Attachment 5
Groundwater Mitigation Plan

Groundwater Mitigation Plan
Beacon Solar Energy Project
Kern County California

Beacon Solar, LLC (Beacon) continues to believe that the Beacon Solar Energy Project (BSEP) does not have the potential to significantly impact groundwater resources. Nevertheless, to address agency concerns over the project's potential impacts to groundwater, Beacon is proposing a groundwater mitigation program with the following four components:

1. Implementing a partial zero liquid discharge (ZLD) process.
2. Incorporating low impact development (LID) practices to facilitate groundwater recharge.
3. Developing and implementing a Tamarisk Removal Program.
4. Monitoring of groundwater within the BSEP Plant Site and adjacent area.

This memorandum summarizes each groundwater mitigation component.

1. Partial Zero Liquid Discharge System

Beacon has proposed to modify the BSEP design to incorporate a partial zero-liquid discharge (ZLD) (i.e., brine concentration) process for the express purpose of reducing water demand to the project. A partial ZLD system will reduce the amount of on site groundwater needed for cooling and will reduce the amount of water discharged to the evaporation ponds therefore reduce the evaporation pond size. The partial ZLD includes pre- and post-treatment systems before and after the cooling tower. The pre-treatment processes are designed to reduce total dissolved solids concentrations (TDS) and scaling species in water entering the cooling water system. Post-treatment includes a brine concentrator, which is placed directly upstream of water discharge into the evaporation ponds. The brine concentrator is a partial ZLD system, as 90% of the process water will be recovered in the brine concentrator to reduce water consumption and significantly decrease the evaporation pond size. Discharge to the post-treatment brine concentrator and the evaporation ponds is derived from two primary sources and one occasional source, listed as follows:

- Blow down of circulating water from the cooling tower;
- Wastewater flow from the ion exchange regeneration stream; and
- Occasionally, storm water accumulated in the proposed LTU that will be used to treat soil affected by spills of HTF.

Wastewater from these sources will be routed to a brine concentrator, where water is boiled off from the feed stream and a slurry, high in dissolved solids, is discharged to the evaporation ponds. Incorporation of the partial ZLD process would result in a reduction in on site groundwater demand for the project by approximately 200 acre-feet per year (AFY).

2. Low Impact Development

The project has been redesigned to incorporate LID practices into the facility layout and design. LID is a process of incorporating best management practices that address water flows and water

quality using onsite processes that minimize hydromodification impacts. As part of the LID design, Beacon has incorporated a series of retention basins across the Plant Site that will contain average storm events and infiltrate the runoff. This approach provides a two-fold benefit: (1) treatment of the first flush and (2) infiltration and recharge of the groundwater basin. The retention basins have been designed to retain flows for the water quality storm event using the Kern County guidelines. More detail on the retention design has been provided as a separate submittal.

3. Tamarisk Removal Program

The purpose of the Tamarisk Removal Program is to provide for an additional mechanism to mitigate for potential impacts to groundwater supply as a result of water use by the BSEP. This component not only provides benefits to the groundwater system, but also provides a substantial biological benefit by the removal of an invasive species that out-competes native vegetation and alters the natural desert ecosystem functions and values by converting the habitats into monocultures void of the diversity that supports native flora and fauna populations.

Tamarisk (salt cedar) is native to southwestern Asia and was introduced to the United States in the early 1800's for wind breaks. In the western United States, tamarisk is a highly invasive weed that has taken hold in semi-arid and arid watersheds in recent decades[1]. Tamarisk can consume up to 250 gallons of ground water per day per mature tree[2]. In addition, it competes for resources utilized by native species and in many cases disrupts ecological cycles. Previous studies suggest that tamarisk spread has significant effects on river channel morphology including the ability to decrease channel width, increase overbank flooding, stabilize sand bars at river bends, and enlarge and stabilize islands[3]. Local Bureau of Land Management (BLM) representatives in Kern County have expressed concern over the spreading of tamarisk in the watersheds surrounding BSEP and have expressed interest in a program for tamarisk removal.

A summary of the proposed approach for the Tamarisk Removal Program is provided below. A detailed plan would be developed prior to implementation that would document the program purpose and components, including implementation mechanisms, monitoring and maintenance, and funding mechanisms.

Tamarisk Removal Program Funding

Program implementation, maintenance, and monitoring would be funded through an Endowment Fund established by Beacon. The fund would be held and managed by the BLM and/or RCD

---

[1] de Gouvenain, Roland C. "Origin, History and Current Range of Saltcedar in the U.S." 1996. USDI Bureau of Land Management. 11 June 2009 http://www.invasivespeciesinfo.gov/docs/news/workshopJun96/ Paper1.html.>.

[2] "Non-Native Invasive Freshwater Plants." 2009. Department of Ecology, State of Washington. 11 June 2009 http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua013.html>.

[3] Lovich, Jeffery E. Phd. "A Brief Review of the Impacts of Tamarisk, or Saltcedar on Biodiversity in the New World." 1996. National Biological Service. 11 June 2009. <http://www.invasivespeciesinfo.gov/docs/news/workshopSep96/lovich.html>.

based on resources and mechanisms available. The BLM and RCD would use the fund to facilitate and manage implementation of the program.

