Module 2

Existing Terrain Models

April 11, 2023

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About this Practice Workbook...

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file. You may have to turn on the bookmark function in your PDF viewer, such as Adobe Reader.

- The dataset used throughout this module uses English units and US Survey Feet.

- Each module in this series is self-contained. You can jump to any module and begin the exercises.

- This training module uses the **DOT-US North Carolina** WorkSpace and the **R-2635C (Training)** Workset installed. It is very important that you select the correct WorkSpace, WorkSet and Desktop Icon/Discipline/future Role **NCDOT_Roadway** when working the exercises in this course.

- The tool tips and help were copied from the Bentley Online Help. See this link for the complete list of tools and common usage.

  OpenRoads Designer CONNECT Edition Help (bentley.com)

- This workbook was written with the release of OpenRoads Designer 10.09.00.91 (2020 Release 3 Update 9).

- This workbook has been updated for OpenRoads Designer 10.10.XX.XX (2021 Release 1 Update 10).

Table of Contents

Overview

Open Roads Designer (ORD) utilizes Terrain Models in place of the GEOAPK TIN file. In the same way GEOPAK uses TIN files for Existing and Proposed surfaces ORD uses Terrain Models for Existing and Proposed surfaces. In this section we will review the EXISTING TERRAIN MODEL (ETM). The Proposed Terrain Model creation and associated tools will be covered in additional training modules.

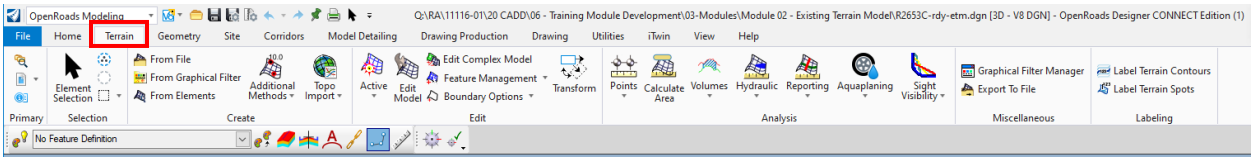
The ETM is a 3D model of the existing ground surface that is stored in a **3D DGN** file. When the designer needs to utilize the existing ground surface for a design application (Contours, Vertical Profiles, Models and Corridors, Cross Sections, etc.) the DGN file that contains the ETM file is attached as a reference file and the surface will be set to Active. This action, attaching the ETM as a reference file and setting the surface to Active replaces all the operations in GEOPAK that required the user to path to and select a TIN file.

For final design Location and Surveys will supply the ETM in a 3D DGN File and there will not be any additional work required of the designer to begin using the ETM for design. Like the GEOPAK TIN file that is supplied by Location and Surveys the user should not attempt to modify or in any way change an ETM that is received from Location and Surveys.

There will be situations when an ETM from Location and Surveys is not available or where more coverage is required, and the user needs to develop an ETM for a project. This could be because the project data is still in the GEOPAK TIN format, the user receives additional data as an XYZ text file, or the project is in the functional stage of design, or there is a need for additional coverage outside the limits of the survey. In these instances, and other similar situations ORD does supply tools that easily allow for the creation of an Existing Terrain Model.

Note: Locations and Surveys will be providing the Project design Existing Terrain Model as a 3D dgn file. The section covers situations where the roadway designer may need review additional coverage. The roadway designer should ensure they understand the source and quality of any data they are using for design purposes. None of the methods, presented in this section, of creating an Existing Terrain Model are meant to replace the Existing Terrain Model produced by Location and Surveys.

Terrain Ribbon Tab



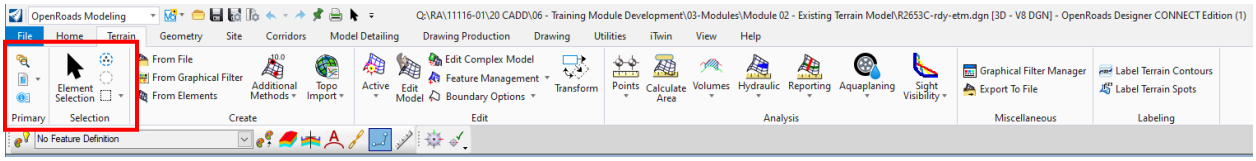
The *Terrain* Ribbon contains all the tools that will be required for the roadway designer to create a basic terrain model and perform some simple analysis functions. The Ribbon is broken into 7 sections.

Each Section will group together similar tools and tools that will be used together in a particular workflow.

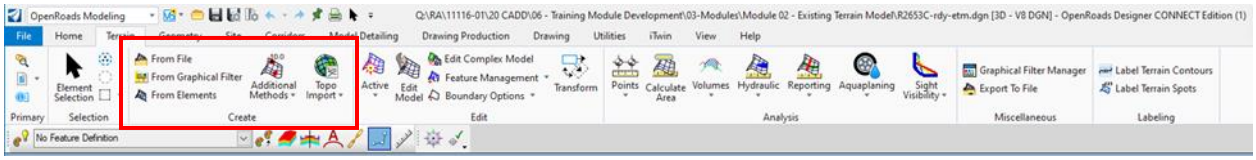
Insert video link that goes over the Terrain Ribbon

Primary & Selection Tool Group

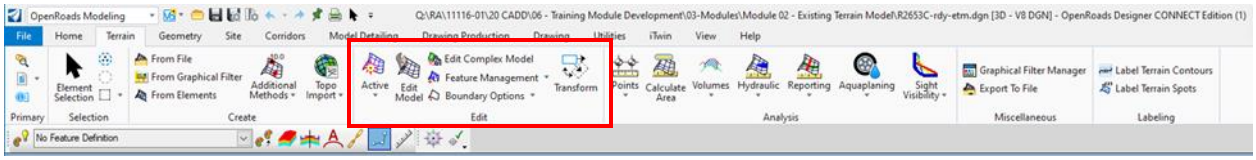
These two (2) groups are common throughout the ribbons. To see all the tools in these sections, use the Home Ribbon. The other Ribbons include a partial group of the tools included in these two sections



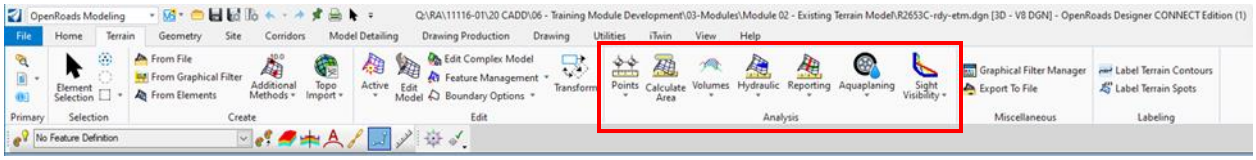
Create Tool Group



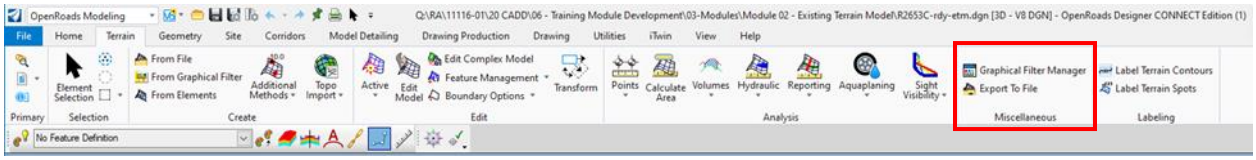
Edit Tool Group



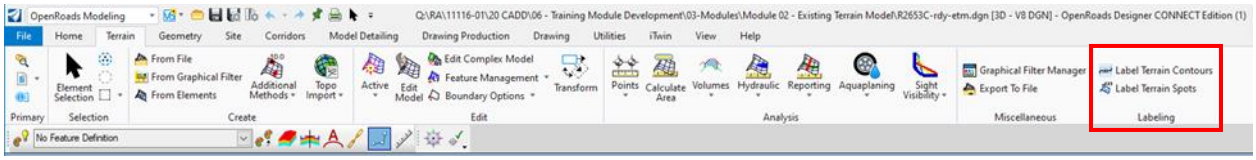
Analysis Tool Group



Miscellaneous Tool Group



Labeling Tool Group

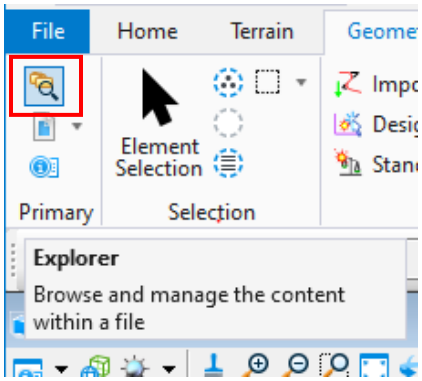


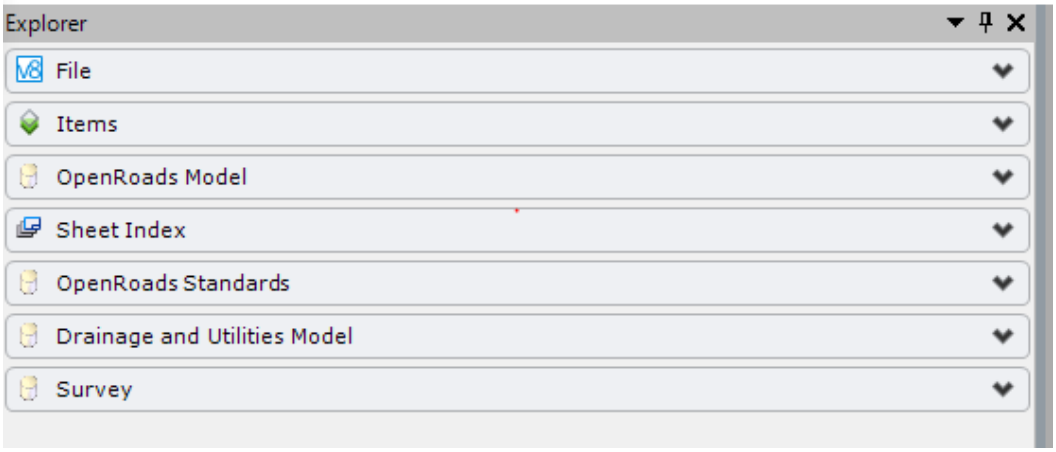
(Table 2-1) Important Tools Used in Existing Terrain Models

 From File	Create a terrain model by importing from an external file. Numerous file formats are supported such as LandXML, Lidar (*.las), and legacy products (InRoads, GEOPAK, and MX).
 Rotate View (Dynamic)	Dynamic — Lets you rotate a view interactively about a defined point (default is the center of the view at the active depth). As you rotate the view, the elements rotate to let you see the result of the rotation. When you select Dynamic, a plus sign (+) appears in the center of the active view to define the center of rotation. Prior to starting any rotation, you can click on the plus sign and move it to redefine the center of rotation.
 Set Active	Sets the active terrain model file. The active terrain model is the model which is displayed by default in profile models and is the default target for corridor modeler.
 Explorer	Manage project data using the Explorer dialog.
 Properties	Review or modify information about an element(s), such as its type, attributes, and geometry.

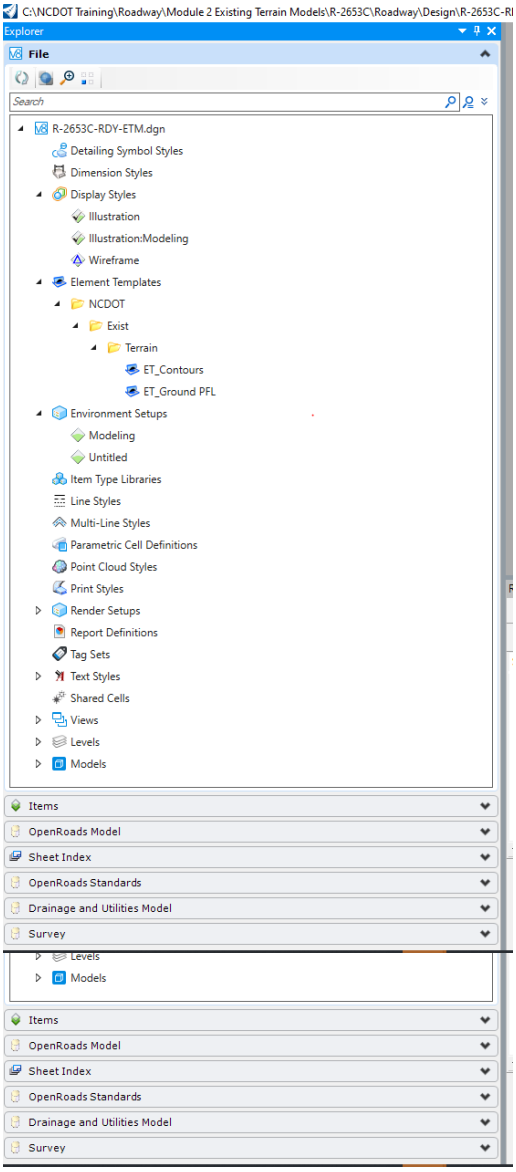
Primary Tools Detailed Overview

The *Primary* group is a launch point for commonly used tools. In the *Primary* section the user can access the **Explorer, Attachment Tools** for **References, Rasters, Point Clouds and Reality Meshes,** and Open the **Properties Dialog**. The **Explorer** is an important Dialog that the user will reference throughout the design process.

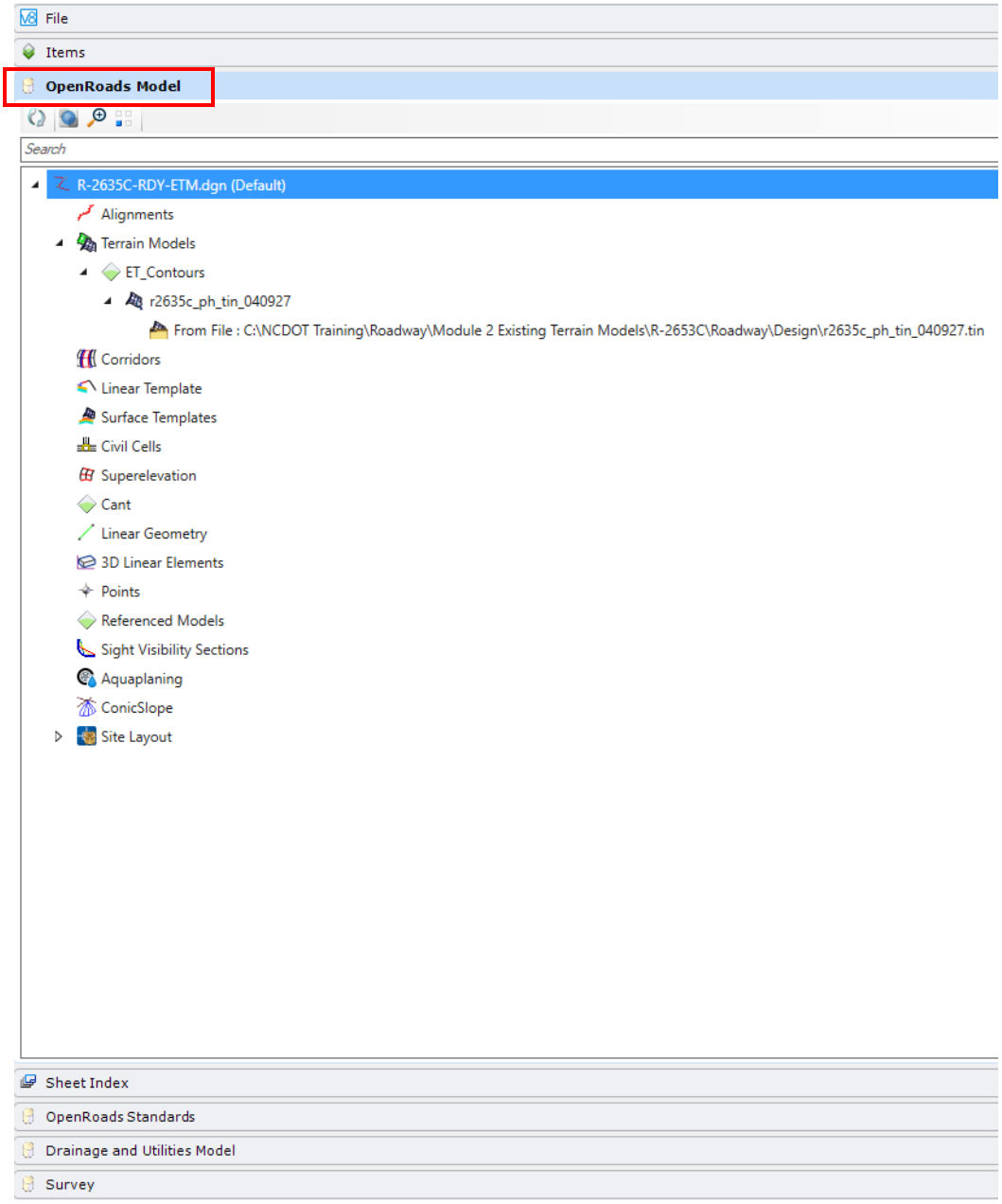




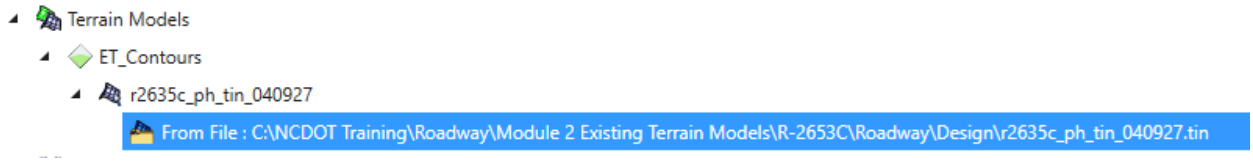
The **Explorer** dialog provides access to many important details about the design file. The format is similar to the tasks pane in MicroStation, but the **Explorer** contains much more information. Each Tab will expand to show the user additional details. The File section will display styles, each t element templates, levels and other basic information about the design file. Each Tab will expand to show the user additional details. The File section will display styles, element templates, levels, and other basic information about the design file.



The *OpenRoads Model* tab will display any ORD components that are in the Active file. In the ETM file this will show the Terrain model. In later training modules this tab will be used to display Corridors, Templates, Civil Cells, and other design elements. This Tab also allows the user to quickly find the location of these elements within the File.

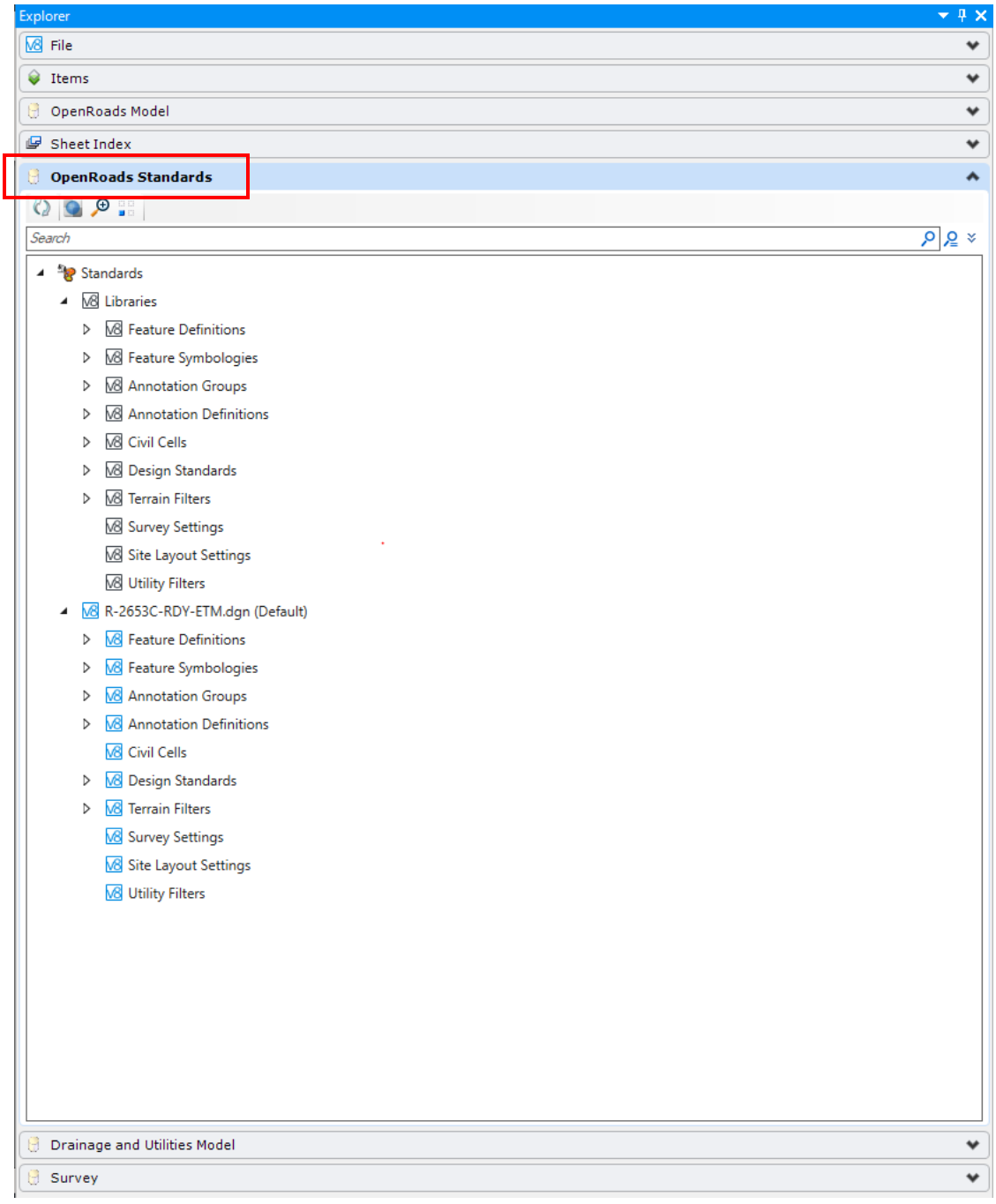


Note that the Terrain Element is named and that the name r2635c_ph_tin_040927 is based on the name of the source data. All ORD elements will have a unique name, for some things the name is important, naming elements during design is something that will be covered more in later Modules. For this Terrain Model the Import Method and Source data are also identified.

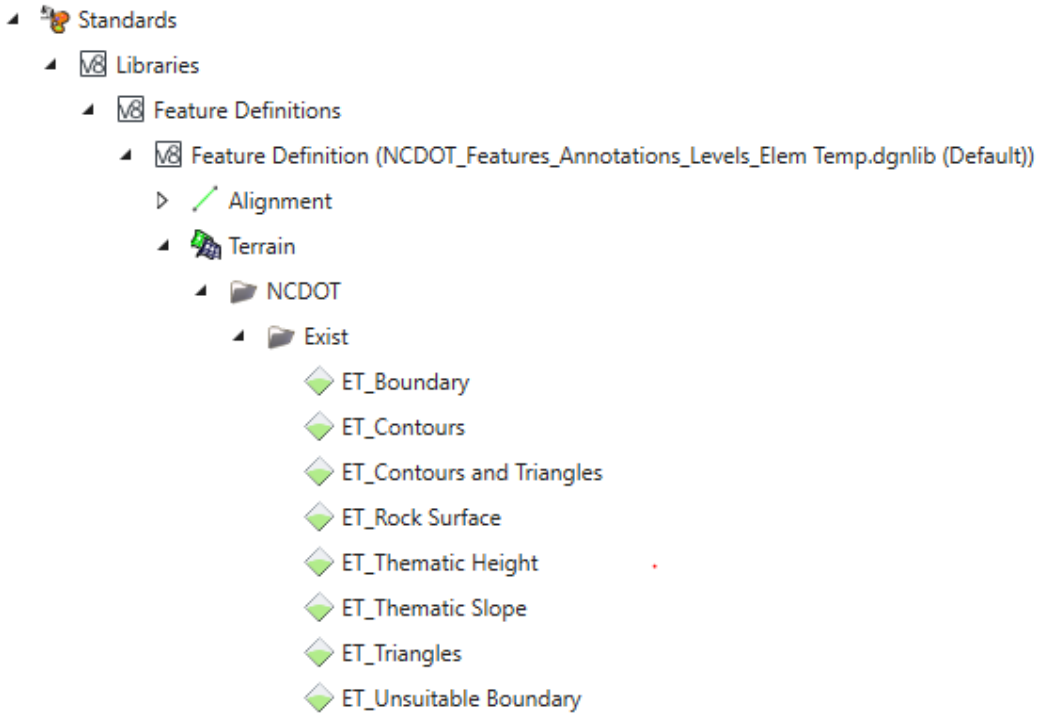


By right clicking on an element in the *OpenRoads Model* tab the user can directly access additional information about the element and apply various tool/operation to the element. In the example of a Terrain Model, the model properties can be accessed, the model can be set as Active, the model can be exported to another format, because the source of the original data is stored with the element the model can be updated from the source. The user can apply templates, which will be more of a focus in the modeling section. Civil elements can be deleted from this location and the user can also Zoom Directly to an element or isolate it for further review. Existing Terrain Model files will have a limited number of elements in them, generally a single terrain model, the display tools available in the *OpenRoads Model* tab will prove very useful as other parts of the model are developed and the files contain hundreds or thousands of design elements.

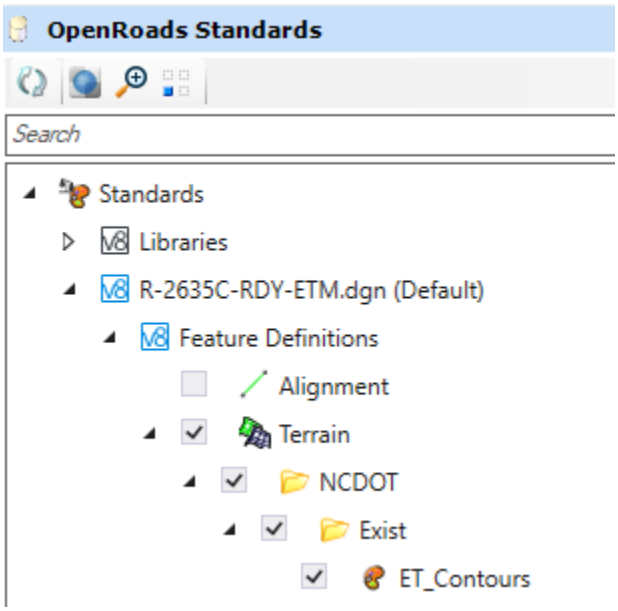
The *OpenRoads Standards* Tab contains all the standards, those available in the workspace and those that have been written into the DGN file.



The Standards available in the workspace are shown in Gray along with the location of the file that contains the standards. The standards include Feature Definitions, Annotation, Text, and Dimension Styles. These are all the NCDOT Workspace standards available to the user for use during the design process. This screen capture shows the available Feature Definitions for Existing Terrain models and the location of the DGNLIB file that contains those standards.



The design standards that have been used in the dgn file will be shown in Blue. When using CONNECT and ORD when a standard is applied to an element, whether it is a feature definition, an Annotation Group, or a Dimension Style or any other that standard, that standard is written to the design file permanently. What this means is that another user can open a dgn file without access to the workspace and still see the correct design standards. When using MicroStation is a file is opened with the wrong workspace the most obvious clue is that the text font is wrong. That is not the case with CONNECT and ORD. Note that review of the same Terrain group of the Feature Definitions section shows only the *ET_Contours* Feature Definition. That is because that is the only Workspace Standard Feature Definition that has been used in the dgn file to this point.



The Explorer will be used throughout the design process and the user will quickly become accustomed to how and when to use it.

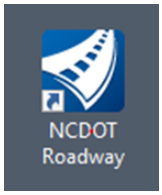
Create DGN file for Existing Terrain Model

In this exercise, you will learn how to create an Existing Terrain Model (ETM) by importing data from one of three sources. In most projects Location & Surveys will provide an ETM, but there will be some instances, where an ETM is not available or additional coverage is required.

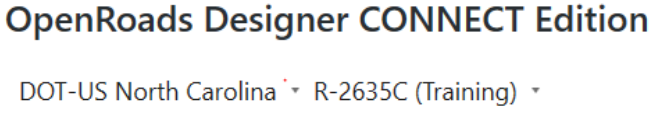
This file creation exercise is outside the ProjectWise platform and intended for Training use Only. For file creation standards refer to Training Module 1.

Create a New ETM dgn file

1. **Open ORD through the NCDOT Roadway desktop icon**
   This Icon will open the **DOT-US North Carolina** workspace using the NCDOT and Roadway standards. Other desktop icons will use the same **DOT-US North Carolina** workspace but open with different standards from different units.



2. **Workspace/Workset/File Location**
   A. For detailed information on Workspaces, Worksets and File Locations see Training Module 1 – File Management
   B. For this training Module
   Workspace = DOT-US North Carolina
   Workset = R-2635C (Training)



3. Create New File

4. File Location

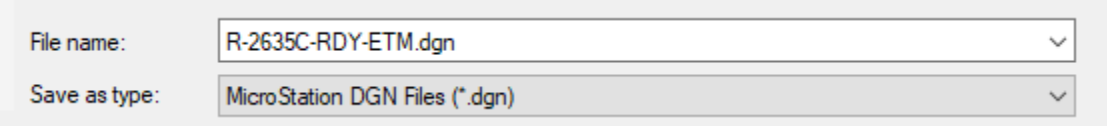
A. For more detailed information on Folder Structure and File Locations see Module 1 – File Management (VERIFY MODULE TITLE)

B. For this training module path to
C:\NCDOT Training\Roadway\Module 2 Existing Terrain Models\R-2635C\Roadway\Design

5. File Name

The filename should follow the ***TIP_RDY_ETM.dgn*** Standard
R-2635C_RDY_ETM.dgn

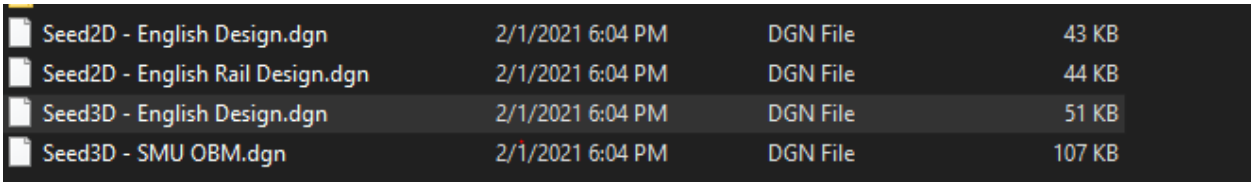
(Note the use of "-"to replace the use of "_" that was part of the previous standard. This is due to compatibility requirements with ProjectWise See Module 1 for further details)



6. Seed File

For Exiting Terrain Model dgn files the user should **ALWAYS** select the 3D seed file. The existing terrain is a 3D object and is always a 3D object, the existing terrain is made up of 3D elements and can only be described with 3D elements. It is true that in ORD a 2D dgn files will include a 3D model, something that will be shown in more detail in other Modules, and although it is possible to use a 2D seed file the resulting terrain would be created in an additional 3D model. This can cause confusion and mistakes when the ETM is used as a reference file during later design operations.

