Extracting Point Features from a Point Cloud

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About this tutorial

This tutorial explains how to use the **Extract Point Feature** command to select an object in a point cloud (for example, a light pole or a tree) and automatically create a new point at the base of the object with an assigned feature code and feature attributes. You will create both individual points (manual mode) and a batch of points (automatic mode). To assist in populating attribute values for the feature from extracted scan data, you will map the feature code's attributes, which are defined in an imported *Feature Definition Library (.fxl)* file, to attributes extracted by the command. This workflow provides a quick, flexible, and efficient means of creating points for extracted features and attributes in scanned areas.

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

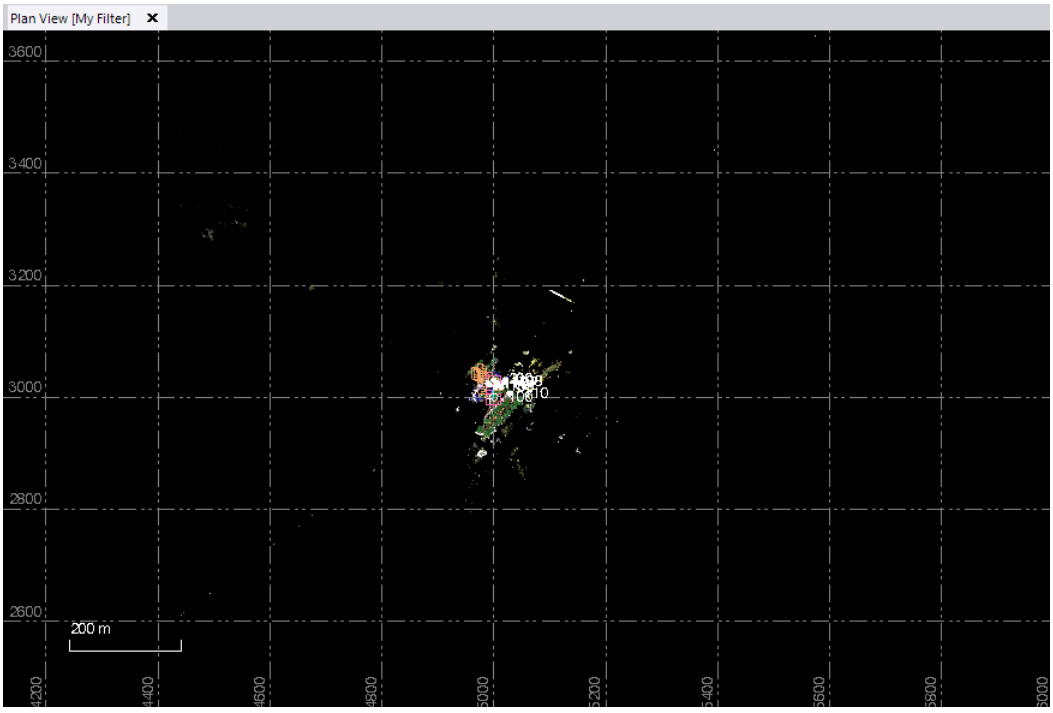
Step 1. Open the project

For this tutorial, you will use the project file *Extracting Point Features.vce*.

Note: The downloaded *ExtractingPointFeaturesFromaPointCloud* folder contains this PDF file and the *Extracting Point Features.vce* project file and project folder.

1. In SO, select **File > Open**.
2. In the **Open File** dialog, browse to ..*ExtractingPointFeaturesFromaPointCloud**Extracting Point Features.vce* and click **Open**.

   The project opens in the **Survey Office** window. It includes an imported point cloud in which region classification has been performed, as described later in this tutorial.

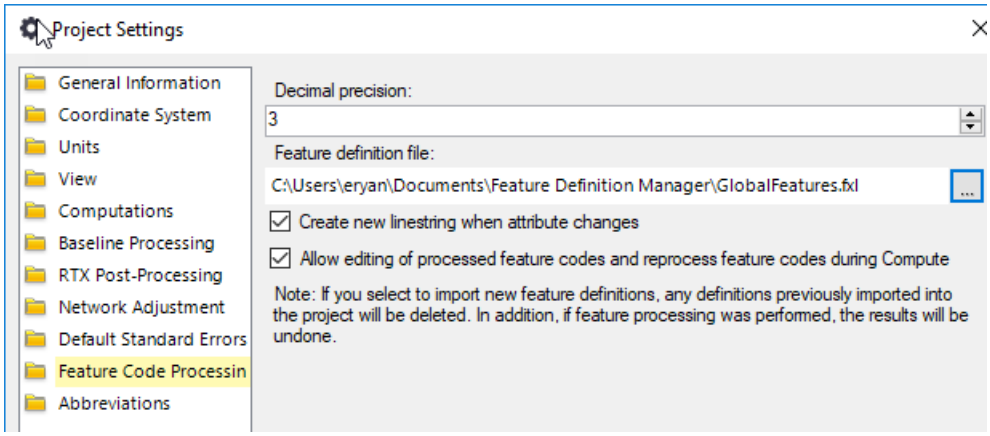


The project file is read-only. You can perform the tutorial steps without saving the project file. However, if you are interrupted while performing the tutorial, you can save it with a new name by selecting **File > Save Project As**. Then, you can re-open the project to continue the tutorial at a later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

Step 2. Prepare for the extraction process

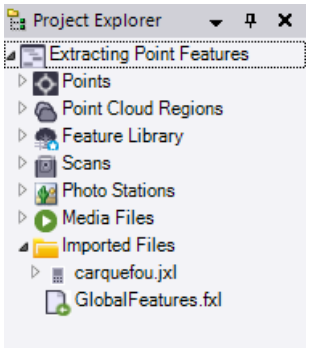
Before you begin the point feature extraction process, you will import a Feature Definition Library (.fxl) file into the project, enabling you to map feature code attributes defined in the Feature Definition Library to attributes defined for the extraction type you select to use to create point features. You will also select a subset of scan points in your project point cloud from which you want to extract point features.

1. In the **SO Quick Access** toolbar, select **Project Settings**.
2. In the **Project Settings** dialog, select **Feature Code Processing** in the left navigation pane.
3. Click the **Browse** button ... located to the right of the **Feature definition file** field. Then, select the *GlobalFeatures.fxl* file and click the **Open** button to import the file into the project

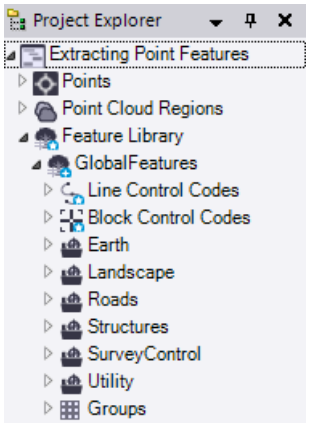


4. When the selected FXL file displays in the **Feature definition file** field, click **OK** to close the **Project Settings** dialog.

   An **Imported Files** node representing the newly imported FXL file displays in the **Project Explorer**.



