Chapter 12 - Volumes and Mass Haul Diagram

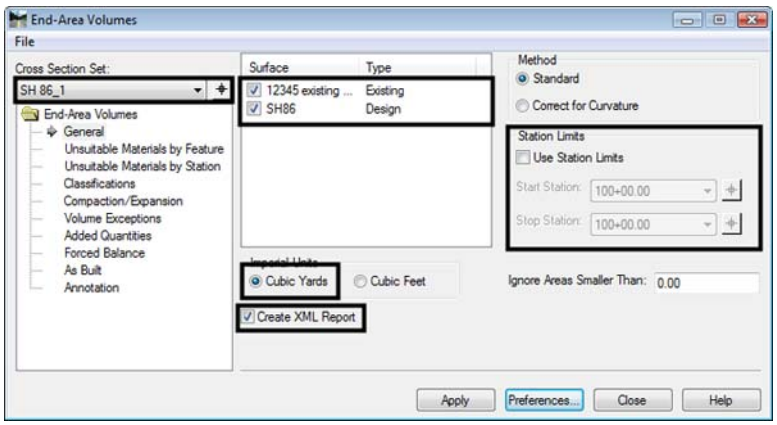
The changes in templates and surface data have made it necessary to change end area volumes as well. The use of components stored in the design surface allows the program to calculate volumes with greater accuracy than previously. To calculate End Area Volumes:

Chapter Objectives:

- Calculate basic end area volumes.
- Create an end area volume report.
- Add unsuitable material to calculations.
- Add a volume exception.
- Generate a Mass Haul diagram.

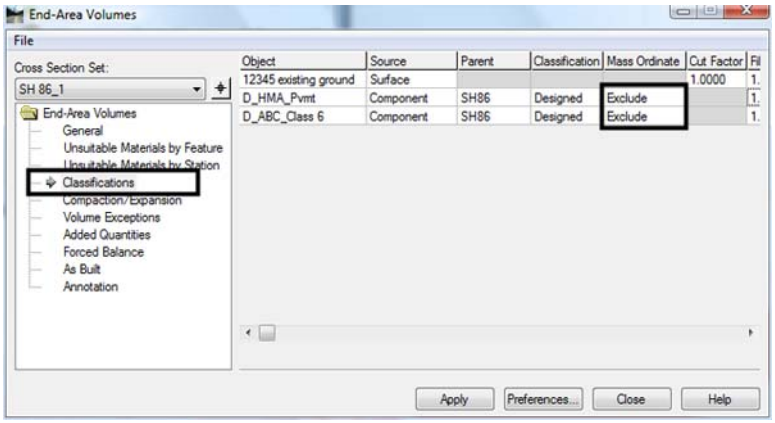
Calculating Volumes

1. Select **Evaluation > Volumes > End-Area Volumes** from the InRoads menu bar.
2. Select **General** leaf from the dialog box explorer.
3. Select the desired Cross Section Set from the drop down menu.
4. Toggle on the desired surfaces.
5. Toggle on ***Cubic Yards*** in the ***Imperial Units*** area.
6. Toggle on ***Create XML Report*** if desired.
7. Toggle on ***Station Limits*** if desired. If used, key in ***Start Station*** and ***Stop Station***.



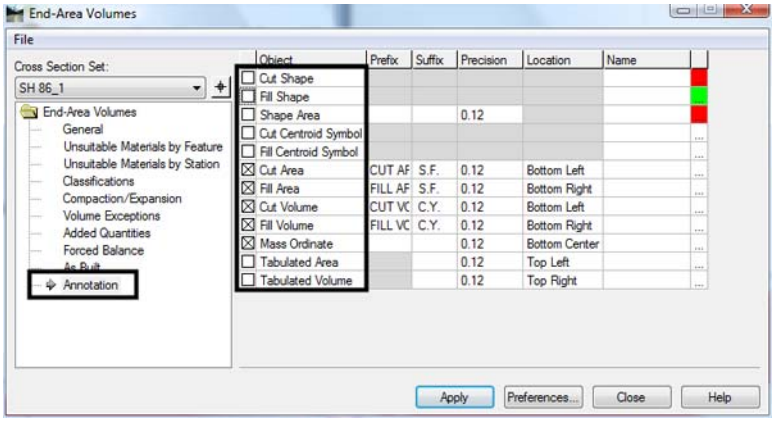
8. Select **Classification** leaf from the dialog box explorer.

