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Workshop – X5

SELECTseries 3 Technology Preview Workshop

Terrain Modeling

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Table of Contents

Command Index

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Preface

In this workshop, you will gain an overview of the Terrain Modeling tools available at V8*i* SELECTseries 3 through the Civil environment. We have structured the contents of the exercises to provide a broad spread coverage of the tools; however, we will not use every tool. The objective for this workshop is to provide examples that you can apply real-life context towards to facilitate utilizing them in your own engineering projects.

This workshop does not cover the Survey tools previously known at SELECTseries 2 as Data Acquisition. Data Acquisition processes essentially remain at SELECTseries 3 as two discrete packages - Survey and Terrain Modeling. While these survey tools have been enhanced over SELECTseries 2 Data Acquisition capability the processes essentially remain as before for creating a survey, the main difference being the creation of a Civil Terrain model.

This workshop is equally applicable for the MX, InRoads or GEOPAK families of products. Each product contains identical toolsets and workflows. The only differences between the three products for the tools are slight differences in the use of feature definitions and some differences in the back-end interaction with other native toolsets, such as drainage. In this workshop, we will use Power InRoads, Power GEOPAK or MX (your choice) V8*i* 08.11.09.xxx.

In each Chapters opening DGN file, there will be text entitled with the chapter number and a "How – To" link. Right clicking on this text will show an option for "Open Link". This will allow a student whom may be struggling with a particular exercise the ability to watch the video to see how the steps were performed. The video will have audio, so you should mute your computer before viewing. It is encouraged to only watch the videos as a last resort or to review them upon completion of the exercise to compare your results.

In order for all participants to design the same layout and to stay on course and on time, we request that all participants utilize the files as listed in the workshop materials. At the beginning of each chapter, we will start with a fresh set of data. This ensures that everyone is using the same data.

The workshop guide is yours to take with you. If you don't finish all the exercises, or just want to work with the dataset upon return to your office, the datasets (both initial and completed files) are provided on the Conference DVD. Many workshops will also have videos of all exercises on the DVD.

Note	Prerequisite Knowledge Level: Participant should have a basic understanding of terrain modeling principles and be fluent in the use of one of the Bentley Power products or CAD and the native application (MX, InRoads or GEOPAK).

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Chapter 1: MicroStation Terrain Element

OVERVIEW

SELECTseries 3 MicroStation provides a Terrain Model Element type and supports creation by importing LandXML, general display controls and provides tools to allow labeling of contours and spots elevations. Bentley Civil extends the available tools to provide the additional creation, edit and analyze functionality needed to create suitable terrains for the complex workflows needed through subsequent design processes.

The intent of this exercise is to help the designer better understand the core tools available in MicroStation SELECTseries 3 since terrain models are the starting base for all infrastructure and form a critical part of the design process for everything we build.

PROJECT DESCRIPTION

In this workshop we will be completing basic steps that can be applied to many different scenarios. The intention here is to give an overview of the Terrain Element and the tools available that will be of benefit in many of the other technology workshops.

Project Steps

1. Confirm setup
1. MicroStation Terrain Model Element
    i. Element Templates
    ii. Display Controls
    iii. Annotation tools

GETTING STARTED

As we begin today's workshop, let's do some quick checks to be sure your workstation / laptop is ready to go. We have preloaded the workshop files and settings in order to save set-up time.

Exercise: Check Workshop / Laptop Settings

Exercise Objective: Open the correct design file selecting the proper user configuration file.

Procedure:

1. Use the provided login and password to access your laptop if not previously logged in.
2. Your instructor will provide you the path to the workshop dataset. Select either the Power InRoads, Power GEOPAK or MX icon on your desktop. In the File Manager dialog, set the User to *BC3WK2 - Technology Preview Workshop - Terrain Modeling*.
3. Open the file Chapter 1 - Import.dgn

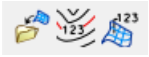
4. Select **Workspace > Configuration** from the main menu bar.
5. Scroll down and click the variable **MS_DGNLibList** and ensure the workshop path is included as one of the listings. If it is not listed, please advise the instructor.

CREATING A TERRAIN MODEL

Exercise: Import from file - LandXML

Exercise Objective: Import a LandXML Terrain Model

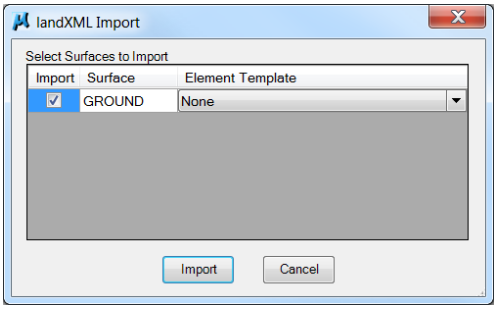
Terrain Model Tool Used:

MICROSTATION TERRAIN MODEL TASKS	ICON	TOOL
		Import LandXML Terrain Model

Note	If you are running one of the Civil Products you can access the same options under the main menu > Tools > Terrain model – just open as a toolbar to simulate the core MicroStation tools

Procedure:

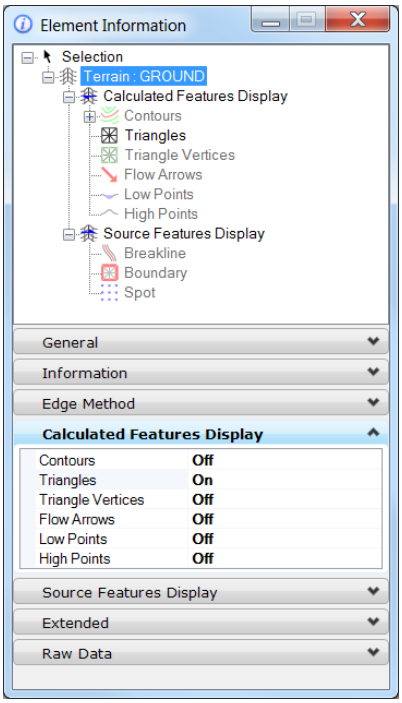
1. Remain in the file Chapter 1 - Import.dgn.
2. Select Import LandXML Terrain Model command **Terrain Model Tasks**.
3. Select *Chapter 1 – LandXML\survey.xml*
4. For now Leave the Element Template as None and Import to display the Ground Terrain using the default display mode.



MicroStation LandXML Import

Note	Element Templates control default display styles and we'll explore these in detail shortly.

5. Select the terrain and open Element Info so we can familiarize ourselves with the elements properties and display controls.



MicroStation Terrain Element Info

TERRAIN MODEL DISPLAY STYLES

Exercise: Controlling the Terrain model display

Exercise Objective: Apply Element Template and modify the style

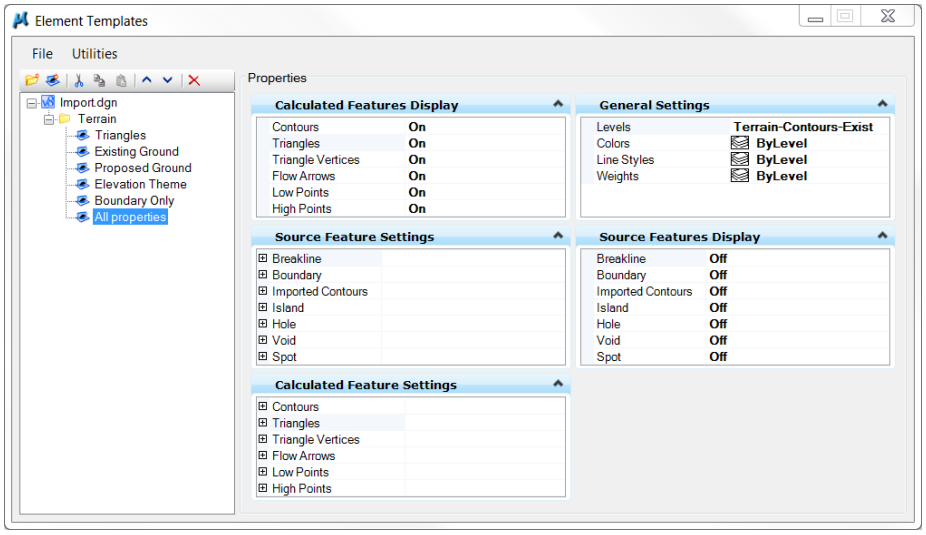
Procedure:

1. Element Info – General. Select template – Terrain\Existing Ground to apply a predefined display style that is available through loaded DGNlibs or the active drawing.
2. Select from the MicroStation main menu > Element > Element Template and open the Existing Ground style.
3. Change the Calculated Feature Settings > Contours.
    i. Major interval to 10
    ii. Minor interval to 1

   Changes to the Element template are instantly reflected in the display for anything using the style
4. Create a new Element Template, name it 'All properties', RHM to active the menu > Add > Terrain Model > All.

