Hemisphere®

875-0439-10

Operator Guide

Revision: **A1**

December 30, 2020

GradeMetrix™

Machine Control & Guidance Software for Excavators

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Device Compliance, License and Patents

Device Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at HTTPS://HEMISPHEREGNSS.COM/ABOUT-US/QUALITY-COMMITMENT.

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6539303	7292185	7689354	8138970
6549091	7292186	7808428	8140223
6711501	7373231	7835832	8174437
6744404	7388539	7885745	8184050
6865465	7400294	7948769	8190337
8214111	8217833	8265826	8271194
8307535	8311696	8334804	RE41358

Australia Patents	
2002244539	2002325645
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Device Compliance, License and Patents, Continued

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Contact your local dealer for technical assistance. To find the authorized dealer near you:

Hemisphere GNSS, Inc
8515 East Anderson Drive
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Terms and Definitions

Introduction

The following table lists the terms and definitions used in this document.

GradeMetrix terms & definitions

Term	Definition
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
DTM	Digital Terrain Model – the 3D grading of a job.
Ellipsoid	Ellipsoidal elevation refers to your height above the WGS84 ellipsoid.
Flat Pad	A set elevation that you grade to over the entire job site, regardless of design elevation.
Galileo	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.
Geoid	A model representing the shape of the earth, represented by mean sea level.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
GNSS	Global Navigation Satellite System
GPS	Global Position System
Heading	The vector created from the primary to secondary antenna. It points to the direction that the receiver is facing.
Latitude	A measure of how far north or south you are on the earth. Uses degrees, with the equator at 0 degrees and the poles at 90 degrees (north or south).

Continued on next page

Terms and Definitions, Continued

GradeMetrix terms & definitions, continued

Term	Definition
Longitude	A measure of how far east or west you are on the earth. Uses degrees with the prime meridian at 0. Positive degrees are east of prime meridian and negative degrees west.
NEZ	Refers to Northing, Easting, and Elevation.
Point of Interest (POI)	The point from which the cut/fill and NEZ information is derived.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.

Chapter 1: Introduction

Overview

Introduction

This Operator Guide provides information to help you quickly set up your GradeMetrix application software for excavator operations.

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Product Overview

Product overview	GradeMetrix™ Excavator is a machine guidance solution for excavators of all sizes ranging from compact to large, with support for multiple bucket types, including tilt buckets.

Key Features

GradeMetrix Excavator key features	GradeMetrix Excavator software features: • Rugged Hardware • Easy to Install • Optional laser receiver kit • Optional tilt bucket accessory kit • Simplified User Interface • Dynamic Cut/Fill • Supports industry standard files • Build flat pads • Build single, dual, or multiple slopes • Stake points

Chapter 2: Getting Started with GradeMetrix

Overview

Introduction

The information in this chapter shows you how to install the GradeMetrix software for excavator and provides an overview of GradeMetrix functions.

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Topic	See Page
Software Installation	11
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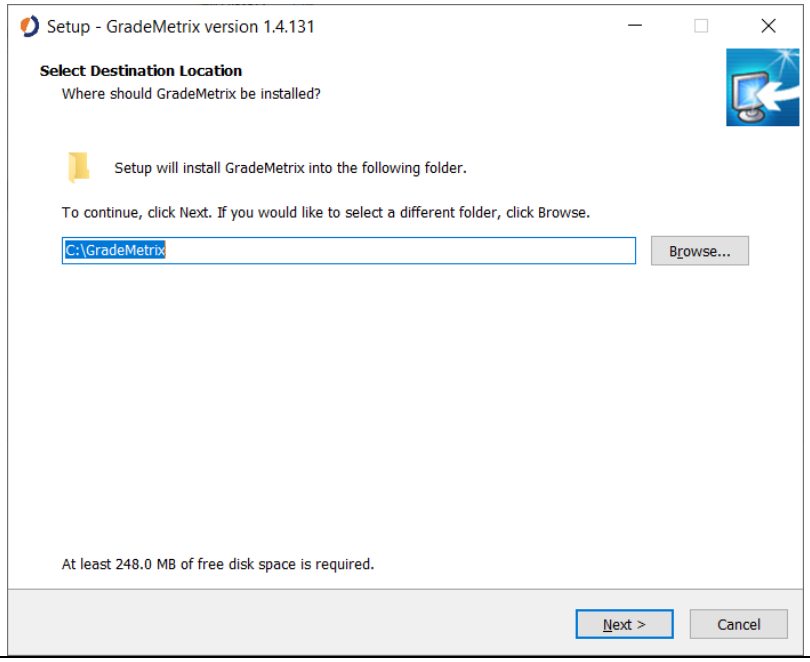
GradeMetrix Main Menu	43

Overview

Install GradeMetrix software

To install your GradeMetrix software, complete the following steps:

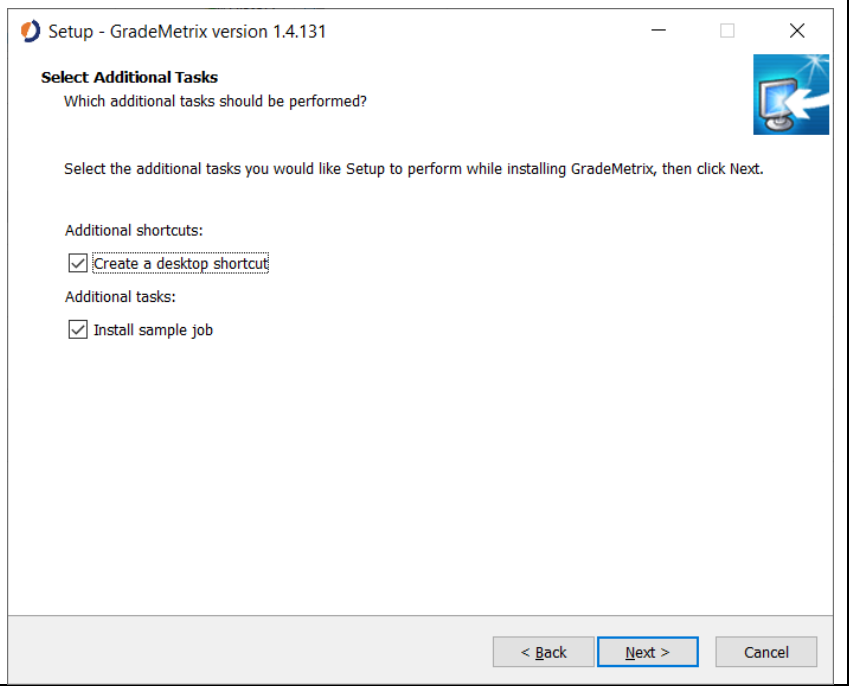
Table 1-1: Software Installation

Step	Action
1	Click the **Install** file. The **Select Destination Location** screen displays. Verify the location is correct or click **Browse** to select another file location. 
2	Click **Next**.

Continued on next page

Install GradeMetrix software, continued

Table 1-1: Software Installation (continued)

Step	Action
3	The **Select Additional Tasks** screen displays. Notice the option to **Create a desktop shortcut** is selected and click **Next**. 

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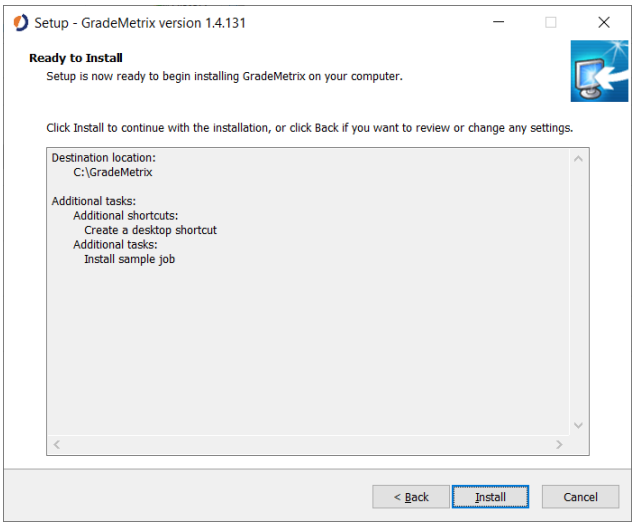
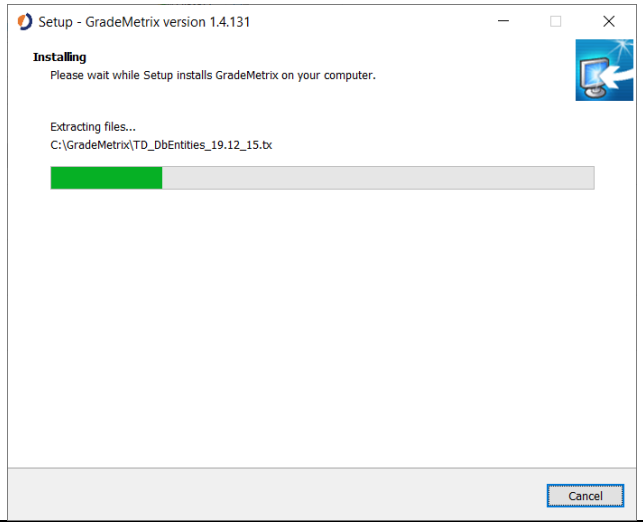
Install GradeMetrix software, continued

Table 1-1: Software Installation (continued)

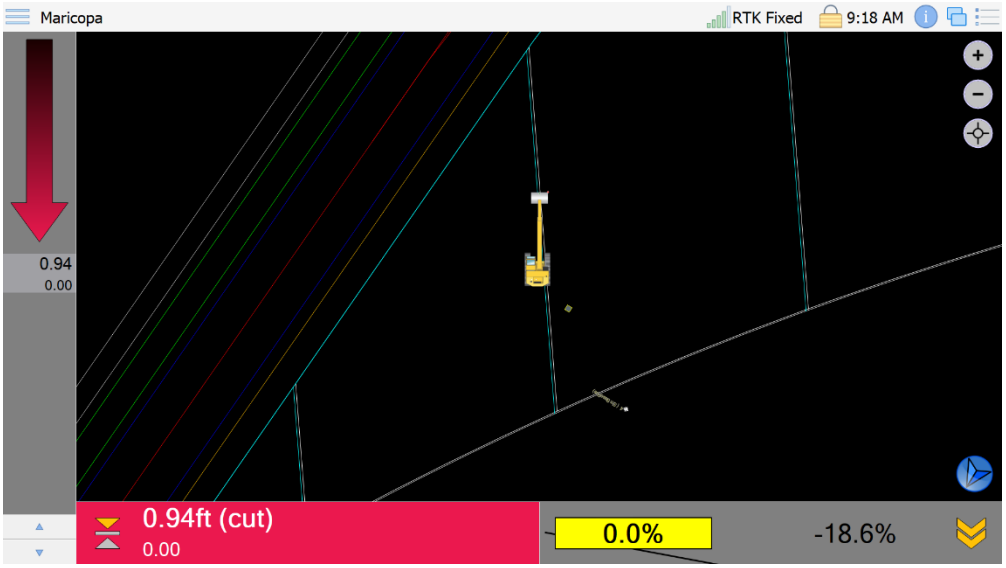
Step	Action
4	Click **Install**.  The GradeMetrix software installation begins on your computer. 

Operator Interface

Plan View

GradeMetrix is designed to open automatically when the IronOne starts up. When the software opens, you are brought directly to the **Plan View**. The **Plan View** has a variety of customizable views shown in the next section.

The **Plan View** has a variety of features.



Vertical Offset

Use the arrows on the bottom-left to add or subtract a vertical offset. For instance, in the example above, a 0.94 ft cut with a 0.00 vertical offset is shown. Clicking on the up arrow once adds a vertical offset of a tenth, decreasing the cut to 0.84 ft as seen in the example below.

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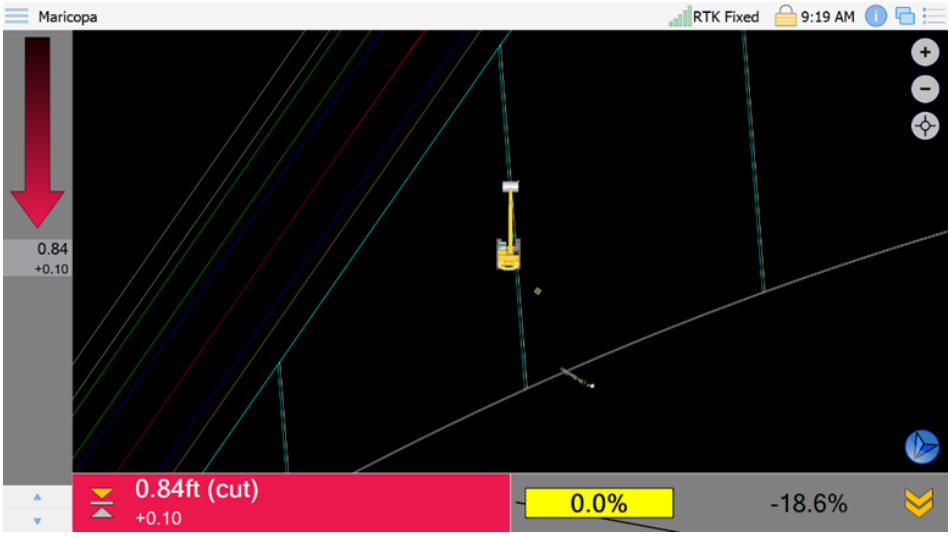
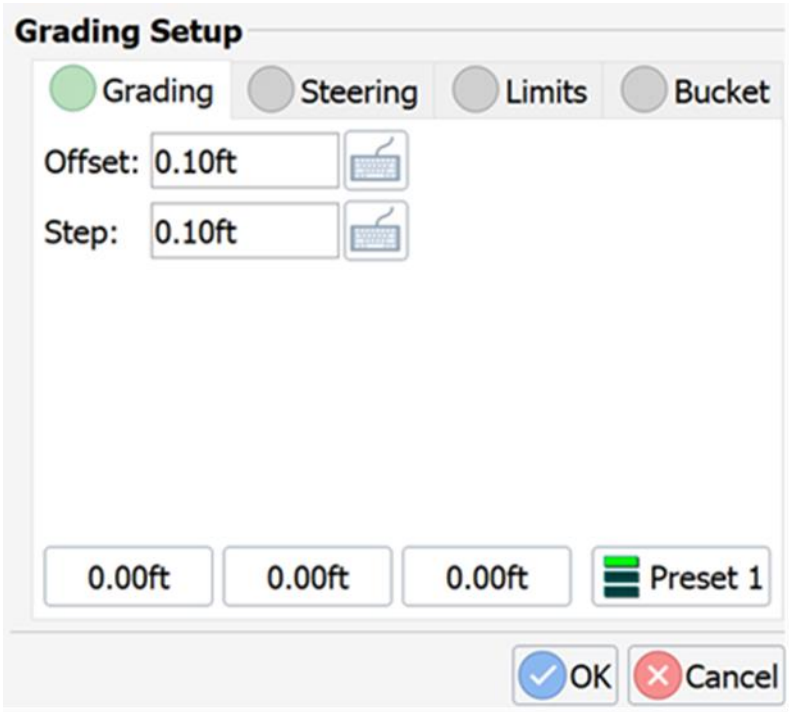
Operator Interface, Continued

Vertical Offset, continued



To add a specific vertical offset, or adjust the step size, click and hold the Cut/Fill arrow. The following dialogue window appears:



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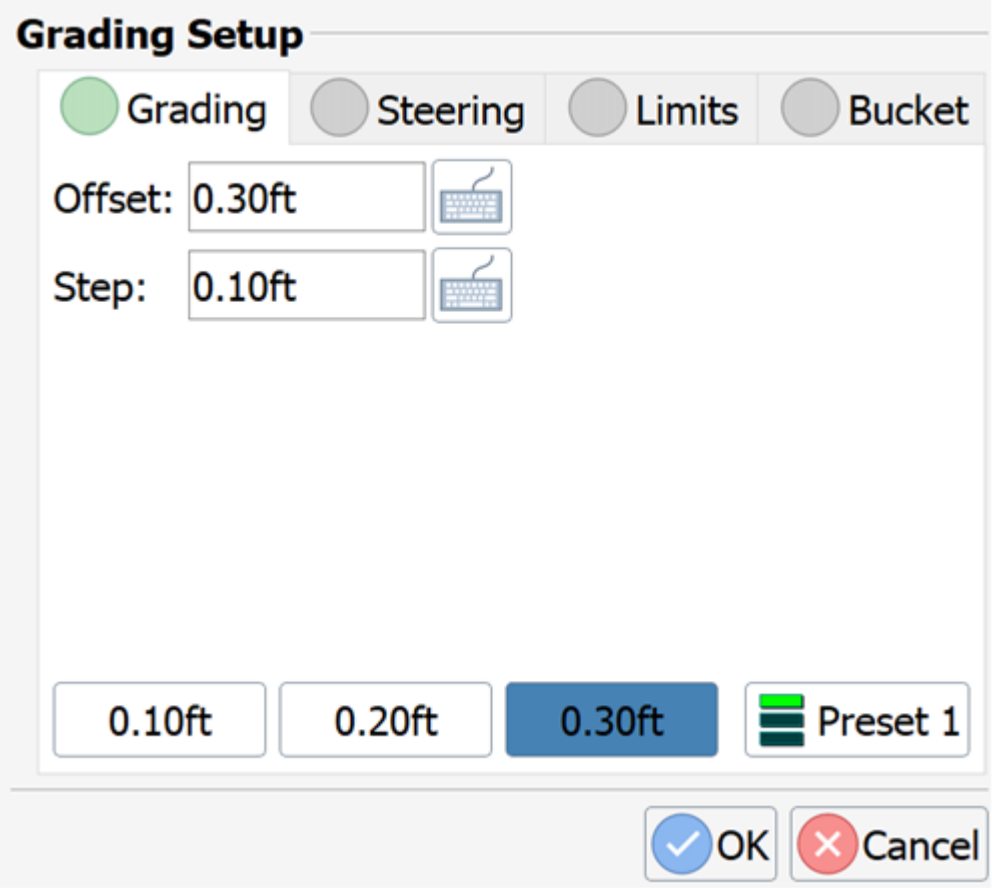
Vertical Offset, continued

You can enter a specific **Offset** in the **Offset** field. The **Step** field configures how much the vertical offset changes each time you click the arrow that is below the Cut/Fill bar.

To add **Preset** values, type a value in the **Offset** field. Next, click and hold one of the three values shown at the bottom. In the example below, **Preset 1** has values of 0.10 ft, 0.20 ft, and 0.30 ft.

To toggle between three independent sets of values, click **Preset 1**.



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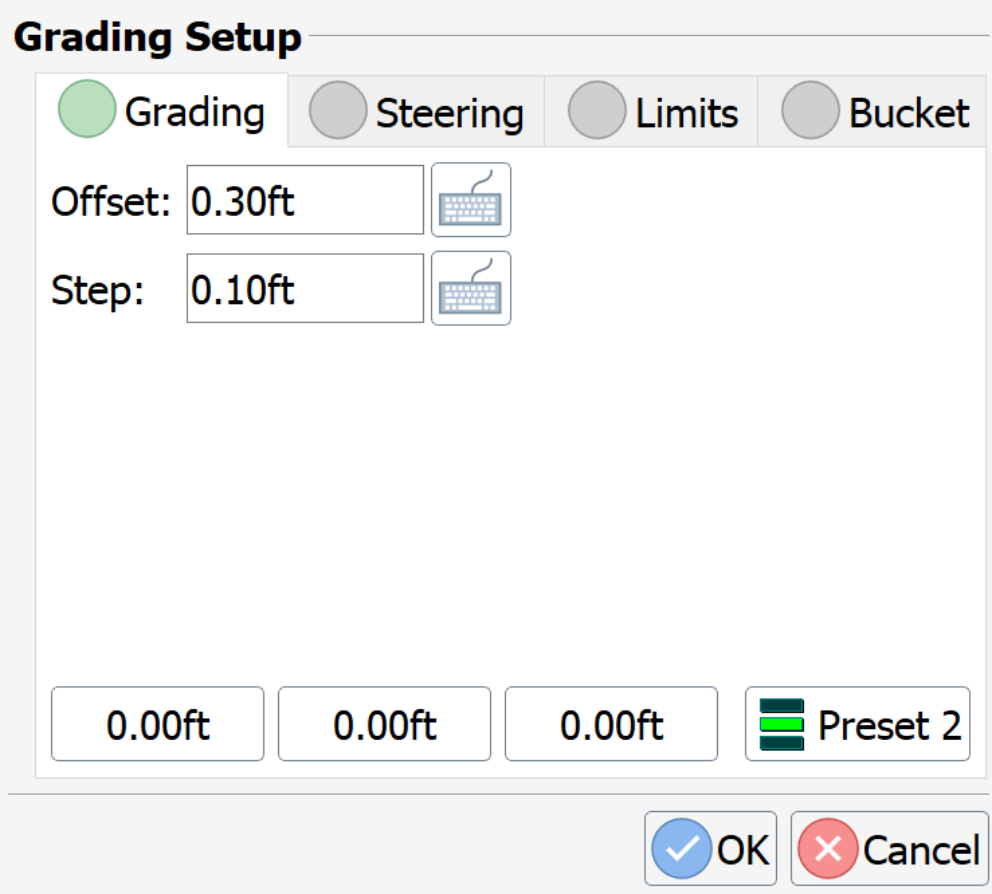
Operator Interface, Continued

Vertical Offset, continued



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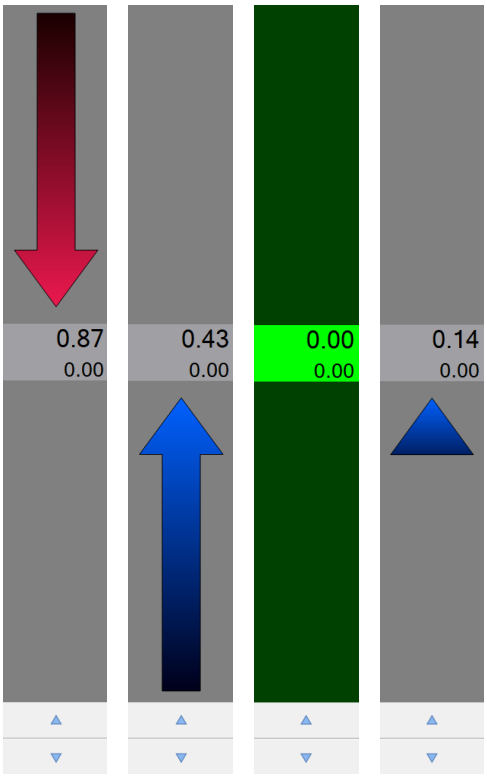
Cut/Fill Bar

The Cut/Fill bar shown on the left side of the screen displays a red arrow when in a cut, a blue arrow when in a fill, and a green band when on grade, this is referred to as the Cut/Fill bar.

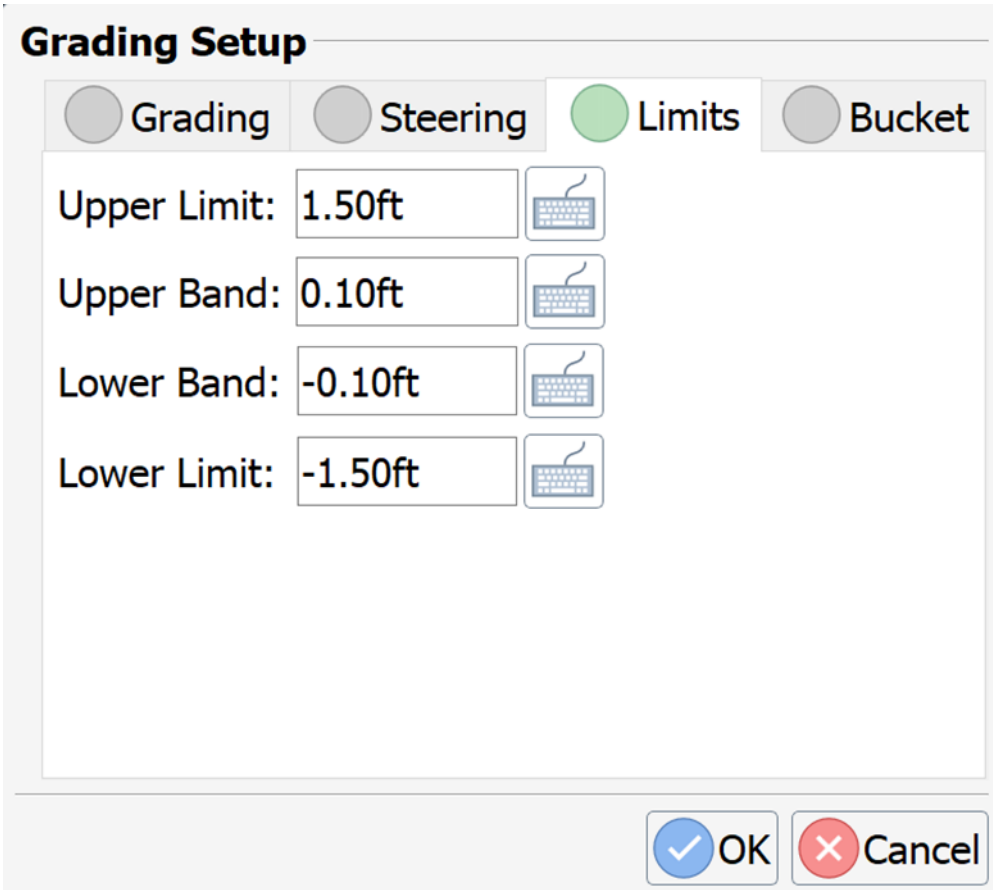
The absolute value of the Cut/Fill value determines the length of the arrow.



Continued on next page

Cut/Fill Bar, continued

The deadband is configurable. Click and hold the arrow. Click **Limits**. The following dialogue displays:



The **Upper Band** and **Lower Band** are "On Grade" tolerances. Any value between these two values (in the above example, -0.10 ft. and 0.10 ft.) is considered on grade.

Continued on next page

Operator Interface, Continued

Cut/Fill Bar, continued

The **Upper Limit** and **Lower Limit** affect the graphical scaling of the "**Cut/Fill**" arrow.

If you set the **Upper Limit** to 5.0 ft, when you have a 5 ft. cut, the cut/fill arrow displays at the top of the dialogue window.

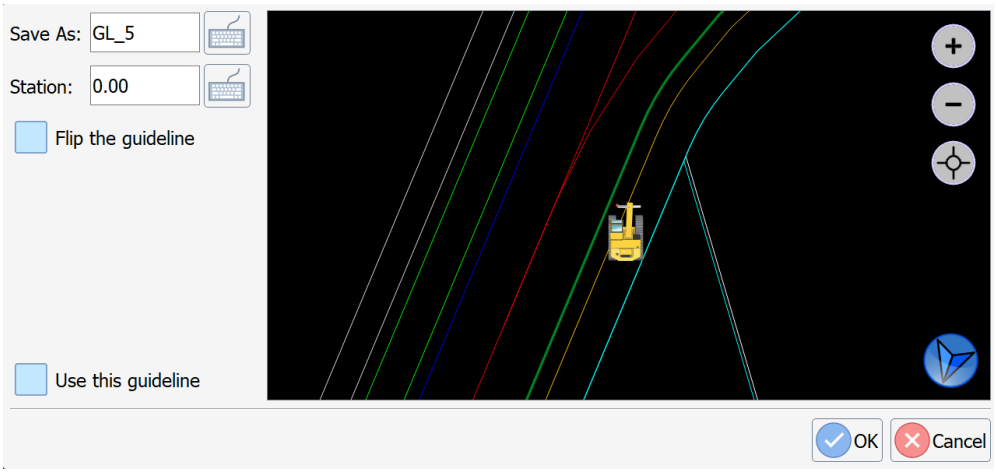
In the following example, the **Upper Band** is set to 5 ft. Therefore, a cut of 2.58 ft. scales the arrow to about half the size of the dialogue window.

Continued on next page

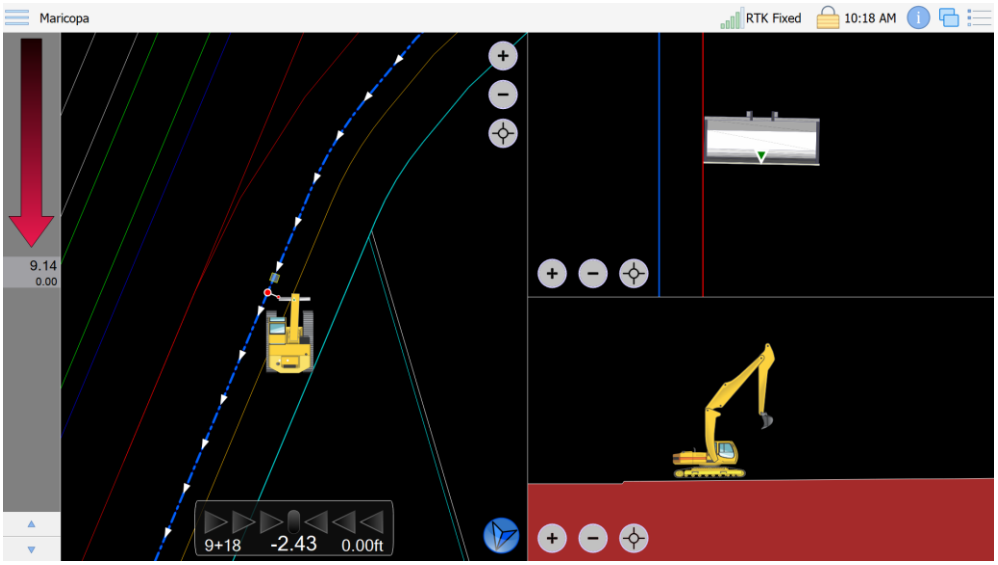
Operator Interface, Continued

Guidelines

To select a guideline, click on a polyline. The following dialogue displays:



To select the station and change the direction, click **Flip the guideline**. You can create and save a filename or use the default filename. Click **Use this guideline** and click **OK**.



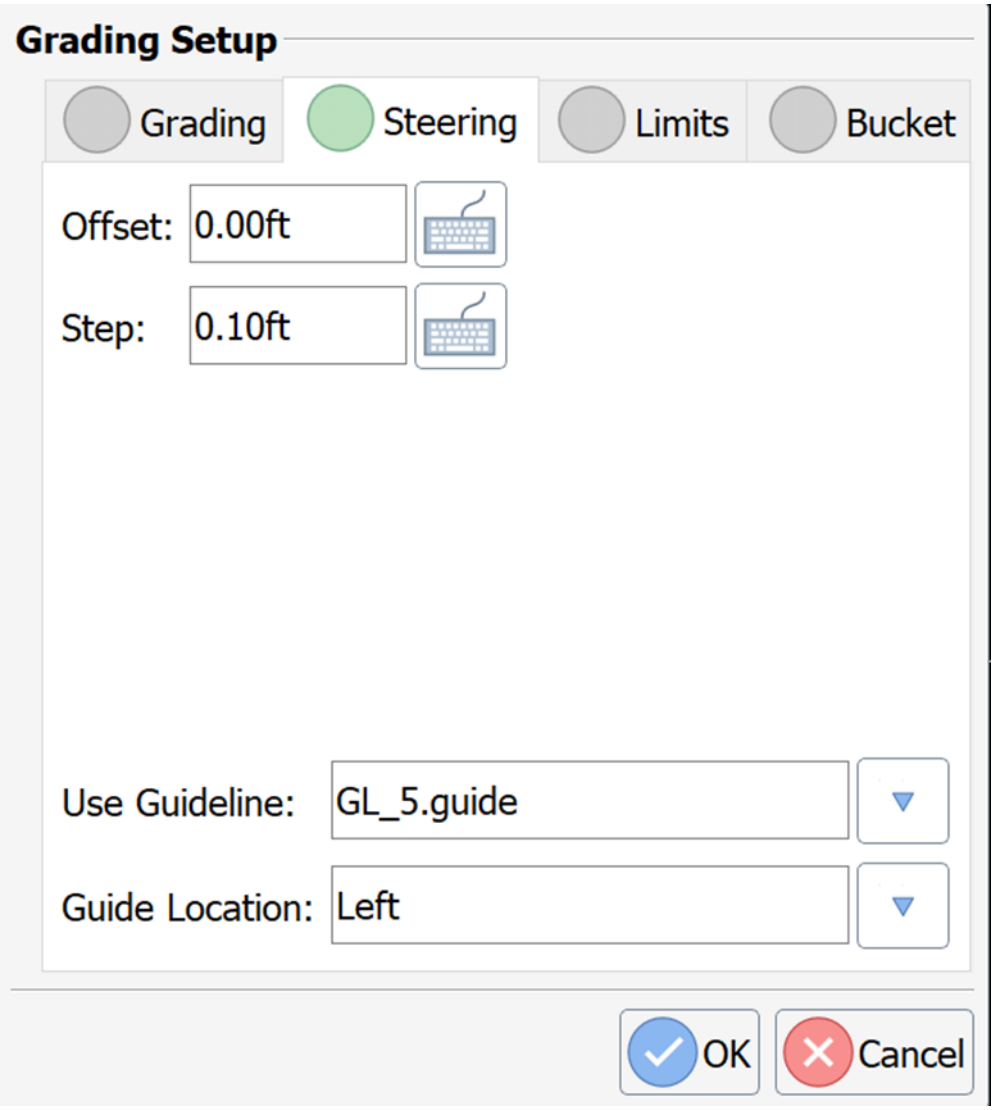
Continued on next page

Operator Interface, Continued

Guidelines, continued

To configure the **Guideline**, click and hold the Cut/Fill arrow.

Click the **Steering** tab. You can use this dialogue to create an offset, adjust the step, and change the **Guide Location** (change the query point from the left/center/right of bucket).



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Operator Interface, Continued

Top panel icons

The top panel icons contain a variety of options. The icons are shown below, and each option is described.

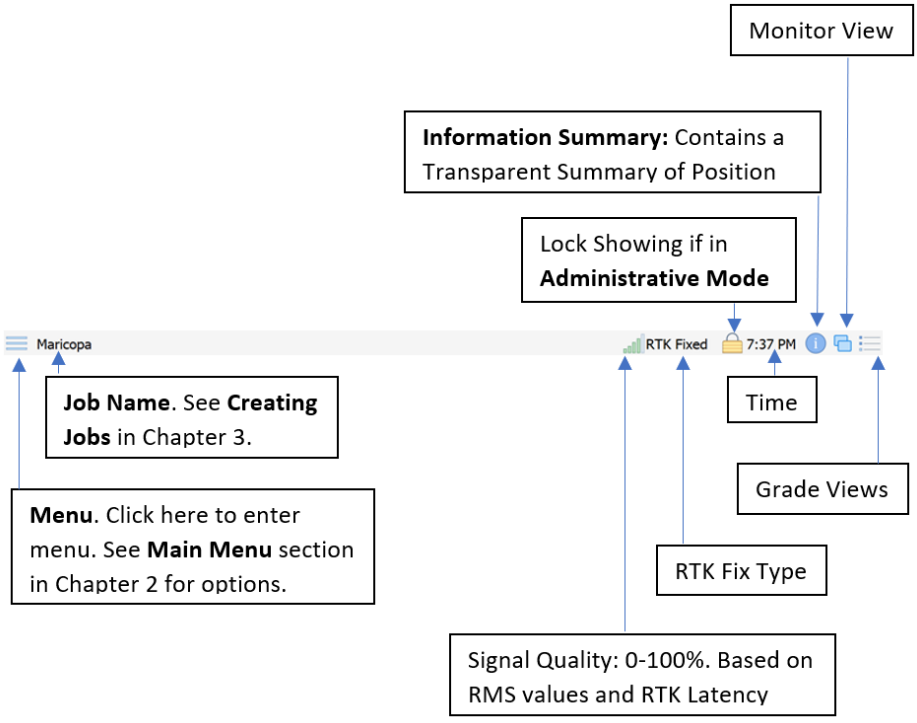


Figure 2-1: Top Panel Icons

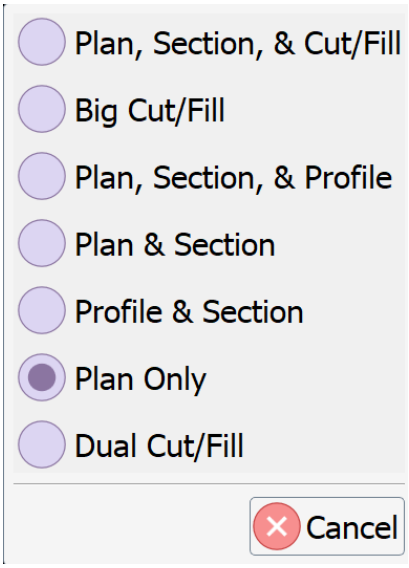
Continued on next page

Operator Interface, Continued

Select View

To select a different view, click the icon (upper right corner of the screen). Several examples are shown below.

