Calibrating a Site

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About this tutorial

In this tutorial, you will do the following:

- Import grid coordinates for a survey of two water towers.
- Import RTK data to use for the site calibration.
- Specify how sideshots in the project are computed.
- Pair up the local control points and GNSS control points, and perform the site calibration.
- Save the calibrated site so you can reuse it for future projects in the same area.

Note: If you need additional help at any time you are using the software, press **F1** to display the online help.

Understanding site calibration

The site calibration process establishes the relationship between WGS-84 data collected by GNSS receivers and local control positions (expressed as a local map grid with elevations above sea level). This relationship is defined by a series of mathematical transformations. To calibrate a site, you must pair up GNSS and local control points to be used in the calibration.

- Grid points must be derived from grid points and terrestrial observations.
- GNSS coordinates must be derived from GNSS points and observations.

The software then computes and applies the mathematical transformations using least squares.

The mathematical transformations that are applied in order to convert WGS-84 positions to grid coordinates are as follows:

- A datum transformation to convert the WGS-84 latitude, longitude, and ellipsoidal height coordinates to latitude, longitude, and ellipsoidal height coordinates relative to the ellipsoid of the local map grid
- A map projection to convert the local ellipsoid latitude and longitude coordinates into local map grid northing and easting coordinates (the height value is not altered in this process)
- A geoid model to WGS-84 height to get approximate elevation above sea level
- A horizontal adjustment of the transformed grid coordinates to best-fit local control data (This adjustment allows for any local variations in the projection system that cannot be accommodated in the overall datum transformation.)

- A height adjustment to convert the heights above the local ellipsoid or elevations derived from the geoid to local control elevations above sea level

The horizontal and vertical adjustment are stored as part of the coordinate system definition for the project. All GNSS points in the database are updated using the calibration parameters, resulting in more accurate local grid coordinate values.

You can save the new coordinate system definition (which includes the calibration parameters) as a site for use in future projects in the same area.

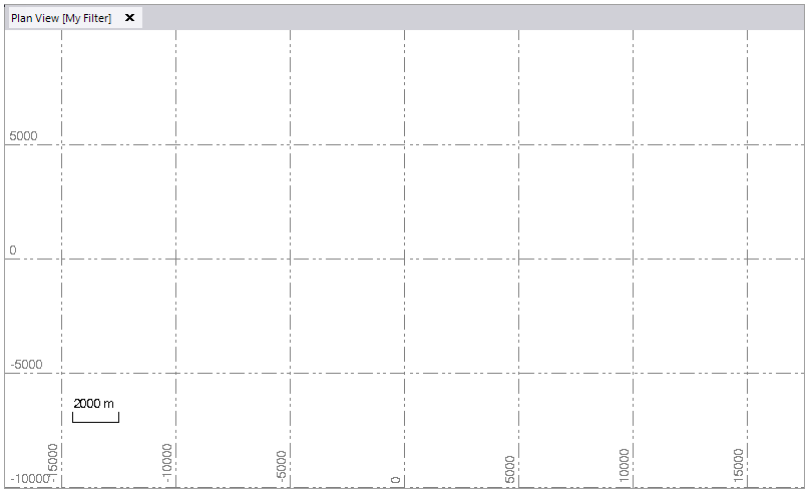
Step 1. Open the project

For this tutorial, you will use the project file *Calibrating a Site.vce*.

Note: The downloaded *CalibratingaSite* folder contains this PDF file, a *Data* folder, and the *Calibrating a Site.vce* project file. You will import data from the *Data* folder later in this tutorial.

1. In SO, select **File > Open**.
2. In the **Open File** dialog, browse to *..\CalibratingaSite\Calibrating a Site.vce* and click **Open**.

   The project opens in the **Survey Office** window.



The project file is read-only. You can perform the tutorial steps without saving the project file.

You are now ready to import data into your project.

