

LAB 16 - Cross Sections, Volumes, and Reports

This lab illustrates the changes in cross sections, volumes, and reporting from InRoads 2004 to InRoads XM. These changes came about due to changes in the templates and dtm.

Chapter Objectives:

- Create and update a set of cross sections to show the design surface and components.
- Calculate End Area Volumes for the cross sections.
- Add an area of unsuitable material to the volume calculation.
- Use a volume exception when calculating End Area Volumes
- Examine the End Area Volume reports.
- Create a Station Base report to an alignment.
- Create a Station Base report to a feature.

Before beginning this lab, verify that the following files are loaded:

- C:\Projects\12345\Design\Drawings\Reference_Files\12345DES_Model.dgn
- C:\Workspace\Workspace-CDOT_XM\Standards-Global\InRoads\Preferences\CDOT_Civil.xin
- C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
- C:\Projects\12345\Design\InRoads\12345 existing ground.dtm
- C:\Projects\12345\Design\InRoads\12345DES.ird
- C:\Projects\12345\Design\InRoads\DES12345_Templates.itl

Lab 16.1 - Create Cross Sections

This lab demonstrates the changes made in the Create Cross Sections command and illustrates the changes made in the surface (dtm) from the 2004 edition to the XM edition of InRoads.

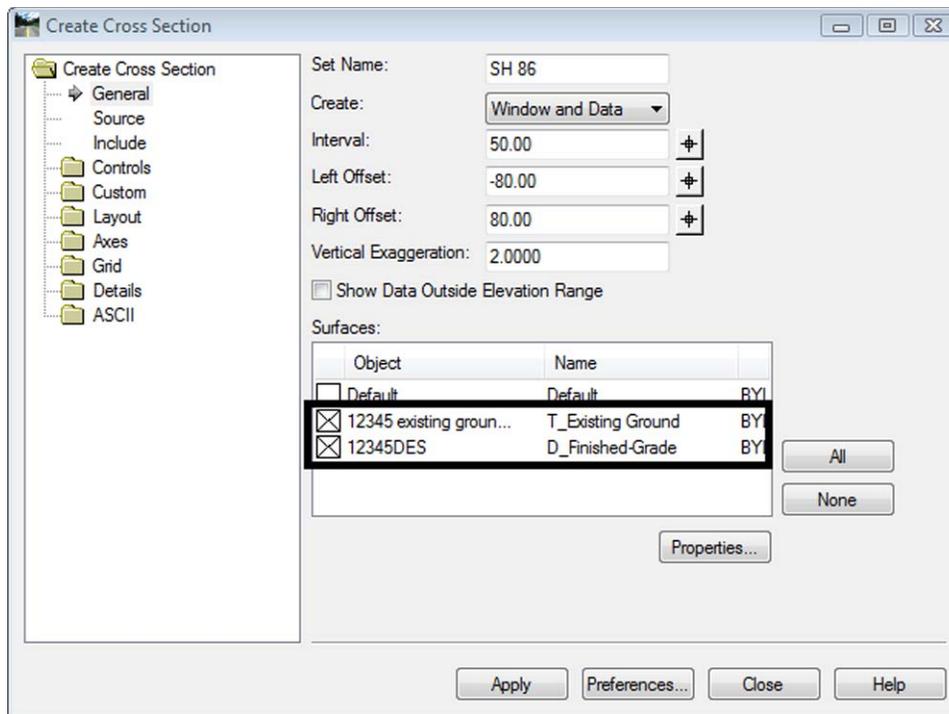
Step 1 resets the text scale factor for InRoads so that the cross sections will display correctly.

1. Select **Tools > Options** and <D> the **Factors** tab and set the scale factors to **30**. This can also be done from the **Global Scale Factors** dialog box.
2. <D> **Apply**.
3. <D> **Close**.

The cross sections created in the following steps display the existing ground and the triangulated design surface only. This is to illustrate what features (template points) are used to create the triangulated surface model.

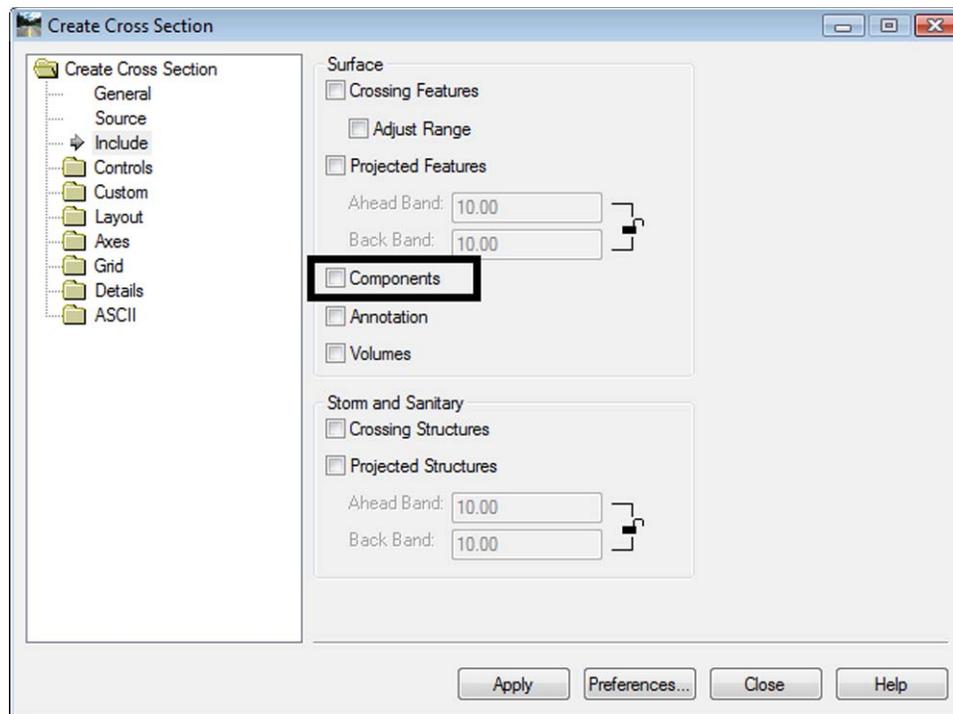
4. Select **Evaluation > Cross Section > Create Cross Section** from the InRoads menu bar.

- In the **Create Cross Section** dialog box, toggle on the **12345 Existing Ground** and the **12345DES** surfaces.

