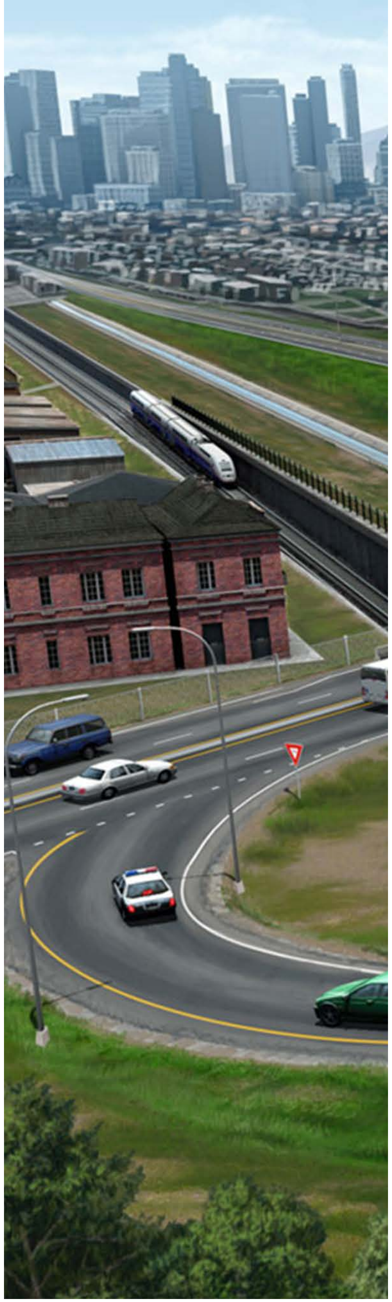


Introduction to OpenRoads Designer - Road Design & Modeling Fundamentals

This course is for the **2024 Release 2** *version of:*

OpenRoads 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 at **learning.bentley.com**
- This PDF file includes bookmarks providing an overview of the document. Click on a bookmark to quickly jump to any section in the file.
- This course workbook uses the *Training and Examples* WorkSpace and the *Integrated Highway Lifecycle* 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, you can submit questions to the *Civil Design Forum* on Bentley Communities where peers and Bentley subject matter experts are available to help.

Bentley Institute

Edition: **13-01**

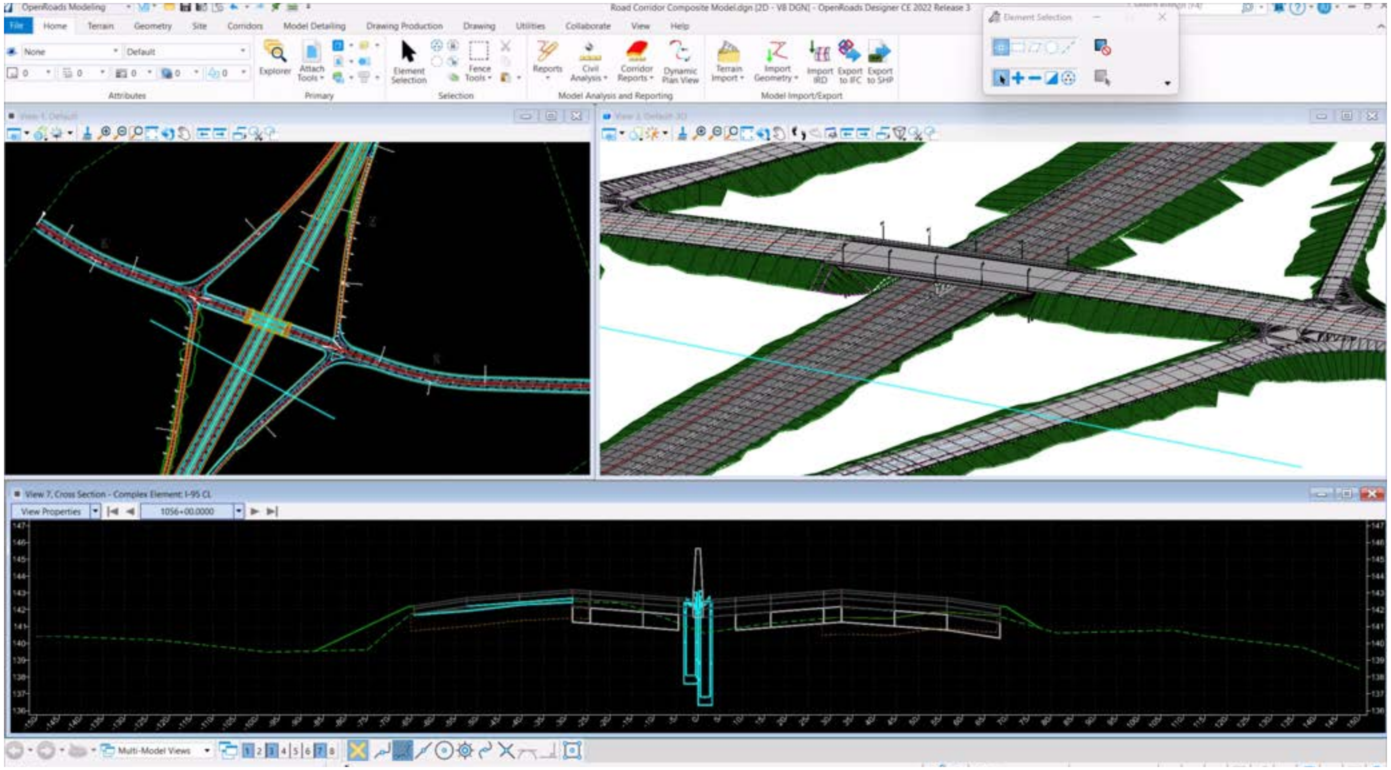
Course Level: **Fundamental**

What is OpenRoads Designer?

OpenRoads Designer is a comprehensive and fully functioned detailed design application for road design, surveying, drainage design, and subsurface utilities. Extremely versatile, OpenRoads Designer is used for all types and phases of civil projects, large and small, by users at every level of expertise. It handles a wide variety of complex tasks with ease, including interchange design, roundabout design, site development, sanitary and stormwater network design, and the production of construction staking reports.

OpenRoads Designer is all you need for geometrics, survey, drainage, utilities, quantity takeoff, cut/fill, site grading, lane configurations, and mobility. Roadway designers and engineers require software that seamlessly collaborates across disciplines, addresses growing industry demands, and includes automation to remove tedious manual work. Whether you need to produce traditional 2D deliverables, advance to 3D modeling, support digital transformation, or all the above, OpenRoads is the choice for road design.

Even as the transportation industry is moving towards the creation of 3D models, the need for a variety of deliverables continues to be part of the project workflow. With OpenRoads Designer, you can create whatever deliverables you might need. Whether it is 2D or 3D, plans or models, digital or paper, OpenRoads Designer is designed to allow you to work in all these arenas simultaneously, leveraging information from one to help populate the other. Our 3D models can be leveraged for 4D scheduling and 5D cost estimation, bringing your design to constructed fruition, on time and on budget.



Course Overview

This course is an introduction to Road Design & Modeling with OpenRoads Designer for new users. In this course you will learn how to design & model a small roadway project.

Topics covered in this course include:

- OpenRoads Designer Interface
- Import Existing Ground Data
- Import and Annotate Existing Geometry
- Create and Edit Civil Geometry (Horizontal & Vertical)
- Corridor Modeling
- Superelevation
- Cross Section Sheet Creation
- Plan and Profile Sheet Creation
- Earthwork Quantities

Typical Road Design Workflow in OpenRoads Designer

1. Collect Survey Data
   - The surveyor will survey the existing conditions of a project and collect the survey data.
2. Import Survey Data
   - After the survey data has been collected it is imported into OpenRoads Designer.
3. Create a Terrain Model
   - Once the survey data has been imported a Terrain Model is created that represents the existing ground surface for the road project.
4. Create the Horizontal Alignment
   - In this step you will create the horizontal geometric layout and design of the road.
5. Create the Vertical Alignment
   - In this step you will create the vertical geometric layout and design of the road.
6. Create Superelevation
   - In this step you will create and design the superelevation transitions (if needed).
7. Create the Corridor Model
   - In this step you will create a 3D corridor model of your road. The 3D corridor Model is used for cross sections and quantities.
8. Create Quantity Reports
   - In this step you will want to create any necessary quantity reports such as earthwork quantities or pay item quantities.
9. Create Drawings and Sheets
   - In this step will create the drawing sheets that may be required: Title Sheet, Typical Section Sheet, Schematic Geometric Layout, Sheet, Plan and Profile Sheets, Cross Section Sheets, Detail Sheets and Quantity Sheets.
10. Review the Design

Module 1: Overview and Terrain

Description

In this module you will review the OpenRoads Designer interface and import the existing ground terrain.

Objectives

- User Interface
- Backstage Functionality
- Search Capability
- Import Existing Terrain

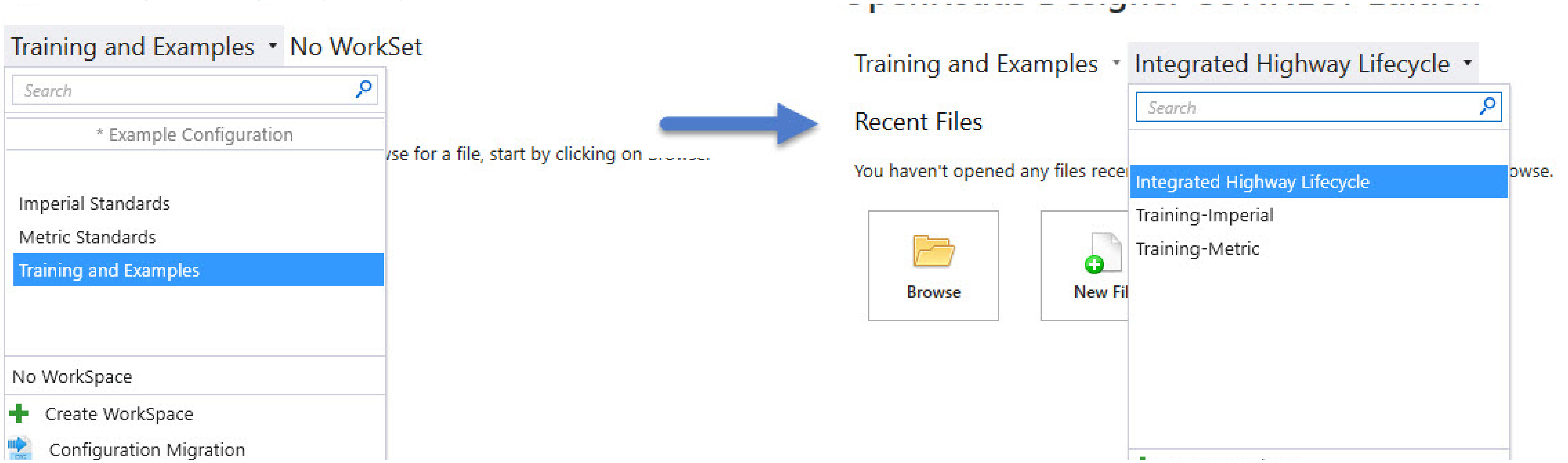
Start OpenRoads Designer and Select WorkSpace

1. Start the **OpenRoads Designer** software.
2. Set the WorkSpace and WorkSet.

   This workshop requires the *Training and Examples* WorkSpace and *Integrated Highway Lifecycle* WorkSet installed with the OpenRoads Designer software.

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

   b. Select **Integrated Highway Lifecycle** from the *WorkSet* menu.



- The *WorkSpace* and *WorkSet* define standards that are used by the software.
- The *WorkSpace* defines the agency/company wide standards and the *WorkSet* is used to define project specific standards.
- The *WorkSpace* and *WorkSet* used for this training are installed during the software installation.
- When a new file is created it gets associated to the current *WorkSpace* and *WorkSpace.*

3. Create a new 3D file for the terrain.

   a. Select **New File**.

   b. Browse to *c:\Bentley Training\Introduction to OpenRoads Designer\Module 1 (Overview and Terrain)* or other folder where you unzipped the dataset files.

   c. Set the *Seed* to **Seed3D-IHL.dgn**.

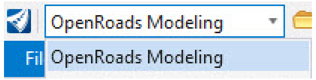
      - Seed files can be thought of as blank templates, they are empty design files and are either a 2D or 3D file. The seed file is used to define the proper workings units, levels, colors, etc. when creating a **new.dgn** file.

   d. Create a new file named **Terrain3D.dgn**.

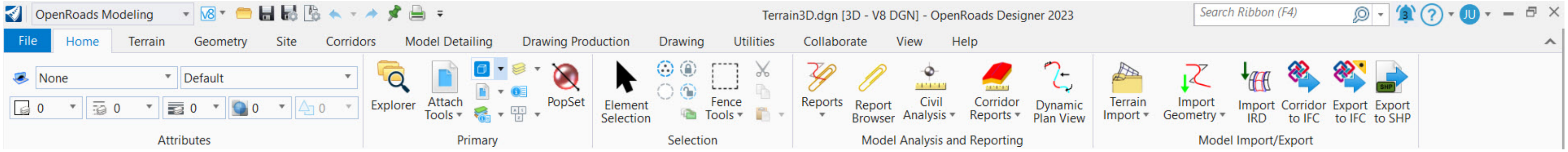
      - ***Terrain and Survey data must be stored in a 3D design file***. All other files such as geometry and corridors should be created in a **2D** design file.

Review the Interface

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



The ribbon menu changes to OpenRoads Modeling tools organized into familiar categories called *ribbon tabs*.



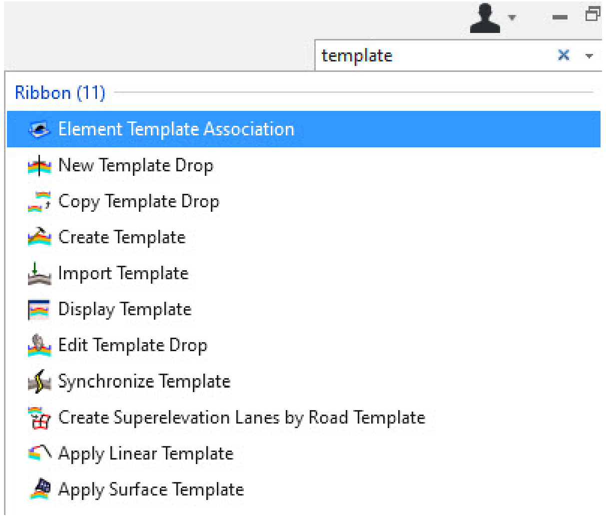
- **Home** - Common tools such as attributes, Explorer, references, models, element selection, fences, and reports.
- **Terrain** - Element selection and terrain modeling tools.
- **Geometry** - Element selection Civil AccuDraw, and geometry tools including Lines, Arcs, and Points.
- **Site** - Specialized tools used for Site Design can be found on this tab.
- **Corridors** - Element selection, superelevation, and corridor modeling tools.
- **Model Detailing** - Element selection, Civil Cells, and 3D (linear template, surface templates, etc.) tools.
- **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 only), or Visualization (3D only).
- **Utilities** - Tools for Geographic Coordinate Systems, Item Types and Reports.
- **Collaborate** - Tools to upload to iTwin, Clash Detection and Markup tools.
- **View** - Commonly used view control tools.
- **Help** - Links to the help contents, user feedback, and Bentley Communities.

2. Searching the ribbon.

When you are not sure where to find a tool on the ribbon interface the Search Ribbon field in the upper right corner is your best friend.

a. Type **Template** in the search field.

The matches found in the ribbon menus appear. The search is across all ribbon menus, not just the currently active ribbon.



b. Hover over **Create Template**.

The search results expand showing where this tool is located on the ribbon.

c. Select **Create Template** to start that tool.

Notice that the Create Template tool started but the ribbon menu did not change.

d. Close the *Create Template* dialog.

e. Type **Template** in the search field again.

f. Hover over **Create Template** to expand the search options.

g. Select **OpenRoads Modeling → Corridors → Create → Template**.

The ribbon changes to the selected menu which contains the Create Template tool.

3. Auto hide ribbon.

a. Double click on any *Ribbon Tab* (such as Corridors) to set the ribbon menu in auto hide mode.

b. Double click a *Ribbon Tab* again disable auto hide mode.

4. Introduction to the Backstage.

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

b. Select **Settings**.

Design File settings, preferences, customizations, etc. are found in the Backstage, keeping the ribbon menus focused on the tools.

c. Click the Arrow in the upper left corner to return to the design canvas.

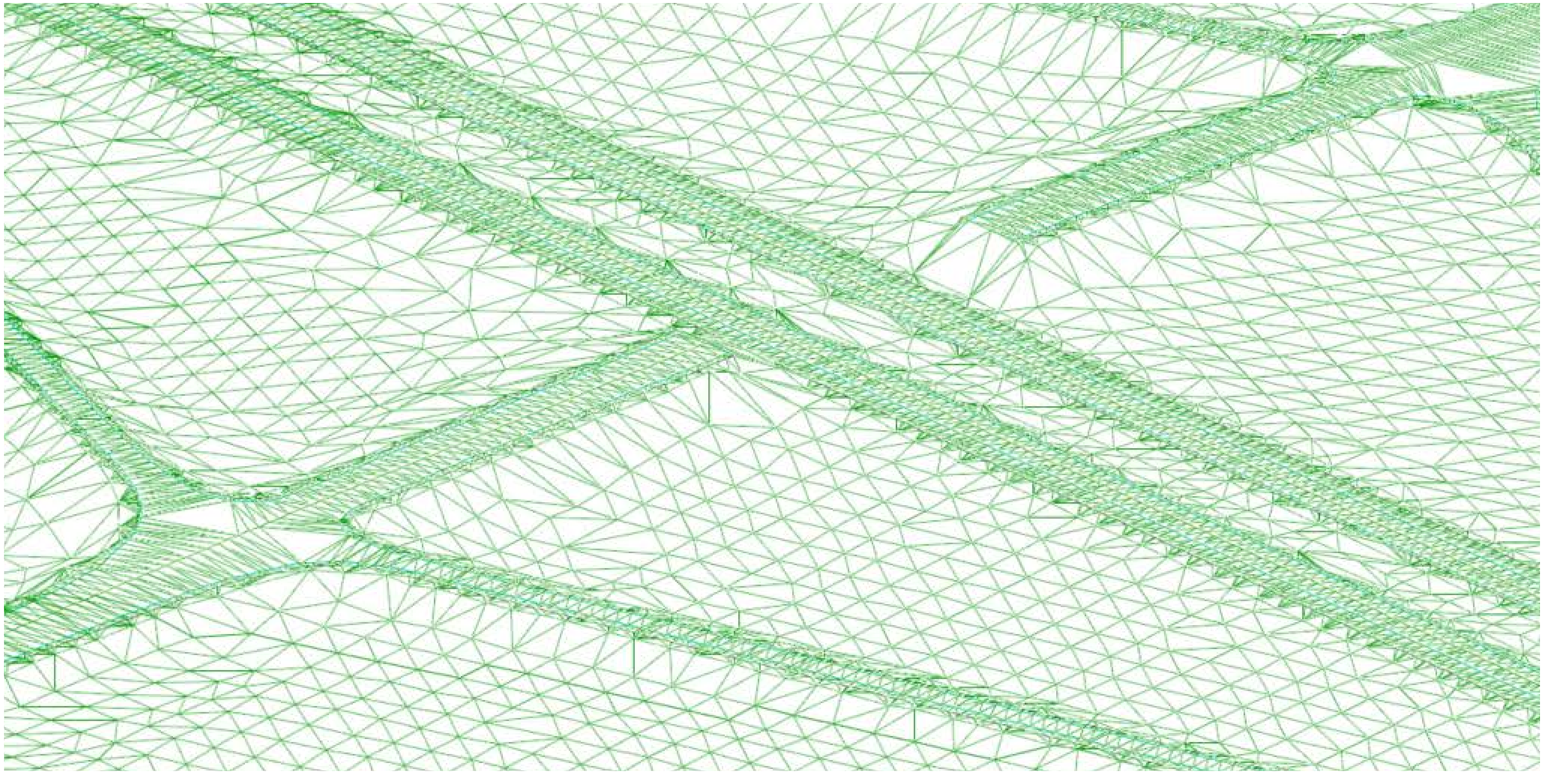
Import Existing Terrain Model

What is a Terrain Model?

A terrain model is a set of triangles mathematically computed from point data collected from the surface being modeled. They are typically used to model highly irregular surfaces, like the surface of the earth. A terrain model is created from 3D features such as points, breaklines, and contours. Terrain models are also referred to as digital terrain models (DTM's), triangulated irregular networks (TIN's), or triangulated surfaces. Terrain models are typically created by Surveyors. Surveyors collect 3D features of the existing ground surface and then build the existing ground terrain model from this data. They will then supply the terrain model to the roadway designers for their design.

In OpenRoads Designer, a terrain model is stored as a 3D mesh element in a 3D design (.dgn) file. When you select a terrain model in the design file, the Element Selection tool recognizes it as a Terrain Model, and the Properties and Explorer Windows will show it as a Terrain Model Element. The display of a terrain model in the product is controlled by using a Feature Definition and Element Template.

Being an element stored in a 3D design file, terrain models are easily shared and used by anyone using other Bentley products.

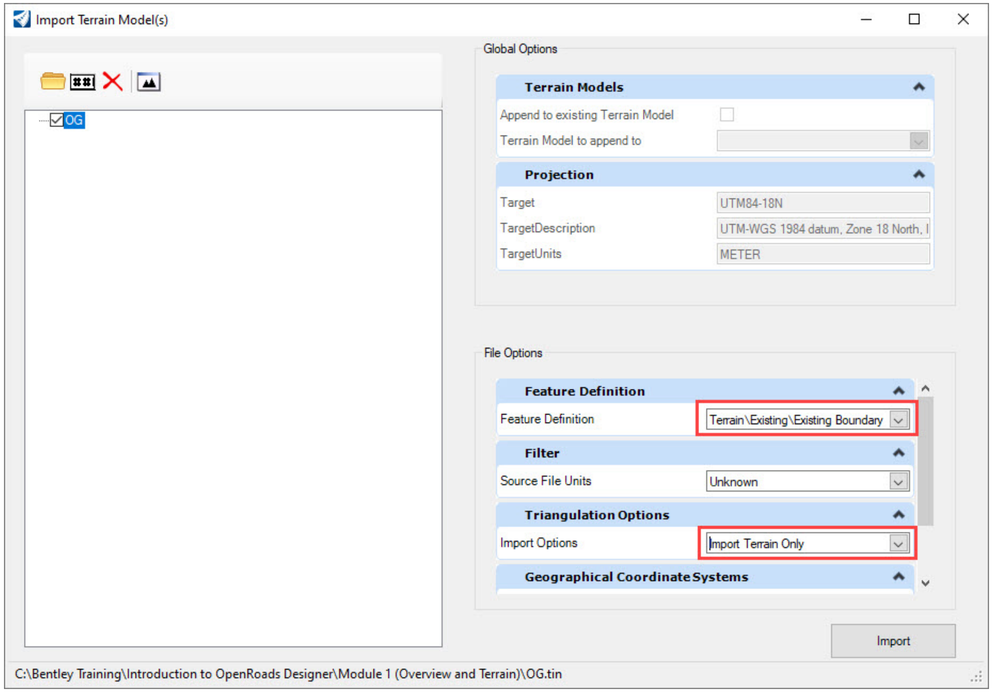


Import Existing Ground Terrain

In this section, you will learn to import an existing ground terrain model from a previously created .tin file. OpenRoads Designer supports the import of legacy file formats such as: **.tin**, **.dtm** and **.fil**. The software can also import terrain data from **.xml** files as well.

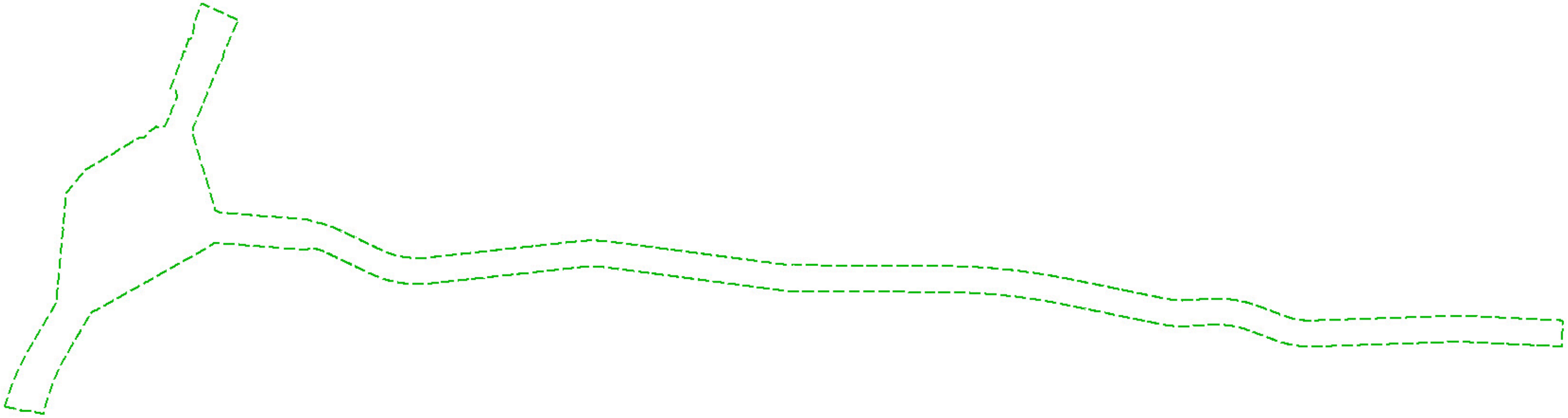
1. Select **From File** from the *Terrain* tab on the OpenRoads Modeling workflow (ribbon).
2. Select **OG.tin** from the *Module 1 (Overview and Terrain)* folder.
   a. Set the *Feature Definition* to *Terrain > Existing >* **Existing Boundary**.
   - This terrain could have originated from ConceptStation, InRoads, GEOPAK, MX or another application.

   b. Set the *Triangulation Options* to **Import Terrain Only**.



   c. Click **Import**.
   d. Close the *Import Terrain Model* dialog.

e. Select **Fit View** to see the terrain model.



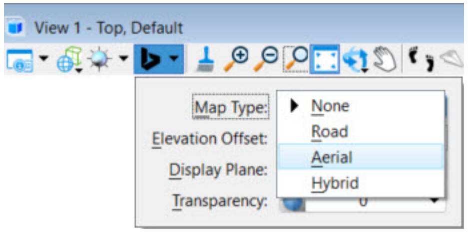
f. Select **Save Settings**.

HINT: The icon is found in the Quick Access toolbar at the top of the screen.

- The important thing to remember is that the terrain model is stored in a 3D design file and not an external database.

3. Review the Aerial Imagery by turning on the BING Maps for the project area.

a. Turn On Bing Maps, and set the *Map Type* to **Aerial**.



b. Review the aerial imagery and the terrain model boundary to get a better understanding of the project area.

c. Set the *Map Type* to **Road** and notice the Bing Map imagery updates to show more a classic road map view.

d. Set the *Map Type* to **Hybrid** and notice the Bing Map imagery updates to show the aerial imagery and a road map view.

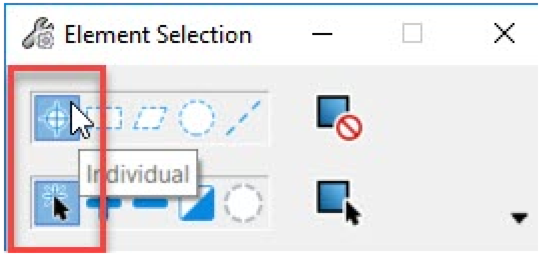
e. Turn off Bing Maps by setting the *Map Type* to **None**.

- This Bing Maps tool only works when there is a Geographic Coordinate System defined and you are connected to the internet.

Display 3D Terrain Model

In this section, you will learn how to display the terrain model triangles and breaklines

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.

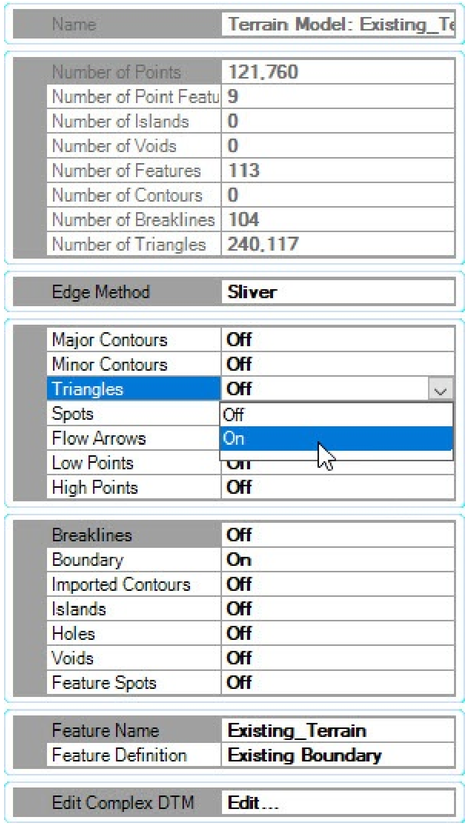
   Move the cursor slightly and **hover** the cursor over the selected outline for a few seconds and the context sensitive toolbar appears displaying tools commonly used with terrain models. More terrain model tools can be found on the Terrain ribbon menu.

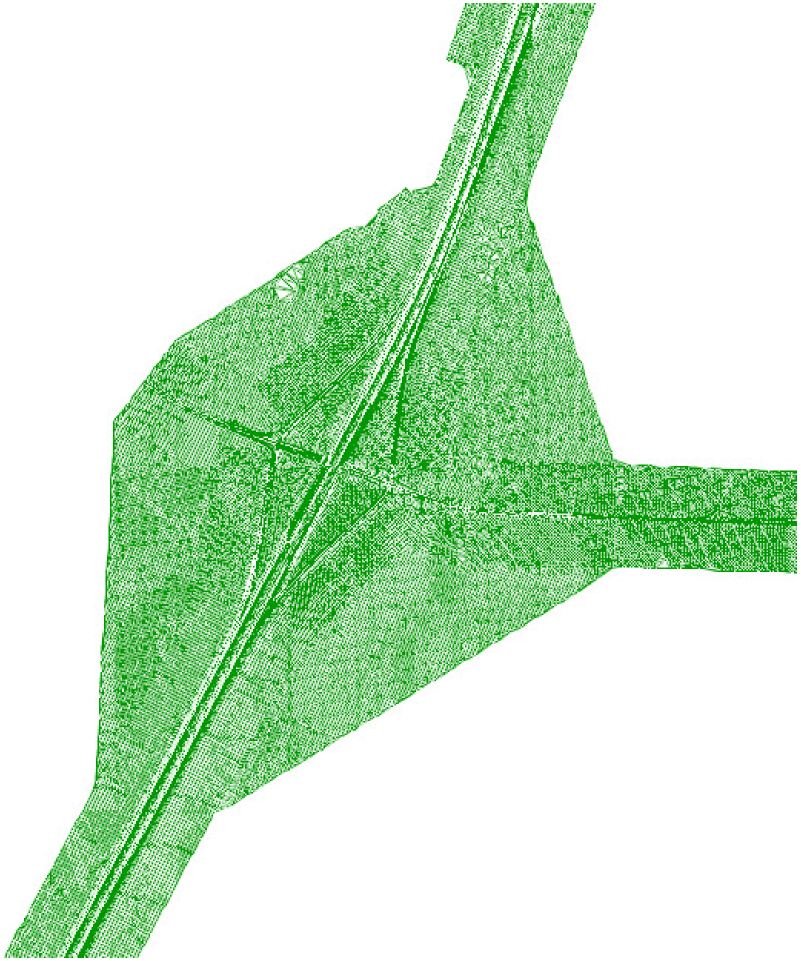
4. **Select** the *Properties* tool.

The context sensitive Properties dialog is displayed near your cursor. Move your cursor over the dialog to select different parameters. Moving your cursor off the dialog will dismiss it.

a. **Select** the *Triangles* option and toggle it **On** keep your cursor over the dialog to keep it active.

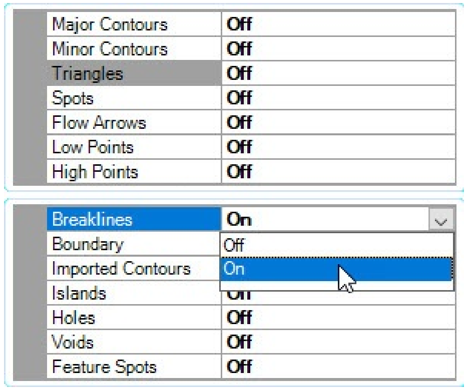
The display updates to display the terrain triangles.

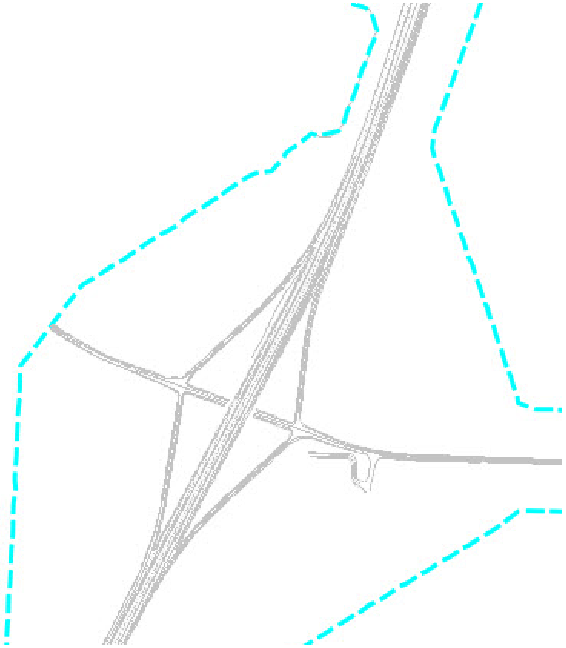




b. Toggle the *Triangles* **Off** and the *Breaklines* **On** and notice how the display changes.

If the properties dialog dismissed, just use the Element Selector tool to select the terrain, hover and select Properties on the context sensitive menu again.





c. Practice with toggling **On/Off** other terrain features.

Notes:

- In this terrain model, as in many terrain models, you will find that all of the different source features may not exist.
- In the dialog, you can double-click on a feature name or the On/Off indicator to toggle that feature display on/off.
- If you toggle all the feature displays off, the boundary feature will still be displayed. At least one feature has to be displayed in order for the terrain to be selected and the boundary is the default feature that will be displayed if all the features are toggled off.

