OpenRoads Designer Best Practice – *Terrain Modeling*

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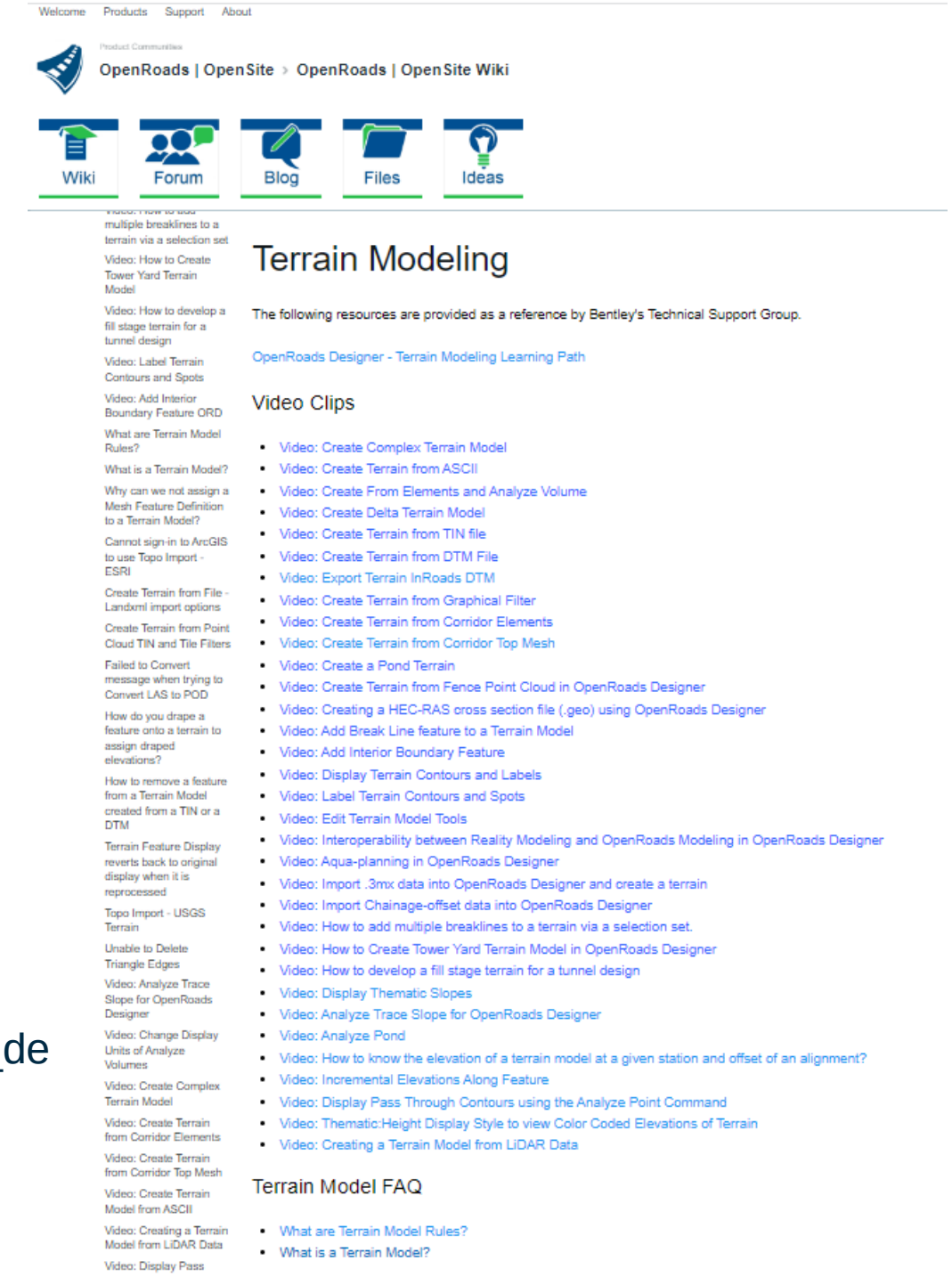
Bentley® Advancing Infrastructure


FAQ

Don’t forget to check the communities

https://communities.bentley.com/products/road___site_design/w/road_and_site_design__wiki/35093/terrain-modeling



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Agenda

- *FAQ*
  - *First things first – terrain fundamentals*
  - *Terrain Considerations*
  - Terrains from Point Cloud Data
  - *LandXML Import Options*
  - *Terrain Rules*
  - *Boundary Options*
  - *Terrains from Corridors*
  - *Image Draping*

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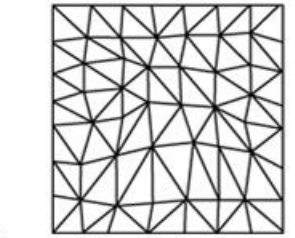
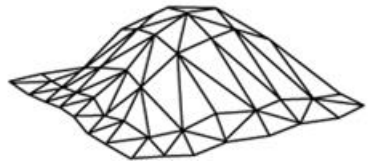
First things first – some terrain fundamentals

What is a Terrain and what are it’s limitations?

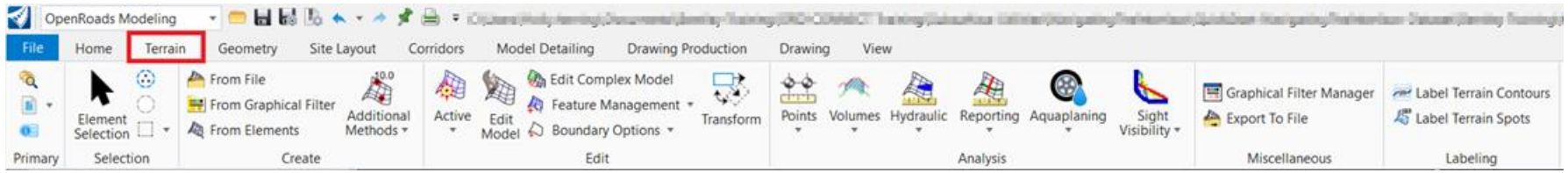
A terrain model is a set of **three-dimensional triangles** mathematically computed from point data collected on the surface being modelled. Also referred to as digital terrain models (DTMs), triangulated irregular networks (TINs), or triangulated surfaces.





MicroStation Terrain vs. OpenRoads Terrain

Think view vrs Create, Edit and View. With Openroads providing a wide variety of creation and edit tools.



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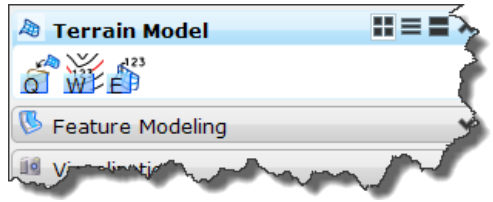
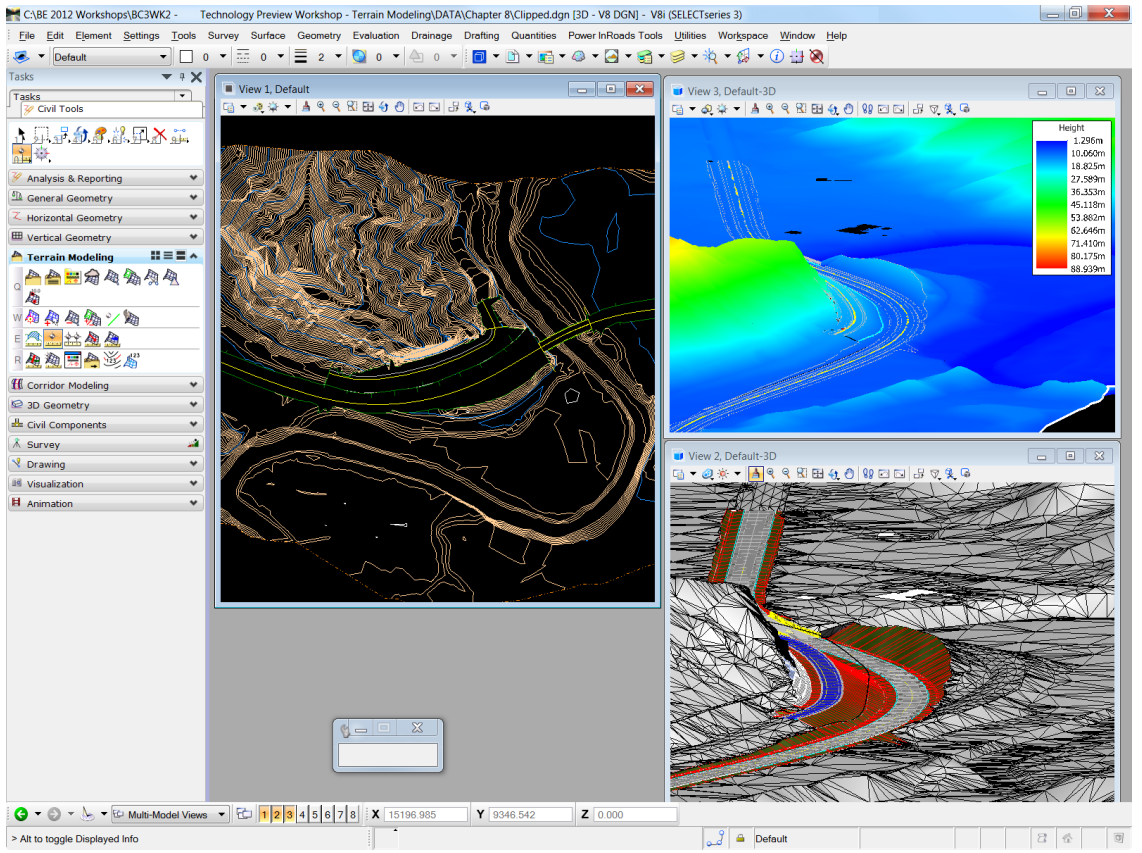
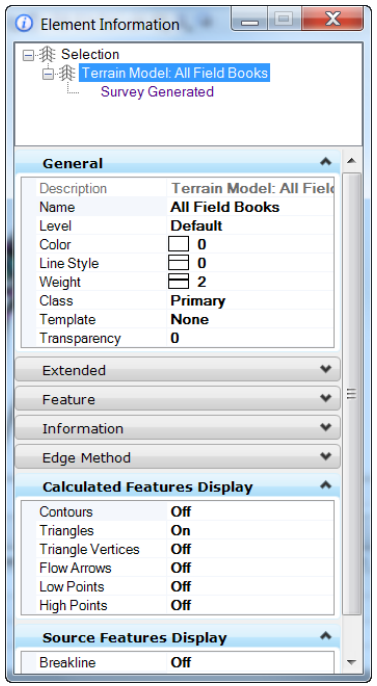
The OpenRoads Terrain