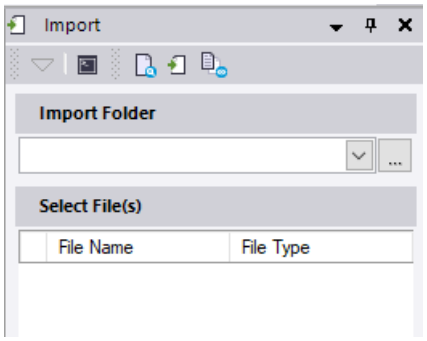
Step 2. Import data

For this tutorial, you will import two data files:

- *2tank.jxl* - This file contains the local grid coordinates.
- *2tankrtk.jxl* - This file contains the GNSS coordinates.

1. Select **Home > Data Exchange > Import**.

   The **Import** pane opens in the right side of the **Survey Office** window.



2. In the **Import** pane, de-select the **Close command after import** checkbox located near the bottom of the pane.

   This will cause the **Import** pane to stay open after the first import so you can perform a second import.

3. In the **Import** pane, click the **Browse** button  .

4. In the **Browse For Folder** dialog, browse to ..*CalibratingaSite**Data* and click **OK**.

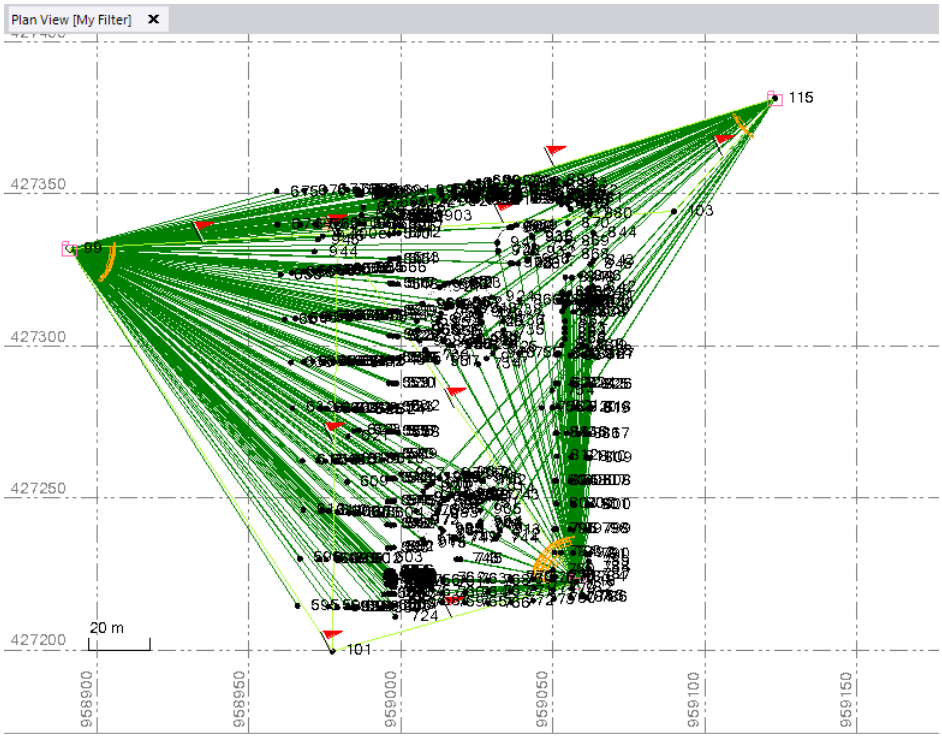
   The content of the *Data* folder displays in the **Select File(s**) list in the **Import** pane. You will first import the data file containing the local grid coordinates.

5. In the **Select File(s)** list, select *2tank.jxl* and click the **Import** button.

   The **Project Definition** dialog displays, allowing you to change the scale factor for the imported file.

6. In the **Project Definition** dialog, do not make any changes and click **OK**.

   The coordinate data is displayed in the **Plan View**.



