Workshop on the Bentley User Group Denmark meeting 2006

The Power Of InRoads Features

Hands-on class sponsored by the Bentley Institute

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1 Introduction to Features

Welcome to the *Power of InRoads Features* workshop. The primary objective of this workshop is to explore how InRoads uses features. Features are one of the most powerful components in InRoads. Once you understand how InRoads uses and stores features, you will be able to take advantage of your knowledge and use features for advanced design techniques.

Course Objectives

The objectives of this course are:

- Learn about InRoads features.
- Learn how InRoads stores features.
- Learn how InRoads uses features.
- Learn how InRoads Survey uses features.

What is InRoads?

The InRoads family of products offers a diverse set of integrated, data-centric, and CAD-neutral civil engineering solutions. These applications supply a complete set of automated 3D modeling capabilities for infrastructure engineering. Combining civil engineering solutions with productivity software, the InRoads family of products offers the tools needed to complete any civil design project.

From surveying to design to construction, InRoads includes the features corridor and site design projects require. It offers advanced DTM capabilities, associative alignments with spiral curves, user-defined typical sections (including superelevation and independent slope and ditch control), and parametrically driven decision tables. In addition, InRoads makes it easy to build plan and profile sheets, cross sections, contour maps, and shaded analytical models to meet project standards.

InRoads enables users to accomplish a variety of projects, such as:

- Road design
- Corridor design
- Road widening
- Road resurfacing
- Landfill design
- Building site design
- Golf course design
- Retention pond design

InRoads is one component of a suite of civil engineering design tools known as the InRoads Suite. The base InRoads software discussed in this course is best suited to corridor design projects such as roads. The other components of the suite include software for site, drainage, and bridge design as well as surveying.

This course uses both InRoads and InRoads Survey.

What is a feature?

The Webster's Collegiate Dictionary defines a feature as follows.

***feature**: the structure, form, or appearance esp. of a person*

Although the reference to a person is not pertinent, the remainder of the definition accurately describes the concept of a feature in InRoads. In InRoads, a feature defines the *structure* and *appearance* of elements.

Which elements? Features relate to elements stored within a Digital Terrain Model or DTM in InRoads and to survey data when using InRoads Survey. Since the survey data is a common source of the DTM, the two components are closely related.

The *structure* component of the feature defines how the points behave and relate to one another. Using a feature, points with the same characteristics and purpose are grouped to electronically replicate real world objects. For example, consider a collection of survey points collected along the flow line and the back of a curb and gutter section. If each point is independent of each other point, the resulting DTM may not accurately model the curb face because the triangulation routine does not understand how the points relate to one another. However, when the points are grouped as a feature, the points more accurately model the curb face by defining a line string along the flow line and another line string along the back of the curb.

The *appearance* component of the feature defines the symbology (color, weight, and so on) used to display the coordinate points. If required per the structure component of the definition, the symbology of lines connecting the coordinate points is also defined by the feature.

Other examples of features are the edge of a roadway or the bottom of a ditch. These features represent either the existing or the proposed roadway. These examples of features are all linear connected features (flow line of a gutter or edge of a roadway). However, features can also contain related points that are not linearly connected. For example, all trees or random elevation shots on a project could be collected into a single feature. Although each tree is its own object, and is represented individually in the drawings as a cell, the trees are all grouped into a single feature in the DTM for easier tracking and management of the data.

As you will see throughout this course, InRoads features are at the core of virtually every process in the software from importing survey data, through design, cross sections, profiles, and reporting. Features are the backbone of the InRoads DTM.

InRoads Feature Terminology

InRoads and InRoads Survey use the term feature to refer to a number of different components of the software. Below are brief definitions of four different uses of the term feature you will encounter when using InRoads. We will continue to discuss each of these in more detail throughout the course.

Survey Feature – Survey features define how elements appear in the graphics file when they are imported from raw data sources, such as data collectors, and processed with InRoads Survey.

In addition to the appearance definition, the survey feature also contains parameters about the contents and purpose of the survey data. For example, how a point should be connected to previous points, and which codes a surveyor can use to collect a point that InRoads will interpret as this feature.

Survey Features are defined in a .xinfile.

Feature Code – The term feature code is frequently used to refer to the the code a surveyor enters into a data collector to identify a survey coordinate. The feature code is matched to the survey feature name when the survey data is imported using InRoads Survey.

Feature – InRoads uses the term feature to refer to the contents of a Digital Terrain Model or DTM. Every coordinate in a DTM is part of a feature. The features within the DTM define how each point behaves and how it influences the triangulated model resulting from the DTM. The DTM feature indirectly defines the appearance of the graphics by linking to a *surface feature*.

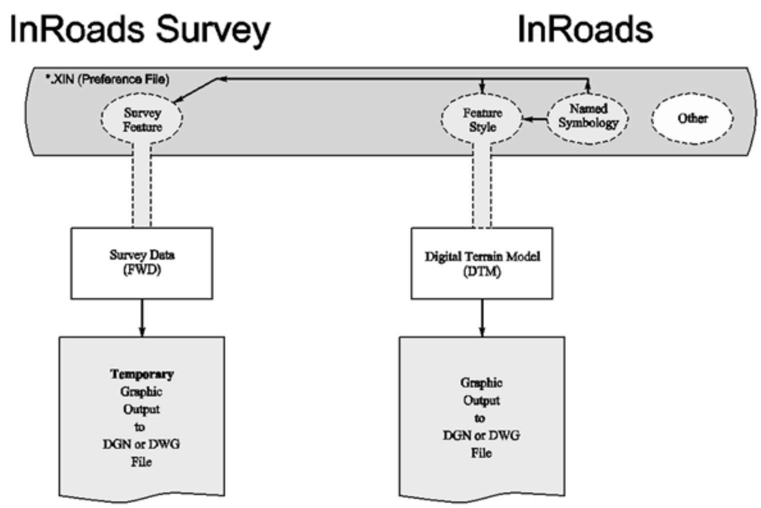
Features are stored in the .dtm file.

Surface Feature – Surface Features define how a point or a series of points can be displayed in the graphics file. For example, can the feature be displayed in plan view, profile view, or cross section view. The surface feature links to a *named symbology* definition that defines the appearance of the graphics.

Surface feature and named symbology are both stored in the .xin preference file.

Feature Type – The feature type defines if the structure of the feature is individual points, linear or a closed area. This definition controls how features affect the triangluated model.

The following illustration shows the relationship of InRoads features and the associated feature preferences in the InRoads Survey and InRoads software.



Relationship between InRoads Features

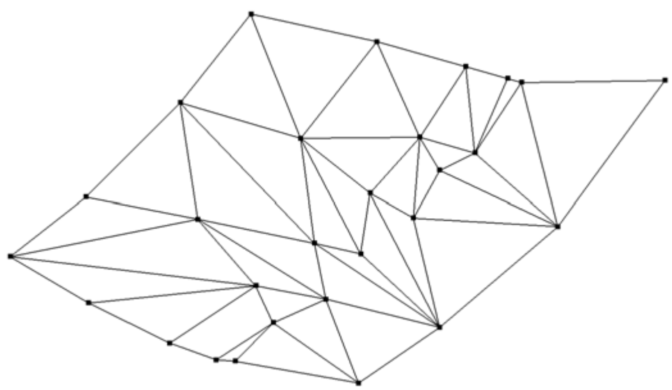
As you can see in the illustration, there are two distinctly separate uses of Features within the InRoads software. The primary objective of this course is to understand how InRoads uses features in the DTM. However, a brief understanding of how InRoads Survey uses features and how the Survey Features relate to and become DTM Features is important.

Therefore, the following chapters discuss both Survey Features and Surface Features.

Feature Types

A common component of both Survey Features and Surface Features is the *feature type,* or *point type* (InRoads uses both names interchangeably) the feature represents. A feature defines the structure of the coordinate points that belong to the feature. Ultimately the coordinate points are used to create a DTM. The feature type specifies how the coordinate points are interpreted and related to each other within the DTM. InRoads supports five point types; Random, Breakline, Contour, Interior Boundary, Exterior Boundary, and Do Not Triangulate.

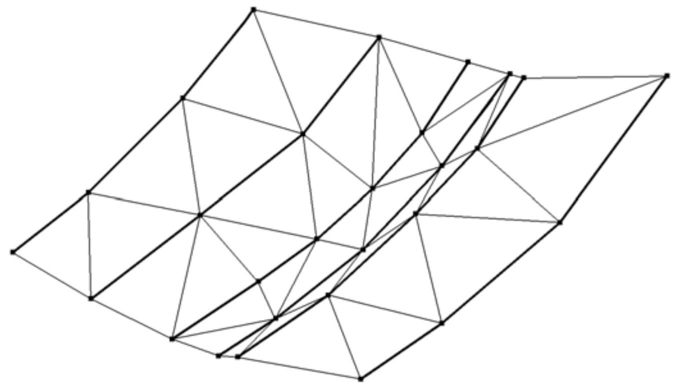
Random Points – Random points, also called spot points, represent non-uniformly spaced points that have no directly relationship to other points. When a triangle model is created from random points, the DTM system determines how to connect the points based on its algorithm. Triangulating random points typically results in a less accurate model than one created using breakline point types. Random points are typically used to supplement breaklines.



Random points triangulated

Breakline Points – Breakline points represent a linear discontinuity in a surface such as a ridge, ditch, edge of pavement, or curb. The breakline feature type specifies that all points in the feature are connected into a linear segment. When the DTM model is created, the triangles are formed so that no triangle crosses any breakline segment. Therefore, the breakline holds a linear relationship that might otherwise be lost during triangulation.

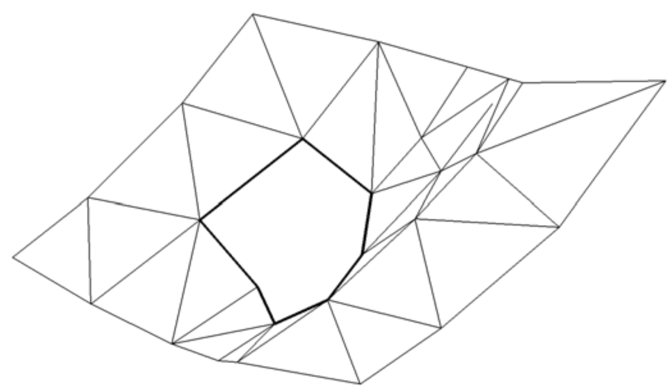
In the following illustration, the random points are replaced by breaklines passing through the same locations as the random points. The resulting triangles more accurately model the linear relationship of this segment of a roadway.



Breakline points triangulated

Contour Points – Contour points behave exactly the same as breaklines. Contour points are special breaklines where all of the points in each contour line are at the same elevation.

Interior Boundary Points – Interior boundary points represent undefined areas in a DTM. For example, the footprint of a building or body of water is specified as an interior boundary. No triangles are created inside the interior boundary. The interior boundary must be a closed shape. A DTM can have more than one interior boundary but they must not overlap.



Interior Boundary points triangulated

Exterior Boundary Points – Exterior boundary points represent the outer extent of the DTM. No triangles can exist outside of the exterior boundary. The exterior boundary must be a closed shape. Only one exterior boundary can exist in a DTM.

Do Not Triangulate – Sometimes it is desirable to include points in a DTM that do not influence the surface model. For example, underground utilities and other planimetrics can be included in the DTM even though they do not contribute to the surface model.

Why include points in the DTM that do not contribute to the surface model?

InRoads can display any feature in the DTM in plan, profile, or cross section views. Therefore, including planimetrics features such as utilities and fences in the DTM allows those elements to be easily shown on cross sections and profile views as well as in the typical plan view display.

2 Overview of Survey Features

One of the first tasks on a project is to create a DTM and planimetrics representing the existing conditions. The existing conditions are surveyed using applicable survey methods such as photogrammetry and field collection. Once collected, the survey data is processed and prepared for the designers by defining both alignments and surface models (DTMs).

The easiest and most robust method to import survey data into InRoads is to use the InRoads Survey application. Using InRoads Survey, the raw data from the survey data collector is imported, processed, and the DTM created in a mostly automated workflow.

In this chapter you will:

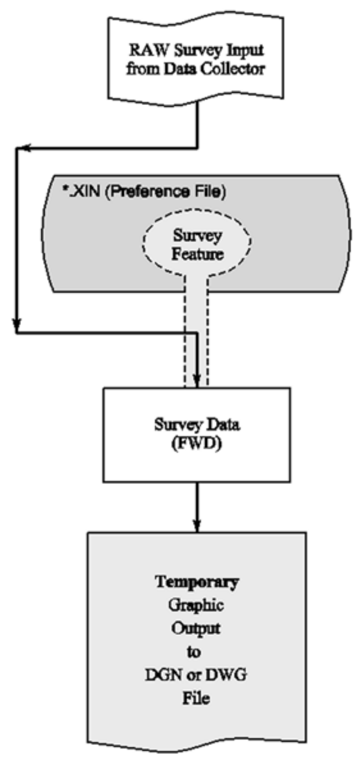
- Learn to import raw survey data.
- Learn how Survey Features work.
- Learn how Survey Features are defined.
- Learn to Export Survey data to a DTM.

This chapter is a brief overview of, and introduction to, InRoads Survey. The purpose of this training is not to teach you how to use InRoads Survey, but instead to expose you to the power of the Survey tools and demonstrate how Survey Features relate to DTM Features.

Importing Survey Data

Field collected survey data is typically stored using a data collector. The format of the data in the data collector is specific to the vendor of that survey equipment. InRoads Survey includes the ability to read from most vendor formats. When the data is collected in the field, the surveyor identifies each point with a code commonly referred to as a *feature code*. The feature code is either an ASCII or numeric code that designates the purpose of the coordinate to the surveyor.

Ultimately, the feature code is the link between InRoads and the field surveying operation. Prior to importing the survey data, *survey features* are setup in the InRoads Survey software. The survey features include the feature code definitions, thus providing the link between the field survey and InRoads. When the raw field survey data is loaded into InRoads, the feature codes are compared to the available survey features. If a match if found, InRoads imports the field survey coordinate point and links it to the matching survey feature.



InRoads Survey Import Workflow

As illustrated above, the imported survey data is written to the Survey Data file (.fwd). However, imported data passes through, and is linked to, the Survey Features in the .xin preference file to establish its behavior and symbology.

Setup Lab Files

Before we can begin the lab exercises, MicroStation and InRoads must be started and setup for the course exercises.

EXERCISE: START MICROSTATION AND INROADS

1. Start InRoads and MicroStation by selecting the **InRoads** icon on the desktop or on the Start menu.

   If MicroStation and InRoads are running from a previous session, close them and restart them to assure the proper lab files are being used.

2. Open the MicroStation file *c:\BE Data\Civil\C1TNC109\Data\Feature Training.dgn.*
3. Select the **Product Add-ins** tool (*Tools > Product Add-Ins*).
4. Locate and enable the *InRoads Survey* option.
5. Click **OK**.