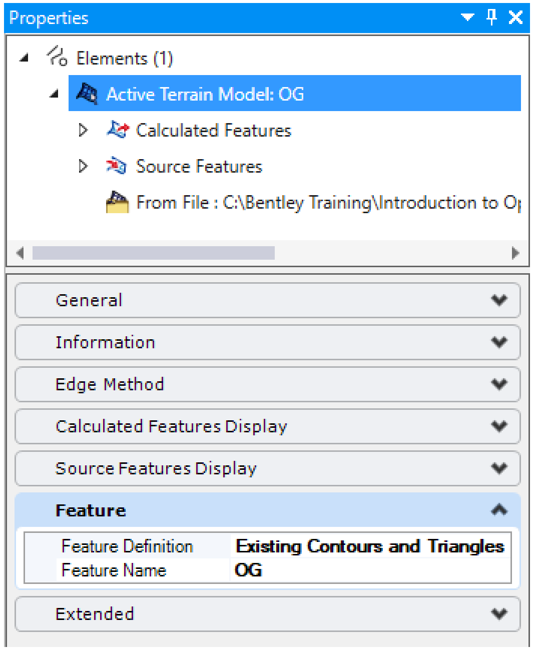
Using Feature Definitions

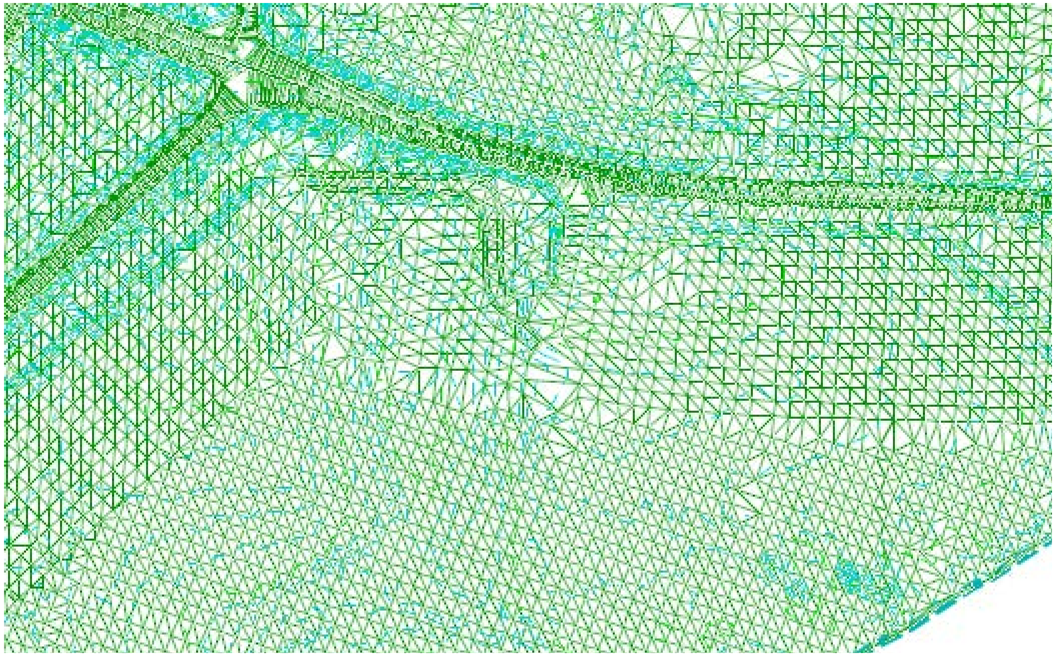
In the previous section, you have changed the terrain display by manually turning on and off different features and changing parameter values. Now you will learn how to adjust the terrain display by changing the feature definition. A feature definition defines *what* an item is and points to *how* it will be displayed. Using a feature definition is a quick way to change the display parameters without having to change each individual setting.

1. Select a Feature Definition to define the display parameters.

   a. Select the terrain and then select the *Properties* tool, then in the *Properties* panel select **Active Terrain Model: OG**

   b. In the *Feature* section, change the *Feature Definition* from Existing Boundary to *Terrain > Existing >* **Existing Contours and Triangles**.

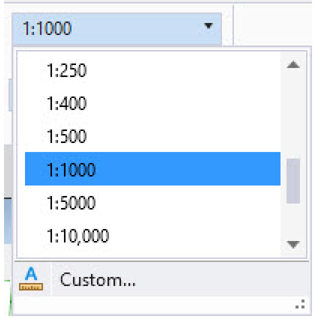


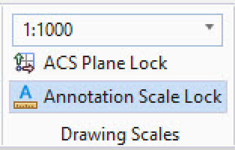


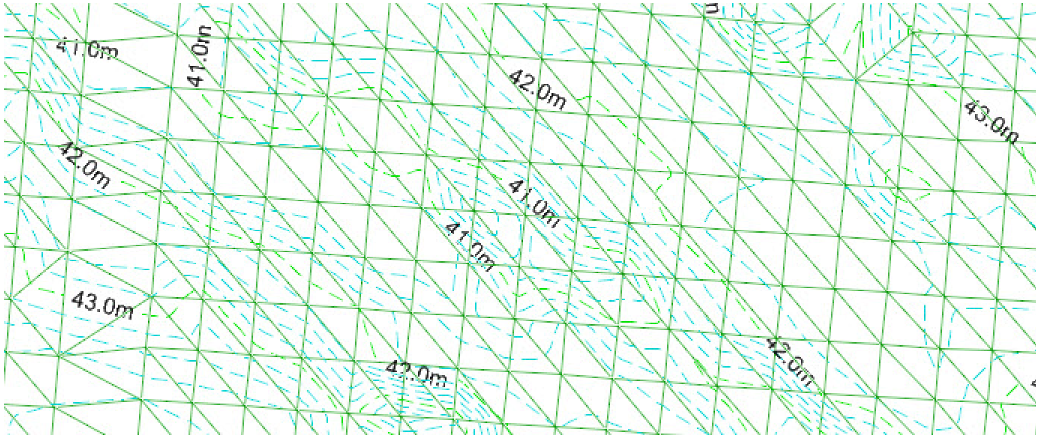
   Note that the triangles are now displayed in addition to the contours.

2. **Zoom** into the view so that you can see the *elevation labels* on the major contours.
3. In the *Feature* section, set the *Feature Definition* to **Existing Contours**.
4. Change the text size.

   a. Select the *Drawing Production* tab and then in the *Drawing Scales* category, select the **drop-down menu** and change the drawing scale to **1:1000**







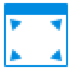
   Note that the text size of the major contour labels increases.

   b. Experiment with **selecting** different *Feature Definitions* and setting different *scales* for the text.

5. Set the final terrain model parameters.

   a. In the *Feature* section, set the *Feature Definition* to **Existing Boundary**.

   This will define *what* the terrain element is and the default values for *how* it will be displayed.



   b. Select **Fit View** at the top of the view window.

   c. **OPTIONAL**: **Close** the **Properties** window that is docked on the left side of your view.

   d. Select **Save Settings** from the Quick Access ToolBar.

Skills Assessment

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

1. A terrain model is created and stored as a 3D mesh element in a 2D design file.
   a. True
   b. False
2. Select ____ on the ribbon menu to activate the Back Stage View to access commands for new file, open file, save settings, user and design file settings and preference, and other tools. (fill in the blank)
   a. Explorer
   b. File
   c. Element Selection
3. Terrain feature displays are toggled on and off using the ______. (fill in the blank)
   a. Key-in Tool
   b. Explorer Window
   c. Properties Window or Properties tool
   d. Context Sensitive Menu
4. Terrain display is controlled by …
   a. Feature Definition
   b. Feature Symbology
   c. Element Templates
   d. Annotation Groups
   e. All of the above

5. A Feature Definition defines "what" an item is and a Feature Symbology defines "how" the item is displayed.
    a. True
    b. False
6. It is a best practice to reference a 3D terrain model design file into a 2D project design file.
    a. True
    b. False
7. A user should manually create a 3D model in their 2D project file.
    a. True
    b. False
8. When a terrain model is referenced into another design file, what must be turned on so that you can change how the terrain is displayed?
    a. Override Symbology
    b. Feature Definition
    c. Element Template
9. Override symbology controls are view dependent, allowing you to separately control how each view is displayed.
    a. True
    b. False
10. When Override Symbology is on, a Feature Definition can be used to quickly change the terrain display.
    a. True
    b. False
11. The Label Contours and Label Spots commands are located on the Drawing tab.
    a. True
    b. False

Module 2: Geometry

Description

In this module you will import and annotate geometry. You will also learn how to create, edit and review geometry.

Objectives

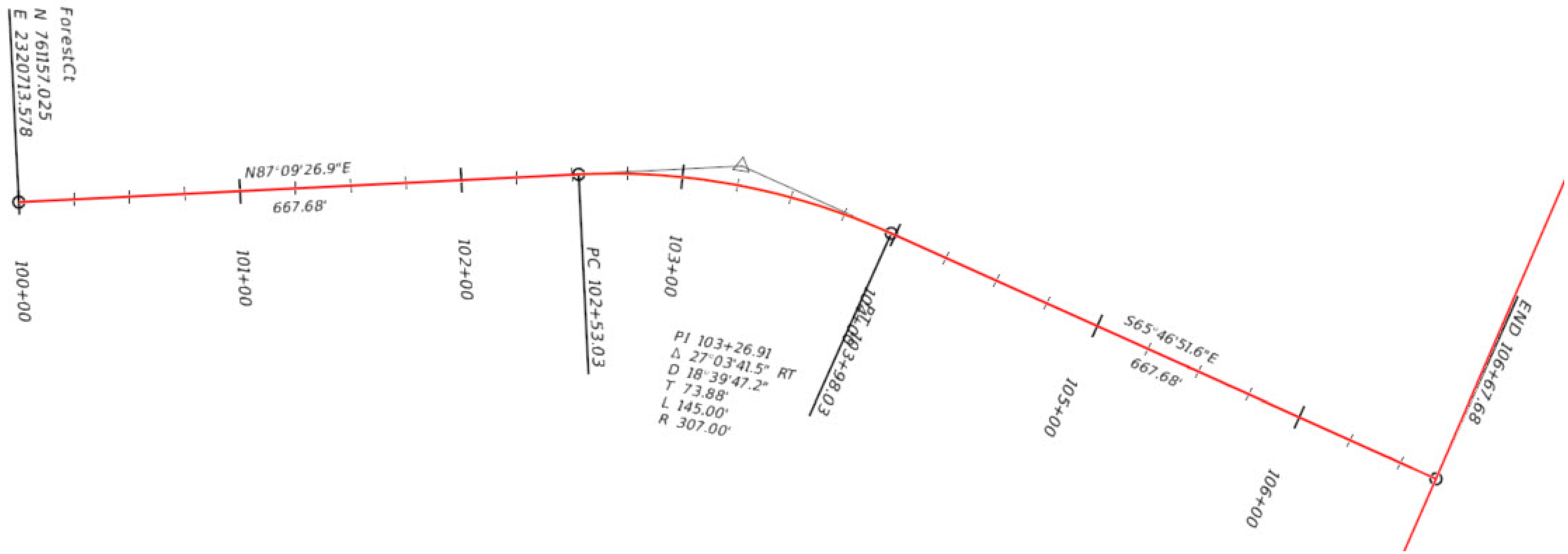
- Import and Annotate Existing Geometry
- Create Civil Geometry (Horizontal and Vertical Alignments)
- Feature Definitions
- Annotation
- Review and Edit Geometry

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.



Attach Existing Ground Terrain

Before we begin creating civil geometry we will first attach the existing ground terrain model.

1. Open the file **Geometry.dgn** from the *Module 2 (Geometry)* folder.
2. Attach **Terrain3D.dgn** as reference using a *Coincident-World* orientation.
    a. Select *Home > Primary > Attach Tools >* **References**
    b. Select **Attach Reference** in the *References* dialog.
    c. Browse to and select the *Terrain3D.dgn* file.
    d. Use a **Coincident - World** *Orientation*.
3. **Fit** the view.

    The original ground terrain loaded in the previous exercise is displayed.
4. Set the terrain model as the **Active Terrain Model**.
5. Select **Save Settings**.

Import Geometry

In this section, you will learn how to import geometry from a previously created .alg file. OpenRoads Designer provides you the ability to import legacy geometry file formats such as: **.alg**, **.gpk**, and **.fil**. You can also import **.xml**, **.ifc**, **.inp** and **.txt** files as well.

1. Import the geometry.

   a. Select **Import Geometry** from the *Geometry* ribbon tab.

   b. Browse to and select the **Geometry.alg** file.

      - You may have to set the file filter to *.alg
      - OpenRoads Designer does support importing of other common geometry files from other software.

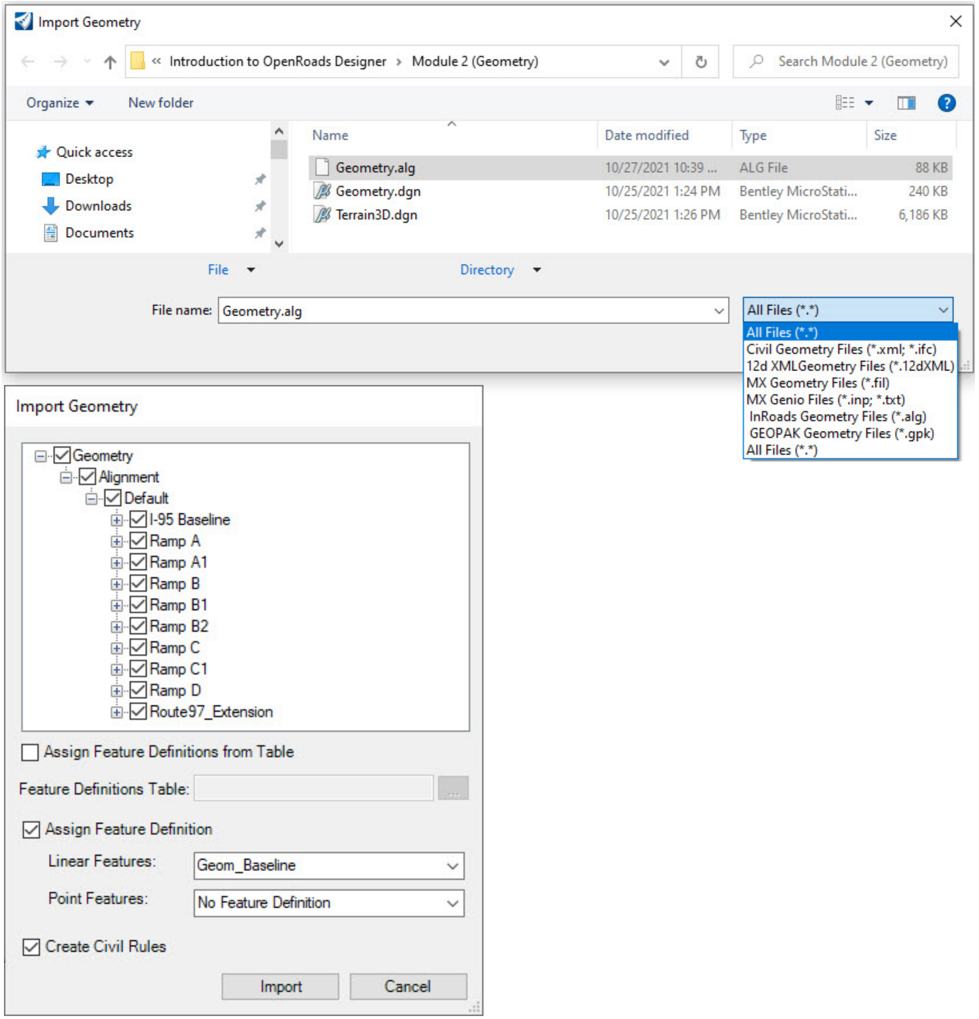
   c. Select the check box next to *Geometry* to select all alignments.

   d. Enable the *Assign Feature Definition* option.

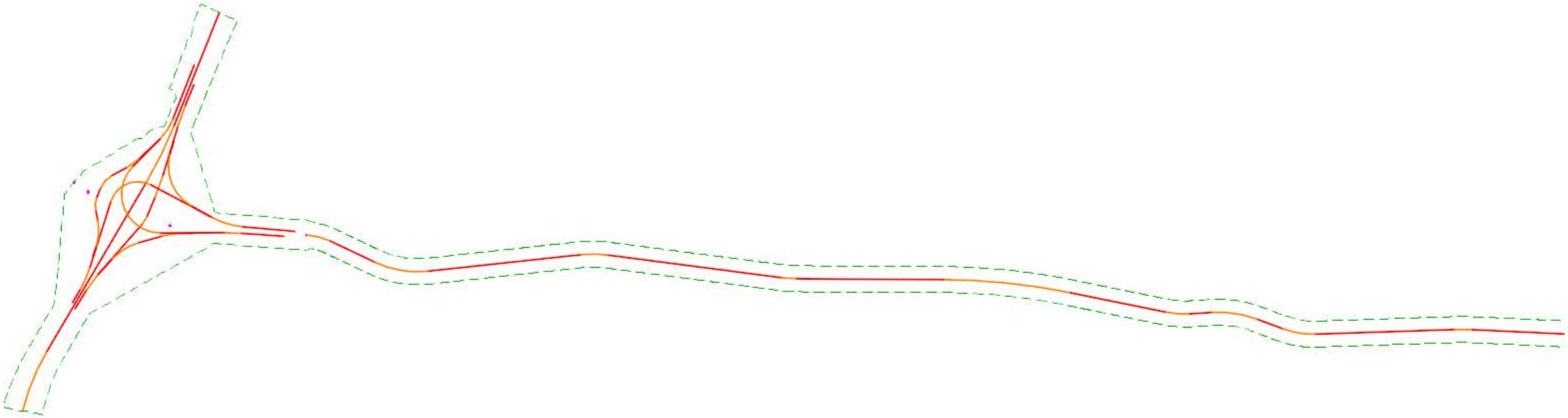
   e. Set *Linear Features: Alignment* > **Geom_Baseline**

   f. Enable the *Create Civil Rules* option.

   g. Click **Import**.



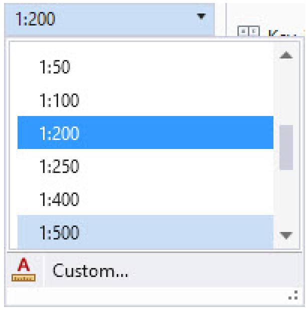
The imported geometry will look like the image below.



Annotate Geometry

Geometry annotation is dynamic and intelligent. It is ruled and associated to the Civil Geometry from which it was created thus making it very easy to update as things change. In this section, you learn how to annotate geometry.

1. Zoom to where about half of the long east-west alignment (**Rt97_Extension**) is visible.
2. Annotate a single alignment
    a. Select *Drawing Production > Annotations > Element Annotation >* **Annotate Element**
    b. Select the *Route97_Extension* centerline (the long east-west alignment).
    c. Reset to annotate the alignment.
3. Change the annotation scale.
    a. Select the *Drawing* ribbon tab.
    b. Set the **Annotation Scale** in the *Drawing Scale* group to **1:500** to make the annotations larger.



4. Remove annotation from a single alignment.
    a. Select *Drawing Production > Annotations > Element Annotation >* **Remove Element Annotations**
    b. Select the *Route97_Extension* centerline
    c. Right click or Reset to clear the annotation.

5. Annotate multiple alignments

   a. Fit the view so all alignments are visible.

   b. **Select All** to add the geometry elements to a selection set.

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

   d. Data point to annotate the selected geometry.

6. Set the **Annotation Scale** on the *Drawing* ribbon tab to **1:200** to update all annotations to a 200 scale.

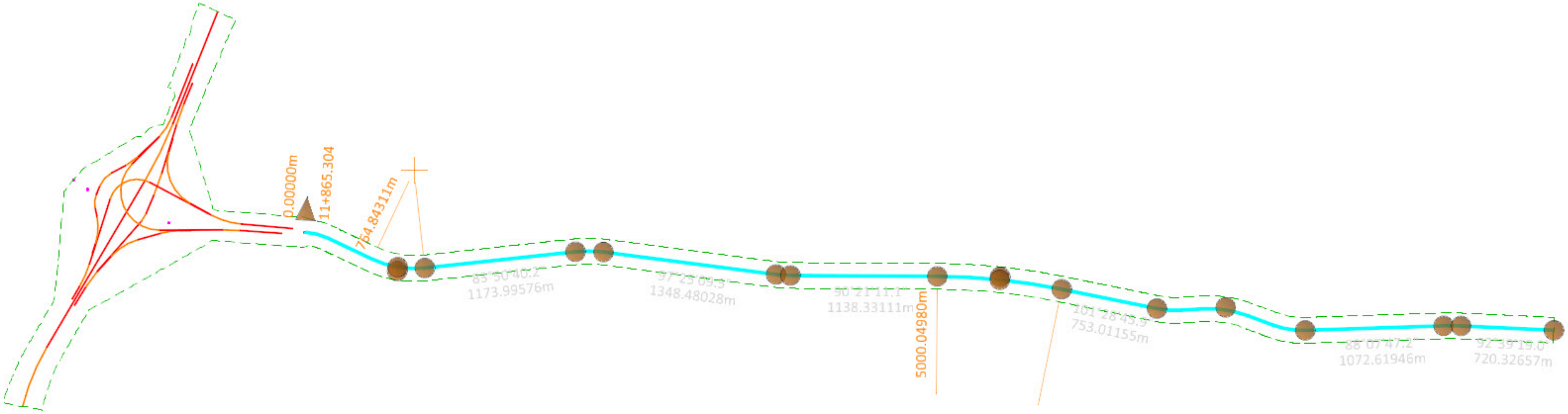
7. *Fit View* and

8. *Save Settings*.

Review the Route 97 Extension Alignment

In this section, you learn how to review Route97 Extension horizontal alignment.

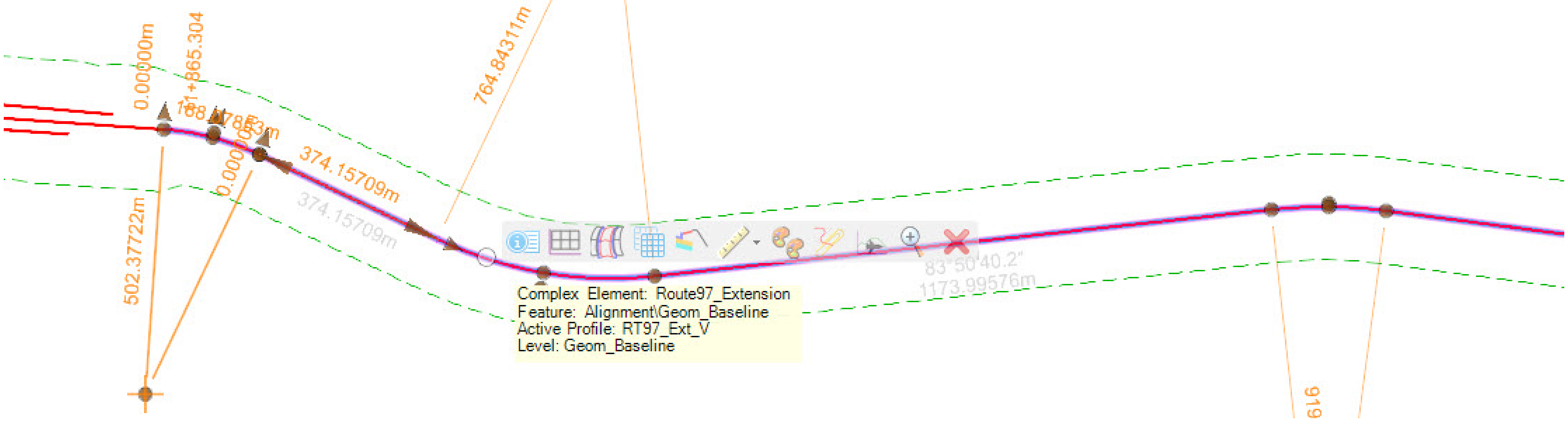
1. Select the *Element Selection* tool.
2. Select the **Route 97_Extension** alignment. Route97_Extension is the long alignment that runs west to east.



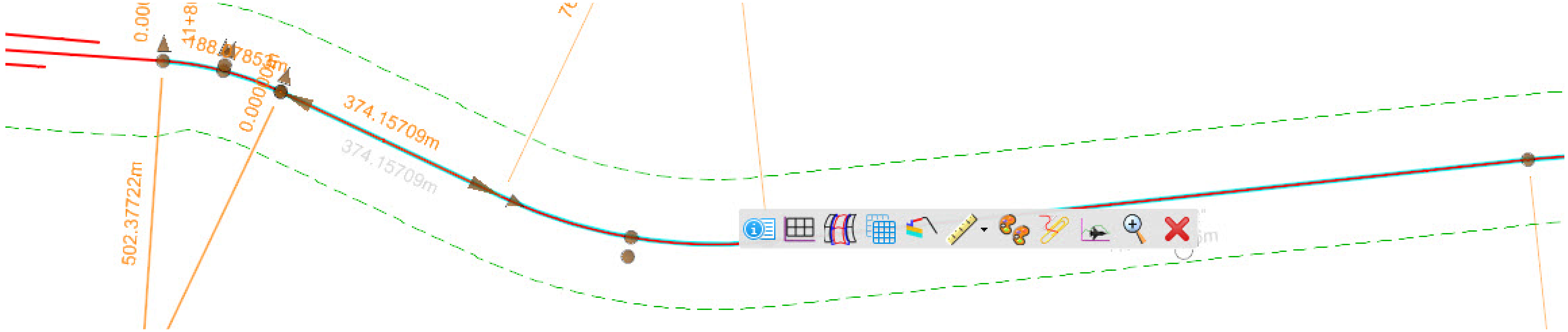
Note that once selected geometric data and graphic manipulators are displayed on the alignment. The geometric data is known as dynamic text and can be easily edited by simply clicking on a value and keying in a new value. The graphic manipulators can be used to move or extend geometry.

3. Zoom in near the western portion of the alignment. **HINT:** You can use the mouse wheel to zoom in and zoom out.
4. With the alignment still selected hover your cursor over the **Route97_Extension** alignment.

Note the element information popup dialog lists the name of the alignment as well as the active profile **RT97_Ext_V**.



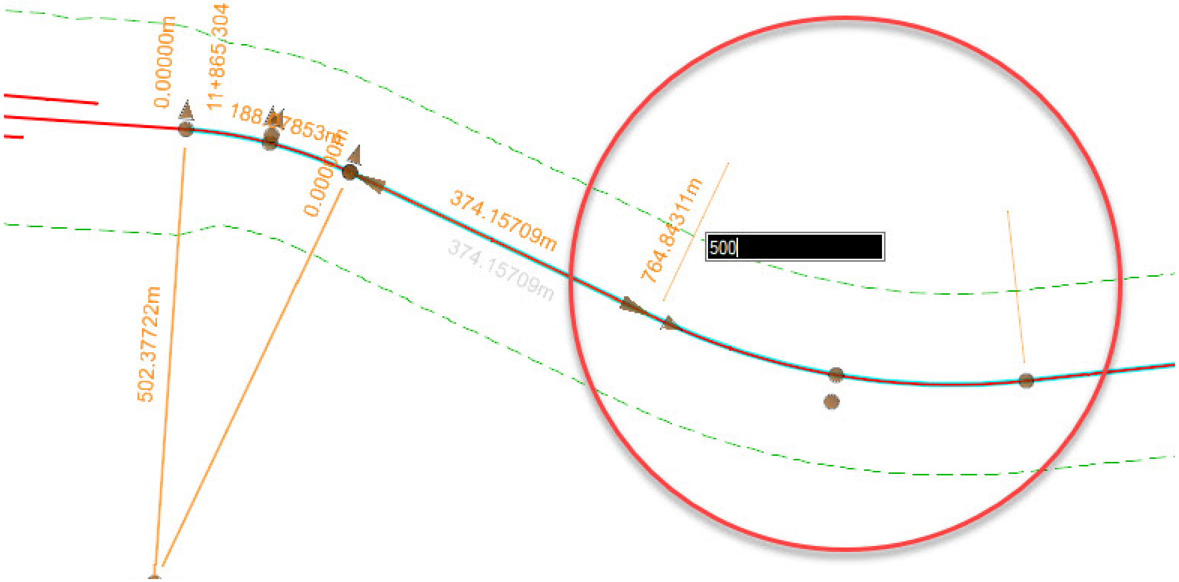
Also, after you select and hover your cursor over the alignment another menu will appear. This is the context menu, it gives you direct access to other tools.



Edit Horizontal Curves

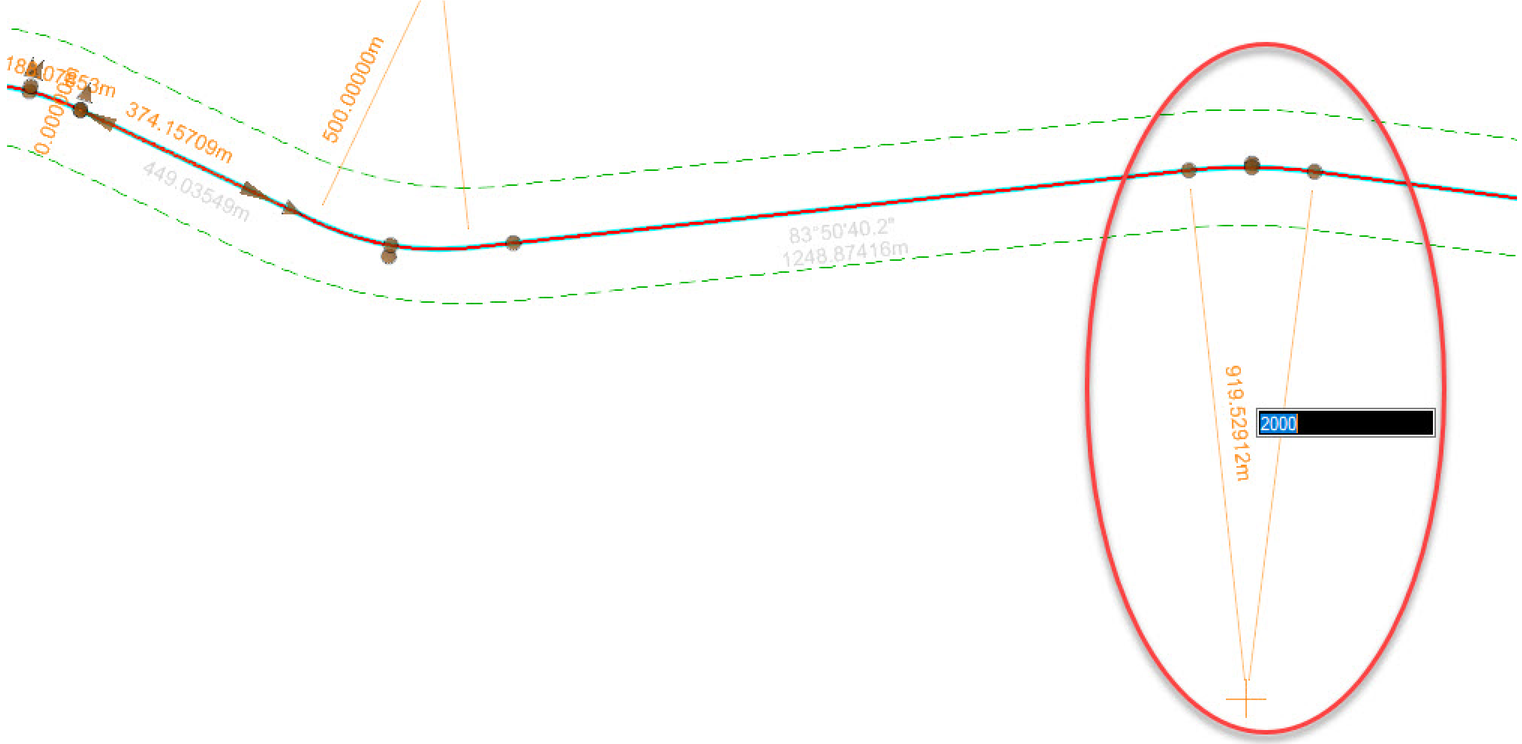
Simple editing of the alignment can be done by simply selecting the dynamic text and keying in new values. In this section, you will learn how to adjust the radius value for the second curve.

1. With the **Route97_Extension** alignment still selected change the radius, left click on the radius value (*764.84311m*) for the second curve and change it to **500** and press **<ENTER>** to complete. **Tip:** You may need to hover your cursor around the PC for the existing Radius value to appear.



The geometry and annotation will automatically update. It may take several seconds to process since there is a lot of annotation to update on the alignment.

2. Left Click on the radius value (*919.52912m*) for the <u>third curve</u> and change it to **2000** and then press **<ENTER>** to complete.



The geometry and annotation will automatically update. It may take several seconds to process since there is a lot of annotation to update on the alignment.

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

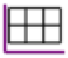
4. Click the **Undo** button <u>two times</u> to undo the changes. **Note:** It may take a minute to update.

Since all geometry is stored and managed in the design file, **Undo** and **Redo** commands are fully supported. There is no need to save your file when geometry is created and edited.

Review the Profile

Profiles are displayed in a separate specialized view known as a Profile Model. Any time you want to view the vertical alignment or profile you must open a Profile Model view window. In this section, you will learn how to view the profile for Route97_Extension.

1. In *View 1,* select the **Route97_Extension** alignment.
2. Hover your cursor over the alignment until the context menu appears.

