



User Guide

Siteworks

SOFTWARE

Revision A
September 2023

Legal Notices

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Release Notice

This is the September 2023 release (Revision A) of the Trimble Siteworks Software User Guide. It applies to version 1.70 of the software.

Product Limited Warranty Information

For applicable product Limited Warranty information, please refer to the Limited Warranty Card included with this Trimble product, or consult your local Trimble authorized dealer.

Safety Information

Before you use your Trimble product, make sure that you have read and understood all safety requirements.

DANGER! ALERTS YOU TO A SITUATION THAT IS LIKELY TO RESULT IN DEATH OR SERIOUS INJURY.

WARNING – Alerts you to a situation that could cause personal injury or unrecoverable data loss.

CAUTION – Alerts you to a possible risk of damage to the equipment/property and/or loss of data.

NOTE – An absence of specific alerts does not mean that there are no safety risks involved.

Vehicle safety

WARNING – When you select the Vehicle mode, the following warning message appears: **WARNING:** Do not operate Siteworks while driving the vehicle. Failure to heed this warning may result in a collision causing property damage or personal injury. Do not interact with the touch screen, keyboard, or software in any way while the vehicle is moving. While the vehicle is moving, the software provides a continuous display of position and data that can be seen at a glance. Operating the device or interacting with the software while the vehicle is moving can be a distraction for the operator, and may result in collision causing property damage or personal injury.

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Introduction

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- [Related information](#)
- [Technical support](#)

This user guide provides you with the necessary information to perform measurement and stakeout tasks with the Trimble® Siteworks site controller software. To perform the many tasks that the Siteworks software is capable of, you need the Siteworks site controller software running on a Trimble controller that is either connected to a Precision or Location GNSS system, or to a total station. You can also use the internal GNSS of the controller to locate objects. The Siteworks software is the field software that runs on Trimble controllers and certain third-party devices. Please see the latest release notes for the currently supported controller hardware devices. For presentation and training purposes, a software emulator that runs on the Microsoft® Windows® operating system is also available on the Siteworks web page of the Trimble website (heavyindustry.trimble.com/en/products/siteworks-positioning-systems).

The Siteworks software is also available on the Android™ operating system on compatible devices.

Even if you have used other GNSS and total station products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product. If you are not familiar with GNSS, GPS, or total stations visit the Trimble website (trimble.com).

NOTE – This manual shows screenshots of the software running on the Windows operating system; the screens may look different on an Android device.

Overview

Trimble Siteworks software is a site measurement tool that streamlines earthworks and surface finishing operations. It enables construction contractors to measure material volumes, monitor grades and laid material thicknesses, and to perform various site layout tasks such as point, line, and surface stakeout, in addition to survey measurement of points, lines, and surfaces.

Start up and set up of sophisticated GNSS and total station technology is quick and easy. The software manages data for multiple project sites, single large project sites, and large sites that have been divided into zones. When a field engineer, grade checker, or surveyor opens a work order, the software opens all the data files needed to complete that work order. Because the software delivers results immediately, informed decisions can be made in the field.

The Siteworks software can also be used to check site grading operations that have been performed using a machine control system, such as Trimble Earthworks, in addition to exporting design and calibrating data to the machines. If your organization does not have a 3D machine control system, the system provides site control, grade checking, progress volumes, and stakeout capabilities to facilitate earthmoving operations.

The field engineer can quantify progress, check data, and set out the information needed to keep the machines moving. The Siteworks system tracks activities at each site and keeps a continuous record of all results. Related data is stored, together, as a permanent construction record and is output as a CSV, TXT, TTM, and/or DXF file. Back at the office, the software delivers comprehensive operation analysis data.

Related information

Sources of related information include the following:

- Release notes – The release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. They can be downloaded from heavyindustry.trimble.com/en/products/siteworks-positioning-systems.
- Trimble training courses – Consider a training course to help you use your GNSS system to its fullest potential. For more information, go to the Trimble website at learn.trimble.com/learn.

Technical support

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, go to the Support area of the Trimble website (trimble.com/Support/). Select the product you need information on. Product updates, documentation, and information relating to support issues are available for download.

Starting the Software

- [Installing the software](#)
- [Starting the software](#)
- [System information](#)
- [Siteworks modules](#)

Installing the software

The software and its modules are downloaded and installed through the Trimble Installation Manager. For Windows and Android devices, you can download this from install.trimble.com.

The Trimble Installation Manager must be installed directly on the device, and the device must be connected to the Internet. The License Manager checks which software options were purchased for the specific controller with this serial number and checks for the latest version of the software that is available for this controller.

Note that the Siteworks version that the controller is entitled to is determined by the serial number of the controller and the status of the Trimble Protection Plan expiration date. The latest version of the Siteworks software is only available to users with software protection plan expiration dates within one month of the release date of the software. Please contact your dealer if your controller is out of protection plan and needs to be reinstated. For brand new controllers, the protection plan period begins when the Siteworks software is first downloaded to the device through a successful connection to the Trimble Installation Manager.

Starting the software

To start the Siteworks software on your controller, double-click the **Siteworks** icon on the controller's desktop. The Siteworks software will start in the **Open Project** screen where you can select an existing project, design, and work order on your controller or create new ones.

The last used project, work order and design will be displayed. Click on the down arrow to the right of the fields to select a different project, work order or design, or click on the plus symbol to create a new one.

The 'Open Project' dialog box is shown with the following fields and options:

- Project:** TrimbleNewBuilding (with a dropdown arrow and a plus icon to create a new project)
- Work Order:** Demo (with a dropdown arrow and a plus icon to create a new work order)
- Design:** FG_All (with a dropdown arrow and a plus icon to create a new design)

An **ACCEPT** button is located at the bottom right of the dialog.

After accepting the selection, the software loads your data and proceeds to the map view. If you have previously connected a GNSS rover receiver to the site base station or were using a total station, the software brings you to the connection screen of the last used positioning device.



If the software does not present the positioning device connection screen, tap on the **Project Setup** menu by going to the **Home** menu / **Connect Device** and selecting either **GNSS** or **Total Station**. The **Device Setup** menu opens to start the connection to the selected type of positioning device. Tapping the measure button (blue plus button in lower right corner) will also bring up a device connection option.

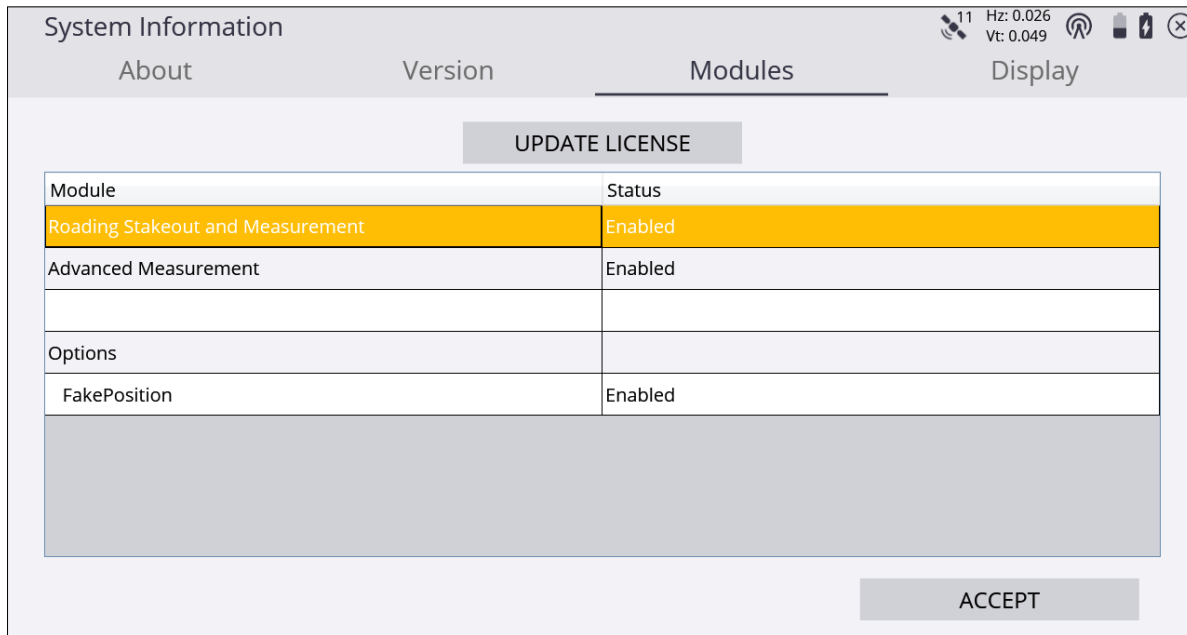
System information

The **System Information** screen has multiple tabs that contain information about the current version of the Siteworks software, the type of license (perpetual or termed), the software protection plan support expiry date, which modules are enabled, which positioning sensors are connected, which firmware the sensors have, and what language to display. This screen also is where position and status update communication to the WorksManager service can be turned off/on.

From the **Home** menu, select **Settings / System Info**.

If you have purchased a module after the controller was activated, either run Trimble Installation Manager again, or on Windows devices activate the new module by tapping **Update License** in the **Modules** tab.

NOTE – The Update license button is not present on Android systems. New modules are added by running Trimble Installation Manager on Android systems.



System Information

11 Hz: 0.026 Vt: 0.049

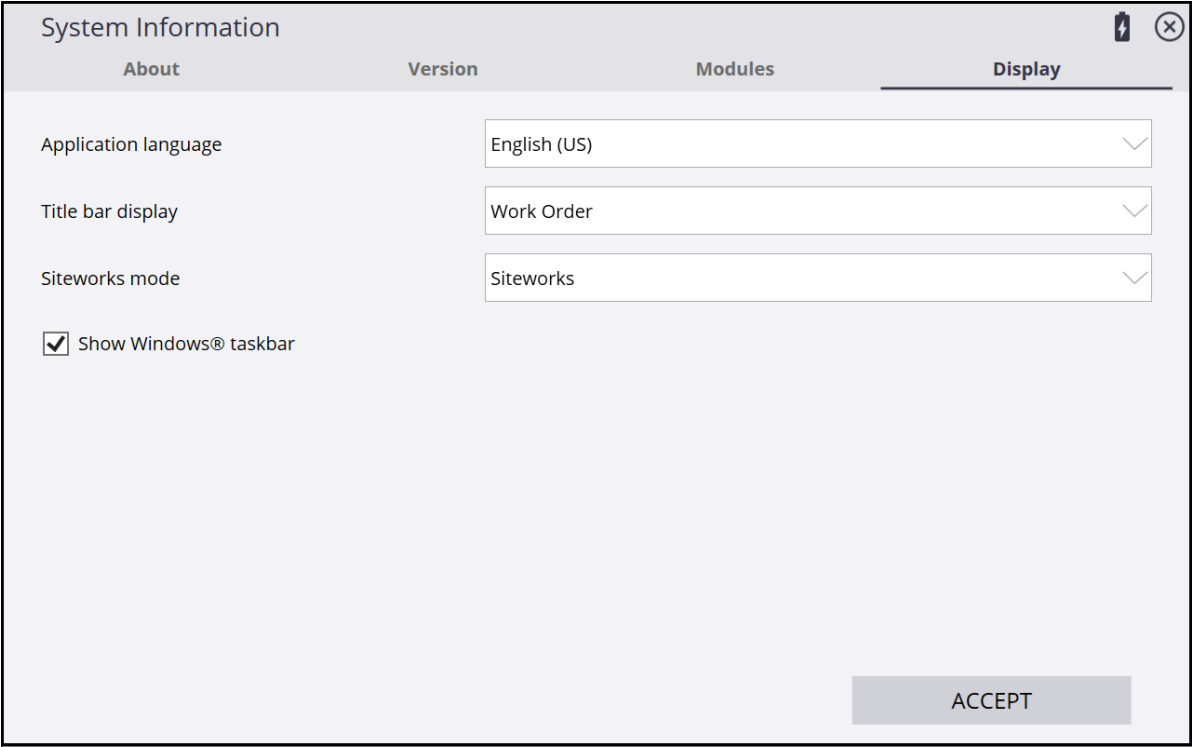
About Version **Modules** Display

UPDATE LICENSE

Module	Status
Rodding Stakeout and Measurement	Enabled
Advanced Measurement	Enabled
Options	
FakePosition	Enabled

ACCEPT

In the **Display** tab, you can toggle between the different supported and installed languages, select what to display in the Title Bar (Project Name, Design Name, or Work Order name), and switch into Siteworks SE Starter Edition mode. Additionally, for Windows systems there is a checkbox to display the Windows taskbar at the bottom of the screen:



Siteworks modules

Modules are available that you can purchase to activate additional features in Siteworks. The following table outlines what features are enabled by each module:

Module	Features
Roading Stakeout and Measurement	<ul style="list-style-type: none">• Stake corridor features, custom features, custom segments• Stake catch points on corridors• Stake location on corridors• Enter/Edit corridors• Load and use .pro design files

Module	Features
Advanced Measurement	<ul style="list-style-type: none"> • Feature Coding (FXL) • Measure functions: measure offset points and lines, extend, close and curve lines • Measure a control network with total station • Measure a traverse with total station • Connect to a utility locator • Enable streaming output of positioning information (Windows only) • Connect to an SX12 scanning total station (Windows only) • Export LAS/LAZ Point cloud data collected with the SX12 scanning total station (Windows only)
Machine Guidance	<ul style="list-style-type: none"> • Requires the purchase of the Siteworks Machine Guidance Hardware kit • Connect to the necessary sensors and hardware to enable Machine Guidance • Use Siteworks on a machine to obtain bucket cutting edge positions

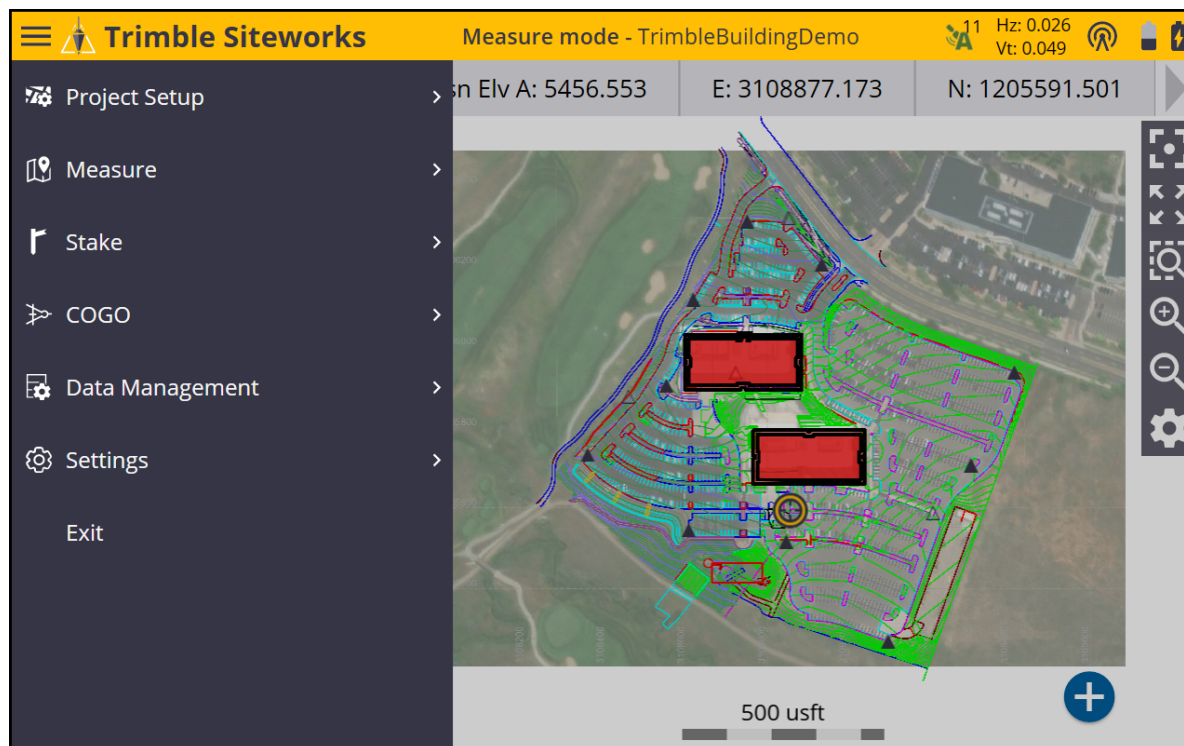
Menus


- Home menu
- The Project Setup menu
- The GNSS menu
- The Total Station menu
- The Measure menu
- The Stake menu
- The COGO menu
- The Data Management menu
- The Settings menu
- The Exit menu
- Navigating the menu using the keyboard
- Ctrl+O menu

The Siteworks software is a menu-driven system. From the **Map** screen you can access the menus through the **Home** button at the top left of the screen (*also known as the Hamburger menu*).

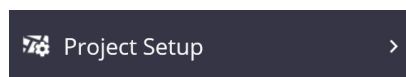
Home menu

The **Home** menu is the main menu of the Siteworks software. It contains the following options:



To access it from any map screen, tap .

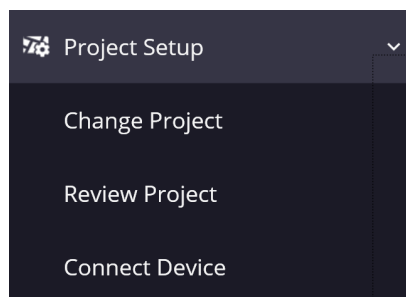
The Project Setup menu




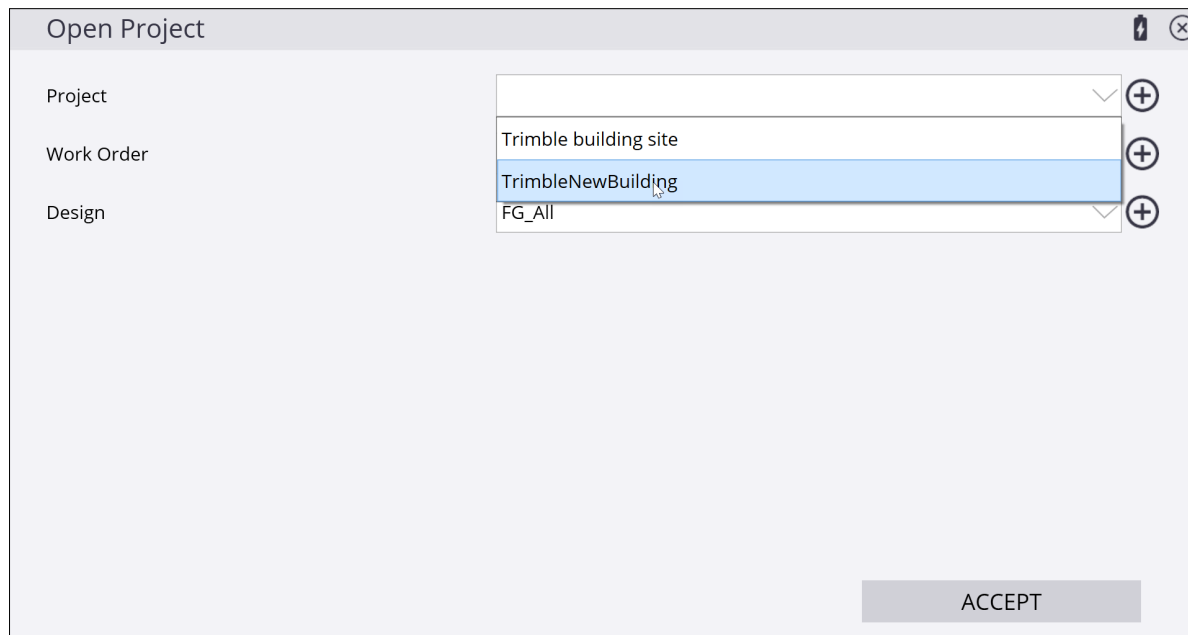
The **Project Setup** menu contains options to manage the details of the project, the tools to create, open, review, and select projects, designs, and work orders. You can also change the design referenced by the current work order and create new designs.

The change and review project buttons are used to create, open, review, and select sites, designs, and work orders.

From the **Home** menu, tap **Project Setup**. This shows the options **Change Project** and **Review Project**:



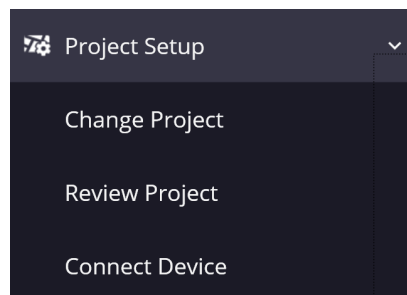
Tap **Change Project** to create a new project, design, and work order, or select from existing projects on the controller. The **Open Project** screen appears. To select an existing project, work order, and design on the collector, tap on the row. To create a new project, work order, and design, tap  to the right of the row or select **Create New**:



The 'Open Project' screen displays a table with three rows: 'Project', 'Work Order', and 'Design'. The 'Project' dropdown menu is open, showing a list of options: 'Trimble building site', 'TrimbleNewBuilding' (highlighted), and 'FG_All'. To the right of each row is a plus icon (+). At the bottom right, there is an 'ACCEPT' button.

Tap **Review Project** to show the names of the currently loaded project, work order and design, along with the **Settings** of distance and angle units, coordinate order and other site settings.

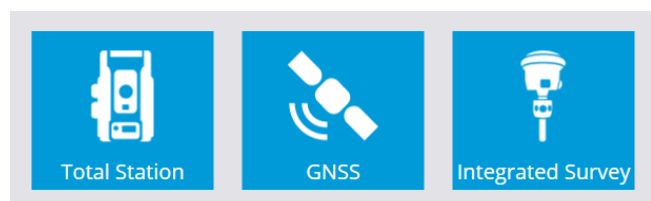
The **Connect Device** menu is used to connect a total station or GNSS to Siteworks.



Select **Connect Device** and then either **Total Station** or **GNSS**.



Users with the Advanced Measurement Module starting with version 1.70 will see an additional option for **Integrated Survey**.



This takes you through the setup of the selected instrument. For information on the use of these, see [Measuring with GNSS, page 129](#), [Measuring with a Total Station, page 182](#), and [Integrated Survey, page 204](#).

When a positioning device is connected, the tabs under **Project Setup** change depending on the device type that is connected. These different menus are outlined below. See [The GNSS menu, page 18](#) and [The Total Station menu, page 18](#).

The GNSS menu

When a GNSS is connected to Siteworks, use this menu to connect to the rover receiver, carry out a site calibration, and select a predefined coordinate system if a calibration has not yet been performed. You can also recheck the system setup on a control point.

From the **Home** menu, tap **Project Setup**.

The following commands are available:

Command	Description
Connect Device	Set up and start a GNSS base station, rover receiver, or start the internal GNSS of the controller.
Coordinate System	Select a predefined coordinate system from the coordinate system library. This option is only available for sites that have not been calibrated or do not yet have a coordinate system assigned.
Project Calibration	Perform or resume a single-point, two-point, or multi-point site calibration, and review the calibration when it is completed.
Recheck System	Check the existing site calibration and base station location by checking in on a known control point.

The Total Station menu

When a total station is connected to Siteworks, use this menu to connect to the instrument and carry out total station setup to establish the position and orientation of the instrument. General functions in this menu include being able to recheck the system setup on a control point or set the total station into Machine Control mode.

From the **Home** menu, tap **Project Setup**.

The following commands are available from this menu:

Command	Description
Connect Device	Connect to the total station using either a cable, Bluetooth® wireless technology, or a 2.4 GHz radio for robotic operation. Tapping this button when connected to a device will ask if you would like to stop the current connection.
Disconnect	Disconnect from the currently connected total station. This will allow for a new connection to either another total station or GNSS.
Total Station Setup	Set up the total station and establish its position and orientation on the site using a known control point or arbitrary location (also known as free station or resection) methods.
Machine Control Setup	Set up the instrument for machine control.
Recheck System	Check an existing instrument setup on a known control point.

The Measure menu



The software always initially starts in Measurement mode. Use this option to switch between stakeout and measure modes.

From the **Home** menu, tap **Measure**.

In this menu, you can accomplish all site measurement functions including:

- Grade checking
- Material thickness checking
- Topographic measurements to create surface models (for example, volume computations)
- Site point and line feature measurements to record the location of non-surface features
- Real-time cut/fill information against a selected design model
- Stockpile Scanning if a total station is connected
- Point cloud laser scanning if connected to an SX10 or SX12 scanning total station

Before you use this menu, you must connect and set up your GNSS or total station in the **Home** menu. If you have not yet done a system setup when you select an option in this menu, the software automatically prompts you to go through the station establishment process for either a total station or the rover setup for GNSS.

In the **Point type** of the **Measure Type** tab, you can define if measured points are to be stored as part of a Digital Terrain Model (DTM) surface or only as a site feature and not included in any surfaces. This menu can also be accessed from the main screen by tapping the **Measure Type** button:



Select **Surface** or **Feature** from the **Point type** field to choose if the point or line will be included in a surface or just stored as a feature. When the Advanced Measurement module is installed, the measurement type is controlled by the settings in the FXL file Feature Code Library for each feature code.

Measure Type

11 Hz: 0.026 Vt: 0.049

Point

Existing Line

New Line

Point name

Topo10

Point code

Point type

Surface

Show every time

Yes

ACCEPT

Lines are measured by selecting one of the Line tabs: **New Line** or **Existing Line**.

Selecting **Existing Line** enables the selection of an existing line from a table and the continuation of measuring that line from the last measured end point along it.

Selecting **New Line** requires entering a **Line Name** and choosing what kind of line type it is. Line types that are included in the DTM surface measurement are Breaklines, Volume Boundaries, and Outer Boundaries. Lines and areas are not included in the DTM surface measurement. Areas, volume boundaries, and outer boundaries will be automatically closed to form a closed polygon when the measurement is complete and either a new line or point is selected to be measured.

Measure Type

Point Existing Line **New Line**

Line name Line1

Line type

Line

Area

Breakline

Volume Boundary

Outer Boundary

ACCEPT

The Stake menu




The **Stake** menu contains all stakeout functions including staking points, lines, alignments, surfaces, side slopes, catch points, and corridor features.

From the **Home** menu, tap **Stake**.

After entering the stakeout function, the **object selection** screen appears. Select the object that you want to stake out either by tapping directly on it in the map or from the list in the top right corner of the screen, by

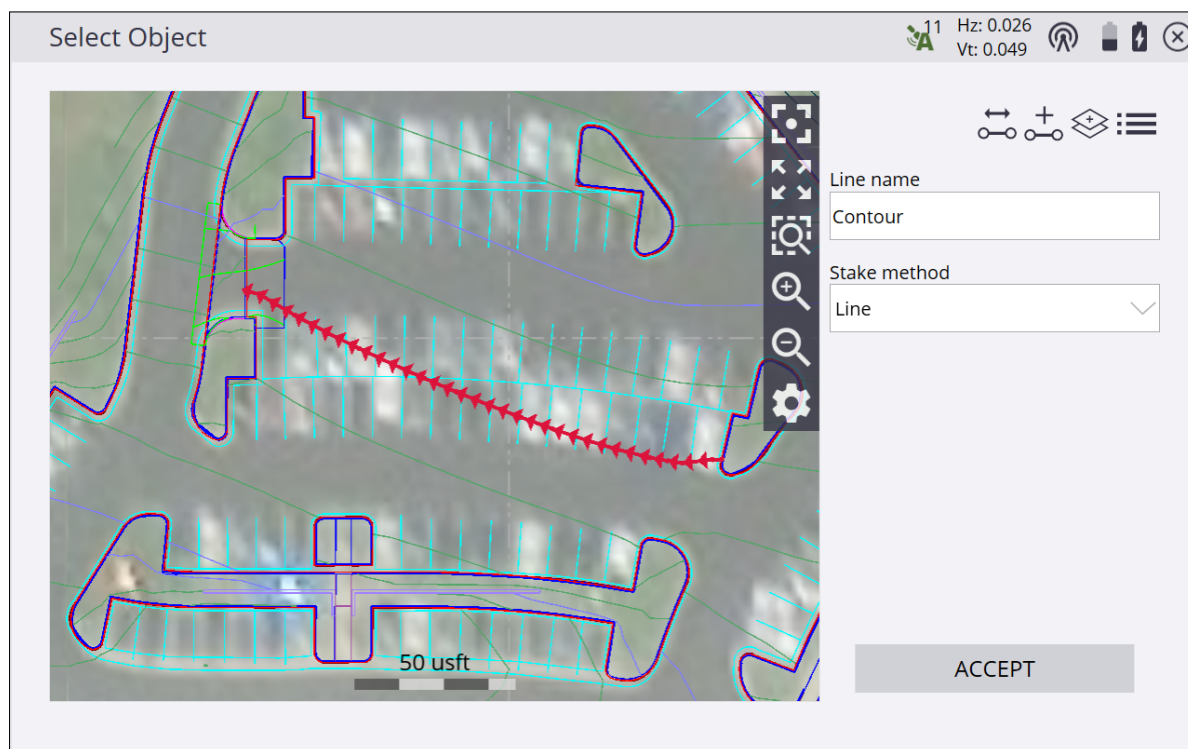
selecting .

To stake a user-defined plane, select .

To define a new line to stake, select .



After you select an object, multiple stake methods are available that differ depending on the type of object that you selected. For more information, see [Stakeout Workflow, page 107](#).



The COGO menu

 COGO


The **COGO** (Coordinate Geometry) menu contains several features, such as area, distance, bearing, slope, and point generation functions, which can be used to generate points for stakeout operation from CAD or measured data in the currently loaded design and work order. The menu also provides access to review and edit functions for editing breaklines and deleting points or lines to resolve surface modeling problems. The items in the **COGO** menu can also be used to create designs in the field for use in machines or within Siteworks.

From the **Home** menu, tap **COGO**.

The following commands are available from this menu:

Command	Description
Review & Edit Data	View or delete point and lines, add breaklines and boundaries, compute distance, areas and angles, calculate surface volumes (stockpiles) or periodic progress volumes, generate contours of measured data, and enter 3D surface viewer mode.
Create Points/Arcs	Create points, lines, boundaries, arcs, and circles by a variety of methods including free point, bearing and distance, radius, and offset to a line. To create free points, tap the screen or enter its coordinates.
Key In Corridors	Enter a basic corridor alignment and corridor cross sections in the field. This function requires the Roading module and is only available on Windows operating systems.

The Data Management menu

 Data Management


Use this menu to view and edit points, import and export data or selected design information to an external memory device such as a USB flash drive. An alternative is to use the Trimble WorksManager service for real-time data sharing. The menu also includes export functions for data use in the GCS900, Earthworks or AccuGrade grade control systems.

From the **Home** menu, tap **Data Management**.

The following commands are available from this menu:

Command	Description
Point Manager	View, create, edit, and delete control, stakeout, and design points in a list format of points in the currently selected work order.
Export Measured Data	Export measured data as a CSV custom point file format, DXF file, Record.txt file, or Network measurements for Advanced Measurement Module users.
Surface as Design	Write the surface data measured in the currently open work order to a new design surface as a .TTM file.

Command	Description
Export to Machine	Export a design to use with the GCS900 Grade Control System or Trimble Earthworks. On the Windows operating system, you can export a design to a CompactFlash card or USB drive. On the Android platform, the design is exported to the path: Internal Storage\TrimbleSync\Siteworks\MC Data.
Streaming Output	Stream position output from a GNSS or total station via a COM port. This option requires the Advanced Measurement Module and is only available on Windows systems. See Streaming data output, page 69
Log	View a data log of the project to date including tasks performed and their detailed measurement settings. Import a comma, tab, or semicolon delimited point file in various formats. For more information, see page 54 .
Grade Report	View a summary of all the grades checked.
WorksManager Sync	Synchronize data with the WorksManager service using the Wireless Data Sync function.
WorksManager Settings	Enter the device credentials to access the Trimble WorksManager services.


The Settings menu



Use this menu to change or view the current settings in the project. This is the menu where you can view the system settings and access multiple project settings such as display, eBubble, and the various types of measurement settings.

From the **Home** menu, tap **Settings**.

The following commands are available from this menu:

Command	Description
System Info	Access the current software version, modules and license information and change the display language.
Map Display Settings	Change display options for measure mode, the design and the map layers. Change the screen view direction and switch which panels are displayed. You can also access this menu by tapping  on the main map screen.
eBubble	Calibrate the eBubble and change the tolerance and sensitivity settings. Only available for receivers with an inertial measurement unit such as the SPS986 or R780.
Measure Mode	Switch measurement modes between standing, walking, vehicle, static and EZ level.
Info Bar/Panel	Change what information is displayed in the information bar and panel.

Command	Description
Measure	View and change the measurement tolerances and settings such as the Default point input field to point name or point code, measurement offsets, and tolerance above/below for setting in-tolerance values.
Stakeout	View and change the stakeout tolerances and settings such as horizontal tolerance, stake marking method, working stake length, cut/fill interval, and default station mode of fixed/random.
Corridor	View and change the settings when in a project using corridor stakeout such as the station interval, auto advance settings, tangent point preferences, subgrade offset, view settings, and guideline offsets.
Surface Settings	View and change the settings for a surface, including the surface offset, the offset type of vertical or perpendicular, and the offset direction of above/below.
Second Surface	View and change the settings when a second surface is being used.
Reference Line	Select and set the settings for a reference line.
Avoidance Zone	Set the tolerances for the avoidance zones loaded into the project.
Catch Point Marking	View and change the settings to be used when staking a catch point.
Total Station Settings	Enter the total station settings to change the scale factor, atmospheric corrections, enable raw data outputs, and change radio settings. This option is available only when connected to a total station.
Total Station Calibration	Enter the total station compensator and collimation calibration routine. See Adjusting the total station, page 240 .
Display Units	Change the displayed units between Decimal feet, Decimal inches, and Fractional inches on projects that are in US Survey or International Feet. See Display units, page 50 .
PDF Settings	Add a company logo and header information to exported PDF reports.

The Exit menu

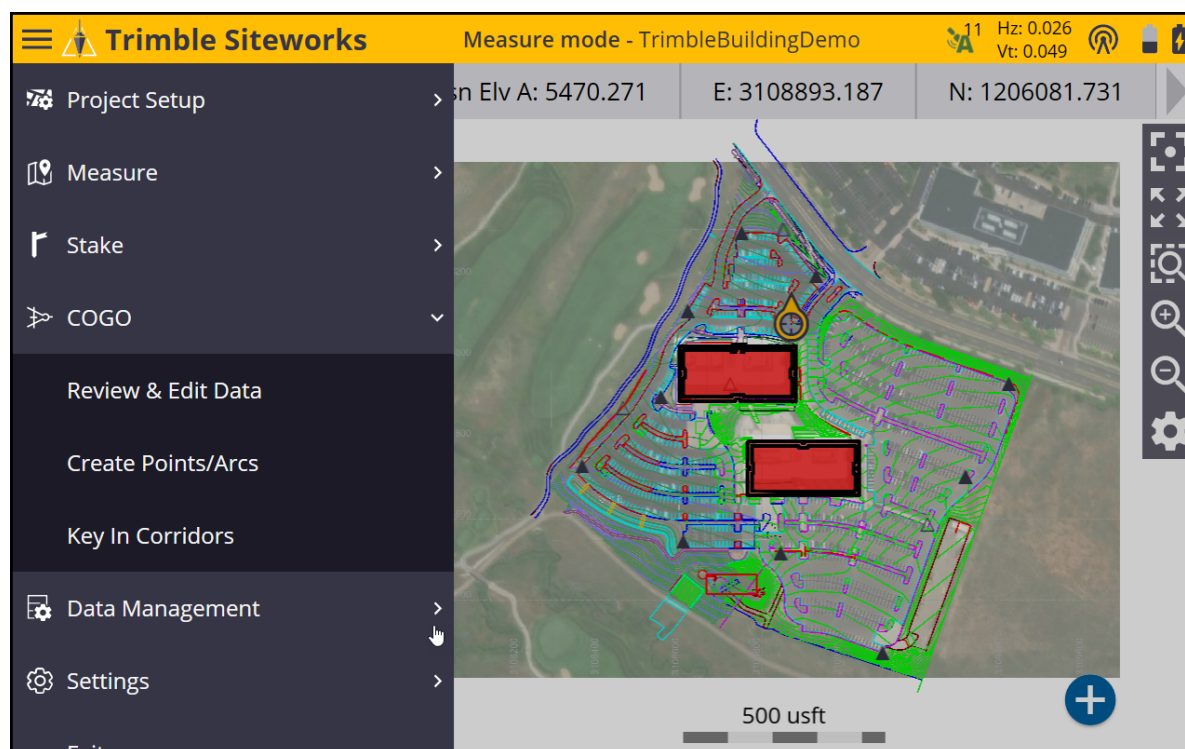
Exit

This menu closes the Siteworks software, and optionally can power down the GNSS receiver.

From the **Home** menu, tap **Exit**.

Navigating the menu using the keyboard

Either tap on the **Home** menu or select the **Home** button on the TSC7 or TSC5 controller, Trimble T7 or T100 Tablet, Site Tablet 10, or laptop/PC. Use the up and down arrows to navigate up or down the menu. The current selection will be highlighted yellow in the menu. To select a menu item, either press the right arrow key or the enter key. Press the left arrow key to unselect an item.



Ctrl+O menu

The **Ctrl+O** menu is a settings menu that contains several important options to configure Siteworks. Tap **Ctrl+O** (letter O, not the number zero) when on the main screen to open the **Settings** menu. This menu is accessible on Android systems, but can only be accessed by the keystroke combination. Therefore, a virtual keyboard with a **Ctrl** button or an external keyboard is necessary to access this menu.

Settings

☐ Prompt for check on control

☐ Prompt for system tap and hold check

☐ Prompt for published coordinate system calibration

☒ Enable Emulated Receivers and Instruments

☒ Enable Utility Locator Setup

☐ Enable NOD Export option

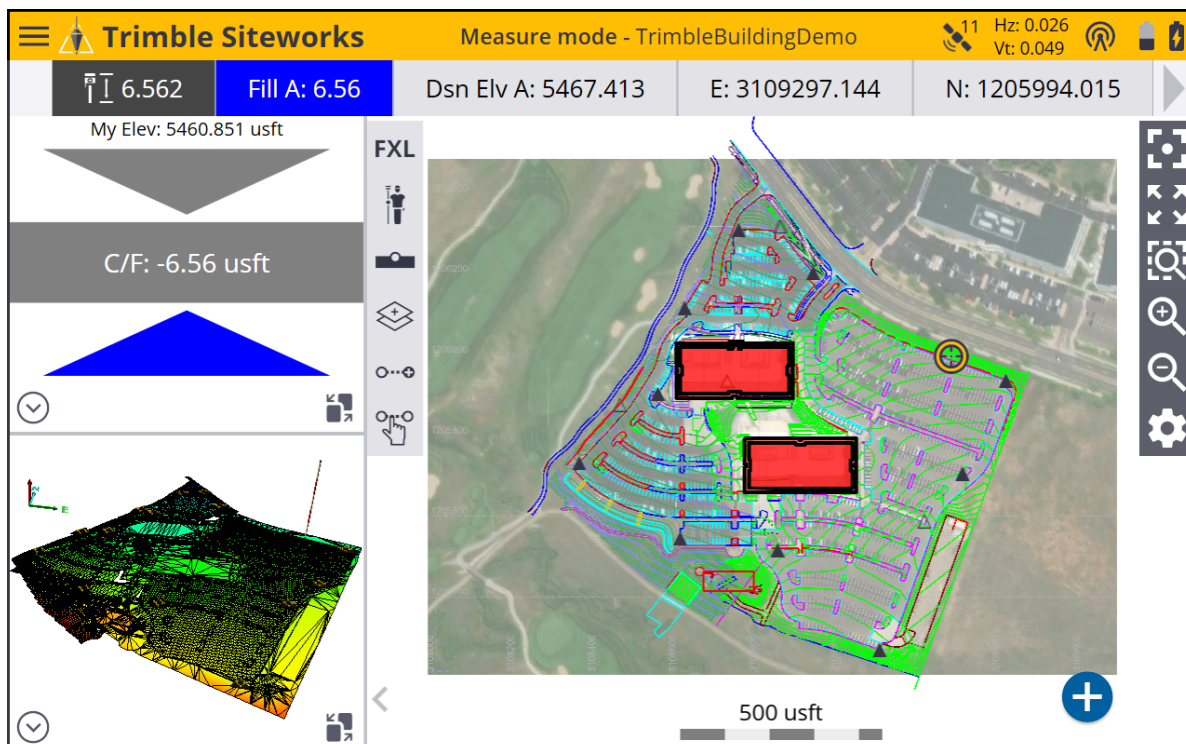
ACCEPT

Option	Description if checkbox selected
Prompt for check on control	When opening a project, you will be asked if you want to recheck the system setup by checking in on a control point.
Prompt for system tap and hold check	If Siteworks determines that the system OS tap and hold has been disabled, it prompts you to turn it on.
Prompt for published coordinate system calibration	If a published coordinate system is being used, Siteworks will prompt to perform a GNSS calibration.
Enable Emulated Receivers and instruments	Allow Siteworks to be used in an emulator mode by selecting emulated GNSS or UTS during the device connection.
Enable Utility Locator Setup	Turns on the ability to use utility locators. Requires Advanced Measurement module. See Utility Locator Workflow, page 257 .
Display Scale Factor Option at Connection	Siteworks will display the corrections tab of the Total Station Settings to set the total station scale factor when opening a project. This option was removed in v1.70.
Enable NOD Export option	Enables the ability to export measured data as a .NOD file in the Data Management / Export Measured Data .

Measurement Screen

- Measure modes
- Status bar
- Precision GNSS control icons
- Map controls
- Toggling between the panels
- Info Bar and Info Panel
- Antenna Height/Target Height
- Display units

The Siteworks software is a menu-driven system. From the **Map** screen you can access the menus through the **Home** button at the top left of the screen. The main map screen contains three panels. One large panel called the main panel, and two small panels on the left side of the screen called the top panel and bottom panel. These can be set up to display different types of information such as a plan view, 3D surface viewer, cut/fill and horizontal lightbars, eBubble, cross section and profile views, and a live video view when connected to an SX12 scanning total station.









Measure modes









The Measure mode controls several functions for the GNSS receiver and total station. There are multiple modes available, which you can switch between by tapping the **Measure mode** icon on the left side of the main map screen.


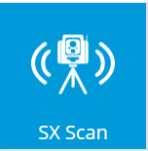



GNSS measure mode


GNSS measure mode	Name	Description
 Standing	Standing	Walk to a point and then take a single measurement.
 Walking	Walking	Walk the site and continuously take measurements. Points are measured based on a setting for horizontal distance and elevation change, at regular time intervals, or when the GNSS receiver is level. See Measure when level , page 90.
 Vehicle	Vehicle	Drive the site in a vehicle. Points are stored based on a setting for horizontal distance and elevation or at regular time intervals. This feature contains an additional function to measure the antenna height by parking the vehicle over a known elevation point.
 Static	Static	Measure a point for a longer period and to achieve a greater accuracy through position averaging.
 EZ Level	EZ Level	Graphically display elevations on a site relative to an arbitrary benchmark. See EZ Level measurement , page 89.
 Machine	Machine	Use Siteworks on an excavator. This requires the Machine Guidance module and an additional hardware kit. See Siteworks Machine Guidance , page 1.

Total Station measure mode

Total Station measure mode	Name	Description
 Standing	Standing	Walk to a point and then take a single measurement.
 Walking	Walking	Walk the site and take continuous measurements. Points are stored based on a setting for horizontal distance and elevation change or at regular time intervals, which can be set by tapping the Measure mode icon either in the status bar or in the Trimble icon menu.
 Vehicle	Vehicle	<p>Drive the site in a vehicle. Points are stored based on a setting for horizontal distance and elevation change or at regular time intervals, which can be set by tapping the Measure mode icon either in the status bar or in the Trimble icon menu.</p> <p>This feature contains an additional function to measure the antenna height by parking the vehicle at a known elevation point. Measurements are acquired at 3 Hz for all prisms except the MT1000 and MT900. The MT1000 can produce measurements at 10 Hz and the MT900 can operate at 20 Hz.</p>
 Averaging	Averaging	Measure a point in multiple faces/rounds and display the standard deviation between measurements.
 DR Mode	DR	Measure a point using a DR reflectorless total station.
 DR Target	DR Target	Measure a point using a DR reflectorless total station that adds a user-defined distance amount, up to 5 m, along the straight-line beam path from where the beam reflects off the surface.
 DR Scanning	DR Scanning	Operate the total station in a scanner mode by manually turning the total station and setting a distance interval to measure points over. This option is replaced with the SX scan option when connected to an SX12 scanning total station.
 DR Averaging	DR Averaging	Measure a point in DR mode using multiple faces/rounds and display the standard deviation between measurements.

Total Station measure mode	Name	Description
 EZ Level	EZ Level	Graphically display elevations on a site relative to an arbitrary benchmark. See EZ Level measurement, page 89 .
 SX Scan	SX Scan	Perform a point cloud laser scan when connected to an SX10 or SX12 instrument. This option requires the Advanced Measurement Module.


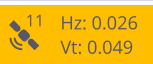

The icon below the **Measure mode** icon on the left side of the main panel below the map control is the **Measure type** icon. This is used to select either point, existing line or new line. 

When in stakeout mode, this icon changes to enable you to select the stake method. The options in this tab are discussed in [Slope staking, page 115](#) .




Status bar

The status bar icons at the top right of the screen contain relevant information about the current status of the positioning system, battery status, measure mode, and measurement type. The icons change depending on the positioning device. The following icons are typically available:


GNSS mode

Icon	Description
	The radio connection status to the base station. Clicking on this provides access to the Radio Information menu. This icon changes depending on how corrections are being received.
	The number of satellites being tracked and the horizontal and vertical precision of the GNSS position solution. Clicking on this opens the GNSS status menu. This icon also gives an indication of the alignment status for tilt-compensation enabled receivers.
	The battery level of the controller and externally connected GNSS receiver.

Total Station mode

Icon	Description
	Indicates the total station is in Target Tracking mode and provides access to the total station control panel. A lock button appears when the instrument is locked onto a prism.
	Indicates the total station is in Standard mode and provides access to the total station control panel. A lock button appears when the instrument is locked onto a prism.
	Shows the battery level of the controller and total station.

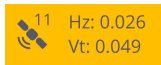


Integrated Survey mode

Icon	Description
	Button to change active positioning instrument. The button slider is on the side of the active instrument. Left is GNSS, right is Total Station.

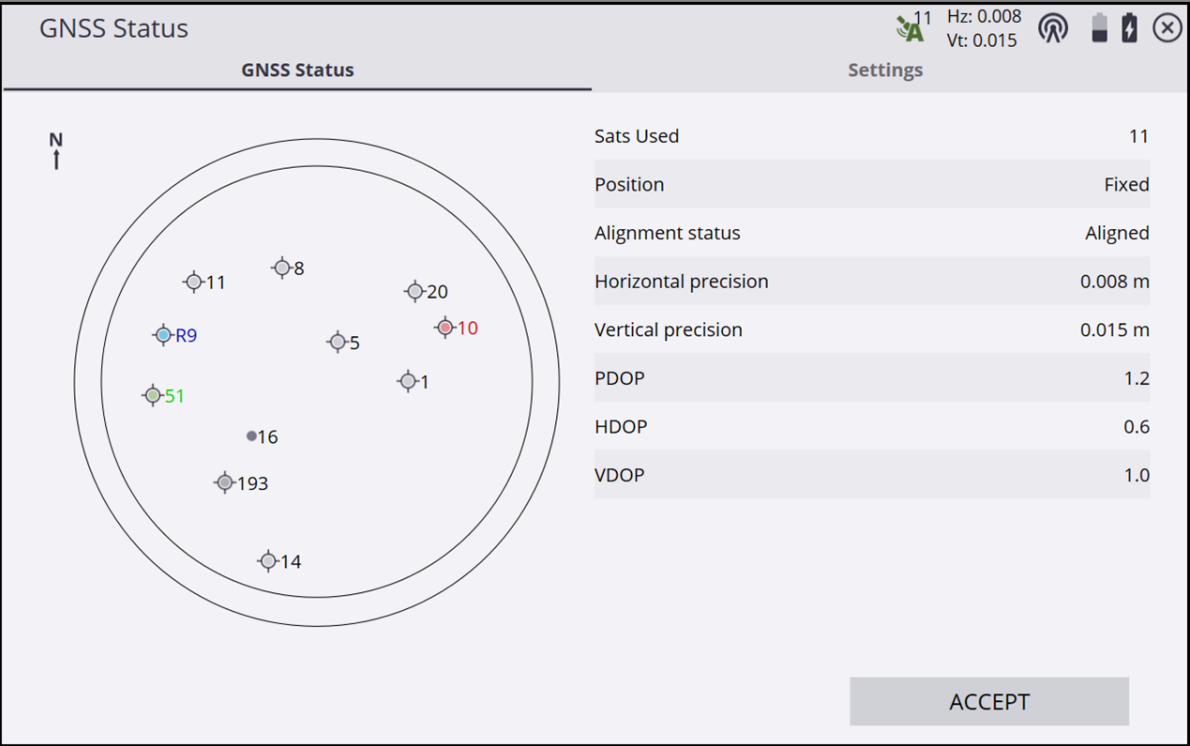
Precision GNSS control icons

When using the internal GNSS or while connected to an external SPS receiver, an icon panel appears at the top right of the screen.

GNSS mode

This icon...	shows...
	how many satellites are being tracked and the horizontal and vertical precision of the GNSS position solution.
	the radio connection status.
	the battery level of the controller and GNSS receiver.

Tap one of these icons to show more detailed information. To access the sky plot of the current satellite constellation, tap the **Satellite** or the **Precisions** icon. The screen defaults to the **GNSS Status** sky plot view. The current Position, Horizontal, and Vertical Dilutions of Precision (DOP) values are also displayed, in addition to the position status, number of satellites used in the solution, and the alignment status of tilt-compensated receivers.



The icons in the sky plot represent the following satellite constellations:

This icon...	shows...
	GPS
	BeiDou
	Galileo
	GLONASS
	QZSS
	SBAS
	Satellite not used in position

The **Settings** tab is a shortcut to the **RTK Precision** option. If the precisions of the GNSS rise above these values, the info bars flash red and a warning pops-up if a measurement is attempted. The **GPS Only** checkbox enables you to toggle between using GPS and GNSS satellite constellations. A toggle for the receiver's Wi-Fi is present, along with the ability to enable or disable tilt-compensation for compatible receivers.




While in the **GNS Status** screen, you can set the elevation mask of the GNSS rover receiver by pressing **Ctrl+M** on the controller's keyboard. Note that you must use the virtual Windows keyboard on a T7, T10, or Site Tablet 10 to access the **Ctrl** key. The rover's elevation mask setting will also govern the elevation mask used for the satellites received from a base station, as the rover will ignore all satellite data from the base for those satellites below the mask elevation value set on the rover.




Tap the **Radio** icon to open the **Radio Information** screen, where you can view information about the model of the radio, its current channel, the base name, and reception information. You can change the radio channel in this screen.

Map controls

The icons on the right of the main panel enable you to move around the screen and toggle information on and off to improve readability when there is a lot of information shown on the screen. They change depending on what data has been selected to be displayed in the main panel.









Plan View, Cross Section, and Profile view map controls

Icon	Description
	Center the map on the current location.
	Zoom to the extents of the file.
	Zoom to a user-defined box (use a stylus or finger to draw a box on the screen).

Icon	Description
	Zoom in.
	Zoom out.
	View the map display options. Enables you to customize what is displayed on the map screen. You can choose the information that you want to view for the task rather than cluttering the screen with too much information. You can also access this option from the Home menu / Settings / Map Display Settings .

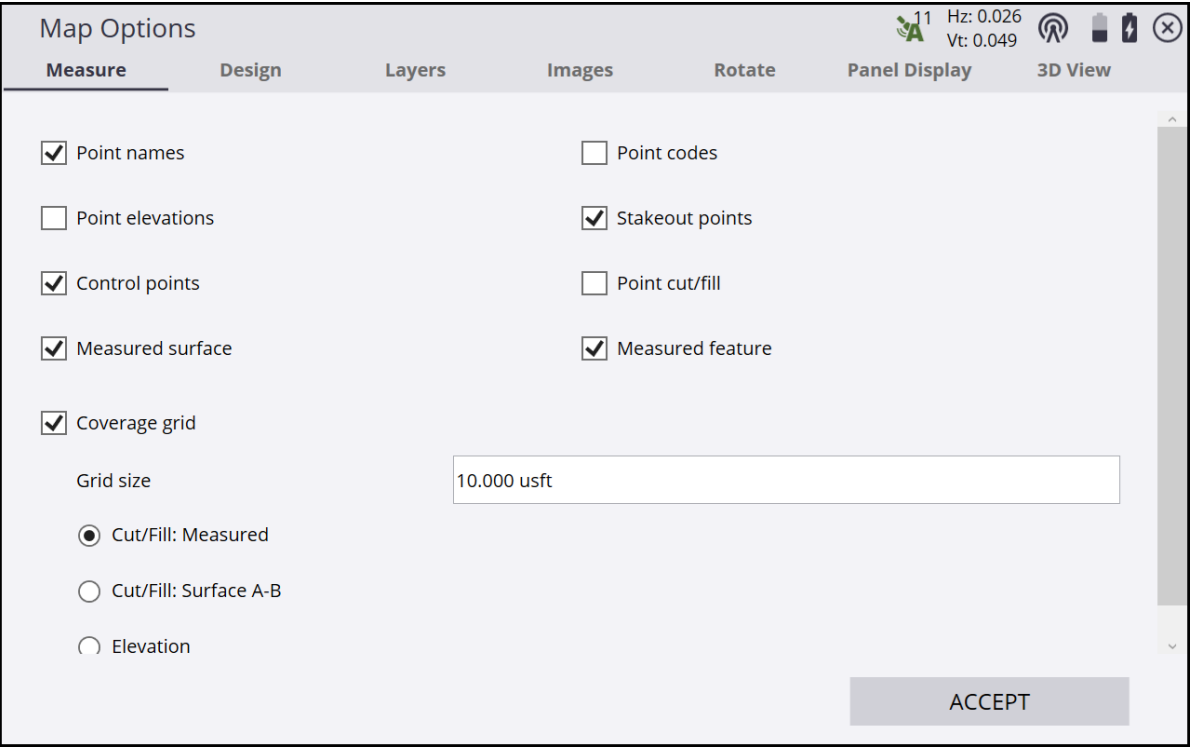
Pinch-to-zoom capabilities are present across all panels when using a controller with a touchscreen.

3D Surface Viewer map controls

Icon	Description
	Center the map on the current location.
	Zoom to the extents of the file.
	3D Orbit by clicking on the map and using the touch screen.
	Zoom. To zoom in, click this and swipe up on the touch screen. To zoom out, swipe down on the touch screen.
	Toggle on or off the TIN/ surface edges.
	Toggle on or off the stakeout flags.
	Open the Surface Selection menu to choose which surface to display.
	View the map display options. Enables you to customize what is displayed on the map screen. This will default to the 3D View tab, where you can select a vertical exaggeration for the 3D surface. If you have a point cloud dataset selected, this button will allow you to turn off/on individual scans.

Map Options: Measure tab

Use the **Measure** tab to filter the different measured data that is being displayed. This is the default tab that is selected every time the **Map Options** icon is tapped:



Select this option...	to display...
Point names	the point names of every point on the map view.
Point elevations	the point elevations of every point on the map view.
Control points	control points on the map view.
Measured surface	measurements that were recorded as a surface.




Select this option...	to display...
Coverage grid	<p>a coverage grid map that shows cut/fill/in tolerance values as shades of red/blue/green respectively between a measured point and the selected design surface, between two design surfaces, or elevation changes as different shades of blue depending on the setting of the radio button.</p> <p>The Coverage grid function has three options:</p> <ul style="list-style-type: none"> • Cut/Fill: Measured – This setting displays a coverage grid based on the current measurement within a grid point relative to the design surface selected in the Open Project screen as different shades of red, blue or green. If there are multiple measured points within a grid cell, the largest cut/fill value is used in the color display. • Cut/Fill: Surface A-B – This setting displays a static coverage grid map of cut/fill between two design surfaces. Surface A is the primary design surface set in the Open Project screen. Surface B is the secondary surface set through the Home / Settings / Second Surface. This display is static and does not update based on any new measurements. It can only be displayed between two existing designs saved in the project. • Elevation – This setting displays the relative elevation of grid cell points as shades of blue. Lighter shades of blue are lower in elevation than darker shades. The color scale gradations are distributed evenly across the difference between the maximum and minimum measured elevations. The colors automatically update if a new elevation value is measured. • Grid Size – Using this setting the size of the coverage grid can be changed and set to a scale to meet the needs on site.
Point codes	the point codes of every point on the map view.
Point cut/fill	the cut/fill information for every point on the map view.
Stakeout points	stakeout points on the map view.
Measured feature	measurements that were recorded as a site feature.

Map Options: Design tab

Use the **Design** tab to filter the different design data types that are displayed:

Map Options

11 Hz: 0.026 Vt: 0.049



Measure

Design

Layers

Images

Rotate

Panel Display

3D View

☒ Design

☒ Project map

☒ Guide arrow

☒ Stakeout flags

☒ Corridor

☒ Cross-section lines

☒ Cross-section slopes

☐ Lightbar sound

☐ Design contours

Contour interval

3.000 usft

Stakeout guide

Receiver Bearing

Cut/Fill precision

0.00

ACCEPT

Select this option...	to display...
Design	the design map on the map view.
Guide arrow	the guidance arrow to navigate to points of interest.
Corridor	the center line of any corridor design.
Cross-section slopes	display the slope values for each segment of a cross section.
Project map	the project map on the map view.
Stakeout flags	stakeout flags on the map view.
Cross section lines	the cross sections of any loaded corridor design.
Lightbar Sound	an indicator sound when approaching the design elevation.
Design contours	contours on the map view, if a design is loaded.
Contour interval	sets the contour interval for the displayed design contour lines.

Select this option...	to display...
Stakeout guide	<p>Set the behavior of the fine stakeout guide bull's-eye when within 2 m of a stakeout point.</p> <p>If you are using a GNSS receiver and select the North/Instrument Orientation option, the guide arrows to the point are orientated to face north.</p> <p>If you are using a total station and select the North/Instrument Orientation option, the guide arrows to the point are orientated to face the instrument.</p> <p>If you select the Approach option, it orients the guide arrows towards the point being staked based on your direction of travel. Your direction of travel is shown as the forward/up direction on the screen of the controller.</p> <p>If you select the Receiver Bearing option, it orients the guide arrows towards the direction the GNSS receiver is facing. This mode requires Tilt Compensation to be enabled and can only be used with a Tilt Compensation compatible GNSS receiver. If Tilt Compensation is not enabled, the guide arrows default to North.</p> <p>The Hide option does not show the guide.</p>
Cut/Fill precision	Determines the number of decimal places displayed in the info bars on the map screen and for the cut/fill of individual points if the Point cut/fill option is selected in the Measure tab.
Cross-section vertical exaggeration	Enter a value to vertically exaggerate the cross section or profile view. This can be a value from 0.05 to 50 and is applied to both the cross section and profile views.
Show vertical exaggeration text	Check this box to show an onscreen indicator of the currently entered vertical exaggeration text.

Map Options: Layers tab

Use the **Layers** tab to turn individual or all layers on and off in the design map to improve readability if there is a lot of data in the linework of the current design file.

Map Options

Measure Design **Layers** Images Rotate Panel Display 3D View

UNSELECT ALL

Name	Entities
<input checked="" type="checkbox"/> FD_-_BUILDING_PAD	2
<input checked="" type="checkbox"/> FD_-_BREAKLINE_-_MANUAL	8
<input checked="" type="checkbox"/> FD_-_BUILDING_OUTSIDE_AREA	2
<input checked="" type="checkbox"/> FD_-_CONTOURS	466
<input checked="" type="checkbox"/> FD_-_CONTOURS_-_PARKING_LO	29
<input checked="" type="checkbox"/> FD_-_CONTOURS_-_ROADS	28
<input checked="" type="checkbox"/> FD_-_CONTOURS_INDEX	42
<input checked="" type="checkbox"/> FD_-_CURB_FLOW_LINES	20
<input checked="" type="checkbox"/> FD_-_CURB_TOP_BOC	27

ACCEPT

To toggle on and off individual layers, select/deselect the checkbox next to their names.

To toggle on and off all layers, tap **Select/Unselect All Layers** at the top of the screen.

To change the width of the two columns, tap and drag on the divider in the top title row.

Tap the **Name** or **Entities** column title to sort the columns.

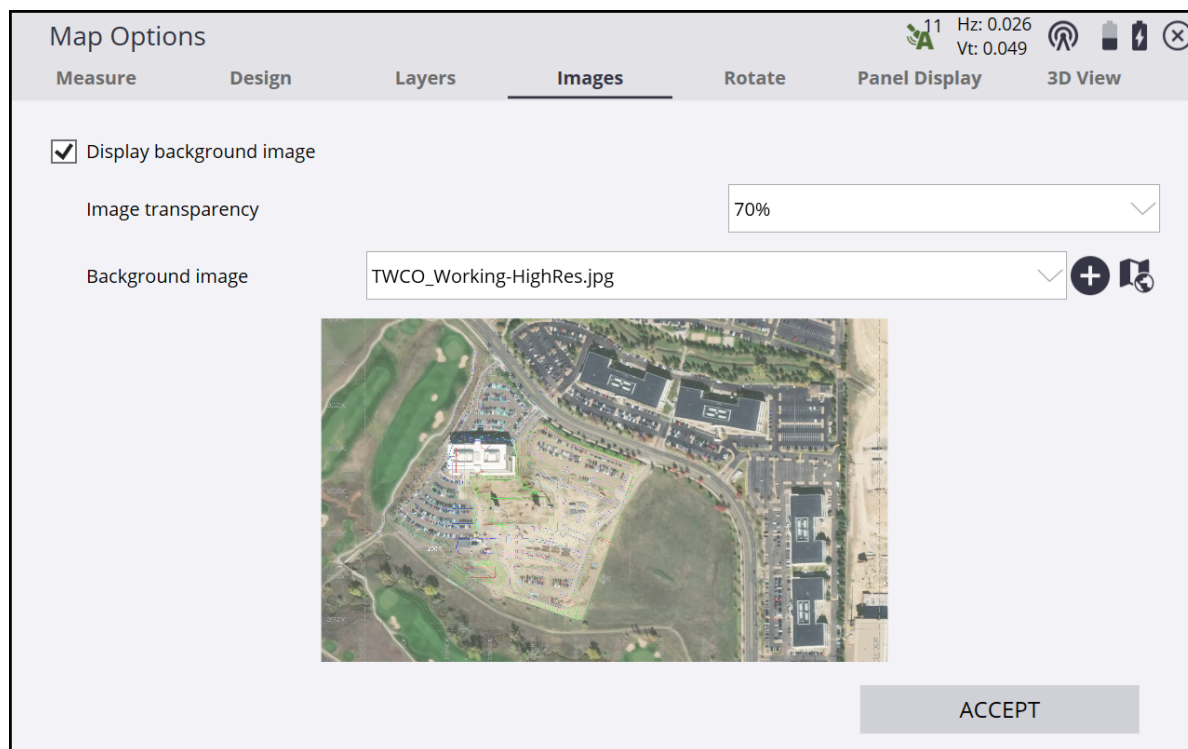
Map Options: Images tab

Use the **Images** tab to select a raster image to display as a background image beneath the design linework. Supported file formats for images are BMP, JPG, GIF, PNG, and TIFF.

From version 1.70, Siteworks can perform the georeferencing directly within Siteworks. You can also import PDF files to use as the background image. Prior to version 1.70, for background images to be displayed in the correct location required an associated World file created in other software, for example, the Trimble Business Center software.


A World file is an associated text file that provides georeferencing information for the image file. The World file contains the northing and easting of the upper left pixel in the current project's coordinate system along with horizontal and vertical pixel dimensions, and rotation parameters. The World file must have the exact same file name as the image file, with the appropriate file type suffix. The format for the World file suffix is the first and last letters of the raster image suffix, plus the letter "w". For example, a JPG image has a world file suffix of JGW, a TIF file would be TFW, and a BMP would be BPW.

Toggle on and off the display of the selected image in the main map view and set the transparency in the **Images** tab:




To select a new image to load, tap  and navigate to the image to select it.

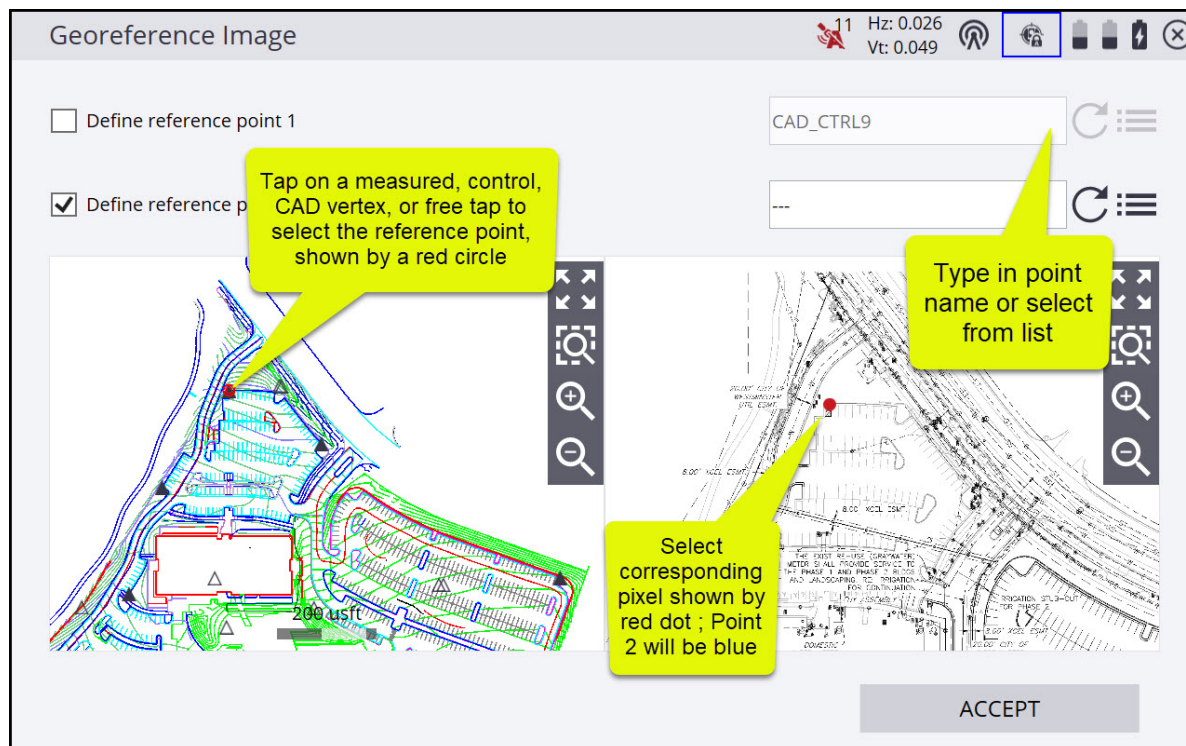
If the image does not have an associated World file, then you can georeference it by tapping the

Georeferencing icon: . Tapping the icon will enter the **Georeference Image** screen. The Siteworks georeferencing process involves selecting two control and/or measured points in the currently open work


order, and then selecting the corresponding points on the raster image. It is also possible to select vertices along CAD lines in the currently open design as the source points. After selecting the two source and image points, the image is scaled and rotated into position and a World file containing the georeferencing information will be created.

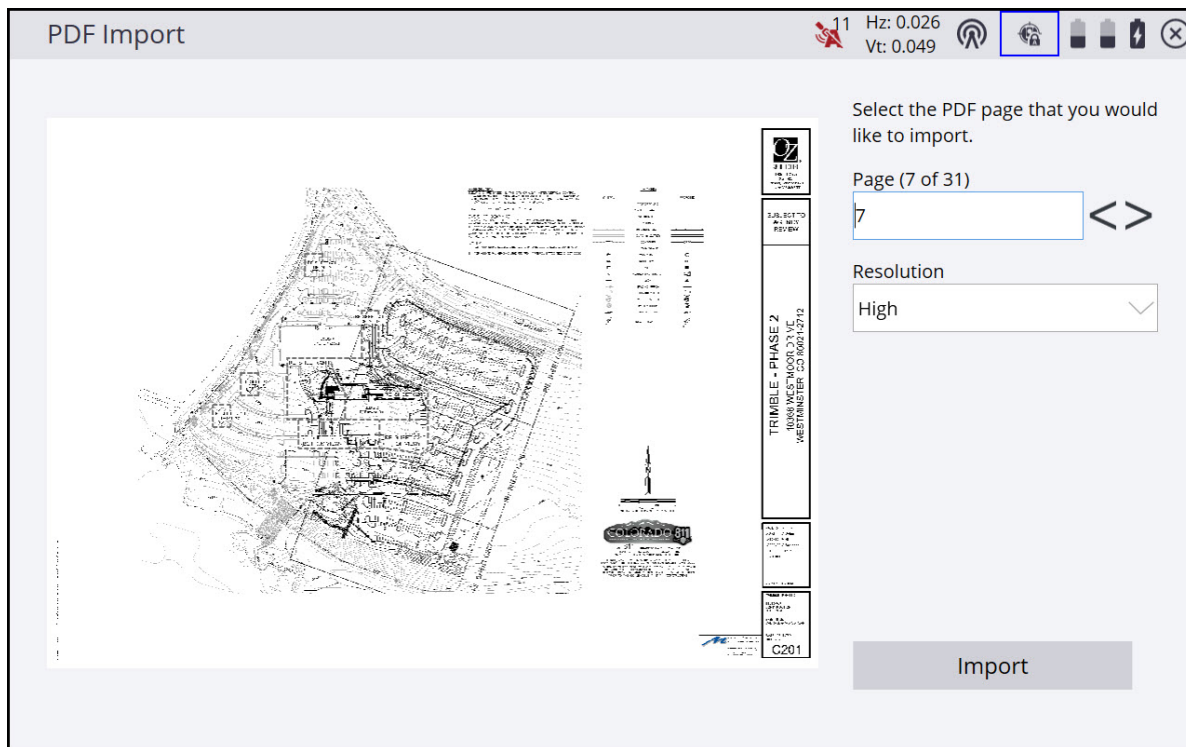
NOTE – Any control or measured points must already be measured before entering the georeferencing workflow; you cannot measure or add points from within the workflow.

In the **Georeference Image** screen, tap a control or measured point, or a vertex of a CAD line in the left window to place a red dot at the reference point. You can also select the point from a point list by tapping . Then tap on the corresponding pixel location on the image in the right panel. Select the reference point two in the left panel and then the corresponding image point two in the right panel. The second set of reference points will be blue. When all the appropriate points have been selected, tap **Accept** to write the World file and return to the main map screen with the newly referenced image displayed.



Siteworks will rasterize both raster and vector type PDFs and convert them into a BMP format raster image. Vector-based PDFs are rasterized and converted to a PNG image. Multi-page PDFs are supported during import by selecting an individual page in a preview window to be imported and converted. Multiple pages from the same PDF are each imported, converted, and manually georeferenced individually.

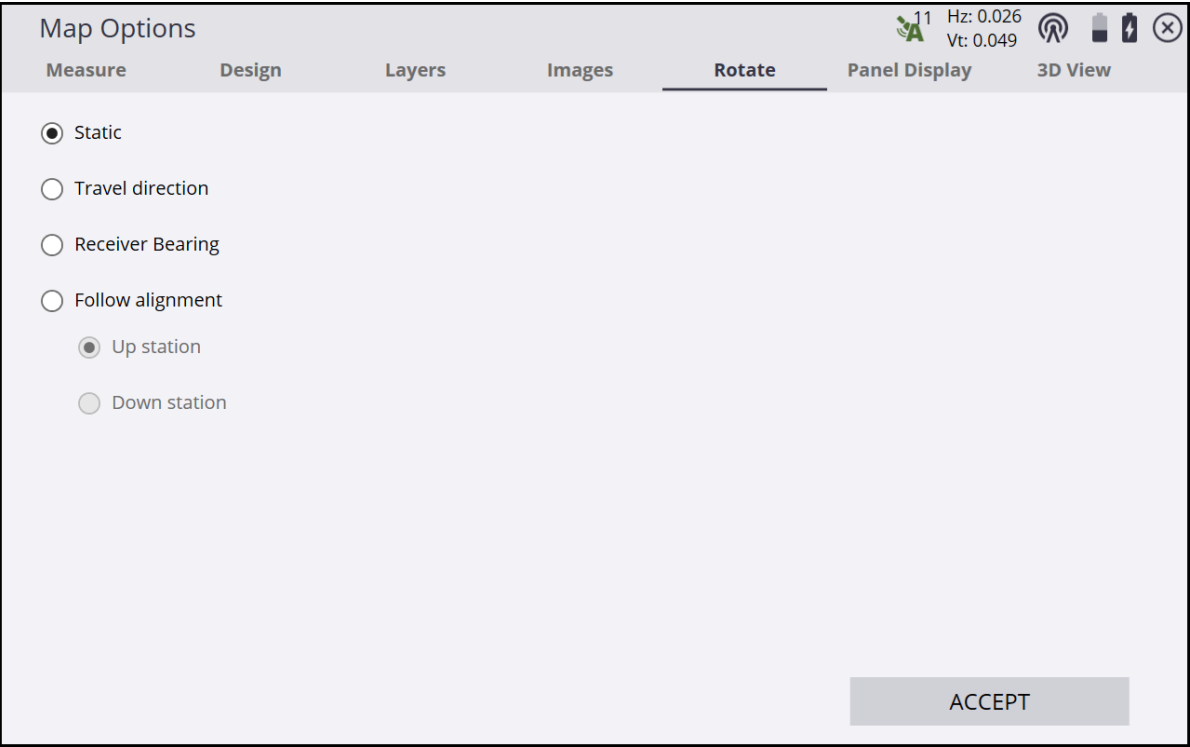
To import a PDF, select it as a new background image in the **Map Settings / Images** tab by tapping , and navigating to the PDF image on the data collector. This will open the PDF preview window where the resolution of the converted image is selected. For multi-page PDFs the desired PDF page is selected by either typing in a page number or tapping the arrow keys to find and then choose the page. After tapping **Import**, Siteworks will convert the PDF to BMP format, save the BMP to the Project's Background image folder and then prompt if you want to perform a georeferencing operation. The georeferencing process for converted PDFs is the same as described above for any non-referenced raster image.



There are selectable options for the resolution of the converted PDF to be used. These settings are hard-coded such that HIGH will produce a converted BMP image that is a maximum of 5200 × 5200 pixels, MEDIUM will produce a maximum resolution of 3200 × 3200, and LOW will yield a max resolution of 1920 × 1920. Siteworks will import the PDF, determine its page size and convert accordingly such that the largest (longest) dimension of the converted image will not exceed the above pixel values. These resolutions are all under the Siteworks maximum of 8192 × 8192 pixels for an image size, therefore using HIGH should not significantly impact performance, as the resulting image file size should be under 1 MB. Users wanting higher resolution converted PDF imagery, then 5200 × 5200 will need to modify the PDF file in external software by cropping it to individual areas of interest.

Map Options: Rotate tab

Use the **Rotate** tab to control the map rotation of the **Measurement** screen:

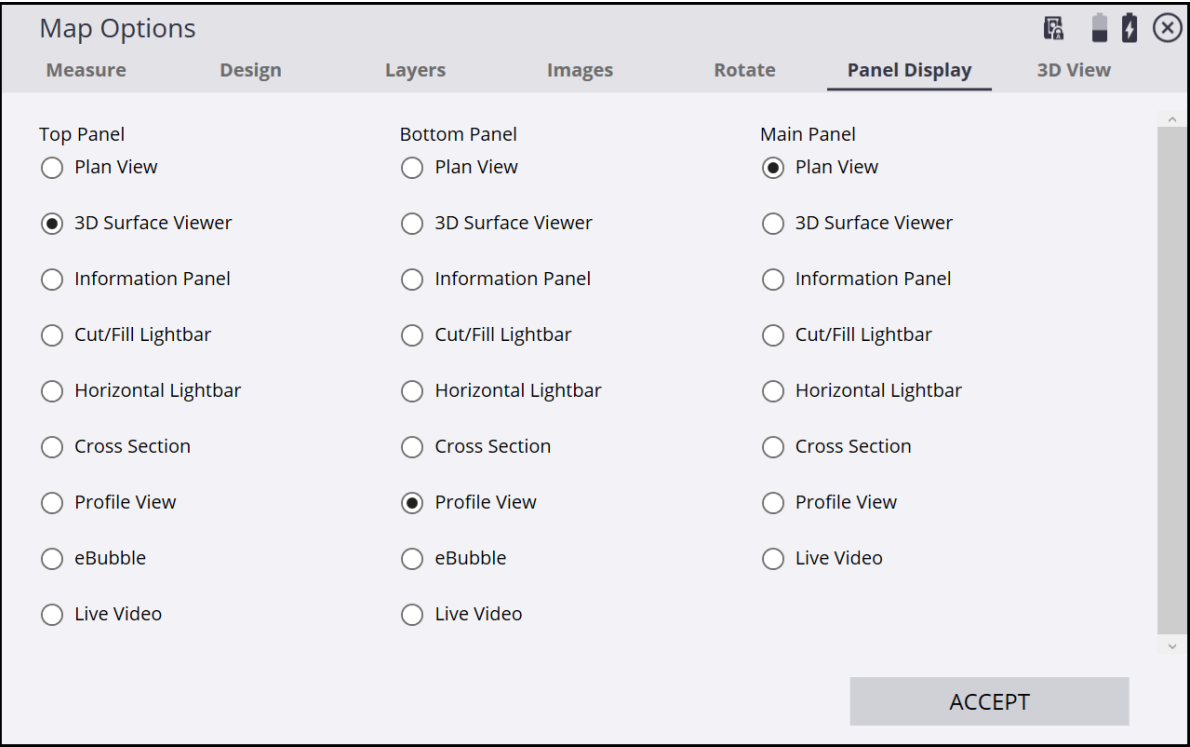


Select this option...	to orientate...
Static	the map view to the Project's North.
Travel direction	the map view to your direction of travel/walking/driving.
Receiver Bearing	the map view to the direction your GNSS receiver is facing. This option requires Tilt Compensation to be enabled.
Follow alignment	(This option is only available when an alignment is selected.)
Up station	the screen up station.
Down station	the screen down station.

NOTE – When any option other than Static is selected, a North arrow automatically appears on the screen.

Map Options: Panel Display tab

Use the **Panel Display** tab to control what information is shown in each of the panels on the main screen:






Select this option...	to display the...
Plan View	plan view in the chosen panel.
3D Surface Viewer	3D surface viewer in the chosen panel.
Information Panel	information panel in the chosen panel.
Cut/Fill Lightbar	cut/fill lightbar in the chosen panel.
Horizontal Lightbar	horizontal lightbar in the chosen panel to a reference line or selected stakeout line.
Cross Section	selected cross section in the chosen panel.
Profile View	selected profile view in the chosen panel.
eBubble	eBubble in the chosen panel.
<div> <div></div> <div>NOTE – This is not available for display in the main panel.</div> </div>	
Live Video	Live streaming video from a connected SX12 or SX10 scanning total station. This option is only displayed when connected to a SX12 or SX10.

Map Options: 3D View tab

Use the **3D View** tab to set the 3D surface view vertical exaggeration, along with options for displaying the vertical exaggeration text and the surface color palette.

Map Options

11 Hz: 0.026 Vt: 0.049



Measure

Design

Layers

Images

Rotate

Panel Display

3D View

Vertical exaggeration multiplier

5.00

☒ Show vertical exaggeration text

☐ Use legacy color palette


ACCEPT

Select this option...	to display the...
Show vertical exaggeration text	vertical exaggeration value as text in the 3D view.
Use legacy color palette	legacy color palette, where blue is high and red is low elevation in the 3D surface (revert to Siteworks version prior to v1.43).

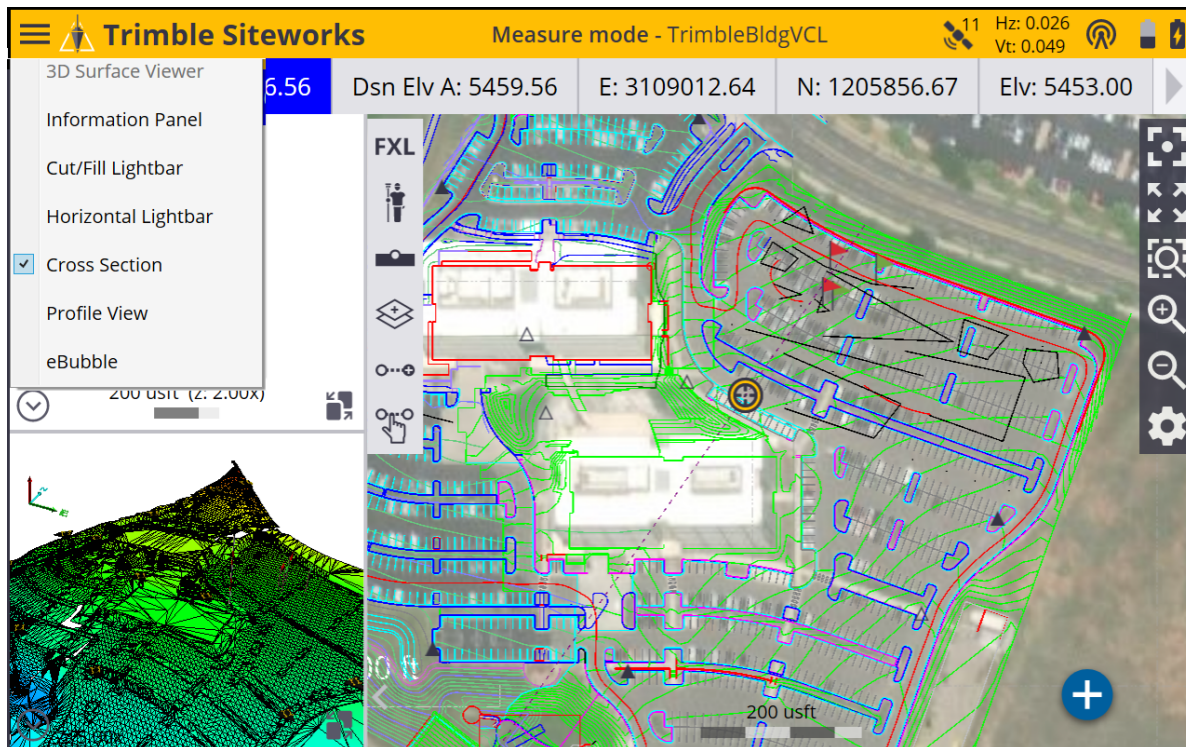
Toggling between the panels


The main screen has three panels. The view in these panels can be set by selecting the **Home** menu / **Settings** / **Map Display Settings** and selecting the **Panel Display** tab.


