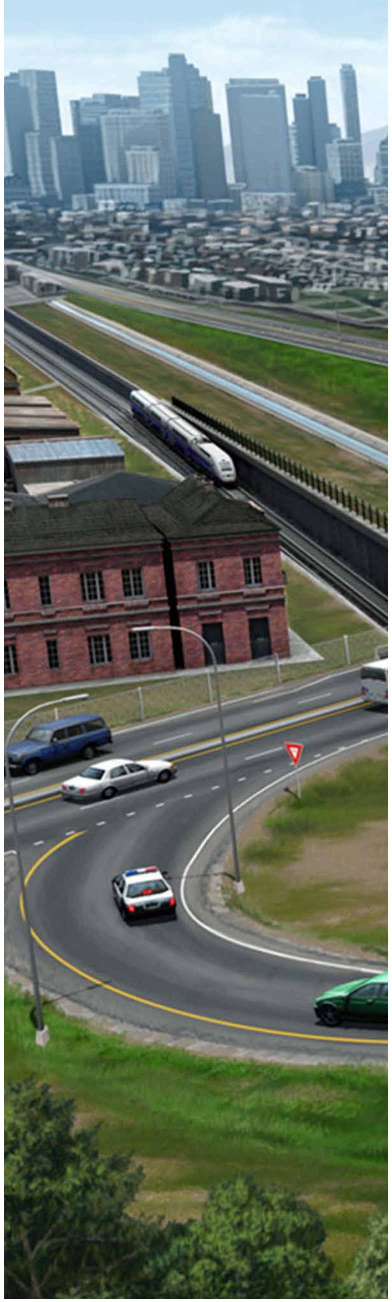


Quantities and Earthwork

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

OpenRoads Designer CONNECT Edition

OpenRail Designer CONNECT Edition

About this Practice Workbook...

- This workbook is designed for use in Live instructor-led training and for OnDemand self study. OnDemand videos for this course are available on **learning.bentley.com**
- This PDF file includes bookmarks providing an overview of the document. Click on a bookmark to quickly jump to any section in the file.
- Both Imperial and Metric files are included in the dataset. Throughout this practice workbook Imperial values are specified first and the metric values second with the metric values enclosed in square brackets.
  For example: *12.0’ [3.4m]*.
- This course workbook uses the *Training and Examples* WorkSpace and the *Training-Imperial* or *Training-Metric* WorkSet delivered with the software.
- The terms “Left-click”, “Click”, “Select” and “Data” are used interchangeably to represent pressing the left mouse button. The terms “Right-click” and “Reset” are also used interchangeably to represent pressing the right mouse button. If your mouse buttons are assigned differently, such as for left-handed use, you will need to adjust accordingly.

Have a Question? Need Help?

If you have questions while taking this course, you can submit questions to the *Civil Design Forum* on Bentley Communities where peers and Bentley subject matter experts are available to help.

Bentley Institute

Edition: **08-02**

Course Level: **Intermediate**

Quantities and Earthwork Course Overview

In this course, you will learn various tools and methods to compute quantities and earthwork from the corridor model. You will learn how to assign unit costs and generate an estimated cost report for your project using the Component Quantities and Element Component Quantities tools. We will take a look at how to generate cut and fill volume reports from single corridor models as well as multiple corridor models. You will also learn how Named Boundaries and the Quantities Report by Named Boundary tool can be used to separate quantities in the corridor model. And lastly, you will learn how to create an End Area Volume Report.

Skills Taught

- Component Quantities
- Assign Unit Costs
- Total Estimated Cost Reports
- Element Component Quantities
- 3D Cut/Fill Volumes
- 3D Cut/Fill and Remove/Replace Volumes
- Feature Definition Volume Options
- Named Boundaries
- Quantities Report by Named Boundary
- End Area Volumes Report

Exercise 1: Component Quantities and Element Component Quantities

In this exercise, you will learn to start the software, select the proper WorkSpace & WorkSet, open the corridor model and how to use the Component Quantities and Element Component Quantities to compute corridor quantities.

Skills Taught

- Start the Software
- Select WorkSpace & WorkSet
- Component Quantities
- Assign Unit Costs
- Total Estimated Cost
- Compute Quantities Report
- Display Cut and Fill Volumes on Cross Sections
- Element Component Quantities

Start The Software and Set the WorkSpace/WorkSet

In this section, you will start the software, set the proper workspace and open the Corridor Model.

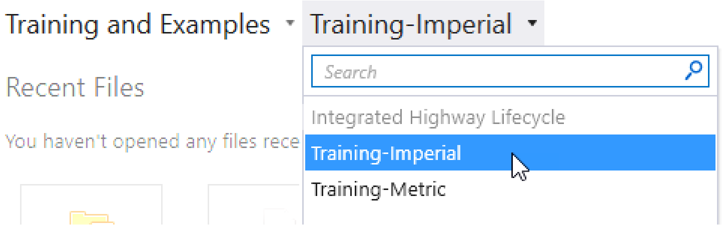
1. Start the software.
2. Set the WorkSpace and WorkSet.

   The WorkSpace and WorkSet define standards that are used by the software, and the ones used for this training are installed during the software installation.

   Typically, the WorkSpace contains organizational standards and the WorkSet contains project standards.

   a. Select **Training and Examples** from the *WorkSpace* drop-down menu.

   b. Select **Training-Imperial** *[Training-Metric]* from the *WorkSet* drop-down menu.



3. Open **Corridor-LondonRd.dgn** *[Metric-Corridor-LondonRd.dgn]*

   a. Select **Open**.

   b. Browse to *C:\Bentley Training\Quantities and Earthwork* or other folder where you unzipped the dataset files.

   c. Select the **Corridor-LondonRd.dgn** *[Metric-Corridor-LondonRd.dgn].*

Component Quantities

In this section, you learn how to extract quantities from the corridor using the Component Quantities tool. Component Quantities is a reporting tool that computes and reports the quantities of components in the corridor model. The volumes are calculated using the Average End Area method and the accuracy of the quantities is determined by the template drop interval, key stations and any critical stations used within the corridor. Items such as: pavement, sub-base, aggregate, curb, sidewalk and cut & fill can be computed using the Component Quantities tool. Additionally, you can assign unit costs to each item to generate an estimated cost report. Also, Corridor Clipping is **NOT** considered in the quantities. This tool is intended for approximate quantities and is typically used in preliminary design.

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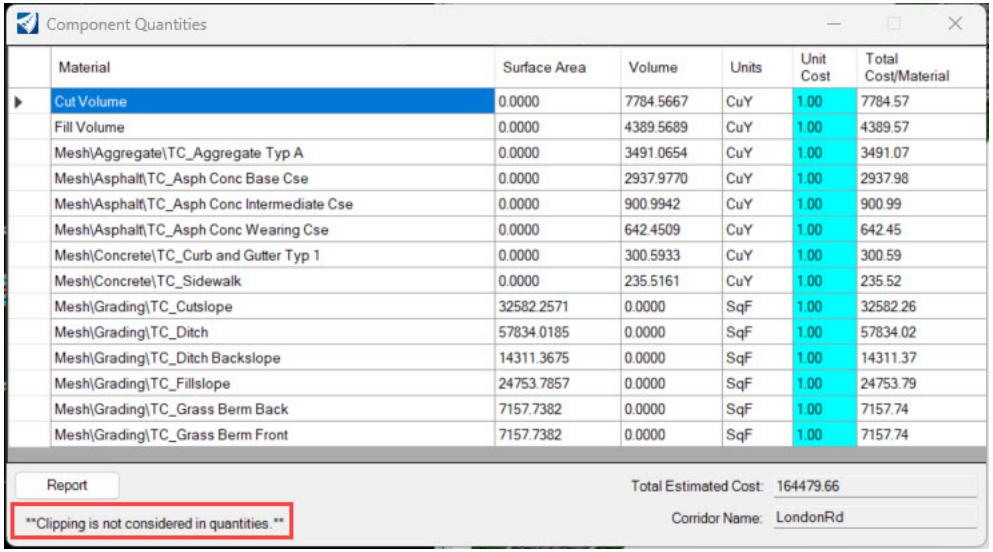
1. Compute *Component Quantities* for the London Rd. corridor.

a. From the ribbon menu, select *Home > Model Analysis and Reporting > Corridor Reports >* **Component Quantities**

b. *Locate Corridor*, **Select** the London Rd. corridor.

The *Component Quantities* window will now appear displaying the *Materials* and *Quantities*.

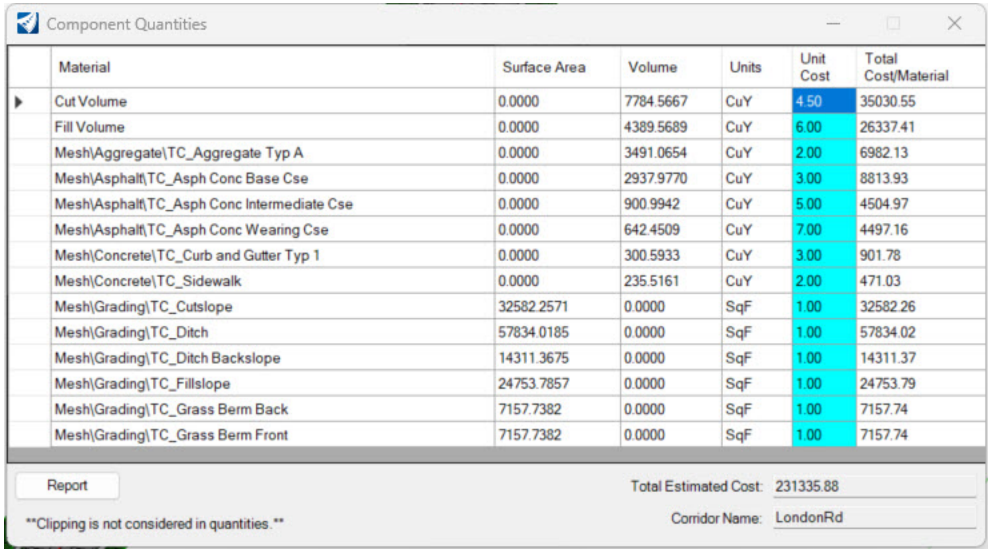


Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
Cut Volume	0.0000	7784.5667	CuY	1.00	7784.57
Fill Volume	0.0000	4389.5689	CuY	1.00	4389.57
Mesh\Aggregate\TC_Aggregate Typ A	0.0000	3491.0654	CuY	1.00	3491.07
Mesh\Asphalt\TC_Asph Conc Base Cse	0.0000	2937.9770	CuY	1.00	2937.98
Mesh\Asphalt\TC_Asph Conc Intermediate Cse	0.0000	900.9942	CuY	1.00	900.99
Mesh\Asphalt\TC_Asph Conc Wearing Cse	0.0000	642.4509	CuY	1.00	642.45
Mesh\Concrete\TC_Curb and Gutter Typ 1	0.0000	300.5933	CuY	1.00	300.59
Mesh\Concrete\TC_Sidewalk	0.0000	235.5161	CuY	1.00	235.52
Mesh\Grading\TC_Cutslope	32582.2571	0.0000	SqF	1.00	32582.26
Mesh\Grading\TC_Ditch	57834.0185	0.0000	SqF	1.00	57834.02
Mesh\Grading\TC_Ditch Backslope	14311.3675	0.0000	SqF	1.00	14311.37
Mesh\Grading\TC_Fillslope	24753.7857	0.0000	SqF	1.00	24753.79
Mesh\Grading\TC_Grass Berm Back	7157.7382	0.0000	SqF	1.00	7157.74
Mesh\Grading\TC_Grass Berm Front	7157.7382	0.0000	SqF	1.00	7157.74

You can assign unit costs to each item by entering the unit cost in the *Unit Cost* field and the Total Estimated Cost will be computed. Also, note clipping is not considered in the quantities. If you have clipped corridors the quantities **WILL NOT** be reported correctly.

2. Experiment with assigning unit costs to some of the materials by entering values in the unit cost fields.

   a. Double-click in the **Unit Cost** field to enter a new unit cost value (any value will do) for some of the materials. Note how the *Total Cost/ Material* and *Total Estimated Cost* will update.


Component Quantities

Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
Cut Volume	0.0000	7784.5667	CuY	4.50	35030.55
Fill Volume	0.0000	4389.5689	CuY	6.00	26337.41
Mesh\Aggregate\TC_Aggregate Typ A	0.0000	3491.0654	CuY	2.00	6982.13
Mesh\Asphalt\TC_Asph Conc Base Cse	0.0000	2937.9770	CuY	3.00	8813.93
Mesh\Asphalt\TC_Asph Conc Intermediate Cse	0.0000	900.9942	CuY	5.00	4504.97
Mesh\Asphalt\TC_Asph Conc Wearing Cse	0.0000	642.4509	CuY	7.00	4497.16
Mesh\Concrete\TC_Curb and Gutter Typ 1	0.0000	300.5933	CuY	3.00	901.78
Mesh\Concrete\TC_Sidewalk	0.0000	235.5161	CuY	2.00	471.03
Mesh\Grading\TC_Cutslope	32582.2571	0.0000	SqF	1.00	32582.26
Mesh\Grading\TC_Ditch	57834.0185	0.0000	SqF	1.00	57834.02
Mesh\Grading\TC_Ditch Backslope	14311.3675	0.0000	SqF	1.00	14311.37
Mesh\Grading\TC_Fillslope	24753.7857	0.0000	SqF	1.00	24753.79
Mesh\Grading\TC_Grass Berm Back	7157.7382	0.0000	SqF	1.00	7157.74
Mesh\Grading\TC_Grass Berm Front	7157.7382	0.0000	SqF	1.00	7157.74

Report

Total Estimated Cost: 231335.88

Corridor Name: LondonRd

Clipping is not considered in quantities.

3. Create Component Quantities Report.

   a. Select the **Report** button on the *Compute Quantities* window to display the Component Quantities Report.

b. Review the Component Quantities Report and note the detailed quantities it provides for each Material: *Area*, *Volume* and *Length*.

Corridor Model Component Quantities Report

Report Created: Friday, August 6, 2021
Time: 11:16:30 AM

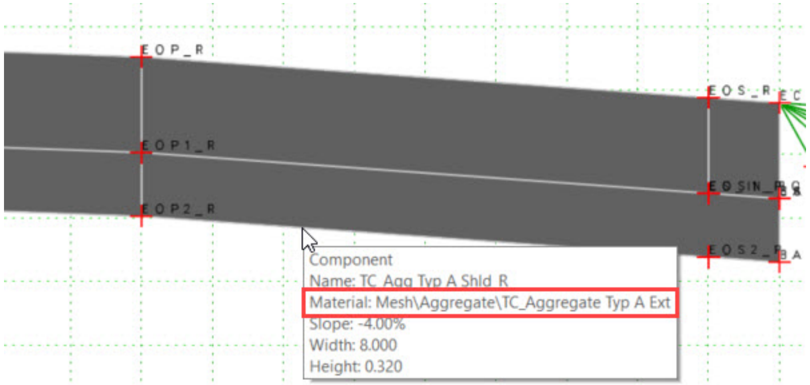
Corridor Name: LondonRd
Alignment Name:
Input Grid Factor: 1.000000

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

		Component End Area Totals		Component Surface Area Totals			
Station	**Material**	**Area**	**Volume**	**Length**	**Area**	**Unit Cost**	**Material Cost**
50+00.000							
	Cut Volume:	76.206				4.50	0.000
	Fill Volume:					6.00	0.000
	Mesh\Aggregate\TC_Aggregate Typ A:	18.450				2.00	0.000
	Mesh\Asphalt\TC_Asph Conc Base Cse:	16.624				3.00	0.000
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	4.732				5.00	0.000
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:	3.350				7.00	0.000
	Mesh\Grading\TC_Ditch:			18.248		1.00	0.000
	Mesh\Grading\TC_Ditch Backslope:			19.832		1.00	0.000
50+10.000							
	Cut Volume:	73.095	746.505			0.17	124.417
	Fill Volume:	0.011	0.054			0.22	0.012
	Mesh\Aggregate\TC_Aggregate Typ A:	18.724	185.873			0.07	13.768
	Mesh\Asphalt\TC_Asph Conc Base Cse:	16.924	167.740			0.11	18.638
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	4.819	47.756			0.19	8.844
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:	3.412	33.810			0.26	8.766
	Mesh\Grading\TC_Ditch:			18.248	182.479	1.00	182.479
	Mesh\Grading\TC_Ditch Backslope:			19.592	197.117	1.00	197.117
50+20.000							
	Cut Volume:	71.718	724.061			0.17	120.677
	Fill Volume:	0.031	0.210			0.22	0.047
	Mesh\Aggregate\TC_Aggregate Typ A:	18.999	188.617			0.07	13.972
	Mesh\Asphalt\TC_Asph Conc Base Cse:	17.223	170.735			0.11	18.971

Note: By default, all units in this report are in feet *[meters]*, square feet *[square meters]* and cubic feet *[cubic meters]* unless specified otherwise. The volumes in this report are calculated using the Average End Area Volume method and the stationing is determined from the template drop interval, key stations and critical stations within the corridor.

All of the materials listed are the different components that make up the corridor. The material names come from the *Feature Definitions* that were assigned to each component in the template that was used to create the corridor.