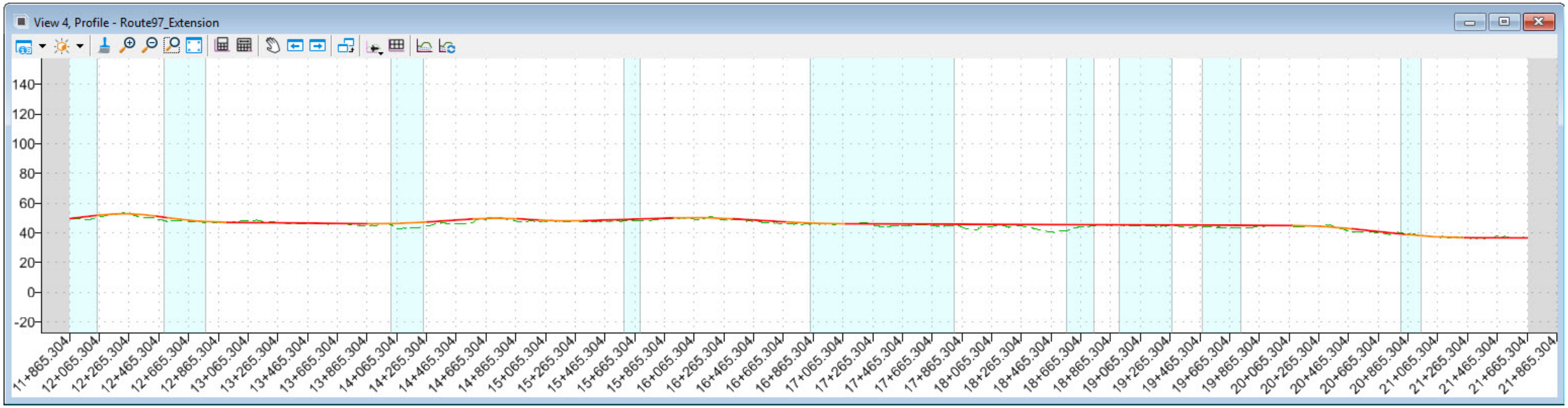


3. Select Open Profile Model.

   a. Follow the prompts:

   - *Select or Open View:* Select the **View 4** button from the view buttons at the bottom of the screen. **View 4** will open.
   - Left click in **View 4** to display the profile.

     The profile will now be displayed in **View 4**.



You will see the existing ground profile (from the terrain model) and the proposed profile for Route97_Extension.

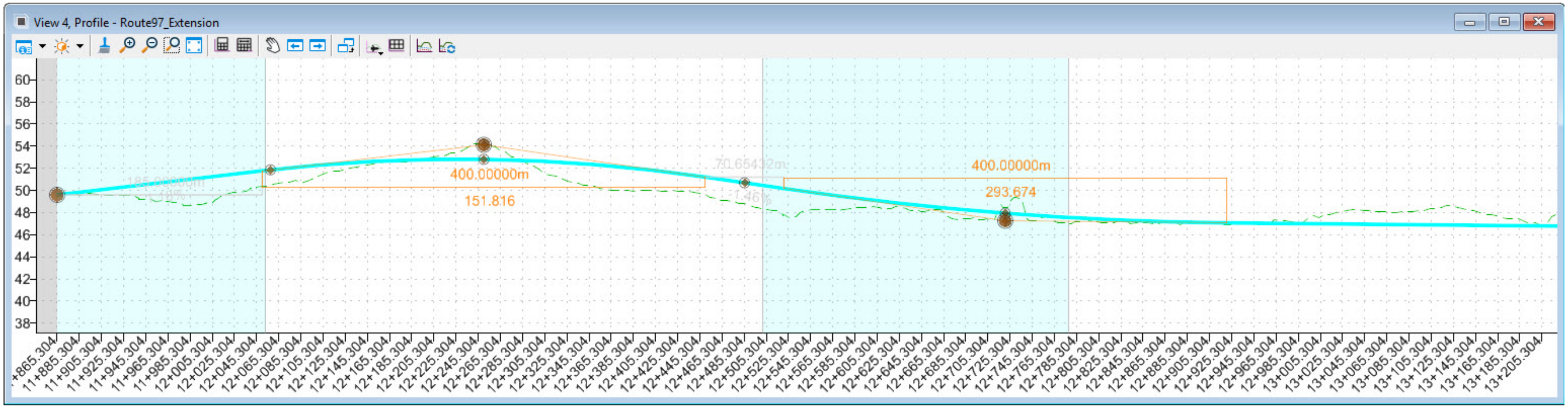
Select the *Element Selection* tool to exit the Open Profile Model command.

Edit the Profile

The process to edit the profile is the same as it is for editing the horizontal alignment. Simple editing of the profile can be done by simply selecting the dynamic text in the profile model view and keying in new values. In this section, you will learn how to adjust the vertical curves for the Route97_Extension profile.

1. Left click in *View 4* to make it the active view.

2. Zoom in to the western portion of the profile. **HINT:** You can use the mouse wheel to zoom in and out.
3. Select the **Route97_Extension** profile.



The geometric data (dynamic text) and graphic manipulators will now be displayed. Also, note the profile is ruled and associated to the horizontal geometry.

4. Edit the vertical curve lengths for the first two curves.

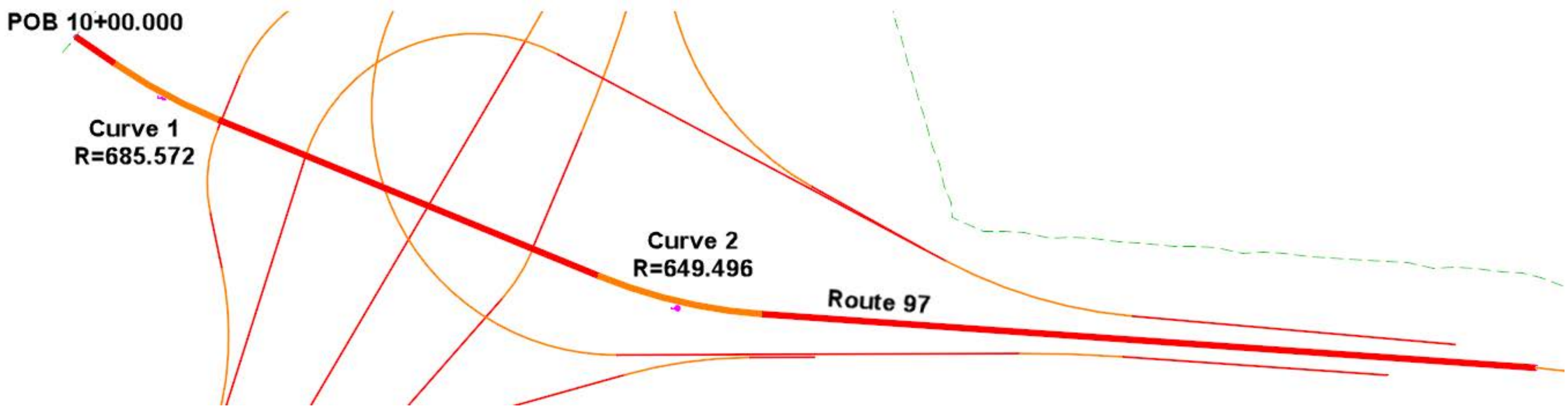
   a. Select the <u>first</u> vertical curve value (*400.0000m*) and key-in **200** and then press **<ENTER>**. The curve and profile will update.

   b. Select the <u>second</u> vertical value (*400.0000m*) and key-in **150 and then press <ENTER>**. The curve and profile will update.

5. Left click in *View 4* to de-select the profile.
6. Close *View 4*.

Create the Horizontal Alignment for Route 97

So far you have learned how to import geometry from legacy data (. alg) and review geometry. In this section you will learn how to use the Civil Geometry tools to create the horizontal alignment for Route 97. The alignment we will be creating is shown in the image below.



1. Create first tangent line and first horizontal curve.

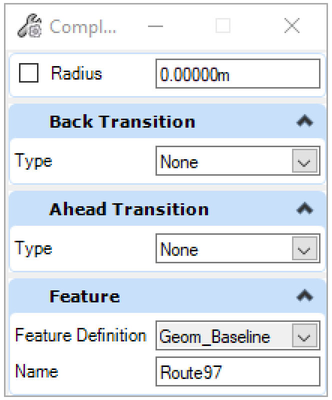
a. Zoom in near the circles labeled **PI #1 and PI #2.** They are located in the western section of the project. This will be the starting point for the alignment.

We will begin placing the alignment starting at **P1 #1** by using the *Complex By PI* tool.

b. Select *Geometry > Horizontal > Complex Geometry >* **Complex By PI**

c. Adjust the dialog as shown.

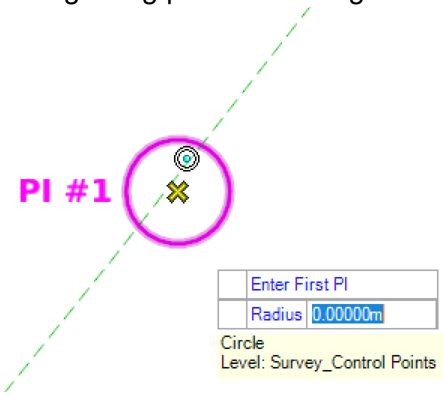
- *Radius:* **0.0**
- *Back Transition:* **None**
- *Ahead Transition:* **None**
- *Feature Definition*: *Alignment >* **Geom_Baseline**
- *Name*: **Route97**



d. Follow the heads-up prompts attached to your cursor:

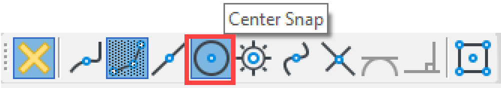
- *Enter First PI:* **0.0** (Press **<Enter>** or **<Tab>** to lock the value).
- Activate *AccuSnap* and left click **Center Snap** to enable it.

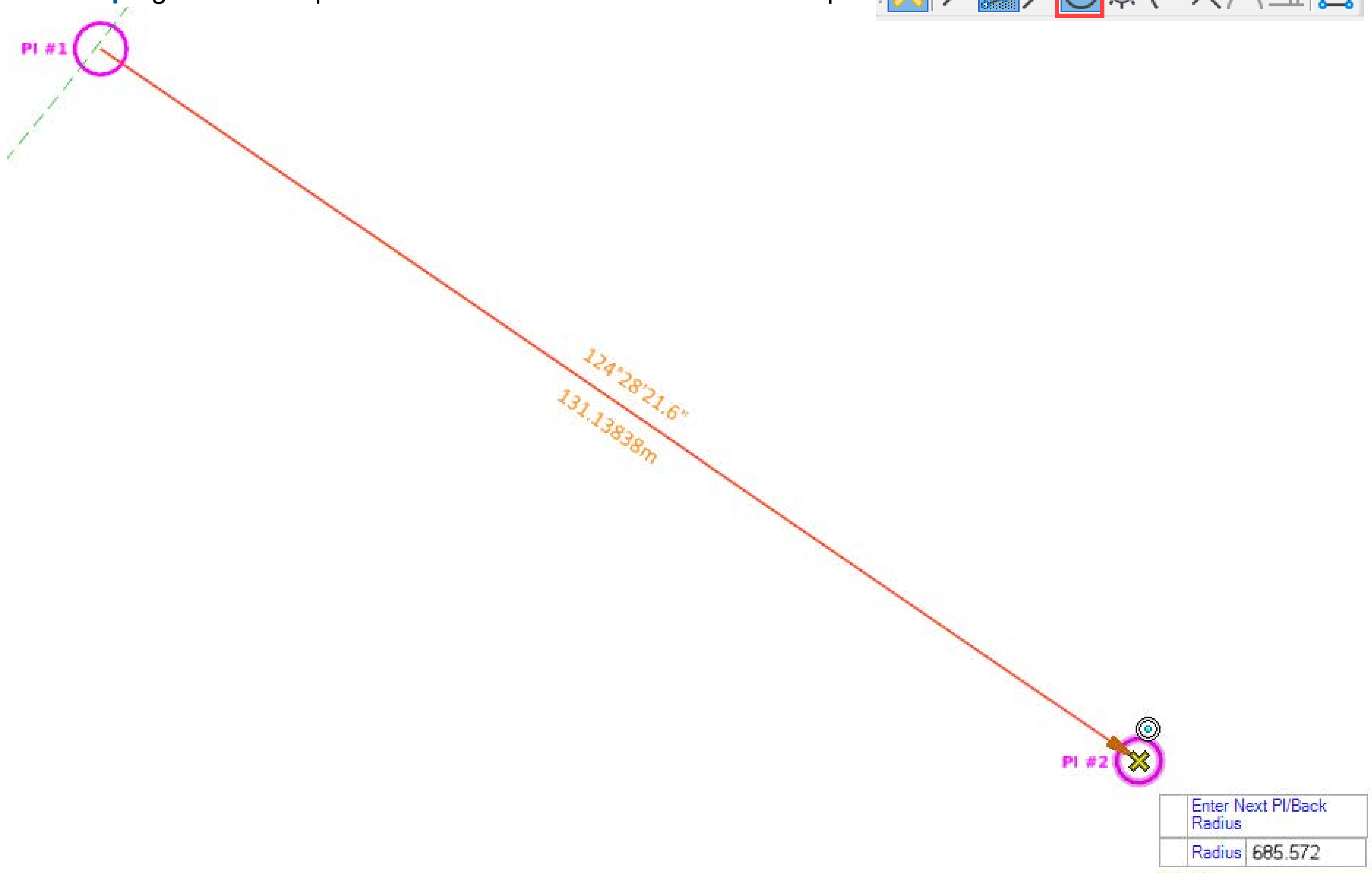
- Snap to the center of **PI #1** to place the beginning point of the alignment. Left click to accept.



- Continue to follow the prompts attached to your cursor.
- *Enter Next PI/Back Radius:* **685.572** (Press **<Enter>** or **<Tab>** to lock the radius value). The **<End>** key can be used to unlock values.
- Slowly move your cursor toward **PI #2**

- Enable **Center Snap** again and snap to the center of **PI #2**. Left click to accept.





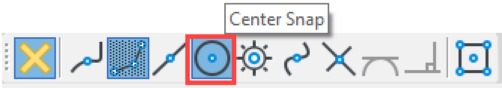
The first tangent section of the alignment has now been placed. Also, a horizontal curve with a radius of **685.572** has been placed at **PI #2**. It will slide along the back tangent as you move your cursor to the next PI location.

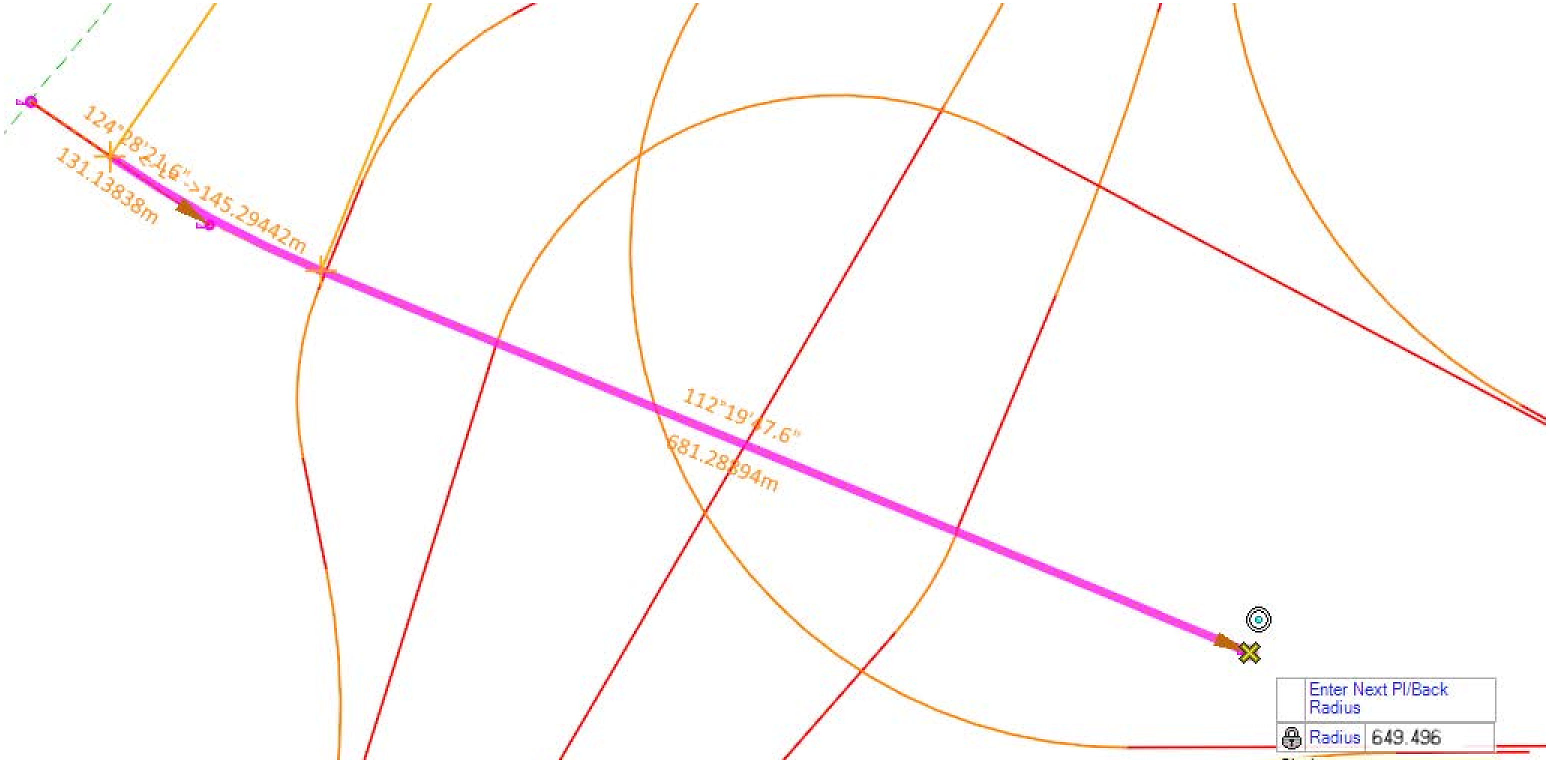
2. Place second tangent line and second horizontal curve.

a. Continue to follow the heads-up prompts:

- *Enter Next PI/Back Radius:* **649.496** (Press **<Enter>** or **<Tab>** to lock the radius value). The **<End>** key can be used to unlock values.
- Slowly move your cursor toward **PI #3**

b. Enable **Center Snap** again and snap to the center of **PI #3**. Left click to accept.





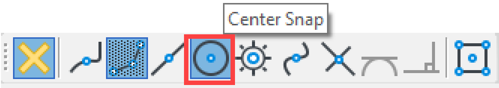
The second tangent of the alignment has now been placed. Also, a curve with a radius of **649.496** has been placed at **PI #3**. It will slide along the back tangent as you move your cursor to the next PI location.

3. Place final tangent.

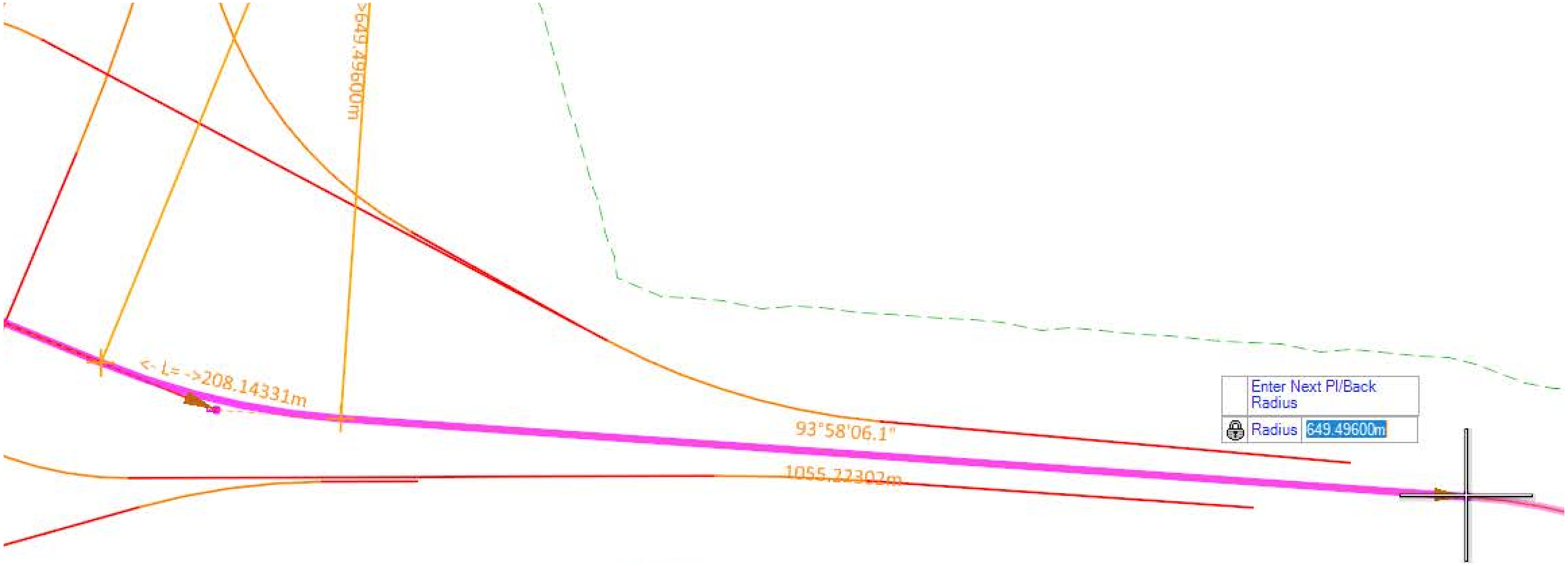
   a. Continue to follow the heads-up prompts:

      - *Enter Next PI/Back Radius:* **649.496** (this will be pre-populated from previous step).
      - Slowly move your cursor toward **PI #4**

   b. Enable **Center Snap** again and snap to the center of **PI #4**.



   c. *Left click* to accept and *Right click* to complete.



4. Annotate the alignment.

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

   b. Select the *Route97* centerline.

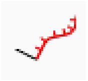
   c. Right click or Reset to annotate the alignment.

5. Review the beginning station.

   a. Zoom to the beginning of the alignment and note the beginning station is 0+000. Since we did not define a start station, zero is used as the default.

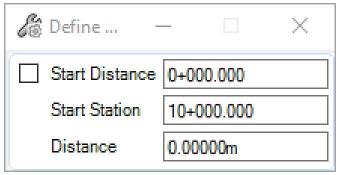
Now let's take a look at how to define the Start Station.

6. Define the Start Station.



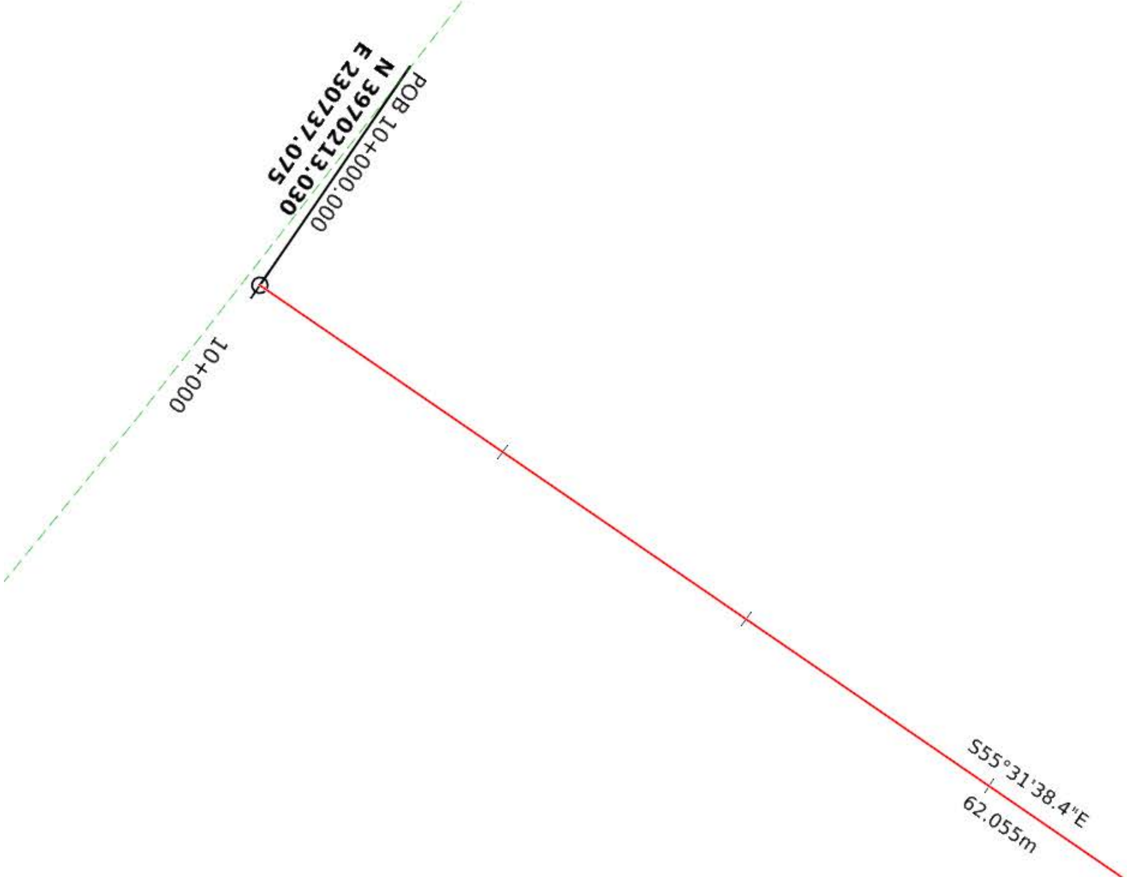
a. Select *Geometry > Horizontal > Modify >* **Start Station**

b. Follow the heads-up prompts:



- *Locate Element:* Select **Route 97** alignment
- *Start Distance:* **0.0** (Press **<Enter>** or **<Tab>** to lock the value).
- *Start Station:* **10+000**

After the start station has been defined note that the annotation updated automatically displaying the new stationing along the alignment.



Create the Vertical Alignment for Route 97

In this section, you will learn how to create the vertical alignment for Route 97.

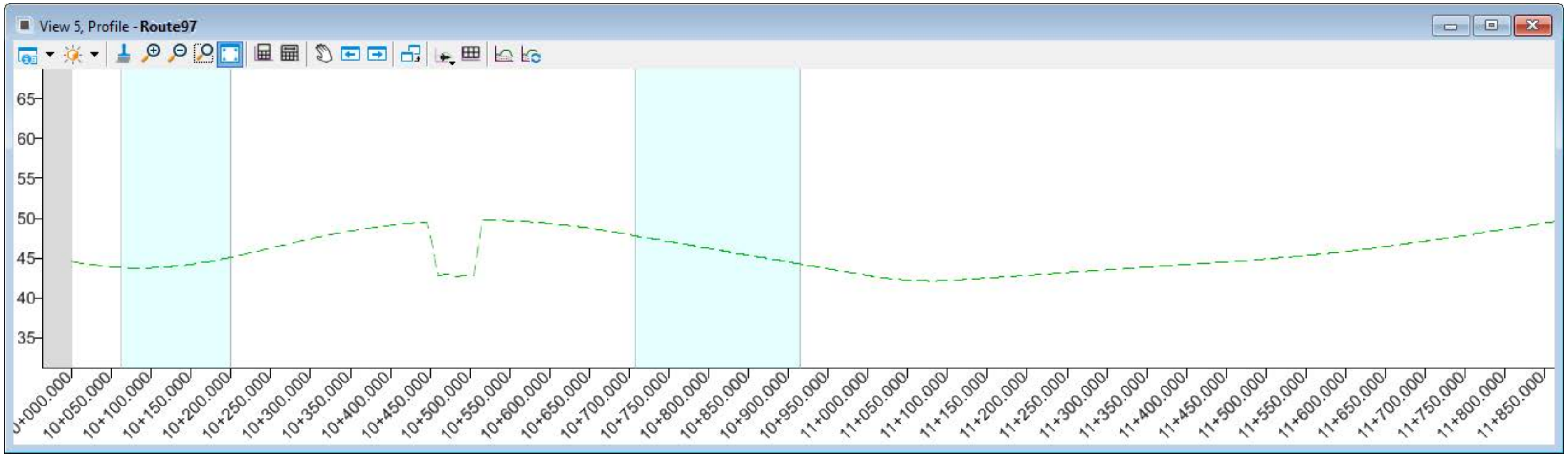
1. In *View 1,* select the **Route97** alignment.
2. Hover your cursor over the alignment until the context menu appears.

3. Select Open Profile Model.

   a. Follow the prompts:

   - *Select or Open View:* Select the **View 5** button from the view buttons at the bottom of the screen. **View 5** will open.
   - Left click in **View 5** to display the profile.

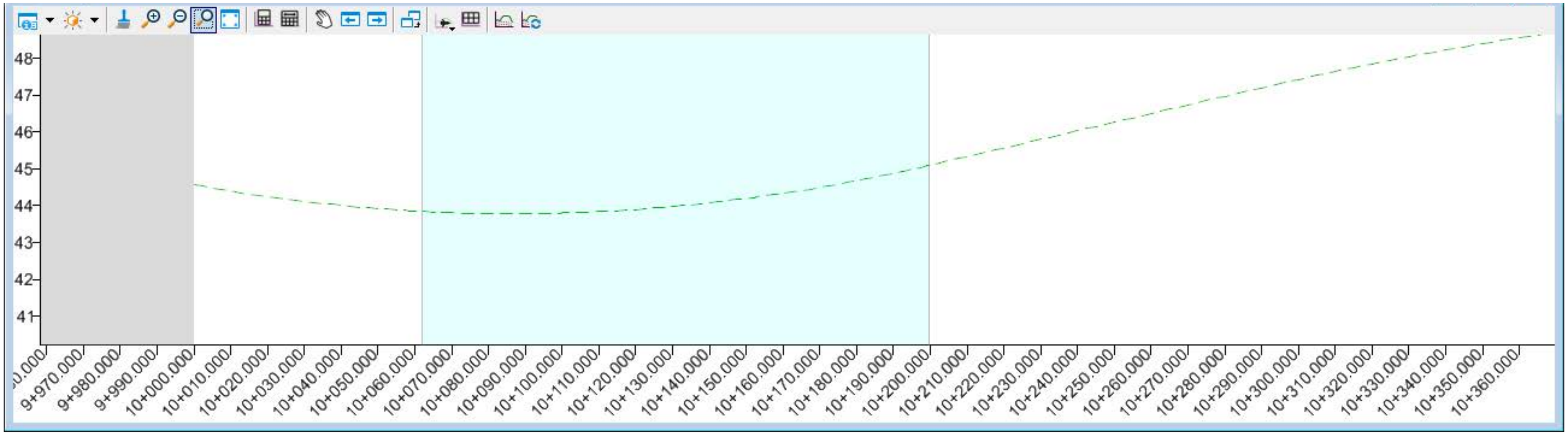
     The existing ground profile will now be displayed in **View 5**.



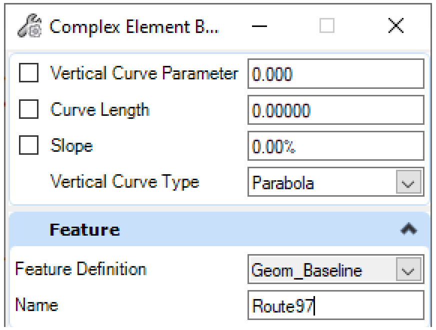
You will see the existing ground profile (from the terrain model).

4. Select the *Element Selection* tool to exit the *Open Profile Model* command.

5. Zoom in near the beginning of the existing ground profile.



6. Place the first VPI and first vertical curve.



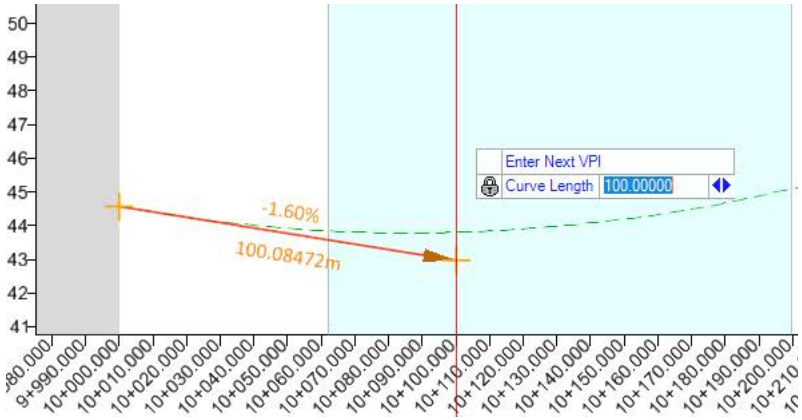
a. Select the *Geometry > Vertical > Complex Geometry >* **Profile Complex By PI**

b. Populate the dialog as shown in the image.

c. Set the *Feature Definition* to **Geom_Baseline** and *Name:* **Route97**

- *Enter First VPI:* Snap to the beginning of the existing ground profile.
- *Enter Next VPI:* Use the left or right arrow key to navigate to the *Slope* field.
- Key in **-1.6%** and press **<Enter>** or **<Tab>** to lock the value.
- Use the left or right arrow key to navigate to the *Curve Length*.
- Key in: **100** and press **<Enter>** or **<Tab>** to lock the value.
- Move the cursor to approximately **10+100** to define the length of the first tangent.
- **Left click** to accept.

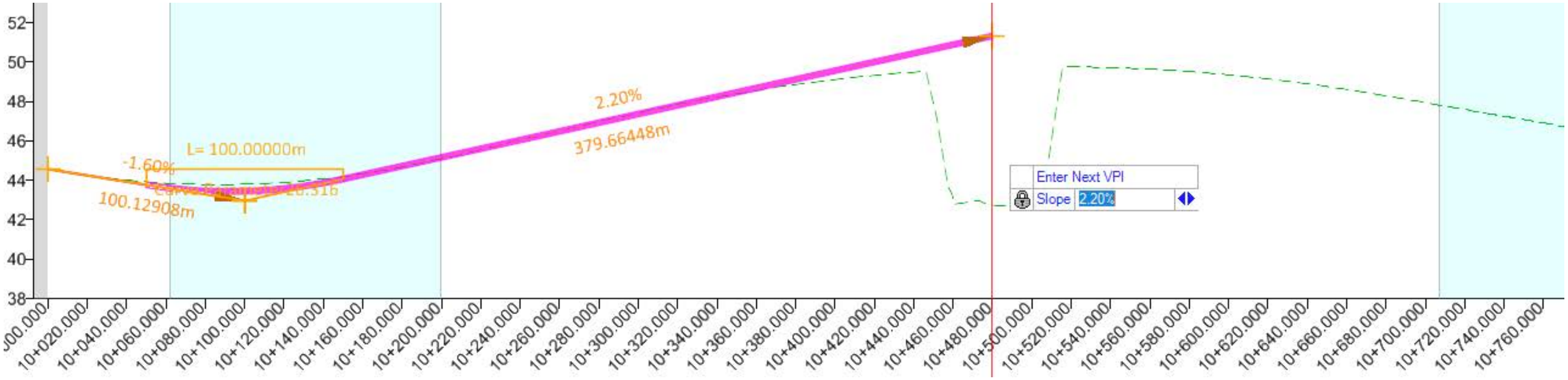
The first tangent and first vertical curve will now be placed.



