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Workshop - X11 DTM Analysis and Site Visibility Tools for InRoads V8i

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DTM ANALYSIS AND SITE VISIBILITY TOOLS FOR INROADS V81

Lesson Name: Create DTM using Data Acquisition tools

LESSON OBJECTIVE:

Using the *Data Acquisition* toolset, build a digital terrain model for future analysis exercises **Data Acquisition toolset**

The Data Acquisition toolset is designed (at release – V8i SELECTseries 1) to provide the User with an alternate set of tools to gather data from various sources, and then edit, merge, append and manipulate that data to build a composite surface to begin the Civil Design process.

Supported data sources at this first release are:

- Raw Survey (many formats)
- Current Bentley DTM formats (DTM, TIN, FIL, LandXML)
- Lidar Data (LIS and XYZ)
- Raster data: SDTS, USGS DEM, TIF, Spot Dimap, NTF, Erdas IMG, BIL, ECW, DTED0, DTED1, DTED2

The list of data sources will grow as the toolset matures.

The simplified workflow and interface, and the intuitive nature of the tool operations reflect a glimpse into the future of Bentley Civil's plans for better tools that provide more focused functionality and are easier to use.

EXERCISE: OPENING DATA ACQUISITION TOOLS

This exercise will guide you through the steps activate the Data Acquisition toolset.

- Open InRoads Suite from the desktop icon or go to Start>Programs>Bentley>InRoads Group (SELECTseries1)>InRoads Suite
- 2. Open the DGN file ... C:/2009 RBC/IW-1/DATA/Aerial.dgn
- 3. Select the **Data Acquisition** tool (*Task menu>Data Acquisition>Data Acquisition*)

Two new panels will open. The Data Acquisition data tree and the Data Acquisition Details panel. These panels should both be docked. Location of the panels is a personal preference. The image of the docked panels will provide an example arrangement.



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EXERCISE: CREATE DATA ACQUISITION SURFACE FROM AERIAL DATA

This exercise will guide you through the steps to build a DA Surface from graphical data. In this scenario, the data has been supplied from an Aerial photography company. Similar steps would apply to the creation of a surface from any graphical 3D data.

- 1. Focus on the DA Data Tree.
- 2. Right Click on "Surfaces" folder.
- 3. Create Surface>Empty Surface.

Data Acquisition 🛛 🖣 🗙		
+ E Contraction Select Details Geo Tool		
E		
Create Surface	E	mpty Surface
	F	From Field Book
	F	rom Selection Set
	I	mport External Surface 🕨 🕨

4. A new surface will be created in the DA Data Tree: Surface 1



5. Drill down the Surface 1 data structure until you see the Surface feature list.

We can now select the graphical data that corresponds to the different feature types and import that data into the DA Surface.

- 6. Select Level Display. (Settings>Level>Display).
- 7. Disable the display for Breaklines and Voids levels

🥩 Level Displa	ay - View 1 📃	
민 🛛 🖸	∕iew Display ▼	
ا 🛱 🌾	(none) 🔻 Levels 💌	록 -
Aerial Total.d	gn	
Name	Used 🔻	^
Default	•	
Breaklines	•	
Spots	•	
Voids	•	
Border		
Border_outline		
BorderPlot		
Coordinate		
DesBuildPad		
DesChains		

- 8. Select all of the "Spots" graphical data
- 9. Return your focus to the **Surface 1>Features** list.

- 10. Right click on Spots label
- 11. Select Import Selection.

The selected graphical spot data has now been imported into the DA Surface.

- 12. Disable the display for the Spots level and enable the display for the Breaklines levels
- 13. Select all of the "Breakline" graphical data
- 14. Return your focus to the **Surface 1>Features** list.
- 15. Right click on Breaklines label
- 16. Select Import Selection.

The selected graphical Breakline data has now been imported into the DA Surface.

- 17. Disable the display for the Breaklines level and enable the display for the Voids levels
- 18. Select all of the "Void" graphical data
- 19. Return your focus to the **Surface 1>Features** list.
- 20. Right click on Drape Voids label.
- 21. Select Import Selection.

The selected graphical Void data has now been imported into the DA Surface.