- The seed file is – ***Seed3D – English Design.dgn***



ALWAYS USE A 3D SEED FILE FOR EXISTING TERRAIN MODELS

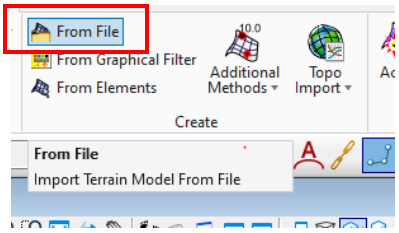
Import a Geopak TIN File

In this exercise, you will learn how to import an existing GEOAPK TIN file to create an ORD Existing Terrain Model. This may be required if the project is older, and the user wants to convert it to an ORD project or if the surveys were completed before the use of ORD

Import a Geopak TIN File

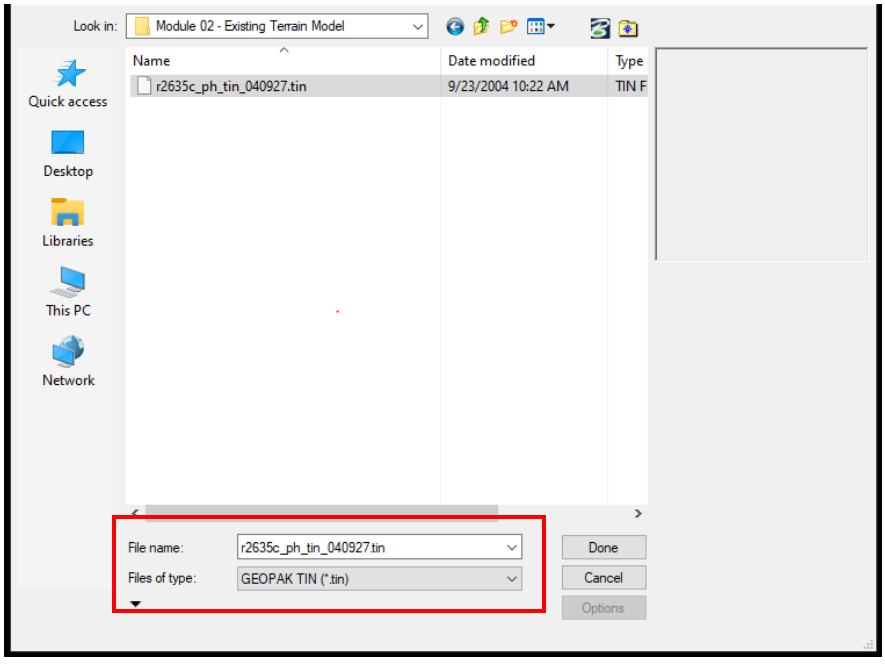
1. Start the From File tool

The **From File** tool is located in the *Create* Section of the *Terrain* Ribbon



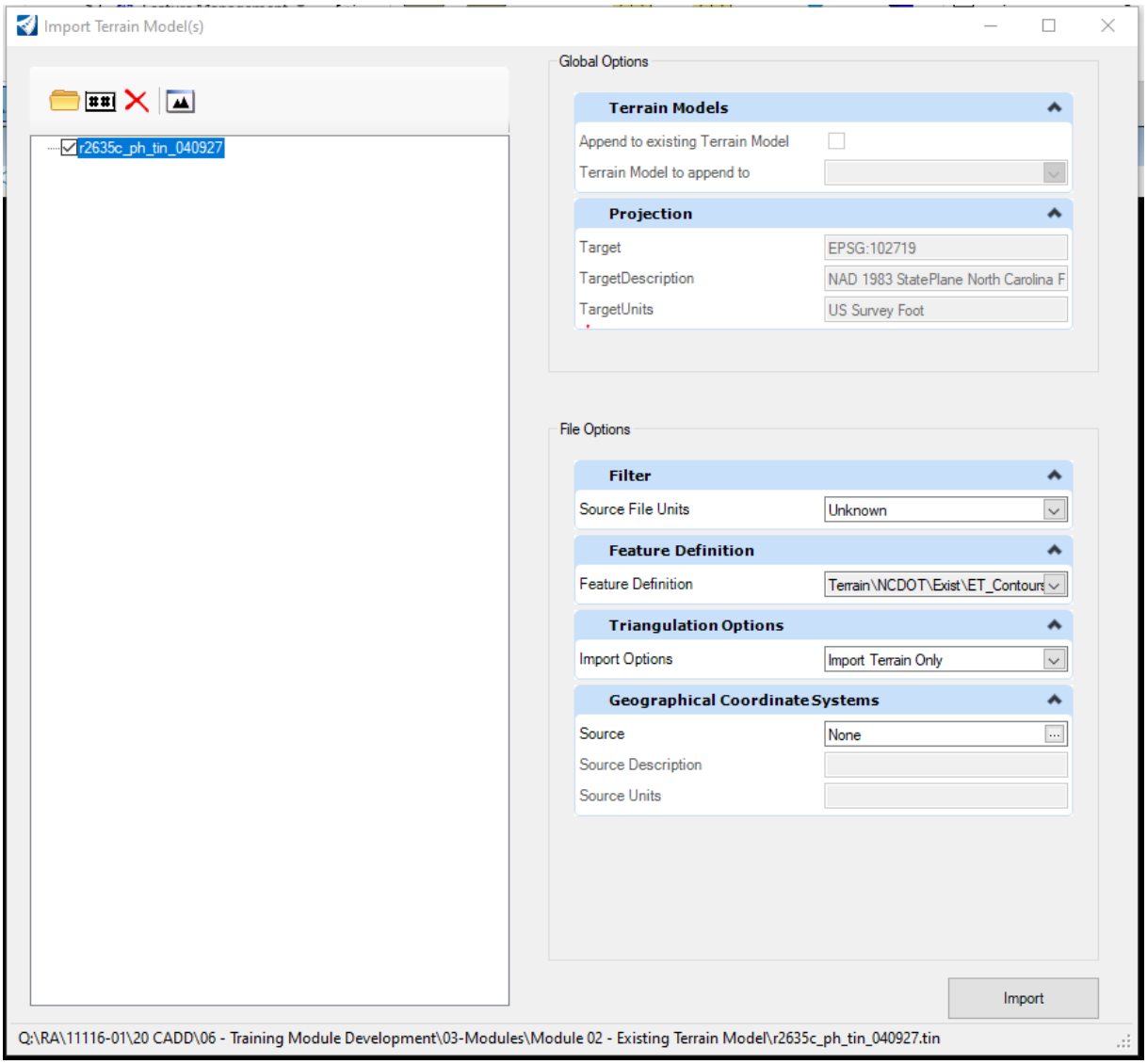
2. Select the Geopak TIN file

A. Set the file type to GEOPAK TIN (*.tin)
B. Path to the training directory.
C. Select the tin file ***r2635c_ph_tin_040927.tin*** and click Done.



3. Import Terrain Model dialog

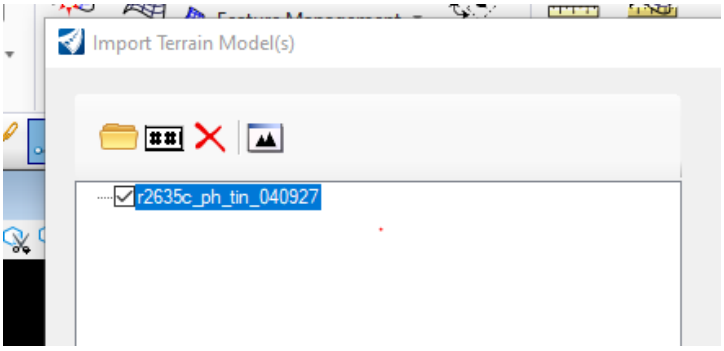
This dialog will appear, this dialog will be very similar with only minor changes based on what type of file has been selected to import.



4. Surface List

A. The pane in the left will show the name of the TIN or TINs being imported.

B. ORD allows the user to import multiple files at a time, this will not merger the files they will be imported independently. The resulting DGN file will contain two surfaces. This may be useful if the designer wants to import 2 TINs and then merge them into single Terrain Model using additional tools. In most cases the designer will only import a single file at a time.

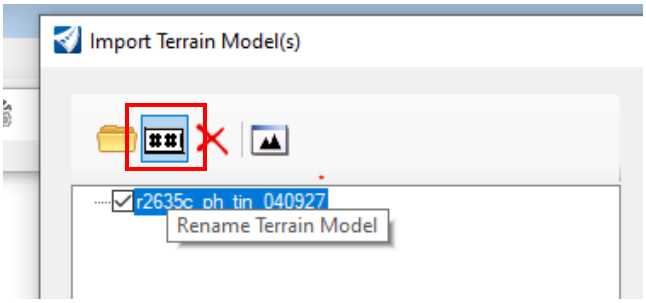


5. Rename

A. At this point the user can rename the model. As discussed in the section on the *Primary* Tools all ORD civil elements will get a name. This is the name that will be shown in the Explorer dialog and will be a way for the designer to readily identify design elements. The Existing Terrain Model is a civil element and will have a name.

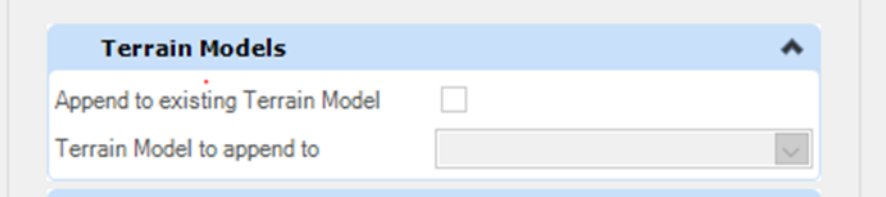
B. The name of this element is not critical (for some element the name is important) but the user should select something that readily identifies the source data.

C. In most instances the name will automatically be taken from the source file name and will be sufficient. If not, the user should rename the Terrain Model to something more appropriate.



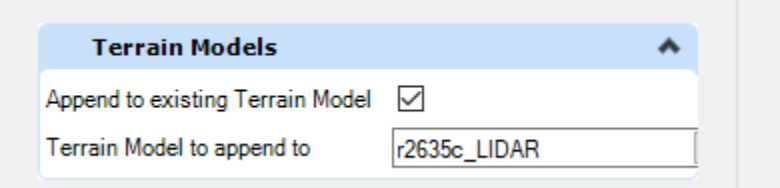
6. Terrain Models

A. This section will be grayed out because there are no other Terrain models in the dgn file. This will be the appropriate setting for most cases. Most of the time the designer will only need to have a single surface in a file at a time. Combining Terrains through the **Edit Complex Model** tool will be covered later in this Module.



B. If the user opened a file with an Existing Terrain model already in the file and imported another set of source data, the option to append to the original Terrain Model would be available.

C. If the original file contained multiple Terrain models the user could select which model to Append to.

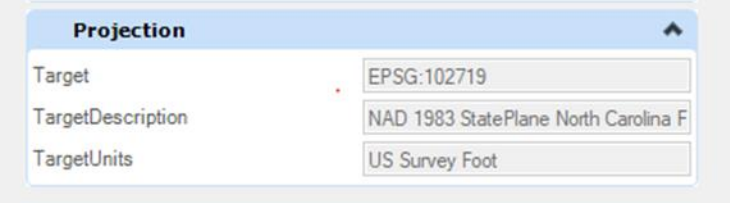


D. It is important to know that *Append* is the only option available and this is not the same action as *Merging* a surface. When Appending a surface all the data points from both source files are used to create the surface. When merging data sources only the data from the merging model is used in areas of overlap. The results of each operation can be dramatically different, and the user should understand how they work. In general, the more reliable method is to import files one at a time and then use the **Edit Complex Model** tool described later in this Module to combine the Terrains.

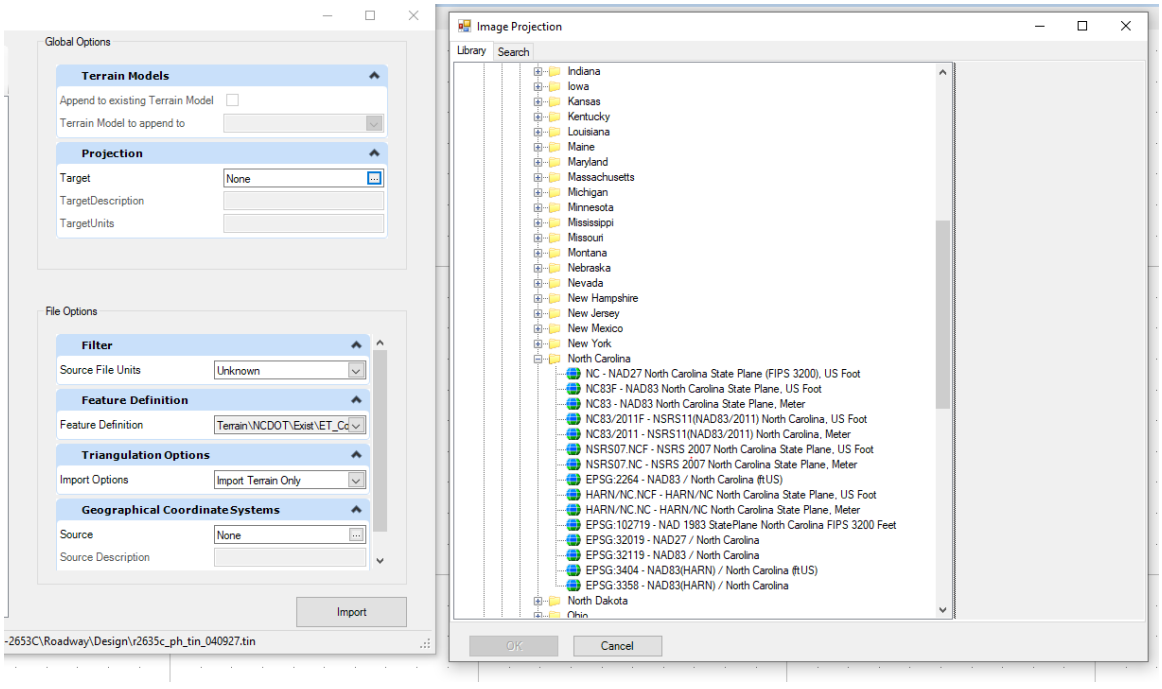
7. Projection

A. The projection is the Project Datum. For the State of North Carolina this is currently NAD 1983.

B. This section will be grayed out and will show EPSG:102719. The seed files contained in the roadway workspace are set to the correct coordinate system, when using the NCDOT Seed files for a NCDOT project there will not be an option to change the DATUM

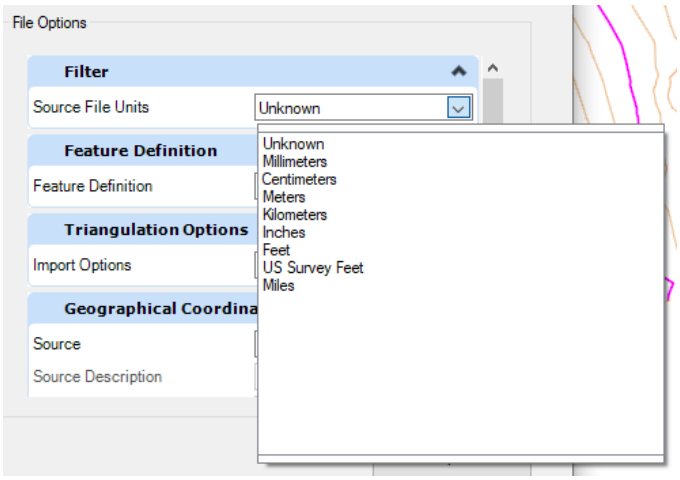


C. If the user were using a seed file that did not have the DATUM set, then the Projection section would need to be set to the correct Project DATUM. This can be done by accessing the DATUM library by selecting the box next to the *None* option. This is not a common task required by the NCDOT user, but the option is available. Custom project specific DATUM can also be created and selected with this option.

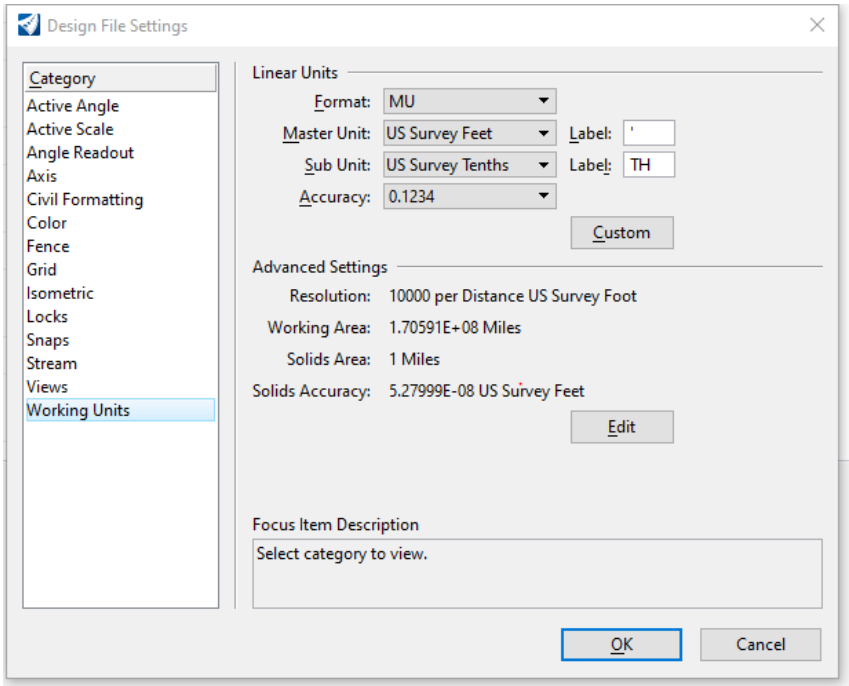


8. Filter

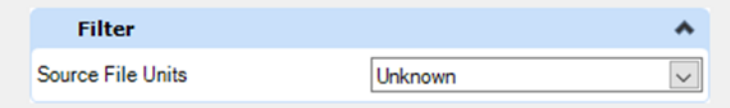
A. This section will allow the user to identify the source units of the TIN file if known.
B. This section could be used to Import a Metric source file into an Imperial DGN file.



C. The NCDOT Seed File uses US Survey Feet, if the source data were in Meters or Miles the user could specify those units and the import process could convert the data to US Survey Feet



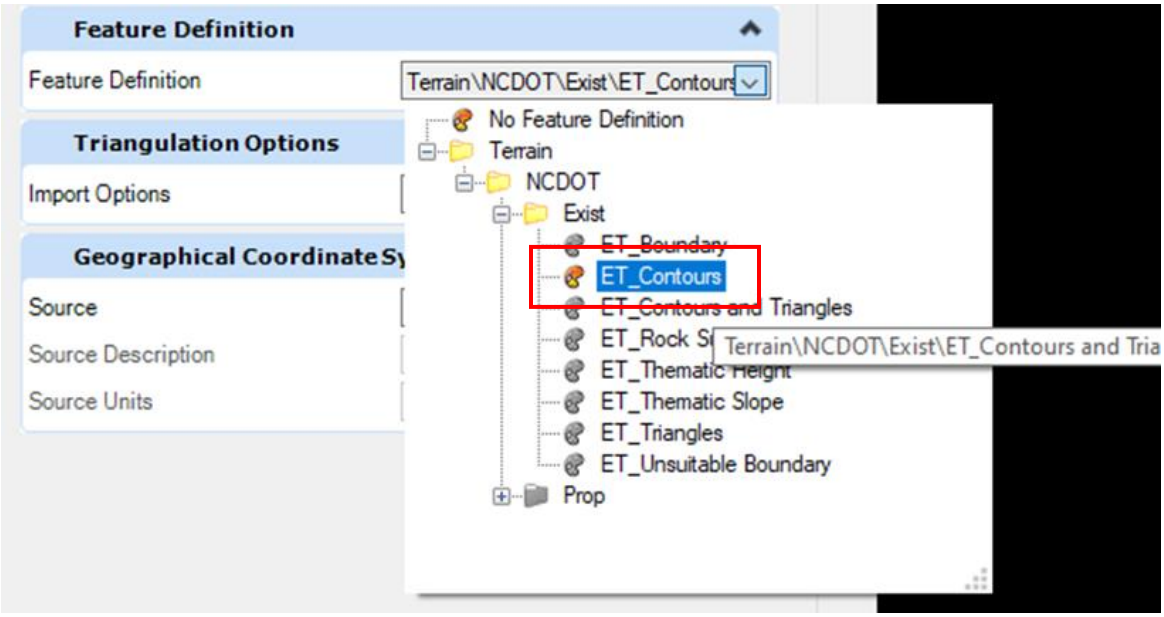
D. In this example the units in the source TIN file are unknown so select unknown. It is always the responsibility of the user to know the quality and the format of the source data. Both of which can have a significant impact on the Existing Terrain Model.



9. Feature Definitions

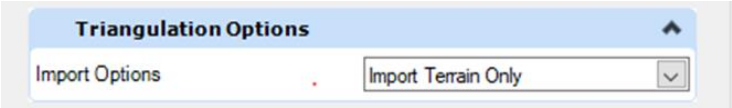
A. This section will allow the user to select the initial feature definition. This will control the display properties of the surface as well as other properties. Feature Definitions are included in the NCDOT workspace and are an integral part of ORD. They are responsible for a large part of the "Intelligence" that is built into the elements. Feature definitions will be a prominent subject in other Modules. For an Existing Terrain changing the Feature Definition after the surface has been imported is an easy task that will be covered later in this module.

B. Set the Feature Definition to *ET_Contours*



10. Triangulation options

A. For this section set the option to *Import Terrain Only*.



B. The Import Features and Import Both options should only be used by advanced users. For roadway designer importing a surface from another data source Import Terrain Only is always the best selection

C. Features in the context of a Terrain model refer to breaklines, boundaries, voids, islands etc. These are the details in a Terrain model that control the triangulation. For example, points separated by a break line will not be triangulated, and breaklines are generally placed at crown points, shoulder points and other locations to define a change in a constant slope.

D. For a Geopak TIN file specifically the features will be included in the original TIN and therefore will be included in the import process, and additional features could create significant errors. For other data sources the origin of the features, and what they represent is likely to be unknown, and the inclusion into the import process may cause significant errors.

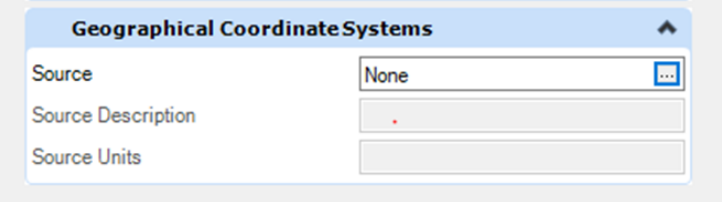
E. It is the responsibility of the user to understand the source data and the quality of the Terrain model created by the various methods.

11. Geographical Coordinate Systems

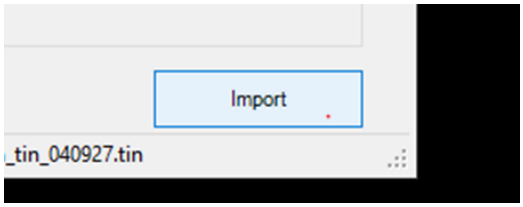
A. This section is like the Projection Section. If the user knows the DATUM of the source data, then it can be selected here. The selection dialog will be the same as the Projection entry.

B. This will be used to reproject data from one Datum to another. The source DATUM should be noted when the source data is collected.

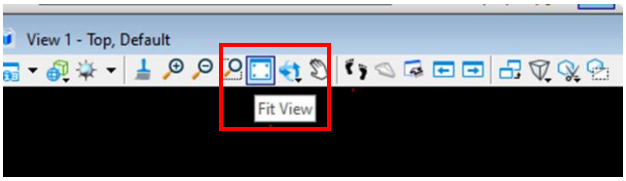
C. For this example, the DATUM of the source data and the new DGN file are the same and the source can be set to *None*.



12. Select Import to begin the process of importing the file



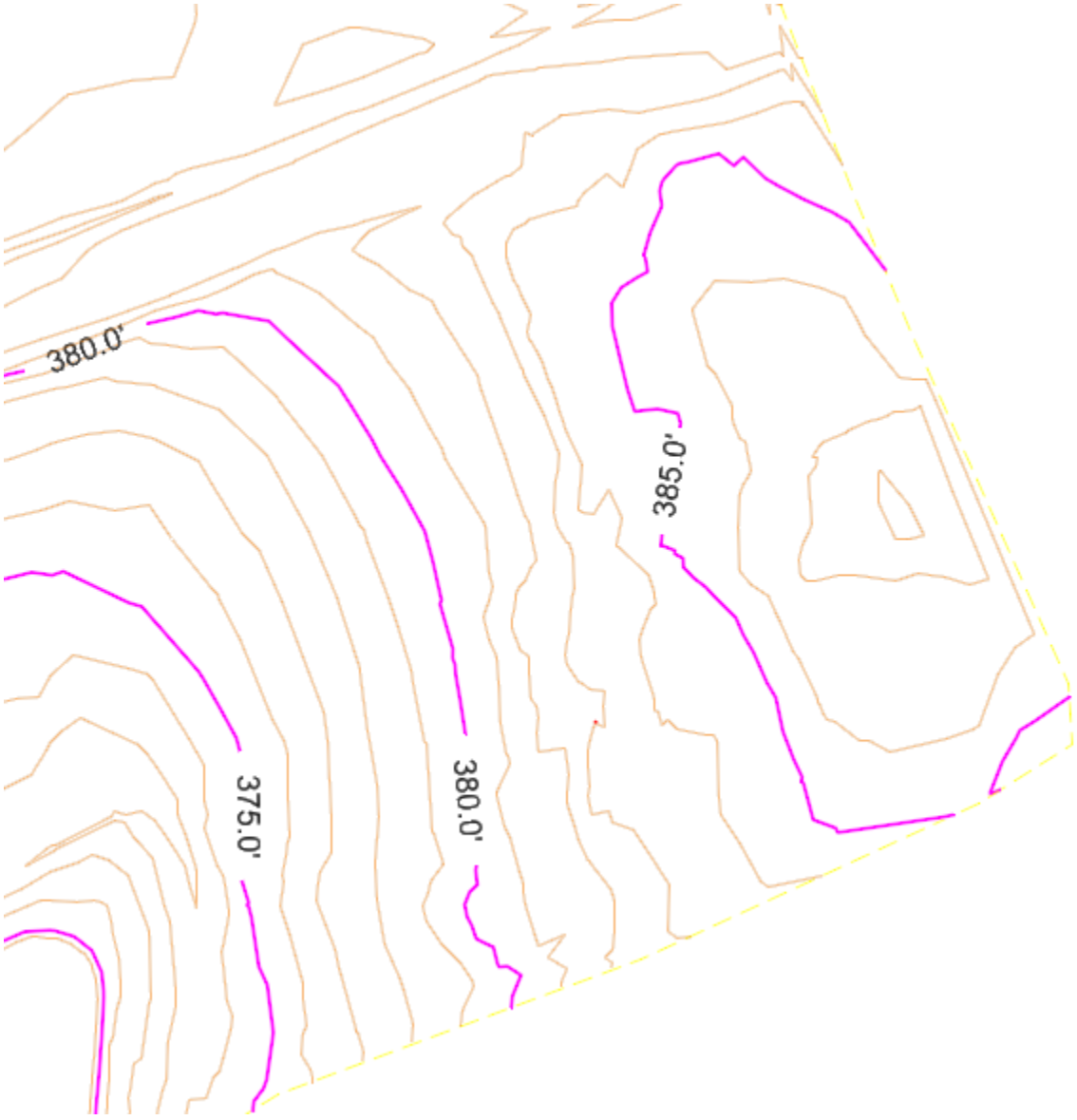
13. Close the dialog and select Fit View



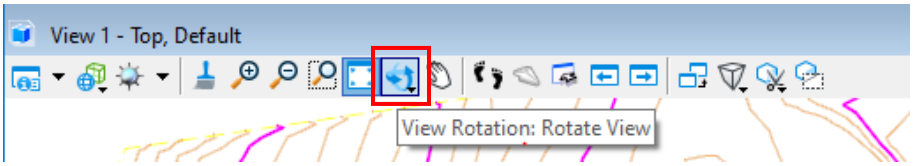
14. The surface with a boundary element and contours should be displayed.

15. **By zooming in the user will see a yellow dashed line that represents the boundary of the ETM. The Major contours will be displayed in purple at 5' intervals with labels. The minor contours will be displayed at 1' intervals without labels.**

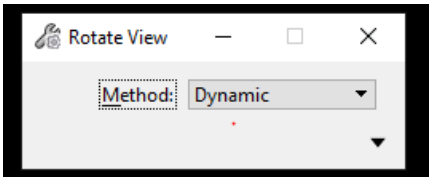
    The contour intervals, colors, line styles, weights, and text settings are all controlled by the Feature Definition *ET_Contours* that was selected during the Import process.



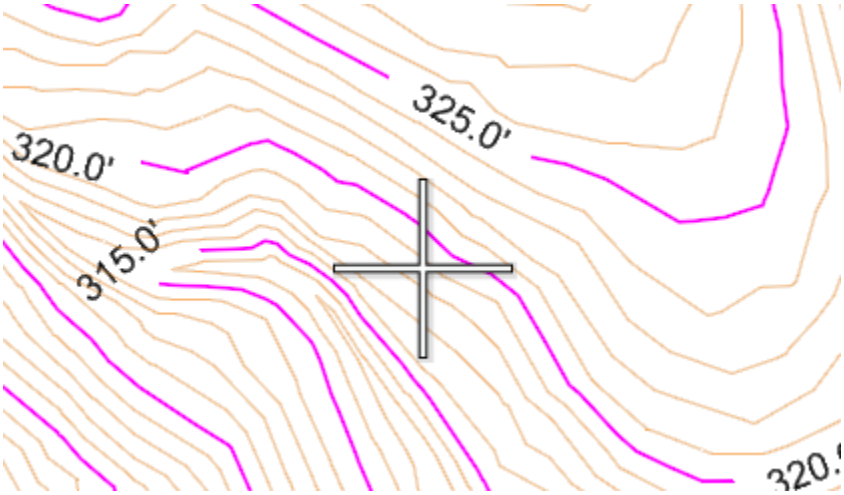
16. **Note that this is a 3D file. In later Modules the user will see how a 3D model is created in a 2D file but in this module the Default model will be 3D and the user can use the 3D view controls to review the contours.**
    A. 3D View control will be a much more common part of the design process using ORD than it was using Geopak. The designer will often review design elements in a 3D view and not a 2D view.
    B. When rotating a 3D view it is often helpful to set the rotation point, this is the point in 3D space that will be the center of the view rotation.
    C. Select **Rotate View**



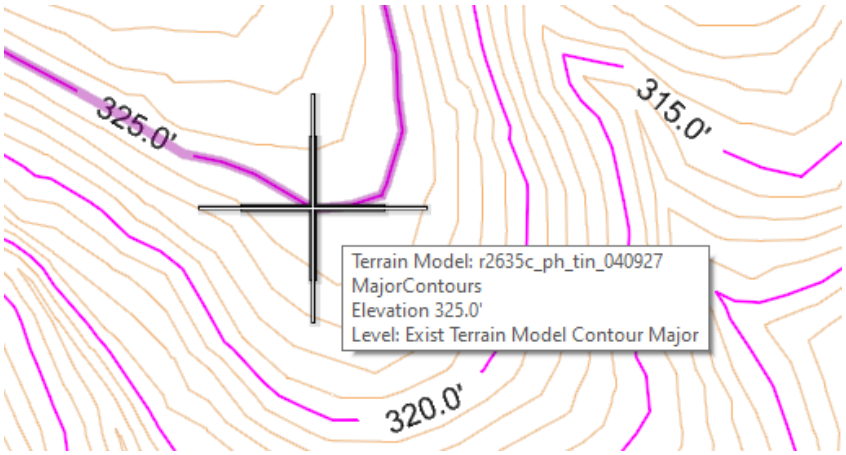
    D. Set the Method to *Dynamic*



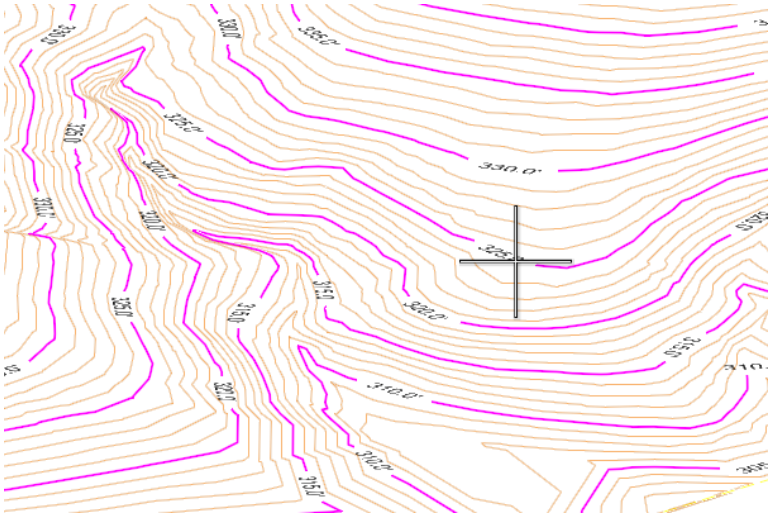
    E. A large “Plus” symbol will appear. Grab the symbol by moving the cursor to the center of the symbol.