The pop-up window displays a list of options:



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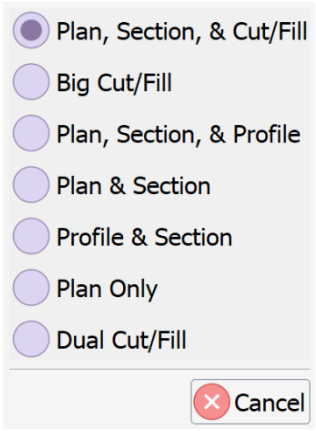
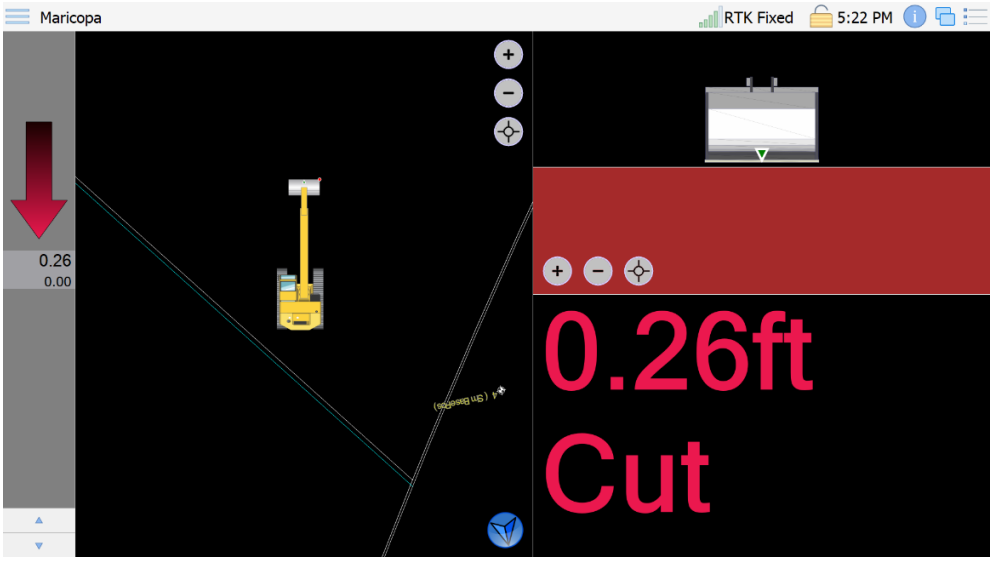
Operator Interface, Continued

Plan, Section, Cut/Fill view

The **Plan, Section, & Cut/Fill** view shows the **Plan** view on the left half of the screen. The right half of the screen is split showing both a **Section** view of the excavator tool (along with the surface) and a **Cut/Fill** value (0.26 ft. in the example below).





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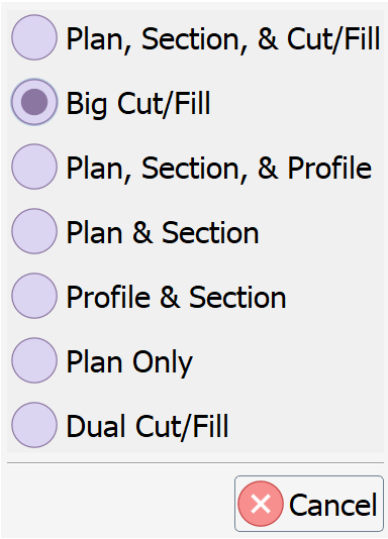
Operator Interface, Continued

Big Cut/Fill view

The **Big Cut/Fill** view displays the cut/fill value only.



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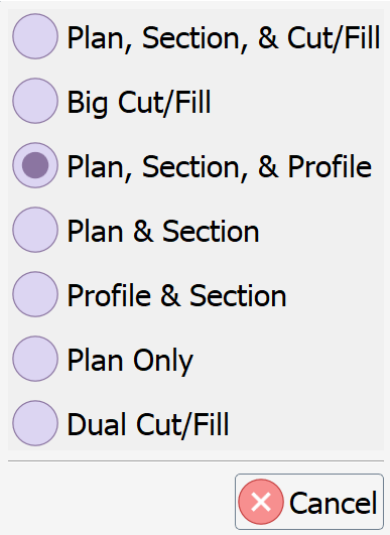
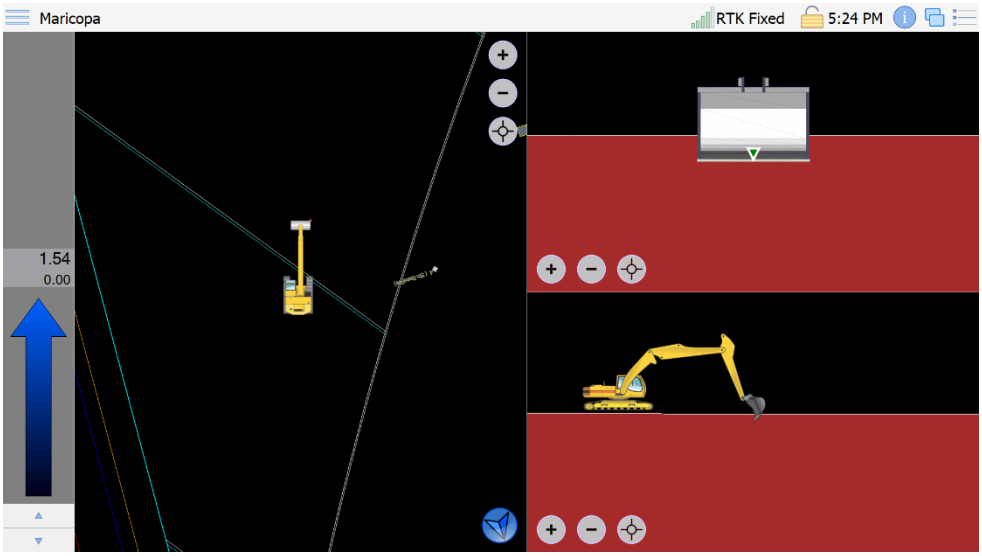
Plan, Section, & Profile view

The **Plan, Section, & Profile** view shows the **Plan** view on the left side of the screen. The right side of the screen is split between a **Section** view of the bucket (and design surface) and a **Profile** view of the machine (and design surface).





Continued on next page

Operator Interface, Continued

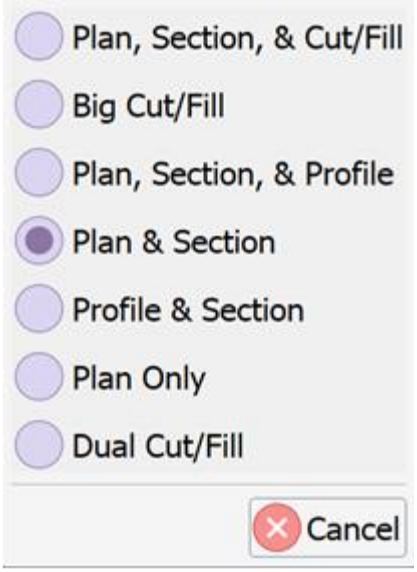
Plan & Section view

The **Plan & Section** view shows the **Plan** view on the top of the screen, and the **Section** view of the tool on the bottom half of the screen (with the design surface).

The bottom of the screen is divided into two sections. The left section shows the cut (or fill) with an arrow pointing down (cut) or up (fill). Additionally, the vertical offset (0.00 in this example) is shown. The right section shows the cross slope of the cutting edge (in this example, 0.0%).

If using a standard bucket, this value is the same as the cross slope of the machine chassis. If using a tilting bucket, this value is independent of the chassis roll.

The cross slope of the design is also shown (-18.6% in this example).



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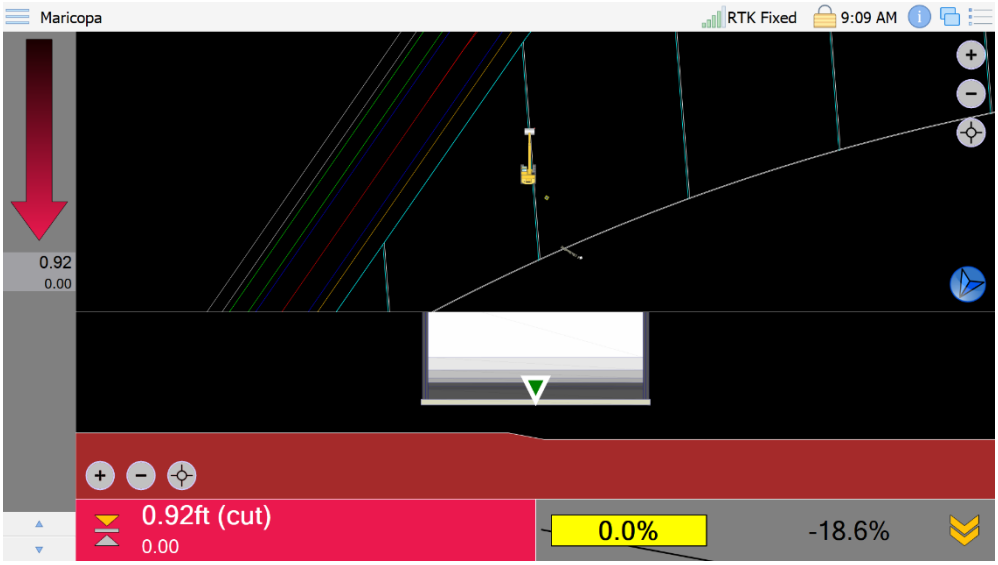
Operator Interface, Continued

Plan & Section view, continued



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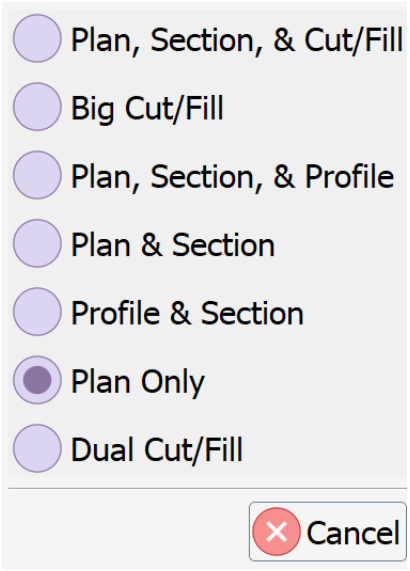
Plan only view

The **Plan Only** view shows the machine on the linework with the Cut/Fill arrow on the left. The design surface is not shown in this view.



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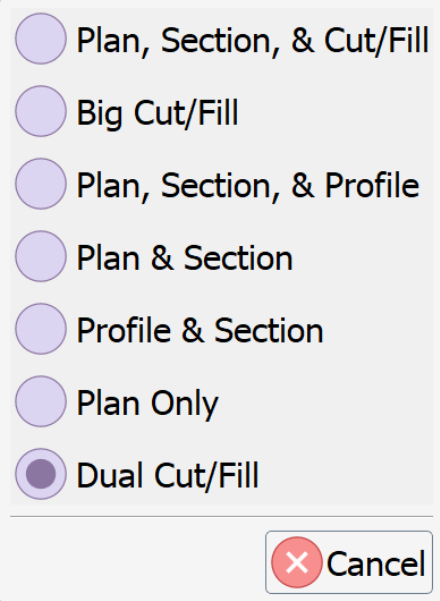
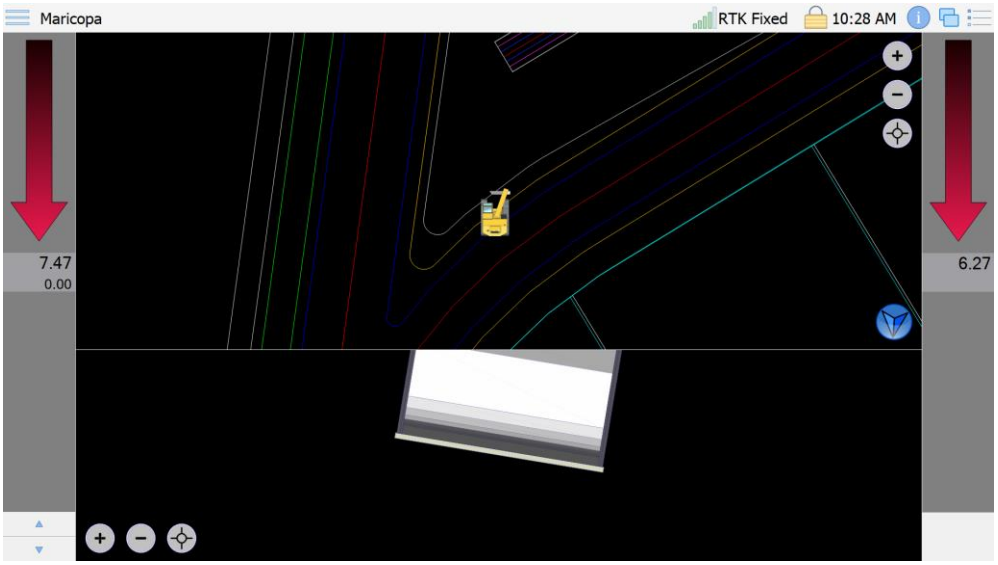
Dual Cut/Fill



The **Dual Cut/Fill** screen displays a cut/fill value on both sides of the bucket.

The Cut/Fill bar on the left shows the Cut/Fill value for the left side of your bucket, and the Cut/Fill bar on the right shows the Cut/Fill value for the right side of the bucket.

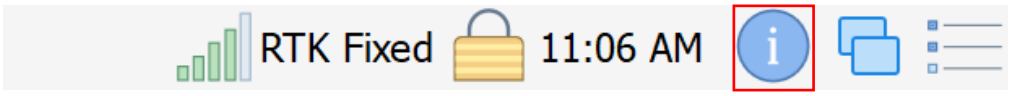


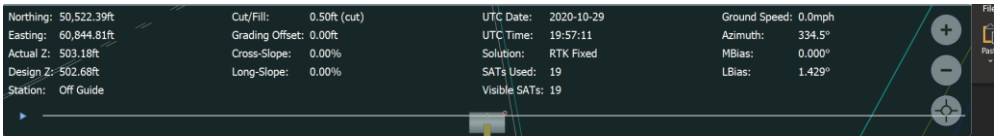
Continued on next page

Operator Interface, Continued

Quick Info

In the top panel icons, click the blue **information ("i")** icon to view configurable text options, such as position, and number of satellites in use, etc.





(Press anywhere in the pop-down screen to hide the menu.)

The following table lists the terms and definitions found in the **information ("i")** menu.

Table 2-1: Information menu

Term	Definition
Northing	The Northward-measured distance from the origin, or the "Y"-axis.
Easting	The Eastward-measured distance from the origin, or the "X"-axis.
Actual Z	The local height above the origin of the local coordinate system. Actual Z is the elevation, or the "Z" axis.
Design Z	The design elevation (Actual Elevation – Design Elevation = Cut Value (if negative-Fill Value).
Station	If using a guideline, indicates the current station on the guideline.
Cut/Fill	The difference between design and actual elevation.
Grading Offset	A small offset (positive or negative) to the Cut/Fill value.
Cross slope	The angle made between the left and right side of the tracks and a horizontal plane (also known as roll).

Continued on next page

Quick Info, continued

Table 2-1: Information menu (continued)

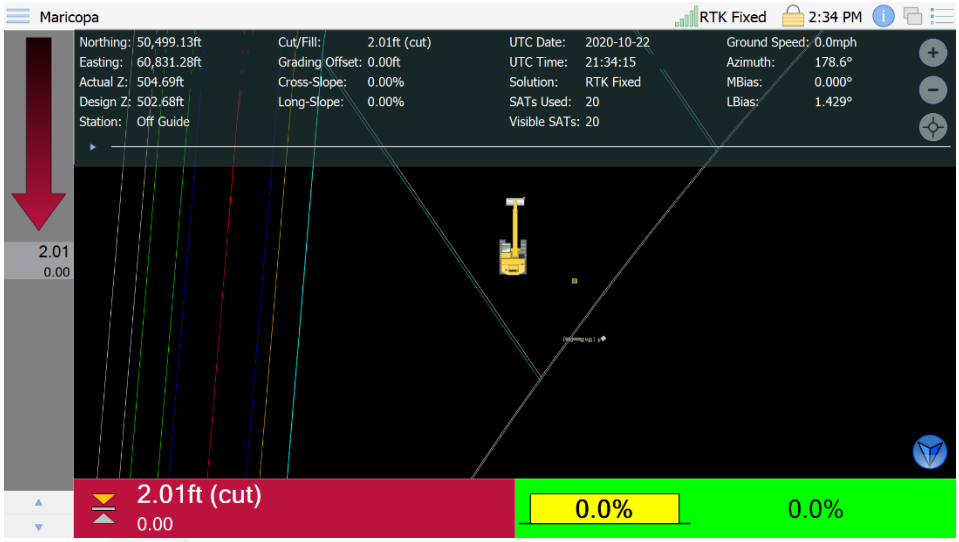
Term	Definition
Long slope	An angle made between the front and back of the machine and a horizontal plane (also known as pitch).
UTC Date	The date based on UTC (Coordinated Universal Time) time zone.
UTC Time	Coordinated Universal Time zone.
Solution	The solution should read “RTK Fixed”.
SATs Used	The quantity of satellites the GNSS receiver is using in the position algorithm.
Visible SATs	The quantity of satellites tracked by the GNSS receiver.
Ground Speed	The speed of the machine travel based on position data.
Azimuth	The angular measurement between the vector created from the back of the machine to the front of the machine and north.
MBIAS	An offset in heading resulting in GNSS antenna placement. For instance, if the machine is facing north (azimuth = 0 degrees) and the receiver reports 358 degrees, there is an MBIAS of -2 degrees (assuming LBIAS is 0. See LBIAS).
LBIAS	The angle between Site North and WGS84 North. For instance, the point located at Northing = 1000, Easting = 500, Elevation = 200 is directly north of a point located at Northing = 500, Easting = 500, Elevation = 200. However, if there is a rotation in the localization, this may not equal true north. **Azimuth (of machine) = Heading (from GNSS receiver) – MBIAS – LBIAS.**

Continued on next page

Operator Interface, Continued

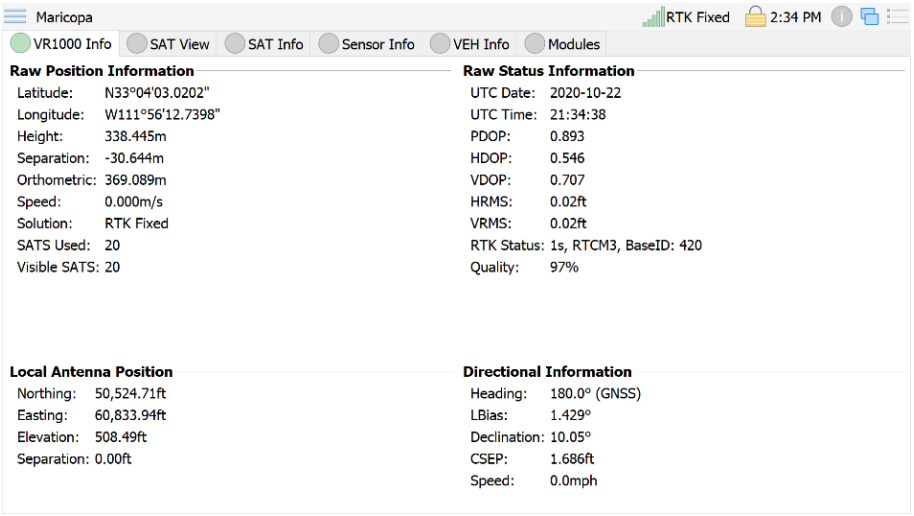
Quick Info, continued

Note: Select/de-select which information fields you want to display by clicking the **Settings** icon, and **Info Summary**.



Click the icon in the upper-right corner to view the **Information** screen.

Note: The **Information** screen icon is disabled when the **Quick Info** menu is displayed. Turn off the **Quick Info** menu to enable the icon.



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Antenna Info

The **VR1000 Info (or VR500 Info, depending on the system in use)** tab provides the following information:

- **Raw Position Information** –raw position and GNSS quality information from the GNSS receiver.
- **Raw Status Information** –additional GNSS status information (i.e., dilution of precision, RMS values, RTK latency, and UTC time) from receiver.
- **Local Antenna Position** –the NEZ in local project coordinates.
- **Directional Information** – the GNSS heading as well as an indicator (if GNSS), or course over ground heading. It also gives the declination and speed. *Troubleshooting Tip: Heading should always read "GNSS." If you do not have a Cut/Fill value, check to see if this value reads "Course over Ground." See more information in the **Troubleshooting** section of this manual.*

The **Raw Position Information** displays the current plan values for:

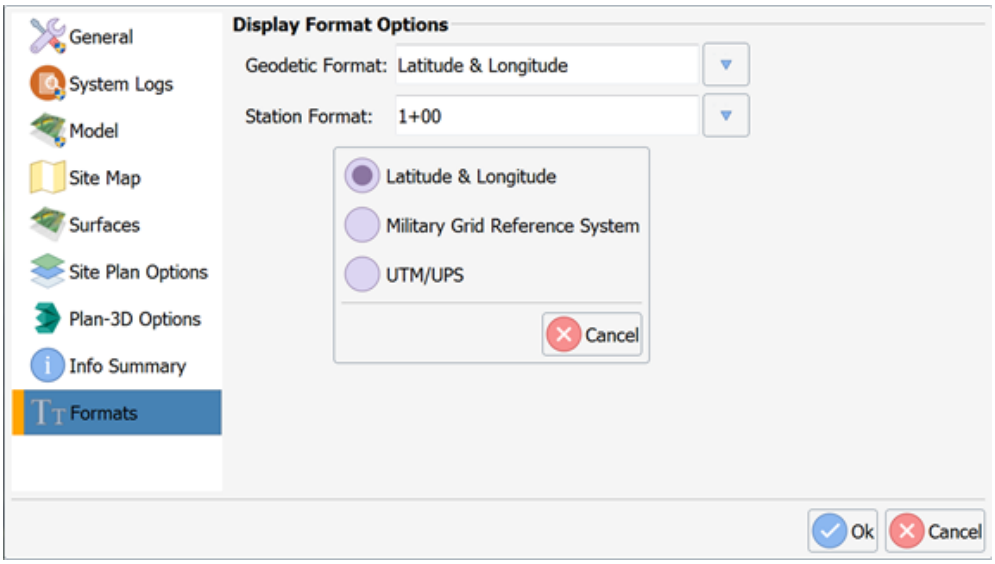
- Latitude
- Longitude
- Height (orthometric height)
- Separation (geoid separation)
- Ellipsoid (ellipsoid elevation)
- Speed
- Solution
- SATS Used
- Visible SATS

Note: The **Local Antenna Position** displays the projected coordinates at the GNSS antenna.

Continued on next page

Antenna Info, continued

Note: To change latitude/longitude to a military grid or UTM (Universal Transverse Mercator) Go to **Settings -> Format**.



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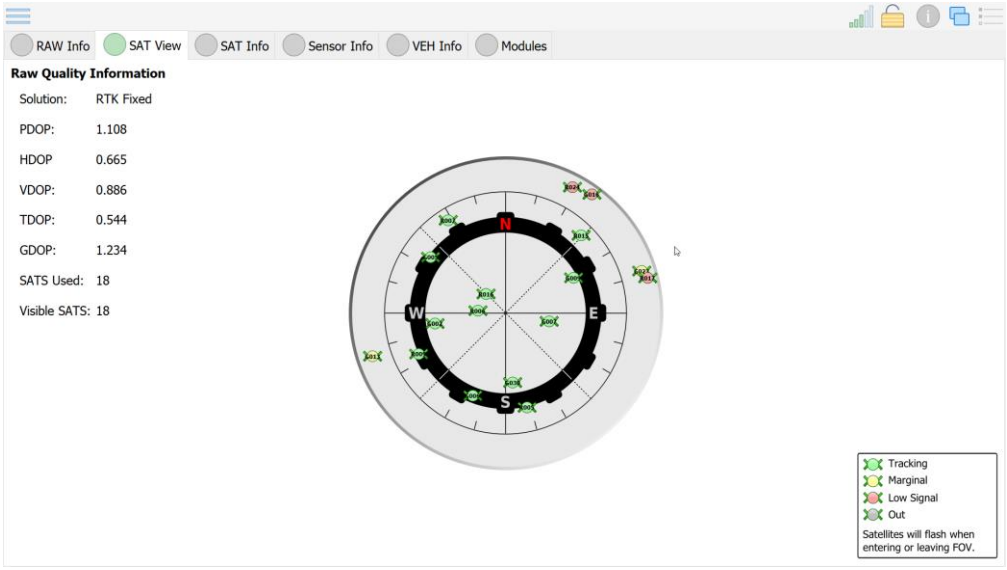
SAT View

The **SAT View** tab displays the available satellites. The strength of each satellite signal is color-coded.

Table 2-2: Satellite Signal Strength Indicators

Color	Description
Green	Strong signal. SNR > 32 dB
Yellow	SNR is greater than or equal to 27 dB, but less than 32 dB
Red	SNR is greater than or equal to 25 dB, but less than 27 dB
White	SNR is less than 25 dB

Satellites that are blinking have an elevation of 3 degrees or less.



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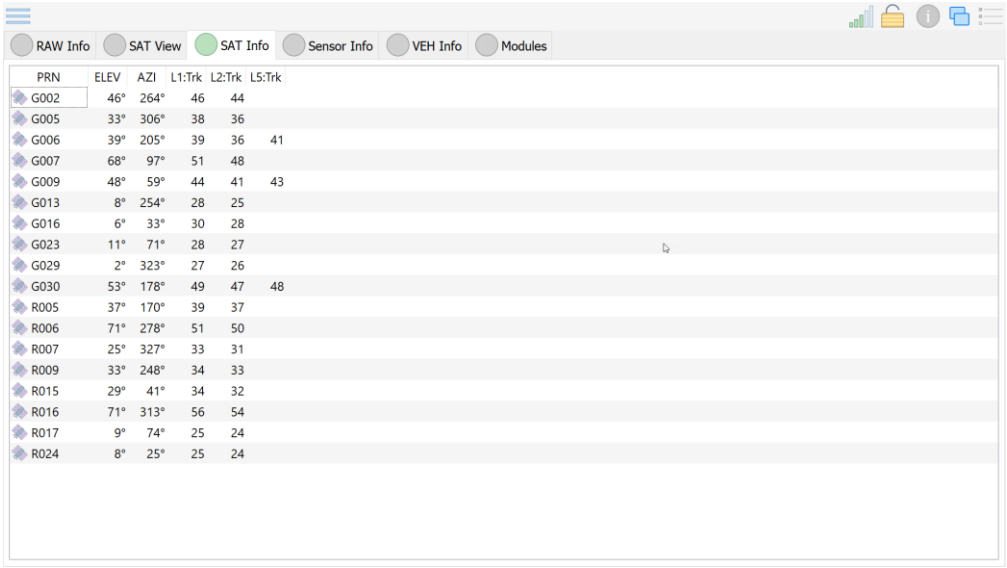
Operator Interface, Continued

SAT Info

The **SAT Info** tab displays data-driven detail about each satellite used in the solution.



PRN	ELEV	AZI	L1:Trk	L2:Trk	L5:Trk
G002	46°	264°	46	44	
G005	33°	306°	38	36	
G006	39°	205°	39	36	41
G007	68°	97°	51	48	
G009	48°	59°	44	41	43
G013	8°	254°	28	25	
G016	6°	33°	30	28	
G023	11°	71°	28	27	
G029	2°	323°	27	26	
G030	53°	178°	49	47	48
R005	37°	170°	39	37	
R006	71°	278°	51	50	
R007	25°	327°	33	31	
R009	33°	248°	34	33	
R015	29°	41°	34	32	
R016	71°	313°	56	54	
R017	9°	74°	25	24	
R024	8°	25°	25	24	

Continued on next page

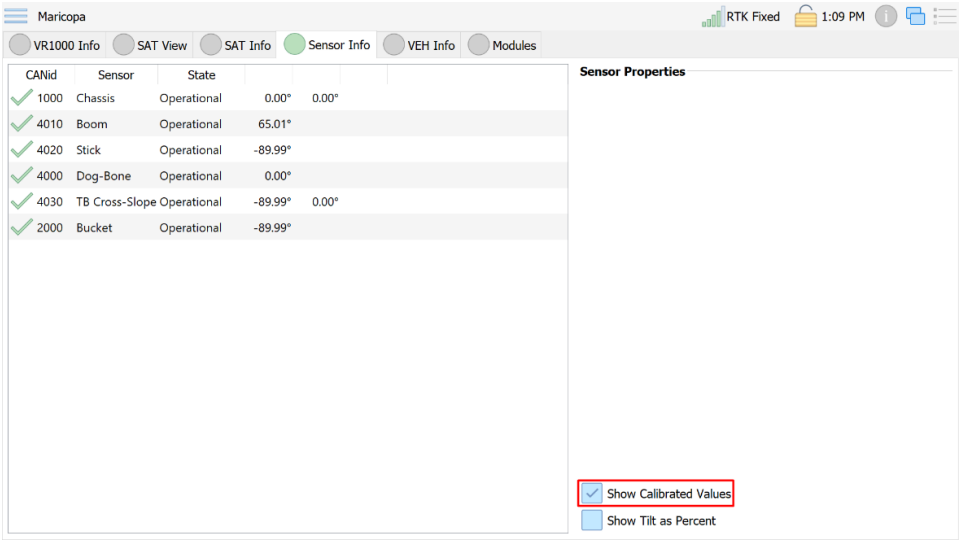
Operator Interface, Continued

Sensor Info

The **Sensor Info** tab displays all the configured sensors. You can check the sensor operation and the pitch and roll.

Click **Show Calibrated Values** to view the calibrated (rather than raw) tilt sensor value.

The green check mark indicates a sensor is connected. If you do not have a cut/fill value and you see a sensor that is not connected, there may be a failed sensor or cable. See the Appendix A, Troubleshooting section for more information.



Continued on next page

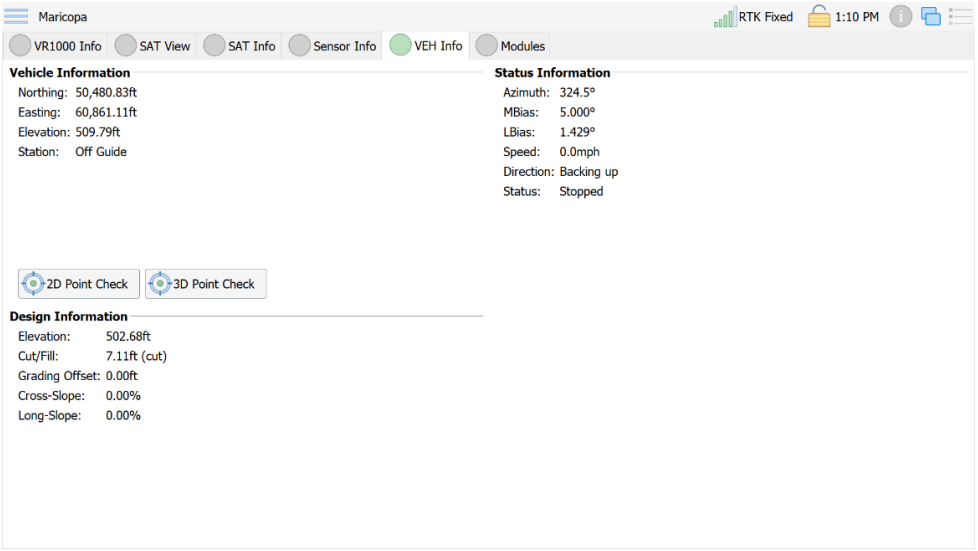
Operator Interface, Continued

VEH Info

The **VEH Info** tab displays the following information:

- **Vehicle**-Northing, Easting, Elevation, and Station
- **Status**-Azimuth, MBias, LBias, Speed, Direction, Status
- **Design**-Elevation, Cut/Fill, Grading Offset, Cross-Slope, Long-Slope

The **2D Point Check** and **3D Point Check** are critical features to diagnose errors and check the quality of a calibration. For more information regarding those features, please consult the HGNSS GradeMetrix Excavator Installation Guide.



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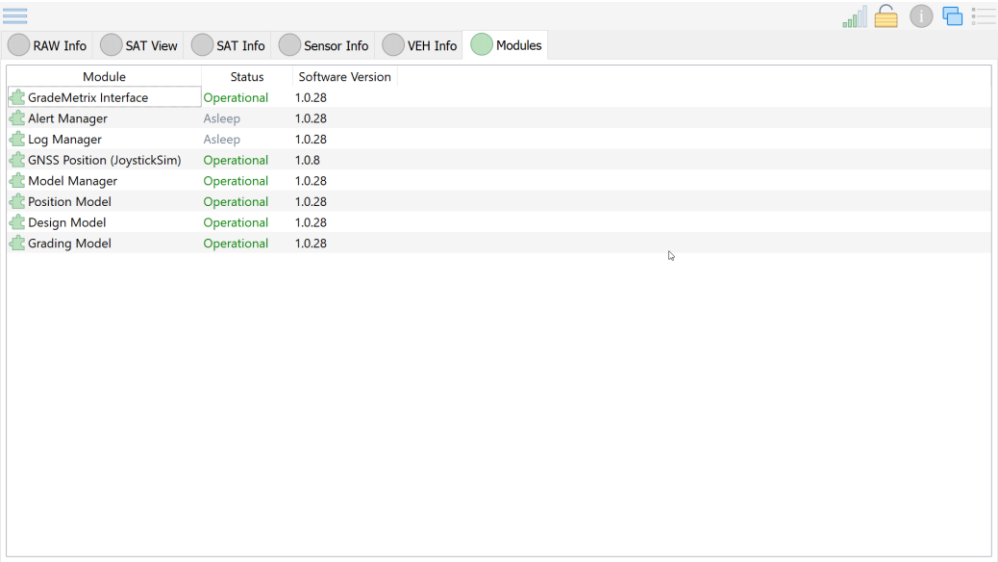
Operator Interface, Continued

Modules

The **Modules** tab displays a listing of modules used and the status of each module.



Return to main screen

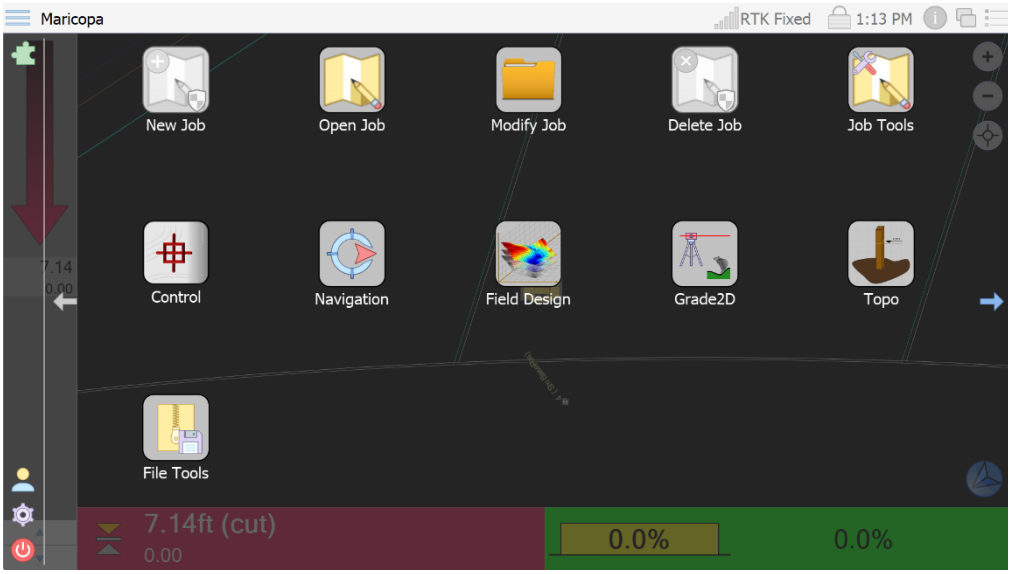
Click the icon to de-select and return to the GradeMetrix Main screen.

Continued on next page

GradeMetrix file requirements

Click the three bars ( ) on the top-left to enter the **Main Menu**.

The following screen displays. Use the arrows on the left and right to toggle between pages.



GradeMetrix Main Menu

Main Menu

The GradeMetrix **Main Menu** displays the following icons. You can use the arrows on the left and the right of the screen to scroll between screen 1 and screen 2.

For a breakdown and listing of **Main Menu** icons related to specific functions (i.e., create a job), refer to the beginning of Chapters 3 through 5 in this manual.

Administrator settings

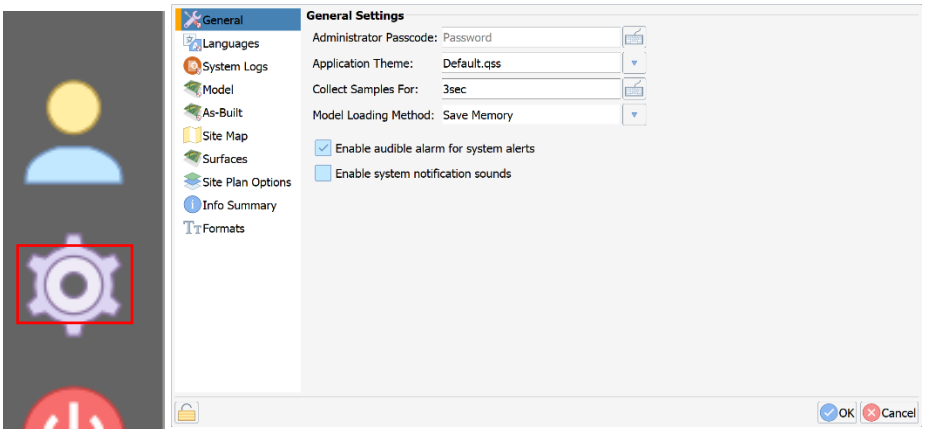
To enable **Administrator** permissions, click the figure icon on the bottom left side of the GradeMetrix **Main Menu**.