   Here we have all the MicroStation controls to define deployable drawing standards.

   Take a moment to explore the available settings, try activating the new style as the current Element Template for the Ground Terrain model.



MicroStation Element Templates

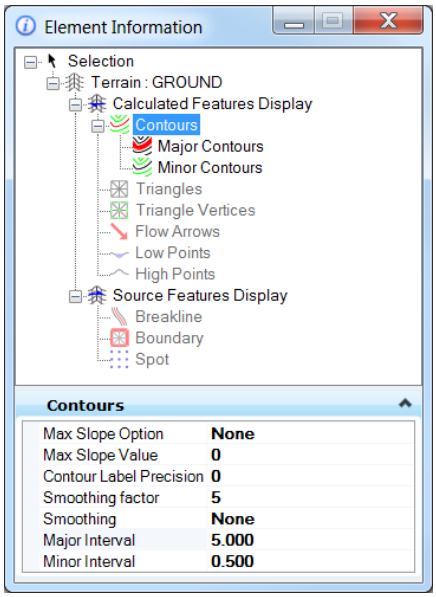
TERRAIN MODEL DISPLAY CONTROLS

Exercise: Modify local display properties

Exercise Objective: Locally adjust style the active Terrains display style

Procedure:

1. Element Info – General. Select template – Terrain\Existing Ground.
2. Element Info – Selection, navigate and select contours to investigate the options.



MicroStation Element Information

Note	Try setting a minor contour interval of 0.05 and smoothing of Spline. Consider the implication of this level of display setting

Hint	Undo and redo work on these changes ☺

DGN DISPLAY STYLES

Exercise: Use MicroStation Display Styles

Exercise Objective: Locally adjust style the active Terrains display style

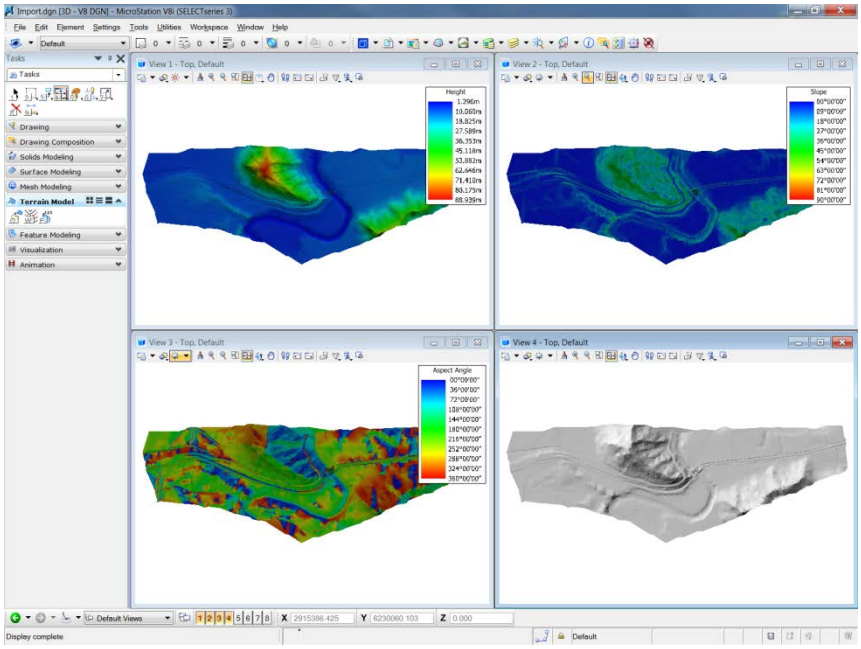
Procedure:

1. Element Info – General. Select template – Terrain\Elevation Theme

   This Element Template has been predefined to turn on thematic height shading for the current view. Shading and lighting are particularly helpful in identifying problems in the terrain.

2. From the Main Menu Select > Settings Element – Display Styles to review Element Info and settings applied in the Template*Elevation Theme*

Note	The Thematic Display Styles work on any mesh object not just Terrain models. To toggle the model on ensure the Triangles are displayed. By default four thematic maps are supplied – Height, Slope, Aspect and Hill



MicroStation Thematic Display Styles

DISPLAY OVERRIDE AND CONTOUR ANNOTATION

Exercise: Use MicroStation Display Overrides and Terrain Annotation Options

Exercise Objective: Produce a sheet drawing with Terrain specific annotation

Procedure:

1. Ensure the Terrains active Template is *Elevation Theme.*

2. Select the MicroStation Sheet model – Simple Drawing.

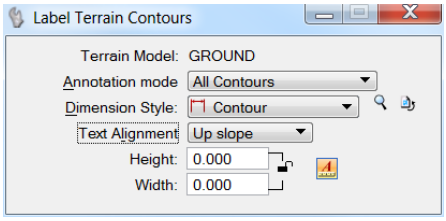
   This Drawing display the terrain model in the same style as is active in the design model.
3. Select the Terrain and open Element Information.
4. Enable Override Symbology.
5. Select the Terrain and pick Template\Existing Ground.

Note	With Override Symbology in place we can change the element template and display properties to suit the drawing use case.

6. Apply the Saved View – Depression Contour.
7. Select from the Terrain Tasks - Label Terrain Contour.

   This MicroStation tool allows manual annotation in areas of specific interest.
8. Ensure the Terrain Model GROUND is active.
9. Use the annotation tool to apply specific annotation.

Hint	Use the following settings and apply by using a crossing line.



MicroStation Thematic Display Styles

Note	Both Label Terrain Contours and Spots require pre-selection of the Terrain.

CHAPTER SUMMARY

In this chapter, we have been introduced to the MicroStation Terrain Model element, its properties and display controls. These options are available to all users of MicroStation V8*i* SELECTseries 3 and beyond.

Chapter 2: Create from File

OVERVIEW

In this and subsequent sections, we will look at a selection of the tools and benefits extended to Terrain Models when a Civil product is present. We do not have time to cover all the options, but intend to cover common options and take the time to highlight benefits with a variety of workflows.

Note	The Civil product adds a level of intelligence to file import option and preserves links to the source data files – relative, full and Projectwise paths are supported. This ability allows the Civil Terrain Element to receive updates / revisions to the base data and preserves the integrity of relationships built with the model.

CIVIL TERRAIN MODEL – CREATE FROM FILE

Exercise: Create a Civil Terrain from a external files

Exercise Objective: .Familiarize the import from file dialog and options

All Terrain Tasks can be located from MicroStation Tasks > Civil Tools > Terrain Modeling

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Create from File

Procedure:

1. Open the file *Chapter 2\Import from file.dgn.*
2. Open Terrain Model Task – Create from File.

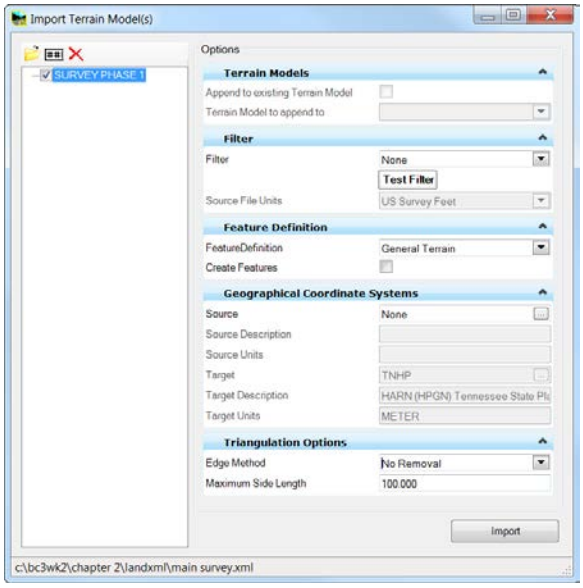
Hint	Files by type gives us a full listing of the supported file formats including the native Civil product main file Tin, dtm and .fil. The general process is the same for these formats

3. Select *Chapter* 2\LandXML\Main Survey.xml

   The XML we are importing contains the name definition for the resulting surface in the left hand side. If you want to rename the surface, click on the name.
4. Set the Feature definition to Terrain\General Terrain

Note	This is the surface type and contains a link to the Element template that defines the style. Feature definitions are covered in the Moving to SELECTseries 3 workshops.