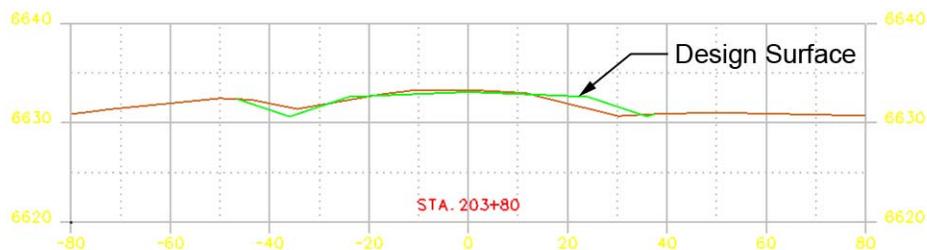


- <D> Include in the **Create Cross Section** explorer.

- Toggle off **Components**. This is done to illustrate what is stored as a surface. Normally, this toggle is left on. The components will be added to the cross sections in later steps.



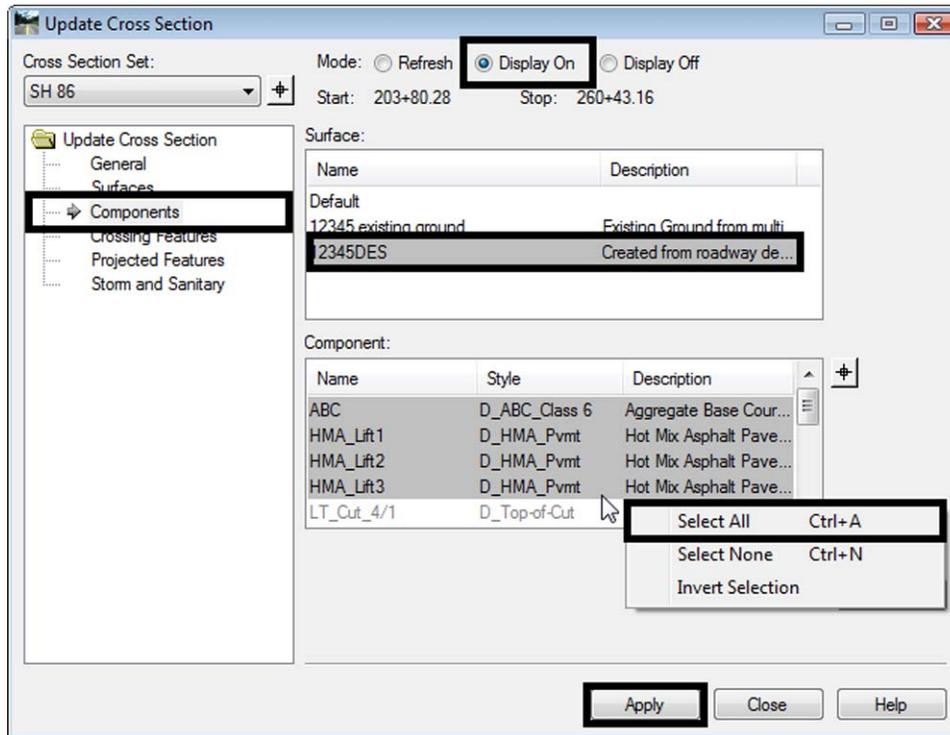
- <D> **Apply**, then <D> in the MicroStation view window to place the cross sections.
- <D> **Close** to dismiss the **Create Cross Section** dialog box.
- Examine the first cross section. The design surface (12345DES) represents the upper most points of the template. The remaining features (created from the template points) are stored in the dtm as untriangulated features.



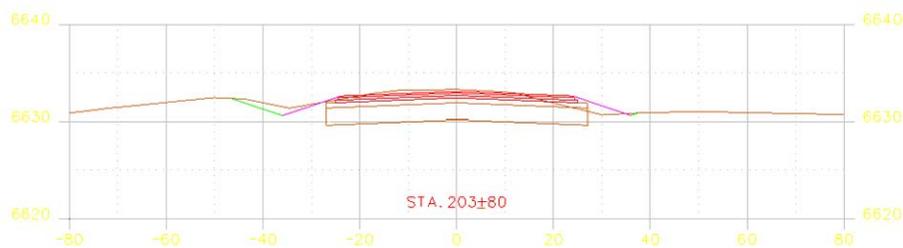
Next, the components are added to the cross sections using the Update Cross Section command.

- Select **Evaluation > Cross Section > Update Cross Section** from the InRoads menu bar.
- Toggle on the **Display On** radio button.
- <D> **Components** in the **Update Cross Section** explorer.

14. Highlight 12345DES in the **Surface** area.
15. <R> in the **Component** area and select **Select All** from the menu.
16. <D> **Apply**.



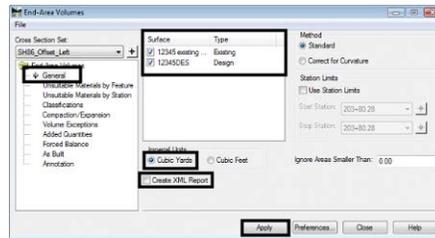
17. <D> **Close** to dismiss the **Update Cross Section** dialog box.
18. Examine the first cross section. The surfacing components are shown. End condition components are not shown in the cross sections because they are also part of the surface.



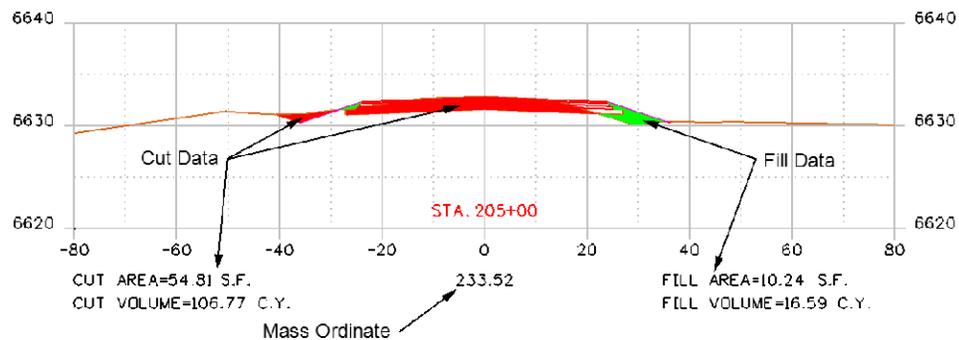
Lab 16.2 - Calculate End Area Volumes

This exercise demonstrates the basic End Area Volume command. This command has changed due to changes in the dtm data, however, the concept is the same. The design surface (specified by the surface **Type** in the **Surface Properties**) is compared to the existing surface (also specified by the surface **Type**) to determine the amount of Cut and Fill.

1. Select **Evaluation >Volume > End Area Volume** from the InRoads menu bar.
2. On the **General** leaf, notice the Surfaces selected. Surface 12345 Existing Ground has the Type of Existing and 12345DES has the type of Design.
3. Toggle off **Create XML Report**.
4. Toggle on **Cubic Yards**.
5. <D> **Apply**.



