

Exhibit A WORK STATEMENT

TECHNICAL TASK LIST

Task #	CPR	Task Name
1		Administration
2	X	Selection and monitoring of target taxa and subpopulations
3		Demographic data collection
3.1	X	Demographic data collection on marked plants at target subpopulations
3.2		Seedbank demography at study subpopulations
4		Data analysis, population viability analysis modeling and interpretation

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
1	Kara Moore and Bruce Pavlik-BMP Ecosciences	N/A	N/A
2	Kara Moore and Alison Stanton-BMP Ecosciences	N/A	Jepson Herbarium
3	Kara Moore and Alison Stanton-BMP Ecosciences	N/A	N/A
4	Kara Moore and Bruce Pavlik-BMP Ecosciences	N/A	N/A

GLOSSARY

Specific terms and acronyms used throughout this Statement of Work and the attached Project Narrative are defined as follows:

Term/Acronym	Definition
Annual	A plant life form that transitions from a germinating seed to an established and reproductive individual that makes progeny seeds in less than one year.
BLM	Bureau of Land Management
CPM	Commission Project Manager
CDCA	California Desert Conservation Area
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
Cooperative species	A taxon that has life history, morphological or physiological attributes that are amenable to measurement, manipulation, modeling and/or restoration.
CPM	Contract Project Manager
CPR	Critical Project Review
Demographic data	Information on classes of populations collected for statistical

	analysis (e.g., survivorship between stages [seed, seedling, non-reproductive adult], fecundity within stages)
Demographic stochasticity	Uncertainty in the fate of individuals in a population through time. It is simulated in some models by “rolling the dice” to determine for each newborn individual whether it is recruited to the established population (e.g. odd = death, even = recruited).
Energy Commission	California Energy Commission
Environmental stochasticity	Uncertainty in an environmental parameter (e.g. annual rainfall) through time that affects all individuals in a population in a similar way (but not necessarily to the same degree).
ETP	Extinction threshold population- The number of individuals in a population or subpopulation that has a pre-selected probability of being sustained over a pre-selected period of time under pre-defined conditions of the model. An updated alternative to MVP calculated in RAMAS Stage.
Fecundity	Annual reproductive output
GIS	Geographic Information System
Metapopulation	A collection of populations or subpopulations of a taxon that are interactively linked by processes of dispersal, establishment and extirpation among a set of isolated patches of occupied and unoccupied habitat
Metapopulation dynamics	The processes of dispersal, establishment and extirpation that determine the size, distribution and resilience of the metapopulation.
MVP	Minimum viable population- an expression of the probability of persistence (= 1-extirpation risk) of a population obtained from a PVA. It is expressed as the minimum (usually mean) population size of a given species in a given habitat that has a pre-selected probability of persisting (often 0.90, 0.95, 0.99) over a given time period (often 100, 500 or 1000 years). See also ETP for a more contemporary expression.
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
Plant taxa of conservation concern	A broad phrase that refers to sparsely distributed or low-abundance plants which may have special status or not.
Perennial	A plant life form that takes more than one year to transition from a germinating seed to a reproductive individual. May be herbaceous (e.g. a bulb-forming plant) or woody (e.g. a shrub).
Phenology	The timing of life cycle events (e.g. germination, flowering), usually linked to seasonality in higher latitudes (e.g. the temperate zone).
Physiognomy	The morphology of a landscape or a vegetation type - its outer “shape”, its architecture
PIER	Public Interest Energy Research

PVA	Population viability analysis- a modeling or data analysis technique that uses stage-or age-structured demographic data (e.g. survivorship between stages, fecundity within stages) to understand the sensitivity of a population to environmental and demographic stochasticity (uncertainty through time). It typically uses Monte Carlo simulation to incorporate stochasticity by using the measured variation (e.g. standard deviation) and statistical distribution (e.g. normal, lognormal) of demographic data obtained under field conditions in different years. Its output can be expressed as an MVP or as an extinction risk.
Integrated PVA	Objective determination of MVP or extinction risk using a single model to mathematically link demographic characteristics and simulate fluctuations in population size over time for a set number of iterations (often 1000).
Non-integrated PVA	Subjective determination of population health by examination of demographic characteristics as measured in multiple years under field conditions.
RAMAS	Commercially available software for performing PVA and obtaining ETP
Seed bank	The population of dormant individuals in the soil of a given habitat. For annuals it is the only buffer against extirpation, so germination triggers, dormancy, resistance to disease and predation, and the size of stored reserves are critical components of population viability.
Sensitivity analysis	A modeling exercise used in PVA to hold all variables constant except one (the experimental variable) to see how changing the magnitude, the variation or the probability distribution of that experimental variable alters the extinction risk, ETP or MVP.
Special status species	Species of conservation concern that may be listed under federal or state rare and endangered species laws, covered under environmental review laws (e.g. CEQA or otherwise protected by regulation (e.g., those on BLM's Sensitive Species list).
Subpopulation	A group of individuals of a species in the same place that may or may not exchange genes or dispersing individuals with other subpopulations of the same species.
Target taxon/species	A taxon that is being used for demographic data collection and PVA
Taxon/taxa (plural)	A taxonomic group of related organisms, such as an order, family, genus, species, subspecies, or variety