F. Snap to the location of an element that will be the center of rotation. In this example snap to a point on one of the contour lines. Left click to set the rotation at that location. It is important to snap to an element to set the Z elevation correctly for the rotation point.



G. Left click again to begin rotating the view, and left click again to stop rotating the view. You will see the "Plus" symbol stayed at the center of rotation



H. This may take some practice to get used to but will make using and manipulating 3D views much easier.

17. Set Active Surface

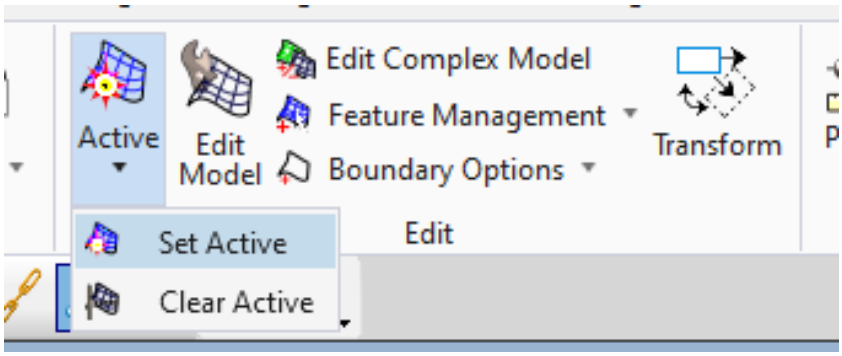
A. At this stage, the Existing Terrain Model has been created in the **3D ETM file**. The last step is to set the surface to Active by selecting **Active** from the *Edit* section of the *Terrain* Ribbon and selection the ETM Boundary.

B. Setting an Active surface is like the Geopak procedure of selecting a TIN file. Active surfaces can be Existing or Proposed. In the case of an Existing Terrain Model a user will set the surface as Active in order to design a profile, the Active surface will be displayed as the existing ground. When designing the corridor, the Active surface will be used as the target for corridor elements. The Active surface will be displayed as the existing ground when creating cross sections.

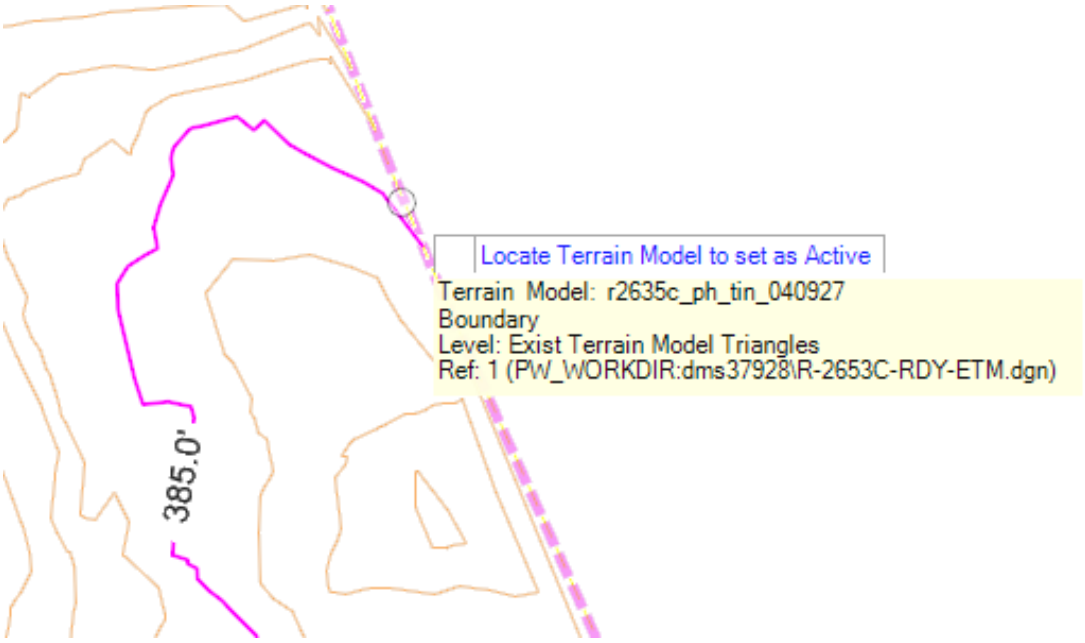
C. The **Set Active** command can be used to select the correct surface from a file that contains multiple surfaces. Similar to selecting from various TINs in Geopak for different operations.

D. Setting an Active Surface is not necessary for the creation of an ETM file, the tool is included in the Terrain Ribbon and is something that the designer will need to understand how to do for many other design operations.

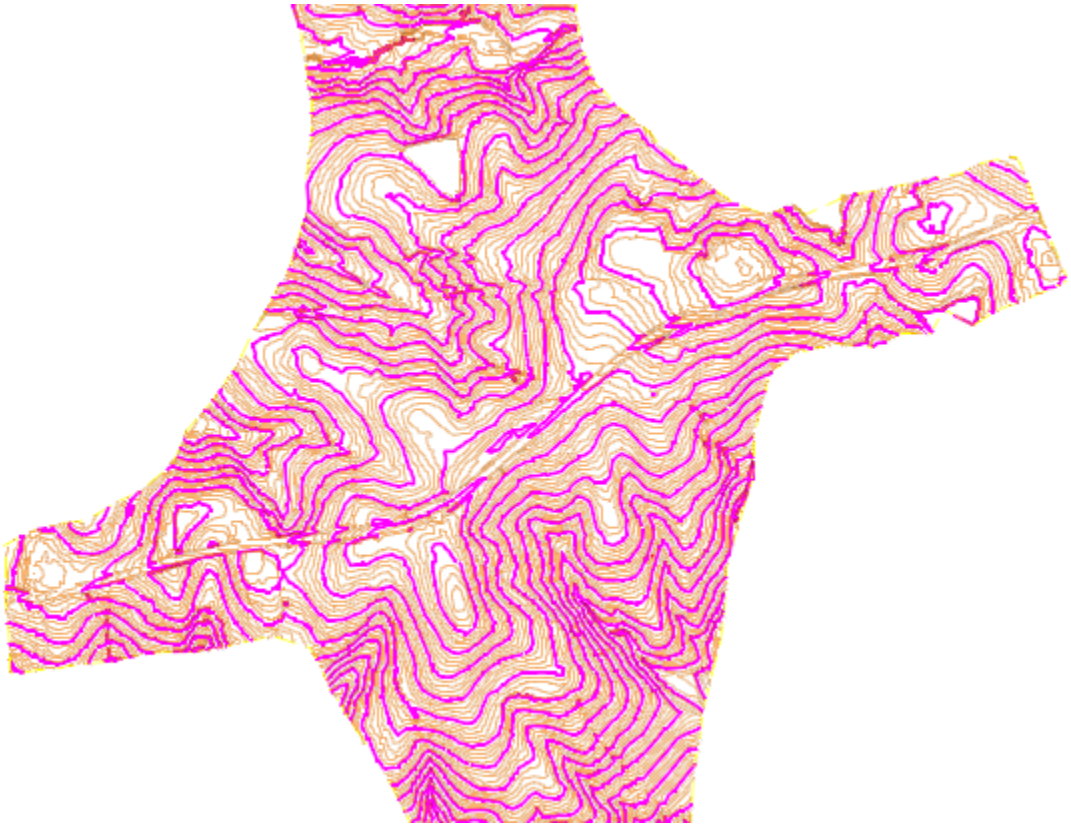
E. Select **Active** → **Set Active**



F. At the prompt to select a surface Left Click on the yellow dashed boundary element. That completes the process of setting an Active surface.



18. **The process of creating the ETM file that will be used throughout the project is now complete. There are no additional steps required to begin using the surface to design profiles and models or create cross sections and develop quantities.**



Import XYZ Data

In this exercise, you will learn how to import an ASCII Text file containing XYZ Data to create an ORD Existing Terrain Model. ORD also has the capability to import XYZ data in the form of an ASCII Text file, another common data source used by roadway designers. This process is very similar to Importing a Geopak TIN file.

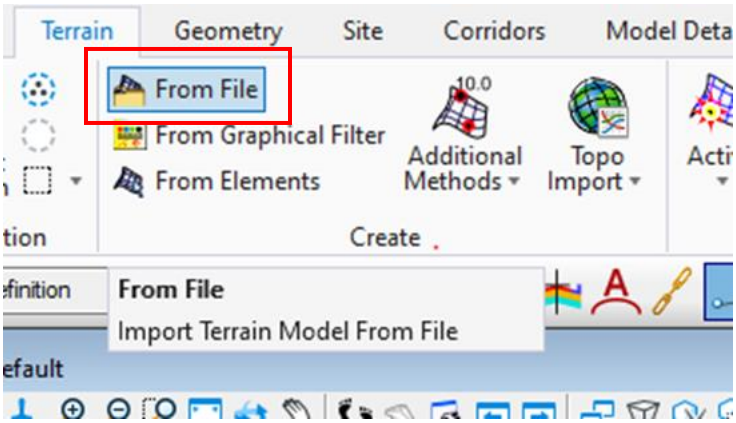
Import XYZ Data

1. **Create a New DGN**

   Using the steps outlined in Create File section make a new a dgn file using the 3D seed file and the filename ***R-2635C_RDY_ETM_XYZ.dgn***

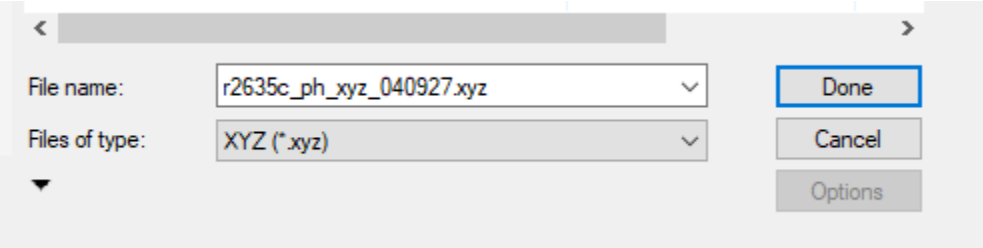
2. **Start the From File Tool**

   Begin by selecting the **From File** tool in the *Create* section of the *Terrain* Ribbon.

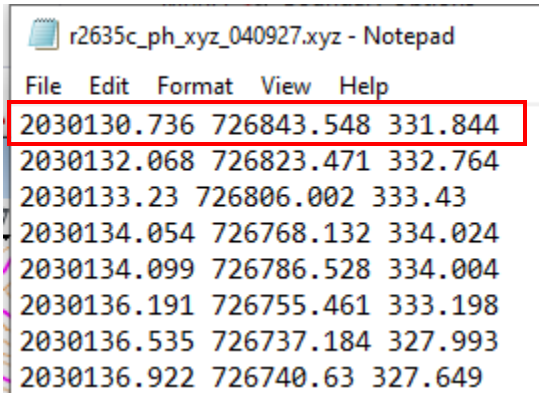


3. Select the XYZ Data

A. The file selection dialog will look the same.
B. Change the File Type to *XYZ (*.xyz)*
C. Path to the Training Module folder.
D. Select the XYZ data file ***r2635c_ph_xyz_040927.xyz***.



- The XYZ data source should be formatted as X (easting) Y (northing) z(elevation) in rows separated only by a space.



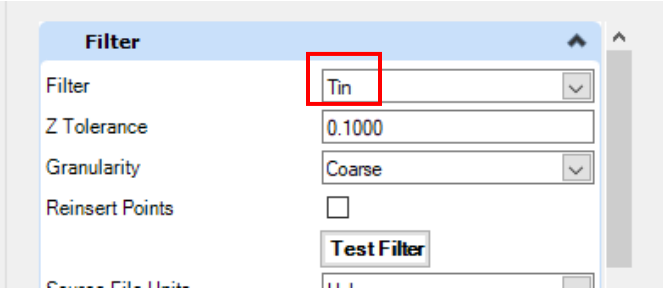
4. Import Terrain Model Dialog

A. This dialog will be very similar to the Geopak TIN Option
B. In the left pane the file that will be imported is shown.
C. The Terrain Models and Projection sections under Global Options are the same as the Import Geopak TIN.

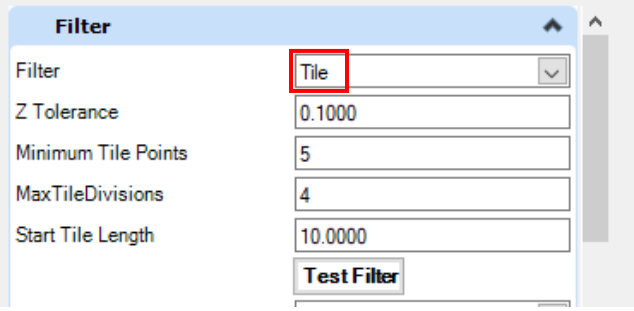
5. Filter

A. The Filter section is different. In addition to the source units option a new option for Filter is available. This will allow the user to remove points based on tolerances to reduce the number of points and the size of the file in a dense grid.

B. There is a Filet by *TIN* option

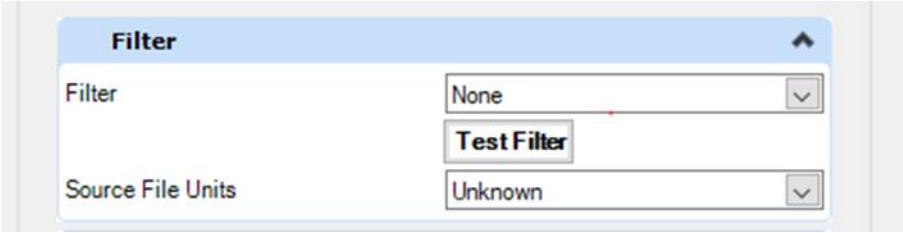


C. And a filter by *TILE* option



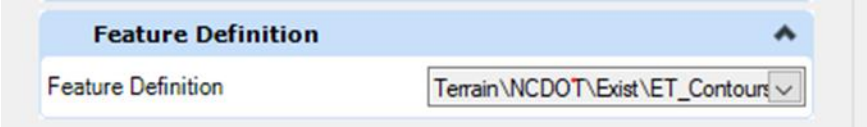
D. Both options function in a similar way. They are used to Filter the total number of points based on user specified criteria. They will look at all the points identifying points that are within a specified horizontal distance and within a specified elevation difference. For these point groups one or more of the points will be eliminated. When points are close together horizontally and close to the same elevation removing some of those points will have a very small impact on the Terrain surface. This is especially useful when working with XYZ data and LIDAR data where the points may be within a few feet of each other. The user will lose some accuracy, but the size of the Terrain Model will be significantly smaller. As will all ETM tasks the user needs to understand the data source quality and what import options may do to degrade the quality of that data. **See the LIDAR section for more examples of the Filter options**.

E. Unless working with extremely large files, in which case the user may consider using multiple Existing Terrain Model dgn files, this setting should be generally set to None. That will ensure that resulting Terrain model is as close to the original source data as possible.



6. Feature Definitions

A. The Feature Definition should be set to *ET_Contours*. Again, this is the initial setting and can be easily modified by the user later.



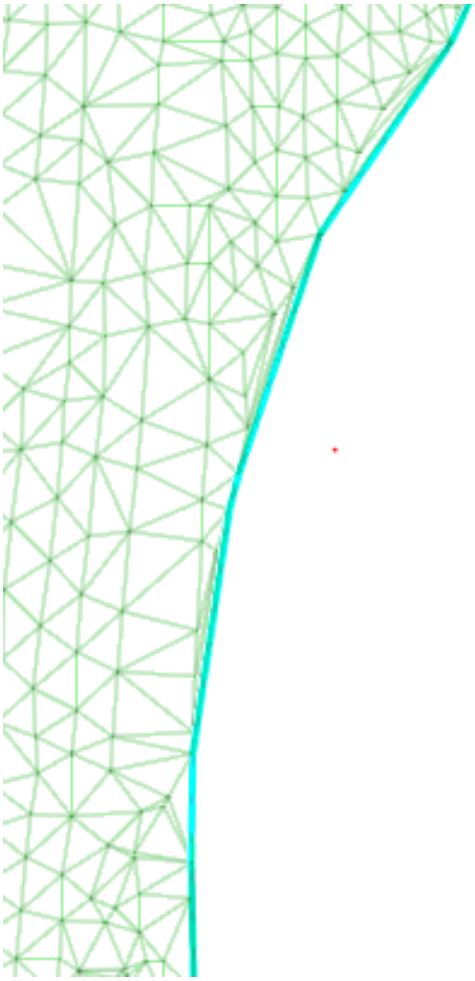
7. Triangulation Options

A. Under Triangulation Options the edge method should be set to *Max*.
B. Triangle Length with a maximum length of *150.00'*.

- Maximum Triangle Length is used for surface where data may be separated by space that has not been surveyed. The white area between the two portions for this surface. The actual length needs to be determined by the user.

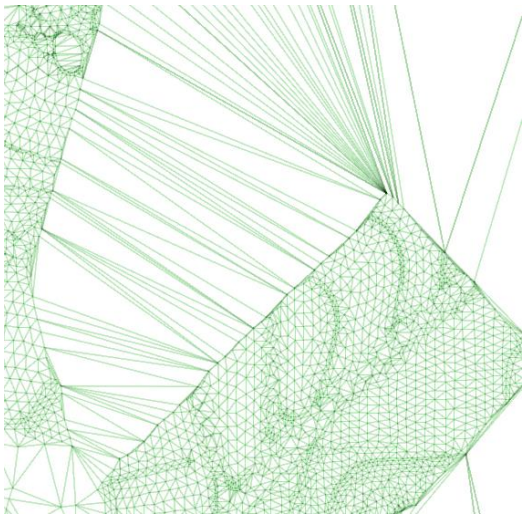
- There is an option for *None* or *Remove Slivers*. All three of these options work the same in ORD as they did in Geopak. The user should select the option that produces the most desirable result.

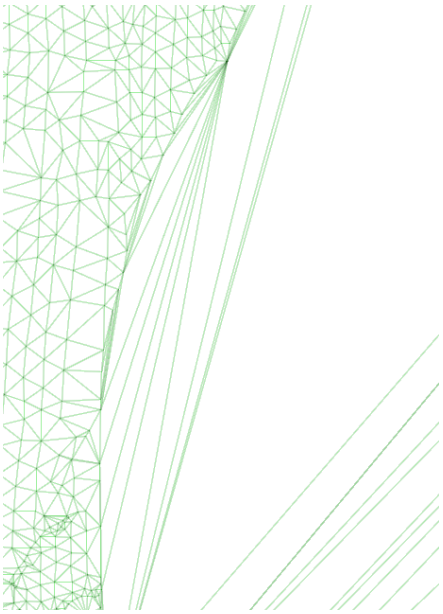
- Remove slivers will remove triangle where two sides are significantly longer than the other side. This is useful for surfaces that follow projects on a horizontal curve. And will help eliminate some of the errors on the inside of the curve.



- There is also an option for None. This will not automatically eliminate any triangles. This options is only applicable to projects that have very even and regular spacing with minimal horizontal curvature. Importing the data with the None option gives the following result. Note all the contours on the outer edges of the surface connecting areas that should not be connected.

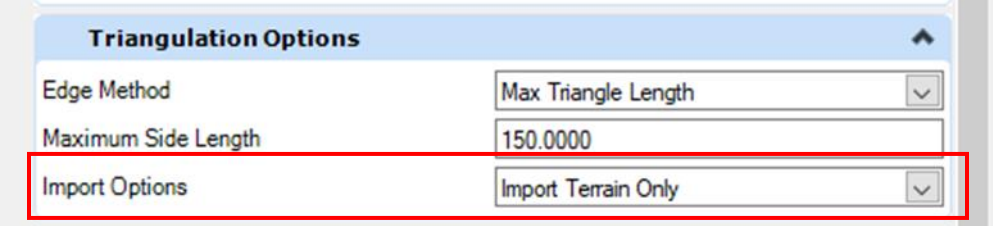
- Reviewing the same two areas previously displayed shows Triangles that were eliminated by the Max Length and Sliver Option





- For this project the best method is Max Triangle Length.

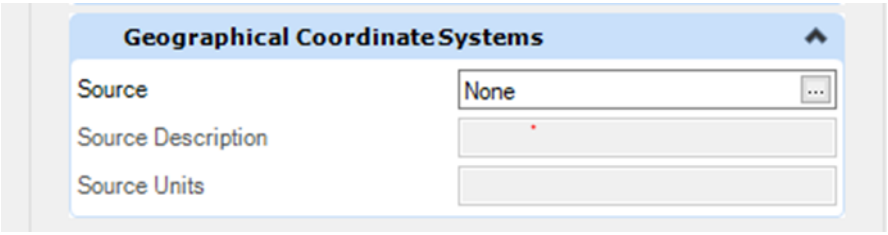
C. Set Import Options to *Import Terrain Only*. This is the same option used for importing TIN files, Features should only be imported if the user is certain of the features and generally an option that will be selected by more advanced users.



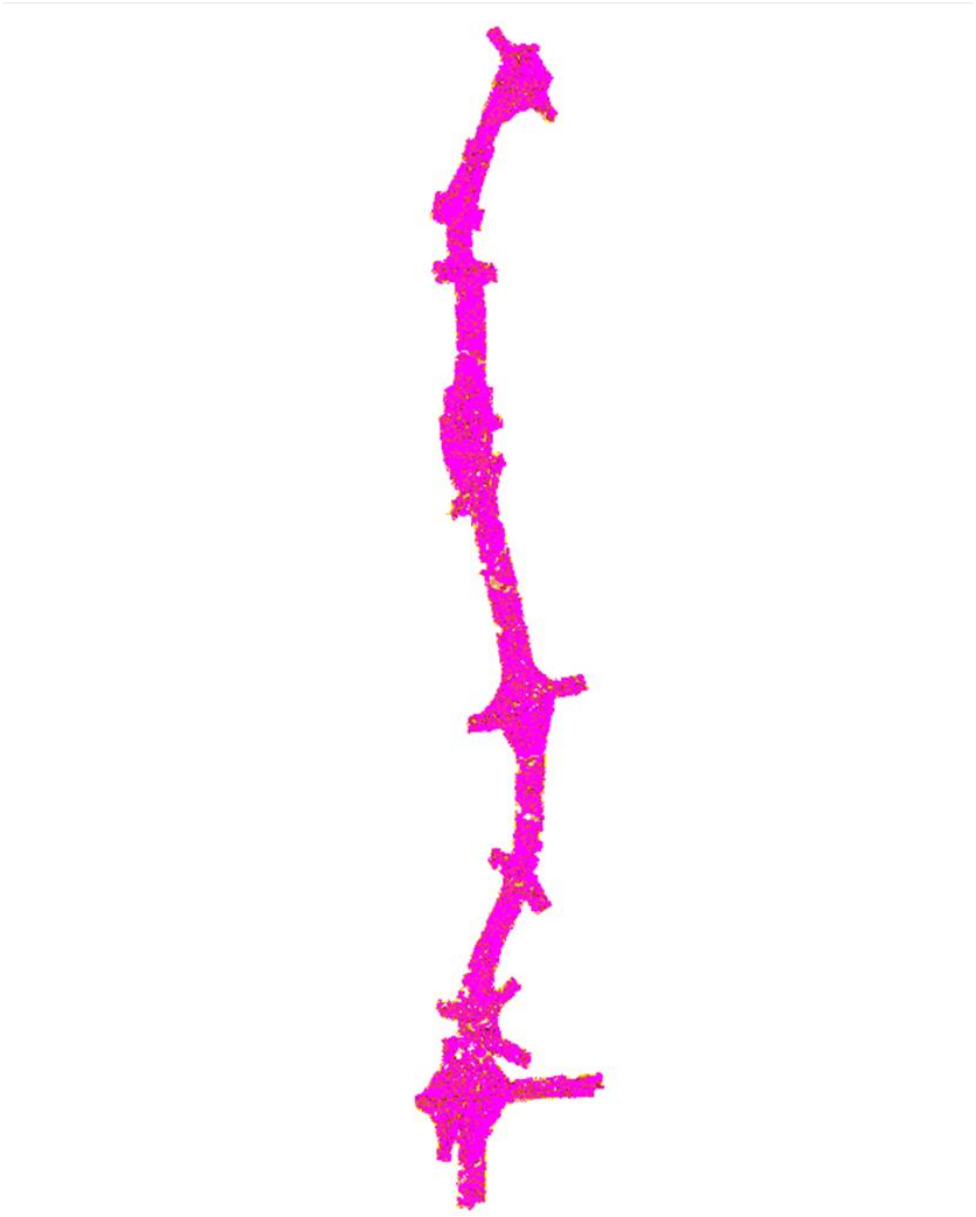
- (Note the Import XYZ function will use XYZ data to create a Triangulated Irregular Network. The is the same principal used to build a GEOPAK TIN file but this is not a TIN file, this will be an Existing Terrain Model)

8. Geographical Coordinate Systems

Under Geographical Coordinate Systems the source should be set as *None*. For more detailed information on the Geographical coordinate system see the Import TIN section of the Training Module.

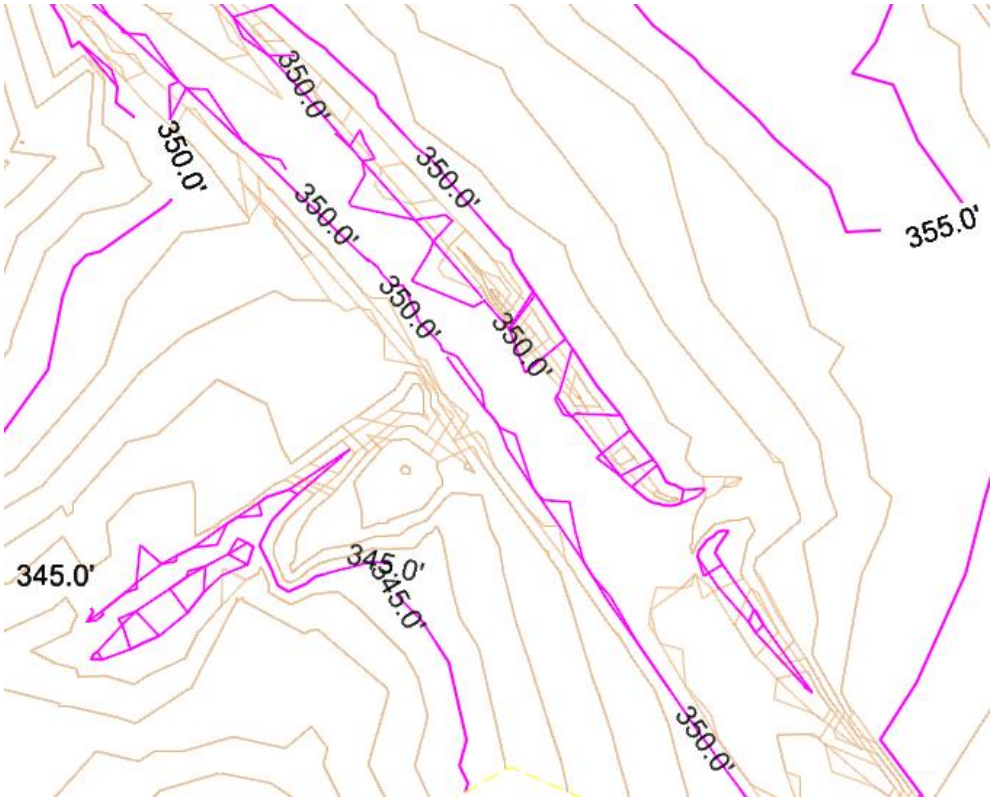


9. **After importing the surface, you should see almost the same information that the Import GEOPAK TIN procedure produced.**



10. Compare TIN and XYZ Method

A. Attach the ***R-2635C_RDY_ETM.dgn*** file as a reference and zoom in on a smaller area.
B. It should be noticeable that the contours displayed by the two surfaces line up in most areas but there are areas where there are differences. This is because the Import XYZ function only brought in the XYZ data with no features.
C. The Import TIN procedure brought in a TIN that was created with breaklines.
D. The file created with no features, the XYZ files shows contours that were made between the closes three points and sometimes crossed over the crown line and shoulder line of the roadway. This is the kind of error that the user needs to be aware of when creating an ETM. While this may be acceptable for some Conceptual design it is certainly not acceptable for roadway plans.
E. The best surface will be an Existing Terrain Model received from a surveyor. An ETM created from a TIN file will be lower in quality that an ETM file and using XYZ will produce the lowest quality ETM and should be used with caution.



Import LIDAR Data

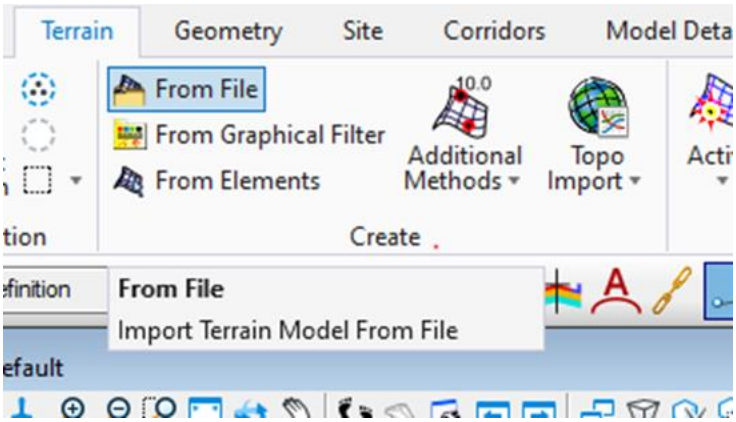
In this exercise, you will learn how to import LIDAR Data to create an ORD Existing Terrain Model. LIDAR data comes in several forms, ASCII XYZ data files are an older format, the new format is a *.las file. This is a Binary format that is the new standard and the highest quality and most readily available data. ORD has the capability to directly import a *.las LIDAR dataset. LIDAR data files can be very large, and care should be taken to use the smallest dataset possible to meet the needs of the project.

