GEOPAK Site I

Bentley Institute Course Guide

TRC001400-1/0001

BENTLEY INSTITUTE

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CIVIL ENGINEERING SIGN-UP SHEET

Date: _____

Course: _____

Location: _____

Instructor: _____

Attendee: _____

Company: _____

Address: _____

_____

_____

Phone: _____

Fax: _____

Email: _____

Name as you would like for it to appear on training certificate:

_____

Please FAX this sign-up sheet to:

FAX: (305) 948-6290

Bentley/GEOPAK
1190 NE 163rd Street
North Miami Beach, Florida 33162
Attn: Roy Balta

Thank you !

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Course Evaluation

Course Name: Course Dates:

Course Location: Instructor Name:

Student Information

- What is your primary job responsibility?

  _____

- How much experience did you have with GEOPAK prior to attending this course?

  __ Zero __ 1-6 months __ 7-12 months __ 1+ years

- When will you be able to apply what you have learned?

  __ Never __ in 1-6 months __ in 7-12 months __ in 1+ years

- Were you fluent in MicroStation before this course? __ Yes __ No

---

Course Content

1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

- Do you feel that you can successfully apply what you have learned? 1 2 3 4

  Comments _____

  _____

- Will the course materials serve as a good reference in the future? 1 2 3 4
- Were the class materials clear and easy to understand? 1 2 3 4
- Were the exercises clear and easy to understand? 1 2 3 4
- Was the material organized in a way in which promoted comprehension? 1 2 3 4
- Was there sufficient time allotted for exercises? 1 2 3 4
- Was the length of the course sufficient? 1 2 3 4

  Comments _____

  _____

- Which sections of the course were MOST valuable to you?

  _____

  _____

- Which sections of the course were LEAST valuable to you?

  _____

  _____

- Overall, did this course meet your expectations? 1 2 3 4

  What expectations did you have that were not met?

  _____

  _____

(OVER PLEASE)

Instructor

- Was the instructor well prepared? __ Yes __ No
- Was the instructor organized? __ Yes __ No
- Did the instructor explain concepts clearly? __ Yes __ No
- Did the instructor explain concepts completely? __ Yes __ No
- Did the instructor clearly state the objectives of the course? __ Yes __ No
- Did the instructor fully cover the objectives of the course? __ Yes __ No
- Did the instructor have a sound and thorough knowledge of the courseware? __ Yes __ No
- Did the instructor have a sound and thorough knowledge of the exercises? __ Yes __ No
- Did the instructor answer questions completely? __ Yes __ No
- Would you take another class from this instructor? __ Yes __ No

What is your overall rating of this instructor?

Excellent Good Average Below Average Poor

Additional Instructor Comments:

_____

_____

General Feedback

- Your training experience with GEOPAK is important to us. Please feel free to offer additional comments, recommendations or suggestions on any aspect of this course.

_____

_____

_____

_____

How would you rate your overall GEOPAK training experience?

Excellent Good Average Below Average Poor

Please FAX this evaluation form to:

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Thank you !

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EDITING WITH SITE MODELER

DRAINAGE DESIGN

WATER AND SEWER

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PLANS PREPARATION

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1 Site Design with GEOPAK

COURSE OBJECTIVES

GEOPAK Site is a fully functional 2D/3D modeling software, suitable for design projects ranging from Subdivisions, Apartment Complexes, Retail & Urban Complexes, to Commercial and Manufacturing Sites, Municipal Facilities, and Golf Courses, Parks and Recreation Areas. The major benefit of GEOPAK Site is the ease with which you can create and revise your designs.

During the Training we will explore the comprehensive set of civil engineering tools for development of sites: survey data management, COGO point management, site modeling, volume earthwork analysis, drainage design, plans preparation, and quantity takeoffs. Based on MicroStation, the software combines site design tools with familiar MicroStation commands to provide a truly integrated solution for creation and manipulation of your designs.

Using GEOPAK's unique, interactive approach to design, we will rapidly create several design objects, such as buildings and parking lots created with MicroStation applications, and incorporate these into the design. As the design is developed we will quickly be able to explore alternative design scenarios and edit working drawings using powerful, visual site modeling. We will look at some of the unique capabilities of the software designed to enhance productivity like drag-and-drop terrain editing. Once a feature is moved, the terrain model regenerates automatically. When the design is complete we will be able to export design information to a variety of sources.

GETTING STARTED

GEOPAK Site is fully integrated with MicroStation. Therefore, each and every MicroStation function can be used in conjunction with each and every GEOPAK tool.

In order to start the GEOPAK software one needs to simply access a MicroStation design file (.dgn) by traditional methods. To verify that GEOPAK is loaded, scan the MicroStation Menu Bar and look for an Applications pull down menu.

To activate GEOPAK simply access the *Applications* menu and select *GEOPAK* > *Activate* GEOPAK. By doing so you will now have access to all available tools from GEOPAK. Subsequent MicroStation sessions will automatically activate GEOPAK.

Now to see the list of GEOPAK Site tools access the *Applications* menu again and select **GEOPAK SITE**. Then select the desired tool.

To utilize the full potential of GEOPAK, usage of the GEOPAK dialogs may be interspersed with generic MicroStation commands. In addition, numerous dialogs may be opened simultaneously. To close most dialogs, one can simply click on the "X" in the upper right corner of the dialog. Exiting the MicroStation design file automatically closes all GEOPAK dialogs.

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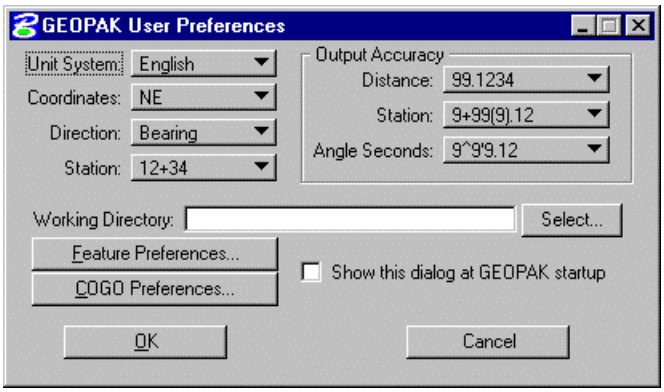
GEOPAK USER PREFERENCES

To provide maximum flexibility to the designers, GEOPAK provides numerous system parameters to allow the user to easily set or change the formats of decimals, stations, coordinates, units, etc. These parameters are utilized by many of the GEOPAK functions and can be changed at anytime. The User Preferences dialog can be accessed from Applications > GEOPAK SITE > User Preferences. The following dialog appears.

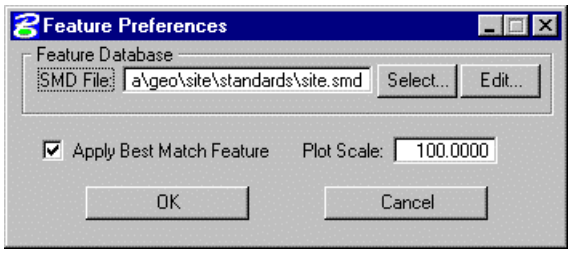
The Working Directory identifies where the data files for a particular project can be found. If a user does not want to work within a specific project, the field may be left blank, and GEOPAK uses the directory wherein the open MicroStation file is located.



FEATURE PREFERENCES

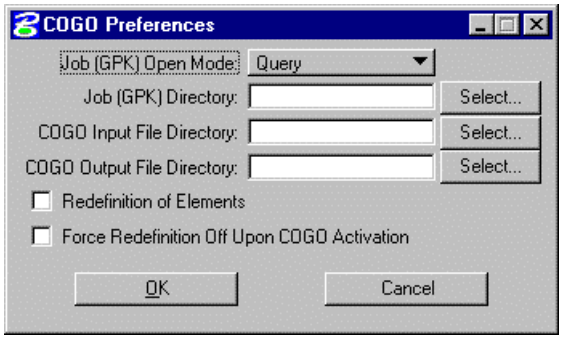
By clicking Feature Preferences, the following dialog is invoked and is utilized when visualizing COGO elements with assigned features. As each element is about to be created, the feature of that element is searched for in the .SMD file.

If a match is found, then the symbology for that feature is used. If a match is not found and there is a feature named "default" in the .SMD file, then the "default" feature symbology is used. If the feature is not found in the .SMD file and no "default" feature is defined in the .SMD file, the current MicroStation symbology is used.



COGO PREFERENCES

By clicking COGO Preferences, the following dialog is invoked. In this dialog, the Redefinition of Elements should be activated if the COGO overwriting feature is desired.



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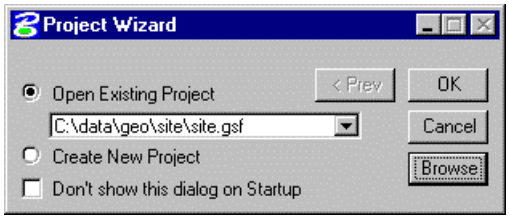
GEOPAK SITE TOOLS

As an alternative to the pull down menus invoking various GEOPAK tools, tool frames and tool boxes are supported within GEOPAK. To activate the tool frame, select Applications > GEOPAK Site > GEOPAK Site Tools. The tool frame is similar to the MicroStation main tool frame. It is not resizable, but dockable. Each icon in the tool frame is a tool box that one can "tear off" to become a "tool box." The individual tool boxes can be docked and resized. There are eight tool boxes, with the following titles:

- Site Modeler
- Design & Computation Manager
- DTM (Digital Terrain Modeling) Surface Tools
- Cross Sections
- Horizontal & Vertical Geometry
- Plans Preparation
- 3D Tools
- Utility

SITE MODELER

The Site Modeler tool box (first column, top row) is depicted has three icons. The left tool invokes the Site Modeler Project Wizard dialog as depicted below. The second tool is the Active Chain Control. The third tool is GPK Attribute tool and is utilized to identify the GEOPAK attributes assigned to an element, if any.



If the bottom toggle is activated, so the Wizard is bypassed, the Site Modeler application menu bar is displayed. An optional tool box is available for all Site Modeler tools and is accessed from the Pull down menu Tool Boxes.

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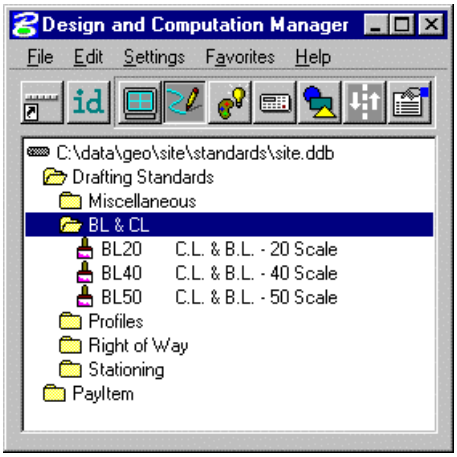
DESIGN AND COMPUTATION MANAGER

The Design and Computation Manager tool box (first column, second row) has two tools.

The Design and Computation Manager (D&C Manager) is a tool that allows the user to standardize graphics elements for drafting and pay item quantities.

The second tool is the Quantity Manager, a database application which manipulates and sorts quantities, creates a variety of reports, and cost estimates.

A hierarchical database is used with the Design and Computation Manager. This database stores information concerning functional classification and display preferences for each feature and item used in a MicroStation file. This file is commonly referred to as the DDB file.



Categories are used to group and classify the features and items used in creating construction drawings. Two common examples of these categories are Pay Items and Drafting Standards. These two categories each contain sub-categories. The sub-categories break down each classification into more specific sections. For example, Pay Items may be broken into several additional categories such as Pipes and Lighting and Signals. Pipes may be broken into many different categories representing various types of pipes and pipe features that may be used in the design of your project like Flared End Sections. Within the category Flared End Sections, the different pay items for flared end sections may be listed.

Each entry represents a specific pay item. These entries are not categories, rather they are called items. Items can be identified by the various icons:

- calculator (quantities calculations)
- paintbrush (draw design elements)
- report icon (default, pavement design, pavement markings, etc.)

The database may also be password protected if desired. This can be used as a security measure to protect the integrity of the database file and ensure its consistent application on a statewide or company wide basis.

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DTM (DIGITAL TERRAIN MODELING) SURFACE TOOLS

The DTM tool box (first column, third row) depicted is a single icon, which invokes the Digital Terrain Modeling tool frame as depicted below.

A Digital Terrain Model (DTM) represents the topography of a project in the form of a triangulated network. The DTM can be drawn in a 2D or 3D file, and then rotated to see the existing surface of the project area.

Digital Terrain Models can be generated from various sources including MicroStation Elements, survey data, photogrammetry data, GEOPAK cross-sections, and geometry data.

Triangulation is a mathematical process applied to stored elevations points and stored elevations along DTM break lines to create surfaces. The result of triangulation is the creation of a TIN file from which existing ground profiles and existing ground cross sections can be generated.

CROSS SECTIONS

The Cross Sections tool box (first column, fourth row) contains six tools. These include (from left to right):

- Cross Section Navigator
- Draw Cross Sections
- Draw Cross Section Tabular Data
- Cross Section Labeling
- Draw Patterns By Station Range
- Draw Patterns From Cross Sections

HORIZONTAL AND VERTICAL GEOMETRY

The Horizontal and Vertical Geometry tool box (second column, first row) consists of nine tools (left to right):

- COGO
- Graphical COGO
- Horizontal Alignment Generator
- VPI Based Vertical Alignment Design Tools
- Component Based Vertical Alignment Design Tools
- Store Graphics
- Auto Store Graphics
- Ground Profiles
- Legal Description Editor

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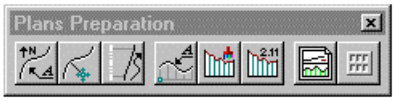
PLANS PREPARATION

The Plans Preparation tool box (second column, second row) contains eight tools (from left to right):



- Plan View Labeling
- DP Station Offset
- Draw Transition
- Profile Labeling
- Draw Profiles
- Draw Profile Tabular Data
- Plan / Profile Sheet Composition
- Tables

DRIVE THROUGH

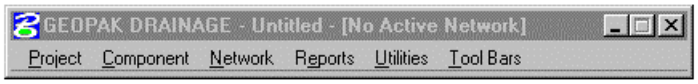
The Drive Through tool box (second column, third row) depicted contains the single tool - Drive Through.

UTILITIES

The Utilities tool box (second column, fourth row) depicted contains two tools - the GEOPAK Text Editor and Geotechnical tools.

ADDITIONAL MODULES

GEOPAK DRAINAGE



GEOPAK Drainage is a comprehensive system for designing and analyzing storm drain systems, which can leverage many roadway design features to create a seamless information exchange to the drainage design process. A GEOPAK Drainage project may contain multiple drainage networks; each comprised of any number of topologically connected drainage areas, inlets, pipes and ditches. The GEOPAK Drainage workflow closely mirrors conventional design processes allowing for the design of the surface collection system (i.e. drainage areas, inlets) then the design of the subsequent conveyance system.

GEOPAK Drainage is extremely flexible, in that the hydraulics designer can create and manipulate elements of the system, while simultaneously seeing the effects. Interactive dialogs and design visualization make the process easy to learn and efficiently produce results. Manipulations and redesign are accomplished quickly and easily, whether it's moving a single inlet or developing an entire network. At any time during the process, customized reports can be generated to provide hard copy outputs.

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Roadway alignments, vertical profile gradelines, and digital terrain models created as part of the design process may be used throughout GEOPAK Drainage to provide pertinent information to drainage design. All drainage components feature interactive graphical placement tools for easy spatial definition of the drainage system. Visualization tools in GEOPAK Drainage for networks, drainage components, and computations all but eliminate the tedium of thumbing through pages of computer output to evaluate whether the system is functioning adequately. The visualization allows for immediate evaluation of the drainage system.

GEOPAK SURVEY

GEOPAK Survey is a comprehensive software package for the collection and processing of survey data for roadway and site projects.

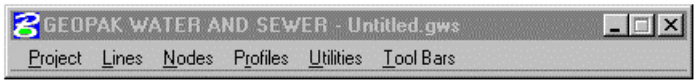
The software is fully integrated with MicroStation CAD software to permit true interactive processing. With GEOPAK, the CAD drawings become one of the records for the project affording true "what you see is what you get" (WYSIWYG) functionality. However, the survey database is a compendium of information stored in double precision accuracy.

The package is full functioned; covering most every aspect of a survey project. Comprehensive tools are available from data collection to the feature / element editing to creation of a DTM. In addition, GEOPAK includes a number of design tools that enhance the right-of-way plans production process. These tools draw labels, produce tables, generate legal descriptions, and perform other tasks that you might normally not expect from a survey software package.

Each component of GEOPAK Survey functions together and interacts with each other. However, there are six primary modes of accessing the software.

- Survey Manager, including powerful processing and editing tools.
- Coordinate Geometry tools.
- Digital Terrain Modeling package.
- Geodetic Conversion tool.
- Interactive tools accessed while editing a MicroStation file including labeling and tabulations.
- Legal Description Editor

WATER AND SEWER



GEOPAK Water and Sewer is extremely flexible, in that the designer can create and manipulate elements of the system, while simultaneously seeing the effects. Interactive dialogs and design visualization make the process easy to learn and can efficiently produce results. Manipulations and redesign are accomplished quickly and easily, whether it's moving a single node or developing an entire system. The Conflict finder tool enables the designer to identify potential problems where sewer, water and utilities conflict.

Roadway alignments, vertical profile gradelines, and digital terrain models created as part of the design process may be used throughout GEOPAK Water and Sewer to provide pertinent information to water and sewer design. All water and sewer components feature interactive graphical placement tools for

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easy spatial definition of the water and sewer system. The visualization allows for immediate evaluation of the water and sewer system.

A Water and Sewer system is composed of two components: nodes and lines:

- Nodes: A node is a point with a defined location. The location may be in Cartesian coordinates (x,y) or in curvilinear coordinates (station, offset).
- Lines: A line represents a linear feature depicting a path connecting two nodes, running from upstream to downstream. The path may be straight line or curvilinear (along any graphics element).

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2 Digital Terrain Modeling

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- Extraction of input data
- Generating a triangulated irregular network (TIN) model
- Displaying and drawing TIN features
- Analysis tools

INTRODUCTION

GEOPAK offers Digital Terrain Modeling components that employ advanced state-of-the-art algorithms and are rich in functionality. GEOPAK DTM features are not limited to triangulated models. Features include: lattice models, contours, interactive editing of TIN files, integrated pads, merged models, surface-to-surface volumetric analyses, thematic analyses, drainage tools, and various utilities.

The GEOPAK DTM tools frame can be accessed by selecting the DTM tool from the GEOPAK Site tool frame or from the pull down menu Applications > GEOPAK Site > DTM Tools.

The DTM Menu tool box (first column, top box) is a single tool, which invokes the GEOPAK DTM menu bar as depicted below.

EXTRACTION OF INPUT DATA

Digital Terrain Models can be generated from a wide range of data sources including MicroStation elements, survey data, ASCII data and GEOPAK cross sections. An Extract utility is included to facilitate the retrieval and formatting of MicroStation graphical elements. These elements can be classified as contours, random points, break lines, voids, islands, and boundary points.

One of the GEOPAK Extract utilities analyzes the MicroStation elements and formulates interpretations. For example, 2D circular arcs can be segmented with elevations interpolated from spot elevations located on the circular arcs and/or upon adjacent elements. Text strings can be interpreted in terms of either the text origin or in terms of the value represented by the text string. A "765.71" text string can be interpreted such that the X and Y coordinates are derived from the origin of the text string and the elevation derived from the "765.71" value represented by the text string.

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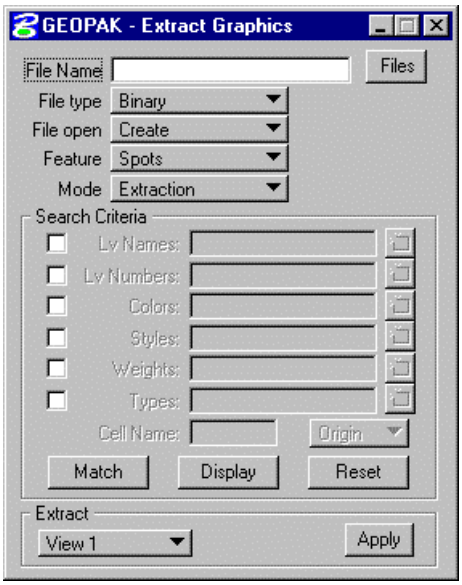
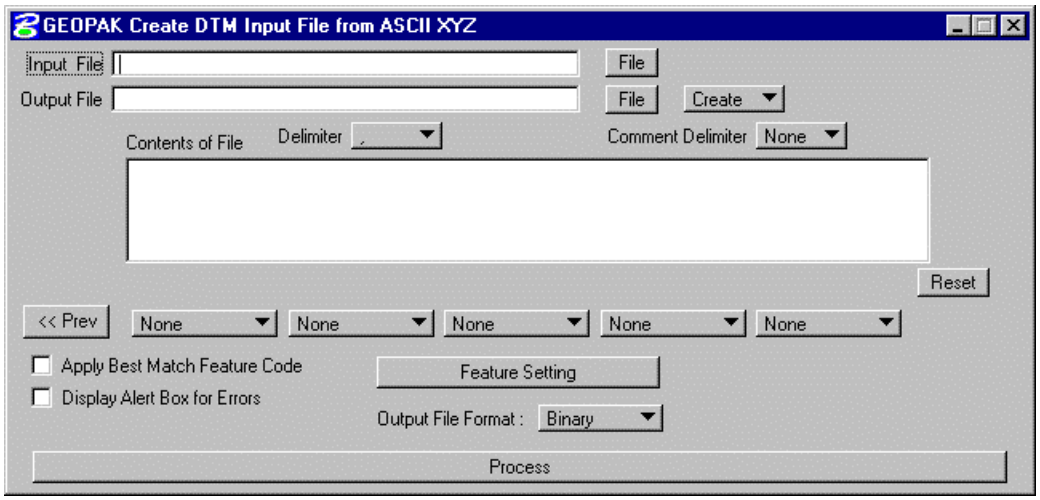
One sample Extract Graphics dialog is depicted below.



Another GEOPAK Extract utility can create DTM input files from various types of ASCII files including: TEX, THD, RT40 and CAiCE.



The GEOPAK Survey Manager dialog can prepare an input file for DTM processing directly from survey data. This input file distinguishes between random spot elevations, contours, voids, boundary polygons, break lines and other features. Points stored in a GEOPAK coordinate geometry database may also be utilized via the Survey Manager to create a DTM input for spot elevations.

