Creating & Editing Centerline Geometry

This course is for the **2021 Release 1** *version of:*

OpenRoads Designer CONNECT Edition

OpenRail Designer CONNECT Edition

About this 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 on the *LEARNserver* and through *CONNECT Advisor*.

- This PDF file includes bookmarks providing an overview of the document. Click on a 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: *12.0' [3.4m]*.

- This course workbook uses the *Training and Examples* WorkSpace and the *Training-Imperial* or *Training-Metric* WorkSet 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 to represent pressing the right mouse button. 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.

Bentley Institute

Course Level: **Intermediate**

OpenRoads Designer Geometry Overview

OpenRoads Designer Geometry is 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.
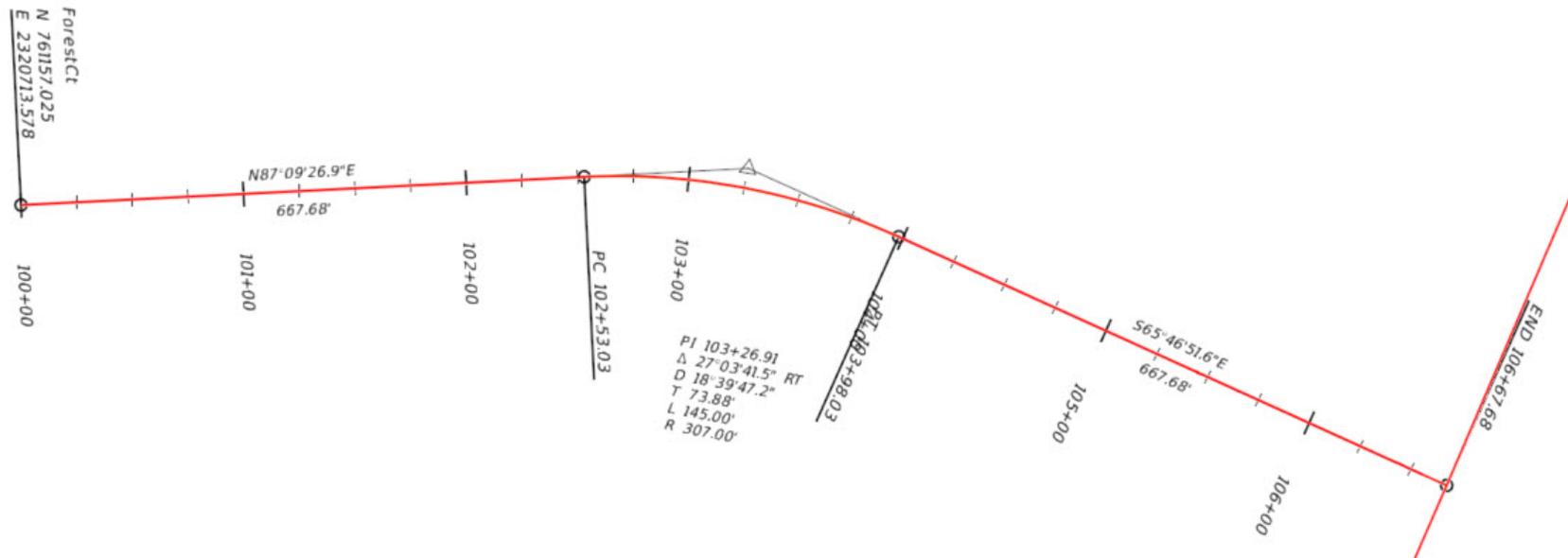
Course Overview

In this course, you will learn how to create and edit horizontal and vertical geometry using various tools and techniques. You will be defining the horizontal and vertical geometry for River Rd. You will also learn how to make changes to the River Rd. geometry and how to make changes to the existing geometry for Mountain Highway and Pike Rd.

This course builds upon the skills taught in the **QuickStart for Geometry - Road** course. Please complete that course before taking this course.
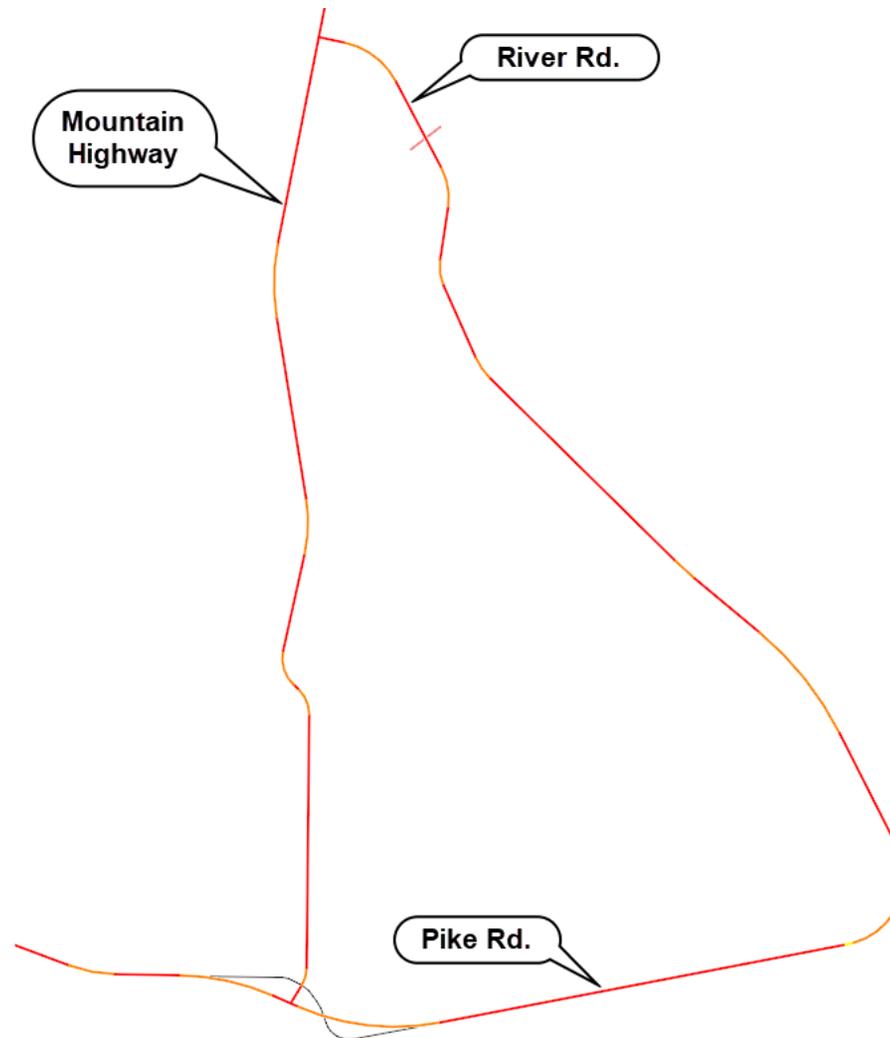
Exercise 1: Creating Horizontal Geometry

Exercise Description

This section contains exercises teaching how to create centerline geometry lines and arcs. In the process, you will learn how to use Civil AccuDraw and snaps to create precision geometry.

Skills Taught

- Civil AccuDraw
- Creating horizontal geometry lines
- Creating horizontal geometry arcs
- Creating complex (alignment/chain) horizontal geometry

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Open Existing Geometry File

In this section you will open a file that contains existing geometry. The file contains two existing alignments: Mountain Highway which runs south to north and Pike Rd. which runs west to east. There are also other existing geometric elements you will use as you progress through this course.

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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. Open an existing design file.

   a. Select **Browse**.

   b. Browse to *C:\Bentley Training\Creating & Editing Centerline Geometry* or other folder where you unzipped the dataset files.

   c. Select the file **Geometry.dgn** *[Metric-Geometry.dgn]* and click **Open**.
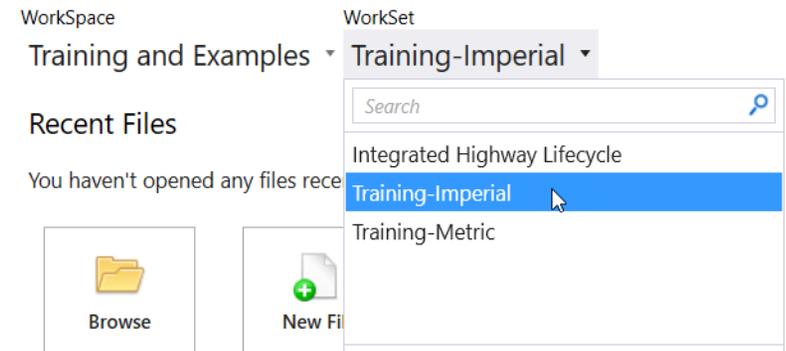
Note: If you get a message stating "Incompatible Civil Data", this is because the training files are "aligned" to OpenSite Designer. Clicking *Yes* will align the file to the software you are using (OpenRoads Designer or OpenRail Designer). This will have zero impact for the training courses. However, note that in production, upgrading the file will make the file read-only in OpenSite Designer. Full information is available at *Bentley Communities - Product Realignment*

Create Geometry using Civil AccuDraw

You will create a new alignment that starts near the north end of the Mountain Highway geometry and connects with the existing alignment (red dashed line). The new alignment intersects Mountain Highway at 411+00 *[12+527].*

---

1. Open the **Feature Definition Toolbar**

   a. Select **Geometry > General Tools > Standards > Feature Definition Toolbar**

   b. Set the *Active Feature* to **Alignment > Geom_Baseline**

2. Enable **Use Active Feature Definition.** This will force all geometry to be created using the *Geom_Baseline* feature definition.

   a. Select the *Use Active Feature Definition* icon to enable the active feature definition *Geom_Baseline*.

3. **Zoom in** to the north end of the Mountain Highway geometry.

4. Set up Civil AccuDraw.

   a. To access *Civil AccuDraw*, Select **Geometry > General Tools > Civil Toggles > Civil AccuDraw**

   The *Civil AccuDraw* tool bar will appear.
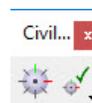
   b. Enable *Civil AccuDraw* by selecting the icon on the left side of the *Civil AccuDraw* tool bar.

The *Civil AccuDraw* toolbar will expand and give you access to the *Civil AccuDraw* tools.

Civil AccuDraw

Note: *Civil AccuDraw* is enabled when its icon has a dark background.

c. Select the **Station-Offset** *Civil AccuDraw* coordinate system. When the *Station-Offset* is toggled on and active, the icon background will be dark.

5. Create a line beginning at station **411+00** *[12+527]*.

a. Select **Geometry > Horizontal > Lines > Line Between Points**

The *Civil AccuDraw* heads-up display will appear attached to your cursor.

Station 0+00.0000
Offset 0.000'
Enter Start Point
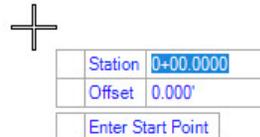
- The **TAB** key is used to move through the input fields in the heads-up display.

- The **ENTER** key is used to lock the values entered in the input fields.

- The **END** key is used to unlock values in the input fields.

b. Press **TAB** to make the *Offset* field in the heads-up display active.

c. Type **O** (origin) to instruct *Civil AccuDraw* to locate the origin element.

d. Select the **Mountain Highway** element.

As you move the cursor notice the two dashed lines indicating the offset and station of the cursor relative to the Mountain Highway element.

e. Type **411+00** *[12+527]* into the *Station* field and press **ENTER** to lock the value.

f. Type **0** (zero) into the *Offset* field of the heads-up display and press **ENTER** to lock the value.

The two dashed lines lock into the specified station and offset.

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g. **Data point** to accept the proposed solution for the first point of the line.

6. Creating the end of line at coordinates **X = 2836895** *[864686]* and **Y = 1286059** *[391991]*

a. On the *Civil AccuDraw* tool bar, select the **X-Y** *Civil AccuDraw* coordinate system.

The heads-up prompt changes to show X and Y fields instead of the station and offset fields.
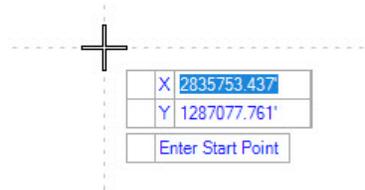
b. Type **2836895** *[864686]* into the *X* field and press **ENTER** to lock the value.

c. Type **1286059** *[391991]* into the *Y* field and press **ENTER** to lock the value.

d. **Data point** to accept the proposed solution and create the geometry line.

Your geometry should resemble the image on right side.
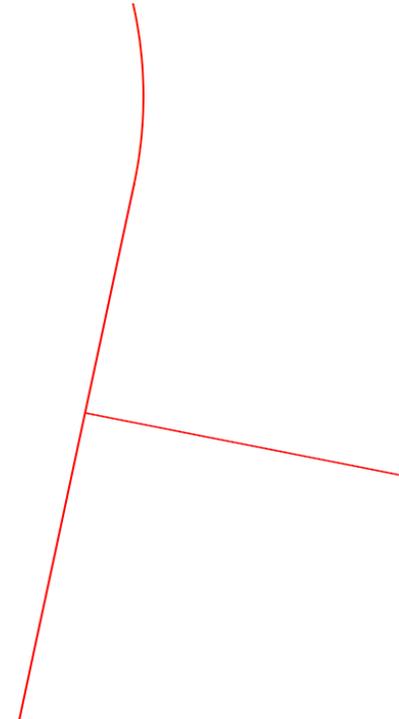
Add a Line By Distance and Direction

1. Disable *Civil AccuDraw*. The *Civil Accudraw* icon background will no longer appear dark when deactivated.

2. Continue with the **Line Between Points** command.

   a. **Snap** to the **east end of the line** just created to start a new geometry line.

   b. Type **5025** *[1532]* into the *Distance* field and press *Tab* to lock the value.

   c. Press the **right arrow key** to display the *Line Direction* field.

   d. Type **S 27:57:06 E** in the *Line Direction* field and press the *Tab* key to lock the value.

   e. **Data point** to accept the proposed solution and create the geometry line.

   Your geometry should resemble the following image.

Active   Inactive
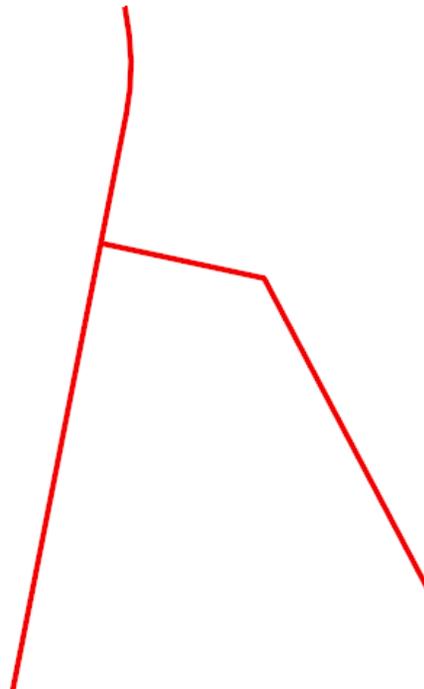
## Add an Arc Between Elements and Arc From an Element

1. Select **Geometry > Horizontal > Arcs > Arc Between Elements > Simple Arc**

2. Follow the heads-up prompts

    a. Select the First and Second elements.

    b. Enter a *Radius* of **2875** *[875]*.

    c. Set *Trim/Extend* to **Both**.

    Sometimes design criteria require you to float an arc from the end of a linear element instead of creating an arc between two existing linear elements. We will now create a curve that is constrained to the southern most line.
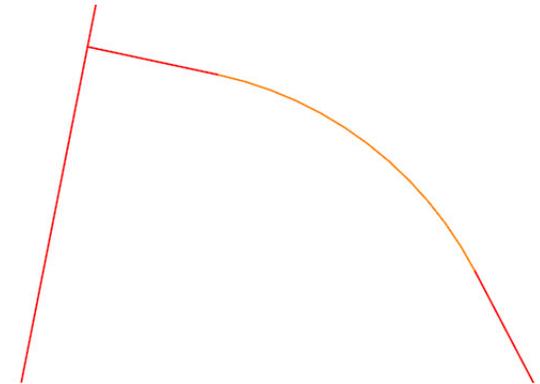
3. Select **Geometry > Horizontal > Arcs > Arc From Element > Simple Arc From Element**

4. Follow the heads-up prompts

    a. Select select the second (southern most) line.

    b. Snap to the end of the line as the Start Point.

    c. Enter a *Radius* of **2425** *[740]* and press the *Tab* key to lock the value.

    d. Position the cursor so the curve turns to the right (assuming stationing is from north to south).