Continued on next page

Administrator settings, continued

A pop-up window displays. Click to select the **Administrator** checkbox.

To set the **Administrator** password, click the **Settings** icon and select the **General** tab. Click the keyboard icon and type your desired password.



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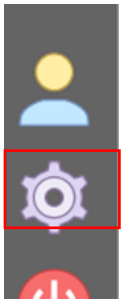
GradeMetrix Main Menu, Continued

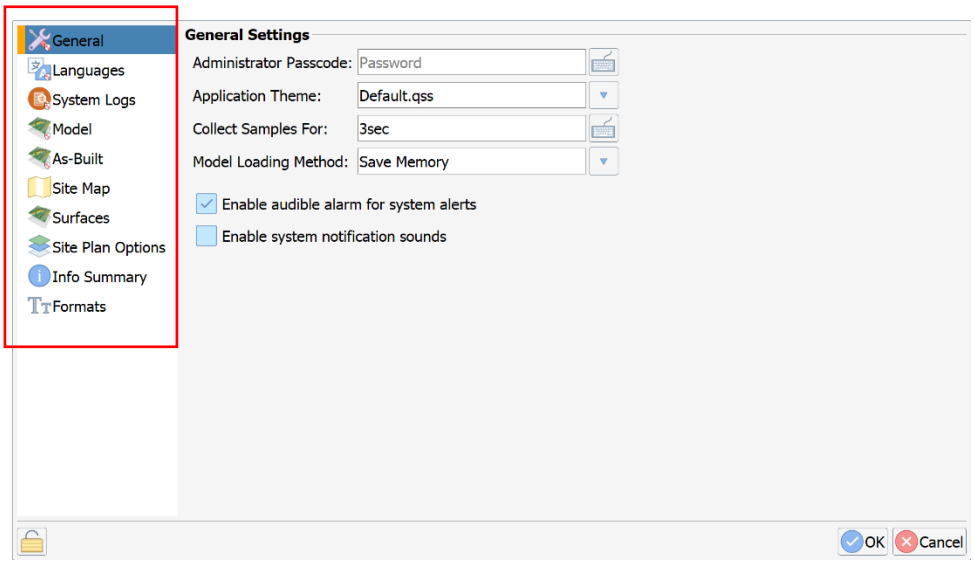
Settings

On the lower-left portion of the GradeMetrix **Main Menu**, click the gear icon to access **Settings**.



Note: You must be logged on as an **Administrator** to make changes to some GradeMetrix **Settings**.

The **Settings** window displays. The left navigation menu lists the GradeMetrix **Settings** options:



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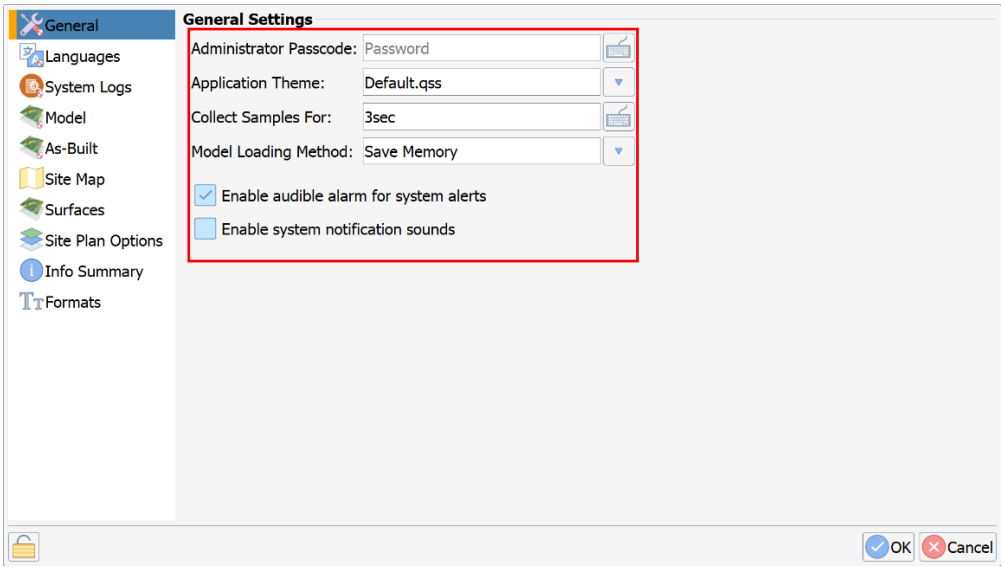
GradeMetrix Main Menu, Continued

General settings

The **Application Theme** can be changed. Click the drop-down arrow to select from default or pre-set custom views.

Click in the **Collect Samples For:** keyboard icon and type in the desired value in seconds.

To save your settings, click **Ok**. To cancel your changes, click **Cancel**.



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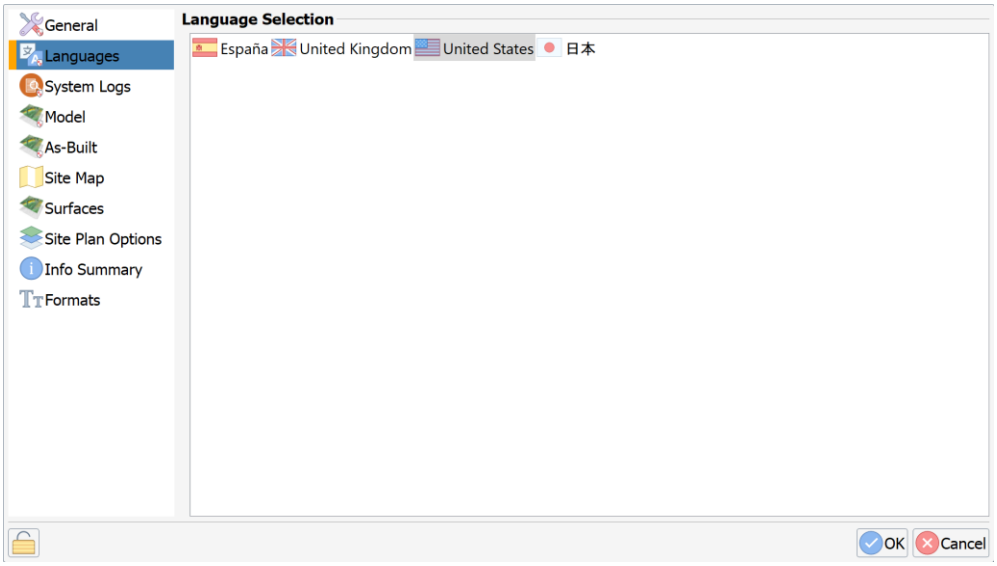
GradeMetrix Main Menu, Continued

Languages

GradeMetrix supports English (American), English (British), Spanish, and Japanese languages.

Click to highlight your desired language. If you wish to change the language, you must reboot the software after making any changes.



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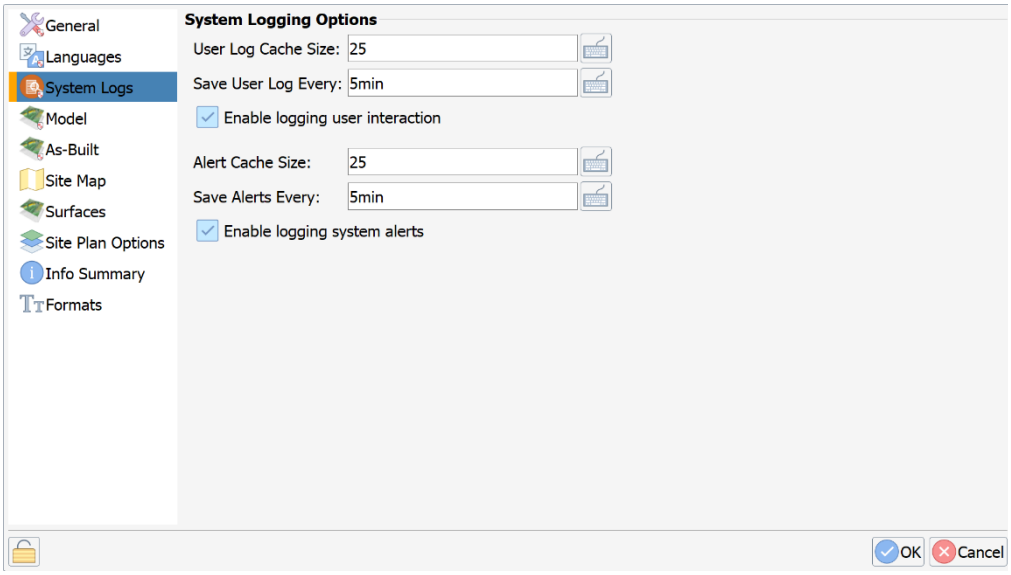
System logs

In the **System Logs** screen, click in the field to set the system logging options.

Table 2-3: System Logs

Option	Function
User Log Cache Size	Determines number of logs held in memory before flushing them to a disk.
Save User Log Every	Performs an autosave to disk.
Enable logging user interaction	Logs all user interactions.
Alert Cache Size	Determines number of logs held in memory before flushing them to a disk.
Save Alerts Every	Performs an autosave to disk.
Enable logging system alerts	Saves error message (GPS errors, sensor errors, etc.).

When you are finished setting the system logging options, click **Ok**. To cancel your changes, click **Cancel**.



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GradeMetrix Main Menu, Continued

Model

On the **Model Options** screen you can check and edit the location settings for your GradeMetrix job in the **Model** screen. Click to select/edit the following fields:

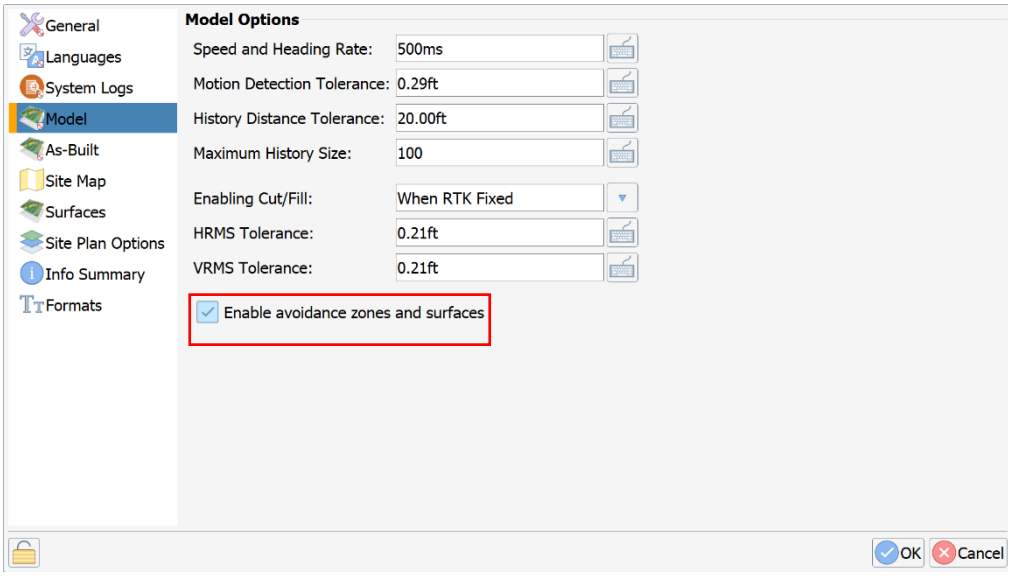
Table 2-4: Model Options

Option	Description
Steering Query Location:	Selects machine POI for steering reference.
Speed and Heading Rate:	The rate at which reverse state is determined.
Motion Detection Tolerance:	GradeMetrix uses your GNSS position to determine motion. **Note:** A change in position is required for GradeMetrix to set the machine from moving to stopped position.
History Distance Tolerance:	Records the cumulative history movement and sets a history marker.
Maximum History Size:	The amount of history markers stored for your previous points.
Enabling Cut/Fill:	The default (and suggested) setting is **When RTK Fixed**. If the GNSS receiver loses an RTK Fix, Cut/Fill will no longer display. If set to **Allow aRTK Fixed**, Cut/Fill will display if the receiver drops into an aRTK™ Fix. If **Allow Atlas** is selected, the receiver will show Cut/Fill when Atlas® is converged, the receiver is aRTK Fixed, and the receiver is RTK Fixed. If set to Always Show, Cut/Fill will always display (even when RTK isn't available).
HRMS Tolerance:	Sets the Horizontal RMS thresholds for when an alert will occur.
VRMS Tolerance:	Sets the Vertical RMS thresholds for when an alert will occur.

Continued on next page

GradeMetrix Main Menu, Continued

Model, continued



Click to select the checkbox to select **Enable avoidance zones and surfaces**. If the module is built with avoidance zones, an alarm will sound when entering those zones.

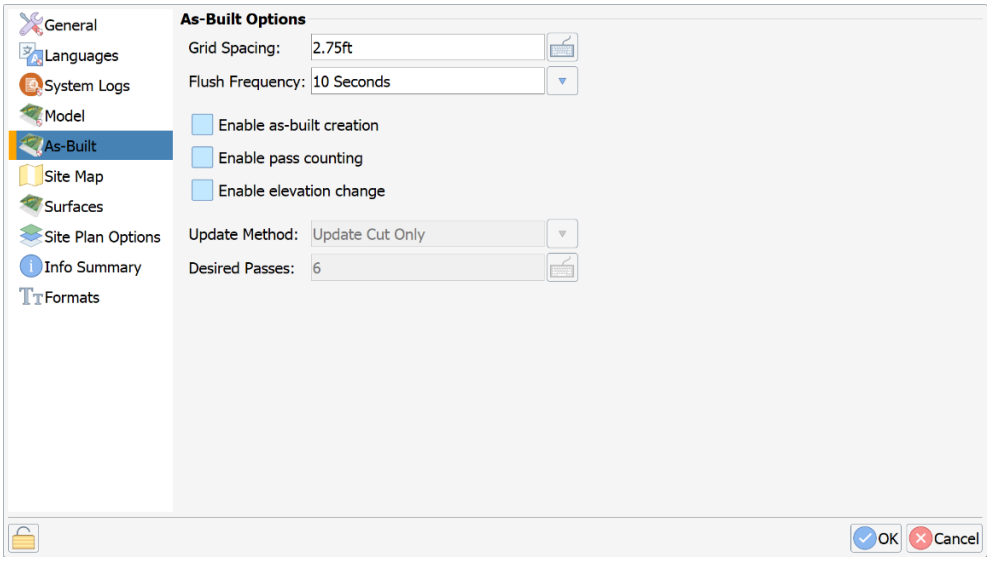
To save your settings, click **Ok**. To cancel your changes, click **Cancel**.

Continued on next page

GradeMetrix Main Menu, Continued

As-Built

The **As-Built** option tracks job progress, and can be configured for pass counts, or Cut/Fill.



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GradeMetrix Main Menu, Continued

Site map

Use the **Site Map** screen to set display and zooming views for your GradeMetrix job.

Click the down-arrow to select any of the following options from the pop-up window.

Show Display As: There are three display options to view your machine as the map rotates:

1. **Moving Map**-machine always faces the top of the screen as the map rotates.
2. **Fixed Rotation**-machine stays in a static position and the map will point toward the specified direction (i.e., north, south, east, west).
3. **North Up**-the top of the map is always north.

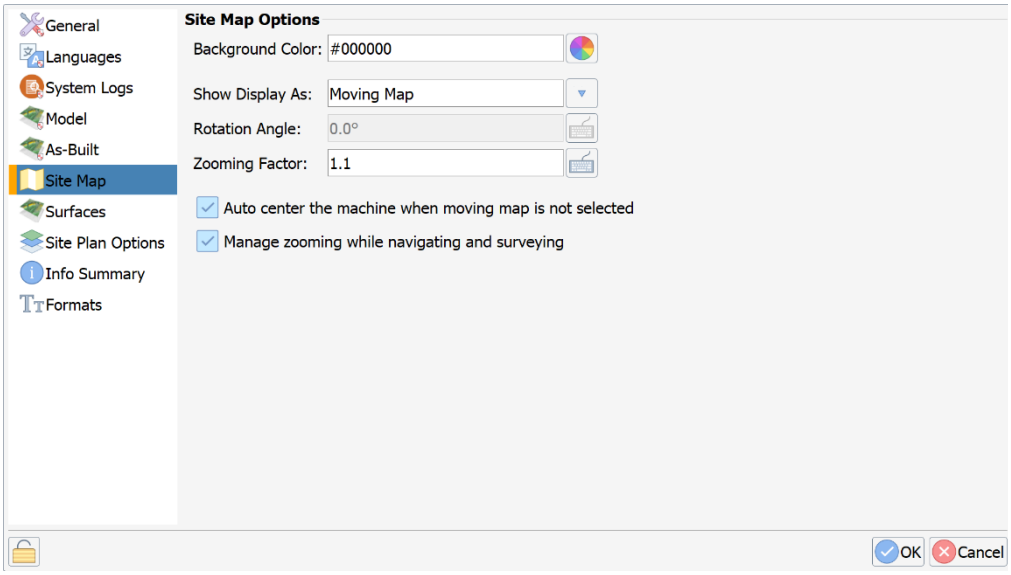
Click the keyboard icon to the right of the following fields to separate auto center and manage zooming:

- **Rotation Angle:** if using fixed rotation, enter the degrees to rotate the map clockwise.
- **Zooming Factor:** set the numeric value to zoom on the right side of the plan view (The greater the value set (50 or above), increases the zoom out.)
- **Auto center the machine when the moving map is not selected:** the view adjusts as your machine moves to prevent your machine from driving off screen.

Continued on next page

Site map, continued

Manage zooming while navigation and surveying: when staking out a point, the view will zoom in closer to the point.



To save your settings, click **Ok**. To cancel your changes, click **Cancel**.

Surfaces

The **Surfaces** option enable/disables on the background surfaces shown on the plan view.

Select from these options:
- Show Using:
- On-Count Color:
- Passes Color:

Show Cut/Fill-select the box to display Cut/Fill surfaces on the **Plan View** and color the grid based upon the Cut/Fill value.

Note: This option is only available if an existing surface file is loaded.

Continued on next page

GradeMetrix Main Menu, Continued

Surfaces, continued

The **Site Plan Options** can be enabled/disabled to show on the **Plan View**.

Refer to Table 2-5 for a description of each option according to the view you select.

Table 2-5: Site Plan Options and Views

Site Plan Option	Selected	Not Selected	View
Show Opaque Vehicle	X		The chassis of the excavator will be filled in.
		X	The excavator chassis will be transparent, allowing for better viewing of the linework.
Show Compass	X		A compass is shown on the **Plan View**.
Show Guideline	X		This option must be checked for the guideline to display.
Show Stake Points	X		Each topo point in the topo file you have loaded will be shown with a marker on the **Plan View**.
Show Stake Text	X		The topo points shown on the screen will have the point number displayed on the screen next to the point marker.

Continued on next page

Surfaces, continued

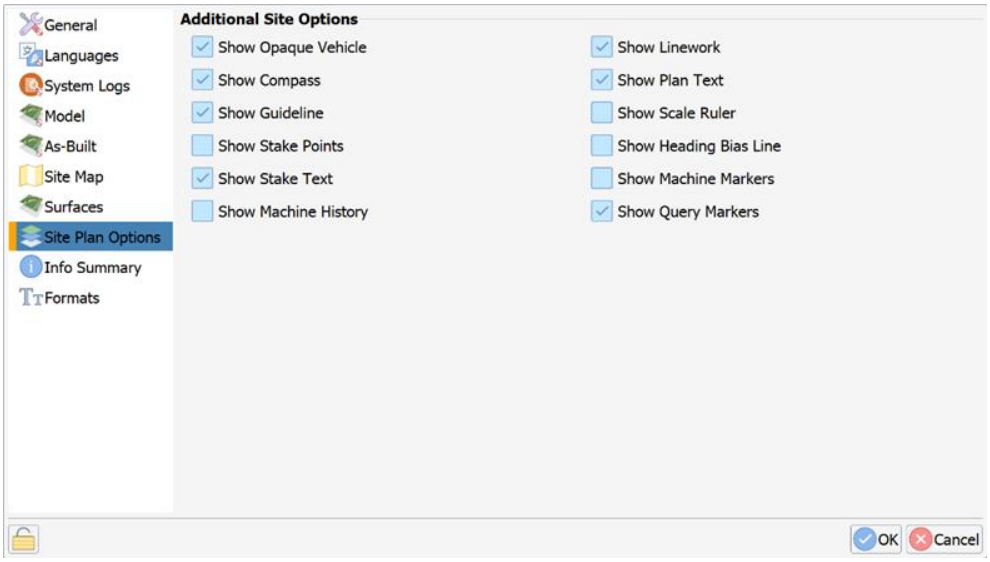
Table 2-5: Site Plan Options and Views (continued)

Site Plan Option	Selected	Not Selected	View
Show Machine History	X		Breadcrumbs display on the screen indicating the machine path. Go to the **Model** tab to configure how many markers are stored and at what distance interval they are to be stored.
Show Linework		X	The linework from your **Plan View** file will not display on the screen.
Show Plan Text	X		Text on the **Plan View** will display.
Show Scale Ruler	X		A distance scale will display in the **Plan View**.
Show Heading Bias Line	X		Two lines will be drawn on the excavator. The angle between those two lines is equal to the MBIAS of your machine.
Show Machine Markers	X		Circles will be drawn on both sides of the bucket, the boom pin, and primary antenna. This only affects the overhead view.
Show Query Markers	X		The guideline location query location is shown on the excavator as a red circle and the cut/fill location is shown as a green triangle.

Continued on next page

GradeMetrix Main Menu, Continued

Surfaces, continued



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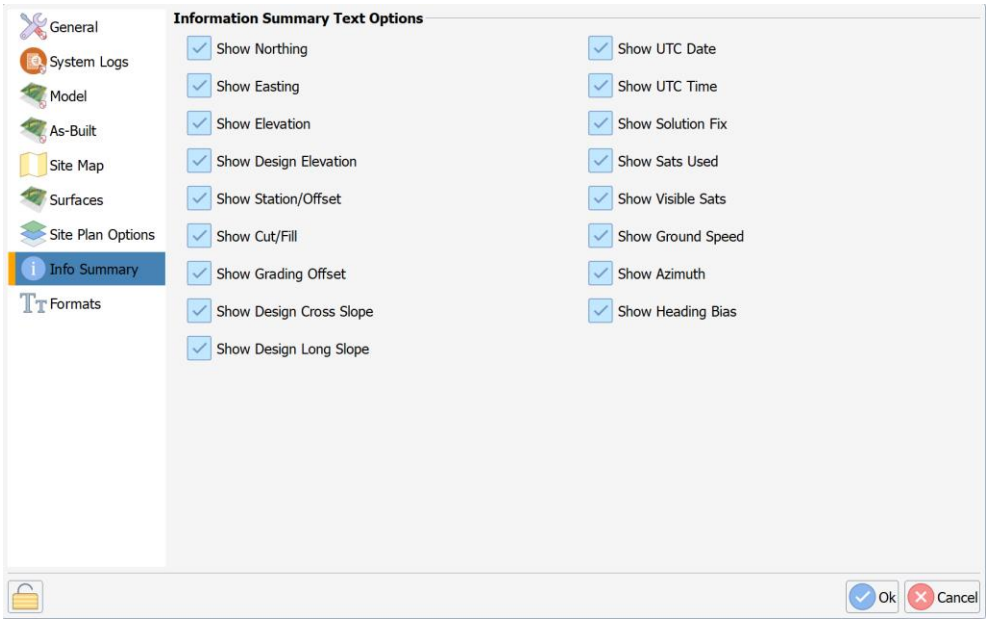
GradeMetrix Main Menu, Continued

Info Summary tab

The **Info Summary** screen displays the list of text options to display on the **Quick Info** screen. Click to select the options you wish to display.

To de-select an option, click the box a second time. After making your selections, click **Ok**.



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GradeMetrix Main Menu, Continued

Formats

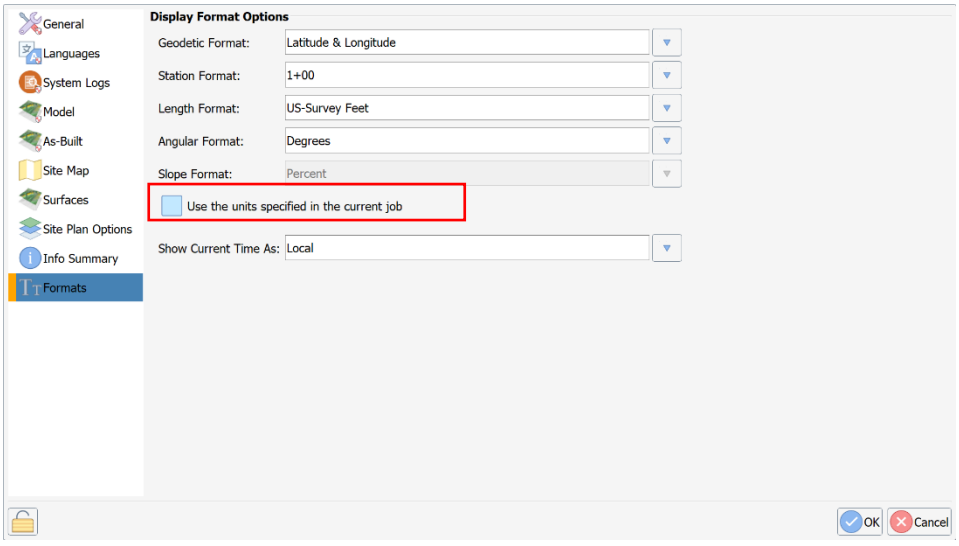
The **Display Format Options** screen lists the format options that can be displayed for a job. Click the down-arrow to the right of each field to change a selection.

- **Geodetic Format-**Displays latitude/longitude, UTM, or military grid.
- **Station Format-**Selects format to show stationing and offset.
- **Length Format-**Selects the unit of measure for northing, easting, and elevation.
- **Angular Format-**Selects between Degrees and Gradians,
- **Slope Format-**Selects between percent and degrees.

Note: If "**Use the units specified in the current job**" is selected, you will not be able to select **Length Format** and **Angular Format** since job units will be used.

Show Current Time As-Click the down-arrow to select **Local**, **UTC**, or **Do Not Show**.

Click **Ok** to return to the GradeMetrix **Home** screen.



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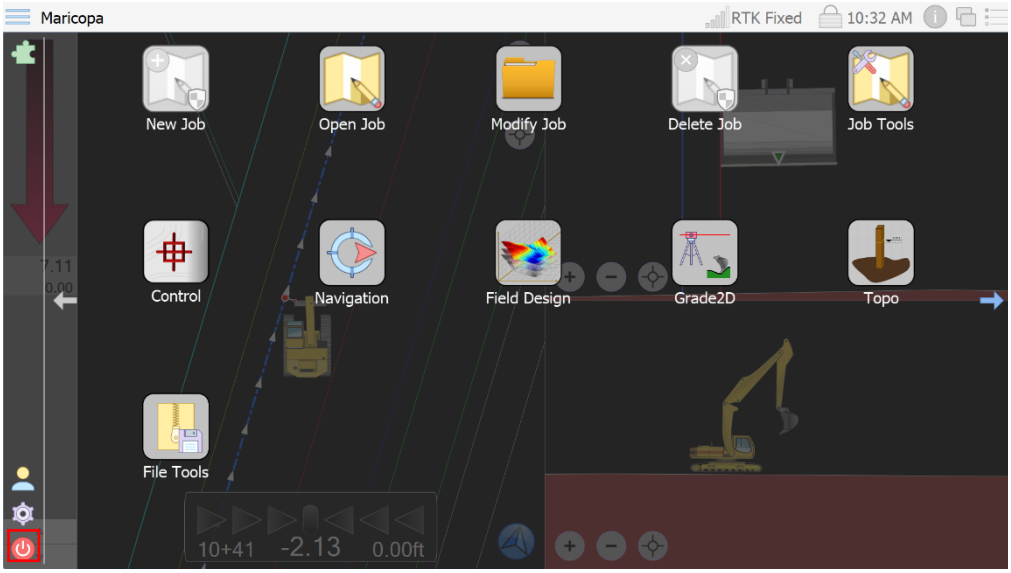
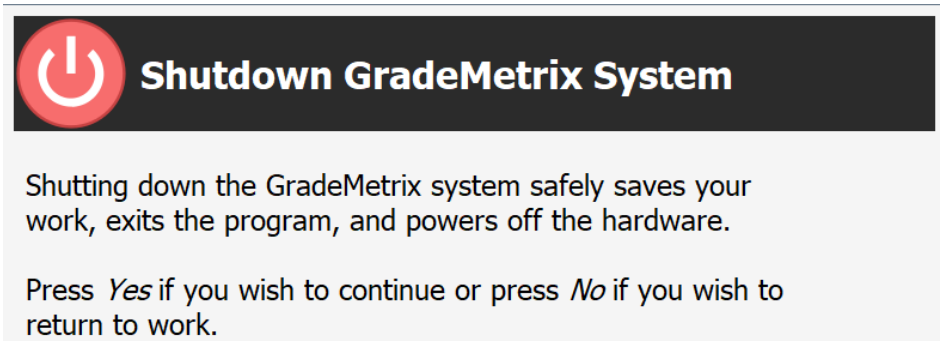
GradeMetrix Main Menu, Continued

Exit GradeMetrix

To exit GradeMetrix, click the red power icon in the lower left side of the GradeMetrix **Main Menu**.



Highlight and click the **Shutdown** option. The confirmation message displays:



Click **Yes.** The GradeMetrix application closes.

Chapter 3: Working with GradeMetrix Jobs

Overview

Introduction

This chapter covers the information you need to create, modify, delete and design jobs in GradeMetrix.

Contents

Topic	See Page
Menu Icons	61
Create a Job	62
Open a Job	75
Modify a Job	76
Delete a Job	78
Job Tools	79
File Tools	81

Menu Icons

Menu icons

The following icons are used to perform job functions in GradeMetrix.

Table 3-1: Main Menu Icons-Job Functions

Icon Name	Icon	Description
New Job (*must be accessed by authorized Admin user)*		Create a new job.
Open Job		Open an existing or saved job.
Modify Job		Edit an existing or saved job.
Delete Job		Delete a created job.
Job Tools		Export a job file to external storage or rename a job.

Create a Job

Overview

Before creating a job in GradeMetrix, review the files and file formats supported by GradeMetrix.

Files and formats used in GradeMetrix

Various files are loaded into GradeMetrix on specific, recommended directories on the Control Panel using two different methods:

1. Manually selecting files in GradeMetrix from memory sticks (USB drives, thumb drives, etc.) or
2. Using Windows Explorer to copy files.

GradeMetrix can support the following files and file formats:

- Site Plan File: DWG, DXF, LandXML
- Surface Model File: DWG, DXF 3D face triangles or polylines, TIN, FLT, GRD, LandXML, and LandXML Grid
- Survey Topo File: TOPO
- Tin File: MESH, TIN, NTR, DXF, DWG, FLT
- Geoid File: BIN
- Localization File: LOCAL (SiteMetrix™ Grade), LOC (SiteMetrix), .COT (SiteMetrix Survey)

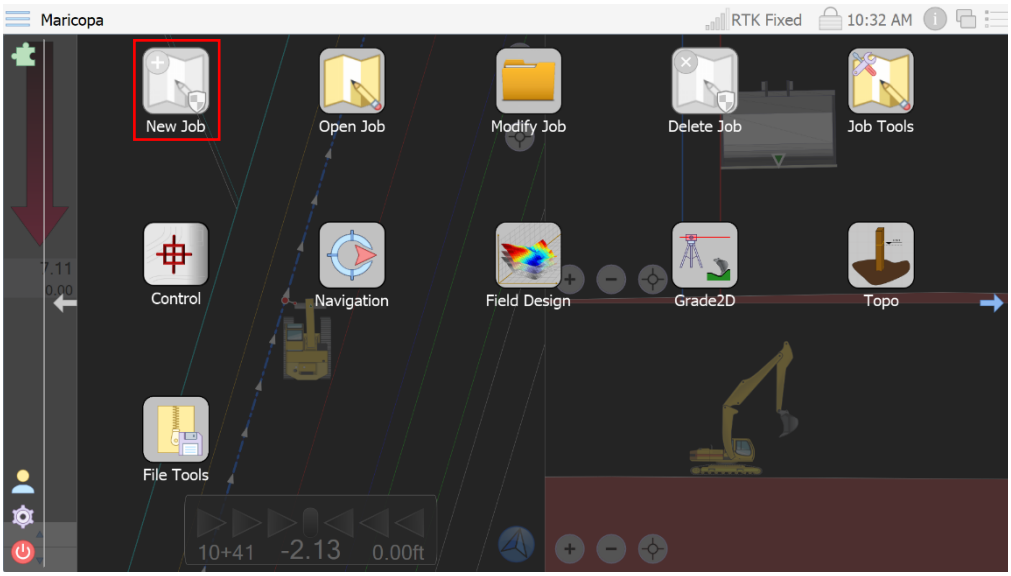
Continued on next page

Create a Job, Continued

Create a job

To create a job, on the GradeMetrix **Main Menu** (screen 1), click **New Job**. The **Job Basics** screen displays.

Note: You must be logged in as an **Administrator** to create a new job in GradeMetrix. The **New Job** icon is disabled for all other users.



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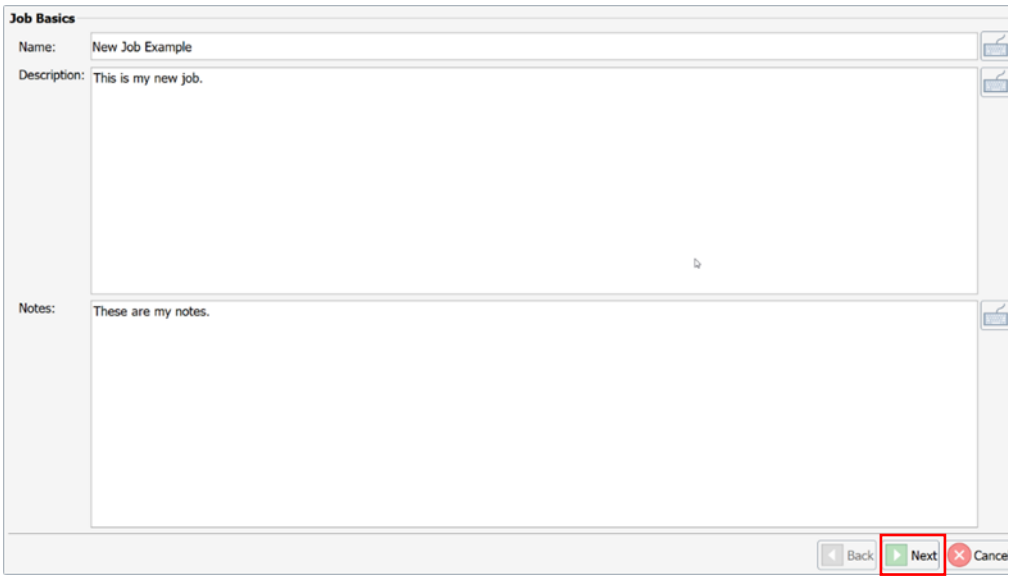
Create a Job, Continued

Job basics screen

Click the keyboard icon and type the job name, description and job notes.

Click **Next**.