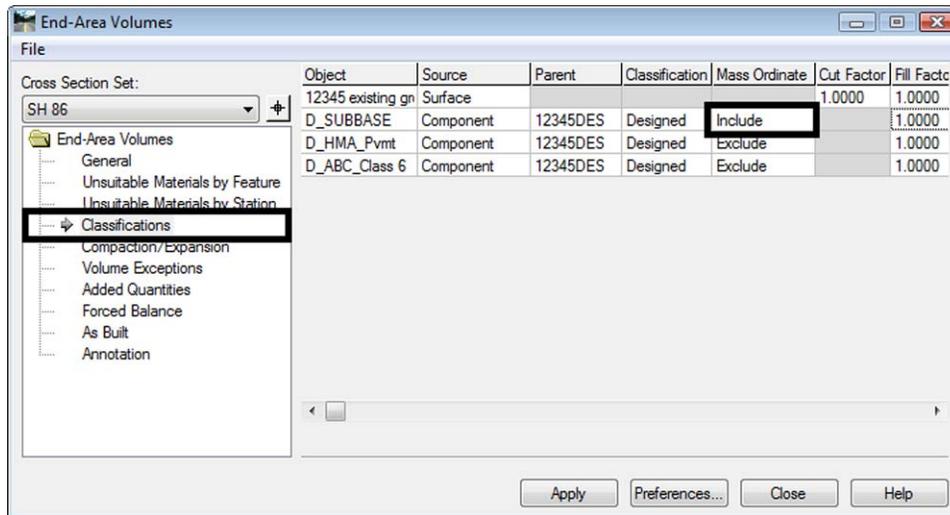
6. Examine the cross sections. Notice the various types of data shown in the illustration below.



Some materials shown in the template are computed as normal embankment. In this example, the D_SUBBASE material is included as embankment. The steps below change the settings for the subbase so that it can be included as embankment.

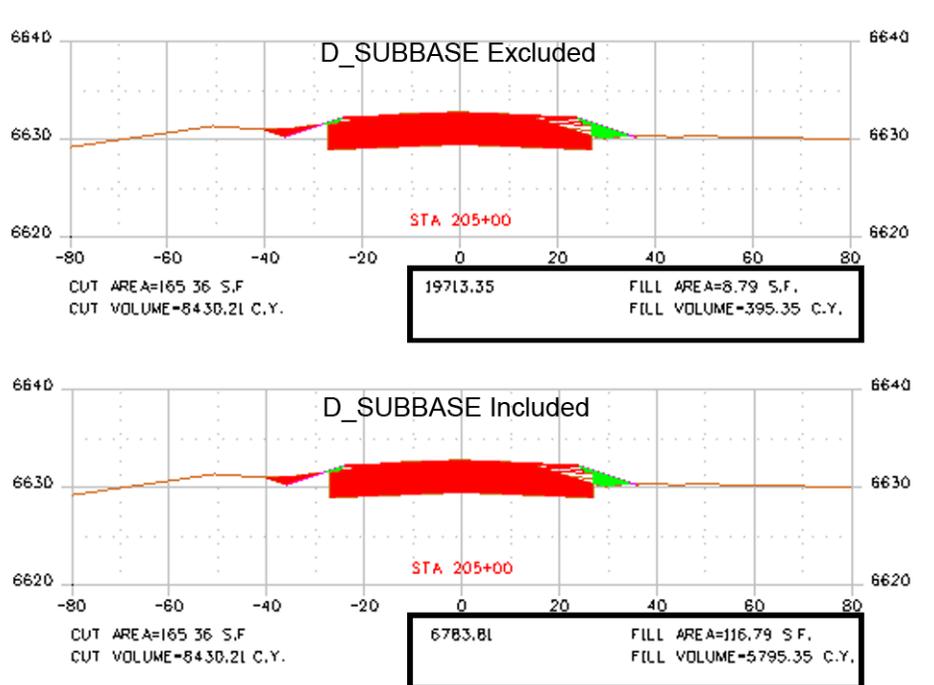
7. In the **End Area Volumes** dialog box, <D> on **Classifications** in the End Area Volumes explorer.

8. <D> in the cell of the **D_SUBBASE** row and the **Mass Ordinate** column so that it reads **Include**.



9. <D> **Apply**.

10. Examine the cross sections. Notice the change in the data.



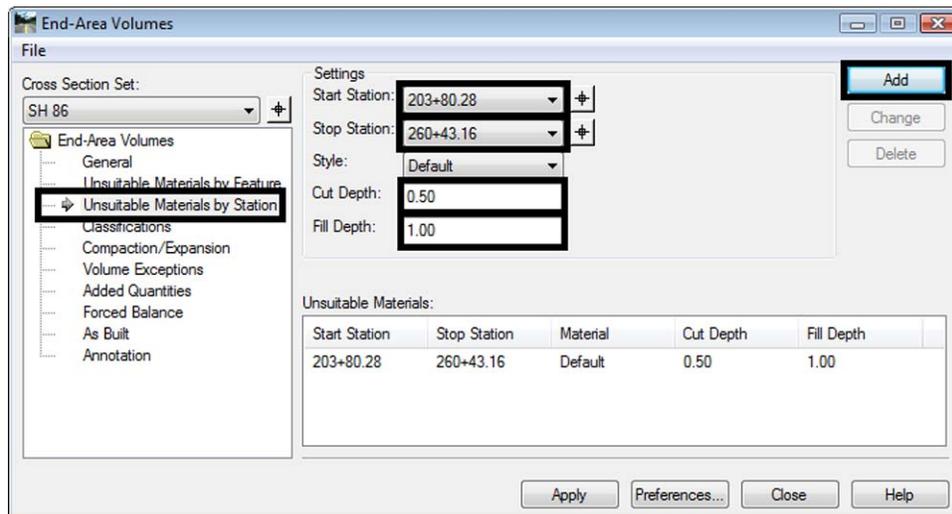
Lab 16.3 - Unsuitable Material

The existing ground may contain material that cannot be used in the construction of the design project. This exercise demonstrates the use of the **Unsuitable Materials by Station** option.

The steps below set up the dialog box to use the unsuitable material options. The other settings remain the same.