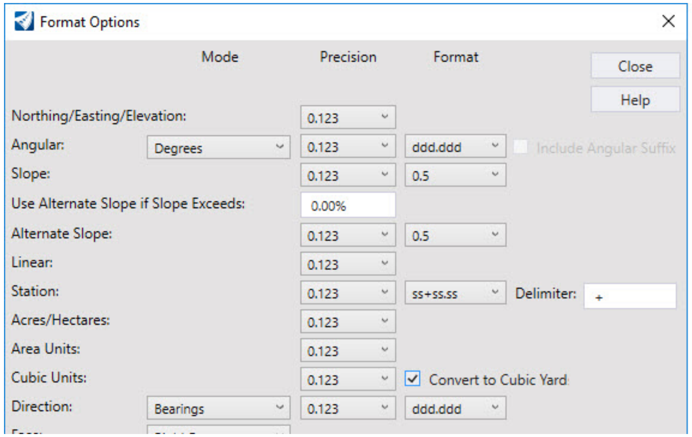


c. Scroll down to the bottom of the report and review the volumes and total estimated cost.

Totals:

Cut Volume:	210328.045		0.17	35054.674
Fill Volume:	118406.018		0.22	26312.449
Mesh\Aggregate\TC_Aggregate Typ A:	94291.722		0.07	6984.572
Mesh\Asphalt\TC_Asph Conc Base Cse:	79348.635		0.11	8816.515
Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	24334.243		0.19	4506.341
Mesh\Asphalt\TC_Asph Conc Wearing Cse:	17351.464		0.26	4498.528
Mesh\Concrete\TC_Curb and Gutter Typ 1:	8123.078		0.11	902.564
Mesh\Concrete\TC_Sidewalk:	6364.573		0.07	471.450
Mesh\Grading\TC_Cutslope:		32576.788	1.00	32576.788
Mesh\Grading\TC_Ditch:		57881.072	1.00	57881.072
Mesh\Grading\TC_Grass Berm Back:		7164.084	1.00	7164.084
Mesh\Grading\TC_Grass Berm Front:		7164.084	1.00	7164.084
			Total Estimated Cost:	**231401.39**

d. Notice the volume quantities, the default volume units used in this report are displayed in **Cubic Feet** or **Cubic Meters**. Display the volumes in **Cubic Yards**, in the *Civil Report Browser* window, select *Tools >* **Format Options** and toggle on the **Convert to Cubic Yard** check box.



No need to adjust this when working in Metric

e. **Close** the *Format Options* dialog and note how the volumes are now reported in cubic yards.

Totals:

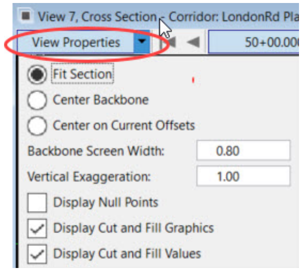
Cut Volume:	7789.928		4.50	35054.674
Fill Volume:	4385.408		6.00	26312.449
Mesh\Aggregate\TC_Aggregate Typ A:	3492.286		2.00	6984.572
Mesh\Asphalt\TC_Asph Conc Base Cse:	2938.838		3.00	8816.515
Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	901.268		5.00	4506.341
Mesh\Asphalt\TC_Asph Conc Wearing Cse:	642.647		7.00	4498.528
Mesh\Concrete\TC_Curb and Gutter Typ 1:	300.855		3.00	902.564
Mesh\Concrete\TC_Sidewalk:	235.725		2.00	471.450
Mesh\Grading\TC_Cutslope:		32576.788	1.00	32576.788
Mesh\Grading\TC_Ditch:		57881.072	1.00	57881.072
Mesh\Grading\TC_Grass Berm Back:		7164.084	1.00	7164.084
Mesh\Grading\TC_Grass Berm Front:		7164.084	1.00	7164.084
			Total Estimated Cost:	**231401.39**

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

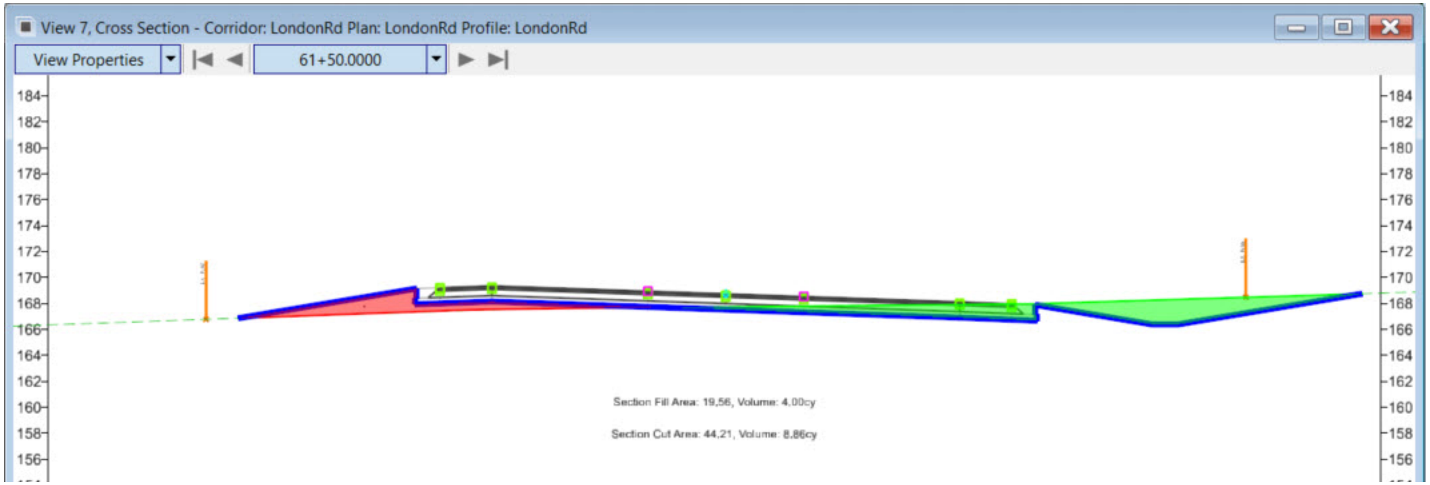
g. **Close** the *Component Quantities* dialog.

Review the Cross Sections and Display the Cut and Fill Graphics and Values

In this section, we will demonstrate how to display the cut/fill graphics and cut/fill values on the cross sections. Displaying the cut/fill graphics and their values is a good way to verify the cut and fill values computed in the Component Quantities report.



1. *Click* in **View 7** to make the Cross Section Model view active.
2. In the upper left corner of the cross section view, Select the **View Properties.**
3. Adjust the **View Properties** as shown.
4. Using the cross section navigation tools at the top of the cross section view window, navigate through and review the cross sections. Notice how the cut and fill graphics are displayed on the cross section as well as the cut and fill quantities.



Reviewing the cut and fill values on the cross sections is a good way to verify the quantities in the report (if the cut/fill values are too small to read just increase the size of the view window).

a. When done reviewing the cross sections you can **Display/Undisplay** the cut and fill graphics and values via the **View Properties** tool.

Element Component Quantities

In this section you will learn about using *Element Component Quantities* which computes quantities directly from the 3D elements in the corridor model. *Element Component Quantities* will produce more accurate results than the *Component Quantities* tool. Also, this tool does allow quantities to be computed from Clipping Corridors.

Note, this tool only calculates volumes for closed shape components, thus cut and fill volumes **ARE NOT** computed since cut and fill components are typically not closed shape components. Furthermore, quantities are not reported by station.

---

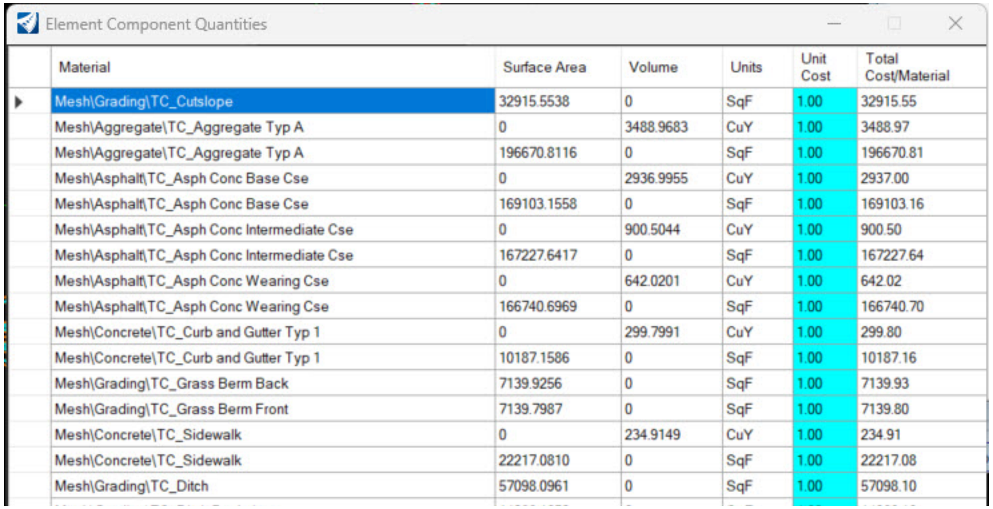
1. Compute *Element Component Quantities* for the London Rd. corridor.

   a. From the ribbon menu, select *Home > Model Analysis and Reporting > Civil Analysis >* **Element Component Quantities**

   b. *Locate First Element*: Select > **LondonRd corridor**

   c. *Locate Next Element - Reset to Complete:* **Right-click** to complete.

   The *Element Component Quantities* window will now appear displaying the materials, quantities, unit cost and estimated cost.



Material	Surface Area	Volume	Units	Unit Cost	Total Cost/Material
Mesh\Grading\TC_Cutslope	32915.5538	0	SqF	1.00	32915.55
Mesh\Aggregate\TC_Aggregate Typ A	0	3488.9683	CuY	1.00	3488.97
Mesh\Aggregate\TC_Aggregate Typ A	196670.8116	0	SqF	1.00	196670.81
Mesh\Asphalt\TC_Asph Conc Base Cse	0	2936.9955	CuY	1.00	2937.00
Mesh\Asphalt\TC_Asph Conc Base Cse	169103.1558	0	SqF	1.00	169103.16
Mesh\Asphalt\TC_Asph Conc Intermediate Cse	0	900.5044	CuY	1.00	900.50
Mesh\Asphalt\TC_Asph Conc Intermediate Cse	167227.6417	0	SqF	1.00	167227.64
Mesh\Asphalt\TC_Asph Conc Wearing Cse	0	642.0201	CuY	1.00	642.02
Mesh\Asphalt\TC_Asph Conc Wearing Cse	166740.6969	0	SqF	1.00	166740.70
Mesh\Concrete\TC_Curb and Gutter Typ 1	0	299.7991	CuY	1.00	299.80
Mesh\Concrete\TC_Curb and Gutter Typ 1	10187.1586	0	SqF	1.00	10187.16
Mesh\Grading\TC_Grass Berm Back	7139.9256	0	SqF	1.00	7139.93
Mesh\Grading\TC_Grass Berm Front	7139.7987	0	SqF	1.00	7139.80
Mesh\Concrete\TC_Sidewalk	0	234.9149	CuY	1.00	234.91
Mesh\Concrete\TC_Sidewalk	22217.0810	0	SqF	1.00	22217.08
Mesh\Grading\TC_Ditch	57098.0961	0	SqF	1.00	57098.10

   You can assign Unit Costs to each item by entering the unit cost in the *Unit Cost* field and the Total Estimated Cost will be computed.

2. Experiment with assigning unit costs for each material by entering values in the *Unit Cost* fields.

3. Create *Element Component Quantities Report*.

   a. Select the **Report** button on the **Compute Quantities** window to display the **Element Component Quantities Report**

   b. Review the *Element Component Quantities Report*. Note, only the volumes of **closed shape** components are computed. Cut and Fill volumes are not computed in this report.

Elements Component Quantities Report

Report Created: Tuesday, September 24, 2024
Time: 11:57:00 AM

Input Grid Factor:

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

Surface	Material	Area	Volume	Unit Cost	Material Cost
	Corridor: LondonRd				
	Mesh\Grading\TC_Cutslope:	32915.554		1.00	32916
	Mesh\Aggregate\TC_Aggregate Typ A:		3488.97	1.00	3489
	Mesh\Aggregate\TC_Aggregate Typ A:	196670.812		1.00	196671
	Mesh\Asphalt\TC_Asph Conc Base Cse:		2937.00	1.00	2937
	Mesh\Asphalt\TC_Asph Conc Base Cse:	169103.156		1.00	169103
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:		900.50	1.00	901
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	167227.642		1.00	167228
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:		642.02	1.00	642
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:	166740.697		1.00	166741
	Mesh\Concrete\TC_Curb and Gutter Typ 1:		299.80	1.00	300
	Mesh\Concrete\TC_Curb and Gutter Typ 1:	10187.159		1.00	10187
	Mesh\Grading\TC_Grass Berm Back:	7139.926		1.00	7140
	Mesh\Grading\TC_Grass Berm Front:	7139.799		1.00	7140
	Mesh\Concrete\TC_Sidewalk:		234.91	1.00	235
	Mesh\Concrete\TC_Sidewalk:	22217.081		1.00	22217
	Mesh\Grading\TC_Ditch:	57098.096		1.00	57098
	Mesh\Grading\TC_Ditch Backslope:	14062.165		1.00	14062
	Mesh\Grading\TC_Fillslope:	25177.217		1.00	25177
	Mesh\Modeling\Top Mesh:	346325.995		1.00	346326
Totals:					
	Mesh\Grading\TC_Cutslope:	32916		1.00	32916
	Mesh\Aggregate\TC_Aggregate Typ A:		3488.97	1.00	3489
	Mesh\Aggregate\TC_Aggregate Typ A:	196671		1.00	196671
	Mesh\Asphalt\TC_Asph Conc Base Cse:		2937.00	1.00	2937
	Mesh\Asphalt\TC_Asph Conc Base Cse:	169103		1.00	169103
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:		900.50	1.00	901
	Mesh\Asphalt\TC_Asph Conc Intermediate Cse:	167228		1.00	167228
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:		642.02	1.00	642
	Mesh\Asphalt\TC_Asph Conc Wearing Cse:	166741		1.00	166741
	Mesh\Concrete\TC_Curb and Gutter Typ 1:		299.80	1.00	300
	Mesh\Concrete\TC_Curb and Gutter Typ 1:	10187		1.00	10187
	Mesh\Grading\TC_Grass Berm Back:	7140		1.00	7140
	Mesh\Grading\TC_Grass Berm Front:	7140		1.00	7140
	Mesh\Concrete\TC_Sidewalk:		234.91	1.00	235
	Mesh\Concrete\TC_Sidewalk:	22217		1.00	22217

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

   d. **Close** the *Element Component Quantities* dialog.