In total, GEOPAK provides the capability to create DTMs from a wide array of data sources.

Extract Graphics

1. Open the MicroStation design file *..\Data\Geo\Site\Site1\Chapter2\Contours.dgn.*
2. Select the **DTM Tools** tool frame. (*Applications > GEOPAK Site > DTM.)*
3. Click the **DTM Menu** Tool. (first tool, first row).

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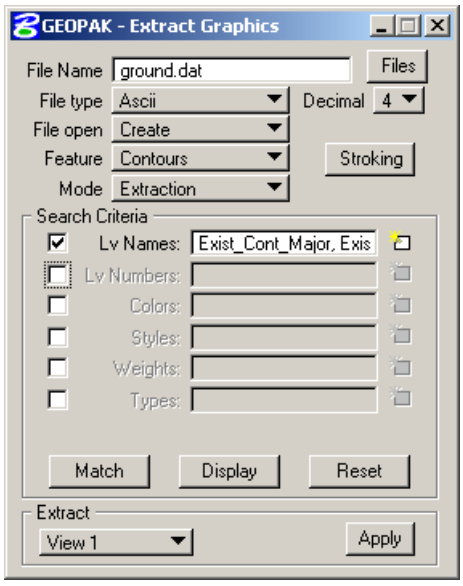
4. Select the **Extract Graphics** tool *(DTM menu: Extract > Graphics)*.



5. Enter the Extract Graphics information

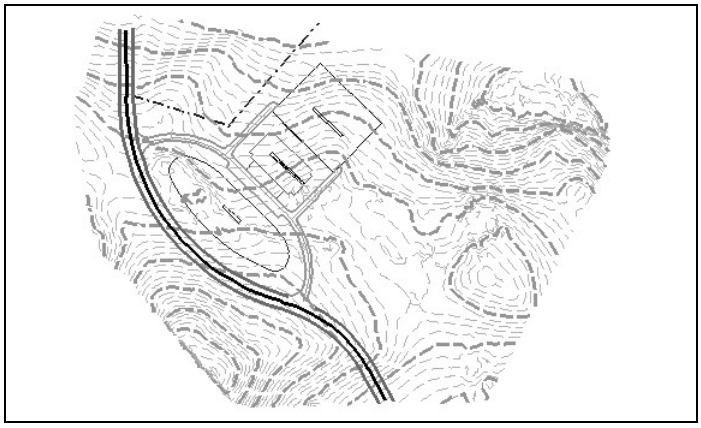
File Name:	`ground.dat`
File Type:	ASCII
File Open:	Create
Feature:	Contours
Mode:	Extraction
LvNames	Enable

6. Click **Match,** then select and accept one of the contour lines.

   Notice that all the lines highlight.

7. Click **Display**.

   This shows all contours that matched the level name of the one selected. The picture below shows the minor contours as being highlighted (light grey) but the major ones not due to the fact that they are on a different level name.



8. Click **Match**.

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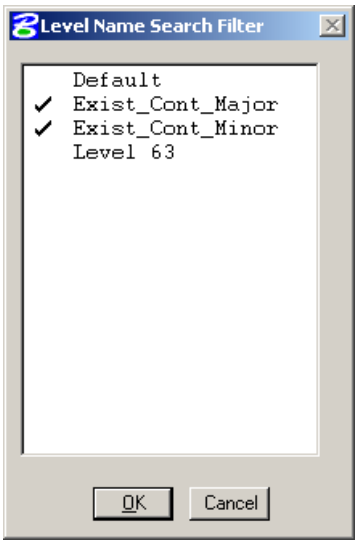
9. Select and accept one of the major contour lines.
10. Click **Select Levels** to the right of **Lv Names**.

    The dialog displays the level names that were matched in the previous steps.



11. Verify the Level Mask is set to Exist_Cont_Major and Exist_Cont_Minor.
12. Click **OK**.
13. Set **Extract** to View 1.
14. Click the MicroStation Fit View tool from the *MicroStation View Controls* tools in the lower left corner of View Window 1.
15. Click **Apply**.
16. Close the Extract Graphics dialog.

GENERATING A TRIANGULATED MODEL

The triangulated model is the core of the DTM process. All subsequent merged models, lattice models and calculations are derived from this core triangulated model. The GEOPAK triangulated model is created using state-of-the-art algorithms. Therefore, processing time is minimal. The presence of state-of-the-art algorithms will be apparent the first time you see the triangulated model display on the screen. Triangles appear from left-to-right in an ordered array; not in a randomized manner as is typical with standard Delauney based algorithms.

The resulting triangulated model is stored in a binary file that stores the data for the triangulated model in a triangulated topological network format. This means that the interrelationships between individual points and individual triangles are all recorded in the binary file. This efficient binary database format permits rapid extrapolation of cross sections and other information derived from the triangulated model.

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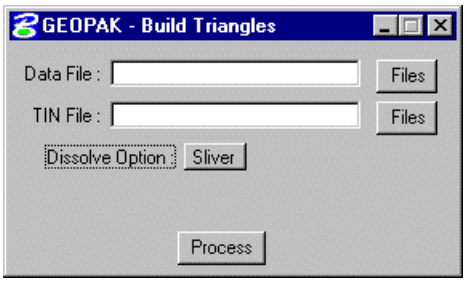
The triangulated model is generated from binary or ASCII input (DAT) files created by the following methods:

- DTM Extract utility
- Survey Project Manager
- Cross Section Reports within GEOPAK Road (DTM Input and DTM 3 Proposed)
- Collected in the raw ASCII DAT format

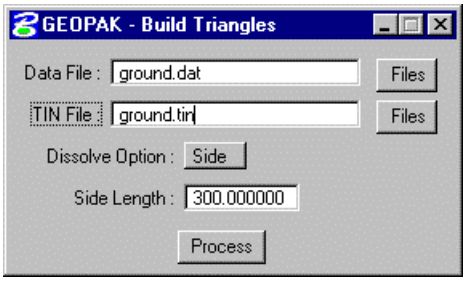
The binary DAT file format facilitates faster processing since the point and/or break line data can be read much faster from a binary file than from an ASCII file. However, other than reduced read time, there are no functional differences between the ASCII and binary files.

The Build Triangles dialog creates a binary file containing the triangulated model.



Build Triangles

1. Select the **Build Triangles** tool. *(DTM Menu: Build > Triangles.)*



2. Enter the Build Triangles information.

Data File	`ground.dat`
TIN File	`ground.tin`
Dissolve Option:	`Side`
Side Length:	300

3. Click **Process**.

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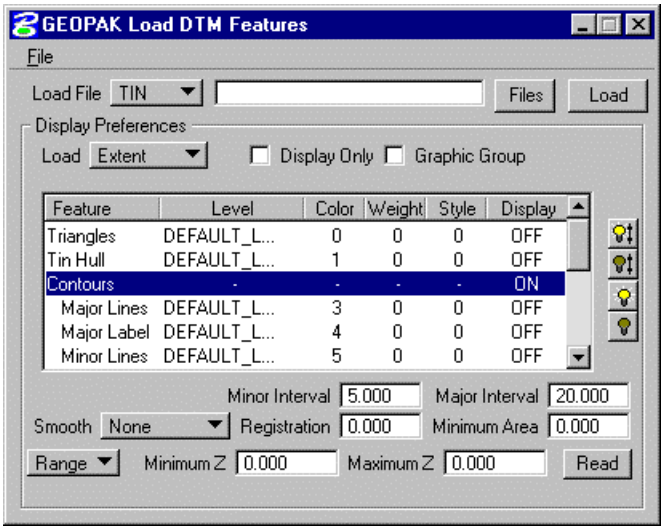
DISPLAY AND DRAW TIN FEATURES

GEOPAK supports a wide variety of options to provide the user with maximum flexibility when drawing and displaying DTM Features, all within a single dialog. The source data can be the DAT file, TIN file or Lattice file. Features can be display only or drawn into the MicroStation file. Features for part of a model can be displayed or drawn by the placement of a MicroStation fence prior to processing.

One sample Load DTM Feature dialog is depicted below.



Different DTM Features can be loaded, then displayed or drawn, depending on the type of source file. As the file is selected, the DTM Features automatically change to reflect the selection.

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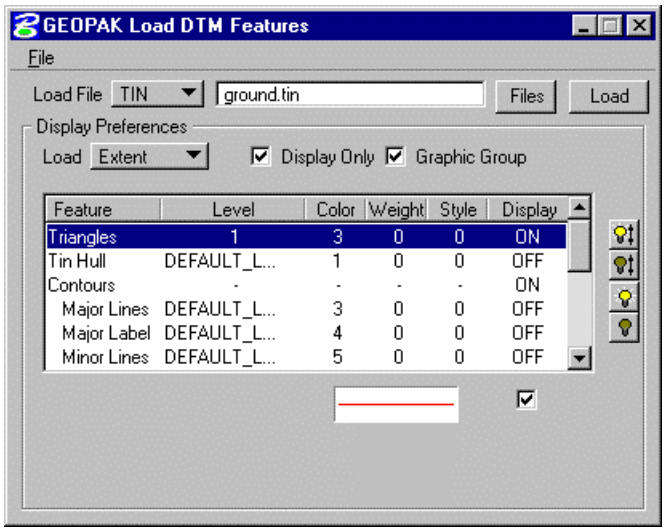
Drawing Contours and Triangles

1. Select the **Load DTM Features** tool. *(DTM Menu: Load > DTM Feature)*



2. Enter the GEOPAK Load DTM Feature Information.

Load File	TIN
File	*ground.tin*
Load	Extent
Display Only	Enabled
Graphic Group	Enabled

3. Double click the **Triangles** row to turn **Display** on.

   This can also be accomplished by highlighting the Triangles row and clicking **Item On** (right side of list box).

4. Double click on the element graphic to set the Triangle Display parameters.

Level	Default
Color	3
Weight	0
Style	0

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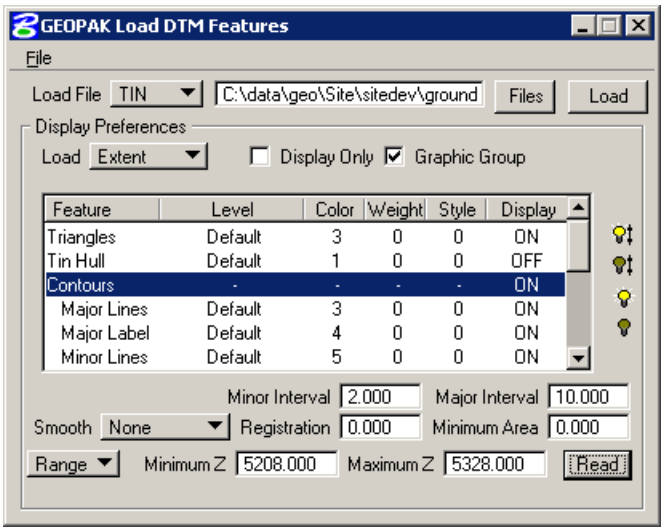
5. Select the **Contours** row and turn **Display** on.



6. Click **Read**. *(Lower Right)*

   This establishes the minimum and maximum elevation of your TIN File.

7. Enter the contour information in the bottom of the dialog.

Minor Interval:	2
Major Interval:	10
Smooth Contours:	None

8. Individually highlight the **Major Lines**, **Major Label**, and **Minor Lines** items and turn **Display** on.

9. Set display preferences for each item.

Major Lines:	Level=Default, Color=0, Style= 0 Weight=1, Display=ON
Major Labels:	Level=1, Color=2, Style=0, Weight=0, Display=ON
	FT=0, Th=5.0, Tw=5.0, Decimal=0
	Distance Between Labels=100.0
Minor Lines:	LV=1, CO=1, Weight=0, Style=0, Display=ON

10. Click **Load**.

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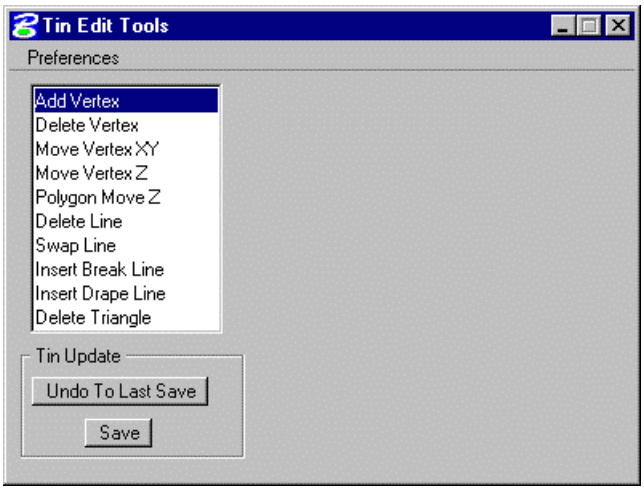
EDITING TRIANGLES

A myriad of tools to interactively edit TIN models are located in the TIN Edit Tools dialog. The triangulated model can be dynamically edited in terms of adding, deleting or moving spot elevations. Break lines can be added, draped or deleted. As editing is initiated, resultant triangles, contours, flow arrows, and voids are optionally displayed "on the fly."

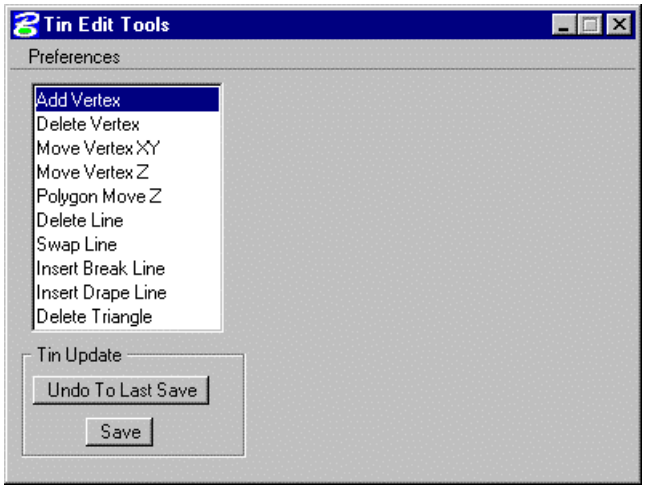
The list box on the left side of the dialog contains the editing options. As each tool is selected, the right side of the dialog dynamically changes to reflect the current tool. All these editing features dynamically show the changes as they occur. In addition, the changes are not written permanently to the triangulated model until the user selects the Save button. This allows the User the option of saving their modifications (Save) OR rejecting the modifications (Undo To Last Save).

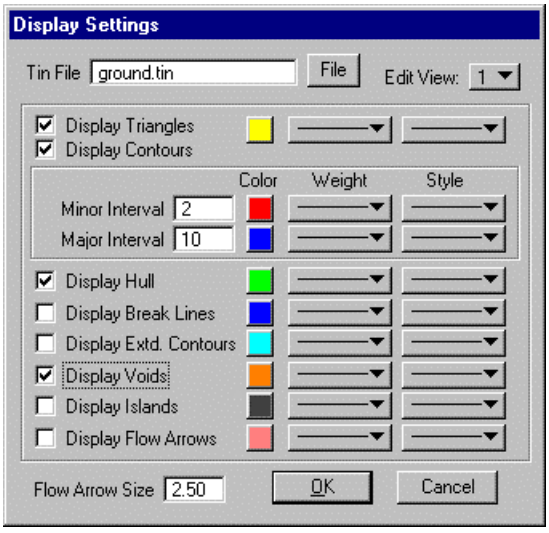


TIN Editing Tools

1. Select the MicroStation Saved Views tool *(MS: Utilities menu > Saved Views).*
2. Select EDIT1 and click **Apply**.
3. Select the **Edit Triangles** tool. *(DTM Menu: Edit > Triangles).*

Note Both the TIN Edit Tools dialog and Display Settings dialogs open.





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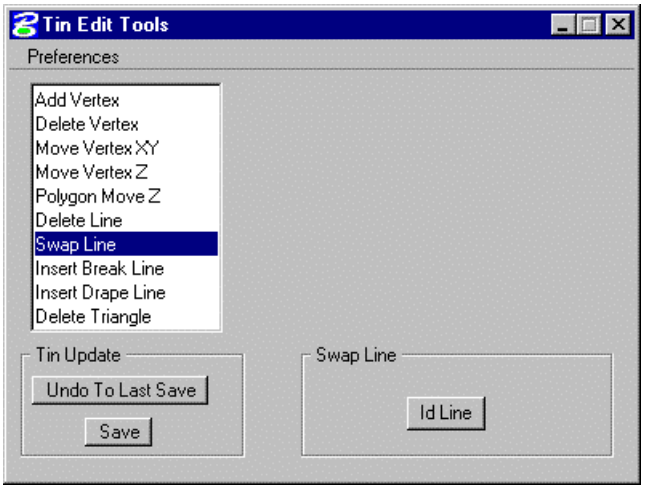
4. Set the Display Settings.

Tin File:	*ground.tin*
Edit View:	1
Display Triangles	Enable
Display Contours	Enable
Minor Interval	2
Major Interval	10
Display Hull	Enable
Display Voids	Enable

5. Set the **Color**, **Weight**, and **Style** of the enabled features to any desired settings.
6. Click **OK**.
7. Select **Swap Line.**

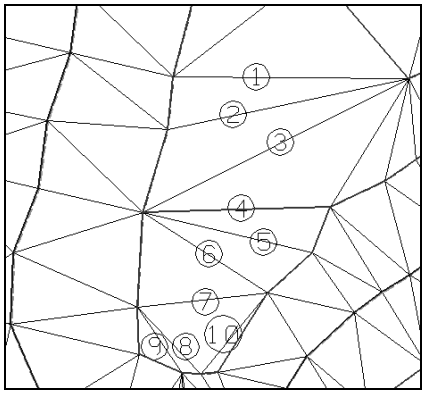


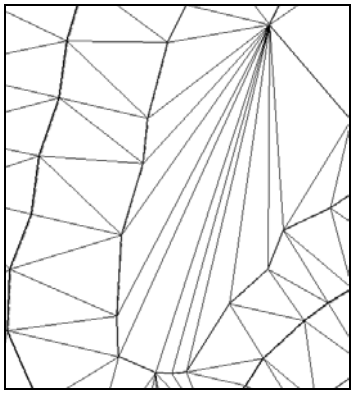
8. Click **Id Line** and select and accept the triangle line labeled number 1 in View 1 of MicroStation.

   Once selected, the triangle and others associated with it highlight.

9. Continue to select and accept the other numbered triangle lines.

   The triangles and contours update as shown.





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10. Click **Save** to commit the changes to the *ground.tin* file.
11. Close the Tin Edit Tools dialog.

DIGITAL TERRAIN MODEL ANALYSIS TOOLS

The Analysis tool box contains ten tools.

These are (from left to right):

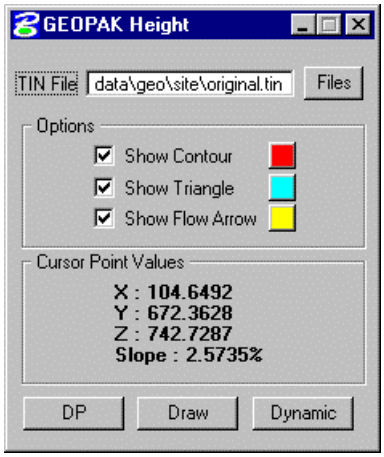
- Height
- Profile
- Volumes
- Elevation Difference
- Slope Area
- Themes
- Drainage Tools
- Visibility
- Trace Slope Path
- DTM Camera

The Analysis Tools are an excellent way for the User to gain instant answers from the TIN surface for a wide range of analysis questions.

We will now use 2 of these tools to provide a quick demonstration of the type of data that is available.

HEIGHT TOOL

GEOPAK offers a tool by which the plan view coordinates; elevation, and slope of the triangulated model can be interrogated at any location. The Height dialog automatically updates for each successive user defined data point.



Verifying Elevations

1. Select the MicroStation **Saved Views** tool *(MS: Utilities menu > Saved Views).*
2. Select ANALY and click **Attach**.

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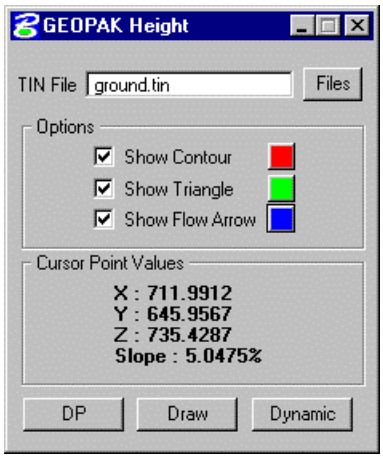
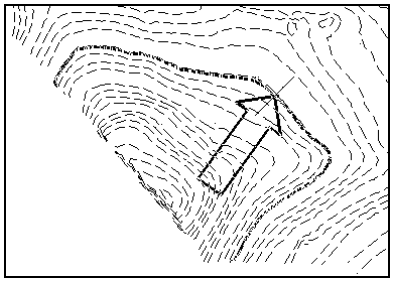
3. Select the **Height** tool. *(DTM menu: Analysis > Height)*.



TIN File	*Ground.tin*
Show Contour	Enable, Red
Show Triangle:	Enable, Green
Show Flow Arrow:	Enable, Blue

4. Click **DP.** You can now data point at any location where you would like to know the elevation.
5. Data point in several other locations to show the elevation, contour and flow direction information.
6. Click **Dynamic** and move your cursor over the dataset.

   The cursor point values are constantly updated.



The cross hair and flow arrow indicate the current cursor position.

7. Reset when finished (normally right mouse button).
8. Close the GEOPAK Height dialog.

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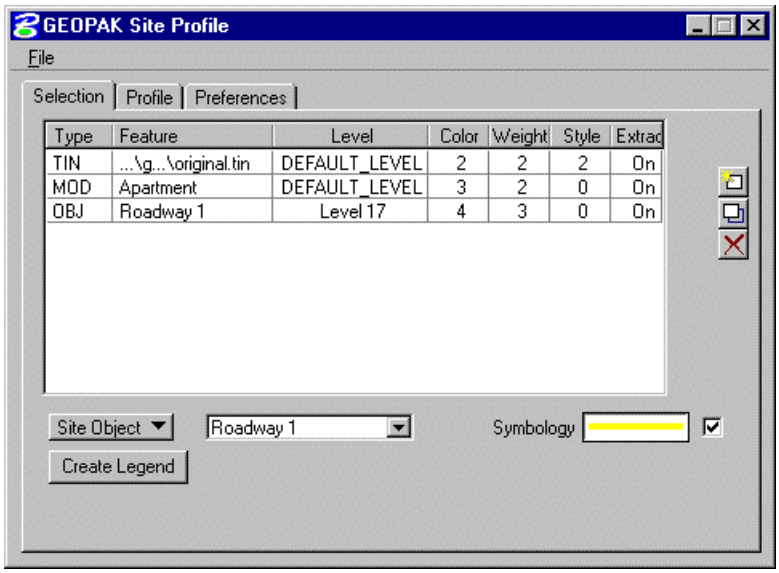
PROFILE TOOL

The Profile tool enables the user to draw a profile at any location based on a MicroStation element draped onto a triangulated model.