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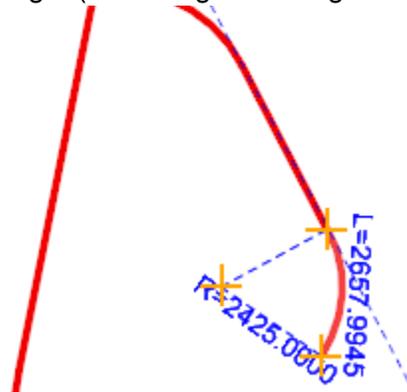
e. **Data point** to accept the radius and direction.

f. Enter a *Arc Length* of **1550** *[470]* and press the *Tab* key to lock the value.

g. **Data point** to accept the arc length.

h. Set *Trim/Extend* to **Back**.

i. **Data point** to create the curve.
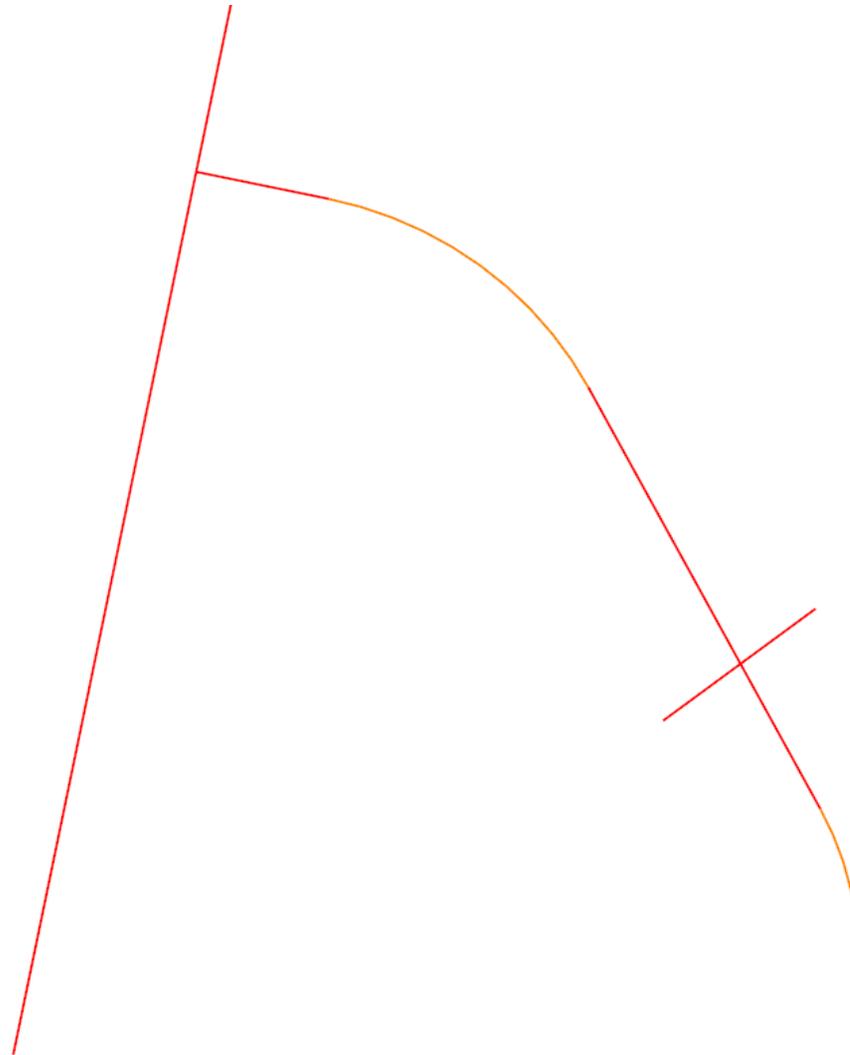
Add Remaining Lines and Arcs

1. Select **Geometry > Horizontal > Lines > Line From Element > Simple Line from Element**

2. Follow the heads-up prompts

   a. Select the arc you just placed.

   b. Snap to the end of the arc as the Start Point.

   c. Enter a *End Distance* of **2500** *[740]* and press the *Tab* key.

   d. **Data point** to accept the distance.

   e. Set *Trim/Extend* to **Back**.

   f. **Data point** to create the line.

3. Select **Geometry > Horizontal > Lines > Line Between Points**

4. **Snap** to the end of the previous line for the first point.

5. **Snap** to the end of the existing alignment (red dashed line) for the second point.

   Note: The red dashed geometry is existing geometry that we are connecting to.

6. Use the **Simple Arc** tool to place a **1650** *[500]* arc between the last two civil geometry lines (solid red graphics).

   Your geometry should resemble the image on the following page.

   Note: Later in the exercise, an arc between the solid red elements and red dashed elements will be added.
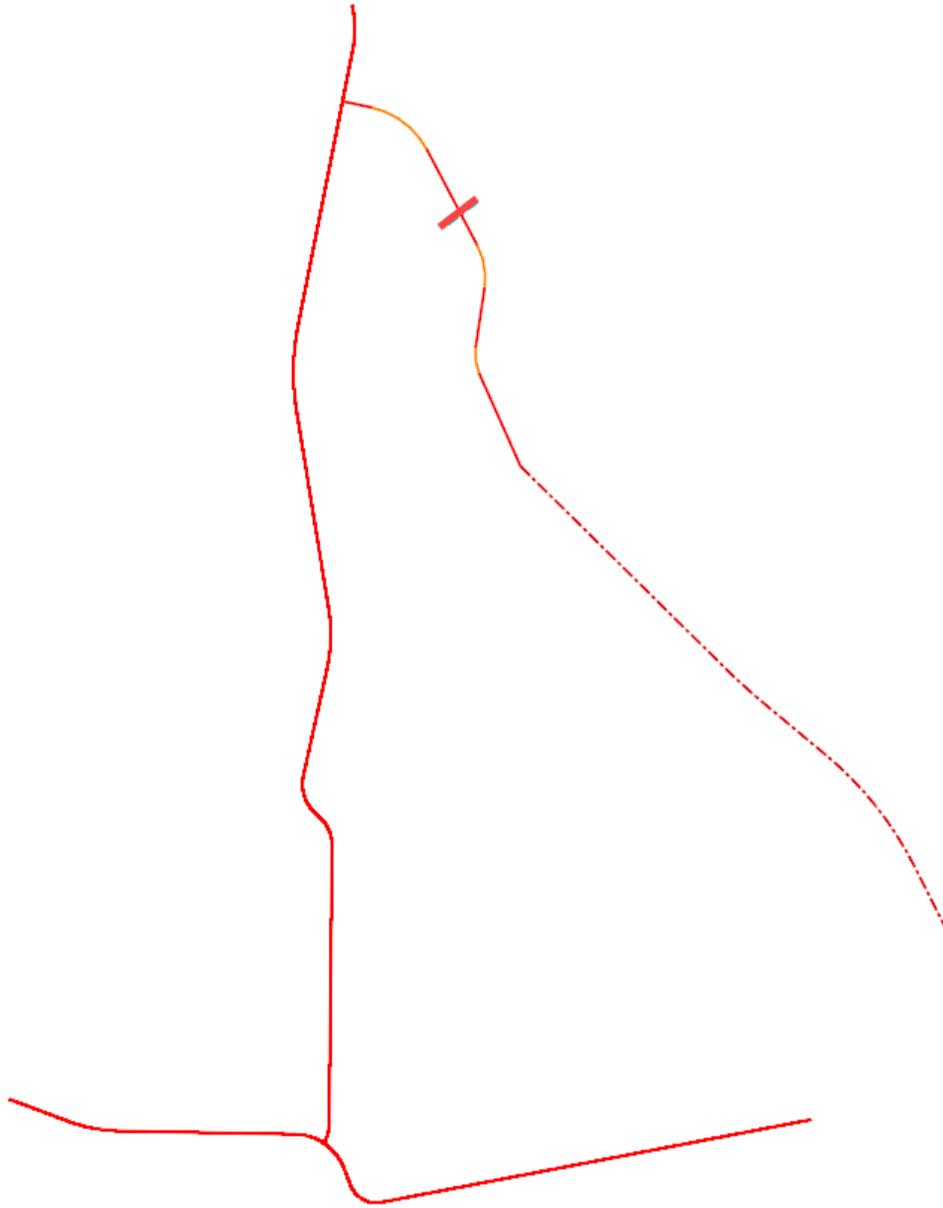
## Create Complex Geometry (Alignment)

1. Select **Geometry > Horizontal > Complex Geometry > Complex By Element**

2. On the dialog box, verify the *Method* is set to **Automatic** in the Create Complex window.

3. Enter **River_Road** in the *Name* field in the Create Complex window.

   Until now we have let the software name the geometry elements for us. We could have provided names for each element but it would not have been much value in this workflow where our goal is the complete complex alignment. Naming your final geometry elements is very important. The name will be the only way to identify the geometry.

4. Select the first line near where it intersects the Mountain Highway geometry.

   Be sure the direction arrow is pointed in the direction of the alignment before selecting the element.


```
Locate First Element

Line: RdCL4
Interval
Feature: Road_Centerline
No Active Profile
Level: Road_Centerline
```
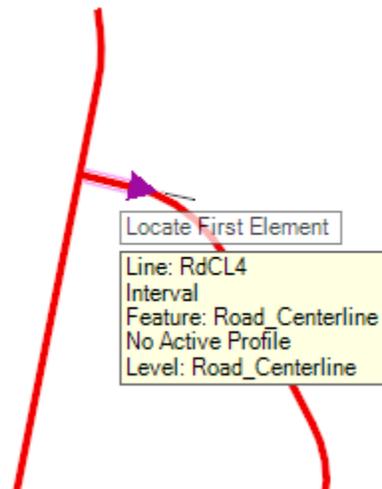
5. **Data point** to accept the complex alignment.

6. Add Starting Station.

    a. Select **Geometry > Horizontal > Modify > Start Station**

    b. Select the complex alignment just created.

    c. In the *Start Distance* field key-in **0.0** and press **ENTER** to lock the value.

    d. In the *Start Station* field key-in **100+00** *[1+000]* and press **ENTER** to lock the value.

    e. **Data point** to complete.

    f. Using the **Element Selection** tool, select the alignment and notice the begin station is now displayed as **100+00** *[1+000]*.

7. Review the Geometry Report.

    a. With the alignment still selected, hover your cursor over the alignment until the context menu appears.

    b. Select the Horizontal Geometry Report tool.

    The Bentley Civil Report Browser will appear displaying the Horizontal Alignment Report.

Horizontal Alignment Review Report

Report Created: Wednesday, July 25, 2018
Time: 10:17:41 AM

Project: Default
Description:
File Name: C:\Training\Creating Centerline Geometry\Geometry-Completed.dgn
Last Revised: 7/24/2018 16:47:10

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

Alignment Name: River_Rd
Alignment Description:
Alignment Style: Alignment\Geom_Baseline

		Station	Northing	Easting
Element: Linear				
POB	( )	100+00.000	1286544.993	2834597.619
PC	( )	110+04.411	1286337.118	2835580.284
Tangential Direction:		S78.056°E		
Tangential Length:		1004.411		

The formatting and precision values in the report can be adjusted by going to **Tools > Format Options**.

8. Adjust the Station formatting to be **ss+ss.ss** *[s+sss.ss]* and the Direction formatting to be Bearings **ddd^mm'ss.s"**

a. In the *Bentley Civil Report Browser* select **Tools > Format Options**.

b. Set the *Station Format* to **ss+ss.ss** *[s+sss.ss]*
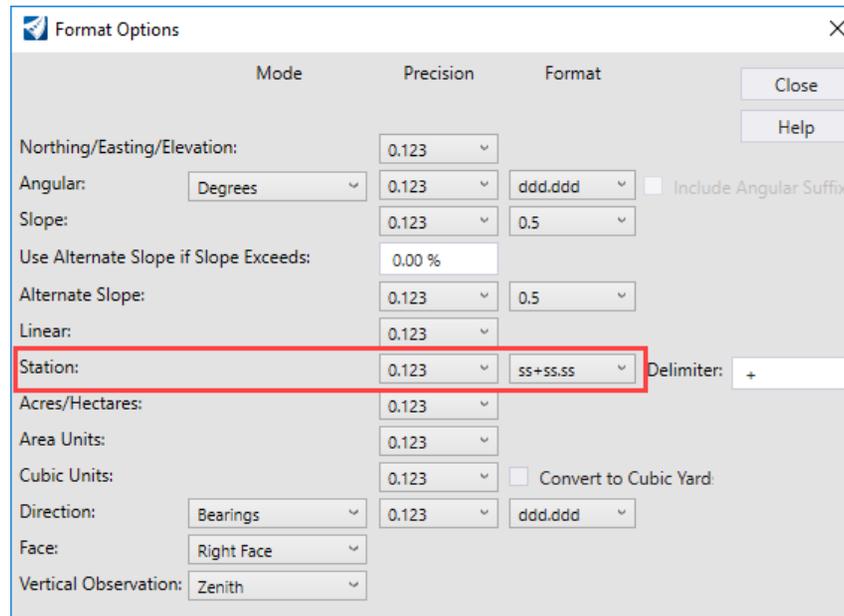
c. Set the *Direction Mode* to **Bearings** and the *Format* to be **ddd^mm'ss.s"**
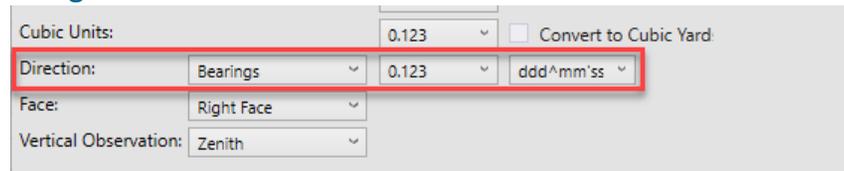
d. Close the *Format Options* window.

e. Review the horizontal alignment report and verify that the formatting has been applied and the start station of the alignment is **100+00.000** *[1+000.000].*

f. Close the *Bentley Civil Report Browser*.

Exercise 2: Editing Horizontal Geometry

Exercise Description

This section contains exercises teaching how the civil geometry captures "design intent" and how to edit geometric elements. You will also practice using Design Standards to evaluate the geometry and find areas which do not meet the standards.

Skills Taught

- Editing geometry elements

- Editing with the Table Editor

- Appending geometry elements

- Using Complex Redefine

- Verifying geometry layout with Design Standards

- Civil Message Center

- Annotating Geometry

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Geometry Editing Tools Overview

There are many tools available to edit geometric elements. Some of the editing tools are available in the **Geometry** ribbon tab and others are located in the **Drawing** ribbon tab. Below is a partial list of the tools that can be used:

The following commands are located in **OpenRoads Modeling > Geometry**:

- **Table Editor** - Use to edit alignment in tabular format. Can be used to add and delete PI's as well as add and remove curves.

- **Insert Fillet** - Use Insert Fillet tool if you need to insert a curve or curve combinations between tangents on previously create alignment.

- **Append Elements** - If you need to add additional elements to the beginning or end of alignment.

- **Complex Redefine** - Allows you to redefine geometry over a certain range, substituting in new horizontal geometry. It preserves all rules built off the original geometry (i.e. other geometry, superelevation, civil cells, etc.)

The following commands are located in the **OpenRoads Modeling > Drawing > Modify**:

- **Insert Vertex** - Use Insert Vertex to insert PI to horizontal alignment.

- **Delete Vertex** - Use Delete Vertex to remove PI's which can also remove horizontal curves.

- **Trim/Extend** - Use to trim or extend geometric elements.

- **Modify Element** - Use to modify elements by changing their shape.

- **Delete** - Use to delete elements.

- **Break Element** - Use to delete a portion of an element.

- **Drop Element** (Found under the **Drawing** workflow: **Home > Groups > Drop Element**) - Use this tool to un-complex the alignment and return it to the base elements. Take care when using this tool, when you drop a horizontal alignment any associated vertical alignment will be deleted.

Dynamic Text and Manipulators - Simple changes to horizontal geometry can be made via the dynamic text and drag handles for easy in place editing.

Properties - Element properties can also be used to change simple curve to more complex curve combinations as well as change distance and direction of elements and other properties.

We will not be able to cover all of these tools in this course but be aware of the various tools that are available to edit and modify geometry.

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Explore Design Intent and Edit Geometry

1. Select the **River Road** alignment and observe the manipulators and handlers.

   Notice the dynamic text, the manipulators (or handlers) and snap icons attached to the geometry. The dynamic text and snap icons are examples of the rules and relationships associated with the geometry and the overall *design intent.*

   Lets explore how *design intent* influenced the rest of the geometry.

2. Select **Set Mark** from the Quick Access toolbar at the top of the ribbon. Set Mark will mark this location in the file so the following steps can easily be undone back to this point.

3. Zoom in on the northern portion of the River Road geometry where we have ruled geometry with manipulators.
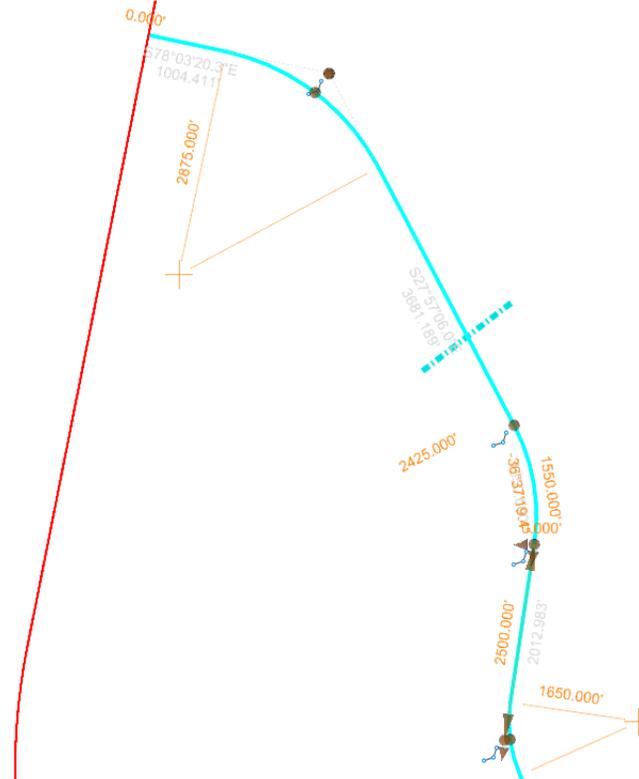
4. Observe the differences in the manipulators for each of the three curves.

