SPECTRA®
GEOSPATIAL

Performing Data Prep

About this tutorial

Survey Office (SO) is designed to help you create high-accuracy surfaces for stakeout using Trimble Access or other positioning systems. Your data for these models may come in any number of formats: paper drawings that describe what to construct, files with 2D or 3D surveys or designs, or some combination of all three.

SO facilitates the management of data for multiple field crews operating on a job site. You can import, review, and analyze digital designs, and then assign, manage, and track that information through the lifetime of a construction project.

This tutorial shows you the power and flexibility of SO by guiding you through a workflow for changing design data depicting the final grade into intermediate surfaces and objects required to construct the final design.

After working through this tutorial, you will be familiar with the following tasks:

- Reviewing and modifying the layers your objects reside on, and deleting unused layers
- Running a cleanup on your data
- Creating missing data and completing partial data
- Creating new objects by copying and offsetting from existing ones
- Moving, rotating, and scaling objects
- Elevating lines using various commands
- Checking the elevations of lines you elevated
- Creating a surface from contour lines

Step 1. Open the project

For this tutorial, you will use the project file *Performing Data Prep.vce*. This project contains a site plan drawing.

Note: The downloaded *PerformingDataPrep* folder contains this PDF file and the *Performing Data Prep.vce* project file.

1. In SO, select **File > Open**.

2. In the **Open File** dialog, browse to ..*PerformingDataPrep\Performing Data Prep.vce* and click **Open**.

   The project opens in the **Survey Office** window.
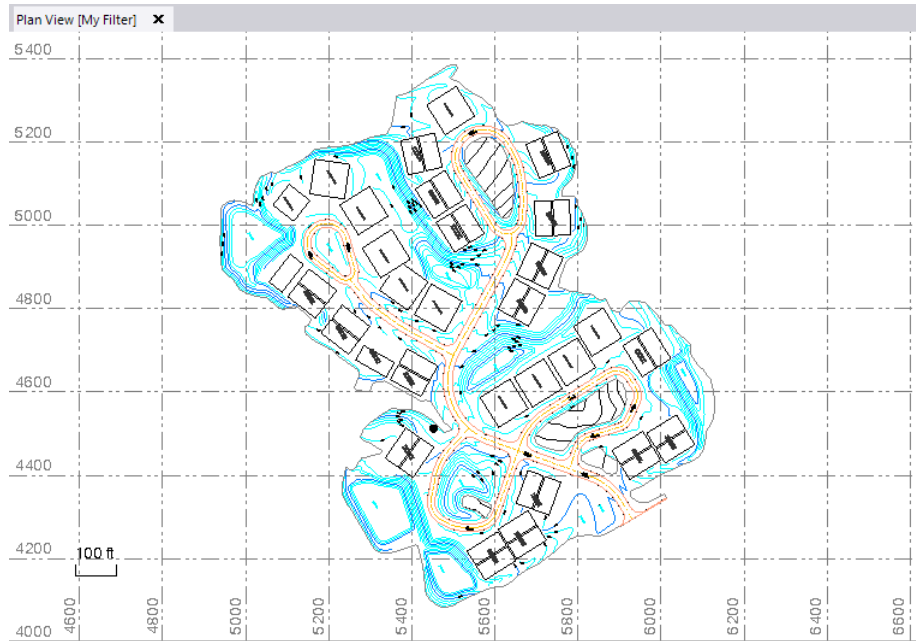
The project file is read-only. You can perform the tutorial steps without saving the project file. However, if you are interrupted while performing the tutorial, you can save it with a new name by selecting **File > Save Project As**. Then, you can re-open the project to continue the tutorial at a later time.

Step 2. Review objects by layer

Your goal in doing data preparation is to create high-accuracy surfaces for stakeout, machine control, or takeoff calculations by making your data as complete and accurate as possible. The following procedures will help you learn useful ways to clean up and prepare your data for any of those surfaces.

As you begin data preparation, make sure that your data is well organized by layer. You can create and delete individual layers, rename layers, purge all empty layers, and review objects by choosing their layer. Layer properties allow you to change layer colors and line styles to help you distinguish more easily between data on different layers.

1.	In the **Survey Office** ribbon, select **Home > View > View Filter Manager**.
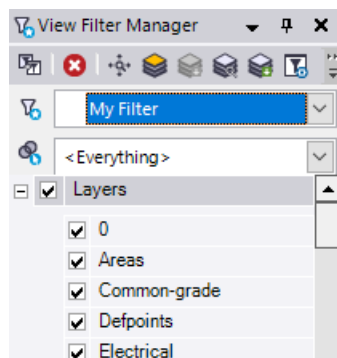
2. In the the **View Filter Manager** do the following:

   a. Click the **Zoom extents** icon on the toolbar at the top of the **View Filter Manager** (1 in the image below) to enter the zoom extents when the filter changes mode.

   b. Filter the view by right-clicking the name of any layer and selecting **View Only This** from the context menu.

      All of the other check boxes in the group are automatically unchecked so that only the selected layer is visible.

      Another way to turn individual layers on or off to better understand what data is on each layer is to isolate layers.

   c. Click the **Isolate Layer** icon on the toolbar (2 below).

   d. Click the names of various layers to see the data that resides on them in the view.

      Only objects on the selected layer are visible. Review each layer to see how your project data is organized.

Notes:
- When in **Isolate Layer** mode, you may find it faster to use the up and down arrow keys to move through the layer list.
- Press **[Spacebar]** to check or uncheck the box for any layer. All checked layers will be visible in the view filter when you exit the Isolate mode.

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   e. Specifically, select the *ROADS* layer and notice that one of the building pad outlines is incorrectly assigned to it (3 below).
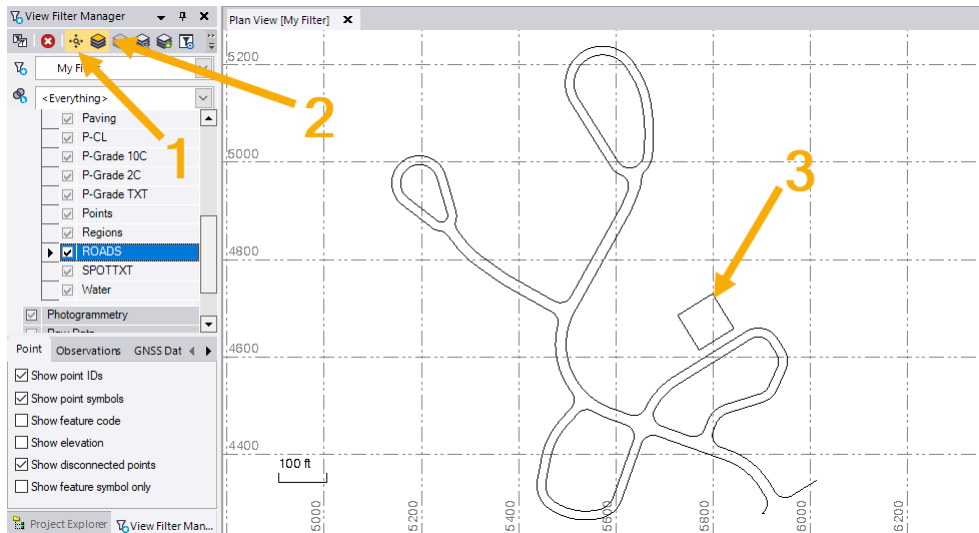

   You will need to move this object to the *Pads* layer.

3. In the **Plan View**, select the pad outline.

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4. Click the **Zoom extents** icon and **Isolate Layer** icon in the **View Filter Manager** toolbar to exit those modes. Then check the **Layers** check box to show all of your layered data.

5. Ensure the pad outline is still selected, then right-click in the **Plan View** and select **Properties** from the context menu.
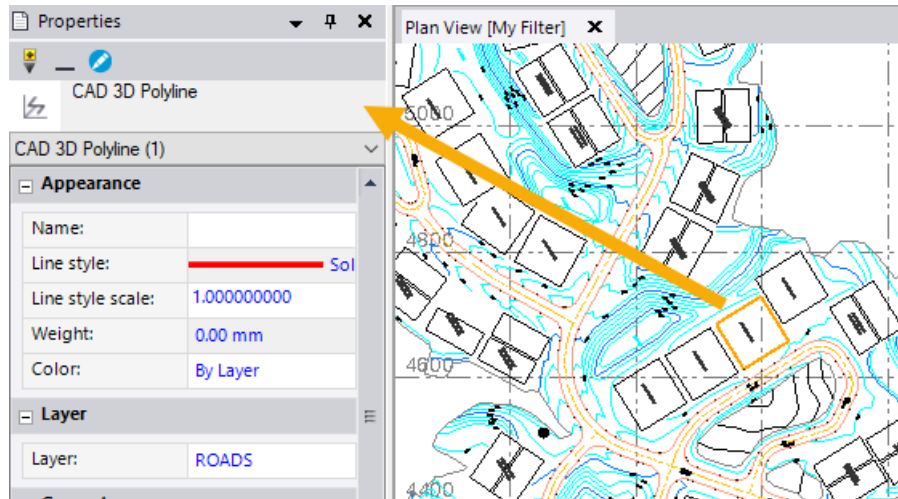
6. In the **Properties** pane, click in the **Layer** drop-down list and select *Pads* as the new layer.

   In your review of the layers, the *Defpoints* layer appeared empty, so you will delete it from the project.

7. Right-click the *Defpoints* layer in the **View Filter Manager** and select **Layer Manager**.

8. In the **Layer Manager** dialog, click the red **Delete** icon located at the right end of the *Defpoints* layer.
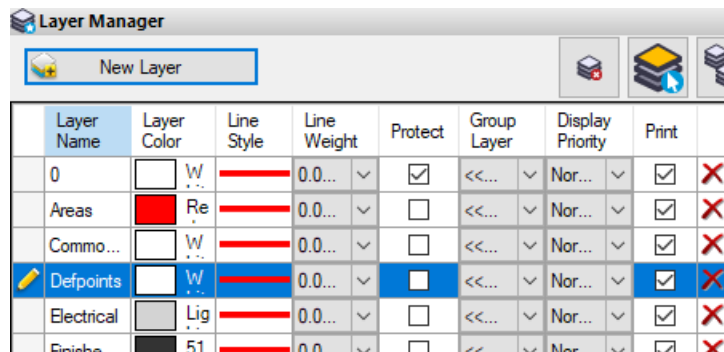
> **Note:** Typically, you want to make sure that all of your objects are on the correct layers before you delete empty layers. Otherwise, you may have to recreate layers that you thought were unneeded. You will automatically remove all remaining empty layers in the next procedure.

9. In the **Layer Manager** pane, select each layer to review its name, color, and line style.

In the **Layer Manager** dialog, you can rename any layers that are unclear so that their names make sense and indicate what type of data is on the layer. Try to keep names as short and straightforward as possible so that when you send data out to a controller or machine in the field, the device operator can readily identify each object. For example, you might add prefixes such as *OG* or *FD* to distinguish layers that contain original ground data from layers that include finished design data. You can also edit any of the other attributes as necessary.

> **Note:** If you select a layer color that is the same as your graphic view's background color, the inverse of that color is used in the view. If you want to hide a layer, do not use color; use the **View Filter Manager**.

10. Close the **Layer Manager** dialog and **Properties** pane.

Step 3. Clean up data

Now that you are done reviewing the initial data, you can automatically optimize it by removing unneeded objects, converting CAD lines into linestrings, and joining lines. You can opt to clean up only a portion of your data by selecting it; however, for this exercise, you will run the cleanup on all of the data in your project.

1. In the **SO** ribbon, select **Data Prep > CAD > Project Cleanup**.
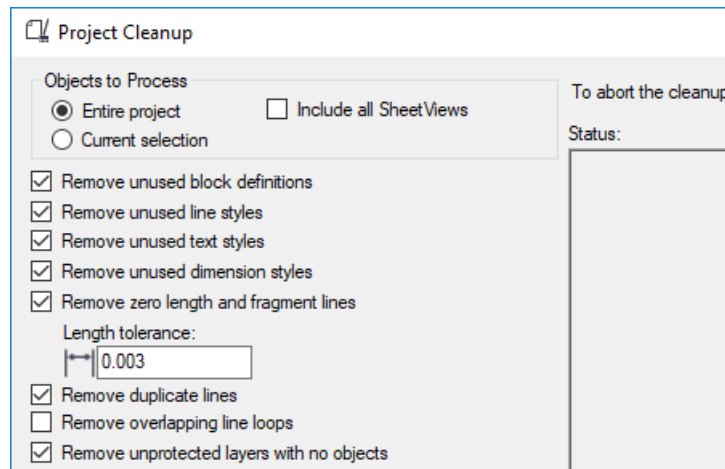
2. In the **Project Cleanup** dialog, do the following:

   a. Review the default settings.

      Although you may correctly suspect that some of them do not apply to your data, you may want to leave them checked just to be sure. If you ever change the settings and need to restore the defaults, you can click the **Defaults** button.

      In the following steps you will change some specific default values.

   b. To simplify your linear data, check the **Filter line vertices** check box.

c. In the **Circle filtering radius** field, enter *0.002*.

This specifies the horizontal distance that a node between two segments must deviate from tangent to be retained. Setting this tolerance lower will retain more nodes.

d. Check the **Set elevation outside range to undefined** check box.

e. Since you do not know the elevation range of your data, click the **Scan for Elevation Range** button.

The results display in the **Minimum elevation** and **Maximum elevation** fields.

f. Uncheck the **Set elevation outside range to undefined** check box.