   The InRoads Survey software is enabled. One new menu item named Survey is added to the InRoads menu.

EXERCISE: LOAD PROJECT DATA

1. Load the InRoads project *c:\BE Data\Civil\C1TNC109\Data\Feature Training.rwk.*

   The project file loads the following files into InRoads:

   Existing Ground.dtm
   Feature Training.alg
   Feature Training.ird
   Feature Training.itl
   Feature Training.fwd
   Feature Training.xin

2. Enable the **Write** lock.
3. Set the **Pen/Pencil** lock to Pencil mode.

Import Survey Data

Survey data can be imported from many different file formats. For this exercise, the data is loaded from a TDS file format. A small sample of the TDS file to be imported is shown below. This data is ASCII data downloaded directly from the TDS data collector.

```
JB,ROUTE70BRIDGE,DT04-27-1999,TM13:01:59
SP,PN1,N 835902.3753,E 3556583.0151,EL150.0262,--PC
SP,PN2,N 835977.3885,E 3558285.6102,EL143.2874,--PC
OC,OP1,N 835902.3753,E 3556583.0151,EL150.0262,--PC
BK,OP1,BP2,BS87.283824,BC0.000000
LS,HI5.1181,HR4.9213
SS,OP1,FP2,AR0.000000,ZE,SD,--PCP
SS,OP1,FP100,AR0.480000,ZE90.520500,SD338.1266,--TOPT
AT,TNSIZE,TV60d
AT,TNMATRL,TVNAIL
SS,OP1,FP101,AR1.092000,ZE90.434500,SD489.3012,--TOPT
AT,TNSIZE,TV60d
AT,TNMATRL,TVNAIL
SS,OP1,FP102,AR1.312500,ZE90.375500,SD636.6995,--TOPT
AT,TNSIZE,TV60d
AT,TNMATRL,TVNAIL
SS,OP1,FP1000,AR239.211500,ZE85.405000,SD70.0984,--ROWM
AT,TNSIZE,TV0.10M X 0.10M
AT,TNMATRL,TVCONCRETE
AT,TNOWNER,TVLDH
OC,OP100,N 835912.5390,E 3556920.9501,EL145.1004,--TOP
BK,OP100,BP1,BS268.163824,BC0.000000
```

The data in the TDS file is formatted by the data collector vendor. Although this file would not be reviewed or edited in a standard workflow, let's examine the file briefly to understand a little about its contents.

The lines that begin with *ss* are coordinate points collected by the field survey crew. Each line contains multiple parameters separated by commas. Consider the following line.

```
SS,OP1,FP1000,AR239.211500,ZE85.405000,SD70.0984,--ROWM
```

The meaning of each parameter is described below.

SS – Defines this is a side shot.

OP1 – The occupied point (location of the survey instrument) is a point named 1. The location of point 1 was previously established.

FP1000 – The name of the new point is 1000.

AR239.211500 – The horizontal angle (turning to the right) from the established backsight point to the point 1000 is 239.211500 degrees.

ZE85.405000 – The vertical (zenith) angle from straight up to the point 1000 is 85.405000 degrees.

SD70.0984 – The distance between the survey instrument and the point 1000 is 70.0984 feet.

ROWM – The field surveyor has designated this point as a right-of-way monument. The code ROWM is a code the surveyor and the InRoads operator have agreed to use for this type of point. ROWM is referred to as the Feature Code.

When this file is imported into InRoads, each line is resolved and its Feature Code matched to an InRoads Survey Feature.

EXERCISE: IMPORT SURVEY DATA

Continue from the previous exercise.

1 Select the **Import Survey Data** tool (*File* > *Import* > *Survey Data*).

2 In the **Files of Type** list, select *TDS (*.rw5)*.

3 Select the file *Feature Training.rw5*.

4 Click **Import**.

ⓘ Be careful to only click import once. Each time Import is clicked, the data is imported. If import is clicked more than one, duplicate data is loaded.

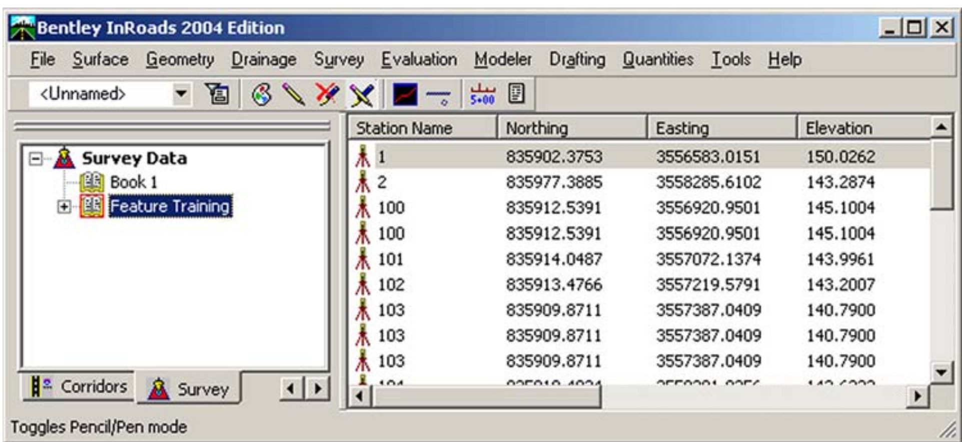
5 Click **Close**.

The survey data is processed and may be displayed on the screen depending on your settings. If you do not see any graphics on the screen do not worry. That will be corrected shortly.

6 In the **InRoads Explorer** window, select the **Survey** tab.

7 Select *Feature Training* in the left pane of the **InRoads Explorer** window.

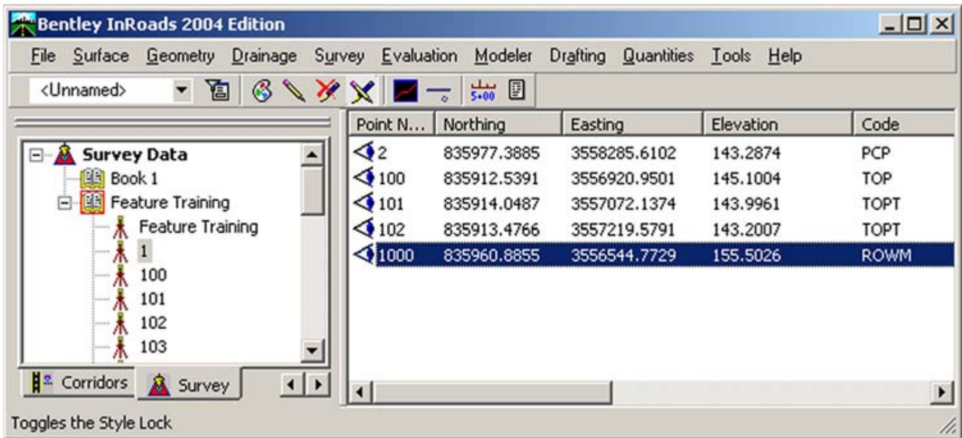
The reduced survey data is shown in the right pane of the InRoads Explorer window. Notice the data has been reduced from its format in the raw data file and is presented in coordinates and elevations.



InRoads Explorer dialog box with Occupied Points in the Right Pane

The points shown with the survey instrument icon to their left are the occupied points or the locations where the survey instrument was located. Recall that point 1000 was collected as a side shot from an occupied point named 1000.

8 Click *1* in the left pane of the **InRoads Explorer** window.



InRoads Explorer dialog box with Side Shot points in the Right Pane

9 Review the point 1000 in the right pane.

Notice the coordinate of the point are displayed. These coordinates were calculated by InRoads as the survey data was imported.

The Code column shows the feature code assigned to the point in the field. In this example, the code is ROWM.

EXERCISE: DISPLAY SURVEY DATA

1 Select the **View Planimetrics** tool (*Survey* > *View Survey Data* > *Planimetrics*).

The imported survey data displays on the screen. Selecting View Planimetrics again disables the display. The graphics is only temporary showing the current status of the survey data allowing necessary review and corrections before exporting the data to a DTM and geometry project.

2 Zoom into the survey data and review the graphics.

Notice how different components of the survey data are symbolized differently. Different colors and line styles represent different features. Also notice that some features are linear (line strings) and others are points (cells or text).

3 The other tools under the *Survey* > *View Survey Data* menu display other aspects of the survey data. For example, the Code tool displays the feature codes.

4 The tool *Survey* > *View Survey Data* > *Write Survey Data to Graphics* creates permanent graphic representations of the survey data into the CAD file.

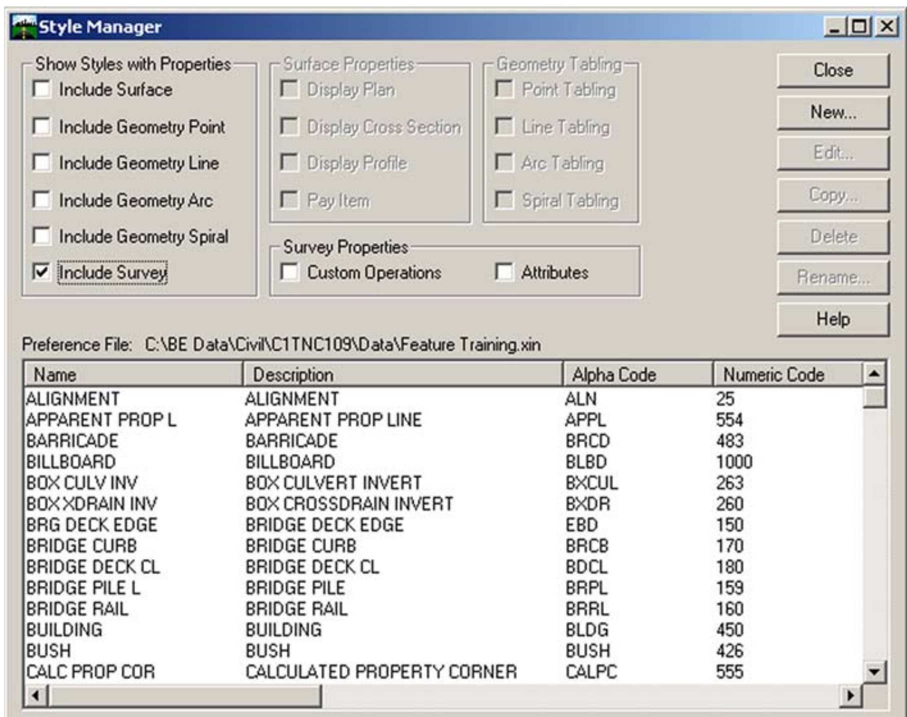
ⓘ If you wrote the survey data to the CAD file, please select all of the graphics and delete it before continuing.

Survey Features

What is a Survey Feature?

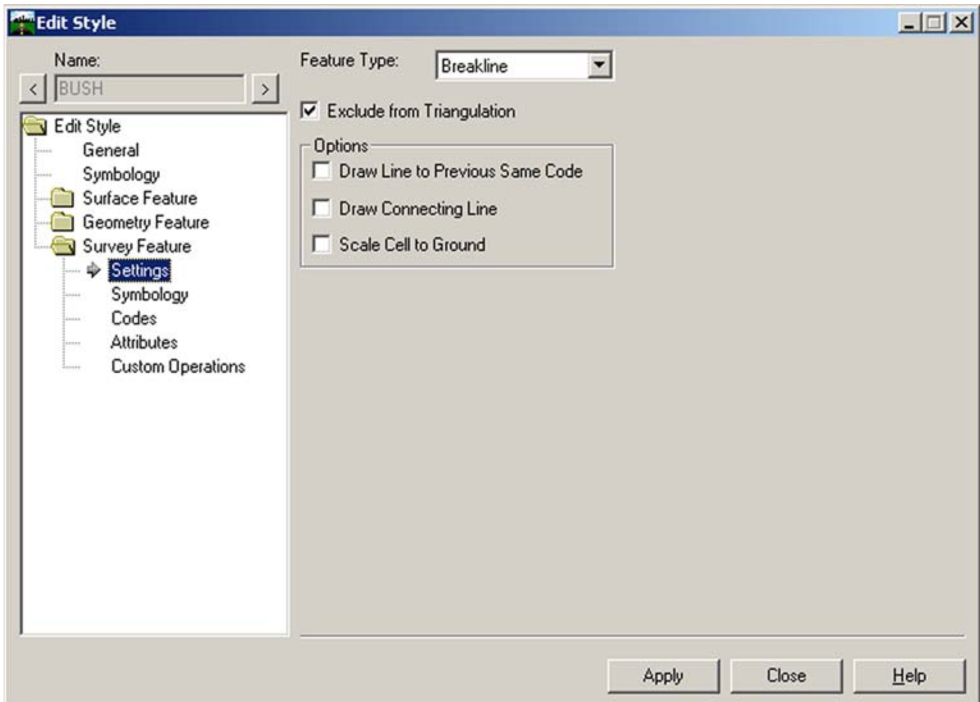
Survey Features are the link between the survey data and InRoads. The survey feature defines how the feature is displayed, how it connects to other features, and how it behaves when included in a DTM or geometry project.

Survey features are stored in the InRoads Preference or .xin file. To access the Survey Features, select *Tools* > *Style Manager*. The following dialog box appears. Select only the *Include Survey* option in the upper left corner to view only the Survey Features.



Style Manager showing survey features

The Style Manager dialog box shows all of the survey features that exist in the active .xin file. Select a feature and click Edit, or double click on a feature, to access the Edit Style dialog box.



Edit Style dialog box

The Edit Style dialog includes settings for InRoads Surface, Geometry and Survey features. During this exercise we are focused on the Survey Features. There are five leaf views (Settings, Symbology, Codes, Attributes, Custom Operations) associated with the Survey Feature branch. The parameters on each leaf are discussed briefly below.

Settings Leaf

Feature Type – Designates how points linked to this survey feature will be triangulated when they are exported to a DTM. Valid point types include; Random, Breakline, Contour, Interior, and Exterior. Refer to chapter 1 for more details on Feature Types.

Exclude from Triangulcation – When enabled, the resulting surface features will not be included in the triangulated surface model.

Options – Specifies how lines are drawn connecting sequential points linked to the same survey feature.

Symbology Leaf

Defines the Named Symbology definition used to display the feature and connecting lines.

Codes Leaf

Numeric Code – A numeric code field surveyors can use to link a survey point to a survey feature definition. Only one numeric code can exist for a survey feature.

Alpha Code – One or more alphabetic codes field surveyors can use to link a point to a survey feature definition.

Attributes Leaf

User defined attributes that can be collected during the survey using some data collectors. The attributes can be used by InRoads Survey to affect the display of the feature or as supplemental information about the feature.

Custom Operations Leaf

Definitions of custom activities that will occur when a feature is displayed.

Editing Survey Features

EXERCISE: EDIT SURVEY FEATURE

Continue from the previous exercise.