   The first and third curves have radius value manipulators and handlers at the PI of the curves. The second curve (or middle curve) has a radius value manipulator but no handler at the PI of the curve. Instead, this curve has arc length and delta angle manipulators.

5. Change the *Radius* for the first (northern most) curve to **1000** *[300]*.

   The curve changes to the new radius but no other changes are made to the geometry.

6. Change the *Radius* for the second curve to **1000** *[300]*.

   The curve changes to the new radius as expected but the geometry also changed significantly. This is not an error, the software maintained our design intent to have a 1550 *[470]* arc length. The only way to maintain this arc length is to adjust the curve's exit bearing.

   Change the *Arc Length* for the second curve to **500** *[150]* and see what happens.

7. Observe the differences of the dynamic text along the tangent elements.

   a. Select the alignment. Notice the distances and bearings are shown in gray, this indicates they cannot be directly edited in the view.

      TIP: To edit the distances and bearings you need to modify the base elements (or "*gap*" elements) from which the alignment was created. This can be done by selecting the alignment and then hover and right click on the element to be edited.

8. Edit the bearing of the first tangent element in the alignment.

   a. Hover your cursor over the first tangent element until the alignment highlights.

   b. Right-click and select the tangent element. The distance and bearing will now be available to edit.

   c. Change the bearing to **N 70:00:00 E**, note the alignment adjusts. Also, note the new distance value being displayed.

9. Select **Edit > Undo Other > To Mark** to undo the previous steps back to the mark set in step 2.

   TIP: If a mark was not set in step 2, the **Undo** tool can be used several times to return all of the arcs to their original configuration.

10. Select **Fit View** to view the entire alignment.

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Notes about individual geometric elements:

When a geometry feature is trimmed or extended, the portion(s) of the modified element which is visible and is being displayed using the Feature Definition settings is called the "*Interval*".

The portion(s) of the original geometry which is not visible is called the "*Gap*". This is the representation of the location of original element before modification. The gap will be displayed when you hover over the original element.

An interval element is ruled to the original geometry (or "*gap*" element), and this dependency can be viewed in the *OpenRoads Model* tab in the *Explorer*.

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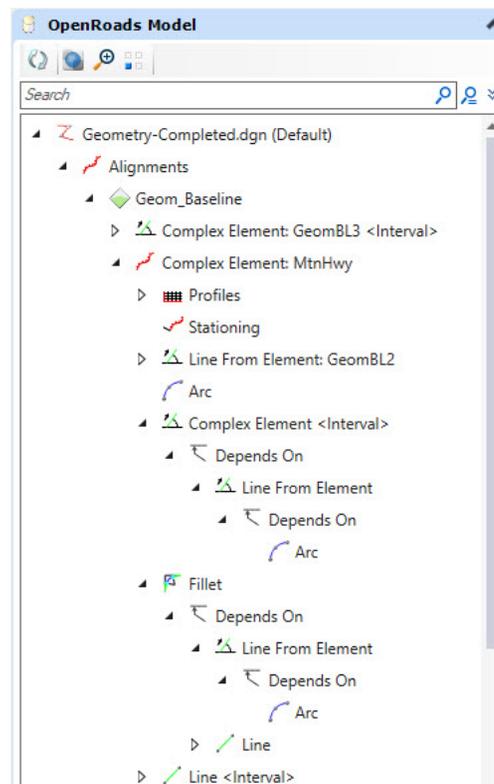
Edit Geometry with the Table Editor

1. Insert a new curve using the Table Editor.

   a. Select **Geometry > Common Tools > Table Editor**

   b. At the *Locate Alignment* prompt, select the **River_Rd** alignment.

   The alignment table editor will appear. This tool will allow you to make modifications to your alignment in a tabular format. The Alignment Table Editor is a great tool to use for making quick changes to your alignment.

Alignment Table Editor: River_Road

Station	Back Tangent Length		Back Bearing	Back Spiral Length		Northing		Easting	Radius	Arc Length	Ahead Spiral Length		Ahead Bearing	Ahead Tangent Length
100+00.0000		☐			☐	1286544.993	☐	2834597.619				☐	S78°03'20.3"E	1004.411
122+61.4746	1004.411	☐	N78°03'20.3"W	0.000	☐	1286059.000	☐	2836895.000	2875.000	2514.127	0.000	☐	S27°57'06.0"E	3681.189
179+74.7270	3681.189	☐	N27°57'06.0"W	0.000	☐	1280911.308	☐	2839626.509	2425.000	1550.000	0.000	☐	S08°40'13.4"W	2012.983
212+36.2801	2012.983	☐	N08°40'13.4"E	0.000	☐	1277646.540	☐	2839128.656	1650.000	947.141	0.000	☐	S24°13'07.8"E	3472.856
251+82.7064	3472.856	☐	N24°13'07.8"W	0.000	☐	1274035.193	☐	2840753.086	0.000	0.000	0.000	☐	S45°37'20.6"E	10299.400
359+86.2219	10299.400	☐	N45°37'20.6"W	0.000	☐	1266479.178	☐	2848475.067	12000.000	1008.230	0.000	☐	S50°26'10.8"E	3186.719
421+29.1215	3186.719	☐	N50°26'10.8"W	0.000	☐	1262544.253	☐	2853237.720	12000.000	4904.132	0.000	☐	S27°01'15.0"E	2313.092
468+94.2788	2313.092	☐	N27°01'15.0"W		☐	1258268.334	☐	2855418.367				☐		

Report   Apply

Tip: The table editor can also be used to Insert and Delete PI's. Just select a row and right click to *Insert Before*, *Insert After* or *Delete*.

Alignment Table Editor: River_Road

Station	Back Tangent Length		Back Bearing	Back Spiral Length		Northing		Easting	Radius	Arc Length	Ahead Spiral Length		Ahead Bearing	Ahead Tangent Length
100+00.0000		☐			☐	1286544.993	☐	2834597.619				☐	S78°03'20.3"E	1004.411
122+61.4746	1004.411	☐	N78°03'20.3"W	0.000	☐	1286059.000	☐	2836895.000	2875.000	2514.127	0.000	☐	S27°57'06.0"E	3681.189
179+74.7270	3681.189	■	N27°57'06.0"W	0.000	■	1280911.308	■	2839626.509	2425.000	1550.000	0.000	■	S08°40'13.4"W	2012.983
Insert Before		☐	N08°40'13.4"E	0.000	☐	1277646.540	☐	2839128.656	1650.000	947.141	0.000	☐	S24°13'07.8"E	3472.856
Insert After		☐	N24°13'07.8"W	0.000	☐	1274035.193	☐	2840753.086	0.000	0.000	0.000	☐	S45°37'20.6"E	10299.400
Delete		☐	N45°37'20.6"W	0.000	☐	1266479.178	☐	2848475.067	12000.000	1008.230	0.000	☐	S50°26'10.8"E	3186.719
421+29.1215	3186.719	☐	N50°26'10.8"W	0.000	☐	1262544.253	☐	2853237.720	12000.000	4904.132	0.000	☐	S27°01'15.0"E	2313.092

c. **Click on the fifth row in the first column** to locate the fifth PI point in the alignment. Notice that the fifth tangent element of the alignment highlights in the plan view. Also, notice the Radius is set to 0.0 indicating there is currently no curve at this location.

Alignment Table Editor: River_Road

Station	Back Tangent Length		Back Bearing	Back Spiral Length		Northing		Easting	Radius	Arc Length	Ahead Spiral Length		Ahead Bearing	Ahead Tangent Length
100+00.0000		☐			☐	1286544.993	☐	2834597.619				☐	S78°03'20.3"E	1004.411
122+61.4746	1004.411	☐	N78°03'20.3"W	0.000	☐	1286059.000	☐	2836895.000	2875.000	2514.127	0.000	☐	S27°57'06.0"E	3681.189
179+74.7270	3681.189	☐	N27°57'06.0"W	0.000	☐	1280911.308	☐	2839626.509	2425.000	1550.000	0.000	☐	S08°40'13.4"W	2012.983
212+36.2801	2012.983	☐	N08°40'13.4"E	0.000	☐	1277646.540	☐	2839128.656	1650.000	947.141	0.000	☐	S24°13'07.8"E	3472.856
▶ 251+82.7064	3472.856	☐	N24°13'07.8"W	0.000	☐	1274035.193	☐	2840753.086	0.000	0.000	0.000	☐	S45°37'20.6"E	10299.400
359+86.2219	10299.400	☐	N45°37'20.6"W	0.000	☐	1266479.178	☐	2848475.067	12000.000	1008.230	0.000	☐	S50°26'10.8"E	3186.719
421+29.1215	3186.719	☐	N50°26'10.8"W	0.000	☐	1262544.253	☐	2853237.720	12000.000	4904.132	0.000	☐	S27°01'15.0"E	2313.092
468+94.2788	2313.092	☐	N27°01'15.0"W			☐	1258268.334	☐	2855418.367				☐	

Report   Apply

d. Click in the *Radius* field and key-in **2580** *[875].*

Alignment Table Editor: River_Road

Station	Back Tangent Length		Back Bearing	Back Spiral Length		Northing		Easting	Radius	Arc Length	Ahead Spiral Length		Ahead Bearing	Ahead Tangent Length
100+00.0000		☐			☐	1286544.993	☐	2834597.619				☐	S78°03'20.3"E	1004.411
122+61.4746	1004.411	☐	N78°03'20.3"W	0.000	☐	1286059.000	☐	2836895.000	2875.000	2514.127	0.000	☐	S27°57'06.0"E	3681.189
179+74.7270	3681.189	☐	N27°57'06.0"W	0.000	☐	1280911.308	☐	2839626.509	2425.000	1550.000	0.000	☐	S08°40'13.4"W	2012.983
212+36.2801	2012.983	☐	N08°40'13.4"E	0.000	☐	1277646.540	☐	2839128.656	1650.000	947.141	0.000	☐	S24°13'07.8"E	2985.277
▶ 251+77.0231	2985.277	☐	N24°13'07.8"W	0.000	☐	1274035.193	☐	2840753.086	2580.000	963.791	0.000	☐	S45°37'20.6"E	9811.821
359+74.8553	9811.821	☐	N45°37'20.6"W	0.000	☐	1266479.178	☐	2848475.067	12000.000	1008.230	0.000	☐	S50°26'10.8"E	3186.719
421+17.7548	3186.719	☐	N50°26'10.8"W	0.000	☐	1262544.253	☐	2853237.720	12000.000	4904.132	0.000	☐	S27°01'15.0"E	2313.092
468+94.2788	2313.092	☐	N27°01'15.0"W			☐	1258268.334	☐	2855418.367				☐	

Report   Apply

e. Click **Apply** and close the Alignment Table Editor dialog.

Append the Alignment by Creating Additional Geometry

Now that you have learned how to insert a curve into the alignment. Now you will learn how to append to the alignment by adding a spiral-curve-spiral to the end of the alignment.

---

1. **Zoom in** near the end of the **River Rd.** alignment and the end of **Pike Rd.**

2. Append the end of the alignment by adding a spiral-curve-spiral to connect to the Pike Road alignment.

   a. Select **Geometry > Horizontal > Arcs > Arc Between Elements > Spiral Arc Spiral**

   b. Following the heads-up prompt:

      - *Locate the First Element:* Select the **River Rd.** base element near its end. Use *Right-click* to toggle between selecting the alignment and base element.

      - *Locate Second Element:* Select the **Pike Rd.** base element near its end. Use *Right-click* to toggle between selecting the alignment and base element.

      Note: It's important to select the base elements of the alignment and not the actual complex alignment when adding additional geometry.

      - *Radius:* **2580** *[875]* press **<Enter>** or **<Tab>** to lock the value, and left-click to accept.

      - Set *Trim/Extend:* **None**.

      - Keep the cursor at the location you can see in the image and **left-click** to accept so that you can see the arc.

   c. Select **Element Selection** tool and **click** on end of the River Rd.

   d. Click on the Drag handler and connect it to the incoming point of the Spiral.
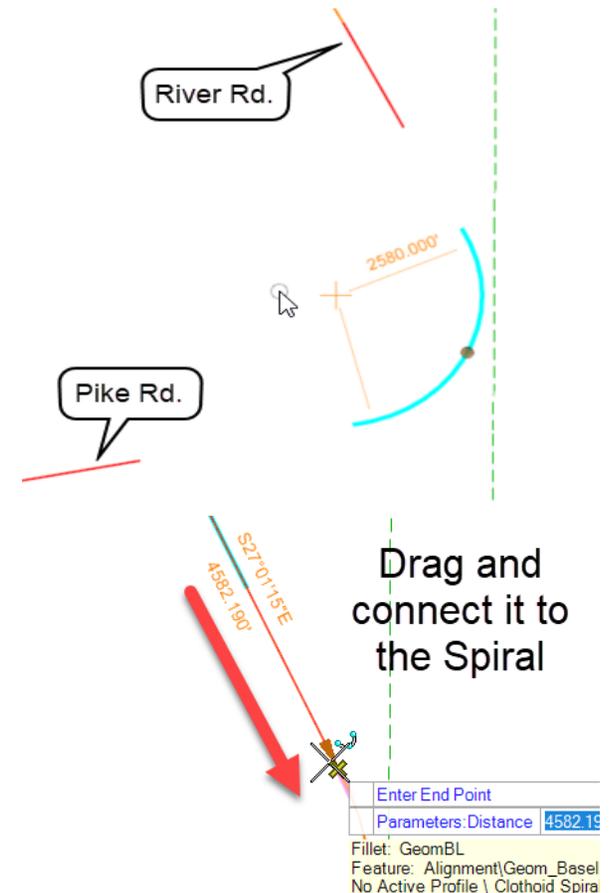
e. Select **Geometry > Horizontal > Lines > Line From Element > Simple Line From Element**

f. Follow the heads-up prompts and left click to accept:

- *Locate Element:* Select outgoing spiral

- *Enter Start Point:* Snap to the end point of the outgoing spiral

- *Enter End Point Distance:* Snap to the end point of the **Pike Rd.** alignment

- *Trim/Extend:* None

Tip: Pay attention to the *Persist Snaps* icon on the Feature Definition tool bar. When this is enabled, snap rules are created when snapping to geometric elements. If you don't want snap rules created be sure to toggle off the *Persist Snaps* icon.

Connect with
Simple Line from Element
tool
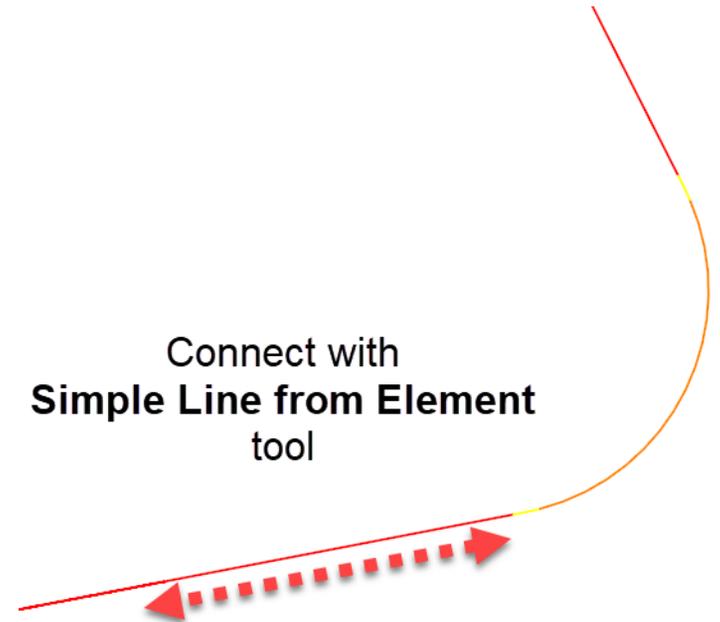
3. Add the newly created geometry to the River Rd. alignment.

a. Select **Geometry > Horizontal > Modify > Append Element**

b. Follow the heads-up prompts:

- *Locate Complex Element:* Select the **River Rd.** alignment

- *Locate Element to Add/Insert:* Select the spiral curve spiral element

- *Locate Next Element to Add/Insert:* Select the line connecting **Pike Rd.** to the spiral curve spiral element

c. **Right click** to complete.

The geometry has now been added to the River Rd. alignment.

4. Select the **River Rd.** alignment to verify the elements have been added to the alignment. When selected, the alignment should now include the additional geometry you created.

5. Annotate the River Rd. alignment.

   a. Select **Drawing Production > Annotations > Element Annotation > Annotate Element**

   b. Select the **River Rd.** alignment.

   c. Reset to complete.