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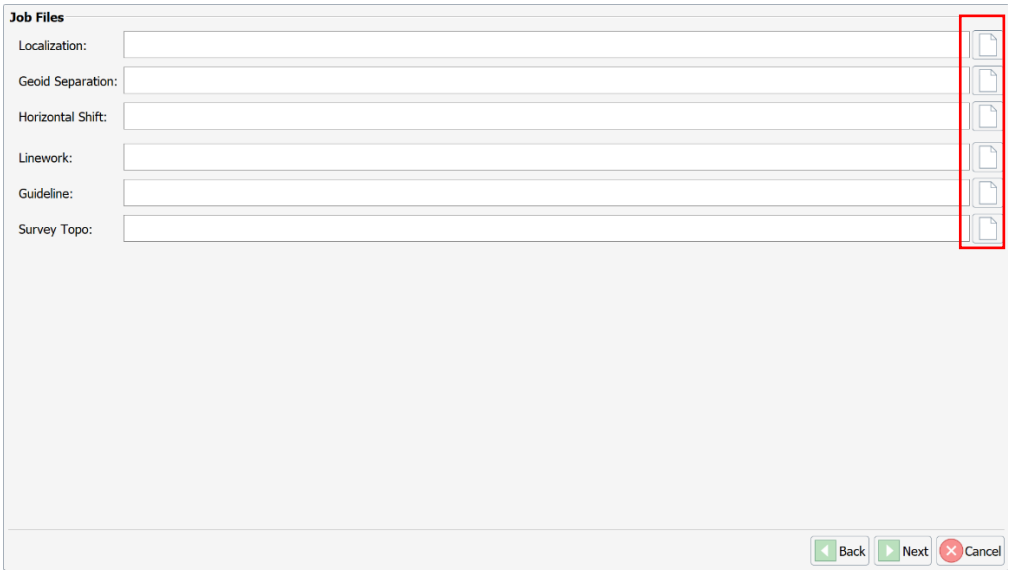
Create a Job, Continued

Job files screen

Click the document icon to the right of each field to add files to your GradeMetrix job:

- Localization
- Geoid Separation
- Horizontal Shift
- Linework
- Guideline
- Survey Topo



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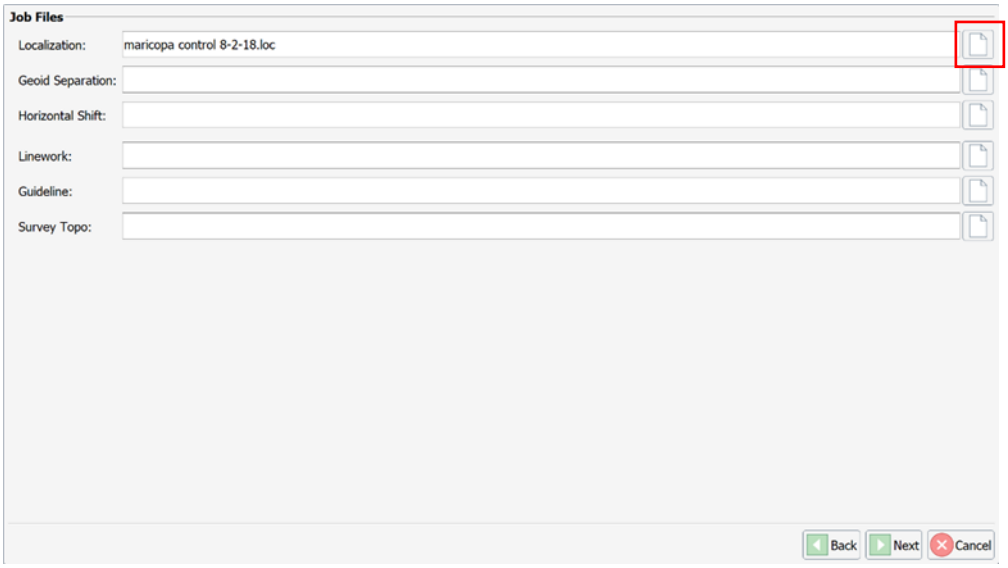
Create a Job, Continued

, continued

To add Job Localization, click the document icon to the right of the **Localization** field.



To add **Geoid Separation**, **Horizontal Shift**, **Linework**, **Guideline**, and **Survey Topo**, click the document icon to the right of that field.

After adding all the associated **Job Files**, click **Next**.

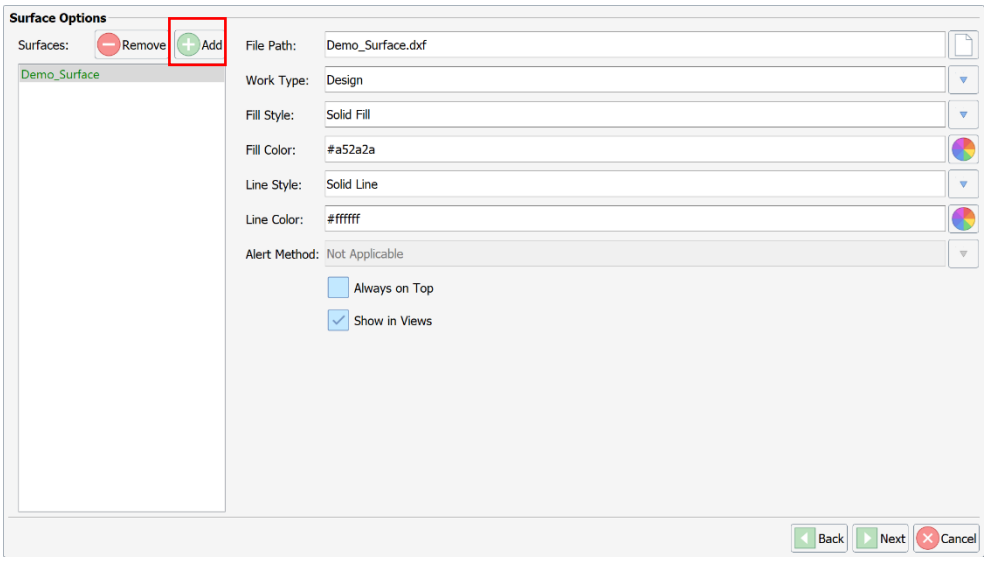
Continued on next page

Create a Job, Continued

Surface options window

The **Surface Options** window displays. Click **Add** and select the file.

Note: You can add multiple types of surfaces.



Continued on next page

Create a Job, Continued

Surface options window, continued

Click the down-arrow to select a **Work Type** option.

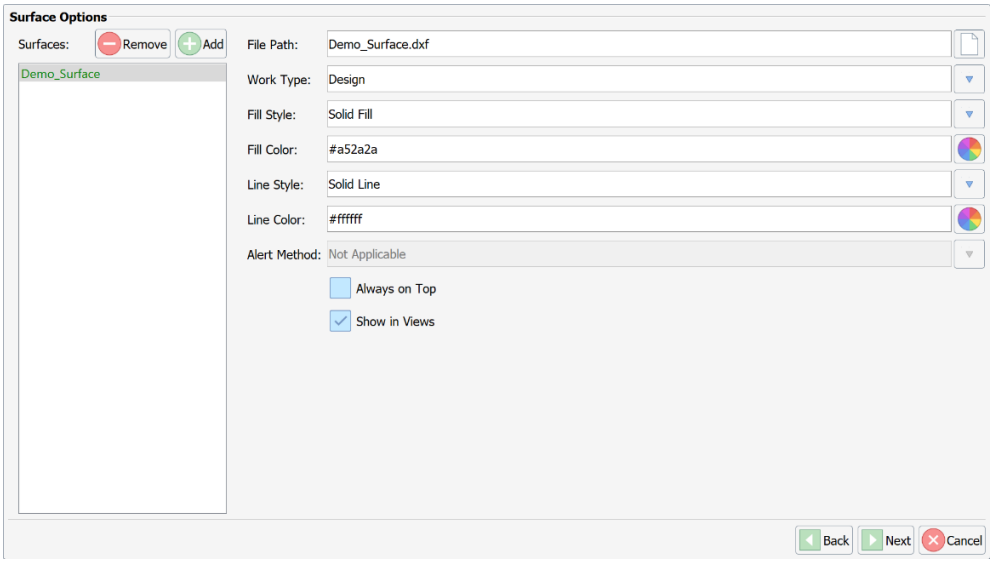
- **Design**- This is the most commonly selected option. The Design surface is the surface you are grading to.
- **Actual** –Select **Actual** if you have a jobsite topo to upload to the current actual surface.
- **Warning** – Select to trigger a warning in the software if your elevation is either above or below the uploaded surface (see **Alert Method**).
- **Watch** – This is similar to Warning. This allows for two levels of alert (i.e., you can choose to upload a 'Watch' surface to set low priority alerts to an operator and set another 'Warning' surface for higher priority alerts to an operator.
- **Pass Count** –Select to color the screen based on how many times a machine has passed over a grid cell.

Continued on next page

Create a Job, Continued

Surface options window, continued

The option you selected displays in the **Work Type:** list.



In addition to **Work Type**, the following options are available:

- Fill Style
- Fill Color
- Line Style
- Line Color
- Alert Method: This option is available when **Work Type** is set to **Warning** or **Watch**. This can be set to **Alert When Below**, **Alert When Above**, or **When Crossing**.
  - **Alert When Below** issues an alert when the cutting edge of the machine is below the warning or watch surface and can be used to prevent over cutting. If set to **Alert When Above,** an alert is issued when the cutting edge is above the surface. This alert could be used for safety purposes. If set to **When Crossing** an alert is set if you are on a dangerous surface, such as a gas well.

Continued on next page

Create a Job, Continued

Surface options window, continued

There are two checkboxes: **Show in Views** and **Always on Top**. Selecting **Show in Views** will allow the surface to show up in the Plan View section and profile views.

Always on Top will show the surface (if a secondary surface) above the primary surface. For instance, you can load multiple design surfaces. The surface at the top of the list drives the Cut/Fill. The other surfaces can be used visually. For instance, if you are cutting to ore and want to see ore deposits, you can upload a surface, click **Always on Top**, and see the surface.

Continued on next page

Create a Job, Continued

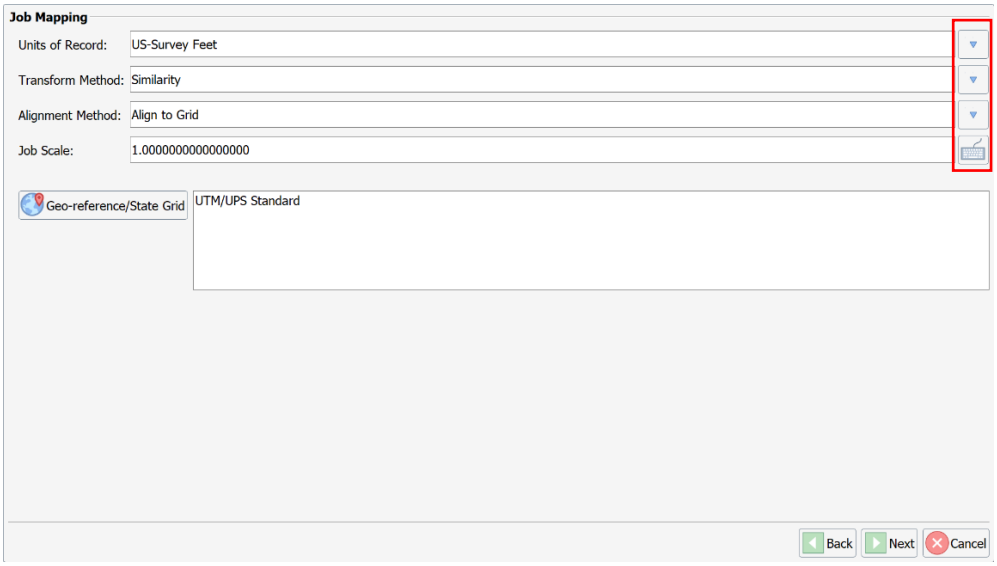
Job Mapping window

The **Job Mapping** window displays.

Click the down-arrow to select units for the following fields:

- Units of Measure
- Transform Method
- Alignment Method

Click to use the keyboard icon and type the **Job Scale**.



Continued on next page

Create a Job, Continued

Job Mapping window, continued

To set a geographical reference grid, click **Geo-reference/State Grid**. Click to select from the displayed list.

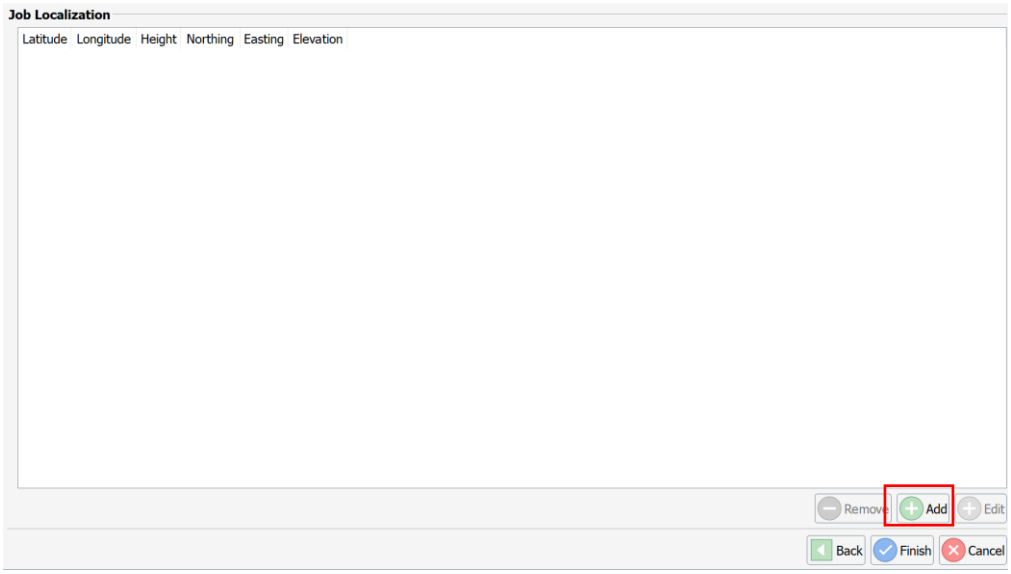
Click **Next**.

Continued on next page

Create a Job, Continued

Job Localization screen

The **Job Localization** screen displays. Click **Add**.



Click the keyboard icon to the right of each field to set the localization settings:

- Latitude
- Longitude
- Height
- Type (drop-down arrow to select **Ellipsoid** or **Geoid**)
- Northing
- Easting
- Elevation

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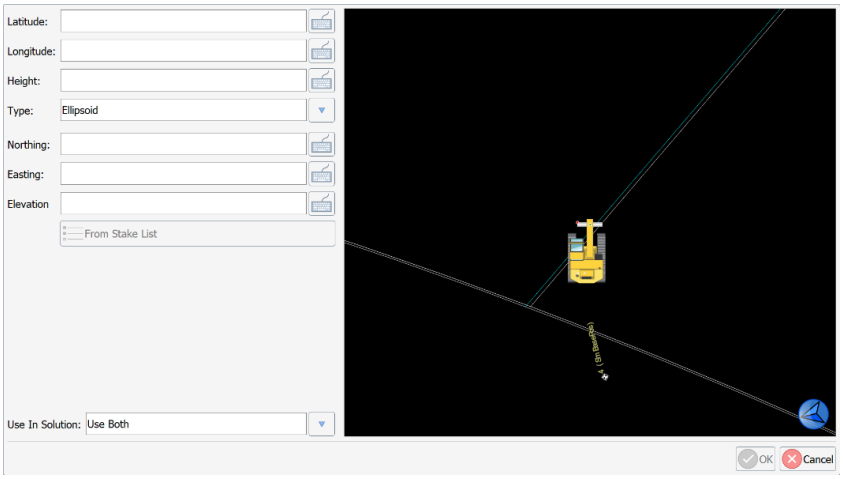
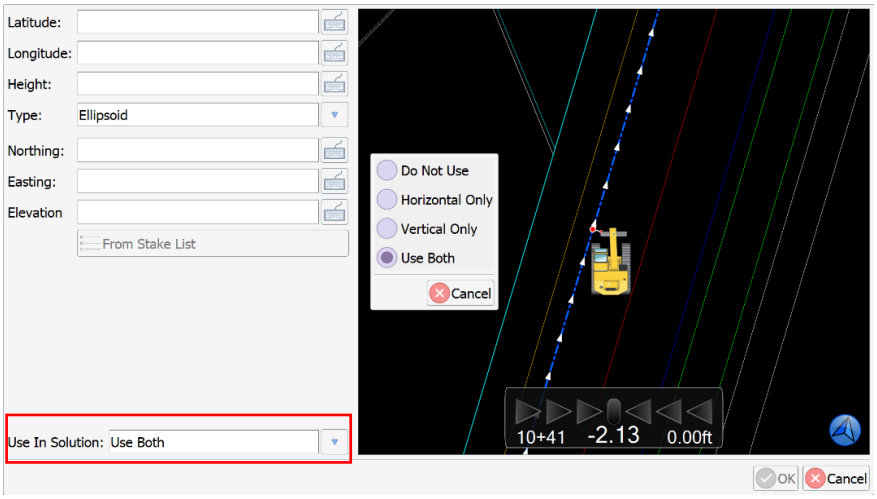
Create a Job, Continued

Job Localization screen, continued



The **From Stake List** button-allows the user to select a control point from the stake list.

Use the drop-down arrow next to **Use In Solution:** to select from the following localization display options:

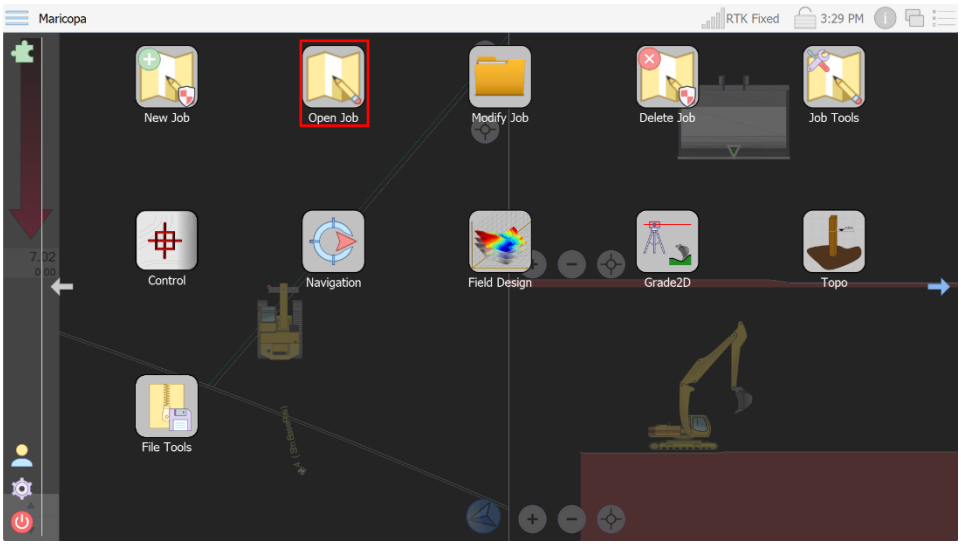


If residuals are high for the point, you may opt to not use the point. Or, if residuals are high for one component (horizontal or vertical), you may opt to turn off that one component. Click **Ok**. Click **Finish**.

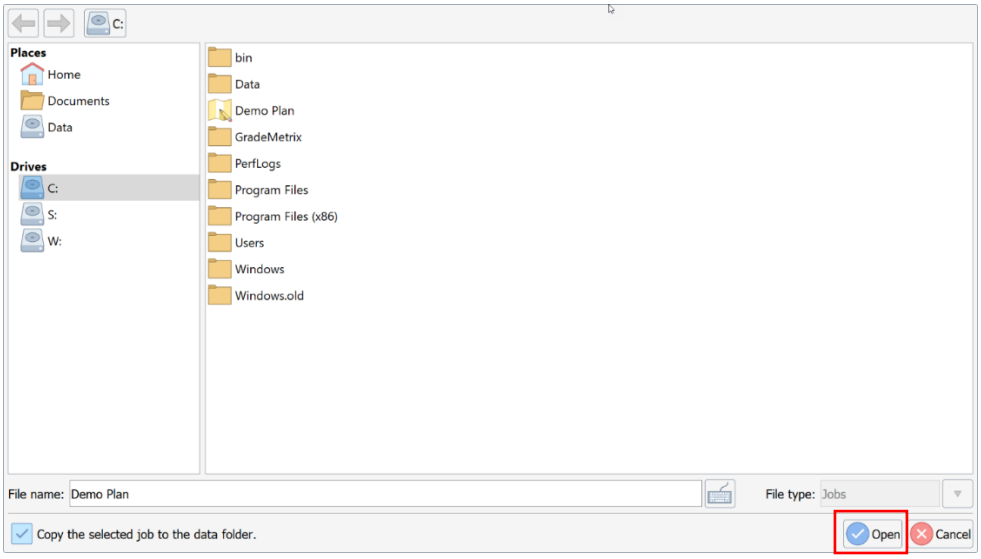
Open a Job

Open a job

To open an existing Job in GradeMetrix, on the **Home** screen, click the **Open Job** on the GradeMetrix home screen.



The file explorer displays. Navigate to the desired job and click to highlight the job you want to open. Click **Open**.

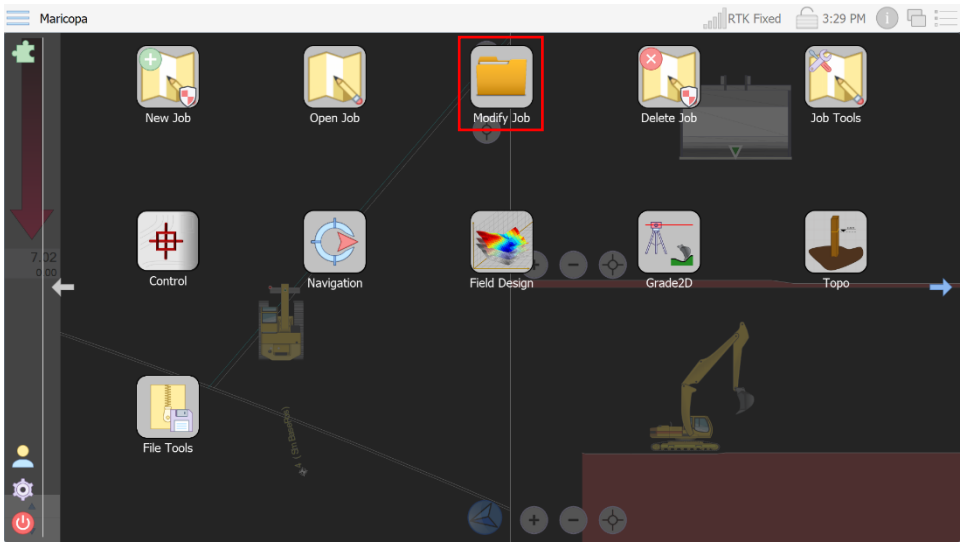


Modify a Job

Modify a job

To modify an existing job in GradeMetrix, click the **Modify Job** icon on the GradeMetrix **Main Menu**.

Note: To modify some **Job** files, you must be logged in as an **Administrator**.



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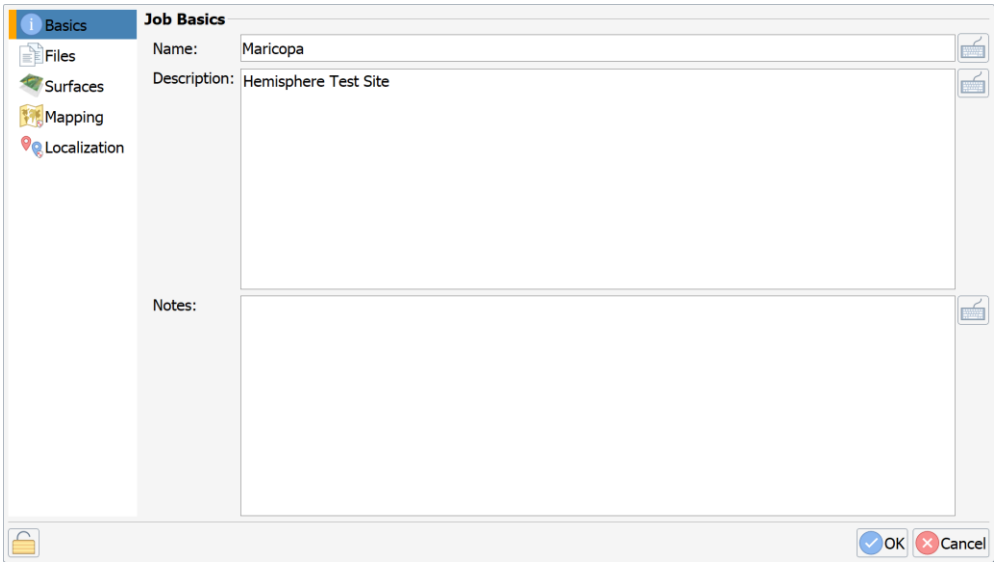
Modify a Job, Continued

Modify Job, continued

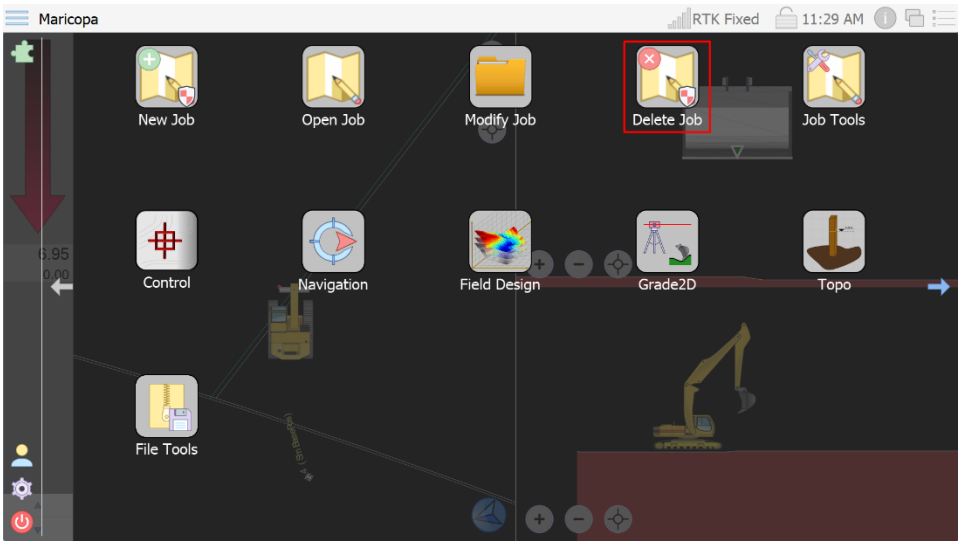
In the **Modify Job** screen you can change your **Mapping** settings, Job **Files**, and **Localization**. See **Create a Job** for a description of each feature.



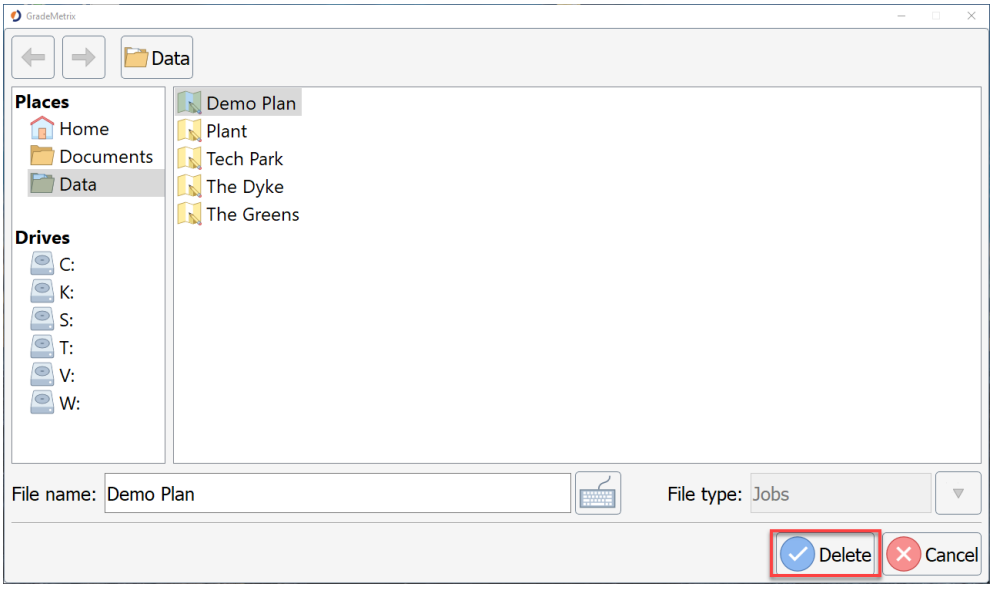
Delete a Job

Delete a job

To delete a job created in GradeMetrix, on the **Main Menu**, click the **Delete Job** icon.



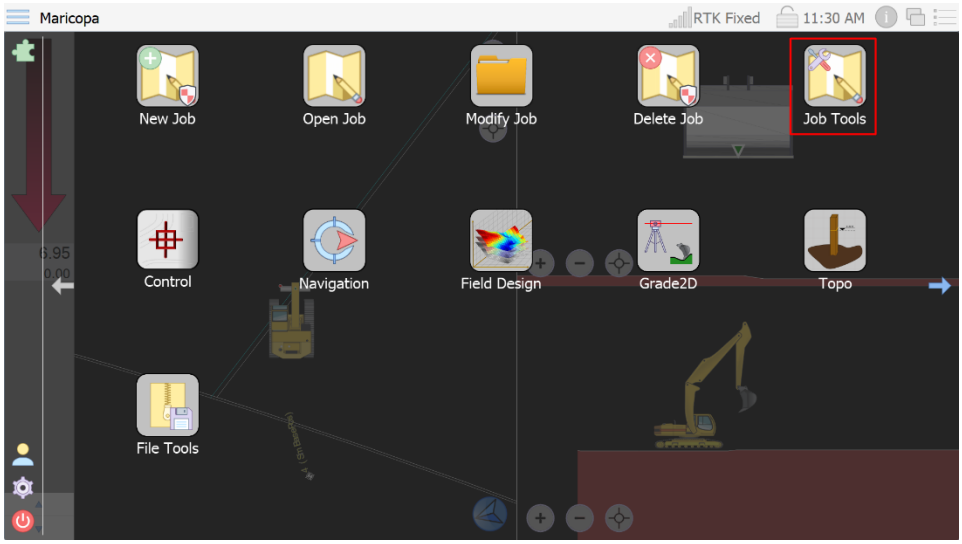
Click to highlight the name of the job you wish to delete and click **Delete**.



Job Tools

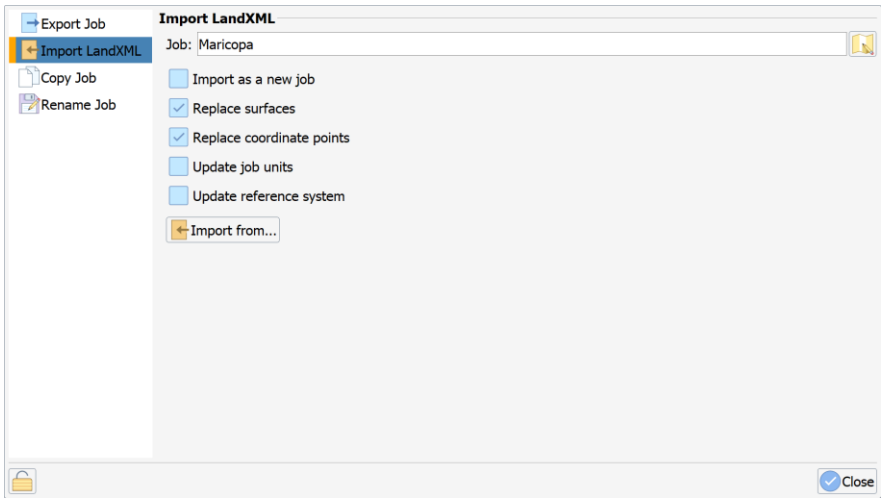
Job Tools

On the GradeMetrix **Main Menu**, click the **Job Tools** icon.



You can select from two options:

1. **Export Job** – Save your job to a thumb drive.
2. **Import LandXML** – This routine allows you to import a LandXML file and convert it to a surface.



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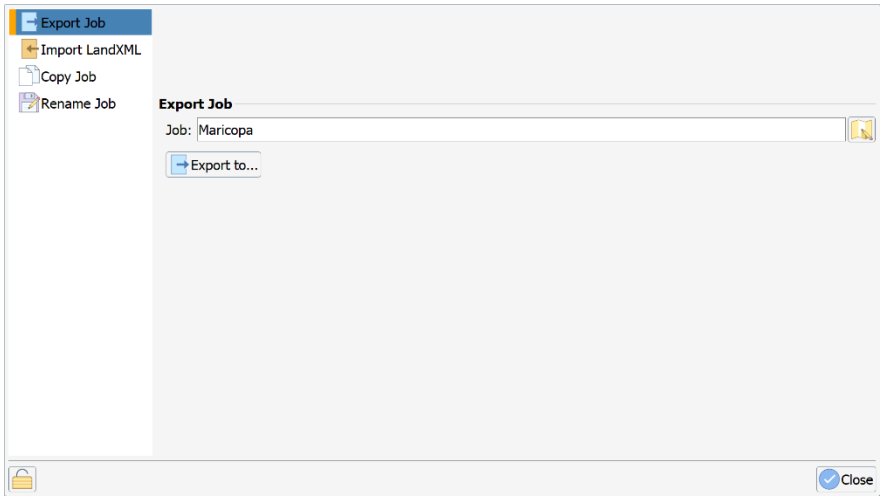
Job Tools, Continued

Job Tools, continued

3. **Copy Job** – Create a clone of your job.
4. **Rename Job** – Change the name under which the job is saved.

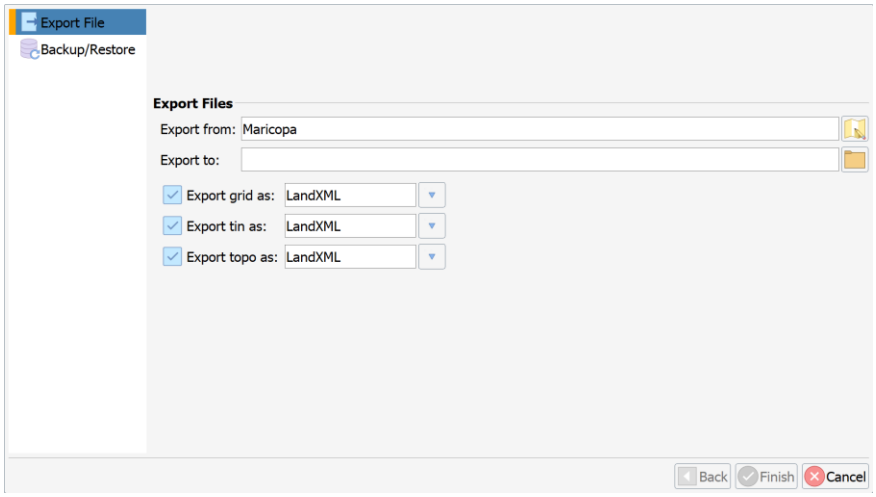


File Tools

File tools

File Tools has several functionalities:

1. Backup job settings
2. Restore job settings (from a backup file)
3. Export Grid
4. Export Tin
5. Export Topo



To export files, click **Export File**. Click to select your job in **Export from:**. Click on the folder next to **Export to** to select a location to save from.

To Export grid, click to check **Export grid as**. Select on the dropdown box to the right to select from **LandXML**, **DXF**, or **CSV**.

To Export tin, click to check **Export tin as**. Click on the dropdown box to the right. Select from **LandXML** or **DXF**.

To Export topo, click to check **Export topo as**. Click on the dropdown box to the right. Select from **LandXML** or **CSV**.

Chapter 4: Machine Configuration

Overview

Introduction

This chapter contains all the information you need to configure your excavator to use GradeMetrix software.

Contents

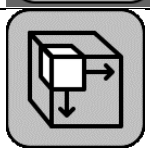
Topic	See Page
Menu Icons	83
Equipment Setup	85
Calibrate Sensors	91
Quick Calibrate	91
3D Calibration	91
Radio Settings	92
NTRIP Configuration	97

Menu Icons

Menu icons

The following icons are used to perform machine configuration functions in GradeMetrix.

Table 4-1: Main Menu Icons-Machine Configuration

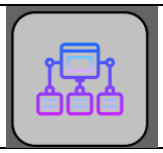
Icon Name	Icon	Description
Equipment Setup		Use in administrator mode. Configure the dimensions of your machine, the GNSS hardware you're using, and save/load these settings.
Calibrate Sensors		Wizard to run you through the process of calibrating the chassis, boom, stick, dogbone, and (possibly) tilt bucket sensors.
Quick Calibrate		Use Quick Calibrate to manually calibrate a single sensor.
3D Calibration		This icon is used to calibrate the primary GNSS antenna offsets as well as the heading offset of the receiver. For complete instructions, please refer to the Hemisphere GNSS GradeMetrix Excavator Installation Guide.
Radio Settings		Configure the internal UHF radio. Authorized personnel can upload channel tables (frequencies and channel spacing) or configure the channel table from within the software. Any user (such as an operator), can select from pre-defined channels and set the protocol/modulation/FEC (for protocols that allow setting FEC).

Continued on next page

Menu Icons, Continued

Menu icons, continued

Table 4-1: Main Menu Icons-Machine Configuration (continued)

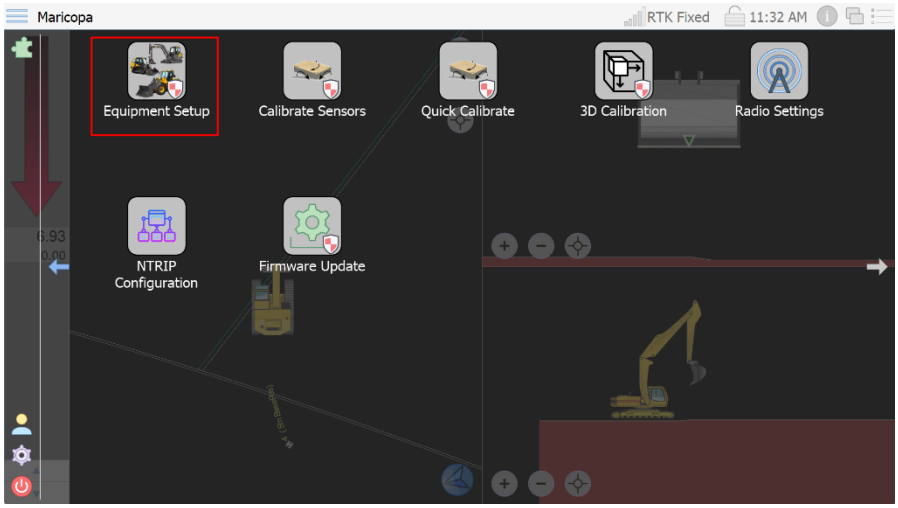
Icon Name	Icon	Description
NTRIP Configuration		This dialogue is an NTRIP client for configuring RTK over network.