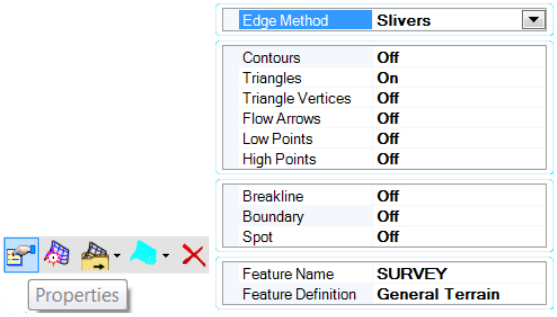
5. Set the Edge Method to No removal.



Import Terrain Tiff Settings

6. Import , close the form and fit the view.
7. Take time to review the available display properties using the Context Toolbar Display Properties

Hint	Select the terrain element and hover on it to active the toolbar. The options available vary according to the element type



Context Toolbar display properties

UPDATING A CIVIL TERRAIN MODEL

Exercise: Update Terrain Source Rule

Exercise Objective: .Update the stored terrain model by activating the associated rule

Warning	The rule is only created and available for update when in a Civil product

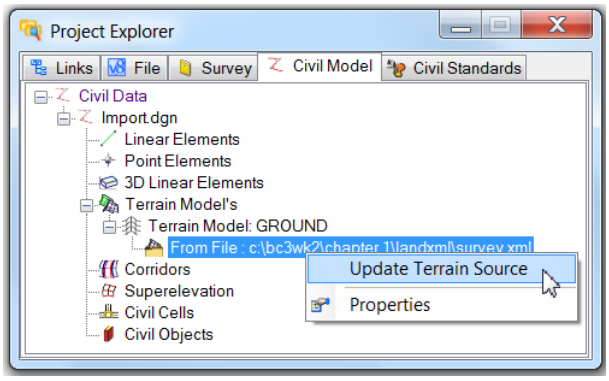
Procedure:

1. Open a Windows Explorer view to \Chapter 2\LandXML and run update.bat (Simulating a file revision from Projectwise)
2. Open Project Explorer and view the Civil model tab.

3. Expand the Terrain Model's tree to allow review the stored terrain model.

Note	The path is relative but resolves locally to show the full path or Projectwise path.

4. Right Click on the Rule 'From file:…' and Select 'Update Terrain Source'.



Update Terrain from File Rule

CHAPTER SUMMARY

In this chapter, we have been introduced to the extended Civil Terrain import file options, the concepts of Terrain Feature Definitions and Terrain Rules for updating terrains created from external sources or bulk imports.

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Chapter 3: Reviewing Terrain Models

OVERVIEW

In this section, we'll look at a selection of the review and editing tools extended to Terrain Models when a Civil product is present. We do not have time to cover all the options, but intend to cover common options and take the time to highlight benefits with practical workflows.

REVIEWING TERRAIN MODELS

Exercise: Reviewing the imported Terrain

Exercise Objective: Identify and resolve errors in the supplied Survey

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Report Crossing Features Report Conflicting Points Edit Terrain Model Analyze Point

Procedure:

1. Open the file *Chapter 3 – Reviewing Terrains.dgn.*

> ***Hint*** Visual inspection – use the various view modes to try and identify any problems, try the height banding option, contours etc to see if there are any gross errors

2. Open the command Report Conflicting Points 
3. Follow the heads-up prompts.

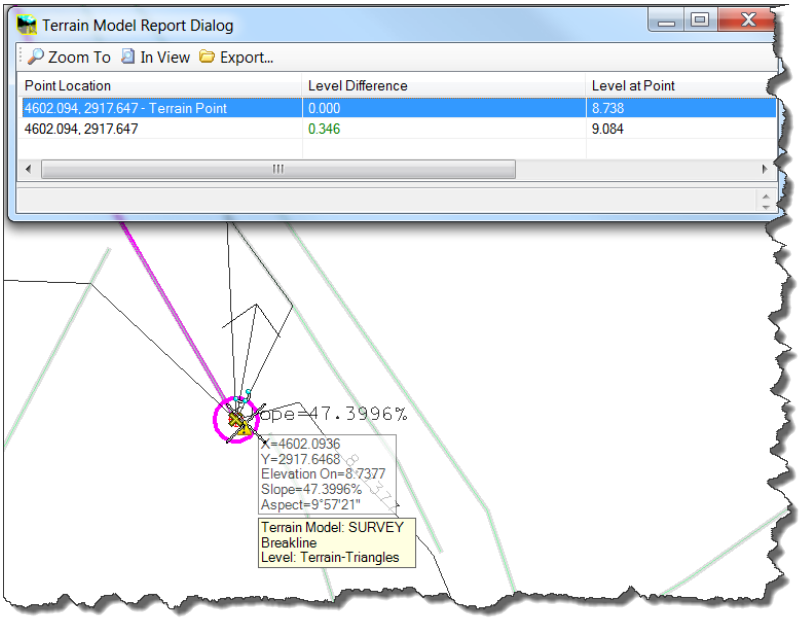
HEADS-UP PROMPT	USER ACTION
Select Terrain Model Element	Select the Terrain SURVEY
Apply Level Tolerance	Select No (up / down keys)
Set Level Tolerance	Data point in the Display

4. In the Terrain Model Report Dialog we have a duplicate point listed. The active point is indicated as – Terrain Point
5. Right Click on one of the warnings in the table and select 'zoom to'

6. To help understand the terrain the command Analyze Point can be used to locally investigate the surface

> ***Hint*** This tool provides dynamic tooltip information and contour trace through the cursor location for the current surface. The graphics can be saved to a 3D linestring in the graphics using the current style if required.

7. Right Click on the active Terrain point and Delete. This will force use of the higher value and smooth the resulting terrain.



Update Terrain from File Rule

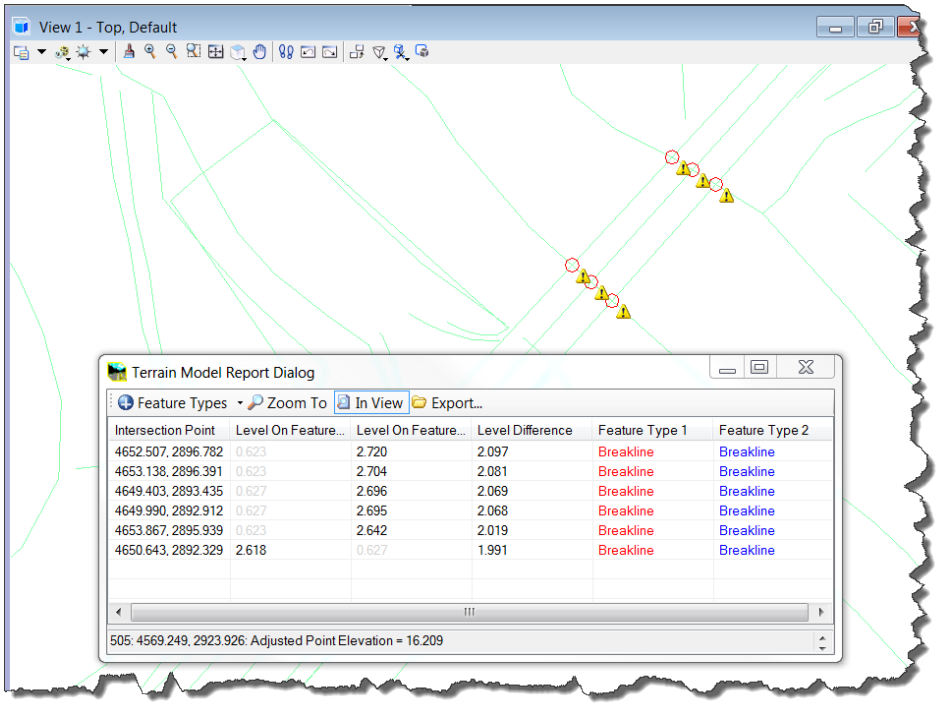
8. Open the command Report Crossing Features
9. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Select Terrain Model Element	Select the Terrain SURVEY
Apply Level Tolerance	Select YES (up / down keys)
Set Level Tolerance	Enter a value of 0.5
	Data point in the Display

