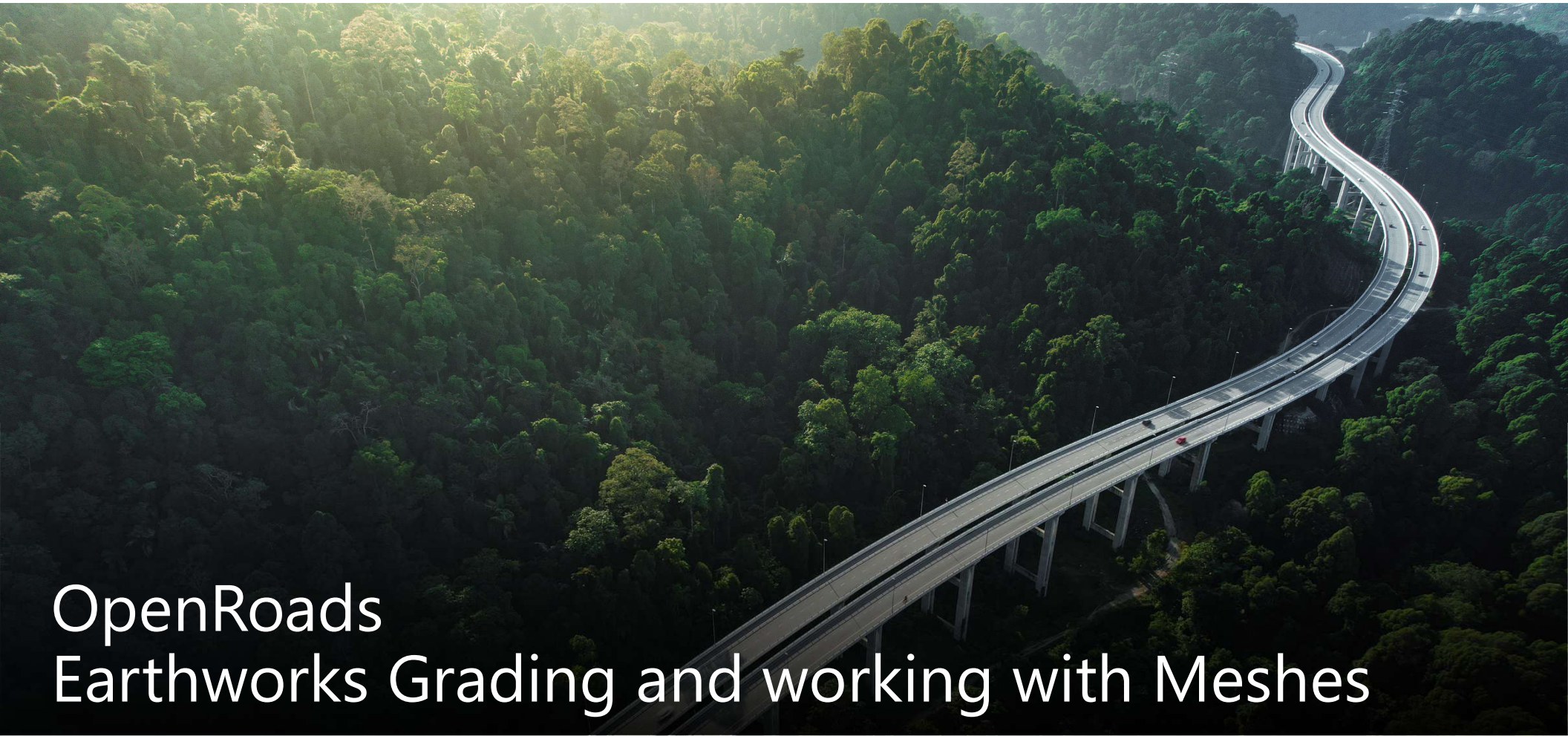

OpenRoads
Earthworks Grading and working with Meshes

Todd Holt, Senior Consultant I (Civil)
Bentley Systems, Inc.

Agenda

- Feature Definitions
  - Why it Matters
  - Volume Options
- Model for Earthwork
  - Existing Features
  - Substrata
- Create Cut and Fill Meshes
- Reporting
  - End Area Volumes
  - Quantities Report by Named Boundary
- Quick Review of Legacy Tools
  - Terrain to Terrain
  - Component Quantities
  - Dynamic End Area Display
  - Element Properties

Feature Definitions

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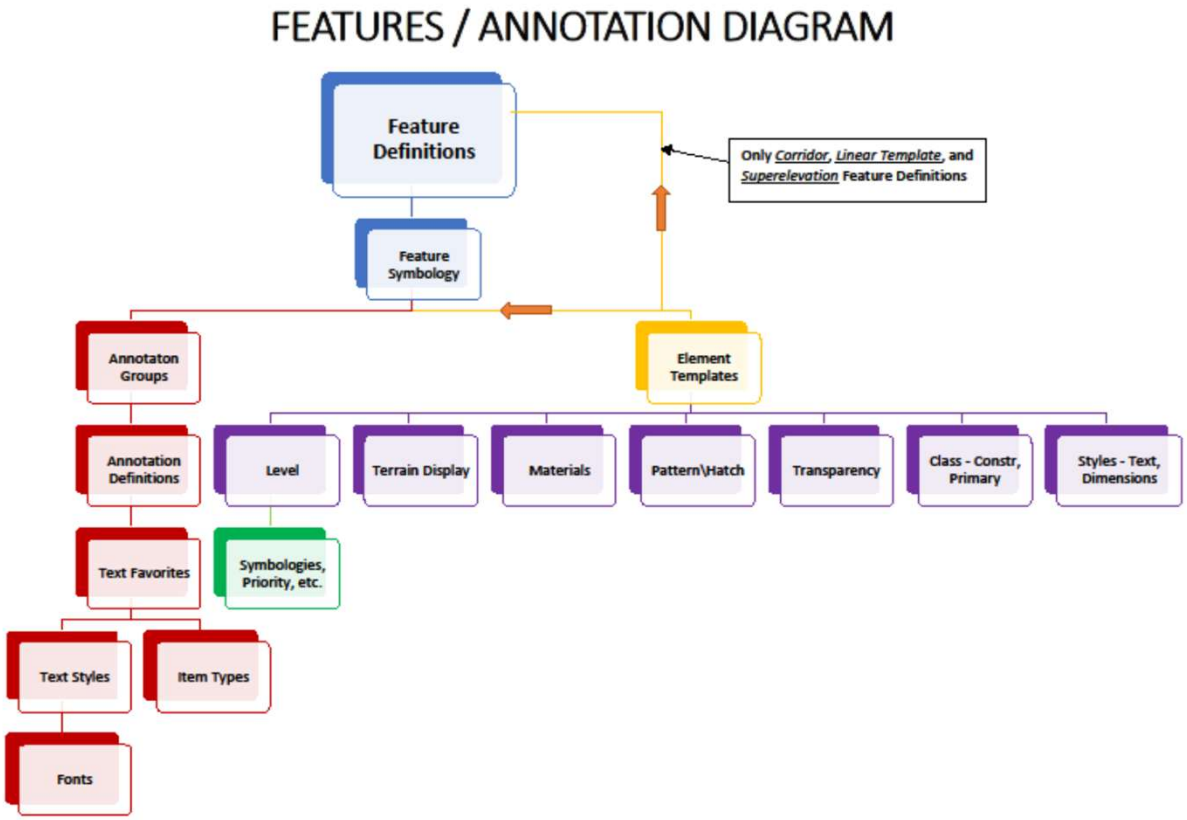
Feature Definitions

- Define the Symbology
  - Level, Color, Weight, Material
- Item Types
  - Location, Pay Items, …
- Terrain Display Attributes
- Earthwork Classification
  - Terrain and Mesh Feature Definitions have a “Volume Option” Property
  - “Create Cut and Fill” Tool Reads Volume Option



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Feature Definitions

- Item Types
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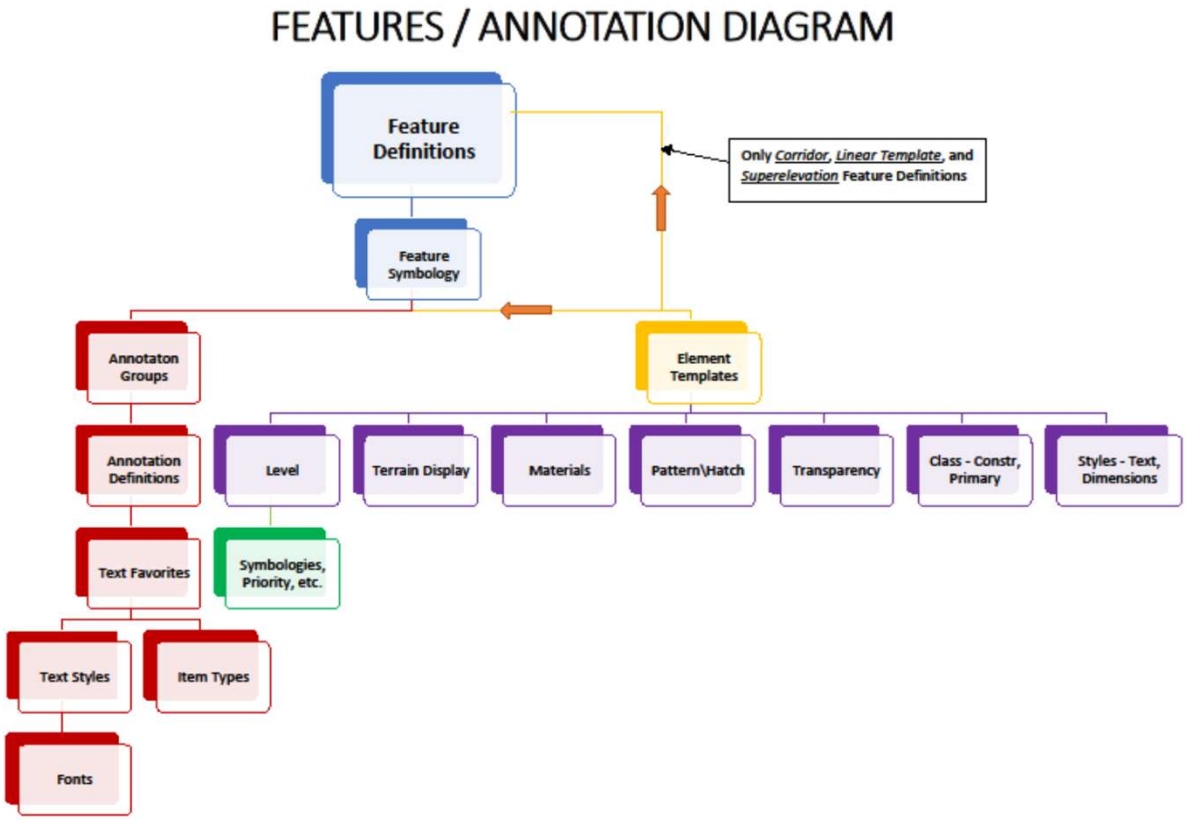

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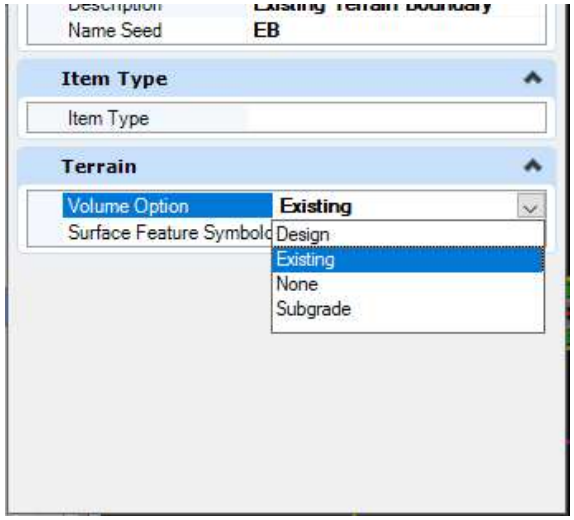
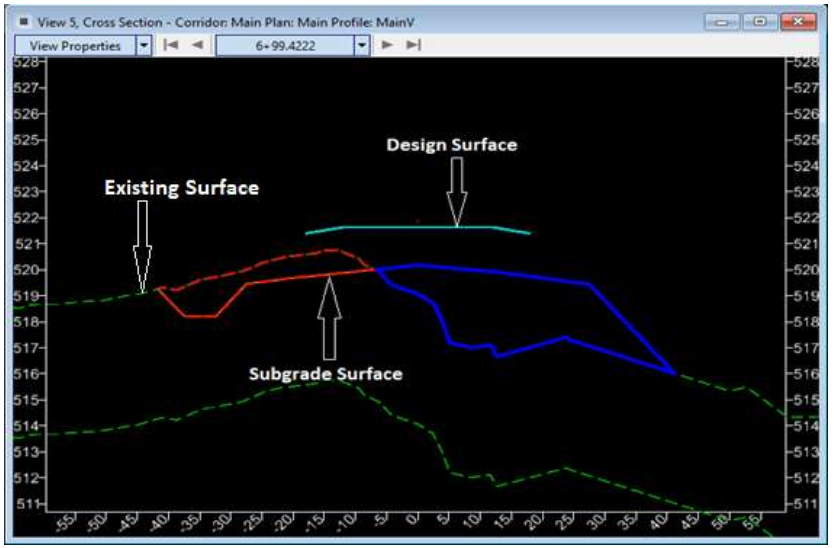
Terrain Volume Options

- Design: Used by Create Cut Fill Volumes to find design surfaces.
- Existing: Used by Create Cut Fill Volumes to find existing surfaces.
- None: Ignores the surface when computing cut fill volumes.
- Subgrade: Legacy: Used like the old InRoads tools to give surface to surface volumes. Treated like design.





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Mesh Volume Options

Feature Definitions Carry the Volume Option Properties

- Design: Defines new construction component or terrain
- Existing: Defines existing ground terrain or existing mesh
- None: Ignores when computing cut/fill volumes
- Subgrade: (Legacy) Uses surfaces for design
- Substrata: Defines a substrata layer of material for meshes (something that cab built on)
- Cut: Assign to a cut mesh, not design components
- Fill: Assign to a fill mesh, not design components
- Unsuitable: Defines material to be removed and not reused
- Custom: Same as Unsuitable but with options for mass ordinate

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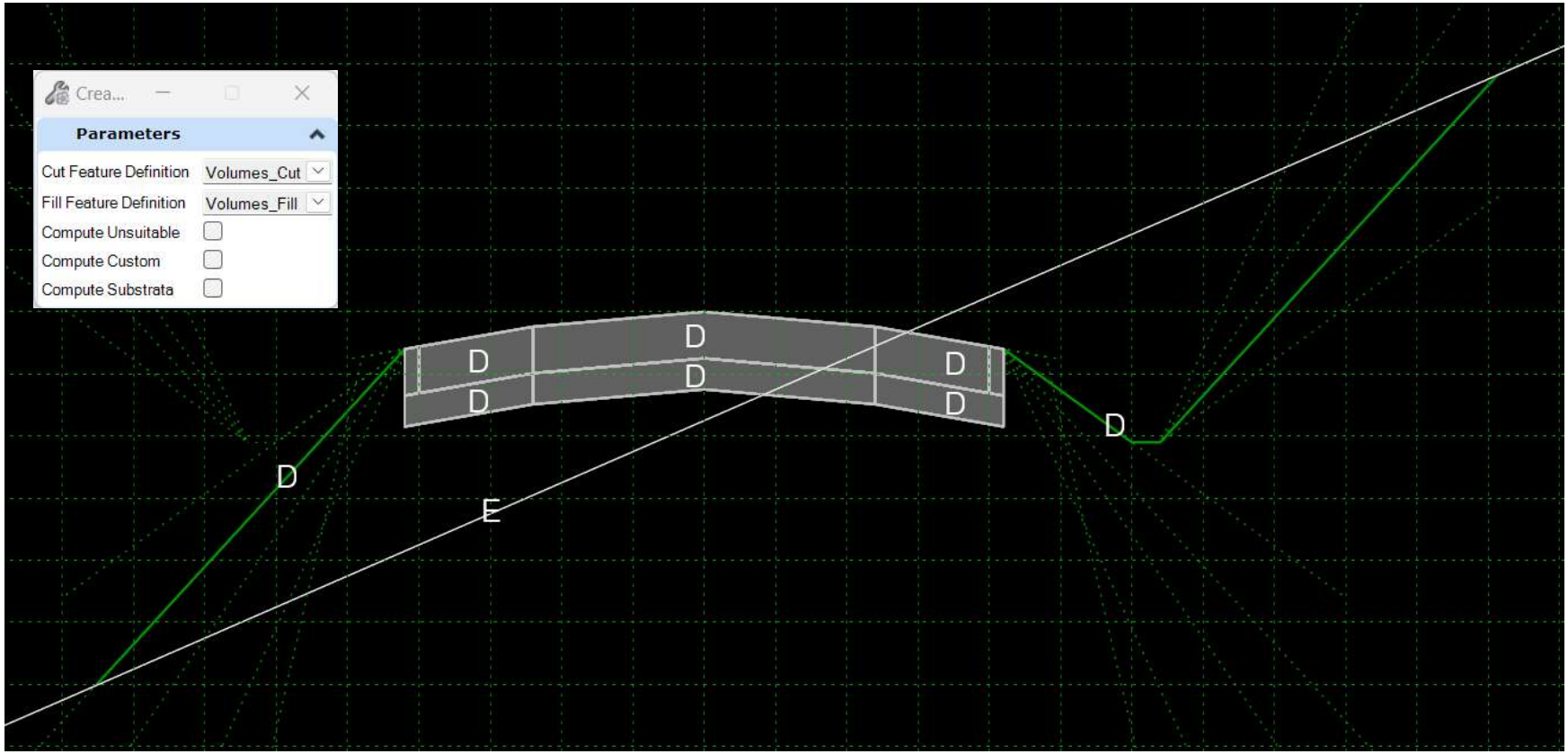
Cut/Fill



