FOLSOM LABS

HelioScope

User Manual

Contact:

Email: support@folsomlabs.com
Web: www.helioscope.folsomlabs.com

Rev-20140730

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Date and Revision

August 2014

Contact Information

Telephone:	(415) 729-4050
Email:	support@folsomlabs.com
Web:	www.helioscope.folsomlabs.com

Contents

1.0 Glossary and Requirements

Glossary of Terms

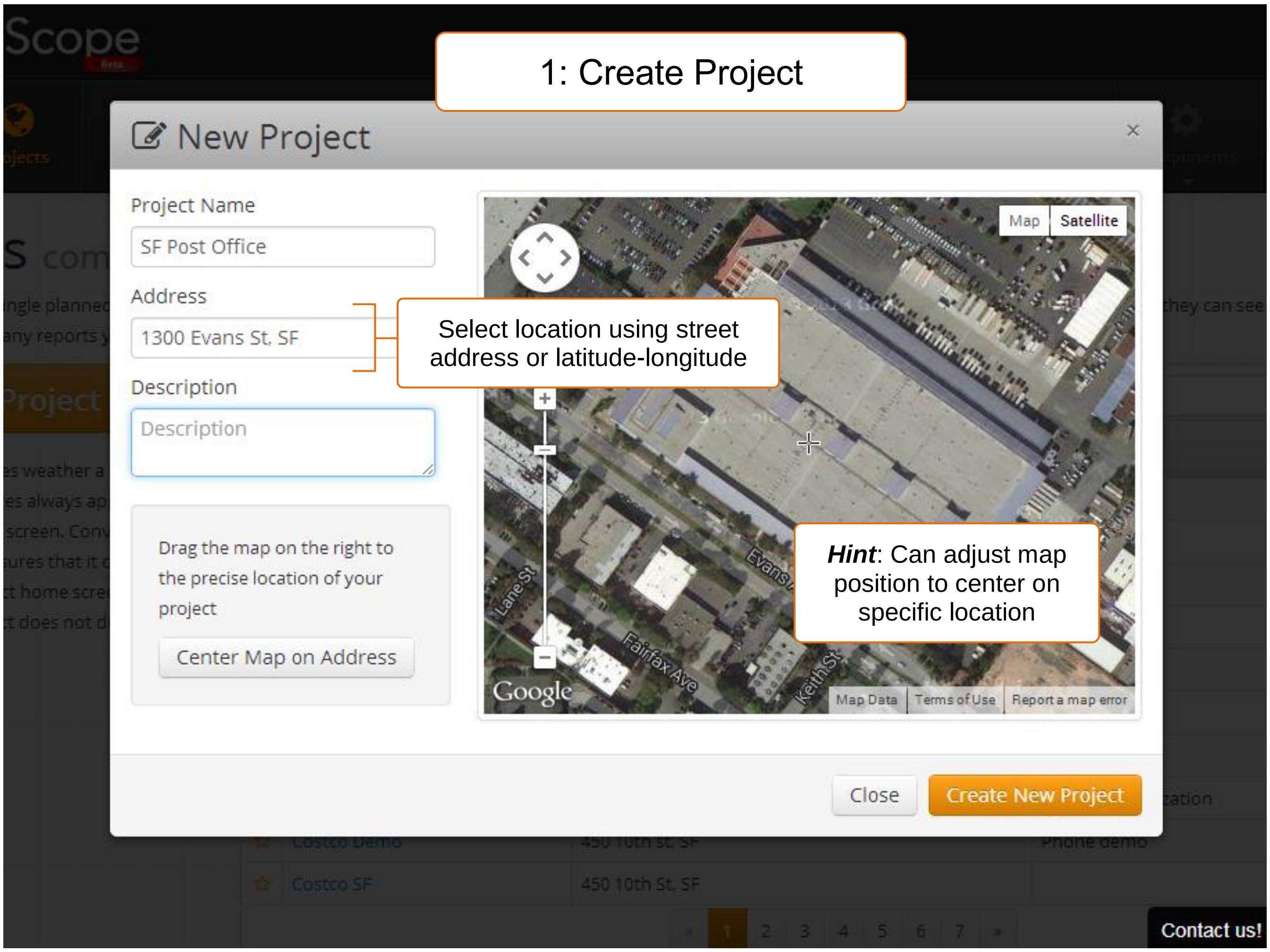
Term	Definition
Project	• A Project represents a specific location where an array (or arrays) will be designed and installed. • The Project is the highest-level structure in HelioScope; all Designs and Condition Sets are created under a Project.
Design	• A Design describes the physical layout of a solar array. • A Design includes the modules used, the quantity and location of the modules, and how the modules are oriented. It also includes the electrical stringing design, the conductors used, the inverters used, and the location of the inverters.
Field Segment	• A Field Segment is an area of the design, used to define module layouts. • A user defines a shape, which is populated with modules based on a set of layout rules. • A Design can consist of multiple Field Segments.
Wiring Zone	• A Wiring Zone defines the electrical rules for the modules that have been laid out in the Field Segment. • A Wiring zone consists of one or more Field Segments, an inverter SKU and quantity, and a set of rules for how to connect the modules electrically (including the string size, conductor size, and combiner box size). • A Design can consist of multiple Wiring Zones, but a single Field Segment may not be split across multiple Wiring Zones.
Condition Set	• A Condition Set describes the environment around the solar array. • A Condition Set includes a weather file, shading assumptions, soiling assumptions, and temperature assumptions.
Shade Profile	• A Shade Profile describes the shading patterns that result from nearby obstructions around an array over the course of the year. • A Shade Profile consists of a series of 2D images that are spatially located around the array. Each shade image will dictate if a module is shaded during that hour. • The Shade Profile is generated from SketchUp, using a plugin available from Folsom Labs. • Shade Profile are calculated every hour, every month, so they are able to represent a full year worth of shading behavior.
Simulation	• A Simulation is an estimate for how much energy a Design will produce over a full year, based on the environment defined in the Condition Set. • Most simulations are based on hourly time intervals (8,760 per year).
Report	• The results of each Simulation can be viewed as a report, which summarizes the production of the corresponding Design under the given Conditions. • Reports will also show the calculation of system losses at each step in the process.

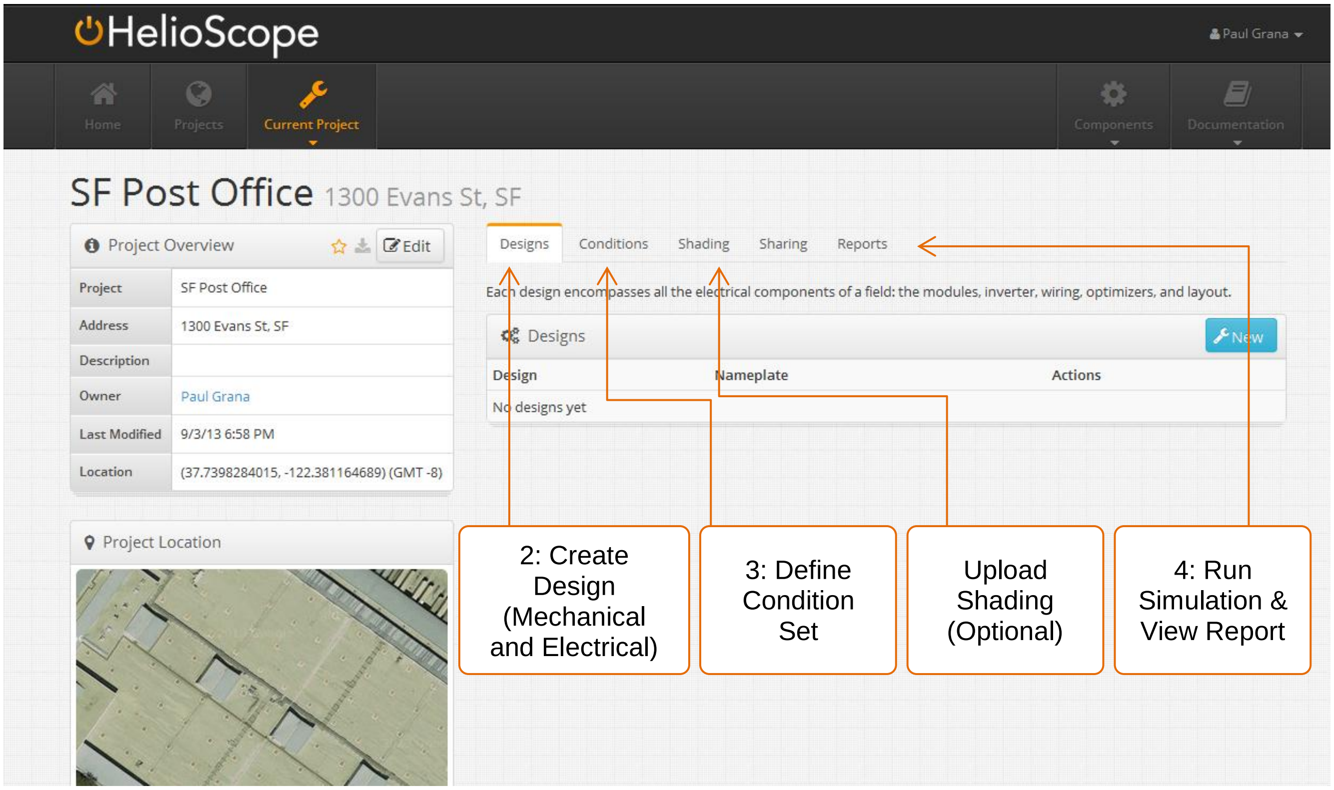
System Requirements

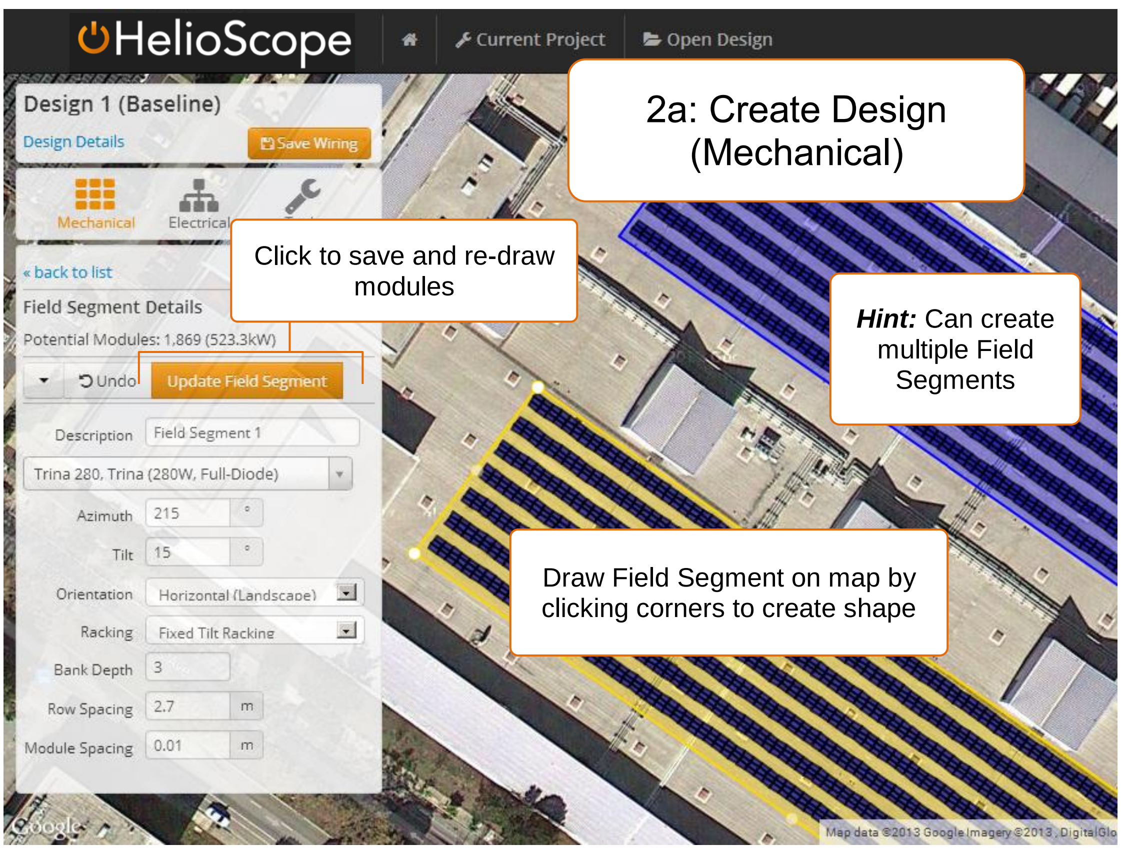
HelioScope is a web-based product that can be accessed from any standard modern browser. Recommended browsers include Chrome, Firefox, Safari, and Internet Explorer 10. Internet Explorer 8 (or earlier) is not supported.

2.0 Quick-Start Guide

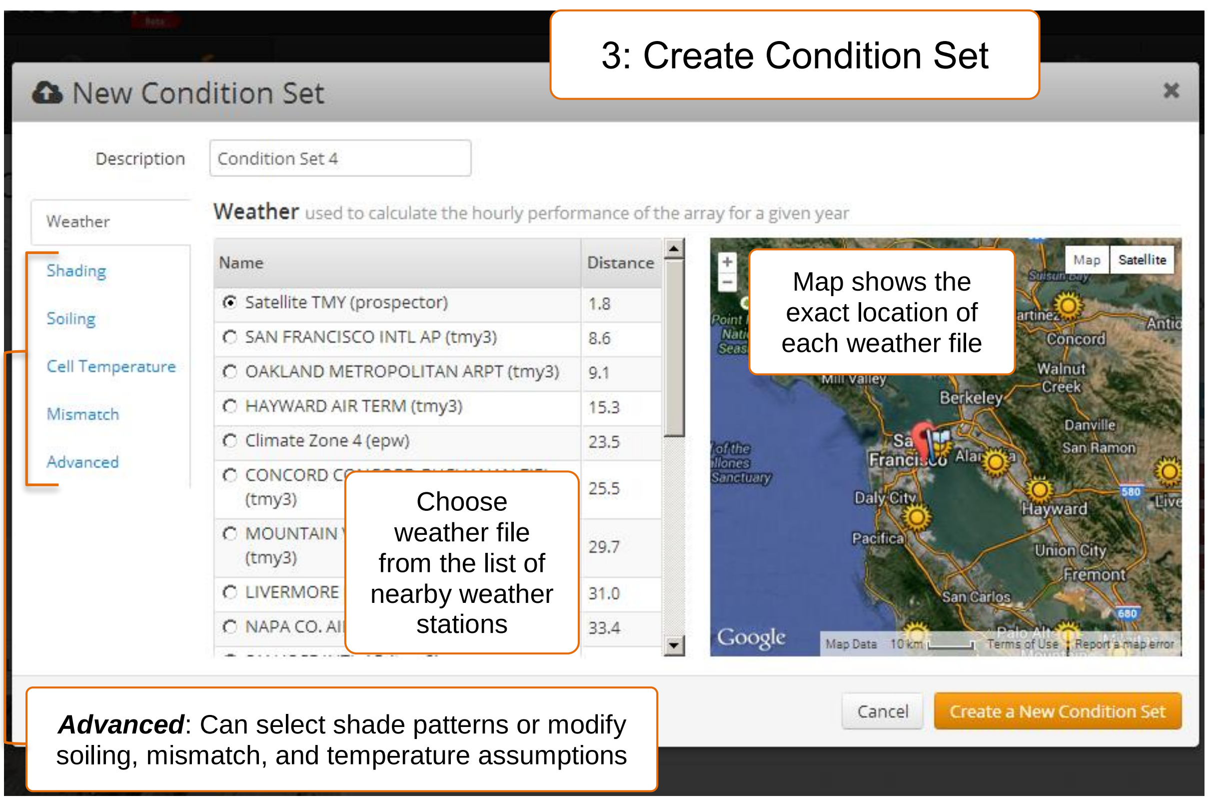
<u>Five steps to using HelioScope:</u>
1) Create Project
2a) Create Design (Mechanical)
2b) Create Design (Electrical)
3) Create Condition Set
4) Run Simulation and View Report




HelioScope
Paul Grana
Home
Projects
Current Project
Components
Documentation
SF Post Office 1300 Evans St, SF
Project Overview
Edit
Project
SF Post Office
Address
1300 Evans St, SF
Description
Owner
Paul Grana
Last Modified
9/3/13 6:58 PM
Location
(37.7398284015, -122.381164689) (GMT -8)
Project Location
Designs
Conditions
Shading
Sharing
Reports
Each design encompasses all the electrical components of a field: the modules, inverter, wiring, optimizers, and layout.
Designs
New
Design
Nameplate
Actions
No designs yet
2: Create Design (Mechanical and Electrical)
3: Define Condition Set
Upload Shading (Optional)
4: Run Simulation & View Report


HelioScope
Current Project
Open Design
Design 1 (Baseline)
Design Details
Save Wiring
Mechanical
Electrical
« back to list
Field Segment Details
Potential Modules: 1,869 (523.3kW)
Undo
Update Field Segment
Description
Field Segment 1
Trina 280, Trina (280W, Full-Diode)
Azimuth
215
Tilt
15
Orientation
Horizontal (Landscape)
Racking
Fixed Tilt Racking
Bank Depth
3
Row Spacing
2.7
m
Module Spacing
0.01
m
2a: Create Design (Mechanical)
Click to save and re-draw modules
Hint: Can create multiple Field Segments
Draw Field Segment on map by clicking corners to create shape
Map data ©2013 Google Imagery ©2013 , DigitalGlo


