CONSTRUCTION

Surface Processing Tool

Instruction Manual

SOLAR

REVISION 0 – Oct 2025

1. Quick Start Guide

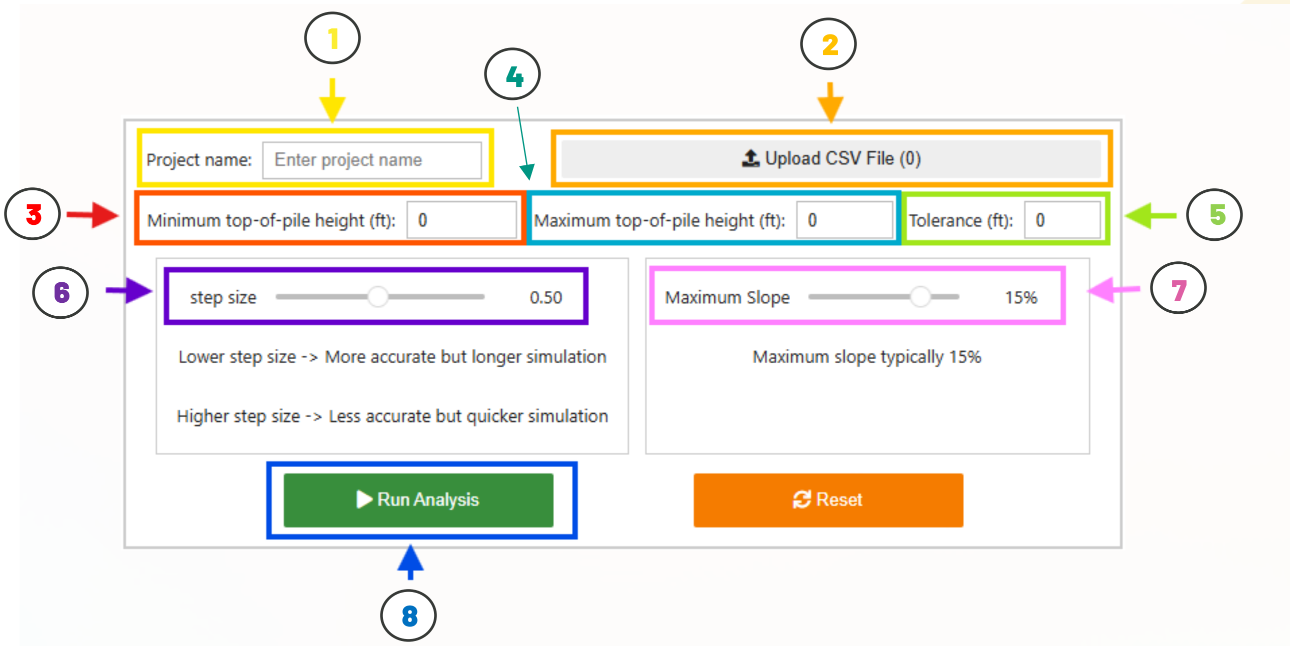


Figure 1: Quick Start Guide

1 – Input project name (e.g. Horus).

2 – Click the button "Upload CSV File (0)". This will open the file explorer where the existing surface data can be selected and uploaded.

3 – Enter the minimum top-of-pile height in feet (e.g. 4.4).

4 – Enter the maximum top-of-pile height in feet (e.g. 5.5).

5 – Enter the tolerance of the top-of-pile height in feet (e.g. 0.125).

6 – Select a step size with the slider. A smaller step size increases accuracy but requires more processing time, while a larger step size reduces accuracy but completes the simulation more quickly. The recommended step size is 0.50.

7 – Select a Maximum slope with the slider. The maximum slope is typically 15%, however it can vary depending on the project.

8 – Click "Run Analysis" once all other sections are completed. This will run the tool according to the chosen inputs and print the outputs in tabs beneath for your review.

2. Overview

This tool has been created to provide a faster, more detailed way to run Cut/Fill Analysis. Users can input existing surface data into the tool, set parameters based on owner, technical and code requirements to automatically generate Cut/Fill heatmaps, quantity summaries and 3D surface models for both the existing and proposed surfaces.

The tool enables multiple scenarios to be evaluated efficiently, allowing for educated decisions on design and construction methodology. This helps provide the best value to the client and PCL by improving accuracy, speed and insight into the grading design process. An image of the full tool without any inputs or results can be seen below in Figure 2.

It is recommended to use this tool with a mouse instead of a trackpad, it will make viewing the outputs much easier.