Equipment Setup

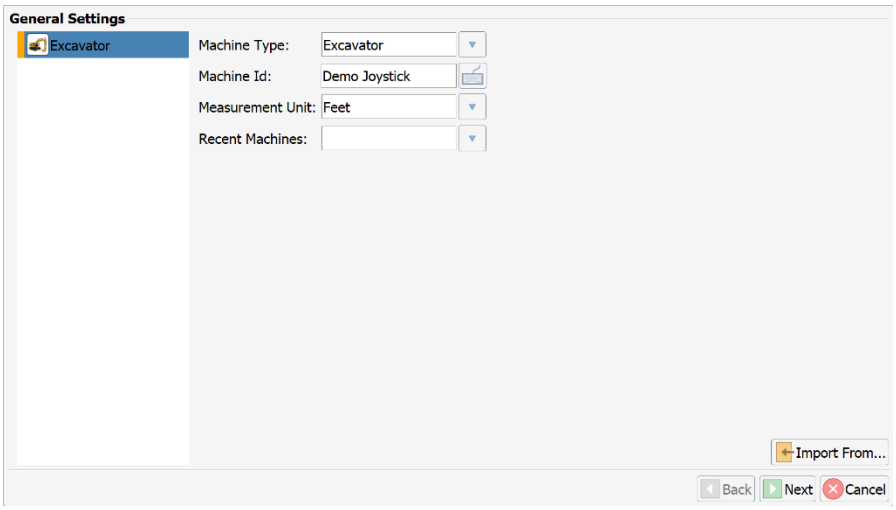
Equipment Setup

On the GradeMetrix **Main Menu** (screen 2), Use **Equipment Setup** to configure and dimensions and sensors for your machine.

This manual contains limited information on how to upload a machine configuration and hang buckets. For full details on Equipment Setup, please see the HGNSS GradeMetrix Excavator Installation Guide.



When you open Equipment Setup, the following screen displays:

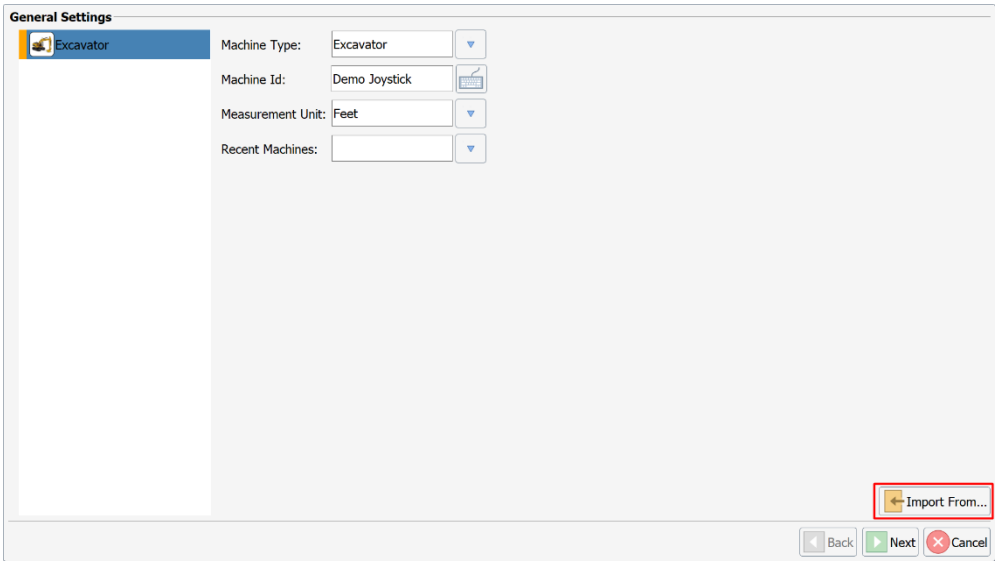


Continued on next page

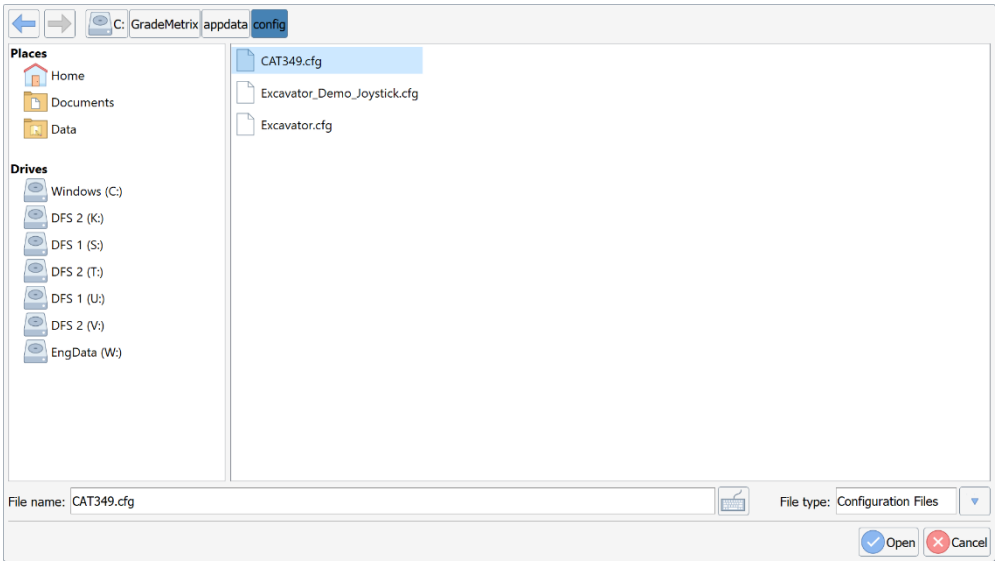
Equipment Setup, Continued

Equipment Setup, continued

Click **Import From…** to upload an existing machine file.



Navigate to the location of the machine file, select the machine file, and click **Open**.



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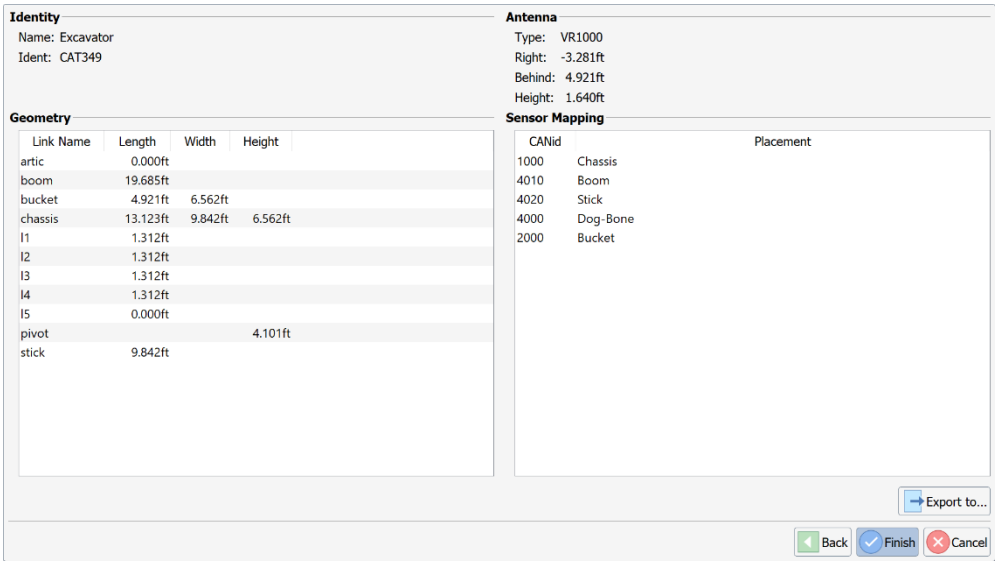
Equipment Setup, Continued

Equipment Setup, continued

The display updates to show the current dimensions and sensors for the machine you are uploading:



Click **Finish**.

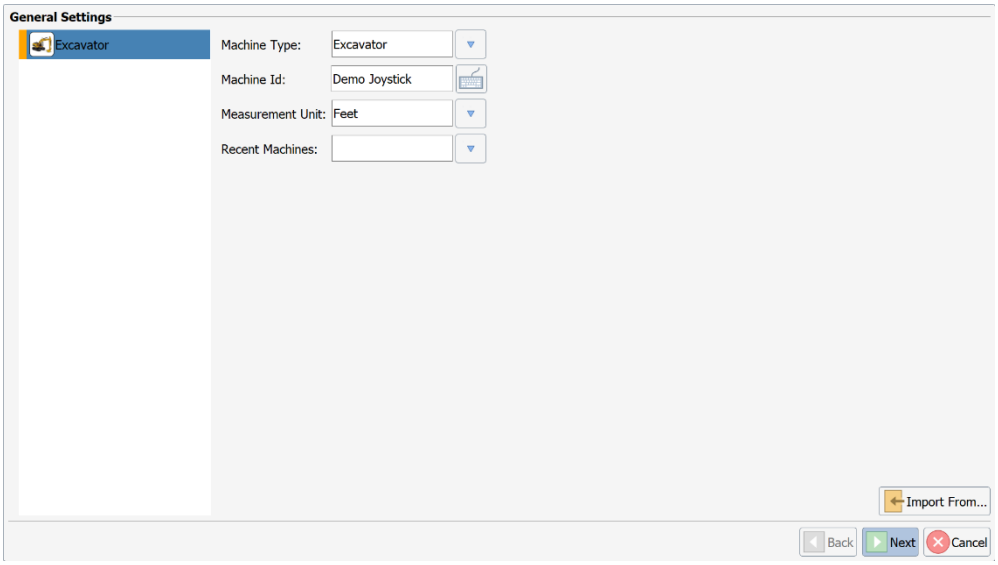
GradeMetrix allows you to move the IronOne hardware between various machines. For example, if you have two excavators, you can purchase one complete GradeMetrix Excavator system and an additional wiring kit. You can then move the VR1000/500 and the IronOne hardware from one machine to another and then load the proper machine dimensions using the **Import from** routine.

Continued on next page

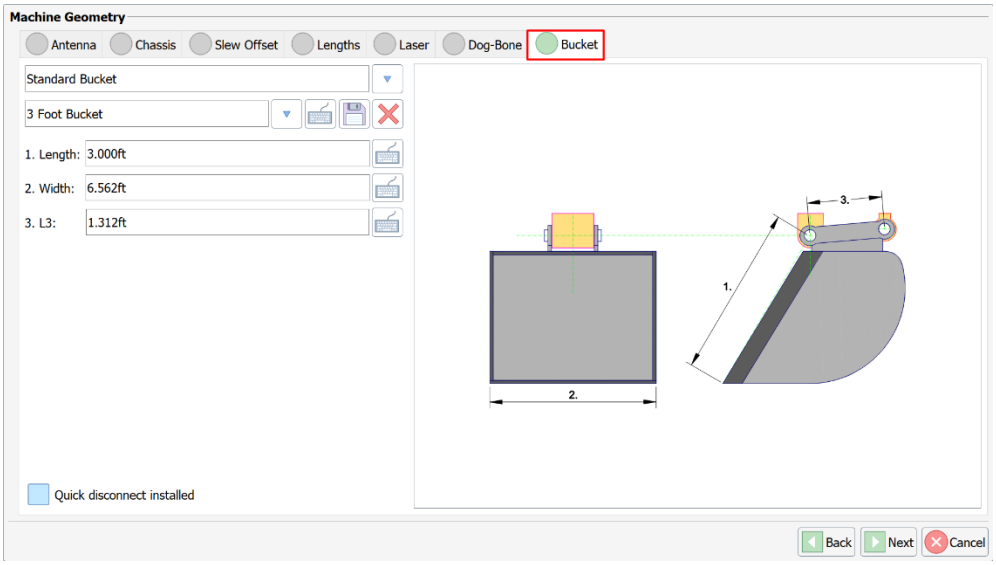
Equipment Setup, Continued

Equipment Setup, continued

After your machine is installed, you can add multiple buckets. To change buckets, go to **Equipment Setup**. Click **Next**.



Click **Bucket**.



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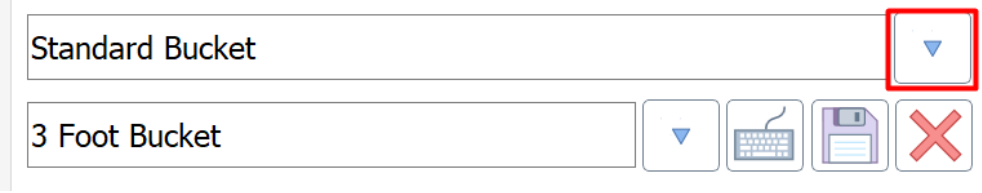
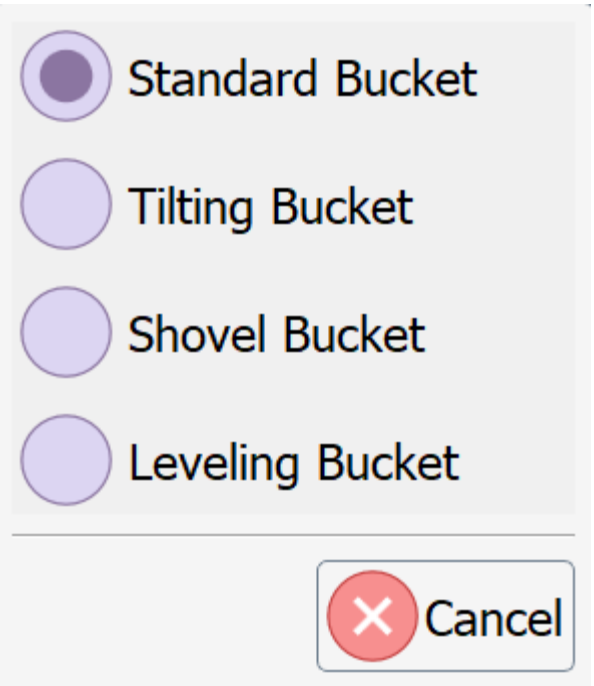
Equipment Setup, Continued

Equipment Setup, continued

The installer may have calibrated several buckets. Click on the down arrow next to the bucket type.



A list of supported bucket types displays:



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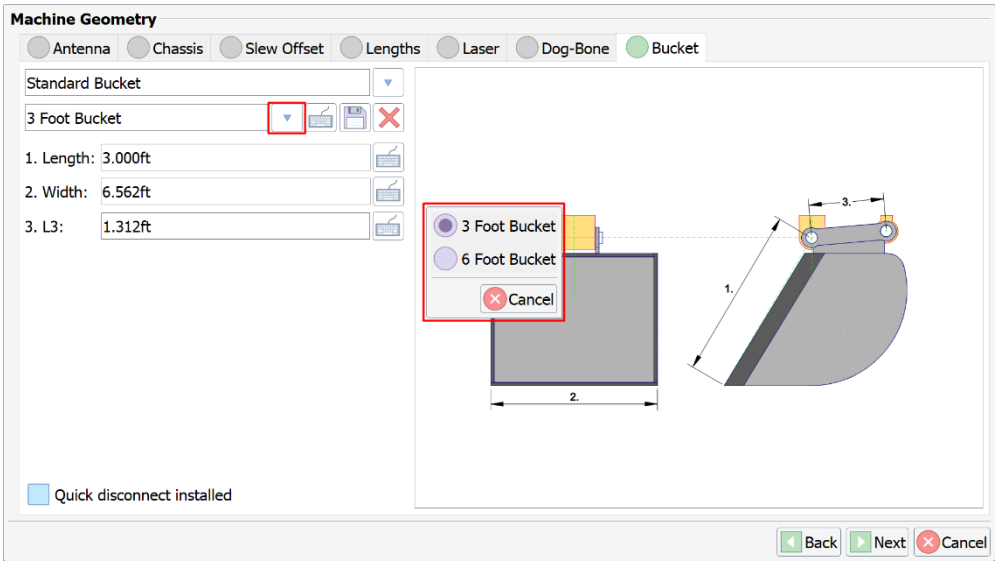
Equipment Setup, Continued

Equipment Setup, continued

Click to select the correct bucket type. Then click on the down arrow next to the bucket name.



After selecting the correct bucket, click **Next**. You will be navigated to the sensor page. Click **Next** again. You will then be navigated to the summary page. Click **Finish**.

Calibrate Sensors

Calibrate sensors	For full details on calibrating sensors, please see the HGNSS GradeMetrix Excavator Installation Guide.

Quick Calibrate

Quick calibrate	For full details to quick calibrate sensors, please see the HGNSS GradeMetrix Excavator Installation Guide.

3D Calibration

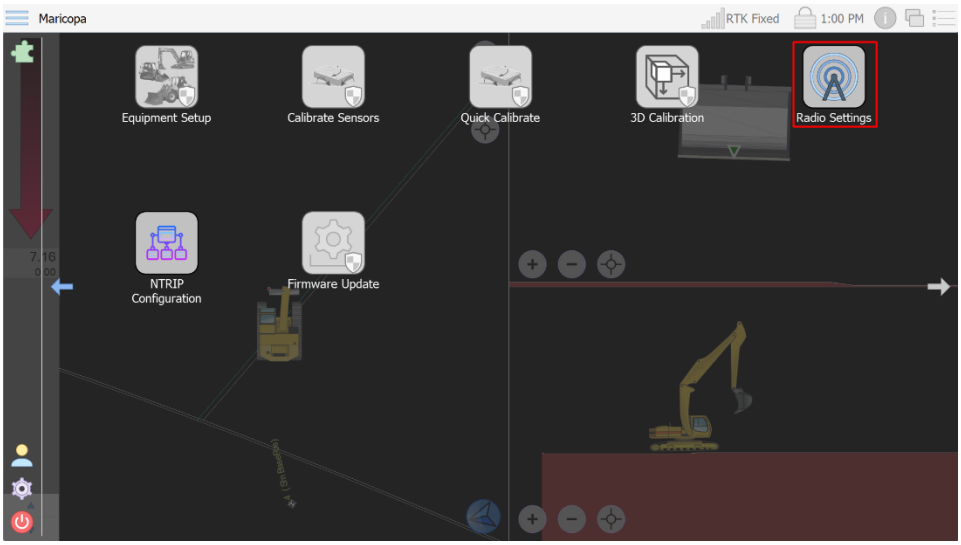
3D Calibrate	For full details on 3D calibration, please see the HGNSS GradeMetrix Excavator Installation Guide.

Radio Settings

Overview

If receiving RTK corrections via the internal UHF radio, you can configure the radio through GradeMetrix.

On the GradeMetrix **Main Menu**, click the **Radio Settings** icon.



Continued on next page

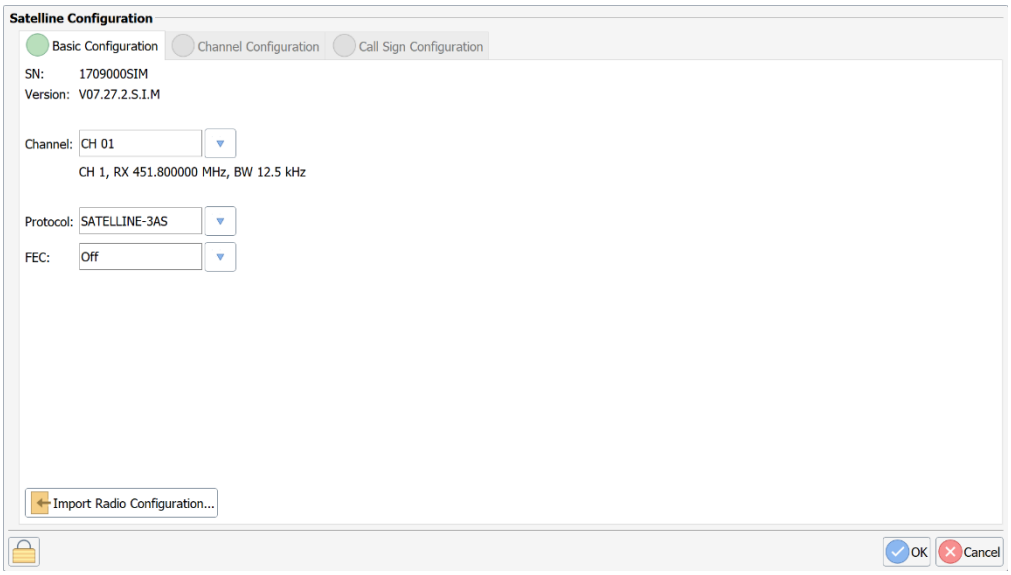
Radio Settings, Continued

Satelline configuration

The **Satelline Configuration** screen displays three tabs:

- Basic Configuration
- Channel Configuration
- Call Sign Configuration

Click the **Import Radio Configuration** button to load a channel file. The explorer window displays. Click to locate and select the configuration file you wish to use.



Continued on next page

Radio Settings, Continued

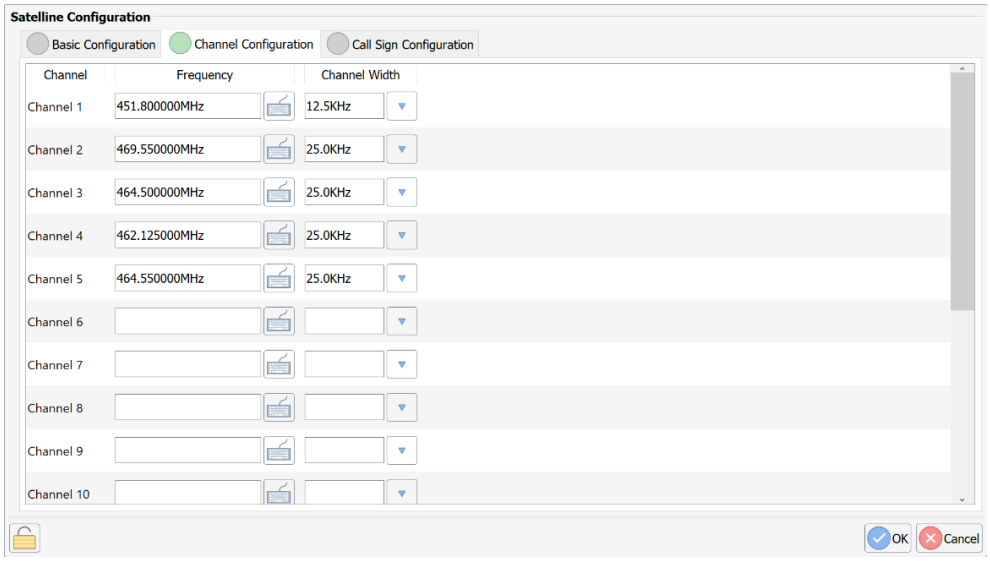
Satelline configuration, continued

On the **Basic Configuration** tab, click the down-arrow to select values for the following fields:

- Channel
- Protocol
- FEC

On the **Channel Configuration** tab, click the down arrows to select values for **Frequency** and **Channel Width**.

Note: You must be logged in as an **Administrator** to set the **Channel Configuration**.



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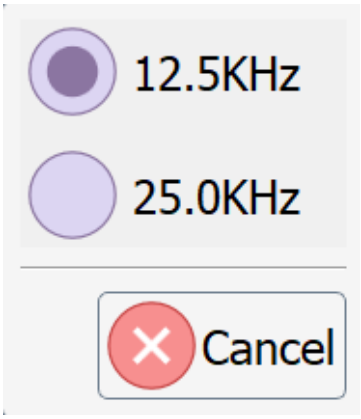
Radio Settings, Continued

Satelline configuration, continued

Channel Width selections



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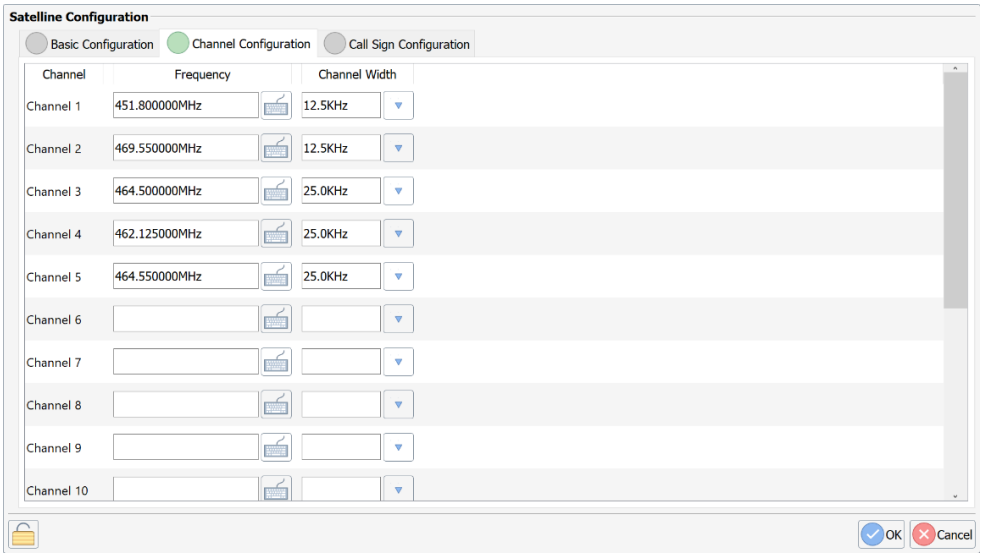
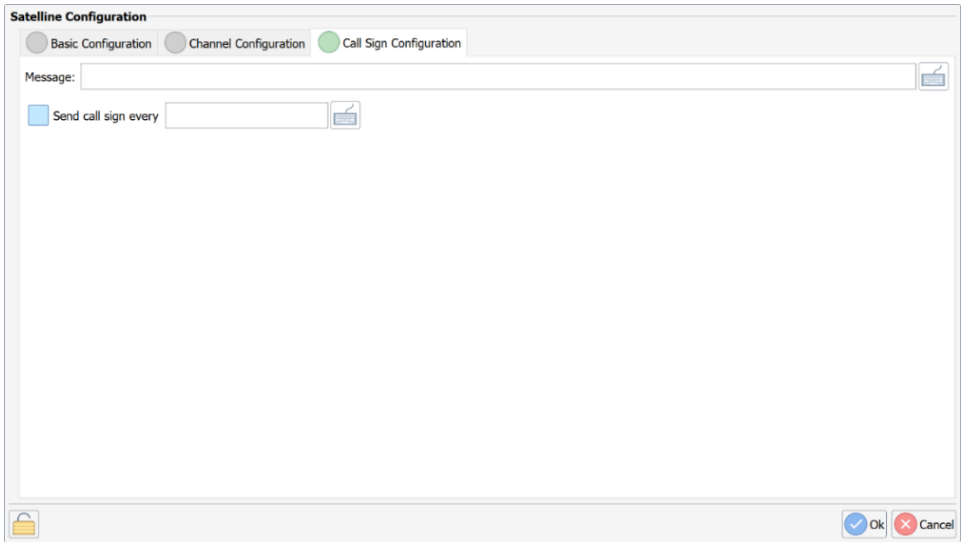
Radio Settings, Continued

Satelline configuration, continued



When finished making your selections, click **Ok**.

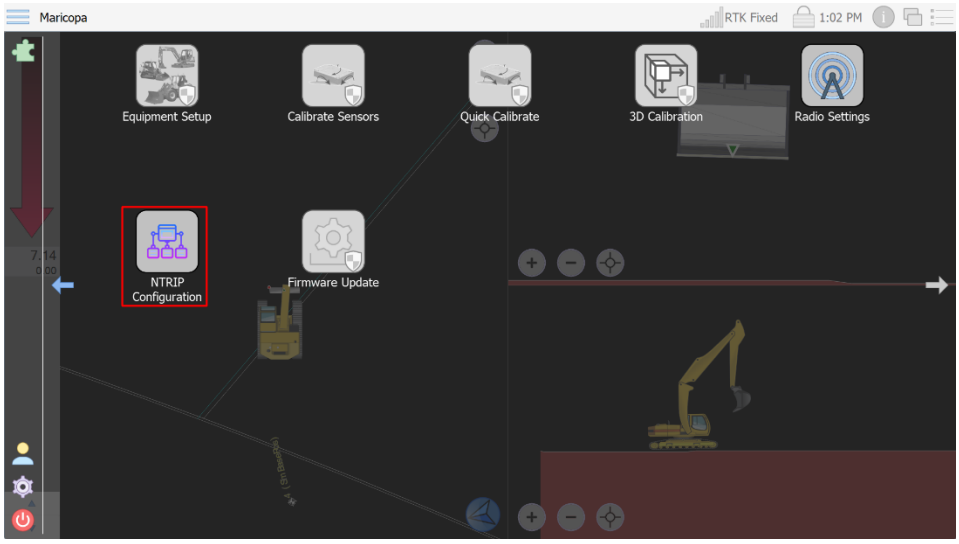
On the **Call Sign Configuration** tab, type a call sign message and select the message rate frequency. Click **Ok**.



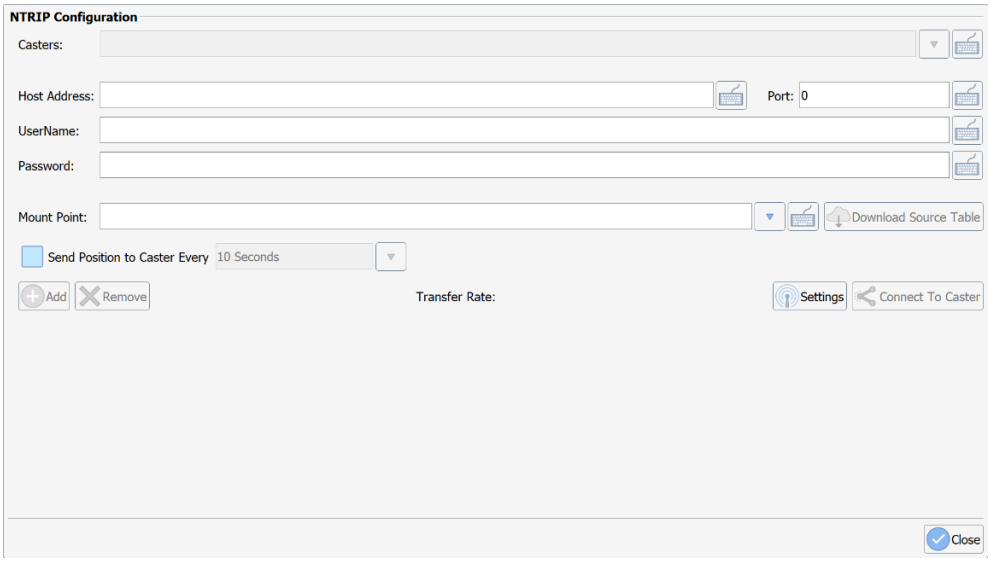
NTRIP Configuration

NTRIP configuration

If receiving RTK over a network, use the embedded NTRIP client to receive RTK corrections from an NTRIP caster. On the GradeMetrix **Home** screen, click the **NTRIP Configuration** icon.



The **NTRIP Configuration** screen displays.



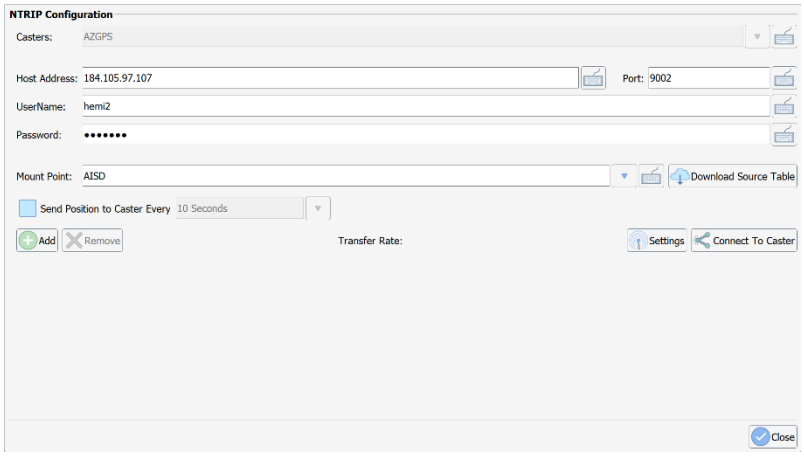
Continued on next page

NTRIP Configuration, Continued

NTRIP configuration, continued

Follow these steps to populate the **NTRIP Configuration** information.

Step	Action
1	Type in a name for the **Caster**. Type the **IP** (or DNS), port, **Username**, and **Password**.
2	Some NTRIP casters will require you send a position to the caster on a set interval (VRS networks and networks with a “nearest” option require this). If your caster requires this, click the checkbox next to **Send Position to Caster Every** and select the interval.
3	Click **Download Source Table**. The source table will download and the list of available mountpoints display. Select the appropriate mountpoint.
4	If you click **Add**, this caster will be saved as a list of available casters to select from (see **Casters** at the top of the screen). If you do not click **Add**, you can still use the NTRIP caster, but the default caster will be used, and you cannot save a list.
5	Click **Setting**. Select the option to auto-connect when the software opens and auto-reconnect to restore a temporarily lost internet connection.
6	Click **Connect To Caster.**



Chapter 5: Navigation and Field Design

Overview

Introduction

Chapter 5 contains all the information you need to set up navigation and field design using GradeMetrix software.

Contents

Topic	See Page
Menu Icons	100
Control	101
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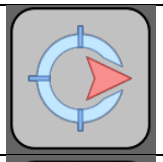
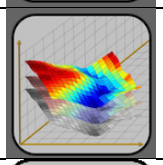
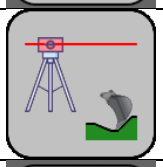
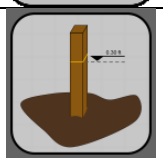
Topo	134

Menu Icons

Menu icons

The following icons are used to perform navigation and field design functions in GradeMetrix.

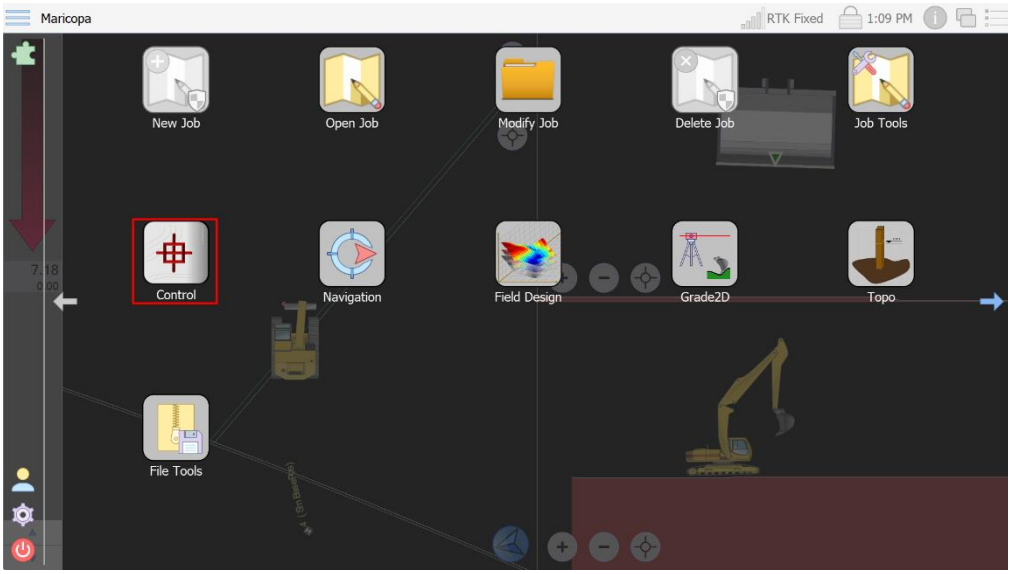
Table 5-1: Main Menu Icons-Navigation and Field Design

Control		Check position and measurements. To check the accuracy of your results, compare the NEZ of the cut/fill location to a known NEZ. If the error displayed is not within specification, refer to Appendix A, Troubleshooting.
Navigation		Enter an NEZ or select from a list of control points. Grade Metrix provides distances/directions to that point.
Field Design		Use Field Design to create a surface when a model is not available.
Grade2D		This is for 2D operation. You can bench and dig and use an optional laser for elevation.
Topo		Use for conducting a topo. Software can be configured to automatically or manually store points in interval (distance or time).

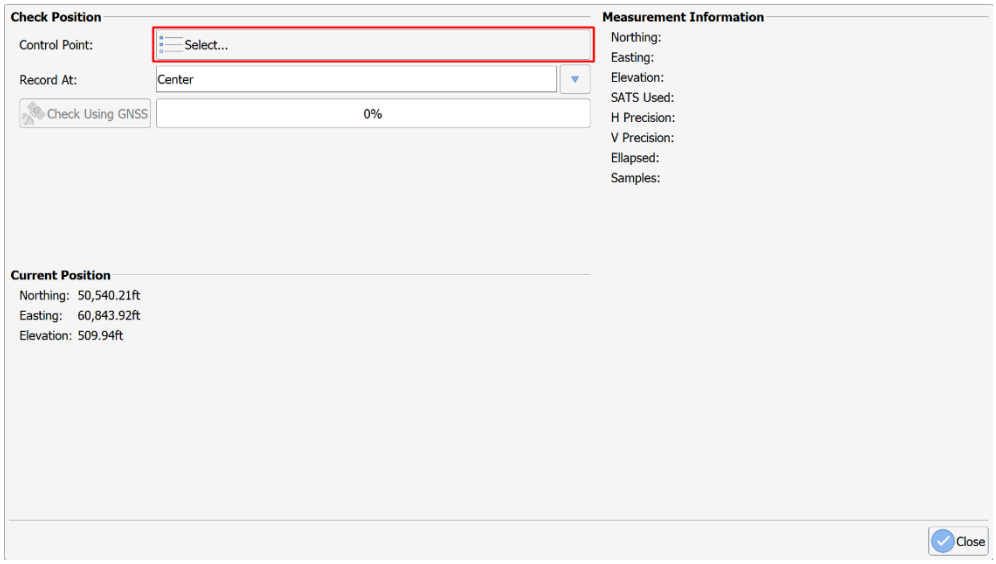
Control

Control

On the GradeMetrix **Main Menu**, click the **Control** icon.