9. To change the status of a material, **<D>** in the **Mass Ordinate** cell of the desired material. ***Include*** adds the material to the volume calculation, ***Exclude*** does not add the material to the volume calculation.



10. Select **Annotation** leaf from the dialog box explorer.

11. Toggle on or off the desired objects.



12. **<D> Apply** to calculate the volume. Cut and fill areas and volumes are displayed under each cross section.

13. **<D> Close** to dismiss the dialog box.

Volume Reports

End Area Volume XML Report

If ***Create XML Report*** was toggled on in *Step 6* above, a Bentley InRoads Report Browser window is displayed. This window uses style sheets to determine the layout of the data. To select a style sheet:

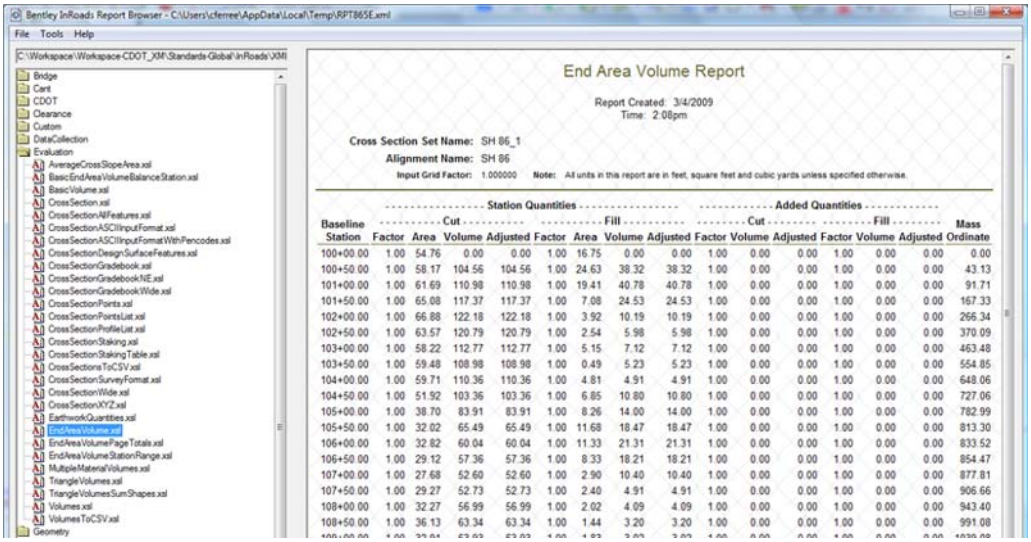
1. Select **Tools > Style Sheet Root** from the ***Bentley InRoads Report Browser*** menu bar. The Browse For Folder dialog box is displayed.

2. Navigate to***: C:\Workspace\Workspace-CDOT\Standards-Global\InRoads\XML Style Sheets***

3. **<D> OK**. The style sheet folder structure is displayed in the left pane of the ***Bentley InRoads Report Browser.***

4. **<D>** on the **Evaluation** folder to expose its style sheets.

5. **<D>** on the desired end-area volume style sheets to format the data in the right pane.



The formatted data can be copied and pasted into Excel or Word.

Unsuitable Material

InRoads has the option to modify end area calculations for unsuitable material (like topsoil and muck). There are two options for determining the area of unsuitable material: by feature and by station extents. If both are used, the station extents override the feature method.

Unsuitable Material by Feature

Before using this option a closed shape feature(s) must be created that defines the area of the material. The feature(s) do not have to reflect the actual elevation of the surface. It can be placed in its own surface at a zero elevation. To use the Unsuitable Material by Feature option:

1. Repeat steps 1 through 11 under Calculating Volumes.

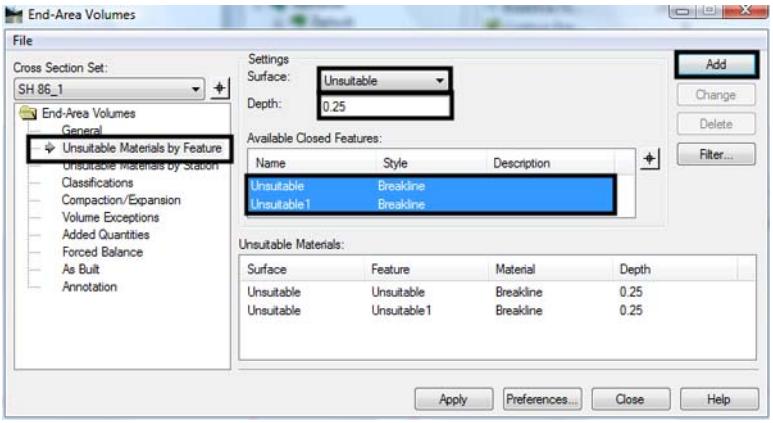
2. Select the **Unsuitable Material by Feature** leaf from the dialog box explorer.

3. Select the desired ***Surface*** from the drop down menu.

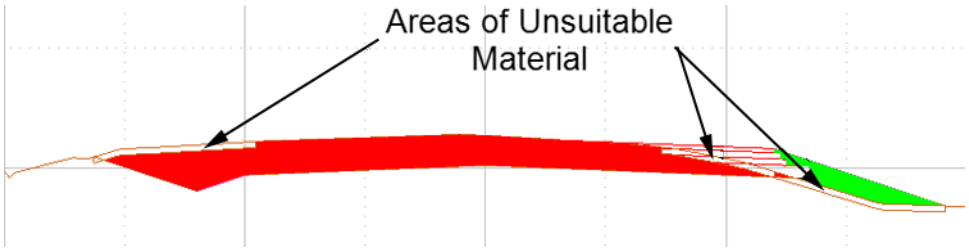
4. Key in the desired ***Depth***.

5. Highlight the desired features from the ***Available Closed Features*** area.

6. **<D> Add**. The data is added to the Unsuitable Materials list.



7. **<D> Apply** to calculate the volumes. The area of unsuitable material is shown on the cross sections.



Note: Unsuitable material located under fill is included in the Mass Ordinate calculation. This occurs because materials removed from under fills must be replaced with embankment material.

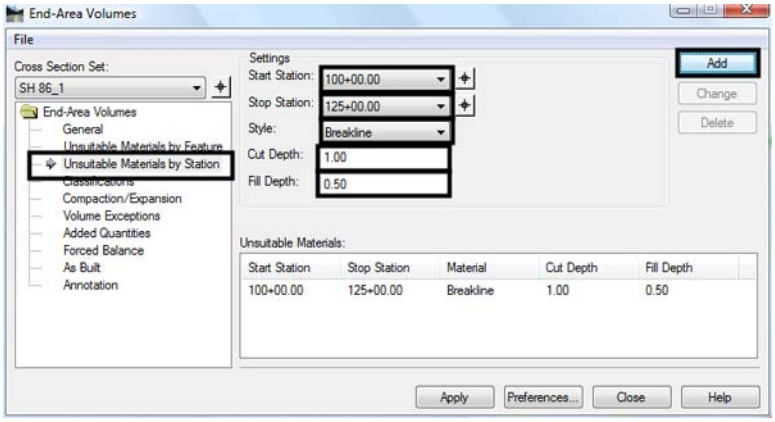
8. **<D> Close** to dismiss the ***End-Area Volumes*** dialog box.

Unsuitable Material by Station

There are no prerequisites for using this option. To use the Unsuitable Material by Station option:

1. Repeat steps 1 through 11 under Calculating Volumes.
2. Select the **Unsuitable Material by Station** leaf from the dialog box explorer.
3. Select the ***Start Station*** using the drop down menu.
4. Select the ***Stop Station*** using the drop down menu.
5. Select the ***Style*** using the drop down menu.
6. Key in the ***Cut Depth***
7. Key in the ***Fill Depth***.

8. <D> Add. The data is added to the Unsuitable Materials list.



9. **<D> Apply** to calculate the volumes. The area of unsuitable material is shown on the cross sections. The calculations and displays are the same as those used for the Unsuitable Material by Feature option.

10. **<D> Close** to dismiss the ***End-Area Volumes*** dialog box.

Volume Exceptions

Volume exceptions are used to remove the amount of earthwork calculated for an area where no work is done but is present in the design model (in the area of a bridge, for example). Using a volume exception allows the user to create a single design dtm for the project and still account for areas where no earthwork will take place.