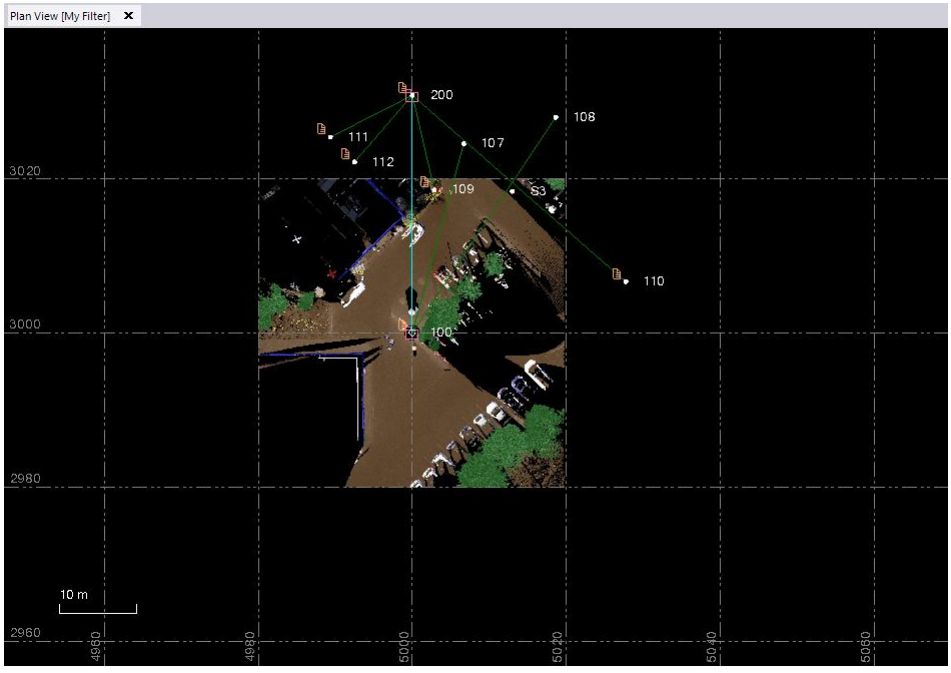
   In addition, the *GlobalFeatures* node displays nested beneath **Feature Library** parent node in the **Project Explorer**. Nested beneath *GlobalFeatures* node are numerous expanding nodes representing each of the control codes and feature definitions defined in the library.



For this project, you do not want to extract feature points from the entire point cloud in your project, so you will select a subset scan points with which to work. This will be particularly helpful later in this tutorial when you use the **Automatic** point extraction method

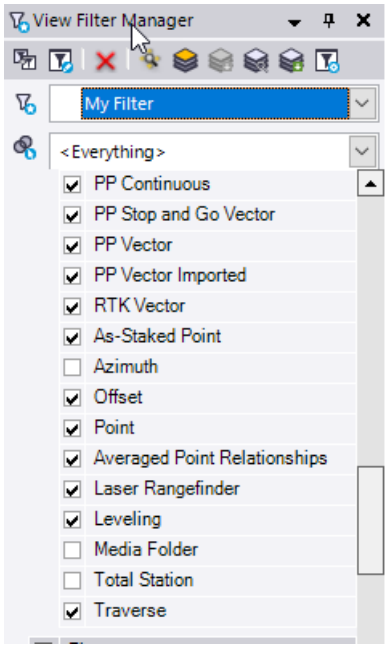
5. Zoom in the **Plan View** as shown here. Then, using your cursor, make a rectangular selection as shown.

6. In the **SO** ribbon, select **Point Cloud > Regions > Keep In** to display only the selected points in the graphic views and hide the others.



This would be a good time to "clean up" the view by hiding unnecessary information.

7. In the **SO** ribbon, select **Home > View > View Filter Manager**.
8. In the **View Filter Manager**, uncheck the following check boxes:
   - **Raw Data > Azimuth**
   - **Raw Data > Media Folder**
   - **Raw Data > Total Station**



9. In the **SO** ribbon, select **Home > View > 3D View** and take a moment to explore the view.

Step 3. Extract point features manually

SO supports two methods for extracting point features:

- **Manual** - This method allows you to pick objects independently for extraction, one at a time. In this step, you will use this method to extract a *Pole* point feature.
- **Automatic** - This method is less accurate than the manual method, but it requires less user input as it allows the software to automatically identify and extract at the same time all of the objects of the selected extraction type included in the displayed scan points. No manual selection is required. You will use this extraction method later in this tutorial.

To extract a *Pole* feature point using the **Manual** method, follow these steps:

1. In the **SO** ribbon, select **Point Clouds > Deliverables >Extract Point Feature**.

   In this project, the following point cloud regions have already been classified based on ASPRS (American Society for Photogrammetry and Remote Sensing) classes using the **Extract Classified Point Cloud Regions** command:

   - Buildings
   - Ground
   - High vegetation
   - Poles and signs

If the classification had not already been performed, a message would display at this point recommending that you classify point cloud regions prior to performing point feature extraction. This step is optional, but highly recommended. It helps ensure faster processing times and higher accuracy. And, the classified regions are saved in the project so the classification process needs to be performed only once, regardless of how many times you run the **Extract Point Feature** command.

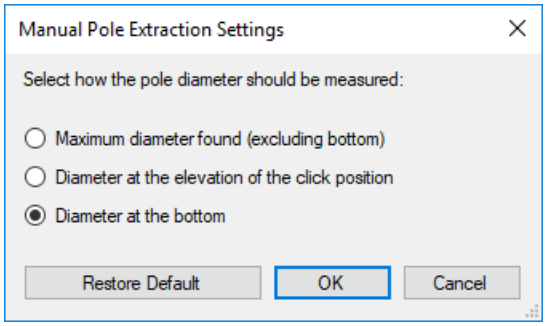
Note: See the online Help for instructions on using the **Extract Classified Point Cloud Regions** command.

2. In the **Extraction type** drop-down list, select *Pole* to indicate that you want to extract a point feature for one or more poles displayed in the graphic view.

   Your selection determines the extraction attributes to which feature code attributes can be mapped during the extraction process.

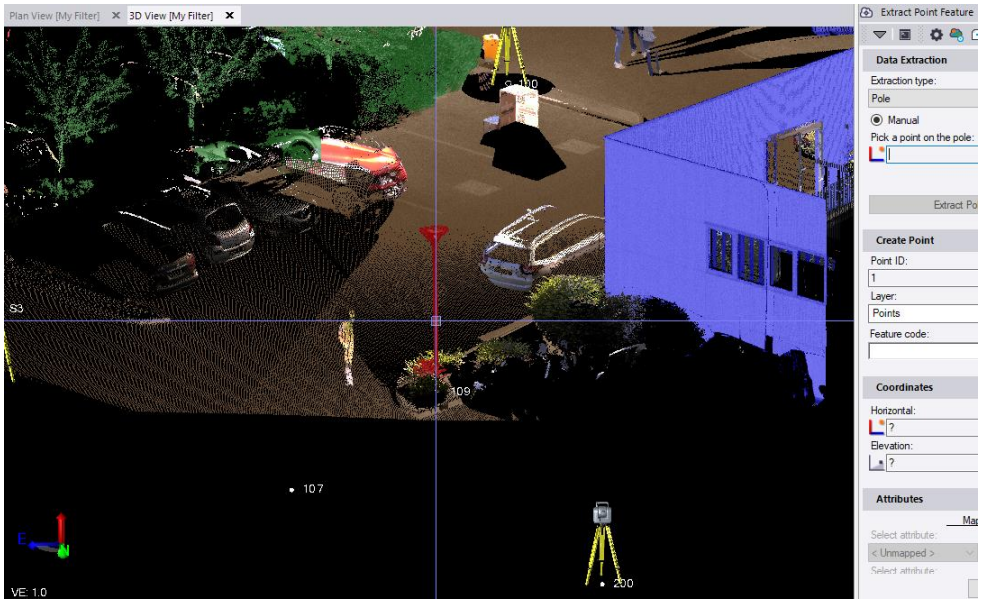
3. Select the **Manual** extraction method option.

