Practice Workbook

This workbook is designed for use in Live instructor-led training and for OnDemand self study. OnDemand videos for this course are available through *CONNECT Advisor* and on the *LEARN Server*.

QuickStart for Geometry - Road

This course is suitable for the **2018 Release 4 (10.06.00.38)** *version of:*

OpenRoads Designer CONNECT Edition

OpenRail Designer CONNECT Edition

About this Practice Workbook...

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file.

- Both Imperial and Metric files are included in the dataset. Throughout this practice workbook Imperial values are specified first and the metric values second with the metric values enclosed in square brackets. For example: *12' [3.4m]*

- This course workbook uses the *Training and Examples* workspace delivered with the software.

- The terms *Left-click, Click, Select* and *Data* are used interchangeably to represent pressing the left mouse button. The terms *Right-click* and *Reset* are also used interchangeably. If your mouse buttons are assigned differently, such as for left-handed use, you will need to adjust accordingly.

Have a Question? Need Help?

If you have questions while taking this course, search in *CONNECT Advisor* for related courses and topics. You can also submit questions to the Civil Design Forum on Bentley Communities where peers and Bentley subject matter experts are available to help.

Course Overview

In this course you will be creating the horizontal and vertical alignment for London Rd. using the geometry tools. You will learn how to create, edit, annotate and review geometric elements. You will also learn how to attach an existing terrain model and aerial imagery as well as define 2D and 3D views.
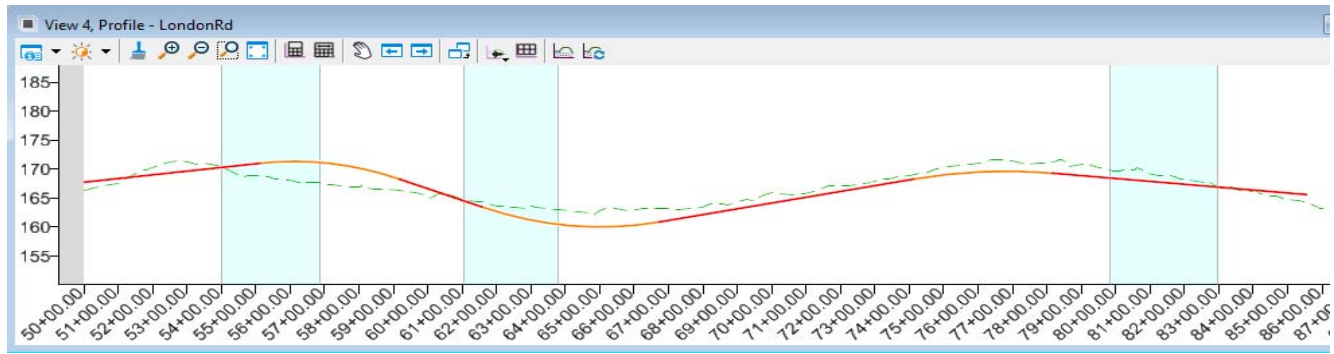
Geometry Overview

The geometry tools are a dynamic, interactive and rules-based approach to geometry. Civil Geometry or geometric rule-based elements are created intelligently as the tools are used and elements are constructed.

Rule-based elements provide *Design Intent* that builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. If an element is modified, any related elements will recreate themselves based on these stored relationships.

All Geometric data is stored directly in the dgn file and can be easily edited and reviewed via the drag handles, dynamic dimensions, text manipulators, etc.
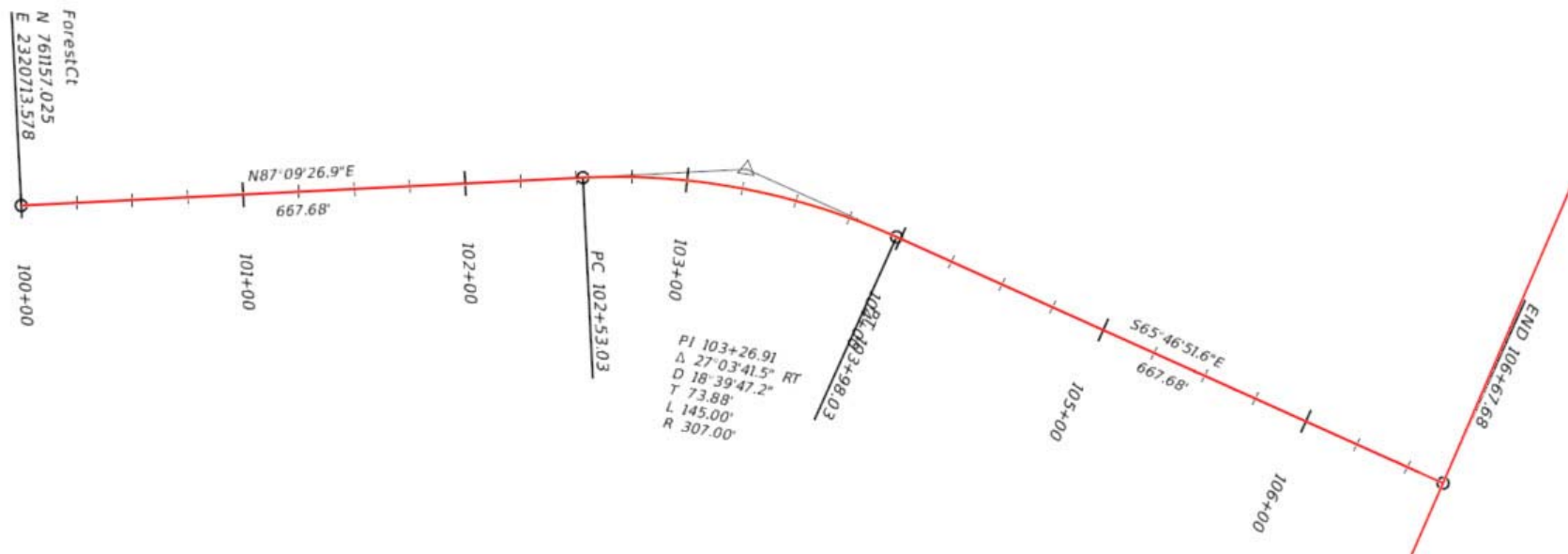
QuickStart for Geometry - Course Workflow

1. Select WorkSpace & WorkSet

2. Create 2D dgn file

3. Attach Aerial Image dgn

4. Create Horizontal Alignment

   a. Set Active Feature Definition

   b. Create Horizontal Elements: Lines and Arcs

   c. Complex Horizontal Elements together

   d. Define Stationing

   e. Create and Review Geometry Report

   f. Annotate Geometry

5. Attach Existing Terrain Model and Set as Active Terrain Model

6. Open 2D & 3D Views and Review Design File Models

7. Create Vertical Alignment

   a. Define Profile Model View

   b. Create Vertical Elements: Lines and Curves

   c. Complex Vertical Elements together

   d. Set Active Profile

   e. Create and Review Geometry Report

Exercise 1: Create a New File and Review the Interface

In this exercise, you will learn how to select a workspace and workset, create a new 2D design file, and review the ribbon interface.

Skills Taught

- Selecting a WorkSpace and WorkSet
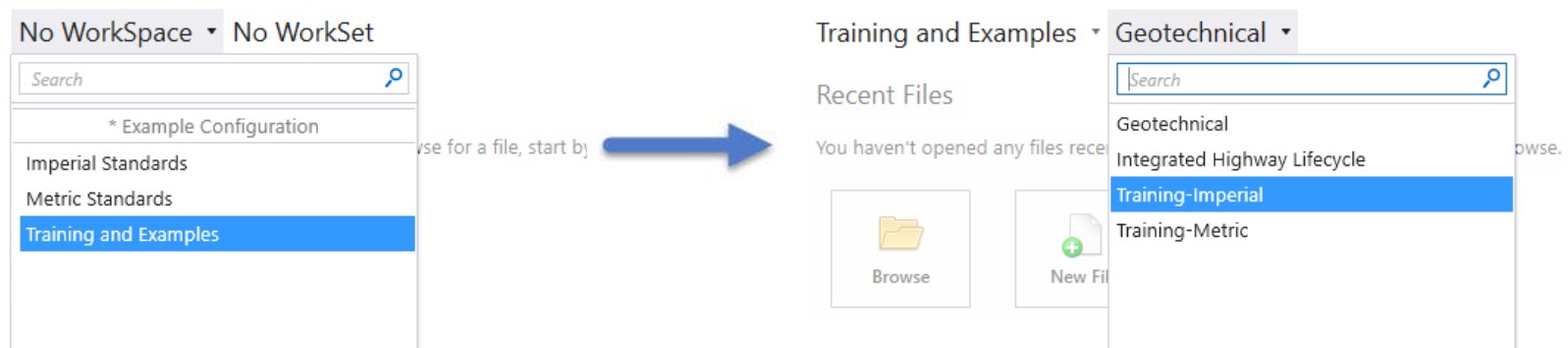- Create a 2D design file
- Review the Ribbon Interface

Select the WorkSpace & WorkSet and Create a New 2D Design File

In this section, you will select the training workspace and workset, and create a new 2D design file. Always start in a 2D design file when creating and working with geometry.

1. Start the software.

2. Set the WorkSpace and WorkSet

   The WorkSpace and WorkSet define standards that are used by the software. The WorkSpace and WorkSet used for this training are installed during the software installation.

   a. Select **Training and Examples** from the *WorkSpace* menu.

   b. Select **Training-Imperial** *[Training-Metric]* from the *WorkSet* menu.


3. Create a new 2D design file.

   a. Select **New File**.

   b. Browse to *c:\Bentley Training\QuickStart for Geometry - Road* or other folder where you unzipped the dataset files.

   c. Set the *Seed* to **Seed2D - Imperial Training.dgn** *[Seed 2D - Metric Training.dgn]*.

   d. Create a new file named **Geometry.dgn** *[Metric-Geometry.dgn]*.

Review the Interface

1. Select the **OpenRoads Modeling** workflow from the pick list in the upper left corner if it is not already active.
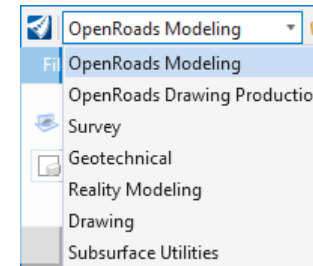

The ribbon menu will change to **OpenRoads Modeling** tools. The tools are organized on **Ribbon Tabs** with the tools grouped into *Categories* on each tab.
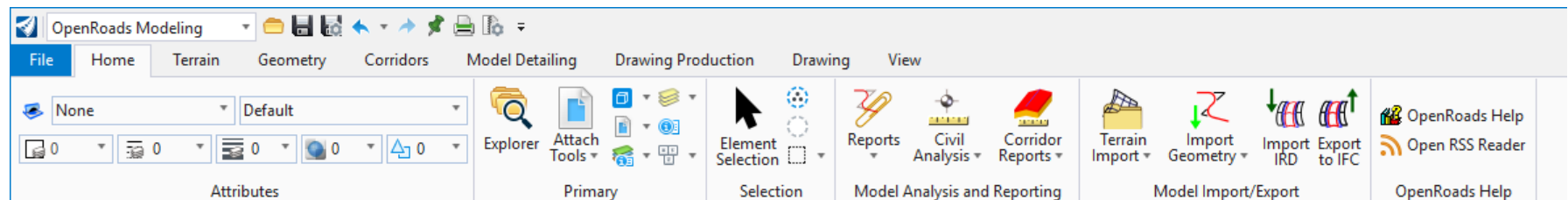

- **Home** - Common tools such as Attributes, Explorer, Attach Reference Tools, Models, Level Display and Element Selection.

- **Terrain** - Element selection and terrain modeling tools.

- **Geometry** - Element selection, Civil AccuDraw and geometry tools.

- **Corridors** - Element selection, superelevation and corridor modeling tools.

- **Model Detailing** - Element selection, Civil Cells and 3D tools (Linear Templates, Surface Templates, etc.).

- **Drawing Production** - Element selection, saved views, notes, text, annotations, and plans production (cross section, plan, and profile) tools.

- **Drawing** - Commonly used MicroStation drawing tools. To access the complete set of MicroStation tools change the active workflow to Drawing, Modeling (3D file only) or Visualization (3D file only).

- **View** - Commonly used view control tools.