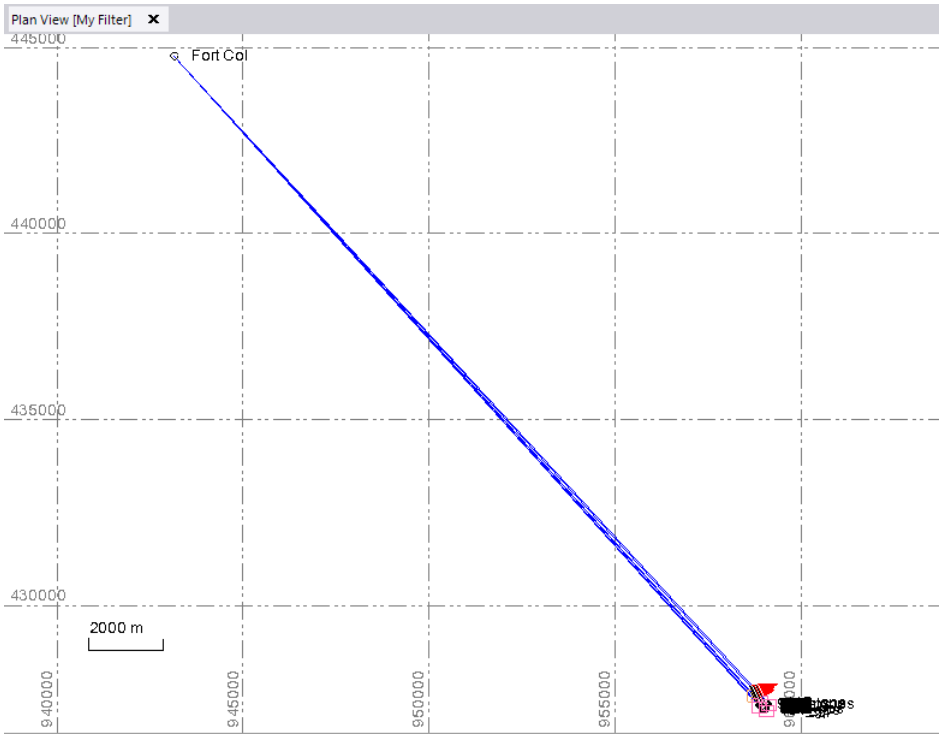
Next, you will import the GNSS coordinates to be used for the site calibration.

7. In the **Import** pane, select *2tankrtk.jxl* in the **Select File(s)** list and click the **Import** button.

   The **Import Feature Definitions** dialog displays alerting you that any feature processing will be undone.

8. In the **Import Feature Definitions** dialog, click **Yes**.

   The content of the *Calibrating a Site* folder displays in the **Select File(s**) list in the **Import** pane. Note that the GNSS coordinates are in a different location than the local grid coordinates.



9. In the **Import** pane, click the **Close** button.

Next, you will specify how sideshot computations are performed in your project.

Step 3. Specify how sideshot points are computed

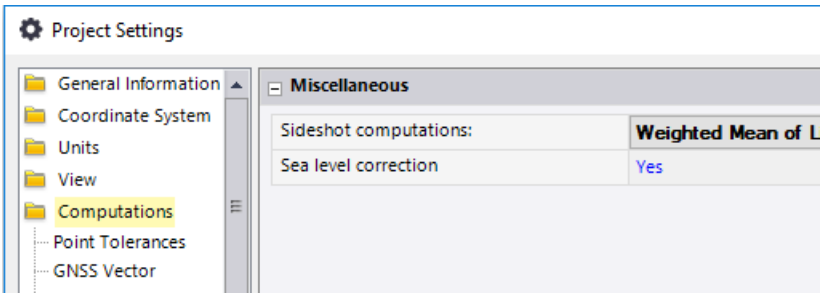
Survey Office allows you to specify how to compute the position for each sideshot point in your project:

- Use a single observation.
- Use the weighted mean of all observations.
- Use the weighted mean of like observations (for example, all RTK observations or all total station observations).

If you select to use a weighted mean, each observation is weighted based on its precision.

For this tutorial you will choose to use the weighted mean of like observations.

1. In the **Quick Access Toolbar** located at the top of the **SO** window, select **Project Settings**.
2. In the navigation (left) pane in the **Project Settings** dialog, select **Computations**.
3. In the **Sideshot computations** drop-down list, select **Weighted Mean of Like Observations**.