> ***Note*** We're only looking for gross errors here so have set the tolerance higher than normal. This report can be run at any time with appropriate settings to refine the model

10. In the resulting table view, select the 'Level Difference' Header to sort the view and review the identified issues.
11. Open Saved View 2 - .(the bridge area in the middle of main view)

12. Turn on the 'Source Feature Display' – breaklines. This will help understanding the problem with the Terrain.

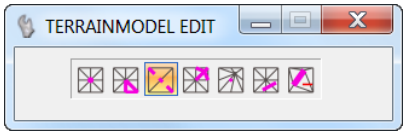


Update Crossing Features

13. Resolve the errors resulting from the inclusion in the surface of the three parallel break line that represent the road surface on a bridge (level difference over 2m) using the right click option Delete Feature. Remember to use undo if unsure
14. Open Saved view 3
15. Turn on '**Breaklines'**, '**Spots'** and '**Triangles'** to aid the

Hint	You can modify the spots style to add a cell or text by exploring the element information selection tree view.

16. Open the command Edit Terrain Model 
17. Explore options to improve contours by swapping triangle faces



Update Crossing Features

Hint	If time allows use the edit options to tidy up the edges of the terrain and remove unwanted triangles

CHAPTER SUMMARY

In this chapter, we have been introduced to the extended Civil Terrain review options. We have been looking at these in relation to solving problems with externally supplied files at a terrain level without introducing the linear / point features; these will be covered in later chapters.

Chapter 4: Appending Terrain Models and Create from ASCII

OVERVIEW

In this section, we continue to look the available options for creating Terrain Models from multiple sources and consider append / merge. The intension is to give an overview of the options so you can establish workflows that suit your practices. We do not have time to cover all options in detail but will cover the more common data formats.

Exercise Objective: Create individual Terrain Models for the various data sources and append

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Create from File
		Create from ASCII

APPENDING A TERRAIN MODEL FROM FILE

Exercise: Appending to a terrain

Exercise Objective: Append terrains together

Terrain Model Tool Used:

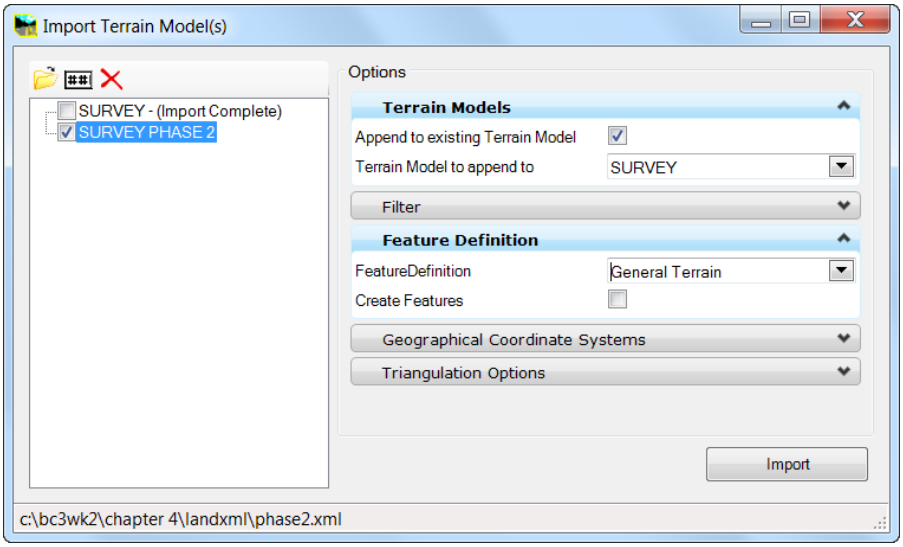
TERRAIN MODEL PANEL	ICON	TOOL
		Create from File

Procedure:

1. Open the file *Chapter 4 – Import from File.dgn.*
2. Create from File 
3. Select the files .\Chapter 4\LandXML\ Phase1 & 2.
4. We can use the Dialog to process multiple files, either to individual Terrain Models in the current DGN or by running the command in sequence and appending them together.
5. Unselect Survey Phase 2 as we will be processing the files seperately.
6. Change the name of Survey Phase 1 to Survey.
7. Set the Feature definition to Terrain\General Terrain.
8. Import and fit View.
9. Select Survey Phase 2.

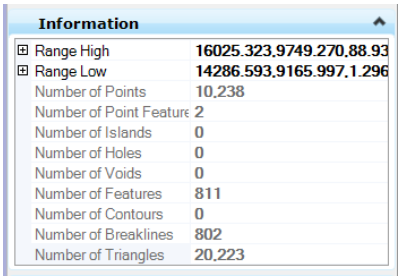
10. Toggle Append to Existing Terrain and pick Survey before importing.

Warning	Append if you know the format, if unsure create separate Terrains and create a Complex Terrain – covered in subsequent Chapter.



Append on Import from file

11. Select the resulting terrain and open Element information to confirm the following surface infromation.



Append on Import from file

APPENDING A TERRAIN MODEL FROM ASCII FILE

Exercise: Appending to a terrain

Exercise Objective: Append terrains together

Terrain Model Tool Used:

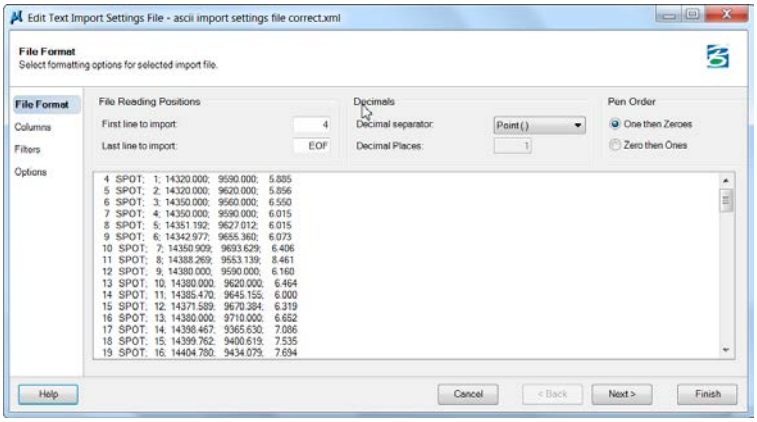
TERRAIN MODEL PANEL	ICON	TOOL
		Create from ASCII

Procedure:

1. Select Create Terrain from ASCII Import 
2. Select \ASCII\SPOTS.txt

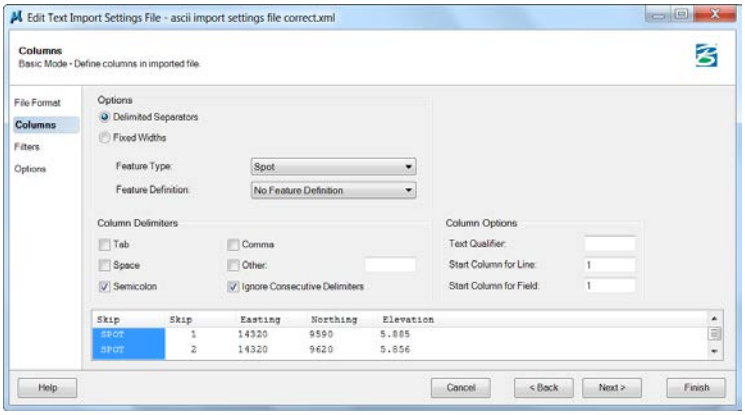
We need to load an existing mapping file or create a new one.