Exercise 2: 3D Volumes & Earthwork

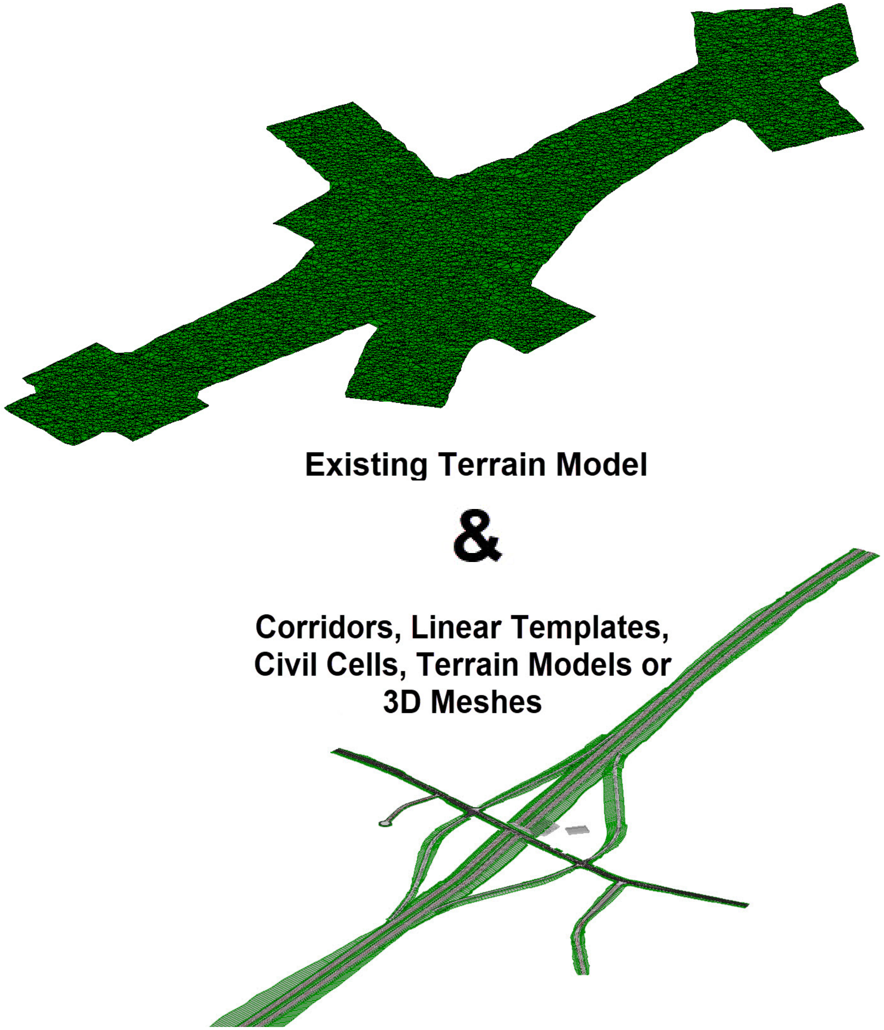
In this exercise, you are going to learn how to create 3D mesh elements that represent the cut and fill volumes between the existing terrain model and the corridor model. This is a more exact method than using average end area method for volumes since it is calculating the volumes directly from the 3D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

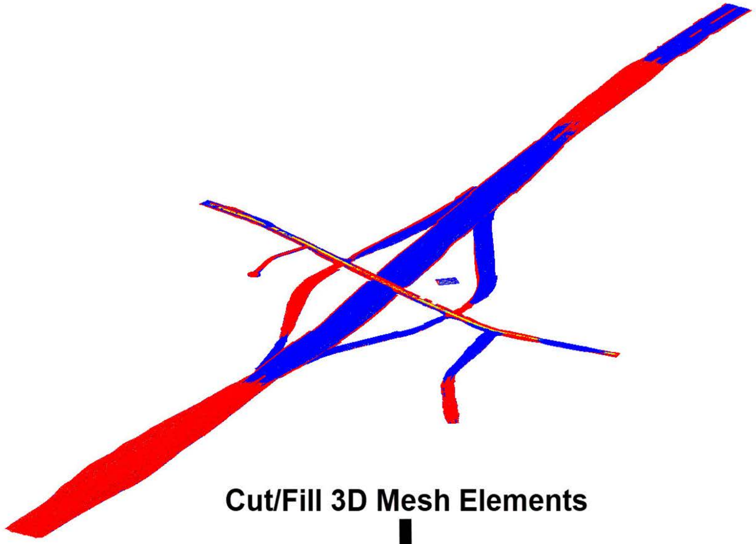
Skills Taught

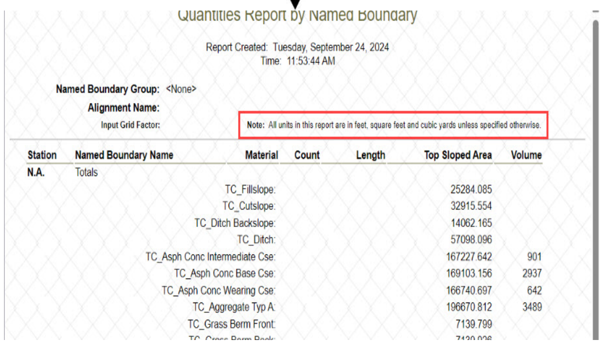
- Create Cut and Fill Volumes (i.e. 3D Mesh Elements)
- Quantities and Volumes Report
- Feature Definitions and Volume Options
- Advanced 3D Volumes

3D Volumes & Earthwork Overview

Earthwork quantities are now calculated from 3D mesh elements. You no longer need to create a set of cross sections to get cut and fill volumes. Earthwork quantities are now truly 3D. The *Create Cut Fill Volumes* tool creates a 3D mesh element for cut and a 3D mesh element for fill. These meshes can then be used to extract earthwork quantities and reports directly from the 3D Model. 3D cut/fill meshes can be created from terrains, corridors, linear templates, civil cells or any 3D mesh element that has a civil feature definition.The software scans the DGN file for *Feature Definitions* that represent *Existing* and *Design* elements. For *Design* elements a bottom mesh is automatically formulated (in memory) and is used to compare to the existing elements (typically an existing ground terrain). The result of this process is 3D cut/fill mesh elements that represent cut and fill volumes.







Quantities Report by Named Boundary

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

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

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

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

Create 3D Cut and Fill Volumes

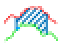
In this section, you are going to learn how to create the 3D cut/fill mesh elements that represent the cut and fill volumes between the existing terrain model and the bottom mesh of the corridor model. We will use the *Create Cut Fill Volumes* tool to accomplish this task.

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

   a. Open the file named **Volumes-Cut-Fill_LondonRd.dgn** *[Metric-Volumes-Cut-Fill_LondonRd.dgn]*, the existing terrain model, geometry and corridor are already attached as reference files.

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

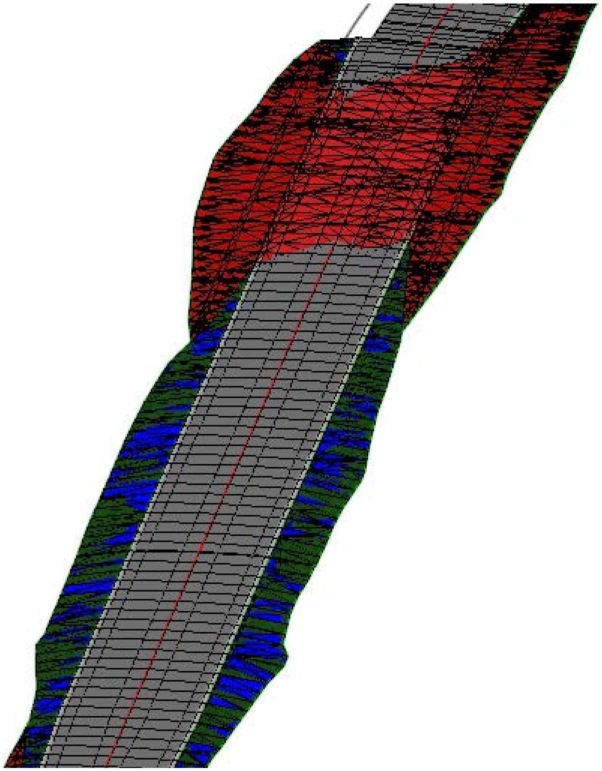
   b. *Left-click* in *View 1* to make it active.



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

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

   - *Cut Feature Definition:* **Volumes_Cut**
   - *Fill Feature Definition:* **Volumes_Fill**
   - *The options to Compute Unsuitable, Compute Custom and Compute Substrata should be set* **No** *or* **unchecked** *in the toolbox.*
   - *Data Point to accept selection:* **Left-click** to complete the command.

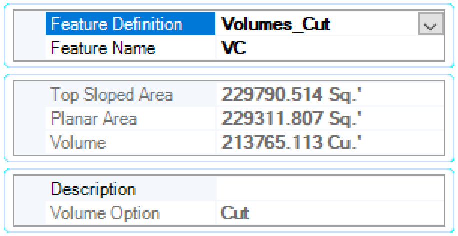


3D mesh elements are now created displaying where the cut and fill are located in the 3D model. This is useful for visualizing earthwork and for the extraction of volumetric quantities. The **Blue** 3D mesh element indicates *Fill* and the **Red** 3D mesh element indicates *Cut.*

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

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

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



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

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

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

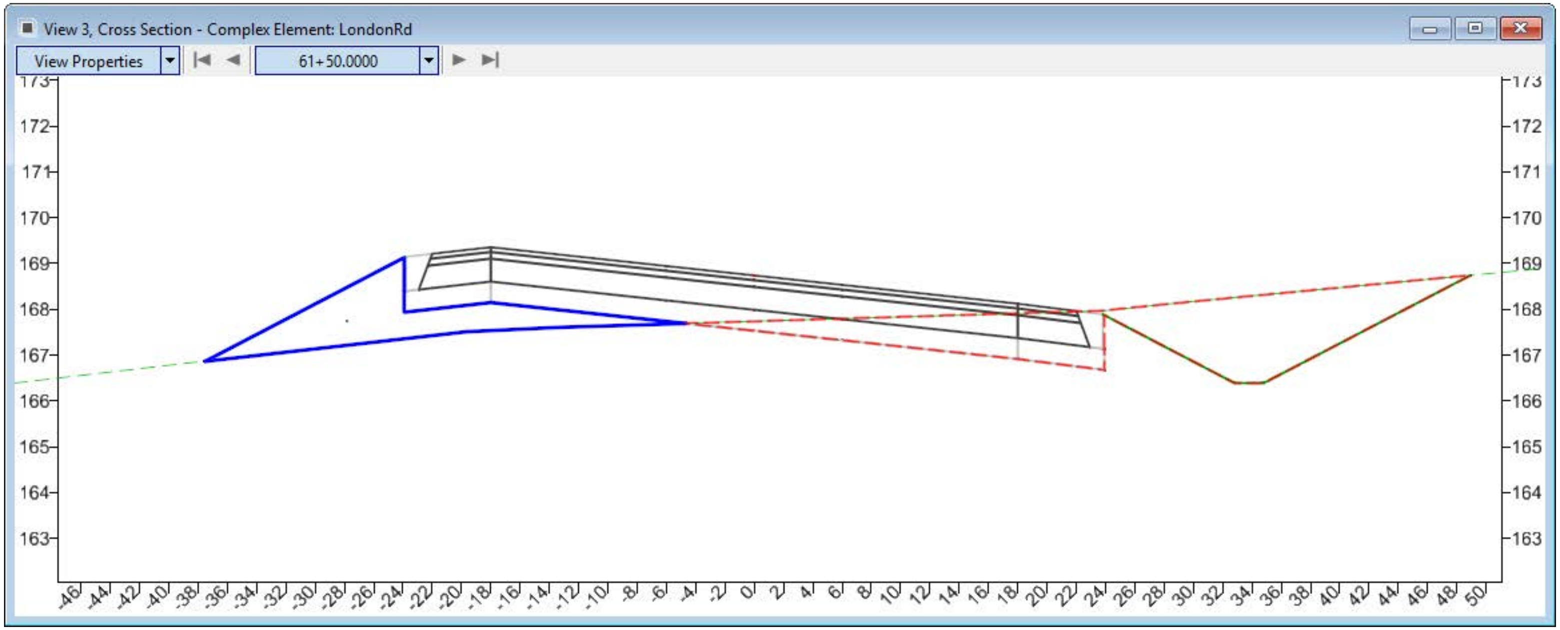
Also, take note of the *Feature Name* and *Feature Definition*. The *Feature Definition* controls the display of the 3D meshes and assigns the volume options of *Cut* or *Fill* to the 3D mesh (the *Volume Option* will be discussed in the next section).

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

3. Review the cross sections.

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

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



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

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

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

   c. Select **Corridor-LondonRd** in the references dialog.

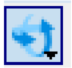
   d. Select the **Display** icon to toggle off the London Rd. corridor.

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

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

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

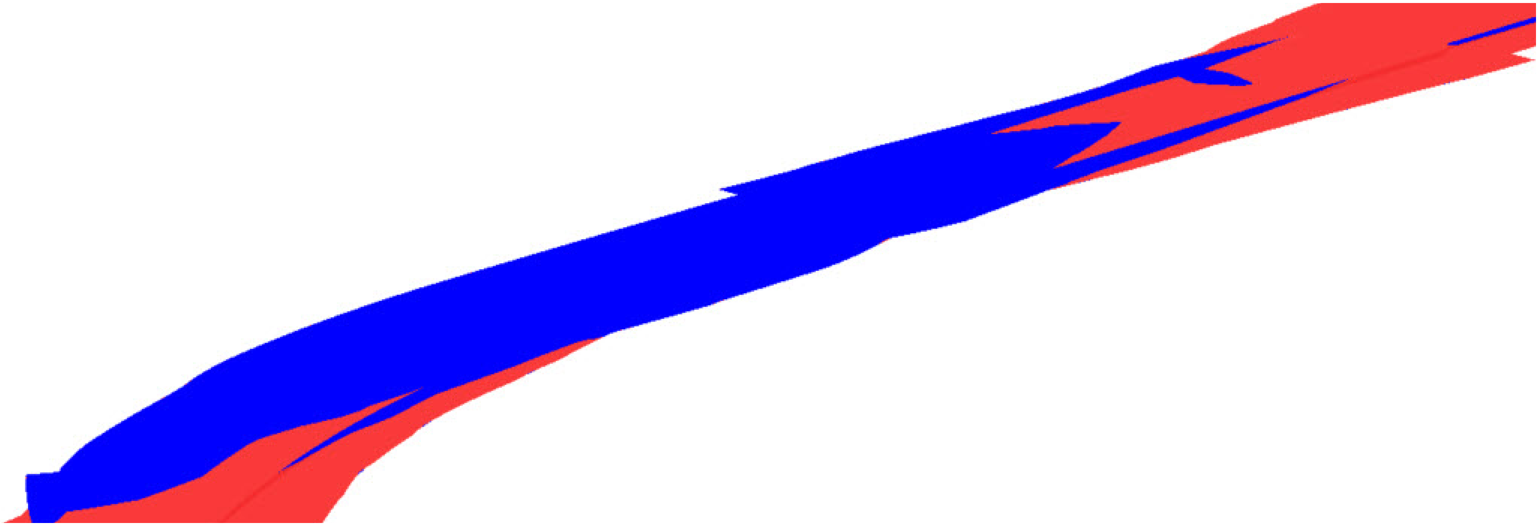
6. Rotate the view and observe the cut and fill areas in 3D.



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

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

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



Quantities and Volumes Report

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

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

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

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

Quantities Report by Named Boundary

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

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

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

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
N.A.	Totals					
		TC_Fillslope:			25284.085	
		TC_Cutslope:			32915.554	
		TC_Ditch Backslope:			14062.165	
		TC_Ditch:			57098.096	
		TC_Asph Conc Intermediate Cse:			167227.642	901
		TC_Asph Conc Base Cse:			169103.156	2937
		TC_Asph Conc Wearing Cse:			166740.697	642
		TC_Aggregate Typ A:			196670.812	3489
		TC_Grass Berm Front:			7139.799	
		TC_Grass Berm Back:			7139.926	
		TC_Sidewalk:			22217.081	235
		TC_Curb and Gutter Typ 1:			10187.159	300
		Volumes_Fill:			117373.289	4215
		Volumes_Cut:			229735.798	7906

   a. **Review** the report (note the volumes are still reported in cubic yards).

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

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

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

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

Named Boundary creation will be discussed in more detail in later sections of this course.

Feature Definition Volume Options

In order to display and calculate earthwork between terrain models and corridors you need to assign them with the proper *Feature Definition* and *Volume Option*. When classifying and calculating earthwork the software looks at the *Feature Definition* and the *Volume Option* (Existing, Design, Cut, Fill, etc.) to determine how to quantify and classify material volumes.

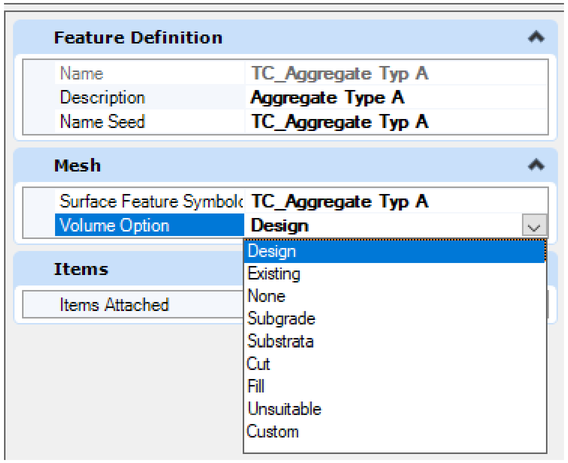
The *Volume Option* determines how earthwork will be classified and calculated. For example, an existing ground terrain would typically have the volume option set to *Existing* and proposed corridor components would be set to *Design*.

Another example would be if you have an existing road where pavement removal occurs, the existing pavement could be classified as *Unsuitable*.

In order to create the most basic cut and fill volumes the *Existing* and *Design* volume option must be defined between any two terrains or corridors.

Volume Options:

- Design
- Existing
- None
- Subgrade
- Substrata
- Cut
- Fill
- Unsuitable
- Custom



Refer to *Appendix B* for descriptions of each of the volume options.