Introduced with V8i SELECTseries 3, MicroStation supported a new Terrain element type, creation methods and new display capability

- *LandXML import*
- *Element Templates*
- *Display Themes*
- *Annotation tools*





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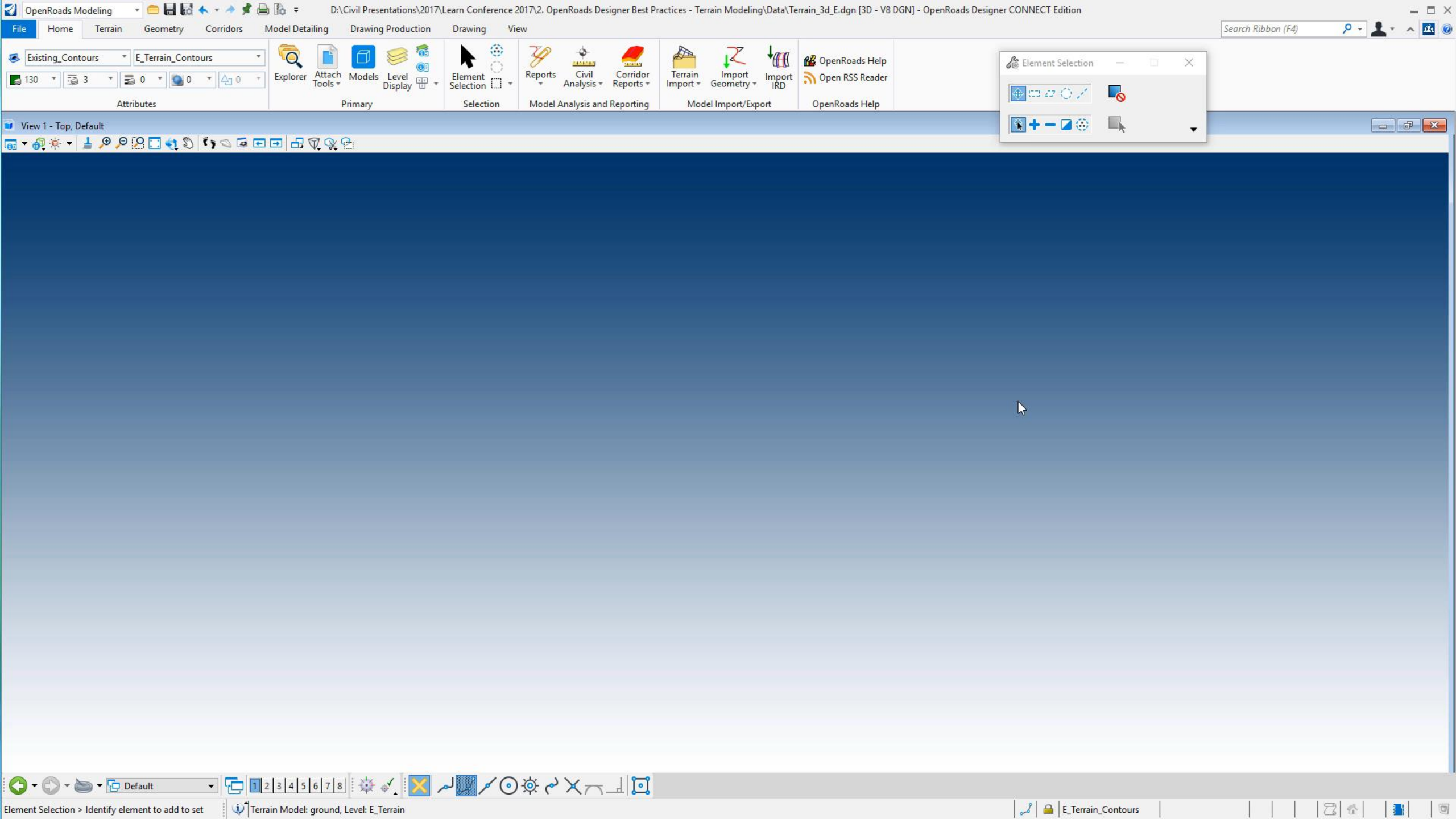
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Import IRD
Model Import/Export
OpenRoads Help
Open RSS Reader
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Element Selection
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Default
Element Selection > Identify element to add to set
Terrain Model: ground, Level: E_Terrain
E_Terrain_Contours

Then why do we need terrain features?

Whereas Element Templates allow you to control the Symbology of a terrain, terrain feature definitions give you additional properties.

- *Surface Volume Type*
  - *None, Design, Existing, Subgrade, Substrata*
- *2D vs. 3D vs. Profile symbologies*
- *Annotation tools*

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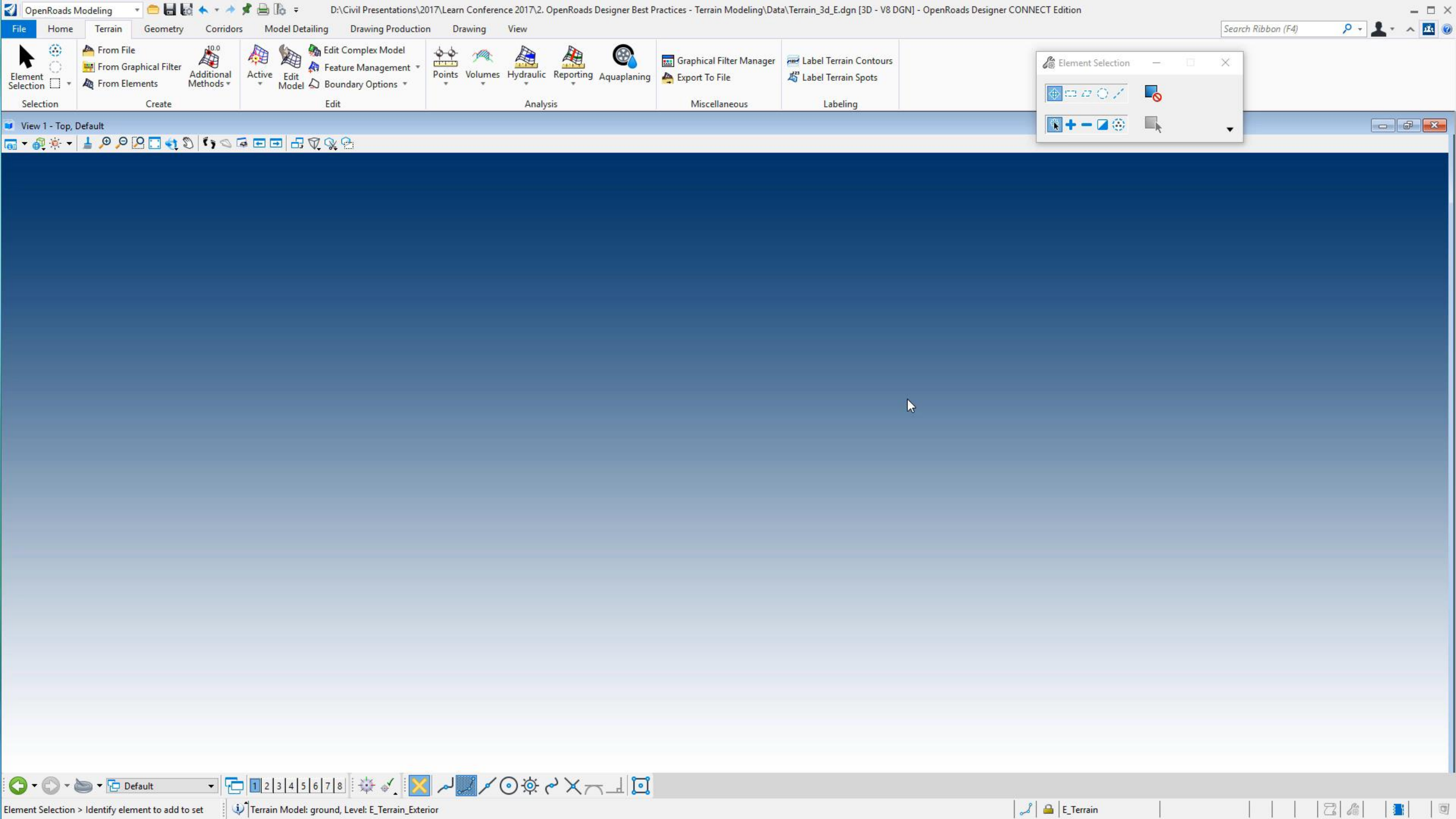
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E_Terrain