2. **Click** on each of the *Ribbon tabs* and notice how each tab has a different set of *Categories* and tools.
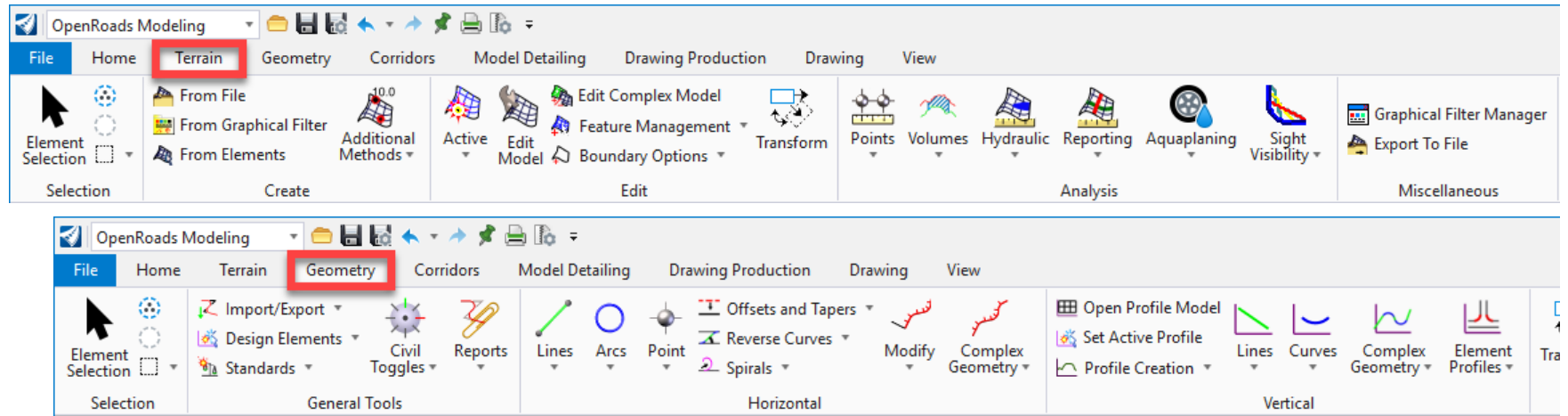
3. Also note the tools to the **right** of the *workflow* drop down list. Tools such as Create New File, Open File, Save Settings Compress File, Undo, Redo, Print, Explorer and Properties can be found here.
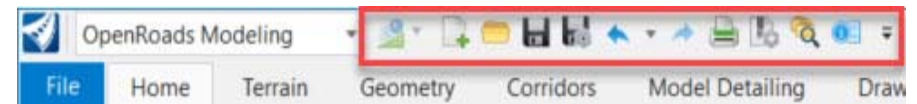

A search ribbon tool is also available to assist with finding tools on the ribbon interface. When you are not sure where to find a tool on the ribbon interface simply key in the command in the *Search Ribbon* field and a search will be performed across all ribbon menus.
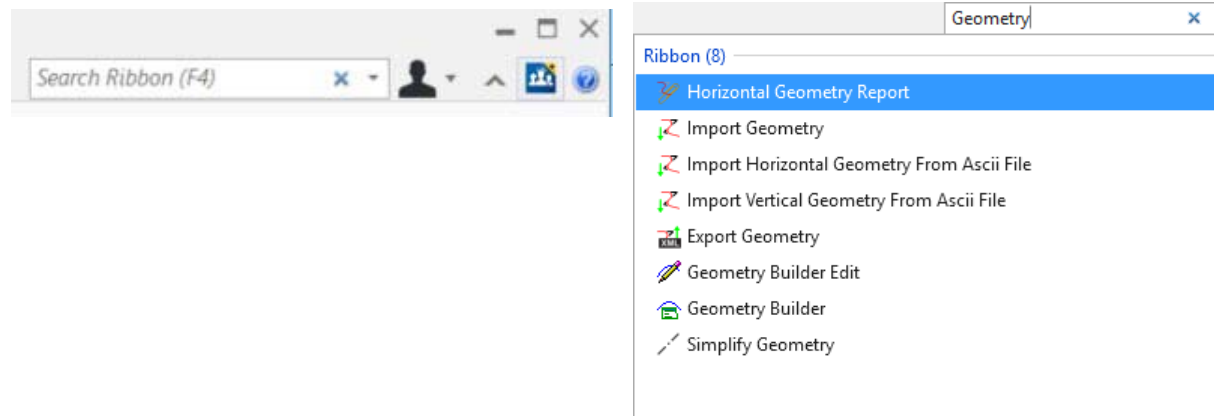
4. Search for a tool using the search ribbon. Key in **Arc** in the *Search Ribbon* field.

5. Notice the results of the ribbon search are displayed in a dialog below the *Search Ribbon* field.

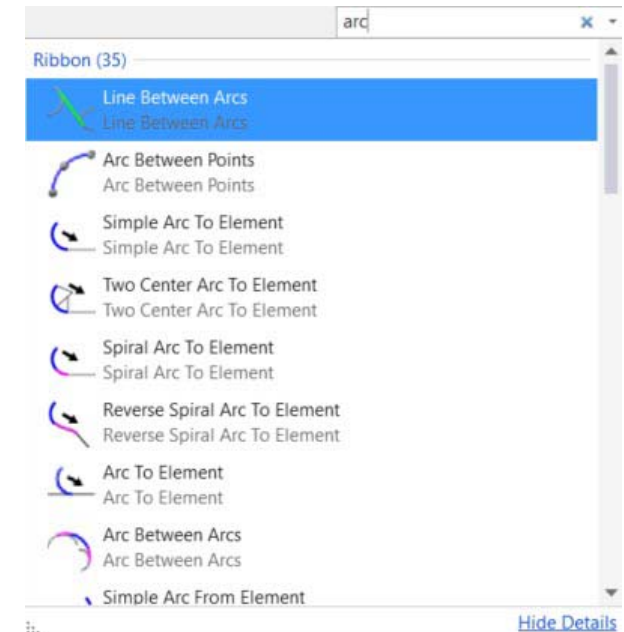6. **Hover** over **Arc Between Points.**

   The search results expand showing where the **Arc Between Points** tool is located on the ribbon: **OpenRoads Modeling -> Geometry -> Horizontal -> Arcs**
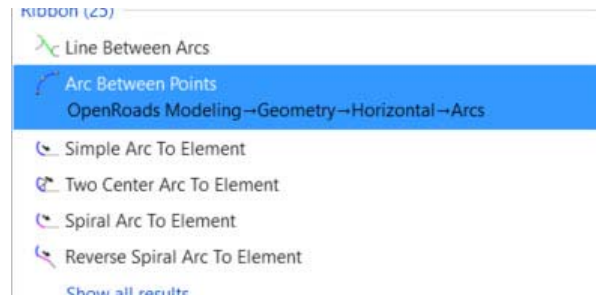
7. From the search results dialog, **Left-click**, *Arc Between Points* to launch the command.
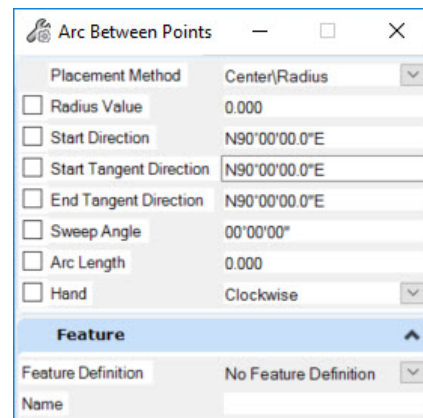
8. **Right-click** to close the Arc Between Points toolbox.

9. Introduction to the Back Stage View.

File

a. Activate the *Back Stage View* by clicking **File** in the ribbon menu.

b. Notice the various other options on this screen such *New*, *Open*, *Save*, *Save settings*, etc. Whenever you need to open a file or create a new file you will have to access the *Back Stage View*.

c. Select **Settings**.

   Design File settings, preferences, customizations, etc. are found in the *Back Stage View*, keeping the ribbon menus focused on the tools.

d. **Click** the Arrow in the upper left corner to return to the main ribbon interface.

Exercise 2: Creating Horizontal Geometry

In this exercise, you will learn how to create a horizontal alignment using the horizontal element tools.

Skills Taught

- Attach aerial imagery reference file

- Create horizontal geometric elements using the Place Line Between Points and Simple Arc tools

- Combine geometric elements into a complex element to create the horizontal alignment

- Review the geometric elements with the Model Explorer

- Define the start stationing of the horizontal alignment

- Create horizontal geometry report

- Annotate horizontal alignment

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Attach Reference File

Let's first attach the *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn]* as a reference file to your design file. The *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn]* file contains the PI locations that you will use to create the tangent elements of the alignment.

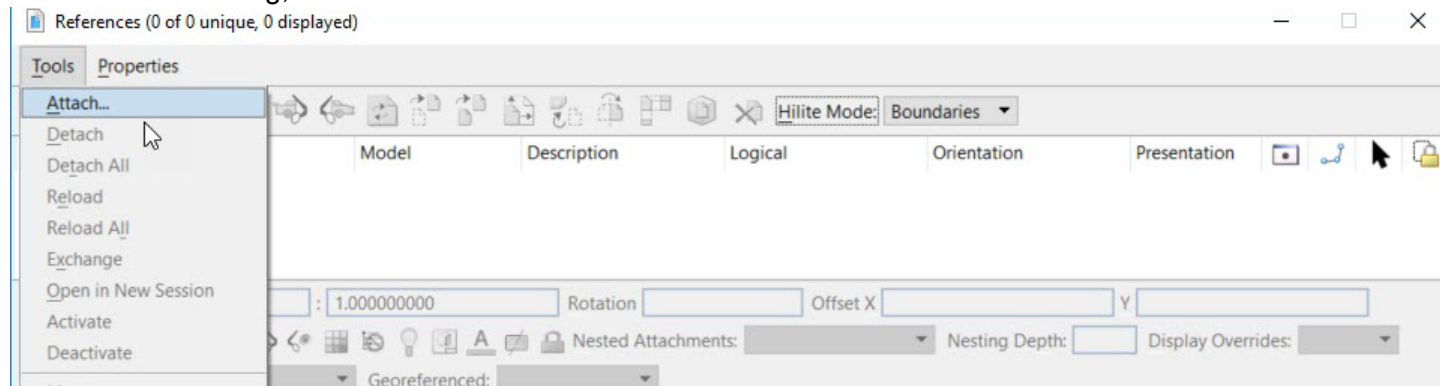1. Attach *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn]* as a reference.

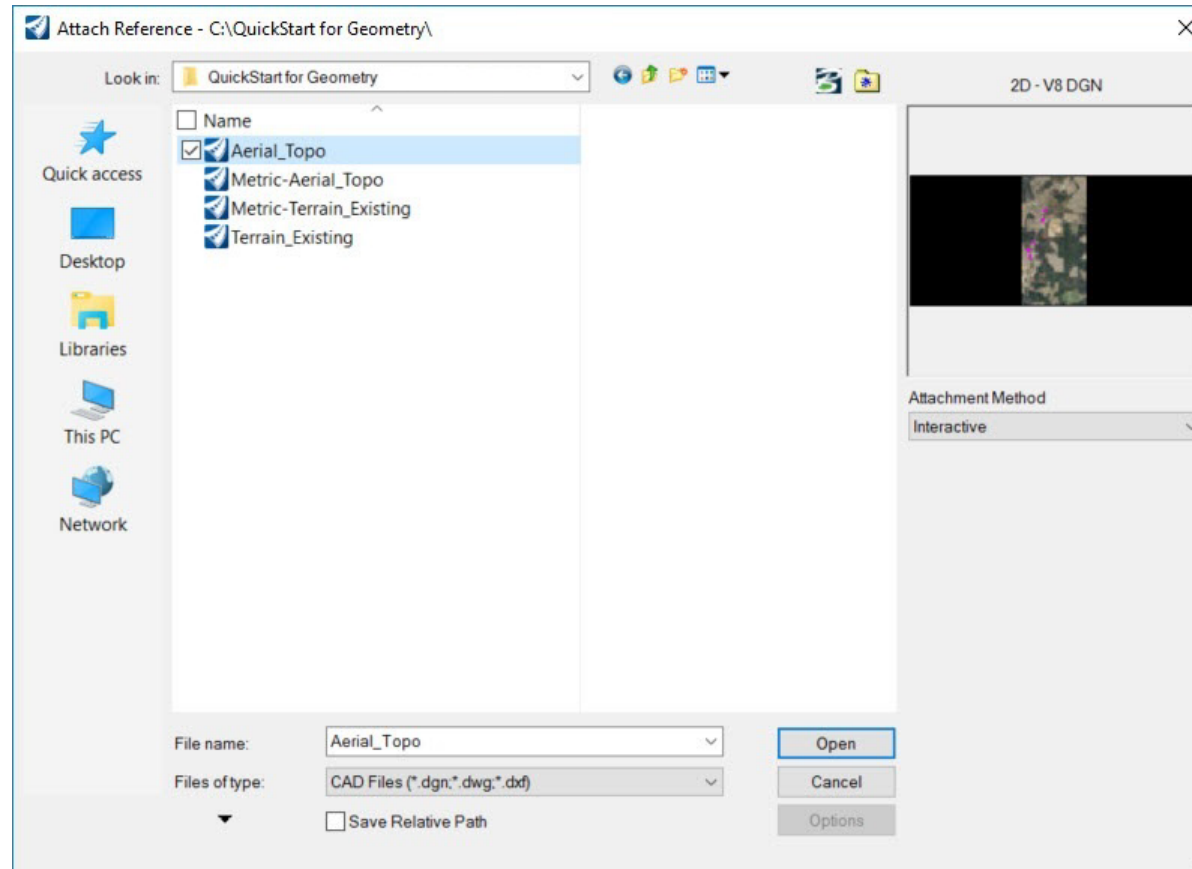   a. Click on **Home > Primary > Attach Tools** and select **References**.
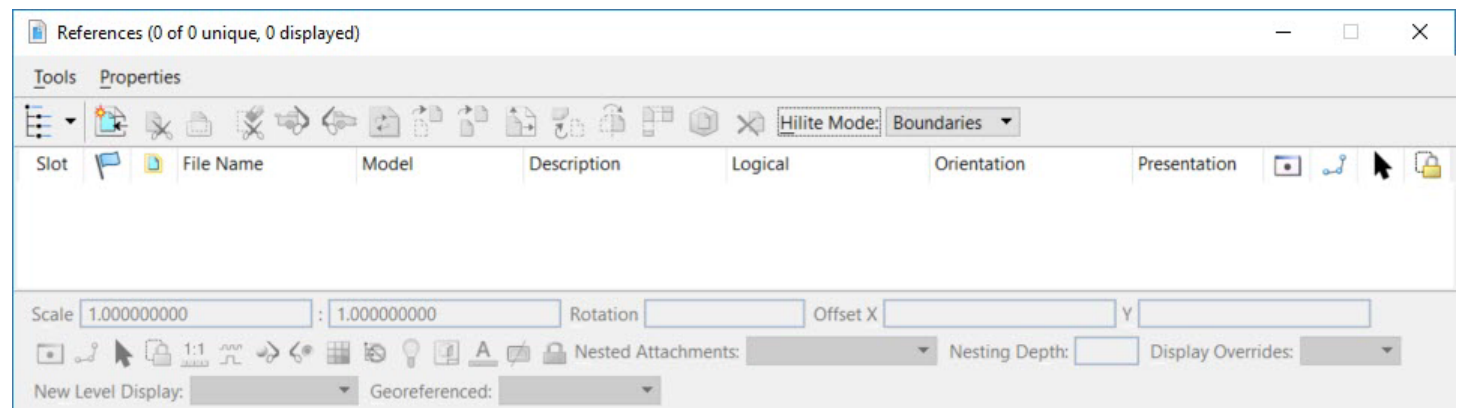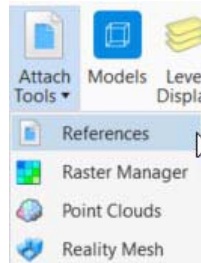
The References dialog will now appear as shown above. You use this dialog to attach reference files to design files.
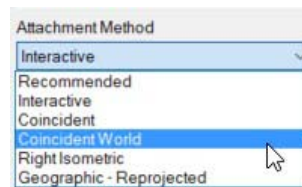
   b. In the *References* dialog, **Click** on **Tools** and choose **Attach**.

c. The **Attach Reference** dialog will appear, **browse** to the location of *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn]* and **left-click** on it.

d. Change the *Attachment Method* to **Coincident World** and then **Click** *Open* to attach the file as a reference.