The cross section set must have a cross section at the beginning station of the exception and the ending station of the exception. Horizontal Event Stations or Key Stations (from Roadway Designer) can be used to include these stations if they do not fall on normal intervals. To set up a volume exception:

1. Repeat *Step 1* through *Step 11* under *Calculating Volumes*.

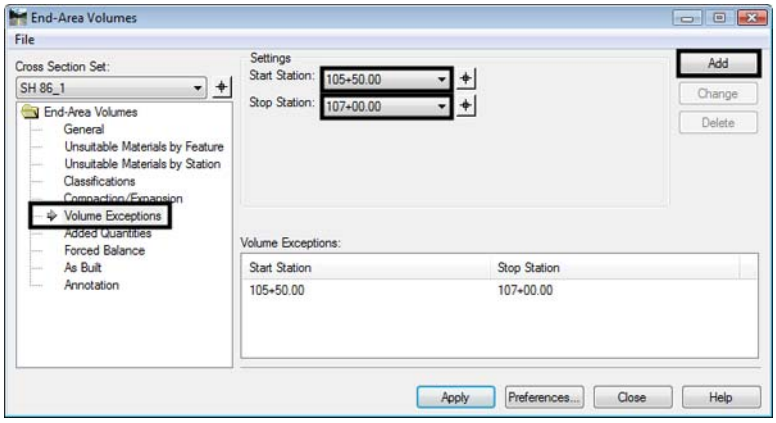
2. Repeat the steps under *Unsuitable Material by Feature* and/or *Unsuitable Material by Station*.

3. Select the **Volume Exceptions** leaf from the dialog box explorer.

4. Select the ***Start Station*** from the drop down menu. This is the last station where a volume will be calculated before the exception.

5. Select the ***Stop Station*** from the drop down menu. This is the last station where no volume will be calculated at the end of the exception.

6. **<D> Add**. This adds the data to the ***Volume Exception*** area.



7. **<D> Apply** to calculate the volumes. Below is an example of an End-Area Volume Report with an exception.

End Area Volume Report

Report Created: 3/5/2009
Time: 10:37am

Cross Section Set Name: SH 86_1
Alignment Name: SH 86
Input Grid Factor: 1.000000 **Note:** All units in this report are in feet, square feet and cubic yards unless specified otherwise.