22. Enable the display for all levels. (*Settings>Level>Display*)

EXERCISE: ENABLE DISPLAY FOR DA SURFACE FEATURES

This exercise will guide you through the steps to display surface features of a DA Surface

- 1. Focus on the DA Data Tree: Surface 1
- 2. Enable the check mark for Triangles. The triangles for the Surface will now be displayed as transient graphics.
- 3. We can reset the **Side Length** and **Dissolve** options to "clean up" the outside triangles of the dataset.
- 4. Focus on the "Survey Details" panel.
- 5. Select the **Surface 1** item in the panel.
- 6. Reset the Side Length attribute to 120 <Enter>
- 7. Reset the **Dissolve Option** attribute to **Side Length** <Enter>

The Surface triangulation should now appear significantly different around the outer edges.

- 8. Reset the Minor Contour attribute to 2 <Enter>
- 9. Reset the Major Contour attribute to 10 <Enter>

Survey	Details										ΨX
E B	🗄 Bement List 😵 Error List 🎾 Adjustment Results 📋 Output										
List											
	Name	Disolve Type	Side Length	Triangles	Breaklines	Major Contour	Minor Contour	High Range	Low Range	Creation Type	Field Book
•	Surface 1	None	20	104532	0	20	5	1661872.19; -	1658349.42; -	Graphic	
		None		2				2			
		Sliver SideLength									
◀ 🖢					III						•

Return focus to the Surface 1 feature enablers on the data tree.

10. Enable Major Contours and Minor Contours features.



EXERCISE: EXPORT SURFACE 1 TO INROADS DTM

This exercise will guide you through the steps to export a DA Surface to a native Bentley Civil Application DTM. For this workshop, we will export to a INROADS DTM.

- 1. Focus on the DA Data Tree: Surface 1
- 2. Select Surface 1.
- 3. Right Click>Export to>InRoads DTM

- 4. Navigate the Save As dialog to the folder *C:/2009 RBC/IW-1/DATA* and key in the file name **Surface1.dtm**.
- 5. Select **Save**. This will create a InRoads DTM named Surface1.dtm.
- 6. Close Data Acquisition data tree.

Lesson Name: Load Project Data & Modify Existing Ground DTM

LESSON OBJECTIVE:

Load the Project data, and modify the existing surface digital terrain model for future exercises.

EXERCISE: LOAD PROJECT DATA

- 1. Open C:\2009 RBC\IW-1\DATA\Roadway Design.dgn
- 2. Open project files C:\2009 RBC\IW-1\DATA\Project.rwk. (On the InRoads Menu: File>Open>(File Type: Project.rwk))
- 3. File>Open>NoVoids.tin
 - *Note* InRoads can now load and converts a GEOPAK Tin file directly. This can be also achieved by dragging and dropping on the InRoads Explorer.

EXERCISE: CREATE AN EXTERIOR BOUNDARY

1. Display Triangles of the NoVoids tin that is now a NoVoids DTM in memory with **Surface>View Surface>Triangles**

;	X
NoVoids	 Apply
Ignore	Close
	Preferences
	Help
Name	
	Ignore Name

- 2. Close the View Triangle Dialog
- **3**. Perform a MicroStation **Fit All** to bring the triangle into view. Notice the slender triangle on the east side of the topography.
- 4. Create an Exterior Boundary using **Surface>Edit Surface>Triangulate By Filter** with Dialog settings showed:

🐂 Delete Triangles By		
Surface:	NoVoids	Apply
Fence Mode:	Ignore	Close
Maximum Leg Length	500.00	Help
Minimum Angle:	0^00'00''	
Maximum Angle:	0^00'00''	
Elevation Range High:	0.00	
Low:	0.00	
Exterior Boundary Generate Exterior Bo Feature Name: ex Feature Style: E Triangulate	oundary terior derior Boundary	•

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- *Note:* This tool created an Exterior Boundary based on a Maximum triangle length of 500 feet in one step....any of the setting can be used in conjunction with each other to handle more complex analysis quickly.
- 5. Apply and then Accept the triangle that are highlighted
- 6. Confirm the overwrite for original boundary for NoVoid by clicking Yes.
- 7. Close the Delete Triangle By Filter
- 8. Notice the triangles over on the East Side have been atomically removed from view.
- 9. Go to **Surface>Feature>Feature Properties** and select the Exterior Boundary Feature, near the bottom of the list. What is description populated for this feature?
- 10. Delete the Triangles with Graphic Group Locks

EXERCISE: RESOLVE NEAR FEATURES

The Resolve near Features tool allows you to chain breaklines together that have the same style within a given Horizontal and/or Vertical tolerance. Since the original tin's breaklines were all translated to a style of Default, all of the breaklines will be used in this analysis. This tool is excellent solution to enhance data that is received from outside sources that may not be as clean as desired.