This would have let you specify an elevation range outside of which object's elevation would be set to zero. In the **Minimum elevation** and **Maximum elevation** fields, you can see that all of your data is in a realistic range, so there is no need for this option
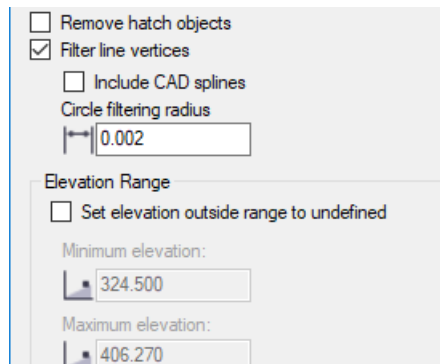
g. Click the **Apply** button to clean your data based on the enabled options.

h. Review the results in the **Status** box.
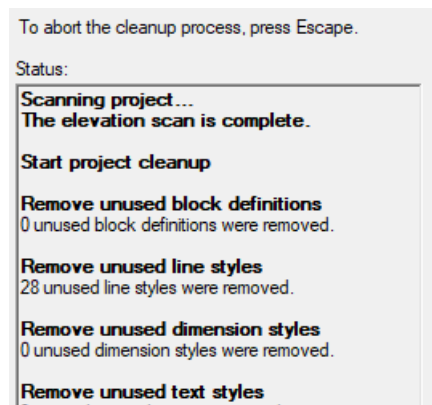
You can see that a number of unused styles, objects, and layers were removed, and that your lines were simplified.

Besides simplifying your data, cleaning up your project makes the file smaller and faster to work with.

i. Click the **Close** button.

Step 4. Create points from spot elevations

One of the first steps in data prep is to ensure that your data is complete and in its most usable form. For example, to prepare for elevating 2D lines so you can make a surface out of them, you can create 3D points from a variety of elevation spot indicators and then use these points to elevate the lines.

To easily identify which lines have been elevated, you can open a **3D View** alongside the **Plan View** and set your zero-elevation data for both views to an alternate color in the **View Filter Manager** before you begin.

1. In the **View Filter Manager**, click the **Display Options** tab located at the bottom of the pane and select the **Display in alternate color** option. Then select *Gray* in the **Alternate color** drop-down list.
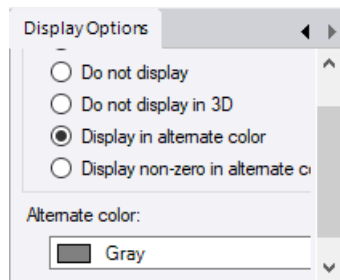
2. In the **SO** ribbon, select **Home > View > 3D View**.

3. Right-click on the **3D View** tab header and select **New Horizontal Tab Group** so you can see both the **Plan View** and **3D View** at the same time.

4. Click the mouse wheel in the **3D View** and drag the mouse until you have an isometric view, as shown below.
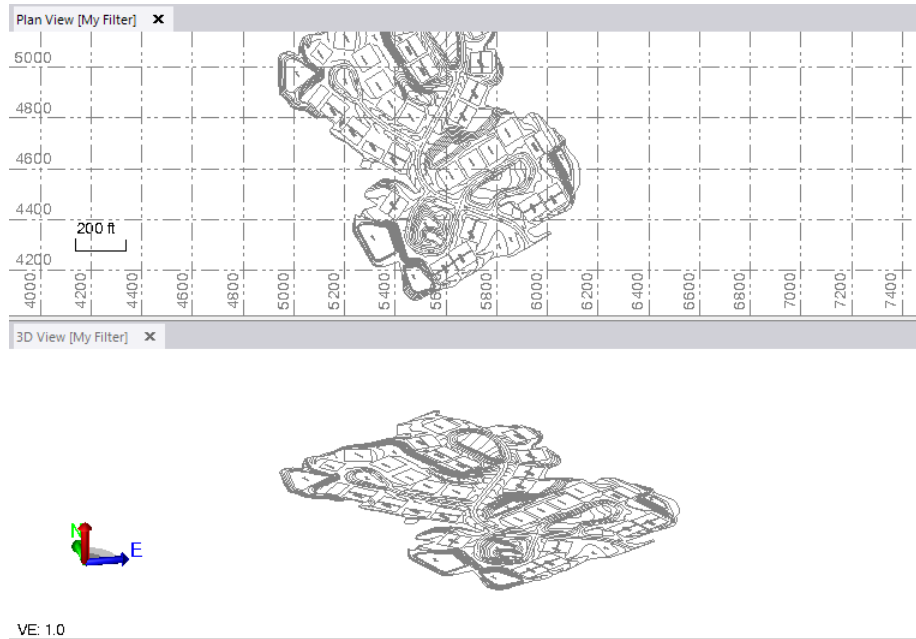
5. To hide the grid lines, as shown above, click on the **Plan View** tab header and then, in the **Status** bar (located at the bottom of the **SO** window), select **Toggle Gridlines**.

6. Click the **Plan View** and use your mouse wheel to zoom in to one of the spot elevations near a road centerline as shown here.
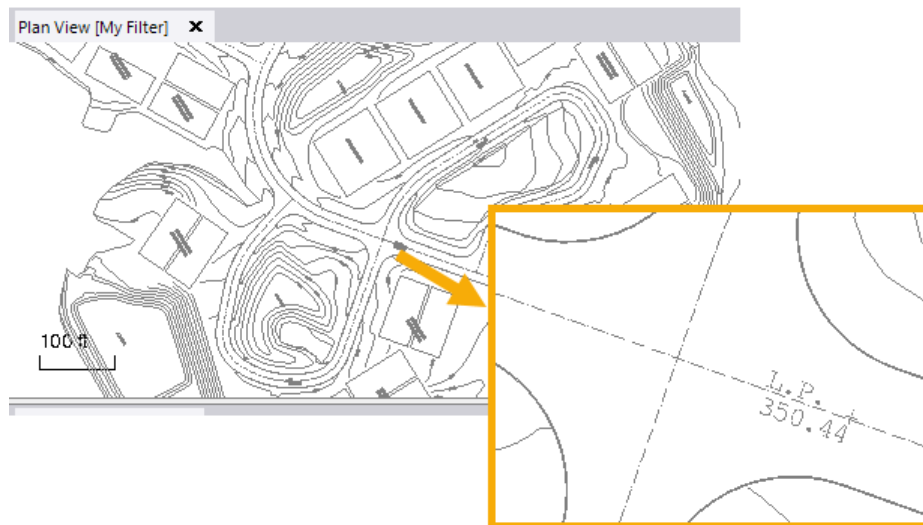
7. In the **SO** ribbon, select **Data Prep > Elevate > Create Points from Spot Elevations**.

For the first three settings in the **Create Points from Spot Elevations** pane, you need to determine the nature of the spot elevation.
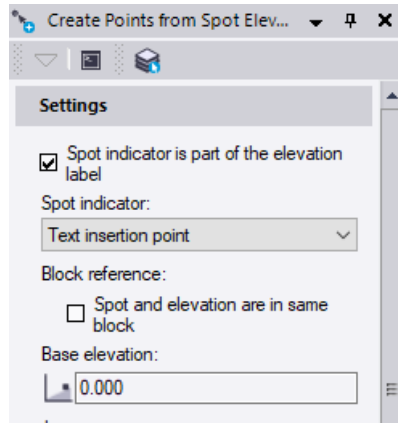
8. Click the **View Filter Manager** tab heading to take the focus off the **Create Points from Spot Elevations** pane and change to a selection cursor.

9. Zoom in and click on each of the three CAD text objects that identify the spot elevation — label abbreviation (1 below), elevation (2), spot location indicator plus sign (3) — to verify they are separate objects.
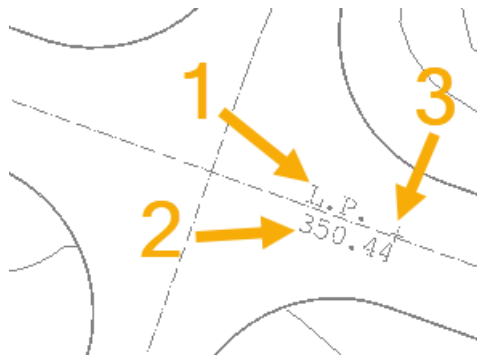
10. Click a blank space in the view to deselect everything.

11. In the **Create Points from Spot Elevations** pane, do the following:

    a. Based on what you have determined about the spot elevation, uncheck the **Spot indicator is part of the elevation label** check box.

    b. In the **Spot indicator** drop-down list, select *Text plus sign.*

    c. Verify the **Spot and elevation are in same block** check box is unchecked since the three objects were not grouped together as a block.

    d. Since the spot elevations are not relative to a common base elevation, do not change the default value *0.000* in the **Base elevation** field.

    e. In the **Layer** drop-down list, select *Points* as the layer on which to create the new points.

    f. Since there are no other points in your project, do not change the default value *1* in the **Starting point number** field as the point ID for the first point created.

       Subsequent points will be numbered sequentially from the starting number.

    g. Leave the **Feature code** field empty.

h. Click the **Options** button located next to the **Spot elevations** field, and select **Select by Layer** from the pop-up menu to display the **Select by Layer** pane.
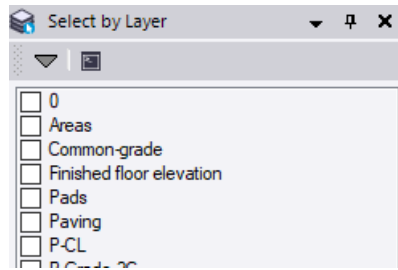
This will make it easy to select all of the objects that are part of spot elevation indicators in your project.

12. In the **Plan View**, click any part of the spot elevation (text, numerals, or indicator) to select the appropriate layer in the **Select by Layer** list (in this case, layer *P-Grade TXT*). Then click the **Close** button.

Notice that 122 objects (and all three parts of each spot elevation) on the *P-Grade TXT* layer are now selected.
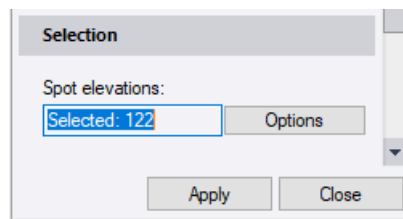
13. In the **Create Points from Spot Elevations** pane, click the **Apply** button.

14. In the **Projection Definition** dialog, click **OK**.

Nine points are created at the locations of the spot elevation indicators. The points inherit the elevations of the text, and appear in the graphic views and **Project Explorer**.
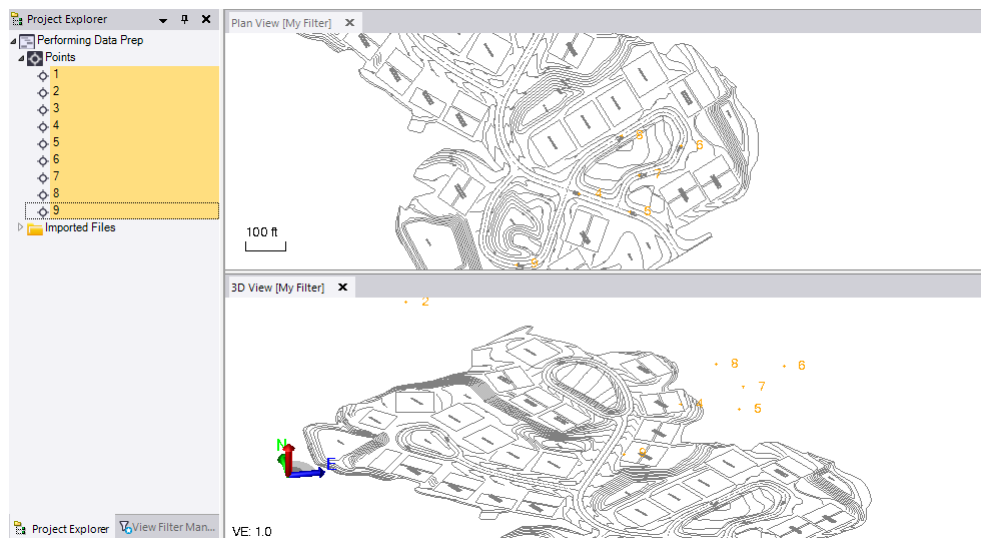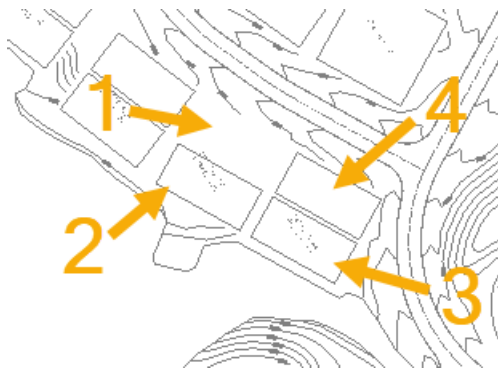
15. In the **Create Points from Spot Elevations** pane, click **Close**.

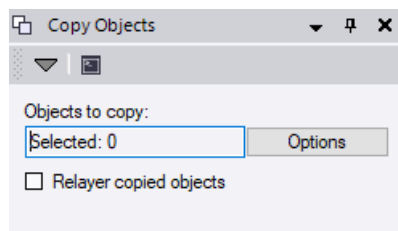# Step 5. Copy and offset objects

1. With the focus in the **Plan View**, use your mouse wheel to zoom in on the site as shown here.
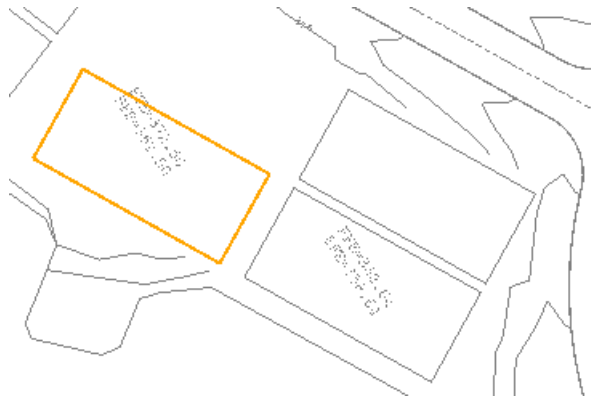

Notice that there is one rectangle (representing a building pad) that is missing from your data set (1 below). You will create a copy of an existing pad and position it where the one is missing.

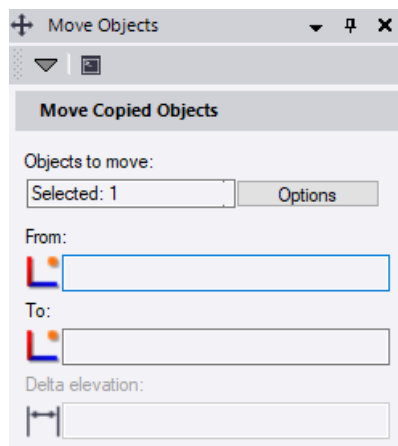2. In the **SO** ribbon, select **CAD > Edit > Copy Objects**.