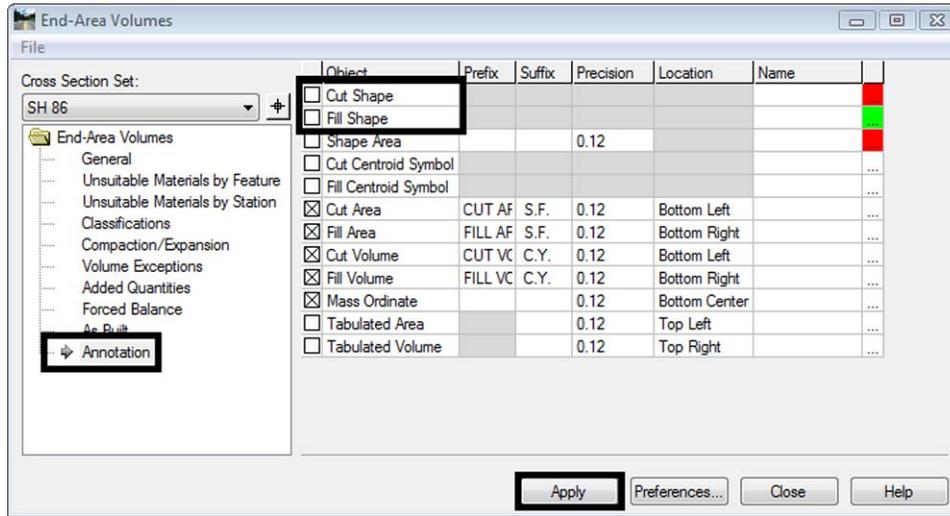
1. In the **End Area Volumes** dialog box, <D> **Unsuitable Materials by Station** in the End Area Volumes explorer.
2. Select **203+80.28** for the **Start Station**.
3. Select **260+43.16** for the **Stop Station**.
4. Key in **0.50** for the **Cut Depth**.
5. Key in **1.00** for the **Fill Depth**.
6. <D> **Add**. The data is placed in the Unsuitable Materials list.

Note: There is currently not a style for unsuitable material. That is why Default is used here.

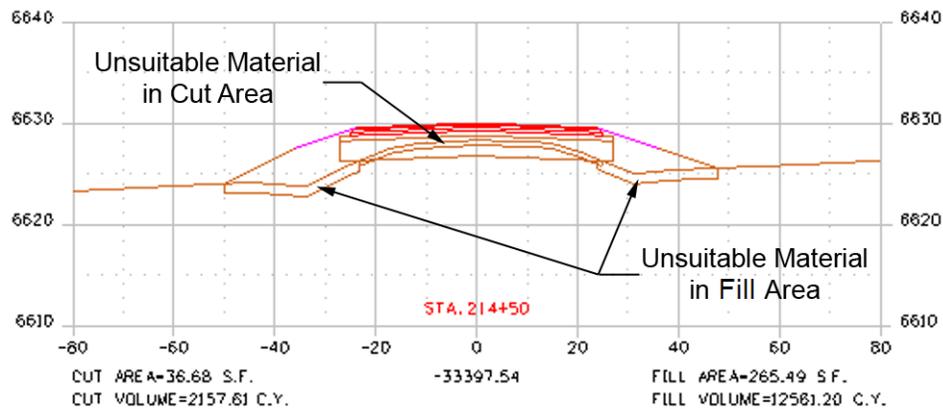


7. <D> **Annotation** in the in the End Area Volumes explorer.
8. **Toggle off Cut Shape** and **Fill Shape**. fThis is so that the unsuitable material shapes can be seen.

9. <D> **Apply**.



10. Examine the cross sections. Notice the change in the data. The cut and fill volumes have changed to account for the unsuitable material.



11. <D> **Close** on the *End Area Volumes* dialog box.
12. <D> **No** on the dialog box that is displayed.

Lab 16.4 - Volume Exceptions

Volume exceptions are used to omit specified cross sections from earthwork calculations. This allows the design model to be run continuously through the project and still account for the area where no earthwork is done. In the exercise, a set of custom cross sections is generated to show the beginning and end of the volume exception. Then the exception is set up in the End Area Volume command. The volume exception runs from station **208+15.83** to station **212+89.50**.

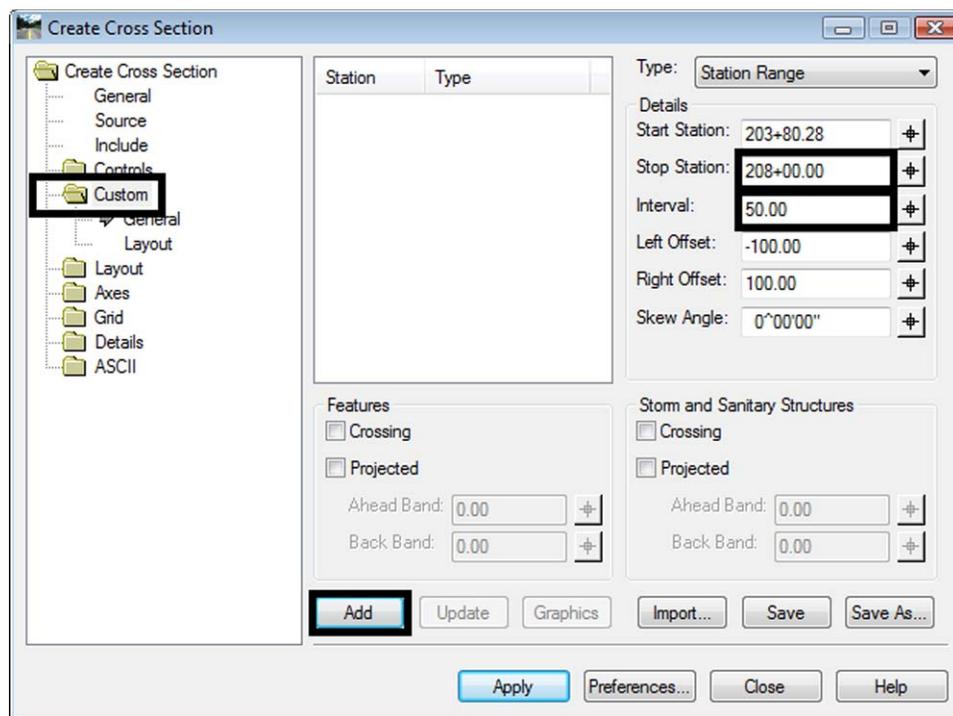
The first series of steps is used to set up the custom cross section set.

1. Select **Cross Section > Create Cross Section** from the InRoads menu bar.

2. In the **Create Cross Section** dialog box, on the **General** leaf, verify that the **12345 Existing Ground** and **12345DES** surfaces are selected.
3. <D> **Include** in the Create Cross section explorer.
4. Toggle on **Components**.
5. <D> **Custom** in the Create Cross section explorer.

The steps below are used to display cross sections normally, from the beginning of the project to station 208+00.