- 1. Make note of the number of breaklines there are in the surface NoVoids by going to **Surface>Surface Properties**.
- 2. Delete All Graphics in the current DGN, if any are present.
- 3. Display all the breakline features in NoVoids, **Surface>Update 3-D/Plan Surface Display.** Remember we are only working with the Feature Type = Breakline

Mode:	Display On	🔘 Dis	play Off		Apply
Fence Mode:	Ignore		-		Close
Surfaces:			_		
Name			Description		Fliter
Default					Edit Style
NoVoids					Help
Perimeter	Surface Elev	vations	Color-Coded Aspects		
Triangles	Slope Vecto	rs	Color-Coded Elevation	ns	
Contours	Profiled Mod	lel	Color-Coded Slopes		
Features:	Gridded Moo	del			
	-		D		+
Name	Style		Description	ĥ	<u> </u>
No Voids 1	Default				
No Voids TU	Default				
No Voids 100	Default				
No Voids 1000	Default				
No Voids 1002	Default				
NoVoids1003	Default				

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- 4. Press the **Filter** button
- 5. Set up Filter as follows:

Feature	Selection Filte	r		
Filter Name:	<unnamed></unnamed>		•	ОК
Start With: Build Sele	C All	None		Cancel
Attribute:	Name		•	Save
Value:				Save As
Mode:	Include	Exclude		Delete
	Add Rule	Replace Rule		Help
Include Typ	pe = Breakline			Move Down Delete Rule Clear All
Current Res	ults:			
No Voids 1 No Voids 10 No Voids 10 No Voids 10 No Voids 10 No Voids 10 No Voids 10 No Voids 10	0 01 05 07 08 09 1		•	

- 6. Press **OK**. Make sure you turn on the Feature Filter Lock or all the Features will still be displayed instead of just the breaklines...you will know if you did not.
- 7. Apply the tool.
- 8. Notice the number of centerline feature along the North/South Corridor by snapping to the element. Make note of the number of chains.
- 9. Set the following settings for **Surface>Utilities>Resolve Near Features** tool and then press **Apply**.

🐂 Resolve Near Fea		
Surface:	No Voids 👻	Apply
Horizontal Tolerance:	0.10	Close
Vertical Tolerance:	0.10	Filter
		Results
		Help

- 10. Delete all the previous breaklines by Selecting All and deleting with MicroStation.
- 11. Redisplay the breakline features as done through Step 3 to 7.
- 12. Revisit the **Surface Properties** Dialog and make note on the number of Breaklines that currently exist with the DGN.
- 13. Triangulate Surface NoVoid....hint you will need to for the next lesson.
- 14. Lastly, Toggle off Feature Filter locks and Delete All the graphics in the DGN.

Lesson Name: Create Finished Surface DTM using Roadway Designer

LESSON OBJECTIVE:

Using the *Roadway Designer* toolset, build a design surface digital terrain model for future analysis exercises

Roadway Designer

The Roadway Designer is designed to interactively create Highway and Roadway designs using a "template" based system that provides instantaneous visual feedback during the design process.

EXERCISE: CREATE PROPOSED DTM IN ROADWAY DESIGNER

- Open the Roadway Designer application dialog Modeler>Roadway Designer. Take a moment to navigate through Roadway Designer, making note of a few new items:
 - 1. Fill for closed shape Components

- 2. Point Control Descriptions, particularly for the Point Controls defining Superelevation
- 3. Lock Button for the Active Surface
- 4. Overlay Tools
- 5. Create Surface Dialog.....to point out a few.



- 2. Select Process All.
 - The **Roadway Designer** will calculate and process the template drops at 50 foot intervals for the complete length of the corridor.
- 3. Close the **Results** pop up dialog.
- 4. Corridor>Create Surface or the Create Surface icon.