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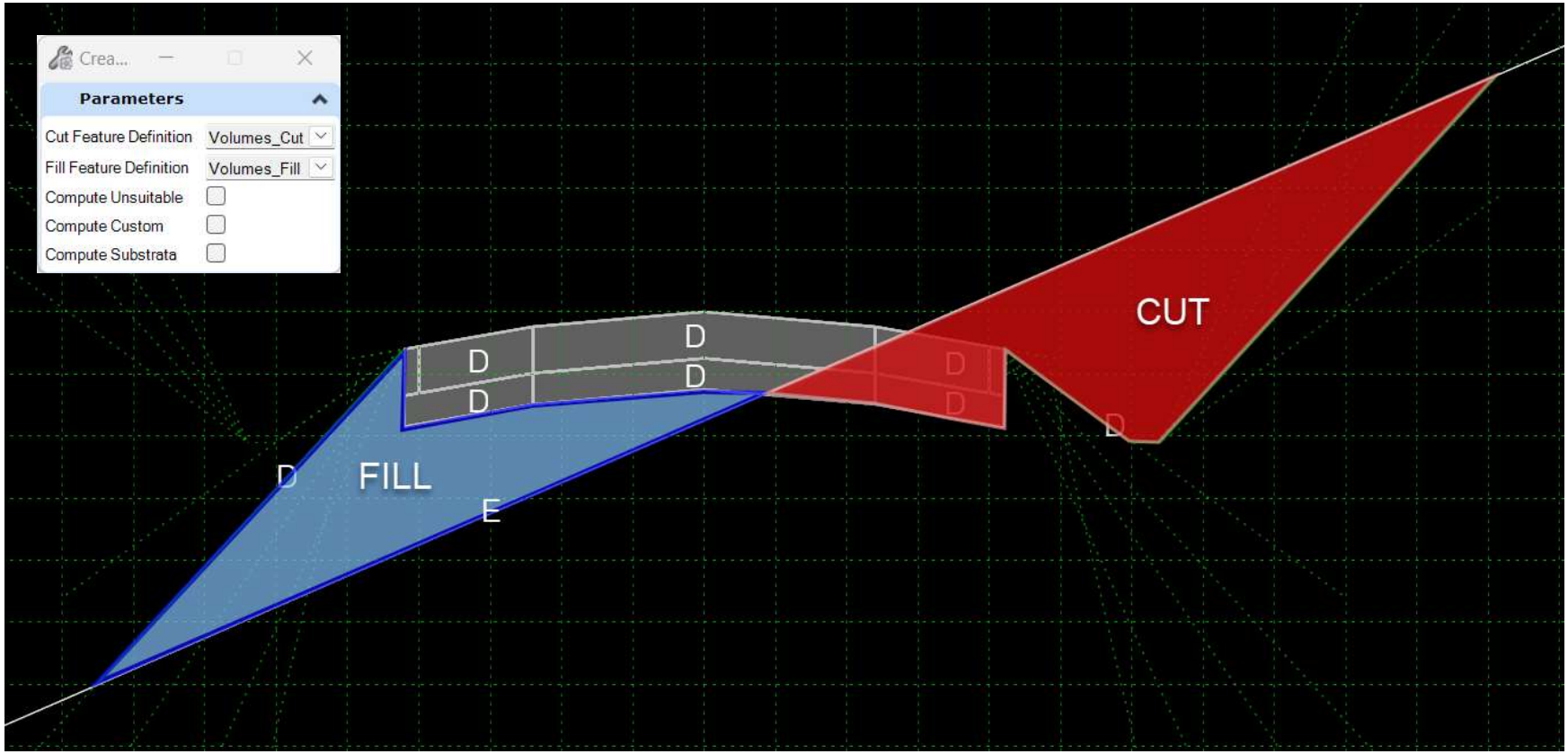
Cut/Fill



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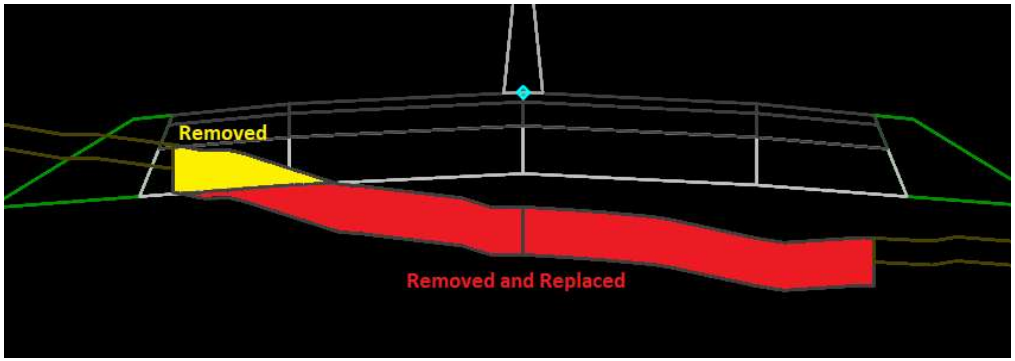
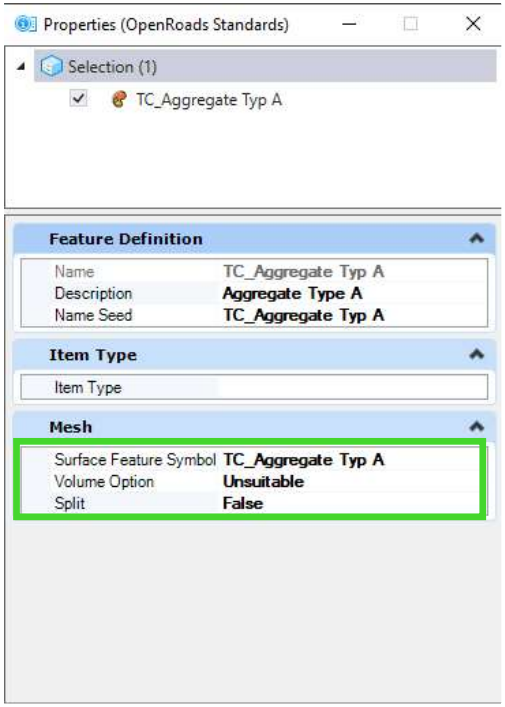
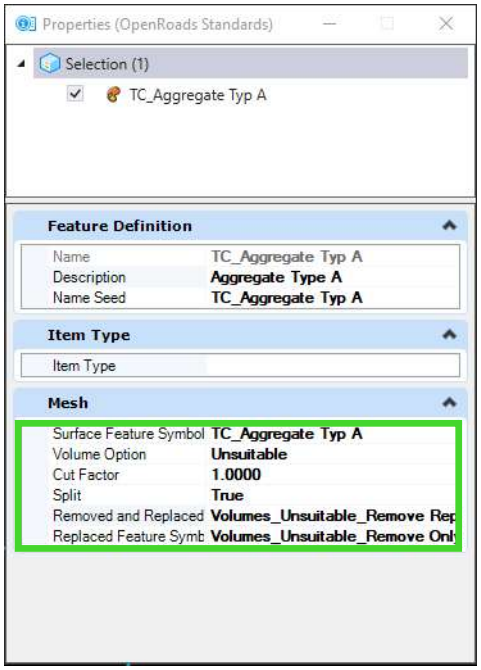
Mesh Volume Option – Unsuitable

Unsuitable: Split or Not Split

- Split = False
  - All material is removed
- Split = True
  - All material is removed
  - Only part of the material is replaced







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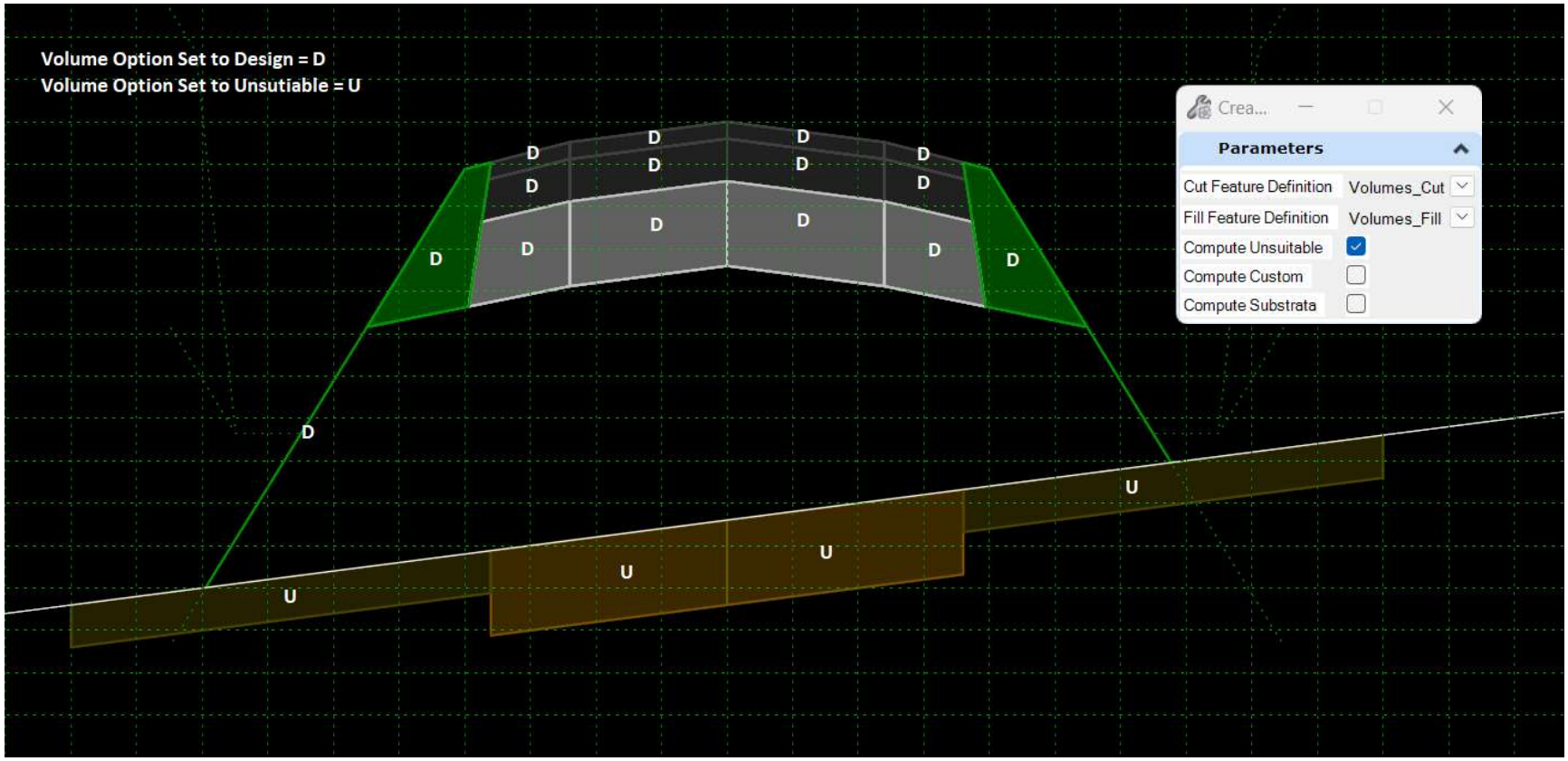
Cut/Fill + Unsuitable



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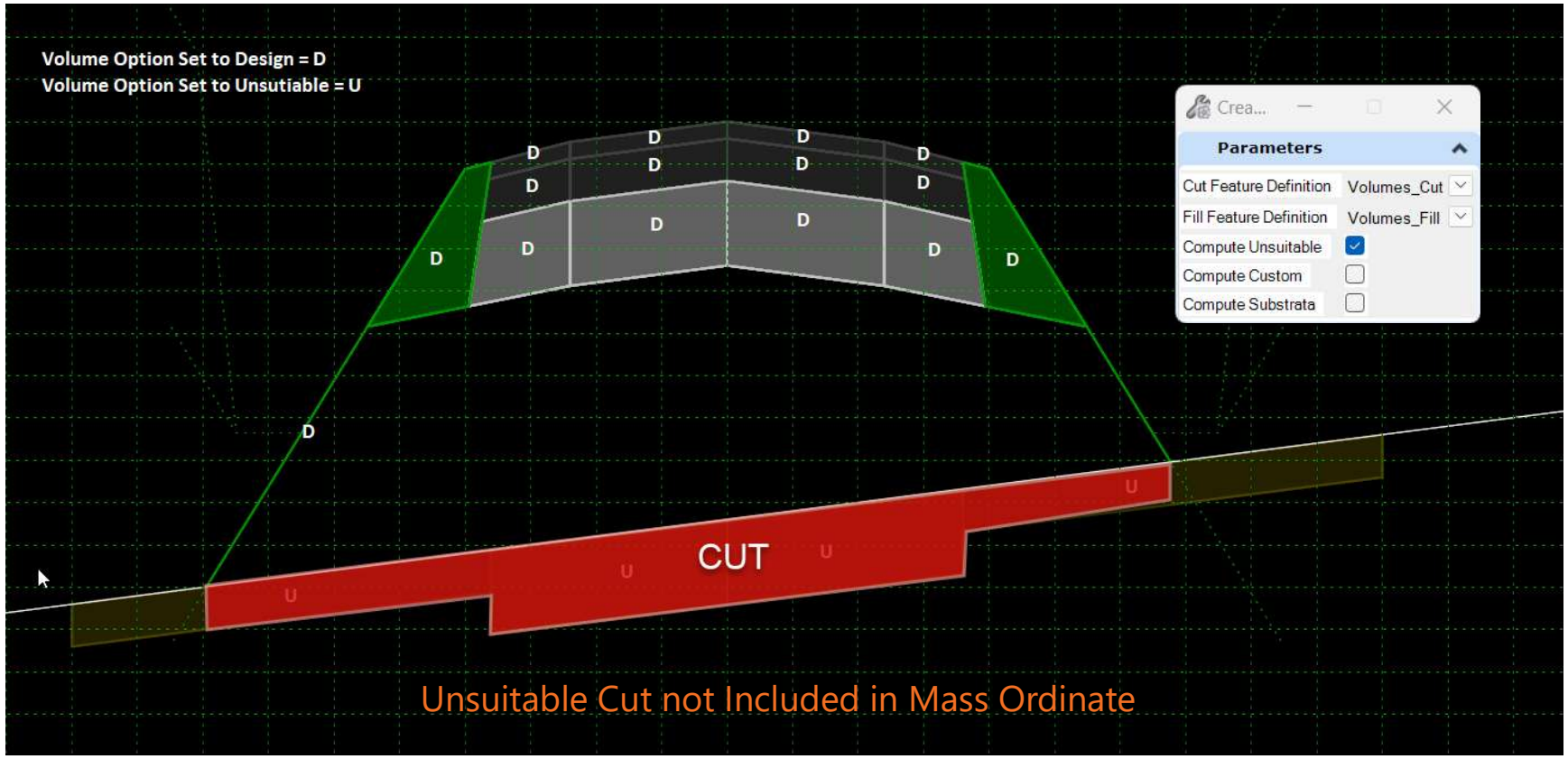
Cut/Fill + Unsuitable



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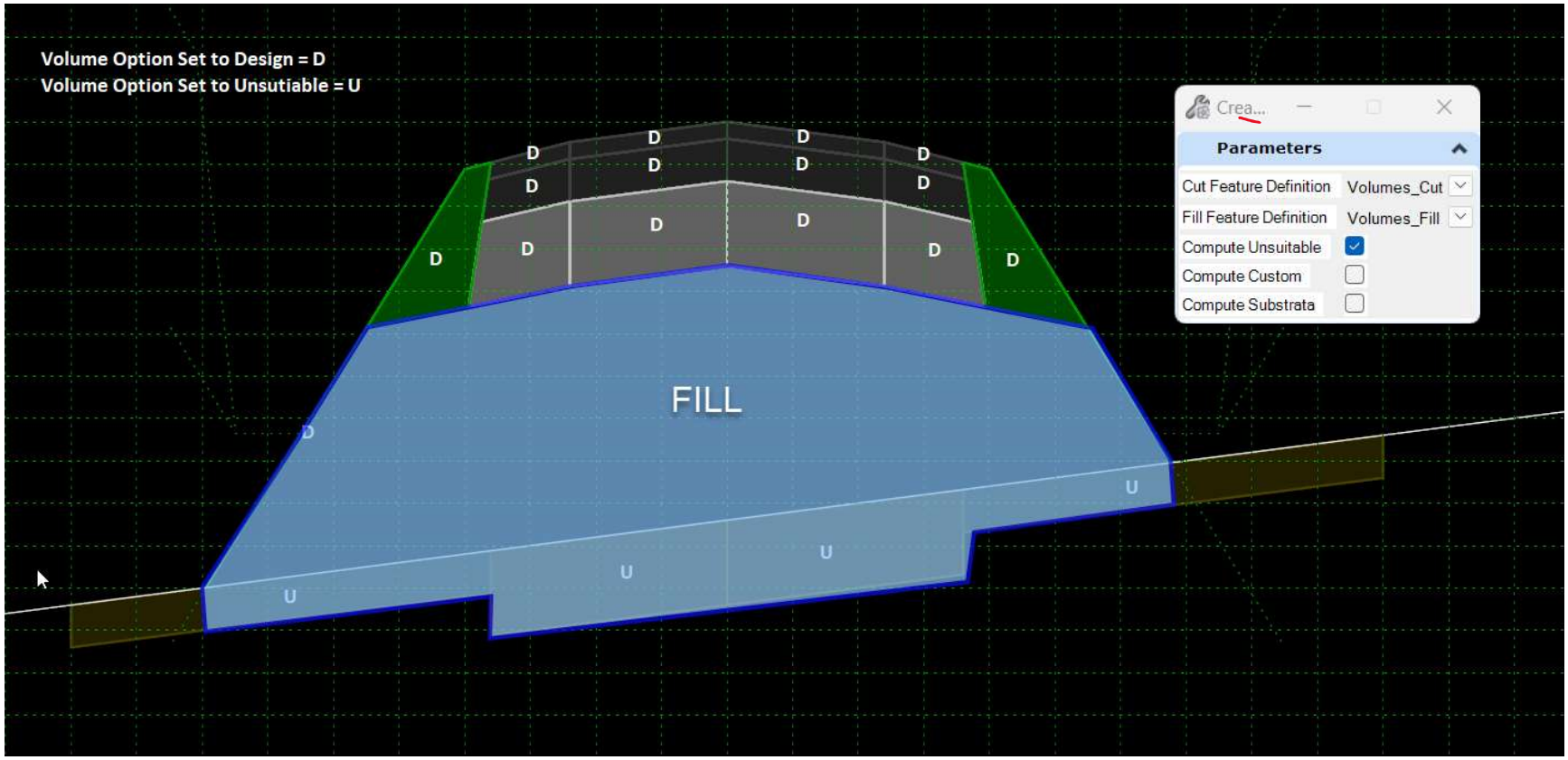
Cut/Fill + Unsuitable