   Note: It may take a few seconds for the alignment annotation to complete.
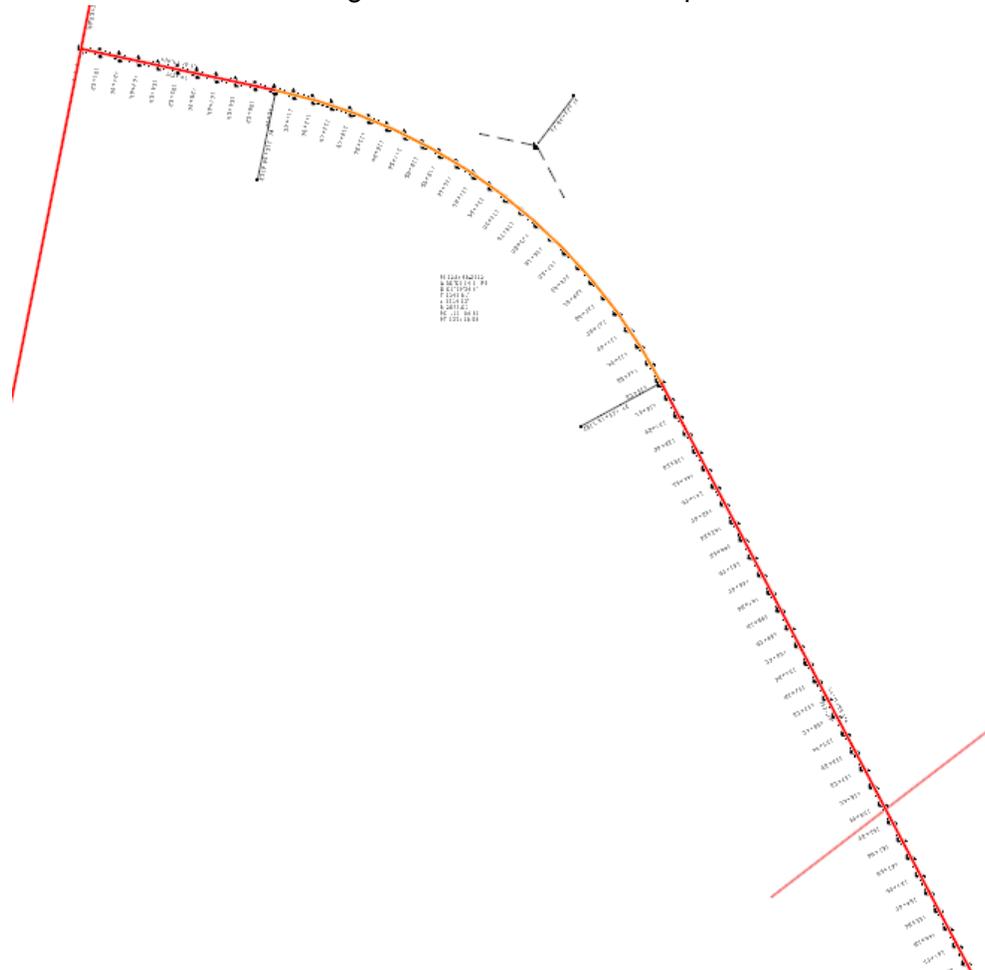
Using Complex Redefine

Sometimes it is necessary to replace (or substitute) a portion of your alignment with a new set of geometric elements. Using the Complex Redefine tool allows you to redefine geometry over a certain range, substituting in new horizontal geometry. It preserves all rules built off the original geometry. In this section you will learn how to re-define a section of the geometry along Pike Rd. using the Complex Redefine tool.

---

1. **Zoom in** near the area where **MtnHwy** intersects **Pike Rd.**

2. Using the *Level Display* tool, **turn ON** the level named **Geom_Secondary**.

   Notice there is an alternate section of geometry connected to Pike Rd. We are going to re-define the Pike Rd. alignment by adding this section of geometry.
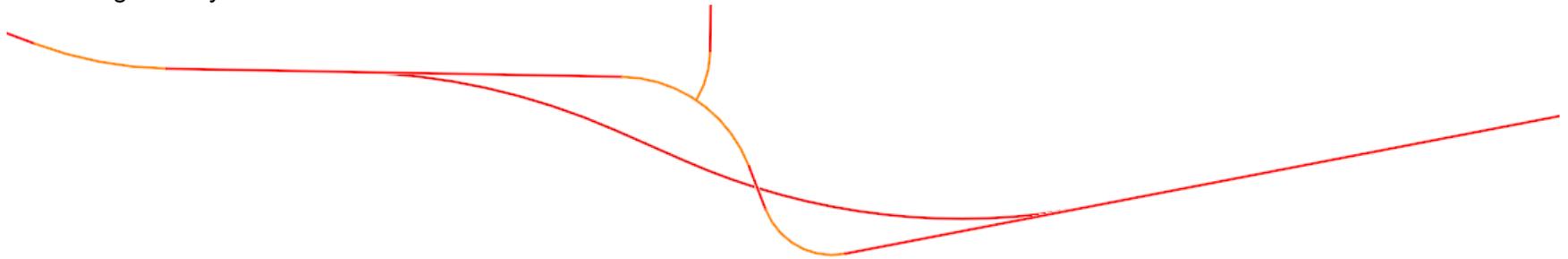
3. Open **View 4** view to see the profile of Pike Rd. Before we make changes to the horizontal its very important to understand the profile is ruled and associated to the horizontal. When the horizontal alignment changes the profile will be updated.
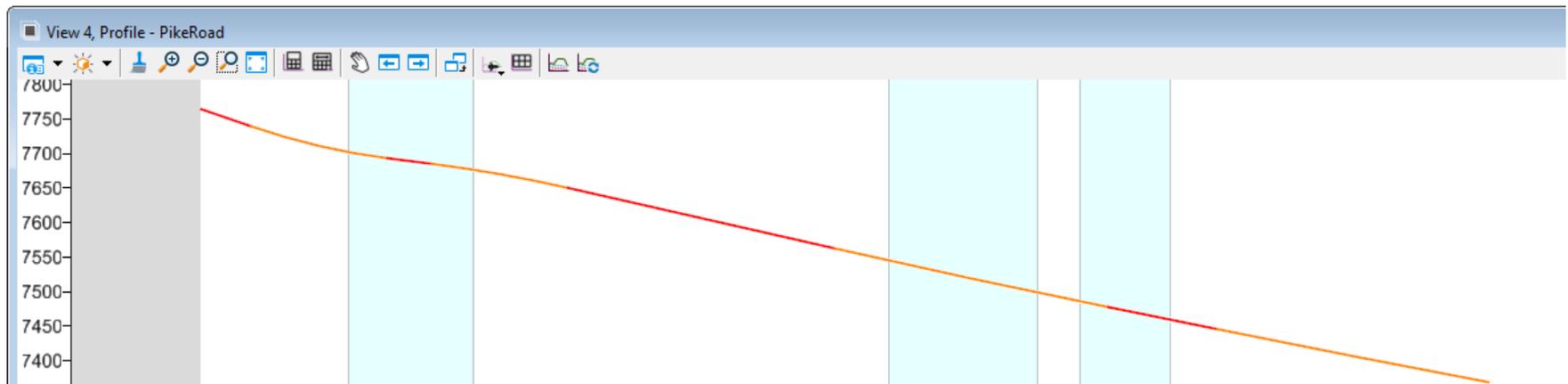
4. Select **Geometry > Common Tools > Complex Redefine**

   a. Follow the heads-up prompts:

      ■ *Locate Complex Element:* Select the Pike Rd. alignment

      ■ *Locate Element Redefining Complex:* Select the alternate section of geometry for Pike Rd.

The Pike Rd. alignment will be updated with the new section of geometry. The old geometric elements still exist but they are no longer part of the Pike Rd. alignment. Also, notice that the profile gets updated and the overall length is adjusted.
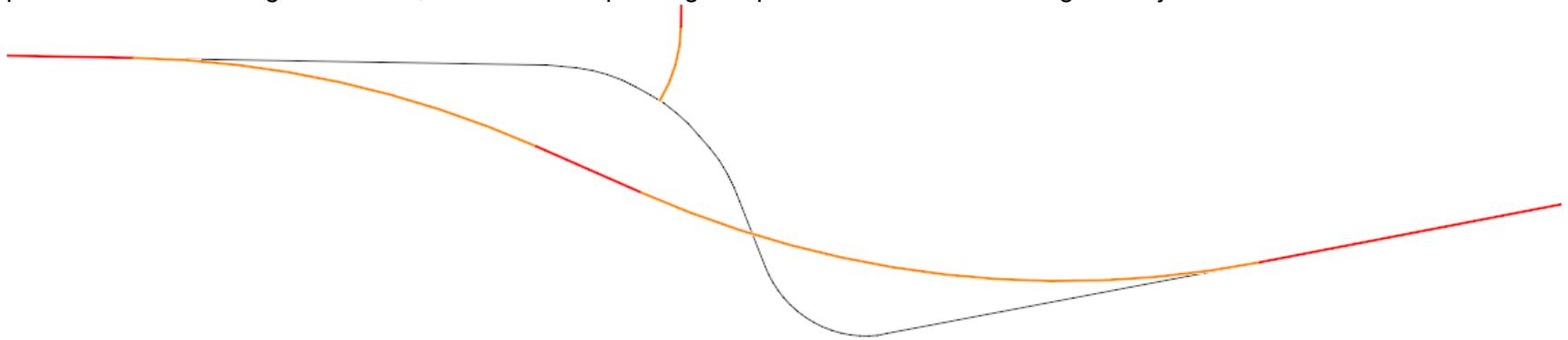
Now that Pike Rd. has been updated we need to extend the Mountain Highway alignment to intersect the new geometry of Pike Rd.

5. Extend Mountain Highway to Pike Rd.

   a. Select **Geometry > Horizontal > Lines > Line From Element > Simple Line From Element**

      ■ *Locate Element:* Select **MtnHwy**

      ■ *Enter Start Point:* Snap the end point of the MtnHwy alignment

      ■ *End Distance:* **-500** *[-150]* (You need to key in a negative value to force the line to be created in the opposite direction).

      ■ *Trim/Extend:* None
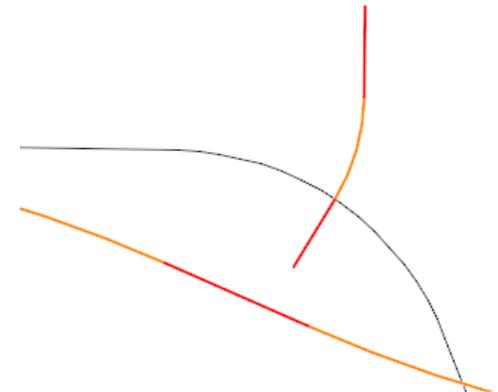
b. Select **Drawing > Modify > Trim To Element**

- *Identify elements to Modify:* Select the line you just created in the previous step.

- *Identify cutting element/edge:* Select the **Pike Rd.** alignment

At this point all you did was create a single line constrained between Pike Rd. and the ending curve of the Mountain Highway alignment. This line still needs to be added to the alignment of Mountain Highway. We will now add this line to the alignment using the *Append Element* command.
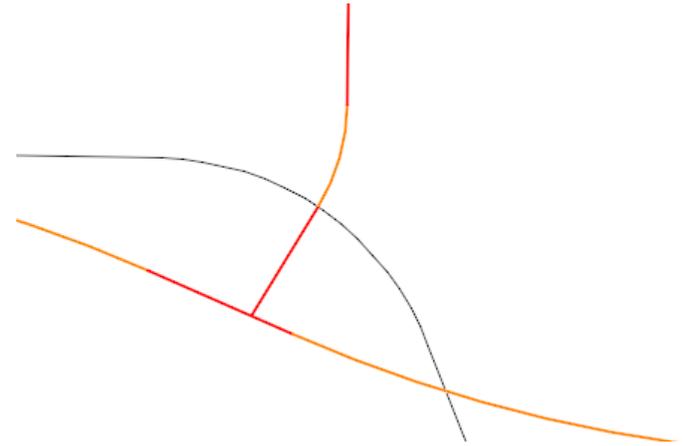
6. Add the newly created line to the Mountain Highway alignment.

a. Select **Geometry > Horizontal > Modify > Append Element**

b. Follow the heads-up prompts:

- *Locate Complex Element:* Select the **MtnHwy** alignment

- *Locate Element to Add/Insert:* Select the line connecting Mountain Highway to Pike Rd.

c. **Right-click** to complete.

The geometry has now been added to the Mountain Highway alignment.

d. Select the **MtnHwy** alignment and verify that the line you just added is now part of the alignment.

e. **Right-click** to de-select the alignment.

f. Close *View 4*.

7. Update the Mountain Highway corridor. Since the geometry has changed you need to open the corridor so that it updates to follow the new geometry.

a. Open **Corridor-MtnHwy.dgn** *[Metric - Corridor-MtnHwy.dgn]*. Notice the corridor will re-process and update.

b. Re-open **Geometry.dgn** *[Metric - Geometry.dgn]*.

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Design Standards

Design standards should be used throughout the design of your project. It ensures that you are meeting minimal standards, generally based on design speed. They can also be based on type of roadway, and other geometric or design characteristics.

1. Select the **Design Standard Toolbar** icon from **Geometry > General Tools > Standards > Design Standards Toolbar** to open the Design Standard Toolbar.

2. In the *Design Standards Toolbar*, set the *Active Design Standard* to **2Lane (AASTO2011)\4%Super\55MPH** *[2 Lane\4%Super\80 KPH]*.
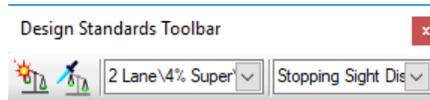
3. Select **Set Design Standard** from either the *Design Standards Toolbar* or the *General Tools > Standards* section of the ribbon.

4. Select the **River_Road** complex geometry element.

5. Verify the design standard is set on the element by using **Project Explorer > OpenRoads Model**

   a. Expand the *Alignments* folder.

   b. Expand the *Geom_Baseline* feature definition.

   c. Expand the *Complex Element: River_Rd* folder. Notice the design standard you set on the geometry is listed. This confirms the design standard has been assigned to the alignment.
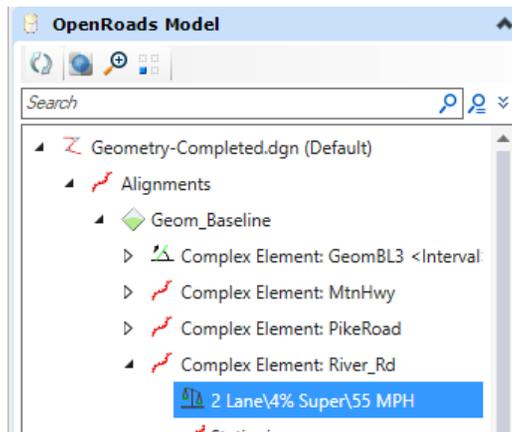
6. Review the Properties of the Design Standard.

    a. **Right-click** on the *2 Lane\4% Super\55 MPH [2 Lane\4% Super\80 KPH]* design standard.
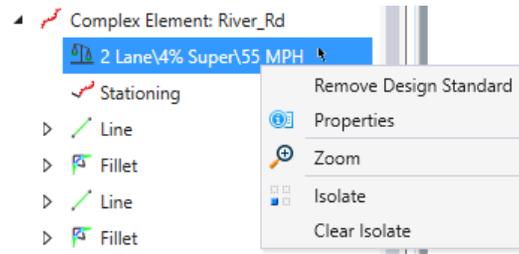
    b. Select **Properties** to review the design standards properties.

    Design standards can be used to maintain required curvature and other horizontal and vertical alignment checks when performing geometric layouts.

    c. Close **Properties** when finished.

    Tip: To remove a standard from a geometry element, right-click on the standard in the OpenRoads Model Explorer and select *Remove Design Standard*.

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7. Open the **Civil Message Center** and review the design standard errors and warnings.

   a. Select **Geometry > General Tools > Standards > Civil Message Center**

8. Click the **MicroStation** tab to clear any MicroStation messages.

9. Observe the warnings and errors. Warnings indicate that the geometry is below the design standard value and errors indicate the geometry is below the minimum requirement.

   Most of the warnings are because the imperial or metric design standard we choose to use recommends spiral transitions between lines and arcs and we did not include any spirals in our design.

   Notice there are 4 warnings stating the *Arc radius is less than default*. This means that our curve radius is less that the minimum value. To clear such messages you must adjust the radius value of each curve.

   NOTE: WHEN WORKING THIS COURSE IN METRIC THE NUMBER OF WARNINGS MAY BE DIFFERENT.

10. Modify curve radius to follow the recommended design standard value.

   a. Click on the last warning message at the bottom of the list.

⚠ Warning	Missing transition between arc and line	Missing transition between arc and line
⚠ Warning	Arc radius is less than default	Design Standard Value = 2860.000' Actual Value = 2580.000'
⚠ Warning	Tangent length is longer than maximum value	Design Standard Value = 5000.000 Actual Value = 9811.821
⚠ Warning	Arc radius is less than default	Design Standard Value = 2860.000' Actual Value = 2580.000'
⚠ Warning	Arc radius is less than default	Design Standard Value = 2860.000' Actual Value = 1650.000'

   b. Right click on last warning message and select **Zoom To**.**

   You will now be zoomed into the location of the curve that is below the minimum value.

   c. Zoom out as necessary to see the entire curve.

   d. Change the radius to **2860** *[870]*.

   ▪ Select the curve and change the radius dynamic text to **2860** *[870].*

   The Error will now be cleared from the *Civil Message Center*. Also, notice the curve data annotation updates automatically.**

   e. Close the *Explorer* and *Civil Message Center*.

   Note: Design standards are developed for both horizontal and vertical geometry and are stored in DGNLibs. Several default libraries are provided in the installation packages. They are utilized by including the file / path in your MS_ DGNLIBLIST configuration variable. An organization can modify the default libraries or create them from scratch, depending on your standards. Multiple standards can be utilized, i.e., consulting firm doing work for multiple governmental agencies who all have their own standards.