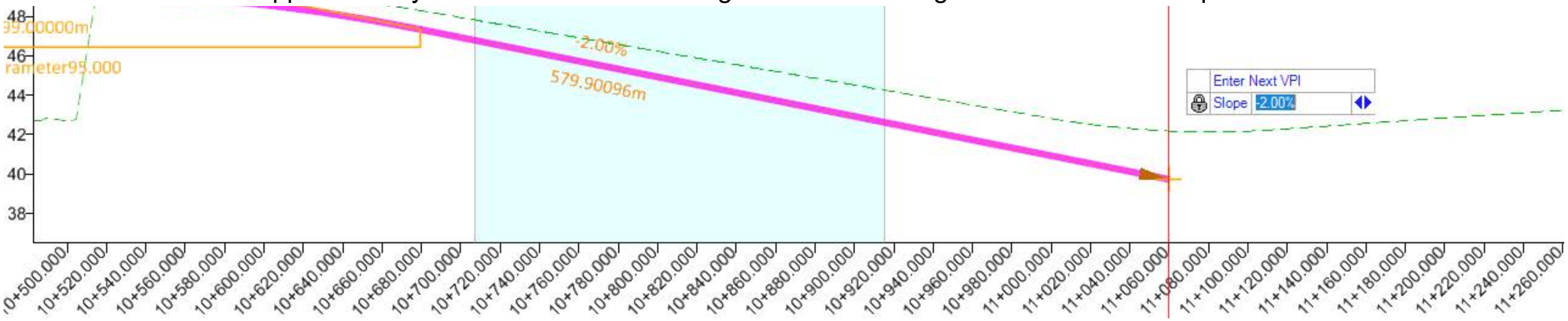
7. Place next VPI and next vertical curve.

a. Continue to follow the heads-up prompts:

- *Enter Next VPI:* Use the left or right arrow key to navigate to the *Slope* field.
- Key in: **2.20%** and press **<Enter>** or **<Tab>** to lock the value.
- Move the cursor to approximately **10+480** to define the length of the second tangent. **Left click** to accept.



- *Enter Next VPI:* Use the left and right arrow to navigate to the *Curve Length* field.
- Key in: **400** and press **<Enter>** or **<Tab>** to lock the value.
- Use the left or right arrow key to navigate to the *Slope* field.
- Key in **-2.0%** and press **<Enter>** or **<Tab>** to lock the value.
- Move the cursor to approximately **11+060** to define the length of the third tangent. **Left click** to accept.

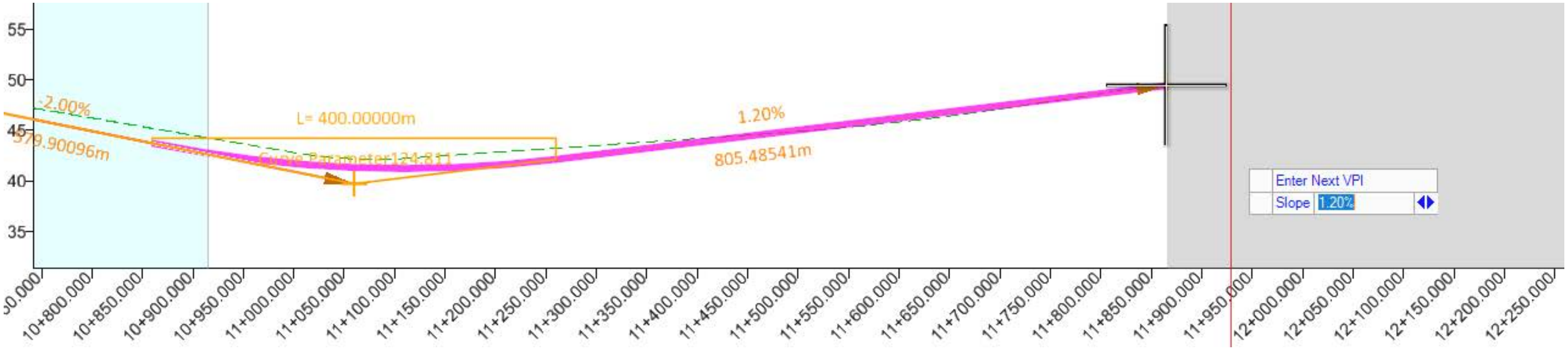


8. Place next VPI and next vertical curve.

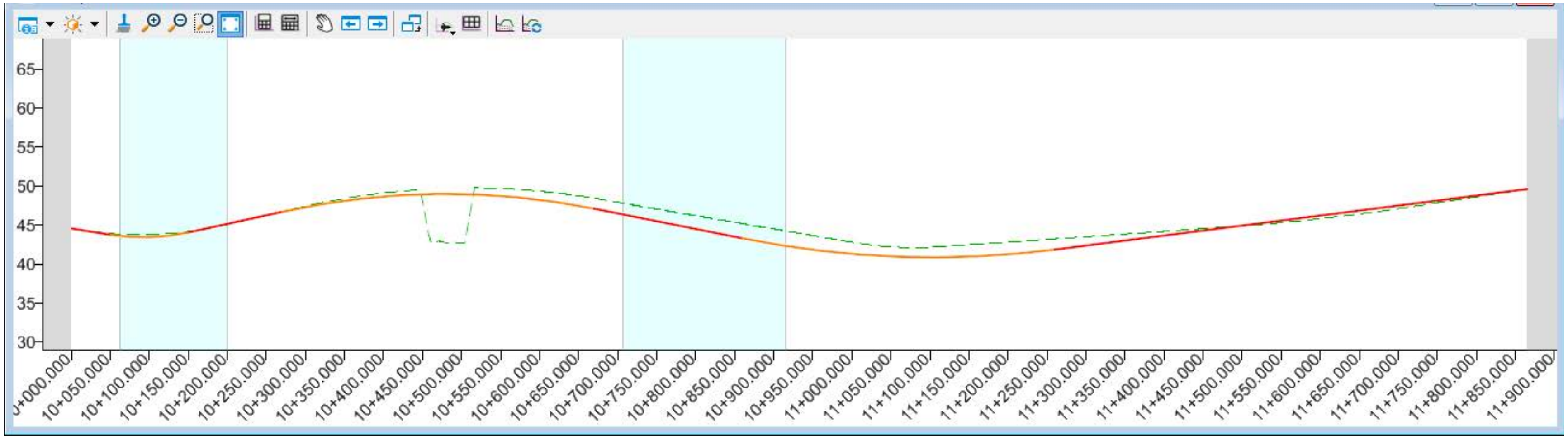
a. Continue to follow the heads-up prompts:

- *Enter Next VPI:* Use the left and right arrow to navigate to the *Curve Length* field.
- Key in: **400** and press **<Enter>** or **<Tab>** to lock the value.
- Snap to the end of the existing ground profile. **Left click** to accept.
- **Right click** to complete.

b. Select the *Element Selection* tool to exit the command.



The completed vertical alignment should look like the image below.

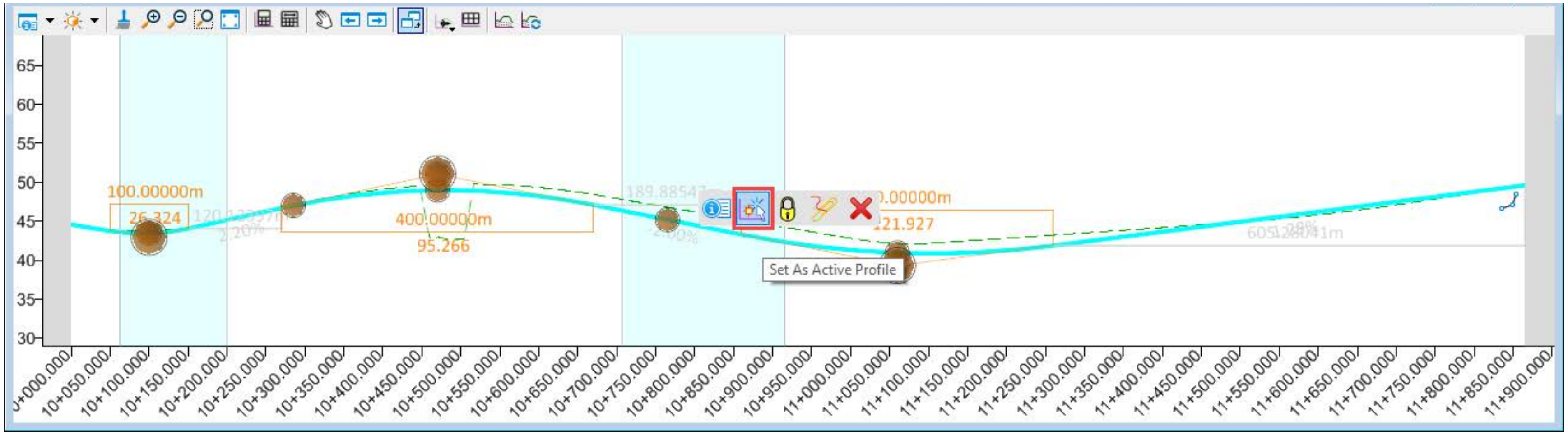


Set Active Profile

Many vertical alignments and profiles can be defined along a horizontal alignment but only one can be the active profile. To define a vertical alignment to be active you must use the *Set As Active Profile* command. In this section, you will learn how to set the active profile.

---

1. In *View 5*, select the vertical alignment for Route 97.
2. Hover your cursor over the alignment until the context menu appears.
3. Select **Set As Active Profile**. This will make the defined vertical alignment active.



Note: Whenever you set the profile active a 3D feature is automatically displayed into the 3D model.

Skills Assessment

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

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1. Geometry should always be created in a 2D dgn?
   a. True
   b. False
2. What controls the symbology and display of geometric elements?
   a. Feature Definitions
   b. Element Attributes
   c. Level Manager
   d. OpenRoads Model Explorer
3. Setting the Active Feature Definition ensures all geometric elements will have the selected feature definition assigned to them as you create geometric elements.
   a. True
   b. False
4. How does the default 3D Model get created?
   a. Setting the Active Terrain Model will automatically create the Default-3D Model.
   b. When you create vertical geometry elements, it is created automatically.
   c. When you create a new 2D dgn a new Default-3D Model will also be created.
5. Curve radii can be changed easily via the text manipulators and edit fields?
   a. True
   b. False

6. Where is all of the OpenRoads Designer Geometry data stored?

   a. .ALG File

   b. .XML File

   c. .DGN file

   d. OpenRoads Model Explorer

7. Individual geometric elements must be complexed together in order to create an alignment?

   a. True

   b. False

Module 3: Corridor Modeling

Description

In this module you will learn how to create a corridor along the Route 97 alignment. You will learn how to create a corridor along the Ramp C alignment.

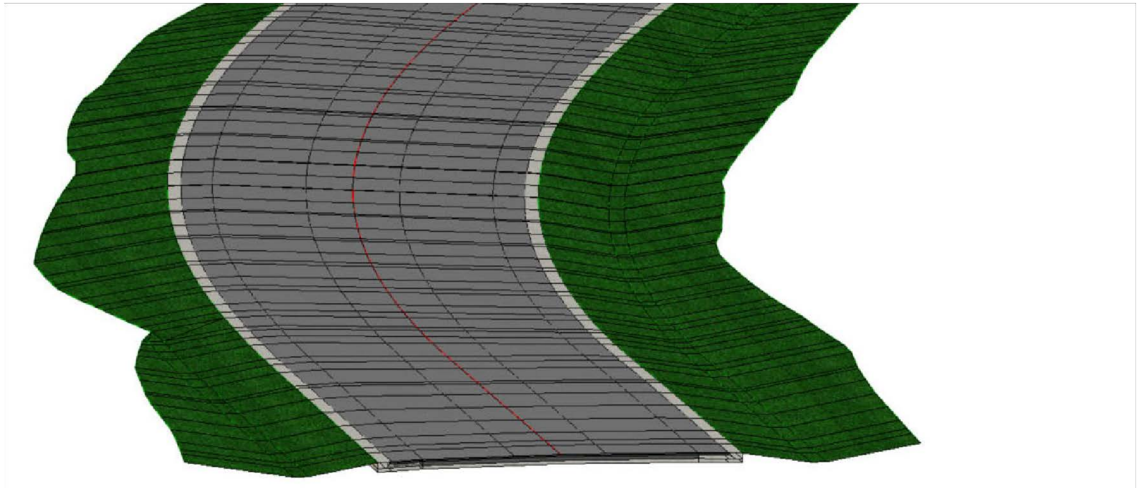
Objectives

- Corridor Modeling
- Preparing the Views
- File Federation

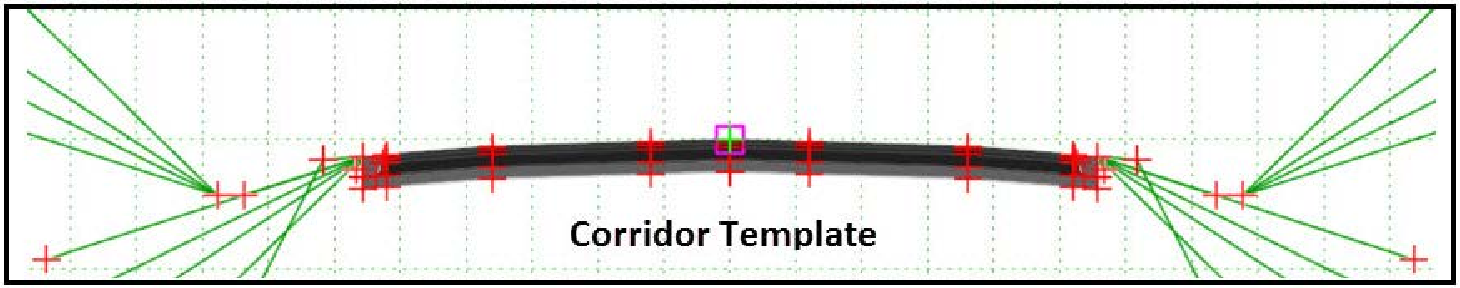
Corridor Modeling Overview

Corridor Modeling allows the user to create a dynamic, intelligent and powerful 3D model of their design. The 3D model is then used to create cross sections, terrain models and generate corridor quantities. A corridor is created first in 2D by assigning a horizontal and vertical alignment to the corridor and then assigning a template to the corridor at a defined interval along the horizontal alignment. Once the template is assigned to the corridor a 3D model is created.

A template represents the transverse geometry or typical section along the corridor. Templates are made up of points and components and are stored in a template library. When a corridor is processed the template points create 3D linear features (edge of pavement, shoulder, curb, sidewalk, cut/fill lines etc.) along the corridor and the template components create the 3D material meshes (i.e. pavement, shoulder, curb & gutter, sidewalk, side slope grading etc.) along the corridor.



Corridor 3D Model



Corridor Template

Corridor Modeling Workflow:

1. Create a 2D dgn file (all corridor information is stored in a dgn file).
   - Corridors always start in 2D. The 3D model is generated automatically.
2. Attach existing terrain model dgn as a reference file.
3. Attach geometry dgn as a reference (horizontal and vertical geometry are required to create a corridor).
4. Create a corridor.
5. Add a template drop(s) to the corridor.
6. Assign horizontal and vertical controls to adjust template points (as needed).
7. Assign superelevation (as needed).
8. Review the 3D model.
9. Review the dynamic cross sections.

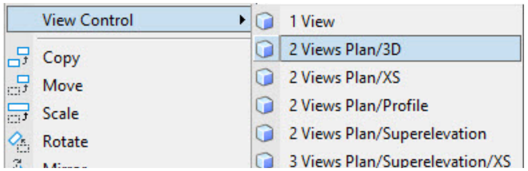
Model the Route 97 Corridor

In this section, you will learn to create the corridor along the Route 97 alignment. A corridor is a 3D model of your roadway. To create a corridor you must be in a 2D Model and have a horizontal and vertical alignment defined. You also need to have an existing terrain model and a template library. The template library is a library of typical sections which represent the cross sectional geometry of your road.

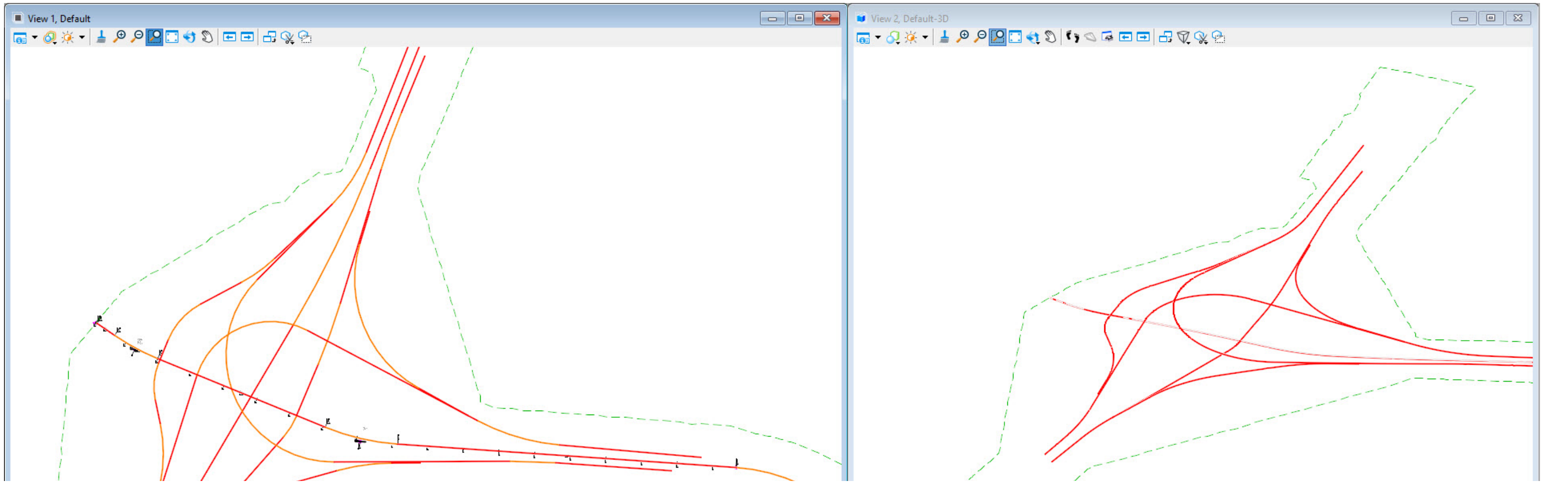
1. Open the file named **Corridor_Route97.dgn** from the *Module 3 (Modeling)* folder.
   - The horizontal/vertical geometry and existing terrain model have already been referenced into this file.
2. Click in *View 1* to make it the active view and model.
   - Clicking in a view window makes it the active view.
   - When creating corridors <u>you always start in a 2D Model view</u>. The software will automatically display and create the corridor in a 3D Model view. You generally want to have a 2D Model view and 3D Model view open when creating corridors.
3. Prepare the views for corridor creation.

   a. In *View 1*, right click and hold until the pop-up menu appears.

   b. Select *View Control >* **2 Views Plan/3D**

   - This will tile the viewing windows to display the 2D Model in *View 1* and display the 3D Model in *View 2*.



4. Create a corridor for the Route 97 corridor.

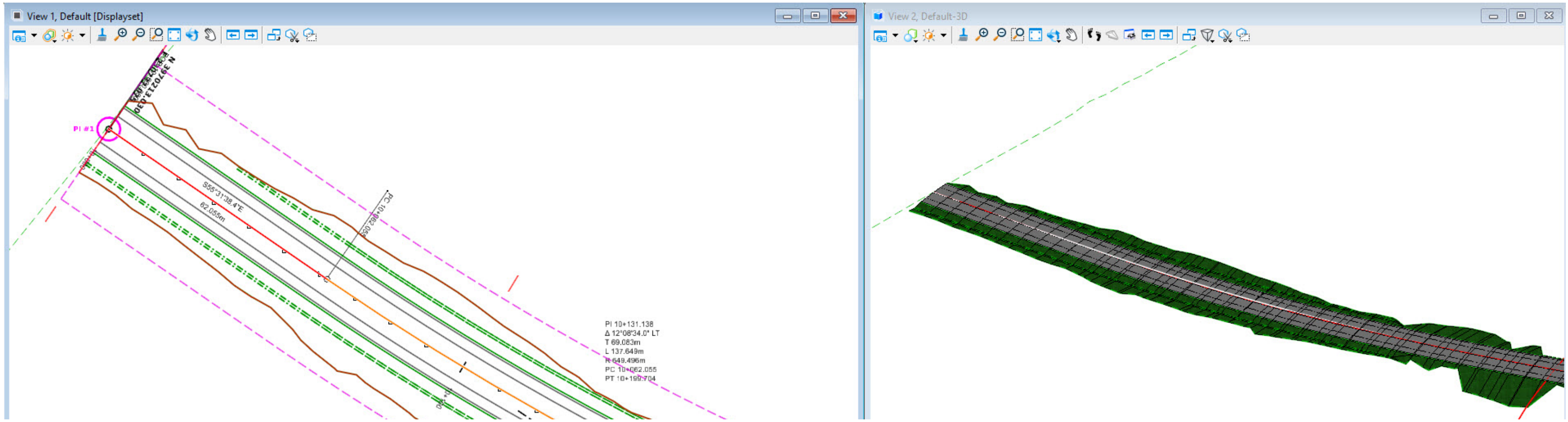
a. Click in *View 1* to make it the active view.

b. Use *Corridors > Create >* **New Corridor** to create a corridor along Route 97.

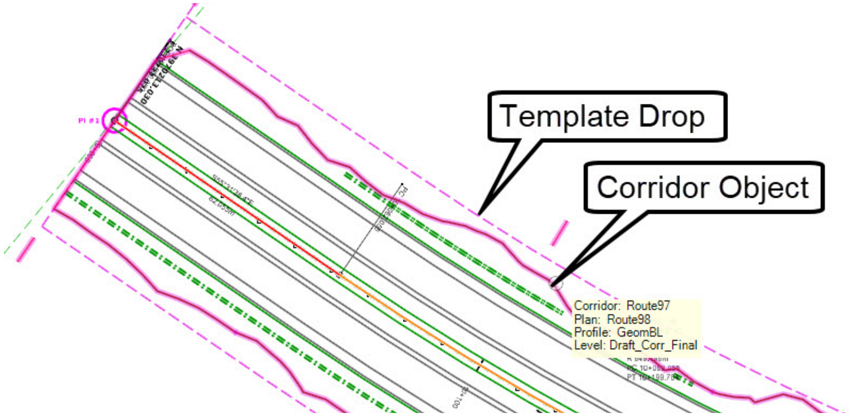
- *Feature Definition* = **Final** (set in the Tool Settings dialog).
- At the *Locate Corridor Baseline* prompt, select the **Route 97** alignment.
- *Feature Definition* = **Corridor > Final**
- *Profile* = **Active Profile** (recall we set the active profile in the previous exercise).
- *Feature Name* = **Route97**
- *Template* = *Templates > Rural > Asphalt Pavt w/ Asphalt Shoulders > Undivided >* **2 Lanes** (this is a simple 2 lane road template)
- *Start Station* = **Press <ALT> to Lock To Start**
- *Stop Station* = **Press <ALT> to Lock To End**
- *Drop Interval* = **5**

5. Review the 2D and 3D views.

- Notice in the 2D view additional graphical elements have been created and notice in the 3D view you now have a 3D representation of the Route 97 corridor. The 3D model is generated from the template you selected in the previous step.

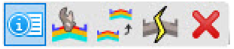


- When creating and editing corridors you always work in the 2D model view. The 3D model is created automatically. The additional graphics you see in 2D are the Corridor Object (displayed in red with element handles) and the template drop element (displayed as a dashed purple element). These two elements contain the properties of the corridor and template drop.
- The Corridor Object and Template Drop graphics are used to make changes to properties of the corridor.



6. The template we used to create the corridor was a simple 2 lane road template but our project is a 4 lane divided highway. Now you will learn how to change the template to model a 4 lane divided highway.

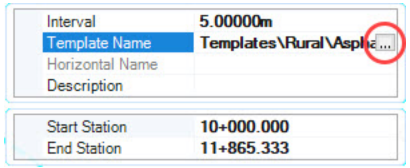
   a. Select the template drop element in 2D.

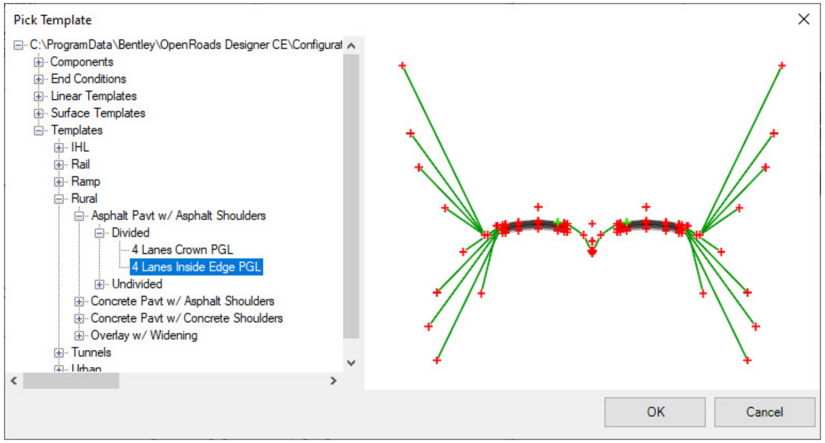
   b. Hover your cursor over the element for a few seconds until the context menu appears. 

   c. Select the *Properties* tool.

   d. In the *Properties* tool click the ellipsis buttion to the right of the *Template Name* (The Template Library will open).

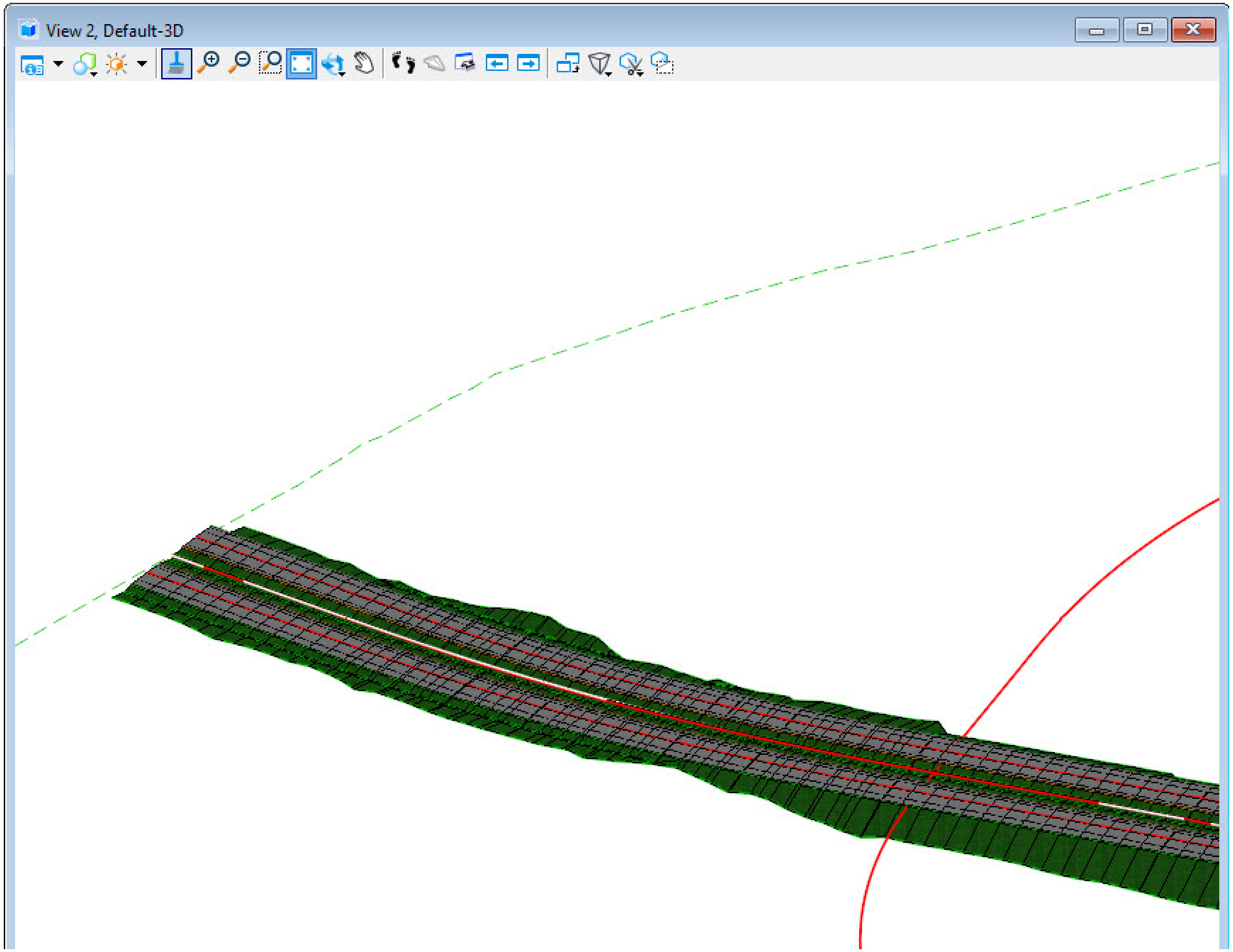
   e. In the *Pick Template* window navigate to *Templates > Rural > Asphalt Pavt w/ Asphalt Shoulders > Divided >* **4 Lanes Inside Edge PGL**



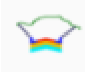


   f. Select the template and then click **OK** to close the *Pick Template* window. Left click in *View 1* to de-select the template drop element.

7. Review the 3D Model.



8. Review the Cross Sections for the *Route 97* corridor.



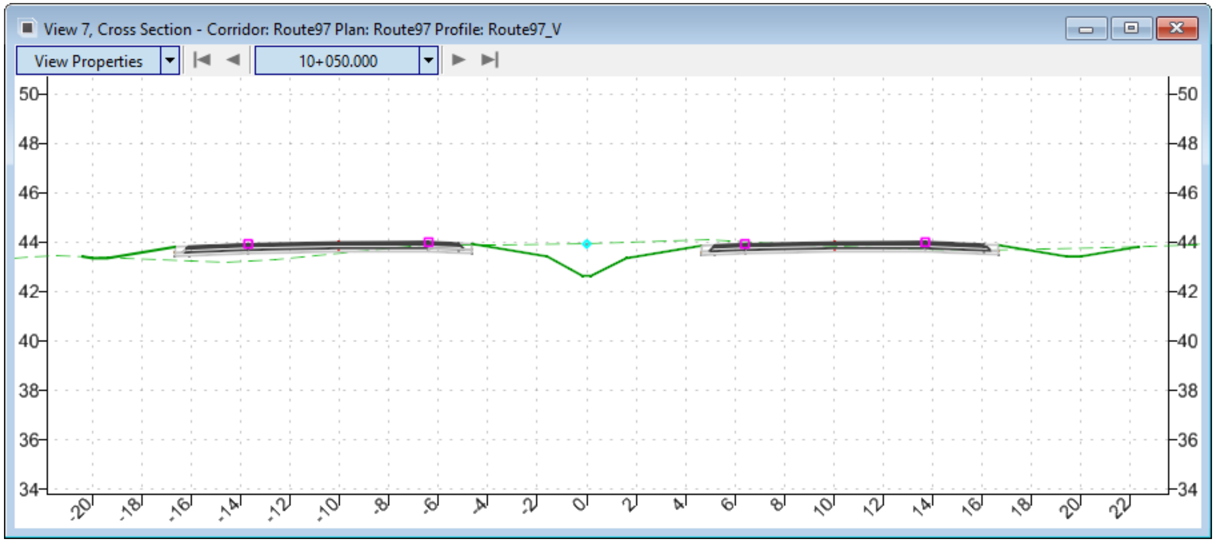
a. From the Corridors tab, select *Review > Dynamic Sections >* **Open Cross Section View**

b. In the 2D model, select the *Route 97* corridor.

c. At the Select or Open View prompt, select *View 7* from the view button toggles at the bottom of the screen.

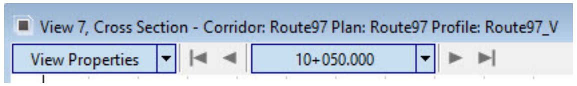
d. Left click in **View 7**. The dynamic cross section will now be displayed.

- *Dynamic Cross Sections* are transverse slices through the 3D model. Whatever is displayed in the 3D model will be displayed in the *Dynamic Cross Sections*.



- Notice that the 3D corridor model is displayed because that is what is currently being displayed in the 3D model.

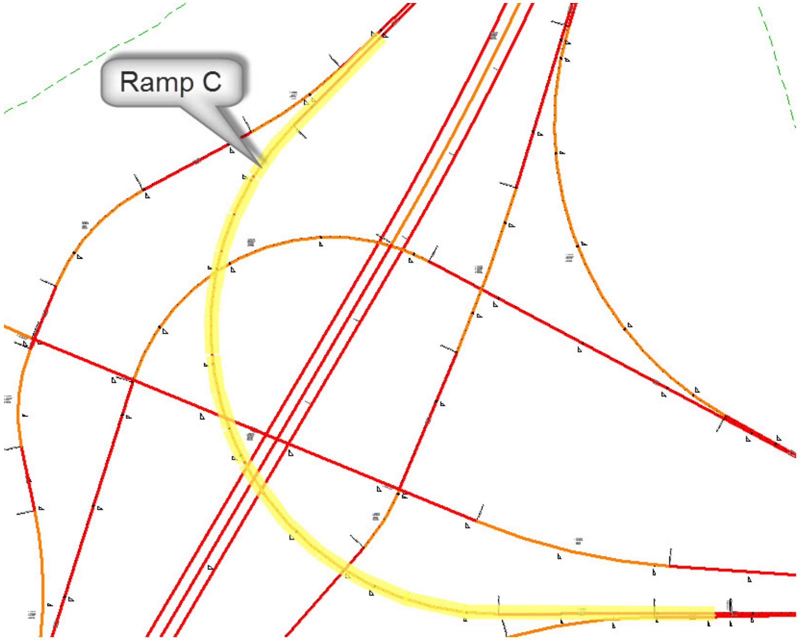
9. Use the cross section navigation buttons at the top of the **View 7** to navigate through the cross sections.