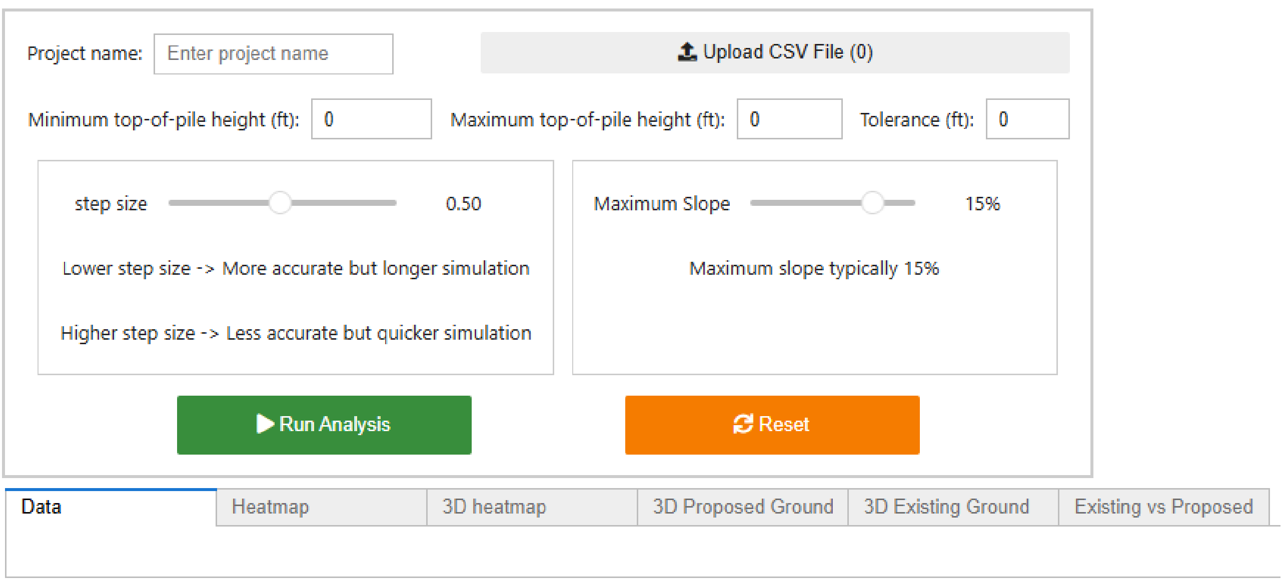


Figure 2: Tool Image

3. Requirements

3.1. Software Requirements

3.2. Input Data Requirements

The tool utilizes several inputs unique to each project to calculate the ideal gradient. These inputs are listed below and must be provided by the user.

- Project Name
- CSV File
- Minimum Top-of-Pile Height (ft)
- Maximum Top-of-Pile-Height (ft)
- Tolerance (ft)
- Maximum Slope

The input CSV file must be formatted according to one of the two accepted structures containing columns with the headings: "PileID, Pile In Tracker / PileInTracker, Northing, Easting, Elevation". See Figure 3 and Figure 4**Error! Reference source not found.** below for the two accepted CSV layouts.

	A
1	PileID,PileInTracker,Northing,Easting,Elevation
2	1,1,1764398.781,1405768.313,731.5655
3	2,2,1764394.019,1405768.313,731.7766
4	3,3,1764372.703,1405768.313,732.6686
5	4,4,1764347.231,1405768.313,732.7929

Figure 3: format A (single column)

	A	B	C	D	E
1	PileID	Pile In Tracker	Easting	Northing	Elevation
2	1	1	686149.5	4584534	1785.874
3	2	2	686144.5	4584529	1786.052
4	3	3	685379.5	4584364	1815.115
5	4	4	685384.5	4584294	1815.614

Figure 4: Format B (Multi Column)

As seen above, the input CSV file can consist of a single column or multiple columns, the tool will accept both formats. However, ensure the column headers are **exactly** as shown. Incorrect headers will result in an error, and the tool will fail to run. Note that the second column header can be written and PilleInTracker or Pile In Tracker.

4. Instructions

The tool is comprised of two sections: the Input Widget, Figure 5, and the Output Widget, Figure 6.

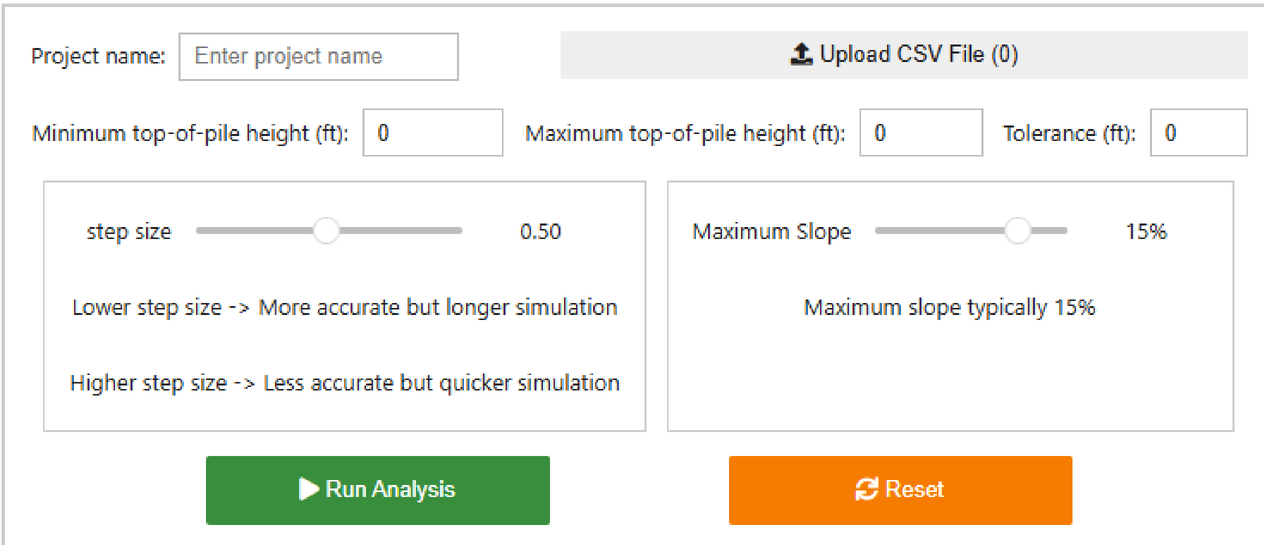


Figure 5: Input Widget

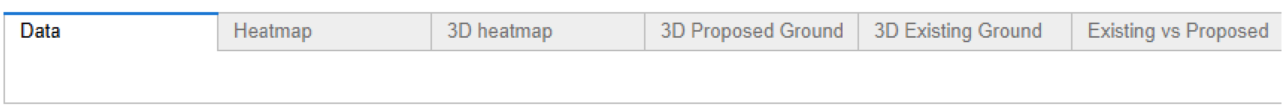


Figure 6: Output Widget

The Input Widget is where the user will input data unique to the project as stated in section 3.2, while the Output Widget is where the tool will plot the generated heatmaps and summary data.

4.1. Input Widget

There are 7 subsections to the Input Widget: Project name, Upload CSV, Minimum top-of-pile height, Maximum top-of-pile height, Tolerance, step size and Maximum Slope. Each of these sections will need to be filled in for the tool to run successfully. There are also 2 buttons in the Input Widget: "Run Analysis" and "Reset". Below are instructions on how to properly fill in the Input Widget.