Alternatively, a quick way to select the view shown in the top and bottom panel is by clicking on the down arrow

icon in the lower left of the panel: 

The required view can then be selected from the pop-up menu:



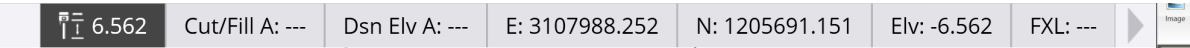
To display the data from the top and bottom side panels, in the main panel select the **Panel switch** icon in the bottom right of the side panels: 

To collapse or expand the side panels, tap the small grey arrow on the lower left of the main panel .

NOTE – The eBubble cannot be displayed in the main panel and Live Video is only available when connected to an SX12 scanning total station.

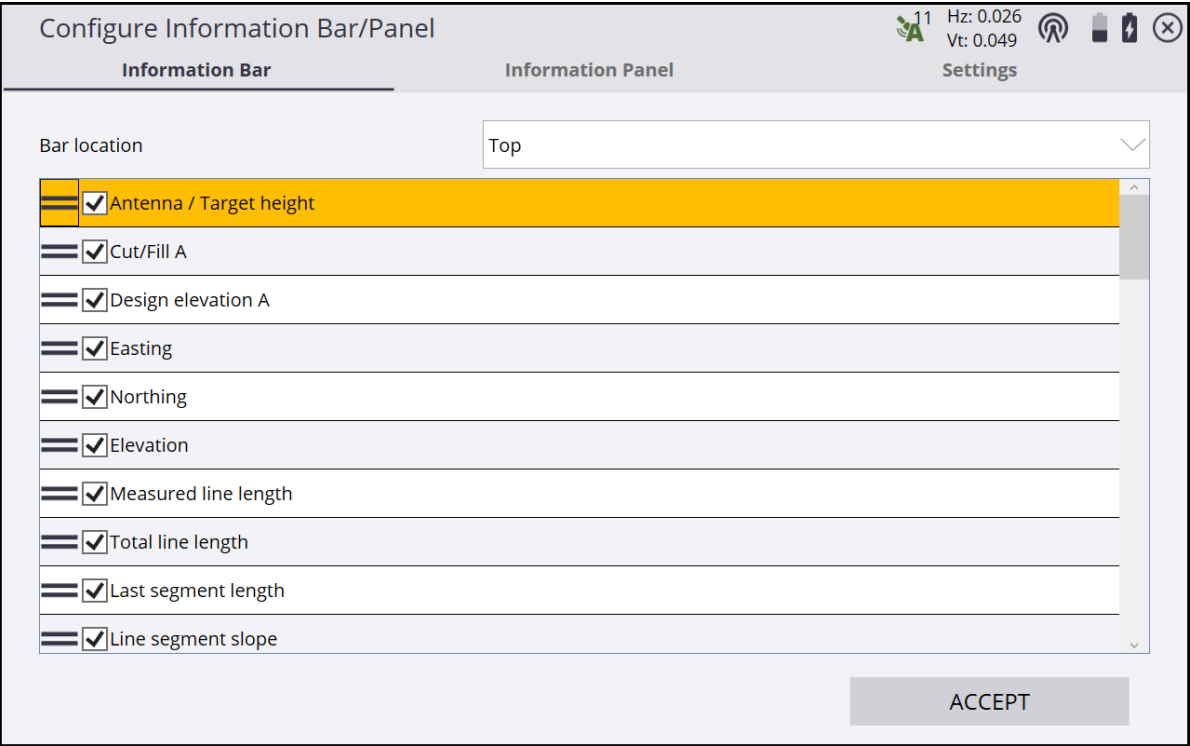
Info Bar and Info Panel

At the top of the screen is a bar that shows readings and values related to the current operation. There is also an option for an Information panel to be displayed in the Siteworks panels on the map screen. The settings are different depending on the Siteworks mode (Measure mode or Stake mode). The settings are saved independently for both the Information bar and Information panel, and also for Stake or Measure mode.



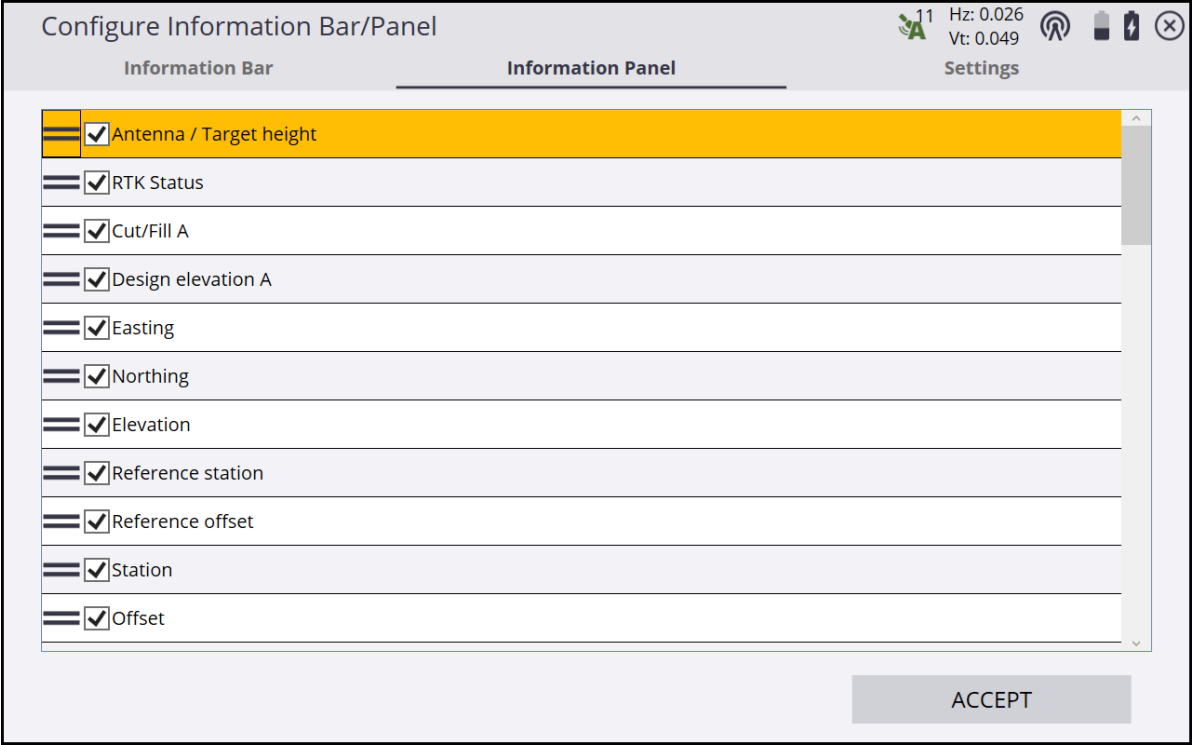
The Information bar can be configured to be displayed at the top or bottom of the screen or hidden all together using the **Bar location** dropdown list.

Use the arrows on the right and on the left of the Info Bar in the main screen to scroll through the different values which are currently enabled. You can also tap on the bar and "flick" through the different values. To change the settings, from the **Home** menu, tap **Settings / Info Bar/Panel / Information Bar** tab:



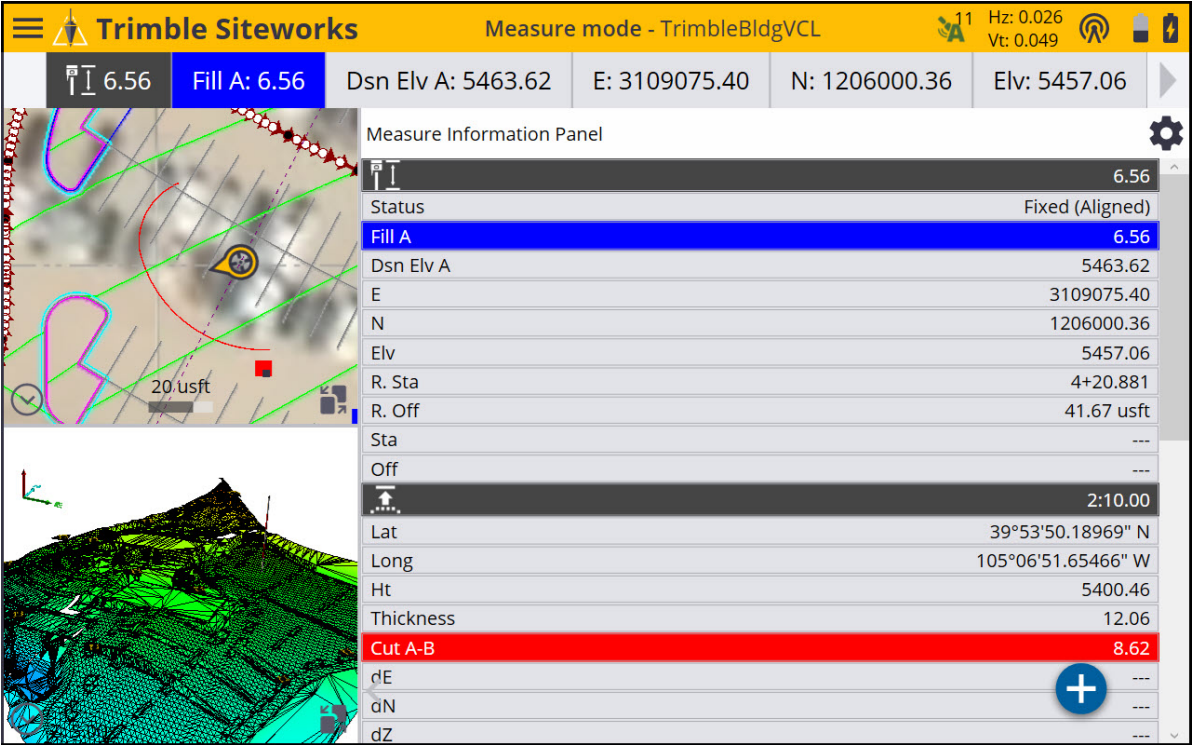
The **Information Panel** tab changes what is displayed when the information panel is selected to be displayed in one of the panels on the main screen.

The Information panel is separate from the Information bar.



When the Information panel is in the main panel of the screen, the mode of the Info Panel is displayed as either **Measure Information Panel** or **Stake Information Panel**. There is also a shortcut to the Info Bar/Panel

settings that can be access by tapping the icon  at the top right of the Information panel.



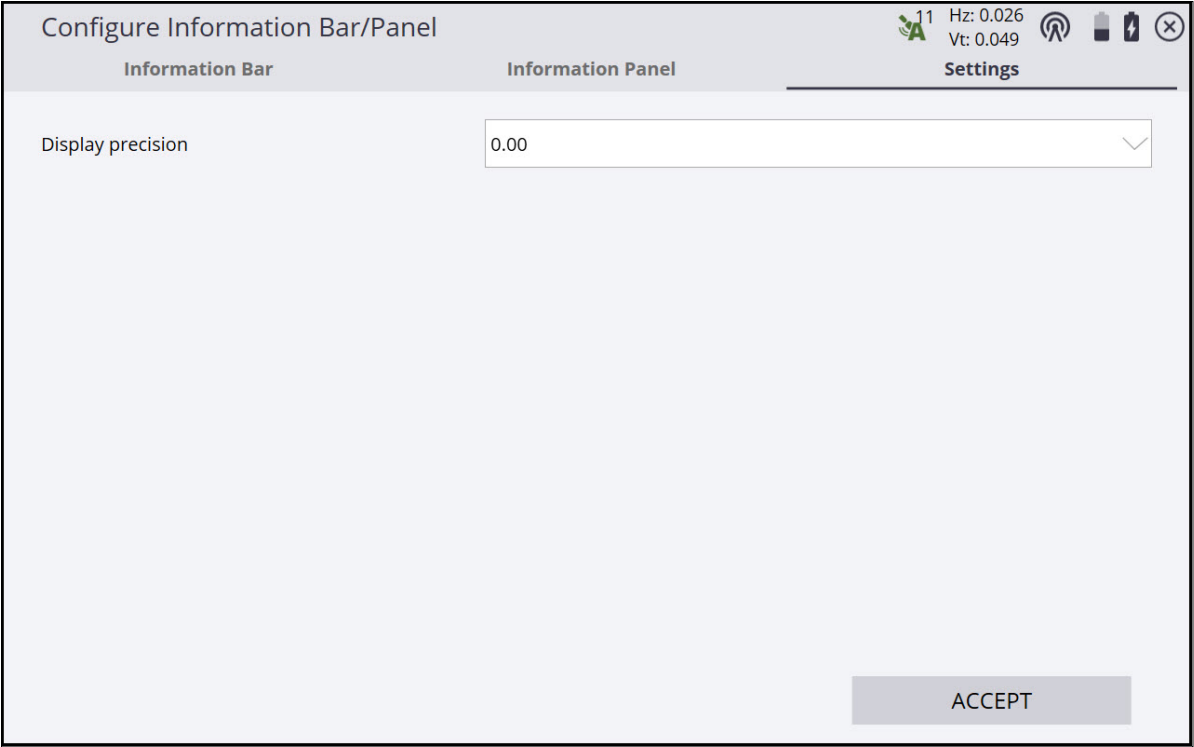
Some fields in the information bar (for example, **Antenna/Target Height**, **Stakeout line offset**, and **Surface offset**) are "active" fields. By tapping on it, you can change the settings and shortcut in the **Settings** screen of this value. The active fields are indicated by white text on dark gray background.

The following values are available in the Information bar; those indicated with an * are “active” fields:

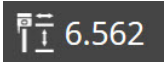
This value...	shows the...
Ant Ht *	currently applied antenna height for GNSS.
Tar. Ht*	currently applied target height for total station.
E	current Easting in the selected/applied coordinate system.
N	current Northing in the selected/applied coordinate system.
Elv	current Elevation in the selected/applied coordinate system.
Horizontal angle	current horizontal angle the instrument is shooting.
Vertical angle	current vertical angle the instrument is shooting.
Slope distance	current slope distance the instrument is shooting.
Lat	current latitude in WGS-84.
Long	current longitude in WGS-84.
Stake Distance	straight line distance from current location to selected stakeout point. This value will not update to individual values of “GO N/S GO E/W” for GNSS when within 2 m of the point, or “Go Farther/Come Near” for UTS (added in v1.70).
Ht	current height in WGS-84.
Sta	current station to a selected corridor or alignment.
Off	current offset from a selected corridor or alignment.
Go	distance and direction guidance to a selected point or object.
Cut/Fill	cut/fill value to a selected design, corridor, or alignment.
Dsn Elv	elevation of the selected design, corridor, or alignment at the current location of the user.
Thickness	current vertical thickness of material layer compared to a previous measured layer that has been saved as a design. See Checking material thickness, page 84
R. Sta	current station to the selected reference alignment or line.
R. Off	current offset to the selected reference alignment or line.
dE	difference in East to a selected point or object.
dN	difference in North to a selected point or object.
dZ	difference in Elevation to a selected point or object.
Ahead/Back	difference in station to a selected point along the selected alignment.
Inward/Outward	difference in offset to a selected point relative to the selected alignment.
Feature B cut/fill	cut/fill value of the feature node that is created while staking a corridor feature using dual segments.
Feature B design elevation	design elevation of the second corridor feature created by the dual segments setting.
Dsn Sta	station to a selected point per design.
Stakeout line offset H*	currently applied horizontal line offset.
Stakeout line offset V*	currently applied vertical line offset.
Surface offset*	currently applied surface offset.
Cut/Fill A	cut/fill values referenced to the primary surface.
Cut/Fill B	cut/fill values referenced to the secondary surface.

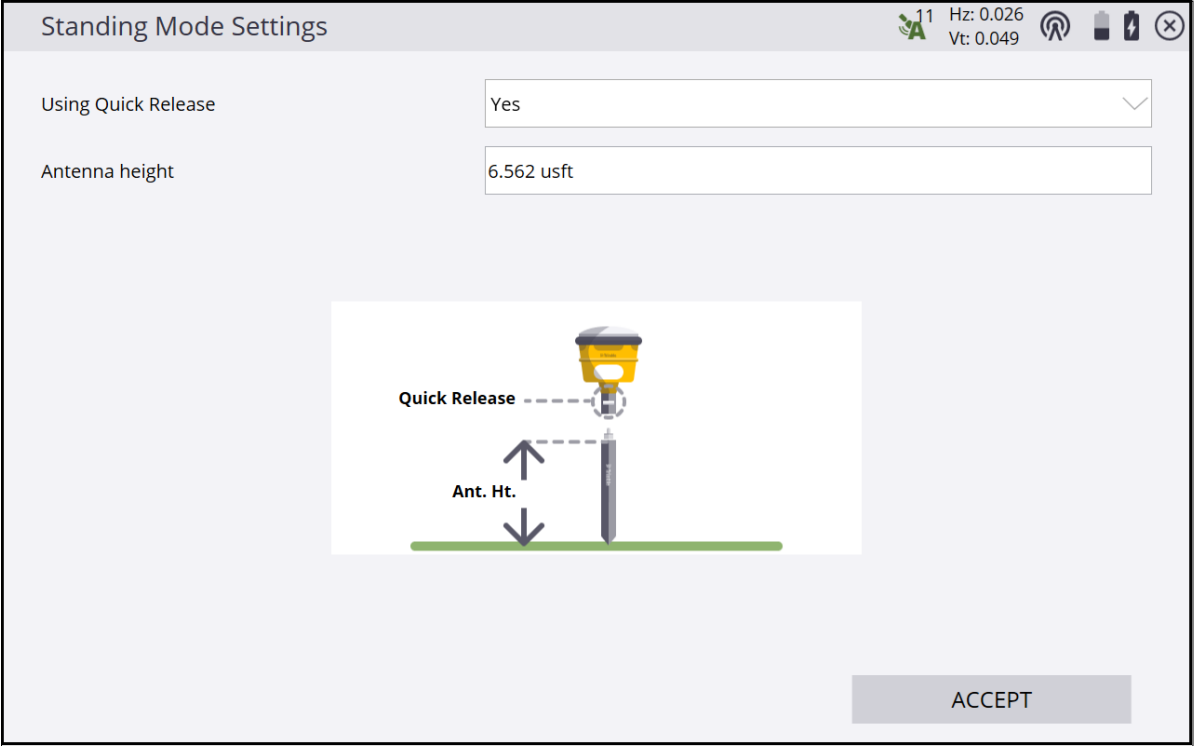
This value...	shows the...
Design Elv A	design elevation referenced to the secondary surface.
Design Elv B	design elevation referenced to the secondary surface.
Cut/Fill between surfaces	distance between the primary and secondary surface at this location.
Second surface settings*	surface selection and offset options for secondary surface.
FXL code	description for the selected feature code.
Heading	heading of the receiver relative to True North when Tilt Compensation is enabled.
Pitch	pitch of the receiver, in degrees, when Tilt Compensation is enabled.
Roll	roll of the receiver, in degrees, when Tilt Compensation is enabled.
Measured Line Length	length of line being measured; only includes measured points.
Total Line Length	length of line being measured; includes segment from last measured point to user's current location.
Last Segment Length	length of line segment from last measured point to user's current location.
Last Segment Slope	slope of segment from last measured point to user's current location.
Measured Line Area	area of line being measured, only includes measured portions of line.
Total Line Area	area of line being measured including segment from last measured point to user's current location.
GNSS Hz Precisions	horizontal GNSS precisions.
GNSS Vt Precisions	vertical GNSS precisions.
RTK Status	current GNSS fix status.
Attachment Selection	current attachment selection when in Machine Guidance mode.
PDOP	current Position Dilution of Precision.

Use the **Settings** tab of the **Configure Information Bar/Panel** to set the number of decimal places to be displayed in the Information bar and panel. This is a display-only setting and all measured values are still stored at full precision.

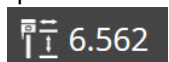


Antenna Height/Target Height

To change the antenna or target height, tap on the value in the info bar  6.562. This value is subtracted from each GNSS elevation or elevation measured with a total station. If the antenna/target height is currently not displayed in the info bar, turn it on in the **Home** menu / **Settings** / **Info Bar/Panel** using the **Information Bar** tab.



Select whether a quick release is being used on compatible GNSS receivers, but only enter the height to the bottom of the quick release as shown in the diagram. Siteworks automatically accounts for the height of the quick release and indicates its use on the map screen with an icon showing a quick release:



Each change of the antenna or target height and quick release use is stored in the log file and can be viewed in the Work Order's task log, or by pressing the **Home** menu / **Data Management** / **Log**.

Display units

Inches display for projects in US Survey and International Feet

For projects that are in units of US Survey or International feet, you can display and enter a distance value in units of inches. This functionality provides the ability to see all displayed values in feet and inches and also to enter values in inches. Two unit formats are available: **decimal inches** and **fractional inches**. These options are selected via a **Settings** menu option for **Display Units**. This setting option is only available for projects that are in US Survey or International feet. When either inch option is selected, all values within the software are displayed in inches, including: northing, easting, elevations, offsets, stationing, rod heights, COGO distances, staking distances, GNSS tolerances, and cut/fill values.

The format of the two new unit settings are as follows:

Decimal Feet (default)	Decimal inches	Fractional Inches
5.220 (five point two two zero feet)	5' 2.64" (five feet two point six four inches)	5' 2-5/8" (five feet two and five eighths inches)

Values can be input in inches regardless of the display setting. So even if your display setting is in decimal feet, you can still enter a value in fractional or decimal inches, and vice versa. To enter values in decimal inches, the software detects and uses the <space> as the foot and inch separator. It is not necessary to enter the single or double quote. For example, entering 5 2.64 (five space two point six four) equates to 5' 2.64" (five feet two point six four inches).

To enter fractional inches the <space> again serves as the foot-inch separator, a <dash> or minus sign serves as the whole-fractional inch separator, and a <forward slash> serves as the fractional separator. For example, entering 5 2-5/8 (five space two dash five forward slash eight) equates to 5' 2-5/8" (five feet two and five eighths inches). You can enter metric values on a project in feet by using an "m" at the end of the value entered for meters. For example, you still can enter 2m for a two meter rod height.

When using fractional inches there is a tolerance option that sets the rounding of the displayed values. The tolerances can be set at 1/16", 1/8", 1/4", and 1/2" whereby the software rounds the displayed value to the nearest fraction based on the selected tolerance. The tolerance is for display purposes only, except as noted below. The software still records all measurements within the work order's SPJ file at full decimal foot precision and those values are not rounded to the nearest fractional inch when recorded.

However, values recorded in the task log (e.g., COGO calculations, rod heights, stakeout reports) are recorded according to the current unit display setting. For example, if you stake a point while in decimal feet, the values are displayed on screen and recorded in decimal feet, then if you change to fractional inches and stake a different point, those values are displayed and stored in the task log as fractional inches based on the current tolerance value. Therefore, changing the unit display setting in a work order may result in recorded task log values that have different units. The Record.txt file and Report utility still are in units of decimal feet and are not

affected by the inches unit setting. There are also no changes in the Trimble Business Center software due to the inches setting when importing the work order data.

Data Management

- Projects, designs, and work orders
- Supported file formats
- Importing and exporting point files with style guides
- Avoidance zone settings
- Creating and opening a work order in the field
- WorksManager service
- Point Manager
- PDF reports
- Streaming data output

Trimble recommends that you use the latest version of the Trimble Business Center software to prepare the data to be used with the Siteworks software. The Trimble Business Center software incorporates the capabilities of the SCS Data Manager and Report Utility for multiple jobsite/controller management and generating work order reports, in addition to linking to the WorksManager service. The correct file folder structure is automatically created, and quality assurance tools are available to ensure that all controllers are using the most recent data.

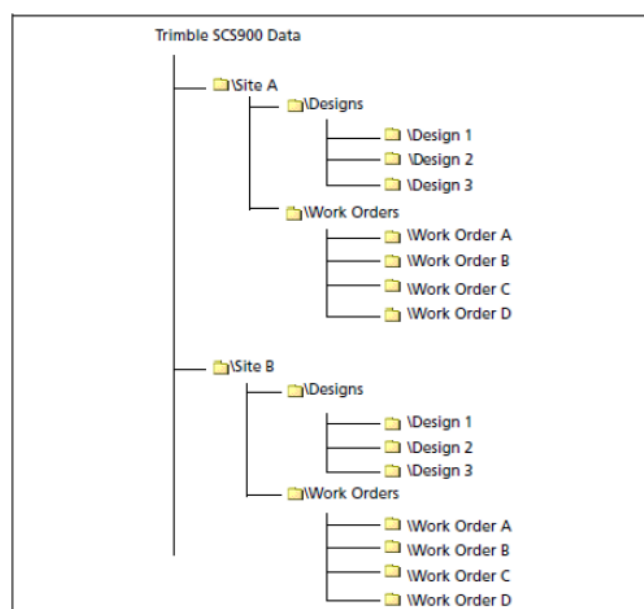
Projects, designs, and work orders

All data for the software is stored in a top-level folder called Trimble SCS900 Data on a Windows device and a top-level folder called Data on an Android device:

- Windows path to project data: C:\Trimble Synchronizer Data\PC\Trimble SCS900 Data\<Project Name>
- Android path to project data: Internal Storage\TrimbleSync\Siteworks\Data\<Project Name>

NOTE – Siteworks data is still placed into a folder called “Trimble SCS900 Data” on Windows 10 controllers to maintain backwards compatibility for running both the SCS900 and Siteworks software on the same controller, in addition to preserving the office-to-field workflows through the Trimble Office Synchronizer, the SCS Data Manager, the Trimble Business Center software, and the WorksManager service.

The file folder structure created on the office computer by the Trimble Business Center software exactly mirrors the file folder structure on the controllers, which makes it easy to manage and archive data between the computer and the controllers. Data is organized by project. Within each project, data is divided into designs and work orders.



Work orders can be created directly in Siteworks or exported from the Trimble Business Center software. Creating a work order in the Trimble Business Center software allows for the assignment of the necessary design, surface offsets, measurement tolerances, instructions, coverage map grid size, and continuous measurement settings. Keeping data organized in work orders allows for easy import and data management within the Trimble Business Center software.

Information on a controller is arranged in the following levels:

Level	Description
Global	Global information is used at all sites. It includes lists of feature codes and Geoid files, and software information such as last connected site.
Project	Project information relates to all activities at the specified site. It includes control points, site calibration results, and background maps. Project information is always available.

Level	Description
Design	Inside each project, a main Designs folder holds individual design folders that contain design data pertaining to the project. Design data relates to a particular phase of construction. Data stored at this level includes foreground maps, stakeout data, and design surface models.
Work Order	Inside each project, a main Work Orders folder holds individual work order folders. This is where the measured data, and any exported data are stored.

Supported file formats

The following table outlines the supported file formats for Windows and Android devices:

Design data	Supported Windows formats	Supported Android formats
Points	CSV, DXF, DWG, VCL	CSV, DXF, DWG, VCL
Linework	DXF, DWG, VCL, LandXML	DXF, DWG, VCL, LandXML
Surfaces	TTM, VCL, LandXML	TTM, VCL, LandXML
Alignments and corridors (Roads)	PRO, VCL	VCL
Avoidance zones	DXF, DWG, VCL	DXF, DWG, VCL
Site Calibration	DC, JXL	DC, JXL

NOTE – LandXML files can be used only when creating a new design in Siteworks and selecting the LandXML file as a new Design File. This will convert the LandXML file into a VCL file that will be used by Siteworks. A copy of the LandXML file will be placed into the **Design** folder with the converted VCL file. LandXML support was added in Version 1.44. JXL support for Site Calibration information was added in v1.70.

Importing and exporting point files with style guides

The Siteworks software enables you to import and export comma, tab, or semicolon delimited ASCII point files in the Siteworks default PNEZD, PENZD or in custom user-defined formats that are set by a style guide.

To import/export point files with formats other than the Siteworks default PNEZD or PENZD, you need to define a point file style guide.

Style guides are saved in a PointStyleGuides.json file in the Trimble SCS900 Data folder on a Windows device and the Data folder on an Android device. This .json file is portable between field controllers and is synchronized during a WorksManager sync.

In each window where a point file can be selected there is an option to select the style guide or create/edit a new one. Current windows where a point file can be imported/exported include importing control points during the site creation process, importing a point file from the **Data Management** menu, and exporting measured data via a custom point file. The Siteworks default style guide is the standard PNEZD or PENZD format. The coordinate order of the Easting and Northing during import/export using the standard Siteworks default format is set in the Project Creation process.

Import Point File

Point type: Control points

Style guide: Siteworks Default

File name (.CSV): Create/Edit Style Guide...

Siteworks Default

ACCEPT

Select the Create/Edit Style Guide option. The **Style Guide Definition** screen appears:

Style Guide Definition

Style guide: Z Lat Long Point

Value separator: Comma

Point file decimal delimiter: Period

File extension: CSV

	Data type	Column index	Prefix value (optional)	Suffix value (optional)
⊖	Elevation	1	Z=	
⊖	Latitude	2	Lat=	
⊖	Longitude	3	Long=	
⊕	Point name	4	Point=	

ACCEPT

Here you can configure various parameters of the file. The basics of style guides involve setting the style guide name, value separator (delimiter), the decimal point delimiter, file extension, if each column has a prefix and/or suffix, and then assigning a Siteworks data type to each column in the file.

Prefixes and suffixes can be defined by typing the optional value directly into the third and fourth column. During import, anything listed in the prefix or suffix box for that data type is ignored, and only the alphanumeric values shown before or after the prefix/suffix are imported. Exporting a point file using a prefix/suffix adds the respective prefix/suffix to the value being exported. The Siteworks software cannot automatically recognize what the data types are based on the prefix or suffix; that information must be set up in the style guide.

To configure a style guide:

1. Select the Create/Edit Style Guide option and enter a name for a new style guide. Alternatively, tap the magnifying glass to open an existing style guide to edit.
2. Select the value separator (comma, semicolon, or tab) that delimits the columns of data in the source file. Select the decimal point delimiter (comma or period).
3. The file extension will be written to the exported file name during an export and provides a means to filter by file type during file imports. Only those files with matching file extensions will be shown in the select file window during import.
4. To import files with different file extensions but otherwise with the same column format, select the All Files option in the **Type** screen.
5. To define the data type for each column select it from the dropdown list and enter the column where it resides in the source file. If appropriate, enter the prefix and suffix values to be added.
6. To add an additional data type, tap +. To remove an existing data type, tap -.

NOTE – During a point import process, only the Point Name, Easting, Northing, Elevation, and Point Code are imported into the Siteworks software; all other fields in the file and associated style guide are ignored during import. An exported point file will contain all the attributes established and configured in the style guide. These attributes include: Antenna/Target Height, Date, Easting, Elevation, HA, Latitude, Longitude, Northing, PDOP, Point Code, Point Name, Slope Distance, Time, VA, and WGS Height. Also note that an exported file will contain column header names in the exported file.

Avoidance zone settings

You can use avoidance zones in the Siteworks software. To create the avoidance zone, use the Trimble Business Center software. In a CAD file, create closed polygons around the different zones and select them as avoidance zones in the site creation process. The Trimble Business Center software will place the CAD file called *.avoid.dxf in the Siteworks Project folder.

DWG and VCL files are also supported for use as avoidance zone files. Any closed polygon within the file will be treated as an avoidance zone. Simply place the file called *.avoid.dwg or *.avoid.vcl into the main project directory for it to be used.

As you approach an avoidance zone, the software warns you audibly and visually:

- Yellow = Inside the avoidance zone tolerance area
- Red = Inside the avoidance zone

To adjust the tolerance for the avoidance zone, select **Home / Settings / Avoidance Zone**.

Creating and opening a work order in the field

From the **Home** menu, tap **Project Setup** and then **Change Project**. After starting the software, you can select an existing project and work order to start with:

Open Project


Project: TrimbleNewBuilding

Work Order: Topo Check

Instructions: Check existing carpark surface

Design: (No design needed)

ACCEPT

For each of these options, you can either decide to open an existing project, design, and work order, or create a new one. Selecting **Create New Project/Work Order/Design** or tapping the plus symbol  on the right side opens a screen with several fields where you can define the settings and add data files from a USB drive or from data already stored on the controller.

New Project

Project: Trimble Westminster

Distances: Meters

Angles: Degrees

Coordinate order: P, N, E, Z, D

Grid coordinate: North and East

Azimuth: North

Stationing: 0+00.000

NEXT

CAUTION – Before taking a measurement or associating a design with the project, ensure that the distance units are correctly set. All files that relate to a single site must be stored and operated with the same units. Once a measurement is taken, or a design is selected, you cannot change the units.

The screenshot shows the 'Project Creation Options' dialog box. It has a title bar with a back arrow, the title 'Project Creation Options', and status icons for signal strength, battery, and a close button. The dialog contains several options:

- ☐ Select project map: Tap to select file
- ☐ Select calibration file: Tap to select file
- ☐ Select control point file: Style guide: Siteworks Default
- File name (.CSV): Tap to select file
- ☐ Select FXL file: Siteworks Default.fxl
- ☐ Select coordinate system: COORDINATE SYSTEM

A 'FINISH' button is located at the bottom right.

When creating a site on the controller, you can import or measure a site calibration or use a published coordinate system from the coordinate system manager. After you select the **Select coordinate system** checkbox and tap **Coordinate System**, the software will list all supported coordinate systems.

To use a geoid for the first time, it must be exported from the Trimble Business Center software and stored in the Trimble GeoData folder on the controller.

The screenshot shows the 'Select Coordinate System' dialog box. It has a title bar with a battery icon and a close button. The dialog contains three dropdown menus:

- Coordinate system: United States/State Plane 1983
- Zone: Colorado North 0501
- Geoid: G12BUS.ggf

An 'ACCEPT' button is located at the bottom right.

A work order can include instructions for the person in the field, explaining what tasks to carry out. Work order instructions entered in the Trimble Business Center software will appear in this screen when selecting the work order. When creating a work order in the field on the controller, instructions can be entered in the instruction box:

The screenshot shows a software window titled "New Work Order". Inside the window, there is a label "Work Order" next to a single-line text input field. Below this, there is a label "Instructions (optional)" next to a larger, multi-line text input area. At the bottom right of the window, there is a button labeled "FINISH".

Work orders should have a meaningful name to make it easy to identify them when multiple work orders are created for a project.

Measured points are saved within individual work orders. For example, if you are staking a building pad, the saved stakeout values are saved into the work order folder. Then, when measuring topo on the same site but in a different work order, the measured topo points will be in that different work order. Also, any data exported via the **Home / Data Management** menu is placed in an Output folder in the associated work order folder to make it easier to separate work tasks and keep the associated data compartmentalized.

WorksManager service

The WorksManager service includes the following features:

- Wireless data synchronization to synchronize Siteworks data with the data stored on the WorksManager website.
- IBSS (Internet Base Station Service) web service to receive base station corrections from the local base station through the Internet.

All these services are tied to the device ID that you need to purchase for the controller with a monthly or annual WorksManager subscription.

Registering the controller

To use the controller with the WorksManager services, you must register the controller online in the Trimble WorksManager site of the user organization. To do this in the Siteworks software:

1. From the **Home** menu, select **Data Management**.

2. Tap **WorksManager Settings**

WorksManager Settings

3. Enter the credentials and then tap **ACCEPT**. The Device ID is hardcoded and set to the serial number of the device. The Device Name is set up the first time the credentials are entered and cannot be easily changed once set; that will be the name of the folder for the device's data that appears on the WorksManager service.

WorksManager Settings

Device ID
Tablet-DELL-46WVNN2

Device name
SPSisBest

Organization
TrimbleCCFS

Password

Workgroup

Test

ACCEPT

CAUTION – The device name entered in the Siteworks software must exactly match the device name entered into the WorksManager when registering the device in WorksManager. The device name can be changed on the Siteworks device by either manually changing the entry for <DeviceFriendlyName> in the AllSites.xml file or deleting or archiving the existing AllSites.xml file. Deleting the AllSites.xml also resets all other settings in Siteworks, requiring them to be set up again, and all WorksManager credentials must also be re-entered.

You only need to do this setup once. You can also enter a workgroup for wireless data sync to group multiple controllers of a company in a certain structure. However, workgroups are not currently supported in the WorksManager service, and only apply to those users who remain or want to use the Trimble Connected Community (TCC).

Wireless Data Sync

The **Wireless Data Sync** option enables Siteworks data to be synchronized with data stored on the Trimble WorksManager website, which eliminates the requirement to physically move data to and from the field by plugging the controller into a computer or using USB sticks. Data can be synced right from the field if an Internet connection is available to the controller via Wi-Fi or a cellular modem.

To manage the synchronization process, the following set of rules controls the dataflow to and from the WorksManager website.

File Type	Currently on WorksManager	Currently on the controller	Action
Work Order	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Upload to WorksManager if the file size is different
Design Data	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Download if the file size is different
Project	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Download if file size is different
Calibration File (*DC & *.CAL)	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager If data that has been previously synced is deleted from WorksManager but remains on the controller, you will be prompted to delete it from the controller.
	✓	✓	Ask when the file size is different
Field Control Point File (*field.csv)	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager If data that has been previously synced is deleted from WorksManager but remains on the controller, you will be prompted to delete it from the controller.
	✓	✓	Ask when the file size is different

File Type	Currently on WorksManager	Currently on the controller	Action
Office Control Point File (*.office.csv)	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager If data that has been previously synced is deleted from WorksManager but remains on the controller, then you will be prompted to delete it from the controller.
	✓	✓	Download if the file size is different
FXL File	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Ask when the file size is different
Report.txt, Tasklog.txt	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Upload if the file size is different
Site.ini, Site.xml, Site.xml.schema	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Do nothing
Trimble GeoData	✓	✗	Download to the controller
	✗	✓	Upload to WorksManager
	✓	✓	Download if the file size is different

The software stores the designs and work order names that have been synchronized in a history file with every synchronization. If designs or work orders are deleted from WorksManager since the last synchronization, the Siteworks software will also delete the files from the controller and then proceed with normal synchronization rules from above thereafter. Deleted work order data from the controller is stored in an Archive folder on the WorksManager servers. If control point files and DC files have been deleted from WorksManager since the last synchronization, then the Siteworks software prompts you to delete the files from the device. Files selected for deletion will also be placed in an Archive folder on WorksManager to preserve a record of them.

The software facilitates two Control Point files in the project folder: a Field Control Point file, where all control points measured or typed in the field are stored; and one or more Office Control Point files. The following file naming conventions must be used:

- Office Control Point File: [filename].office.csv
- Field Control Point File: [filename].field.csv

The Office Control Point file cannot be edited in the field, however the Field Control Point file can. Using the Trimble Business Center software, the data manager can take the control points from the Field Control Point file of one controller, move it to the Office Control Point file and then push the new Office Control Point file out to other controllers.

When a project is opened for the first time and the software cannot find a Field Control Point file, the software converts the name of the existing Control Point file selected during the project creation process and applies the

naming convention for the Field Control Point file. From that point forward, the software will ignore all other CSV files in the Project folder that are not tagged office or field. The synchronization with the WorksManager software will only include Control Point files that are marked as Office or Field Control Point files. The synchronization rules for the Office and Field Control Point file from above apply.

Point Manager

To access the Point Manager, select **Home / Data Management / Point Manager**. Options will appear to select either the point manager, view/ edit control points, or to import control file. Select Point Manager. Use this feature to retrieve a list of all points in the currently loaded work order. Tap **Edit**, **Add**, or **Delete** to make changes to an existing point, add a new point, or to completely delete a point.





Columns can be sorted by clicking on the column name. Use the search box at the top of the window to search by **Point Name** and **Point Code** fields. Point types can be filtered to display only certain point types by selecting




. Office control points denoted by the * cannot be changed.










Point Manager

11 Hz: 0.026 Vt: 0.049



Search

Count: 12 

	Point Name	Point Code	Northing	Easting	Elevation	Height
	*3	CP 3/MAG	1205858.411	3108523.219	5463.350	
	*3_GNSS	CP 3/MAG	1205858.382	3108523.235	5463.336	
	*300000	mag	1206091.436	3109175.243	5470.081	
	*4003	CP MAG	1205817.922	3108634.617	5465.163	
	*4064	CP 60D	1205323.931	3108819.240	5442.042	
	*4064_GNSS	CP 60D	1205323.930	3108819.216	5442.056	
	*4098	CP 60D	1205294.613	3109265.792	5444.393	
	*4098_GNSS	4004	1205294.618	3109265.797	5444.379	
	*CREFO001		1205932.938	3108681.852	5541.250	

EDIT

ADD

DELETE

Tap **Add** to enter 1D, 2D, and 3D control points, and 2D and 3D Stakeout points.

To edit points, select a point and then tap **Edit**. You can change the point name, point code, elevation, and antenna/target height for measured points. Click on the down arrow to the right of the data field to switch between elevation and antenna/target height. Northing and Easting values of measured points cannot be changed, but may be changed for non-measured points that were added by key-in. If an FXL file and the Advanced Measurement Module are active, you can assign an FXL code to the point. FXL attributes cannot currently be edited for existing points; but they can be replaced with new information by tapping **Select FXL Code**.

Clicking **Previous** or **Next** takes you to the previous or next point in the list according to the sorting set in the list view. Unsaved changes will be prompted for saving before switching points.

Information about the point can be viewed by selecting the **Point Information** tab.

PDF reports

Version 1.20 and later can produce a PDF report associated with any measured point or as part of individual COGO commands. These reports contain the point information or calculated COGO results, user-entered comments, along with up to three user-selected photos that are taken at the time of report creation or selected from the controller's memory.

The reports are stored in the currently open work order's *Output* folder and have a user-defined title with a date and time stamp appended to the filename.

PDF reports can be created immediately after a point measurement by selecting the **Create report after storing point** checkbox in the **Measure Type** screen.

Measure Type

Point name: MH2

Point code: STMH

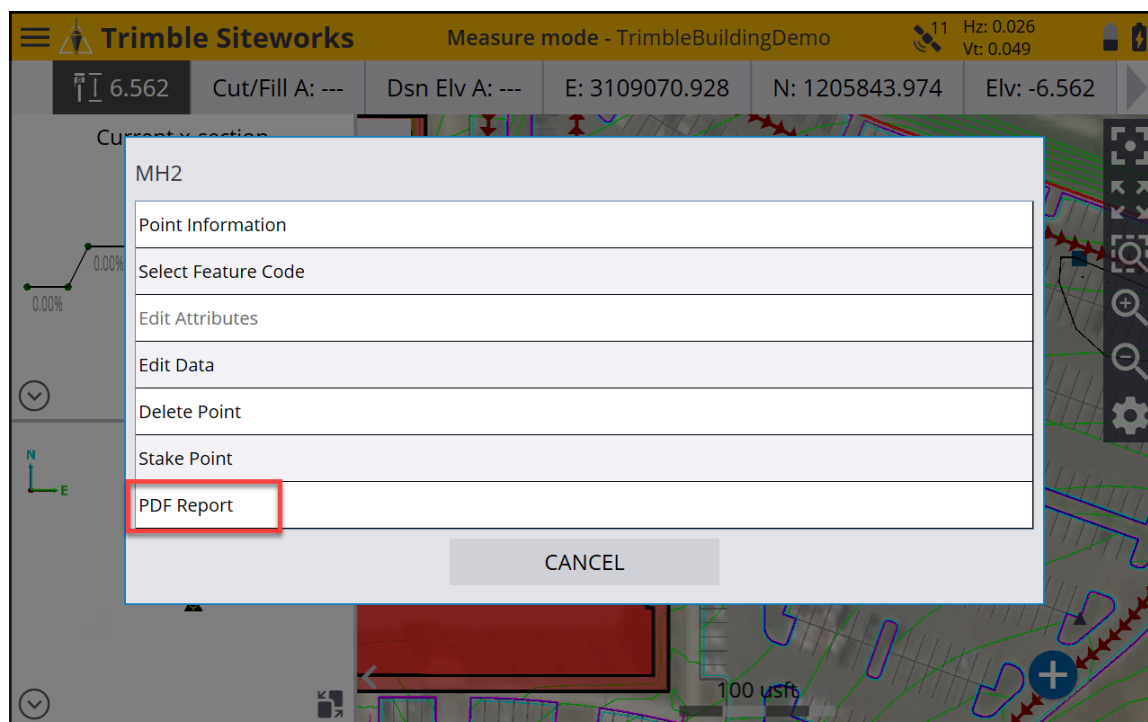
Point type: Feature

Show every time: Yes

☒ Create report after storing point

ACCEPT

Alternatively, tap and hold on an existing measured or control point and select **PDF Report** from the pop-up menu:



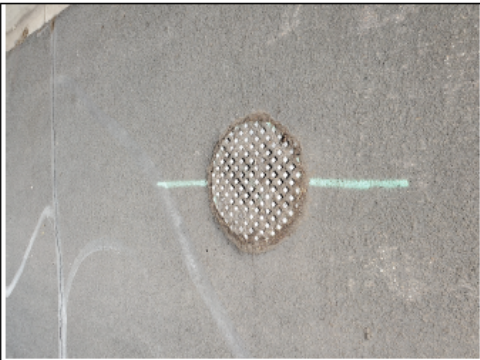
Once the **PDF Report** option is selected, complete the appropriate information relating to the report title, any comments, and take or select up to three existing photos in the **Report** tab:


The screenshot shows a mobile application interface for creating a PDF report. The top bar displays 'PDF Report' and three tabs: 'Report', 'Point Information', and 'PDF Header'. The 'Report' tab is active. It contains the following elements:

- Report title:** A text input field containing 'Manhole Status'.
- Comment:** A text area containing 'This storm Manhole has asphalt over the rim. Needs cleaning and inspection'.
- Photo:** Three rows, each with a grey rectangular placeholder for a photo. To the right of each placeholder are three icons: a camera, a folder, and a photo gallery.
- Open file location after creation:** A checkbox that is checked.
- SAVE:** A button located at the bottom right of the form.

Select the **Open file location after creation** checkbox to open a Windows explorer window where the PDF has been saved. Alternatively, select the slider button for **Open Report** on Android devices to use the Android OS PDF viewer to open the PDF report.

Tap **Save**. The PDF report is generated and saved to the currently open work order's *Output* folder according to the following naming convention: <Title>_YYYY-MM-DDTHHMMSS.

Trimble Siteworks Report		Date: 3/23/2020	
Manhole Status		Time: 8:44 AM	
		Project: TrimbleBuildingDemo	
		Design: TrimbleBldgVCL	
		Design Surface:	
		TrimbleBldgVCL:PerimeterCorridor	
		Work order: NPI Presentation	
Comment			
This Storm manhole has asphalt over the rim. Needs cleaning and inspection.			
Photo			
		20200308_124159(1).jpg	
Point Information			
Point name	MH2	Point code	STMH
Northing	1205843.974 usft	Easting	3109070.928 usft
Elevation	-6.562 usft	Date	3/23/2020
Time	8:42 AM		
Record Type Data			
Record type	Measure	Sub type	Point
Precision type	RTK Fixed		
GNSS Raw Data			
Latitude	39°53'48.64495" N	Longitude	105°06'51.72112" W
Height	-63.163 usft	Horizontal precision	0.026 usft
Vertical precision	0.049 usft	Antenna height	6.562 usft
Tilt Data			
Tilt Angle	0.0000°	Tilt Error	0.000 usft
Tilt tolerance	0.080 usft		

To create a PDF report from a COGO function, tap  on the upper right of the **Save Computation** screen.

Save Computation

11 Hz: 0.026 Vt: 0.049

DescriptionHaulPile1

Volume typeStockpile/Depression Volume

Expansion factor0.00%

Total cut volume121.931 cu yds

Total fill volume0.000 cu yds

Net cut balance121.931 cu yds

Base area3837.430 usft²

Base perimeter254.518 usft

Measured surface area3866.993 usft²

BoundaryStockPile1

ACCEPT

With Siteworks v1.41 or later, you can add an optional image file, such as a company logo, and also a text field such as a company name and address to the header of the PDF file. To add an image and company information, tap on the **PDF Header** tab on the **PDF report** screen, navigate and select the logo image file and add the company name to the appropriate field.

PDF Report

ReportPoint InformationPDF Header

Company logoGEN_BLUTrans_45++.jpg


Company nameTrimble Inc.
Site Positioning Systems Team
103683 Westmoor Dr.
Westminster, CO
80021

SAVE

Sample report with logo and company information:

Trimble Siteworks Report

Sample PDF with Logo



Trimble Inc.
Site Positioning Systems Team
103683 Westmoor Dr.
Westminster, CO
80021

Date: 4/12/2021
Time: 11:47 AM
Project: TrimbleBuildingDemo
Design: MultiVAL
Design Surface:
MultiVAL:MiddleCorridor
Work order: AMM Demo

Comment

This is a sample of the new Logo and Company Info that can now be imported into PDF reports starting in Siteworks v1.41.

Point Information

Point name	LinePt14+4.000	Point code	DemoLine1
Northing	1206057.120 usft	Easting	3109018.179 usft
Elevation	5468.287 usft	Date	4/12/2021
Time	8:50 AM		

Record Type Data

Record type	Measure	Sub type	Line
Precision type	INS RTK Fixed		

GNSS Raw Data

Latitude	39°53'50.82709" N	Longitude	105°06'52.38361" W
Height	5411.744 usft	Horizontal precision	0.026 usft
Vertical precision	0.049 usft	Antenna height	0.100 usft

Streaming data output

You can stream positioning and other data out over the collector's COM port. This feature requires the Advanced Measurement module and is only available on Windows 10 operating systems. Streaming is available out of the device's COM ports that are currently recognized by the Windows operating system in the System Registry settings and displayed in Windows Device Manager's "Ports (COM & LPT)". These can be either physical or virtual ports, however the COM port must be recognized and displayed in the Device Manager by the Windows operating system to be able to select it in Siteworks.

For users with the AMM installed, a **Streaming Output** option is available in the **Data Management** menu. Select this option to open the **Streaming Output Settings** screen where the following options can be configured:

The screenshot shows the 'Streaming Output Settings' dialog box. It features a title bar with the text 'Streaming Output Settings' and a series of icons on the right, including a red 'X', a signal icon, '11', 'Hz: 0.026', 'Vt: 0.049', a signal strength icon, a battery icon, and a close icon. The settings are organized into a list of dropdown menus:

- Streaming output:** Streaming only
- Output rate:** 3Hz
- Output Format:** StreamNEZ_GNSS
- COM Port:** COM5
- Baud rate:** 38400
- Encoding format:** ASCII

An 'ACCEPT' button is located at the bottom right of the dialog.

Streaming output: Off, Streaming only, Streaming + Measured Point, Measured point only. This option chooses what type of output is streamed and when.

- **Streaming only** continuously streams data at the selected output rate.
- **Streaming + Measured Point** continuously streams data and adds an additional output for each measured point. The measured points are not differentiated in format in the data stream from continuously streamed points.
- **Measured Point Only** sends only measured points to the data stream.

Output rate: 3 Hz, 2 Hz, 1 Hz, 2 s, 3 s, 4 s, 5 s. This option sets the frequency of output ranging from 3 Hz to every 5 seconds.


Output Format: User customizable through the use of a streaming style guide; see below.


COM Port: Select the available COM port to stream out on. Available COM ports are based on Windows-recognized ports.


Baud Rate: 38400, 19200, 9600, 4800, 2400. Select the baud rate of the output stream.

Encoding Format: ASCII, UTF8. Select the format of the text output.

Data are streamed out only when the main Siteworks window is active and the user's position is known, i.e., in measure or stakeout mode with a prism lock or GNSS connection. The plan or 3D views do not have to be selected as active panels to be visible on the main screen for streaming to work; however, streaming data is not output when in COGO or workflow selection maps, such as when entering a point code. Streaming is possible

only when in the main Siteworks home screen, where the  measurement button is visible.

There is a status icon in the top status bar that indicates when data is being streamed  or when streaming

is paused or interrupted . Tap this icon to display the **Streaming Output Settings** screen.

Streaming output formats are configured through the use of streaming style guides in the **Streaming Configuration Definition** screen, similar to the existing point import/export style guides (see [page 54](#)). Here, you can select what outputs are required, the delimiter to be used to separate individual data pieces in a row of data, the column of the output string where each item goes, and also if an optional prefix or suffix for each column is present.

	Data type	Column index	Prefix value (optional)	Suffix value (optional)
–	Northing	1	N=	
–	Easting	2	E=	
–	Elevation	3	Z=	
–	Latitude	4		
–	Longitude	5		
–	Delta E	6	dE	m
–	Delta N	7	dN	m
+	Delta Elv	8	dZ	m

ACCEPT

Available options for data types to stream are: Antenna/Target height, Cut/Fill, Date, Delta E, Delta Elv, Delta N, Easting, Elevation, Horizontal Angle (HA), Latitude, Longitude, Nothing, PDOP Value, Point Code, Point Name, Point Type, Slope Distance (SD), Site Bearing (from tilt-enabled GNSS receivers), Tilt Pitch, Tilt Roll, Time, Vertical Angle (VA), and WGS Ht.

Note that the Delta E, Delta Elv, and Delta N are equivalent to the “Go” distances when a point or line station is selected for stakeout, i.e., they are the deltas between your current position and the location of the stakeout item.

NOTE – A known issue is that each time you enter the **Streaming Output Settings** window, the COM port defaults down to the lowest number COM port available on the device. This is generally not an issue on TSC7 controllers, where the physical COM port is COM1, but on other devices or configurations not using COM1, you must ensure that you set the COM port back to the correct port each time you enter this window.

VCL Data

- Export
- Background/Project Map
- Avoidance zones
- VCL designs
- VCL surfaces
- Surface offset
- VCL points
- VCL lines
- VCL alignments
- Measure
- Second surface
- Stakeout
- COGO
- Review & Edit Data
- Create Points/Arcs
- Key In Corridors
- Cross Section View
- Enhancements

Version 1.20 added the ability to use Trimble VCL files for several functions within the Siteworks software. VCL files are a Trimble-proprietary file format exported by the Trimble Business Center (TBC) software. These files can be used as design files, site (background) maps, and avoidance zone files. When using VCL files for linework data, you have the same functionality as with DXF/DWG files. When using surface data from the VCL file, you will experience the same behavior as with TTM files. More information on how to produce VCL files in the Trimble Business Center software for use in Siteworks can be found in the relevant Trimble Business Center documentation.

The Siteworks software offers some of the same functionality as it does with PRO files when using corridor data from a VCL file, but also some additional and enhanced functionality is gained. However, some of the workflows around using and selecting the data have changed when using VCL corridor data. Additionally, VCL files now offer equivalent and enhanced Roadway functionality to PRO files on the Android operating system since PRO files are not and never will be supported on Android devices.

Several benefits of using VCL files over the existing TTM/DXF/DWG/PRO design scheme are:

- One VCL design file now can contain points, multiple surfaces, multiple corridor surfaces, multiple template surfaces, and multiple alignments. This reduces the file and design management burdens of office and field personnel.
- Direct design file sharing capabilities with Trimble Earthworks version 1.9 or later.
- Ability to choose any alignment and get a station/offset and cut/fill to any selected active surface.
- 3D visualization of corridor surfaces and corridor template surfaces.
- Corridor and corridor template surfaces can now be used in volume calculations.
- Design contour lines can now be created and visualized in the map view for corridor and template surfaces.
- Richer data format allows for enhanced future capabilities.
- Support for corridors, alignments, cross sections and templates on Siteworks Mobile for Android.

The use of VCL files for any corridor and alignment-related functionality in the Siteworks software requires the purchase and installation of the optional Roding Stakeout and Measurement module (see [page 13](#)) on both Microsoft Windows and Android operating systems. The module is not required to use VCL files for points, surfaces, and linework. If an alignment is present in a VCL design file and the module is not installed, the alignment is treated as a normal polyline and stationing along the alignment is not available.

Export

The software does not write any data to VCL files. There is no export to VCL files from within the Siteworks software. Linework is still written to a DXF file, surfaces are still saved as TTM files, and key-in road data as PRO files. Note that key-In road functionality and reading or writing PRO files is not and never will be available on the Android operating system due to the lack of an appropriate cross-platform PRO software library.

When saving the measured surface as a design, you can still merge the measured surface with the active design surface of the VCL file. The merged surface is then saved as a TTM surface in a new design folder.

You can also still select to include the VCL linework when saving the measured surface as a new design. The design VCL's linework is saved as a DXF file in the new design folder.

When exporting a VCL Design to an Earthworks system, a copy of the currently loaded VCL design in Siteworks will be placed in the appropriate Project Library for use in Trimble Earthworks.

Background/Project Map

A VCL file can be used as a project background map, similar to a DXF/DWG file. This is a separate VCL file from any VCL designs or avoidance zone files.

While creating a new site, you can select a VCL file as the "project map" file. If the project is already created, copy the VCL file into the project's root folder. All the linework within the VCL file appears as the background linework.

Only the linework from the Project Map VCL file will be displayed in the map views when the project is loaded; alignments and text data are not displayed. The linework in the project map cannot be selected or interacted with. This is the same behavior as with DXF/DWG files currently used as project maps.

Avoidance zones

When placing a separate VCL file with the file name <file name>.avoid.VCL in the project's root folder, closed circles and polygons present within the file are used as the project's avoidance zones. This behavior matches

the current behavior of DXF/DWG avoidance zone files. Siteworks does not support embedded avoidance zone boundary types as defined in Trimble Business Center, it will simply treat any closed polygon present in the <filename>.avoid.vcl as an avoidance zone. See also [Avoidance zone settings, page 56](#).

VCL designs

A valid VCL design and associated design folder contains a single VCL file and an optional CSV stakeout point file. The design folder can also have additional DXF files in it to continue supporting the ability to create circles and arcs via the COGO feature and for any additional design based DXF or DWGs. If an additional DXF with design linework is in the design folder with the VCL file, that linework is also present and can be selected on the map screen. It is recommended to only use the Siteworks COGO-created circle and arc DXF files in the design folder when using VCL files and not include an additional DXF linework file. This reduces the potential for operator confusion and errors when selecting linework and objects to stake from the design.

When creating a design in Siteworks, you can select a VCL file as the *design file*. Once selected as the design file, the VCL file is automatically selected as the linework file, and the “design map” (linework) file selection is grayed out in the **Create Design** screen. All of the linework in the VCL file is displayed and available for selection, regardless of the surface selected. In other words, all of the linework in the VCL file is visible and can be selected no matter what surface is active.

When selecting a VCL design, a **Surface** option is displayed. This option is used to select the *active surface* to be used. Only one surface can be the active surface at a time. The option contains all the supported surfaces from the VCL file, and displays an icon to indicate the surface type.

You can change the active surface in the **Surface** option displayed in the **Open Project** screen when a VCL design is selected, or from the **Surface** option in the **Surface Settings** screen (select **Home** menu / **Settings** / **Surface Settings**). Tip: The **Surface** option only appears while in the measure feature; if the screen is accessed from the stakeout feature, the option is hidden.

Open Project

Project: TrimbleBuildingDemo

Work Order: Siteworks Is Awesome

Design: TrimbleBldgVCL

Surface: (No Surface Needed)

(No Surface Needed)

- FG_All
- PerimeterCorridor
- PerimeterCorridor (Finish)
- WestCorridor
- WestCorridor (Finish)

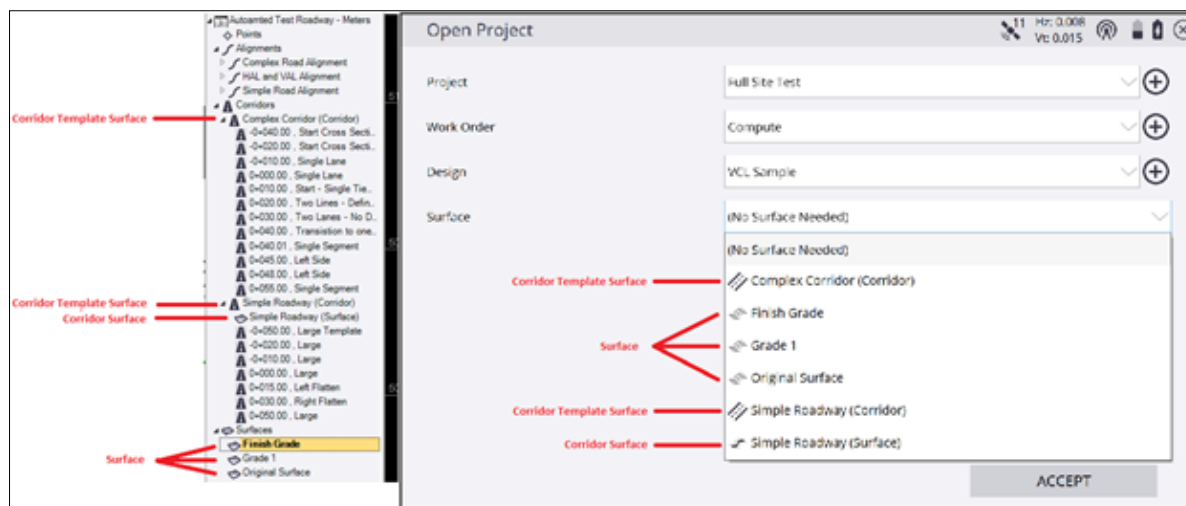
ACCEPT

VCL surfaces


Siteworks supports three surface types defined in a VCL file:

- Surface (see [page 75](#))
- Corridor surface (see [page 75](#))
- Corridor template surface (see [page 76](#))


Tapping and holding on the active surface in the map screen opens a menu containing a **Stakeout Surface** option. Similar to TTM surfaces, this menu option takes you to the stakeout surface feature.



VCL surface


A **VCL surface**  is one or more triangulated surface(s) defined in the VCL file. This surface type is treated the same as a TTM surface. You can use these surfaces as the grade check surface in the measure routine, as the second surface in the measure feature, as a stakeout surface in the Stakeout feature, and as a design surface in the COGO features. VCL surfaces are shown in the 3D view similar to how TTMs are currently displayed. These types of surfaces can be used in volume calculations.

Corridor surface

A **corridor surface**  is a triangulated surface generated in the Trimble Business Center software from the defined cross sections for a corridor model. The corridor surface is treated like a TTM surface in Siteworks. You can select this surface as the grade check surface in the measure feature, as a second surface in the measure feature, as the stakeout surface in the stakeout feature, and as the design surface in the COGO feature. Corridor surfaces are shown in the 3D surface viewer. Corridor surfaces can now be used in volume calculations.

When selecting a corridor surface as the active surface, the surface's alignment, as defined in the Trimble Business Center software, is automatically selected as a reference line. To change/deselect the reference line, use the tap-and-hold menu or select **Home / Settings / Reference Line**.

Corridor template surface

A **Corridor template surface**  is the surface defined by the corridor's templates created in the Trimble Business Center software. This surface is similar to PRO roadway surfaces. A corridor template surface can be used as the grade check surface in the measure feature. In the stakeout feature, you can select to stake the corridor template as a surface, stake specific features and nodes from the template data, or stake catch points from the template data. The corridor template surface cannot be selected as a second surface. Corridor template surfaces are shown in the 3D surface viewer. Siteworks displays a cross section view similar to a PRO roadway when using a corridor template surface.

Similar to corridor surfaces, when a corridor template surface is selected, the surface's alignment associated via the Trimble Business Center software is automatically selected as the reference line. To select or change/deselect the template surface's alignment as the reference line, use the tap-and-hold menu or select **Home / Settings / Reference Line**.

When a corridor template surface is used to compute volumes, displayed in the 3D surface viewer, or when design contour lines are generated, the corridor template surface is internally converted to a corridor surface in the Siteworks software. As a result, the design tie slopes are included as part of the surface. However, when using the corridor template surface feature in the measure, stakeout, and COGO features, the template data only is utilized and the design tie slopes are not included as part of the surface.

Surface offset

Regardless of the VCL surface type being used as the active surface, you can apply a surface offset to it. Access the surface offset setting in the **Surface Settings** screen (select **Home / Settings / Surface Setting**), info bar (see [page 45](#)), or some workflow settings buttons.

The VCL surfaces can be offset vertically or perpendicularly above or below the original surface. Once the surface offset is set for the current active surface, it is applied in all Siteworks features (measure, stakeout, and COGO).

Changing the active surface in the **Open Project** screen defaults the surface offset setting to zero. Changing the offset in the **Surface Settings** screen applies the surface offset value displayed in the same window.

The current surface offset value is saved with the measured data, just like when using a TTM or PRO design.

VCL points

Similar to point data from a DXF/DWG file, if a 3D or 2D point in the VCL file has a valid point name then it can be used in the Siteworks software. VCL points are displayed as an "X" in the map view just like DXF/DWG points. To toggle on/off these points, use the option in the **Map Options: Measure** tab (see [page 34](#)). Starting with the Siteworks v1.70, point visibility in VCL and DXF/DWG files is controlled by the layer the points are on. Use the **Map Options: Layer** tab to control the design point visibility. VCL points that do not have a valid name associated with them are drawn as a hollow circle and cannot be selected in the Siteworks software.

A VCL point can be selected in the stakeout feature and COGO feature. Tapping and holding on the VCL point gives you the same menu options as tapping and holding on a stakeout point from the design's stakeout point CSV file.

VCL lines

Line data from the VCL design is displayed in the map views. All the valid lines within the VCL file are displayed, regardless of the design's surface selection; this includes linestrings, polylines, and lines. The lines can be selected in the stakeout feature, the COGO features, or as reference lines. Tapping and holding on the lines opens a tap-and-hold menu similar to the one currently seen with DXF/DWG linework data.

To toggle on/off the line data, use the **Map Options: Design** tab (see [page 36](#)) or toggle the individual design layer the line data is on.

If the VCL line data has a defined name, that name is displayed in the software. Otherwise the software uses a generic "Unnamed CAD" string as the line's name, as is currently done with unnamed lines in DXF/DWG files. The line's layer name is also displayed as part of the tap-and-hold menu title bar.

VCL alignments

All defined alignment objects created in the Trimble Business Center software and exported into the VCL design are displayed and can be selected in the software. The alignments can be used as reference lines, selected in the stakeout feature to stake a station and offset location, and in the COGO features.

Unlike with PRO files, selecting an alignment does not automatically select the surface associated with that alignment. You must manually select the surface you want to use via the **Surface** option (see [page 74](#)).

To toggle on/off the alignment data visibility, use the **Corridor** map options setting or select/deselect the design layer the alignment is on.

The tap-and-hold menu for the VCL alignment gives you the option to stake a location (station and offset) from the alignment or select the alignment as a reference line.

Measure

If you have a surface from the VCL file selected in the measure feature, **Cut/Fill**, **Dsn Elv**, and **Thickness** are values displayed in the info bar (see [page 45](#)) and recorded with the measured point. These values are only displayed while you are over the active surface.

This is the same functionality and behavior as with a TTM or PRO design. However, when using a corridor surface or corridor template surface, the surface's alignment is automatically selected as the reference line. If you change or deselect the surface's alignment as the reference line, the software highlights the surface's alignment as a blue line, while the reference line will be red. The **Sta** and **Off** value displayed in the info bar is to the surface's alignment, and the **R. Sta** and **R.Off** values are to the selected reference line. Siteworks will continue to only record the reference station and offset with the measured data.

The active surface name is recorded with the measured data in the format of [Design Name]:[Surface Name].

Second surface

VCL surfaces and corridor surfaces can be used as second surfaces in the measure feature. However, you can only select second surfaces from the currently loaded VCL design and not from a separate design file. VCL corridor template surfaces cannot be selected as a second surface.

In the **Second Surface Settings** screen, you can select the current VCL design as the *Second surface design*. Once selected, a **Surface** option is displayed enabling you to select a surface from the VCL design.

There is no change in functionality when using a VCL surface or VCL corridor surface as a second surface, compared to when using a TTM surface.

Stakeout

Siteworks supports the staking of lines, points, alignments, and surfaces from the VCL design. If the active surface is a corridor template surface, then template nodes, and template catch points can be staked.

VCL points

Staking VCL points behaves the same as staking other points in the software. The points can be selected via the tap-and-hold menu or through the **Stakeout Object** screen. In the **Stakeout Object** screen, select the point by tapping on it in the map view, by manually entering the point's name in the **Object** field, or by selecting it from the **Point table** in the **Select Object** screen (to access it, tap the List icon). As with DXF/DWG points, the point must have a defined name.

Once selected, the point can be staked. A side slope can also be projected from the point, and the side slope or catch point can be staked.

The stake report's data and saved data for the VCL point matches the stake reports and saved data for any other selectable point in the software.

Just like with DXF points, a 2D or 3D point can be selected and staked. An elevation for the point can be defined if you want to stake a side slope or catch point from the 2D point.

VCL lines

Staking lines from the VCL design behaves the same as staking lines from DXF/DWG designs. The lines can be selected via the tap-and-hold menu and through the **Stakeout** screen. In the **Stakeout** screen, select the line by tapping on it in the map view or by selecting it from the **List table** in the **Select Object** screen (to access it, tap the List icon).

Once selected, you can stake the line, a side slope from the line, or a catch point projected from the line. The line direction of the VCL line can be reversed. A horizontal and vertical offset can also be applied to the selected line.

Starting with the v1.41 release, linestring objects with Vertical Points of Intersection (VPI) definitions as created in the **Vertical** tab of the Edit Linestring command in the Trimble Business Center software are now supported. In older versions of the Siteworks software, linestrings with VPI definitions were treated as 2D lines when staking out. Note that linestrings with VPI definitions will be treated as 2D lines for any COGO commands associated with that linestring.

VCL surfaces

Only the *active* surface (see [page 74](#)) can be staked. Once a surface from the VCL file is selected as the active surface, you can select the surface to stake via the tap-and-hold menu or through the stakeout feature.

In the stakeout feature you can select the surface by tapping on it (note that if there are other objects in the tap radius they are selected instead), by manually entering the surface's name in the **Object** field, or by selecting the surface from the **Surface table** in the **List** screen. The **Surface** tab only lists the currently active surface, regardless of the surface type (VCL surface, corridor surface, or corridor template surface).

If a VCL surface or corridor surface is selected, the only stake method option is surface. The surface stake method is the same as staking a TTM surface. For corridor surfaces, the surface's alignment is selected as the reference line if another reference line is not selected. If a different line is selected, you are asked if you want to use the corridor surface's alignment as the reference line. Selecting to use the surface's alignment as the

reference line will set the reference line to the surface's alignment for all features. You can still manually change the reference line to a different line if required.

If you select to stake the active VCL corridor template surface, you have the following stake method options: surface, template nodes, template catch points.

Selecting the surface stake method for the corridor template surface behaves the same as selecting the same option for a corridor surface. The template surface's alignment is selected as the reference line if no other reference line is selected. If another reference line is already selected, then you are asked if you want to use the corridor template surface's alignment as the reference line.

Selecting the feature stake method takes you into the same workflow and features as staking roadway nodes from a PRO file. The stakeout reports, stake options, and saved data for staking VCL template nodes is identical to PRO node features.

Selecting the catch point stake method for a VCL template surface takes you into the same tie slope selection workflow that was used with PRO files. This workflow has the same options of selecting existing tie slopes, defining custom tie slopes from a selected node, or using the outer segments if there are no defined tie slopes. The stakeout reports, settings, and saved data for staking a VCL catch point match staking a PRO catch point.

NOTE – Version 1.20 and later only support basic design tie slopes that are defined from the last node of the cross section during template creation in the Trimble Business Center software. If tie slopes are defined in the middle of the cross section or via look-up tables, these types of tie-slopes are not yet supported.

Just like with PRO data, the tie slopes are always projected from the original surface, even if a surface offset is applied to the template surface.

VCL alignments

An alignment in a VCL file can be selected to stake via the tap-and-hold menu or through the Stakeout feature. In the **Stakeout** screen, you can select any VCL alignment by tapping on it in the map, entering the alignment's name in the **Object** field, or selecting the alignment from the **Alignment** tab in the **List** window. Note that if still using a PRO file there is a **Corridor** tab instead where you can select any available corridor from the PRO file.

Staking a VCL alignment is slightly different than staking a PRO alignment. When a VCL alignment is selected (as opposed to the VCL surface associated with it), you can only stake a station and offset location. Selecting this option takes you into a workflow similar to staking a location from a HAL only or HAL/VAL PRO alignment (that is, a PRO file with no corridor surfaces or templates present). You can select a station and offset to define the stake location and define the elevation for the stake location. The elevation options available change depending on if the selected alignment is 3D (HAL and VAL) or 2D (HAL only). Having a surface associated with the selected alignment does not have any impact on the stakeout options.

When staking a 3D VCL alignment, the available elevation options are: ignore, define grade, vertical offset, manually entered elevation, and design surface. The design surface is the currently selected VCL surface.

For 2D VCL alignments, the available elevation options are: ignore, manually entered elevation, and design surface. The design surface is the currently selected VCL surface.

When staking a 2D VCL alignment, Siteworks v1.30 and later will stop along both vertical and horizontal tangent points. The tangent points along a VCL are differentiated on the map screen by white circles for horizontal tangent points and black circles for vertical tangent points.

COGO

VCL data of points, lines, alignments, and active surface are supported for use in the Siteworks COGO features. Note that Linestring objects with VPI definitions will be treated as 2D lines when using COGO commands with the line.

Review & Edit Data

In the **Review & Edit Data COGO** feature, you can select VCL lines and points when defining segments for compute distance, compute total distance, compute area, and compute down and out. You can use VCL points for computing angles, and can use the active surface for computing volumes. This includes all surface types of VCL surface, corridor surface, and corridor template surface. See also [Review & Edit Data, page 95](#).

Create Points/Arcs

In the **Create Points/Arcs** feature, you can select VCL Lines, points, and alignments. Similar to DXF data, you can select the VCL lines and points for the tools that use line segments. You can select VCL points for the toolbar that use points.

The VCL alignments can only be selected for the create point at offset from corridor and the deflection from corridor tools. See also [Create Points/Arcs, page 97](#).

Key In Corridors

The **Key In Corridor COGO** feature still only generates PRO roadways. VCL corridor template surfaces cannot be created or edited in Siteworks. Key in Corridors and writing PRO files are not available on Android devices. See also [Key In Corridors, page 99](#).

Cross Section View

The software supports displaying any type of surface cross section in the cross section view.

When a surface offset is applied to a surface, both the original template cross section and the offset template cross section are displayed in the cross section view. The original surface will appear as a dashed line, while the offset surface will be a solid line.

While in the measure feature with a template surface selected as the active surface, the cross section segment you are currently over/under is highlighted. A vertical line from your location (in the cross section view) to the highlighted segment is also drawn.

When staking a VCL alignment, the cross section view generally shows the alignment's location marked by a small dot underneath a CenterLine icon and the entered offset location required to be staked as an open green circle. A red line is typically drawn connecting the two locations. If there are no elevations for either the alignment (HAL only) or the required stake point (elevation set to "Ignore"), then there is no display in the cross section view. When the **Elevation Method** is set to Vertical Offset in the **Station Selection** screen, a vertical line represents the vertical offset and a horizontal line represents the horizontal offset to the required stake location. For all other elevation methods, a straight line is drawn from the alignment's position to the required offset position location.

Enhancements

Unlike with PRO designs, Siteworks now displays the corridor template surface in the 3D surface viewer and can generate and display design contour lines for the surface. However, the 3D View surface and the design contours are generated from a surface version of the corridor template surface, so the design's tie slopes are included. As a result, when your location is over the design tie slopes, Siteworks won't display design elevation data in the measure feature even though they are over the 3D surface or within the design contour area.

In the Stakeout feature, you can select a corridor alignment independent of the active surface/corridor. This enables you to stake a station and offset from any VCL alignment to the currently active surface, even if that surface is not associated with the selected alignment.

In the **Stakeout Object** screen, if you tap on the alignment for the active surface, a pop-up menu appears giving you the option to select the alignment or the active surface. This is to help PRO users transition to VCL data. With PRO data you select the alignment to stake the cross section data. With VCL data, you must select the corridor template surface to stake the cross section data.

In the **Review & Edit Data COGO** feature, if the active surface is a corridor template surface, you can use it to compute the volume between the measured surface and the template surface. It is important to note that the template's design tie slopes are included in the volume computation. These tie slope surfaces are calculated in the Trimble Business Center software and depend on what surface was selected when defining the template. They may not be part of the original design and may extend outside the boundaries of the design's footprint. Therefore, volume calculations may include calculated or extrapolated data instead of only design data. To see the extents of the template surface that is used to compute the volume calculation, select the **Design contours** option in the **Map Options: Design** tab (see [page 36](#)). The red line drawn around the design surface indicates where the design tie slopes end.

When saving the current work order's measured data as a new design, you can now merge the measured data with the corridor template surface. When merging the measured data with the template data, the design tie slope segments of the template surface are included in the merge. To see the full extent of the template surface that is included in the merge, select the **Design contours** option in the **Map Options: Design** tab (see [page 36](#)). The red line around the design surface seen in the plan map view indicates the extent of the template surface, and what data is used when merging the template surface with the measured surface.

Measurement Workflows

- Displaying cut/fill
- Checking a grade/elevation
- Checking material thickness
- Checking cut/fill between two saved surfaces
- Measuring a surface or a feature
- EZ Level measurement
- Measure when level
- Measuring with feature codes

The Siteworks software is a site measurement tool that enables you to monitor earthworks and surface finishing operations. It enables construction contractors to measure material volumes, monitor and measure grade elevations relative to the site design, determine laid material thicknesses, and to perform site measurement tasks such as measuring points, lines, and surfaces.

Displaying cut/fill

A valid design containing a surface model must be loaded via the **Project Setup** menu for cut and fill values to be displayed. If the software is not in Measure mode, tap the **Home** button and then tap **Measure**. Walk anywhere on the design surface and view the current cut/fill to the design elevation on the [Info Bar and Info Panel, page 45](#). The lightbar can be displayed in any of the panels by clicking the down arrow in the bottom or top side panel.



This lightbar indicates whether the surface is in cut, fill, or on grade:

- Blue = fill (below design elevation)
- Red = cut (above design elevation)
- Green = on grade

The lightbar can also be turned off/on in the **Panel Display** tab of the Map Options by selecting/deselecting the **Lightbar** checkbox. The lightbar will blink when approaching within approximately 0.33 m or 1 ft of grade elevation.


Audio indicators also will also sound when within 0.33 m or 1 ft of grade:

- A steady tone = on grade
- A slow beeping = below grade
- A fast beeping = above grade

The lightbar sound can be turned off/on in the **Design** tab of the Map Options by selecting/deselecting the **Lightbar sound** checkbox.

Checking a grade/elevation

Measure a surface point at a location where you want to view and record the difference in elevation between the design surface and the survey rod tip. As you move around, the values in the info bar on the screen update with current values.

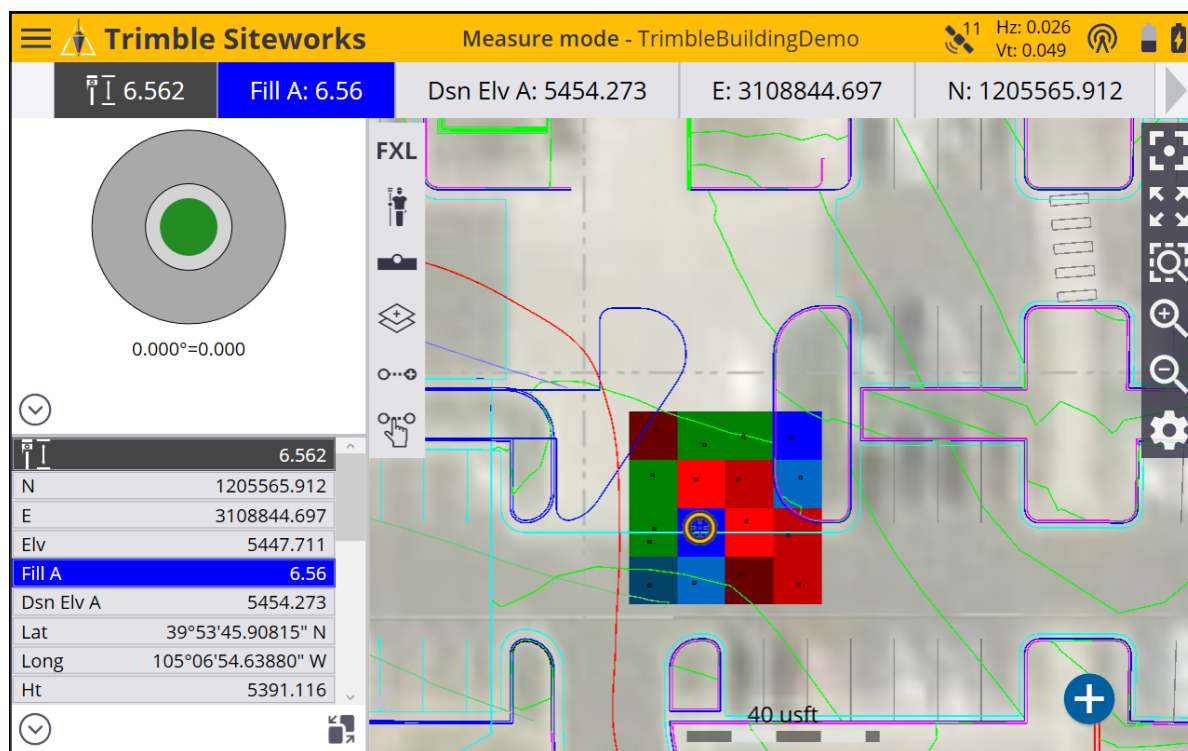
1. If not in Measure mode, tap the **Home** menu and then tap **Measure**.
2. Tap the **Measure** button to record a surface point and the cut/fill value at that location .