3. Use the Text Import Wizard browse button to load the saved settings file Chapter 4\ASCII\Spot import settings file.xml
4. Select Edit Settings file from the icons to review them.
5. Edit the Settings file to review the formatting is correct



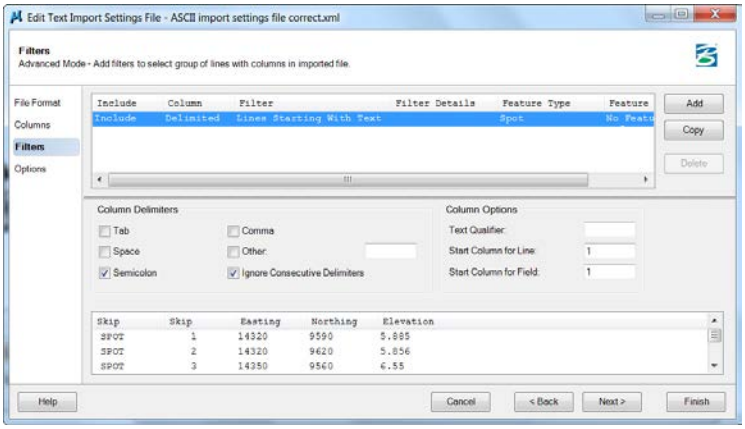
Text File Import - File Format Settings

Hint	Ensure the file header is ignored by starting the file at line 4.



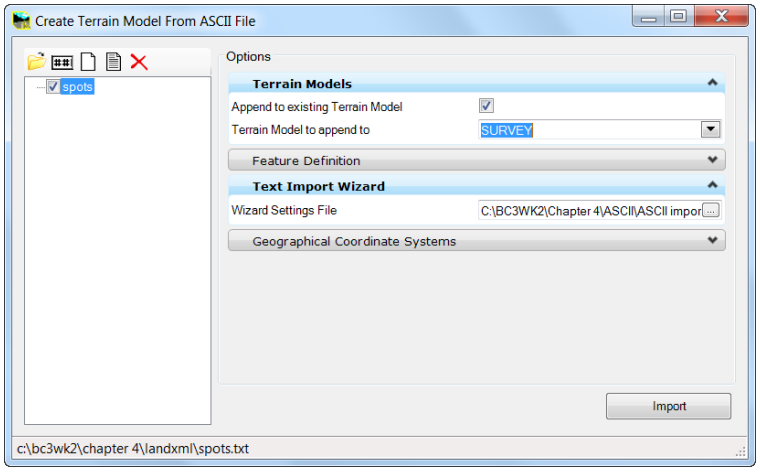
Text File Import - Column Format Settings

Hint	Ensure the Feature Type is set to **SPOT.**



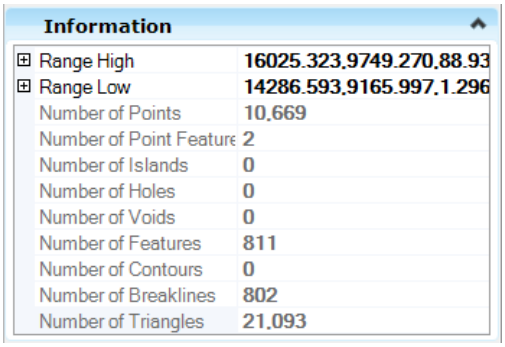
Note	If we have multiple codes and formats that we need to cater for filters are required, in this case we just have a single feature type.

6. Finish the Text Import Settings and save a new settings file with any changes
7. Toggle Append to Existing Terrain and pick Survey before importing



ASCII File Import

8. Select the resulting terrain and open Element information to note the changes to surface from before.



CHAPTER SUMMARY

In this chapter, we have been introduced to the processes behind multiple imports from file, appending terrains and defining a custom import from an ASCII file.

Chapter 5: Create Terrain from Graphical Elements

OVERVIEW

In this section, we will learn the steps associated with using bulk import options to create Terrain Models from graphical information. The automated processes applied used with bulk import methods provide deployable standards to simplify date import. We will also look at the associated manual creation process and the difference in the resulting models.

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Create from Elements
		Add Features
		Create by Graphical Filters
		Graphical Filter Manager

CREATING TERRAIN MODEL BY GRAPHICAL FILTERS (BULK IMPORT)

Exercise: Creating Terrain models by Graphical Filters

Exercise Objective: Create Terrain Model from stored graphics

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Create Terrain by Graphical Filters

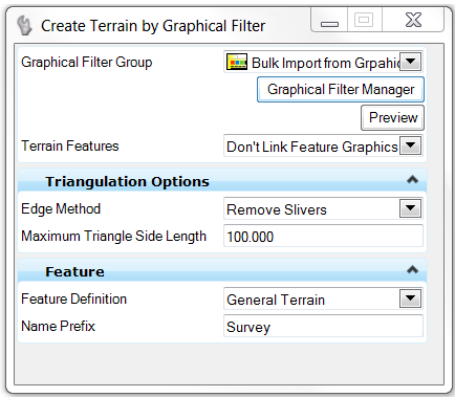
Procedure:

1. Open Chapter 5 – Import from Graphics.dgn.
2. Select the Terrain Modeling task Create Terrain by Graphical Filters 
3. Select Graphical Filter Group – Bulk Import from Graphics and preview

> ***Note*** The filter is stored in a DGNlib and can be viewed in Project Explorer; to use and edit a local copy is created when it is selected.

4. In the form Ensure the following settings
   i. Edge Method = Remove Slivers
   ii. Terrain Features Feature Definition = General Terrain

iii. Name Prefix = Survey



Graphical Filter Managers

5. Follow the on screen prompts to confirm and accept the import.

CREATING GRAPHICAL FILTERS

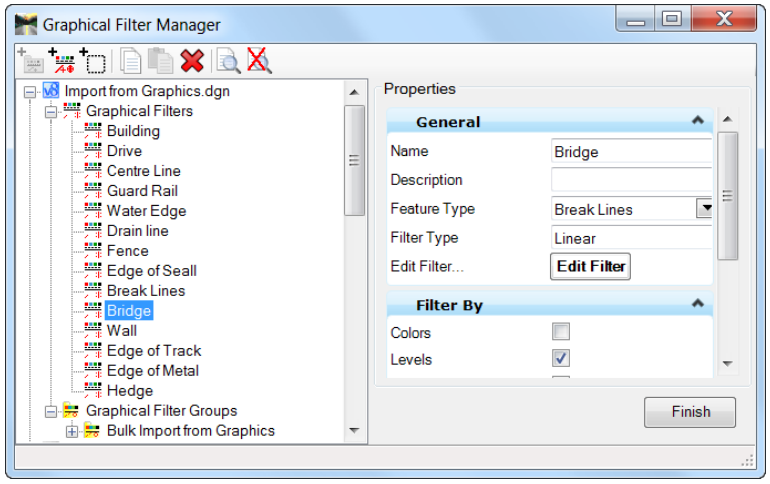
Exercise: Creating Graphical Filters

Exercise Objective: Create a new Graphical Filter

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Graphical Filter Manager

1. Select Graphical Filter Manager 
2. Expand the tree view to review the stored Filters and Filter Groups.



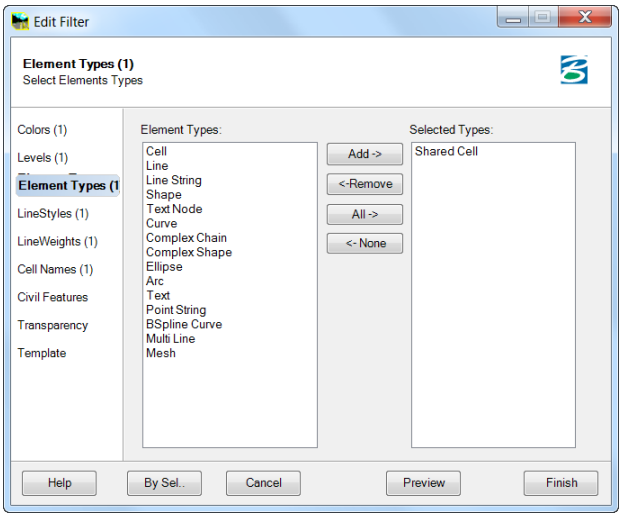
Graphical Filter Managers

3. In Level Display – Enable the level Spot Height
4. Zoom in and select a point In the drawing select an element representing the Spot features - Ref3:Surevey Phase3 Ground model
5. In the Graphical Filter Manager select Create Filter by Selection Set 

Edit Filter allows you to review all the display properties for the current Selection. These filters properties can be wild card or explicit based on multiple properties.