Create Surface
Name: finished Apply
Default Preference: Proposed Close
Create Surface(s) from:
4 Lane Devided
Help
None
Clipping Options
General Ontions
New Surface for Each Corridor Create Alternate Surfaces
Empty Design Surface Process Visible Range Only
Include Null Points
✓ Triangulate
Features
Duplicate Names:
Append Replace Rename Modify
Add Transverse Features
Style: Default -
Add Exterior Boundary
Style: Default
Densify using Chord Height Tolerance Display in Plan View
Horizontal Curves Features

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- 5. Set the Default Preference to **Proposed**.
- 6. Select Apply.
- 7. Close the **Results** pop up dialog.
- 8. Close the **Create Surface** dialog.
- 9. Save and Close the Roadway Designer application dialog.

EXERCISE: CREATE "DRIVE THROUGH" OF YOUR ROADWAY DESIGN

This exercise will guide you through the steps to create a "drive through" of your roadway design.

There has been some view settings enabled with View 5 of the DGN. We shall generate the drive through from that view.

Hint Please stop and listen to your Instructor before proceeding with this exercise!

- 1. Applications>InRoads Group>Modeler>Drive Roadway.
- 2. Open View 5.

IMPORTANT: DP in View 5 to ensure it is the "Active" view.

- 3. Select **Drive Roadway** button from Corridor Modeling dialog.
- 4. Populate the dialog as shown below.

🐂 Drive Roadway			- • •
Horizontal Alignment:	Relocated MAINRD -		Run
Vertical Alignment:	Proposed -	j	Display
Horizontal Offset:	17.00		Close
Vertical Offset:	12.00		Preferences
Speed:	45.00]	Freielences
Frames per Second:	4		Help
Start:	0+00.00	+	
Stop:	51+82.66	†	
Target Distance:	45.00	+	

- 5. Select **Run** and identify View 5 by DP.
 - Hint: Modifying the Frames per Second to a smaller number can aid with performance.
- 6. Display the Existing Ground Triangles as a Mesh. Go to **Surface>View Surface>Triangles** and toggle on **Mesh** and **Apply**

View Triangles							
Surface:	NoVoids	•	Apply				
Fence Mode:	Ignore	-	Close				
Colored Model			Preferences				
V Mesh			Help				
Symbology:							
Object	Na	me					
Triangles							

- *Note:* A mesh is a more efficient method on displaying triangles. It also allows raster images to be draped onto them for presentation and visualization.
- 7. Select Drive Roadway and Run.
- 8. This time, Copy the Exterior Boundary of the surface Finished to NoVoids DTM with **Surface>Edit Surface>Copy Single Feature**

🐂 Copy Sing	Je Feature	[- • 💌
From Surface: Name: Description:	finished Exterior Boundary Created by roadway designer run	+	Apply Close Filter
Style:	Default		New Style Help
lo Surface: Name:	No Voids 👻		
Description: Style:	from proposed Exterior Boundary		

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- 9. Change Feature Type from Exterior to Interior in **Surface>Feature>Feature Properties** for NoVoid.
 - Hint: The Exterior Boundary is at the bottom of the list in NoVoid and make sure NoVoid is your active surface

urface:	NoVoids			Style Available:	Apply
eature:			-100201	Aggregate	Close
Name	Style	Description	* <u>+</u>	Asphalt	
NoVoids977	Default			Asphalt_Milling	Hiter
NoVoids979	Default			Base	Edit Style
VoVoids98	Default			BB	
VoVoids984	Default			Primary:	New Style
VoVoids986	Default			Exterior Boundary	List Points
VoVoids987	Default			Secondary	
VoVoids988	Default			Secondary.	Help
VoVoids989	Default				10
VoVoids990	Default				
VoVoids992	Default				
VoVoids993	Default			P 1	
NoVoids997	Default			Pay items	
VoVoids998	Default			Name Description From Style	
NoVoids999	Default			×	
Random Point	random	Create by Geo	_		
ederior	Exterior Boundary	from proposed	-		
٠	III	F			
lame:	exterior		-	Triangulation	
lescription:	from proposed			Feature Type:	
2.1 	1			Point Density Interval: 0.00	

- 10. Toggle off Refresh/Display in 3-D/Plan View and Apply
- 11. Triangulate surface NoVoid.