1. Ensure that the planimetrics are displayed and all other types of survey data displays are disabled.
2. Select the **Style Manager** tool (*Tools > Style Manager*).
3. Enable the **Include Survey** option.

4 Locate and select the *ROW MON* feature.

ⓘ Click on any column heading in the Style Manager dialog box to sort the contents of that column.

5 Double click the feature name to open the Edit Style dialog box.

6 Select the *Survey Feature > Codes* leaves.

7 Observe that this feature has a single Alpha code named ROWM. This is the code that point 1000 became linked to when it was imported into InRoads.

8 Click **Cancel** to close the Edit Style dialog box.

9 Locate and select the *FENCE LINE* feature.

10 Click **Edit**.

The Edit Style dialog box appears.

11 Select the *Survey Feature > Symbology* leaves.

12 Click **Edit**.

The Edit Named Symbology dialog box appears.

13 Select *Plan Line* and click **Edit**.

The Line Symbology dialog box appears.

14 In the **Line Style** field, select *{Rail Road}*.

Changing the Line Symbology changes how any survey data associated with this feature is displayed.

15 Click **OK** on the Line Symbology dialog box.

16 Review the graphics and locate the yellow lines using a diamond line style along each edge of the roadway. These lines represent the fence and are linked to the FENCE LINE feature.

17 Click **Apply** on the Edit Named Symbology dialog box.

The yellow fence line immediately updates from the diamond line style to the rail road line style. This demonstrates the linkage between the survey feature and the survey data.

18 Set the line style associated with the FENCE LINE feature back to *{Diamond}*.

19 **Close** the Edit Named Symbology, Edit Style, and Style Manager dialog boxes.

Exporting Survey Data to a DTM

After appropriate corrections and adjustments are made to the survey data, it is exported to an InRoads DTM or geometry project. Once exported to a DTM or geometry project, the Survey Features are no longer used.

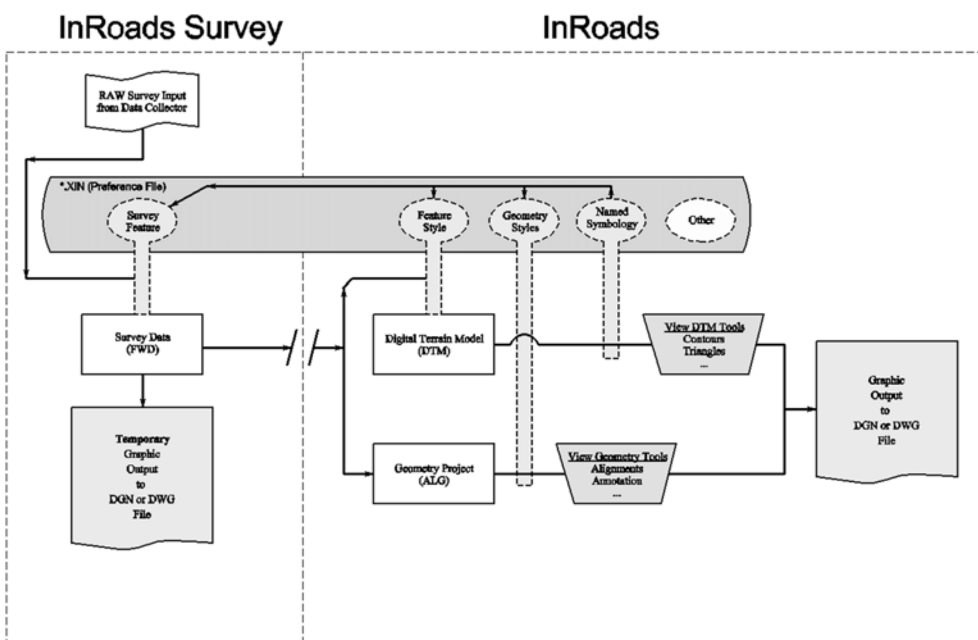
The Survey Features are only used while the data is being processed by the InRoads Survey software.

Once the data is stored in a DTM or geometry project, a different “feature” definition is used. There are actually two definitions, one for the DTM data and another for the geometry project data.

InRoads uses *Surface Features* to define the “feature” properties of elements contained in a DTM. Surface Feature are stored in the .xin preference file. Geometry project data rely on *geometry styles* for their symbology definitions. Geometry styles are also stored in the .xin preference file.

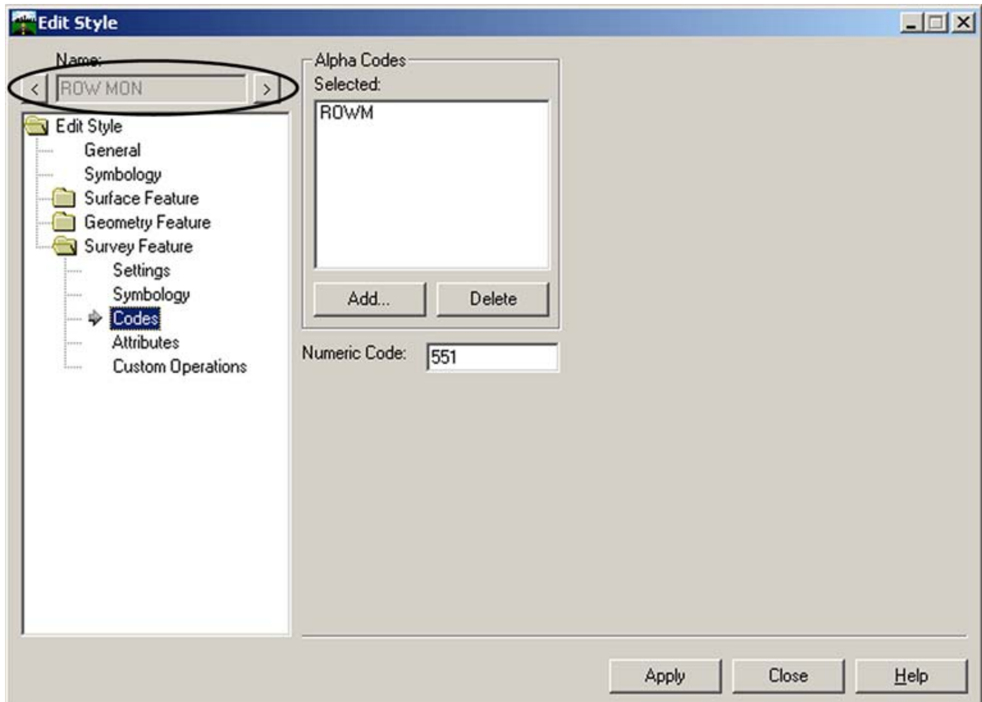
When data is exported from InRoads Survey to a DTM or geometry project, InRoads uses the commonly named *Survey Features, Surface Features* and *Geometry Features*. If appropriate definitions exist, the data is linked to the respective style. If no match is found, the data is linked to the default style.

The following illustration shows the division between InRoads Survey and InRoads. As the data is exported from the Survey Data file (.fwd), it is sent to either a DTM or a geometry project.



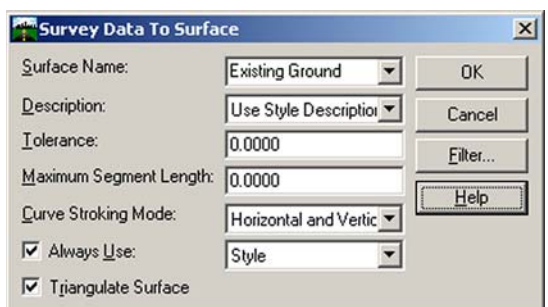
Survey Export to DTM and Geometry Project Data Flow

When survey data is sent to a geometry project, the Style name is used to find a matching Geometry Feature style in the .xin preference file.



The Style name is used to locate a Geometry Style when Survey Data is exported to a geometry project

When survey data is exported to a DTM, InRoads attempts to match one of three survey feature parameters to a feature style. Which survey feature parameter is matched is controlled on the Survey Data to Surface dialog box.



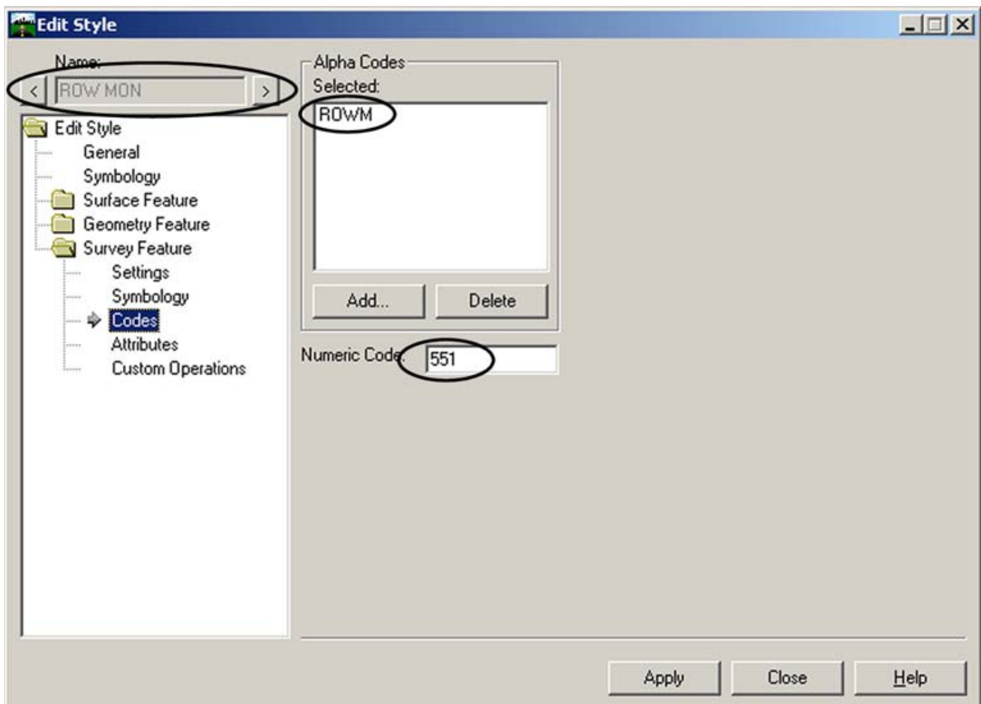
Survey Data to Surface dialog box

The *Always Use* parameter controls which Survey Feature parameter is matched to the Surface Feature. There are three options.

Style – The style name is matched to the Surface Feature.

Alpha Code – The first Alpha Code parameter is matched to the Surface Feature.

Numeric Code – The Numeric Code parameter is matched to the Surface Feature.



The Style name, alpha code, or numeric code is used to match a Surface Feature when Survey Data is exported to a DTM

If there is not a Surface Feature that matches the specified parameter from the survey feature, the Surface Feature named *default* is assigned to the data.

If the *Always Use* parameter is disabled, InRoads attempts to locate a match using the first non-blank parameter. The parameters are searched in the following order. Style first, then Alpha Code, followed by Numeric Code.

EXERCISE: EXPORT SURVEY DATA TO DTM

Continue from the previous exercise.

1. Select the **Survey Data to Surface** tool (*Survey* > *Survey Data to Surface*).
2. Set the following parameters on the dialog box.

   Surface Name: *Survey*

   Description: *Use Style Description*

   Tolerance: *0.0000*

   Maximum Segment Length: *0.0000*

   Curve Stroking Mode: *Horizontal and Vertical*

   Always On: *Enabled, Style*

   Triangulate Surface: *Enabled*
3. Click **OK**.

   The data is exported to the DTM and the Triangulate Surface dialog box appears.
4. Click **Apply** on the Triangulate Surface dialog box.
5. Click **Close** on the Triangulate Surface dialog box.

   The new DTM is created.

   We will review the contents of this DTM in the following chapter.

3 DTM Features

The InRoads DTM is a very powerful tool. In its most basic since, the DTM stores the coordinate data (random points, breaklines, and so on) that defines a ground surface. However, a thorough understanding of the “features” stored in the DTM enable more advanced uses of the DTM data beyond simply storing the surface model.

In this chapter you will:

- Learn how InRoads stores a DTM.
- Learn how to view DTM data.
- Learn how to create a DTM.
- Learn how to use a DTM

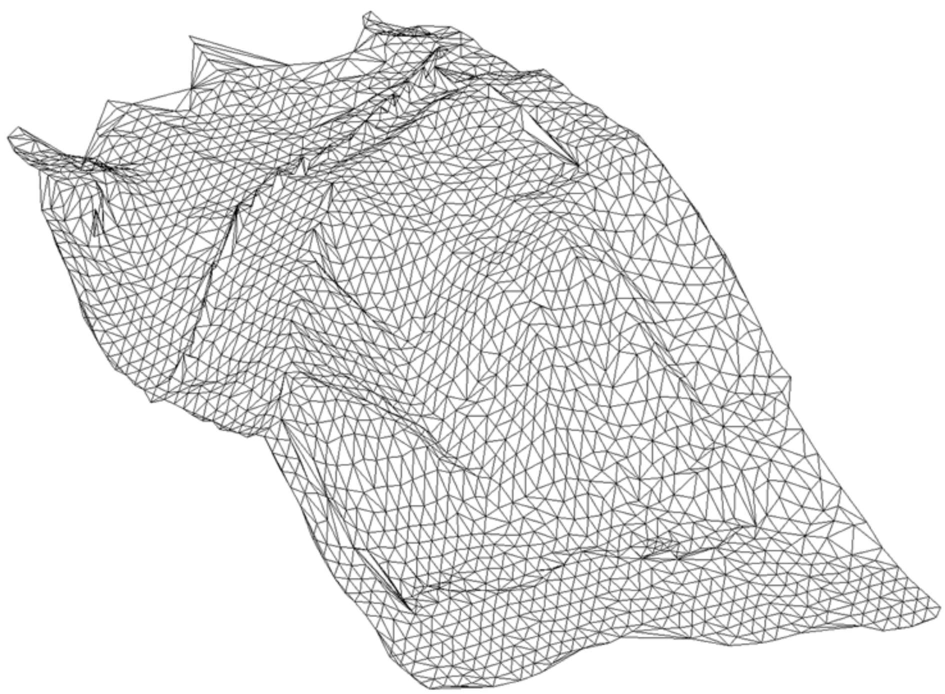
What is a DTM?

The InRoads DTM is really quite simple. It is a database of coordinates (often linked together into line strings or shapes) that represent real world objects. The most common use of the DTM is to model a ground surface.

For example, an existing ground DTM would likely contain line strings along all major breaks in the terrain such as the edges of the roadway, bottoms of ditches, edges of waterways, and so on. In addition, shapes may be included to define areas where reliable data is not available such as inside the perimeter of a pond or a building. Finally, random or spot points are included to supplement the data with additional elevations.

A proposed design DTM would include line strings along the linear features of the roadway such as the edge of roadway, ditches, and so on.

When these coordinate points are connected together or triangulated, the result is a three-dimensional model of a terrain surface similar to that shown below.