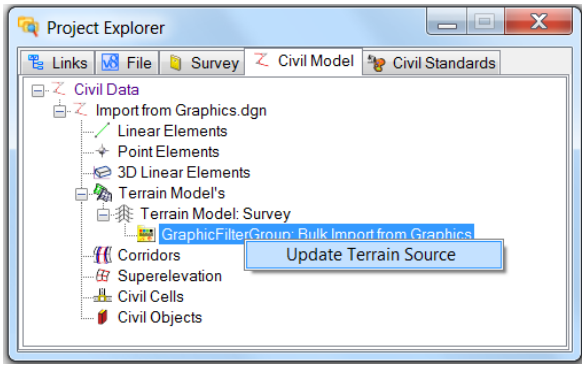
6. Preview to ensure all the random spots are selected before Finish.

Hint	Clear the current Selection in the drawing before trying the preview



Graphical Filter Manager

7. Under Filter Properties enter Name = Random Spots
8. Feature Type = Spot
9. Select the Graphical Filter Group – Bulk Import from Graphics
10. Add the newly created Random Spots filter and Finish.
11. In Project Explorer for the Survey Update Terrain Source



Project Explorer – Update Terrain Source

ADDING ELEMENTS TO A TERRAIN MODEL

Exercise: Manually adding graphical elements into Terrain models

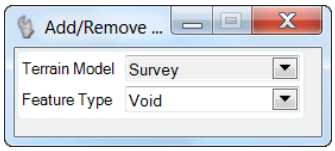
Exercise Objective: Manually add features to an existing terrain

Procedure:

1. Select all the elements on the level Buildings

Hint	Use Level display to help isolate the building level

2. Select Terrain Task – Add Features 
3. Select Survey as the Terrain model
4. Select Void as the feature type



Create From Elements

Note	Voids need to be closed shapes, try moving a building to see what happens -

5. Accept the command to add the buildings as voids.
6. Zoom into one of the buildings to confirm it has no triangles crossing it.

Note	Elements added in this way are ruled and so the terrain updates automatically if they are moved. This rule is available on the bulk import options but as it's bulk import we typically would use the bulk rule and so set the option 'Do not link Elements'.

CHAPTER SUMMARY

In this chapter, we have been introduced to several possible creation methods, from simple elements to automated bulk import. Individual elements added from the graphics are ruled directly to the terrain, so if you make changes to the element the Terrain automatically updates, this dynamic updating is useful with site design type scenarios where the design elements are combined into Terrains with surface and linear templates. Bulk import creates a rule that can be manually updated to refresh the Terrain.

Chapter 6: Create from Point Cloud

OVERVIEW

In this section, we look at the processes involved in creating a terrain from a simple point cloud.

Note	To aid in importing the required information the Terrain from Point Cloud supports selection by classification and fence selection. In this instance we'll simply bring in the entire scan.

CREATING A TERRAIN MODEL BY POINT CLOUD

Exercise: Creating Terrain models from a Point Cloud

Exercise Objective: Append to an existing terrain graphical elements

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Create from Point Cloud

Procedure:

1. *Open Chapter6\Point Cloud.dgn*

   The point cloud has already been attached. Take a moment to review the View Attributes to look at the point cloud.

2. Select the Terrain Model task Create by Point Cloud 
3. Before testing the Filter Select
   - Filter method as Tin,
   - Z Tolerance of 0.1
   - Granularity of Fine

   The method of filtering and settings depends on the scans resolution, in this case we're using an artificial surface created to represent a scan and so due to its uniform surface it returns a high reduction factor.

4. Select the Feature as Large Terrain (to display just as the Terrain Boundary)
5. Set Edge Method to Remove Slivers and Import.
6. Turn on Contours for the resulting Terrain to validate the surface.
7. Turn off the Point Cloud's display under File > Point Clouds.

ANALYZE VOLUMES

Exercise: Analyze Volumes from multiple Terrain Models

Exercise Objective: Report volumes between two terrain models

Terrain Model Tool Used:

TERRAIN MODEL PANEL	ICON	TOOL
		Analyze Volumes

Procedure:

1. Open Chapter6\Volumes.dgn
2. Select the Terrain Model task Create Analyze Volumes 
3. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Volume Method	Terrain Model to Terrain Model Volume
Locate From Terrain Model	Enter Survey
Locate From Terrain Model	Enter Point Cloud DTM
Cut and Fill Factors	Enter 1
Boundary	Reset for no boundary
Save Results	Yes

Hint	A delta terrain between surfaces could be created and stored if an Isopach contour map is required

CHAPTER SUMMARY

In this chapter, we have been introduced to Point Cloud and analysis methods for extracting volumetric information from multiple Terrain models.

Chapter 7: Creating a Complex Terrain Model

OVERVIEW

In this section, we look at the processes involved in combining surfaces into a complex terrain model.

CREATING A COMPLEX TERRAIN MODEL

Exercise: Creating a Complex Terrain Model

Exercise Objective: Gain an overview of the complex terrain options for merge and append

Terrain Model Tool Used:

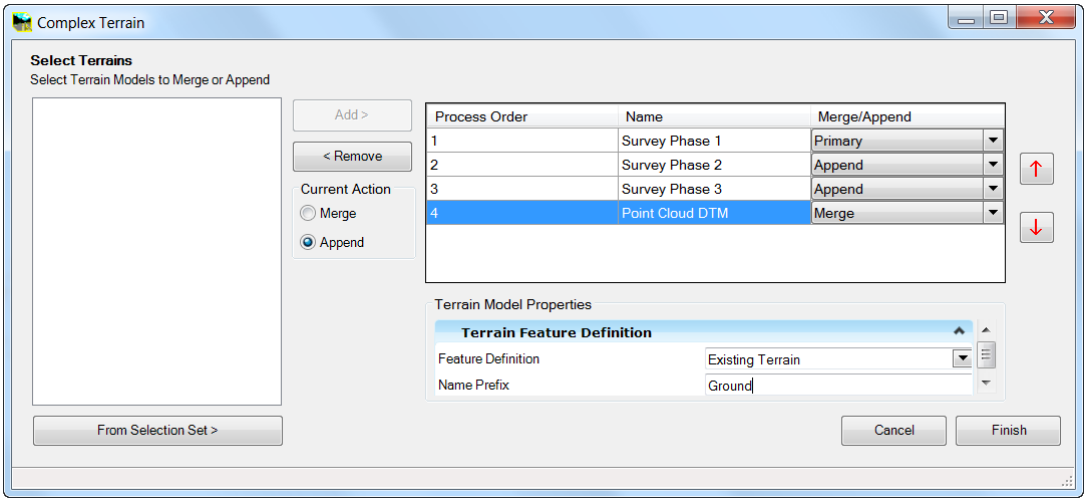
TERRAIN MODEL PANEL	ICON	TOOL
		Create Complex Terrain Model

Procedure:

1. *Open Chapter 7\Complex Terrain.dgn*
2. Select the Terrain Model command **Create Complex Terrain Model**.
3. Add the models and the method as indicated below.
   - Survey Phase 1 – Primary
   - Survey Phase 2 – Append
   - Survey Phase 3 – Append
   - Point Cloud DTM - Merge

> ***Note*** Order and method are important and needs to be given some thought as the wrong order and or processes will yield different results. When appending, the software triangulates the combined data from the two terrain models using all data from both models and ignoring none. The two models may overlap or be adjacent to one another. If there is data in both models in a common area, it is all utilized for triangulation. The Merge function uses the boundary of the merge surface to clip out current data and replaces it with the merge surface.