Best Practice

The preferred method is to **use Terrain Features to control your terrains**, **not the element templates directly**.

You can overwrite a Terrain Feature symbology with an Element Template.

However, keep in mind that if the terrain regenerates itself for some reasons (*e.g. change boundary option*), it will revert back to it's original symbology.

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Terrain Considerations

Terrain considerations - The 64 Bit Difference

In SS4, which is a 32 bit application, there are essentially limitations on the size of terrains that can be used.

- *Typically 10 Million points is considered the celing which creates a DGN file @ 300 mb*

In Connect, which is a 64 bit application, those limitations are '*removed*'

- Terrains can be much, much larger – but consider the use / performance ….
- How large depends on how much memory you have on your machine.
- How they operate graphically (e.g. *rendering*, *rotating*, etc.) will depend on your graphics card.

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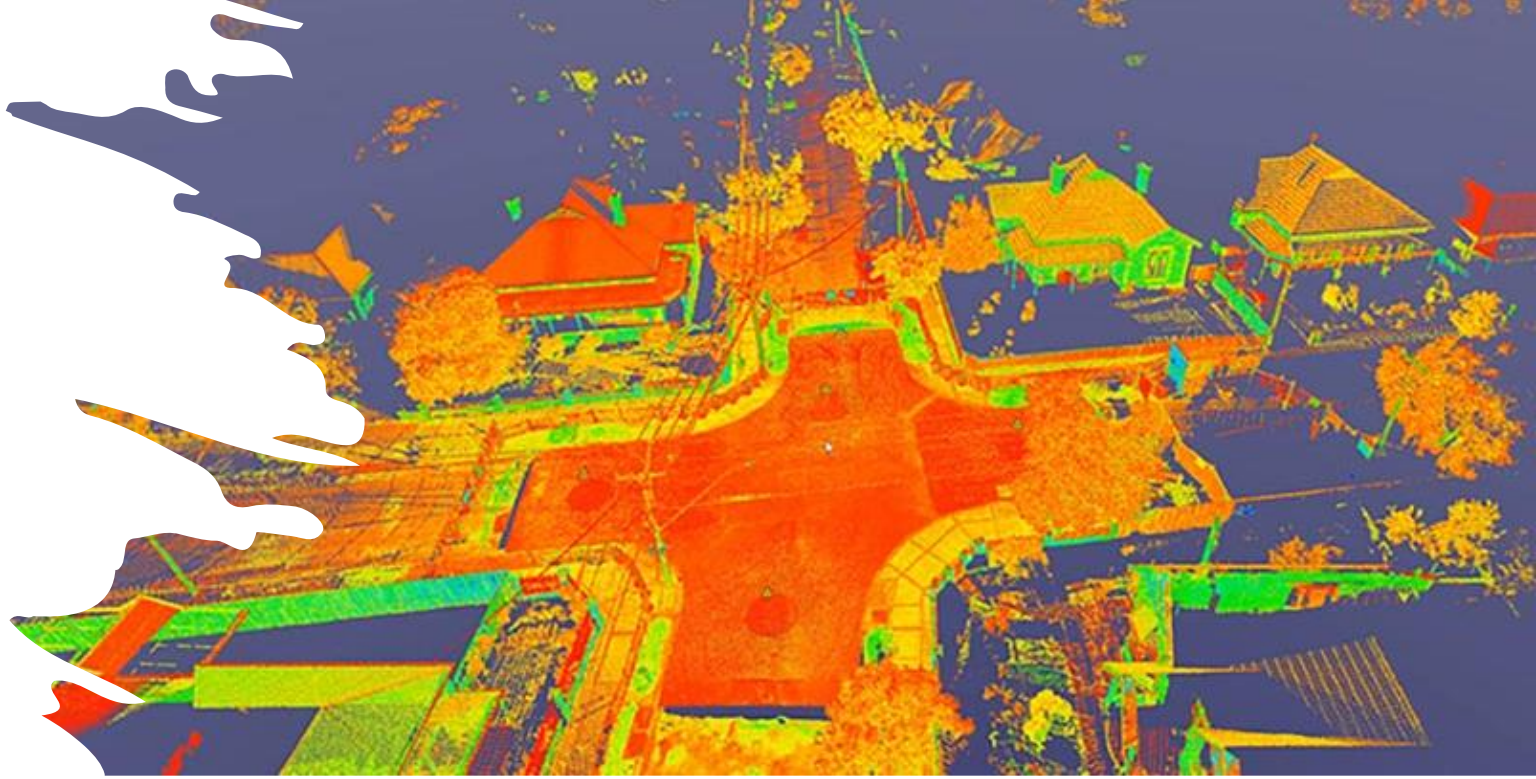
What problems would real world models like these present for terrains ?

Terrain imitations and considerations



Surface Aspects

Vertical Faces and **Over Hangs** are not supported since Terrains are a ‘top down’. Note meshes can represent these.

Consider using / creating boundaries

Size (number of points)

Terrains are heavy on data and are susceptible to performance issues, especially when *ruled** (more on this later)

Consider **point density** and potential source data thinning to achieve a good terrain

Best Practice

Don’t forget - use a 3D seed file

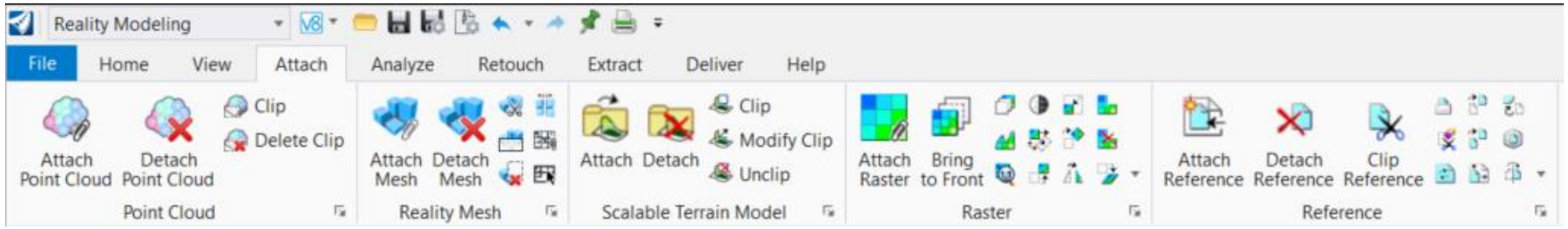
We need to be aware of how terrains work in 2d files. Civil manage the terrain in a 2D file and automatically create the 3D and resolve the referencing, but this can add some referencing complications down the line. Best avoid and work from just a 3D file where possible (the same goes for survey).