HelioScope
Current Project
2b: Create Design (Electrical)
Design 1 (Baseline)
Design Details
Save Wiring
Important: You must save Design before exiting the Designer
Mechanical
Electrical
Tools
« wiring zones
Default Wiring Zone (1,046.6KWp)
Clear
Generate Wiring
Click to automatically generate wires, combiner boxes, and inverters
Description
Default Wiring Zone
Inverter (DC/AC 1.05)
Count
AE 250NX, Advanced Energy ...
4
Hint: Inverters and combiner boxes can be moved by dragging to a new location
Trunk Gauge
MCM500
Bus Gauge
GA2
Combiner Poles
24
String Gauge
GA10
String Length
13
Stringing
Along Racking
– Select an Optimizer (Optional) –
Define system wiring rules


3: Create Condition Set
New Condition Set
Description
Condition Set 4
Weather
Shading
Soiling
Cell Temperature
Mismatch
Advanced
Weather used to calculate the hourly performance of the array for a given year
Name
Distance
Satellite TMY (prospector)
1.8
SAN FRANCISCO INTL AP (tmy3)
8.6
OAKLAND METROPOLITAN ARPT (tmy3)
9.1
HAYWARD AIR TERM (tmy3)
15.3
Climate Zone 4 (epw)
23.5
(tmy3)
25.5
(tmy3)
29.7
LIVERMORE
31.0
NAPA CO. AI
33.4
Choose weather file from the list of nearby weather stations
Map shows the exact location of each weather file
Map
Satellite
Concord
Walnut Creek
Berkeley
Danville
San Ramon
Daly City
Hayward
Pacifica
Union City
Fremont
San Carlos
Google
Cancel
Create a New Condition Set
Advanced: Can select shade patterns or modify soiling, mismatch, and temperature assumptions


Home
Projects
Current Project
Components
Documentation
4: Run Simulation
SF Post Office 1300 Evans St, SF
Project Overview
Project
SF Post Office
Address
1300 Evans St, SF
Description
Owner
John Doe
Last Modified
7/20/13 8:52 PM
Location
(37.7399079291662, -122.38116602737) (GMT -8)
Project Location
Designs
Users
Conditions
Shading
Reports
For each Condition Set and Design HelioScope can run a simulation to see exactly how that design will perform.
Condition Sets
New
Condition Set 1
Condition Set 2 (SFO TMY3)
Prospector, Shade
Initiate simulation and generate report
Simulate
1,549.3
1,565.4
1,495.3
1,535.9
Design 4 (Shorter Strings)
Simulate
Simulate
Select to view completed annual report
1,535.9
Initializing
Hint: Can compare all reports using these summary metrics
KWh/KWp
Performance Ratio
Energy

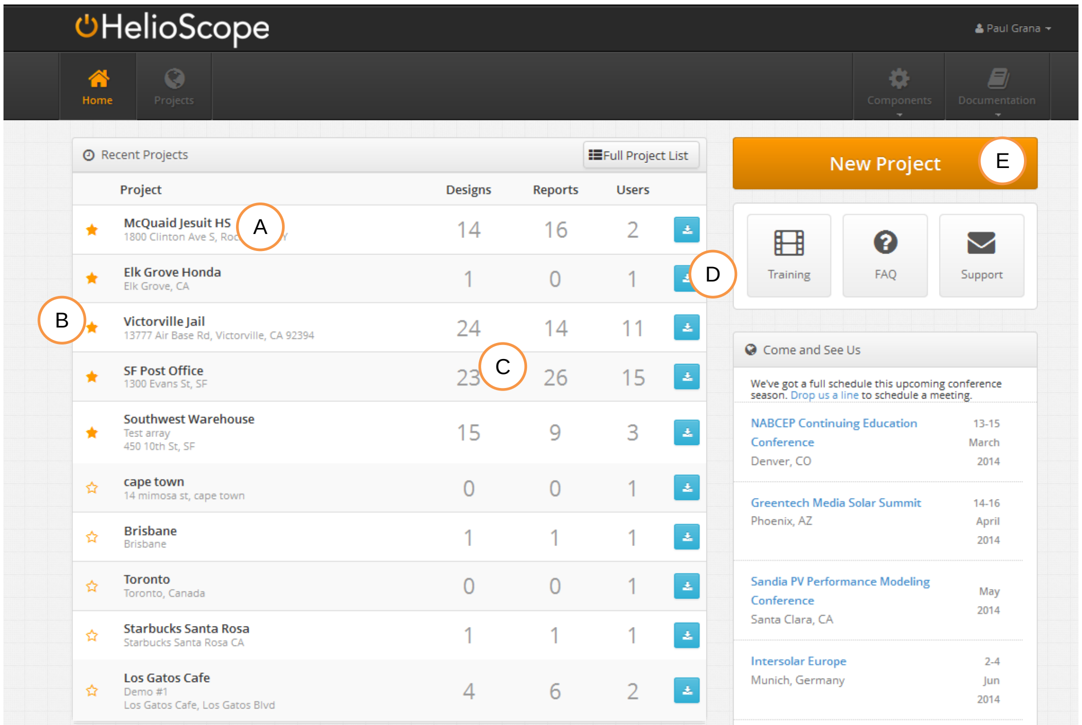
3.0 Project

A Project represents a specific location where an array (or arrays) will be designed and installed. The Project is the highest-level structure in HelioScope; all Designs and Condition Sets are created under a Project.

3.1 Project List

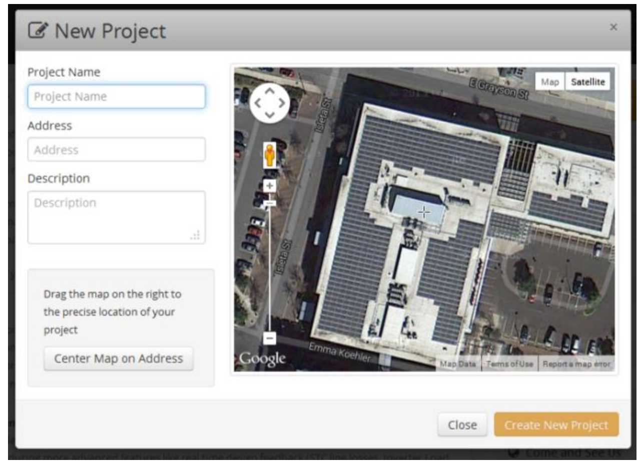
The HelioScope home page shows a Project list and link to create a new project.

A. Project list, in order of last modified
B. Starred projects are at the top of the list
C. The number of Designs, Reports, and users for each Project
D. Archive a Project
E. Create a New Project



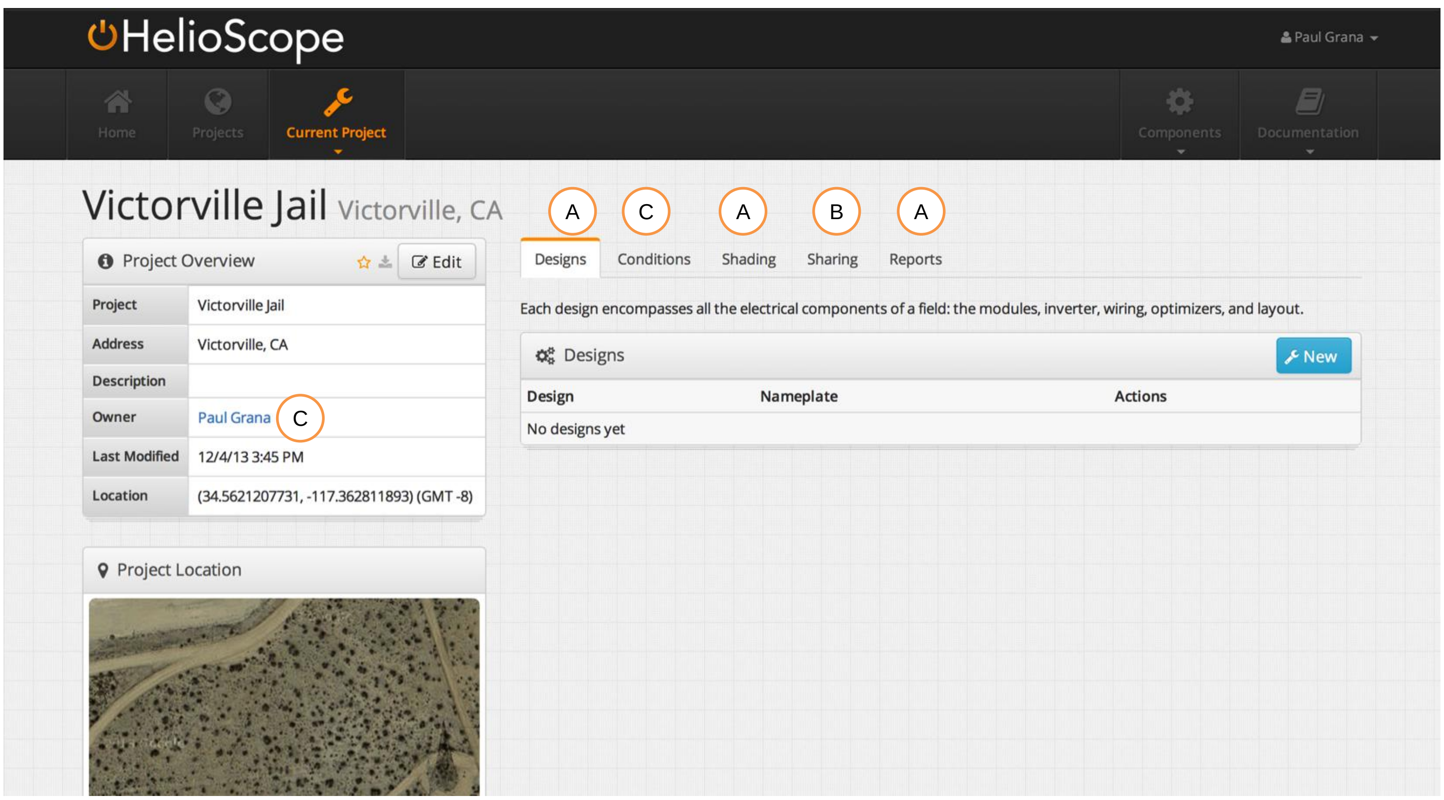
3.2 Create Project

Create a project using a name and address. Center the map on the area where the system will be designed, and select “Create New Project”.



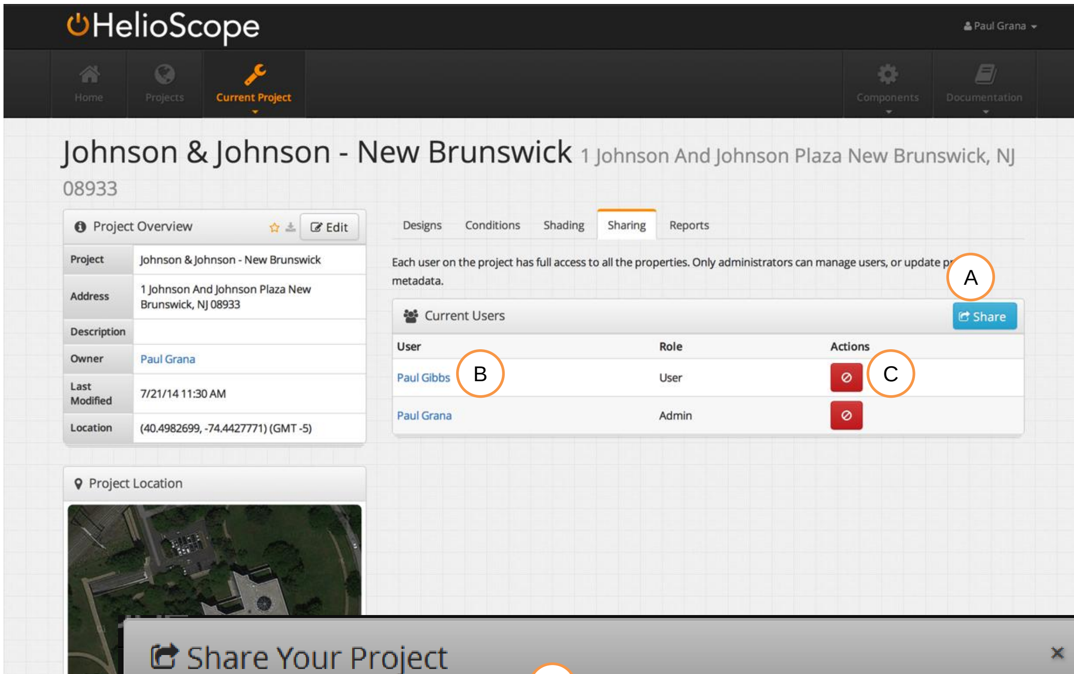
A Project consists of several components that are created in the software:

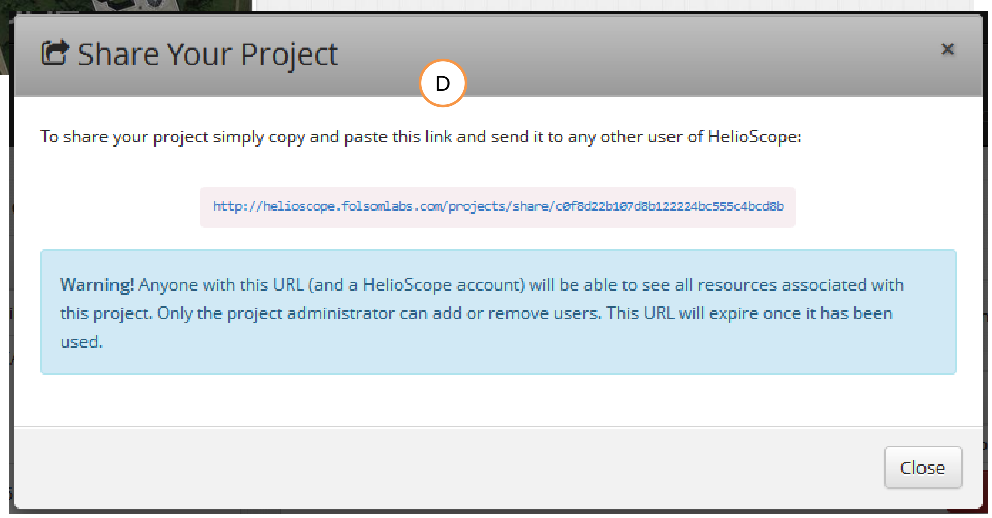
A. **Designs** and **Condition Sets** are the core aspects of modeling, and the resulting **Simulation Reports** are stored within the Project
B. **Shade Profiles** are created based on obstructions around the array
C. A Project has an owner, who can share the Project and control user access



3.3 Project Sharing

HelioScope enables sharing at the Project level. Users have full access to the Project, including read/write access to Designs and Reports.





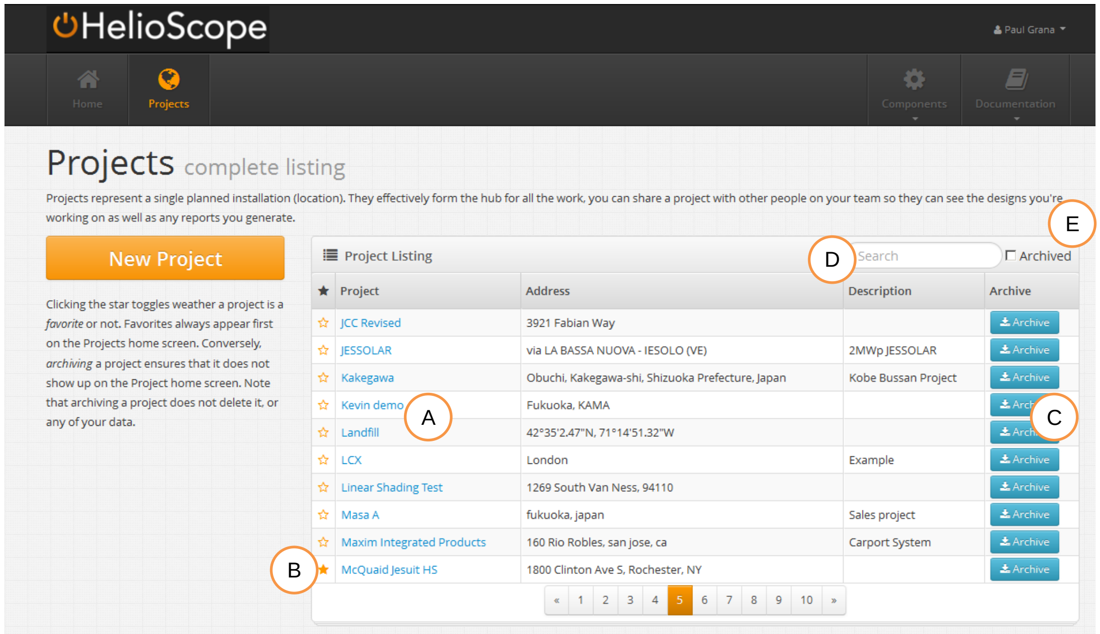
Sharing is controlled under the “Users” tab:

A. Button to generate a share link
B. Users list
C. Delete users
D. The share link appears in a separate window. Copy and send the link to collaborators (they must have a HelioScope account to view the Project).