The software draws a colored grid box of the size that you specify in the **Settings / Map Display Settings / Measure** tab around every recorded point, so you can easily view where data is missing, and determine areas of cut or fill.


Once a point is recorded, a colored box appears around it, showing it as in tolerance (green), cut required (red), or fill required (blue). The colors are shaded depending on how far away from grade they are.

To change the cut/fill tolerances:

1. Tap the **Home** menu and then tap **Settings / Measure**.
2. Enter the required tolerances and then tap **ACCEPT**.

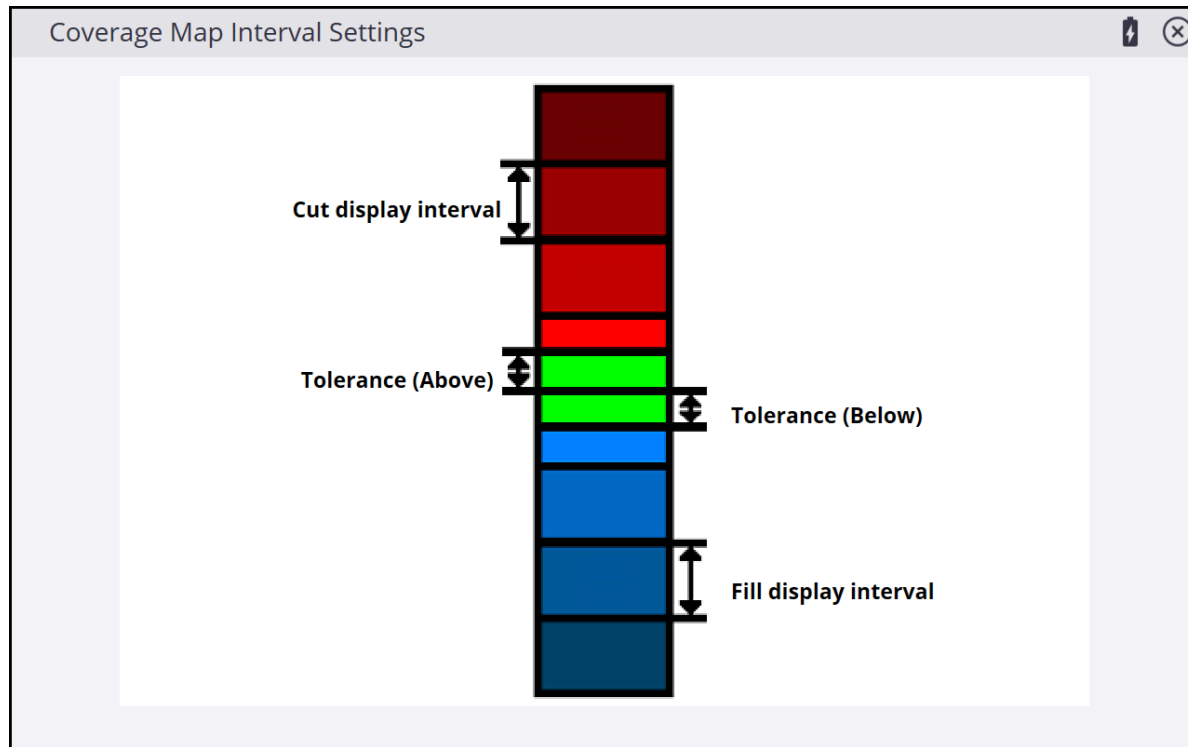


TIP – If a gray box appears, tap the **Zoom window** icon and draw a box around the area of the gray box. Gray boxes appear when the map is zoomed out too far to see the colored boxes at the specified resolution.

If no boxes appear, tap  from the toolbar on the right. Ensure that the **Coverage Grid** checkbox and the **Cut/Fill: Measured** option are selected. You can also change the grid size. Note that if a too small grid size is

entered (that will result in more than 600,000 grid cells being created over the site's extents), then no grid cells will appear. In this case, increase the grid size.

Grid cut/fill color display values are graduated into four shades each of blue and red. These cut/fill display color intervals are set through the **Home menu / Settings / Measure** settings as shown below.



The Tolerance (Above/Below) value is how far above or below the design surface elevation the measured point can be to plot in a green, within tolerance color. The Cut/Fill display interval is the distance over which one color shade will be plotted. Different values can be set individually for the Cut and Fill display intervals, along with different individual Tolerance above and below values.

Checking material thickness


The typical procedure for checking a material thickness is:

1. Measure the existing surface before laying the material.
2. Save the measured surface as a design.
3. Create a new work order and then load the saved design as the active design.
4. Lay the new material.
5. Check the material thickness by measuring points on the laid material, after entering a surface offset value equal to the required thickness.

If the current material thickness is too thin, a blue square appears to show that more "fill" material is required. If the current material thickness is too thick, a red square appears to show that material is required to be "cut" away. If the current material thickness is within a specified tolerance, a green square appears to show that no action is required.

1. If not in Measure mode, tap the **Home** button and then tap **Measure**.
2. Tap the **Home** button and then select **Settings / Measure**.
3. Ensure that the measurement offset is enabled in this menu (you can change tolerances here too).


4. Select the **measure type** icon in the main panel  and enter the required thickness as a vertical offset. Tap **ACCEPT**.

5. Tap **Measure**  to record a point and the cut/fill value at that location.

As you move around, the values in the info bar at the top of the screen update; the thickness of the material is shown in the Thickness box. The Thickness in the info bar can be activated, if it is not displayed, by pressing the **Home Menu / Settings / Info Bar/Panel**.


Once a point is recorded, a colored box appears around it showing whether it is within the tolerance range or whether more or less material is required.

TIP – If a gray box appears, tap the **Zoom window** icon and draw a box around the area of the gray box. Gray boxes appear when the map is zoomed out too far to see the colored boxes at the specified resolution.

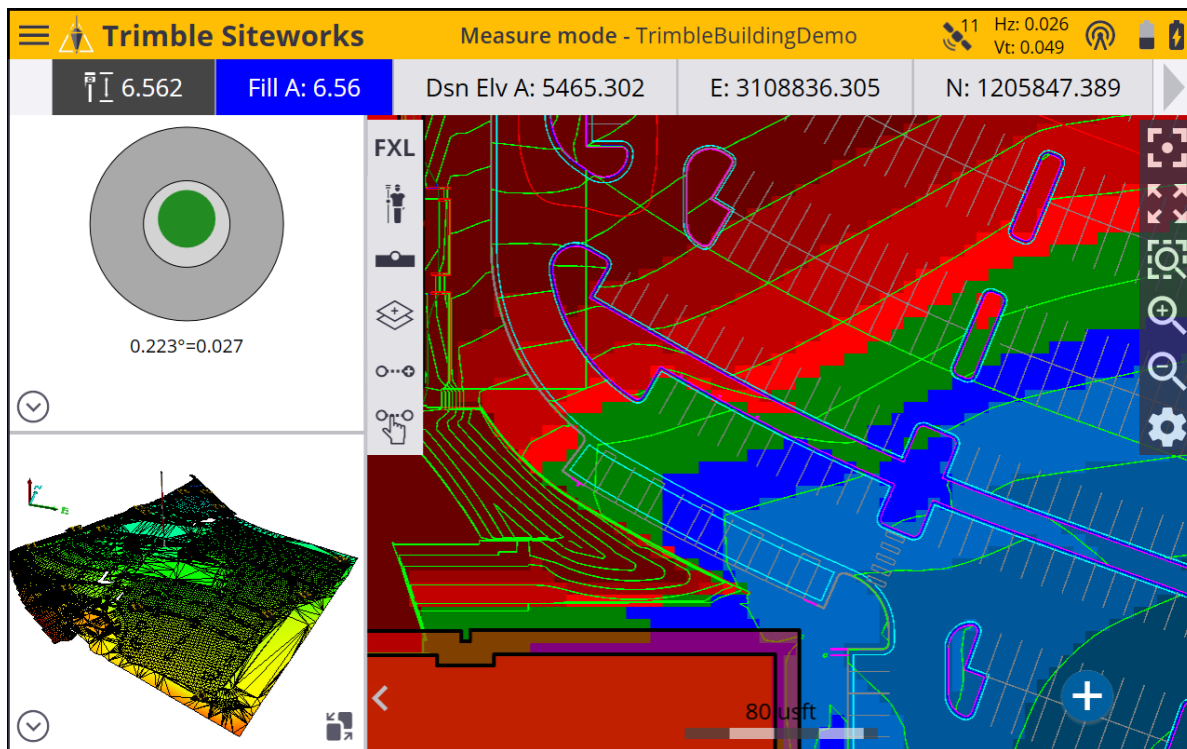
If no boxes appear, tap  from the toolbar on the right. Ensure that the **Coverage Grid** checkbox and the **Cut/Fill: Measured** option are selected. You can also change the grid size.

If a small grid size is entered that will result in more than 600,000 grid cells being created over the site's extents, then no grid cells will appear. In this case, increase the grid size.

Checking cut/fill between two saved surfaces

It is possible to produce a grid display of the cut/fill between two saved design surfaces. Tap  to open the **Map Options** screen and select the **Coverage Grid** option of Cut/Fill: Surface A-B. Surface A is the primary design surface loaded in the **Open Project** menu, and Surface B is selected via **Settings / Second Surface**. This displays colored cut/fill grid cells between the two surfaces using the color settings set via the **Settings / Measure, Tolerance Above/Below and Cut/Fill Display Interval**.





If too small a grid size is entered, you are notified of the minimum grid size to produce a display grid.



TIP – If a gray box appears, tap the **Zoom window** icon and draw a box around the area of the gray box. Gray boxes appear when the map is zoomed out too far to see the colored boxes at the specified resolution.

Measuring a surface or a feature

Siteworks can measure points and lines and can create a real-time Digital Terrain Model (DTM) from the measured points or lines. Points can be toggled to be included in the DTM if the **Point type** is set to **Surface**. If a point does not need including in the DTM creation, then select **Feature** as the point type. Certain line types are included in the DTM creation as well. This is discussed below.

- 1. If the software is not in Measure mode, tap **Home** and then tap **Measure**.
- 2. To open the **Measure Type** settings screen, tap one of the icons     on the right side of the main panel to choose between point, line, surface, and non-surface feature to be measured. The icon displayed on the main panel changes depending on the type of measurement being performed. The **Measure Type** screen is also accessible via **Menu / Measure / Measure Type**.

Measure Type

11 Hz: 0.026 Vt: 0.049

Point Existing Line New Line

Point name

Topo36

Point code

SH

Point type

Surface

Show every time

No

ACCEPT

Lines are measured by selecting one of the Line tabs for New Lines or Existing Lines. Selecting **Existing Line** enables the selection of an existing line from a table and the continuation of measuring that line from the last measured end point along it. Selecting **New Line** requires entering a Line Name and choosing what kind of line type it is. Line types that are included in the DTM surface measurement are Breaklines, Volume Boundaries, and Outer Boundaries. Line and Area are not included in the DTM surface measurement.

Measure Type

PointExisting LineNew Line

Line name

Line1

Line type

Line

Area





Breakline

Volume Boundary

Outer Boundary

ACCEPT

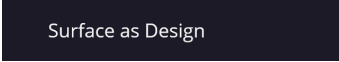
3. You can also enter a point name (will be automatically incremented) and optional point code. The **Status bar** icon changes depending on what kind of point or line you choose to measure:

Icon		Definition
	Surface Point	Elevation is used to create a terrain model.
	Feature Point	Elevation is not used to create a terrain model.
	Feature Line or Area	Elevation is not used to create terrain model.
	Breakline, Volume Boundary, or Outer Boundary	Elevation is used to create a terrain model.

To create an outer boundary, volume boundary, or surface points to add to an existing line, select the correct line type. Once a surface is measured, you can save the surface as a design and then perform a material thickness check. See [Checking material thickness, page 84](#).

NOTE – To change the default point input value from **Point name** to **Point Code**, go to **Menu / Settings / Measure** and select either the Point Name or Point Code for the **Default point input** field value.

To save the measured DTM surface as a design:

- From the **Home** menu, tap **Data Management**.
- Tap **Surface as Design**  and enter a design name.
- Choose whether to include measured linework, design linework, or no linework.
- Select if you wish to merge the measured surface with the currently selected design surface.
- Tap **ACCEPT** to export the measured surface as a design.

EZ Level measurement

This feature provides a simple and easy way to graphically display elevations on a site relative to an arbitrary benchmark that is measured as part of the EZ Level workflow. This is a display and indicate-only feature and does not store any points or measurements. It is available for both GNSS and total stations. It does not require a site to be calibrated for GNSS use, or a total station to be set up on a known point. The intent of this feature is to provide a laser level-like workflow to quickly and accurately determine cut/fill values from an arbitrary EZ Level elevation relative to a measured benchmark elevation.


To open the EZ Level feature, tap the **Measure Mode** icon on the right side of the main panel:



Alternatively, tap the **Home** menu and then tap **Measure** and select **EZ Level**:



The **EZ Level Settings** screen appears. Enter a benchmark elevation which is the reference elevation that you wish to measure. Enter an arbitrary value for the benchmark elevation or select the elevation of a control point

from a list of control points by tapping the list icon: 

EZ Level Settings

11 Hz: 0.026 Vt: 0.049

Place target over benchmark and press 'MEASURE'.

Benchmark elevation

100.00 usft

EZ Level elevation

103.50 usft

Tolerance (Above)

0.050 usft

Tolerance (Below)

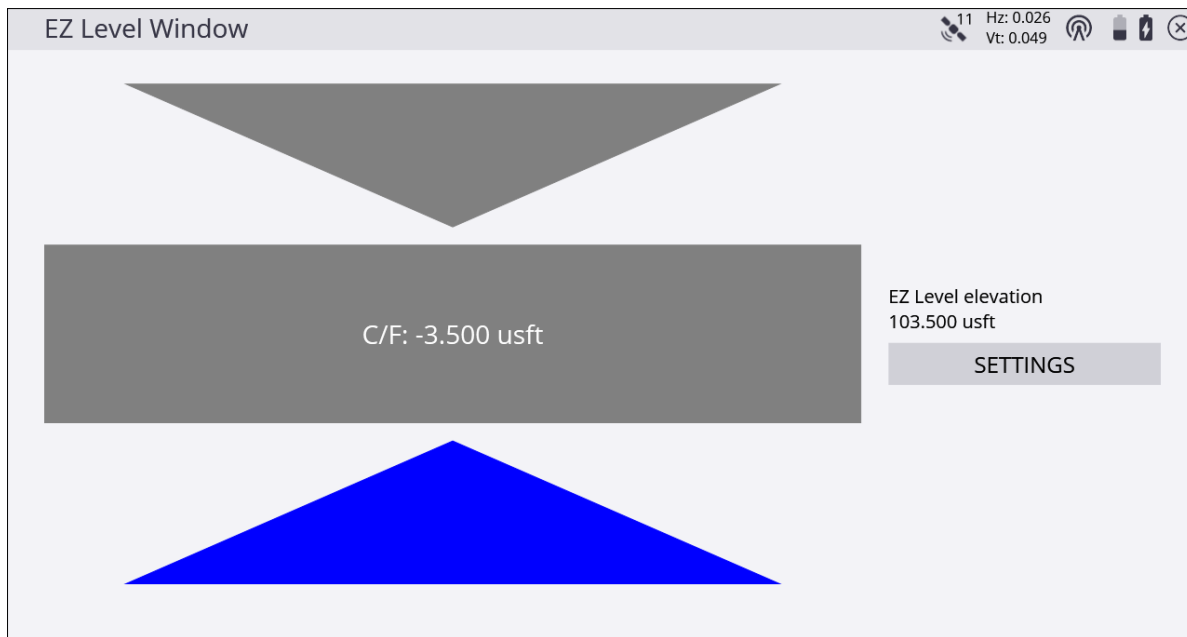
0.050 usft

Antenna height

6.562 usft

MEASURE

The EZ Level elevation is the elevation value that is used to display the cut/fill values to on the **EZ Level** screen and is relative to the arbitrary benchmark elevation. For example, if there is a benchmark at elevation 100, and you want to determine cut/fill values for a finished floor elevation of 103.5, you would place the rod on the benchmark at 100, enter 103.5 for the EZ Level Elevation, and then measure the benchmark. On-screen values then indicate the cut/fill relative to the 103.5 EZ Level elevation. The current elevation is displayed in the center of the screen, between the two arrows, and the cut/fill values to get to the EZ Level elevation are displayed on the upper or lower arrows respectively.




To re-enter the settings window to change the EZ Level elevation and/or measure a new benchmark elevation, tap **SETTINGS**.

Measure when level

This feature automatically measures and stores a point whenever the GNSS receiver is level. To use this feature, you need a GNSS receiver with eBubble functionality, such as the SPS986 or R780. This function does not require the Tilt Compensation IMU option to be installed on the GNSS receiver, and is typically used when the IMU option has not been activated. See [Tilt Compensation, page 146](#).

A point is automatically measured when the eBubble is within the set tolerances. First set or change these tolerances to your satisfaction. Do this, by either tapping on the eBubble or selecting **Home / Settings / eBubble**. The value to set is the tilt tolerance. A point will be measured each time the eBubble is within this set tolerance.

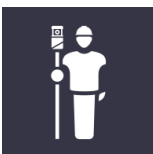
A second recommendation before starting is to turn on the volume of the controller so you can hear when a measurement is taken and stored, or if the receiver goes out-of-tilt tolerance while measuring.

Thirdly, set your measure type to a point or a line by either tapping the **Measure type** icon () or selecting **Home / Measure / Measure Type**. For efficiency, set the **show every time** option to No.

Taking measurements

To open the Measure When Level feature:

1. Tap the **Measure mode** icon on the right side of the main panel or select **Home / Settings / Measure Mode**:



2. Select **Walking**:



The following screen appears:

3. Set your pole height settings:
- a. In the **Record mode** field, select Measure When Level.
 - b. If not completed already, set the **Tilt tolerance** option (this also updates the **Tilt tolerance** option in the eBubble settings).
 - c. In the **Time interval** field, enter the time you want the receiver to be level before a measurement is recorded (the same as minimum measuring time in static mode).
 - d. Tap **ACCEPT** to return to the **Measure** screen.

In the lower-right corner of the main measurement screen, there is now a play button:






Icon	Definition	
	Play	Starts the Measure When Level function. When this is tapped, a measurement is recorded every time the receiver is level within the tolerances set. The receiver must go out-of-level tolerance and back in to trigger another measurement.
	Stop	Stops the Measure When Level function from automatically recording a point every time the receiver is level within the set tolerances.
	Measure button	Triggers a measurement manually, even if the receiver is not level.


Measuring with feature codes

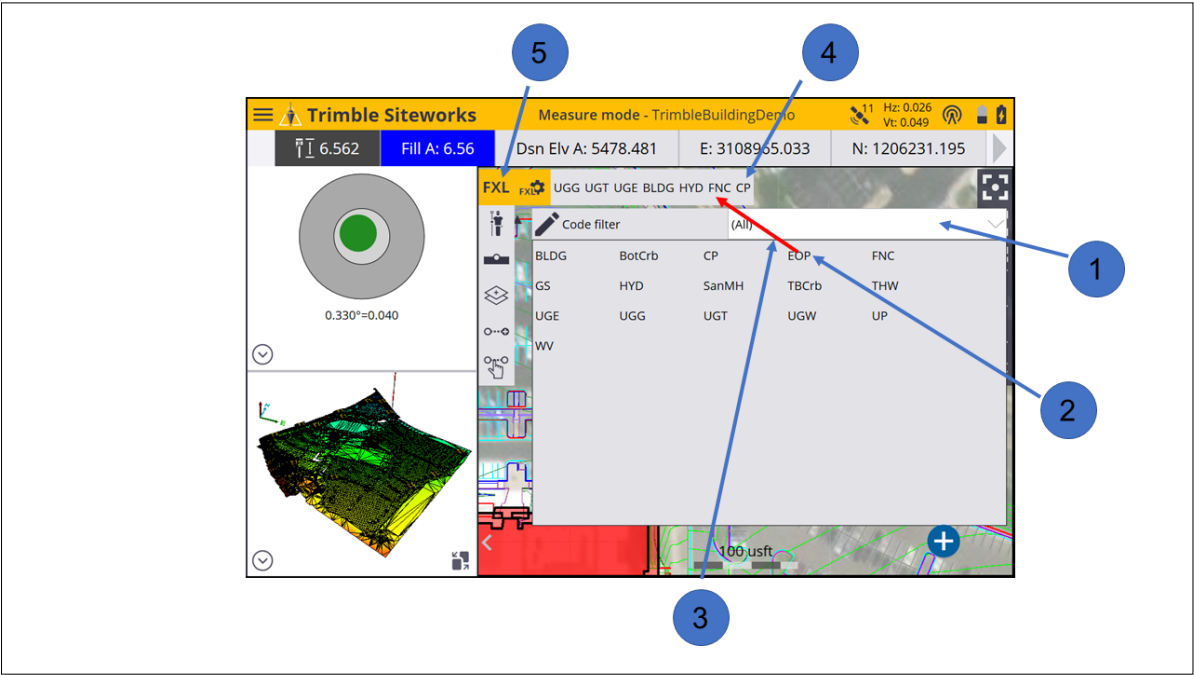
NOTE – The Advanced Measurement module is required to use a Feature Code library.

The software can use feature codes to record data on site. Create and customize the feature code library using the Feature Definition Manager of the Trimble Business Center software.

The feature code defines if a point, line, or breakline is measured. The following classes of feature codes are available:

Feature code class	Definition
	Point feature, but no surface feature.
	Line feature, but no surface feature.
	Point feature and surface point.
	Line feature and breakline.
	Feature contains optional or compulsory attributes.

The currently selected feature code and its class can be identified in the info bar/panel when the **FXL code** option is checked. To select and manage feature codes in the field, tap **FXL** on the main panel to slide out a quick access toolbar. Tap the FXL Settings icon  to open the FXL code matrix.



Select this option...	to...
①	filter by group or category.
②	select a feature code.
③	drag code to the Quick Select list.
④	select from the Quick Select list.
⑤	toggle to the Grid view.

To select a feature code, either tap on one of the buttons in the Quick Select list or select a feature code from the Grid view. The Grid view enables you to measure data without seeing the map. Instead you have up to 34 codes to choose from with a single tap.

Both the Grid view and the Quick Select list selection enable you access feature codes quicker by filtering feature codes by group and category. Groups and categories must be defined in the Feature Definition Manager in the office.

A category is a class of related feature codes, for example, vegetation. For certain measurements or tasks, you might want to group feature codes from different categories into a group for faster access.

With each feature code, different attributes can be stored, which enables you to describe a recorded point or line with more information. Attributes need to be set up in the Feature Definition Manager and cannot be changed or created in the field.

Different properties can be applied to each attribute, for example, if it is optional or compulsory to fill out this attribute, which values are required for this attribute, the permitted length of the text string that you can enter, or available items in a dropdown list.

Photos

Photos can be attached as an attribute using the internal camera of the controller or from photos imported onto the site controller.

The pictures are associated with the measured point and will be available to view in a Trimble Business Center project. Photo attributes are set up in the Feature Definition Manager.

Volume and COGO

- [Review & Edit Data](#)
- [Create Points/Arcs](#)
- [Key In Corridors](#)











When collecting data in the field, it can be useful to review and edit the data. This section covers reviewing and editing any surface data you have measured, calculating new points and lines in the field, and calculating the volumes, areas, and other information from measured data. It is possible to create and save a PDF report with the resulting COGO calculations.

Review & Edit Data

Use this feature to delete points you may have incorrectly measured. You can also use this feature to calculate volumes of any surfaces that you have measured, in addition to displaying line lengths, and calculating areas. It also enables you to display contours of the surface, which serves as a quick check that you have correctly collected data.

From the **COGO** menu, tap **Review & Edit Data** .

The **Review and Edit Data** screen has a list of icons on the left side, which represents all the available functions. These functions can also be accessed directly by pressing the **Help** icon in the upper right of the screen.

Icon	Description
	Compute Volumes
	Create Line/Boundary
	Delete Point/Line
	Generate Measured Contours
	Compute Horizontal & Vertical Distance, Bearing and Slope Percent
	Compute Total Distance, including the slope distance between two points
	Compute Area
	Compute Down and Out from Line
	Compute Angle
	Help


To undo an action, tap . To reset an action, tap .


Compute volumes

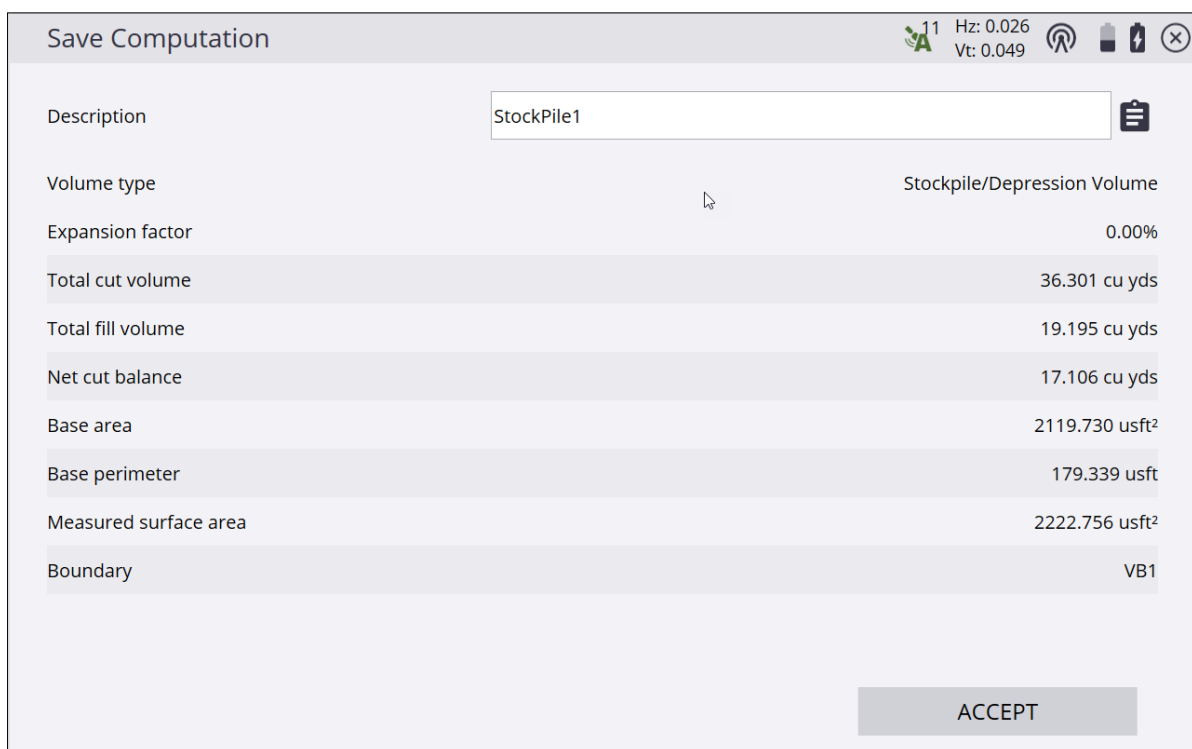
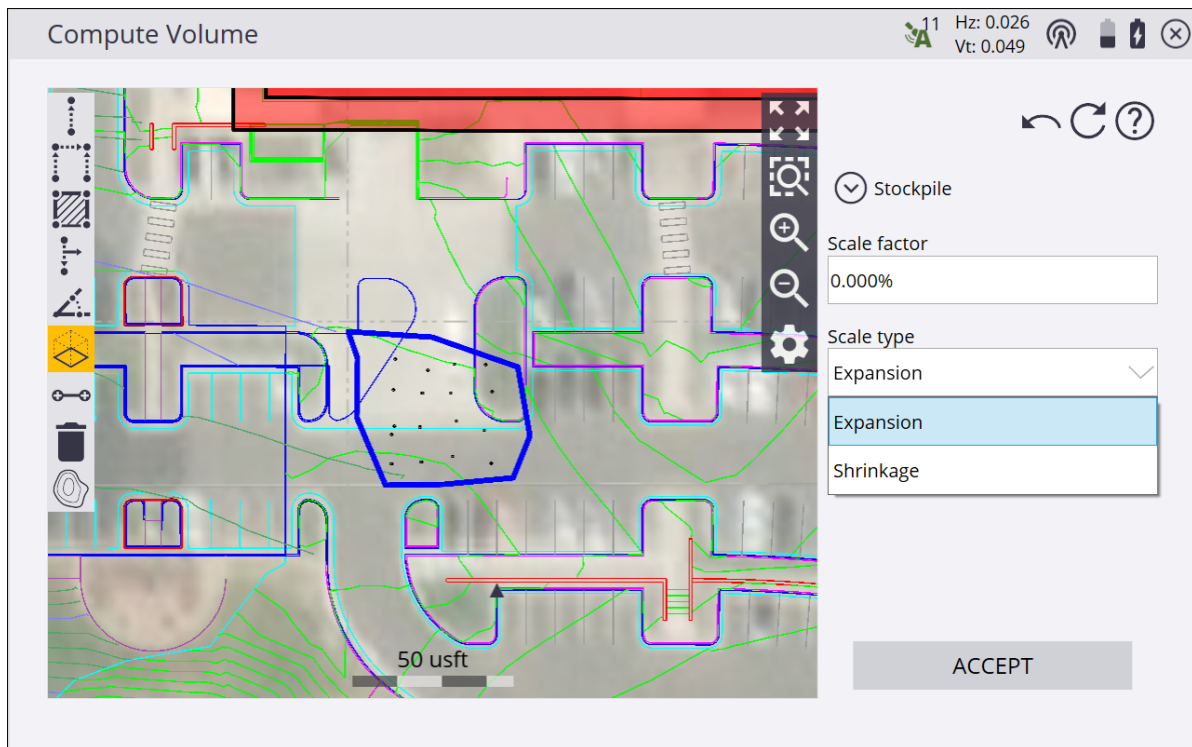
Use the **Compute Volume** option to calculate a volume from the data you have measured. Three types of volumes can be calculated:

- To or from a design surface
- To an entered elevation
- To a surface created by the volume boundary (stockpile/excavation volume)

NOTE – Before entering the Compute Volumes workflow, you must have measured or created—via the appropriate COGO functions—a closed volume boundary around the area which you wish to measure the volume. You cannot determine a design to design volume; all volume measurements must have a volume boundary measured and use some component of measured points, lines or surfaces.

From the **Review & Edit Data** menu, tap **Contour Measured Surface**  to view contours based on the surface you have measured. This is a useful tool to check for any major errors in measurement that can then be adjusted via the relevant COGO commands. The contours highlight any elevation errors in the data. The software controls the minimum contour interval based on the elevation range of the measured data. Displaying the contours is not required to compute a volume. Using the 3D viewer of the measured surface is also an alternative way to visualize the measured surface to check for measurement errors and to visualize the surface.

1. In the **Elv. Interval** field, enter a contour interval and then press **Enter**.
2. Tap the **Compute volume** icon .
3. Tap on the boundary of the area for which you want to calculate the volume and then tap **OK**.
4. Select the type of volume to compute:
 - a. **Stockpile** – The volume of a stockpile/depression – this calculation uses a “rubber sheet” surface created from the measured line of the selected volume boundary as the upper or lower bounding surface, with the volume being calculated between this rubber sheet and the measured surface within the boundary. Enter any required settings for **Expansion** or **Shrinkage** and an expansion/shrinkage scale factor.
 - b. **Measured to Entered Elevation** – The volume to a user-defined elevation. Enter the base elevation of a flat plane to be used as the comparison elevation and any required settings for **Expansion** or **Shrinkage** and an expansion/shrinkage scale factor.
 - c. **Measured to Design** – The volume from the surface you have measured to the design surface, or the volume from the design to the measured surface. Select this via the **Volume Direction** option. Enter any required design surface offsets and enter any required settings for **Expansion** or **Shrinkage** and an expansion/shrinkage scale factor.
5. The following screens show the result of the volume calculation for a stockpile.




The results of the volume calculation are stored in the task log. Review the results using the name of the volume in the log. Select **Data Management / Log**.

Create Points/Arcs


Use the **Create Points/Arcs** option to create design data in the field. You can create new points relative to other points and lines in the work order or in the current loaded design.

From the **COGO** menu, tap **Create Points/Arcs**.

Create Points/Arcs

A variety of functions are available in the bar on the left. These functions can also be accessed directly by pressing the **Help** icon  in the upper right of the screen.

Icon	Description
	Create a radius point for an arc.
	Create offset points from a line.
	Create an offset point at a certain station.
	Create a mid-point of a line or arc.
	Subdivide a line or arc in segments.
	Create a point at a distance and bearing.
	Enter the coordinates of a stakeout point.
	Create points at the end of a line or arc.
	Free Point Pick.
	Toggle display bar.
	Create a point at the intersection of a line.
	Deflection from line.
	Delete points and lines.
	Create an arc from three points or two points and radius.
	Create a circle by selecting a center point and either clicking or entering a radius or diameter.
	Create a new line from two points.
	Select points from a list.
	Define 2D object elevation.
	Create an offset line by tapping on an existing line.

Icon	Description
	Access the Help. NOTE – The Help icons are active, and the associated task and workflow can be accessed by tapping on the icon.

Points can be stored as stakeout points or as measured points. A surface can be generated from measured points, which you can then export to the GCS900, AccuGrade, or Earthworks grade control systems for machine guidance through the **Home / Import/Export / Export to Machine** command.






Key In Corridors

NOTE – The Roding Stakeout and Measurement module is required (see [page 13](#)). Key In Corridors is not supported on the Android operating system; it is only available on Windows 10 operating systems. In version 1.20, the name was changed from Key in Roads to Key in Corridors.


From the **COGO** menu, tap **Key In Corridors**

Key In Corridors

A variety of functions are available in the bar on the left:

Icon	Description
	Create/edit a corridor alignment.
	Create and position corridor templates.
	Create stakeout points at a certain station and offset from the corridor alignment.
	Create stakeout points at a certain station and with a deflection angle from the corridor alignment.
	Change the key in corridor entry method.

Creating an alignment

Tap the **Create/Edit corridor alignment**  icon. A tabular entry screen appears to enter the geometry for the horizontal and optional vertical alignment.

← Create Horizontal Alignment 11 Hz: 0.026 Vt: 0.049

MAP End Station: 1+00.000

Type						
POB	0+00.000	800000.000	400000.000			
Line	100.00.00	100.000	799982.635	400098.481		
Empty	Empty	Empty	Empty	Empty	Empty	Empty

NEXT

Complete the numeric boxes to define it.

To convert a polyline of the current loaded design or work order in an alignment, tap **Map**.

If corridors already exist in the current design that were created in the Siteworks software, you are prompted to choose to edit an existing corridor or create a new one:

Corridor Creation Option 11 Hz: 0.026 Vt: 0.049

☒ Create new corridor

Name

☐ Select existing corridor

Name ⌵

NEXT

The following table shows the record types that the Siteworks software supports and the data that you must enter for each type. Depending on the Key In Corridor settings, the alignment can be entered via segments or via coordinates for the points of intersections. The POB is the Point Of Beginning, which is always the first record for a horizontal alignment and contains the start station and coordinates. The azimuth is always automatically computed and appears in the table as Tangent. If you tap on this field, the software displays the actual calculated azimuth. If required, you can overwrite it with your own value. You can also enter the azimuth as a bearing (that is, S 90 W = azimuth of 270°).

Record type	Col1	Col2	Col3	Col4
POB (Point of Beginning)	Station	Northing	Easting	
Line	Azimuth	Length		
Spiral In	Azimuth	Direction	Radius	Length
Arc	Azimuth	Direction	Radius	Length
Spiral Out	Azimuth	Direction	Radius	Length
Combining Spiral	Azimuth	Length		

The end station value appears as you enter the corridor details. Tap **Map** to see the plan view of the alignment you are creating:

←
Create Horizontal Alignment

11 Hz: 0.026
Vt: 0.049

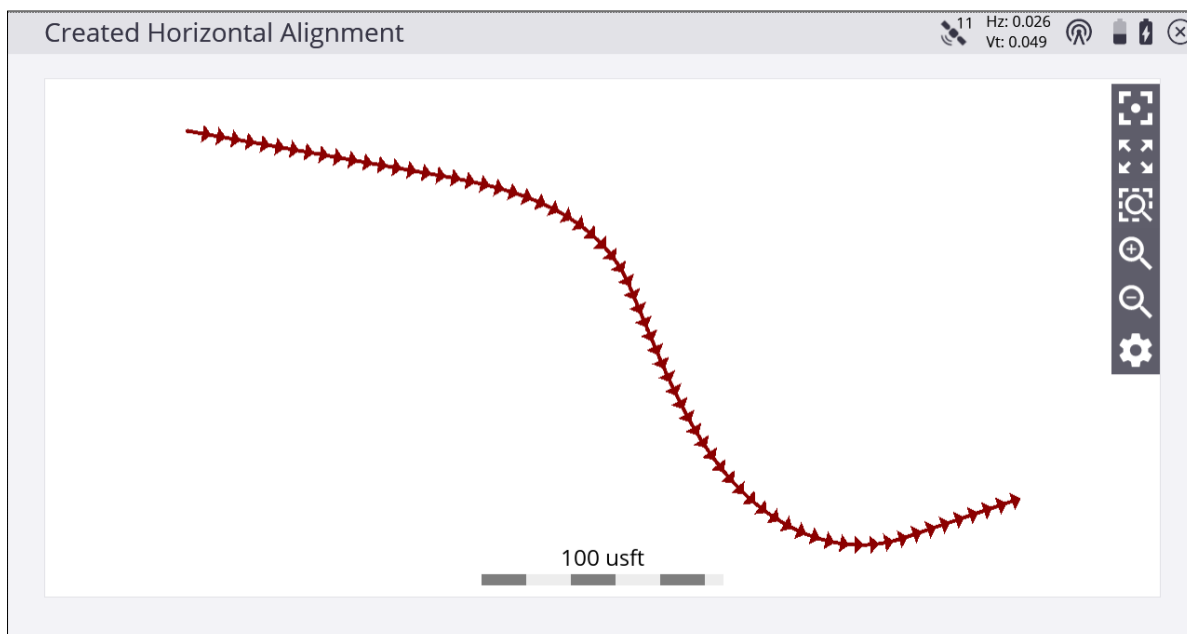
+

MAP

End Station: 4+20.000

Type	Azimuth (N)	Length	Northing	Easting		
POB	0+00.000	800000.000	400000.000			
Line	100.00.00	100.000	799982.635	400098.481		
Spiral In	Tangent	Right	50.000	100.000	799936.373	400182.171
Line	Tangent	20.000	799917.923	400189.891		
Spiral In	Tangent	Left	50.000	150.000	799832.217	400294.883
Line	Tangent	50.000	799848.204	400342.258		
Empty	Empty	Empty	Empty	Empty	Empty	Empty

NEXT



Creating a vertical alignment

Tap **Next**. The **Create Vertical Alignment** screen appears:

Type	Station VPI	Elevation		
POB	0+00.000	5000.000		
Asym	4+00.000	5030.000	100.000	100.000
Sym	8+00.000	5100.000	100.000	
Sym	20+00.000	5000.000	200.000	
Grade Break	23+00.000	5000.000		
Empty	Empty	Empty	Empty	Empty

ACCEPT

Complete the numeric boxes to define it.

This table shows the record types that the Siteworks software supports and the data that you must enter for each type. The POB is the Point Of Beginning, which is always the first record for a vertical alignment and contains the start station and elevation.

Record type	Col1	Col2	Col3
POB (Point of Beginning)	Station	Elevation	
Arc VPI	Station	Elevation	Radius
Vertical VPI	Station	Elevation	Length
Grade Break	Station	Elevation	

The final station value must be the same as the end station displayed in the previous Horizontal Alignment entry screen. Tap **Map** to see the profile view of the alignment you are creating:

Create Vertical Alignment (Optional)

11 Hz: 0.026 Vt: 0.049

+

MAP

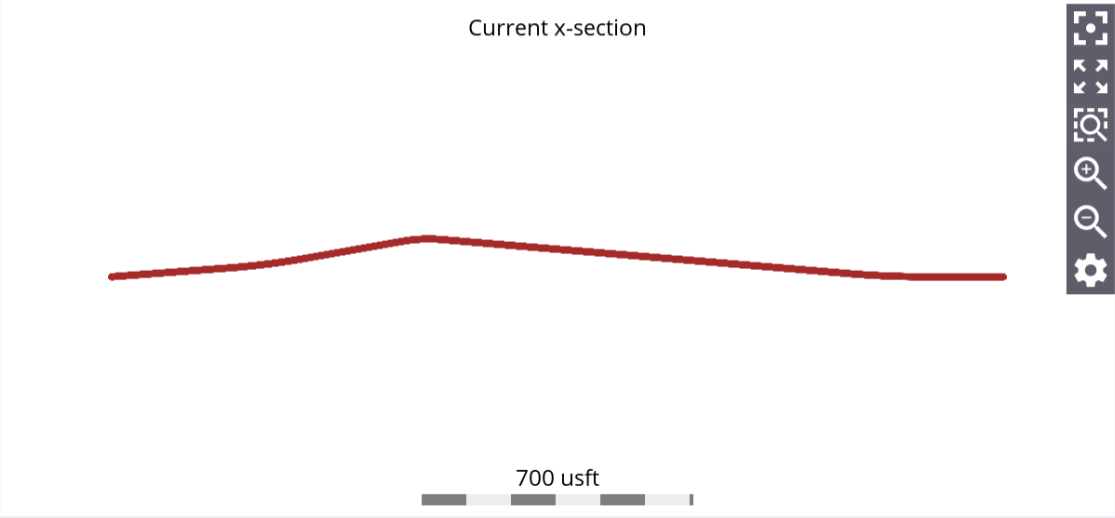
Type	Station VPI	Elevation		
POB	0+00.000	5000.000		
Asym	4+00.000	5030.000	100.000	100.000
Sym	8+00.000	5100.000	100.000	
Sym	20+00.000	5000.000	200.000	
Grade Break	23+00.000	5000.000		
Empty	Empty	Empty	Empty	Empty

ACCEPT

Created Vertical Alignment

11 Hz: 0.026 Vt: 0.049

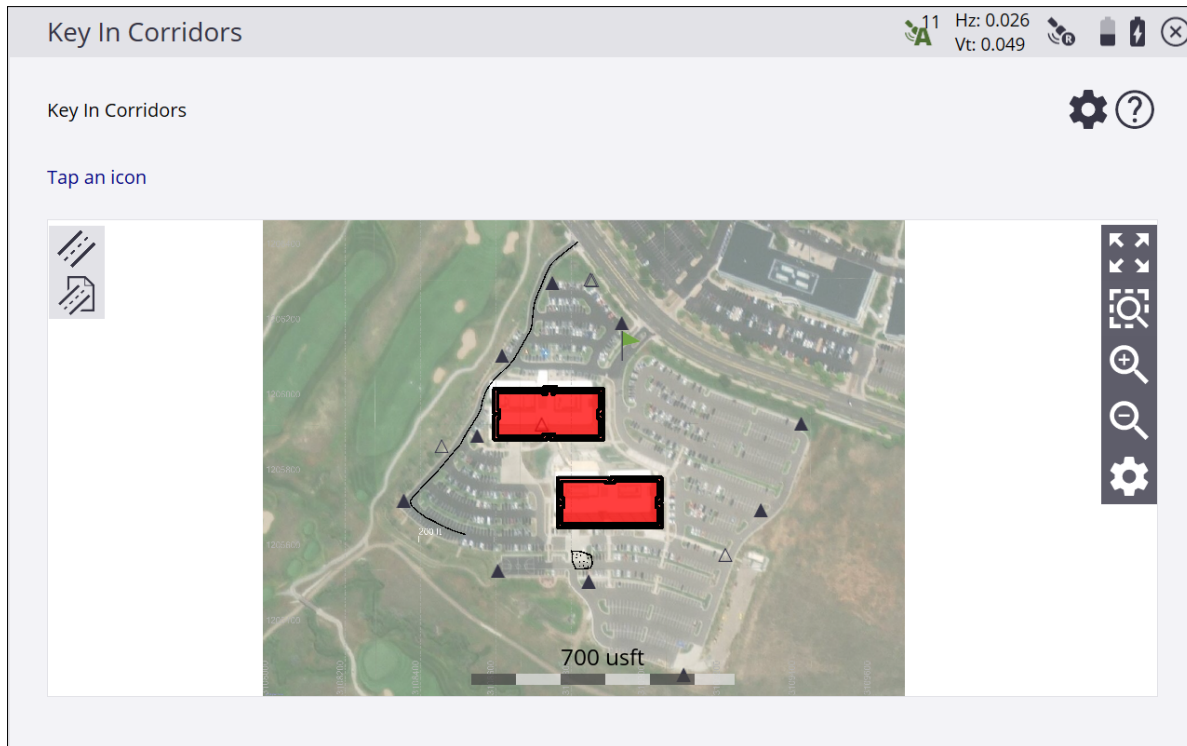
Current x-section



700 usft

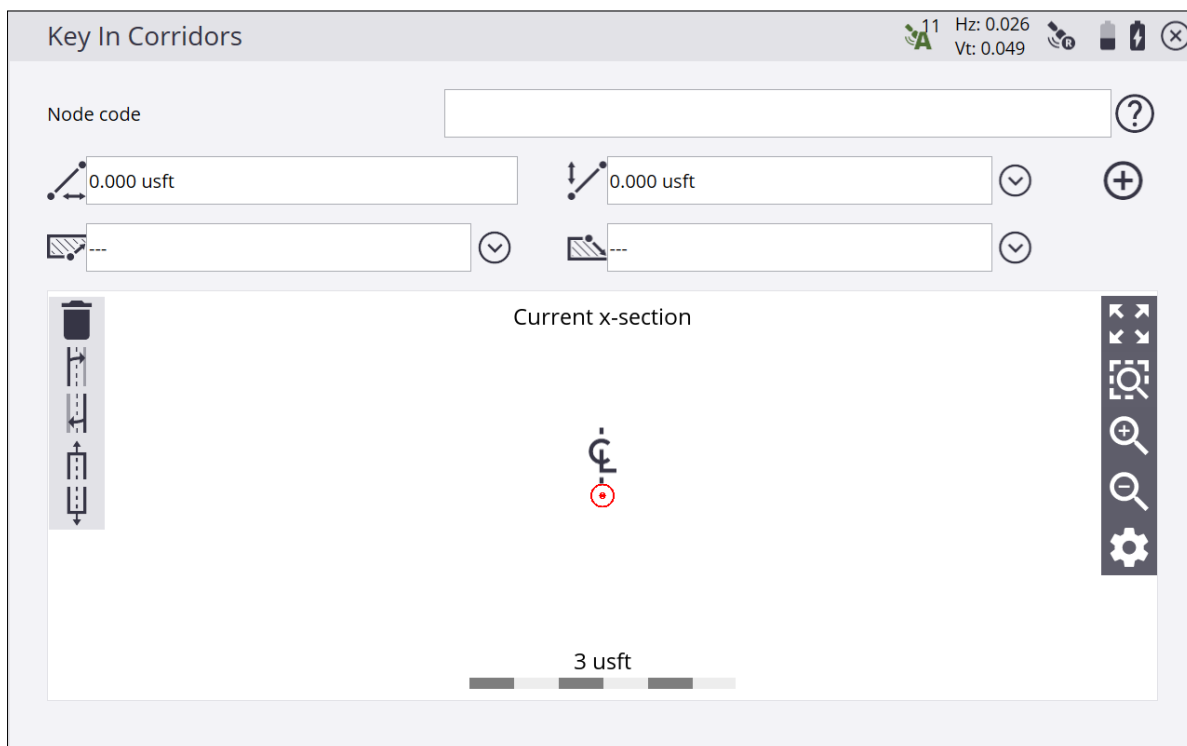
If there is no current design, you are also prompted to create a new Siteworks design.

The main create corridor screen reappears showing you the plan view of the alignment you have just created:













Positioning and creating templates

Tap the position and then tap the **Create corridor template** icon . The following screen appears:

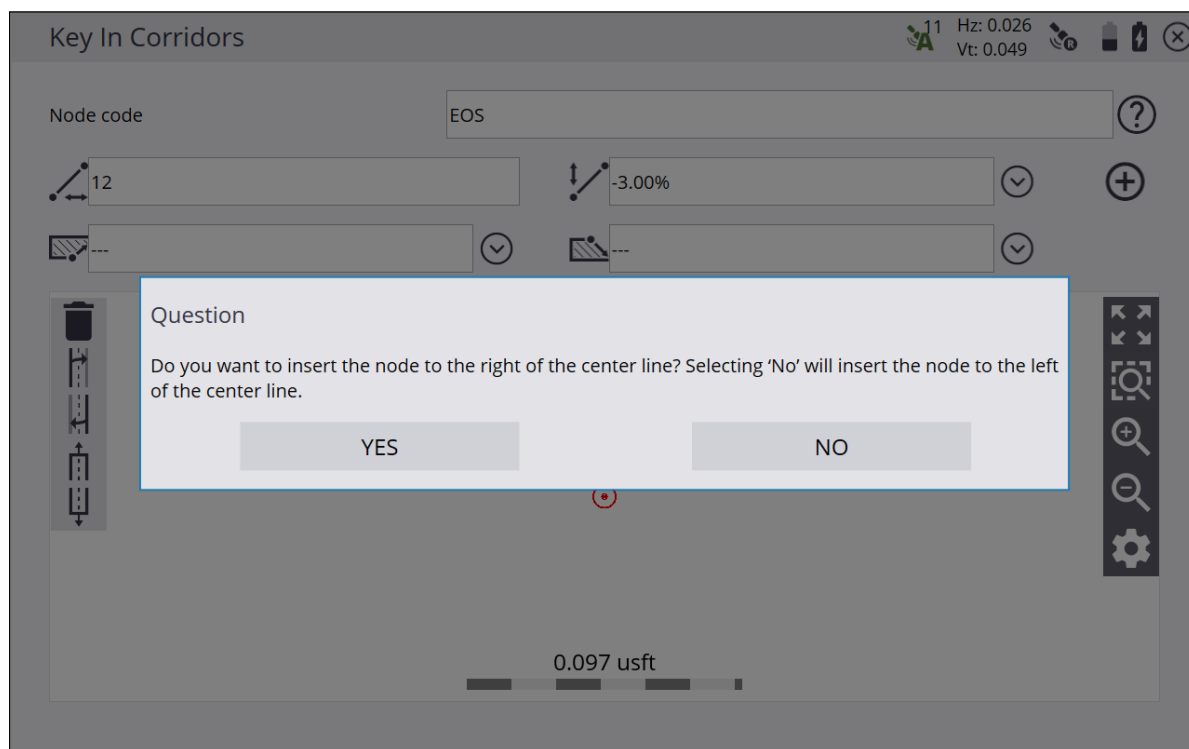


Pick the required station for the template.

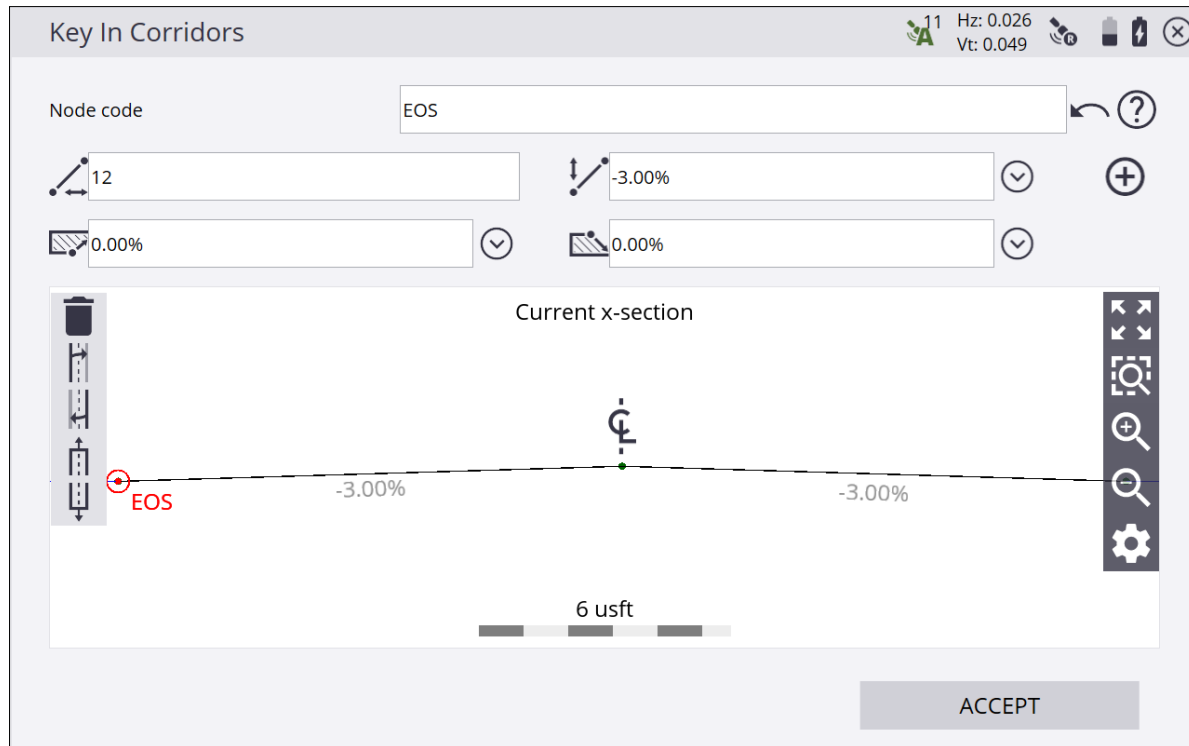
Several functions are available in this screen:

Button	Description
Node code	Code for the feature node you are about to enter.
	Horizontal distance to the last feature node which was entered.
	Vertical distance to the last feature node which was entered.
	Create Feature Node with the entered values.
	Slope values for the Cut tie.
	Slope values for the Fill tie.
	Delete feature node.
	Copy the left side to the right side.
	Copy the right side to the left side.
	Import a previously entered template.
	Export a previously entered template.

When you first enter this screen, you will be asked if the values apply for the right side or the left side of the corridor; the values are applied from the centerline.



Tap **Insert** to see the edge of seal on the right side of the corridor on the cross section.



Copy the right side of the corridor over to the left side by tapping the copy template button. When the template is complete, tap **ACCEPT**. Enter a name for the template and whether you want to store the template in a library that can be accessed from any site on the controller.

Using templates means you can easily recall them by tapping the import template button. Select a template from the list. The whole definition appears in the cross section view.

You can view the templates either in plan view or cross section view at any station you want. You can also view the templates at stations between definitions. The Siteworks software transitions between the templates.

Creating stakeout points

Two COGO functions are available for creating stakeout points from a Corridor or Alignment. These are available in the **Menu / COGO / Create Points/Arcs**:

- Create stakeout points at an offset from the alignment.
- Create stakeout points at an offset from the alignment at a deflection angle. For example, this can be useful where a drain crosses a road.

These functions can be used for any corridor or alignment, not just ones created using the Siteworks software.

Stakeout Workflow

- Points
- Stakeout Settings
- Lines
- Slope staking
- Reference Line
- Surfaces
- Planes
- Corridors


The Siteworks software enables the stakeout of points, lines, surfaces and corridors stored in a design. Access the **Stake** menu either through the **Home** menu, or by tapping and holding on items in the **Measurement** screen.

Selecting **Menu / Stake** puts Siteworks into Stake mode. At the completion of the staking operation, Siteworks remains in Stake mode and you are prompted to select another object for stakeout.

When in Measure mode, by tapping and holding on an item on the **Map** screen and selecting to stake it, Siteworks enters **Quick Stake Mode**. At the completion of the staking operation, Siteworks returns to the Measure mode. Quick stake mode is intended to just stakeout one object, while going through the **Stake** menu is intended for staking multiple objects consecutively.

Points

Before you can stake out points, the points must be part of the currently loaded work order. There are several ways to get points that were not measured in the field into a work order:



- Enter the coordinates of the point using the Point Manager feature.
 - Use the Create Stakeout Points COGO features.
 - Import stakeout points during the project creation process.
 - Import a point file by selecting **Home / Data Management / Point manager / Import Point File**.
1. From the main screen, tap the **Menu / Stake**.
 2. Select a point by tapping on a point in the **Select Object** screen, or by opening the item list view by tapping  in the upper right side. Select a point in the **Points** tab. Alternatively, select the point directly from the main map screen (tap and hold and then select **Stake Point** from the pop-up menu). If there is more than one object available in this area, a list of different objects appears that you can select from.

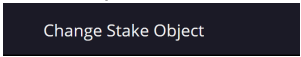
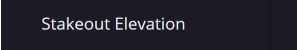
The list puts different stakeout items into separate tabs: **Point**, **Line**, **Alignment**, or **Surface**:

Select Object				
<div> <div>Point</div> <div>Line</div> <div>Alignment</div> <div>Surface</div> </div>				
Name	Code	Northing	Easting	Elevation
*CAD_CTRL1	CP_CAD	1205266.805	3109119.686	5448.359
*CAD_CTRL10	CP_CAD	1206201.475	3108954.979	5476.869
*CAD_CTRL12	CP_CAD	1205934.267	3109432.584	5461.855
*CAD_CTRL13	CP_CAD	1205704.039	3109325.183	5456.284
*CAD_CTRL3	CP_CAD	1205514.930	3108866.959	5453.772
*CAD_CTRL4	CP_CAD	1205542.998	3108625.343	5454.013
*CAD_CTRL5	CP_CAD	1205729.967	3108375.058	5457.261
*CAD_CTRL7	CP_CAD	1205901.516	3108570.346	5467.777
*CAD_CTRL8	CP_CAD	1206114.768	3108636.678	5470.636
*CAD_CTRL9	CP_CAD	1206308.376	3108770.351	5479.809
CircleCenter		1205848.604	3108856.260	5458.725

ACCEPT

3. If you need to calculate a stakeout point from design data, return to the main map screen, tap **Menu / COGO** and use the functions in the **COGO** menu.
4. Multiple stake methods (point, side slope, and catch point) are available. For information about slope staking, see [Slope staking](#), page 115.
5. Use the values in the info bar (for example, GO) to navigate to the point. A green line will be drawn between your current location and the point on the screen to provide you with guidance. In addition, a large arrow on the top right of the screen will point in the correct walking direction to the point after the software recognizes the direction you are currently moving. When using a map rotation in travel direction or following a selected alignment, an additional North Arrow on the top left indicates North so that the values in the info bar can be used to navigate to the point.

6. When you are within two meters of the stakeout point, the software switches into the Fine Stake mode. Fine guidance bullseye arrows appear on the top right corner of the map to indicate the remaining distance in each direction for the rod tip to reach the stakeout point.
 - When staking with a GNSS receiver, the fine navigation arrows will be displayed in a north "up" orientation or the direction of approach when the fine navigation arrows appear, depending on the setting of the **Stakeout Guide** in the **Design** tab of the **Map Options** screen.
 - For staking performed with a total station, the fine navigation arrows will be oriented depending on the connection method to the total station.
 - For Bluetooth and cable connections, the directions will be as if you were standing behind the total station looking towards the point.
 - For radio connections, the directions will be as if you were standing at the prism pole looking towards the total station.
7. Once the rod tip is within the horizontal tolerance (set via the **Home Menu / Settings / Stakeout**), the dot in the circle of the stake guidance bull's-eye turns yellow. After tapping the **Measure** button , a stakeout report for this point appears. The software remembers which tab of the stakeout report was last viewed and opens the same tab after staking the next point.
8. Select the **Edit stakeout name** checkbox to store the staked point using a different point name and point code. If an FXL feature code library is being used with the Advanced Measurement module, tap  to add or change the feature code of the stakeout point.

In the **Diagram** tab, a graphical diagram shows how to put an elevation mark on the stake. The software does all the calculations for you. The way that the software calculates the elevation mark and cut/fill depends on the stakeout settings in the **Stake Marking Method** settings in the **Home Menu / Settings / Stakeout**.
9. After the stakeout of the point has been completed, the software returns to the **Stakeout Selection** screen or to the main map screen, if the point was selected via tap and hold. If during the stakeout process a different point is required, tap the **Home** menu and then tap **Change Stake Object** .
10. To change the stakeout elevation to a different value, tap the **Home** menu and then tap **Stakeout Elevation**  from within the **Stake** menu.

Stakeout Settings

To access these settings, from the main screen, select the menu and then tap **Settings / Stakeout**. The software supports three elevation reference methods used to mark cut depths or fill heights on a grade stake or location/grade stake:

- Measuring the cut/fill reference mark from the ground surface
- Measuring the cut/fill reference mark from the top of the stake
- Cut/fill reference from the measured point

These methods help you to establish a cut/fill reference mark on the stake at a specified cut/fill measurement interval, such as at one-foot increments. If you choose to place a cut/fill reference mark on the grade stake, a Stake Marking report helps you establish the position of the reference mark on the stake and helps you correctly label it.

Typically, you will use one of the above methods consistently. Usually, you use only one method. When you first receive the software, switch to the correct setting. The software then uses that setting for all stakeout operations. When you tap **Measure** during a stakeout operation, the software converts the measured elevation,

design elevation, and computed cut depth or fill height into information that you can then write on the stake. It also informs you where to mark the stake based on the settings that you enter in this screen:

Stakeout Settings

Horizontal tolerance: 0.100 usft

Stake marking method: Ground Surface

Working stake length: 4.000 usft

Cut/Fill interval: .25

Min. bottom of stake spacing: 1

Min. top of stake spacing: .5

Default station mode: Random

ACCEPT

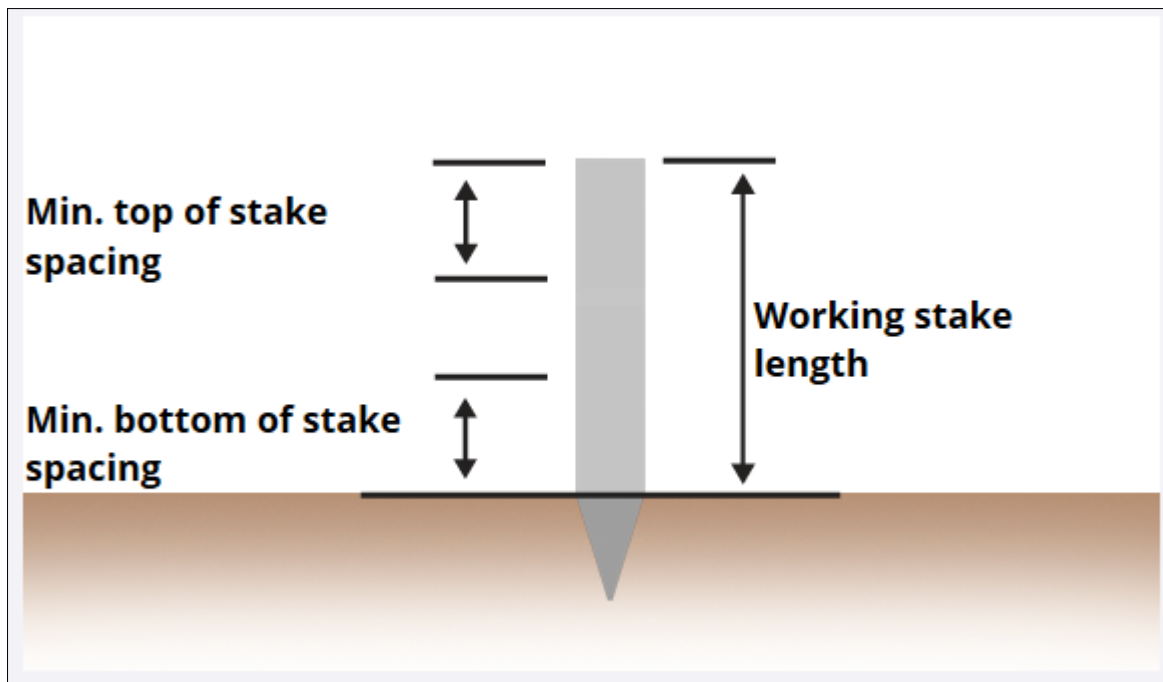
The stakeout tolerance is also entered in this screen and dictates if the stakeout point is within tolerance, denoted by a green flag on the map screen and recorded.

Additionally, the default station method for staking lines is also selected on this screen, whether to enter a line-staking command in random or fixed mode.

The software supports three elevation reference methods used to mark cut depths or fill heights on a grade stake or location/grade stake. Tap next to **Stake marking method** to see a graphical representation of each method.

- Measuring the cut/fill reference mark from the ground surface
- Measuring the cut/fill reference mark from the top of the stake
- Cut/fill reference from the measured point

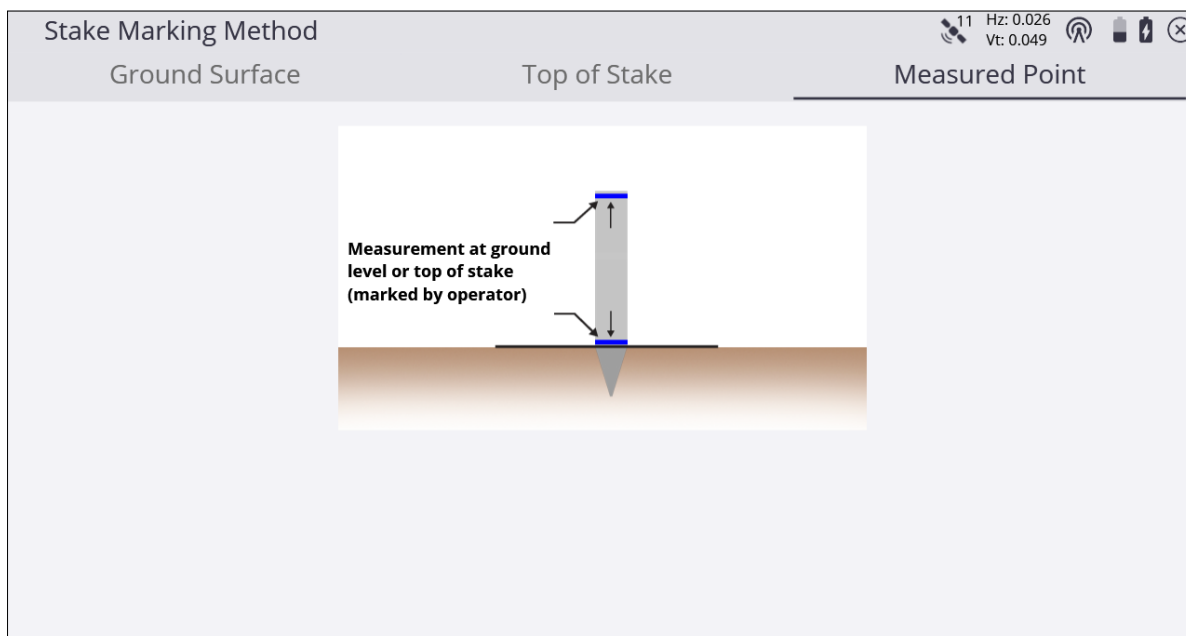
These methods and the working stake length, cut/fill interval, and minimum bottom and top of stake staking, help you to establish a cut/fill reference mark on the stake at a specified cut/fill measurement interval, such as at one-foot increments. If you choose to place a cut/fill reference mark on the grade stake, a Stake Marking report helps you establish the position of the reference mark on the stake and helps you correctly label it. Tap next to the **Working Stake Length** to see what each value represents on the Stake Marking Parameters.



Typically, you will use one of the above methods consistently. Usually, you use only one method. When you first receive the software, switch to the correct setting. The software then uses that setting for all stakeout operations. When you tap Measure during a stakeout operation, the software converts the measured elevation, design elevation, and computed cut depth or fill height into information that you can then write on the stake. It also informs you where to mark the stake based on the settings that you enter in this screen.

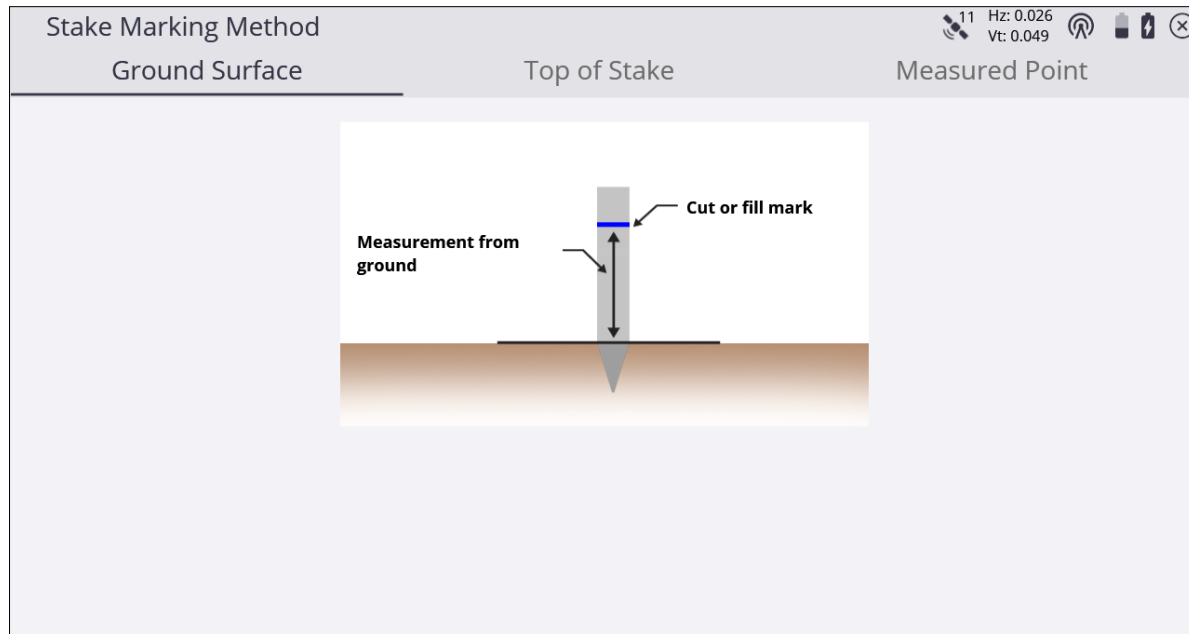
Measured Point

This method enables you to label a grade stake with the required cut depth or fill height as measured from the measured point, which can be either the top of stake or the current ground surface. If you choose to mark the stake with the cut depth or fill height as referenced to the measured point, the software simply informs you of the direct cut or fill measurement from that point. In this case, you can mark that measurement on the stake, using your normal convention to indicate from where the measurement is referenced.



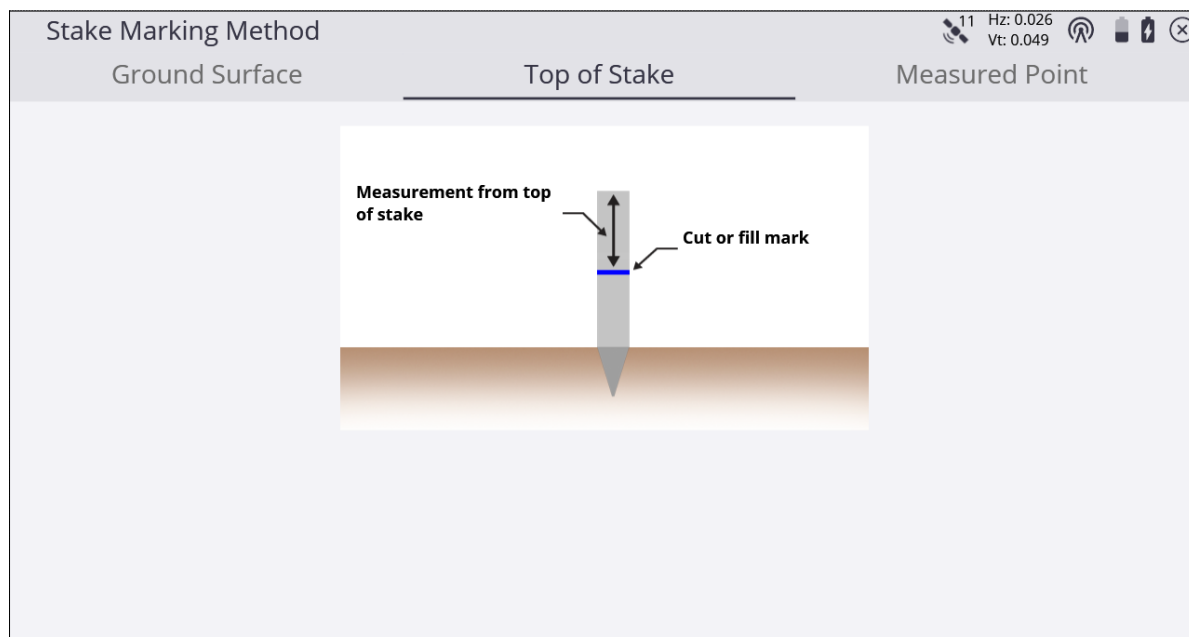
Ground Surface

With this method, the software guides you to the horizontal location of the stakeout point. The software generates a Stake Marking report that shows the distance from the ground up to where you must mark the stake. It also shows the value of cut or fill to mark on the stake.



Top of Stake

With this method, the software guides you to the horizontal location of the stakeout point. You then hammer the stake into the ground and measure the top of the stake. You can change the antenna height for this measurement in case you want to take the receiver off the pole and place it directly on the stake. The software shows the distance from the top of the stake down to where you must mark the stake. It also shows the value of cut or fill to mark on the stake.





Lines

The lines you want to stake out must be part of a design map in the currently loaded design. There are multiple ways to get these lines into a design, in addition to measured lines:


- From a DXF, DWG, or VCL design map with lines containing lines, linestrings, or polylines.
- By creating lines from points using the COGO functions.


To stake a line object:

1. From the Main map screen, tap the **Home** button and then tap **Stake**.
2. Select a line by tapping on a line in the **Select Object** screen, or by using the list icon  on the top right of the screen and then select a line in the **Lines** tab. Alternatively, select the line directly from the main map screen (tap and hold and then select **Stake Line** from the pop-up menu). If there is more than one object available in this area, a list of different objects appears that you can select from.
3. When using the Trimble Business Center software, names can be assigned to lines to improve the orientation.


You can also create a new line from points in your loaded design or work order by tapping the **New line**  icon in the top right corner of the screen:





4. If necessary, before confirming the selection, change the line direction using the  button on the top right of the screen. This function is not available for lines selected by tap and hold.
5. Different stake methods (side slope and catch point) are available. See [page 115](#).
6. When **Fixed** is the selected Station mode, enter the station to be staked out or tap on the line where you want to stake it and then tap **ACCEPT**. To change the settings related to the line staking, such as desired horizontal and vertical offsets, stakeout elevations, station advancement interval and if corner/tangent

points should be created, tap . For Random mode, it is not necessary to select a station and offset.


7. The map view then guides you to the point. To help you find the point, the guide arrow in the upper right side needs to point up the screen to show that you are traveling directly toward the point. You can turn the guide

arrow off and on in the **Design** tab of the **Map Options** screen, accessed by tapping . The information bars at the top of the screen can be customized using the **Info Bar/Panel** option. The display shows the design elevation for the point, the amount of cut or fill required to get to that elevation, and how far and in what direction you need to travel to get to the point.

8. The default map view has the direction north pointing up. You can change this so that the guide arrow is pointing in the direction you are walking by changing the map rotation in the **Map Options** screen. It is recommended to turn on the cut/fill lightbar in the top or bottom panel on the left to graphically show the cut and fill.
9. For Fixed mode, when you are close to the selected line point, the software switches into the Fine Stake mode. Additional guidance arrows appear on the top right corner of the main panel to indicate the remaining distance in each direction. The screen is oriented to the last moving direction before the Fine Stake mode was activated if map rotation in travel direction was selected.
 - When staking with a GNSS receiver, the fine navigation arrows will be displayed in a north "up" orientation or in the direction of approach at the time the fine navigation arrows appear. Set this Stakeout guide option in the **Design** tab of the **Map Options** screen.
 - For staking performed with a total station, the fine navigation arrows will be oriented depending on the connection method to the total station. The direction of the fine stakeout guide will be in the direction of approach when the fine navigation arrows appear if **Approach Orientation** is selected. If **North/Instrument Orientation** is selected, the behavior will be as outlined below.
 - For Bluetooth and cable connections, the directions will be as if you were standing behind the total station looking towards the point or prism.
 - For radio connections, the directions will be as if you were standing at the prism pole looking towards the total station.
10. After tapping **Measure**, a stakeout report appears. The software creates a Stake Marker report. A graphical diagram shows how to put an elevation mark on the stake. The software does all the calculations for you. The way the software calculates the elevation mark and cut/fill depends on the stakeout settings in the Trimble icon menu. The software remembers which tab of the stakeout report was last viewed and opens the same tab after staking the next point.
11. Instead of staking a certain station it is also possible to stake a line at random stations using the buttons on the status bar on the right side of the main panel:

Tap...	to...
	stake at fixed station intervals starting at a certain station.
	stake at random and arbitrary station intervals anywhere along the line, based on your current station location perpendicular to the line.
	The fine stakeout guide arrows will not appear when in random mode.

Settings available for staking lines include options to enter a horizontal and vertical offset for the stakeout line. The line elevation can be defined using different methods and the start station, station interval (increment distance), and whether or not to automatically advance to the next station can also be determined. If a horizontal offset is applied and yes is selected in the **Create tangent/corner points** selection menu, three stakeout points are created at each corner to help you stake out the lines. Access these settings from the

Home menu under **Stake / Line settings** or by tapping the **Line Settings** button  on the **Select Line Station** selection screen or in the top left of the main panel.

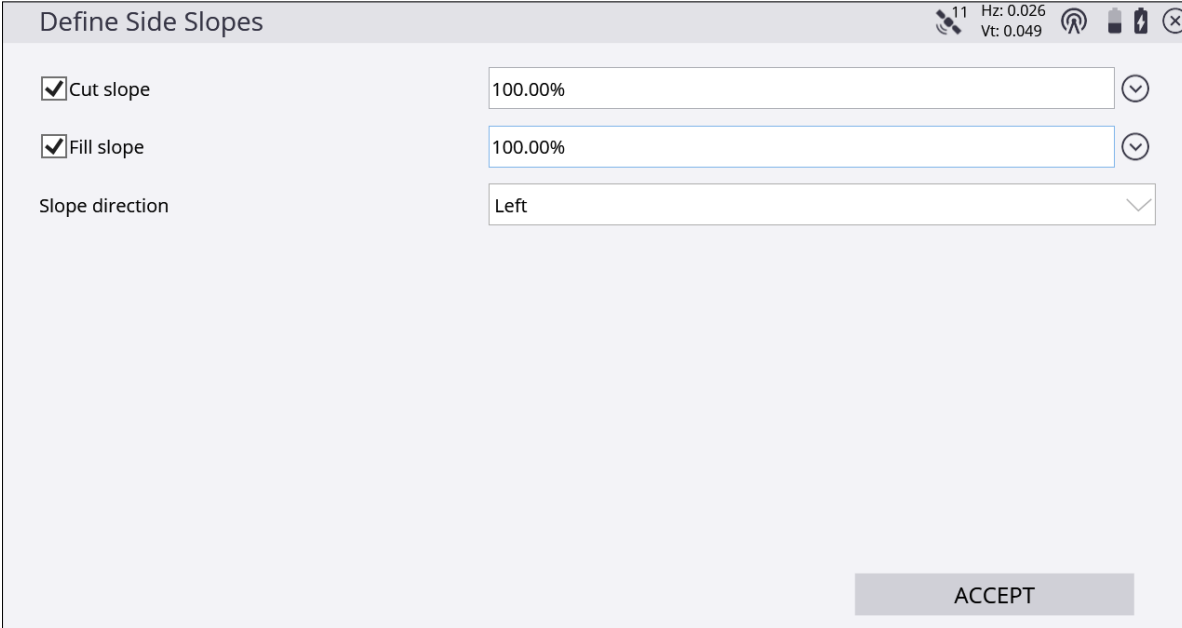
Slope staking

For both stakeout point and stakeout lines, side slope and catch point stakeout modes are available that enable staking out the slope or the catch point between this slope and the existing ground. This function can be applied to any earthwork operation that involves a tie to the current ground surface. Examples include staking earthworks for pad placement, earth dams, site drainage, ponds, lagoons, embankments, and keyways.

The tie-slope can be projected from a 3D point using a bearing or from a 3D Line. After defining either one of those, the stakeout process is very much alike. Tap the **Stake mode** icon on the bottom of the status panel on the right side of the main panel:



You can then select line, side slope or catch point. Use the **Define Side Slope** screen to select the direction of the slope and whether you define a cut and/or fill side slope to the left or right of the reference line. To select what the slope designation is to be based on, alter the selection in the **Slope direction** field.



The screenshot shows the 'Define Side Slopes' screen. At the top, there is a status bar with '11 Hz: 0.026 Vt: 0.049' and icons for signal, location, and battery. The screen has three input fields on the left: 'Cut slope' with a checked checkbox, 'Fill slope' with a checked checkbox, and 'Slope direction'. To the right of these are three corresponding input fields: the first two contain '100.00%' and the third contains 'Left'. Each of these three fields has a dropdown arrow icon on its right side. At the bottom right of the screen is a large 'ACCEPT' button.