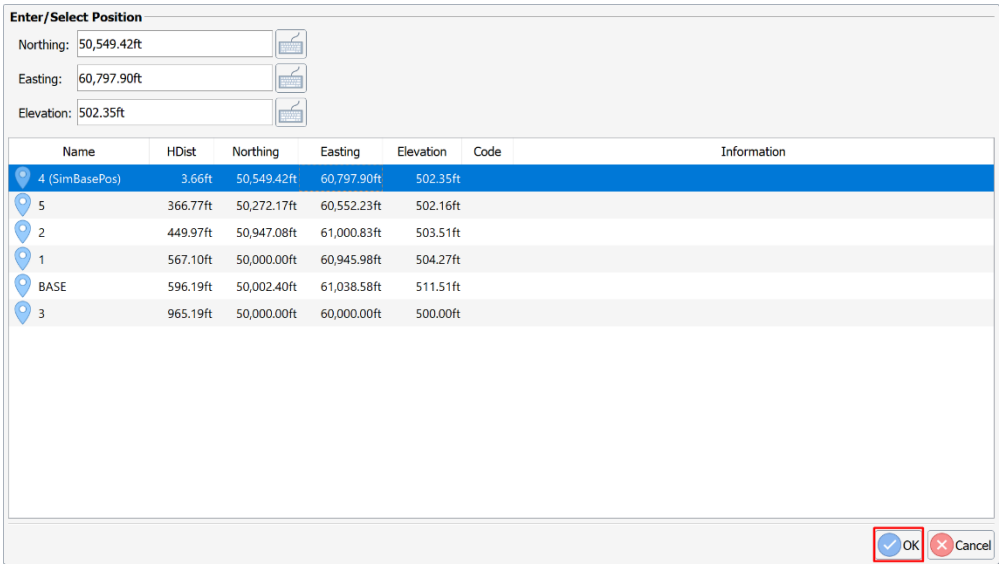
The **Check Position** screen displays. Click **Select …** to set the **Control Point**.



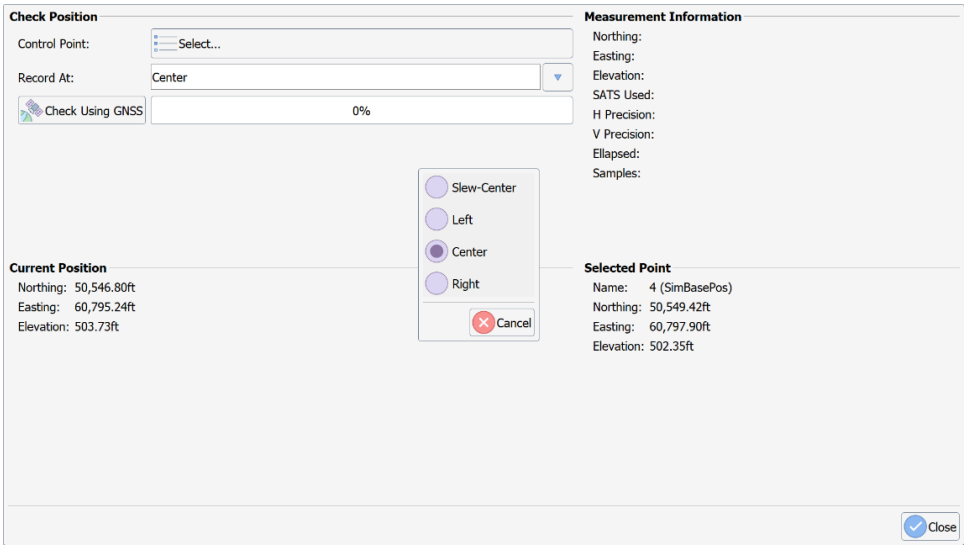
Continued on next page

Control, continued

Click to highlight the point name and click **Ok**.



Click the down arrow to select the **Record At:** reference point, and select from the following options:

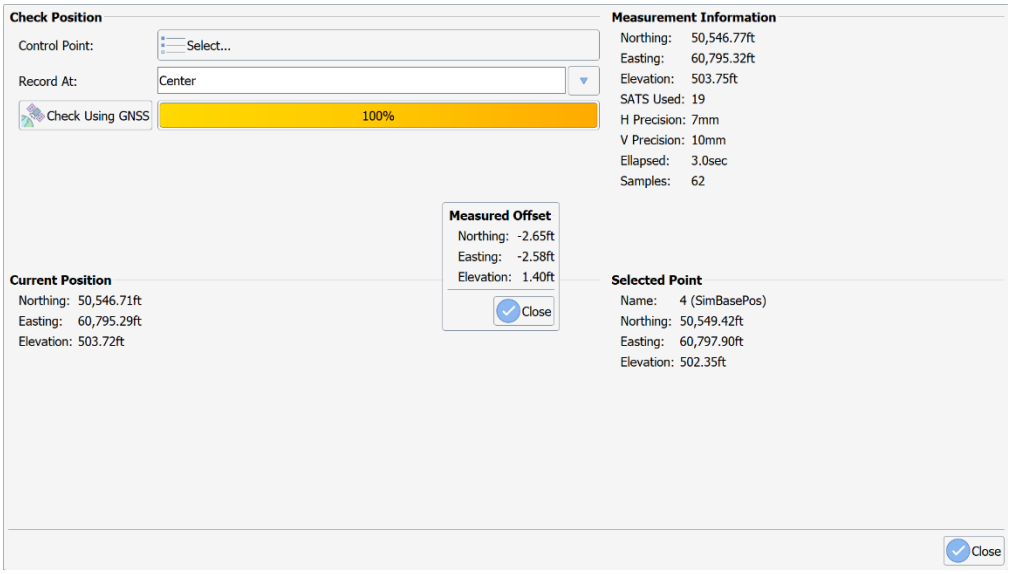


Continued on next page

Control, Continued

Control, continued

Press **Check Using GNSS**.



A pop-up window displays the **Measured Offset** of your reference point.

For **Current Position**, refer to the bottom left of the screen. Note the current position values continuously update due to standard GNSS error (machine vibration, etc.)

Refer to the **Measurement Information** column on the right side for the number of satellites used, the horizontal and vertical position, how many seconds averaged, and how many samples were collected.

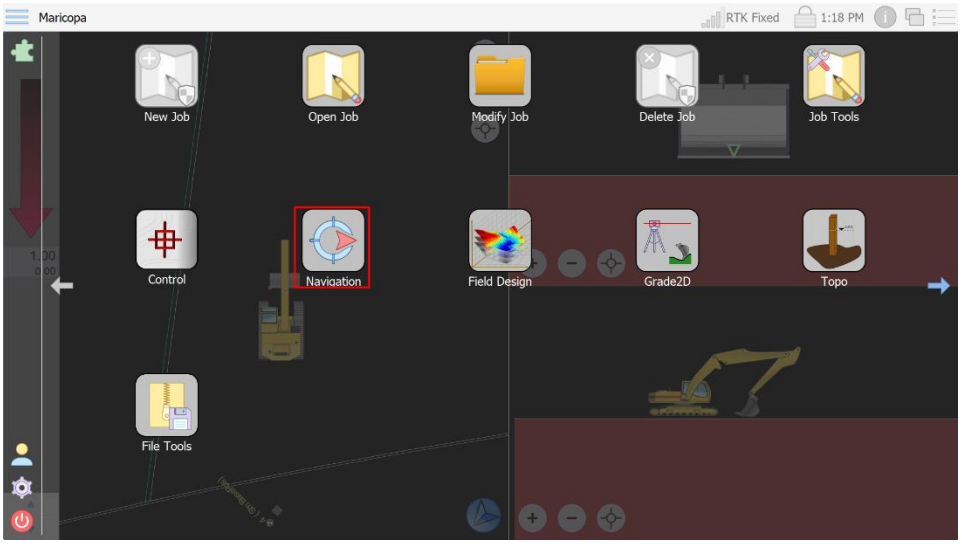
- **Measurement Information-**the position of the point just measured.
- **Selected Point-** the points you selected to check.

Navigation

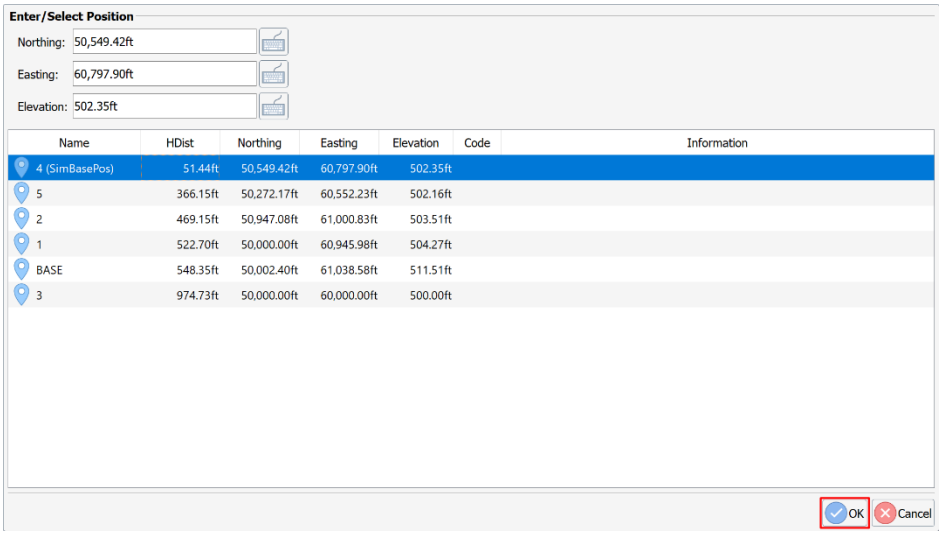
Navigation

The **Navigation** option provides real-time guidance (distance and direction).

On the GradeMetrix **Main Menu**, click the **Navigation** icon.



First, choose a point. Press **OK**.



Continued on next page

Navigation, Continued

Navigation, continued

A navigation screen displays showing the red line indicating direction the machine should travel.

The dotted line shows the direction of the machine. The heading is shown in degrees. The arrows illuminate on the right or on the left side, depending upon which direction the machine needs to move.

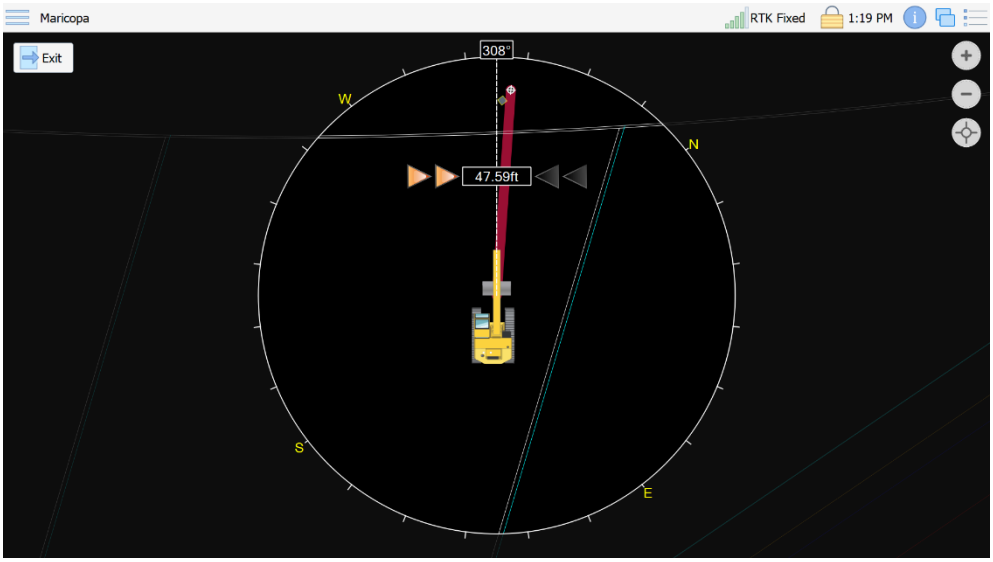
Distance shows how far the machine is from the point.

Continued on next page

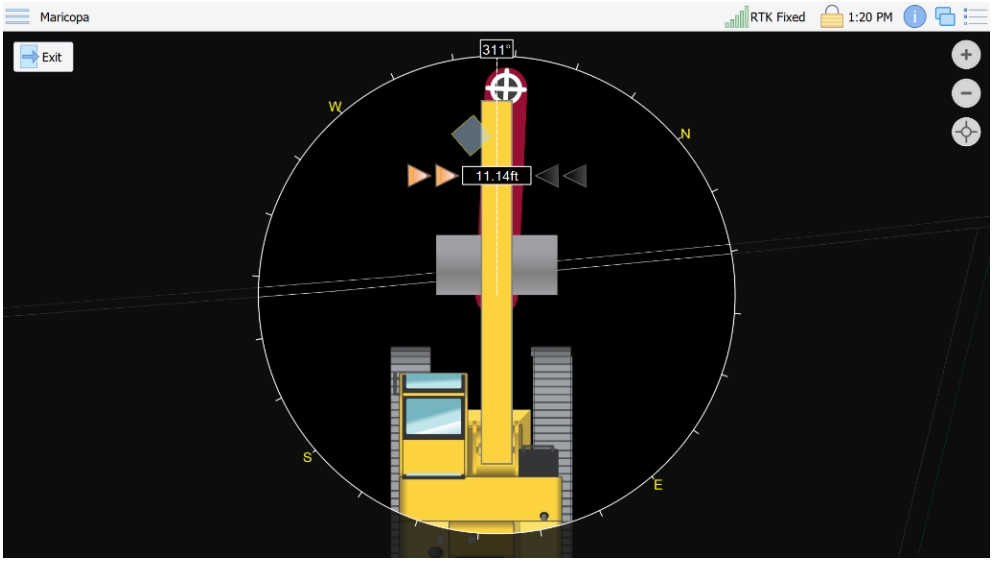
Navigation, Continued

Navigation, continued

Two illuminated arrows indicate how far the machine is off the line. As the position is corrected, the arrows indicate you are getting closer to the red line (correct position).



As the machine is driven closer, the screen begins to zoom in automatically.

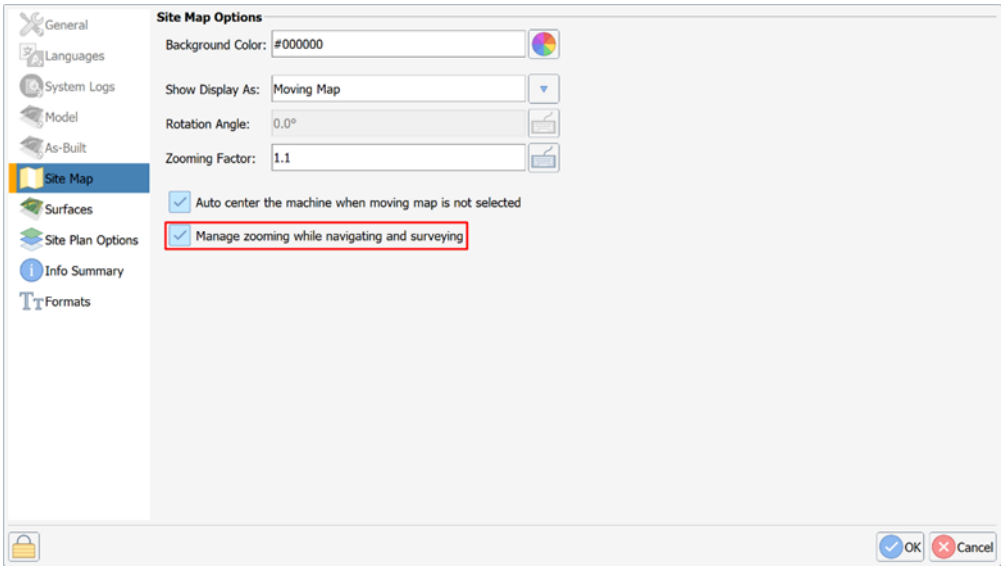


Continued on next page

Navigation, Continued

Navigation, continued

Note: To disable auto-zoom, go to **Settings -> Site Map -> Manage zooming while navigating and surveying**.

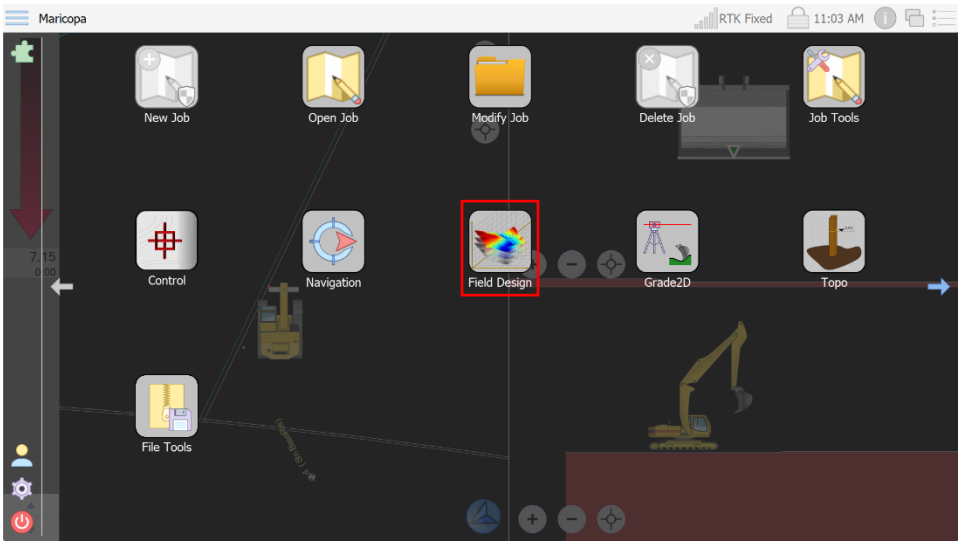


To exit **Navigation**, click the **Exit** button.

Field Design

Field design

To set job design settings. Click the **Field Design** icon in the GradeMetrix **Main Menu**.



Flat pad

Use **Flat Pad** to enter a set elevation to grade to (regardless of design file).

To set your flat pad elevation:

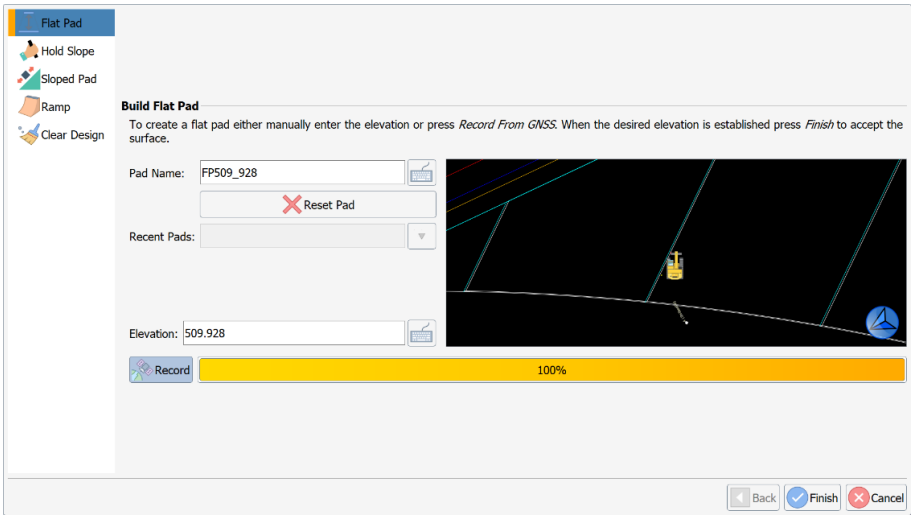
1. Type a name for the 'pad.'
2. Type "Measure From GNSS"
3. Edit the elevation if desired.

Note: Naming the pad allows you to the ability to save and edit the elevation at any time.

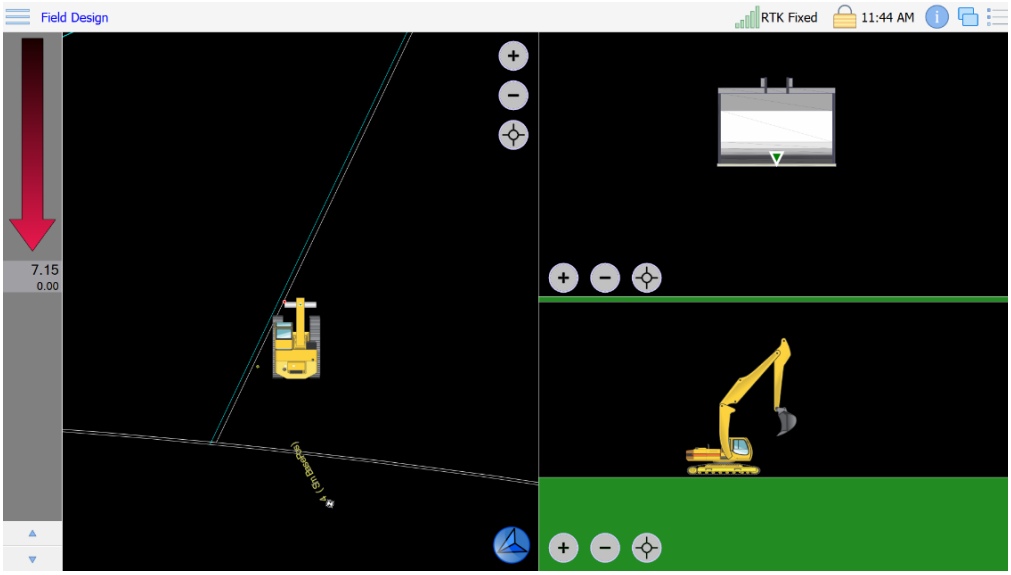
Continued on next page

Flat pad, continued

Click **Finish**. Design elevation is set to 509.928' in the following example.



Notice the surface is now green (indicating field design is used instead of DTM) and the **Job Name** at the top-left of the screen is now **Field Design**.

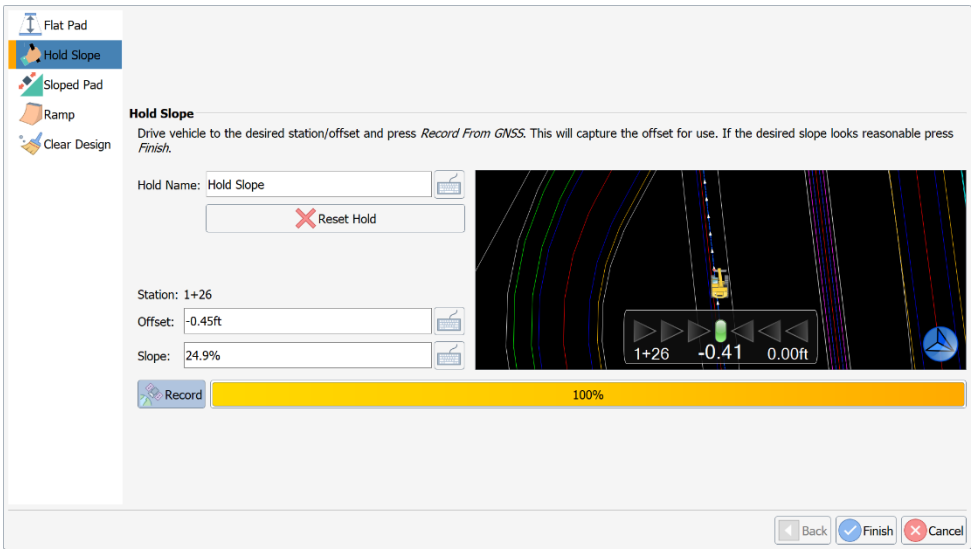


Continued on next page

Field Design, Continued

Hold slope

Select **Hold Slope** to extend the surface at the current slope angle.



Continued on next page

Field Design, Continued

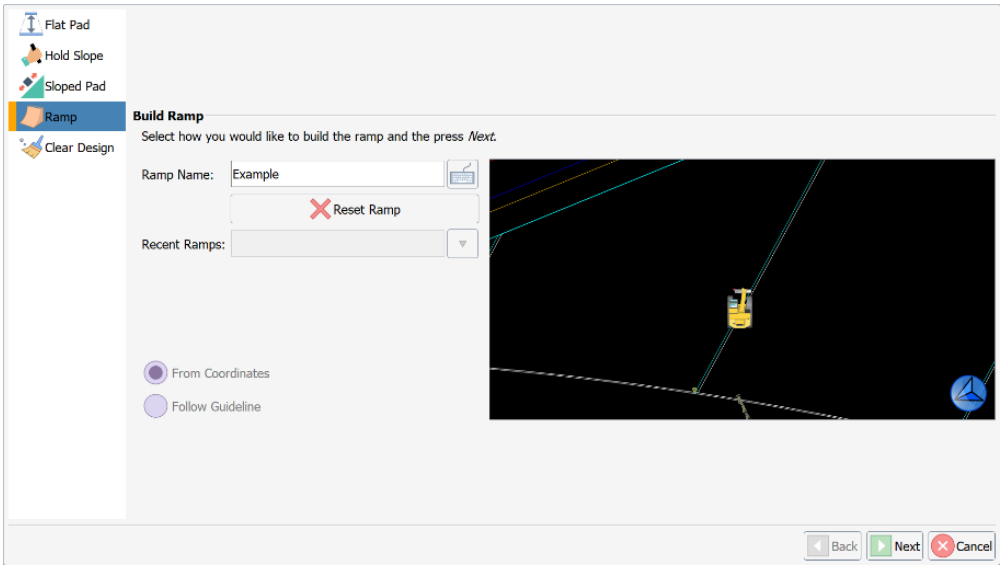
Ramp

Choose **Ramp** to build the ramp by using coordinates or following a set guideline.

Note: If you do not have a guideline selected, you must create this ramp based on coordinates.

To set your ramp type a **Ramp Name** using the keyboard icon.

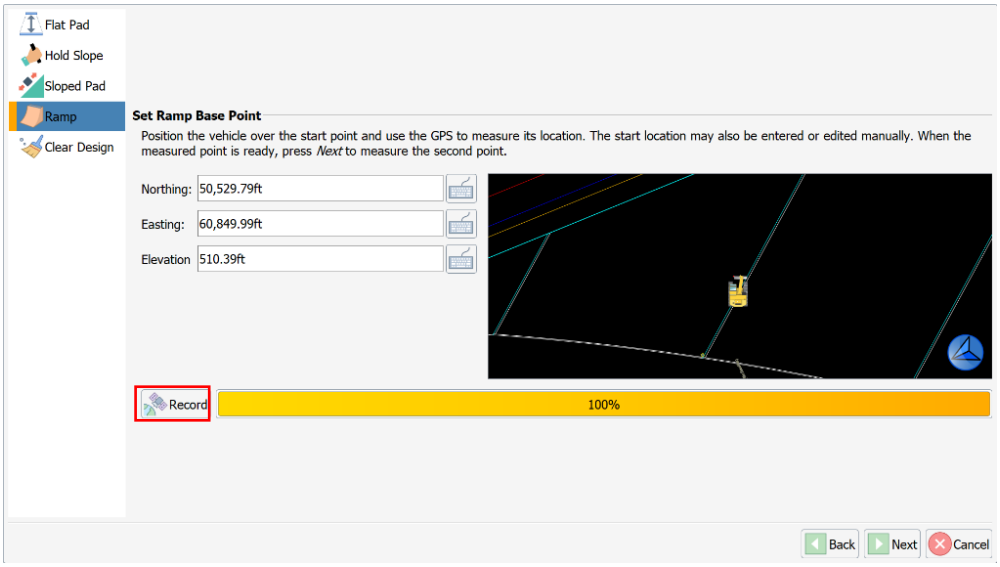
Press **Next**.



Continued on next page

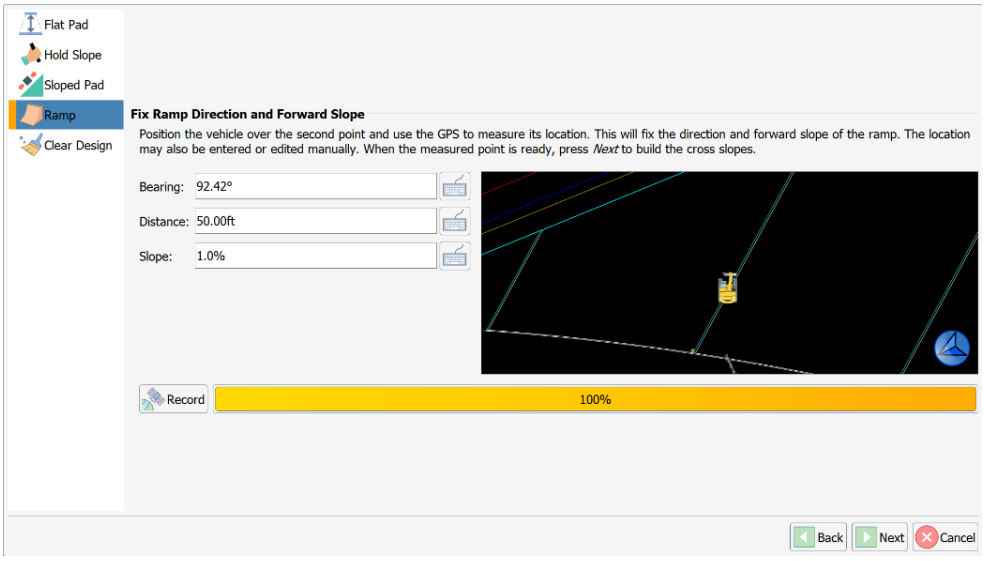
Ramp, continued

Drive to the starting point and click **Record**.



Drive to the second point (calculates heading). Click **Record**.

Note: If you wish this ramp to exceed the length the vehicle has driven, edit the distance. You can also edit the calculated heading (bearing) and slope.

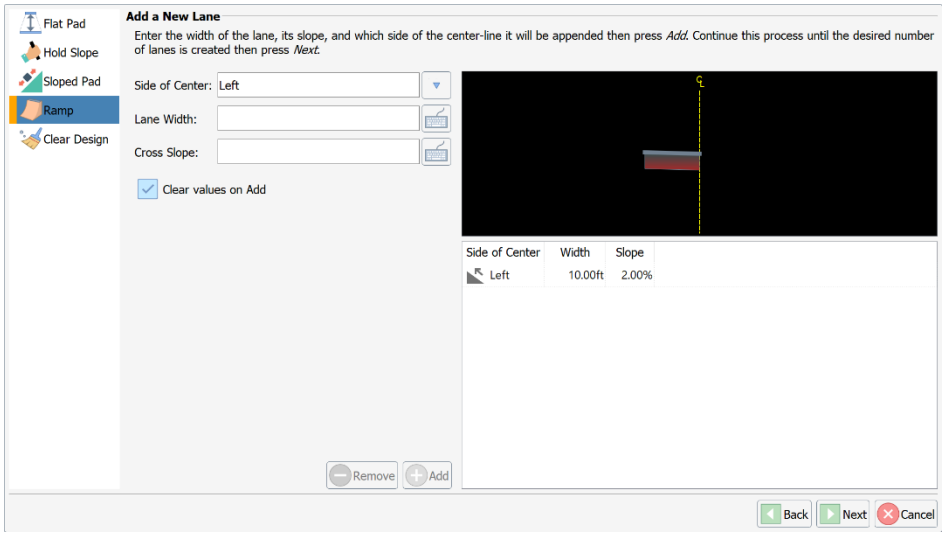


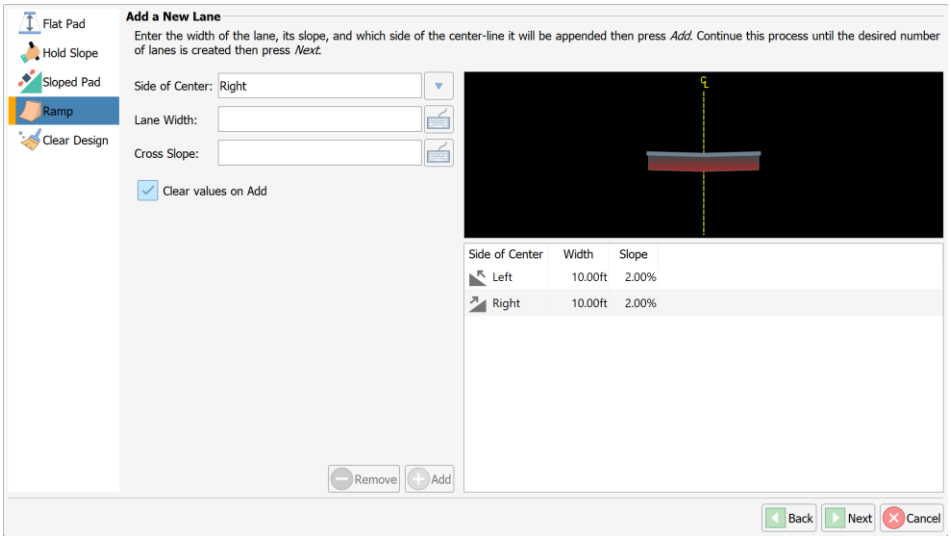
Continued on next page

Field Design, Continued

Ramp, continued

To remove cross slope fields, click **Clear values on Add**. This will clear the field a new value can be added each time the **Add** button is pressed. Click on a lane and press **Remove**.



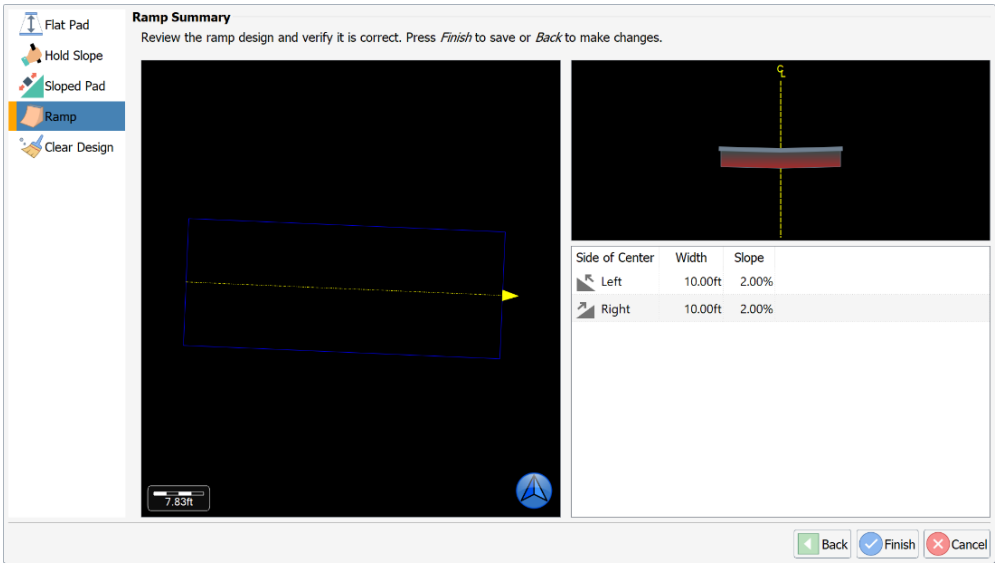


Continued on next page

Field Design, Continued

Ramp, continued

Review the ramp and press **Finish**.



Continued on next page

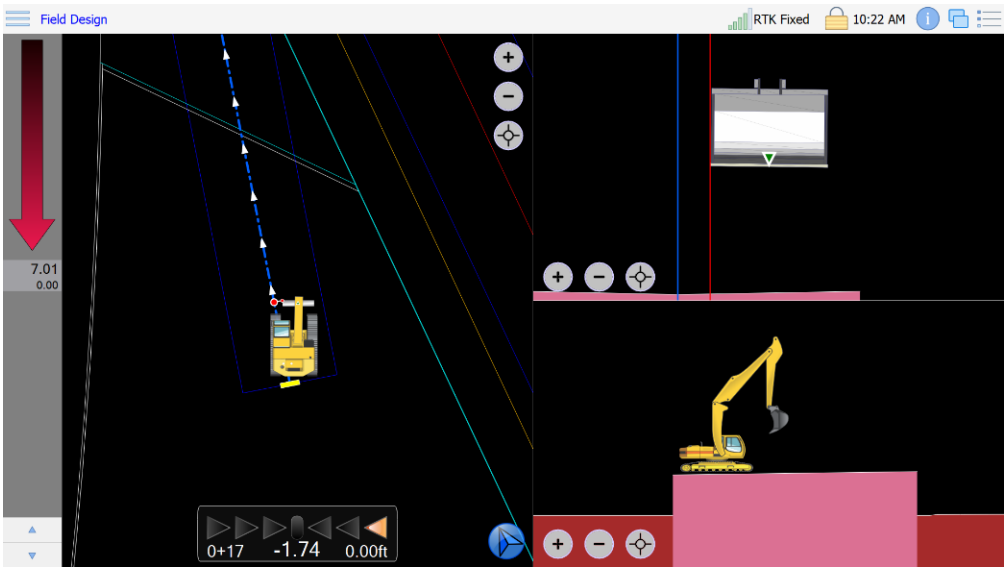
Field Design, Continued

Ramp, continued

The example below shows the newly created ramp (in blue). To make the ramp longer, edit the distance towards the beginning.