3.4 Project Management

The Project page shows all available projects:

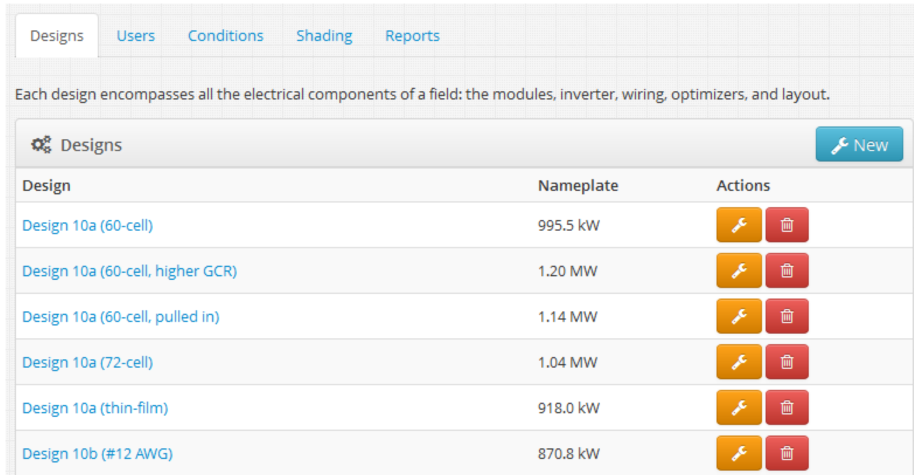
A. Projects sorted by name
B. Click the orange star to make a Project a “favorite”
C. Click to archive projects (will not show up on the Home page)
D. Search projects based on name, address, or description
E. Toggle check-box to show archived Projects



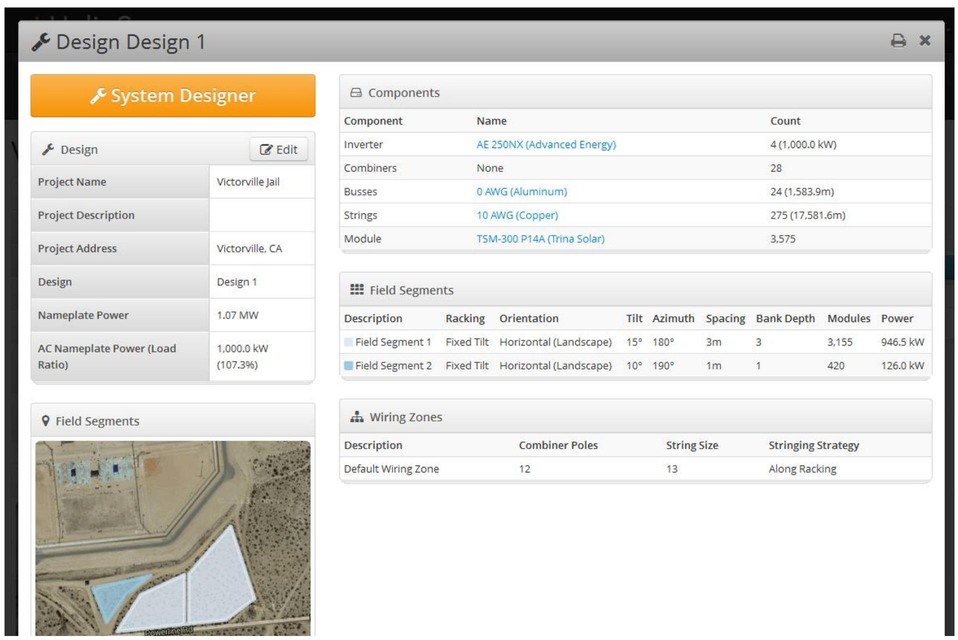
4.0 Design

A Design describes the physical layout of a solar array, including the module layout and orientation. It also includes the wiring and conductor design and inverter topology.

A Project can have multiple Designs. Often, these multiple designs are used to compare design alternatives, or to model sub-sections of an array.

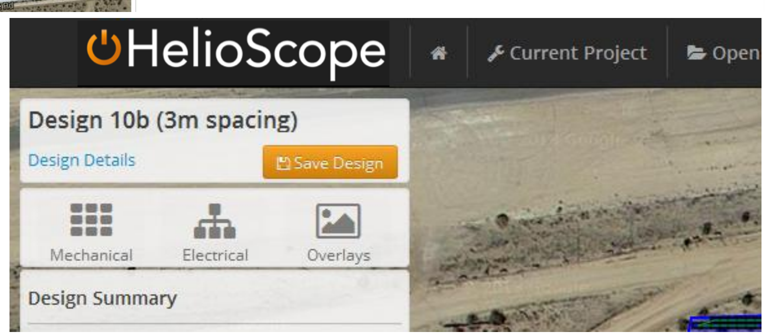


Each design includes a bill of materials including the module quantity, wire quantity, combiner boxes, and inverters



A Design requires both a Mechanical layout and an Electrical layout, selected at the top of the Design tool.

Important: Each Design must be saved (with the "Save Design" button) once it is finished.

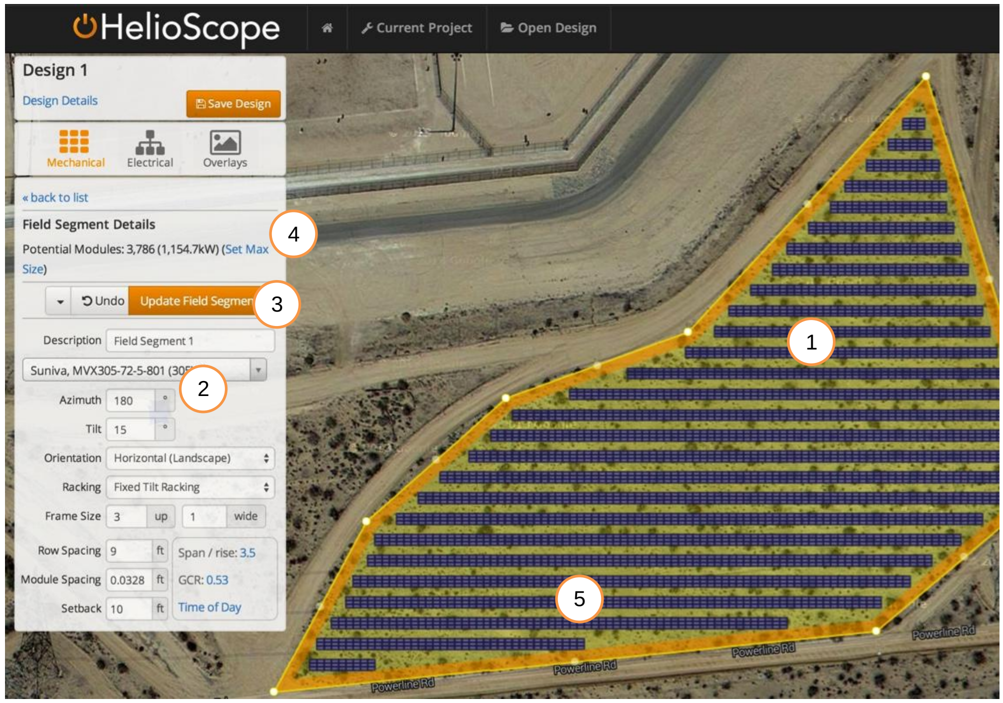


4.1 Mechanical Layout

A Mechanical Layout is based on Field Segments that define the areas to be filled with modules, and Keepout Zones which define the areas to be excluded.

Generating a Field Segment:

1) Click points to create a Field Segment shape
2) Define module layout & racking assumptions
3) Click "Update Field Segment" to populate the Field Segment
4) If desired, set the maximum system size
5) Every line segment has a grey circle that can create a new point when dragged

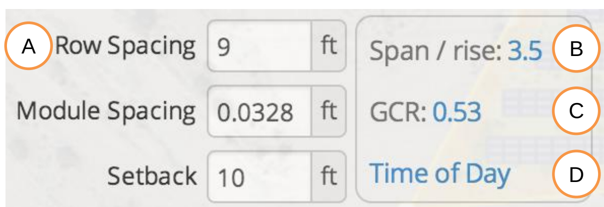


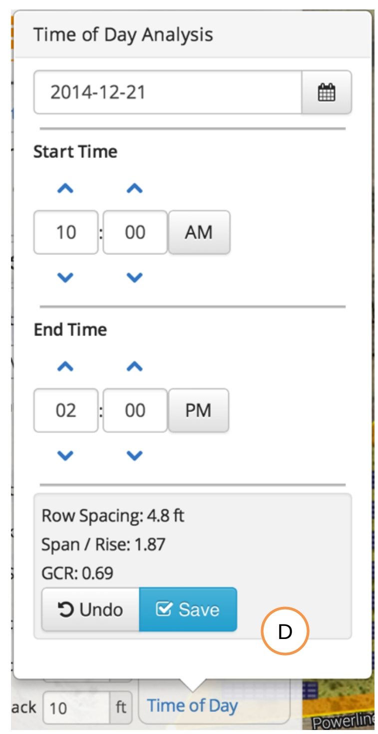
Row Spacing Metrics:

There are four ways to define the spacing between modules:

A) **Row Spacing** is the back-to-front spacing between rows
B) **Span / Rise** defines the ratio of the distance between rows over the height at the back of the module bank
C) **Ground Coverage Ratio (GCR)** is the ratio of module area divided by the surface area covered by the modules
D) **Time of Day** specifies a day and time range without shade, based on sun angles at the Project location

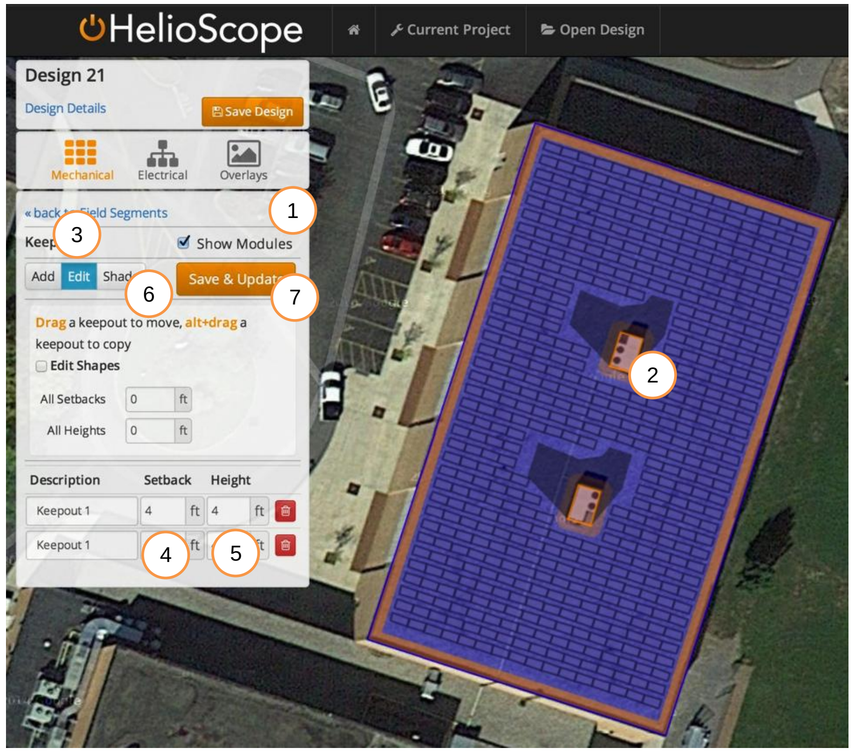
All of the metrics are linked: any can be specified, and the others will be adjusted automatically.





Generating a Keepout Zone:

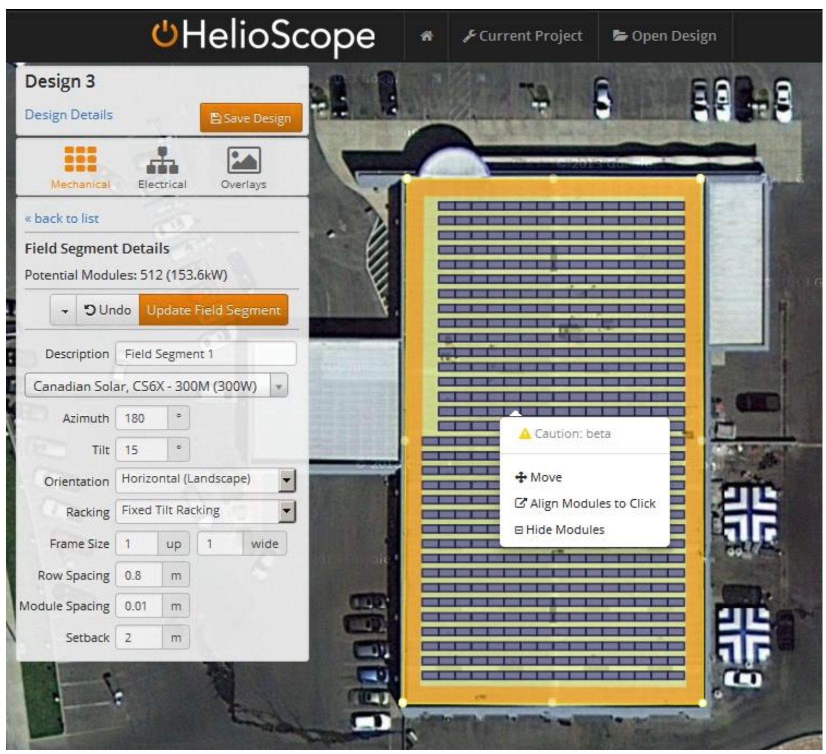
1) Toggle “Show Modules” to hide modules
2) Draw Keepout shapes on map
3) Switch to Edit mode to modify or copy the Keepout objects
4) (optional) Define setback distance for buffer around the perimeter of Keepout object
5) (optional) Define height of the object for shade calculations
6) Define time range for generating shade patterns
7) Save to re-draw modules



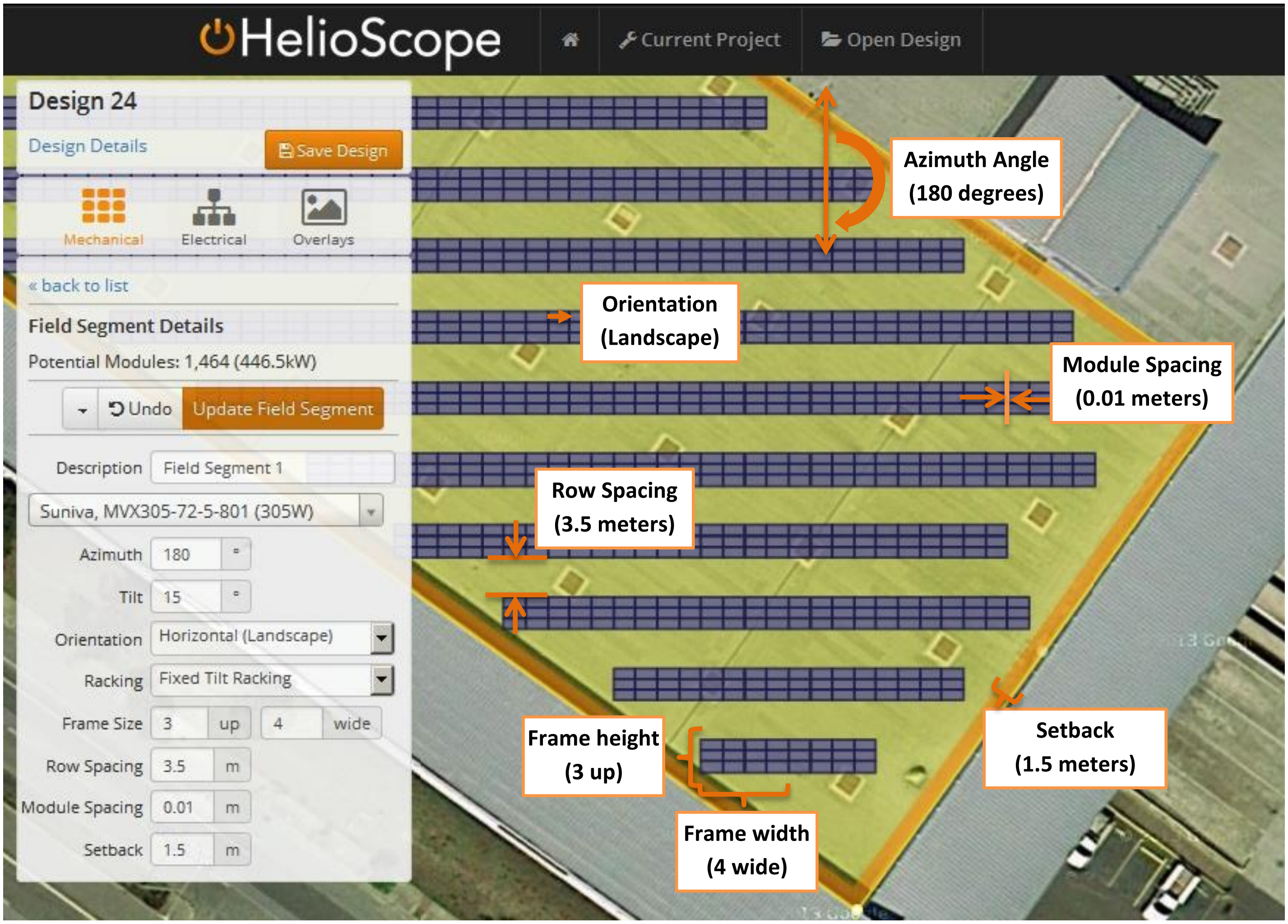
Field Segment Editing

Right-click on a Field Segment for a menu of advanced controls:

- Select **Move** to drag the entire Field Segment
- Select **Align Modules to Click**, and the modules align to the point that was just clicked (with the top left corner of a frame at the exact point)
- **Hide Modules** to see the imagery underneath the modules



Mechanical Layout Assumptions



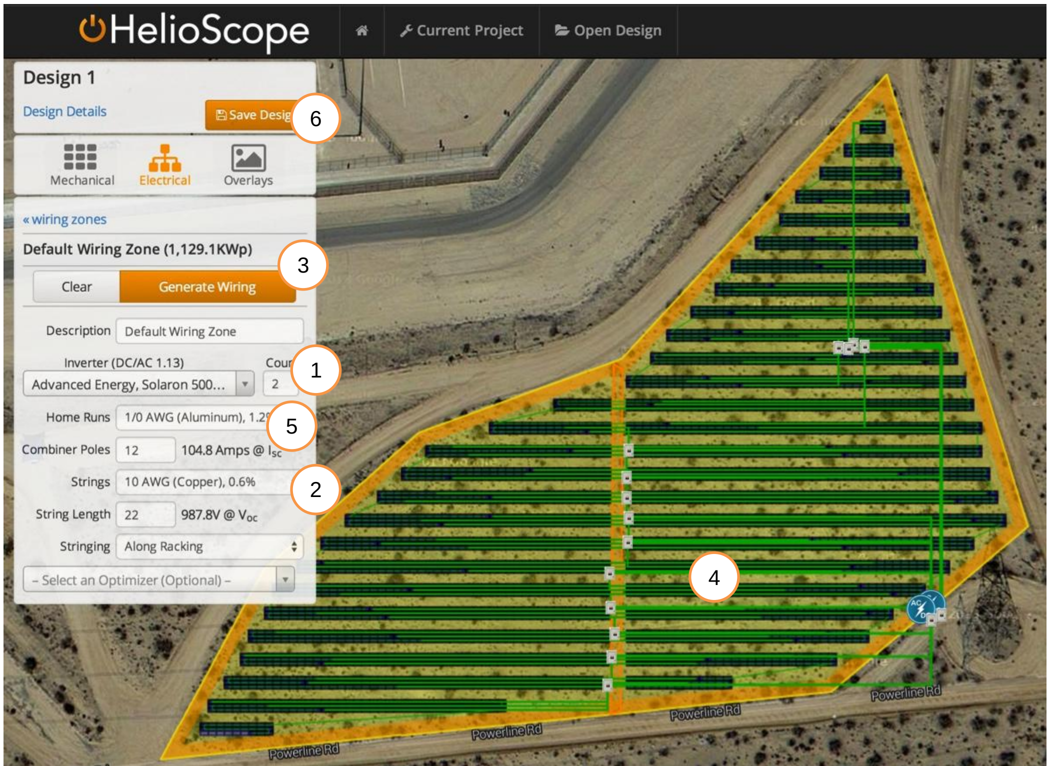
Glossary: Mechanical Layout

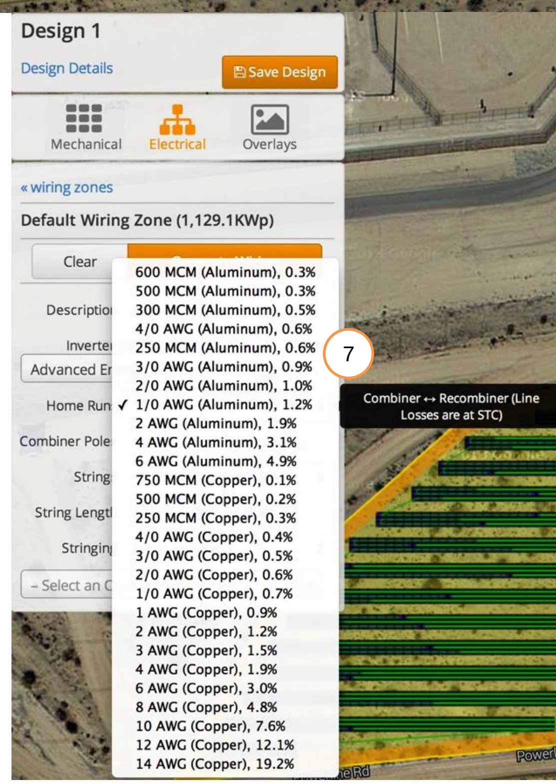
Term	Description
Azimuth Angle	The orientation angle of the modules, following a compass: 90 degrees is East, 180 degrees is South
Tilt Angle	The angle of inclination of the modules. Zero is flat.
Orientation	The direction that the modules are mounted in the racking, either vertical (portrait) or horizontal (landscape).
Racking Type	Indicates whether modules are mounted in fixed-tilt racking on a flat plane, or are mounted flush to a roof in the same plane. This effects the row-to-row shading (zero for flush-mount), and the thermal coefficients (thermal losses will be higher in flush-mount).
Frame Size	The number of modules in each frame, including the vertical (“up”) and horizontal (“wide”) size
Row Spacing	The distance (in meters) from the back of one bank of modules to the front of the next bank.
Module Spacing	The distance between adjacent modules in the same frame.
Setback	The area around the perimeter of the Field Segment that is off-limits to modules

4.2 Electrical Design

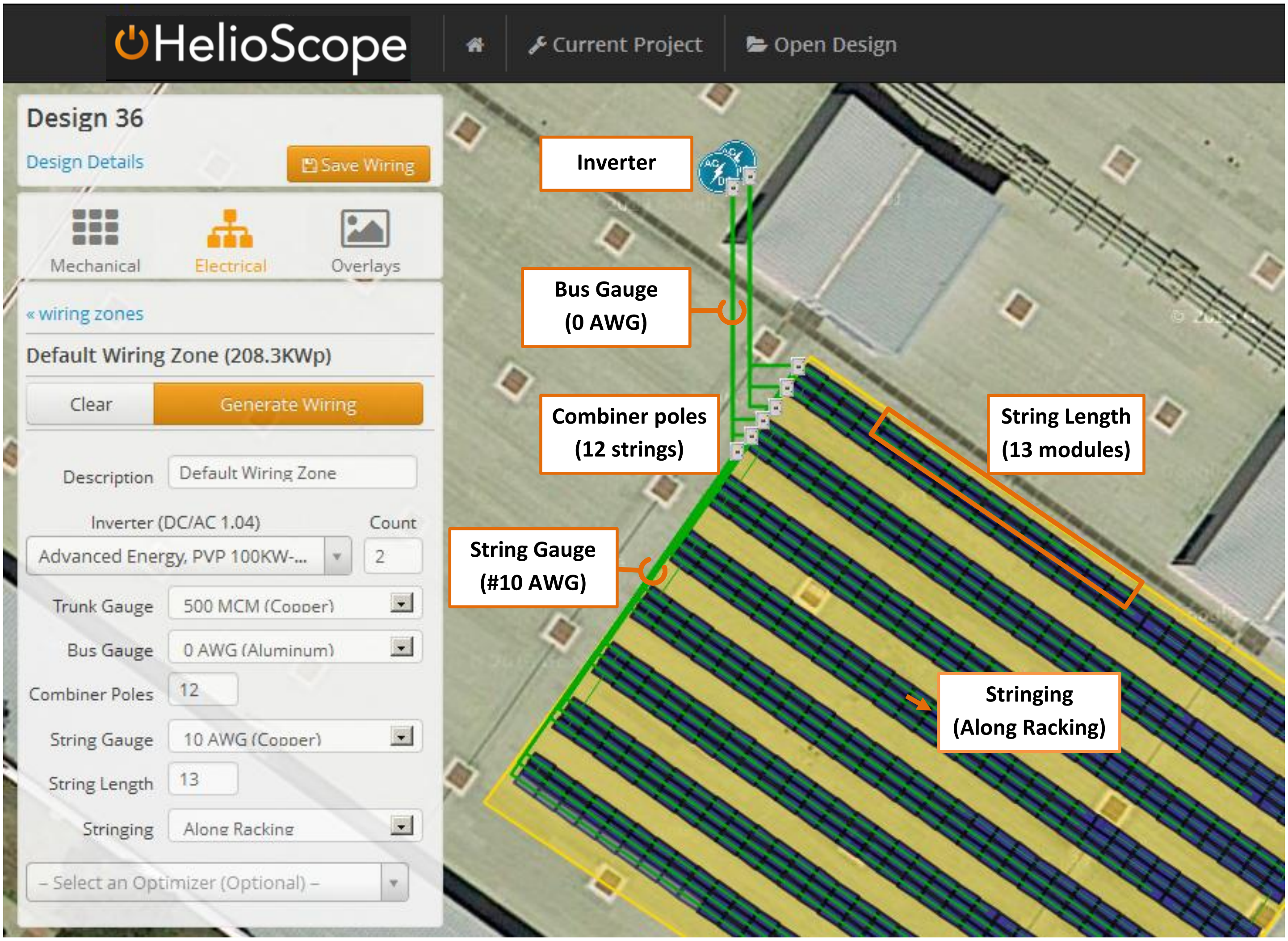
Select the “Electrical” icon for the electrical layout:

1) Choose inverter and quantity
2) Confirm electrical design assumptions
3) Click “Generate Wiring” to generate electrical layout, including wires, combiner boxes, and inverters
4) Inverters and combiner boxes can be moved, and the wires will be re-routed
5) Percentage values next to the conductors show their total voltage drop at STC. These numbers are based on the wire distances shown in the Designer.
6) When finished, click “Save Design”
7) The drop-down menu of conductors shows the corresponding voltage drop for each conductor.





Electrical Layout Assumptions

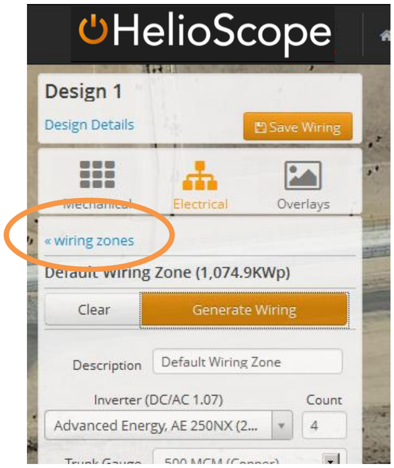


Glossary: Electrical Layout

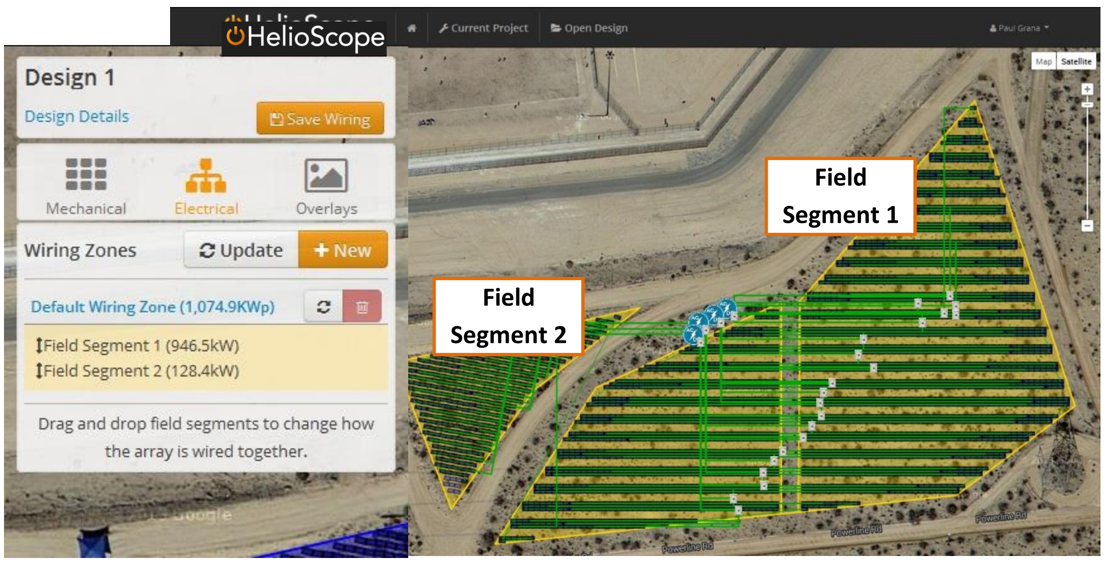
Term	Description
Trunk Gauge	The conductor size between the re-combiner box and the inverter. If no re-combiner has been configured, this is not used.
Home Run	The conductor size between each combiner box and the inverter or recombiner.
Combiner Poles	The number of strings connected to each combiner box. **Important**: If the combiner box size is larger than the inverter, then the strings will feed directly to the inverter.
Strings	The size of the conductor for the source circuits from the modules.
String Length	The number of modules wired in series. **Important**: If the Wiring Zone does not divide evenly into full strings, then the remaining modules will not be included in the final Design.
Stringing Direction	The direction in which modules are connected to each other.

4.3 Managing Multiple Field Segments and Wiring Zones

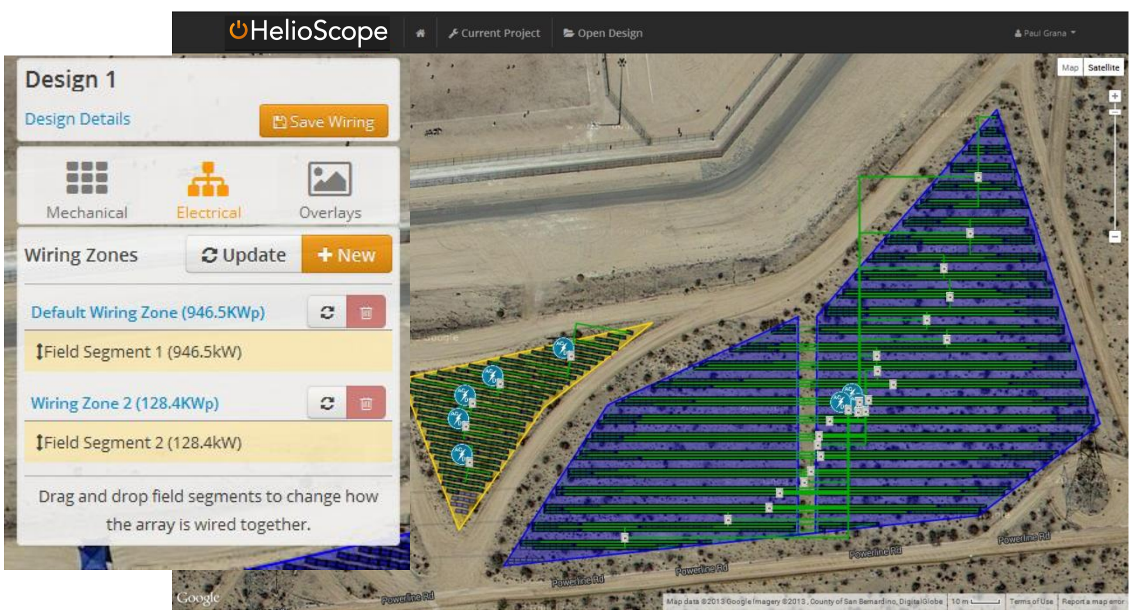
If the Design has multiple Field Segments, they can either be wired in one or multiple Wiring Zones. Click the “<< Wiring Zones” link at the top of the Electrical control.



With one Wiring Zone selected, all modules in the Field Segments will be assigned to strings as one group, and connected to the inverter(s). In this case, modules will be assigned to strings in the order that the Field Segments are listed.



When Field Segments are assigned to separate Wiring Zones, each electrical design is independent.