The *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn]* will now be attached to the active file and displayed in the References Dialog.
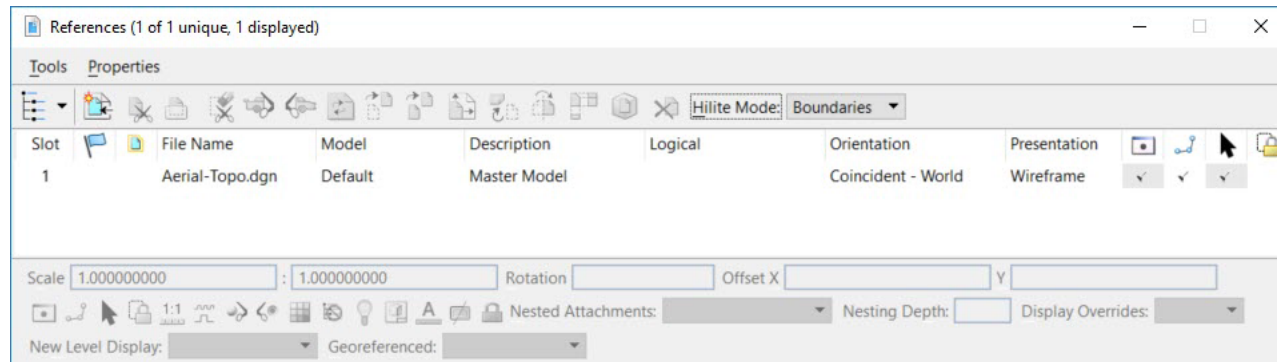

e. **Close** the Reference dialog.

f. **Click** the *Fit* view icon so you can see all of the graphics in the design file.

g. Locate and review the PI points (magenta circles) drawn in the *Aerial_Topo.dgn [Metric-Aerial_Topo.dgn].* Notice there are 5 PI points, you will be creating tangent lines between these points.

TIP: The software also provides the ability to display a background map directly from Bing Maps. This option can be found under the *View Attributes > Background Map* panel.

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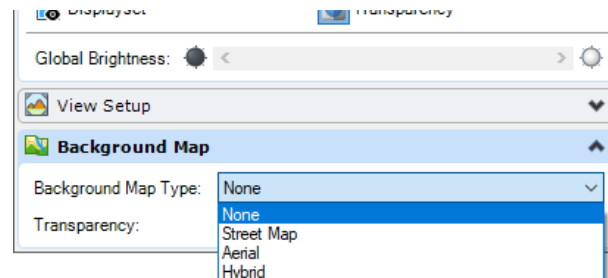
Create Horizontal Elements for London Rd.

In this section, you will be creating the horizontal alignment for *London Rd.* (see image to the right). *London Rd.* runs from south to north and is made up of 4 tangents and 3 curves. You will first define the tangents between PI points and then add horizontal curves.

1. Set a **Feature Definition** to be used with your geometric elements.

    Feature Definitions are used to control symbology, annotation, and various other properties that are applied to the geometric elements. The feature definitions are used to:

    - Define what the geometric elements actually are. What is being modeled such as curb, centerline, edge of pavement, etc.

    - Control symbology in various views, including capability to define differing symbology in plan, profile, and 3D spaces

    - Define terrain modeling attributes (spot, break line, void, etc.)

    - Define surface display characteristics

    Feature Definitions are defined and stored in a DGN library delivered with the WorkSpace.

    a. Open the *Feature Definition Toggle Bar* tool by going to **Geometry > General Tools > Standards > Feature Definition Toolbar**.
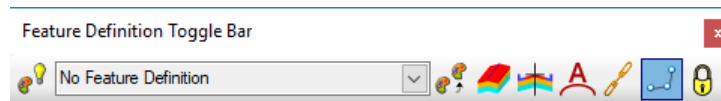
    b. Set the active feature to **Geom_Baseline** by pressing the down arrow.
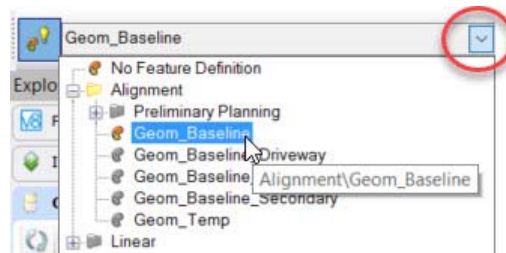
c. **Click** on the **Use Active Feature Definition** tool on the *Feature Definition Toggle Bar* to toggle it on.

Setting the **Active Feature Definition** ensures that all geometric elements created will have the selected feature definition assigned to them as you create geometric elements.

2. Prior to creating geometry, review the **Civil Formatting** options for the design file. **Civil Formatting** is used to control the formatting and precision of the design file settings. Coordinate format and precision as well as Station format and precision can be adjusted here.

File

a. Select **File > Settings > File > Design File Settings > Civil Formatting**

b. **Close** Design File Settings

c. **Click** the Arrow in the upper left corner to return to the main ribbon interface.

3. Create the tangent lines between known PI points. Use the image to the right as a guide.

   a. From the ribbon menu select **Geometry > Horizontal > Lines > Line Between Points**

      Notice the heads up display attached to your cursor will be prompting you for a start point.

   b. **Left-click** on the *Center Snap* tool. Be sure AccuSnap is enabled as shown below.

   c. **Snap** to the center of PI#1 and **Left click** to accept.

      Hint: If you have trouble snapping to the center just approximate the center point and move on to the next step.

      A Note About Snaps and Design Intent:

      When you snap to elements, the software remembers how you snapped to elements and what type of snap was used. Thus, a relationship exists between the elements. This is an example of *Design Intent.*

      Design Intent builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. This is a very important concept to remember as you work with the product.

The heads up prompt changes and gives you the option to key in the distance and/or direction as needed. Pressing the *Right arrow* or *Left arrow* on your keyboard will toggle between *Distance* and *Line Direction* input fields.

d. Define the Distance, key in **546.00** *[166]* in the *Distance* field and press **Enter** to lock the value.

e. Press the **Right Arrow** on your keyboard to switch to the *Line Direction* field.

f. In the *Line Direction* field, key in: **N01^33'00"W**, press **Enter** to lock the value.

g. **Left-click** to accept.

4. Select the **Element Selection** tool. The **Element Selection** tool is used to select elements so they can be edited or manipulated with other commands.

5. Set the **Element Selection** tool to the individual mode by selecting the Individual and New icons in the Element Selection tool setting window.

a. **Select** the line you just created.

Recall, geometric elements are rule-based elements that provide *Design Intent*. Notice the line has a distance and direction associated with it. The distance and direction represent the rules associated to the element.

Also, note the *Drag Handles* as well as the *Text Manipulators* (direction/distance) attached to the line. These provide the ability to quickly modify the line. If you need to modify the distance and/or direction you can simply click on distance/direction *Text Manipulators* and key in new values in the edit fields. You can use the *Drag Handles* to trim/extend, rotate or move the line.

Text Manipulators

N89°50'10.2"E
100.000

Edit Field

100.000

Drag Handles

N89°50'10.2"E
100.000
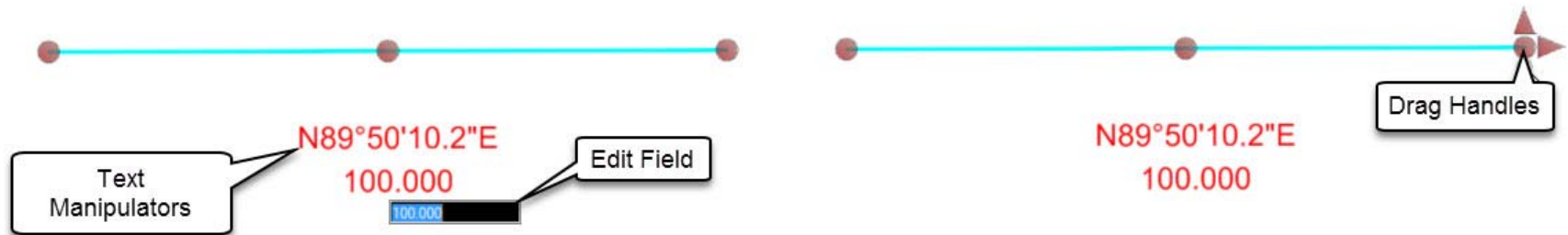
b. **Hover** your cursor over the beginning point of the line, the *Drag Handle* arrows will appear as well as the center point snap indicator.

The *Drag Handle* arrows give you the ability to dynamically adjust the end point of the line. By selecting the *Drag Handle* arrows you can extend or trim the line and also change the location of the end point.

The center snap indicator shows that the beginning point of the line was placed by snapping to the center of the circle. This is an example of *Design Intent*. A relationship exists between the beginning point of the line and the circle. Be aware, if the circle is moved the line will move. If the circle is deleted the relationship will be removed but the line will remain. This is an important concept to understand with regards to snaps.

c. Next, **Hover** your cursor over the line for a few seconds. A *context sensitive menu* will appear giving you access to other tools related to the element. Context sensitive menus appear if you hover your cursor over OpenRoads Designer elements or objects.

d. Select the **Properties** tool and review the properties of the line.

Note that the line can be edited within the **Properties** dialog. The *Length*, *Direction*, *Start Point*, *End Point*, *Feature Name* and *Feature Definition* can all be modified within this dialog if needed.

	Start Point	2320589.392',758661.790
>	End Point	2320574.623',759207.590
	Length	546.000'
	Direction	N01°33'00.0"W

| Feature Name | GeomBL |
| Feature Definition | Geom_Baseline |

| Length | 546.000' |
| Direction | N01°33'00.0"W |

| > | Start Point | 2320589.392,758661 |
| > | End Point | 2320574.623,759207 |

e. **Left-click** anywhere in the view to de-select the line.

6. Continue placing tangent lines.

a. **Click** the *Chain Commands* tool on the *Feature Definition Toggle Bar*. When the *Chain Commands* tool is enabled, the next element is automatically connected to the previous element without having to select the start point each time.

b. Re-select the **Geometry > Horizontal > Lines > Line Between Points** tool.

c. **Snap** to the end point of the first tangent line to place the start point of the second tangent line.

d. **Left-click** to accept.

e. **Left-click** near the center of the circle at PI #3 to complete placing the tangent line between PI #2 and PI #3.

f. **Left-click** near the center of the at PI #4 to place the tangent line between PI #3 and PI #4.

g. **Left-click** near the center of the at PI #5 to place the tangent line between PI #4 and PI #5.

h. **Right-click** to complete.
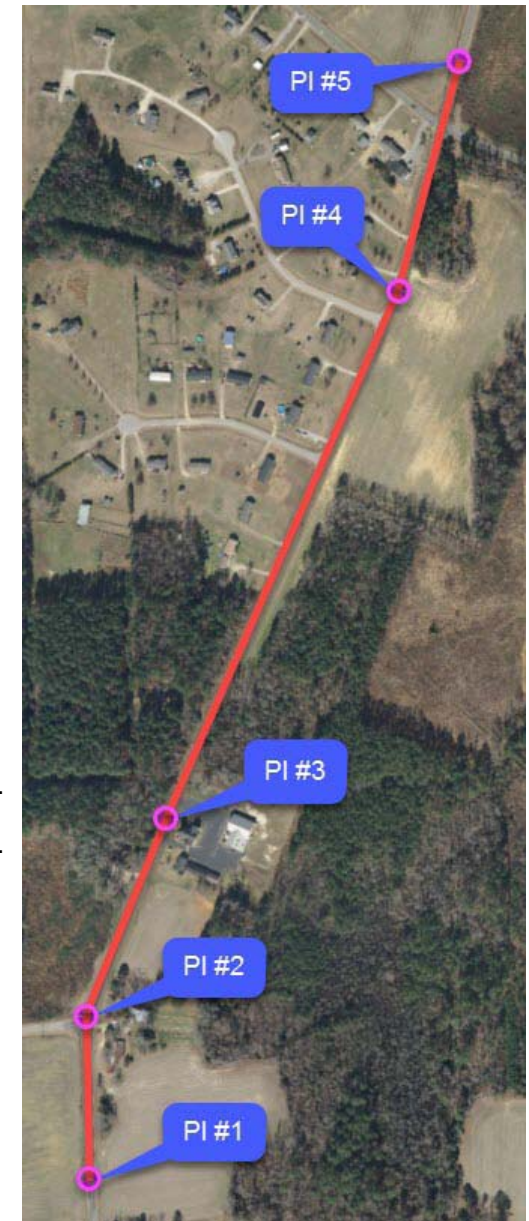
Your geometric elements should look like the image to the right once you have completed placing all tangent lines.