Due to the size of these files and the amount of time it takes to process this section will not include a live training demonstration. These instructions are only for reference.

The roadway designer should understand that there are various sources of LIDAR data with various levels of accuracy and it is up to the individual designer to understand the data that is available. The resulting ETM will only be as good as the underlying data.

Import LIDAR Data

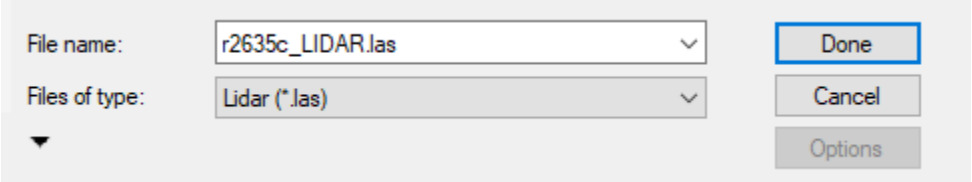
1. **Create a New DGN**
   Using the steps outlined in Create File section make a new a dgn file using the 3D seed file and the filename ***R-2635C_RDY_ETM_LAS.dgn***
2. **Start the From File Tool**
   Begin by selecting the From File tool in the *Create* section of the *Terrain* Ribbon. Select the **From File** tool in the Create Section of the Terrain Ribbon



3. Select the LIDAR Data

A. Change the File type to *Lidar (*.las)*

B. Path to the Training Module folder and select the LAS data file ***r2635c_LIDAR.las***

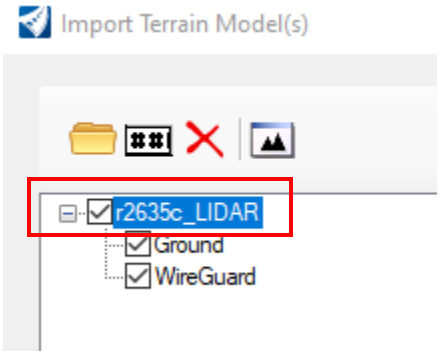


(Note : Due to the size of LIDAR data files the process of opening the Import Terrain Model(s) dialog can take several minutes)

4. Import Terrain Model Dialog

A. In the left pane on the Import Dialog there will be an option for Ground and Wireguard.

B. *Check Ground and Wireguard*. In this downloaded LIDAR data, the pavement surface has been separated from the existing ground and classified as Wireguard. LIDAR data has the capability of being separated into individual point groups and it is the user's responsibility to understand the groups and ensure that the correct selections are being made.



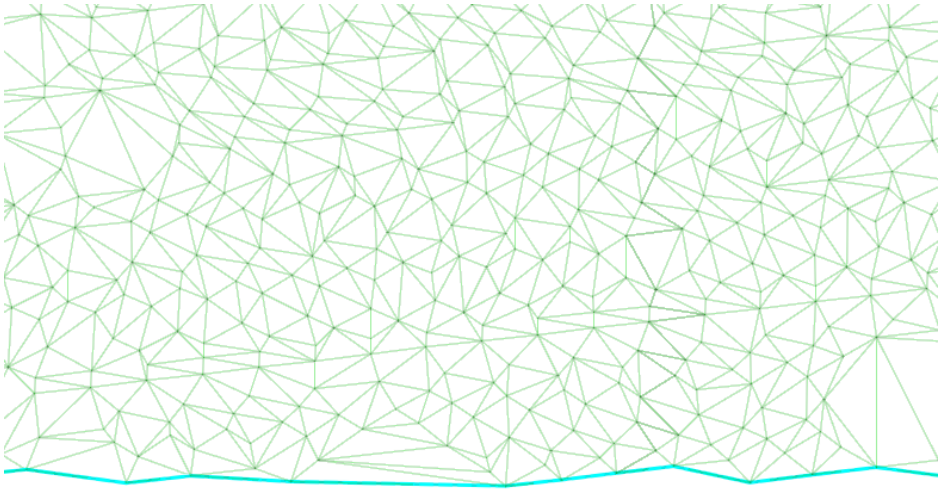
5. Global Options

The Terrain Models selections and the Projection Selections sections of the LIDAR import dialog are the same as the TIN and XYZ section and function the same way.

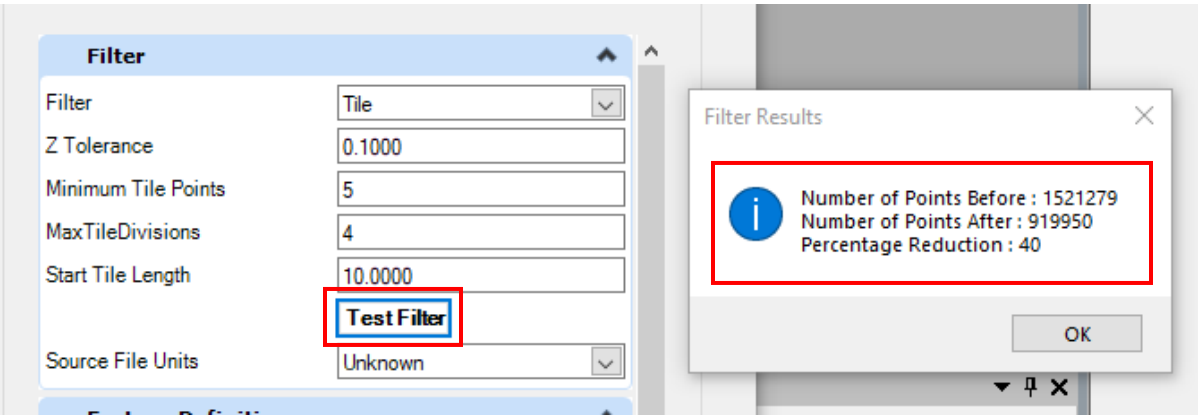
6. Filter

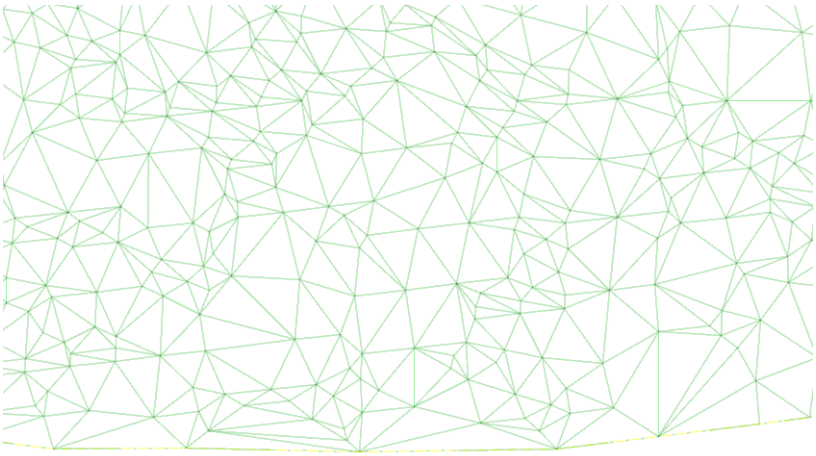
A. The filter section provides the user the ability to reduce the number of LIDAR points and make the file size much smaller.

B. This will eliminate some of the data and should be used with caution. This is a section of the ETM created with LIDAR data and the Filter Option set to None. The points are very close together 5’ or less.

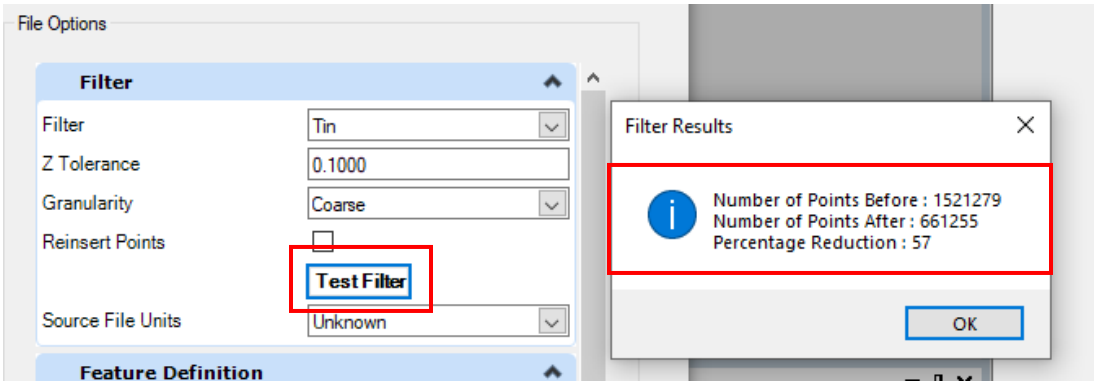


C. This is the same section of the ETM created with the Tile filter option. Using the parameters below the **Test Filter** toll shows the reduction in points which can also been seen in the ETM

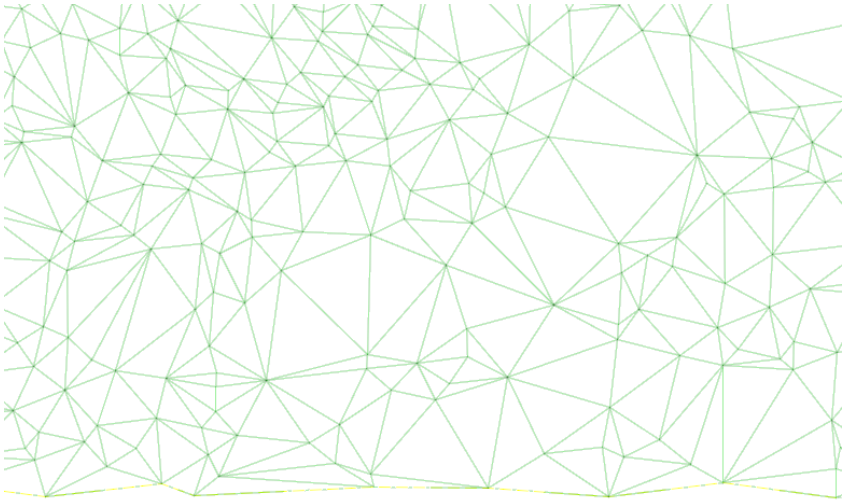




D. This is the same section of the ETM created with the TIN filter option

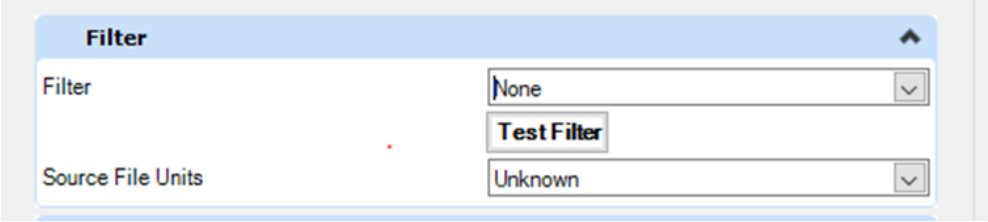


This produces a similar result to the Tile Option.



E. When using large LIDAR data files in situations where the accuracy is not critical using a Filter option to reduce the number of points and the overall file size is a good option. The user should understand that the accuracy will be lower than the source data and how that will affect the results.

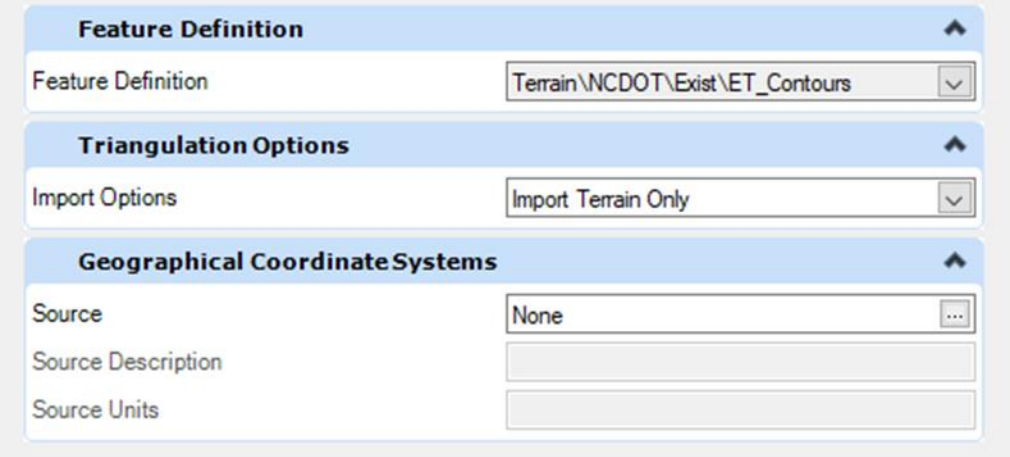
F. For this exercise set the *Filter* to *None*. When using LIDAR data, depending on the source of the data the user may need to specify the Source File Units. Some data may be in metric units in which case the Source file units would need to be set to match. That information should eb available from the source of the data, in this example the data is Imperial and the Source File Units can be let as Unknown.



When using LIDAR data, the user should always verify the location of the data by comparing to a coordinately correct aerial image or some coordinately correct CADD data.

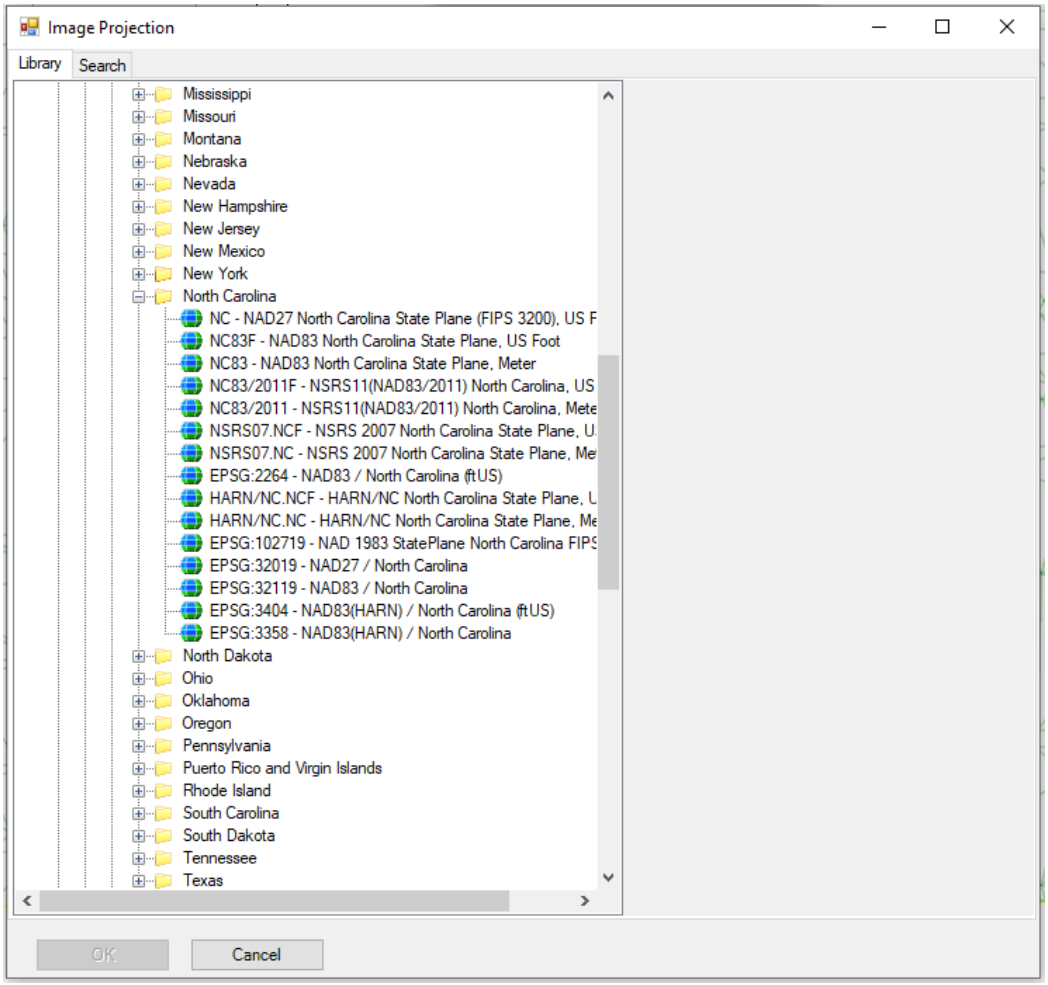
7. Feature Definition and Triangulation Options

These options are like the Import TIN and Import XYZ options and should be set the same way.



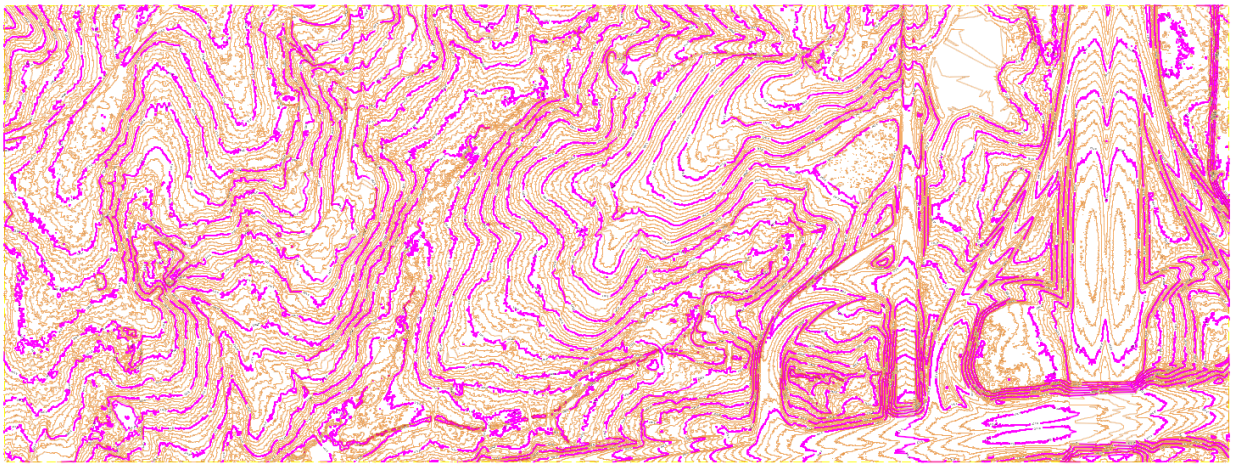
8. Geographical Coordinate Systems

This is a section the user may need to make a selection. Because LIDAR can come from some many sources the user must determine the source DATUM. This is the area where a source DATUM could be selected allowing ORD to project the data to the DGN coordinate system

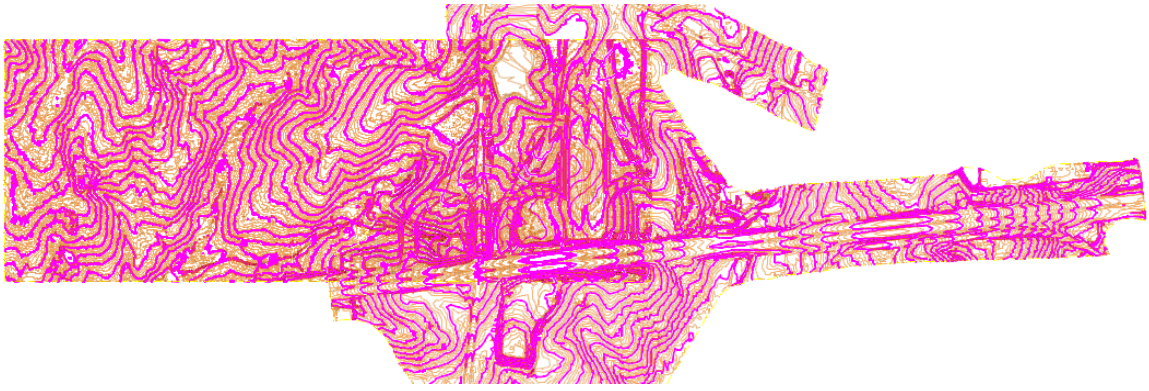


The user needs to verify the datum of the source data. It is also best practice to use the methods above or something like verify the Import operation produced the desired results and the data is in the correct location.

9. **Due to the amount of LIDAR data the actual Import process can take several minutes. This ETM was created with a LIDAR dataset that provides coverage for a small area outside the original survey limits.**



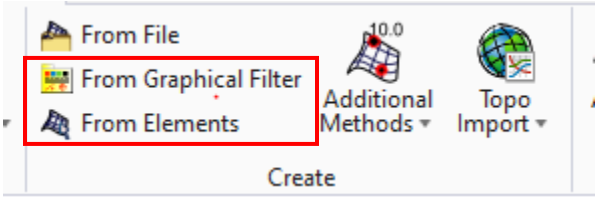
10. **By attaching the original R2635C_RDY_ETM.dgn file the user can see the overlap of the LIDAR data and the survey data near the first interchange. This LIDAR dataset will be used in later exercises to demonstrate merging and clipping operations.**



11. This covers the three most common situations that a roadway designer will use to create an Existing Terrain Model.

There are two additional methods shown in the create section of the Terrain Ribbon, that are both for Advanced Survey Users and should not be used by the average roadway designer.

A. The **From Graphical Filter** tool
B. The **From Elements** tool



Feature Definitions

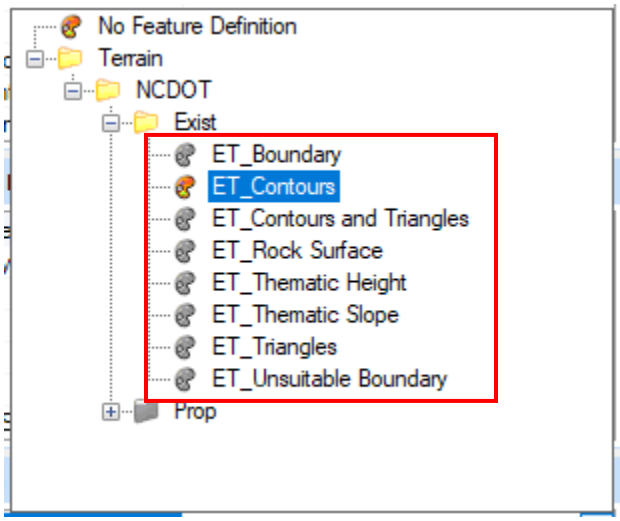
Part of CONNECT and Open Roads Designer that is new and different than Microstation and Geopak is the use of Feature Definitions. Feature Definitions will be covered and discussed in all the training modules they are an integral part of the CONNECT / ORD platform. One way of thinking about a Feature Definition is that it tells the computer what a specific element represents. At the most basic level the Feature Definition controls the display properties of an element. At the most complex level the Feature definition controls how an element interacts with the 3D model and how it interacts with other elements. Feature definitions control element naming, something that will be very important for plans production and attributes for quantity calculations.

For Terrain Models the Feature Definition controls the display of the surface.

Feature Definitions

Feature definitions are included in the NCDOT Roadway Workspace. The Feature Definitions are grouped together in a logical folder structure and are available based on what type of element is selected

For Existing Terrain Models the following Feature Definitions are available.



The Feature Definitions can be changed through the Properties Dialog while in the Active File. The Properties Dialog can be accessed through the Context Menu or through the Home Ribbon.

Changing the Feature Definitions

1. Open a Terrain Model

A. Open the ***R-2635C_RDY_ETM.dgn*** Terrain model created in the earlier exercises and Zoom into a section of the model. The Boundary should be Visible as Yellow Dashed line and the contours should be visible, the Major Contours will be purple and labeled at 5' intervals and the Minor Contours will be brown and at 1' intervals.

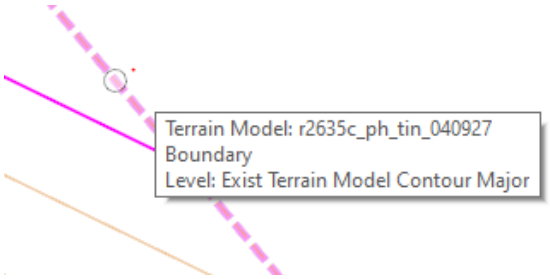
B. These display settings, the information displayed and the way it appears on the screen are controlled by the Feature Definition *ET_Contours*. This is the Feature Definition that was assigned to the surface when the file was created.

2. Access the Properties Dialog

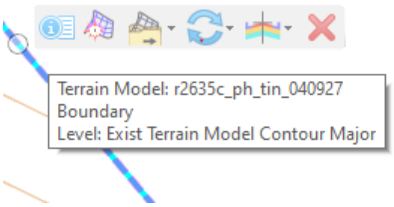
A. One way to access the Properties Dialog is to activate the Context Menu. The Context Menu is another concept that the user needs to become familiar with, it will be used throughout the design process. The context menu is a set of tools that will appear when an element is selected, the tools will be associated with that element.

Insert Link to Video on Activating the Context Menu and the Tools on the Menu and work through selecting a new Feature Definition

B. To Activate the Context Menu, select the Terrain Boundary



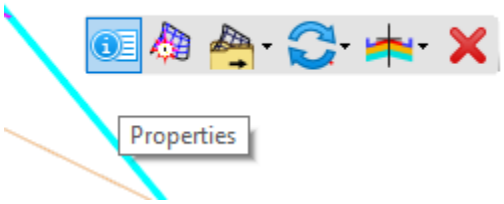
C. Move the cursor off the Boundary and then back to the Boundary and the Context Menu will appear



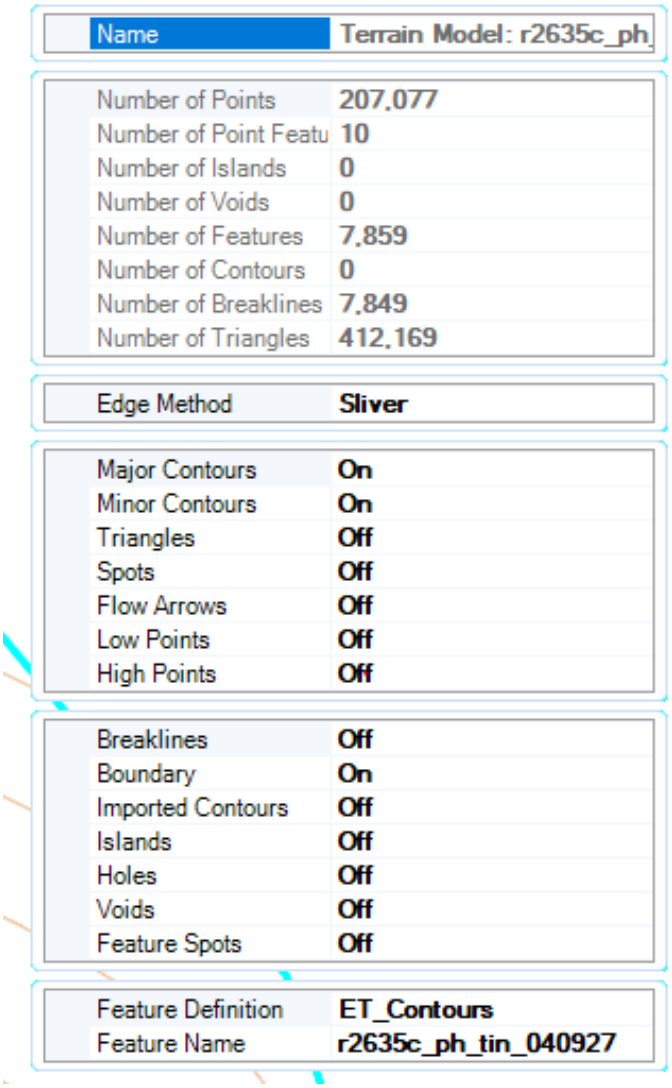
D. The Context Menu contains tools for **Properties, Active, Export, Update from Source, Templates and Delete**. These tools will depend on what type of element is

selected.

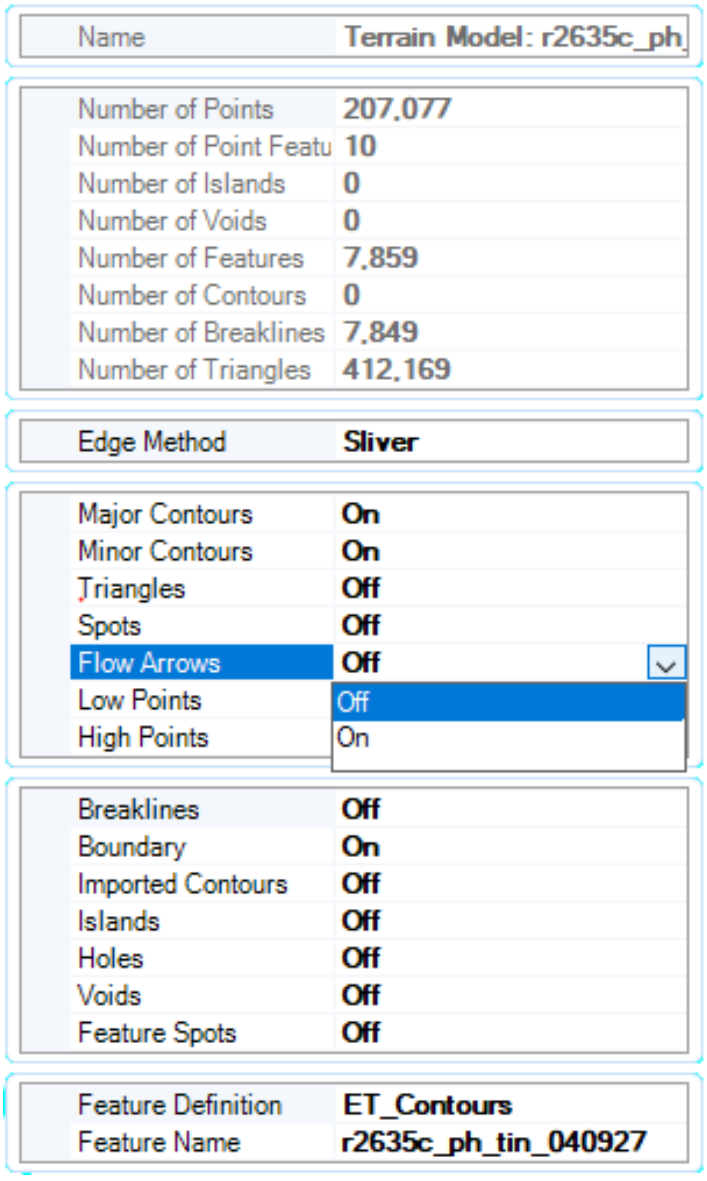
E. For this exercise select the Properties Tool



F. A properties dialog will appear and remain on the screen if the pointer remains within the dialog.

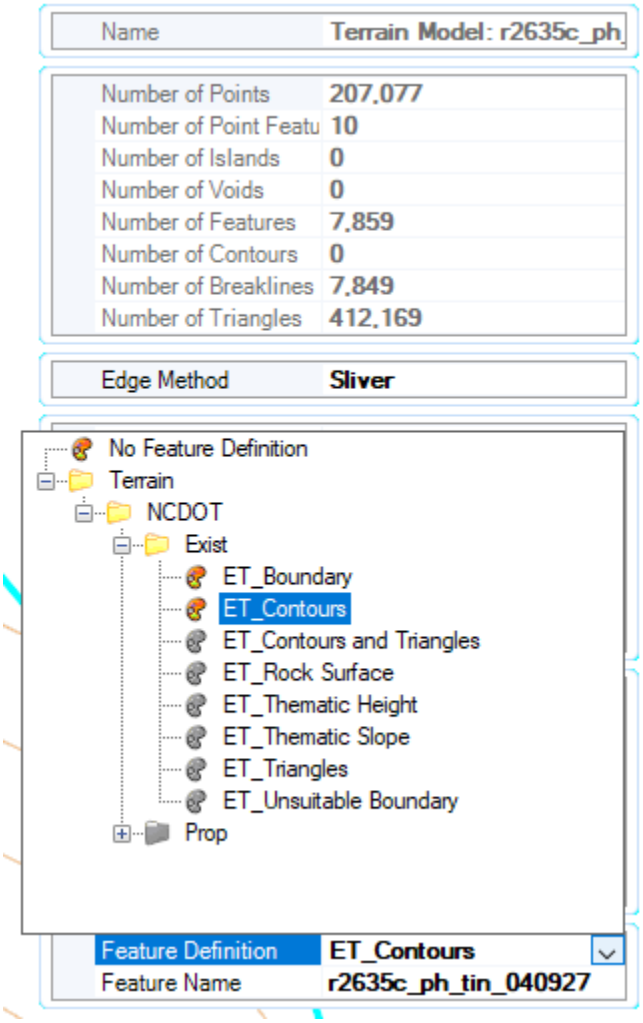


G. The dialog will display a significant amount of information about the Existing Terrain and the Display Properties. It is possible to turn things off and on using the OFF/ON Toggles in the Properties Dialog. This could be done in special situations to see very specific items. For the average user changing the Feature Definition will be a better option.



