

PREDICTIONS

The data input files for the verification and prediction runs were received from ESI in June 2009, and staff ran the model in DOS using executable files obtained from the U.S. Geological Survey's Water Resource Divisions website (MODFLOW Version 1.15.00, 8/6/2004). The models as provided converged in all time steps.

ESI (DB 2009o) reported model simulation results for groundwater pumping and use owing to project construction and project operations. Project construction is expected to take place over a period of about 26 months, but the most intensive pumping will occur during the first 5 months as the site is prepared and graded. Actual project operations are planned to begin about 21-months after grading and site preparation, during which time a small amount of pumping will continue (about 9 AF per month or less). At the end of the 26-months, project operations are expected to use at most 1,600 AFY of groundwater. For the purposes of their impact assessment, ESI (DB 2009o) initiated the 5-month construction period in 2011 and followed it with 30-years of constant pumping to represent project operations.

Five-Month Construction Pumping

Water usage during site preparation and grading was simulated by the model. The simulated pumping schedule consisted of 338 AF the first month (month 1), 2,025 AF during the next three months at an average rate of 675 AF per month (months 2-4), and 338 AF during the final month (month 5). The total pumpage during the 5-month site preparation and grading period was 2,701 AF, and the pumping rate was assumed equally distributed between seven existing site wells.

Thirty-Year Project Pumping

For project operations, 1,600 AF/yr of pumping was simulated for a continuous 30-year period (DB 2009o). The pumping was assumed to come from one well during the entire 30-year period (either well 48 or 63).

Simulated Impacts

ESI (DB 2009o) summarized the uncertainty in projected maximum water level changes due to pumping owing to uncertainty in model input. Their summary is reproduced below in **Soil & Water Table B2**. For all but the "Zero Recharge" analysis, the impact represents the difference between simulated future water levels without the project and future water levels after 30 years of project pumping. Because the model simulates rising water levels into the future, the impacts in **Soil & Water Table B2** represent the decrease in water level rise relative to future conditions without project pumping. In contrast, for the "Zero Recharge" analysis the impact represents the difference between predicted 2010 water levels and water levels after 30 years of project pumping assuming no mountain front recharge or infiltration of storm run-off. Calculated impacts greater than zero indicate future water levels are lower than predicted in 2010, whereas negative impacts (values less than zero) indicate future water levels are greater than predicted in 2010. Increasing water levels without recharge is the result of the redistribution of groundwater already in storage.

Soil & Water Table B2

Maximum Thresholds and Simulated Impacts from Project Pumping.

Well	Distance to Pumping Well (miles)	Simulated Drawdown and Impacts (feet) ^a					
		Zero Recharge ^b	Base		Maximum from Sensitivity Tests		
			Drawdown ^a	Impact ^c	Drawdown ^a	Impact ^c	Test Name
Pumping Well 63	0.0	33.4	-40	24.5	-30	34.6	K x 0.5
31S37E08C001M	0.6	30.0	-43	21.4	-36	28.5	K x 0.5
31S37E05M01	0.9	31.6	-44	20.5	-37	27.1	K x 0.5
Pumping Well 48	1.0	28.3	-44	21.2	-38	27.7	K x 0.5
31S37E10A01	1.9	-11.0	-48	2.9	-42	8.4	No Cantil Fault
30S37E34H02	2.7	24.1	-43	11.4	-40	14	K x 0.5
31S37E14L01	3.0	-11.7	-47	2.6	-42	7.7	No Cantil Fault
30S37E27H002M	3.4	24.3	-41	9.3	-39	11.2	K x 0.5
31S37E30F001M	3.6	-2.0	-23	2.0	-18	6.6	No Cantil Fault
Well 24	4.1	-7.9	-46	2.0	-43	5.1	No Cantil Fault
31S38E06E001M	4.2	-9.4	-45	1.9	-42	4.7	No Cantil Fault
30S37E36G001M	4.3	15.1	-44	7.3	-43	8.6	K x 0.5
31S37E33H001M	4.5	9.5	-2	0.6	0	2.1	No Cantil Fault
31S37E35N001M	5.3	9.8	-1	0.5	1	1.9	No Cantil Fault
30S37E24J001M	5.4	11.8	-35	5.4	-34	6.5	Sy x 0.5
30S38E32D03	5.6	-10.9	-40	1.3	-38	2.9	No Cantil Fault
30S38E19K01	5.9	9.1	-33	4.5	-32	5.4	Sy x 0.5
30S38E03K002M	10.2	6.3	-25	1.7	-24	2.2	Sy x 0.5
30S38E24F001M	10.2	-6.3	-19	0.3	-18	1.2	K x 2
29S39E32E001M	13.6	13.5	-22	1.3	-22	2	Sy x 0.5
30S39E08A001M	13.7	4.5	-7	0.4	-6	1.2	K x 2
29S39N29N01	13.9	14.8	-22	1.3	-22	2	Sy x 0.5
29S39E33K001M	14.9	8.5	-7	0.4	-6	1.3	K x 2
29S39E28H001M	15.8	18.1	-20	1.1	-19	1.9	K x 2, Sy x 0.5

- a) Drawdown calculated as the simulated 2007 water level minus the 2040 water level with project pumping. Negative values indicate that simulated water levels in 2040 are greater than in 2007.
- b) ESI (2009) reported simulated impacts in their Table 4 assuming Zero Recharge (no mountain front recharge or rainfall runoff infiltration), and defined the impact as the predicted water level in 2010 minus the predicted water level in 2040 with project pumping. The impact for this model run is equivalent to drawdown.
- c) Reported by ESI (2009) in their Table 4, and defined as the simulated 2040 water level without project pumping minus the simulated 2040 water level with project pumping.

CONCLUSIONS

The Koehn Sub-basin model employs a verified computer code (MODFLOW) that is widely used and an appropriate application for this evaluation. The specified aquifer parameters and most boundary conditions appear generally consistent with the published conceptual groundwater system (WR2003; Koehler1977; and others). However, staff identified potential problems with two boundaries specified in the model (Antelope Valley inflow and discharge to Koehn Lake). Model testing conducted by ESI (May 2009) indicate including agricultural return flows can have a significant effect on simulated water levels, but this process was not considered during model calibration.

The key findings and outstanding issues identified by our assessment are summarized below.

1. The model utilizes a specified constant inflow of 1,000 acre-feet per year (AF/yr) in 1958 and decreases linearly to 200 AF/yr by 2007. In the future, the specified inflow is assumed to be constant at 200 acre-feet per year. Previous Antelope Valley modeling studies suggest the inflow is probably significantly less than 200 AF/yr in 2007. In the real world, this inflow enters the Fremont Valley southeast of California City; however, the model introduces the flow at a location northwest of California City. Existing extraction wells in the California City Sub-basin probably capture some, if not all of this inflow prior to reaching the location it is introduced into the Koehn Sub-basin. As a result, there may be little to no contribution of subsurface inflow from Antelope Valley to the Koehn Sub-basin.
2. The model employs drain cells to simulate groundwater discharge from Koehn Lake. In the "verification" run (DB 2009o), the simulated discharge ceases by 1976. A number of factors contribute to the uncertainty of groundwater flow and discharge near and beneath Koehn Lake. For example, water level data and groundwater elevation contour maps seem to indicate groundwater discharge to the lakebed continued beyond 1976. Detailed evapotranspiration studies in other desert basins determined that annual groundwater discharge from dry, salt encrusted and bare-soil playa lakebeds could be significant even when water levels are 5 to 10 feet below land surface. If significant volumes of groundwater continued to discharge from Koehn Lake after 1975, then an important component could be missing from the simulated volumetric water budget.
3. The magnitude, distribution, and timing of historical agricultural return flows are not explicitly considered during model calibration and "verification" runs. Including "agricultural return flows added with a 10-year lag" influenced the timing of simulated drawdown and recovery as well as the magnitude of water levels at the end of the "verification" run (simulated water levels at some locations were 30 to 50 feet higher in 2007).
4. The reported short-term pumping impacts during project grading activities need to be qualified as minimum impacts owing to possible delayed yield effects. Pumping test analyses indicated aquifer storage coefficients vary with time yet the model assumes groundwater releases from storage instantaneously. The assumption is probably reasonable for long-term simulations (i.e., simulations that consider water level changes over the 30-year project period); however, the simulated water level response to shorter pumping periods (i.e., simulations that consider changes over a period of several days, weeks or possibly months) may under-estimate the short-term water level decline. ESI (DB 2009o) reported a sensitivity test using the lower storage coefficients to maximize local impacts from the 5-month construction period; the lower storage coefficient increased the simulated water level decline by about 5 feet.
5. Staff compared the simulated and observed water level recoveries at 16 locations. At nine locations, the directions of the simulated and observed water level trends agree, but simulated recovery rates were typically greater than observed. At the remaining seven locations, the simulated and observed water level trends were

opposite in direction. In other words, the model simulated increasing water levels where observed water levels are decreasing, or the model simulated decreasing water levels where observed water levels are increasing. Lastly, the reported water level data sets for some wells considered by the applicant are incomplete, and in some wells, the missing observations reveal significant differences between actual and simulated water level trends after about the year 2000.

6. Simulated water level trends are sensitive to the balance between water inflows and outflows (net recharge). The applicant conducted a test that eliminated mountain-front recharge and runoff infiltration and showed simulated water levels continue to rise at some locations. Rising water levels in the absence of significant water inflow indicate existing groundwater in storage contributes substantially (almost 70-percent on average) to the simulated water level recovery in some model areas.

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SOIL AND WATER RESOURCES – APPENDIX C

PROPOSED PINE TREE CREEK DIVERSION CHANNEL HYDROLOGIC AND HYDRAULIC ANALYSIS

OVERVIEW/PURPOSE

The proposed Beacon Solar Energy Project (BSEP) site is located near the mouth of the Pine Tree Creek watershed in the South Lahontan Hydrologic Region of the Mojave Desert (DWR2003). Pine Tree Creek, which is mapped by FEMA as a Special Flood Hazard Area (SFHA), crosses the BSEP site. Grading and construction for the BSEP would eliminate 10,900 linear feet (approximately 15 acres) of Pine Tree Creek, 2,150 linear feet (approximately 1 acre) of an unnamed wash on the west side of the project boundary and approximately 400 to 650 acres of Pine Tree Creek flood plain. BSEP has proposed an onsite realignment of Pine Tree Creek around the solar plant. The diversion channel would route the design discharge along the inside perimeter of the BSEP property.

Staff's review and analyses focused on the applicant's analyses of the existing site and the proposed diversion channel presented in following key areas:

- Special Flood Hazard Areas
- Hydrology
- Geomorphic Assessment
- Channel Hydraulics
- Sediment Transport
- Bank Protection
- Grade Control

This appendix provides staff's technical evaluation of the computer models developed by the applicant to study Pine Tree Creek, an ephemeral desert wash, and prepare the preliminary design documents for the diversion channel. Staff's review was to determine: 1) the reasonableness of the applicant's hydrologic analyses; 2) whether the diversion channel would replicate the existing wash's channel morphology and geomorphic function; 3) if the diversion channel design would contain the design discharge; and 4) whether the flood control measures effectively eliminate alluvial fan flood hazards to avoid significant flood impacts. These metrics establish the thresholds of significance for determining increased flood hazards that would result from the proposed flood control facilities.

TECHNICAL REVIEW EVOLUTION AND REFERENCES

Carlton Engineering, Inc. prepared a Conceptual Drainage Study (CDS) (Carlton 2008) to assess drainage patterns associated with the project. The CDS included detailed analyses for the existing and proposed drainage flows through and around the proposed

project and provided the initial basis for the conceptual design. The CDS was submitted to the California Energy Commission as part of the AFC (BS 2008a) and was revised as part of a supplemental drainage study in response to staff's Data Requests.

Staff met with the applicant and their consultants on January 20, 2009 to discuss specific requirements related to the National Flood Insurance Program (NFIP) Regulations, Chapter 44 of the Code of Federal Regulations (44 CFR). Staff also presented the applicant with the local requirements contained in the Kern County Division Four Standards for Drainage and the Kern County Hydrology Manual. The meeting addressed several basis of design related issues identified during staff's review of the AFC. These issues included existing flood hazard analyses, proposed site improvements, hydrologic analysis, hydraulic analysis, proposed flood hazard mapping, and FEMA's Conditional Letter of Map Revision / Letter of Map Revision (CLOMR/LOMR) application process. The applicant agreed to re-evaluate their design and resubmit detailed engineering analyses for the diversion channel.

California Department of Fish and Game (CDFG) commented on the BSEP AFC in a January 26, 2009 letter to the Energy Commission with provisions typically included in a Streambed Alteration Agreement. CDFG also provided comments on the engineering design of the channel in a February 10, 2009, Interoffice Technical Memorandum, prepared by Kris Vyverberg, CDFG Senior Engineering Geologist. CDFG's written comments echoed Energy Commission staff's concerns with the engineered channel design.

Staff published the Preliminary Staff Assessment (PSA) on April 1, 2009. The PSA concluded that the design of the engineered channel was inadequate for flood control and for reproducing the hydrologic and hydromorphic functions of the wash. Staff presented the applicant with numerous requests for data needed to determine whether the BSEP diversion channel would replicate the existing wash's channel morphology and geomorphic function, contain the design discharge to reduce the risk of flooding, and replace the natural and beneficial functions of the existing desert wash, especially wildlife habitat/movement corridor. Staff requested the following engineering studies: Revised Conceptual Drainage Study, Geomorphic Study, Revised Diversion Channel Design, and a Soils Engineering Report.

On April 14, 2009, a public meeting was held to discuss issues related to the project identified in the PSA. At the time of the meeting, the applicant had not fully completed the studies required for developing their basis of design for the diversion channel. In a letter from the California Regional Water Quality Control Board, Lahontan Region (Lahontan Water Board) dated April 17, 2009, the Lahontan Water Board's staff concurred with CEC staff concerns regarding storm water management as described in the PSA. Lahontan Water Board staff understood that the diversion channel design was being revised and, therefore, did not provide detailed comments on the applicant's plan in their letter.

On May 1, 2009, the applicant submitted its comments on the PSA. These comments did not address Staff's assessment of the proposed diversion channel plan. The applicant requested a meeting with Energy Commission staff which was held on May 13, 2009 to present their basis of design and to present new maps of the revised

diversion channel design. The primary changes to the design were an increase in the design flow to 28,000 cfs, grade control structures for the channel, and slightly revised channel dimensions. Staff asked detailed technical questions and provided comments for the applicant to address prior to the applicant formally submitting the updated design.

The applicant provided the Energy Commission with an update to the conceptual design on June 23, 2009 (DB2009r). Staff requested numerous electronic data files used to test the design criteria. On June 29, 2009, staff was provided access to the applicant's computer models. Several of the models had missing input files and could not be adequately reviewed without making considerable assumptions on the model setup and procedures. Two days later, on July 1, 2009, the CEC held a public workshop in California City, CA. At the workshop, staff provided additional comments on the basis of design and proposed diversion channel design. Staff also requested additional hydrology and hydraulic modeling data that the applicant was revising subsequent to the July public workshop. On July 20, 2009, the applicant reported that their application for the CLOMR would be completed and sent to the County of Kern for review and comment before submitting to FEMA for approval. As of the date of this FSA, the hydrology updates and the CLOMR application have not been provided to staff.

SPECIAL FLOOD HAZARD AREAS

The Flood Insurance Study (FIS) for Kern County, California and Incorporated Areas (FIS Number 06029CV001A), became effective on September 26, 2008. The county-wide FIS investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Kern County, California and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Most of the hydrologic and hydraulic analyses for the original FIS study are from the 1980s. The County's FIS includes flood hazard data in the region of BSEP. Staff used the data to evaluate the applicant's floodplain management plan. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations, 44 CFR, 60.3. (FEMA 2008).

The effective Digital Flood Insurance Rate Maps (DFIRM) were developed using a straight conversion from paper maps or Flood Insurance Rate Maps (FIRMs). The method used to convert the Special Flood Hazard Area (SFHA) to the digital format did not include new analyses. The "straight conversion" did not correct for topographic irregularities in the mapping. The result of the effective DFIRM mapping is that there continues to be inconsistencies with the actual flood hazard and the mapped flood hazard. For instance, when comparing the Pine Tree Creek SFHA to the existing channel, staff notes that the mapped floodplain does not always contain the low flow channel. These inaccuracies reflect the limitations of applying the effective floodplain mapping to the BSEP project.

In addition to data retrieved from published FEMA documents, staff collected data from various sources including the National Weather Service; National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE); U.S.

Geological Survey (USGS); National Resources Conservation Services (NRCS), California Department of Water Resources (DWR), California Department of Fish and Game (CDFG), California Department of Transportation (CalTrans); Kern County Water Agency (KCWA), Kern County Planning Department, Public Works Department, and several other sources.

Kern County Water Agency and Kern County Planning Department participate in the Cooperative Stream Gauging Program. The stream gauge at Pine Tree Creek (USGS 10264750) is located 13 miles northeast of Mojave, CA. The gauge is located on the downstream side of the Los Angeles aqueduct siphon pier near the right bank. The drainage area at this gauge is approximately 33.5 square-miles. USGS established the gauge in 1958. Data is available from 1958 through 1976. Another gauge on Cottonwood Creek (USGS 10264770) recorded annually during the period 1967 to 1972. A third nearby gauge is located on Cache Creek, which also has less than 10 years of data.

RIVERINE FLOOD HAZARDS

Kern County, due to its large extent and varied geography, has several hundred potential flood sources and approximately one-half million acres of FEMA identified SFHA's. The types of floodplains within the County are very diverse and include riverine floodplains (fast moving channelized flow), distributary flow floodplains (very broad, slow moving, shallow flow), and alluvial fan floodplains (heavily sediment laden, broad, shifting, and rapid moving flow) (FEMA, 2008).

Pine Tree Creek is the principal drainage feature with a high potential for flooding at the proposed BSEP site. Pine Tree Creek originates from the Pine Tree Canyon, which has a drainage area of 33.5 square-miles near the mouth of the canyon. After leaving the canyon, Pine Tree Creek forms and flows across an alluvial fan and crosses beneath State Route-14 (SR-14) and the Southern Pacific Railroad (SPRR) tracks before it becomes more of a distributary flow floodplain on the alluvial flat or piedmont where the Beacon site is proposed. The distal terminus of the Pine Tree Creek alluvial fan is near its confluence with Jawbone Creek.

Pine Tree Creek conveys offsite runoff across the property from the south to the northeast. The Federal Emergency Management Agency's effective DFIRM for Kern County (FEMA, 2008) indicates that portions of the BSEP site are within the FEMA designated SFHA 'Zone A' floodplain area. The FEMA SFHA Zone A is the flood insurance rate zone used for 1-percent-annual-chance (base flood) floodplains that are determined for the Flood Insurance Study (FIS) by approximate methods of analysis. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations (BFEs) or depths are shown in this zone. Mandatory flood insurance purchase requirements apply.

FEMA SFHAs in the Pine Tree Creek watershed are mapped for several miles upstream from its confluence with Jawbone Creek. Upstream of the BSEP property, the SFHAs follow two primary sub-watershed drainage paths: Pine Tree Canyon and the

Barren Ridge flats. It is clear from comparing recent aerial photos to the DFIRM mapping (especially along the flats) that the SFHAs do not always coincide with the location of the channels.

The requirements of the CLOMR process require delineation of the revised 1-percent-annual-chance floodplain in accordance with 44 CFR 65.12. Staff recommends the applicant use FEMA's Guidelines and Specifications for Flood Mapping Partners for guidance in determining the technical requirements for submitting an application for a CLOMR / LOMR. Staff has requested a copy of the CLOMR application as part of Condition of Certification **SOIL&WATER-6**, which is being prepared concurrently with this FSA.

HYDROLOGY

The applicant's CDS provided a preliminary evaluation of pre- and post-development site hydrology for the site and its tributary areas. The results of the CDS were used to provide preliminary design flow rate criteria for the proposed diversion channel and onsite drainage features. The applicant used USDA Natural Resource Conservation Service Technical Release 55 for estimating runoff from the site and from small offsite areas draining the site. In the PSA, staff commented on the analysis results and recommended a new analysis for further staff evaluation. Subsequently the applicant used the US Army Corps of Engineers rainfall-runoff computer model HEC-HMS to re-study the hydrology at the site.

This section provides Staff's technical comments on the hydrologic analyses conducted for BSEP, describes regional watersheds near the project, and presents a summary of historic flood events for context. Staff reviewed the hydrologic analyses, a basis-of-design component, in the development of the Soil & Water impacts analysis section of the FSA.

The goal of staff's review of the applicant's hydrologic evaluation is to provide an assessment of the "reasonableness" of the applicant's proposed base flood discharge estimates and, if necessary, to suggest alternative methods that may provide more reasonable flood discharges. The reasonableness of a flood discharge depends on the study requirements and hydrologic conditions in the region of interest (FEMA 2008).

REGIONAL WATERSHEDS

California Department of Water Resources identified 10 hydrologic regions in California that were delineated based on their similar geographic, climatic, and hydrologic characteristics. The BSEP site is within the South Lahontan Hydrologic Region. The South Lahontan Hydrologic Region has been further subdivided into 78 basins and sub-basins. This analysis primarily evaluates the Pine Tree Creek Watershed located within the Fremont Valley Groundwater Basin. Pine Tree Creek originates at Barren Ridge and Pine Tree Canyon in the Tehachapi Mountains, southwest of the BSEP site.

Pine Tree Canyon drains along an alluvial channel that flows through an existing six cell 8'x8' Reinforced Concrete Box (RCB) culvert at SR-14. Staff estimates this culvert can convey flows of nearly 4,000 cubic feet per second (cfs). The SR-14 culvert outfall forms an artificial hydrographical apex for flows within the culvert's capacity. Flows greater than the capacity of the culvert would simply overtop SR-14. No attenuation of flow is expected in any overtopping event. According to Caltrans, the six cell culvert has not been overtopped since its construction. Downstream of SPRR, Pine Tree Canyon flows join with runoff from the Barren Ridge area and drain toward the BSEP site. The total drainage area is approximately 83.2 square-miles.

Based on staff's review of a regional topographic map, a large portion of the Chuckwalla Mountains appears to be tributary to the BSEP site. Staff could not determine the historic offsite drainage patterns from this offsite watershed area. State Route-14 and the SPRR separate the Chuckwalla Mountains sub-watersheds from the BSEP site. Staff has identified several large culvert crossings along SR-14 and SPRR that currently direct runoff from the foothills toward the site. Staff identified this basin and its possible alignment toward the BSEP site in our PSA Appendix C conclusions. The applicant maintains that a ditch located immediately outside of the BSEP's western property boundary that would divert runoff from this area to the north. Drainage from this basin is not accounted for in the current BSEP onsite drainage plan.

A small sub-watershed, having a drainage area of approximately 1.5 square miles, drains to State waters that cross the site from the west. Staff calculated the peak flowrate for this sub-watershed using regional regression equations. The 100-year peak discharge entering the BSEP site could range between 700 cfs and 1,440 cfs depending on which regression equation is used. Staff estimates that a ditch with similar design characteristics (roughness, side slopes, longitudinal slope, etc) to ditches planned at the site would require a bottom width of at least 20 feet and require 3.0 feet of depth plus another foot for freeboard. The applicant has proposed to route the drainage from this small sub-watershed through the site in a culvert or ditch but has not provided specific details about the size of conveyance required to convey the offsite runoff. Peak runoff calculations for this sub-watershed were not included in the Project Design Refinements, hydrologic calculations (DB 2009r). Staff is concerned that an insufficiently sized conveyance could affect areas adjacent to the BSEP site including the transportation corridors: SR-14 and SPRR.

BSEP ONSITE HYDROLOGY

The applicant's CDS presented the results of an onsite drainage analyses required by Kern County to quantify the pre- and post-developed conditions runoff and appropriately size attenuation basins. The BSEP Retention Methodology chapter of their Conceptual Retention and Grading Study (DB2009r) established the plan for attenuation of post-developed runoff. The applicant would design retention basin (ponds) with enough capacity to store onsite runoff from the developed solar plant and match pre-developed runoff from the site. Staff has not received the final design calculations but the applicant has adequately described their proposed methods in the BSEP Project Design Refinements (DB 2009r).

Final design considerations for the onsite peak runoff, conveyance facilities, and retention basin size and location are primarily a function of the proposed site imperviousness and ability to percolate rainwater. The CDS identified Desert Shrub as the hydrologic cover type for the site, which is a predominantly pervious surface. CDS classified most of the soils across the site as Hydrologic Soil Group A, which has a very rapid permeability (6-20 inches per hour). A small portion of the site contains Hydrologic Soil Group D, which has moderately slow percolation rates from 0.2 to 0.6 inches per hour. Due to the increase in impervious area from site development, the post-development curve numbers or runoff coefficients (related to imperviousness in hydrologic calculations) need to increase above the existing condition values in the final analysis.

As proposed, BSEP would alter historic storm water flow paths and change runoff patterns from the property. To reduce the peak developed-conditions discharge from the site to the estimated pre-developed conditions, the applicant proposes several shallow retention basins to collect runoff generated from the developed solar array. The ponds would be linked via shallow, gradually sloped swales. The applicant used an approximate imperviousness estimate of 17.34% to calculate the preliminary retention volume for the entire site. Using the Kern County Division Four drainage standards, the applicant estimated the total retained volume at 58.5 acre-feet. The applicant compared this estimate to the requirements in the California Storm Water Quality Association (CASQA) California BMP Handbook and found the Kern County method would provide sufficient storage to meet the CASQA's requirements.

At the time of this FSA, the applicant has not determined the impervious relationship between pre- and post-developed conditions. The applicant met with Kern County to discuss their methods for estimating BSEP imperviousness but could not determine a final value since the BSEP finished surface is not yet certain. Staff agrees with the applicant that the impervious area is somewhat subjective for this type of development. Staff's Condition of Certification **SOIL&WATER-10** requires that the applicant demonstrate how imperviousness for the site was calculated. The applicant shall report site imperviousness in the DESCP in accordance with Condition of Certification **SOIL&WATER-5** and apply the CPM-approved imperviousness to size retention basins as part of the final onsite drainage study.

Staff is concerned that application of dust suppressants on disturbed land would affect the infiltration and percolation of rainwater. A reduction in the percolation rate could dramatically increase the amount of anticipated runoff from the developed site. The applicant has not provided an acceptable recommendation for increasing the runoff coefficient for these treated lands but has agreed to increase the capacity of the site's retention facilities to account for higher values. Condition of certification **SOIL&WATER-10** requires that the storm water retention facilities account for increased rainfall-runoff resulting from the application of dust suppressants.

BSEP will convey offsite sub-watersheds that drain toward the site historically across the solar field. These flows would not mix with onsite storm water. Staff agrees with this approach and has established Condition of Certification **SOIL&WATER-10** that requires conveyance on the surface (not piped) and that the applicant provide an adequately sized easement for maintenance.

PINE TREE CREEK HYDROLOGY

In their initial estimate of the peak design flow for the Pine Tree Creek diversion channel, the applicant plotted drainage area versus peak flow estimates from the 1995 FEMA Flood Insurance Study (FEMA, 1995). The applicant interpolated from the curve to estimate the design discharge for the 83.2 square-mile watershed between 14,000 to 20,000 cfs for Pine Tree Creek (BS 2008a). Staff concluded in the PSA that 20,000 cfs is a reasonable estimate compared to peak flood estimates in analogous watersheds and regional regression statistics. Staff recommended that the applicant conduct additional analyses following Kern County's method and select a model from the list of FEMA's "Numerical Models Meeting the Minimum Requirements for the NFIP". Staff also recommended that the applicant assess the potential for sediment to increase, or bulk, the peak design flow rate.

On May 13, 2009, the applicant reported their new design flow at 28,000 cfs. Sediment bulking did not influence the results. Staff requested the HEC-HMS computer model in an effort to conduct a detailed review of this important basis-of-design value. The main file was provided but several files associated with the model were not. Staff was unable to review the input parameters used in the model. Relying on the information provided in the Project Design Refinements, hydrologic calculations (DB 2009r), staff concluded that the 28,000 cfs was reasonable, and may be considered conservative when compared to prior studies in the South Lahontan Hydrologic Region of the Mojave Desert. At the July public workshop, staff recommended that the applicant determine the sediment bulking factor using methods acceptable to FEMA before submitting the CLOMR application.

Staff requested a copy of the final technical analyses used as the basis for the CLOMR application. At this time staff has not received this information.

REGIONAL HISTORIC FLOODS / FLASH FLOODS

Staff's research on historic flood events near the BSEP site acknowledge the potential for flood hazards associated with desert hydrology. Nearby areas in Kern County have suffered from numerous damaging floods. The following accounts describe several large events that were reported or recorded since 1961. (Source: NOAA, The Interior Central California Climate Calendar, <http://www.wrh.noaa.gov/hnx/WXCALENDER.pdf> and FEMA 2008). These flood events are important to include in this analysis because they provide a realistic understanding of the damaging potential for flash flooding in the region and where the applicant is proposing the BSEP.

August 23, 1961 - Flooding resulting from a thunderstorm covered roads with water and mud, trapping passengers in at least 20 cars in the Mojave area. Railroad tracks were blocked with debris for up to 18 hours.

August 17, 1983: Portions of California City were flooded after heavy rain fell in the Tehachapi Mountains and caused Cache Creek to swell. Water was the height of car windows and some houses flooded.

In 1984, there was a significant debris/mud flow from Short Canyon, which deposited sediment up to eight feet deep on properties within the subdivision in the immediate vicinity of Short Canyon.

September 5, 1991: Near Inyokern, CA, heavy rain fell causing water and mud to cover Highways 178, 395 and SR-14.

September 5, 1997 - An evening thunderstorm unleashed heavy rain in the El Paso Mountains. The thunderstorm moved from southwest to northeast up the El Paso Mountains. Reports indicated that 4.5 inches of rain fell from this storm in a little over an hour's time. The resulting flash flood through Red Rock Canyon State Park brought 28,000 cfs down through the park, across SR-14 and the Redrock-Randsburg Road. Reports indicated that a 12-foot wall of water swept over Highway 14 and subsequently over Redrock-Randsburg Road. The flooding stranded one hundred motorists and swept four cars into the water.

July 23, 2005 - Monsoonal moisture swept northwestward into the south half of California early in the morning and lingered through the next day. The deserts and mountain areas received locally heavy rain from thundershowers that resulted in numerous areas of desert stream flows. Radar estimates indicated 1-hour precipitation amounts of 2-3 inches and storm totals in excess of 4 inches. Flooding was reported along Highway 14 near Redrock-Randsburg Road.

August 15, 2005 - Thunderstorms unleashed heavy rain in California City during the evening hours resulting in flash flooding. The California City Fire Department recorded 5 inches of rain in just an hour. Portions of Highway 14 and Highway 58 flooded.

STAFF'S HYDROLOGIC ANALYSES

Staff conducted hydrologic analyses to assess the reasonableness of the applicant's peak discharge estimate. The results of the analyses below are compared to the results from the applicant's HEC-HMS model results. Staff did not prepare a rainfall-runoff model for the Pine Tree Creek watershed. Staff used the following hydrologic methods to analyze the Pine Tree Creek Watershed hydrology:

- Bulletin 17B, Guidelines for Determining Flood Flow Frequency, to determine peak flow data at the following gauging stations: Pine Tree Canyon; Cottonwood Creek; and Cache Creek
- Developed Regional Regression based on FEMA FIS Data
- California Regional Regression - South Lahontan-Colorado Desert Region
- Hybrid regional regression equations
- USGS regional regression equations (WSP 2433)

Because little historical streamflow and precipitation data exist, Staff's hydrologic analyses are rough estimates. With little historic data, the possibility of accurately predicting discharge for a given frequency is low.

Flood Flow Frequency

Staff performed statistical flood-frequency analysis using the Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (Interagency Advisory Committee on Water Data, 1982) to perform a flood-frequency analysis. Staff obtained data from Water Supply Paper (WSP) 2433 – Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States (USGS, 1997a). Pine Tree Canyon stream gage data from 1958 through 1976 were used for the analysis. **Soil & Water Table C1** presents data collected by the USGS. The highest measured flow was approximately 30,000 cfs in 1961 although the data source noted a footnote for this event. Unfortunately, staff could not locate the actual footnote. The 1961 data point was omitted from the final analyses because staff could not find any other historic record of the extreme rainfall event and determined the data may be inaccurate. In addition, staff's flood-frequency analysis, with the data point included, showed values too extreme for the 1% annual chance flood (base flood).

Soil & Water Table C1
Annual Peak Flowrate measured from the Pine Tree Canyon Gauge

Year	Annual Peak Flow (cfs)	Year	Annual Peak Flow (cfs)
1959	7.6	1969	76
1960	6.9	1970	0
1961	30,000	1971	0
1962	103	1972	330
1963	1,220	1973	77
1964	5	1974	0
1965	10	1975	4,900
1966	660	1976	5.3
1967	60	1977	130
1968	0	1978	7,700

Pine Tree Canyon is a sub-watershed having much different characteristics from the remaining Pine Tree Creek watershed area. The canyon also represents less than half of the watershed area but has the greatest potential to influence peak flow rates to the BSEP site. Staff concludes that a direct area transformation of the gauge data would not be appropriate for this assessment.

Using standard statistical methods, Confidence Intervals (C.I.) were determined at one standard deviation, or 68% C.I. to identify the upper and lower limits of the standard error for the base flood flow derived from the flood-frequency analysis. The proposed base flood discharges from the BSEP assessment are considered reasonable if they are generally within one standard error (68-percent confidence intervals) (FEMA, 2008).

Regression Analyses

Soil & Water Table C2 below presents the results of several hydrologic studies conducted for watersheds having similar climatic characteristics as Pine Tree Creek. Each watershed peak discharge is plotted with its tributary area on the log-log scale plot. The following table shows which watersheds are plotted on **Soil & Water Figure C1**.

Soil & Water Table C2
100-year Peak Flowrate from the effective FEMA FIS

Watershed	Location	Tributary Area	Annual 1% chance Peak Flow (cfs)
Blackburn Creek	downstream of Tehachapi Blvd	28.2	12,030
Blackburn Creek	at Tehachapi Bldg & Dennison Rd	10.1	7,450
Blackburn Creek	at Western Corporate Limits	16.2	9,090
Blackburn Creek	Near Highline Road	4.5	5,290
Cache Creek	at Downstream Limit of Study	163.4	7,800
Jawbone Canyon Wash	at Munsey Road	280.4	36,000
Cottonwood Creek	at mouth	51.0	7,800
Erkskine Creek	At State Highway 179	37.7	7,700
Kelso Creek	At State Highway 178	159.5	22,700

Discharge-frequency values for Kelso Creek and Erskine Creek were determined by FEMA study contractors using NRCS Technical Release No. 20 (TR-20). This rainfall-runoff model is consistent with the BSEP's initial onsite hydrologic analyses. The model considers factors such as precipitation duration-frequency data, hydrologic soils groups and land use, time of concentration, and storm type. The FEMA study contractor for Kelso and Erskine Creeks compared results from the TR-20 computer model with the results of log-Pearson Type III analyses of nearby gauging station data (FEMA 2008). The results of these two rainfall runoff models produced a base flood flow within the range of the regional regression equations described below.

The authors of the California state-wide rural regression equations, Waananen and Crippen, mention that in the Lahontan region, the equations are defined for watersheds having a maximum drainage area limit of 25 sq. miles. Because the drainage area of the Pine Tree Creek watershed is 83.2 sq. miles, the California regression equations were

not used for estimating peak discharges. The authors also describe the regression equations standard error of estimate has a range of 60% to more than 100% (Waananen and Crippen, 1977).

Hybrid Regional Regression Equations

The California Department of Transportation, Division of Research and Innovation published the "Improved Highway Design Methods for Desert Storms" in August 2007 (West, 2007). This report was recommended to staff by Andrew Brandt, an engineer with Caltrans, District 9 (Brandt, Pers Comm, January 21, 2009). Using the following regression equation from the West study, the Q100 is 10,400 cfs.

$$Q = 557.31 * A^{0.662}$$

This regression equation is applicable for sites with a drainage area between 0.01 and 3090 square miles, with a mean annual precipitation of less than 15 inches and a mean basin elevation of less than 4500 ft. This regression equation is plotted on **Soil & Water Figure C1**.

USGS Regional Regression Equations

Water Supply Paper 2433 (WSP2433), Methods for Estimating Magnitude of Frequency of Floods in the Southern United States (USGS, 1997), identifies the BSEP site as being located in the USGS Southern Great Basin Area 10. Staff tested the USGS regional regression methods for the USGS Southern Great Basin. This method is applicable for drainage areas less than 200 square miles and below 8000 feet in elevation. The USGS regression equation for Q100 is shown above and plotted in **Soil & Water Figure C1**.

$$Q = 850.0 * A^{0.690}$$

The resulting USGS regression analysis peak flow for the site is 17,960 cfs. The envelope curve shown in **Soil & Water Figure C1** is reproduced from the USGS WSP2433, represents the maximum flow potential for a given area.

The Pine Tree Creek watershed is approximately 83.2 square-miles at the BSEP site. A range of peak flood predictions for the Base Flood Flow or Capitol Storm Design Discharge (CSDD) can be approximated from **Soil & Water Figure C1**.

SEDIMENT / BULKING FACTORS

The applicant did not provide sufficient information for staff to assess the potential for significant debris laden flows and their impacts. Sediment has a high potential for contributing to the volume of flow being transported during a flood. Kern County currently does not require increasing the volume of water discharge to account for high concentrations of sediment in the flow but does require sediment analyses per Division Four Chapter IV. This method is generally applied to the peak design flow to obtain a total (bulked) peak flow. Typical bulking factors are 1.11 – 1.25 for normal stream flow, 1.25 – 1.67 for hyperconcentrated flow, and up to 2.0 for debris (Bradley, 1986).

Caltrans recommends selection of a larger bulking factor when the flow is confined to a single, well-defined channel (Caltrans 2006), such as the proposed diversion channel.

Determining the appropriate bulking factor would require a significant understanding of the watershed and its ability to produce sediment debris flow (West, 2007). The applicant conducted a preliminary sediment transport analysis (discussed below) and applied a bulking factor of 15% to the inflow boundary condition. The applicant also identified the potential for "high suspended sediment concentration during flood conditions" that can exceed concentrations of 100,000 parts per million by weight. Staff's Condition of Certification **Soil&Water-11** requires that the applicant determine a bulking factor, consistent for use on alluvial fans, as part of their hydrologic analyses to comply with Kern County Division Four Standards for Drainage, Chapter IV, Section 404-2. Compliance with this condition will ensure the diversion channel design mitigates the effects of sediment-laden flow.

GEOMORPHIC ASSESSMENT

Staff conducted a desktop geomorphic assessment and reconnaissance of Pine Tree Creek to develop an understanding of the current geomorphic conditions of the wash and assess the potential for the diversion channel to provide similar morphological conditions for successful mitigation. Staff used topographic maps, aerial photographs, and ground reconnaissance to estimate flood boundaries to show areas at risk from flooding. These boundaries were used to define the active channel and flood-prone areas that have undetermined magnitude or frequency.

Staff focused on fluvial erosion and deposition to be the main geomorphic processes affecting Pine Tree Creek. Aeolian deflation and deposition (winds' ability to erode, transport, and deposit materials) might have minor effects on the existing wash but could have a significant effect on the low-lying diversion channel to accumulate wind blown sands. It is important to note that ephemeral channels on alluvial fans are among the most unpredictable and unstable channel forms and attempts to predict their future evolution and behavior are subject to great uncertainty.

Staff initially compared the existing wash and proposed diversion channel slopes to the work conducted by Leopold and Wolman (1957), as shown in **Soil & Water Figure C2**, to establish the threshold between meandering and braided channel forms, based on a bankfull discharge and channel slope relationship.

The work performed by Leopold & Wolman, shown on **Soil & Water Figure C2**, help explain channel form, given channel slope and flow rate. Staff used **Soil & Water Figure C2** and data from the design to estimate potential channel form for the active channel. The longitudinal slopes of the diversion channel would be set to approximately 0.002 feet/feet (or mm^{-1}) with non-cohesive sediment forming the bed. The bankfull discharge is 877 cfs (24.8 cubic meters per second). Data from the study compared to the design slope-discharge suggest a meandering channel, as shown with the red dot. It is important to note that other factors such as sediment supply significantly affect whether channels are braided or not. The applicant has not provided evidence that a

significant amount of sediment supply is available from the Pine Tree Creek watershed to support a braided channel (see Sediment Transport Analysis discussion below).

REFERENCE REACH

Staff examined watersheds in the region to locate a likely candidate for a “reference reach” that had similar characteristics to the proposed channel. Due to past agricultural activities on the property, staff considered it likely that the natural morphology of Pine Tree Creek was altered, affecting its geomorphic response. Staff removed it as a potential reference reach for the diversion channel.

Immediately upstream (south) of the property line is a braided reach, with a slope of 0.01 feet/feet, which provides a good example of the desired channel form and size. This reference reach is a high gradient reach (approximately 1.0%) with bed and banks that appear to be composed of coarse sand. The solid black line in **Soil & Water Figure C3** delineates this reference reach. Due to the potential influence of small input channels, staff recommended omitting that portion of the reference reach. Staff’s recommended reference reach is delineated in **Soil & Water Figure C3** by the dashed tan line, and begins ~2,500 ft upstream of the property line and ends ~6,500 ft upstream of the property line. For the recommended reference reach, the average width of the active channel here is approximately 185 ft, with a maximum width of 300 ft and a minimum width of 112 ft.

SITE RECONNAISSANCE

During a visit to the proposed BSEP site, staff conducted a reconnaissance of Pine Tree Creek. The Cantil Valley Fault scarp separates two significantly different channel formations. Below the scarp, the ephemeral channel had vague channel definitions and a braided channel bottom consisting of unconsolidated sand. The active channel had scattered to dense populations of long-lived desert shrubs. Above the scarp, the wash tends to be more channelized with little vegetation up to the BSEP property line.

There is clear evidence of recent lateral channel movement upstream of the BSEP site. An exposed, ten-foot high bank has eroded along the right bank. This is clear evidence of an aggradational reach of the channel. Sediment transport in the bed of the channel was apparent from small deposits of sediment covering the root collars of shrubs. Minor gully head cutting was also apparent.

GEOMORPHOLOGICAL ASSESSMENT METHOD

Alluvial fan ecology is linked to alluvial fan geomorphology: the pattern of overflowing, laterally migrating channels, vegetation disturbance, creation of mid-channel bars, etc. Staff has determined that to reproduce the desired biological, hydrologic, and hydromorphic functions of the existing wash will depend on having a braided channel system. Staff conducted this geomorphic assessment to understand if the proposed hydraulic design would result in braiding of the diversion channel bed. Staff will use these basic criteria to assess impacts from the project to hydrologic functions of the

rerouted channel and to gage the success of the proposed mitigation plan. This section describes Staff's geomorphic assessment and Staff's review of the applicant's geomorphic assessment.

Staff has directed the applicant to submit a diversion channel design that recreates the form and function of an active alluvial stream. Braiding on alluvial fans is a function of high sediment load relative to transport capacity. This is not a stable channel form in the sense of transporting all the sediment delivered to the channel, which is the usual goal of a channel design. Staff, CDFG, and Lahontan RWQCB agree that a braided system of channels provides the most favorable outcome in terms of reestablishing biological character of the natural wash. To improve the chances for a braided channel, staff directed the applicant to design the system "slightly aggradational", and then deal with the consequences in terms of channel maintenance, should flood capacity be lost. Scouring channels and equilibrium channels, which do not become braided, should be avoided.

Staff studied the existing wash to develop an understanding of the carrying capacity of the bank full channel. Staff also approximated the extent of the floodplain and its capacity. Cross section 1 (XS 1), was cut from the recommended reference reach shown on **Soil & Water Figure C3**. The main active channel (or low flow channel) for XS 1 has an approximate capacity of 877 cfs (24.8 cubic meters per second), which matches the region's Hybrid Regional Regression results (West, 2007) for the 5-year event.

A second cross section was located on the southern property line, XS 2, to examine the channel capacity at property line and for staff to understand the change in cross sectional area between the natural channel and the diversion channel. According to staff's estimates, the approximate capacity of the natural channel at the property line is approximately 4,000 cfs. Flood flows greater than the active channel capacity would flow out of bank to the northeast and result in shallow flooding along uncertain paths. **Soil & Water Figure C4** illustrates the reference reach capacity at XS 1, the channel at the property line (XS 2) and its capacity and the typical diversion channel cross section.

Staff finds that active alluvial fan flooding is characterized by flow path uncertainty, abrupt deposition, and ensuing erosion of the sediment as the channel loses its capacity to carry material eroded from steeper, entrenched Pine Tree Canyon. The high level of uncertainty in hydrology, sediment, deposition, scour, and flow path ultimately results in uncertainty in defining the hazard associated with flooding. Staff concluded that shallow flooding would occur along highly unpredictable flow paths given the flow variability, flat topographic relief, and potential for channels to shift. Sediment and debris would be deposited or removed during or after a flood altering the flow path. Because flow paths and discharge are uncertain, staff estimates that without mitigation, nearly the entire area of the site is susceptible to an equal risk of shallow flooding.

Staff concludes that the natural wash upstream of BSEP does not have the capacity to deliver the contained design flood to the point of diversion. Peak floods would cause shallow flooding along the right and left banks. The shallow flooding would sheet flow

toward the northeast. The applicant confirmed Staff's PSA conclusions and shows the depth and extent of this shallow flooding as Pine Tree Creek approaches BSEP. The applicant has shown that the direction of flow would not converge at the point of entry to the diversion channel. In the BSEP- developed condition, the diversion channel grading does not fully would intercept the shallow flooding along the southernmost property line. As required in Condition of Certification **SOIL&WATER-11**, the applicant will extend the diversion channel grading to the west to intercept the extent of the natural channel floodplain and avoid significant flood damage to the solar field during a design discharge runoff event.

The applicant provided a Fluvial Geomorphic Assessment in their Project Design Refinements (DP 2009r) submittal. The applicant used aerial images to delineate the active channel and flood-prone areas that have undetermined magnitude or frequency. The applicant produced images from 1952 (pre-agriculture), 1983 (during agricultural practices), and a current 2007 aerial photo which provided a rough snapshot over a 55 year period. The photo coverage is primarily onsite and does not show much of the area to the south of BSEP. The applicant suggests that the lateral movement of the channel has been minimal. From the offsite area that is visible, it appears that the active channel has shifted between 1952 and 2007. Staff confirmed this lateral migration during the site reconnaissance. The applicant also included statements in their Geomorphic Assessment that support Staff's claim that the stream may have instabilities that contribute to channel degradation. These factors include relative small particle size of the silty sand and gravel surficial deposits, lack of vegetation and history of tectonic activity.

Channel morphology and geomorphic function are intimately linked to the balance between sediment delivery and sediment transport capacity. In the PSA, staff requested that the applicant provide a geomorphic assessment and provide engineering calculations that compare the sediment transport capacity of the existing wash compared to the proposed diversion channel. CDFG and Lahontan RWQCB also requested a geomorphic assessment of the engineered channel. The applicant's project design refinements included hydrodynamic, scour and sediment transport analysis (discussed below). While the applicant's studies provide a greater understanding of the system's sediment delivery and transport capacity, it is not clear that the future response of the diversion channel is fully-understood, or likely to preserve braiding. The reason for this ambiguity results from the uncertainty of computer models to predict accurately the channel response. A higher-level or additional sediment analysis is necessary to improve prediction and identify potential failure mechanisms related to sediment and floods. Completion of the analyses required as part of Condition of Certification **SOIL&WATER-13** will provide relevant information about sediment mobility needed to finalize the diversion channel design. The analysis results required under this condition would identify potentially damaging flood-related impacts caused by sediment aggradation or degradation. The analyses results will also be used to establish

maintenance metrics to manage sediment and improve the success of the desert wash mitigation. Channel monitoring and maintenance are required in Conditions of Certification **SOIL&WATER-7**, **SOIL&WATER-8**, and **BIO-18**.

The width of the diversion channel was largely determined based on the desire to convey the design discharge and maximize the area available for the solar field. Assuming the current diversion channel design would pass the design discharge, it is expected that additional widening would improve the hydraulic characteristics (velocity, shear stress, depth, etc), improve the longevity of the channel, and possibly require less maintenance. In the PSA, staff requested that the applicant consider a wider corridor to improve these conveyance characteristics and allow options to structural channel treatments such as soil cement. A wider channel would allow the low flow channel to migrate and erode / deposit to form a multi-stage channel similar to the existing wash and its floodplain. As proposed, the diversion channel would have roughly 200 feet to 250 feet to form a multi-stage channel. Staff estimated the reference reach width ranged from 185 to 300 feet, which suggests minor benching may occur at various locations of the channel.

Staff has assessed the potential for the proposed diversion channel to accumulate sediment, migrate laterally, downcut or erode. Staff concludes that the diversion (low flow) channel would potentially become a braided channel that could migrate along the base of the channel. To support this understanding, staff has concluded that the 0.2% channel bed slope would allow sediment to aggrade over time. The proposed diversion channel as designed for BSEP would have some degree of natural geomorphic function, including a limited ability to braid, meander and laterally migrate between Grade Control Structures (GCSs). Staff has determined that for the protection against the possibility that the channel would migrate towards and erode a section of the channel bank, bank toes would require adequate stabilization. Staff discusses bank stabilization methods below.