7. Create horizontal curves between tangent lines using the **Simple Arc tool**.

    a. From the ribbon menu select **Geometry > Horizontal > Arcs > Arc Between Elements > Simple Arc**

    b. Following the heads up prompts, locate and select first tangent element (line between PI #1 and PI #2).

    c. Locate and select second tangent element (line between PI #2 and PI #3).

    d. Define the arc *Radius* as **600** *[183 m],* press **Enter** to lock the value and **Left-click** to accept.

    e. Set the *Trim/Extend* option to **Both** and **Left-click** to trim both tangent elements.

       NOTE: In lieu of using the heads up prompts, you can also key in values in the dialog box but you still need to Left-click to accept the values entered.
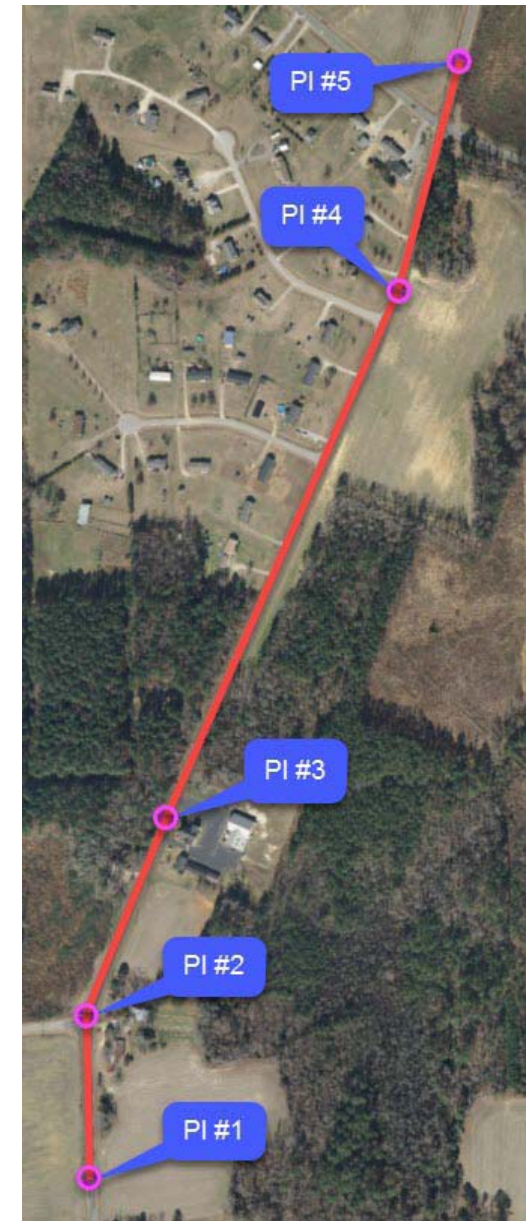
8. Create remaining curves for PI#3 and PI#4 using the same methods described in steps **7a.** through **7e.** on the previous page. The radius values are given below:

- Curve at PI#3 Radius =**10000** *[3048]* (curve to the right). **Take care when placing this curve, since it has a very flat radius. It must curve to the right.**

- Curve at PI#4 Radius = **2100** *[640]* (curve to the left)

9. Modify the first horizontal curve radius.

a. Pick the **Element Selection** tool.

b. **Select** the first horizontal curve, notice the radius is displayed as 600 *[183]*.

c. **Left-click** the **600** *[183]* value, an edit field will appear.

d. Key-in **700** *[213]* in the edit field and press **Enter** (or **Left-click**) to change the radius.

The curve will update with the new radius and the tangent lines adjust automatically to maintain their relationship with the curve. This is another example of *Design Intent* and the rules and relationships that exist between civil geometry elements. The software remembers that the original curve was placed between the two tangents and when the radius value changed the geometry adjusted itself to maintain the geometric relationship.

Now that you have all of your elements created, you need to combine them together into an alignment. You will do this by using the **Complex By Elements** tool.

10. Use **Complex By Elements** tool to create a horizontal alignment for *London Rd.*

   a. From the ribbon menu select **Geometry > Horizontal > Complex Geometry > Complex By Element**

    b. In the dialog box, set the following parameters:

       - *Method:* **Automatic**

       - *Maximum Gap:* **0.100** *[0.01]*

       - *Name:* **LondonRd**

    c. Following the heads up prompts,

       - *Locate First Element:* **Select** the first tangent line (between PI#1 and PI#2) near the beginning

       - *Accept Complex:* **Left-click** to accept and create the complex profile element

    NOTE: *Where* you select the element is important. Each element has a midpoint. Notice when selecting the element near the start point an arrow appears pointing north, indicating the direction the alignment will be created. If you select the element near the end point, the arrow will change direction, pointing south and will not create the alignment in the proper direction.
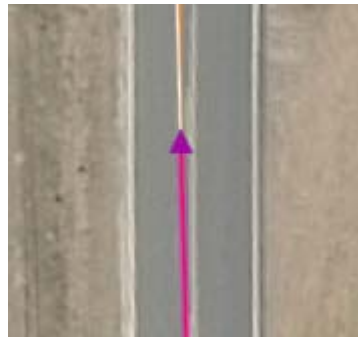
The completed complexed horizontal alignment should look like the image to the right. The alignment is made up of 4 tangents and 3 curves.

d. **Hover** over the alignment and **select** it to display the element information and the edit handles. Note that the full alignment is highlighted and is a complex element.


Complex Element: LondonRd
Feature: Alignment\Geom_Baseline
No Active Profile
Level: Geom_Baseline
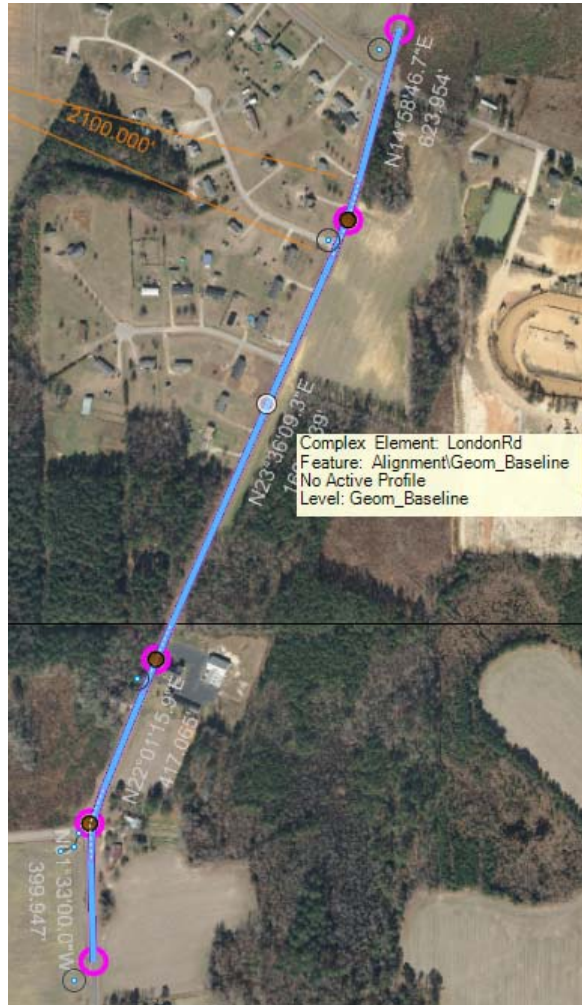
Review Geometry with the Explorer Window

In this section, you will learn how to review geometry in the **Explorer window**. The Explorer window can be used to browse and manage data in the design file. You can also use it to search, zoom to and isolate data. All data is organized and displayed in the **Explorer** window. As the design progresses, the information is automatically created and updated.

1. Review geometric elements in the **Explorer** window.

   a. Select **Home > Primary > Explorer** to display the Explorer window.

      Expand the **OpenRoads Model** group by pressing the down arrow.
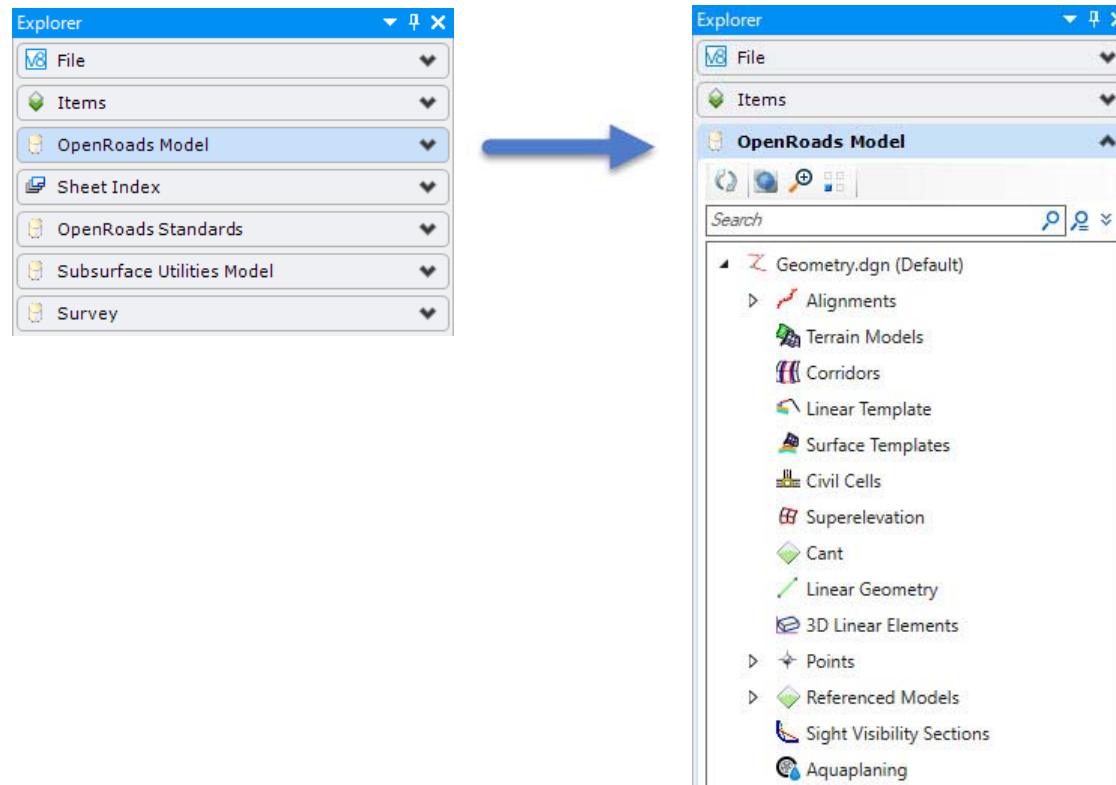
   TIP: It is recommended to always have **Explorer** open when working in the software.

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Geometric elements associated with alignments are grouped under the *Alignments* category. To see which elements are part of the *Alignments* category simply click on the small arrow next to the category to expand the list.

b. **Click** the small arrow next to *Alignments* to expand the list to see next item in the list.

c. **Click** the small arrow next to *Geom_Baseline* to the expand the list (recall *Geom_Baseline* was the feature definition you used to create your geometry.

d. **Select** *Complex Element: LondonRd*, observe that the London Rd. alignment is highlighted in *View 1*. This is an example of how **Explorer** can be used to locate and select an alignment in the design file.
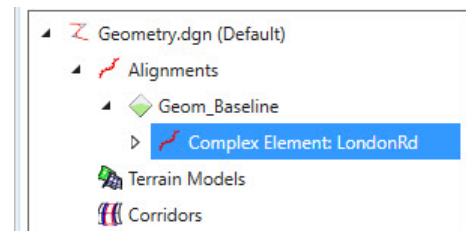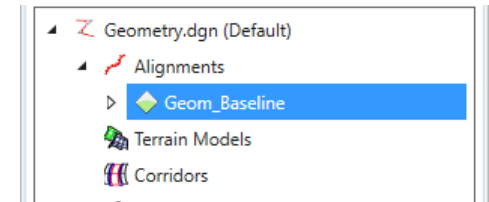
e. **Right-click** on *Complex Element: LondonRd* to review other tools related to the alignment. You can left-click on any item in the list to gain access to other tools that can be used.
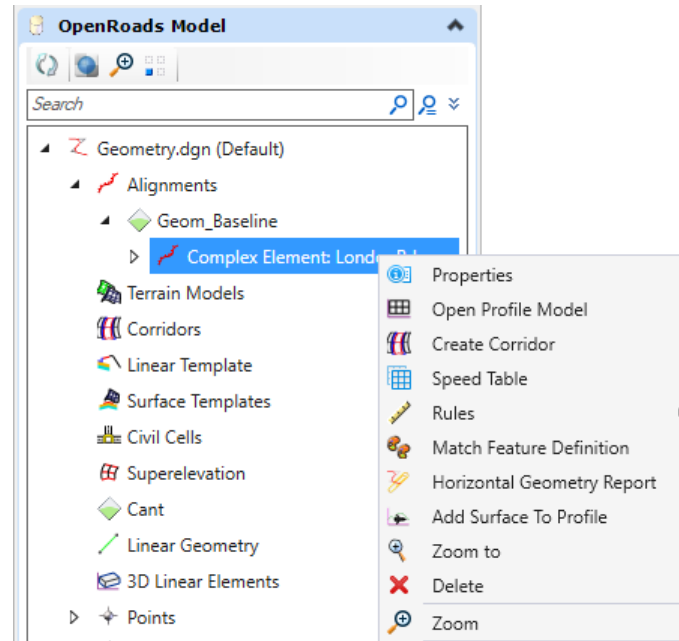
f. **Click** the small arrow next to *Complex Element: LondonRd* to expand the list to see the geometric elements associated with the alignment. Continue to expand the list to see the details and dependencies.