Review the Volume Options

1. Review the Volume Option for the Existing Terrain.

   a. In the *Explorer* pane navigate to the **OpenRoads Model**.

   b. *Left-click* the arrow next to each of the following items to expand this list:

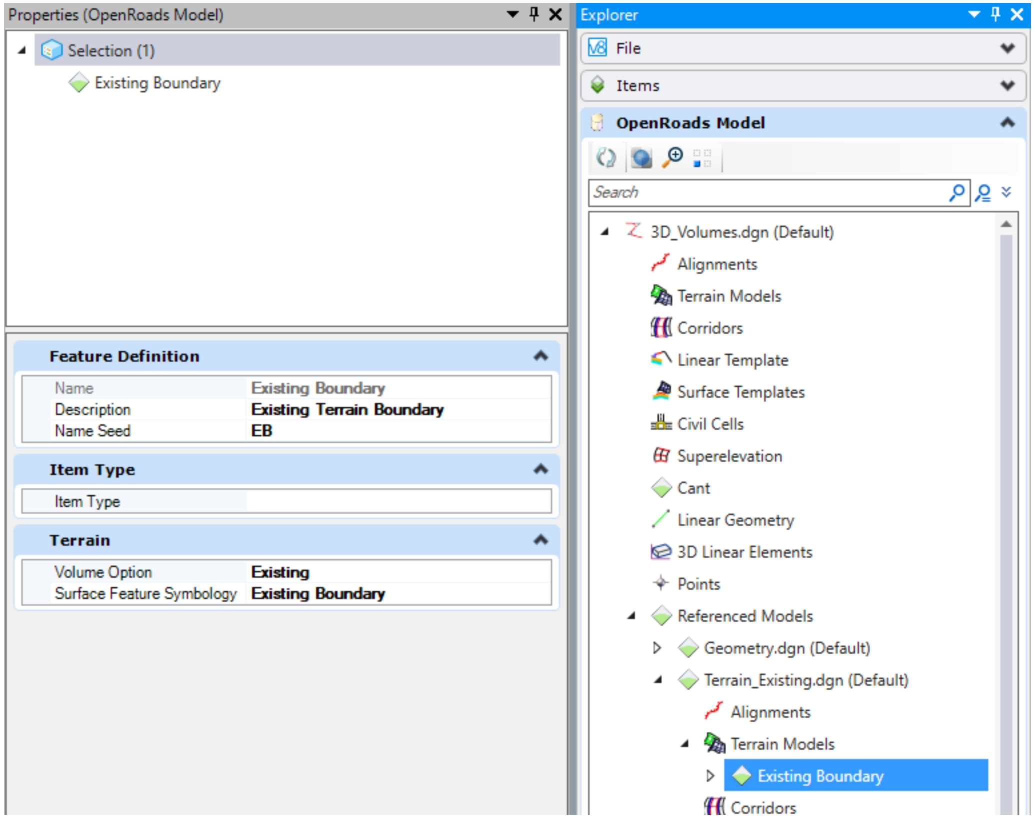
   - *Referenced Models*
   - *Terrain_Existing.dgn (Default)*
   - *Terrain Models*

   c. Select the **Existing Boundary** feature definition.

   d. *Right-click* and select **Properties**. The *Properties* window will open.

   You may have to do step d. twice for the Properties to appear.

   e. Review the *Volume Option* and note it is set to **Existing**. This defines how the terrain will be classified when creating the 3D mesh for cut/fill volumes.



2. Review the Corridor Volume Options for the London Rd. Corridor.

a. Open **Corridor-LondonRd.dgn** *[Metric - CorridorLondonRd.dgn]*

b. In *Explorer* pane, navigate to the **OpenRoads Standards** group.

c. *Click* the down arrow to expand the group.

d. *Left-click* the arrow next to each of the following items to expand the list:

- *Standards*
- *Corridor-LondonRd.dgn (Default)*
- *Feature Definitions*
- *Mesh*
- *Aggregate*

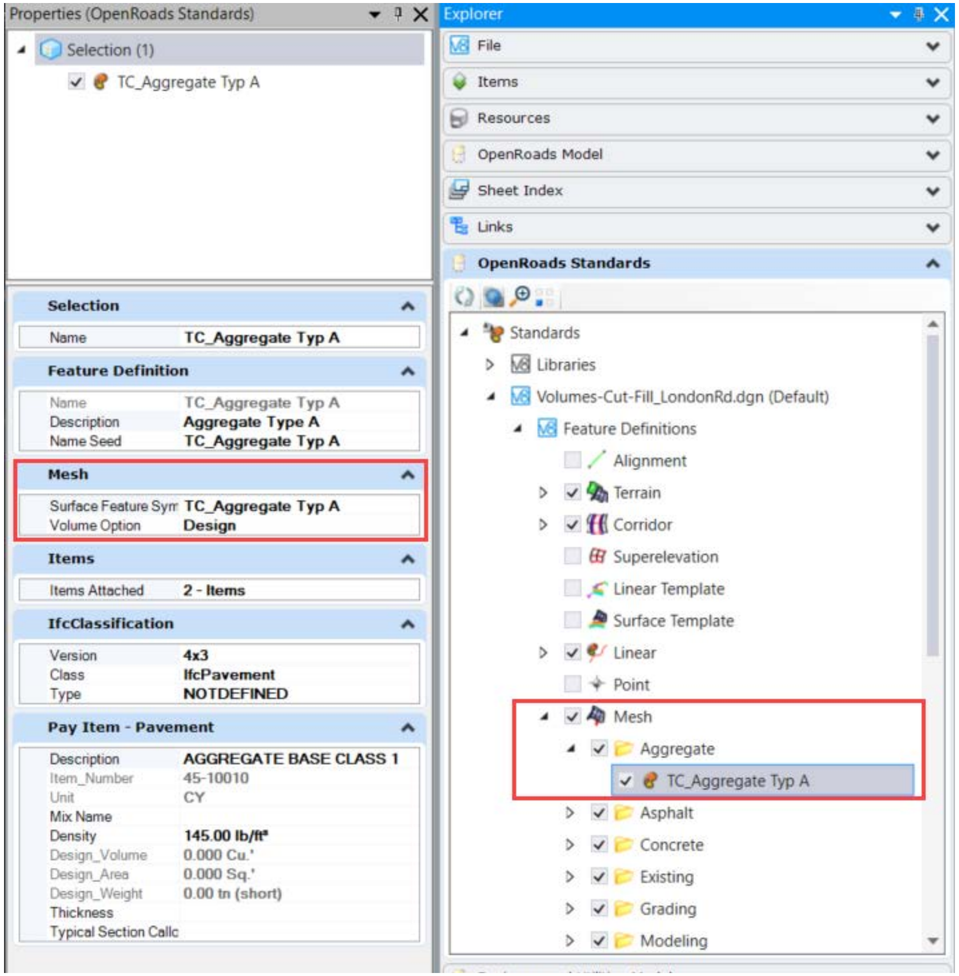
e. Select **TC_Aggregate TypA**

This feature definition is assigned to the aggregate components in this corridor.

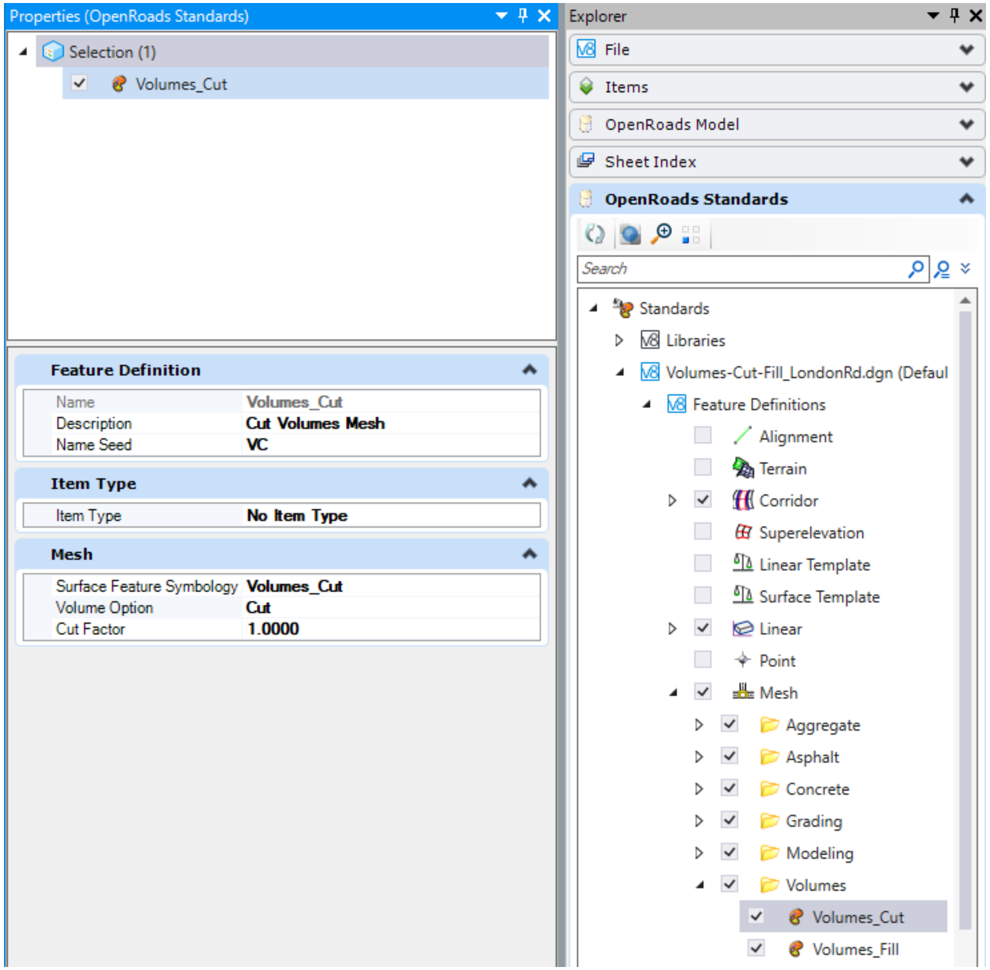
f. *Right-click* and select **Properties**.

g. Review the *Volume Option* and note it is set to **Design**.

Generally, the volume option for corridor components should be set to *Design*.



3. Review the Cut and Fill Volume options of the Cut/Fill 3D Mesh.



a. Open **Volumes-Cut-Fill_LondonRd.dgn** *[Metric - Volumes-Cut-Fill_LondonRd.dgn]*

b. In *Explorer* pane, navigate to the **OpenRoads Standards** group.

c. *Click* the down arrow to expand the group.

d. *Left-click* the arrow next to each of the following items to expand the list:

- *Standards*
- *Volumes-Cut-Fill_LondonRd.dgn (Default)*
- *Feature Definitions*
- *Mesh*
- *Volumes*

e. Select **Volumes_Cut**

This feature definition is assigned to 3D mesh elements that represent cut volumes.

f. *Right-click* and select **Properties**.

g. Review the *Volume Option* and note it is set to **Cut**.

Generally, the volume option for a cut elements should be set to *Cut.*

h. Repeat the steps above to review the volume option for **Volumes_Fill**.

i. **Close** the *Properties* pane.

Advanced 3D Volumes & Earthwork

In this section you will learn how to create more advanced 3D volumes & earthwork that take into account existing pavement removal, removal of muck material and topsoil stripping.

1. Apply Existing Pavement Surface Template to the existing pavement terrain.

   a. Open **Exist_Pavt.dgn** *[Metric-Exist_Pavt.dgn].*

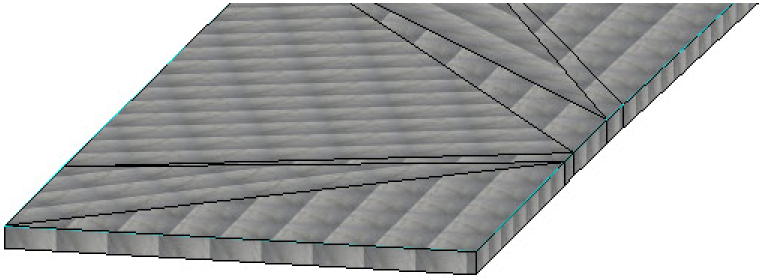
      A terrain model representing the top surface of the existing pavement has already been created. We are now going to apply an existing pavement surface template to this terrain so that we can get the volume of existing pavement for quantity and earthwork purposes.

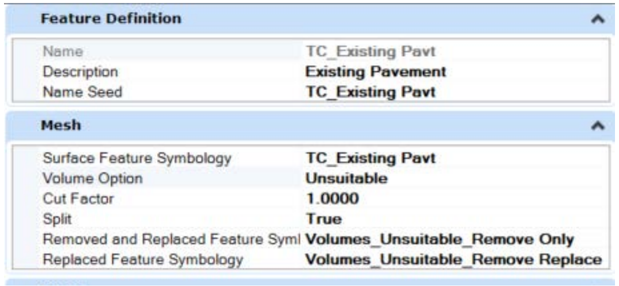
   b. Select *Modeling Detailing > 3D Tools >* **Apply Surface Template**

   c. Follow the heads-up prompts:

      - *Locate a Terrain Model:* In **View 2**, select the **Exist_Pavt** terrain model.
      - *Apply External Clip Boundary:* **No**
      - *Select Template - <ALT> Down to Browse Templates:* Select **Surface Templates\Existing Pavement**
      - *Data point to accept selection:* **Left-click**

      The existing pavement surface template is now applied to the terrain. The surface template applies a material thickness to the terrain.





Note: The Existing Pavement Surface Template uses a feature definition named *TC_Existing Pavt* and its volume option is set to **Unsuitable**. When using the **Unsuitable** volume option, the existing pavement will be removed and replaced with the default fill material where necessary.

2. Apply Muck Surface Template to the existing muck terrain.

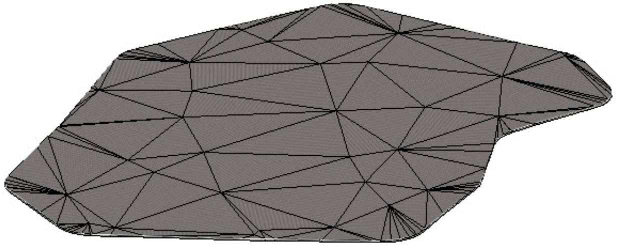
a. Open **MUCK.dgn** *[Metric-MUCK.dgn].*

a. Select *Modeling Detailing > 3D Tools >* **Apply Surface Template**

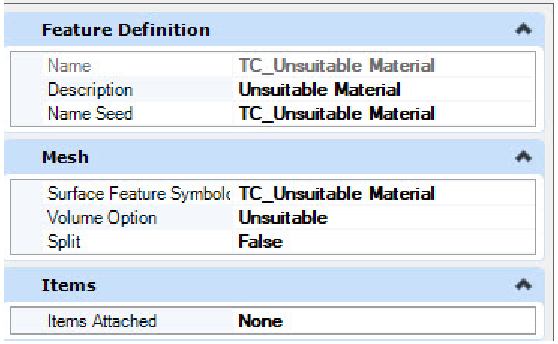
b. Follow the heads-up prompts:

- *Locate a Terrain Model:* In **View 2**, select the **Exist_Pavt** terrain model.
- *Apply External Clip Boundary:* **No**
- *Select Template - <ALT> Down to Browse Templates:* Select **Surface Templates\Muck**
- *Data point to accept selection:* **Left-click**

The Muck Surface Template is now applied to the terrain.



The Muck Surface Template uses a feature definition named *TC_Unsuitable Material* and its volume option is set to **Unsuitable**. When using the **Unsuitable** volume option, the muck will be removed and replaced with fill material where necessary.

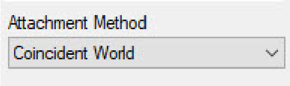


Feature Definition	
Name	TC_Unsuitable Material
Description	Unsuitable Material
Name Seed	TC_Unsuitable Material
Mesh	
Surface Feature Symbolc	TC_Unsuitable Material
Volume Option	Unsuitable
Split	False
Items	
Items Attached	None

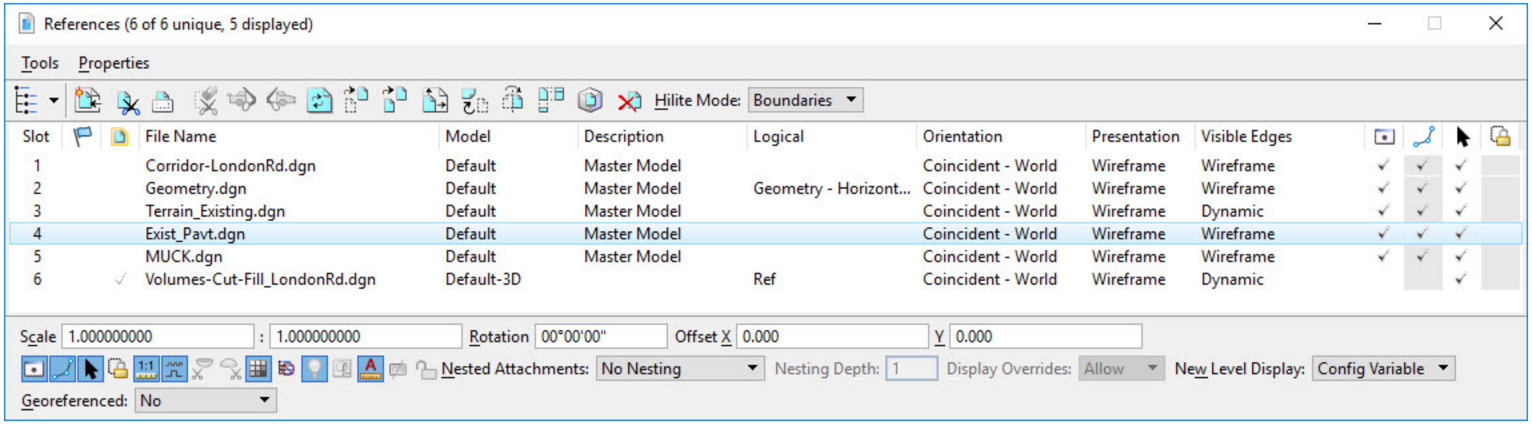
Create 3D Mesh for Cut/Fill/Existing Pavement and Muck

In this section, you are going to learn how to create 3D mesh elements for Cut/Fill, Existing Pavement and Muck.