4. Click the **Settings** link (located above the **Extraction type** field) to display the **Manual Pole Extraction Settings** dialog. Then, select the **Diameter at bottom** option to specify that the diameter that is automatically measured at the base of the pole be used to populate the *Diameter* attribute for the pole feature.



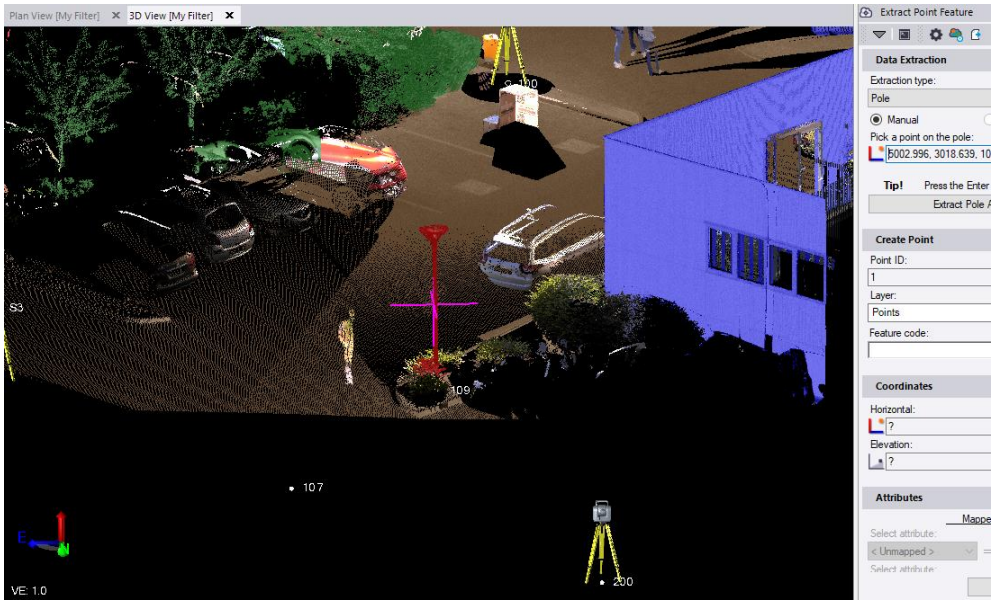
5. Click the **OK** button to close the **Manual Pole Extraction Settings** dialog.

6. In the **Extract Point Feature** pane, click in the **Pick a point on the pole** field and then, in the **3D View**, select a scan point on a pole for which you want to create a feature point, as shown here.

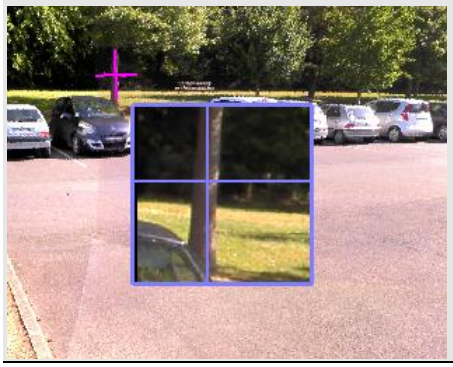


Due to the nature of point clouds, you may need to rotate the **3D View** slightly to be sure that you have actually selected a point on the object, not a point that is in front of or behind it.

A visual selection indicator displays on the light pole, verifying your selection.

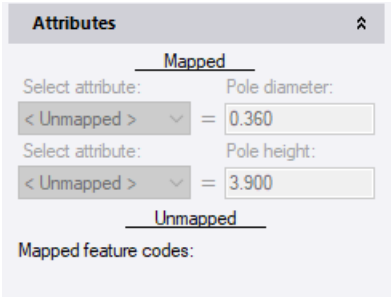


Note: You can also make your selection using a **Station View** (if applicable). If referenced photo images are included, you can check the **Virtual DR** check box on the **Station View** tab to display the **Pixel Picker**, which enables you to select on a referenced photo image the location (pixel) on the object you want to select. SO then projects a nearby scan point onto the line-of-sight ray to help calculate the 3D position of the selection. If there are no nearby scan points, an appropriate error message is displayed and you will need to make a new selection. Note that before using the Virtual DR feature, it is highly recommended that you register the scans in your project.

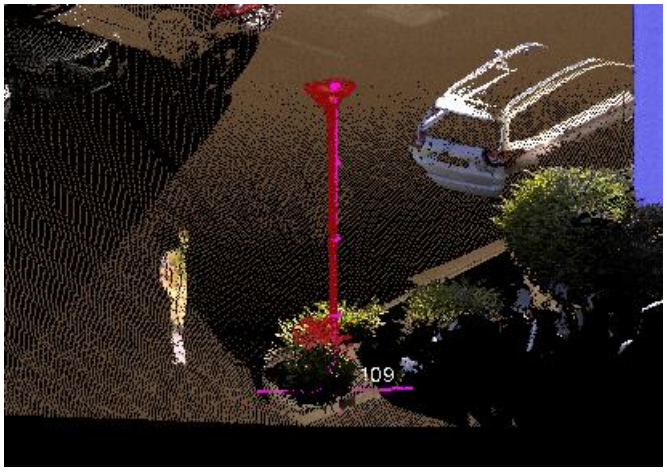


7. Click the **Extract Pole Attributes** button, or press the **Enter** key.

   When the extraction process is complete, the **Mapped** section in the **Attributes** group located at the bottom of the **Extract Point Feature** command pane displays a row for each attribute defined for the selected **Extraction type** (along with an extracted attribute value). This two-column section allows you to map a feature code attribute (left column) to each of the extraction attributes (right column). Since a feature code has not yet been entered in the **Feature code** field, the **Select attribute** drop-down lists are disabled and the **Unmapped** section of the **Attributes** group is empty.



   A visual extraction indicator displays in the **3D View** for the selected object. The visual indicator, along with the values displayed in the **Mapped** section of the **Attributes** group, provides the feedback you need to verify that the extraction was accurate.



You could change the displayed **Point ID**, which will be assigned to the new point. The point ID will automatically increment as each subsequent point feature is extracted, unless you change it. Do not make any changes for this tutorial.

Do not select a different **Layer**. The feature code you select in the next step will determine the layer on which the point is displayed and the **Layer** control will become disabled.