The main dialog has three tabs:

- Selection - TIN file, Model or Object specifications, profile element symbology and create legend button.
- Profile - profile definition and placement buttons and preview window. Allows the User to set the alignment where they would like the surface profile extracted from and then provides a preview of the surface profile.
- Preferences - Profile and grid scales, text parameters, elevation and station ranges.

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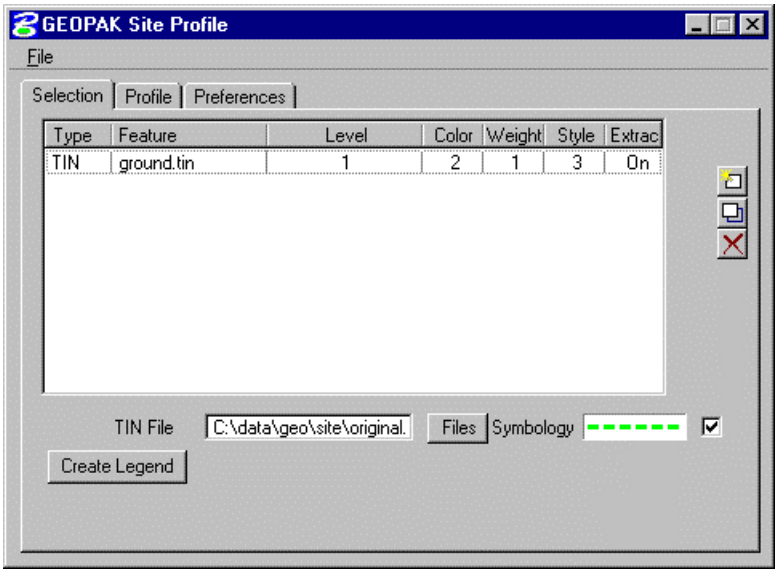
Creating a Site Profile

1. Select the **Profile** tool. *(DTM tool frame: Analysis > Profile).*

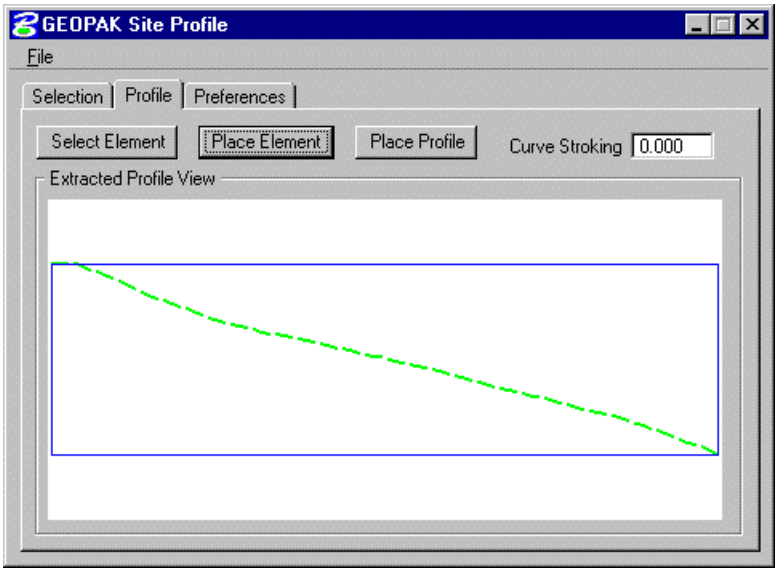


2. Select the **TIN File** by clicking **Files** and selecting *ground.tin*.

   Set the element symbology by double-clicking the sample line graphic.

3. Click **OK** to close Set Feature dialog.
4. Click **Add List Item** (right side of dialog).
5. Click **Profile** tab.
6. Click **Place Element** and data point (twice) to define the beginning and endpoints of the desired profile.

   The extracted profile is displayed in the dialog.



7. Click **Reset**. *(Right mouse button)*

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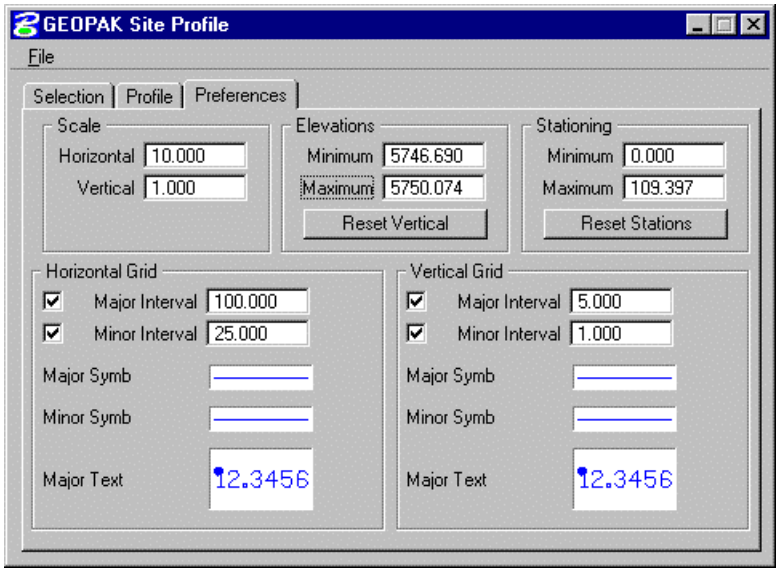
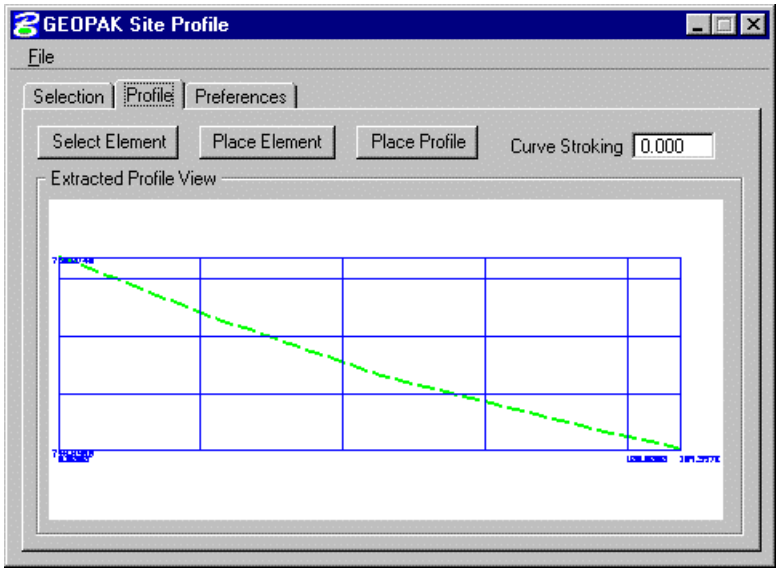
Note To extract another profile, click the **Place Element** button again and data point in MicroStation View 1.

8. Click the **Preferences** tab.
9. Fill out the dialog as shown below.

Note The Elevations and Stationing values are automatically read directly from your TIN file and do not need to be changed.



10. Switch back to the **Profile Tab** to see the grid.



11. (Optional) Click **Place Profile** and data point in the desired location in MicroStation View 1.
12. Close the GEOPAK Site Profile dialog.
13. Exit MicroStation.

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3 GEOPAK Site Modeler

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- Site Modeler project components
- Site Modeler main menu
- Project menu options

INTRODUCTION

The GEOPAK Site Modeler enables fast, dynamic development of site models and easy management of the many changes that occur on site projects. It captures design intent as users work and provides immediate visual feedback. The software allows users to perform engineering modeling within a Digital Terrain Model (DTM)—without merging or extracting graphics into the DTM. Many traditionally cumbersome processes are reduced to one step: for example, you can dynamically move a building pad in a single drag and drop step—without measurement, clipping, merging, and placement steps.

The Site Modeler offers unprecedented flexibility in interactively working with site designs without the limitations of traditional iterative steps. No cumbersome triangle or point editing is necessary. The software maintains existing ground and provides full control over defining elevations and side slopes and balancing cut-and-fill. Analytical tools are included to afford powerful evaluation of site designs.

GEOPAK Site integrates digital terrain modeling with interactive 3D site design. The software allows you to incorporate design features in the model while maintaining existing ground. Move building pads. Change pond elevations. Extend retaining walls. Trim curbs. Resize berms. The Site Modeler automatically regenerates the DTM, yet retains full integrity of the models and the original DTM. There is no need for merging or extracting graphics into the terrain model. Easy, on-the-fly functions let you change elevations and side slopes and balance cut-and-fill. You can add features such as contours to the model as needed to define your design. Tools are supported for evaluating the site design and producing drawings and site models.

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SITE MODELER PROJECT COMPONENTS

A GEOPAK Site Project is comprised of three components: Elements, Objects and Models.

GEOPAK SITE ELEMENTS

Elements are any MicroStation graphical element assigned an elevation and DTM Feature (breakline, boundary, contour, etc.) with GEOPAK Site tools. They can be placed into a 2D or 3D design file utilizing any generic MicroStation command, except Make or Drop Complex Chain. Once the elements are drawn, elevations are assigned with GEOPAK Site tools. At any time, they can be moved, copied or otherwise manipulated. Once a group of elements is drawn to the designer's satisfaction, they can be defined as an object.

Elements can be modified at any time during the site design process. To move the location of an element in the X-Y plane, utilize any MicroStation command except Create Complex Chain.

Let's review several types of modifications, their impact on element elevation(s) and their results on the site element. If the User takes advantage of the Site Element Association feature, the element elevations will be recreated per their original definition. If this feature is disabled or not used, then the following will apply to the elevations of the site elements.

Note All modifications support selection sets and fence operations.

Extend / Shorten Line	Use generic MicroStation commands to shorten or lengthen. The Site Modeler holds the elevations of the original element and re-proportions them.
Insert Vertex	Elevation of new vertices is interpolated between adjacent vertices.
Move Element	Maintains all vertices at the original elevations.
Scale	Maintains the elevations at all vertices.
Rotate	Maintains the elevations at all vertices.
Mirror	Maintains the elevations. If there are duplicate vertices due to the mirroring, the second elevation is utilized.
Delete	Deletes the element from the Site Modeler object.

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GEOPAK SITE OBJECTS

Site Objects are collections of Site Elements that are grouped together for the purposes of side slope definition, merging into the Model, volume quantity calculations or as logical design features.

Site Object examples include:

- Parking lots
- Buildings
- Ponds

Each object can contain an unlimited number of elements. Objects contain their own attributes.

- *Side slopes* - defines the interrelationship between the object and the model. Cut and fill side slopes are automatically generated around the extent or boundary of each Object in the model. The boundary is automatically determined from the extent of the elements contained in the object. Side Slopes can be as basic as a single cut or fill slope from the edge of a building to existing ground, or intersecting slopes between two objects, i.e., a building and a parking lot.
- *Quantity Depth* - In order to do excavation quantities, an object may have an associated quantity depth. For example, a building may have a quantity depth of two master units which represents the amount of granular material required beneath the building. These quantities can be easily changed and quickly computed.
- *Display Settings* - A specific set of visualization settings can be applied to each object to control the display symbology of each.
- *Maximum Triangle Length* – Defines the maximum length for the Object of an external (outside) triangle. The triangulation must follow this rule while still including all element data.

Other things to consider during the creation of Objects:

- A Site Model is created by merging each of the triangulated Objects specified in the Model FIFO list together in the order they are listed within the list. The designer determines which slopes control the merging process by means of a FIFO list. The first Object, called the Base Object, is the starting surface. Each object is then merged "on the fly" in the order listed. To change the controlling slopes for intersecting, move objects up and down in the Model FIFO list.
- Site Objects can be raised and lowered in their entirety to easily evaluate design alternatives.
- The feature types of elements used within an Object have an effect on how that Object will be triangulated. Failure to use Boundary elements as the outer most elements of an Object may lead to undesired triangulation result. Similarly, using Boundary elements inside an Object may also cause an undesired triangulation result. Layout, geometry and DTM feature type of the member elements should always be considered. The boundary of the Object is determined from the extent of the elements and their feature type.

Objects can be modified at any time during the site design process. The following are methods of modification:

- Add / remove elements from the object
- Modify Object Slopes
- Raise or lower the object

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GEOPAK SITE MODELS

A Site Model is comprised of an unlimited number of objects arranged based on the "First In – First Out" (FIFO) list which dictates the merging order and a base object (i.e., existing ground).

> ***Note*** The designer does not have to merge, as it's done automatically "on the fly." As a new object is added to the model, its resultant slopes, contours, etc., can be displayed on the screen.

Models can be modified at any time during the site design process. This can be accomplished in three methods:

- Add or remove objects from the model
- Change the base object, i.e., update/change existing ground terrain data
- Changing the order of Objects in the FIFO list

The workflow involved in using the Site Modeler is designed to expedite the creation of digital terrain models while providing enough flexibility to easily accommodate design changes. The following outlines getting started with the Site Modeler.

- Establish base design planimetrics in 2D or 3D MicroStation design file. This includes design graphical features that define the DTM (e.g., centerlines, curbs, berms, ponds, property line etc..).
- Obtain existing information, such as original ground or survey information, that serves as the basis of the initial design.
- Review the geometric layout of design features and determine a preliminary concept for the type and configuration of Site Objects to be used in the design.
- Start Site Modeler New Project Wizard.
- Create an empty Model.
- Import the base design information into the Model.
- Select a location to begin the design.
- Create a new Site Object that describes the starting feature.
- Begin defining the elevations of the Site Elements and adding them to the Active Object.
- Continue to create Site Objects and Site Elements as needed.
- Evaluate and analyze the Site Model and adjust Site Elements, Site Objects and Model.

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SITE MODELER MAIN MENU

GEOPAK Site is invoked from within a MicroStation design file. If the Project Wizard dialog is bypassed (by activation of the Don't Show this dialog at Startup), the GEOPAK Site Modeler main menu bar (along with the Active site Object Control) is automatically displayed. An alternate method of invoking the menu bar is completion (without clicking Cancel) of the Project Wizard.

Each menu selection accesses GEOPAK Site project information, feature placement and tools necessary to complete a GEOPAK Site project. Tool frames and toolboxes are also supported for all functions and are accessed via the Tool Boxes pull down. The current Site working directory and Project File are displayed in the header of the menu bar.

PROJECT MENU OPTIONS

The Project Menu selections are utilized for creating new GEOPAK Site projects, opening existing projects, saving projects, establishing the project Preferences, Importing and Exporting data in and out of the project file, and exiting the Modeler.

When working on a project, frequent use of the File > Save pull down is important. Any changes made in the project are not recorded in the GEOPAK Site File (GSF) file unless a File > Save or File > Save As operation is executed. Hence, any power interruption or other malfunction will result in loss of data that can be avoided through the judicious use of the File > Save tool.

Each GEOPAK Site project contains a set of Preferences. The preferences control the project tolerances, visualization settings, update settings and save settings.

GEOPAK Site Modeler supports two operations to import data into a site project:

- Data
- 3D to Object

In addition, it supports five operations to export data from a site project:

- Visualization to DGN (Contours, Triangles, etc)
- Model / Object (Creates DAT & TIN Files)
- To COGO (Creates Points in the COGO Database)
- To COGO Profile (Creates a Profile in COGO)
- Drape Elements

To exit GEOPAK Site, the designer may utilize the File > Exit tool on the Project menu. When exiting, GEOPAK Site Modeler prompts for saving the current project.

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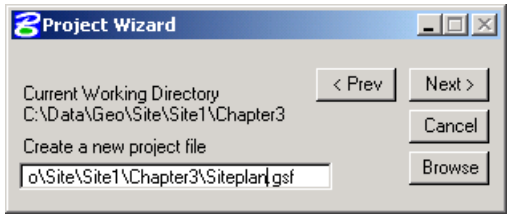
WORKSHOP: CREATING A SITE MODELER PROJECT

Creating a Project

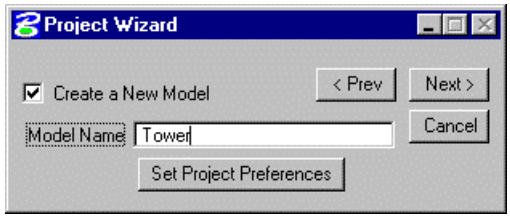
In this workshop we will set up a project in GEOPAK Site Modeler to include Project Preferences. We will import our previously created Digital Terrain Model from the DTM Workshop in Exercise 2.

1. Open the file *C:\Data\Geo\Site\Site1\Chapter3\Siteplan2D.dgn*.
2. Select the **Site Modeling** Tool *(Applications > GEOPAK Site > Site Modeler).*

3. Enable **Create New Project.**
4. Click **Next>.**



5. Enter the project file. *(..\Data\Geo\Site\Site1\Chapter3\Siteplan.gsf)*.
6. Click **Next.**



7. Toggle on **Create a New Model**.
8. Key in Tower as the **Model Name**.

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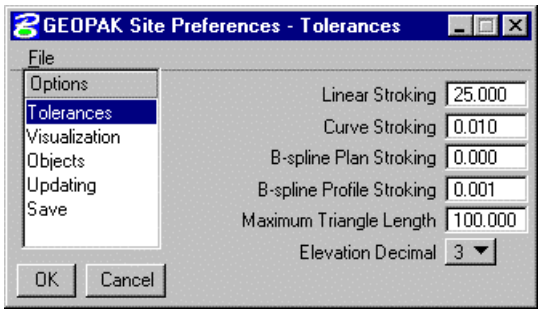
PROJECT PREFERENCES

GEOPAK Site Modeler supports a wide array of user defined Preferences which enables the designer to set project specific options, or a larger organization to set parameters to maintain standards. Each GEOPAK Site project contains a set of Preferences and they remain with the project.

The general groupings of Options are displayed in a list box in the left side of the dialog. The right side displays parameters for the highlighted Option. As different options are selected in the list box, the right side of the dialog changes dynamically to reflect the parameters for the highlighted Option.



The Options and very brief descriptions are listed below.

Tolerances	Tolerance and stroking options used in the creation of Site Elements.
Visualization	Variety of element symbology and display options
Objects	Standard List of Object Types and default values for Object parameters
Updating	Toggle for automatic updating and setting a Working Boundary
Save	Automatic save and backup options

On the right side of the dialog, **OK** and **Cancel** commence closing the dialog and storing the preferences, if required.

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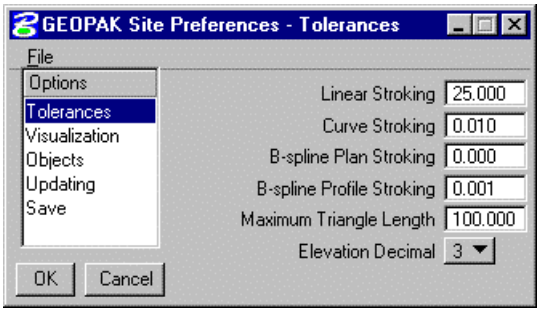
TOLERANCES



Linear Stroking	Linear Stroking provides additional interpolated elevation values at intervals along linear elements based on the value set.
Curve Stroking	Curve Stroking provides additional interpolated values at intervals along curve elements. Segmenting the curve using small chord segments creates these interpolated values. The maximum distance between the chord and the original arc will not exceed the value specified in the dialog.
B-Spline Plan Stroking	Similar in effect to the Curve Stroking, but this value is applied to B-Spline elements.
B-Spline Profile Stroking	Used exclusively for the Edit Profile tool. The Stroking tolerance set determines how many points are returned from the Edit Profile tool to the Site Elements after a proposed profile is accepted. This value should be set to the minimum acceptable number of vertical elevation decimal. For example, if the User supplies elevations to the construction team to 2 decimal places, the value set should be 0.001.
Maximum Triangle Length	This value is used to determine what triangles should be removed from the outside of an Object. External triangles whose external edge is longer in length than the Maximum Triangle Length are dissolved.
Elevation Decimal	The Elevation Decimal controls the number of decimal places displayed on the elevation labels for points within the objects and models.

Note Stroking is the process of automatically inserting points along Site Elements by interpolating new points from the linear and curved sections of the data.

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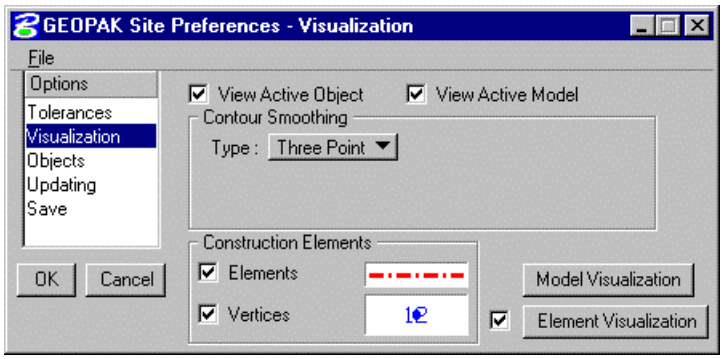
VISUALIZATION

A variety of user-defined parameters are supported to provide the designer with maximum flexibility in Visualization. These parameters are briefly detailed below.



View Active Object	When activated, the current object listed in the Active Site Object Control dialog is displayed. The Object will maintain the display settings during view updates and changes. All visualization settings are derived from the definition of the specific object that is active.
View Active Model	When activated, the current model listed in the Active Site Object Control dialog is displayed. The Model will maintain the display settings during view updates and changes. All visualization settings are derived from the definition of the specific model that is active.
Smooth Contours	Contour smoothing is controlled by one of three options. None provides no smoothing. Three Point provides minimal smoothing by rounding the contour corner at each triangle vertex. B Spline analyses the entire triangulated network (Model or Object) and provides a complex algorithm to display contours as B-Spline graphical elements. The B Spline option is much more processor intensive then the other options and it is recommended that this option not be employed until the User is ready to draw completed contours into the DGN file.
Construction Elements	The element symbology for Site Elements created in the modeler that are not contained in a Site Object. It may be desirable to establish Site Elements and their elevations purely as a reference or to construct other elements. These Site Elements are not needed in the Site Objects themselves and are considered Construction Elements. Site Elements contained in Site Objects are displayed according to the object visualization of the object to which they belong. The Construction Elements are displayed using these settings in the preferences.