4.1.1 Project Name

Enter the name of your project in the box provided to the right of the prompt (Enter project name).

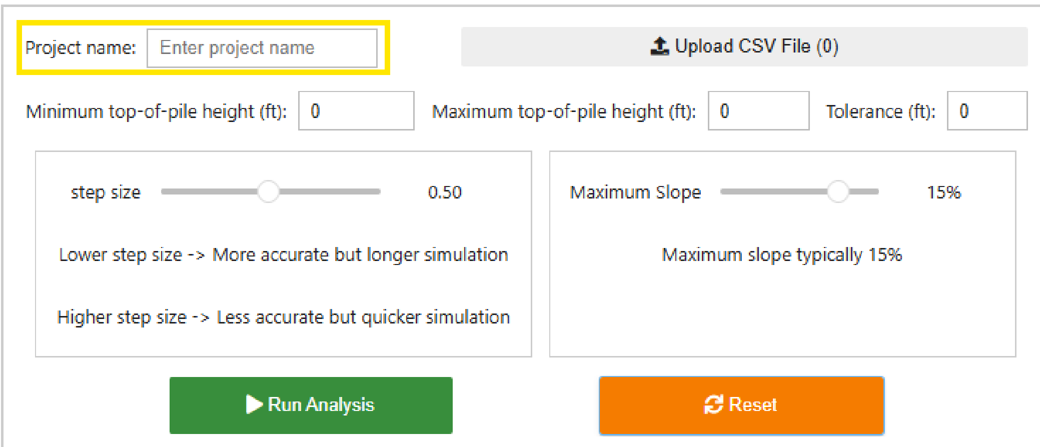


Figure 7: Input Widget - Project Name

4.1.2 Upload CSV File

Click the button with the text "Upload CSV File", this will open your file explorer. Find the desired CSV file for the existing surface of your project and double click it. This will load the file into the tool for processing. Please ensure the CSV file is formatted properly according to the formats discussed in section 3.2.

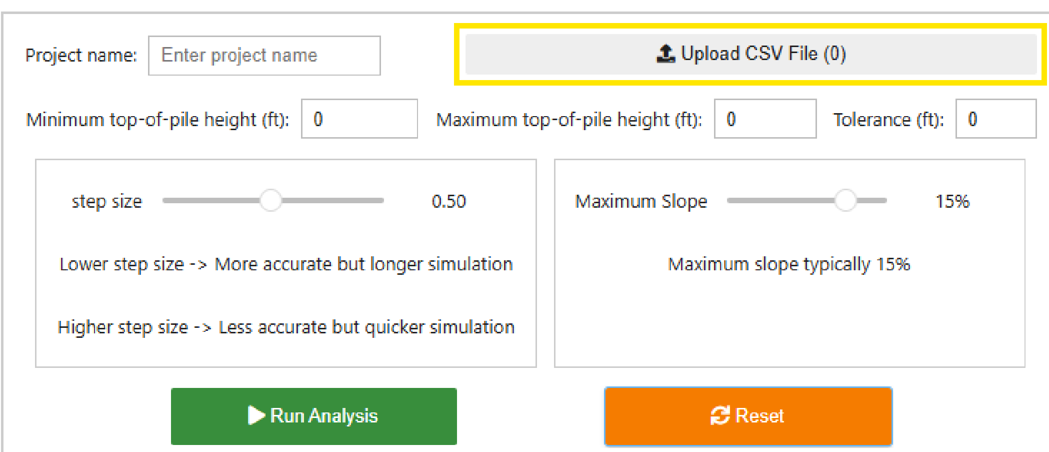


Figure 8: Input Widget - Upload CSV File

4.1.3 Minimum Top-of-Pile Height

Enter the minimum allowable top-of-pile height in the box provided to the right of the prompt (ensure the height entered is in feet). The Minimum Top-of-Pile Height sets the lower limit for how tall piles can be after grading adjustments are applied. It should reflect the minimum pile height allowed by the design and should be paired with the maximum Top-of-Pile Height to create an acceptable installation range.

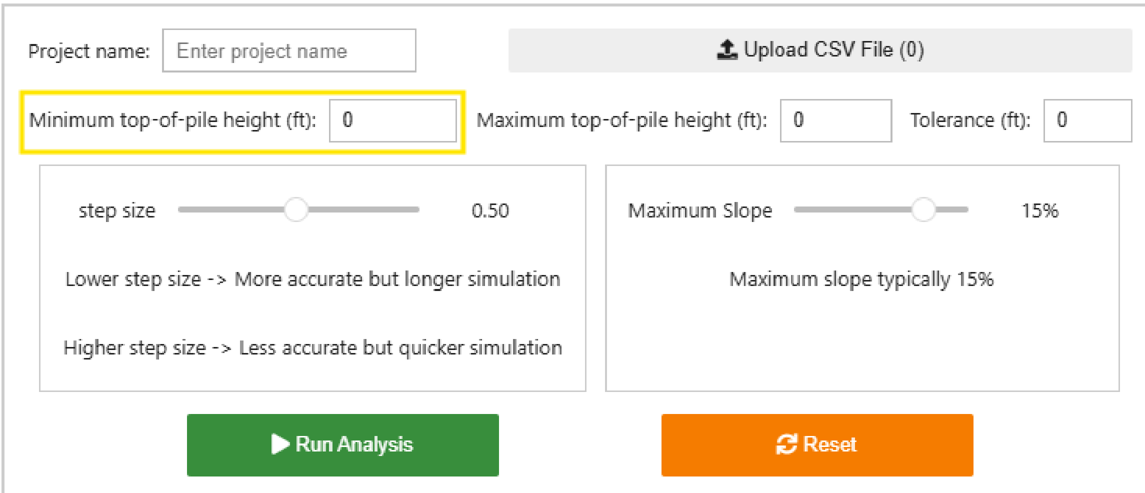


Figure 9: Input Widget - Minimum Top-of-Pile Height

4.1.4 Maximum Top-of-Pile Height

Enter the maximum allowable top-of-pile height in the box provided to the right of the prompt (ensure the height entered is in feet). The Maximum Top-of-Pile Height sets the upper limit for how tall piles can be after grading adjustments are applied. It should reflect the maximum pile height allowed by the design and should be paired with the minimum Top-of-Pile Height to create an acceptable installation range.