Digital Terrain Model

Many different software packages use DTM's to store terrain data and most do it in a similar fashion. Although the algorithm used to triangulate the surface may vary, the basic definition is similar using points, line strings, and shapes.

Many civil design tools use a Triangulated Irregular Network (TIN) as their DTM model. While the TIN model provides an accurate terrain model, it is limited in its usage beyond the model. The coordinate points, line strings, and shapes are loaded into the DTM and triangulated. However, once they are loaded, the DTM does not store any information about origin or purpose of each coordinate. For example, the DTM cannot distinguish between a line string representing a curb and a line string representing a fence. Since the DTM cannot tell one line string from another, the DTM cannot graphically display the individual DTM elements symbolized to represent the purpose of the element.

However, the InRoads DTM is different. It is a *feature based* DTM. A feature based DTM not only stores the coordinate data, but also feature data (structure and appearance) with each element stored in the DTM. Since the feature data is included with the elements in the DTM, each element can be evaluated or displayed using appropriate symbology. For example, when the DTM features are displayed, a water line will look different from an edge of pavement or a curb line.

The InRoads DTM can also store data that does not contribute to the terrain surface but is valuable to the design process. For example, the location of a culvert, waterline, or guardrail can be stored in the DTM even though these elements sould not be included in the surface model. Since the DTM stores the true three-dimensional location of all points, utility or planimetric data is also stored in its true three-dimensional location.

There are many benefits to storing data in the DTM that does not contribute to the terrain surface. First, any data in the DTM can be displayed in a plan view, profile view or cross section view. Therefore, it is very simple to show the location of a waterline or guardrail in the plan view as well as on the profiles and cross sections if the data is included in the DTM. Another uses of including the data in the DTM is for design decisions. For example, if the right-of-way line is stored in the DTM, the roadway modeler can make decisions to determine the best side slope so that the toe of the slope does not fall outside of the right-of-way.

What is a Feature?

InRoads uses the term *feature* to describe an element in a DTM file. Every element in the DTM belongs to one and only one feature. A feature is a named *set* of coordinate points in a DTM. By itself, a coordinate point is just that, a single location in space unrelated to all other points. However, when a set of related points is grouped into a feature the result has far more meaning than the points themselves.

The grouping defines which points to connect together, the linear relationship of the points, and the order of the points. Most importantly, the feature identifies the purpose (structure) and graphical display (appearance) of the points.

Although the feature is stored in the DTM, not all of the feature *parameters* are stored in the DTM. The feature parameters are stored in both the DTM and the .xin preference file. The feature parameters are distributed across the two files so that common parameters can be reused without duplicate setup.

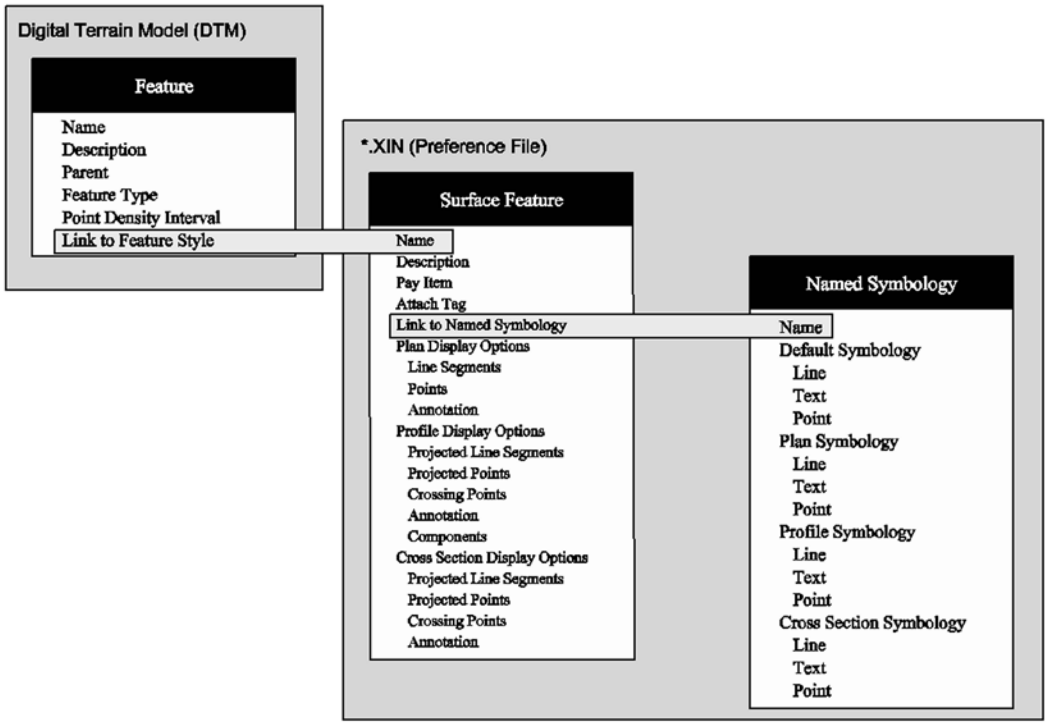
The feature parameters are divided into three sets; the feature, the feature style, and named symbology.

The *feature* is stored in the DTM and defines the parameters unique to a single feature as well as a linkage to a feature style.

The *feature style* is stored in the .xin file and defines where a feature is graphically displayable. However, the feature style does not define the symbology used to draw the feature. It only defines if a feature can be displayed in plan, profile, or cross section views. The feature style is linked to a named symbology.

The *named symbology* defines the graphic symbology used to display the feature. Separate symbology is defined for the plan, profile, and cross section display of a feature.

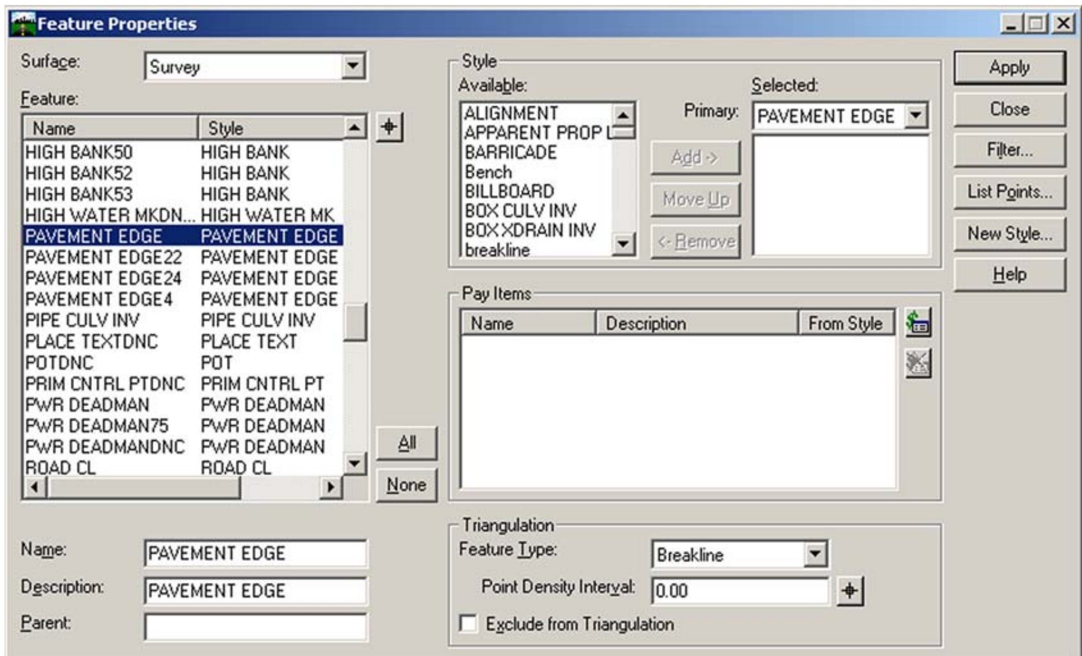
The following illustration shows the relationship between the different feature parameters.



Relationship between Feature, Surface Feature, and Named Symbology

Feature

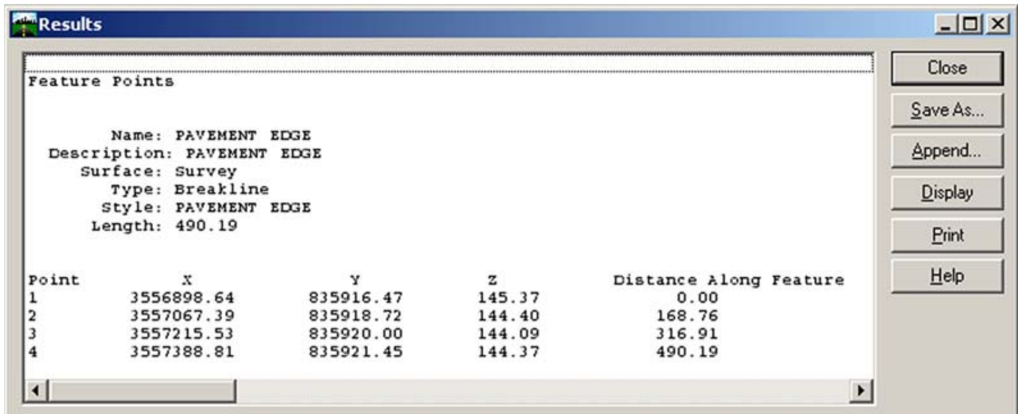
The Feature Properties tool (*Surface > Feature > Feature Properties*) is used to view and edit the features stored in the DTM file.



Feature Properties dialog box

The *Surface* parameter specifies the DTM surface displayed in the other fields on the dialog box.

The *Feature* area lists the individual feature stored in the surface. Remember, all coordinate points must be stored in a feature. To view the coordinate points that belong to a feature, select the feature and click the List Points button.



Results dialog showing the coordinate points that belong to the EOP feature

It is common to have multiple features that represent the same type of element in a surface. For example, in the Survey surface, there are four edge of pavement features named PAVEMENT EDGE# where # is a number.

The Style column in the Feature area shows the Surface Feature style linked to the respective feature. In the example, all four edge of pavement features are linked to the feature style named PAVEMENT EDGE. In this case, the feature name and the style name were substantially similar. However, the names do not need to be the same or similar.

There are many reasons for having multiple features linked to the same feature style. For example, if the field survey crew was unable to collect the entire area in one session, they may have started with new features when they began each session or day. Another reason may be discontinuous features. The exercise project includes a bridge. Therefore, there are two edges of pavement (left and right side of the road) from the beginning of the project to the bridge. Two more edges of pavement are needed to define the road from the end of the bridge to the end of the project. A major benefit of separating the feature style from the feature is that the surface feature style is reusable on multiple projects even though the DTM file for each project is different.

When the desired feature is selected from the feature list, the name, description and parent of the feature appear in their respective fields on the dialog box. The feature can be renamed, a description or parent added at any time.

The parent parameter is used to group together multiple features for reporting or processing. By default, most InRoads actions leave the parent parameter blank. However, the parent parameter for features generated by the Roadway Designer is automatically set to *Alignment*. A feature filter is needed to process groups of features based on their parent parameter. Feature filters are discussed later in this course.

At the bottom of the dialog box, in the Triangulation area, are parameters that define the structure of the feature. The first parameter is the *Feature Type*. Feature Type specifies how (breakline, random point, interior boundary, …) a feature is included in the triangulated model. Chapter 1 includes a discussion of the different feature types. Enabling the *Exclude from Triangulation* parameter, tells InRoads to not include the selected feature when building the triangulated model. The feature is still available for display and design decisions but does not affect the surface model. A common use of this parameter is to store utilities, fences, vegetation, and other planimetric features that do not directly influence the terrain. For example, a waterline is below the ground. If the water line feature is included in the triangulated model, the model would have a hole or cavern along the water line. Excluding the water line from triangulation allows it to exist in the model but not affect the terrain.

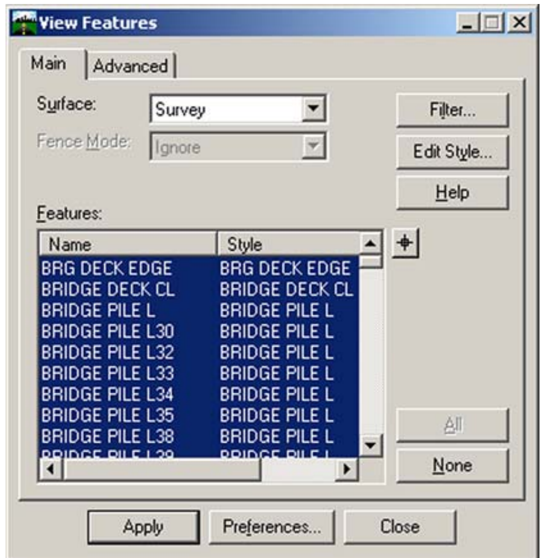
The *Point Density Interval* parameter increases the density of triangle vertices so that no triangle has a side that is longer than the specified value. Models with shorter, more uniformly sized triangles result in a better model. A value of zero causes the model to be generated using only the coordinate points stored in the surface, no densification occurs. Any other value, causes triangles to be densified until the maximum length of any triangle edge equals the point density interval.

The final area on the dialog box is the Style setting. This area defines the linkage to the *feature style* stored in the .xin preference file. The list on the left shows all available styles. The list on the right shows the feature styles currently linked to the active feature. A feature can be linked to more than one feature style. For example, you may choose to designate a fence line as both a *fence* style and a *right-of-way* style. Then, InRoads would match this feature when searching for both fence and right-of-way feature syles.

If a feature is associated with more than one feature style, the feature style at the top of the list (known as the Primary style) defines how the feature is displayed graphically.

Viewing Features

The features in a surface are displayed using the View Features tool (*Surface > View Surface > Features*).



View Features dialog box

EXERCISE: VIEW SURFACE FEATURES

Continue for the previous exercise.

1 If any graphics are displayed from the previous exercises, delete them and disable the InRoads Survey display options (*Survey > View Survey Data > …)*.

2 Select the **View Features** tool (*Surface > View Surface > Features*).

3 In the **Surface** field, select *Survey.*

Survey is the name of the surface previously exported from InRoads Survey.

4 Select all of the features in the Features list.

ⓘ Use the CTRL and SHIFT keys to select multiple features or click the All button to select all of the features.

5 Click **Apply**.

The features are displayed in the graphics file. Notice that these features appear the same as the features displayed with InRoads Survey. Since InRoads Survey and InRoads are both using .