Model Ramp C

Now that you have learned the basics of modeling a roadway corridor let's take a look at modeling Ramp C to further enhance your skills. In this module, you will model a flyover ramp including the approach and exit roadways and a temporary model of the bridge.

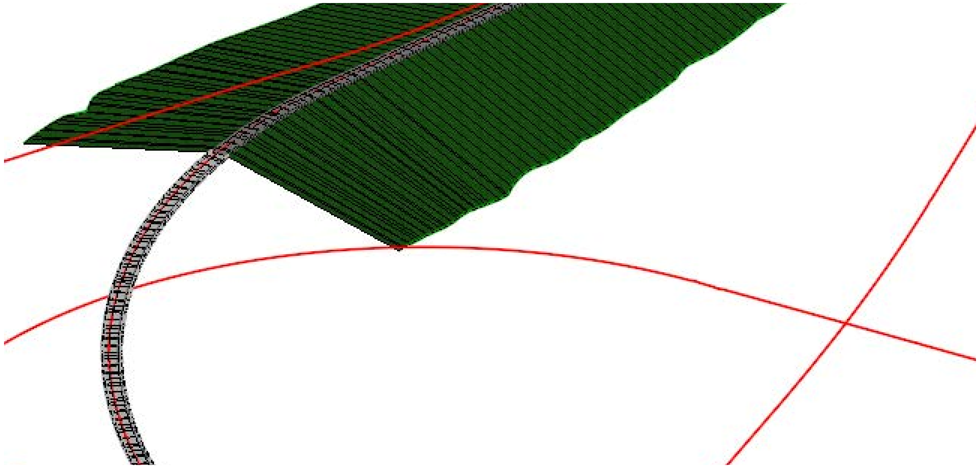
1. Open the file **Corridor_RampC.dgn** from the *Module 3 (Modeling)* folder.
2. Click in *View 1* to make it the active view and model.
3. Use *Corridors > Create >* **New Corridor** to create a corridor along Ramp C from the beginning of alignment to the bridge at station 1+000.
   - *Feature Definition* = **Conceptual**
   - At the *Locate Corridor Baseline* prompt, select the **Ramp C** geometry.
   - *Profile* = **Active Profile**
   - *Feature Name* = **RampC**
   - *Template* = *Templates > IHL >* **Ramp RT Tie**
   - *Start Station* = **Press <ALT> to Lock To Start**
   - *End Station* = **1+000**
   - *Drop Interval* = **5**



4. Review the 2D and 3D views. Notice the template drop interval is larger than expected and model is not as smooth as we would like. This is because we used the *Conceptual* feature definition.
5. Change corridor feature definition to increase the level of detail for the corridor.
   a. Select the corridor.
   b. Open the corridor *Properties.*
   c. Set the *Feature Definition* = **Corridor > Final**
   d. Close the *Properties* Window.

6. Add another template drop that represents the bridge deck.

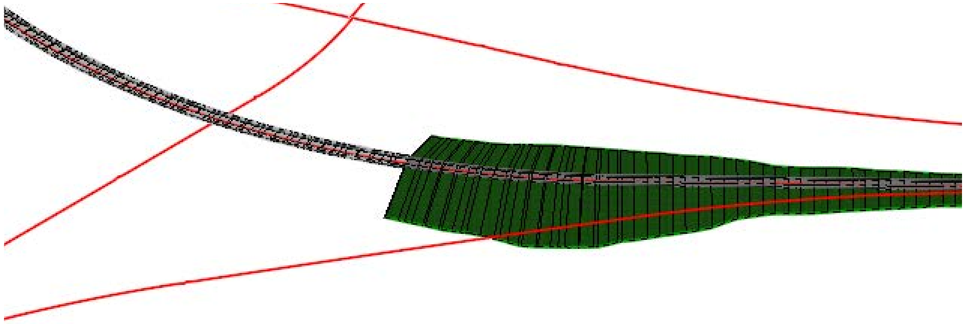
 - Select *Corridors > Create >* **New Template Drop**
 - At the *Locate Corridor* prompt, select the **Ramp C** corridor.
 - *Template* = *Templates > IHL >* **Ramp BridgeRT Tie**
 - *Start Station* = **1+000**
 - *End Station* = **1+550**
 - *Drop Interval* = **5**



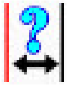
Modeling the bridge in this manner can help with other design activities before the detail bridge model is Create another template drop for Ramp C from the end of the bridge at 1+550 to the end of the alignment.

7. Create another template drop for Ramp C from the end of the bridge at 1+550 to the end of the alignment

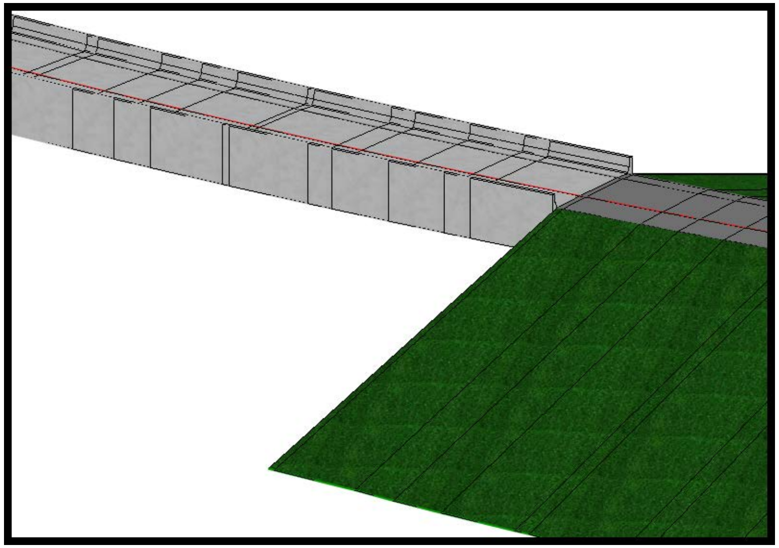
 - Select *Corridors > Create >* **New Template Drop**
 - At the *Locate Corridor* prompt, select the **Ramp C** corridor.
 - *Template* = *Templates > IHL >* **Ramp RT Tie**
 - *Start Station* = **1+550**
 - *End Station* = **<Alt> Lock to End**
 - *Drop Interval* = **5**



8. Modify the depth of the bridge deck.



- Select *Corridors > Edit > Edits >* **Create Parametric Constraint** and locate the RampC corridor to change the bridge deck depth to approximate the depth of the superstructure.
- *Start Station* = **1+000**
- *Stop Station* = **1+550**
- *Constraint Label* = **BR_Deck_Depth**
- *Start Value* = **-2.4**
- *Stop Value* = **-2.4**



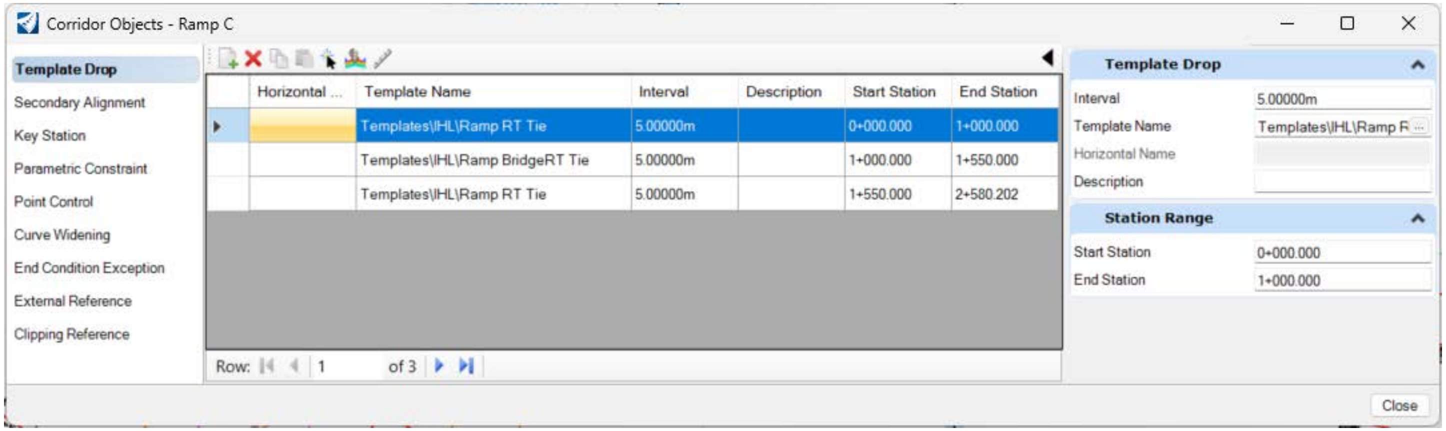
Parametric Constraints can be used to modify pavement thickness, ditch widths, slopes, etc. between any station range along a corridor

9. Review the 3D Model and notice the bridge deck has now been expanded to the proper depth.

10. Review the Template Drops and Parametric Constraints assigned to the corridor.

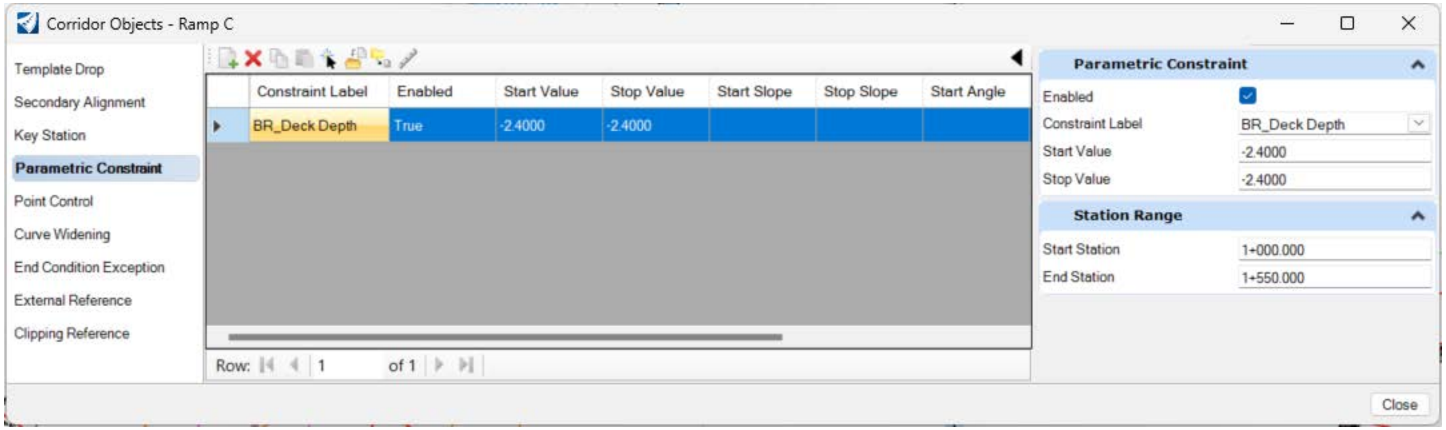
a. Select *Corridors > Edit >* **Corridor Objects**

b. The *Corridor Objects* dialog will appear. This tool lets you review corridor settings that have been applied and make changes. For example, if we want to change the template drop or adjust the parametric constraints we can do that here.



c. Select the **Template Drop** category from the panel on the left. Notice the dialog will list the templates assigned to the corridor and will also show the *Interval* and *Start* and *End Stations*. Template Drops can be added or removed using this tool.

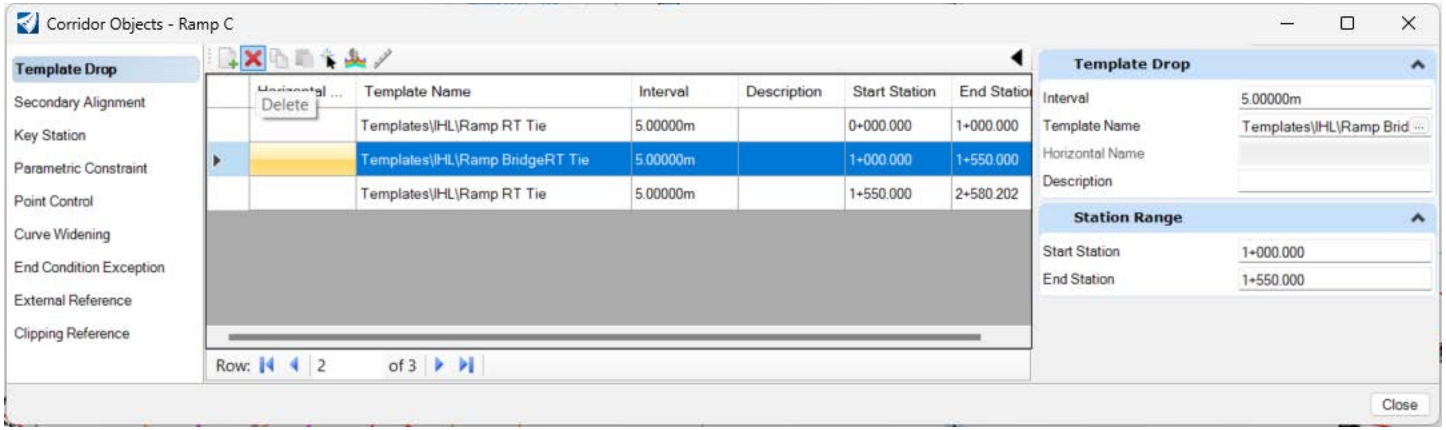
d. Select the **Parametric Constraints** category from the panel on the left. Notice the *Constraint Label* we created is listed as well as the values we defined. *Constraint Labels* can be added, removed or modified with this tool.



11. Delete the **Ramp BridgeRT Tie** template.

a. Navigate back to the **Template Drop** category and select the **Ramp BridgeRT Tie** template drop.

b. Select the **Delete** icon to delete the template drop. The template drop will be removed from the corridor model.



c. Close the **Corridor Objects** dialog.

Integrate the 3D Bridge Model from OpenBridge Modeler

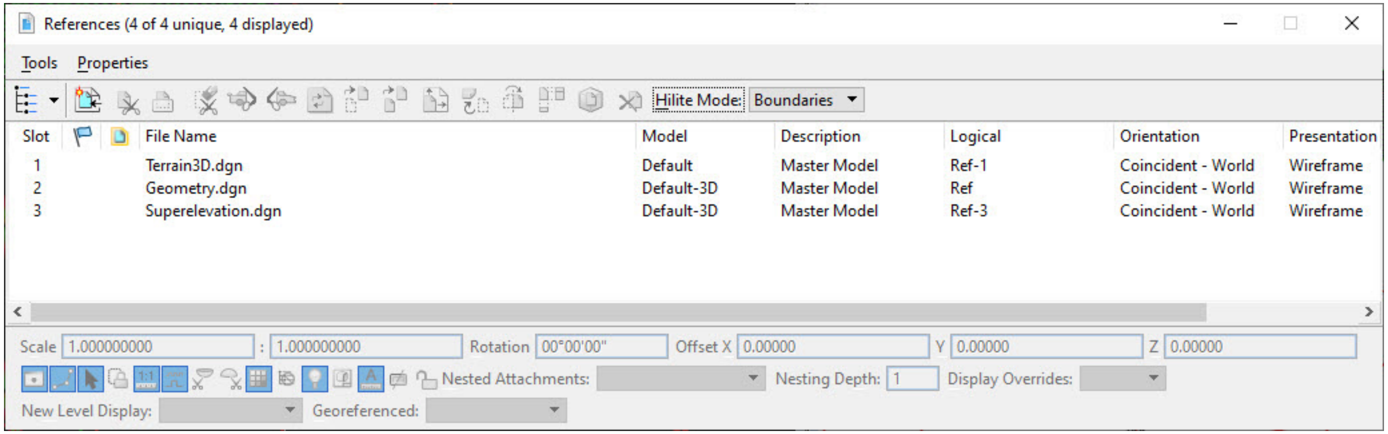
There will now be a gap in the corridor. Since we removed the bridge template we are now going to fill the gap with the detailed 3D Bridge Model from OpenBridge Modeler.

---

1. Attach the **OBM Bridge RampC.dgn** to the 3D view as reference using a *Coincident-World* orientation.

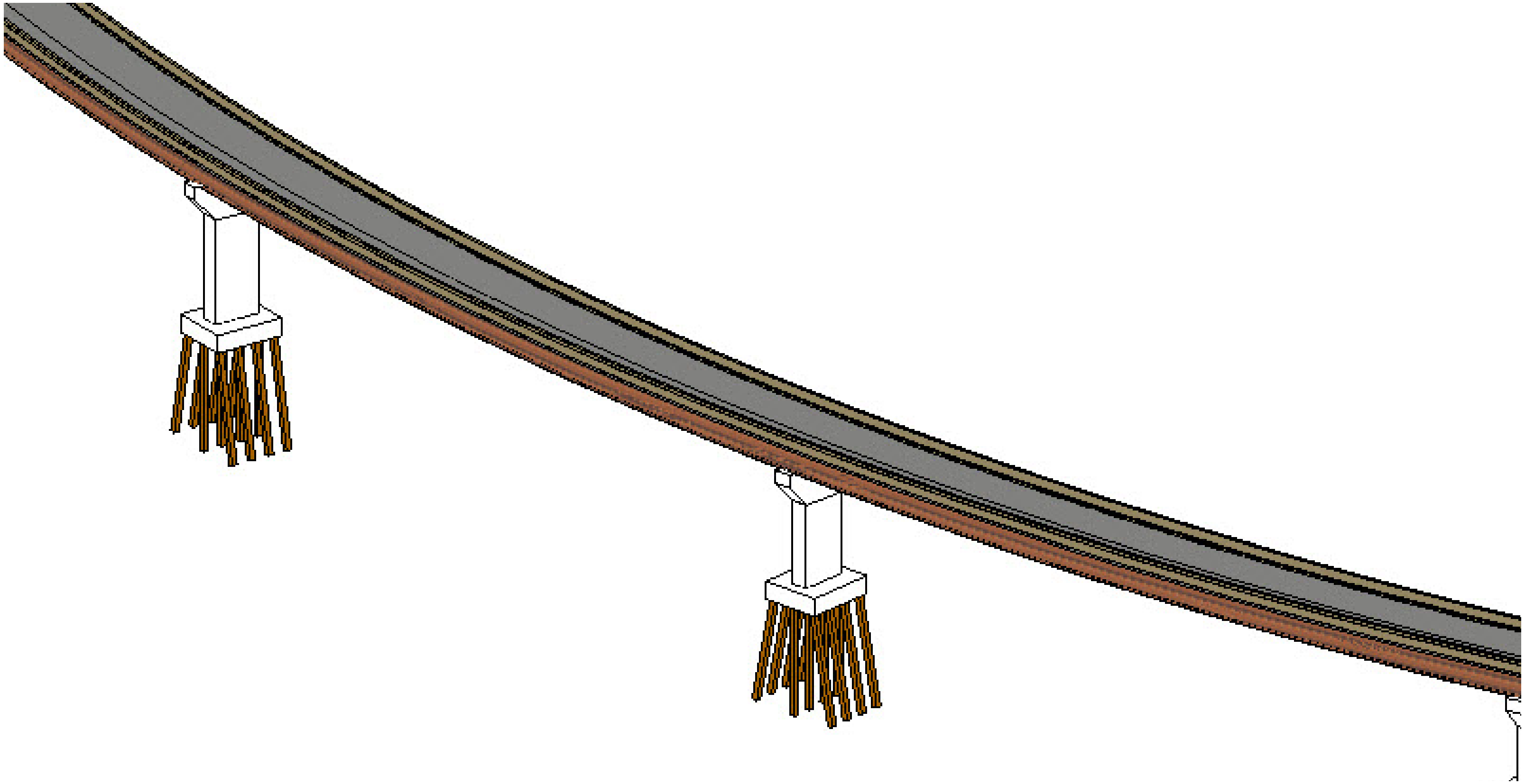
a. Select the *Home > Primary > Attach Tools >* **References**.

b. Click in the 3D view to ensure the references for that file are being manipulated. There should be 3 references.



c. Attach **OBM Bridge RampC.dgn** to the 3D view as reference using a *Coincident-World* orientation.

d. Review the detailed bridge now included in the model.



Skills Assessment

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

1. Corridors should always be created in a 2D dgn?
   a. True
   b. False
2. Which tool is used to view the dynamic cross sections?
   a. Create Cross Sections
   b. Create Dynamic Cross Sections
   c. Define Cross Section Model
   d. Open Cross Section View
3. Which tool gives users the ability to vary pavement thickness, ditch widths, slopes, etc. between any station range along a corridor.
   a. Create Point Control
   b. Create Parametric Constraint
   c. Corridor Objects
4. Templates are stored in an external template library (.itl file).
   a. True
   b. False

5. Which tool lets you review, add or remove Template Drops and Parametric Constraints that have been applied to the corridor?
    a. Corridor Objects
    b. Create Point Control
    c. Create Parametric Constraint
    d. Open Cross Section View
6. Where is the corridor data stored?
    a. In an external file with an .IRD
    b. In an external file with an .ITL
    c. In the .dgn file
    d. OpenRoads Model Explorer

Module 4: Superelevation

Description

In this module you will define and edit superelevation and assign the superelevation to multiple corridors.

Objective

- General Superelevation
- Superelevation Model

Superelevation Overview and Terminology

Superelevation is the rotation of the pavement on the approach to and through a horizontal curve. Superelevation calculations are used to determine how the roadway pavement will transition from normal cross slope to a fully superelevated section and back again.

The concept of superelevation is simple but many agencies and countries apply superelevation to their projects differently. Before getting started with superelevation a few basic terms need reviewing:

Maximum Superelevation Rate (e_{max}): Based on local conditions, this is the maximum cross slope allowed for any curve for a given design speed.

Superelevation Rate (e): Indicates the design cross slope used for a given design speed, horizontal curve radius and e_{max}.

Table 3-8. Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 4%

Metric									
	V_d = 20 km/h	V_d = 30 km/h	V_d = 40 km/h	V_d = 50 km/h	V_d = 60 km/h	V_d = 70 km/h	V_d = 80 km/h	V_d = 90 km/h	V_d = 100 km/h
e (%)	*R* (m)	*R* (m)	*R* (m)	*R* (m)	*R* (m)	*R* (m)	*R* (m)	*R* (m)	*R* (m)
NC	163	371	679	951	1310	1740	2170	2640	3250
RC	102	237	441	632	877	1180	1490	1830	2260
2.2	75	187	363	534	749	1020	1290	1590	1980
2.4	51	132	273	435	626	865	1110	1390	1730
2.6	38	99	209	345	508	720	944	1200	1510
2.8	30	79	167	283	422	605	802	1030	1320
3.0	24	64	137	236	356	516	690	893	1150
3.2	20	54	114	199	303	443	597	779	1010
3.4	17	45	96	170	260	382	518	680	879
3.6	14	38	81	144	222	329	448	591	767
3.8	12	31	67	121	187	278	381	505	658
4.0	8	22	47	86	135	203	280	375	492

Superelevation Rate Example

Pivot Point (or Point of Rotation): Determines the point on the cross section that the superelevated lanes rotate about.

Relative Gradient (G): The slope of the edge of pavement relative to the axis of rotation. Used to determine the superelevation runoff length.

Runoff Length (L_r): Length required to transition a 0% cross slope to full superelevation.

Tangent Runout Length (L_t): Length required to transition from normal crown to 0% cross slope.

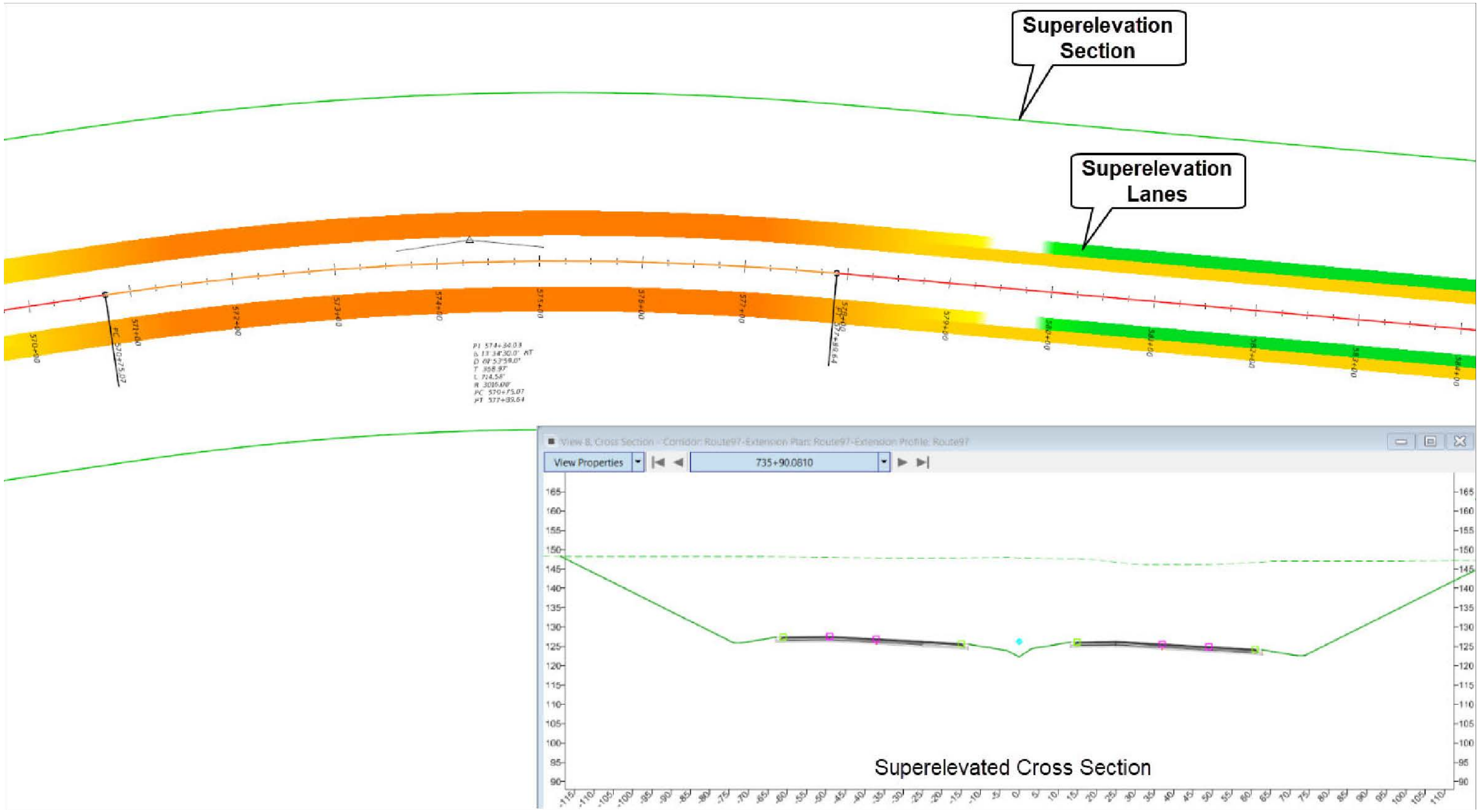
Location of Superelevation: Generally a certain percentage of the Runoff Length (L_r) or Total Length (L_r + L_t) is placed on the horizontal curve.

Adjustment Factors for Number of Lanes rotated (b_w): Used to reduce the length of transition when multiple lanes are rotated to reduce excessively long transition lengths.

Superelevation XML Preferences (or Rules File): OpenRoads Designer uses an XML-formatted rules file to calculate various aspects of superelevation. The XML preferences file can calculate superelevation rates for each curve of an alignment and the transition lengths needed to rotate the road from normal crown cross slope(s) to full superelevation cross slope.

Superelevation Section: Defines the limits of superelevation for a curve or set of curves. The section(s) are created based on the minimum tangent between curves.

Superelevation Lanes: Defines the number of pavement lanes and the width of the pavement lanes that superelevation calculations will be applied to.



Superelevation Workflow

The typical steps for creating superelevation is as follows:

1. Create a 2D dgn file where the superelevation data will be stored

   TIP: A best practice is to create superelevation data in its own 2D dgn file. It can also be created in the geometry or corridor dgn files as needed.

2. Attach horizontal geometry reference file (Horizontal geometry is required to create superelevation).
3. Create the superelevation section(s).
4. Define the superelevation lanes.
5. Calculate superelevation transitions and cross slopes.
6. Review and edit as needed.
7. Assign superelevation to a corridor.

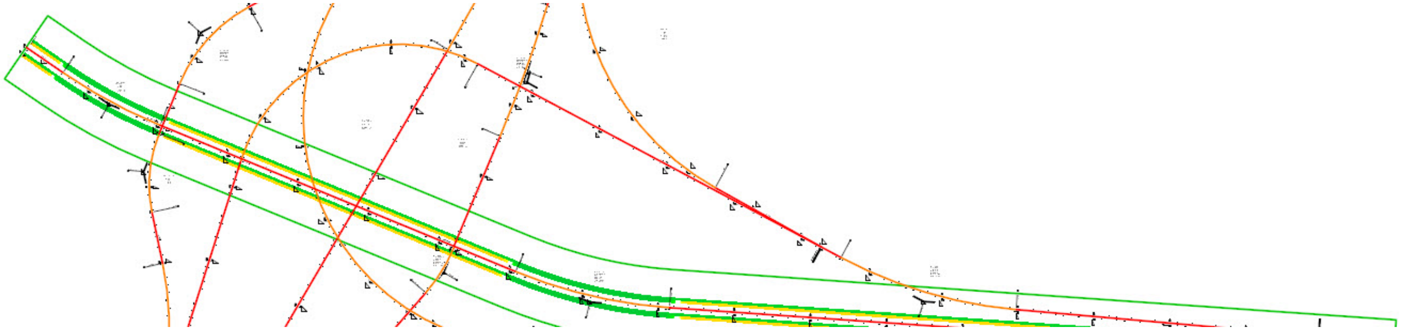
Define Superelevation for Route 97

1. Open the file **Superelevation_Route97.dgn** from the *Module 4 (Superelevation)* folder.
2. Create superelevation section and lanes for Route 97.

a. Select *Corridors > Superelevation > Create >* **Create Superelevation Sections**.

- *Feature Definition* = *R* **Superelevation** (set in the Tool Settings dialog)
- *Name* = **Route97**
- *Feature Name* = **Route97**
- *Minimum Tangent Length* = **10000**
- *Start Station:* **<Alt> to Lock to Start**
- *End Station:* **<Alt> Lock to End**
- *Lane Creation Method:* **Template**
- *Select Template - <Alt> Down to Browse Templates:*
- Select *Templates\Rural\Asphalt Pavt w/ Asphalt Shoulders\Divided* **4 Lanes Inside Edge PGL** and click **OK**.
- Left click to complete. The superelevation section and lanes will now be created.

Note: Using the template method for lane creation makes lane creation much simpler since the number of lanes and lane widths can be defined directly from the selected template.



3. Calculate the Superelevation Transitions.

a. Select *Corridors > Superelevation > Calculate >* **Calculate Superelevation**

b. Follow the heads-up prompts and left click to move through each prompt.

- *Locate First Superelevation Section:* Select the **Route 97** superelevation section.
- *Locate Next Superelevation Section - Reset to Complete:* Right click.
- The **Calculate Superelevation** tool should start automatically and you will be prompted to **Select Rules File**. If not, select the tool at *Corridors > Superelevation > Calculate >* **Calculate Superelevation**.
- Press **<ALT><Down Arrow>** to browse to and select the **Rules File** *(AASHTO_2018_metric.xml).*

  Following the heads up prompts, enter the following and Left-Click to advance to the next prompt:

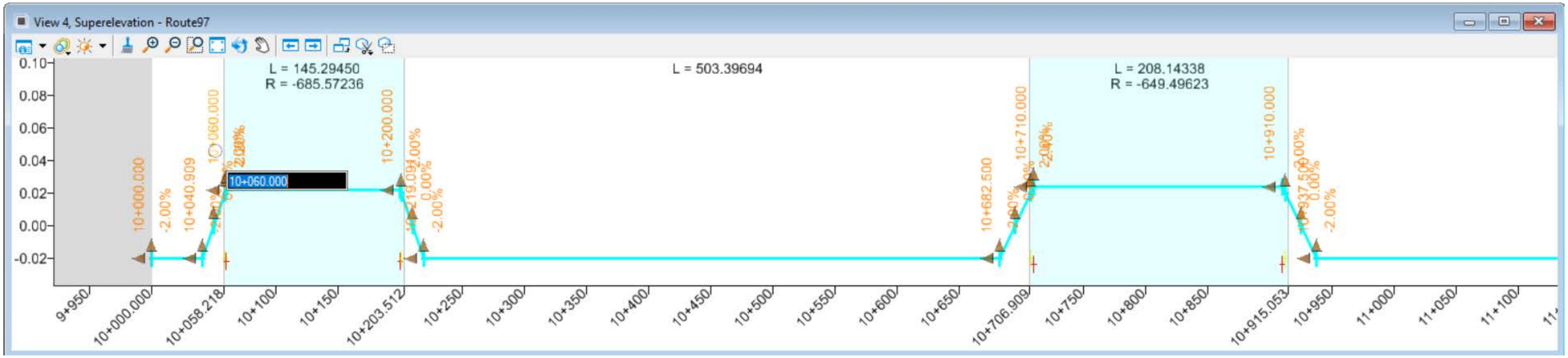
- *e selection* = **6%**
- *L Selection* = **AASHTO Relative Gradient**
- *Design Speed* = **50**
- *Pivot Method* = **Crown**
- *Open Editor* = **No**

c. Left click to complete. The superelevation transitions will now be assigned to the lanes.

Review and Edit the Superelevation

1. Select *Corridors > Superelevation >* **Open Superelevation View**.
2. Display the model in *View 4*.
3. Select the upper superelevation transition line.
4. Zoom into the area of full super between **10+050** and **10+250**.