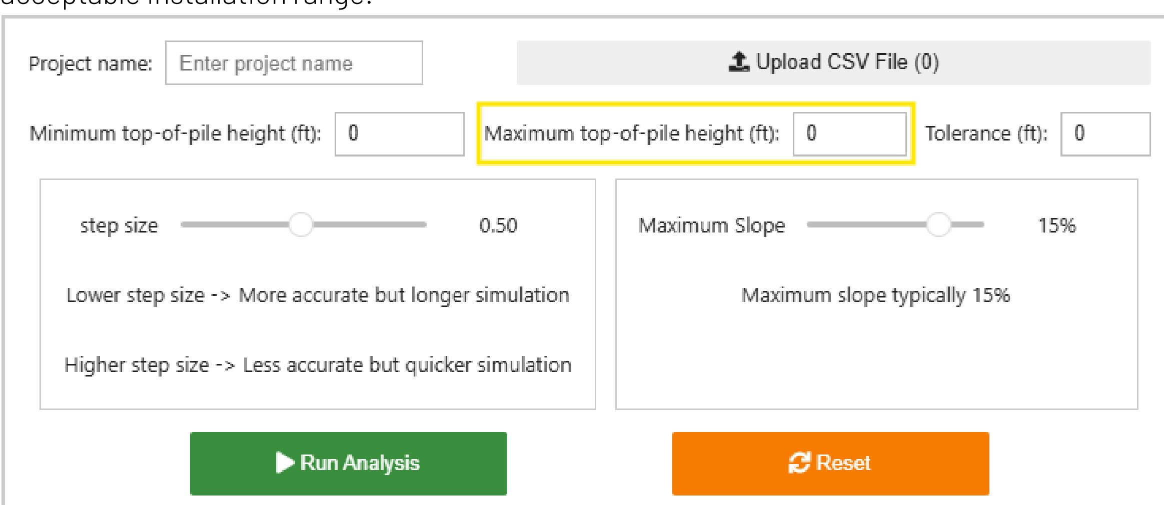


Figure 10: Input Widget - Maximum Top-of-Pile Height

4.1.5 Tolerance

Enter the maximum allowable tolerance for the pile heights in the box provided to the right of the prompt (ensure the tolerance is entered in feet). The Tolerance defines a small allowable buffer above and below the target pile height range. A larger tolerance reduces grading efforts but allows for greater variation in pile heights. While a smaller tolerance enforces tighter precision at the cost of potentially more surface adjustments.

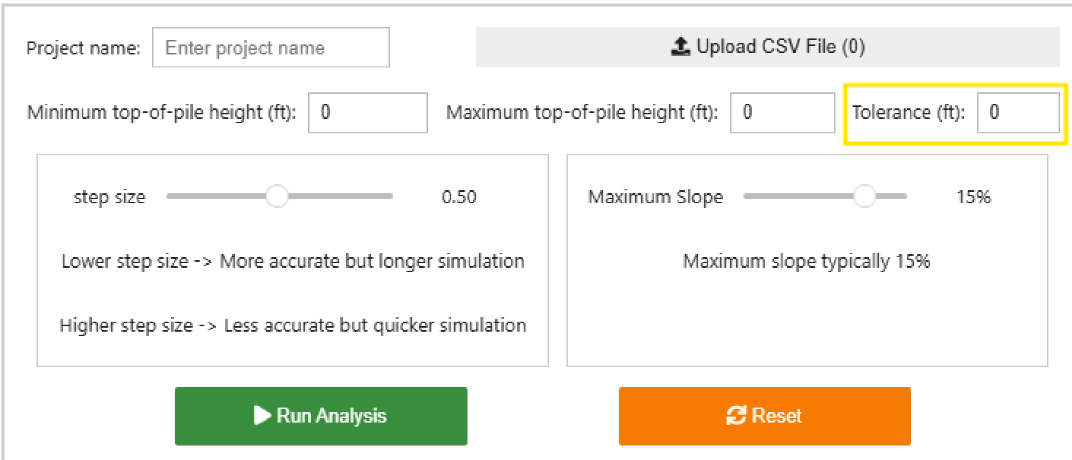


Figure 11: Input Widget - Tolerance

4.1.6 Step Size

Move the slider to select your desired step size. The Step Size controls how precisely the program searches for the optimal vertical position of each tracker during the optimization process. More specifically, it defines the vertical increment, in feet, used to test potential shifts up or down within the allowable range. A smaller Step Size results in a more accurate optimization; however, it requires a longer computation time. Conversely, a larger step size reduces processing time but may decrease accuracy. In general, use a larger Step Size (e.g. 0.50) for a quick initial view and a smaller step size (e.g. 0.01) when decisions will be made from the data/views generated.