Terrains from Point Cloud Data

Terrains from Point Cloud Data

Attaching Point cloud data is similar to referencing

Point Clouds provide efficient display of large amounts of data using the native file format, POD is the default / preferred, but other supported files types are available



The example we have 16 POD file that each contain @5million classified points,

representing @ 1 mile of dual carriageway, So this is @80million points

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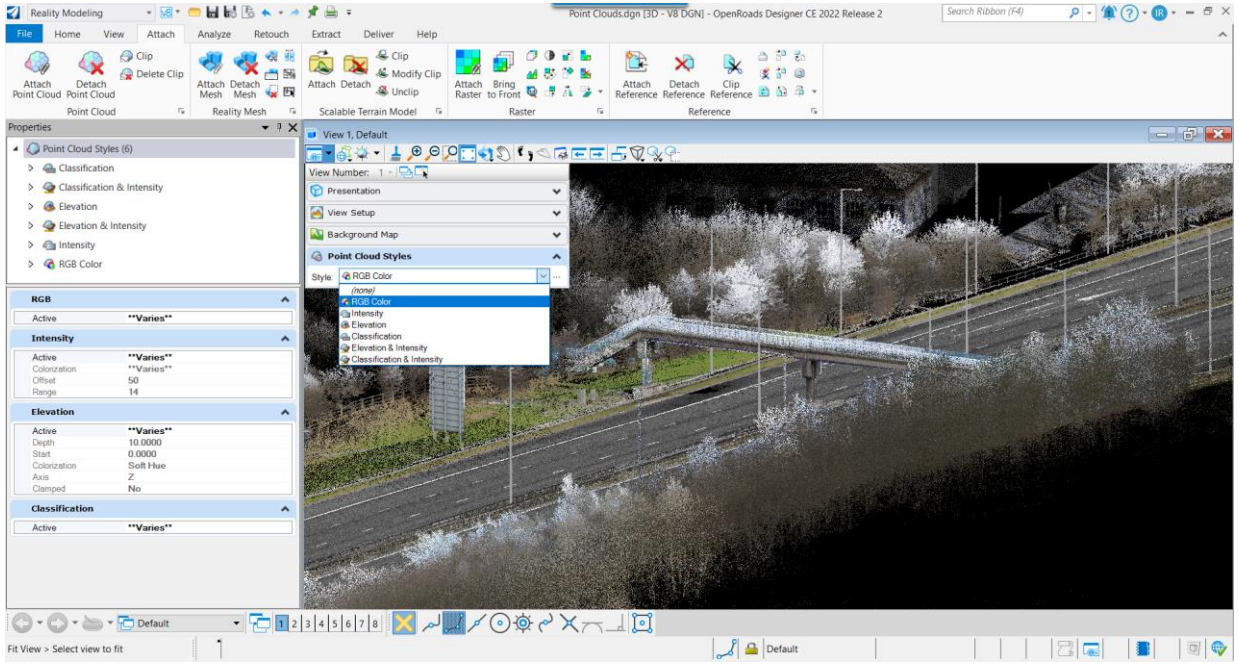
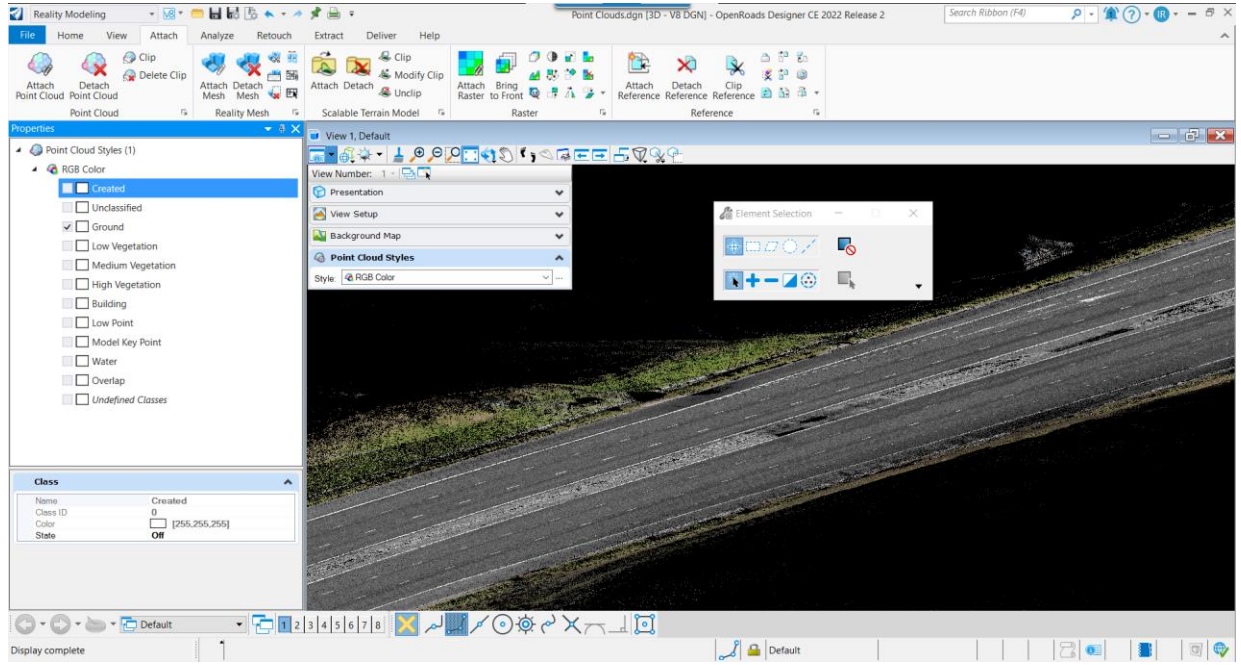
Terrains from Point Cloud Data

Display is controlled by ‘Point cloud styles’, that when applied can also be used to filter the displayed content and aid in import to terrains.





The same data displayed with RGB selections off

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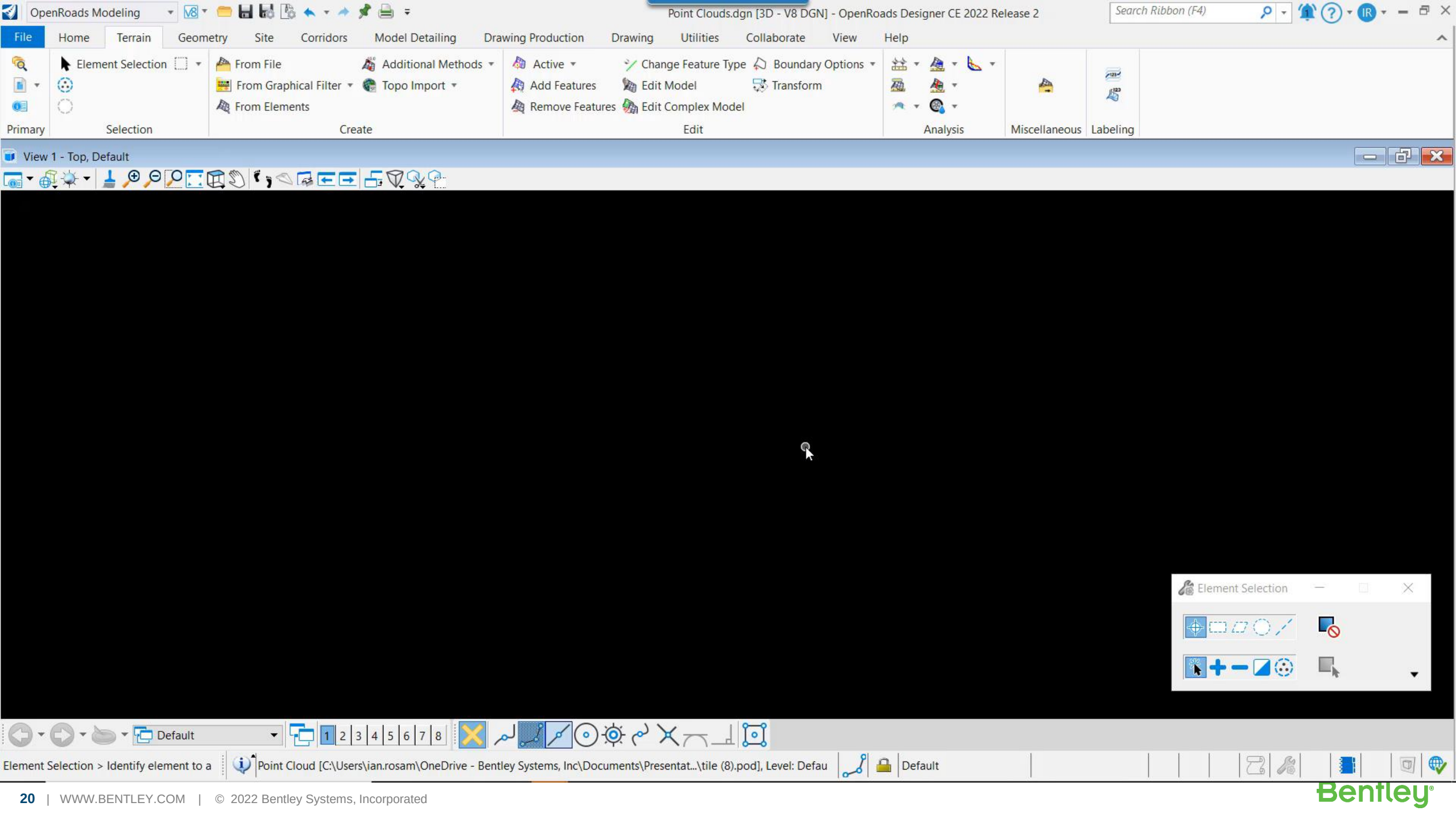
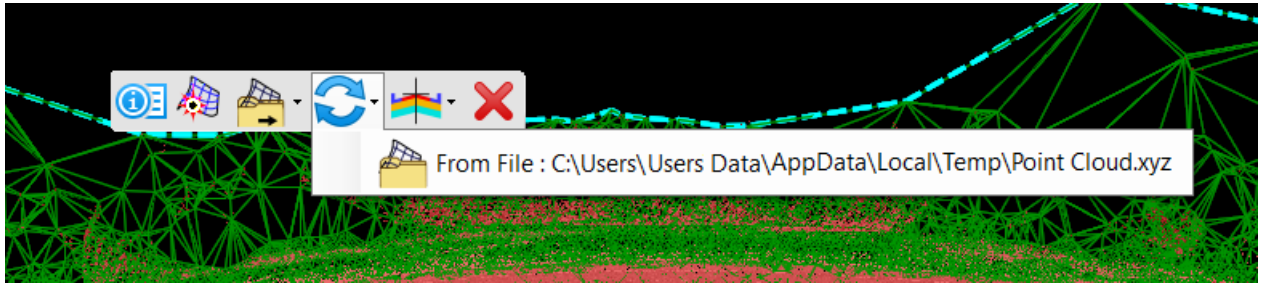


Best Practice

Use Classifications to control display and limit what is brought in.