3. In the **Copy Objects** pane, do the following:

   a. Click in the **Objects to copy** field and pick the pad outline labeled 2 in the image above.

    b. Leave the **Relayer copied objects** check box unchecked to inherit the layer from the selected pad.
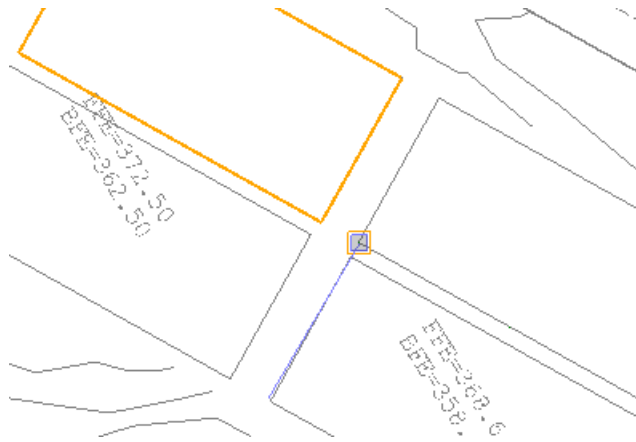
    c. Click **Apply**.

    The **Move Objects** pane displays.

4. In he **Move Objects** pane, do the following:

    a. Click in the **From** field and then zoom in on the **Plan View** and pick the corner of the pad labeled 3 in the earlier figure and as shown here.
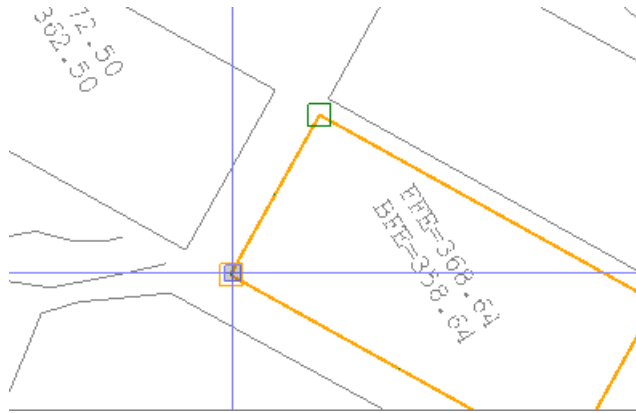
b. Click in the **To** field and then pick the corner of the pad labeled 4 in the earlier figure and as shown here.

Picking these two points moves the pad copy the same relative distance and direction as the existing pads.
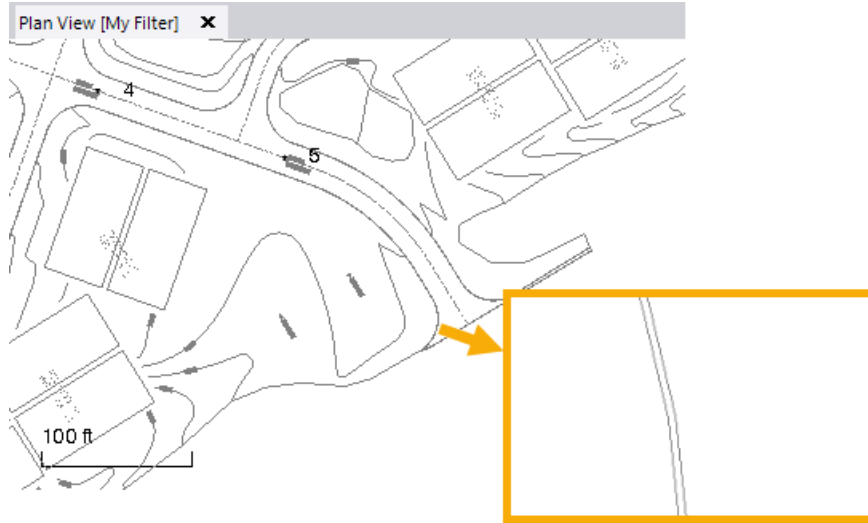
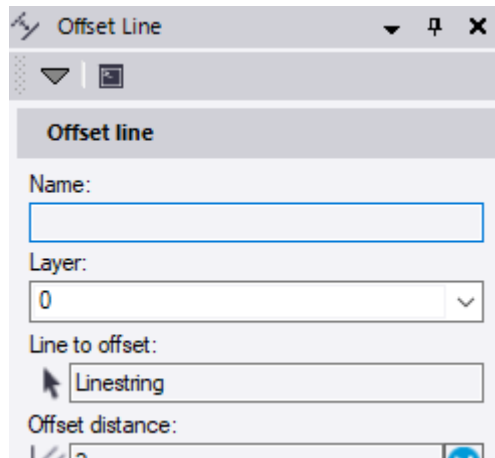Your data in the **Plan View** should now look like this.

c. Click **Close** and then de-select the pad line.

Next, you will create a back-of-curb line offset from the existing edge of pavement lines.

5. In the **Plan View**, zoom in to the lines at the edge of the road near the bottom of the data, as shown here.


6. In the **SO** ribbon, select **CAD > Edit > Offset Line**.

7. In the **Offset Line** pane, do the following:

   a. Click in the **Line to offset** field and then pick the outer line in the **Plan View** as shown here.

CAD 3D Polyline [ROADS]
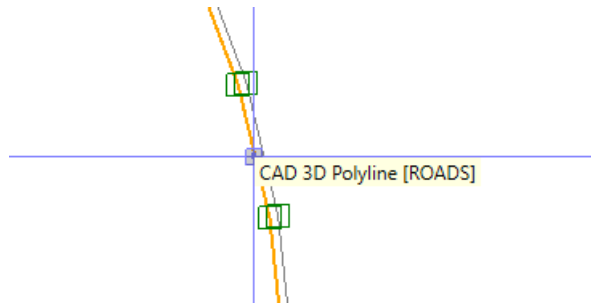
b. Typically, the **Name** field is filled with the name of the original line. Since the original line is unnamed, type *Back of curb* in the field.

c. Click in the **Layer** drop-down list and then click the line highlighted in the **Plan View** again to select its layer: *Roads.*

d. In the **Offset distance** field, type *1.0*.

e. Click in the **Side to offset** box and click a location to the left of the selected line in the **Plan View**.

Based on the direction of the line, *Right* displays in the field.

f. Leave the **Vertical offset** at *0.00*, and click **Apply** to create the offset line.

The new offset line displays in the **Plan View** and **3D View**.
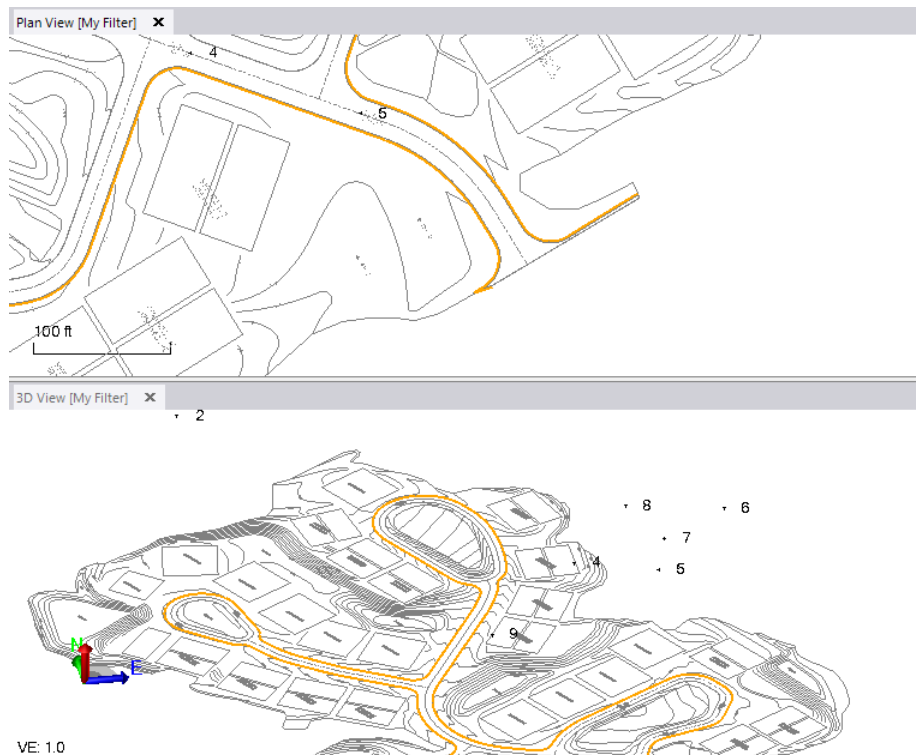
g. Click **Close**.

You can use this same process to create additional back-of-curb lines around other parts of the road where they are missing. However, for this tutorial, that will not be necessary.

Step 6. Move objects and create a polyline

As long as you are adding new data, there is one more object to fix. Notice the building pad that is not closed in the image below:
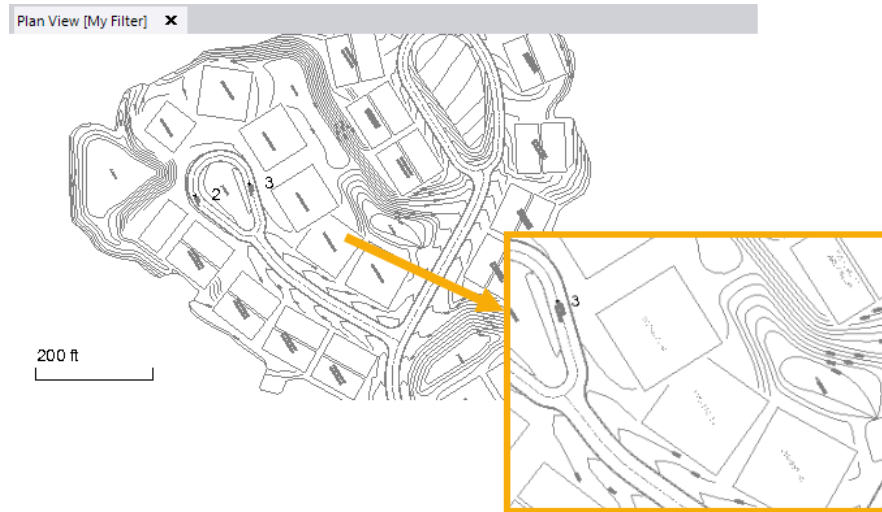
Based on an updated design from the site planners, you need to move the building pad above the broken pad to the northwest and complete the broken pad line by drawing a polyline.

1. In the **SO** ribbon, select **CAD > Edit > Move Objects**.
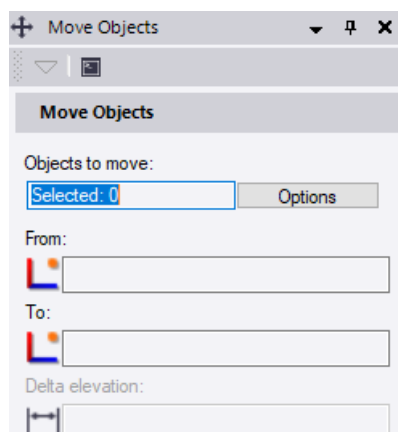
2. In the **Move Objects** pane, do the following:

    a. If any of the three **Settings** check boxes are checked, uncheck them.

Although these options can be very useful, you will not use any of them for this step. You will be moving the pad a specific, relative distance without using the **Plan View**.

b. Click in the **Objects to move** box, and select the pad shown in the image below.
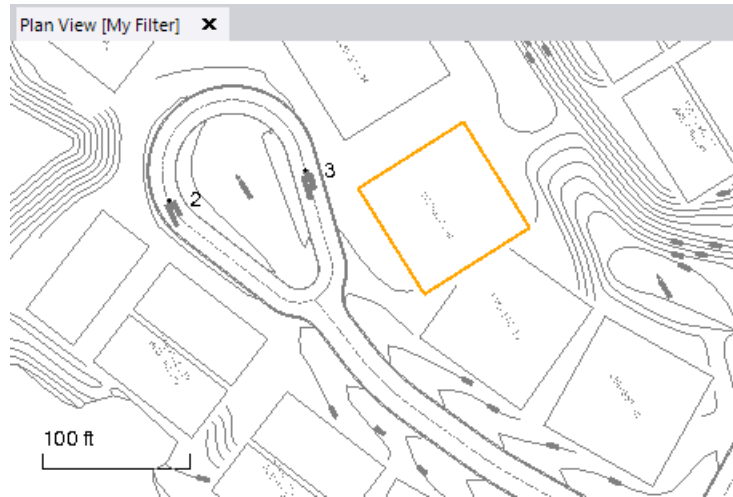
c. Click in the **From** field, and the click any point on the selected pad line to specify the **From** point.

d. In the **To** field, type: *@-10,@12*

e. Click **Apply** to move the pad 10 feet west and 12 feet north, relative to its current position.
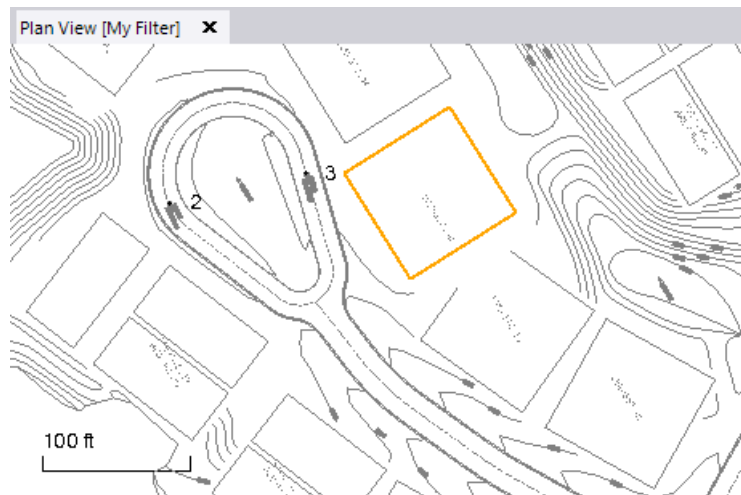
f. Click **Close**.