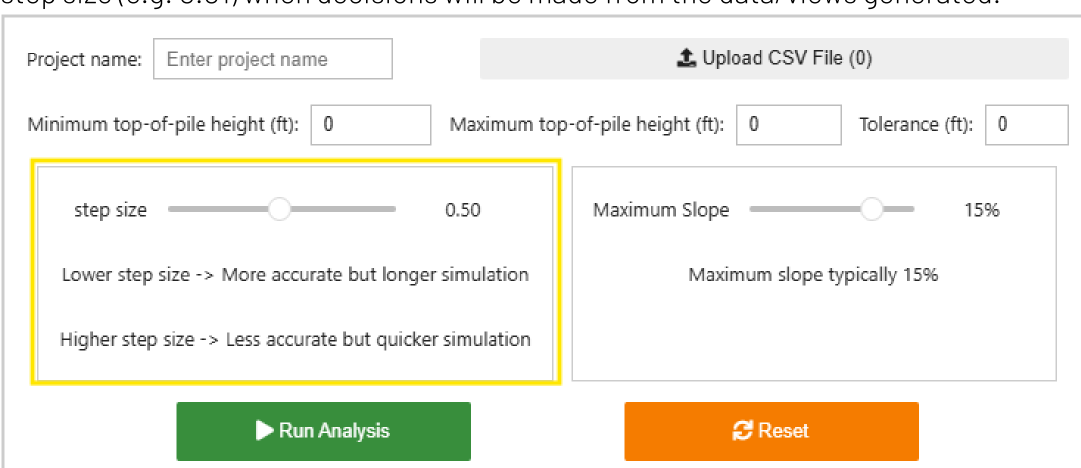


Figure 12: Input Widget - Step Size

4.1.7 Maximum Slope

Move the slider to select your desired Maximum Slope. The Maximum Slope defines the steepest allowable grade (in degrees) that the trackers can follow along the ground surface. It limits how much the top-of-pile elevation can change between the first and last pile in a tracker. If the natural ground slope exceeds this limit, the program automatically adjusts the surface to meet the specified maximum slope. The standard value is 15% but can vary depending on the specific project.

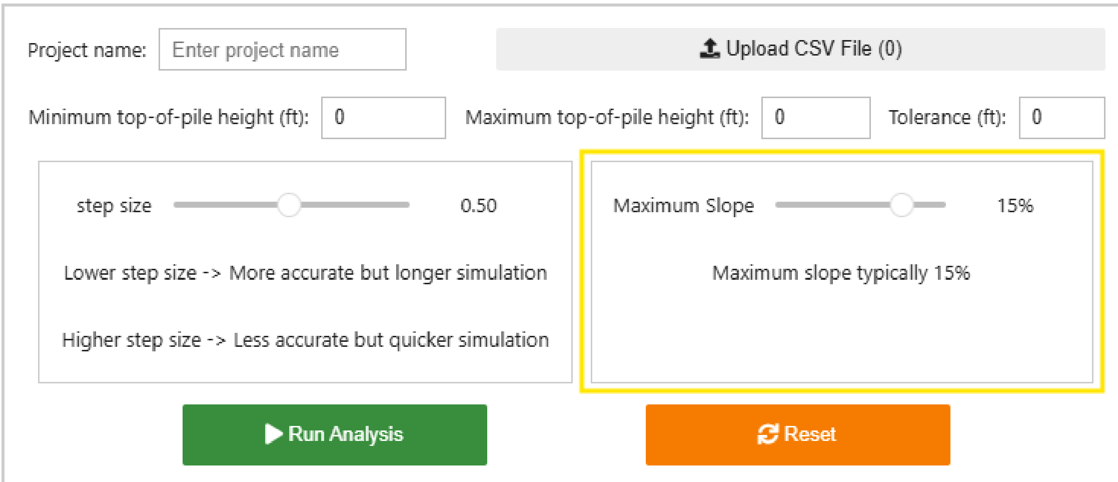


Figure 13: Input Widget – Maximum Slope

4.1.8 Run Analysis

Once all previous inputs are completed, the tool is ready to start. Click the green "Run Analysis" button and the tool will begin processing the data. Once the tool has begun, the progress will be displayed between the Input and Output Widget. Once the tool has completed, the progress displays will be removed and the Output Widget will be completed and able to be viewed.

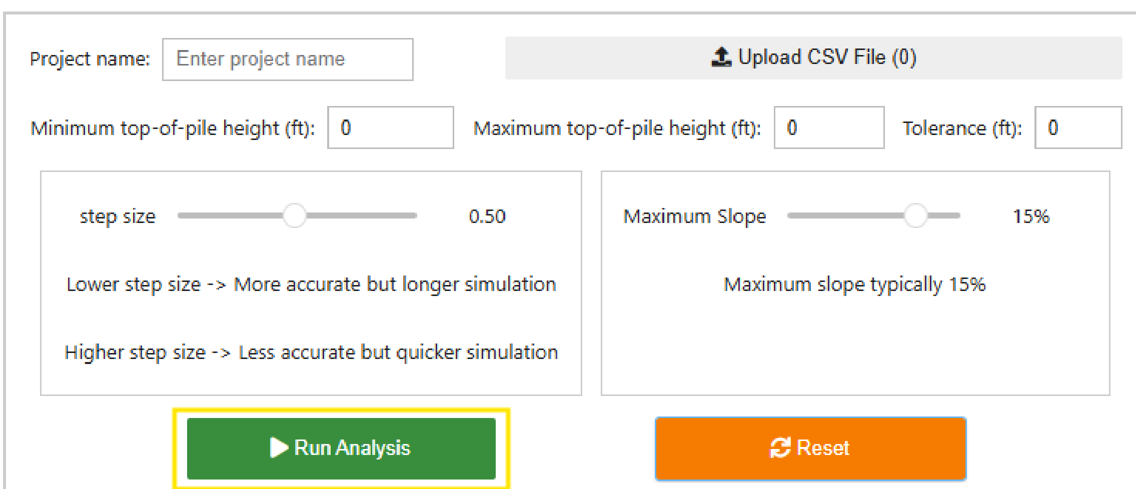


Figure 14: Input Widget - Run Analysis

4.1.9 Reset

After the tool has run and been completed, the data will be displayed below in the Output Widget. However, if you wish to run the tool again with different inputs, pressing the orange "Reset" button will reset the Input Widget to their original values and remove all plots and data from the Output Widget. This enables you to repeat the steps above to quickly run the tool again.