   As you select a standard, it is copied from the DGNLib into your design file. Therefore, your organization can maintain the integrity of the standards by having them "read-only" in a central location, but a designer has the flexibility to override for a project-specific circumstance. The Project Explorer has one set of standards derived from DGNLibs, and another set shown for the design file.

Exercise 3: Creating Vertical Geometry

Exercise Description

This section contains exercises teaching how to create vertical geometry. The vertical geometry for River Road is constrained where it intersects Mountain Highway and where it crosses the river. We will build this vertical geometry by creating lines at specified grades and then connect the lines with parabolic vertical curves. Snaps and *Civil AccuDraw* are used to ensure the geometry satisfies the constraints.

Skills Taught

- Displaying a profile model

- Creating vertical geometry lines

- Creating vertical geometry parabolic curves

- How to create a 3D Cut

- Creating complex vertical geometry

- Using Civil AccuDraw with vertical geometry

- Displaying intersection point of other alignments and features onto the profile

Create Vertical Lines

In this section we will first determine the tie-in point and take off grade where River Rd. meets Mountain Highway. We will do this by displaying the pavement surface of the Mountain Highway corridor onto the River Rd. profile. We will then create three tangent lines at specific grades along the length of the alignment.

---

1. Turn On the Mountain Hwy. Corridor reference file.

    a. Select **Home > Primary > Attach Tools > References**. The *References* dialog will open.
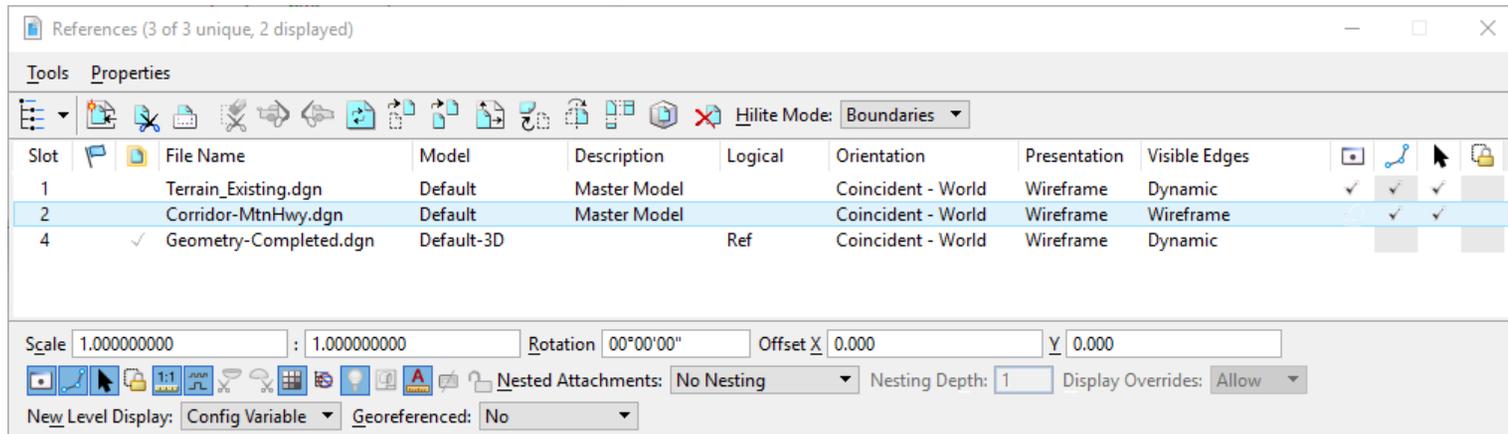
    Notice that *Corridor-MtnHwy* is attached as a reference file and is currently not displayed.

    b. Select **Corridor-MtnHwy.dgn** in the References dialog.

    c. Select the **Display** icon to turn on the display of *Corridor-MtnHwy.dgn*.

    d. Close the *References* dialog.

2. Open a Profile Model for River Road.

    a. Select the **Open Profile Model** tool from the context menu on the River Road geometry.

    b. Display the profile in **View 2**. *View 2* will now be the active view.

3. Project the centerline and right edge of pavement feature from the Mountain Highway corridor onto the profile.

a. In the profile view, **Zoom in** near elevation **7481** *[2270]* at station **100+00** *[1+000]*.

b. In *View 1*, **Zoom into** the intersection of Mountain Highway and River Road.

Notice the plan view graphics drawn along the Mountain Highway corridor. These graphics are the template geometry features drawn in the corridor file. These template geometry features can be used to display information into profile views.
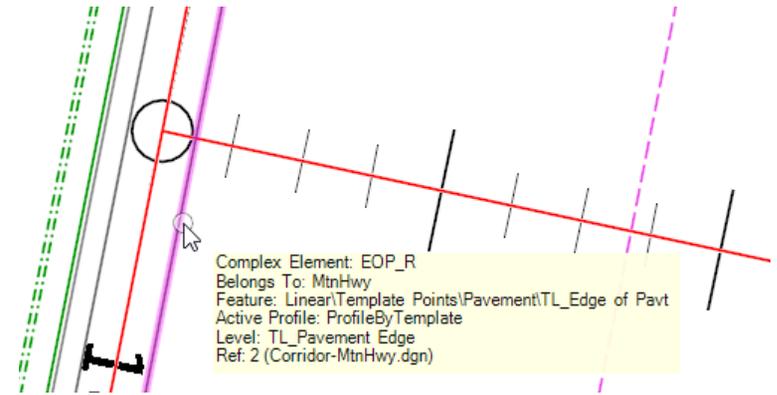
c. Select the **Geometry > Vertical > Profile Creation > Profile Intersection Point** tool.

Following the heads-up promoting:

- *Locate Element To Show Intersection:* In Plan view, Select the **River_Rd.** alignment.

- *Locate Element Which Intersects:* In the Plan view, select the **MtnHwy** centerline geometry.

- *Locate Element For Next Intersection- Reset to Complete:* In the Plan view, select the **MtnHwy** right edge of pavement feature (**EOP_R** from the MtnHwy corridor).

d. **Right-click** to complete.

e. If necessary, **Zoom in** to see the two points.

Two points will appear on the River Road profile where the centerline and right edge of pavement cross the River Road alignment.
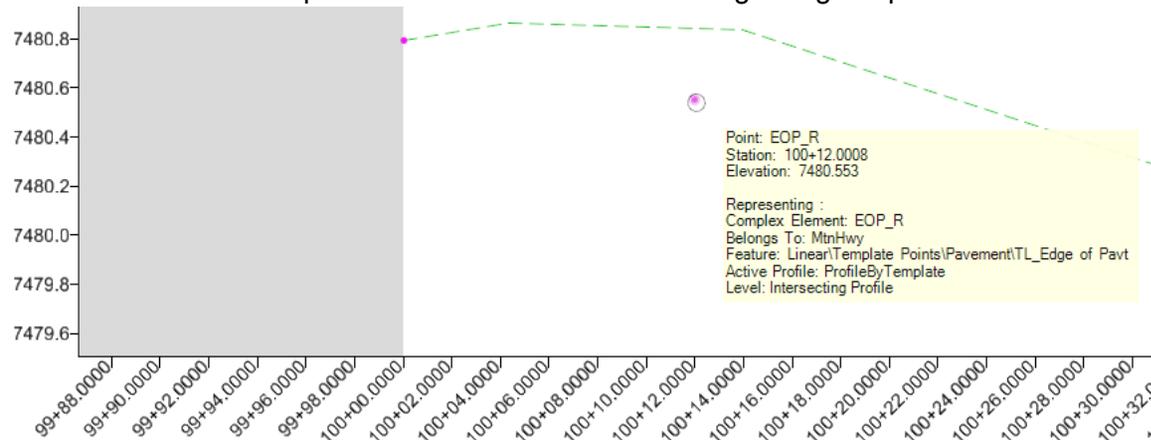
4. Establish the take-off grade line beginning at station 100+00 *[1+000]*.

a. From the *Vertical Geometry* tools, select the **Profile Line Between Points** tool.

b. In the profile view, **Snap** to the centerline point.

c. In the profile view, **Snap** to the edge of pavement point.
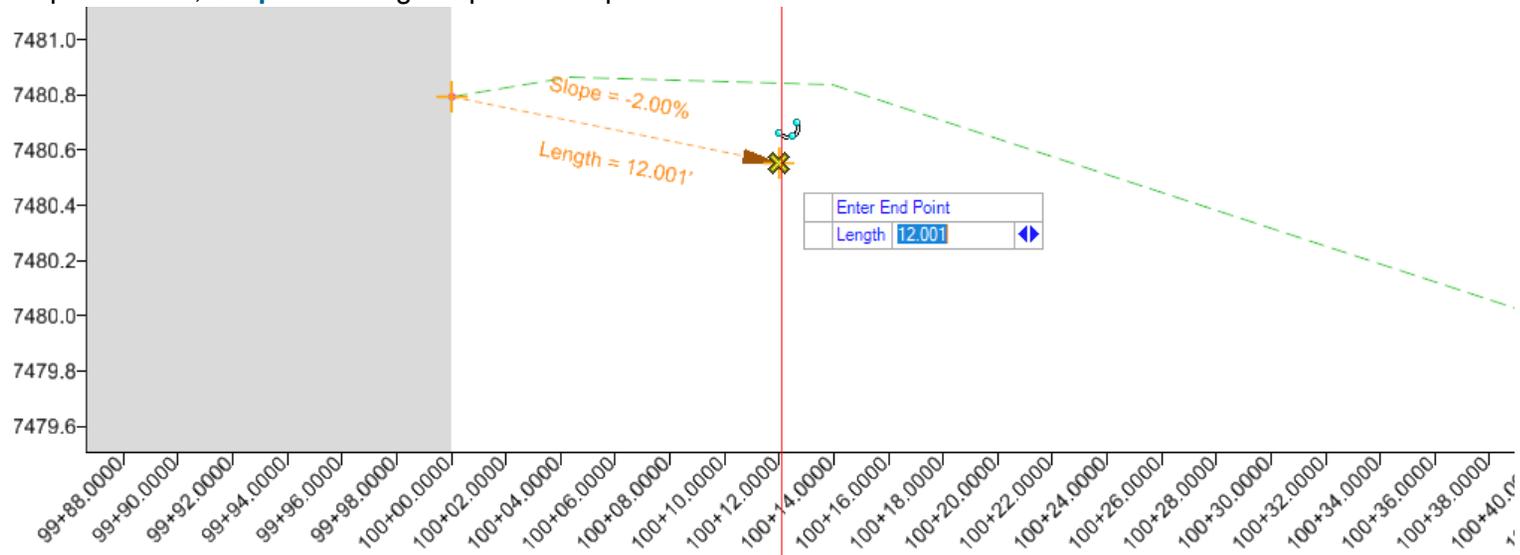
d. Select the line you just placed.

e. Review the slope and elevations.

Notice the slope and end point elevation. The slope is our take-off grade and the end point elevation is our tie-in elevation. These will be used to begin designing our vertical geometry.

Also, since we snapped to the intersection points in the profile, a vertical geometry rule is established with those points. Therefore, if the corridor updates the vertical geometry element connected to the intersection points will also update.

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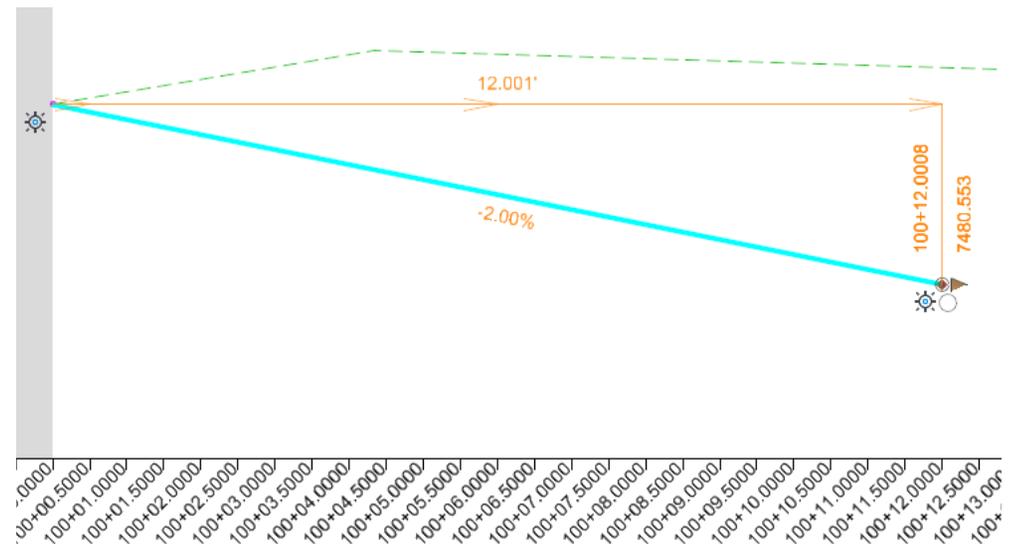
Sometimes it is necessary to display components of a corridor onto the profile. You can do this by using the *Create 3D Cut* tool. This tool will allow you to cut through a corridor and display the corridor's components onto the profile.

5. Display the 3D Cut from the MtnHwy corridor.

a. In the profile view, select **Create 3D Cut** from the top menu of tools.

b. Following the heads-up prompts:

Placement Method: Select **Corners**

Locate Start Point: **Data point** near elevation **7478** *[2279]* at approximately station **100+00** *[1+000]*.

Locate End Point: **Data point** near elevation **7482** *[2281]* at approximately station **100+25** *[1+005]*.
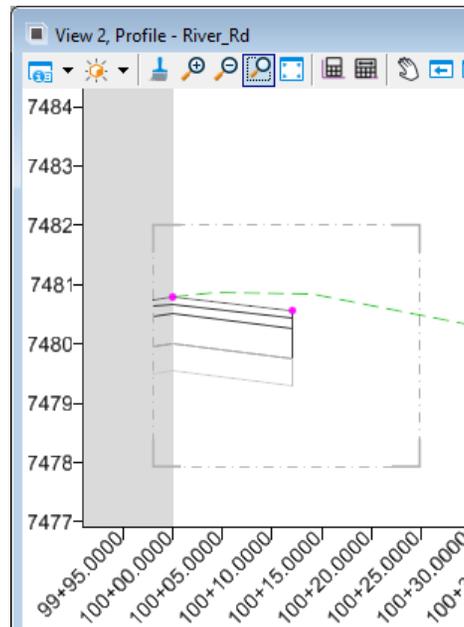
Upon completion the components of the MtnHwy corridor will now be displayed onto the profile. If the corridor changes, you will need to refresh the 3D cut by using the *Refresh 3D Cut* tool located to the right of the 3D Cut icon.

Now let's continue with the design of the vertical alignment. We will begin by creating a tangent line from the previously created vertical geometry.

6. Select **Geometry > Vertical > Lines > Profile Line From Element > Tangent Profile Line From Element**

   a. Follow the heads-up prompts:

   - *Locate Reference Profile:* Select the previously placed vertical geometry.

   - *Start Point:* Snap to the edge of pavement point displayed on the profile.

   - *End Point:* Dynamically place the right end of the line near station **110+00** *[1+300]*. The exact station is not important because it will be extended/shortened when the vertical curve is added. Use the Mouse Wheel to zoom out as necessary.

   - *Trim/Extend:* None
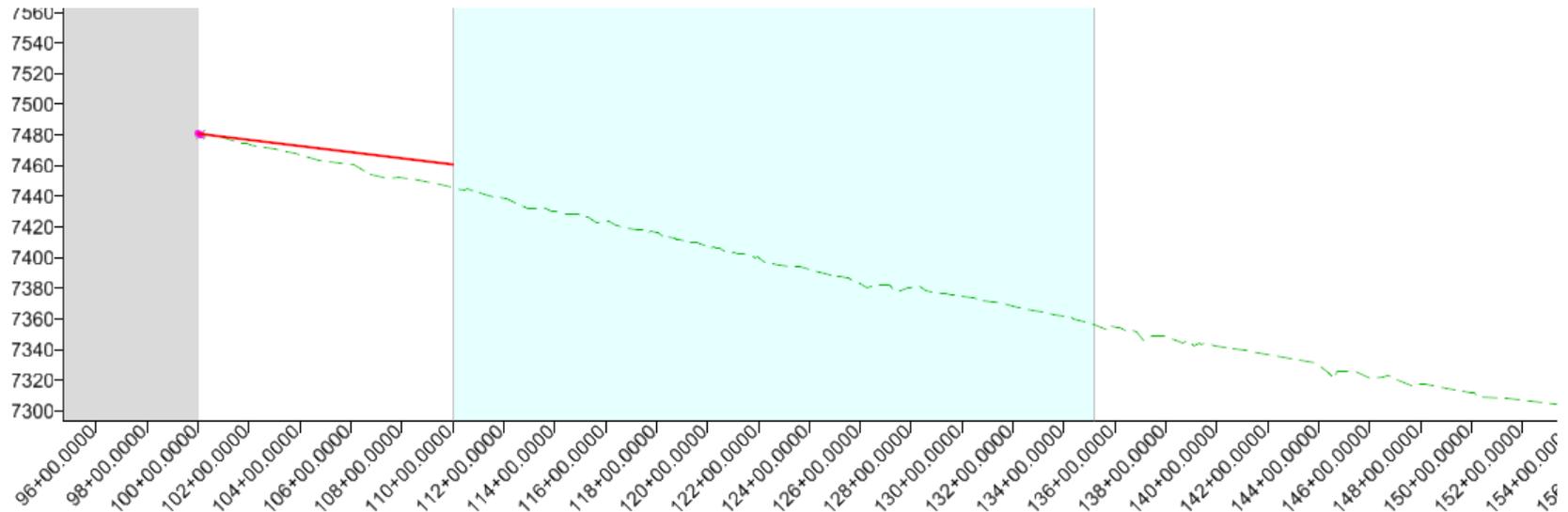
Tip: Sometimes it's useful to be able to scale the profile view horizontally or vertically to better see vertical elements. You can do this by utilizing the mouse wheel and holding down either **CTRL** or **SHIFT** keys.