Problem Statement:

The coming decade will bring radical physical and biological changes to the California deserts. Utility scale solar energy development will help meet California's ambitious Renewable Portfolio Standard goal, under which electricity retailers are mandated to provide 20 percent of their load from renewable energy by 2020. The Bureau of Land Management (BLM) currently has almost 50 applications for solar energy projects located within the California Desert Conservation Area (CDCA).

Several fast-track renewable energy projects are at the forefront of solar development in California including the Ivanpah Brightsource Solar Project, the Solar Millennium Blythe Solar Project, and the Solar Millennium Palen Solar Project. These proposed utility scale solar developments are located in two geographically distinct regions in the northeastern Mojave and the northwestern Sonoran desert. Each of these areas differ in the plant taxa of conservation concern and landscape physiognomy. They hold in common, however, plant life forms and microsite habitat patterns that ultimately determine the occurrence, abundance and persistence of rare plants. The proposed Ivanpah solar project supports 37 special status plant species and is scheduled to begin in mid-2010. The proposed Blythe and Palen solar projects support 14 and 15 special status plant species, respectively.

The state and federal permitting process under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) requires that significant impacts to special-status plants be minimized. Potential mitigation measures may include (1) permanent protection of offsite target population; (2) translocation of existing plants to an offsite location; (3) salvage of the plants to botanical institutions or the general public; or 4) mitigation banking of seed. Successful implementation of these measures depends on many factors including the rarity of the species, population size, and habitat quality. Of concern to agencies and conservation organizations, is how many populations and individuals of rare plant taxa should be conserved to maintain the “viability” of each species in the region. Managers and policy makers need clear, understandable and defensible population size thresholds for different kinds of special-status plants that have a low probability of extinction under desert conditions. Such extinction threshold population (ETP) sizes can be determined from using field-generated data in a population viability analysis (PVA) that links population persistence to different levels of impact. PVA can also model potential mitigation and restoration actions that reduce impacts and improve population viability.

The researchers will meet state and federal regulatory requirements by performing PVA on a spectrum of special status plant species likely to be impacted by solar energy development throughout the region. This has never before been accomplished for desert plants. The outcomes of PVA-ETP or minimum viable population (MVP) are not magic numbers that prescribe with certainty the number of individuals that a taxon requires for persistence. Instead, they are indices that can vary depending on factors that affect survivorship and fecundity under defined levels of environmental or demographic uncertainty. PVA can be used to simulate a practical management action to determine how MVP or ETP might shift. For example, if MVP moves downward when seedlings are protected from herbivory, it means that fewer individuals are required to achieve the same extinction probability over the same period. Likewise, an upward shift in ETP is favorable, signaling that the population will be composed of a greater number of individuals for the same extinction probability over the same time period. Efforts will be focused on identifying those practical management actions that maximize ETP over a 50-year simulation period.

Assembling demographic data into a PVA allows resource managers to perform experimental manipulations of populations in a model to identify sensitive life history stages and propose conservation or restoration prescriptions to protect or enhance those stages *in situ*. Such practical management actions will be directly informed by field data, but will still require implementation, monitoring and evaluation. This project will allow us to identify disturbance-sensitive stages in the life histories of several rare plant taxa that may represent a broader array of desert plants sharing the same life forms.

Goals of the Agreement:

The goal of this Agreement is to provide information on population viability for a suite of rare plant taxa that may be impacted by utility scale solar energy development in the Mojave and Sonoran Deserts of California. Analysis and interpretation of this data will inform the development of management strategies, including restoration and mitigation.