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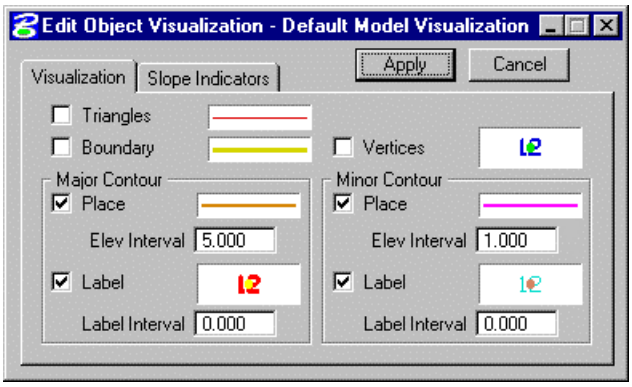
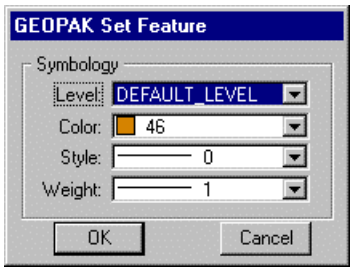
MODEL VISUALIZATION



The Model Visualization button provides access to the default specifications for all features that are available for display in Site Models including triangles, boundaries, and vertices. These symbology will be applied to all models created subsequent to setting these. All symbology controls, the sample line and text graphics in this case, can be set by double clicking the sample graphic and using the Set Feature dialog shown below.



Additional options can be invoked by clicking the right mouse button over these sample controls.

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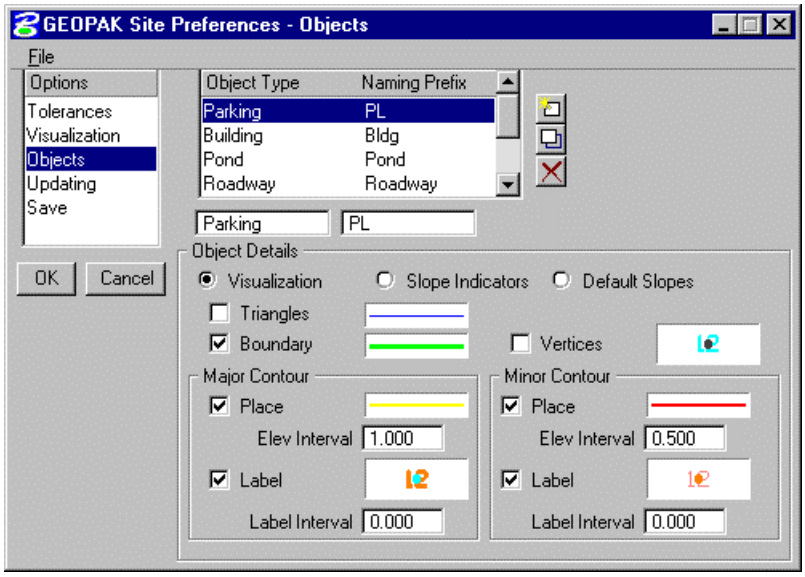
OBJECTS

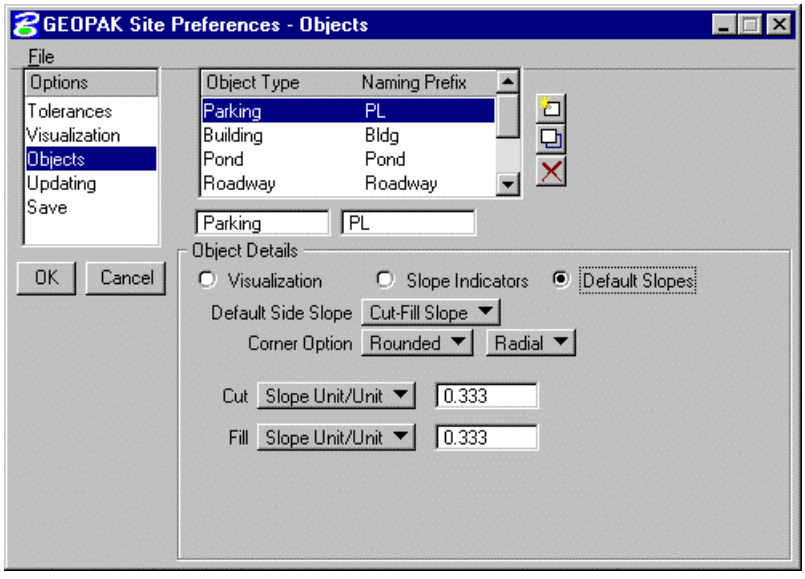
This option is utilized for creation, deletion, and manipulation of the library of Object Types. The information includes the Object Type and Naming Prefix, visualization settings for that Object type and default Object side slopes for that Object type.



This list box displays all Object Types within the active project. Default types delivered with GEOPAK Site Modeler are: Parking, Building, Pond, Roadway, Lot, Openspace and Ground.

These Object Types assist in organizing and categorizing design features, controlling standard symbology and establishing defaults for Objects created.

The group box portion of the dialog titled Object Details allows the user to set Visualization of the highlighted Object Type. Each Object Type may have its own settings, providing maximum flexibility to the user to display only specified parameters for the particular Object Type. Note its similarity to the Default Model Visualization dialog.



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After the Preferences have been set and saved, any new Objects of a particular type that is created within the Site project will obtain the default settings. The defaults are applied when an object is created and remain in effect until the slopes are modified by editing the Object. Note that any specific Objects slopes can be modified at any time.

Slopes are applied around the boundary of the entire object and are generated as the intersection from the Object boundary to the Model. Three Default Side Slope options are supported:

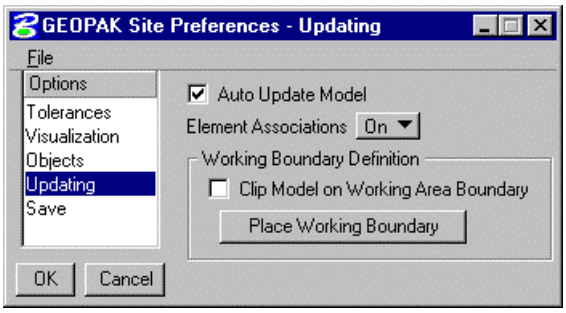
- No Slopes
- Cut - Fill Slope
- Cut-Fill Table

Corner Options can be specified to generate either Rounded or Straight slopes around corners of Objects and can be projected Radial or Planar. Supported options for Cut and Fill specifications are:

- Slope run:rise
- Slope rise:run
- Slope %
- Slope Unit / Unit (ft. / ft. or meter/meter)

Simply specify the desired slope.

UPDATING



When the Auto Update Model is active, the model is updated whenever a change is made to an element, object or to the FIFO list of the Active Model. As Models get larger, it may not be necessary to update the Model on every single edit. Deactivating this toggle will speed up the modifications that are being performed. The toggle must be re-activated or the Model processed for the Model/Object visualization to reflect any changes made.

Element Association provides a history of how Elements were created. Elements that are created based on another Element or Object can always maintain the same dependency to the items referenced during their creation.

When activated (On), Element associations are enabled. When the reference Element or Object is modified, the dependant Element will automatically update/recreate itself. Turning the toggle off (OFF) disables the associations.

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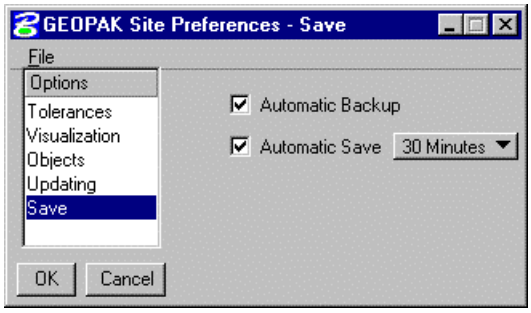
SAVE



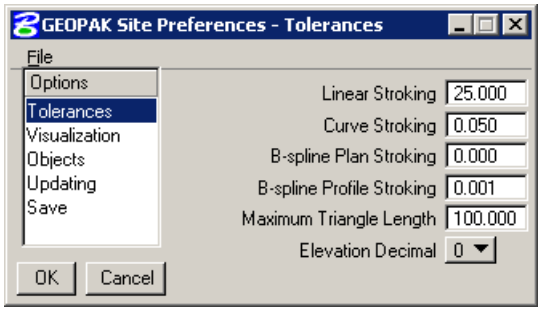
When the Automatic Backup option is activated, a backup file is always created (in the project directory with a *.bak extension) when the project is opened.

The Automatic Save Option saves the GEOPAK Site project file (.GSF) to the disk at the user specified interval. Automatic Save intervals include 1, 2, 5, 10, & 30 minutes.

WORKSHOP: SETTING SITE MODELER PREFERENCES

Defining the Project Preferences

1. Click **Set Project Preferences.**



2. Select **Tolerances** and set the parameters.

Linear Stroking	25
Curve Stroking:	0.05
B-spline Profile Stroking	0.001
Maximum Triangle Length:	100
Elevation Decimal:	3

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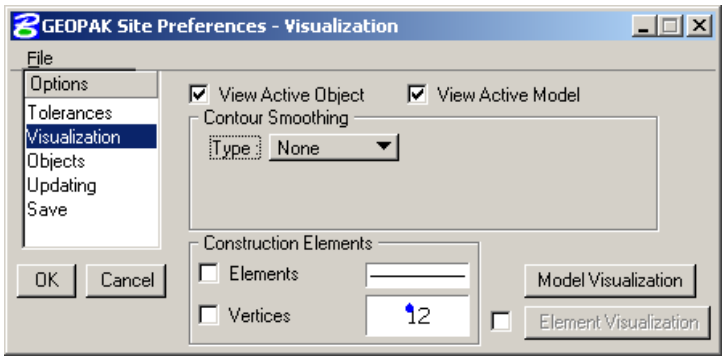
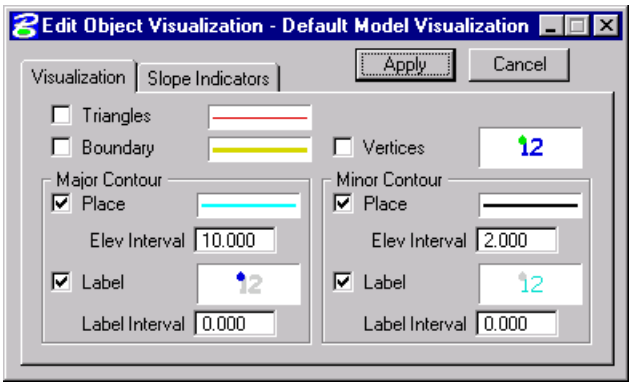
3. Select **Visualization** and set the parameters.



View Active Object	Enable
Curve Stroking:	Enable
Smooth Contours	None

4. Click **Model Visualization**.



5. Enter the Default Model Visualization information.

Triangles	Disable
Boundary:	Disable
Vertices:	Disable
Major Contour: Elev Interval: Label:	Enable 10 Enable
Minor Contour: Elev Interval: Label:	Enable 2 Enable

To change the symbology of each item, double click on the sample graphic to open the Set Feature dialog. Make the appropriate changes and then click **OK**.

6. Click **Apply**.

7. Select **Objects**.

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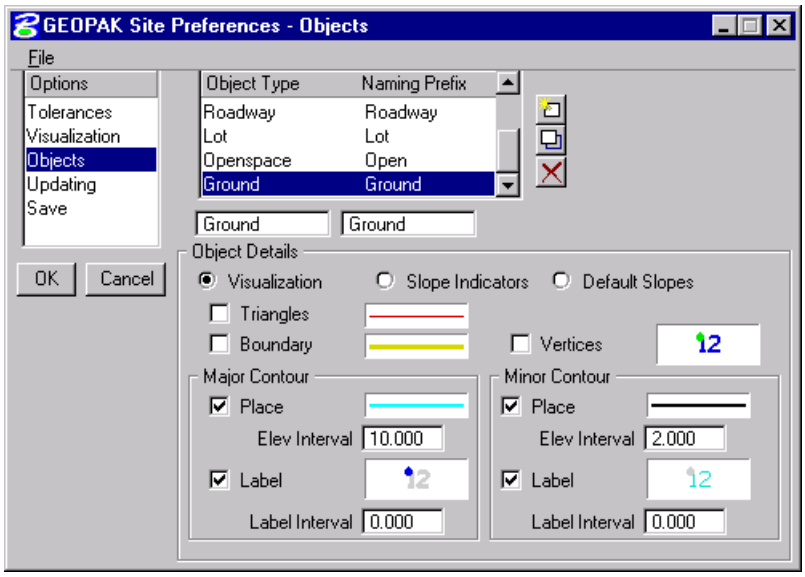
8. Select the **Object Type** Ground and set the Visualization preferences as shown.



To change the symbology of each item, just double click on the sample graphic. Once the appropriate changes have been made click OK to save your changes and return to the main dialog.

Hint Use the same visualization settings for Object type "Ground" as were used for the Model Visualization.

9. Click **Modify** (next to the **Object Type/Naming Prefix** list).
10. Click **Yes** when prompted to modify existing objects.

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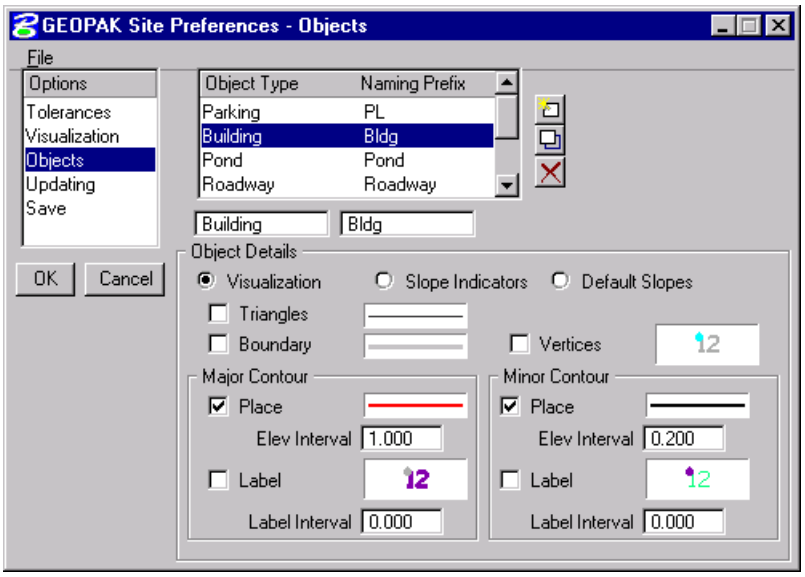
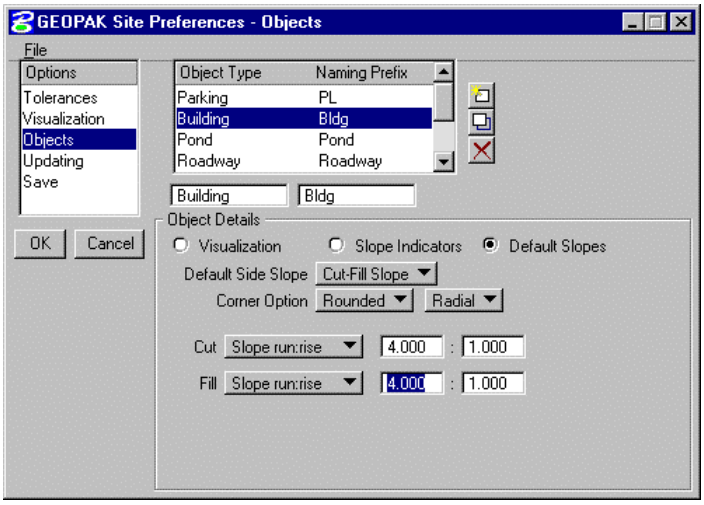
11. Select the **Object Type** Building and modify settings as shown.



Triangles	Disable
Boundary:	Disable
Vertices:	Disable
Major Contour:	Enable
Elev Interval:	1.0
Label:	Disable
Minor Contour:	Enable
Elev Interval:	0.2
Label:	Disable

12. Click **Modify** to accept the visualization changes and **Yes** to the Alert dialog.
13. Click **Default Slopes**.



14. Change the default **Cut** and **Fill** slopes to 4:1 (run:rise).

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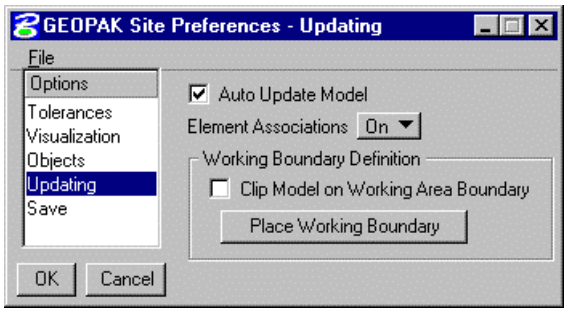
15. Click **Modify**.

    You may want to modify other Object Types in order to get the desired display preferences.

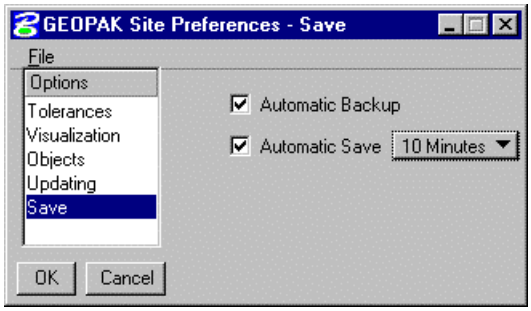
16. Select **Updating**.



17. Enter the Updating information.

Auto Update Model	`Enable`
Element Associations	`On`

18. Select **Save**.



19. Enable **Automatic Save** and set to 10 Minutes.

20. Click **OK**.

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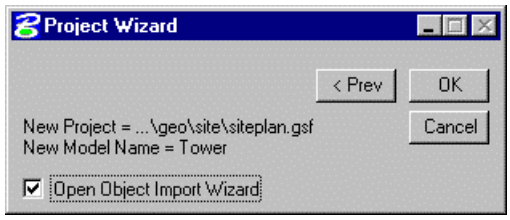
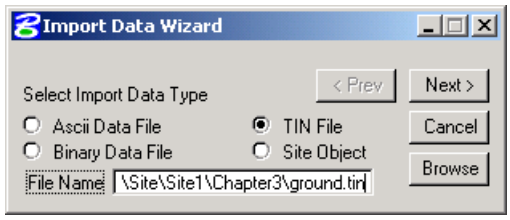
Completing Project Set-up

1. Click **Next.**



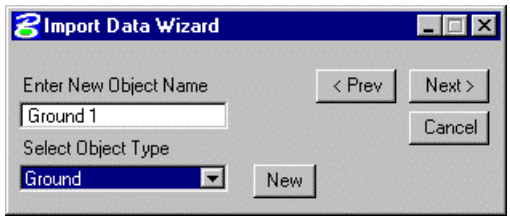
2. Enable **Open Object Import Wizard**.
3. Click **OK**.



4. Enable **TIN File**.

Note We created a TIN file *(ground.tin)* in a previous exercise. We will select TIN File as the Import Data Type option and use the previously created TIN file.

5. Click **Browse** to select *ground.tin*.
6. Click **Next.**



7. Set **Select Object Type** to Ground.

   By selecting the Ground Object Type, the Enter New Object Name field is automatically populated.

8. Click **Next.**

Use as Base Object for	Enable
Model	Tower

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9. Click **OK**.

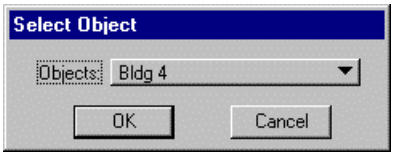
   This initiates the visualization of the Active Model (`Tower`) and the Active Object (`Ground 1`) into View 1 of MicroStation.

10. Save the site project. (*Site Modeler: Project>Save*).

ACTIVE SITE OBJECT CONTROL TOOLBAR

Upon opening an existing GEOPAK Site Project or creation of a new project, the Active Site Object Control dialog is activated.

The tool bar is resizable and dockable and remains open throughout the entire Site Modeler session.

Display View	When the toggle to the left of Display View is activated, the Active Model and/or Active Object are displayed, based on their respective visualization settings in the view selected.
Model	Shows the User what Model is currently active. Selection of any other model from the list changes the active model. When the model is selected, all Objects that reside in the models FIFO list will be available in the Object listing to the right. When <All Objects> is selected, all objects in the project are listed. When <Orphan Objects> is selected, all objects that currently do not belong to a model are listed.
Object	Shows the User what Model is currently active. The Object list changes dynamically based on the Model selection.
ID? 	Clicking ID, and then identifying any Site Modeler element highlights the selected element and invokes the Select Object dialog depicted below. Clicking OK makes that Object Active. 
Center Window On Object 	Centers and fits the Active Object in the Display View.

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MAIN TOOLBAR

The **Tools** menu selections provide access to all **Tool Boxes**. The Main Tools tool frame is depicted below and accesses the other tool boxes.

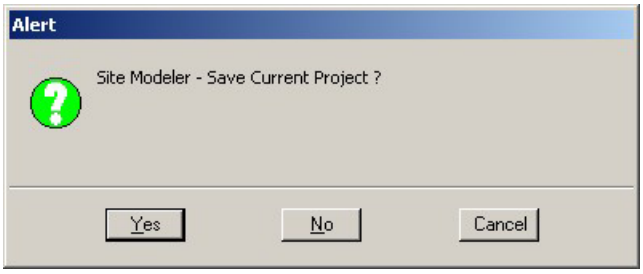
Each icon in the tool frame (except single tools) is a tool box that one can "tear off" to become a "tool box." The individual tool boxes (except those which have single tools) can be docked and resized. There are six tool boxes, with the following titles (order down first column, then down second column):

- Project Tools
- Object Tools
- Analysis Tools
- Element Tools
- Model Tools
- Exit

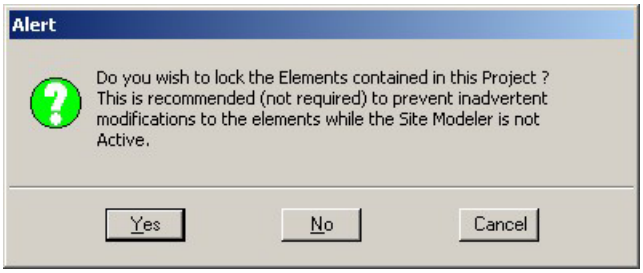
If the function of an icon is not apparent to the user, position the cursor on the icon. A detailed description is displayed in the status bar and a tool tip (flyover) appears.