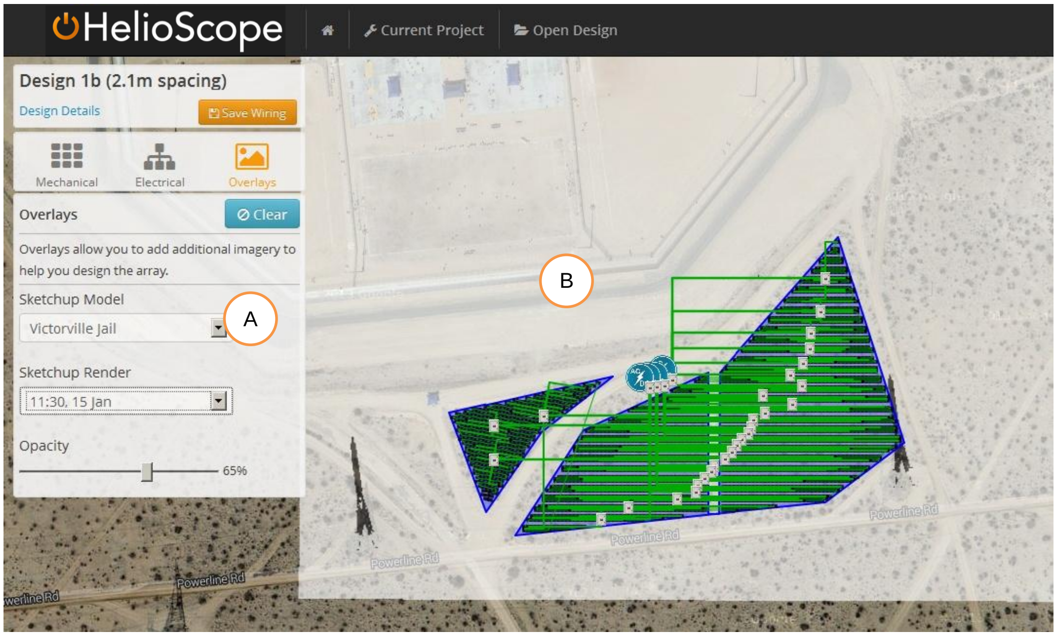


4.4 Shade Overlays

Use overlays to compare the positioning of modules relative to shade patterns*:

A. Select the Shade Profile and timestamp
B. The shade pattern the date & time will be shown as an overlay on the map

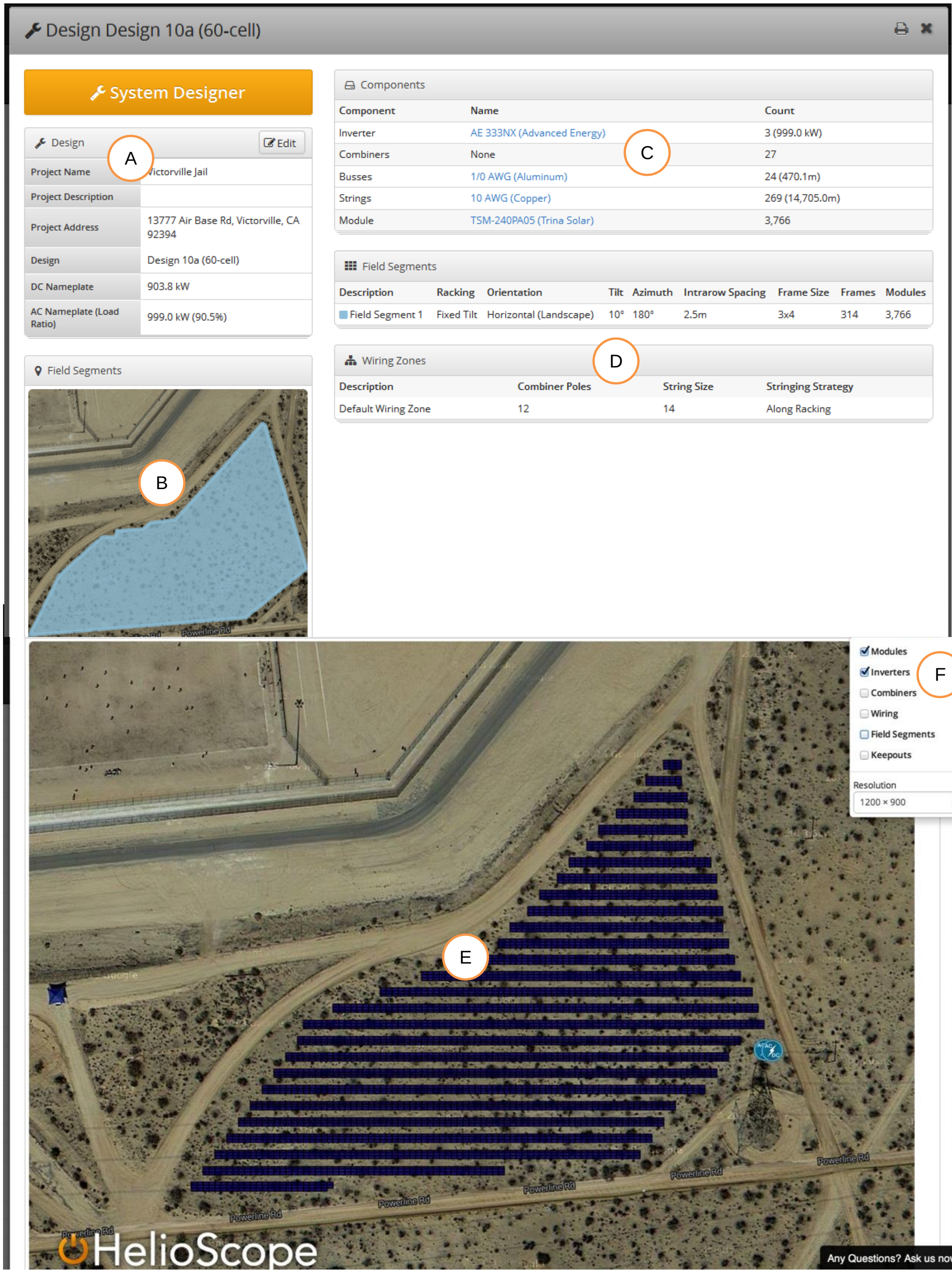
Note*: requires Shade Profiles loaded via the SketchUp plugin (see “Shade Modeling”, section 8).



4.5 Design Summary

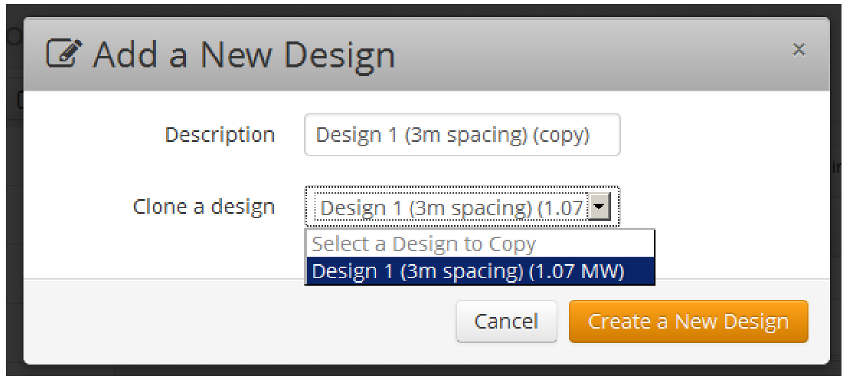
From the Design home, click a Design to view the details:

A. Design name and size
B. Location of Field Segments on map
C. Bill of materials, including modules, wire, combiners, and inverters
D. Module layout and wiring assumptions
E. Full image of Layout
F. Configurable list of Design details to be shown in image

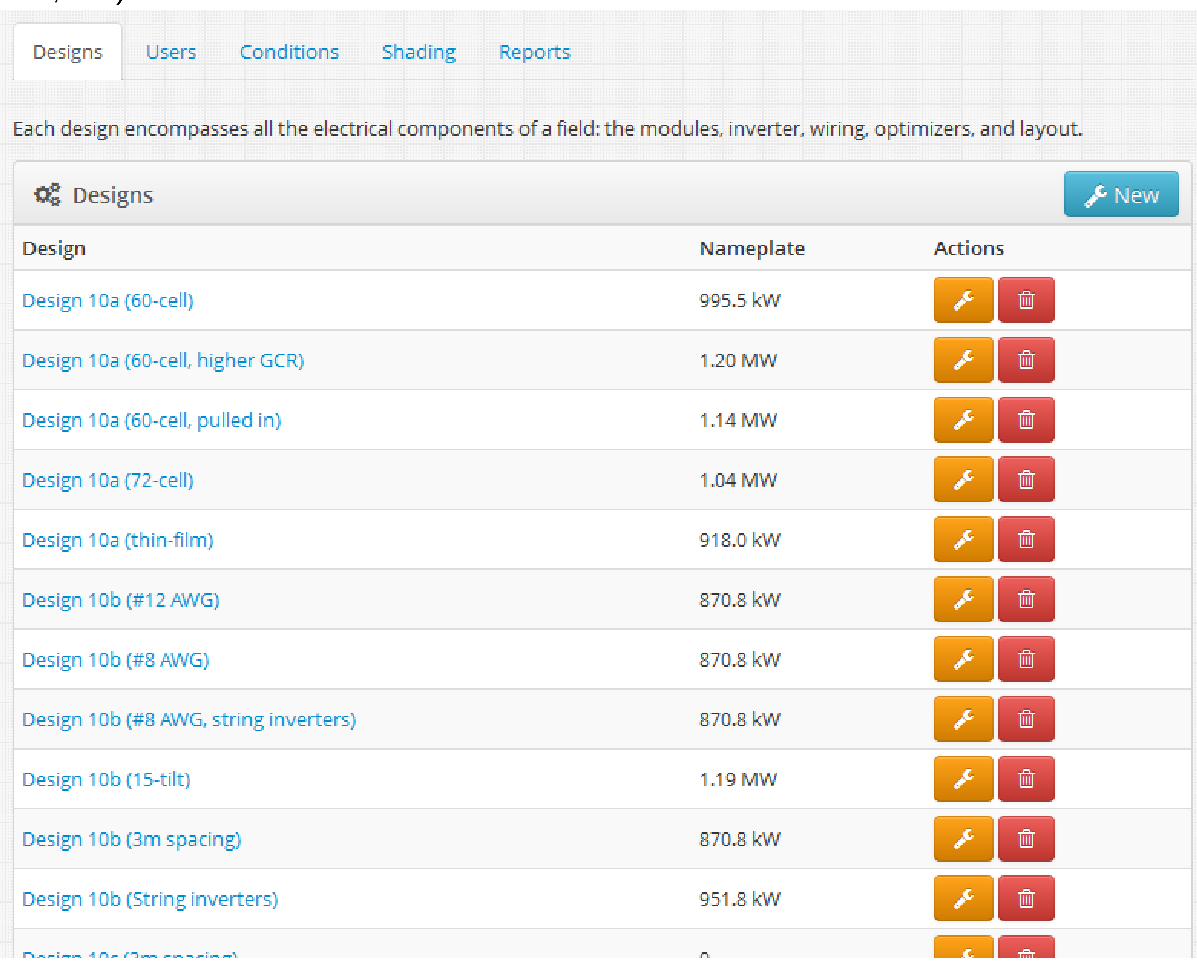


4.6 Cloning

Use Design cloning to copy a design from an original.



Use cloning to create multiple Designs for detailed engineering analysis (ground coverage ratio, tilt, conductor size, etc.):

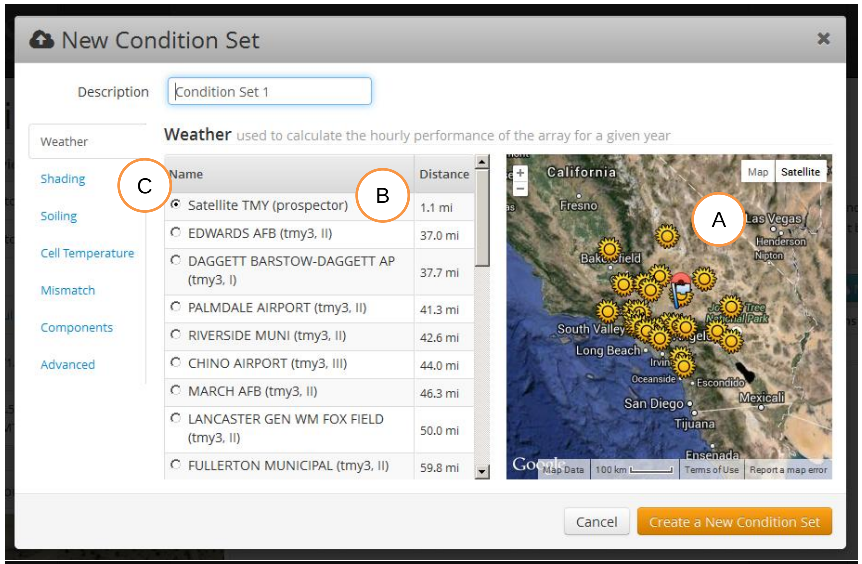


5.0 Condition Sets

A Condition Set describes the environment around the solar array, including the weather conditions, shading patterns, and soiling losses.

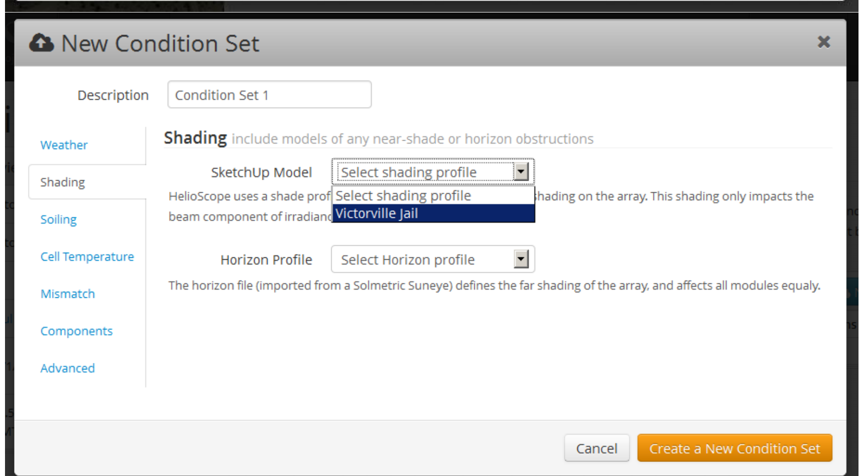
Weather:

A. Nearby weather stations are shown on map
B. Weather stations are sorted by distance from Project. The source and class of each file is shown in parenthesis
C. Select the desired weather file

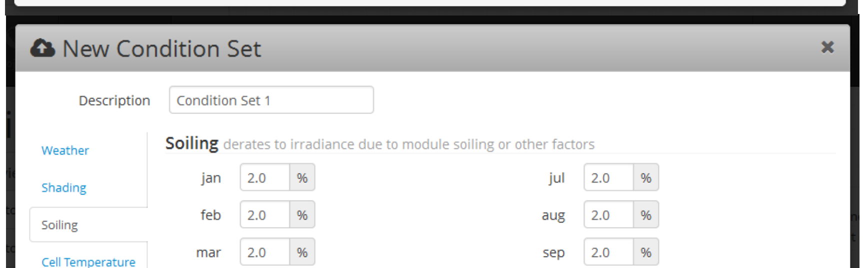


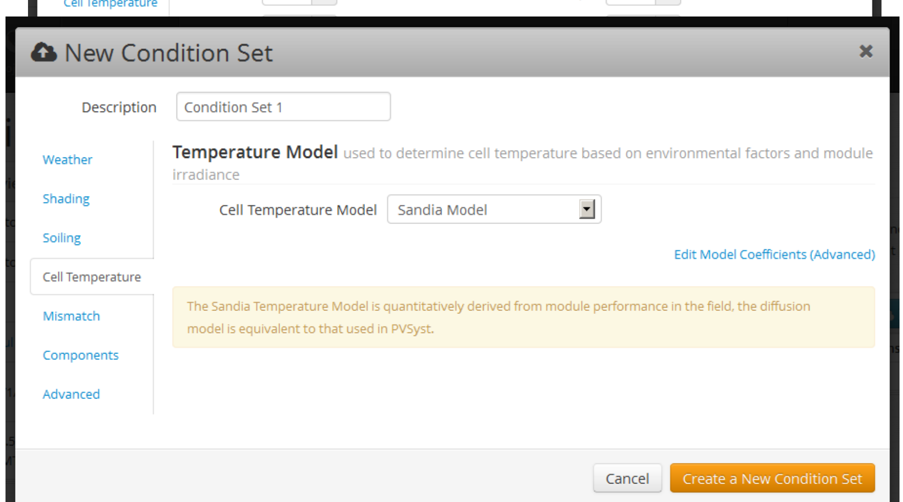
Shading: If the Project has shading, choose the Shade profile and/or Horizon profile

Note: the Shade Profile must have first been loaded (see Section 8)



Soiling: Confirm or adjust monthly soiling losses.

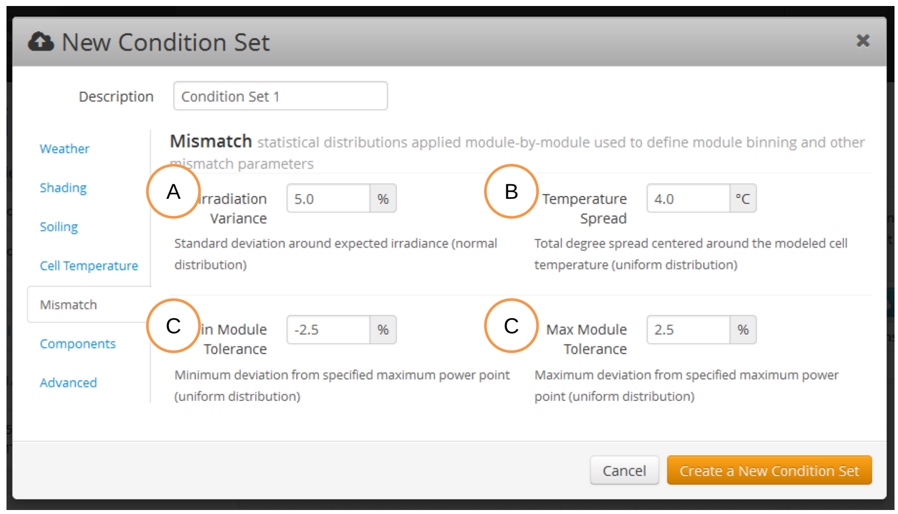




Cell temperature model: Choose temperature model (HelioScope supports both the Sandia Labs Temperature Model and the Linear Diffusion model used by PVsyst).
A) Click "Edit Model Coefficients" to view and modify the coefficients.