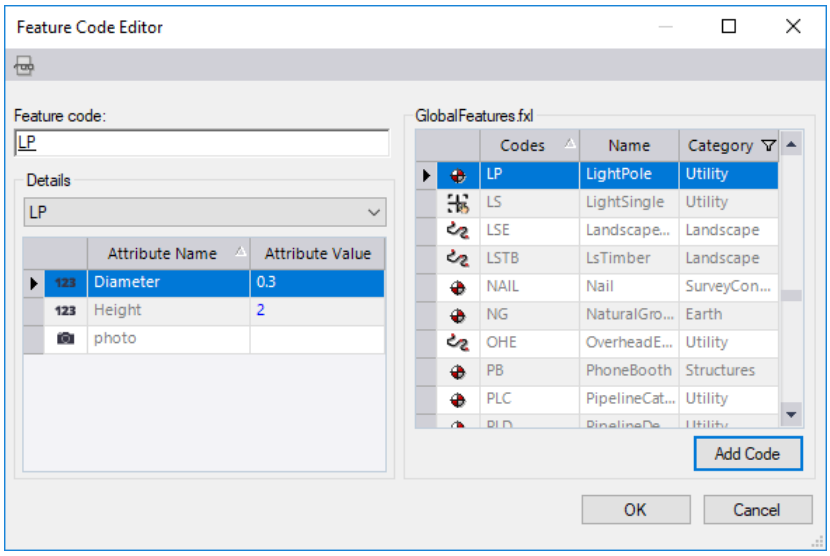
Note: The **Extract Point Feature** command supports the creation of a point without assigning a feature code. In this case, you could use the **Layer** drop-down list to select the layer on which to create the new point.

8. Click the **Browse** button located to the right of the **Feature code** field to open the **Feature Code Editor**. Then do the following:

   a. Select *LP - LightPole* in the **GlobalFeatures.fxl** list.

   b. Click the **Add Code** button.

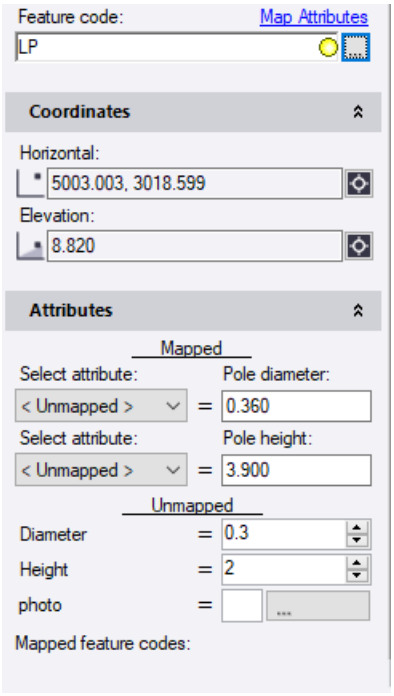
      Note that this feature code supports three optional attributes.



Note: If you know the feature code you want to use, you do not need to use the **Feature Code Editor** to select it as you have done here. Instead, you can type the code directly in the **Feature Code** field.

9. Click **OK**.

The **Feature Code Editor** dialog closes and the newly selected code displays in the **Feature code** field. Attributes for the *LP* feature code display in the **Unmapped** list in the **Attributes** group.



Note: If you do not enter a feature code, no feature or attributes will be assigned to the new point. This is an allowable alternative if you simply want to create new points without features.

Default values for the *Height* and *Diameter* feature attributes assigned to the *LP* feature code in the imported Feature Definition Library are displayed in the right column of the **Unmapped** list. If you do not map these attributes to the extraction attributes displayed in the **Mapped** list, these default values will be used for the new point feature. The *photo* attribute has no default value; therefore, because this attribute is not required (a yellow circle displays with an attribute if it is required) and there is no corresponding extraction attribute, you will ignore it.

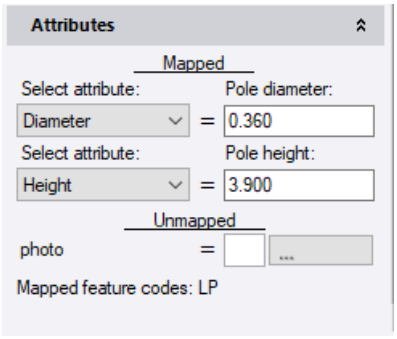
If a feature attribute supports the same data type as an extraction attribute (for example, number, integer, text, file, or other data type), the feature attribute is also displayed in the **Select attribute** drop-down list located in the left column in the **Mapped** section so that you can select it to map to the corresponding extraction attribute. In this case, the two extraction attributes on the right (*Pole diameter* and *Pole height*) support only number values. Two of the feature attributes also support only number values; therefore, these two feature attributes are included in the drop-down list for selection for each of the two extraction attributes. The non-number feature attribute (*photo*) is not included in the drop-down lists.

10. To map the *Height* and *Diameter* feature attributes to the extraction attributes in the **Mapped** list,, do the following:

    a. In the **Select attribute** drop-down list that corresponds to the *Pole diameter* extraction attribute, select *Diameter*.

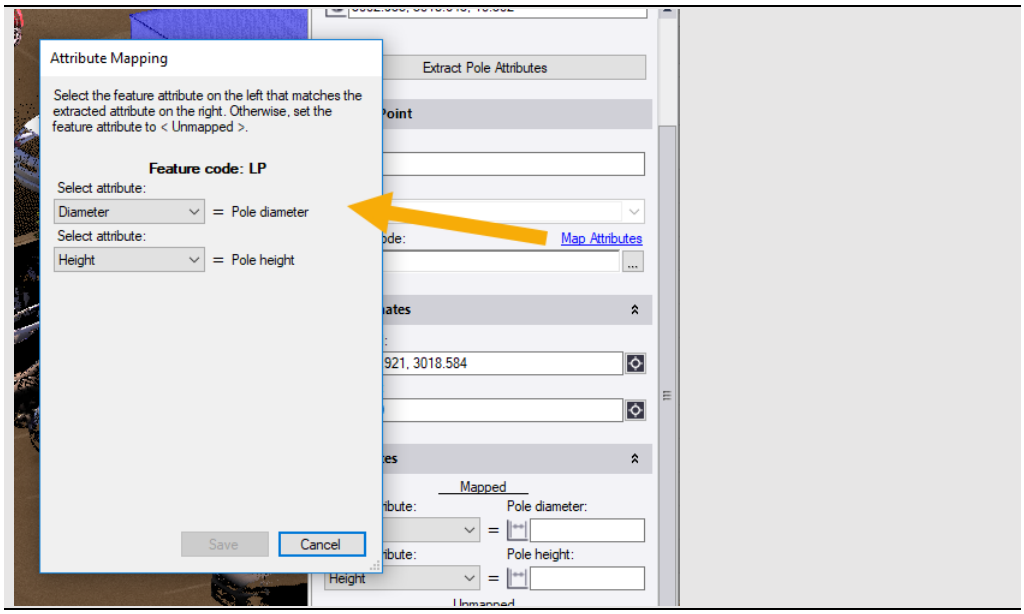
    b. In the **Select attribute** drop-down list that corresponds to the *Pole height* extraction attribute, select *Height*.

    Note that the *photo* feature attribute is the only attribute left in the **Unmapped** list.



If there was an extraction attribute for which there was not a corresponding feature attribute, you would simply leave the **Select attribute** drop-down list with the default <*Unmapped*> selection.

Note: As an alternative to the mapping method described in this step, you could use the **Map Attribute** dialog to achieve the same results. See the online Help for additional instructions.