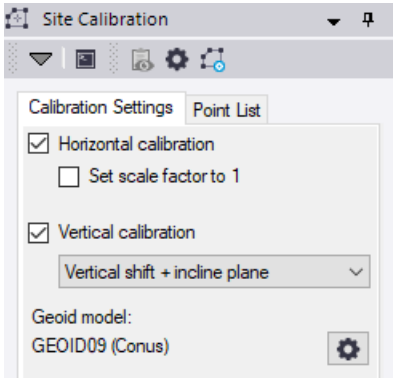
4. Click **OK.**

You are now ready to calibrate the site.

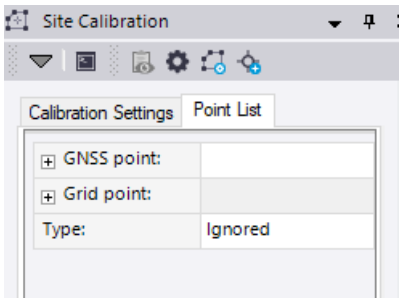
Step 4. Calibrate the site

While performing the site calibration, you should be able to identify any major blunders. In addition, considering the size of the site, you should ensure all point residuals are less than 0.020 m.

1. Select **Survey > Network > Site Calibration** to display the **Site Calibration** pane.



2. Select the **Point List** tab.



This tab allows you to match the GNSS and grid point pairs to be used in the site calibration. For this tutorial, you will match the following pairs:

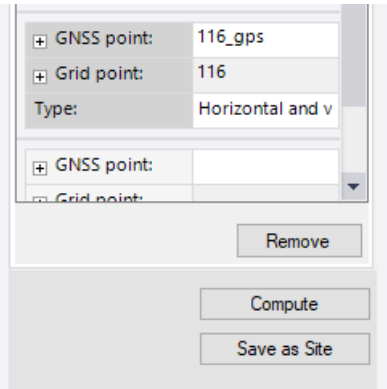
- *99_gps - 99*
- *100el_gps - 100el*

- *101_gps - 101*
- *103_gps - 103*
- *115_gps - 115*
- *116_gps - 116*

Note: The coordinates of each point you select must be computed from global coordinates. Points with local coordinates cannot be selected as GNSS points.

3. Enter the point pairs as follows:
   a. Click in the field to the right of the **GNSS Point** label and enter *99_gps*.
   b. Click in the field to the right of the **Grid Point** label and enter *99*.
   c. Press the **Tab** key to display fields to enter the next point pair.
   d. Repeat steps a through c for each of the point pairs listed in the previous step.

   As an alternative, you can choose the point to enter in any field by selecting it in the **Plan View**.



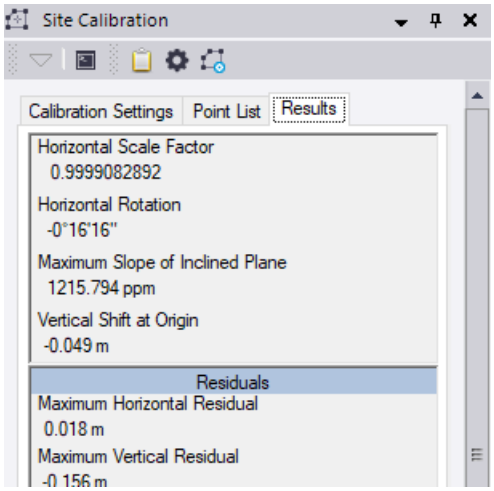
4. Click the **Compute** button.

Note: You may need to scroll down in the **Site Calibration** pane to see the **Compute** button.

A warning message is displayed indicating that one or more points has a calibration computation that exceeds the maximum allowed residual of *0.100* m. This usually indicates some sort of blunder occurred either in the field or when selecting point pairs.

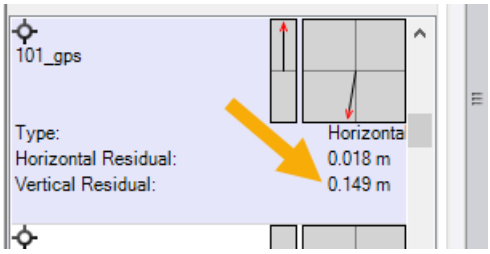
5. Click **OK** in the **Warning** dialog.