1. Open **Volumes-Cut-Fill_LondonRd.dgn** *[Metric-Volumes-Cut-Fill_LondonRd.dgn]*, the existing terrain model, geometry and corridor are already attached as reference files. *View 1* is the 2D plan view, *View 3* is the 3D model view and *View 7* is the cross section view.
2. *Left-click* in *View 3* (this is the 3D model view) to make it active.
3. Using the *Element Selection* tool, select all of the previously created 3D cut/fill elements and **delete** them.
4. Attach **Exist_Pavt.dgn** *[Metric-Exist_Pavt.dgn]* and **Muck.dgn** *[Metric-MUCK.dgn]* as reference files.
   a. Left-click in *View 1* to make it active.
   b. Select *Home > Primary > Attach Tools >* **References**
   c. Go to *Tools >* **Attach**, the *Attach Reference* dialog will appear.
   d. Change the *Attachment Method* to **Coincident World**.



   e. Browse to the location of the course files and select **Exist_Pavt.dgn** *[Metric-Exist_Pavt.dgn]* and **MUCK.dgn** *[Metric-MUCK.dgn]*
   f. Click **OPEN** and then **Close** the *References* dialog.

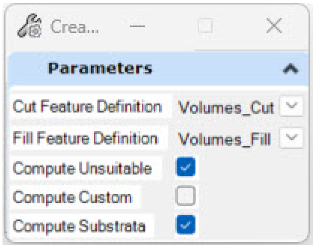


5. Create the 3D Mesh Elements.

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

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

- *Cut Feature Definition:* **Volumes_Cut**
- *Fill Feature Definition:* **Volumes_Fill**
- *Compute Unsuitable:* **Yes** (This tells the software to create 3D meshes for the unsuitable materials you defined, i.e. existing pavement and muck).

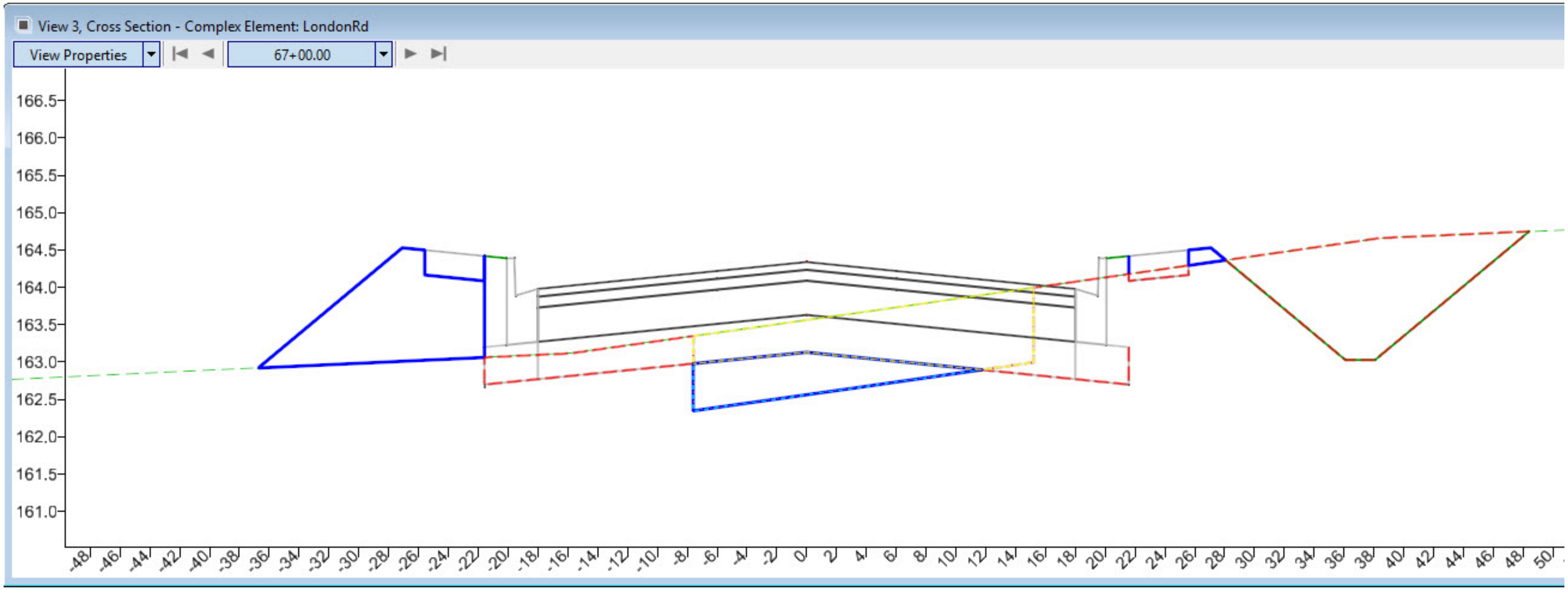


c. *Data Point to accept selection:* **Left-click**.

6. Review the cross sections.

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

b. Navigate through the cross sections and notice that the cut/fill, existing pavement and muck graphics are being displayed on the cross sections.



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

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

- *Display Clipped Graphics:* **No**
- *Left Click* to display report.

b. Select **Volumes.xsl** to change the report type and review the report.

Volumes Report

Report Created: Tuesday, September 24, 2024
Time: 12:35:11 PM

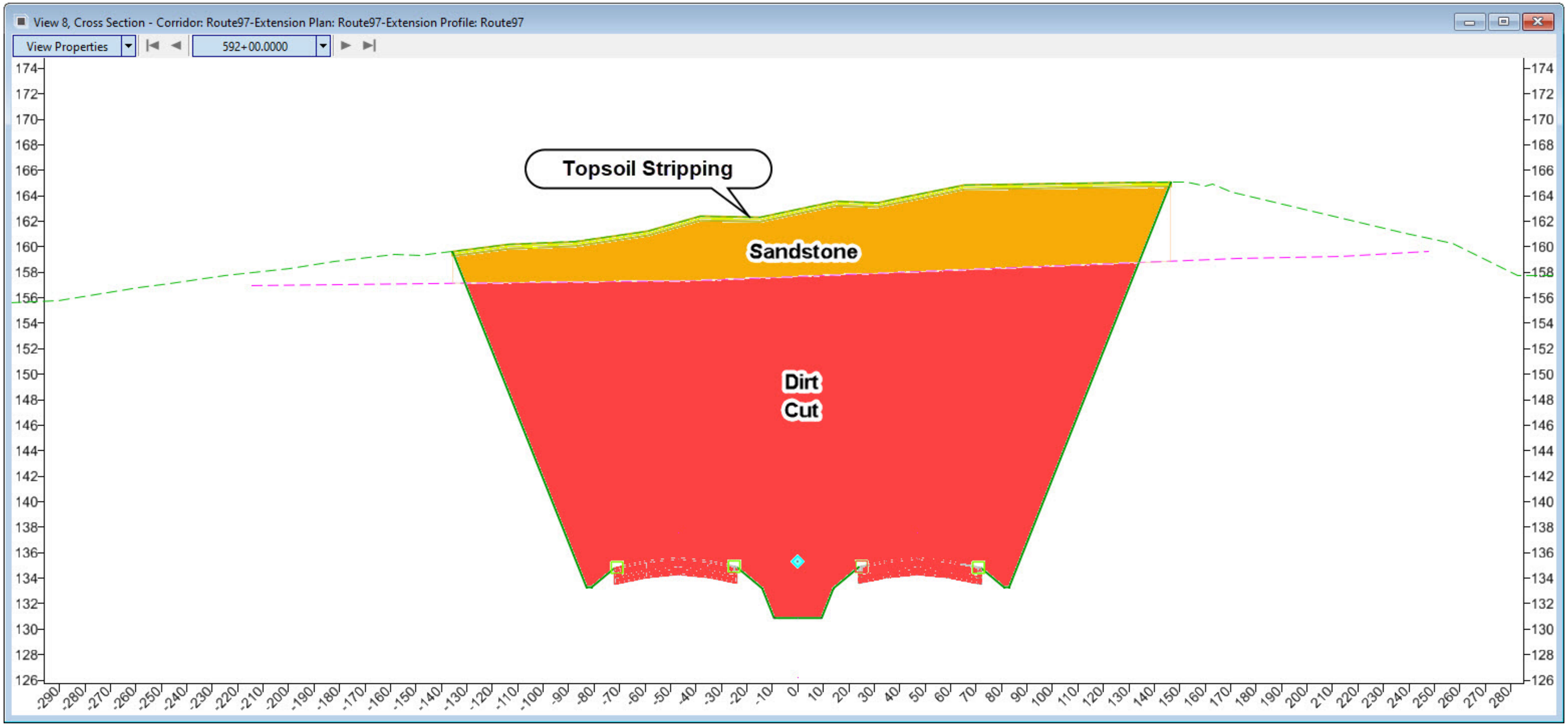
Cross Section Set Name: <None>
Alignment Name:
Input Grid Factor:

Note: All units in this report are in feet, square feet an

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?
0.000						
	TC_Aggregate Typ A:		3489	1.000	3489	No
	TC_Asph Conc Intermediate Cse:		901	1.000	901	No
	TC_Asph Conc Wearing Cse:		642	1.000	642	No
	TC_Existing Pavt (removed):		1636	1.000	1636	No
	Total TC_Existing Pavt:		3118	1.000	3118	
	TC_Sidewalk:		235	1.000	235	No
	TC_Asph Conc Base Cse:		2937	1.000	2937	No
	TC_Unsuitable Material:		2821	1.000	2821	No
	TC_Curb and Gutter Typ 1:		300	1.000	300	No
	Volumes_Cut:		6269	1.000	6269	Yes
	Volumes_Fill:		5696	1.000	5696	Yes
Totals:						
	Total TC_Ditch:		0		0	
	Total TC_Fillslope:		0		0	
	Total TC_Cutslope:		0		0	
	TC_Aggregate Typ A:		3489		3489	No
	Total TC_Aggregate Typ A:		3489		3489	
	TC_Asph Conc Intermediate Cse:		901		901	No
	Total TC_Asph Conc Intermediate Cse:		901		901	
	TC_Asph Conc Wearing Cse:		642		642	No
	Total TC_Asph Conc Wearing Cse:		642		642	
	Total TC_Ditch Backslope:		0		0	
	Total TC_Grass Berm Back:		0		0	
	Total TC_Grass Berm Front:		0		0	
	TC_Existing Pavt (removed):		1636		1636	No
	TC_Existing Pavt (removed and replaced):		1481		1481	No
	TC_Existing Pavt:		3118		3118	No
	Total TC_Existing Pavt:		3118		3118	
	TC_Sidewalk:		235		235	No
	Total TC_Sidewalk:		235		235	
	TC_Asph Conc Base Cse:		2937		2937	No
	Total TC_Asph Conc Base Cse:		2937		2937	
	TC_Unsuitable Material:		2821		2821	No
	Total TC_Unsuitable Material:		2821		2821	
	TC_Curb and Gutter Typ 1:		300		300	No
	Total TC_Curb and Gutter Typ 1:		300		300	

Excavation of Other Materials

In the next example, we are going to have a **4 inch** *[0.100 m]* topsoil stripping layer, a variable depth sandstone layer and normal cut material layer.



Topsoil Stripping

So far you have learned how to handle pavement removal and muck removal quantities. Now let's take a look at how to handle topsoil stripping. In this section, you will learn how to use the *Create Closed Mesh* tool to create a 3D mesh element that represents the topsoil stripping. By creating a topsoil stripping 3D mesh element it can be used to compute the amount of topsoil removed.

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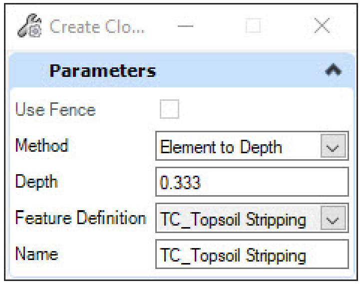
1. Create **4"** *[0.100 m]* Topsoil Stripping.

   a. Open **Mesh-Topsoil_Stripping.dgn** *[Metric-Mesh-Topsoil_Stripping.dgn].*

   a. Select *Modeling Detailing > 3D Tools >* **Create Closed Mesh**

   b. Follow the heads-up prompts:

   - *Method:* **Element to Depth**
   - *Select Top Surface Element:* **Select the existing terrain model**
   - *Depth:* **0.333** *[0.100 m]*
   - *Select Boundary Surface Element > Select the S.R. 97 corridor >* **Level Draft_Corr_Final**
   - *Feature Definition: Mesh > Existing >* **TC_Topsoil Stripping**
   - *Select Top Surface Elements:* Select the **Existing Ground** terrain model and then data point.
   - *Select Boundary Surface Elements. Reset when complete:* **Right click.**
   - Left click through the rest of the prompts to complete the process.

   You now have a 3D mesh element that represents the **4"** *[0.100 m]* topsoil stripping. The 3D mesh element is used to calculate the amount of topsoil stripping.

   The *Create Closed Mesh* produces a closed mesh for a variety of functions. It creates closed mesh entities representing substrata (i.e. rock), unsuitable materials (i.e. poor soil material), and a variety of Design artifacts. The closed meshes created can be used for many purposes but the main function is to facilitate volumetrics and earthwork computations. If substrata quantifications are required for a project, the substrata layer must be closed mesh entities with appropriate feature definitions designated so the Create Cut Fill volume tool can perform the analysis with their inclusion.

This tool has the capability to work with terrain models, corridors, linear templates, and mesh elements and is able to distinguish if the mesh is closed or not which enables the user to select the top or the bottom of the closed mesh for use for the top or bottom of the resultant closed mesh. If a corridor or linear template is selected it will use the top mesh of these objects.

2. Review the amount of topsoil removed using the *Quantities Report By Named Boundary* tool.

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

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

    - *Display Clipped Graphics:* **No**
    - *Left Click* to display report.

3. Select **Volumes.xsl** to change the report type and review the report.

Volumes Report

Report Created: Tuesday, September 24, 2024
Time: 12:57:57 PM

Cross Section Set Name: <None>
Alignment Name:
Input Grid Factor:

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

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
0.000							0
	TC_Concrete Pavt:		28058	1.000	28058	No	
	TC_Aggregate Typ A:		10920	1.000	10920	No	
	TC_Aggregate Typ A Ext:		9746	1.000	9746	No	
	TC_Topsoil Stripping:		248202	1.000	248202	No	

Totals:

	Type	Volume	Adjusted Volume	Included in Mass Ordinate?
	Total TC_Ditch:	0	0	
	Total TC_Fillslope:	0	0	
	Total TC_Ditch Backslope:	0	0	
	TC_Concrete Pavt:	28058	28058	No
	Total TC_Concrete Pavt:	28058	28058	
	TC_Aggregate Typ A:	10920	10920	No
	Total TC_Aggregate Typ A:	10920	10920	
	TC_Aggregate Typ A Ext:	9746	9746	No
	Total TC_Aggregate Typ A Ext:	9746	9746	
	Total TC_Draft-DNC:	0	0	

Rock Removal

On some projects there may be areas where rock removal is required. In the previous exercise the topsoil stripping was a constant depth which is typical for topsoil removal but when working with rock and other substrata materials the depth usually is not constant. In this section, you will learn how to handle the rock removal by again using the *Create Closed Mesh* tool and setting the method to *Element to Element* which will create the rock depth between the bottom of the topsoil and the rock terrain.

---

1. Create **Rock** 3D Mesh

   a. Open **Mesh_Rock.dgn** *[Metric-Mesh_Rock.dgn].*

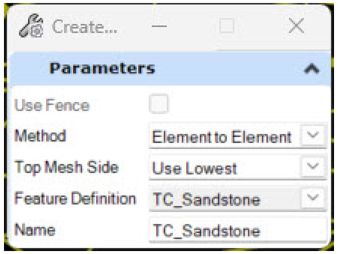
      - Note that a sandstone (i.e. rock) terrain model and the topsoil stripping mesh are attached as reference files.

   a. Select *Modeling Detailing > 3D Tools >* **Create Closed Mesh**

   b. Follow the heads-up prompts:

      - *Method:* **Element to Element**
      - *Select Top Surface Elements:* **Topsoil_Stripping Mesh**
      - *Select Side of Close Mesh:* **Use Lowest**
      - *Select Bottom Surface Elements:* **Sandstone Terrain Model**
      - *Select Boundary Surface Elements:* **Topsoil_Stripping Mesh**
      - *Feature Definition:* **Mesh\Existing\TC_Sandstone**
      - *Data point to create mesh(es):* **Left-click**

   The sandstone mesh will now be created.



2. Review the rock quantities using the *Quantities Report By Named Boundary* tool.

Now that you have mesh elements that represent the topsoil stripping and rock, let's incorporate those materials into the earthwork calculations for the S.R. 97 corridor.

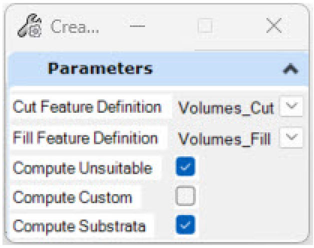
3. Compute the earthwork quantities for the S.R. 97 corridor.

   a. Open **Volumes-Cut-Fill_SR97.dgn** *[Metric-Volumes-Cut-Fill_SR97.dgn]*

   b. *Left-click* in *View 1* and attach the **Mesh-Topsoil_Stripping.dgn** *(Metric-Mesh-Topsoil_Stripping.dgn)* and **Mesh-Rock.dgn** *[Metric-Mesh-Rock.dgn]* as reference files using the *References* tool.