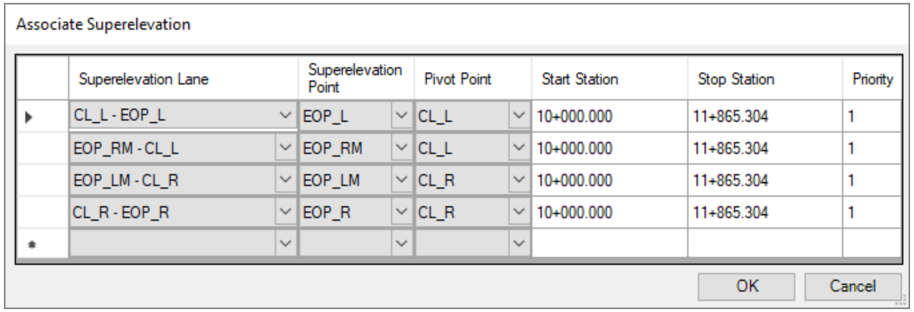
   TIP: Hold down the Shift key and use the scroll wheel to change the vertical exaggeration



5. Change the stations of the near full superelevation section.
   - *Start Station* = **10+065**
   - *End Station* = **10+205**

Assign Superelevation to Route 97 Corridor

1. Open the file **Corridor_Route97.dgn** from *Module 4 (Superelevation)* folder.
2. Click in *View 1* to set the 2D model active.
3. Attach the *Default* model from **Superelevation_Route97.dgn** as a reference to the *2D model*.
4. Assign the superelevation to the Route 97 corridor.
    a. Select *Corridors > Superelevation > Calculate >* **Assign to Corridor**.
    b. Select the *Route 97* superelevation section.
    c. Right click to complete.
    d. Locate and select the **Route 97** corridor.
    e. Confirm the Superelevation and Pivot points set automatically by the template.

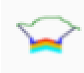

Associate Superelevation

Superelevation Lane	Superelevation Point	Pivot Point	Start Station	Stop Station	Priority
CL_L - EOP_L	EOP_L	CL_L	10+000.000	11+865.304	1
EOP_RM - CL_L	EOP_RM	CL_L	10+000.000	11+865.304	1
EOP_LM - CL_R	EOP_LM	CL_R	10+000.000	11+865.304	1
CL_R - EOP_R	EOP_R	CL_R	10+000.000	11+865.304	1

OK Cancel

    f. Click **OK** to associate the superelevation with the corridor.

5. Review the Cross Sections for the *Route 97* corridor.



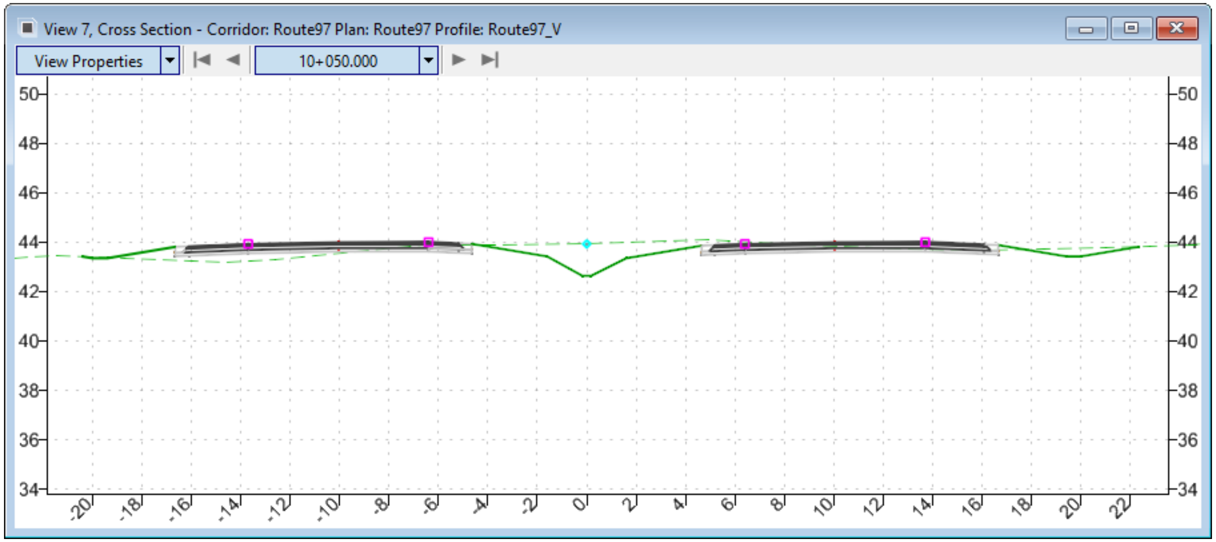
a. From the Corridors tab, select *Review > Dynamic Sections >* **Open Cross Section View**

b. In the 2D model, select the *Route 97* corridor.

c. At the Select or Open View prompt, select *View 7* from the view button toggles at the bottom of the screen.

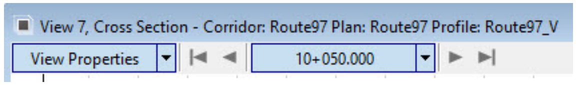
d. Left click in **View 7**. The dynamic cross section will now be displayed.

- *Dynamic Cross Sections* are transverse slices through the 3D model. Whatever is displayed in the 3D model will be displayed in the *Dynamic Cross Sections*.



- Notice that the 3D corridor model is displayed because that is what is currently being displayed in the 3D model.

6. Use the cross section navigation buttons at the top of the **View 7** to navigate through the cross sections.



Skills Assessment

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

1. Superelevation is calculated using the Superelevation XML Preferences File?
   a. True
   b. False
2. If superelevation was created using the rules file, what happens to the superelevation calculations if the geometry changes?
   a. If superelevation was created using the rules file then the calculations will update based on the geometry changes.
   b. The superelevation will not update at all.
   c. If the geometry changes you have to re-import your superelevation calculations.
3. Changing the design speed in the properties of the superelevation section will update the superelevations calculations?
   a. True
   b. False
4. Multiple superelevations are typically used for:
   a. Projects that have multiple design speeds or for users that prefer to create/edit calculations per curve set.
   b. Divided highway situations.
   c. Ramp geometry that has reverse curves and spirals.
5. When importing superelevation from a .csv file the superlevation transitions will automatically update if the geometry is changed?
   a. True
   b. False

Module 5: Cross Sections Sheets

Description

In this module you will create cross sections sheets along the Route 97.

Objective

- Create cross section sheets along an alignment

Creating Cross Section Sheets for Route 97

1. Open the file **Cross Sections_Route97.dgn** from the *Module 5 (Cross Sections)* folder.

   This is essentially a blank file with the terrain, geometry and corridor files attached as reference files.

2. Select the **OpenRoads Modeling** workflow from the pick list in the upper left corner.

3. Create cross section named boundaries along Route 97 alignment.

   The named boundaries define the location, width and height of the cross sections.

   a. Click in *View 1* (2D view) to set it as the active model.

   b. Select *Drawing Production > Named Boundaries > Named Boundary >* **Place Named Boundary**.

   c. Select **Civil Cross Section** mode.

   d. Set the *Drawing Seed* to **A1_XS**.

   The drawing seed sets the seed files and default values for the values on the dialog except the start and stop locations.

   e. Graphically select the centerline geometry for **Route 97** in the 2D view.

   f. Change the following parameters from their defaults.

   - *Interval* = **100**
   - *Bottom Clearance* = **2.0** (The extra bottom clearance is to allow the drainage pipes to appear on the cross sections)
   - Keep the default values set by the Drawing Seed for the other parameters.

   g. Disable the **Include Control Points** option.

   When enabled, cross sections are added at horizontal control points such as PC and PT.

   h. Enable the **Create Drawing** option.

   When enabled, the process to create the cross section sheets is automatically started after the named boundaries are created. When disabled, the named boundaries are created but the sheets are not created.

i. Enable the **Show Dialog** option.

When enabled, a dialog with additional parameters set by the Drawing Seed is shown.

j. Define the start and stop locations.

- *Start Location* = **Click** **to lock to the beginning of the alignment**
- *Stop Location* = **11+865.304**

k. Data point in the 2D view to accept the starting station of the named boundaries.

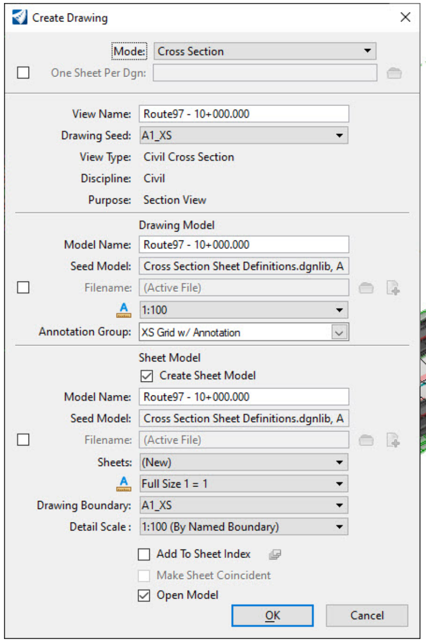
NOTE: If the Start Location was not defined and locked in the dialog it is selected graphically at this step.

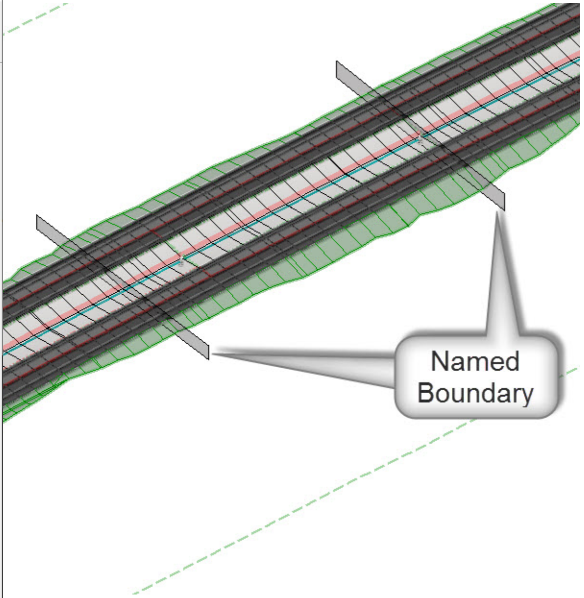
l. Data point a second time in the 2D view to accept and create the named boundaries.

NOTE: If the Stop Location was not defined and locked in the dialog it is selected graphically at this step.

Creating the named boundaries will take a short time. Once complete the Create Drawing dialog appears and the named boundaries are visible in the 3D view.

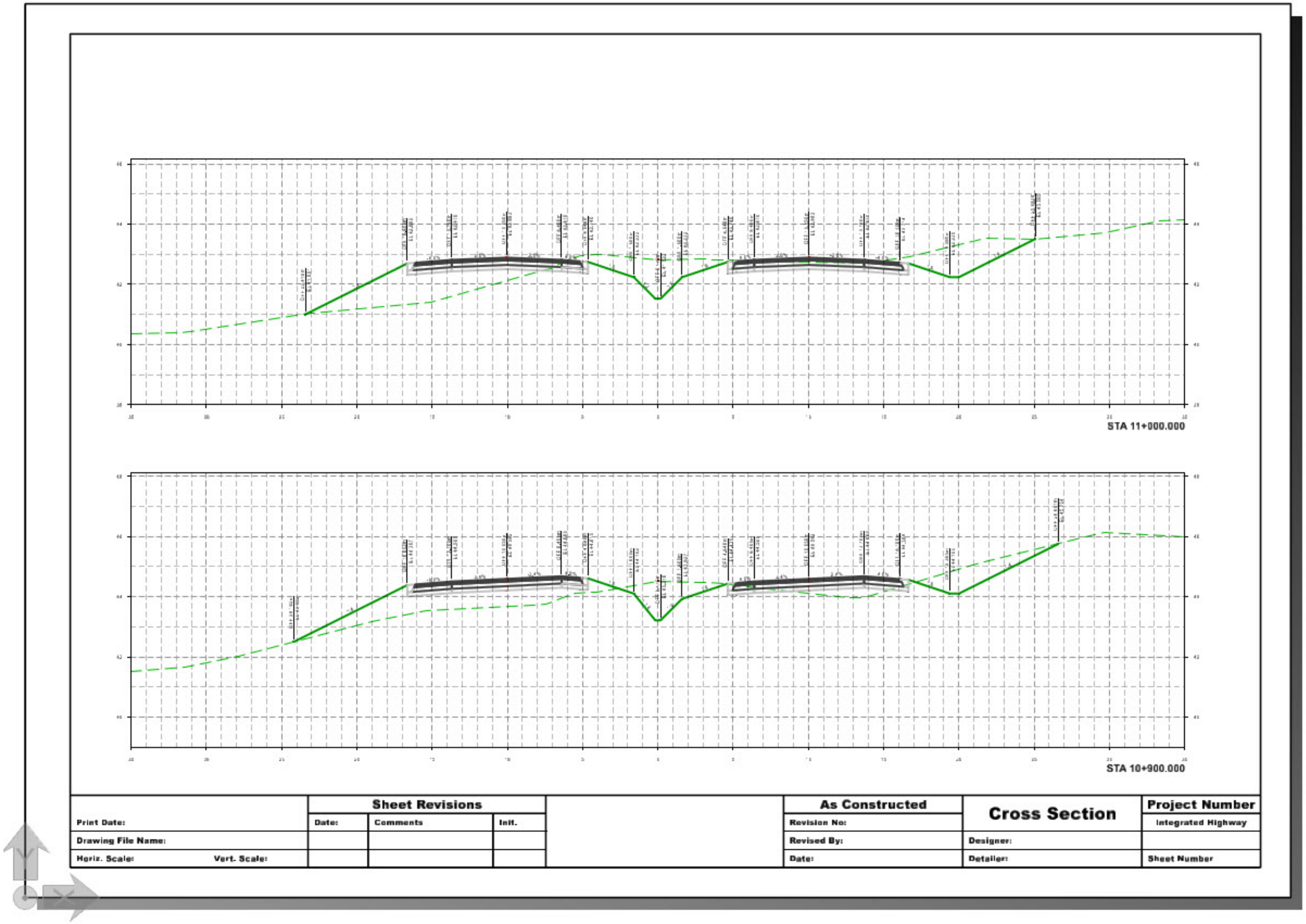
4. Click **OK** on the *Create Drawing* dialog to create the cross section sheets.





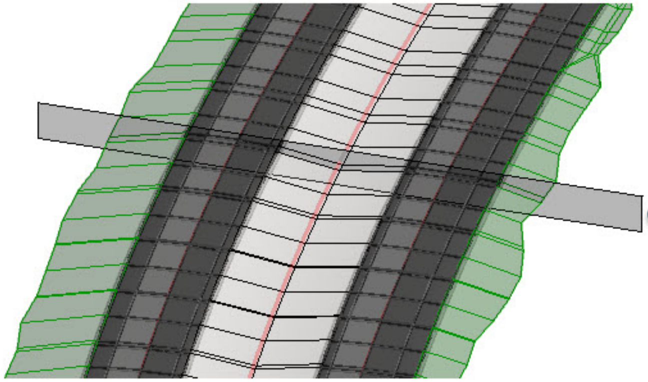
The Create Drawing dialog provides an opportunity to adjustments the parameters being used. However, in a typical workflow these parameters do not need to be changed because the default values are all set by the Drawing Seed selected when creating the named boundaries in the previous steps.

Creating the cross sections sheets will take a minute or so. This might take a little time since the cross section sheets will be created and annotated. A progress bar is provided at the bottom of the screen. Once complete, a cross section sheet appears.

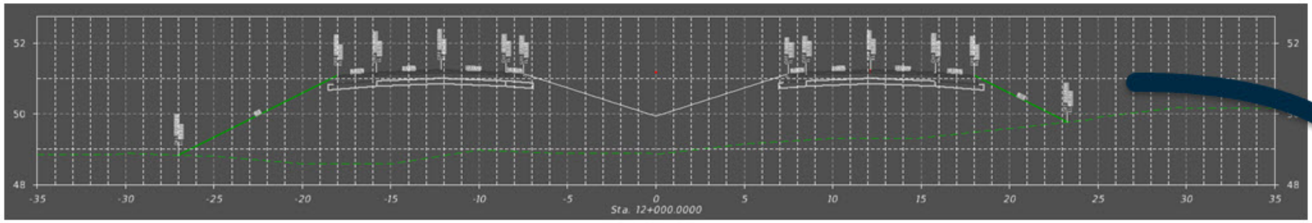


Each cross section is a live reference to a drawing model which in turn is a live reference to the 3D design model. The drawing model is where annotations are added to the cross sections. All graphics that appear in the 3D model are automatically shown on the cross section. In addition, since these are live references, any changes to the 3D model are automatically updated on the cross sections.

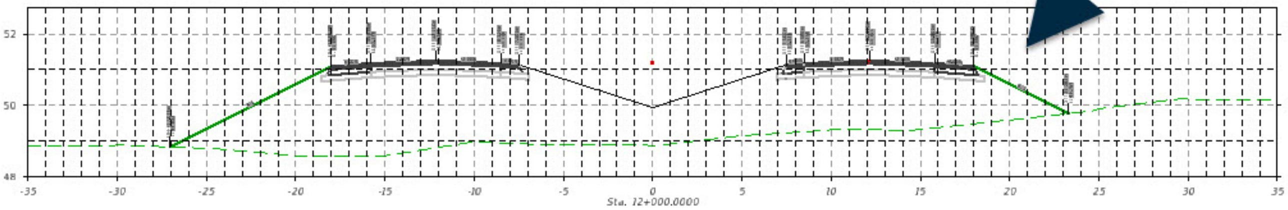
3D Design Model - Named Boundary Layouts



Drawing Model - Reference of 3D Design Model clipped to Named Boundary



Sheet Model - Reference of Drawing Model Laid Out on Sheets



5. Review Cross Section sheets.

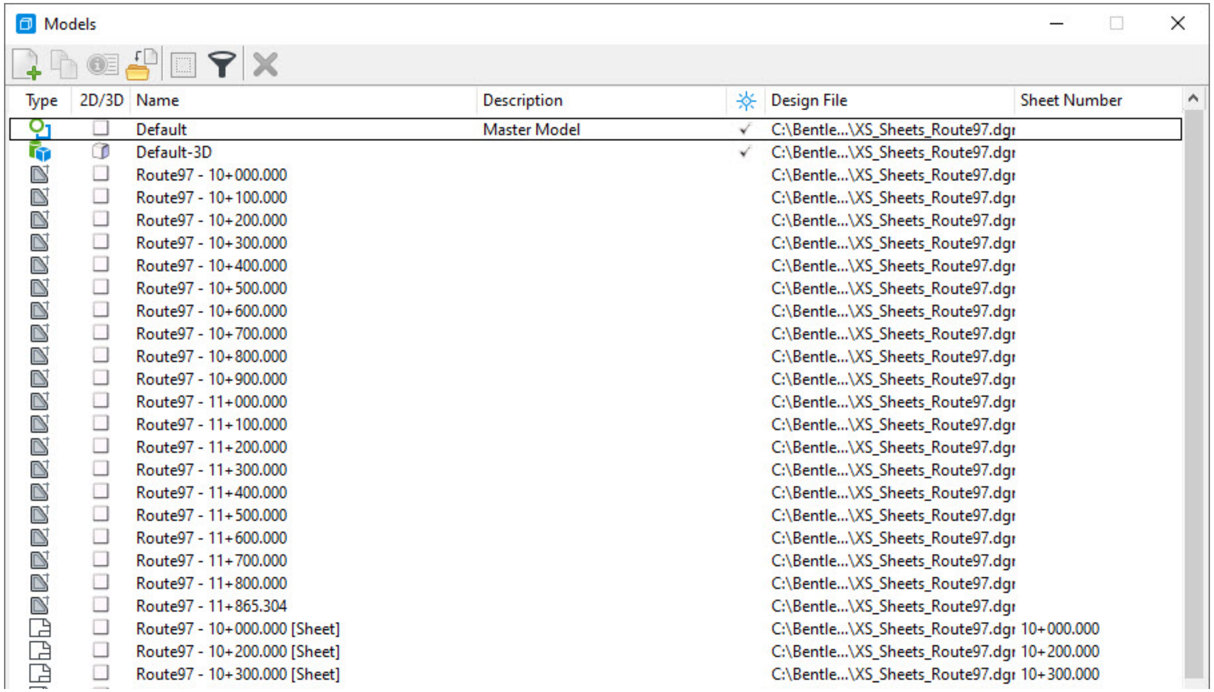
   a. Select *Home > Primary >* **Models**.

      = Drawing Model

      = Sheet Model

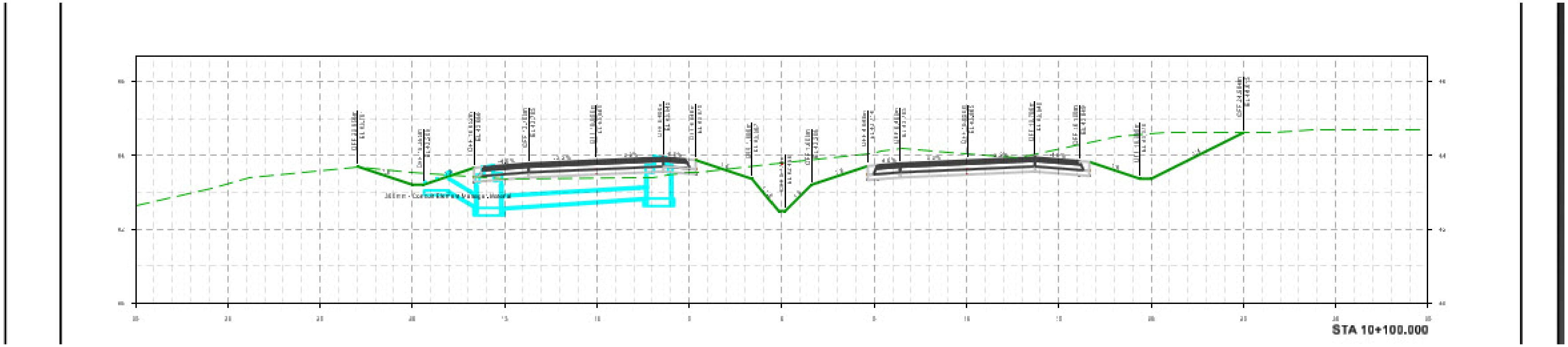
   b. Double click on one of the sheet models.

   TIP - Since the cross section sheets were added to the sheet index when they were created, the sheets can also be navigated using the Sheet Index tab in the Explorer.



6. Set the **Route97 - 10+100.000 [Sheet]** view active and observe the drainage network pipes are included on the cross sections at station **10+100.00.**

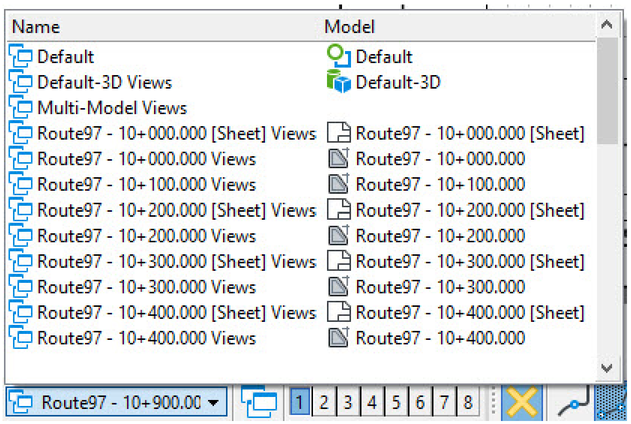
   These drainage structures were created with the drainage and utility tools available within OpenRoads Designer.



7. Return to design model.

   You can select the design model from the Models dialog, however only the selected Default or Default-3D model will be shown, not the multiple model view of both the 2D and 3D models. There is a better way by selecting a view group.

   a. Select **Multi-Model Views** from the *View Group* list in the lower left corner of the screen.



Skills Assessment

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

1. Which of the following types of models are used when cross section sheets are created.
   a. Design Models
   b. Details Models
   c. Drawing Models
   d. Sheet Models
   e. Layout Models
2. The Named Boundary...
   a. Defines the extent of what is displayed on the cross section sheet.
   b. Defines the location where a cross section will be extracted from the 3D model.
   c. Is a live “slice” through the 3D model.
   d. All of the above.
3. The drawing seed defines default values and other parameters required to create sheets. Three drawing seeds for cross section drawings are included in the default training and examples workspace.
   a. True
   b. False
4. Labels should be placed in Drawing Models.
   a. True
   b. False

Module 6: Plan-Profile Sheets

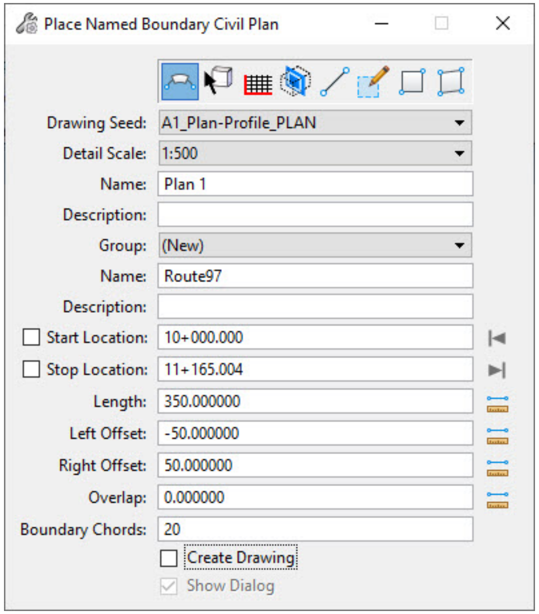
Description

In this module you will learn to create Plan & Profile sheets and make minor modifications to the sheet layouts. You will also use the sheet index to navigate and batch print the sheets.

Objective

- Create Plan-Profile Sheets
- Using Sheet Index
- Batch Printing

Create Plan Boundaries



1. Open the file **Plan Sheets.dgn** from the *Module 7 (Plan Profile Sheets)* folder.

   This is a blank file that has the geometry and terrain referenced.

2. Select *Drawing Production > Named Boundaries > Named Boundary >* **Place Named Boundary**.

3. Select the **Civil Plan** mode.
4. Disable the check boxes for the *Start Location* and *Stop Location* if they are enabled.
5. Set the *Drawing Seed* to **A1_Plan-Profile_PLAN**.

   This drawing seed is for creating the PLAN portion of a Plan & Profile sheet.

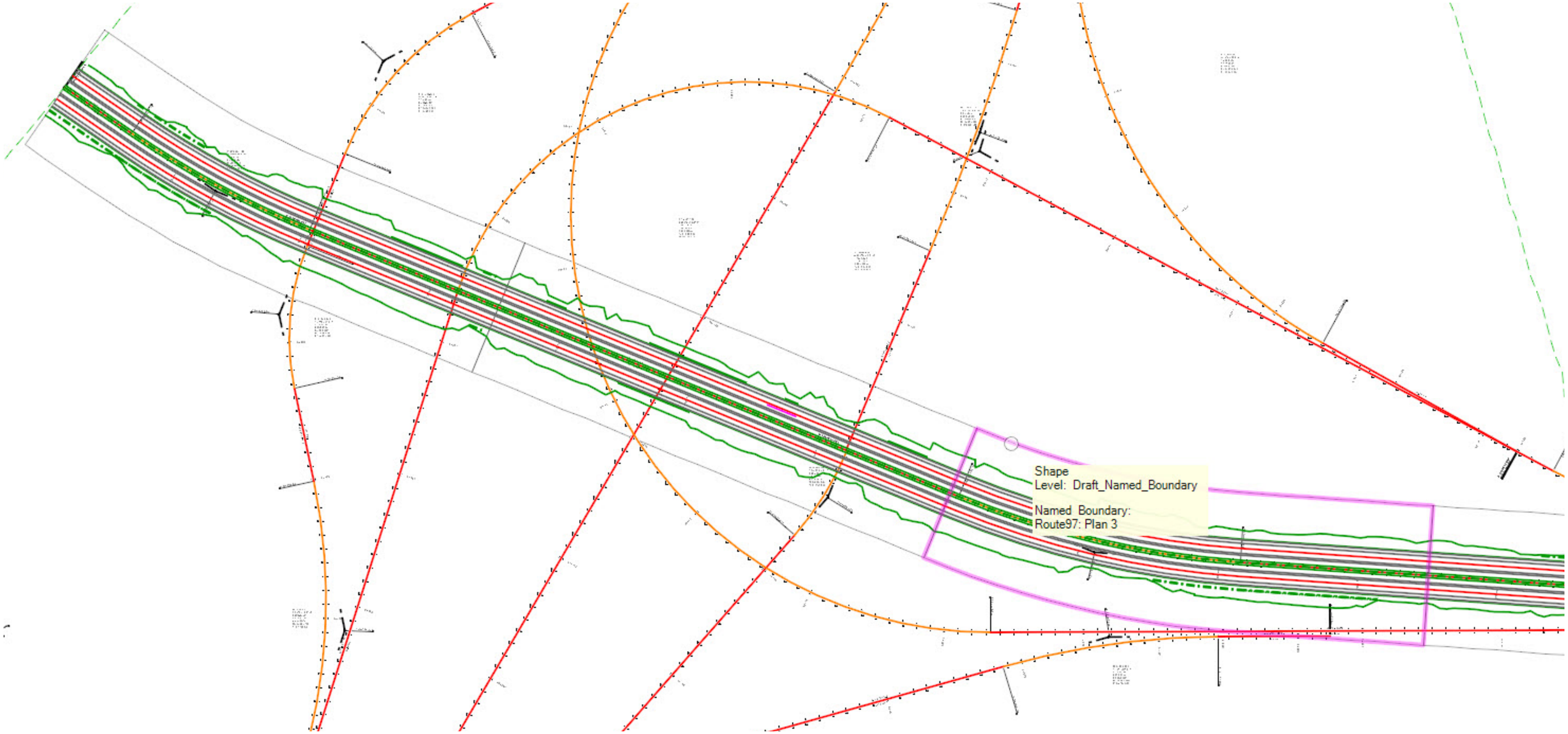
6. Set the *Detail Scale* to **1:500**.
7. Graphically select the centerline geometry for **Route 97**

   The top Name field which defines root name of plan named boundaries and the bottom Name field which defines new group that the named boundaries will be organized into are automatically populated.

8. Set the following options.
   - *Start Location* = Lock to the beginning station of **10+000.000** (Use icon at right to set beginning station)
   - *Stop Location* = Lock to the ending station of **11+865.304** (Use the icon to the right to set the ending station)
9. Disable the **Create Drawing** option.

   This is important! You are creating Plan and Profile sheets but at this time you are only creating out the Plan boundaries. The drawings or sheets cannot be created until both the plan and profile boundaries have been created. If you accidentally leave Create Drawing enabled, click **Cancel** on the *Create Drawing* dialog to stop the process before creating the sheets.

10. Data point in the view to define, or accept, the start location and initiate placement of named boundaries.
11. Move the cursor near the end of the alignment and observe the plan named boundaries that will be created.
12. Data point to define the stop location of the plan named boundaries.
13. Data point again to accept and create the named boundaries.



Create Profile Boundaries and Sheets

1. Open **View 8** where the profile is already displayed.
2. Select *Drawing Production > Named Boundaries > Named Boundary >* **Place Named Boundary**.
3. Select the **Civil Profile** mode.
4. Set the *Drawing Seed* to **A1_Plan-Profile_PROFILE**.

   This drawing seed is for creating the PROFILE portion of a Plan & Profile sheet.

5. Set the *Detail Scale* to **1:500**.
6. Graphically select the profile geometry for **Route 97**

   The top Name field which defines root name of profile named boundaries and the bottom Name field which defines new group that the named boundaries will be organized into are automatically populated.

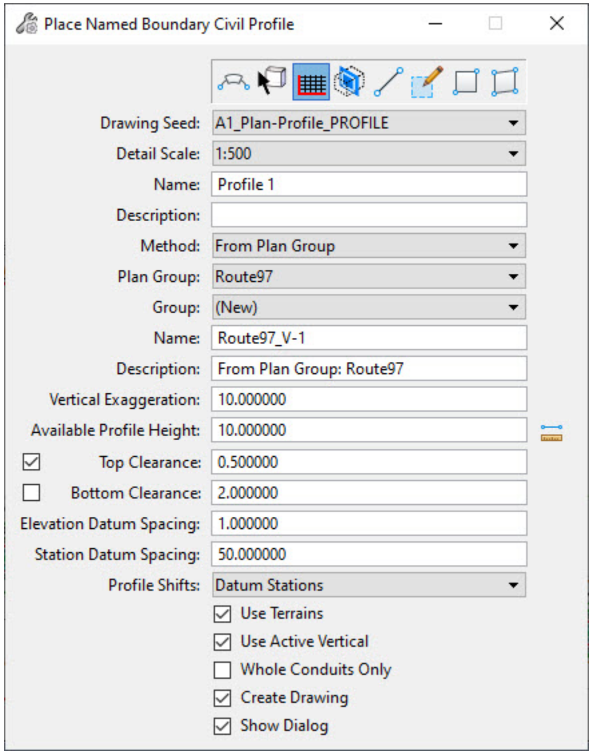
7. Set the following options.
   - *Method* = **From Plan Group**

     The limits of the profile boundaries will match the plan boundaries in the specified Plan Group.

   - *Plan Group* = **Route 97**
8. Enable the **Create Drawing** option.