- **CTRL + Mouse Wheel** = Scales the view horizontally.

- **SHIFT + Mouse Wheel** = Scales the view vertically.

7. Place a second line near the station **110+00** *[1+300]* line created previously and ending at approximately **150+00** *[2+500]* using a slope of **-3.5%**.

    a. Enable **Chain Commands** from the *Feature Definition Toolbar*.

    b. Select **Geometry > Vertical > Lines > Profile Line Between Points** tool.

    c. Snap to the right end point of the previously placed geometry at **110+00** *[1+300]*.

    d. Press the right arrow key until the *Slope* field appears in the heads-up prompt.

    e. Enter **-3.5%** in the field and press *Tab* key.

    f. Dynamically place the right end of the line near station **150+00** *[2+500]*.

    g. Right click to complete.
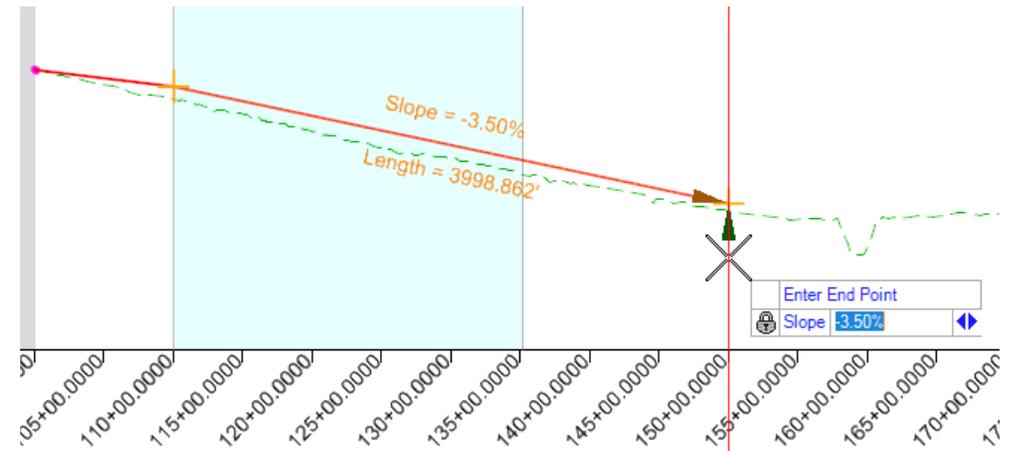
8. Place a third line between **170+00** *[3+000]* and **200+00** *[4+000]*. This line will be offset **5′** *[1.5 m]* above the existing ground at station **170+00** *[3+000]* and at a -0.5% grade.

    a. Enable **Civil AccuDraw**.

    b. Set the *Civil AccuDraw* coordinate system to **Profile Offset**.

    c. Enter **170+00** *[3+000]* in the *Station* field on the heads-up prompt.

    d. Press **Tab** to make the *Profile Offset* field in the heads up prompt active.

    e. Type **o** (for origin) to set the *Civil AccuDraw* origin.

    f. Select the existing ground profile.

    g. Enter **5** *[1.5]* in the *Profile Offset* field on the heads-up prompt. Press the tab key to lock the value.
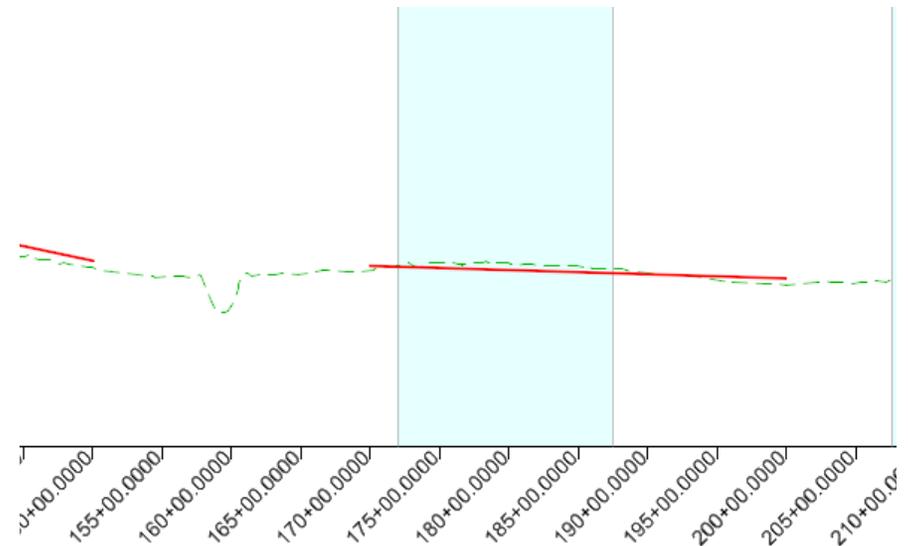
h. **Data point** to place the first point.

i. Enter **200+00** *[4+000]* in the *Station* field.

j. Press **Tab** two times to move the cursor focus to length field.

k. Press the right arrow key to move to the slope option.

l. Enter -**0.5%** in the field and press **Tab.**

m. **Data point** to create the line.
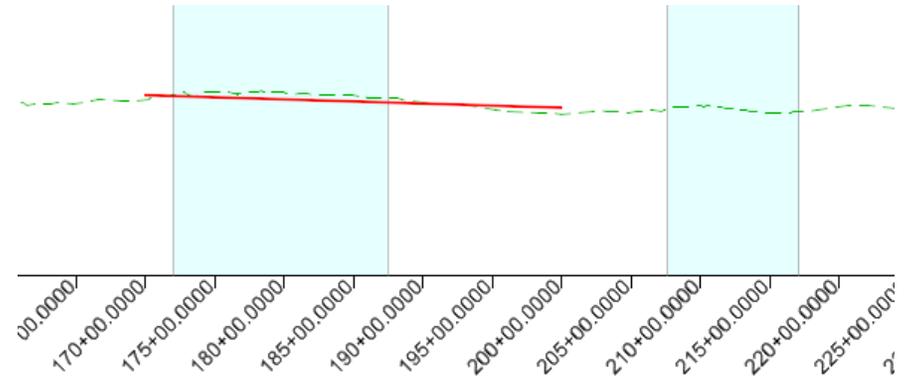
9. 200Place the fourth line between station **200+00** *[4+000]* and **450+00** *[11+620]*. The beginning point of this line will be the end point of the previously placed line and at a -1.0% grade. Since we toggled on the *Chain Commands* tool the *Place Line Between Points* tool will still be active.

a. In *Civil AccuDraw*, enter **450+00** *[11+620]* in the Station field.

b. Enter -**1.0%** in the Slope field.

c. **Data point** to create the line.

d. Right click to reset.

e. Select the **Chain Commands** icon to turn Off the *Chain Commands* tool.

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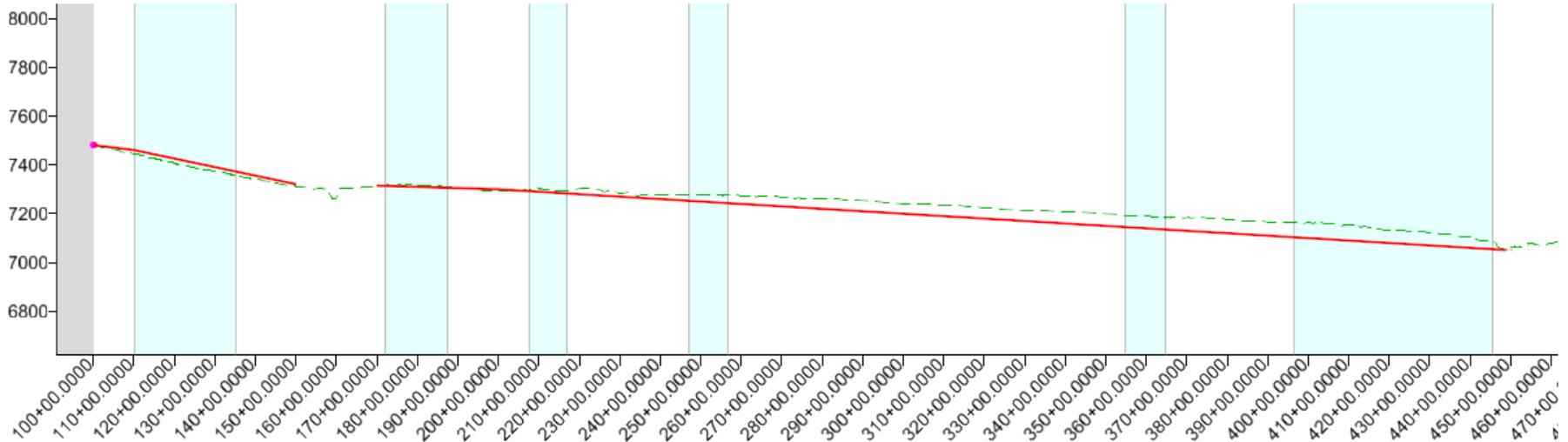
Place Parabolic Curve at the End of Vertical Geometry

1. Turn off *Civil AccuDraw*.

2. Select **Geometry > Vertical > Curves > Profile Curve From Element > Parabola from Element**

3. Following the heads-up prompting:

   a. Select the last tangent line as the *Reference Profile*.

   b. **Snap** to the end of the last line as the *Start Point*.

   c. Set the *Curve Parameter* to **3000** *[929]*.

   d. **Snap** to the end point of the existing ground profile.

   e. **Data point** to place the arc.

   f. Trim the back element.
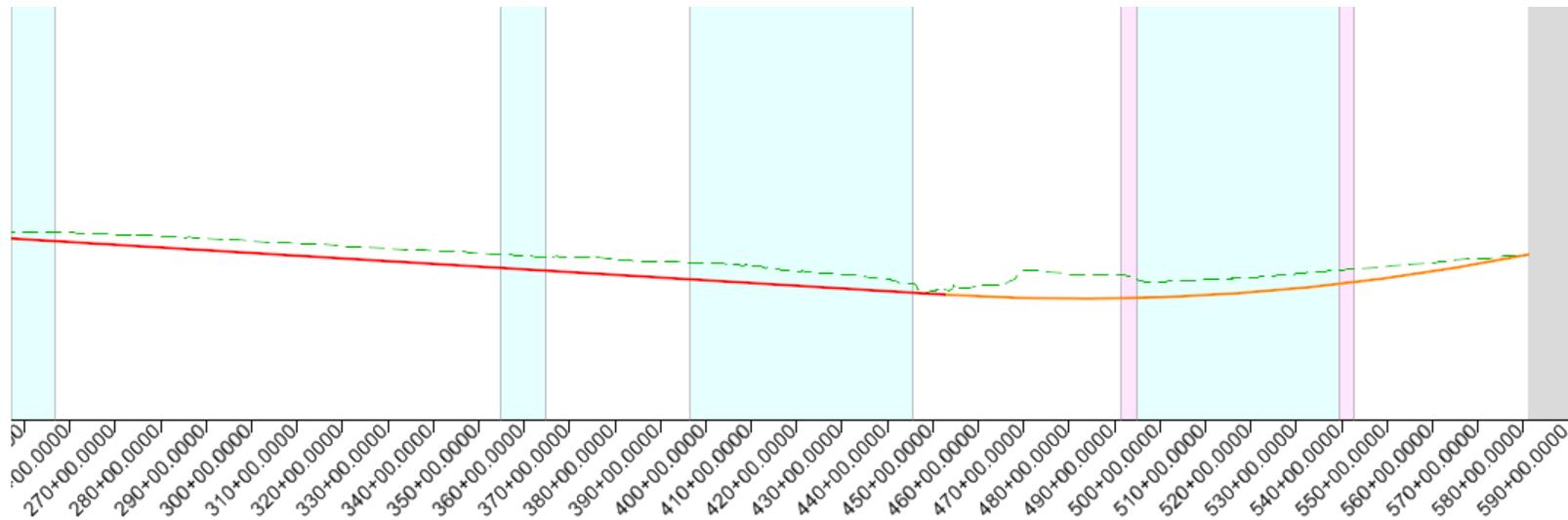
Place Parabolic Curve at Station 200+00 [4+000]

1. Select the **Parabola Between Elements** tool.

2. Following the heads-up prompting:

   a. Select the First profile element to the left of station **200+00** *[4+000]*.

   b. Select the Second profile element to the right of station **200+00** *[4+000]*.

   c. Set the *Length* to **2200** *[670]*.

   d. Trim both elements.
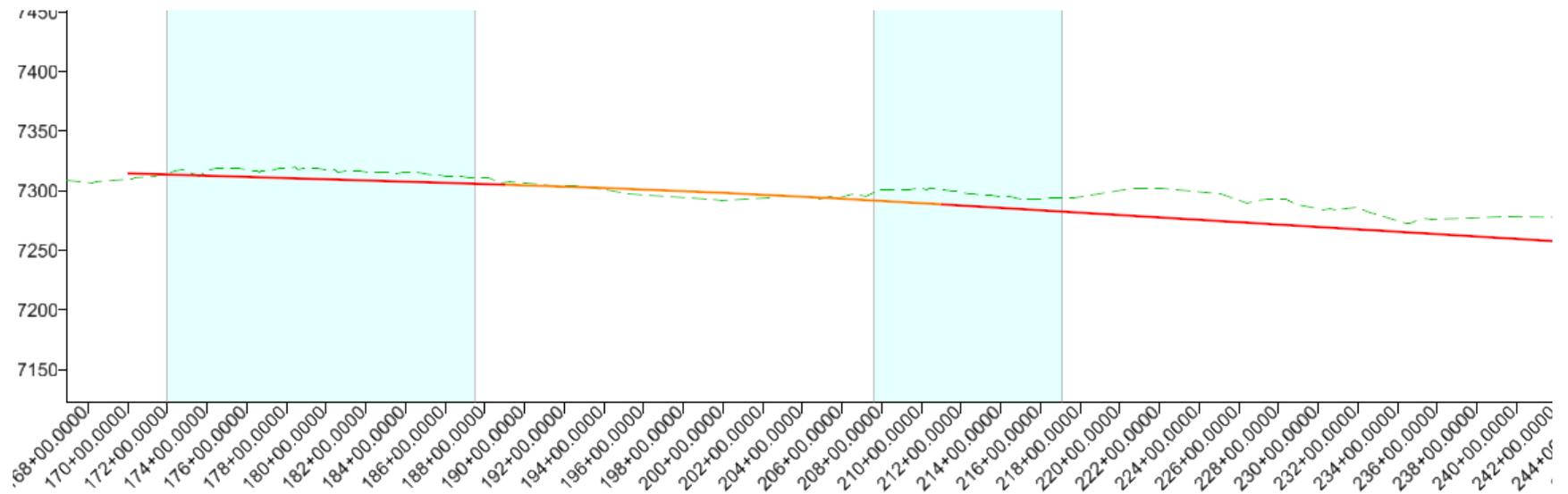
Place Parabolic Curve over the River

The engineering requirement (design intent) for this curve is that it be 25 feet [7.6 m] above the water surface elevation of the river. The centerline and water surface elevation of the river are defined with horizontal and vertical geometry elements displayed as a dark red line.

1. Project the water surface elevation onto profile.

   a. Select the **Profile Intersection Point** tool.

   b. Following the heads-up promoting:

   c. In the Plan view, select the **River Road** geometry.

   d. In the Plan view, select the centerline of the river geometry. The river centerline is the dark red line that crosses River Road.