To ensure the hydraulic constraints of the proposed engineered channel meet the design standards of Kern County, staff is recommending compliance with Conditions of Certification **SOIL&WATER-12**, and **SOIL&WATER-13**. These conditions require engineering analyses for the transition and the 90-degree channel bend using appropriate hydraulic software capable of determining the appropriate hydraulic losses associated with these transitions. As a requirement of Condition of Certification **SOIL&WATER-6**, the preliminary design for these transitions are to be included as part of the CLOMR submittal to FEMA to demonstrate the stability of the channel under base flood conditions. These constrictions and other structural design elements or channel protection measures shall be designed in accordance with Kern County standards, and submitted to Kern County for review and comment as required in Condition of Certification **SOIL&WATER-9**. The ultimate design of the diversion channel must take into account the existing flood hazard upstream of the site, potential impacts to downstream properties, and recommendations from the County. Condition of Certification **SOIL&WATER-16** requires that the project owner evaluate potential geomorphic impacts to Pine Tree Creek wash upstream of BSEP in accordance with Kern County Division Four Standards for Drainage, Chapter IV Section 404-2.04.

HYDRAULICS

The applicant provided several computer models that simulated the existing Pine Tree Creek and the diversion channel hydraulics. Staff reviewed these models and the reported results in the Project Design Refinements (DB 2009r). Staff also conducted an independent technical assessment of the channel and its capacity to convey the design discharge (28,000 cfs) and meet the biologic, geomorphic, and hydromorphic recommendations of other state agencies. Staff's independent hydraulic analysis of the applicant's original plan published in the PSA is no longer valid because the proposed diversion channel design changed so significantly following the PSA workshop.

The applicant designed the new diversion channel and the setup hydraulic models to simulate the design flood and verify the basis-of-design. Staff is concerned with the channel's capacity to convey the design flood (28,000 cfs) and the other characteristics of the flow including: velocity, depth, shear stress, and Froude Number. The following equation determines the Froude Number:

$$\text{Froude Number} = V / (g * Y)^{(1/2)}$$

Where g is equal to 32.2 ft/s², Y is the depth of flow in feet, and the velocity (V) is in feet per second (fps).

The current, proposed diversion channel would intersect Pine Tree Creek at the BSEP property line where the natural channel enters the site. The diversion channel is planned as a trapezoidal channel having 3:1 or 4:1 side slopes, with a minimum bottom width of 200 feet to more than 4,000 feet at the outfall. For most of the diversion channel, the bottom width is approximately 250 feet. The total area available for revegetation (the long, gradually sloping channel bottoms between drop structures) is 53.0 acres measured from the point of diversion to the location of the proposed channel fan (Channel Station 36+00). This area is measured from toe-of-slope to toe-of-slope on the opposite bank and does not include the area proposed for soil cement in the bed of the channel from Station 143+50 to 135+00. The area in the channel bottom available for revegetation is 41.5 acres, which excludes hardened elements such as grade control structures, soil cement bank protection and channel bottom, or rock riprap constructed in the bed or along the banks.

The diversion channel design incorporates grade control structures that dissipate energy and establish an effective channel slope. The applicant presented a typical grade control structure (GCS) design in their Project Design Refinements. The applicant recommends eleven sloping soil cement GCS constructed at various locations along the channel, each 10 feet high (effective drop), and each fitted with a USBR Type IV stilling basin at their downstream bases. The GCSs would prevent significant downward cutting and dissipate energy. In addition, the GCSs would lower the base flood profile to an elevation below the tops of the adjacent ground, thereby, avoiding the need for levees.

At the point of diversion, the bed of the channel would be lined with rock to protect the natural channel transition from the diversion to the crest of the first sloping soil cement drop structure. The applicant plans to construct a drop structure (or grade control structure) at the point of diversion to lower the hydraulic profile below the elevation of

the solar fields to the north. The channel invert elevation would drop nearly 25 feet below the natural channel invert and be redirected toward the east. Staff estimated this bend at approximately 90 degrees with a centerline radius of 600 feet. Staff asked about this unique transition during the July 2009 workshop. The applicant has not provided any specific design details to date.

The diversion channel would continue to flow due east and make another 90 degree bend to the north before reaching the eastern property boundary. Roughly one mile north of the 90 degree bend, the channel widens through a transition and its alignment would be redirected toward the northeast corner of the BSEP property.

The applicant has provided typical channel section details showing banks protected with soil cement and the base of the channel lined with soil cement for approximately 800 feet along the centerline of the upper channel. During the July 2009 workshop, staff emphasized their concern with the proposed lining on the channel bottom, as that condition would limit the development of a naturally braided channel.

The applicant assigned the channel roughness for all areas of the channel at 0.025 to 0.030, depending on the hydraulic model. Rock would be located in the bed of the channel to protect the transition to and from the grade control structures. The applicant designed the channel to convey the design discharge with a maximum hydraulic depth of eight feet. The height of the banks includes a minimum of one foot of freeboard. The diversion channel segment would be approximately 14,000 feet long. The applicant would revegetate the channel with native vegetation following construction. Topsoil material excavated from Pine Tree Creek wash will be used to backfill the grade control structures in the diversion channel in accordance with Condition of Certification **SOIL&WATER-17** to prevent movement barriers or hazards for desert tortoise or other wildlife that may otherwise get trapped in the stilling basins.

The applicant designed the diversion channel with a transition near the outlet of the channel that widens to nearly 10 times the top width of the typical channel cross section. The intent of this design is to reduce flow depths and spread the channel flow onto a wide area to induce shallow flooding. The applicant proposes a concrete sill, or flow spreading structure, to disperse flood flows. The preliminary concrete sill design shows the structure keyed in to the proposed channel to a depth of 4 feet below the channel invert.

The hydraulic calculations made by the applicant indicated that the hydraulic depth of flow is between 4.5 to about 8.5 feet and the velocity would be between 8 to 13 feet per second (fps). These velocities are high for earthen channels. Velocities at the grade control structures are much higher. The structures, as proposed, would dissipate the energy of the flow and protect the channel from scour and erosion.

The resulting Froude Number provides a preliminary check on the flow regime. Froude numbers ranged between 0.75 and 0.90, which is within the range of natural channel flow. To ensure that the diversion channel design addresses Kern County Division four Standards for Drainage, staff is recommending adoption of Conditions of Certification **SOIL&WATER-11**, **SOIL&WATER-12** and **SOIL&WATER-13**, which establish the minimum design guidelines for the diversion channel. In accordance with

SOIL&WATER-4, the Froude Number in the open channel areas between GCSs shall maintain a subcritical value less than 0.80. A Froude number approaching 1.0 means the flow is approaching critical depth and may possibly transition into supercritical flow, which is not typical for a natural channel. Staff expects Froude Numbers to increase significantly above 1.0 at the GCS. The Froude Number values are important for GCS final design.

The BSEP hydraulic models report shear stress values along the channel and overbanks of the study reach. These shear stress results are relatively high for an earthen channel with sparse desert vegetation. High shear typically requires bank treatments to protect banks from erosion and failure. Staff examined several bank and channel treatments in the PSA and specified typical ranges of allowable shear stress for each. The applicant's proposed bank treatment method, soil cement, would be sufficient for preventing shear stress erosion.

SEDIMENT TRANSPORT ANALYSIS

The applicant conducted a preliminary scour and sediment transport analysis using FLO-2D v2007.06 and HEC-RAS. FLO-2D is a two-dimensional model designed to simulate unconfined shallow flooding similar to the current channel's flow regime. HEC-RAS is a one-dimensional model with the capability to simulate sediment transport in the proposed diversion channel. Staff agrees that these computer models are appropriate for estimating the transport efficiency of the existing wash and proposed diversion channel. Staff reviewed the analyses results in the Project Design Refinements (DB 2009r) and spoke with the applicant's engineer responsible for the sediment transport calculations. Staff recognizes the challenges of sediment transport modeling and is satisfied with the level of effort that went into setting up these preliminary computer models. The applicant's engineer tested various sediment transport methods, varied boundary conditions and other inputs, and simulated several flow regimes including the annual average and design discharge ($Q_D=28,000$ cfs).

Staff subsequently conducted sensitivity tests using the models provided by the applicant. Staff changed the sediment transport formula to Yang to coincide with the measured grain size characteristics of silty sand. Staff checked a reasonable range of possible hazard scenarios to assess the adequacy of flood control measures exposed to significant sedimentation hazards. Using the annual rainfall data derived by the applicant, staff ran the HEC-RAS model simulating 10-years of average-annual runoff to assess sediment accumulation over a ten-year period. Staff also tested the base flood model using Yang.

Staff's analyses show scour and aggradation occurs throughout the channel. In some locations between grade control structures sediment was dropping out at an acceptable rate. An acceptable rate of deposition would allow sediment to accumulate and form microfeatures on the channel bed. In other locations along the profile, the results show the channel scoured below the bed. The results of Staff's modeling were highly variable and produced a lot of "noise". Staff did not have the time to refine the model but

assumed the variability could be resolved with further study by the applicant. Staff concludes that with implementation of Condition of Certification **SOIL&WATER-15** the applicant would identify the final channel design slope that produces the most likely "slightly aggradational" conditions. This Condition of Certification supports **BIO-18** and will ultimately improve the opportunities for successful desert wash mitigation.

Channelizing the wash would tend to increase transport efficiency and switch the channel from braided to single thread, slightly sinuous. Braiding is also related to bank erosion: braided rivers erode their banks easily, widen, lose sediment transport capacity and deposit excess sediment on their beds in a positive feedback loop. The applicant has proposed hardened banks made of soil cement in order to preserve the character and capacity of the flood control channel. The hardened banks would deprive the creek of a source of sediment. With high sediment transport capacity and few in-channel sediment sources, recreating or preserve braiding is difficult to predict.

BANK AND TOE PROTECTION

The applicant has proposed various bank and toe protection treatments throughout the diversion channel. The applicant has provided riprap-sizing calculations for the channel bends, drop structure armoring, and side slope protection on the channel banks (BS 2008a Appendix C). At the point of diversion, BSEP has proposed a soil cement-lined channel (bed and banks) to protect the excavated channel through the transition to the proposed channel (Station 135+00 to 143+50). Soil cemented banks are shown in Exhibit 1-C to account for the entire channelized reach of the engineered channel (Station 36+00 to 143+50). The applicant proposes channel banks as steep as 3:1 from the channel bottom to the solar field. On the opposite bank, slopes would not be steeper than 4:1.

Regardless of the final design bank treatment, one aspect of the design that staff recommended in the PSA is a subsurface keyway. Condition of certification **Soil&Water-14** requires this continuous keyway or other type of toe protection, constructed along the toe of the bank slope to avoid significant flood-related impacts that would result from bank failure. Keyways are typically embedded below the anticipated channel bed and below the expected scour line to prevent bank failure. The keyway rock would be sized using appropriate methods to determine rock size, thickness, and depth. Toe protection and soil cement banks are constructed together as a homogenous slope protection, continuous along the channel.

In the July 2009 workshop, staff recommended a "slightly aggradational" diversion channel. It is important to recognize that lateral bank erosion is not just associated with channel incision. Channel aggradation can raise the channel bed and increase lateral movement of the active channel causing bank erosion.

The applicant has proposed riprap to protect the grade control structures from scour across bed transitions to the earthen channel. The rock protection would extend roughly 50 feet downstream and some distance upstream of each structure. The size, depth,

and rock coverage shall be determined during final design. When calculating the in-stream mitigation credit, staff will not include the areal coverage of riprap.

STAFF'S BANK PROTECTION CONCLUSIONS

Staff has concluded that proposed bank protection (bank treatments from the toe of slope up to the height of the freeboard elevation) options be selected based on the hydraulic response of the design flow. The type of protection would be selected to sufficiently prevent erosion of the newly constructed banks or significant lateral movement of the channel into areas where infrastructure, future homes (adjacent properties), structures, or higher public use may occur. Bank protection would be designed as a permanent treatment that would protect from the maximum hydraulic design criteria established for the channel.

In an effort to respond to CDFG comments, staff provided methods for establishing bank protection selection criteria to the applicant in the PSA. The selection criteria has been modified following subsequent analyses submitted by the applicant (DB 2009r). Various options for bank protection should be evaluated based the following selection criteria:

Selection Criteria

1. Examine Maximum Potential shear stress and velocity for the following conditions: at bends; in areas of fill; at contractions and expansions; along maintenance roads; and where the proposed channel ties into the existing natural channel
2. Use results from proposed conditions hydraulic analysis to determine channel velocity, left and right overbank velocity and shear stress. Summary tables and graphs provide a good overview of the channel response for velocities and shear stress.
3. If the criteria has been exceeded, select an appropriate bank protection option that meets the shear stress and velocity criteria or re-evaluate the channel design.
4. Use appropriate methods to estimate potential scour depth and height of bank protection - design bank protection to meet the Kern County Division Four, Standards for Drainage.

Bank Protection Options

In the PSA, staff identified a variety of bank protection methods considered appropriate for different applications: Vegetation, Biotechnical Solutions, Synthetic Geotextiles and Structural Methods. Each method relied on maximum thresholds for velocity, shear stress, bank slope and in some cases, plant moisture regime. Where the design flow shear stresses and velocities are low enough, staff emphasized use of bioengineering solutions over traditional engineering stabilization methods (e.g. rock or concrete armoring) to provide long-term resilience and habitat enhancement. The hydraulic characteristics of the channel were unknowns at the time of the PSA and are now mostly determined as a result of the BSEP Project Design Refinements (DB 2009r).

Staff reassessed the four main categories for potential bank protection options made available to the applicant in the PSA. Where shear stresses and velocities are higher than those that biotechnical solutions can withstand, staff had recommended approaches that rely upon hardened materials for their basic mechanical resistance. Staff had recommended incorporating live materials to enhance both strength and biological function but now believes that desert vegetation would not survive without irrigation.

Vegetal shear and particle shear resisting capacity of the floodplain reduces the potential for lateral migration of the low flow channel. The wider the floodplain the more the vegetation and earth that separates the low flow channel from the toe of slope. Staff has assumed three potential categories for the migration of the low flow channel at this time: Low, Medium and High potential. The potential for the channel to migrate is important for the selection of an appropriate bank treatment.

Staff has identified various permanent bank stabilization options and assessed their applicability at the site. The bank protection options may provide longitudinal protection, have transverse construction, or be used for erosion control during re-vegetation of the channel for mitigation. Bank treatment applications that incorporate vegetation are discussed but no longer recommended for in-channel use. Staff presented all four options for their potential use in non-diversion channel applications. A general introduction to these options follows.

Vegetation and Biotechnical Solutions - Bioengineering solutions achieve stability by incorporating live vegetation with more structural materials (e.g. rock, deep rooted vegetation). Over time, the vegetation establishment strengthens the bank at the surface (by increasing roughness and reducing shear stress) and subsurface (via the root matrix). Proper selection of the appropriate plant materials (e.g. shrubs) is critical for success. Unfortunately, staff was unable to identify native vegetation that would suit a biotechnical approach. Biotechnical approaches would also require sufficient soil moisture for plant establishment and subsequent survival, which is a limiting factor in the diversion channel. Staff does believe that the resulting shear stress, velocities, and anticipated meander of the low flow channel are within the range of using biotechnical solutions but without a reliable deep-rooted plant the success of the biotechnical solution is uncertain.

Synthetic Geotextiles – Synthetic geotextiles may be considered for specific cases requiring slope stabilization. Because of the limited opportunities to integrate vegetation with synthetic geotextiles, the potential for successful, long-term protection is low. Turf reinforced matting and fabrics are relatively inexpensive for certain applications compared to concrete and riprap and are typically less invasive. A wide variety of geotextiles are available to match specific needs, although few are specifically designed for desert application. Primary permanent uses of synthetic geotextiles would be above the toe slope protection. In-channel uses or as an erosion protection for swales would be limited unless manufacturer's recommendations are not exceeded. Given the difficulty for vegetative cover to establish, staff does not recommend the use of synthetic geotextiles for the diversion channel, bank protection treatment.

Planted Riprap Toe Protection – Staff identifies this protection measure for use where the proposed channel has a medium to high potential for lateral migration into the channel banks. The applicant, for select areas of the channel, has studied this option. Toe protection would protect the bank from local scour to a calculated depth below the stable bed. Kern County methods for bank protection and freeboard provide guidance for the riprap bank design. Staff agrees with the applicant that FHWA's HEC-11 "Design of Riprap Revetment" and NCHRP Report 569 "Riprap Design Criteria, Recommended Specifications, and Quality Control" are good design references but ultimately the final design would need to comply with Kern County design standards.

Planted rock contains voids that when filled with soil provides a means to establish vegetation. Unfortunately, staff has not identified an appropriate desert vegetative cover capable of maintaining cohesive root systems between the rocks. The applicant has not identified specific uses for planted riprap beyond bank protection. The applicant shall follow installation procedures that minimize voids in the planted riprap. Large voids create migration barriers for young desert tortoises and their existence would not comply with Condition of Certification **BIO-18**.

Structural Solutions - Channels where vegetation is difficult to establish and maintain as a defense provide a reasonable opportunity to consider hard armor (structural) protection. This option is also more likely for flood control channels that have a high potential for lateral migration into the channel banks. The applicant has proposed structural bank stabilization using soil cement. These types of solutions would prevent volunteer plant growth on the channel banks where the soil cement is applied. Benefits of soil cement include the ability to roughen the surface for wildlife migration, roughly 80% of the construction materials are already at the site, and the channel banks would require less maintenance.

Transverse Bank Protection - Additional channel stabilization options would provide benefits for protecting the channel banks. Permanent transverse options such as rock vanes, bend way weirs, or J-hooks may also be considered to provide additional protection for redirecting an active low flow channel, especially at significant bends in the channel, as proposed by the applicant.

Staff has identified several constraints that reduce the ability of the diversion to restore the beneficial uses of the existing wash. Staff concludes that the most favorable iterative design solution for the diversion channel would provide the greatest hydrogeomorphic benefit while ensuring the highest level of flood hazard protection. Staff has concluded that the impervious soil cement banks, proposed by the applicant, would offer the highest level of protection for the channel. Staff's assessment of the velocity and shear stress along the channel does suggest other non-structural options are possible. These other forms of bank protection would not promote vegetative cover but also would not prevent it. The trade-off is the value of unknown vegetal bank cover or a higher level of flood protection.

Staff has concluded that the proposed soil cement bank treatments would sufficiently protect the channel from the hydraulic forces anticipated from the design flow. Staff supports the embedment design for the toe protection to prevent the lateral migration of the low flow channel and protects the bank from under-cutting. Because the lateral

movement of the channel is mostly unpredictable in the straight reaches of the channel, staff is requiring as part of Condition of Certification **SOIL&WATER-14** that the bank protection for the channel include the installation of toe protection for the entire length of the channel. This Condition of Certification requires toe protection in the reach downstream of Station 36+00 to avoid potential bank failures caused by channel migration.

The BSEP channel protection treatments proposed by the applicant do not adequately respond to LRWQCB and CDFG comments that sought to restore distinctive vegetational types and distribution, found along the natural Pine Tree Creek, in the diversion channel. Staff concludes that the most favorable channel response will come from the integration of grade control structures set to make the channel slightly aggradational. The channel deposition shall be studied using advanced sediment transport methods that omit sediment sources from the banks and add sediment sources in the GCS stilling basins as part of Condition of Certification **SOIL&WATER-15**. These additional analyses, when applied to the channel's final design, shall improve the success of the desert wash mitigation by recreating characteristics of the natural wash in the bed of the diversion channel.

GRADE CONTROL

The applicant has controlled the diversion channel profile using GCS in the design to reduce the effective longitudinal slope of the channel. Typically, a controlled channel profile reduces potential bank erosion by improving the hydraulic characteristics and damage potential of the flow. The controlled flow regime reduces the shear stress on the banks and improves the success of the selected bank treatment to protect the banks from erosion and failure.

The use of 10-foot vertical drop structures may increase the tendency for the channel to incise and lose braiding because the structures are often located far apart. Immediately downstream of the drops the channel flows would be concentrated and deep armoring would be required to protect the earthen channel from scouring at the transition from the GCS. The hydraulic depth would drop gradually as the channel flow approaches the next drop structure.

Condition of Certification **SOIL & WATER-15**, requires the project owner to use the GCS design to set the final longitudinal channel grade to be slightly aggradational (depositional) to preserve braiding between GCSs. The current channel design establishes the finished channel slope at 0.2% (DB 2009r). The calculated slope is determined from rise over run. Run is the horizontal distance along the channel centerline from the downstream GCS crest to the sill at the upstream GCS. Rise is the difference in elevation between these endpoints. BSEP hydraulic and sediment transport analyses show 0.2% slope provides a stable corridor for the design discharge.

Staff expects sediment deposition near the uppermost GCS, at the point of diversion. Staff also expects sediment to deposit in the stilling basins of the GCS. The GCS stilling basin is a hydraulic design feature intended to keep the hydraulic jump from moving

downstream into the earthen reaches of the channel. Hydraulic jumps dissipate energy and the GCS stilling basin prevents the high energy from scouring the channel during a major runoff event. These stilling basins would be several feet below channel grade and create a significant impediment for wildlife. No potentially significant wildlife habitat/movement corridor impacts are expected as attributable to the grade control structure design if the project owner meets Condition of Certification **SOIL&WATER-8** that requires backfilling the stilling basins with topsoil from the channel excavation. This additional sediment supply benefits the sediment transport in the channel and complies with Condition of Certification **BIO-18**. The backfilled stilling basin would avoid significant trapping hazards for desert tortoise. Staff anticipates that the sediment in these basins would mobilize during a significant event and the GCS would function as intended.

CONCLUSIONS

The applicant's original concept for Pine Tree Creek, as presented in the BSEP AFC and currently in the Project Design Refinements has not significantly changed. As proposed, the BSEP would completely excavate or fill in the wash for the solar field, route the design discharge (28,000 cfs) around the solar field through an engineered channel, and defile the beneficial uses of the natural wash.

The challenge to design a diversion channel on an alluvial fan, for the design discharge, requires detailed engineering studies that form the basis of design. In the PSA, staff requested several additional studies and engineering analyses for staff to assess BSEP's plan to re-route Pine Tree Creek flows through an engineered channel. Staff included hydrologic, hydraulic, sediment transport, bank treatments, and grade control recommendations in the PSA to direct the applicant develop their design criteria and diversion channel basis of design. Staff requested that the applicant meet Kern County and FEMA's flood control requirements. Staff emphasized to the applicant that BSEP must address resource agency concerns through an iterative design process that results in the preservation of the biological and hydrological functions and values of the existing wash. On June 23, 2009, the applicant submitted the Project Design Refinements (Docket Log No. 52116), which included many of the studies requested by staff.

Staff relied on the results of the applicant's engineering studies to develop confidence in the project's ability to avoid potentially significant flood-related impacts and support in-channel mitigation. The iterative diversion channel design process resulted in trade-offs between the functional flood management elements and the ability to recreate the continuous biological and hydrological functions and values found in the existing wash. For instance, grade control structures would flatten the effective slope of the channel, prevent hazardous head-cuts, reduce flow velocities, and dissipate (erosive) energy in a flood. Grade control structures are impervious surfaces, which reduce the infiltration area within the channel but ultimately improve the resident time for nuisance flows passing through the channel. However, grade control structures are structural elements with steep facing inclines that segment the mitigation and disrupt wildlife habitat/movement corridor. Similarly, soil cement provides protection from bank erosion and

failure, uses mostly in situ materials for construction, and allows the engineer to increase shear stress thresholds but prevents beneficial vegetal growth within a large portion of the channel. Rock bank protection is typically a preferred solution over an impervious cover such as soil cement. For the engineered channel, rock may become exposed and create voids that can trap desert tortoises and ultimately there is no guarantee that plants would establish within the rock-soil matrix.

Staff has reviewed the applicant's studies, calculations, and models to determine whether the overall design for the diversion channel has reached an adequate point in the final design process for staff to assertively require conditions of certification that address potential flood-related impacts and mitigation. Staff concludes that the basis of design and the applicant's related studies provide adequate information for staff to evaluate the diversion channel capacity and determine potentially significant flood impacts based on the channel's ability to function properly. Staff has identified several elements of the diversion channel design that have not reached a significant stage in the final design process but are important for understanding the potential for impacts related to the entire diversion channel concept and more importantly, operation. Staff believes that the diversion channel and all its elements need to function properly to avoid significant flood related impacts. Several structural channel elements (point of diversion, 90-degree channel bend, grade control structure, and bank protection) have only reached conceptual or preliminary design and staff has not reviewed final design drawings that provide the level of detail necessary to make a determination as to the suitability of these structural elements to function properly during a design discharge event.

Staff also concludes that the diversion channel presents a reasonable opportunity to recreate the biological and hydrological functions and values that exist in Pine Tree Creek. To reach this conclusion staff evaluated the sediment transport models associated with the diversion channel design. Based on these designs and models, a total of approximately 53 acres of gently sloping channel surface will be created between the diversion structure and the channel outlet, located at Station 36+00.

Staff recognizes the challenges and uncertainties associated with identifying sediment loads and simulating sediment transport in diversion channels constructed on alluvial fans. Staff also understands that the heavily armored diversion channel can withstand minor variations in longitudinal slope that can result in significant variations in the sediment transport characteristics. Staff believes with additional sediment transport analyses the iterative design would resolve the most appropriate channel bed slope that predicts a slightly aggradational condition in the channel. Staff recognizes that the effective channel slope would be fine-tuned using crest elevation adjustments at the grade control structure. Staff has concluded that the applicant must conduct additional sediment transport simulations to select the most accurate channel slope to minimize the amount of sediment accumulation to what would be necessary to support the channel bed mitigation and not compromise channel capacity.

Staff concludes that the uncertainty of the structural diversion channel elements to perform and the uncertainty related to the sediment transport in the diversion channel require a Maintenance District, in perpetuity, to monitor, inspect, and conduct maintenance to sustain the conveyance capacity up to the design discharge. Staff

believes that the BSEP flood control measures would effectively maintain flood protection with implementation of Condition of Certification **SOIL&WATER-8** that establishes a Maintenance District and a drainage easement for the channel and Condition of Certification **SOIL&WATER-9** that outlines the Channel Maintenance Program. These conditions of certification require CPM approval. The CPM will consider comments from the state resource agencies and Kern County. Condition of certification **SOIL&WATER-9** requires implementation of a Channel Maintenance Program in accordance with **Soil and Water - Appendix J**.

SOIL AND WATER RESOURCES - APPENDIX D

ANALYSIS OF ALTERNATIVE WATER SUPPLY AND COOLING TECHNOLOGIES

State Water Board Resolution 75-58 addresses the use of inland waters used for power plant cooling. The resolution defines unreasonable use, and promotes the consideration of alternative power plant cooling options. Pertinent statements contained in Resolution 75-58 follow:

- The loss of inland waters through evaporation in power plant cooling facilities may be considered an unreasonable use of inland waters.
- The source of power plant cooling water should come from the following sources in this order of priority depending on site specifics such as environmental, technical and economic feasibility consideration:
 1. Wastewater being discharged to the ocean,
 2. Ocean,
 3. Brackish water from natural sources or irrigation return flow,
 4. Inland wastewaters of low TDS, and
 5. Other inland waters.
- Use of fresh power plant cooling will be approved by the Board only when it is demonstrated that the use or other water supply sources or other methods of cooling would be environmentally undesirable or economically unsound.
- Studies associated with power plants should include an analysis of the cost and water use associated with the use of alternative cooling facilities employing dry, or wet/dry modes of operation.

The following sections describe our independent analysis of alternative water supply and cooling technologies.

The examination of alternative water supplies and cooling technologies begins with a determination of whether a project will use fresh water for cooling. The IEPR itself does not define what constitutes fresh water. Resolution 75-58, upon which the IEPR water policy is based, defines fresh inland waters as "*those inland waters which are suitable for use as a source of domestic, municipal, or agricultural water supply...*" (State Water Resources Control Board Resolution 75-58, p. 3.) Thus, fresh water is not given a narrow definition but is broadly defined by how it is used, evincing an intent to be as inclusive as possible. The groundwater proposed for use by the BSEP meets the definition of fresh inland water under Resolution 75-58 because it is used for agricultural and domestic use in the area.

Another indication of the suitability of this water as a domestic source is its compliance with the Drinking Water Standards found in Title 22 of the California Code of Regulations. As discussed in the groundwater quality section of the AFC, the BSEP proposes to use groundwater that has a TDS of 470 - 550 mg/l (AFC). This TDS level is well within the secondary maximum contaminant level (MCL) for TDS in drinking water of 1000 mg/l and near the recommended limit of 500 mg/l (Cal. Code Regs., tit. 22, §§ 64431, 64449). Secondary MCLs are based on aesthetics and intended to protect odor, taste and appearance. Exceeding these secondary MCLs does not necessarily preclude the use of that water for drinking.

BSEP has proposed to use this onsite fresh groundwater for all plant needs including cooling and steam generator feed water as well as potable uses. Cooling would be provided by a mechanical draft cooling tower. Plant wastewater (from all sources) would be sent to evaporation ponds for final disposal. No backup cooling water supply is proposed by the applicant although they offer to use future tertiary treated effluent from California City if it becomes available.

In the AFC, the applicant estimates water use as follows:

**Soil & Water Table D1
Proposed Annual Operational Water Demands**

Water Use			
Water Use	Annualized Average Rate¹, gpm	Peak Rate², gpm	Estimated Annual Use, Acre Feet
Plant Operation	990	4,054	1,388
Potable Water	5	5	8
1. The estimated groundwater usage in gallons per minute is based on an average daily consumption.			
2. The peak rate is the instantaneous maximum for summer usage.			

Water uses would include cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, plant wash down (housekeeping and maintenance), dilution water for chemical feed systems, etc. Well water would also be used for potable uses - drinking, showers, sinks, and toilets. Well water would be stored on site in the Raw Water Tank. Most of the water would be treated using ion exchange utilizing strong acid cation (SAC) and strong base anion (SBA) and stored in the Process Water Tank. Process water would be used for cooling tower makeup. A portion of the process water would be treated further for steam generator makeup and mirror washing utilizing portable demineralizers (these are regenerated offsite and generate no wastewater).

ALTERNATIVE WATER SUPPLY

Resolution 75-58 is clearly intended to broadly protect beneficial uses of the State's water resources. In this vein, the SWRCB states that "*in considering issuance of a permit or license to appropriate water for power plant cooling, the Board will consider the reasonableness of the proposed water use when compared with other present and future needs for the water source and when viewed in the context of alternative water sources that could be used for the purpose*" (Resolution 75-58, pgs. 5 & 6). Although no appropriative right is at issue in this case, increasing groundwater demands on a fresh

water supply dictate that the Energy Commission consider the reasonableness of allowing BSEP to use groundwater of a quality suitable for domestic use when a source of lower quality water (TDS in excess of 1000 mg/L) that cannot be used for domestic purposes without extensive treatment is available in the aquifer approximately 5 miles to the east of the site in the vicinity of Koehn Lake. Staff considers the higher TDS (brackish) groundwater located near Koehn Lake to be a possible alternative to the proposed use of high quality fresh groundwater located beneath the proposed project site.

The brackish groundwater located southwest of Koehn Lake is the same water source considered for all of the alternatives (1 through 5). Each to-be-constructed well is assumed to be 500 feet deep. The pipeline diameter for Alternatives 1 and 3 is 14 inches and for Alternatives 2, 4 and 5, 12 inches. The size differences are a function of water demand for each alternative. For this analysis, the line was sized to operate 24 hours per day at half the water demand rate.

WATER TREATMENT PROCESSES

With alternative water supply sources, alternative water treatment processes must be considered. Each of the five alternatives uses a combination of water treatment processes. All of the processes shown in **Soil & Water Table D2** are well established commercial technologies. A discussion of each water treatment process is provided below:

SAC-SBA

As mentioned above, SAC-SBA vessels contain ion exchange resin specifically designed to remove cations (positive ions) and anions (negative ions) from water. This process is the same ion exchange process proposed by BSEP and would be used in Alternatives 1, 2 and 4.

REVERSE OSMOSIS (RO)

RO is a technology that utilizes permeable membranes (under relatively high pressure) to repel salt and pass water. Most of the dissolved salts are repelled by the membrane surface (95% to 98% for most ions) allowing only water to pass through the membrane. RO must have highly filtered water with modified chemistry (usually pH adjustment) to operate successfully. In the alternatives utilizing RO, the water would be filtered by the use of microfiltration (MF). MF is also a membrane process that is commonly used with RO in difficult industrial or reuse applications. This process would be used in two ways, 1) as Makeup treatment or 2) in a wastewater recovery configuration.

RO would be used to directly treat cooling tower makeup, steam generator makeup and mirror washing water in alternatives 2 and 5, and would be used to treat cooling tower blowdown to recover used water and reduce overall wastewater volume either for disposal or as a pretreatment to an evaporator in Alternatives 2, 3 and 5.

EVAPORATOR/CRYSTALLIZERS

This process would be used to reduce wastewater volume to essentially zero. In the evaporator, 90% to 95% of the wastewater would be recovered. Brine from the evaporator would be sent to a crystallizer to further recover water. Waste from the crystallizer would be in the form of highly concentrated salt brines that would crystallize to solid form for offsite disposal. This process would be used in Alternatives 4 and 5. A recovery RO would be used to pre-concentrate the wastewater stream to the evaporator as shown in Alternative 5.

WATER TREATMENT ALTERNATIVES

As a means of conserving high quality (fresh) onsite groundwater, staff has analyzed alternatives to using 100% fresh groundwater. In the analysis, five treatment alternatives were evaluated utilizing offsite brackish water (See **Soil & Water Table D2**). All of the alternatives would utilize well water from a brackish makeup source. The water is considered brackish because its total dissolved solids (TDS) content is at least twice that of onsite well water (1,000 mg/l versus 500 mg/l). The brackish aquifer is accessible at the southwest corner of Koehn Lake approximately 5 miles from the project site. It was assumed that four wells would be required to supply BSEP needs. In all of the alternatives, well water would be transported to the site via a 12-inch or 14-inch pipeline (depending on water demand).

Five water treatment alternatives have been identified and analyzed to determine the most effective alternatives to using fresh on-site groundwater. These five alternatives are shown on **Soil and Water Table D2** and discussed below:

Soil & Water Table D2
Offsite Brackish Water Alternatives

	SAC-SBA	Makeup RO	Recovery RO	Evap/Crys	Evap Ponds
Alternative 1	X				X
Alternative 2	X		X		X
Alternative 3		X	X		X
Alternative 4	X			X	
Alternative 5		X	X	X	

ALTERNATIVE 1

Alternative 1 utilizes brackish water from offsite wells for plant needs, e.g. cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, etc. Steam generator blowdown and plant drains would be recycled to the cooling tower. That is the same process proposed by BSEP. In Alternative 1, well water from onsite wells would still be used for potable needs. Plant wastewater would be sent to an evaporation pond for final disposal. The evaporation ponds needed in Alternative 1 would be about 15% larger than those proposed by BSEP because more wastewater would be generated by the SAC-SBA treating brackish water.

ALTERNATIVE 2

This alternative combines Alternative 1 (SAC-SBA) with a recovery RO to reduce the cooling tower blowdown portion of the wastewater stream. MF would be used as pretreatment for the recovery RO. The evaporation ponds would be slightly smaller than the ponds proposed by BSEP.

ALTERNATIVE 3

In this alternative, offsite water would be treated with MF and RO prior to storage in the Process Water Tank (replacing SAC-SBA). A portion of cooling tower blowdown would also be recovered via RO prior to discharge to evaporation ponds. MF would be used as pretreatment for the makeup and recovery RO. Steam generator blowdown and plant drains would be recycled to the cooling tower. RO permeate would be recovered to the cooling tower. This alternative would generate more wastewater than Alternatives 1 or 2 and would require significantly larger evaporation ponds.

ALTERNATIVE 4

This alternative combines Alternative 1 (SAC-SBA) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream. There would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and SAC-SBA wastewater would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

ALTERNATIVE 5

This alternative combines Alternative 3 (makeup RO/recovery RO) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream, i.e. there would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and makeup RO wastewater (known as reject) would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

Alternatives 4 and 5 would be the only Alternatives employing treatment options that would require offsite waste disposal.

Soil & Water Table D3 provides a comparative summary of using onsite fresh water versus using offsite brackish water for BSEP makeup. The analysis was based on typical summer conditions. Note the evaporation pond sizing for the BSEP-proposed treatment.

Wastewater sources include cooling tower blowdown, steam generator blowdown, plant drains, water treatment waste streams, etc. Cooling tower blowdown and SAC-SBA neutralized wastewater would be sent to three 8.3 acre evaporation ponds. Steam generator blowdown and plant drains would be recycled to the cooling tower. The applicant claims that the ponds are sized to accommodate all solids residue generated throughout the life of the plant.

The treatment process proposed by BSEP was driven by the PM10 requirements that would be placed on the cooling tower by the Air Quality Management District. The total dissolved solids (TDS) of the circulating water must be less than 1,600 mg/l to meet the PM10 limit. Also, BSEP plans to operate the cooling tower at 15 cycles of concentration (the ratio of feedwater flow to blowdown flow is 15) to minimize wastewater generation. This also means that the TDS of the makeup water (onsite wells) must be reduced to approximately 100 mg/l. BSEP proposes using SAC-SBA ion exchangers to accomplish this. SAC-SBA vessels contain ion exchange resin specifically designed to remove cations (positive ions) and anions (negative ions) from water.

The SAC and SBA vessels have a fixed capacity to remove ions, and therefore, must be removed from service frequently and regenerated. This is accomplished by passing dilute sulfuric acid through the SAC vessel (strong acid cation) and dilute sodium hydroxide through the SBA vessel (strong base anion). Water treatment waste, which can have very high or low pH, will require neutralization prior to disposal.

In the applicant's water balance for typical annual conditions, they show a wastewater rate to the evaporation ponds of 471 gpm (BS 2008a, Section 2, Figure 2-13). This consists primarily of cooling tower blowdown and wastewater from water treatment. They plan to operate at an annual 26.5% capacity factor (94% capacity factor during daylight periods). Adjusting wastewater flow to a 24-hour operating basis, flow to the evaporation ponds would be 125 gpm (471 gpm x 26.5%). In this scenario, all wastewater disposal ponds, as designed, would have to operate for the entire year to accommodate this flow. Stated another way, the evaporation rate from the ponds would have to be 97 inches per year.

Evaporation pan data for this area is about 120 inches per year. Pan data is a measure of net evaporation rate and is determined with a National Weather Service Class A pan (measuring 48" diameter x 10" deep). Evaporation rate for small ponds²⁵ is calculated as follows:

$$\text{Evaporation Rate} = k_1 \times k_2 \times \text{Class A Pan Evaporation Rate}$$

Where k_1 is the pan coefficient and k_2 is the salinity coefficient.²⁶ For evaporation ponds, a small pond pan coefficient of 0.7 should be used. The salinity factor can range from 1 (insignificant salt concentration) to 0.7 concentrated brines. It could be argued that the brine in the BSEP ponds will reach saturation, i.e. all the salt (as ions) that enters the pond will saturate and start to precipitate. If a midpoint k_2 factor of 0.85 is used, the corrected evaporation rate would be approximately 72. The BSEP ponds are marginally sized to contain expected flow and a fourth pond will likely be required. Also, if water use in the plant is greater than that described in the water balance²⁷, additional pond

²⁵ These could be naturally formed ponds, wastewater evaporation ponds, solar brine ponds, etc.

²⁶ Linsley, R. K. and Franzini, J. B., 1972, *Water Resources Engineering*, 2nd edition, McGraw-Hill Inc., New York, New York.

²⁷ Figure 2 in the applicant's Project Description.

area will be required. Staff calculated a pond size (utilizing the criteria discussed above) of 43.5 acres versus the 25 acres identified in the BSEP project description.

Soil & Water Table D3 Water Treatment Summary

<i>Typical Summer Conditions Basis</i>						
	Offsite Wells - Koehn Lake Source Water					
	BSEP Onsite Wells SAC-SBA	Alternative 1 SAC-SBA	Alternative 2 SAC-SBA Recov RO	Alternative 3 MU- RO Recov RO	Alternative 4 SAC-SBA Evap-Crys	Alternative 5 MU-Recov RO Evap-Crys
Water Demand - Instantaneous						
Onsite Wells Demand, gpm	4,038	5	5	5	5	5
Koehn Lake Water Demand, gpm	N/A	4,086	3,772	3,959	3,463	3,480
Total Wastewater, gpm	572	650	565	801	0	0
Water Demand - Annual Average Conditions						
Annual Capacity Factor	26.5%	26.5%	26.5%	26.5%	26.5%	26.5%
Onsite Wells Demand, gpm	1,070	5	5	5	5	5
Koehn Lake Water Demand, gpm	N/A	1,083	1,000	1,049	918	922
Onsite Wells Demand, AF/yr	1,726	8.1	8.1	8.1	8.1	8.1
Koehn Lake Water Demand, AF/yr	N/A	1,747	1,612	1,692	1,480	1,488
Total Wastewater, gpm	152	172	150	212	0	0
Evap Pond, acres	43.5	49.4	42.9	60.8	0	0
Notes.....						
1. BSEP project evap pond size was altered from that presented in the AFC based on CEC staff calculations.						

COST ANALYSIS

Soil & Water Table D4 presents a cost analysis of using fresh groundwater obtained from BSEP onsite wells versus obtaining and using offsite brackish water. From a capital perspective, Alternative 1 (SAC-SBA) and Alternative 2 (SAC-SBA with recovery RO) are the least costly of the offsite alternatives, and would cost an additional \$12.6 million and \$12.1 million, respectively. Alternatives 1 and 2 also have the lowest operating cost of the mentioned alternatives, exceeding the BSEP design by \$0.8 million per annum. Lastly, when the installed cost is capitalized (amortized at 7% for 20 years), Alternatives 1 and 2 are still the least costly of the five offsite alternatives. However, its annual cost would exceed BSEP costs by \$2 million per year.

Again, Alternatives 1 and 2 achieve the goal of using non-potable quality water for project cooling. Given the budget level of analysis, the costs of these alternatives are quite close and should be considered equivalent.

Soil & Water Table D4 Water Treatment Summary & Cost Analysis

<i>Typical Summer Conditions Basis</i>						
	BSEP Onsite Wells SAC-SBA	Alternative 1 SAC-SBA	Alternative 2 SAC-SBA Recov RO	Alternative 3 MU RO Recov RO	Alternative 4 SAC-SBA Evap-Crys	Alternative 5 MU-Recov RO Evap-Crys
Equipment & Evap Pond Installed Cost						
SAC-SBA	\$20,610,000	\$20,610,000	\$20,610,000	N/A	\$20,610,000	N/A
MU-Recovery RO	N/A	N/A	\$3,380,000	\$23,840,000	N/A	\$21,160,000
Evaporator Crystallizer	N/A	N/A	N/A	N/A	\$33,750,000	\$36,190,000
Common Tankage & Pumping	\$11,140,000	\$11,270,000	\$10,520,000	\$10,970,000	\$9,770,000	\$9,810,000
Water Treatment Subtotal	\$31,750,000	\$31,880,000	\$34,510,000	\$34,810,000	\$64,130,000	\$67,160,000
Evaporation Pond	\$10,960,000	\$12,460,000	\$10,820,000	\$15,340,000	N/A	N/A
Total Water & Wastewater	\$42,710,000	\$44,340,000	\$45,330,000	\$50,150,000	\$64,130,000	\$67,160,000
Pipeline from Koehn Lake						
4 Wells	N/A	\$880,000	\$880,000	\$880,000	\$880,000	\$880,000
Pump Station	N/A	\$3,080,000	\$3,000,000	\$3,050,000	\$2,910,000	\$2,910,000
5 Mile Carbon Steel Pipeline	N/A	\$6,970,000	\$5,580,000	\$6,970,000	\$5,580,000	\$5,580,000
Total	N/A	\$10,930,000	\$9,460,000	\$10,900,000	\$9,370,000	\$9,370,000
Total Installed Water Treatment Costs						
	\$42,710,000	\$55,270,000	\$54,790,000	\$61,050,000	\$73,500,000	\$76,530,000
Base		\$12,560,000	\$12,080,000	\$18,340,000	\$30,790,000	\$33,820,000
Total Annual Operating Costs						
	\$1,215,000	\$2,056,000	\$2,075,000	\$2,235,000	\$3,781,000	\$4,215,000
Base		\$841,000	\$860,000	\$1,020,000	\$2,566,000	\$3,000,000
Capitalized Equipment Costs¹						
	\$4,032,000	\$5,218,000	\$5,172,000	\$5,763,000	\$6,938,000	\$7,224,000
Base		\$1,186,000	\$1,140,000	\$1,731,000	\$2,906,000	\$3,192,000
Annual Operating & Capital Cost						
	\$5,247,000	\$7,274,000	\$7,247,000	\$7,998,000	\$10,719,000	\$11,439,000
Base		\$2,027,000	\$2,000,000	\$2,751,000	\$5,472,000	\$6,192,000
Notes.....						
1. Capitalized at 7% per year for 20 years.						

Soil & Water Table D5 shows the cost sensitivity of increased TDS in the offsite wells. Refer to the following for an analysis comparing the costs of offsite well alternatives if well water TDS were 2,500 mg/l instead of 1,000 mg/l. The operating costs of Alternatives 1, 2 and 4, which utilize SAC-SBA treatment, would increase by 61.0% to 67.9%. The additional ion loading would require larger and/or more ion exchange vessels. Alternative 3 (makeup RO/recovery RO) operating costs increased by 3%. The operating pressure of the RO equipment would be higher at higher feed TDS. Equipment costs also increased for Alternatives 1, 2 and 4 by 45.9% to 48.8%. Alternative 3 will be carried forward in this evaluation (along with Alternatives 1 and 2) because it offers more operating flexibility from an operating and capital viewpoint.

Soil & Water Table D5
Water Treatment Cost Comparison – Increase in TDS from Offsite Wells

<i>Typical Summer Conditions Basis</i>							
	BSEP Onsite Wells SAC-SBA	Koehn Lake TDS, mg/l	Offsite Wells - Koehn Lake Source Water				
			Alternative 1 SAC-SBA	Alternative 2 SAC-SBA Recov RO	Alternative 3 MU RO Recov RO	Alternative 4 SAC-SBA Evap-Crys	Alternative 5 MU-Recov RO Evap-Crys
Annual Operating Costs	\$1,215,000	1,000	\$2,056,000	\$2,075,000	\$2,235,000	\$3,781,000	\$4,215,000
		2,500	\$3,452,000	\$3,341,000	\$2,302,000	\$6,228,000	\$4,750,000
		Pct Change	67.9%	61.0%	3.0%	64.7%	12.7%
Install Equipment Cost	\$42,710,000	1,000	\$55,270,000	\$54,790,000	\$61,050,000	\$73,500,000	\$76,530,000
		2,500	\$81,350,000	\$81,550,000	\$62,590,000	\$107,200,000	\$78,510,000
		Pct Change	47.2%	48.8%	2.5%	45.9%	2.6%
Annual Op & Cap Cost	\$5,247,000	1,000	\$8,767,000	\$8,625,000	\$7,998,000	\$12,140,000	\$11,439,000
		2,500	\$11,131,000	\$11,039,000	\$8,211,000	\$16,347,000	\$12,161,000
		Pct Change	27.0%	28.0%	2.7%	34.7%	6.3%

COOLING ALTERNATIVES

BSEP evaluated three Air Cooled Condenser (ACC) dry cooling alternatives (refer to Worley Parsons report "FPLE Beacon Solar Energy Project Dry Cooling Evaluation", dated February 1, 2008). The report evaluated three ITD scenarios (35 °F, 40 °F and 45 °F). Each ITD scenario yields a slightly different operating profile. For evaluation purposes, the 40 °F scenario was compared to wet cooling alternatives, i.e. the BSEP base case and Alternatives 1, 2 and 3. In the Worley Parsons study, the cost for solar arrays was increased to provide 250 MW (i.e. same as base case) on the hottest summer day to offset energy use for ACC.

A summary of cooling system comparisons is presented in **Soil & Water Table D6**. Note that the cooling system (cooling tower) costs remain the same for the base case and Alternatives 1, 2 and 3. After combining the costs for the cooling systems (wet and dry), water treatment and additional solar arrays, the BSEP base case is the lowest estimated capital cost followed by Alternatives 1, 2 and 3 (in that order) and dry cooling. As can be seen in this analysis, the additional solar arrays strongly affect the capital cost comparisons. The annual operating costs were calculated by adding power for the wet and dry cooling system to the annual cost for water treatment. Other power costs (outside the cooling loop) were considered equivalent. Of note, the dry cooling alternative has the lowest operating costs of all the Alternatives and is \$403,000 less than the BSEP base case.