   The **Results** tab displays in the **Site Calibration** pane.



6. Review the **Results** tab to identify which point pair is exceeding the maximum residual of 0.100 m.

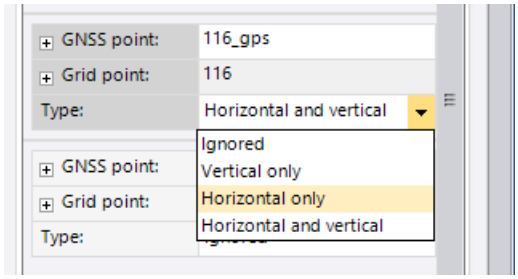
   You can see that point *101_gps* and point *116_gps* both exceeded the maximum residual of 0.100 m.



   Because an error in a single point can propagate throughout the network causing other points to have large residuals even if they are correct, either of these points could be in error. So both points should be checked individually by changing the calibration to use the horizontal plane only and ignore the vertical plane, since this is the cause of the large residual.

   Normally, to resolve this problem you would start by checking for errors in the observation properties for each of these points (for example, instrument, target, and antenna information). You would also want to verify that the correct points were entered for these two point pairs. However, for this tutorial, you do not need to check for these types of blunders.

7. In the **Site Calibration** pane, select the **Point List** tab and change the calibration type for point *116_gps* from **Horizontal and vertical** to **Horizontal only**.



8. Click the **Compute** button.

   This time, no warning message is displayed.

9. Review the **Results** tab.

   Although no points have a calibration computation that exceeds the maximum allowed residual of *0.100* m, note that points *103_gps* and *115_gps* have vertical residuals of *-0.036* m and *0.027* m respectively. These residuals exceed the limit of *0.020* m you specified as an objective for this site calibration. So you will reset the calibration type for point *116_gps* and change point *101_gps* to horizontal only.

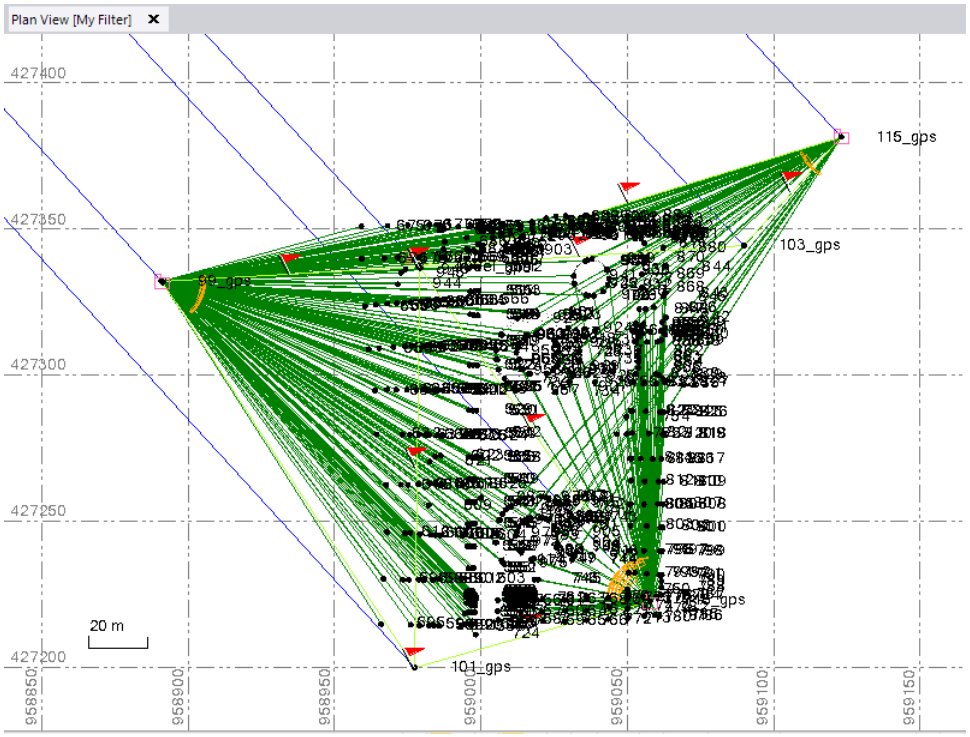
10. In the **Point List** tab, reset the calibration type for point *116_gps* to **Horizontal and vertical** and change point *101_gps* to **Horizontal only**.