Saving and Exiting the Project

1. Close GEOPAK Site Modeler *(Modeler: Project > Exit)*.
2. Click **Yes** to save the current project.



3. Click **No** to the Lock Elements alert.



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4 Designing With Site Modeler

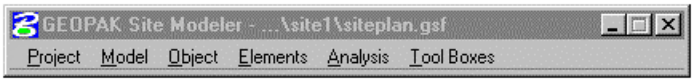
CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- Model menu
- Objects menu
- Elements menu
- Designing with Site Modeler

INTRODUCTION

GEOPAK Site is invoked from within a MicroStation design file. If the Project Wizard dialog is bypassed (by activation of the "Don't Show this dialog at Startup"), the GEOPAK Site Modeler main menu bar (along with the Active Site Object Control) is automatically displayed. An alternate method of invoking the menu bar is completion (without clicking Cancel) of the Project Wizard. The GEOPAK Site Modeler main menu bar is displayed.



Tool frames and toolboxes are also supported for all functions and are activated from the Tool Boxes pull down. The current Site Modeler working directory and Project File are displayed in the header of the menu bar.

MODEL MENU

The Model menu selections provide the mechanism to add, edit and delete the various elements that comprise a Model. This includes display parameters, merging order (FIFO), and Display options. Each of these tools invokes a dialog wherein the specific Model information can be added, edited or the entire Model deleted.

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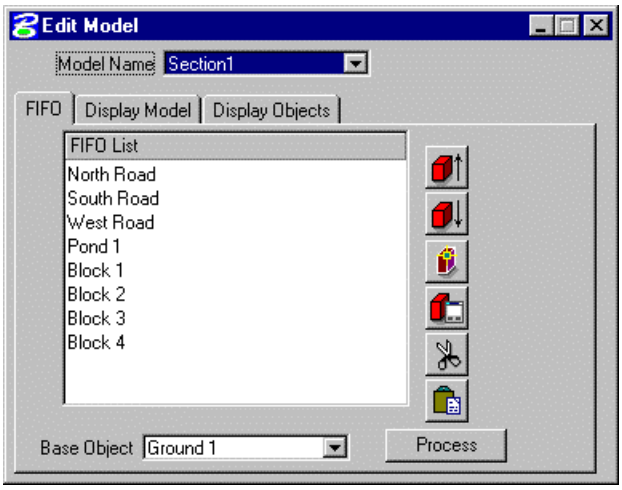
EDIT MODEL

The Model editing options provide the mechanism to change the list of Objects contained in the Model and to modify the display setting of the Model and its Objects. At the top of the dialog the active Model Name is displayed, however, any Model in the current site project may be selected.

The three Edit Model options are:

- *FIFOList* - "First in, first out" list. Determines the merging order of all objects in the active Model. In addition, tools are provided to manipulate the list.
- *Display Model* - a complete range of element symbology and text parameters utilized for visualization for the active model.
- *Display Objects* – Additional controls for displaying the Object Types that make up the Model simultaneously and provides clipping options for the Model and Base Object.



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FIFO FUNCTIONALITY

The FIFO (First in, First out) List contains the list of all the Site Objects contained in the selected Model and the order in which the Objects are to be merged. This Object list is processed from the top to bottom. Starting with the Base Object, each Object is merged into the Model in this order – top one first, then the second one, etc. Any time a change is made to a Site Object or Site Element contained in the Model, the Model is reprocessed.

The Site Preferences contain an option to disable this automatic updating should this immediate feedback be unnecessary or grow too time consuming as the model grows. Since Objects can easily be added and removed from the FIFO list, certain time savings can be achieved by removing Objects not needed for the current design process and can be added back at the end or at such time as their impact is needed.

The process used in the creation of the final triangulated Site Model is as follows:

- The Base Object starts as the initial state of the Model.
- The first Object in the FIFO list is retrieved.
- The boundary of the Site Object is determined from the extent of all the Site Elements contained in it.
- The Side slopes associated with that Object are applied around the boundary down or up to the Model depending on the cut fill situation.
- This Object is then merged into the Model.
- This new state of the Model with the first Object and its side slopes merged into the base Object becomes the initial sate of the model for the next Object in the FIFO list and the process is repeated for all the objects in the list.

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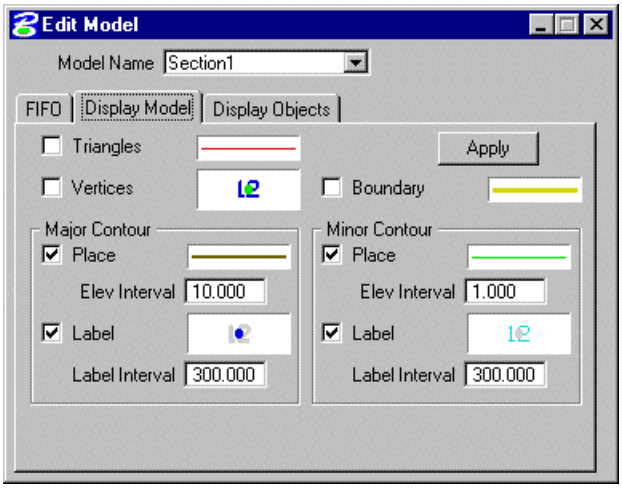
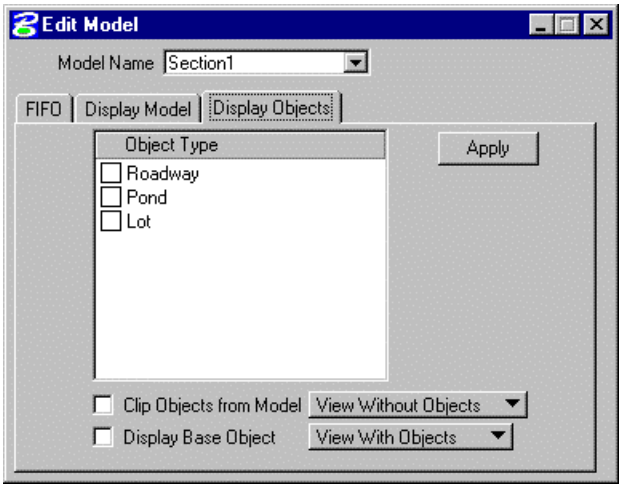
DISPLAY MODEL TAB

The Display Model Tab is utilized to control the visualization settings of the active Model. The dialog is depicted below and contains specifications for features displayed within the Model including triangles, boundaries and vertices. When the toggle to the left of the feature is active the element is displayed. When inactive the feature is not displayed. To the right of each feature is the level and element symbology.



DISPLAY OBJECTS TAB



Object Type	List box containing all Object Types in the current model. If the User clicks the box to the left of the Object Type in the list, an "eye" icon is displayed. All objects of the activated type are displayed with their visualization settings.
Clip Objects from Model	When activated, this clips every object out of the model prior to display. It is good for showing proposed vs. existing.
Display Base Object	This toggle indicates whether the Base Object should be displayed with its visualization settings.
Apply	Applies any changes that have been made to this tab.

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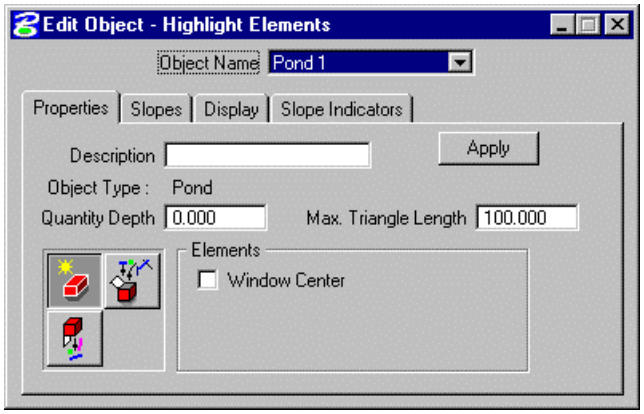
OBJECTS MENU

The Object menu selections provide tools to Add, Edit, Copy, Move, Raise, Lower, or Delete an Object. Also allows the User to draw Profiles and Cross Sections directly from the Site Objects.

EDIT OBJECT

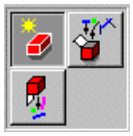
The Object editing options provide the mechanism to modify an Object's properties, side slopes, display settings and to display Slope Indicators.



OBJECT PROPERTIES

Under the Properties Tab the Object Name for the object to be edited is displayed in the dialog. A description can be entered if desired. Quantity Depth is the vertical depth beneath an Object where the earthwork volume is adjusted to compensate in the total volume.

Note that this depth is applied to the limits of the Object's elements and is optional when Volumes are computed. Three tools are supported within the Elements group box. Highlight and/or window center Site elements within the Active Site Object. Add previously created Site Elements to the Active Site Object and Remove Site Elements from the Active Site Object.



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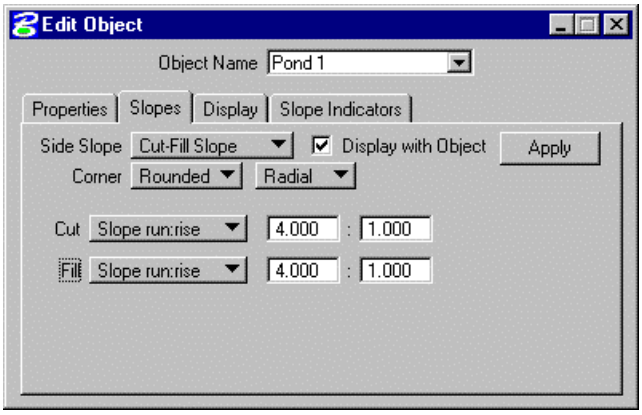
OBJECT SLOPES TAB

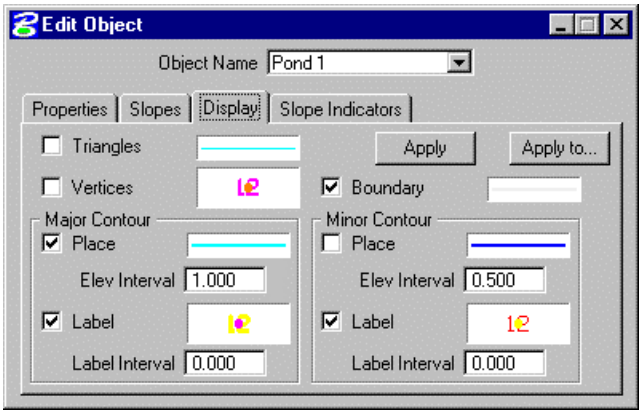
The Slopes options dictate the type of side slopes generated from the outer extent or boundary edge of the Object. These slopes are applied when the Object is placed into a Model and computed from the Object to whatever the state of the Model when it is merged. When the Display with Object toggle is activated, GEOPAK includes the display of slopes in the Object symbology.



There are four slopes options available: No Slopes, Cut - Fill Slope, Cut-Fill Table, Dynamic Slopes. Corner Options can be specified to generate either Rounded or Straight slopes around corners of Objects.

DISPLAY OPTIONS TAB

The Edit Object Display tab is utilized to control the visualization settings of the Object displayed in the dialog. The dialog contains specifications for features displayed including triangles, boundaries, and vertices. When the toggle to the left of the feature is active, the element is displayed. When inactive the feature is not displayed. To the right of each feature is the level and element symbology.



SLOPE INDICATORS TAB

The Slope Indicators Tab is used to set the display preferences of Object Slopes Indicators.

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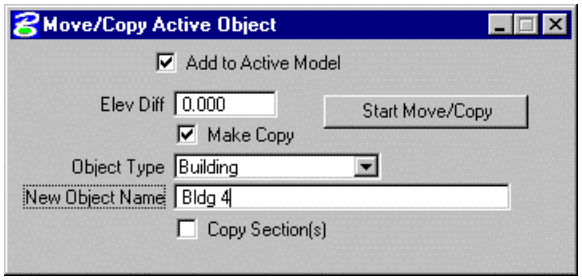
COPY OBJECT

The copy tool is useful when the object is comprised of numerous elements which need to be copied. When invoked, the dialog depicted opens.

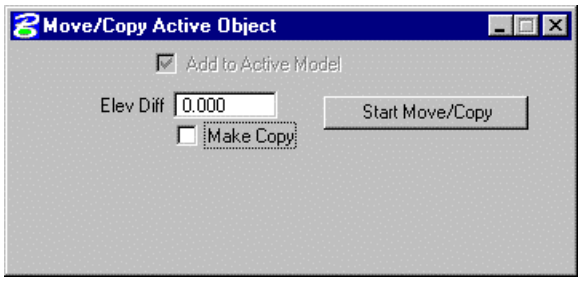
To copy an object, simply key in the Elev Diff (0 if there is none), then click Start Move / Copy and identify the object to be copied. A second data point defines the revised location.



Note When the Make Copy toggle is not activated, the dialog dynamically changes to a Move Object dialog.

MOVE OBJECT

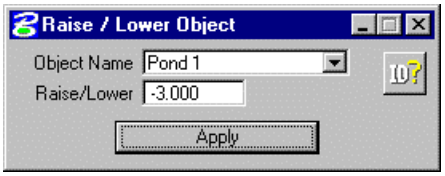
To move an object, simply key in the Elev Diff (0 if there is none), then click Start Move / Copy and identify the object to be moved. A second data point defines the revised location.



Note When the **Make Copy** toggle is activated, the dialog dynamically changes to a copy Object dialog.

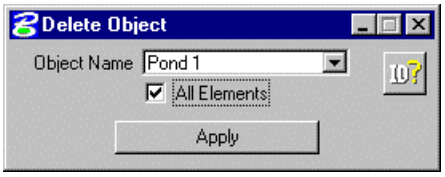
RAISE/LOWER OBJECT

Raise/Lower Object tool can be used to change the elevation of an entire object by raising or lowering it. Note the value is in terms of master units, i.e., feet or meters.



DELETE OBJECT

The Delete Object tool deletes the entire object from the project file and (if desired) all the Site elements that are part of the Object.



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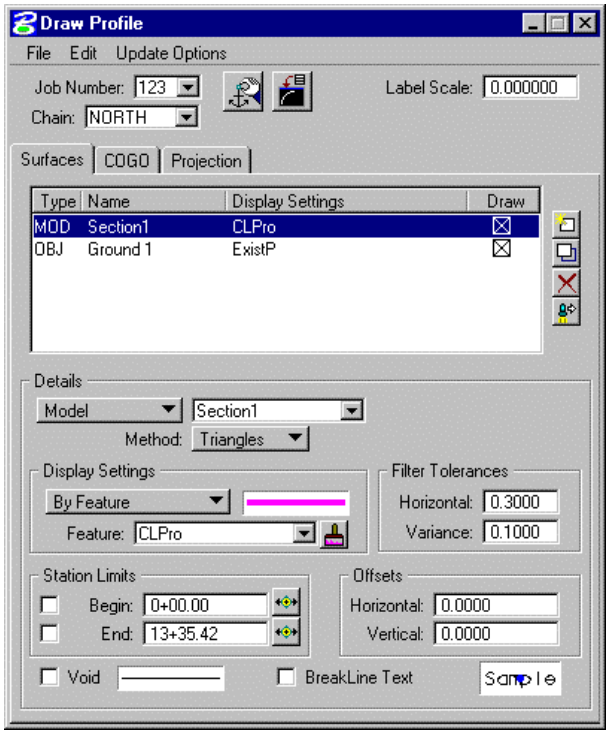
DRAW PROFILES

The Draw Profile tool enables the User to draw several profiles from a variety of sources simultaneously.

- Surfaces: Allows the User to draw “ground” profiles for the specified Chain based on the Model, the Model Base, a specific Object, an Object and it’s slopes or a TIN file.
- COGO: Allows the User to draw profiles for the specified Chain from profiles stored in COGO.
- Projection: Allows the User to draw profiles that are based on another COGO Chain or Survey Chain into the current Chain’s Profile Cell. *This is very useful when designing alignments or elements that run “parallel” to other roads or survey features.*



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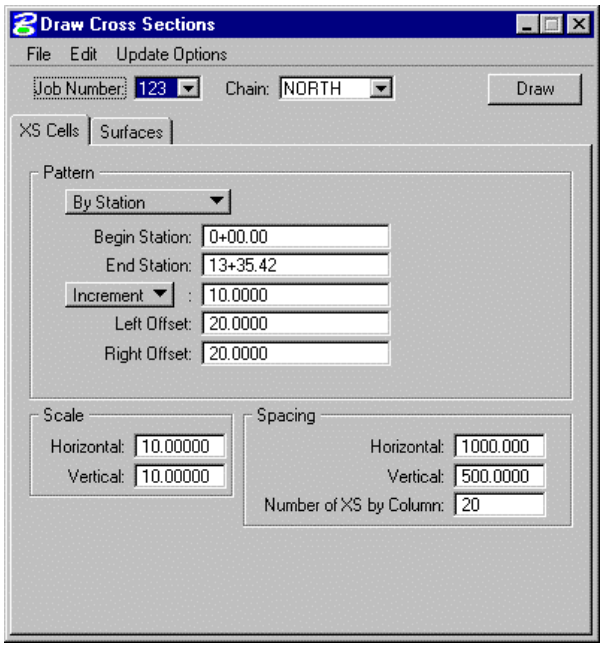
DRAW CROSS SECTIONS

The Draw Cross Sections tool draws existing ground cross sections (within a 2D MicroStation design file) utilizing a GEOPAK binary DTM file, Site Object or Site Model.



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ELEMENTS MENU

The fundamental components in the GEOPAK Site Modeler are Site Elements. Site Elements are simply MicroStation graphics (2D or 3D) that have been assigned elevations using one of these Site Element tools.

GEOPAK Site Modeler supports a wide variety of tools that when combined with generic MicroStation commands create and modify elements. These operations include:

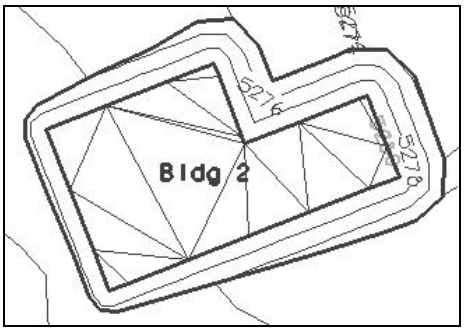
- Creating / editing elements
- Changing element feature types
- Change Element Associations
- Raising/Lowering of elements
- Copy parallel existing elements
- Modifying elements
- Deleting element Z
- 3D elements
- Composite Sections
- Edit Profile
- Element Information

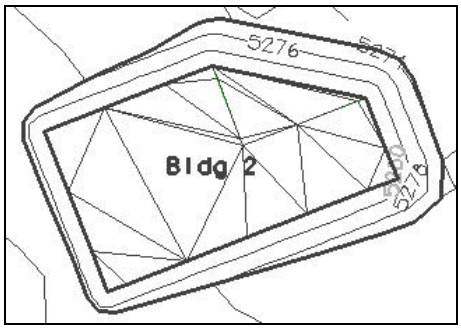
Note The 3D Element is active only within MicroStation 3D design files.

ELEMENT FEATURE TYPES

All Site Elements require a Feature Type to describe the way in which to process and interpret the element within the digital terrain model.

A Boundary is used to constrain the external boundary of the object or model. For example, an L-shaped building can be defined as a boundary so that no triangles are created within the internal corner. If the elements are defined as breaklines, the limits of the object would result from the convex area of all the elements contained in the object.





Feature types can be modified at any point in the design to create the desired results. It is often desirable to leave features as break lines until the object design is near completion and then the required elements can be specified as boundaries.

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Break Lines designate linear features such as edges of buildings, parking lots and other pavement. The generated triangles never cross a break line; rather the edges of the triangles are coincident with a break line.

A Contour is an element of constant elevation. The generated triangles never cross a contour; rather the edges of the triangles are coincident with a contour.

A Void delineates an area of no data or obscured area and is defined in a series of points forming a closed element.

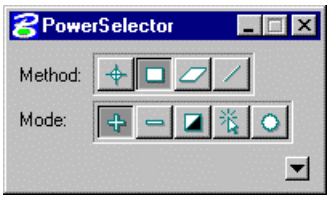
A Hole is extremely useful when the base object surface (i.e., existing ground) is desired within an object. For example, an area of existing within a building footprint is to be landscaped and remain at the original ground elevation, while surrounded by a building pad.

SELECTION SETS

Many of the Element tools utilize selection sets, therefore, a generic discussion is warranted into the operation and use of selection sets. Two options are supported: the MicroStation Power Selector or GEOPAK selection tools within each dialog.

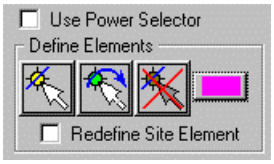
USE POWER SELECTOR

When active, the MicroStation Power Selector is utilized. To invoke, click Select Elements in the Element Selection group box.



GEOPAK SELECTION TOOLS

Selection commands can be utilized without the Power Selector. The leftmost button is Select Elements. Simply click and then select the desired elements. To select multiple elements, depress <Control> on the keyboard while selecting.



After utilizing numerous MicroStation commands, the highlighted elements may not be highlighted. To display previously selected elements, click Reselect Elements (center of the three) and the highlighted elements are displayed again in the specified color. To remove all selected elements from the selection set, press the Reset Selection Set button (rightmost of the three). The color of the selected elements is set with the color picker on the far right side of the group box. Note that Element Selection must be invoked through these selection icons. While the Site Modeler uses a selection set, it must be started through the use of these commands, not the MicroStation Selection set commands.

Hint To turn off and on handle display, use the Disable Edit Handles setting on the Preferences dialog box, Operation category (Workspace > Preferences). If handles are disabled, when you select an element it is highlighted with a specified color.

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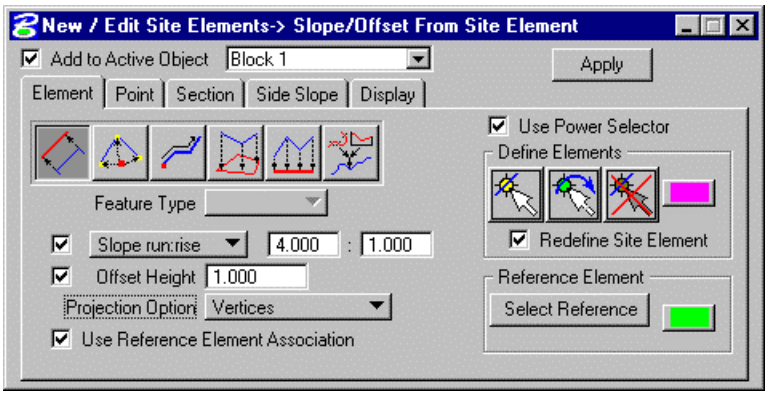
NEW/EDIT SITE ELEMENTS

One of the primary tools within Elements is the New / Edit Elements tool. When invoked, the dialog depicted below is displayed.