The software computes the elevation of the reference line at that point and projects the designated cut and/or fill side slope magnitudes from that reference point, through your position, along a line referred to as the slope indicator. The slope indicator line is shown in the map view, extending from the reference line to the currently predicted catch point location. In predicting the location of the catch point, if you have defined both cut and fill slope magnitudes, the software determines whether the cut slope or fill slope is applicable at the reference point.

When staking building pad side slopes, the building pad has both internal and external right-angled corners. If you are staking external corner points, then the software automatically calculates the side slope as projected radially from the corner point. At an internal corner, the software calculates the catch point at a bi-sectional angle.

The Catch point option enables you to stake out points where the side slope intersects the ground surface as it is found to exist. As you stake catch points at fixed intervals, you should adapt to the existing terrain and be

aware of the effect that it may have on the location of the daylight line. You can freely switch between the Stake at fixed intervals mode and Stake at randomly chosen interval modes.

The Line option enables you to stake out the side slope's reference line. The software guides you to the line at the nearest point to where you currently are, or to a specific station. The Side Slope option enables you to place a grade stake at any required location on the side slope between the reference line and the catch point. You can toggle between the different stakeout methods by selecting the icon at the bottom of the status bar on the right side of the main panel:

Icon	Description
	Stake catch point
	Stake side slope
	Stake line




Reference Line

While staking out different objects like a point, line, surface or corridor, a separate line or alignment can be selected and referenced to record the station and offset values relative to the reference line in the stake record. To select a reference line or alignment, go to the **Home menu / Settings** and then tap **Reference Line**. Select the reference line from the map. Alternatively, tap and hold on a line you want to select as the reference line, and choose **Select as Reference Line** from the pop-up menu.

When a line is selected to be used as a reference line, an optional horizontal offset and a line start station can be applied.

Reference Line Settings

11 Hz: 0.026 Vt: 0.049

Line start station

0.000 usft

Horizontal offset

0.000 usft


☒ Left
 ☐ Right

ACCEPT

The station and offset to this reference line can be displayed in the info bar as reference station (R. Sta) and reference offset (R. Off) while staking the actual object. To deselect the reference line, return to the **Reference Line** in the **Home menu / Settings** and then click on a blank area of the map screen. Alternatively, tap and hold on the original line (not the reference line) and choose **Unselect Reference Line**.

Surfaces


Use the **Stake Surface** feature to put grade stakes over a design surface indicating the cut/fill to it. The surface you want to stake out must be in the currently loaded design. There are multiple ways to get a surface into a design:

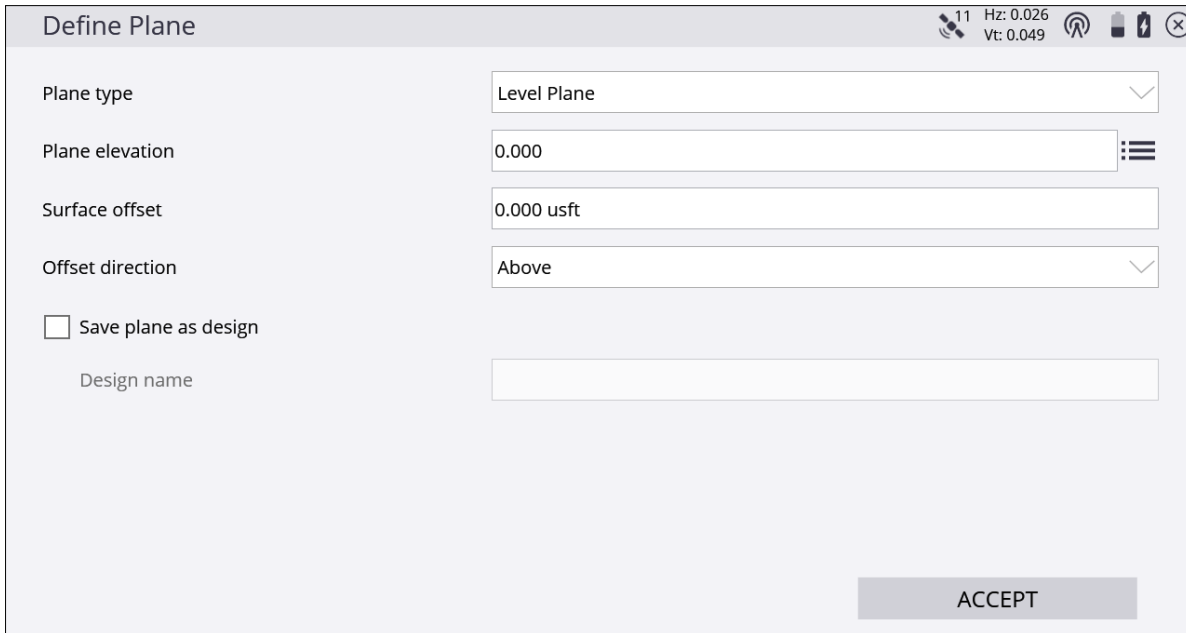
- From an imported TTM or VCL surface file (this can be created in the Trimble Business Center software).
 - By creating a surface design from an existing Siteworks work order with a measured surface that uses measured points and lines. To do this, select **Data Management / Surface as Design**.
1. From the **Measurement** screen, tap the **Home** menu and then tap **Stake**.
 2. Select the surface using the list selection icon  at the top right of the screen and then in the **Surface** tab select a stakeout surface.
 3. Use the values in the display bar to indicate the current cut/fill of the surface.
 4. After tapping **Measure**, the software creates a Stake marker report. A graphical diagram shows how to put an elevation mark on the stake. The method that the software uses to calculate the elevation mark and cut/fill depends on the stakeout settings in the **Home** menu / **Settings / Stakeout**.

Planes

Use the **Stake Plane** feature to define a plane similar to how a grade laser works and then use a GNSS or a Total Station to get an indication of the resulting cut/fill between the current position and the plane. There are four options to create a plane to stakeout:

- Level Plane – Choose an elevation to define the level plane.
 - Sloping Plane – Choose an origin point and elevation, a main slope, and an optional cross slope.
 - Three Point Plane – Create a plane from three points.
 - Circular Plane – Select or measure the center point, add an elevation, and the radius of the circle. This feature was added in v1.60.
1. From the **Home** menu, tap **Stake**. This command is also accessible in the main panel by clicking on the icon shown below.

2. On the top right corner of the **Stake Object** screen, tap the **Define plane** icon . The **Define Plane** screen appears:



3. Select and configure the plane you want to stake.
- Level plane is a flat surface with a defined elevation; sloping plane is defined by an origin point, main slope, and cross-slopes; three-point plane is defined by picking or measuring three points; circular plane is a flat plane with a center point, elevation, and radius.
4. To save the specified plane as a design, select the **Save Plane as Design** checkbox and enter a name into the **Name** field. The plane will then be available in the site's Design folder and available for loading through the **Project** menu or loaded as a second surface. Note that a saved circular plane will be transformed to an octagon and will not be a true circle.
5. Use the values in the display bar to show the current cut/fill of the plane.
6. To record a point and view the stakeout report, tap the **Measure** icon in the main panel.

Corridors

The corridor or alignment that you want to stake out must be part of the currently loaded design. These files are saved as .PRO or .VCL files. There are multiple ways to get a corridor into a design:

- From a corridor created in the Trimble Business Center software and exported through the **Field Data** menu.
- Convert LandXML files with the SCS Data Manager.
- Export a corridor from the Terramodel® software.



If you have the Roding module installed and a corridor design loaded, you can select a corridor/alignment from the map by tapping and holding on it, or from the list in the **Stake** menu and then selecting one of the three corridor staking methods that are available:

- [Corridor feature staking](#) (see [page 120](#))
- [Catch point staking](#) (see [page 125](#))
- [Location on Surface](#) (see [page 127](#))

If no Roding module is installed on the controller, a warning appears.

Corridor segment staking


The grade stake marking preferences in the **Stakeout Settings** screen also apply to staking corridors. Staking methods for catch point staking can be determined from the **Home** menu / **Settings** / **Catch Point Stake Settings**.

1. From the **Measurement** screen, tap the **Home** menu and then tap **Stake**.
2. Select a corridor or alignment using the list selection icon  at the top right of the screen and then select an alignment in the **Corridor** tab. Alternatively, select an alignment directly from the map by tapping and holding on the screen. If there is more than one object available in this area, a list of different objects appears where you can specify the selection.
3. Enter a station or select one from the map at which to stake out the corridor feature. To change the settings related to the corridor staking, such as the desired subgrade offset, station advancement interval, what tangent points to automatically stop at, guide line offset, and the view settings, tap .


After selecting the station, a cross section of the corridor appears. It notes the location of each corridor feature as a node on that cross section. The **Select Corridor Feature** screen appears.

4. Select the corridor feature node that represents the corridor feature that you want to stake out. To select a node, do one of the following:
 - Select from a node list (tap the list icon in the top right corner).
 - Tap the required node.

If the node is on the finished grade model, the name of the node would be SHLD, for example. If the node being selected is on the subgrade adjusted surface, it would be named SHLD-0.250; meaning it is the SHLD

node, but it has a -0.250 m offset. To enter a subgrade offset, either tap  or access the corridor settings by selecting **Settings** / **Corridor**.

If you are navigating up station, the normal cross-section view is displayed left to right as expected. If you are navigating down station, then the cross section would normally be back to front. To reverse the view of

the section, change the view setting to up station or down station by either tapping  or by accessing the corridor settings (select **Settings** / **Corridor**).

5. Let the software guide you to the point to be staked on the selected feature using the values in the info bar. To help you find the point, the guide arrow needs to point up the screen to show that you are traveling directly toward the point. You can turn the guide arrow off and on in the **Design** tab of the **Map Options** screen. The information bars at the top of the screen can be customized using the **Customize info bar** option in **Settings** / **Info Bar/Panel**. By default, the info bar shows the design elevation for the point, the amount of cut or fill required to get to that elevation, and how far and in what direction you need to travel to get to the point. You can scroll through the different values using the gray arrows on either side of the info bar or “flick” the menu. The default map view has the direction north pointing up. You can change this so that the direction you are walking is pointing at you by changing the map rotation the **Rotate** tab of the **Map Options** screen. It is recommended to turn on the cut/fill lightbar and the Cross Section in the top or the bottom panel on the left of the main panel. The lightbar will graphically show the cut and fill.
6. When you are close to the required line point, the software will switch to the Fine Stake mode. The design map will be overlaid by guidance arrows to indicate the distance in each direction. The screen is orientated according to the map rotation settings in the map options function.

Once you are within tolerance, the center of the guidance arrows will become solid yellow. After tapping **Measure**, a stakeout report appears, indicating the storyboard items that can be written on the stake. A graphical diagram indicates how to put an elevation mark on the stake. The method that the software uses

to calculate the elevation mark and cut/fill depends on the stakeout settings in the **Home** menu / **Settings** / **Stakeout**.

7. Instead of staking a certain station, you can also stake an alignment at random stations based on the location perpendicular to the centerline of the alignment, using the buttons on the bottom right in the status bar.

Corridor feature staking

1. From the **Measurement** screen, tap the **Home** menu / **Stake**.
2. Select a corridor or alignment using the list at the top right of the screen and then select an alignment in the **Road** tab. In the **Stake Method** dropdown menu, select **Feature** and click **ACCEPT**.
3. Enter a station or select one from the map at which to stake out the corridor feature. The **Select Corridor Feature** screen appears. A cross section of the corridor notes the location of each roadway feature as a node on that cross section.
4. Select the corridor feature node that represents the corridor feature that you want to stake out. To select a node, do one of the following:
 - Select from a node list (tap in the top right corner).
 - Tap the required node.



If the node is on the finished grade model, the name of the node would be EP, for example. If the node being selected is on the subgrade adjusted surface, it would be named EP-0.250; meaning it is the EP node, but it has a -0.250 m offset. A subgrade can be entered by accessing the corridor settings through **Settings** / **Corridor** or by tapping the **Corridor settings** icon on the upper right side of the screen and entering a subgrade offset value.






If you are navigating up station, the normal cross section view is displayed left to right as expected. If you are navigating down station, then the cross section would normally be back to front. To reverse the view of the section, select the **Home menu / Settings / Roads**, and change the view setting to up station or down station.

5. Let the software guide you to the point to be staked on the selected feature using the values in the info bar. To help you find the point, the guide arrow needs to point up the screen to show that you are traveling directly toward the point. You can turn the guide arrow off and on in the **Design** tab of the **Map Options** screen. The information bars at the top of the screen can be customized using the **Info Bar/Panel** option in the **Home** menu / **Settings**. By default, the info bar shows the design elevation for the point, the amount of cut or fill required to get to that elevation, and how far and in what direction you need to travel to get to the point. You can scroll through the different values using the gray arrows on either side of the info bar. The default map view has the direction north pointing up. To change this so that the direction you are walking is pointing at you, change the map rotation in **Map Options** screen. You can turn on a cut/fill lightbar in the top or bottom panels on the left to graphically show the cut and fill.
6. When you are close to the stakeout point, the software switches into the Fine Stake mode. Additional guidance arrows appear on the top right corner of the map to indicate the remaining distance in each direction. The screen is oriented to the last moving direction before the Fine Stake mode was activated if map rotation in travel direction was selected.
 - When staking with a GNSS, the fine navigation arrows are displayed in a north "up" orientation or based on the direction of approach when the fine stake arrows first appear. Change this behavior with the **Stakeout Guide** option in the **Design** tab of the **Map Options** screen.
 - For staking performed with a total station, the fine navigation arrows are oriented depending on the connection method to the total station.
 - For Bluetooth and cable connections, the directions are as if you were standing behind the total station looking towards the point or prism.
 - For radio connections, the directions are as if you were standing at the prism pole looking towards the total station.

7. After tapping the **Measure** icon, a stakeout report appears. The software creates a Stake Marker report, including the Cross-Section Storyboard to write on the stake in the **Report** tab. A graphical diagram shows how to put an elevation mark on the stake. The software does all the calculations for you. The way that the software calculates the elevation mark and cut/fill depends on the stakeout settings in **Settings / Stakeout**. The software remembers which tab of the stakeout report was last viewed and opens the same tab after staking the next point.

Instead of staking a certain station, you can also stake an alignment at random stations using these buttons on the bottom right of the status bar:

Tap...	to...
	stake at fixed intervals starting at a certain station.
	stake at random intervals somewhere along the alignment, based on the perpendicular location from the centerline.

8. Set the **Auto advance** option field to one of the following options using the **Corridor Settings** screen. From the **Home** menu, select **Settings / Corridor**, or tap :

To...	select...
automatically move to the next station.	To next station.
automatically move to the previous station.	To previous station.
manually move to the next or previous station.	No. This option maintains the current station between points and enables you to increase or decrease the station when you are ready.
not move a station.	Depending on the settings for Station Interval, the Siteworks software will or will not advance to the next station.

9. To set whether the next auto-advanced station will be on a tangent point in the Horizontal and/or Vertical Alignment of the corridor, in the **Tangent Point** option:

Select...	to...
Horizontal only	stop at Horizontal tangent points.
Vertical only	stop at Vertical tangent points.
Horizontal and Vertical	stop at Horizontal and Vertical tangent points.
None	not stop at any tangent points.

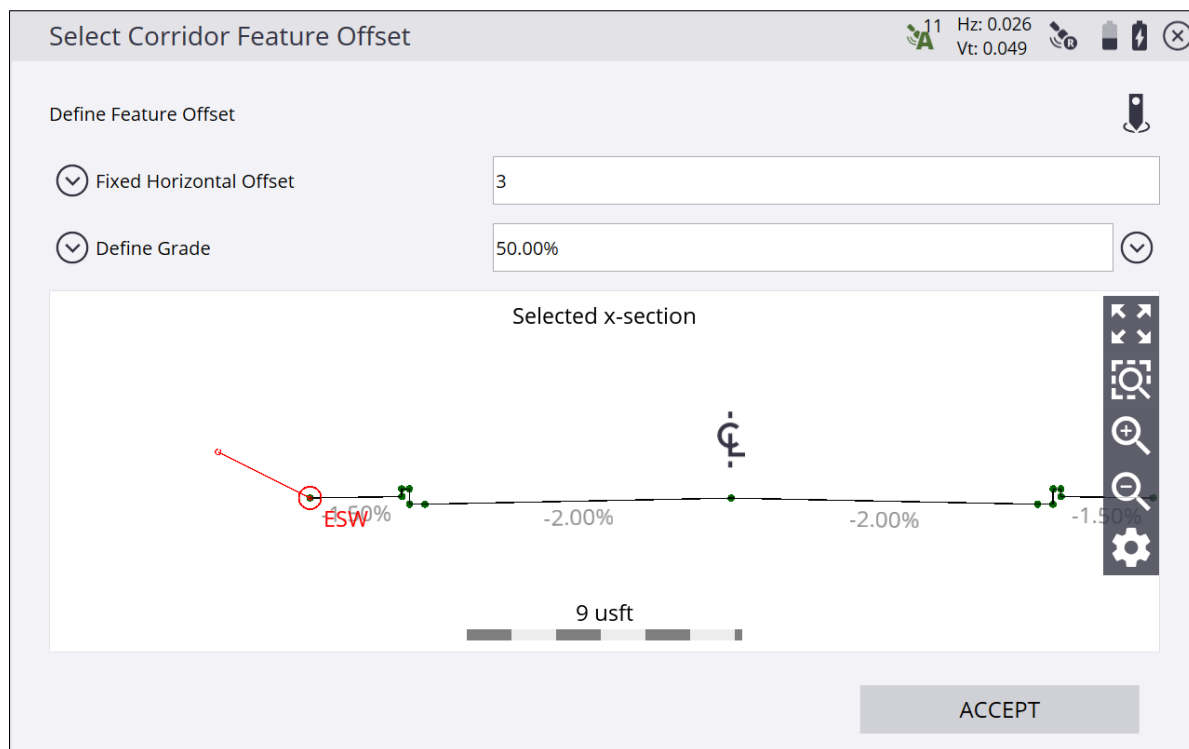
Simple feature offset


When staking a feature, an offset is usually applied. The software is extremely flexible in the way that it enables you to specify an offset.

After selecting a corridor feature node (see [Step 4 in Corridor feature staking, page 120](#)) tap the button with the stake and the two arrows (**Corridor Feature Offset** icon) on the top right of the screen:



The **Select Corridor Feature Offset** screen appears. The second line enables you to specify the fixed horizontal offset or select a random horizontal offset. When specifying a fixed offset, a red line and a circle shows you where that offset point is. When specifying a random offset, you can stake anywhere along the cross section; the software displays the results to the point you are at:

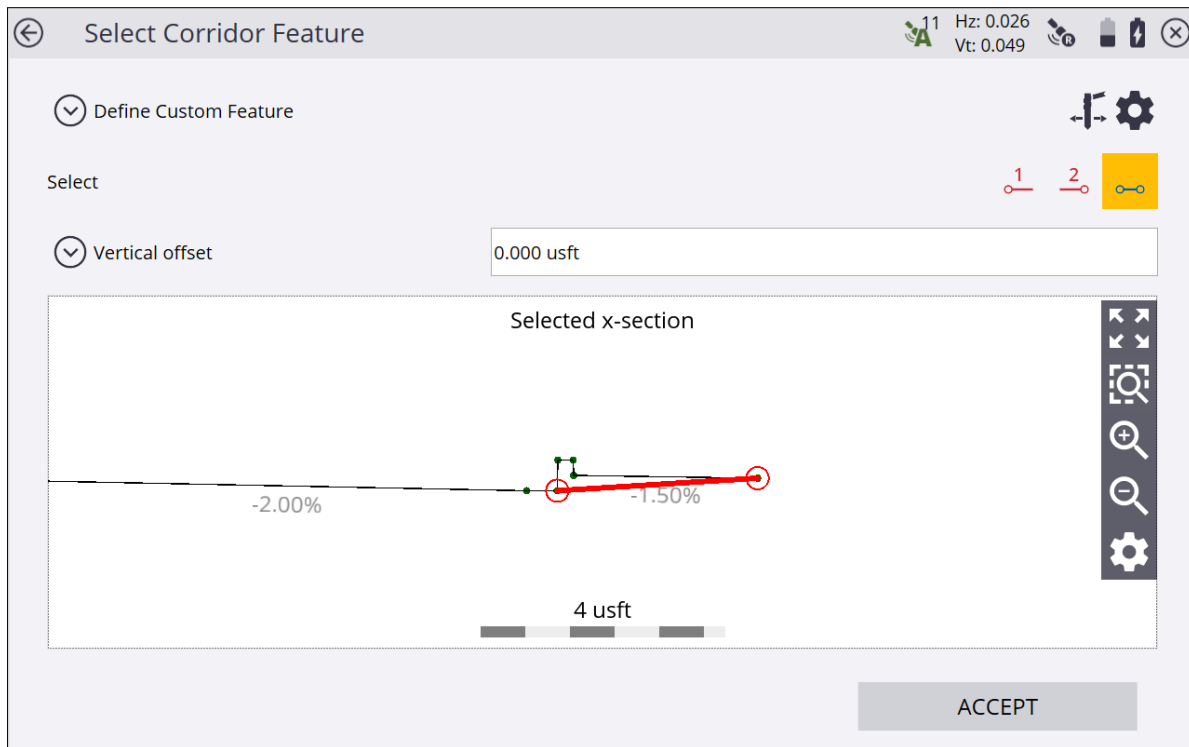


- The third line enables you to specify the kind of offset you want to use from the choices of Define Grade, Select Adjacent Segments, Select Dual Segments. Define Grade enables you to specify a slope for the offset. A grade of 0.000% is horizontal.
- The **Stake** icon  on the top right side of the screen enables you to apply the offset from a different feature node instead of the selected feature node itself.

Custom feature staking

Instead of staking a corridor feature node, you can define your own custom feature on a cross section. One example could be where the subgrade intersects with the tie slope. Follow these steps:

1. While in the **Select Corridor Feature** screen, select the **Define Custom Feature** option from the dropdown menu at the top of the window:

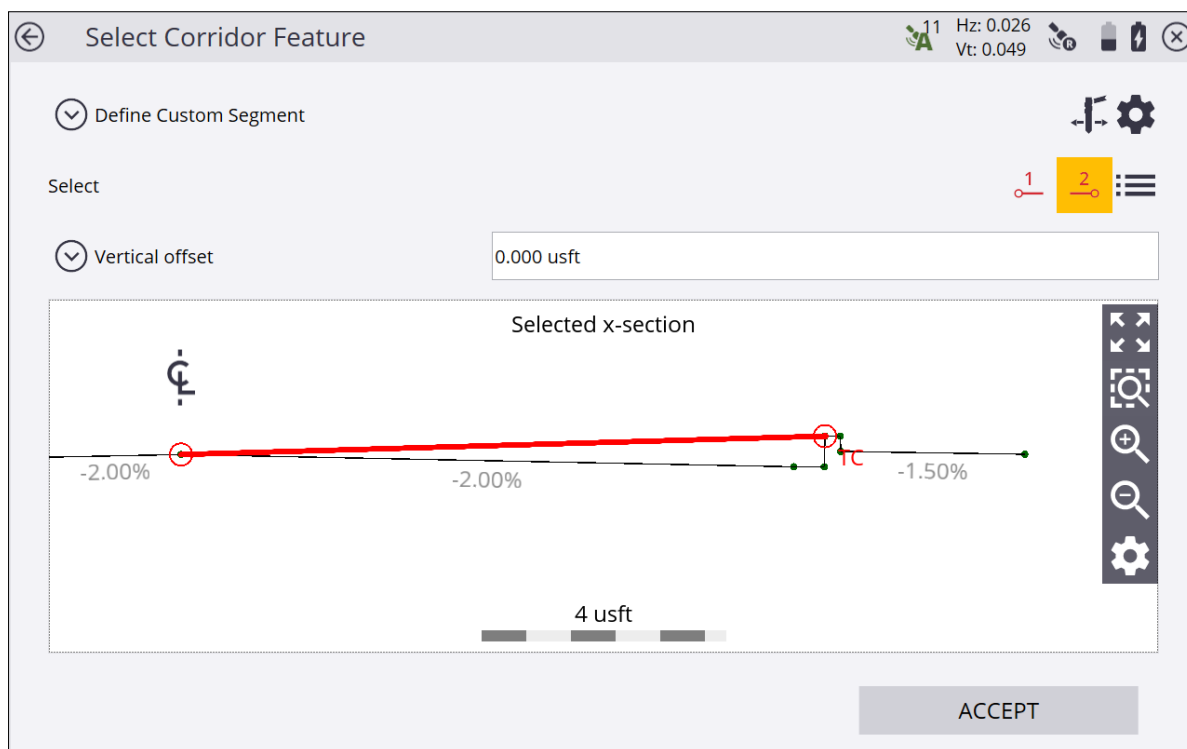


2. Select two feature nodes that will form the subgrade. You can access subgrade adjustments of the finished grade from the map view during stakeout or by tapping on the **Corridor Settings** gear icon in the upper right side of the screen (access the corridor settings through **Settings**, and then enter the amount and direction for the offset).
3. Select a segment (e.g., the tie slope). If required, enter a vertical offset for this segment and if you want to apply the offset vertical or perpendicular.
4. A green circle stake location appears where this subgrade intersects the tie slope. Stake out this point as usual. You can also specify a horizontal offset for the stake the same way as a normal corridor feature.

Custom segment staking

Instead of staking a corridor feature node, you can define a custom segment on a cross section. A segment is defined as the surface between two corridor feature nodes with an optional offset to reflect a subgrade. One example could be where a dam or a road gets built in multiple layers without having the complete shape of the finished grade. With this layered lift function, you can do the following:

1. While in the **Select Corridor Feature** screen, select the **Define Custom Segment** option from the dropdown menu.
2. Select two feature nodes that will form the subgrade. If required, enter a vertical offset for this segment and if you want to apply a vertical or perpendicular offset.



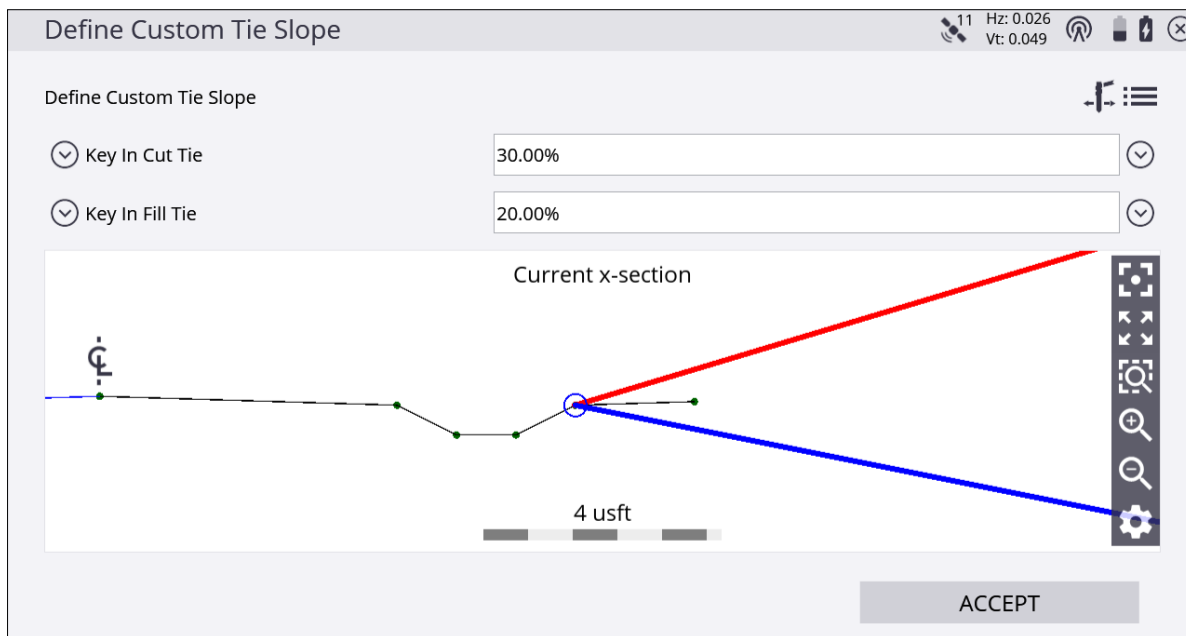
3. You will get guidance to the first point you have selected. Stake out this point as usual. You can also specify a horizontal offset for the stake the same way as for a normal corridor feature. You can also enter a random offset and apply the grade of the corridor and then stake this layer infinitely to the left or to the right and get the cut/fill to this segment.

Catch point staking

Catch point staking from the **Corridor** menu operates in an almost identical way to the catch point staking associated with the side slope function. The only difference is that the tie slopes are defined in the corridor model itself and are automatically displayed. In a typical corridor model, there are at least two tie slopes; one for the right and one for the left side of the road. In the case of a divided highway, it is common to find four tie slopes, one for the left and right of each of the two traveled ways.

1. From the **Measurement** screen, tap the **Home** menu and then tap **Stake**.
2. Select a corridor using the list at the top right of the screen and then select an alignment in the **Alignment** tab. Alternatively, select the corridor alignment directly from the map or by tapping and holding and selecting a corridor from the pop-up menu. If there is more than one object available in this area, a list of different objects will appear where you can specify a selection.

3. Select a stake method catch point and click **ACCEPT**.
4. Enter a station or select one from the map at which to stake out the corridor feature. A cross section of the corridor appears unless no tie slopes were defined for this cross section. You can then choose to extend the outer segments of the corridor and use them as tie slope instead. Other options include defining a tie slope or choosing another station with tie slopes.
5. Select if you want to stake the tie slope of left or the right side of the corridor by tapping on the tie slope itself or using down arrow on the top right. The selected tie slopes as defined in the corridor model (a cut slope shows in red and a fill slope shows in blue) will be highlighted.



In the top line of the display, the corridor that the tie slope is associated with is displayed. In the example above, there is only one corridor in the selected corridor job, and that was not named—hence Roadway 0 is displayed.

You can redefine the current tie slope while you are staking out. For example, the design may specify a 1:3 cut, but when you stake it out you find that the point is outside the site limits, so you change the tie slope to a 1:2.5 cut. You can also project the tie slope from any node on the cross section.

From the list, select one of the following options:

- Original cut/full
- Key-in cut/fill (%) – Enter the new value and then select the node to apply it from
- Key-in cut/fill (rise:run) – Enter the new value and then select the node to apply it from
- Key-in cut/fill (run:rise) – Enter the new value and then select the node to apply it from
- No cut/fill tie – If you select this option, the tie slopes disappear



It is also possible to offset the hinge point by clicking the **Stake** icon on the top right of the screen.

6. Navigate to the correct station using the Ahead/Backward values in the info bar. Then toggle the cross section view using the bottom icon in the map control bar and walk toward the tie-slope you are going to stake.
7. The software calculates the intersection between this recreated surface and the tie-slope and provides you with guidance to this point by extending this surface toward the slope. This point is dynamic and changes depending on the way you walk and how the terrain is formed. Use inward/outward to find the actual catch point, but also keep an eye on the station.

Once you are in proximity of the point where the tie-slope intersects with the existing ground, tap the **Measure** icon.

The software creates a **Stake Marker** report. A graphical diagram shows how to put an elevation mark on the stake. Depending on the settings for catch point marking in the **Home menu / Settings / Catch Point Marking**, you will get guidance to one or two more stakes which mark the point. Single Stake, Dual Stake, and Batter Rail methods are available. The placement and marking of these stakes is completely guided. The software remembers which tab of the stakeout report was last viewed and opens the same tab after staking the next point.

8. Instead of staking a certain station you can also stake a line at random stations using these buttons on the bottom right in the status bar:



Tap...	to...
	stake at fixed intervals starting at a certain station
	stake at random intervals somewhere along the line

Location on Surface




Location on Surface is a very basic method of staking a corridor. You can walk over the corridor surface and have the display showing station, offset, and cut/fill to this corridor surface or navigate to a certain station and offset of this corridor.

1. From the **Map** screen, tap **Home / Stake**.
2. Select a corridor using the list at the top right of the screen and then select an alignment in the **Corridor** tab. Alternatively, select the corridor alignment directly from the map. If there is more than one object available in this area, a list of different objects will appear where you can specify the selection.
3. Select **Location** as the stake method from the dropdown menu and tap **ACCEPT**.
4. Enter a station and offset into the boxes or select one by tapping a location on the screen. You can also overwrite the design elevation at this station by selecting **Custom Elevation** by tapping the down arrow in the upper left side of the screen.
5. The map view then guides you to the point. To help you find the point, the guide arrow needs to point up the screen to show that you are traveling directly toward the point. You can turn the guide arrow off and on in the **Design** tab of the **Map Options** screen. The information bars at the top of the screen can be customized using the **Configure Info Bars** option in **Settings / Info Bar/ Panel**. The display below shows the design elevation for the point, the amount of cut or fill required to get to that elevation, and how far and in what direction you need to travel to get to the point. The default map view has the direction north pointing up. You can change this so that the direction you are walking is pointing up by changing the map rotation in map options. A cut/fill light bar can be turned on in the top or bottom panels on the left to graphically show the cut and fill.
6. When you are close to the selected line, the software switches into the Fine Stake mode. Additional guidance arrows appear on the top right corner of the map to indicate the remaining distance in each direction. The screen is oriented to the last moving direction before the Fine Stake mode was activated if map rotation in travel direction was selected.
 - When staking with a GNSS, the fine navigation arrows are displayed in a north "up" orientation.
 - For staking performed with a total station, the fine navigation arrows are oriented depending on the connection method to the total station.

- For Bluetooth and cable connections, the directions are as if you were standing behind the total station looking towards the point or prism.
 - For radio connections, the directions are as if you were standing at the prism pole looking towards the total station.
7. After tapping the **Measure** icon, a stakeout report appears. The software creates a Stake Marker report. A graphical diagram indicates how to put an elevation mark on the stake. The software does all the calculations for you. The way the software calculates the elevation mark and cut/fill depends on the stakeout settings in the **Home** menu. The software remembers which tab of the stakeout report was last viewed and opens the same tab after staking the next point.
 8. Instead of staking a certain station, you can stake a line at random stations using these buttons on the bottom right of the status bar:

Tap...	to...
	stake at fixed intervals starting at a certain station.
	stake at random intervals somewhere along the line.

To toggle between Feature, Location, and Catch point staking, tap the icon in the bottom of the status bar on the right side of the main panel:

Icon	Description
	Feature
	Location on Corridor Surface
	Catch point

Measuring with GNSS

- GNSS measurement methods
- Setting up the GNSS base station
- Setting up the GNSS rover receiver
- Calibrating the site
- Measuring a new control point with GNSS
- Measuring using xFill technology
- Static measurements

To perform these measurement tasks, you need the Siteworks software running on a controller that is either connected to a positioning device like a GNSS system or a total station. This chapter explains how to set up and use the different components of an RTK GNSS system.

GNSS measurement methods

This section describes the different measurement methods used in Siteworks, the quality of the accuracy achieved, and why one method may be more accurate than another.

Best Quality

- 1 **Tripod and Tribrach eBubble** Until Tilt Compensation this has been the static control measurement of choice for the highest confidence. This is done on a surface and the eBubble can be used to remove all projected values directly below the Antenna Phase Center (APC) of the receiver.
- 2 **Plumb pole routine on a pole** The Plumb Pole routine centers the pole tip to be directly under the APC when level. This routine also gets the pitch and roll values to be near 0 when level. This routine enables tilt measurements while tilted on the pole as it combines the Inertial Measurement Unit (IMU) observations with the GNSS observations and calculates a pole tip position.

Better Quality

- 3 **Calibrated eBubble on a pole** Due to manufacturing of survey poles and the multiple joints, a highly calibrated ebubble is degraded by the pole it is attached too. This is easily checked by measuring a point in multiple directions and seeing the effects of the “crooked pole”.

Good Quality

4 Tilt compensation without PPR

Running Tilt Compensation without the Plump Pole routine results in points being taken with the default IMU mounting angles and thus the receiver is not correcting and projecting the pole tip position. This error, while it primarily affects the horizontal position, has the potential to affect the vertical when tilted and rotated.

5 Rod bubble

This method is the primary use case since it has been around the longest but has potential for large errors. This is due to the manufacturing of the poles and the multiple joints that make them crooked. Also the maintenance and use of the poles while observing are often overlooked as the source of errors when high precision horizontal positions are required.

Setting up the GNSS base station

For Precision RTK (Real-Time Kinematic) GNSS operations, two main components are generally required, a base station and a rover receiver. The two components are connected by radio (450 MHz or 900 MHz frequency bands), Wi-Fi, or through several different types of Internet-based communication protocols over which RTK corrections are transmitted from the base station to the rover receiver. The base station is set up in a fixed location where it tracks the satellites of the GPS and, optionally, the GLONASS, Galileo, BeiDou, and QZSS constellations. The rover receiver moves around the jobsite on a pole, backpack, vehicle, or earthmoving machine.

The SPS GNSS modular receivers (such as the R750) have a front panel and keypad that enables the base station receiver to be initialized and set up without needing a controller; however, this guide focuses on using the Siteworks software to correctly set up the base station. Refer to the relevant R750 documentation for using the front panel for setup (receiverhelp.trimble.com/R750-gnss/Welcome.html).

The base station setup process remembers how the previous setup was made. It automatically reconnects the components, selects the appropriate radio channel or network number used previously, and then automatically starts to transmit GNSS positions. If the base station has never been previously established on the site, or if on the last base station setup, a cellphone was used to broadcast corrections, you must completely set up the base station again using the options in the **Connection Type** and **Connection Method** screen. In these situations, the **Setup radio only** option is not available.

When using the SPS Smart GNSS antenna or SPS Modular GNSS receivers, which use AutoBase™ technology, once a base station has been established for the first time, if nothing was changed between base setups, you can simply set up the receiver at the exact same base station location and then switch it on. Using AutoBase technology, the receiver reloads all appropriate data, makes all appropriate connections, and then starts to transmit corrections on the last used radio channel or network number. This eliminates the need to use a controller with the Siteworks software to set up the base station each day. If you want the SPS GNSS receivers (SPS Smart GNSS antennas, and the SPS Modular GNSS receivers) to operate in AutoBase mode, you must name each base station with a different name; otherwise the AutoBase mode will not work. The AutoBase technology can be configured in the web interface. Note that you must set up the base station at the exact same antenna height each time for the AutoBase technology to correctly work (that is, the base station is set up on a dedicated rigid pole). If different base antenna heights are used, for example on a tripod that is broken down and setup each day, then the base must be set up each time in Siteworks software using the following process to ensure the correct heights and settings are configured.

To set up a GNSS base station:

1. From the **Home** menu / **Project Setup**, select **connect device** and then tap **GNSS**.

The screenshot shows the 'Receiver Setup' dialog box. The fields are as follows:

Field	Value
Connection type	SPS855 Emulator
Correction method	Radio in Receiver
Network ID	3
Base position	Control point
Base name	Control2
Antenna	Zephyr 3 Base
Antenna height	0.000 usft (Bottom of antenna)
Elevation mask	10
Corrections	CMRx

An 'ACCEPT' button is located at the bottom right of the dialog.

2. Set the **Mode** field to Base and then answer each question to complete the base station setup. In the **Base position** field there are several options on where the base is setup.
 - Control Point – An existing control point present on the site and imported into the Project folder.
 - Unknown Position – For a site with no known coordinates; uses an autonomous “HERE” position as the base location.
 - Local Coordinate – A site that has control points in local site coordinates.
 - Lat/Long/Height – Enables you to enter a known latitude/longitude and height, or use an autonomous “HERE” position.
 - BaseAnywhere – Allows the base to be set up anywhere on site, not on a control point, and will use an autonomous HERE position as its location. Note this type of base setup should only be used with a rover receiver also configured in BaseAnywhere mode. For more information, see [page 132](#).

You only need to set up the base station once; the software remembers your settings and prompts you to use the same ones the next time you set up the base station within a given site. If necessary, you can then change any of the base settings such as the control point the base station is set up on or the antenna height. For new sites, the base will need to be set up from the beginning.

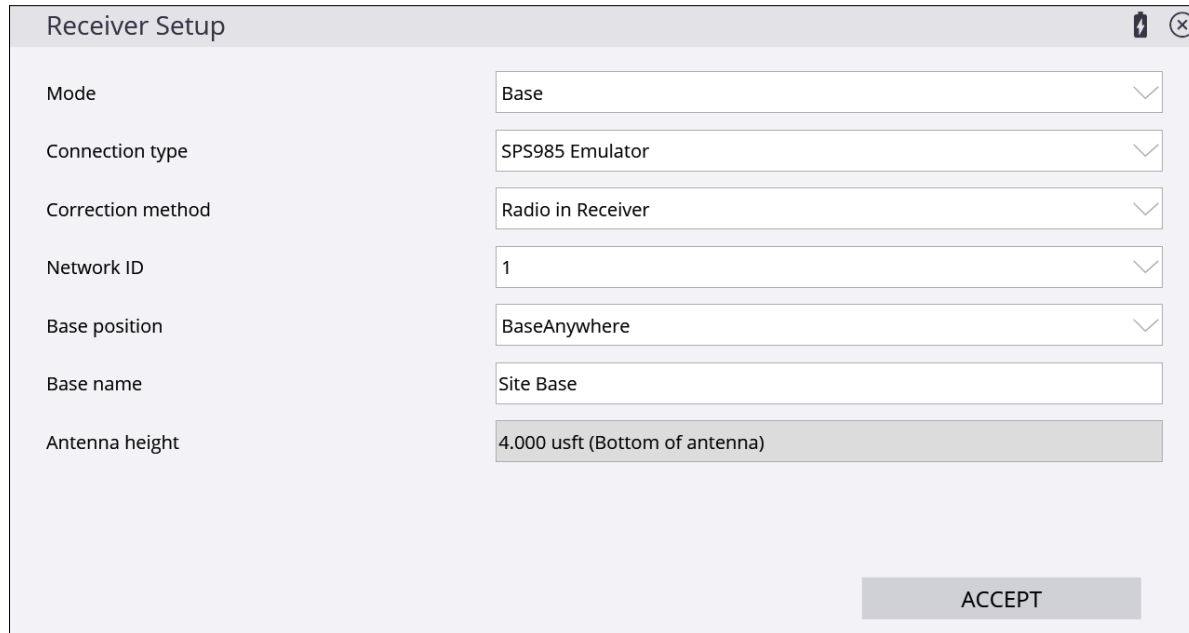
BaseAnywhere base station setup

BaseAnywhere is a feature that enables a base station to be set up anywhere on the job site, including on the roof of a vehicle, a range pole with a bipod, or any other stable platform. It does not require the base station to be set up on an established control point and greatly simplifies and quickens the ability to get started with an RTK GNSS survey on a site. This feature is generally intended for use by smaller contractors on sites that do not have existing survey control points.

It works by setting the base station into **AutoBase HERE Always** mode, which means that each time the base station is turned on or power-cycled, the base will determine its autonomous position and begin to broadcast

corrections on the last used radio or Wi-Fi settings. This base station setup configuration must be used with the associated BaseAnywhere and Bench My Rover configuration on the GNSS rover to ensure that correct positions are being used, as the “Here” position of the base station will change each time the base is restarted.

To configure the base receiver to broadcast in BaseAnywhere mode, select BaseAnywhere in the **Base position** field when setting up the base station:



The image shows a 'Receiver Setup' dialog box with the following fields and values:

Field	Value
Mode	Base
Connection type	SPS985 Emulator
Correction method	Radio in Receiver
Network ID	1
Base position	BaseAnywhere
Base name	Site Base
Antenna height	4.000 usft (Bottom of antenna)

An 'ACCEPT' button is located at the bottom right of the dialog box.

Once this mode for the base station is set there is no need to reconfigure the base station again unless there has been a 15-second restart of the receiver, you want to set up on a known point, or use/change any of the other base setup options. Note that BaseAnywhere base stations can only be set up to broadcast corrections via the receiver’s internal radio or Wi-Fi.

Also note that the base name when using BaseAnywhere will default to AUTO000X after a restart of the base receiver, where X is the number of times that the base has been started. So, if the base station has been restarted five times, the base station name will be AUTO0005. The base name broadcast from the base station will not match what was originally entered in the **Base Setup** screen.

Setting up the GNSS rover receiver

To set up the rover receiver:

1. From the **Home** menu, select **Project Setup / Connect Device** and then tap **GNSS**.

Receiver Setup

Mode: Rover

Connection type: SPS986 Emulator

Correction method: Radio in Receiver

Network ID: 1

Connected to base: Emulator

Using Quick Release: Yes


Antenna height: 6.562 usft


ACCEPT

2. Set the **Mode** option to Rover.
3. Select the **Connection type**: Bluetooth, Cable, or EM100 (if an EMPOWER EM100 GNSS module is connected to a compatible EMPOWER controller).
4. Select the appropriate **Correction method**: Radio in Receiver, RTX, Internet (VRS), Autonomous, etc. Then continue to configure the correction methods as prompted.
5. For SPS985, SPS986, and R780 receivers, select if a quick release is being used.
6. For SPS986 or R780 receivers with the INS tilt compensation option installed, choose whether or not to enable Tilt Compensation.
7. Enter the **Antenna height** values and tap **Accept** to complete the GNSS setup.

You only need to do this once per site; the software remembers your settings and pre-fills them for the next time you set up the same rover receiver in the same site. You can change any of the rover settings if necessary. If any of the settings have changed, such as the base station radio channel, the rover must be configured from the start for each new site or to connect to a new base.

When using the **Radio in Receiver** option on 450 MHz receivers, Siteworks v1.60 has added the ability to add and delete receive-only frequencies to 450 MHz GNSS receivers. This functionality is not available for the Trimble SPS785 GNSS smart antenna, Trimble MPS865 Marine GNSS receiver or any Spectra SP model GNSS receivers. Note that receive-only frequencies can be added or deleted from within Siteworks. Transmit frequencies must be added via the Virtual Warehouse, WebUI, or WinFlash.

On the **Receiver Setup** page, tap  next to the radio channel to open the new **Advanced Radio Setting** page. On this page you can view the installed frequencies, and add or delete receive-only frequencies to receivers with a 450 MHz radio.

To add a frequency, type the value in **New receive only frequency (MHz)** field, and then tap  to add it. Siteworks will only allow the addition of valid frequencies from 410 to 473 MHz with a step size of 6.25 kHz.

To delete a receive-only frequency, select its checkbox and then tap **Delete**.

Advanced Radio Settings

11 Hz: 0.026 Vt: 0.049

New receive only frequency (MHz) 456.650 +

Enter New Receive frequency here; Tap the "+" button to add

Channel	Frequency (MHz)
0	<input type="checkbox"/> 464.5000(TxRx)
1	<input type="checkbox"/> 464.5500(TxRx)
2	<input type="checkbox"/> 433.1250 (Rx)
3	<input checked="" type="checkbox"/> 456.6500 (Rx)

Select checkbox for a Rx-only frequency tap the DELETE button to remove it from the receiver

DELETE

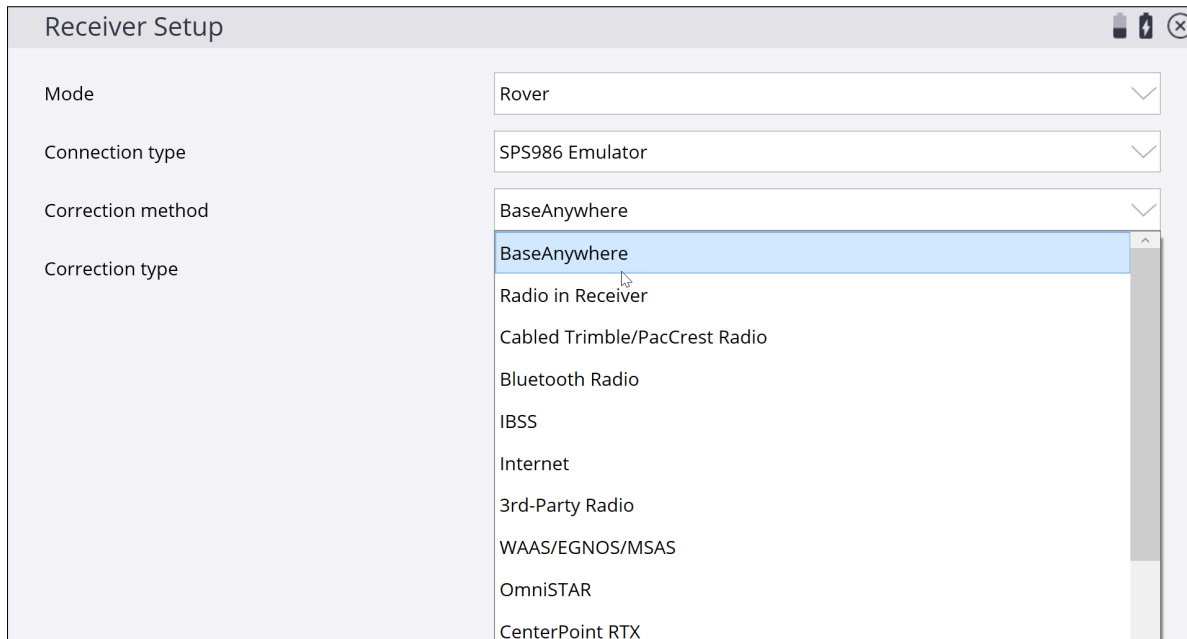
Determine if a frequency is Transmit Receive (Tx/Rx) or Receive-only (Rx)

ACCEPT

BaseAnywhere rover receiver setup

Using BaseAnywhere at the rover receiver involves benching the rover at a known control point so that a proper offset from the base station's autonomous position to a known control point measured at the rover receiver can be determined. After turning on and configuring a BaseAnywhere base station, and configuring the rover for use in BaseAnywhere mode, you are required to bench the rover receiver on a control point before any measurements can be taken. The only exception is for new sites without existing control points that have not yet been calibrated. In this case, you are prompted to calibrate the site using a one-point calibration before any measurements can be taken.

To use BaseAnywhere at the rover, select it from the **Correction method** field:



The screenshot shows the 'Receiver Setup' window with the following fields and values:

- Mode:** Rover
- Connection type:** SP5986 Emulator
- Correction method:** BaseAnywhere (selected)
- Correction type:** (empty)

The dropdown menu for 'Correction method' is open, showing the following options:

- BaseAnywhere
- Radio in Receiver
- Cabled Trimble/PacCrest Radio
- Bluetooth Radio
- IBSS
- Internet
- 3rd-Party Radio
- WAAS/EGNOS/MSAS
- OmniSTAR
- CenterPoint RTX

If your site does not contain any control points and has not been calibrated yet, you will be prompted to perform a one-point site calibration, which is the standard Siteworks workflow. After performing the site calibration, you must measure at least one additional control point so that you can successfully perform a system check as part of the Bench My Rover process.



If the site is using an existing coordinate system or you are importing an existing calibration into a new site, you will need to have existing control points in the Site folder so that the Bench My Rover process can be completed.

Bench My Rover

To access Bench My Rover, tap **Home / Project Setup / Bench My Rover**. This option is only available after a site has been calibrated. When opening an existing calibrated site when using BaseAnywhere, you are taken to the **Bench My Rover** screen before being able to measure any points.

After entering the Bench My Rover workflow, the following screen appears prompting you for a Bench measurement point:

Select the point by doing one of the following:

- Tap it on-screen.
- Tap  next to the **Point Name** field and select it from the list.
- Tap  to enter a new control point.

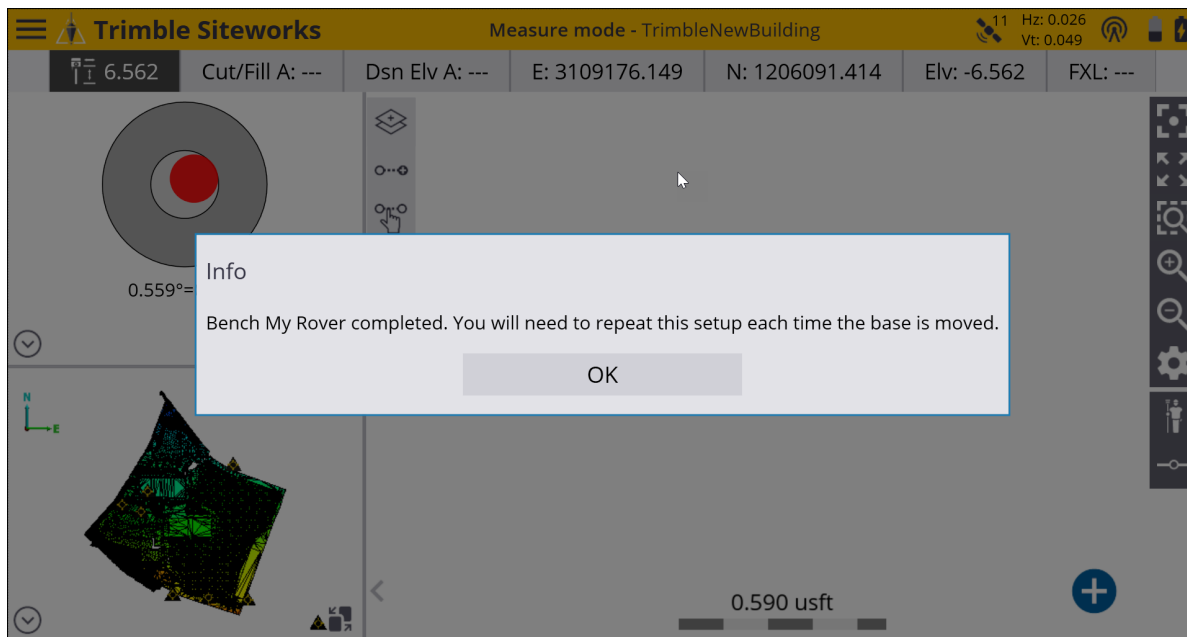
After performing the Bench My Rover routine, you are required to measure a check point to ensure that the measurements are correct. The software prompts guide you through the check point measurement process. After measuring the check point, you will be shown the tolerances and given the option to select to measure a new check point or complete the Bench My Rover setup. To use BaseAnywhere, at least one check point must be measured to ensure data integrity:

Deviation from control	
Delta N	0.003 usft
Delta E	0.019 usft
Delta Elv	0.000 usft

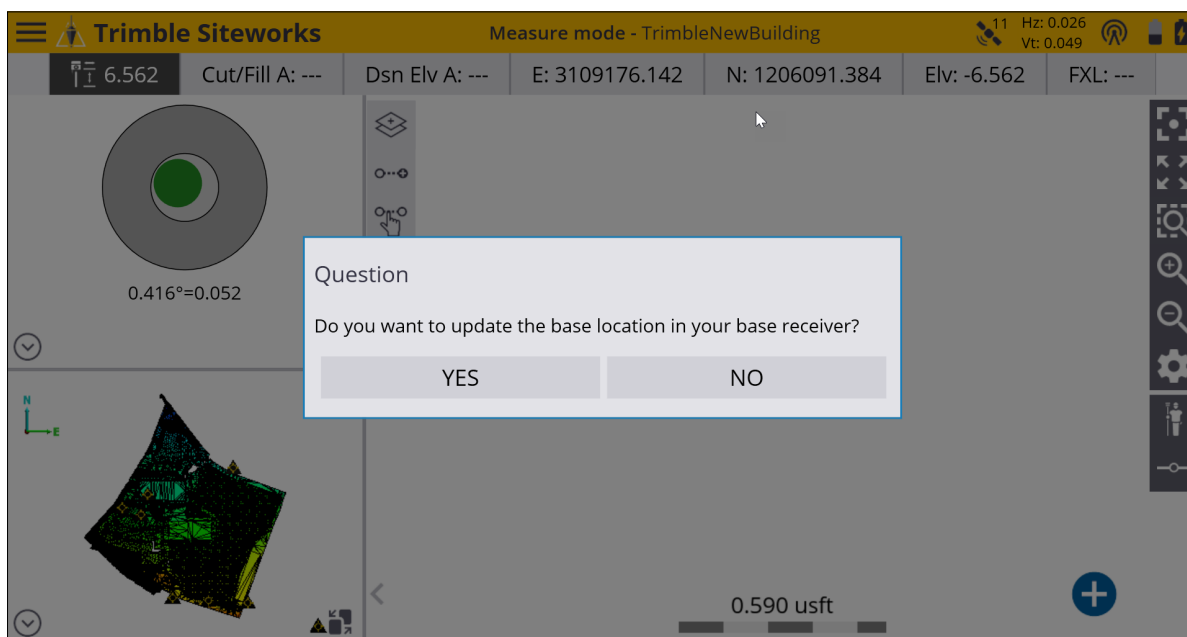
Select option to continue

☐ Check another point

☒ Complete Bench My Rover setup



After the Bench My Rover routine is performed, a prompt appears asking if you want to update the position of the base location:



Selecting **Yes** will enable an update of the location of the base receiver from its autonomous position to its true RTK-calculated location. This is now the equivalent of having a traditional base setup on a known control point.

Update Base Location

11 Hz: 0.026 Vt: 0.049

Move back within the Bluetooth range of the base receiver and press next.

Current offset

Delta N	-0.452 usft
Delta E	-0.678 usft
Delta Elv	-0.562 usft

New base location

Latitude	44°33'00.02124" N
Longitude	123°16'11.65579" W
Height	163.480

NEXT

Updating the base receiver location this way enables the base, **while operating at its current location only**, to be used for machine control applications and by additional rover receivers on site, without having to perform Bench My Rover routines on each rover. If the base receiver loses power, is restarted or moved, a new Bench My Rover routine and updating of the base location must be performed before the base station can again be used by machine control applications or additional rovers.

Trimble recommends that you perform a Bench My Rover routine several times during the day, and any time after the base station may have moved (if for example, the base is placed on the roof of a vehicle). The software will force a Bench My Rover routine if it detects that the base station has been power cycled or if a new base name on the same channel is detected.

CAUTION – As with any base station setup, if the base station moves while transmitting corrections you will get incorrect measurements at the rover receiver. If base movement is suspected, performing a Bench My Rover routine will adjust for any movement in the base station.

Calibrating the site

Global Navigation Satellite Systems (GNSS) produce positions in latitude, longitude, and height coordinates. Construction projects are generally designed in northing, easting, and elevation (or X,Y,Z) Cartesian coordinates. A project calibration ties the GNSS positions to the local site coordinate system so that GNSS can be used to measure or stake out on the construction site. The project calibration process involves measuring several known control points in the local site coordinate system using a GNSS rover, allowing the software to create pairs of measured latitude, longitude, height, and known control points.

To calibrate the project:

1. From the **Home** menu, select **Project Setup** and then tap **Project Calibration**.
2. If you have no control points in your project, you are prompted to enter a coordinate for where you are standing. The software computes a one-point calibration based on this coordinate and will be oriented without any rotation so that the project's local north direction will be true north:

No Control Point Calibration

Enter rover's local coordinate and press "MEASURE" to calibrate.

Geoid file: (None)

Name: Start


Northing: 1205883.255 usft

Easting: 3108868.967 usft

Elevation: 5400.2

MEASURE

3. If control points exist in your project, you are prompted to select a control point and then measure the physical point on the ground with your rover receiver. To add a calibration point in the Project Calibration

table, tap the plus icon: .

Project Calibration

3 or more measurements are required to compute the calibration errors.

11 Hz: 0.026
Vt: 0.049

+ **MOVE BASE** **REPORT** **⚙**

Point Name	H Residuals	V Residuals
<input checked="" type="checkbox"/> CONT 1	<input checked="" type="checkbox"/> ---	<input checked="" type="checkbox"/> ---

FINISH

4. When enough control points have been measured, horizontal and vertical residuals will appear on the screen.
5. If these are acceptable, tap **Finish** to end the calibration. The calibration is then used for the project.

The project calibration is stored in a DC file that can be used with other Trimble equipment working on the project. The software can also export the project calibration as a CFG file for use with Trimble GS900 or as a CAL file for use with Trimble Earthworks machine control systems.

The software notifies you after three points have been measured whether the calibration is in or out of tolerance with respect to the calibration tolerances. After each point you have the following options:

- measure additional points
- retake a point flagged as potentially in error
- save the partial calibration and resume later

The danger of using residuals as the only means of controlling a calibration is that the best precisions can be achieved using the wrong combination of points in the calibration solution. When an inclined plane is in use, this manipulation of residuals can result in a steeper tilt of the plane to best fit the data, resulting in better precisions and an in-tolerance calibration. Monitor the tilt of the plane closely, especially when the geometry of the control points is not strong. Widespread control that covers the entire site is good; narrow-based control around a corridor is not as good. An incorrect tilt of the plane can result in increasing errors in height as you move away from the center of the controlled area.

Once a project calibration is performed and completed, you cannot change or add to the calibration in that project. To add points to a completed project calibration, start a new project and import the existing DC file from the project which you want to add control points to.

You can review a project calibration completed in Siteworks by tapping the **Home / Project Setup / Project Calibration**. You are prompted if you would like to review the calibration report. Tap **Yes** to bring up a table showing the calculated scale factors, point pairs, and residuals:

Project Calibration

11 Hz: 0.026 Vt: 0.049

Calibration is in tolerance.
H res: 0.007 usft V res: 0.032 usft
H Scale Factor: 2.205535713
Slope north (ppm): 0.000
Slope east (ppm): 0.000
Compute inclined plane after 5 vertical points.

Point Name	H Residuals	V Residuals
CONT 1	0.008	-0.002
CONT 2	0.008	0.040
CONT 3	0.004	-0.039

CLOSE

Tap again in the table to activate the table and enable you to turn off/on individual points, to see the effects on the residuals and scale factors. Note however that this is a display-only feature, therefore any changes made in the **Project Calibration Review** table are not saved, and the calibration will not be affected.

Performing a two-point calibration

Trimble recommends that wherever possible you use a multi-point calibration of at least three points. Use the two-point calibration method in situations where a baseline of only two control points is available. In the two-point calibration, the first point establishes the position and elevation for the project; the second point establishes the project orientation.

In a two-point calibration, the heights for the project are computed using a simple block shift method that ties all heights to the first measured control point. A two-point calibration is carried out in the same way as a multi-point calibration.

Troubleshooting a site calibration

If a project calibration fails repeatedly, try the following solutions:

- Try a different combination of control points. The software cannot always identify the bad point.
- Start the calibration process again. You may have incorrectly measured a point or points.
- Check the equipment. The source of the error may be as simple as the adjustment of the rod bubble, or a bent rod.

Once the system is setup, there are limited sources of error when using RTK GNSS systems. The most common sources of error include:

- A poor project calibration
- Incorrect base antenna height
- Incorrect rover antenna height

- Incorrect selection of the correct antenna type at the base or rover, which causes height errors
- Incorrect location of the base station antenna
- A GNSS rod bubble is out of adjustment or the rod is bent

These errors can easily be detected by rechecking the system setup. After starting the rover each day, the software prompts you to recheck the system setup. All recheck system setup operations are logged in the work order report and record files for reference and troubleshooting requirements.

TIP – To turn off the prompt for a system recheck, open the managers menu (tap **Ctrl+O** (letter “oh”)). You can also turn off the prompt to adjust a published coordinate system with a site calibration.

Measuring a new control point with GNSS

There are several reasons why you may need to measure a new control point during a project and then add the measured position to the Control Point file for the project. Typical cases include:

- When operating the project with a mixture of GNSS and total station equipment; total stations require more control points around the project because of their line-of-sight dependence. Control points can be established very rapidly using GNSS and can be used later by total station crews to establish their position and orientation.
 - When operating a site, a base station often needs to be moved closer to the current working location to provide better radio coverage. The base station must be relocated to a known point in the local coordinate system, unless BaseAnywhere is used. Using the Measure control point option ensures that the point is created in the correct location, with the correct coordinates, and guarantees that the project calibration remains valid after the base station is moved.
 - When carrying out topographic measurements on a new site before control for the project is established, you may set the base station up in an arbitrary and convenient location and then carry out a single-point calibration. Once completed, measuring three or more control points around the project provides a common set of reference points that can be used later to transform the data measured using the single-point calibration, to the project coordinate system once it is established.
1. From the **Home** menu, tap **Measure / Measure Control Point**.
 2. Create the control point location using a stake, a hub, or a road nail as required and then mark the stake with the name for the control point, for example, CP3.
 3. Set up the GNSS rod over the point and hold it steady using a bipod. The software displays the current GNSS position on the map.
 4. When you are ready to take the measurement, tap the **Measure** icon. The measurement process takes approximately 15 seconds to complete. Measuring for 15 seconds takes an average position that increases the accuracy of the computed control point.


When each control point is measured, the software stores the control point data position in the control point (Control.field.csv) file for the site, and also records the measurement data into the record and report files for the work order.

Static measurements

Static measurements allow for the averaging of the GNSS results over a user-selected time period, resulting in a more precise position. A data file can also be configured and stored on the GNSS receiver, that can be downloaded from the receiver for use in postprocessing applications. Static measurements require the receiver to be vertical and plumb over the point being measured. It is not possible to take a static measurement with a tilted survey rod. Starting with v1.60, if Siteworks is in Tilt Compensation mode (see [Tilt Compensation, page](#)

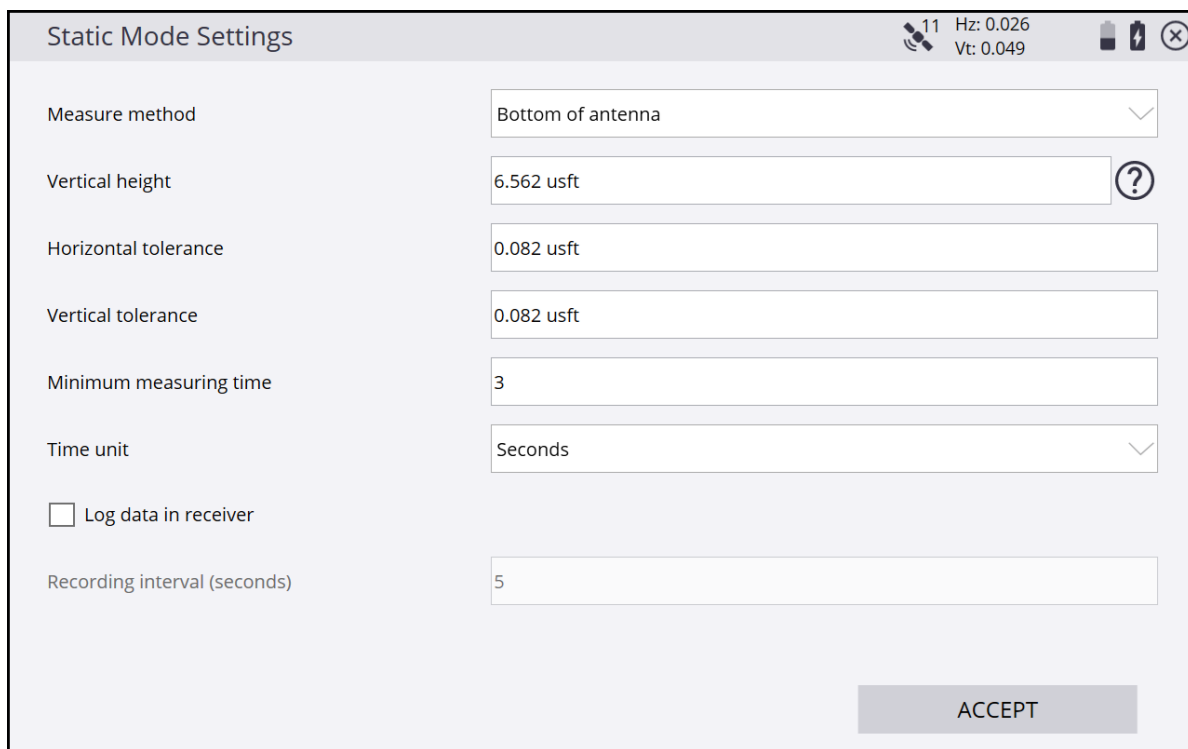
146Tilt Compensation, page 146page 146) when a static measurement is started, it prompts if you want to temporarily shut off tilt compensation during the static measurement.

To set up the receiver for static measurements:

1. From the **Home** menu, tap **Project Setup**, tap **Connect Device** and then configure the Rover as desired with the appropriate correction method.
2. After setting up the receiver, a message may appear asking if you want to calibrate the site; tap **No**.
3. Change the measurement mode to Static; tap the **Measure mode**  icon in the status bar on the right side of the main panel and then tap the **Static** icon:



Alternatively, from the **Home** menu, select **Settings / Measure Mode**. Selecting **Static** opens the following screen:



Static Mode Settings

Measure method: Bottom of antenna

Vertical height: 6.562 usft

Horizontal tolerance: 0.082 usft

Vertical tolerance: 0.082 usft

Minimum measuring time: 3

Time unit: Seconds

☐ Log data in receiver

Recording interval (seconds): 5

ACCEPT

4. Complete the options for the antenna height, how long you want to measure for, and select whether or not to store the raw data in the receiver. You need to measure at least four minutes to store raw data in the receiver, which can then be used for postprocessing. The data logging option code also needs to be installed on the receiver to enable Logging.

If the receiver has the Data Logging option installed, the software can configure an SPS GNSS rover receiver for static measurements.

5. If you want to log the data into the receiver to later download via a USB cable or the web interface, enter a point name into this field, which will be saved into the .T02 or .T04 file. This log point name will appear as the point name when the .T02 or .T04 file is imported into the Trimble Business Center software. Note that the point name entered in the **Static Mode Settings** screen is different than the point name that is entered after the static measurement is complete. The name entered first into the **Static Mode Settings** screen is only

stored in the .T02 file. The name prompted for after the measurement is complete is the point name stored and displayed in the work order in the Siteworks software.

6. When you are ready to start the static measurement, tap the **Measure** icon and check the **Static Mode Settings**. Then tap **Start**. The software counts down the time that you have entered and then gives you the option to fill in the point name and code and accept and store the measurement.

NOTE – If the receiver loses power, shuts down, or the measurement canceled, no raw data is saved and all the static data for that point will be lost.

Tilt Compensation

- [Accuracy specifications](#)
- [Using Tilt Compensation](#)
- [Tilt Compensation workflow](#)
- [The Plumb Pole routine](#)
- [Tilt Compensation data in the Trimble Business Center software and elsewhere](#)

Tilt Compensation is a measurement mode for pole- and vehicle-mounted GNSS receivers. It uses Inertial Measurement Units (IMUs) in the SPS986 and R780 receiver to automatically correct measured points for receiver/vehicle tilt, which enables more accurate point and line measurements when the receiver is not perfectly vertically plumb over the rod tip.

The requirements for Tilt Compensation are:

- Siteworks software, version 1.10 or later.
- SPS986 or R780 receiver with firmware version 6.01 or later.
- IMU or the Premium Precise Rover option code installed on the SPS986 or R780 receiver.

After entering Tilt Compensation mode, you must "align" the receiver to begin obtaining tilt-corrected measurements. To align the receiver, move the receiver so that it experiences accelerations. In survey pole-mounted workflows, simply rock the pole back and forth or walk a short distance and change direction several times. For vehicle-mounted workflows, driving in a circle is the fastest way to align. For best results when using Tilt Compensation, Trimble recommends that you **do not** use the quick release.

Tilt Compensation in Siteworks:

- is immune to magnetic disturbances (that is, not dependent on a magnetometer or a compass).
- the maximum tilt is limited only by practical reasons (that is, the visibility of GNSS satellites).

Accuracy specifications

Accuracy specifications without Tilt Compensation

The current SPS986 specification for Real-Time Kinematic (RTK up to 30 km) without Tilt Compensation active is:

- Horizontal accuracy 8 mm + 1 ppm RMS (0.026 ft + 1 ppm RMS)
- Vertical accuracy 15 mm + 1 ppm RMS (0.05 ft + 1 ppm RMS)

Accuracy specifications with Tilt Compensation

Tilt Compensation adds an additional 8 mm (0.026 ft) + 0.5 mm per degree of tilt RMS to the horizontal RTK accuracy specified above.

Vertical accuracy specifications do not change when Tilt Compensation is activated.

Accuracy specifications using Tilt Compensation and running the Plumb Pole routine

For the best accuracy when Tilt Compensation is active, run the Plumb Pole routine, remove the quick release from the survey pole, and ensure all the joints on the pole are screwed tight (that is, there is no wobble in the pole). Following these recommendations can enable you to obtain horizontal accuracy comparable with the RTK specification.

For further details on the accuracy of measurements, see [GNSS measurement methods, page 129](#).

Plumb Pole routine

Tilt Compensation works out of the box. The Plumb Pole routine is a feature to achieve increased horizontal accuracy when Tilt Compensation is turned on. For more information, see [The Plumb Pole routine, page 164](#).

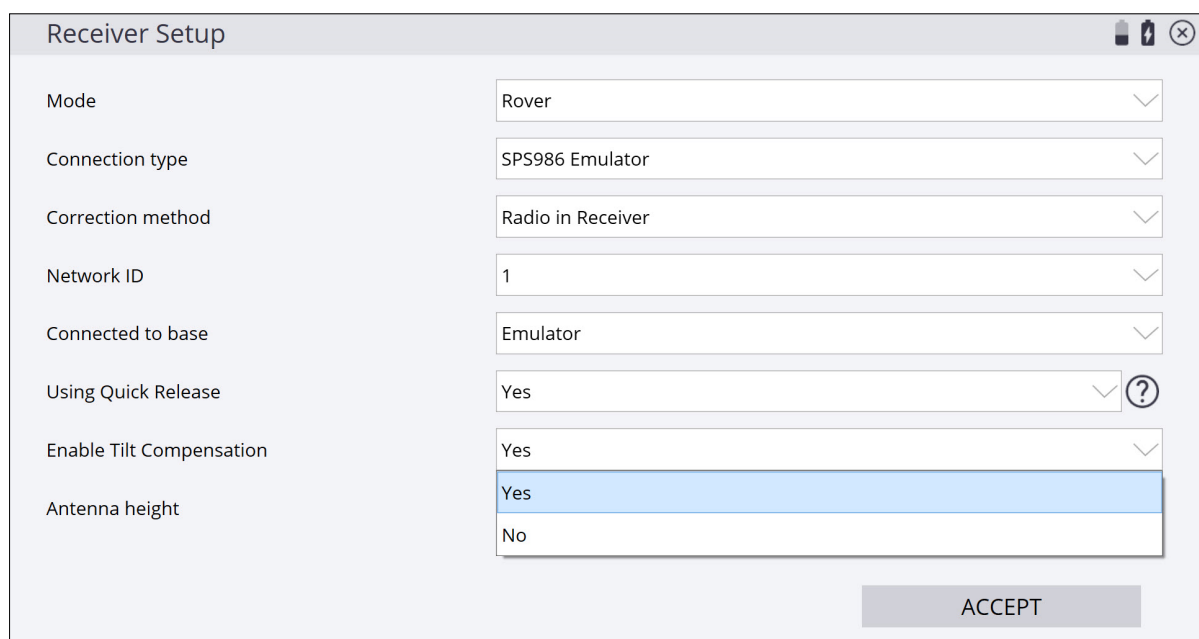
Using Tilt Compensation

Enabling Tilt Compensation

There are two ways to turn on Tilt Compensation:

1. During receiver setup in the **Receiver Setup** screen.

When connected to an SPS986, R780 or other Trimble tilt enabled receivers GNSS smart antenna with the required INS option code installed, the **Enable Tilt Compensation** option becomes available. Select Yes to activate Tilt Compensation during the receiver setup process.



The screenshot shows the 'Receiver Setup' screen with the following settings:

Setting	Value
Mode	Rover
Connection type	SPS986 Emulator
Correction method	Radio in Receiver
Network ID	1
Connected to base	Emulator
Using Quick Release	Yes
Enable Tilt Compensation	Yes
Antenna height	Yes

An 'ACCEPT' button is located at the bottom right of the screen.

2. In the main working screen.

You can enable Tilt Compensation in the **GNSS Status** screen. Tap the GNSS icon or current GNSS precision in the top right corner of the Siteworks screen. Then in the **Settings** tab, select YES from the Tilt Compensation dropdown list.



GNSS Status

11 Hz: 0.026 Vt: 0.049

GNSS Status

Settings

GNSS horz precision

0.082 usft

GNSS vert precision

0.082 usft

☐ GPS Only

Enable Tilt Compensation

Yes

Yes

No

ACCEPT




Icons and GNSS precision values

When Tilt Compensation is active, an alignment status symbol appears in the top right corner of the Siteworks screen. The symbol displays the number of connected satellites and the alignment status. Next to this are the current precision values. The precision values are calculated in real time and account for the number of satellites, current DOP, the quality of the alignment and the tilt of the receiver. Precision values displayed are at the pole tip when Tilt Compensation is active. In GNSS-only mode without Tilt Compensation, the precisions are calculated at the Antenna Phase Center. Generally, the more a receiver is tilted, the larger the precision values become.

Desired precision tolerance values are set in the **GNSS Status / Settings** tab to prevent recording a value outside of the tolerances. As in GNSS-only mode, once the precision values exceed the input tolerances the info panel and info bar flash red until the precision values drop below the tolerances.

When Tilt Compensation is enabled, the following icons display the status of Tilt Compensation.


Symbol	Description
	<p>Receiver is not aligned, measurements are not corrected for receiver tilt.</p> <p>No precision values are displayed when the receiver is not aligned in standing and walking mode.</p>

Symbol	Description
	Receiver is aligned, measurements are corrected for receiver tilt. Precision values are only displayed when the receiver is aligned.
	Receiver is not aligned. The Siteworks software does not know the direction the receiver is orientated.
	Receiver is aligned. The arrowhead displays the direction the receiver is facing in relation to the Site Bearing (that is, the local north of the project). On the SPS986 or R780 GNSS smart antenna, the front panel needs to be facing the user for this to be orientated correctly (same as the eBubble).

The receiver alignment status is also displayed in the **GNSS Status** screen:

GNSS Status

GNSS Status



Settings

Sats Used

11

Position

Fixed

Alignment status

Aligned

Horizontal precision

0.026 usft

Vertical precision

0.049 usft

PDOP

1.2

HDOP

0.6

VDOP

1.0

ACCEPT

Correction methods available with Tilt Compensation

Tilt Compensation can be used with the following correction methods:

- Radio in Receiver
- IBSS
- Internet (VRS)
- External Radio
- Wi-Fi
- Centerpoint® RTX correction service over satellite and internet

NOTE – Base station setup is not supported with tilt compensation.

Measurement modes available with Tilt Compensation

Tilt Compensation can be used with the following measurement methods:

- Standing
- Walking
- Vehicle

The following features are not available when tilt compensation is active: Static measurement mode and EZ level. Measure control points, recheck system, Bench My Rover routine, and project calibration are not supported in Tilt Compensation mode as they use the static measurement mode.

Siteworks version 1.60 added a new option to toggle off Tilt Compensation when a static measurement is taken. A prompt asks you if you want to temporary disable Tilt Compensation. Tapping **YES** at the prompt will turn off Tilt Compensation during the static measurement and re-enable it when changing measure modes from static. Tapping **NO** will return you to the main map screen.

Standing and walking modes



Standing and walking modes are designed to be used with pole-mounted receivers. By tilting the pole or walking a few steps (generally less than 3 m) to measure the first point, the receiver will be aligned and ready to record measurements without needing to level or plumb the pole.

To correctly orientate the internal hardware components and the eBubble on the Siteworks screen, ensure that the GNSS receiver faceplate on the pole is pointed toward you.

Vehicle mode



Vehicle mode is designed to use with vehicle-mounted receivers. Alignment occurs by driving the vehicle for a short distance. Alignment can be achieved most rapidly by driving in a circle or with multiple direction changes. As in regular vehicle mode, points are measured at either defined horizontal and vertical distance intervals or at defined time intervals.

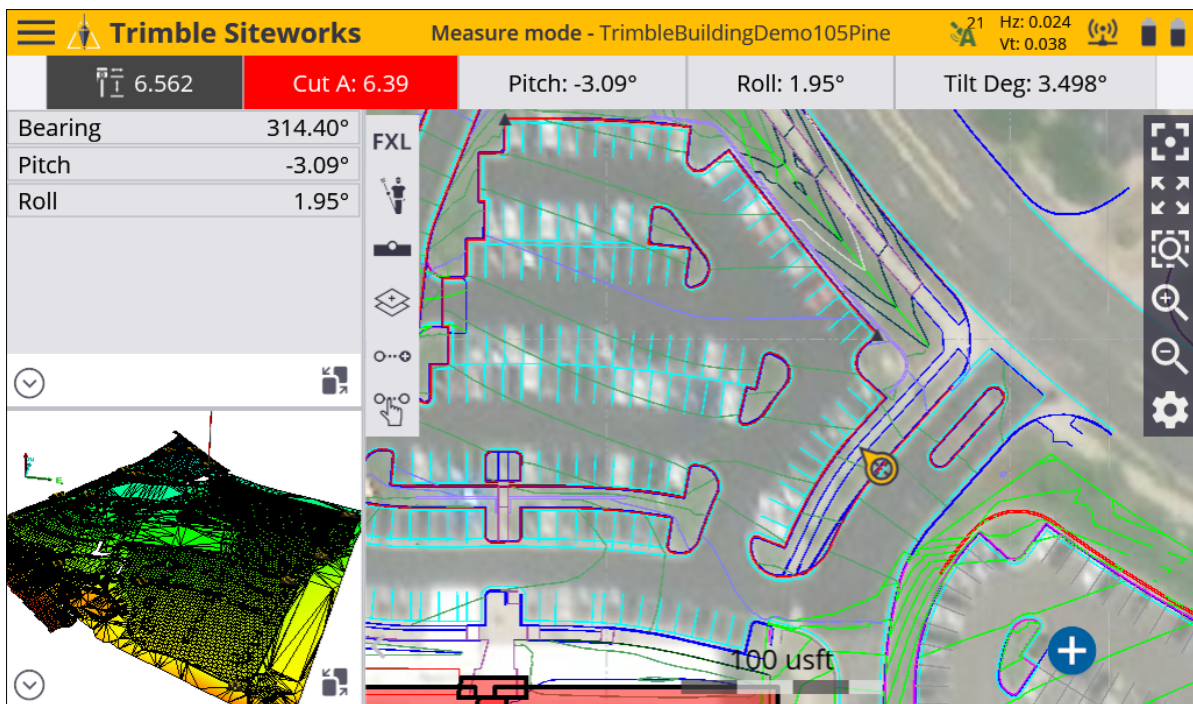
Vehicle mode uses a different internal kinematic model within the receiver than walking mode, leading to better results in vehicle-mounted applications. Therefore, it is recommended to always use Vehicle mode with a Tilt Compensating receiver when it is to be used on a vehicle.