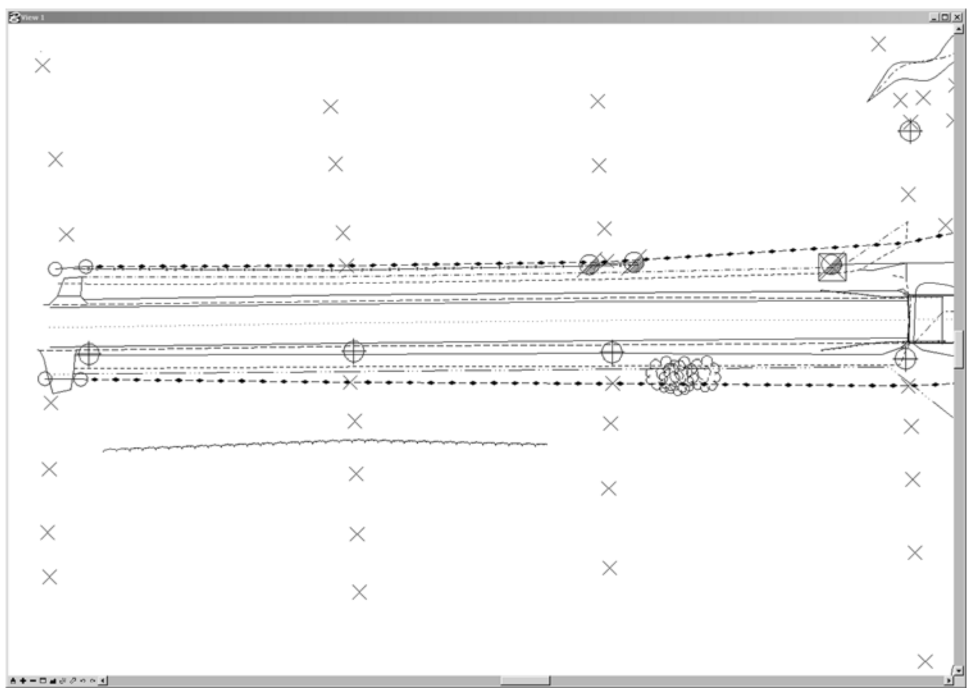
InRoads Survey relies on the Survey Feature (.fwf) file to define the display symbology of the features. The InRoads DTM relies on the Feature Style (civil.ini) file for the display symbology. In this example, care has been taken to keep the survey features and the feature styles synchronized so that they data appears the same.

6 Click **Close**.

EXERCISE: EDIT FEATURE PROPERTY

Continue from the previous exercise.

1 Zoom into the graphics so that the road segment left of the bridge is visible.



2 Select the **Feature Properties** tool (*Surface > Feature > Feature Properties*).

3 In the **Surface** field, select *Survey*.

4 Select the target button next to the Feature list.

5 Locate and select the fence line along the bottom of the road. The fence line is the yellow line with the diamond line style pattern.

6 Data point to accept the fence line.

The feature FENCE LINE is selected in the Feature Properties dialog box. FENCE LINE is the name of the feature that contains this fence segment.

7 In the *Style* area set **Primary** to *WATERLINE*.

8 Click **Apply**.

The feature FENCE LINE is redefined and linked to the feature style named *WATERLINE*.

9 Click **Close**.

EXERCISE: UPDATE FEATURE DISPLAY

Continue from the previous exercise.

1 Select the **View Features** tool (*Surface > View Surface > Features*).

2 In the **Surface** field, select *Survey*.

3 Select all of the features in the Features list.

ⓘ You could select only the feature named FENCE LINE since that is the only feature that was modified. However, it is easier to just re-display all of the features.

4 Click **Apply**.

The fence line feature display is updated to represent a water line. The water line displays as a light blue line with a dash dot dot dot line pattern.

EXERCISE: RESET FEATURE PROPERTY

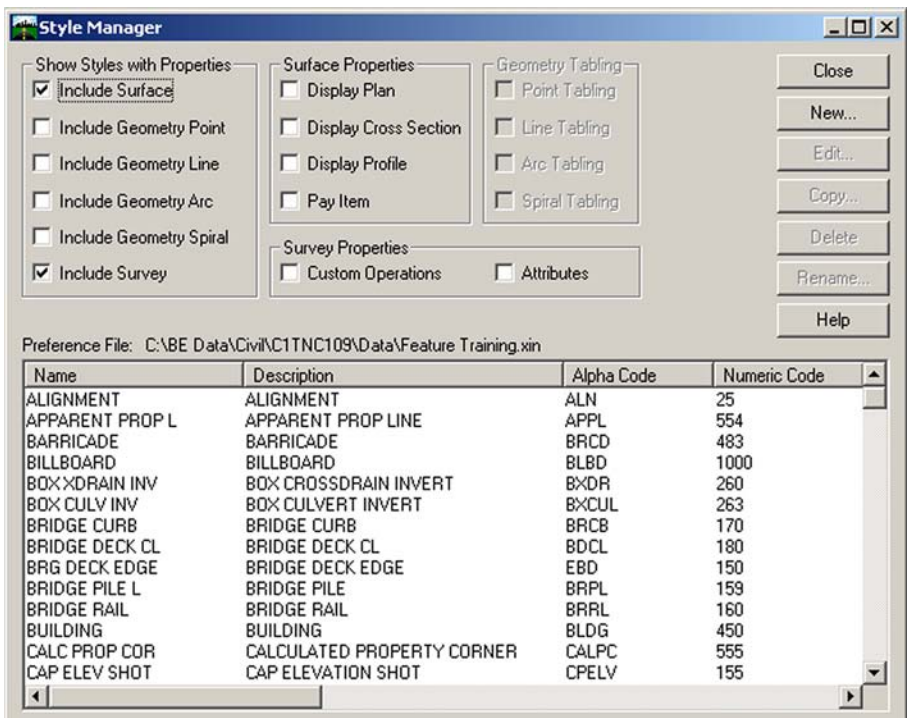
Continue from the previous exercise.

1. Use the Feature Properties tool to reset the feature FENCE LINE to link to the feature style FENCE LINE.
2. Use the View Features tool to update the feature display. The fence will again display in yellow using a diamond line style.

Surface Feature

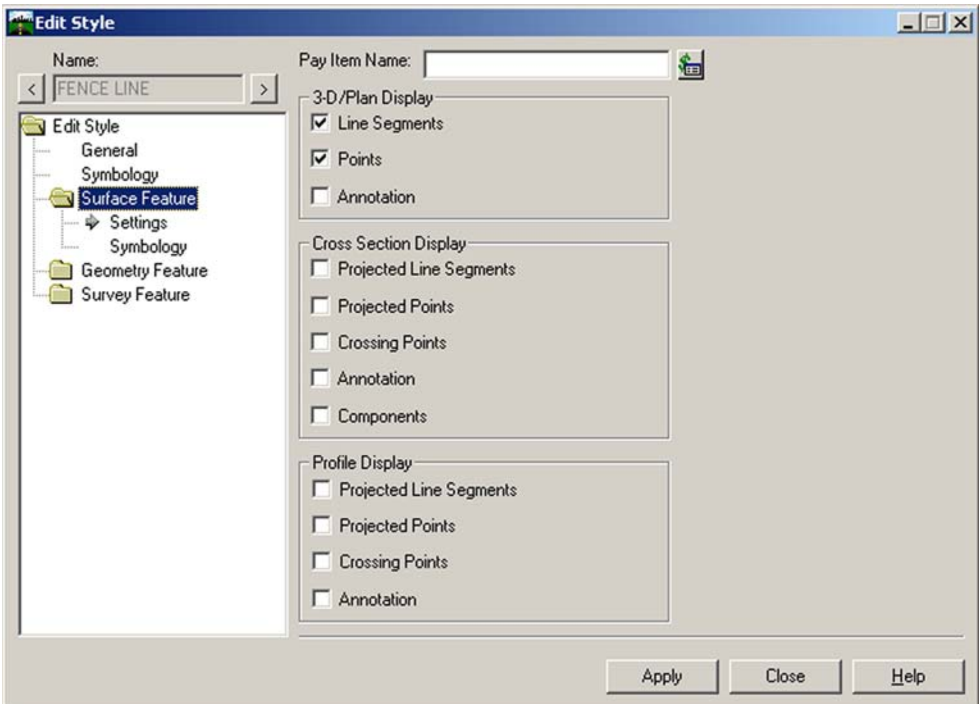
The feature (defined in the DTM) is linked to a surface feature. The surface feature defines where a feature is displayable. The surface feature also has a link to a *named symbology* that defines the graphical symbology of the feature.

Surface Features are stored in the .xin preference file and are defined using the Style Manager tool (*Tools* > *Style Manager*). The Style Manager dialog box lists all of the available features.



Style Manager dialog box

Select a surface feature name and click Edit or double click on a surface feature name to edit that surface feature.



Edit Style dialog box

The name of the surface feature appears but is not editable in the Edit Style dialog box. To edit a surface feature name, use the Rename button on the Style Manager dialog box.

The Attach Tag option on the *Edit Style > General* leaf defines if a MicroStation tag is attached to the graphic elements displayed in plan view. MicroStation tags are non-graphical information stored with an element. InRoads generates a MicroStation tag that contains the type of feature, its name, and its origin.

The tag data has several uses. First, each graphic element has data associated with it that is easily reviewable using MicroStation tools. Another use of tags is when graphic elements are imported into InRoads. If the graphics have the appropriate tag, InRoads automatically understands pertinent information about the element. For example, if features are displayed graphically and later loaded back into a DTM, InRoads reads the tag data on each element to determine the feature name of the element and its feature type (breakline, random point, …).

Select the Surface Feature branch to view the parameters associated with surface features. There are two leafs under the Surface Features branch.

The symbology leaf specifies the link to a named symbology definition. The named symbology definition stores the symbology (color, weight, and so on) used to display the feature. Existing named symbology definitions are selected from the drop down list. The New and Edit buttons are shortcuts to access the Edit Named Symbology dialog box. The named symbology settings are discussed in more detail below.

The Pay Item parameter on the Settings leaf is an optional attribute that can be assigned to a feature style. If assigned, the Pay Item can be used to select features to be processed or reported on using Feature Filters and XML Reporting. Feature Filters are discussed later.

The remainder of the leaf is divided into three areas; plan, cross section, and profile. Each area includes toggles to specify if and how a feature can be displayed in the respective view orientation.

3-D/Plan Display Parameters

The 3-D/Plan Display area specifies how each feature is displayed in a plan view drawing. There are four parameters as described below.

Line Segments – When enabled, the linear component of the active feature is displayed in the plan view using the View Feature tool. Features with connected points such as breaklines and interior boundaries have a linear component. An example of a linear feature is a fence line.

When disabled, linear features are not displayed in the plan view.

Points – When enabled, the point component of a feature is displayed in the plan view using the View Feature tool. All features have point components. Random features have a point at each coordinate value. Linear features, such as breaklines, interior boundaries, and exterior boundaries, have point components at each vertex.

When disabled, point features are not displayed in the plan view.

Annotation – When enabled, features are annotated in the plan view using the Annotate Feature tool.

When disabled, features are not annotated.

EXERCISE: DISABLE PLAN VIEW FEATURE DISPLAY

Continue from the previous exercise.

1 Select the **Style Manager** tool (*Tools* > *Style Manager*).

2 Locate and select the *FENCE LINE* feature.

3 Click **Edit**.

The Edit Style dialog box appears.

4 Select the *Surface Features* > *Settings* leaf.

5 Disable the **Line Segments** parameter in the 3-D/Plan Display area.

6 Click **Apply**.

7 Click **Close** to close the Edit Style dialog box.

8 Click **Close** to close the Style Manager dialog box.

9 Delete all graphics in the CAD file.

10 Use the **View Features** tool to view all features in the *Survey* surface.

None of the fence features are displayed. The fence features were the yellow lines using the diamond line style.

The fence lines are no longer displayed because the ability for them to display was disabled in the feature style.

11 Close the View Features tool.

EXERCISE: ENABLE PLAN VIEW FEATURE DISPLAY

Continue from the previous exercise.

1 Select the **Style Manager** tool (*Tools* > *Style Manager*).

2 Locate and select the *FENCE LINE* feature style.

3 Click **Edit**.

The Edit Feature Style dialog box appears.

4 Select the *Surface Features* > *Settings* leaf.

5 Enable the **Line Segments** parameter in the 3-D/Plan Display area.

6 Enable the **Points** parameter in the 3-D/Plan Display area.

7 Click **Apply**.

8 Click **Close** to close the Edit Feature Style dialog box.

9 Click **Close** to close the Feature Style Manager dialog box.

10 Use the **View Features** tool to update all features in the *Survey* surface.

The fence features appear because the ability for them to display has been enabled again in the feature style. In addition, a red circle appears at each vertex along the fence features. The red circles appear because the ability to display points in the plan view is now enabled in the feature style.

11 Close the View Features tool.

Annotate Feature

The Annotate Feature tool (*Surface* > *View Surface* > *Annotate Feature*) places annotation text at feature points and along linear features. However, before a feature can be annotated, the annotation parameter must be enabled in the feature style.

The Annotate Feature tool has several options specifying what (north coordinate, east coordinate, elevation, feature name, and so on) gets annotated and where the annotation is located relative to the feature.

EXERCISE: ANNOTATE FENCE LINE FEATURE

Continue from previous exercise.

1 Select the **Annotate Feature** tool (*Surface* > *View Surface* > *Annotate Feature*).

2 Select the **Main** tab.

3 In the **Surface** field, select *Survey*.

4 Browse through the feature list.

Notice that all of the features in the surface are listed. However they are all dimmed and unavailable.

The features are all unavailable because the Annotate parameter in the feature style linked to each of the features is disabled.

5 Locate and select a feature using the *FENCE LINE* feature style.

6 Click **Edit Style**.

The Edit Style dialog box appears. The Edit Style button is a shortcut to the Style Manager.

7 Enable the **Annotate** parameter in the *3-D/Plan Display* area.

8 Click **Apply** on the Edit Style dialog box.

9 Click **Close** on the Edit Style dialog box.

10 Browse through the feature list again.

Notice the FENCE LINE features are now black and available for annotation. All four of these feature names are linked to the FENCE LINE feature style.

11 Select the four features that use the *FENCE LINE* feature style.

12 *Disable* the **Line Segments** parameter.

13 *Enable* the **Points** parameter.

The Points and Line Segments tabs define what attributes are included in the annotation and where they are position relative to the feature. For this exercise we will accept the defaults.

14 Click **Apply**.

Each vertex in the fence feature is annotated with its station, offset and elevation.

15 Close the Annotate Feature tool.

Profile Display Parameters

The *Surface Features > Settings > Profile Display* area on the Edit Style dialog box specifies how each feature style is displayed in a profile view drawing. There are four parameters as described below.

Projected Line Segments – When enabled, the linear component of the active surface feature is displayed in the profile view using the Create Profile and Update Profile tools. Features with connected points such as breaklines and interior boundaries have a linear component. An example of a linear feature is a water line feature.

By default, all enabled features are projected onto the profile no matter how far the feature is located from the profile centerline. However, the Create Profile and Update Profile tools both have the ability to restrict the features that are projected onto the profile by specifying a bandwidth. Only those features inside the bandwidth are projected onto the profile.

When disabled, linear features are not displayed in the profile view.