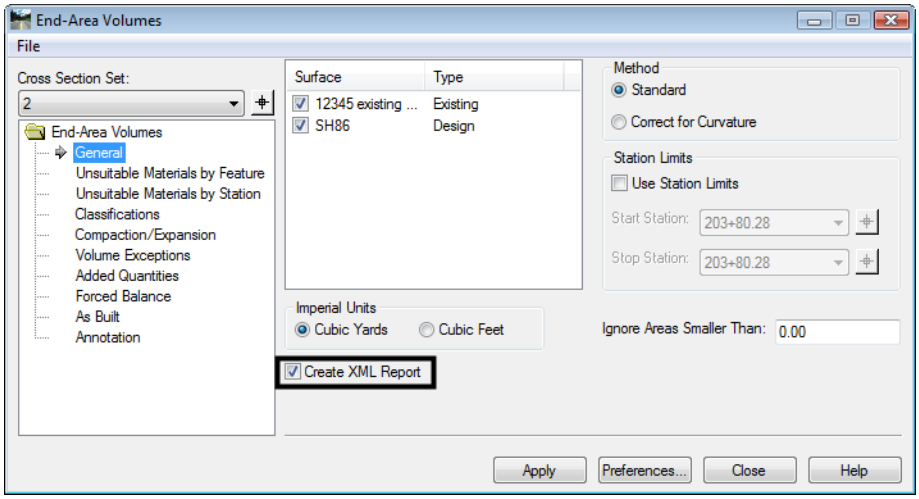
	Station Quantities								Added Quantities							
	Cut				Fill				Cut			Fill				
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
100+00.00	1.00	88.40	0.00	0.00	1.00	16.75	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00
100+50.00	1.00	91.57	166.64	166.64	1.00	24.63	38.32	38.32	1.00	0.00	0.00	1.00	0.00	0.00	128.33
101+00.00	1.00	95.00	172.75	172.75	1.00	19.41	40.78	40.78	1.00	0.00	0.00	1.00	0.00	0.00	260.30
101+50.00	1.00	98.83	179.47	179.47	1.00	7.08	24.53	24.53	1.00	0.00	0.00	1.00	0.00	0.00	415.24
102+00.00	1.00	103.11	186.98	186.98	1.00	3.92	10.19	10.19	1.00	0.00	0.00	1.00	0.00	0.00	592.03
102+50.00	1.00	101.52	189.47	189.47	1.00	2.54	5.98	5.98	1.00	0.00	0.00	1.00	0.00	0.00	775.52
103+00.00	1.00	91.30	178.54	178.54	1.00	5.15	7.12	7.12	1.00	0.00	0.00	1.00	0.00	0.00	946.93
103+50.00	1.00	92.90	170.55	170.55	1.00	0.49	5.23	5.23	1.00	0.00	0.00	1.00	0.00	0.00	1112.26
104+00.00	1.00	91.84	171.05	171.05	1.00	4.81	4.91	4.91	1.00	0.00	0.00	1.00	0.00	0.00	1278.40
104+50.00	1.00	83.52	162.36	162.36	1.00	6.85	10.80	10.80	1.00	0.00	0.00	1.00	0.00	0.00	1429.96
105+00.00	1.00	66.31	138.73	138.73	1.00	8.26	14.00	14.00	1.00	0.00	0.00	1.00	0.00	0.00	1554.69
105+50.00	1.00	59.31	116.31	116.31	1.00	11.68	18.47	18.47	1.00	0.00	0.00	1.00	0.00	0.00	1652.54
106+00.00	1.00	61.03	0.00	0.00	1.00	11.33	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1652.54
106+50.00	1.00	56.48	0.00	0.00	1.00	8.33	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1652.54
107+00.00	1.00	59.52	0.00	0.00	1.00	2.90	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	1652.54
107+50.00	1.00	60.52	111.15	111.15	1.00	2.40	4.91	4.91	1.00	0.00	0.00	1.00	0.00	0.00	1758.77
108+00.00	1.00	66.63	117.73	117.73	1.00	2.02	4.09	4.09	1.00	0.00	0.00	1.00	0.00	0.00	1872.41
108+50.00	1.00	71.36	127.77	127.77	1.00	1.44	3.20	3.20	1.00	0.00	0.00	1.00	0.00	0.00	1996.98
109+00.00	1.00	64.90	126.17	126.17	1.00	1.83	3.02	3.02	1.00	0.00	0.00	1.00	0.00	0.00	2120.12
109+50.00	1.00	63.71	119.08	119.08	1.00	2.44	3.96	3.96	1.00	0.00	0.00	1.00	0.00	0.00	2235.25

8. **<D> Close** to dismiss the ***End-Area Volumes*** dialog box.