Mismatch: View or modify three statistical mismatch parameters:

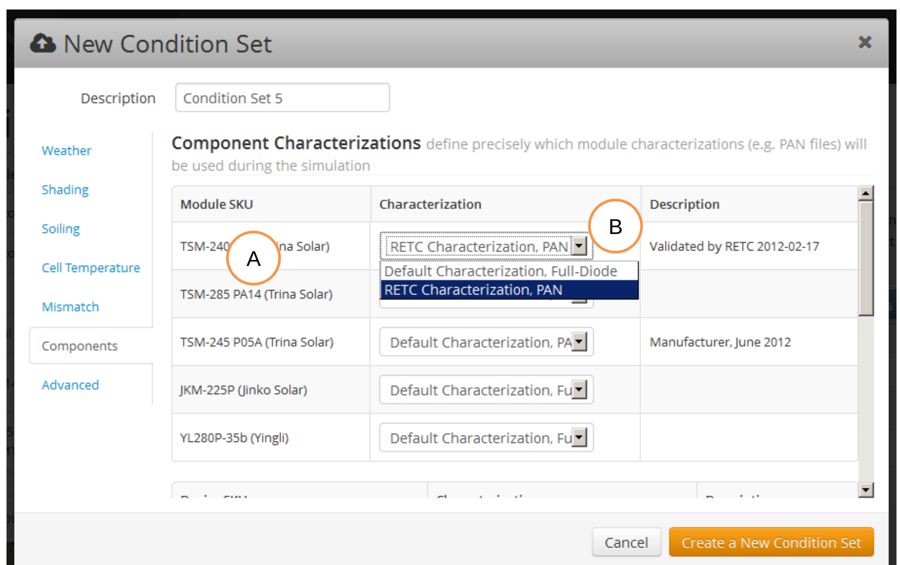
A. Difference in plane-of-array irradiance (normally distributed)
B. Module temperature differences (uniform distribution)
C. Module manufacturing tolerance (uniform distribution). This has two inputs to account for positive-tolerance module binning.



Components: Manage the mathematical characterizations used for each module or inverter.

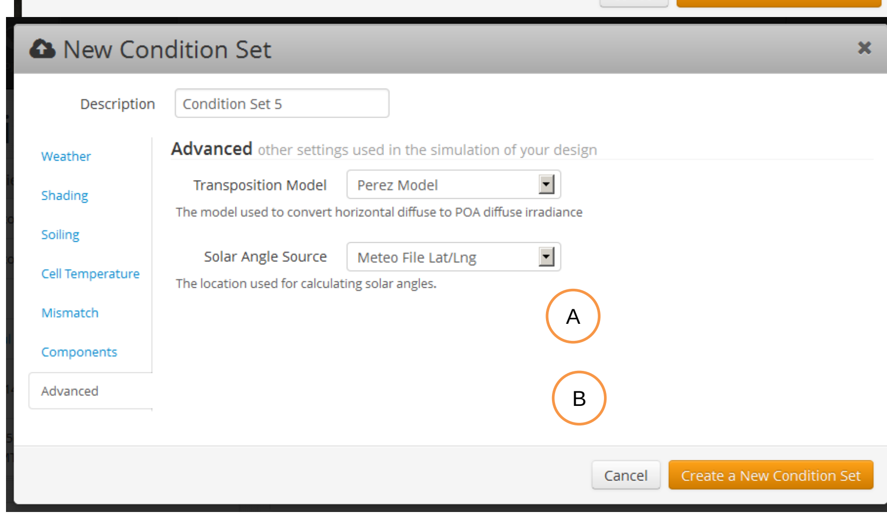
A. List of all modules used on any Design in the Project.
B. If multiple PAN files are available (including a custom PAN file), configure then via the drop-down menu

See Section 7 for additional information on managing component characterizations.



Advanced:

A. Choose the transposition model (the mathematics used to convert diffuse light to effective irradiance).

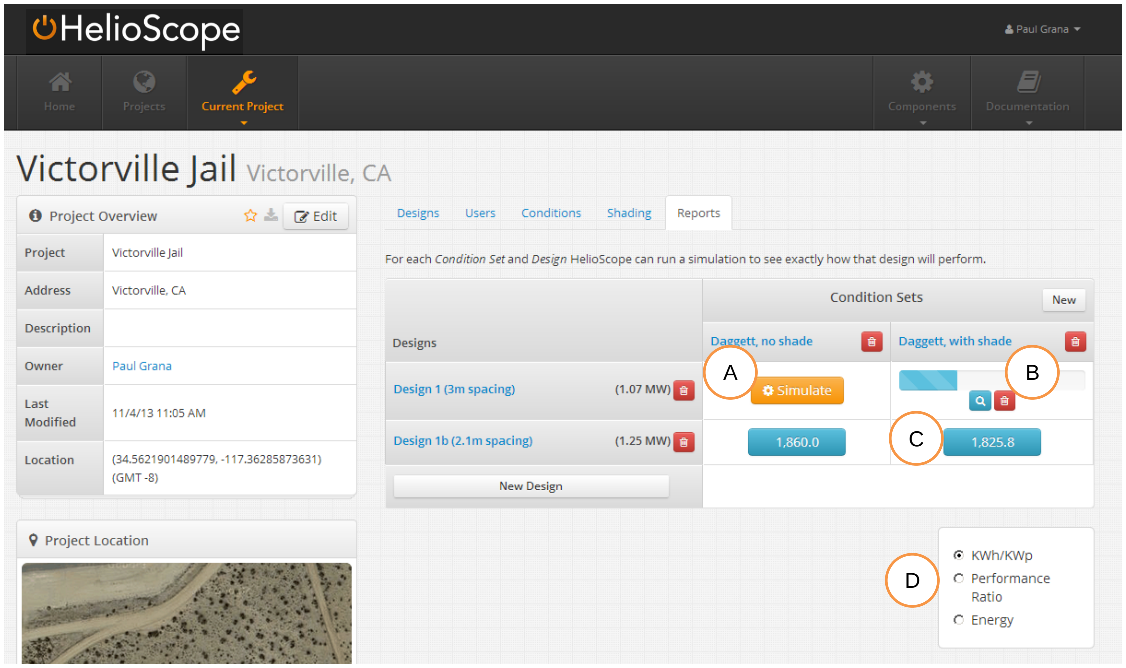


B. Choose the location used for calculating solar angles (either the location of the weather file, or the project location).

6.0 Reports

The Reports page shows the full set of Designs and Condition Sets that have been created in the Project. Each combination of a Design and Condition Set can be Simulated to create a Report.

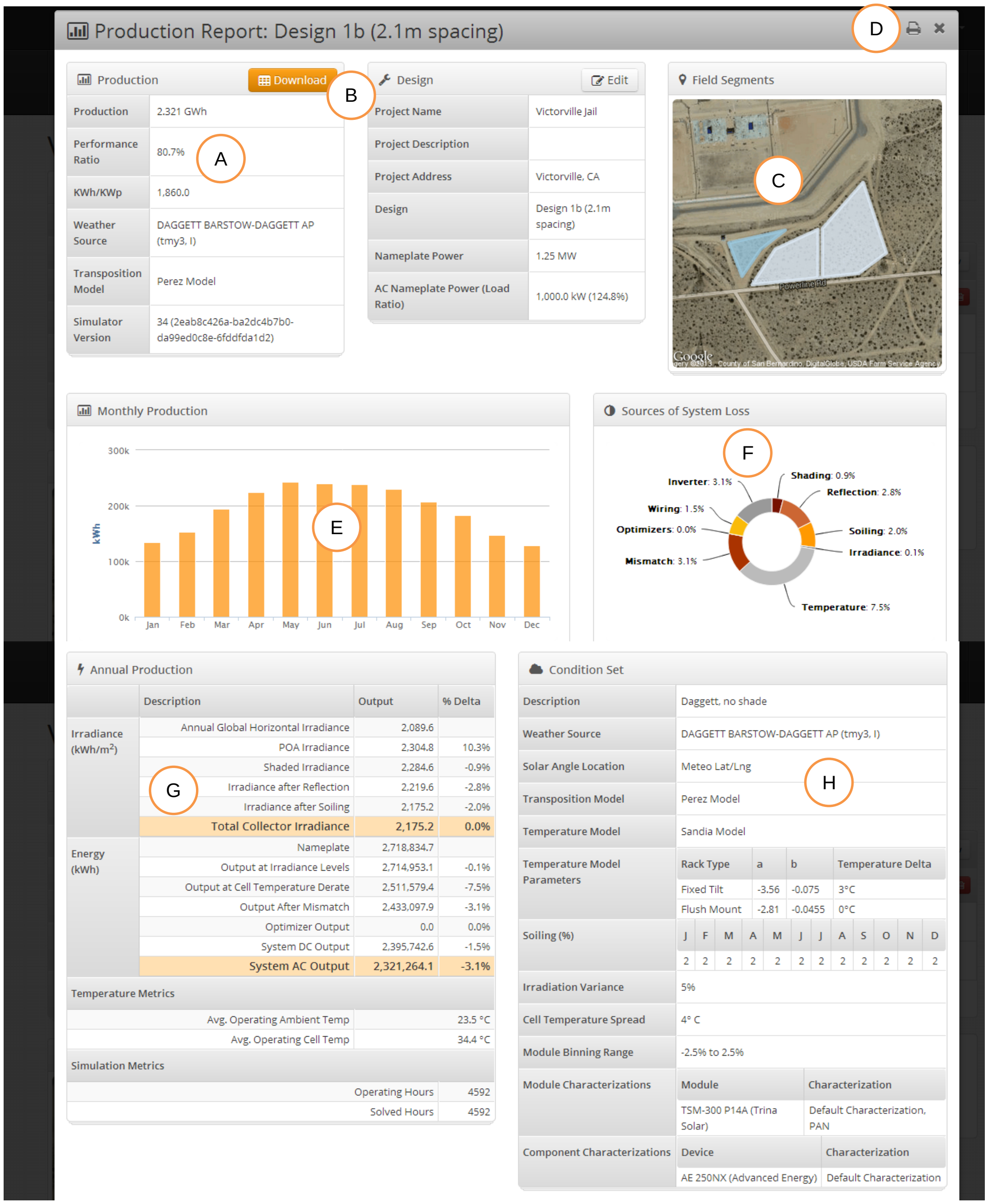
A. Click on orange "Simulate" button to trigger a simulation
B. Blue progress bar shows the status of active simulations
C. Completed Reports are shown with a blue button. Click to view the detailed Report
D. The metric shown on the completed Reports can be configured from the controls below



6.1 Production Report

A detailed Report is available for each completed Simulation:

A. Summary metrics, including energy production, performance ratio, and kWh/kWp
B. Hourly results can be downloaded in CSV format
C. Locations of Field Segments shown on map
D. Download a PDF report
E. Monthly production values
F. Chart shows loss factors
G. Detailed loss tree shows the total losses at each step of the irradiance and energy calculations
H. Records of condition set assumptions



I. Bill of materials, including modules, wire, and inverters
J. Electrical design assumptions
K. Mechanical layout assumptions
L. Image of detailed layout

Components (I)

Component	Name	Count
Inverter	AE 250NX (Advanced Energy)	4 (1,000.0 kW)
Combiners	None	32
Busses	0 AWG (Aluminum)	28 (2,152.1m)
Strings	10 AWG (Copper)	320 (17,822.3m)
Module	TSM-300 P14A (Trina Solar)	4,160

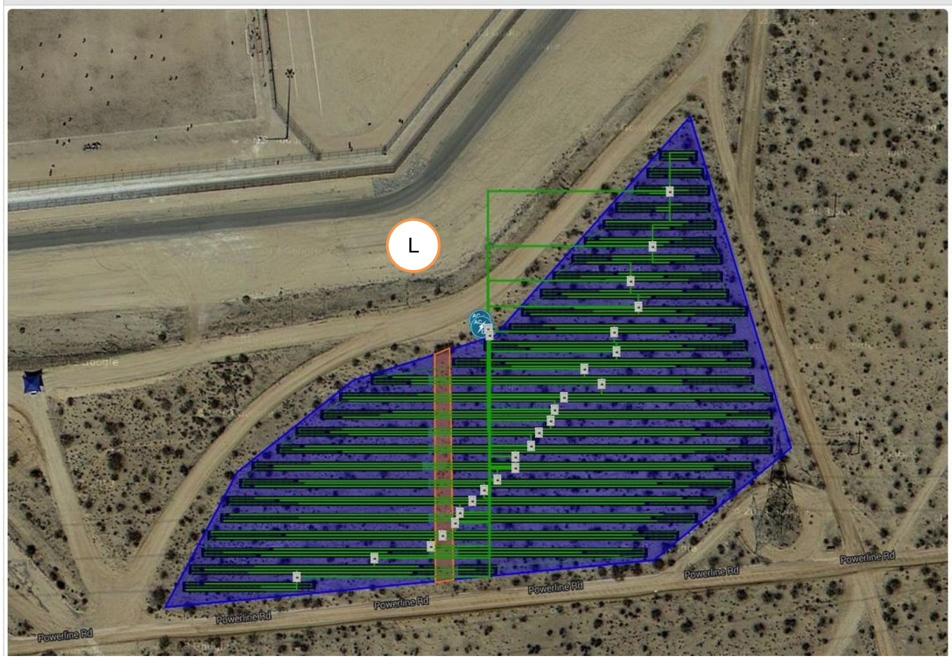
Wiring Zones (J)

Description	Combiner Poles	String Size	Stringing Strategy
Default Wiring Zone	12	13	Along Racking

Field Segments (K)

Description	Racking	Orientation	Tilt	Azimuth	Spacing	Bank Depth	Modules	Power
Field Segment 1	Fixed Tilt	Horizontal (Landscape)	15°	180°	2.1m	3	3,739	1.12 MW
Field Segment 2	Fixed Tilt	Horizontal (Landscape)	10°	190°	1m	1	421	126.3 kW

Detailed Layout

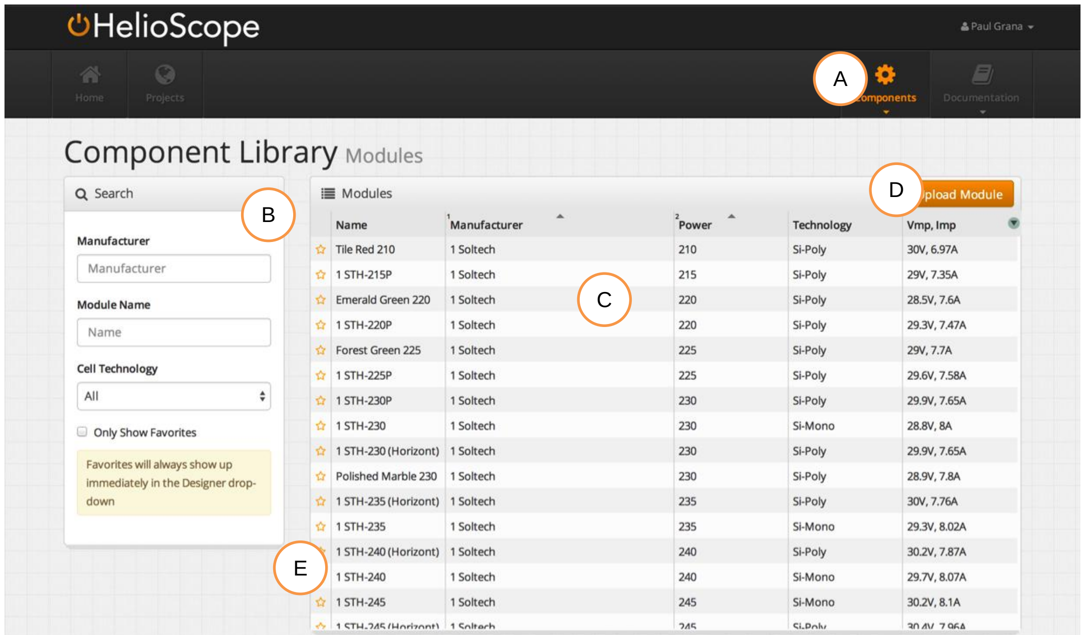


7.0 Components

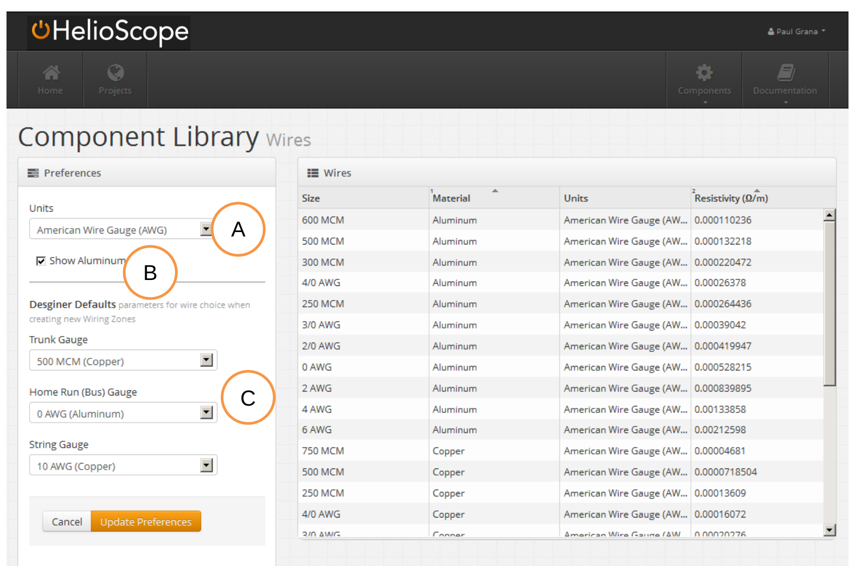
HelioScope includes three different component databases: modules, Inverters/optimizers, and wires.

Modules and inverters are organized in a hierarchy. The SKU represents the product (e.g., a Trina PC14 280-watt module). Each SKU can have multiple characterizations, which define the product's behavior. For a module, a PAN file is a characterization, so a single module SKU can have multiple PAN files.