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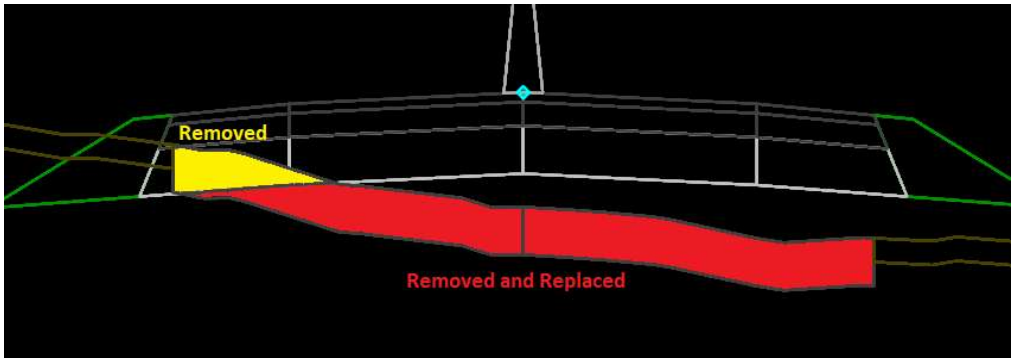
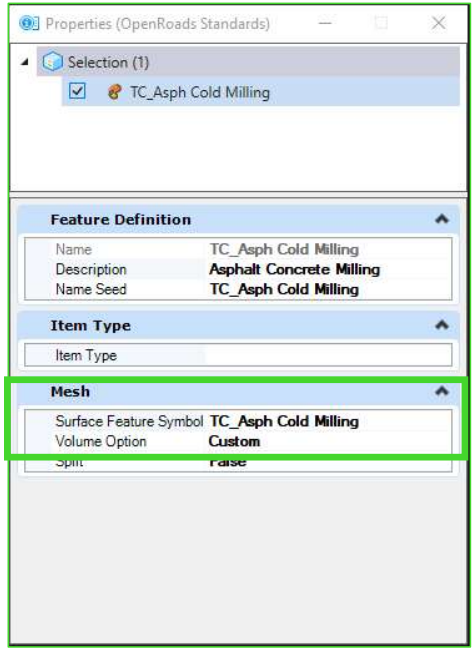
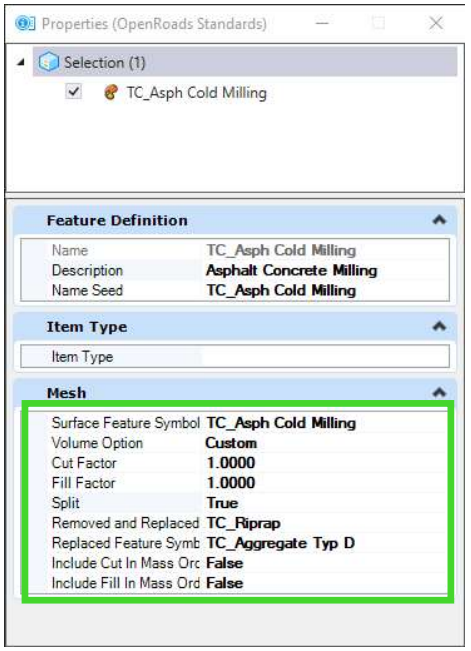
Mesh Volume Option – Custom

Custom: Split or Not Split

- Split = False
  - All material is removed
- Split = True
  - More Options on Split
  - All material is removed
  - Only part of the material is replaced







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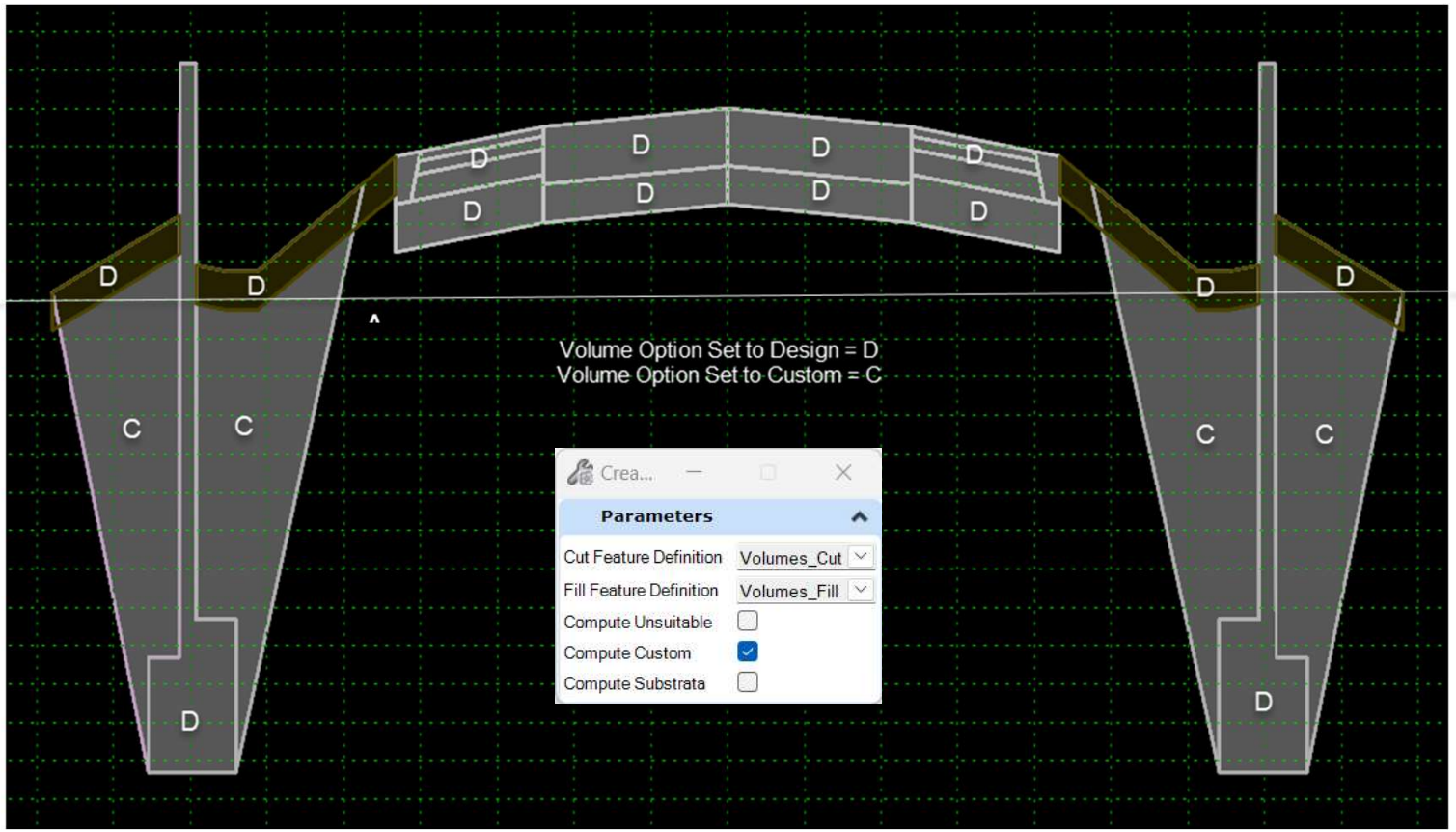
Cut/Fill + Custom



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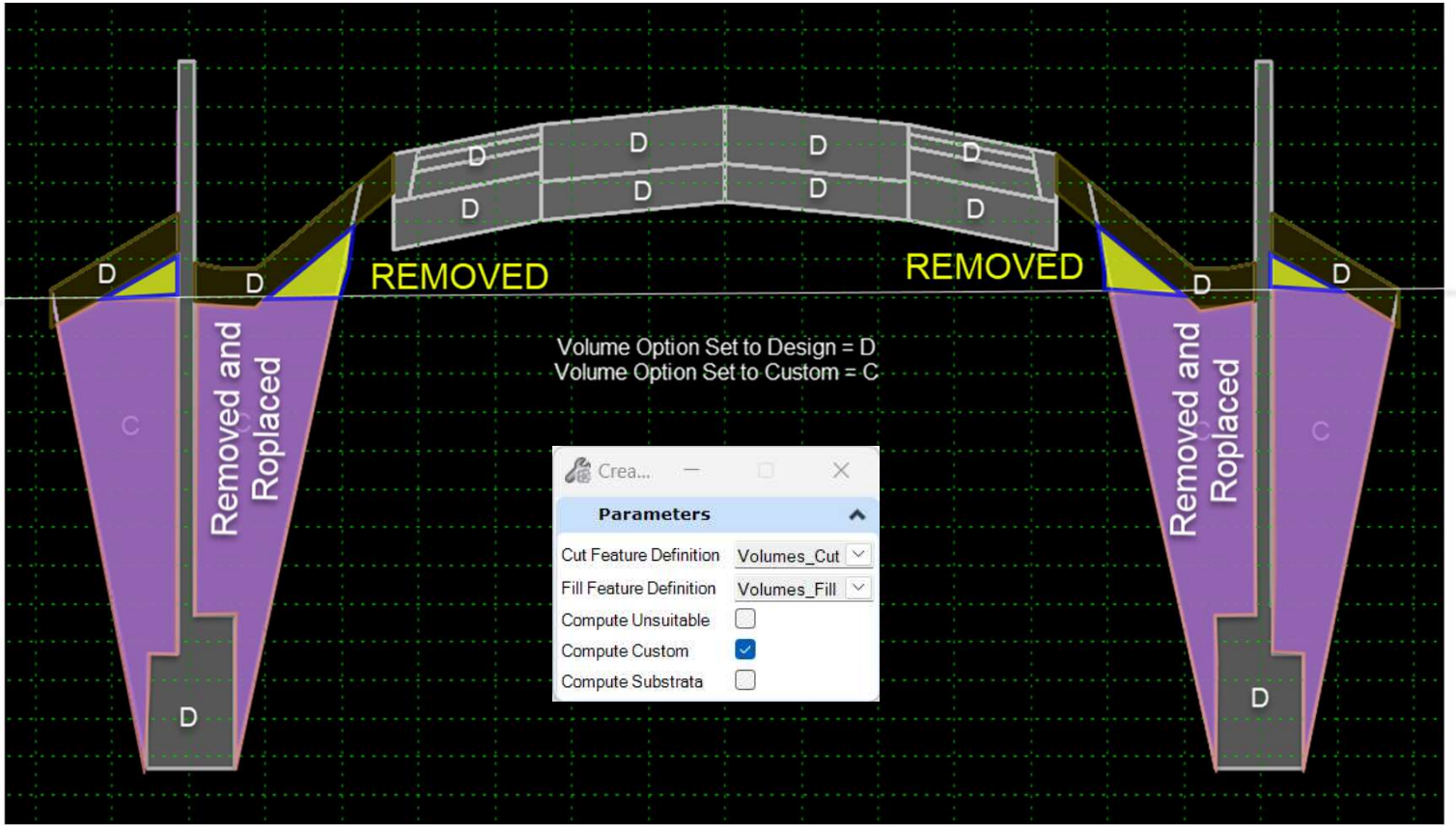
Cut/Fill + Custom



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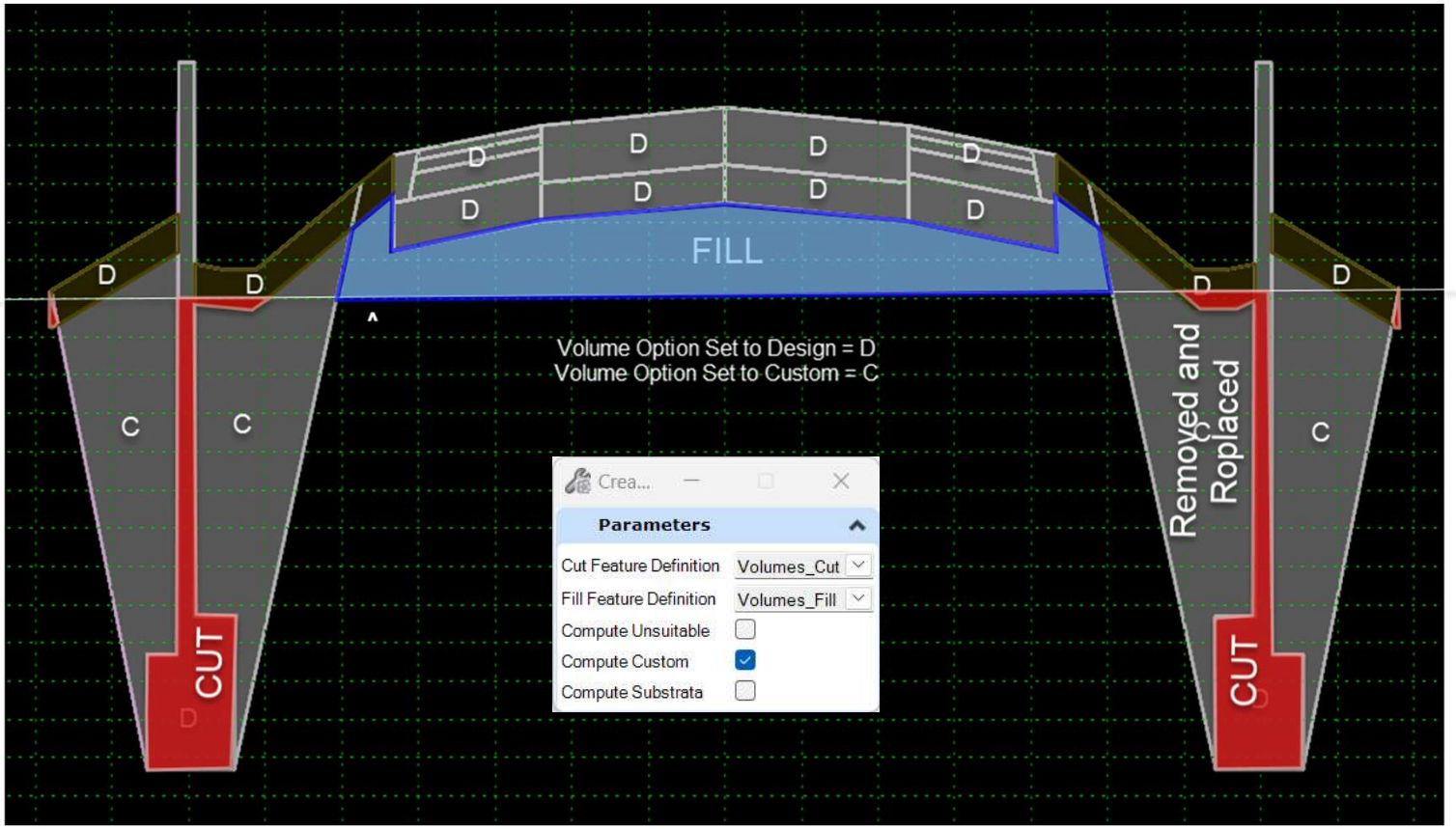
Cut/Fill + Custom



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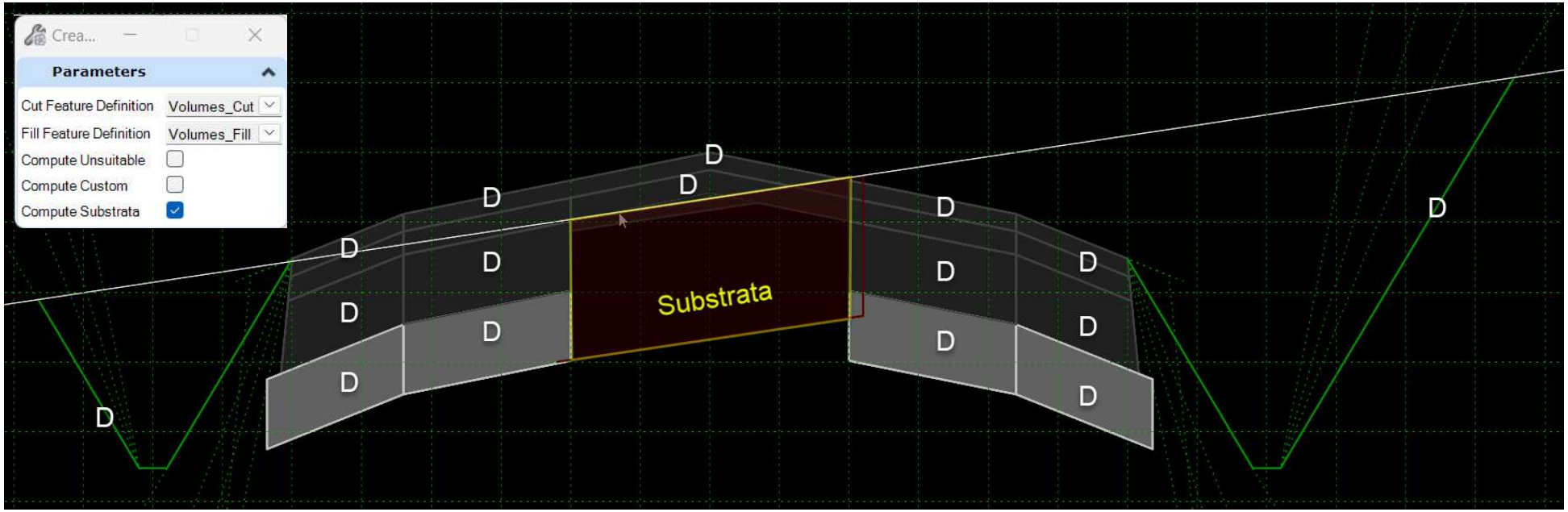
Cut/Fill + Substrata