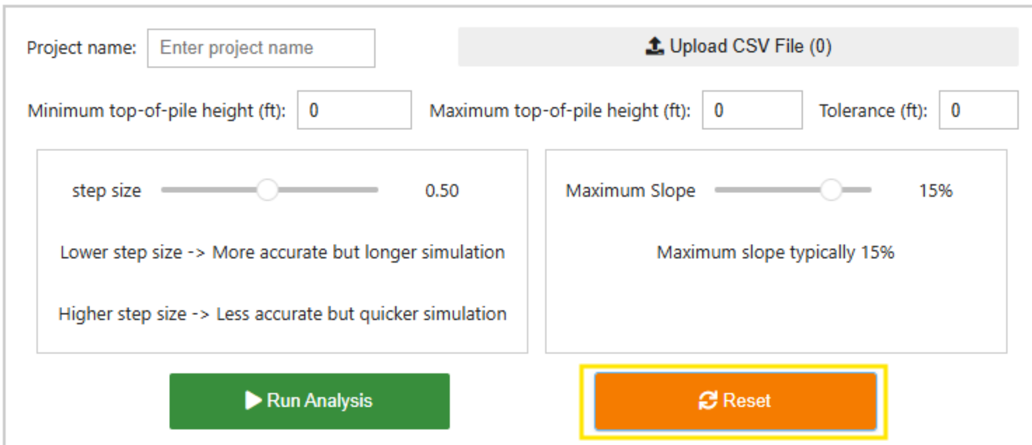


Figure 15: Input Widget – Reset

4.2. Output Widget

There are 6 subsections to the Output Widget: Data, Heatmap, 3D Heatmap, 3D Proposed Ground, 3D Existing Ground, Pile Heatmap and Cross Section. Each of these subsections are located in an individual tab of the Output Widget as seen in Figure 6. Please keep in mind that the Output Widget will remain empty until the analysis has been completed at which point the resultant outputs will be displayed there.

4.2.1 Data

The Data tab contains overall information on the site including total Cut/Fill volumes, maximum Cut/Fill heights and depths as well as other useful information. An example output can be seen below in Figure 16.

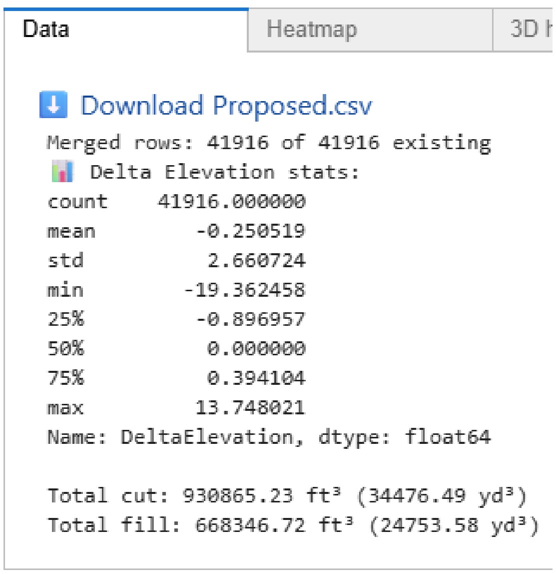


Figure 16: Data Output

The Data tab also contains a link to download the new proposed surface data as a CSV file. This can be downloaded by clicking the blue link at the top of the tab labeled "Download {project name} Proposed" (In Figure 16, the download link is labeled "Download Proposed").

4.2.2 Surface Heatmap

The Surface Heatmap tab contains 3 figures: The Heatmap, an Earthwork Summary and a legend relating the colour of the heatmap to different elevation changes. This tab gives a surface level view of the locations where the terrain will need to be either cut or filled. For example, you can determine if the Northwest section will require primarily to be cut while the south must be filled. An example Heatmap can be found below in Figure 17.

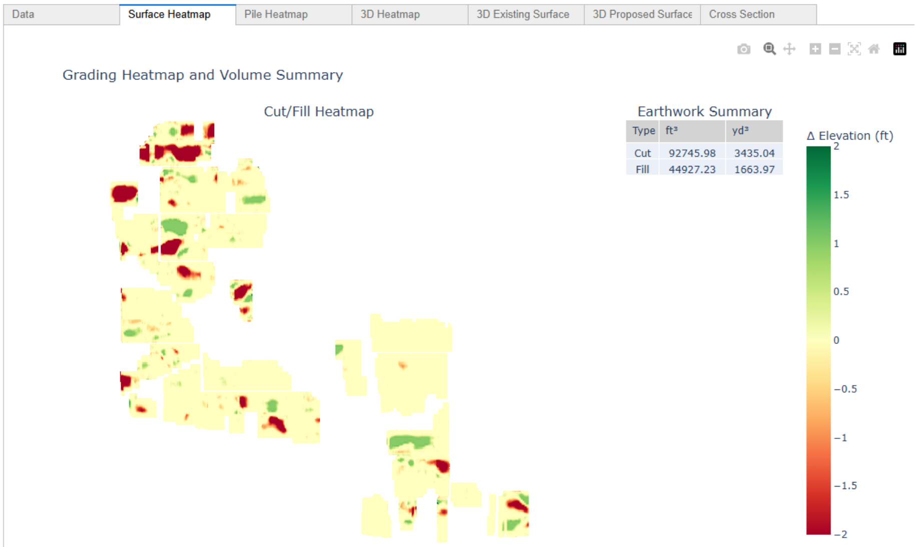


Figure 17: Surface Heatmap Tab

Hovering your mouse over a location on the plot will reveal its change in elevation, a positive value means it must be filled while a negative value means it must be cut. While left-clicking, continue to depress the button and drag the mouse over an area. This will magnify the area enclosed in the square allowing for a more detailed understanding of the cut/fill areas. To return to the original view of the entire site, you can double click the left button or click the "home" icon in the top right.

4.2.3 Pile Heatmap

The Pile Heatmap also gives a complete view of the site showing cut/fill areas. What distinguishes this view from the Surface Heatmap is how these areas are displayed. Instead of interpolating a surface, this view shows the elevation of each individual pile.

Figure 18: Pile Heatmap Tab

Hovering your mouse over a pile on the plot will reveal its easting and northing location, the elevation can be seen by comparing the colour of the pile to the scale on the right. While left-clicking, continue to depress the button and drag the mouse over an area. This will magnify the area enclosed in the square allowing for a more detailed understanding of the cut/fill areas. To return to the original view of the entire site, you can click the "home" icon in the top right.