Create a Horizontal Geometry Report

1. In the Explorer window, **right-click** on *Complex Element: London Rd*. to access the *Horizontal Geometry Report*

2. **Select** *Horizontal Geometry Report*

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3. The *Bentley Civil Report Browser* dialog will appear and the report will be displayed. **Review** the report.

After reviewing the report you may want to adjust the precision and format of distances, angles, bearings, etc. You can easily adjust the report with the *Format Options* tool.

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4. Go to **Tools > Format Options** in the *Bentley Civil Report Browser*.
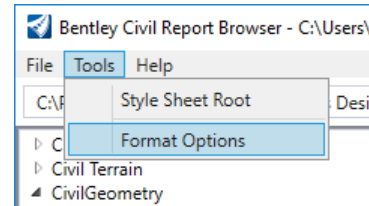
5. Change the **Format Options** as follows:

   ▪ *Angular - Precision:* **0**

   ▪ *Angular - Format:* **ddd^mm'ss.s"**

   ▪ *Slope - Format:* **50%**

   ▪ *Station - Precision:* **0.12** *[0.123]*

   ▪ *Station - Format:* **ss+ss.ss** *[s+sss.ss]*

   ▪ *Direction - Precision:* **0**

   ▪ *Direction - Format:* **ddd^mm'ss.s"**

6. Close the **Format Options** window.
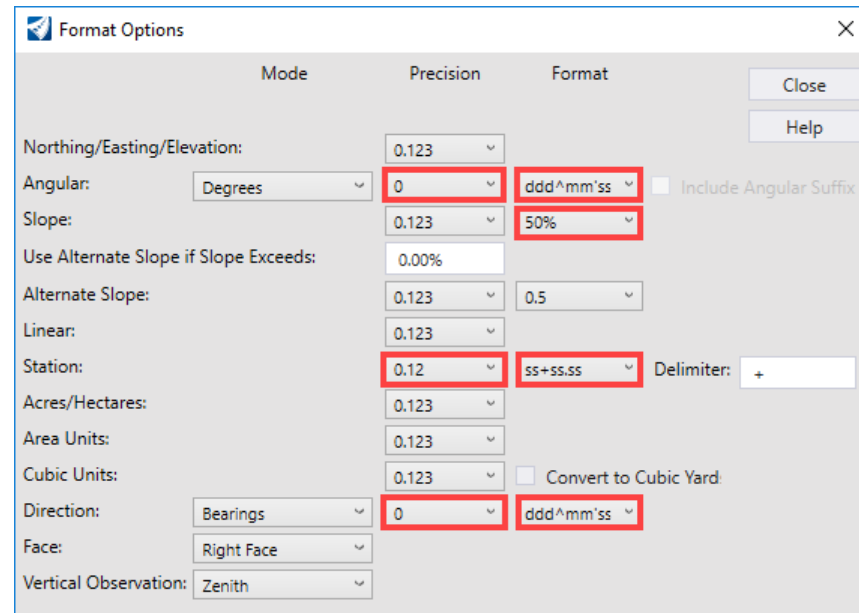
7. **Review** the report to ensure the formatting has been adjusted.

8. Save the report.

    a. In the *Bentley Civil Report Browser* window, select **File > Save As**.

        ▪ **Browse** to *C:\Bentley Training\QuickStart for Geometry - Road* or other folder where you unzipped the dataset files

        ▪ *File name:* key in **HR-LondonRd**

        ▪ *Save as type:* choose **Doc File (*.doc).**

        ▪ **Click Save**, to save the report.

    NOTE: You can also print the report by going to **File > Print** or Right-click in the report window and choose **Print**.

Review the Bentley Civil Report Browser

The list in the left pane of the *Bentley Civil Report Browser* dialog shows the different report categories and report types available. Clicking on each category will give you access to a list of report types known as *XSL Style Sheets* (or simply called *Style Sheets*). Each *Style Sheet* contains the formatting for how a report is displayed. Selecting a *Style Sheet* will display the report in the right portion of the dialog.

Also, by **right-clicking** on a *Style Sheet* you can set that style sheet to be the **default** report display for a selected report type. As shown below, the default *Style Sheet* for Geometry (horizontal geometry) is *HorizontalAlignmentReview.xsl.*

The default *Style Sheets* are stored in the registry by user and can be changed at any time.
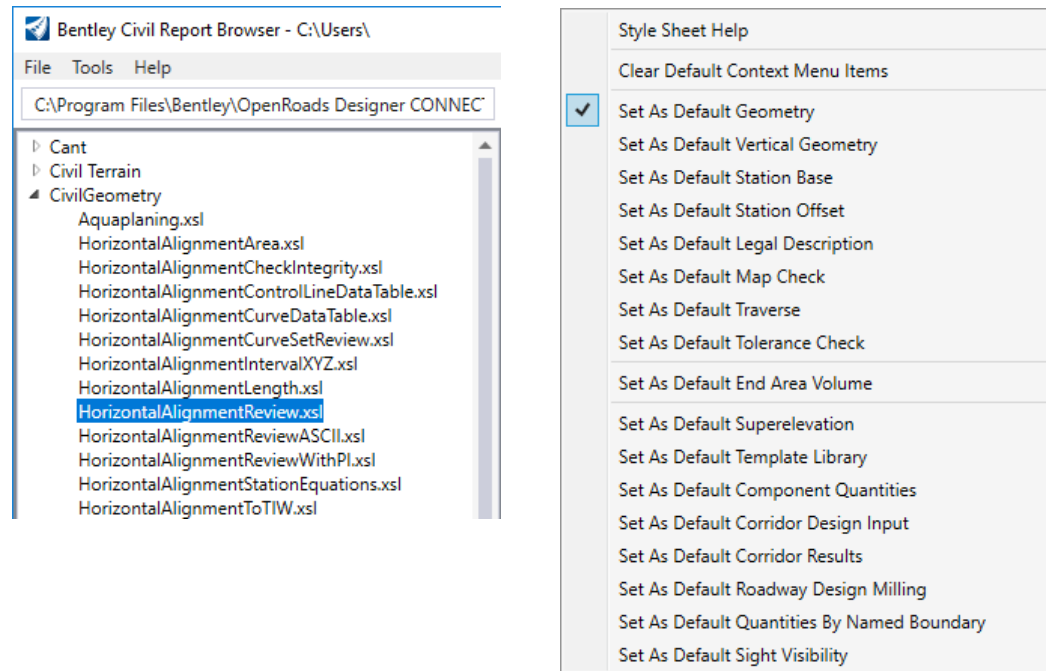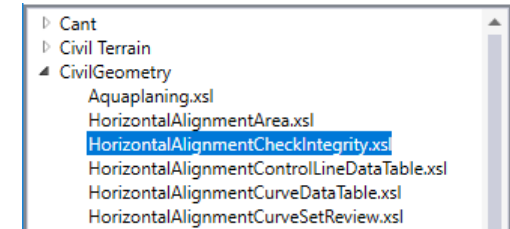
View Other Horizontal Geometry Reports

1. If necessary, **left-click** the small arrow next to the *Civil Geometry* category to expand the report list to display available style sheet reports.

2. **Select** the *HorizontalAlignmentCheckIntegrity.xsl* style sheet.

3. **Review** the report.


```
▷ Cant
▷ Civil Terrain
▲ CivilGeometry
      Aquaplaning.xsl
      HorizontalAlignmentArea.xsl
      HorizontalAlignmentCheckIntegrity.xsl
      HorizontalAlignmentControlLineDataTable.xsl
      HorizontalAlignmentCurveDataTable.xsl
      HorizontalAlignmentCurveSetReview.xsl
```

Simple Horizontal Integrity Report

Report Created: Tuesday, November 20, 2018
Time: 3:40:58 PM

Project: Default
Description:
File Name: C:\Bentley Training\QuickStart for Geometry\Geometry.dgn
Last Revised: 11/20/2018 08:31:12

Note: All units in this report are in feet unless specified otherwise.

Alignment Name: LondonRd
Alignment Description:
Alignment Style: Alignment\Geom_Baseline

Element	Point Type	Station	Start Northing	Start Easting	Start Direction	Type	End Northing	End Easting	End Direction	Length	Radius	Northing Difference (End to Next)	Easting Difference (End to Next)	Angular Difference (End to Next)	Radii Difference (End to Next)
Linear	START	0+00.00	758661.790	2320589.392	N01°33'00"W	PC	759061.590	2320578.574	N01°33'00"W	399.947		0.000	0.000	-00°00'00"	0.000
Circular	PC	3+99.95	759061.590	2320578.574	N01°33'00"W	PT	759342.988	2320629.386	N22°01'16"E	287.975	+700.000	0.000	0.000	-00°00'00"	0.000
Linear	PT	6+87.92	759342.988	2320629.386	N22°01'16"E	PC	759729.627	2320785.764	N22°01'16"E	417.065		0.000	0.000	00°00'00"	0.000
Circular	PC	11+04.99	759729.627	2320785.764	N22°01'16"E	PT	759984.051	2320892.775	N23°36'09"E	276.021	+10000.000	0.000	0.000	00°00'00"	0.000
Linear	PT	13+81.01	759984.051	2320892.775	N23°36'09"E	PC	761451.062	2321533.776	N23°36'09"E	1600.939		0.000	0.000	-00°00'00"	0.000
Circular	PC	29+81.95	761451.062	2321533.776	N23°36'09"E	PT	761749.083	2321638.089	N14°58'47"E	316.047	-2100.000	0.000	0.000	00°00'00"	0.000
Linear	PT	32+97.99	761749.083	2321638.089	N14°58'47"E	END	762351.833	2321799.366	N14°58'47"E	623.954					

4. Select several other **Horizontal Alignment** style sheets and review how the *same* alignment data is presented differently.

5. **Close** the *Bentley Civil Report Browser.*

Define the Start Station

In this section, you will learn how to define the start station value and assign it to the horizontal alignment.

1. From the ribbon menu select **Geometry > Horizontal > Modify > Start Station**

2. Following the heads up prompts:

   a. *Locate Element:* **Select** the *London Rd.* alignment.

   b. *Start Distance:* **0**, press **Enter** to lock the value and **Left-click** to accept.

   c. *Start Station:* **50+00** *[5+000]*, **Left-click** to accept.

3. Review the stationing

   a. **Click** the **Element Selection** tool.

   b. **Select** the alignment, notice the alignment displays the new beginning station value. The begin station is dynamic text which can be adjusted by simply selecting the begin station value and keying in a new value. The stationing of the alignment will then update.

   c. **Hover** your cursor over the alignment until the context sensitive menu appears.
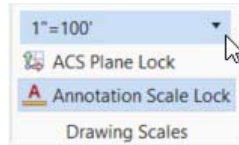
   d. **Select** *Horizontal Geometry Report* to review the alignment again to verify the stationing.

   e. **Close** the *Bentley Civil Report Browser* dialog box.

   f. **Left-click** anywhere in *View 1* to de-select the alignment.

Annotate Horizontal Alignment

1. From the ribbon menu select **Drawing Production > Drawing Scales > Annotation Scale Lock** and set the scale to **1"=100'** *[1:500]*

2. From the ribbon menu select **Drawing Production > Annotations > Element Annotation > Annotate Element**

3. At the prompt *Locate Elements - Reset to Complete*, **select** the alignment and then **right-click** to complete.

   The alignment is now annotated. The annotation is also dynamic and associated to the alignment. Any changes made to the alignment will update the annotation.

   The annotation is defined by an *Annotation Group* which is associated with the *Feature Definition*. The text size is controlled by the *Annotation Scale Lock*.

Exercise 3: Existing Terrain Model and Define 2D & 3D Views

Skills Taught

- Attach Terrain Model

- Set Terrain Model Active

- Define 2D & 3D Views

- Review Design File Models

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Attach Terrain Model

In this section, you will learn to attach a terrain model to your design file. Terrain models are stored in 3D design files. Any time you need to use a terrain model within your design file, you just need to attach the terrain model as a reference.