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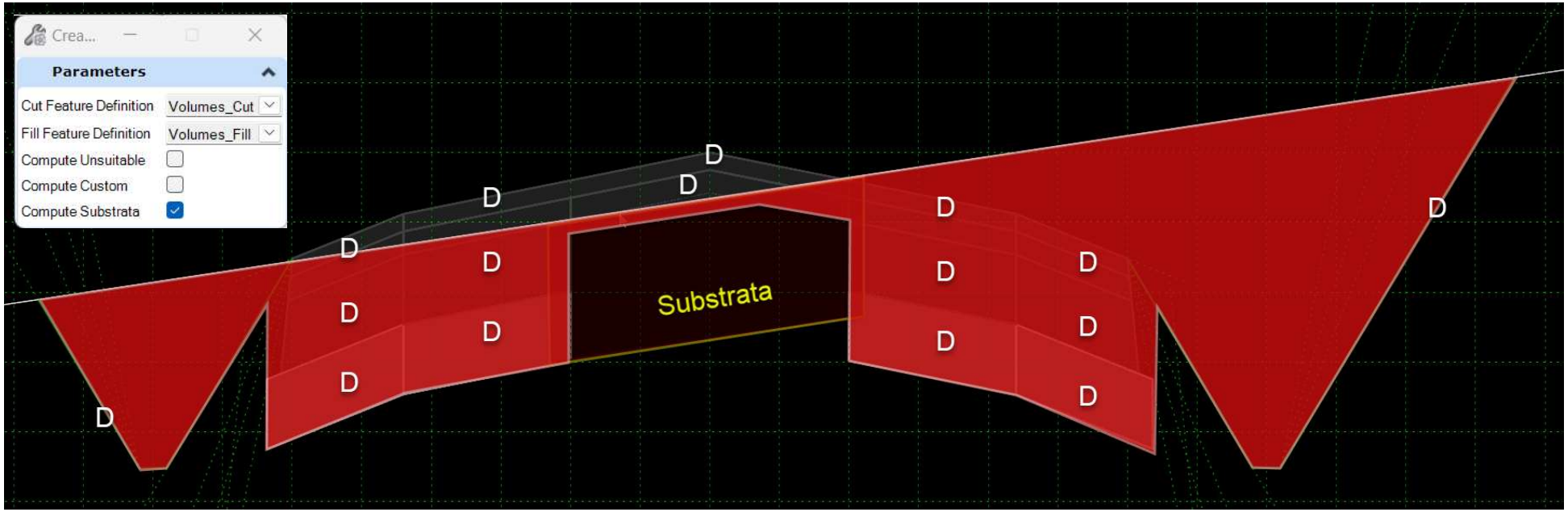
Cut/Fill + Substrata



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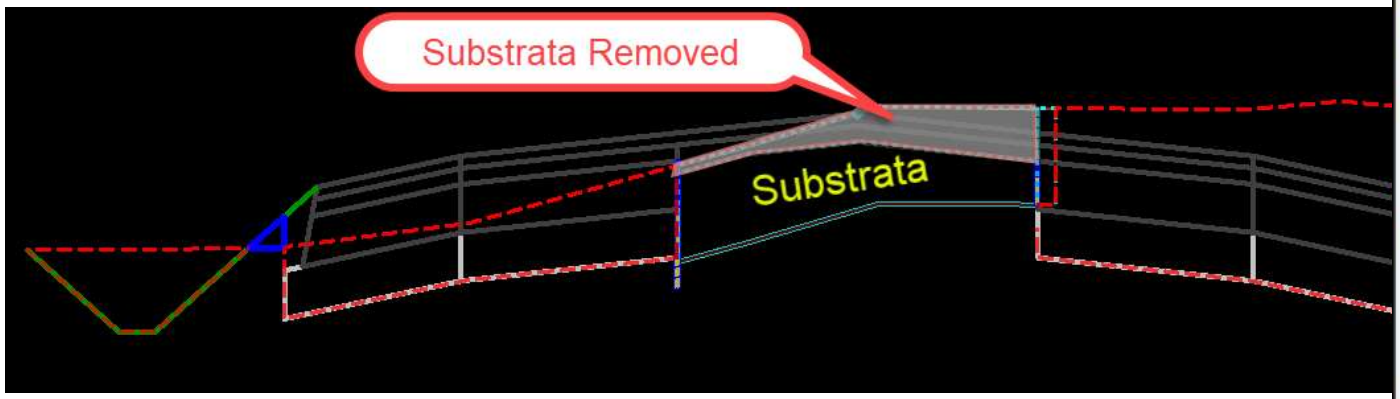
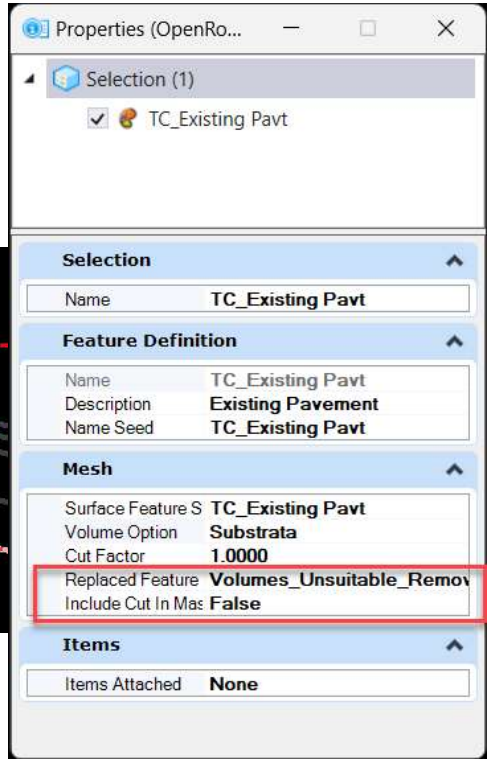
Cut/Fill + Substrata





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Modeling for Earthwork

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Modeling for Earthwork

- Design
- Existing Features
- Substrata

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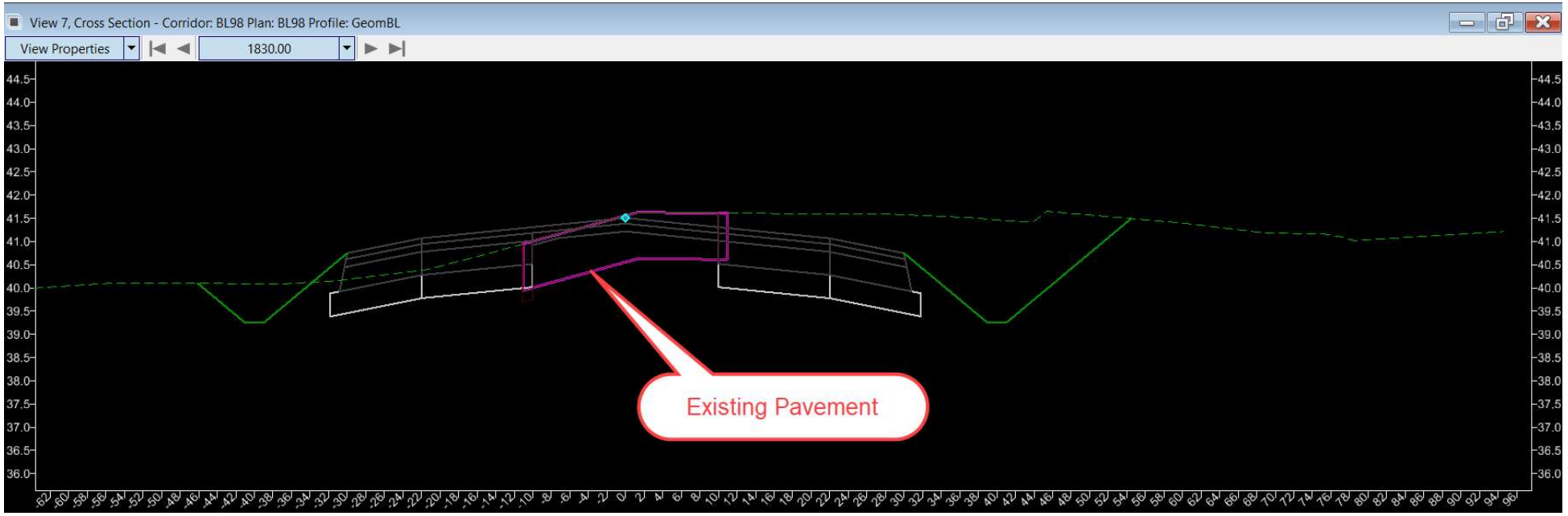
Model Existing Features

- Think of everything inside the project limits and consider if it can be built on top of or be reused as fill elsewhere on the project.
- If ***it can be built on*** but cannot be used as fill feature should be set as a “Substrata” volume option.
- If ***it cannot be built on*** or reused as fill its feature should be set as a an “Unsuitable” Volume Option.
- Existing Pavement, Sidewalks, Curb, Pads, Topsoil, Rock, Clay, Muck, …
- Can be in multiple files
  - Corridors
  - Linear Templates
  - Surface Templates
  - Create Closed Mesh

Resurfacing and Widening

- Existing Pavement Model



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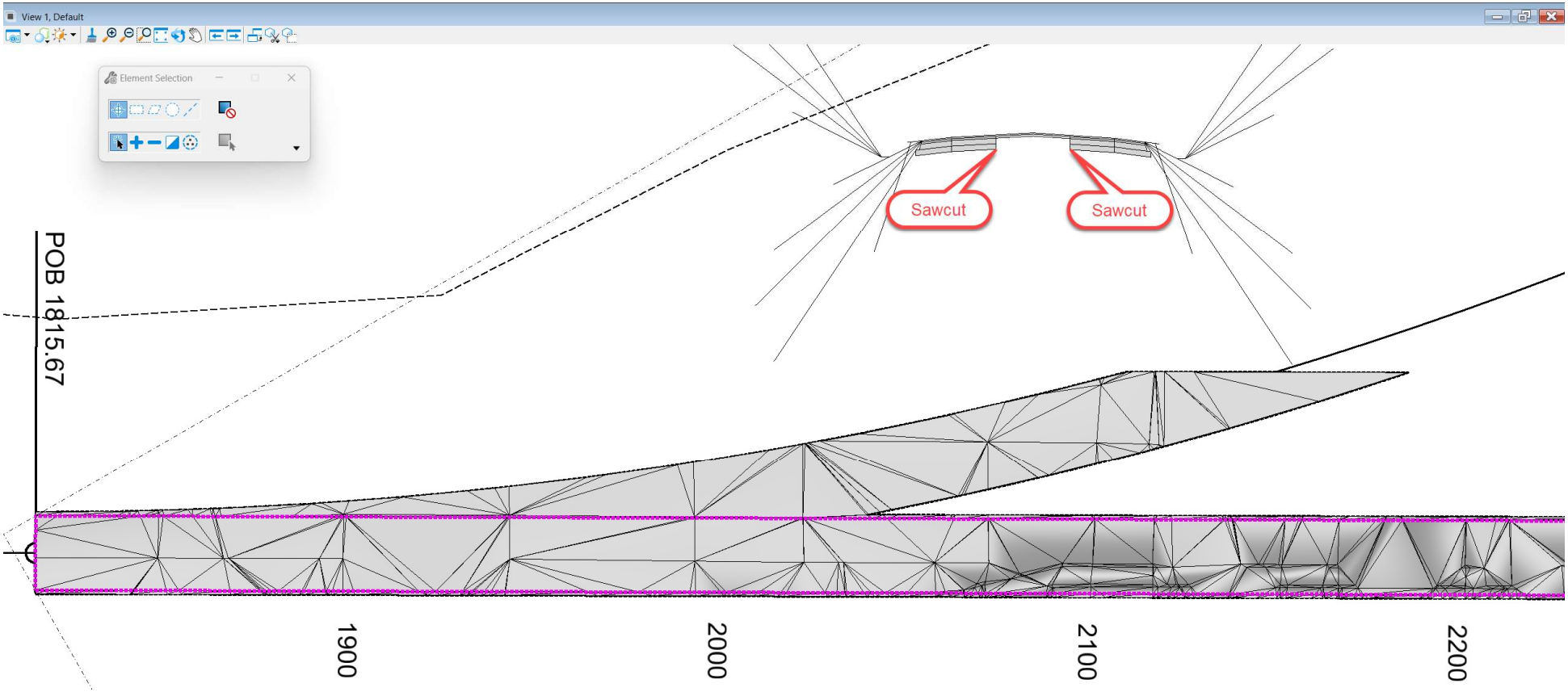
Resurfacing and Widening



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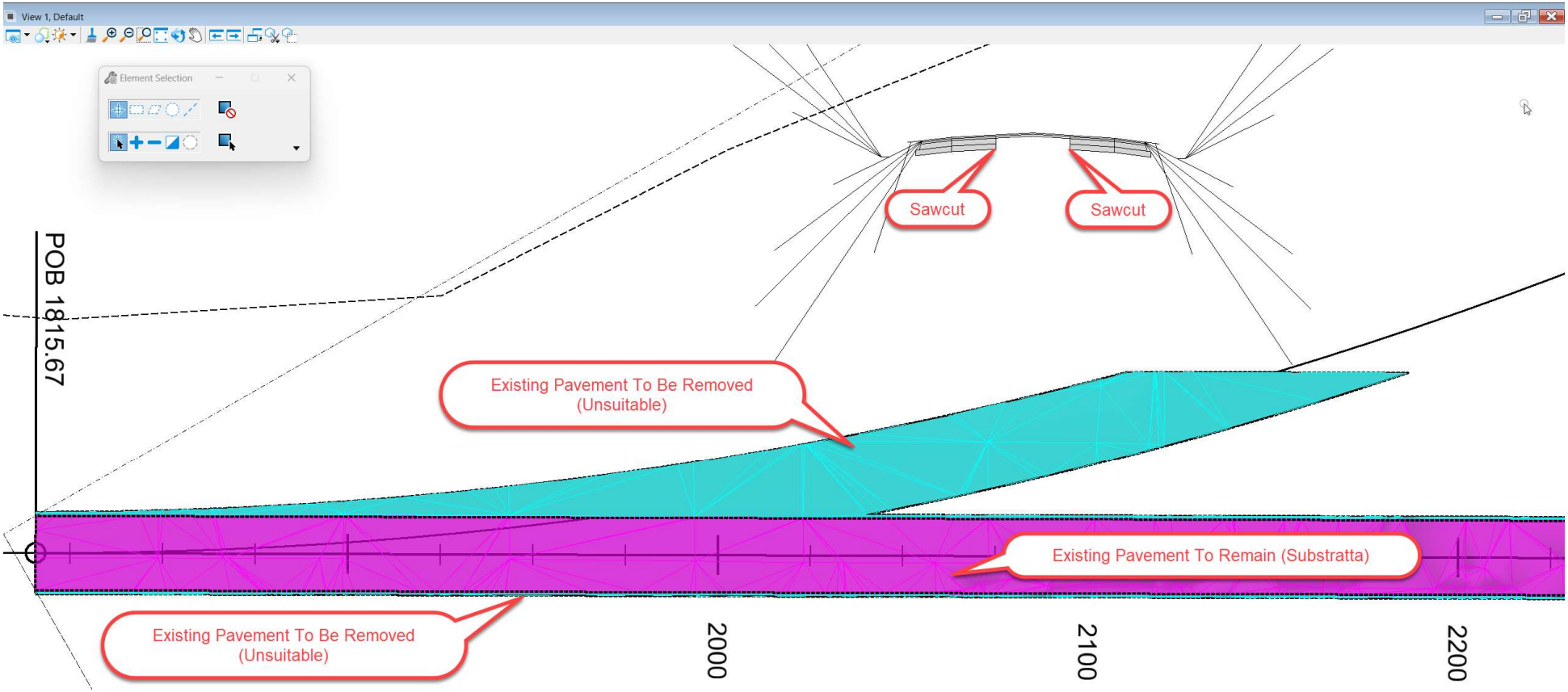
Resurfacing and Widening



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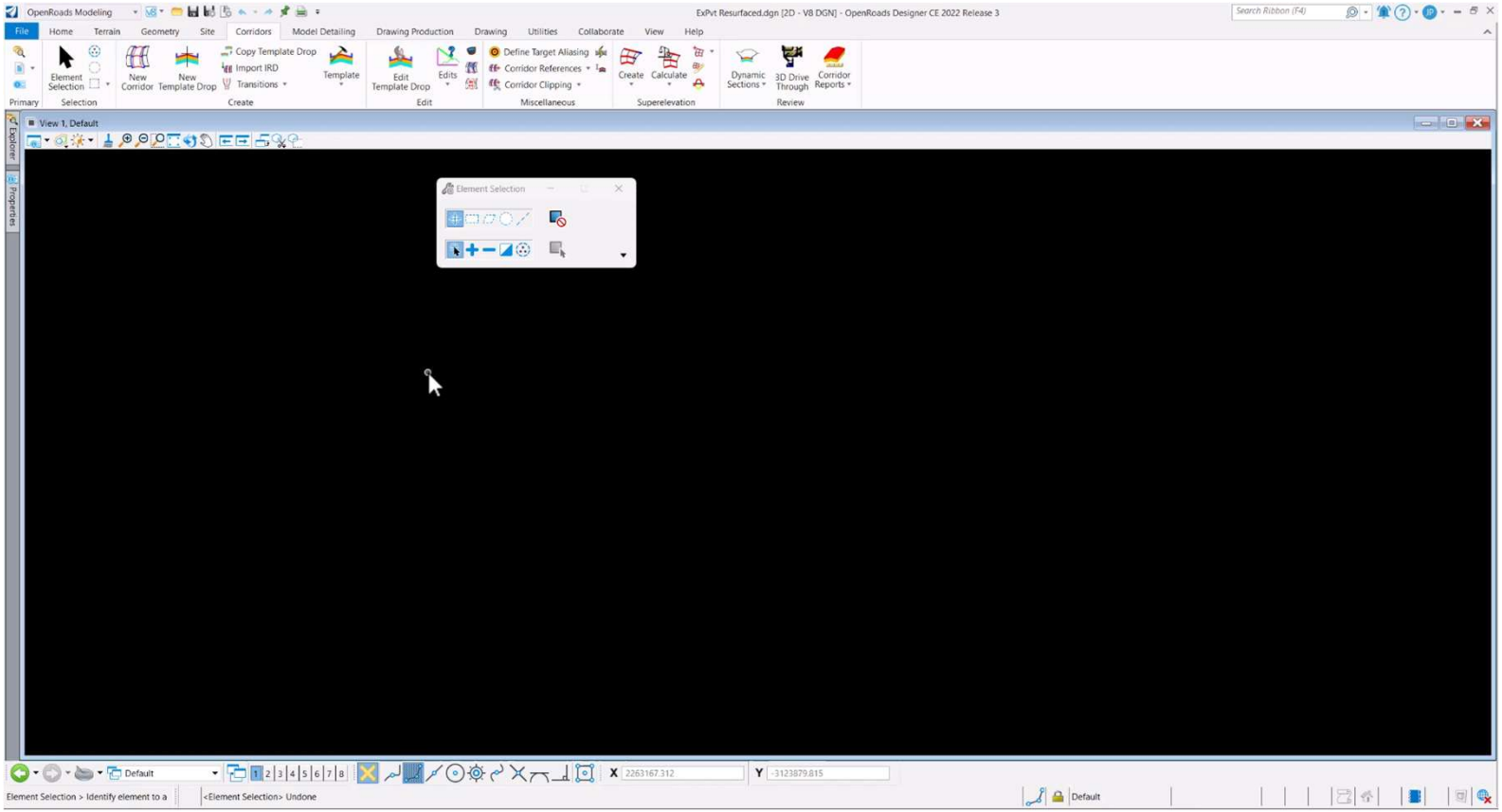
Corridor
(Existing Pavement for Resurfacing)