Projected Points – When enabled, the point component of a feature is displayed in the profile view using the Create Profile and Update Profile tools. All features have point components. random features have a point at each coordinate value. Linear features, such as breaklines, interior boundaries, and exterior boundaries, have point components at each vertex.

By default, all enabled features are projected onto the profile no matter how far from the profile centerline the feature is located. However, the Create Profile and Update Profile tools both have the ability to restrict the features that are projected onto the profile by specifying a bandwidth. Only those features inside the bandwidth are projected onto the profile.

When disabled, point features are not displayed in the profile view.

Crossing Points – When enabled, a point element is created in the profile at the location where a linear feature crosses the profile.

When disabled, the point element is not created at the location where a linear feature crosses the profile.

Annotation – When enabled, features can be annotated in the profile view using the Annotate Features in Profile tool.

When disabled, features cannot be annotated.

EXERCISE: CREATE PROFILE WITH FEATURES

Continue from the previous exercise.

1 Zoom out the graphics so there is room above the planimetric data to draw a profile.

2 Select the **Create Profile** tool (*Evaluation* > *Profile* > *Create Profile*).

3 Select the *Profile* > *General* leaf.

4 *Enable Existing Ground, Disable all other surfaces*

5 Select the *Profile* > *Source* leaf.

6 Set the following parameters.

Create: *Window and Data*

Source: *Alignment, Mainline*

7 Select the *Profile* > *Include* leaf.

8 *Enable* the **Projected Features** parameter.

9 Click **Apply**.

10 Locate the lower left corner of the profile above the left end of the planimetric graphics and click the data button.

The profile is generated.

The dashed green line is the triangulated surface of the model. The blue line is the projected water line feature.

11 Click **Close**.

Cross Section Display Parameters

The Cross Section Display area specifies how each feature can be displayed in a cross section. There are five parameters as described below.

Projected Line Segments – When enabled, the linear component of the active surface feature is displayed in the cross section. Features with connected points such as breaklines and interior boundaries have a linear component. An example of a linear feature is a water line feature.

By default, all enabled features are projected onto the cross section no matter how far the feature is located from the centerline. However, the Create Cross Section and Update Cross Section tools both have the ability to restrict the features that are projected onto the cross section by specifying a bandwidth. Only those features inside the bandwidth are projected onto the cross section.

When disabled, linear features are not displayed in the cross section.

Projected Points – When enabled the point component of a linear feature is displayed in the cross section at the location where the feature intersects the cross section using the Create Cross Section and Update Cross Section tools.

When disabled, linear features intersecting the cross section are not displayed.

Crossing Points – When enabled, a point element is created in the cross section at the location where a linear feature crosses the cross section.

When disabled, the point element is not created at the location where a linear feature crosses the cross section

Annotation – When enabled, features can be annotated in the cross section using the Annotate Cross Section tool.

When disabled, features are not annotated.

Components – When enabled, surface components created by the Roadway Designer can be displayed in the cross sections.

EXERCISE: CREATE CROSS SECTIONS WITH FEATURES

Continue from the previous exercise.

1 Zoom out the graphics so there is room to the right of the planimetric data to draw cross sections.

2 Select the **Create Cross Section** tool (*Evaluation > Cross Section > Create Cross Section*).

3 Select the *General* leaf.

4 Set the following parameters.

Create: *Window and Data*

Interval: *25*

Offset Left: **-***50*

Offset Right: *50*

Surfaces: *Enable Existing Ground, Disable all other surfaces*

5 Select the *Source* leaf.

6 Set the source Alignment to *Mainline.*

7 Select the *Include* leaf.

8 *Enable* the **Crossing Features** parameter.

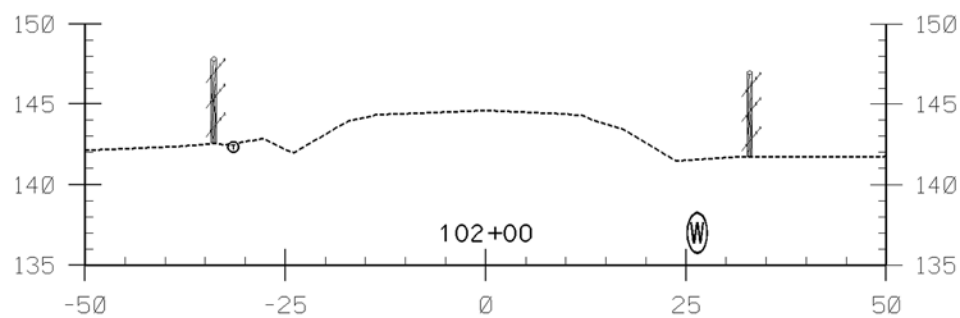
9 Click **Apply**.

10 Locate the lower left corner of the cross sections to the right of the planimetric graphics and click the data button.

The cross sections are created.

11 Click **Close**.

12 Zoom in on the cross sections and review the results. Notice the fence symbol at the location of the existing fence line, the water line symbol, and the telephone line symbol.



Cross Section showing fence, telephone line, and water line features

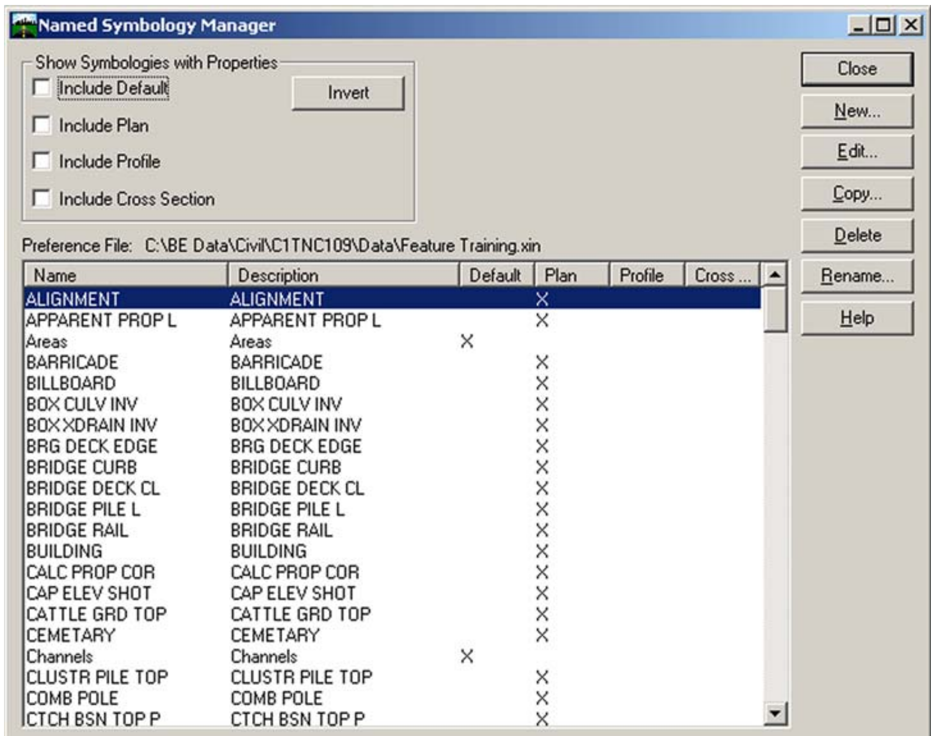
Did you notice InRoads ability to represent a feature differently in each of the views?

The water line is drawn in the plan, profile, and cross section views. In the plan and profile views it is a line string and in the cross section it is a oval. The fence line and the telephone line also differ between the plan view and the cross section view.

Named Symbology

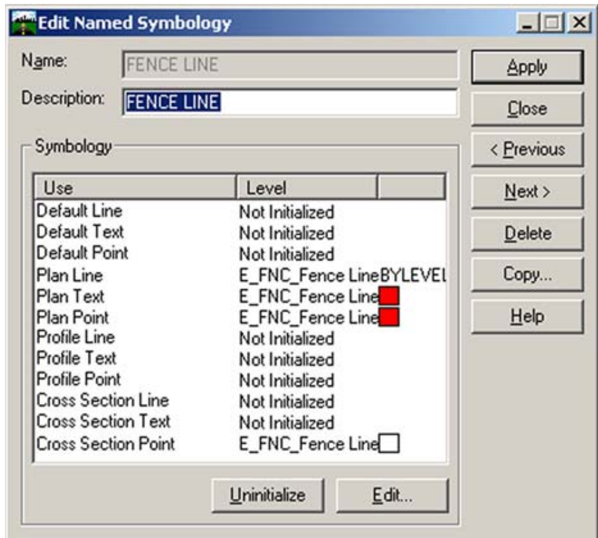
So far we have learned how the feature name is stored in the DTM (surface) and linked to the surface feature. The surface feature then defines which components of the feature are displayable in the plan, profile, and cross section views. The final piece to the puzzle is how the graphic symbology is defined. The symbology is defined using a named symbology.

The named symbology definitions are stored in the .xin preference file along with the surface and survey features. Named symbology definitions are created and edited using the Named Symbology Manager tool (*Tools > Named Symbology Manager*).



Named Symbology Manager dialog box

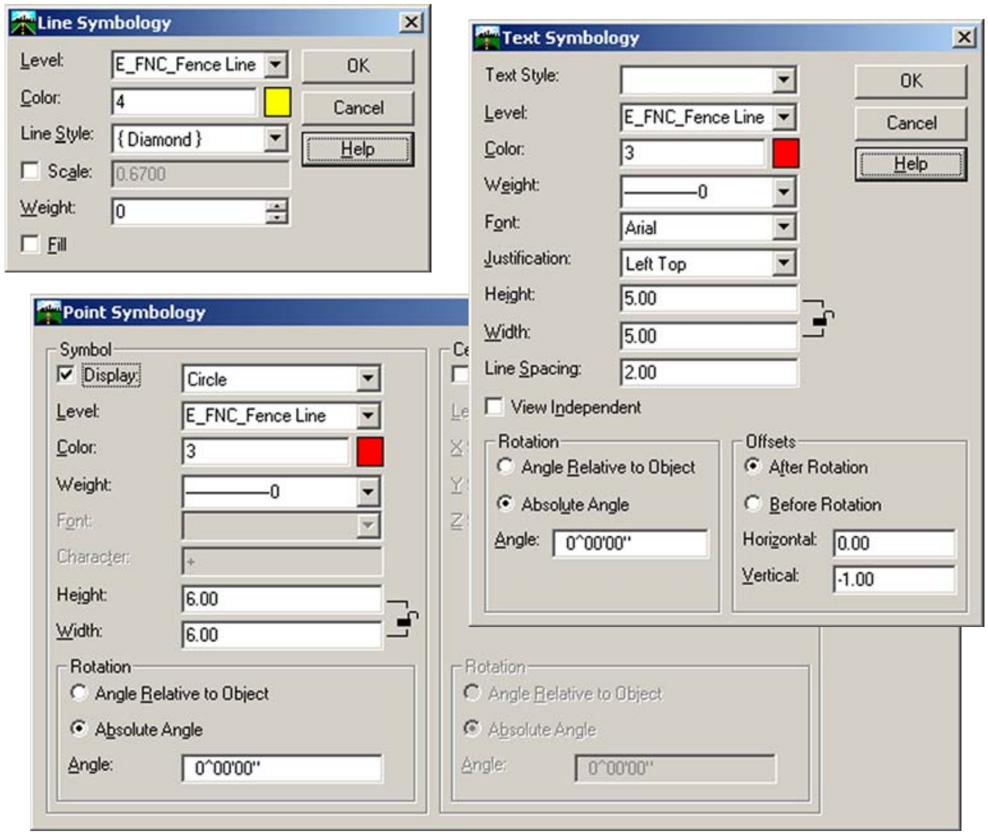
Select a named symbology and click Edit, or double click on the named symbology to access the Edit Named Symbology dialog box.



Edit Named Symbology dialog box

The named symbology definition is separated into 12 categories. The definitions are grouped into four sub categories; Default, Plan, Profile, and Cross Section. Within each sub categories is a definition for Lines, Text, and Points.

Double clicking on any category opens a dialog box where appropriate symbology settings are defined. For example, the Line settings define level, color, weight, and line style. The Text settings include font and other text parameters. The Point symbology settings define how a point is displayed. Points are displayable as cells, symbol fonts, or several built in shapes.



When an InRoads tool draws graphics, it looks to the named symbology category that most closely matches the type of graphics being drawn. InRoads first attempts to locate the symbology using the Plan, Profile, or Cross Section definitions. If the appropriate definition (line, text, or point) exists it is used. However if the definition is set to “Not Initialized”, it then reverts to the Default category. If the Default category is also “Not Initialized”, no graphics are created.

For example, when plotting an intersecting feature on a cross section, InRoads first looks to the Cross Section Point definition. The symbology in this definition is used if it exists. If the definition is “Not Initialized”, InRoads reverts to the Default Point definition and uses the symbology defined there. If the Default Point definition is also “Not Initialized”, no graphics are created.

EXERCISE: CHANGE FEATURE ANNOTATION SYMBOLOGY

Continue from the previous exercise.

The goal of this exercise is to update the feature annotations put on the fence feature in an earlier exercise to the color red.

1 Zoom into the graphics so you can easily see the fence feature and the associated annotations.

2 Select the **Named Symbology Manager** tool (*Tools > Named Symbology Manager*).

3 Locate and select the *FENCE LINE* named symbology.

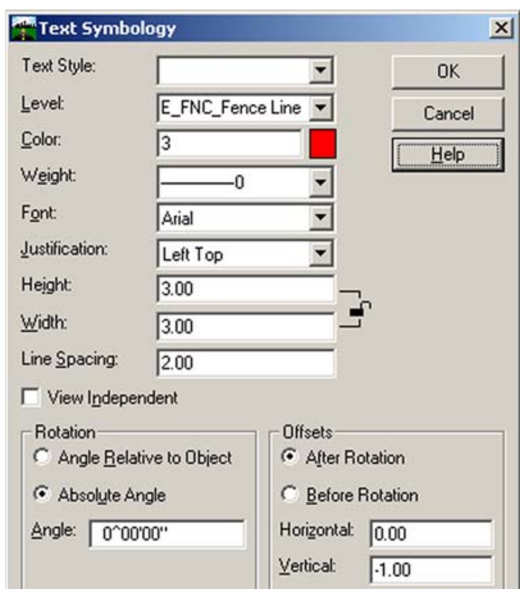
The fence feature is linked to the FENCE LINE feature style that is in turn linked to the FENCE LINE named symbology. Therefore, updating the FENCE LINE named symbology will influence the FENCE LINE feature.

4 Click **Edit**.

The Edit Named Symbology dialog box appears.

5 Double click on the **Plan Text** definition.

The Text Symbology dialog box appears.