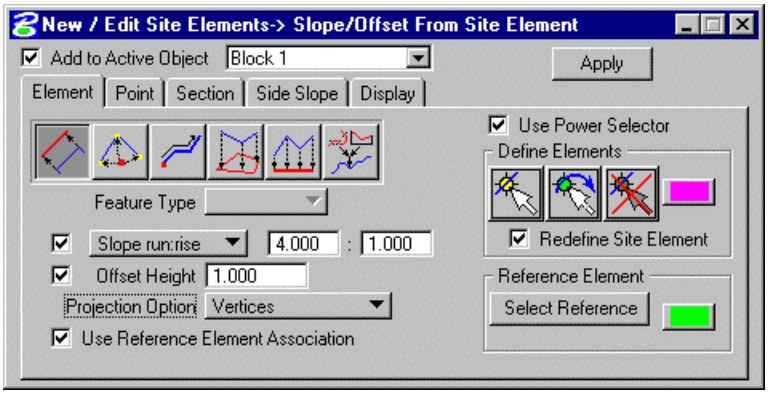


The dialog contains five main options: Element, Point, Section, Side Slope and Display. When a tab is selected, the dialog dynamically changes to reflect the selection. The fields below are displayed regardless of which tab is selected.

Add to Active Object	When toggled ON, created and/or edited elements are automatically added to the active object. The Active Object is displayed on the New/Edit dialog.
Current Object	Located between the Add to Active Object and Apply, the active Object can be selected.
Apply	Commences the processing. This includes redrawing of the elements, inclusion into the active object and, if the active object is part of a model, reprocessing of the model.

ELEMENT TAB OPTIONS

The element options provide for the primary mechanism for the creation and redefinition of Site Elements. When the Element tab is selected, the dialog depicted below is displayed.



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Six tools to assign or modify elevations are provided. As each option is selected, the title bar as well as the left side of the dialog dynamically changes to reflect the selection.

Slope/Offset from Site Elements 	The Slope/Offset from Site Element option is used for assigning elevations to Site Elements by placing the elements at an optional slope and offset height from existing Site Elements. In calculating the elevation from the existing Site Element, a projection is performed from the new Site Elements to the reference based on the minimum distance from the element to the existing reference element.
Radial From Existing Points 	The Radial From Existing Point option is useful for establishing the elevation of elements relative to a specific point within another Object or Model. The tool uses a reference data point elevation and an optional slope and offset height to compute the elevation for the new element vertices.
Along Element From Existing Point 	The Along Element from Existing Point tool assigns the elevations along an element at a constant slope and/or offset height from a data point. The data point will be projected to the element and the distance along the element from this point to the vertices will be used in conjunction with the slope and offset height to compute the elevation of the new element vertices.
Drape on Model / Object 	The Drape on Model/Object tool is used to establish the elevation of Site Elements relative to the elevations contained in a model or object. It can be useful to set the elevation of elements relative to existing ground or another object.
Constant Elevation 	Placing elements at a Constant Elevation may be utilized when the desired elevation of an element is known. It can be used to set the elevation of a building or even place a contour into an object. If the computed contours within an Object do not exactly match the desired results, simply draw the contour wanted and then place in the Object as a Contour Feature at a constant elevation.
Alignment 	The Alignment tool is used to create Site Elements from a GEOPAK horizontal and vertical alignment. The alignments must have previously been created using one of the GEOPAK Coordinate Geometry features or the Horizontal and Vertical Alignment Generators. Once a Site Element is created from an alignment, the curbs, edges of pavement, etc., can be created using one of the other Site Element Creation tools based on this alignment. Typically this would be the Slope/Offset from Site Element.

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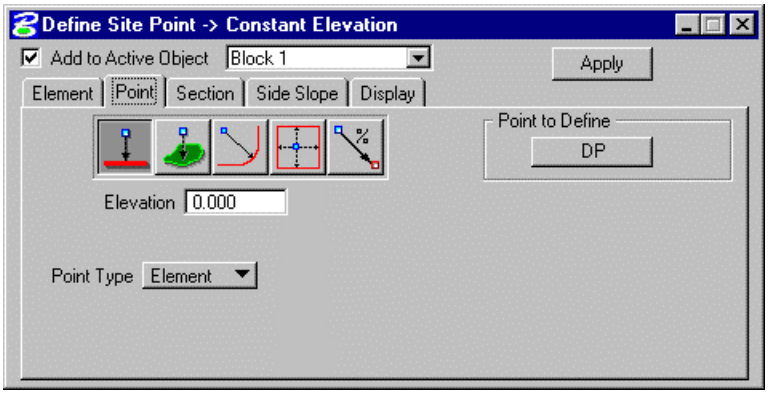
POINT TAB OPTIONS

When the Point Tab is selected within the New/Edit Site Element dialog, the dialog changes as displayed below.



Point elements can be created and added to Objects to refine the surfaces or edit the vertices of exis ting Site Elements. When placing points, the Site Modeler can detect when an existing Site Element is snapped to. If there is an existing vertex at the snapped location it will be reset to the new value. If no existing Site Element is detected, a MS point graphic element will be added to the design file and the Active Object.

If a point is snapped to a Site Element, but not to a natural vertex of the graphic element, the Site Modeler will actually insert the point along the Site element. This point is now considered dependent on the site Element and as the element is modified or moved, so will the point.

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Five options are supported within the Point tab.

As each option is selected, the title bar as well as the left side of the dialog dynamically change to reflect the selection. These options include:

Constant Elevation 	Used to add a point or edit a vertex of an existing Site element at a constant elevation.
Drape on Model / Object 	The Drape on Model / Object option is useful for placing or editing points and placing them at an elevation relative the elevation in a Model or Object.
Slope from Site Element 	The Slope from Site Element option is used for placing points at a given slope from a Site Element.
Min. / Max. Elevation at Slope From Elements 	The Min. / Max Elevation at Slope from Elements option is used for placing points at the minimum or maximum elevation computed from a set of Site Elements. It can be used to insure a low point or high point amongst elements.
Slope from Point to New Point 	The Slope from Point to New Point option is used to create a point at a given slope to an existing point in an object or model.

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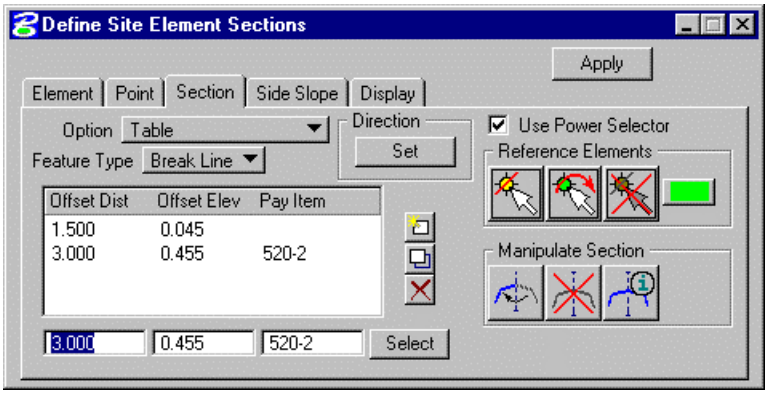
SECTION TAB OPTION

Sections are special Site Elements that are created and attached to existing Site Elements to define a constant vertical and horizontal offset from the existing element(s). It can be used to attach curb and gutter sections to the edge of pavement, retaining walls or benching sections.



Section Elements is another feature where the MS graphics are actually created by the Site Modeler in the active MS symbology. Section elements cannot be directly edited; they are locked and connected to the elements on which they are placed. As the Site Elements containing the section are modified, moved, deleted or elevations reassigned, the Section Elements are automatically updated accordingly.

Provisions for assigning sections to multiple Site Elements at once, even disconnected Site Elements, are available. This capability is provided by gathering all the Site Elements selected for section placement and assigning the Direction or which side to place the section element. The Site Modeler may not be able to logically determine a direction given very complex sets of Site Elements. Suitable messages are provided in this case and a smaller selection set of Site Elements should be used.

CREATING SECTIONS

The following is the procedure for creating Section Elements.

- Select the Reference Elements to place the section on. It is recommended that the Power Selector be used in Single element select mode. If the elements are chosen in an order which would easily accommodate chaining the elements together the resulting sections will be simplified.
- Determine if a cell or table of horizontal and vertical offset is desired and populate the dialog.
- Click **Set** and set the direction – this will indicate the side of all the elements for which to place the Section Elements. It indicates the positive horizontal offset direction.
- The Site Modeler attempts to chain all the elements together and then determine the side based on a single data point. If the element selection does not easily facilitate this process, it may be necessary to hit any key and reselect a smaller set of elements.
- Once the Site Modeler has chained the elements together, a dynamic display will indicate which direction would correspond to positive offsets.
- Set the Feature Type and click Apply.
- The Section Elements are created and added to all the Objects that contain the Site Elements for which they were placed.

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MANIPULATING SECTIONS

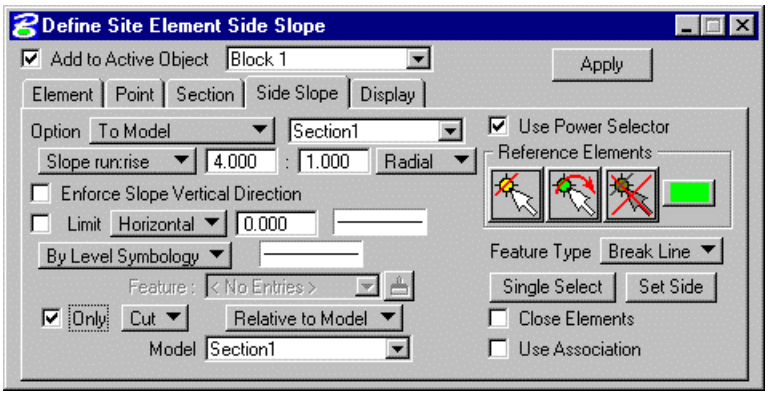
The Manipulate Section has three tools, as detailed in the table below.

Reverse Section 	Flips the sections of the currently selected Site Elements to the other side of the Site Elements.
Remove Section 	Removes the sections from the selected Site Elements. Since Section Elements are locked, this is the only way to remove them from graphics.
Query Section 	Queries a Site Element to see if it that currently has a section attached and, if it does have a section attached, populates the offset table with the values from the attached section.

SIDE SLOPES TAB OPTIONS

This tab creates Site Elements based on a variety of slope options. It utilizes the stroking tolerance of the original element during creation. One typical application is creating bench sections.

This is a very powerful tool that has a large number of setting options to control the created element.



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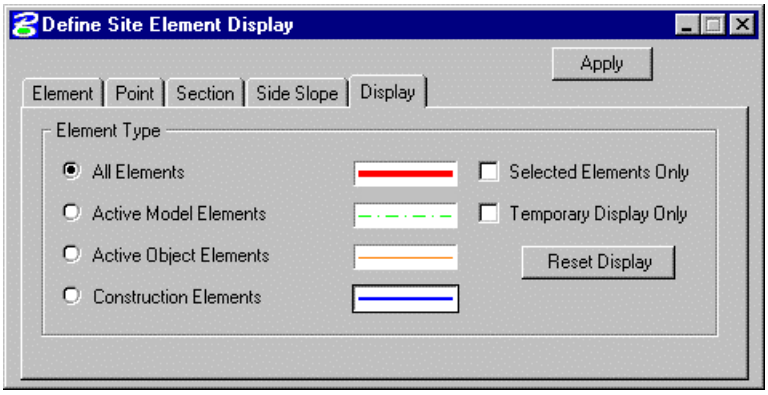
DISPLAY TAB OPTIONS



Element symbology is supported in this dialog for the following elements:

- All Elements
- Active Model Elements
- Active Object Elements
- Construction Elements

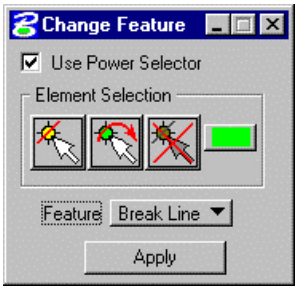
Activate the desired elements option. Options are also supported for:

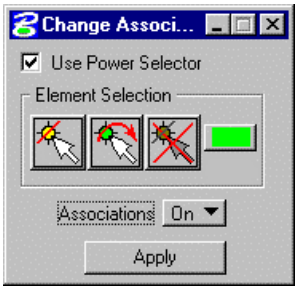
- Selected Elements Only
- Temporary Elements Only

Both of these toggles may be active simultaneously. Reset Display redisplays the Elements within the selected group in the desired symbology.

CHANGE SITE ELEMENT FEATURE & ASSOCIATIONS

These two element tools can be used to change the feature type of a previously defined site element or group of site elements as well a turn on or off the site element associations.





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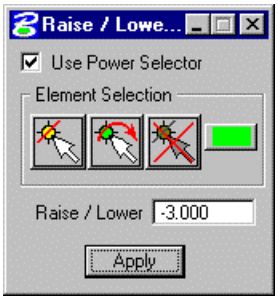
RAISE/LOWER SITE ELEMENTS

This tool is utilized to change the elevation(s) of an existing element or group of elements.



MODIFY SITE ELEMENTS

A variety of tools are supported to modify existing site elements.

The tools (from left to right) are:

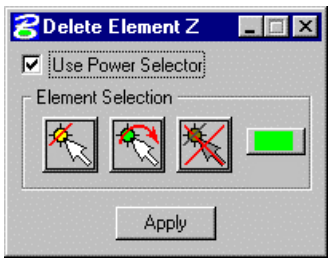
- Site Element Extend Line
- Site Element Extend Arc
- Site Element Extend to Intersect
- Site Elements Extend Both to Intersect
- Site Elements Fillet
- Site Elements Chamfer

All tools function identically to their generic MicroStation counterparts, except the Extend to Intersect and Extend Both To Intersect. These two commands have elevation options to be considered. The Modify Element Tools are only available within a 2D MicroStation Design File.

DELETE SITE ELEMENTS

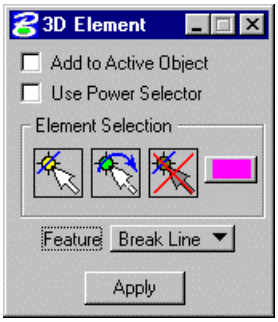
This tool is used to delete a Site Element that is associated with a MicroStation Element.

It does not delete the MS graphical element – just the Site Modeler link to that graphic.



3D ELEMENT

Elements placed at the correct X, Y, Z coordinates within a MicroStation 3D design file can be utilized in the Site Model by using this tool.



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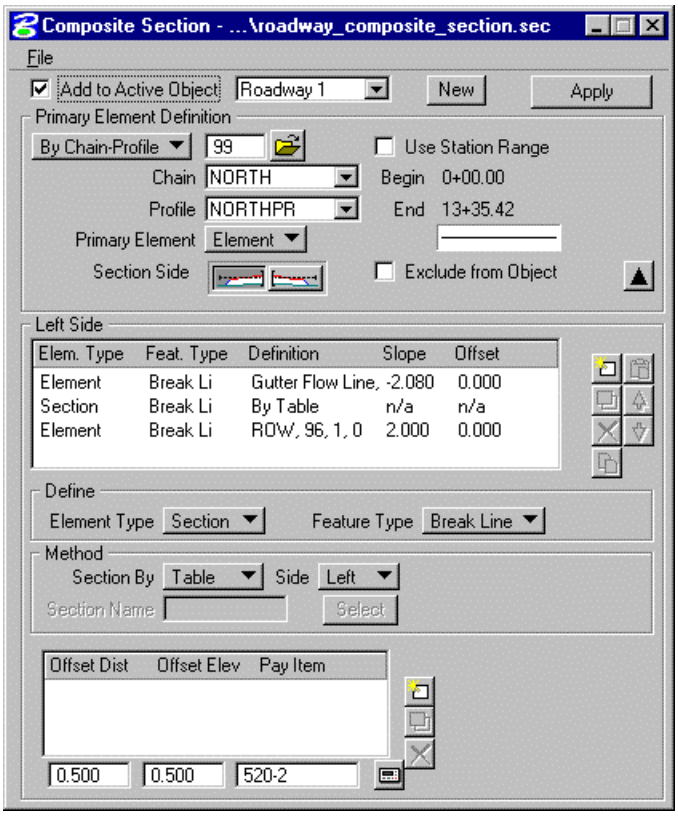
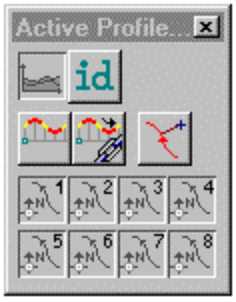
COMPOSITE SECTION TOOL

The Composite Section Tool is used to create multiple Site Elements that will be grouped into a Site Object. This tool can be useful for creating Roadways, Channels, Levees, etc.



EDIT PROFILE



The Edit Profile tool allows the User to select a single Site Element or a series of connected Site Elements and redefine the element/elements elevations.

After the element/elements are selected a profile representation of their current elevations is created and placed into a profile cell. Now the User can place vertical tangents and curves to redefine a portion or all of the profile. The redesigned portions of the profile are then returned to the original Site Elements.

We track the extent of each plan view graphic, which enables us to send the new elevations back to the correct elements.

The selected elements do not need to be in the same Object.

This is a very powerful tool.

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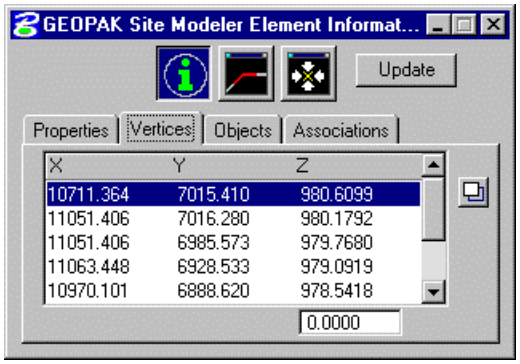
SITE ELEMENT INFORMATION

The Information Tool can be used to display coordinate information, Feature type, stroking information, Member Objects and Site Element Association information. Most importantly however, the Information Tools can be used to quickly change element information when needed. The dialog shows one tab of the Information Tool dialog. Any vertices of the Site element can be modified and returned to the Site Element to achieve the desired result.



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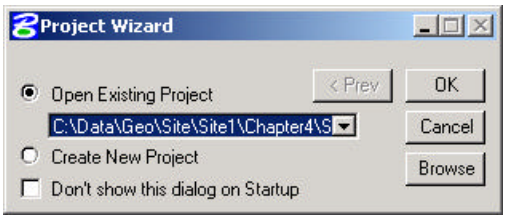
WORKSHOP: DESIGNING A SITE MODEL

During this workshop we will learn how to use Site Modeler to assist us in creating a final site design surface. The workshop consists of several exercises. The exercises will address creating and manipulating Site Elements, Site Objects and Site Models within our GEOPAK Site Project. We will gain considerable experience in how to create Roadways, Buildings, Parking Lots, Ponds and Retaining Walls. After the successful completion of the workshop in the previous Section, we should have a GEOPAK Site Model called Tower, which at this point is composed of our existing ground Site Object, Ground1.

Opening an Existing Site Project

1. Open the MicroStation file *..\Data\Geo\Site\Site1\Chapter4\Siteplan2D.dgn*.
2. Select the **Site Modeling** tool (*Applications > GEOPAK Site > Site Modeler> Site Modeling)*.



3. Enable **Open Existing Project**.
4. Click **Browse** and select *..\data\geo\site\site1\Chapter4\siteplan.gsf.*
5. Click **OK**.

The conventional design process may typically start by creating the various access roads first. However, for the purpose of this training session, we will start by creating a building. This will allow us to explore some basic tools within GEOPAK Site Modeler before moving on to more sophisticated tools that will be used during roadway design.

Creating a Building Object Type

We are now going to create a building pad and add the building pad to our Site Model. We have a previously placed MicroStation shape that represents the footprint of our building. We will assign an elevation to this element based on the current existing ground conditions; place the element in a building object that, in turn, will be placed into our model.

1. Select the MicroStation Saved Views tool *(MS: Utilities menu > Saved Views).*
2. Select **Bldg**.
3. Click **Apply**.

   This will center the building graphics in the Microstation view.

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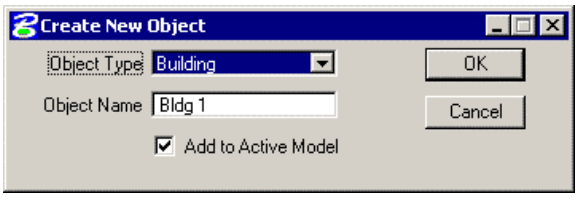
4. Select the **Create New Object** tool *(Site Modeler menu: Object > New).*



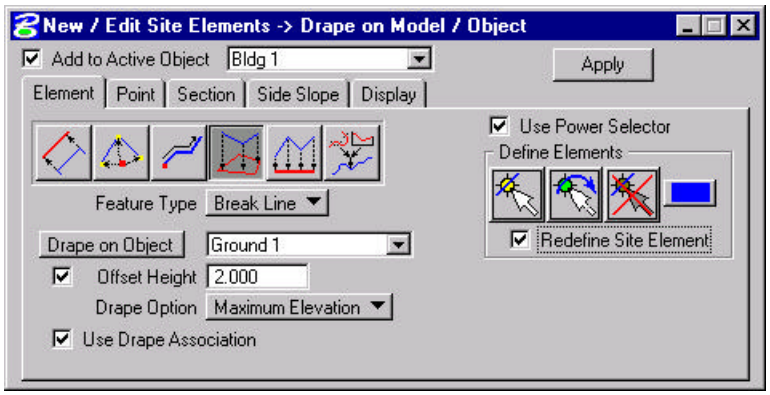
5. Enter the New Object information.

Object Type:	Building
Add to Active Model:	Toggle On

This creates an Object Name of Bldg 1 based on the naming prefix assigned to this Object type. We shall use the default Object Name.