- 12. Repeat Surface>View Surface>Triangles and toggle on Mesh and Apply for NoVoids.dtm
- 13. Repeat Drive Way in Step #4.
 - *Note*: We modified the extent of the existing terrain model without merging the DTM's, this give us better control for visualization task if needed later down the pipeline.
- 14. For Future use Delete the Exterior Boundary Feature from NoVoids by using the **Surface>Edit Surface>Delete Feature** tool for the next exercises and then re-triangulate the surface.

🐂 Delete Featu	ire				- • •
Surface:	NoVoids -]			Apply
Fence Mode:	Ignore 💌]			Close
Features:					Filter
Name	Style	Description	*	+	
NoVoids992	Default				Results
NoVoids993	Default				Holo
NoVoids997	Default				neip
NoVoids998	Default				
NoVoids999	Default				
Random Point	random	Create by Geopak			
exterior	Exterior Boundary	from proposed	.		

15. Turn off the **Camera** under **View Attributes** and return your view to **Top** and then perform a MicroStation **Fit All.**

View 5, Layout 2	
1 🗸 🔊 🗴 🗕 🔍 🖞	< □ ■ ∞ ≫ № ⊡ ⊡
/iew Number: 5 + 🛛 🖳 🛚	¥
Presentation	#≡^
Display Style: 🔊 Illustrat	ion With Shadows 👻 🭳
🛵 ACS Triad	🖹 Fill
ackground	III Grid
Boundary Display	Cevel Overrides
🧕 Camera	Line Styles
Clip Back	E Line Weights
Clip Front	😻 Pattern/Bump Maps
😟 Clip Volume	Patterns
Constructions	Default Lighting

EXERCISE: ROADWAY VISIBILITY AND REPORTING

This exercise will evaluate the Sight Distance along the North Bound and South Bound lanes of this corridor using the **Roadway Visibility Tool**. This tool will provide the results graphically and in a XML based report to easily see where the Design Criteria has been met.

- 1. Select Evaluation>Sight Visibility>Roadway Visibility
- 2. Select NoVoids and Finished

📷 Roadway Visibility		[
🔁 Roadway Visibility	Surfaces:		
	Name	Description	
Positions Sight Line	Default		
	NoVoids		
	finished	Created from roa	adway
	Horizontal Alignment:	Relocated MAINRD -	1
	Start Station:	0+00.00	
	Stop Station:	30+06.60 +	Reverse
	Interval:	50.00	-
	Sight Distance:	750.00	
	Relaxed Distance:	600.00	
	Create XML Report	t	
	Apply Pre	ferences] Close	Help

- The North Bound Lanes will be analyzed first, go to Preferences and select NB.
 Note: This sets the values for the North Bound Lanes. We desired 750 ft of SSD but 600 ft would be acceptable. Anything less does not meet 65 MPH design speed as we used to define Superelevation.
- 4. Examine the setting under the General, Positions, and Sight Lines.
- 5. Verify the Create XML Report is toggled on
- 6. Press Apply
- 7. Examine the results in MicroStation and in the XML Reports.
 - Note: The areas along the Cut Slope on the Horizontal Curve and the areas along the vertical curve fail to meet the design criteria.
- 8. Repeat for the South Bound Lanes using the delivered SB preferences.
- 9. Examine Results Graphically and in the Bentley Civil Report Browser

Note: The South bound lanes has the stationing reversed to match the flow of traffic. The failures on the South bound lanes are mainly due to the median barrier. These SSD issues would be easily resolved by using curve widening tools in Roadway Designer to expand the shoulder width along this median barrier to provide the additional SSD.

Bonus Material: Take time to explore using Actual Distance vs. Sight Distance on the Sight Line tab. Then try reviewing the results with the Drive Roadway tool.