Next you will close the broken line in the second pad (2 in the figure above) using a polyline.

3. In the **SO** ribbon, select **CAD > Lines > Create Polyline**.
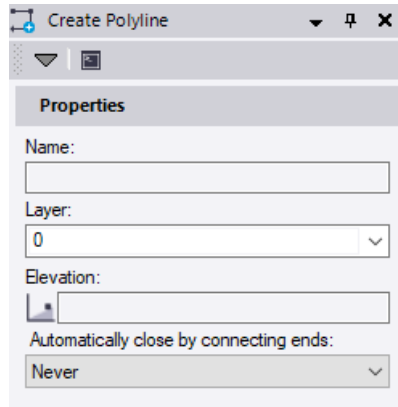
4. In the **Create Polyline** pane, do the following:

    a. None of your lines are named, so you can leave the **Name** box blank.

    b. In the **Layer** drop-down list, select *Pads* as the layer on which you want the polyline to reside.

    c. Click in the **Elevation** field. Then, in the **Plan View**, click the elevation text within the broken pad line to specify the polyline's elevation: *374.140*
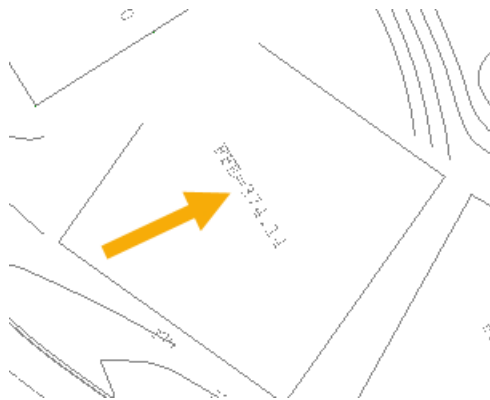

    d. Leave the **Automatically close by connecting ends list** set to *Never*.

    e. In the **Method to Add Points** group, select the **Specify individual points** option to pick the start and end point for each segment in the polyline.

    f. Click in the **Next point** field, and then select the end of the line on the left as shown here.
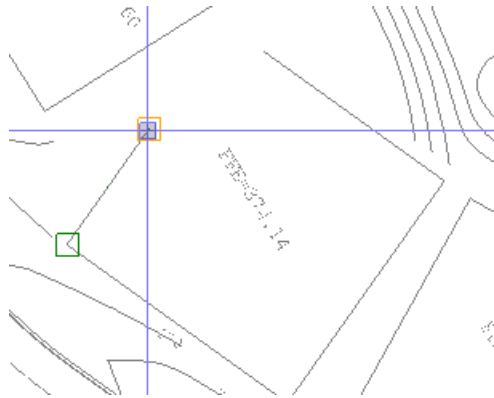
A coordinate displays in the **Next point** field.

g. Right-click in the **Next point** field and select **Intersection > Intersection of Segments** from the context menu to display the **Intersection of Segments** pane.
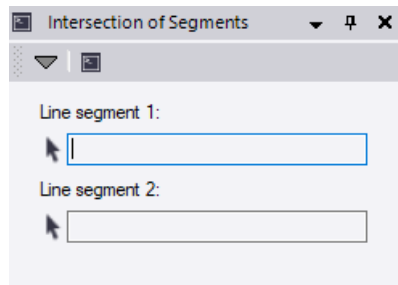
This snap will let you draw from one of the existing segment's end points to the point where it would intersect with the other existing segment.

5. In the **Intersection of Segments** pane, do the following:

a. Click in the **Line segment 1** field and then click anywhere on the *left* broken pad linestring to select it.

The cursor automatically moves to the **Line segment 2** field.

b. Click anywhere on the *right* broken pad linestring to make your selection in the the **Line segment 2** field.

The first segment of the polyline is drawn to the intersection point of the two lines.

The **Intersection of Segments** pane closes and the **Create Polyline** pane displays.

6. In the the **Create Polyline** pane, do the following:

   a. Click in the **Next point** field and then click the remaining end point to finish the polyline and close the pad line.
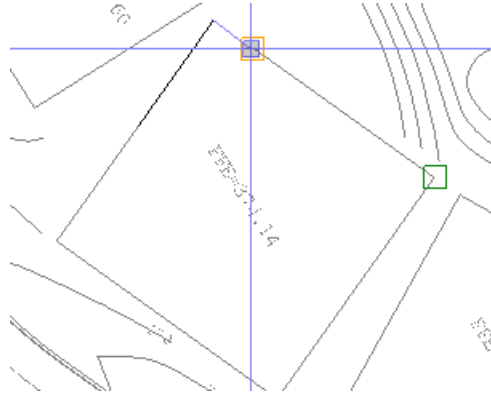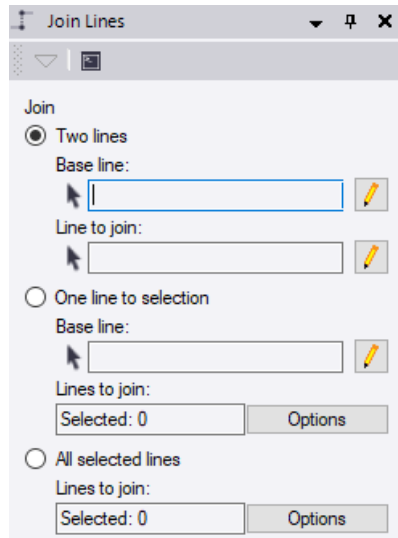

   b. Click **Close**.

   The two pads should now look like this:

7. To join the new polyline with the pad line, in the **SO** ribbon select **CAD > Edit > Join Lines**.
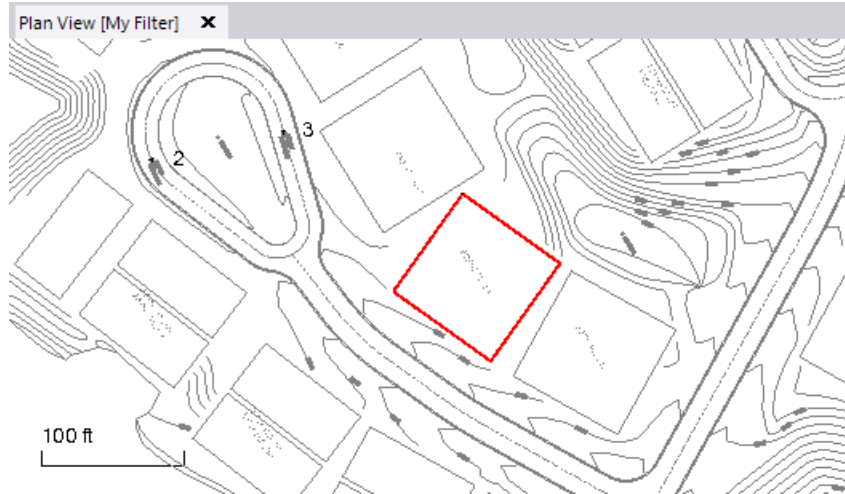
8. In the **Join Lines** pane, do the following:

   a. Select the **Two lines** option.

   b. Click in the **Base line** field and then select the existing pad line.

   c. Click in the **Line to join** field and then select the new polyline you created.

   The lines are joined creating a single linestring for the pad.

d. Click **Close**.

Step 7. Transform objects

Earlier, you moved an object. You can also transform objects by moving, rotating, and scaling them in one operation. The three transformations are done in this order:

1. Move

2. Rotate

3. Scale

Dependent objects, such as surfaces, are updated when you transform objects, although points with control quality or local / global coordinates (in latitude and longitude) cannot be moved; only points defined as grid-only during import or creation can be moved or elevated.

In this step you will move, rotate, and scale another of the pad outlines that the site engineers have changed.

1. In the **SO** ribbon, select **CAD > Edit > Move/Rotate/Scale Objects**.
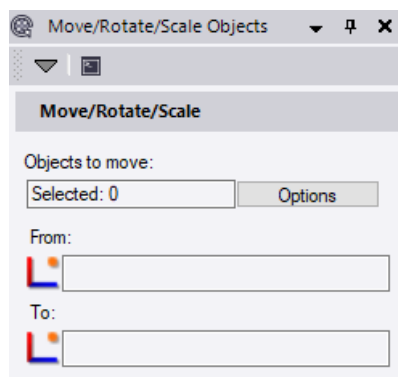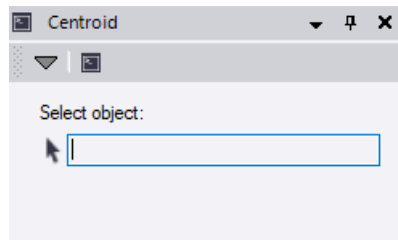
2. In the **Move/Rotate/Scale Objects** pane, do the following:

a. Click in the **Objects to move** field, and then pick the pad line shown in the image below.
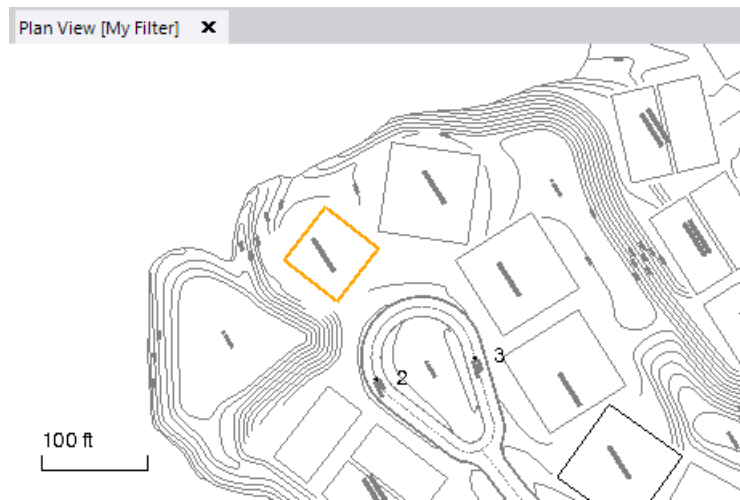
b. Right-click in the **From box** and select **Centroid** to use the center of the pad's area as the rotation and scaling point.

The **Centroid Snap** pane displays.

c. Click in the **Select object** field, and then select the same pad in the **Plan View**.

The **Centroid Snap** pane closes and the **Move/Rotate/Scale Objects** pane displays with the **From** field populated.

d. Because you want to rotate and scale the pad in its current location, copy the value in the **From** field and paste it into the **To** field.

Since you are doing a 2D planar transformation, the **Delta elevation** field is disabled.

e. Based on the pad redesign, in the **Rotation angle** field type *20*.

f. To make the pad the same size as the others on the site, in the **Horizontal scale** field type *1.33333* for the factor by which to resize it.

g. Click **Apply** to transform the object. Then click **Close**.

Your pad outline should now look like this:
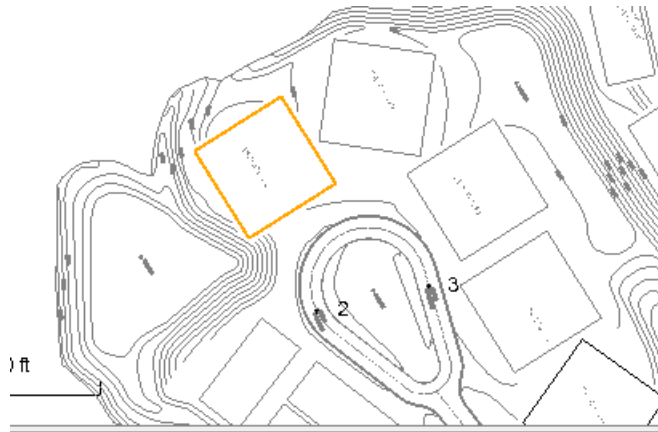
Step 8. Elevate contour lines

Now you are ready to elevate many of the lines in your data so you can create a surface from them. You will start by using in-line elevation labels to quickly elevate 2D lines that represent topographic contours. The elevation is derived from the text of the label.

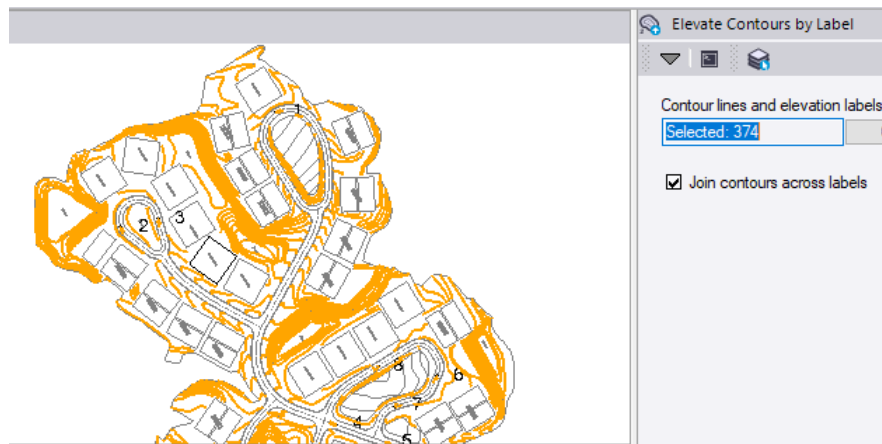1. In the **SO** ribbon, select **Data Prep > Elevate > Contours by Label**.
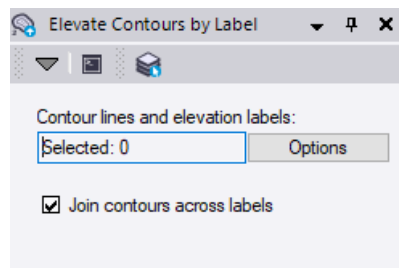
2. In the **Elevate Contours by Label** pane, do the following:

   a. Click the **Options** button and choose **Select by Layer** from the context menu to display the **Select by Layer** pane.

   b. If the *Pads* layer is selected in the **Select by Layer** pane, uncheck the check box.

   c. Check the check boxes for the *P-Grade 2C*, *P-Grade 10C*, and *P-Grade TXT* layers.
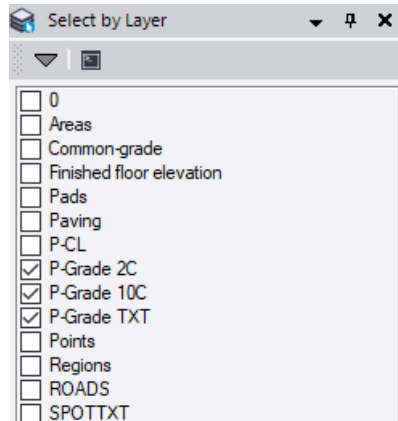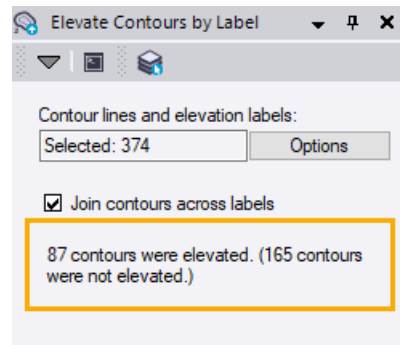
d.   Click the **Close** button.