Objectives of the Agreement:

The objectives of this Agreement are to:

- 1) Identify a representative suite of six to eight target plant taxa of special status or conservation concern (including listed taxa if possible),
- 2) Identify and characterize two to three occupied natural study populations of each target taxon,
- 3) Collect four years of field demographic data to parameterize population viability models for each target taxon. Complete demographic data collection will include experiments to determine rates of seed dormancy, a seldom-studied yet essential model component,
- 4) Develop and interpret PVA models for each of the target taxa, including estimation of extinction threshold subpopulation size and its associated expressions as generated by a sensitivity analysis that links population viability to levels of project impact.

Product Guidelines:

For complete product guidelines, refer to Section 5 in the Terms and Conditions.

TASK 1 ADMINISTRATION

Task 1.1 Attend Kick-off Meeting

The goal of this task is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a “Kick-Off” meeting with the Commission Project Manager, the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the Commission Project Manager to this meeting. The administrative and technical aspects of this

Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Project Manager will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Discussion of the terms and conditions of the Agreement
- Discussion of Critical Project Review (Task 1.2)
- Match fund documentation (Task 1.6)
- Permit documentation (Task 1.7)

The technical portion of the meeting shall include, but not be limited to, the following:

- The Commission Project Manager's expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- Discussion of Progress Reports (Task 1.4)
- Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
- Discussion of the Final Report (Task 1.5)

The Commission Project Manager shall:

- Designate the date and location of this meeting.

Recipient Products:

- Updated Schedule of Products (no draft)
- Updated List of Match Funds (no draft)
- Updated List of Permits (no draft)

Commission Project Manager Product:

- Kick-Off Meeting Agenda (no draft)

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule or budget.

CPRs provide the opportunity for frank discussions between the Energy Commission and the Recipient. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Project Manager and as shown in the Technical Task List above. However, the Commission Project Manager may schedule additional CPRs as necessary, and any additional costs will be borne by the Recipient.

Participants include the Commission Project Manager and the Recipient and may

include the Commission Grants Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Project Manager to provide support to the Energy Commission.

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These meetings generally take place at the Energy Commission, but they may take place at another location.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if continuing, whether or not modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. Modifications to the Agreement may require a formal amendment (please see the Terms and Conditions). If the Commission Project Manager concludes that satisfactory progress is not being made, this conclusion will be referred to the Energy Commission's Research, Development and Demonstration (RD&D) Policy Committee for its concurrence.
- Provide the Recipient with a written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more product(s) that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work of the projects. This report shall be submitted along with any other products identified in this scope of work. The Recipient shall submit these documents to the Commission Project Manager and any other designated reviewers at least 15 working days in advance of each CPR meeting.
- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants (no draft)
- Schedule for written determination (no draft)
- Written determination (no draft)

Recipient Product:

- CPR Report(s) (no draft)

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the Commission Project Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Project Manager.

The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The Commission Project Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Project Manager and the Grants Officer about the following Agreement closeout items:

- What to do with any equipment purchased with Energy Commission funds (Options)
- Energy Commission's request for specific "generated" data (not already provided in Agreement products)
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions, such as repayment provisions and confidential Products
- Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement

Products:

- Written documentation of meeting agreements (no draft)
- Schedule for completing closeout activities (no draft)

Task 1.4 Monthly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining

whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report which summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the Commission Project Manager within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in Exhibit A, Attachment A-2.

Product:

- Monthly Progress Reports (no draft)

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further RD&D projects and improvements to the PIER project management processes.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

Task 1.5.1 Final Report Outline

The Recipient shall:

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Project Manager for review and approval. The Commission Project Manager will provide written comments back to the Recipient on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Recipient shall submit the final outline to the Commission Project Manager. The Commission Project Manager shall provide written approval of the final outline within 5 working days of receipt.

Products:

- Draft Outline of the Final Report

- Final Outline of the Final Report

Task 1.5.2 Technical Editor and Peer Reviewers

The Recipient shall:

- Acquire services of a technical editor who is capable of preparing the final report in exact accordance with the latest version of the PIER Style Manual published at the Energy Commission's web site:
<http://www.energy.ca.gov/contracts/pier/contractors/index.html>
- Acquire services of three independent technical peer reviewers with expertise in the subject matter of the final report. The Commission Project Manager will provide approval of the proposed technical reviewers within 10 working days. Any technical reviewers rejected by the Commission Project Manager must be replaced within 10 working days.