   A dot appears on the River Road profile where the centerline of the river crosses.
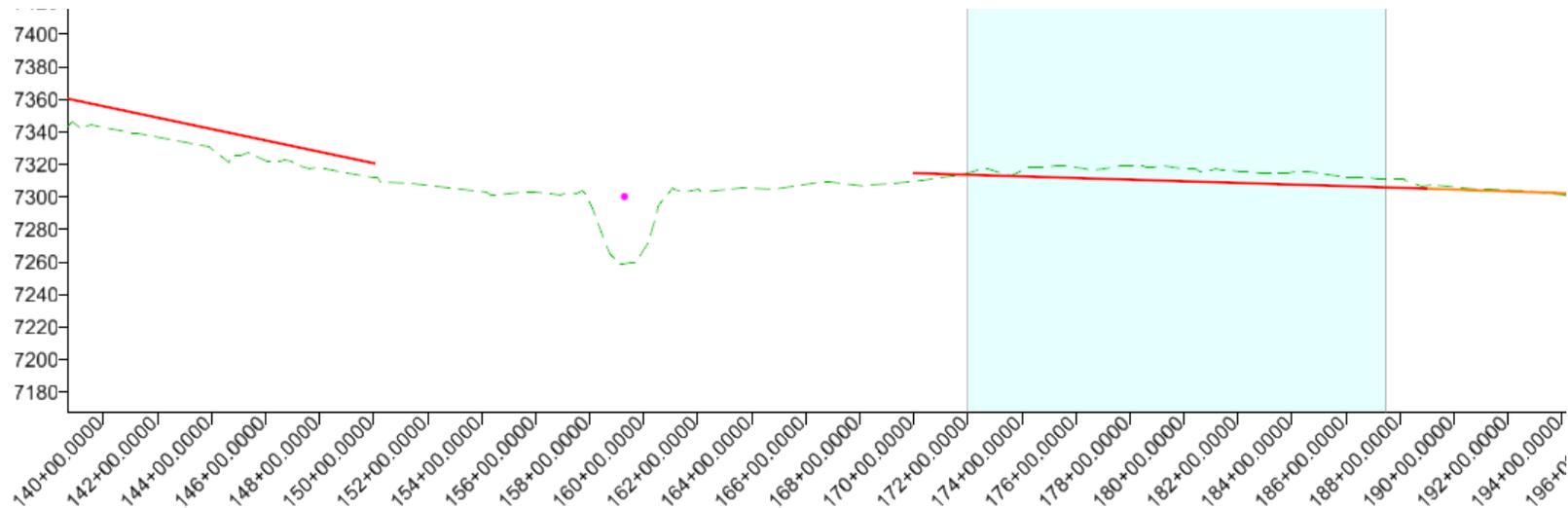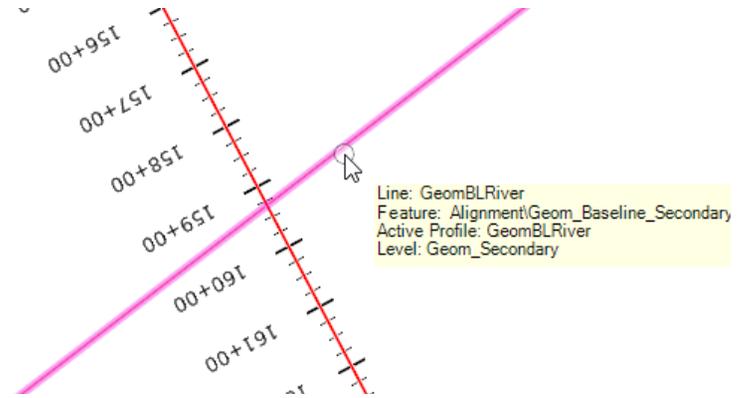
2. Enable *Civil AccuDraw* by selecting **Geometry > General Tools > Civil Toggles > Civil AccuDraw**

3. Select the **Element Selection**

4. **Left-click** in the Profile view to make it active.

5. Set the *Civil AccuDraw* coordinate system to **Delta Z**.

6. Create the parabolic curve.

   a. Select the **Parabola Between Elements** tool.

   b. Following the heads-up prompting:

   c. Select the First profile element to the left of the river.

   d. Select the Second profile element to the right of the river.

   e. **Tab** to set focus in the *Station* field.

   f. **Snap** to the dot representing the water elevation and press **Enter** to lock the station value.

      Hint: Let AccuSnap lock onto the dot.

   g. In the *dZ* field, type **o** to set the *Civil AccuDraw* origin.

   h. Snap to the dot representing the water elevation to define the origin.

      Hint: Let *AccuSnap* lock onto the dot.

   i. Enter **25** *[7.5]* in the *dZ* field. Click **TAB** to lock the value. Civil Accudraw compass will turn purple when the offset is properly locked.

   j. **Data point** to accept the point.

   k. Trim both elements.

   l. Turn off *Civil AccuDraw*.

The result is a vertical curve 25 feet [7.5 meters] above the water elevation.

7. **Zoom in** to the water surface intersecting point and **Select** the vertical curve you just created. Notice the dynamic text displays the 25 foot clearance to the water surface elevation.
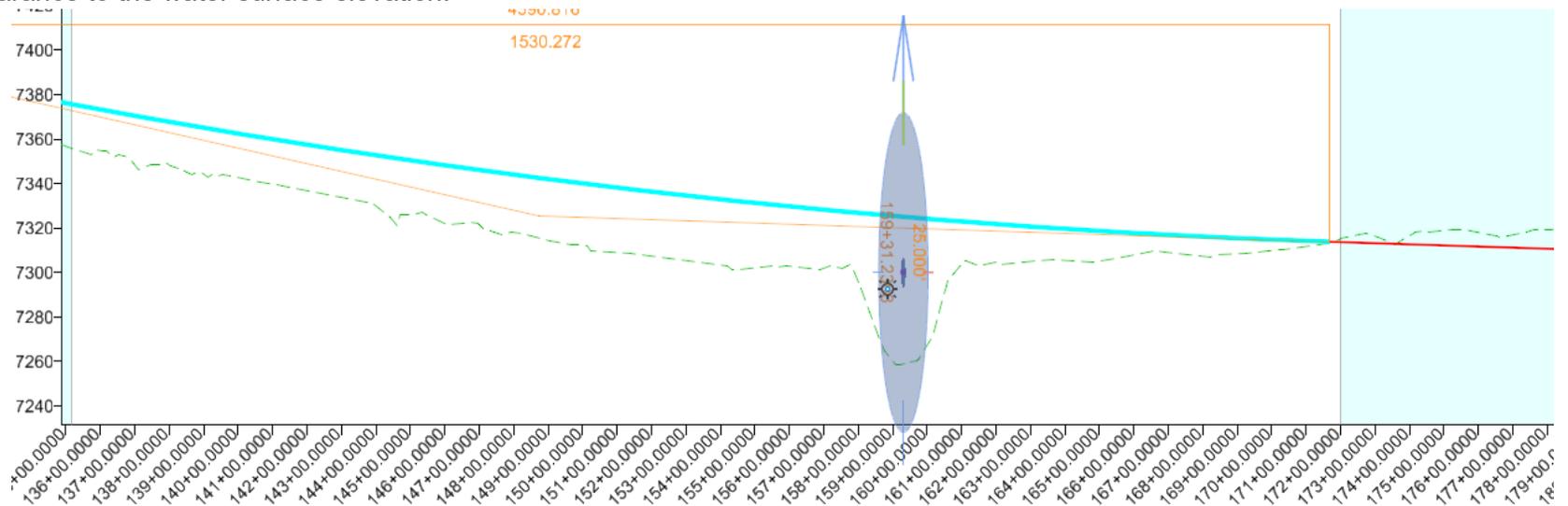
To finish up the vertical geometry, we need to create one last vertical curve at station **110+00** *[1+300]*.

8. Create the parabolic curve.

   a. Select the **Parabola Between Elements** tool.

   b. Following the heads-up prompting:

   c. Select the First profile element to the left of station **110+00** *[1+300]*.

   d. Select the Second profile element to the right of station **110+00** *[1+300]*.

   e. Use a vertical curve length of **800** *[240]*.

   f. Trim both elements.

   g. **Data point** to complete.
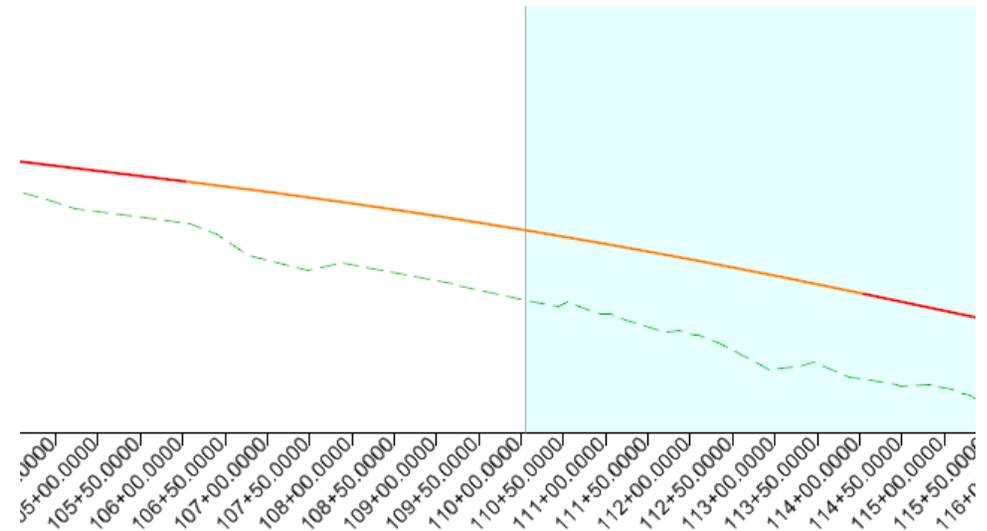
Create Complex Vertical Geometry

1. Create complex vertical geometry element.

   a. From the Vertical Geometry tools, select the **Profile Complex by Elements** tool.

   b. Verify the *Method* is set to **Automatic** in the Create Complex window.

   c. Set the *Maximum Gap* to **0.033**

   d. Enter **River_Road** in the *Name* field in the Create Complex window.

   e. Select the beginning element.

   NOTE: Be sure the direction arrow is pointed in the direction of the alignment before selecting the element.
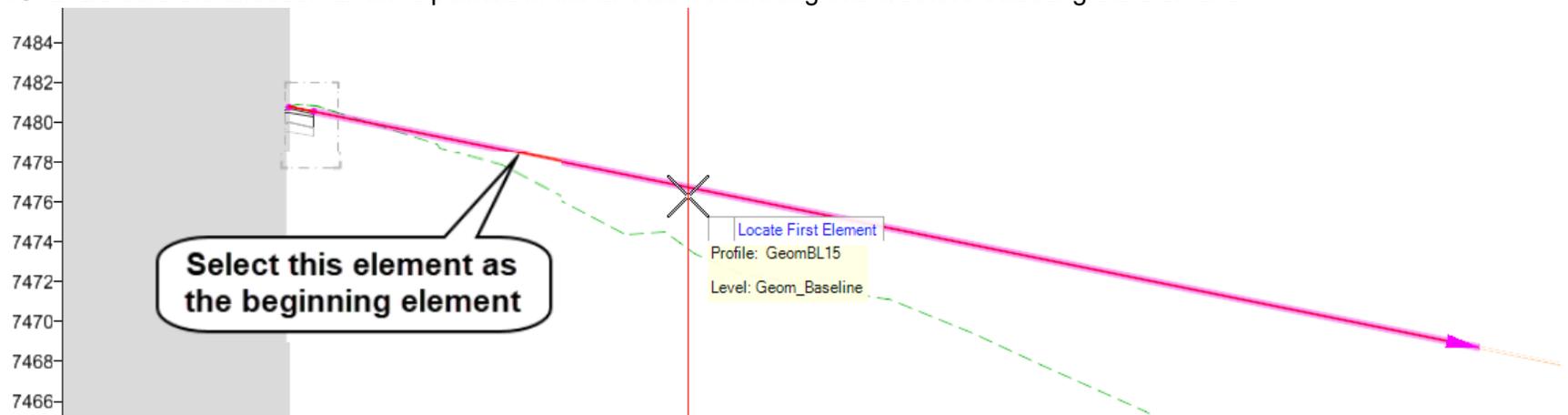
   You may need to zoom out to get all of the elements to complex correctly.

   f. **Data point** to accept the complex alignment.

2. Set the complex vertical alignment **Active** if it is not already active.

   Tip: Remember you can have multiple profiles but you can only have one active profile per horizontal alignment.

Exercise 4: Editing Vertical Geometry

Exercise Description

In this section you will learn how to make changes to the vertical geometry.

Skills Taught

- Edit Vertical Geometry with the Table Editor

- Edit Vertical Geometry with Right Click

- Append Vertical Geometry Elements

Editing Vertical Geometry

Editing vertical geometry is done in a similar manner to how horizontal geometry is edited. Some of the editing tools are available in the **Geometry** ribbon tab and others are located in the **Drawing** ribbon tab. Below is a partial list of the tools that can be used:

The following commands are located in **OpenRoads Modeling > Geometry**:

- **Table Editor** - Use to edit alignment in tabular format. Can be used to add and delete VPI's as well as add and remove curves.

- **Profile Insert Curve** - Use Profile Insert Curve tool if you need to insert a curve between tangents on previously created vertical alignment.

- **Append Profile Element** - Use this tool If you need to add additional elements to the beginning or end of an alignment.

- **Complex Redefine** - Allows you to redefine geometry over a certain range, substituting in new vertical geometry. It preserves all rules built off the original geometry (i.e. other geometry, superelevation, civil cells, etc.)

The following commands are located in the **OpenRoads Modeling > Drawing > Modify**:

- **Insert Vertex** - Use Insert Vertex to insert a VPI to horizontal alignment.

- **Delete Vertex** - Use Delete Vertex to remove VPI's which can also remove horizontal curves.

- **Trim/Extend** - Use to trim or extend geometric elements.

- **Modify Element** - Use to modify elements by changing their shape.

- **Delete** - Use to delete elements.

- **Break Element** - Use to delete a portion of an element.

- **Drop Element** (Found under the **Drawing** workflow: **Home > Groups > Drop Element**) - Use this tool to un-complex the alignment and return it to the base elements. Take care when using this tool, when you drop a horizontal alignment any associated vertical alignment will be deleted.

Dynamic Text and Manipulators - Simple changes to vertical geometry can be made via the dynamic text and drag handles for easy in place editing.

Properties - Element properties can also be used to change simple curve to more complex curve combinations as well as change distance and direction of elements and other properties.

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Edit Vertical Geometry with the Table Editor

In this section, you are going to learn how to "slide" or move vertical curves while holding slopes using the Table Editor and you will also learn how to adjust station values.

1. Select **Geometry > Common Tools > Table Editor**

2. At the *Locate Alignment* prompt, select the **River Rd.** vertical alignment.

   The *Profile Table Editor* will appear. This tool will allow you to make modifications to your alignment in a tabular format. The Alignment Table Editor is a great tool to use for making quick changes your alignment.

3. In the *Profile Table Editor*, select the field with the **-2.00%** Ahead Slope.

4. Lock the **-2.00%** *Ahead Slope* by clicking on the check box next to the -2.00% value.

   By locking this slope, it will prevent the slope from changing when we adjust the stationing of the VPI station in the next row.

5. Select the second row station and change the station to **110+05.00** *[1+310].*

The station will change and the vertical curve will be adjusted slightly. The back grade (or slope) is held at -2.00% since we locked it in the previous step.

6. Select the fifth row *Ahead Slope* value of **3.19%** (slope value may vary) and lock it using the check box next to the value.

7. Select the fifth row station and change the station to **516+85.00** *[13+600].*

Even though you have had changes in the dialog, they have not yet been applied to the alignment. You must click the Apply button for the changes to be saved.

8. Click **Apply** to save the changes to vertical alignment. Close the *Profile Table Editor* dialog.

Using the table editor is an easy way to make detailed changes to the vertical alignment. Notice how you have the ability to lock and change any value in the dialog. This is a very useful feature for when you have to make adjustments but need to hold or lock certain values.

Another useful feature of the Table Editor is the ability to insert and delete VPI's. Simply select any row and right click to gain access to **Insert Before**, **Insert After** or **Delete**.
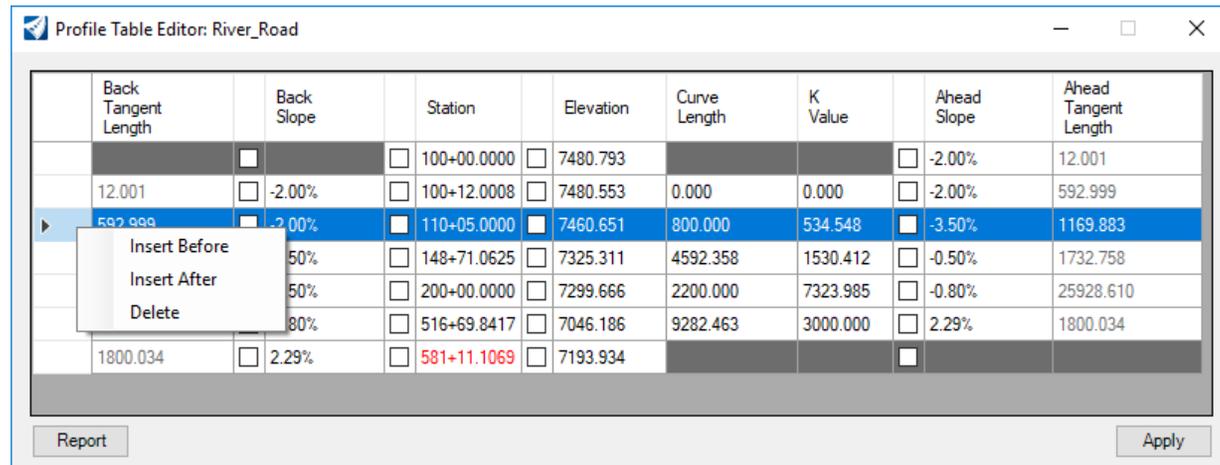
Edit Vertical Geometry With Right Click

When vertical alignments are created they are typically created from several individual vertical elements and complexed together to form a single vertical alignment. The individual vertical elements are ruled to the vertical alignment and control the design intent and behavior of the overall vertical alignment. Sometimes it is necessary to change the slope, tangent length or curve length of one or more of the individual elements. We will now take a look at how to make a change to an individual element by utilizing the right click functionality.