6. Click **OK**.

7. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit).*



8. Click **Drape on Model/Object** on the **Elements** tab.

9. Enter the Element information.

Feature Type	Break Line
Drape on Object	Exist Ground
Offset Height	Toggle On, 2.0
Drape Option	Maximum Elevation
Use Drape Association	Toggle On

10. Click **Select Elements** in the Define Elements group box.

11. Select the building footprint in MicroStation.

Note The element highlights when selected. Ensure it is the same color as your highlight color.

12. Click **Apply**.

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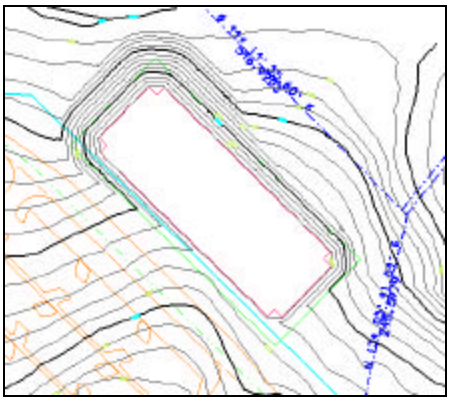
Once the building pad is successfully added to the model the contours are drawn.

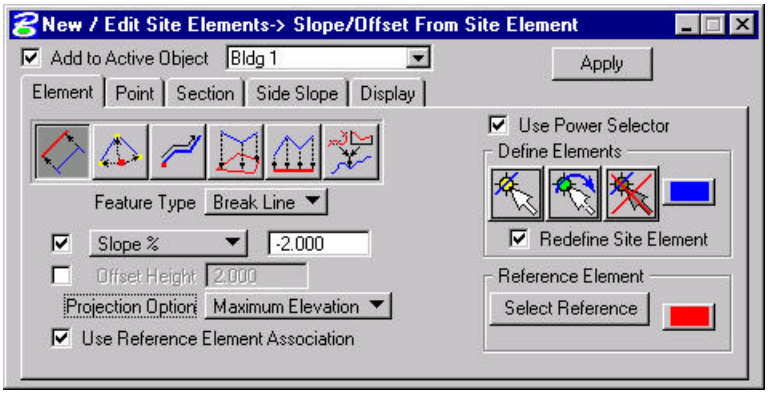


Building Pad and associated contours

Adding A Grass Area Around The Building

We will now add a grass area around the building pad element. This grass area will have a -2% slope away from the building to ensure proper drainage. It should be noted that an element representing the outer boundary of this grassy area has been drawn into the file.

1. Continuing with the **New / Edit Site Elements** tool, click **Slope/Offset From Site Element** on the Element tab.



2. Enter the Element information.

Feature Type	Break Line
Slope %	Enable, -2.0
Projection Option	Maximum Elevation
Use Reference Element Association	Enable
Use Power Selector	Enable

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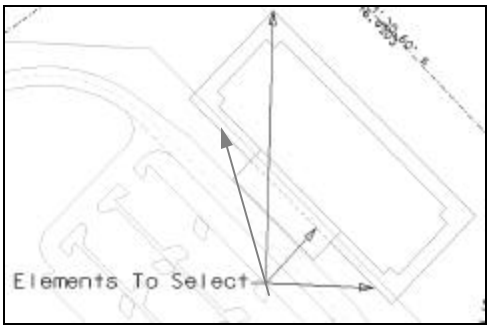
3. Click **Select Elements** in the Define Elements group box.

   Define Elements are those elements that we will calculate elevation for based on a user defined relationship with another previously created site element (The Reference Element). In our case the relationship is a –2% slope from the edge of the building pad.

4. Select the elements which comprise the outline of the grass area.

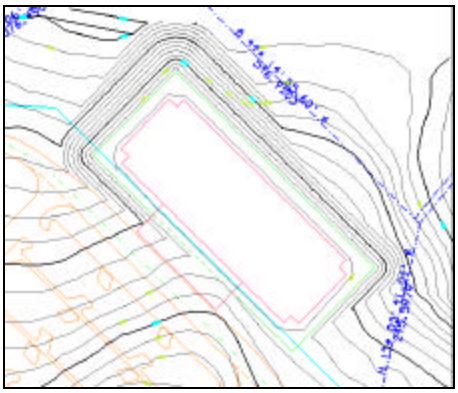
Hint The elements are the solid and dashed green lines around the building outline.



Elements selected as part of the grassy area.

5. Click **Select Reference**.
6. Select and accept the previously created building pad site element.
7. Click **Apply**.

   The grass area elements are added to the BLDG 1 object.



Building Pad, Grass Area, and Associated Contours

This completes our building object for now. We may come back later and change it in some way, possibly raising or lowering it.

Next we will look at various tools in conjunction with creating a roadway object. It should be noted that the roadway alignment and profile have previously been created and we will simply use them in our design process. Future sections of this training guide will demonstrate in more detail how to create alignments and profiles within the GEOPAK software.

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Creating A Roadway Object

1. Select the MicroStation **Saved Views** tool *(MS: Utilities menu > Saved Views).*
2. Select Main and click **Apply**.
3. Disable **Display View** 1 on the Active Site Object Control dialog.

4. Select the **Create New Object** tool *(Site Modeler menu: Object > New).*

5. Enter the Create New Object information.

Object Type:	Roadway
Object Name:	Main Rd
Add to Active Model:	Enable

6. Click **OK**.

Creating the Roadway Elements - Centerline

The first step in designing the roadway is to establish the centerline site element. Again, we have an alignment and profile that have been previously created. Using the GEOPAK New/Edit Element tool, we will use those to create our centerline site element. Then we can continue with other roadway features such as edges of pavement, shoulders, curb and gutter, etc.

1. Select the MicroStation **Fit View** tool *(MS: Tools >View Control > Fit View).*

Hint As we will create the centerline graphic with Site Modeler tools, we will delete the current graphic before proceeding.

2. Select the MicroStation **Delete Element** tool *(MS: Tools >Main menu > Delete Element).*
3. Select and accept the main road centerline (dashed green complex element).

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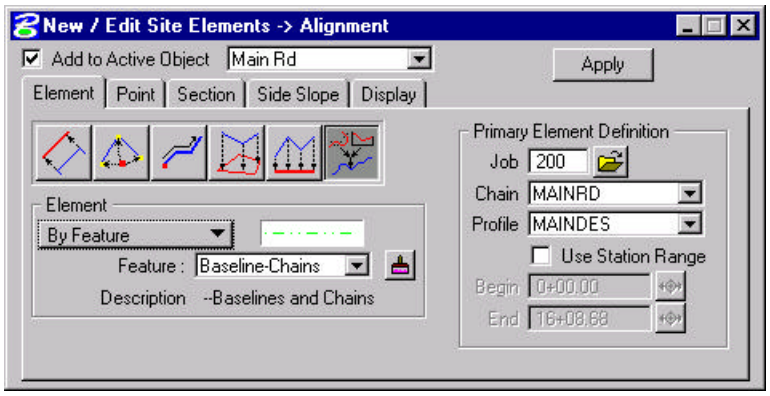
4. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit).*

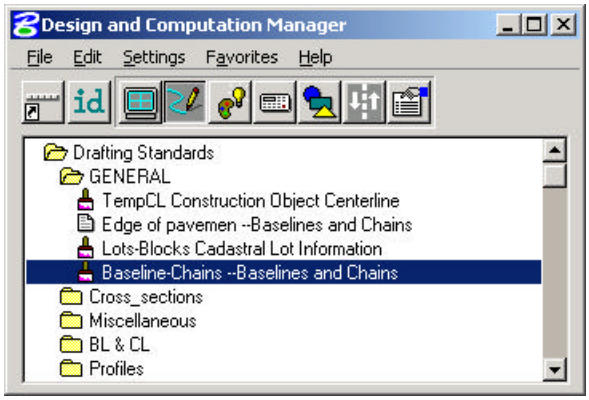


5. Click **Alignment.** *(right tool under the Elements Tab)*

6. In the Element Group Box, set **By Feature.**

   The By Feature option allows us to select an item from our feature database. The item we select would contain all the information to draw the element in MicroStation. The element would be drawn at the correct level, weight, color, style, etc. that conforms to our company/client standards.

7. Click **Select Payitem** *(paintbrush)* and navigate to Drafting Standards > General > Baseline-Chains.



8. Select the item and click **OK**.

9. In the Primary Element Definition group box, click **Open GPK File** (*folder*).

10. Select **job200.gpk** .

11. Click **OK**.

12. Set the **Chain** to **MAINRD**.

13. Set the **Profile** to **MAINDES** .

14. Click **Apply**.

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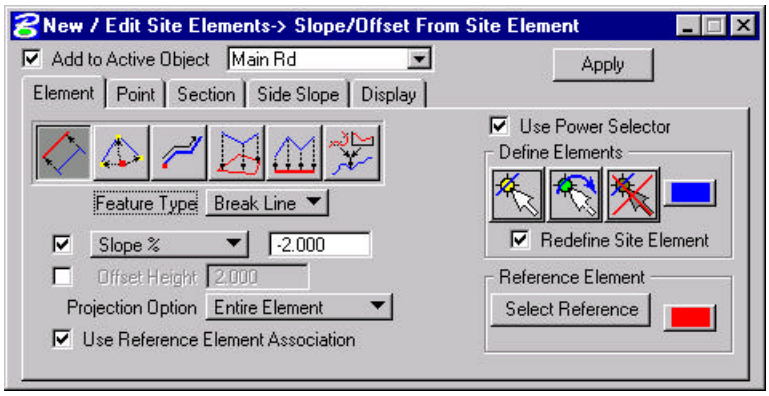
Creating the Roadway Elements – Edges of Pavement

Now that the centerline site element has been created, we will use the centerline to establish the appropriate elevations for the edges of pavement. The edges of pavement will be based on a –2% cross slope from the centerline element.

1. On the **New/Edit Site Elements** dialog, click **Slope/Offset From Site Element**.



2. Enter the Element information.

Feature Type	Break Line
Slope %	Toggle on, -2.00
Projection Option	Entire Element
Use Reference Element Association	Toggle on
Use Power Selector	Toggle on
Redefine Site Element	Toggle on

3. Click **Select Elements** from the Define Elements group box.
4. Select all edges of pavement on the left and right side of the Main Road.

Hint Do not select the dashed elements in the intersection or the curb return elements joining the two roadways. We will create the design for those in future steps.

5. Click **Select Reference** from the Reference Element group box.
6. Select and accept the centerline element
7. Click **Apply**.

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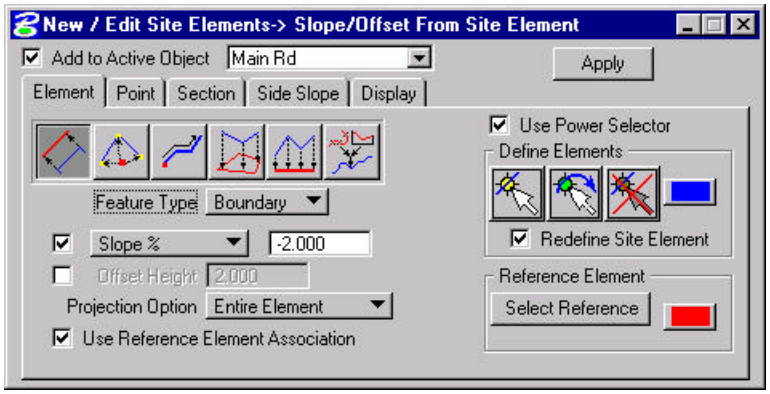
Now the edges of pavement for the roadway have been created. Next we will design the elements in the intersections of the roadways. These will also be calculated at a –2% cross slope from the centerline. The only difference is we will create these elements as a boundary feature type.



8. Change the **Feature Type** to Boundary.
8. Click **Select Elements** from the Define Elements group box.
9. Select the two dashed line elements in the intersection of the two roadways.
10. Click **Select Reference** from the Reference Element group box.
11. Select and accept the centerline element.
12. Click **Apply**.
13. To see the results, enable the **Display View** toggle on the **Active Site Object Control** dialog.

Note Use the Display View toggle whenever you wish to navigate the design file quickly. As long as the Display View is enabled, contours are drawn with every view change. Zoom window, pan, fit view, etc.

Creating the Roadway Elements – 6' Outside Shoulder

Now it is time to design the elements outside the edges of pavement. For our project we are proposing a 6' paved outside shoulder with a 3% cross slope. However, as we will see later, one could construct any type of roadway feature. The designer has the ability to make the typical section as elaborate and detailed as necessary.

1. Disable **Display View** 1 on the Active Site Object Control dialog.

   This will make the edge of pavement elements easier to select.

2. Select the **New / Edit Element** tool *(Site Modeler menu: Element > New/ Edit).*

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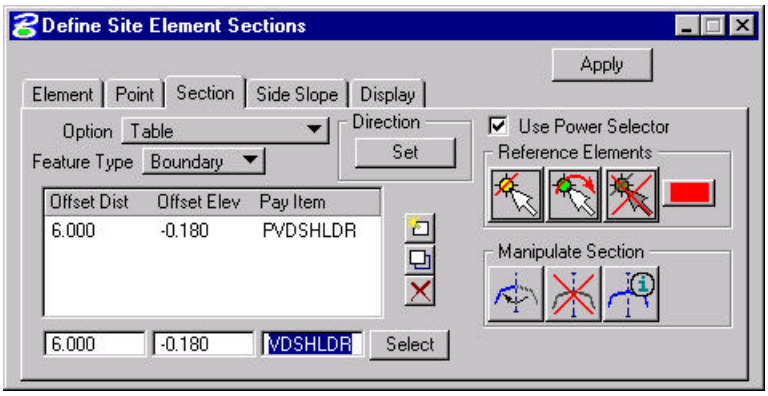
3. Select the **Section** tab.



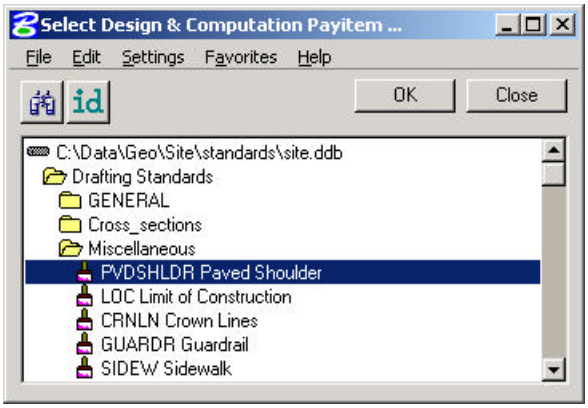
4. Enter the Section information.

Option	Table
Feature Type	Boundary

5. Enter the information in the edit boxes along the bottom.

Offset Distance	6
Offset Elevation	-0.180

6. Click **Pay Item** and navigate to Drafting Standards > Miscellaneous > PVDSHLDR.



This item contains all the necessary information on how to draw the paved shoulder line in MicroStation.

7. Select the item and click **OK**.
8. Click **Add List Item** (right side of the table entries).
9. Click **Select Reference Elements** from the Reference Elements group box.

   The reference elements are those elements that we are planning to put the section on. In our case, we plan to place the section off of the edges of pavement.

10. Select the edges of pavement elements previously created. Do not select the dashed lines in the intersection of the roadways.

Hint There should be 8 elements in the selection set. This value is displayed in the bottom right hand corner of the Microstation Window.

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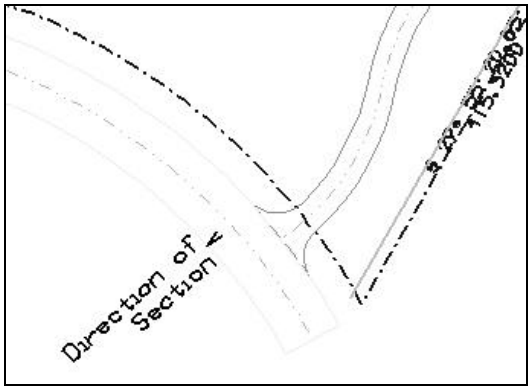
11. Click **Set** from the Direction group box.
12. Data point outside the edge of pavement.



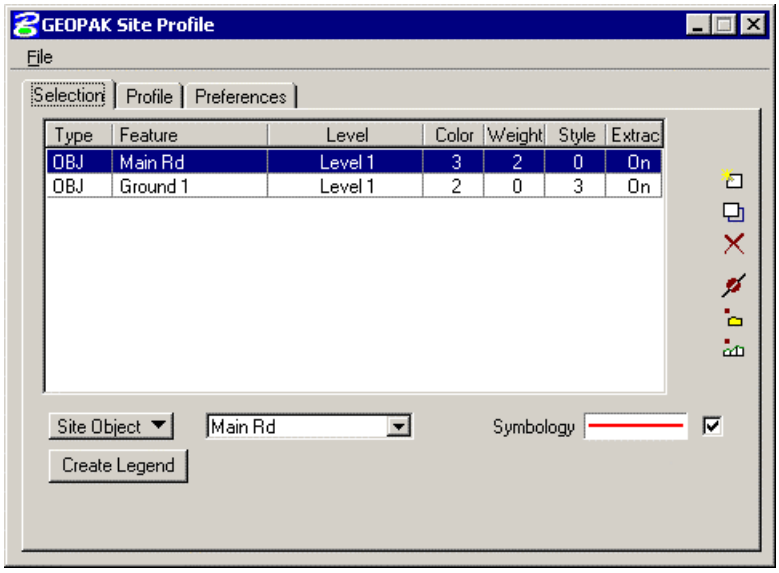
Direction of Section Elements

13. Click **Apply**.

Cut Profile/Section Across Roadway

Let's use the GEOPAK Site Profile Tool to cut a profile across the roadway.

1. Select the **Site Profile** tool. *(Site Modeler: > Analysis > Profiles).*



From the Selection tab, we will create a list of Site Objects to cut a profile across.

2. Select **Site Object** and Exist Ground.
3. Set the element symbology (level 1, color 2, style 3, weight 1) by double-clicking the sample line graphic.
4. Click **OK** to close Set Feature dialog.
5. Click **Add List Item** (right side of dialog).
6. Change the **Site Object** to Main Rd.
7. Set the element symbology (level 1, color 3, style 0, weight 1).

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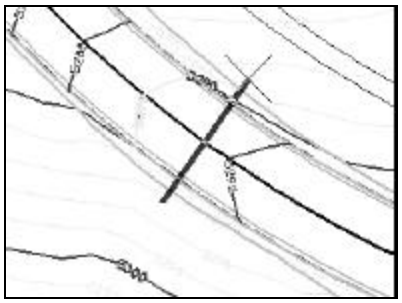
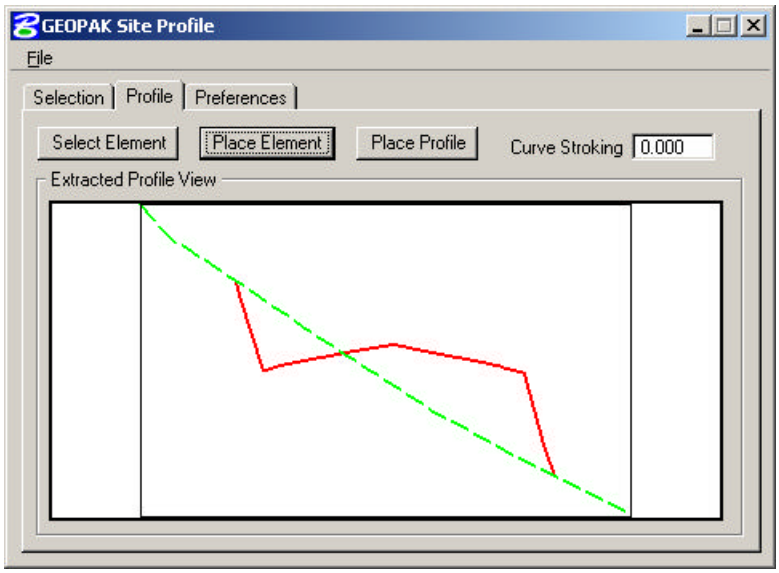
8. Click on the **Profile** tab.
9. Using the **Window Area** tool located along the bottom of the MicroStation View window. Zoom in to any particular area along the roadway.



10. Click **Place Element**.
11. Data point on each side of the roadway.

    The profile is displayed in the Extracted Profile View area. To extract a different profile in another location, simply place data points in two more locations.



12. Reset (right mouse button) when done.
13. Close the **GEOPAK Site Profile** dialog.

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EDIT PROFILE

The GEOPAK Edit Profile Tool allows site elements to be redefined and edited using the component based vertical alignment tools. It also allows usage of MicroStation tools to place site elements in any view in accordance with the curvilinear coordinates settings.

There are a series of steps the User must undertake to use this tool for the redefinition of vertical geometry of existing Site elements.

1. Create a profile cell based on the elements that are to be redefined. Use the Profile Cell Setting Dialog to achieve this step.
2. Place vertical components over part or the entire profile to accurately define the proposed vertical information.
3. Apply this new vertical geometry back to the existing Site Elements using the Define Site Element Profile tool.
4. The existing elements will be redefined using the vertical information from the vertical components. The interval that the new Z values will be replaced is based on the vertices of the plan view graphics, the linear and curve stroking tolerance set in the Site Modeler User Preferences, the B-Spline Plan stroking tolerance set in the Site Modeler User Preferences, critical vertical component points and the B-Spline Profile stroking tolerance set in the Site Modeler User Preferences.

The first step is the creation of a profile cell in which the site profile may be developed or modified. This can also be accomplished by utilizing a previously placed Site Element profile cell.

The eight view tools on the right side of the tool frame can be utilized to define the various profile and plan views the designer wants to view while developing the profile. Simply right click on the view, then select profile or plan view. Once the views are defined, right click on the Profile Status tool and select the Profile Cell Setting tool.

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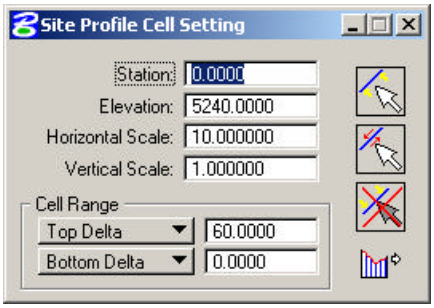
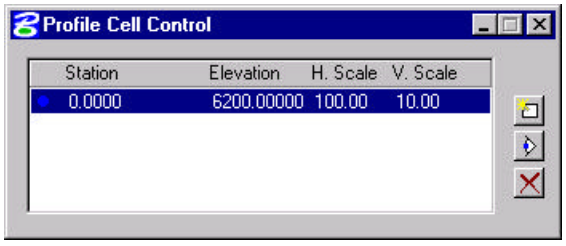
Profile Cell Status tool

Activates the current Profile system, which is associated to a Profile Cell. If there are several Profile cells, it is possible to designate the active one in the Profile Cell Control dialog. When the tool is right clicked, a pop-up menu appears :

The first option of the pop-up menu allows for the selection of a single or multiple joining Site elements and the placing of a Profile cell, which opens the dialog depicted below.