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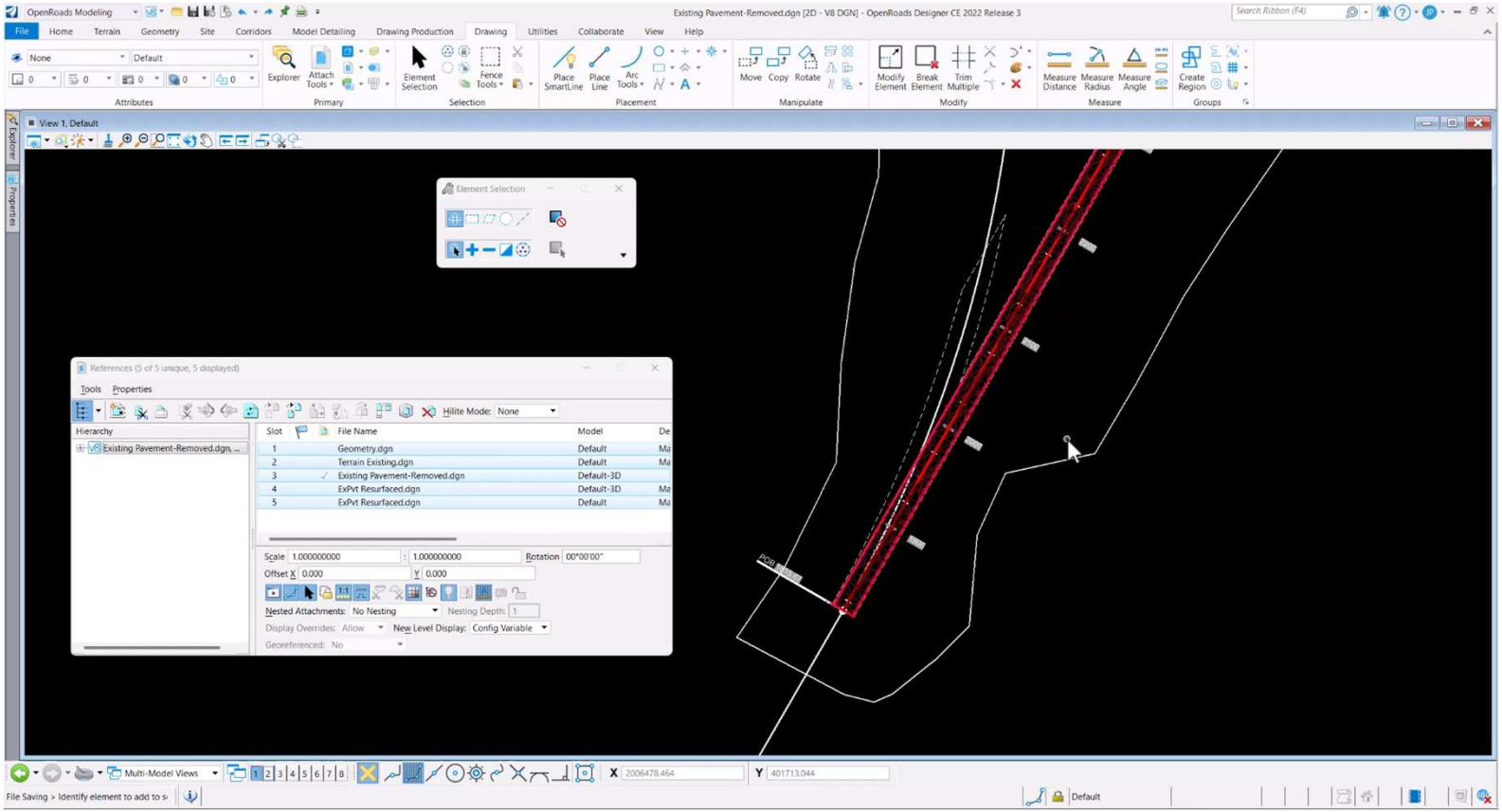
Clipped Terrains + Surface Template
(Existing Pavement To Be Removed)



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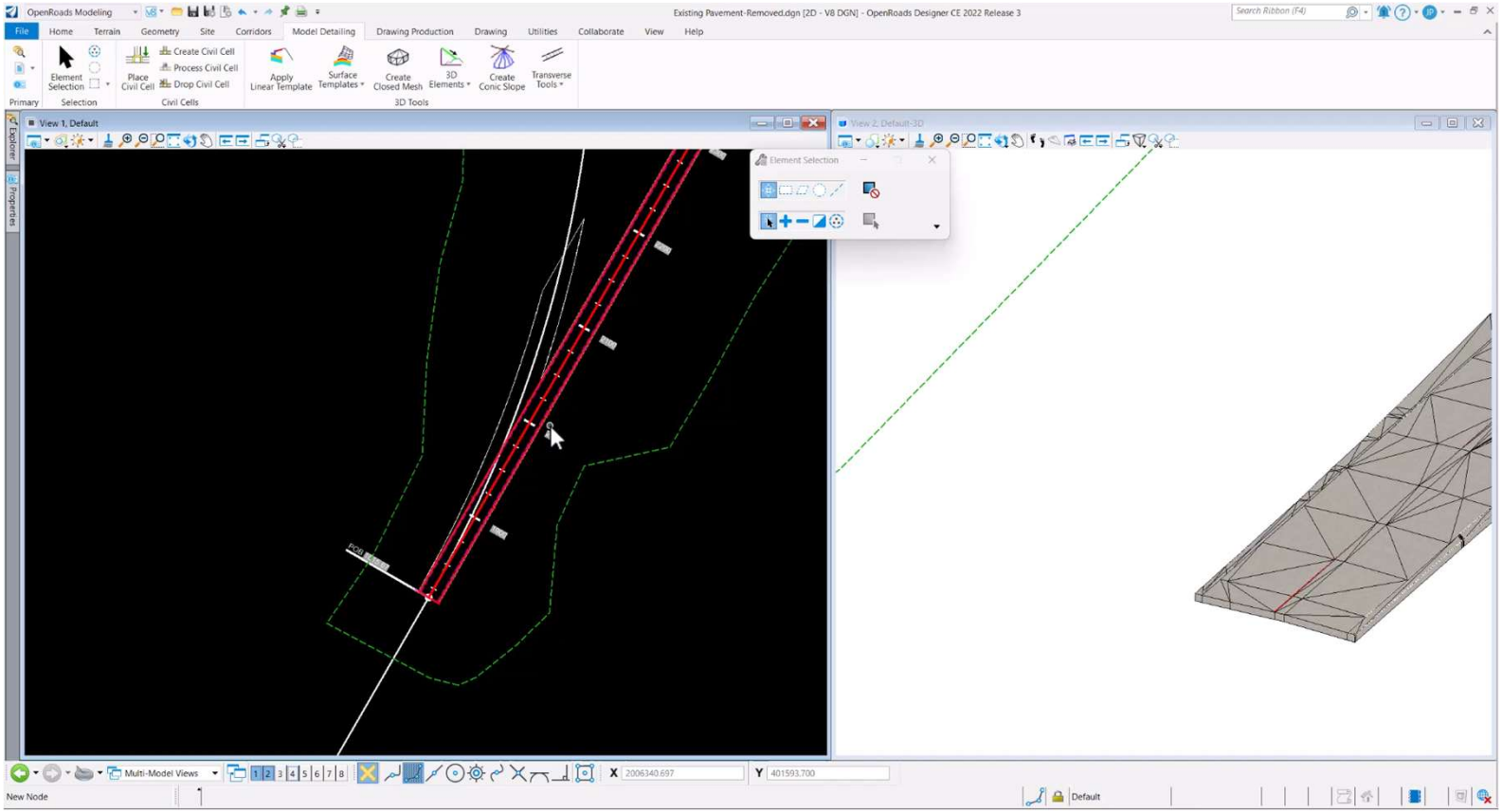
Linear Templates
(Existing Curbs)



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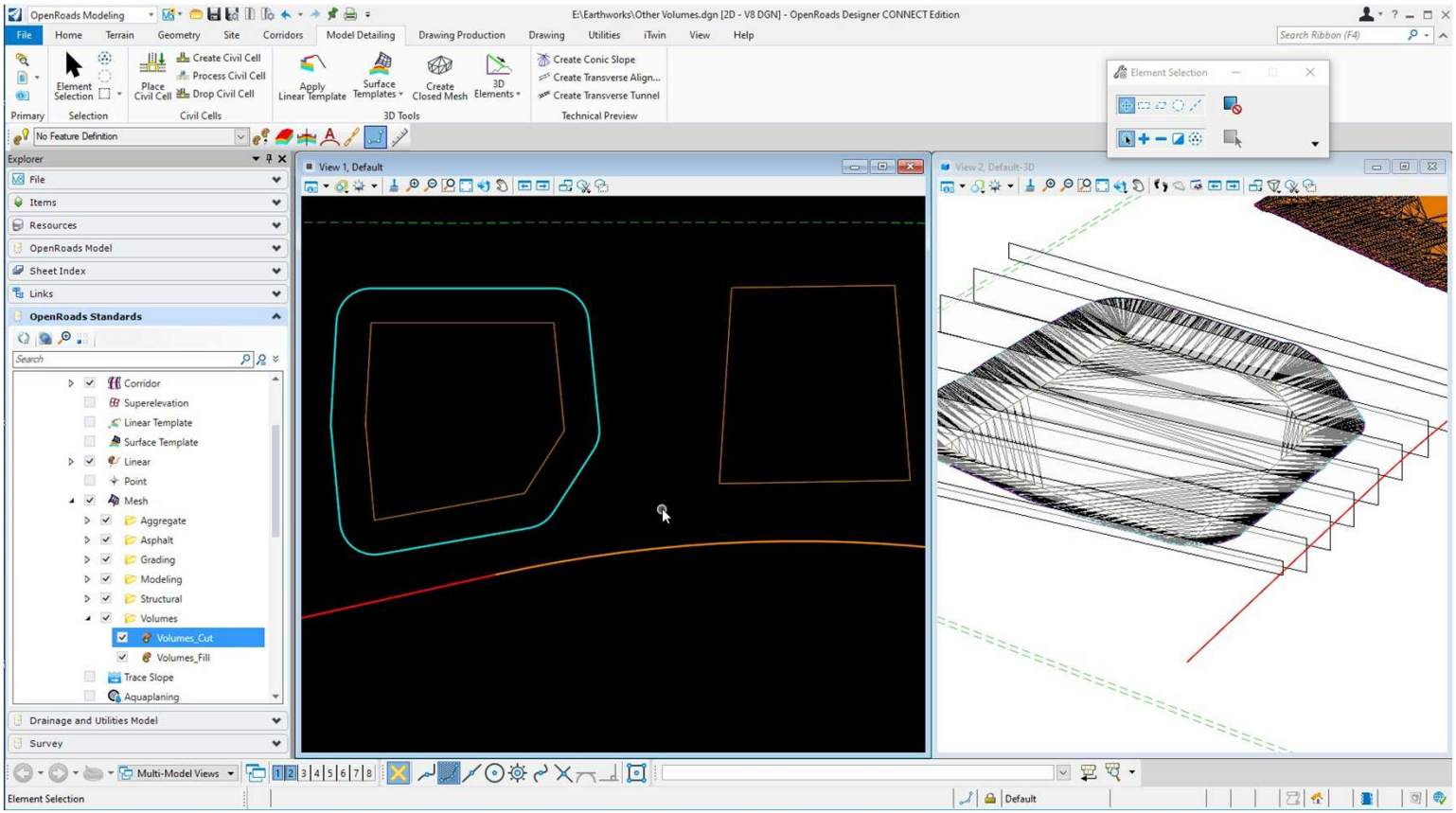
Create Closed Mesh – Surface to Depth



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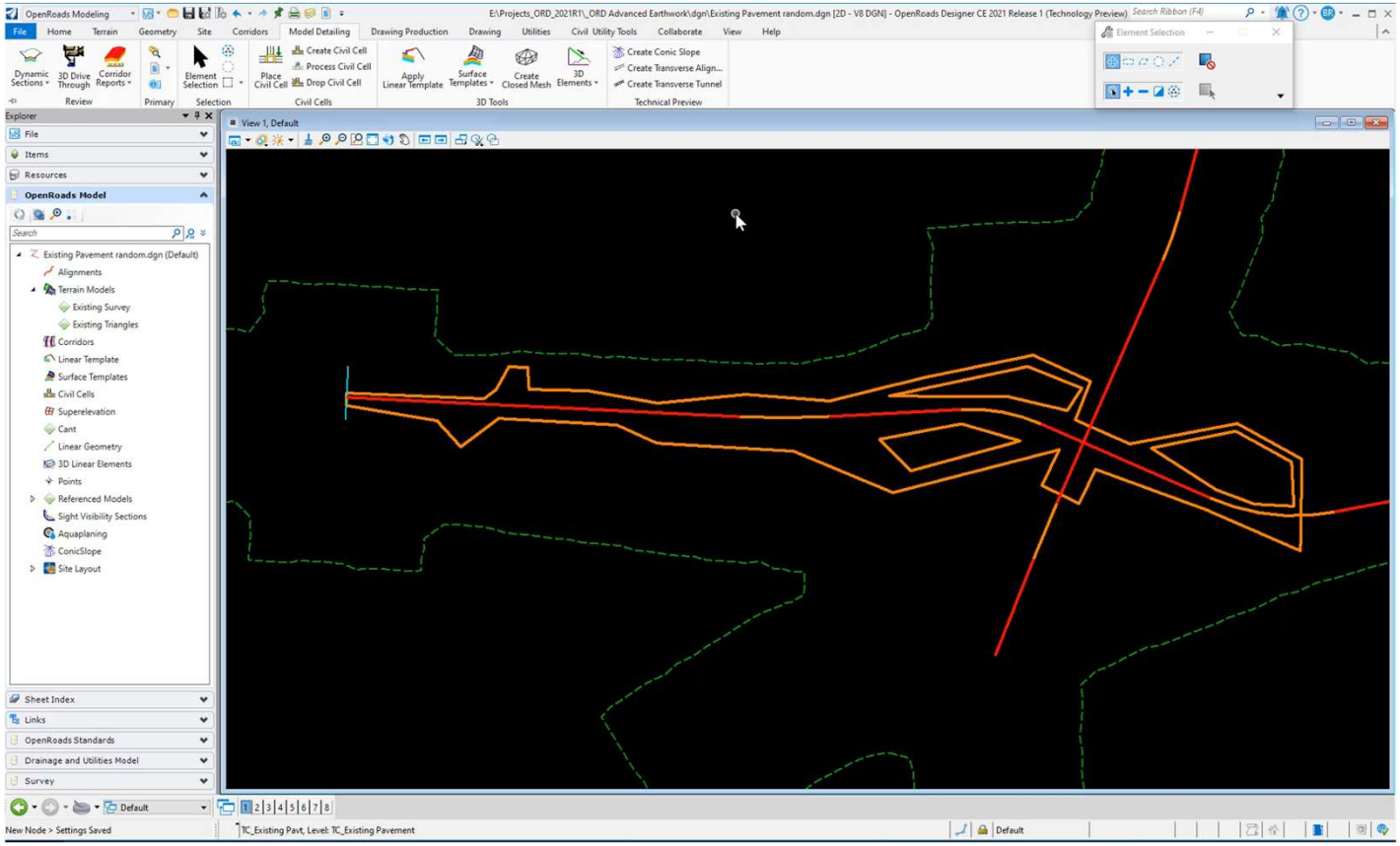
Clipped Terrains + Create Closed Mesh