11. Click the **Compute** button and review the **Results** tab.

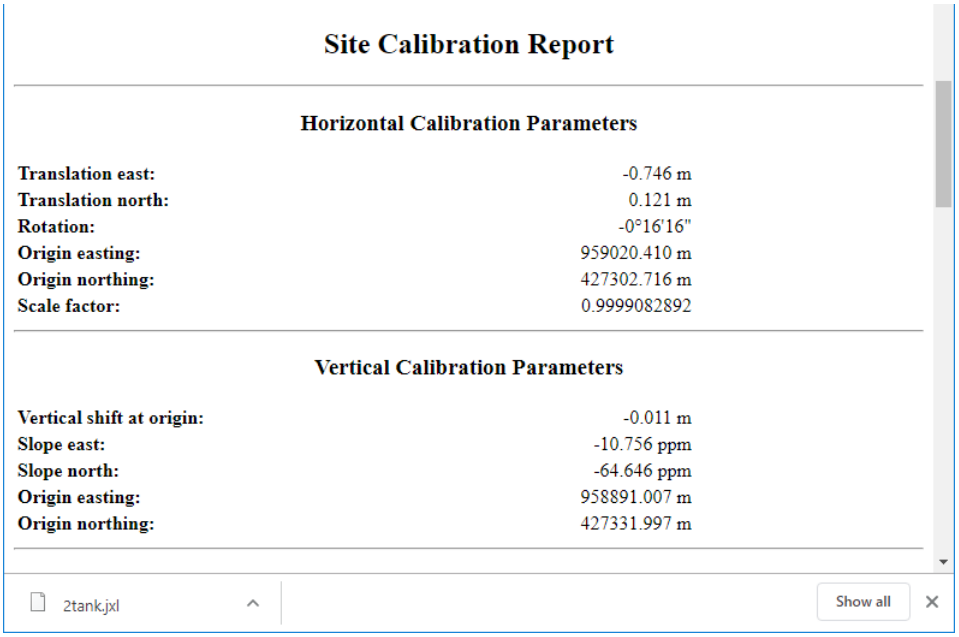
    No residuals exceed the limit of *0.020* m.

> **Note:** If any *horizontal* residuals had exceeded *0.020* m, you would follow this same procedure.

12. Click the **Apply** button to apply the calibration to the project.



13. Click the **Site Calibration Report** button located at the top of the **Site Calibration** pane.



Site Calibration Report

Horizontal Calibration Parameters

Translation east:	-0.746 m
Translation north:	0.121 m
Rotation:	-0°16'16"
Origin easting:	959020.410 m
Origin northing:	427302.716 m
Scale factor:	0.9999082892

Vertical Calibration Parameters

Vertical shift at origin:	-0.011 m
Slope east:	-10.756 ppm
Slope north:	-64.646 ppm
Origin easting:	958891.007 m
Origin northing:	427331.997 m

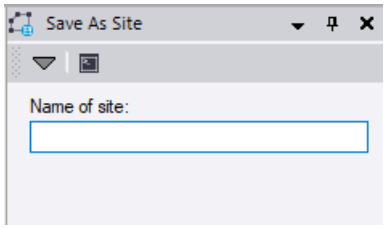
Keep the report open as you will need to refer to it in the next procedure.

Next, you will save the new calibration as a site that can be used by other projects in the same area.