4.2.4 3D Heatmap

The third and final heatmap is the 3D Heatmap. This plot adds texture to the heatmap by extruding the cut/fill areas from the surface. This plot provides a more visual way to understand which areas could be potential problem area's and which require minimal grading.

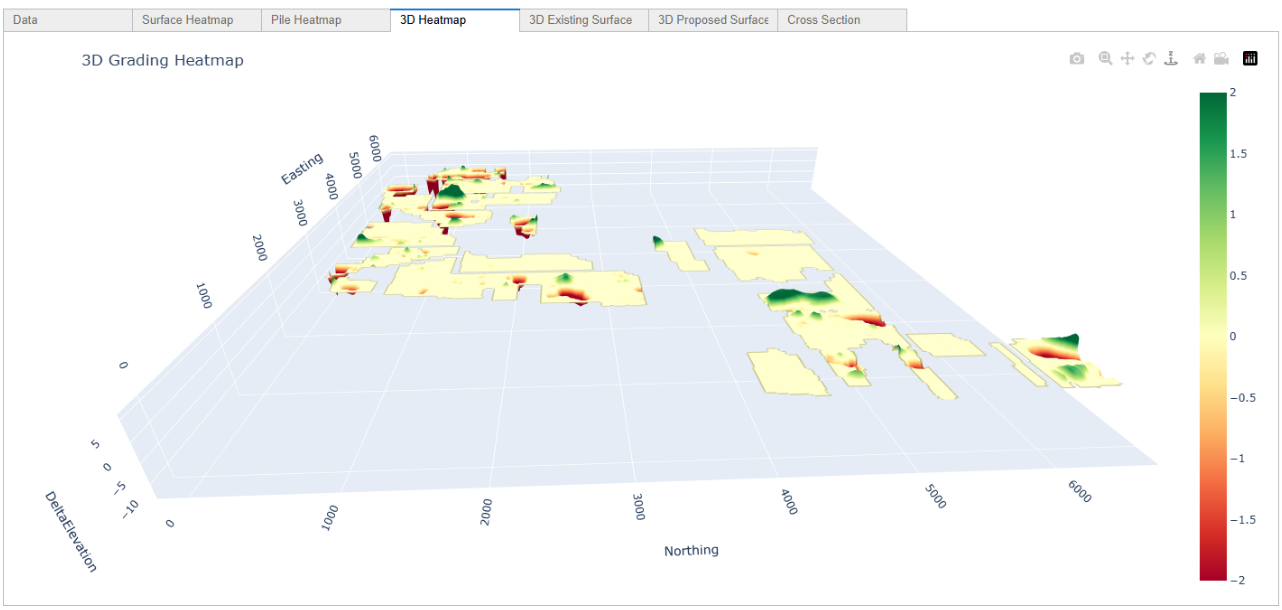
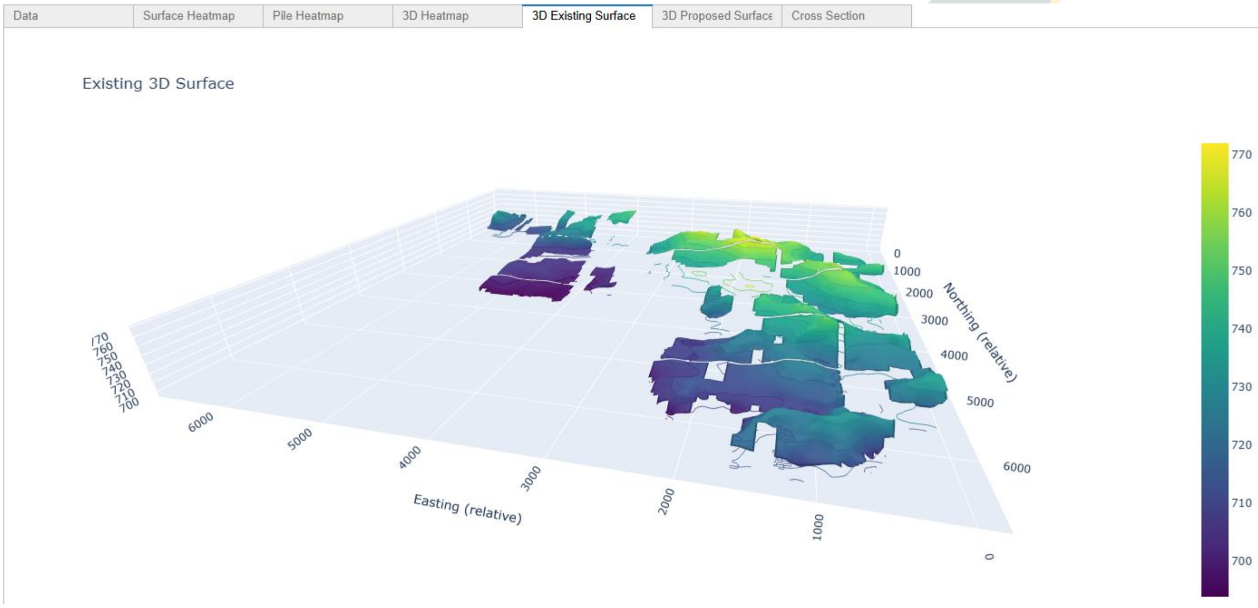


Figure 19: 3D Heatmap Tab

Hovering your mouse over a location on the plot will reveal the change in elevation at that location, a positive value means it must be filled while a negative value means it must be cut. To rotate the view, left-click and drag your mouse across the screen. You can zoom in or out using the mouse wheel and pan by right-clicking.