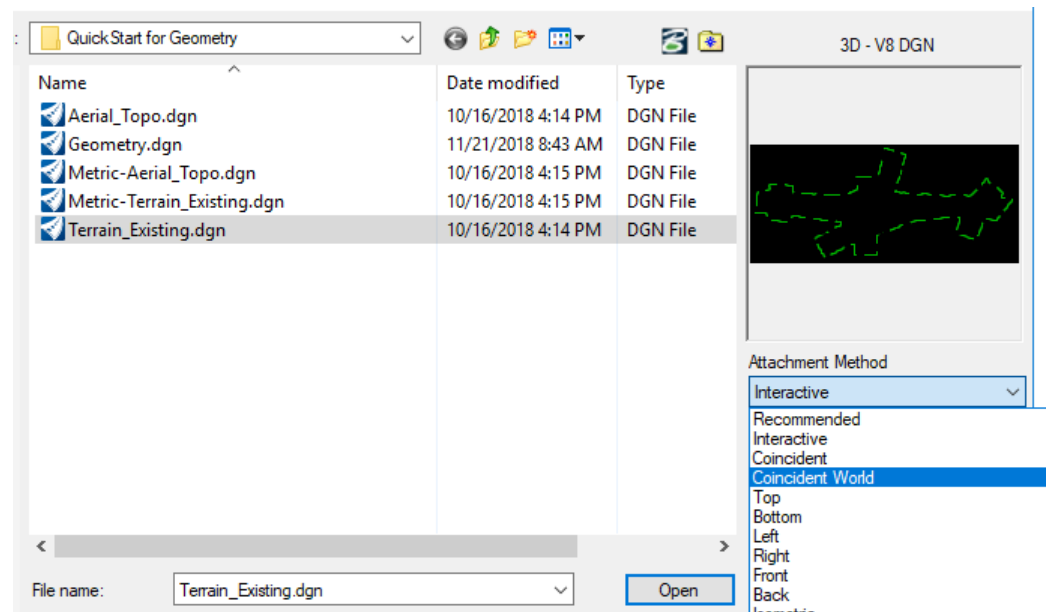1. Attach *Terrain_Existing.dgn [Metric-Terrain_Existing.dgn]* as a reference.

   a. **Click** on **Home > Primary > Attach Tools > References**.
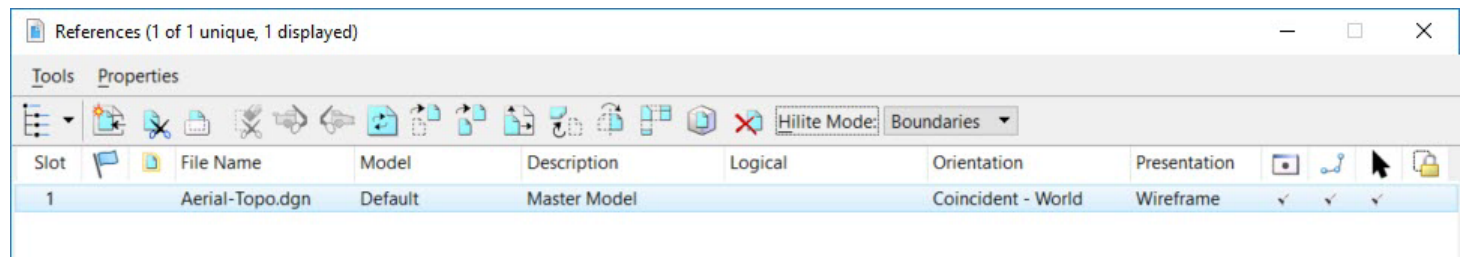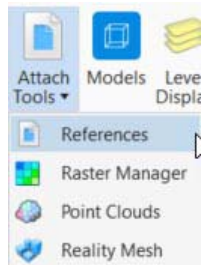
    The References dialog will now appear as shown above. You use this dialog to attach reference files to dgn files.

    b. From the References dialog, select the **Attach Reference** icon or **Tools > Attach...**

    c. **Select** the file *Terrain_Existing.dgn [Metric-Terrain_Existing]*

    d. Set the *Attachment Method* to **Coincident-World**.

    e. **Click** *Open*

f. The terrain model, *Terrain_Existing.dgn [Metric-Terrain_Existing.dgn]* is now attached to the file.
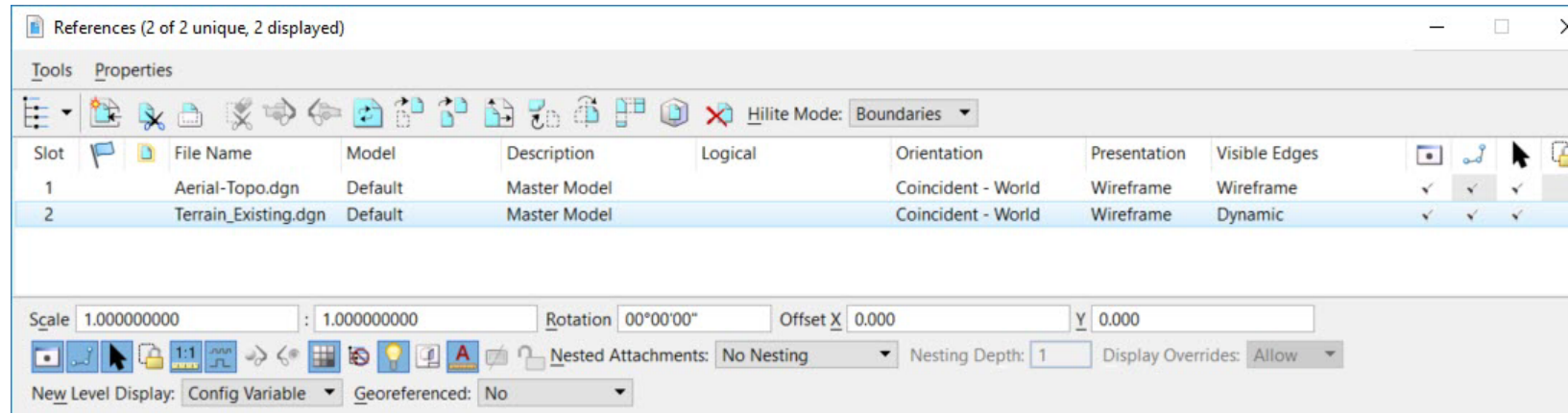
g. **Close** the References dialog box.

h. **Click** the *Fit View* icon in the top of the view window so you can see all of the graphics in the design file.

Notice the green shape that is now present in the design file. This green shape represents the boundary of the terrain model.

NOTE: For the purposes of this course we are not going to view the terrain model triangles or features.

Setting the Active Terrain Model

1. **Click** the **Element Selection** tool

2. Set the **Element Selection** tool to the individual mode by selecting the **Individual** and **New** icons in the *Element Selection* tool setting window.

3. **Left-click** anywhere on the green shape that outlines the terrain model.

4. **Hover** the cursor at this location for a few seconds and context sensitive toolbar appears displaying tools commonly used with terrain models. More terrain model tools can be found on the Terrain ribbon menu.

5. **Select** the *Set As Active Terrain Model* tool.

Setting the terrain model active instructs the software to use the active terrain model as the default terrain model when using other OpenRoads Designer tools. You can always change or clear the active terrain model at any time.

Also, when setting the Active Terrain Model the software will **automatically** create a 3D model inside of your 2D design file. The 3D model will be used for the display of 3D data.

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Open 2D and 3D Views

1. Press **F9** on your keyboard.

   Notice the views change, you now have 2 view windows open. *View 1* on the left is the 2D model view that you started with and *View 2* on the right is the 3D model view. Pressing the **F9** key automatically configures this particular view setup for you, 2D on the left and 3D on the right. This will come in handy as you move through the design process.
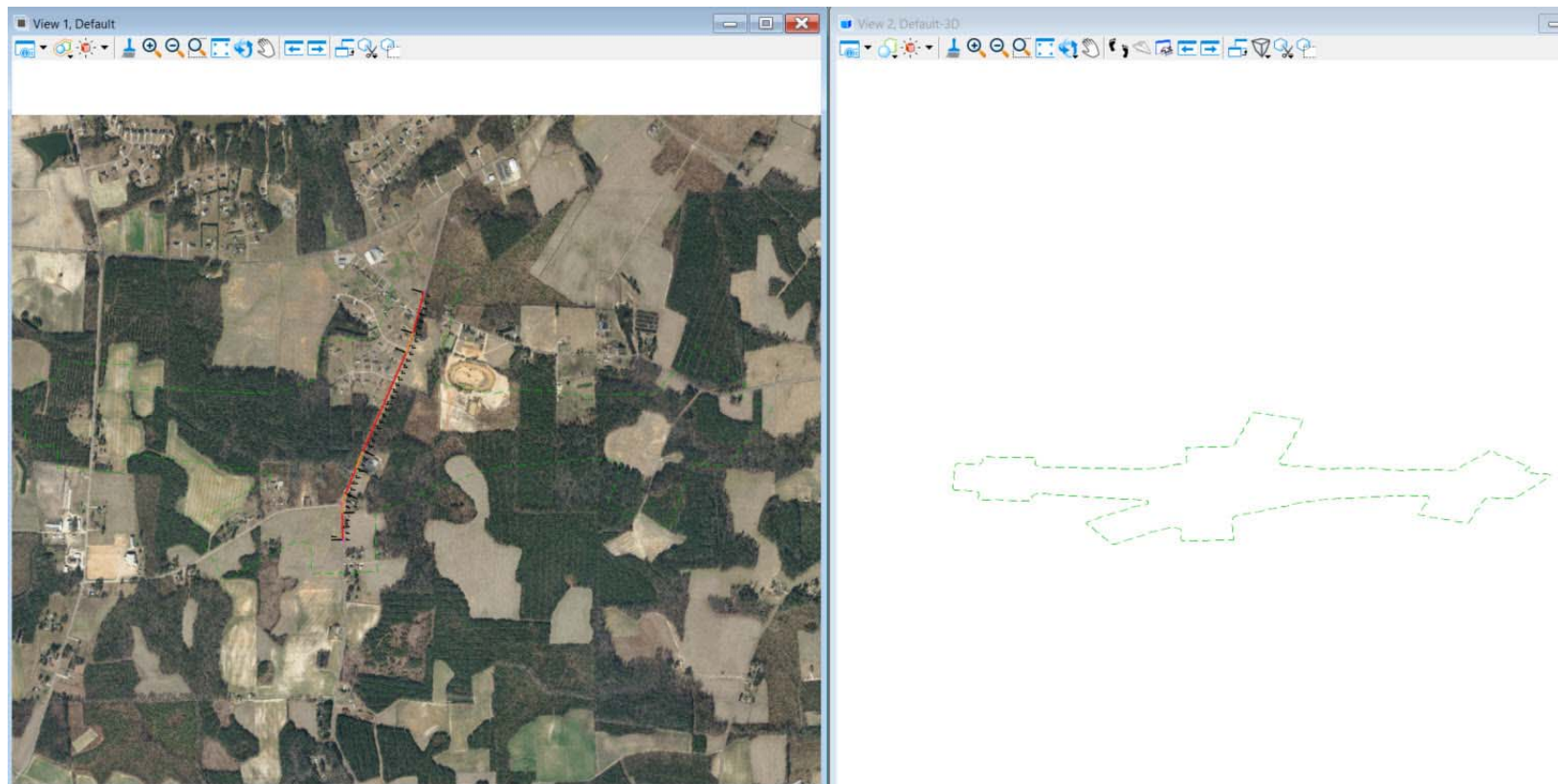

   Also, observe the existing terrain model boundary is displayed in 2D and 3D. The terrain model triangles are not displayed at this time. Triangles, breaklines, feature spots and contours can be displayed via the terrain model properties as needed.

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2. Alternatively, in *View 1* you can **right-click** and **hold down** the right mouse button to access special view control tools.
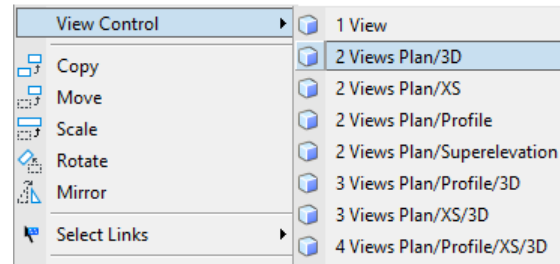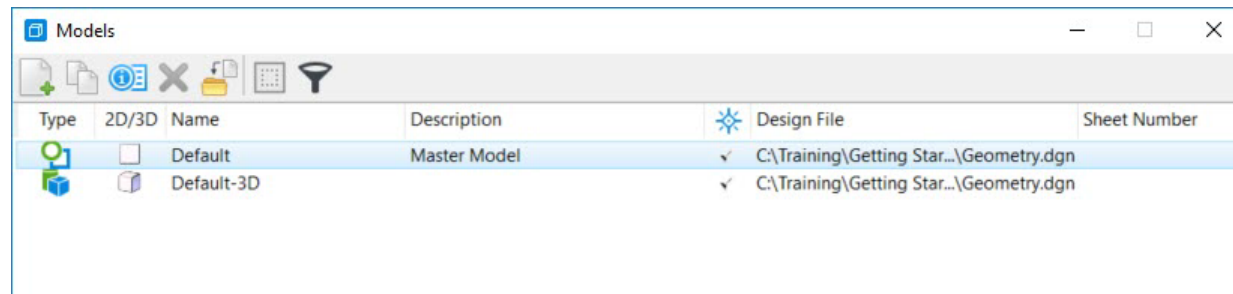