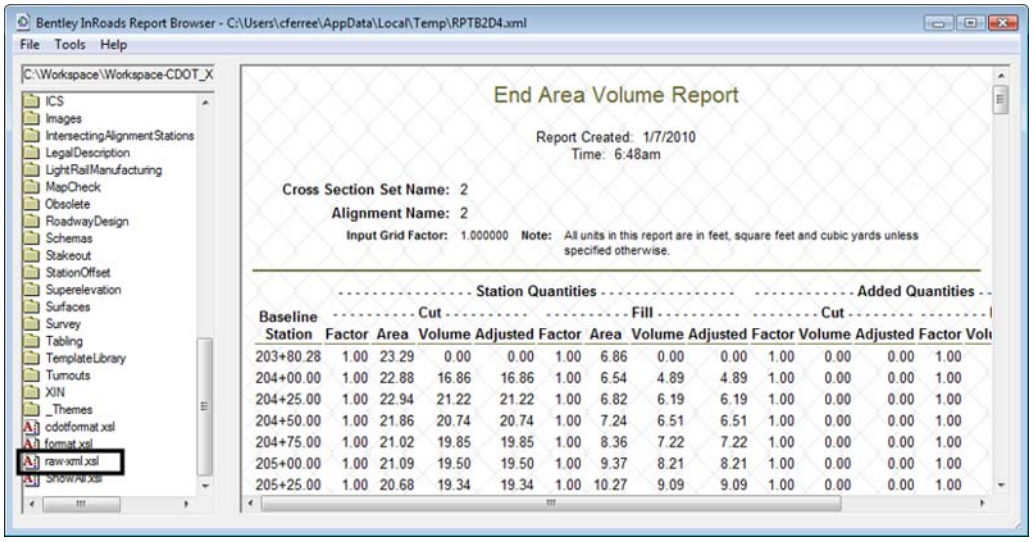
Creating a Mass-Haul Diagram

A mass-haul diagram looks like a profile but the “ground line” represents the amount of earthwork. It is, in fact, using the Mass Ordinate for the data line. The Mass-Haul diagram uses the raw data from the End Area volume report to plot the mass line. To save the End Area volume report as a Mass-Haul data file:

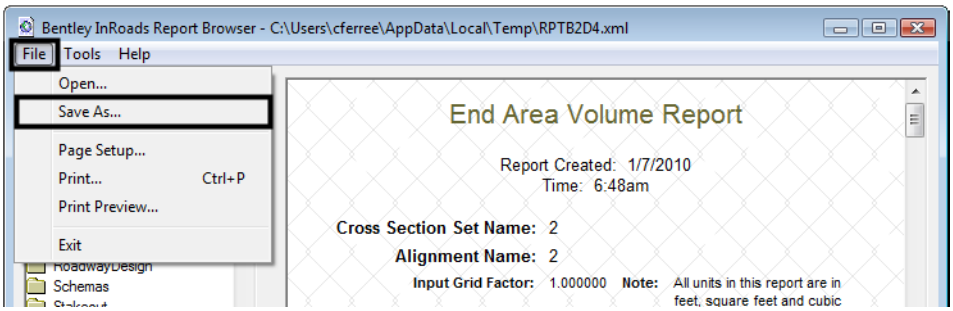
1. Set up the ***End Area Volumes*** dialog box as desired.
2. Toggle on ***Create XML Report***.



3. **<D> Apply** to calculate the volumes and create the XML report. This displays the ***Bentley InRoads Report Browser***.
4. In the style sheet list of the report browser, select the **raw-xml.xsl** style sheet.



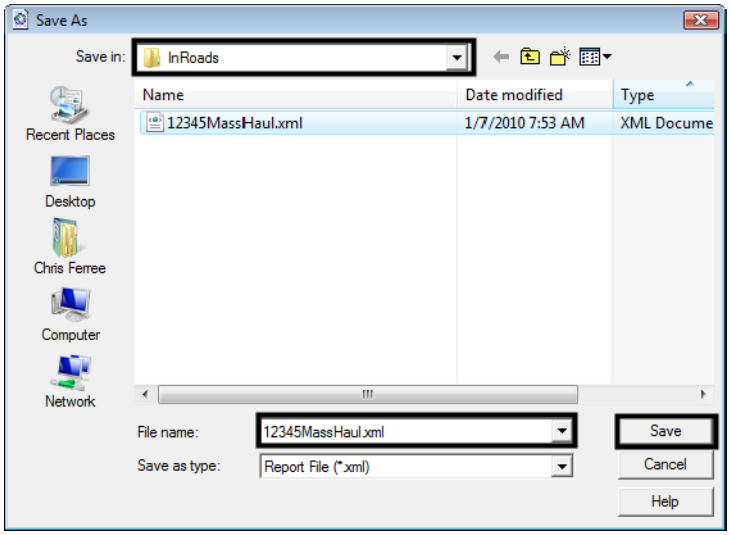
5. From the report browser menu bar, select **File > Save As**.



6. In the ***Save As*** dialog box, navigate to the ***\Project\Design\InRoads*** directory.

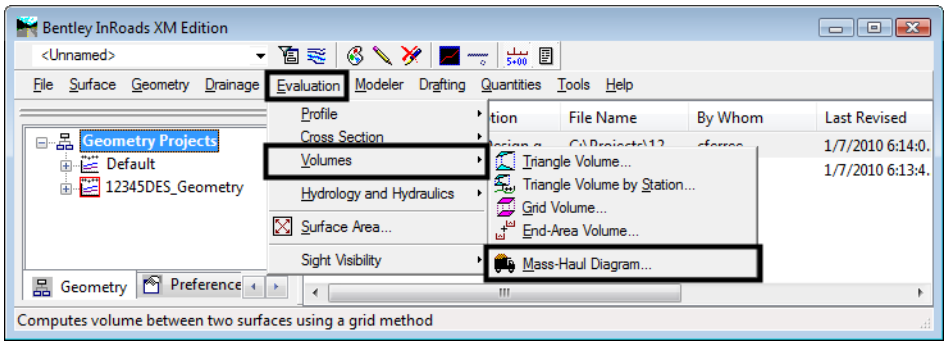
7. In the ***File name*** field, key in the desired name.