Text Symbology dialog box

6 Set **Color** to *Red*.

7 Click **OK** to close the Text Symbology dialog box.

8 Click **Apply** on the Edit Named Symbology dialog box.

9 Click **Close** on the Edit Named Symbology dialog box.

10 Click **Close** on the Named Symbology Manager dialog box.

11 Select the **Annotate Feature** tool.

12 Click **Apply**.

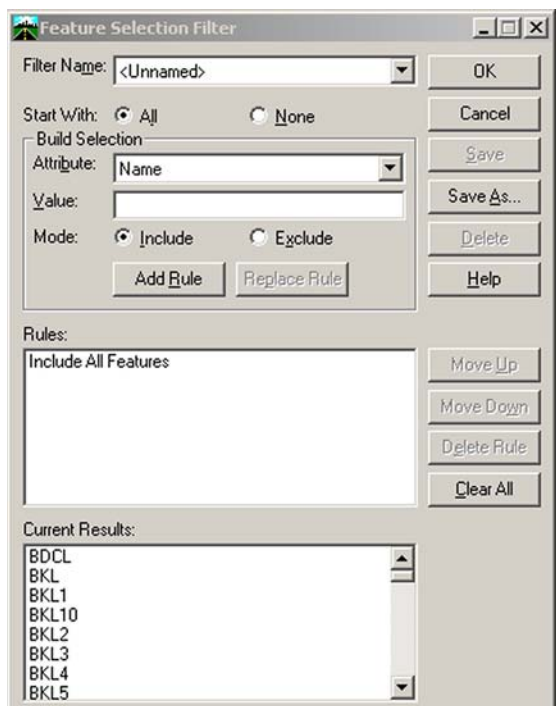
The fence line features update to a red color.

13 Click **Close**.

Feature Filter

Feature filters are selection sets of features based on a set of rules. The purpose of feature filters is to limit the features avilable to InRoads tools. When a feature filter is active, the InRoads tools will only display and operate on those features that satisfy the feature filter, not all of the features in the surface.

Feature filters are defined with the Feature Selection Filter tool (*Surface > Feature > Feature Selection Filter*).



Feature Selection Filter dialog box

The filter is defined by including or excluding features by creating rules. Each rule states that features satisfying a particular attribute, such as feature name, feature description, feature style, and feature type, are either included or excluded in the filter.

As rules are added to the filter, they are listed in the Rules section of the dialog box. The Current Results portion of the dialog box shows which features in the active surface satisfy the active filter.

ⓘ The order of the rules is significant. The rules are processed from top to bottom, and the first rule is always determined by the Start With parameter. The Start With parameter defines if all features are included or excluded from the filter before any rules are applied.

Feature filters can be saved and recalled later for use with most of the InRoads tools that operate on features.

Although any number of filters can be saved, there is only one active feature filter at a time. The active filter is set using the Filter Name parameter on the Feature Selection Filter dialog box or the Filter list on the Locks toolbar. The filter list is the pick list on the left end of the toolbar.

Locks toolbar

Feature filters work in conjunction with the Feature Filter Lock. The Feature Filter Lock is the leftmost lock on the Lock toolbar. When the Feature Filter Lock is enabled, only the features that pass the active feature filter are listed in dialog boxes. In addition, only features that satisfy the feature filter can be located in the graphics file when using a target button. If the Feature Filter Lock is disabled, InRoads behaves as if there is no feature filter defined.

EXERCISE: CREATE A FEATURE FILTER

Continue from the previous exercise.

This exercise builds a feature filter that includes only features that are not part of the triangulated surface model.

1. Delete all existing planimetric elements in the graphics file.
2. Select the **Feature Selection Filter** tool (*Surface* > *Feature* > *Feature Selection Filter*).
3. Set the **Start With** parameter to *None*.

The filter will start with no features and add only those features that satisfy the rules.

4 Select *Exclude from Triangulation* from the **Attributes** field.

5 Set the **Value** parameter to *True*.

6 Set the **Mode** parameter to *Include*.

7 Click **Add Rule**.

The Current Results list updates showing the features that satisfy the filter.

8 Click **Save As**.

9 In the **Name** field, enter *DNT Features*.

10 Click **OK**.

11 Click **OK** to close the Feature Selection Filter dialog box.

The new filter is automatically set as the active filter.

EXERCISE: DRAW FEATURES WITH FEATURE FILTER

Continue from the previous exercise.

1 *Enable* the **Feature Filter Lock**.

2 Select the **View Features** tool.

The list of features in the dialog box is automatically restricted to those features that pass the active feature filter.

3 Enable and disable the Feature Filter Lock and observer how the list of available features changes in the dialog box.

4 Make sure the **Feature Filter Lock** is *enabled* before continuing.

5 Click **Apply**.

The features that satisfy the feature filter lock display.

6 Click **Close**.

7 *Disable* the **Feature Filter Lock**.

ⓘ Most dialog boxes that use features include a button named Filter. The Filter button is a shortcut to the Feature Selection Filter tool.

Creating a DTM

In many workflows, the raw survey data is not available. Therefore, the DTM cannot be created as described in the previous chapter. Instead, the terrain data may be available in a graphical or an ASCII text format.

InRoads includes several import options to create surfaces from data sources other than raw survey data.

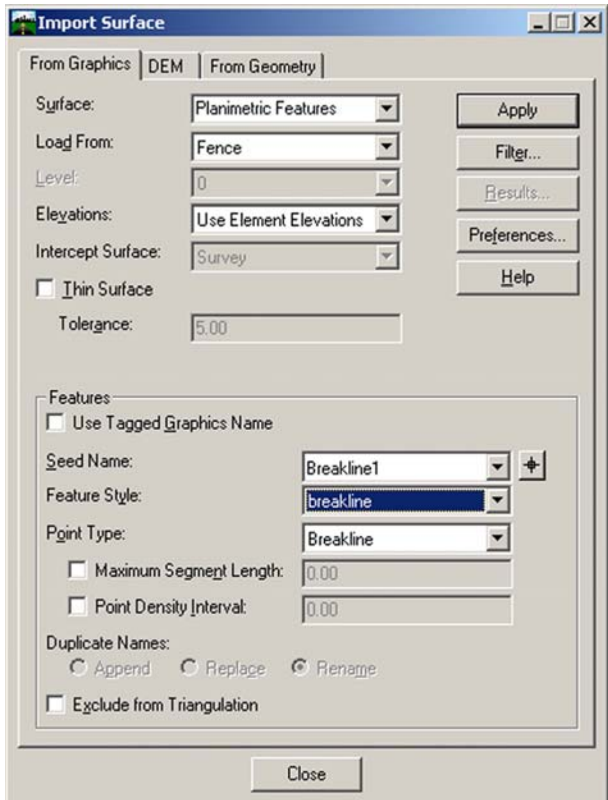
The Import Surface tool (*File* > *Import* > *Surface*) is used to import non-ASCII data into a DTM. The dialog box has three tabs across the top corresponding to the three types of non-ASCII data that can be imported.

All of the methods are similar in specifying the feature parameters such as name, type, and style. The Import from Graphics tool is described below.

The Text Import Wizard tool (*File* > *Text Import Wizard*) is used to import ASCII data into a DTM. This course does not discuss the Text Import Wizard tool.

From Graphics

The Import Surface tool, From Graphics tab, is use to import graphical elements into an InRoads DTM.



Import Surface from Graphics dialog box

Using this tool, graphical elements are loaded as features into a surface. Once all of the features are loaded, the surface is triangulated. Each of the parameters on the dialog box is discussed below.

Surface – Name of the surface the features are loaded into. The surface must exist prior to using the import tool.

Load From – The graphic elements to be loaded are selected as a single element, all elements on a level, or all elements inside a fence. A selection set can also be used. When the parameter is set to single element and a selection set exists, the elements in the selection set are loaded automatically.

Elevations – Specifies how the elevations of the imported graphics are defined. The *Use Element Elevations* option uses the elevations from the imported graphics.

The *Use Text* options causes InRoads to read the value of the text as the elevation of the feature.

Finally, when additional features are being added to an existing surface that has been previously triangulated, the imported feature can be draped onto the existing surface to determine the elevations. This is done using the *Drape Surface* option.

Thin Surface – When enabled, the thinning algorithm checks the deflection angle between the consecutive line segments of the input element. If the deflection angle is less than the specified tolerance value, the middle point is discarded.

Use Tagged Graphics Name – When enabled the import process reads the feature style and point type from the tag data if the graphics being imported are tagged with the InRoads feature tag (inciv_ftr). If the graphics do not have tag data, or this parameter is disabled, the feature style and point type are defined by the respective fields on the dialog box.

Seed Name – The seed name is the feature name that is created in the surface model for each imported graphic element. However, since more than one graphic element is typically loaded at a time, this parameter specifies the base name of the feature. InRoads automatically appends a sequential number to the end of the base name thus making each feature name unique.

Feature Style – The name of the surface feature style that the imported features are linked to.

Point Type – The type of feature (breakline, random, …) that the imported feature is stored as in the surface.

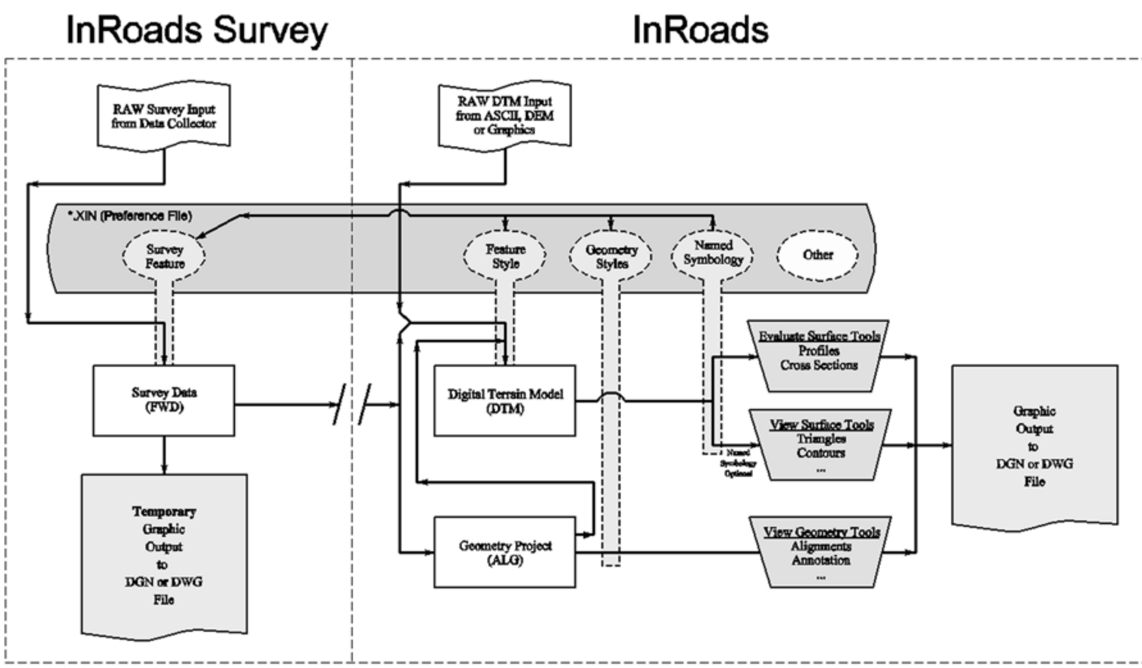
Maximum Segment Length – When enabled, specifies the maximum segment length any linear feature can have between two vertices. If the segment length exceeds the defined value, additional vertices are automatically added along the segment until the segment length is below the maximum allowed length. If disabled, any segment length is allowed.

Point Density Interval – Specifies the maximum length of any triangle leg generated from the feature. If enabled, additional vertices are added until the triangle leg length is below the specified density interval. If disabled, no additional vertices are added.

Exclude from Triangulation – When enabled, the feature is loaded into the surface but is not included in the triangulation process.

Summary

The following diagram summarizes the flow of data and feature elements through the InRoads and InRoads Survey software.



Summary of flow of InRoads DTM data and related feature definitions

4 Using Features in Design

Features are a major component of the InRoads design process, especially when using more advanced design techniques.

In this chapter you will:

- Learn how Roadway Designer uses features.

Roadway Designer

The Roadway Designer creates surface models of the design roadway surface. As we learned earlier, all data stored in a surface must exist in features. Therefore, the Roadway Designer creates features.

The features created by the Roadway Designer are named based on the Point Names assigned in the template definition. Template Points are definitions that include a name and a link to a feature style.

When the results of the Roadway Designer are saved to a surface, the point names become the name of linear features in the surface. The features run parallel to the roadway connecting matching template points from one template drop station to the next. For example, a linear feature is created for each lane line, the edge of pavement, ditch foreslopes, ditch bottoms, and so on.

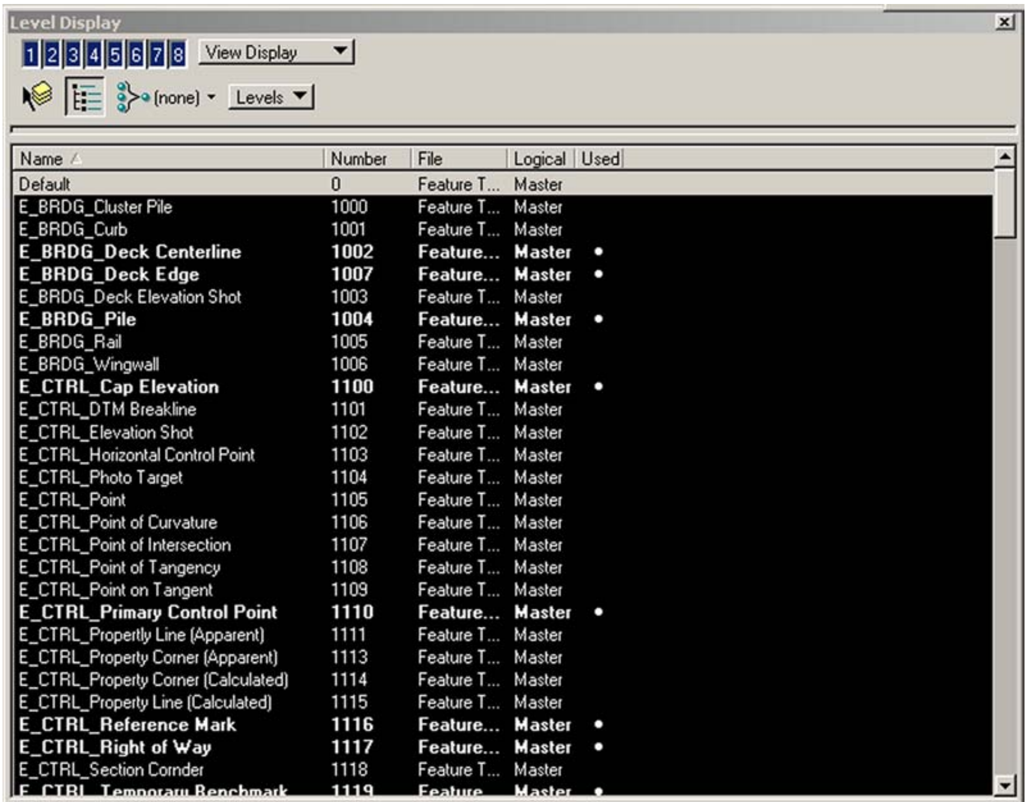
Recall that the feature style links to a named symbology that defines the graphical appearance of the feature when displayed in the graphics file. Therefore, the point names control how each segment in the template is stored in the surface model and displays in the graphics file.