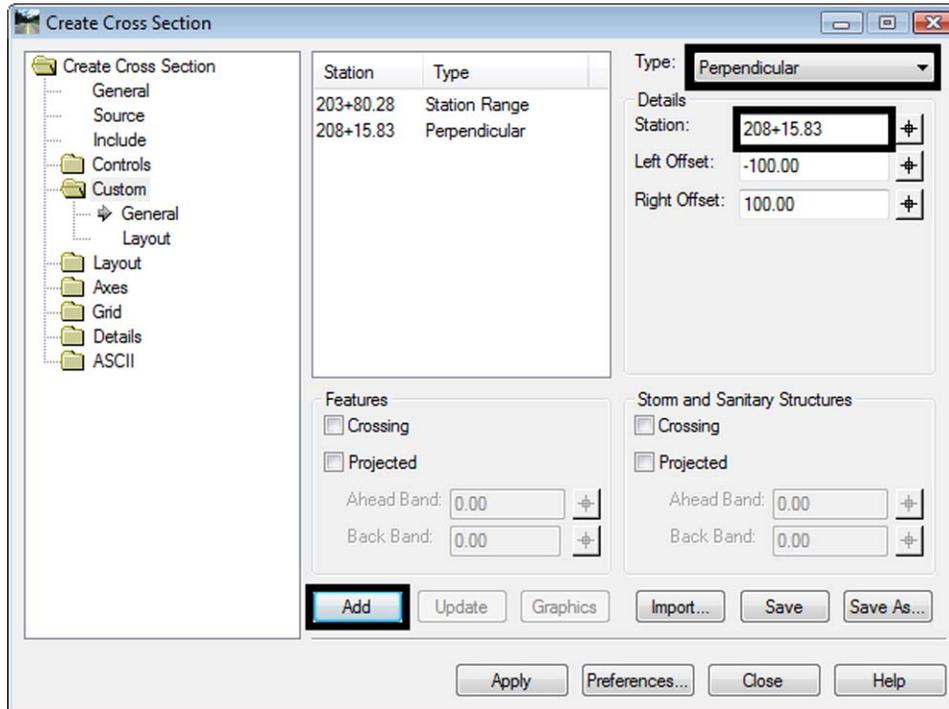
6. Key in **208+00.00** for the **Stop Station** (the Start Station is set to the beginning station by default).
7. Key in **50.00** for the **Interval**.
8. <D> **Add**.



The steps below are used to display a single cross section at station 208+15.83 and at station 212+89.50 .

9. Set the **Type** to **Perpendicular**.
10. Key in **208+ 15.83** for the **Station**.

11. <D> Add.



12. Key in **212+89.50** for the **Station**. (all other settings remain the same)

13. <D> Add.

The steps below are used to display cross sections normally, from station 213+00 to the end of the project.

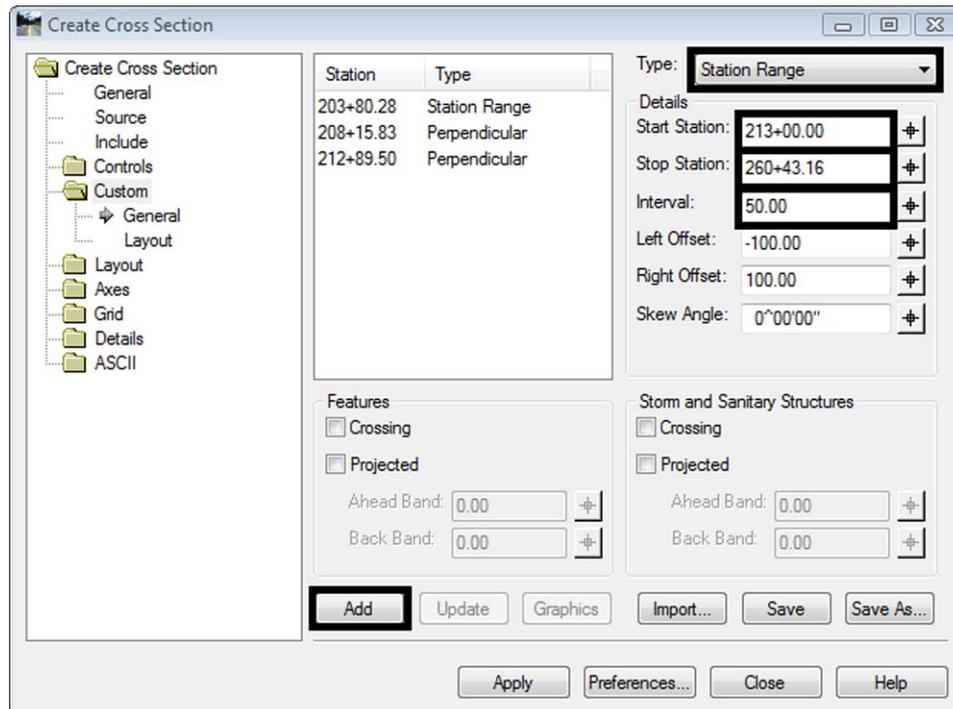
14. Set the **Type** to **Station Range**.

15. Key in **213+00.00** for the **Start Station**.

16. Key in **260+43.16** for the **Stop Station**.

17. Key in **50.00** for the **Interval**.

18. <D> Add.



19. <D> **Apply**. <D> a blank area of the MicroStation view window to display the cross sections.

20. <D> **Close** to dismiss the **Create Cross Sections** dialog box.

The data used for the custom cross section set can be saved for use at a later time. The steps below save the data.

21. <D> **Yes** for the message to save the data for the custom cross sections.

22. In the **Save AS** dialog box, navigate to **C:/Projects/12345/Design/InRoads/** directory.

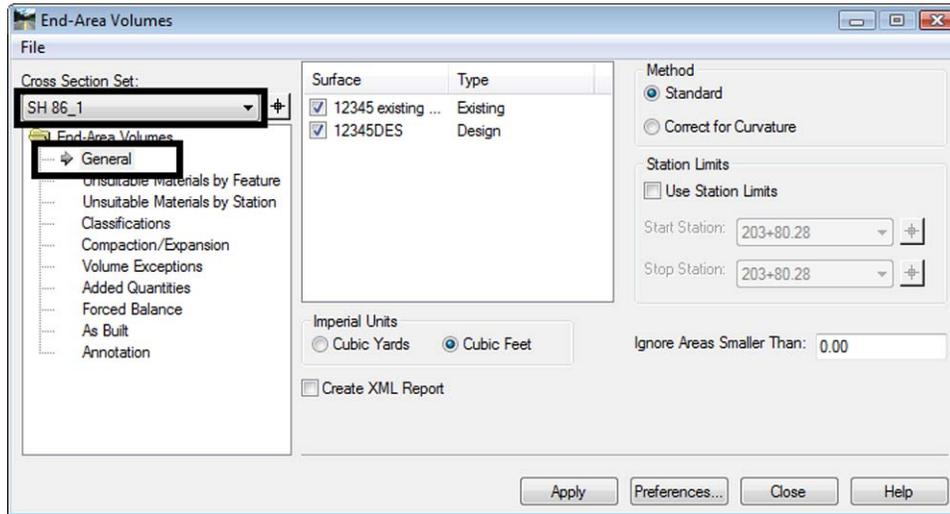
23. Key in **SH 86.xsc** for the file name and <D> **Save**.