4. Set the Feature Definition to Existing Terrain.
5. Set Name Prefix to Ground.



Complex Terrain

6. Apply and inspect the finished terrain.

Hint	If you get the order or method wrong or need to add more terrain models, further editing of the Complex Terrain can be accessed from the quick properties or Element Information.

CHAPTER SUMMARY

In this chapter, we have been introduced to Complex Terrain Model creation methods and options for file management.

Chapter 8: Clipping Terrains to Corridors

OVERVIEW

In this section, we will look the processes involved in clipping terrains.

CLIPPING A TERRAIN MODEL TO A CORRIDOR

Exercise: Clipping Terrain to Corridor Objects

Exercise Objective: Understand the process of clipping

Terrain Model Tool Used: Create Clipped Terrain

TERRAIN MODEL PANEL	ICON	TOOL
		Create Clipped Terrain Model

Procedure:

1. *Open Chapter 8\Clipped.dgn*

   The model is made up of the following references

   - Corridors
   - Complex Terrain

2. Select the Terrain Model command **Create Clipped Terrain Model**.
3. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Locate Reference Terrain Model Element	Select the Terrain Model Ground
Locate Clipping Element	Select The Primary Route Corridor
Locate Next Clipping Element	Select The Access Track Corridor
Clipping Method	Internal
Horizontal and Vertical Offsets	Enter 0
Feature Definition	Proposed Terrain
Name Prefix	Enter Clipped Terrain
	Data Point to accept

Note The Clipped Terrain is ruled to the corridor, so as the corridor updates so does the Clipped Terrain.

CHAPTER SUMMARY

In this chapter, we have been introduced to the concept of Clipping Terrain Models. These clipped Terrain Models are ruled to the elements that clip them and refresh as the model is accessed.

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Appendices

TERRAIN MODEL FEATURES

The concept of feature types is used throughout the Terrain Model tools.

Spot or Spot Elevation	Points (with X,Y,Z data) that have no functional relationship to any other point. Random survey shots in open terrain would be an example of random spots. Point elements such as cells, circles, and text strings are typical MicroStation elements used to graphically define spot elevations. Lines, line strings, and other longitudinal elements are equally valid. The software creates a spot elevation for each vertex of each longitudinal element.
Break Line	Breaks are used to designate linear features such as edges of pavement, ditch bottoms, ridges, etc. where an abrupt change of slope occurs. Any longitudinal element may be defined as a break line. Triangles will not cross a break line in the terrain model.
Soft Break Line	A soft break line is a break line, however, if it crosses a break line, it will not affect the triangulation and is ignored.
Graphic Break Line	A soft break line is a soft break line that is not stored in the terrain model.
Contour	Element or set of elements of the same elevation. Contours may be used as source data to generate a terrain model, or may be computed (i.e., drawn based on terrain model). Contour interval is the elevation difference between two adjacent contours.
Hole	An area defined by a closed shape that demarcates a region where the current terrain is ignored and the underlying terrain is utilized.
Boundary	external boundary of the surface.
Drape Boundary	exterior surface boundary that determines its elevations by draping on the underlying surface.
Void	An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates are inserted as drape lines on the surface. Therefore, they do not change the slope or elevations of the surface.
Drape Void	An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. In the drape void, the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines are draped on the TM surface. Even though a user must provide an elevation for Drape Void vertices, the user elevations are changed to the elevation of the TM surface at the XY Drape Void coordinate position.

Break Void	An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. It differs from Voids and Drape Voids in that it utilizes the vertex elevations of the graphical element, while the void lines between successive void coordinates are inserted as break lines. Therefore, break voids change the slope and elevations of the surface.
Island	An area defined by a closed shape that demarcates a region of data wholly within a void. Void (islands in the middle of rivers, lakes, etcetera).

TRIANGULATION OPTIONS - EDGE METHOD

Several of the terrain model tools utilize the triangulation options section where the Edge Method is specified.

Many of the external edge triangles are thin and narrow and not representative of the surface. This is particularly evident where the edge of the data set is concave in nature. One approach to eliminate these triangles is the use of the Edge Method.

None or No Removal	No external triangles are deleted. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters
Remove Slivers	Long, thin triangles are dissolved based on a formula hard coded within the software. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters.
Max Triangle Length	External triangles whose external edge is longer in length than the user specified distance are deleted. Note the side option does not apply to internal triangles, only those on the edge of the model. Specify the Maximum Triangle Side Length in master units.

POINT FILTERING

Three options are supported: None, Tile, and Tin. From empirical studies, the tiling algorithm is faster and typically produces a 30% to 50% reduction in file size. The TIN algorithm typically produces a 70% to 90% reduction.

The tiling algorithm is a recursive divide and conquer algorithm that divides the data set into tiles. A best fit plane is calculated for each tile and LIDAR points are removed if they fall within the user set Z tolerance to the plane.

The TIN algorithm filters points if they fall within the user set Z tolerance of the triangle planes. The TIN algorithm first tiles the points into tiles with a maximum of 2 million points and then repetitively triangulates each tile filtering out points.

Once the filtering is complete, the Point Features Before Filter, After Filter, and Percentage Reduction are displayed in the dialog (read-only). Where multiple data files are loaded the test filter results are applicable only to the active selection.

Once the option is selected, the input fields change to reflect the selection. Fields common to all options are listed below.

Test Filter	Once the filter fields are populated, check Test Filter to commence the filter routines are populate the Report fields. The fields can be adjusted and processed again (if desired) before the data is imported as a surface.
Source File Units	If the software can determine the units from the data file, this field is populated. If it cannot determine the units, Unknown is displayed. The user can specify Unknown, Millimeters, Centimeters, Meters, Kilometers, Inches, Feet, US Survey Feet, Miles. If Unknown, then the design file units are used.

NONE

No filter is applied if None is selected. No additional inputs are required.

TILE

The tiling algorithm is a recursive divide and conquer algorithm that divides the data set into tiles. A best fit plane is calculated for each tile and points are removed if they fall within the user set Z tolerance to the plane.

Z Tolerance	The variation in the Z coordinate that the surface is allowed to move during the filtering process. Typically for the first invocation of the filtering function, the Z tolerance should be set from 0.5 to 1.0 for imperial data sets and from 0.25 to 0.5 for metric data sets. Depending on the outcome and desired result, the Z tolerance can be varied up or down.
Minimum Tile Points	A tile will not be subdivided if it has less than this number of points. Typically set this to five.
Max Tile Divisions	Allowable level of recursion allowed and is the number of times the initial tiling set can be subdivided. Typically set this to five.
Start Tile Length	The data set is initially divided into tiles of this size, prior to recursion to the minimum tile points. The setting of this parameter requires some knowledge of the distance between the points, which requires an inspection of the points in MicroStation to determine. Typically set this to 10 times the distance between the points.

TIN

The TIN algorithm filters points if they fall within the user set Z tolerance of the triangle planes. The TIN algorithm first tiles the points into tiles with a maximum of 2 million points and then repetitively triangulates each tile filtering out points.

Z Tolerance	The variation in the Z coordinate that the surface is allowed to move during the filtering process. Typically for the first invocation of the filtering function, the Z tolerance should be set from 0.5 to 1.0 for imperial data sets and from 0.25 to 0.5 for metric data sets. Depending on the outcome and desired result, the Z tolerance can be varied up or down.
Granularity	Course - Filters more points with some blurring of ridges and valleys. Fine - Filters fewer points with less blurring of ridges and valleys.