The **Elevate Contours by Label** pane displays. The **Contour lines and elevation labels** box displays the number of objects selected.

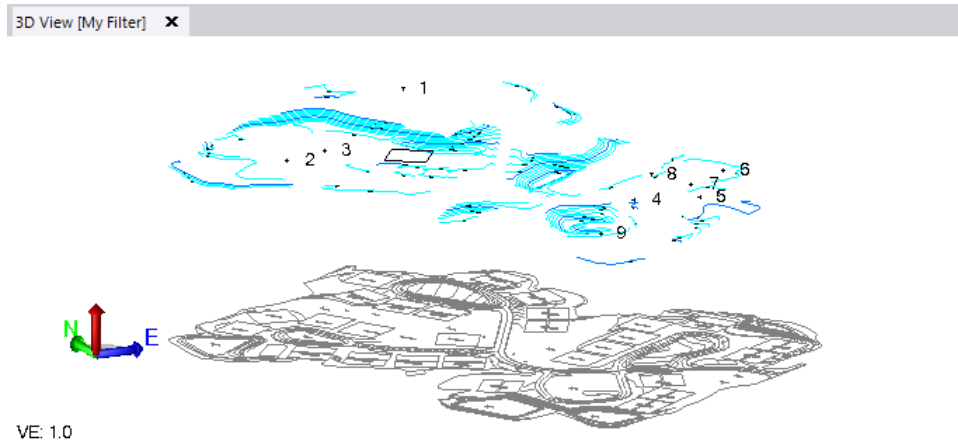e.   In the **Elevate Contours by Label** pane, click the **Apply** button.

A message displays indicating that 87 of the contour lines were elevated based on their labels.

f.   Click the **Close** button.

3.   Click a blank space in a graphic view to de-select everything.

Now your data in the **3D View** should look like this:

VE: 1.0

You can quickly elevate many of the remaining contour lines by crossing them with a line that applies elevations based on a specified starting elevation, increment direction, and contour interval.

4. In the **SO** ribbon, select **Data Prep > Elevate > Contours by Crossing**.
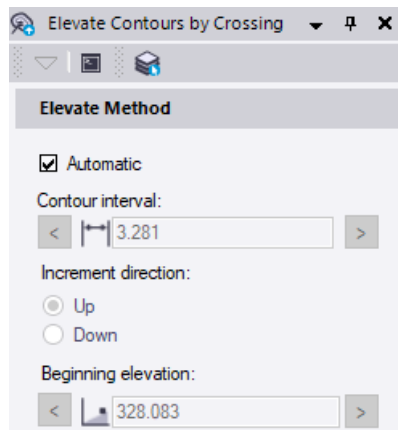
If the **Automatic** mode is selected in the **Elevate Contours by Crossing** pane, you can draw across two or more elevated lines to specify that the contour interval, increment direction, and beginning elevation of the unelevated lines around them are automatically computed. At least two of the crossed lines must have different elevations from which the slope direction and interval can be determined.

Note: The **Contour interval**, **Increment direction**, and **Beginning elevation** controls are disabled when the **Automatic** mode is selected.

5. Since some of the lines already have elevations assigned from the previous command, verify that the **Automatic** check box is checked in the **Elevate Contours by Crossing** pane.

6. To avoid crossing lines that are not contours, and still be able to view elevation labels, select only the following layers in the **View Filter Manager**:

   - *P-Grade 10C*
   - *P-Grade 2C*

- *P-Grade TXT*
- *SPOTTXT*

As necessary during this workflow, you can toggle between viewing just these layers as you create crossing lines, and all layers as you attempt to identify related series of contour lines.

7. In the **Plan View**, find a series of contour lines where some are elevated and some are not, such as on the upper-left (northwest) corner of the site.
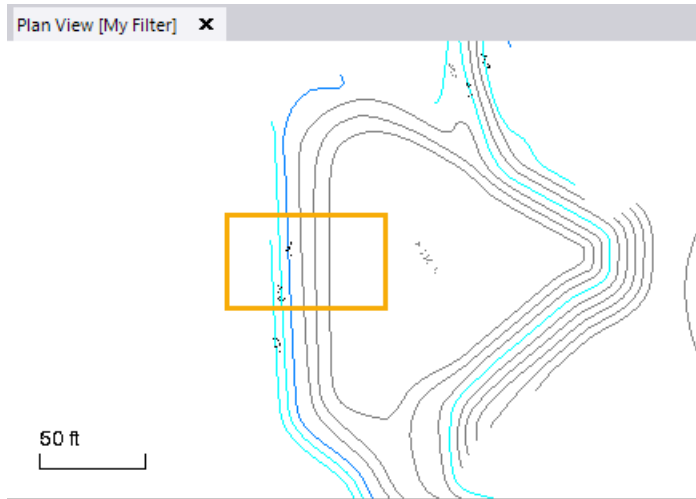

8. In the **Elevate Contours by Crossing** pane, click in the **From** field. Then click a location in the **Plan View** on one side of the series of contour lines (as shown below) to specify the beginning of the crossing line.
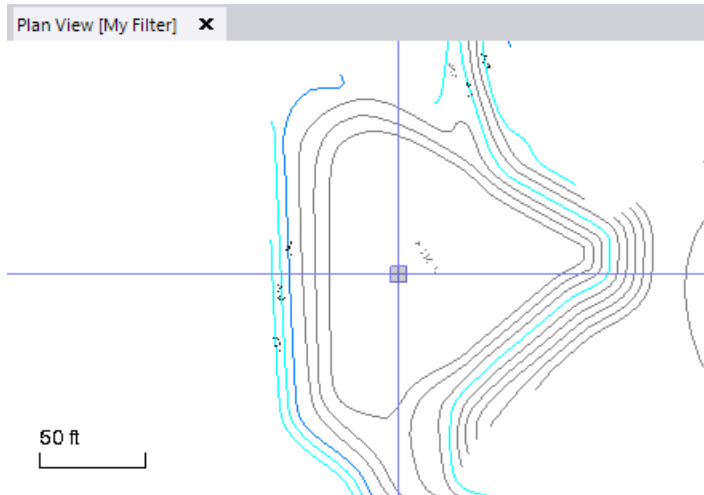

The selected coordinate is displayed in the **From** field and the cursor moves to the **To** field.

9. Click a location in the **Plan View** on the other side of the series of contour lines (as shown below) to specify the end of the crossing line.
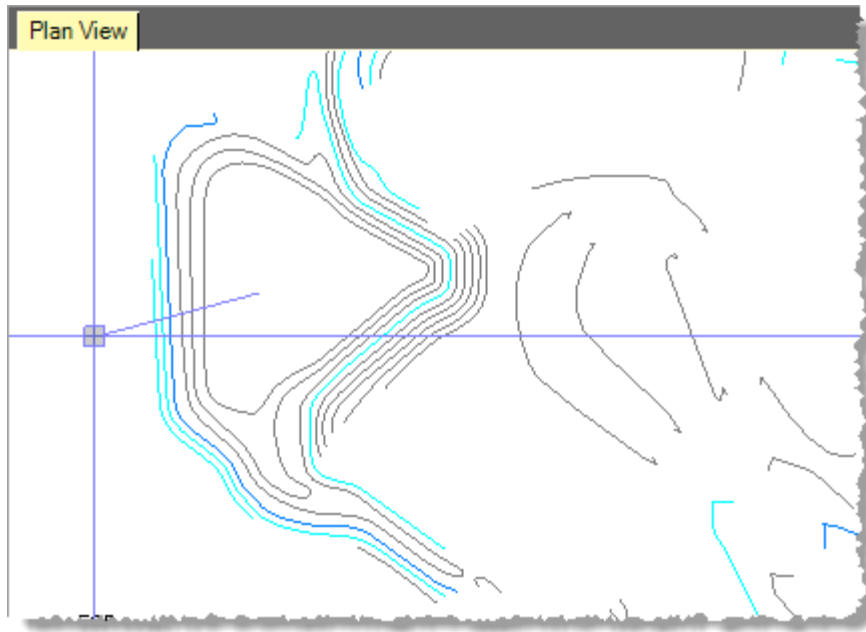
This coordinate is displayed in the **From** point after you make your selection and the elevations are applied.

Notice how the gray contour lines change color in the **Plan View** and **3D View** when the elevation is applied. You can also see that they have been elevated in the **3D View**.
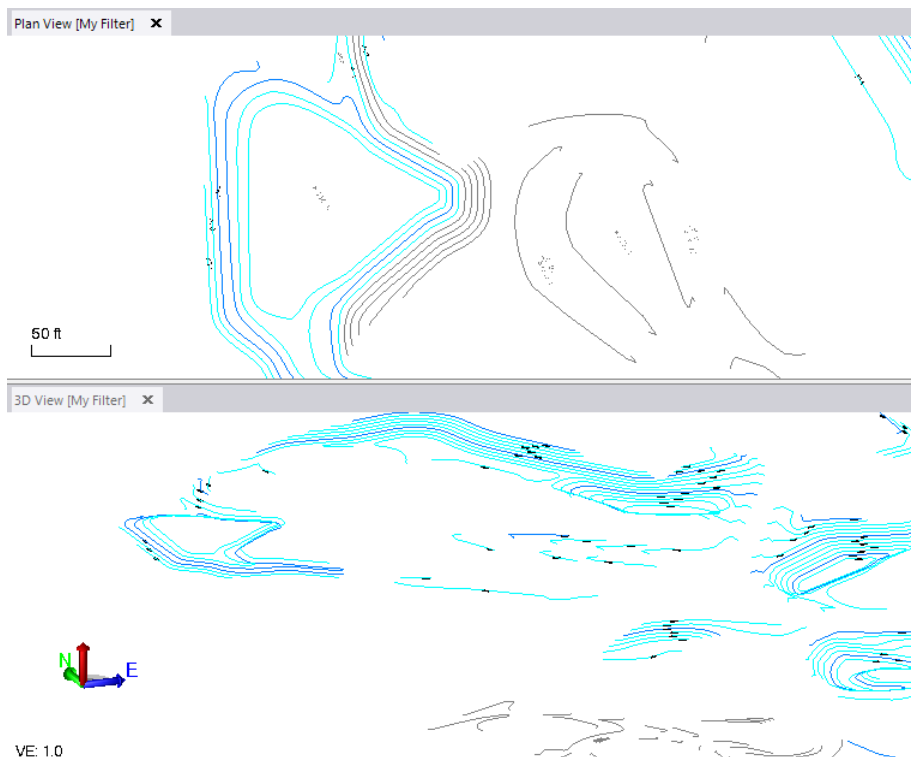
10. Find other series of contour lines where two or more are elevated and some are not, and repeat this procedure for each.
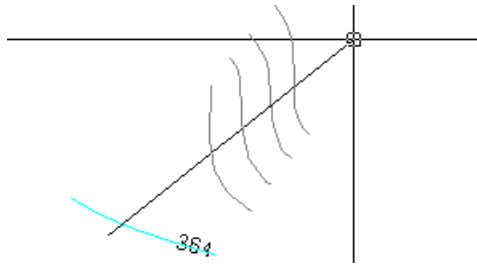
> **Note:** For this tutorial, it is not necessary that you elevate every contour line. In addition, your screen images may not match exactly the images shown here. The intent is that you at least obtain a basic understanding of the workflow and the tools at your disposal to perform the elevations.

When selecting contour lines to elevate, avoid elevating the lines shown here. You will use a different method to elevate these later in this procedure.
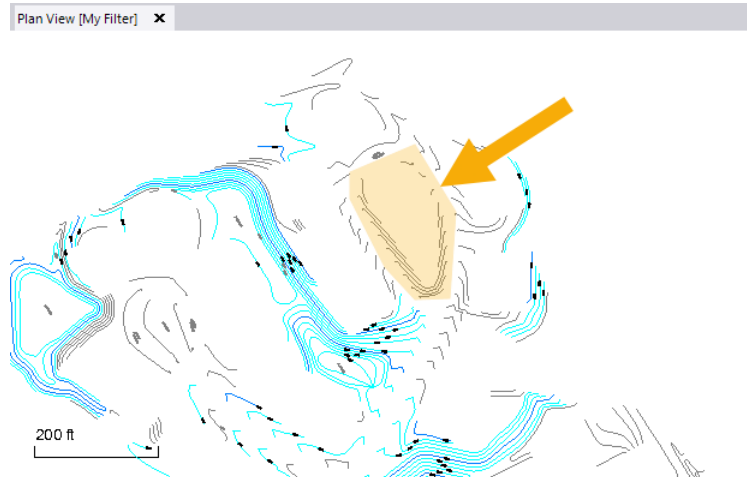
11. For areas in which there is only one elevated contour line (or one elevation label) in a series, do the following:

a. Uncheck the **Automatic** check box.

b. Because the labeled contours indicate elevation increments of 2, type *2* in the **Contour interval** field.

c. Looking at the trend of the lines you need to elevate, specify whether you want the elevations to increase or decrease from the first line crossed by selecting an **Increment direction**.

d. Click in the **Beginning elevation** field, and then click an elevated line or label in the **Plan View** to specify that the elevation of the selected line will be used to compute the elevation of each line you cross.