EXERCISE: DISABLE DISPLAY OF EXISTING FEATURES

Continue from previous exercise.

Before beginning any design, we will toggle the display of the existing features off so that they do not interfere with the design graphics

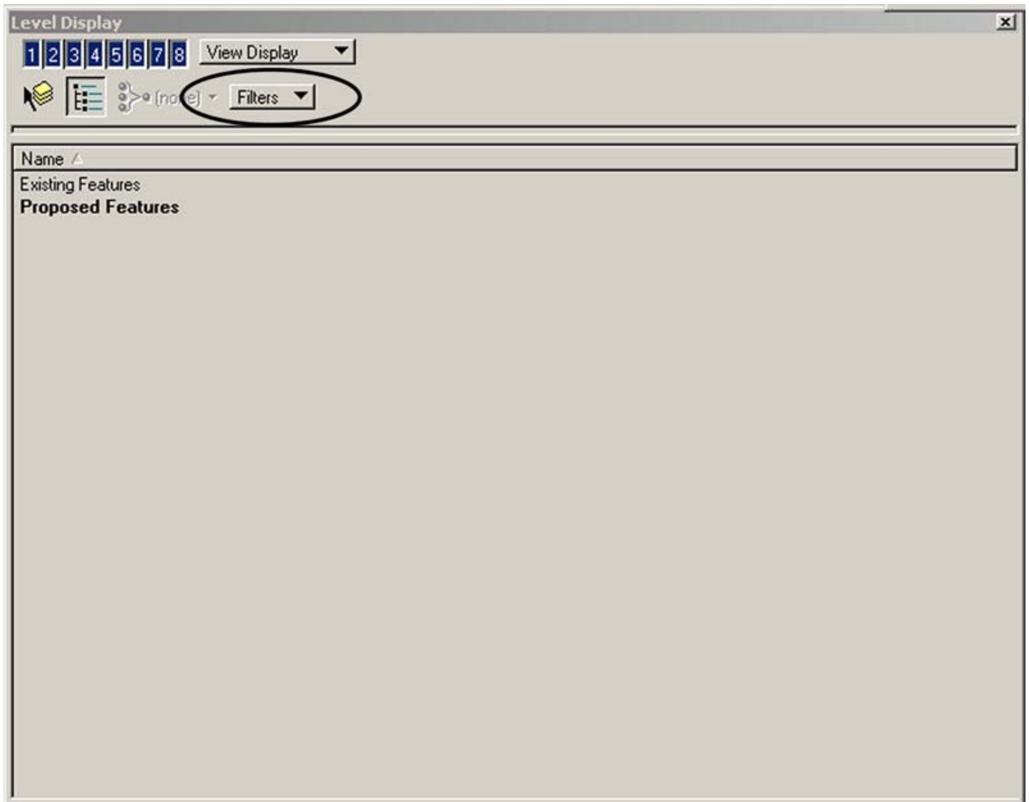
1 Select the **Level Display** tool (*Settings* > *Level* > *Display* on the MicroStation menu).



The introduction of unlimited named levels in MicroStation V8 is a great improvement that permits organizations to better implement their standards. However, having a great deal of levels also makes it difficult to enable or disable the display of individual levels. For example, the file in this exercise has over 200 levels. Locating and disabling the display of levels one at a time would be too time consuming to be practical.

To address this problem, MicroStation V8 includes level filters.

2 Set the Show Level option button near the top of the Level Display dialog box to Filters. The result is the following dialog box.



The lab file includes two filters, one for the Existing Features and another for the Proposed Features. Enabling or disabling the level filter enables or disables the display of all levels that belong to the level filter.

3 **Enable** the *Proposed Features* filter.

4 **Disable** the *Existing Features* filter.

The graphic display updates to show only the proposed features. The proposed featuers include the profile and cross section elements.

5 Close the **Level Display** dialog box.

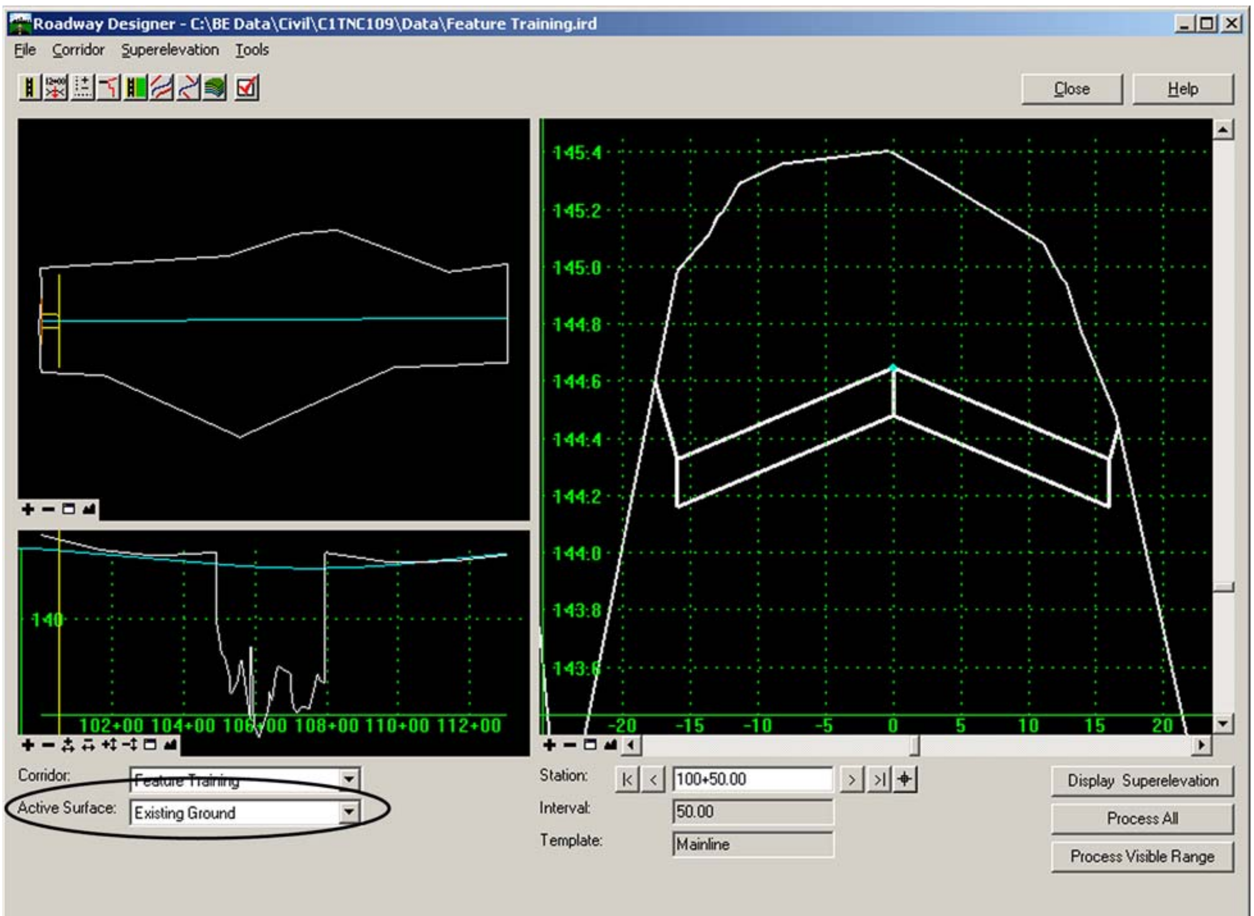
EXERCISE: ROADWAY MODELER

Continue from the previous exercise.

1 Select the **Roadway Designer** tool (*Modeler > Roadway Designer*).

The Corridor has already been setup with the correct template and template drops.

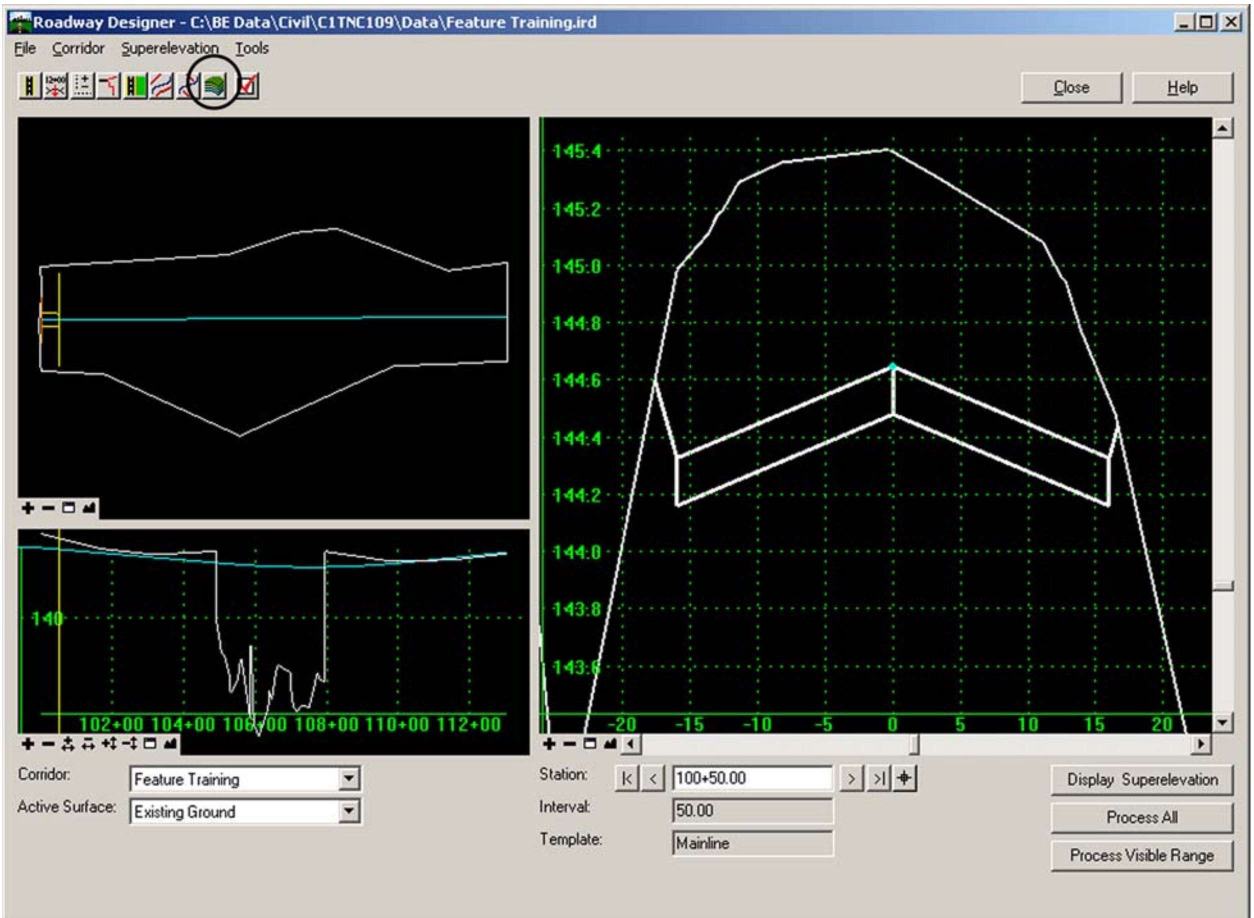
2 Verify that the **Active Surface** is to *Existing Ground.*



Roadway Designer Active Surface definition

3 Click **Process All** to create the proposed road design.

4 Click **Create Surfaces** to save the proposed road design to a surface.



The Create Surface dialog box appears.

5 Set the following parameters.

Name: *Design*

Default Preference: *Proposed*

Empty Design Surface: *Enabled*

Add Exterior Boundary - Style: *Enabled, Exterior Boundary*

Triangulate: *Enabled*

Display Features in Plan View: *Enabled*

All Other Settings: *Disabled*

6 Click **Apply**.

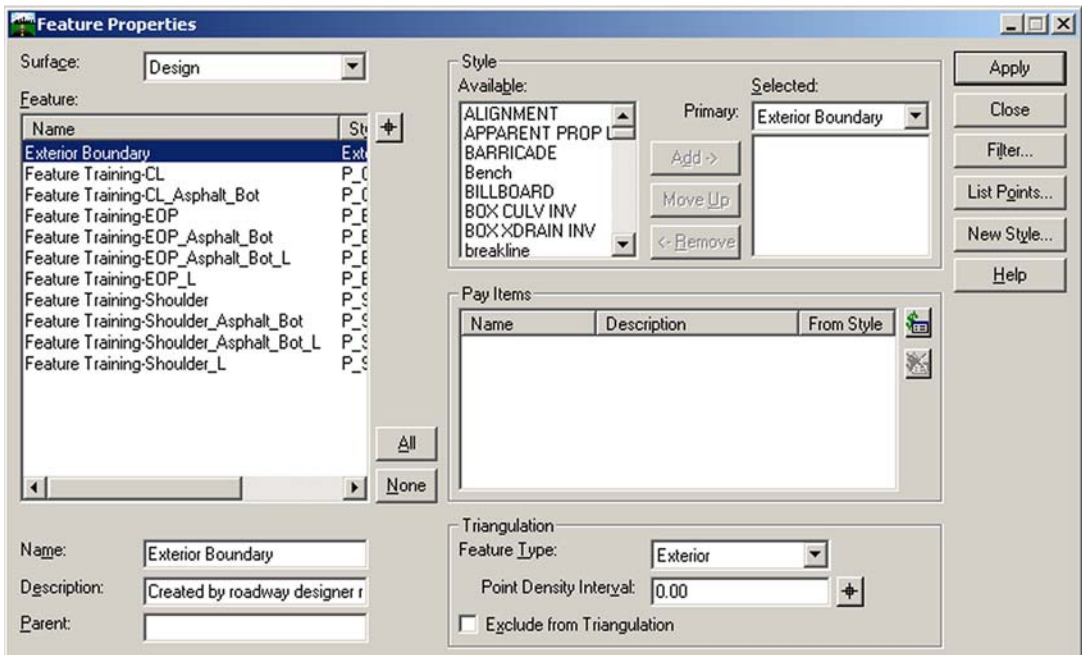
The surface Design is created.

7 Close the **Create Surface** dialog box.

8 Close the **Roadway Designer**.

9 Select the **Feature Properties** tool.

10 Select *Design* from the **Surface** field.



11 Review the features in the surface.

12 Close the **Feature Properties** dialog box.