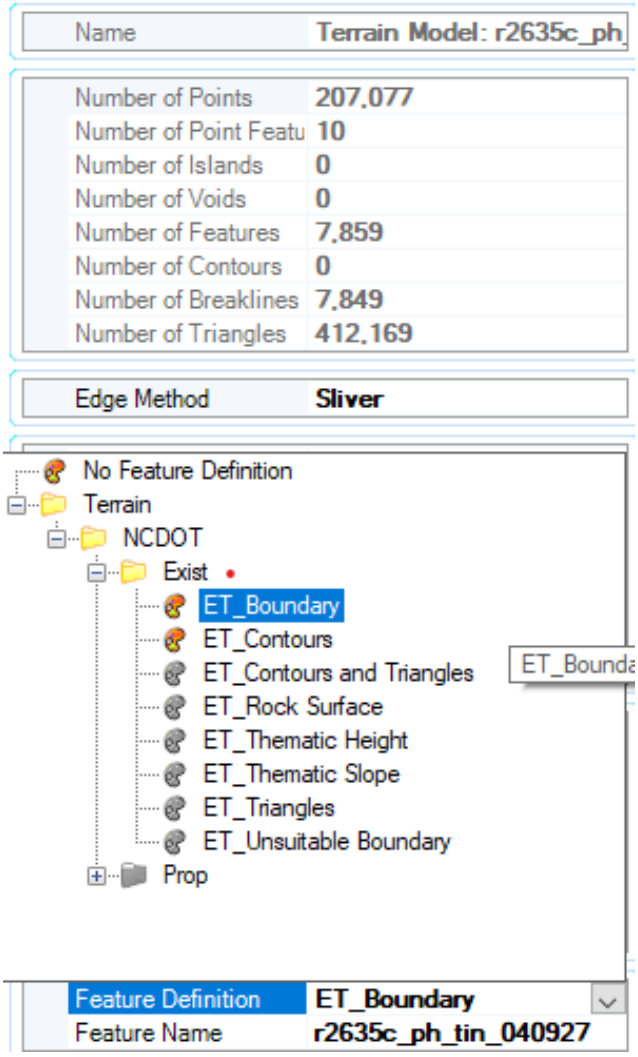
H. A more convenient way to set displays is the use of Feature Definitions. The Feature Definitions included in the workspace have been developed to provide a consistent display based on the most common requirements of a roadway designer during project development.

I. From the Properties Dialog select the *ET_Contours* text in the Feature Definition section near the bottom of the dialog. This will bring up a drop-down menu that displays all the available feature definitions that can be applied to Existing Terrains.

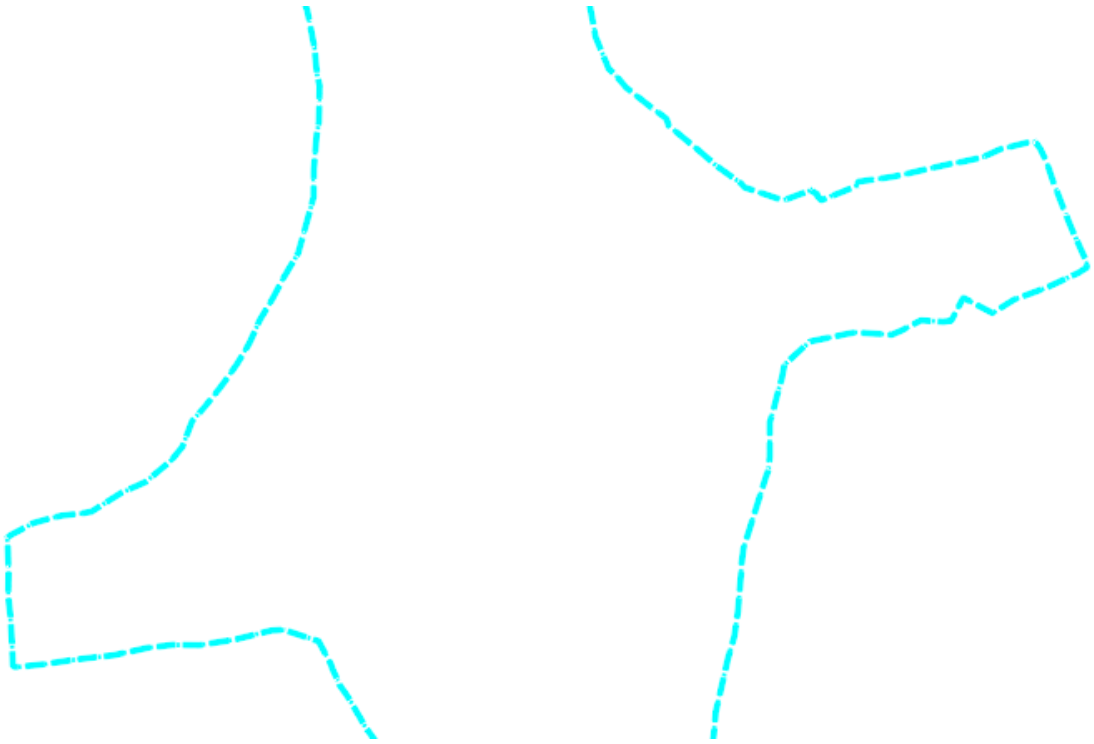


Notice the Feature definitions are grouped into a logical folder structure *Terrain/NCDOT/Exist/Available Feature Definitions*

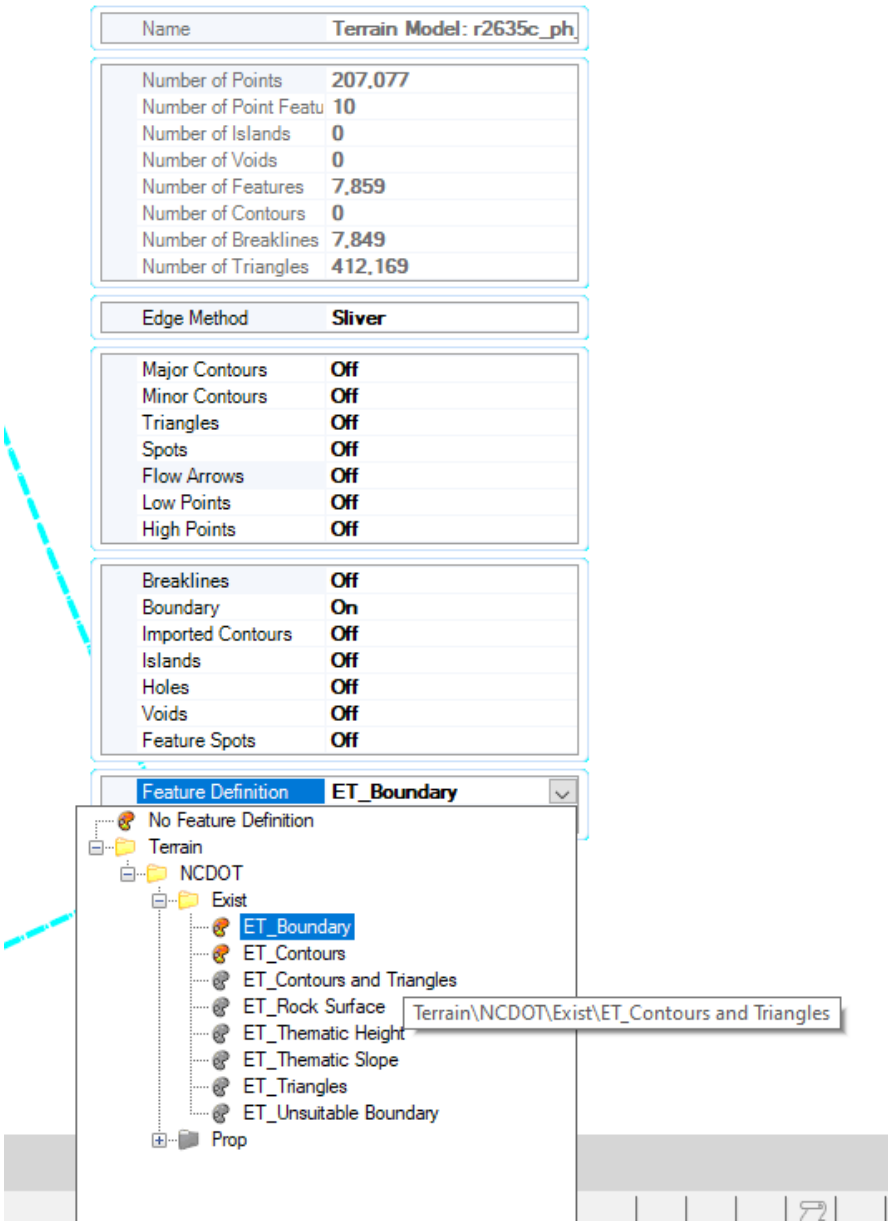
J. Select the *ET_Boundary* Feature Definition.



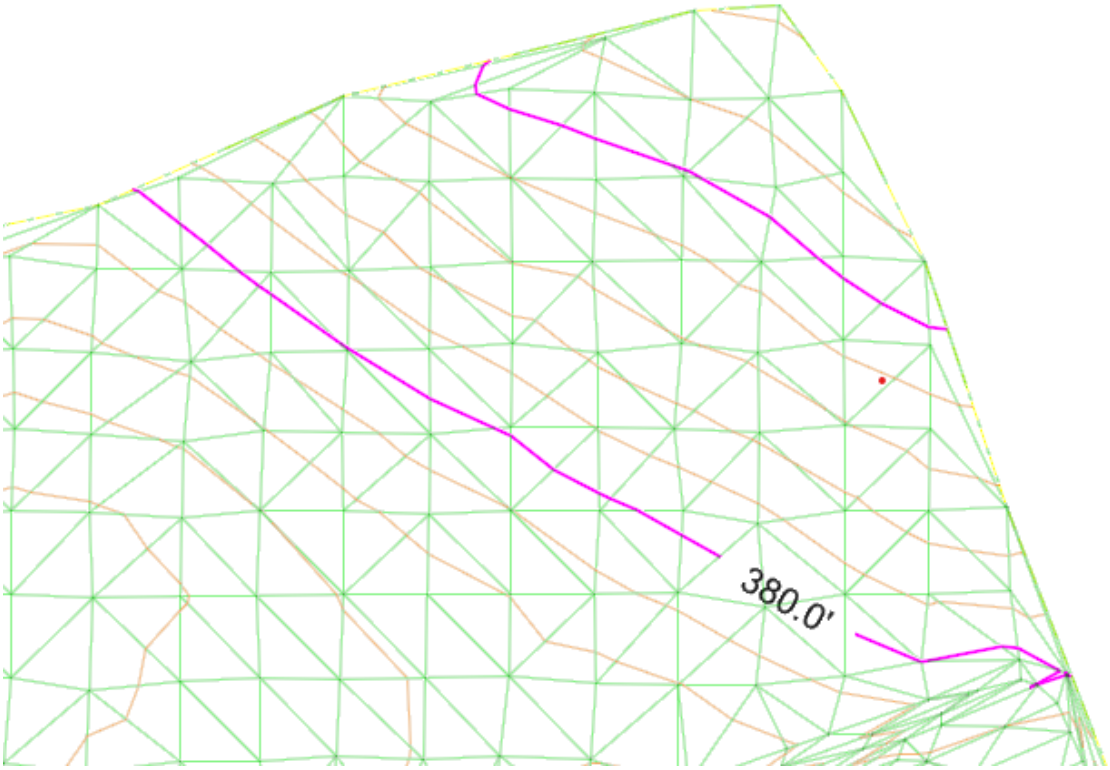
K. Notice that the Contours have been turned off and the only element displayed is the Dashed Boundary Line



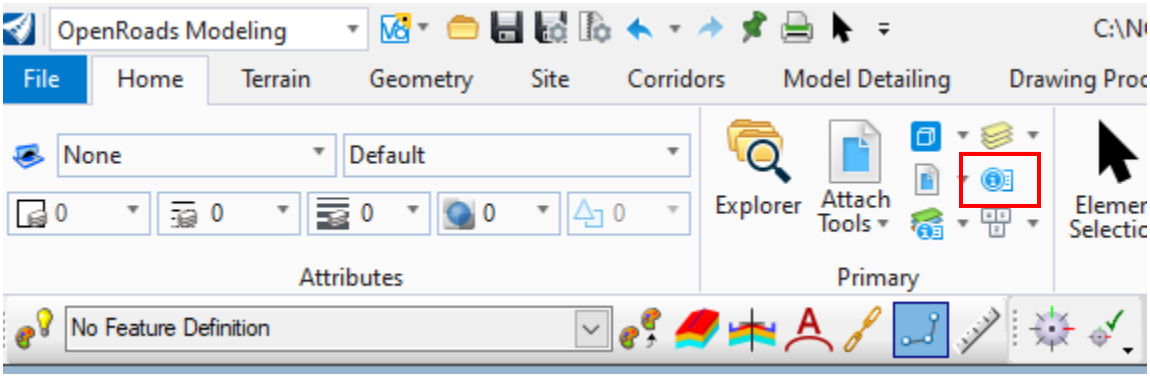
L. Use the same process to Activate the Context Menu, select the Feature Definition drop down Menu and Change the Feature definition to *ET_Contours and Triangles*.



M. The display will change to show the Boundary, Contours Elements, and the Triangles

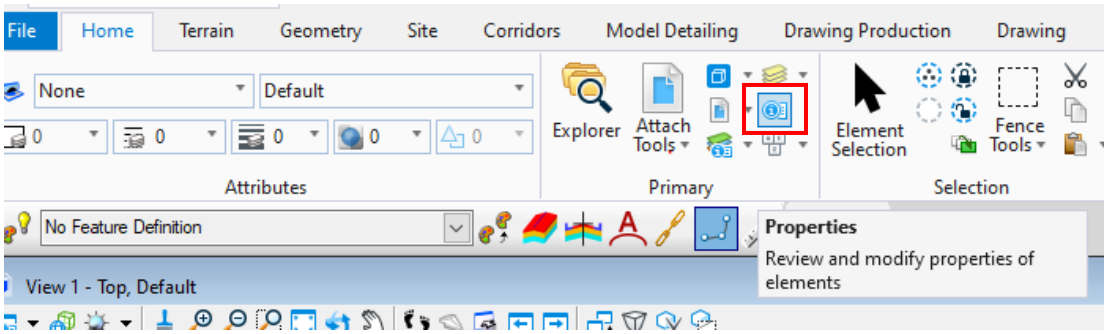


N. The properties dialog can also be accessed through the Primary Section of the Home Ribbon

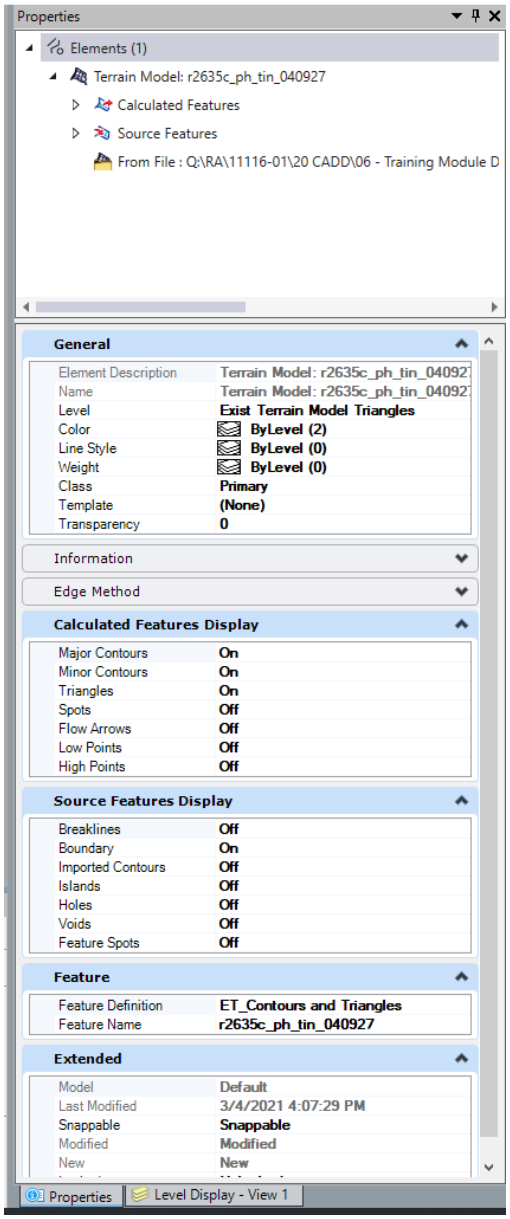


O. Select the Boundary element of the Terrain model and Select the **Properties** Icon from the *Primary* Section of the *Home* Ribbon

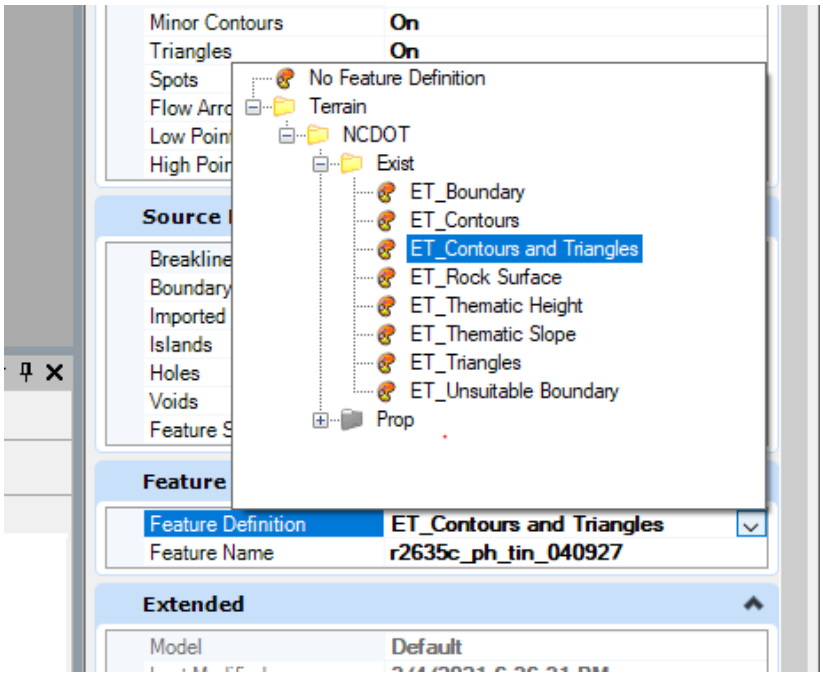
Insert Video Link showing how to Access this Properties Dialog, Dock it to the Corner of the Screen and Use it to change the Feature Definition



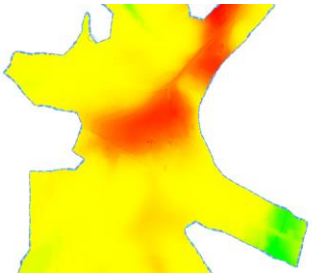
P. This will Activate the Properties Dialog. This dialog is very similar to the Properties Dialog in MicroStation and can be docked to the side of the screen. Using the Properties Dialog is common during the design process and most users will find that keeping the dialog docked will be a benefit.



Q. The Current Feature Definition *ET_Contours and Triangles* is shown in the Feature section near the bottom of the Properties Dialog. Like the Context Menu select the *ET_Contours* and Triangles Feature from the Feature Definition and the drop down will appear showing the available Feature Definitions. Select each Feature Definition in turn to see the changes to the display of the Terrain model.

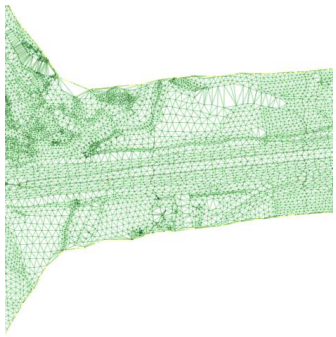


- *ET_Rock Surface* (this is not active)
- *ET_Thematic Height* – Displays color gradients to represent differences in elevation



- *ET_Thematic Slope* (this is not active)

- *ET_Traingles* – Displays the Triangulated Surface



- *ET_Unsuitable Boundary* (this is not active)

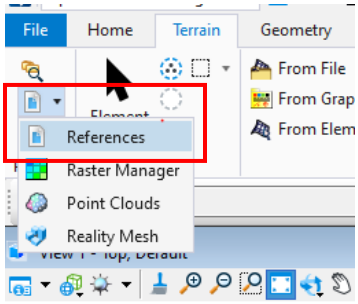
This ends the Feature Definition exercise. It is important to understand Feature Definitions and the integral role they have in the Connect/ORD design process. Feature Definitions will be discussed and used throughout the training materials.

Symbology in Reference Files

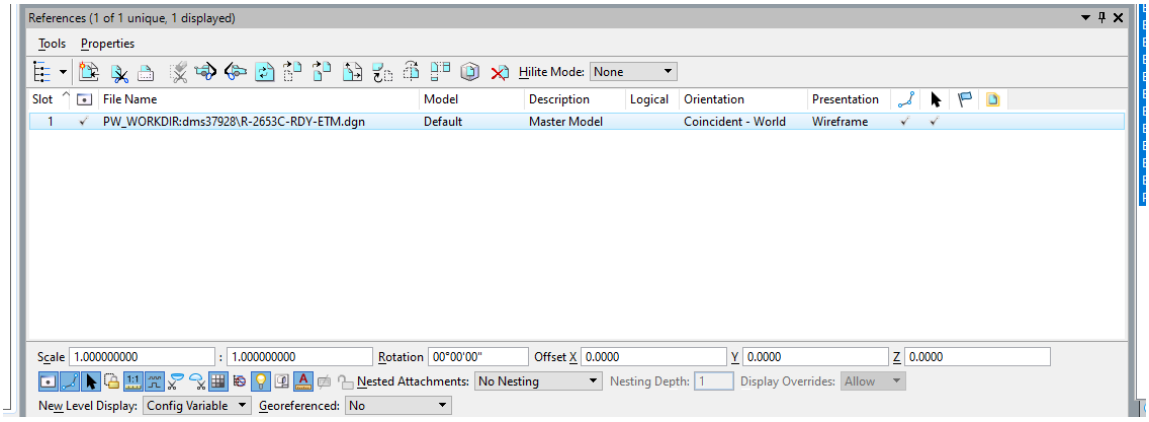
The symbology of the Existing Terrain Model is controlled by a Feature Definition. The Feature Definition can only be controlled in the active dgn file. After creating the Existing Terrain Model, it will almost exclusively be used as a reference file. The ETM will be referenced to an ALG file of a CMD file, set Active and used in the Design Process. Because the user cannot control the feature definition of the ETM file when it is attached a reference there is a way to control the display without having to close and open multiple files.

Using Override Symbology

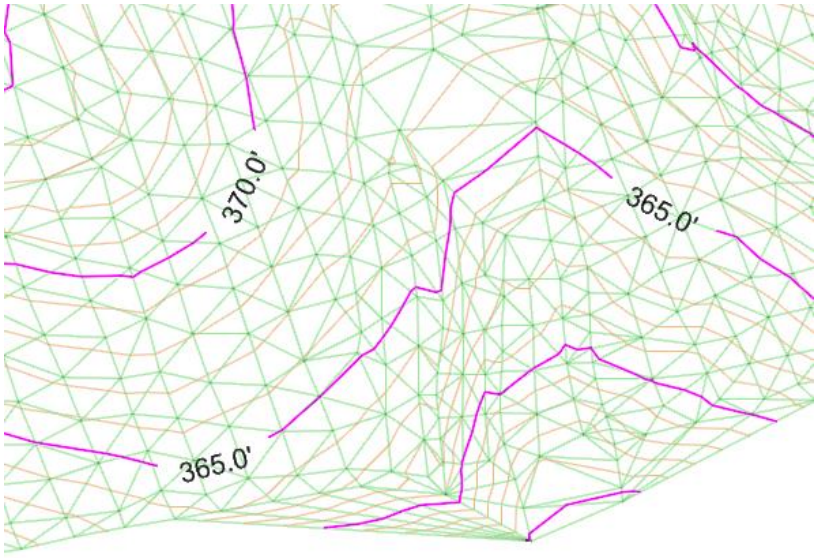
1. **Open the DSN file**
   A. Path to the Training file and open the ***R-2563C_RDY_DSN.dgn*** file
   B. Open the references dialog from the attach tool section under the *Primary* Tools Group



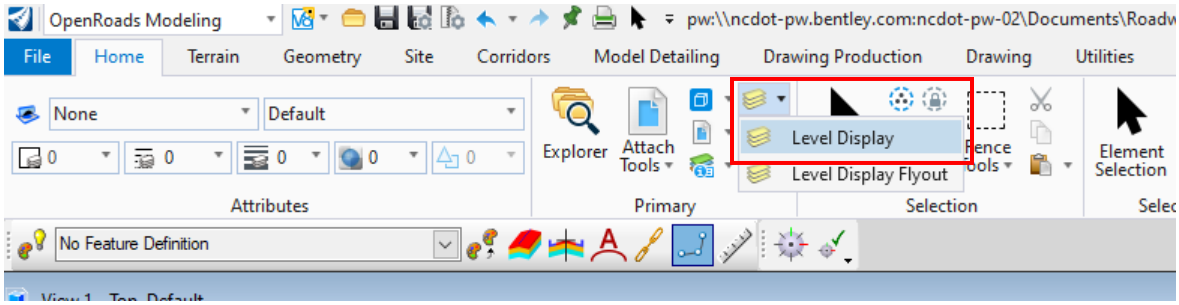
   C. In the reference dialog attach the ***R-2635C_RDY_ETM.dgn*** file. This is a similar operation to using MicroStation. Note that the file path may be slightly different depending on where the training files are located.



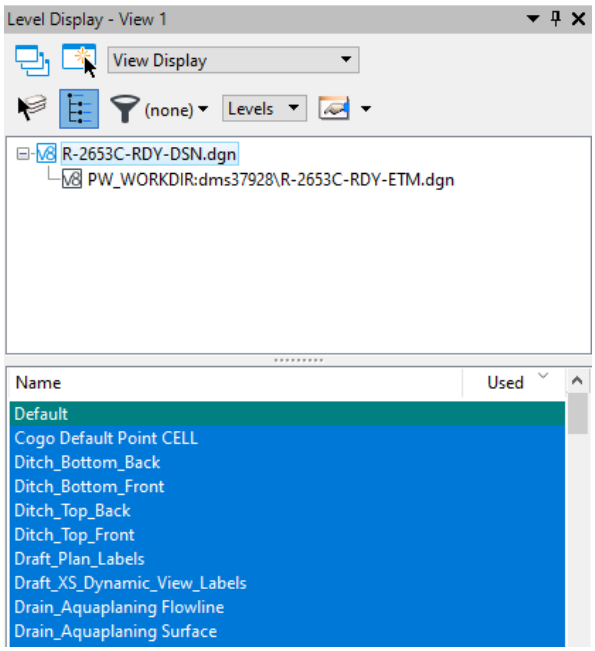
D. The ETM should show the contours, the triangles and the surface boundary.



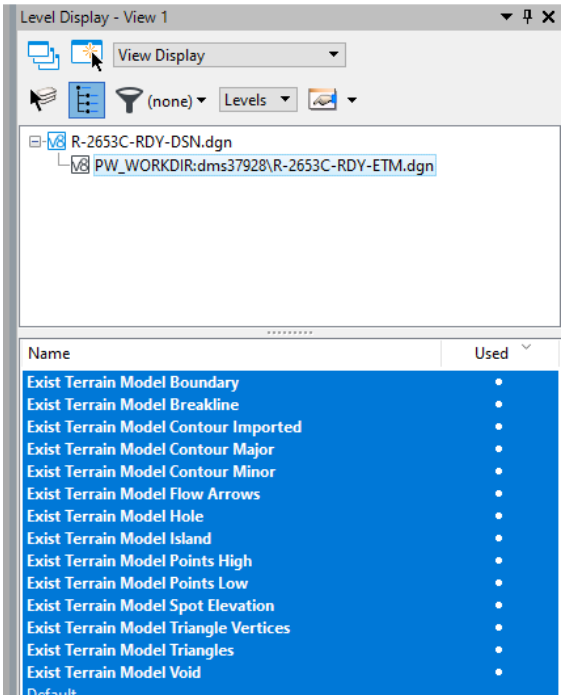
E. To open the Level Display dialog, go the *Home* Ribbon to the *Primary* Tools Section and select the level display icon. This will activate the Level dialog that should look like the dialog used by MicroStation.



F. The dialog will show no Used levels in the Active dgn file

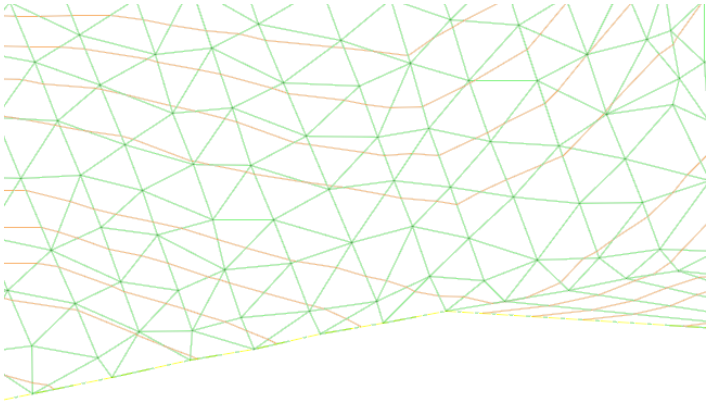


G. The dialog will show used levels in the ETM reference file.

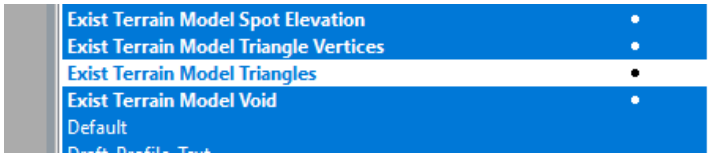


H. The level in the reference file can be turned off and on the exact same way they can in MicroStation but depending on the level the results may not be what the user is expecting or needs.