For example, if the only labeled/elevated contour line to be crossed shows an elevation of *364* and the next contour line is uphill, specify the contour interval as *2.0*, set the increment direction to **Up**, and select the line for the beginning elevation. Then cross all of the lines in the uphill direction to elevate them.

e. Find other series of contour lines where only one or more are elevated and rest are not, and repeat this procedure for each.

Note: Again, for this tutorial, it is not necessary that you elevate every contour line correctly. Elevate as many as you feel comfortable with so that you at least understand the workflow and how to use the tool.

12. Work your way around the job site, elevating as many contour lines by crossing as possible (or as many as you are comfortable doing). Keep in mind the following:

- The more care you take in this process, the more accurate your results will be.

- If you are not sure about a series of lines, do not elevate them yet. There are other tools you can use.

- Try to work across series of lines in small areas so you are not skipping elevations in adjacent areas.

- Be wary of contours that double back on themselves or are broken by gaps or other lines.

- Zoom out periodically to try to understand the general trend of the topography. Display and hide layers as necessary.

- You might miss contours because of gaps or someone might have deleted some, so the sequence is wrong.

- Go only one direction (up or down) in one process.

- Watch out for "benches" where two contours have the same elevation.

- If you resume using your method of crossing two elevated lines to elevate nearby lines, remember to recheck the **Automatic** check box.

- If you need to determine the elevation of a line that is not labeled, select **Data > Explore > Explore Object** and select the line. The elevation of the line appears next to the cursor (annotated as *E:*).

Tip: Check your **3D View** periodically to find contours that you have missed, and to ensure that you are elevating them correctly. How carefully you want to prepare your data for the purpose of this tutorial is up to you, but you should be very careful when using your own real job site data.

200 ft
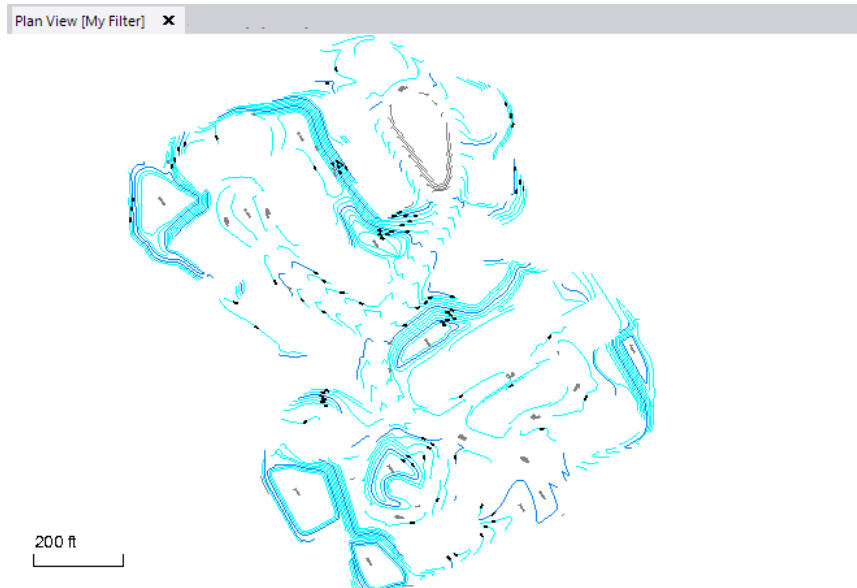
13. When you are done elevating as many contour lines by crossing as you can (or are comfortable with performing), click the **Close** button.

14. In the **View Filter Manager**, select to view all layers.

With all layers visible, your data should look something like this in the **3D View.** (Don't worry if you screen image does not look exactly like the same.)

200 ft

VE: 1.0
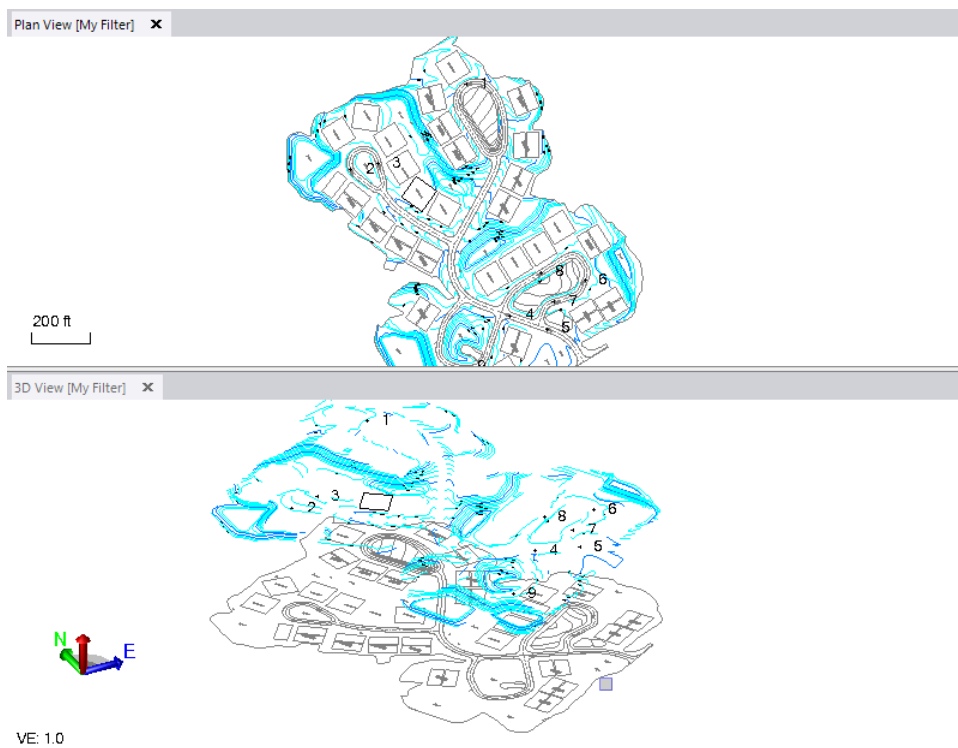
Note that you can elevate some of the lingering contours by clicking one line at a time, elevating them based on a specified starting elevation, increment direction, and contour interval.
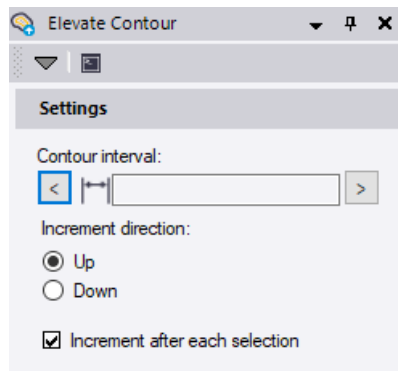
15. In the **Plan View,** zoom into the area specified above where you did not elevate lines.
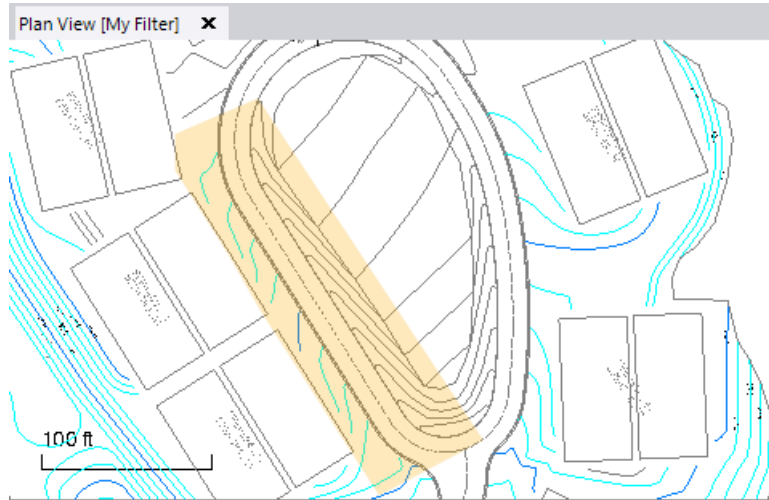

Notice how the elevated contour lines on the left side of the roadway correspond with the contours on the right side. You can use one of the elevated lines as a starting point for elevating the other lines.

16. In the **SO** ribbon, select **Data Prep > Elevate > Contour**.

17. In the **Elevate Contour** pane, do the following:

    a. In the **Contour interval** field, enter 2 for the vertical distance between each line.

    b. For the **Increment direction**, ensure the **Up** option is selected.

    c. Ensure that the **Increment after each selection** check box is checked so the elevation automatically increments for the next line after you pick a line.

    d. Click in the **Current elevation** field. Then, in the **Plan View,** pick the elevated line labeled 1 in the image below to specify its elevation.
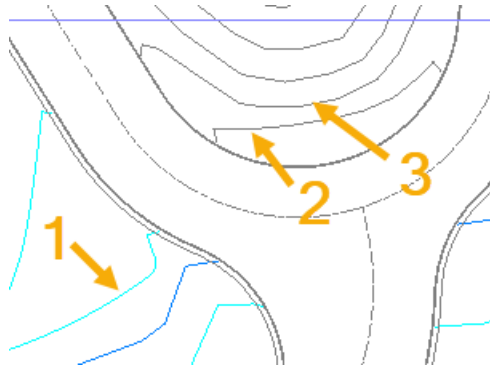
382 is specified in the **Current elevation** field and the **Contour line** field is selected.

e. Pick the first line in the unelevated series in the Plan View (2 in the image above).

The line is elevated to *382*.

f. Click the next unelevated line in the series (3 in the image above).

The contour interval value is added to the elevation of the last line picked and applied to the current line.

g. Moving north along the left side of the circle only, continue picking the contour lines in the series to elevate them.
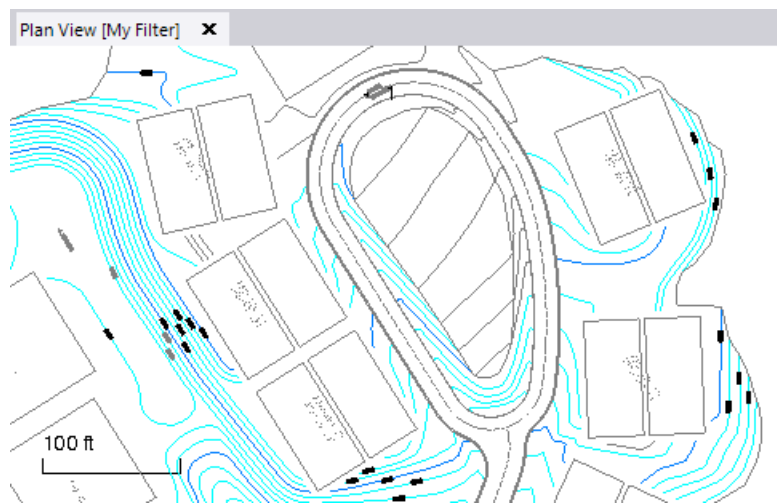
After elevating all of the contour lines on the left side of the oval, you are ready to elevate the remaining contours on the right side of the oval.

h. Click in the **Current elevation** field and select the last elevated line on the right side of the circle to establish a new starting elevation of *388*.
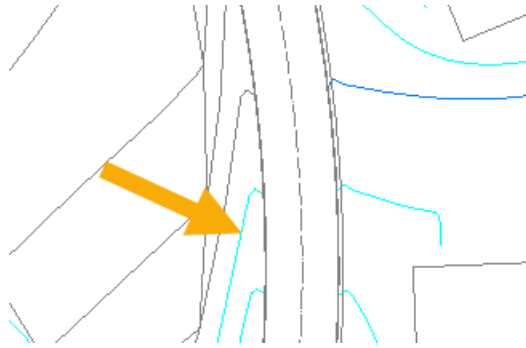
i.   Moving north along the right side of the circle, continue picking the contour lines in the series to elevate them.

Optionally, after elevating several lines in a series this way using the **Elevate Contour** command, you could use the **Elevate Contours by Crossing** command to elevate the remaining lines in the series.

j.   When you are done, click **Close**.
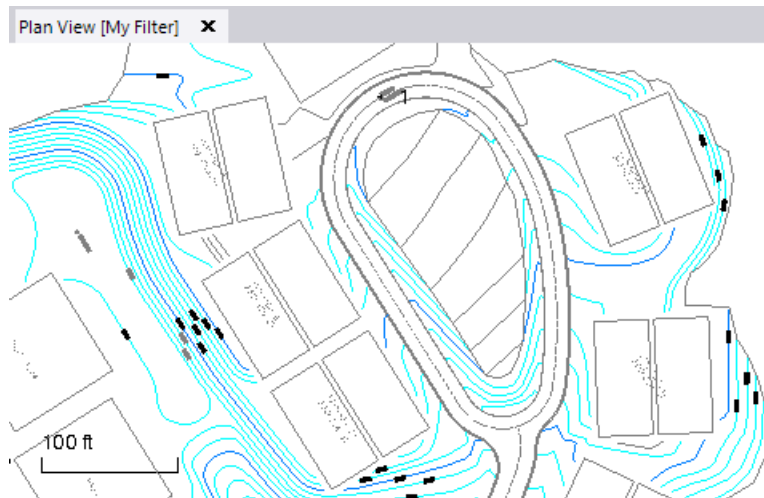
Step 9. Elevate other lines

In this step you will elevate the roadway lines using a variety of objects that either intersect or lie near them, including the points that you created from spot elevation at the beginning of the tutorial. The elevations of the intersecting and nearby objects create and elevate vertical points of intersection (VPIs) along the elevated linestrings.