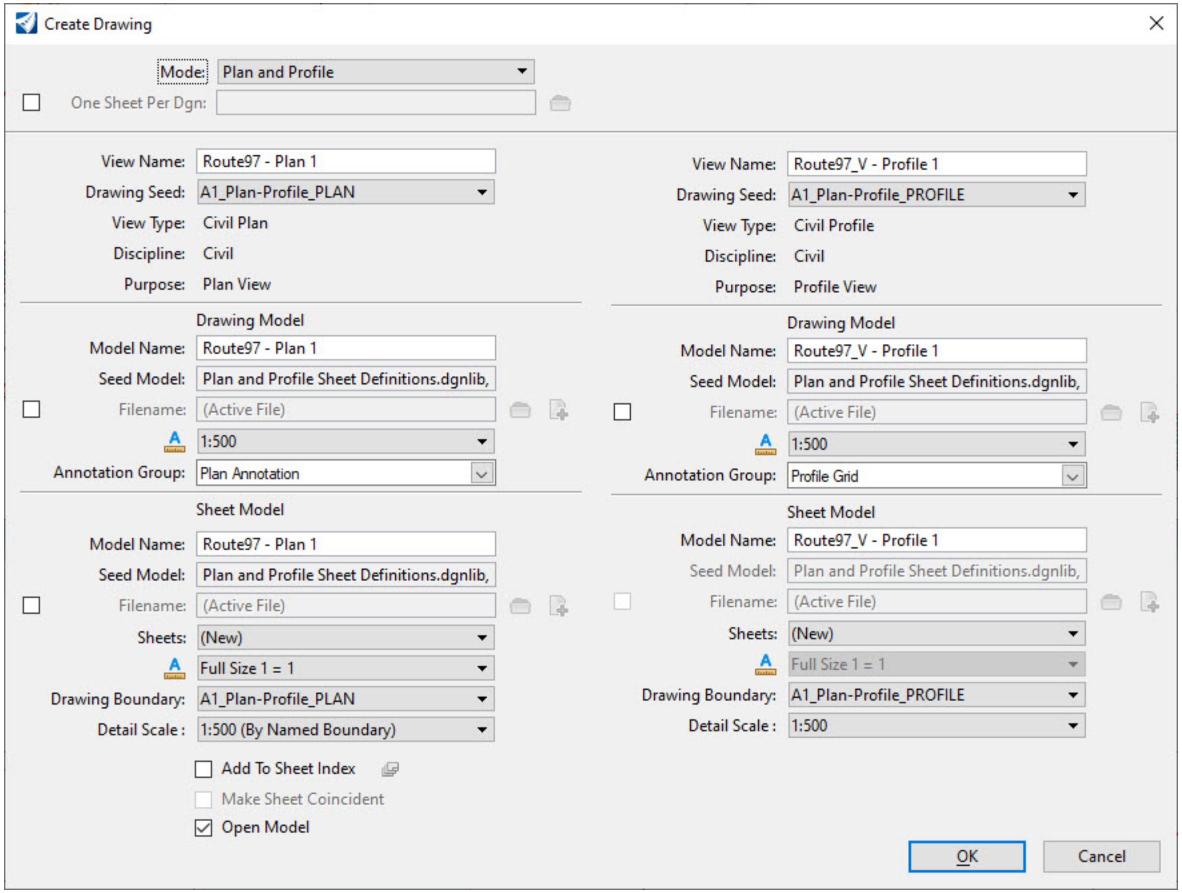
   Enabling the Create Drawing option will initiate creation of the sheets immediate after the named boundaries are created. This can be done now that both Plan and Profile named boundaries have been defined. This option can also be disabled at this step and the sheets created later using the Named Boundary Manager.

9. Enable the **Show Dialog** option.
10. Data Point again in **View 8** to accept the named boundaries and initiate creating the sheets.



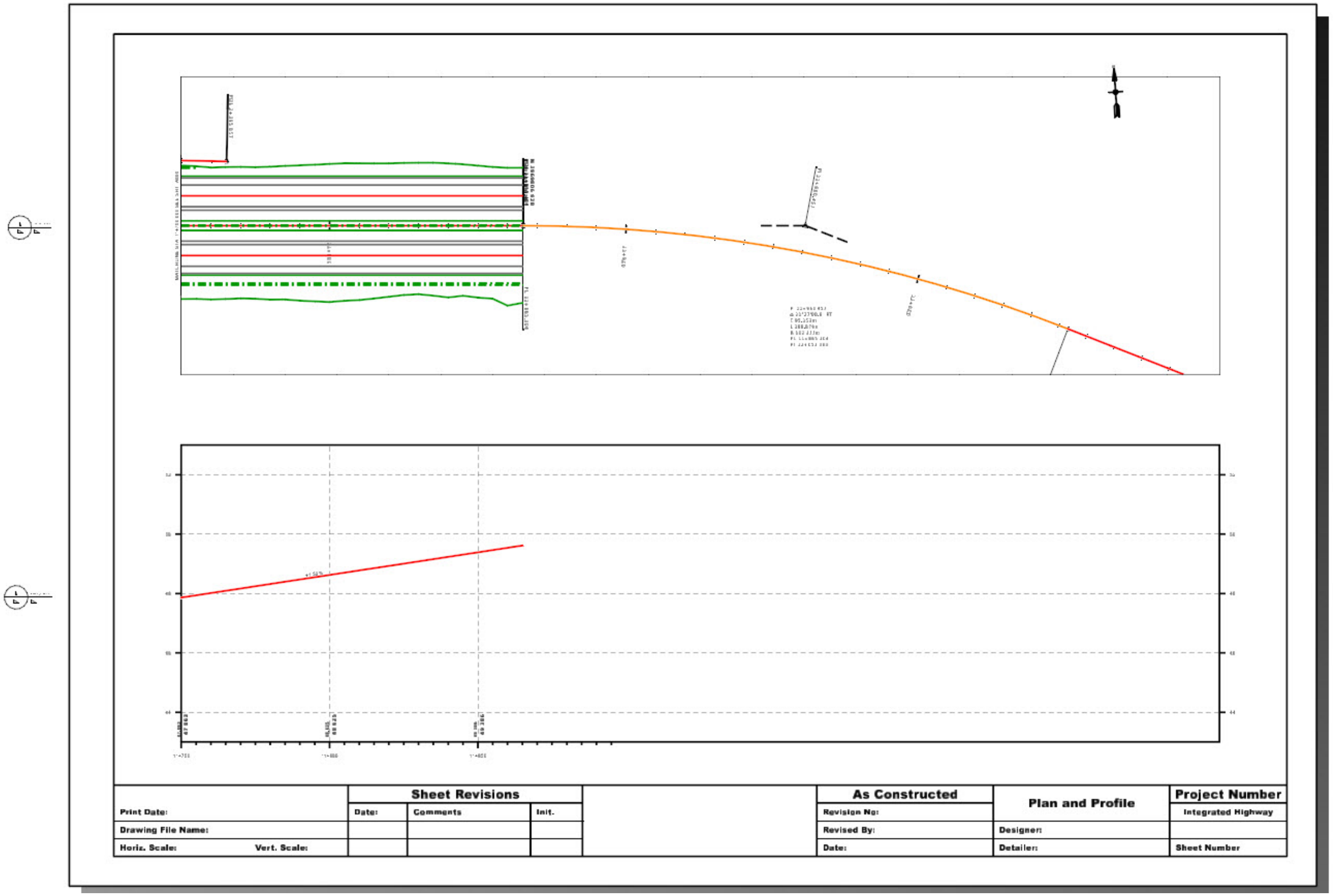
The Create Drawing dialog appears.

This is the beginning of the Create Drawing process. When the Show Dialog option is enabled the Create Drawing dialog appears providing the opportunity to adjustment the parameters. However, in a typical workflow these parameters do not need to be changed because the default values are all set by the Drawing Seed selected when creating the named boundaries in the previous steps.



11. Enable the **Add to Sheet Index** option.
12. Click **OK** to create the Plan and Profile sheets.

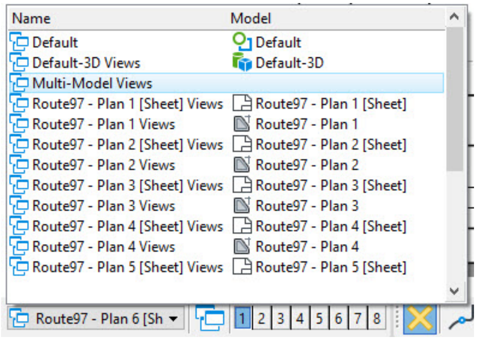
    A progress bar in the lower right corner is shown as the sheets are created. Once complete, a sheet appears.



Notice that the plan sheets only show the horizontal alignment and corridor. To add additional data such as the drainage network, simply reference the data into the Default 2D model and it will automatically be included on all of the sheets.

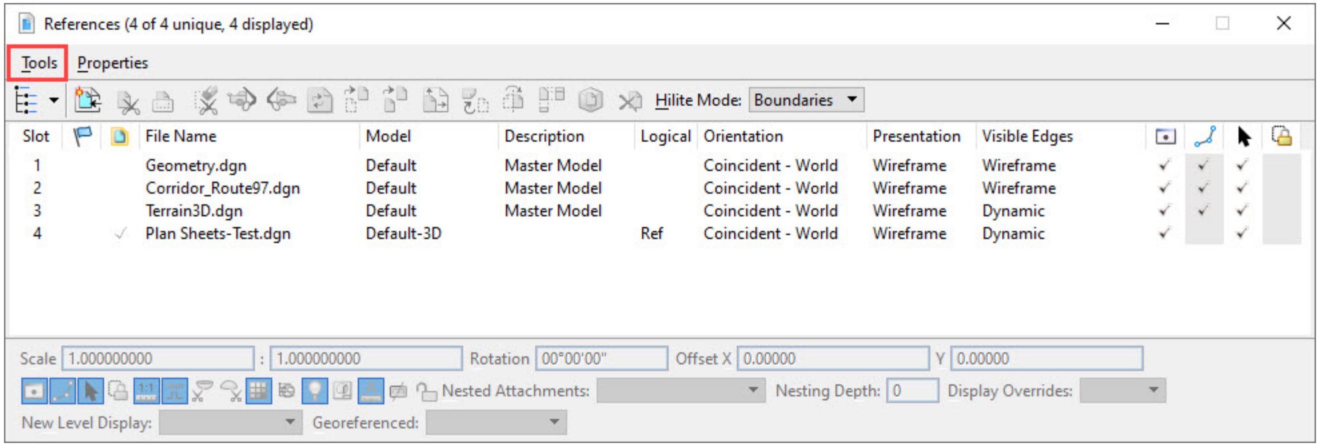
13. Reference the drainage network.

a. Select **Multi-Model Views** from the *View Group* list in the lower left corner of the screen.



b. Click in **View 1** (2D view) to make it active.

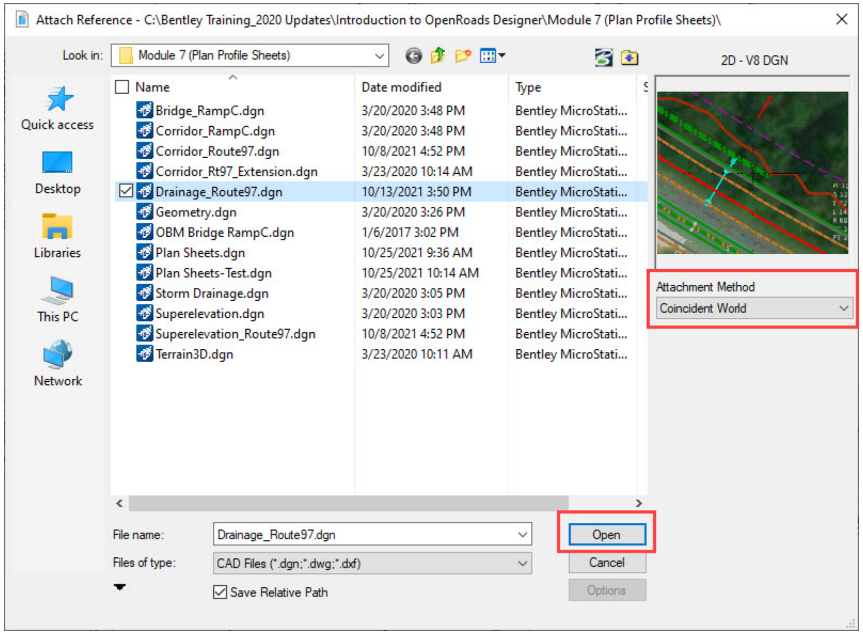
c. Select *Home > Primary > Attach Tools >* **References**

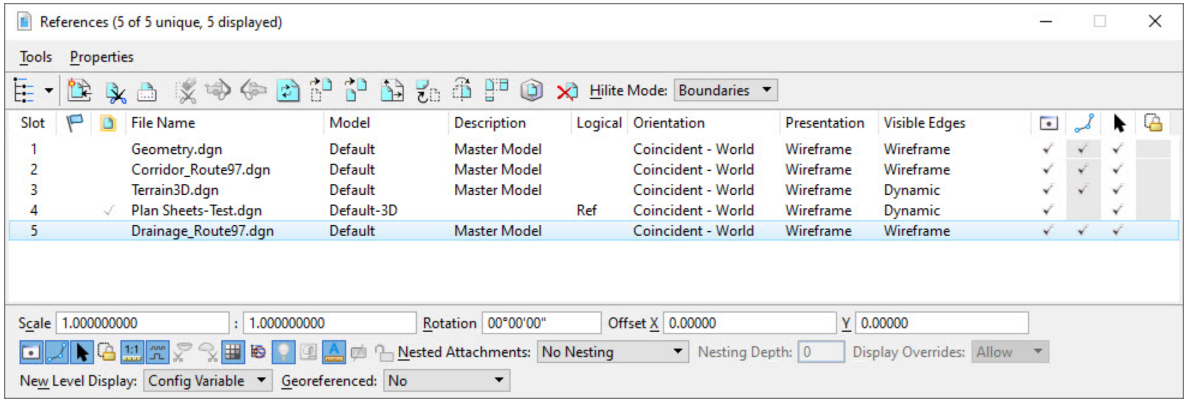


d. Select *Tools >* **Attach**

e. Set the *Attachment Method* to **Coincident World**.

f. Select **Drainage_Route97.dgn** and select **Open** to attach it as a reference file.

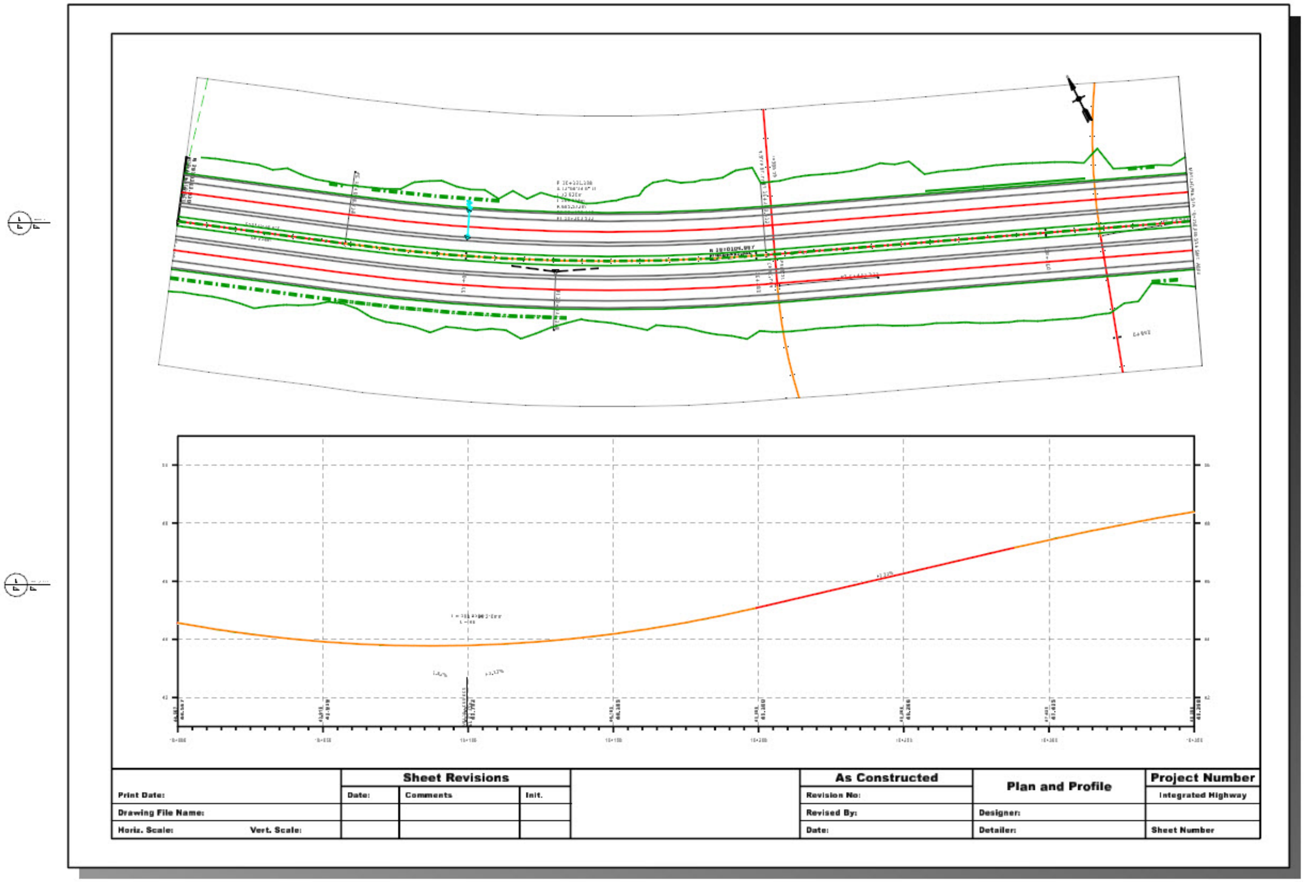




g. Close the *References* dialog.

14. Navigate back to the Plan and Profile Sheet to review the drainage structures on the sheet 1.

   a. Select **Route97 - Plan 1 [Sheet] Views** from the *View Group* list in the lower left corner of the screen.



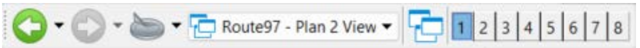
Place Labels with the Civil Labeler Tool

In this section, you will learn how to place labels using the Civil Labeler tool. The Civil Labeler tool provides extensive labeling capabilities made specifically for labeling civil data. The tool creates dynamic and intelligent labels that are easy to customize and can handle almost any label you would need. Labels can be placed for plan, profile, and cross sections objects. Labels such as alignment names, station/ offset, intersecting geometry stations, station/offset are some of the example label types that can be placed.

---

1. Label the **Route97** alignment name.

   b. Use the *View Group* tool to select **Route97 - Plan 2 Views** model. This will take you to the plan view drawing model for sheet 2.



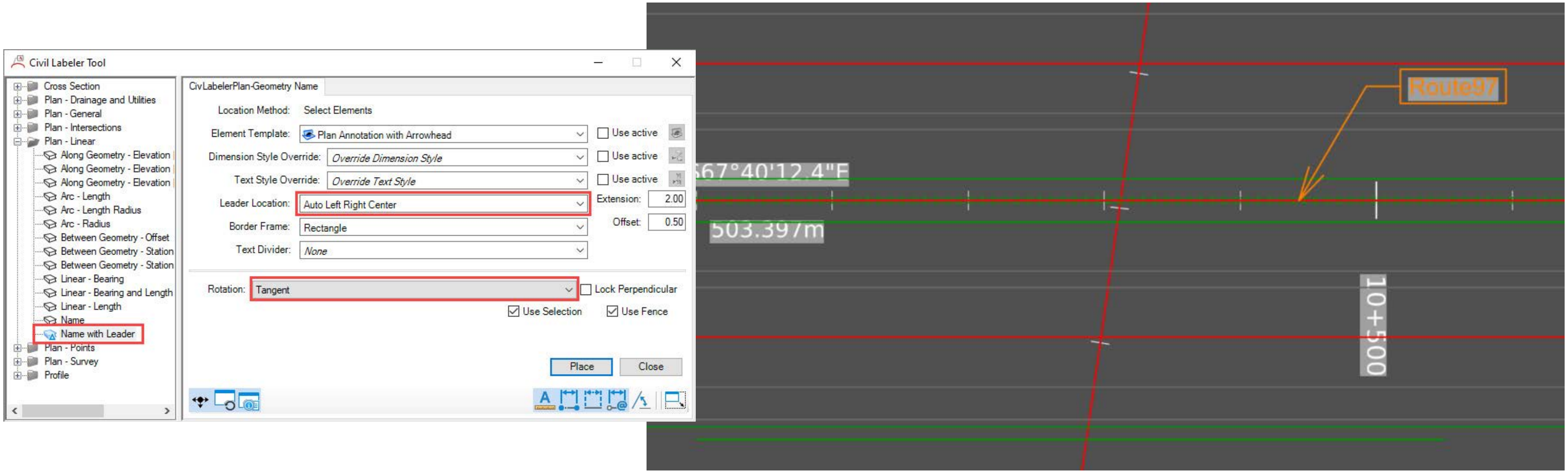
   c. Zoom into the area where **Route97** crosses the **I-95 Baseline**. This will be where the second named boundary was placed.

   d. Select *Drawing Production > Labels >* **Civil Labeler**

   e. Expand the Civil Labels folder to *Civil Labels > Plan - Linear*

   f. Select the item called **Name with Leader**. This label will place the name of the alignment with a rectangular frame and leader line.

   g. Set the *Rotation* option to **Tangent** and set the *Leader Location* to **Auto Left Right Center**



h. Select **Place** and follow the prompts at the lower left corner of the screen.

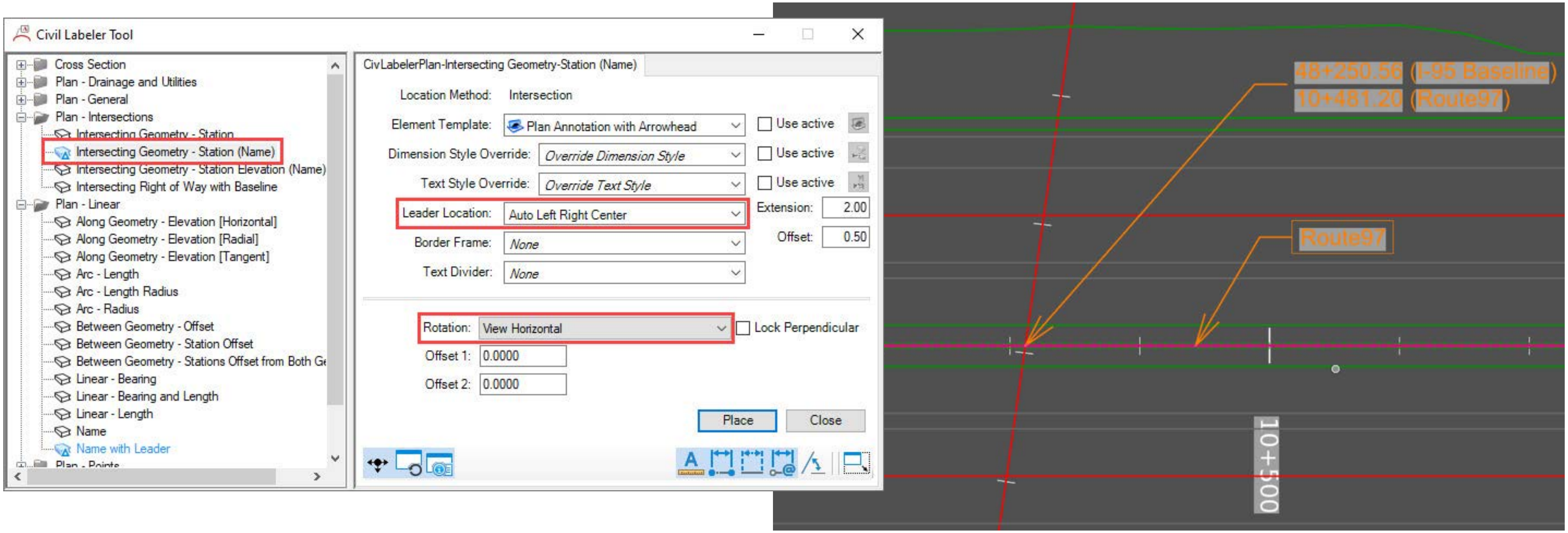
- *Identify Geometry*: Select the **Route97** centerline geometry.
- *Place Label*: Place the label anywhere above the **Route97** centerline geometry.

2. Label the intersection point of the **I-95 Baseline** and **Route97** with intersecting station and alignment name.

a. Expand the *Civil Labels* folder to *Civil Labels > Plan - Intersections*

b. Select the label called **Intersecting Geometry - Station (Name)**

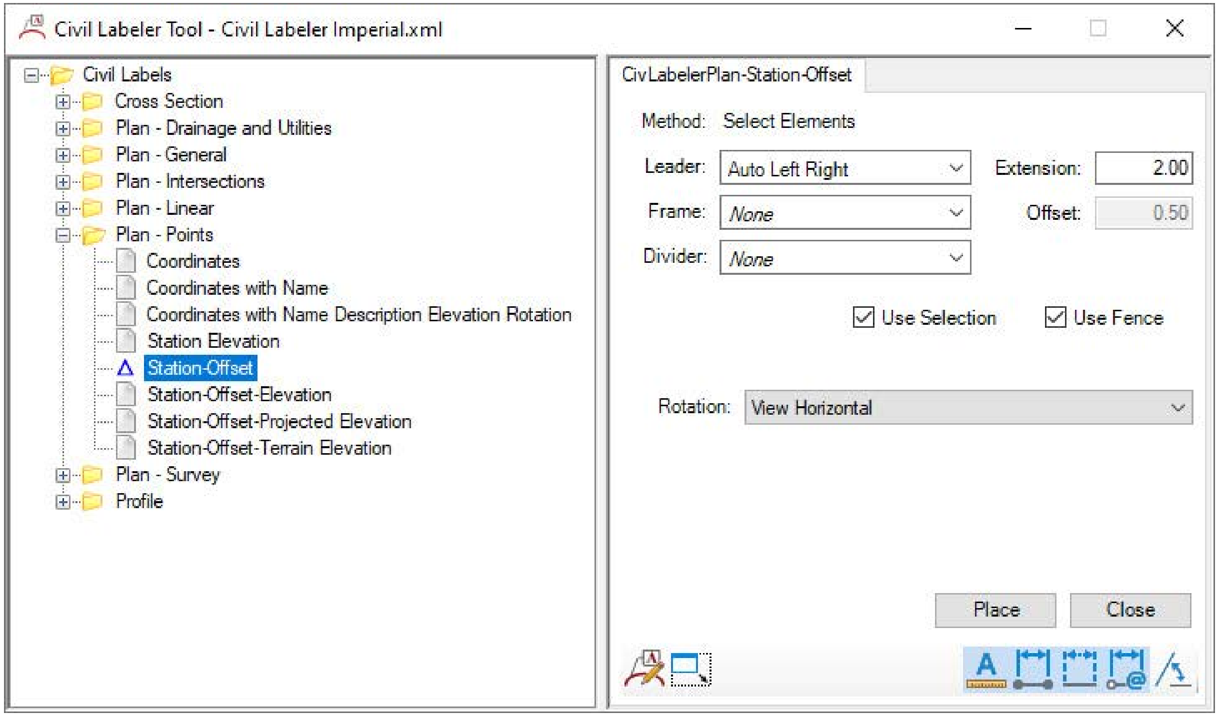
c. Set the *Rotation* option to **View Horizontal**



d. Select **Place** and follow the prompts at the lower left corner of the screen.

- *Identify first intersecting geometry*: Select the **I-95** centerline geometry.
- *Identify second intersecting geometry*: Select the **Route97** centerline geometry.
- *Place Label:* Place the label as shown in the image above.

3. Experiment placing other types of labels such as **Station-Offset** and **Station-Offset-Elevation**. Also, try labeling in the profile drawing model as well.

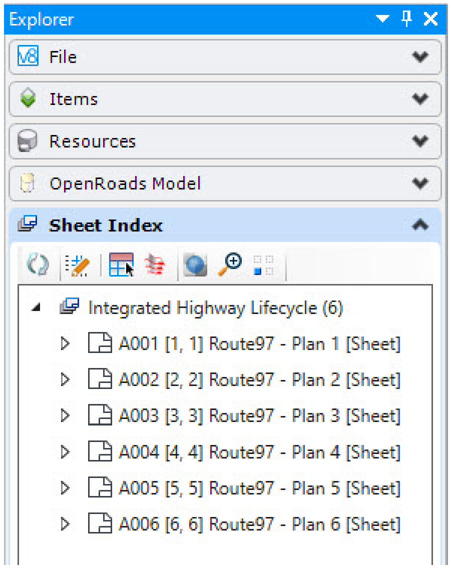


4. Using the *View Group* tool, open the **Route97 - Plan 2 [Sheet]** sheet model and review the labels in the sheet.

NOTE: Although we are placing labels in the drawing model for this course. A best practice would be to place the labels in a separate labeling file and reference it into the container file used to create the name boundaries and sheets. This allows for easier updating of labels if the sheets ever need to be re-cut.

Batch Print Plan and Profile Sheets

1. Open **Explorer** from the *Home* ribbon tab.
2. Select the **Sheet Index** tab.
3. Expand the **Integrated Highway Lifecycle** folder.
4. Batch Print sheets to PDF.



   a. Select the **Integrated Highway Lifecycle** project folder in the *Sheet Index* tab of the Explorer.

   b. Click the **Open Print Organizer** icon.

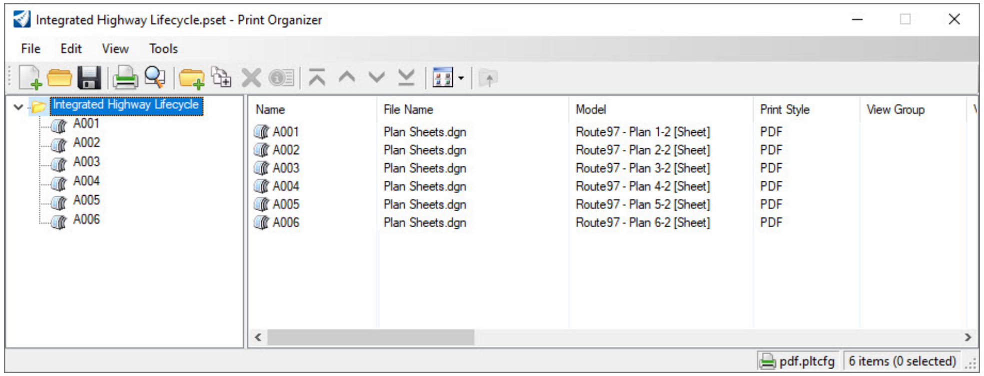
   c. Select **PDF** and click **OK**.

   The Print Organizer dialog appears.

   All of the sheets that will be printed are listed on the right side of the dialog.In this situation that includes both the cross section and plan and profile sheets.

   d. Click the **Print** icon. This *Print* dialog will appear.

   e. Click the **Ellipsis** icon next to the *Destination* field.



   f. Browse to the output location and name of the PDF that will be created and click **Save**.

   g. Click **OK** to create the PDF.

   h. Close Print Organizer.

5. Open and review the **Integrated Highway Lifecycle.pdf**.

Skills Assessment

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

---

1. Which of the following types of models are used when plan sheets are created.
    a. Design Models
    b. Details Models
    c. Drawing Models
    d. Sheet Models
    e. Layout Models
2. The Named Boundary...
    a. Defines the extent of what is displayed on the sheet.
    b. Defines the plan or profile view that is displayed in the Drawing Model and Sheet Model.
    c. Can be thought of as a shape used to clip the reference files.
    d. All of the above.
3. The drawing seed defines default values and other parameters required to create sheets. Three drawing seeds for plan drawings are included in the default workspace.
    a. True
    b. False
4. Labels should be placed in Drawing Models.
    a. True
    b. False

Module 7: Earthwork

Description

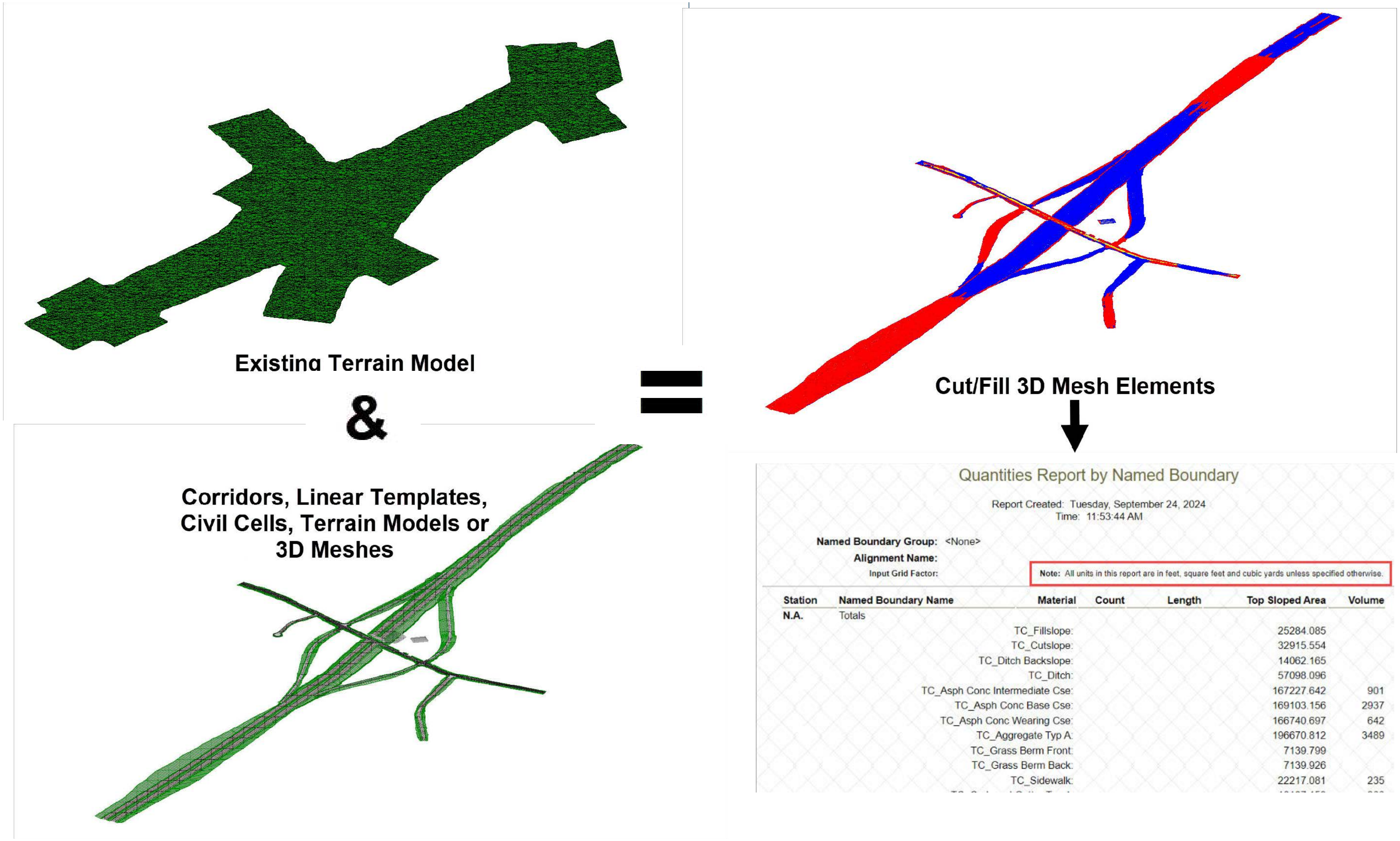
In this exercise, you are going to learn how to generate earthwork quantities. This process involves the creation of 3D mesh elements that represent the cut and fill volumes between the existing terrain model and the corridor model. This is a more exact method than using average end area method for volumes since it is calculating the volumes directly from the 3D data and using a **true prismoidal method**.