a. **Select** *View Control > 2 Views Plan/3D*.
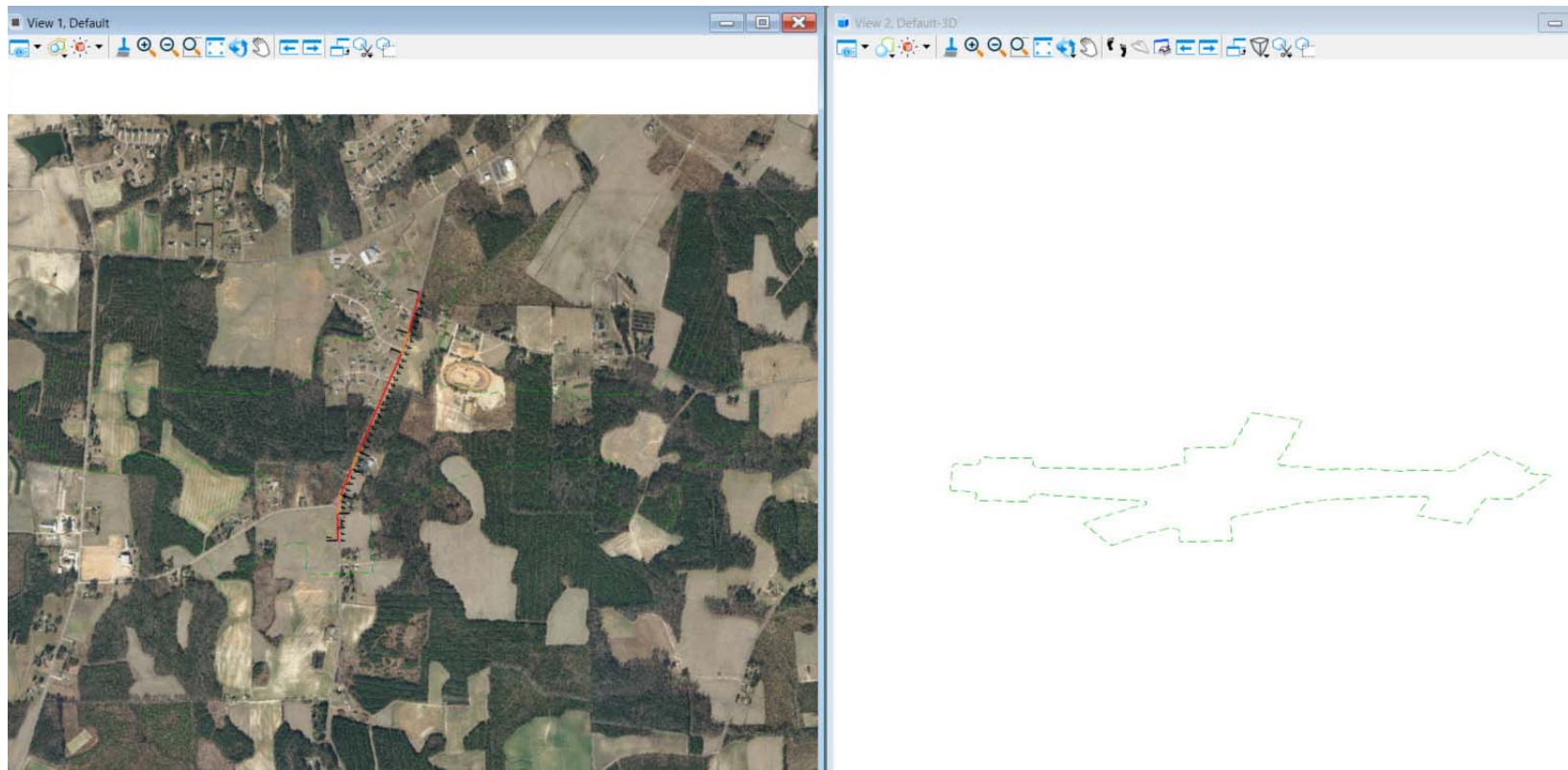
b. **Click** the *Fit View* icon in the top of the view windows so you can see all of the graphics in both views.

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Review Design File Models

1. From the ribbon menu select **Home > Primary > Models**

2. Review the **Models** dialog, notice there are 2 models available, *Default* and *Default-3D*.

Models can be 2D or 3D. It's very important to realize that even though you started with a 2D dgn file it is possible to have a 3D model also available in the same design file. Recall that setting a terrain model active *automatically* creates a 3D model for you. The 3D model must be created by the product. Do not create your own model named *Default-3D*, it will not work properly.

Also, the 2D and 3D models are directly related to the model views, recall *View 1* is named *Default* and *View 2* is named *Default-3D*.
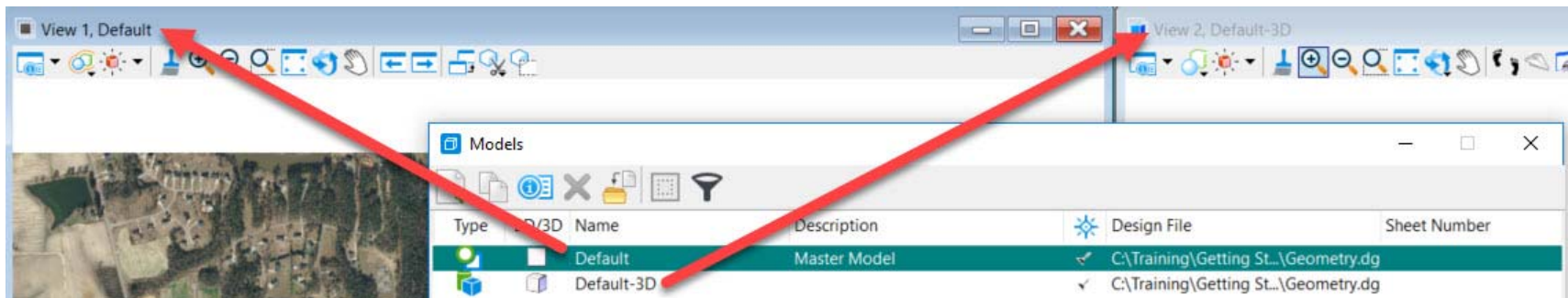
3. **Close** the *Models* dialog.

4. **Close** the *View 2*.

Exercise 4: Creating Vertical Geometry

In this section, you will learn how to create a vertical alignment using the vertical geometry tools.

Skills Taught

- Define Profile Model View

- Create vertical geometric elements using the Place Line Between Points and Parabola Between Elements tools

- Combine geometric elements into a complex element to create the vertical alignment

- Create a vertical alignment report

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Define Profile Model View

In this section, you will learn how to define a profile view. Prior to creating vertical geometry you must first define a profile model view to display the vertical geometry.

---

1. **Maximize** *View 1* by clicking the maximize view icon in the view window.
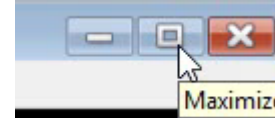
2. **Click** the *Fit View* icon in the top of the view window so you can see all of the graphics in the design file.
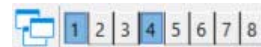
3. **Click** the **Element Selection** tool.

4. **Select** the *horizontal alignment*. **Hover** your cursor over the alignment until the context sensitive menu appears.

5. **Select** the *Open Profile Model* icon, the heads up display will prompt you to *Select or Open View*.

6. Open *View 4* by selecting the view 4 button from the views toggle menu at the bottom of the screen. Profiles can be displayed in any view.

7. **Click** inside of the *View 4* window. *View 4* is now defined as the profile model view. Only one profile model view can be active at a time.

8. In *View 4*, **click** *Fit View*. You should now see the existing ground profile (green dashed line).
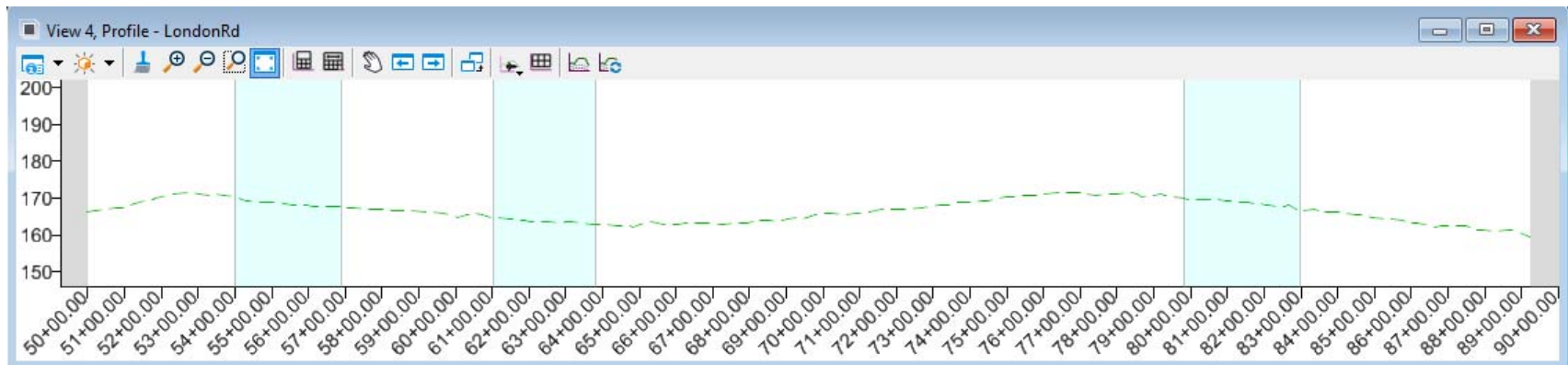
9. **Select** the **Element Selection** tool.

10. **Select** the existing *ground profile line* (green dashed line).

11. **Hover** your cursor over the existing ground profile line until the context sensitive menu appears.
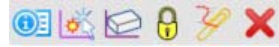

12. **Click** the *Set As Active Profile* icon to set the existing ground line as the active profile.

   Setting the existing ground profile active associates it with the horizontal alignment. It also draws the profile in the 3D model. This will be the default profile for now until you design the proposed vertical alignment. The active profile can be changed at any time.

13. In *View 4*, select **View Attributes** in the upper left corner of the view window.

14. Set the profile view *Exaggeration* to be **20**.
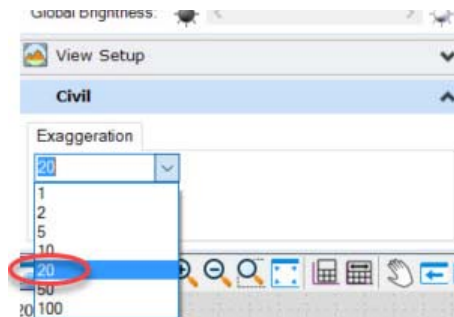
   Notice how the profile view dynamically adjusts itself to reflect the new vertical exaggeration. The vertical exaggeration can be changed at any time.

15. **Click** the **Fit View** icon again in *View 4* to re-center the graphics.

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Create Vertical Geometry

In this section, you will be creating the vertical alignment for *London Rd.* (see image below). The vertical alignment is made up of 4 tangents and 3 vertical curves. You will first define the profile tangent lines and then add vertical curves.
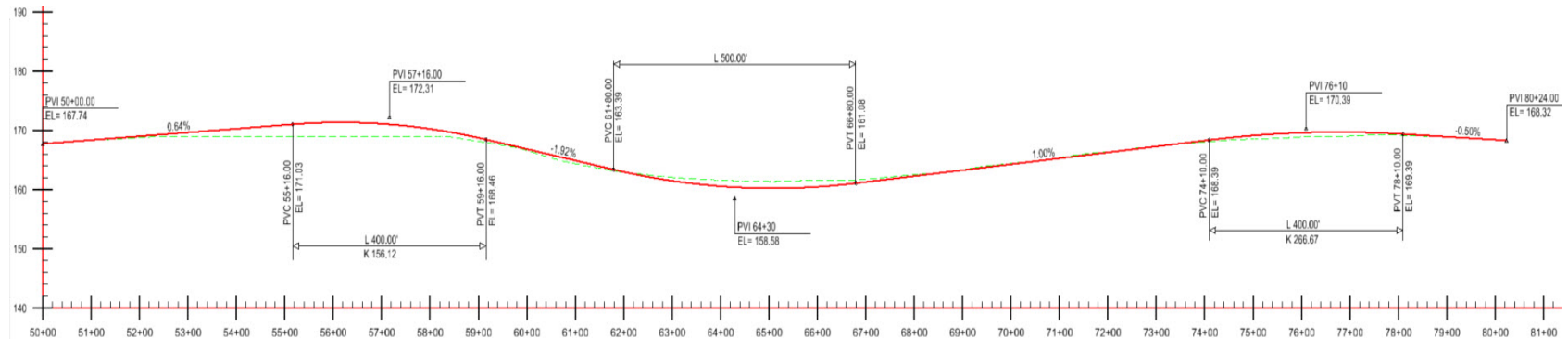
1. Prior to placing elements, on the *Feature Definition Toggle Bar* ensure that

    - *Active Feature Definition* is still set to **Alignment > Geom_Baseline**

    - *Use Active Feature Definition* toggle is **On**
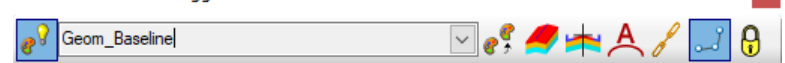
2. **Click** the **Chain Commands** tool on the *Feature Definition Toggle Bar.*

    When the Chain Commands tool is enabled the next element is automatically connected to the previous element without having to select the start point each time.
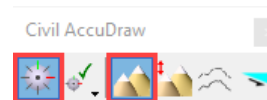
3. Select **Geometry > General Tools > Civil Toggles > Civil Accudraw** to display the *Civil AccuDraw* toggle bar.

    Civil AccuDraw is used for precision input with civil geometry and will be used to place profile elements by station and elevation.

    a. **Click** the **Toggle Civil AccuDraw** icon on the toggle bar.

    b. **Click** the **Z** (elevation) icon on the toggle bar.

4. Create first profile tangent line between PVI's.

    a. From the ribbon menu select **Geometry > Vertical > Lines > Profile Line Between Points**

    a. Move your cursor into *View 4*, notice the heads up prompts for *Station* and *Z (elevation).* These are the **Civil AccuDraw** input fields.

    b. In the *Station* field key in **50+00** *[5+000]* and press **Enter**. Notice the station value is now locked.

Station	50+00.00
Z	192.432
Enter Start Point	

    c. In the *Z* field key in **167.74** *[50.7]* and press **Enter**.

Station	50+00.00
Z	167.740
Enter Start Point	

    d. **Left click** to accept.

5. Continue following the heads up prompts to place the end point of the profile tangent line.

    a. Key in **57+16.00** *[5+218]* in the *Station* field and press **Enter**.

    b. Key in **172.31** *[52.1]* in the *Z* field and press **Enter**.

   c. **Left click** to accept. The first tangent line is now placed.
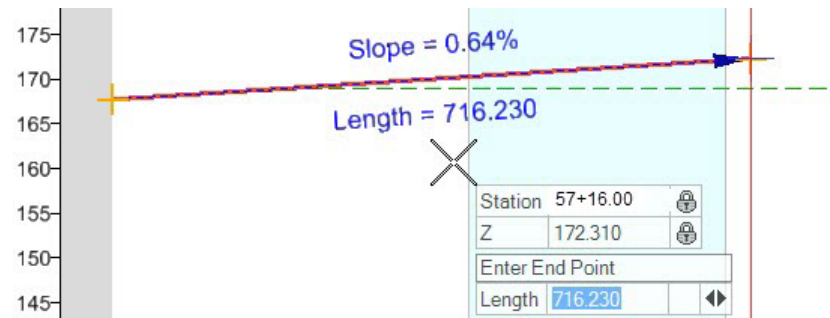
Note the dynamic display showing the slope and length as you place the line. In addition to placing the line by station and elevation you can also place it using a length and slope.