8. **<D> Save** to create the file and dismiss the ***Save As*** dialog box.



Now the mass-haul diagram can be generated. The mass-haul diagram should be placed in its own dgn file, so a new one should be created and opened before proceeding to the next steps.

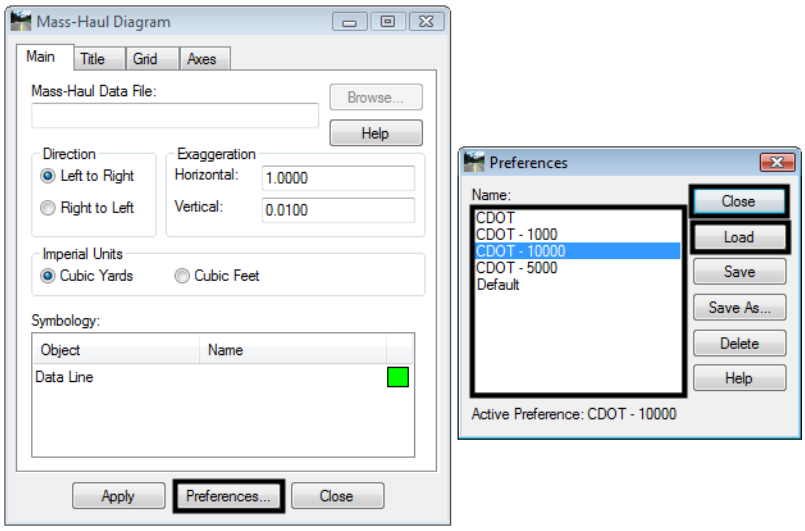
9. Select **Evaluation > Volumes > Mass-Haul Diagram** from the InRoads main menu. This displays the ***Mass-Haul Diagram*** dialog box.



10. In the ***Mass-Haul Diagram*** dialog box, **<D>** the **Preferences** button to display the ***Preferences*** dialog box.

11. Select the desired preference from the list in the ***Preferences*** dialog box.

12. **<D>** the **Load** button then **<D>** the **Close** button to dismiss the ***Preferences*** dialog box.

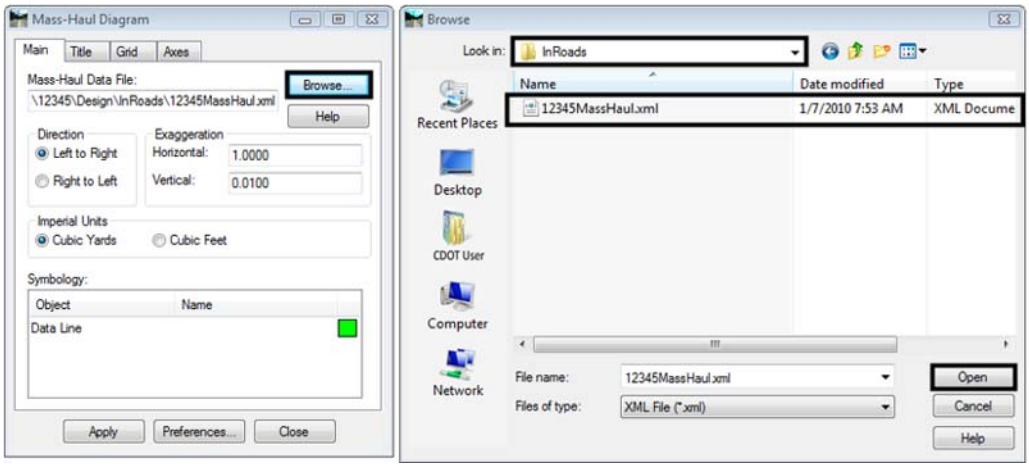


13. **<D>** the **Browse** button to display the ***Browse*** dialog box.