Soil & Water Table D6 Cooling System Cost Comparison

Cooling System Comparison Summary					
Typical Summer Conditions Basis					
	BSEP Base Case	Alternative 1 Offsite Wells SAC-SBA	Alternative 2 Offsite Wells SAC-SBA Recov RO	Alternative 3 Offsite Wells MU/Recov RO	ACC 40F ITD
Cooling System					
Cooling Tower Cells	11				N/A
ACC Cells	N/A				40
Power Requirements					
Fan Power, HP	250				200
Circ Pump Power, HP	2509				N/A
Total Power, HP	5259				8000
Total Power, kw	3918				5960
Average Op Capacity	26.5%				26.5%
Power, kw-hr/year	9,096,000				13,836,000
Power Cost, \$/year	\$1,364,400	\$1,364,400	\$1,364,400	\$1,364,400	\$2,075,400
Cooling System Costs					
HTF Pumps	\$3,000,000				\$3,000,000
BFW Pumps	\$2,300,000				\$2,400,000
SG Heat Exchanger	\$12,500,000				\$14,100,000
Additional Solar Arrays ¹ (installed)	Base				\$53,000,000
Cooling Tower	\$4,275,000				N/A
CT Basin	\$1,500,000				N/A
Circ Water Pumps	\$600,000				N/A
Surface Condenser	\$3,500,000				N/A
Circ Water Piping	\$1,300,000				N/A
Circ Water Piping Install	\$520,000				N/A
ACC Equipment	N/A				\$36,900,000
ACC Install	N/A				\$11,500,000
Closed Cycle Aux Cooler	N/A				\$450,000
Total Cooling System Cost	\$29,495,000	\$29,495,000	\$29,495,000	\$29,495,000	\$121,350,000
Water Treatment Costs	\$42,710,000	\$55,270,000	\$54,790,000	\$61,050,000	\$4,600,000
Total System Cost	\$72,205,000	\$84,765,000	\$84,285,000	\$90,545,000	\$125,950,000
	Base	\$12,560,000	\$12,080,000	\$18,340,000	\$53,745,000
Annual Operating Costs					
Water Treatment	\$1,215,000	\$2,056,000	\$2,075,000	\$2,235,000	\$101,000
Cooling System Power	\$1,364,400	\$1,364,400	\$1,364,400	\$1,364,400	\$2,075,400
Total Operating Cost²	\$2,579,400	\$3,420,400	\$3,439,400	\$3,599,400	\$2,176,400
	Base	\$841,000	\$860,000	\$1,020,000	\$403,000
Capitalized Equipment Costs³	\$6,820,000	\$8,010,000	\$7,960,000	\$8,550,000	\$11,890,000
	Base	\$1,190,000	\$1,140,000	\$1,730,000	\$5,070,000
Annual Operating & Capital Costs	\$9,399,400	\$11,430,400	\$11,399,400	\$12,149,400	\$14,066,400
	Base	\$2,031,000	\$2,000,000	\$2,750,000	\$4,667,000
Notes.....					
1. Costs extracted from Worley Parsons report, "FPLE - Beacon Solar Energy Project Dry Cooling Evaluation" dated Feb February 1, 2008.					
2. Water treatment costs plus cost for cooling system power. All other power costs were assumed to be equivalent.					
3. Capitalized at 7% per year for 20 years.					

Typical Summer Conditions Basis			
	BSEP Base Case	Alternative 3 Offsite Wells MU/Recov RO	ACC 40F ITD
Cooling System			
Cooling Tower Cells	11		N/A
ACC Cells	N/A		40
Power Requirements			
Fan Power, HP	250		200
Circ Pump Power, HP	2509		N/A
Total Power, HP	5259		8000
Total Power, kw	3918		5960
Average Op Capacity	26.5%		26.5%
Power, kw-hr/year	9,096,000		13,836,000
Power Cost, \$/year	\$1,364,400	\$1,364,400	\$2,075,400
Cooling System Costs			
HTF Pumps	\$3,000,000		\$3,000,000
BFW Pumps	\$2,300,000		\$2,400,000
SG Heat Exchanger	\$12,500,000		\$14,100,000
Additional Solar Arrays (installed)	Base		\$53,000,000
Cooling Tower	\$4,275,000		N/A
CT Basin	\$1,500,000		N/A
Circ Water Pumps	\$600,000		N/A
Surface Condenser	\$3,500,000		N/A
Circ Water Piping	\$1,300,000		N/A
Circ Water Piping Install	\$520,000		N/A
ACC Equipment	N/A		\$36,900,000
ACC Install	N/A		\$11,500,000
Closed Cycle Aux Cooler	N/A		\$450,000
Total Cooling System Cost	\$29,495,000	\$29,495,000	\$121,350,000
Water Treatment Costs	\$42,710,000	\$61,050,000	\$4,600,000
Total System Cost	\$72,205,000	\$90,545,000	\$125,950,000
	Base	\$18,340,000	\$53,745,000
Annual Operating Costs			
Water Treatment	\$1,215,000	\$2,235,000	\$101,000
Cooling System Power	\$1,364,400	\$1,364,400	\$2,075,400
Total Operating Cost¹	\$2,579,400	\$3,599,400	\$2,176,400
	Base	\$1,020,000	-\$403,000
Capitalized Equipment Costs²	\$6,820,000	\$8,550,000	\$11,890,000
	Base	\$1,730,000	\$5,070,000
Annual Operating & Capital Costs	\$9,399,400	\$12,149,400	\$14,066,400
	Base	\$2,750,000	\$4,667,000
Notes.....			
1. Costs extracted from Worley Parsons report, "FPLE - Beacon Solar Energy Project Dry Cooling Evaluation" dated February 1, 2008.			
2. Water treatment costs plus cost for cooling system power. All other power costs were assumed to be equivalent.			
3. Capitalized at 7% per year for 20 years.			

Lastly, the Worley Parsons study determined that the net output for the 40 °F ITD ACC would be 7.50% less than that of the base case. The base case would include the BSEP proposed cooling configuration or Alternative 3 (offsite wells with makeup and

recovery RO). At high ambient dry bulb temperatures (summer conditions), the ACC cannot cool as efficiently as wet cooling resulting in higher condenser backpressure and reduced turbine output. **Soil & Water Table D7** provides a comparison of annual net output for the wet and dry alternatives. The difference in generating output is an indirect measure of ACC cooling efficiency relative to wet cooling.

**Soil & Water Table D7
Net Output Comparisons**

	BSEP Wet Cooling	ACC 40° F ITD
Design Point Ambient Temperature, F	68 °F WB	103.5 °F DB
Design Point Backpressure, "Hg	2.1	7.1
Plant Output, MW _{Net}	250	250
Annual Average Backpressure, "Hg	1.5	2.0
Estimated Annual Output, MW-hr	602,527	557,365
Est Annual Output Difference, MW-hr	Base	45,162
Pct Difference to Base	Base	-7.50%

The design requirement for the ACC is rigorous in that the ACC must meet design point summer conditions. To compensate for reduced efficiency and to achieve 250 MW net output based at a design point of 103.5 °F (DB temperature)²⁸, the applicant increased the size of the solar array. Additionally, the ACC alternatives were sized to provide 2" mercury (Hg) of backpressure based on annual average conditions as compared to the 1.5" Hg expected for wet cooling. The loss of output was calculated based on the difference in annual average backpressure, i.e. 1.5" Hg for wet cooling versus 2" Hg for dry cooling. The installed cost (and presumably collector area) of the solar arrays would have to be increased by 12.9 percent to achieve their design requirements.

The applicant should review their design criteria to minimize the impact on the solar array. For example for slightly lower design points, review ACC size versus required solar field array. Incrementally increasing the size of the ACC (e.g. 36 fans to 40 fans) is much less costly than increasing the size of the solar array.

CONCLUSIONS

1. The BSEP waste disposal evaporation ponds are marginally sized and a fourth pond will likely be required. Also, if water use in the plant is greater than that described in the water balance, additional pond area will be required.
2. Alternative 1 (SAC-SBA), Alternative 2 (SAC-SBA with recovery RO) and Alternative 3 (makeup RO/recovery RO) are viable non-potable (high TDS) water options in lieu of using onsite high-quality fresh groundwater. Alternative 3 is much less sensitive to higher TDS groundwater available from offsite wells.

²⁸ The design temperature is the average of the July, August and September ASHRAE summer peak 2% dry bulb (DB). It is within the 0.4% and 1% annual occurrences of high temperatures for this area.

3. The applicant should review their design criteria for the ACC. The rigorous design point (103.5 °F DB) forces them to expand the collector array area by 12.9 percent. The applicant should review their design criteria to minimize the impact on the solar array. For example, for slightly lower design points, ACC size versus required solar filed array should be evaluated.

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SOIL AND WATER RESOURCES - APPENDIX E

FACTS FOR WASTE DISCHARGE

1. Reason for Action and Regulatory Authority

The applicant filed an Application for Certificate (AFC) with the Energy Commission on March 13, 2008. The AFC proposed the construction and operation of a solar power plant at the Facility site. In conjunction with Facility construction, the applicant proposes to discharge wastes, dredged, and/or fill material to State waters.

Under the Warren-Alquist Act, and Governor's Executive Order S-14-08, the California Energy Commission (Energy Commission) has the authority to streamline permitting for renewable energy generation facilities. The Energy Commission implements an "in lieu of" permit process by incorporating the regulatory requirements and conditions of the various local and State agencies in its certification process. All necessary State and local permits for this Facility, including those permits typically issued by the Water Board are issued to the applicant through the Energy Commission's certification process. The Water Board has cooperated with the Energy Commission in evaluating the Beacon Solar Energy Project (BSEP) and provided to the Energy Commission the Board's analysis and recommended waste discharge requirements, herein, which staff has independently evaluated and hereby adopts as its own.

In a February 5, 2008 letter, the U.S. Army Corps of Engineers (USACE) determined that the ephemeral drainages on the site are not waters of the United States (U.S.). The USACE stated that the basis for this non-federal jurisdiction determination was because the waters did not meet the requirements of Code of Federal Regulations 33 parts 328.3(a)(3)(iii) and 328.3(a)(1). However, the drainages affected by the Facility are waters of the State, as defined by California Water Code (Water Code) section 13050, and are subject to State requirements in accordance with Water Code section 13260 and to the Water Quality Control Plan for the Lahontan Region (Basin Plan). All actions impacting or potentially impacting these drainages, including dredge and fill activities and construction and industrial activities, will be regulated through these requirements, which will be incorporated in the Energy Commission's certification process.

2. Waste Discharge Requirements History

The Facility is a new project. There are no previous Lahontan Water Board actions at this Facility or location. These requirements for waste discharge address storm water, dredge and fill, and groundwater requirements for the Facility.

3. Climate

The Mojave Desert has a typical desert climate, i.e., extreme daily temperature changes, low annual precipitation, strong seasonal winds, and mostly clear skies.

The annual highest temperature in the Mojave Desert exceeds 100 degrees Fahrenheit. Winter temperatures are more moderate, with mean maximum temperatures in the 60s and lows in the 30s.

Nearby California City has a total average annual precipitation of less than 7 inches. Over 70 percent of the precipitation occurs between December and March. However, occasional heavy precipitation occurs in the summer due to thunderstorms.

4. Site Geology

a. Setting

The Facility is located in Fremont Valley at the northwest edge of the Mojave Desert Geomorphic Province. Fremont Valley is a deep structural depression, i.e., a pull-apart basin, formed between two sections of the Garlock fault. The unconsolidated deposits of Fremont Valley are over 10,000 feet thick. Shallow deposits consist of Holocene (11,000 years and younger) alluvium, lacustrine, and playa deposits. Deeper deposits consist of older alluvium. The Holocene and older alluvium are comprised of mixtures, layers, and lenses of silt, sand, and gravel. The lacustrine and playa deposits are generally finer grained, consisting of sands, silts, and clays. These deposits overlie igneous or metamorphic basement rocks at depth.

The Facility site is located at the northwestern edge of the Fremont valley on the apron of coalesced alluvial fans formed at the base of the Sierra Nevada. The elevation of the Facility ranges from 2,030 feet to 2,260 feet above mean sea level.

b. Faulting and Seismicity

The Facility is located in a highly seismic region of southern California and within the influence of several active fault systems. The nearest fault system is the southwest/northeast trending Garlock fault. The U.S. Geologic Survey (USGS) classifies the Garlock fault as a "major Holocene active fault." The USGS divides the fault into western, central, and eastern sections. Based on USGS maps, the Facility is located in the structurally complex area where fault movement steps from the western section to the central section of the Garlock fault. The western section (also locally referred to as the Cantil or Cantil Valley fault) crosses through the center of the site. At the Facility, the fault trace of the western section is expressed as an eroded escarpment with the southeastern side approximately 15 to 25 feet higher than the northwestern side. The central section of the Garlock fault is approximately 2,000 feet northwest of the site. North to north-northwest trending secondary faults from the western and central sections are mapped by the USGS as extending into northern portions of the Facility.

Both fault sections of the Garlock fault and the secondary faults are designated by the State of California as Alquist-Priolo Fault Zones. The intent of the 1972 Alquist-Priolo Earthquake Fault Zoning Act was to mitigate the hazard of surface fault rupture to structures intended for human occupancy. The width of the

Alquist-Priolo Fault Zone associated with the western section on the Facility ranges from approximately 800 to 400 feet. Alquist-Priolo Fault Zones for the secondary faults covers much of the northeastern corner of the Facility and a small portion in the northwest portion of the Facility. The USGS estimates a peak ground acceleration of 70 percent for both the western and central sections of the fault.

c. Soils

Most of the Facility is covered by soil types that have rapid (i.e., high) permeability and negligible to low runoff potential. The exceptions are areas underlain by clay loams, which have moderate runoff potential and moderate to moderately slow permeability (i.e., low permeability). Clay loam soils are present in the northeast portion of the Facility and are slightly to moderately saline.

5. Groundwater

The Facility is located in the northwestern portion of the Fremont Valley groundwater basin (Department of Water Resources [DWR] groundwater basin No. 6-46). The Fremont Valley groundwater basin is divided into several sub-basins based on the presence of bedrock barriers and faults that influence groundwater movement.

The Facility site overlies the Koehn groundwater sub-basin, which is in the northern portion of Fremont Valley groundwater basin. The unconsolidated deposits comprising the sub-basin may be as thick as 1,900 feet and consist of mixtures of silt, sand, and gravel with some clay lenses. Depth to groundwater varies from as shallow as 14 feet in the vicinity of Koehn Lake to more than 300 feet in areas more distal from the lake. The groundwater flow direction in the sub-basin is generally toward Koehn Lake. The primary source of water to the groundwater basin is from surface infiltration at the base of the mountains and in ephemeral washes. Additionally, there may be some flow into the Koehn sub-basin from the adjacent sub-basins.

Depth to groundwater measured at the Facility in October 2007 ranged from approximately 200 to over 400 feet below ground surface. The groundwater flow direction is to the east-northeast at a gradient of approximately 0.012 foot per foot. Historic well level data show that from the 1970s to the 1980s groundwater pumping for agricultural use lowered the groundwater level in the vicinity of the Facility by as much as 250 feet. Since agriculture use ceased in 1988, groundwater levels have slowly recovered to within 100 to 130 feet of 1970s levels. A groundwater depression still exists in the northeastern portion of the site. Fourteen agricultural groundwater wells are proposed to remain on the Facility site. Several of these wells are proposed to be used for providing water for the construction of the Facility. These wells may also be used for Facility operations. In accordance with State Water Resources Control Board (State Water Board) Resolution No. 75-58, *Water Quality Control Policy on the Use and Disposal of Inland Waters Used for*

Powerplant Cooling and Resolution No. 77-01, Policy with Respect to Water Reclamation in California, staff is evaluating alternative water sources for Facility operation.

In the vicinity of Koehn Lake, some groundwater wells produce water with high total dissolved solids (TDS). Groundwater quality is generally good outside of the immediate vicinity of the lake.

6. Surface Water

Surface water flow in Fremont Valley is to Koehn Lake, a saline wet playa. The playa is a flat, unvegetated area in the lowest part of this undrained valley.

All drainages in this portion of the valley exist as ephemeral washes. There are two major washes in the vicinity of the Facility: Pine Tree Creek and Jawbone Creek. Pine Tree Creek drains the Sierra Nevada via Pine Tree Canyon, southwest of the Facility site. Pine Tree Creek continues north-northeast across the Facility site and discharges to Jawbone Creek which runs along the Facility's northern boundary. Jawbone Creek continues to Koehn Lake, 5 miles to the northeast. A smaller unnamed drainage crosses into the western portion of the site and discharges to Jawbone Creek at the northern boundary of the Facility.

The portion of Pine Tree Creek that crosses the Facility is mapped as a 100-year flood hazard zone by the Federal Emergency Management Agency (FEMA). The applicant has completed a modeling effort based on the 1986 Kern County Hydrology Manual, U.S. Army Corps of Engineers Hydrology Engineering Center (HEC) and FEMA-approved software. The site-specific analysis found that the flow during the 100-year event would largely be contained in the well-defined channel south of the Garlock fault escarpment. However, a gradient change on the north side of the Garlock fault would cause the 100-year event to spread outside of the channel and cover much of the northern portion of the Facility.

7. Land Uses and Existing Site Conditions

Land use in the vicinity of the Facility site is primarily open desert land, typified by creosote bush scrub vegetation with patches of desert saltbush scrub, desert wash scrub, and agriculture (mostly abandoned). A residential area exists approximately 0.5 miles north and an automotive test center is 0.8 mile northeast of the site.

The 2,012-acre site is largely vacant and previously disturbed from agriculture activities, which ceased in the 1980s. Although vegetation in the Facility's dry washes has been degraded by past agricultural activities, these washes are characterized by natural processes that support recruitment of native desert wash vegetation and provide wildlife habitat. A 2008 report by the U.S. Environmental Protection Agency, *The Ecology and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest* states that ephemeral and intermittent streams provide the same ecological and hydrological functions as perennial streams by moving water, nutrients, and sediment throughout the watershed.

8. Description of Direct Impacts to State Waters

According to the Energy Commission's *Preliminary Staff Assessment* (April 2009), one of the most significant impacts of the Facility is the re-routing of Pine Tree Creek and the channelization of an unnamed ephemeral wash on the west side of the Facility. These dredge and fill activities will result in the loss of 16 acres of jurisdictional waters of the State. The applicant proposes to replace the existing Pine Tree Creek channel with an engineered channel, which will be aligned along the south and east boundaries of the Facility site. The design of this channel will incorporate components designed to replicate the hydrological and biological functions and processes in this new drainage. The applicant also proposes rerouting and channelizing the unnamed wash. The unnamed wash will discharge to the rerouted Pine Tree Creek.

The Facility involves the proposed discharge of structural materials and/or earthen wastes (fill) to all of approximately 16 acres of natural watercourses. Impact areas and linear feet are shown in the table below.

Table 1: Impacts to Waters of the State

Water Body Name	Area (acres)			Linear Feet	Impacts	
	Wetlands	Vegetated	Unvegetated		Feet	Area (acres)
Pine Tree Creek	0	2.4	12.56	10,900	10,900	14.96
Unnamed wash	0	0	1.04	2,500	2,500	1.04
Total (Temp)	0	0	0	0	0	0
Total (Perm)	0	2.4	13.6	13,400	13,400	16.0
Total	0	2.4	13.6	13,400	13,400	16.0

9. Mitigation and Monitoring Plan (and long-term management)

The FSA specifies that the applicant shall mitigate the effects of the discharges of fill through:

- 1:1 replacement ratio for permanent impacts to unvegetated State waters,
- 2:1 replacement ratio of permanent impacts to State waters vegetated with southern alluvial fan scrub.

The applicant proposes to achieve these mitigation measures by replicating the hydraulic and biological function of the existing waters in the rerouted engineered channel for Pine Tree Creek. The channel will be designed to allow low flows to meander across the 250-foot width of the channel. Based on the applicant's analysis of the design, there should be little or no change in the sediment transport or scour from pre-development conditions.

The FSA specifies various requirements for the mitigation effort under its Condition of Certification, Biology-18. These requirements include the submittal of a Desert Wash Revegetation Plan for the approval of the Energy Commission and California Department of Fish and Game. The FSA concludes that there is a significant level of uncertainty as to whether the Facility's revegetation criteria can be met and includes various remedial actions. If the revegetation criteria are not obtained within 10 years after initiation of the revegetation effort, the FSA specifies that the applicant shall acquire, in fee or in easement, 16 acres of State jurisdictional waters. The acquired waters of the State will be in the same watershed and similar in hydraulic and biological function to the waters of the State at the site prior to Facility construction.

10. Storm Water Discharges

Under pre-development conditions, the Facility site has a low gradient (between 1 and 3 percent) and storm water moves via sheet flow to Pine Tree Creek or Jawbone Creek. These conditions will be permanently modified by construction of the Facility.

The following requirements regulate waste discharges in storm water runoff and other discharges associated with Facility construction activity and industrial storm water runoff.

The requirements also direct the applicant to maintain pre-development infiltration, surface retention and recharge rates in order to minimize post-development impacts to offsite water bodies and underlying groundwater. The applicant is required to avoid adverse effects of altering the hydrologic characteristics (hydromodification) of the Facility by site design and construction practices in accordance with these requirements.

a. Construction Storm Water Management

The applicant estimates that the construction phase will last 25 months, during which time the entire Facility site will be regraded and Pine Tree Creek and the unnamed wash will be rerouted and channelized. Site drainage will be managed in accordance with the best management practices (BMPs) as described in the Final Storm Water Pollution Prevention Plan (SWPPP) and Final Drainage, Erosion, and Sediment Control Plan (DESCP).

A primary component of storm water management involves the design of the rerouted Pine Tree Creek channel. As noted in Section 6, above, the applicant's analysis of the effects of flooding under pre-development conditions, determined that much of the northern portion of the Facility would be inundated by a 100-year flood event. The applicant has proposed a channel design that will convey the 100-year flood event (28,000 cubic feet per second) around the southern and eastern boundaries of the site without overtopping the banks. The channel will redirect flows back into the natural drainage at the northeastern corner of the Facility. The rerouted channels will be completed prior to any modifications to the existing channels.

b. Post-Construction Storm Water Management

The applicant proposes to manage storm water, erosion and sedimentation at the completed Facility through a comprehensive system of source controls, treatment BMPs, and site design. The final storm water management system must replicate pre-development hydrographs for the 2-year through the 10-year, 24-hour storm events. At a minimum, the applicant proposed to adhere to Kern County's detention and retention requirements.

Onsite storm water will be diverted to approximately 30 detention areas distributed throughout the Facility. The detention areas will be designed to infiltrate the runoff within 72 hours, which will allow for storm water treatment. Offsite flow in the unnamed wash will be conveyed across the site, without any input from onsite flows, and discharged into the rerouted Pine Tree Creek with appropriate dissipation structures. The power block will drain via sheet flow away from equipment foundations to the solar field and the detention areas. Local area containments will be provided around areas containing chemicals or compounds that could impact water quality, such as oil-filled transformers and chemical storage areas. Storm water from these areas will be conveyed to an onsite oil-water separator and then added to the plant cooling water. Good housekeeping and prompt removal of spills and leaks will be implemented to minimize storm water contact with contaminated materials.

11. Receiving Waters

The receiving waters are the minor surface waters of the Koehn Hydrologic Area (Hydrologic Subunit 625.40) and groundwater of the Fremont Valley Ground Water Basin (DWR No. 6-46).

12. Lahontan Basin Plan

The Lahontan Water Board adopted a Water Quality Control Plan for the Lahontan Basin (Basin Plan), which became effective on March 31, 1995. These requirements implement the Basin Plan.

13. Beneficial Uses -Surface Waters

The Basin Plan designates beneficial uses for surface waters in each watershed of the Lahontan region. Beneficial uses of surface waters within the Facility area and vicinity that could be impacted by the Facility include:

- a. municipal and domestic water supply (MUN),
- b. agricultural supply (AGR),
- c. groundwater recharge (GWR),
- d. navigation (NAV),
- e. water contact recreation (REC-1),
- f. non-contact water recreation (REC-2),

- g. warm freshwater habitat (WARM),
- h. wildlife habitat (WILD).

14. Beneficial Uses -Groundwater

The Basin Plan designates beneficial uses for groundwater in each watershed of the Lahontan region. Beneficial uses of groundwater within the Facility area and vicinity that could be impacted by the Facility include:

- a. municipal and domestic water supply (MUN),
- b. agricultural supply (AGR),
- c. industrial surface supply (IND),
- d. freshwater replenishment (FRSH).

15. Non-Degradation

The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16 (*Statement of Policy with Respect to Maintaining High Quality of Waters in California*). Resolution No. 68-16 requires that existing quality of waters be maintained unless degradation is justified based on specific findings or facts. The Basin Plan implements, and incorporates by reference, state antidegradation policies. The permitted discharge is consistent with the antidegradation provision of Resolution No. 68-16.

In accordance with State Water Board Resolution No. 68-16 and the Basin Plan, the following conditions must be met prior to any degradation of water of the State:

- a. Any change in water quality must be consistent with maximum benefit to the people of the State;
- b. The degradation will not unreasonably affect present and anticipated beneficial uses;
- c. The degradation will not result in water quality less than that prescribed in the Basin Plan;
- d. Discharges must use the best practicable treatment or control to avoid pollution or nuisance and maintain the highest water quality consistent with maximum benefit to the *people of the State*.

16. Other Considerations and Requirements for Discharge

Pursuant to Water Code section 13241, these requirements take into consideration:

- a. *Past, present, and probable future beneficial uses of water.*

These requirements identify past, present and probable future beneficial uses of water as described in Facts Nos. 16 and 17. The proposed discharge will not

adversely affect present or probable future beneficial uses of water, including domestic water supply, agricultural supply, industrial supply, and freshwater replenishment.

- b. *Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.*

Facts Nos. 6 through 13 describe the environmental characteristics and quality of water from this hydrographic unit.

- c. *Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area.*

These requirements will not result in any significant changes to groundwater quality. Adverse effects to surface water quality will be minimized.

- d. *Economic considerations.*

These requirements authorize the Discharger to implement closure and post-closure maintenance actions at the Facility as proposed by the Discharger. These requirements accept the Discharger's proposed actions as meeting the best practicable control method for protecting water quality from impacts from the Facility.

- e. *The need for developing housing within the region.*

The Discharger is not responsible for developing housing within the region.

- f. *The need to develop and use recycled water.*

The Energy Commission is currently evaluating the feasibility of using recycled water as the water source for Facility operations.

SURFACE IMPOUNDMENTS

17. Description of Surface Impoundments (evaporation ponds)

The three proposed surface impoundments are lined evaporation ponds used for disposal of process wastewater generated primarily as spent cooling water and process water. The surface impoundments are waste management units. The total dissolved solids concentrations of the wastewater could vary between 60,000 to 120,000 milligrams per liter (mg/L) [Source June 2009 Report of Waste Discharge (ROWD) see also March 2009 ROWD]. Wastewaters are co-mingled in the surface impoundments which provide a combined evaporation surface of approximately 8 acres (three surface impoundments each with a nominal surface area of 2.7 acres are required). The collective operating capacity of the surface impoundments is designed to accommodate a summer peak discharge rate of 56 gallons per minute (gpm) or 0.081 million gallons per day, and an annual discharge rate of 46 gpm (0.066 million gallons per day).

Saturated or equilibrium concentrations of impounded wastewaters result in precipitation of solids out of solution. For safety and operational purposes, accumulated solids are to be removed from the surface impoundments when the solids reach a depth of three feet. The surface impoundments must be designed to contain the 1,000-year, 24-hour precipitation storm event (pursuant to California Code of Regulations (CCR), title 27, section 20310) while maintaining the mandatory 2-foot freeboard requirement.

18. Surface Impoundments Construction Design

The proposed design for the three surface impoundments, from the surface downwards, consists of the following:

- a. A hard surface/protective layer with granular fill/free draining sub-base over geotextile;
- b. A primary 60 mil high-density polyethylene (HDPE) liner;
- c. An interstitial leak detection and removal system (LDRS) comprising a geomembrane geonet and collection piping;
- d. A secondary 40 mil HDPE liner; and
- e. A base layer consisting of either a geosynthetic clay liner (GCL) or 2 feet of onsite material with a hydraulic conductivity of less than 1×10^{-6} centimeter per second of which 30 percent, by weight, shall pass through a No. 200 standard sieve
- f. A moisture detection system beneath the secondary liner.

19. Leachate Collection and Removal System (LCRS)

In accordance with CCR, title 27, section 21600, subdivision (b)(8)(C), there is a LCRS proposed to be located beneath the primary liner in the surface impoundment. Additionally, a LCRS will be located between the primary and secondary liners underlying each surface impoundment. The LCRS will comprise of a layer of geonet sloped to a leak detection sump in each surface impoundment. The leak detection sump will include a 16-inch diameter leak-detection-and-removal-well fitted with an electronic leak sensor and a submersible pump to allow removal of collected fluids. The pump will discharge back into the surface impoundment. The discharge pipe shall be equipped with a recording flow totalizer to allow monitoring of the amount of fluid removed over time and calculation of leakage rates. The inspection and maintenance requirements for the LCRS are outlined in Section 12 of the June 2009 ROWD.

20. Action Leakage Rate of Surface Impoundment Liners

The Action Leakage Rate (ALR) is the allowable leakage from the primary liner system above which a spill prevention, control, and countermeasure (SPCC) plan actions are triggered (Section 13 of the March 2009 ROWD and June 2009 ROWD). According to Code of Federal Regulations, title 40, section 264.222, the ALR is

defined as "...the maximum design flow rate that the leak detection system can remove without the fluid head on the bottom liner exceeding 1 foot." The ALR must also include an adequate safety margin to allow for variability in the containment system design (e.g. liner and collection pipe slope, interstitial fill hydraulic conductivity, thickness of drainage material, etc.). The estimated ALR for the surface impoundments as documented in the June 2009 ROWD is 2,750 gallons per acre per day. This is based on one standard hole per acre, a drainage layer geonet with hydraulic conductivity of 0.06 meters per second and a 50 percent safety factor. The assumption underlying this ALR calculation will be verified in the actual constructed surface impoundments. Based on a 2.7-acre pond, each surface impoundment would have an ALR of 7,425 gallons per day. However, the ALR will need to have field verification because this rate will vary depending on actual drainage material used and its hydraulic conductivity. A final ALR will be submitted to the California Energy Commission based on field analysis. A large hole in the geomembrane may cause a rapid large leakage rate (RLLR) of approximately 9,500 gallons per acre per day. This would equate to a RLLR of 25,650 gallons per day per surface impoundment. The RLLR is provided for informational purposes only. The recording flow totalizer at each sump will be monitored at least daily to determine the leakage rate through the primary liner. If the leakage rate exceeds the ALR, then the appropriate actions in the SPCC Plan will be implemented.

LAND TREATMENT UNIT

21. Description of Land Treatment Unit

The Land Treatment Unit (LTU) is a waste management unit and will cover an area of approximately 800 feet by 800 feet. The LTU will not incorporate a liner containment system or LCRS, but will be constructed with a prepared base consisting of 2 feet of compacted, low permeability, lime-treated material. This base will serve as a competent platform for land treatment activities, and will serve to slow the rate of surface water infiltration in the treatment area. The treatment zone consists of compacted and native soil beneath the land farm unit to a depth of 5 feet. The lime treated layer is to be compacted to a minimum of 95% of the maximum dry density as determined by ASTM D1557 and have a low permeability.

The compacted and native soil beneath the LTU is designated as a "treatment zone" to a depth of 5 feet. Although the LTU will be taking vehicle traffic, no hard surface will be required, as there is no liner system to protect. A staging area is allocated in the LTU for storage of HTF-impacted soils while they are being characterized. Soil characterized as hazardous will be removed from the site; therefore, no additional liner system is required in the LTU for the hazardous waste.

The LTU will be surrounded on all sides by a 2-foot high compacted earthen berm with side slopes of approximately 3:1 (horizontal: vertical). These berms will control and prevent potential inflow (run on) of surface storm water into the LTU or runoff of storm water from the unit. CCR, title 27, section 20250 (b)(5) prescriptive requirements require that no waste shall migrate below 5 feet below the treatment zone.

Approximately 2.4 million gallons of HTF (Therminol VP-1 [Diphenyl ether (73.5%) and Biphenyl (26.5%)]) will be utilized at any one time within the Facility. However, the anticipated volume of soil within the LTU contaminated with HTF would not exceed 750 cubic yards. Based on available operation data from other sites, it is anticipated that approximately 750 cubic yards (on average) of HTF-affected soil may be treated per year. Larger or smaller quantities could be generated during some years, depending on the frequency and size of leaks and spills. A SPCC plan will be developed for the Facility (June 2009 ROWD Section 13.4).

HTF spill or leak reporting requirements will be incorporated into the SPCC Plan for the Project as follows:

- Project personnel will be required to submit an internal report detailing a HTF spill, regardless of size.
- A release of 20 gallons or more is reportable to the California Energy Commission.

Storm water may occasionally accumulate in the LTU. This storm water would be pumped to the surface impoundments only after visual observation establishes that the water is free from HTF product and sheen. Based on conditions at similar sites in the area, it is anticipated that such discharge, if necessary, would only occur approximately once every three to five years.

22. Waste Management Units Classification

Pursuant to CCR, title 27, section 20250, the surface impoundments and the land treatment unit are classified as Class II waste management units. Pursuant to CCR, title 27, section 20310, the units will be located outside of the 100-year flood plain and seismic hazard zones. In addition, the base of the waste management units will have a greater than 5-foot separation to the underlying groundwater.

23. Waste Classification

Hazardous wastes, per California Health and Safety Code section 25208 (Toxic Pits Cleanup Act), are prohibited from being either discharged into, being stored or accumulating via evaporative process within the surface impoundments. The nonhazardous wastewater discharged to the surface impoundments is hereby classified as a liquid designated waste. Residual solids remaining after evaporation are expected (June 2009 ROWD) to contain inorganic salts below hazardous waste levels.

The anticipated wastewater concentrations have been compared to the Soluble Threshold Limit Concentrations (STLCs) as reported in the CCR, title 22, section 66261.24 "Characteristics of Toxicity", and compared to Toxicity Characteristic Leaching Procedure (TCLP) values as reported in the Code of Federal Regulations (CFR) Part 261, section 261.24. The anticipated concentration of chemical constituents in wastewater discharging into the evaporation ponds is less than the STLC and TCLP for all reported parameters. Therefore, the wastewater is not considered a hazardous waste under State or Federal regulations.

The Department of Toxic Substances Control will determine a hazardous waste concentration (in milligrams of HTF per kilogram of soil) for HTF-contaminated soil. HTF-contaminated soil will be considered inert if the concentration is less than or equal to 100 milligrams per kilogram (mg/kg) or is 1/100 of the hazardous waste level, whichever is more conservative. (Hazardous waste classification at another similar site for HTF-contaminated soil is 10,000 mg/kg.) HTF-contaminated soil at concentrations between the hazardous waste concentration and the inert concentration is classified as designated waste.

The Water Code section 13173 defines a designated waste as:

- a. Hazardous waste that has been granted a variance from hazardous waste management requirements pursuant to Health and Safety Code, section 25143 ; or
- b. Nonhazardous waste that consists of, or contains, pollutants that, under ambient environmental conditions at a waste management unit, could be released in concentrations exceeding applicable water quality objectives, or that could reasonably be expected to affect beneficial uses of the waters of the state as contained in the appropriate state water quality control plan.

The wastewater discharged into the surface impoundments is expected to be nonhazardous; however, the wastewater will contain pollutants (e.g., TDS, fluoride) which could exceed water quality objectives if released, or that could be expected to affect the beneficial uses of waters of the state. Therefore, the wastewater is classified as a "designated waste." This classification is consistent with CCR, title 27, section 20210.

GROUNDWATER MONITORING NETWORK

24. Groundwater Monitoring Network (GMN)

The June 2009 ROWD proposes a Groundwater Monitoring Network (GMN) for two scenarios: an on-site industrial water supply scenario, and, an off-site industrial water supply scenario. Both proposed GMN layouts include three categories of monitoring wells: (1) background wells (located upgradient of the surface impoundments and land treatment unit); (2) detection wells (located adjacent to the surface impoundments and land treatment unit); and (3) compliance wells. For both onsite and offsite water supply scenarios, the detection wells are comprised of three proposed wells (MW-1 through MW-3) located immediately adjacent to the surface impoundments. The Point of Compliance as defined in CCR, title 27, section 20405 is "a vertical surface located at the hydraulically down gradient limit of the Unit that extends through the uppermost aquifer underlying the Unit."

The GMN layouts for the two water supply scenarios are:

Onsite Water Supply Scenario (Figure 4-1A of the June 2009 ROWD):

Background Wells – Well 47, Domestic Well, Well 50 and USGS Well. As shown in Figure 4-1A in the June 2009 ROWD, a cone of depression will develop under the

surface impoundments due to the location of primary pumping Wells 49 and Well 63 and backup Well 41 and Well 42. Under pumping conditions, groundwater is predicted to move toward the primary pumping well(s) from all points of the compass. Thus, all wells, except the pumping well(s), become background wells.

Detection Wells – MW-1, MW-2 and MW-3

Compliance Well(s) – The compliance well(s) will be the primary pumping well(s) that is/are active, either Well 49, Well 63, Well 41 or Well 42.

Offsite Water Supply Scenario (Figure 4-1B of the June 2009 ROWD):

Background Wells – Well 47, Domestic Well and Well 41

Detection Wells – MW-1, MW-2 and MW-3

Compliance Wells – Well 50, Well 51 and USGS Well

MONITORING PROGRAMS

25. Statistical Methods

Statistical analysis of monitoring data is necessary for the earliest possible detection of a statistically significant evidence of a release of waste from the Facility. CCR, title 27 requires statistical data analysis. The Monitoring and Reporting Programs (MRPs) includes methods for statistical analysis. The monitoring parameters listed in the MRPs are believed to be the best indicators of a release from the Facility.

26. Detection Monitoring Program

Pursuant to CCR, title 27 section 20420, the applicant has proposed a detection monitoring program for the Facility. The detection monitoring program for the surface impoundments consists of monitoring the LCRS, moisture detection network (neutron probe network), and monitoring wells for the presence of liquid and/or constituents of concern. The program to monitor the LCRS and water bearing media for evidence of a release, as well as the monitoring frequency is specified in the MRP. The detection monitoring program for the Land Treatment Unit consists of collecting and analyzing samples of the native soil in, and underneath, the treatment zone for the presence of HTF. The frequency of monitoring is specified in the MRP.

27. Evaluation Monitoring Program

An Evaluation Monitoring Program (EMP) is required, pursuant to CCR, title 27 section 20425, to evaluate evidence of a release if detection monitoring and/or verification procedures indicate evidence of a release.

28. Corrective Action Program

A Corrective Action Program (CAP) to remediate detected releases from the surface impoundments or land treatment unit may be required pursuant to CCR, title 27, section 20430, if results of an EMP warrant a CAP.

29. Closure and Post-Closure Maintenance Plan for the Surface Impoundments

The applicant submitted a preliminary closure plan for the surface impoundments.

30. Reasonably Foreseeable Release for the Surface Impoundments

The applicant submitted a CAP to address a reasonably foreseeable release. The scenario presented in the CAP is a dike failure in which the applicant is required to remediate and clean up soil that may become contaminated due to a release from the surface impoundments.

31. Closure and Post-Closure Maintenance Plan for the Land Treatment Unit

The applicant submitted a Preliminary Closure and Post-Closure Maintenance Plan which proposes that the Land Treatment Unit will be Clean Closed in accordance with the requirements of CCR, title 27, section 21090, subdivision (f).

32. Reasonably Foreseeable Release for the Land Treatment Unit

The applicant submitted a CAP to address a reasonably foreseeable release from the Land Treatment Unit. The scenario presented in the CAP for the Land Treatment Unit is a release to native soil underlying the five-foot treatment zone. A five-foot treatment zone is specified in CCR, title 27, section 20250 (b)(5).

Corrective action includes excavation and proper disposal of HTF-contaminated soil from the Land Treatment Unit and replacing the excavation with clean native soil.

33. Narrative and Numerical Water Quality Objectives

The Basin Plan incorporates narrative and numerical water quality objectives that apply to all ground and surface waters within the Lahontan Region. In general, where more than one objective is applicable, the stricter objective applies.

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SOIL AND WATER RESOURCES - APPENDIX F

REQUIREMENTS FOR WASTE DISCHARGE

I. DISCHARGE SPECIFICATIONS

A. Storm Water Discharges

Waste in discharges of storm water must be reduced or prevented to achieve the best practicable treatment level using controls, structures, and management practices. The applicant shall comply with all requirements (with the exception of purely administrative requirements, e.g., filing a Notice of Intent) contained in State Water Board's *Waste Discharge Requirements For Discharges of Storm Water Discharges Associated With Construction Activity, General Permit No. CAS00002* and *Waste Discharge Requirements For Discharges of Storm Water Associated With Industrial Activities, General Permit No. CAS00001* and all subsequent revisions and amendments.

These requirements do not preclude the applicant from requirements imposed by municipalities, counties, drainage districts, and other local agencies regarding discharges of storm water to separate storm sewer systems or other water, conveyances and water bodies under their jurisdiction.

B. Receiving Water Limitations

Surface Water and Groundwater Objectives

Receiving water limitations are narrative and numerical water quality objectives contained in the Water Quality Control Plan for the Lahontan Basin (Basin Plan) for all surface waters and groundwater of the Lahontan Region. As such, they are required to be met. The discharge of waste to surface waters shall not cause, or contribute to, a violation of the following water quality objectives for waters of the Koehn Hydrologic Unit.

a. Ammonia

Ammonia concentrations shall not exceed the values listed in Tables 3-1 to 3-4 of the Basin Plan for the corresponding conditions in these tables. Tables 3-1 to 3-4 of the Basin Plan are incorporated into these requirements by reference.

b. Bacteria, Coliform

- i. Waters shall not contain concentrations of coliform organisms attributable to anthropogenic sources, including human and livestock wastes.
- ii. The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 milliliter (ml), nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml. The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log

mean concentration exceeding 20/100 ml, or one sample exceeding 40/100 ml, for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected.

c. Biostimulatory Substances

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect the water for beneficial uses.

d. Chemical Constituents

- i. Waters designated as MUN (a beneficial use of surface water of the Koehn Hydrologic Unit) shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary MCL based upon drinking water standards specified in provisions of the CCR, Title 22, Division 4, Chapter 15, hereby incorporated by reference into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.
- ii. Waters shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.

e. Chlorine, Total Residual

For the protection of aquatic life, total chlorine residual shall not exceed either a median value of 0.002 milligrams per liter (mg/L) or a maximum value of 0.003 mg/L. Median values shall be based on daily measurements taken within any six-month period.

f. Color

Waters shall be free of coloration that causes nuisance or adversely affects the water for beneficial uses.

g. Dissolved Oxygen

- i. The dissolved oxygen concentration as percent saturation shall not be depressed by more than 10 percent, nor shall the minimum dissolved oxygen concentration be less than 80 percent of saturation.
- ii. For waters with the beneficial uses of WARM (a beneficial use of surface water in the Koehn Hydrologic Area), the minimum dissolved oxygen concentration shall not be less than that specified in Table 3-6 of the Basin Plan. Table 3-6 of the Basin Plan is incorporated herein by reference.

h. Floating Materials

- i. Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect the water for beneficial uses.

- ii. The concentrations of floating material shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.

i. Oil and Grease

- i. Waters shall not contain oils, greases, waxes or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect the water for beneficial uses.
- ii. The concentration of oils, greases, or other film or coat generating substances shall not be altered.

j. Pesticides

- i. For the purposes of these requirements, pesticides are defined to include insecticides, herbicides, rodenticides, fungicides, piscicides and all other economic poisons. An economic poison is any substance intended to prevent, repel, destroy, or mitigate the damage from insects, rodents, predatory animals, bacteria, fungi, or weeds capable of infesting or harming vegetation, humans, or animals (California Agriculture Code 12753).
- ii. Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life.
- iii. Waters designated as MUN shall not contain concentrations of pesticides or herbicides in excess of the limiting concentrations set forth in the CCR, Title 22, Division 4, Chapter 15. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

k. pH

- i. In fresh waters with designated beneficial use of WARM, changes in normal ambient pH levels shall not exceed 0.5 pH units.
- ii. The California Energy Commission recognizes that some waters of the Lahontan Region may have natural pH levels outside of the 6.5 to 8.5 range. Compliance with the pH objective for these waters will be determined on a case-by-case basis.

l. Radioactivity

- i. Radionuclides shall not be present in concentrations, which are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent, which presents a hazard to human, plant, animal, or aquatic life.

- ii. Waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified by the more restrictive of the CCR Title 22 Division 4, Article 5 sections 64441 et seq. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

m. Sediment

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect the water for beneficial uses.

n. Settleable Materials

Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or that adversely affects the water for beneficial uses. The concentration of settleable materials shall not be raised by more than 0.1 milliliter per liter.

o. Suspended Materials

- i. Waters shall not contain suspended materials in concentrations that cause nuisance or that adversely affect the water for beneficial uses.
- ii. The concentration of total suspended materials shall not be altered to the extent that such alterations are discernible at the 10 percent significance level.

p. Taste and Odor

Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. The taste and odor shall not be altered.

q. Temperature

- i. The natural receiving water temperature of all waters shall not be altered unless it can be demonstrated to the satisfaction of the California Energy Commission that such an alteration in temperature does not adversely affect the water for beneficial uses.
- ii. For waters designated WARM, water temperature shall not be altered by more than 5 degrees Fahrenheit above or below the natural temperature.

r. Toxicity

- i. All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

- ii. The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary, for other control water that is consistent with the requirements for "experimental water" as defined in the most recent edition of *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, et al.).

s. Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

The discharge of waste to groundwater shall not cause, or contribute to, a violation of the following water quality objectives for waters of the Fremont Valley Groundwater Basin.

a. Bacteria, Coliform

In groundwater designated as MUN (a beneficial use of groundwater of the Fremont Valley Ground Water Basin), the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters.

b. Chemical Constituents

- i. Groundwater designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary MCL based upon drinking water standards specified in provisions of the CCR, Title 22, Division 4, Chapter 15, hereby incorporated by reference into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

- ii. Groundwater shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses.

c. Radioactivity

Groundwater designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified by the more restrictive of the CCR Title 22 Division 4, Article 5 sections 64441 et seq. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

d. Taste and Odor

Waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For groundwater designated MUN, at a minimum, concentrations shall not exceed adopted secondary MCLs based upon drinking water standards specified in provisions of the CCR, Title 22, Division 4, Chapter 15, hereby incorporated by reference

into these requirements. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

II. PROHIBITIONS AND REQUIREMENTS

The discharge of wastes and fill associated with the Facility must not violate the following waste discharge prohibitions. These waste discharge prohibitions do not apply to discharges of storm water when wastes in the discharge are controlled through the application of management practices or other means and the discharge does not cause a violation of water quality objectives. The California Energy Commission expects that control measures will be implemented in an iterative manner as needed to meet applicable receiving water quality objectives.

A. REGIONWIDE PROHIBITIONS

1. The discharge of waste⁽ⁱ⁾ which causes violation of any narrative water quality objective contained in the Basin Plan, including the Nondegradation Objective, is prohibited.
2. The discharge of waste which causes a violation of any numeric water quality objective contained in the Basin Plan is prohibited.
3. Where any numeric or narrative water quality objective contained in the Basin Plan is already being violated, the discharge of waste which causes further degradation or pollution is prohibited.
4. The discharge of untreated sewage, garbage, or other solid wastes into surface waters of the Region is prohibited. (For the purposes of this prohibition, "untreated sewage" is that which exceeds secondary treatment standards of the Federal Water Pollution Control Act, which are incorporated in the Basin Plan in Section 4.4 under "Surface Water Disposal of Sewage Effluent.")
5. For municipal⁽ⁱⁱ⁾ and industrial⁽ⁱⁱⁱ⁾ discharges:
 - a. The discharge, bypass, or diversion of raw or partially treated sewage, sludge, grease, or oils to surface waters is prohibited.
 - b. The discharge of wastewater except to the designated disposal site (as designated in waste discharge requirements) is prohibited.
 - c. The discharge of industrial process wastes^(iv) to surface waters designated for the Municipal and Domestic Supply (MUN) beneficial use is prohibited.

Definitions:

- (i) "Waste" is defined to include any waste or deleterious material including, but not limited to, waste earthen materials (such as soil, silt, sand, clay, rock, or other organic or mineral material) and any other waste as defined in the California Water Code § 13050(d).
- (ii) "Municipal waste" is defined in Section 4.4 of the Basin Plan.
- (iii) "Industry" is defined in Section 4.7 of the Basin Plan.
- (iv) "Industrial process wastes" are wastes produced by industrial activities that result from one or more actions, operations, or treatments which modify raw material(s) and that may (1) add to or create within the effluent, waste, or receiving water a constituent or constituents not present prior to processing, or (2) alter water temperature and/or the concentration(s) of one or

The discharge of industrial process wastes to surface waters not designated for the MUN use may be permitted if such discharges comply with the General Discharge Limitations in Section 4.7 of the Basin Plan and if appropriate findings under state and federal anti-degradation regulations can be made.