To exclude the material within the volume exception, end area volumes must be recalculated. The following steps create the the volume exception and recalculate the volumes.

24. Select **Evaluation >Volume > End Area Volume** from the InRoads menu bar.

25. <D> **General** in the End Area Volume explorer.

26. Select **SH 86_1** for the **Cross Section Set**. The other settings are correct.

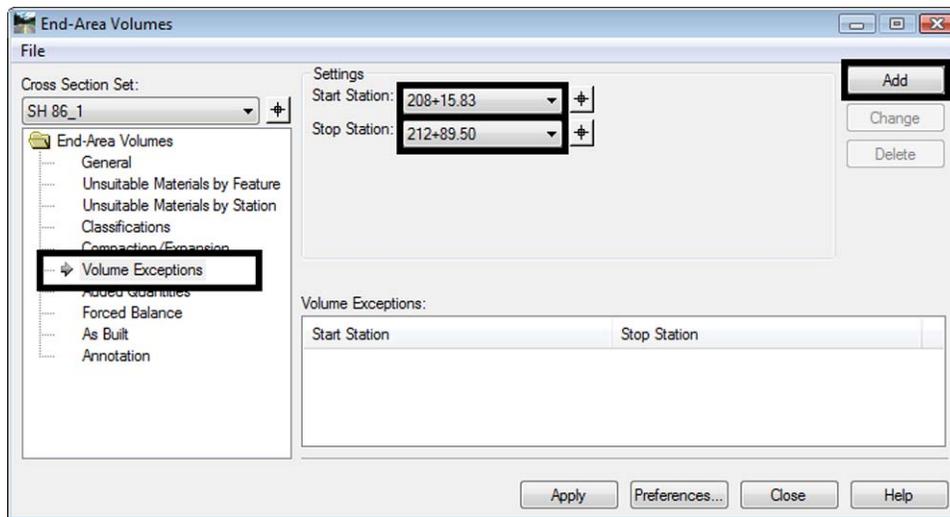


27. <D> **Volume Exceptions** in the End Area Volume explorer.

28. Select **208+15.83** for the **Start Station**.

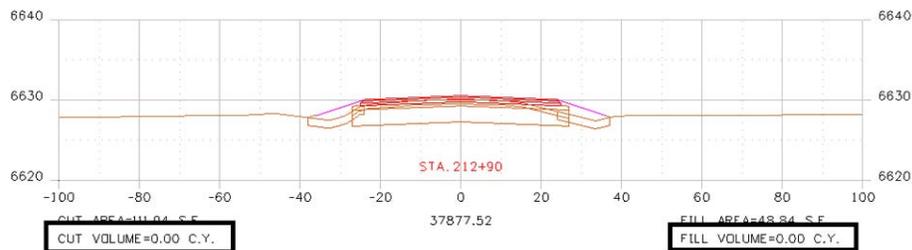
29. Select **212+89.50** for the Stop Station.

30. <D> **Add**.



31. <D> **Apply** to calculate the volumes.

32. Examine the cross section at station **212+89.50**. Notice the volumes listed for both cut and fill are 0.00. No earthwork was calculated between the stations **208+15.83** and **212+89.50**.



Lab 16.5 - Volume Reports

In addition to having volume information displayed on the cross sections, it can also be written to a tabular report. This exercise demonstrates how to create the report and the various templates used with the report.

The steps below create the XML data used for the report.

1. In the **End Area Volumes** dialog box, <D> **General** in the End Area Volume explorer.
2. Select **SH 86_1** for the **Cross Section Set**.
3. Toggle on **Create XML Report**.
4. <D> **Apply**. This displays the **Bentley InRoads Report Browser**.

The XML data is passed to the Bentley InRoads Report Browser so that it can be displayed in a useful manner. The steps below use several report templates to present the volume data in different ways.

5. In the **Bentley InRoads Report Browser**, <D> the **Evaluation** folder.
6. <D> the **EndAreaVolume.xml** template.

Station	Station Quantities				Added Quantities				Mass
	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	
203+80.28	1.00	177.19	0.00	0.00	1.00	7.01	0.00	0.00	0.00
204+00.00	1.00	175.71	128.86	128.86	1.00	7.03	5.12	5.12	0.00
204+50.00	1.00	171.85	321.81	321.81	1.00	7.02	13.01	13.01	0.00
205+00.00	1.00	165.36	312.23	312.23	1.00	8.79	14.64	14.64	0.00
205+50.00	1.00	156.92	298.41	298.41	1.00	11.20	18.51	18.51	0.00
206+00.00	1.00	156.50	290.20	290.20	1.00	16.77	25.90	25.90	0.00
206+50.00	1.00	157.81	291.02	291.02	1.00	26.59	40.14	40.14	0.00
207+00.00	1.00	160.17	294.42	294.42	1.00	35.36	57.36	57.36	0.00
207+50.00	1.00	159.77	296.24	296.24	1.00	33.52	63.78	63.78	0.00
208+00.00	1.00	154.51	291.00	291.00	1.00	33.00	61.60	61.60	0.00
208+15.83	1.00	153.32	90.24	90.24	1.00	38.78	21.04	21.04	0.00

7. Examine the report in the right pane of the browser. This report only has a grand total line.
8. <D> on the **EndAreaVolumePageTotals.xml** template.

9. Examine the report in the right pane of the browser. This report only has page totals as well as a grand total line.
10. <D> on the **Volumes.xml** template.
11. Examine the report in the right pane of the browser. This report lists areas and volumes for cut and fill along with the volumes for the components in the design dtm.

Volumes Report							
Cross Section Set Name: SH 86_1				Report Created: 3/26/2009			
Alignment Name: SH 86				Time: 1:32pm			
Input Grid Factor: 1.000000				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
203+80.28							0.00
	Normal Cut:	177.19	0.00	1.00	0.00	Yes	
	Normal Fill:	7.01	0.00	1.00	0.00	Yes	
	Added Cut:		0.00	1.00	0.00	Yes	
	Added Fill:		0.00	1.00	0.00	Yes	
	D_SUBBASE:	108.00	0.00	1.00	0.00	Yes	
	D_HMA_Pvmt:	36.75	0.00	1.00	0.00	No	
	D_ABC_Class 6:	27.00	0.00	1.00	0.00	No	
204+00.00							44.86
	Normal Cut:	175.71	128.86	1.00	128.86	Yes	
	Normal Fill:	7.03	5.12	1.00	5.12	Yes	
	Added Cut:		0.00	1.00	0.00	Yes	
	Added Fill:		0.00	1.00	0.00	Yes	
	D_SUBBASE:	108.00	78.87	1.00	78.87	Yes	
	D_HMA_Pvmt:	36.75	26.84	1.00	26.84	No	
	D_ABC_Class 6:	27.00	19.72	1.00	19.72	No	