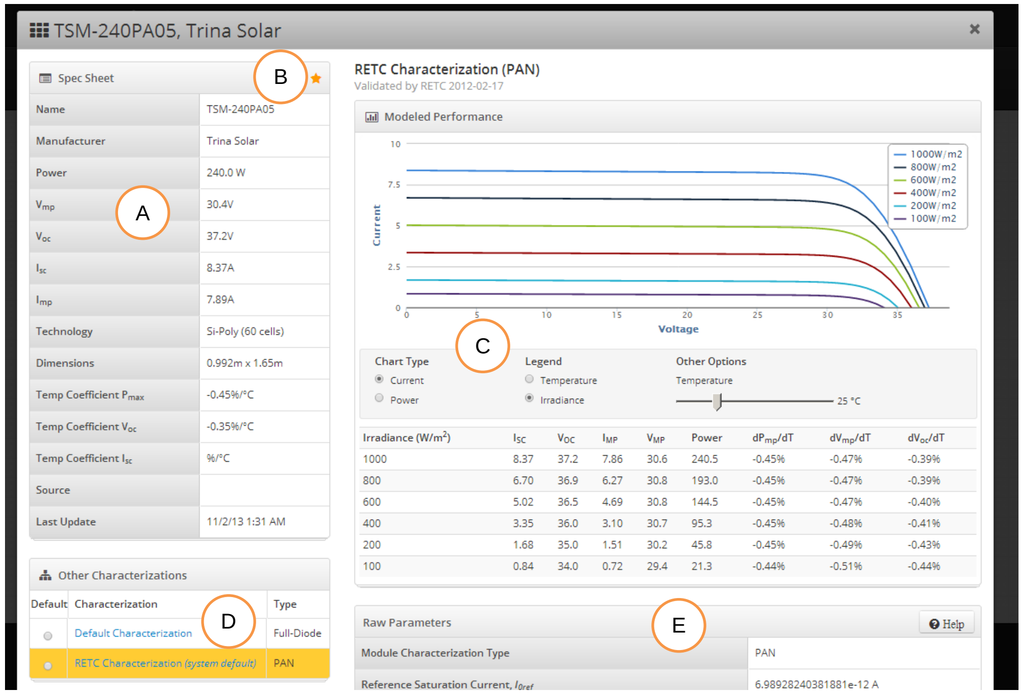
A. Access the library from the Components menu
B. Search for specific products
C. Click any module or inverter to view its details (see section 7.1)
D. Click "Upload Module" to open PAN file uploader (see section 7.2)
E. Click the orange star to 'favorite' a device. It will show up on the drop-down menu in the Designer.



Wiring database details:
A. Select preferred wires (North American wires (AWG) or metric)
B. Select to include aluminum conductors
C. Choose default conductors for the three conductor runs



7.1 Component Detail



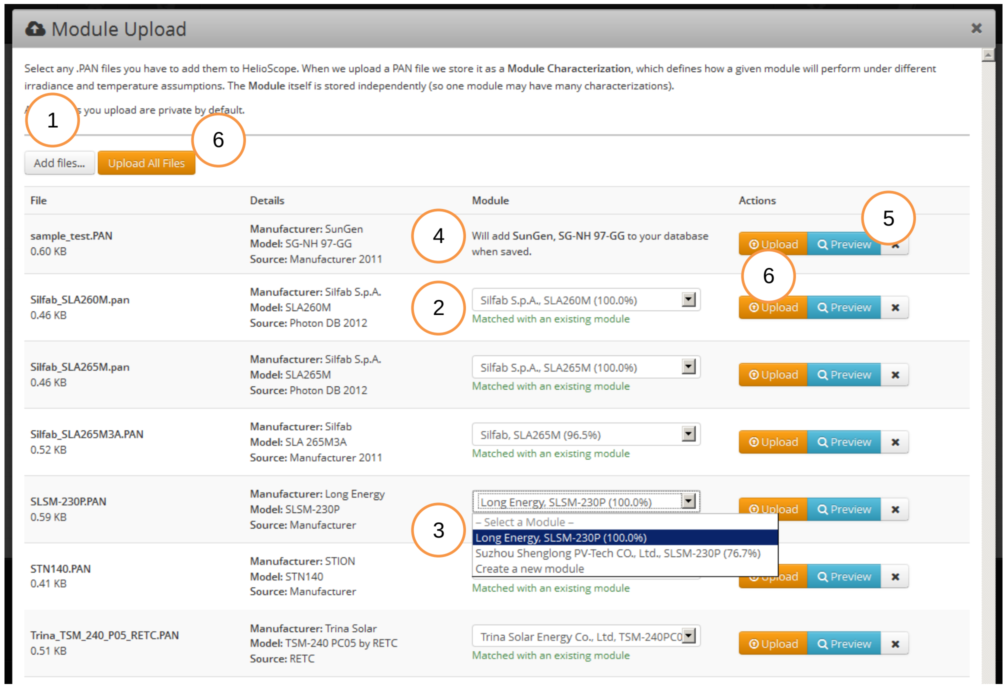
Detailed view of module or inverter:

A. The key specifications are shown at the left
B. Toggle the orange star to make the product a ‘favorite’
C. Choose the temperature and irradiance levels for viewing the I-V or P-V curves
D. If multiple characterizations are available for the product, choose the default characterization. These can still be modified in the Condition Set of the Project.
E. The details of the module PAN file are shown in the “Raw Parameters” table.

7.2 PAN File Uploader

Use the PAN file uploader to import module characterizations.

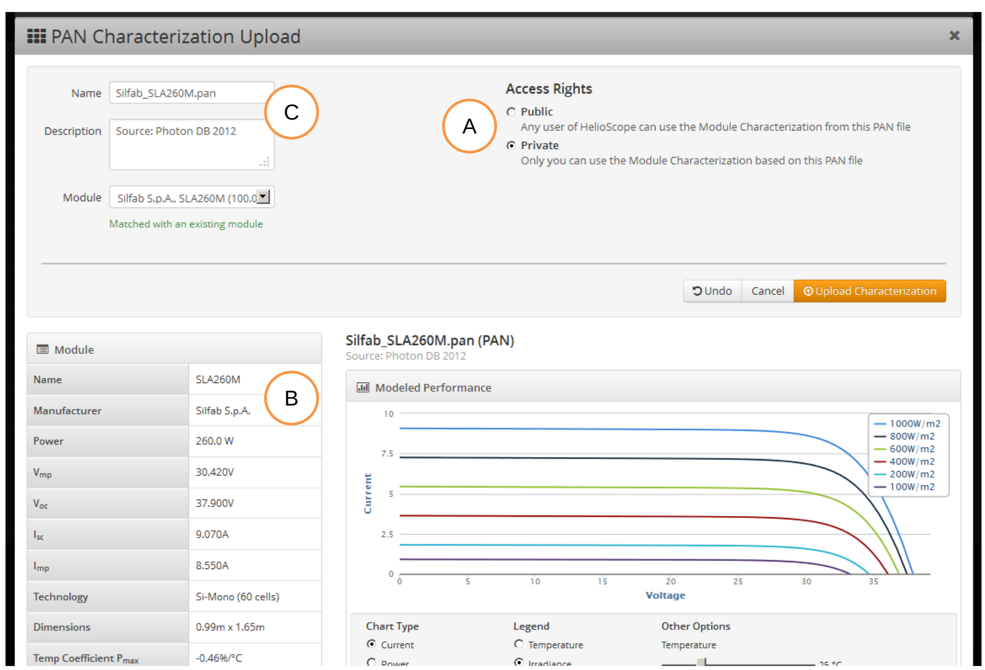
1) Click “Add files” to browse and select PAN files
2) The characterizations are automatically matched to modules in the database
3) View drop-down menu to choose or confirm the module used
4) If no match is found, a new module will be created
5) Click Preview to view and edit the characterization details (see section 6.3)
6) Upload files to add them to the database



7.3 Characterization Preview & Editing

The PAN Characterization page shows the PAN details:

A. Default access rights are private (only available to the user), but can select Public
B. The PAN details (coefficients and curves) are shown for confirmation
C. Edit the characterization name, description, and module SKU



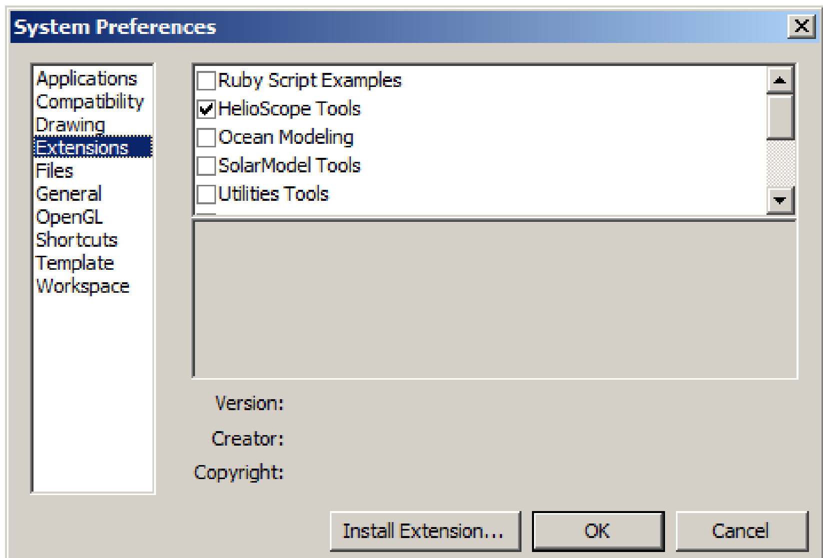
8.0 Shade Modeling

HelioScope incorporates obstruction shading using SketchUp, a widely-used and freely available 3D modeling program. SketchUp enables detailed geo-location through Google Earth. HelioScope integrates with SketchUp via a software plugin.

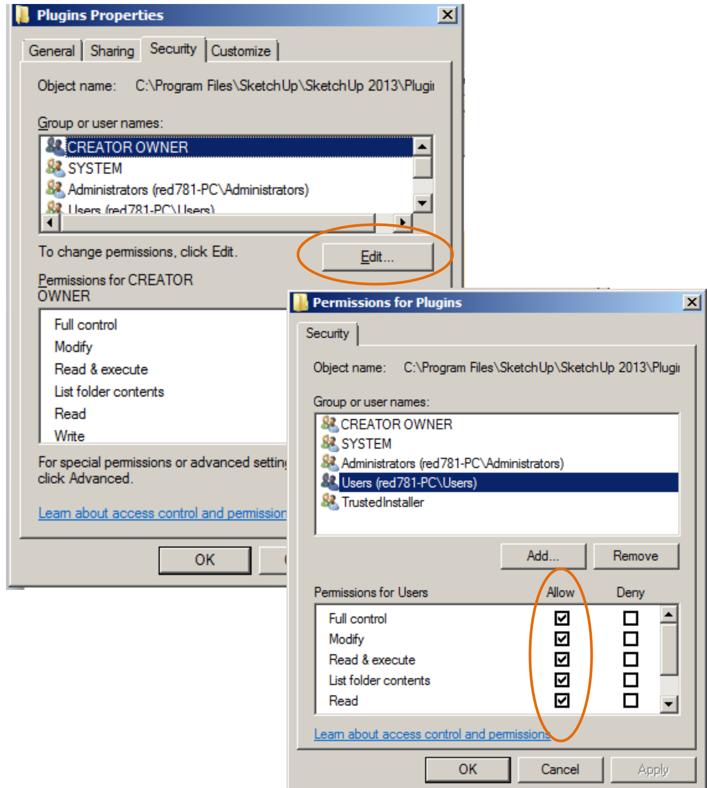
8.1 Installing the Plugin

1. **Download plugin**: The SketchUp plugin for HelioScope can be found on the ‘Shading’ tab within any Project. The SketchUp plugin file has the standard “.RBZ" extension and is compatible with both the Windows and Mac versions of SketchUp . Download and save this file to your computer.
   A note on compatibility: some versions of Internet Explorer will change the file extension to .ZIP while downloading. If this happens, please rename the extension to .RBZ.

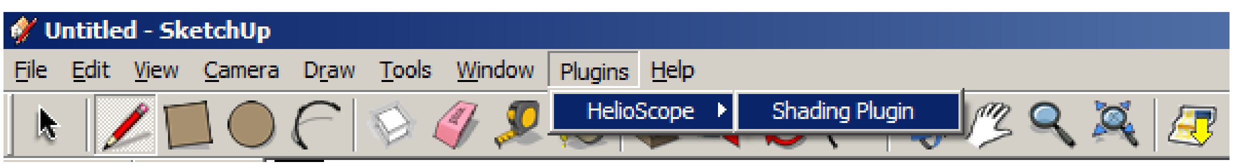
2. **Install plugin**: From within SketchUp, open the System Preferences window. On Windows this can be found under the “Windows” menu (Windows → Preferences), while on Macs this is located under the “SketchUp” menu (SketchUp > Preferences). From here, highlight “Extensions” in the left menu, and select “Install Extension.” Navigate to the RBZ file on your computer and select it. A dialog box will pop up to ask if you trust the source; confirm that you know and trust the author. The installation will complete automatically, and the unpacked plugin will be added to your computer.



3. **For SketchUp Make – Grant Permissions for Plugin Folder**: In the latest version of SketchUp (known as “SketchUp 2013” or “SketchUp Make”), an additional step is needed for the SketchUp program to access the plugin.
   - **3.1** Navigate to the SketchUp Plugin folder, likely at “C:\Program Files\SketchUp\SketchUp 2013\Plugins”
   - **3.2** Right-click on the HelioScope plugin folder, which will be named “helioscope_ext”, and select ‘Properties’.
   - **3.3** Select the “Security” tab and click the “Edit” button to modify permissions.
   - **3.4** A separate window will appear with a list of users. Go down the list of users, and select “full control” for each user in the box below for “Permissions for Users”.



4. **Re-start SketchUp**: at this point, SketchUp may need to be re-started.
5. **Activate plugin**: The HelioScope Plugin should show up in the Plugin menu under “HelioScope” > “Shading Plugin”. If you do not see this menu option, ensure that the plugin has been activated in the Sketchup Preferences pane described in step 1.b. The HelioScope plugin will show up as ‘HelioScope Tools.’

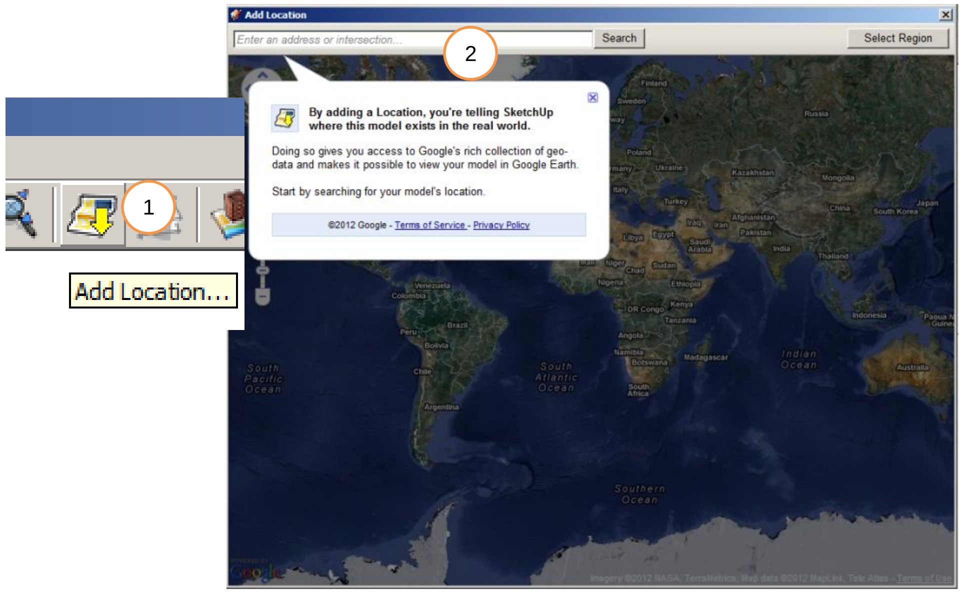


8.2 Modeling the 3D Obstructions in HelioScope

The HelioScope SketchUp plugin requires a geo-located 3D model of the obstructions near the array.

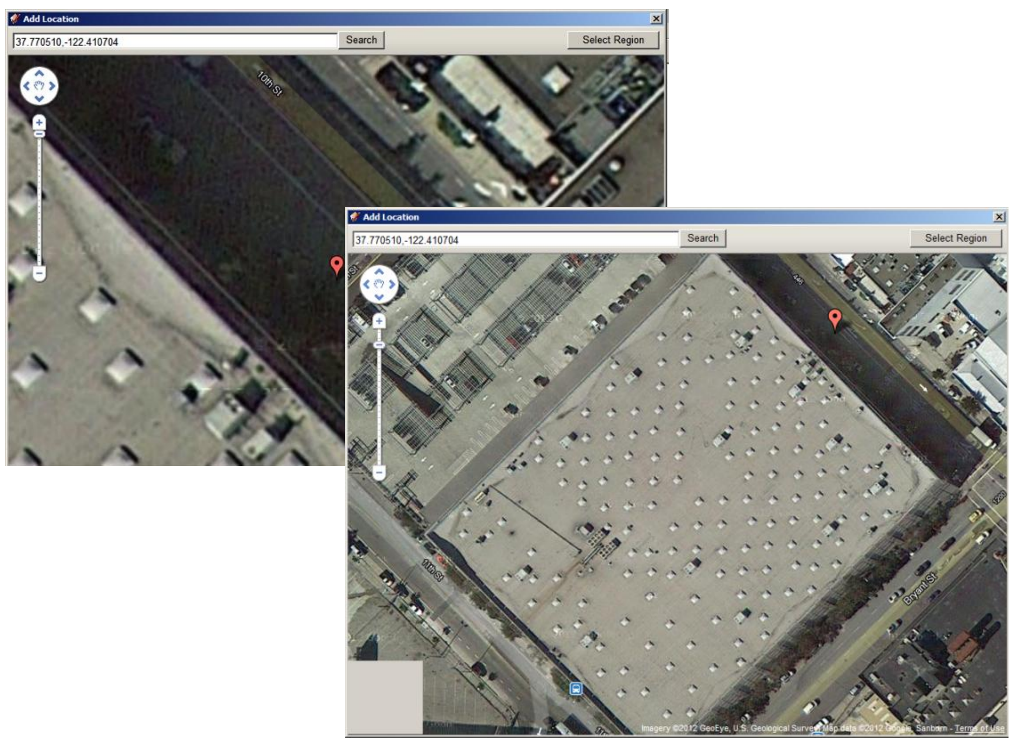
Add Location.