Background Data Acquisition

A literature review would include researching background information on tamarisk, existing conditions of groundwater use and impacts specifically related to tamarisk, a description of Koehn Subarea Watershed/Cache Creek drainage area (area of concern), land ownership issues and requirements within Cache Creek drainage area including railway ownership, and a summary of GIS data to assist with mapping populations of tamarisk.

Stakeholder Coordination

Stakeholder coordination would occur with key agencies and groups including the BLM, Kern Weed Management Area, RCDs, and the Union and Southern Pacific Railroads. Stakeholder meetings are key to obtaining program support and access to private and public lands where tamarisk is located. Coordination with the railways is important for the implementation of tamarisk removal within their right-of-way (ROW). Coordination with the BLM and RCDs is important for identifying and securing funding mechanisms and managing resources for development of a cost-effective program.

Tamarisk Population Mapping

The current area of concern identified by the BLM for tamarisk removal is located within the Koehn sub-basin area of influence is the Cache Creek drainage. This area, however, needs to be mapped to better characterize the extent of tamarisk populations and the property ownership affected by the representative species. The area within the Cache Creek watershed will be assessed and tamarisk populations will be mapped using GPS and photo-documentation. Once tamarisk populations are identified, it will be possible to more accurately quantify total acreage and square footage of tamarisk trees, which will help determine the acre-feet per year of water absorbed by tamarisk in the Cache Creek drainage.

Tamarisk Removal Implementation

Implementation of the Tamarisk Removal Program will involve site preparation including site boundary identification, boundary marking, and permission to access property. Tamarisk will be removed from the specified areas using both manual and chemical means including use offhand tools such as saws and shovels and use of herbicides such as Rodeo ® or other chemical approved for use in waterways, if necessary. Tamarisk can be removed with use of contractors and local volunteer groups who have expressed interest in the Program. Herbicide application, if necessary, would only be performed by contractors who are licensed to apply herbicide by the State of California. Program implementation would be managed by the BLM and/or the RCD(s), based upon the funding mechanism established as discussed below.

Tamarisk Removal Monitoring

Monitoring is an integral part of the success of a re-vegetation project. A five-year monitoring program would begin after implementation of initial removal activities and would involve periodic visits to monitor the sites. A combination of horticultural (qualitative) and botanical (quantitative) methods would be used to track the progress of the sites according to success criteria that will be established for the Program. The results of these visits will be detailed in periodic status reports including a comparison of the progress of the mitigation areas with success criteria.

Tamarisk Removal Maintenance

If necessary, maintenance procedures such as dethatching (dead thatch removal), hand weeding, herbicide spot treatments, or other agency approved methods can be implemented to assist in meeting success criteria. Maintenance activities will utilize the most appropriate methods based on site conditions, rainfall patterns, and development stage of the weeds. Weed control may include dethatching (dead thatch removal), hand weeding, weed eating, herbicide application, or other agency approved methods.

Tamarisk Removal Program Mitigation

The Tamarisk Removal Program has the potential to conserve a substantial amount of groundwater consumption within the BSEP groundwater basin by removing a high water demand habitat that also monopolizes resources and negatively impacts native habitats in the area. A summary of water consumption estimates based on two scenarios is provided below.

Table 1a - Water savings assuming mature trees

VARIABLES		**Calculations**	
20	acres		
250	gallons/tree/day	Trees/Acre	217.8
200	sf/tree	Trees Removed	4356
43560	sf/acre	Gallons/Day	1089000
365	days/year	Gallons/Year	397485000
		Acre-feet/Year	
325,851	gal/ac-ft	**Savings**	**1220**

Table 1b - Water savings assuming a mix of mature and immature trees

VARIABLES -			
20	acres		
100	gallons/tree/day	Trees/Acre	435.6
100	sf/tree	Trees Removed	8712
43560	sf/acre	Gallons/Day	871200
365	days/year	Gallons/Year	317988000
		Acre-feet/Year	
325,851	gal/ac-ft	**Savings**	**976**

Conversion Factors

4. Groundwater Monitoring

The groundwater monitoring program was provided in the response to PSA comments (May 1, 2009) and represents a significant part of the approach toward groundwater mitigation for the project. The following is what was provided in the response to PSA comments.

Proposed Groundwater Monitoring Program

To provide for land owner protection and participation in evaluation of project impacts, a Koehn Sub-basin 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.

<u>Gather Historic Water Level and Water Quality Data</u>

- 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 affects from pumping in water level trends.

<u>Establish Pre-Project Baseline Water Quality and Water Level Database</u>

- 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 1,600 acre feet per year (AFY). Options to offset that include implementation of a partial ZLD and tamarisk removal program, which are described in detail above.

5. Summary

In summary, inclusive of the partial ZLD and estimates for the tamarisk removal program, the mitigation alternatives proposed could yield between about 1,200 to 1,400 AFY to the project in water savings. This represents about 75 to 87 percent of the total annual water demand (1600 AFY) for the project. This percentage may also be higher given the enhancement through storm water retention as proposed through Low-Impact Development.