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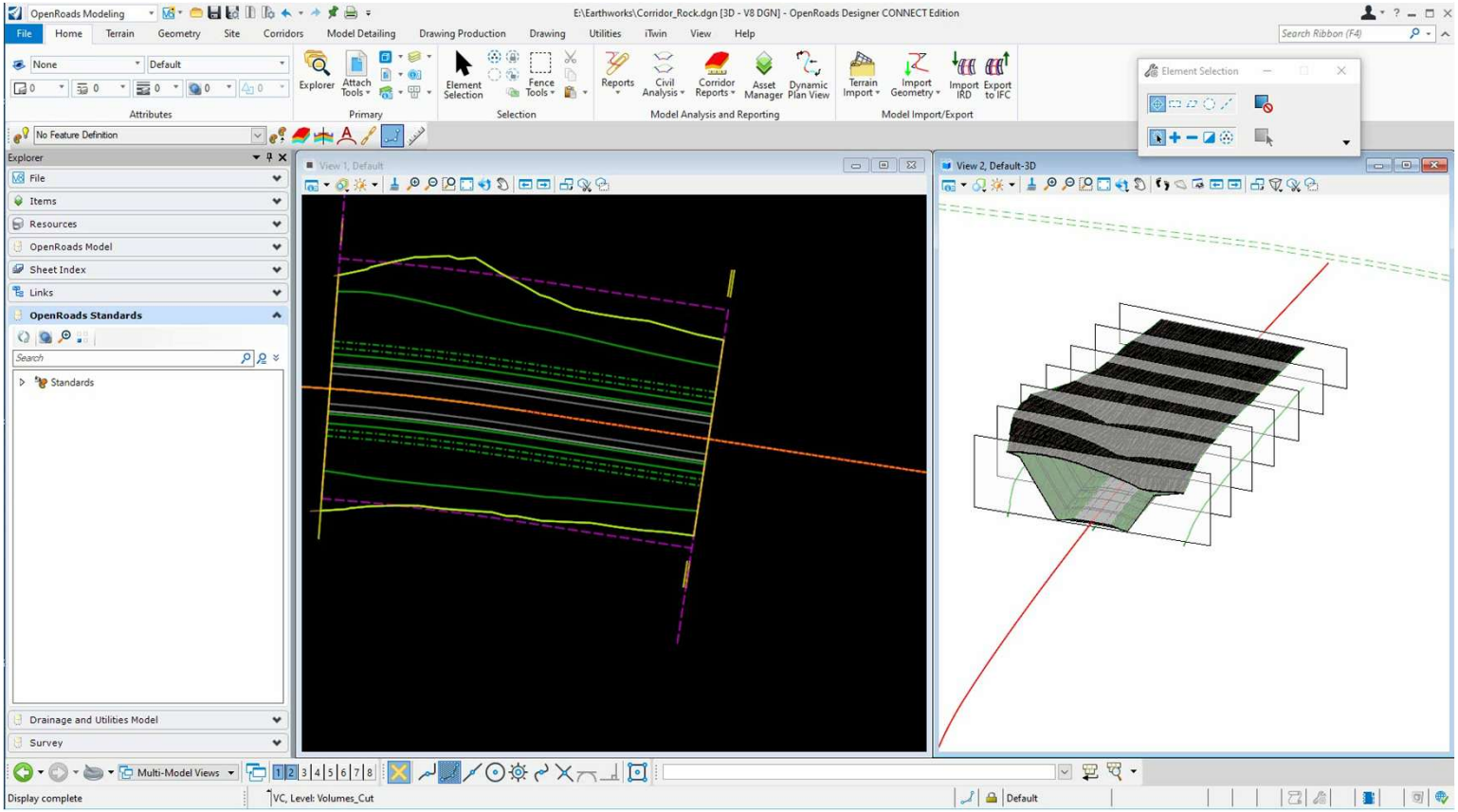
Substrata - Rock Cut



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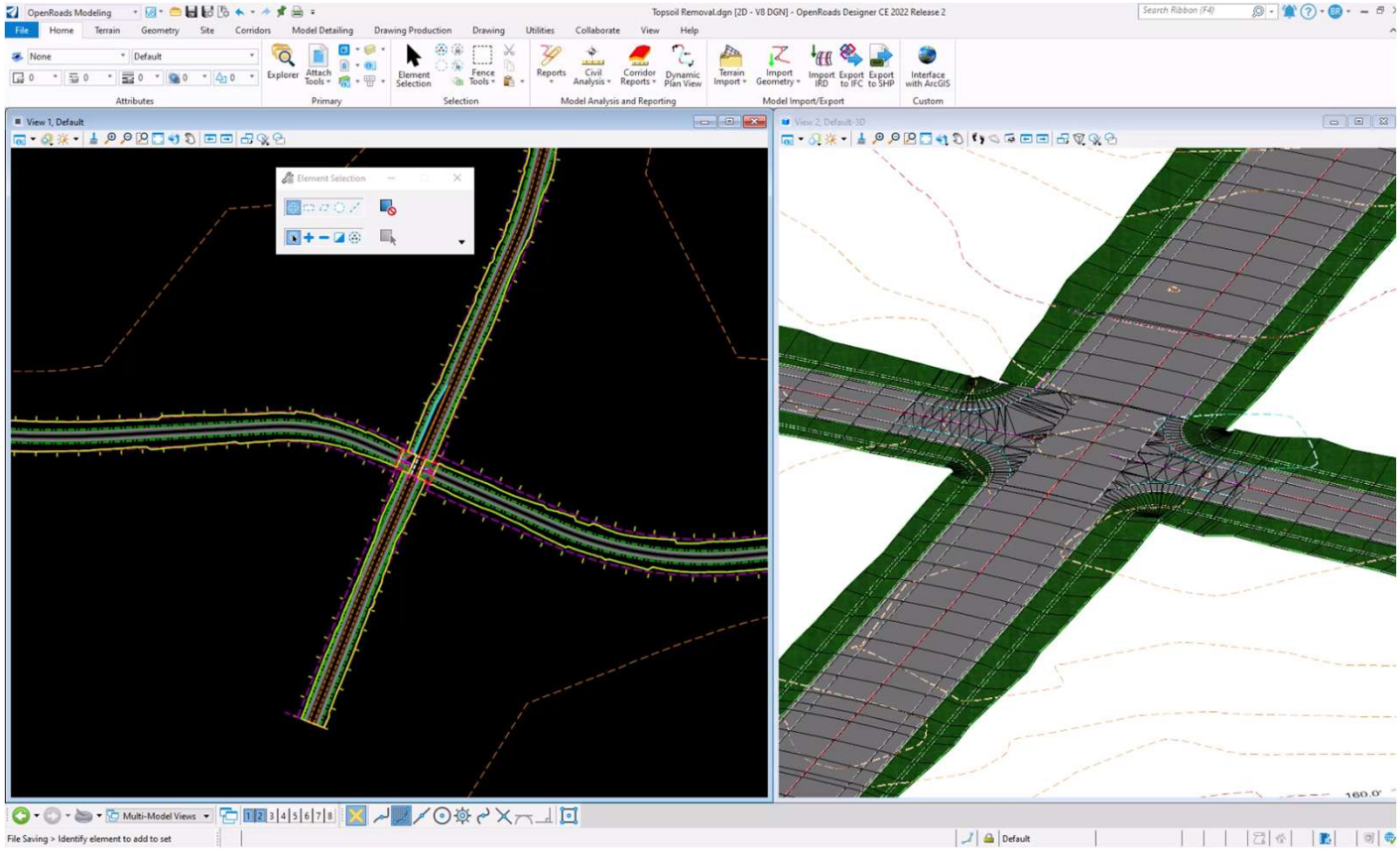
Topsoil Removal



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Create Cut \ Fill Volumes

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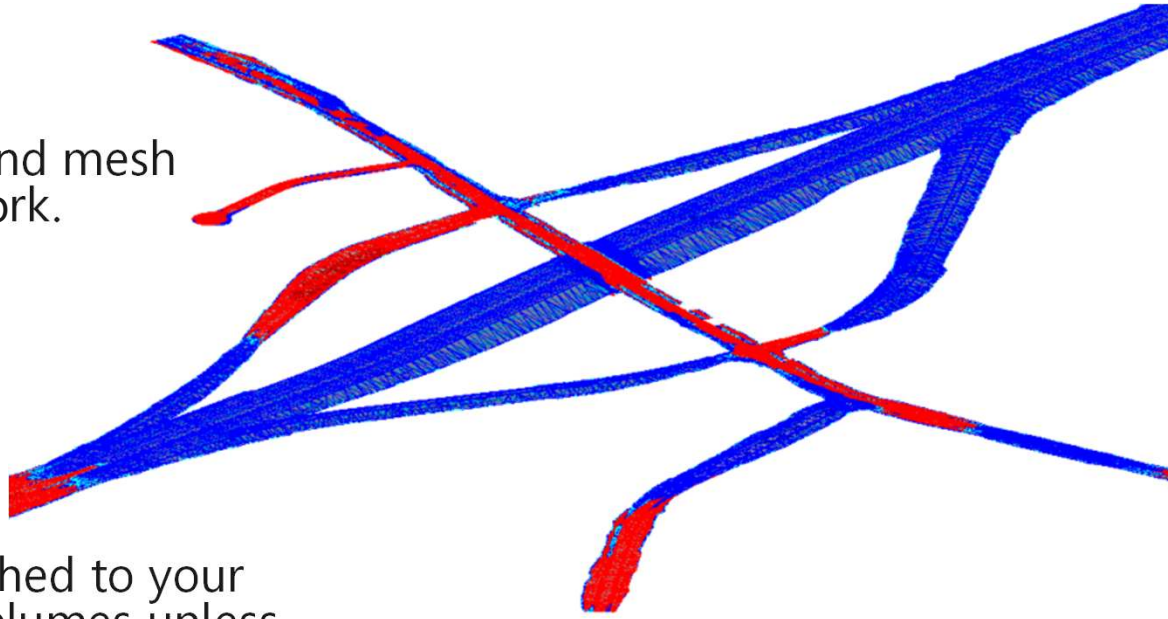
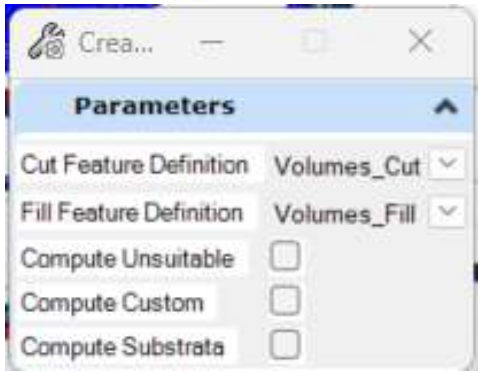
Create Cut/Fill Meshes

- Create 2d File for Earthwork
- Reference in files containing terrain and mesh elements to be considered in earthwork.
  - Corridors
  - Civil Cells
  - Ponds
  - Stock Piles
  - Existing Feature
  - Etc…
- Whatever is in the design file or attached to your file will be used to compute cut/fill volumes unless the volume option is marked as None.
  - Turning off the display of the reference does not matter. All files ATTACHED are considered.
- Run Create Cut Fill Volumes





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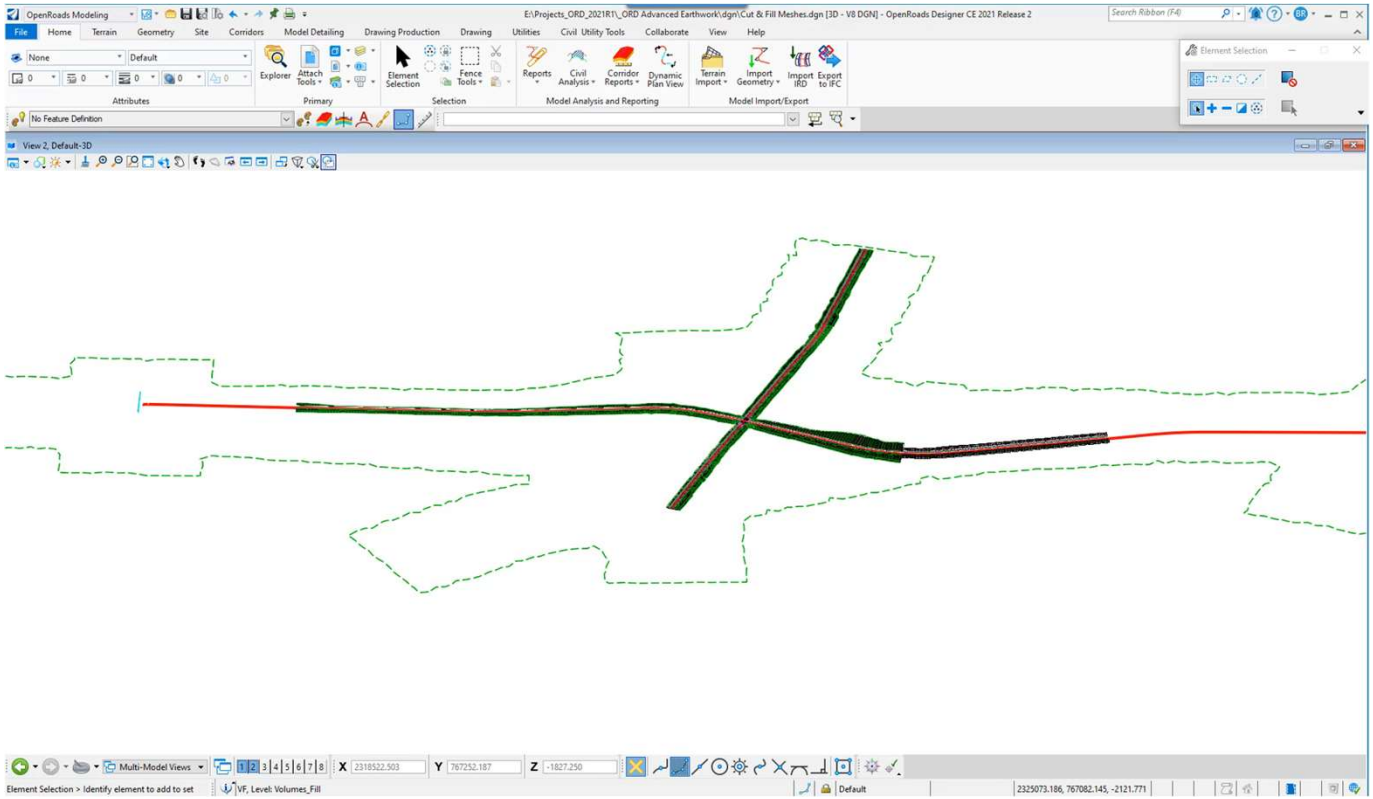
Create Cut/Fill Meshes



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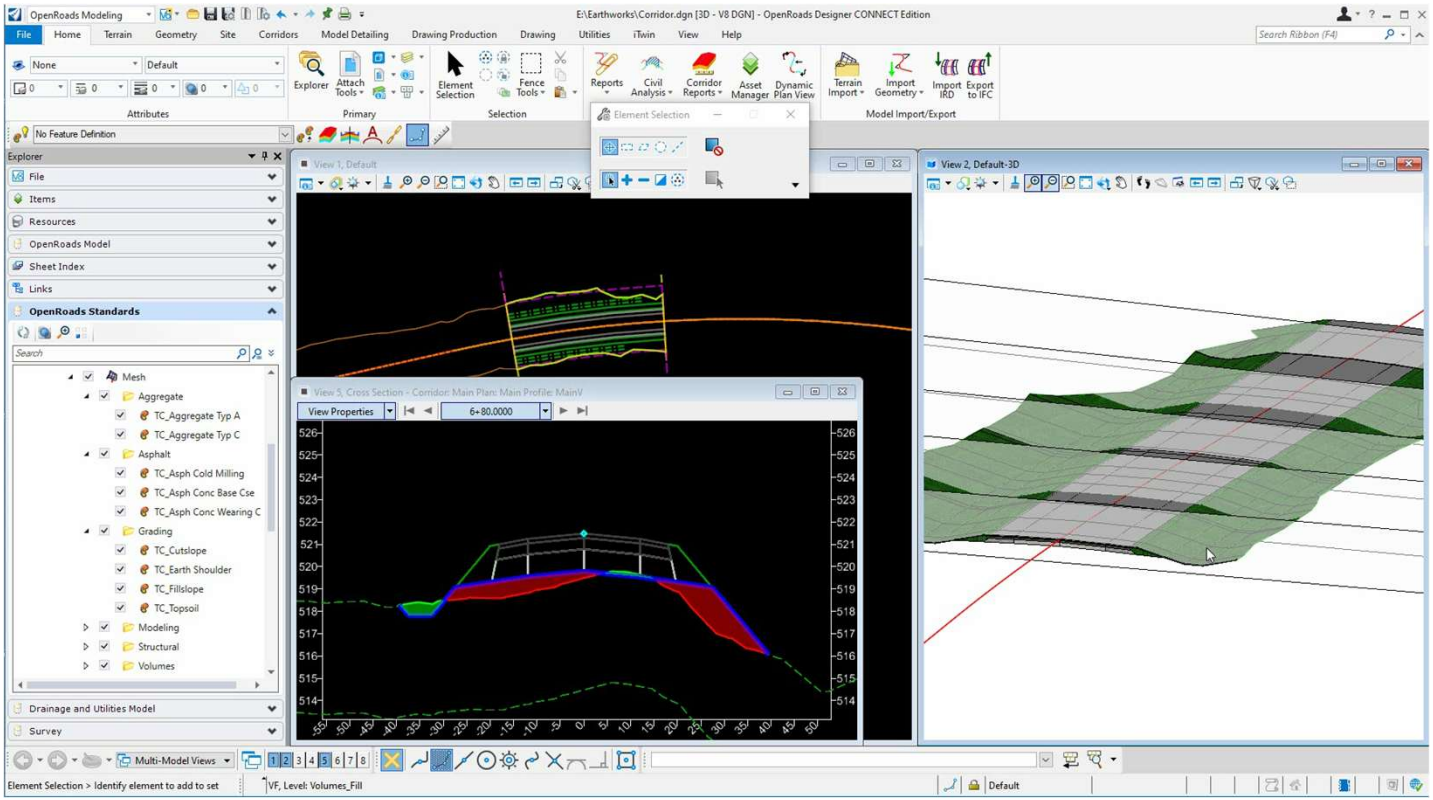
Create Cut/Fill Meshes - Unsuitable Substrata Custom