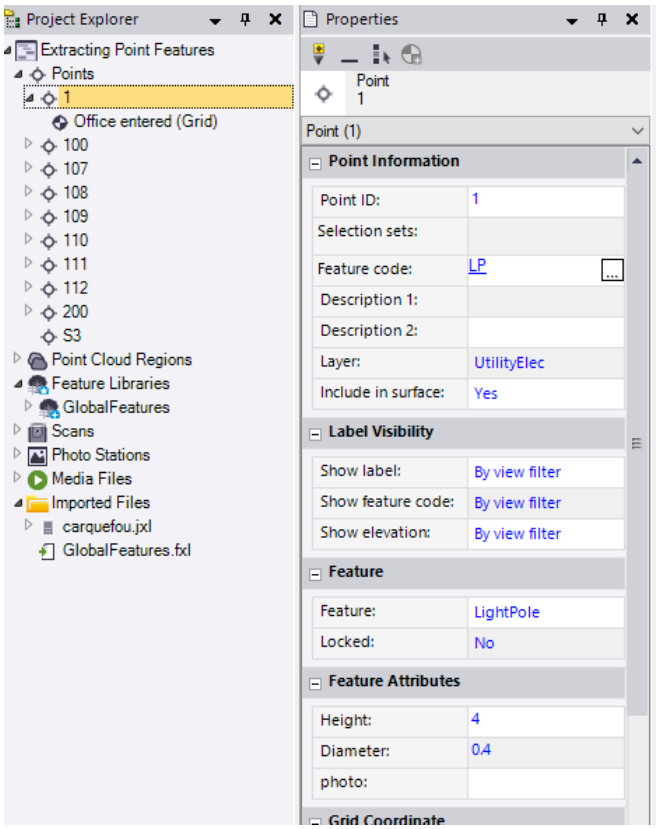


11. Click the **Add** button.

    The new feature point is created at the base of the light pole. The associated feature icon is displayed with the point in the graphic views.

12. In the **Project Explorer**, double-click the new point *1* to view its properties, including its associated feature and attributes.

    Note that the new point is located on the *UtilityElec* layer, as specified in the feature code's properties.



Note on productivity:

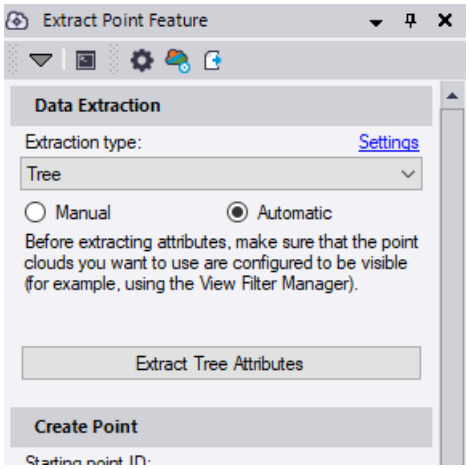
For the highest productivity when using the **Manual** extraction method, it is recommended that you extract the same types of objects in groups so that you are not constantly changing feature codes. For example, extract all broadleaf trees, then extract all coniferous trees, then extract all poles, and so on. This allows for a streamlined workflow in which, once the feature code has been selected and its attributes mapped, you can simply select an object, press the **Enter** key once to extract attributes (same as clicking the **Extract Attributes** button), press the **Enter** key a second time to add the new point (same as clicking the **Add** button), and repeat until you have extracted all of the point features for the specified feature code. Then you can select the next feature code and repeat.

Step 4. Extract point features automatically

In this step, you will use the **Automatic** extraction method to enable the software to automatically extract point features for all of the trees displayed in your graphic view.

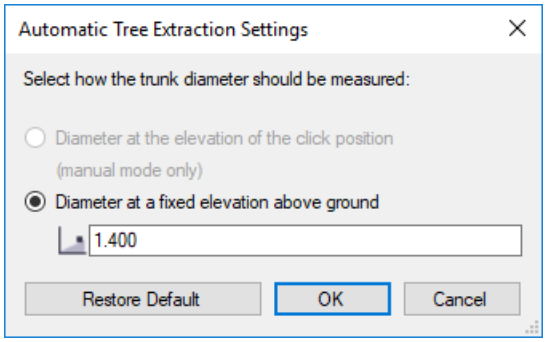
1. In the **Extract Point Feature** command pane, select *Tree* in the **Extraction type** drop-down list.
2. Select the **Automatic** extraction method option.

Note that the **Pick a point** field is no longer displayed. The software will pick points automatically on each of the *Tree* objects it finds.



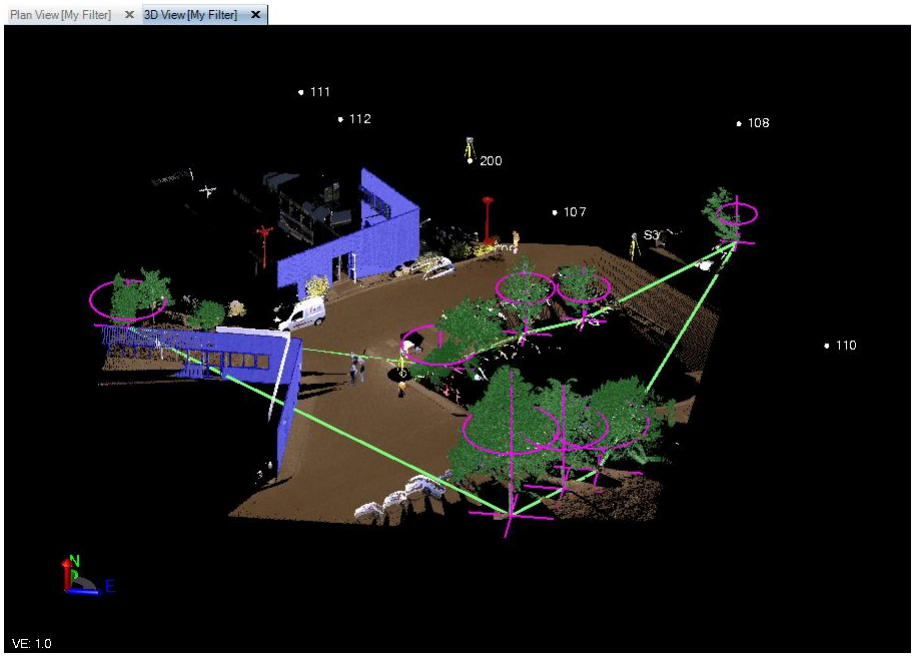
3. Click the **Settings** link to display the **Automatic Tree Extraction Settings** dialog.

   If you had selected the **Manual** selection method, you would have the option of selecting to measure the diameter of the tree trunk at the location where you click or at a fixed elevation above ground. Since you selected the **Automatic** selection method, only the *fixed elevation* option is available, which allows you to change the displayed elevation value if necessary. For this tutorial, you will not make any changes.



4. Click the **OK** button to close the **Automatic Tree Extraction Settings** dialog.
5. In the **Extract Point Feature** pane, click the **Extract Tree Attributes** button.

   The status of the extraction process is displayed in the **SO Status Bar**. When the extraction process is complete, a visual selection indicator displays on each of the tree objects the software has extracted.

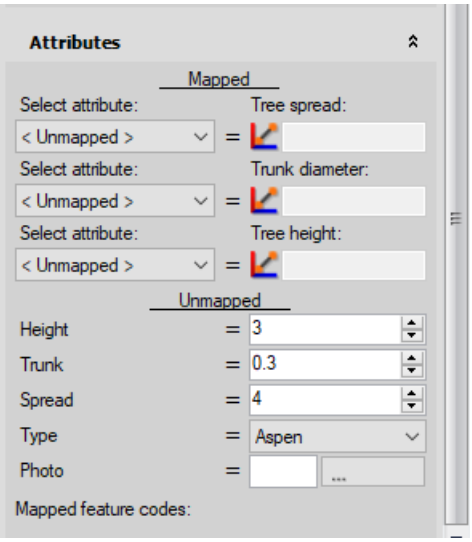


The software attempts to identify and extract all of the objects matching the selected **Extraction type** in the displayed point cloud. But the selections are not always perfect. For example, tree extraction may be difficult if trees are crowded very close together. Therefore, it is important that you review the extraction selections to ensure they are correct. Fortunately, SO provides a number of tools to make your QA/QC workflow as efficient as possible. But before you do this, you will select the feature code you want to assign to the extracted trees and map its associated feature attributes to the extraction attributes.