Test Filters and adjust to data as no one size fits all

Import from point clouds creates a **ruled** terrain



Keeping this file might be a good idea ☺

Edit resulting terrain and consider creating a manual boundary to refine the result

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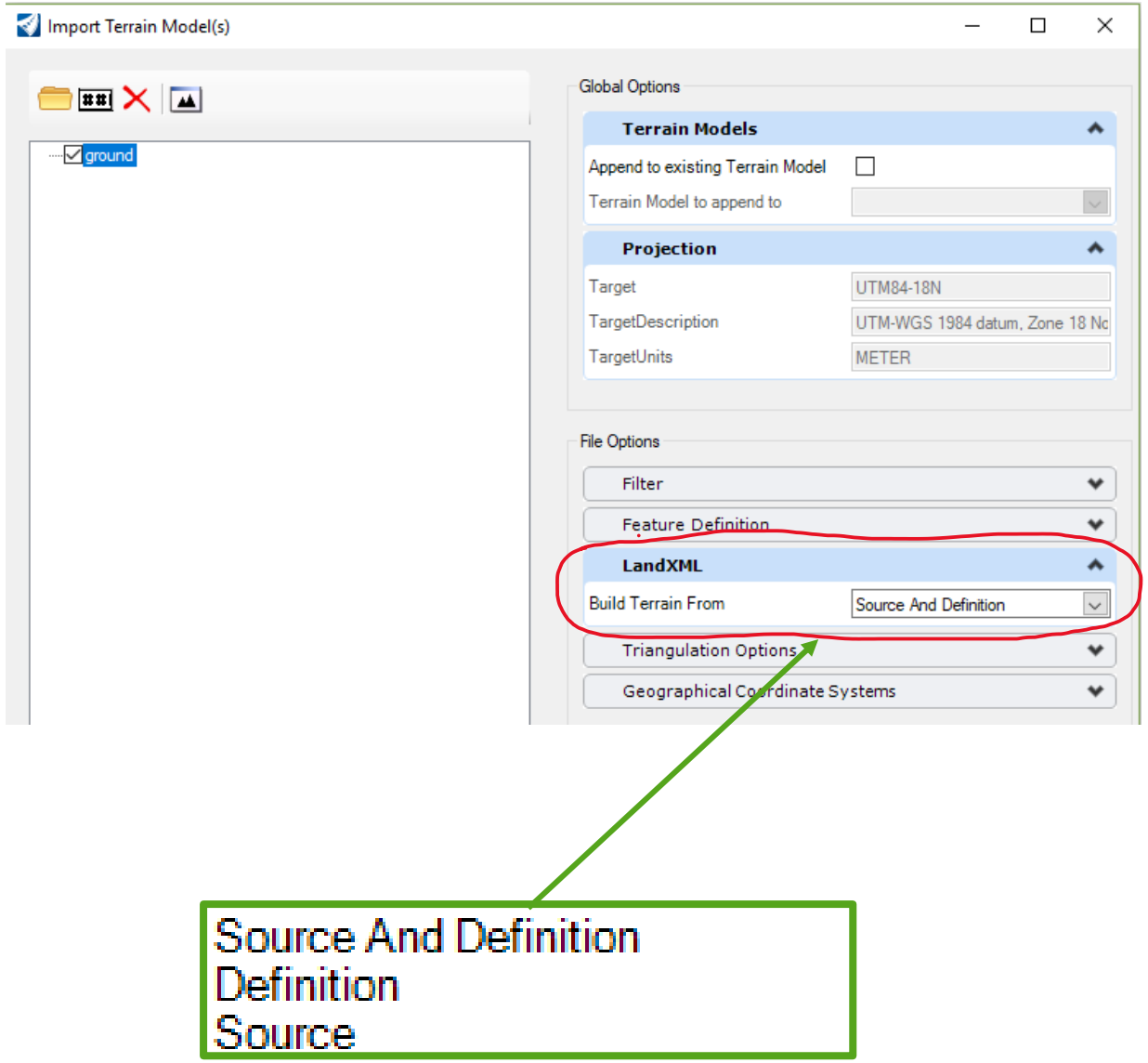
LandXML Import Options

LandXML Import Options

- ***Definition***
  - Utilizes the stored triangulated faces to define the Terrain
- ***Source***
  - Utilizes survey features such as breaklines, voids and points, then triangulates
- ***Source and Definition*** (default)
  - Utilizes both in creating the terrain and resolves
- ***Unique to LandXML***



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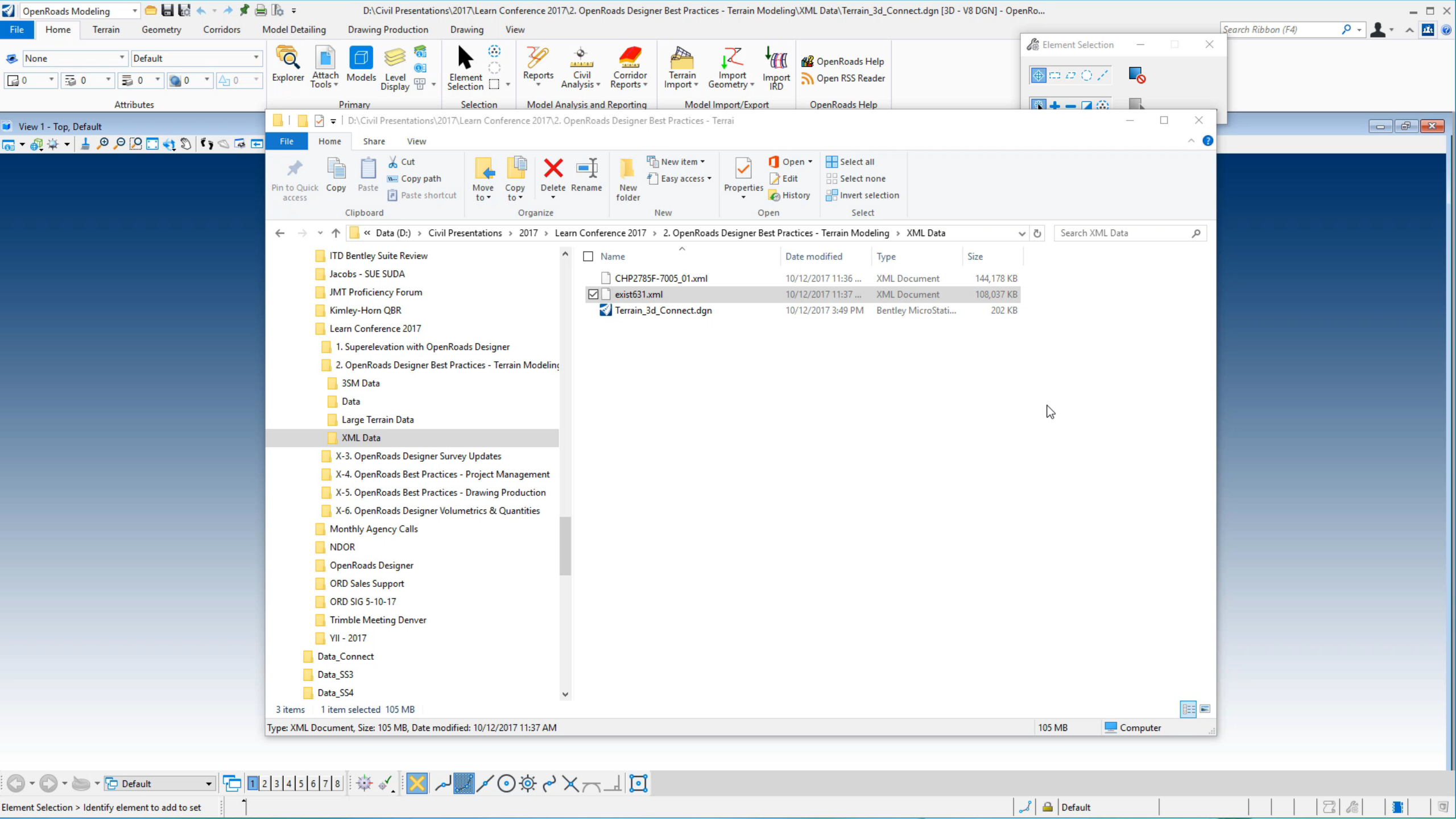
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Best Practice

The method used will usually depend on the file and the situation.