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Reporting

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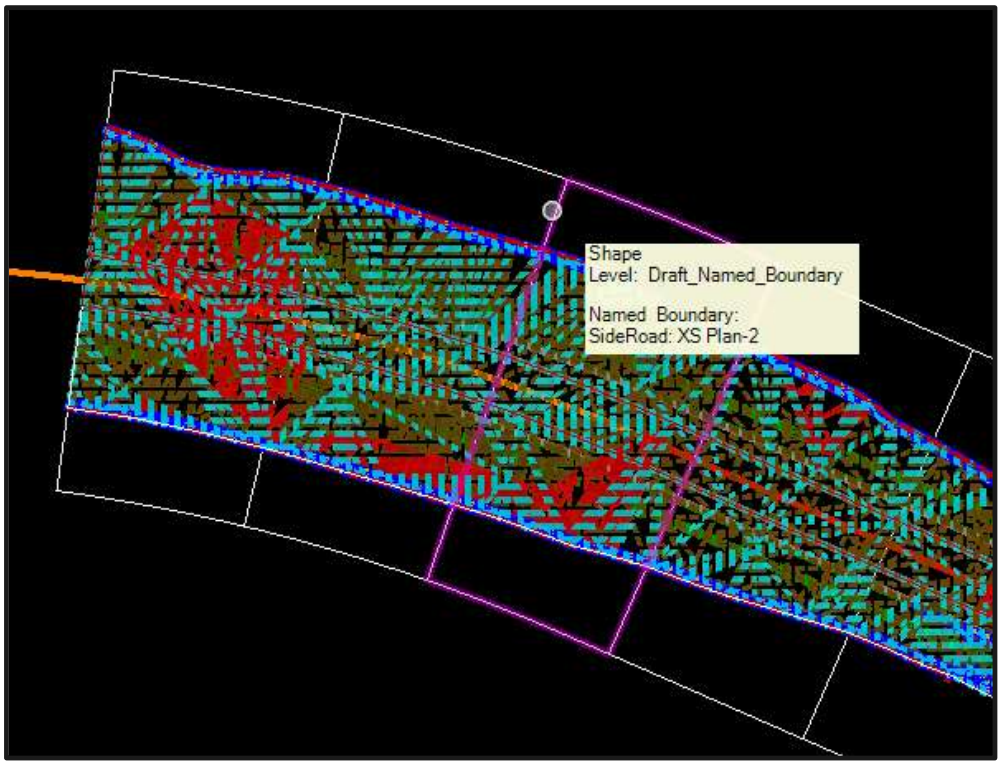
Plan Named Boundaries Volumes

- Reference Surfaces
  - Components
  - Terrains
  - Mesh
- Feature Definitions
- Cut Fill Meshes
- Plan Named Boundaries
- Can Create Clipped Graphics



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Plan Named Boundary Volumes

- Simulates End Area Volume (More Accurate)
- Set Plan Named Boundary Length to Cross Section Increment
- Run Quantites by Named Boundary
- Will Not Match End Area Volumes
  - Prismodial Volume Inside Boundaries
  - Not Average of Area

Volumes Report

Report Created: Tuesday, April 6, 2021
Time: 10:47:43 AM

Cross Section Set Name: SideRoad
Alignment Name: SideRoad
Input Grid Factor:

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

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
38+00.000							1463.217
	TC_Existing Pavt (removed):		2399.955	1.000	2399.955	No	
	Total TC_Existing Pavt:		2399.955	1.000	2399.955		
	TC_Existing Topsoil (removed):		10084.657	1.000	10084.657	No	
	Total TC_Existing Topsoil:		10247.976	1.000	10247.976		
	TC_Shale (removed):		1506.510	1.200	1807.812	No	
	Total TC_Shale:		154539.283	1.000	154539.283		
	TC_Sandstone (removed):		34999.190	1.200	41999.028	No	
	Total TC_Sandstone:		115461.284	1.000	115461.284		
	Volumes_Cut:		1626.536	1.000	1626.536	Yes	
	Volumes_Fill:		163.319	1.000	163.319	Yes	
	TC_Concrete Pavt:		2999.946	1.000	2999.946	No	
	TC_Aggregate Typ A:		1349.976	1.000	1349.976	No	
	TC_Aggregate Typ A Ext:		899.938	1.000	899.938	No	
	TC_Topsoil:		4224.104	1.000	4224.104	No	
	TC_Limestone:		600001.260	1.000	600001.260	No	
39+00.000							1426.523
	TC_Existing Pavt (removed):		2399.955	1.000	2399.955	No	

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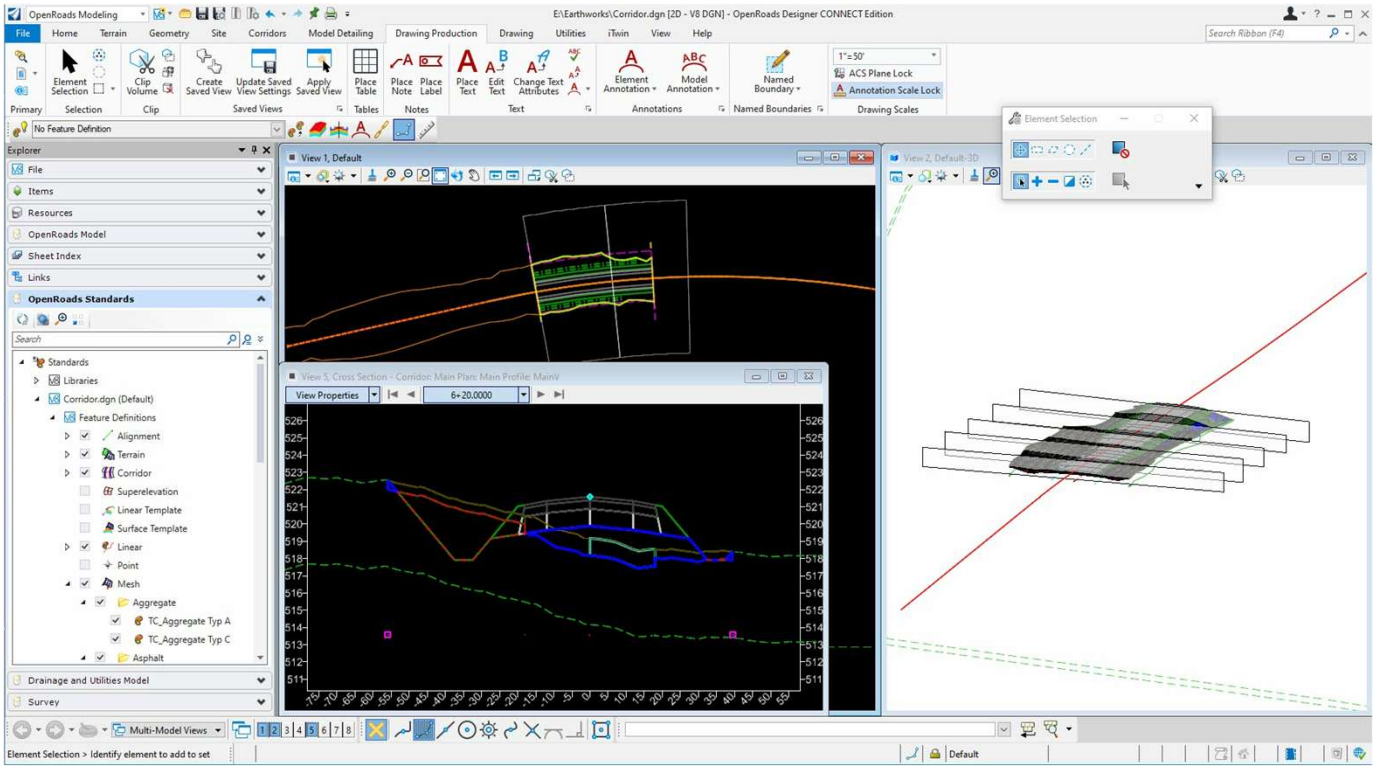
Plan Named Boundary Volumes



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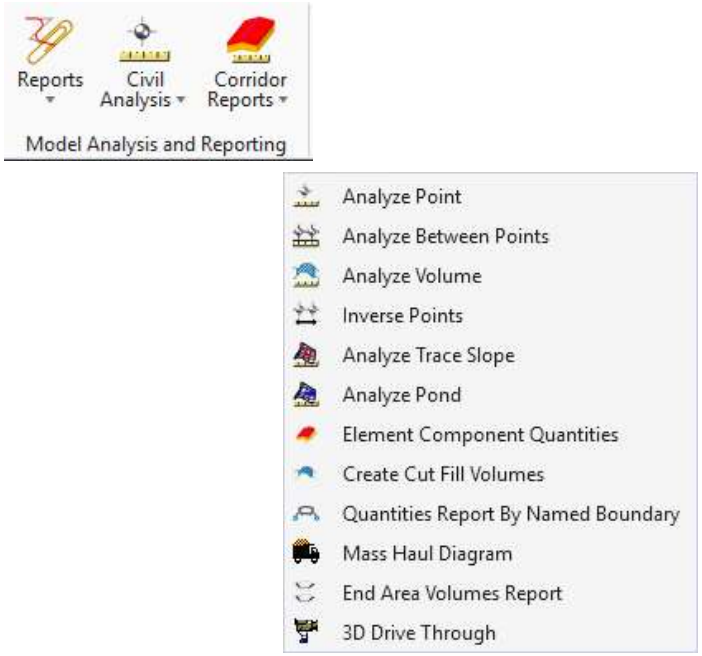
End Area Volume Report

- Requires Cross Section Named Boundaries
  - Location/Interval Defined by Named Boundaries
  - Can be referenced in Quantity \ Earthwork File
  - If use for Cross Section Sheet Annotation must be ran in file containing

- True End Area Calculations
  - Calculated from Cut/Fill Meshes
  - Does Not Consider Centroid



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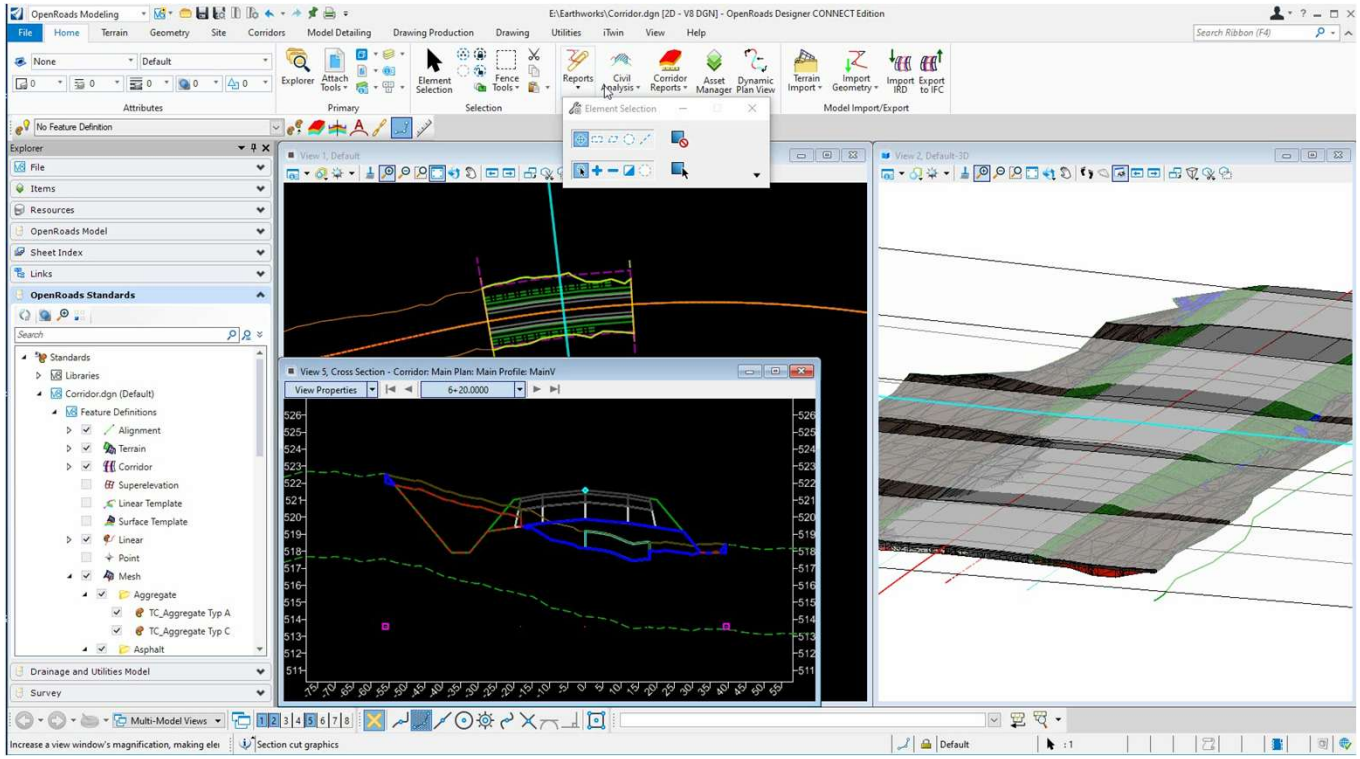
End Area Volume Report



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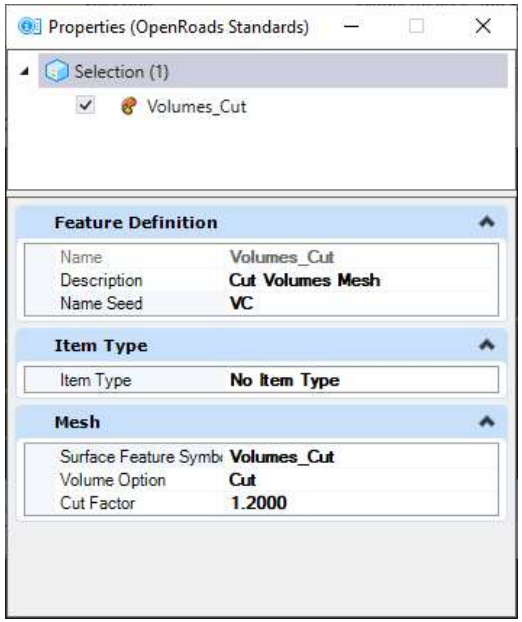
Cut/Fill Factors (Shrink/Swell)

- Cut/Fill Factors (Shrink/Swell) are associated with the Feature Definitions
- Taken into account when reported



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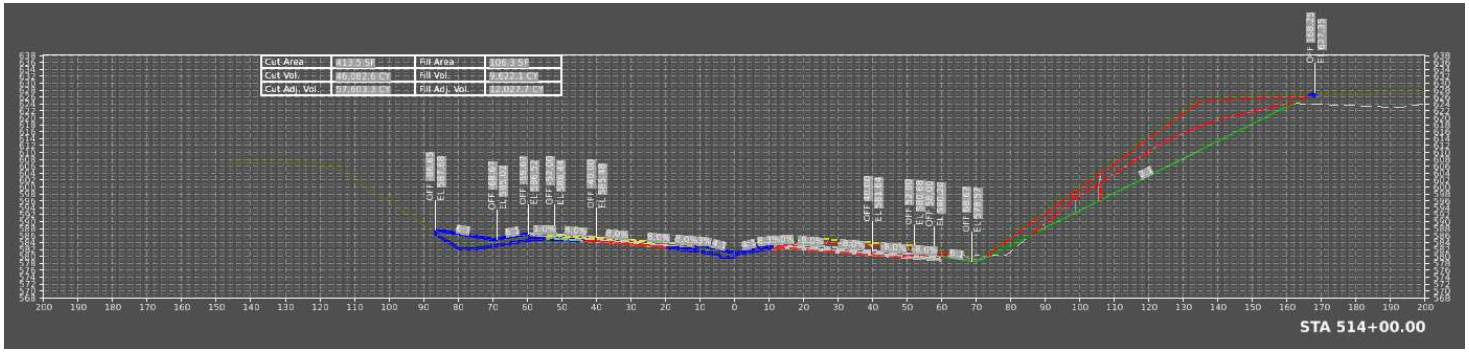
Cross Section Annotation

- End Area Volume Report and Annotation on Cross Section Sheets
- Only Cut & Fill can be Annotated on XS

Cut Area	413.5 SF	Fill Area	106.3 SF
Cut Vol.	46,082.6 CY	Fill Vol.	9,622.1 CY
Cut Adj. Vol.	57,603.3 CY	Fill Adj. Vol.	12,027.7 CY



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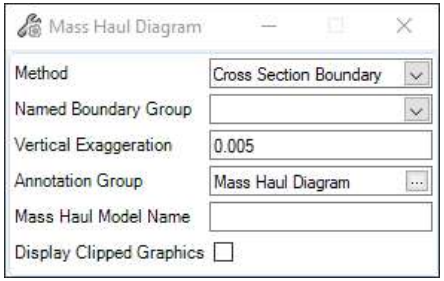
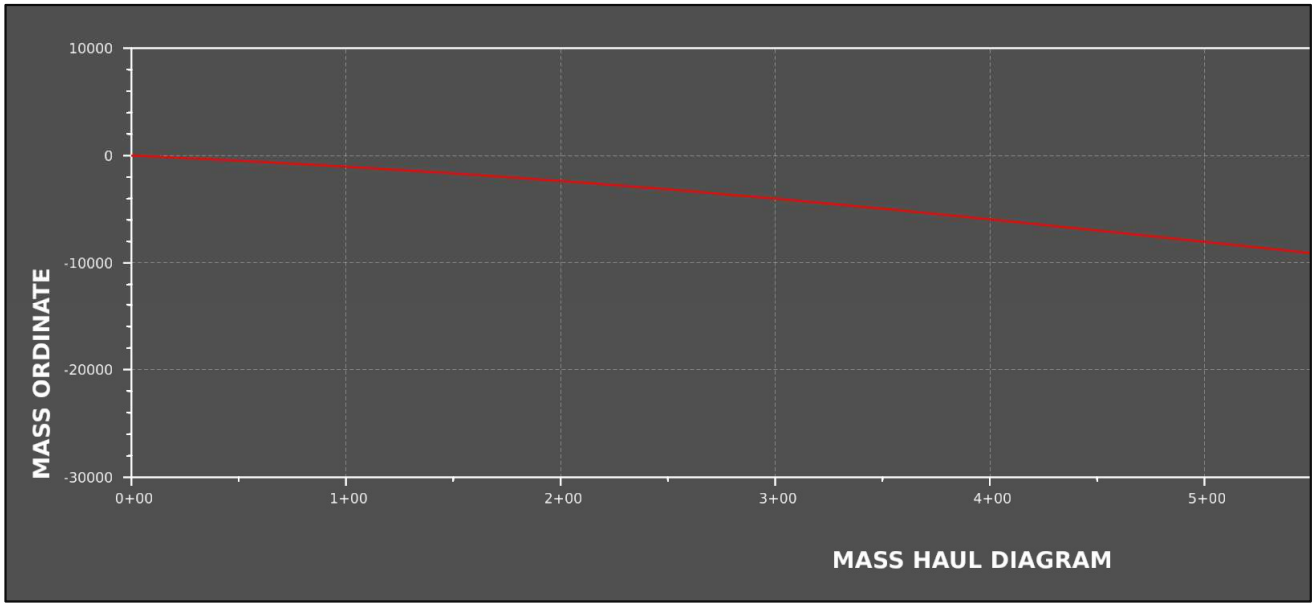
Mass Haul