EXERCISE: CREATE BAR GRAPH REPORT USING A SVG FILE

- Note: Remember the RoadwayVisibilityGraphSVG.xsl does not provide formatted results
- Select Sight Visibility>Sight Visibility>RoadwayVisibilityGraphSVG.xsl
 Right Click and Select Style Sheet Help

Style Sheet Help . Notes The output from this report is SVG (scalable vector graphics) which is similar to XML in many respects. To view the graph created by the output, follow these Ξ steps: 1. Save the results of the Evaluation > Sight Visibility > Roadway Visibility command to an XML file by toggling on the Create XML Report option. 2. Once the report is displayed, select File > Save As from the Report Browser menu. Leave the Save as type set to Text Files (*.txt) but save the output from this report with an extension of SVG. 3. In the left pane of the Report Browser, select the raw-xml.xsl style sheet. Select File > Open from the Report Browser menu, and set the Files of type to All Files (*.*). Browse to the SVG file you saved in the previous step and the graph will be displayed.

3. The Adobe plug-in is included in this workshop. **Install** Adobe SVG Viewer found at **IW-1****SVGView.exe**

- 4. Follow the Style Sheet Help and rerun the North Bound Lanes using the **NB** Preference.
- 5. Examine Results of the Report Generated.

For future reference the Adobe SVG Viewer can be found at: http://www.adobe.com/svg/viewer/install/main.html

EXERCISE: CREATE MERGE SURFACES

- 1. Select Surface>Edit Surface>Merge Surface
- 2. Set the setting as defined in the screen capture below. And then Apply.

	Ces	L	
Surfaces Original:	NoVoids	-	Apply
Design:	finished	-	Close
Destination:	Merged	-	Filter
			Preferences
Retain All Orig	ginal Surface Points	ſ	Help
🗸 Retain Featur	es Excluded from Triangu	lation	
Merge Selecte	ed Areas from Original		
🗸 Add Design S	urface Edge as Breakline	•	
	-		
Included Desig	n Surface Features		
Included Design	n Surface Features Style	Description	<u>+</u>
Included Desig Name 4 Lane Devide	n Surface Features Style d-Left Curb	Description Created by roadw	<u>+</u> اعرين
Included Desig Name 4 Lane Devide 4 Lane Devide	n Surface Features Style d-Left Curb d-RighCurb	Description Created by roadw Created by roadw	ray
Included Design Name 4 Lane Devider 4 Lane Devider 4 Lane Devider	n Surface Features Style d-Left Curb d-RighCurb d-Tie Toe of Slope	Description Created by roadw Created by roadw Created by roadw	ау ау ау
Included Design Name 4 Lane Devider 4 Lane Devider 4 Lane Devider 4 Lane Devider	n Surface Features Style d-Left Curb d-RighCurb d-Tie Toe of Slope d-Tie Toe of Slope	Description Created by roadw Created by roadw Created by roadw Created by roadw	ау лау лау лау

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EXERCISE: SIGHT VISIBILITY

Sight Triangles at any intersection is an important part of the design process. A quick analysis can change your design from a simple Stop Condition to high speed ramp. The Surface Visibility tool can help determine what you can see from a critical point, so you can determine the appropriate facility needed for you Design.

This lesson will determine if an existing stop condition is adequate for newly design corridor and Existing DTM.

EXERCISE: SIGHT VISIBILITY- SURFACE POINTS

1. Display the two cogo points, **Eye & Target**, these will be used for references in this exercise. Navigate to **Geometry>View Geometry>Horizontal Annotation** and select these points.

Apply Style	Filter
Assigned O Active O)verwrite
Horizontal Alignment: Default	- Heip
Cogo Points: Default	-
Horizontal Alignments	Cogo Points
nclude: 🗕 🕂	Include:
Selected:	Selected:
Name Descri Style	Name Descri Style
	EYE Default
Display	Annotate
	Points
Vn-Alignment Event Point	s Elements
Off-Alignment Station Equ	ations Duplicates
Elements	Dual Dimensions
Radials Tangents	Try Alternate Styles
Chords Subtangent	s Extend Beyond Eleme

- 2. Select Evaluation>Sight Visibility>Surface Visibility
- 3. Select the surface named Merged under the General tab.
- 4. The intersection being analyzed is at Station 40+60. Locate the cogo point, **Eye**. Set the Eye Position with the pick button and select cross hair symbol to acquire its coordinates.
- 5. Choose Drape Surface and set the Eye Height at 3.5 ft

🐂 Surface Visibility		
Surface Visibility General Surface Points Surface Regions Line of Sight	Surface: Mode: Eye Position Northing: Easting: Elevation: I Drape Surface	Merged ▼ Surface Points ▼ -274168.53 ↓ 1660691.12 ↓ 1043.24 ↓
	Eye Height:	3.50 Preferences Close Help

- 6. Go to the Surface Points tab and set the Object Height **2.0** ft and the Sight Radius to **750** ft.
- 7. Press Apply and evaluate the results.
 - Note: Every triangle vertices within 750 ft from the Eye Position is analyzed to see if there is a direct line of sight with taking into account the height of the Eye and the target.