If you do not want to re-triangulate (*i.e you want to duplicate the triangles from the terrain that generated the LandXML file*), then use the Definition method.

Otherwise, the default (and recommended method) is to use Source and Definition. This does re-triangulate, but uses both triangles and source data to produce a “best” triangulation.

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Terrain Rules

Terrain Rules

- Civil adds ‘intelligence’ by ruling the terrain. This in effect creates a link between the terrain and the data/information used to create it.
- This rule capability comes in two forms:
  - **Dynamic**
    - Terrain model automatically updates when it’s informed that a dependent element has changed.
  - **Static**
    - Terrain model has a link to it’s original data, but must be manually updated.

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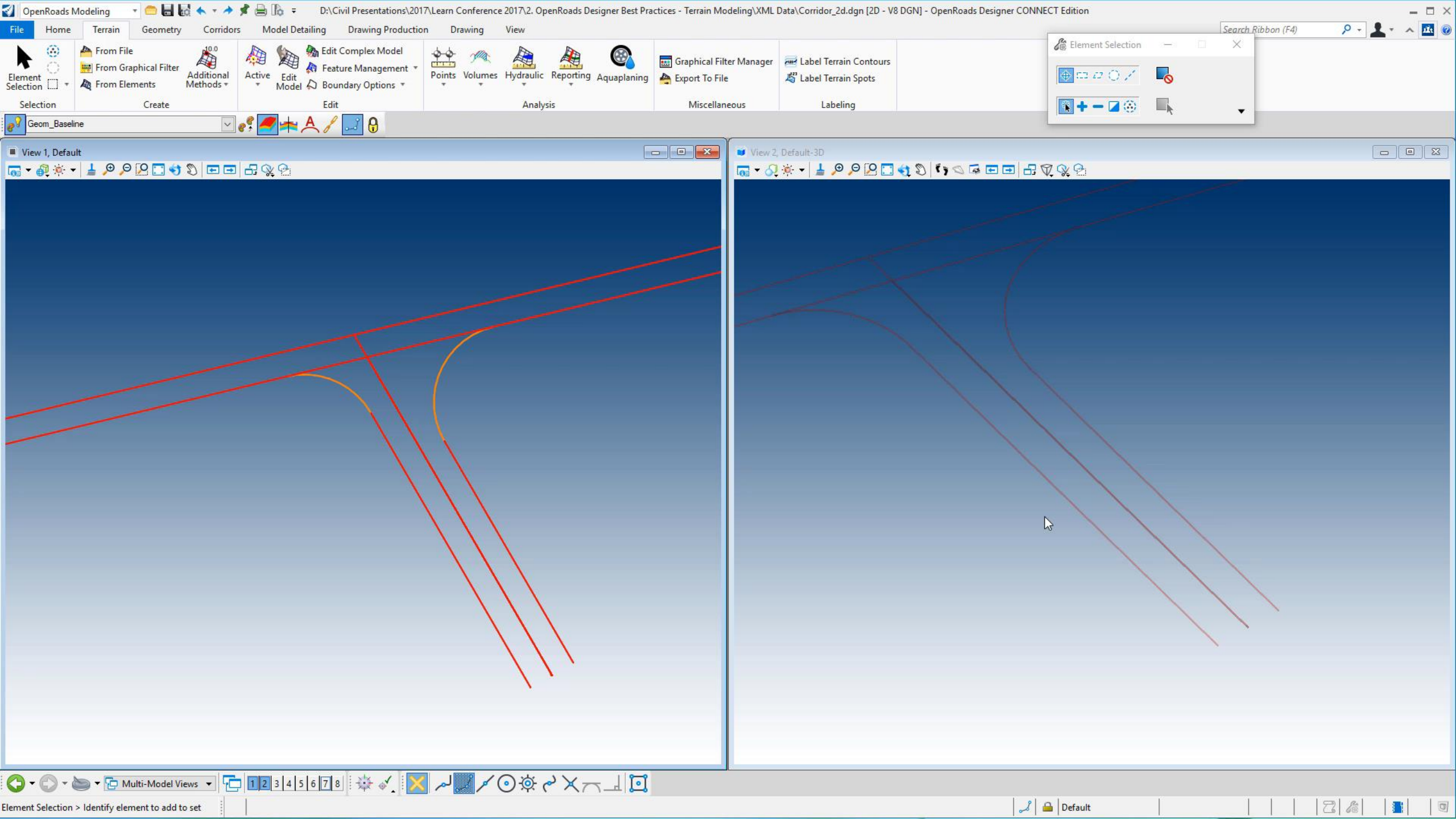
Dynamic Rules

- Created by
  - Survey; Create from Elements; Complex Terrains; Clipped Terrains; Delta Terrains
- **Advantages**
  - Always up to date
  - Essential in site modeling type situations
- **Disadvantages**
  - Performance overhead for large amount of rules
  - Individually ruled elements limited to 10,000 (pre-checked)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Static Rules

- Created by
  - Import from file; Ascii import; Graphical Filters; Point Clouds; Text Interpolation
- **Advantages**
  - User decision when to update
  - Overcomes overhead for large amount of rules
- **Disadvantages**
  - No change management notification

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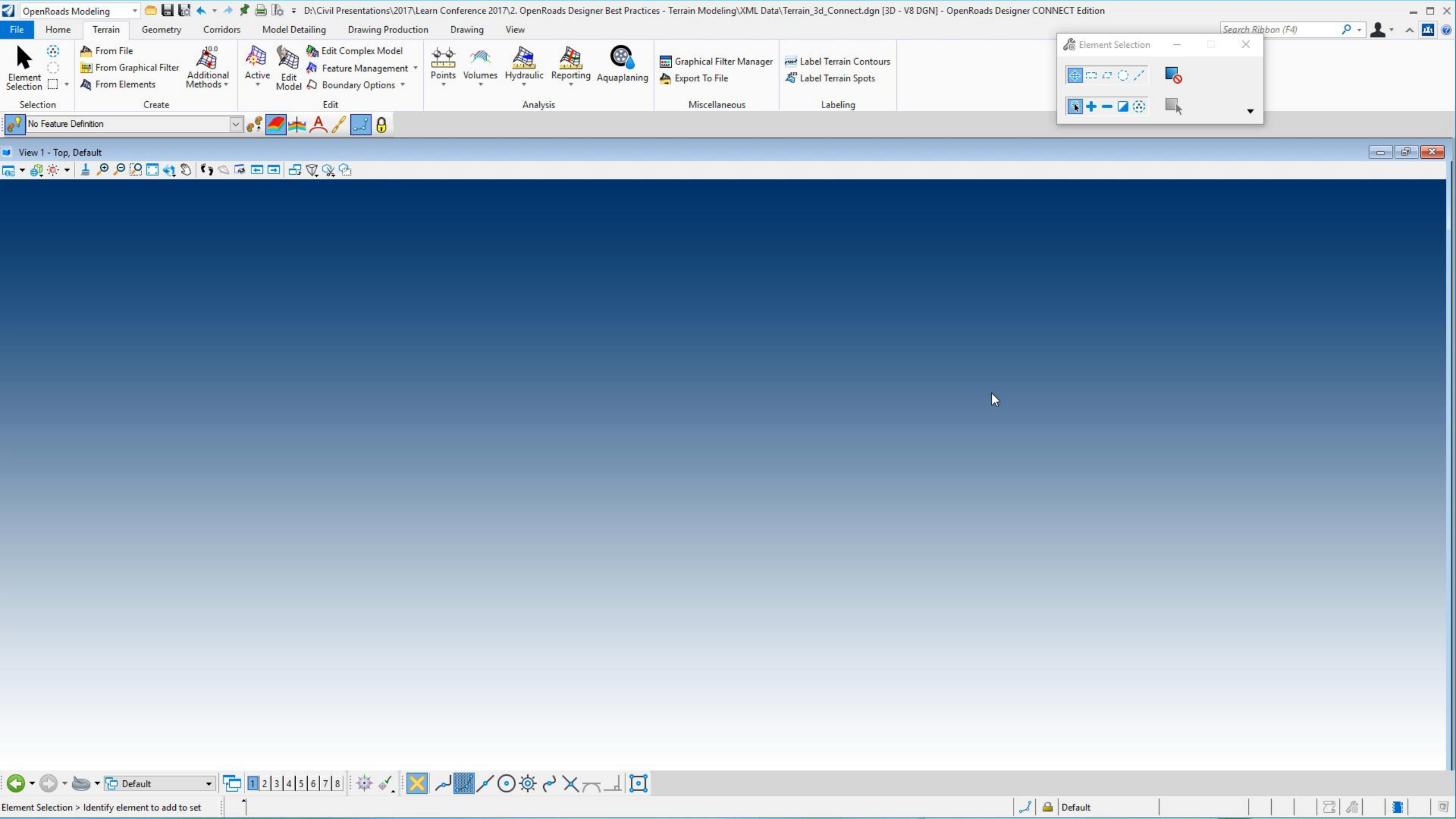
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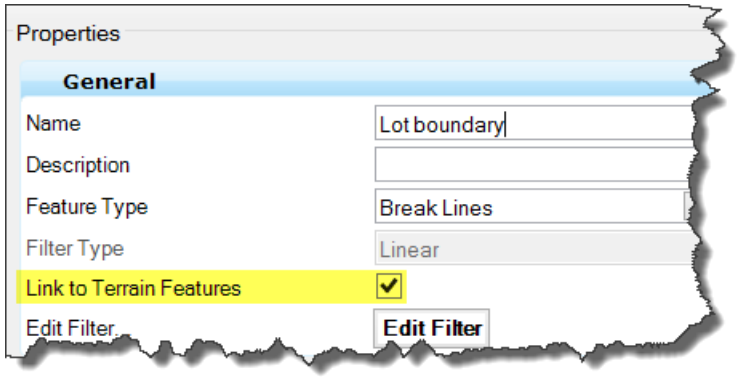
To Rule or Not to Rule?