1.   In the **SO** ribbon, select **Data Prep > Elevate > Lines**.
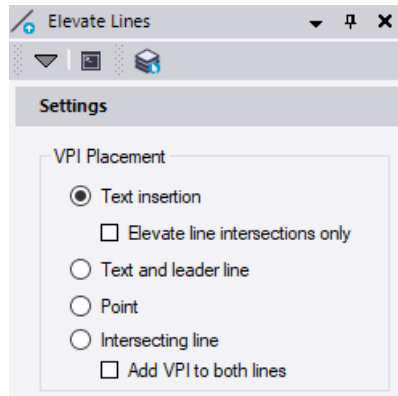
2. In the **Elevate Lines** pane, do the following:

   a. In the **VPI Placement** options group, select **Point** to use the elevations of points that lay on or near the lines you are elevating.

   b. In the **Offset tolerance** field, enter *0.5*.

   c. Ensure nothing is selected in the **Plan View**. Then, click the **Options** button located next to the **Points** field and choose **Select by Layer** from the context menu to display the **Select by Layer** pane.

   d. Select *Points* to specify the nine points on the *Points* layer. Then click the **Close** button.
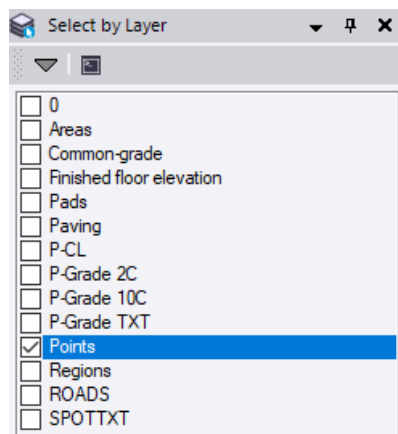
   e. Click the **Options** button located next to the **Lines** field and choose **Select by Layer** from the context menu.

   f. In the **Select by Layer** pane, select the *P-CL* layer to specify the five centerlines on the *P-CL* layer. Then click the **Close** button.

○ Point
○ Intersecting line
☐ Add VPI to both lines

Offset tolerance:
0.5000

Base elevation:
0.000

Selection

Points:
Selected: 9   Options

Lines:
Selected: 5   Options

g. In the **Elevate Lines** command pane, click the **Apply** button.

Four centerlines are elevated based on the elevation of the points. However, note that the fifth centerline was not elevated. This is because this centerline has no elevation data. To elevate this centerline, you will use the **Intersecting line** option.
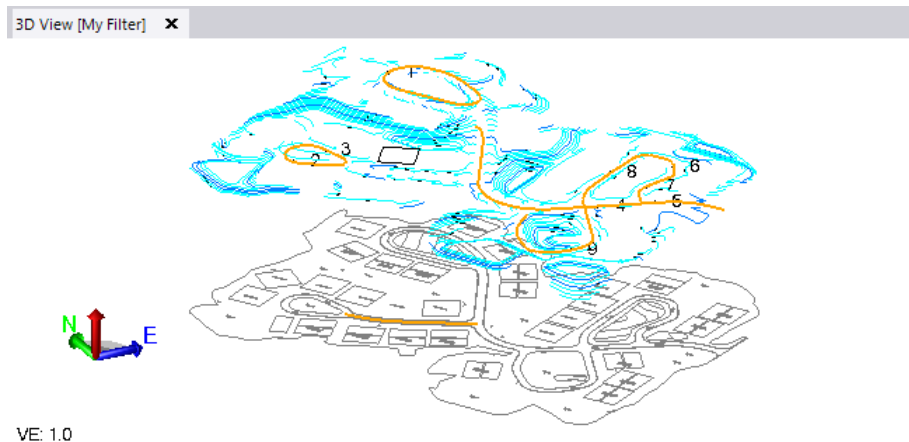
h. Select the **Intersecting line** option in the **VPI Placement** group.

i. Ensure nothing is selected in the **Plan View**. Then, click in the **Intersecting lines** field and use **Ctrl + click** to select the two centerlines intersecting either side of the unelevated centerline as shown here.

Plan View [My Filter] ✕

100 ft
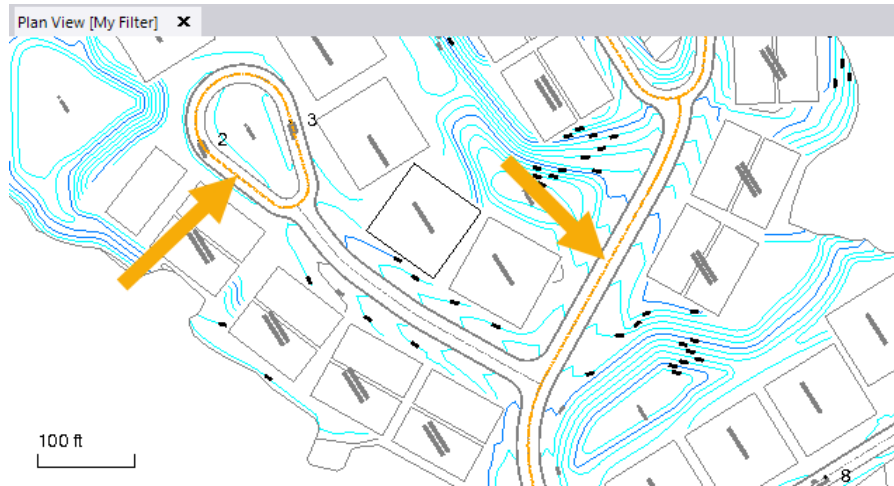
j. Click in the **Lines** box and then select the unelevated centerline.

k. Click **Apply** to elevate the remaining centerline.

3D View [My Filter] ✕

VE: 1.0
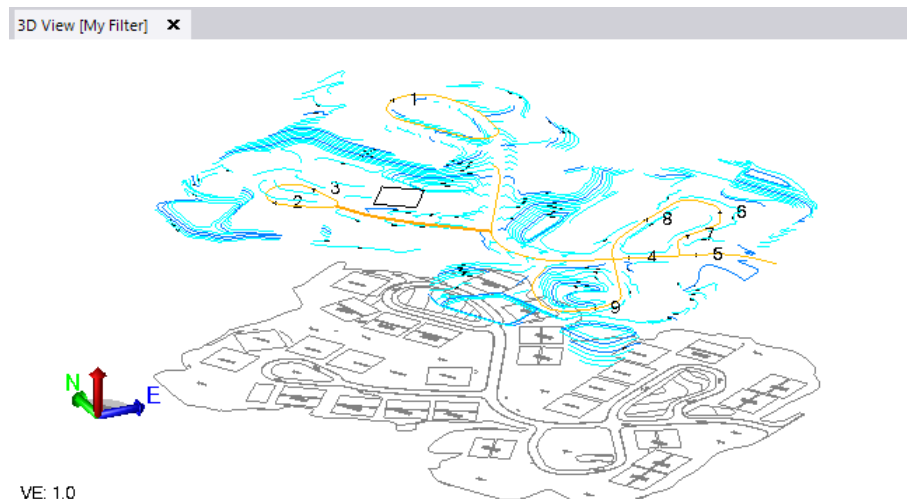
You are now ready to elevate the rest of the roading lines.

l. Ensure nothing is selected in the **Plan View**. Then, click in the **Intersecting lines** field, click the **Options** button, and select the layers *P-Grade 2C* and *P-Grade 10C.*

m. Ensure nothing is selected in the **Plan View**. Then, click in the **Lines** field, click the **Options** button, and select the layers *Paving* and *ROADS.*

Selection

Intersecting lines:
Selected: 252   Options

Lines:
Selected: 12   Options
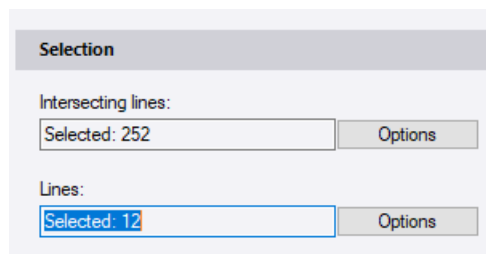
n. Click **Apply** to elevate the the remaining roading lines

o. Click the **Close** button.

Your data should now look similar to this. Do not be concerned if your's does not. What is important is that you understand the workflow.
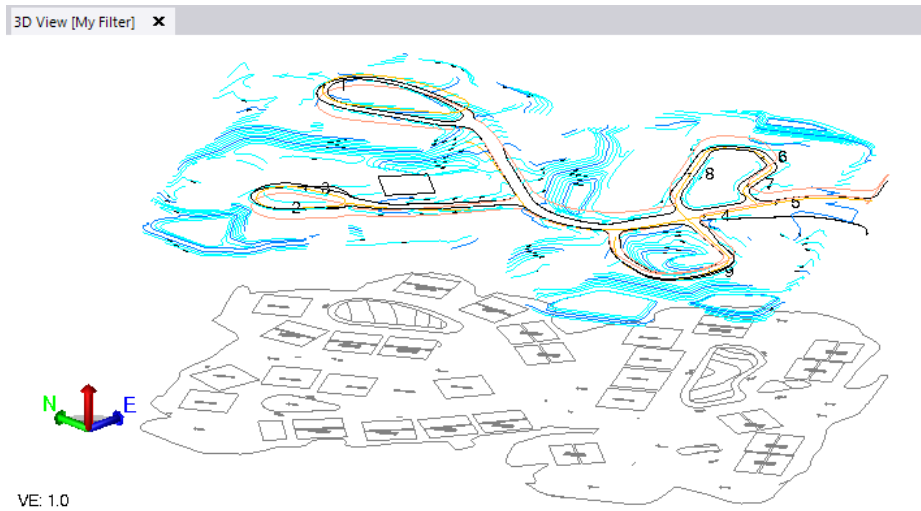
Most of the remaining unelevated lines represent building pads. You can elevate these using the elevation labels that lie inside the pad lines.

In the **SO** ribbon, select **Data Prep > Elevate > Pads**.
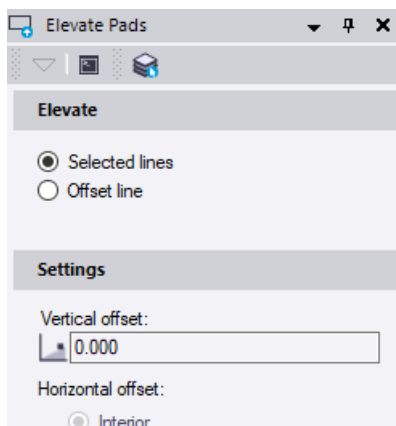
3. In the **Elevate Pads** pane, do the following:

a. Verify the **Selected lines** option is selected so you elevate only the existing pad lines.

The **Offset line** option enables you to create and elevate new pad lines that are offset from the original pad lines. Since you do not need to offset the selected lines, you do not need to make changes in the **Settings** group.

b. Click the **Select by Layer** icon on the pane's toolbar to select the pad lines and their elevation labels by layer.

c. In the **Select by Layer** pane, select the *Finished floor elevation* and *Pads* layers. Then click **Close**.

d. In the **Elevate Pads** pane, click the **Apply** button.

Because there are labels for both finished floor elevations and base floor elevations, the **Elevate Pads Prefix/Suffix Review** dialog displays.
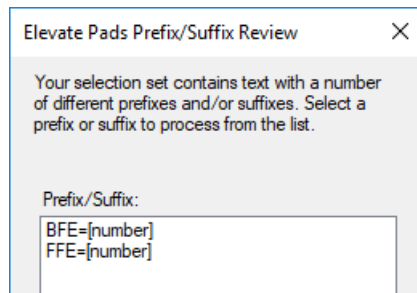
e. Select *FFE=[number]*, which is the finished floor elevation prefix, and click **OK**.
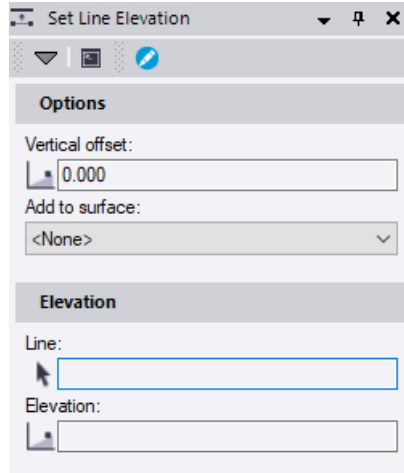
Most of the pad lines should be elevated, but other pad lines did not encompass elevation labels, so they are not elevated. You will elevate these using the **Set Line Elevation** command.
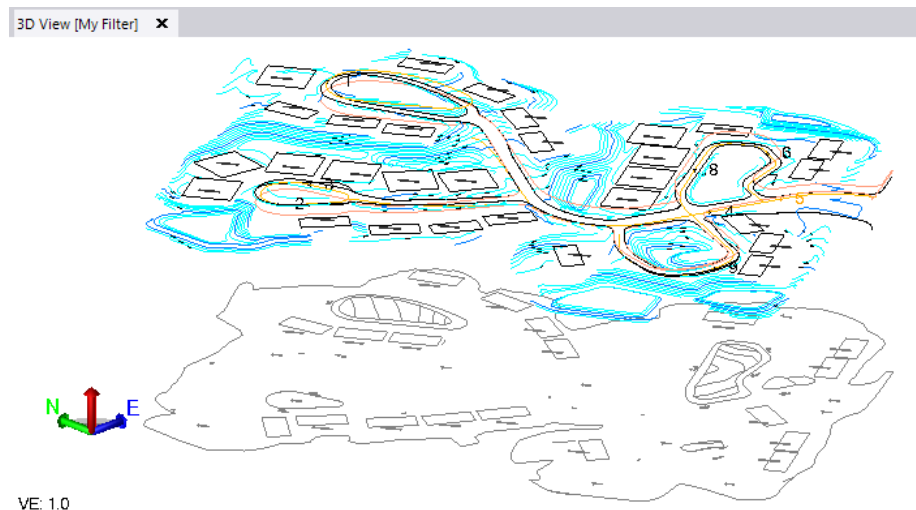
f. Click **Close**.

4. In the **SO** ribbon, select **Data Prep > Elevate > Set Line Elevation**.

5. In the **Set Line Elevation** pane, do the following:

   a. Skip the **Options** group, and click in the **Line** field.

   b. In the **Plan View**, pick an unelevated pad line (1 in the figure below).

      The cursor automatically moves to the **Elevation** field.

   c. Pick the pad that it is paired with it (2 in the figure below), or its corresponding FFE elevation label.

      The unelevated pad is elevated to the same elevation as its paired pad.

   d. Repeat the previous steps until the rest of the pads are elevated.

      You can make your selections in the **Plan View** and then verify that the pad has been elevated in the **3D View.**

   e. When you are done, click **Close**.