Prohibitions 5(b) and 5(c) do not apply to industrial storm water. For control measures applicable to industrial storm water, see Section 4.3 of this Basin Plan, entitled "Stormwater Runoff, Erosion, and Sedimentation."

Prohibitions 5(b) and 5(c) do not apply to surface water disposal of treated ground water. For control measures applicable to surface water disposal of treated ground water, see Lahontan Regional Board Order No. 6-93-104, adopted November 19, 1993 (Basin Plan Appendix B).

B. Facility Discharge Prohibitions

1. Activities and waste discharges associated with the Facility must not cause or threaten to cause a nuisance or pollution as defined in Water Code section 13050.
2. The discharge, including discharges of fill material, must be limited to that described in the applicant's *Project Design Refinements*, dated June 2009.
3. The discharge or deposition of any wastes into channels, surface water, or any place where it would be discharged or deposited where it would be eventually transported to surface waters, including the 100-year floodplain, must not contain or consist of any substance in concentrations toxic to animal or plant life.
4. The discharge or deposition of any wastes into channels, surface water, or any place where it would be discharged or deposited where it would be eventually transported to surface waters, including the 100-year floodplain, must not contain or consist of oil or other floating materials from any activity in quantities sufficient to cause deleterious bottom deposits, turbidity, or discoloration in surface waters.
5. The discharge of waste, as defined in the Water Code, that causes violation of any narrative water quality objective contained in the Basin Plan is prohibited.
6. The discharge of waste that causes violation of any numeric water quality objective contained in the Basin Plan is prohibited.
7. Where any numeric or narrative water quality objective contained in the Basin Plan is already being violated, the discharge of waste that causes further

more naturally occurring constituents within the effluent, waste or receiving water. Certain non-storm water discharges may occur at industrial facilities that are not considered to be industrial process wastes for the purposes of Prohibition 5(c). Examples include: fire hydrant flushing, atmospheric condensates from refrigeration and air conditioning systems, and landscape watering.

degradation or pollution (as defined in Water Code Section 13050) is prohibited.

8. The discharge of septic tank pumpings (septage) or chemical toilet wastes to other than a sewage treatment plant or a waste hauler is prohibited.

C. Requirements

1. The applicant shall develop a final Storm Water Pollution Prevention Program (SWPPP) in accordance with the State Water Board's *General Permit No. CAS00001* and *General Permit No. CAS00002*. This SWPPP, or any future revision to this SWPPP, shall be implemented after approval by the Compliance Project Manager (CPM)
2. The applicant must, at all times, maintain appropriate types and sufficient quantities of material on site to contain any spill or inadvertent release of materials that may cause a condition of pollution or nuisance if the materials reach waters of the State.
3. Discharges of wastewater generated by the Facility's operations, including cooling water, are not allowed to be released to the offsite environment.
4. The applicant must permit California Energy Commission staff or their authorized representative upon presentation of credentials:
 - a. Entry onto Facility premises.
 - b. Access to copy any record required to be kept under the terms and conditions of the Commission's Decision.
 - c. Inspection of any treatment equipment, monitoring equipment, or monitoring method required by the Commission's Decision.
 - d. Sampling of any discharge or surface water covered by the Commission's Decision.
5. The applicant must immediately notify the California Energy Commission and SWRCB by telephone whenever an adverse condition occurs as a result of this discharge. Such a condition includes, but is not limited to, a violation of the conditions of the Commission's Decision, a significant spill of petroleum products or toxic chemicals, or damage to control facilities that would cause noncompliance. A written notification of the adverse condition must be provided to the California Energy Commission within two weeks of occurrence. The written notification must identify the adverse condition, describe the actions necessary to remedy the condition, and specify a timetable, subject to any modifications by California Energy Commission staff, for the remedial actions.

6. The applicant must comply with the Monitoring and Report Program for Surface Water and Monitoring and Report Program Groundwater, included in these requirements.

III PROVISIONS

A. Special Provisions for Fill Impacts to State Waters

1. Detailed final grading plans must be provided to the CPM a minimum of 60 days prior to commencement of construction activities.
2. Construction equipment must be clean and free from oil, grease, and loose metal material and must be removed from service if necessary to protect water quality.
3. No debris, cement, concrete (or wash water therefrom), oil or petroleum products must be allowed to enter into or be placed where it may be washed from the Facility site by rainfall or runoff into waters of the State. When operations are completed, any excess material must be removed from the Facility work area and any areas adjacent to the work area where such material may be transported into waters of the State as defined in Water Code section 13050.
4. No equipment may be operated in areas of flowing or standing water; no fueling, cleaning, or maintenance of vehicles or equipment must take place within any areas where an accidental discharge to waters of the State may occur; construction materials and heavy equipment must be stored outside of the flow of the waters of the State. When work within the boundaries of waters of the State is necessary, the entire streamflow must be diverted around the work area, temporarily, as needed to control waste discharge.

B. Special Provisions for Storm Water

1. The applicant must ensure that storm water discharges and non-storm water discharges do not cause or contribute to an exceedance of any applicable water quality standards.
2. At least 60 days prior to commencement of construction activities, the applicant must develop and implement a Construction Area Monitoring Program (CAMP) in accordance with the Monitoring Program and Reporting Requirements for Surface Water.
3. Post-construction storm water flows emanating from the Facility site must not exceed predevelopment levels. Runoff from newly constructed impervious areas that is greater than background levels must be treated and detained to predevelopment runoff levels. Methods such as *low impact development* may be used to achieve this requirement (see State Board Resolution No. 2008-0030). Detention and/or infiltration facilities for a 10-year, one-hour storm event fulfills this requirement for the purposes of these requirements.

4. The applicant must implement Best Management Practices (BMPs) to prevent or reduce the discharge of wastes associated with water contacting construction materials or equipment.
5. The applicant must provide effective cover, mulch, fiber blankets, or other erosion control for soils disturbed by construction activities.
6. The applicant must provide BMPs for erosion stabilization for all areas of disturbed soil regardless of time of year, including erosion from rainfall, non-storm water runoff, and wind.
7. The applicant must stabilize from erosion all finished slopes, open space, utility backfill, and graded or filled lots within two weeks from when excavation or grading activity has been completed.
8. The applicant must control runoff from offsite areas, route flows away from disturbed areas in a manner that does not cause onsite or offsite erosion, and provide controls to minimize runoff and problems from storm water flows into active or disturbed Facility areas from offsite areas.
9. The applicant must, at all times, maintain effective perimeter controls and stabilize all construction entrances/exits sufficiently to control erosion and soil or sediment discharges from the site.
10. The applicant must properly install and effectively maintain all BMPs for storm drain inlets and perimeter controls, runoff control BMPs, and stabilized entrances/exits.
11. The applicant must ensure that construction activity traffic to and from the Facility is limited to entrances and exits that employ effective controls to prevent offsite tracking of soil.
12. The applicant must ensure that all storm drain inlets and perimeter controls, runoff control BMPs, and pollutant control at entrances/exits are maintained and protected from activities that could reduce their effectiveness.
13. The applicant must comply with the following source control requirements:
 - a. Maintain vegetative cover to the extent possible by developing the Facility in a way that reduces the amount of soil exposed to erosion at any time.
 - b. Inspect and remove accumulated deposits of soil at all inlets to the storm drain system at frequent intervals during rainy periods.
 - c. Provide buffer strips and/or vegetation protection fencing between the active construction area and any water bodies.
 - d. Provide "good housekeeping" measures for construction materials, waste management, vehicle storage and maintenance, and landscape materials at all times including, but not limited to, the list of required measures in

Attachment B of the Monitoring and Reporting Program for Surface Water, which is made a part of these requirements.

14. The applicant must maintain, in perpetuity, post-construction control and treatment measures for storm water, or must identify in writing to the California Energy Commission, the entity that is legally responsible for maintaining the post-construction controls at the Facility site.
15. The applicant shall have in place adequate emergency response plans in order to clean up any spill or release of any waste at the Facility.

C. Special Provisions for the Waste Management Units (Surface Impoundments and Land Treatment Unit)

1. There shall be no discharge, bypass, or diversion of wastewater from the collection, conveyance, or disposal facilities to adjacent land areas or surface waters.
2. All facilities used for the collection, conveyance, or disposal of waste shall be adequately protected against overflow, washout, inundation, structural damage, or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years. The surface impoundments and land treatment unit (LTU) shall be designed and maintained with the capacity to capture the 1,000-year, 24-hour storm.
3. The release of wastewater shall not cause the presence of the groundwater monitoring parameters listed in the Monitoring and Reporting Programs to be in excess of background levels as described in the June 2009 Report of Waste Discharge (ROWD).
4. The discharge, storage or evaporative accumulation of hazardous waste to waste management units at the Facility is prohibited.

Special Provisions for Surface Impoundments

1. Only wastewater from the brine concentrator or storm water that may accumulate in the LTU shall be discharged to the surface impoundments.
2. The flow of wastewater to the surface impoundments shall not exceed a total of 0.066 million gallons per day for any consecutive 12 month period.
3. The maximum average daily flow rate of wastewater to the surface impoundments shall not exceed 0.081 million gallons per day.
4. The discharge of wastewater at the facility except to the authorized disposal sites (i.e., the surface impoundments) of these requirements is prohibited.
5. All lined facilities shall be effectively sealed to prevent the exfiltration of liquids.

For this project, "effectively sealed" facilities are the surface impoundments that are designed and constructed in accordance with the requirements of CCR, title 27.

6. The vertical distance between the liquid surface elevation and the highest part of a surface impoundment dike (i.e. the freeboard), or the invert of an overflow structure, shall not be less than two feet.

Special Provisions for the Leachate Collection and Removal System

1. If liquids are detected in the leachate collection and removal system (LCRS) sumps at a rate equal to or greater than the "Action Leakage Rate" of 2,750 gallons per acre per day as described in the June 2009 ROWD, then the applicant shall comply with the notice of evidence of response to exceeding the action leakage rate requirements presented in the appropriate section of the Monitoring and Reporting Program for Groundwater included with these requirements.
2. If liquids are detected in the LCRS sumps at rates greater than the "Rapid and Large Leakage Rate" of 9,500 gallons per acre per day as described in the June 2009 ROWD, the applicant shall immediately notify the CPM and cease the discharge of waste to the affected impoundment. Discharges of waste to the affected impoundment shall be prohibited until the appropriate repairs are made.
3. The depth of leachate in the leachate collection sump shall be kept at the minimum needed to ensure efficient sump dewatering pump operation.
4. The LCRS shall be operated to function without clogging throughout the life of the project including closure and post closure maintenance periods.
5. The LCRS shall be tested at least once annually to demonstrate proper operation.
6. The LCRS shall be capable of removing twice the maximum anticipated daily volume of leachate from the surface impoundments.
7. Any leachate collected in any LCRS shall be returned to the surface impoundments.

Special Provisions for the Land Treatment Unit

1. Only soil contaminated with Therminol or similarly approved HTF and originating at this Facility shall be accepted for treatment at the Land Treatment Unit.

2. Soil treated at the Land Treatment Unit may be used as fill material, road base or as a cover at the Facility (excluding any area within the 100-year floodplain) if the following concentration limit is not exceeded:

Parameter	Maximum Concentration of the Composite Sample
Heat Transfer Fluid - Therminol, (Biphenyl, and diphenyl oxide) or related HTF that has similar environmental fate and transport characteristics as Therminol.	100 milligram per kilogram (mg/kg) or 1/100 of the hazardous waste level, whichever is less (i.e., more conservative) (The hazardous waste level for heat transfer fluid is to be determined.)

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SOIL AND WATER RESOURCES - APPENDIX G

MONITORING AND REPORTING PROGRAM FOR SURFACE WATER

I. MONITORING

A. General Requirements

- 1. The applicant must comply with the "General Provisions for Monitoring and Reporting," which is attached to and made part of this Monitoring and Reporting Program (Attachment A).**
- 2. The applicant must comply with the "Good Housekeeping Best Management Practices," which is attached to and made part of this Monitoring and Reporting Program (Attachment B).**

B. Construction Site Storm Event Water Monitoring

The applicant must monitor site precipitation continuously and keep a record of storm events that produce more than 0.5 inch of precipitation at the site.

During storms and/or within one business day after each 0.5 inch of precipitation from a storm event, the applicant must visually observe and document observations of storm water discharges from the site to both the unnamed wash and to Pine Tree Creek.

For visual observations, the applicant must look for and document the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

The applicant must visually observe and document observations of the discharge of stored or contained storm water that is discharged subsequent to a storm event. The applicant is only required to visually observe such discharges if they occur under daylight conditions. Stored or contained storm water that will likely discharge after operating hours due to anticipated precipitation must be observed prior to the discharge to determine whether controls and BMPs are in place and functioning as required.

For the purposes of these requirements, a "potential storm event" is defined as any storm event with a 30 percent or greater chance of precipitation as predicted by the National Weather Service's nearest weather station for the local climate zone. Forty-eight (48) hours prior to each potential storm event, the applicant must visually observe and implement appropriate corrective action for (1) all storm water drainage areas, to identify any spills, leaks, or uncontrolled pollutant sources, (2) all Best Management Practices (BMPs; see Attachment B), to identify whether they have been properly installed and maintained, and (3) any storm water storage and containment areas, to detect leaks and ensure maintenance of adequate freeboard.

Within one business day after each storm event that produces precipitation of 0.5 inch or more, the applicant must conduct a post-storm event inspection to:

1. identify whether BMPs were adequately designed, implemented, and effective,
2. identify if and where additional BMPs are needed, where BMPs are in need of maintenance, and
3. photograph each discharge location and the associated BMPs.

Within one business day after the initial 0.5 inch of precipitation from a storm event, and every 1 inch thereafter, the applicant must collect and analyze samples of storm water discharged from each detention basin.

If no discharge occurs from a basin, no sample is required, but the absence of discharge must be documented.

Storm water sampling and analyses must be performed in accordance with the following requirements:

1. The applicant must analyze the samples for pH and turbidity.
2. The applicant is not required to physically collect samples or conduct visual observations during dangerous weather conditions or outside of scheduled site operation hours.

The applicant must perform sampling of storm water discharges from all drainage areas associated with construction activity. The storm water discharge collected and observed must represent the worst quality storm water discharge in each drainage area based on visual observation of the water and upstream conditions. For example, if there has been concrete work recently in an area, or drywall scrap is exposed to the rain, a pH sample must be taken of drainage from the relevant work area. Similarly, if muddy water is flowing through some parts of a silt fence, samples must be taken of the muddy water even if most water flowing through the fence is clear.

C. Construction Site Monitoring

1. On a daily basis, the applicant must inspect all public and private paved roads serving the Facility and daily remove, by vacuuming or sweeping, visible accumulations of sediment or other construction activity-related materials that are deposited on the roads. All inspections under this provision must be documented in writing.
2. The applicant must ensure that inspections and observations at locations where runoff may discharge from the Facility site are performed weekly, and at least once each 24-hour period during extended storm events, to identify any problems and/or BMPs that:
 - a. need maintenance to operate effectively,

- b. have failed, or
 - c. are inadequate to achieve effective control.
3. The applicant must visually observe construction areas and each drainage area for the presence of (or indication of prior) non-storm water discharges and their sources to ensure that all BMPs are in place and effective.
- a. One visual observation must be conducted quarterly in each of the following periods: January – March, April – June, July – September, and October – December. Visual observations are only required during daylight hours (sunrise to sunset).
 - b. Visual observations must document the presence of evidence of any non-storm water discharge, pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source. The applicant must maintain on-site records indicating the personnel performing the visual observation, the dates and approximate time each drainage area and non-storm water discharge was observed, and the response taken to eliminate non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water discharges.
4. The applicant must monitor and report run-on from surrounding areas that may contribute to exceedances or excursions from requirements (violations).

D. Post-Construction Monitoring

On a semi-annual basis, the applicant must inspect and document inspections of post-construction treatment controls at the Facility site. Maintenance must be provided to address any controls that are not in compliance with requirements.

E. Receiving Water Monitoring

1. Receiving water sampling must occur at the following locations in Pine Tree Creek and the unnamed wash:
 - a. 200 feet upstream of the Facility site in the natural watercourse.
 - b. 200 feet downstream of the Facility site in the natural watercourse.
 - c. Midpoint between the upstream and downstream samples.
 - d. 50 feet downstream of each outfall into the above creeks.
2. Twice monthly and at no less than 10-day intervals from November through May of each year, the applicant must sample the Facility's receiving waters, Pine Tree Creek and the unnamed wash, with grab samples for the following constituents:
 - a) Turbidity,
 - b) Temperature,

- c) Dissolved Oxygen,
- d) Suspended Solids,
- e) Total Dissolved Solids, and
- f) pH.

If no water is present (documented by photographs), no sampling is required.

3. The applicant must also sample the receiving waters for the above parameter(s) when discharge from any detention basin occurs.

II. REPORTING

A. Required Program Reports

1. The applicant must develop and implement a Construction Area Monitoring Program (CAMP), as described in II.C, below, and provide the CAMP to the CPM 60 days prior to commencement of construction activities. The CAMP must include receiving water monitoring locations as required above.
2. The applicant must provide a Sampling and Analysis Plan (SAP) as referenced in I.A, above, to the California Energy Commission 60 days prior to commencement of construction activities.

B. Construction Area Management Plan

1. The CAMP must be developed and implemented to address the following objectives:
 - a. To demonstrate that the site is in compliance with these requirements;
 - b. To determine whether immediate corrective actions, additional BMP implementation, or Storm Water Pollution Prevention Plan (SWPPP) revisions are necessary to reduce pollutants and wastes in storm water discharges and non-storm water discharges; and
 - c. To determine whether BMPs included in the SWPPP are effective in preventing or reducing pollutants in storm water discharges.
2. The applicant must develop a written site-specific CAMP that includes all monitoring procedures and instruction, location maps, forms, and checklists as required in these requirements and this MRP. This CAMP must be made a part of a revised SWPPP that is to be kept and used on the Facility site.

C. Storm Water Pollution Prevention Plan Annual Report

1. The applicant must prepare and provide an annual report no later than January 30 of each year.

2. The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, a summary of all corrective actions taken during the compliance year, identification of any recommended compliance activities or corrective actions that were not implemented.
3. The Annual Report must include all records and reports of visual observations and sample collection exceptions, the analytical method, method reporting unit, and method detection limit of each analytical parameter. Analytical results that are less than the method detection limit must be reported as "less than the method detection limit."

D. Records

1. The applicant must maintain records on-site of all visual observations, personnel performing the observations, observation dates, weather condition, locations observed, and corrective actions taken in response to the observations.
2. All inspections and observations pursuant to Section I.C. above must be documented in writing and must include:
 - a. Inspector's name, title, and signature.
 - b. Inspection date and date the inspection report was written.
 - c. Weather information: estimate of beginning of storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall (inches).
 - d. A list and description of BMPs evaluated and any deficiencies noted. If there are no deficiencies, the report must indicate (under penalty of perjury) that the Facility is in compliance with these discharge requirements.
 - e. Report the presence of noticeable odors or any visible sheen on the surface of any discharges.
 - f. Corrective actions required, including any changes necessary to comply with requirements, and implementation dates for completing corrective actions.
 - g. Photographs taken during the inspection.
3. Records of all storm water monitoring information and copies of all reports (including Annual Reports) required by these requirements must be retained for a period of at least five years from the date of the sample, measurement, report, or application. This period may be extended when requested by the CPM. Records must be retained on-site while construction is ongoing. The records must include:
 - a. The date, place, time of facility inspections, sampling, visual observation, and/or measurement, including precipitation;
 - b. The individual(s) who performed the facility inspections, sampling, visual observations, and or measurement;

- c. The date and approximate time of analyses;
- d. The individual(s) and company who performed the analysis;
- e. A summary of all analytical results from the last five years, the method detection limits and reporting units, and the analytical techniques or methods used;
- f. Quality assurance/quality control records and results;
- g. Non-storm water discharge inspections and visual observations and storm water discharge visual observation records; and
- h. Visual observation and sample collection exception records.

TTACHMENT A

GENERAL PROVISIONS FOR MONITORING AND REPORTING

1. SAMPLING AND ANALYSIS

- a. All analyses shall be performed in accordance with the current edition(s) of the following documents:
 - i. Standard Methods for the Examination of Water and Wastewater
 - ii. Methods for Chemical Analysis of Water and Wastes, EPA
- b. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the Compliance Project Manager (CPM). Specific methods of analysis must be identified on each laboratory report.
- c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The methods used shall also be reported. If methods other than EPA-approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the CPM prior to use.
- d. The applicant shall establish chain-of-custody procedures to insure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage, and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.
- e. The applicant shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall insure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.
- f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.
- g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

2. OPERATIONAL REQUIREMENTS

- h. Sample Results

The applicant shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the California Energy Commission.

i. Operational Log

An operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

3. REPORTING

j. For every item where the requirements are not met, the applicant shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and shall submit a timetable for correction.

k. All sampling and analytical results shall be made available to the CPM upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the CPM.

l. The applicant shall provide a brief summary of any operational problems and maintenance activities to the California Energy Commission with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

m. Monitoring reports shall be signed by:

iii. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;

iv. In the case of a partnership, by a general partner;

v. In the case of a sole proprietorship, by the proprietor; or

vi. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

n. Monitoring reports are to include the name and telephone number of an individual who can answer questions about the report.

ATTACHMENT B

GOOD HOUSEKEEPING BEST MANAGEMENT PRACTICES

1. Good housekeeping measures for construction materials include:
 - a. Maintaining an inventory of the products used and/or expected to be used and the end products that are produced and/or expected to be produced.
 - b. Covering and berming loose stockpiled construction materials (i.e. soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.).
 - c. Storing chemicals in watertight containers or in a bermed storage shed (completely enclosed), with appropriate secondary containment.
 - d. Minimizing contact of construction materials with precipitation.
 - e. Implementing BMPs to reduce or prevent the offsite tracking of loose construction and landscape materials.
2. Good housekeeping measures for waste management include:
 - a. Preventing disposal of any rinse/wash waters or materials into the storm drain system.
 - b. Berming sanitation facilities (e.g. Porta Potties) and preventing them from being kept within the curb and gutter or on sidewalks or adjacent to a storm drain.
 - c. Cleaning or replacing sanitation facilities and inspecting them regularly for leaks and spills.
 - d. Covering waste disposal containers when they are not in use and preventing them from overflowing.
 - e. Berming and securely protecting stockpiled waste material from wind and rain at all times unless actively being used where spill would enter surface drainage systems.
 - f. Addressing procedures to deal with hazardous and non-hazardous spills.
 - g. Preparing and implementing a spill response and implementation plan prior to commencement of construction activities, including:
 - i. Locations of on-site equipment and materials for cleanup of spills and leaks.
 - ii. Procedures to follow in the event of spill or leak that includes immediate cleanup.
 - iii. Locations and procedures of disposing of waste materials.
 - iv. Identification of and training for spill response personnel.
 - h. Lining and berming of concrete washout areas so there is no leakage or overflow into the underlying soil and onto the surrounding areas. Washout areas must be positioned away from drain inlets and waterways and be clearly labeled.
3. Good housekeeping measures for vehicle storage and maintenance include:
 - a. Not allowing oil, grease, or fuel to leak in to the soil.
 - b. Placing all equipment or vehicles to be fueled, maintained and/or stored in a designated area fitted with appropriate BMPs.
 - c. Cleaning leaks immediately and disposing of leaked materials and sorbents properly.
 - d. Fix leaks immediately or remove equipment for service.

4. To assess the potential pollutant sources and identify all areas of the site where good housekeeping or additional BMPs are necessary to reduce or prevent pollutants in storm water discharges and non-storm water discharges, the applicant must assess and report on the following:
 - a. The quantity, physical characteristic (liquid, powder, solid, etc.), and locations of each potential pollutant source handled, produced, stored, recycled, or disposed of at the site.
 - b. The degree to which pollutants associated with those materials may be exposed to and mobilized by contact with storm water.
 - c. The direct and indirect pathways that pollutants may be exposed to storm water discharges and non-storm water discharges. This must include an assessment of past spills or leaks, non-storm water discharges, and discharges from adjoining areas.
 - d. Sampling, visual observation, and inspection records.
 - e. Effectiveness of existing BMPs to reduce or prevent pollutants in storm water discharges and non-storm water discharges.

Soil and Water Resources - APPENDIX H

MONITORING AND REPORTING PROGRAM FOR GROUNDWATER (THREE SURFACE IMPOUNDMENTS AND A LAND TREATMENT UNIT)

I. WATER QUALITY PROTECTION STANDARD

Water Quality Protection Standard is required by Title 27 of the California Code of Regulations (CCR, title 27) to assure the earliest possible detection of a release from the Beacon Solar Energy Project (Beacon) to underlying soil and/or groundwater. The Water Quality Protection Standard shall consist of the list of constituents of concern, the concentration limits, the Point of Compliance and all Monitoring Points. This Water Quality Protection Standard shall apply during the operation, closure, post-closure maintenance period, and during any compliance period. Beacon will initially undergo construction and then will be under a Detection Monitoring Program as documented in the March and June 2009 Report of Waste Discharge (ROWD).

II. MONITORING

A. Flow Monitoring of Discharges to the Surface Impoundments (the three evaporation ponds)

The Groundwater Mitigation Plan (June 2009 ROWD) states that discharge to the surface impoundments is derived from two primary sources (blow down of circulating water from the cooling tower and wastewater from the ion exchange regeneration stream) and one occasional source (storm water that may accumulate in the Land Treatment Unit). Wastewater from these sources will be routed to a brine concentrator, where the dissolved solids are concentrated into a brine liquid and discharged to the surface impoundments.

The applicant shall monitor the following:

1. The volume, in million gallons per day (mgd), of wastewater delivered to the surface impoundments;
2. The cumulative total of wastewater flow delivered to the surface impoundments, in million gallons per month; and
3. The maximum daily flow rate, in mgd, delivered to the surface impoundments each month.

B. Monitoring of Wastewater Discharges to the Surface Impoundments

Semi-annually, the applicant shall record the following:

1. The sources of wastewater delivered to the surface impoundments;

2. The amount and types of chemical additives added to the cooling system water that may be discharged to the surface impoundments; and
3. The analytical results of a composite wastewater grab sample that shall be collected and analyzed for the parameters in Table II-1.

Wastewater Sampling Parameters
Table II-1

Parameter	U.S. EPA or Standard Method	Reporting Limit Goal	Units
Ammonia (as N)	350.1	100	µg/L
Aluminum	200.7	20	µg/L
Arsenic	6020	2	µg/L
Antimony	6020	10	µg/L
Barium	6020	5	µg/L
Beryllium	6020	2	µg/L
Boron	200.7	140	µg/L
Cadmium	6020	5	µg/L
Calcium	200.7	40,000	µg/L
Chloride	300.0	14,000	µg/L
Chromium (total)	6020	5	µg/L
Cobalt	6020	5	µg/L
Copper	6020	5	µg/L
Cyanide (total)	SM 4500	10	µg/L
Fluoride	300.0	500	µg/L
Iron	200.7	20	µg/L
Lead	6020	3	µg/L
Magnesium	200.7	10,000	µg/L
Manganese	200.7	15	µg/L
Mercury	7470A	0.2	µg/L
Molybdenum	6020	10	µg/L
Nickel	6020	5	µg/L
Nitrate as nitrogen	300.0	1,000	µg/L
Nitrite as nitrogen	SM 4500	4	µg/L
Phosphate (total)	365.3	100	µg/L
Potassium	200.7	3,000	µg/L
Selenium	6020	10	µg/L
Silver	6020	5	µg/L
Sodium	200.7	10,000	µg/L
Strontium	200.7	500	µg/L
Sulfate	300.0	100,000	µg/L
Thallium	6020	10	µg/L
Total dissolved solids	SM 2540C	10,000	µg/L
Total alkalinity(as CaCO ₃)	SM 2320B	100,000	µg/L
Vanadium	6020	5	µg/L
Zinc	6020	10	µg/L
Biphenyl	8015M	500	µg/L
Diphenyl oxide	8015M	500	µg/L
Cyclohexamine (20-	8015M	500	µg/L

40%)			
Morpholine (1-10%)	8015M	500	µg/L
pH	Field	+/- 0.1	pH units
Temperature	Field	+/- 0.1	° F or °C

µg/L = micrograms per liter

C. Surface Impoundment Monitoring

1. Dikes and Liners

- a. Daily, the freeboard shall be measured from the top of the lowest part of the dike to the wastewater surface. If the surface impoundment is dry, indicate that it is empty of wastewater.
- b. Monthly, the integrity of the dikes and liners shall be inspected. Should the inspection indicate any damage to the dikes or liners or if an unauthorized discharge has occurred, or is likely to occur, the California Energy Commission shall be notified within 48 hours, followed by confirmation in writing.

2. Leachate Collection and Removal System (LCRS)

- a. Weekly, visual inspection for liquid in the leachate collection detection sumps for each surface impoundment shall be conducted. The results of those inspections shall be recorded in a permanent log book.
- b. All volume of liquid pumped out of the leakage detection sumps for each surface impoundment shall be recorded along with date, time and discharge location, in a permanent log book kept on-site.

3. Surface Impoundment Wastewater Monitoring

Semi-annually, at each surface impoundment, liquid grab samples shall be collected at three (3) sample locations in the surface impoundments spaced approximately equidistant. The collected samples shall be composited into one sample by the laboratory and analyzed to determine the quantification of the parameters in Table II-1.

4. Surface Impoundment Sludge Monitoring

Annually, in the last quarter of each year, three (3) representative grab samples of the bottom sludge in each surface impoundment, if present, shall be collected, composited and analyzed for the parameters in Table II-2.

Surface Impoundment Sludge Monitoring

Table II-2

Parameters	Unit
CCR title 22 metals (CAM 17)- Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc	Milligrams per kilogram (mg/kg)
Biphenyl, diphenyl oxide (Therminol or similar)	mg/kg

D. Detection Monitoring

Using approved statistical or non-statistical data analysis methods approved in these requirements, and in compliance with CCR, title 27, the applicant shall, for each monitoring event, compare the concentration of each monitoring parameter with its respective concentration limit to determine if there has been a release from the surface impoundments. Monitoring shall be completed in compliance with this Section D as further described below.

1. Unsaturated Zone Monitoring - Neutron Probe

- a. Quarterly, the applicant shall check for moisture below the surface impoundment liners using a neutron moisture probe calibrated for use at the site. If moisture content is detected above 30 percent by volume, field verification testing shall be performed and the applicant shall notify the California Energy Commission and report physical evidence of a release (see notification procedures below). Field verification testing may include a combination of additional neutron analysis, laboratory analysis of liquids drawn from the neutron probe casing and visual observation to verify existence of a release.
- b. Annually, the applicant shall submit documentation of instrument calibration and performance checks. Performance checks shall be a comparison of quarterly results of neutron moisture. Pre testing with earlier tests made under comparable conditions to verify proper operation of equipment must be documented.

2. Groundwater Monitoring

The June 2009 ROWD proposes Groundwater Monitoring Network (GMN) for two scenarios: an on-site industrial water supply scenario, and, an off-site industrial water supply scenario. Both proposed GMN layouts include three categories of monitoring wells: (1) background wells (located upgradient of the surface impoundments and land treatment unit); (2) detection wells (located adjacent to the surface impoundments and land treatment unit); and (3) compliance wells. For both onsite and offsite water supply scenarios, the detection wells are comprised of three proposed

wells (MW-1 through MW-3) located immediately adjacent to the surface impoundments. The Point of Compliance as defined in CCR, title 27, section 20405 is "a vertical surface located at the hydraulically down gradient limit of the Unit that extends through the uppermost aquifer underlying the Unit."

The GMN layouts for the two water supply scenarios are:

Onsite Water Supply Scenario (Figure 4-1A of the June 2009 ROWD):

Background Wells – Well 47, Domestic Well, Well 50 and USGS Well. As shown in Figure 4-1A in the June 2009 ROWD, a cone of depression will develop under the surface impoundments due to the location of primary pumping Wells 49 and Well 63 and backup Well 41 and Well 42. Under pumping conditions, groundwater is predicted to move toward the primary pumping well(s) from all points of the compass. Thus, all wells, except the pumping well(s), become background wells.

Detection Wells – MW-1, MW-2 and MW-3

Compliance Well(s) – The compliance well(s) will be the primary pumping well(s) that is/are active, either Well 49, Well 63, Well 41 or Well 42.

Offsite Water Supply Scenario (Figure 4-1B of the June 2009 ROWD):

Wells – Well 47, Domestic Well and Well 41

Detection Wells – MW-1, MW-2 and MW-3

Compliance Wells – Well 50, Well 51 and USGS Well

- a. Semi-annually, samples shall be collected in the groundwater monitoring network as proposed in the June 2009 ROWD and analyzed for the parameters listed in Table II-3.

The results of the analysis shall be reported in the semi-annual report in tabular and graphical form. Each such graph shall be plotted with raw data at a scale appropriate to show trends or variations in water quality. For graphs showing the trends of similar constituents, the scale shall be the same. The data shall also be used to construct an Upper Tolerance Limit to determine evidence of a release and shall be used to evaluate data from the previous three quarters for evidence of a release.

Monitoring Well Sampling Parameters

Table II-3

Parameter	U.S. EPA or Standard Method	Reporting Limit Goal	Units
Ammonia (as N)	350.1	100	µg/L
Aluminum	200.7	20	µg/L
Arsenic	6020	2	µg/L
Antimony	6020	10	µg/L
Barium	6020	5	µg/L
Beryllium	6020	2	µg/L
Boron	200.7	140	µg/L
Cadmium	6020	5	µg/L
Calcium	200.7	40,000	µg/L
Chloride	300.0	14,000	µg/L
Chromium (total)	6020	5	µg/L
Cobalt	6020	5	µg/L
Copper	6020	5	µg/L
Cyanide (total)	SM 4500	10	µg/L
Fluoride	300.0	500	µg/L
Iron	200.7	20	µg/L
Lead	6020	3	µg/L
Magnesium	200.7	10,000	µg/L
Manganese	200.7	15	µg/L
Mercury	7470A	0.2	µg/L
Molybdenum	6020	10	µg/L
Nickel	6020	5	µg/L
Nitrate as nitrogen	300.0	1,000	µg/L
Nitrite as nitrogen	SM 4500	4	µg/L
Phosphate (total)	365.3	100	µg/L
Potassium	200.7	3,000	µg/L
Selenium	6020	10	µg/L
Silver	6020	5	µg/L
Sodium	200.7	10,000	µg/L
Strontium	200.7	500	µg/L
Sulfate	300.0	100,000	µg/L
Thallium	6020	10	µg/L
Total dissolved solids	SM 2540C	10,000	µg/L
Total alkalinity(as CaCO3)	SM 2320B	100,000	µg/L
Vanadium	6020	5	µg/L
Zinc	6020	10	µg/L
pH	Field	+/- 0.1	pH units
Temperature	Field	+/- 0.1	° F or °C

- b. Semi-annually, the groundwater potentiometric surface shall be illustrated on a 8.5" x 11" copy of a site plan showing the static water level, in feet below ground surface; the monitoring well locations; the location of the surface impoundments; and the groundwater gradient under each surface impoundment.
- c. Prior to sampling, each monitoring well shall be sufficiently purged in accordance with generally accepted sampling practices in order to obtain a representative ground water sample. If any monitoring well is dry for more than a year, a new or modified monitoring well shall be installed.

Groundwater samples must be collected after the wells have been purged in accordance with California Environmental Protection Agency guidance document, *Representative Sampling of Groundwater for Hazardous Substances*, revised February 2008 (see: http://www.dtsc.ca.gov/SiteCleanup/upload/SMP_Representative_Sampling_GroundWater.pdf). The required stability parameters and criteria from this guidance are summarized in Table II-4.

**Table II-4
Stabilization Parameters and Criteria**

Parameter	Criteria
temperature	± 3% of reading (minimum of ± 0.2 C)
pH	+/- 0.1
specific electrical conductance	+/- 3%
Oxidation-reduction potential	+/- 10 millivolts
dissolved oxygen	+/- 0.3 milligrams per liter

E. Heat Transfer Fluid Contaminated Soil - Spills

1. All spills of heat transfer fluid (HTF) shall be cleaned up within 48 hours. Spills of 20 gallons or more of HTF must be reported to the California Energy Commission within 48 hours. The cleanup shall be performed according to the approved Spill Management Plan. The June 2009 ROWD outlines the procedure for removing contaminated soils from the Facility and temporarily staging the soils within the Land Treatment Unit for hazardous waste testing. Representative soil samples shall be analyzed by a California certified laboratory accredited to conduct the specific analytical method. Disposal of contaminated soil resulting from HTF spills that exceed hazardous waste levels shall be accomplished in accordance with applicable waste disposal regulations.
2. HTF-contaminated soil that does not exceed the hazardous waste levels may be discharged into the Land Treatment Unit. A report for every batch of HTF-contaminated soil discharged into the Land Treatment Unit must include the volume of cubic yards discharged, the sampling method and laboratory analytical reports.

3. Semi-annually, the applicant shall provide to the CPM a report that summarizes onsite HTF spills. The report shall include (1) HTF spill volumes of 20 gallons or greater, (2) locations of spilled HTF, and (3) the dates of spills. The report shall also include (1) the total volume of contaminated soil resulting from spills regardless of the volume of HTF spilled, (2) the disposition of the contaminated soil, (3) the total volume of contaminated soil, and (4) a breakdown of the total volume by disposition location (e.g., hauled offsite as hazardous waste, discharged to the LTU, or re-used onsite).

E. Land Treatment Unit (LTU) - Heat Transfer Fluid Contaminated Soil

1. After treatment, the HTF-contaminated soil may be reused at the Facility in accordance with "Special Provisions for the Land Treatment Unit" in Section III C. (Special Provisions for the Waste Management Units) in the Requirements for Waste Discharge. Representative soil samples shall be collected for every batch of treated HTF-contaminated soil prior to removal from the LTU. The samples shall be composited according to methods specified in the U. S. Environmental Protection Agency's current version of the manual: "Test Methods for Evaluating Solid Waste" (SW-846). The status and/or results of sample analysis shall be reported semi-annually.
2. Annually, the applicant shall verify that HTF is not migrating past the five-foot vertical treatment zone underlying the LTU. Four soil samples (one sample from each quadrant of the LTU) shall be collected at a depth of one foot below the five-foot vertical treatment zone and analyzed for the monitoring parameters listed below. If results of any sample analysis indicate that components of HTF are detected, the applicant shall, within two weeks, repeat deeper sample collection at one foot intervals. The applicant shall repeat sample collection until laboratory analytical results show that concentrations are non-detect. If components of HTF are detected beneath the five-foot treatment zone, the applicant shall, within two weeks, report the evidence of release.

The samples shall be collected and composited according to methods specified in the U. S. Environmental Protection Agency's current version of the manual, "Test Methods for Evaluating Solid Waste" (SW-846). The samples shall be analyzed for the parameters in Table II-5 listed below using a California certified laboratory.

Land Treatment Unit Monitoring Parameters
Table II-5

Monitoring Parameter	Units
Biphenyl, a component of HTF (Therminol or similar)	mg/kg
Diphenyl oxide , a component of HTF (Therminol or similar)	mg/kg

F. Waste Management Unit Monitoring and Maintenance

1. **Quarterly** the applicant must inspect the condition of the waste management units (three surface impoundments and the land treatment unit) to ensure their integrity. The applicant must provide reports on the inspections **annually**. The quarterly inspection must consist of the following:
 - a. The applicant must inspect the waste management units for integrity.
 - b. The applicant must inspect the drainage features for the entire site including those which will divert water from the site.
 - c. During sampling events, groundwater monitoring wells shall be inspected for damage.
 - d. Any adverse conditions found in the visual inspection of the wells must be documented and promptly corrected. Documentation of the correction must be submitted with each annual report.

III. DATA ANALYSES

All data analyses methods (statistical or non-statistical) shall meet the requirements of CCR, title 27, section 20415, subdivision (e)(9).

A. General Non-statistical Methods

Evaluation of data will be conducted using non-statistical methods to determine if any new releases from the surface impoundments or land treatment unit have occurred. Non-statistical analysis shall be as follows.

1. Physical Evidence

Physical evidence can include dike or berm(s) damage or loss, unexplained volumetric changes in the surface impoundments, groundwater mounding, or soil discoloration. Each annual report shall comment on the absence or presence of physical evidence of a release.

2. Time Series Plots

Each annual report must include time series plot for groundwater monitoring parameters. Time series plots are not required for parameters that have never been detected above their method detection limit (as specified by the applicable USEPA Method) or if there are less than four quarters of data. Evidence of a release may include trends of increasing concentrations of one or more constituent over time.

B. General Statistical Analysis Methods

For Detection Monitoring, the applicant shall use statistical methods to analyze the constituents of concern listed in Table 11-4 of this Monitoring and Reporting Program that exhibit concentrations that equal or exceed their respective method detection limit in at least ten percent of applicable historical samples. The applicant may propose and use any statistical method that meets the requirements of CCR, title 27, section 20415, subdivision (e)(7). The report titled "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities" (USEPA, 1989) or subsequent versions may also be used to select the statistical test to use for comparing detection monitoring well data to background monitoring data. All statistical methods and programs proposed by the applicant are subject to CPM approval and must be in compliance with CCR, title 27.

IV. RECORD KEEPING AND REPORTING REQUIREMENTS

A. Scheduled Reports to be filed with the California Energy Commission

A detection monitoring report shall be submitted to the CPM of the California Energy Commission. The content of the detection monitoring report shall be as follows:

1. results of sampling analysis, including statistical limits or each monitoring point;
2. a description and graphical presentation of the velocity and direction of ground water flow under or around the Waste Management Units, based upon water level elevations taken during the collection of the water quality data submitted in the report;
3. a map or aerial photograph showing the locations of observation stations, monitoring points, and background monitoring points;
4. an evaluation of the effectiveness of the leachate collection and recovery system, and of the runoff/runon control facilities; and
5. a letter transmitting the essential points in each report, including a discussion of any requirement violations found since the last report was submitted, and describing actions taken or planned for correcting those violations. If the applicant has previously submitted a detailed time schedule for correcting

requirement violations, a reference to the correspondence transmitting this schedule will be satisfactory. If no violations have occurred since the last submittal, this shall be stated in the letter of transmittal.

B. Unscheduled Reports To Be Filed

1. Release from the Surface Impoundments

The applicant shall perform the procedures contained in this subsection whenever there is evidence of a release from the surface impoundments.

The applicant shall immediately notify the CPM verbally whenever a determination is made that there is physical or statistically significant evidence of a release (as determined in compliance with CCR, title 27, section 20164) from a surface impoundment. This verbal notification shall be followed by written notification via certified mail within seven days of such determination. Upon such notification, the applicant may initiate verification procedures or demonstrate that another source other than the Impoundment caused evidence of a release (see below). The notification shall include the following information:

- a. the surface impoundment that may have released or be releasing wastewater;
- b. general information including the date, time, location, and cause of the release;
- c. an estimate of the flow rate and volume of waste involved;
- d. a procedure for collecting samples and description of laboratory test to be conducted;
- e. identification of any subsurface water bearing zone affected or threatened;
- f. a summary of proposed corrective actions; and

For statistically significant evidence of a release (as determined in compliance with CCR, title 27, section 20164) - monitoring parameters and/or constituents of concern that have indicated statistically significant evidence of a release from the surface impoundments; or

For physical evidence of a release - physical factors that indicate physical evidence of a release.

2. Exceeding the Action Leakage Rate

The applicant shall immediately notify the CPM verbally within twenty-four hours whenever a determination is made that there is a fluid volume in the LCRS

sumps in excess of the Action Leakage Rates. This verbal notification shall be followed by written notification via certified mail within seven days of such determination. This written notification shall be followed by a technical report via certified mail within thirty days of such determination. The technical report shall describe the actions taken to abate the adverse condition, and shall describe any proposed future actions to abate the adverse condition.

3. Evaluation Monitoring

Pursuant to California Water Code section 13267, subdivision (b), the applicant shall, within 90 days of verifying a release, submit to the CPM an amended Report of Waste Discharge proposing an evaluation monitoring program (CCR, title 27, sections 20420, subdivision (k)(5) and 20425). If applicant decides not to conduct verification procedures, or decides not to make a demonstration that a source other than the surface impoundments or land treatment unit are responsible for the release, the release will be considered verified.

4. Preliminary Engineering Feasibility Study Report

The applicant shall, within 180 days of verification of a release or detection, submit to the CPM a Preliminary Engineering Feasibility Study pursuant to CCR, title 27, section 20420, subdivision (k)(6), that shall contain either corrective action measures that could be taken to achieve background concentration or demonstrate that the waste management units are not the cause of the detection.

V. REPORTING REQUIREMENTS

O. General Provisions

The applicant shall comply with the "General Provisions for Monitoring and Reporting" which is attached to and made part of this Monitoring and Reporting Program.

B. Semi-Annual Report

Beginning on June 30, 2010, a Semi-annual Monitoring Report, including the preceding monitoring information, shall be submitted to the CPM. Subsequent semi-annual monitoring reports shall be submitted to the CPM by January 30 and June 30 of each year.

C. Annual Report

Beginning on January 30, 2011, and by January 30 of each year, the applicant shall submit an Annual Report to the CPM including the preceding information and with the following information:

- a. Evidence that adequate financial assurance for closure, post-closure, and reasonably foreseeable releases is still in effect and may include a copy of the renewed financial instrument or a copy of the receipt for payment of the financial instrument;

- b. evidence that the amount is still adequate or increase the amount of financial assurance by the appropriate amount if necessary, due to inflation, a change in the approved closure plan, or other unforeseen events; and
- c. a review of the closure plan and a statement that the closure activities described are still accurate or an updated closure plan.

D. Data Analysis Report

The applicant shall, by **January 30 of every year**, submit to the CPM a Data Analysis Report as specified in Section III (Data Analysis) of this Monitoring and Reporting Program.

E. Electronic Submittal of Information

Pursuant to CCT title 23, section 3890, the applicant shall submit reports, including soil, vapor and water data, prepared for the purpose of subsurface investigation or remediation of a discharge of waste to land subject to Division 2 of Title 27 electronically over the internet to the State Water Resources Control Board's Geotracker system. This requirement is in addition to, and not superceded by, any other applicable reporting requirement.

GENERAL PROVISIONS FOR MONITORING AND REPORTING

4. SAMPLING AND ANALYSIS

- p. All analyses shall be performed in accordance with the current edition(s) of the following documents:
 - vii. Standard Methods for the Examination of Water and Wastewater
 - viii. Methods for Chemical Analysis of Water and Wastes, EPA
- q. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the CPM. Specific methods of analysis must be identified on each laboratory report.
- r. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The methods used shall also be reported. If methods other than EPA-approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the CPM.
- s. The applicant shall establish chain-of-custody procedures to insure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage, and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.
- t. The applicant shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall insure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.
- u. A grab sample is defined as an individual sample collected in fewer than 15 minutes.
- v. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

5. OPERATIONAL REQUIREMENTS

w. Sample Results

The applicant shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the CPM.

x. Operational Log

An operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

6. REPORTING

y. For every item where the requirements are not met, the applicant shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and shall submit a timetable for correction.

z. All sampling and analytical results shall be made available to the CPM upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the CPM.

aa. The applicant shall provide a brief summary of any operational problems and maintenance activities to the CPM with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

bb. Monitoring reports shall be signed by:

- ix. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;
- x. In the case of a partnership, by a general partner;
- xi. In the case of a sole proprietorship, by the proprietor; or
- xii. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

- cc. Monitoring reports are to include the name and telephone number of an individual who can answer questions about the report.

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Soil and Water - APPENDIX I

GROUNDWATER MITIGATION PLAN

Groundwater Monitoring

This groundwater monitoring program was provided in Attachment 5 of the Project Design Refinements (DB2009r) submitted to the CEC by the applicant in June 2009. As proposed by the applicant, the following describes the groundwater mitigation plan to be incorporated if the use of site groundwater is approved by CEC for power plant operation.

Proposed Groundwater Monitoring Program

To provide for land owner protection and participation in evaluation of project impacts, a Fremont Valley Groundwater Monitoring Committee will be formed. The committee will include a representative from the following:

- California City
- Community of Cantil
- Rancho Seco
- Honda
- Beacon Solar LLC

The monitoring committee's function will be to implement and oversee the groundwater monitoring program and to verify that there are no unacceptable impacts to groundwater levels or quality in water supply wells adjacent to the BSEP.

Gather Historic Water Level and Water Quality Data

- Secure access, if authorized by the land owner, for the purpose of monitoring of water levels and water quality for those water supply wells predicted by the numerical groundwater model to experience water level decline over the term of the project (30 years).
- Through the access agreement, obtain all historic water level and water quality data for each water supply well. Additionally, obtain well completion information, historic well performance data, including pumping and non-pumping water levels and pump specifications for each well to be monitored.
- Update the application for certification (AFC) water level and geochemical and water level database with all new information.
- Prepare time series graphs (i.e., trend plots) for water level and total dissolved solids (TDS) data, as information is available for each well.
- Perform statistical trend analysis using Mann-Kendall Trend Test and Sen's Slope Estimator for water levels and the TDS data. The Mann-Kendall Trend Test and the

Sen's Slope Estimator are proposed to statistically analyze the data because they are the accepted non-parametric trend analysis methods for data that are not normally distributed. Use trend analysis to determine the significance of an apparent trend and to estimate the magnitude of that trend. Further, use adjacent well data to evaluate local effects from pumping in water level trends.