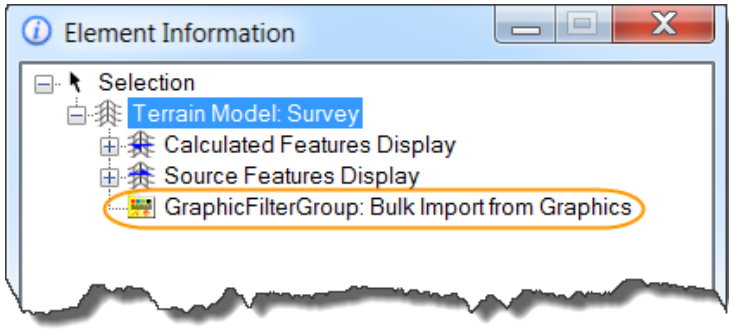
- In most cases, this decision of **dynamic** vs. **static** is made for you.

  For example, as we saw, *Import from File* creates a static rule, while *Create from Elements* creates a dynamic rule.

- But sometimes the decision is yours.

  This happens in the case of **Graphical Filters**.





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Best Practice

Dynamic rules are intended for smaller terrains.

Typical Use Case

- Think *'Proposed'* situations / site modeling
- Think 100's of elements as opposed to 1000's of elements

Static rules are intended for larger terrains.

Typical Use Case

- Think *'Existing' or 'Legacy' terrains*
- Think 1000's of elements as opposed to 100's of elements

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Boundary Options

Terrain Boundary Options

- ***None*** (least control)
- ***Slivers***

  Long, thin, external triangles are dissolved based on a formula hard coded within the software *(i.e. nobody really knows ☺)*.

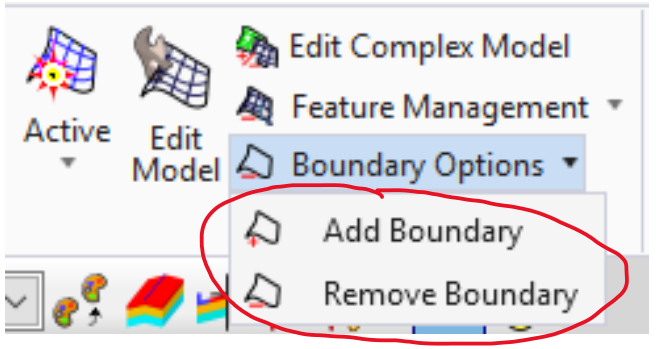
- ***Max Edge Length***

  External triangles longer in length than the user specified distance are deleted.

- ***Boundary*** (most control)

  All triangles outside of the Boundary feature are removed.

Boundary Tool Options



- **Add Boundary**
  - *Extract Graphic*
    - Creates a graphical 3D line string. It is just a simple graphic and is not linked to the terrain in any way.
  - *Add Boundary*
    - Creates a non-graphical boundary feature within the terrain and overrules all other trimming methods.
  - *Add Ruled Boundary*
    - Creates an editable graphical boundary that is ruled to the terrain. It overrules all other trimming methods.
- **Remove Boundary**
  - Removes any type of boundary (graphical or non-graphical) from the specified terrain.

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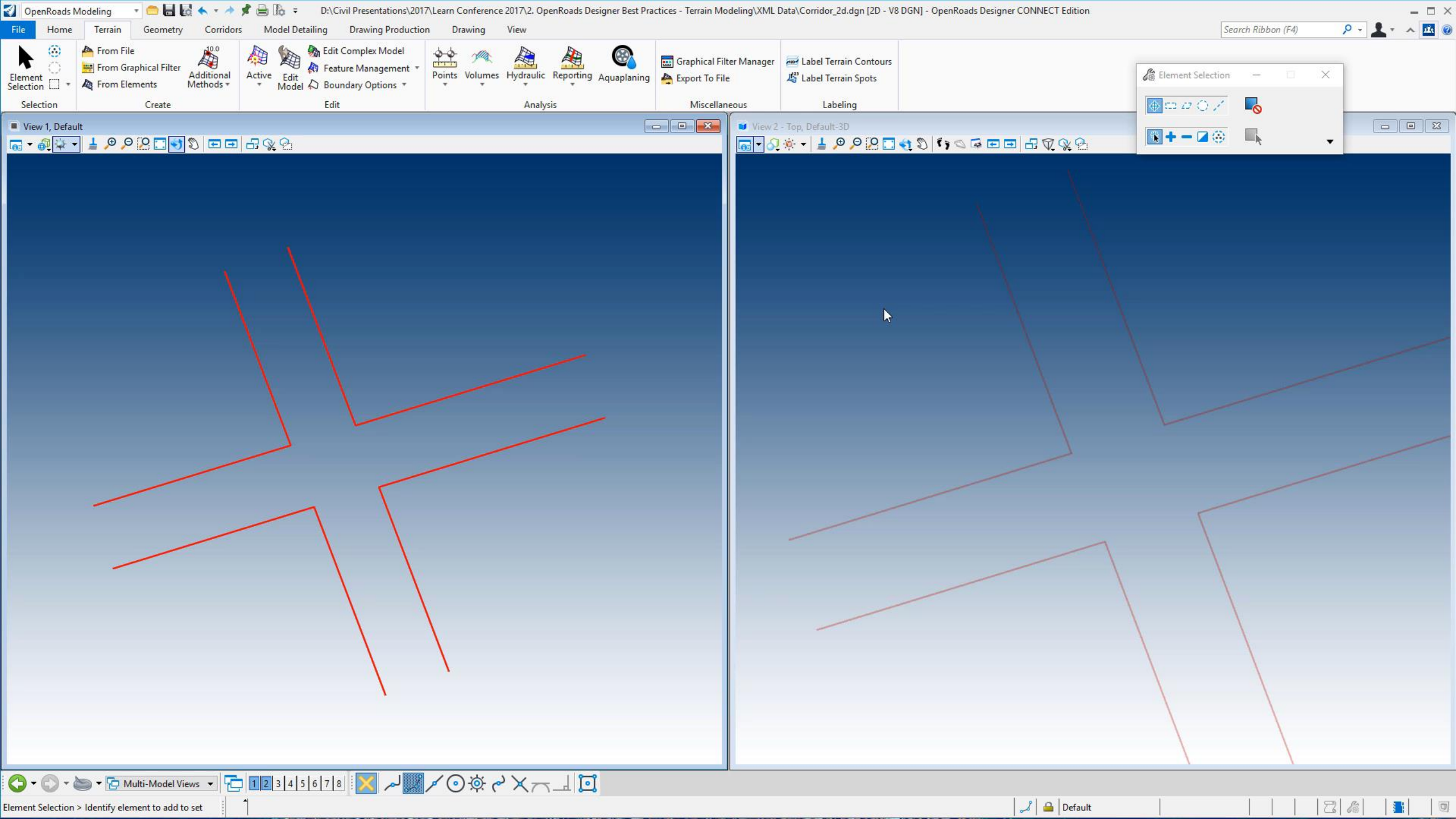
Use Cases

- **Add Boundary**
  - Adding a boundary overrides all other trimming methods
  - Provides the greatest control over a terrain

- **Remove Boundary**
  - Allows you to remove a boundary from a terrain in order to add additional data.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Element Selection > Identify element to add to set
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Terrains from Corridors

Terrains from Corridors

- Design terrains can be valuable for a myriad of reasons.
  - *Drainage or Aquaplaning analysis*
  - *Final Contours*
  - *Merge with existing to create final terrain*
  - *Etc.*

- For a single corridor, the process is very straightforward.
  - Enable the Top Mesh display in the Corridor feature properties.
  - Re-process the corridor to create the Top Mesh
  - Using *Create Terrain from Elements*, create a terrain from the mesh.