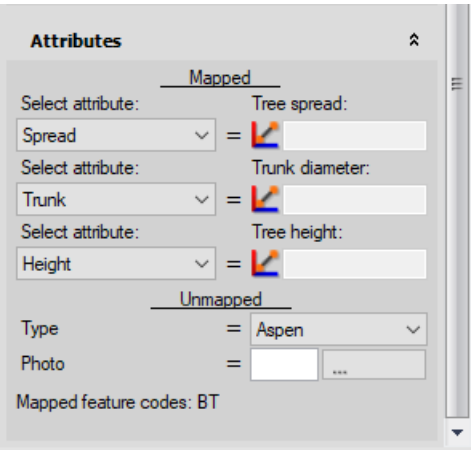
6. In the **Feature Code** field, enter *BT* (for the *Broadleaf Tree* feature type).

   The **Attributes: Mapped** list includes an entry for each of the attributes defined for the extraction type.

   The **Attributes: Unmapped** list includes an entry for each of the attributes defined for the *Broadleaf Tree* feature definition, along with default values. Since none of the attributes are required, none are flagged with a yellow "Required" circle icon and any of them could be ignored.



Using the three **Select attribute** drop-down lists, configure the attribute mapping as shown here.



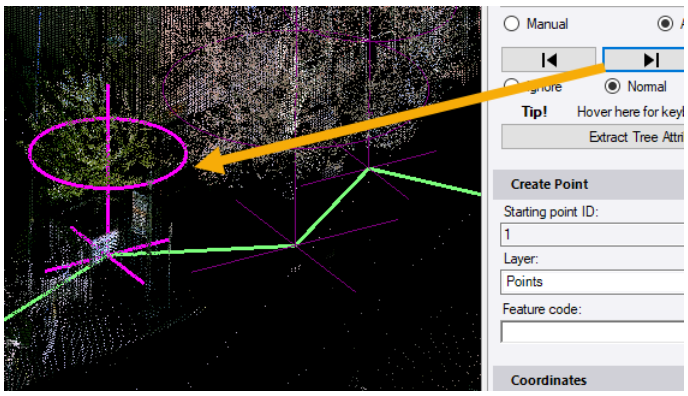
The *Tree* extraction type does not include a **Photo** attribute. Therefore, the *Photo* feature definition attribute cannot be mapped to the extracted tree features. Again, since this attribute is not required, you can ignore it.

Note that the default *Type* attribute for the *Broadleaf Tree* feature definition is *Aspen*. Obviously, all of the selected trees in the scene are not aspen, but you will leave this selection for now. After creating the point features, you can change the *Type* attribute for any of them using the **Properties** pane. As an alternative, you might consider modifying or creating a feature definition that includes a generic tree feature code that does not include a *Type* attribute.

You are now ready to perform the QA/QC workflow to ensure that all of the tree objects have been extracted correctly. To assist you in reviewing the selections in a sequential, systematic manner, a green line is displayed showing a single path that connects all of the extracted tree objects. Using the available controls or keyboard shortcuts, you can easily review each of the objects along the path and make changes if necessary, without losing track of which extracted tree objects you've reviewed and which you have not.

To review and edit the extracted tree objects, you can do any or all of the following, as necessary. (There is no need to make any changes in your tutorial project until the next step in this procedure.)

- To view each of the extracted objects in sequence along the green selection path, click the **Next** or **Previous** button to highlight the next or previous selection. Or, press the **Ctrl + Left Arrow** or **Ctrl + Right Arrow** keys.

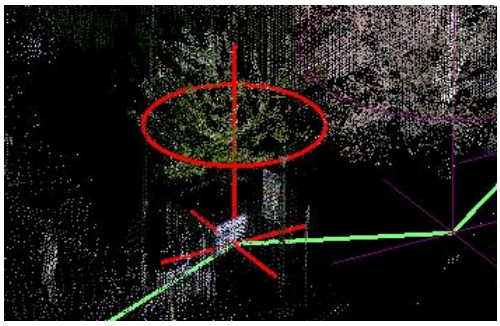


  To display and hide the green extraction selection path, click the **Path** button  . Or, press the **Ctrl + 0** (numeric keypad) keys.

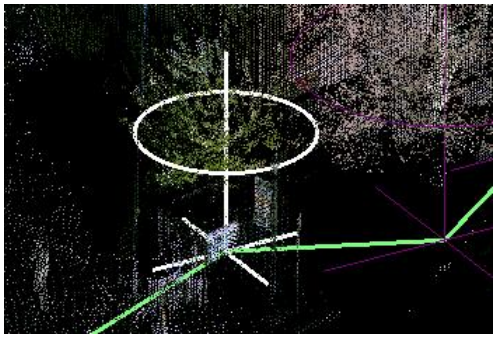
- To view any of the extracted objects independently, simply navigate to the object in a graphic view and click the associated selection indicator. The unselected selection indicators are dimmed so the that the selection is clearly identified.

- To change the status of a highlighted object, select one of the following options. Or, press the **Ctrl + Up Arrow** or **Ctrl + Down Arrow** keys to toggle between the options.

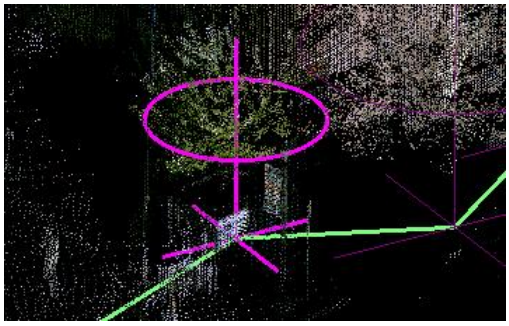
Ignore - Select this option to display the selection indicator in red, indicating the associated object will be ignored during the actual extraction process.



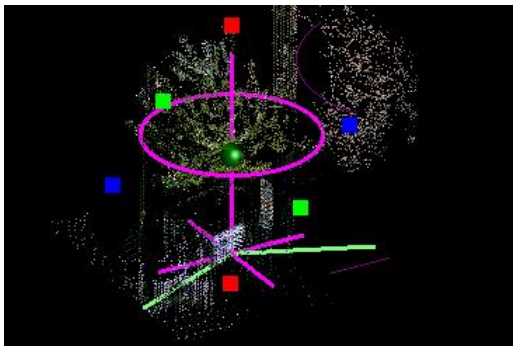
Mark - Select this option to display the selection indicator in white simply as a visual "flag". For example, you may want to mark the selection to be revisited at a later time or to indicate where you started or ended your review.



Normal - Select this option to remove a **Mark** or **Ignore** option for a selected object and display its associated selection indicator in its **Normal** default color purple.