I. For example, turn off the *Exist Terrain Contour Major* level in the reference file and the major contours will turn off.



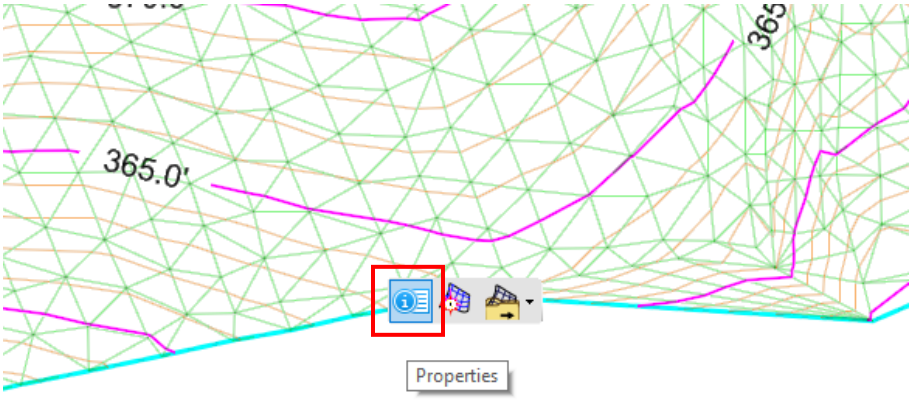
J. Turn off the *Exist Terrain Model Triangles* and all the elements will turn off. This is because the Triangles are the actual surface. Like many other civil elements in ORD the surface is a dynamic element and without the triangles displayed the elements in the surface; contours, breaklines, boundaries etc. cannot be displayed.



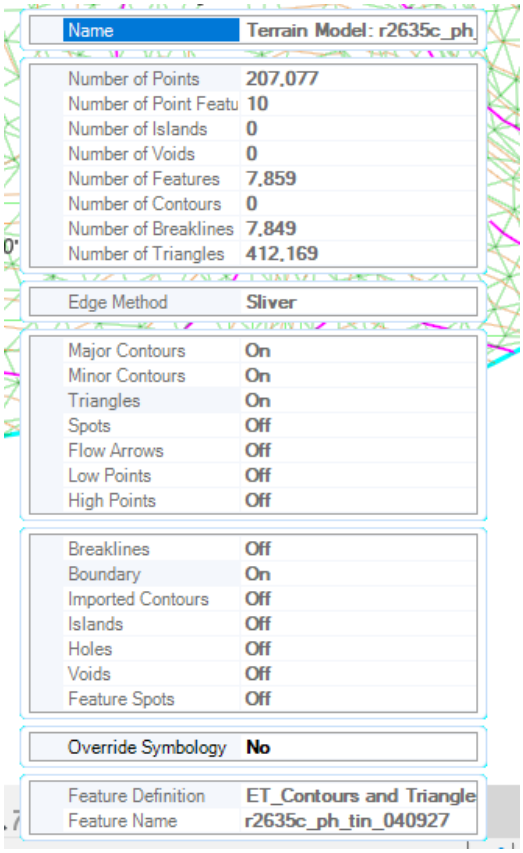
K. The way to control the symbology of an ETM that is attached as a reference is to turn on the Symbology Override.

L. Turn the *Exist Terrain Model Triangles* level back on and the Triangles and the surface will display

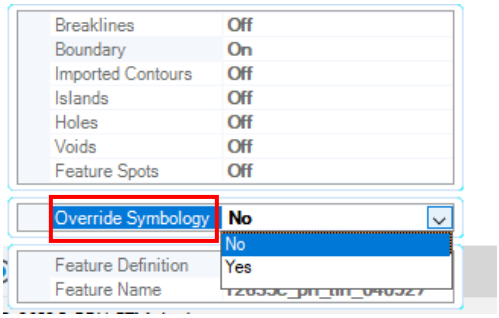
M. Activate the context menu by selecting the surface boundary, moving the cursor slightly off the boundary and then back on to the boundary



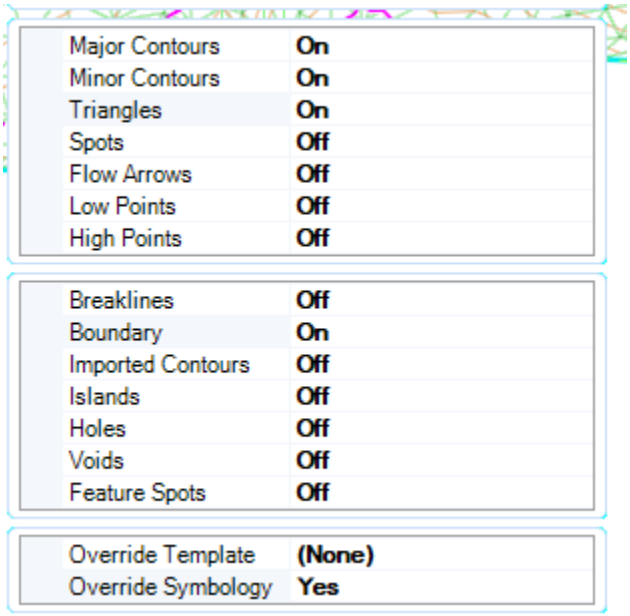
N. Select the Properties Icon from the context menu, note that the individual components of the Terrain model are Grayed out.



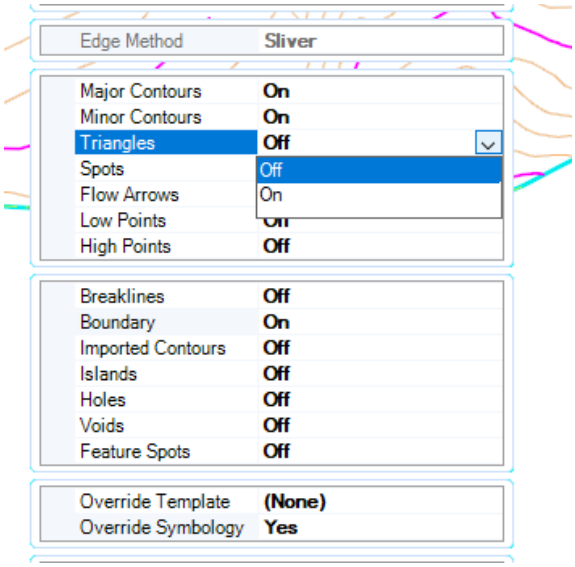
O. Set Override Symbology to Yes



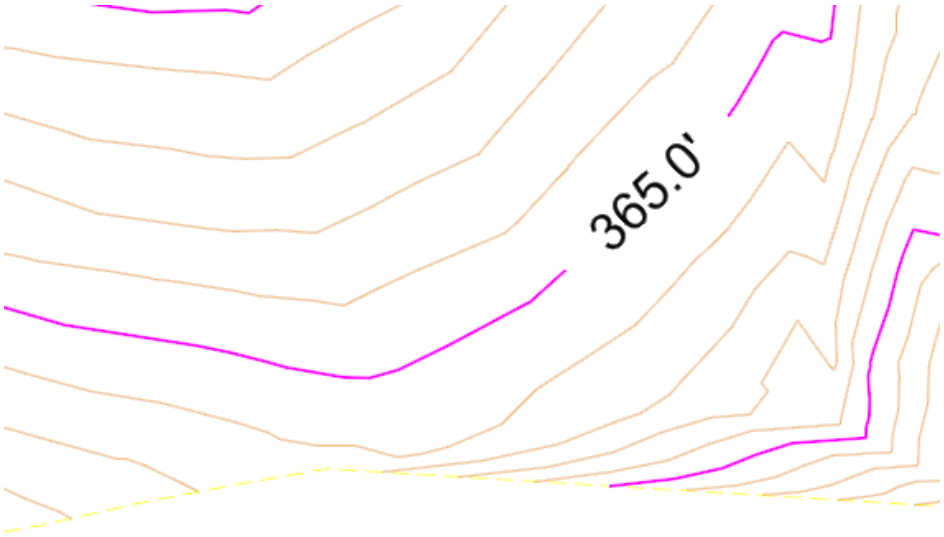
P. The individual features of the Terrain Model will be active and selectable by the user. These components can now be turned off and on individually.



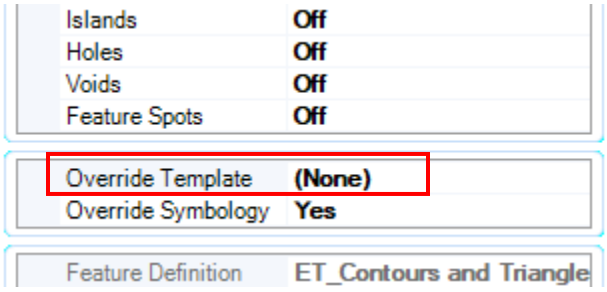
Q. Select and set the Triangle option to *Off*



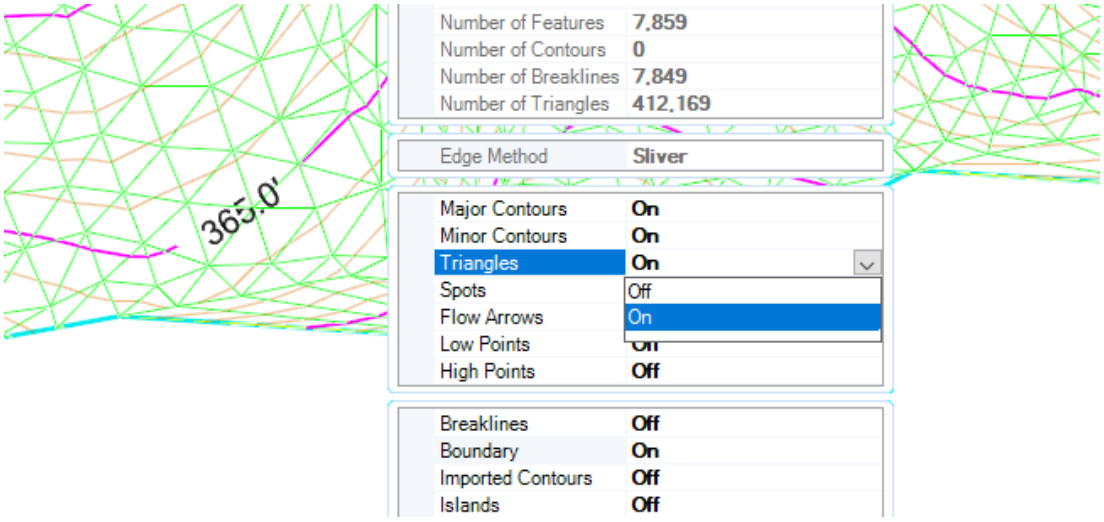
R. Now the triangles will be turned off, but the contours and boundary will remain. This is different that when the Triangles were turned off using the Level Display dialog and then entire surface was turned off>



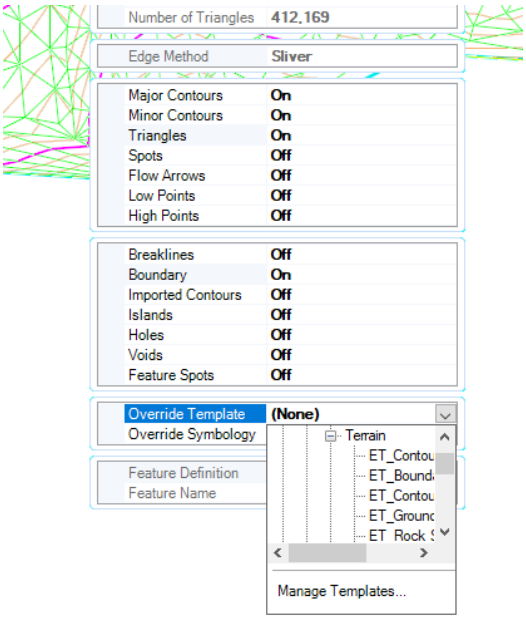
S. Note the Override Template section. If the Symbology Override is set to *Yes,* then the Override Template is available. This section will allow the user to select a new Feature Definition to apply to the ETM.



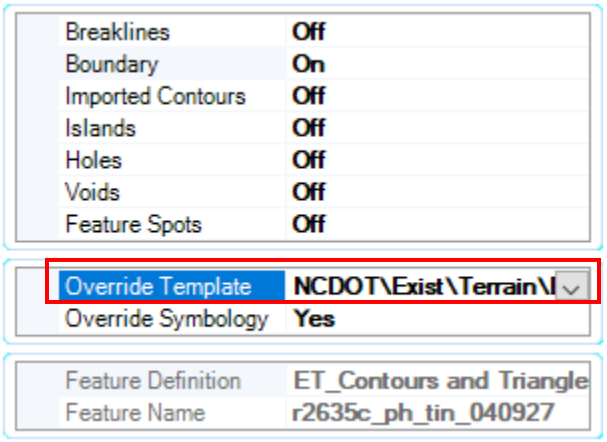
T. Set the Triangles option back to *On*. This will turn the Triangles back on in the display.

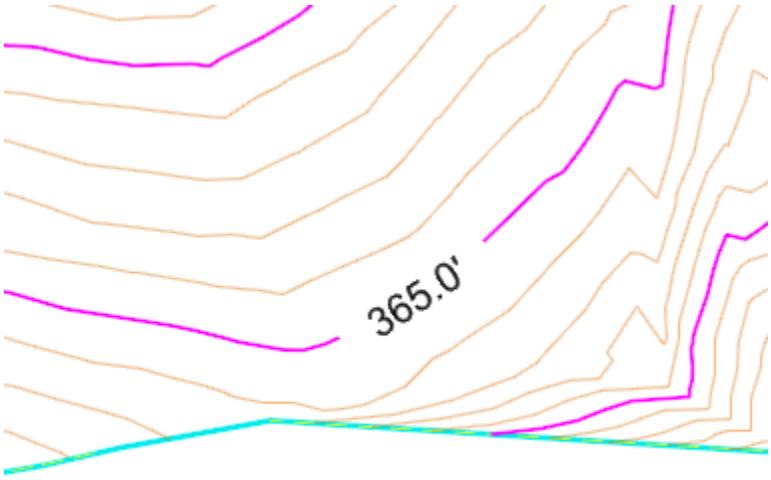


U. Go to the Override Template section and select the *ET_Contours* Feature Definition from the *NCDOT/Terrain* section, the text may be cut off, this is the top selection.

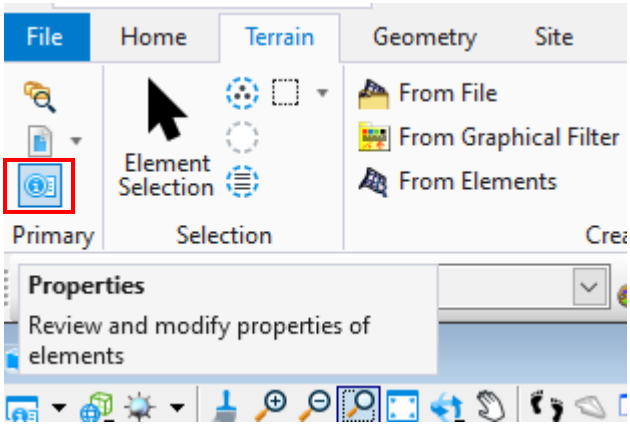


V. The template override selection will now be displayed in the context menu and the surface will display only the contours and the boundary





W. In addition to using the Context Menu the user can also access all the options through the Properties dialog. Most users will keep the properties dialog open and docked to a window permanently. In order to open the dialog, select the Terrain model and then select the **Properties** Icon from the *Primary* Tool section in the *Home* or the *Terrain* Ribbon.

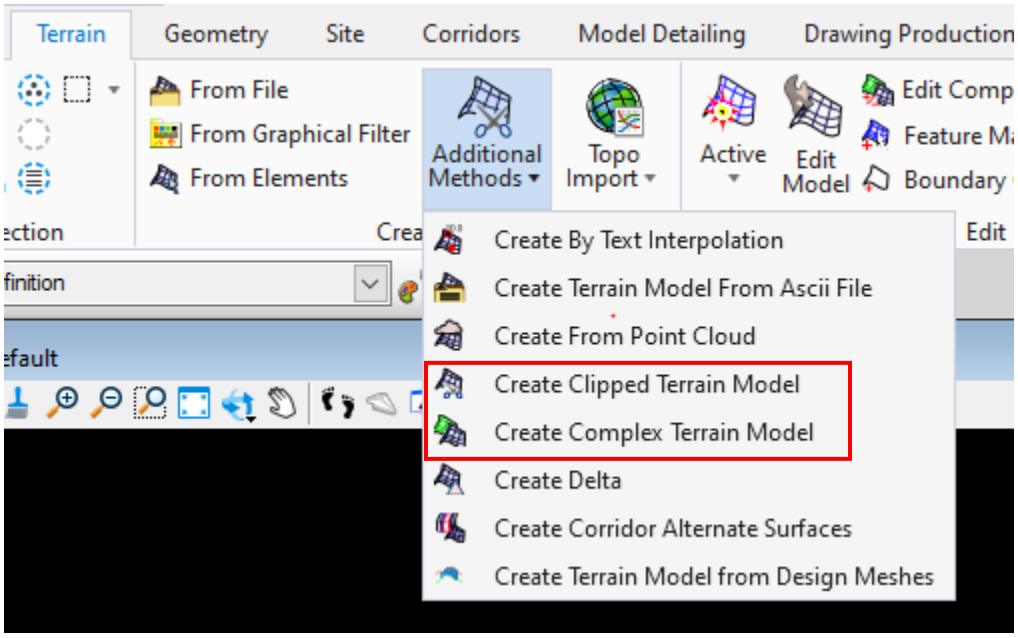


X. This will open the properties dialog. There are two sections of the properties dialog that can be used to control the feature display of the Terrain reference.

Y. The top section will show a list of features that can be turned off and on with a check box.

Clipped and Complex Terrain Models

The *Create* section of the *Terrain* Ribbon has additional tools under the *Additional Methods* section that may be required by a roadway designer.



The tools a roadway designer may need are **Create Clipped Terrain Model** and **Create Complex Terrain Model**.

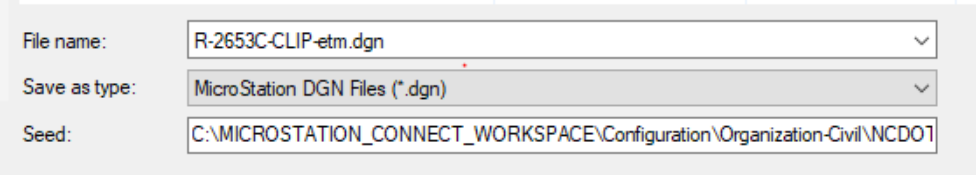
In this exercise you will learn to clip an existing terrain model, which could be used to reduce the size of a large LIDAR ETM file. You will also learn to merge models together which could be used to add LIDAR data to an ETM to increase the coverage.

Create Clipped Terrain Model

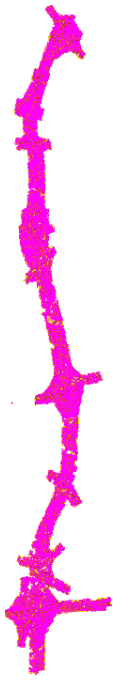
A Clipped Terrain Model will generally be used to make a larger Terrain model smaller; the tool can also be used to create a void in a Terrain Model, but the focus of this exercise will be to create a smaller Terrain model. The base ETM, the ETM that will be clipped can be clipped as a reference file, in this way the original source data can be left in the original form and not changed in any way.

1. **Create a New DGN .**

   Using the steps outlined in Create File section make a new a dgn file using the 3D seed file and the filename ***R-2653C_RDY_ETM_CLIP.dgn*** file.

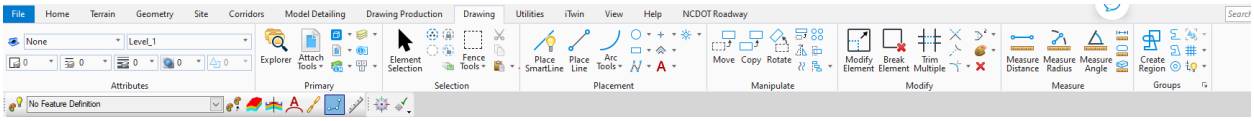


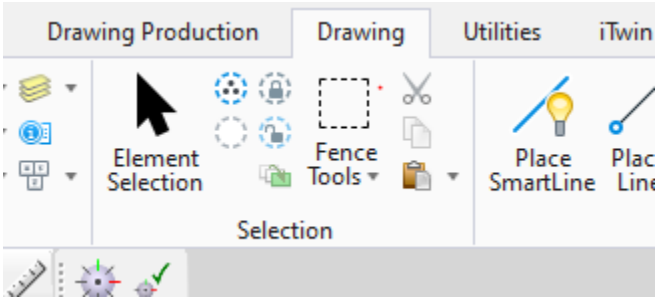
2. **Reference Base ETM**
   A. Attach the ***R-2635C_RDY_ETM.dgn*** file from the training directory
   B. Fit view, the ETM file from the original training exercise should be visible.



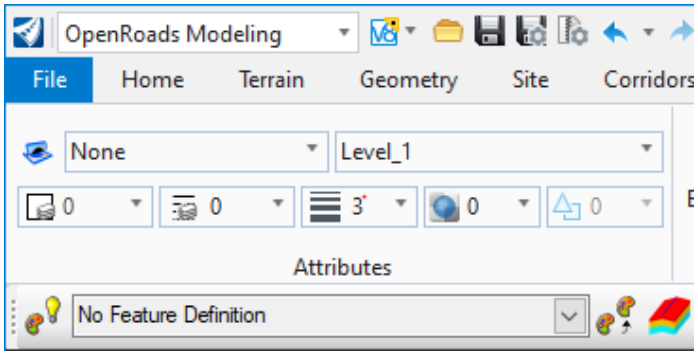
3. Create a Clip Boundary

A. Switch to the *Drawing* Ribbon

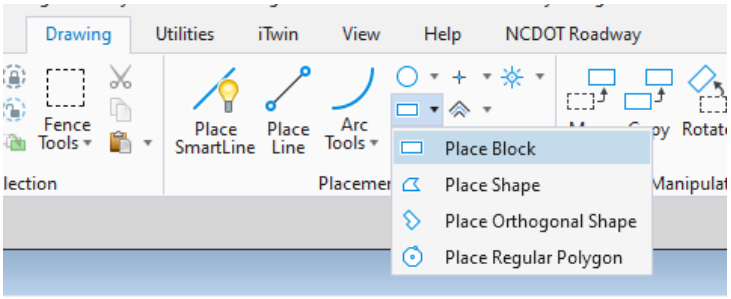




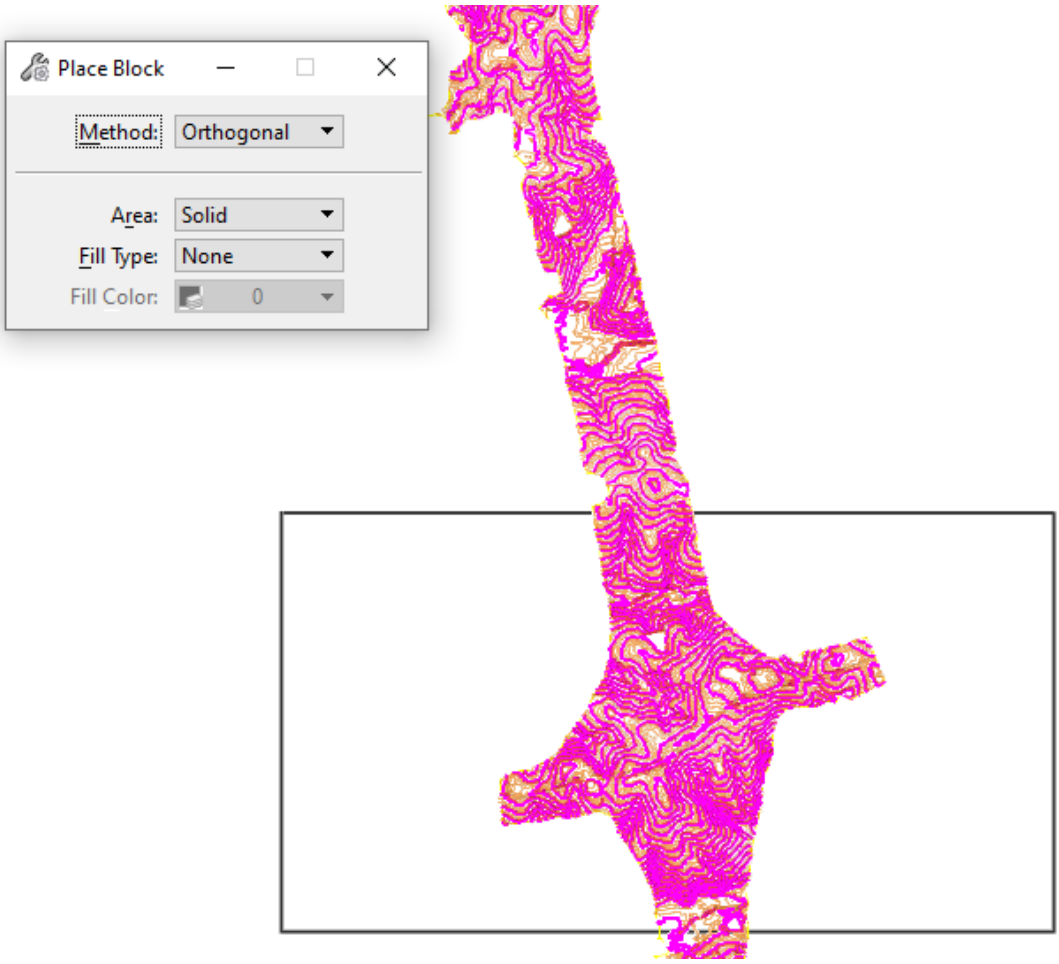
B. Set the level symbology



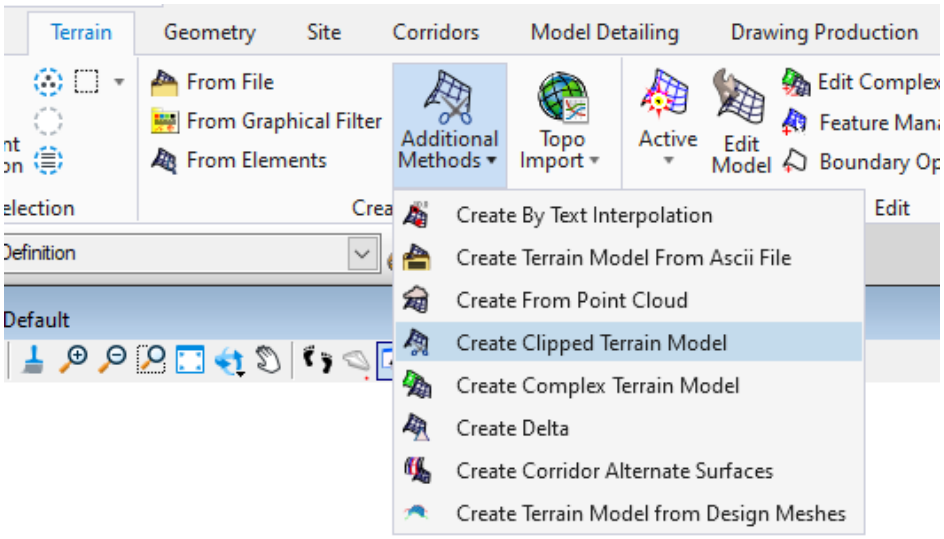
C. In the placement section of the *Drawing* Ribbon select the **Place Block** tool.



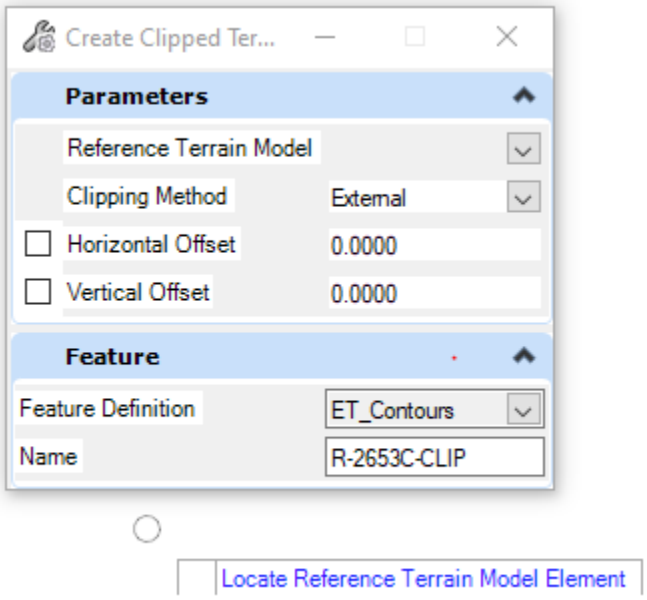
D. Place a block around the center portion of the center portion of the ETM (For this exercise the exact location is not important). This block will be the clipping boundary.



E. Switch to the *Terrain* Ribbon and from the *Create* section select *Additional Methods* → **Create Clipped Terrain** model.