1. Select the **River_Road** vertical alignment. Notice how some of the dynamic text appears gray. This indicates it cannot be edited directly by just clicking on its value. So, how do we edit the individual elements when they appear to be locked? Answer: **Right Click!**
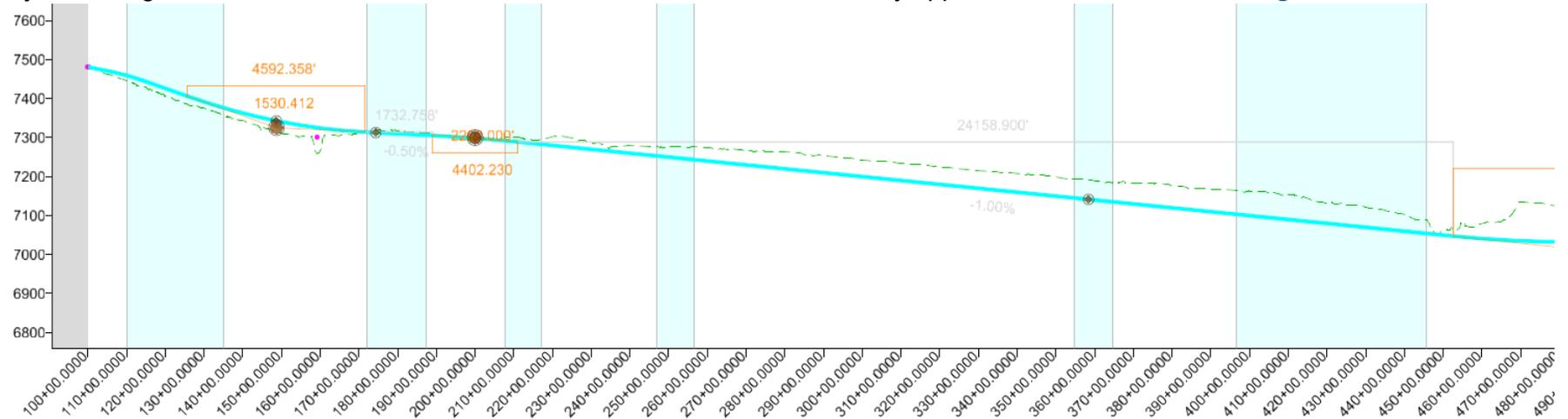

2. With the alignment still selected, **hover** your cursor over the **-1.00%** vertical element.

3. **Right click**. You will now have access to make changes to the element.
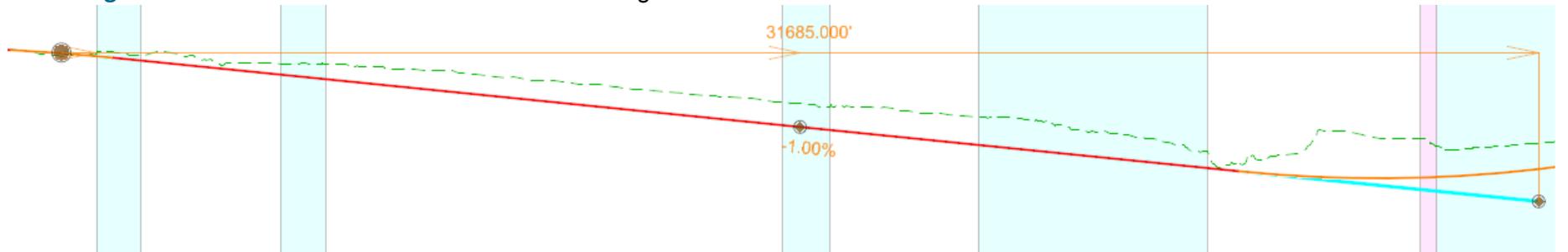
4. Click on the **-1.00%** value and change it to **-0.80%**. The vertical alignment will update with the new value.

5. **Left click** to complete.
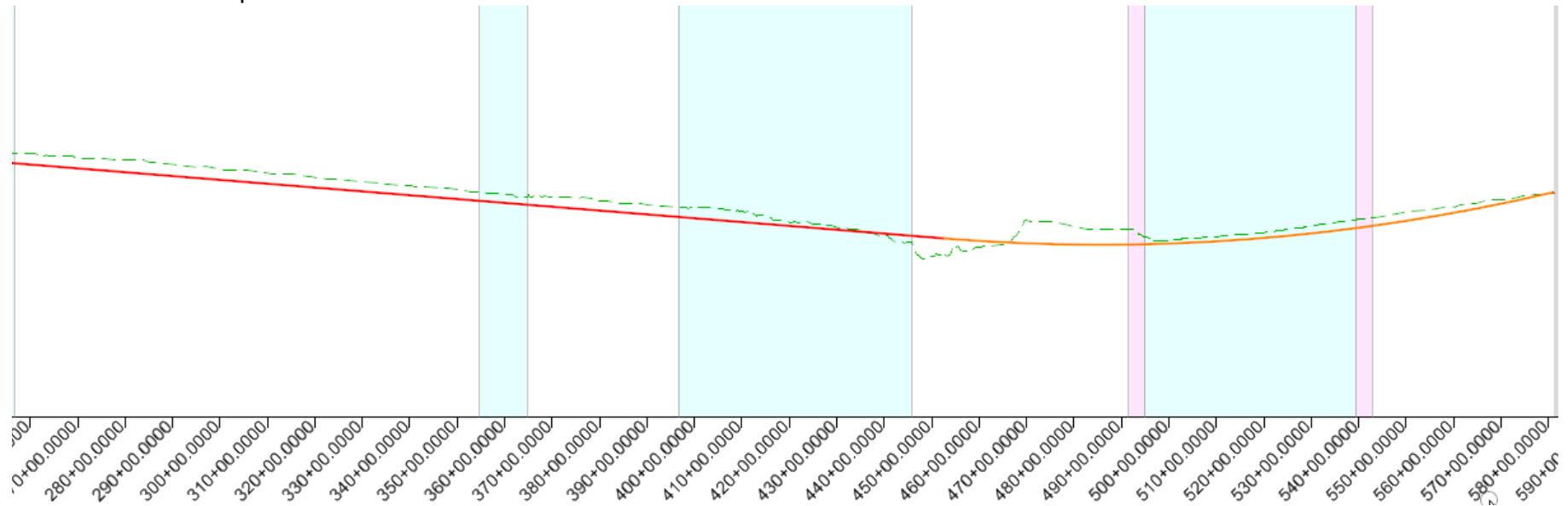
Notes about individual geometric elements:

When a geometry feature is trimmed or extended, the portion(s) of the modified element which is visible and is being displayed using the Feature Definition settings is called the "*Interval*".

The portion(s) of the original geometry which is not visible is called the "*Gap*". This is the representation of the location of original element before modification. The *gap* will be displayed when you hover over the original element.

An *interval* element is ruled to the original geometry (or "*gap*" element), and this dependency can be viewed in the *OpenRoads Model* tab in the *Explorer*.

Append Vertical Geometry Elements

In this section, you will learn how to add additional elements to the vertical alignment by using the Append Element tool.

1. **Zoom in** to the beginning of the vertical alignment.

   Recall that one of the first things we did was place a vertical line between two points. Also, recall we did not include this piece of geometry as part of the vertical alignment. Now we will append our alignment by adding this vertical element.
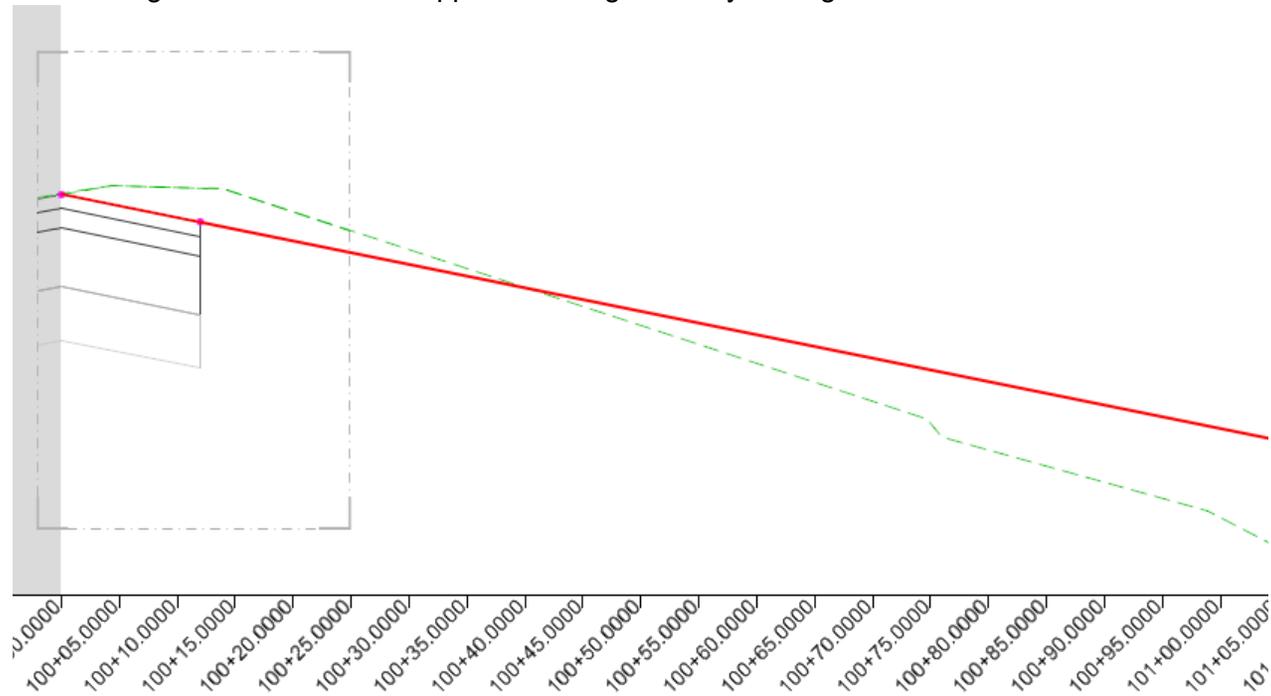
2. Delete the 3D Cut.

   a. Select the gray shape.
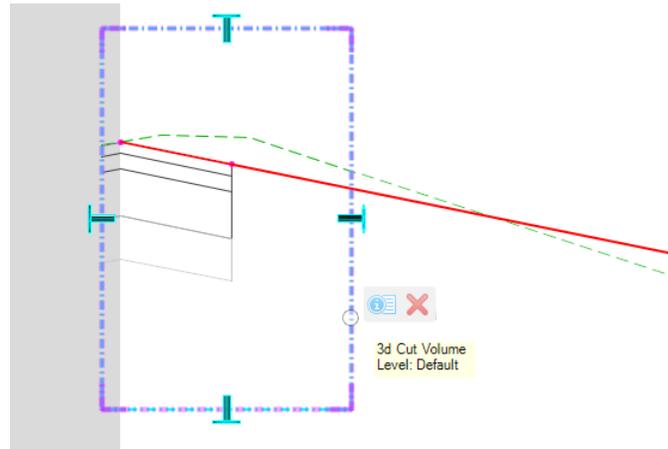
   b. Hover your cursor over the shape until the context menu appears.

   c. Select **Delete**.

3. Append the vertical alignment.

   a. Select **Geometry > Vertical > Complex Geometry > Append Profile Element**

   b. Follow the heads-up prompts:

   ▪ *Locate Complex Element:* Select the vertical alignment

   ▪ *Locate Element To Add/Insert:* Select the vertical geometry line between the two points.
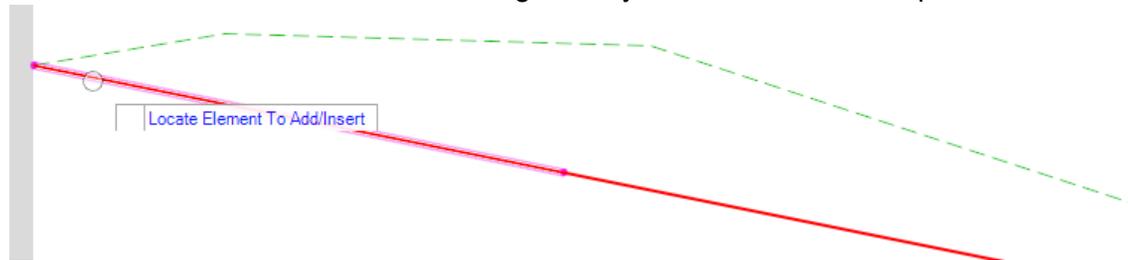
   c. **Right click** to complete.

4. Verify the vertical geometry element has been added.

    a. Select the vertical alignment and notice that it now includes the element you just added.
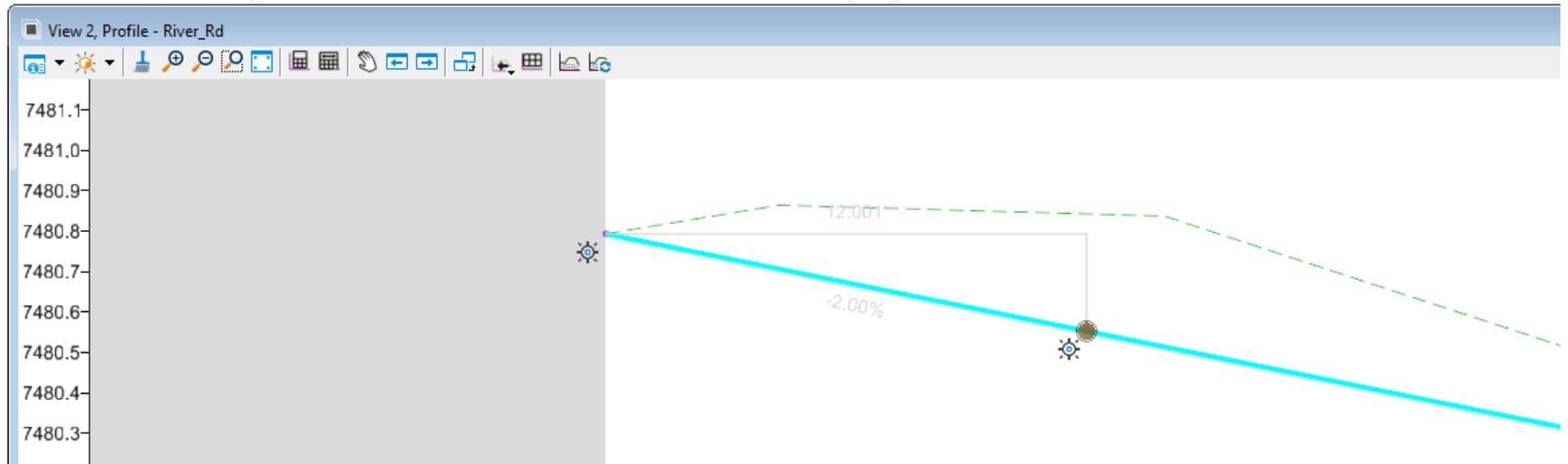
5. Create the Vertical Alignment Report.

    a. With the vertical alignment still selected, hover your cursor over the alignment until the context menu appears.

    b. Select **Profile Report** and review the vertical alignment data in the Bentley Civil Report Browser.

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

Skills Assessment

The questions below will test your retention of the skills covered in this course.

---

1. Which tool will allow you to place a line at a specific station and offset location?

   a. AccuDraw

   b. Civil AccuDraw

   c. Key-In command line

2. Are rules and relationships created when placing civil geometric elements?

   a. True

   b. False

3. How do you edit geometry when the dynamic text appears gray or appears you cannot directly edit the dynamic text?

   a. Select the element and right-click to access the base geometric element.

   b. Select the element and left-click to access the base element.

   c. Snap to the element you would like to modify.

4. Which tool will allow you to make modifications to your alignment in a tabular format?

   a. Horizontal Geometry Report

   b. Table Editor

   c. Microsoft Excel

5. The Append Element command allows you to add geometry to a previously created complex alignment.

   a. False

   b. True

6. Using the Complex Redefine tool allows you to redefine geometry over a certain range, substituting in new horizontal geometry..

   a. True

   b. False

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Skills Assessment - Answers

The answers to the skills assessment questions are highlighted below.

---

1. Which tool will allow you to place a line at a specific station and offset location?

   a. AccuDraw

   b. **Civil AccuDraw**

   c. Key-In command line

2. Are rules and relationships created when placing civil geometric elements?

   a. **True**

   b. False

3. How do you edit geometry when the dynamic text appears gray or appears you cannot directly edit the dynamic text?

   a. **Select the element and right-click to access the base geometric element.**

   b. Select the element and left-click to access the base element.

   c. Snap to the element you would like to modify.

4. Which tool will allow you to make modifications to your alignment in a tabular format?

   a. Horizontal Geometry Report

   b. **Table Editor**

   c. Microsoft Excel

5. The Append Element command allows you to add geometry to a previously created complex alignment.

   a. False

   b. **True**

6. Using the Complex Redefine tool allows you to redefine geometry over a certain range, substituting in new horizontal geometry..

    a. **True**

    b. False

Summary

In this course you have now learned the tools and techniques that can be used to create and edit horizontal and vertical geometry.

You have learned:

- How to create and edit lines, arcs and spirals using the horizontal geometry tools.

- How to create and edit profile elements using the vertical geometry tools.