   Now, your unelevated data is getting sparse:
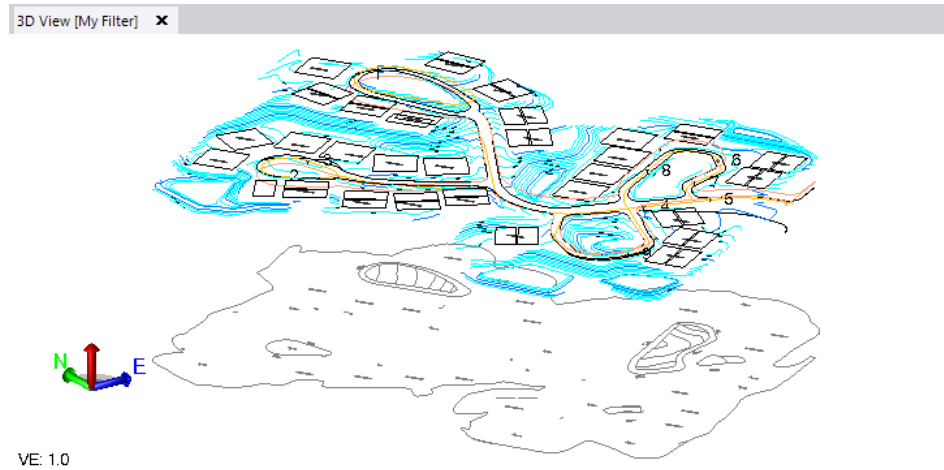
You could use any of the methods you have learned to elevate other lines you feel confident about. However, that is not necessary for this tutorial.

Step 10. Check and fix your work

Before you build a surface from your elevated objects, you should spot check their elevations in areas that you suspect may have errors. There are a variety of ways you can identify and check such areas.

1. Click the **3D View** tab.

2. In the **SO** ribbon, select **Home > View > 3D View > 3D View Settings**.
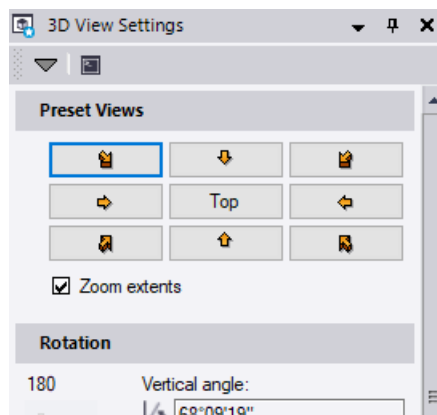
3. In the **3D View Settings** pane, do the following:

   a. Click the ⬅ preset view button to see your elevated data from an orthographic side view (*90°* **Vertical angl**e and *90°* **Azimuth**).

   b. Move the **Vertical Exaggeration** slider to the right to increase the vertical spacing between elevations, and look for anomalies (for example, outlying elevated lines or a zero-elevation VPI on a linesting).
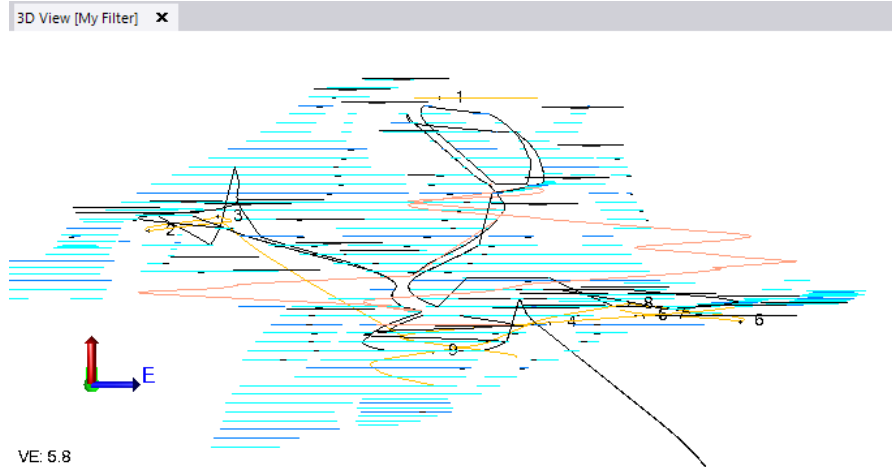
c. Make any required corrections as follows:

- To correct the elevation of an outlying line, select it in the **3D View** so you can find it in the **Plan View**. Then determine what the correct elevation should be, and edit the elevation using the **Set Line Elevation** command you used earlier.

- To correct a zero-elevation VPI on a linesting, right-click the selected linestring and choose **Edit** from the context menu. In the **Edit Linestring** pane, select the **Vertical** tab and then click the **Browse** button located adjacent to the **Current VPI** field. In the **Browse Vertical Information** dialog, double-click the row with the incorrect elevation. Back in the pane, edit the value in the **Elevation** field.

d. When you are done using the **3D View Settings** to look for errors, set the **Vertical Exaggeration Factor** back to *1.00* and click the **Close** button.

4. Press **F11** to open the **Properties** pane. Then spot check elevations in either view by clicking lines and checking their elevations.

   Watch for the trends in ascending and descending elevations.

5. To show line markings, in the **Status** bar (located at the bottom of the **Survey Office** window), select **Toggle Line Marking**.
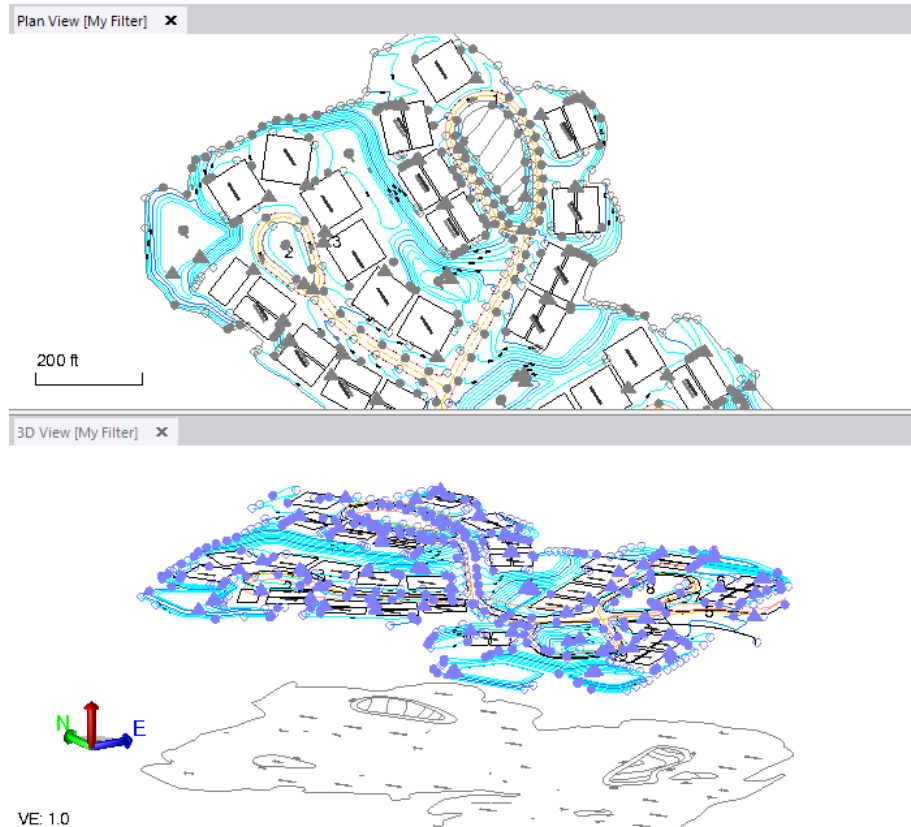
Markers are symbols that distinguish between horizontal segment end points, arc mid points, VPIs, and the overall line's start and end points.

- Filled circles denote linestring start points.

- Filled triangles denote VPIs.

- Smaller square dots denote "point on curve" mid points on arcs.

- Smaller round dots denote segment end points.

- Hollow circles denote linestring end points.

Labels are annotations that indicate the elevation of vertical control points.

6. To check linestrings that may have multiple elevations, in the **SO** ribbon, select **Home > Data > Explore Object**. Then pick a linestring in the **Plan View**. Move the cursor along the linestring to see the elevation at various locations.

The elevation appears to the right of the cursor, as shown here.
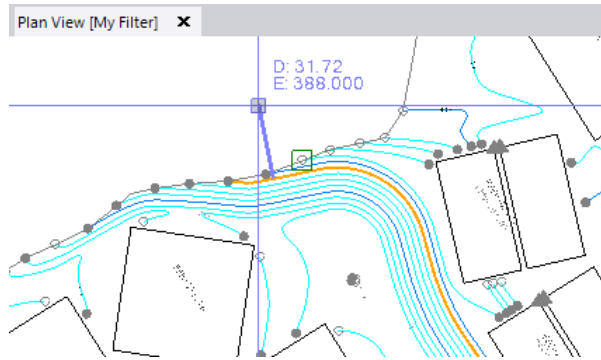
7. If you discover missing or incorrect elevations, you can fix them using any of the following methods (based on the type of line):

- **CAD polyline or polyline** - Edit the value in the **Elevation** field in the **Properties** pane.

- **CAD 3D polyline** - Edit a constant elevation using the **Set Line Elevation** command or variable elevations using the **CAD > Edit > Transform (Move/Rotate/Scale Objects)** command.

- **Linesting** - Edit VPIs using the method described in step 3c above.

You can also display or hide markers and labels for horizontal and vertical values along lines in 2D views to make viewing, understanding, and editing them easier. In the **Quick Launch** tool bar, select the **Project Settings**. Then, in the **Project Settings** dialog, select **View > Display Options > Marking** and set **Line marking** to *Show*.

8. To hide line markings, in the **Status** bar, select **Toggle Line Markings**.

Step 11. Create a surface

Once you are satisfied with the accuracy of your elevated data, you are ready to create a surface out of it.

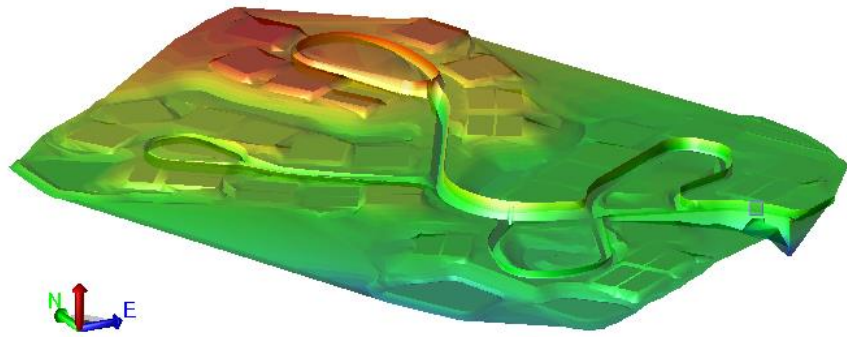1. In the **SO** ribbon, select **Surfaces > Create > Create Surface**.
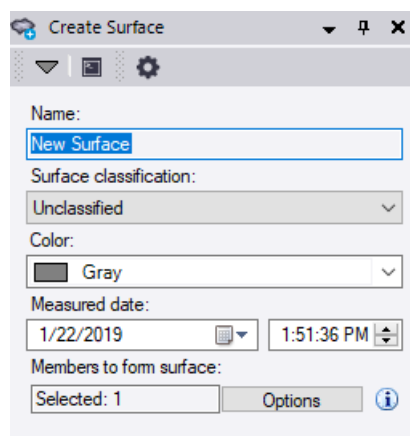
2. In the **Create Surface** pane, do the following:

    a. In the **Name** field, enter *Design Surface*.

    b. In the **Surface Classification** drop-down list, select **Design**.

        Classifications can be helpful when comparing one surface to another with a different classification in various reports.

    c. Click in the **Members to form surface** field. Then, in the **3D View**, draw a window around just the elevated objects.
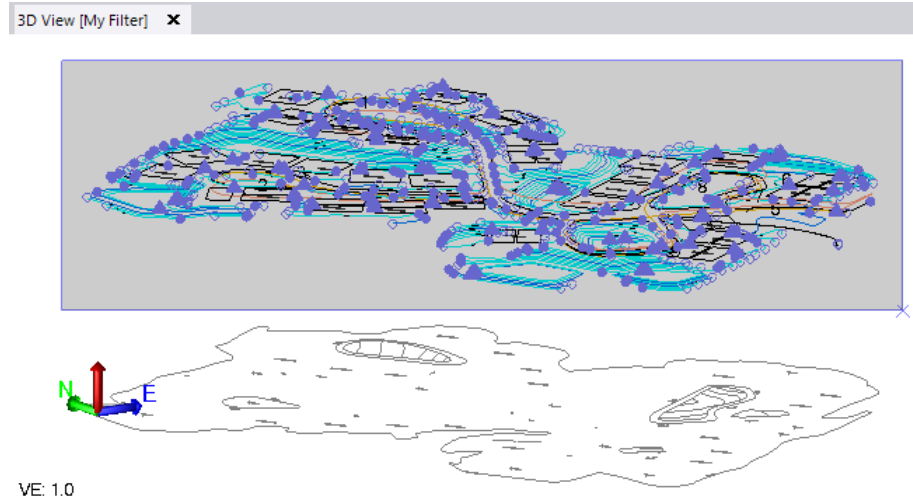
    d. Click **OK** to create the new surface.

3. Use the **View Filter Manager** to filter the **3D View** to show to only the newly created surface (deselect the other filter categories).
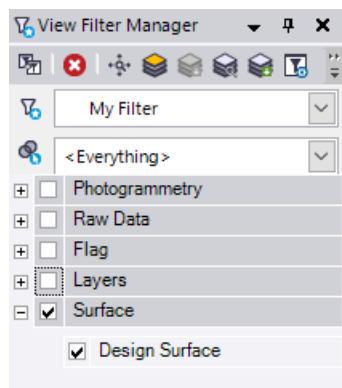
4. Review the surface in the **3D View**.

5. To further simplify the view, right-click the surface and select **Properties**. Then experiment with hiding the wireframe, vertices, breaklines, and drapelines by setting their properties to **No** in the **Show in Plan View** and **Show in 3D View** sections.

This concludes the tutorial.