Important: This ramp becomes the job design. If the machine is not on the ramp, the machine is off the job design.

The job on the top-left is shown as **Field Design** – indicating that you are not grading to your DTM but instead grading to the **Field Design**.



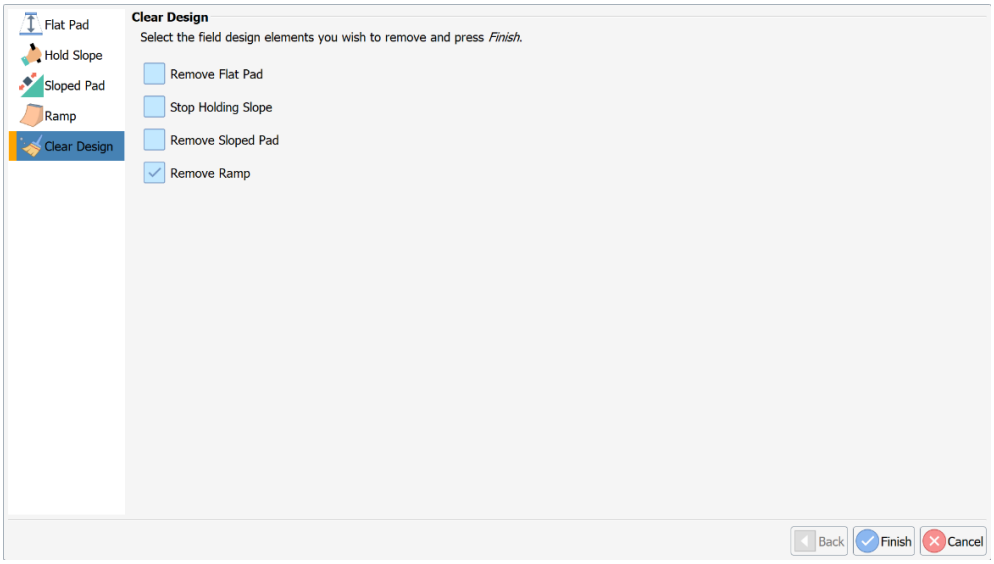
Continued on next page

Field Design, Continued

Clear design

If you wish to remove a field design element, click to select one of the options in the **Clear Design** list.

For example, to remove the flat pad option, click to select **Remove Flat Pad**, and click **Finish**.

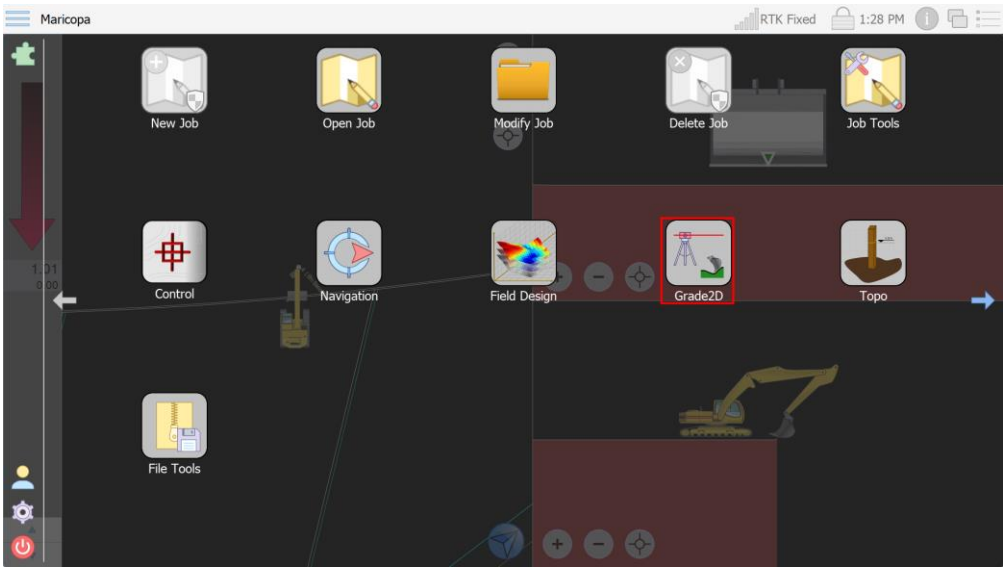


Your design elevation returns to the previously loaded Digital Terrain Model (DTM) file.

Grade 2D

Grade2D

GradeMetrix Excavator has a **2D** option. You can use an optional laser receiver on the excavator or bench each time you move the machine.

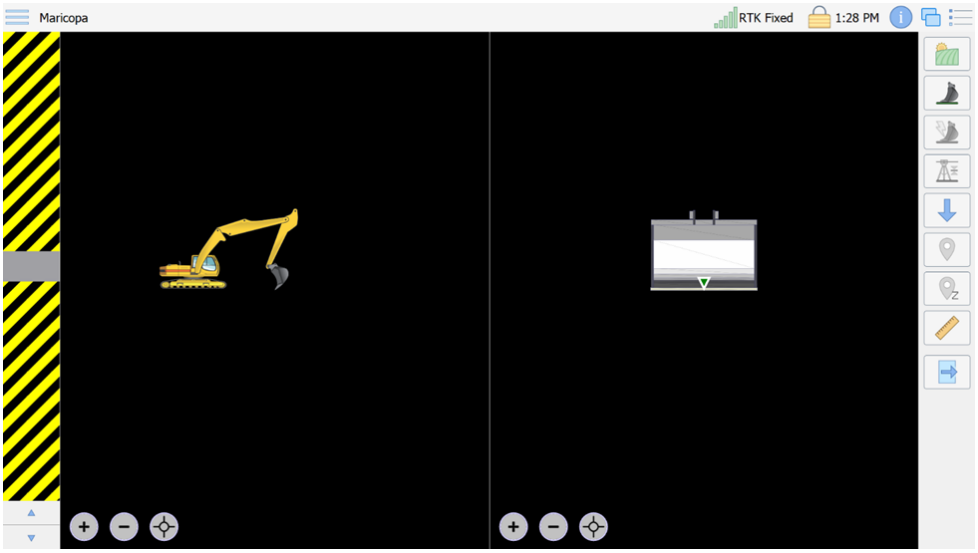


Once you are in **Grade2D,** your DTM/linework will disappear.

Continued on next page

Grade 2D, Continued

Grade2D, continued



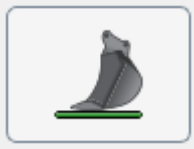
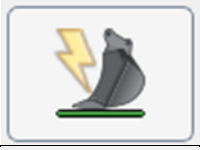
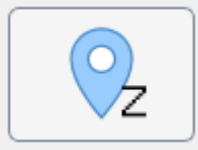
Continued on next page

Grade 2D, Continued

Grade2D, continued

There are several icons on the left of the screen. The following table lists the icons and definitions used in **Grade2D**.

Table 5-2: Grade2D Icons and Definitions

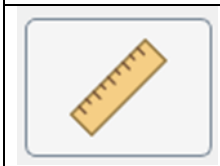
Icon	Definition
	Create the main design work (flat pad, trench, profile, single slope pad, dual slope pad)
	Set reference elevation
	Set reference elevation with last bench elevation
	Reference to laser level
	Cache current elevation for when traversing
	Reference next node. When digging to a Profile or Trench, the field design will be built with nodes. Click this button to bench to the next node.
	Memorize node

Continued on next page

Grade 2D, Continued

Grade2D, continued

Table 5-2: Grade2D Icons and Definitions (continued)

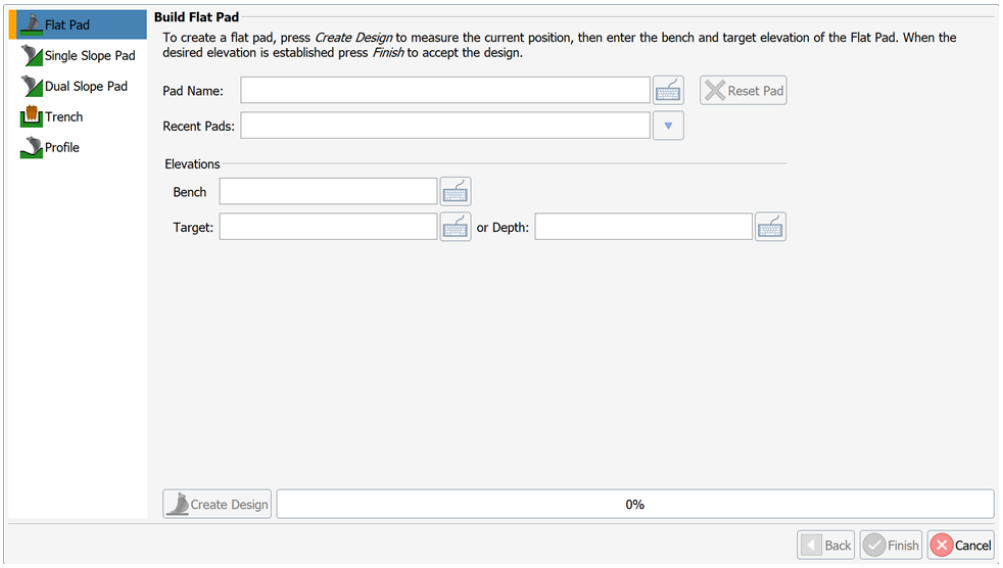
Icon	Definition
	Measure a slope with the bucket
	Exit Grade2D

When you enter **Grade2D**, the first step is to create a surface ( ).

Continued on next page

Grade 2D, Continued

Grade2D, continued



Use **Flat Pad** to create a surface at a set elevation:

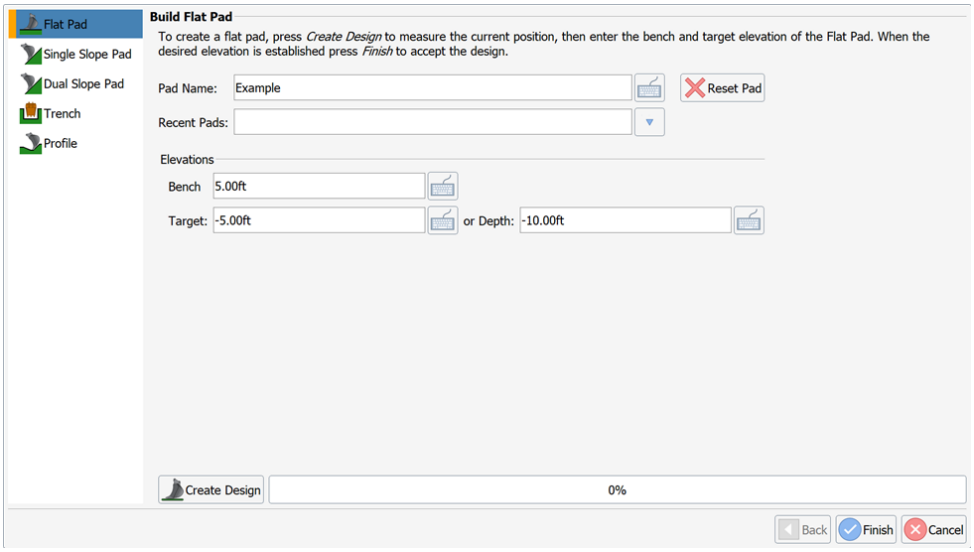
1. Type a **Pad Name** (or select a **Recent Pad**).
2. Set the **cutting edge** on a benchmark.
3. Type in the **elevation** of that benchmark (in the example below, the **benchmark elevation** is 5.00 ft.).
4. Type **either** a **Target** or a **Depth**. The **Target** is the target elevation that you want to reach.

Example: If you benchmark is 5.00ft and set Target of 12.00ft, you would have a fill of 7.00 ft. (or a Depth of 7.00 ft.). If you set a Target of -5.00 ft., you would have a cut of 10.00 f.t (or a Depth of -10.00 ft.).

Continued on next page

Grade 2D, Continued

Grade2D, continued

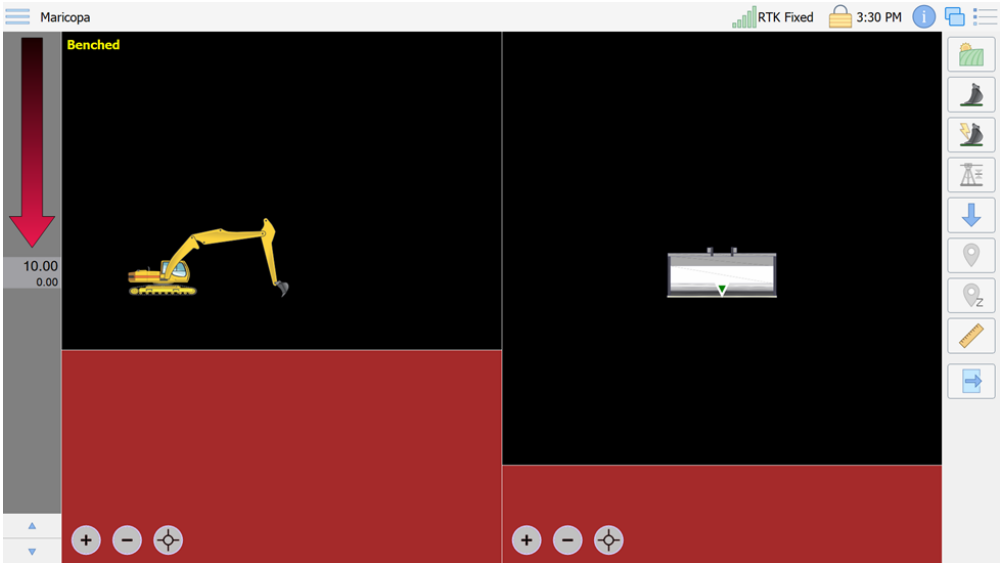


Click **Create Design** and click **Finish**.

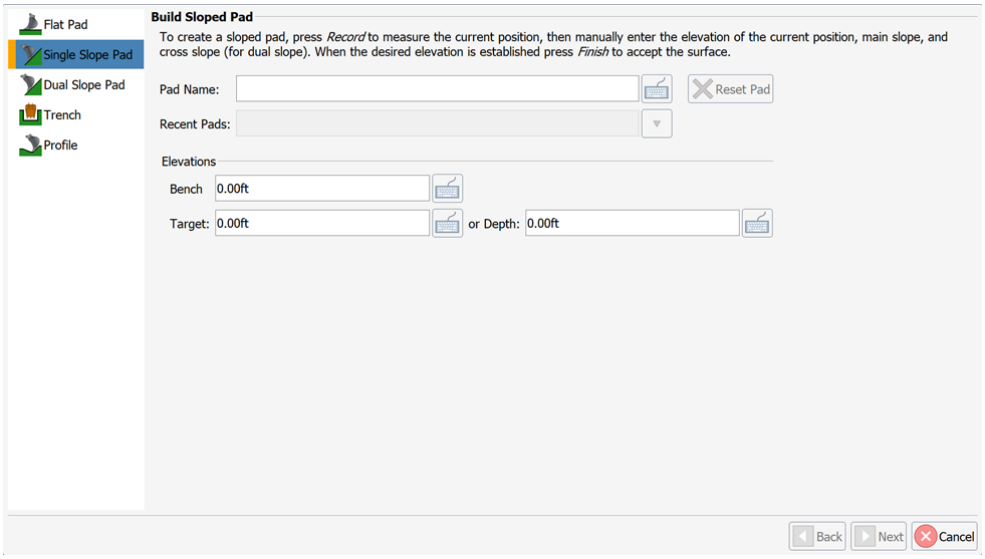
Continued on next page

Grade 2D, Continued

Grade2D, continued



You can create a **Single Slope Pad**.



Continued on next page

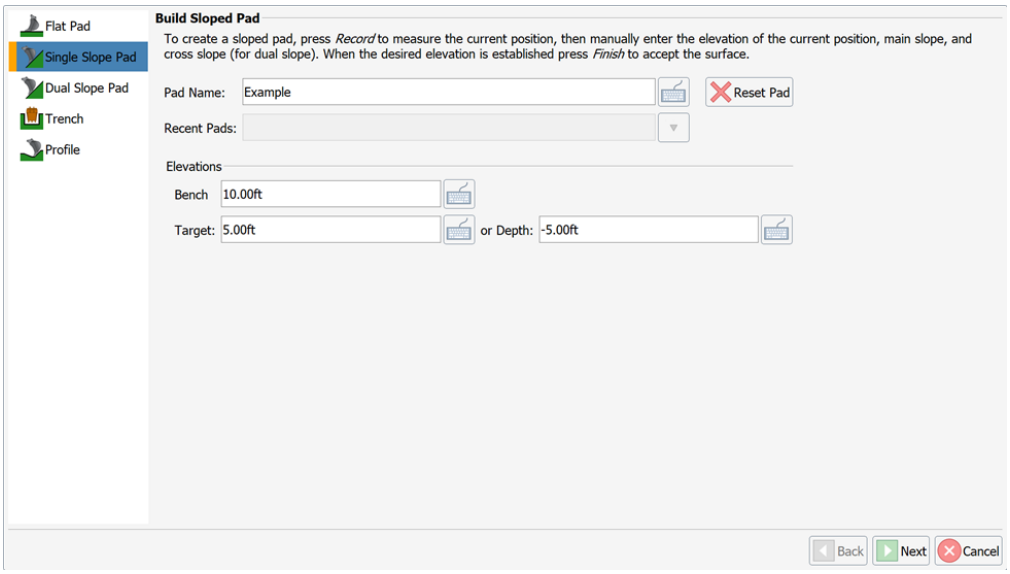
Grade 2D, Continued

Grade2D, continued

To set a **Single Slope Pad**:

5. Choose a **Pad Name** (or select from a **Recent Pad**).
6. Set the **cutting edge** on a benchmark and type a **bench elevation**.
7. Set **either** a **Target** or a **Depth**. The **Target** is the target elevation that you want to reach.

Example: If you benchmark is 5.00 ft. and set a Target of 12.00 ft., you would have a fill of 7.00 ft. (or a Depth of 7.00 ft.). If you put a Target of -5.00 ft., you would have a cut of 10.00 ft. (or a Depth of -10.00 ft.).



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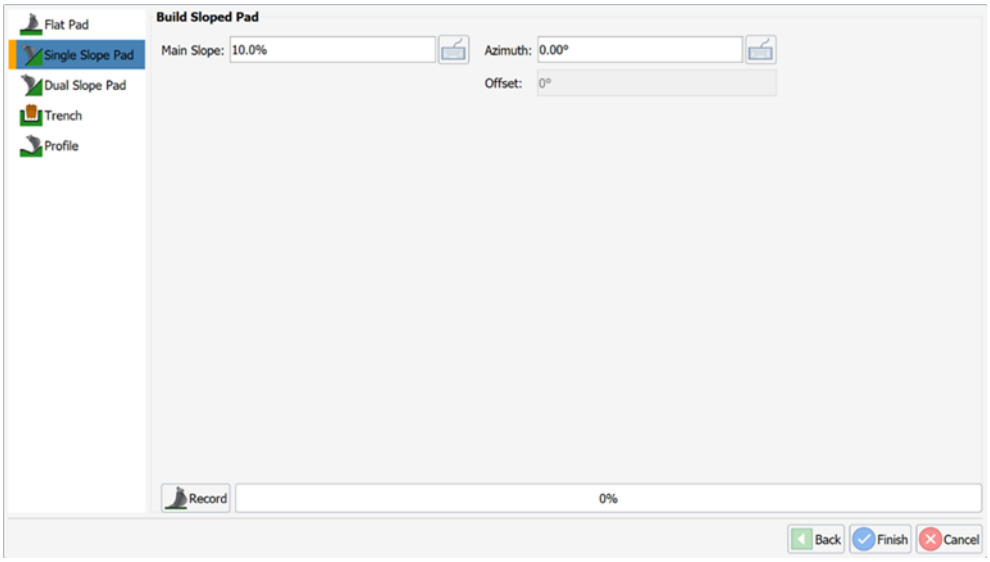
Grade 2D, Continued

Grade2D, continued

Click **Next**. Enter the long slope of the pad and the azimuth for this slope.



Click **Record**. The **Offset** is the difference between the current machine azimuth (coming from the GNSS receiver) and the azimuth you type in. If you do not have a dual antenna GNSS receiver connected, azimuth will be 0.

Click **Finish**.

Continued on next page

Grade 2D, Continued

Grade2D, continued

You can create a **Dual Slope Pad**.

To set a **Dual Slope Pad**:

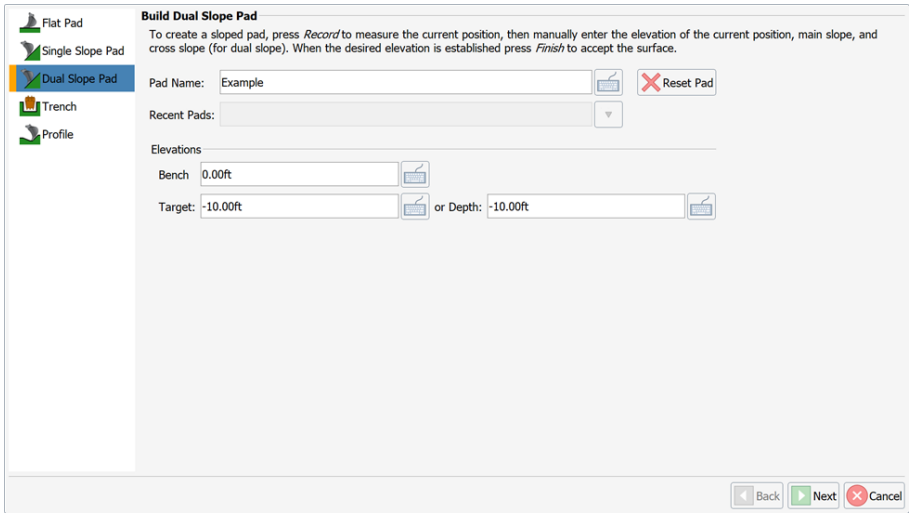
1) Choose a **Pad Name** (or select from a **Recent Pad**).
2) Set the **cutting edge** on a benchmark and enter a **bench elevation**.
3) Set **either** a **Target** or a **Depth**. The **Target** is the desired target elevation.

Example: If you benchmark is 5.00 ft. and put a Target of 12.00 ft., you would have a fill of 7.00 ft. (or a Depth of 7.00 ft.). If you put a Target of -5.00 ft., you would have a cut of 10.00 ft. (or a Depth of -10.00 ft.).

Continued on next page

Grade 2D, Continued

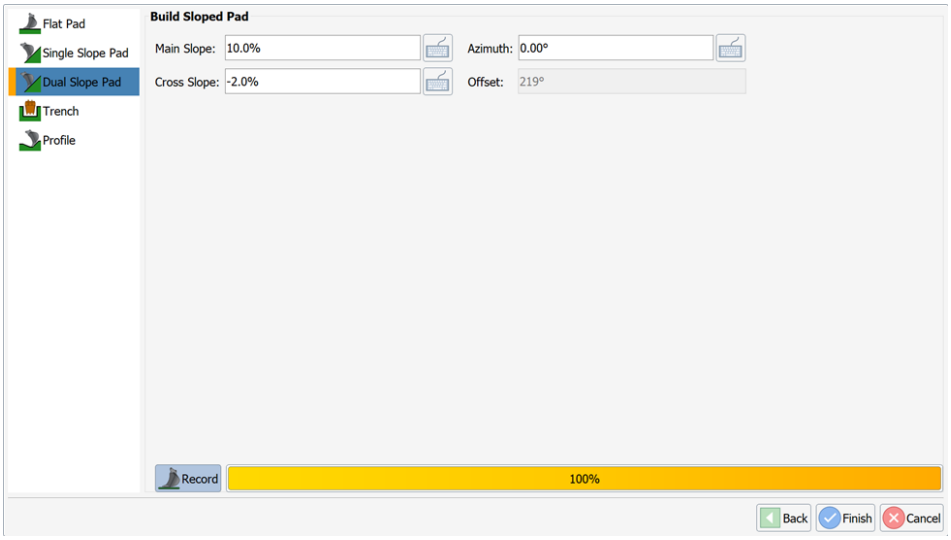
Grade2D, continued



Click **Next**.

Type in a **Main Slope**, **Cross Slope**, and **Azimuth**. Click **Record**. The **Offset** is the difference between the current machine azimuth (coming from the GNSS receiver) and the azimuth you type in. If you do not have a dual antenna GNSS receiver connected azimuth will be 0.

Click **Finish**.



Continued on next page

Grade 2D, Continued

Grade2D, continued

To create a **Trench**:

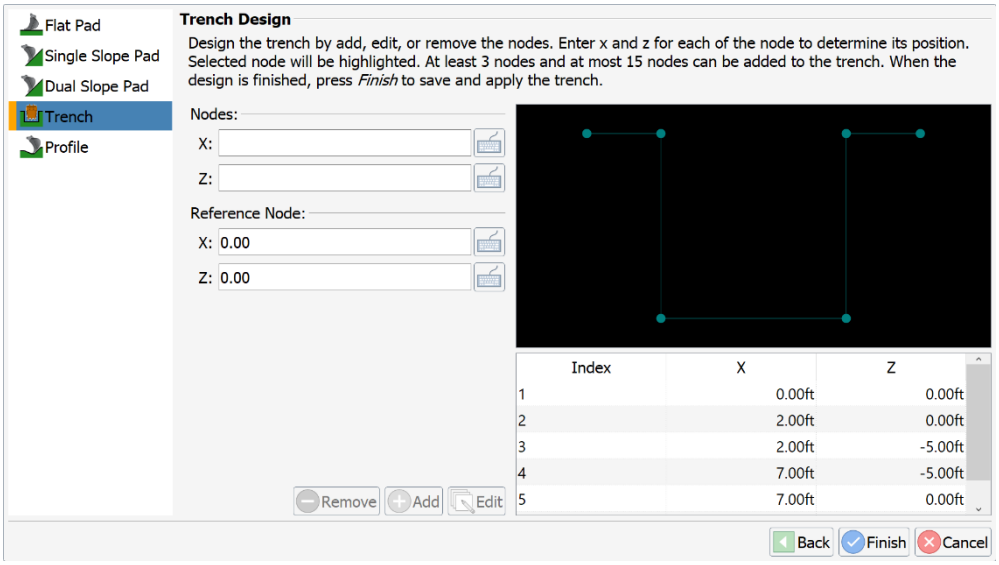
- Type a **Trench** name (or select a **Recent Trench**).
- Type a **Bench**, **Azimuth**, and **Main Slope**.
- Click **Record**. The Offset is the difference between the current machine azimuth (coming from the GNSS receiver) and the azimuth you type in. If you do not have a dual antenna GNSS receiver connected azimuth will be 0.
- After clicking **Next**, you will be prompted to enter a **Reference Node**. The Reference Node is a node that is drawn on the screen for display/reference purposes only and is not involved in the design of the trench. Design the trench by adding **X** and **Y** values under **Nodes** and click **Add**. You can start with an arbitrary **X**, **Z** for the first node.

4) When you are finished designing the trench, click **Finish**.

Continued on next page

Grade 2D, Continued

Grade2D, continued



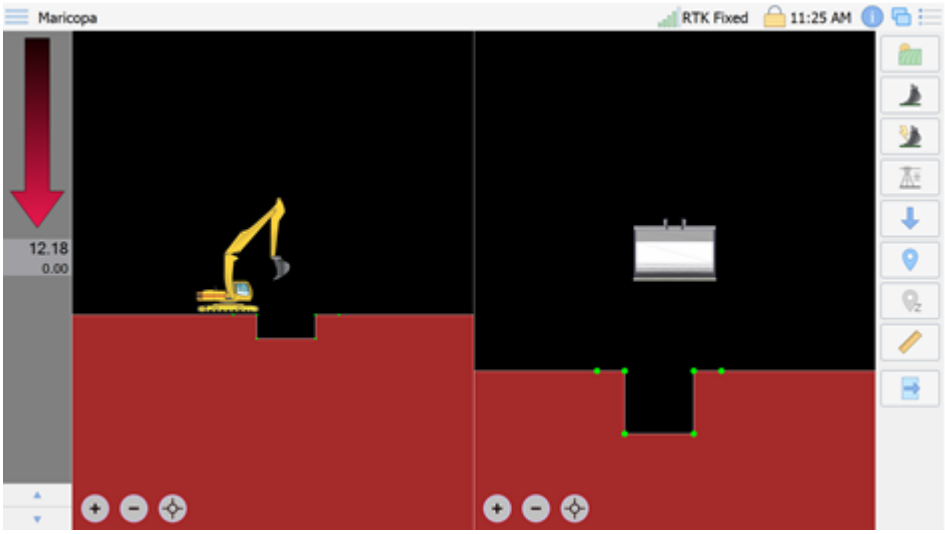
Click **Next**.

If you traverse the machine, you will need to re-bench. Set the bucket (point of interest) a benchmark and click the **Set Reference Elevation** icon ( ).

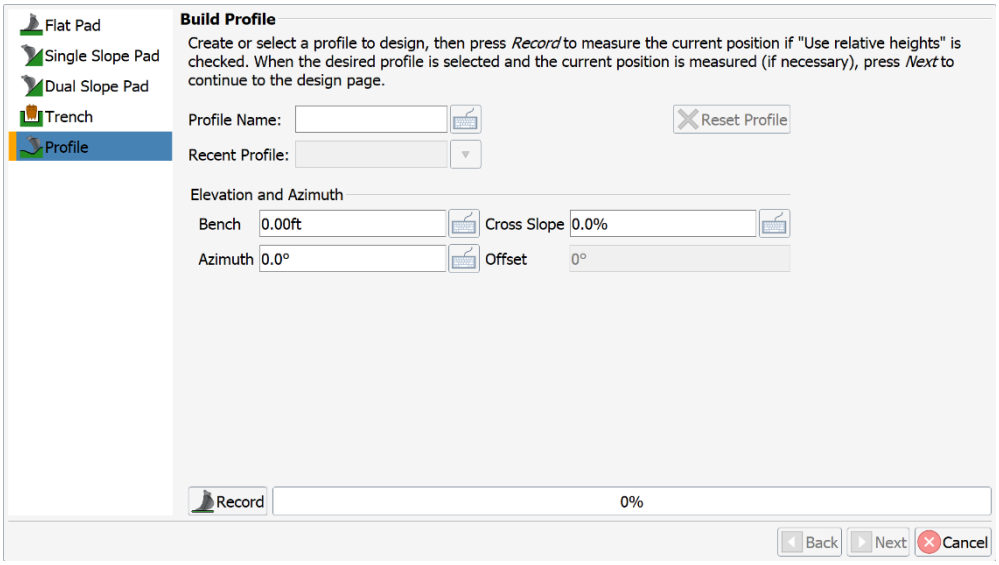
Continued on next page

Grade 2D, Continued

Grade2D, continued



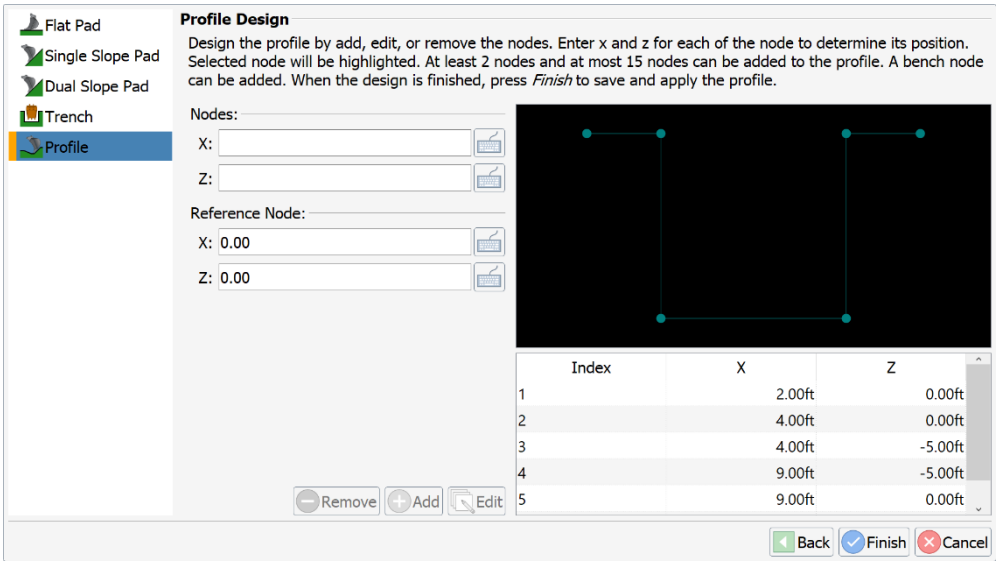
The final design is **Profile**.



Type a **Profile Name**. Type a **Bench** height and azimuth (if you do not have GNSS, azimuth will be 0).
Click **Record**. Enter a Cross Slope if necessary.
Click **Next**.

Continued on next page

Grade2D, continued



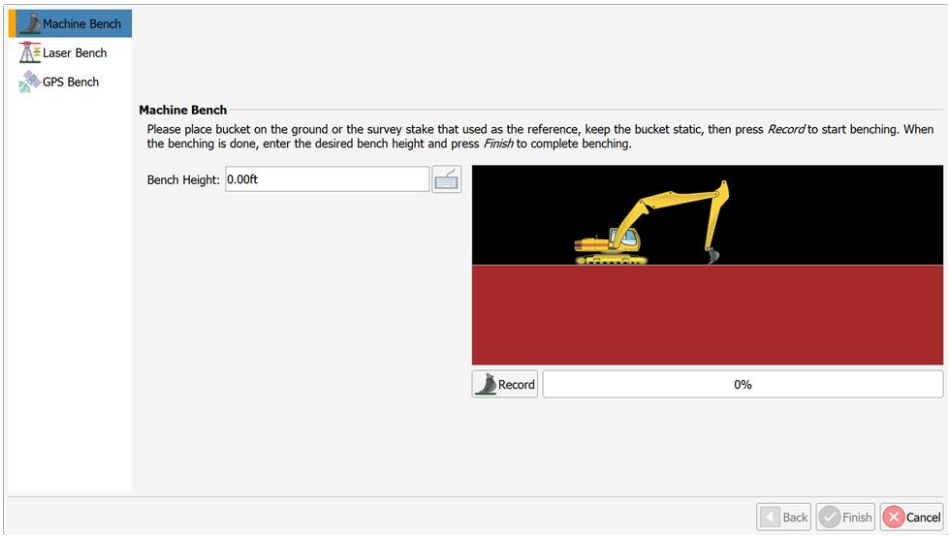
Enter a **Reference Node**. The **Reference Node** is only for reference on the screen and is not part of the profile. Build the **Profile** by entering the nodes and click **Add**.

Click **Finish** when complete.

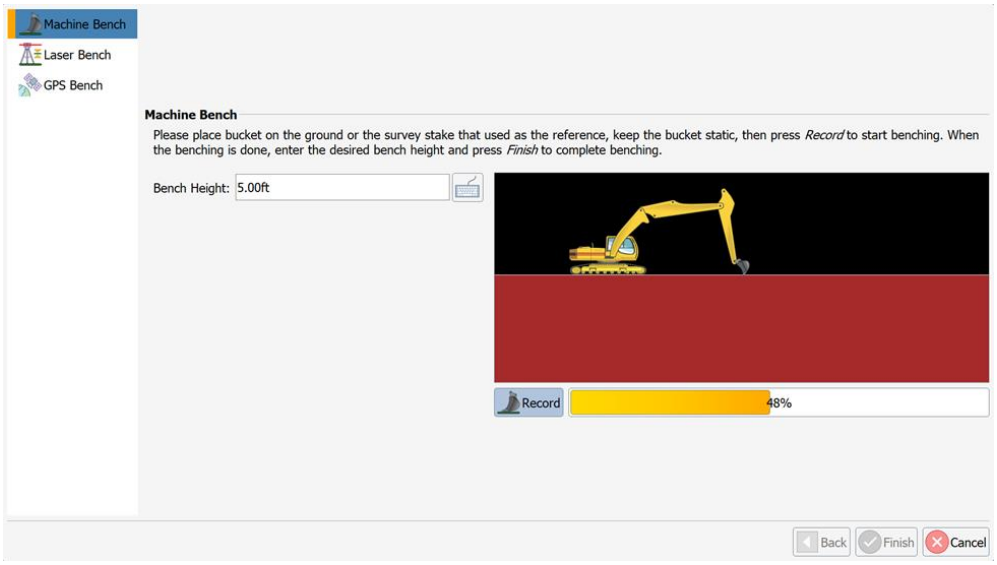
Continued on next page

Grade 2D, Continued

Grade2D, continued



You can set the cutting edge on a benchmark, **Machine Bench – to GPS Bench**. Type the **Bench Height** and click **Record**.