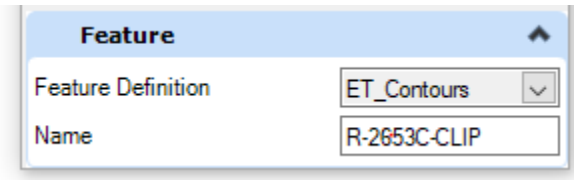
F. The Create Clipped Terrain dialog will appear, along with the heads-up prompt



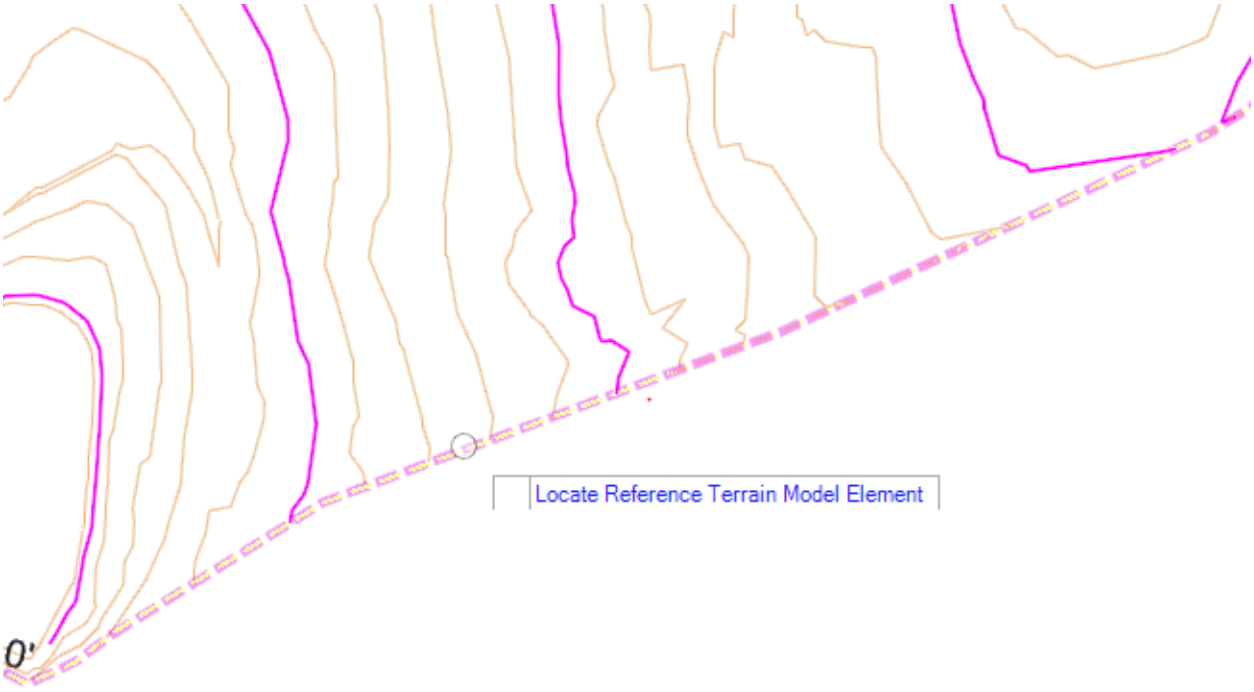
G. Under the Feature section of the dialog set the feature to *ET_Contours*,

- This will be the active feature definition for the new clipped surface

H. Set the Name to *R-2635C-CLIP*,
   - This will be the name of the new Existing Terrain Model.



I. Follow the prompts from the heads-up display
J. Locate Refence Terrain Model Element
   - Selecting the Boundary Element of the Terrain Model in the reference File
   - Left click on the Yellow Dashed Boundary to Select



K. Locate Clipping Element

- Left Click on the Box representing the clipping element

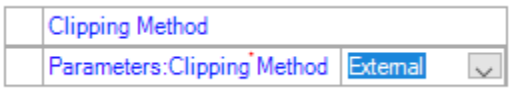
L. Locate Next Clipping Element
   - The user can apply more than a single clipping element. For this exercise there is only one element.
   - Reset by Right Clicking to move to the next Option

M. Horizontal Offset

- The user can apply a horizontal offset to the boundary, in general it will be easier to draw the boundary where needed and set the horizontal offset to 0.00'
- Left click to accept 0.00'

N. Vertical Offset
- The user can apply a vertical offset to the clipped surface area
- This is generally used for more advanced tasks associated with Geotechnical design
- The roadway designer should leave this set to 0.00
- Left click to accept 0.00

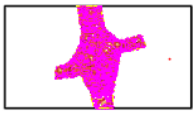
O. Clipping Method
- Options are External and Internal
- External Clips all data on the outside of the Clip Boundary Shape
- Internal Clips all data on the inside of the Clip Boundary Shape, creating a void
- This value can be changed with the 'Up' and 'Down' Arrow keys
- Set value to External and Left Click to Accept



P. This will complete the Create Clipped Terrain operation and the initial heads-up display will appear. Right Click to exit the Tool.

Q. At this point no change in the file will be visible.

R. Turn off the attached ***R-2635C_RDY_ETM.dgn*** file and the clipped portion of the Existing Terrain Model will be visible.



S. There are some relationships that have been built during this process.
   - The dependency of the clipped terrain model on the base Terrain Model. The refence file contains the base model and if the base file stays attached the clipped model will update to include any changes made to the base model. If the reference is detached the dependency is broken and the clipped model will not update.

   - The clipping element operates like a Clip Boundary in Geopak. If the base ETM file is maintained as a reference file if the clipping boundary is deleted or modified, it will modify the Clipped ETM to show more or less of the base ETM.
   - By detaching the reference file and then deleting the clip boundary a new smaller ETM will be created.

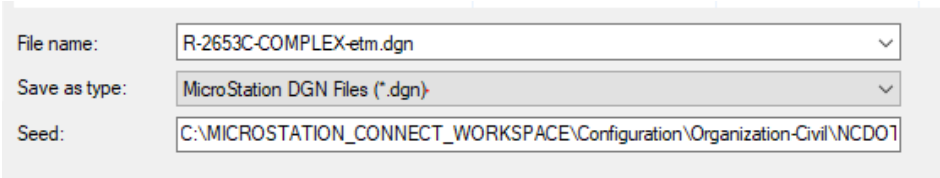
T. This is the end of the Create Clipped Terrain Model exercise

Create Complex Terrain Model

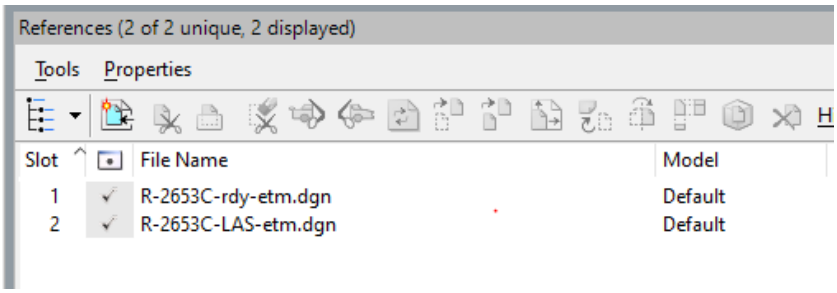
A Complex Terrain Model is a terrain models that combines data from two separate Terrain Models. The data can be combined either by *Merging* or *Appending*, the most common method for the roadway designer would be to merge files. For example, if LIDAR data was merged with survey data to provide additional coverage outside of the project limits.

1. **Create a New DGN**

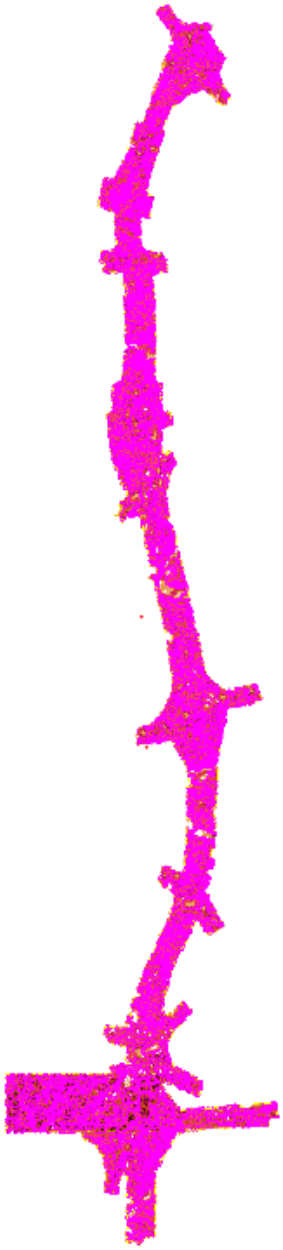
   Using the steps outlined in Create File section make a new a dgn file using the 3D seed file and the filename ***R-2653C_RDY_ETM_CLIP.dgn*** file.



2. **Reference Base ETM file**
   A. Attach the ***R-2635C_RDY_ETM.dgn*** file from the training directory
   B. Attach the ***R-2635C_RDY_ETM_LAS.dgn*** file from the training directory

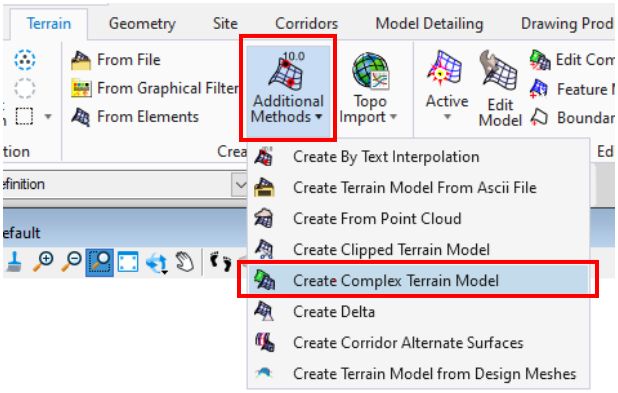


C. Fit View to see the two surfaces.

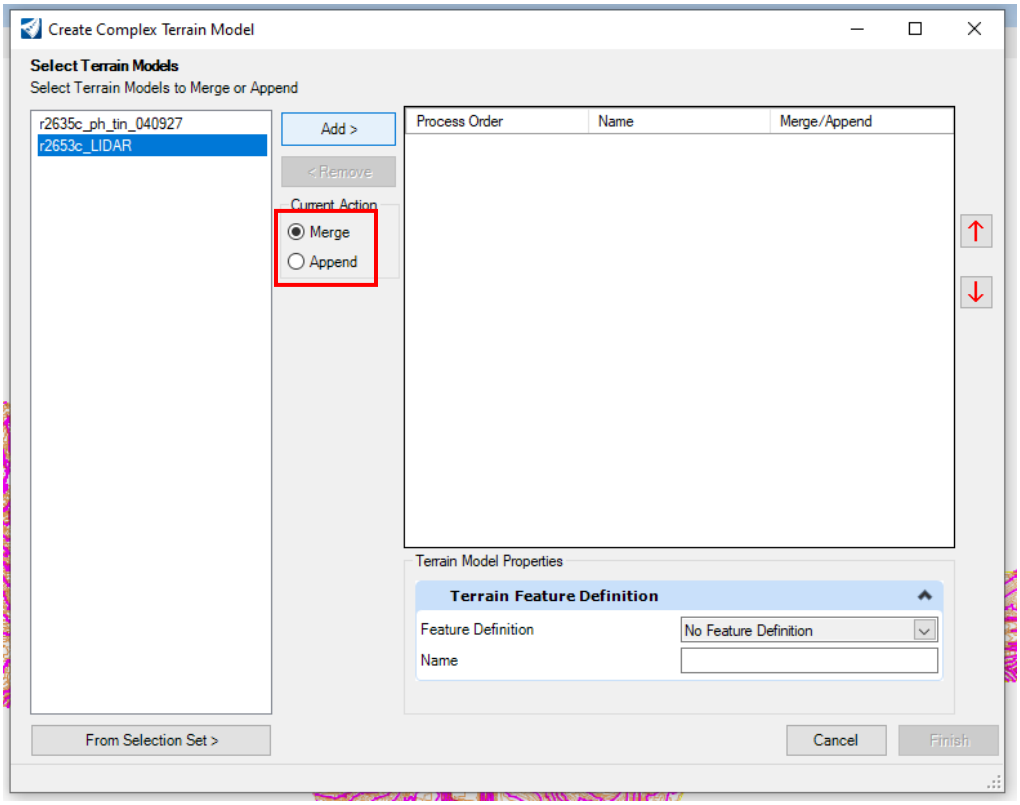


3. Create a merged ETM

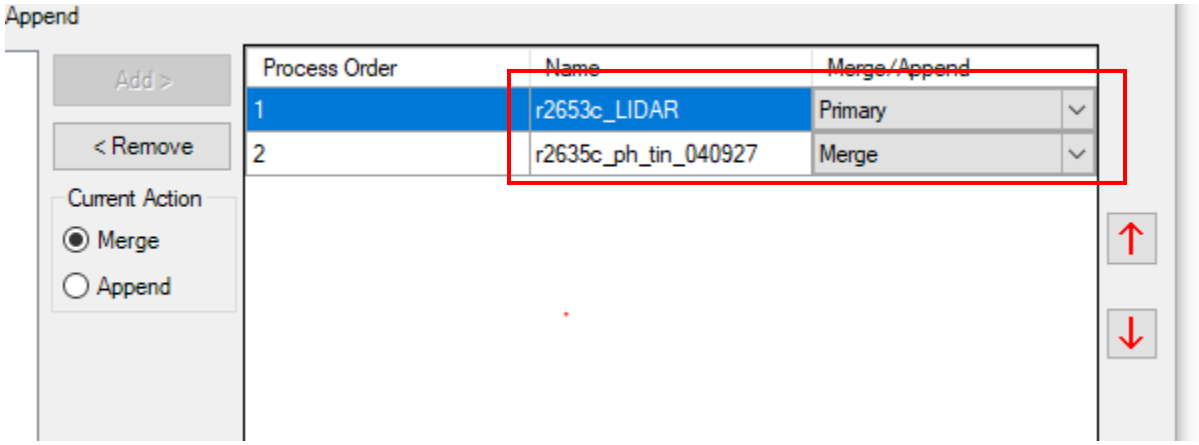
A. Select the **Create Complex Terrain Model** tool from the **Additional Methods** dropdown in the *Create* section of the *Terrain* Ribbon.



B. In the Create Complex Terrain Model Dialog
- Set the Current Action to *Merge*
- Select the *r2635c_LIDAR* surface and select *ADD*

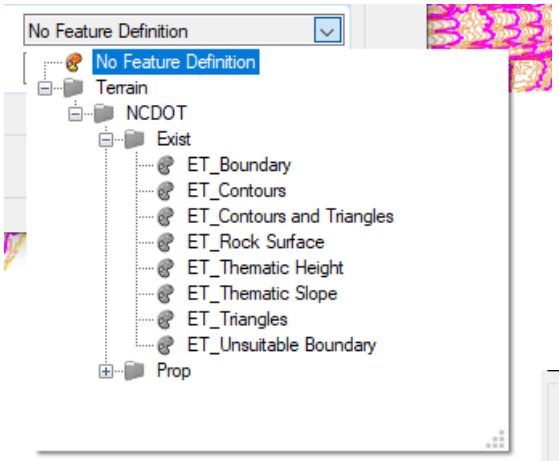


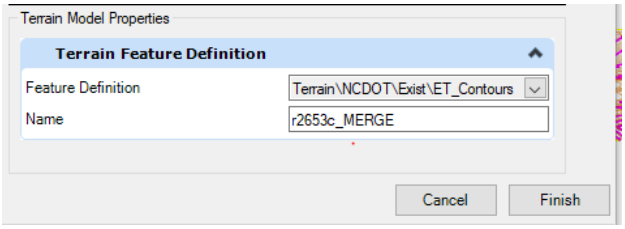
C. Select the *r2635c_ph_tin_040927* surface and select *ADD*



D. Now both surfaces are shown on the right side of the dialog.
- The LIDAR surface is first in the list and shown as the **Primary Surface**
- The survey surface is second in the list and shown as the **Secondary Surface**
- When merging surfaces the Primary and Secondary designations are critical. In areas of overlap and data in the Primary Model is discarded and only data from the Merge Model is used.
- In this example where the two surfaces overlap the LIDAR data will be replaced by the survey data.

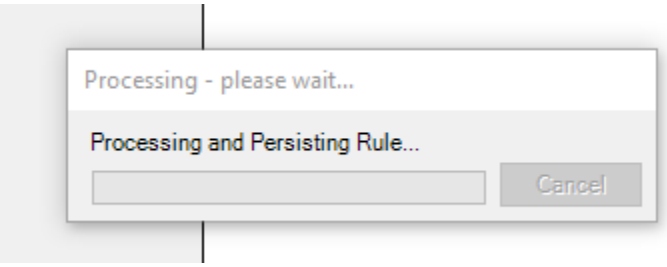
E. Set the Feature Definition to *ET_Contours* and the name to *r2635c_MERGE*





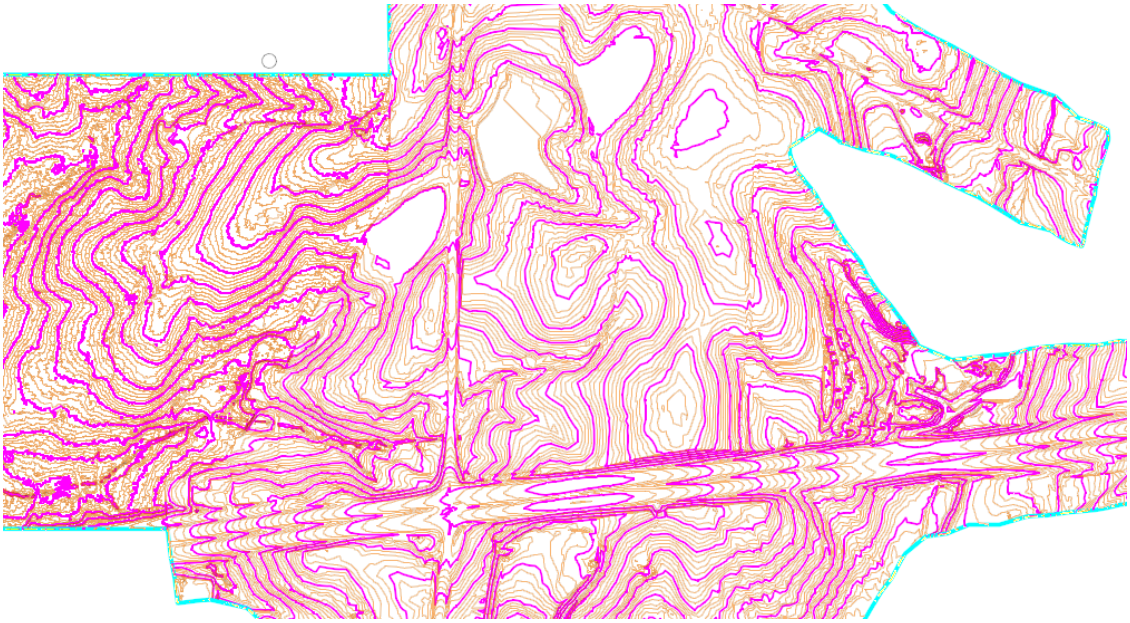
F. Note the progress box showing Processing and Persisting Rule

- During the merge process rules are being persisted similar to the clip boundary process. If the base reference files remain attached any changes to the underlying ETM files will be reflected in the Merged ETM file.



Persisting rules is an important concept that will be used throughout the training modules.

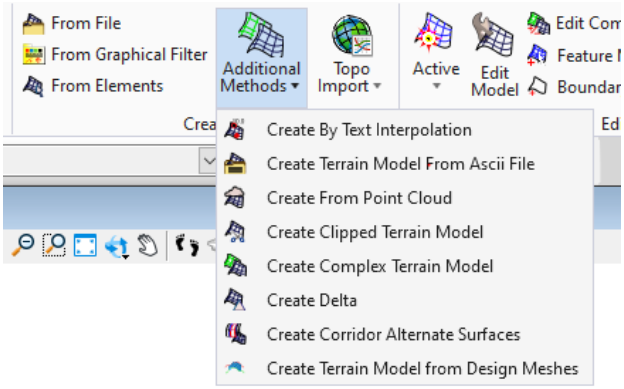
G. Turn off the reference files and you should see a single surface where the LIDAR data has been replaced by the Survey data

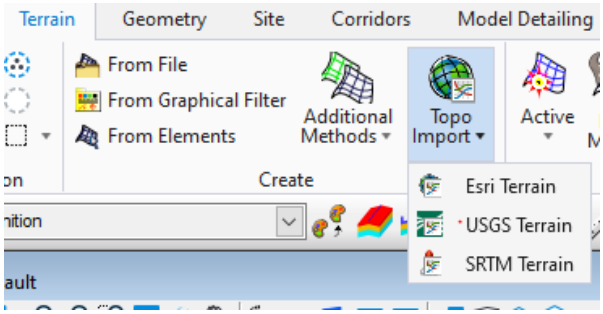


H. This completes the process of merging two Existing Terrain Models together.

Additional Methods – Other Tools

That covers all the basic tools in the *Create* Section of the *Terrain* Ribbon that a roadway designer will likely use. There are several additional tools available in this section located under the **Additional Methods** drop down and the **Topo Import** dropdown. These are more advanced tools that should be reserved for Location and Surveys. It is unlikely that a roadway designer would need to use these tools during normal project development.



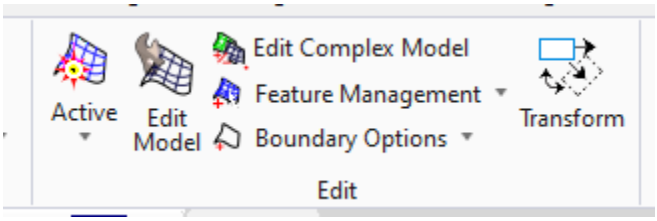


The previous sections were not meant as a way to replace an Existing Terrain Model delivered by Location and Survey, it was meant to show some basic ways to begin a project prior to having Final Surveys provided and to supplement Location and Surveys data when additional coverage is required.

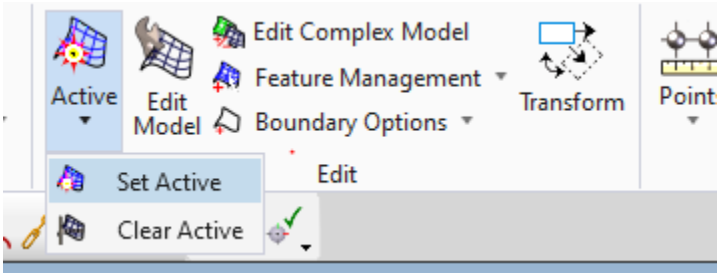
The best surface and the surface used during design should always be a 3d DGN file containing the Existing Terrain model developed by Location and Surveys.

Terrain Ribbon - Edit

The *Edit* Section of the *Terrain* Ribbon contains various tools for editing an Existing Terrain model. There are tools for editing the triangulated model, adding, and removing features and editing the boundary. These tools should all be reserved for the advanced user. The roadway designer will very rarely, if at all, have a use for any of these tools. In addition, the roadway designer should never try to edit an Existing Terrain Model delivered by Location and Surveys.



The only tool within this group that the roadway designer needs to be familiar with are under the **Active** dropdown menu.

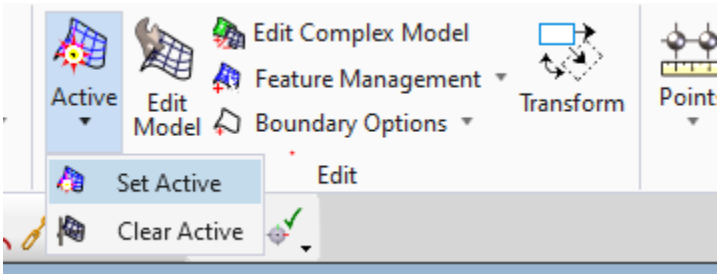


The Set Active and Clear Active tools.

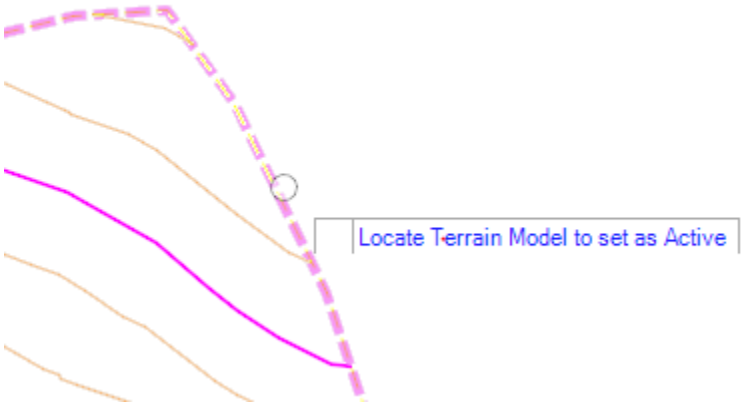
1. **The Set Active Tool**
   A. This tool will be used constantly throughout the design process. This tool is used to tell the program which surface is the Active ground. This can be an Existing Surface or a Proposed Surface. It is the surface that is targeted during the modeling process and is required for the vertical design process.
   B. This tool can be accessed in two ways
      - The dropdown menu shown above
      - The Context Menu

2. Active Model with Dropdown Menu Tools

A. Path to the training folder and open the ***R-2635C_RDY_ETM.dgn*** file
B. Zoom into an edge of the Existing Terrain Model
C. Select the Set Active tool from the Active dropdown menu in the Edit Section of the Terrain Ribbon.

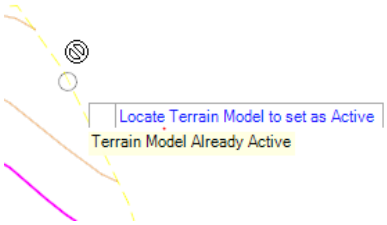


D. At the prompt Left click on the Boundary of the Terrain Model

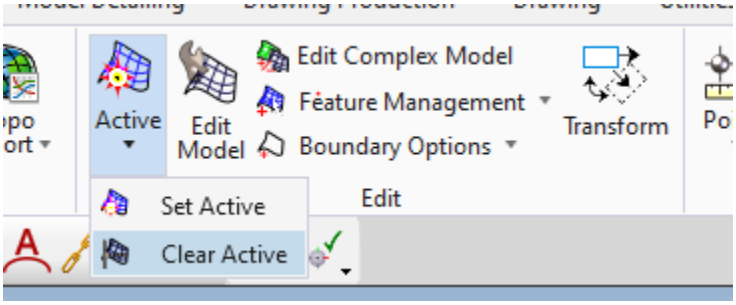


E. This will set the Terrain model to Active.

F. Note that if the user attempts to set a Terrain model Active that is already Active the program will not allow it.



G. To Clear an Active Terrain Model, which will remove the active status and allow the user to select a new Model as Active, select the **Clear Active** tool from the Active dropdown menu in the *Edit* Section of the *Terrain* Ribbon.

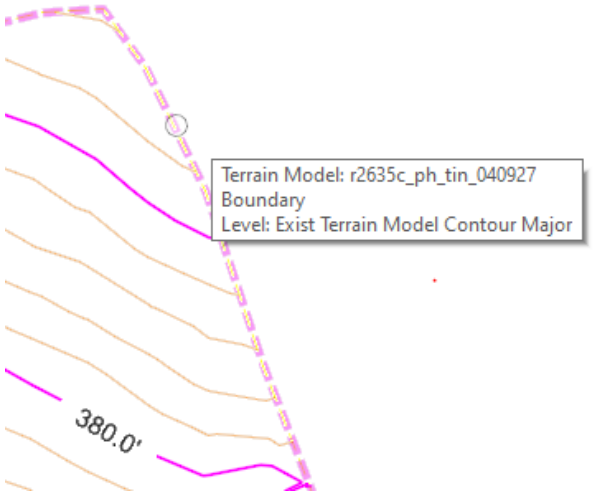


H. The user does not have to select the surface, since there is only one Active surface allowed at any time the Active surface is automatically cleared.

3. Active Model with Context Menu Tools

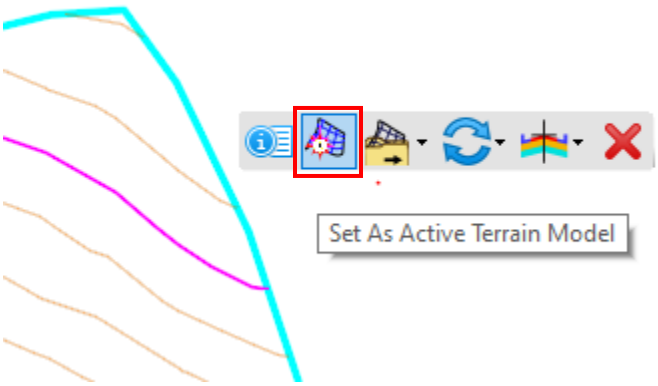
A. To Activate the Context Menu

- Select the element – In this case select the Terrain Boundary

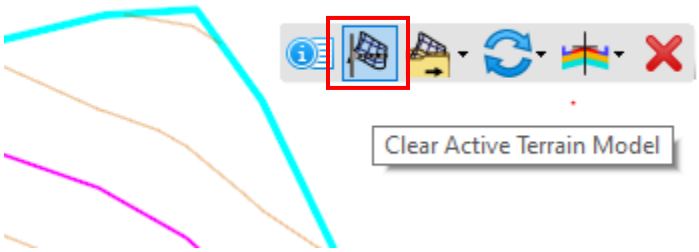


- While the Terrain boundary is highlighted, move the selection tool off the boundary and then back on to the boundary and the Context Menu will appear.

B. From the Context Menu Select **Active**

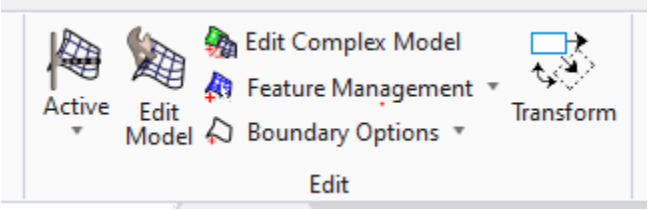


C. No other selection is required, because the terrain had to be selected to activate the context menu, the Set Active tool makes that terrain Active.
D. There is also a **Clear Active** tool in the Context Menu, this toll appears in place of the Set Active tool if an Active Terrain is Selected.
E. Select the Terrain again and move the cursor off and then back to the boundary to activate the Context Menu. The **Clear Active** tool will be visible where the Set Active tool was located.



F. Setting and Active Terrain and Clearing an Active Terrain will be operations that show up repeatedly throughout the design process, they can be performed in the ETM file that contains the 3D Terrain Model or on an ETM file that has been referenced to an alignment or corridor file.

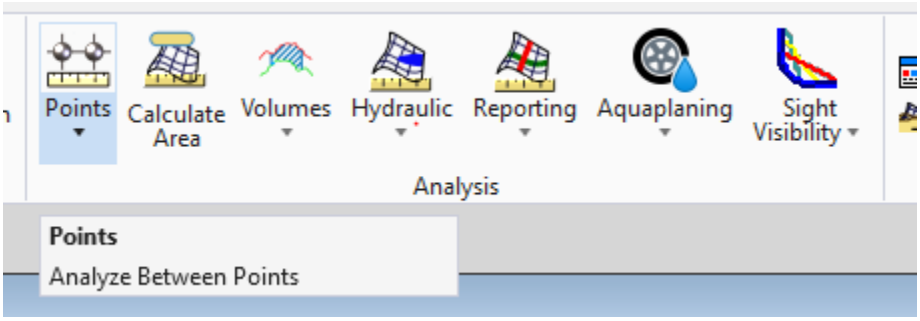
G. The remaining tools under the *Edit* section of the *Terrain* Ribbon are for more Advanced users, primarily Locations and Surveys and will rarely, if ever, be needed by the Roadway Designer.



The roadway designer should never edit a Terrain Model received from Location and Surveys.

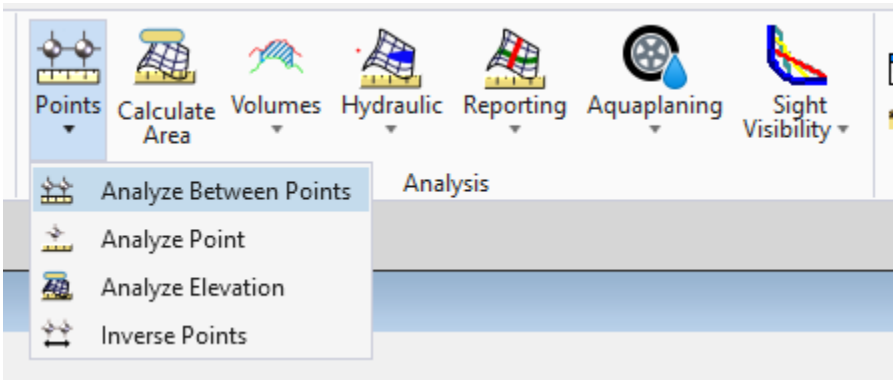
Terrain Ribbon - Analysis

The analysis section of the *Terrain* Ribbon contains various tools used to pull information out of the Terrain Model. Most of these tools will be used during design operation on Proposed Terrain Models and will be covered in other training modules. The section that the roadway designer should be familiar with that will be used on Existing Terrain Models is the Points dropdown menu.