Products:

- Written documentation showing that arrangements have been made for a Technical Editor to prepare the final report in exact accordance with the latest version of the PIER Style Manual (no draft)
- Name and resume of the Technical Editor (no draft)
- Names and resumes of three technical reviewers (no draft)

Task 1.5.3 Final Report

The Recipient shall:

- Prepare the draft Final Report for this Agreement in accordance with the approved outline and using the Technical Editor to ensure accordance with the latest version of the PIER Style Manual published at the Energy Commission's web site:
<http://www.energy.ca.gov/contracts/pier/contractors/index.html>.
- Submit the draft Final Report to the (3) technical peer reviewers for comments.
- Submit the draft Final Report and the results of the peer reviews electronically to the Commission Project Manager for review and comment. The Commission Project Manager will provide written comments within 30 working days of receipt.
- Once agreement on the draft Final Report has been reached and the draft has been prepared in exact accordance with the latest version of the PIER Style Manual, the Commission Project Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Project Manager shall provide written approval to the Recipient within 5 working days.
- Submit one bound copy of the Final Report with the final invoice.

Products:

- Draft Final Report
- Comments On Draft Final Report From Three Technical Peer Reviewers

- (no draft)
- Final Report

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state such in the letter. If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter a list of the match funds that identifies the:
 - Amount of each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied
 - Amount of each in-kind contribution, a description, documented market or book value, and its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the Commission Project Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Project Manager within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the

Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds or stating that no match funds are provided (no draft)
- Copy(ies) of each match fund commitment letter(s) (if applicable) (no draft)
- Letter(s) for new match funds (if applicable) (no draft)
- Letter that match funds were reduced (if applicable) (no draft)

Task 1.7 Identify and Obtain Required Permits

The goal of this task is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track.

Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement. Although the PIER budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditures for which a permit is required.

The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Project Manager at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
- The schedule the Recipient will follow in applying for and obtaining these permits.
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule and the copies of the permits. The implications to the Agreement if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the Commission Project Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Project Manager.
- If during the course of the Agreement permits are not obtained on time or

are denied, notify the Commission Project Manager within 10 days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required (no draft)
- A copy of each approved permit (if applicable) (no draft)
- Updated list of permits as they change during the term of the Agreement (if applicable) (no draft)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable) (no draft)

TECHNICAL TASKS

TASK 2 SELECTION AND MONITORING OF TARGET TAXA AND SUBPOPULATIONS

The goal of this task is to; a) select representative and cooperative rare plant taxa as targets of this study, based on California Natural Diversity Database (CNDDDB) occurrence records and field reconnaissance; and b) locate, select and characterize study subpopulations for each of the target taxa. Target taxa will exemplify rare plant taxa found within California desert ecosystems, occur in locations amenable to study, and have characteristics that suggest they are likely to be cooperative research subjects.

The Recipient shall:

- Use CNDDDB records for rare and listed California desert plants to screen candidate target taxa.
- Include a variety of common desert life forms among the selected target taxa.
- Select potential target taxa that have recorded evidence of subpopulations that will be large enough for study and assessable to research methods.
- Collaborate with the key partner to identify potential target taxa and subpopulations including known and predicted occurrences.
- Use field reconnaissance to select the final list of target taxa based on observation of population sizes, site access, and hands-on evidence of cooperation with field and modeling methodologies.
- Locate potential study subpopulations of each target taxon *in situ* that are representative of target taxa subpopulations in the region.
- Develop and submit to the Commission Project Manager (CPM) criteria for selection of study subpopulations of each target taxon based on known characteristics of representative subpopulations (from review of CNDDDB element occurrences [EOs] within the region, and expert opinion, if available).

- Create and submit to the CPM a candidate target taxa list including 10 to 12 taxa for field screening and how they meet the selection criteria above.
- Map the spatial extent and density of potential target occurrence using Geographic Information System (GIS) software. Generate maps and directions to possible study subpopulations for submission to the CPM.
- Select and mark 30 individuals at each study subpopulation for continued study.
- Select two common desert taxa to be studied in parallel at chosen rare taxa subpopulations.
- Provide a list of final selected rare and common subpopulation taxa to the CPM (no draft)
- Create maps of the final selected study subpopulations for each target taxon.
- Annually estimate subpopulation density for the years 2011 through 2014. Submit population estimates to the CPM.
- Provide a characterization of the soil, vegetation and location (slope, aspect, extent) of each subpopulation, for year one of the project, to the CPM.
- Participate in a CPR and write CPR report as per Task 1.2