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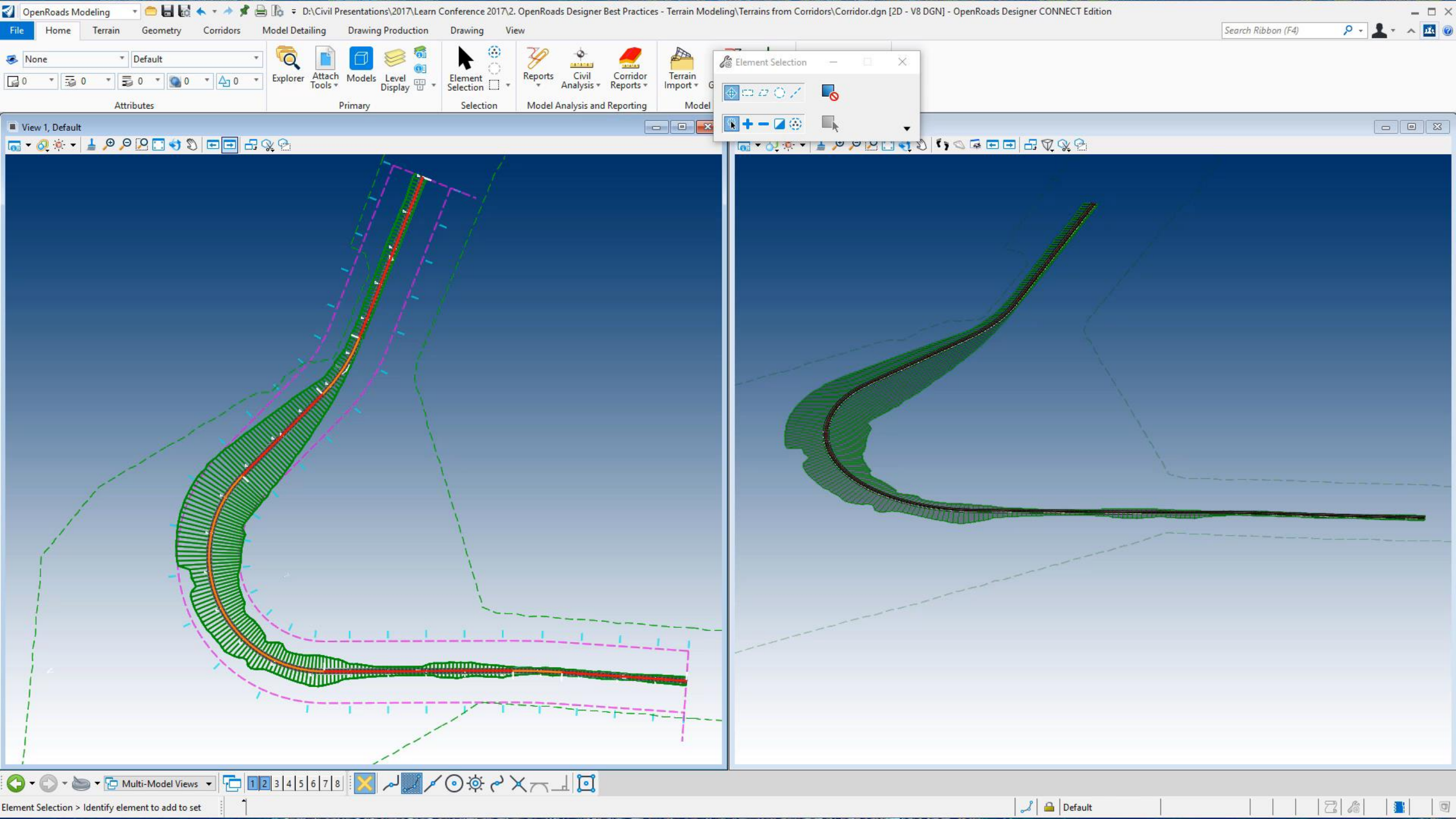
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Multi-Model Views
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Best Practice

- But what if you have something more complicated, like multiple corridors with civil cells?

- In these more common scenarios, *Graphical Filters* become an indispensable tool to read the 3d linear features and create a terrain.
  - With well defined workspace features and templates, they provide a quick and efficient way to output a design terrain.
  - Can be built once and then work repetitively.
  - Can be saved to DGN Libraries and propagated across an organization.

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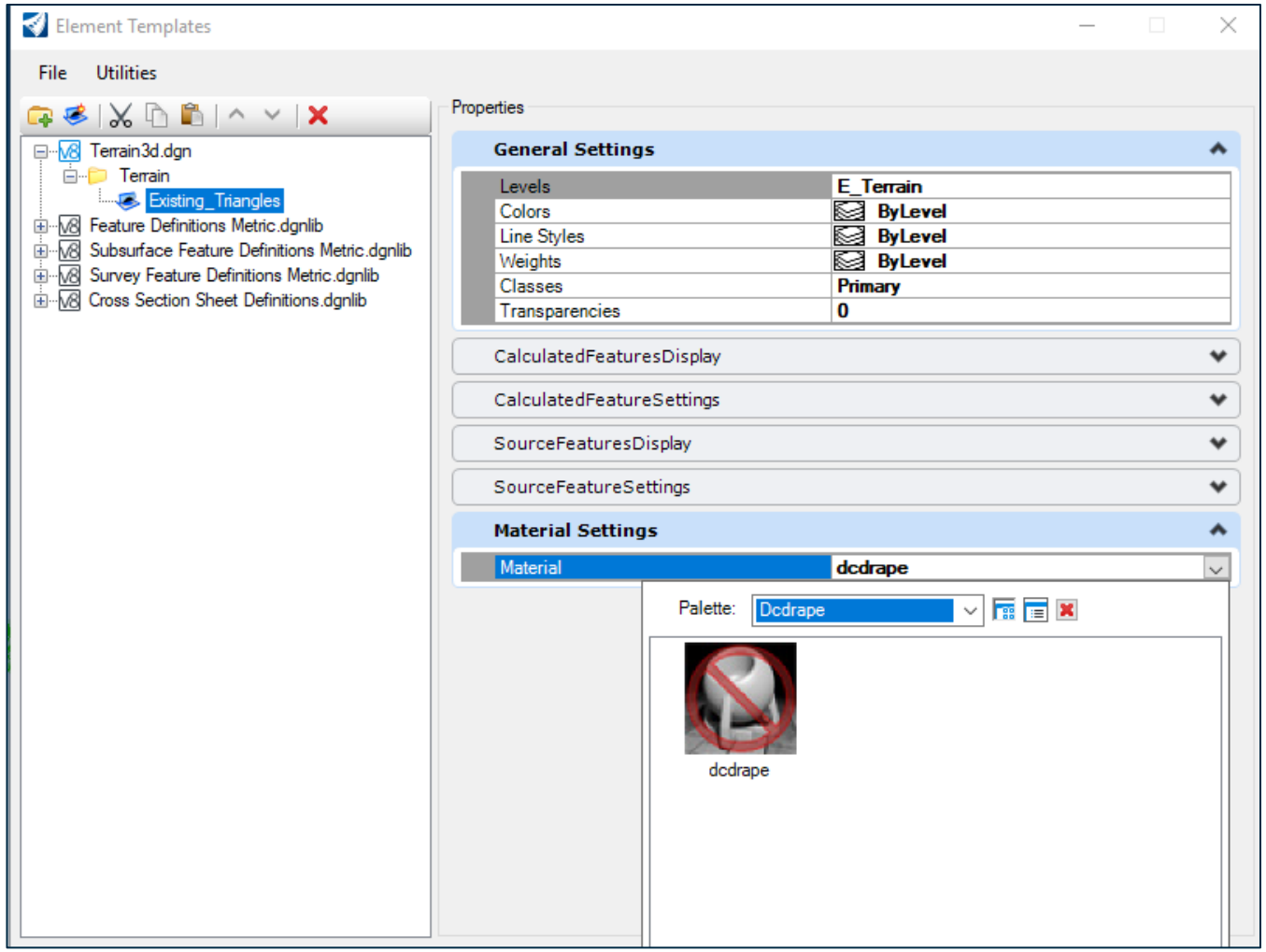
Image Draping

Draping Images on Terrains

- Remember, if you want to drape an image on a terrain, you must have the material *dcdrape* assigned to the terrain.
- *This is done through the element template.*



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Best Practice

Even if you're not sure you'll need draped imagery, it's worth going ahead and adding the material to your terrain element templates.

That way when you do need to drape, it will 'just work'.

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Bonus Tips

Remember to check the communities for lots of great feature clips and tips

How do I thin out the vertices for imported contours or other linestrings?

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Thank You

Have a great conference!

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