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

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



   - *Cut Feature Definition:* **Volumes_Cut**
   - *Fill Feature Definition:* **Volumes_Fill**
   - *Compute Unsuitable:* **Yes** (This tells the software to create 3D meshes for the unsuitable materials you defined, i.e. topsoil stripping).
   - *Compute Custom:* **No**
   - *Compute Substrata:* **Yes**

   e. *Data Point to accept selection:* **Left-click**.

f. Review the rock quantities using the *Quantities Report By Named Boundary* tool.

Volumes Report

Report Created: Tuesday, September 24, 2024
Time: 1:30:47 PM

Cross Section Set Name: <None>

Alignment Name:

Input Grid Factor:

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

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
0.000							-134472
	TC_Concrete Pavt:		28058	1.000	28058	No	
	TC_Aggregate Typ A:		10920	1.000	10920	No	
	TC_Aggregate Typ A Ext:		9746	1.000	9746	No	
	TC_Unsuitable Material:		2821	1.000	2821	No	
	TC_Sandstone (removed):		33811	1.000	33811	No	
	Total TC_Sandstone:		50640	1.000	50640		
	TC_Topsoil Stripping:		248202	1.000	248202	No	
	Volumes_Cut:		448286	1.000	448286	Yes	
	Volumes_Fill:		582758	1.000	582758	Yes	
Totals:							
	TC_Concrete Pavt:		28058		28058	No	
	Total TC_Concrete Pavt:		28058		28058		
	Total TC_Ditch Backslope:		0		0		
	Total TC_Ditch:		0		0		
	Total TC_Fillslope:		0		0		
	TC_Aggregate Typ A:		10920		10920	No	
	Total TC_Aggregate Typ A:		10920		10920		
	TC_Aggregate Typ A Ext:		9746		9746	No	
	Total TC_Aggregate Typ A Ext:		9746		9746		
	Total TC_Draft-DNC:		0		0		
	TC_Unsuitable Material:		2821		2821	No	
	Total TC_Unsuitable Material:		2821		2821		

Create Quantities and Earthwork From Multiple Corridors

Up to this point we have focused on generating quantities and earthwork for one corridor. At some point you may need to create quantities and earthwork from multiple corridors, linear templates and civil cells. In this section, you will learn how to create quantities and earthwork from multiple design files (.dgn) that contain corridors, linear templates and civil cells.

---

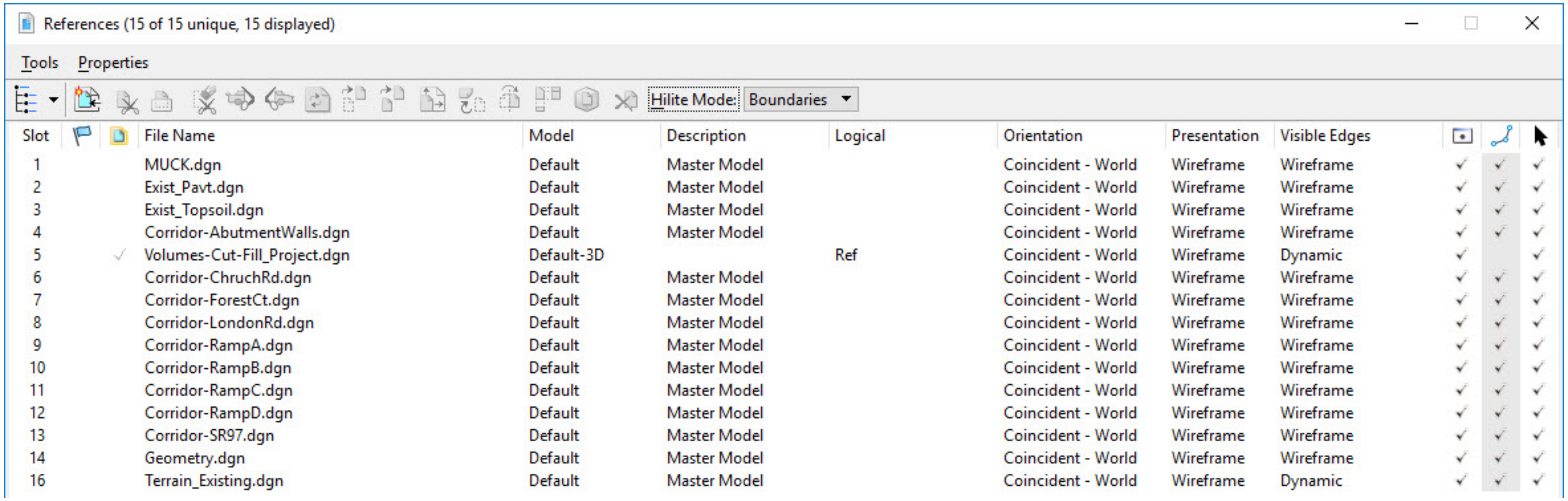
1. Create 3D Volumes From Multiple Corridors.

   a. Open **Volumes-Cut-Fill_Project.dgn** *[Metric-Volumes-Cut-Fill_Project.dgn]*

   b. *Click* anywhere in **View 1**

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

   d. Review the attached reference files and note that multiple corridors have been attached. Quantities will be extracted from the attached references.



Slot			File Name	Model	Description	Logical	Orientation	Presentation	Visible Edges			
1			MUCK.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
2			Exist_Pavt.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
3			Exist_Topsoil.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
4			Corridor-AbutmentWalls.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
5		✓	Volumes-Cut-Fill_Project.dgn	Default-3D		Ref	Coincident - World	Wireframe	Dynamic	✓		✓
6			Corridor-ChruchRd.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
7			Corridor-ForestCt.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
8			Corridor-LondonRd.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
9			Corridor-RampA.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
10			Corridor-RampB.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
11			Corridor-RampC.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
12			Corridor-RampD.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
13			Corridor-SR97.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
14			Geometry.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	✓	✓	✓
16			Terrain_Existing.dgn	Default	Master Model		Coincident - World	Wireframe	Dynamic	✓	✓	✓

   e. Close the **References** dialog.

2. Create 3D Volumes.

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

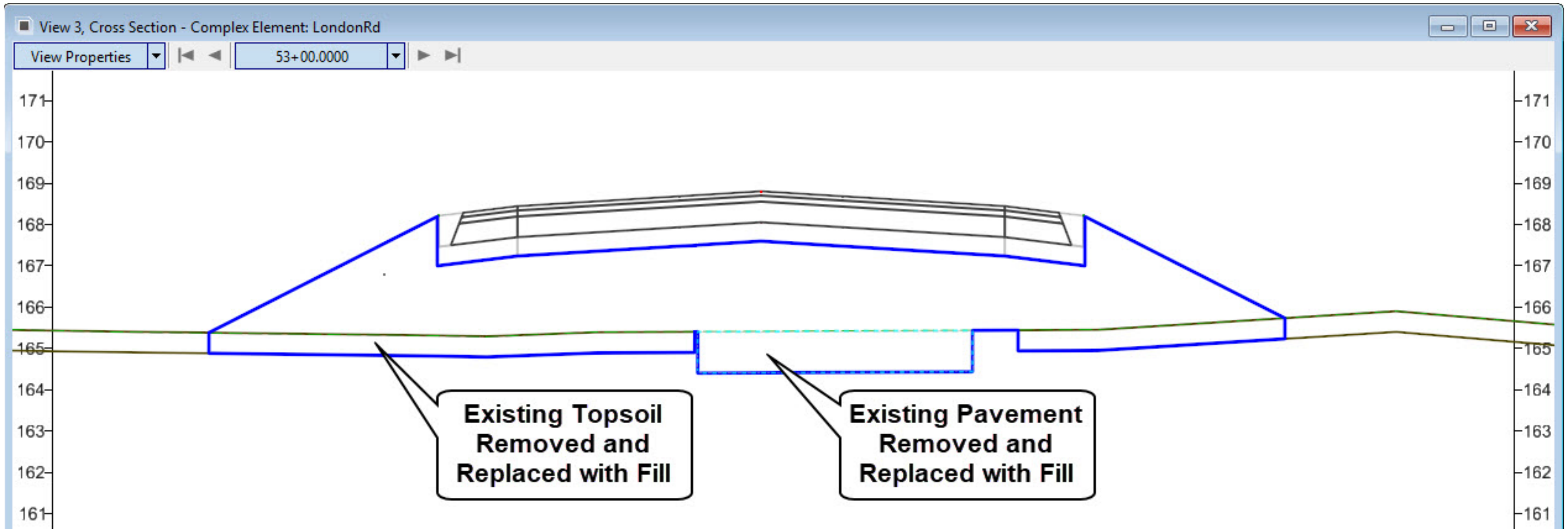
   b. Follow the heads up prompts (after each prompt, **Left click** to accept values and move to next prompt):

      - *Cut Feature Definition:* **Volumes_Cut**
      - *Fill Feature Definition:* **Volumes_Fill**
      - *Compute Unsuitable:* **Yes** (This tells the software to create 3D meshes for the unsuitable materials you defined (i.e. existing pavement, existing topsoil stripping and muck).
      - *Data Point to accept selection:* **Left-click** to complete the command.

3. Review the cross sections.

   a. *Left-click* in **View 3** to make the cross section view active.

   b. Navigate through the cross sections and notice that the cut/fill, existing pavement, existing topsoil and muck graphics are being displayed on the cross sections.



4. We will now use the **Quantities Report by Named Boundary** tool to generate quantities from all of the attached reference files.

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

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

- *Named Boundary Group:* **<None>**

c. *Left Click* to display the report.

d. **Review** the report and then close the report window.

The quantities listed in the report are determined directly from the 3D Models attached as reference files. Also, it's important to note that the cut and fill volumes are computed from the 3D cut/fill mesh elements.

Quantities Report by Named Boundary

Report Created: Tuesday, September 24, 2024
Time: 1:38:59 PM

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

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

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
N.A.	Totals					
		TC_Aggregate Typ A Ext:			545199.756	10082
		TC_Curb and Gutter Typ 1:			24435.571	675
		TC_Fillslope:			837987.256	
		TC_Cutslope:			64093.848	
		TC_Grass Berm Back:			15761.916	
		TC_Ditch:			207656.515	
		TC_Grass Berm Front:			15759.918	
		TC_Sidewalk:			44810.143	509
		TC_Grass:			63.305	
		TC_Asph Conc Wearing Cse:			176000.100	685
		TC_Aggregate Typ A:			1024284.316	19320
		TC_Concrete Pavt:			1231091.825	34174
		TC_Asph Conc Intermediate Cse:			176487.045	958
		TC_Asph Conc Base Cse:			178362.559	3094
		TC_Ditch Backslope:			361057.179	
		TC_Ret Wall-Cut:			15812.108	645
		TC_Existing Pavt:			84197.257	3118
		TC_Med-Depressed:			522914.854	
		TC_Draft-DNC:				
		TC_Topsoil Stripping:			10775000.329	199476
		Volumes_Cut:			1378729.628	497399
		Volumes_Fill:			2184199.597	746122

e. Close the *Bentley Civil Report Browser*.

Exercise 3: Create Quantities Report by Named Boundary

In this exercise, you will learn how to extract and compute quantities from the 3D Model using the **Named Boundaries** and **Quantities Report by Named Boundary** tools. The **Named Boundary** tool allows the user to create custom boundary shapes along the corridor, quantities can then be calculated within a **Named Boundary** using the **Quantities Report by Named Boundary** tool.

Practical applications include quantities reported between station ranges for earthwork, construction phasing and/or staging.

This exercise will focus on how to create **Named Boundaries** along the London Rd. corridor and then how to calculate quantities within each **Named Boundary.**

Skills Taught

- Create Named Boundaries
- Create Quantities Report by Named Boundary

Create Quantities Report Using Named Boundaries

In this section, the objective is to create a quantities report at 100 foot *[30 m]* intervals along the London Rd. corridor.

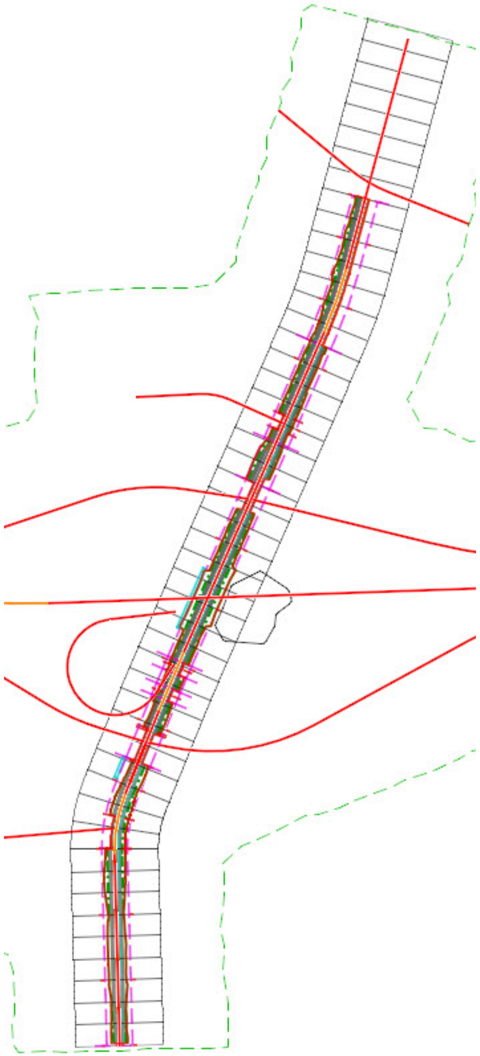
1. Open **Named Boundaries-LondonRd.dgn** *[Metric - Named Boundaries-LondonRd.dgn].*
2. From the ribbon menu, select *Drawing Production > Named Boundary >* **Place Named Boundary**
3. Select the *Civil Plan* tool and populate the following fields with the values shown:
   - Set *Drawing Seed*: **ANSI D_PLAN** *[A1_PLAN]*
   - *Detail Scale:* **1"=50'** *[1:500]*
   - *Name (under Detail Scale):* **LondonRd**
   - *Set the length:* **100** *[30]*
   - *Left Offset:* **-200.0** *[-60]*
   - *Right Offset:* **200.0** *[60]*
   - *Overlap:* **0**
   - *Boundary Chords:* **10**
   - *Create Drawing:* **Disable**

   a. Select *London Rd.* alignment to identify path element.

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

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

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



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

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

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

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

Quantities Report by Named Boundary

Report Created: Tuesday, September 24, 2024
Time: 1:45:14 PM

Named Boundary Group: LondonRd
Alignment Name: LondonRd
Input Grid Factor:

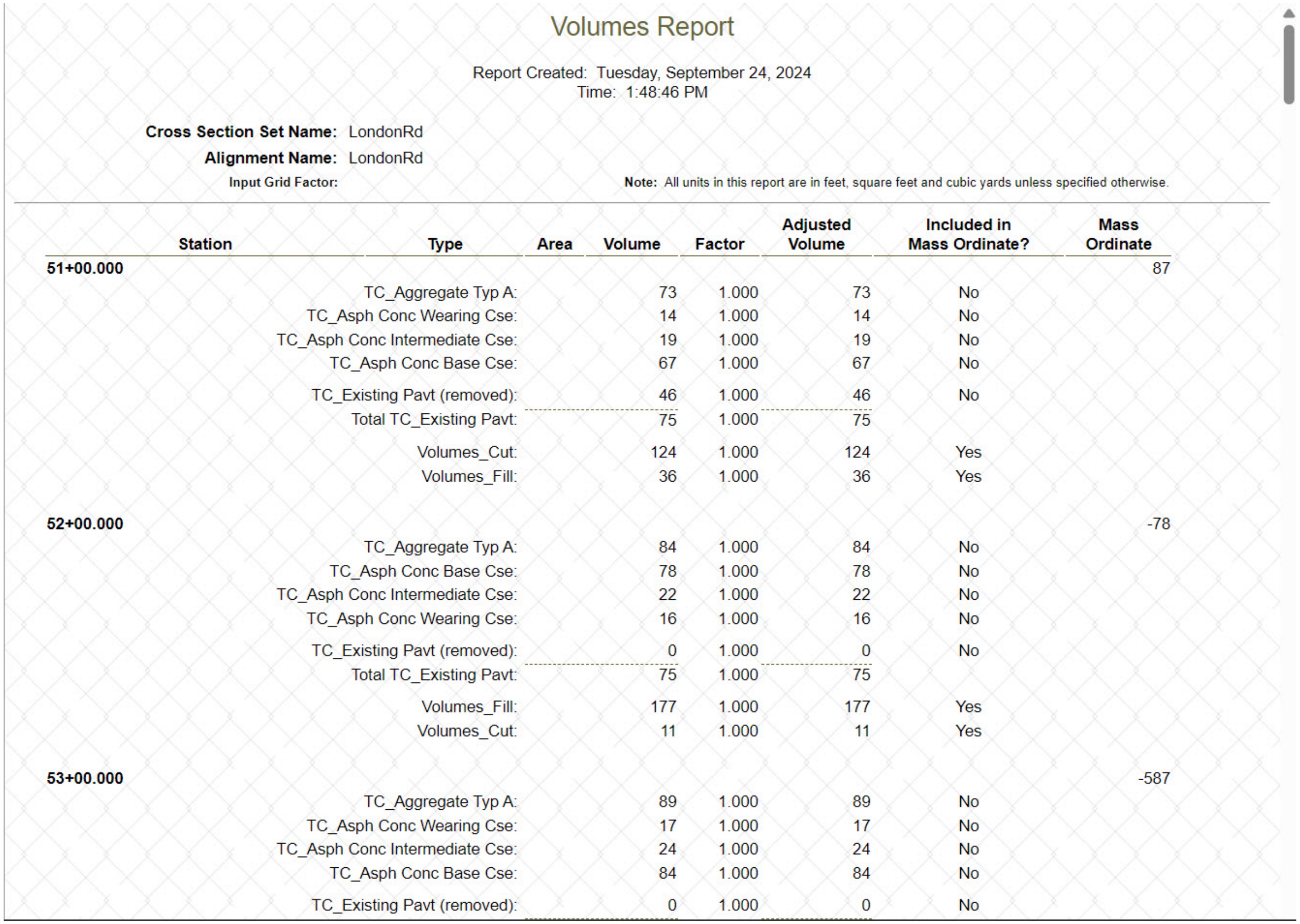
Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
51+00.000	LondonRd					
		TC_Ditch:			1824.892	
		TC_Ditch Backslope:			1548.221	
		TC_Asph Conc Wearing Cse:			3535.026	14
		TC_Asph Conc Intermediate Cse:			3573.928	19
		TC_Aggregate Typ A:			4341.130	73
		TC_Asph Conc Base Cse:			3728.237	67
		TC_Existing Pavt:			2026.751	75
		Volumes_Cut:			5453.161	124
		Volumes_Fill:			1774.863	36
		TL_Base Ext 1:		300.090		
		TL_Base Ext:		200.090		
		TL_Centerline:		100.000		
		TL_Centerline 1:		100.000		
		TL_Centerline 2:		100.000		
		TL_Centerline 3:		100.000		
		TL_Centerline 4:		100.000		
		TL_End Cond Hinge:		200.090		
		TL_Edge of Pavt 1:		200.090		

Tip: You may need to adjust the station formatting to SS+SS.SS and also adjust the decimal readout.