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Glossary

2D Point Feature	Contains no elevation (Z). 2D Point Features are defined and stored in plan model.
3D Geometry	3D geometry is created in 3D model by mathematically combining the horizontal and vertical geometry to create 3D elements. These 3D geometry elements in turn define a design model.
3D Model	This is created and managed automatically. User can interact with it but this is not usually required. The mathematical combination of Plan Geometry and Profile Geometry is stored in the 3D model.
3D Point Feature	3D points can be defined in plan model or 3D model. They are stored in 3D model but represented in both plan and 3D.
Active Object	The current object to which is added all geometry which is created.
Active Profile	Of the multiple possible profiles for an element, the active profile is the one used for design. The active profile is combined with the horizontal geometry to build a 3D element which is used in the 3D model.
Active Terrain Model	One terrain model can be designated as "Active". The active terrain model is the one used to display "existing ground"; in other words the one which displays automatically in a profile model when it is opened. The active terrain model is also the one which is targeted by side slopes unless the template defines a different target by name.
ALG	A legacy (proprietary) InRoads file containing coordinate geometry information, superelevation, and alignment information for a specific geometry project.
Alignment	A linear feature which serves the special purpose of defining the centerline or baseline of a roadway.
Apply Linear Template	Applies a corridor template along a feature while hiding some of the complexity of creating a corridor.
Apply Surface Template	Applies a corridor template to a terrain model for the purpose of creating components (such as pavement layers) under the terrain model.
Arc Definition	Curve definition method generally used in roadway applications. The radius R is used to define the curve and is defined by the equation R=5729.58/D where the degree of curvature D is the central angle subtended by a 100-foot arc. Set in the Design File Settings > Civil Formatting under Radius Settings. *See also Chord Definition.*
Aspect	An angular measure of the direction that the face of a surface is oriented. The format of the value is dependent on angular settings In the DGN file.

Base Geometry	In many instances the geometry element will be trimmed. The original (or base), untrimmed element is always preserved as it is the storage for the rule.
Boundary (Terrain Model)	Used to constrain the external boundary of the terrain model. No triangles are created outside the boundary. In addition, any point data outside the boundary is ignored.
Break Line	A surface feature consisting of a collection of spatial coordinates that have an implied linear relationship. No triangle side (in the triangulated surface) can cross over a break line.
Break Void	A closed area of missing or obscured data that uses the elevations of each vertex, while the void lines between successive void coordinates are inserted as break lines. Therefore, break voids change the slope and elevations of the TIN surface.
Cardinal Points	One of the points used to define the geometry of an alignment. Cardinal points include PC, PT, PI, and CC points for horizontal geometry and VPC, VPI and VPT for vertical geometry.
Centroid (triangle)	Geometric center of a triangle in a terrain model.
Chord Definition	Curve definition method generally used in railway applications. The radius R is used to define the curve, and is defined by the equation R=50/SIN(0.5*D) where the degree of curvature D is the central angle subtended by a 100-foot chord. *See also Arc Definition.*
Civil Cell	Used as a mechanism to preconfigure commonly used complex geometric layouts. These layouts will commonly be stored in DGNLIB files for reuse across multiple projects but it is possible and sometimes useful to store directly in an active DGN file for use in that single location. The civil cell will contain horizontal geometry and can also contain the vertical geometry.
Civil Message Center	Used to display a continuous updating log of Civil messages, including warnings and errors. As errors and warnings are resolved, they are removed from the list. New messages are added whenever the conditions warrant. Most messages relate to civil geometry, superelevation, and corridor modeling.
Civil Template	A civil design concept used most often for corridor modeling but also has other applications. The Civil Template defines the cross-sectional shape of the object being modeled. This cross-section is then “extruded along” a 3D geometry element to form the final model. The corridor template can create or target features such as road edges. The result is the creation of a corridor.
Clipping Reference	Clipping allows you to remove areas of overlap when working with multiple corridors in a single surface. For example, in a corridor intersected by a crossing roadway, clipping would be used to remove all overlapped features within the intersection.
Complex Terrain Model	A terrain model created by merging or appending two or more terrain models.

Context Toolbox	When an element is selected, hovering over the element provide a heads-up and context sensitive toolbar which pops up at the cursor. This toolbar provides a few of the most commonly used tools which operate on the element selected element type. The first tool in this toolbar is always Quick Properties.
Contour	A linear symbol representing points of equal elevation relative to a given datum.
Contour, Isopach	Contours of a delta terrain model which represent cut and fill values as contours, not elevations. A positive contour represents fill, while a negative contour is cut.
Contour, Major	The primary elevation line indicating a specific elevation in a surface model. Usually major contours are drawn with a heavier line weight or using a different color. Elevation text labels are usually drawn in association with major contours.
Contour, Minor	A secondary elevation line indicating a specific elevation in a surface model. Minor contours are often drawn without special color or weight indexing and without elevation text labels.
Corridor	A civil object used for modeling a roadway and is automatically managed by the corridor modeling tools.
Cross Section Model	DGN models (extracted perpendicular to defined horizontal geometry) with special station elevation coordinates defined and other specialized capabilities such as view exaggeration. Cross section stations match the interval in the template drop when a corridor is used as the basis. When horizontal geometry is utilized, the left / right offsets and interval are user-defined.
Curve Stroking	Stroking is the process of automatically adding shots to the terrain model or corridor by interpolating new shots from the curved sections of the data. This distance is used to interpolate new shots along the curved element in corridor processing and applying linear templates. This value is used as a perpendicular minimum distance from chords generated along the arc. Chords are drawn along the arc and the perpendicular distance is measured from the middle of each chord to the arc. If this distance is larger than the Curve Stroking, the process is repeated with a shorter chord length. This process is repeated until the end of the curve is reached. The flatter the curve, the fewer number of points will be calculated. The steeper the curve, the greater number of points that will be calculated.
DDB File	GEOPAK file (Design DataBase) which contains features definitions, associated symbology and annotation settings.
Delta Terrain Model	A surface containing data derived from the difference in elevation between two terrain models or a terrain model and a plane.
Dialog	The tool settings box for the active command. The dialog shows all available options for a command. For most civil commands, most of the time, the dialog can be hidden and ignored since the user is given all necessary instruction and inputs by way of the cursor prompt. The dialog is necessary for configuring command customizations.
Drape	The process of vertically projecting elements onto a surface so that the element elevations are defined by the surface.

Drape Void	A closed area of missing or obscured data where the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines are draped on the TIN surface. Even though a user must provide an elevation for the Drape Void vertices, the user elevations are changed to the elevation of the TIN surface at the XY Drape Void coordinate position.
Element Template	MicroStation concept which allows preconfigured definitions for symbology and other miscellaneous display of MicroStation elements and civil features.
End Condition	A specialized component of a corridor template which provides information tie into active surface.
End Condition Exception	Used to modify the behavior of an end condition solution without requiring the use of additional template drops. When an end condition exception is added, it must be edited to change its behavior.
Export to Native	Option to automatically or manually push horizontal and vertical geometry into native products (InRoads - ALG, MX - PSS and GEOPAK - GPK).
Feature	A Feature is anything that can be seen or located and is a physical part of your design, representing a real world thing. A feature's definition is one of its properties. At any given time in the design process, the feature will have a Horizontal Geometry, a Vertical Geometry, 3D Geometry or a combination to define its location.
Feature Definition	Used to define options when creating features. These are the items which are created in advance, usually used across multiple projects and define symbology, annotation and quantities. The feature definition is assigned (usually) in the plan model and profile/3D feature definitions follow from there.
Feature Name	Each Feature can have a name.
Gap	When a feature is trimmed the part(s) which are invisible on the base geometry.
GPK	A legacy (proprietary) GEOPAK database containing coordinate geometry information.
Graphical Filter	Using in developing terrain models, an automated way of storing search settings for graphic elements when creating terrain models using 3D element. A graphical filter can be created for each feature (i.e., spots, breaks, voids) then the filters can be defined as a Graphical filter group.
Heads Up Prompt	Command instructions are given in a heads up and dynamic prompt which floats at the cursor.
Horizontal Geometry	The elements which define the horizontal layout of the design. These elements are 2D elements even if the DGN model is 3D. Horizontal Geometry may be points, lines, arcs, spirals, splines or any combination in a complex element.
Interval	When a feature is trimmed the part(s) which are visible on the base geometry.
Island	Closed area used to place within a void, i.e., islands in the middle of rivers, lakes, etc.

Key Station	Additional station added to the corridor to force processing at the particular location.
LIDAR	(Light Detection And Ranging) is an optical scanning technology which scans ground and other physical features to produce a 3D model.
Linear Feature	In plan model, composed of lines, arcs, spirals, splines or combinations of these. In profile model, composed of lines, parabola, splines or combinations of these.

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