Establish Pre-Project Baseline Water Quality and Water Level Database

- To the extent possible, prior project construction collect groundwater levels from the off-site and on-site wells. Additionally, collect groundwater samples to provide baseline TDS data for both on-site and off-site wells. Analyze TDS samples using Standard Methods 2540C by a California Certified Analytical Laboratory.
- Map TDS data and groundwater levels within the Koehn Sub-basin from the groundwater data collected prior to construction. Update trend plots and statistical analyses, as data is available.

Groundwater Monitoring During Construction

- During construction, collect water levels on a quarterly basis for a period of one year or on a quarterly basis through the construction period, and collect TDS data at the end of the construction period and prior to site operations.

Groundwater Monitoring During Operation

- On a quarterly basis for the first five years, collect water level measurements from the wells and collect TDS data to evaluate operational influence from the project. Additionally, monitor quarterly operational parameters (i.e., pumping rate) of the water supply wells.
- After a period of five years, evaluate the data and determine if the sampling frequency and TDS sampling should be revised or eliminated.
- Subsequently, evaluate the data set every five years and determine if the sampling frequency and TDS sampling should be revised or eliminated.

Proposed Mitigation Options

Water Level Offset Mitigation Options

Based on the results of the statistical trend analyses, determine if the project pumping has induced a drawdown in the water supply at a level of five feet or more below the baseline trend. If water levels have been lowered below pre-site operational trends, then implement any of the following options, as appropriate and considering the cost effectiveness of each option.

- Electrical cost reimbursement – If the pumping water level falls below a depth of 5 feet from an average of the baseline measurements, the well owner will be

compensated for the additional electrical costs commensurate with the additional lift required to pump. The water level in the well will be assessed relative to the pumping rate during pre-site operational period.

- Pump lowering – In the event that groundwater is lowered and existing pumps are day lighted, pumps can be lowered to maintain production in the well.
- Deepening of wells – If the groundwater is lowered enough that there is insufficient water in the well and pump lowering is not an option, then wells can be deepened.

Groundwater Storage Mitigation Options

Expected groundwater usage during BSEP operation is estimated to be 1,388 acre feet per year (AFY). Options to offset that water consumption include implementation of a partial ZLD and tamarisk removal program, which are described in the Project Design Refinements (DB 2009r).

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SOIL AND WATER RESOURCES - APPENDIX J

GUIDANCE FOR BSEP MAINTENANCE DISTRICT'S CHANNEL MAINTENANCE PROGRAM DEVELOPMENT

Channel Maintenance Program

Purpose and Objectives

This Appendix describes the purpose, objectives and applicability of Staff's requirements for the BSEP Maintenance District's Channel Maintenance Program (Program). Staff is requiring as part of Condition of Certification **SOIL&WATER-8** that the Channel Maintenance Program provide long-term guidance to the applicant to implement routine channel maintenance projects and comply with BSEP's related biological (**BIO-18**) and flood protection (**SOIL&WATER -5 and -6**) Conditions of Certification in a feasible and environmentally-sensitive manner. The main goals of the Program would be to maintain the diversion channel to meet its original design to provide flood protection, maintain native plant communities, provide wildlife habitat and a wildlife movement corridor, and maintain groundwater recharge. In this appendix, staff provides a summary of related programmatic documentation required for implementation of the Channel Maintenance Program.

The Channel Maintenance Program would be used by the applicant and the CPM to ensure that routine channel maintenance practices would be conducted in an efficient, consistent, and environmentally-sensitive manner. Staff's objectives for the Channel Maintenance Program are as follows:

1. Develop standardized practices and protocols for routine sediment removal, vegetation management, channel maintenance, and structural repair.
2. Ensure routine channel maintenance activities reflect the Energy Commission's Conditions of Certification for BSEP.
3. Avoid or minimize adverse environmental impacts and encourage preservation and restoration of the diversion channel and its revegetated areas.

Applicability and Use of the Channel Maintenance Program

The Channel Maintenance Program applies to routine channel maintenance activities, including three major types of activities: sediment removal, vegetation management, and bank protection and grade control maintenance/repairs. These activities would be undertaken to ensure flood conveyance capacity is maintained in the channel. Additional minor maintenance activities would also be included in routine channel maintenance.

The channel maintenance work area addressed by this Channel Maintenance Program would include the BSEP engineered channel, typically extending to the top of bank, include access roads, and any adjacent property that BSEP or the District owns or holds an easement for access and maintenance. The Program would include Pine Tree Creek

diversion channel maintenance as needed to protect the BSEP facilities. The District would not provide maintenance on private property, unless requested, or an easement was provided.

The Channel Maintenance Program would be a process and policy document prepared by BSEP, reviewed and approved by the CPM through consultation with CDFG and Kern County, and adopted by the District. Once adopted, the Channel Maintenance Program would be used by the applicant to guide the implementation of routine channel maintenance activities and projects. The Channel Maintenance Program would outline specific measures, protocols, policies, and inspection and reporting requirements to ensure that routine channel maintenance projects would be implemented in an efficient and environmentally-sensitive manner. This Channel Maintenance Program would be a living program that would change as improvements and modifications are made to reflect the best available knowledge, technology, and practices.

The Channel Maintenance Program is intended to establish an ongoing District program of indefinite length. Projections of future channel maintenance activities for the Channel Maintenance Program cannot represent the exact extent of work that would occur. Actual channel maintenance activities would vary from year to year. The Channel Maintenance Program would be reviewed annually by the CPM in the Annual Compliance Report as required in Condition of Certification **SOIL&WATER-8**. The overall program would be reviewed in ten years as part of the **BIO-18** revegetation milestone. Condition of Certification **BIO-18** specifies that within 10 years the applicant shall establish at least 15 percent of the 41.5-acre channel bottom, or 6.2 acres, with native desert shrub plant community, and that non-native weeds constitute less than 2 percent cover of the vegetated channel.

Channel Maintenance Activities

The following provides an overview and brief discussion of the major activities to be addressed by the Channel Maintenance Program. In addition, the Channel Maintenance Program applies to more minor, routine activities such as fence repair, trash removal, or other blockage clearing.

Sediment Removal

In most cases, sediment deposition is a natural process that occurs where the channel gradient flattens out or where the gradient is otherwise flat over long reaches. Some sediment is desirable in the engineered channel to support biological functions such as vegetation colonization. Unfortunately, sediment can build up to a point where it begins to compromise the design. Sediment removal is the act of mechanically removing sediment that has been deposited in the channel. Typically, sediment is removed when it: (1) reduces flood capacity, (2) prevents appurtenant hydraulic structures from functioning as intended, and (3) becomes a permanent, non-erodible barrier to instream flows. Staff recommends that sediment removal projects be implemented in the dry season. The applicant would be required to implement BMPs to ensure that sediment removal projects have the least impact possible to native plant communities and wildlife habitat.

The method of sediment removal is dependent on the channel type (earth bottom, soil concrete bed, or stilling basin), equipment, soil characteristics, and maintenance access

location. The average annual quantity of sediment to be removed would vary from year to year depending on rainfall conditions and sediment delivery from the watershed. During some or most years, no sediment would need to be removed. Aeolian processes may also cause a significant volume of sediment to accumulate from wind blown sand collecting in the low lying channel. Staff anticipates that the location of sediment removal within the channel would vary each year. The applicant and the District would develop Maintenance Guidelines (discussed below) to determine when and where sediment removal is required.

Vegetation Management

The applicant would manage vegetation in and adjacent to the diversion channel to maintain the biological functions and values described in **BIO-18**. Vegetation is not expected to adversely affect the ability of the channel to contain the design discharge owing to the relatively sparse nature of arid zone vegetation typically found in ephemeral channels. The applicant's vegetation management would include control of invasive or nonnative vegetation as described in **BIO-18**. Vegetation management can be accomplished through hand clearing or herbicide applications. A method or combination of methods could be chosen for each area depending on the maintenance needs. Staff recommends that the applicant only use herbicides according to the label directions and for uses approved by the United States Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation (DPR).

The applicant would also plant and maintain revegetation for the BSEP instream mitigation. In the first few years after initial planting, the applicant would provide weed control at mitigation areas to increase the number of native shrubs and establish a self-sustaining plant community which provides wildlife habitat as required in Condition of Certification **BIO-18**. The applicant would manage vegetation for other purposes including the protection of soil cement linings from plant roots, levees (if applicable), and maintaining access roads.

The frequency of vegetation management activities and inspections shall be as described in **BIO-18**.

Bank Protection and Grade Control Repairs

Channel erosion is a natural process, which mostly happens during major storm events. Erosion can occur because of hydraulic forces and geotechnical instabilities. Bank protection and grade control structure repairs involve any action by the applicant to repair eroded banks, incised toes, scoured channel beds, as well as preventative erosion protection. The applicant would implement instream repairs when the problem (1) causes or could cause significant damage to BSEP, adjacent property, or the structural elements of the diversion channel, (2) is a public safety concern, (3) negatively affects groundwater recharge, or (4) negatively affects the native plant communities and wildlife habitat within the channel, or poses an entrapment hazard to desert tortoise and other wildlife.

Erosion of banks can result in increased sediment deposition, which can lead to decreased flood flow capacities and potential flood hazards. Vegetation and soil loss would be zero where the channel design incorporates soil cement bank treatment. A

major failure to the soil cement bank cover or grade control structure would cause severe erosion, may cause property damage, and would create a safety hazard and threat to wildlife. Repair of soil cement bank protection and grade control structures shall occur when these structures fail and would be replaced with in-kind, in-place materials within the same footprint. Obstructions at grade control structures would be removed to maintain functions of such structures and access for desert tortoise and other wildlife.

Banks and grade control structures would be inspected after all major storms for damage and maintenance needs. The applicant would make an inspection of the channel upstream and downstream of an erosion site to determine if there is an identifiable cause of the erosion. Design of a particular facilities repair may require evaluation of other site-specific characteristics such as bank slope, shear stress, soil type, flow velocity and depth, Froude number, or the active channel's geomorphic characteristics.

Routine Channel Maintenance

Routine channel maintenance activities included in this Channel Maintenance Program would be: trash removal and associated debris to maintain channel design capacity; repair and installation of fences, gates and signs; grading and other repairs to restore the original contour of access roads and levees (if applicable); and removal of flow obstructions at BSEP storm drain (flap gate) outfalls.

Routine maintenance occurs on a year-round basis. Typically, routine maintenance that requires the operation of heavy equipment in the channel would be limited to the dry conditions.

Channel Maintenance Program - Exclusions

Routine channel maintenance would not include emergency repair. A situation is considered an "emergency" if it is a sudden, unexpected occurrence involving a clear and imminent danger that demands immediate action to prevent or mitigate loss of or damage to life, health, property, or essential public services (Public Resource Code Section 21060.3).

Large construction projects or Capital Improvement Projects (CIP) would not be considered routine channel maintenance and would not be addressed through the Channel Maintenance Program. Staff recommends that the applicant coordinate with Kern County and the CPM to develop a long-term plan that deals with CIP for the diversion channel.

Related Programmatic Documentation

Because this Channel Maintenance Program would be designed to guide the implementation of routine channel maintenance projects and activities over the long-term, it shall address channel maintenance at a general or "programmatic" level. As such, staff's Condition of Certification **SOIL&WATER-8** provides guidelines and implementation measures that characterize how channel maintenance would be conducted by the District.

The applicant would be required to comply with the Requirements of Waste Discharge provided in **Soil and Water Appendices E, F, G & H** as discussed in Condition of Certification **Soil&Water-4**. The applicant would also be required to meet CDFG requirements for channel maintenance activities and provide CDFG with a copy of the Channel Maintenance Program for review and comment. Because the diversion channel would be mapped as a SFHA, the applicant would be required to comply with NFIP regulations. The CPM would review all agency permits for routine channel maintenance activities and approve the Channel Maintenance Program.

Channel Maintenance Process Overview

This section describes Staff's recommendation for three distinct phases of the Channel Maintenance Program: program development and documentation, implementation of annual routine channel maintenance activities, and annual compliance reporting.

Program Development and Documentation

This Channel Maintenance Program would be developed to guide the long-term implementation of the District's annual routine channel maintenance work. The Channel Maintenance Program would enable the applicant to participate in a watershed-wide approach to environmental protection. Through these programmatic documents, the applicant would be committed to implementing individual maintenance projects in an environmentally-sensitive manner.

Maintenance Guidelines

Staff's Maintenance Guidelines are based on two concepts: (1) the maintenance standard and (2) the acceptable maintenance condition. The maintenance standard is defined as the design facility condition, where the engineered channel has full design capacity and freeboard. The acceptable maintenance condition is the condition to which a channel can be allowed to deteriorate before capacity is determined to be compromised and maintenance work becomes essential. The focus of BSEP's hydraulic and sediment transport analyses were related to the study of these two concepts. These analyses were prepared to investigate the *annual* accumulation of sediment and forecast the threshold of an acceptable maintenance condition. Further study is needed to understand annual sediment contribution, accumulation and capacity constraints.

The Maintenance Guidelines may also apply to other activities such as vegetation management, trash and debris collection, blockage removal, fence repairs, and access road maintenance. Vegetation in the desert channel environment does affect the channel's roughness, but increases in channel roughness would be slight because of the sparse vegetation and it is not expected to have an impact on the channel's flood capacity. By conducting these routine maintenance activities, the applicant would ensure that facilities continue to provide the level of flood protection for which they were constructed. These efforts protect channel function and help to comply with NFIP regulations and Kern County's Floodplain Management Ordinance.

Implementation

Maintenance work would be proposed either as part of a Channel Maintenance Work Plan or as other work identified later in the year through inspection. Staff recommends

specific Maintenance Guidelines be developed to ensure that the maintenance meets pre-established conditions of certification and engineering requirements. Staff recommends that field reconnaissance, inspection or survey be implemented to monitor the channel's maintenance condition and compare to specific Maintenance Guidelines. Maintenance Guidelines for BSEP's vegetation management activities are established in Condition of Certification **BIO-18**.

BSEP's Maintenance Guidelines for sediment removal would provide information on the allowable depth of sediment for the engineered channel that would continue to provide design discharge protection. Sediment should be allowed to store in the channel as minor aggradation which is part of the sediment transport and geomorphic function of the channel. Staff believe that sediment storage in the basin of the grade control structures provide an excellent source of sediment for long-term transport through the engineered channel. Staff recommends that the channel sediment be allowed to accumulate, on average, up to the sill elevation plus the depth of the active channel. Staff estimates that the depth of the active or bank full channel is roughly 1.5 to 2.5 feet, but further study is recommended. BSEP's engineer should verify that this sediment storage threshold, several feet above the sill elevation, would not affect the grade control structures ability to perform under the design discharge. Staff also recommends that BSEP verify that the channel would maintain capacity for the design discharge as part of compliance with Conditions of Certification **SOIL&WATER-7, -11, and -15**.

Reporting

Staff requests that a Channel Maintenance Work Plan, which would include a description of the planned "major" maintenance activity and extent of work to be accomplished, would be submitted to the CPM for approval prior to the commencement of the work. CIP would also be identified in the work plan. This work plan may be submitted annually as part of the BSEP's Annual Compliance Report.

To assess the overall progress of the mitigation program and determine the accuracy of the impact projections, annual reports would be made to the CPM for review as part of the BSEP's Annual Compliance Report. The Channel Maintenance Program Annual Report would specify which maintenance activities were completed during the year including type of work, location, and measure of the activity (e.g. cubic yards of sediment removed). Staff requires that the applicant provide a report describing "Lessons Learned" to evaluate the effectiveness of both resource protection and maintenance methods used throughout the year. The information and assessments would be used to update BMPs, Channel Maintenance Program processes, and the Maintenance Guidelines and to create a greater understanding of how to accomplish environmentally-sensitive maintenance work.

In addition to reporting on the maintenance activity completed for the year, the applicant would also provide reporting on the implementation of the mitigation program. For the first 10 years of the program, the applicant would provide photographs of the diversion channel and meet the verification requirements of Condition of Certification **BIO-18**.

Resource Protection Policies

Staff recommends the Channel Maintenance Program establish policies to ensure that resources would be protected to the furthest extent feasible during routine channel maintenance activities and are consistent with state and federal laws protecting special status species. The Channel Maintenance Program policies would be developed to guide decision-making for channel maintenance activities. The applicant would develop these policies through the routine channel maintenance planning process. BMPs would be developed to implement these policies. All routine channel maintenance activities would adhere to the policies contained in the program. Staff recommends that the applicant implement the following policies:

Policy 1: *The applicant will conduct all routine channel maintenance activities according to the process and protocols established in the Channel Maintenance Program.*

Policy 2: *Decisions regarding the necessity of routine sediment removal (to restore design discharge capacities) and vegetation management activities will be made by the applicant using the thresholds established in the Maintenance Guidelines. This information will be used to formulate in part an annual routine maintenance work plan.*

Policy 3: *The District will continue to develop, implement, and update BMPs for implementation of channel maintenance projects to ensure that maintenance activities are conducted in the most effective and environmentally-sensitive way possible and are technically feasible and economically reasonable.*

Policy 4: *The applicant will use the Channel Maintenance Program to manage its routine channel maintenance activities in a programmatic way.*

Policy 5: *The applicant will implement measures to avoid and minimize impacts to native species, especially special-status and riparian-dependent species. All management actions taken shall be consistent with state and federal laws protecting special status species (California Endangered Species Act of 1984, Fish and Game Code, sections 2050 through 2098; Federal Endangered Species Act (Title 16, United States Code, section 1531 et seq., and Title 50, Code of Federal Regulations, part 17.1 et seq.)*

Policy 6: *Control and removal of native vegetation will be minimized to the extent practicable. Where appropriate, measures will be taken to leave the work site in a vegetated condition after routine channel maintenance activities are completed.*

Policy 7: *The applicant's use of herbicides will be consistent with environmental goals, including protection, preservation, and restoration. Herbicides will be used such that negative effects to the environment are avoided or minimized.*

Policy 8: *The applicant will implement measures to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means when removing sediments from the channel.*

Policy 9: The temporary stockpiling, transportation, and disposal of removed sediments from channel maintenance projects shall be implemented, avoiding or minimizing impacts to the surrounding natural environment.

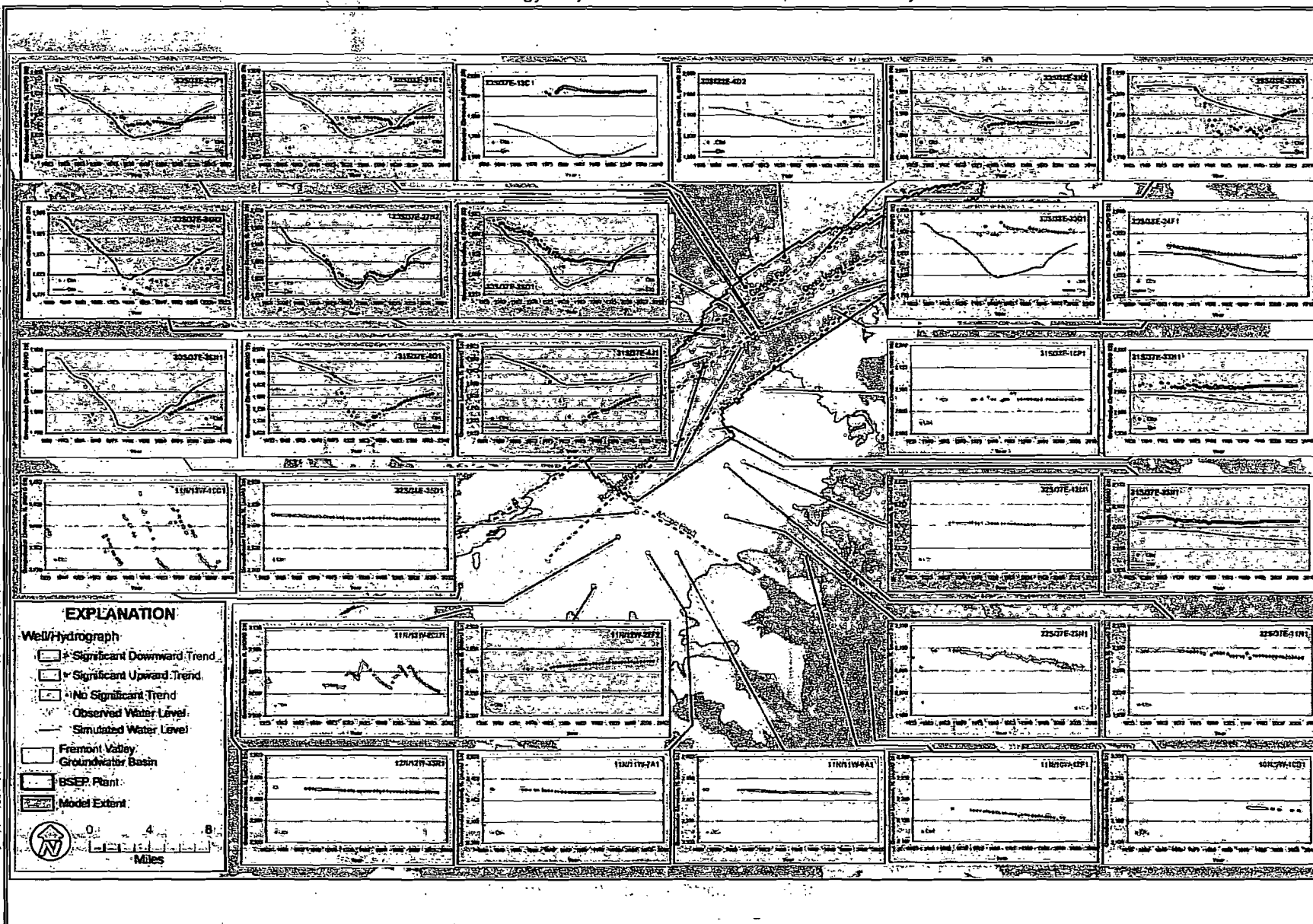
Policy 10: Channel maintenance projects shall be implemented, avoiding or minimizing the potential for short-term noise nuisances and short-term air quality impacts to the surrounding community.

Policy 11: Measures shall be implemented at the work site to ensure that the potential for significant impacts to previously undiscovered cultural resources are reduced to less-than-significant levels.

SOIL AND WATER RESOURCES - FIGURE 1
Beacon Solar Energy Project - Water Level Trends, Fremont Valley Basin

SEPTEMBER 2009

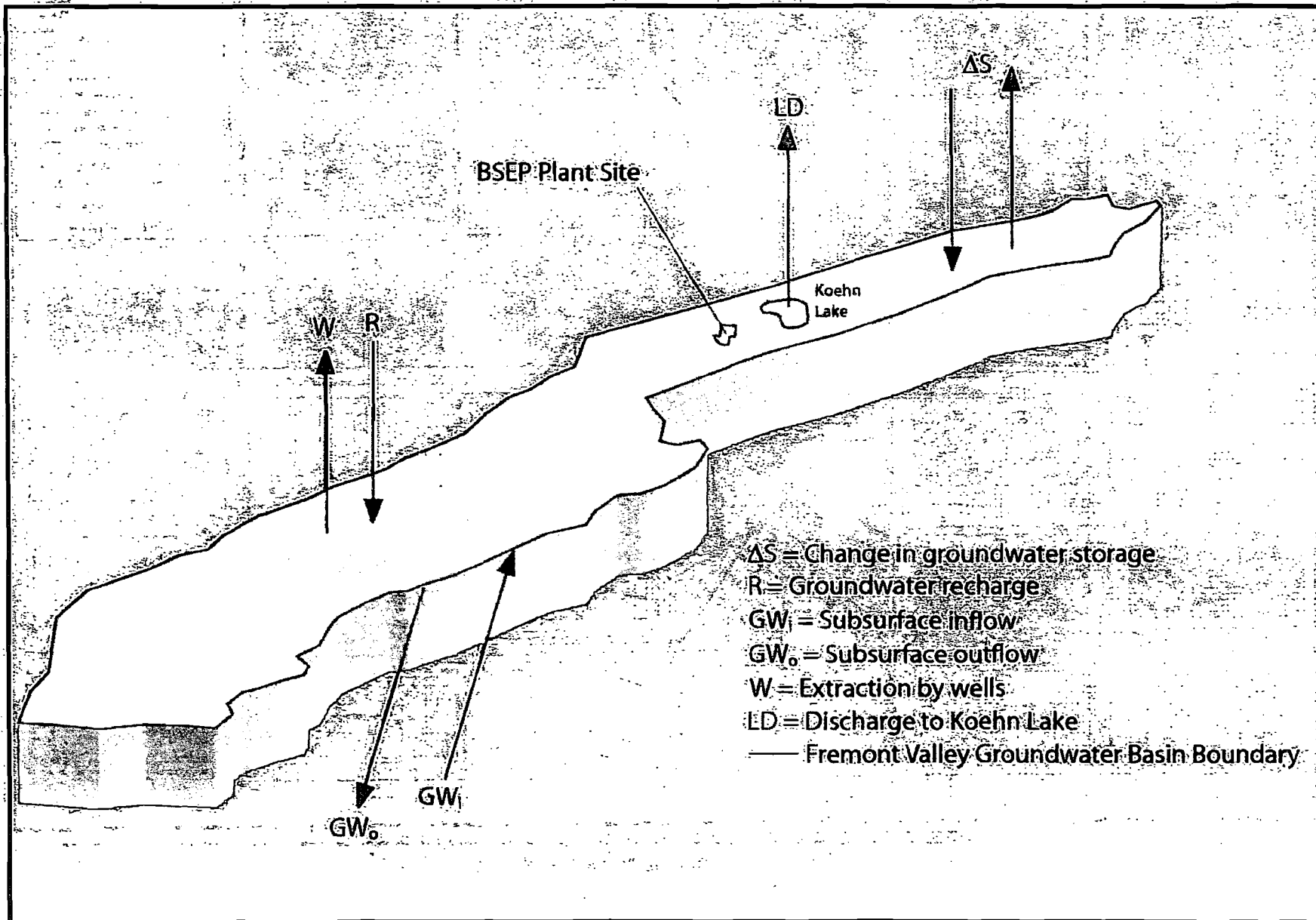
SOIL AND WATER RESOURCES



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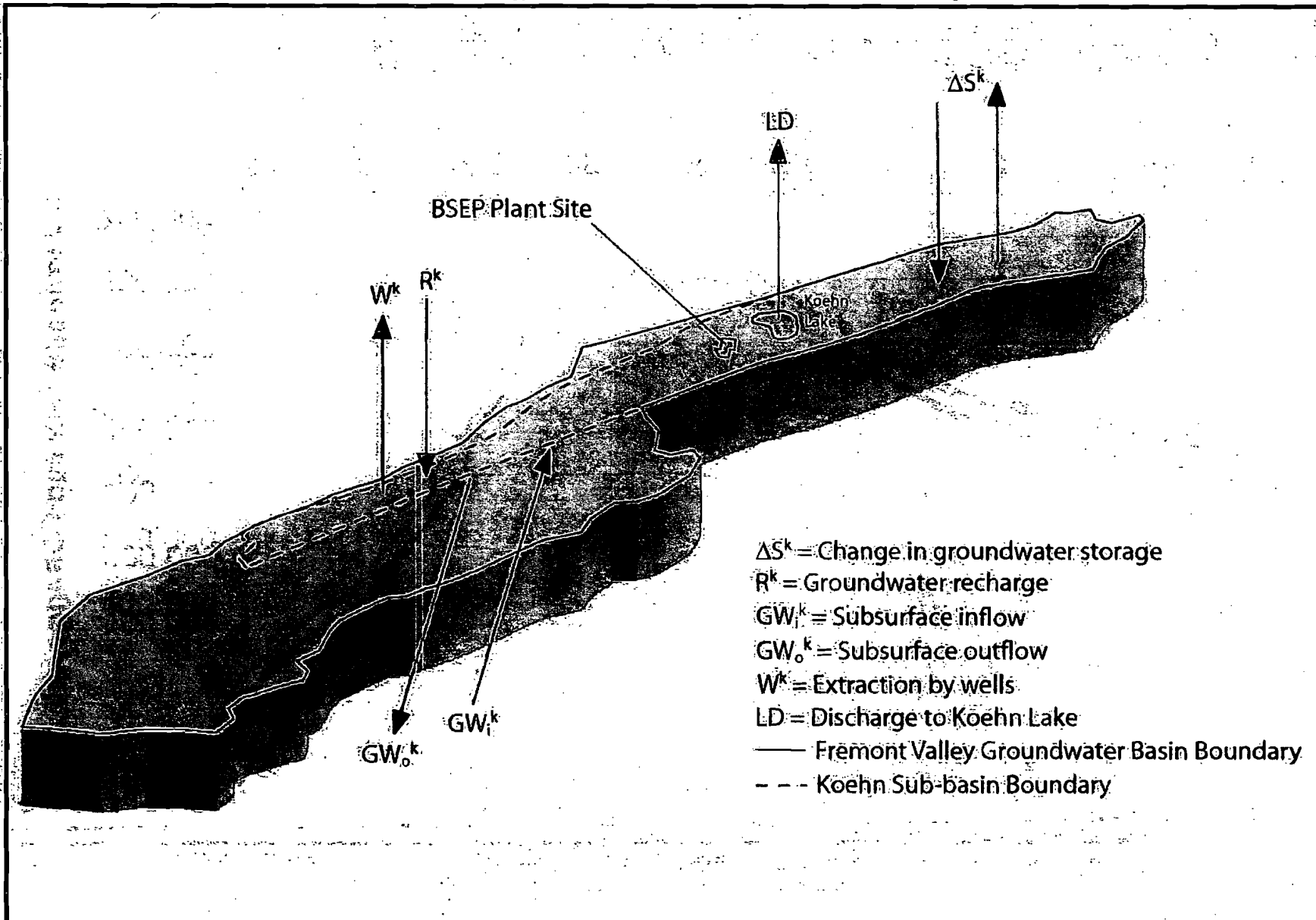
SOIL AND WATER RESOURCES

SOIL AND WATER RESOURCES - FIGURE 2
Beacon Solar Energy Project - Conceptual Fremont Valley Basin Water Budget



SOIL AND WATER RESOURCES - FIGURE 3

Beacon Solar Energy Project - Conceptual Koehn Sub-Basin Water Budget

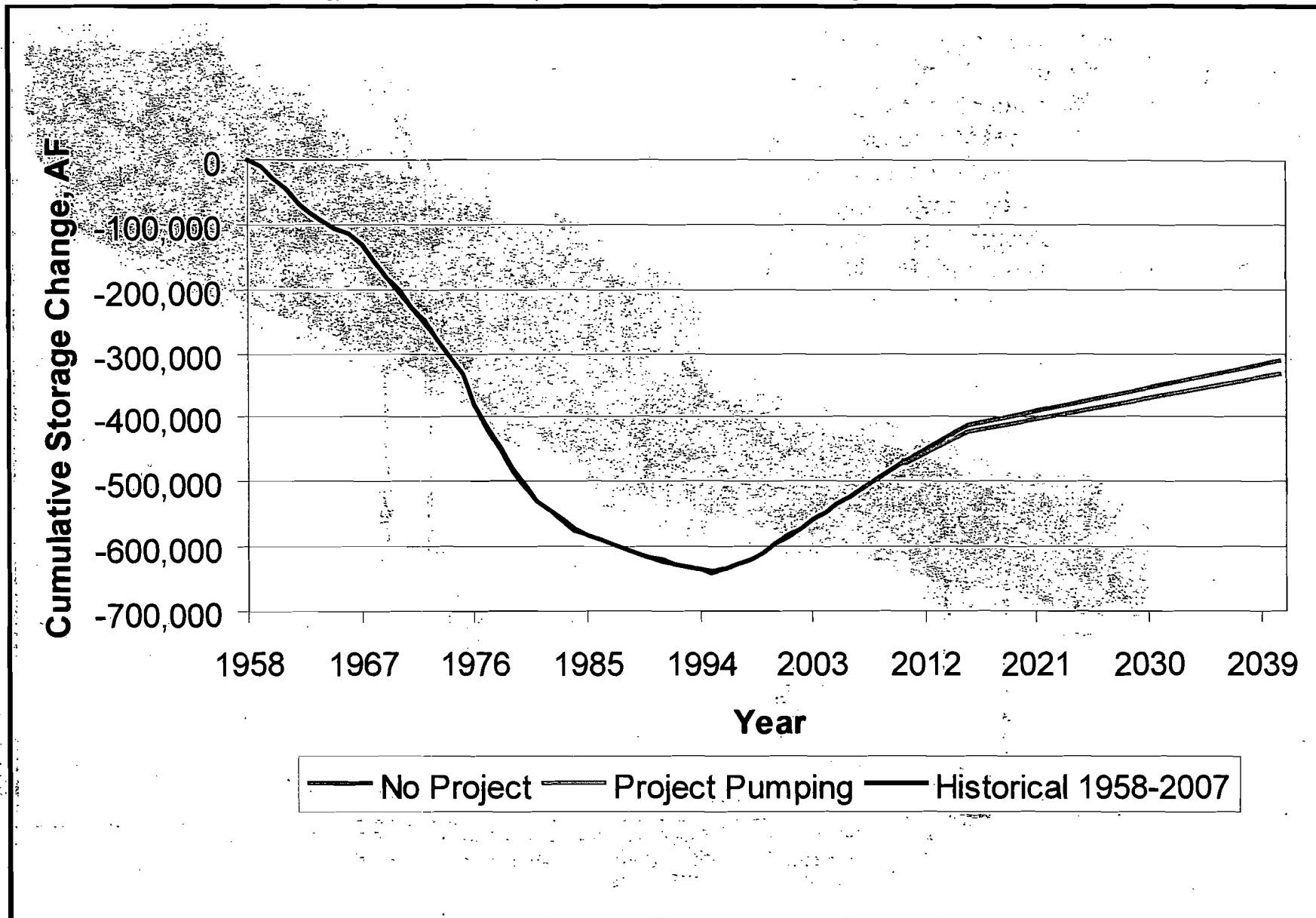


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SOIL AND WATER RESOURCES

SOIL AND WATER RESOURCES - FIGURE 4

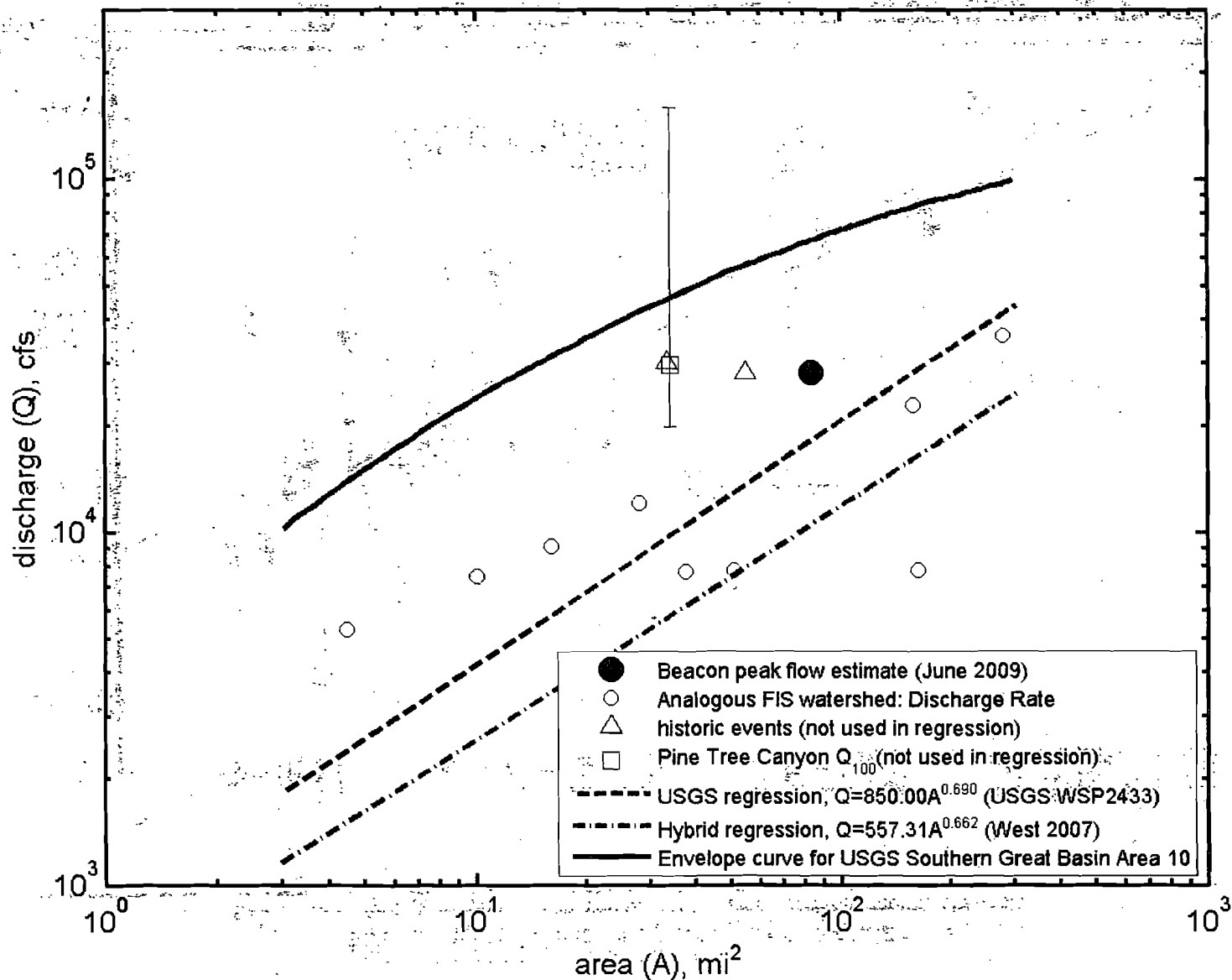
Beacon Solar Energy Project - Simulated Cumulative Groundwater Storage Change With and Without Project Pumping



SEPTEMBER 2009

SOIL AND WATER RESOURCES

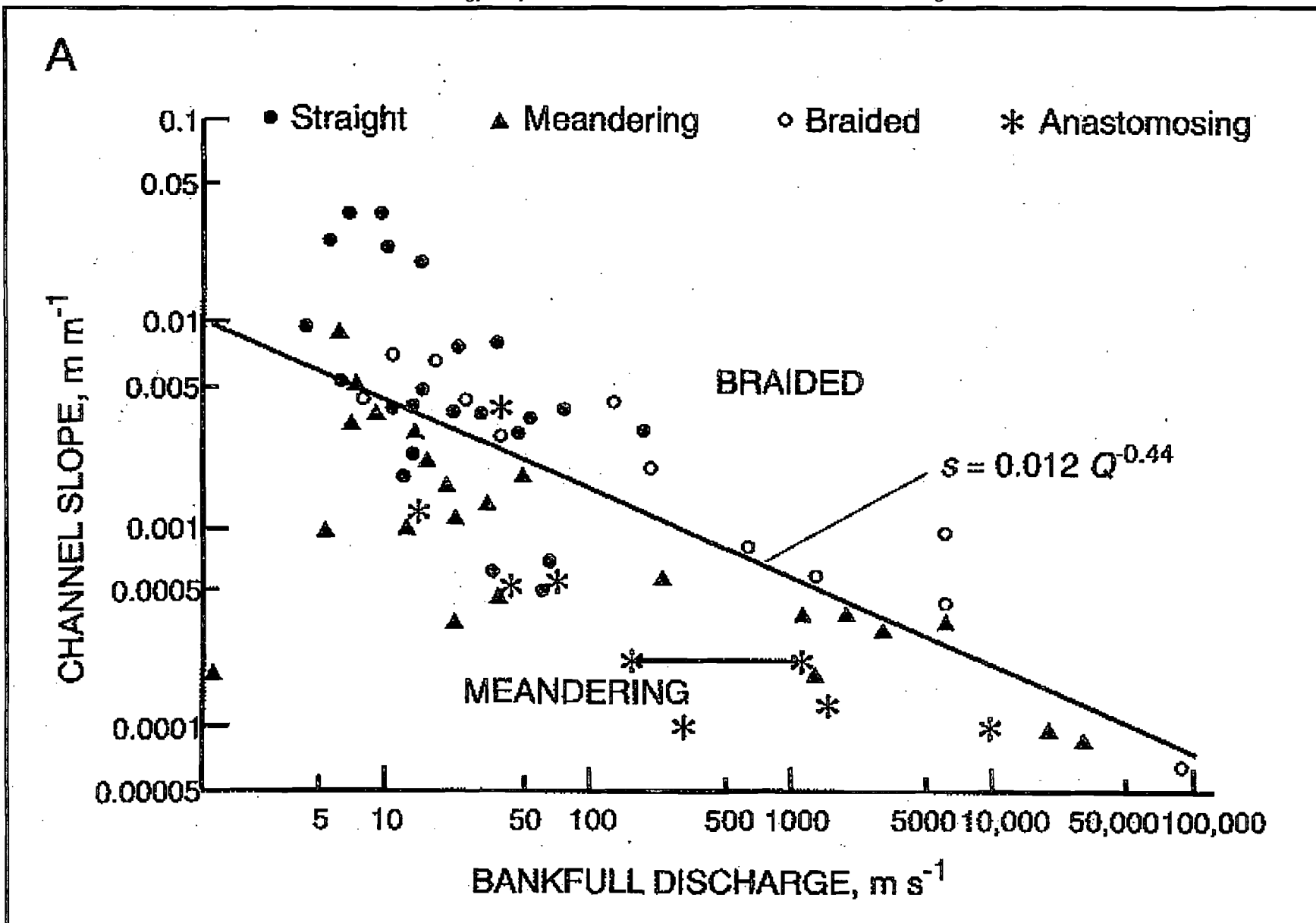
SOIL AND WATER RESOURCES APPENDIX C - FIGURE 1
Beacon Solar Energy Project - Hydrologic Assessment of Peak Flood Flows



SOIL AND WATER RESOURCES APPENDIX C - FIGURE 2
Beacon Solar Energy Project - Distinction between braided and meandering channels

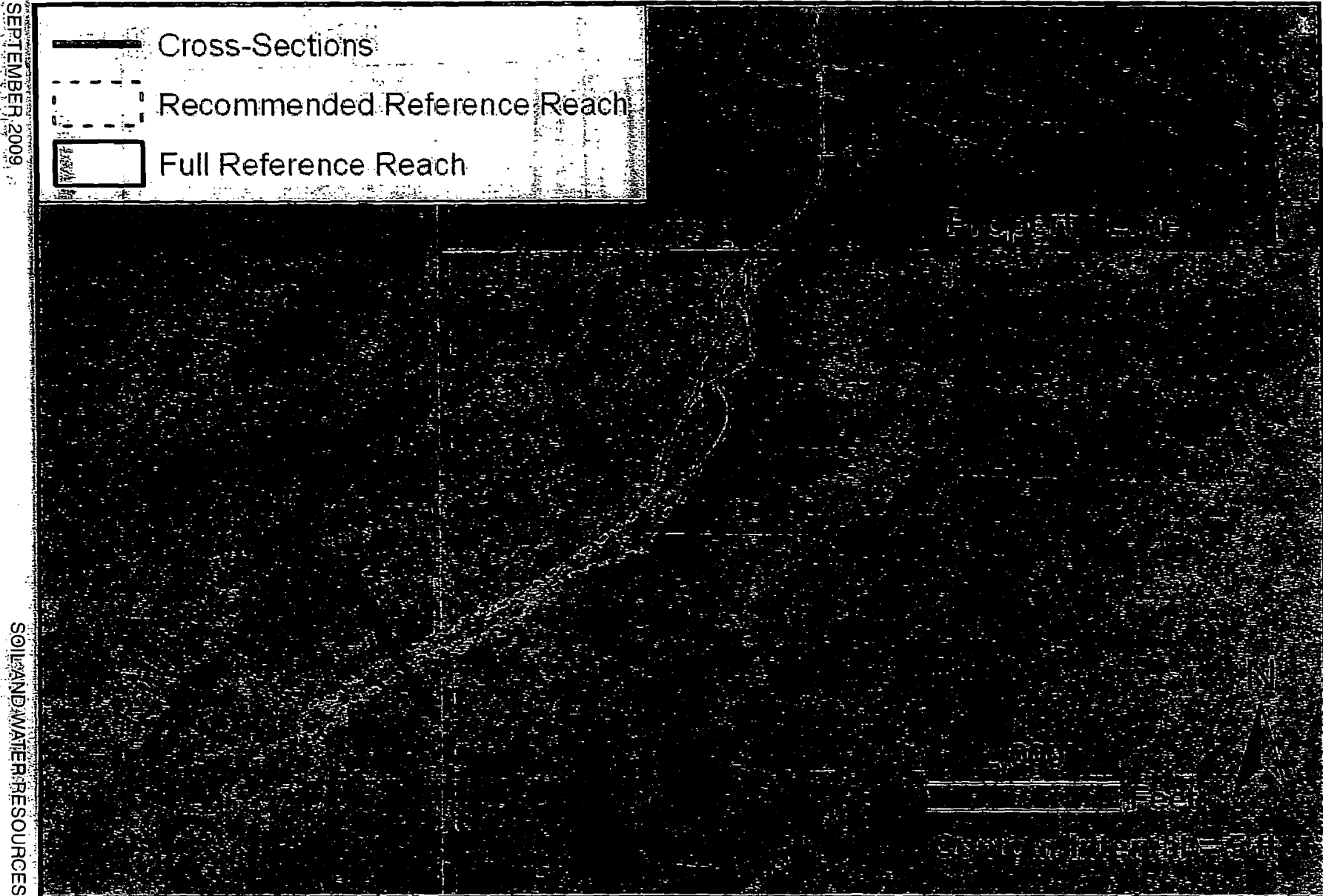
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SOIL AND WATER RESOURCES

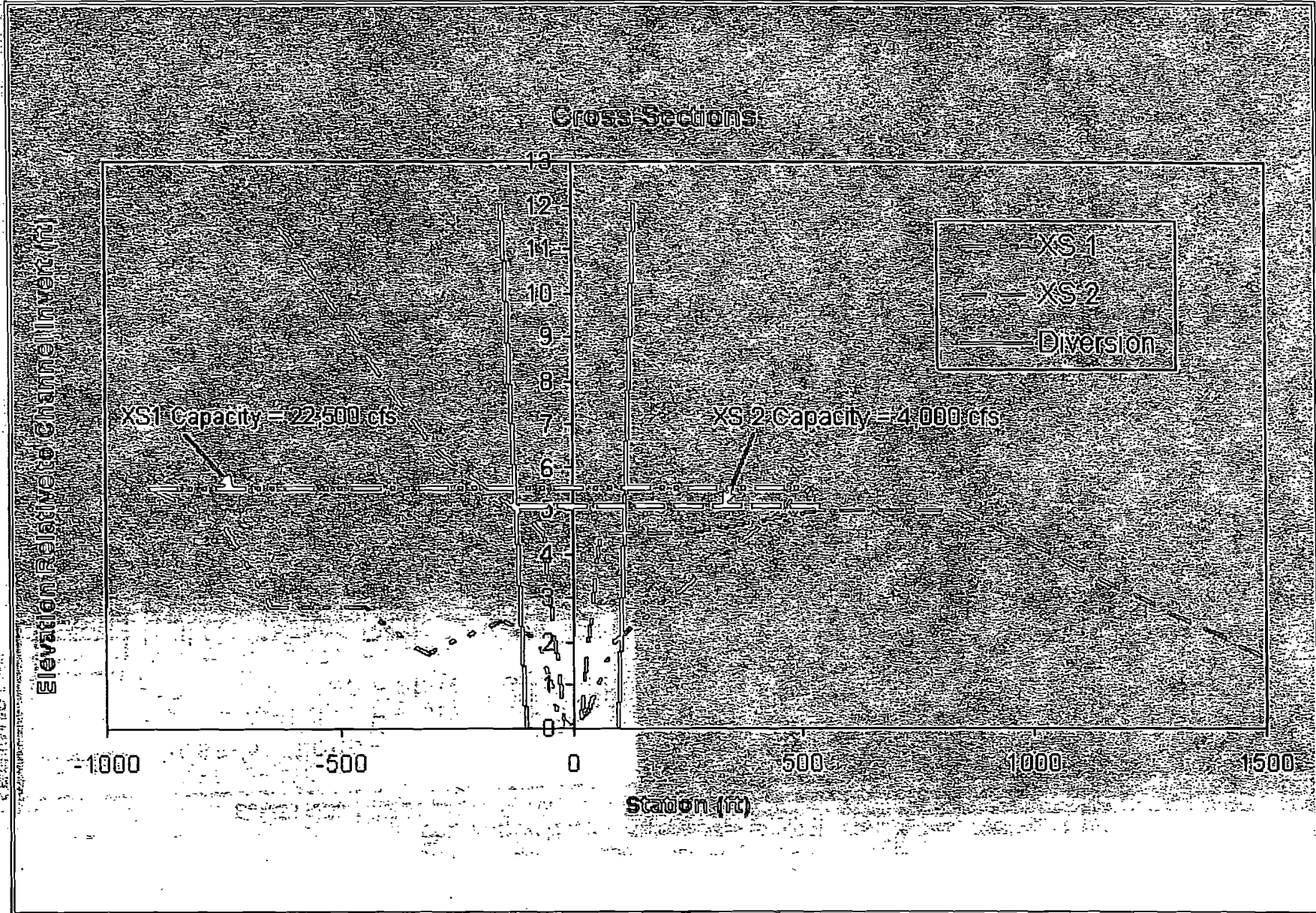


SOIL AND WATER RESOURCES APPENDIX C - FIGURE 3

Beacon Solar Energy Project - Plan View of Staff's Reference Reach Locations of Cross-Sections 1 and 2



SOIL AND WATER RESOURCES APPENDIX C-FIGURE 4
Beacon Solar Energy Project: Cross Section Comparison Peak Flow Capacity Estimated



ALTERNATIVES

Testimony of Eric K. Solorio, Michael N. DiFilippo and John S. Maulbetsch

SUMMARY OF CONCLUSIONS

Staff has concluded that, as proposed, the Beacon Solar Energy Project (BSEP) will have significant adverse impacts to biological resources, cultural resources, and visual resources. The project can avoid and or reduce some of these significant environmental impacts, and utilize water resources in a manner consistent with state policies by implementing any one of staff's proposed project alternatives, including utilizing tertiary treated wastewater for power plant cooling or incorporating an air cooled condenser ("dry cooling").