When mounting the GNSS receiver on the vehicle, ensure that the faceplate is pointed toward the rear of the vehicle. This ensures correct orientation of the internal hardware components and the eBubble on the Siteworks screen. Trimble recommends that the receiver is mounted on the vehicle in a rigid location that is least likely to be subject to deformation and vibration as it allows the antenna height to be as consistent as possible and minimizes excess vibrations to the IMU sensors. Placing the receiver near the engine compartment of the vehicle is not recommended due to excessive vibration. Examples of good mounting locations are over the rear wheels of a truck, or on an overhead rack. The receiver should also be mounted in as level a position as possible on the vehicle (that is, not on a steeply sloping hood or roof). If the receiver is mounted at an angle while the vehicle is on a flat surface, vehicle mode measurements project the tilt of the receiver to calculate the position of the “virtual rod tip” as if the receiver were on a tilted survey pole and not directly under (or vertically plumb to) the receiver.

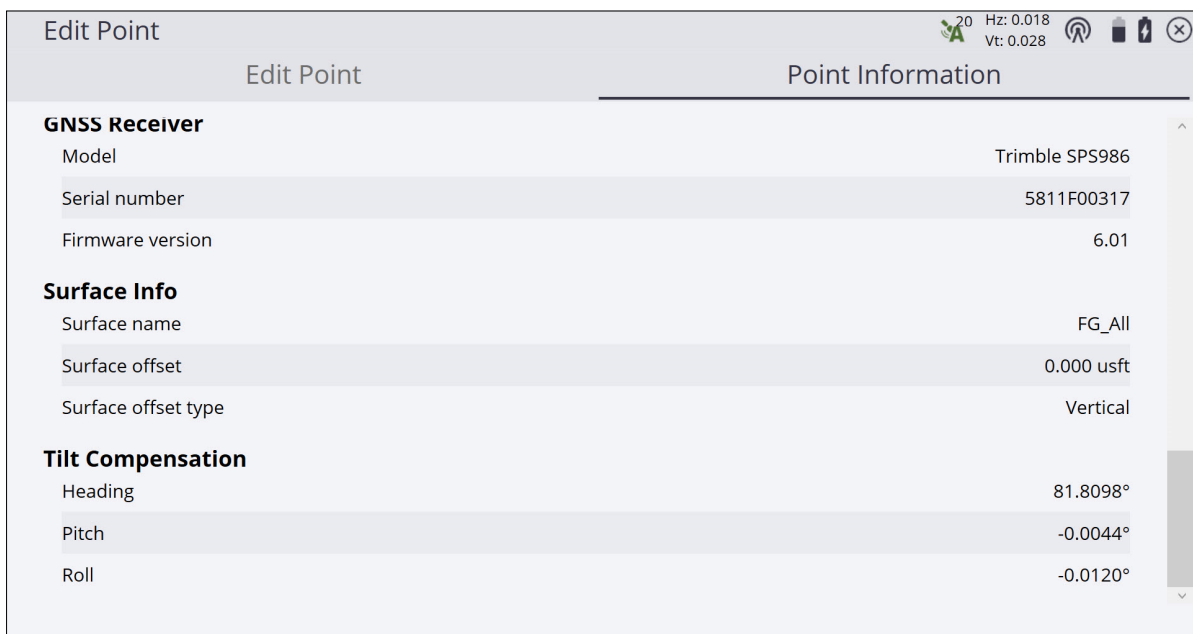
NOTE – A Tilt-Compensated vehicle mode was previously available in Siteworks version 1.02 and 1.03. In these versions of Siteworks, vehicle mode was called Dynamic Tilt. The SPS986 receiver required firmware version 6.00 or later to use Dynamic Tilt. In Siteworks version 1.10 and later, Dynamic Tilt has been changed so that it is activated as vehicle mode when Tilt Compensation is on. Using any Tilt Compensation features in Siteworks version 1.10 or later requires GNSS firmware 6.01 or later to be installed on the SPS986, R780 or any other Trimble tilt capable receivers.

Displaying and storing tilt data

When Tilt Compensation is enabled, the current bearing, pitch, and roll of the receiver can be turned on in the information panel and information bar. The Bearing is the direction of the receiver relative to True North. The Pitch and Roll display the tilt of the receiver on the X and Y axis. These values are always displayed in degrees regardless of the user’s settings.



When a point is measured in Tilt Compensation mode, the bearing, pitch, and roll of the receiver at the time of measurement can be viewed in the **Point Information** tab. This is displayed under the **Tilt Compensation** section. The **Tilt Data** section is obtained from the eBubble. The eBubble data is independent of the Tilt Compensation data. For example, if the eBubble is calibrated or “zeroed” while tilted, the “Tilt Angle” will be zero, but the pitch and roll will represent the amount of pitch and roll at the receiver relative to a flat surface.

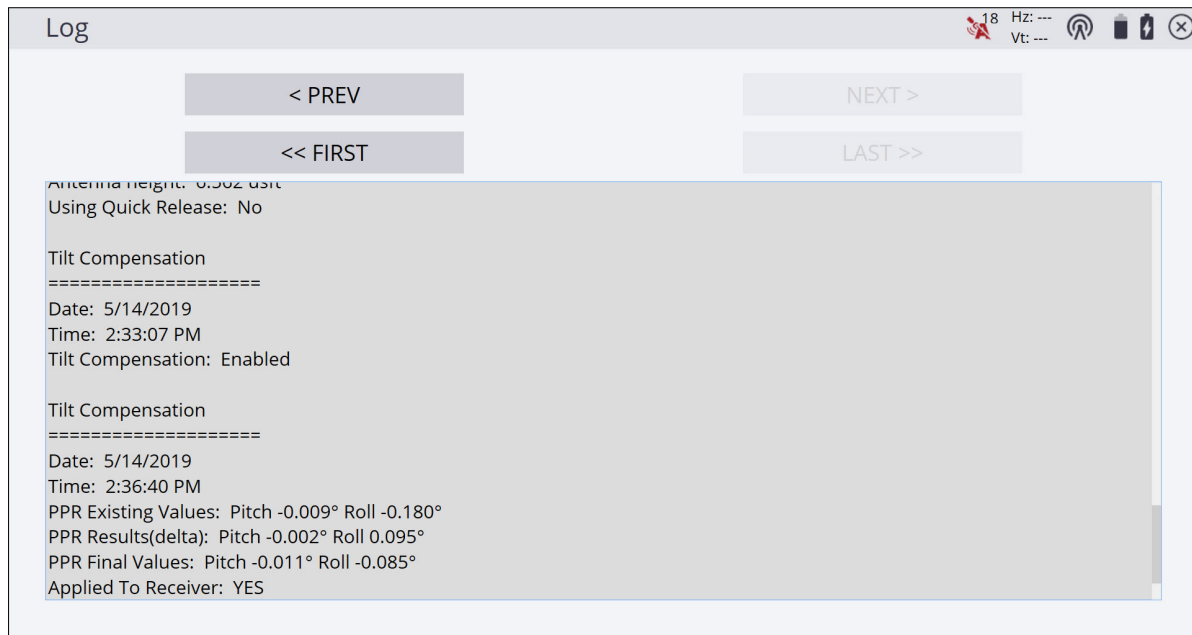


Additional quality assurance data is contained for points measured with Tilt Compensation when a CSV file is exported. From the **Home** menu, select **Data Management / Export Measured Data**). Ensure the **Include QA data** option is set to Yes. The heading, pitch, roll values are

exported along with the Antenna Phase Center and the latitude, longitude, and height of the pole tip.

Log file

When Tilt Compensation is enabled or disabled, a new entry is made in the task log. Whenever the Plumb Pole routine is run this data is also stored. To view the log, select **Home** menu / **Data Management/ Log**.



Emulator and Tilt Compensation

The emulator supports Tilt Compensation. In the receiver setup, select the SPS986 Emulator. The receiver is not initially aligned. Click on two locations in the main map screen to change the receiver position; the emulator will change to aligned mode.

eBubble and Tilt Compensation

By default, the **Enable tilt warning for measurements** checkbox is turned off when starting Tilt Compensation, so that Siteworks does not display a tilt warning message while taking measurements when the receiver is tilted. To enable or disable this warning, tap the **eBubble** icon on the Siteworks main screen or from the **Home** menu, select **Settings / eBubble**:

eBubble Settings

11 Hz: 0.026 Vt: 0.049

eBubble response Medium

eBubble sensitivity Medium

Tilt tolerance 0.066 usft

☒ Enable tilt warning for measurements

0.533°=0.065

Calibration expires in 30d 0h 0m

CALIBRATE TILT SENSOR

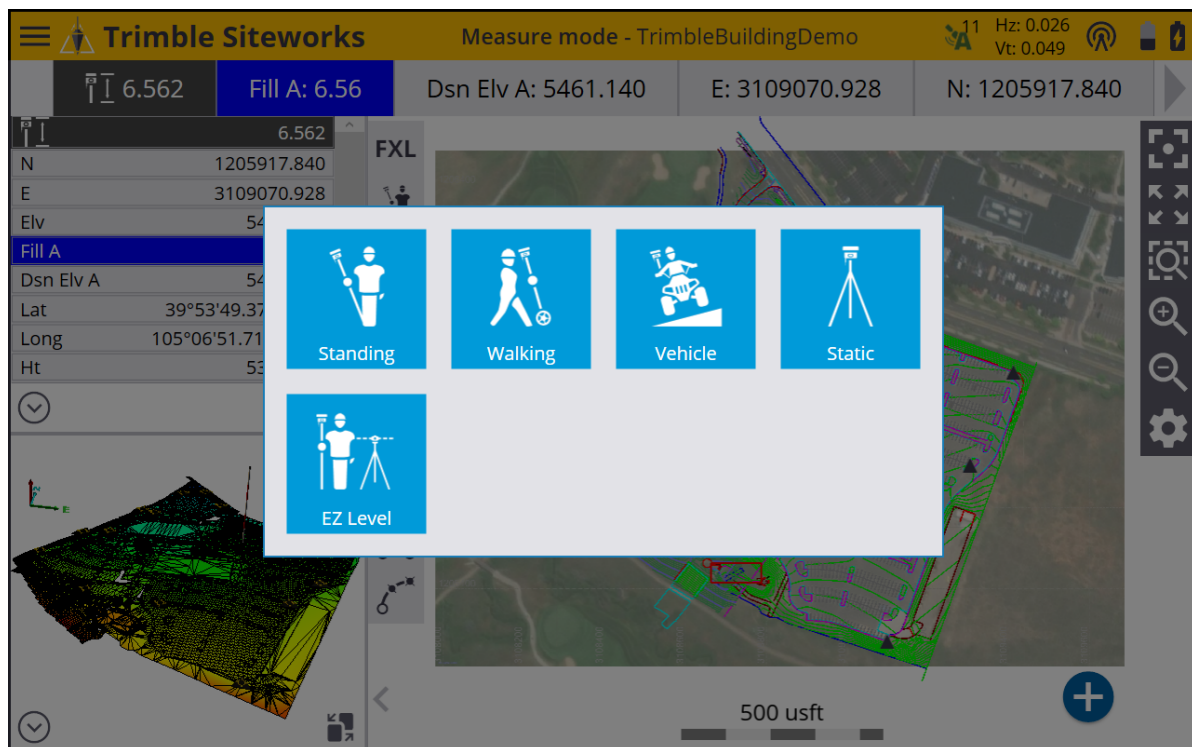
ACCEPT

NOTE – The eBubble operates independently of the IMU sensors used in Tilt Compensation. Calibrating the eBubble to “zero” while it is tilted (for example, on the sloped roof of a vehicle parked on a flat surface) has no impact on the IMU sensors and measurements in Tilt Compensation. If the receiver is mounted at an angle while the vehicle is on a flat surface, Tilt Compensation measurements still project the tilt of the receiver to calculate the position of the “virtual rod tip” as if the receiver were on a tilted survey pole and not to a point directly under (or vertically plumb to) the receiver. To obtain the most accurate results while operating in vehicle mode, mount the receiver as level as possible on the vehicle.

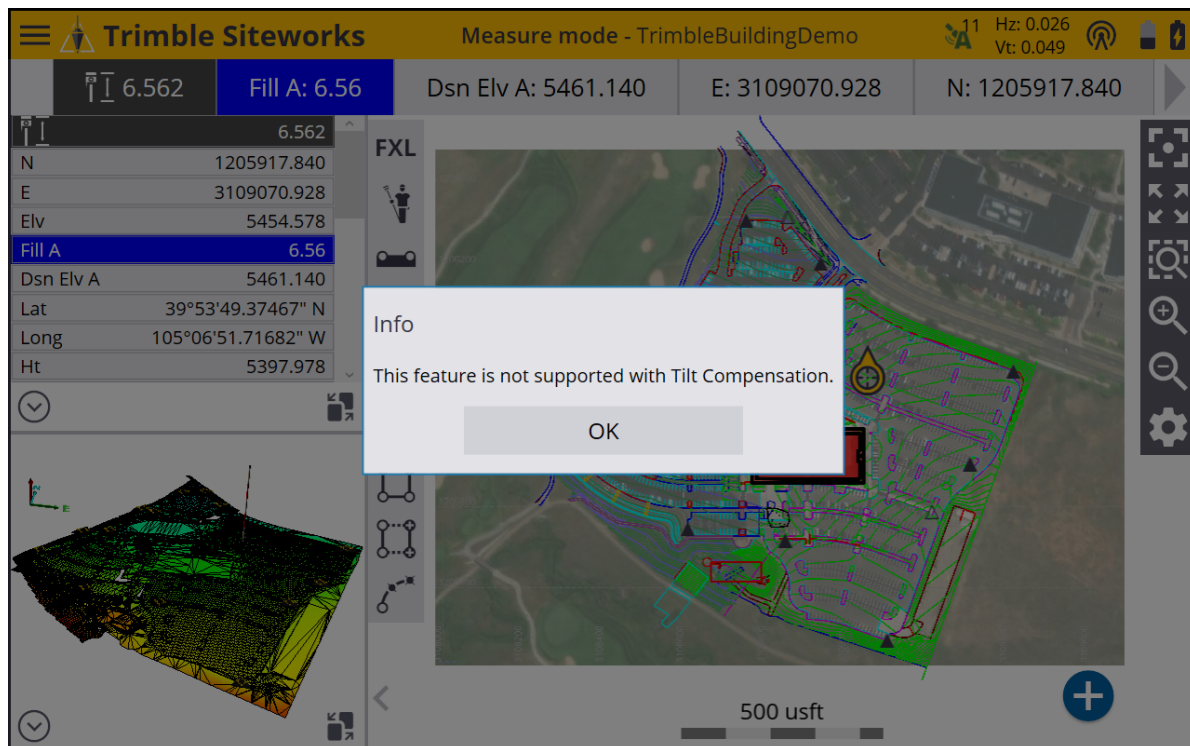
Tilt Compensation workflow

Select measurement mode

Once Tilt Compensation is turned on, select the required measurement mode. If a measurement mode is not selected, the default is standing mode. Note the difference in the icons when Tilt Compensation is enabled versus when it is disabled. The Tilt Compensation icons show a tilted rod or vehicle.

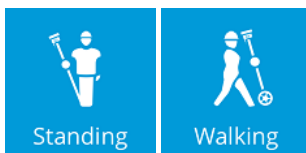


If an unsupported measurement mode is selected while Tilt Compensation is active, a warning message appears:



Standing and walking mode workflow

1. From the **Measurement Mode** menu, select Standing or Walking.

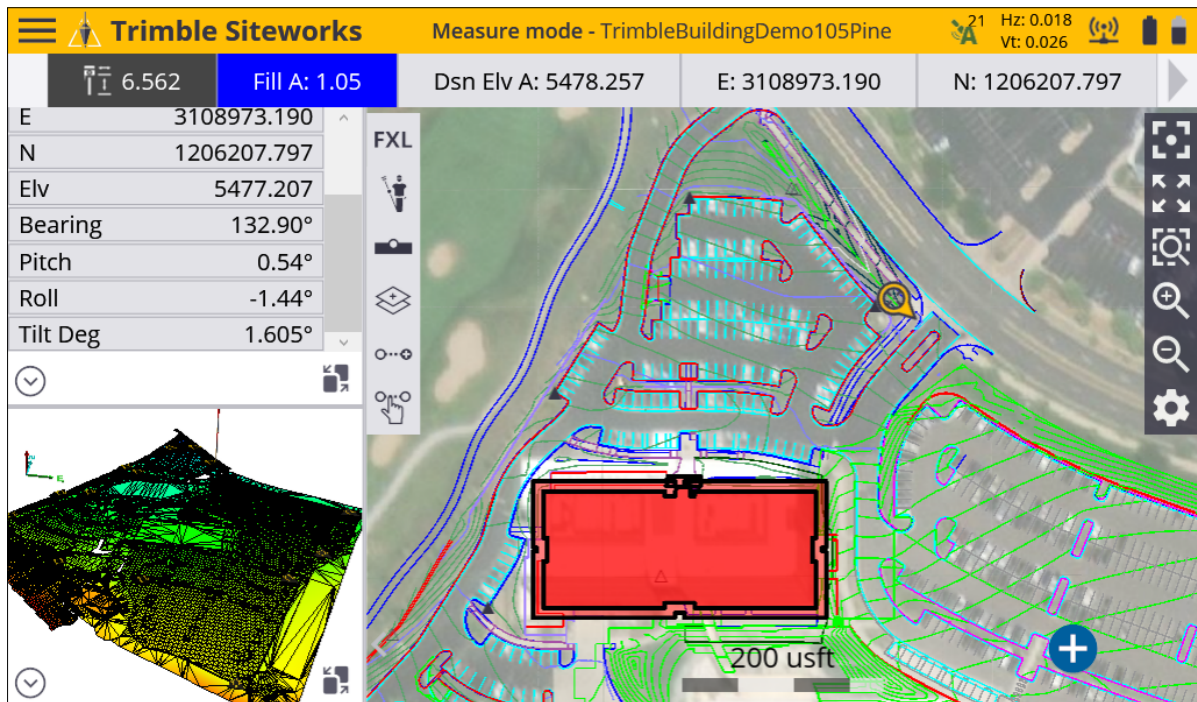


2. Ensure the antenna height is correct. For best results when using Tilt Compensation, Trimble recommends that you do not use the quick release.

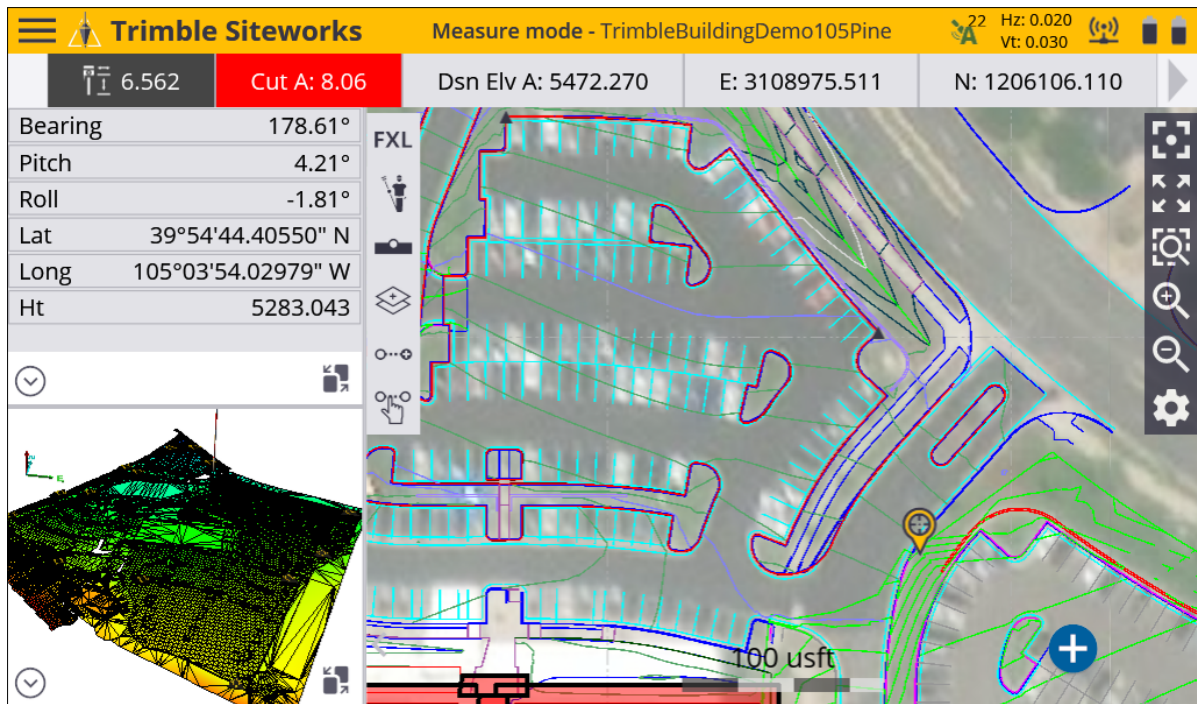
CAUTION – It is very important that the pole height is correct when Tilt Compensation is turned on; it is no longer possible to correct data with a wrongly entered pole height by simply modifying the Z (height) value of the points to correct the error. Changing the pole height in the Point Manager or in the Trimble Business Center software only vertically shifts the point's elevation; it does not take into account any tilt of the pole at the time of measurement. This could lead to horizontal errors in the point if there was a large amount of tilt at the time of measurement.

3. Tilt Compensation uses the antenna height to accurately compute the pole tip position. Whenever the pole height is changed, the receiver is reset to an unaligned state. You will need to realign with the updated pole height before measuring.

4. Once back in the main map screen the receiver now can be aligned. To align the receiver, make minor movements such as tilting the pole or walking a few steps to measure the first point. The alignment symbol turns from red to green and the GNSS precision will be displayed. Alignment status is also displayed in the **GNSS Status** screen / **GNSS Status** tab by tapping on the alignment symbol. The **Alignment Status** line in the **Skyplot** screen displays the current state of the receiver's alignment.



5. Once the receiver is aligned it is ready to take tilted measurements. The GNSS precisions reflect the accuracy of the alignment and the precision calculated at the pole tip. The horizontal precision value generally becomes larger the more the pole is tilted.



6. Set the required precision values to prevent recording a value outside of the tolerances. To set this, tap on the GNSS precisions in the status bar in the top right corner of the main screen. Select the **Settings** tab and enter the horizontal and vertical precision. The precision values and info panel/bar flashes red on the map when outside of these defined tolerances.

GNSS Status

GNSS Status

Settings

GNSS horz precision

0.082 usft

GNSS vert precision

0.082 usft

☐ GPS Only

Enable Tilt Compensation

Yes

Plumb Pole Routine

ACCEPT

NOTE – If the GNSS loses its correction stream (e.g., the VRS connection is dropped or base station radio disconnects), the receiver will go into xFill mode for up to 5 minutes. During this time, you can continue to take measurements. Once xFill quality has deteriorated and the xFill fix is no longer valid, the receiver will switch to Autonomous mode. In this mode, the precisions displayed will be dashed out and no measurements can be taken.

Vehicle mode workflow

1. Ensure the vehicle is stopped and parked in a safe location.
2. If Tilt Compensation is not on, activate it through the **GNSS Settings** screen.
3. Once the receiver has been mounted to the vehicle, tap the measure mode icon from the quick access toolbar on the lower right side of the plan view map window, or from the **Home** menu, select **Settings / Measure Mode**.
4. From the **Measurement Mode** menu, select Vehicle. The tilted slope of the icon shows that Tilt Compensation is active.



NOTE – The vehicle must be stationary during the activation of vehicle mode to enable the IMUs to be correctly initialized.

5. Update the height of the receiver in the **Vehicle Mode Settings** screen to reflect its mounted position on the vehicle. To do this, use a measuring tape or park the receiver above a point of known elevation.
 - a. To set the height by parking the vehicle over a known elevation, Tilt Compensation must be turned off. Return to the main map screen, turn off Tilt Compensation and then select the vehicle measure mode again. Park the vehicle on a level surface over the known elevation point and select the **Measure antenna height** icon.



- b. Select either a control point or manually enter the elevation of the ground surface below the antenna. Tap **Measure**. The antenna height has now been measured relative to the ground surface elevation. Turn Tilt Compensation back on and re-enter the **Vehicle Mode Settings** screen to complete the configuration.
- c. Alternatively, measure the height of the receiver to the bottom of the quick release (if using) or the bottom of the receiver by using a measuring tape or other method and manually enter the antenna height. Tap the ? icon for a graphic showing the correct antenna height measurement point.

- d. To change a height measured with a tape measure, tap the antenna height in the information bar. Each time the antenna height is changed, the receiver must be re-aligned.
6. Select a recording mode:
 - **Fixed Distance** – Enter horizontal and vertical intervals; a point is automatically stored each time the vehicle moves the defined distance.
 - **Fixed Time** – A point is recorded at the defined time interval.
- a. Tap **Accept** to start vehicle mode and return to the main map screen.

Vehicle - Dynamic Tilt Mode Settings

Using Quick Release: Yes

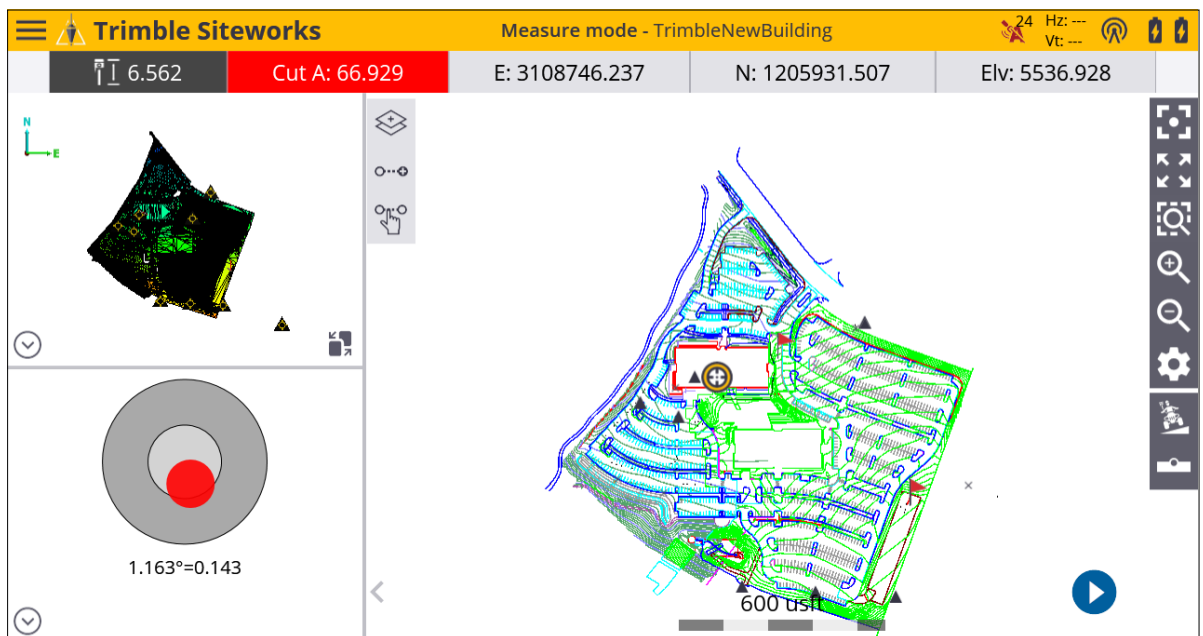
Vertical height: 0.000 usft

Record mode: Fixed Distance

Horizontal interval: 16.404 usft

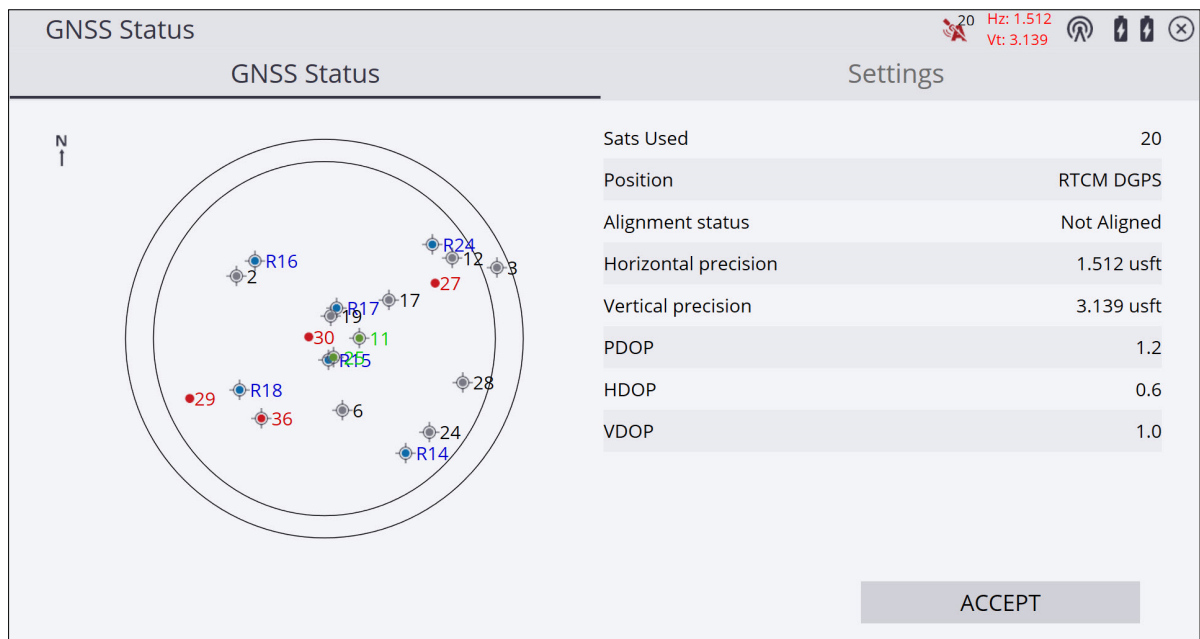
Vertical interval: 0.656 usft

ACCEPT



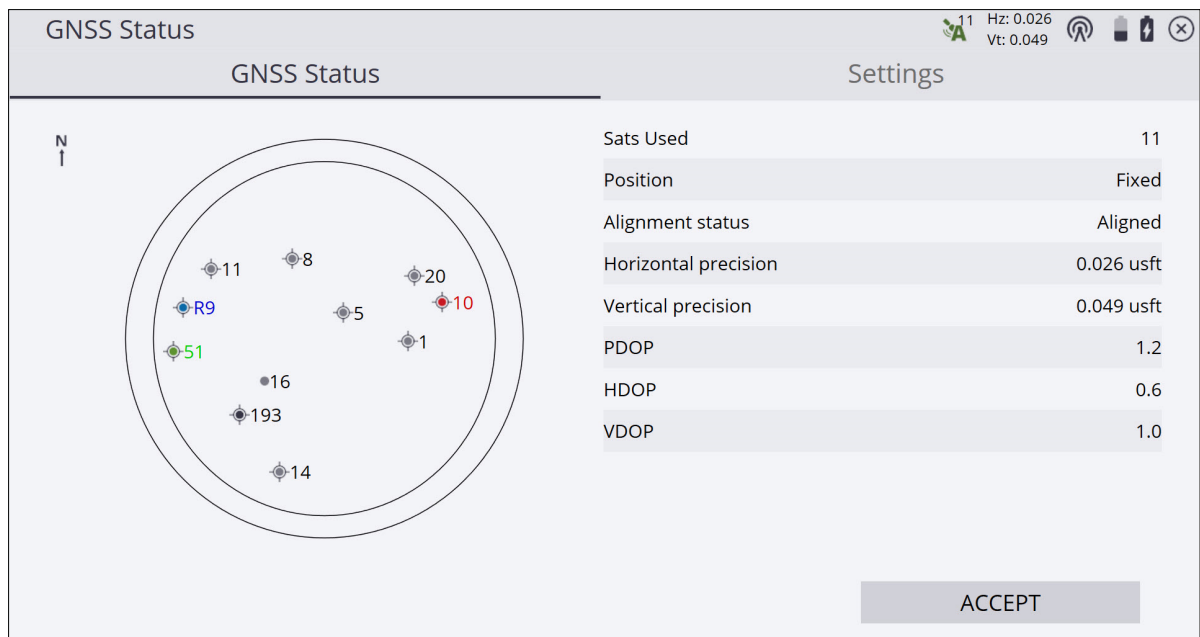
NOTE – The vehicle must remain stationary for 30-45 seconds after returning to the map screen for the IMU sensors to initialize in a non-moving state before beginning the alignment process. Moving the vehicle before this sensor initialization may prevent a successful alignment.

7. Remain stationary for at least 30 seconds to ensure that the GNSS + INS engine has reset successfully, and the receiver is not in RTCM DGPS mode. Trimble recommends waiting for the position status to change to Float. This can be confirmed in the **GNSS Status** (skyplot) screen by tapping on the alignment symbol/GNSS precisions and waiting until the position is no longer RTCM DGPS (it should read “Float” or “Autonomous”).



8. You must now align the receiver by driving the vehicle. Alignment completes the initialization process of the IMU sensors to achieve high precision positions. Drive the vehicle until the alignment symbol turns from red to green and displays the precision within defined tolerances. Driving in a circle or with direction and speed changes can achieve alignment faster than driving in a straight line. Alignment status is also displayed in the **GNSS Status** screen / **GNSS Status** tab accessed by tapping on the alignment symbol. The Alignment Status line in the **Skyplot** screen displays the current state of the receiver's alignment.

NOTE – If alignment cannot be obtained after driving for more than one minute, stop the vehicle and open the **GNSS Status** (Skyplot) screen. Check the Position status to ensure it is not in RTCM DGPS mode. If RTCM DGPS is still active, remain stopped until the Position status changes to Float or Autonomous before driving again.



9. Returning to Siteworks' main map screen, select the **Measure Type** icon from the quick access toolbar. Define the point or line type to be collected and return to the main map screen to begin measurements.



10. To start recording measurements tap the “play button” in the main measurement screen. The function of these buttons is the same as in walking and vehicle modes.

Icon	Definition
	Starts recording measurements automatically in accordance with Dynamic Tilt mode settings.
	Stops recording measurements.
	Triggers a manual measurement.

The Plumb Pole routine

The Plumb Pole routine can be used to obtain increased horizontal accuracy when Tilt Compensation is active. The routine corrects for a pole that may have become bent and is no longer completely plumb or straight, or if the physical spirit level bubble vial is not correctly calibrated on the pole. This means that no matter what state the pole or physical vial bubble is in, Tilt Compensation can give accurate horizontal results.

Trimble recommends that you run the routine the first time an SPS986 or R780 receiver is used for Tilt Compensation, if the receiver is dropped, or in any situation where greater horizontal accuracy is needed when using Tilt Compensation. This routine only affects Tilt Compensation measurements. For GNSS-only measurements without Tilt Compensation, ensure that the survey rod is straight and has a calibrated physical spirit level, and an accurately calibrated eBubble (if eBubble use is needed).

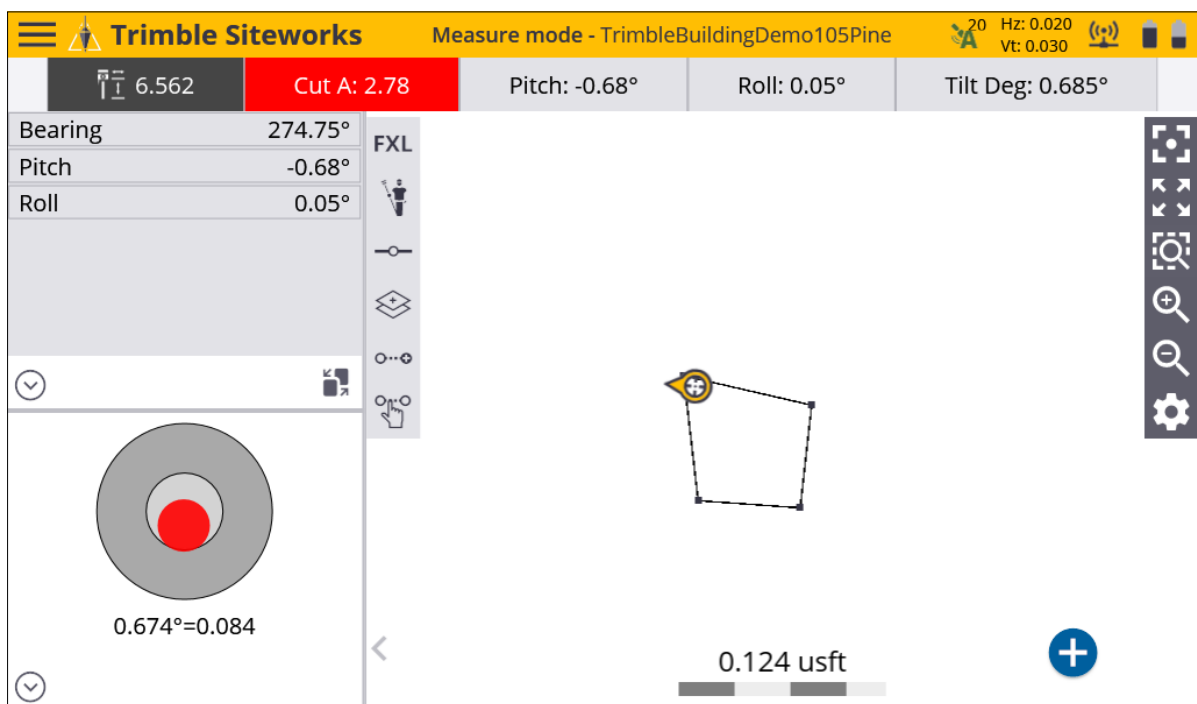
Before running the Plumb Pole routine

1. The Plumb Pole routine is designed for use with the pole that is used with the receiver. The routine corrects for a pole that is no longer completely plumb or straight. It can be used with or without bipod legs. If the SPS986 or R780 receiver is used with a different pole, Trimble recommends that you re-run the routine on the new pole. Trimble also recommends that you remove the quick release from the pole and mount the receiver directly to the pole (without the quick release), to eliminate any play between the pole and the receiver.
2. Start this routine when you are on a control point. The pole tip should not move during the routine so it is best to place it on the control or other stable and indented point, where the tip of the rod can positively rest throughout the routine and you can make sure that the rod tip did not move during the procedure.
3. The routine can only be run in standing or walking mode. Before running the routine, turn on Tilt Compensation and align the receiver. The more movement or distance walked during the alignment process, the better the quality of the alignment.
4. Determine if you need to run the routine by checking the horizontal accuracy of the receiver and survey rod pair as described below.

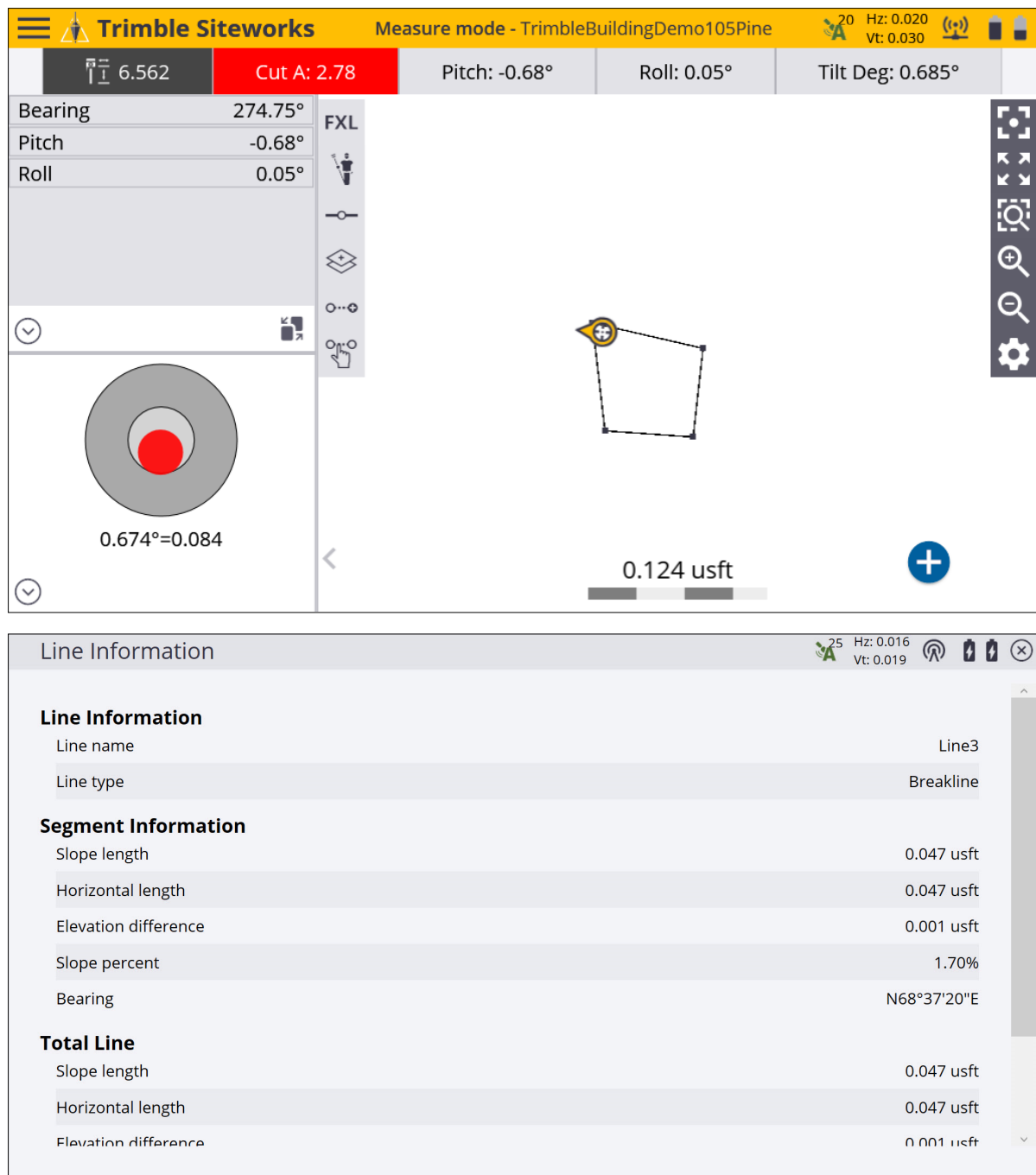
Check the horizontal accuracy of Tilt Compensation

1. Ensure the receiver is aligned and the pole tip is on a control point.
2. Holding the receiver approximately level take a single standing measurement facing North, East, South, and West. Before starting the measurements, set the measure type to New Line (not a Breakline) for easier interpretation and visualization.

Measure Type		Existing Line		New Line	
Line name		Line1			
Line type		Line			
ACCEPT					



- Measure the distance between the opposite points (for example, North and South) to get an estimate of the horizontal accuracy of the receiver (if needed, use the **Cogo** menu to create a line between) or tap and hold on a measured line. In the case below the distance is 0.014 m (0.047 U.S. survey feet). If the distance between the two points is outside of the horizontal tolerance needed for the task, Trimble recommends that you run the Plumb Pole routine.



Plumb Pole routine workflow

1. In an area of good open sky coverage for satellites, ensure that the receiver is aligned and the pole tip is on a control point. The more movement or distance walked during the alignment process, before placing the receiver on the control point, the better the quality of the alignment. The Plumb Pole routine takes one set of measurements while facing one direction, and then a second set of measurements after rotating the receiver 180 degrees and keeping

the pole tip in the same location. Based on these measurements, it then corrects the receiver for any bends in the survey rod.

GNSS Status

GNSS Status Settings

GNSS horz precision 0.082 usft

GNSS vert precision 0.082 usft

☐ GPS Only

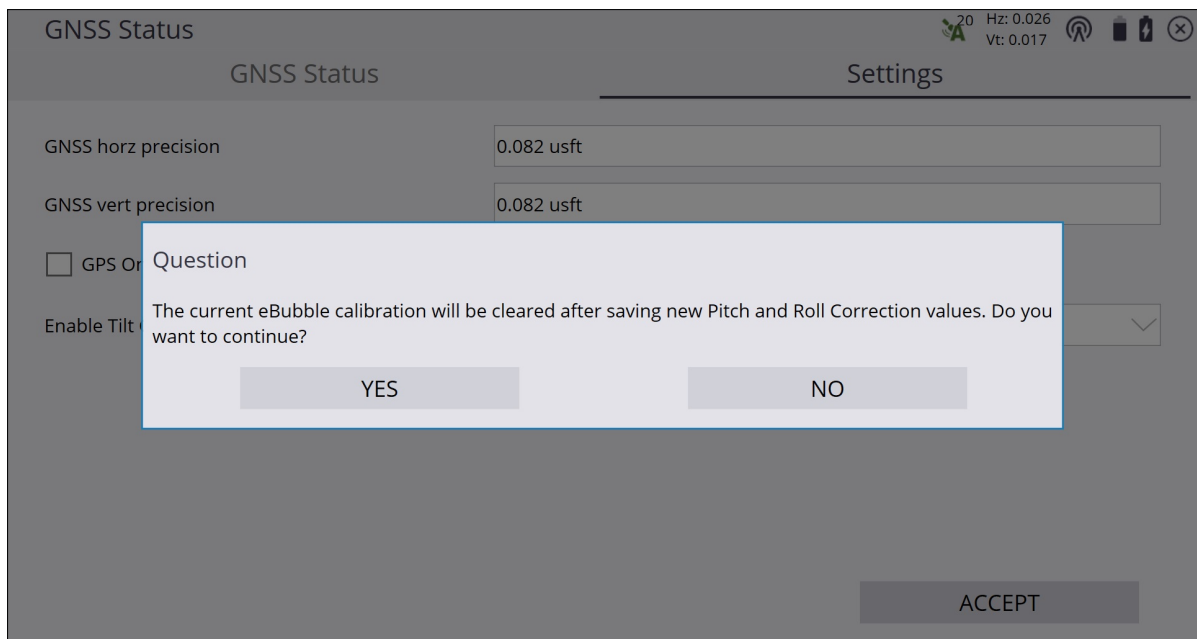
Enable Tilt Compensation Yes

Plumb Pole Routine

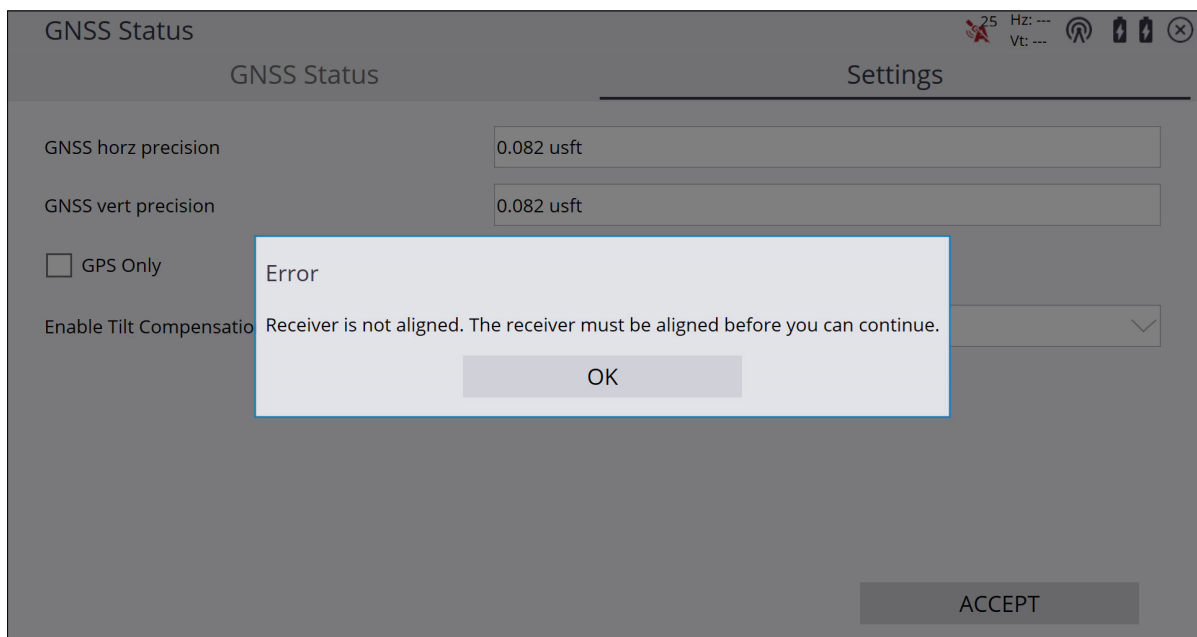
ACCEPT

- To access the Plumb Pole routine, tap the **Precisions** icon in the top right corner. The **GNSS Status** (skyplot) screen appears. Select the **Settings** tab.
- Tap the **Plumb Pole Routine** button to start the workflow.

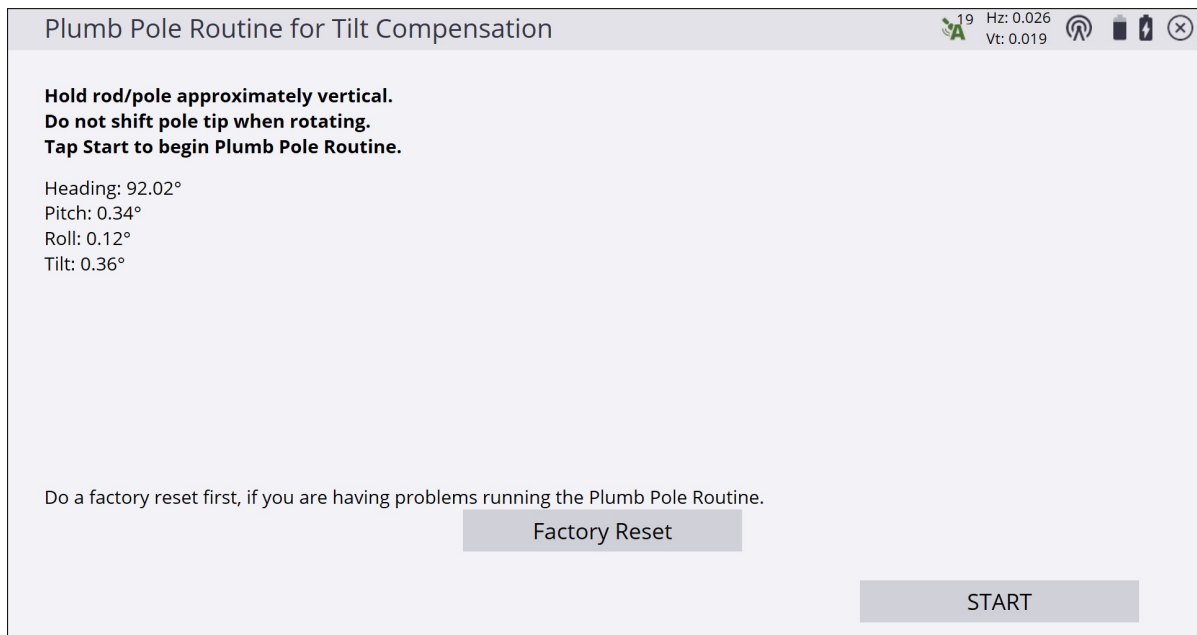
CAUTION – Running the Plumb Pole routine and either accepting the new values at the end of the routine, or doing a factory reset changes the eBubble to an uncalibrated state. **After completing the Plumb Pole routine, you must complete a new eBubble calibration.** A message appears asking if you want to continue. Tap **YES**. Tapping **NO** cancels the routine without any changes to the eBubble.



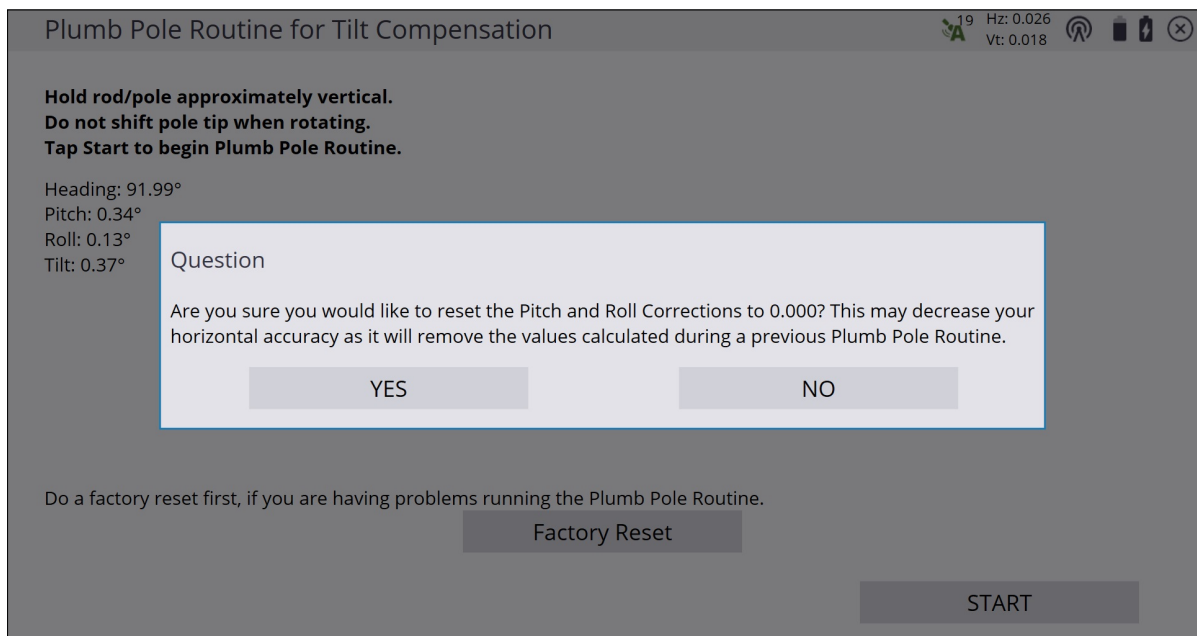
4. To enter the Plumb Pole routine, Tilt Compensation must be enabled, the receiver aligned, and the measurement mode in either standing or walking mode. If not, a message appears:



5. Carefully read the messages in the start screen. To start the routine, tap **START**.



6. The **Factory Reset** button should only be used if the routine fails to run after tapping **START** (for example, you get an out-of-tilt warning when the receiver is level). This button removes any values calculated during a previous routine and may decrease your horizontal accuracy. If a factory reset is completed, then the routine should be run directly after to obtain the most accurate results when in Tilt Compensation.



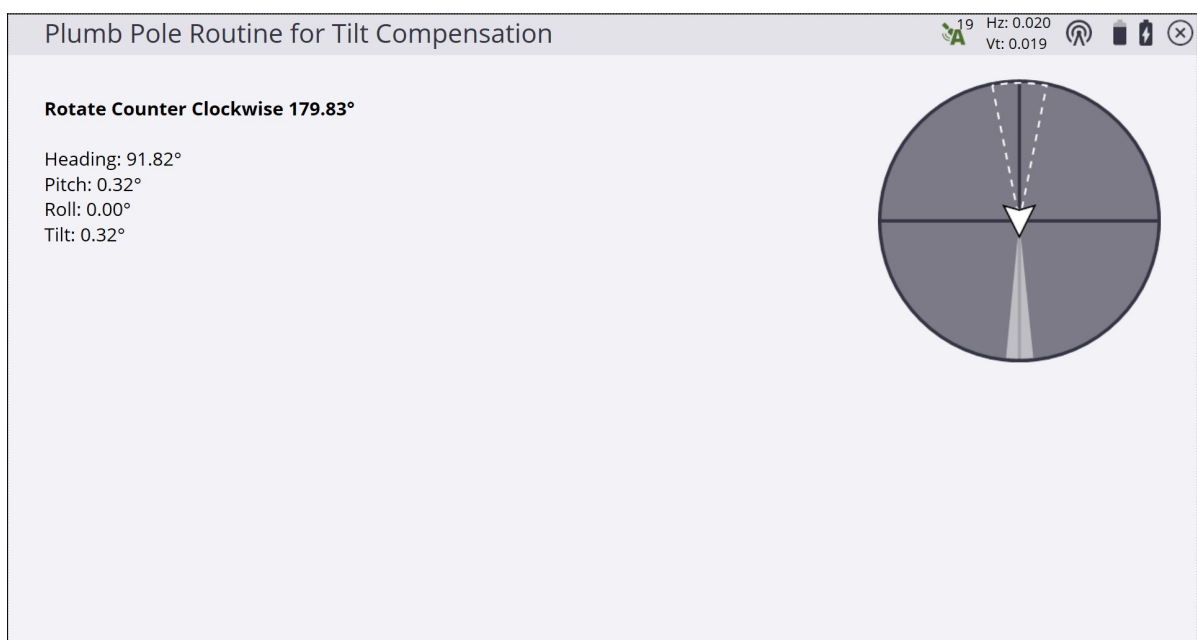
7. When the **START** button is tapped, phase one begins. Keep the pole level and stationary and the pole tip in the same location while the measurements are recorded. A bipod is not necessary, but ensure that you hold the receiver as stable as possible.



8. During the routine, values are constantly checked to ensure accurate measurements. If they go out of tolerance, the measurements stop and a message appears. Some of these checks include:
- The receiver must be kept at the same rotation/heading.
 - The receiver must be kept roughly level.
 - The receiver must stay aligned.
 - The GNSS precision values of the receiver must stay in tolerance of 0.021 m Horizontal, 0.030 m Vertical. You cannot change these precision values.

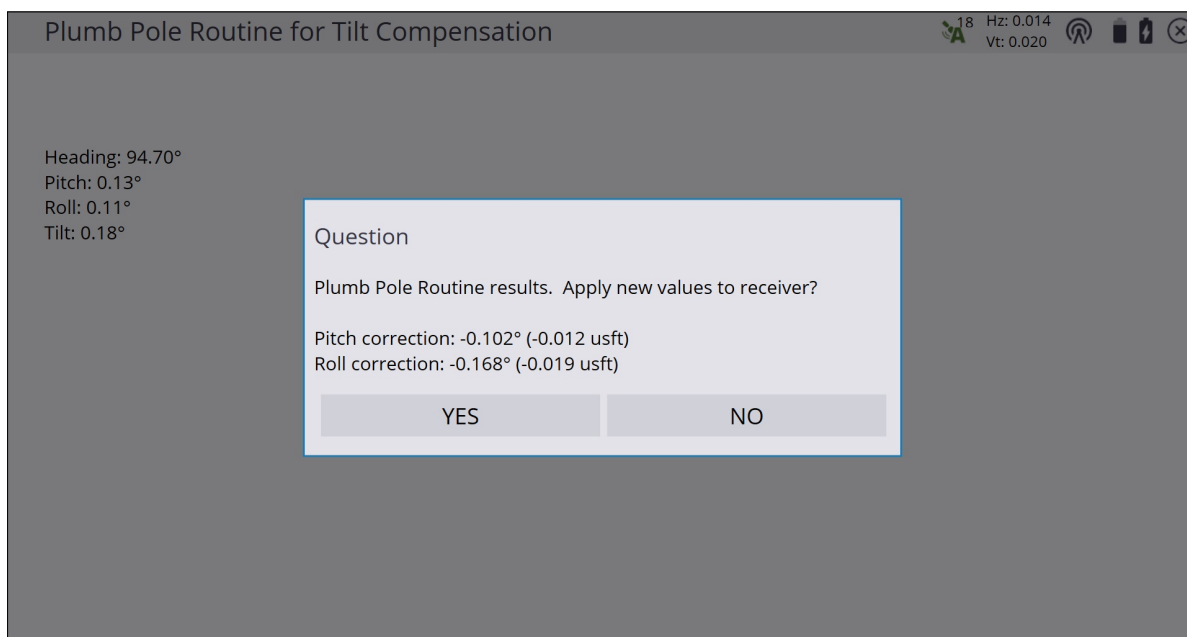


9. When phase one is complete, rotate the receiver 180° *without moving the pole tip*. Once rotated, the **START** button appears in the lower right. Tap **START** to begin phase two.

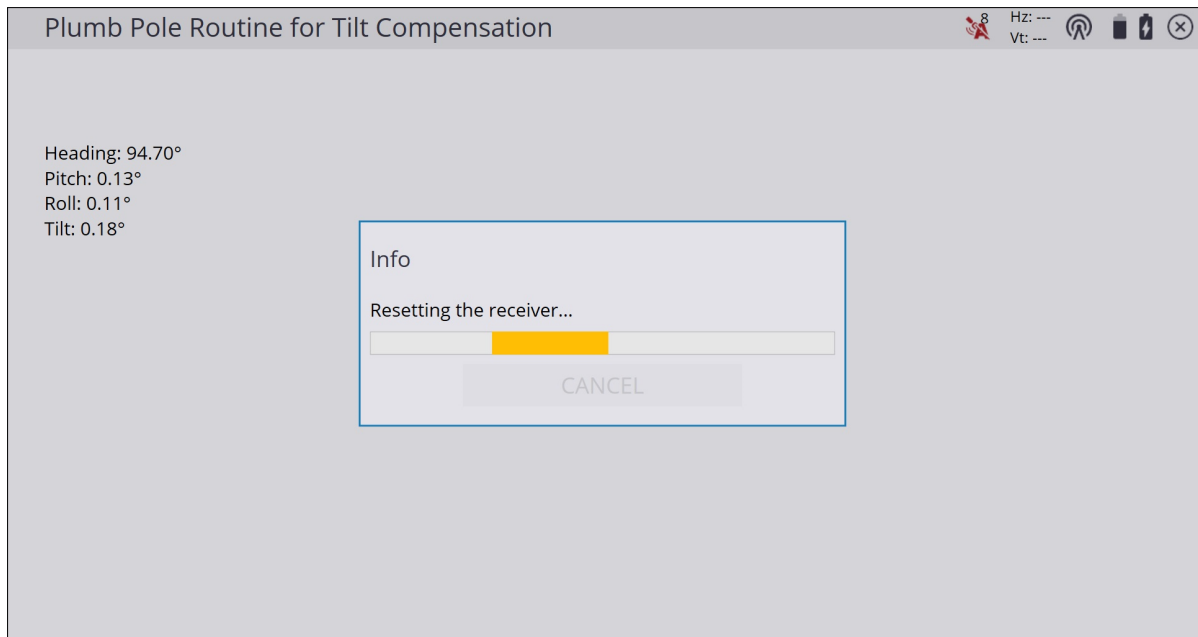




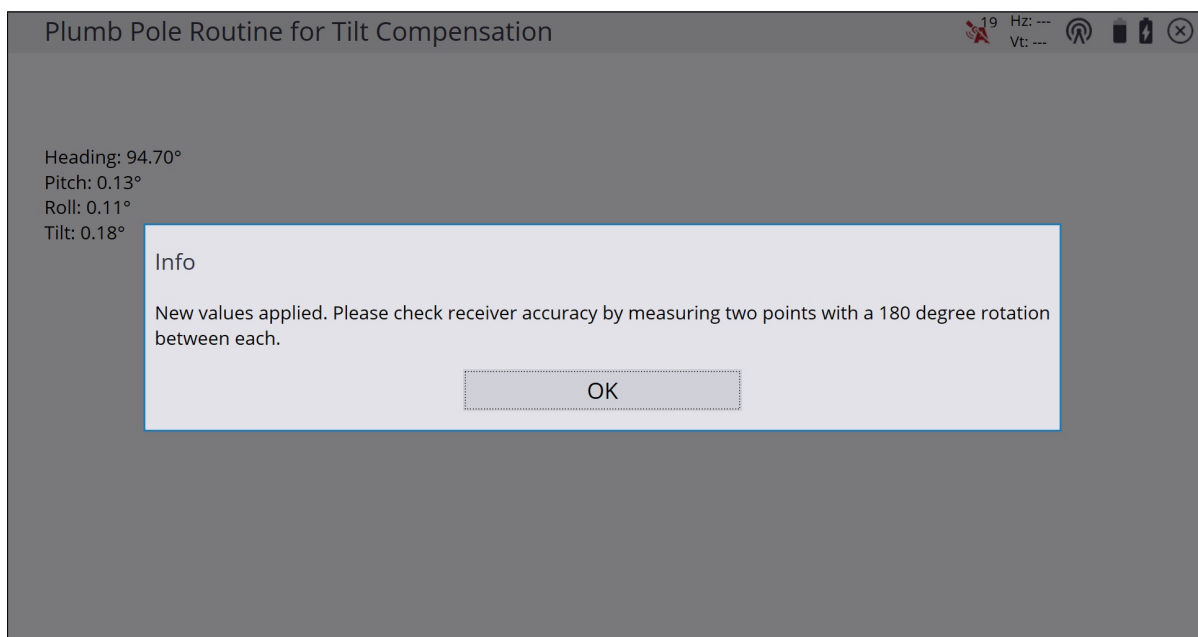
10. At the end of the routine, the values are displayed and you can apply the new values. A good guide is to apply the values if they are above 5 mm (0.02 U.S. survey feet) or when using a 2 m (6.562 U.S. survey feet) long survey pole.



11. If you tap **NO**, the values are not applied to the receiver and the eBubble values are not reset. This is a useful way check the accuracy of the receiver. If you tap **YES**, the values are applied to the receiver, the eBubble Calibration is reset, and the receiver is reset.



12. A message appears once connection is established with the receiver. Check the accuracy of the completed routine by running through the accuracy check above (keep the pole tip on a control point, measure two points, and rotate the receiver 180° between each observation).



Frequently asked questions about the Plumb Pole routine

Does the pole tip need to stay in the same location during the Plumb Pole routine?

Yes. It is important to keep the pole tip in the same location otherwise you will get incorrect results.

How level does the receiver need to stay during the Plumb Pole routine?

Only approximately. Generally, a bipod will not give better results when running the routine. The software informs you when the tilt limit is reached, and it stops taking measurements.

How close do you need to keep the heading, and how close to 180° do you need to be when rotating between phase one and phase two?

The software informs you if the rotation tolerances are not met and it does not record measurements if the heading exceeds the necessary tolerances.

Can the values from the Plumb Pole routine be viewed anywhere?

The values are recorded in the task log. To view the results, tap **Home / Data Management / Log**.

Tilt Compensation data in the Trimble Business Center software and elsewhere


The Siteworks software stores the tilt angle and tilt error (calculated from the eBubble) and the heading, pitch, and roll values at the time of point measurement. Recorded tilt information is not currently used or available for review in the Trimble Business Center software. The point information is stored in the Siteworks task log and can be exported as CSV data when the **Include QA Data** option is selected. Tilt, heading, pitch, and roll values for any point can also be viewed in Siteworks by tapping and holding on the point and selecting **Point Information**.

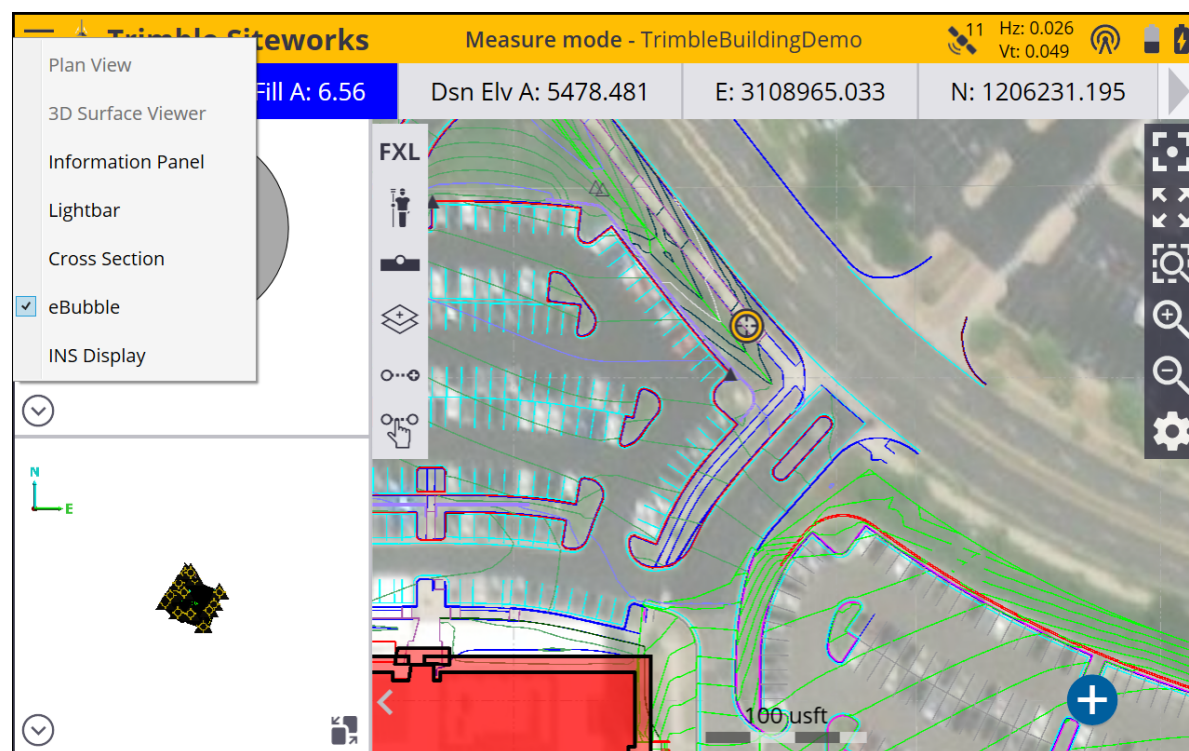
eBubble

- eBubble operation
- eBubble calibration
- eBubble settings

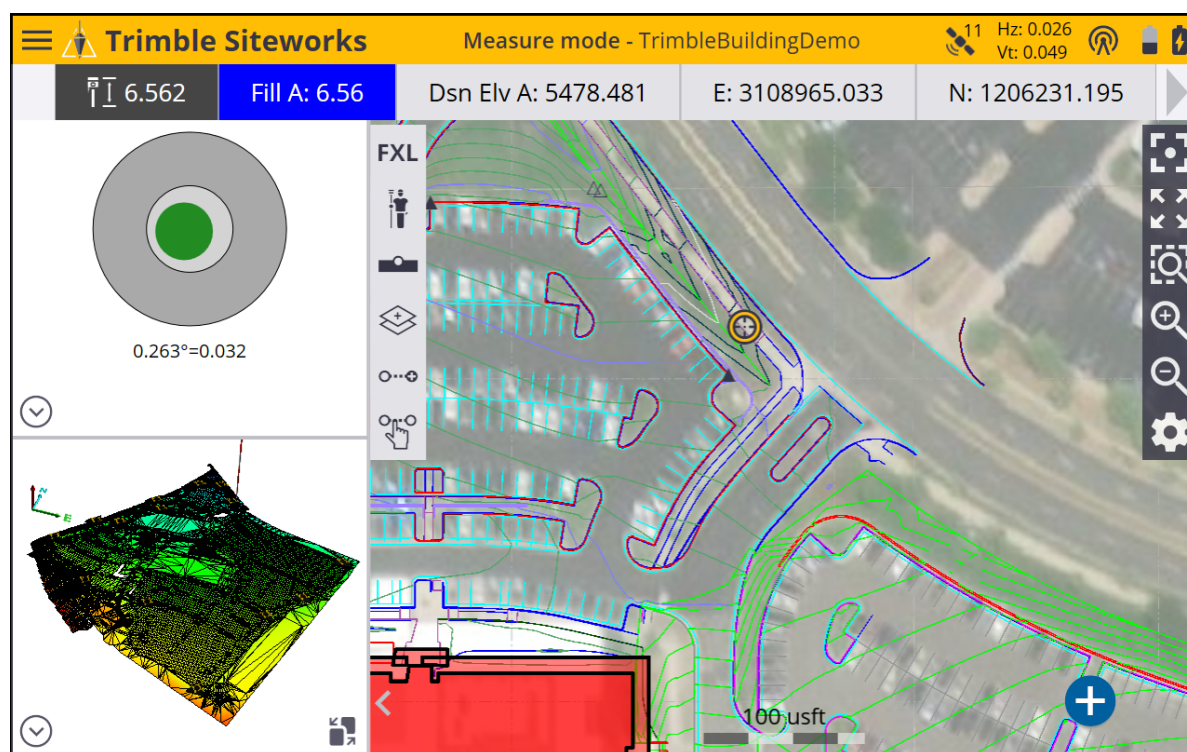
Siteworks software supports eBubble functionality for GNSS receivers that contain the appropriate tilt sensor hardware (currently the Trimble SPS986, R780, R10, R12, and R12i receivers). The eBubble is independent of Tilt Compensation, and is used to give a visual indication of when the receiver is level. It is similar to the level bubble on a survey rod, just now it can be displayed in Siteworks. The eBubble can also be used to trigger a measurement when the receiver is level or within a certain tolerance of level. When Tilt Compensation is active, the tilt of the survey rod and GNSS receiver is accounted for in the calculated position of the rod tip.


eBubble operation

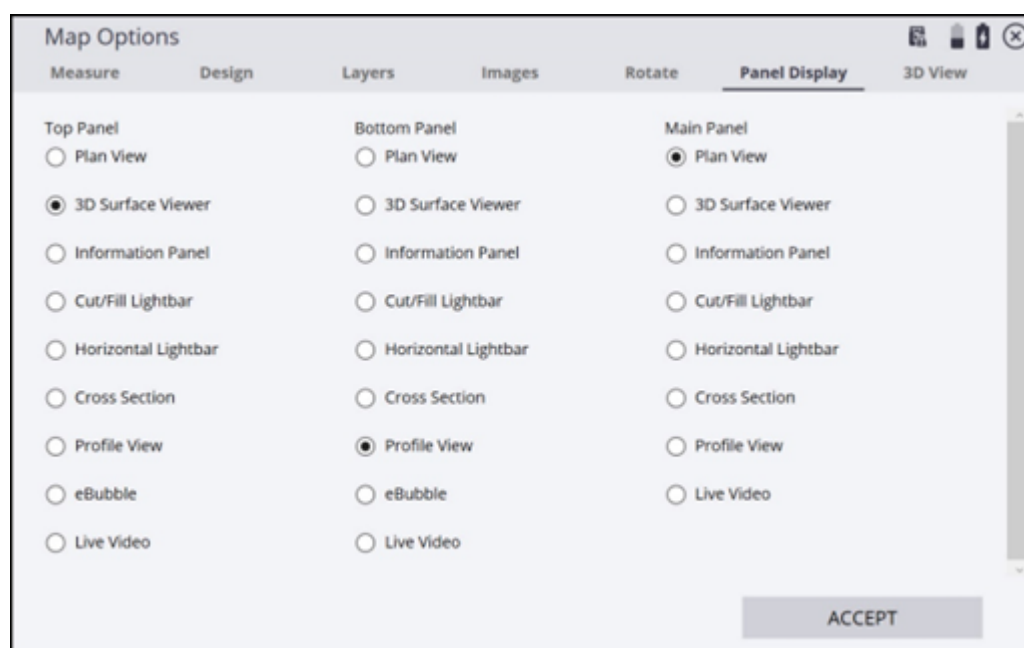
The eBubble is displayed in the top or bottom side panel. It is turned on by tapping on the down arrow  and selecting **eBubble**.



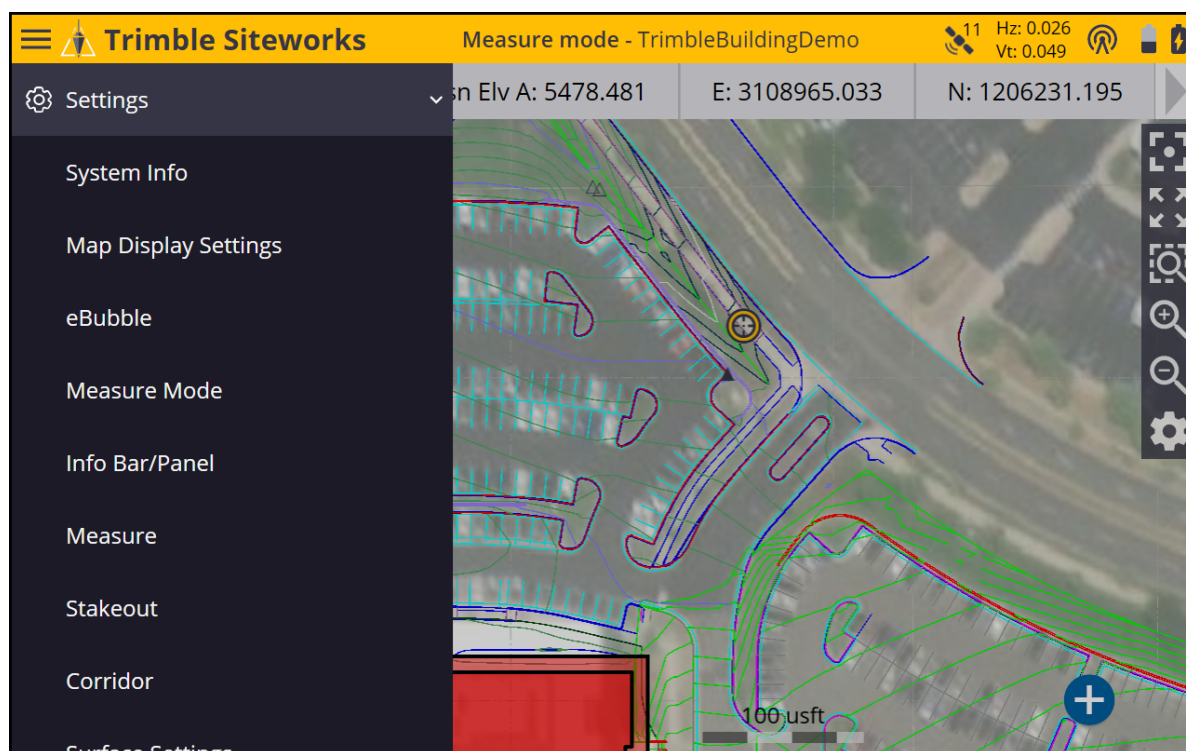
The eBubble is automatically available whenever a compatible receiver is connected to the Siteworks software. It shows the degrees of tilt in the lower left, and the tilt distance in site units (meters, international feet, US survey feet) in the lower right, calculated based on the current rod height. The bubble turns red when the tilt distance exceeds the tilt tolerance value input in the **eBubble Settings** screen. The eBubble can only be displayed in the side panels and not the main working panel.



The eBubble can also be turned on or off by going to the map display options (select the **Settings** icon ) and choosing eBubble under the **Panel Display** tab of the **Map Options** screen. Select the checkbox to display the eBubble.