Products:

- Subpopulations selection criteria list (no draft)
- Candidate target taxa list
- Maps and directions of potential target subpopulations (no draft)
- Final selected rare and common subpopulation taxa list (no draft)
- Map of final selected study subpopulations for each target taxon (no draft)
- Annual population density estimates (no draft)
- Description of subpopulation soil, vegetation, and location (no draft)

TASK 3 DEMOGRAPHIC DATA COLLECTION

Task 3.1 Demographic data collection on marked plants at target subpopulations

The goal of this task is to collect demographic data on marked plants of each target taxon at each of its study subpopulations over four years. Data will be collected on the life history stage, survival and fecundity of each marked study individual for four consecutive field study years 2011-2014.

The Recipient shall:

- Identify all significant life history stages for each target taxon. For perennials the stages will likely include: seed, seedling, young, and reproductive individuals. For annuals the stages will include seedlings, non-reproductive adults, and reproductive adults.
- Provide a stage-structure diagram (a depiction of plant population demographic rates and stages) for each target taxon to the CPM.
- Make six field trips per year to study all subpopulations of each target

- taxon, collecting essential demographic data for PVA modeling.
- Estimate subpopulation density in each field study year using methods specific to the surveying of dense or diffuse subpopulations.
- For each target taxon, study subpopulation and field study year, the Recipient shall:
 - Record the life history stage of each marked study individual on all field trips.
 - Record the survival and reproductive output of each marked study individual.
 - Record or estimate the number of emergent seedlings.
 - Record the number of fruit produced and estimate the seed production of each marked study individual.
 - Mark and track the success of up to 15 additional individuals as necessary to provide demographic information on under-represented life stages.
 - Exclude herbivores from up to 10 individuals (non-shrub species only).
 - Provide annual demographic data (including a brief assessment of herbivore exclusion success) for parameterization of population viability models for each target taxon to the CPM.
- Participate in a CPR and write CPR Report as per Task 1.2

Products:

- Stage-structure diagram (no draft)
- Annual demographic data (no draft)

Task 3.2 Seed bank demography at study subpopulations

The goal of this task is to collect data on seed germination and storage for the target taxa. Data will be collected on the annual fate of seed bank seeds in all years where seed is available for experimentation. Laboratory germination studies will address seed germinability and viability.

The Recipient shall:

- Assess seed dormancy rates by burying packets of seed of each target taxon at its study subpopulations whenever seed is available.
- Excavate and survey packets following natural seedling emergence each remaining field study year.
- Provide data on seed dormancy and mortality for each target taxon to the CPM.
- Conduct laboratory assessment of germination rates and propagation potential using germination trials and tetrazolium tests.
- Provide data on seed germination and propagation methods for each target taxon to the CPM.
- Incorporate these data on seed bank demography into the PVA of each cooperative target taxon.

Products:

- Seed dormancy and mortality data (no draft)
- Seed germination and propagation methods data (no draft)

TASK 4 DATA ANALYSIS, POPULATION VIABILITY ANALYSIS MODELING, AND INTERPRETATION

The goal of this task is to archive and analyze demographic data from marked plants and seed bank studies and to incorporate them into a PVA for each target taxon. The PVA will be interpreted based on comparative field and literature research. Products for this task will be included in the final report.

The Recipient shall:

- Parameterize the PVA for each subpopulation and target taxon based on the demographic data collected in Task 3.
- Develop a draft PVA for each subpopulation and target taxon following the year of field study.
- Develop a final PVA for each subpopulation and target taxon following the fourth year of field study.
- Estimate ETP size and its associated expressions for each target taxon as generated by a sensitivity analysis that links population viability to levels of project impact. Provide estimates to the CPM.
- Identify sensitive life history stages and demographic characteristics that influence the probability of extinction or recovery.
- Provide an interpretation of extinction probability of each target taxon and recommendations for management of existing subpopulations under different levels of solar development impact to the CPM.
- Provide recommendations for subpopulation restoration, mitigation, and taxa propagation methods based on PVA and seed germination experiments to the CPM.

Products:

- ETP Estimates and Expressions (no draft)
- Extinction probability and management recommendations (no draft)
- Subpopulation recommendations (no draft)