Although staff concluded the "no project" alternative is not a reasonable alternative to the proposed project, staff concluded there are at least four feasible project alternatives that are reasonable alternatives to the proposed BSEP. Each of the four alternatives is a reasonable alternative to the proposed BSEP because each alternative could reduce the BSEP's consumption of potable water by up to 97%. The first alternative would utilize the proven technology of dry cooling which does not require the use of water in the cooling process. The second alternative would utilize tertiary treated wastewater obtained from the Rosamond Community Services District. The third alternative would utilize tertiary treated wastewater from the city of California City. The fourth alternative would utilize photovoltaic (PV) solar panels for power generation, as PV panels do not require a cooling system or the related water use.

Both PV panels and dry cooling have the added benefit of not only eliminating 97% of the water use but also eliminating the need for evaporation ponds which are a source of concern to staff, the California Department of Fish and Game and the United States Fish and Wildlife Service (see the **Biological Resources** section for discussion of evaporation ponds). Staff has concluded that utilizing either PV technology or tertiary treated wastewater or dry cooling could avoid and or reduce the proposed project's significant environmental impacts. Staff's conclusion is that each of the separate alternatives is reasonable, technically feasible and economically feasible to incorporate.

INTRODUCTION

In this section staff evaluated potential alternatives to the construction and operation of the proposed Beacon Solar Energy Project (BSEP). Staff conducted the alternatives analysis in accordance with state environmental laws by providing an analysis of reasonable alternatives that are capable of reducing or avoiding any adverse impacts of the proposed project. Staff also evaluated project alternatives that would utilize non-potable water for power plant cooling.

This Alternatives analysis and the Final Staff Assessment, as a whole, are produced as part of the evidentiary record which is considered by the Energy Commission when the Commission decides whether or not to approve the proposed BSEP or require modifications to the proposal. The decision making process takes into account various

laws, ordinances, regulations, standards, state resource conservation policies, Commission policies, the *California Environmental Quality Act (CEQA)*, and the *Warren-Alquist Act (Public Resources Code Section 25500 et seq.)*.

DETERMINING THE SCOPE OF THE ALTERNATIVES ANALYSIS

The Guidelines for Implementation of the California Environmental Quality Act, Title 14, California Code of Regulations, section 15126.6(a) and(b), provide direction for scoping the alternatives analysis by requiring an evaluation of alternatives based upon the comparative merits of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project"; "...even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly".

"The fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. What is required is evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339, italics added.)

The range of alternatives required to be evaluated is governed by the "rule of reason" which requires consideration only of those alternatives necessary to permit a reasoned choice. Potentially feasible alternatives are selected and discussed to foster informed decision making and public participation. The *California Environmental Quality Act (CEQA)* guidelines state that an environmental document does not have to consider an alternative where the effect cannot be reasonably ascertained and whose implementation is remote and speculative (Cal. Code Regs., tit. 14, §15126.6[f][3]). To prepare the alternatives analysis, staff used the methodology summarized below:

- Establish the basic project objectives to use as screening criteria for project alternatives.
- Identify the proposed project's significant adverse environmental impacts.
- Identify different types of alternatives to the project that could avoid or lessen the projects significant impacts, such as:
 - Sources of non-potable water for use in power plant cooling and processes.
 - Alternative project sites.
 - Alternative energy generation technologies.
 - Alternative equipment and processes that can be incorporated into the proposed project.
 - The "No Project" alternative.

- Evaluate and determine whether any of the alternatives would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the environmental impacts of the proposed project.
- Summarize which alternatives, if any, can feasibly avoid or reduce the proposed project's environmental impacts.

Sources of Non-Potable Water as Alternative to Using Fresh Water

In scoping the Alternatives analysis, staff also considered the project's need to comply with several Laws, Ordinances, Regulations and Standards (LORS), specifically, Article X, Section 2 of the California Constitution and California Water Code Section 13551. Staff also considered the need for the BSEP to comply with several state policies, specifically, State Water Resources Control Board (SWRCB) Resolution No. 75-58, and Resolution No. 09-11, and the 2003 Integrated Energy Policy Report (IEPR). Both, the LORS and the state policies address the importance of avoiding the use of fresh water for industrial processes (including power plant cooling) when sources of "non-potable" water is reasonably available. As such, this Alternatives analysis also evaluates the feasibility of the BSEP using non-potable water for power plant cooling.

BASIC OBJECTIVES OF THE PROJECT

After reviewing the BSEP Application for Certification (08-AFC-2), staff has determined the four basic objectives of the Beacon Solar Energy Project (BSEP) to be as follows:

1. To construct, operate and maintain an efficient, economic, reliable, safe and environmentally sound solar-powered generating facility that will help achieve: (i) the State of California's renewable energy objectives mandated by Senate Bill 1078 (California Renewable Portfolio Standard Program) and accelerated by Senate Bill 107, (ii) Assembly Bill 32 (California Global Warming Solutions Act of 2006), and (iii) other local mandates adopted by the State's municipal electric utilities to meet the requirements for the long term, wholesale purchase of renewable electric energy for distribution to their customers.
2. To develop a site with an excellent solar resource.
3. To develop a previously disturbed site with close proximity to transmission infrastructure in order to minimize environmental impacts.
4. To interconnect directly to the Los Angeles Department of Water and Power (LADWP) electrical transmission system.

Staff eliminated applicant's fifth project objective as described on page 2-2, in the Application for Certification, *"To develop a site with available water resources to allow wet cooling in order to optimize power generation efficiency and reduce Project cost."* Staff eliminated this project objective as a screening criterion because the ground water at the project site is potable and therefore the objective to use potable water for power plant cooling, especially in a desert environment, is inconsistent with state policies, as generally described in the table below:

Alternatives Table 1
Laws, Ordinances, Regulations, and Standards (LORS), and
State Water Use Policies Affecting Power Plants

LORS	Purpose
California Constitution, Article X, Section 2	This section <u>requires that the water resources of the State be put to beneficial use to the fullest extent possible</u> and states that the waste, unreasonable use or unreasonable method of use of water is prohibited.
California Water Code Section 13551	Requires the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare.
State Water Resources Control Board (SWRCB) Resolution No. 09-11	State Water Resources Control Board Resolution 09-11 <u>encourages and promotes use of recycled water to replace the use of potable water for non-potable purposes.</u> The policy supports the sustainable use of surface water and groundwater and encourages the use of recycled water where this water is not being put to other beneficial uses. The policy provides for a streamlined permitting process for recycled water use with local Regional Water Quality Control Boards.
Warren-Alquist, State Energy Resources Conservation and Development Act, California Public Resources Code 25008	<u>"It is further the policy of the state and the intent of the Legislature to promote all feasible means of...water conservation..."</u>

POTENTIALLY SIGNIFICANT ENVIRONMENTAL IMPACTS OF THE PROJECT

In analyzing the Beacon Solar Energy Project (BSEP) staff identified potentially significant adverse impacts to biological resources; cultural resources and visual resources. This analysis evaluates the feasibility of incorporating potential alternatives that can avoid and or lessen impacts to some of these resource areas.

If the BSEP is approved as currently proposed, staff estimates that construction and operation of the project would consume more than 50,000 acre feet of high quality fresh water, equating to more than 20 billion gallons, during the 30-year life of the project. The water would be pumped from on-site wells, drawing approximately 8,080 acre feet during construction and an additional 1,400 acre/feet per year for operations, from an aquifer already in overdraft condition. The aquifer has taken approximately 25 years to recharge half of the level of drawdown that occurred at the project site, from prior intensive agriculture activities that ceased in the mid 1980s (BS 2008a, p. 1-10). Staff's independent analysis indicates that approximately 70% of this "recharge" is actually due to water migrating within the basin and not necessarily due to new inflow from precipitation. See the **SOIL AND WATER RESOURCES** section. The BSEP would reduce the annual rate of groundwater recharge (BS 2008a, p. 1-11).

Impacts to biological resources, from the proposed BSEP project would result from mass grading more than 7 million cubic yards of soil covering more than 2,000 acres. The grading activities include removal of approximately 430 acres of vegetation that provides cover, foraging, and breeding habitat for wildlife. Impacts to biological resources also include the loss of approximately 60 acres of desert wash scrub habitat and 16.0 acres of jurisdictional waters of the state. Additionally, the construction of 6 acres of evaporation ponds to receive highly concentrated brine discharge could have a significant adverse impact on migratory birds, water fowl and wildlife as well as potentially increase predation of protected species. Please see the **BIOLOGICAL RESOURCES** section.

Staff also concluded that because there are known cultural resources on site, the mass grading of more than 7 million cubic yards of soil would have significant direct impacts on surface and subsurface prehistoric archaeological resources. Please see the **CULTURAL RESOURCES** section.

The introduction of the project would change the existing physical setting of the Fremont Valley floor from a moderately disturbed desert floor landscape to a highly human-altered landscape. This change principally would be caused by two square miles of the project site being covered with parabolic trough solar collectors. In addition, the introduction of the radiance from the parabolic trough arrays during operation would be prominent from elevated locations. Staff concluded the project would cause significant adverse impacts to visual resources from two sensitive view points. These significant adverse impacts would be unmitigatable. Please see the **VISUAL RESOURCES** section.

IDENTIFY, SCREEN AND EVALUATE PROJECT ALTERNATIVES

The range of project alternatives considered in this analysis includes an alternative site, an alternative generation technology, alternative water treatment equipment, and sources of tertiary treated wastewater for power plant cooling.

ALTERNATIVE PROJECT SITES

The applicant provided a general discussion (BS 2008a, pp. 4.5-7) of alternative **areas** to site the proposed project. Although the proposed BSEP site is previously disturbed and in close proximity to transmission lines, the proposed site is bisected by designated waters of the state (Pine Tree Creek) which applicant proposes to relocate one-half mile to the east. An alternative site that has been previously disturbed by agriculture activities and does not contain any waters of the state, could potentially avoid impacts to several environmental resource areas.

Antelope Area

Staff conducted a windshield survey of the Antelope area which generally consists of previously disturbed lands. As shown on **Alternatives Figure 1**, the Antelope area has reasonable access to infrastructure. There appears to be potential project sites surrounding the Neenach substation. Staff concluded that the area south of Rosamond Boulevard appears to be absent of any waters of the state and/or waters of the US.

However, the majority of large parcels appear to be designated as "farmlands of statewide importance" by the Farmland Mapping and Monitoring Program (FMMP). The FMMP produces maps and statistical data used for analyzing impacts on California's agricultural resources. Agricultural land is rated according to soil quality and irrigation status; the best quality land is called Prime Farmland. The maps are updated every two years with the use of a computer mapping system, aerial imagery, public review, and field reconnaissance. Because this alternative would create a different type of impact to limited farmland resources, staff concludes a similar 2,000 acre project sited in the immediate Antelope area is not a viable alternative site to the proposed project.

ALTERNATIVE ELECTRICITY GENERATION TECHNOLOGIES

The second component of the Alternatives analysis is to consider project alternatives to the proposed electricity generation technology. Staff considered fossil fuel based energy generation such as simple-cycle and combined-cycle, natural gas-fired power plants but ruled them out as alternatives because of their more significant impacts to air quality and failure to meet most of the project objectives. Because staff considers five alternatives to be a "reasonable range" of project alternatives, staff therefore limited its analysis of alternative generating technologies to photovoltaic technology because the use of PV solar panels would meet most of the project objectives.

Photovoltaic Technologies (PV)

Photovoltaic technologies (PV) are considered the primary competitor with solar thermal technologies because both applications convert solar energy into electricity. The reliability of PV technology is equivalent to that of solar thermal technology due to the same dependence on solar incidence necessary to allow the collection of solar radiation. In considering PV technology as an alternative to the BSEP, staff finds cost advantages and environmental advantages of utilizing PV applications compared to solar trough thermal technology.

Although both PV applications and the proposed BSEP would have similar impacts to land resources and vegetation that provides cover, foraging and breeding habitat for wildlife, staff concludes that a PV application could avoid substantial impacts to biological resources and cultural resources that could otherwise result from the proposed BSEP. These impacts can be avoided because PV applications do not require power plant cooling systems and related evaporation ponds to discharge spent cooling water to, as reflected in the BSEP proposal. Because PV applications can avoid using evaporation ponds, the use of PV technology can also avoid significant impacts to cultural and biological resources associated with the excavation and operation of these ponds. Please see **Biological Resources** and **Cultural Resources** sections.

The proposed BSEP would require approximately 1,400 acre feet of potable water annually for use in a wet cooling system. The only water consumption that PV applications require would be for biannual washing of the PV panels which is far less than the need to regularly wash the solar troughs proposed by the BSEP (BCV 2009a and BS 2008a, Figure 2-13).

Economic Feasibility of Photovoltaic (PV) Technology on a "Cost per Watt" Basis

Due to the increasing market demand for solar technology applications, there has been substantial progress in reducing the cost per watt of PV technologies, to the point where PV technology is affordable, scalable and has a low environmental impact on a life-cycle basis. There are two cost components that make PV technology cost competitive with solar thermal technology. The first component is the installed cost per watt. Staff identified a utility scale PV project being developed by Sempra Generation, a subsidiary of San Diego-based Sempra Energy. The project is a 10 MW plant recently constructed in Boulder City, Nevada. According to Michael Allman, President of Sempra Generation, PV technology is more cost effective than solar thermal trough technology. Mr. Allman states *"We looked at both concentrated solar power and photovoltaic and it was our belief that photovoltaic was the least expensive electricity to develop from solar power."* (BCV 2009a). Staff also contacted the company Applied Materials, an international manufacturer of equipment that manufactures thin film PV solar panels (CEC 2009j). Steve Stokowski, Solar Sales Manager of Applied Materials, estimated the installed cost of thin film PV technology at approximately \$3.90 per watt. This cost appears to be equivalent to the BSEP project cost (BS 2008a). Based on these two market reference points, staff concludes that the cost of PV technology is equivalent to the installed cost per watt of solar trough thermal technology, as proposed by BSEP.

The second cost advantage of PV is the significantly reduced operating costs. Solar thermal electricity generating facilities have far greater staffing requirements than PV electricity generating facilities. The proposed BSEP facility would require 66 full time workers to operate and maintain the facility compared with a PV facility that can operate with a staff of 13 people (1 Person per 20 MW) (BS 2008a, BCV 2009a, and CEC 2009i). The lower operating costs of PV applications results in more free cash available for debt servicing, which is a key determinate (debt service coverage ratio) for lenders when considering project financing. Staff finds there are cost advantages from utilizing PV technology in place of solar thermal technology, as proposed by BSEP. Because PV technologies have a less than or equivalent cost per watt to develop, as compared with solar thermal technologies, and PV technologies have much lower operating costs, staff concludes that PV technology is an economically feasible alternative to solar thermal technology.

Market Based Approach to Economic Feasibility of Photovoltaic (PV) Technology

Staff next applied a market based approach to determine if the broader market of energy generators (developers) considered PV technology to be cost competitive with solar thermal technology. Staff researched the US Department of Interior, Bureau of Land Management (BLM) website at <http://www.blm.gov/ca/st/en/prog/energy/solar.html> and found a list (BLM Applications Table) of utility scale PV projects proposed to be developed by the private sector (BLM 2009a). The scope of these PV projects can be described as 23 projects covering more than 150,000 acres with capacity to produce more than 14,500 megawatts of electricity.

In addition to the projects proposed to be developed on BLM lands, staff researched PV projects at the Solar Energy Industries Association at <http://www.seia.org>. Staff found that the parent company of BSEP, Florida Power & Light (FPL) has several PV projects under development in Florida (SEIA 2009a). Considering the breadth of proposed PV

projects on BLM lands, and applicant's PV projects in Florida, the overall market (and applicant) has determined that PV technology is economically viable and competitive with solar thermal technology.

Staff concludes that generating 250 MW of electricity using PV technology has cost advantages, financing advantages, reduces potable water consumption by up to 97 percent, could avoid significant impacts to cultural resources by avoiding the need for excavation of evaporation ponds, and could avoid impacts to biological resources by eliminating the need for excavation of evaporation ponds that can be toxic to wildlife. Staff finds PV technology to be economically feasible and a reasonable alternative to the proposed BSEP.

ALTERNATIVE COOLING TECHNOLOGY; AND SOURCES OF NON-POTABLE WATER

The project proponent, Beacon Solar LLC, a subsidiary of NextEra Energy Resources, has proposed a wet cooling system using potable water, on the basis that using non-potable water or dry cooling technology would "...create a significant cost disadvantage..." and rejects these reasonable alternatives as being "...economically unsound" (BS 2008a, pp. 1-4, 4-15). Currently, the proposed BSEP is the only solar thermal project engaged in the Energy Commission's licensing process that has proposed to use potable water for wet cooling. Because installing a water line to convey recycled water or constructing a dry cooling system are both logistically and technically feasible as demonstrated by their respective industries over the past 30 years, staff focuses the remainder of this analysis on the economic feasibility of using *non-potable* water for wet cooling or in the alternative using dry cooling technology.

Air Cooled Condenser (ACC) Also Known As "Dry Cooling"

In a power plant application, a "dry cooling" system can be used in place of a "wet cooling" system to accomplish power plant cooling needs. The similarities are that both cooling systems utilize fans to cool the steam that drives the main turbine. The difference between wet cooling and dry cooling is: a wet cooling tower applies water to the outside of the condenser while simultaneously using fans to evaporate the water. This evaporation provides approximately a 5% to 7% more efficient cooling process (see **Appendix B**). The efficiency "loss" associated with using a dry cooling system, as compared to a wet cooling system, is the basis for applicant's assertion that dry cooling is not economically feasible.

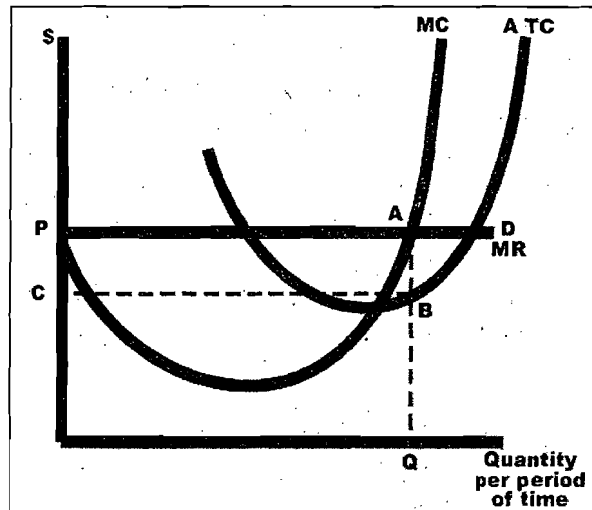
In order to offset the efficiency loss of using dry cooling, the applicant proposed expanding the solar field and related equipment by approximately 12%. Staff finds this approach to be practical and implementable. See **Alternatives Figure 3** that illustrates an expanded solar field. In **APPENDIX A**, staff established capital equipment costs and annual operating costs for the BSEP to utilize a dry cooling system with an expanded solar field. In **APPENDIX B**, staff independently verified the dry cooling alternative, as it was presented in the AFC. However, when considering the economic feasibility of dry cooling with an expanded solar field, staff concludes that the AFC did not account for the additional revenues that would be generated by the increased capacity derived from the expanded solar field.

Applying the Marginal Cost – Marginal Revenue Model to Profit Maximization

In **APPENDIX B** staff analyzed the average hourly and monthly ambient temperatures to determine when the efficiency losses occur under the dry cooling scenario. Those losses are primarily restricted to the hottest times of the year, from May through September. Next staff calculated the additional power generated during times when the efficiency loss was *not* a factor, generally from October through April. During these “off season” times, the project benefitted from the expanded solar field by utilizing the idle capacity in the power plant and related infrastructure. Staff found that utilizing this idle capacity generated a significant amount of additional revenues.

Expanding the solar field comports with the general business practice¹ of increasing production (solar field capacity and related output) as long as marginal costs are less than marginal revenues. Profit maximization is reached when marginal costs equal marginal revenues, as illustrated by point “A” in the diagram² below. Applying the profit maximization model, it is apparent that the proposed BSEP (which uses wet cooling) has not optimized its production and related revenues. This becomes evident when considering that with dry cooling and an expanded solar field, the BSEP would generate 4% more energy than the proposed wet cooled project; would slightly exceed the internal rate of return for the wet cooled project; and would generate more than an additional \$65 million in net revenues, as compared to the proposed wet cooled project.

Marginal Cost – Marginal Revenue Diagram



¹ Since total profit increases when marginal profit is positive and total profit decreases when marginal profit is negative, it must reach a maximum where marginal profit is zero - or where marginal cost equals marginal revenue. This is because the producer has collected positive profit up until the intersection of MR and MC (where zero profit is collected and any further production will result in negative marginal profit, because MC will be larger than MR). The intersection of marginal revenue (MR) with marginal cost (MC) is shown in the diagram as point A. If the industry is competitive (as is assumed in the diagram), the firm faces a demand curve (D) that is identical to its Marginal Revenue curve (MR), and this is a horizontal line at a price determined by industry supply and demand. Average total costs are represented by curve ATC. Total economic profits are represented by area P,A,B,C. The optimum quantity is ("Q").

² The diagram illustrates the mathematical relationship between marginal costs, marginal revenues and the resulting profit maximization. However, the diagram does NOT represent the exact linear functions of the BSEP costs, revenues and profit maximization.

Brackish Water

Appendix A describes alternative equipment and process configurations that would use brackish water from the vicinity of Koehn Dry Lake. **Appendix A** also evaluates the cost of using an air cooled condenser (ACC), also known as “dry cooling” technology. Although adding an additional cost to the project, each of the alternatives discussed in **Appendix A** would potentially provide a means for the BSEP to comply with LORS and state policies regarding the use of high quality fresh water.

Rosamond Community Services District (RCSD)

The Rosamond Community Services District (RCSD) has submitted to staff, a Letter of Intent to provide the BSEP with tertiary-treated water for BSEP's planned process needs (RCSD 2009d). The District's wastewater treatment plant produces enough effluent to meet the annual quantity of water demanded by the proposed BSEP cooling tower. All of the effluent is currently being disposed of in evaporation ponds. The RCSD is currently constructing wastewater treatment plant upgrades that include a tertiary level treatment facility. Upon completion of phases I and II, the wastewater treatment plant will have sufficient capacity to provide the tertiary-treated quality of water that is suitable for the proposed BSEP. The wastewater treatment plant upgrades will be completed prior to the planned operation of the BSEP.

In order for the RCSD to supply water to the proposed BSEP a 40-mile pipeline would be constructed, using public rights-of-way which have been selected by the RCSD, and are identified on the Kern County General Plan. See “Western Alternative”, **Alternatives Figure 2**. The RCSD has previously engaged in a separate and unrelated effort to provide tertiary-treated wastewater to Edwards Air Force Base (EAFB) by installing a 10-mile pipeline. EAFB completed an environmental review and approved installation of the pipeline which will have excess capacity that can also be used to deliver water for 10 miles of the total distance to the BSEP (EAFB 2009a). See “Eastern Alternative”, **Alternatives Figure 2**. In this overall FSA, staff has analyzed the environmental impacts of installing the pipeline along the Western Alternative route and identified mitigation measures to reduce any potential environmental impacts to less than significant.

Staff supports and recommends the RCSD project alternative because it would facilitate compliance with state water policy, effectively bring new water (which is otherwise being evaporated) into the Koehn sub-basin, and implementing this alternative would directly increase the project's positive economic impact on the local community of Rosamond, California.

California City as a Source of Tertiary-Treated Wastewater

California City has also submitted a proposal to staff that would supply BSEP with tertiary-treated water for its planned process needs (CofC 2009c). California City has a different dynamic than the Rosamond Community Services District, in that California City has a tertiary treatment plant in operation but does not have the household sewer connections to generate the tertiary-treated effluent. As a result, California City's

proposal is based largely upon the cost to connect the existing residents to the system and install a pipeline to the BSEP site. In summary, although California City requires a 15-mile pipeline as compared to RCSD's 40-mile pipeline (or 30-mile pipeline if the EAFB line is built first), the costs of the two alternatives are equivalent.

Staff is concerned that California City's proposal also includes a "return line" that would allow the BSEP to pump an undetermined amount of high quality, fresh groundwater and sell it to California City. See **Alternatives Figure 4**. As currently proposed, staff does not support this proposal because pumping an undetermined amount of groundwater from the BSEP site has the potential to significantly impact groundwater wells near the BSEP site. However, if as a Condition of Certification BSEP is prohibited from pumping site groundwater to sell or trade, then staff would support the California City recycled water pipeline alternative, as a feasible measure for the BSEP to comply with state water policy. California City Council has approved this modified alternative which excludes any purchase of groundwater from BSEP but still provides the BSEP with recycled wastewater to use for power plant cooling.

Staff has considered the potential environmental impacts arising from California City providing tertiary treated waste water to the BSEP and staff has recommended mitigation measures to reduce such impacts to less than significant levels, if the alternative is adopted. However, staff did not evaluate the environmental impacts associated with BSEP pumping an undetermined amount of high quality, fresh groundwater to sell to California City.

On June 25, 2009 the California City Council voted 5-0 to support RCSD's proposal to provide recycled water to the BSEP (CofC 2009b). California City has been fully supportive of the proposed Beacon Solar Energy Project and has submitted their proposal to provide recycled water, solely as a back-up plan to the RCSD proposal. The representatives of California City have stated in a public workshop and letters to staff that it is their preference for the BSEP to utilize water from RCSD rather than from California City because it effectively brings new water into the basin. Staff agrees that implementation of the RCSD alternative would allow California City the flexibility to use their reclaimed water for other beneficial purposes in the basin while allowing BSEP to make use of RCSD's tertiary-treated water that is otherwise being evaporated.

Profit Based Approach to Determine Economic Feasibility of Project Alternatives

Staff begins by considering a legal standard for establishing economic feasibility under CEQA. "The fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. What is required is evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339.)

Solar Energy Industry Benchmark for Profitability – Internal Rate of Return (IRR)

Staff's approach to evaluate the economic feasibility of each alternative began with first establishing reasonable benchmarks for the expected rate of return on investment, also known as the internal rate of return (IRR). Staff first considered the company eSolar, a

developer who plans to build large scale solar thermal power plants. eSolar is considered a solid market reference point because they have entered into power purchase agreements to sell their electricity in New Mexico and California. The company has signed a 20-year contract to provide Southern California Edison (SCE) the energy from a 245 megawatt solar thermal power plant. That project is nearly identical in size to the proposed 250 megawatt BSEP. According to Bill Gross, Chief Executive of eSolar, internal rates of return are expected to fall within the range of 11% to 14% for a "wet cooled" plant (GW 2009a) (GB 2009a). Considering that eSolar is developing projects of smaller scale and larger scale than the proposed BSEP staff concludes eSolar is a fair representative of the marketplace.

Staff next considered the international solar development company, Abengoa Solar. Abengoa has recently filed an Application for Certification with the Energy Commission to develop the Mojave Solar 1 project (09-AFC-5). The Mojave Solar 1 project is the same scale (250 MW) and utilizes the same solar trough technology as the BSEP. In their Application for Certification, Abengoa establishes their internal rate of return as 8%. Staff considers Abengoa to be a fair representative of the marketplace.

Although eSolar "expects" to generate an 11% to 14% internal rate of return (IRR), eSolar submitted a formal comment letter to staff emphasizing that this is an expectation and not a commitment (GB 2009a). Comparatively, Abengoa as a successful developer of solar energy projects has a much more competitive IRR of 8%. Staff believes that a median, industry benchmark for profitability will likely fall somewhere between the most competitive companies such as Abengoa Solar and the upper end of profitability such as the target rate of 14%, identified by eSolar. Staff therefore concludes that economic feasibility for solar energy power plants appears to be achieving an internal rate of return (annualized net profit margin) 11% or more.

Applying the Industry IRR Benchmark to Beacon Solar Energy Project

The next step in staff's analysis was to establish BSEP's internal rate of return (IRR) under different scenarios that accounted for the cost of each alternative. Staff therefore requested the baseline project cost data and revenue data from the BSEP proponent. The data was submitted to staff under an application for confidentiality which was granted by the Commission's Executive Director (DB 2009I). Staff then generated a feasibility study to estimate costs for several alternatives that each would utilize non-potable, brackish water from the general vicinity of Koehn Dry Lake. The feasibility study also evaluates the marginal cost of using dry cooling technology, see "ACC 40F ITD", **APPENDIX A**. Staff also conducted a detailed review of applicant's dry cooling and hybrid cooling study, see **APPENDIX B**. Additionally, staff obtained preliminary engineering and cost estimates for the Rosamond Community Services District's (RCSD) alternative and the California City alternative, as described above.

In **CONFIDENTIAL APPENDIX C**, staff provides a detailed project cost analysis of the various alternatives. The analysis utilizes the confidential revenue model submitted by applicant to staff. Staff created three separate revenue models reflecting the marginal project costs of the RCSD alternative, California City alternative and the Dry Cooling alternative, respectively. In the case of dry cooling, staff added the additional revenue from expanding the solar field, as proposed in the AFC. In all three scenarios, the

revenue models show that BSEP would surpass the benchmark internal rate of return (IRR) of 11%. Additionally, the applicant's revenue model shows that even without expanding the solar field, the BSEP would still meet or exceed the benchmark IRR. Due to the confidential nature of the revenue models, **CONFIDENTIAL APPENDIX C** will be presented to the Commission during an "in camera" hearing (closed door session) that will be part of the formal hearings on the BSEP (08-AFC-2) case.

It is also worth noting that a "residual value" of the BSEP was missing from the BSEP revenue model which would yield an IRR that is more than staff's estimate, therefore staff's estimate is conservative. The residual value component would reflect what the power plant was worth at the end of the 30 years. Because the revenue model assumes a cost for annual maintenance, the power plant would be fully maintained and operating at the end of 30 years (revenue model) and long after the debt financing was repaid. Therefore it could be sold for a lump sum or held for its continuing cash flow. The residual value is a significant factor that should have been included in the revenue model when establishing the complete project cash flow (DB 2009I). It follows that staff's estimate of value is understated and the project would likely reach an IRR above staff's estimate.

Market Based Approach to Economic Feasibility

Staff also took a broader approach to establish economic feasibility based upon the overall market (supply side) – solar power plant, development industry in California. Staff defined the market by solar thermal projects with capacity of 50 megawatts or more, constructed within the last 10 years in California or proposed to be built in California. **Alternatives Table 2** below provides a brief description of solar thermal projects being considered for certification by the Energy Commission. Each project proposes to use a cooling system that complies with state water policy and avoids adverse impacts to fresh water resources. Some of the projects listed below are identical in size to the BSEP. They are also proposed to be built in the same general area (climate) and therefore would have similar if not identical efficiency losses from using dry cooling. Although the nominal megawatt (MW) rating may appear larger for the Palen and Blythe projects, respectively, each project is actually divided into separate 250 MW power plants using the same technology as the BSEP.

Alternatives Table 2
Solar Thermal Projects with Cooling Systems Consistent with State Policy

Project	Capacity	Generation Technology	Cooling System
Ridgecrest Solar Power Project (09-AFC-9)	250 MW	Solar parabolic trough	Dry cooling (air-cooled condenser)
Blythe Solar Power Project (09-AFC-6)	1 GW (1,000 MW)	Solar parabolic trough	Dry cooling (air-cooled condenser)
Palen Solar Power Project (09-AFC-7)	500 MW	Solar parabolic trough	Dry cooling (air-cooled condenser)
Carrizo Energy Solar Farm (07-AFC-8)	177 MW	Compact Linear Fresnel Reflector solar thermal technology	Dry cooling (air-cooled condenser)
Ivanpah Solar Electric Generating System	400 MW	Power tower solar thermal technology	Dry cooling (air-cooled condenser)
San Joaquin Solar 1&2 Hybrid Project (08-AFC-12)	106 MW	Solar parabolic trough/biomass	Wet cooling using reclaimed water
Palmdale Hybrid Power Project (08-AFC-9)	570 MW	Solar parabolic trough and natural gas-fired combined cycle	Wet cooling using reclaimed water
Victorville 2 Hybrid Power Project (07-AFC-1) APPROVED	563 MW	Solar parabolic trough and natural gas-fired combined cycle	Wet cooling using reclaimed water

Staff also considered the company BrightSource Energy ("BrightSource"), as a market referent. BrightSource was considered for several reasons: 1.) they currently propose to develop the Ivanpah Solar Electric Generation System ("Ivanpah") which is a solar thermal project in a similar desert environment and Ivanpah will use dry cooling, 2.) BrightSource has entered into the world's largest power purchase agreement to sell Southern California Edison 1,300 megawatts of electricity from BrightSource's solar thermal projects (GW 2009 B), and 3.) the Ivanpah project consists of three power plants, two of which are 100 megawatts each and one that is 200 megawatts. These three plants are each smaller than the proposed BSEP project and therefore demonstrate the economic feasibility of dry cooling, on a scale smaller than the proposed BSEP.

BrightSource has demonstrated by its development proposals to supply SCE with 1,300 megawatts, that dry cooling is economically feasible (CEC 2009k). BrightSource also acknowledges that the efficiency loss of using dry cooling in place of wet cooling is "marginal" and therefore does not render a project infeasible (CEM 2009 A). More so, the proposed BSEP appears to be twice as efficient, on a megawatt per acre basis, than Ivanpah, see **Efficiency Table 1** in the **EFFICIENCY** section of this FSA.

Considering the facts above, staff concludes that solar thermal energy generators in the overall marketplace have established the economic feasibility of both: using dry cooling technology or in the alternative - reclaimed water in a wet cooling system. The economic feasibility of dry cooling technology is further demonstrated by the proposed use in smaller projects; projects of the same size; and projects using identical solar trough technology in the same desert environment, as compared to the proposed BSEP.

THE "NO PROJECT" ALTERNATIVE

CEQA Guidelines and Energy Commission regulations require consideration of the "No Project" alternative. The CEQA Guidelines state that "the purpose of describing and analyzing a No Project Alternative is to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project" (Cal. Code Regs., tit. 14 §15126.6[i]). Toward that end, the "No Project" analysis considers "existing conditions" and "what would be reasonably expected to occur in the foreseeable future if the project were not approved..." (§15126.6[e][2]).

In short, the site-specific and direct impacts associated with the power plant would not occur at this site if the project does not go forward. Selection of the "No Project" alternative would render all concerns about project impact moot. The "No Project" alternative would preclude any construction or operation and, thus, grading of the site or installation of new foundations, piping, or utility connections.

If the project were not built, off-takers of the renewable energy from BSEP would not benefit from the annual, solar power this project would provide. A primary benefit of the BSEP is that it would help achieve: the State of California objectives mandated by SB 1078 (California Renewable Portfolio Standard Program), and AB 32 (California Global Warming Solutions Act of 2006).

If the proposed project was not constructed then during peak demand periods, potential off-takers of the solar power may have to rely on existing, inefficient, older natural gas-fired power plants which are known to consume more fuel and emit more air pollutants per kilowatt-hour generated than the proposed BSEP.

In light of the California Renewable Portfolio Standard Program and the California Global Warming Solutions Act of 2006, in the absence of the proposed Beacon Solar Energy Project, other power plants with unknown technologies would likely be constructed in the region to supply the market demand for energy. As such, staff has concluded the "No Project" alternative would not be a reasonable alternative or a feasible alternative to the proposed project.

AGENCY AND PUBLIC COMMENTS

COMMENT

California Department of Fish and Game

In their June 19, 2008 comment letter on BSEP, the CDFG recommended avoiding impacts to state waters and requested that the applicant evaluate alternative site layouts that would avoid the desert washes (DFG 2008b).

STAFF RESPONSE

Staff believes the applicant need not locate the entire project on one side of the desert wash nor straddle the wash with the entire project utilizing one 250 megawatt (MW) power block. Instead applicant could avoid Pine Tree Creek entirely by constructing two half scale facilities: a 125 MW plant on each side of the desert wash (still achieving the desired 250 MW). Such a modification to the layout could provide increased efficiencies in land use while avoiding impacts to state waters. The efficiencies could be gained by

avoiding the substantial excavation costs of filling the existing 2-mile long channel and constructing a new longer diversion channel. Further cost savings could be realized by avoiding the requirement to provide mitigation lands, endowment funds and a management plan.

COMMENT

Scott Galati, Galati | Blek LLP, Legal Counsel for eSolar

In a letter dated June 4, 2009, Mr. Galati, on behalf of eSolar, commented on staff's Preliminary Staff Assessment (PSA). The PSA cited public statements made by Bill Gross, CEO of eSolar. The PSA cited Mr. Gross as stating internal rates of return (IRR) **will be** between 11% and 14%. Mr. Galati clarifies that Mr. Gross said the "internal rates of return were **expected** to be between 11 to 14 percent".

STAFF RESPONSE

Staff has made the correction which is reflected on pages 6-11 and 6-12, herein.

COMMENT

Scott Galati, Galati | Blek LLP, Legal Counsel for eSolar

In a letter dated June 4, 2009, Mr. Galati, on behalf of eSolar, commented on staff's Preliminary Staff Assessment (PSA). Mr. Galati states "*First, eSolar believes it is unreasonable to apply broad statements made by one company concerning its business strategy and how it calculates internal rates of return to other industry participants. Second, it is important to note that the rates of return noted by Mr. Gross were based upon wet cooling. Last the internal rates of return for any project must be balanced by the risk management strategy adopted by each industry participant. These risks are different for every project and are largely related to transmission interconnection, ability to access capital, financing costs, expectations of rates of return by company shareholders, risks of successful permitting, and the specific risks of a power purchase agreement. We believe it is imprudent for the CEC staff to dictate the reasonable internal rates of return on any applicant...*" *"We strongly urge the CEC to refrain from comparing internal rates of return between companies or technologies"*.

STAFF RESPONSE

Staff respectfully disagrees with Mr. Galati's interpretation of a permitting Agency's responsibility to evaluate the economic feasibility of project alternatives that can avoid or lessen a project's environmental impacts in accordance with CEQA, and or allow the project to comply with state LORS and water use policies. An Agency **may not** simply accept at face value the project proponent's assertion regarding economic feasibility: (*Sierra Club v. County of Napa*, 121 Cal.App.4th at p. 1504, 19 Cal.Rptr.3d 1; see also *Laurel Heights*, p. 404, 253 Cal.Rptr. 426, 764 P.2d 278 [courts will not "countenance blind trust by the public"].)

Because staff must evaluate the economic feasibility of alternatives, staff must consider "[t]he fact that an alternative may be more expensive or less profitable is not sufficient to show that the alternative is financially infeasible. What is required is evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to

proceed with the project." (*Citizens of Goleta Valley v. Board of Supervisors*, 197 Cal.App.3d at p. 1181, 243 Cal.Rptr. 339). Staff must therefore gather evidence of profitability, as established in the marketplace, to determine whether it is "practical to proceed with the project".

Regarding "the unreasonableness...of applying how one company calculates an internal rate of return to another company", staff replies that the method of calculating an internal rate of return (IRR) is not unique to any one company because an IRR is always calculated by the same equation*, as illustrated below:

$$NPV = \sum_{n=0}^N \frac{C_n}{(1+r)^n} = 0$$

*Given a collection of pairs (time, cash flow) involved in a project, the internal rate of return follows from the net present value as a function of the rate of return. A rate of return for which this function is zero is an internal rate of return. Given the (period, cash flow) pairs (n, C_n) where n is a positive integer, the total number of periods N, and the net present value NPV, the internal rate of return is given by r.

Regarding Mr. Galati's description of various project risk factors being indicative of differing internal rates of return, staff replies that staff's analysis began with a comparison of similar projects in the same industry (renewable energy) and more so in the same subsector (solar thermal energy). Staff then assumed that no project will be built unless all of the risks are fully mitigated to acceptable levels, as established by the financial markets. Therefore working under the assumption that projects in the same industry subsector are required to mitigate risks to the same levels in order to obtain debt financing from the same financial markets, the internal rates of return between these projects are absolutely comparable. In other words, a financial institution is not likely to fund a project that does not have a transmission interconnection or a power purchase agreement, regardless of the projected IRR or risk management strategy. As such, project risks will be mitigated to acceptable levels before the project is constructed. Therefore, the risk factors noted by Mr. Galati are only applicable to a developer in the **permitting stage** where less than 2% of the total project funding will be spent. The market forces require all developers to implement appropriate "risk management strategies" in the planning phase as well as the development phase, in order to arrive at the same point – project risks mitigated to acceptable levels, as determined by the financial debt markets, not necessarily by private investors projected IRRs.

Regarding Mr. Galati's comment that "...it is imprudent for the CEC staff to dictate the reasonable internal rates of return on any applicant...". Neither staff nor the Energy Commission is dictating profit margins to developers. By a close reading of the FSA it is apparent that staff has identified industry benchmarks to assess whether the project developer will "**meet or exceed**" the "**minimum**" profit threshold staff identified as the industry median level of profitability. Staff applied this threshold as screening criteria, in

order to determine whether or not "it is impractical to proceed with the project". Such an approach is supported by CEQA case law, as discussed in *Citizens of Goleta Valley v. Board of Supervisors*. Moreover, an Agency may not simply accept at face value the project proponent's assertion regarding economic feasibility (*Sierra Club v. County of Napa*).

COMMENT

California Unions for Reliable Energy ("CURE")

On April 30, 2009, as an Intervener in the BSEP (08-AFC-2) case, CURE, submitted written comments on the Preliminary Staff Assessment (PSA). The comments relevant to the Alternatives analysis were various arguments and calculations of internal rates of return supporting the use of dry cooling.

STAFF RESPONSE

Because the revenue models are confidential staff will not attempt to provide any calculations here, in response to the comments. More importantly, staff agrees with CURE's comments that in fact dry cooling is economically feasible, as discussed in this **Alternatives** section.

CONCLUSIONS

ALTERNATIVE SITES

After evaluating the alternative project siting areas proposed by applicant, staff concludes the Antelope alternative site area would likely cause a significant impact to prime agricultural lands and thus in order to avoid impacting waters of the state the project proponent would create a much more significant impact to farmland resources, on an overall acreage basis. Staff therefore concludes this particular alternative site area is not a feasible alternative to the proposed BSEP.

ALTERNATIVE ELECTRICAL GENERATION TECHNOLOGIES

After evaluating the alternative electrical generation technologies and applying the screening criteria, staff has determined photovoltaic technology (PV) is a feasible alternative generation technology for the proposed BSEP because PV technology can reduce consumption of high quality fresh water by up to 97 percent, as compared with the proposed BSEP. The use of PV technology could also avoid the need to excavate evaporation ponds which could impact cultural resources. The evaporation ponds associated with the proposed BSEP also pose a threat to wildlife due to the toxicity of the wastewater and other factors. Staff concludes that utilizing PV solar panel technology could avoid or lessen certain environmental impacts from the proposed BSEP.

ALTERNATIVE COOLING TECHNOLOGY – AIR COOLED CONDENSER ("DRY COOLING")

Staff concludes that utilizing a dry cooling system is a feasible project alternative to the proposed BSEP. Staff has reached this conclusion because the dry cooling alternative "...would feasibly attain most of the basic objectives of the project [and] would avoid or substantially lessen any of the significant effects of the project...even if these

alternatives would...be more costly", Title 14, California Code of Regulations, section 15126.6(a)(b). In fact, staff has concluded that utilizing dry cooling with an expanded solar field actually provides a slightly higher profit margin, as compared to the proposed wet cooled project. Staff also finds that even without expanding the solar field, the BSEP would still meet or exceed the benchmark internal rate of return.

SOURCES OF NON-POTABLE WATER FOR POWER PLANT COOLING

Staff concludes that using tertiary treated wastewater from either the Rosamond Community Services District (RCSD) or California City (with staff's condition) are both feasible project alternatives that would also increase the positive economic impact on the local communities. Staff supports and recommends the RCSD project alternative because it would facilitate compliance with state water policy. Staff also agrees with California City's assessment that the RCSD project alternative should be the preferred alternative because it effectively brings new water (which is otherwise being evaporated) into the sub-basin.

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APPENDIX A

FEASIBILITY STUDY OF WATER SUPPLIES AND COOLING SYSTEMS

Testimony of Michael N. DiFilippo

WATER SUPPLY & COOLING

The Beacon Solar Energy Project (BSEP) would utilize onsite groundwater for all plant needs including cooling and steam generator feedwater as well as potable uses. Cooling will be provided by a mechanical draft cooling tower. Plant wastewater (from all sources) would be sent to evaporation ponds for final disposal. No backup cooling water supply is planned for by the applicant although they offer to use future tertiary treated effluent from California City if it becomes available.

Staff has compared the environmental and economic merits of the proposed project with an alternate water supply and one cooling alternative as follows:

PROPOSED PROJECT

All BSEP water needs (including potable needs) will be met by groundwater pumped from wells on the plant site. There are 12 existing water supply wells that were previously used for farming at the site - four wells would be used to supply water for the project (two operating and two backup). The applicant projects water use as follows:

Water Use			
Water Use	Annualized Average Rate ¹ , gpm	Peak Rate ² , gpm	Estimated Annual Use, Acre Feet
Plant Operation	990	4,054	1,599
Potable Water	5	5	8

1. The estimated groundwater usage in gallons per minute is based on an average daily consumption.
2. The peak rate is the instantaneous maximum for summer usage.

Water uses would include cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, plant wash down (housekeeping and maintenance), dilution water for chemical feed systems, etc. Well water would also be used for potable uses - drinking, showers, sinks, and toilets. Well water would be stored on site in the Raw Water Tank. Most of the water would be treated using ion exchange (SAC-SBA) and stored in the Process Water Tank. Process water would be used for cooling tower makeup. A portion of the process water would be treated further for steam generator makeup and mirror washing utilizing portable demineralizers (these are regenerated offsite and generate no wastewater). Wastewater sources include cooling tower blowdown, steam generator blowdown, plant drains, water treatment waste streams, etc. Cooling tower blowdown and SAC-SBA neutralized wastewater would be sent to three 8.3 acre evaporation ponds. Steam generator blowdown and plant drains would be recycled to the cooling tower. The applicant claims that the ponds are sized to accommodate all solids residue generated throughout the life of the plant.

The treatment process selected by BSEP was driven by the PM10 requirements placed on the cooling tower (by the AQMD). The total dissolved solids (TDS) of the circulating water must be less than 1,600 mg/l to meet the PM10 limit. Also, BSEP plans to operate the cooling tower at 15 cycles of concentration (the ratio of feedwater flow to blowdown flow is 15) to minimize wastewater generation. This also means that the TDS of the makeup water (onsite wells) must be reduced to approximately 100 mg/l. BSEP proposes using SAC-SBA ion exchangers to accomplish this. SAC-SBA vessels contain ion exchange resin specifically designed to remove cations (positive ions) and anions (negative ions) from water. The SAC and SBA vessels have a fixed capacity to remove ions, and therefore, must be removed from service frequently and regenerated. This is accomplished by passing dilute sulfuric acid through the SAC vessel (strong acid cation) and dilute sodium hydroxide through the SBA vessel (strong base anion). Wastewater which can have very high or low pH would require neutralization prior to disposal.