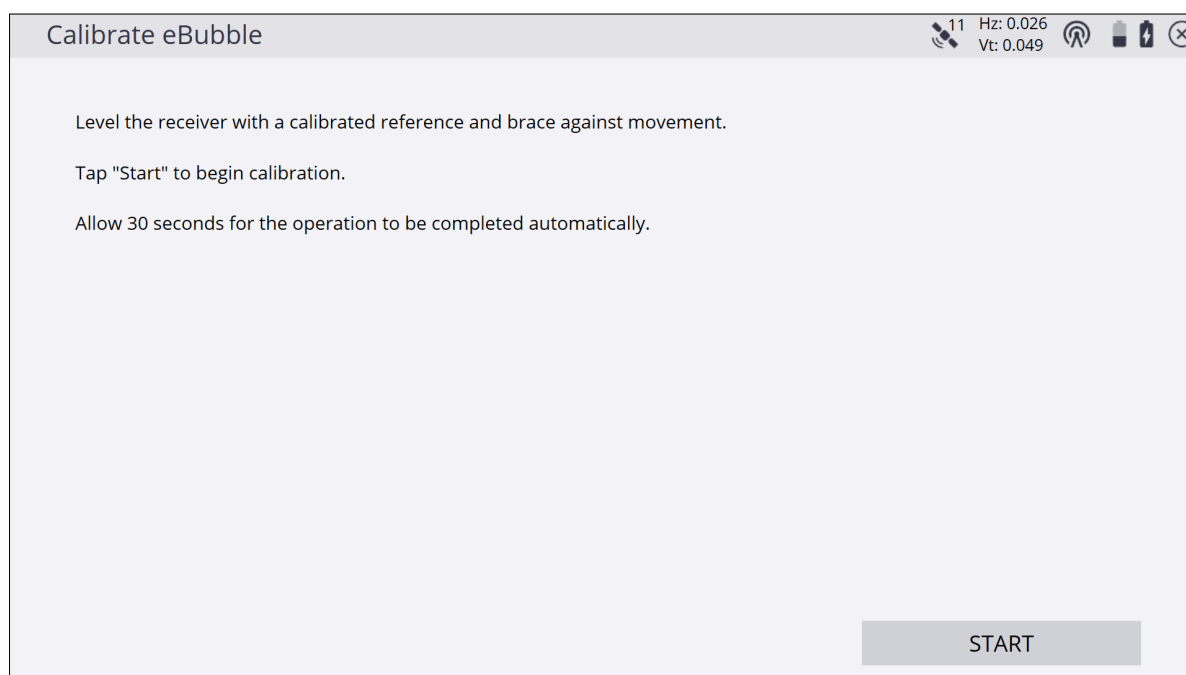


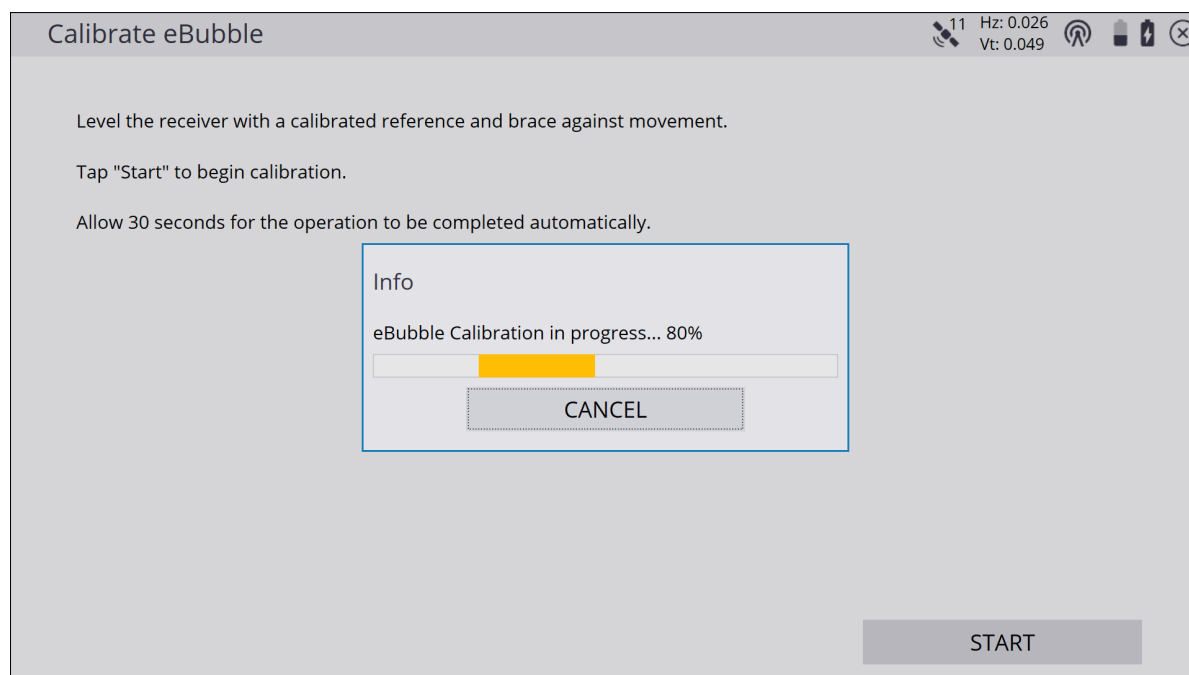
To access the eBubble settings, from the **Home** menu, select **Settings / eBubble**.



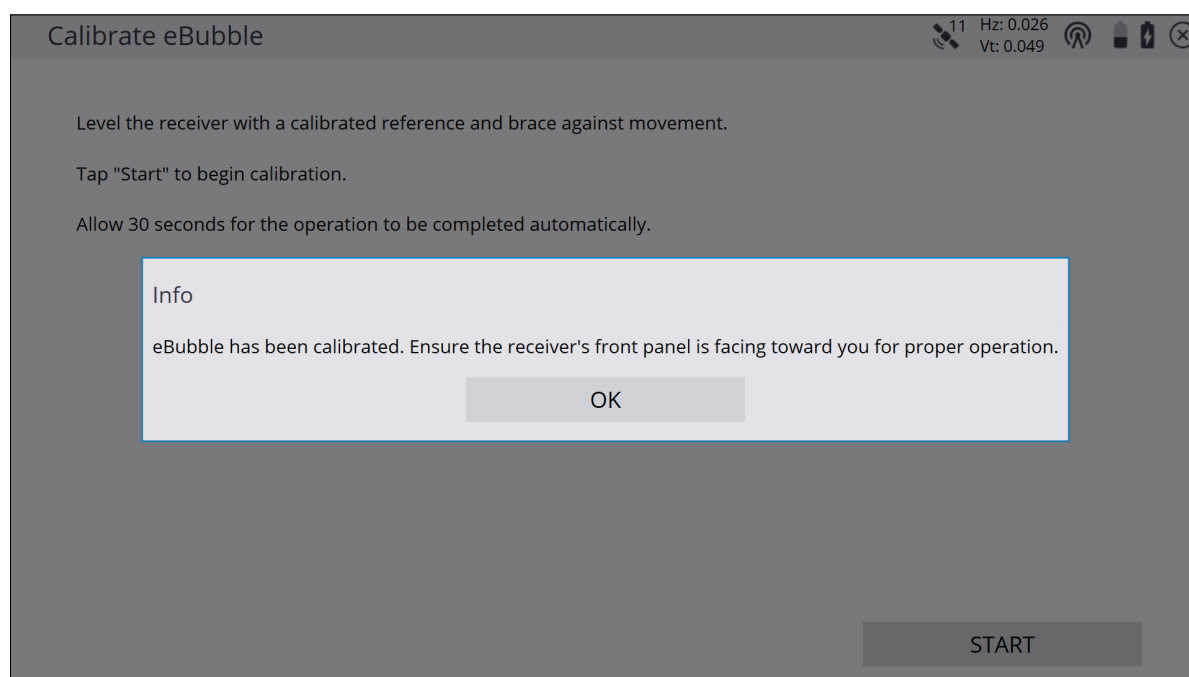
eBubble calibration

The first time an eBubble capable GNSS smart antenna is used, and every 30 days afterward, it needs to have its tilt sensors calibrated to use the eBubble. To perform a calibration, ensure that the receiver is level and plumb using a calibrated reference (for example on a tripod and calibrated and leveled tribrach) and tap the **Calibrate Tilt Sensor** button to begin the calibration. The receiver must have a clear view of the sky and a satellite lock while performing the calibration, as GNSS time is used to timestamp the calibration. A minimum of four satellites is necessary to be tracked during the calibration. If the receiver is moved significantly during calibration, the process will restart until it is completed without any motion or you cancel it.





After the calibration is complete, a message appears indicating the finished calibration. The receiver's front panel must be facing you for correct operation, as the eBubble's movements and display within Siteworks are oriented based on the receiver's front panel facing the operator. When mounting and using the receiver in vehicle mode, the front panel should be oriented towards the rear of the vehicle.



CAUTION – It is very important to have a well-calibrated eBubble. The accuracy of tilt information used to display the eBubble, and stored with measured points, is totally dependent on the calibration of the tilt sensors inside the GNSS receiver. Using a poorly-calibrated eBubble directly degrades the accuracy of the coordinates measured using the eBubble as a level reference. **Take great care when you are calibrating the eBubble to ensure the most accurate tilt information is available at all times.**

- **Bubble reference:** Calibrate the eBubble against a correctly calibrated physical bubble. The accuracy of the eBubble depends totally on the accuracy of the physical bubble used to calibrate it.
- **Pole stability:** When calibrating the eBubble, the pole the GNSS receiver is on should be as vertical and as stable as possible. In practice this means using at least a bipod to hold the pole as still as possible.
- **Pole straightness:** A bent pole affects the tilt measured by the sensors in the GNSS receiver. If you calibrate the eBubble using a bent pole and then change poles, the accuracy of points is affected. Likewise, if you calibrate using a straight pole and then change to a bent pole, the GNSS will not be plumb even though the eBubble will say it is, again affecting the accuracy of the measured points.
- **Abuse:** If the GNSS receiver suffers severe abuse such as a pole drop, you should recalibrate the eBubble.

eBubble settings

The **eBubble Settings** screen contains controls for the eBubble response, eBubble sensitivity, tilt tolerance, tilt warning, and performing an eBubble calibration:

eBubble Settings

11 Hz: 0.026 Vt: 0.049

eBubble response Medium

eBubble sensitivity Medium

Tilt tolerance 0.066 usft

☒ Enable tilt warning for measurements

0.533°=0.065

Calibration expires in 30d 0h 0m

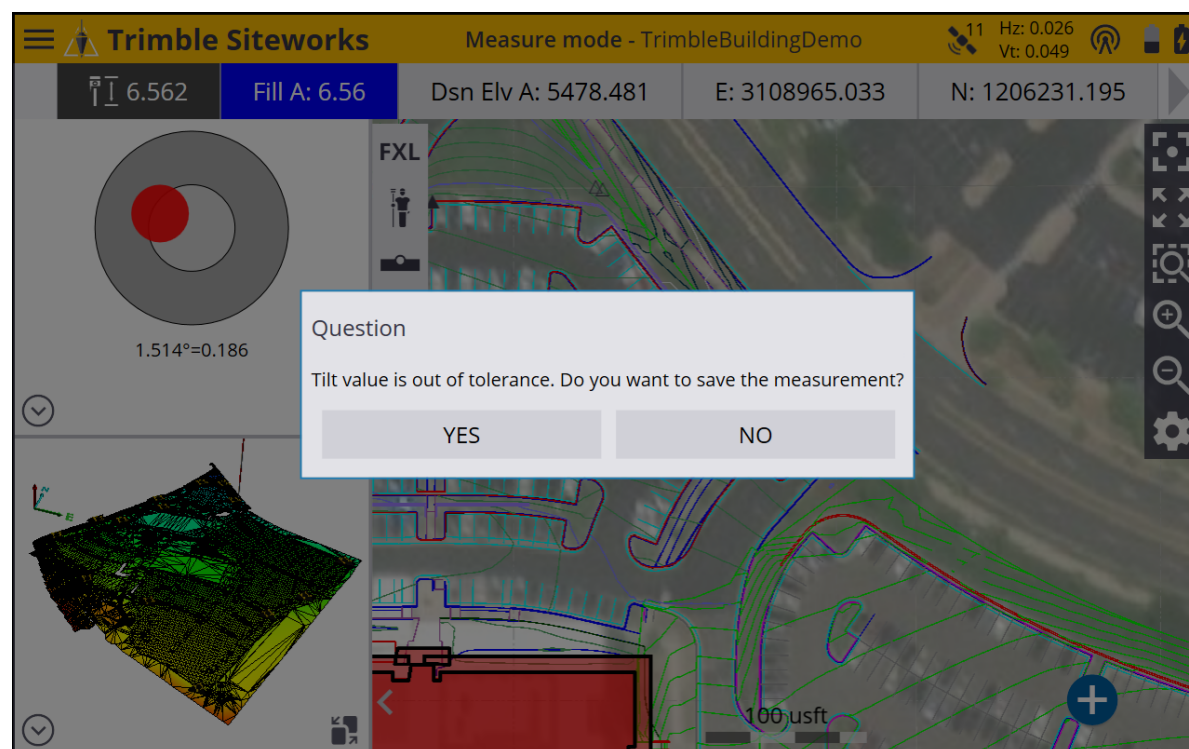
CALIBRATE TILT SENSOR

ACCEPT

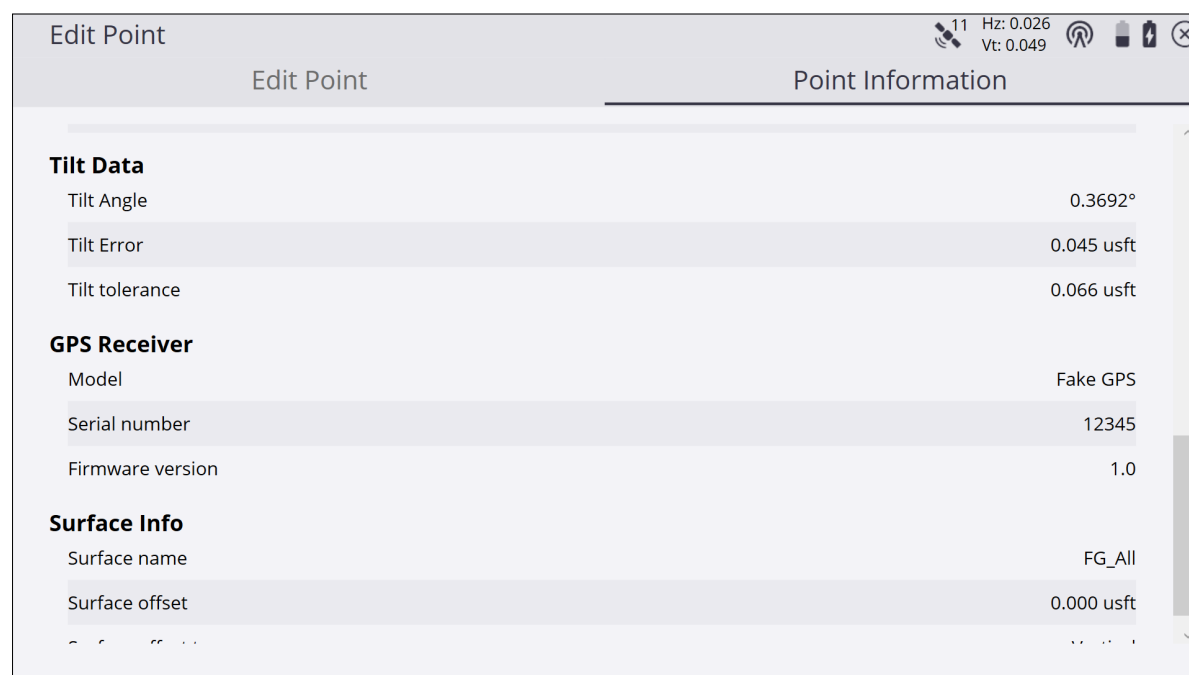
The **eBubble response** setting controls how quickly the bubble's position is updated on the screen, which affects its speed of movement.

The **eBubble sensitivity** setting controls how much the bubble moves on screen for a given change in angle. Select High to make the eBubble move a lot for a given change in angle, and Low to move the eBubble a little for a given change in angle. Changing this sensitivity value also affects the diameter of the Tilt Tolerance display of the inner ring of the eBubble display. The inner ring of the eBubble display represents the tilt value where the calculated tilt distance will exceed the Tilt Tolerance amount. The eBubble will turn red when the bubble touches or extends beyond this inner ring. The diameter of the inner ring changes depending on the current rod height, eBubble sensitivity setting, and the Tilt Tolerance value.

The **Tilt tolerance** setting is the value at which the eBubble display will turn red, and a warning will appear if a measurement is taken while the tilt distance is greater than the Tilt tolerance value. Select the **Enable tilt warning for measurements** checkbox to activate a warning message if a measurement is made and the tilt distance is greater than the Tilt Tolerance value.



Tilt data are stored with each point measured with a compatible receiver and can be viewed by tapping-and-holding on a point and selecting **Point Information**, or by viewing point information via the Point Manager. The Tilt Angle, Tilt Error, and Tilt Tolerance values are stored. These tilt values are included in exported CSV data if the **Include QA data** option is selected.



To use the eBubble to take a measurement when the receiver is level, select **Walking Mode** as the measure mode, and then select **Measure When Level** in the **Record mode** field.

The image shows a 'Walking Mode Settings' dialog box. At the top right, there is a status bar with icons for signal strength, battery, and a close button, along with text: '16 Hz: 0.017' and 'Vt: 0.034'. The settings are as follows:

Setting	Value
Using Quick Release	Yes
Vertical height	6.562 usft
Record mode	Measure When Level
Tilt tolerance	0.080 usft
Time interval (seconds)	1

An 'ACCEPT' button is located at the bottom right of the dialog.

A measurement is automatically triggered when the GNSS receiver's tilt tolerance value is less than the entered **Tilt tolerance** for the **Time interval** field. In other words, the receiver must be held level, within the **Tilt tolerance** value for the number of seconds in the **Time Interval** field. In the example in the above screen, this would be within 0.080 usft for 1 second.

Measuring with a Total Station

- Connecting to a total station
- Disconnecting from a total station
- Leveling the total station
- Establishing the station
- Arbitrary location
- Setting up on a known point
- Reading station setup data from the total station
- Using the last station setup
- Completing a station establishment setup where the height of the setup point has not been determined
- Measuring a new control point or remeasuring a control point with a total station
- Outputting data through the COM port
- Computing the total station scale factor

To perform measurement or stakeout tasks, you need the Siteworks software running on a controller that is connected to a positioning device. This chapter explains how to set up and use SPS Series total stations with the Siteworks software. Many of these controls will be the same when connecting to an SX10 or SX12 scanning total station. See [Using the SX12 Scanning Total Station in Siteworks, page 218](#) for more information on working with an SX12 scanning total station.

Starting with Siteworks version 1.30, total station support is available on Android operating systems.

Connecting to a total station

When you start the software the most common connection to the total station is through a radio. The connection can also be made through Bluetooth or a cable although both these methods require you to be near the total station. Connecting to an SX12 or SX10 scanning total station can also be made via a Wi-Fi connection. See [Using the SX12 Scanning Total Station in Siteworks, page 218](#) for information about connecting via Wi-Fi. When the connection is made, the **Level Compensator** screen (see [Leveling the total station, page 184](#)) appears.

The **Connect to Total Station** screen either automatically appears during the project startup process if a total station was the last used positioning device, or can be accessed via **Home** menu / **Project Setup** / **Connect Device** and selecting **Total Station**. This opens the **Connect to Total station** menu where you can select the connection type.

The screenshot shows a software window titled "Connect to Total Station". Inside, there are three dropdown menus. The first is labeled "Brand" and has "Trimble" selected. The second is labeled "Model" and has "SPS Series" selected. The third is labeled "Connection type" and has a list of options: "Radio", "Bluetooth", "Cable", and "Radio" (the second "Radio" is highlighted in blue). At the bottom right of the window is a button labeled "SELECT".

If you are setting up a radio connection for the first time:

1. Select Trimble as a Brand.
2. Select the model of total station you are using. The most common is the SPS series.
3. Select Radio as the connection type.
4. Ensure the total station is turned on and configured for a radio connection. The screen of the total station should say waiting for connection.
5. Select the Radio channel and Network ID that are displayed on the total station screen.
6. Tap **ACCEPT** and follow the instructions that appear on the screen.

If you are using Bluetooth wireless technology to connect to the total station:

1. Select Trimble as a Brand.
2. Select the model of total station you are using. The most common is the SPS series.
3. Select Bluetooth as the connection type.
4. Ensure the total station is on and the Bluetooth is turned on in the total station. The screen of the total station should say waiting for connection.

5. Enter the PIN code set in the total station. This is typically 0000.
6. Tap **ACCEPT** and follow the instructions that appear on the screen.

If you leave the controller in GPS mode, it cannot find the connection even if it is connected directly to a total station.

To connect to the instrument via cable:

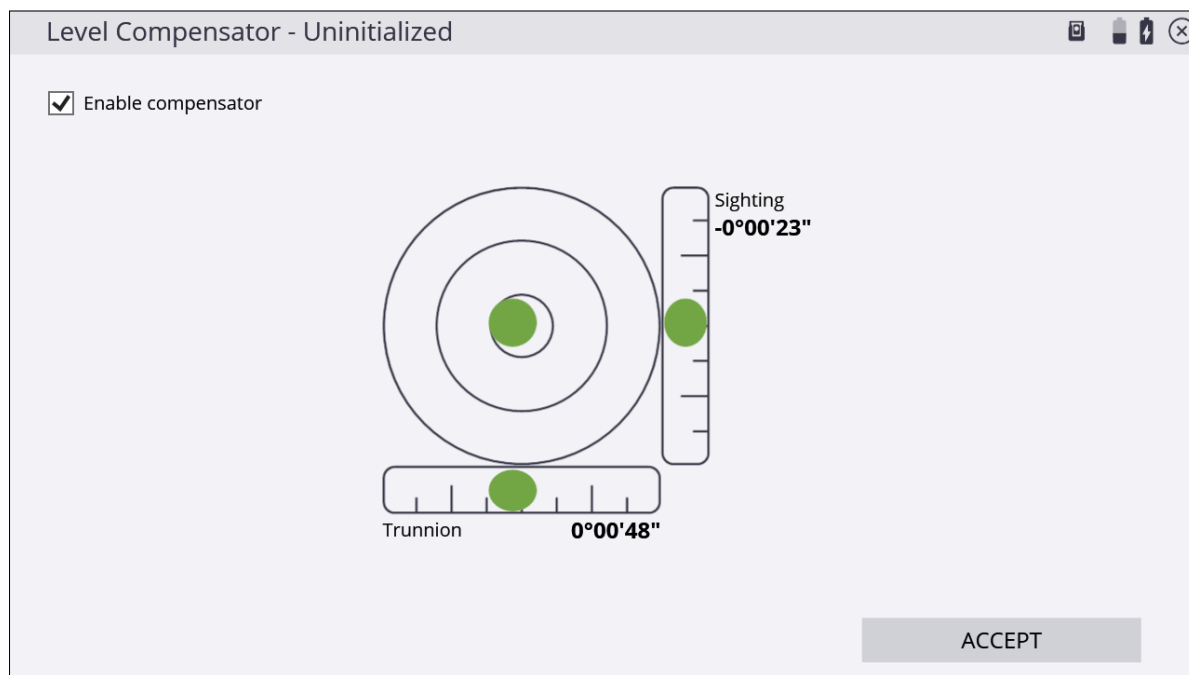
1. Select Trimble as a Brand.
2. Select the model of total station you are using. The most common is the SPS series.
3. Select Cable as the connection type.
4. Tap **ACCEPT** and follow the instructions that appear on the screen.

Disconnecting from a total station

After successfully connecting to the total station, a disconnect button appears in the **Home** menu / **Project Setup**. Tapping this button disconnects the controller from the total station and places the total station into standby mode, where it can be picked up by a GCS900 or Earthworks machine control system or be re-connected to in Siteworks. This feature is beneficial if you are using machine control systems, as you no longer need to travel back to the instrument to physically power cycle the instrument or unplug the battery to put the instrument into standby mode so a GCS900 or Earthworks system can connect.

Leveling the total station

The compensator inside the total station provides dual-axis correction for any misleveling of the instrument during operation, for a working range of up to 6' of arc. The display enables you to level the total station accurately using the foot-screws on the tribrach. If the total station is too far off level, no level data will appear in this screen. To fix this, get the bubble on the total station tribrach approximately level:



To level the total station:

1. Align the front face of the total station with two tribrach foot-screws.
2. Adjust the horizontal bubble in the display using those same two foot-screws.
3. Adjust the vertical bubble using the third foot-screw.
4. Once level, tap **ACCEPT**.

You can disable the compensator, however, **only do this in extreme working conditions** such as when working:

- near a piling rig, vibratory compactor, or other source of extreme ground vibration that continuously affects the compensation effect on the total station.
- on a mobile platform where the level is continuously changing, but where all measurements are needed in the reference frame of the platform itself, for example on a marine vessel or oil platform.
- in extremely windy conditions where wind buffet on the total station is significant and continuously affects the compensation of the total station.

If the compensator is switched off, the total station stops correcting for instrument mislevel. In these situations, watch and adjust the level on a regular basis. At this point, Trimble assumes that the total station is set up accurately over a known point (see [Setting up on a known point, page 192](#)) or that you have set it up in a convenient location, and will establish its position via a resection using the [Arbitrary location](#) (see [Arbitrary location, page 186](#)).

Establishing the station

You must know the total station position and orientation if the total station is to be used for site measurement or stakeout operations where the positions computed are related to a project coordinate system. There are two methods of establishing the position and orientation of the total station:

- [Arbitrary location](#) also known as *free station* or *resection* (see [Arbitrary location, page 186](#))
- [Setting up on a known point](#) (see [Setting up on a known point, page 192](#))

Once the station setup has been established, the total station can be used for measurement or stakeout operations.

If you have not yet established the position of the total station and you select a measurement or stakeout function, the software automatically forces you into the instrument setup process when connected to a total station. If you have not entered any control point data for the site, the station establishment process only allows you to set up at a manually entered coordinate location and orientation of the angle system to 0.000 in a chosen direction. This method is acceptable only if you are measuring a new site that has not been measured before and if you are not trying to measure or stake anything from a loaded design. In most cases, you should have control points available.

You can take angle-only measurements during a station setup, both when the total station is set up on an arbitrary location or on a known control point. Using the angle-only option will not calculate any distance errors in the setup table. When performing an angle-only setup on an arbitrary location, you must shoot a minimum of three control points. Only two control points are necessary in an arbitrary setup when a distance measurement is taken.

Arbitrary location

The arbitrary location setup enables you to set up the total station at a location that is convenient for the operation to be carried out (and not over a known point). It measures the angle and distance to two or more known points to determine the position and orientation of the total station.

- 1. In the **Home** menu, select **Project Setup / Total Station Setup**. If you just connected to the total station, the software prompts you for the station establishment method. Select the **Set up at an arbitrary location** option:

Total Station Setup

☒ Set up at an arbitrary location

☐ Set up on a known control point

☐ Measure Control Network

☐ Measure Traverse

☐ Read station setup data from instrument

ACCEPT

- 2. Add at least two control points. Tap **ADD POINT**:

Unknown Station Setup

Use 'ADD POINT' to select a control point to start station setup.

ADD POINT


SETTINGS

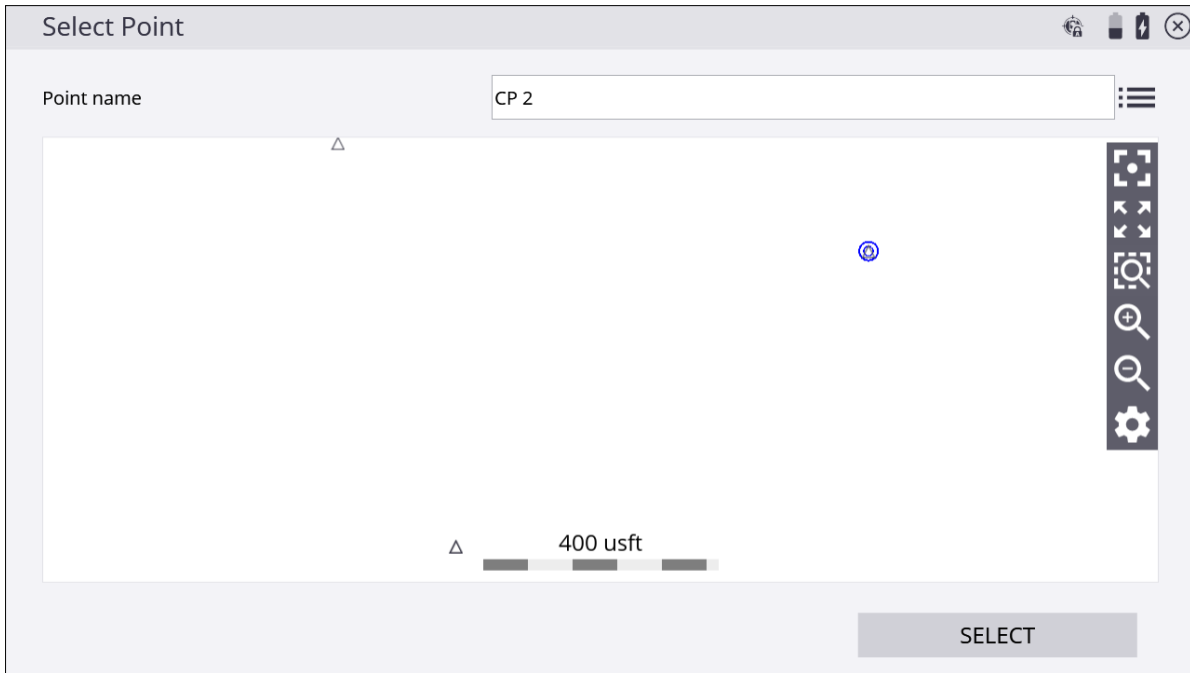
REPORT

☐ Overwrite instrument elevation with benchmark measurement

Point Name	HA Error	HD Error	VD Error	Delta N	Delta E
------------	----------	----------	----------	---------	---------

ACCEPT

3. Select a point on the map by tapping directly on it and entering the name into the text box, or from the list, by tapping  on the upper right side and then tap **ACCEPT**:



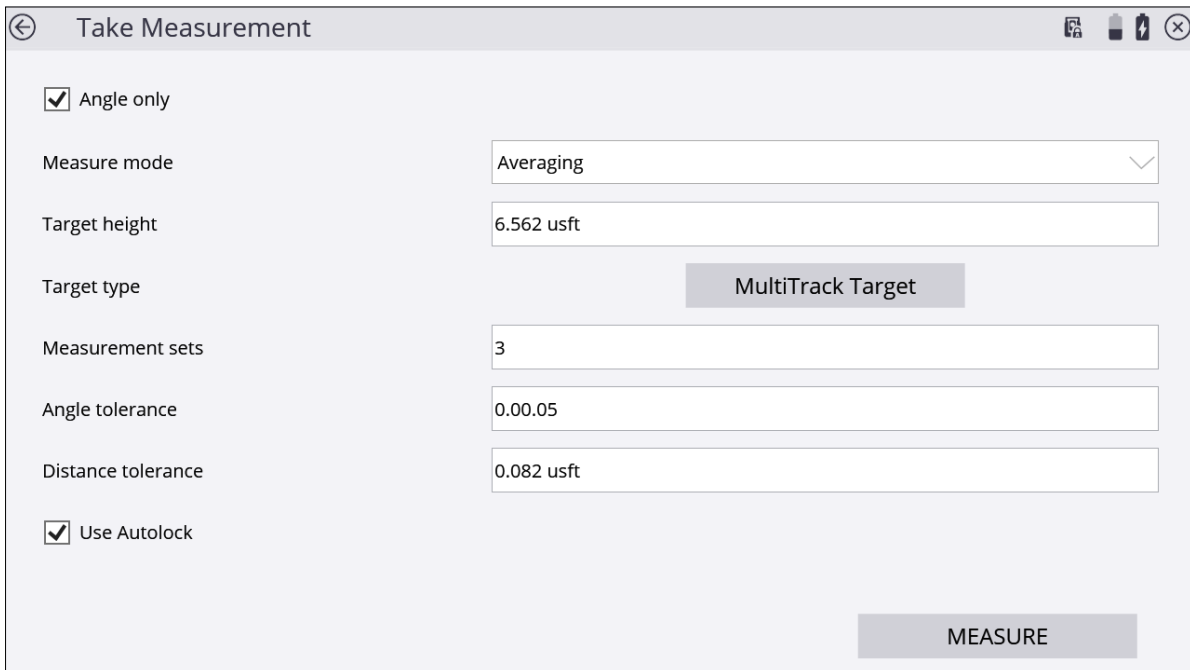
Select Point

Point name CP 2

400 usft

SELECT

4. Configure your measurement settings by selecting the measurement mode (Standing, Averaging, DR, DR Target, or DR Averaging), prism target type and height (in Standing and Averaging modes), DR options (in DR, DR Target, or DR Averaging modes), measurement sets and tolerances (in Averaging and DR Averaging modes), and whether Angle only and/or Autolock (for prism targets) measurements should be used:



Take Measurement

☒ Angle only

Measure mode Averaging

Target height 6.562 usft

Target type MultiTrack Target

Measurement sets 3

Angle tolerance 0.00.05

Distance tolerance 0.082 usft

☒ Use Autolock

MEASURE

5. After the measurements are complete, the **Station Setup** table will indicate if the setup is in or out of tolerance:

Unknown Station Setup

✓

Setup error is in tolerance.
HA: 0°00'01" HD: 0.042 Delta Z: 0.021

ADD POINT

SETTINGS

REPORT

☐

Overwrite instrument elevation with benchmark measurement

Point Name	HA Error	HD Error	VD Error	Delta N	Delta E
<input checked="" type="checkbox"/> CONT 2	RefPt	<input checked="" type="checkbox"/> 0.042	<input checked="" type="checkbox"/> -0.021	0.037	0.019
<input checked="" type="checkbox"/> CONT 1	-0°00'01"	<input checked="" type="checkbox"/> 0.042	<input checked="" type="checkbox"/> 0.021	-0.037	-0.019

ACCEPT

6. Tap **Settings** to adjust the setup tolerances for horizontal and vertical distances and angle tolerance:

TS Setup Tolerances

Horizontal tolerance

0.082 usft

Vertical tolerance

0.082 usft

Angle tolerance

0.00.05

ACCEPT

7. Tapping **Report** gives more detailed information about the setup quality of the station:

TS Setup Report

✓

Setup error is in tolerance.

Number of control points measured2

Average errors

HA0°00'01"

HD0.042 usft

Delta N0.037 usft

Delta E0.019 usft

Delta Z0.021 usft

Instrument location

Northing100.010 usft

Easting300.005 usft

ACCEPT

8. To change the instrument elevation by shooting in a benchmark point, select the **Overwrite instrument elevation with benchmark measurement** checkbox. At the end of the measurement process, you are prompted to shoot a benchmark point from which the station elevation is calculated:

Measure Benchmark

Enter the benchmark elevation or select it from a 1D or 3D control point.

Elevation

Measure mode

Standing

Target height

6.562 usft

Target type

MultiTrack Target

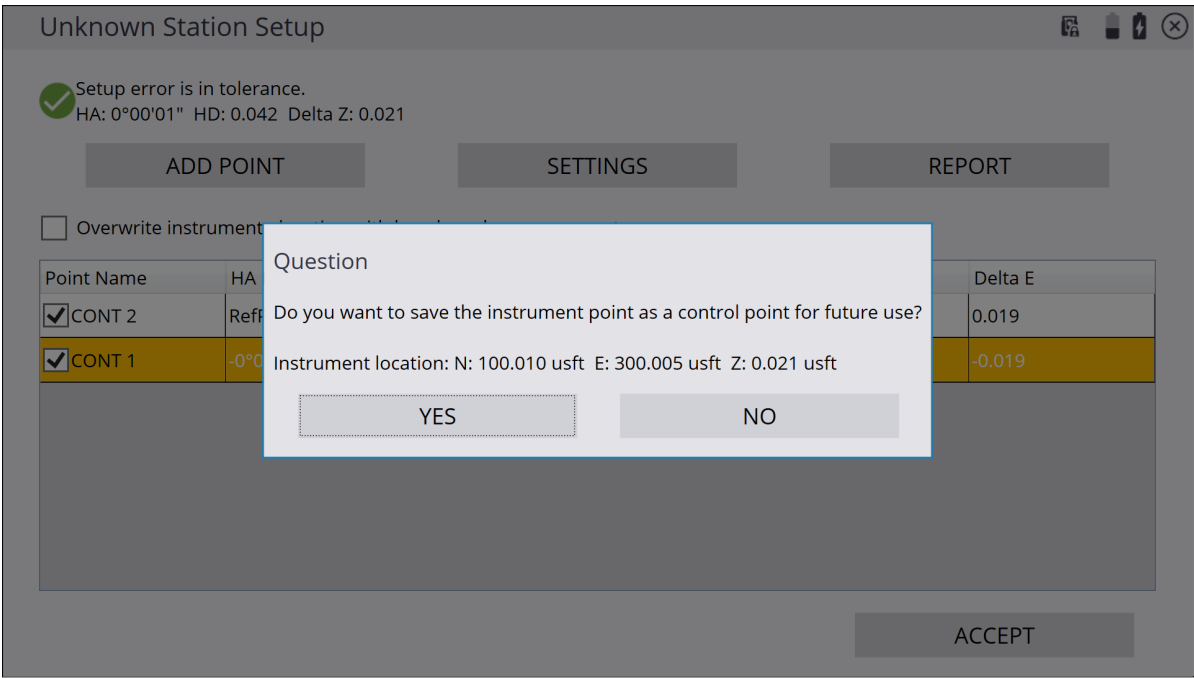
☒ Use Autolock

MEASURE

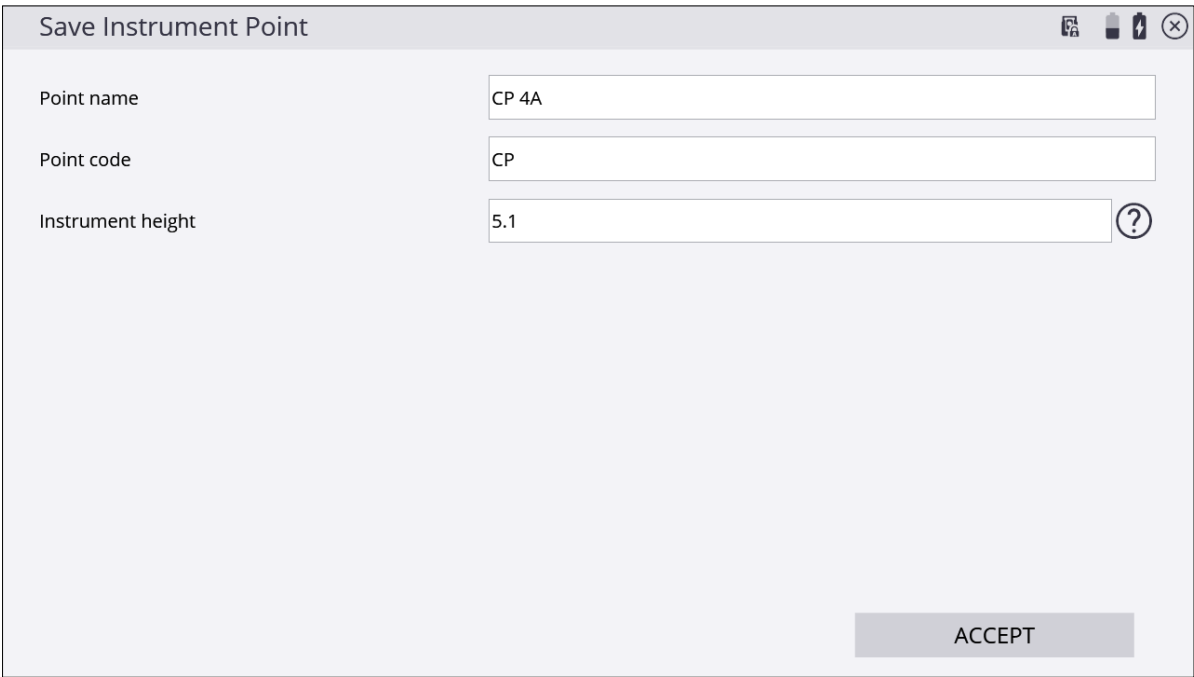
NOTE – The station elevation is calculated relative to this benchmark elevation; it does not simply set the instrument elevation to the benchmark elevation.

9. Tap **ACCEPT** to complete the arbitrary instrument location setup and view the coordinates of the instrument setup.

A prompt appears asking if you want to save the instrument location as a control point. Tap **YES** to store the instrument location as a control point, and **NO** to ignore it:



If you tap **YES**, you are prompted to enter a point name and an instrument height:



The instrument height can be measured in two ways:

- a vertical height from the ground surface to the center cross-hair mark on the side of the instrument
- the slope height, measured directly from the control point to the bottom notch on the side of the instrument.

Selecting the slope height is generally easier to perform more accurately in the field, due to potential height variations between the control point hub and the surrounding ground surface and the ability to get a tape measure to the notch. In version 1.60 and earlier, the default height method was always vertical. Version 1.70 and later will default to slope height as the height method. Tapping the



on the **Instrument height** field opens the following screen, where you can select the measurement method:

Enter Instrument Height

Instrument slope height

0.000 usft

Measurement method

Slope height

ACCEPT

Enter Instrument Height

Instrument vertical height

0.000 usft

Measurement method


Vertical height

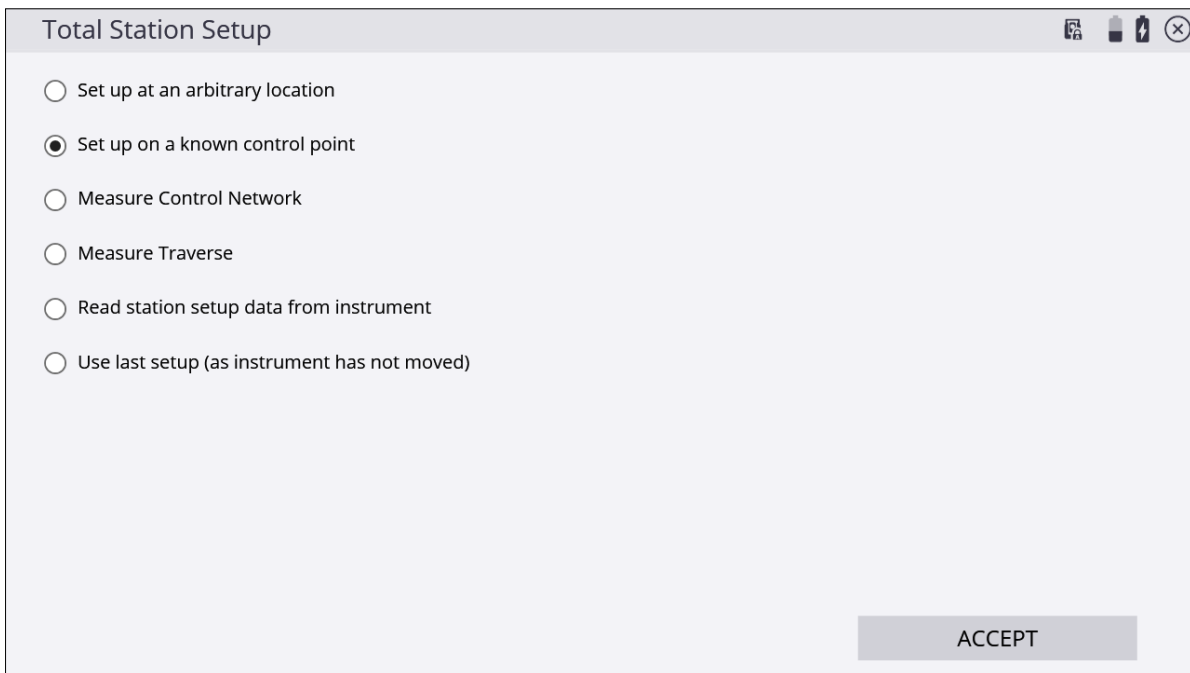
ACCEPT

NOTE – If a slope height is entered, the vertical height is automatically calculated by adding .156 m (.511 foot) to the slope height. The updated vertical is displayed as the instrument height in the **Save Instrument Point** screen.

Setting up on a known point

This enables you to set up the total station over a known control point and then measure to one or more reference backsight control points to establish its position and orientation on the jobsite. In most cases, a single reference backsight control point may be all that is required. In other cases, where the accuracy of the work is higher, measuring more than one reference backsight control point can provide better control over the orientation of the total station and a further check that the control point at the total station position or any of the measured reference control point locations has not moved. You can follow similar steps to those used in the arbitrary location method of station establishment. Select from one of the following options:


1. From the **Home** menu, select **Project Setup / Connect Device** and tap . If you have just connected to the total station, the software prompts you to select the station establishment method. Select the **Set up on a known control point** option and then click **ACCEPT**.

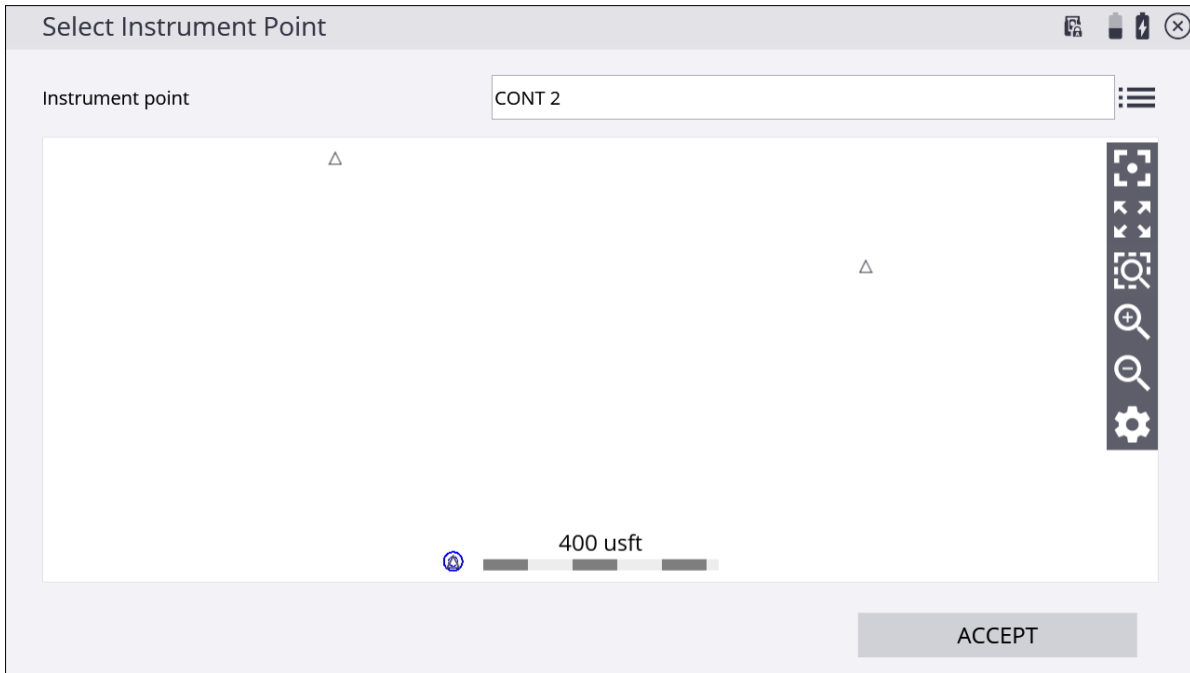


Total Station Setup

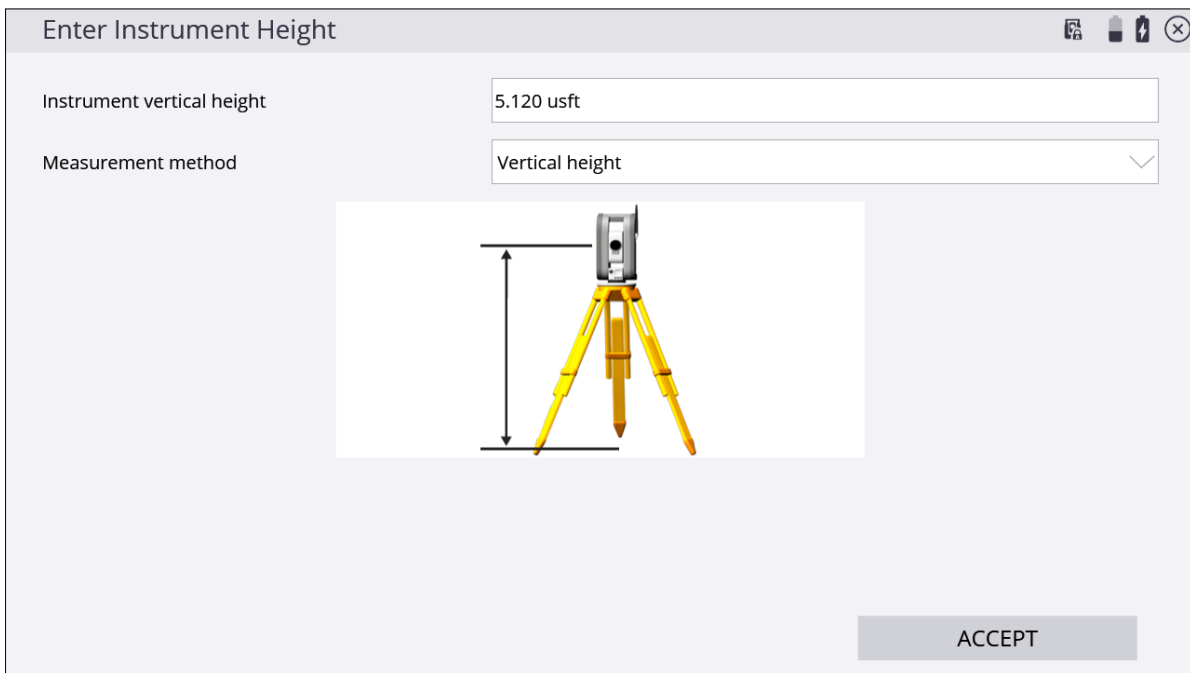
- ☐ Set up at an arbitrary location
- ☒ Set up on a known control point
- ☐ Measure Control Network
- ☐ Measure Traverse
- ☐ Read station setup data from instrument
- ☐ Use last setup (as instrument has not moved)

ACCEPT

2. Select the instrument's location point by tapping directly on it in the map screen, typing the name into the text box, or from the list, by tapping  in the upper right side and then tapping **ACCEPT**:



3. Enter the instrument height:



The instrument height can be measured in two ways:

- a vertical height from the ground surface to the center cross-hair mark on the side of the instrument.
- the slope height measured directly from the control point to the bottom notch on the side of the instrument.

Selecting the slope height is generally easier to perform more accurately in the field, due to potential height variations between the control point hub and the surrounding ground surface. In version 1.60 and earlier, the

default height method was always vertical. Version 1.70 and later will default to slope height as the height method.

NOTE – If a slope height is entered, the vertical height is automatically calculated by adding .156 m (.511 feet) to the slope height; the updated vertical height is then displayed as the instrument height in the **Save Instrument Point** window.

4. Add at least one control point to backsight to. Tap **ADD POINT**.

Known Station Setup

Use 'ADD POINT' to select a control point to start station setup.

ADD POINT


SETTINGS

REPORT

☐ Overwrite instrument elevation with benchmark measurement

Point Name	HA Error	HD Error	VD Error	Delta N	Delta E
------------	----------	----------	----------	---------	---------


ACCEPT


5. Select a point on the map by tapping directly on it and entering the name into the text box, or from the list, by tapping  in the upper right side and then tapping **SELECT**:


Select Point

Point name

CP 3







900 usft

SELECT

6. Configure your measurement settings by selecting the measurement mode (Standing, Averaging, DR, DR Target, or DR Averaging), prism target type and height (in Standing and Averaging modes), DR options (in DR, DR Target, or DR Averaging modes), measurement sets and tolerances (in Averaging and DR Averaging modes), and whether Angle only and/or Autolock (for prism targets) measurements should be used:

Take Measurement

☒ Angle only

Measure mode

Averaging

Target height

6.562 usft

Target type

MultiTrack Target

Measurement sets

3

Angle tolerance

0.00.05

Distance tolerance

0.082 usft

☒ Use Autolock

MEASURE

After the measurements are complete, the **Station Setup** table indicates if the setup is in or out of tolerance:

Known Station Setup

☒ Setup error is in tolerance.
HA: 0°00'00" HD: 0.016 Delta Z: 0.004

ADD POINT

SETTINGS

REPORT

☐ Overwrite instrument elevation with benchmark measurement

Point Name	HA Error	HD Error	VD Error	Delta N	Delta E
<input checked="" type="checkbox"/> CONT 3	RefPt	0.016	-0.004	-0.011	0.011

ACCEPT

7. Tap **Settings** to adjust the setup tolerances for horizontal and vertical distances and angle tolerance:

TS Setup Tolerances

Horizontal tolerance

0.082 usft

Vertical tolerance

0.082 usft

Angle tolerance

0.00.05

ACCEPT

8. Tap **Report** to get more detailed information about the setup quality of the station:

TS Setup Report

✔ Setup error is in tolerance.

Number of control points measured

1

Maximum errors

HA

0°00'00"

HD

0.016 usft

Delta N

0.011 usft

Delta E

0.011 usft

Delta Z

0.004 usft

Instrument point: CONT 1

ACCEPT

9. To change the instrument elevation by shooting in a benchmark point, select the **Overwrite instrument elevation with benchmark measurement** checkbox. At the end of the measurement process, you are prompted to shoot a benchmark point from which the station elevation will be calculated:

Measure Benchmark

Enter the benchmark elevation or select it from a 1D or 3D control point.

Elevation

Measure mode

Target height

Target type

☒ Use Autolock

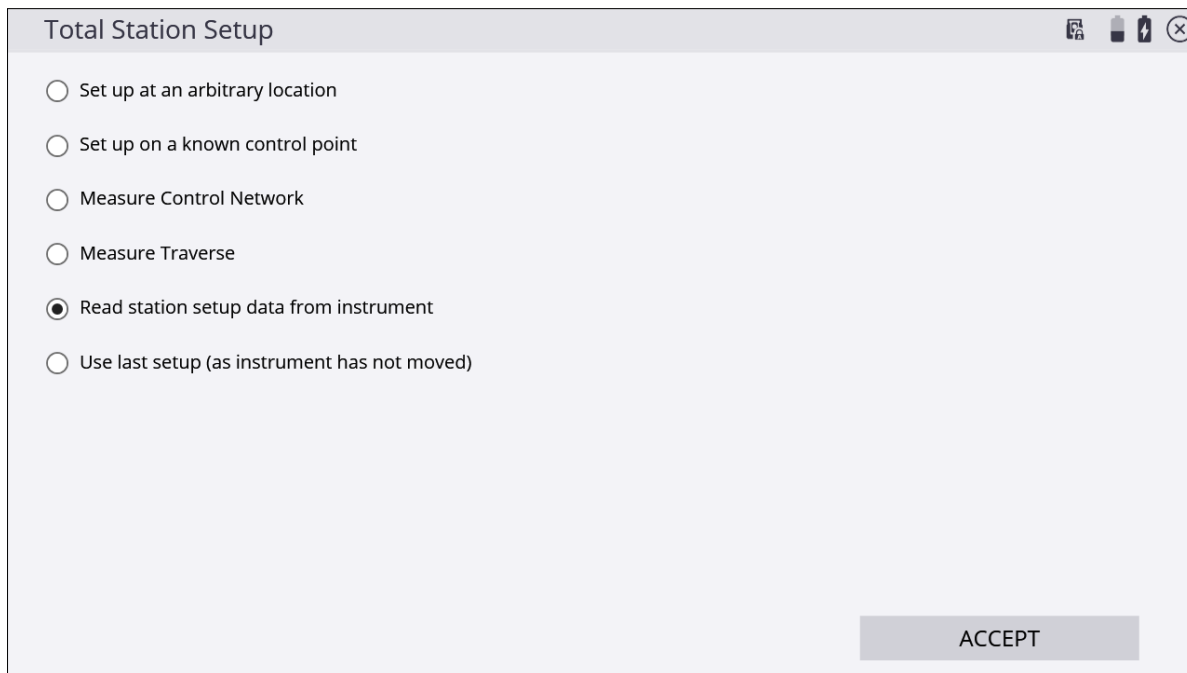
MEASURE

NOTE – The station elevation is calculated relative to this benchmark elevation; it does not simply set the instrument elevation to the benchmark elevation.

Reading station setup data from the total station

After you have performed a station establishment, the total station stores the information in its memory so that other controllers running the software can access it. Subsequent users can save time by simply retrieving the station setup information from the total station's memory without resetting up at an arbitrary location or on a known control point.

Only one controller can connect to a total station at one time. The stored setup information can be used when a different controller that set up the total station wishes to connect, or after the total station has been released from Machine Control mode. To retrieve this setup information, connect to the instrument and select **Read station setup data from instrument** in the **Total Station Setup** screen:



The screenshot shows the 'Total Station Setup' window. It has a title bar with a close button. The window contains a list of six radio button options. The third option, 'Read station setup data from instrument', is selected with a filled circle. The other options are 'Set up at an arbitrary location', 'Set up on a known control point', 'Measure Control Network', 'Measure Traverse', and 'Use last setup (as instrument has not moved)'. At the bottom right, there is an 'ACCEPT' button.

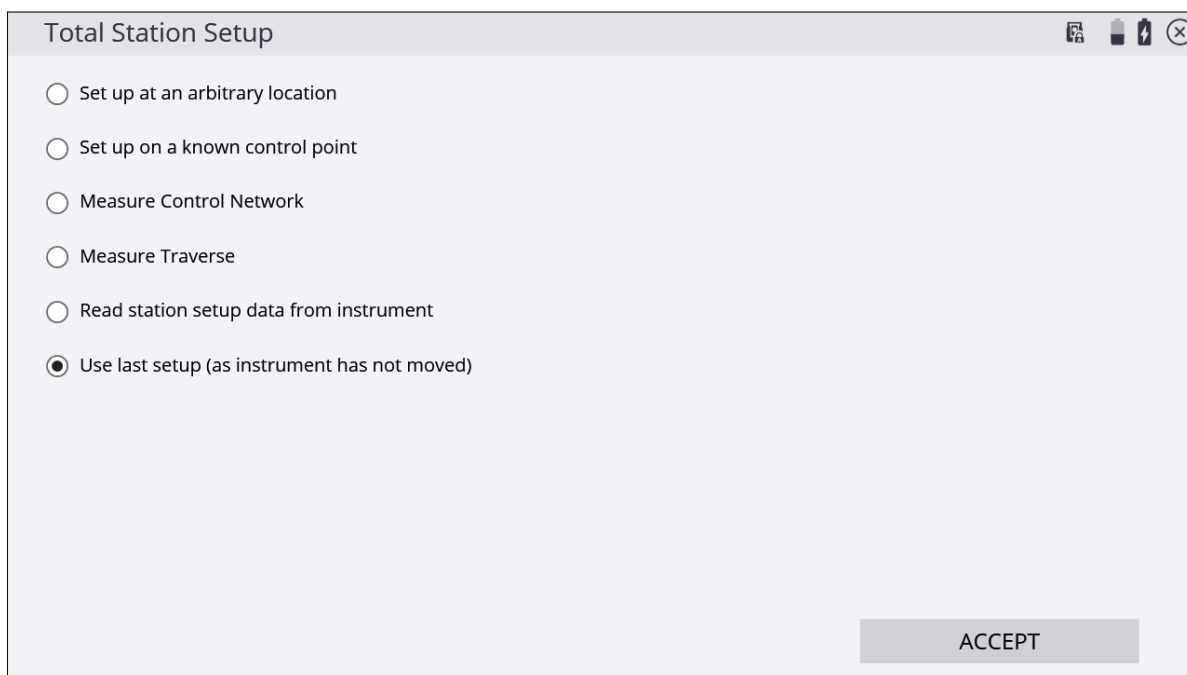
Total Station Setup

- ☐ Set up at an arbitrary location
- ☐ Set up on a known control point
- ☒ Read station setup data from instrument
- ☐ Measure Control Network
- ☐ Measure Traverse
- ☐ Use last setup (as instrument has not moved)

ACCEPT

Using the last station setup

If the total station has not moved since being setup last, you can connect to the instrument and select **Use last setup**. This uses the same station setup parameters from the last time the instrument was setup. This method is useful for performing setups after the total station has been powered down or the battery replaced, but the instrument has not moved off the tripod.



This screenshot is similar to the previous one, showing the 'Total Station Setup' window. In this instance, the sixth option, 'Use last setup (as instrument has not moved)', is selected with a filled circle. The other options and the 'ACCEPT' button remain the same.

Total Station Setup

- ☐ Set up at an arbitrary location
- ☐ Set up on a known control point
- ☐ Measure Control Network
- ☐ Measure Traverse
- ☐ Read station setup data from instrument
- ☒ Use last setup (as instrument has not moved)

ACCEPT

Completing a station establishment setup where the height of the setup point has not been determined

If the height of the total station has not been established at the end of the station establishment process, the software prompts you to either enter a known height for the setup point or to a height from a known benchmark location defined as a 1D or 3D point.

Instrument Elevation

The elevation of the instrument cannot be determined.

☒ Measure a benchmark

☐ Enter elevation of the instrument point

Instrument point's elev.

ACCEPT

This occurs when:

- setting up at an arbitrary location and the reference backsight control points measured were all 2D control points.
- setting up on a known point and the known point and reference backsight control points selected were all defined as 2D control points.

The benchmark point is measured in the same way as any other control point. It is used in combination with the target height and instrument height to determine the setup point elevation.

Measure Benchmark

Enter the benchmark elevation or select it from a 1D or 3D control point.

Elevation

Measure mode

Target height

Target type

☒ Use Autolock

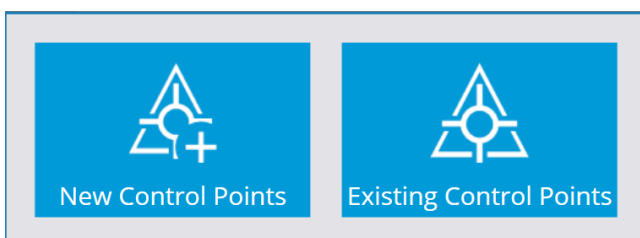
MEASURE

Measuring a new control point or remeasuring a control point with a total station

Total stations require more control points around the project because of their line-of-sight dependence; therefore, you may need to set and measure additional control points throughout the site.

NOTE – The measure mode (Standing, Averaging, DR, DR Target, DR Averaging) selected before entering the Measure Control Point command is the mode that is used to measure the control point. Ensure the correct mode is selected before entering the measure control point command. For the highest accuracies, it is recommended that you use **Averaging** mode when using a prism on a bipod, or a backsight prism on a tripod. If the control point is to be measured reflectorlessly, **DR Averaging** is the recommended mode.

1. From the **Home** menu, tap **Measure / Measure Control Point**.
2. Select **New Control Points** from the menu to measure a new control point, or **Existing Control Points** to remeasure existing control points to check their position.



3. Create the control point location using a stake, a hub, or a road nail as required on the ground and then mark the stake with the name for the control point, for example, CP3.
4. Set up the prism rod on the point and hold it steady using a bipod. The software displays the current Prism position on the map.
5. When you are ready to take the measurement, tap the **Measure** icon.

When each control point is measured, the software stores the control point data position in the control point (Control.field.csv) file for the site, and records the measurement data into the record and report files for the work order.

Outputting data through the COM port

In some applications, it is useful to have the controller deliver the raw measurement data or the computed coordinate data to the serial port of the controller, so that other software, for example hydrographic positioning applications, can pick it up and use it. See [Streaming data output, page 69](#) for additional options for streaming data via a style guide on Windows systems.

To set up the COM port:

- 1. Connect to the SPS total station and complete a station establishment.
- 2. From the **Home** menu, tap **Settings** and then tap **Total Station Settings**. The **Total Stations Settings** screen appears.
- 3. Tap the **Settings** tab:

Total Station Settings

CorrectionsAtmospheric CorrectionsSettings

Instrument typeEmulated SPS930

Firmware versionC1.0.0

Instrument nameEmulated Device

Reticle illumination0

Raw data outputEnabled

Output formatHAVASD

Output modeAfter recording

Baud rate38400

ACCEPT

- 4. Enable the **Raw data output** option.
- 5. In the **Output format** list, select either HAVASD raw data or XYZ coordinates.

RAW data format	Coordinate data format
0	0
7 = HA	37 = Northing
8 = VA	38 = Easting
0 = SD	39 = Elevation

The first line of data is always a 0, which is a status tag indicating a complete measurement record. Each line of data is terminated with a carriage return and line feed. Coordinate data output is always in meters, regardless of the units selected in the site.

6. In the **Output mode** list, select either the After recording (every time you tap **Record**) option or the Continuous (every time the total station has a new measurement) option.
7. In the **COM Port** list, select the controller port through which to send the data.
8. In the **Baud rate** list, select the rate in bits per second that you want to send the data to the COM port.

NOTE – Parity is set to 0 (No Parity), data bits is set to 8, and stop bits is set to 1. You cannot change these settings.

9. Tap **OK**. Once the connection is established, and measurement commences, the data will be sent to the selected COM port in the format you selected.

Computing the total station scale factor

The software can calculate a projection scale factor using a preselected coordinate system or site calibration in the site folder, for example, to measure accurately in a zone of the UTM coordinate system.

Starting with Siteworks v1.70, the **Corrections** screen appears every time a total station is connected to when the **Show Corrections at Startup** checkbox is selected. In versions earlier than v1.70, to turn on the total station's **Corrections** screen when starting a project, tap **Ctrl+O** (letter "O", not the number "zero") from the main map screen and select the **Display scale factor option at connection** checkbox. The **Corrections** screen (shown below) then appears the first time a total station is connected to in a project.

To enable the automatic project scale factor:

1. From the **Home** menu, tap **Settings**.
2. Tap **Total Station Settings**. The **Total Stations Settings** screen appears.
3. Tap the **Corrections** tab:

TIP – Starting with v1.70, this screen automatically sets to display during the total station connection when the **Show corrections on startup** checkbox is selected. The screen still appears even after entering values and confirming that once they are set they cannot be changed. Clear the **Show corrections on startup** checkbox to hide this window at every total station connection.

Total Station Settings

Corrections Atmospheric Corrections Settings

Choose the corrections you want to apply to the measured distance:

☒ Curvature and refraction

☐ Mean sea level correction

Scale factor

☐ Entered

☒ Computed

ACCEPT

You can enter a fixed scale factor, leave the scale factor at 1, or let the software calculate a scale factor based on the site calibration measured with GNSS or imported from Business Center. The software uses the instrument coordinates resulting from the station establishment to calculate the correct scale factor for this instrument location in the selected coordinate system zone.

Enabling the **Mean sea level correction** checkbox will account for the elevation of the instrument above mean sea level and incorporate an appropriate scale factor. This checkbox should be selected after at least one GNSS point is measured or a site calibration has been performed, as the GNSS elevation data from the site calibration is used to set the project elevation in the mean sea level correction calculation.

Once the option is set to **Computed** and site measurements have been taken, the **Computed** option is locked to guarantee the consistency of the measurements.

The automatic scale factor is also written to the instrument scratch pad to apply it for machine control operations with the GCS900, Earthworks, or AccuGrade grade control systems.

Integrated Survey

- Integrated Survey connections
- Measure GNSS control points during UTS setup
- GNSS antenna heights in Integrated Survey
- GNSS-based prism search and turn to GNSS location
- Recheck System in Integrated Survey
- eBubble and tilt warning for UTS measurements

The Integrated Survey functionality was added in Siteworks v1.70, and requires the Advanced Measurement module (AMM).

NOTE – Integrated Survey is not available in Siteworks SE Starter Edition, as total stations are not supported in Siteworks SE.

The main improvements include:

- You can now simultaneously connect to both a GNSS receiver and a total station and then to switch between them to take measurements from either device.
- The SX12 and SX10 scanning total stations are now fully supported as the optical instrument, as are all currently supported GNSS receivers. Measurements can only be taken from one device at a time, but with one click in the Siteworks status bar the primary positioning device can be swapped.
- The UTS can now “turn to” the GNSS location, thereby streamlining a prism search.
- You can now measure a new GNSS control point during a UTS setup and then immediately take the UTS measurement to station the instrument.

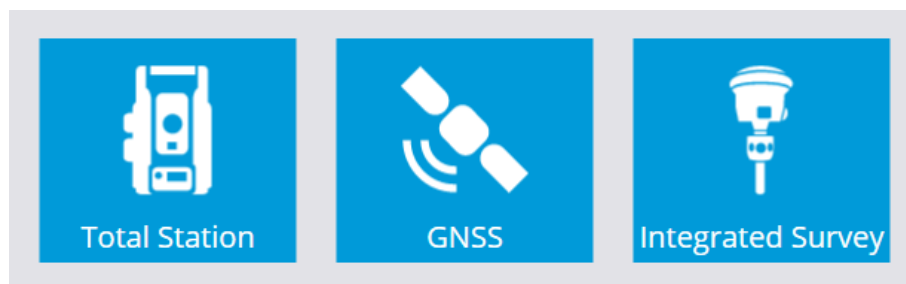
NOTE – To measure a new control point during the instrument setup process, the project must already have a site calibration completed or be using a published coordinate system.

Integrated Survey connections

The new connection option for Integrated Survey has been added in the **Connect Device** options for users with the Advanced Management module installed.

When selected, you are prompted to first connect to a GNSS rover and then to a total station. All existing connection methods (cable, Bluetooth, radio, Wi-Fi) are supported, including the data collector's internal GNSS.

Select **Connect Device / Integrated Survey**:




You are taken to the existing GNSS setup, where all options for a standard GNSS rover setup are available (you cannot set up a GNSS base station in the Integrated Survey workflow). To set up a base station you must use the standard GNSS setup workflow. After completing the GNSS setup, you are taken into the Total Station setup, where again, all the initial connection options are the same.

Measure GNSS control points during UTS setup

With the Integrated Survey, a new functionality has been added to the **Select Instrument** and **Select Point** screen during the station setup that allows for a new control point to be measured by GNSS.

To measure a new GNSS control point:

1. From the **Select Point** screen, tap  (New Control Point) to enter into the Measure Control Point workflow. After selecting this option, you are taken to the GNSS static measurement setting window. You can enter the new control point's name and code, and set the static measurement settings.
2. Tap **Measure** to start the static GNSS measurement. Once the measurement has been completed you are returned to the **Instrument Setup Point Selection** window with the newly measured point selected by default.

NOTE – The status bar will continue to indicate that the active connection is the total station throughout this workflow. This is because Siteworks doesn't actually change active devices, it just performs a static measurement from the GNSS receiver.



Switching devices in Integrated Survey mode

Once the setup of both the UTS and GNSS is complete, Siteworks displays a new slider switch in the status bar at the top of the screen. The statuses of both the GNSS (for example, the precisions, number of satellites, and correction status) and the total station status are now also displayed. These status bar items behave as previously; clicking on them will take you to the respective screens, like the Skyplot and Total Station Control Panel. The battery level for both connected devices is also shown, and tapping on the battery icons will take you to the battery level display window which shows the current UTS, GNSS, and data collector battery levels.

Tapping on the slider button will switch the primary positioning instrument between the GNSS and UTS. The currently active device will have its status bar items highlighted by a blue box.

UTS as active device:

GNSS as active device:

You can change active devices only while in the plan map. With the exception of measuring new points in a workflow window, the slider button is hidden in most workflow windows.

You cannot change devices while staking batter rail locations or the reference stake for a dual-stake catch point. You can change active devices while in the EZ level UI. Also, you cannot switch to GNSS mode when measuring a point at an offset with the dual measurement option, as that is a total station-only option.

When switching devices, the measure mode will always return to **Standing**, regardless of the mode that was last used. For example, if you are in vehicle mode in GNSS and switch to UTS, the UTS will be in Standing mode, and then when switching back to GNSS it will also be in Standing mode.

Recorded measurements will only store information from the active device. When taking a GNSS measurement, the point information will only contain GNSS information (will not contain any UTS information, since the UTS was not used to measure that point).

GNSS antenna heights in Integrated Survey

GNSS antenna height options now has a new **Use target height plus offset to receiver** checkbox on the **GNSS height settings** pages for all measure modes (walking, standing, static, vehicle) and for the supported prisms that have the 5/8" threads at the top: AT360, 360 degree, and MT1000 prisms.

Receiver Setup

Connection type

SPS986 Emulator

Correction method

Radio in Receiver

Network ID

3

Connected to base

Emulator

Using Quick Release

No

Enable Tilt Compensation

Yes

Target height

6.562 usft

☒ Use target height plus offset to receiver

ACCEPT

Standing Mode Settings

11 Hz: 0.026 Vt: 0.049

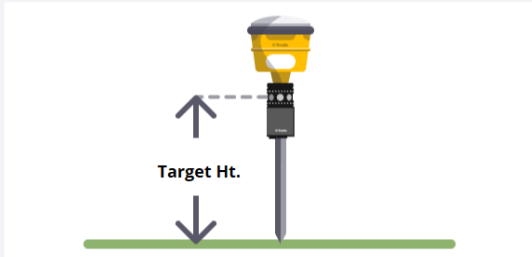
☒ Use target height plus offset to receiver

Using Quick Release

No

Target height

6.562 usft



Target Ht.

ACCEPT

When this checkbox is selected, the GNSS height to the bottom of the receiver is automatically adjusted, based on the specific prism selected in the UTS settings and the entered height of the prism. Instead of **Antenna**

height, **Target height** is shown. The height in the **GNSS setting** window will be grayed out and can only be changed in the **UTS height** window. The adjusted GNSS height is displayed in the Info Bar/Panel for the GNSS antenna height on the main screen.

NOTE – The graphic shown in Siteworks will always be of the MT1000 and will not update to the prism type in use.

The following offsets are applied to the height of the prism as it is entered in the UTS height settings:

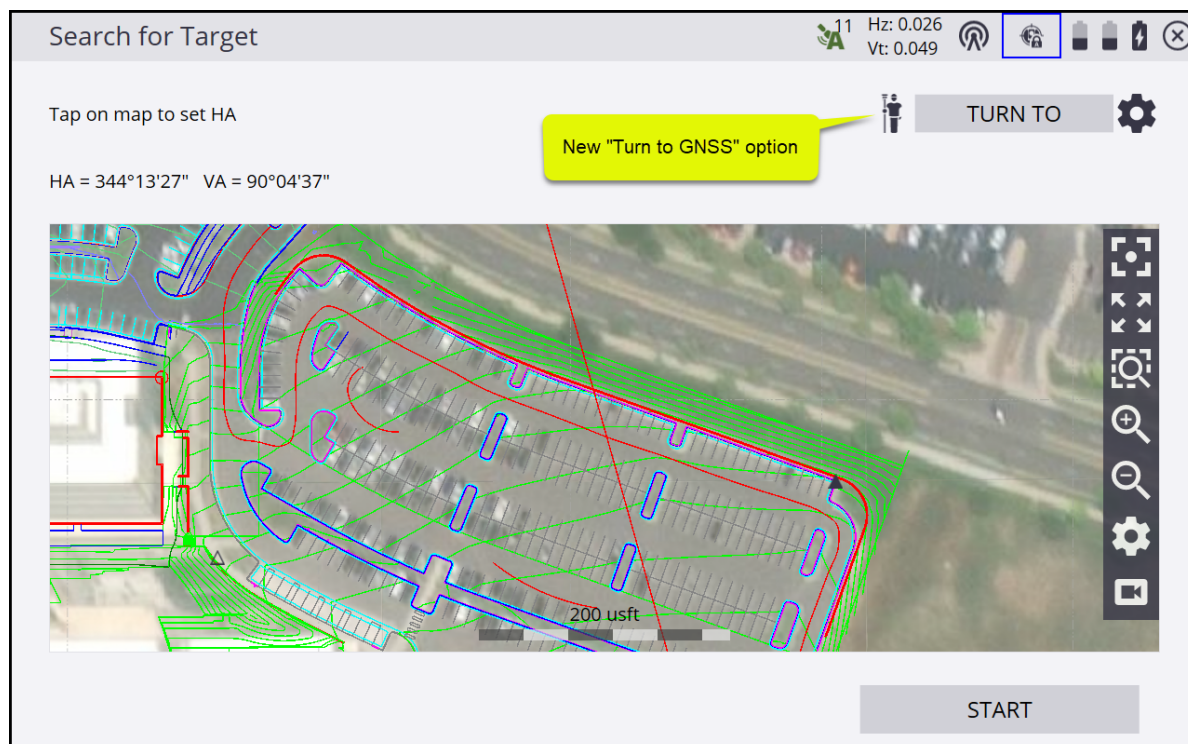
Prism Type	Offset Value
AT360	0.095 m
360 Prism	0.034 m
MT1000	0.034 m

When using Integrated Survey, you can select any prism type available in Siteworks, even those that do not have threads at the top (for example, a backsight prism). If any prisms other than the ones listed in the table above are selected, then the **Use target height plus offset to receiver** checkbox will not be available in the **GNSS height settings** pages and the antenna height will have to be manually entered.

GNSS-based prism search and turn to GNSS location

The GNSS-based prism search is a new functionality implemented in the **TURN TO** option of the total station search function.

When in the **Search for Target** screen (reached from the total station control panel Search button), tap icon next to the **TURN TO** button to turn the instrument to the current GNSS position.



When tapping the **TURN TO** in the screen above, you have a new option for **Turn to GNSS location**:

Turn Instrument To

11 Hz: 0.026
Vt: 0.049

☐ Turn from last tracked position

Δ H. dist.(+/-)

Δ V. dist.(+/-)

☐ Turn to point

Point name

☐ Turn to specified angles

Turn to HA ☐ Turn to GNSS location

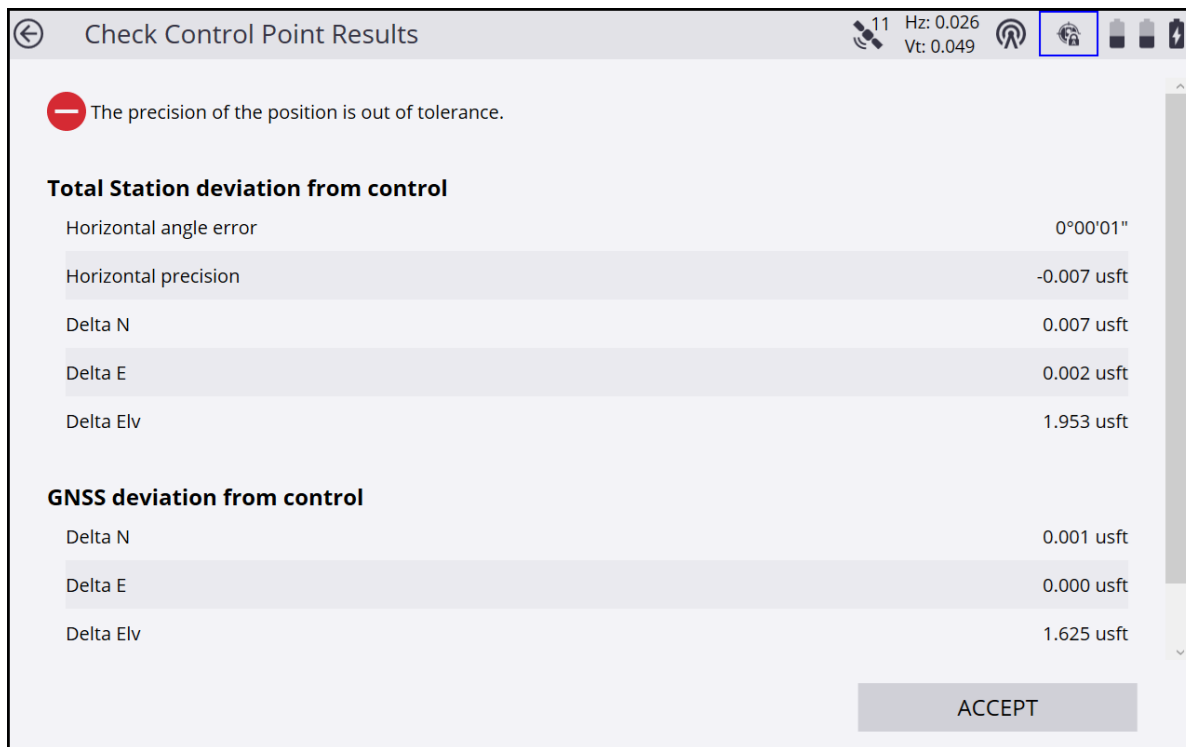
Selecting these new GNSS-based options turns the instrument to the current GNSS location and greatly facilitates the reacquisition of the prism by the total station.

In Integrated Survey, you can use the internal GNSS of a compatible data collector as the GNSS connection. Selecting the internal GNSS as the Integrated Survey's GNSS will allow the use of the internal GNSS during the new "Turn To GNSS" prism search. For best results, set the GNSS antenna height to be the height of the top of the data collector above the ground.

NOTE – The non-differential correction nature of the internal GNSS may not cause the UTS to turn directly to the prism. Also, the precision values of the GNSS in the status bar may flash red due the higher precisions of the internal GNSS compared to an RTK-enabled receiver.

Recheck System in Integrated Survey

A new **Integrated Survey Measurement** option has also been added to the Recheck System workflow that enables taking both GNSS and UTS measurements over the control point. When the **Integrated survey measurement** box at the top of the **Take Measurement** screen is selected, the system performs the measurements from both devices, starting with the currently active device. Once the measurements from both devices are collected, the **Check Control Point Results** screen displays the deltas for both instruments, as shown below, and the values are saved to the task log.



Check Control Point Results

11 Hz: 0.026 Vt: 0.049

— The precision of the position is out of tolerance.

Total Station deviation from control

Horizontal angle error	0°00'01"
Horizontal precision	-0.007 usft
Delta N	0.007 usft
Delta E	0.002 usft
Delta Elv	1.953 usft

GNSS deviation from control

Delta N	0.001 usft
Delta E	0.000 usft
Delta Elv	1.625 usft

ACCEPT

eBubble and tilt warning for UTS measurements

When connected to a GNSS receiver with eBubble capabilities, the eBubble remains active in a side panel even when the UTS is selected as the primary positioning device. This will allow for the use of the receiver's eBubble view on the screen to level the survey pole, regardless of which positioning device is selected as the primary device. To ensure the best results, it is recommended to perform an eBubble calibration with the receiver mounted on top of the prism when the pole is plumb.

NOTE – The eBubble does not need to use the IMU or Tilt Compensation option code, and is standard on SPS986 and R780 receivers.

If the **Enable tilt warning for measurements** checkbox is selected in the **eBubble settings** window, then if the survey pole is tilted beyond the specified settings, Siteworks will warn of excessive tilt when taking either a GNSS or a UTS measurement.