Skills Taught

- Create Cut and Fill Volumes (i.e. 3D Mesh Elements)
- Quantities and Volumes Report

Earthwork Overview & 3D Volumes Overview

Earthwork quantities are now calculated from 3D mesh elements. You no longer need to create a set of cross sections to get cut and fill volumes. Earthwork quantities are now truly 3D. The *Create Cut Fill Volumes* tool creates a 3D mesh element for cut and a 3D mesh element for fill. These meshes can then be used to extract earthwork quantities and reports directly from the 3D Model.



Quantities Report by Named Boundary

Report Created: Tuesday, September 24, 2024
Time: 11:53:44 AM

Named Boundary Group: <None>
Alignment Name:
Input Grid Factor:

Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
N.A.	Totals					
		TC_Fillslope:			25284.085	
		TC_Cutslope:			32915.554	
		TC_Ditch Backslope:			14062.165	
		TC_Ditch:			57098.096	
		TC_Asph Conc Intermediate Cse:			167227.642	901
		TC_Asph Conc Base Cse:			169103.156	2937
		TC_Asph Conc Wearing Cse:			166740.697	642
		TC_Aggregate Typ A:			196670.812	3489
		TC_Grass Berm Front:			7139.799	
		TC_Grass Berm Back:			7139.926	
		TC_Sidewalk:			22217.081	235

Create 3D Cut and Fill Volumes

In this section, you are going to learn how to create the 3D cut/fill mesh elements that represent the cut and fill volumes between the existing terrain model and the bottom mesh of the corridor model. We will use the *Create Cut Fill Volumes* tool to accomplish this task.

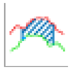
---

1. Create the 3D cut and fill mesh elements.

   a. Open the file named **Earthwork_Route97.dgn** the existing terrain model, geometry and corridor are already attached as reference files.

   View 1 is the 2D plan view, *View 3* is the 3D model view and *View 7* is the cross section view.

   b. *Left-click* in *View 1* to make it active.

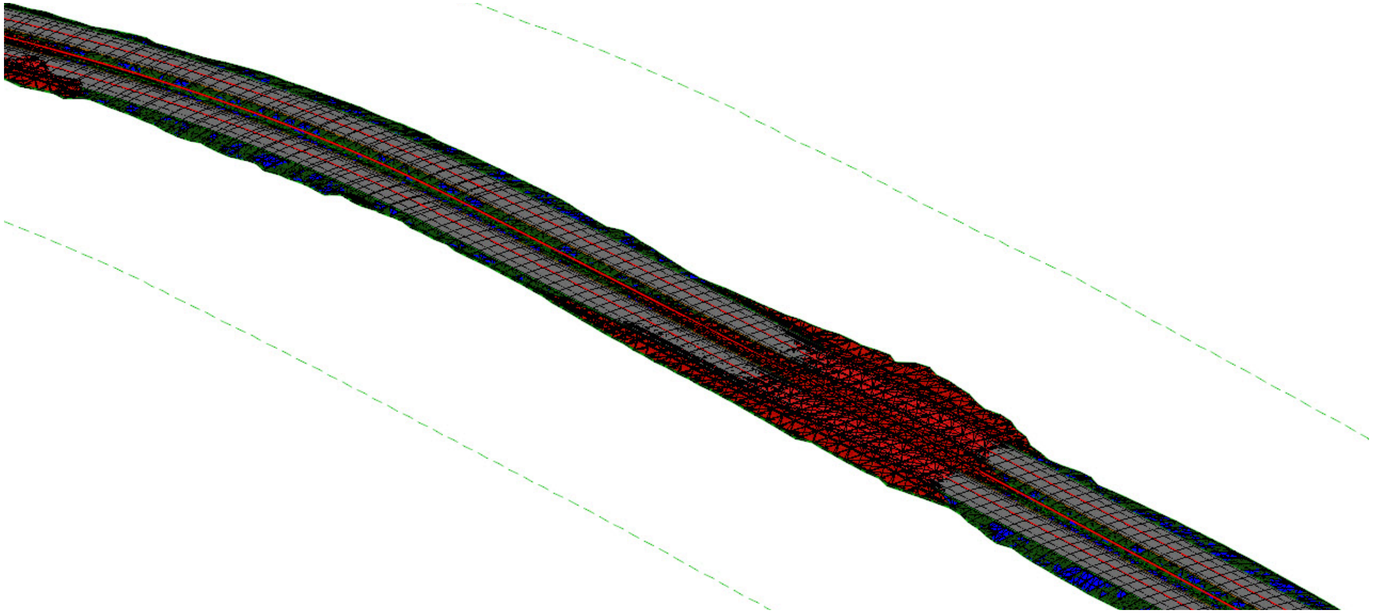


   c. Select *Home > Model Analysis and Reporting > Civil Analysis >* **Create Cut Fill Volumes**

   d. Follow the heads up prompts (after each prompt, **Left click** to accept values and move to next prompt):

   - *Cut Feature Definition:* **Volumes_Cut**
   - *Fill Feature Definition:* **Volumes_Fill**
   - *The options to Compute Unsuitable, Compute Custom and Compute Substrata should be* **unchecked***.*
   - *Data Point to accept selection:* **Left-click** to complete the command.

3D mesh elements are now created displaying where the cut and fill are located in the 3D model. This is useful for visualizing earthwork and for the extraction of volumetric quantities. The **Blue** 3D mesh element indicates *Fill* and the **Red** 3D mesh element indicates *Cut.*



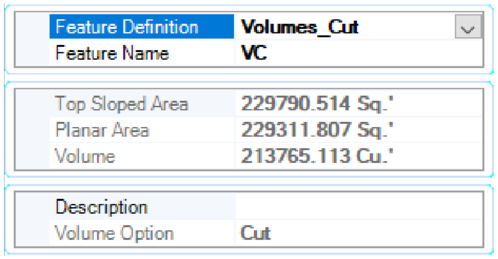
Also, note a proposed terrain model of the corridor(s) is no longer required to produce cut and fill volumes.

Volumes are now based on *Feature Definitions* **that are assigned to civil elements (terrains, corridor components, linear templates, civil cells, etc.)**

2. Review the Cut/Fill 3D Mesh Properties.

   a. Using the *Element Selection* tool, select any of the 3D mesh elements.

   b. Hover your cursor over the 3D mesh and then select **Properties** from the heads-up display.



   The 3D mesh elements have volume attributes associated with them which can be viewed via the *Properties* tool. Note the volume is in cubic meters which is based on the linear units of the DGN file.

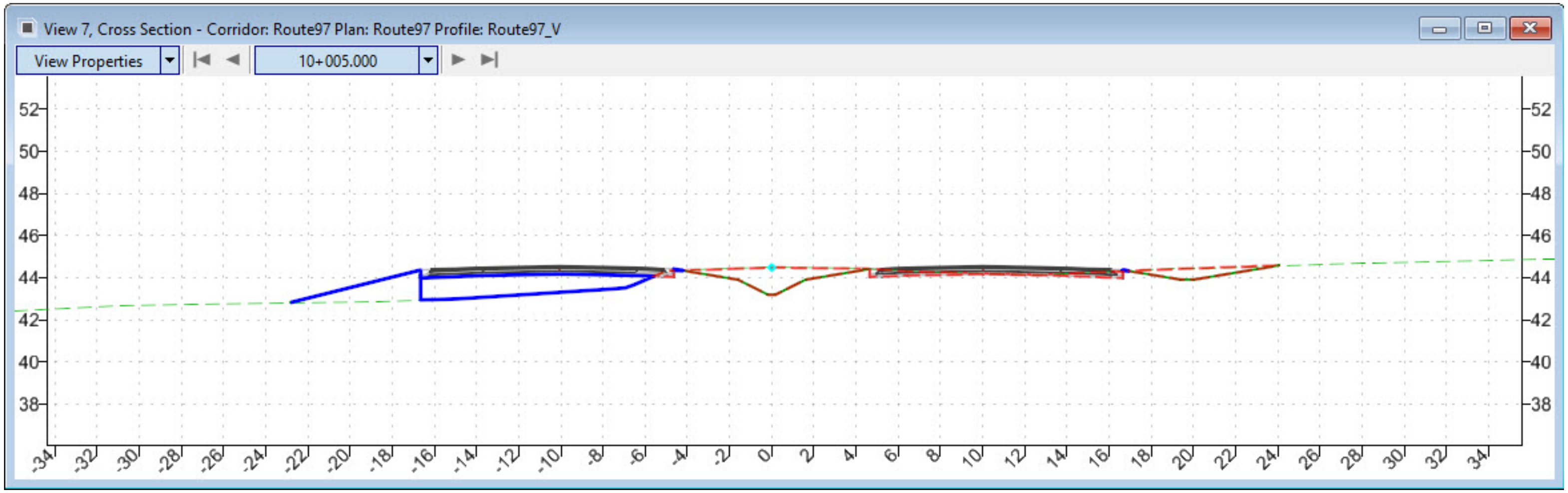
   Also, take note of the *Feature Name* and *Feature Definition*. The *Feature Definition* controls the display of the 3D meshes and assigns the volume options of *Cut* or *Fill* to the 3D mesh (the *Volume Option* will be discussed in the next section).

   The cut and fill quantities report can be created by using the **Quantities Report by Named Boundary** and **End Area Volumes Reports**. We will discuss those in more detail in later sections.

3. Review the cross sections.

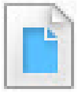
   a. *Left-click* in **View 7** to make the cross section view active.

   b. Navigate through the cross sections and notice that the cut and fill graphics are being displayed on the cross sections. The cut/fill graphics come directly from the 3D model.



4. Review the 3D Model to get a better understanding of where the cut and fill areas are located along the corridor.

   a. *Left-click* in the 3D view.



   b. Select *Home > Primary > Attach Tools >* **References**

   c. Select **Corridor_Route97.dgn** in the references dialog.

   d. Select the **Display** icon to toggle off the corridor.

5. Change the 3D Model *Display Style* to **Smooth: White Background**.

   a. Select the **View Attributes** tool, in the upper left portion of the *View 3 (Default-3D)* window.

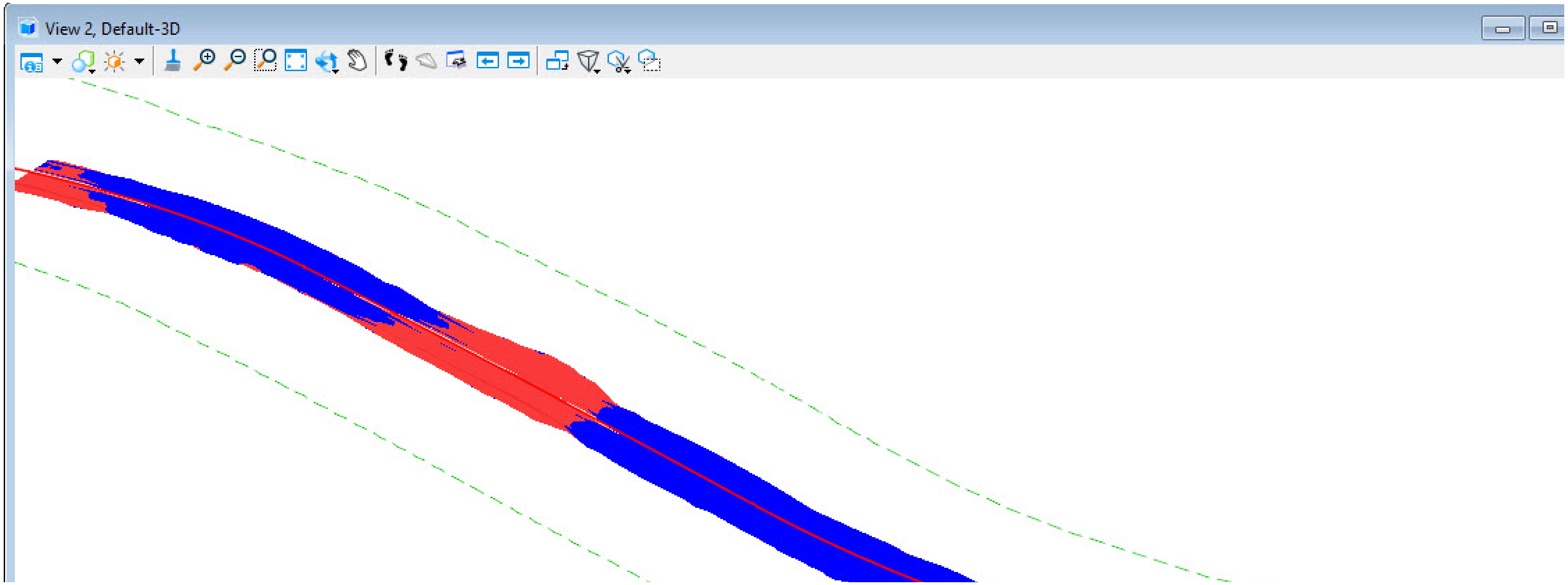
   b. Set the *Display Style* to be **Smooth: White Background**

6. Rotate the view and observe the cut and fill areas in 3D.

   a. Select the **View Rotation** tool at the top of the view window.

   b. *Left click* and **hold** the left mouse button to begin view rotation. Slowly move your mouse up and down or side to side to rotate the view.

   c. Release the left mouse button and **Right click** to reset.



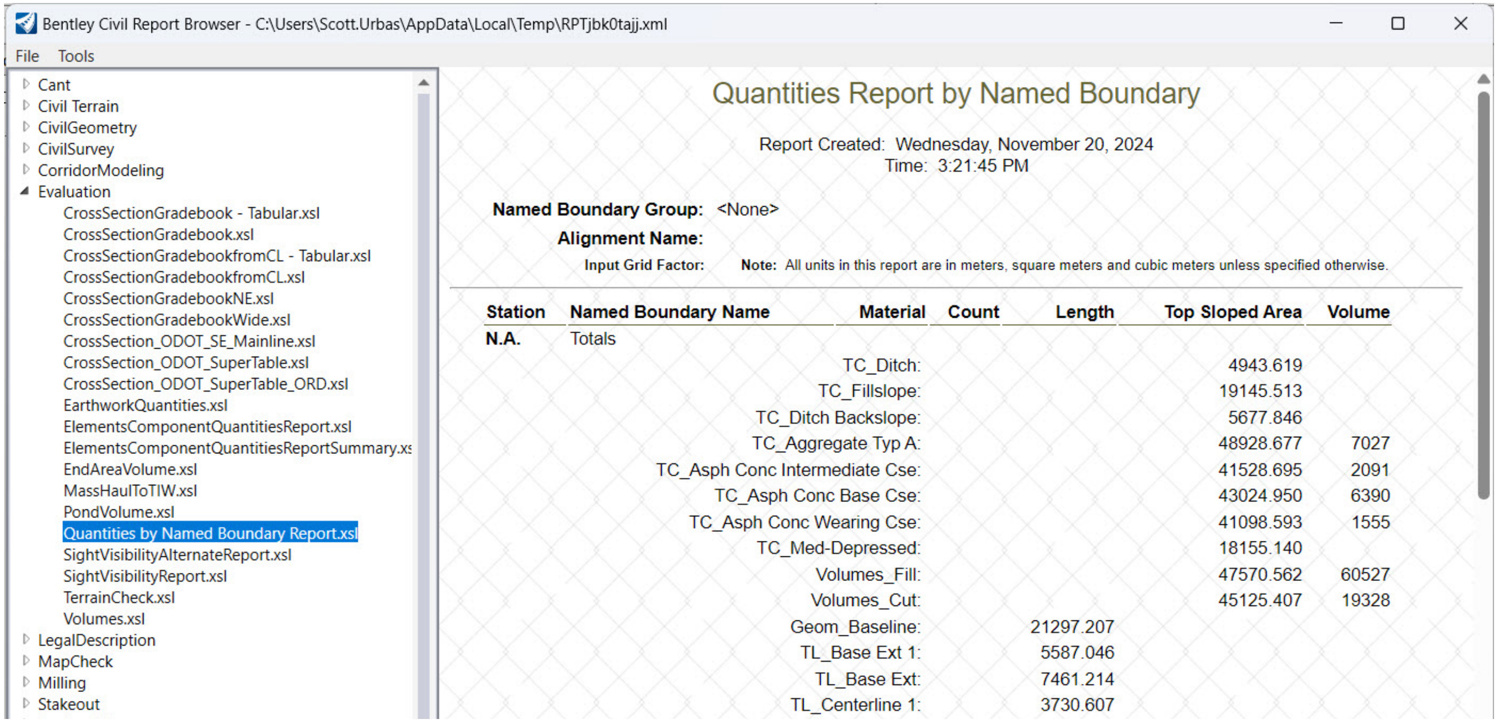
Quantities and Volumes Report

In this section, you will learn how to create a report of the corridor quantities and volumes for the entire corridor model using the **Quantities Report by Named Boundary** tool. This report will compute *Length*, *Slope Area* and *Volume* from the 3D Model.

1. Select *Home > Model Analysis and Reporting > Civil Analysis >* **Quantities Report by Named Boundary**

   a. Follow the heads up prompts (after each prompt, **Left click** to accept values and move to next prompt):

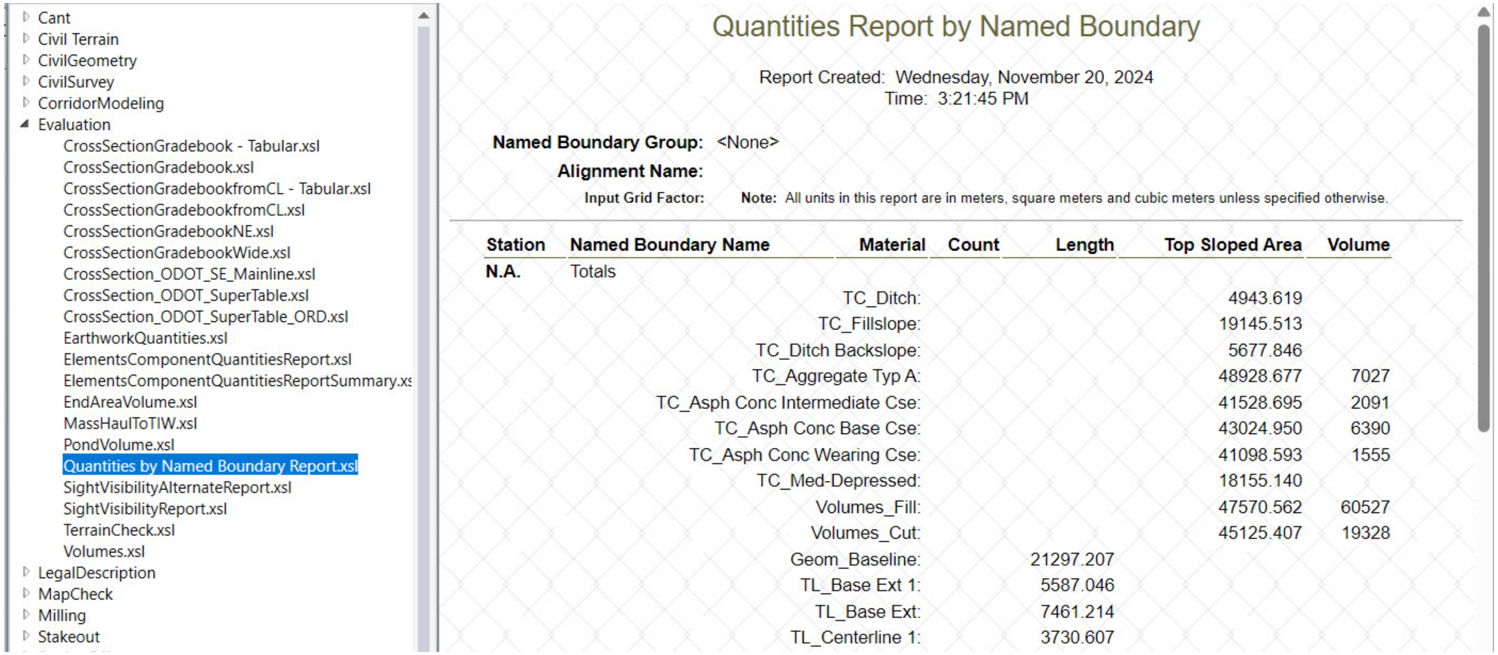
   - *Named Boundary Group:* **<None>**
   - *Display Clipped Graphics:* **No**
   - *Left Click* to display report.



2. **Review** the report (note the volumes are still reported in cubic meters).

The cut and fill volumes are determined from the 3D cut and fill mesh elements that were created using the *Create Cut Fill Volumes* tool. The other material quantities are computed directly from the 3D corridor models that have been attached as reference files.

If you only want the cut/fill volumes displayed in this report just detach the necessary corridor reference files.



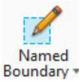
The quantities listed in the report when a **Named Boundary** <u>**does not**</u> exist are the <u>**total quantities**</u> extracted from the 3D Model. The software also provides the ability to compute quantities within a closed boundary area known as a **Named Boundary.**

3. Close the *Bentley Civil Report Browser*.

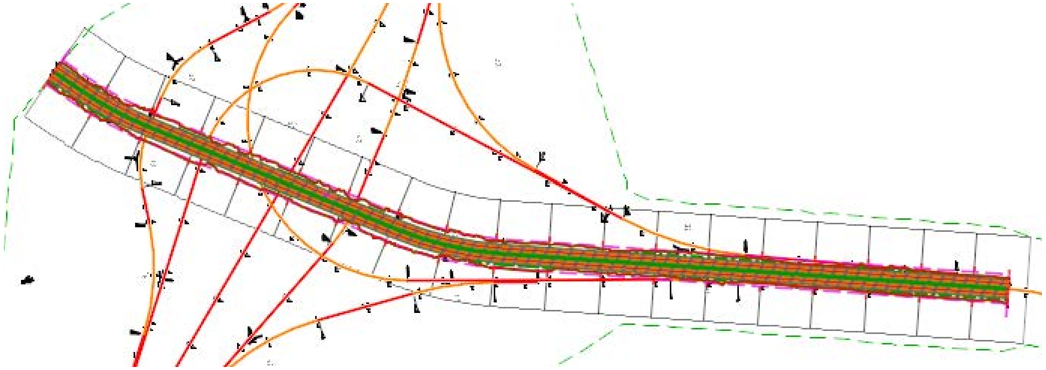
Create Quantities Report Using Named Boundaries

In this section, the objective is to create a quantities report at 100 unit intervals along the Route 97 corridor.

1. Continuing in the **Earthwork_Route97.dgn**



2. From the ribbon menu, select *Drawing Production > Named Boundary >* **Place Named Boundary**
3. Select the *Civil Plan* tool and populate the following fields with the values shown:



   - Set *Drawing Seed*: **A1_PLAN**
   - *Detail Scale:* **1:500**
   - *Name (under Detail Scale):* **Route97**
   - *Set the length:* **100**
   - *Left Offset:* **-100.0**
   - *Right Offset:* **100.0**
   - *Overlap:* **0**
   - *Boundary Chords:* **10**
   - *Create Drawing:* **Disable**

   a. Select *Route97* alignment to identify path element.

   b. Select *Lock Start Location* icon to lock the starting location.

   c. Select *Lock End Location* icon to lock the end location.

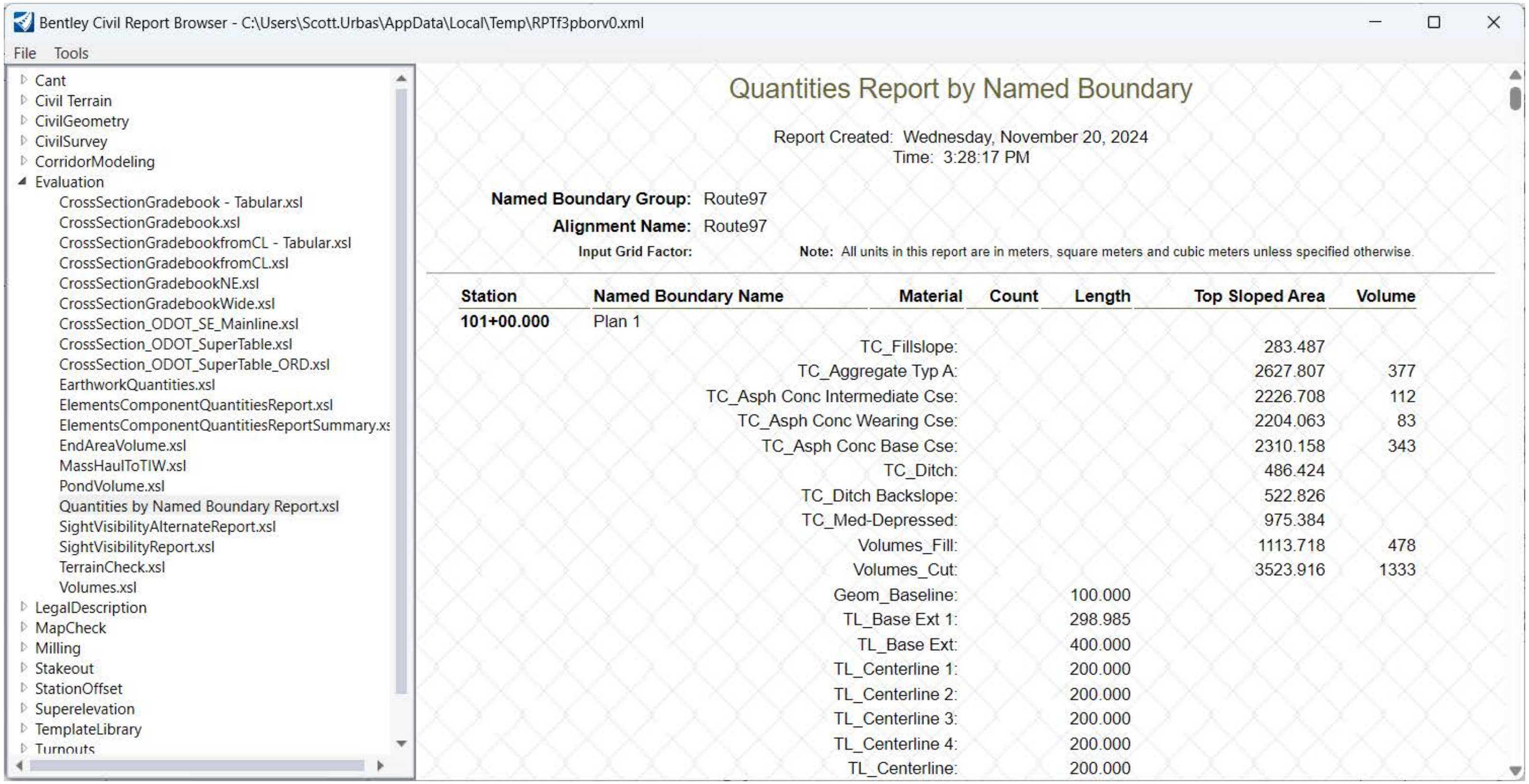
   d. *Left-Click* to accept (Multiple Left-Clicks are be required to complete).

4. Select *Home > Model Analysis and Reporting > Civil Analysis >* **Quantities Report by Named Boundary**

   a. Follow the heads up prompts (after each prompt, **Left click** to accept values and move to next prompt):

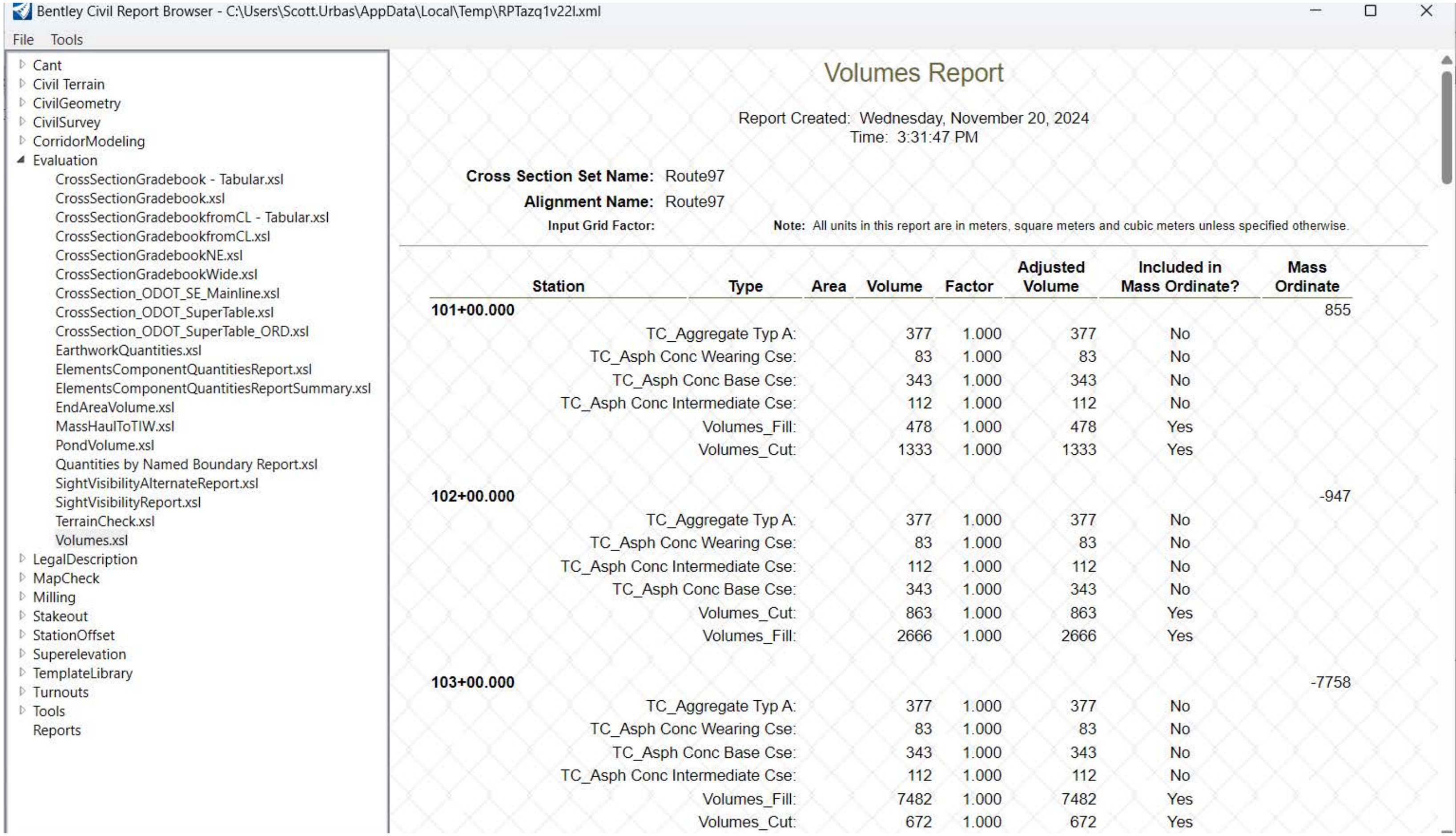
      - *Named Boundary Group:* **Route97**
      - *Display Clipped Graphics:* **No**
      - *Left Click* to display the report.

5. Review the report and note all of the materials are being quantified by the station range of each named boundary. Also, the quantities included in the report are extracted from all reference files attached to the design file (.dgn).



6. Review the Volumes report.

a. Select the **Volumes.xsl** (this style sheet only displays the volumes for each material type). The volumes come directly from the 3D corridor modeling and 3D cut and fill meshes.



Volumes Report

Report Created: Wednesday, November 20, 2024
Time: 3:31:47 PM

Cross Section Set Name: Route97
Alignment Name: Route97
Input Grid Factor:
Note: All units in this report are in meters, square meters and cubic meters unless specified otherwise.

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
101+00.000							855
	TC_Aggregate Typ A:		377	1.000	377	No	
	TC_Asph Conc Wearing Cse:		83	1.000	83	No	
	TC_Asph Conc Base Cse:		343	1.000	343	No	
	TC_Asph Conc Intermediate Cse:		112	1.000	112	No	
	Volumes_Fill:		478	1.000	478	Yes	
	Volumes_Cut:		1333	1.000	1333	Yes	
102+00.000							-947
	TC_Aggregate Typ A:		377	1.000	377	No	
	TC_Asph Conc Wearing Cse:		83	1.000	83	No	
	TC_Asph Conc Intermediate Cse:		112	1.000	112	No	
	TC_Asph Conc Base Cse:		343	1.000	343	No	
	Volumes_Cut:		863	1.000	863	Yes	
	Volumes_Fill:		2666	1.000	2666	Yes	
103+00.000							-7758
	TC_Aggregate Typ A:		377	1.000	377	No	
	TC_Asph Conc Wearing Cse:		83	1.000	83	No	
	TC_Asph Conc Base Cse:		343	1.000	343	No	
	TC_Asph Conc Intermediate Cse:		112	1.000	112	No	
	Volumes_Fill:		7482	1.000	7482	Yes	
	Volumes_Cut:		672	1.000	672	Yes	

b. Close the *Bentley Civil Report Browser* dialog when done reviewing.

Since the quantities and volumes reports are reading 3D information in the design file earthwork reporting is going to be more accurate than using the average end area method.

If you need to produce an end area volume report the software does have the capability to do that utilizing cross section Named Boundaries and the End Area Volumes Report tool.

Skills Assessment

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

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1. Which tool do you use to create the 3D cut and fill mesh elements?
   a. Create Corridor
   b. Create Cut Fill Volumes
   c. Quantities Report by Named Boundary
2. Which tool creates boundary shapes along the corridor?
   a. Component Quantities
   b. Element Component Quantities
   c. Place Named Boundary
3. Which tool will calculate and report on lengths, areas and volumes?
   a. Component Quantities
   b. Element Component Quantities
   c. Quantities Report by Named Boundary
4. Which report will display only Volumes?
   a. Component Quantities
   b. Volumes
   c. Quantities Report by Named Boundary
5. Which report will display length, areas and volumes?
   a. Quantities Report by Named Boundary
   b. Element Component Quantities

Summary

In this course you have learned about the fundamentals of road design and modeling with OpenRoads Designer. Upon completion of this course you should have a good understanding of how OpenRoads Designer works.

The topics covered in this course included the following:

- OpenRoads Designer Interface
- Import Existing Ground Data
- Import and Annotate Geometry
- Create Civil Geometry (Horizontal & Vertical)
- Corridor Modeling
- Superelevation
- Cross Section Sheet Creation
- Plan and Profile Sheet Creation
- Earthwork Quantities