6. Select the **Civil AccuDraw** tool to turn off **Civil AccuDraw**.

   We will now place profile tangent elements by length and slope.

7. Follow the heads up prompt to place the next profile tangent #2

   a. In the *Length* field enter **700** *[213]*, press **Enter** to lock the value.

   b. Press the **right arrow** to toggle to the *Slope* field and enter **-2.0%**, press **Enter** to lock the value.

   c. **Left-click** to accept and move to the next prompt.

8. Create the remaining tangent elements (#3 and #4) using the previous step and the image below as a guide. If you are having trouble keying in values, you can approximate the lengths and slopes. If you make a mistake you can use the **Undo** button to get back to the previous steps.
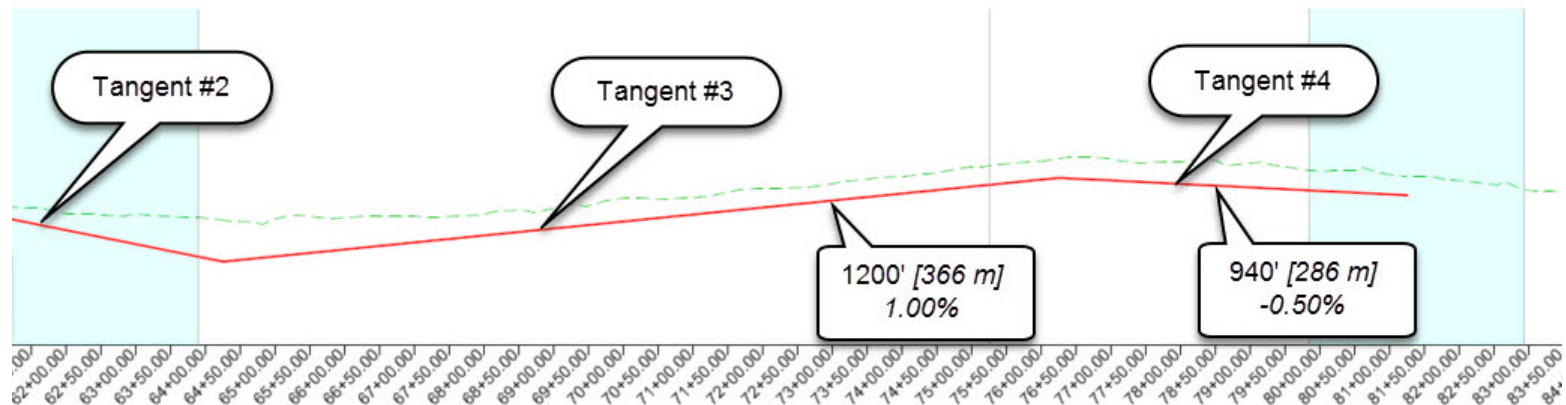

9. After the last tangent line is placed, **Right-click** to complete.

10. Press the **Esc** key to exit the command.

11. Review tangent lines.

    a. Use the **Element Selection** tool and **left-click** on profile tangent line #1 and notice the slope and length are displayed as well as the *Drag Handles* and *Text Manipulators*. Clicking on the slope, length, station or elevation will enable you to enter new values at any time. Adjusting the *Drag Handles* will trim/extend or move the line.
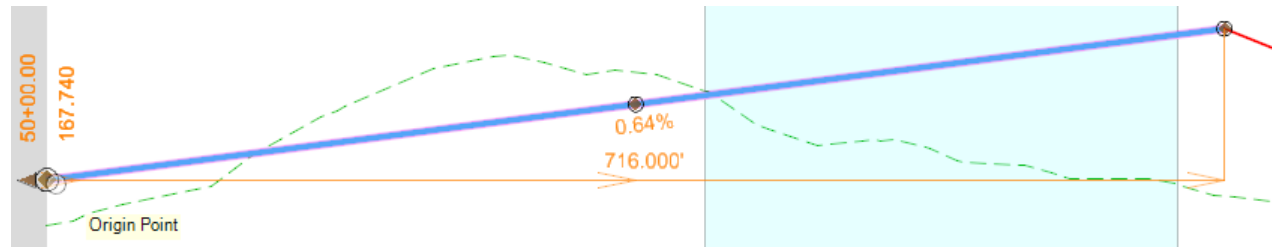
    b. **Right-click** to de-select the line or **left-click** anywhere in the view.

12. Review the remaining tangent lines using the procedures described in the above step.

13. **Click** the **Fit View** icon again in *View 4* to re-center the graphics.

Define the Vertical Curves

14. Define a **300'** *[91' m]* vertical curve between tangent lines #1 and #2.

    a. Select **Geometry > Vertical > Curves > Profile Curve Between Elements > Parabola Between Elements**

    b. Following the heads up prompts, **select** *tangent line #1* and when prompted **select** *tangent line #2*.

    (Be sure to keep your cursor below the tangent lines to ensure a crest curve will be created).

    c. Following the heads up prompts, in the *Length* field key in **300** *[91]* and press **Enter** to lock the value.

    d. **Left-click** to accept and move to the next prompt.

    e. Set the *Trim/Extend* option to **Both** and **left-click** to complete the command.

    A **300'** *[91' m]* vertical curve is now placed between tangent lines #1 and #2.

15. Define a vertical curve with a K value of **171.00** *[52]* between tangents #2 and #3.

The **Geometry > Vertical > Curves > Profile Curve Between Elements > Parabola Between Elements** tool should still be active, if not, re-select it.

a. Following the heads up prompts, **select** *tangent line #2* and when prompted **select** *tangent line #3*.

b. Following the heads up prompts, press the **Left Arrow** key to toggle to *Vertical Curve Parameter.*

c. Key in **171.00** *[52]* in the *Vertical Curve Parameter* field and press **Enter** to lock the value.

d. **Left-click** to accept and move to the next prompt.

e. Set the *Trim/Extend* option to **Both** and **left-click** to complete the command.

A vertical curve with a K value of **171.00** *[52]* is now placed between tangent lines #2 and #3.

16. **Repeat** step 14 and create a **400'** *[122 m]* vertical curve between tangent lines #3 and #4.

The completed vertical geometry elements should look like the image below.
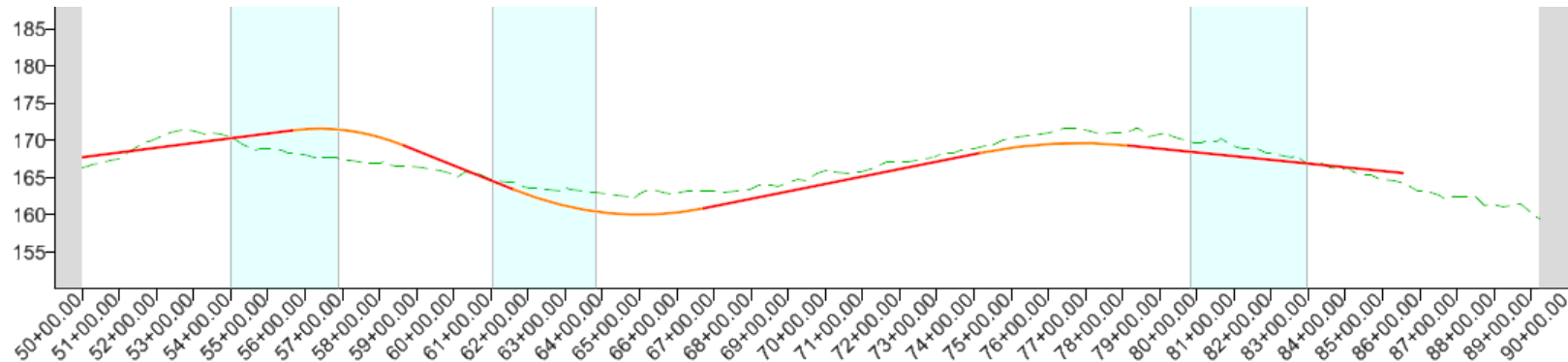
17. Modify vertical curve #1 length to be **400'** *[122]*

a. **Select** vertical curve #1, notice the curve length **300** *[91]* is displayed as well as the K value.

b. **Left-click** on the curve length value, enter **400** *[122]* in the edit field and press **Enter**.

The vertical curve updates and displays the new curve length and K value.
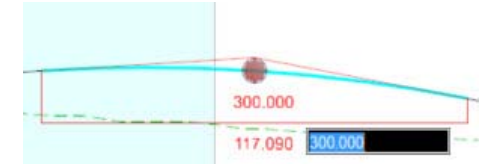
18. Group the *London Rd.* vertical geometry elements into a single complex element to create the vertical alignment.

a. **Select** the **Geometry > Vertical > Complex Geometry > Profile Complex by Elements** tool.

b. In the dialog box, set the following parameters:

- *Method:* **Automatic**

- *Maximum Gap:* **0.100** *[0.01]*

- *Name:* **LondonRd**

c. Following the heads up prompts,

- *Locate First Element:* **Select** tangent line #1 near the beginning and then **left-click** to accept it

- *Accept Complex:* **Left-click** to accept and create the complex profile element

d. Select the vertical (profile) alignment and note that all the elements are now a complex profile.
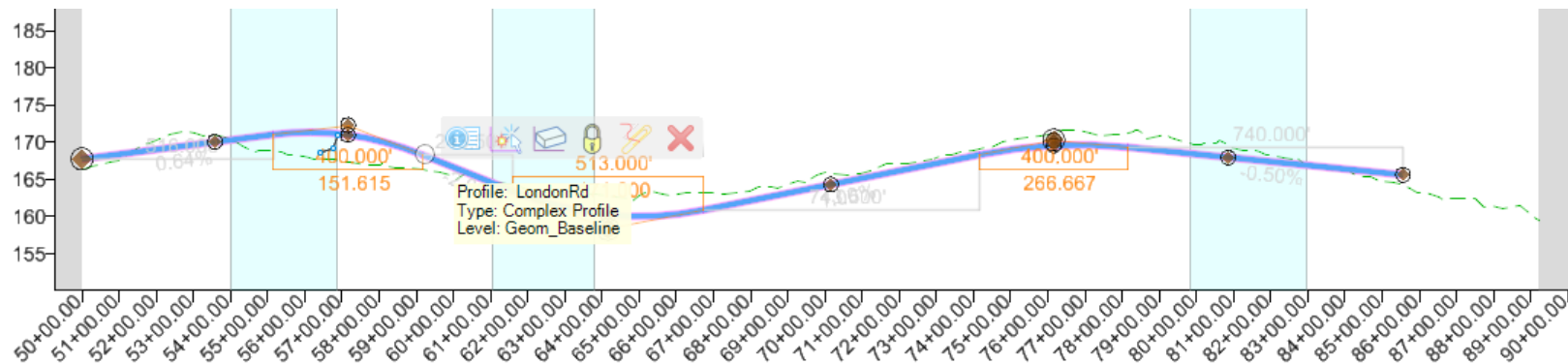
19. Set the newly designed profile as the active profile.

a. **Select** the **Element Selection** tool.

b. **Select** the complex profile element and **hover** your cursor over it until the context sensitive menu appears.
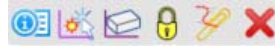
c. **Select** the **Set As Active Profile** tool.

The newly designed vertical alignment will now be the active vertical alignment associated with the horizontal alignment. A relationship now exists between the horizontal and vertical geometry. Be aware that deleting the horizontal geometry or dropping the horizontal geometry will impact the vertical geometry.

NOTE: Whenever you set the active profile a 3D alignment feature will automatically be displayed in 3D.

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Create the Vertical Geometry Report and View the Vertical Alignment in 3D

In this section, you will learn how to create a vertical geometry report and also how to view the vertical alignment in 3D.

1. **Select** the **Element Selection** tool.

2. **Select** the complex profile element and **hover** your cursor over it until the context sensitive menu appears.

3. **Select** the **Profile Report** tool.

4. **Review** the Vertical Alignment report and adjust the report formatting as needed using Tools > Format Options from the report dialog menu bar.

5. **Close** the report window and **close** the profile window, *View 4*.

   Review the vertical alignment in the 3D view.

6. **Press** the **F9** key to switch the view windows to display the 2D and 3D views.

7. Alternatively, you can Right-click in *View 1* and hold down the right mouse button to access special view control tools.

   a. **Select** *View Control > 2 Views Plan/3D*.
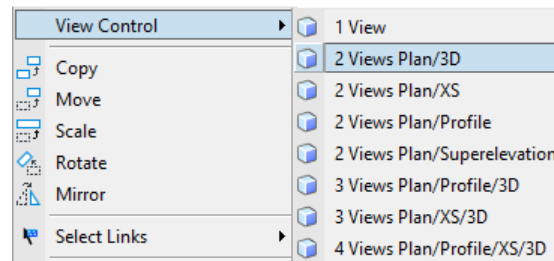
8. **Click** the *Fit View* icon in *View 2.*

   Notice a 3D element is displayed in the 3D view. This is the newly created vertical alignment shown in 3D.

Summary

In this course you have learned how to attach an existing terrain model and aerial imagery to your design file as well as define 2D and 3D views. You have also learned how to create, edit, annotate and review geometric elements, and how to create horizontal and vertical alignments for London Rd. using the geometry tools.