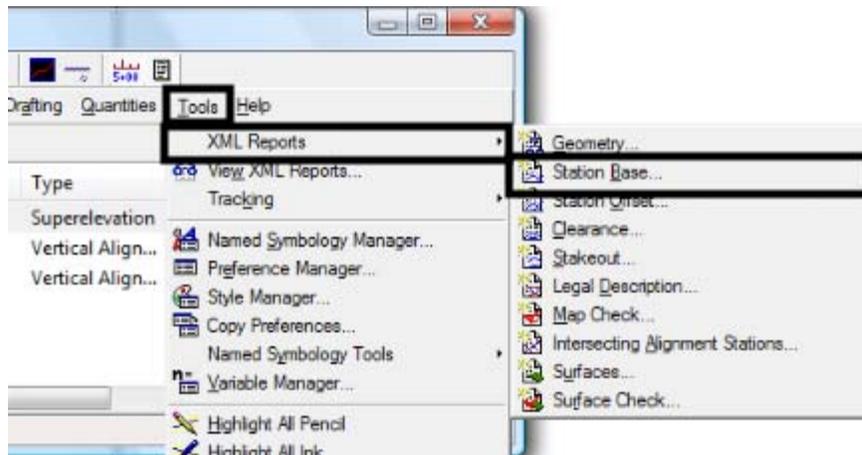
12. Close the **Bentley InRoads Report Browser** and all open dialog boxes (except the main InRoads dialog box).

Lab 16.6 - Station Base Reports

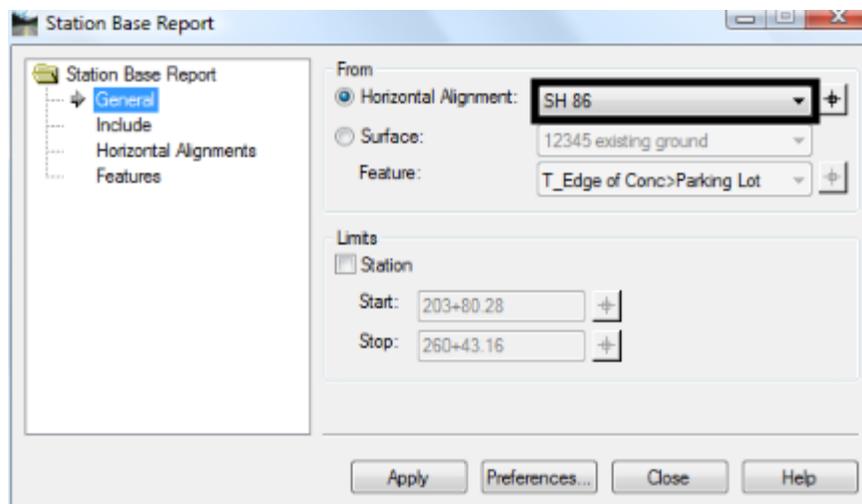
There are numerous other reports that can be generated from InRoads. they all function in a similar manner. This lab demonstrates the process of creating reports. The Geometry Station Base report is used for an example.

The Station Base report measures the offset distance from the active alignment to a specified alignment at given intervals along the active alignment. The steps below create the XML data file for the station base report, then uses several report templates to present the data in a variety of formats.

1. From the InRoads menu bar, select **Tools > XML Reports > Station Base**.

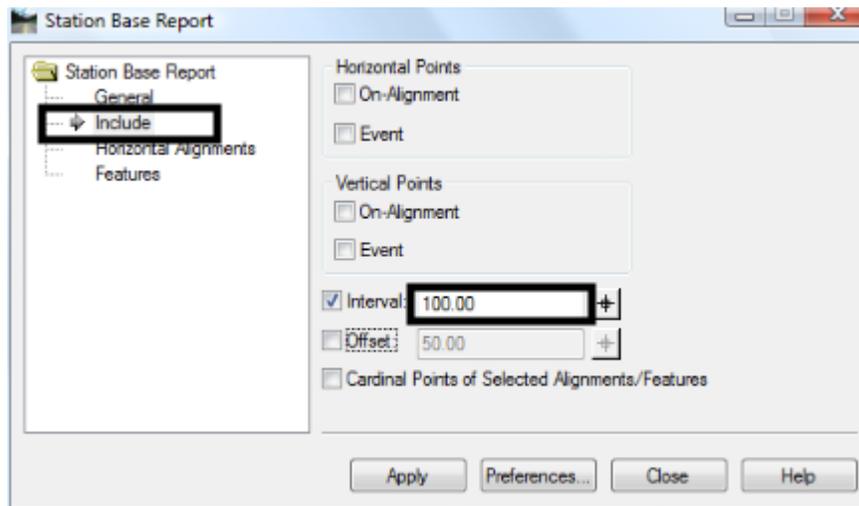


2. In the **From** area of the **Station Base Report** dialog box, note that the alignment **SH 86** is selected. Measurements are made perpendicular to this alignment.

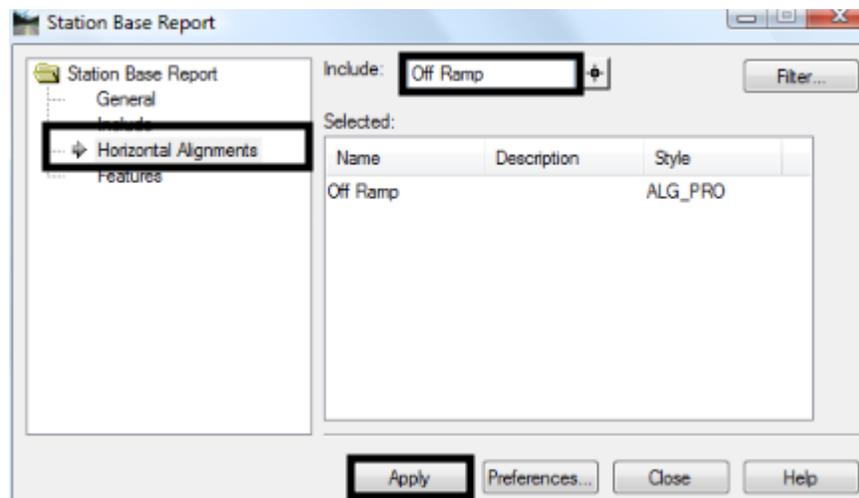


3. <D> **Include** from the **Station Base Report** explorer.

4. In the **Interval** field, key in **100**.



5. <D> **Horizontal Alignments** from the **Station Base Report** explorer.
6. In the **Include** field, key in **Off Ramp**. Press the **Tab** key to accept the entry.
7. <D> **Apply**. This displays the **Bentley InRoads Report Browser**.