6. Review the Volumes report.

a. Select the **Volumes.xsl** (this style sheet only displays the volumes for each material type).



Volumes Report

Report Created: Tuesday, September 24, 2024
Time: 1:48:46 PM

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

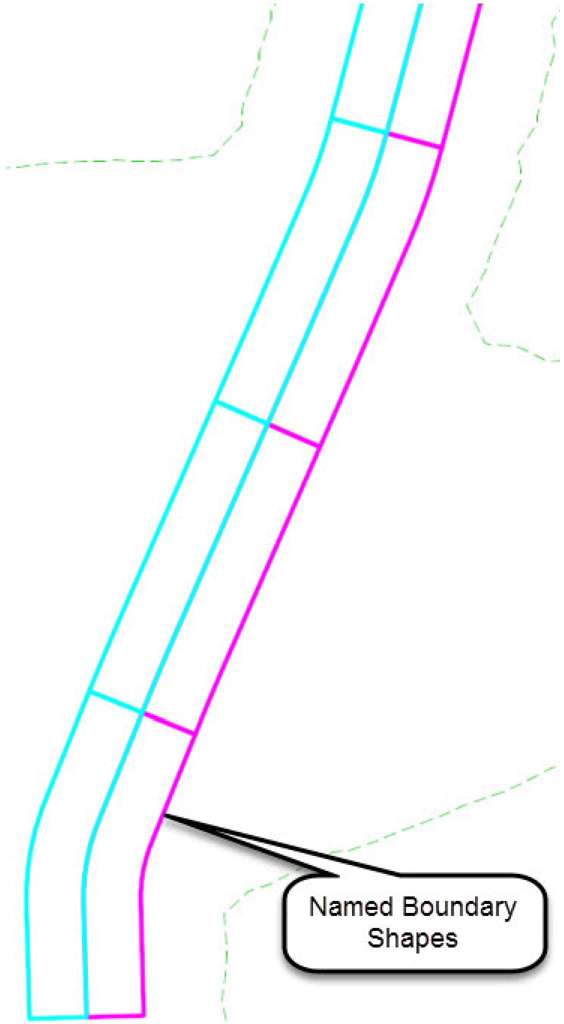
Note: All units in this report are in feet, square feet and cubic yards unless specified otherwise.

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
51+00.000							87
	TC_Aggregate Typ A:		73	1.000	73	No	
	TC_Asph Conc Wearing Cse:		14	1.000	14	No	
	TC_Asph Conc Intermediate Cse:		19	1.000	19	No	
	TC_Asph Conc Base Cse:		67	1.000	67	No	
	TC_Existing Pavt (removed):		46	1.000	46	No	
	Total TC_Existing Pavt:		75	1.000	75		
	Volumes_Cut:		124	1.000	124	Yes	
	Volumes_Fill:		36	1.000	36	Yes	
52+00.000							-78
	TC_Aggregate Typ A:		84	1.000	84	No	
	TC_Asph Conc Base Cse:		78	1.000	78	No	
	TC_Asph Conc Intermediate Cse:		22	1.000	22	No	
	TC_Asph Conc Wearing Cse:		16	1.000	16	No	
	TC_Existing Pavt (removed):		0	1.000	0	No	
	Total TC_Existing Pavt:		75	1.000	75		
	Volumes_Fill:		177	1.000	177	Yes	
	Volumes_Cut:		11	1.000	11	Yes	
53+00.000							-587
	TC_Aggregate Typ A:		89	1.000	89	No	
	TC_Asph Conc Wearing Cse:		17	1.000	17	No	
	TC_Asph Conc Intermediate Cse:		24	1.000	24	No	
	TC_Asph Conc Base Cse:		84	1.000	84	No	
	TC_Existing Pavt (removed):		0	1.000	0	No	

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

Create Named Boundaries for Northbound and Southbound

This section will focus on how to create **Named Boundaries** along the northbound side and southbound side of the corridor model. The objective is to create a quantities report that can be used for construction phasing on the northbound and southbound sections of the project.

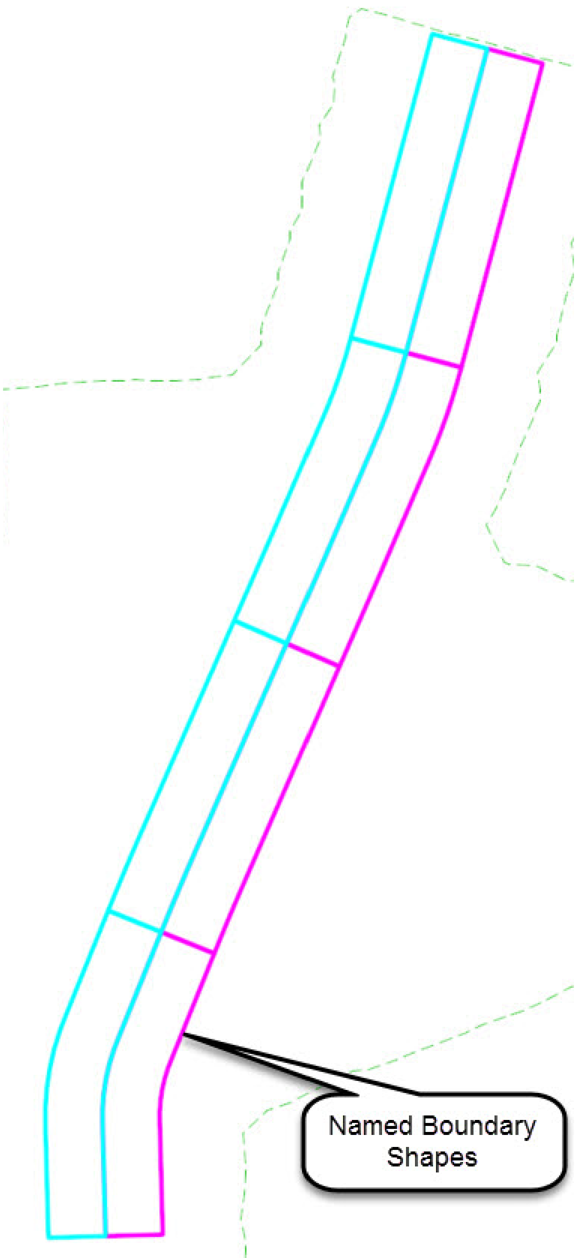


1. Open **NamedBoundaries-LondonRd-Phasing.dgn** *[Metric - Named Boundaries-LondonRd-Phasing.dgn]*
2. Create Named Boundaries for the northbound side of London Rd.
   a. Select **Drawing Production > Named Boundary > Place Named Boundary**
   b. Select the **Civil Plan** tool and populate the following fields with the values shown:
      - *Set Drawing Seed:* **ANSI D_PLAN** *[A1_PLAN]*
      - *Detail Scale:* **1”=50’** *[1:500]*
      - *Name (under Detail Scale):* **NB**
      - *Set the length:* **1100** *[335]*
      - *Left Offset:* **0.0**
      - *Right Offset:* **200.0** *[60]*
      - *Overlap:* **0**
      - *Boundary Chords:* **10**
      - *Create Drawing:* **Disable**

   c. Select **London Rd.** alignment to identify path element.
   d. Select **Lock Start Location** icon to lock the starting location.
   e. Select **Lock End Location** icon to lock the end location.

f. In the *Name (Under Group)* field key in: **LondonRd-NB**, press **Tab** on your keyboard

g. *Left-Click* to accept (multiple Left-Clicks may be required). *Named boundaries* will now be created on the northbound side of London Rd.



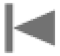
3. Create *Named Boundaries* for the southbound side of London Rd.

a. From the ribbon menu, select *Drawing Production > Named Boundary >* **Place Named Boundary**

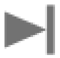
b. Select the *Civil Plan* tool and populate the following fields with the values shown:

- Set *Drawing Seed*: **ANSI D_PLAN** *[A1_PLAN]*
- *Detail Scale:* **1"=50'** *[1:500]*
- *Name (under Detail Scale):* **SB**
- *Set the length:* **1100** *[335]*
- *Left Offset:* **-200.0** *[-60]*
- *Right Offset:* **0.0**
- *Overlap:* **0**
- *Boundary Chords:* **10**
- *Create Drawing:* **Disable**

c. Select *London Rd.* alignment to identify path element.



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



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

f. In the *Name (Under Group)* field key in: **LondonRd-SB**, press **Enter** on your keyboard.

g. *Left-Click* to accept (multiple Left-Clicks may be required). *Named boundaries* will now be created on the southbound side of London Rd.

Create Northbound and Southbound Quantities Report by Named Boundary

This section will show how to compute the corridor quantities within each named boundary.

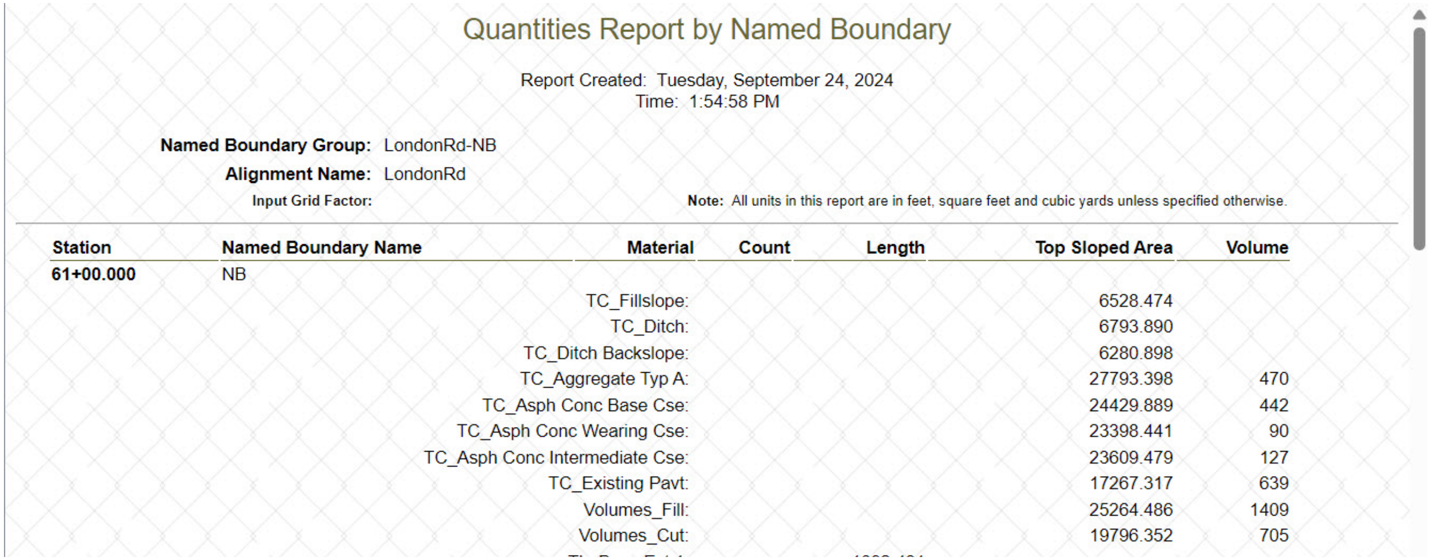
1. Create the Quantities Report for **LondonRd-NB**.

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

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

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

2. Review the report and note the station ranges are based on the begin and end location of each named boundary placed and the quantities are calculated within each named boundary. **Close** the *Bentley Civil Report Browser* dialog when done.



Quantities Report by Named Boundary

Report Created: Tuesday, September 24, 2024
Time: 1:54:58 PM

Named Boundary Group: LondonRd-NB
Alignment Name: LondonRd
Input Grid Factor:

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

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
61+00.000	NB					
		TC_Fillslope:			6528.474	
		TC_Ditch:			6793.890	
		TC_Ditch Backslope:			6280.898	
		TC_Aggregate Typ A:			27793.398	470
		TC_Asph Conc Base Cse:			24429.889	442
		TC_Asph Conc Wearing Cse:			23398.441	90
		TC_Asph Conc Intermediate Cse:			23609.479	127
		TC_Existing Pavt:			17267.317	639
		Volumes_Fill:			25264.486	1409
		Volumes_Cut:			19796.352	705

TIP: When *Display Clipped Graphics* is set to **Yes**, the 3D data inside of each named boundary will be clipped and copied into the 3D model. This is useful for **checking** and **verifying** the results of the **Quantities Report by Named Boundary.** One could simply select a clipped 3D element and use the **Properties** tool to verify the quantity.

3. Create the quantities report for **LondonRd-SB**.

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

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

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

4. Review the report.

Quantities Report by Named Boundary

Report Created: Tuesday, September 24, 2024
Time: 1:57:43 PM

Named Boundary Group: LondonRd-SB
Alignment Name: LondonRd
Input Grid Factor:

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

Station	Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
61+00.000	SB					
		TC_Ditch:			5306.574	
		TC_Fillslope:			7288.398	
		TC_Aggregate Typ A:			27435.707	464
		TC_Asph Conc Base Cse:			24484.237	444
		TC_Ditch Backslope:			4396.905	
		TC_Existing Pavt:			5664.110	210
		TC_Asph Conc Intermediate Cse:			23760.124	128
		TC_Asph Conc Wearing Cse:			23573.144	91
		Volumes_Cut:			17039.101	681
		Volumes_Fill:			25524.531	1323

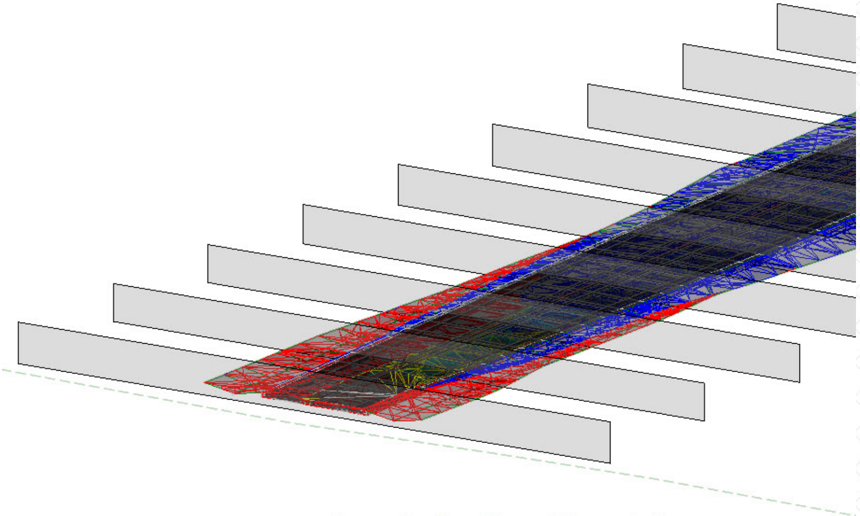
5. Close the *Bentley Civil Report Browser* dialog when done reviewing.