In the applicant's water balance for typical annual conditions, they show a wastewater rate to the evaporation ponds of 471 gpm (Section 2, Figure 2-13). This consists primarily of cooling tower blowdown and wastewater from water treatment. They plan to operate at an annual 26.5% capacity factor (94% capacity factor during daylight periods). Adjusting wastewater flow to a 24-hour operating basis, flow to the evaporation ponds would be 125 gpm ($471 \text{ gpm} \times 26.5\%$). All ponds would have to operate for the entire year to accommodate this flow. Stated another way, the evaporation rate from the ponds would have to be 97 inches per year. Evaporation pan data for this area is about 120 inches per year. Pan data is measure of ambient evaporation rate and is measured with a National Weather Service Class A pan (measuring 48" diameter x 10" deep). Past experience in sizing evaporation ponds (by author) was to adjust the Class A pan data by 40% to 45% for salinity and edge effects. This equates to an adjusted evaporation rate of approximately 66 to 72 inches. As ponds concentrate, high levels of salt inhibit evaporation. Additionally, the size, shape and depth of the pond also reduce evaporation. The ponds as sized are marginal and a fourth pond would likely be required. Also, if water use in the plant is greater than that described in the water balance (Figure 2), additional pond area would be required.

ALTERNATIVE WATER SUPPLY (BRACKISH WATER) AND TREATMENT PROCESSES

As a means of conserving high quality (potable) onsite groundwater, five treatment alternatives were evaluated utilizing offsite brackish water. Refer to the following table. All the alternatives would utilize well water from a brackish makeup source. The water is considered brackish because State Water Resources Control Board, Resolution 75-58 defines brackish waters as "all waters with a salinity range of 1,000 to 30,000 mg/l" and the water at Koehn Lake fits within those parameters. The aquifer is accessible at the southwest corner of Koehn Lake approximately 5 miles from the project site. It was assumed that four wells would be required to supply BSEP needs. In all of the alternatives well water would be transported to the site via a 12-inch or 14-inch pipeline (depending on water demand).

Offsite Brackish Water Alternatives					
	SAC-SBA	Makeup RO	Recovery RO	Evap/Crys	Evap Ponds
Alternative 1	X				X
Alternative 2	X		X		X
Alternative 3		X	X		X
Alternative 4	X			X	
Alternative 5		X	X	X	

All of the processes in the above table are well established commercial technologies.

SAC-SBA in Alternative 1 is the same ion exchange process proposed by BSEP.

Reverse osmosis (RO) would be used in two ways – as makeup treatment or in a wastewater recovery configuration. In alternatives 2 and 5, RO would be used to directly treat cooling tower makeup, steam generator makeup and mirror washing water. In Alternatives 2, 3 and 5, RO would be used to treat cooling tower blowdown to reduce overall wastewater volume either for disposal or as a pretreatment to an evaporator. RO is a technology that utilizes permeable membranes (under relatively high pressure) to repel salt and pass water. Most of the dissolved salts are repelled by the membrane surface (95% to 98% for most ions) allowing only water to pass through. RO must have highly filtered water with modified chemistry (usually pH adjustment) to operate successfully. In the alternatives utilizing RO, the water would be filtered by the use of microfiltration (MF). MF is also a membrane process that is commonly used with RO in difficult industrial or reuse applications.

Evaporator/Crystallizers in Alternatives 4 and 5 would be used to reduce wastewater volume to essentially zero volume. In the evaporator 90% to 95% of the water would be recovered. Brine from the evaporator would be sent to a crystallizer to further recover water. Waste from the crystallizer would be in the form of highly concentrated salt brines that would crystallize to solid form for offsite disposal. In Alternative 5, a recovery RO would be used to pre-concentrate the wastewater stream to the evaporator. Alternatives 4 and 5 would be the only treatment options requiring offsite disposal.

COMPARATIVE WATER CONSUMPTION OF VARIOUS PROCESSES

Refer to the following table for a comparative summary of onsite water versus offsite brackish water for BSEP makeup. The analysis was based on typical summer conditions. Note the evaporation pond sizing for the BSEP proposed treatment. Staff calculated a pond size (utilizing the criteria discussed above) of 43.5 acres versus 25 acres in the BSEP project description.

Water Treatment Summary						
Typical Summer Conditions Basis						
	Offsite Wells - Koehn Lake Source Water					
	BSEP	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	Onsite Wells		SAC-SBA	MU RO	SAC-SBA	MU-Recov RO
	SAC-SBA	SAC-SBA	Recov RO	Recov RO	Evap-Crys	Evap-Crys
Water Demand - Instantaneous						
Onsite Wells Demand, gpm	4,038	5	5	5	5	5
Koehn Lake Water Demand, gpm	N/A	4,086	3,772	3,959	3,463	3,480
Total Wastewater, gpm	572	650	565	801	0	0
Water Demand - Annual Average Conditions						
Annual Capacity Factor	26.5%	26.5%	26.5%	26.5%	26.5%	26.5%
Onsite Wells Demand, gpm	1,070	5	5	5	5	5
Koehn Lake Water Demand, gpm	N/A	1,083	1,000	1,049	918	922
Onsite Wells Demand, AF/yr	1,726	8.1	8.1	8.1	8.1	8.1
Koehn Lake Water Demand, AF/yr	N/A	1,747	1,612	1,692	1,480	1,488
Total Wastewater, gpm	152	172	150	212	0	0
Evap Pond, acres ¹	43.5	49.4	42.9	60.8	0	0
Notes.....						
1. BSEP project evap pond was sized based based on staff calculation.						

The offsite well field at Koehn Lake would be the same for all of the alternatives (1 through 5). Each well was assumed to be 500 feet deep. The pipeline diameter for Alternatives 1 and 3 is 14 inches and 12 inches for Alternatives 2, 4 and 5. The size differences are a function of water demand for each alternative. For this analysis, the line was sized to operate 24 hours per day at half the water demand rate.

ALTERNATIVE 1

Alternative 1 utilizes "brackish" water from offsite wells for plant needs, e.g. cooling tower makeup, closed cooling system makeup, steam generator makeup, mirror washing, etc. Steam generator blowdown and plant drains would be recycled to the cooling tower. It is the same alternative proposed by BSEP. Well water from onsite wells would still be used for potable needs. Plant wastewater would be sent to an evaporation pond for final disposal. The evaporation ponds would be about 15 percent larger than the BSEP ponds because more wastewater would be generated by the SAC-SBA treating brackish water.

ALTERNATIVE 2

This alternative combines Alternative 1 (SAC-SBA) with a recovery RO to reduce the cooling tower blowdown portion of the wastewater stream. MF would be used as pretreatment for the recovery RO. The evaporation ponds would be slightly smaller than the BSEP ponds.

ALTERNATIVE 3

In this alternative offsite water would be treated with and RO prior to storage in the Process Water Tank (replacing SAC-SBA). A portion of cooling tower blowdown would also be recovered via RO prior to discharge to evaporation ponds. MF would be used as pretreatment for the makeup and recovery RO. Steam generator blowdown and plant drains would be recycled to the cooling tower. RO permeate would be recovered to the cooling tower. This alternative would generate more wastewater than Alternatives 1 or 2 and would require a significantly larger evaporation pond.

ALTERNATIVE 4

This alternative combines Alternative 1 (SAC-SBA) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream. There would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and SAC-SBA wastewater would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

ALTERNATIVE 5

This alternative combines Alternative 3 (makeup RO/recovery RO) with an evaporator/crystallizer and would essentially eliminate a liquid waste stream, i.e. there would be no evaporation pond in this alternative. Crystallizer solid waste would require offsite disposal. Steam generator blowdown and plant drains would be recycled to the cooling tower. Cooling tower blowdown and makeup RO wastewater (known as reject) would be fed to the evaporator/crystallizer. Distillate from the evaporator/crystallizer would be recovered to the cooling tower.

COST ANALYSIS

Refer to the following table for a cost analysis of BSEP onsite wells versus offsite brackish water. From a capital perspective Alternative 1 (SAC-SBA) and Alternative 2 (SAC-SBA with recovery RO) are the least costly of the offsite alternatives (i.e. at this level of evaluation they are too close to call). Alternative 3 is the least costly based on operating costs. Relative to the BSEP treatment, Alternatives 1 or 2 would cost an additional \$12.0 to \$12.5 million to install. Likewise, Alternative 3 (makeup & recovery RO) would cost \$1 million more to operate relative to the BSEP base case. When the installed cost is capitalized (amortized at 7% for 20 years), Alternative 3 is the least costly of the five offsite alternatives. However, its annual cost would exceed BSEP costs by over \$2.75 million per year.

Lastly, Alternatives 1, 2 or 3 achieve the goal of using non-potable quality water for project cooling. Given the budget level of analysis, the costs of these alternatives are quite close and should be considered equivalent.

Water Treatment Summary & Cost Analysis						
Typical Summer Conditions Basis						
	Offsite Wells - Koehn Lake Source Water					
	BSEP Onsite Wells SAC-SBA	Alternative 1 SAC-SBA	Alternative 2 SAC-SBA Recov RO	Alternative 3 MU RO Recov RO	Alternative 4 SAC-SBA Evap-Crys	Alternative 5 MU-Recov RO Evap-Crys
Equipment & Evap Pond Installed Cost						
SAC-SBA	\$20,610,000	\$20,610,000	\$20,610,000	N/A	\$20,610,000	N/A
MU-Recovery RO	N/A	N/A	\$3,380,000	\$23,840,000	N/A	\$21,160,000
Evaporator Crystallizer	N/A	N/A	N/A	N/A	\$33,750,000	\$36,190,000
Common Tankage & Pumping	\$11,140,000	\$11,270,000	\$10,520,000	\$10,970,000	\$9,770,000	\$9,810,000
Water Treatment Subtotal	\$31,750,000	\$31,880,000	\$34,510,000	\$34,810,000	\$64,130,000	\$67,160,000
Evaporation Pond	\$10,960,000	\$12,460,000	\$10,820,000	\$15,340,000	N/A	N/A
Total Water & Wastewater	\$42,710,000	\$44,340,000	\$45,330,000	\$50,150,000	\$64,130,000	\$67,160,000
Pipeline from Koehn Lake						
4 Wells	N/A	\$880,000	\$880,000	\$880,000	\$880,000	\$880,000
Pump Station	N/A	\$3,080,000	\$3,000,000	\$3,050,000	\$2,910,000	\$2,910,000
5 Mile Carbon Steel Pipeline	N/A	\$6,970,000	\$5,580,000	\$6,970,000	\$5,580,000	\$5,580,000
Total	N/A	\$10,930,000	\$9,460,000	\$10,900,000	\$9,370,000	\$9,370,000
Total Installed Water Treatment Costs	\$42,710,000	\$55,270,000	\$54,790,000	\$61,050,000	\$73,500,000	\$76,530,000
	Base	\$12,560,000	\$12,080,000	\$18,340,000	\$30,790,000	\$33,820,000
Total Annual Operating Costs	\$1,215,000	\$3,549,000	\$3,453,000	\$2,235,000	\$5,202,000	\$4,215,000
	Base	\$2,334,000	\$2,238,000	\$1,020,000	\$3,987,000	\$3,000,000
Capitalized Equipment Costs¹	\$4,032,000	\$5,218,000	\$5,172,000	\$5,763,000	\$6,938,000	\$7,224,000
	Base	\$1,186,000	\$1,140,000	\$1,731,000	\$2,906,000	\$3,192,000
Annual Operating & Capital Cost	\$5,247,000	\$8,767,000	\$8,625,000	\$7,998,000	\$12,140,000	\$11,439,000
	Base	\$3,520,000	\$3,378,000	\$2,751,000	\$6,893,000	\$6,192,000
Notes.....						
1. Capitalized at 7% per year for 20 years.						

DRY COOLING

BSEP evaluated three Air Cooled Condenser (ACC) dry cooling alternatives (refer to Worley Parsons report "FPLE Beacon Solar Energy Project Dry Cooling Evaluation", dated February 1, 2008). The report evaluated three inlet temperature differences (ITD) scenarios (35 °F, 40 °F and 45 °F). Each ITD scenario yields a slightly different operating profile. For evaluation purposes, the 40 °F scenario was compared to wet cooling alternatives, i.e. the BSEP base case and Alternative 3 (offsite water, MU/Recovery RO). In the Worley Parsons study, the cost for solar arrays was increased to provide 250 MW (i.e. same as base case).

Refer to the following table. Note that the cooling system (cooling tower) costs remain the same for the base case and Alternative 3. After adjusting the costs for water treatment, the BSEP base case is the lowest estimated capital cost followed by Alternative 3 (\$18.3 million difference) and dry cooling (\$53.7 million difference). The annual operating costs were calculated by adding power for the wet and dry cooling system to the annual cost for water treatment. Other power costs (outside the cooling loop) were considered equivalent. The dry cooling alternative has the lowest operating costs by \$403,000 when compared to the BSEP base case.

Cooling System Comparison Summary

Typical Summer Conditions Basis

	BSEP Base Case	Alternative 3 Offsite Wells MU/Recov RO	Alternative 6 Dry Cooling ACC 40F ITD
Cooling System			
Cooling Tower Cells	11		N/A
ACC Cells	N/A		40
Power Requirements			
Fan Power, HP	250		200
Circ Pump Power, HP	2509		N/A
Total Power, HP	5259		8000
Total Power, kw	3918		5960
Average Op Capacity	26.5%		26.5%
Power, kw-hr/year	9,096,000		13,836,000
Power Cost, \$/year	\$1,364,400	\$1,364,400	\$2,075,400
Cooling System Costs			
HTF Pumps	\$3,000,000		\$3,000,000
BFW Pumps	\$2,300,000		\$2,400,000
SG Heat Exchanger	\$12,500,000		\$14,100,000
Additional Solar Arrays ¹ (installed)	Base		\$53,000,000
Cooling Tower	\$4,275,000		N/A
CT Basin	\$1,500,000		N/A
Circ Water Pumps	\$600,000		N/A
Surface Condenser	\$3,500,000		N/A
Circ Water Piping	\$1,300,000		N/A
Circ Water Piping Install	\$520,000		N/A
ACC Equipment	N/A		\$36,900,000
ACC Install	N/A		\$11,500,000
Closed Cycle Aux Cooler	N/A		\$450,000
Total Cooling System Cost	\$29,495,000	\$29,495,000	\$121,350,000
Water Treatment Costs	\$42,710,000	\$61,050,000	\$4,600,000
Total System Cost	\$72,205,000	\$90,545,000	\$125,950,000
	Base	\$18,340,000	\$53,745,000
Annual Operating Costs			
Water Treatment	\$1,215,000	\$2,235,000	\$101,000
Cooling System Power	\$1,364,400	\$1,364,400	\$2,075,400
Total Operating Cost²	\$2,579,400	\$3,599,400	\$2,176,400
	Base	\$1,020,000	-\$403,000
Capitalized Equipment Costs³	\$6,820,000	\$8,550,000	\$11,890,000
	Base	\$1,730,000	\$5,070,000
Annual Operating & Capital Costs	\$9,399,400	\$12,149,400	\$14,066,400
	Base	\$2,750,000	\$4,667,000

Notes.....

1. Costs extracted from Worley Parsons report, "FPLE - Beacon Solar Energy Project Dry Cooling Evaluation" dated February 1, 2008.
2. Water treatment costs plus cost for cooling system power. All other power costs were assumed to be equivalent.
3. Capitalized at 7% per year for 20 years.

EFFICIENCY LOSS CALCULATIONS

The Worley Parsons study determined that the net output for the 40 °F ITD ACC would be 7.50% less than that of the base case. The base case would include the BSEP proposed cooling configuration or Alternative 3 (offsite wells with makeup and recovery RO). At high ambient dry bulb temperatures (summer conditions), the ACC cannot cool as efficiently as wet cooling resulting in higher condenser backpressure and reduced turbine output. Refer to the following table for a comparison of annual net output for these alternatives. The difference in generating output is an indirect measure of ACC cooling efficiency relative to wet cooling.

Net Output Comparisons			
	BSEP Wet Cooling	Alternative 3 Offsite Wells MU/Recov RO	ACC 40° F ITD
Estimated Annual Output, MW-hr	602,527	602,527	557,365
Est Annual Output Difference, MW-hr	Base	Base	45,162
Pct Difference to Base	Base	Base	-7.50%

APPENDIX B
Review and Analysis of Alternative Cooling Systems
Testimony of John S. Maulbetsch

BACKGROUND AND OBJECTIVES

The Beacon Solar Power plant is a 250 MWe (net) parabolic trough solar plant to be located in Kern County, California, 4 miles north-northwest of California City. The developers have investigated the use of 7 alternative cooling system designs for meeting the main steam condenser and other auxiliary plant cooling loads. The alternatives include:

- Closed-cycle wet cooling with a surface steam condenser and a mechanical-draft wet cooling tower
- Three sizes of dry cooling each using a forced-draft air-cooled condenser
- Three hybrid (wet/dry) systems each with a different mix of wet and dry cooling using a surface condenser/wet cooling tower for the wet portion and an air-cooled condenser for the dry portion.

The basis for the sizing of the systems and a discussion of the comparative costs, performance and water consumption was reported in the "Dry Cooling Evaluation" report. [1]

This current study was undertaken with the general intent of providing an independent review of the approach, methodology and results of the cooling systems report [1] with the specific objectives of:

1. determining which of the three dry cooling systems appears to be economically preferred alternative among dry cooling systems
2. estimating the differential cost and annual performance of the dry and wet systems
3. estimating the size, configuration and water consumption of a hybrid system capable of providing the most comparable performance to the all wet system

The remainder of the report is organized as follows:

- Review of original cooling system design and selection
- Review effect of cooling system capability on plant performance
- Comparison of dry and wet systems
- Comparison of three alternative dry systems
- Estimating the size, cost and water consumption of the desired hybrid system

COOLING SYSTEM DESIGN AND SELECTION

All cooling systems were designed in conjunction with an appropriate turbine selection to deliver 280 MWe (gross) and 250 MWe (net) at design conditions.

WET COOLING

The wet cooling system is a closed-cycle system with a surface steam condenser of the shell-and-tube type and a mechanical-draft, counterflow wet cooling tower.

Ambient Conditions

Site elevation: 2,314 feet (above sea level)
Design wet bulb temperature: 68 °F (1% wet bulb)
Mean coincident dry bulb temperature: 95 °F

Cooling tower specifications:

Circulating water flow: 149,000 gpm (7.45×10^7 lb/hr)
Circulating water temperature drop: 20 °F
Approach temperature:³ 9 °F
Heat load (calculated): 1.49×10^9 Btu/hr

Condenser specifications:

Circulating water flow: 149,000 gpm (lb/hr)
Range:⁴ 20 °F
Terminal temperature difference (TTD):⁵ 5 °F

Design operating point:

Condensing temperature: 102 °F ($T_{\text{cond}} = \text{wet bulb} + \text{approach} + \text{range} + \text{TTD}$)
Condensing pressure: 2.1 in Hga

DRY COOLING

The dry cooling system is a direct dry cooling system with the turbine exhaust steam condensed in the tubes of a forced-draft air-cooled condenser. The tubes are arranged in an A-frame configuration with the inlet steam duct at the top and a condensate collection pipe at the bottom. The outsides (air-sides) of the tubes are finned for enhanced air-side heat transfer.

³ Approach = Wet bulb temperature – cold water temperature

⁴ Range = Circulating water temperature rise in condenser = temperature drop in tower

⁵ Terminal temperature difference (TTD) = Condensing temperature – hot water temperature

Ambient Conditions:

Site elevation: 2,314 feet (above sea level)
Design dry bulb temperature: 103.5 °F (0.4% dry bulb)
Mean coincident wet bulb temperature: 66 °F

Three different air-cooled condensers were considered with specified ITD's (Initial Temperature Difference's) of 35, 40 and 45 °F. For a given heat duty, a lower ITD represents a larger and more costly air-cooled condenser than a higher ITD. As noted in the WorleyParsons report (1) a 40 °F is a common selection for ACC's, often (but not always) representing a preferred trade-off between cost and performance. Specifications for the three ACC's are given below in Table 1.

Table 1: Dry Cooled System Specifications

Design Parameters	ACC Alternative Designs		
	A	B	C
Initial temperature difference (ITD) ⁶ , °F	35	40	45
Condensing temperature, °F	138.5	143.5	148.5
Turbine exhaust pressure, in Hga	5.67	6.44	7.30
Steam flow, lb/hr	1,848,207	1,884,259	1,919,791
Steam enthalpy, Btu/lb	1,045.8	1,054.6	1,063.6
Heat load (calc.), Btu/hr	1.74 x 10 ⁹	1.78 x 10 ⁹	1.82 x 10 ⁹

OPERATING PROFILE

An annual operating profile of site conditions (solar insolation, solar field output, thermal input to the power block, and net electrical power generated) is provided in Reference 1 for both a wet cooled and a dry cooled plant design. The dry cooled design uses the intermediate sized ACC (Case B; ITD = 40 °F). While the solar field profile does not represent the real annual variability in solar field output, this "synthetic" profile where all the several solar field efficiencies are held constant, was used in Reference 1 to simplify the analysis. It is considered appropriate since the cooling systems are compared at identical power block input conditions throughout the year and differences in net plant output are attributable solely to differences in cooling system capabilities and their variation with ambient conditions. These profiles will be used as the basis for comparisons in this study for the same reasons and to provide a consistent comparison to the results discussed in Reference 1.

Table 2 lists the site ambient conditions, the solar field output and the power block input for all operating hours of the year.

⁶ Initial temperature difference (ITD) = Condensing temperature – ACC air inlet temperature

Table 2: Site Ambient Conditions and Solar Field Operating Profile

Day/Hour				Field Insolation	Field Output	Collector Output	Dry Bulb Temperature	Wet Bulb Temperature
No.	Month	Hour	Hrs/yr	W/m2	MWth	MWt	F	F
1	Jan	7	31	3.48	5.03	2.66	38.13	32.45
2	Jan	8	31	264	381.83	202.06	41.98	34.97
3	Jan	9	31	518.42	749.81	396.78	45.88	37.35
4	Jan	10	31	655.23	947.69	501.49	49.73	39.48
5	Jan	11	31	692.29	1001.29	529.86	52.81	41.16
6	Jan	12	31	722.55	1045.05	553.02	55.86	42.73
7	Jan	13	31	724.1	1047.30	554.20	58.94	44.15
8	Jan	14	31	716.58	1036.42	548.45	59.37	44.46
9	Jan	15	31	652.65	943.96	499.52	59.79	44.75
10	Jan	16	31	523.32	756.90	400.53	60.23	45.06
11	Jan	17	31	240.35	347.63	183.96	56.67	43.26
12	Jan	18	31	2.94	4.25	2.25	53.11	41.28
13	Feb	7	28	71.04	102.75	54.37	42.14	37.09
14	Feb	8	28	387.36	560.26	296.47	47.27	40.36
15	Feb	9	28	545.36	788.78	417.40	52.42	43.31
16	Feb	10	28	628.79	909.45	481.26	57.54	45.83
17	Feb	11	28	664.61	961.25	508.67	60.43	46.97
18	Feb	12	28	683.75	988.94	523.32	63.32	47.91
19	Feb	13	28	667.86	965.95	511.16	66.21	48.68
20	Feb	14	28	677.11	979.33	518.24	66.98	48.91
21	Feb	15	28	645.64	933.82	494.15	67.72	49.08
22	Feb	16	28	581.07	840.43	444.73	68.5	49.29
23	Feb	17	28	426.14	616.34	326.16	64.34	47.62
24	Feb	18	28	83.86	121.29	64.18	60.16	45.68
25	Mar	6	31	11.84	17.12	9.06	49.02	40.09
26	Mar	7	31	272.52	394.16	208.58	48.83	39.96
27	Mar	8	31	557.16	805.84	426.43	53.01	42.31
28	Mar	9	31	691.71	1000.45	529.41	57.24	44.46
29	Mar	10	31	737	1065.95	564.08	61.42	46.3
30	Mar	11	31	780.35	1128.65	597.26	63.94	47.26
31	Mar	12	31	768.19	1111.07	587.95	66.46	48.06
32	Mar	13	31	769.16	1112.47	588.69	68.98	48.78
33	Mar	14	31	744.13	1076.27	569.54	69.32	48.87
34	Mar	15	31	701.32	1014.35	536.77	69.59	48.97
35	Mar	16	31	624.19	902.79	477.74	69.93	49.05
36	Mar	17	31	510.52	738.39	390.74	67.07	48.12
37	Mar	18	31	204.84	296.27	156.78	64.22	47.1
38	Mar	19	31	0.71	1.03	0.54	61.32	45.87
39	Apr	6	30	155.03	224.23	118.66	54.93	45.08
40	Apr	7	30	510.9	738.94	391.03	55.38	45.43
41	Apr	8	30	681.33	985.44	521.47	59.68	47.36
42	Apr	9	30	797.87	1153.99	610.67	63.93	48.95
43	Apr	10	30	846.7	1224.62	648.04	68.23	50.15
44	Apr	11	30	871.17	1260.01	666.77	70.83	50.97
45	Apr	12	30	890.3	1287.68	681.41	73.38	51.64
46	Apr	13	30	846.13	1223.79	647.60	75.99	52.18
47	Apr	14	30	833.77	1205.92	638.14	76.39	52.32
48	Apr	15	30	814.17	1177.57	623.14	76.77	52.47
49	Apr	16	30	721.77	1043.93	552.42	77.18	52.62
50	Apr	17	30	653.43	945.08	500.12	74.4	51.91
51	Apr	18	30	429.07	620.58	328.40	71.62	50.99
52	Apr	19	30	37.07	53.62	28.37	68.79	49.99
53	May	5	31	15.16	21.93	11.60	58.85	48.9
54	May	6	31	296.74	429.19	227.12	60.86	50.2
55	May	7	31	549.94	795.40	420.91	64.84	52.18
56	May	8	31	676	977.73	517.39	69.88	54.21
57	May	9	31	735.74	1064.13	563.11	74.03	56.07
58	May	10	31	769.97	1113.64	589.31	77.71	57.01
59	May	11	31	805.97	1165.71	616.87	81.27	57.99
60	May	12	31	829.45	1199.67	634.84	83.64	58.19
61	May	13	31	822.61	1189.78	629.60	85.3	58.61
62	May	14	31	801.68	1159.50	613.58	86.52	58.38
63	May	15	31	756.32	1093.90	578.87	87.06	57.65
64	May	16	31	716.55	1036.38	548.43	86.42	57.61
65	May	17	31	642.87	929.81	492.03	84.19	56.68
66	May	18	31	457.06	661.07	349.82	81.41	55.95
67	May	19	31	108.35	156.71	82.93	77.35	54.62

Day/Hour				Field Insolation	Field Output	Collector Output	Dry Bulb Temperature	Wet Bulb Temperature
No.	Month	Hour	Hrs/yr	W/m2	MWth	MWt	F	F
68	June	5	30	40.57	58.68	31.05	72.1	55.33
69	June	6	30	408.7	591.12	312.81	73.21	55.94
70	June	7	30	642.3	928.99	491.60	74.29	56.58
71	June	8	30	749.87	1084.57	573.93	78.46	58.09
72	June	9	30	812.17	1174.68	621.61	82.66	59.38
73	June	10	30	837.43	1211.21	640.94	86.83	60.26
74	June	11	30	853.83	1234.93	653.50	89.31	60.95
75	June	12	30	859.43	1243.03	657.78	91.72	61.54
76	June	13	30	826.47	1195.36	632.56	94.2	62.02
77	June	14	30	842.2	1218.11	644.60	94.9	62.33
78	June	15	30	776.63	1123.27	594.41	95.58	62.63
79	June	16	30	747.53	1081.18	572.14	96.28	62.93
80	June	17	30	670.3	969.48	513.03	93.58	62.15
81	June	18	30	528.07	763.77	404.17	90.89	61.27
82	June	19	30	216.97	313.81	166.06	88.15	60.28
83	July	5	31	13.06	18.89	10.00	77.33	59.36
84	July	6	31	297.23	429.90	227.49	78.4	60.13
85	July	7	31	543.13	785.55	415.70	79.44	60.83
86	July	8	31	667.13	964.90	510.60	83.56	62.4
87	July	9	31	731.77	1058.39	560.08	87.64	63.67
88	July	10	31	782.48	1131.73	598.89	91.75	64.68
89	July	11	31	798.35	1154.69	611.03	94.61	65.65
90	July	12	31	806.58	1166.59	617.33	97.39	66.42
91	July	13	31	821.32	1187.91	628.61	100.24	67.17
92	July	14	31	801.81	1159.69	613.68	101.14	67.42
93	July	15	31	798.94	1155.54	611.49	102.07	67.64
94	July	16	31	749.29	1083.73	573.48	102.97	67.87
95	July	17	31	658.84	952.91	504.26	100.45	66.9
96	July	18	31	519.06	750.74	397.27	97.98	65.93
97	July	19	31	197.13	285.12	150.88	95.41	64.84
98	Aug	6	31	179.39	259.46	137.30	75.58	60
99	Aug	7	31	504.65	729.90	386.24	75.8	60.21
100	Aug	8	31	669.32	968.07	512.28	80.15	62.15
101	Aug	9	31	745.94	1078.88	570.92	84.53	63.82
102	Aug	10	31	809.35	1170.60	619.45	88.88	65.21
103	Aug	11	31	806.87	1167.01	617.55	91.49	65.82
104	Aug	12	31	828.9	1198.87	634.42	94.06	66.19
105	Aug	13	31	799.23	1155.96	611.71	96.67	66.51
106	Aug	14	31	784.87	1135.19	600.72	97.25	66.42
107	Aug	15	31	743.32	1075.09	568.92	97.85	66.45
108	Aug	16	31	663.42	959.53	507.76	98.43	66.33
109	Aug	17	31	569.52	823.72	435.89	96.23	65.49
110	Aug	18	31	403.45	583.53	308.79	93.98	64.56
111	Aug	19	31	73.61	106.47	56.34	91.74	63.62
112	Sep	6	30	81.27	117.54	62.20	65.82	54.5
113	Sep	7	30	487	704.37	372.74	69.02	56
114	Sep	8	30	683.77	988.97	523.34	74.17	57.97
115	Sep	9	30	785.43	1136.00	601.15	78.97	59.42
116	Sep	10	30	848.47	1227.18	649.39	83.09	60.99
117	Sep	11	30	850	1229.39	650.57	86.85	61.83
118	Sep	12	30	851.53	1231.60	651.74	89.76	62.49
119	Sep	13	30	819.9	1185.86	627.53	91.69	63.18
120	Sep	14	30	776.93	1123.71	594.64	92.81	63.73
121	Sep	15	30	734.17	1061.86	561.91	93	63.93
122	Sep	16	30	603.9	873.45	462.21	92.23	63.13
123	Sep	17	30	517.67	748.73	396.21	90.16	62.66
124	Sep	18	30	237.8	343.94	182.01	87.07	61.72
125	Sep	19	30	2.33	3.37	1.78	83.99	60.67
126	Oct	6	31	9.29	13.44	7.11	58.37	46.48
127	Oct	7	31	324.84	469.83	248.62	58.13	46.41
128	Oct	8	31	580.65	839.82	444.41	62.81	48.92
129	Oct	9	31	703.65	1017.72	538.55	67.49	51.13
130	Oct	10	31	763.13	1103.75	584.08	72.17	53.06
131	Oct	11	31	806.71	1166.78	617.43	74.99	54.07
132	Oct	12	31	776.52	1123.11	594.33	77.77	54.94
133	Oct	13	31	752.9	1088.95	576.25	80.58	55.67
134	Oct	14	31	756.71	1094.46	579.16	80.99	55.74
135	Oct	15	31	699.06	1011.08	535.04	81.4	55.74
136	Oct	16	31	596.45	862.67	456.51	81.81	55.81
137	Oct	17	31	343.26	496.47	262.72	78.12	54.43

Day/Hour				Field Insolation	Field Output	Collector Output	Dry Bulb Temperature	Wet Bulb Temperature
No.	Month	Hour	Hrs/yr	W/m2	MWth	MWt	F	F
139	Nov	7	30	118.5	171.39	90.70	45.77	38.29
140	Nov	8	30	496	717.39	379.62	50.17	41.02
141	Nov	9	30	672.53	972.71	514.73	54.56	43.5
142	Nov	10	30	739.03	1068.89	565.63	58.96	45.74
143	Nov	11	30	779.3	1127.13	596.45	62.18	47.2
144	Nov	12	30	775	1120.92	593.16	65.47	48.52
145	Nov	13	30	731.53	1058.04	559.89	68.69	49.63
146	Nov	14	30	668	966.16	511.27	69.03	49.8
147	Nov	15	30	567.33	820.55	434.22	69.36	50
148	Nov	16	30	461.37	667.30	353.12	69.7	50.17
149	Nov	17	30	107.33	155.24	82.15	65.73	48.25
150	Dec	7	31	24.26	35.09	18.57	41.12	34.84
151	Dec	8	31	347.81	503.05	266.20	44.05	36.78
152	Dec	9	31	550.81	796.66	421.57	46.99	38.59
153	Dec	10	31	650	940.12	497.49	49.92	40.33
154	Dec	11	31	690	997.98	528.11	52.8	41.82
155	Dec	12	31	682.52	987.16	522.38	55.74	43.22
156	Dec	13	31	681.48	985.65	521.58	58.62	44.43
157	Dec	14	31	661.06	956.12	505.96	58.84	44.5
158	Dec	15	31	568.1	821.67	434.81	59	44.52
159	Dec	16	31	409.23	591.89	313.21	59.23	44.59
160	Dec	17	31	109.32	158.11	83.67	56.5	43.22

ANALYSIS OF WET SYSTEM PERFORMANCE

To infer the effect of cooling system performance on plant efficiency and output it is necessary to understand the effect of steam flow and turbine exhaust pressure on turbine performance. The steam flow is determined primarily by the thermal energy delivered to the power block. The turbine exhaust pressure is determined by the steam flow, steam inlet conditions and the ambient conditions as they affect the cooling system performance.

These relationships are estimated from the information provided in Appendices H (for the wet-cooled plant) and G (for the dry cooled plant) in Reference 1.

TURBINE CHARACTERISTICS---WET COOLING DESIGN

Appendix H tabulates the net turbine output for each month and hour of day during that month. The net turbine output is the output available for export from the plant and is equal; to the gross turbine output minus the auxiliary load which is consumed in the plant. The plant auxiliary load is approximated based on the following assumptions: (2)

Auxiliary load at design plant output: 30 MWe

Auxiliary load at 25% design output: 15 MWe

The variation in auxiliary power is estimated with a linear relationship established by these two points.

$$\text{Auxiliary power (MW)} = 10. + 0.2 \times \% \text{ Design Load}$$

Gross output, which is required to generate the basic turbine performance curves, is calculated as the net output plus the auxiliary load.

The wet cooling system rejects 1.49×10^9 Btu/hr ($436.6 \text{ MW}_{\text{th}}$) at design conditions at a net electrical output of 250 MW (280 MW gross output) implying a power input to the power block at design conditions of 2.45×10^9 Btu/hr ($716.6 \text{ MW}_{\text{th}}$). Therefore, at the design turbine exhaust pressure of 2.1 in Hga, the steam cycle efficiency (gross) is 39.1%. ($= 280 \text{ MWe}/716.6 \text{ MW}_{\text{th}}$). The corresponding net cycle efficiency is 34.9% which agrees well with the tabulated value of 34.7% in Table 5 of the WorleyParsons report. (1)

It will be assumed that the steam flow to the HP turbine inlet is proportional to the thermal input to the power block. Therefore, for each of the 160 operating conditions listed in Table 2, the steam flow as a percentage of the design steam flow can be determined.

The heat rejected at each condition is determined by the difference between the thermal input to the power block and the gross electrical generation. The circulating water flow is held constant. Therefore, to a reasonable approximation, the operating range and TTD are scaled from the design values to the operating point values proportionally to the heat rejected by the cooling system. Finally, using the CTI Toolkit [Ref. 3] published by the Cooling Technology Institute (CTI), the off-design condensing temperatures and pressures are calculable for each operating point.

Figure 1 (attached) displays the calculated efficiency for all the operating points vs. steam flow expressed as a percentage of the design steam flow. The slight variation in efficiency at a given steam flow is a result of the variation in turbine exhaust pressure resulting from the variation in ambient wet bulb temperature and its effect on the performance of the cooling tower. Figure 2 (attached) displays the effect of turbine exhaust pressure at constant steam flow. Each curve represents a narrow range of steam flow and illustrates the fall-off in efficiency with increasing turbine exhaust pressure. The family of curves indicates the fall-off in efficiency at constant exhaust pressure as the steam flow is reduced. The slight mismatch in the shape of the curves and their relative positions are due to slight imprecision in the tabulated data and the resulting effect on the curve fits.

TURBINE CHARACTERISTICS---DRY COOLING DESIGN

A similar analysis can be applied to the plant and turbine performance for a dry cooled design equipped with an ACC sized for a 40 °F ITD. However, this condition requires some additional explanation.

The ACC, when sized for the selected turbine and the required plant output, has the design specifications given in Table 1 under Case B and a heat duty of 1.74×10^9 Btu/hr or $520.6 \text{ MW}_{\text{th}}$. This combined with a turbine/generator output of 280 MW (gross) requires a thermal input to the power block of $800.6 \text{ MW}_{\text{th}}$ and would yield a gross efficiency of 35.% and a corresponding net efficiency of 31.2%. This agrees well with the net efficiency of 31.1% tabulated in Table 5 of the WorleyParsons report. (1)

However, the "Summary" page at the beginning of Appendix H where the comparative performance of the dry cooled plant is presented lists a gross output of 251.7 MW_e, a net output of 223.4 MW_e and a corresponding net efficiency of 31.3% (35.3% gross efficiency). This implies a thermal input to the power block of 713.7 MW_{th} corresponding to within 0.4% of that calculated for the system with a wet cooling system. Therefore, the comparative performance tabulated in Appendix H is based on a thermal input from the base solar field originally sized for the plant equipped with a wet cooling system.

This apparent internal inconsistency is acknowledged in the text of p. 8 (1) where the comparative cooling system performance analyses are discussed. The report notes that

"the FPLE⁷ requirement that the facility should have 250 net MW regardless of the heat rejection system".

and that, therefore,

"it has been assumed (emphasis added) that there is sufficient solar thermal energy available from the field to generate the necessary steam flow for the alternate cooling system to meet 250 net MW".

and further,

"Because of the requirement to meet 250 net MW at the design point, the performance table below shows equal plant output for all the cooling options at this operating condition. The performance item that then distinguishes the cooling options is the steam cycle efficiency so that a lower efficiency translates to increased solar thermal energy needed for the steam cycle".

Therefore, to meet the performance objectives as tabulated in Table 5 (1), an expanded solar field capable of delivering 800.6 MW_{th} (or approximately 12% more input power than the 714 MW_{th} available from the base field) is required.

The initial comparison of plant performance with dry cooling to plant performance with wet cooling will be made assuming the base field input of 714 MW_{th} in order to be consistent with and comparable to the results tabulated in Appendix H or the WorleyParsons report with the following system design point.

Design gross output:	251.7 MW _e
Design net output:	223.4 MW _e
Design thermal input:	713.7 MW _{th}
Design efficiency (gross):	35.3%
Design efficiency (net):	31.3%

An important difference between the operation of dry cooled plants and wet cooled plants occurs at low turbine exhaust pressures. Wet cooled plants can operate at low turbine exhaust pressures as low as 0.5 to 1. in Hga. Dry cooled plants are normally

⁷ FPL Energy

controlled to maintain the turbine exhaust pressure above 2. in Hga. This is a result of the fact that large ACC's are subject to some amount of air in-leakage which must be removed with air removal equipment such as air ejectors. At backpressures below 2 in Hga the air in-leakage becomes large and difficult to handle. Therefore, at conditions where the turbine exhaust pressure would fall below 2. in Hga (low steam flow and/or low ambient temperatures) some of the ACC fans are operated at half speed or shut down entirely to maintain the backpressure at 2. in Hga.

The ability to operate at low turbine exhaust pressures gives the wet cooled plants and additional efficiency advantage as shown in Figure 2. Also, as seen in that figure, the curves bend over and approach a maximum efficiency for any given steam flow as the backpressure drops below 1 in Hga.

The efficiency curves for the dry cooled turbine are shown in two parts. For turbine backpressures above 2 in Hga, Figure 3 (attached) shows cycle efficiency vs. turbine exhaust pressure for several narrow ranges of steam flow. Figure 4 (attached) shows the cycle efficiency vs. % of design steam flow for turbine exhaust pressure controlled to 2 in Hga.

COMPARISON OF WET AND DRY COOLED PLANTS

Figure 5 (attached) displays the comparative cycle efficiency between the wet cooled plant and the dry cooled plant. Three points are noteworthy. First, the turbine used with wet cooling is consistently more efficient over the entire range of operating conditions than the turbine used with dry cooling. Second, the variation (spread in the plotted points) at the higher flow rates is substantially greater for the dry cooled turbine than for the wet cooled turbine. This results from the greater variation in backpressure with ambient conditions for a dry cooled plant than for a wet cooled plant. This occurs because the seasonal and diurnal variation in dry bulb temperature is greater than the concurrent variation in wet bulb temperature with a correspondingly greater variation in turbine exhaust pressure. Finally, the increasing difference in cycle efficiencies at the lower flow rates is related to the reduction in condenser range and TTD at the lower heat duties which benefits the wet system and the decrease in Q/ITD at the lower back pressures which hurts the dry system.

Figure 6 (attached) displays the comparative net output for the two plants. The abscissa on this plot is divided into months. Within each month, the individual points are the output for a particular hour of an average day for that month. The points are for only those hours of the day during which the output of the solar field is sufficient to operate the plants...typically from early morning to late afternoon.

On the basis of this comparison which assumes the use of an ACC with a 40°F ITD and a constant solar field size and a synthetic solar field output model, the wet cooled plant delivers just over 8% more net electrical output than does the dry cooled plant. The annual net output totals (725,745 MWh for the wet cooled plant; 671,226 MWh for the dry cooled plant) are not representative of realistic operation because of the "synthetic" solar field output, but the ratios are indicative of the effect of the relative performance of the alternative cooling systems.

ADDITIONAL COMPARISONS

Two further comparisons are relevant. These are:

1. the effect of different size ACC's on plant performance.
2. the effect of expanding the solar field to meet the required net output of 250 MW_e at design conditions on the annual output.

EFFECT OF DIFFERENT SIZE ACC'S:

The choice of a larger (lower ITD) or smaller (higher ITD) ACC will affect the plant performance both at the design point and throughout the year by changing the turbine exhaust pressure achieved for any given combination of steam flow and ambient temperature.

The performance differences relative to the dry cooled plant with a 40°F ACC are estimated for both a larger (35°F ITD) and a smaller (45°F ITD) ACC. An important assumption made in this comparison is that the same turbine characteristics are used in all three cases. While this need not be the case in practice, it is consistent with other published studies on this subject and is also all that can be done in this study with the information available. It is not believed that it would have a significant effect on the comparisons.

The determination of efficiency for the 40°F ITD unit was straightforward since both the thermal input to the power block and the net power output were known from Appendix G (1). For the other two ACC's, the calculation is an iterative one since the thermal input is known but the power output and the heat duty on the ACC are not. The calculation begins with the assumption that the cycle efficiency and hence the heat duty on the ACC are the same as for the 40°F ITD case. For that assumed heat duty and the known ACC capability (Q/ITD) of the selected ACC, the ITD, condensing temperature, and condensing pressure can be calculated for each point. Assuming, as noted above, that the turbine characteristics are the same as for the 40°F ITD case, a cycle efficiency, net power output and ACC heat duty can be determined, all of which will differ from the 40°F ITD case. The calculations are then repeated using the new value for the ACC heat duty, and the process is repeated until the results converge. The final results of cycle efficiency and net output for each of the ACC's are shown for each operating hour of the year in Figure 7 (Cycle efficiency) and Figure 8 (Net output).

Figure 7 (attached) shows the cycle efficiencies for the three cases. Figure 8 (attached) displays the comparable net output profiles.

As can be seen the differences are quite small. The ordinate scale in Figure 8 (attached) is expanded compared to the similar plot in Figure 6 (attached) in order to make the differences even slightly visible. The more relevant comparison is among the total annual net outputs which are tabulated in Table 3.

Table 3: Comparative Annual Output with Different ACC's

Cooling System	Wet Cooled	Dry Cooled		
ITD		35	40	45
Annual Output, MWh	725,000	667,000	665,000	664,000
% of Wet Cooled Plant	Base	92.	91.7	91.6
Reduced Output	Base	58,000	60,000	61,000

EFFECT OF EXPANDED SOLAR FIELD

A suggested approach to compensating for the reduced cycle efficiency and plant output with dry cooling is to expand the solar field and some of the plant components to provide increased thermal input to the power block and increased steam flow to the turbine. The following considerations are relevant to making an appropriate comparison.

As noted previously, the existing (base) solar field in combination with a 40°F ITD ACC produces a gross plant output of 251.7 MW_e, a net plant output of 223.4 MW_e at the design ambient temperature of 103.5°F. This corresponds to a gross cycle efficiency of 35.3% and a net plant efficiency of 31.3% implying a thermal input to the power block of 714. MW_{th}. This further implies a heat duty to the ACC of 462 MW_{th} (1.58×10^9 Btu/hr) which is less than the 1.78×10^9 Btu per hour heat duty for which the 40°F ITD ACC was designed. Therefore the backpressure is well below the design value even at the design ambient temperature.

In comparison to the same solar field input to a thermal block equipped with the wet cooling system, the net output at design is reduced by 10.6% and the annual net output by 7.5%. However, these analyses are based on the performance of an ACC sized by the supplier for the full design heat duty of 1.78×10^9 Btu/hr (See Table 1) or 520.6 MW_{th} at a turbine backpressure of 6.44 in Hga at an ambient temperature of 103.5°F. A heat balance on the power block for this operating point requires a thermal input from the solar field of 800.6 MW_{th} or a 12% increase over the base solar field input of 715. MW_{th}.

Figure 9 (attached) shows the hourly plant net output with a solar field expanded by 12% compared to the base case determined previously and plotted in Figure 6. It should be noted that for several conditions, the net output exceeds the net design output. This results from the fact that the annual profile used in Appendix G (1) and in this study, includes periods of high insolation coincident with ambient temperatures well below the design level of 103.5°F. The increased capacity is then available to provide added plant output throughout the year.

Figure 10 (attached) shows the net output of the expanded solar field with the dry-cooled plant compared to the base solar field with the wet-cooled plant originally plotted in Figure 6. It is seen that the dry cooled plant output exceeds the wet cooled plant output in this comparison for nearly the entire year. They would be equal at the design point, but the design condition is never reached in this annual profile.

The assumed field expansion used in the WorleyParsons (1) report was a solar field cost increase of 13% which agrees well with the calculated 12% increase in thermal input necessary to meet the design requirements. (Table 3 of Reference 1).

Table 4 summarizes the annual net energy production in MWh for the several cases discussed.

Table 4: Comparison of Net Annual Outputs from Alternate Systems

System	Annual Net Output	Difference from Base, wet	% Difference
	MWH	MWh	%
Base field, wet cooled	725,436	0	0.0%
Base field, dry cooled	665,460	-59,976	-8.3%
12% expanded, dry cooling	755,512	30,076	4.1%

HYBRID COOLING

An alternative to either an all-wet or an all-dry cooling system is the hybrid system consisting of an air-cooled condenser operating in parallel with a conventional surface steam condenser paired with a wet cooling tower. The plant would operate using the dry portion alone for periods of low solar insolation or low ambient temperatures during which a sufficiently low turbine exhaust pressure can be maintained. At higher insolation levels or higher ambient temperatures, if the turbine exhaust pressure rises above desired levels, the wet system fans and circulating water pumps are turned on and a portion of the steam flow and heat duty diverts to the surface condenser. The system will equilibrate at a lower turbine exhaust pressure with the steam flow divided between the wet and dry portions of the cooling system in the proportion where both reach the same condensing pressure.

The design approach taken in the WorleyParsons report (1) was the following:

1. Three ACC's of different sizes were selected to carry the cooling loads consistent with plant net electrical outputs of 250, 200 and 150 MWe respectively while maintaining a turbine exhaust pressure of 2.97 in Hga at an ambient temperature of 71°F.
2. For each ACC, a wet cooling system was sized to have the cooling capability which, in conjunction with the corresponding ACC, would meet the plant cooling requirements consistent with a net electrical output of 250 MWe maintaining a turbine exhaust pressure of 5.1 in Hga at the design ambient conditions of an ambient temperature of 103.5°F and an ambient wet bulb temperature of 68°F.

The basis for the choice of the design criteria of backpressure and ambient conditions was not discussed in the report (1). However, based on the stated criteria, the operating points for the wet and dry portions and for the integrated hybrid cooling system are listed in Tables 5, 6 and 7.