- Methods
  - Interval
  - Plan Named Boundary
  - Cross Section Boundary





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Legacy Tools

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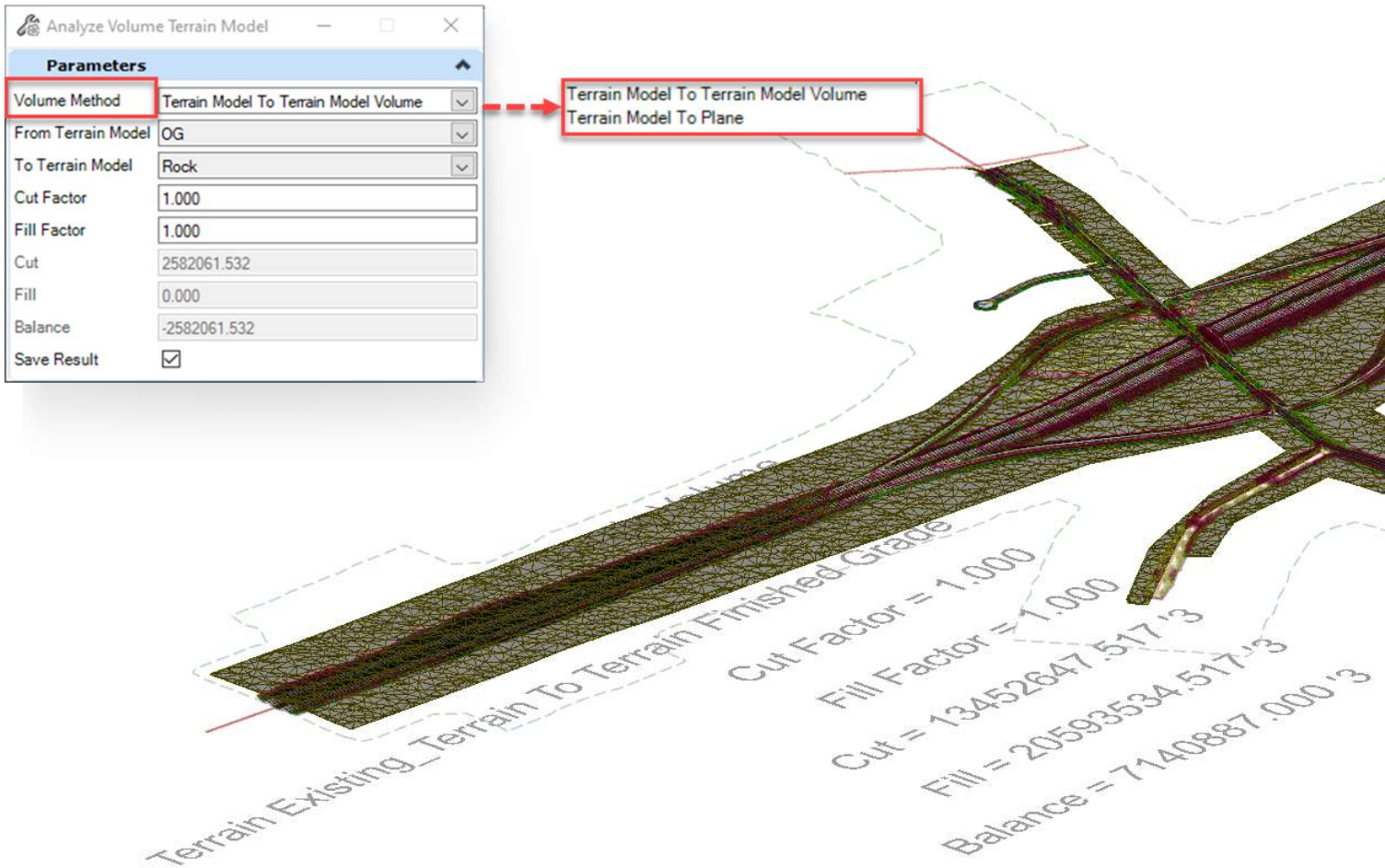
Legacy Tools

- Terrain to Terrain
- Component Quantities
- Dynamic End Area Display
- Element Properties
- Measure Volume

Terrain to Terrain Volumes

- Terrain to Terrain
- Terrain to Plane



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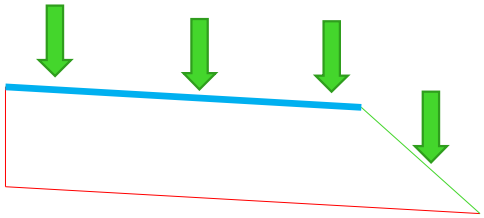
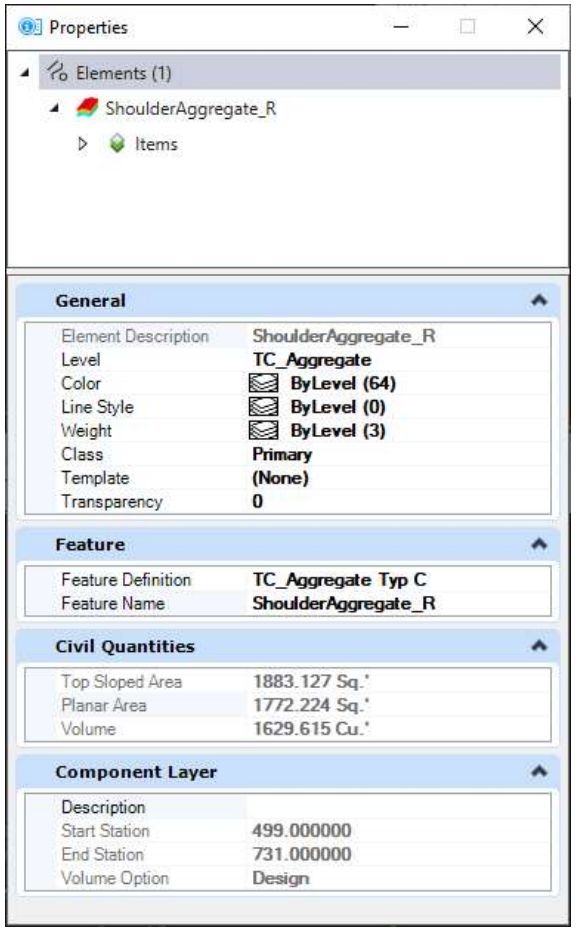
Element Properties

- Civil Quantities:
  - Volume
  - Planar Area
  - Top Sloped Area

- Displayed in Master Units
- The Surface That a Drop of Water May Hit
- Will require Separate component if wedge not included in area





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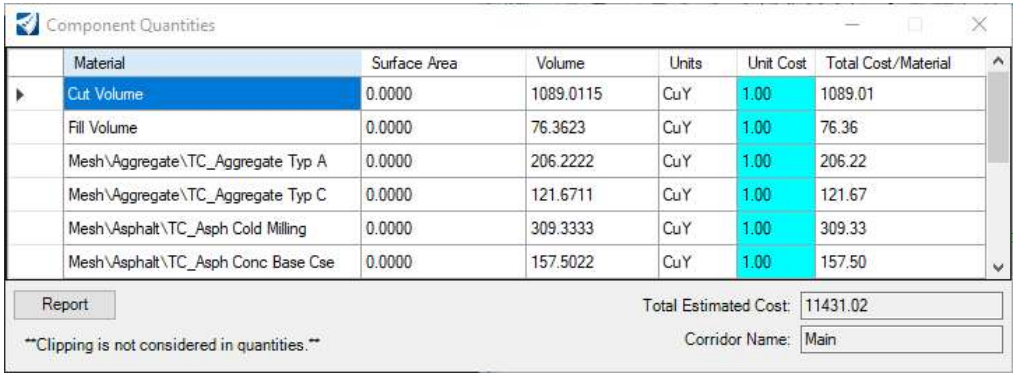
Component Quantities

- Only one corridor at a time
- Does not recognize clipping
- Computes Cut/Fill from lowest components



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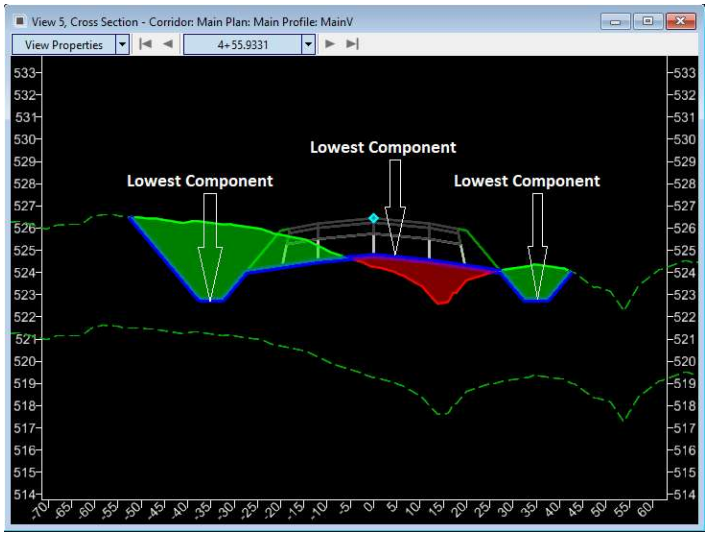
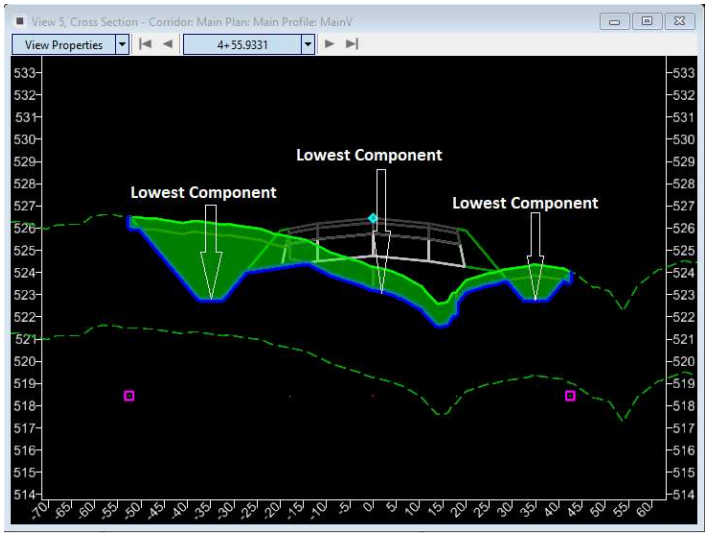
Dynamic End Area Volumes



With No Unsuitable/Milling



With Unsuitable/Milling

NOTE: Example shows Cut/Fill in Dynamic Sections.
Values in Dynamic Section Will Reflect the Same

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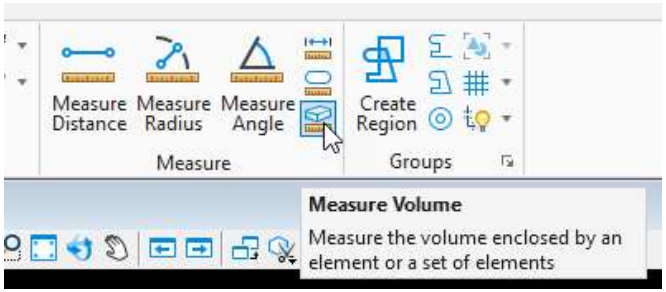
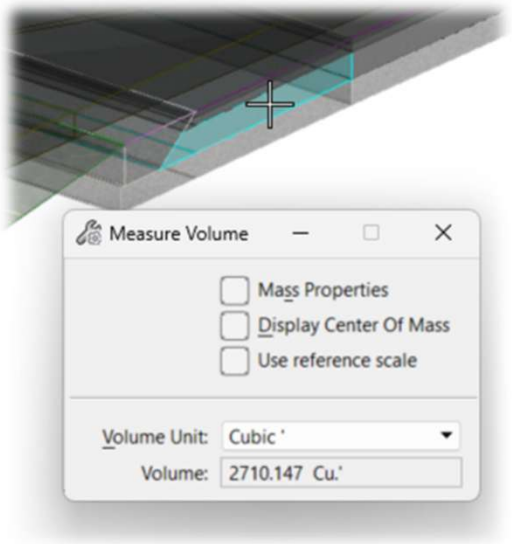
Measure Volumes

- MicroStation Measure Volume Tool
  - Can be Used with Selection Set





Setting	Description
Mass Properties	If on, the **Mass Properties window** displays the mass property analysis for the measured volume.
Display Center Of Mass	If on, a graphic crosshair that represents the center of mass for the measured element(s) is displayed.
Use reference scale	Allows users to measure in true model units while in a Sheet model that contains a scaled reference file. This checkbox is off by default. **Note:** This setting is only applicable in the Sheet models.

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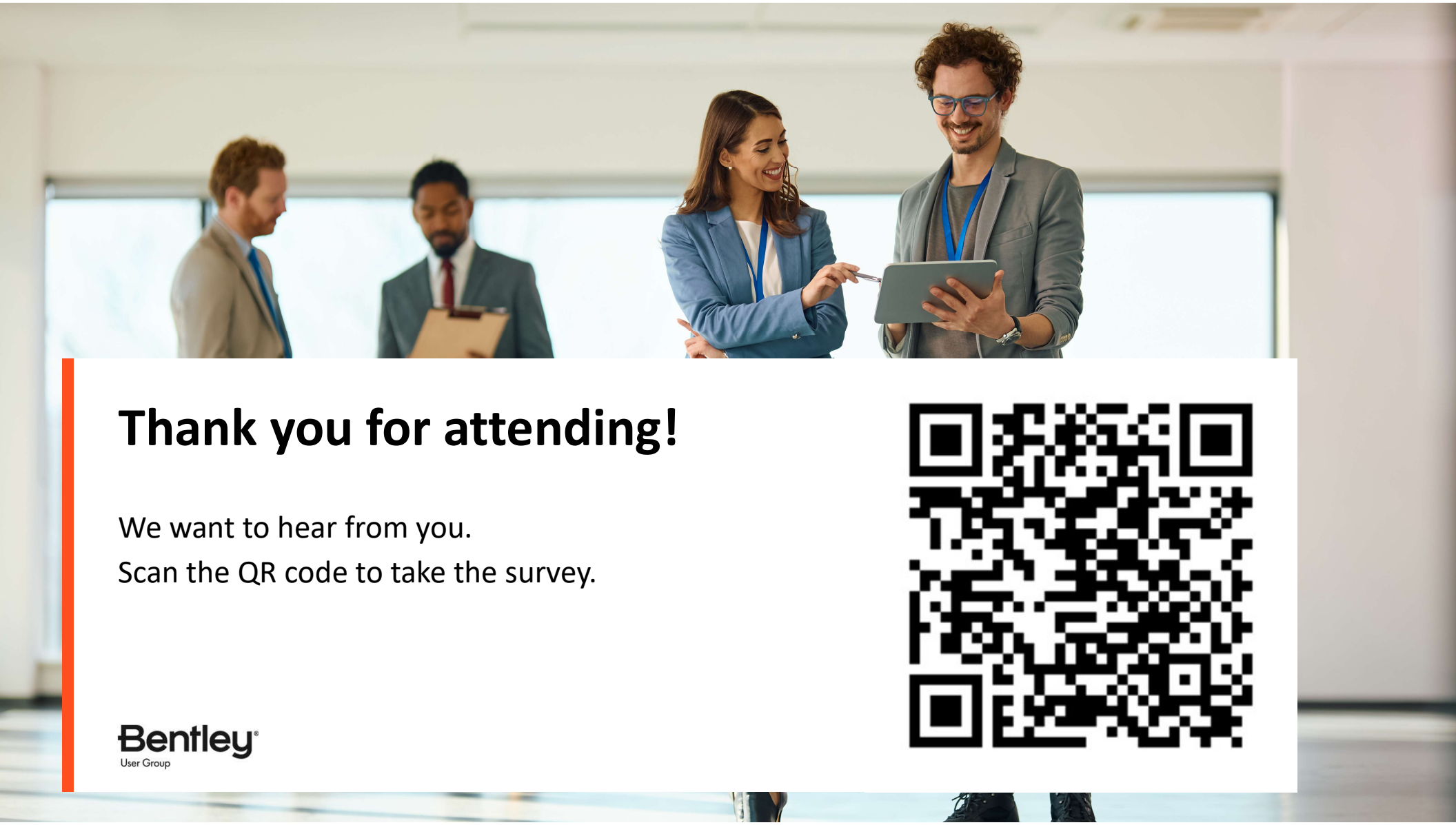

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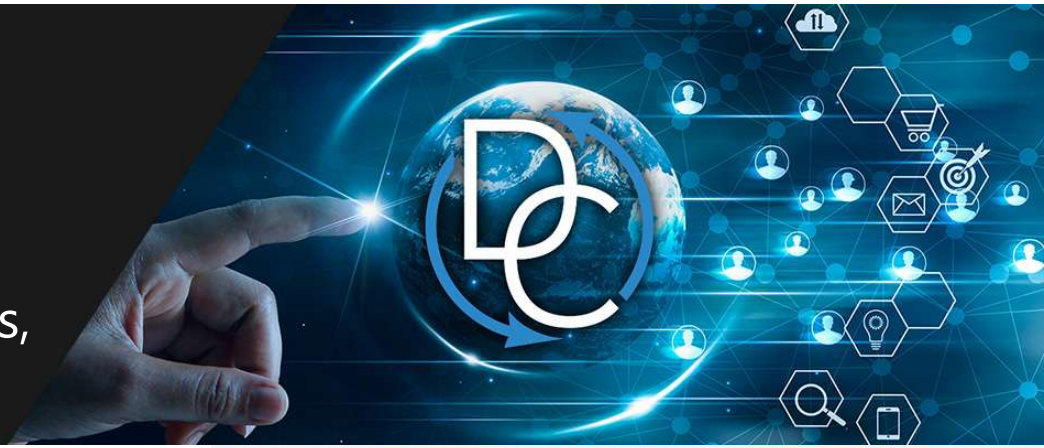

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