EXERCISE: SIGHT VISIBILITY- SURFACE REGIONS

- 1. Select Evaluation>Sight Visibility>Surface Regions
- 2. Change the Mode to **Surface Regions** on the General Tab but keep all of the other settings the same.
- 3. Navigate to the **Surface Regions** Tab.
- 4. Set the setting as follows:

Surface Visibility	Method:	
General	Radial Angle Interval:	10^00'00''
Surface Points	Number of Radials:	1
Line of Sight	Object Height:	2.00
	Sight Radius:	750.00
	Symbology:	
	Symbology: Object	Name
	Symbology: Object Visible Not Visible	Name

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- 5. Apply the tool.
 - *Note:* The tool display the line of sight that is visible/Not Visible radial from the Eye Position out to the desired sight distance. The number of instance is based radial angle interval or number.

EXERCISE: SIGHT VISIBILITY- LINE OF SIGHT

- 1. Select Evaluation>Sight Visibility>Line of Sight
- 2. Change the Mode to **Line of Sight** on the General Tab but keep all of the other settings the same.
- 3. Navigate to the Line of Sight Tab.
- 4. Select the pick Button for the Object Position and select the cogo point **Target** located north of the intersection approximately at Station 47+60 in the Southbound lanes.
- 5. Toggle on the Drape Surface and set the object height again 2 ft
- 6. Apply

Examine the results. Does a high speed ramp need to be done based only on Sight Distance or does simply improving the existing intersection suffice? What other items need to be considered after completing this simple assessment to determine if an intersection with a stop sign would be adequate.

EXERCISE: LOCATE SAGS AND CRESTS ALONG DTM FEATURES

Locating the Low and High Points is the beginnings of any hydraulic design. Indentifying these point aid in formulating your drainage areas and inlet/culvert locations.

The ability to analyze DTM data for this information prevents one from examining the Vertical Geometry, Superelevation, typical section, and other data.

1. Select Surface>View Surface>Annotate feature for the surface Merged

lain	Points	Line Segments	Slope Direction	Crests and Sags	
Surfac	e:	Merged	•		Filter
Fence	Mode:	Ignore	+		Edit Style.
eatur	es:				Help
Nam	e		Style	Description *	+
4 Lan	e Devide	d-IS-Unpaved	Lawn	Created by roa	
4 Lan	e Devide	d-EP_R	EOP	Created by roa	
4 Lan	e Devide	d-IEP4_R	EOP	Created by roa	
4 Lan	e Devide	d-IEP4_L	EOP	Created by roa	
4 Lan	e Devide	d-IEP3_R	EOP	Created by roa	
4 Lan	e Devide	d-IEP3_L	EOP	Created by roa	
4 Lan	e Devide	d-IEP1_R	EOP	Created by roa	
4 Lan	e Devide	d-Connect_L_L	EOP	Created by roa	
4 Lan	e Devide	d-Connect_R	EOP	Created by roa	
4 Lan	e Devide	d-IEP1_L	EOP	Created by roa	
4 Lan	e Devide	d-EP_L	EOP	Created by roa	
4 Lan	e Devide	d-Ditch Foreslo	Ditch Foreslope	Created by roa	
4 Lan	e Devide	d-Ditch Foreslo	Ditch Foreslope	Created by roa	
4 _	a Navida	d-Ditch Rattom III	Ditch Rottom	Created hv m:	
Anne P	otate oints	Line Segment	s 👘 📃 Slope Din	ection 🔽 Crests	s 🔽 Sags

- 2. Select Points selected in dialog above. Then **Apply** the tool.
- **3**. Evaluate the results.
 - 1. Why are there 2 crests at 22+00 for the North Bound and 23+00 for the South Bound are at different stations?
 - 2. Why are several crests and sags bunched together at approximately Station 45+00?