Table 5: ACC Design Specifications

Quantity	Case		
	"250 MW"	"200 MW"	"150 MW"
Tamb, F	71	71	71
Steam flow, lb/hr	1,672,843	1,272,761	1,084,459
Steam enthalpy, Btu/lb	1,010	1,010	1,010
Condensate enthalpy, Btu/lb	83	83	83
Exhaust pressure, in Hga	2.97	2.97	2.97
Tcond, F	114.70	114.70	114.70
ITD, F	43.70	43.70	43.70
Heat duty, Btu/hr	1.551E+09	1.180E+09	1.006E+09
Q/ITD	3.55E+07	2.70E+07	2.30E+07

Table 6: Wet System Design Specifications

Quantity	Case		
	1	2	3
WBT, F	68	68	68
Water flow, gpm	41,768	63,811	74,039
HWT, F	110	110	110
CWT, F	85	85	85
TTD, F	24.5	24.5	24.5
Approach, F	17	17	17
Tcond, F	134.5	134.5	134.5
Exhaust pressure, in Hga	5.10	5.10	5.10
Heat duty, Btu/hr	5.221E+08	7.976E+08	9.255E+08

Table 7: Hybrid Cooling System Design Specifications

Quantity	Case		
	1	2	3
Dry heat duty, Btu/hr	1.134E+09	8.583E+08	7.304E+08
Wet heat duty, Btu/hr	5.221E+08	7.976E+08	9.255E+08
Total, Btu/hr	1.656E+09	1.656E+09	1.656E+09
Qrej, MWth	485.2	485.2	485.2
Gross output, Mwe	280.0	280.0	280.0
Power block input, MWth	765.2	765.2	765.2
Implied efficiency	36.59%	36.59%	36.59%
Net output, Mwe	250	250	250
Net efficiency	32.67%	32.67%	32.67%

The values for the hybrid system at design conditions can be used, as previously in the case of the all-dry system, to evaluate plant cycle efficiency. The total heat rejected is 1.656×10^9 Btu/hr (~MWh) for a gross electrical output of 280 MWe. This requires a thermal input to the power block of 765.2 MWth and implies a gross efficiency of 36.6% and a net efficiency of 32.7%. Two points are noteworthy:

1. The net efficiency compares well with that tabulated in Table 5 of the Worley Parsons report (1)
2. The thermal input for the solar field of 765.2 MWth (for Case 1) is approximately 7.2% greater than that from the base solar field at design conditions of 714. MWth. This corresponds well to the 7.6% increase in solar field cost indicated in Table 3 of the Worley Parsons report (1).

The steam flow at design conditions for 280 MWe gross output is 1.78×10^6 lb/hr. The steam turbine to be used in conjunction with a hybrid cooling system will be similar in design and performance characteristics to the turbine used with dry cooling, since it must operate at elevated turbine exhaust pressures above 5. in Hga. Therefore, the turbine curves will be assumed to be the same as those of the turbine used in the dry cooling analysis. The cycle efficiency as a function of steam flow (expressed as a percentage of the design steam flow) and exhaust pressure will be the same as shown in Figures 3 and 4.

The determination of the operating point and net power output for each of the 160 conditions used in Appendices G and H proceeds as follows:

First, the turbine exhaust pressure achievable with the ACC alone is calculated using the same approach used in the previous section but using the ACC sized for the "250 MW" hybrid system. Since the operation of an ACC is controlled to maintain the condensing pressure at or above 2. in Hga, all conditions for which the ACC alone achieves a condensing pressure of 2. in Hga or lower, are "all dry" operating points with a condensing pressure of 2. in Hga. The cycle efficiency for these conditions is determined with the correlation shown in Figure 4 with the "% flow" calculated as the ratio of the actual thermal input to the design thermal input of 765.2 MWth. Of the 160 operating conditions, 67 result in all dry operation and are distributed throughout the year at times of low insolation and low ambient temperature. The points are plotted in Figure 11 (attached) as the thermal input to the power block vs. the ambient temperature for all points where the dry section alone achieves a condensing pressure of 2. in Hga or lower.. A rough boundary shows the combination of thermal input and ambient temperature below which no wet cooling is required to maintain 2 in Hga.

For the remaining points, some degree of wet cooling can be used to reduce the turbine exhaust pressure and increase the cycle efficiency. The split of the heat load between the dry and wet parts of the hybrid cooling system and the resulting turbine exhaust pressure, cycle efficiency and net plant output is determined through an iterative calculation as follows:

1. For a given condition, specified by the thermal input to the power block, the ambient temperature and the ambient wet bulb temperature and an assumed cycle efficiency,

the total heat load to the cooling system is determined. (The design value of the cycle efficiency is used as a starting point)

2. A split in the heat duty between the wet and dry sections is assumed. (The design value of the split is used as a starting point.)
3. A condensing pressure is then calculated for both the wet and dry sections individually.
 - a. For the dry section...the ITD is determined assuming that Q/ITD is constant at the design value (See Table 5) for condensing pressures above 3.5 in Hga. For condensing pressures between 3.5 in Hga and 2. in Hga, a correction is applied to the Q/ITD . The ITD is calculated for the assumed heat duty and the condensing temperature is the sum of the ITD and the ambient temperature.
 - b. For the wet section...the range, the TTD are scaled from the design values by the ratio of the heat duty to the design heat duty. The approach temperature is determined using the CTI Workbook (3) assuming tower and fill characteristics established using the design specifications. The condensing temperature is calculated from the sum of the wet bulb temperature, range, TTD and approach.
4. In general, the condensing pressures calculated for the two sections will differ. The split between the wet and dry heat duties is then adjusted until they are equal. This establishes the operating backpressure for the assumed total heat load. The calculated turbine exhaust pressure is used to calculate a new cycle efficiency.
5. The calculation is repeated using the new cycle efficiency and the iterations continued until the condensing pressure and the cycle efficiency converge, usually after two or three iterations.

If the resulting condensing pressure is 2. in Hga or lower, it is assumed that the wet cooling tower capability will be reduced by shutting off fans or reducing the circulating water flow until the pressure is raised to 2. in Hga for proper operation of the dry section ACC. The same adjustment could be made by modulating the dry portion but, in the interest of water conservation, the ACC will be maintained at full capability whenever possible. For these points, the condensing pressure is assumed to be 2. in Hga and the cycle efficiency is calculated on that basis using the correlation from Figure 4.

For all other points, the calculation proceeds to establish a balanced operating point where the condensing pressures in both the wet and dry sections are the same at which the cycle efficiency and net plant output are determined.

CONCLUSION AND SUMMARY OF COMPARISONS

Figure 12 (attached) shows the comparison of the plant output profiles for the wet cooled plant and the hybrid cooled plant with an expanded solar field. Table 5 summarizes the annual output for all systems analyzed including the hybrid system. The 0.4% output shortfall compared to the wet system is within the level of precision possible with the information available to this study and the performance of the two systems is essentially identical.

Table 5: Comparison of Annual Net Output from Plant with Alternative Cooling Systems

System	Annual Net Output	Difference from Base, wet	% Difference
	MWH	MWh	%
Base field, wet cooled	725,436	0	0.0%
Base field, dry cooled	665,460	-59,976	-8.3%
12% expanded, dry cooling	755,512	30,076	4.1%
7% expanded, hybrid cooling	722,000	-3,000	-0.4%

APPENDIX B, REFERENCES

FPLÉ – Beacon Solar Energy Project: Dry Cooling Evaluation, Prepared by WorleyParsons Group, Inc., Report No. FPLS-0-LI-450-0001 Rev B, February, 1, 2008.

Personal communication, J. Foster, July, 2009

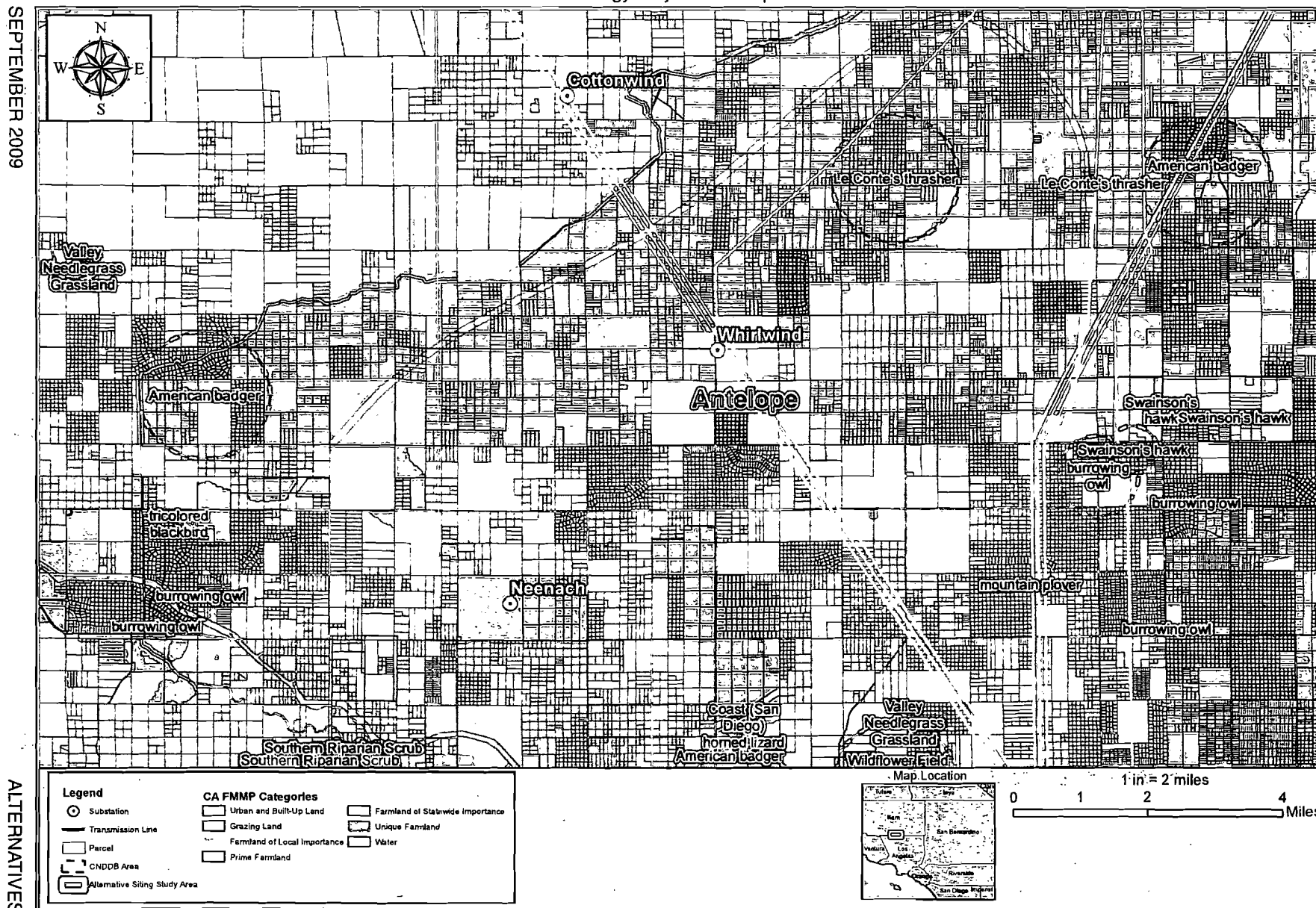
CTI ToolKit, Cooling Technology Institute,

CONFIDENTIAL APPENDIX C

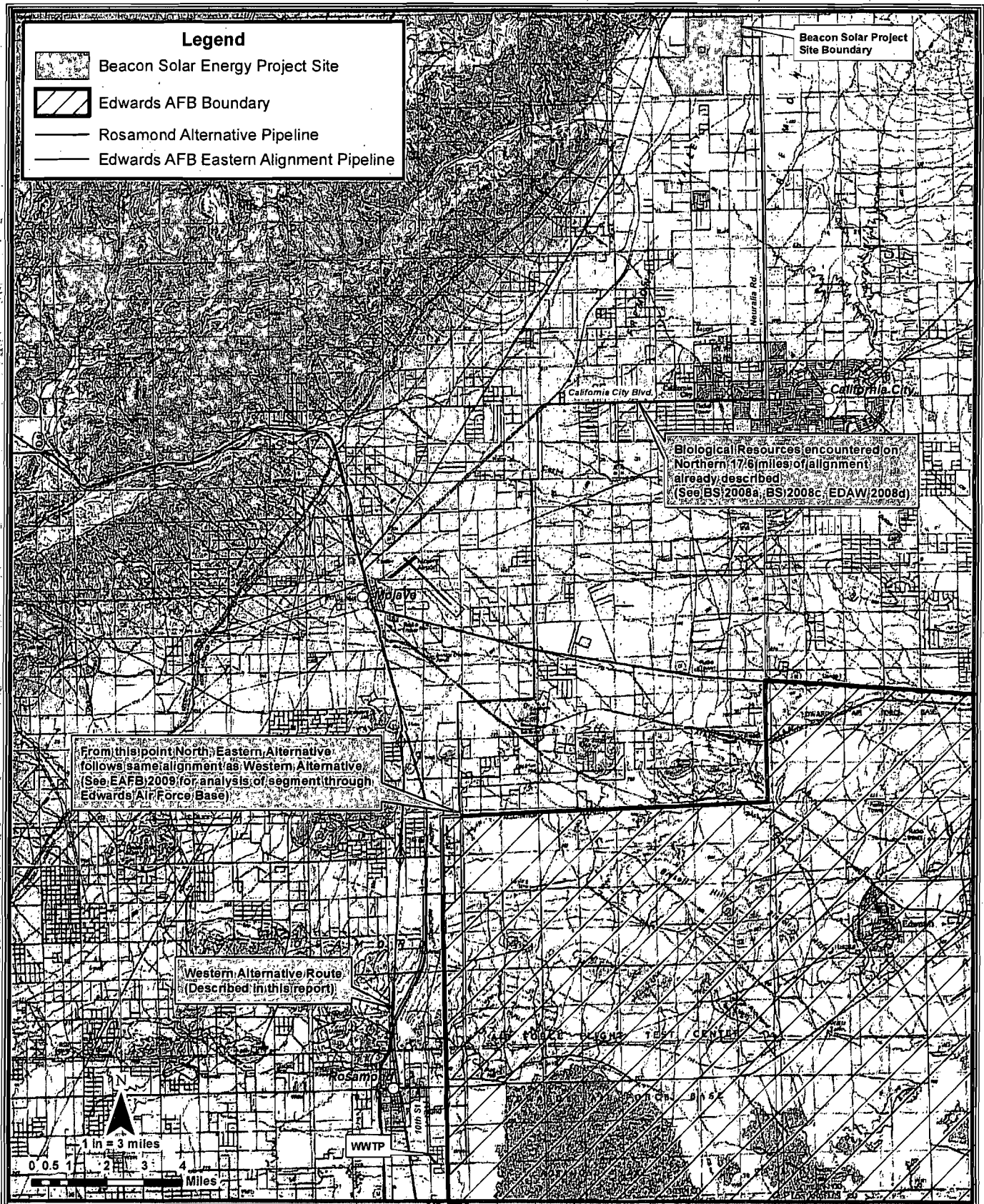
1. Revenue Model for Dry Cooling
(Intentionally Omitted)
2. Revenue Model for Rosamond Community Services District Alternative
(Intentionally Omitted)
3. Revenue Model for California City Alternative
(Intentionally Omitted)
4. Confidential Appendix C, Figure 1 – Revenue and Internal Rate of Return (IRR)
Summary Chart
(Intentionally Omitted)

ALTERNATIVES - FIGURE 1

Beacon Solar Energy Project - Antelope Site Alternative

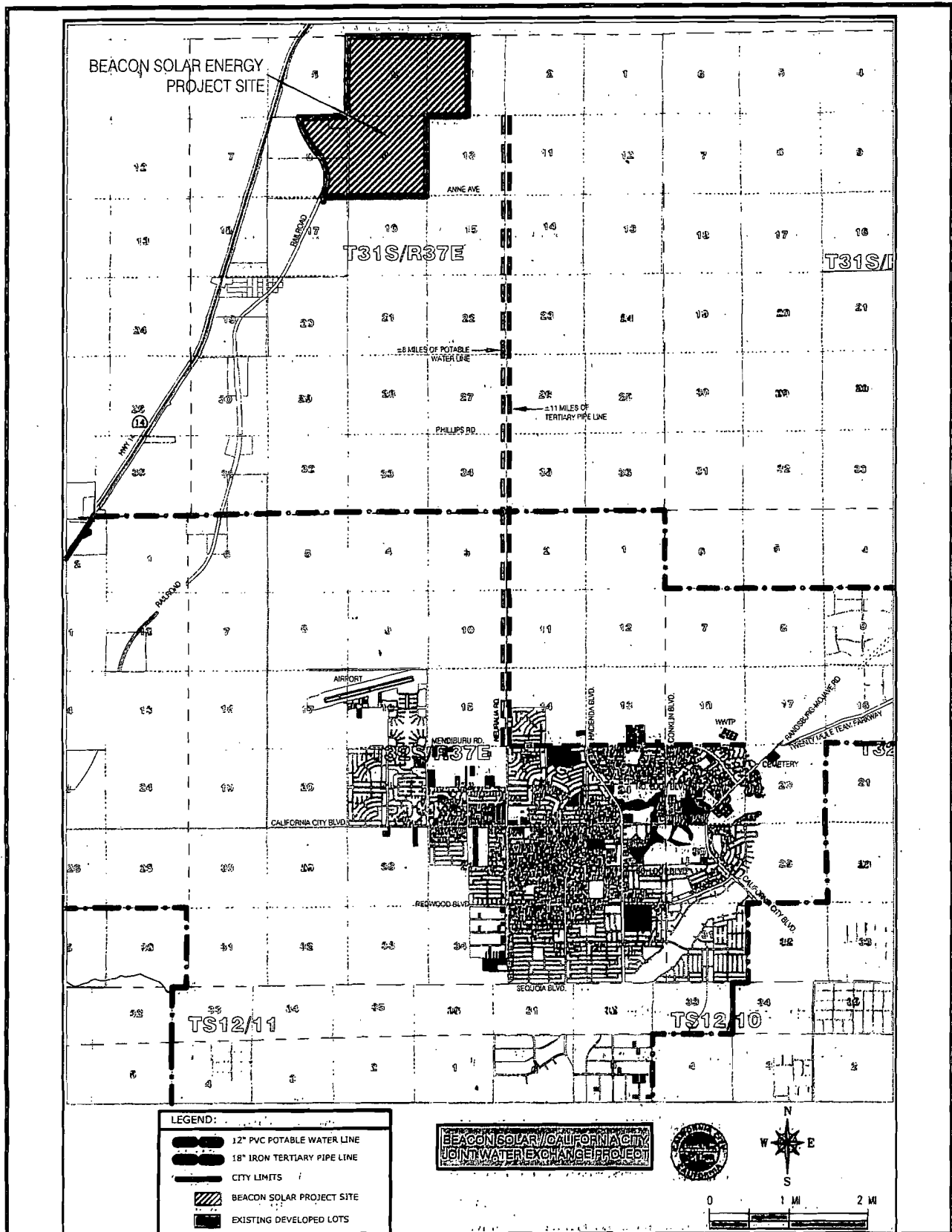


ALTERNATIVES - FIGURE 2 **Beacon Solar Energy Project - Vicinity Map**



CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
 SOURCE: California Energy Commission - TOPO Map - 7.5 minute USGS quadrangles: Rosamond, Soledad Mtn, Bissell, Sanborn and Mohave NE

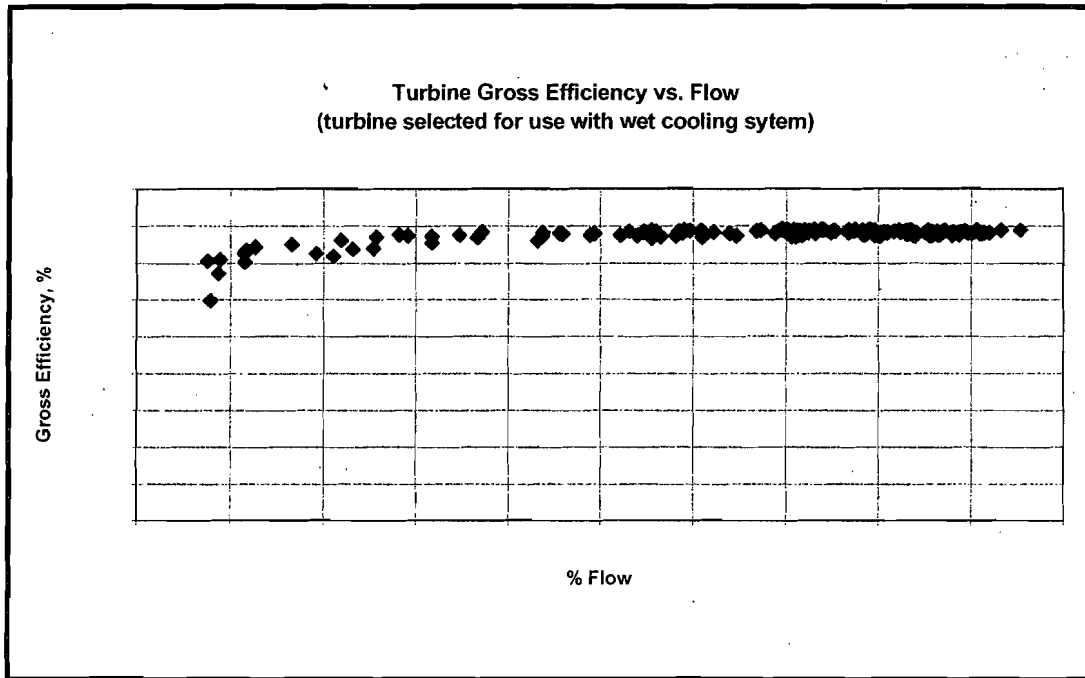
ALTERNATIVES - FIGURE 4 **Beacon Solar Energy Project - California City Alternative**



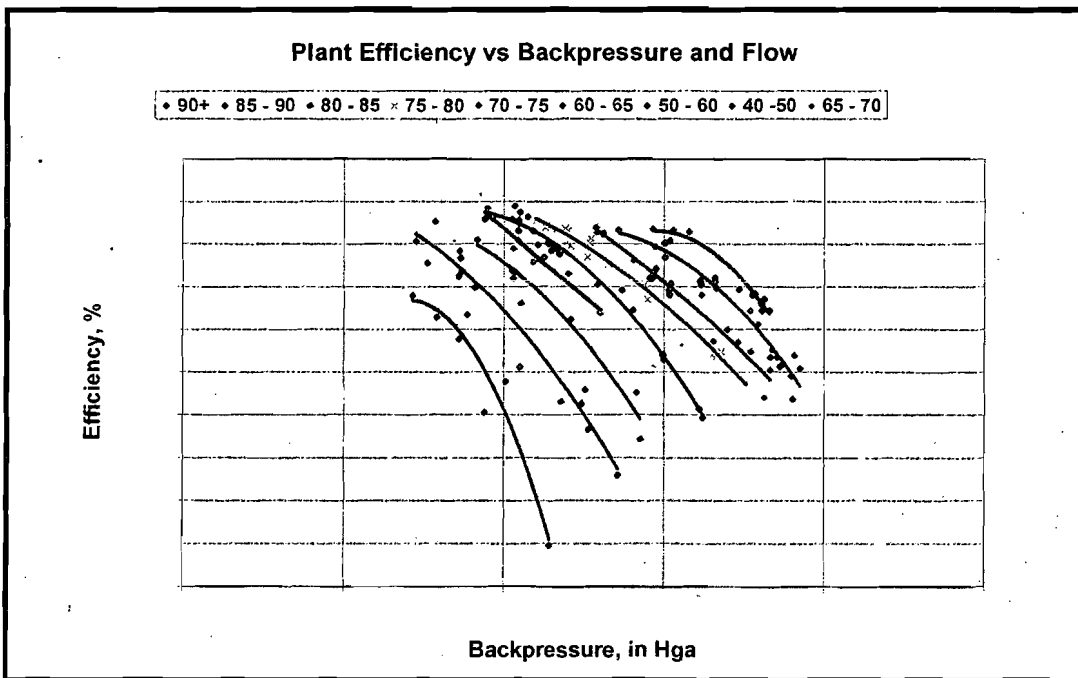
CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
 SOURCE: City of California City, Public Works Department

APPENDIX B - FIGURE 1 & 2
Beacon Solar Energy Project

Variations in Gross Cycle Efficiency vs. Steam Flow (wet cooled turbine)

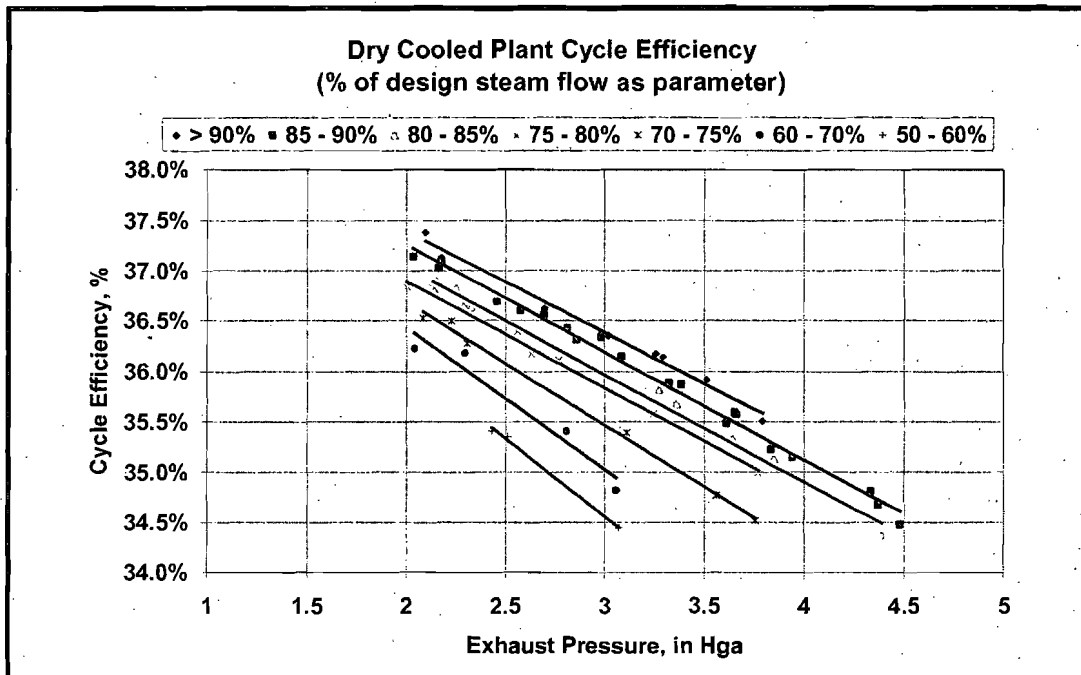


Variations in Gross Cycle Efficiency vs. Turbine Exhaust Pressure
(for different steam flow rates)

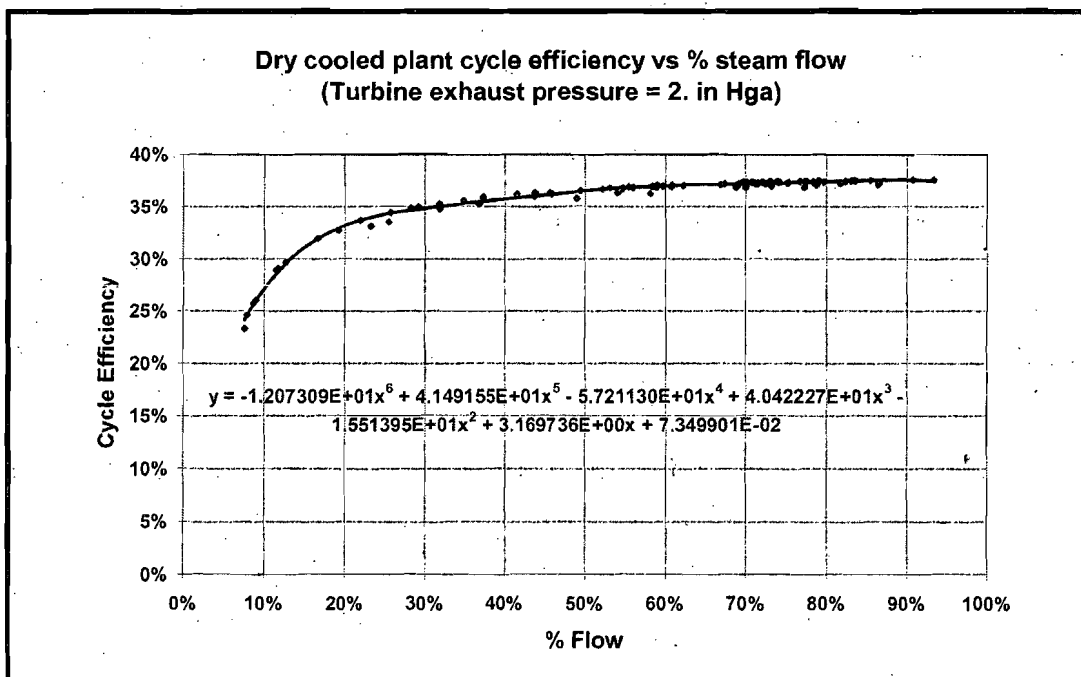


APPENDIX B - FIGURE 3 & 4
Beacon Solar Energy Project

Dry Cooling Turbine Efficiency vs. Backpressure (flow as parameter)



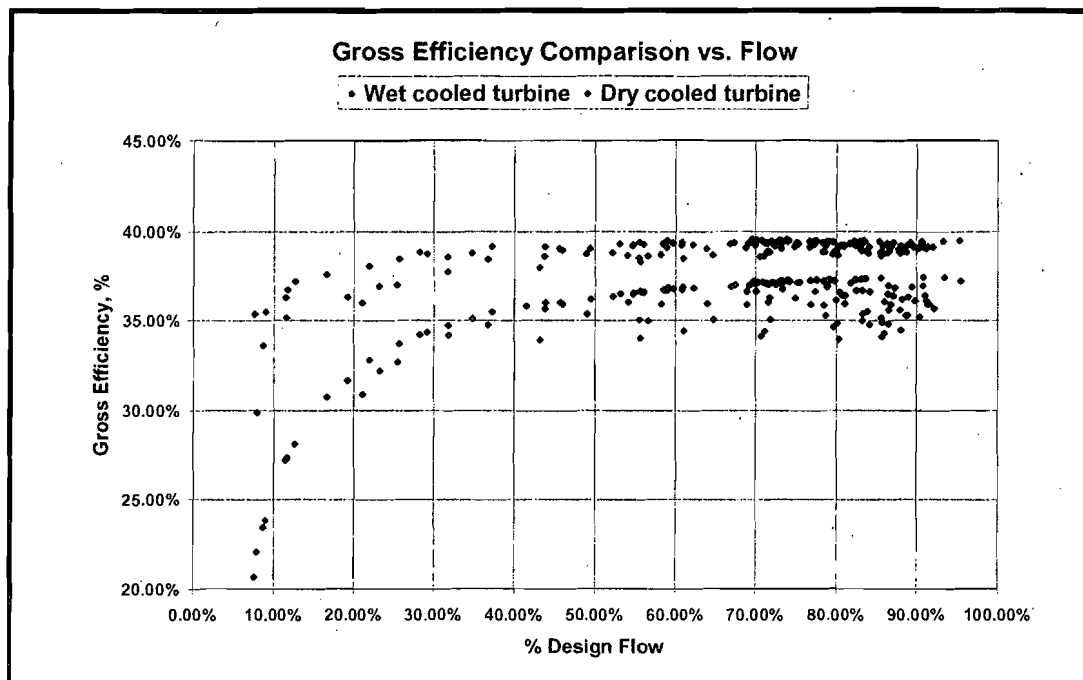
Dry Cooling Turbine Efficiency vs. Steam Flow (Backpressure of 2. in Hga)



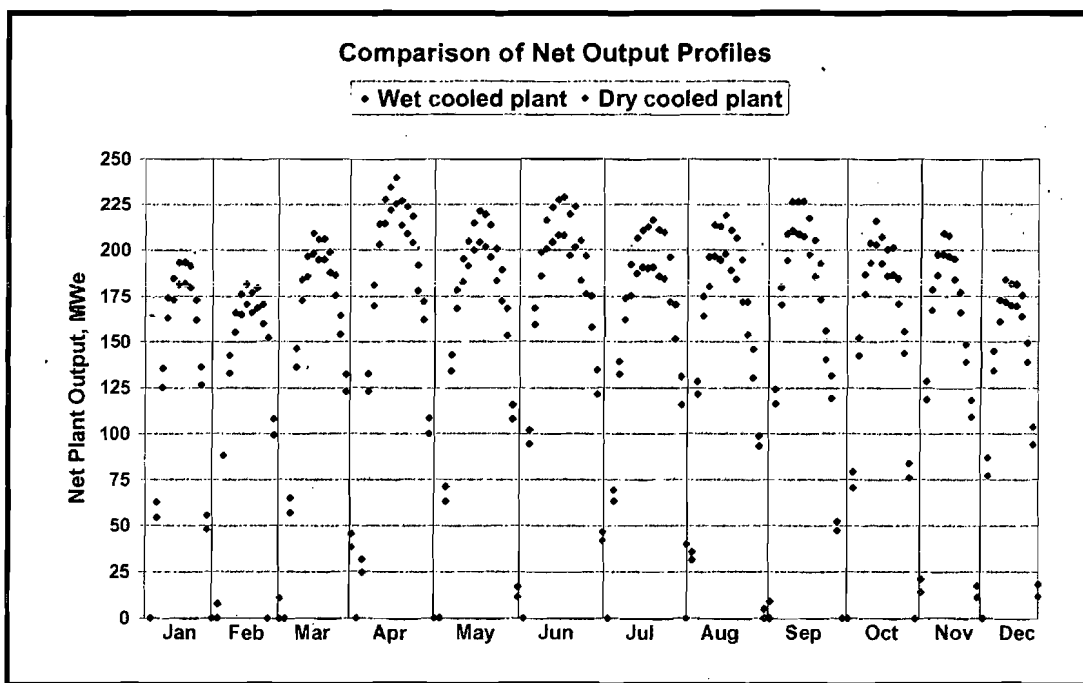
APPENDIX B - FIGURE 5 & 6

Beacon Solar Energy Project

Cycle Efficiency Comparison of Wet and Dry Cooled Plants



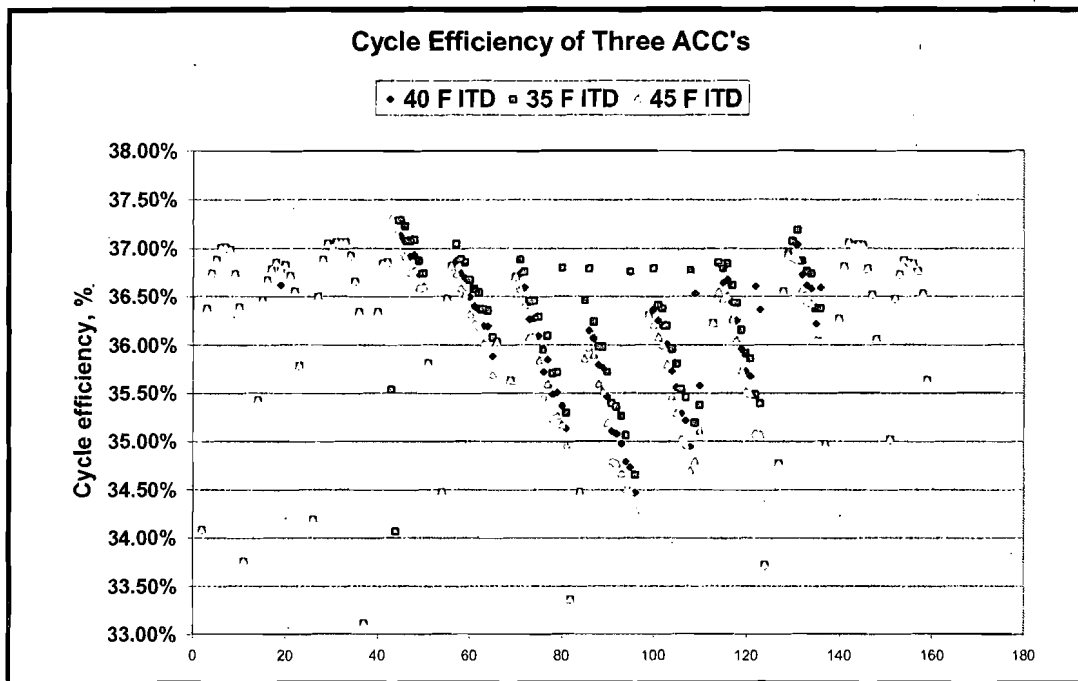
Net Output Comparison of Wet and Dry Cooled Plants



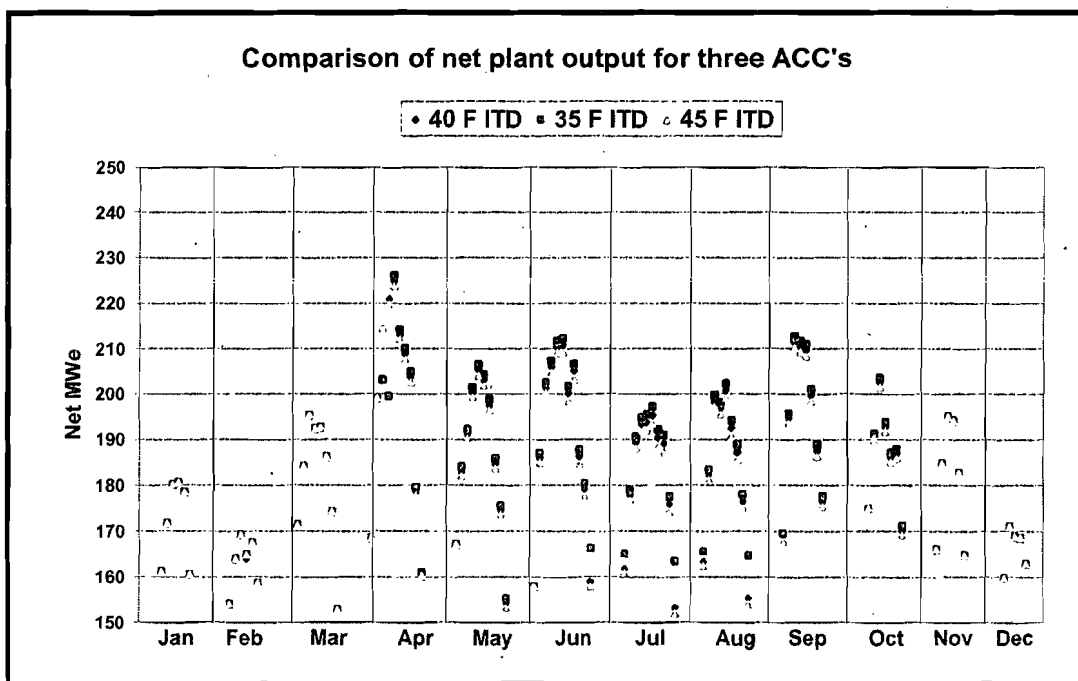
CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
SOURCE: APPENDIX B Maulbetsch 8-30-09

APPENDIX B - FIGURE 7 & 8
Beacon Solar Energy Project

Comparison of Cycle Efficiencies for Three ACC's



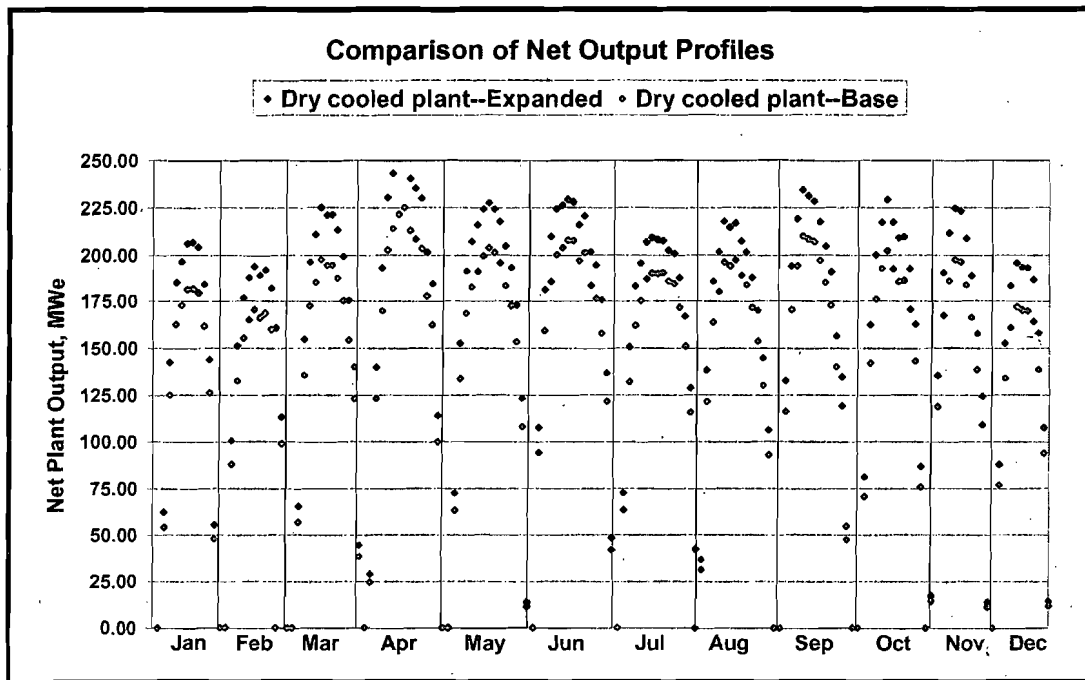
Comparison of Plant Net Output Profiles for Three ACC's



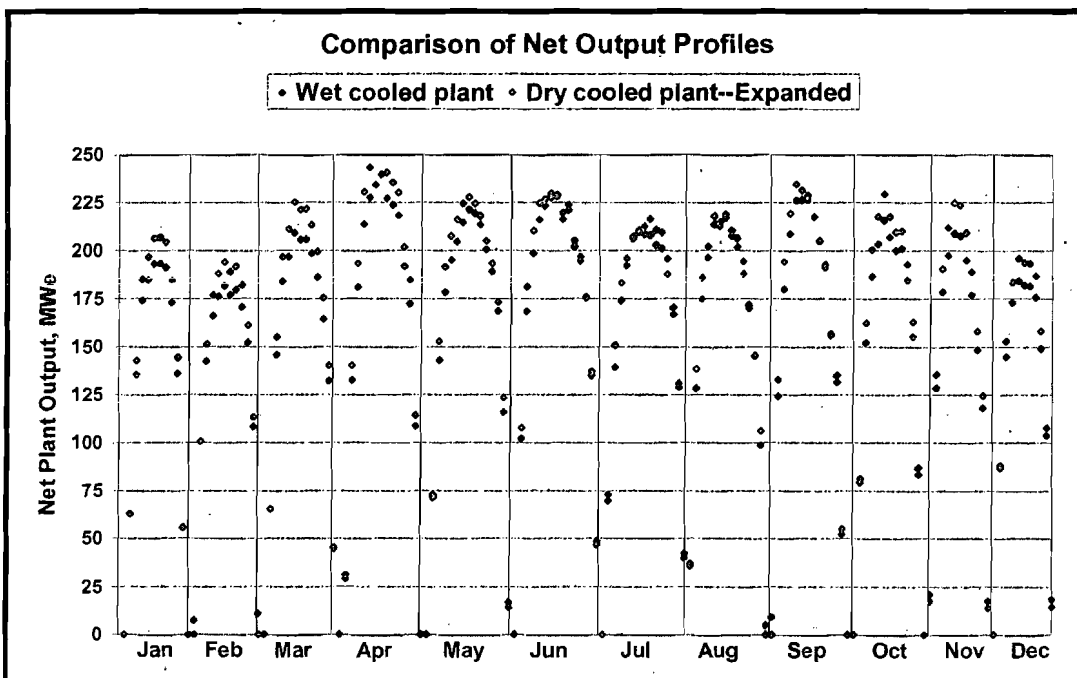
CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
SOURCE: APPENDIX B Maulbetsch 8-30-09

APPENDIX B - FIGURE 9 & 10
Beacon Solar Energy Project

Expanded Field Performance



Expanded Field Performance (12% Expansion)

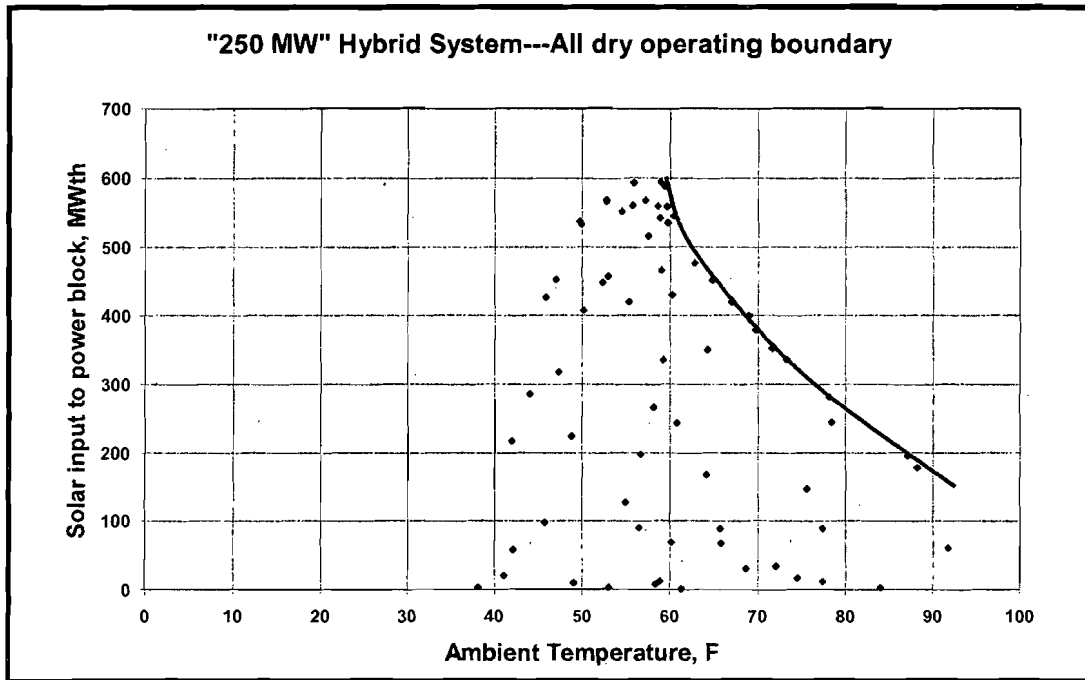


CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
SOURCE: APPENDIX B Maulbetsch 8-30-09

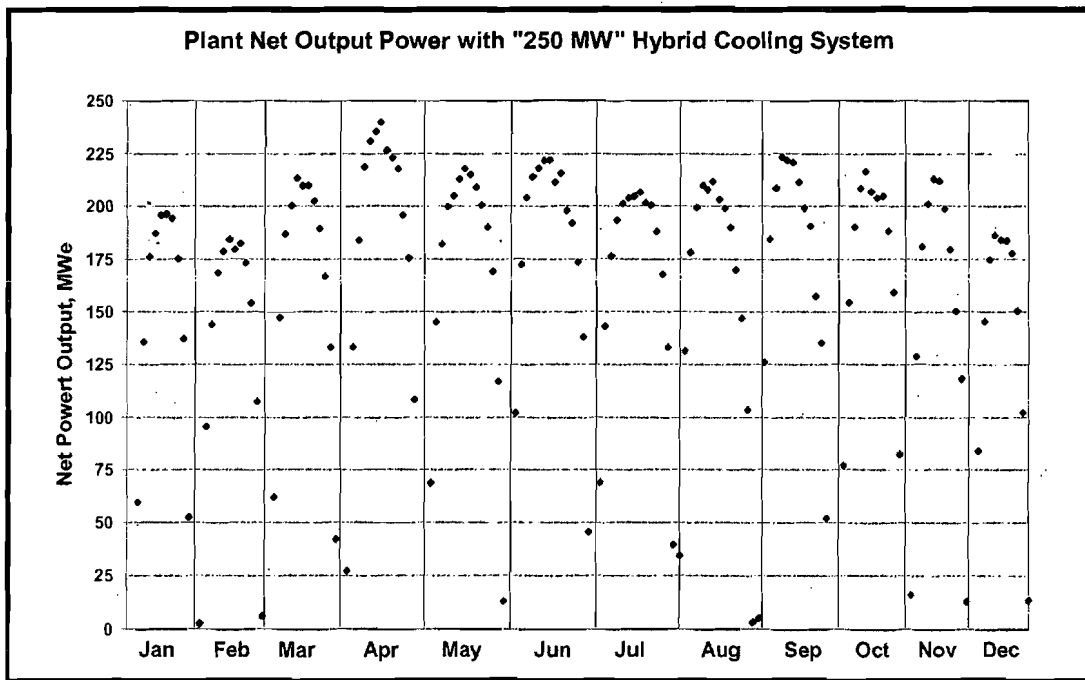
APPENDIX B - FIGURE 11 & 12

Beacon Solar Energy Project

"All Dry" Operation Conditions With Boundary



Annual Operating Profile for Plant with "250 MW" Hybrid System



CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION, SEPTEMBER 2009
SOURCE: APPENDIX B Maulbetsch 8-30-09

APPENDIX B - FIGURE 13

Beacon Solar Energy Project - Comparison of Output Profiles Wet vs. Hybrid

Comparison of Net Output Profiles

• Wet cooled plant • Hybrid plant--Expanded