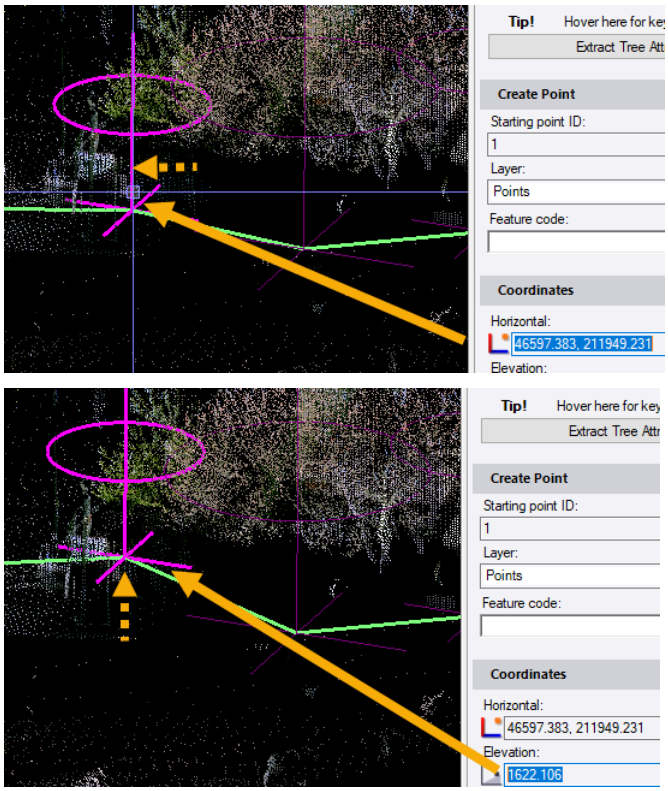


- To display or hide a customizable limit box around the selected object in the active graphic view, click the **Limit Box** button . Or, press the **Ctrl + Space** keys.

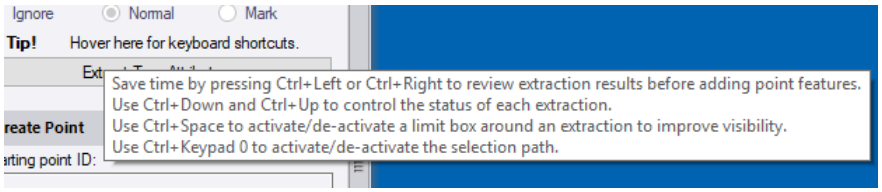


By using the limit box to isolate the object from its surroundings in the **3D View**, you might find it easier to verify the selection is correct. This can be especially helpful when, for example, you are extracting tree point features and multiple trees and bushes are clustered closely together.

- To move a selection indicator horizontally or vertically to correctly align it on its associated object, click in the **Horizontal** or **Vertical** field and select a new location for the indicator. Or, type in a new coordinate. (You will try this in the next step.)



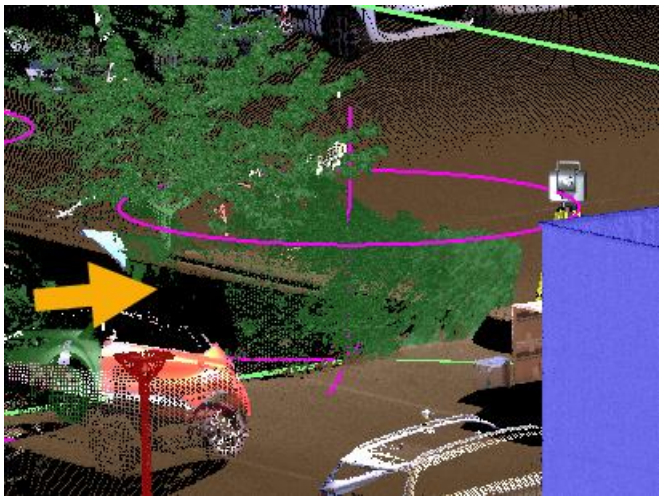
Note that you can hover your cursor over the **Hover here for keyboard shortcuts** link to display a list of applicable keyboard shortcuts



Note: In addition to these guidelines, be sure to navigate the **3D View** carefully from different perspectives and zoom levels to verify that all of the trees were accurately extracted. If the scene includes closely overlapping trees, tall walls or buildings, or other visual complications, the software can err in its selection process, as you will see.

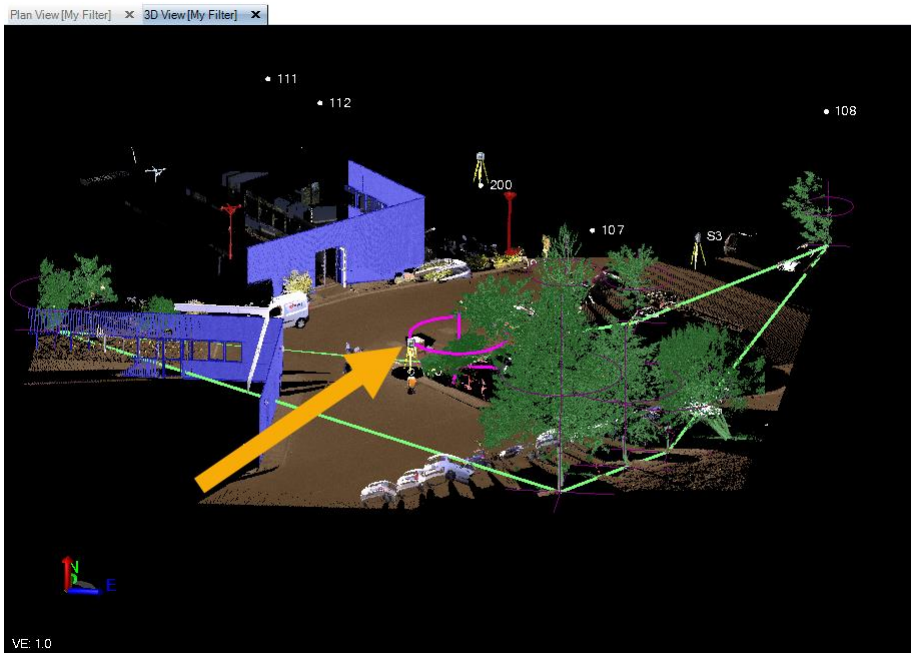
If you are reviewing the extraction selections in **Automatic** mode and you find a feature object that was not found by the extraction selection process (that is, there is no extraction indicator on the object), you can select the **Manual** option, make your selection, and then re-select the **Automatic** option to continue your review where you left off.

In the following tutorial example, you can see that the selection indicator is offset from the actual tree trunk to which it should be associated, probably due to the fact that the bottom of the trunk is obscured and was not included in the scan (arrow in image) and there are thick bushes immediately adjacent to the tree.