1) Click the "Add Location" button, which will open up an "Add Location" window
2) Enter the Project address or latitude/longitude into the dialog box and select "Search"

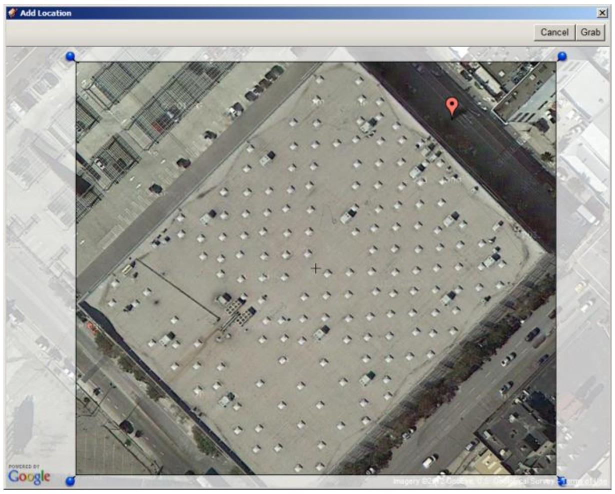


The control box will now show the Google Earth satellinte image for the location.

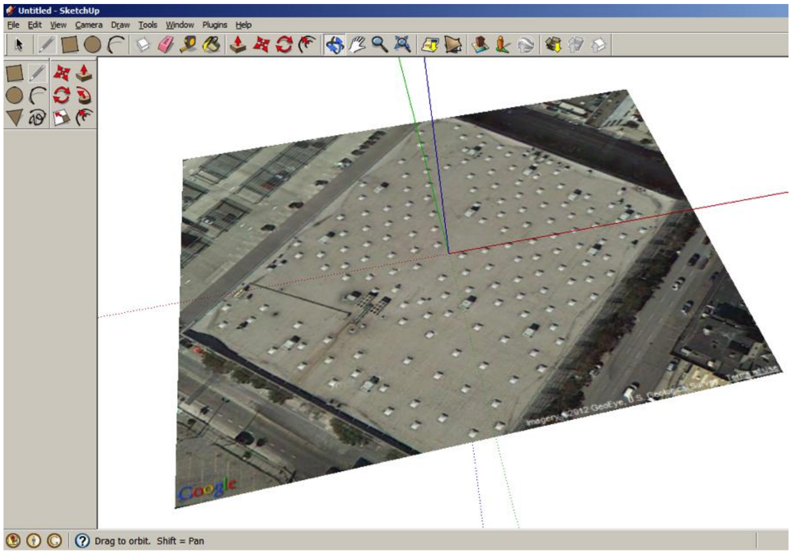
Re-center the map and zoom out so the entire project area is in the box. Click "Select Region".



The control window will now show an active area, surrounded by push pins. Size the active area to match the array, including all relevant obstructions. When finished, click “Grab”.

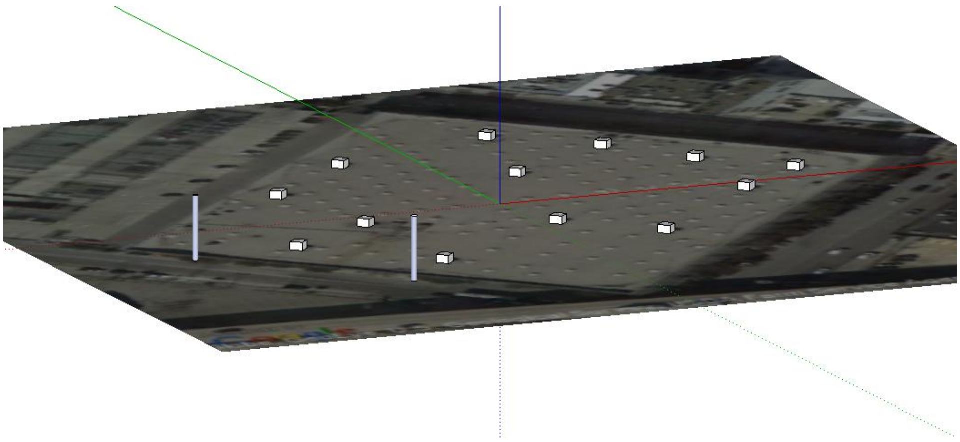


The satellite image will now be a layer in the SketchUp model.



Create shade objects. Build the obstructions, including roof objects, nearby trees, and nearby buildings, in the SketchUp model.

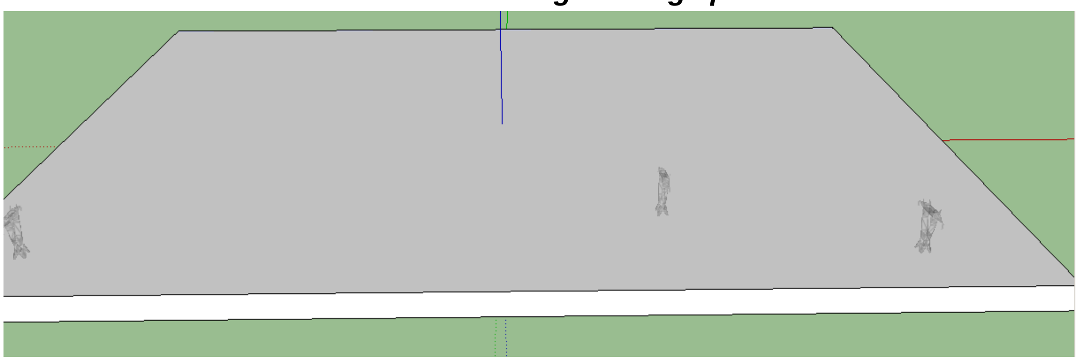
Pay attention to the locations and dimensions of the objects. Use the Google Earth layer to locate the exact position of each object.



Best Practices for modeling shade in SketchUp:

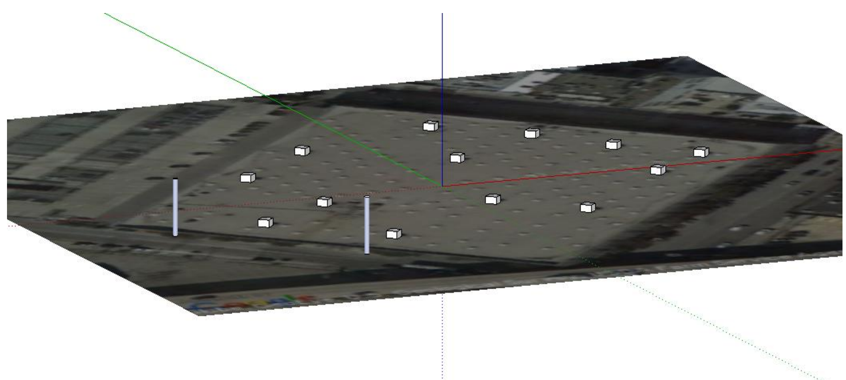
A. Only model objects (in SketchUp) that will cause shade on the modules. For example, if there is a vent pipe below the module plane (and therefore has no impact on the array's performance), then it should be omitted from the 3D model.
B. Avoid modeling the modules themselves. Row-to-row shading is already calculated within HelioScope based on the exact geometry of the modules.
C. In the cases where the modules will be raised from the ground (say, in a carport or canopy application), create a raised shape (at the same height of the modules) across the entire array area. This will shorten the shade patterns, based on the relative height of the modules versus the nearby obstructions.

Standard 3D model of high-voltage powerlines



3D model of high-voltage powerlines with vertical adjustment for raised modules

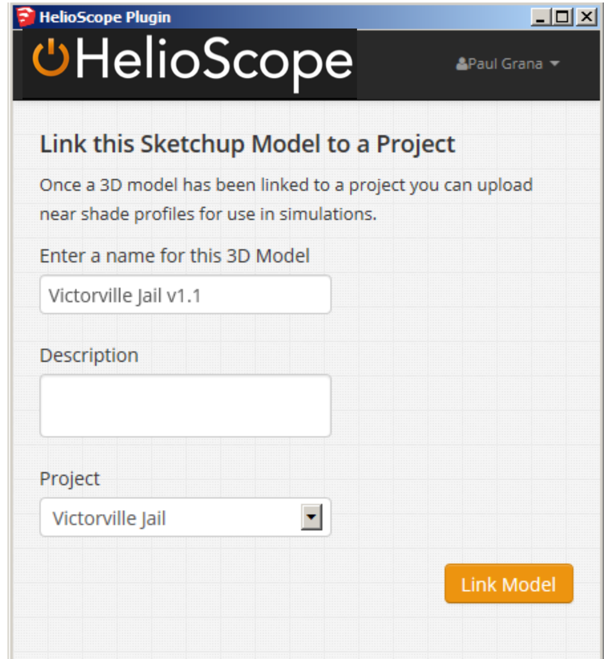
D. Beware modeling shade from wires. Shade from wires will often be diffused by the time it reaches the modules, yet HelioScope treats all shade as binary. So a single pixel of shade will remove a module's entire DNI.
E. In the Z (height) axis, it may be easier to adjust the zero point to the plane of the modules. This may require the user to shrink shade obstructions if the modules are elevated from the ground level. For example, say a 40-foot tall tree is near an array on a 10-foot roof. The tree in SketchUp would be 30 feet high, representing the top 30 feet of the tree.



8.3 Importing Shade Profile Using the SketchUp Plugin

1. **Initiate plugin and log in**: Once the SketchUp obstructions are designed, select the HelioScope plugin from the plugin menu. Log in to your HelioScope account.

2. **Link to a Project and begin upload**: The dialog box will show the list of all Projects under your account. Select the Project where you would like the shade profile uploaded. Click "Link Model" to associate the local file with the Project in HelioScope.



3. **Run plugin**: Click "Upload Shade Profile" to begin the shadow rendering and uploading process. The SketchUp plugin will run automatically, taking several minutes. During the process, you can track the progress via the status bar.

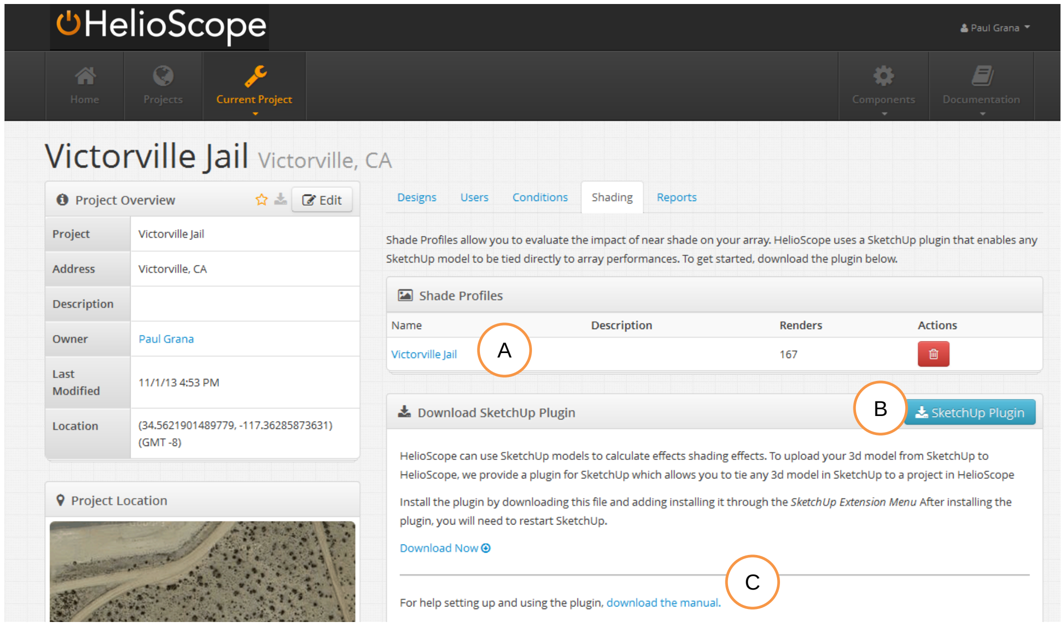
   The plugin generates a series of 2-dimensional shade patterns that characterize the shade patterns on the array throughout the year. These can be viewed from the Shade Tab in HelioScope (see Section 5.1), and also in the Overlays section of the Designer (see Section 4.4).

8.4 Verifying Shade Patterns in HelioScope

After importing a shade profile from the SketchUp Plugin, the shade patterns can be viewed in HelioScope.

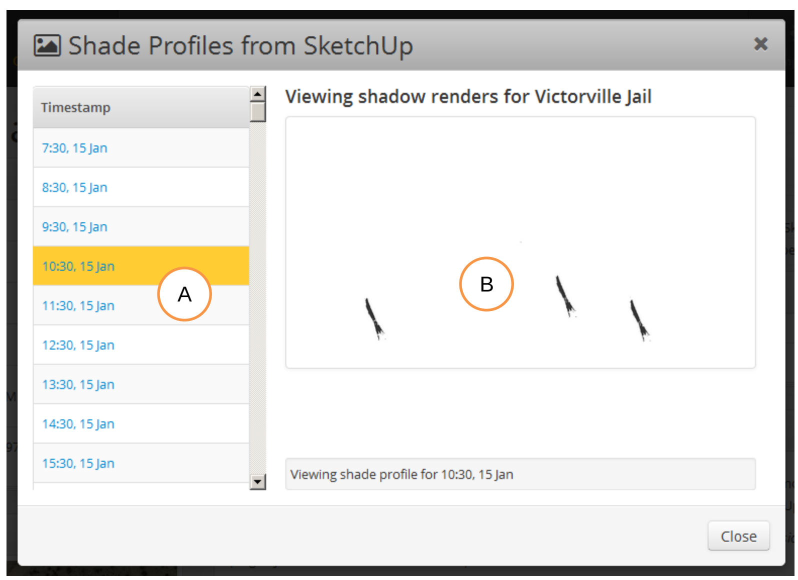
Manage the Shade Profiles from the "Shading":

A. List of Shade Profiles
B. Link to download the Plugin
C. SketchUp Plugin User Manual



Each Shade Profile includes a full year worth of geo-located shade images for a given 3D design.

A. Shade patterns are calculated for every hour of each month
B. Each shade render is a black-and-white image of the shade pattern, based on the position of the sun and the shape of the obstructions



The shade patterns can also be viewed in the Designer by using the shade overlays functionality (see section 4.4).

Note that shading must be selected as part of the Condition Set in order to be used in a Simulation.

9.0 Appendix

Glossary: Report Summary Metrics

Term	Description
Production	The total energy generated during the simulation, in AC MWh or GWh
Performance Ratio	Performance Ratio (PR) shows the percentage of total potential energy for the array that is converted to AC energy. Mathematically, the PR is defined as the AC power production, divided by the product of plane-of-array (POA) irradiance times the system DC nameplate power.
kWh/kWp	The specific energy – total simulation energy generation divided by the system DC nameplate power.

Glossary: Annual Production Metrics

Term	Description
Annual Global Horizontal Irradiance	The total irradiance that will fall on a flat plane at the location of the array. This is aggregated directly from the weather file.
POA Irradiance	The total irradiance in the Plane of Array (POA), accounting for tilt and azimuth angles. This is averaged across all modules in the array.
Shaded Irradiance	The total irradiance accounting for all shading (from horizon, row-to-row, and obstruction)
Irradiance after Reflection	The total irradiance after accounting for reflection off the surface of the module (also known as the Incident Angle Modifier, or "IAM" reflection).
Irradiance after Soiling	Irradiance after module soiling is accounted for. Note that soiling assumptions are made in the Condition Set.
Total Collector Irradiance	The total annual irradiance available to the modules in the array. This is averaged across all modules.
Nameplate	The maximum potential power of the array, defined as the total collector irradiance multiplied by the system nameplate power.
Output at Irradiance Levels	The total energy output by the modules, after accounting for low-light effects and module IV curve distortions.
Output at Cell Temperature Derate	The total output of the modules, factoring in the temperature effects on the IV curves. This is the sum of the modules at their maximum power points.
Output After Mismatch	The total energy output of the modules, factoring in all system constraints (e.g. series & parallel mismatch, voltage drop, etc.).
Optimizer Output	If DC optimizers are present, this shows the total output of the optimizers, factoring in their efficiency curves and principles of operation.
System DC Output	The total energy output of the DC system, accounting for all wire resistive losses.
System AC Output	The total AC energy output from the inverters, taking into account inverter performance losses.

Questions or Comments:

Email: support@folsomlabs.com
Office: 415-729-4050

Folsom Labs, LLC
San Francisco, CA
www.folsomlabs.com