Step 5. Save the site calibration as a new site

1. On the **Calibration Settings** tab, click the **Save as Site** button.

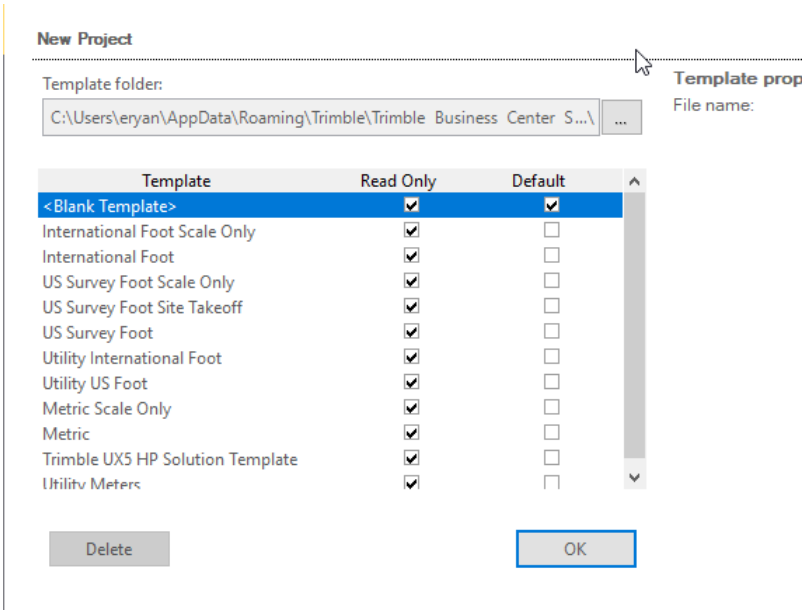
   The **Save as Site** pane displays.



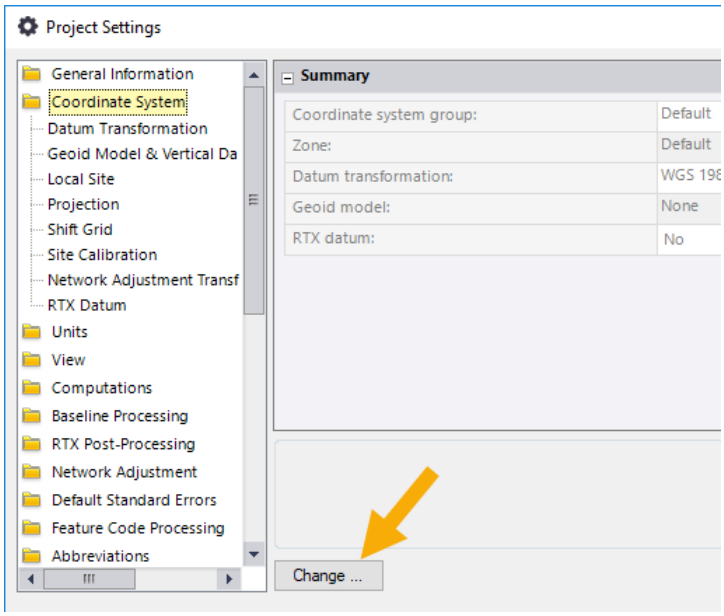
2. In the **Name of site** field, enter a name for the new site: *Tutorial.* Then click **OK.**

   You can now close the current project and start a new project using the newly created site.

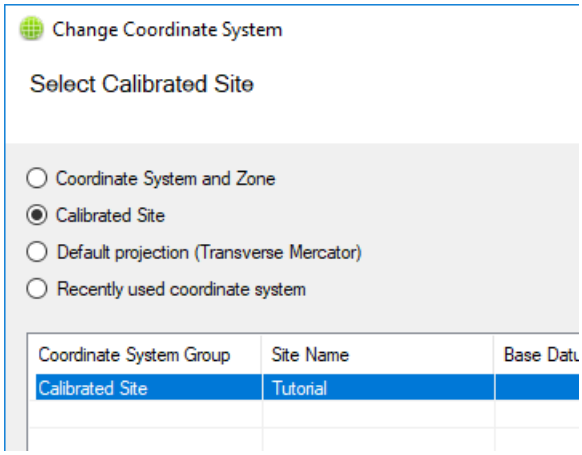
3. Select **File > Close**.
4. In the **Save Changes** dialog, click **No**.
5. In **Survey Office**, select **File > New**.
6. In the **New Project** dialog, select **<Blank Template>** and click **OK**.