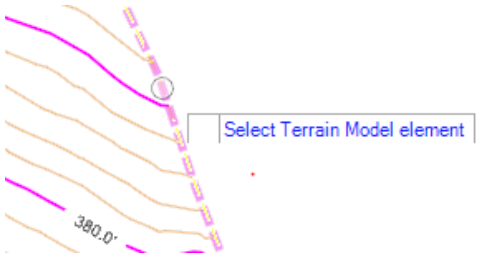


Analysis – Points

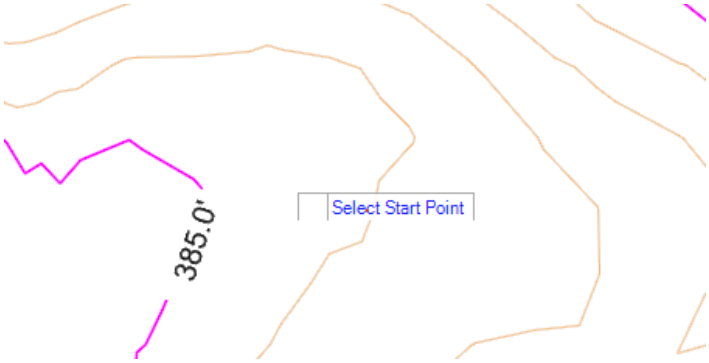
1. **Analyze Between Points**
   A. The **Analyze Between Point** tool will display elevation data and slope data between any two points. This tool could be used to determine existing roadway embankment slopes, existing roadway cross slopes or existing roadway longitudinal slope.
   B. Select the **Analyze Between Points** tool from the Points dropdown menu in the Analysis section of the Terrain Ribbon.



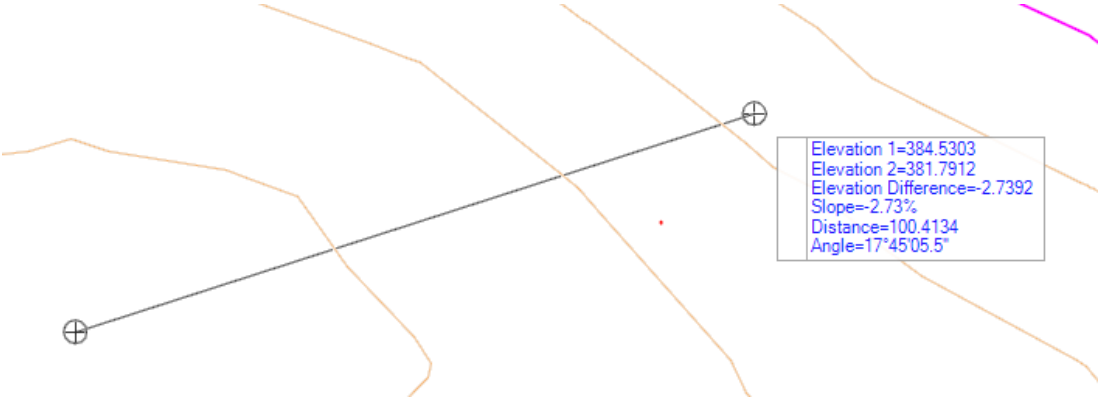
C. At the prompt select the boundary of the existing terrain model



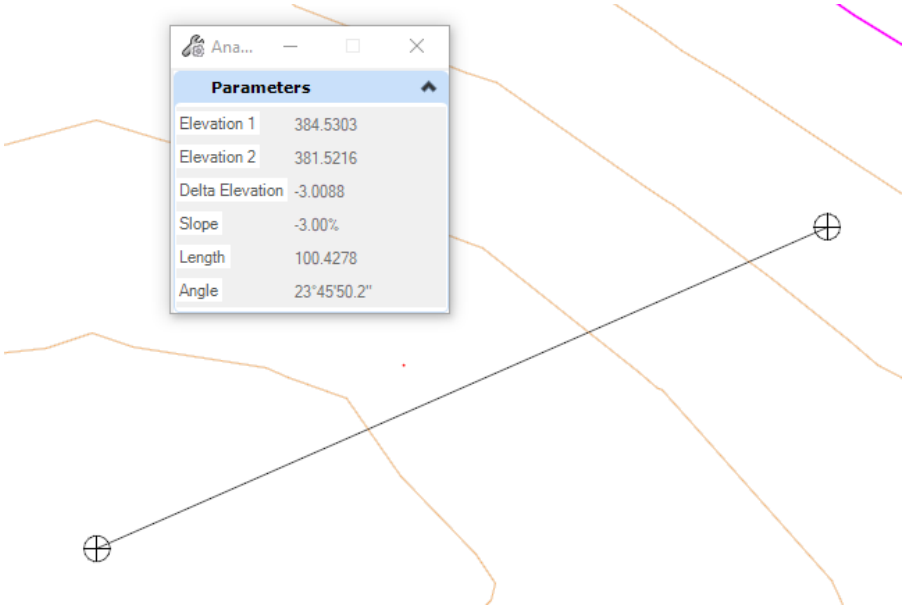
D. Select a Start point by Left Clicking inside the terrain model boundary



E. A pop-up window will display showing dynamic elevation and slope data based on the pointer location.

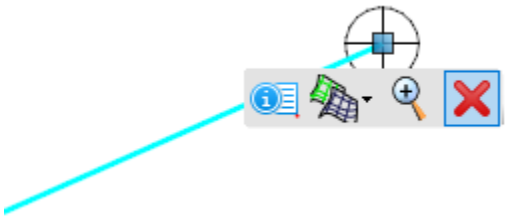


F. Select the second point left clicking inside the terrain model boundary. A line will be drawn in the dgn file that shows the location of the two points and a dialog will appear that shows the relevant elevation and slope data based on those two points.



G. Note that the graphics displayed are permanent graphics and can be removed by using the delete commands. The commands can be accessed on the *Drawing* Ribbon or by activating the context menu>

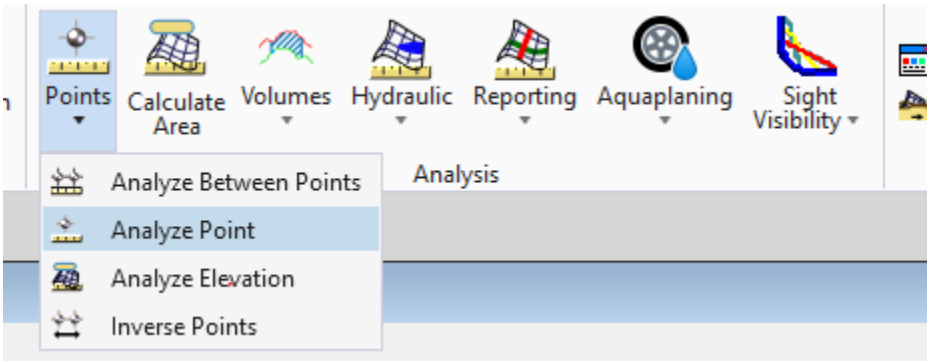
H. Highlight the line that the **Analyze Between Points** tool placed in the dgn file. Move the cursor off and then back onto the line to activate the Context Menu. Select the delete tool to remove the line from the dgn file.



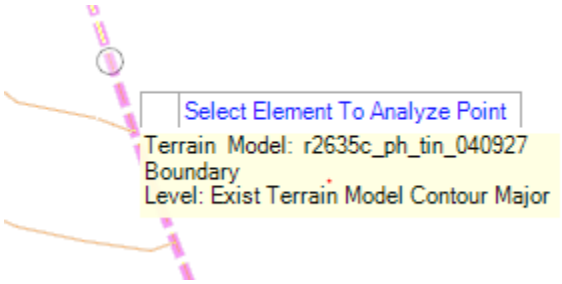
2. Analyze Point

A. The **Analyze Point** tool is very similar to the Analyze Between Points tool.

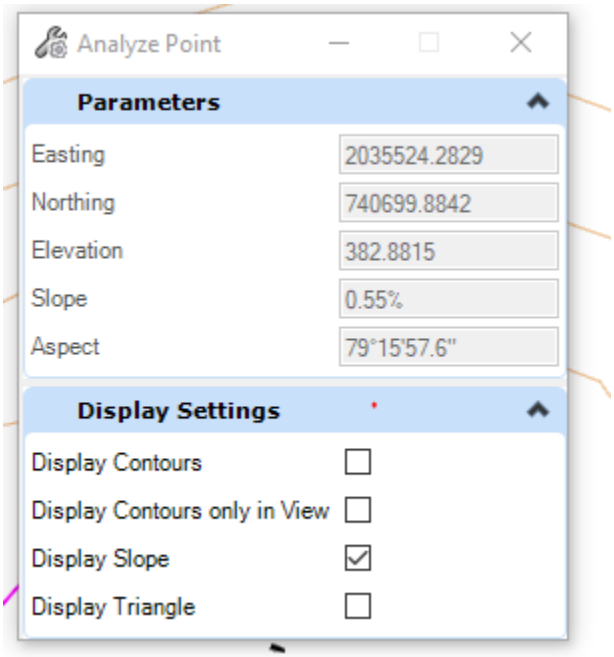
B. Select the **Analyze Point** tool from the **Points** dropdown on the *Analysis* Section of the *Terrain* Ribbon.



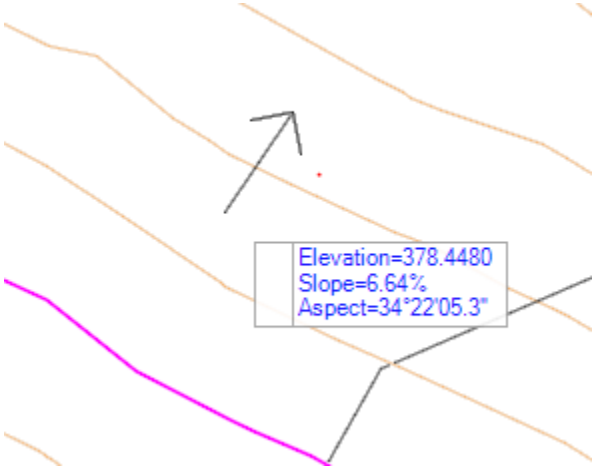
C. At the prompt select the existing terrain boundary



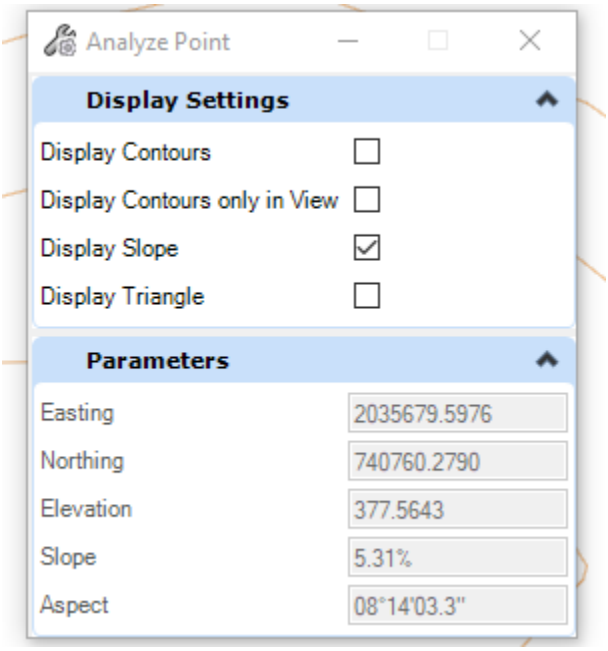
D. A dialog will display showing Display Setting for the graphics that will be drawn into the file and the parameters displayed for the point to be analyzed.



E. A pop-up window will display that will dynamically display the Elevation, Slope and Aspect. (The Aspect is the angular direction of the Slope based on True North as 0)



F. Left Click to select the point and the Dialog Box will show the relative information.



3. Other Analysis Tools

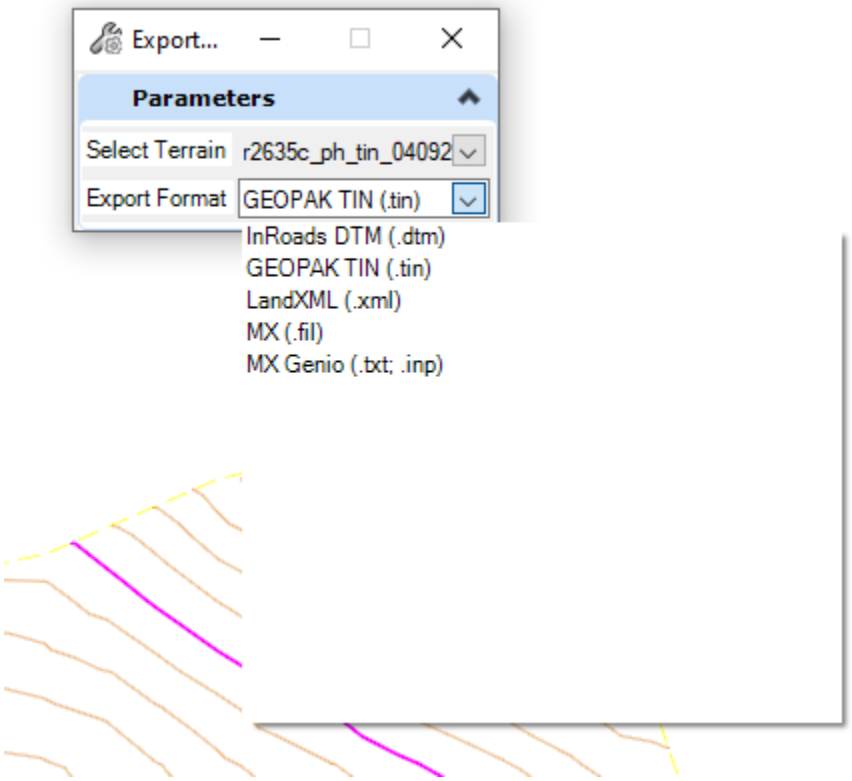
The remaining tools in the *Analysis* Section of the *Terrain* Ribbon will either be covered during other training modules or are tools that will rarely be used by a roadway designer.

Terrain Ribbon - Miscellaneous

The *Miscellaneous* Section of the *Terrain* Ribbon contains two tools.

The **Graphical Filter Manager** is an advanced tool that would only be used by Location and Surveys.

The **Export to File** Tool is a very simple tool where the user selects the terrain to export by selecting the boundary element and then selecting the format to export.

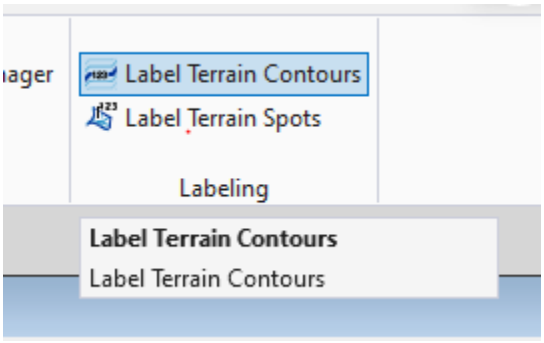


This may be a tool the roadway designer would use but it be in special circumstances.

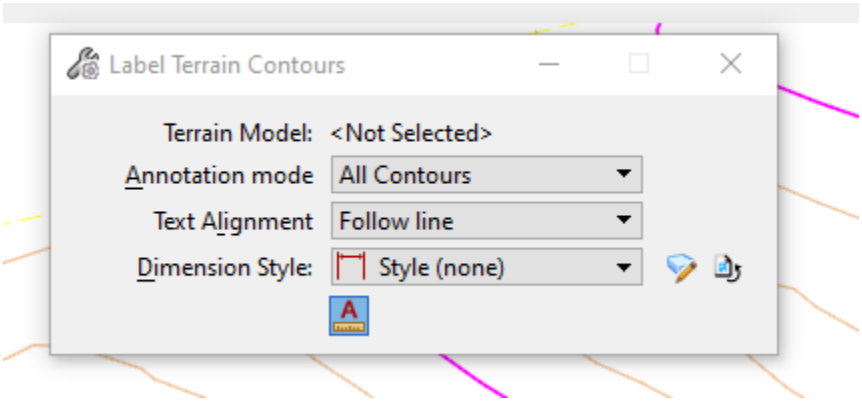
Terrain Ribbon - Labeling

The *Labeling* Section of the *Terrain* Ribbon contains two tools used to label contour elevations and spot elevations. The roadway designer may use these during preliminary plan development for delivery to the hydraulics unit.

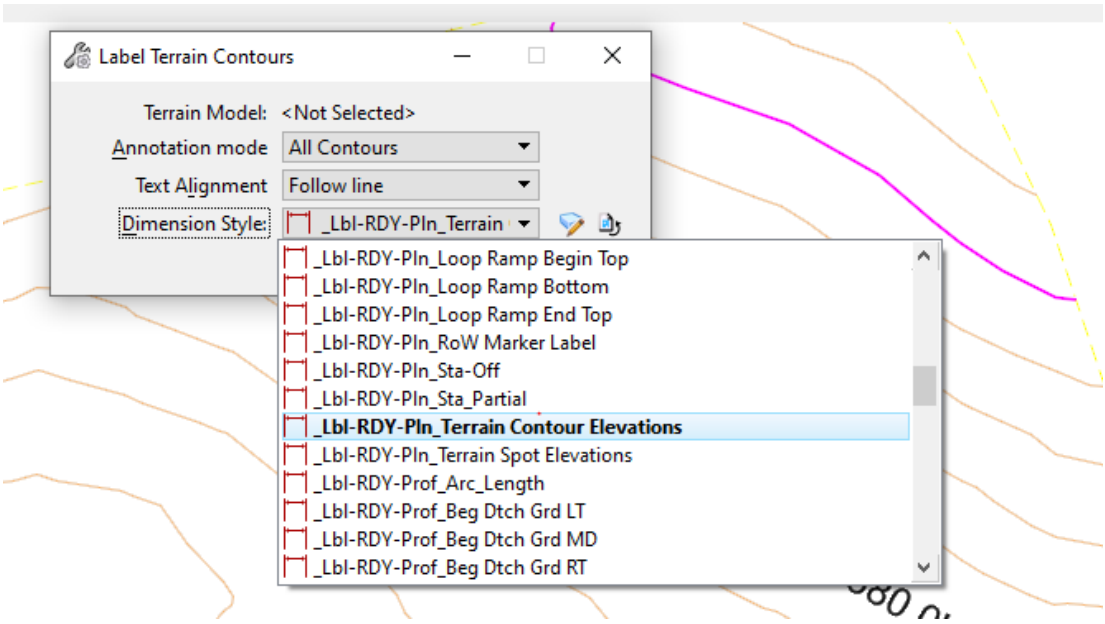
1. **Label Terrain Contours**
   A. Select the **Label Terrain Contours** tool from the *Labeling* Section of the *Terrain* Ribbon



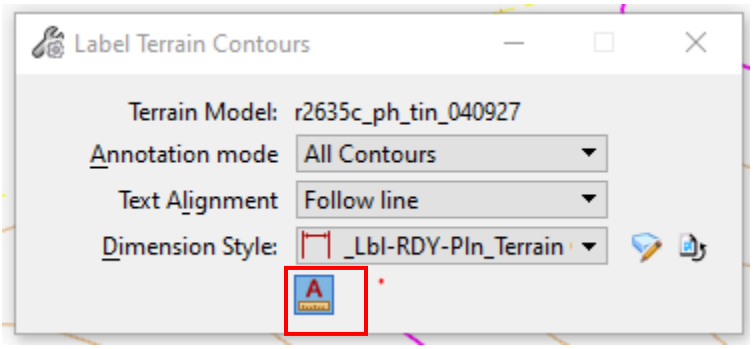
   B. The Label Terrain Contours dialog box will appear



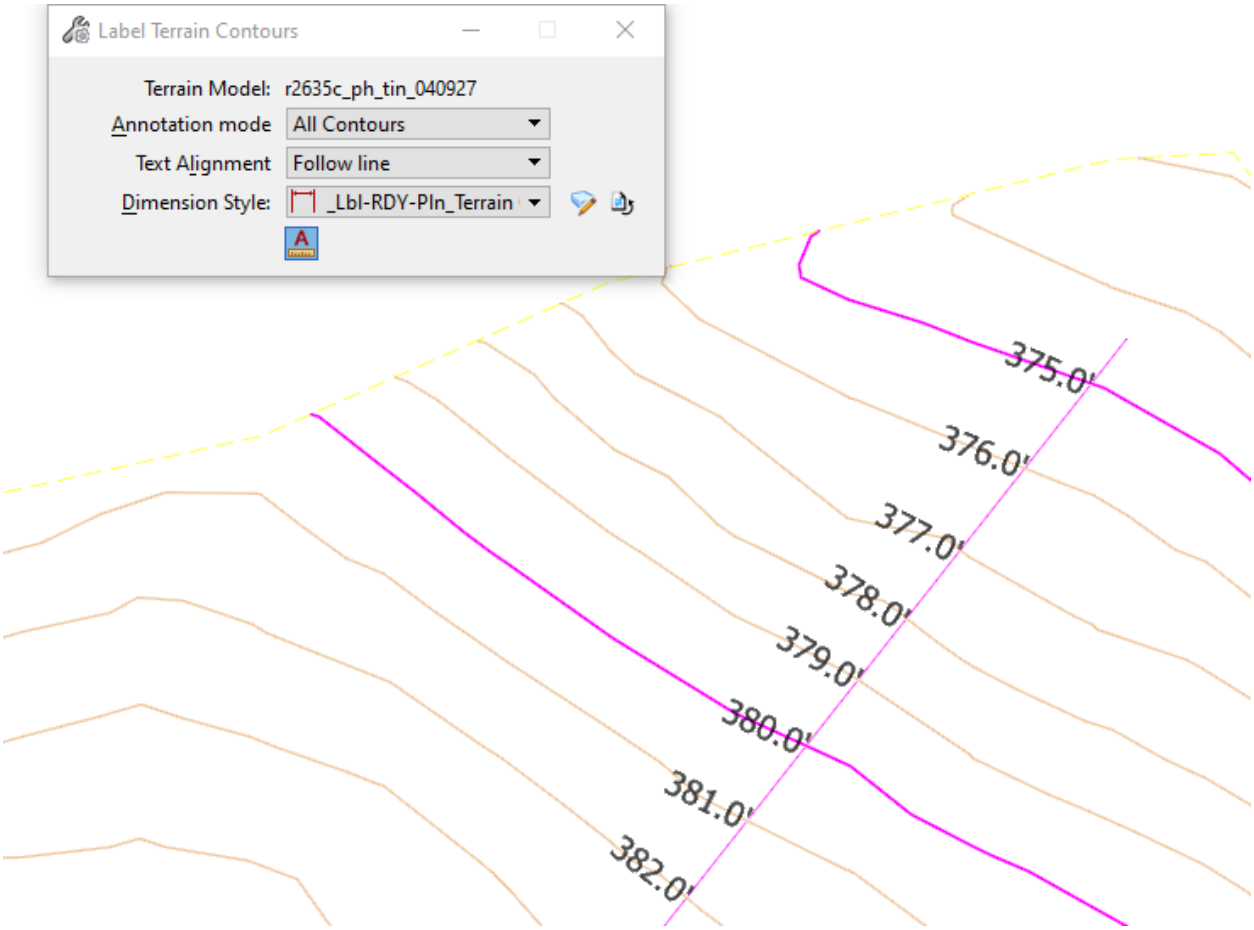
C. The first step is to set the Dimension Style to *_Lbl-RDY-Pln_Terrain Contour Elevations*
   - This dimension style will set the Text Size and Font. This also needs to be the first step, each time a new Dimension Style is selected it resets the Terrain model selection.



D. Next select the Terrain Model by selecting the terrain boundary
E. Set Annotation Mode to All Contours and Text Alignment to *Follow Line*
F. Set the Annotation Scale Lock to *On.*



G. Select a beginning and ending point for the labels. Note that the direction of the selected points affects the orientation of the text



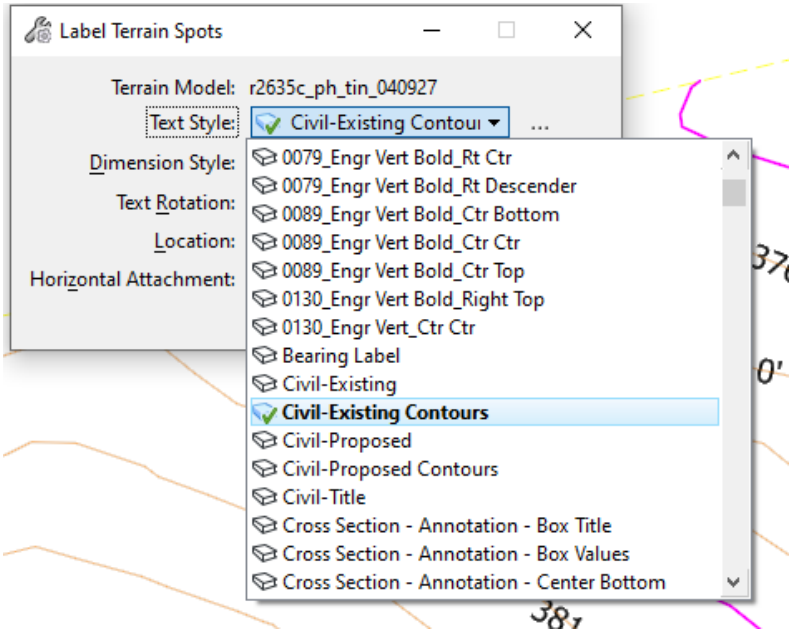
These elevation labels will be drawn into the dgn file.

2. Label Terrain Spots

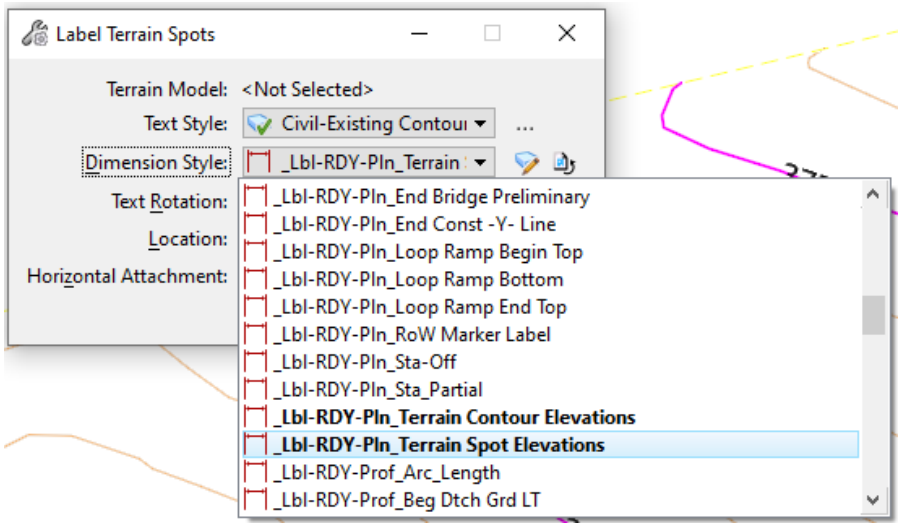
A. This tool is very similar to the Label Terrain Contours tool

B. Select the **Label Terrain Spots** tool from the *Labeling* Section of the *Terrain* Ribbon.

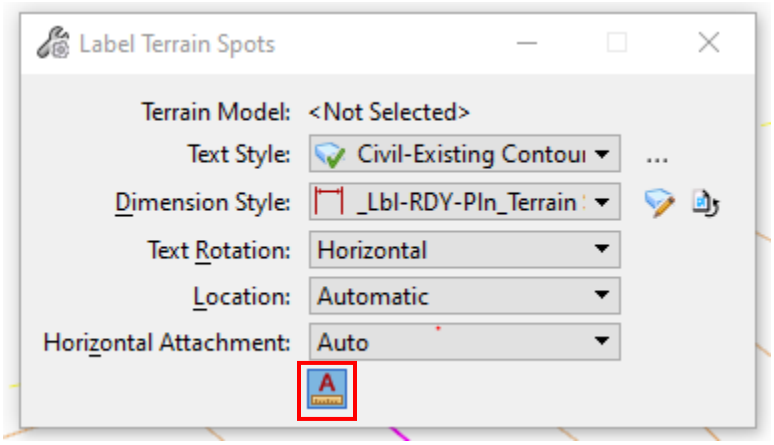
C. When the dialog box appears set the Text Style to *Civil-Existing Contours*



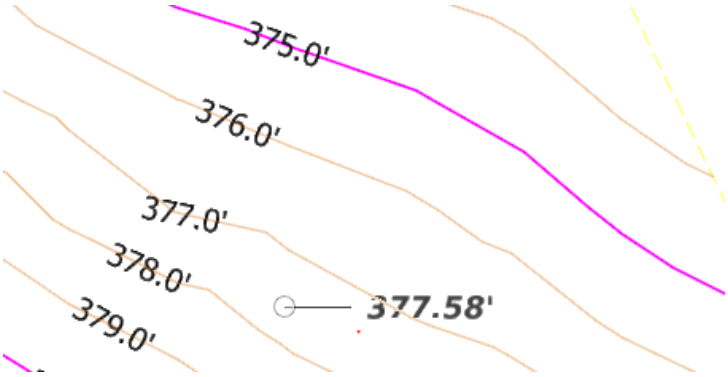
D. Set the Dimension Style to *_Lbl-RDY-Pln_Terrain Spot Elevations*



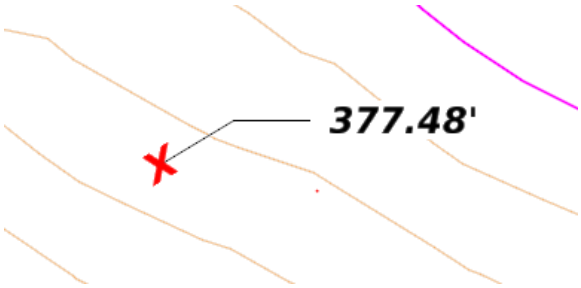
E. Set the Text Rotation to *Horizontal*
F. Set the Location to *Automatic*
G. Set the Horizontal Attachment to *Auto*
H. Set the Annotation Scale Lock to *ON*



I. Select the Terrain Model and a dynamic display of the elevation at the cursor location will appear.



J. Left Clicking will add this elevation label to the dgn file.



Conclusion

This module should provide the typical roadway designer with all the tools required to work with Existing Terrain Models. The information presented in this Module is not intended for advanced users from Location and Surveys. The training in this module is not meant to replace the 3D dgn containing the Project Design Existing Terrain Model that the roadway designer will receive from Location and Surveys.

This Module is intended to provide some basic skills that the roadway designer can utilize to begin conceptual level design and supplement data received from Locations and Surveys when necessary. None of these tools or methods should be used on a 3D dgn file received from Locations and Surveys.

It is the responsibility of the roadway designer to understand the quality of the data and how to interpret the results.