8. In the **Bentley InRoads Report Browser**, <D> the **StationBaseSingle.xls**.

9. Examine the report in the right pane.

Bentley InRoads Report Browser - C:\Users\cferree\AppData\Local\Temp\RPT4696.xml

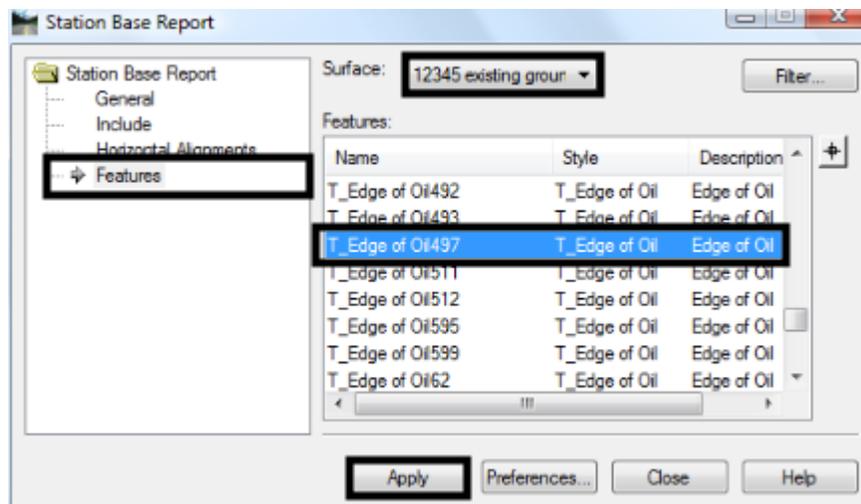
Project: 12345DES_Geometry
 Description: SH 86 Design geometry
 Baseline (Active) Alignment: SH 86
 File Name: C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg
 Last Revised: cferree 3/26/2009 6:20:33 AM
 Input Grid Factor: 1.00000000

Notes: All units in this report are in feet unless specified otherwise.

Baseline Alignment			Offset Alignment		
Station	Distance to Offset Point	Radial Direction	Station	Distance to Offset Point	Radial Direction
Offset (Specified) Alignment: Off Ramp					
205+00.00	0.00	S 15°14'41" W	205+00.00	24.00	S 15°14'41" W
206+00.00	0.00	S 15°14'41" W	206+00.00	24.00	S 15°14'41" W
207+00.00	0.00	S 15°14'41" W	207+00.00	24.00	S 15°14'41" W
208+00.00	0.00	S 15°14'41" W	208+00.00	24.00	S 15°14'41" W
209+00.00	0.00	S 15°14'41" W	209+00.00	24.00	S 15°14'41" W
210+00.00	0.00	S 15°14'41" W	210+00.00	24.00	S 15°14'41" W
211+00.00	0.00	S 15°14'41" W	211+00.00	24.00	S 15°14'41" W
212+00.00	0.00	S 15°14'41" W	212+00.15	28.69	S 20°47'52" W
213+00.00	0.00	S 15°14'41" W	213+01.29	43.55	S 26°35'34" W
214+00.00	0.00	S 15°14'41" W	214+04.54	69.05	S 32°30'30" W
215+00.00	0.00	S 15°14'41" W	215+11.23	106.08	S 38°37'16" W
216+00.00	0.00	S 15°14'41" W	216+23.10	156.12	S 45°01'52" W
217+00.00	0.00	S 15°14'41" W	217+42.70	221.59	S 51°53'01" W

This report is useful for determining the distance between two alignments. It can also be used to determine the distance from an alignment to a surface feature. The steps below create a station base report between an alignment and a surface feature.

10. Minimize the **Bentley InRoads Report Browser**.
11. In the **Station Base Report** dialog box, <D> **Horizontal Alignments** in the explorer.
12. In the **Include** field, key in a space and press the **Tab** key to accept the entry. This clears the **Selected** list.
13. <D> **Features** in the explorer.
14. Select **12345 Existing Ground** for the **Surface**.
15. In the **Features** list, Highlight **T_Edge of Oil497**.
16. <D> **Apply**.



17. In the **Bentley InRoads Report Browser**, <D> the **StationBaseSingle.xls**.
18. Examine the report in the right pane.

Station Base Report					
Report Created: 3/26/2009 Time: 2:41pm					
Project: 12345DES_Geometry					
Description: SH 86 Design geometry					
Baseline (Active) Alignment: SH 86					
File Name: C:\Projects\12345\Design\InRoads\12345DES_Geometry.alg					
Last Revised: cferree 3/26/2009 6:20:33 AM					
Input Grid Factor: 1.00000000 Note: All units in this report are in feet unless specified otherwise.					
----- Baseline Alignment -----			----- Offset Alignment -----		
Station	Distance to Offset Point	Radial Direction	Station	Distance to Offset Point	Radial Direction
Offset (Specified) Alignment: T_Edge of Oil497					
226+50.00	0.00	S 15°14'41" W	0+35.23	-13.20	S 15°34'50" W
227+00.00	0.00	S 15°14'41" W	0+85.23	-13.36	S 15°00'34" W
227+50.00	0.00	S 15°14'41" W	1+35.23	-13.11	S 15°34'39" W
228+00.00	0.00	S 15°14'41" W	1+85.23	-12.99	S 15°20'33" W
228+50.00	0.00	S 15°14'41" W	2+35.23	-12.94	S 15°16'24" W
229+00.00	0.00	S 15°14'41" W	2+85.23	-13.07	S 15°01'46" W
229+50.00	0.00	S 15°14'41" W	3+35.23	-13.20	S 15°09'46" W
230+00.00	0.00	S 15°14'41" W	3+85.23	-13.33	S 15°00'27" W
230+50.00	0.00	S 15°14'41" W	4+35.23	-13.60	S 14°49'03" W
231+00.00	0.00	S 15°14'41" W	4+85.23	-13.85	S 14°37'48" W

19. Close the **Bentley InRoads Report Browser** and all open dialog boxes (except the main InRoads dialog box).
20. Save the InRoads project then close InRoads.

Chapter Summary:

- In [Lab 16.1 -Create Cross Sections](#) a set of cross sections was created showing the existing ground and design finished grade. These were updated to show the design components.
- In [Lab 16.2 -Calculate End Area Volumes](#) the cross sections generated above were used to calculate End Area Volumes. The ability to include or exclude components from the volume calculations was demonstrated.
- In [Lab 16.3 -Unsuitable Material](#) an area of unsuitable material was defined using the station method. This was used to modify the volume calculation.
- In [Lab 16.4 -Volume Exceptions](#) A set of custom cross sections was created, then a volume exception was defined.
- In [Lab 16.5 -Volume Reports](#) the various templates for End Area Volume reports were examined.
- In [Lab 16.6 -Station Base Reports](#) the procedure for creating a Station Base report was demonstrated. Reports from alignment to alignment and alignment to feature were created