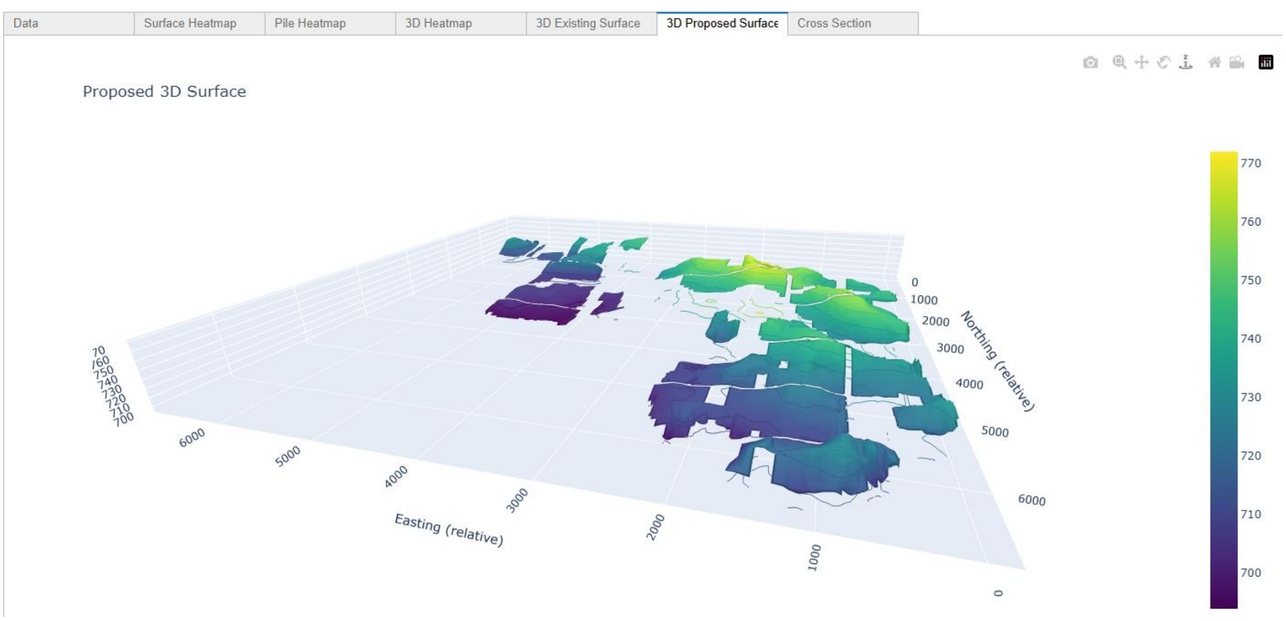
4.2.1 3D Existing Surface

The 3D Existing Surface tab gives a view of the surface topography before any grading has been applied. This plot allows users to explore variations in elevation across the site before any grading occurs. Users can left-click and drag to rotate the view, use the scroll wheel to zoom and right-click to pan. Hovering over the surface displays the coordinates and elevation at that point.



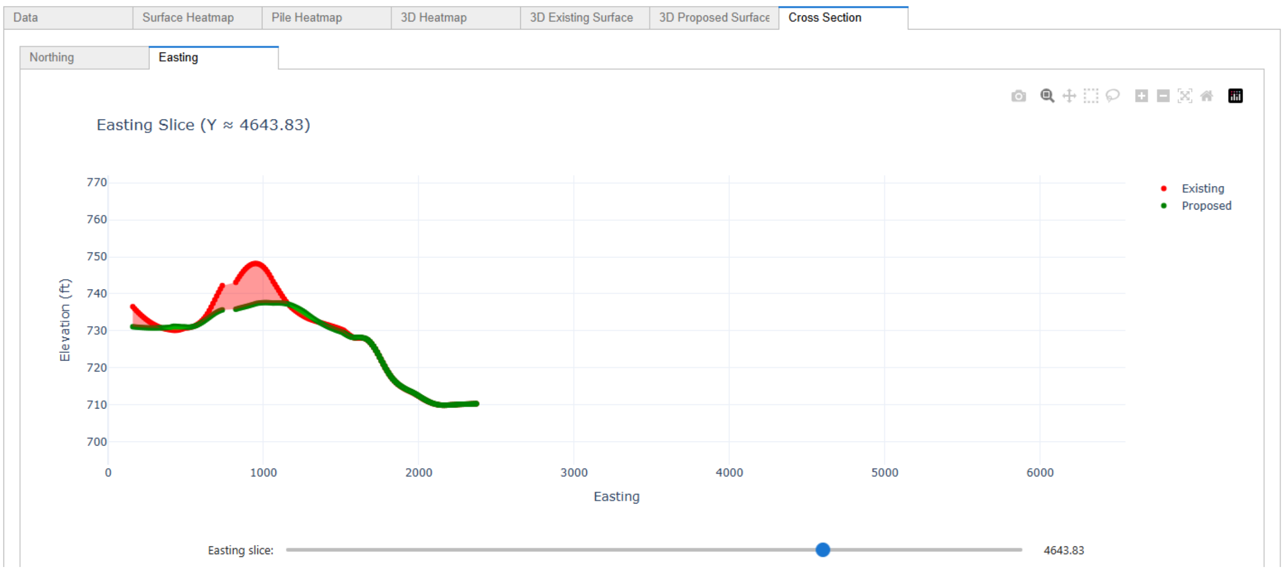
4.2.2 3D Proposed Surface

The 3D Proposed Surface tab gives a view of the surface topography after the grading has been applied. Similar to the 3D Existing Surface, this plot allows users to explore variations in elevation across the site now after the grading has been applied. Users can left-click and drag to rotate the view, use the scroll wheel to zoom and right-click to pan. Hovering over the surface displays the coordinates and elevation at that point.



4.2.3 Cross Section

The Cross Section tab is a unique tab that shows the elevation change across a cut of the site. The tab contains two sub tab, Northing and Easting. The difference between these two plots is the direction in which they cut the site. As the names suggest, the Northing sub tab cuts the site along the northing direction while the Easting sub tab cuts the site along the easting direction.



Similar to the Surface and Pile Heatmaps, you can zoom in on specific sections of the plot to gain a more detailed view. While left-clicking, continue to depress the button and drag the mouse over an area to magnify the area enclosed in the square.