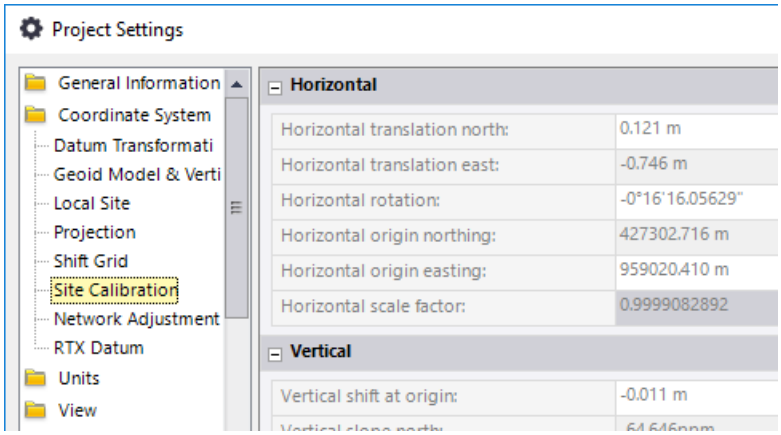
7. After the new project opens, in the **Quick Access Toolbar** select **Project Settings**. Then select **Coordinate System** in the left navigation pane and click the **Change** button.



8. In the **Change Coordinate System** dialog, select the **Calibrated Site** option.
9. Select the newly created *Tutorial* site in the list. Then click the **Finish** button.



10. In the **Project Settings** dialog, select **Coordinate System > Site Calibration** in the left navigation pane.



11. Compare the horizontal and vertical parameters displayed the **Project Settings** dialog with the parameters contained in the *Site Calibration* report you created at the end of "Step 4. Calibrate the site."

12. Click **OK** to close the **Project Settings** dialog.

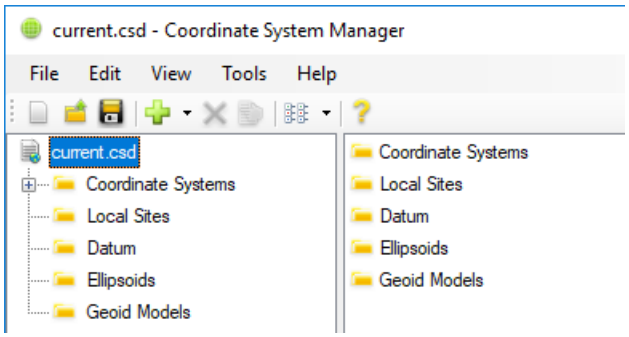
    You are done verifying the newly saved site.

Note: To further verify the site, you could import the *2tank.jxl* file into the new project and view the data in Google Earth. See the SO Help for instructions.

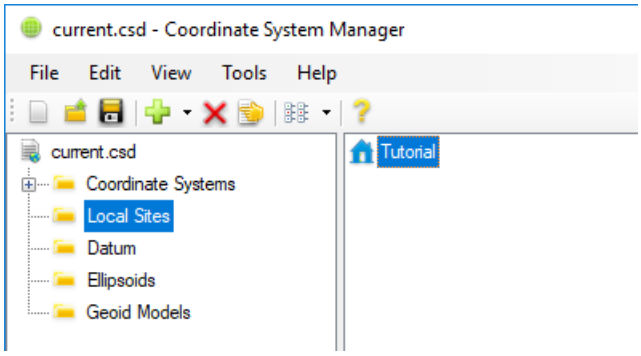
Since you will not be using the new *Tutorial* site after completing this tutorial, you can delete it.

13. To delete the *Tutorial* site, do the following:

    a. In the **Quick Access Toolbar**, select **Coordinate System Manager**.



b. In the **Coordinate System Manager** window, select **Local Sites** in the left pane.



c. Right-click the *Tutorial* site and select **Delete** in the context menu.

d. In the **Confirm Delete** dialog, click **OK**.

e. Select **File > Exit** to close the **Coordinate System Manager** window.

f. Click **Yes** in the message prompting you to save changes to the .CSD file

14. On the **Survey Office** menu bar, select **File > Close**.

    There is no need to save the project.

This completes the tutorial.