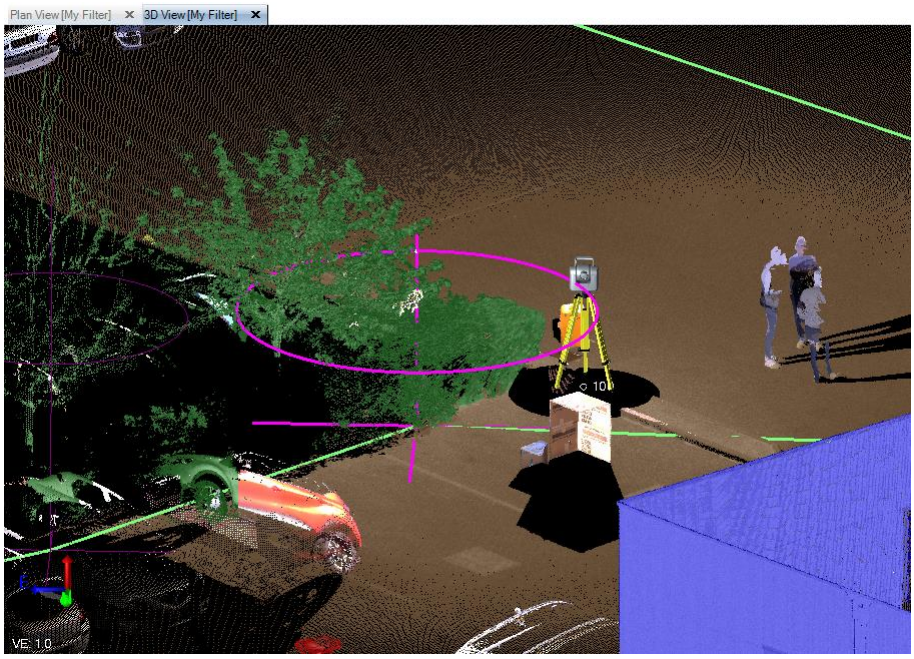


7. To move the selector indicator onto the correct tree object:

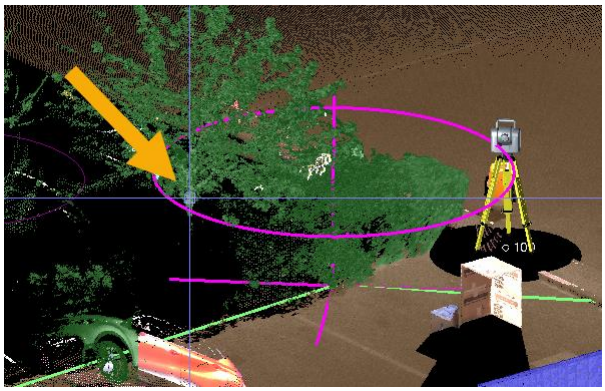
a. Use the **Next** button to navigate to and select the errant selection indicator, or manually select the indicator.

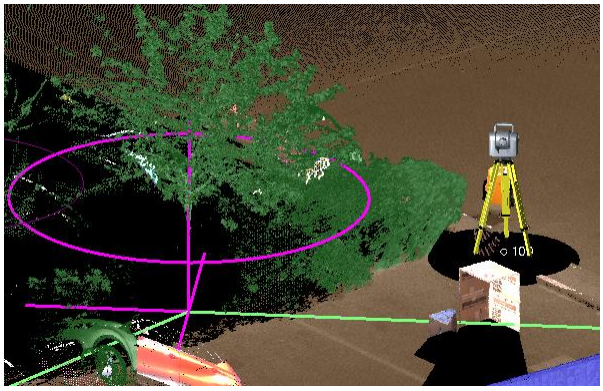


b. Navigate the **3D View** to provide the following perspective:



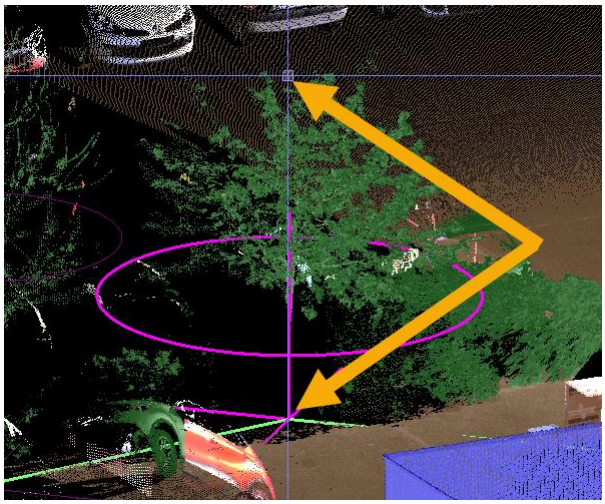
c. Click in the **Coordinates: Horizontal** field. Then, select a scan point on the tree trunk located adjacent to the selection indicator, as shown here.

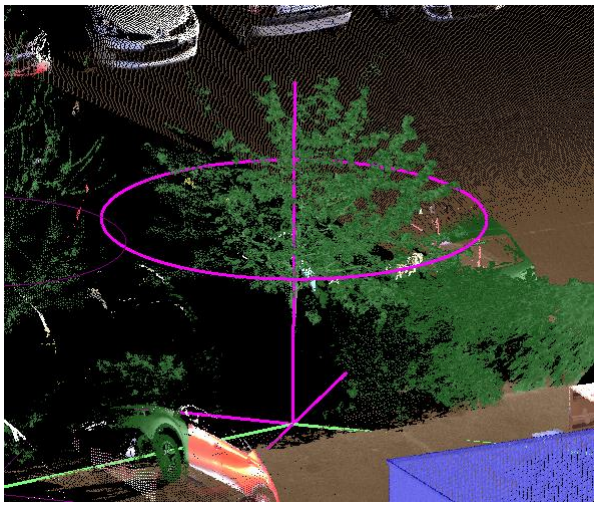




Note the selection indicator does not reach to the top of the tree. It is still using the tree height computed for the bush on which the errant selection indicator was located before moving it. To fix this, you will need to change the tree height.

d. Click in the **Tree height** field in the **Attributes: Mapped** list. Then, (1) select a scan point at the bottom of the trunk (as indicated by the selection indicator) and (2) select a scan point at a location indicating the height of the tree, as shown here:





Feel free to review the rest of the selections and make any changes as necessary.

8. When you are done making any changes, click the **Add** button.

   A new feature point is created at the base of each of the extracted tree objects. The associated feature icon is displayed in the graphic views.

   In addition, the new points are displayed in the **Project Explorer**.


Plan View [My Filter]
3D View [My Filter]
111
112
200
108
107
S3
110
N
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VE: 1.0


Plan View [My Filter]
3D View [My Filter]
3030
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2980
200
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111
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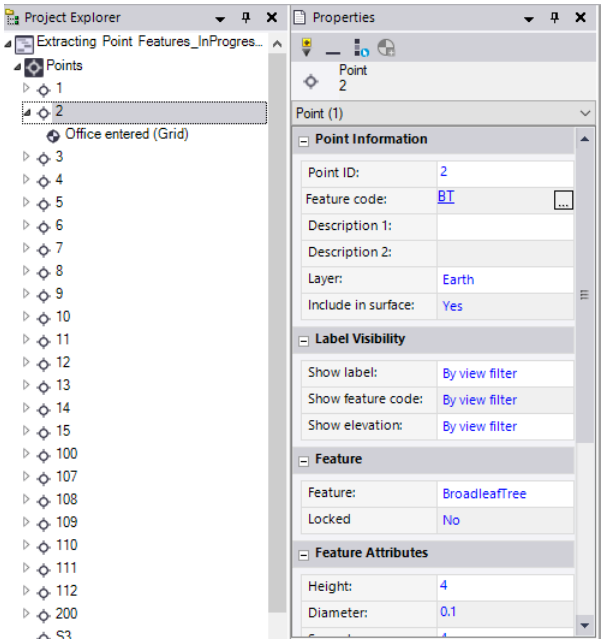

Again, navigate the **3D View** carefully from different perspectives and zoom levels to verify that each tree includes a new point at the base of its trunk. Optionally, you can modify or add missing attribute values for any newly created point feature in the point's **Properties** pane.

Note: For instructions on extracting points with more than one feature code, see the SO Help.