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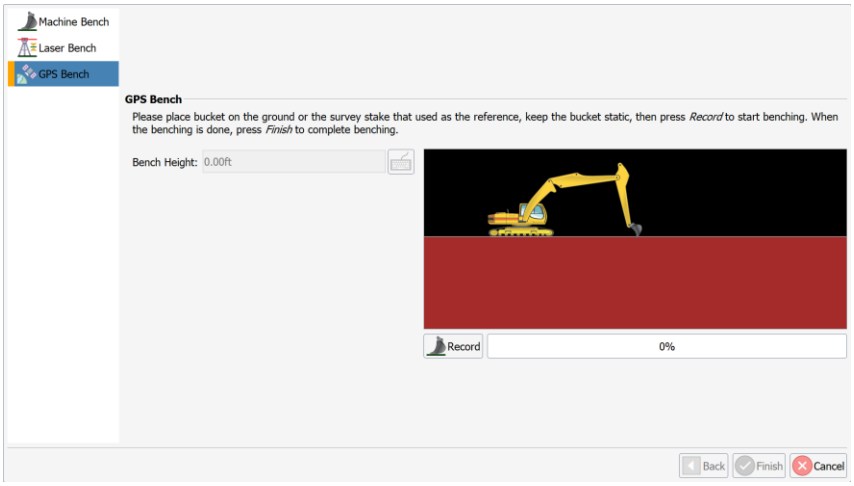
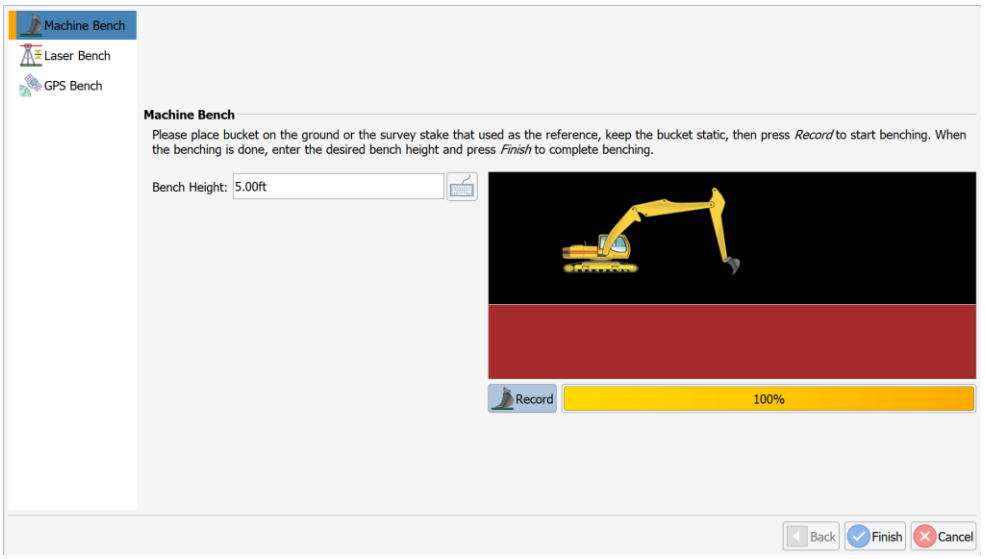
Grade 2D, Continued

Grade2D, continued

Use the **Laser Bench** if you have an optional laser receiver installed on your stick.



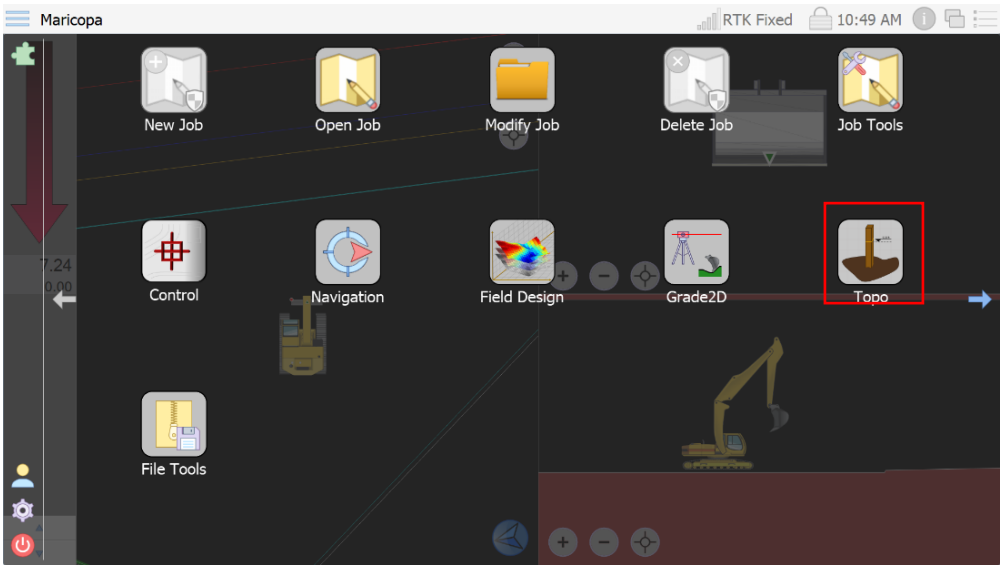
Set the **GPS Bench** and click **Finish**. In the example below, we benched the bucket at 5.00 ft.



Topo

Topo

Use **Topo** to create a topo point file by either manually storing points, or auto-storing points by time or distance intervals.



Continued on next page

Topo, Continued

General Settings

The **General Settings** window displays the selections shown in the following table.

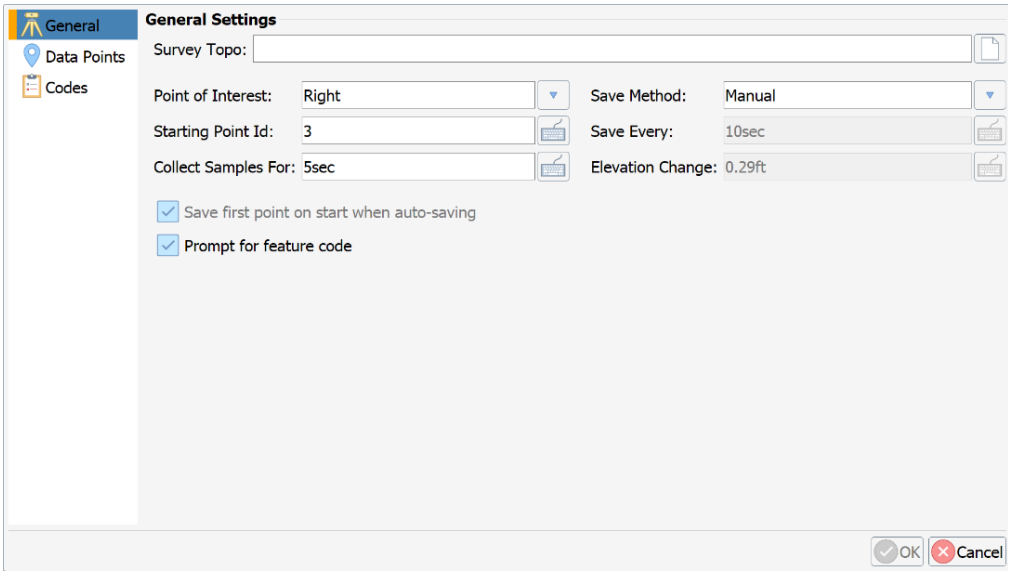
Table 5-3: General Topo Settings

Setting	Description
Survey Topo	Create a Survey Topo to store points. Click the icon to the right of the dialogue box and name the file.
Point of Interest	Select the point of the machine that the NEZ will be taken from when storing points.
Starting Point Id	Each time a point is stored, a corresponding point ID is created. Starting Point ID increments by 1 each time you shoot a point. The value entered indicates the ID of the first stored point.
Collect Samples For	When storing a manual point (not when auto-saving), the point will be averaged for this many seconds prior to saving.
Save Method	Click the down-arrow to select from the following options: – **Time**-the number input into 'Save Every' must be in seconds. – **Distance**-store the point by distance interval. Type a distance value in the **Save Every** field. – **Manual**-store points only when **Single Shot** is pressed.
Elevation Change	If doing an auto-topo, a point will be stored if elevation changes by this value – even if the saving interval has not been met.
Save first point on start when auto-saving	Click the checkbox to select. This option may only be selected if the **Save Method** is **not** manual.
Prompt for feature code	The software prompts to select from one of the available feature codes.

Continued on next page

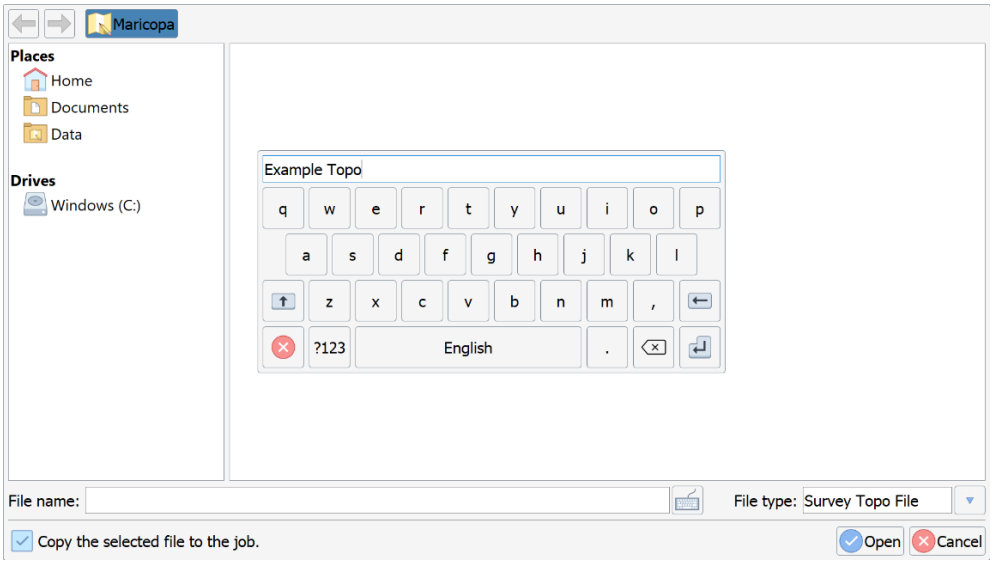
Topo, Continued

General Settings, continued



Storing points

On the **General** tab, click the document icon to the right of the **Survey Topo** field to select or create a new file.

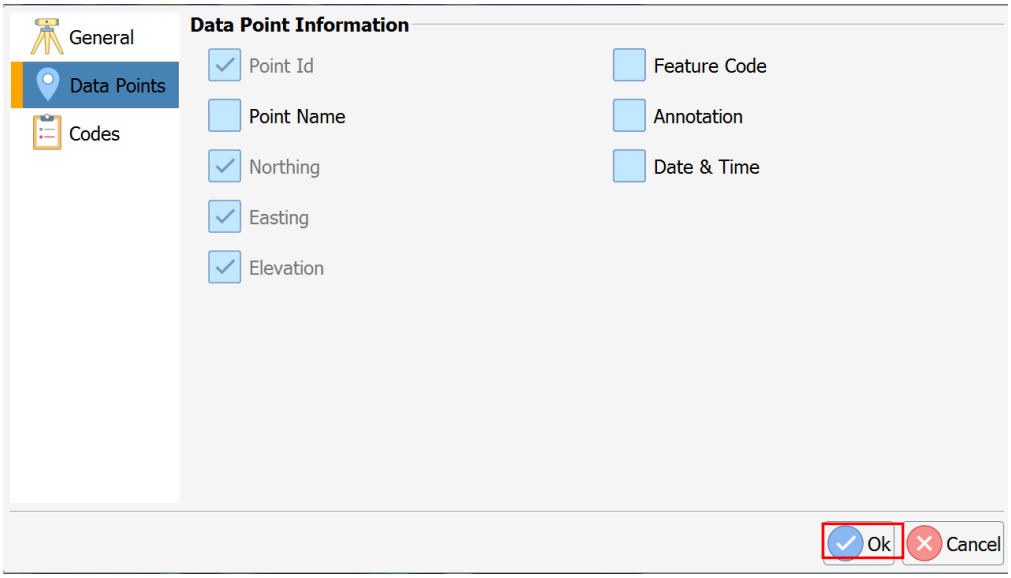


Continued on next page

Storing points, continued

Click **Data Points**. The **Data Point Information** screen displays.

Click the box to select the options you wish to save to the topo file. When you are finished making your selections, click **Ok**.



Codes

You can select to prompt for **Feature Code**. When a point is stored you will receive a prompt for a code.

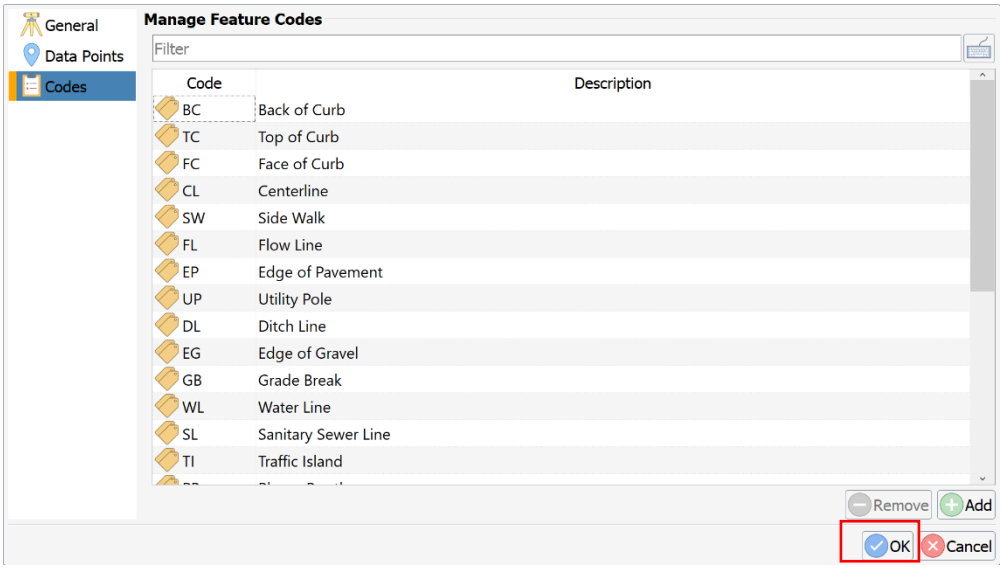
The **Manage Feature Codes** screen displays the listing of feature codes. Click to highlight the **Feature Code** you wish to add and click **Add**. Press **OK**.

Note: Do not select this feature if auto storing points.

Continued on next page

Topo, Continued

Codes, continued

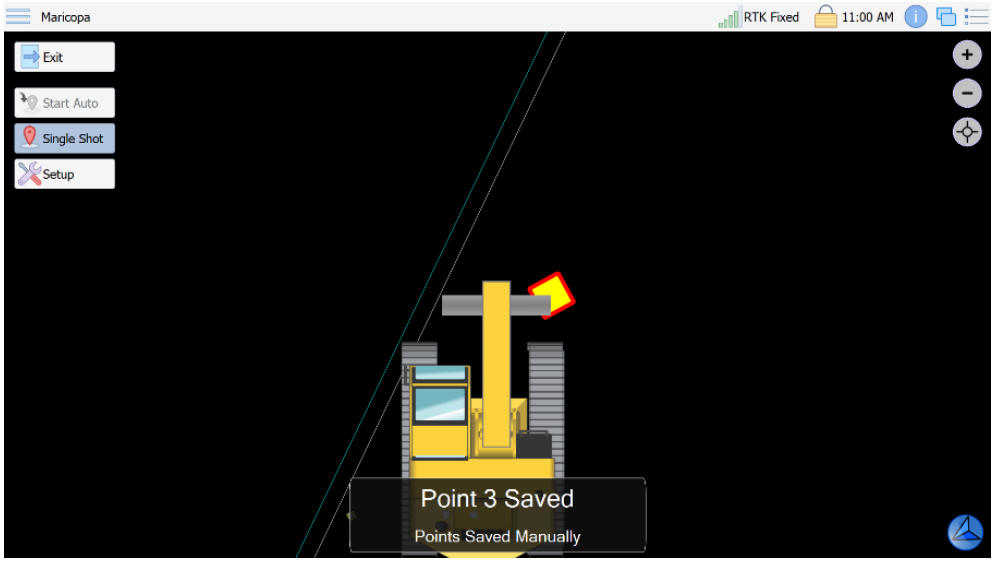


Continued on next page

Codes,
continued

Note: If storing points manually, **Start Auto** is disabled.

To store a point, click **Single Shot**.



In the example above, locate the orange square on right side of cutting edge. This is the point just stored. Note it is on the right, as you set up in settings (**Point of Interest**), and the message reads "**Point 3 Saved**", because you started with 3 (see following screenshot). If for example, you start with 50, the message would read "**Point 50 Saved**".

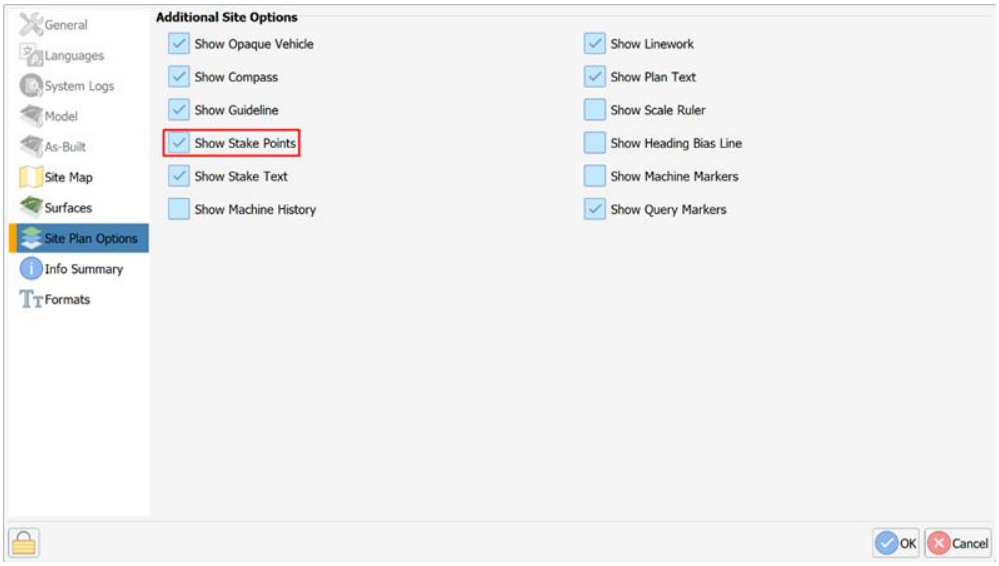
Continued on next page

Codes, continued

To exit, press the button on top right corner of the screen.

Note: When you return to the **Plan View** you will not see the saved points.

To view stored points, go to **Settings -> Site Plan Options -> Show Stake Points**.



Appendix A - Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

Topic	See Page
GradeMetrix Troubleshooting	142

GradeMetrix Troubleshooting

Troubleshooting

Table A-1: Troubleshooting

Symptom	Possible Solution
Incorrect position	First, check a control point with the machine and the survey rover. If the horizontal or vertical position is off, the first thing you should consider is if it is off by a consistent amount throughout the jobsite, or if the position bust varies throughout the job. If it is consistent, consider the following: • Check your machine measurements/offsets. If any of these are incorrect, your projected position will be off. • Bad localization. Make sure that all of the points in your localization file have low residuals and/or that the correct coordinate system has been chosen. If there is an inconsistent position bust, check: • Sensor mounting was incorrectly chosen and/or sensor was not calibrated. – The above is evident if your position is correct when flat, but not if you are on a slope • If the position at the GPS antenna is correct, but the position bust worsens as you approach the cutting edge, it may be a heading offset error.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
No GNSS position	• First, check to see if the VR500 or VR1000 is powered on. • If the receiver isn't powered, disconnect the cable and use a multimeter to verify it is receiving power and ground. • Check the Monitor screen and Sky Plots to see if there is any data from the receiver. If there is no data, but the receiver is powered, there could be a bad serial connection/mismatched baud rate. • If using a VR1000, use a multi-meter to measure the voltage from the primary antenna port. The voltage should be 5V. If it is reading 5V from the receiver, check the other end of the cable (that would plug into the antenna). If there isn't any voltage, it may be a damaged cable or bulkhead connector.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
No RTK	• If using a base station onsite (versus an NTRIP service), first check to verify the base station is turned on. • If the base station is turned on and sending RTK out over UHF, check to see if the Tx (or TD on some radios) light is flashing once per second. • Verify that the other rovers on the job site are receiving RTK corrections, if available. • If it is flashing once per second, check to verify the settings (frequency, bandwidth, forward error corrections, modulation, and protocol) at the base match that of the rover. • Check to see if the UHF light at the rover is blinking once per second. • The receiver may be out of UHF range. Consider installing the external UHF antenna (if using a VR500). You may need to install repeaters. See if the RTK corrections work when the machine is closer to the base station. • If using NTRIP, check cellular connectivity. One option is to exit GradeMetrix and verify you can go to a website via the browser.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
IronOne will not power on	• Check to verify the power cable is connected to machine power. The positive should go to a reliable, clean power source and ground to the chassis of the machine. • Disconnect the cable and refer to the pinout to see if 12V or 24V (depending on machine) is going into the IronOne by using a multi-meter. If the multimeter reads 12V or 24V, then power is confirmed, and the IronOne may need to be serviced. If you don't have any power, then check your power source, ground, and all fuses.
No heading	• If using a VR1000, you need two external antennas. Use a multi-meter to check the voltage coming out of the N-type connectors Is 5V. If 5V is coming from the receiver, check the other end of the cable (that would plug into the antenna). If there is no voltage, then it is a damaged cable or bulkhead connector. • If using a VR1000, check your MSEP antenna separation measurement. It is the distance, in meters, between the two antennas, and must be accurate to within 2 cm.
No cut/fill	• Check to see if your GNSS receiver is RTK Fixed. If Settings -> Model -> Enabling Cut/Fill is set to "When RTK Fixed" (the default, and suggested, setting), cut/fill will be disabled if the GNSS receiver is not RTK Fixed • Check your RMS tolerances. If HRMS or VRMS is higher than configurable values in Settings -> Model, cut/fill will be disabled. • Check to make sure the receiver has valid GNSS heading.

Appendix B: Supported Hardware

Overview

Introduction

Appendix B contains the pin-out and data specifications of GradeMetrix supported hardware.

Contents

Topic	See Page
VR500 Vector Smart Antenna	147
VR1000 GNSS Receiver	153
IronOne Hardware	160

VR500 Vector™ Smart Antenna

VR500 pin-out

Figure B-1 shows the power/data cable pin-out assignments for the VR500 Smart Antenna.

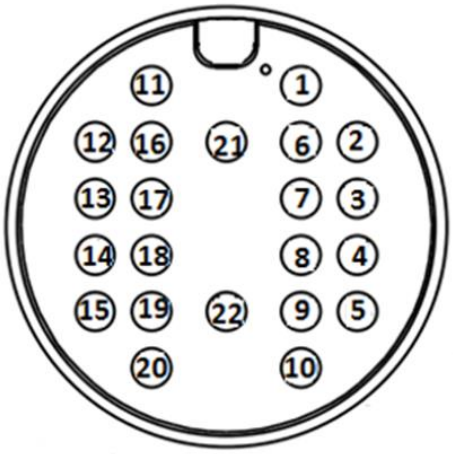


Figure B-1: VR500 pin-out assignments

Continued on next page

VR500 pin-out, continued

Table B-1 shows the cable pin-out specifications.

Table B-1: VR500 pin-out specifications

Pin	Function	Color
1	Power +	Red
2	CAN1 High	Orange-Black stripe
3	CAN1 Low	Yellow Black stripe
4	Port B RS-232 RX/RS-422 A	Orange
5	Port B RS-232 TX/RS-422 Z	Yellow
6	CAN2 High	Green
7	CAN2 Low	Blue
8	Port B RS-422 B	Purple
9	Port B RS-422 Y	Grey
10	PPS Output	White
11	Port A RS-232 RX	Pink
12	Port A RS-232 TX	Turquoise
13	Signal Ground	Black-White stripe
14	Ethernet TD+	Brown-White stripe
15	Ethernet TD-	Red-White stripe
16	Heading Warning	Orange-White stripe
17	Speed Output	Green-White stripe
18	Ethernet RD+	Blue-White stripe
19	Ethernet RD-	Purple-White stripe
20	Manual Mark Input	Red-Black stripe
21	Power +	Brown
22	Power -	Black

Continued on next page

VR500 data specifications

The following lists the data specifications for the VR500 Smart Antenna.

Table B-2: VR500 Sensor

Item	Specification
Receiver type	GNSS Position & Heading RTK Receiver
Channels	1059
Sensitivity	-130 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, and 20 Hz optional
Horizontal accuracy	<table><tr><th></th><th>RMS (67%)</th><th>2DRMS (95%)</th></tr><tr><td>RTK[1,2]</td><td>8 mm + 1 ppm</td><td>15 mm +2 ppm</td></tr><tr><td>Atlas</td><td>0.04 m</td><td>0.08 m</td></tr><tr><td>SBAS [1]</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA[1]</td><td>1.2 m</td><td>2.4 m</td></tr></table>
Heading accuracy	0.27° RMS
Pitch/roll accuracy	1° RMS
ROT	100°/s maximum
Timing (PPS) accuracy	20 ns
Cold start time	< 40 s typical (no almanac or RTC)
Warm start time	< 20 s typical (almanac and RTC)
Hot start time	< 5 s (almanac, RTC, and position)
Maximum speed	1,850 km/h (999 kts)
Maximum altitude	18,000 (59.055 ft)
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3, L-band (Atlas)
Antenna LNA gain input	10 to 40 dB

Continued on next page

VR500 communication specifications

Table B-3: VR500 Communication

Item	Specification
Ports	2 full-duplex: 1x RS-232, 1x RS-232/RS-422, CAN
Baud rates	4800 - 230400
Data I/O protocol	Output: NMEA 0183, NMEA 2000, Hemisphere GNSS Proprietary ASCII and Binary Messages Input: Hemisphere GNSS Proprietary ASCII and CAN commands (for configuration)
Correction I/O protocol	Hemisphere GNSS ROX, CMR, CMR+, RTCM v2.3 (DGPS), RTCM v3x incl MSM
Timing output	PPS, CMOS, active low, programmable falling or rising edge sync, 10kΩ, 10 pF load
Ethernet	1x

VR500 power specifications

Table B-4: VR500 Power

Item	Specification
Input voltage	9-32 VDC
Power consumption	10.8W Maximum (All signals and L-band)
Current consumption	1.2A Maximum

Continued on next page

VR500 Vector™ Smart Antenna, Continued

VR500 environmental specifications

Table B-5: VR500 Environmental

Item	Specification
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration	Shock: 50Gs, 11ms half sine pulse (MIL-STD-810G w/Change 1 Method 516.7 Procedure 1) Vibration: 7.7Grms (MIL-STD-810G w/Change 1 Method 514.7 Category 24)
EMC[4]	CE (ISO 14982/EN 13309/ISO 13766/IEC 60945) Radio Equipment Directive 2014/53/EU, E-Mark, RCM
Enclosure	IP69

VR500 mechanical specifications

Table B-6: VR500 Mechanical

Item	Specification
Dimensions	68.6 L x 22 W x 12.3 H cm
Weight	3.9 kg
Status indication	Power, GNSS, Heading, Radio
Power/Data connector	22-Pin environmentally sealed

Continued on next page

VR500 L-band sensor specifications

Table B-7: VR500 L-band sensor

Item	Specification
Receiver type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-130 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and Automatic
Reacquisition time	15 seconds (typical)

VR500 aiding device specifications

Table B-8: VR aiding device

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 0.5° per minute heading for periods up to 3 minutes when loss of GNSS has occurred.[4]
Tilt sensor	Provide pitch and roll data and assist in fast startup and reacquisition of heading solution.

[1.] Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity
[2.] Depends on multipath environment, number of satellites in view, WAAS coverage and satellite geometry
[3]. Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity
[4.] Based on a 40 second time constant
[5.] Hemisphere GNSS proprietary

VR1000 GNSS Receiver

VR1000 pin-out

Figure B-2: VR1000 pin-out assignments

1. Primary antenna
   GNSS_RF1+5V
2. Secondary antenna
   GNSS_RF2+5V
3. Radio antenna
   Radio RF
4. BT/Wi-Fi antenna
   BT/Wi-Fi RF

Continued on next page

VR1000 pin-out, continued

Table B-7 lists the VR1000 connector pin-out.

Table B-7: VR1000 Connector Pin-out

Pin	Description	Note
1	CAN2_L	CAN2 Low
2	CAN1_H	CAN1 High
3	RD-	Ethernet RX-
4	TD-	Ethernet TX-
5	PA_RX	RS232 Port A Rx
6	PPS	1PPS OUT
7	RS422 TX+/SPEED OUT	Port B RS422 TX+/SPEED OUT
8/15	POW-	Power Ground
9	CAN2_H	CAN2 High
10	CAN1_L	CAN1 Low
11	RD+	Ethernet RX+
12	TD+	Ethernet TX+
13	PA_TX	RS232 Port A Tx
14	RS422 RX-/EVENT MARK	Port B RS422 RX-/EVENT MARK
16	CAN2_Shield	CAN2 Shield
17	CAN1_Shield	CAN1 Shield
18/19	GND	Signal Ground
20	RS232_TX PB RS422_TX-	Port B RS232 TX/RS422 TX-
21	RS232_RX PB RS422_RX+	Port B RS232 RX/RS422 RX+
22/23	POW+	Power Positive

Continued on next page

VR1000 GNSS Receiver, Continued

VR1000 data specifications

Table B-8: VR1000 receiver

Item	Specification
Receiver Type	GNSS Position & Heading RTK Receiver
Signals Received	GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC (IRNSS) and Atlas
Channels	1059
GPS Sensitivity	-142 dBm
SBAS Tracking	3-channel, parallel tracking
Update Rate	10 Hz standard, 20 Hz optional
Timing (PPS) Accuracy	20 ns
Rate of Turn	100°/s maximum
Cold Start	40 s (no almanac or RTC)
Warm Start	20 s typical (almanac and RTC)
Hot Start	5 s typical (almanac, RTC and position)
Heading Fix	10 s typical (Hot Start)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 mph (999 kts)
Maximum Altitude	18,288 m (60,000 ft)
Differential Options	SBAS, Atlas (L-band), RTK

Continued on next page

VR1000 accuracy specifications

Table B-9: VR1000 Accuracy

Item	Specifications
Positioning	<table><tr><th></th><th>Horizontal (95%)</th><th>Vertical (95%)</th></tr><tr><td>Autonomous, no SA[2]</td><td>1.2 m</td><td>2.5 m</td></tr><tr><td>SBAS (WAAS)[2]</td><td>0.25 m</td><td>0.5 m</td></tr><tr><td>Atlas (L-band) [2,3]</td><td>0.04 m</td><td>0.08 m</td></tr><tr><td>RTK[1]</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr></table>
Heading (RMS)	< 0.2° @ 0.5 m antenna separation < 0.1° @ 1.0 m antenna separation < 0.05° @ 2.0 m antenna separation < 0.02° @ 5.0 m antenna separation < 0.01° @ 10.0 m antenna separation
Pitch/Roll (RMS)	1°
Heave (RMS)	30 cm (DGPS) [3],10 cm (RTK) [3]

Continued on next page

VR1000 GNSS Receiver, Continued

VR1000 communication specifications

Table B-10: VR1000 Communication

Item	Specification
Ports	2 full-duplex, RS-232, CAN
Baud Rates	4800 - 230400
Correction I/O Protocol	Hemisphere GNSS ROX, CMR, CMR+, RTCM v2.3 (DGPS), RTCM v3x incl MSM
Data I/O Protocol	Output: NMEA 0183, NMEA 2000, Hemisphere GNSS Proprietary ASCII and Binary Messages Input: Hemisphere GNSS Proprietary ASCII and CAN commands (for configuration)
Timing Output	PPS, CMOS, active low, programmable falling or rising edge sync, 10kΩ, 10 pF load

VR1000 power specifications

Table B-11: VR1000 Power

Item	Specification
Input Voltage	9-36 VDC
Power Consumption	10.8W Maximum (All signals and L-band)
Current Consumption	1.2A Maximum
Maximum Power Isolation	No
Reverse Polarity Protection	Yes

Continued on next page

VR1000 environmental specifications

Table B-12: VR1000 Environmental

Item	Specification
Operating Temperature	-40°C to +70°C (-40°F to +158°F)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Mechanical Shock	50G, 11ms half sine pulse (MIL-STD-810G w/ Change 1 Method 516.7 Procedure 1)
Vibration	7.7 Grms (MIL-STD-810G w/Change 1 Method 514.7 Category 24)
EMC	CE ISO14982/EN13309/ISO13766/IEC60945), Radio Equipment Directive 2014/53/EU, E-Mark, RCM
Enclosure	IP69K

VR1000 mechanical specifications

Table B-13: VR1000 Mechanical

Item	Specification
Dimensions	No mounting Plate 23.2 L x 16.5 W x 7.9 H (cm) 9.1 L x 6.5 W x 3.1 H (in) With Mounting Plate 23.2 L x 21.4 W x 8.3 H (cm)
Status Indications (LED)	Power, Primary Antenna, Secondary Antenna, Heading, Quality, Atlas, Bluetooth, Wi-Fi, CAN1, CAN2, Ethernet, Radio
Power/Data Connector	23-pin multi-purpose

Continued on next page

VR1000 GNSS Receiver, Continued

VR1000 L-band sensor specifications

Table B-14: VR1000 L-band sensor

Item	Specification
Receiver Type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-140 dBm
Channel Spacing	5 kHz
Satellite Selection	Manual or Automatic
Reacquisition Time	15 sec (typical)

VR1000 aiding device specifications

Table B-15: VR1000 Aiding devices

Item	Specification
Gyro	Provides smooth heading, fast heading reacquisition and reliable < 0.5° per min heading for periods up to 3 min. when loss of GNSS has occurred [4]
Tilt Sensors	Provide pitch/roll data and assist in fast start-up and reacquisition of heading solution

[1]Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity

[2] Depends on multipath environment, number of satellites in view, WAAS coverage and satellite geometry

[3] Requires a subscription

[4] Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity

IronOne Hardware

IronOne pin-outs

Figure B-3 shows the display pin-outs for the IronOne OEM Hardware.

Figure B-3: IronOne pin-out assignments

Table B-16: IronOne display pin-outs

Comm 12 pin	Description	
1	CAN H	COM1 in Win10 device manager
2	RS232 TX 1	COM2 in Win10 device manager
3	RS232 RX 1	
4	GPIO	
5	GND	Signal ground
6	RS422 TX 1	COM4 in Win10 device manager RS232/RS422/RS485 can Switch on BIOS setup: BIOS setup->Advanced->F81216SEC Super Io Configuration->Serial Port 4 Configuration
7	RS422 TX 2	
8	RS422 RX 1	
9	RS422 RX 2	
10	GND	Power ground
11	V12+ OUT	Power out for serial device
12	CAN L	COM1 in Win10 device manager

Continued on next page

IronOne pin-outs, continued

Table B-17: IronOne video pin-outs

Video 12 pin	Description
1	V12+ OUT1
2	GND
3	CAN2 L _IN
4	CAN2 H _IN
5	NET 1TX+_IN
6	NET1 TX-_IN
7	NET 1RX-I_N
8	NET1 RX+_IN
9	GPIO2_IN
10	GND
11	VIDEO2_IN
12	VIDEO1_IN

Table B-18: IronOne communications

Comm DT15-12PA
CAN x 1
UART（RS-232 x 1）
RS-422/RS-485/RS-232 x 1 Software switch）
GPIO x 1（Default input pullup 5V）
12V/0.75A Power output

Table B-19: IronOne power connector

Power	Description
1	PWR+
2	PWR-
3	ACC
4	NC
5	PWR-
6	PWR+

Continued on next page

IronOne Hardware, Continued

IronOne pin-outs, continued

Table B-20: IronOne video communication

Video DT15-12PB
CAN x 1
CVBS video input x 2
10M/100M LAN x 1
GPIO x 1（Default input pullup 5V）
12V/0.75A Power output

The following lists the data specifications for the IronOne OEM Hardware.

Table B-21: IronOne Mechanical

Specification	Description
Dimensions	22.9 L x 16.9 W x 5.2 H (cm) 9.0 L x 6.6 W x 2.0 H (in)
Weight	1.38 kg (3.04 lbs.)
Mount	Adjustable 1.5” RAM ball mount

Table B-22: Environmental

Specification	Description
Operating Temperature	-20°C to +70°C (-4°F to 158°F)
Storage Temperature	-40°C to +85°C (-40°F to 185°F)
Operating Humidity	30% ~ 95% (Relative Humidity)
Storage Humidity	45% ~ 80% (Relative Humidity)
Enclosure	IP67
Vibration	EP455 5.15

Continued on next page

IronOne pin-outs, continued

Table B-23: Power

Specification	Description
Input Voltage	7 - 36 VDC
Power Consumption	36 W
Current Consumption	3.0 A @ 12 VDC

Table B-24: Sensor and Multimedia

Specification
1x 2W Buzzer
1x Headphone Jack

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IronOne pin-outs, continued

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IronOne pin-outs, continued

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