Machine Control

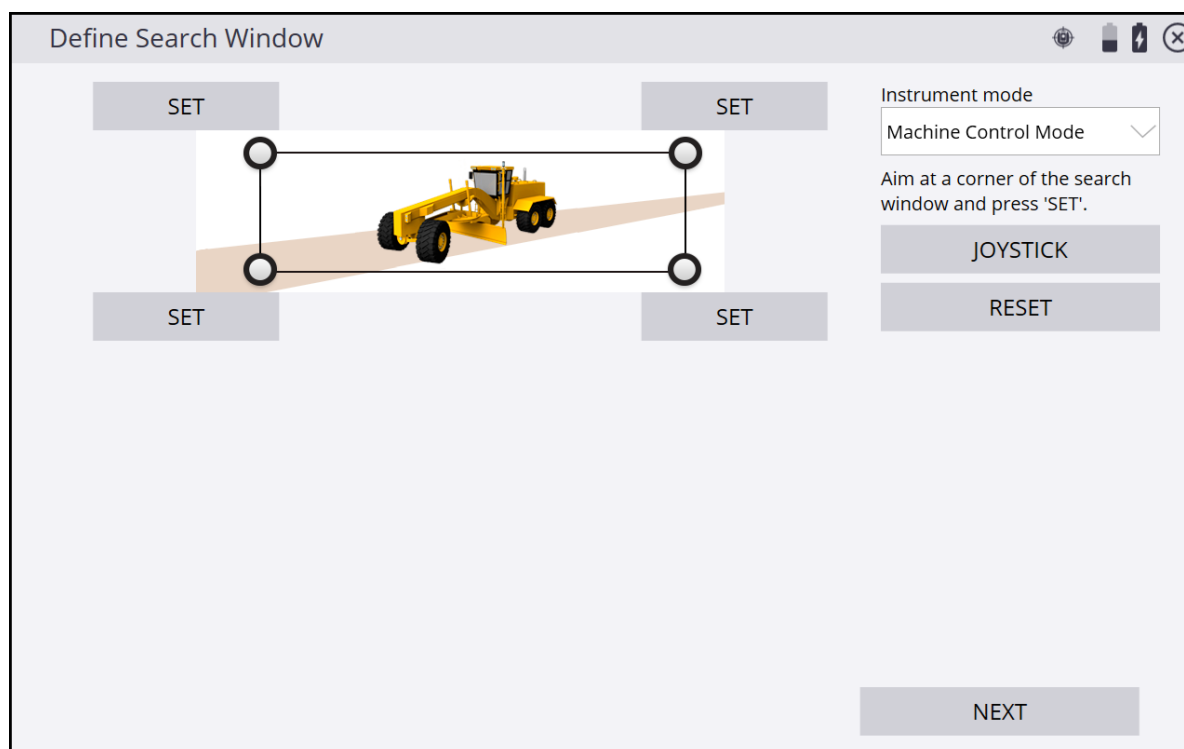
- Setting up for machine control
- Exporting data to machine control systems

Setting up for machine control

From the **Home** menu, tap **Project Setup / Machine Control Setup**

Machine Control Setup

To set up the instrument for a Trimble GCS900 or Earthworks machine control system, select Machine Control Mode in the **Instrument Mode** dropdown menu. If the instrument has the OEM option installed, an OEM mode is available.



Defining the window for Full Search mode

When defining the window for the Full Search mode:

- Accommodate the fact that the prism can be mounted on an electric mast, and that the vertical window of operation at close range will be higher or lower than at longer ranges.

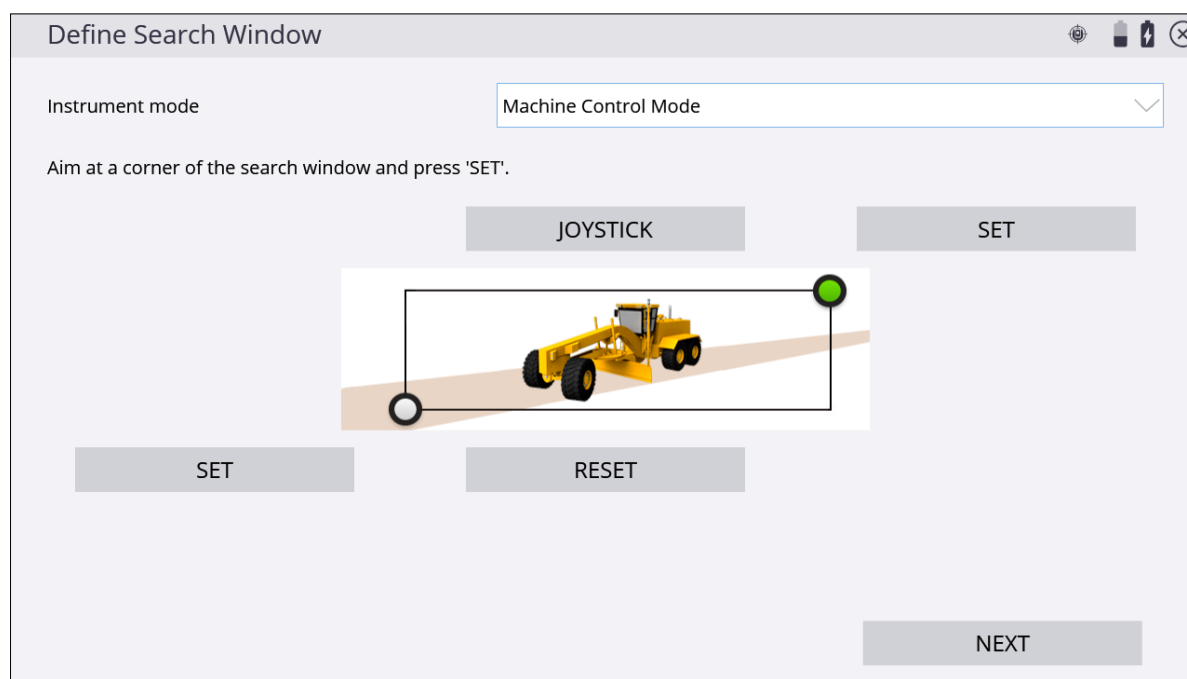
- Ensure that you set the window of operation to cover the extents of all grading operations to be completed from that location's instrument setup.
- Ensure that if the machine is taken outside that window, to turn around or to bench on a known height point, those locations are also included in the search window.

You can define either the upper left/lower right extents of your search window or the upper right/lower left extents of your search window. Ensure that you take a good look at any high or low points in the area where you will be working and then define your search window to what most closely resembles the actual working area in front of the instrument.

- Point the total station to an upper left location and then to a lower right location; tap the appropriate **Set** button at each pointing.
- Point the total station to an upper right location and then to a lower left location, tapping the appropriate **Set** button at each pointing.

You can use the joystick function, or physically turn the total station by hand to aim at the corner points. To use the joystick to set the corner points, tap **JOYSTICK** and use the joystick commands to point the total station to one corner. When the total station is pointed in the correct corner, tap **ACCEPT** in the **Joystick** window to return to the **Define Search Window**, and then hit the appropriate corner's **Set** button. Repeat this process for the opposite corner.

As soon as the first corner is defined, the only option available in the software is to define the opposite corner. For example, if you define the upper right extent first, the lower left corner only is made available to define. If the lower right corner is set first, then the upper left corner only is made available to define.



A single SPSx30 total station can be shared by multiple machines and a single SPS robotic rover pole. Only one user can use the total station at a time, but when not in use, it continually scans a predefined list of radio channels assigned to different machines and the last used site positioning system channel in sequence, looking to see if anyone needs access to the total station. When a machine or site positioning system calls the total station, it connects and provides a positioning service. When completed, the total station returns to Standby mode and becomes available to the radio channels previously loaded to the instrument. Note that this process is made easier in Siteworks software by tapping the **Disconnect** button in the **Project Setup** menu after the Siteworks uses are complete. To facilitate this process, in the set up for machine control process, you can create a list of machines, each with a name and a specified radio channel, for example:

- CAT 140H Grader 1 33
- CAT D6 Dozer 1 34

The machine list is scanned sequentially whenever the total station is placed in Standby mode for machine control. The more entries in the list, the longer the scan takes to complete a full cycle and therefore the slower the initial connection will be with the total station. If you are not continually using the entries in the list in earthmoving operations, delete the entries from the list to speed up initial connection times.

Tap the **+** icon to create a machine in the machine list, enter a machine name and assign a network channel. Also, select a Network ID for the instrument.

Network ID: 2

GET MACHINE LIST

Channel	Machine Name
31	CAT 140H Grader
35	Liebherr PR724
38	Volvo Grader

NEXT

This completes the instrument setup. The total station goes into Standby mode waiting for a machine to connect to it. Tap **NEXT** to confirm the machine control setup. The following screen appears:

The setup is complete. Tap "FINISH" to set the instrument to the Machine Control mode.

FINISH

The total station goes into Standby mode for machine control and then it scans the machine list in chronological order until a machine is found calling the instrument on one of the channels. The software now disconnects from the total station. Move to the machine and initiate connection to the total station from the machine's grade control software.

If a machine control setup has already been performed at a given station setup, and the total station has not been moved to a new location or had a new station setup performed, when entering the **Machine Control Setup** screen, a prompt appears asking if you would like to use the machine control settings already saved to the instrument. Selecting **YES** will use the same search window and machine ID previously configured. Selecting **NO** will enter into the machine control setup workflow again.

If you are tracking a machine and the target becomes lost for any reason, the total station continues to turn at a constant horizontal and vertical speed for a short period, in the expectation that the target will appear on the same trajectory when it clears the obstruction. A line-of-sight obstruction, a passing vehicle, or simply losing the target because of movement speed can cause the total station to lose the target. When the target is 'lost', that is, the above method failed to reacquire the target, the total station searches for the target. The total station has two search modes:

Mode	Description
Quick Search	Initiated as soon as the target is 'lost'. This search is centered on the last known location, and inside a window defined by a horizontal angle width (for example, 15°) and a vertical angle width (for example, 15°). The machine control software sets the values for the search window.
Full Search	This search looks inside a larger window, defined by the screen shown previously. When the Quick Search mode fails to locate the target, the Full Search mode is initiated.

If you are operating at the total station, point it at the MT900 target on the machine. When the machine connects to the total station, this speeds up the initial search and lock-on process for the total station as it instantly “sees” the target and locks to it.

Exporting data to machine control systems

Siteworks can package and export calibration, measured surface and linework, and design data to GCS900 and Earthworks machine control systems. Siteworks will package and convert, where possible, the necessary data into the appropriate file formats and folder structure for a direct importation onto the machine control systems using a USB drive.

The **Export Data for Machine** commands are accessed via the **Menu / Data Management / Export to Machine**. Options for export formats vary depending on the type of data and machine control system selected.

When exporting data to machine control systems, the following parameters apply:

- For GCS900 exports, if a DXF and TTM are the design file types, then the DXF and TTM are copied into the appropriate GCS900 file structure on the USB stick. This is because GCS900 supports DXF and TTM file types. It is not possible to convert or “flip” a DXF/TTM design to SVD/SVL within the Siteworks software. When exporting *measured* data to GCS900, you can choose whether or not to convert the measured data to SVD/SVL or to TTM/DXF.
- If the design linework is a DWG file, it is not exported as part of the export. The **Include Design Linework** is not an option when exporting a surface for GCS900 if a DWG or VCL file is selected.

NOTE – VCL designs loaded in the Siteworks software cannot be exported or converted for GCS900 machines. VCL files must be converted and prepared for GCS900 machines with Trimble Business Center or Trimble FileFlipper. Design linework contained in a VCL file also is not exportable to GCS900 machines when selecting any of the **Include Design Linework** options.

- Calibration exports for GCS900 machines are exported as CFG files. Calibration files for Earthworks are a copy of the existing .DC file that has its file extension changed to .CAL.
- When exporting designs for Earthworks, if the design type is a TTM/DXF, the software converts the data to a DSZ file type. If the design is a VCL, then the software simply copies the VCL to the Earthworks machine control folder. When exporting designs to Earthworks, only the currently loaded design is exported. To export a different design, you must first load it in Siteworks via **Menu / Change Project**.
- On Android data collectors in Siteworks v1.41 and later, you can send the data to either the device's internal storage or to a USB drive. This option is available in the **File Location** setting on the **Export data for Machine** screen. If **Device** is chosen as the storage location during the export, then the machine control data is saved to the device's *Internal Storage / TrimbleSync / Siteworks / MC Data* folder.

Export Data for Machine

Export data type: Calibration

Machine control device: CB430/CD700

File location: USB Drive

USB Drive

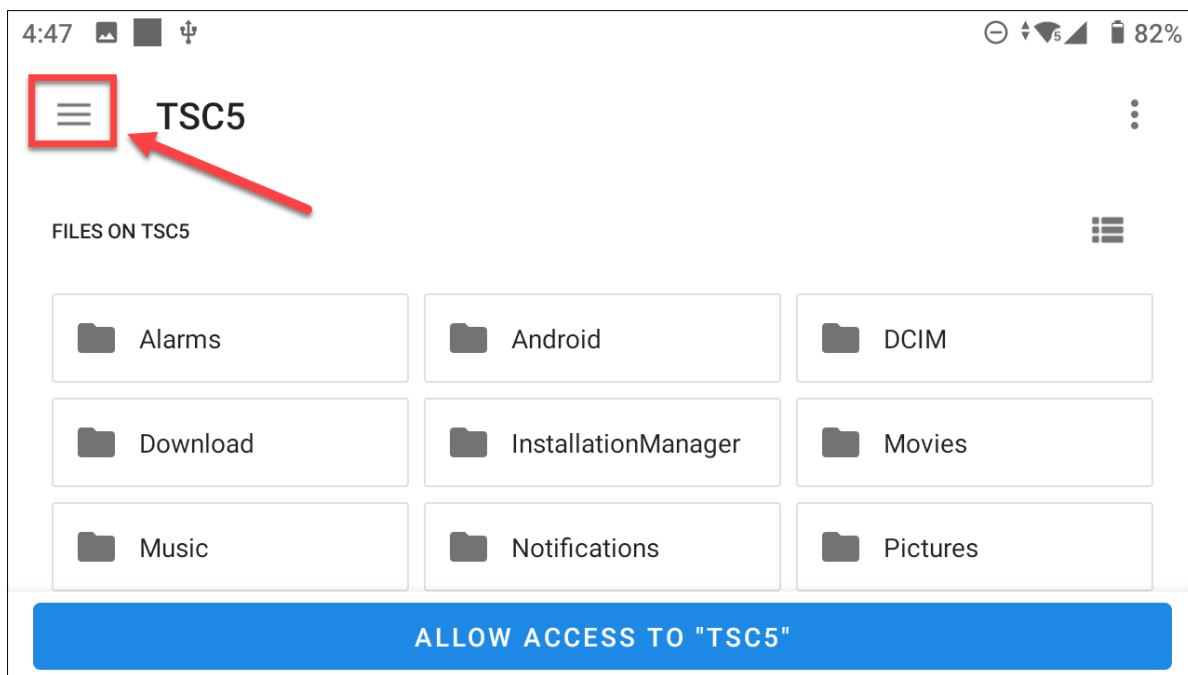
Device

ACCEPT

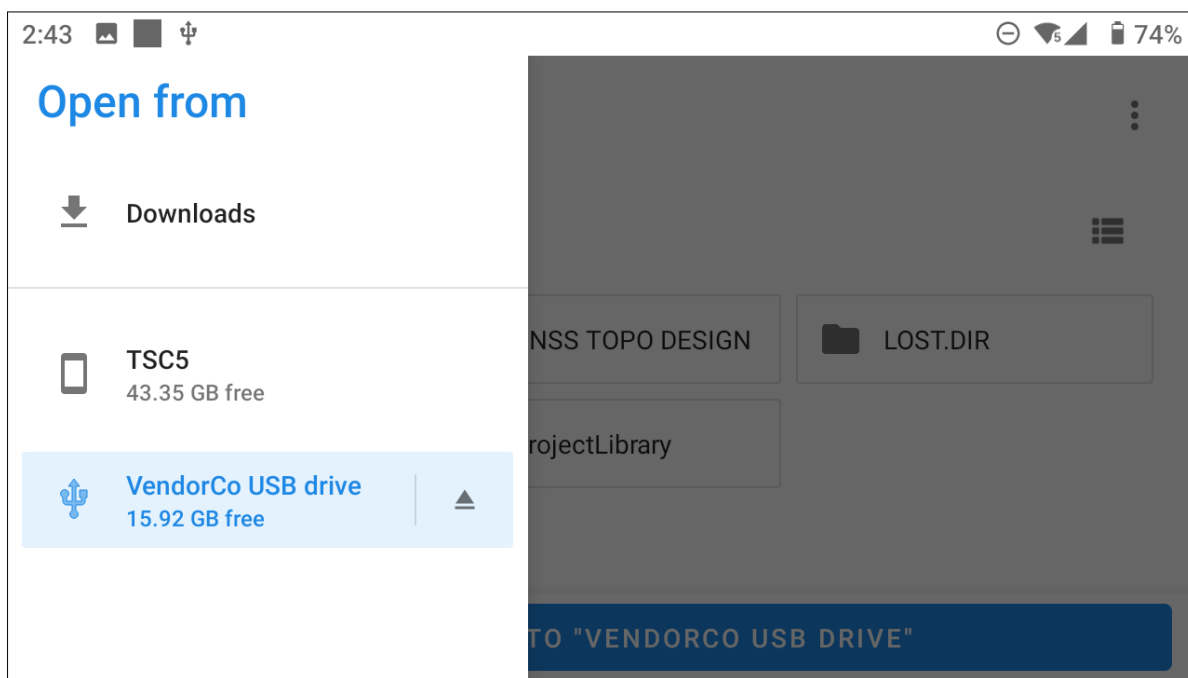
When a USB drive is selected for the first time, an Android operating system folder selection screen appears. The USB drive must be selected from the main menu in the upper left side. Once the USB drive is selected, choose **USE THIS FOLDER, ALLOW ACCESS TO USB DRIVE**, or **SELECT** blue button at the bottom of the screen and allow system permission to access the drive. You must choose only the root directory of the drive and not any sub or other individual folders within the drive. This process is only necessary the first time a particular drive is used; that drive will be remembered. Any new drives inserted into the device need to be selected in the Android operating system.

To select the USB drive:

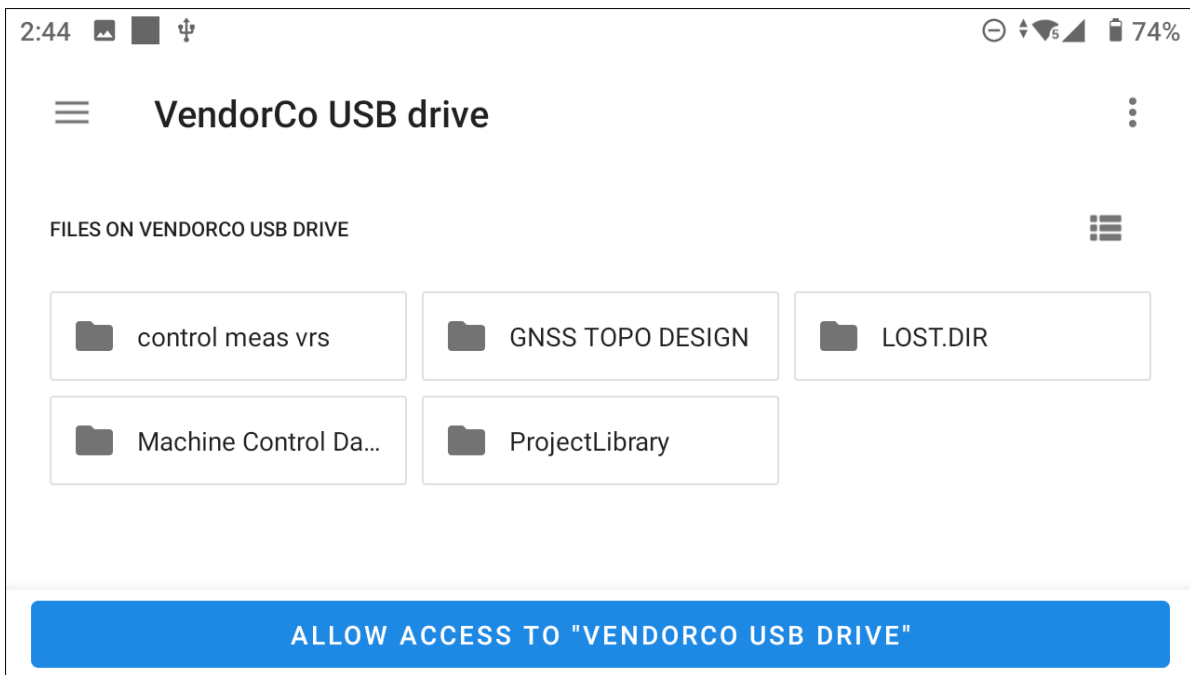
1. Tap the *Hamburger Menu* at the top left of the screen (red box):



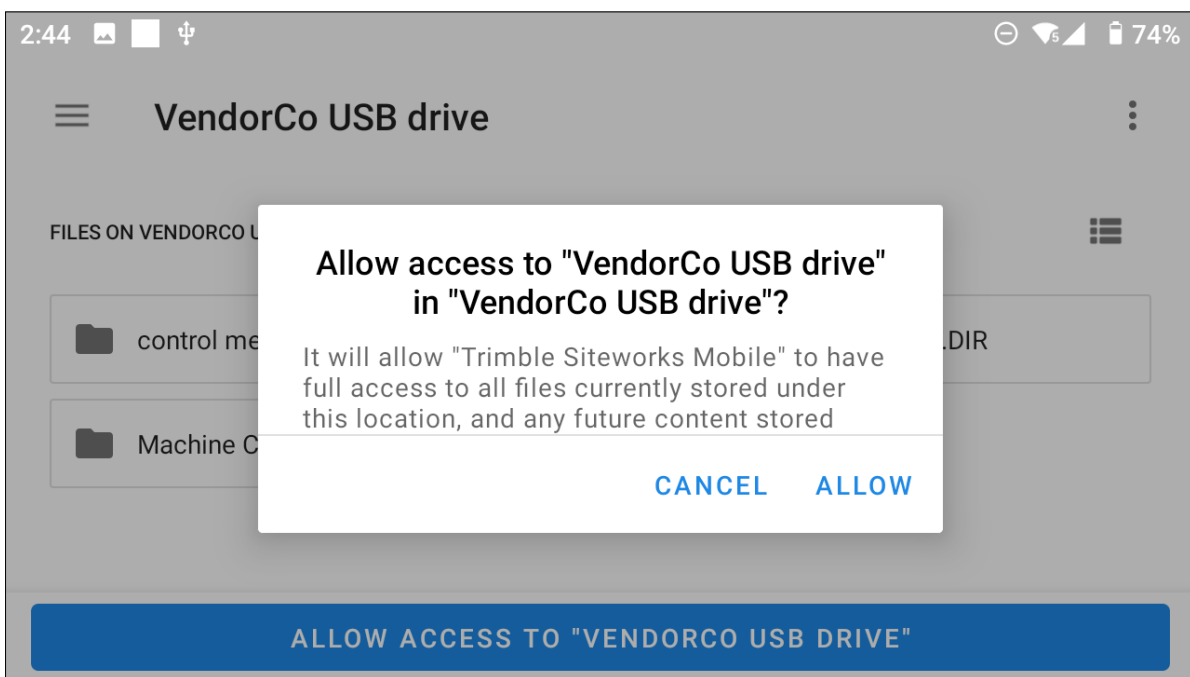
2. Select the USB drive from the list at the left side of the screen (highlighted in blue); note that the name of your drive will likely be different:



3. Tap the **Allow Access to <USB Drive Name>** blue bar at the bottom of the screen; note that the wording in the bar may be different depending on the device and Android version on the device, and the USB device name will likely be different.



4. Tap **Allow** in the system dialog asking for access permission. The software will complete the export to the USB drive.



Using the SX12 Scanning Total Station in Siteworks

- [Introduction](#)
- [Using the SX12 as a total station](#)
- [Scanning with Siteworks](#)

SX12 scanning total station hardware activation

New SX12 instruments must be activated by applying the correct activation code to the instrument in the Virtual Warehouse and then activating the instrument via Trimble Installation Manager.

The activation code is applied to the SX12 instrument in the Virtual Warehouse by your SITECH dealer. The process is similar to applying activation and constellation options to a GNSS receiver.

After applying the activation to the SX12 scanning total station in the Virtual Warehouse, use the Hirose-to-USB cable included with the hardware to connect the SX12 instrument to a PC. Then, run Trimble Installation Manager (TIM) on the PC to activate and update the instrument firmware. The instrument will not function until the activation is successfully completed by TIM. TIM is also how the instrument firmware is updated when a new firmware version is available.

Connection and setup

The supported release version of Siteworks is v1.50. The Advanced Measurement module is required to connect to the SX12 instrument in Siteworks. The SX12 instrument is not supported on Android devices.

To connect to the SX12 in Siteworks: from the **Connect to Total Station** screen, select the **SX10/SX12** option in the **Model** dropdown list.

Connect to Total Station

Brand: Trimble

Model: SPS Series

Model options: SPS Series, SX10/SX12, RTS773

SELECT

The SX12 instrument can communicate with Siteworks via a Hirose-to-USB cable, Wi-Fi, or 2.4 GHz Cirronet radio connection via the EM120 EMPOWER module. Wi-Fi is generally the preferred wireless connection method due to greater bandwidth and higher quality video streaming. The range is less when using Wi-Fi compared to 2.4 GHz Cirronet Radio connections, however the video experience and scan transfer times are much better with Wi-Fi. Scans are always recommended to be done over Wi-Fi or cable, since the scan data is sent to the data collector and is not stored on the instrument.


NOTE – Some large scans may not transfer via radio. If a scan data transfer fails or the instrument power is lost during the scan, the scan data is lost and the scan will need to be completed again.

To switch between radio and Wi-Fi modes on the SX12 instrument, tap the **Power** button. The power light on the instrument flashes rapidly while the instrument is changing modes and will change to either a slow or fast flash.

The wireless mode of the SX12 instrument is identified by the rate of flashing: A quick flash with the light off more than on, indicates the instrument is in Wi-Fi mode, while a flash with the light on more than off, indicates radio mode. For more information on setting the wireless modes on the instrument, refer to the *SX12 User Guide* available online at geospatial.trimble.com/en/links?dcs=Collection-131173.


To configure and use the 2.4 GHz radio, first connect to the SX12 instrument via Wi-Fi or cable in Siteworks and then go to the **Menu / Settings / Total Station / Radio** tab to configure the radio channel and network settings for the SX12. You can then connect in Siteworks using the radio option and selecting the Channel and Network settings configured in the **Radio** tab.

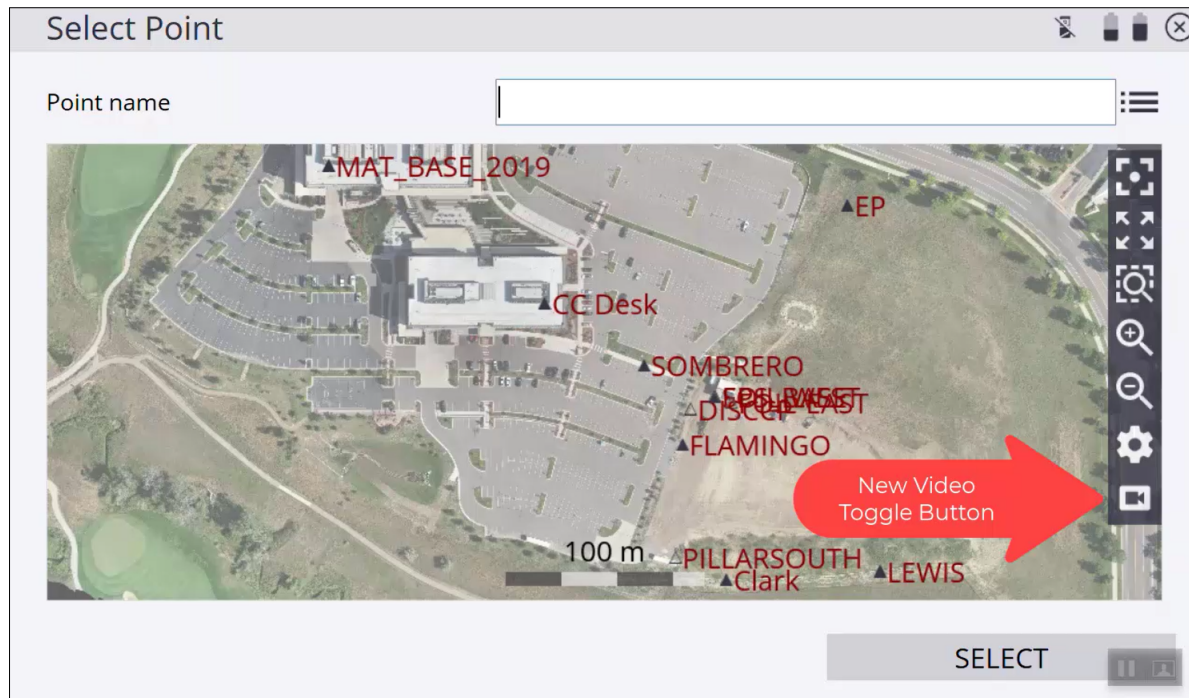
NOTES –

- When a cable is connected, the wireless options of Wi-Fi and radio are disabled until the cable is unplugged.
- If difficulties arise in connecting via Wi-Fi, it is recommended to power cycle the SX12 scanning total station and then perform a new Wi-Fi scan by tapping  in Siteworks to re-establish the connection.


Video support

Siteworks now supports Video workflows for the SX12 in most workflows including during station setup, using the joystick, and in standard operation with video-enabled Total Station workflows, in addition to numerous other screens. To view the video screens, use the “Video View” buttons or camera buttons throughout the software.

During station setup in the **Select Point** screen, there is a new video camera icon  on the bottom right of the video controls toolbar. Tap this icon to open the live video view.

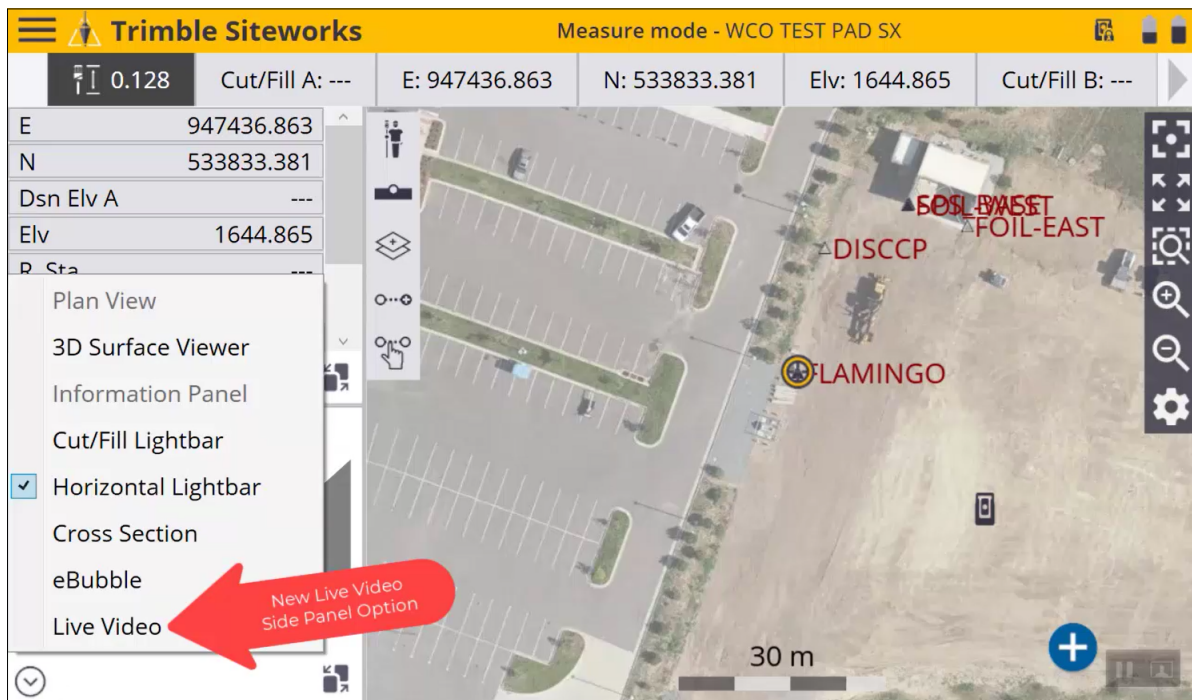


Once in the video screen, there are several new toolbar items on the right side of the screen for controlling the video and instrument. These settings are available in every video view.

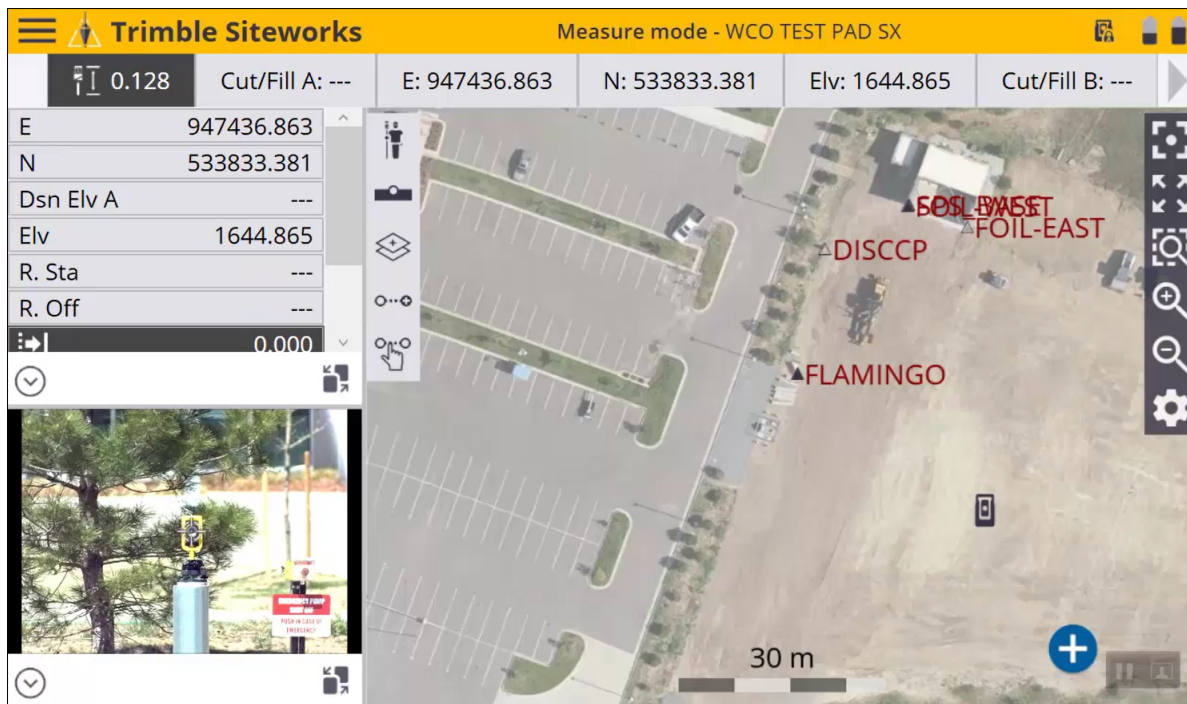
NOTE – The Toggle Map View  is not available when on the main Siteworks screen, as there is no map to toggle back to.




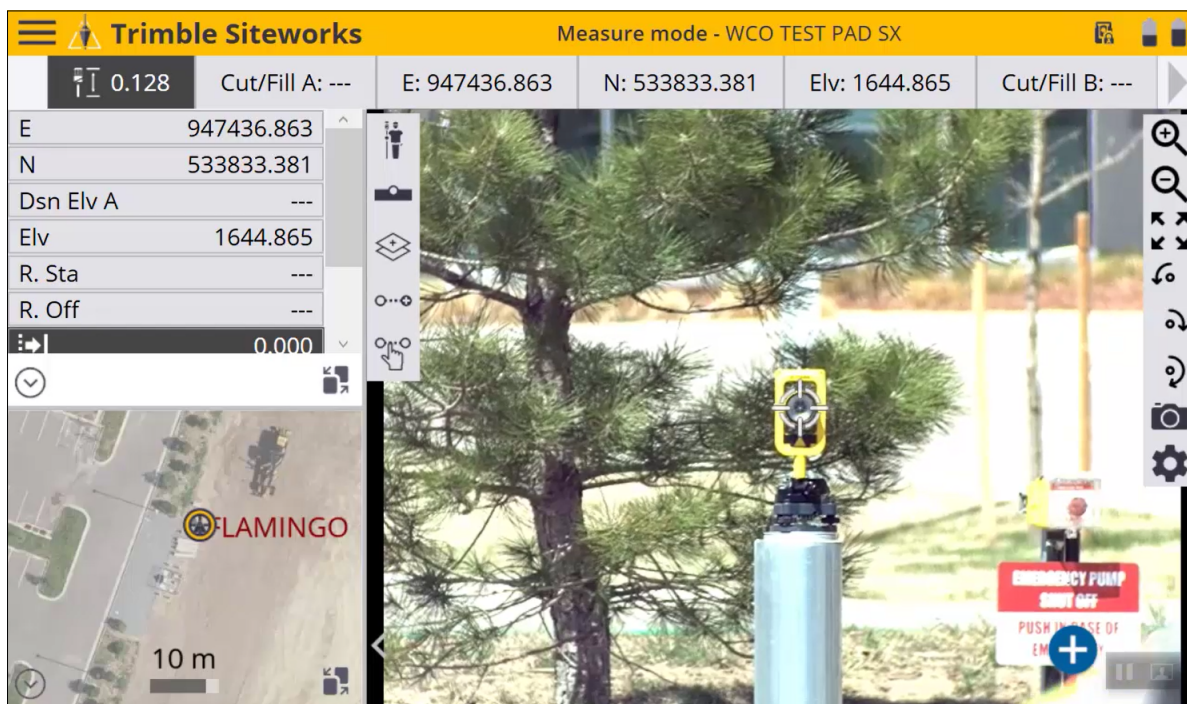
On the main Siteworks screen, the video can be accessed via a side panel where **Live Video** is a new option. This option is only available when connected to a SX12.



Selecting **Live Video** places the live video feed into the side panel, where you can tap in the panel to turn the camera, pan by dragging, and pinch to zoom the camera view.



The side panel can then be sent to the main map panel by tapping . This makes all the video command buttons available. These video toolbar buttons are not available when the video is in a smaller side panel.



Tapping in the video screen turns the instrument to the tap location. Tapping near a prism should cause the instrument to lock onto the prism. Pinch to zoom is available, along with using the zoom in/out buttons on the toolbar on the right side. There are seven (7) levels of zoom available via the SX12's three cameras: Overview, Primary, and Telecamera. The Overview camera has a 54° field of view, the Primary camera has a 12° field of view, and the Telecamera has a 2° field of view.


On data collectors such as the TSC7 or T7 that have a directional keypad, the physical keypad works to turn the video screen when the video is in the main screen or in a side panel.


NOTE – If the keypad is not working to turn the instrument, tap in the video view panel in Siteworks to bring the focus of the software to the video view.

The speed of turning is set in the **Joystick Software** window. The joystick command is in the UTS control panel, which is activated by tapping the UTS icon in the upper title bar of Siteworks and then tapping the Joystick. The joystick command can also be activated by tapping the F3 key on the TSC7.

Video views have not yet been added to the EZ Level workflow.

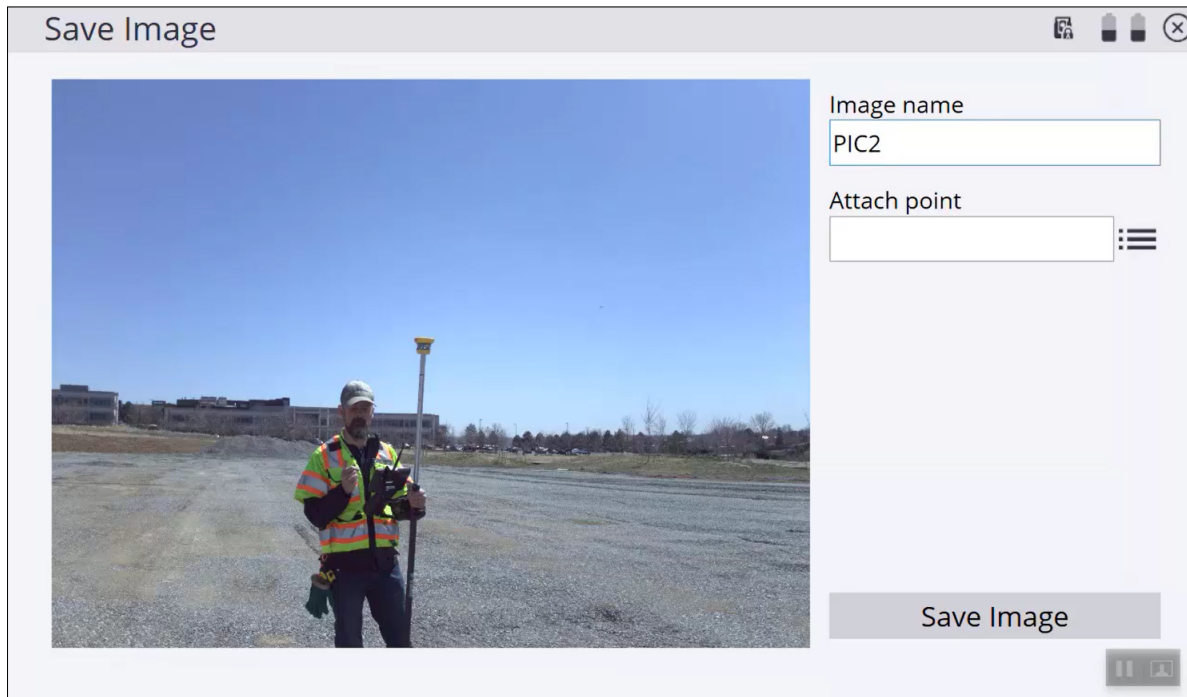
Photo captures

You can take a photo from the **Video** screen by tapping  on the lower right of the video toolbar. This captures the image that is in the video view when the camera button is pressed. You must enter an **Image name** and, optionally, you can attach the photo to an existing point. Photos are attached to a point by typing in

an existing Point name, or opening the point list by tapping the list icon  to the right of the **Attach Point** input field.

All photos taken by tapping the camera icon are saved to the **Media** folder of the currently open work order. Importing the work order's SPJ file into the Trimble Business Center software will associate the photos to any points that had photos attached. Photos that do not have points attached will not be accessible in the Trimble Business Center software, but will still be in the Media folder of the work order where the photos were taken.

NOTE – Photos taken as part of a panorama during a scan are placed into the **Scan Data** folder of the work order.



The screenshot shows a 'Save Image' dialog box. On the left is a large photo of a surveyor in a high-visibility vest holding a total station. To the right of the photo are two input fields: 'Image name' with the text 'PIC2' and 'Attach point' with a list icon to its right. At the bottom right is a 'Save Image' button. The dialog has a title bar with standard window controls.

Using the SX12 as a total station

All existing total station functionality within Siteworks on SPS series instruments is available for use with the SX12 scanning total station. The functionality and setup of the SX12 is the same as with other SPS total stations. The added benefit is now having the video stream, which allows for easy re-acquisition of a lost prism

by tapping on the prism in the video screen, the ability to take DR shots through the data collector video view, and the ability to take photos with the instrument.

Prism support

The SX12 scanning total station is not an active tracking instrument. It does not support “Active Tracking” prism targets with diodes, such as the MT1000 or AT360. It uses cameras to detect the reflection from the prism, rather than infrared diode technology to track only glass prisms and not foil type prisms, like the AT360. The MT1000 can be used as a passive target that the SX12 will follow and track using Autolock, however the channel setting of the prism is ignored. The AT360 will not be followed or tracked and can only be used as a DR type target when manually sighted to. Therefore the AT360 is not recommended for use with the SX12. The recommended prism for use with the SX12 is the standard 360 degree prism.

Acrylic or other reflective foil prisms or stickers are indirectly supported only when using DR mode. Acrylic targets have been removed from the list of available prisms when connected to an SX12 instrument. To shoot an acrylic prism or a foil sticker target, switch to DR mode and manually aim to the center of the target using the video controls. Autolock is not available when using DR mode and therefore not available on acrylic or reflective foil targets. Autolock is only available on targets that have glass prisms in them, like the 360 degree or MT1000.

Machine control

The SX12 scanning total station does not support Machine Control applications. This is in part due to the lack of active target prism support. An SPSx30 total station with the MC option will need to be used for connecting to GCS900 or Earthworks.

Laser pointer

The laser pointer of the SX12 scanning total station is supported in Siteworks. Use the total station control panel to turn the laser off and on. Functionality is similar to the SPS model total stations, but does have some differences. With the SX12, the laser will be in flashing mode instead of being constant. This is because Siteworks uses TRK mode at all times except when actually taking a measurement to update the user location in the plan view. If Siteworks is in STD mode, the laser will still flash, although it may remain solid for a short time while the measurement is actually being taken or Siteworks is not displaying the main map screen with a user position.

By default, the laser in the SX12 instrument is off. It shares the same optical path as the telecamera, therefore when the laser is on, the telecamera is not available, and the video view zoom levels are constrained to the overview and primary cameras only. To re-enable the telecamera, turn off the laser.

Target Illumination / Track Light

The SX12 scanning total station does not have a red/green track light like the SPS series of total stations. It does have a function called **Target Illumination (TIL)**, which is a white light that shines from the instrument and helps to locate, track, and autolock onto targets, especially in dark environments. Target illumination works best when using the primary camera in the video view.

To turn on TIL, open the **Total Station Control** panel and tap the **TIL** icon to turn the light on/off or set it to flash.



Traverse and Network measurement

The Traverse and Network Measurement features are available and with an SX12 scanning total station. Video view options have been added to all of the traverse and network measurement workflows, except for the **Check** workflow in **Network Measurement**.


Scanning with Siteworks

Siteworks can be used to collect both point cloud scans and photo panoramas with the SX12 scanning total station. The instrument must be set up in the project coordinate system (for example, at an established location on a control point or via resection) to complete a scan. If the SX12 instrument is not set up and you tried to perform a scan, the Siteworks software informs you that you must complete a station setup and takes you to the **Station Setup** menu. You cannot take a “free-station” scan and collect a non-georeferenced point cloud. To collect a photo panorama, you cannot collect only a photo panorama; you also must collect a point cloud.

At the completion of the scan, the data are sent from the SX12 instrument to Siteworks over the currently selected communication protocol (Wi-Fi, radio, or cable). Wi-Fi or cable is the preferred connection method when performing a scan, due to the limited bandwidth of the 2.4 GHz radio connections. If the scan transfer fails or the instrument or data collector battery dies during the scan, then the scan data are lost and the scan will need to be recollected.

NOTE – The scan data engine used by Siteworks has some system path limitations that limit the length of the work order name if a long project name and work order name are used. If the path length is too long when attempting to start a scan, Siteworks prompts you to create a new work order with a shorter length.

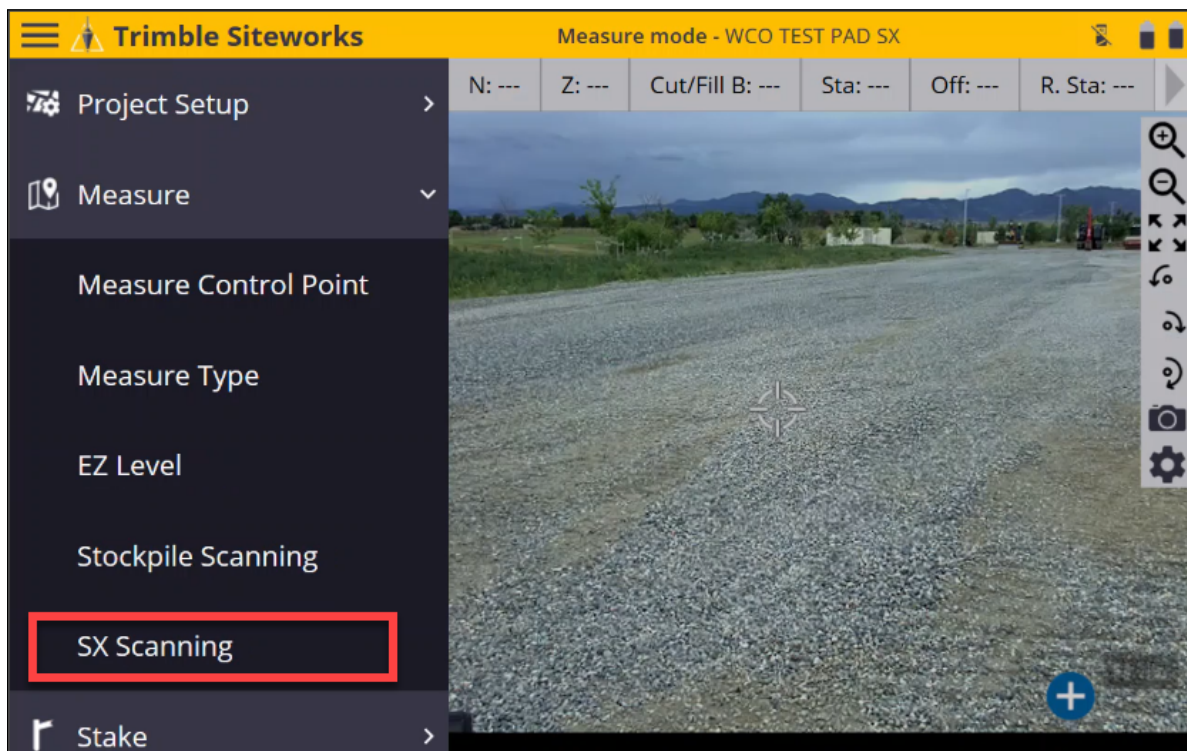
Configuring and collecting a scan

To configure a scan, tap the Measure Mode icon  to show the various measure modes when in the main map screen. Select **SX Scan** to enter into the Scan workflow.

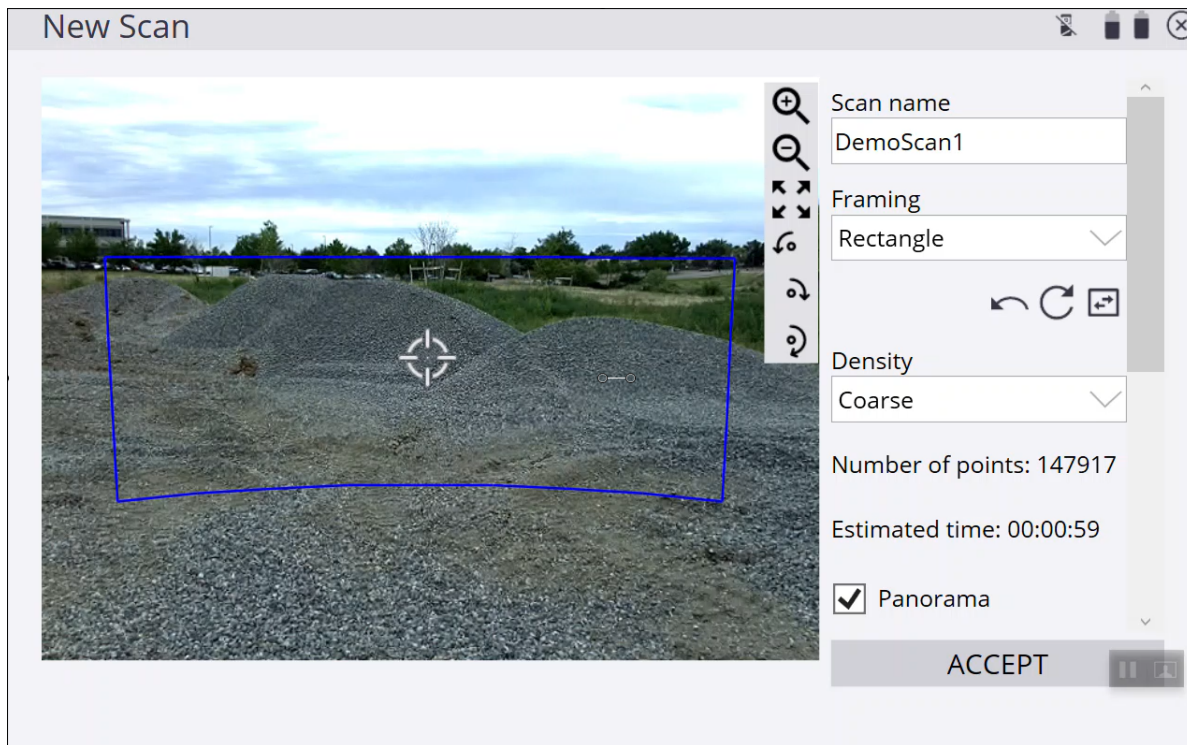
NOTE – The existing “DR Scanning” available on the SPS series total stations has been removed from this menu when connected to an SX12 scanning total station, since a full point cloud can now be collected. DR Scanning is still available with SPS series total stations. The Stockpile scanning functionality with the SX12 remains the same as with SPS total stations.



You can also access the **SX Scanning** menu option through the **Menu / Measure / SX Scanning**:







In the **New Scan** window, configure the **Scan name**, **Framing** (Rectangle, Polygon, or Full Dome), **Density**, and if a photo **Panorama** is to be collected.



Selecting **Rectangle** allows for tapping two corner points of a rectangle and collecting the scan and photo panorama within the rectangle. Tap on opposite corners of the rectangle to create it on screen. The rectangle may show curved top and bottom boundaries that reflect the true geometry of the rectangle when overlain onto the video image.

To tap a corner point outside the current field of view, drag on the screen to pan the view or use the turn 90°




left  / right  or 180°  to turn the instrument and then tap on the second corner point of the rectangle. It does not matter if you tap on the lower or upper corners of the rectangle first, however the side of the rectangle that is tapped first will configure the geometry of the rectangle: Tapping first on the left and then right of the video view creates a rectangle between the two points. Tapping right first and then left creates an “inverted” rectangle that is drawn behind the instrument and represents a horizontal band scan connected on the outside of the tapped points.

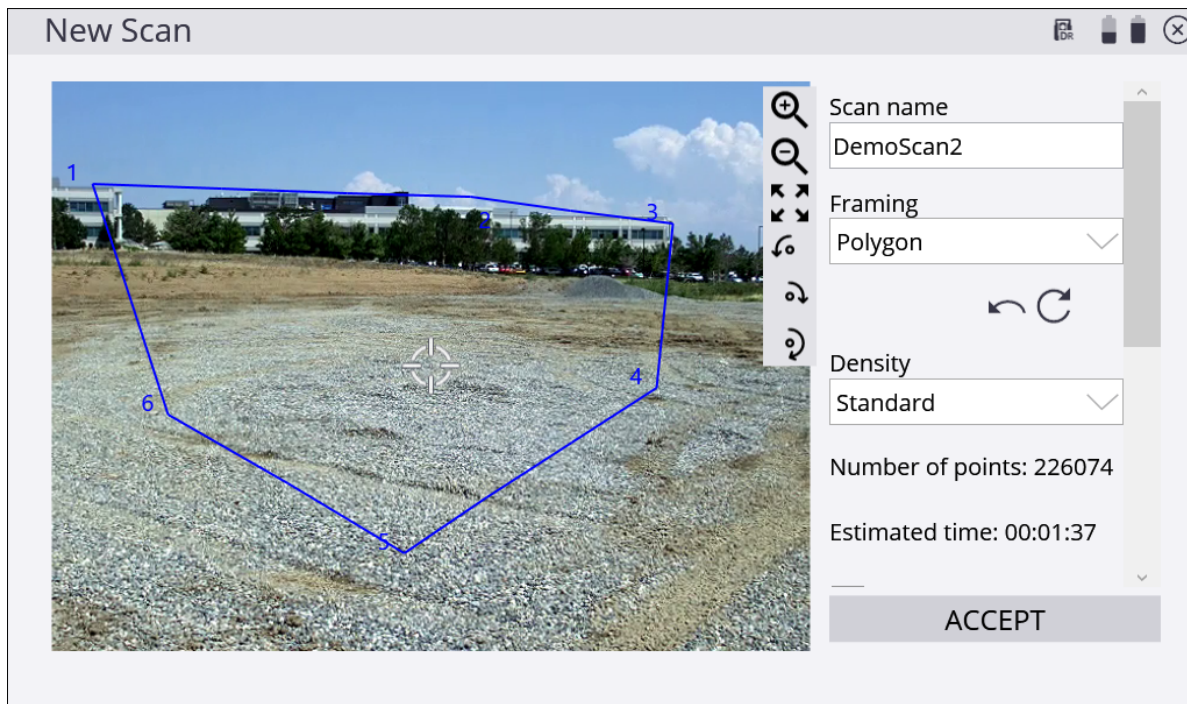
To reverse or invert the rectangle, tap .

The  button undoes the last selected point and  resets the rectangle.

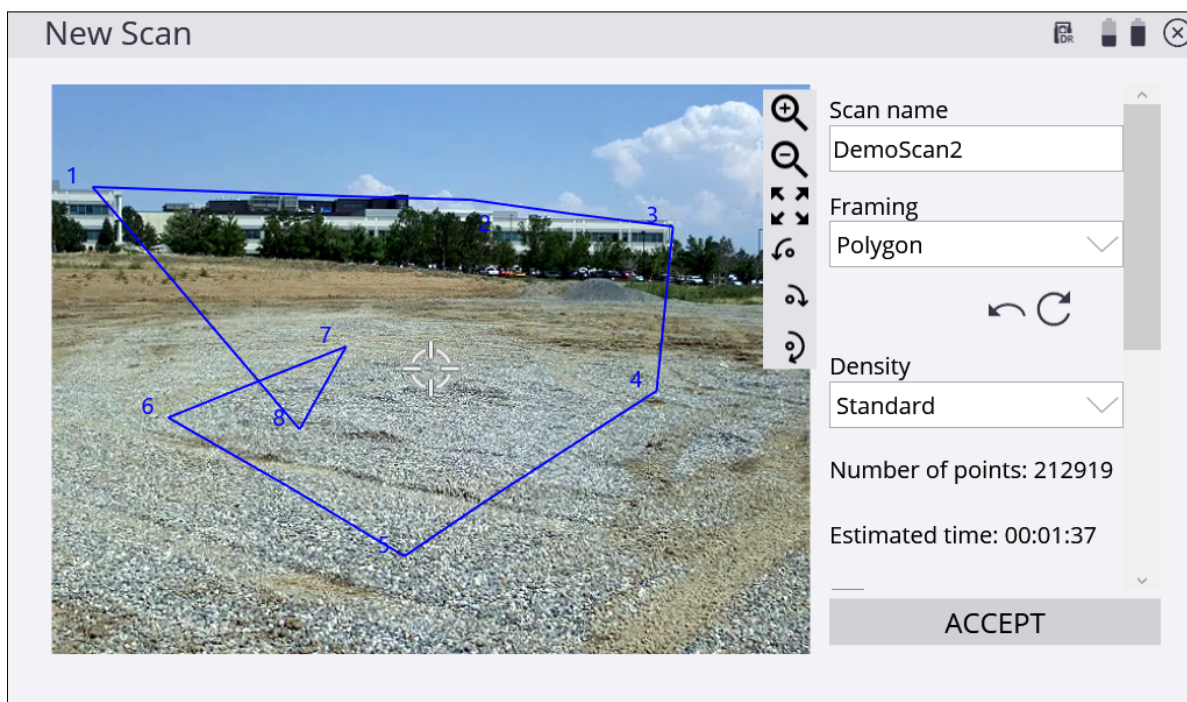
The estimated number of points and time to collect the point cloud are updated in real time depending on the size of the rectangle.



Select **Polygon** to draw a closed polygon around the area of interest to collect a scan and panorama within the polygon. Tap points on the video view to draw a polygon. A minimum of three points are required. To tap a point

outside the current field of view drag on the screen to pan the view or use the turn 90° left  / right  or 180°  to turn the instrument and then tap on the next points of the polygon. The polygon may appear to show curved segments that reflect the true geometry of the polygon when overlain onto the video image.



NOTE – The polygon segments are not allowed to cross each other, and Siteworks sends an error if any of the segments cross over. For example, the polygon geometry shown below is **not permitted** and causes an error in Siteworks.

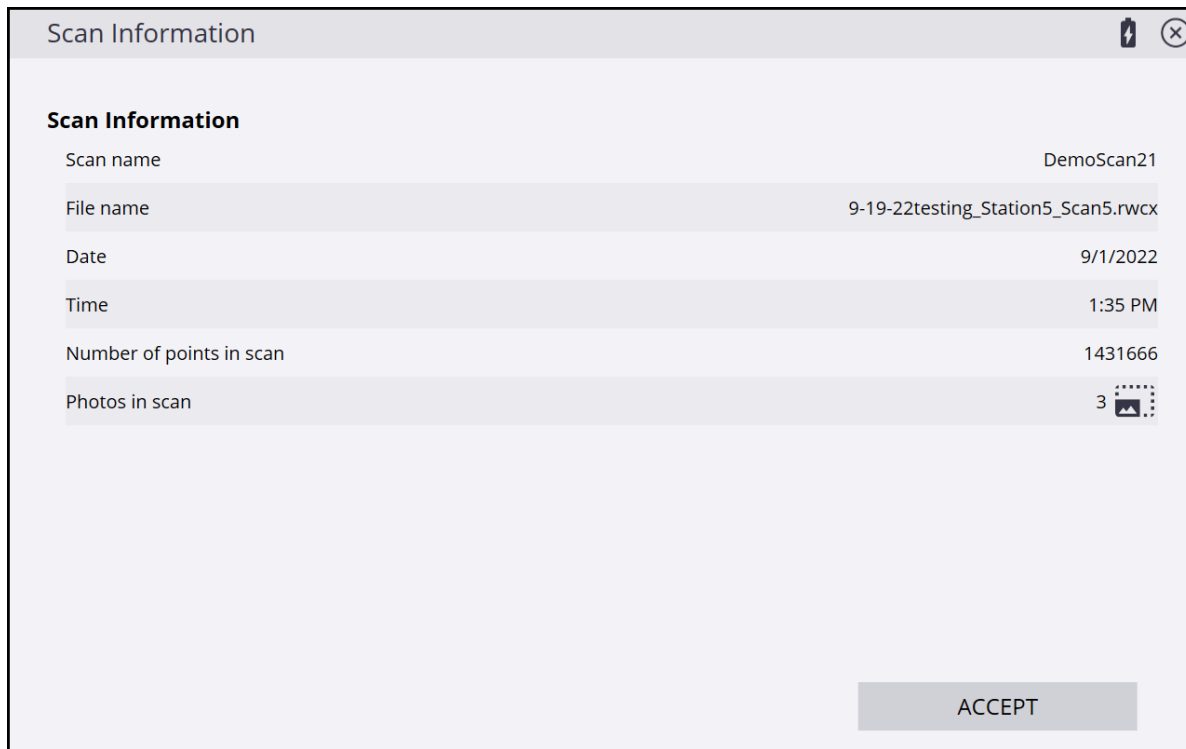



The  button undoes the last selected point and the  button resets the polygon. You cannot edit the shape of the polygon once drawn, other than by undoing individual points or resetting the entire polygon. The estimated number of points and time to collect the point cloud are updated in real time depending on the size of the polygon.

A **Full Dome** scan collects a full 360° scan from the lowest downward facing view of the SX12 instrument, up to the sky, and all the way around the instrument.


Min Max – This setting is used to configure the distance range over which scan points are collected. Only those points between the min and max will be saved to the point cloud. At this time, the setting only accepts values in project units, for example, you cannot enter "5m" for using meters in a foot project, or feet in a metric project.

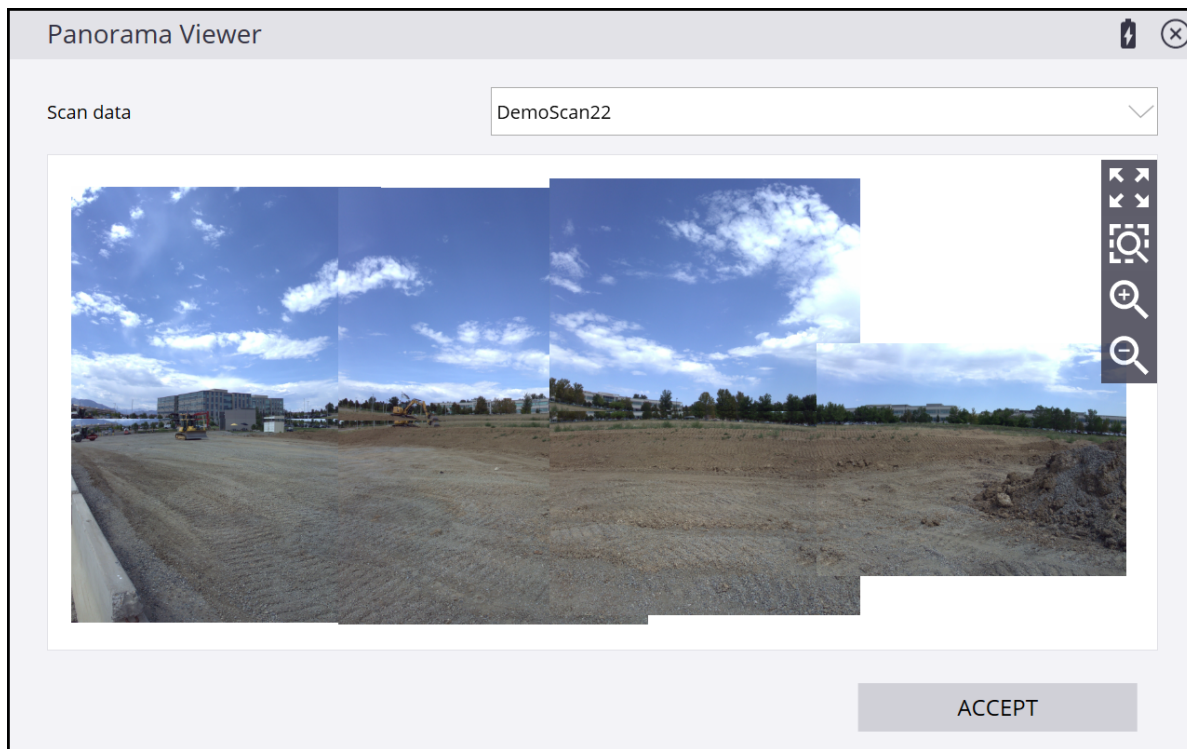
Scan location markers & Scan Information – A new red triangle symbol has been added to indicate the location of scan stations on the plan view. The symbol is similar to the control point marker, just red in color. Tapping and holding on this marker will open the **Scan Selection** dialog, where you can choose from the scans made at that station. If only one scan was performed, then the **Scan information** page appears. The scan information page indicates the scan name, file name of the RWCX file collected, date, time, number of points, and number of photos in the panorama.




Scan Information	
Scan name	DemoScan21
File name	9-19-22testing_Station5_Scan5.rwcx
Date	9/1/2022
Time	1:35 PM
Number of points in scan	1431666
Photos in scan	3 

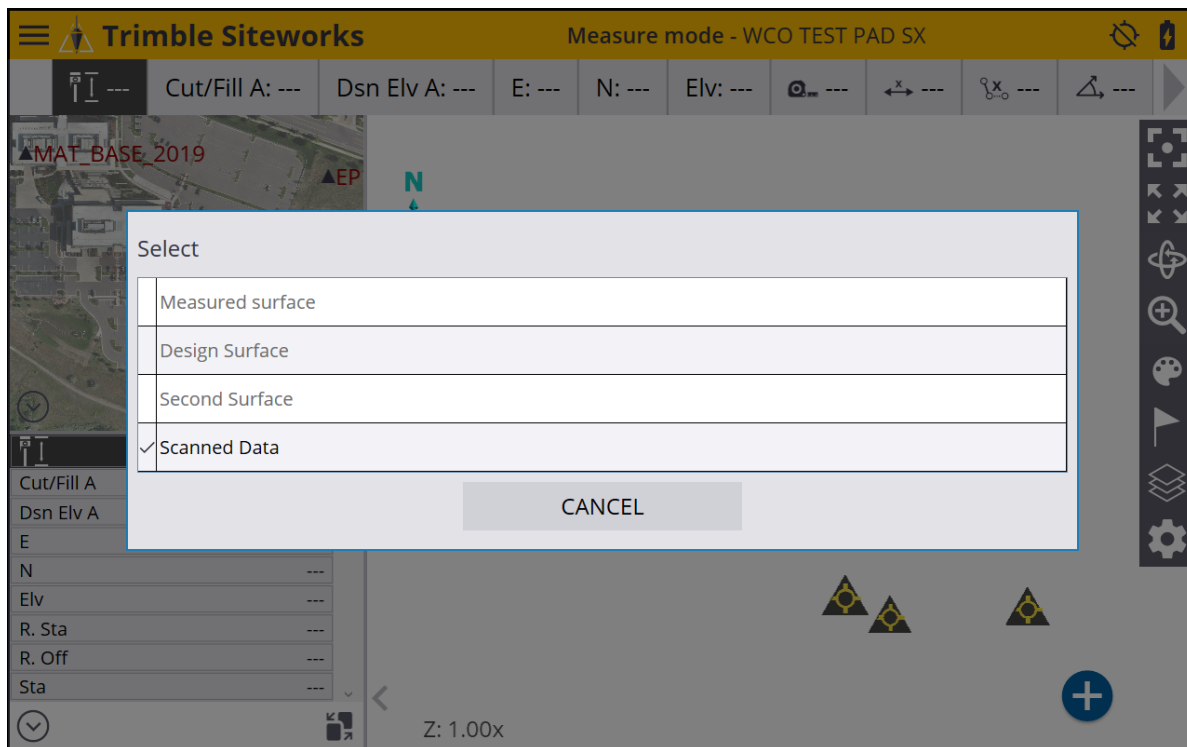
ACCEPT

Tapping the  icon next to the number of photos will open the **Panorama Viewer** page. This icon is only present if a photo panorama was collected. The Panorama Viewer allows for panning and zooming on a stitched panorama of the photos collected at each station. To select a different scan, select it from the dropdown menu at the top of the screen. Tapping in the panorama will show the individual photo that is tapped on.



Visualizing point clouds in Siteworks

Collected point clouds are visualized in the 3D window on the main Siteworks screen. When the 3D window is in the main panel, tap the surface selection icon  from the 3D view toolbar and select **Scanned Data**.




A progress bar appears while Siteworks creates the necessary database files in the currently opens Scan Data folder of the work order.

NOTE – Due to some of the internal visualization settings in Siteworks, the point cloud may not appear immediately as it can take several seconds to render the point cloud in the 3D view.


All standard 3D view controls for center on position, zoom extents, rotate, zoom, etc., all work the same with point clouds, as with surfaces.










All scans collected in the currently open work order are displayed. To change the colors of the scan data, tap the palette icon . The following options appear:

Option	Description
Scan Color	Each individual scan is colored separately
Station Color	All scans from a given station are the same color
Gray Scaled Intensity	All scans are gray scale based on the intensity values
Color Coded Intensity	All scans are colorized based on the intensity values

You cannot set the colors of individual scans. Also, “true color” scans based on a colorized point cloud extracted from the photo panoramas are not available in Siteworks.

To open the **Scanned Data** info screen, tap  when scanned data are selected. This screen displays the colors of the individual scans, and lets you turn the display of individual scans off and on by tapping the **Enabled** check box.

Scanned Data

Scan name	Station Name	Scan Color	Enabled
FullDome1	Resection0001		<input checked="" type="checkbox"/>
Demo1	Resection0002		<input checked="" type="checkbox"/>
RECT1	Resection0003		<input checked="" type="checkbox"/>
POLY1	Resection0003		<input checked="" type="checkbox"/>
POLY2	FLAMINGO		<input checked="" type="checkbox"/>
POLY3	FLAMINGO		<input checked="" type="checkbox"/>
POLY4	FLAMINGO		<input checked="" type="checkbox"/>


ACCEPT






Photo panorama

To collect a photo panorama, select the **Panorama** checkbox and configure the **Camera**, **Image Overlap**, **Target illumination**, and **Fixed exposure** options.

There are two options for the **Camera** field: Overview and Primary. The Telecamera is not available due to its small field of view and the large number of photos that would be collected. The selection of the camera will affect how many photos are included in the Panorama. The number of images and estimated time to collect the panorama will update in real time based on the camera selection.

New Scan



Estimated time: 00:02:17

☒ Panorama

Camera

Primary

Image overlap (%)

10

☒ Target illumination

☒ Fixed exposure

Number of images: 40

Estimated time: 00:02:39

ACCEPT

Selecting the **Target illumination** checkbox will turn on a small light on the SX12 scanning total station, that will typically cause any targets present in the panorama to be brighter, depending on ambient lighting conditions. The Target illumination checkbox is only available when the Primary camera is selected.

Selecting the **Fixed exposure** checkbox will lock the camera exposure to keep the exposure values consistent across all the photos in the panorama.

Managing scan and photo panorama data

All scan data including the point cloud and photo panoramas are placed into a new **Scan Data** folder that is created in the currently open Work Order folder. The scan produces .RWCX point cloud files, .JPEG files for the panorama images, and several other scan database files necessary for referencing the scan information into the project's coordinate system.

The .RWCX files are Trimble proprietary data formats that must be imported into the Trimble Business Center software or the Trimble RealWorks software to view and process. To ensure proper point cloud visualization in Siteworks and importing into office software, **do not move** any files from their locations in the Scan Data folder.

Scan and photo panorama data is not uploaded to the WorksManager software; the scan data folder will not be available for download from WorksManager. Scan data transfers off the data collector need to be done via USB or some other means such as a shared drive, OneDrive, Google Drive, or DropBox. It is suggested to simply copy the entire Work Order folder containing the scan data onto a USB drive for import and use on a PC.

Using point cloud data in the Trimble Business Center software

To use point clouds in the Trimble Business Center software, you must version 5.80 or later installed, and have the Scanning module installed in siteworks.

To import scan data, copy the Work Order folder containing the scan data onto a USB drive from the data collector, or otherwise place the Work Order folder on the computer running the Trimble Business Center software. Drag and drop or import the .SPJ file in the Work Order folder.

NOTE – If the Work Order folder is on a USB drive, it is not necessary to copy it onto the PC first. Dragging and dropping the .SPJ file into the software directly from the USB automatically copies the scan and panorama data into the project folder.

For versions earlier than 5.80, you must first export a .JXL file from Siteworks via the **Menu / Data Management / Export Measured Data / SX scan data** and select JXL, LAS or LAZ, and then import the files into the Trimble Business Center software.

Export Measured Data

Export type: SX Scan Data

Data format: JXL

File name: JXL, LAS (Universal), LAZ (Compressed)

ACCEPT

The .JXL, .LAS or .LAZ file is placed in the Scan Data folder in the folder of the currently open work order. Dragging and dropping or importing the file into the Trimble Business Center software automatically imports and properly georeferences the scans and any photo panoramas collected with the scan. LAS or LAZ data can be used in third-party software used for point cloud visualization and processing.

All the individual scans are imported, georeferenced, colored (if a photo panorama was collected), and the photo panorama referenced for use in a Station View.

For more details about working with point clouds, refer to the Trimble Business Center Help installed with the software.

Emulator

An emulator is available for the SX12 scanning total station when connecting in **Emulator** mode. The functionality to emulate scanning is limited and the video view used throughout the emulator is a static image.

Advanced Total Station Features

- Scanning stockpiles
- Adjusting the total station
- Measure Control Network
- Measuring rounds of angles

Direct reflex (DR) technology is included in all SPSx30 Universal Total Stations as well as all SPSx20 Construction Total Stations. This technology offers many advantages such as stockpile scanning for accurate volume calculations.

The range varies depending on the total station you are using:

- The SPS620 and SPS720 total stations offer DR Standard technology, which enables you to measure reflectorlessly, to a maximum distance of 150 m (492 feet).
- SPSx30 total stations offer DR+ technology, allowing reflectorlessly measurement of objects up to 1,600 meters (5,249 feet) from the instrument.

Scanning stockpiles

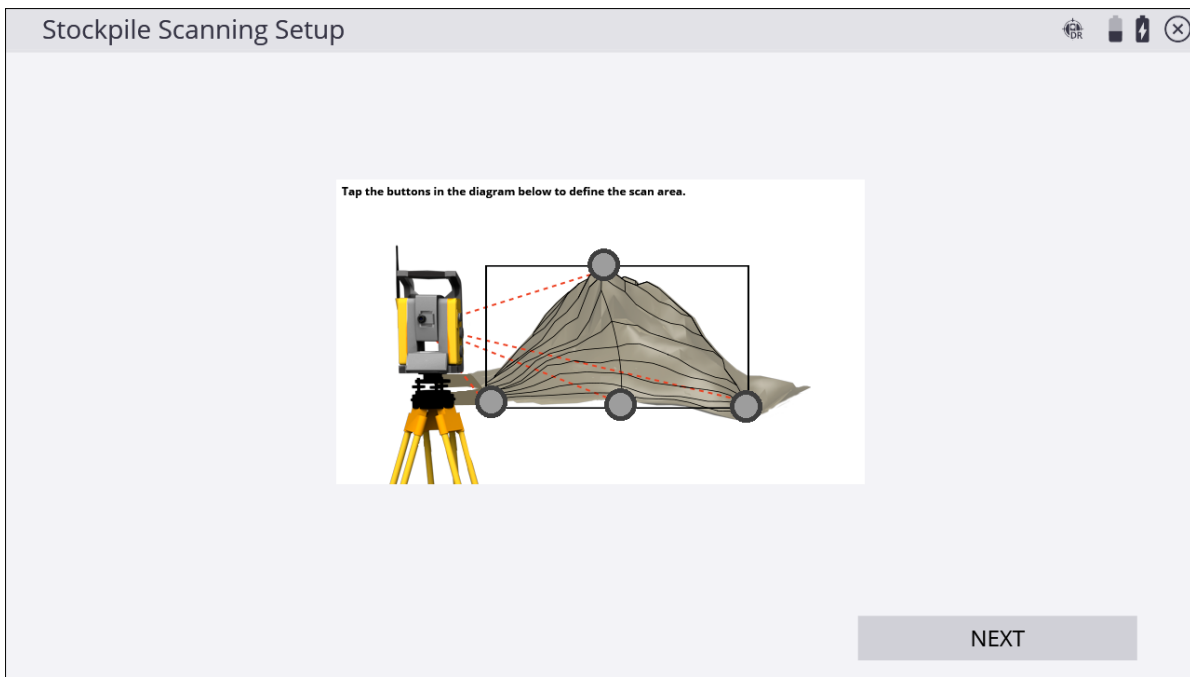
The Stockpile scan is designed to collect very accurate data for reporting on the volume of material that you have or that has been excavated. By scanning the stockpile or excavation, the need to place a worker in potentially unsafe conditions is eliminated. Reflectorless measurement technology enables you to set up the total station and measure to surfaces without using a target or prism.

Given the line-of-sight restrictions when using a total station, you need to perform a minimum of two station setups to collect all sides of the stockpile:

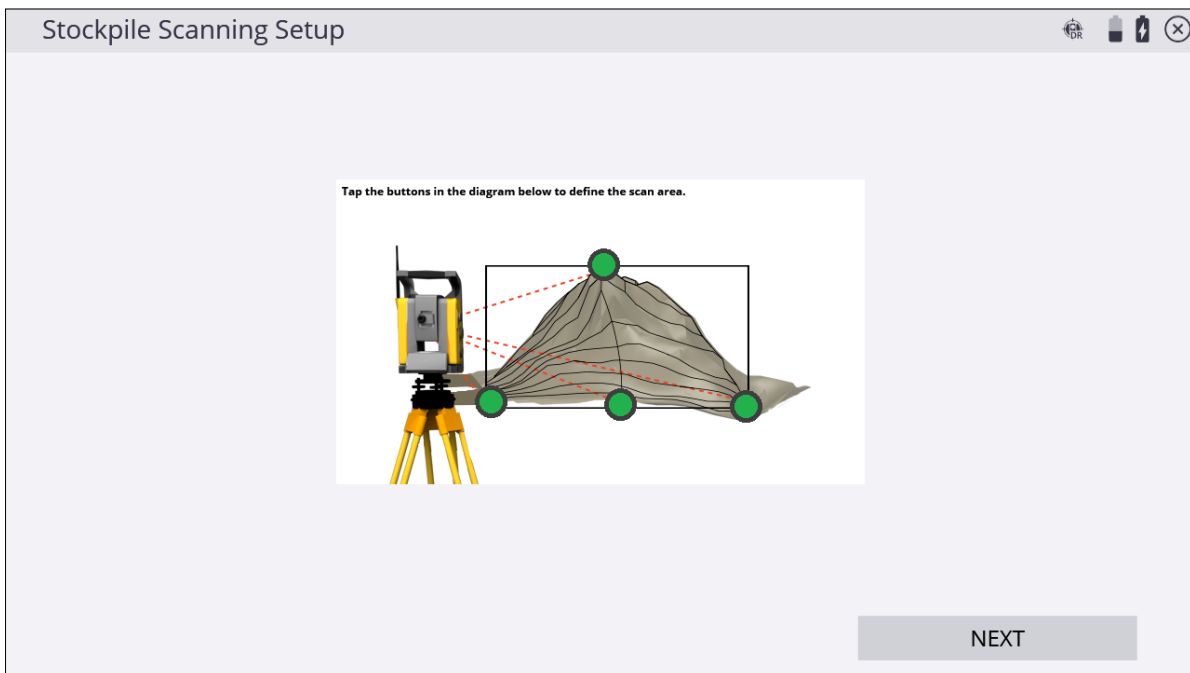
1. From your first setup, measure new control points around the stockpile in locations that will give you the fewest setups and the best vantage points to scan the largest surface area of the stockpile. This enables you to collect all sides of the stockpile and have the surface points correctly related to each other.
2. Once the whole stockpile has been scanned, define a volume boundary in the **Cogo** menu by tapping the points to be used to define the boundary, or by selecting an existing measured Volume Boundary Line and then perform a volume calculation in the field.

To set up stockpile scanning:

1. From the **Home** menu, tap **Measure** and then tap **Stockpile Scanning**.
2. The software sets the instrument to DR mode, and then the following screen appears:



3. Define the shape of your stockpile. Start by tapping the gray dot at the highest point of the stockpile image on the screen.
4. Select a measured or control point by tapping on the screen, selecting it from the dropdown list and tapping **Select**. Alternatively, manually sight your instrument to the highest point of the stockpile and then tap **Measure**. The **Point Mode** screen appears.
5. If required, enter a point code and point name and then tap **OK**. The **Stockpile Scanning Setup** screen reappears.
6. Repeat Step 4 through Step 6 to define the bottom left, bottom right, and bottom most points of your stockpile. Once successfully measured, the points appear green:



NOTE – This feature and the way that the corner points are configured is based on setting the target points on a vertical plane. The lower left and right points set the vertical edges of the plane, and the top and center bottom points define the upper and lower horizontal edges of the plane. If this feature is used at long range, along a gently sloping surface, and/or with a large vertical distance between top and bottom points, it will result in a non-uniform “fan-shaped” spacing of points, as the scan continues to measure points located upwards along the plane, and further from the instrument. This feature is not a substitute for traditional 3D laser scanning methods.