Exercise 4: End Area Volumes Report

In this exercise, you are going to learn how to create the *End Area Volumes Report* for the London Rd. corridor. The workflow is very similar to the process used to create the *Quantities Report By Named Boundary*. Instead of creating plan view named boundaries you will create cross section named boundaries and then run the *End Area Volumes Report* tool.

Skills Taught

- Create Cross Section Named Boundaries
- Create End Area Volumes Report



Cross Section Named Boundaries

Volumes Report

Report Created: Friday, September 21, 2018
Time: 1:42:06 PM

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

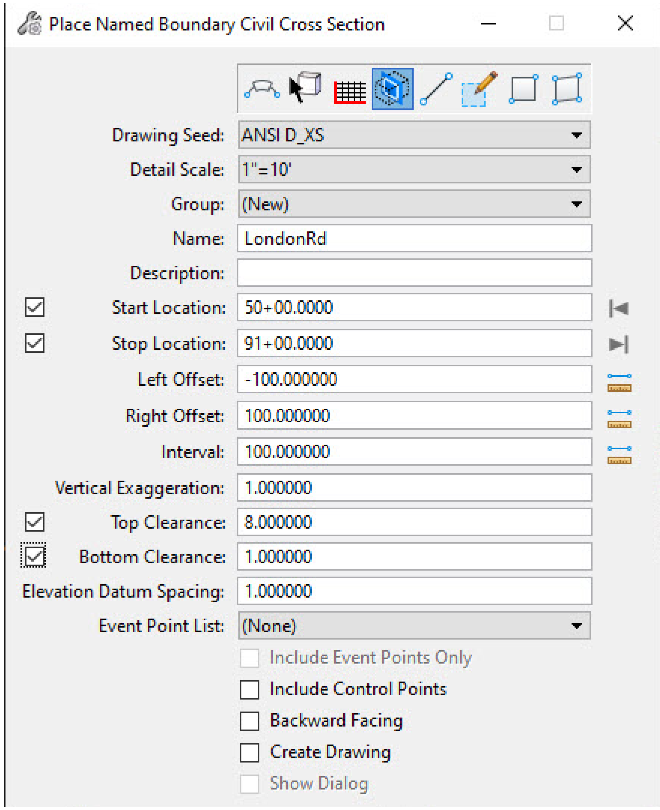
Note: All units in this report are in feet, square feet and cubic feet unless specified otherwise.

Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
50+00.000							0.000
	TC_Aggregate Typ A:	18.450	0.000	1.000	0.000	No	
	TC_Asph Conc Base Cse:	16.624	0.000	1.000	0.000	No	
	TC_Asph Conc Intermediate Cse:	4.732	0.000	1.000	0.000	No	
	TC_Asph Conc Wearing Cse:	3.350	0.000	1.000	0.000	No	
	Volumes_Cut:	76.370	0.000	1.000	0.000	Yes	
50+50.000							2613.965
	TC_Aggregate Typ A:	19.822	956.800	1.000	956.800	No	
	TC_Asph Conc Base Cse:	18.122	868.648	1.000	868.648	No	
	TC_Asph Conc Intermediate Cse:	5.169	247.514	1.000	247.514	No	
	TC_Asph Conc Wearing Cse:	3.662	175.293	1.000	175.293	No	
	TC_Existing Pavt (replaced):	4.643	116.066	1.000	116.066	No	
	TC_Existing Pavt (not replaced):	15.888	397.200	1.000	397.200	No	
	Total TC_Existing Pavt:	20.531	513.266	1.000	513.266		
	Volumes_Cut:	33.854	2755.600	1.000	2755.600	Yes	
	Volumes_Fill:	5.665	141.635	1.000	141.635	Yes	
51+00.000							2925.354
	TC_Aggregate Typ A:	21.194	1025.385	1.000	1025.385	No	
	TC_Asph Conc Base Cse:	19.619	943.523	1.000	943.523	No	

Create Cross Section Named Boundaries

In this section, you are going to learn to create the cross section named boundaries every **100’** *[30 m]* along the London Rd. corridor.

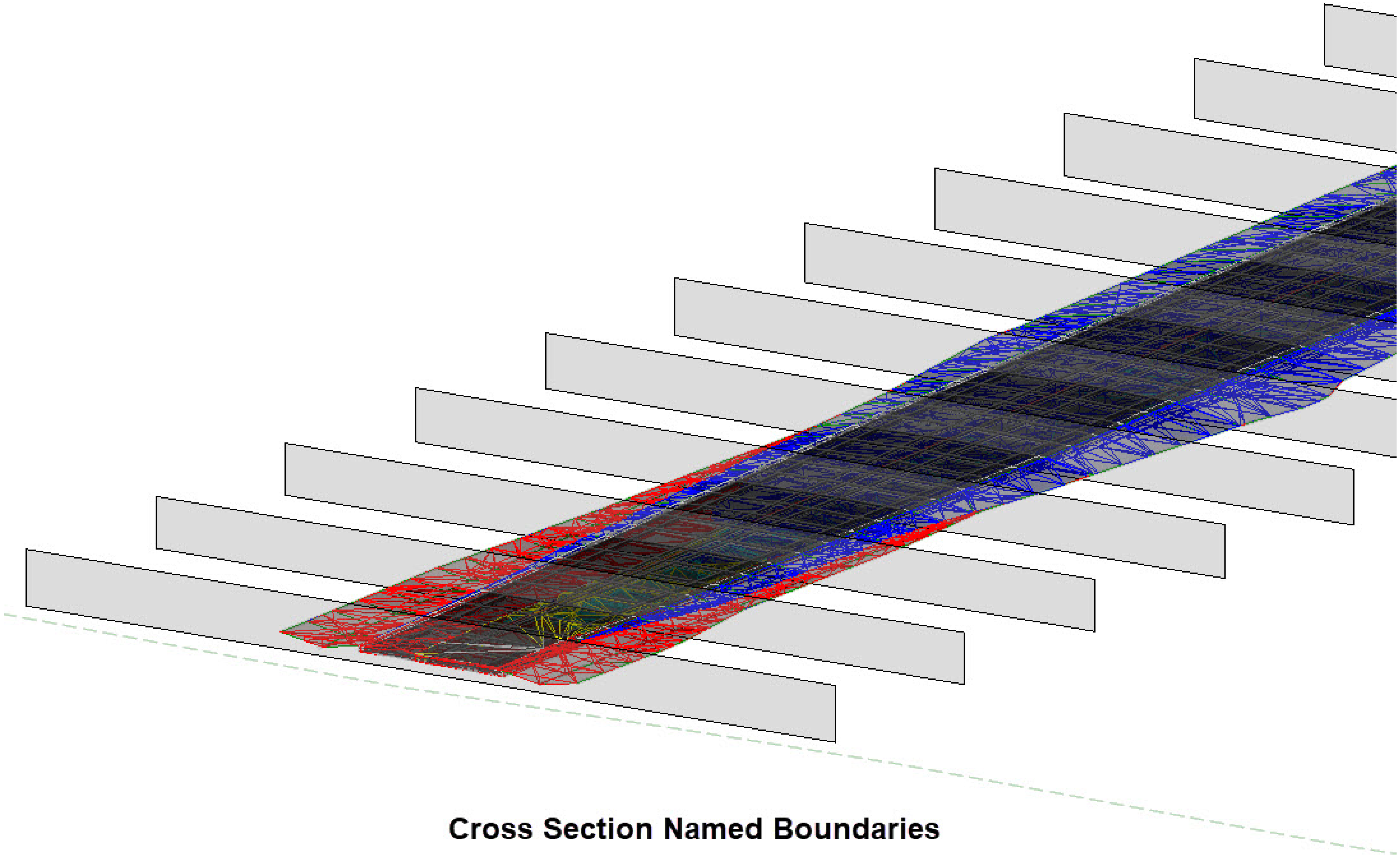
1. Create Cross Section Named Boundaries every **100’** *[30 m]*
   a. Open **XS NamedBoundaries-LondonRd.dgn** *[Metric-XS NamedBoundaries-LondonRd.dgn]*
   b. Select *Drawing Production > Named Boundary >* **Place Named Boundary**
   c. Select the **Civil Cross Section** tool
   d. *Identify Path Element* will display at the lower left corner of screen, Select the London Rd. centerline geometry.
   e. Populate the following fields with the values shown:
      - *Drawing Seed:* **ANSI D_XS** *[A1_XS]*
      - *Detail Scale:* **1”=10’** *[1:100]*
      - *Group:* **(New)**
      - *Name:* **London Rd**
      - *Start Location:* **50+00** *[1+524]*
      - *End Location:* **91+00** *[2+774]*
      - *Left Offset:* **-100** *[-30]*
      - *Right Offset:* **100** *[30]*
      - *Interval:* **100** *[30]*
      - *Vertical Exaggeration:* **1**
      - *Top Clearance:* **8.0**
      - *Bottom Clearance:* **1.0**
      - *Elevation Datum Spacing:* **1.0**



f. *Left-click* to complete (you will have to left click multiple times to complete).

The Cross Section Named Boundaries will now be placed in the 3D model. You can think of cross section named boundaries as windows into the 3D model at a specific station. They are cross sectional “slices” or “cuts” through the 3D Model.

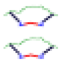
TIP: When creating cross section named boundaries make sure the 3D model elements fit inside the named boundaries. Using the appropriate left and right offset along with the top and bottom clearance options will allow you to customize the size of each cross section named boundary.



Cross Section Named Boundaries

Create End Area Volumes Report

In this section, you are going how to learn to create the *End Area Volumes Report* using the *Cross Section Named Boundaries* created previously.



1. Select *Home > Model Analysis and Reporting > Civil Analysis >* **End Area Volumes Report**

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

   - *Named Boundary Group:* **LondonRd**
   - *Select the start cross section named boundary for volume exception. Reset to complete:* **Right-click** (or Reset).

2. Review the **End Area Volume Report**.

End Area Volume Report

Report Created: Tuesday, September 24, 2024
Time: 2:02:25 PM

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

	Station Quantities									
	Cut				Fill					
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Mass Ordinate
50+00.000	1.000	76.370	0	0	1.000	0.000	0	0	0
51+00.000	1.000	10.047	160	160	1.000	25.758	48	48	112
51+60.358	1.000	3.983	75	75	1.000	61.387	142	142	0
52+00.000	1.000	0.000	19	19	1.000	84.787	205	205	-74
53+00.000	1.000	0.000	0	0	1.000	158.064	450	450	-524
54+00.000	1.000	0.000	0	0	1.000	161.124	591	591	-1115
55+00.000	1.000	0.000	0	0	1.000	167.223	608	608	-1723
56+00.000	1.000	0.547	1	1	1.000	67.576	435	435	-2156
57+00.000	1.000	98.355	183	183	1.000	0.000	125	125	-2098
58+00.000	1.000	130.688	424	424	1.000	0.000	0	0	-1674
59+00.000	1.000	44.065	324	324	1.000	9.938	18	18	-1369
60+00.000	1.000	32.192	141	141	1.000	25.794	66	66	-1294
61+00.000	1.000	35.372	125	125	1.000	50.464	141	141	-1310
62+00.000	1.000	28.246	118	118	1.000	25.576	141	141	-1333
63+00.000	1.000	50.269	145	145	1.000	7.073	60	60	-1248
64+00.000	1.000	14.875	121	121	1.000	1.745	16	16	-1144
65+00.000	1.000	34.128	91	91	1.000	20.180	41	41	-1094
66+00.000	1.000	34.716	127	127	1.000	14.496	64	64	-1030
67+00.000	1.000	31.693	123	123	1.000	22.205	68	68	-975
68+00.000	1.000	32.731	119	119	1.000	4.060	49	49	-905
69+00.000	1.000	53.794	160	160	1.000	2.146	11	11	-756
70+00.000	1.000	141.999	363	363	1.000	35.708	70	70	-464

3. Close the *Bentley Civil Report Browser*. This concludes the training course.

Skills Assessment

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

1. Component Quantities computes volumes based on the average end area method
   a. True
   b. False
2. To calculate cut and fill quantities from multiple clipping corridors, which tool would work best?
   a. Component Quantities
   b. Element Component Quantities
   c. Quantities Report by Named Boundary
3. Which tool do you use to create the 3D cut and fill mesh elements?
   a. Create Corridor
   b. Create Cut Fill Volumes
   c. Quantities Report by Named Boundary
4. Which tool creates boundary shapes along the corridor?
   a. Component Quantities
   b. Element Component Quantities
   c. Named Boundary
5. Which tool will calculate liner feature lengths, areas and volumes?
   a. Component Quantities
   b. Element Component Quantities
   c. Quantities Report by Named Boundary

Skills Assessment - Answers

The answers to the skills assessment questions are highlighted below.

1. Component Quantities computes volumes based on the average end area method
   a. **True**
   b. False
2. To calculate cut and fill quantities from multiple clipping corridors, which tool would work best?
   a. Component Quantities
   b. Element Component Quantities
   c. **Quantities Report by Named Boundary**
3. Which tool do you use to create the 3D cut and fill mesh elements?
   a. Create Corridor
   b. **Create Cut Fill Volumes**
   c. Quantities Report by Named Boundary
4. Which tool creates boundary shapes along the corridor?
   a. Component Quantities
   b. Element Component Quantities
   c. **Named Boundary**
5. Which tool will calculate liner feature lengths, areas and volumes?
   a. Component Quantities
   b. Element Component Quantities
   c. **Quantities Report by Named Boundary**

Summary

As you can see Quantities and Earthwork can be reported with many different tools. First, we looked at the *Component Quantities* tool which computes quantities and earthwork from the corridor via the dynamic sections. This is the least accurate method since it uses an average end area volume and it will only be as accurate as the interval of your template drops in the corridor. When using *Component Quantities* corridor clipping is not considered in the quantities.

Second, we looked at *Element Component Quantities* which extracts the quantities directly from the 3D model but does not compute cut/fill volumes.

Third, we looked at creating 3D cut/fill meshes with *Create Cut Fill Volumes* tool and the *Quantities By Named Boundary Report*. This method will yield the most accurate results since it is truly a 3D prismoidal approach. Quantities are extracted directly from the 3D model and mesh elements.

Lastly, we looked at creating an *End Area Volume Report* based on *Cross Section Named Boundaries*.

Appendix A on the following page details the differences between the various civil analysis tools used for computing quantities and volumes.

Appendix B lists and describes the various volume options available that can be assigned to features such as terrain models and corridor components.

Appendix A: Civil Analysis QuantityTools Comparison

	CUT AND FILL VOLUMES								
Civil Analysis Quantity Tools	Computes Cut and Fill Volumes Using Average End Area Method	Computes Cut and Fill Volumes from 3D Mesh Elements	Computes Quantities from 3D Elements	Computes Quantities from Multiple Corridors	Computes Quantities within Named Boundaries	Computes Linear Feature Quantities	Displays Quantity Station Ranges	Computes Total Material Cost and Total Estimated Cost	Supports Clipping Corridors
Component Quantities	YES	NO	NO	NO	NO	NO	YES	YES	NO
Element Component Quantities	NO	NO	YES	YES	NO	NO	NO	YES	YES
Quantities Report by Named Boundary	NO	YES	YES	YES	YES	YES	YES*	NO	YES
					*If Named Boundaries are created the quantity station ranges will be displayed in the report				

Appendix B: Feature Definition Volume Options

None - The mesh/terrain is totally ignored when the earthwork is computed. This is good for items like structures. There is no fill under a bridge.

Design - Mesh/Terrain(s) that are proposed design. The cut fill tool finds the bottom of all elements that have a Feature Definition that has volume option of Design and compares it to existing ground.

Existing - Finds all Mesh/Terrain(s) that are Existing and formulates a composite mesh sheet for earthworks. Typically, the existing ground is a Terrain(s).

Substrata - Volume option is for a geotechnical terrain model/mesh. The Cut Fill Volumes tool will take this in account when toggled on. It separates cut meshes into 2 distinct meshes so a volume can be formulated for the "substrata" and normal cut so one can get distinct volumes for each.

Cut - Volume option is for the resultant Cut mesh created for the Cut Fill Volumes tool. Do not confuse this with template end conditions, these items are Design, as they were since the conception of ITL and the Roadway Designer.

Fill - Volume option is for the resultant fill mesh created for the Cut Fill Volumes tool. Do not confuse this with template end conditions, these items are Design, as they were since the conception of ITL and the Roadway Designer.

Unsuitable - Volume option is for items like Muck/Swamp/Existing Pavement that is needed to be removed. The Cut Fill Volumes tool has a toggle to include this. This will in essence modify existing ground by taking the unsuitable material out. But the material is broken into 2 meshes-Remove Only & Remove and Replace. One cannot build a road on a void.

Custom is an extension of unsuitable but different. This allows you to model the likes of structural excavation in your template, so you can get a volume for backfill. but it allows you to get 2 volumes. One for the volume of existing ground that needs to be removed to fit this and a volume of this backfill does not need to remove existing. This is done to quantify the two items since their costs are different, the cut/fill tool has a toggle to take this in account.

Subgrade - Volume option is from the old InRoads realm. This was done back in the day for As-Built surveys. The logic is still there for terrain model to terrain model here but this item is not needed in the OpenRoads Designer generally but can be handy for old data.