14. In the ***Browse*** dialog box, navigate to the ***|Project\Design\InRoads*** directory.

15. Highlight the mass-haul data file saved above.

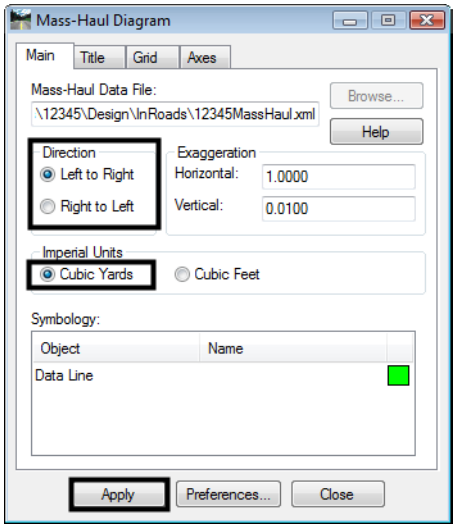
16. **<D>** the **Open** button to select the file and dismiss the ***Browse*** dialog box.



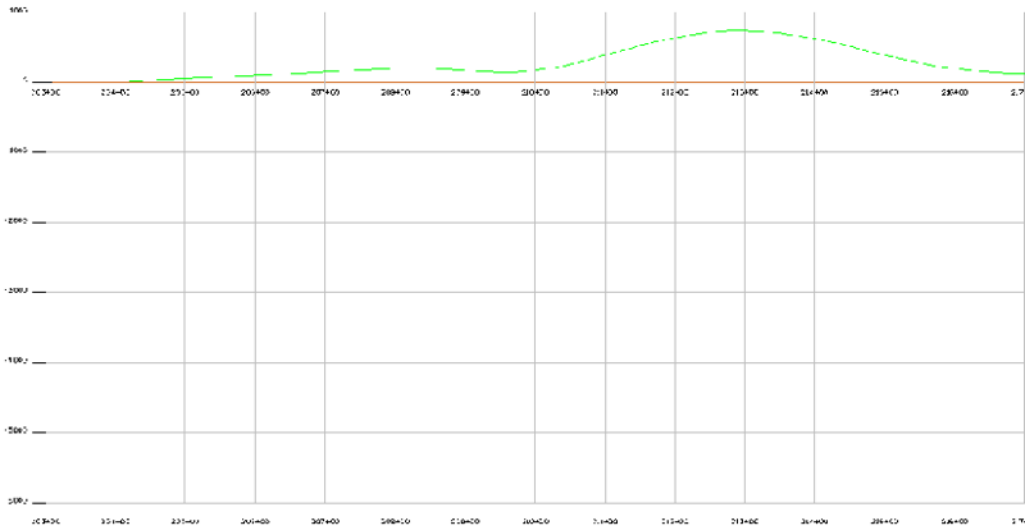
17. Select the desired ***Direction***. Typically, this will be ***Left to Right***. However is the project alignment runs from right to left then the ***Right to Left*** option can be used.

18. Verify that the ***Imperial Units*** is set to **Cubic Yards**.

19. **<D>** the **Apply** button then **<D>** in the MicroStation view window to locate the diagram



20. **<D>** the **Close** button to dismiss the Mass-Haul Diagram dialog box. Below is an example of a mass-haul diagram.



Chapter Summary:

- Surfaces are compared based on their Type property. There must be an Existing and at least one Design type surface loaded to calculate volumes.
- The end area volume report can be created when the volumes are calculated.
- Unsuitable material locations can be defined based on a station range or a closed feature. Volumes within these areas are adjusted to account for the removal of this material.
- Volume exceptions ignore earthwork quantities through a given cross section range. This allows the user to calculate a single quantity for the project instead of separate quantities between each area of no construction.

- The Mass-Haul Diagram command uses the raw data from the end area volume report to create its data line.
- Choose the Mass-Haul preference that best suits the amound of earthwork on the job. Small jobs can use the CDOT - 1000 preference (1000 Cu. Yds. per major grid) while large jobs should use the CDOT - 10000 preference (10,000 Cu. Yds. per major grid).