7. Tap **Next**. The **Stockpile Scanning Settings** screen appears:

Point name	Topo3
Point code	
Horizontal interval	0.328 usft
Vertical interval	0.328 usft
Minimum distance	3.281 usft
Maximum distance	1968.500 usft
Timeout (seconds)	3

NEXT

8. Enter a point name and code and set the horizontal and vertical distance intervals. Setting the distance intervals low results in more measured points; setting the distance intervals high results in fewer measured points. Also, having a smaller interval (more points) will result in a longer scan. When entering these values, keep the size and shape of the stockpile in mind. Define your minimum and maximum distances for point data collection and then tap **Next**. Correct use of these settings helps you collect only the relevant points in the field on your stockpile. If a point falls outside of these distance values, it will not be measured. Consider setting the minimum distance to be approximately the distance from the instrument to the bottom of the stock pile (closest desired point to be measured), and the maximum distance to be near the top of the stockpile (furthest desired point to be measured). The software will default to the recommended Timeout value depending on which instrument is being used.
9. The **Scanning Area Estimates** screen displays the total number of points to be collected as a result of the dimension and distance intervals previously entered and an estimation of the time it will take to record the points. This time is an estimate only and the reflectivity of the material, distances involved, and the type of instrument used alters the total time once the scan has started.


Rectangle Dimensions	
Width	38.500 usft
Height	12.000 usft


Scanning Points	
Horizontal	77
Vertical	24
Total number	1848
Estimated time	1 hr 33 min


START

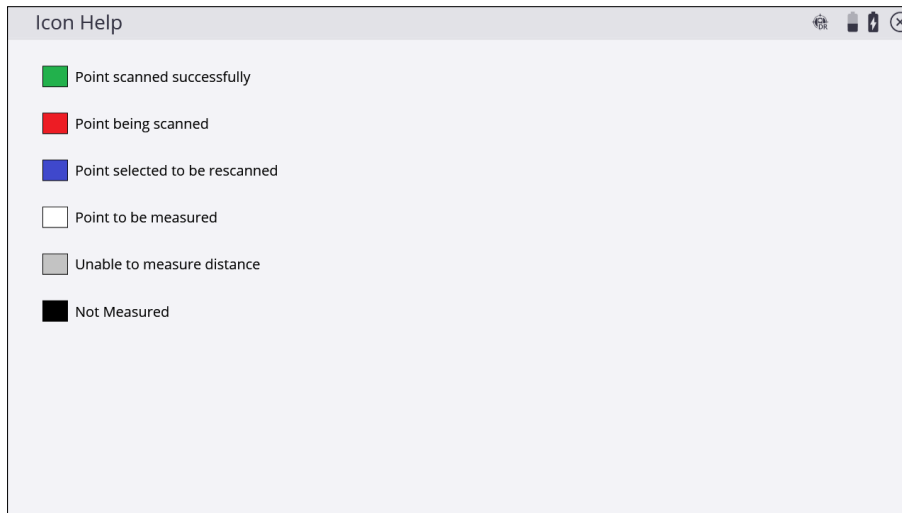
CAUTION – The values stored in Step 8 are overwritten by the minimum and maximum values set in the **DR Target Settings** screen. Ensure that you check the values set in the **DR Target Settings** screen to eliminate confusion by another operator when they are setting the Stockpile Scan settings. Setting the minimum distance to 2 meters (6.56 feet) and maximum distance to 1600 meters (5,249 feet) in the **DR Target Settings** screen eliminates any errors when setting the Stockpile Scan settings.

TIP – When working at the maximum ranges of the DR technology, increase the timeout setting. When adjusting the timeout settings, be aware the material being measured affects the strength of the response signal. The instrument's technology also affects the time it takes to record each individual point.

10. Either tap the back arrow to go back and change any settings before starting the scan or tap **Start** to start the scan.
11. A grid is displayed as the scan proceeds. Scan time remaining is displayed in the **Estimated Time Remaining** field. If you need to change the minimum and maximum distance settings, tap **Pause** and then tap . Change the minimum and maximum settings and then tap **Next**. The scan will resume.

12. Tap  in the map control bar on the right to display the map view so you can see the points being collected.

TIP – For an explanation of the different grid sector colors, tap  in the upper right of the screen. The following screen appears:



13. To rescan any cells, tap **OK** to return to the measured cells display. Tap the associated grid sectors with your stylus. Selected sectors turn blue. Once the selection is made, tap **Rescan**. Repeat the rescan function until results are satisfactory and then tap **Finish**.

Adjusting the total station

All total stations require regular and routine checks and adjustments to deliver optimum results. All Trimble total stations allow fully accurate measurements to be made with a single pointing to a target. To achieve those results, the total station stores its current adjustment values internally, and then corrects all measured data accordingly. For accurate measurements to be made, the current adjustment values need to be determined and stored in the memory. Total station adjustments are required because of the optical-mechanical design of the instrument. The following conditions can move the optics and mechanics out of adjustment:

- Shipping and handling
- Bumps and knocks
- Temperature and pressure changes
- Storage conditions
- General wear and tear of mechanics

To start the calibration:

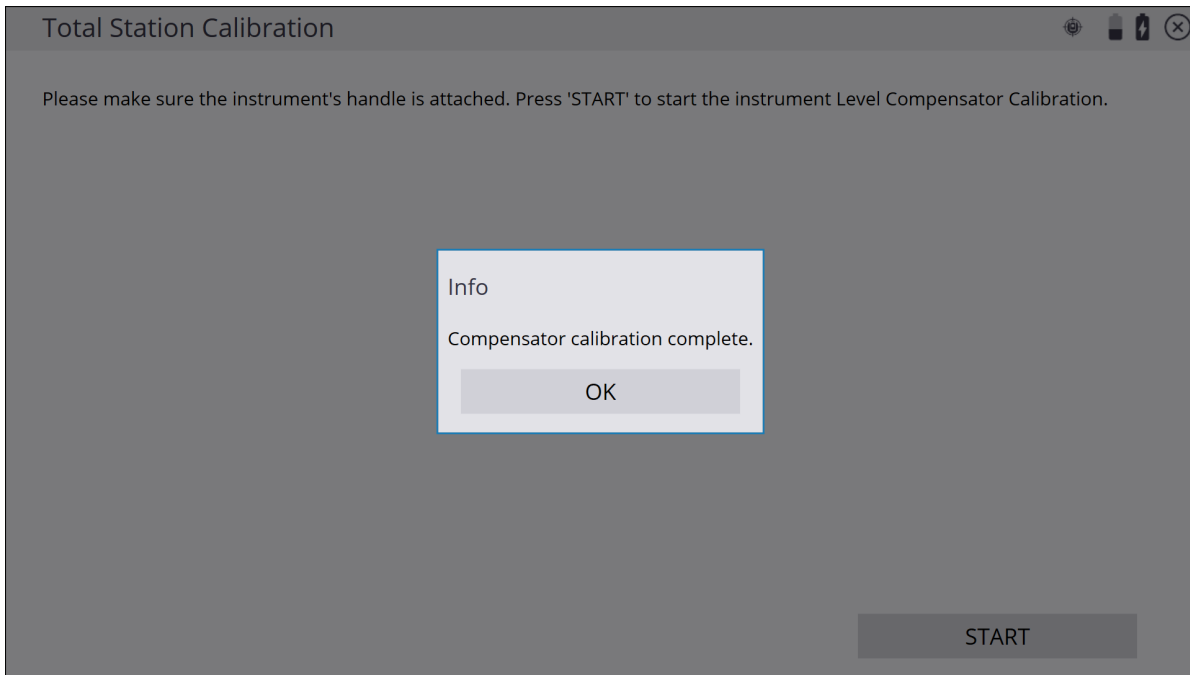
1. From the **Home** menu, tap **Settings / Total Station Calibration**.

Compensator Calibration

CAUTION – You must perform this calibration before the HA VA Collimation and Tracker Collimation. The compensator does not need to be calibrated every time the other collimations are performed, but if the Compensator Calibration is performed, you should immediately perform the HA VA Collimation and Tracker Collimation. Performing the Compensator Calibration negates the validity of the values of the errors found from previous HA VA Collimations and Tracker Collimations.

The SPS family of motorized total stations is all equipped with a dual-axis compensator. The compensator is active when the total station is switched on. You should periodically calibrate the compensator to adjust for any minor changes in the total station caused by normal wear and tear, as well as shipping or temperature variations. It is extremely important to perform this calibration when you are working within a very tight tolerance range. You should also perform this calibration whenever the highest accuracies are needed.

2. Tap **Start** to initiate the instrument Level Compensator Calibration:



3. Tap **OK** when the calibration is complete.

HA VA Collimation test

You should perform this test to a target that can be easily bisected with both the horizontal and vertical cross-hair, placed at a location at least 100 m (328 feet) from the total station, and at approximately the same elevation as the total station telescope. The target can be any object including a road sign, window frame, or an adhesive prism target. The test involves taking a series of HA VA measurements to the target in both instrument faces, to generate a mean or averaged pointing in face 1 and face 2, from which the difference between face 1 and face 2 readings can be determined. The difference between the two face readings is known as the collimation error. In the horizontal axis, the collimation error has little effect on measurements. However in the vertical axis, if not corrected for, the collimation error will result in erroneous elevation values for all measured points.

4. Enter the number of measurements, aim at the target and then tap **Measure**:

Set target at about 100m away and aim at the target for HA VA Collimation.

Number of measurements

Press 'MEASURE' to take measurements.

Face 1 observations	0
Face 2 observations	0

MEASURE

The collimation test computes the collimation error, stores the error inside the total station and then corrects all subsequent measurements for that error before displaying them on the screen or storing them in memory.

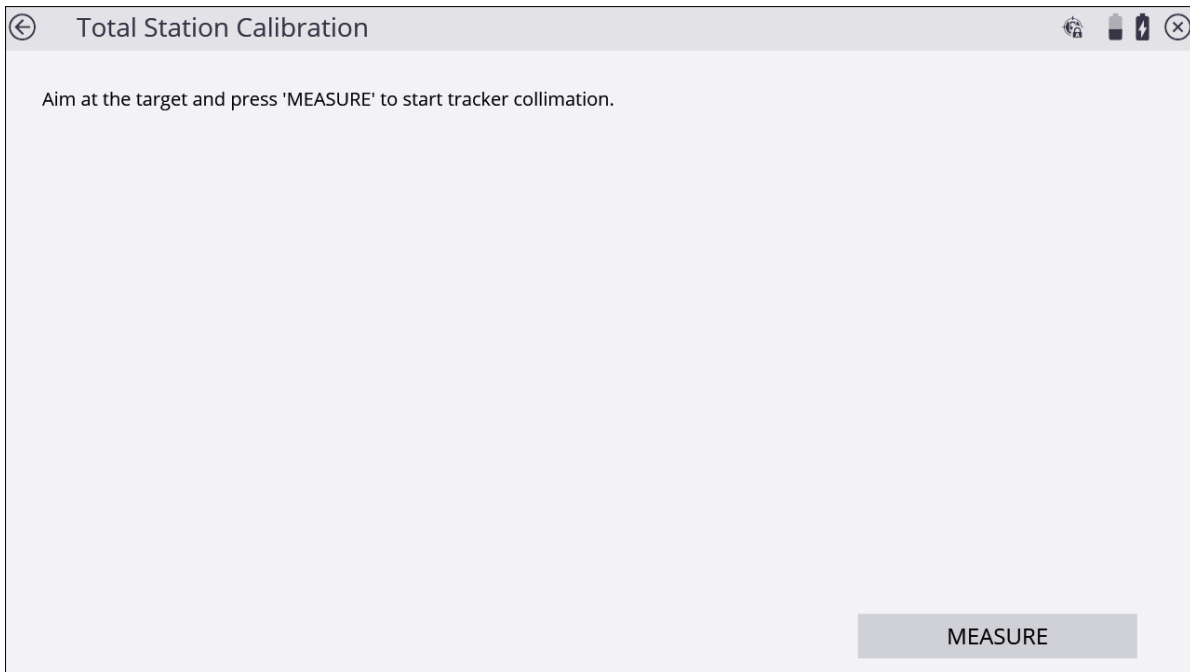
5. Tap **Next**.

Tracker Collimation test

You should perform this test towards a prism or active target set up at a distance of around 100 m and at approximately the same elevation as the total station telescope. Ideally, perform the test at the approximate range that subsequent measurements will be made.

The test involves the total station locking onto and measuring an average position over a period of time in both faces to determine any misalignment of the tracker in relationship to the telescope cross-hair. If not corrected for, this error results in erroneous position determination in both horizontal and vertical axes, and also between measurements made with and without Autolock technology. Once measured, the error is stored in the total station, and is used to correct all subsequently measured positions.

6. Aim at the target and tap **Measure**:



NOTE – There can be two reasons for significant change between old and new values: (1) The total station has received a knock or bump in transit that may need a service correction, or (2) there has been an observation error.

If you suspect an observation error, repeat the process. If the values are repeated, you may want to contact an authorized Trimble Service Center for advice. When the values exceed a certain level, you will be advised to send the total station to an approved Trimble Service Center for recalibration.

NOTE – The values displayed when new will be close to zero, but over time these are expected to change. Non-zero values are no cause for concern; however, sudden large changes should be cause for concern because they indicate misuse, abuse, or transportation problems. For full details of the instrumentation errors, refer to your instrument manual.

7. Tap **Finish**.

Measure Control Network

The Siteworks software includes the Measure Control Network function, which enables you to configure and measure rounds of angles to different control points of a network or traverse. When you measure at least two rounds to a control point, the software will calculate the standard deviation for each foresight and backsight target (accuracy) and the standard deviation of the mean (precision). This enables you to evaluate the quality of the measurements in the field.

To use this function, you must purchase and install the Advanced Measurement module. When connected to an SPS instrument, the **Total Station Setup** menu contains a new option called **Measure Control Network**. To adjust a traverse or control point network measured with this feature, you need the Total Station Processing module for the Trimble Business Center software. The Siteworks software exports the RAW data to a DC file, which is then imported into the Trimble Business Center software.

Measuring rounds of angles

To start the network measurement:

1. Open a project and work order that contains your existing control points and connect the controller to an instrument.

Optionally, you can perform an instrument setup before starting the network measurement. This enables you, during the configuration of the network measurement, to check the point locations to verify if the prisms were set up over the correct control point.







2. Tap **Home / Project Setup / Total Station Setup** and select **Measure Control Network**. Tap **Accept**.
3. Use the following screen to configure the measurements for a control point:

Network Measurement

Point name	Point code	Northing	Easting	Elevation	Target height	Target type	DR	Angle only	Autolock

NEXT

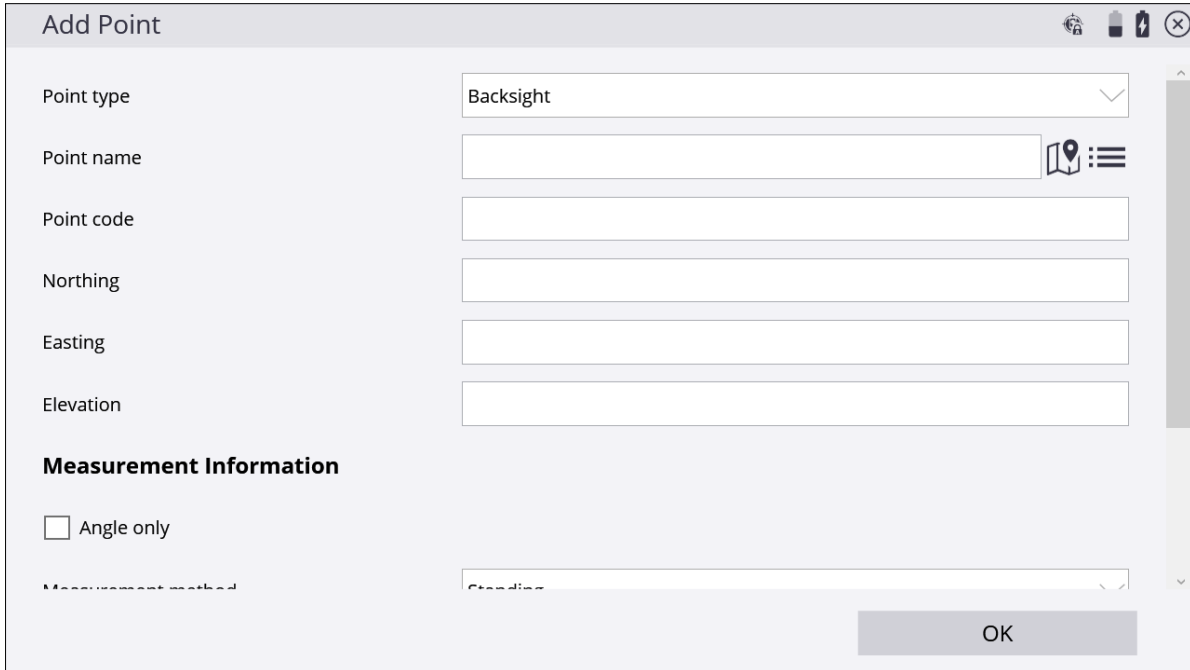
4. The **Network Measurement** screen contains the following buttons:

Tap this button ...	to ...
	add a new point to the list.
	measure and add a foresight point to the list.
	check a point location.
	edit point information.
	delete a point from the list.
	edit the settings for network measurement.

5. To add an instrument point followed by all the backsight points for your setup,

tap .

If the control point is not included in the Control Point file yet, then enter the coordinates in the following screen:



Add Point

Point type: Backsight

Point name:

Point code:

Northing:

Easting:

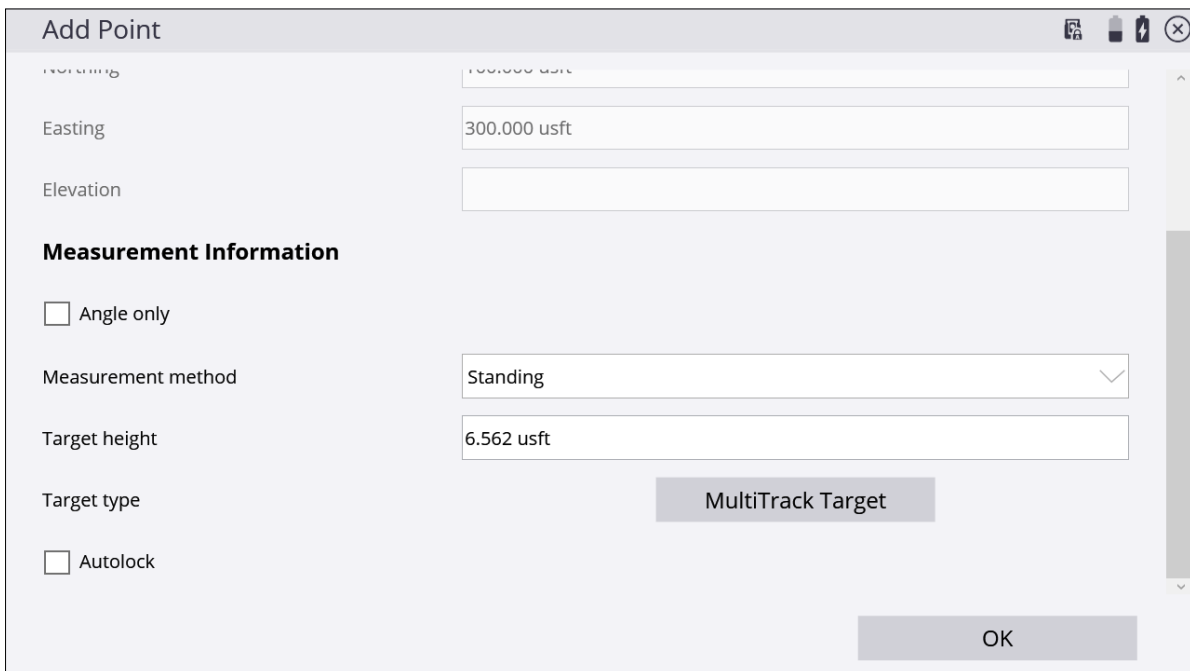
Elevation:

Measurement Information

☐ Angle only

Measurement method: Standing

OK



Add Point

Northing: 100.000 usft

Easting: 300.000 usft

Elevation:

Measurement Information

☐ Angle only

Measurement method: Standing

Target height: 6.562 usft





Target type: MultiTrack Target

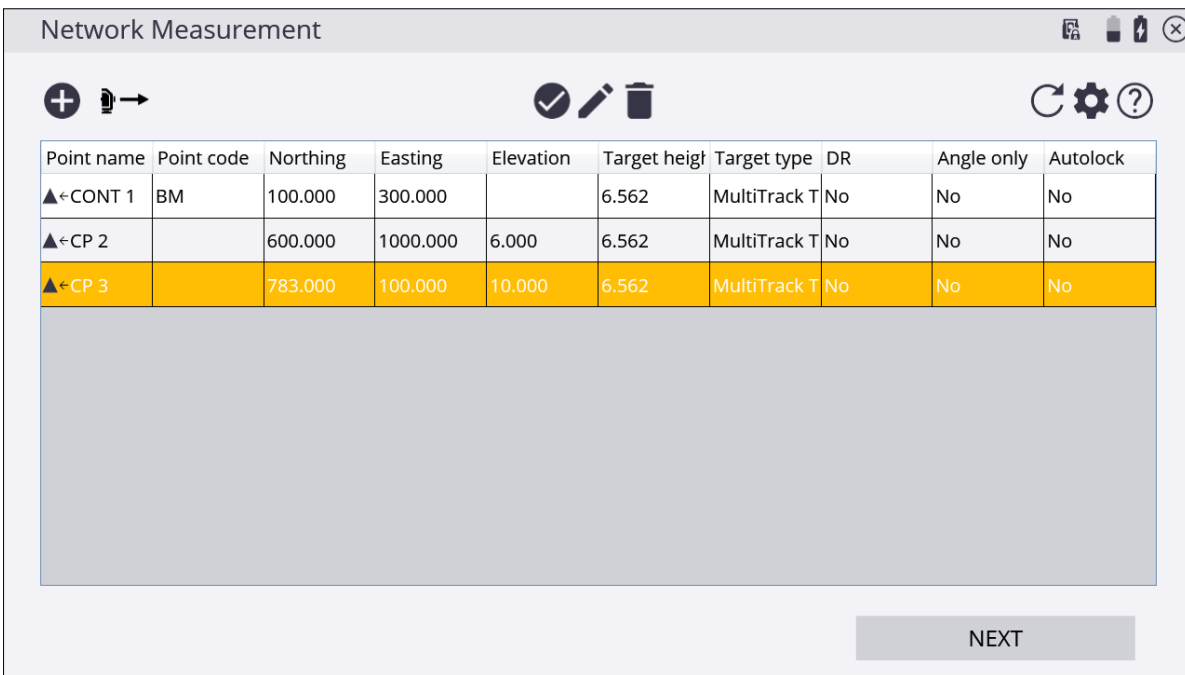
☐ Autolock

OK

6. In the **Measurement Information** group, you can decide if an individual control point should only be measured reflectorlessly or angle only, and can enter the correct target height, target type, and target ID.
7. When selecting the **Autolock** option, the instrument will automatically lock on the prism after the first set. If you leave this option cleared, you will manually need to aim the total station at the prism each time.

TIP – When adding the next point, tap **Use Last Settings** to copy the settings from the previous point so that you do not have to re-enter all the values.


8. To add and measure new control points as foresight points, tap . To configure the point, see Step 4 through Step 5.
9. If required, tap  to check the point location of an individual point from the list and verify that the prism is set up over the correct point.
10. Tap  to edit the configuration of each point or tap  to delete it from the list completely.
11. Once the configuration is correct, tap **Next**:



The screenshot shows the 'Network Measurement' screen. At the top, there are icons for adding a point, using last settings, checking a point, editing, deleting, and a help/question mark. Below these is a table with the following data:

Point name	Point code	Northing	Easting	Elevation	Target height	Target type	DR	Angle only	Autolock
▲←CONT 1	BM	100.000	300.000		6.562	MultiTrack T	No	No	No
▲←CP 2		600.000	1000.000	6.000	6.562	MultiTrack T	No	No	No
▲←CP 3		783.000	100.000	10.000	6.562	MultiTrack T	No	No	No

Below the table is a large empty rectangular area. At the bottom right, there is a button labeled 'NEXT'.

12. Tap  to configure the face and round order as follows:

Tap ...	to set ...
F1	all targets only in face 1.
F1 F2	all targets only in face 1 first and then swaps in face 2 and measure all targets again.
F1/F2	each target in face 1 and then face 2 before going to the next target.
123...123...	all targets in face 1 from left to right then swap in face 2 and measure from left to right.
123...321...	all targets in face 1 from left to right then swap in face 2 and measure from right to left.

13. To calculate the standard deviation for each target, measure at least two rounds.
14. Tap **Next** and then tap **Next** again to access the **Measurement** screen. The Siteworks software prompts you to aim at the different targets and measure the first set. To measure the remaining sets automatically, enable Autolock.
15. While measuring the second set, the software indicates the differences between face 1 and face 2. If the measurements are within the tolerances that were entered for the differences between face 1 and face 2, the software shows the status "PASS" for that point.

16. When all the rounds are measured, the software shows the **Standard Deviation of Measurements**, which is an indication for the accuracy of all of the measurements. The **Standard Deviation of the Mean** gives an estimate of the precision of the measurement.

Network Measurement Result

Standard Deviation of Measurements

σ HA	0°00'00"
σ VA	0°00'00"
σ SD	0.000 usft
σ HD	0.000 usft
σ VD	0.000 usft

Standard Deviation of the Mean

σ HA	0°00'00"
σ VA	0°00'00"
σ SD	0.000 usft
σ HD	0.000 usft
σ VD	0.000 usft

NEXT

17. The next screen shows the differences between the measured rounds for each target:

Set Up Instrument Position

Setup error is in tolerance.
 HA: 0°00'00" HD: 0.032
 ΔX: 0.014 ΔY: 0.028 ΔZ: 0.000

Point Name	HA Error	HD Error	VD Error	Delta N	Delta E
<input checked="" type="checkbox"/> CONT 2	0°00'00"	0.032	0.000	0.028	0.014
<input checked="" type="checkbox"/> CONT 1	RefPt	0.029	0.000	-0.026	-0.013

ACCEPT

18. The next screen allows you to select which control points should be stored in the Control Point file of the site. The coordinates are a result of the average angle and distance measurements on one control point, but they do not take a traverse or network adjustment in account:

Save Points

Select the points you wish to save from the list below.

Point Name	Point code	Northing	Easting	Elevation
<input checked="" type="checkbox"/> NCP	CP	100.047	307.538	0.000

ACCEPT

19. Once all measurements and all control points are measured, you can export the RAW data of the measurements for doing a network adjustment. Select the **Home** menu / **Data Management** / **Export Measured Data**. To adjust the network in the Trimble Business Center software, export the data with the Network Measurement (DC) option. An export for StarNet network adjustment software is also available. Use the Network measurement (XSLT). The files with the raw data are stored in the Output folder of the current work order.

Traverse Workflow

- [Example of a closed-loop traverse](#)
- [Control points](#)
- [Building the traverse](#)
- [Adjusting traverses](#)

A *traverse* is a surveying method used by construction surveyors to establish horizontal and vertical control point networks in situations where high accuracy is needed and where GPS is unsuitable to use. The process involves placing survey stations (control points) along a path of travel, and then using the previously surveyed points as a base for observing the next point. To perform a traverse measurement in Siteworks, you require the Advanced Measurement Module.

Traverses consist of three parts: the starting station, the intermediate stations, and the ending station. The starting and ending stations may, or may not, be the same control point. A traverse is said to be closed when it starts and ends on two sets of known control points, and open when it ends on an unknown point. Traverses can be closed with two, three, or four control points depending on traverse type, but the starting and ending stations must be set on and shot to another control point that existed prior to starting the traverse. Currently, the Siteworks software only supports closed traverses.

The intermediate stations are all the stations between the starting and ending station that are “set” as part of the traverse. In all configurations, the points these intermediate stations are set up on will be adjusted after the traverse measurements are completed.

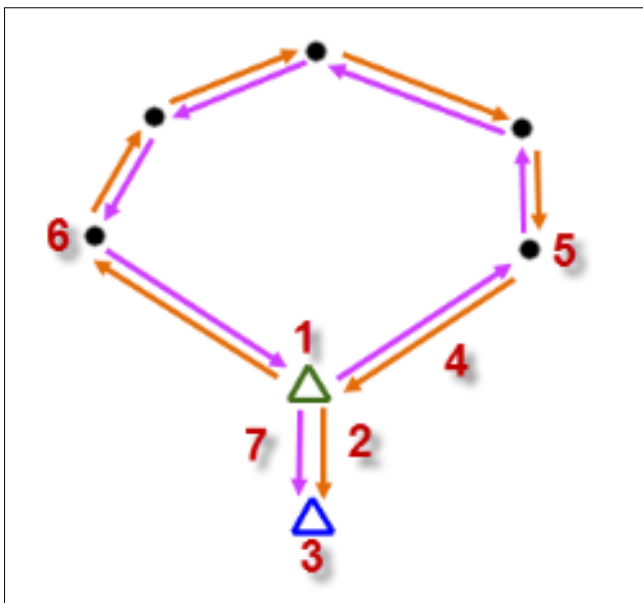
By using the traverse feature in the Siteworks software, you can run any closed traverse and get final adjustment results in the field without needing to export data to other software. The adjustment results will match those calculated in a Trimble Business Center project.

NOTE – You can only measure a Traverse on Windows data collectors. Traverse is not supported on Android devices.

Example of a closed-loop traverse

Below is an example of a typical closed-loop traverse in which the traverse starts and ends on the same control point:

- The starting station (1) is set on a control point with a backsight (orange line; 2) to another control point or known azimuth (3).
- The starting station then foresights (purple line; 4) to the first intermediate station (5).
- Each intermediate station in turn backsights (orange lines) the previous station and foresights (purple lines) the next station.
- The ending station (1) then backsights the last intermediate station (6) and foresights (7) the original control point (3) that was backsighted from the starting station.




Control points

This chapter assumes that the data collector is already connected to a total station. For a detailed description on how to connect to a total station, see [Connecting to a total station, page 183](#).





NOTE – The traverse function only works with 3D control points.

To build a closed traverse, control points for the starting and ending stations are required. There are multiple ways to obtain control points:



- Enter and/or edit the coordinates of the point using the Enter/Edit Control Points functions.
See [The Total Station menu, page 18](#).
- Measure the coordinates of the point using the Measure Control Point functions.
See [Measuring a new control point with GNSS, page 143](#).
- Import control points from a .csv file.
See [The Project Setup menu, page 16](#).

3. To add a traverse station, tap .

The **Traverse Measurement Table** screen contains the following buttons:

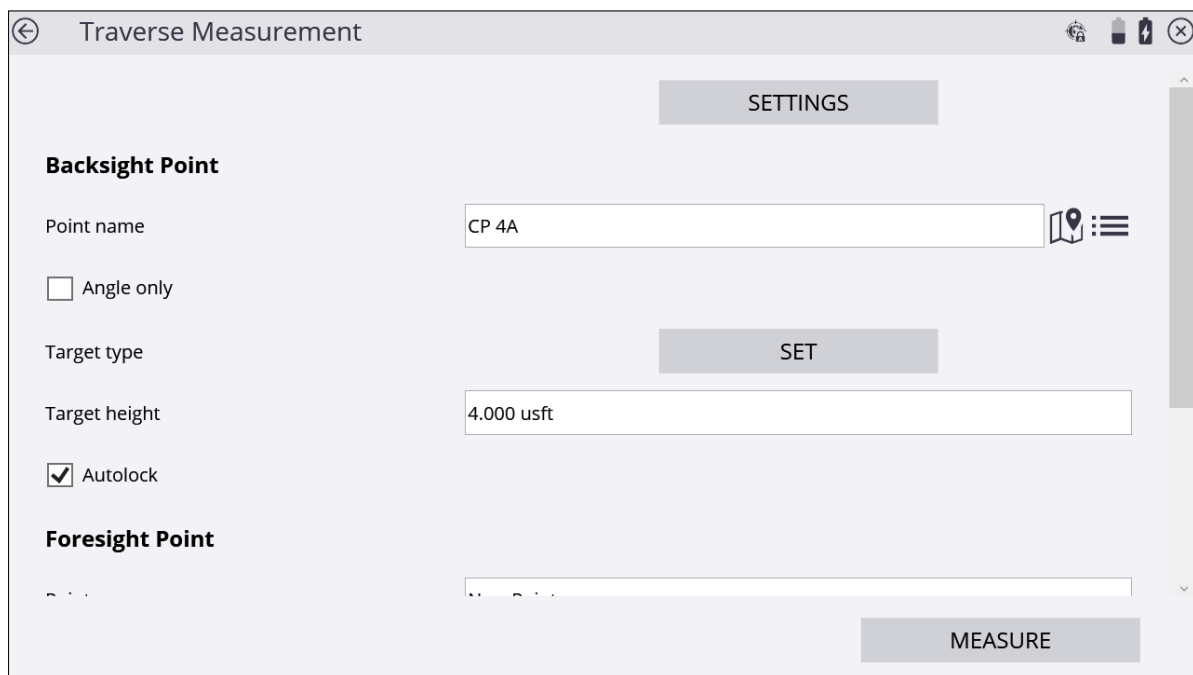
Tap ...	to ...
	measure a new traverse station
	remeasure a traverse station
	remove the last traverse measurement
	clear traverse measurements

4. In the **Instrument Setup** window, there are two ways to define an instrument point:



- Select a control point/point from the map .
- Select a control point/point from the point list .

You can also manually enter the control point/point name.

5. After all the instrument point information is entered, tap **Next**.
6. In the **Traverse Measurement** screen, enter the backsight and foresight point information:
 - a. Backsight point:



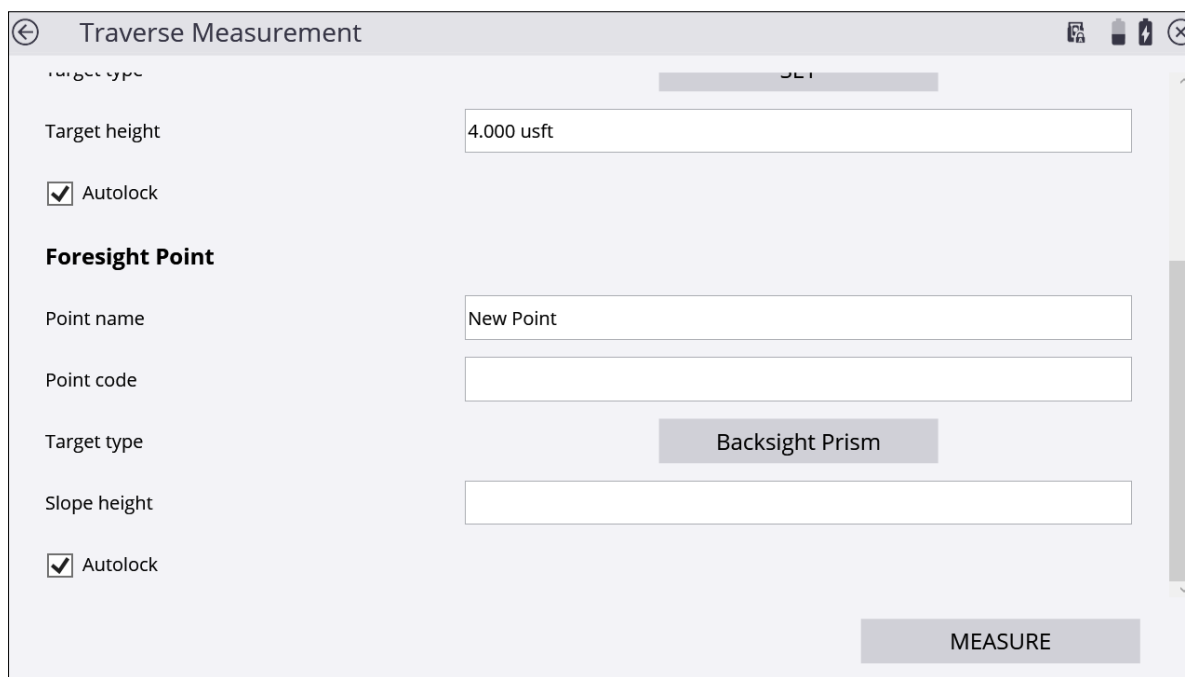
The backsight point can be selected by two methods:

- i. Select a control point/point from the map .
- ii. Select a control point/point from the point list .

You can also manually enter the control point/point name.

For subsequent points, the Point name, Target type, and Target height are pre-filled using the previous instrument point information.

b. Foresight point:



The screenshot shows the 'Traverse Measurement' app interface. The 'Foresight Point' section is active, displaying the following fields and controls:

- Target height:** A text input field containing '4.000 usft'.
- Autolock:** A checked checkbox.
- Foresight Point:** A section header.
- Point name:** A text input field containing 'New Point'.
- Point code:** An empty text input field.
- Target type:** A dropdown menu with 'Backsight Prism' selected.
- Slope height:** An empty text input field.
- Autolock:** A checked checkbox.
- MEASURE:** A large button at the bottom right.

When foresighting to an intermediate station, enter the point name, point code, target type, and target height.

When foresighting to the ending station, a known control point or point must be selected. Enter the target height and ensure that the point name, point code, and target type are correct.

7. After all backsight and foresight information have been verified, tap **Measure**.

NOTES –

The first foresight point is assumed to be a new point, and its name must be entered. For subsequent foresight points at intermediate stations, the Point Type must be selected as either a New Point or Existing Point.

When checking Autolock, the instrument will lock onto the prism automatically after the first measurement set. If this option is left unchecked, the total station must be manually aimed at the target each time.

When using the Angle only option, decide if an individual control point should only be measured by angle only.

The target type and height must be entered unless using the Angle only option.

Ensure that all input values are correct because it is not possible to edit keyed-in data without re-measuring the station.

To change the Traverse Measurements settings, tap **Settings**. For a detailed description of the configuration options, see [Measuring rounds of angles, page 244](#).

8. In the **Traverse Measurement** screen:
 - a. Follow aiming instructions and when prompted, tap **Measure**.
 - b. When all rounds of measurements are completed, tap **Next**.

Please aim at CP 4A and measure.

Point Name	Status	Round
CP 4A	Waiting	0/2
New Point	Waiting	0/2

+ROUND

MEASURE

9. Repeat Step 3 through Step 7 to create traverse measurements at all required stations and complete building the traverse.

Adjusting traverses

The Siteworks software will only adjust complete, closed traverses that have starting and ending stations on sets of existing control points.

To perform an adjustment:

1. After completing all traverse measurements on the **Traverse Measurement Table** screen, tap **Adjust**.

Station Pt	Instrument Ht	Backsight Pt	Backsight Ht	Foresight Pt	Foresight Ht
CP 4A	0.000	CONT 1	1.473	TRAV 1	1.473
TRAV 1	1.473	CP 4A	1.473	CONT 1	1.473
CONT 1	0.000	TRAV 1	1.473	CP 4A	1.473

ADJUST

The following screen appears:

Traverse Adjustment Settings

Adjustment type: Compass

Error Distribution

Angular: Equal Proportions

Elevation: Proportional To Distance

Tolerance

Horizontal precision 1: 50000

Vertical precision 1: 25000

Raw Data

File name:

ACCEPT

2. The adjustment settings are:

- a. **Adjustment type:** Compass or Transit.
 - b. **Error Distribution** for Angular and Elevation: Proportional to Distance, Equal Proportions, or None.
 - c. **Tolerance** settings for Horizontal and Vertical precisions: Enter manually.
3. When all of the adjustment settings are entered, and a filename has been entered, tap **ACCEPT**.
 4. After performing the adjustment calculations, the results are displayed for review in a Traverse Adjustment report. To modify the Traverse Adjustment Settings again, tap **Back**.
 5. If the report generated is accepted, the adjusted traverse points can be saved as control points by tapping **ACCEPT**.

Utility Locator Workflow

- Overview
- Pairing and connecting to a utility locator
- Testing the locator in Siteworks
- Operating the locator with Siteworks

Overview

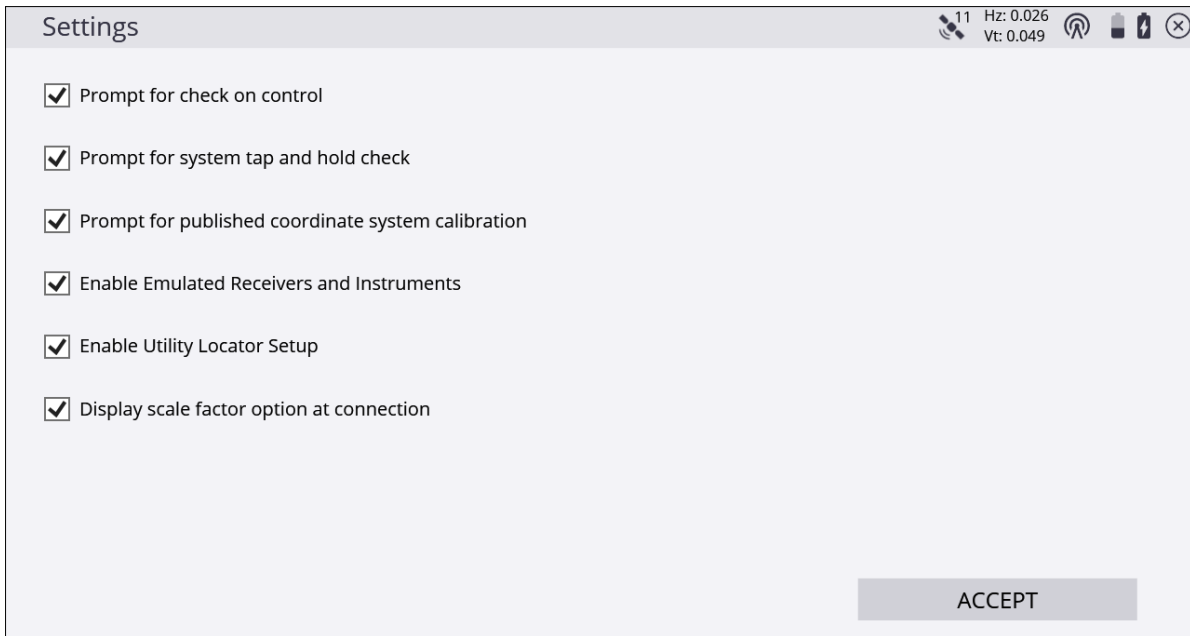
Siteworks can connect to and log the data stream of several radio frequency utility locator instruments including the Radiodetection RD8000 and 8100 models, and the Vivax-Metrotech vLocPro2 model. Utility locators support requires the Advanced Measurement Module.

Functional integration of the locators into the Siteworks software includes the ability to record position measurements within Siteworks from GNSS and total stations and log the depth and other data output from the locator by pressing the **Depth** button on the locator wand. The locator triggers a measurement in Siteworks and records the data streamed out of the locator by using a Bluetooth connection between the locator and the data collector.

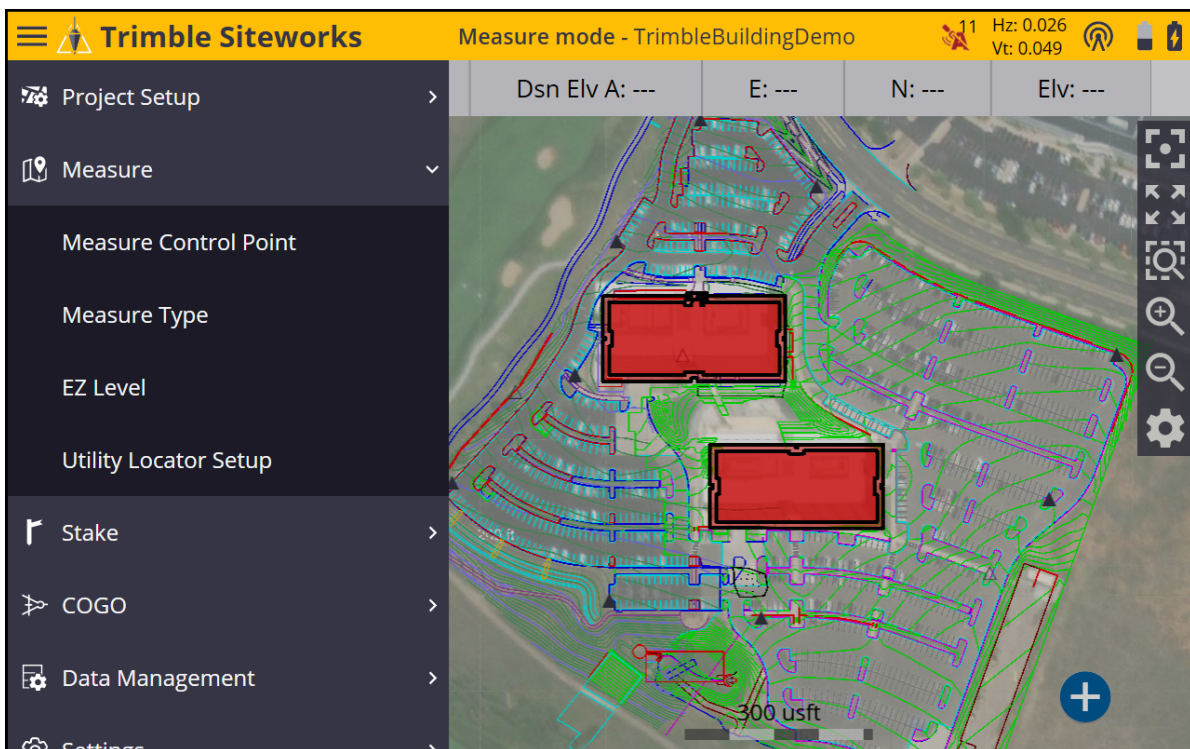
The depth of the utility as calculated by the locator can be subtracted off the elevation at the survey rod tip. This results in the recording of the elevation of the utility. The additional information stored by Siteworks depends on the locator model, and can include, the selected locator frequency, gain settings, locate current, and other information as output by the locator. Please refer to the utility locator manuals for correct operating instructions of those devices, for additional information on setting up the streaming outputs, and the types of information output by the locators.

To enable the locator functionality in Siteworks:

1. In the **Ctrl+O** menu, select the **Enable Utility Locator Setup** checkbox.



2. Tap **Home** and then tap **Measure**. You will see a new menu item for utility locator setup.



3. Tap **Utility Locator Setup** tab to open the **Utility Locator Setup** screen, where the locator model, communication protocols, option for subtracting out the depth calculated by the locator are shown, in addition to enabling the connecting, disconnecting, and testing of the locator's output in Siteworks.

Pairing and connecting to a utility locator

First, place the utility locator in pairing mode to allow to establish a connection with the Siteworks software.


On the Radiodetection locator:

1. Press the power button.
2. Use the down button to scroll through the menu to **BT**. Select it with the right arrow button (immediately to the right of the up and down arrow).
3. Scroll through and select **Pair** with the right arrow button.
4. Scroll to and select **BT-PC** with the left arrow button (the "f" button to the left of the up and down arrow).
5. The Bluetooth icon on the locator's screen will flash to indicate the locator is in pairing mode. You can now perform a search and connect to the locator from within the **Siteworks Utility Locator Setup** window.

On the Vivax-Metrotech:

1. Press and hold the "i" (information depth/current) button on the Locator, and then the "+" button on the locator to navigate to the locator's Bluetooth menu options.
2. Press the Locate Mode (rightmost) button on the locator to enable the Bluetooth search setting until the screen on the locator displays the message: **Bluetooth Search: Enabled**.
3. Once this is enabled, you can perform a Bluetooth search and connect to the locator from within the Siteworks **Utility Locator Setup** window.

Now connect to the utility locator in the Siteworks software:

1. Select the brand and model of the utility locator.
2. On the right side of the **Device name** field, tap  to begin a Bluetooth search for the locator in Siteworks:

NOTE – When using an Android device, the Radiodetection locator must first be paired in the operating system before opening the Siteworks software.

3. After finding the locator and completing the Bluetooth pairing process within the Siteworks software, select the device in the **Device name** field.

4. Set the required option for applying the depth correction to measured points and then tap **Connect**.

Utility Locator Setup

Brand: Vivax-Metrotech

Model: vLocPro 2

Device name: vLocPro

Apply depth correction: Yes

Status: Siteworks is listening to vLocPro 2 for device data.

DISCONNECT TEST CLOSE

Testing the locator in Siteworks

After pairing and connecting the locator in the Siteworks software, pressing the **Test** button in the **Setup** screen will open a screen where the output from the locator can be seen. This screen enables the checking of the connection between the collector and the locator and previewing the data that will be logged by Siteworks.

Press the **Depth** button on the Radiodetection devices or the “i” and then “+” button on Vivax-Metrotech devices to send the string of data from the locator to Siteworks and ensure that the correct data are being sent. Tap **Close** when done to return to the **Utility Locator Setup** Screen.

Example Vivax-Metrotech test data:

Utility Locator Test

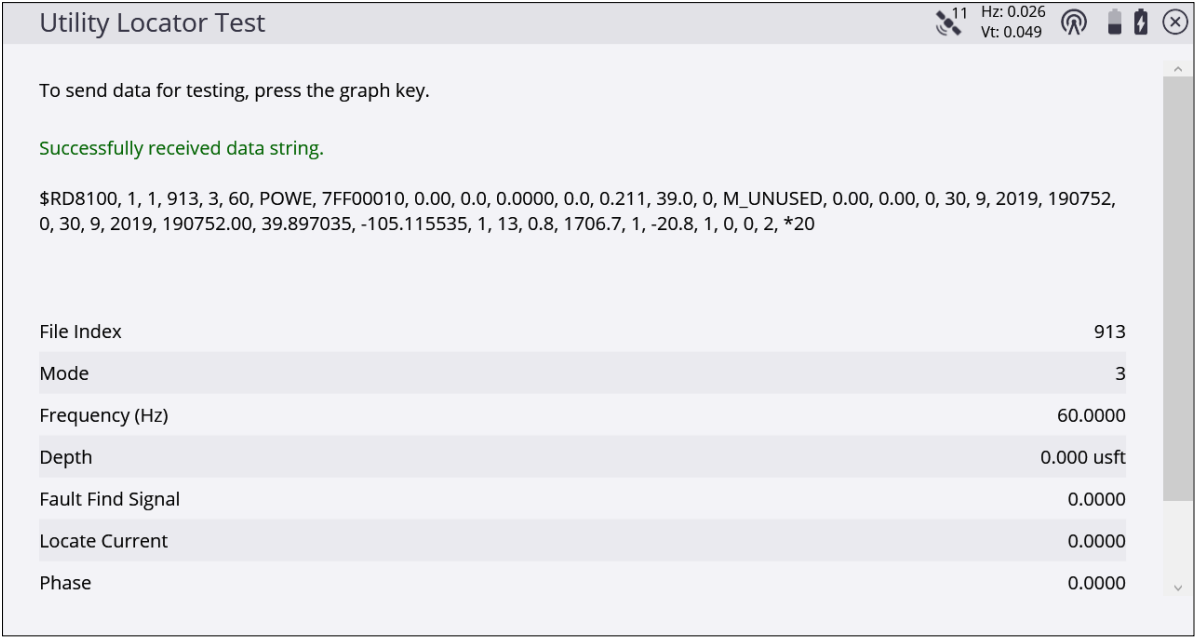
To send data for testing, press the "i" key, then the "+" key.

Successfully received data string.

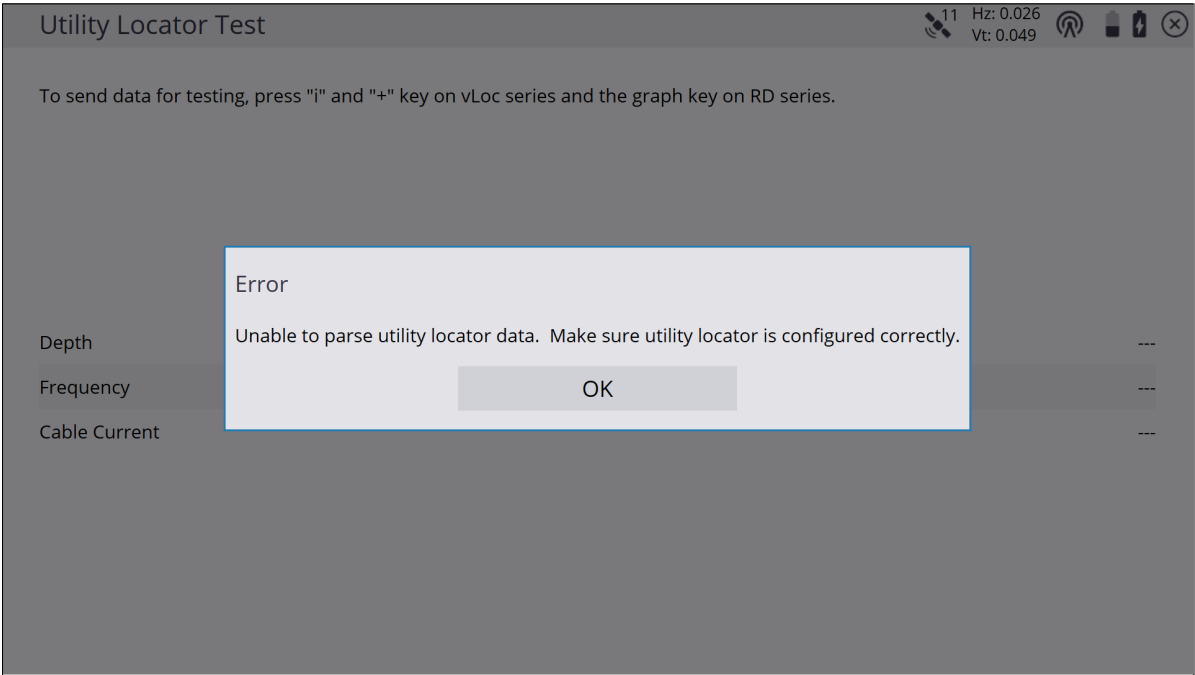
LOG, LOC1, 113, 20401130441, 65536, 1474, 0, 2, 0, 130, 0

File Index	113
Frequency (Hz)	65536.0000
Depth	4.836 usft
Locate Current	0.0000
Current Direction	2
Mode	0
Gain	130.0000

Example Radiodetection test data:



If you are using a Radiodetection locator and receive the following error, it indicates that the locator's output is not configured to the ASCII – 1 protocol. To configure it to the correct protocol, on the Utility Locator, press the power key, scroll to **BT**, scroll to **PROT**, and set this to ASCII 1.



Operating the locator with Siteworks

Once the locator is correctly configured and connected to the Siteworks software, whenever Siteworks is in measure mode pressing the **depth** button on the locator will trigger either a point or line measurement in Siteworks depending on what measure type is selected. Depth and other data streamed from the location is also recorded.

Pressing the **Measure** key in Siteworks while connected to a locator will record a normal measurement that will not include any information from the locator. The only way to record locator data in Siteworks is by triggering the measurement by pressing the **Depth** button on the locator. The locator cannot be used to trigger a measurement while in Stake mode.

If the **Apply Depth Correction** is set to Yes in the **Utility Locator Setup** screen, then the depth calculated by the locator will be subtracted from the survey rod tip elevation. This will record the elevation of the utility. The original, unadjusted surface elevation is also recorded with the point, but the measured point stored in Siteworks will represent the surface elevation at the rod tip minus the depth the locator calculated.

For best results, ensure that both the locator and survey rod tip are in the proper location when a measurement is triggered with the locator depth button. Refer to the locator's operating instructions for how to obtain the best quality depth readings, to understand the limitations of the calculated depth values, and for more information on setting up the Bluetooth connections.

A preview of the data output from the locator is shown in the **Measure Type** screen for point measurements before being stored. Tap **Accept** to record the point and store the data. This preview function is not available for line measurements, as those are always stored without a preview option.

Measure Type	
Point name	Topo 105
Point code	TEST
Point type	Feature
Vertical offset	0.000 usft
Show every time	Yes
Depth	10.052 usft
Locate Current	0.0000
Gain	140.0000
Frequency (Hz)	8192.0000
Current Direction	2

ACCEPT

Measure Type

11 Hz: 0.026 Vt: 0.049

Feature type	Feature	
Vertical offset	0.000 usft	V. offset
Show every time	Yes	
Depth	10.052 usft	
Locate Current	0.0000	
Gain	140.0000	
Frequency (Hz)	8192.0000	
Current Direction	2	
Mode	2	
File Index	163	
Depth Applied	Yes	

ACCEPT

The stored locator data for both points and line points can also be reviewed by tapping and holding on a point and selecting **Point Information**, or via the **Point Manager**.

Edit Point

11 Hz: 0.026 Vt: 0.049

Edit Point

Point Information

Surface offset	0.000 usft
Surface offset type	Vertical
Utility Locator	
Depth	10.052 usft
Locate Current	0.0000
Gain	140.0000
Frequency (Hz)	8192.0000
Current Direction	2
Mode	2
File Index	163
Depth Applied	Yes

PREVIOUS

While measuring, consider the line measurement type, especially if applying depth corrections based on the locator output. For example, if you are measuring surface topography for grade checking, then it may not be desired to measure utility lines as breaklines or volume boundaries, or include utility point measurements as surface points (i.e., set them as “feature” points in the **Measure Type** settings) as not to disrupt any other measured surface points.

To export the recorded locator data for use in other software programs, select the **Include QA data** option in the CSV export of Measured Data. The locator data is also included in the exported Record.txt file.

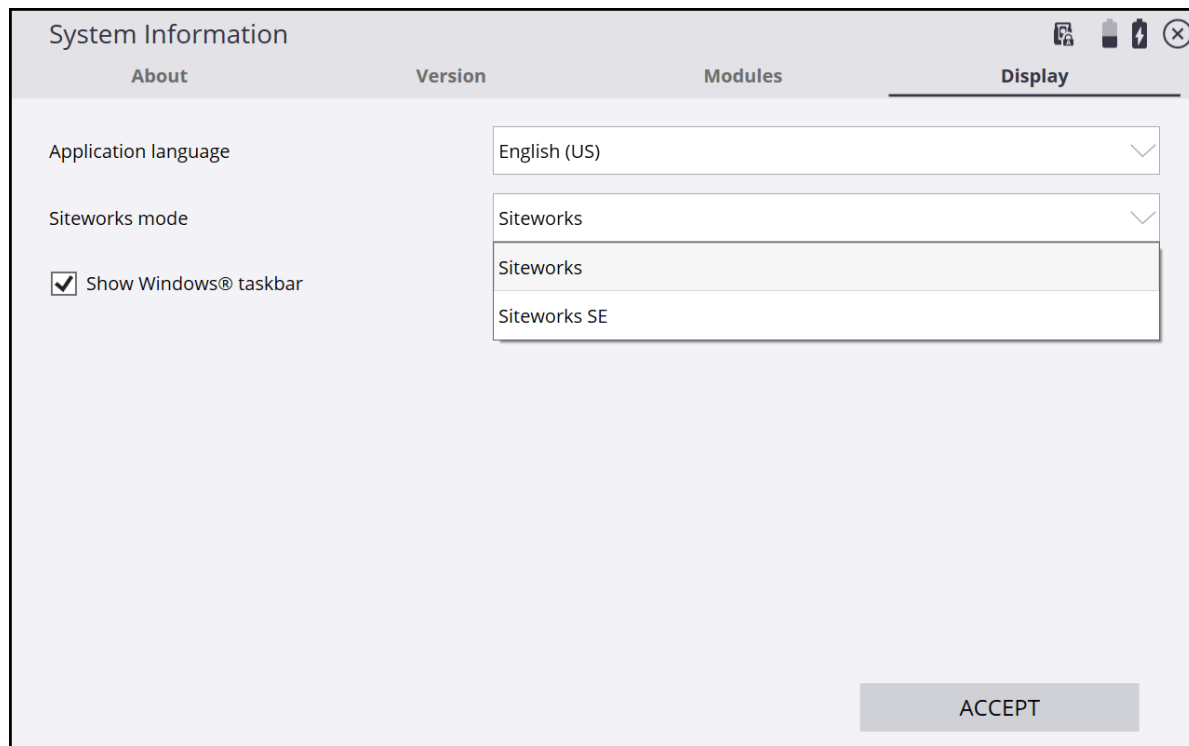
Siteworks SE Starter Edition

- [Overview](#)
- [Enabling Siteworks SE Starter Edition mode in Siteworks Standard](#)
- [Map screen](#)
- [User interface updates](#)

Enabling Siteworks SE Starter Edition mode in Siteworks Standard

Starting with Siteworks v1.40, devices that have a full Siteworks Standard license can switch into Siteworks SE mode. Select **Menu / Settings / System Information / Display** tab, and then selecting Siteworks SE in the **Siteworks mode** dropdown menu. This option is not available for devices that are licensed only for Siteworks SE.

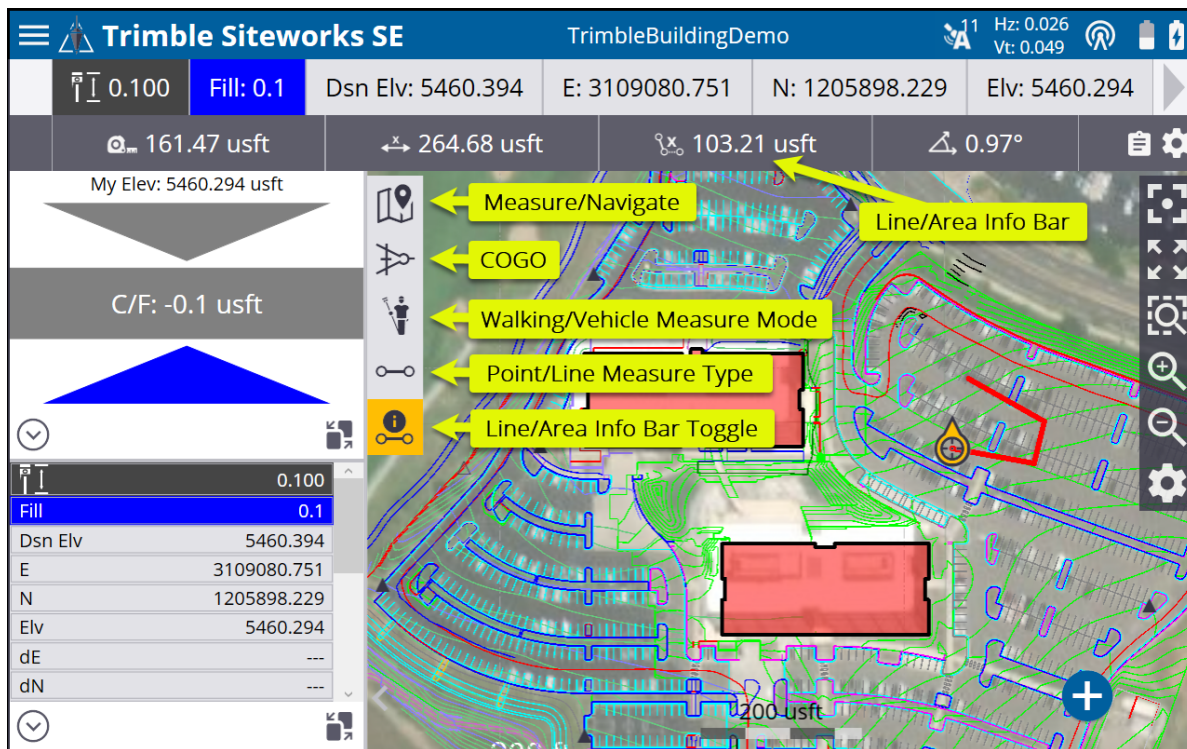
NOTE – When in Siteworks SE mode, only those features and options in Siteworks SE are available (e.g., no UTS support or site calibrations).



Map screen

The Siteworks SE Starter Edition main screen is similar to Siteworks Standard, with several notable differences. The overall side and main panel display control is the same, with the ability to collapse the side panels by tapping the small arrow to the right of the lower side panel. Changing the contents of the individual side panels is identical in Siteworks SE, achieved by tapping the small circled down arrow in the lower right of each side panel. The map controls (zoom, center, etc.) on the right side of the Plan View map screen are identical.

The main differences in the user interface in Siteworks SE compared to Siteworks Standard is the blue title bar in Siteworks SE, the actions of the icons used to switch between measure/navigate mode, a new COGO button to easily access COGO functions, interactions with switching between standing and vehicle modes, and choosing between a point or line measure type. There is also a new line/area information bar only available in Siteworks SE that can be toggled when measuring a line or area.



User interface updates

The Siteworks SE introduces several new user interface elements intended to simplify the user experience and make it easier to access commonly used functions.

The main title bar at the top of the software is now blue, as to differentiate it from Siteworks Standard, but otherwise the title bar has the same functionality as in the Standard version. GNSS precisions, battery levels, and correction status are all still “live” icons that are tappable to enter the same screens as Siteworks Standard.

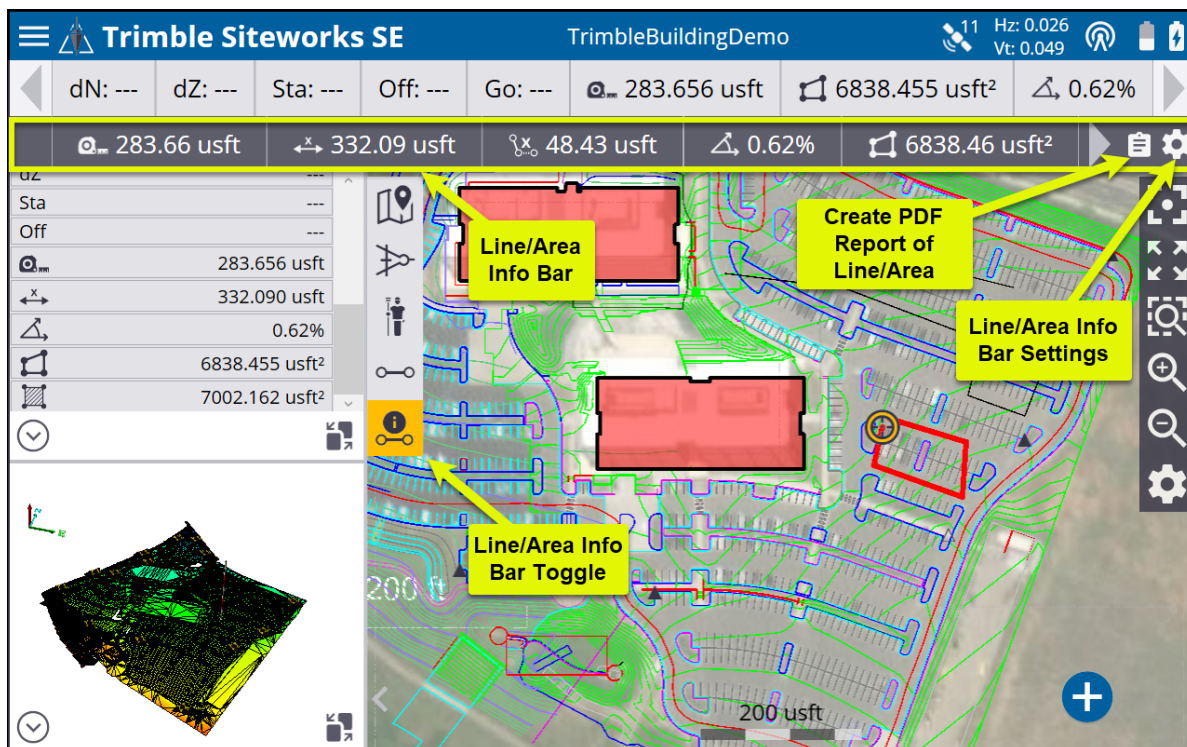
On the main Plan View map screen several updates to the user interface have been made that provide easier access to core functionality such as **Measure/Navigate**, **Walking/Vehicle Measure Modes**, **Point/Line Measure Type** and the **COGO** menu. In Siteworks SE the icons now “slide out” for easy selection right on the map screen, compared to Siteworks Standard which typically brings the user to a separate menu/screen to make the selection.

A new **Line/Area Info Bar** has also been added when measuring a line or area to give real time length, areas and slopes displays. The Line/Area Info bar is toggled on when in line or area measurement mode.


Line Info Bar

A new feature to Siteworks SE is the Line/Area Information Bar. This is an information bar that you can toggle between options when measuring a line or an area. Options for items to display in the bar include:

- Total line distance
- Measured distance
- Last segment distance
- Last segment slope
- Total area
- Measured area



The difference between total and measured distances and areas are that “measured” distances include only the portion of the line between measured points, while the “total” distances include the measured distance plus the segment distance from the last measured point to the user’s current position. A PDF report of the line or area currently being measured can also be created by tapping the **clipboard** icon on the right side of the bar.

The **Line/Area Info Bar Settings** options are accessed by tapping  at the right side of the bar. Configurable settings allow for the selection of the items to display, the line slope units (Percent, Degrees, Rise:Run, Run:Rise), and number of decimal points for all values displayed in the bar.

Line Information Bar

- ☒ Show measured distance
- ☒ Show total distance
- ☒ Show last segment distance
- ☒ Show segment slope
- ☒ Show measured area
- ☒ Show total area

Line slope units: Degrees

Display precision: 0.00

ACCEPT

Navigate Mode

Siteworks SE introduces a new **Navigate** mode versus **Stakeout** mode in Siteworks Standard. The key difference between Navigate and Stakeout is that in Navigate mode you cannot measure any as-staked information, therefore no stake writer or storyboard tools are available in Siteworks SE. Also, all line and alignment navigation is performed in **Random** mode and you cannot select a specific station/chainage and offset to navigate to.

Navigate mode enables you to select a point, line, or alignment, and then Siteworks SE guides you to the selected location through the use of “GO” distances, directional arrows, and the fine staking bull's-eye when within 2 meters of a selected point. Navigation to lines or alignments are performed by selecting the line or alignment object and reading the current station/offset values in the Info Bar/Panel and then navigating to the required station. When a line or alignment is selected for navigation, the directions are always to the center of the line/alignment.

The Info Bar and Panel can be configured with the required items based on whether Siteworks SE is in **Measure** or **Navigate** mode. When in a particular mode, the settings are remembered so that a configuration made and saved while in Navigate mode will be different than those items selected when in Measure mode. Trimble recommends that you configure the Info Bar/Panel when in Navigate mode to show the **GO** and **Station/Offset** values, so that when selecting to navigate to a line or alignment it is easy to determine the current station and offset are.

Roading functionality in Siteworks SE

Siteworks SE licenses contain some basic abilities to read corridor and road objects that Siteworks Standard without the optional Roding module does not have.

Siteworks SE can open and visualize Corridor Template Surfaces and Corridor Surfaces from VCL and PRO files, including displays of the cross section (note that PRO support is only available on Windows 10 systems).

Alignments can also be selected as navigation objects. When in measure mode, the displayed Cut/Fill values are to the corridor surface directly beneath the user. When an alignment is selected for navigation, the Cut/Fill

values are to the centerline of the alignment. Corridor cross section node staking is not available in Siteworks SE, as the Navigate mode does not allow for selecting of individual nodes.

The Roding module is not required for this corridor functionality in Siteworks SE. However, users with a Siteworks Standard license that are running in Siteworks SE mode, cannot open Corridor models, unless the additional Roding module is installed.

The Roding module is required to enable the use of Corridor data for all Siteworks Standard editions, including those upgraded from Siteworks SE and when operating the Standard edition in Siteworks SE mode. Therefore, upgrading from Siteworks SE to Standard will require the purchase and installation of the Roding module to be able to open PRO files and use corridor template models contained in VCL files.

Feature Comparison Matrix of Siteworks Standard and Siteworks SE Starter Edition

The following table shows the individual features that are in Trimble Siteworks Standard and Siteworks SE Starter Edition. This list is current as of the Siteworks v1.41 release. A second table covers those features in the Roding and Advanced Measurement modules, which are available for installation on Siteworks Standard versions.

Features availability

Feature	Siteworks SE Starter Edition	Siteworks Standard
Avoidance zones	x	x
PDF reports	x	x
WorksManager Sync	x	x
Point Manager	x	x
CSV exports of measured points	x	x
Import comma, semicolon, and tab delimited files of control and stakeout points	x	x
Cut/Fill display to current design surface	x	x
Design contour display	x	x
System check into control point	x	x
Measure RTX datum shift	x	x
Create new projects with existing DC file or published coordinate system	x	x
3D View of design surface	x	x
Fine navigation bull's-eye within 2 m of selected stakeout/navigation point	x	x
SPS986 Tilt Compensation support	x	x
Background raster images with World file	x	x
Tap-and-hold menu	x	x
Reference line support	x	x

Feature	Siteworks SE Starter Edition	Siteworks Standard
Continue measuring an existing line via the measure mode menu	x	x
COGO Review & Edit Data	x	x
COGO Create Points/Arcs	x	x
Measure lines (line not included in measured surface creation)	x	x
Measure surface point (points included in real time measured surface creation)		x
Measure surface lines (breaklines, volume boundaries; included in real-time measured surface creation)		x
Stakeout (detailed navigation to point or station/offset, staking tolerance indicator, record staked point, stake writer tool)		x
Stakeout a plane		x
Stakeout a surface		x
Measure site calibration		x
Total station support		x
GNSS base station setup		x
GNSS Static measure mode		x
Measure control points		x
Define and stake a plane		x
Corridor cross section slope value displays		x
Second surface support		x
EZ Level		x
Coverage map grid of cut/fill or elevation		x
Tangent points on lines support		x
Export DXF files	x	x
Export Record.txt files		x
Export custom comma, semicolon and tab delimited files via style guides)		x
Stockpile scanning with UTS		x
3D view of measured surface		x
3D view of secondary surface		x
Grade reports		x
.PRO and .VCL corridor template cross section view (PRO on Windows 10 only)	x	
Load corridor data from .PRO and .VCL (PRO on Windows 10 Only)	x	
Live Line Info Bar during line/area measurement	x	

Feature	Siteworks SE Starter Edition	Siteworks Standard
Navigate (no recording of point, only display of distance to reach point and current station/offset)	x	
Vehicle mode measurements: Fixed Time, Fixed Distance; Receiver Height measurement	x	x
Walking mode measurements: Fixed Time, Fixed Distance, Measure When Level		x

Roding and Advanced Measurement modules

The following table summarizes the features that are present in the Advanced Measurement and Roding modules. These modules are available as individual add-ons for Siteworks Standard licenses. Modules and associated features, except for those Roding items specifically listed in the table above for Siteworks SE, are not available in Siteworks SE Starter Edition.

Feature	Advanced Measurement module	Roding module
Feature code library (FXL) measurements	x	
Measure offset lines	x	
Measure offset points	x	
Measure curves	x	
Continue measuring existing line via Tap-and-Hold and Map screen icon	x	
UTS survey control network measurement (Windows 10 Only)	x	
UTS traverse measurement (Windows 10 Only)	x	
Utility Locator Support	x	
Support streaming output (Windows 10 only)	x	
SX10 and SX12 Camera & Scanning Support (v1.50+)	x	
Integrated Survey (v1.70+)	x	
Export LAS & LAZ Point Cloud data	x	
.PRO and .VCL corridor template cross section View (PRO on Windows 10 only)		x
Load corridor data from .PRO & .VCL (PRO on Windows 10 only)		x
Corridor feature staking		x
Corridor side slope staking		x
Corridor catch point staking		x
Storyboard stake writer items		x
Corridor node/location staking		x
Key-In Roadways (Windows 10 only)		x

Glossary

benching	Benching is a process of aligning your GNSS position (latitude, longitude, and height) to a benchmark that has been added as a reference point. The calibration offsets your GNSS position to that of the benchmark, improving accuracy and providing a point that you can return to later.
AutoBase	AutoBase technology uses the position of the receiver to automatically select the correct base station; allowing for one button press operation of a base station. It shortens setup time associated with repeated daily base station setups at the same location on jobsites.
BaseAnywhere	BaseAnywhere technology allows the user to place the GNSS base station anywhere on site and does not require the base station to be setup on an existing control point. After the base is configured in BaseAnywhere mode it calculates an autonomous position and begins broadcasting corrections via radio or Wi-Fi. The rover is then used to bench into a control point which calculates the necessary offsets and parameters to allow for fully accurate RTK GNSS operations.
base station	Also called <i>reference station</i> . In construction, a base station is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GNSS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.
corridor	A corridor is a model of a linear feature such as a road or canal usually defined by one or more cross section templates consisting of template instructions. It also is a collection of corridor information expected to function together to define the corridor. These models can be parametric, meaning the geometry of the model can change based on input conditions. A corridor contains a main alignment, typically but not always the centerline, all sub alignments, the templates from which the corridor cross sections are defined, and all the information used to define the widening, slope ties, and super-elevations for the corridor. The term <i>corridor</i> is often used interchangeably with <i>road</i> in previous versions of the software.
DGPS	See real-time differential GPS .
design map	The map that provides live linework within a design for stakeout operations. The design map is a DXF, DWG, or VCL file.

differential correction	<p>Differential correction is the process of correcting GNSS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data.</p> <p>Differential correction can be done in real-time, or after the data is collected by postprocessing.</p>
differential GPS	See real-time differential GPS .
elevation (elev, elv)	(1) Vertical distance (height) above or below mean sea level. (2) Vertical distance above or below the geoid. (3) Distance above or below Local Datum.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, atmospheric issues, and multipath errors.
feature	A feature is a physical object or event that has a location in the real world, which you want to collect position and/or descriptive information (attributes) about. Features can be classified as surface or non-surface features, and again as points, lines/breaklines, or boundaries/areas.
GLONASS	Global Orbiting Navigation Satellite System. GLONASS is a Soviet space-based navigation system comparable to the American GPS system. The operational system consists of 21 operational and 3 non-operational satellites in 3 orbit planes.
GNSS	Global Navigation Satellite System.
GPS	Global Positioning System. GPS is a space-based satellite navigation system consisting of multiple satellites in six orbit planes.
height	It can mean a target height or antenna height (for example, 2 m of rod height).
Here position	An autonomous instantaneous position derived from the GPS receiver's uncorrected latitude, longitude, and height.
IBSS	Internet Base Station Service. This Trimble service makes the setup of an Internet-capable receiver as simple as possible. The base station can be connected to the Internet (cable or wirelessly). To access the distribution server, the user enters a password into the receiver. To use the server, the user must have a Trimble Connected Community or WorksManager site license.
Location GPS	Location GPS covers decimeter to submeter GNSS positioning techniques including Satellite Based Augmentation Systems (SBAS) such as WAAS, EGNOS, and MSAS), DGPS (reference station and rover operations), OmniSTAR VBS/HP/XP services, and Location RTK (decimeter-level RTK positioning).

Location RTK	Some applications such as vehicular-mounted site supervisor systems do not require Precision RTK accuracy. Location RTK is a mode in which, once initialized, the receiver will operate either in 10 cm horizontal and 10 cm vertical accuracy, or in 10 cm horizontal and 2 cm vertical accuracy.
Precision GPS	GPS positioning provided by techniques that typically deliver centimeter-level accuracy. These include RTK (Real-Time Kinematic) techniques and signals obtained from a VRS (Virtual Reference Station) system.
Project	A project that is to be worked on for a significant period. A project stores all design data and all executed work orders, so you can easily find data whether you are in the office or in the field.
postprocessing	Postprocessing is the processing of satellite data after it is collected to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.
real-time differential GPS	<p>Also known as <i>real-time differential correction</i> or <i>DGPS</i>. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field.</p> <p>Most real-time differential correction methods apply corrections to code phase positions.</p> <p>While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GNSS base station to a rover GNSS receiver to provide sub-meter position accuracy. The rover receiver can be at a long range (greater than 100 km (62 miles)) from the base station.</p>
Road job	A road job is the term that defines a complete road model within the Terramodel and Siteworks software. It is a collection of roadway information that is expected to function together to define a roadway or a portion of a roadway between specific stationing limits. A road job contains the main alignment and all sub alignments, the road templates, and all the information used to define widening and super elevation for the road. A single project can contain multiple road jobs for different roads also contained within that single construction project.
road model	The road model used by the Siteworks software is a Trimble Terramodel PRO file. This file can be used for both staking and grade checking operations. The Road model is a template-based model that provides full accuracy anywhere within the roadway surface.
rover receiver	A rover is any mobile GNSS receiver that is used to collect or update data in the field, typically at an unknown location.
Roving mode	Roving mode applies to the use of a rover receiver to collect data, stakeout, or control earthmoving machinery in real time using RTK techniques.
RTK	real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater accuracy.

site map	The site map within the Siteworks software is stored as a part of the site data. The site map provides linework as a reference only and is not live, which is why you cannot select it for stakeout purposes.
station	A station is the running distance along the centerline of a corridor or road that starts at 0.0 and increments as you proceed along the route. This term is used primarily in the US, whereas the equivalent term chainage is used throughout many other areas of the world, such as Australia, Asia, Europe, and New Zealand.
surface model	The surface model used by the Siteworks software is a Trimble Terrain Model file (TTM file). It provides a 3D surface model that can be used for stakeout or grade checking operations.
work order	<p>A work order covers a task to be performed by a crew on a single jobsite. A work order contains the reference to the appropriate design, required settings and tolerances for the task, and a record and report of all the data measured or staked out in the process of completing the task.</p> <p>A work order can cover a short-term task (such as the stakeout of a specific building pad) or a task that will last the duration of the project (such as the stakeout of storm water drainage) and that will be executed periodically as required during the project.</p> <p>When the project is complete, all the information regarding the task is stored in a single file that is easy to recall.</p>