The second option allows getting information about Profile cells that reside in the master and reference files. The User can select and make active a specific profile cell if there are several profile cells.



Graphically select the Site Element chain in the plan view.

Opens the Vertical Component Tools tool frame. For a detailed discussion on these tools, refer to GEOPAK online help under Site > Horizontal and Vertical Geometry.

Click when the profile has been developed in order to redefine the Site Elements based on the profile vertical components.

Opens the Precise Curvilinear Coordinates dialog that allows entering precise curvilinear coordinates relative to the active chain. This will be discussed later.

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UTILIZING THE ACTIVE PROFILE CONTROL

The left side of the toolbox has eight tools that set each view. Use one of these items to fit the corresponding view (left) or to define the type of the view (right). Two views are supported: plan and profile, whose tools are detailed in the table below.

	Corresponding view is a Plan view. A Plan view is fitted in such a way that the active chain is entirely displayed in the view.
	Corresponding view is a Profile view. Note: A Profile view is fitted in such a way that the origin point of the Profile Cell stays at the left bottom corner of the view, and the end of the chain stays at the right side of the view. If a command is waiting for a curvilinear data-point, a data point in a Profile view will produce a curvilinear data-point, corresponding to its [station, elevation] location. This is useful for Vertical alignment element creation commands

When right clicking on Plan or Profile view, a pop-up menu opens:

Plan	Allows attaching a Plan Representation System to the view.
Profile	Allows attaching an active Profile Representation System to the view.

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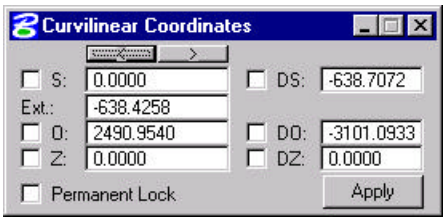
UTILIZING THE PRECISE CURVILINEAR COORDINATES DIALOG

The Curvilinear Coordinates dialog enables the user to enter precise curvilinear coordinates relative to the site chain.



S:	Enter station along actual active chain. The left toggle locks the value.
Ext.:	Enter an extension to the station along actual active chain. A negative value means that the extension is before the beginning of the chain. A positive value means that the extension is after the end of the chain. If the lock toggle is on, the cursor follows a perpendicular to the chain in plan views, and a vertical line in Profile views.
O:	Enter a horizontal offset from the actual active chain. Use the left toggle to lock the value of this field. If the lock toggle is on, the cursor follows a parallel line to the chain in plan views.
Z:	Enter elevation. The left toggle locks the value of this field. If the lock toggle is on, the cursor follows a horizontal line in profile views.
DS:	Enter delta station from the previous data point or tentative point. The left toggle locks the value of this field. If the lock toggle is on, the cursor follows a perpendicular to the chain in plan views, and a vertical line in profile views.
DO:	Use this field to enter delta offset from the previous data point or tentative point. Use the left toggle to lock the value of this field. If the lock toggle is on, the cursor follows a parallel to the chain in plan views.
DZ:	Use this field to enter delta elevation from the previous data point or tentative point. Use the left toggle to lock the value of this field. If the lock toggle is on, the cursor follows a horizontal line in profile views.

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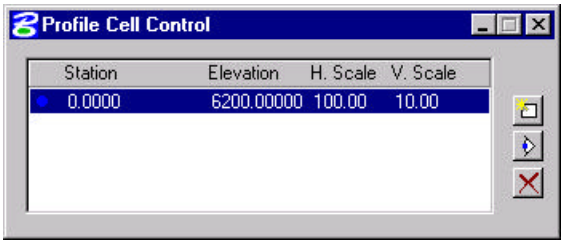
Perm. Lock	When toggled on, coordinate locks remain active even after a data point is issued.
Apply	Send a data point to the input queue. Entering a data point by a click in a view has the same effect.

The dialog can be utilized in conjunction with generic MicroStation commands as it allows the user to precisely key-in information such as elevation, station, offset, etc., then apply that information to the active tool.

For example, to place a line into MicroStation, data point to start the line and data point again to finish the line placement. Instead of clicking a data point, the user can key-in station and elevation then click Apply. That information is sent to the active tool as the first data point. Next, the user would then key-in the ending station and elevation, click Apply which would be sent to the active tool as the second and final data point.

UTILIZING THE PROFILE CELL CONTROL DIALOG

The Profile Cell Control dialog enables the user to place or manipulate profile cells and associated data.



The dialog is comprised of a list box with information about all the Profile Cells in the current MicroStation file.

	Place a new Profile Cell
	Activate the selected Profile Cell
	Delete the selected Profile Cell

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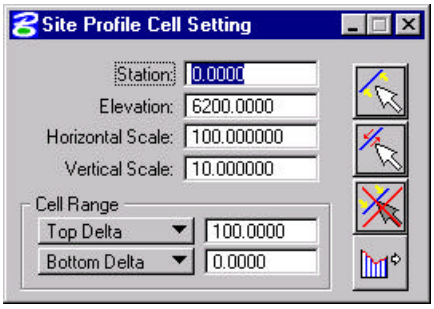
PLACING A SITE PROFILE CELL



	Click, and then identify the site elements to be added to the chain utilized in the profile cell.
	Click to reverse the chain utilized for the profile cell.
	Click to erase the chain.
	Once the dialog is populated, click to place the site profile cell.

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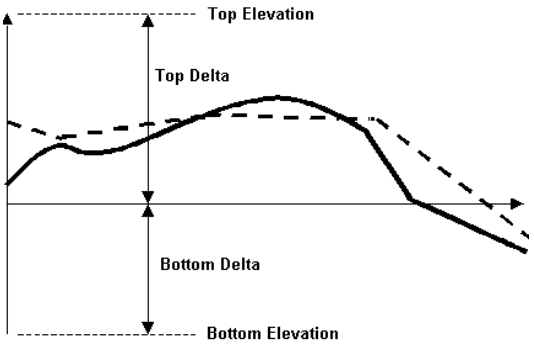
The fields are detailed in the table below.

Station	Defines the corresponding station of the reference point (profile cell origin).
Elevation	Defines the corresponding elevation of the reference point (profile cell origin).
Horizontal / Vertical Scale	Controls the scale, and subsequently the distortion utilized to draw the profile.
Cell Range: Top Elevation Top Delta Bottom Elevation Bottom Delta	Use these fields to define the height of the Profile Representation system. These values are given in true length (without taking into account horizontal and vertical scales).  Care must be given that the Top and Bottom Delta values of the profile cell are set large enough such that all elements fall completely within the cell limits. For example, all elements must be between a horizontal line drawn at the top of the cell and one drawn at the bottom of the cell. If any element falls outside these limits they will not be recognized as vertical alignment elements.

By default, the profile cell is placed on level 63, and contains a vertical and horizontal axis, plus a text node containing the following information.

- S=<station>
- Z=<elevation>
- HS=<horizontal scale>
- VS=<vertical scale>
- GAP or NOGAP

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WORKSHOP: ADDING THE ENTRANCE ROAD

Now we will design the entrance road. The layout of the alignment is complete. We will explore the tools necessary to create the proposed vertical profile. Following that, we will look at the GEOPAK Composite section tool that will aid us in creating all the roadway elements at one time. This approach differs slightly from the way in which we designed the Main road.

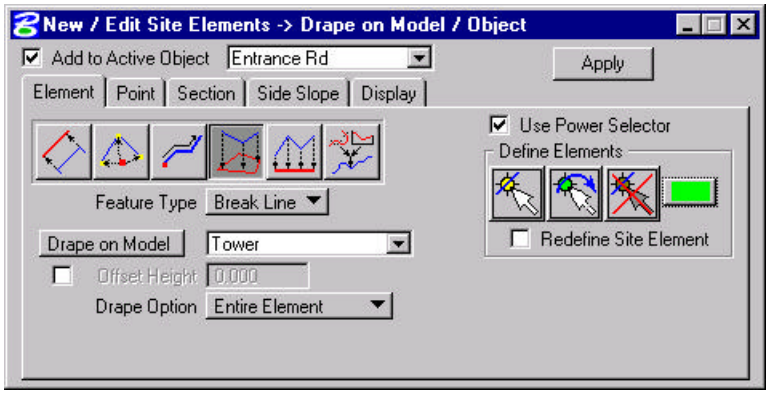
Creating the Entrance Road Object

1. Select the **Create New Object** tool *(Site Modeler menu: Object > New)*.
2. Create the New Object.

Object Type:	Roadway
Object Name	Entrance Rd
Add to Active Model:	Enabled

Creating the Entrance Road Elements – centerline

1. Select the **New / Edit Element** tool.



2. Click **Drape on Model/Object**.
3. Enter the Element information.

Feature Type:	Break Line
Drape on Model:	Tower
Drape Option:	Entire Element
Use Power Selector:	Enable

4. Click **Select Elements** from the Define Elements group box.
5. Select the centerline element of the entrance road.
6. Click **Apply**.
7. Close the New/Edit Site Elements dialog.

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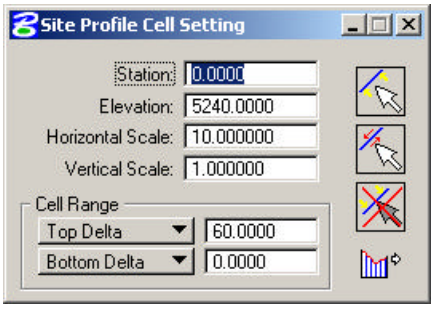
Creating the Entrance Road Elements – Profile the Centerline

We are going to plot a centerline profile of the entrance road off to the side of the project in view window 2.

1. Open View Window 2. *(MS: Window>Views>2)*
2. Click **Fit View**.
3. Access the Active Site Profile tool frame. *(Site Modeler Menu: Elements>Edit Profile).*

4. Right mouse click on **Profile Cell Status**.

5. Select the **Profile Cell Setting**.



6. Fill in the Profile Cell Setting information.

Station:	0.00
Elevation:	5240.00
Horizontal Scale:	10.00
Vertical Scale:	1.00
Top Delta:	60.00
Bottom Delta:	0.00

7. Click **Add Element PCell Chain**.
8. Select the entrance road centerline element and accept it with a data point.
9. Click **Place Site PCell**.
10. Place the profile cell in a clear area of the previously opened view window 2.

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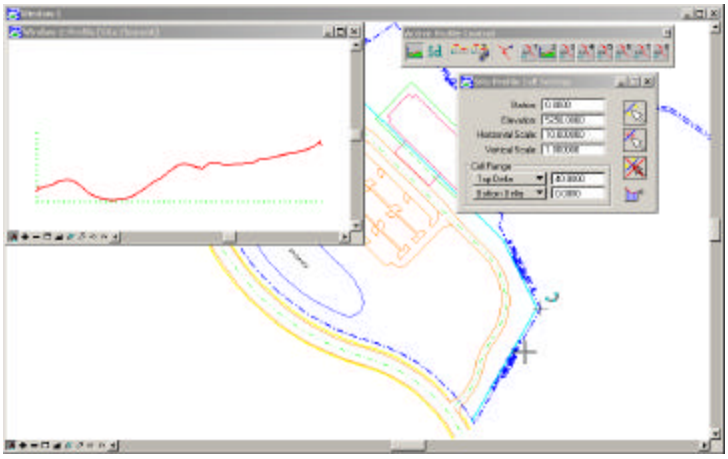
11. On the **Active Profile Control** tool frame, right click on View 2 and set it to **Profile**.

    As you slide your cursor along the profile you will notice a cursor locked on the plan view centerline element in view window 1.



Site Element Profile of Entrance Road Centerline

Now that we can visually see the existing centerline profile, it is time to create the design profile. We will do this right on top of the existing profile.

Creating the Entrance Road Elements – Design the Centerline Profile

There are some constraints to consider before starting this profile design.

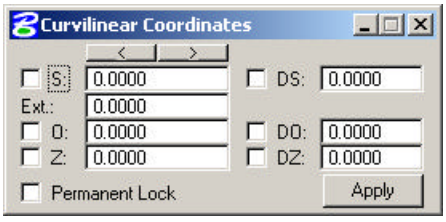
Both ends of the Entrance Road join to the Main Road. The cross slope on the Main road is –2%. Our profile grade should match this to ensure a smooth transition.

The roadway passes quite close to the Building Object. We need to make sure that the profile is at a similar or lower elevation to the outside of the building grass but still has longitudinal slope for drainage purposes.

With these constraints in mind, we shall begin the profile design.

1. Click **Vertical Component Tools**. *(Active Profile Control tool frame)*

2. Click **Curvilinear Coordinates.** *(Active Profile Control tool frame)*



   The curvilinear coordinates dialog allows the user to precisely key-in information such as elevation, station, offset, etc., then apply that information to the active tool.

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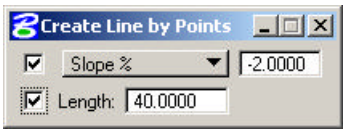
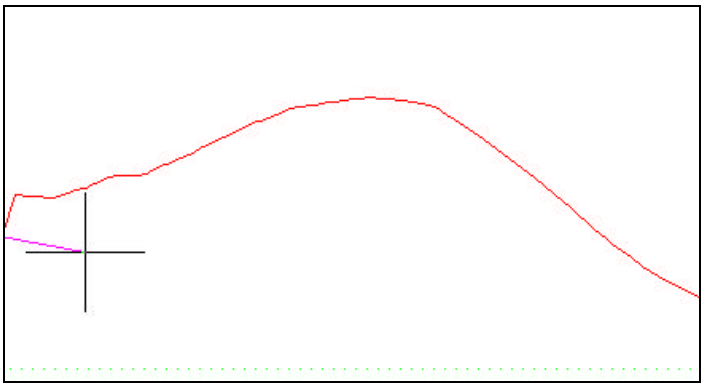
3. Click **Create Profile Line by Points** *(Vertical Components)*.



Slope %	Enable, -2
Length	Enable, 40

4. Enter the Create Line by Points information
5. Window in on the left hand end of the Profile (in View 2).
6. Snap to the left end of the Model profile that represents the elevation at the edge of the Main Rd Object. Data point to accept the first point to the tangent.
7. Data point to draw in the tangent.



9. Click **Fit View 2** on the **Active Profile Control** dialog.

   This fits the Profile to View window 2.
10. Window in on the right hand end of the Profile (in View 2).
11. Snap to the right end of the Model profile that represents the elevation at the edge of the Main Rd Object. Data point to accept the first point to the tangent.
12. Set the **Slope%** to 2.
13. Set **Length** to 40.
14. Data point to draw in the tangent.
15. Click **Fit View 2** on the **Active Profile Control** dialog.

Note This satisfies the first part of the profile design criteria – setting the same slope as the Main Road pavement to ensure a smooth transition.

Determine Station and Elevation of a Critical Point

We will now find the station and elevation at the center of the front edge of the Building Object grass area. We will use both the Site Modeler **Height** tool and the Active Chain Control **Curvilinear Coordinates** tool to get this information.

1. Select the **Height** tool *(Site Modeler menu: Analysis > Height)*.

   Curvilinear Coordinates should already be open.

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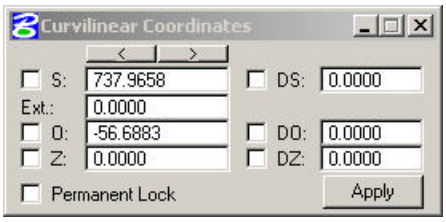
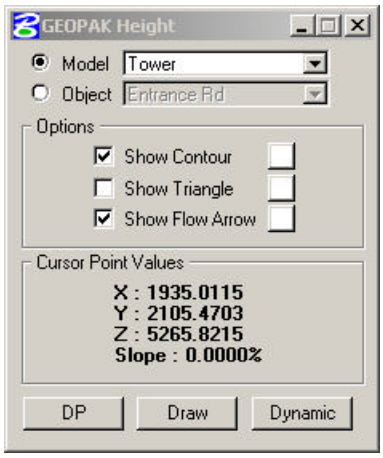
2. Toggle on Model.
3. Click **DP**.
4. Set the MicroStation snap to "**midpoint**".
5. Snap to the dashed green line at the front of the building.





The **Curvilinear Coordinates** tool displays the station at this location along the Entrance road centerline as **737.9658**.

The **Height tool** displays the Model elevation as **5265.8215.**

From this data we can set the next VPI of our profile.

6. Close the **Height** tool.

Adding the Critical Point as a VPI

1. Click **Create Profile Line by Points**.
2. Toggle off **Slope%** and **Length** in the Create Line by Points dialog.
3. Set the Station and Elevation values in the Curvilinear Coordinates dialog.

S:	Toggle on, 740.00
Z:	Toggle on, 5265.000
Permanent. Lock	Toggle on

4. Click **Apply.**

   This creates the first tangent point.
5. Toggle off the **S** and **Z** locks.
6. Set the **Create Lines by Points** dialog.

Slope %	Toggle on, 0.5
Length	Toggle on, 220.0

7. Data point to the left of the first tangent point.

   A tangent line is created.
8. Snap to the right hand end of the just created tangent line and accept the point.

   This is the first point of our next tangent line.
9. Set the **Create Lines by Points** dialog.

Slope %	Toggle on, -0.5
Length	Toggle on, 260.0

10.

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11. Data point to the right of the first tangent point.

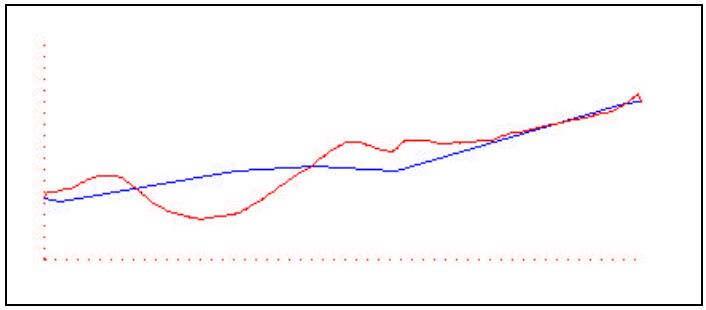
    This creates a tangent line.

Note This satisfies the second design constraint of staying below the Building grassy area and ensuring the roadway drainage is acceptable.

Completing the Profile Tangents

We will now create the remaining tangent line portions of the profile. This will be accomplished by simply filling in the gaps.

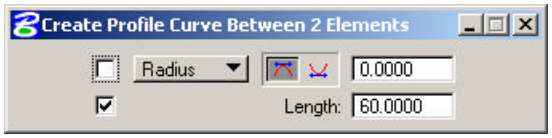
1. Click **Create Profile Line by Points** and create 2 tangent lines in the gap areas.



We shall now create some Vertical curve components. We currently have 7 VPIs in this profile – we need to create 5 Vertical Curves.

We shall start from the left hand end of the profile and work to the right.

2. Click **Create Profile Curve Between 2 Elements** *(Vertical Component Tools)*.



3. Turn on the toggle and set the **Length** to 60.
4. Select and accept the first tangent.
5. Select and accept the second tangent.

   The vertical curve is drawn and the tangents are trimmed.

6. Continue along the profile setting the other four vertical curves with the same procedure.

CURVE	LENGTH
1	60 (already done)
2	160
3	60
4	160
5	60

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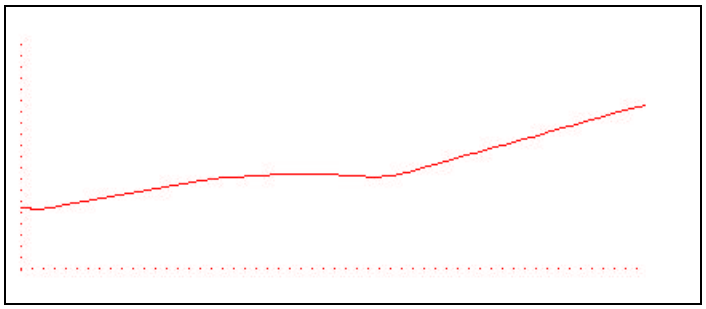
Incorporating the Profile into Site Modeler

We shall now send the proposed profile information back to the Site Modeler element.

1. Click **Define Site Element Profile** *(Active Profile Control tool frame).*
2. Select and accept any proposed profile element.

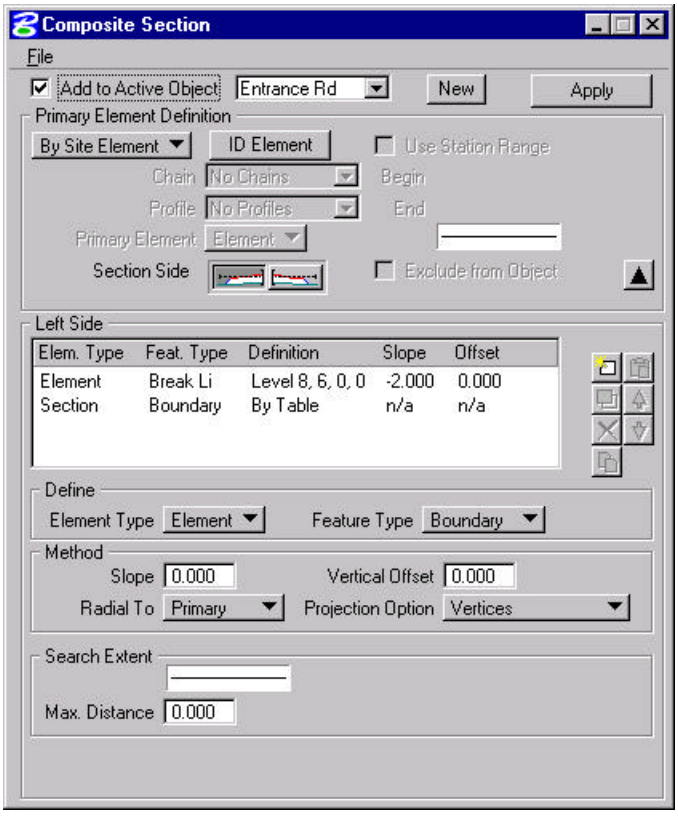
   This strings all of the profile elements together.
3. Data point to accept the proposed profile.

   The profile information is now returned to the Site Element. The Profile element redraws to reflect the new state of the Site Element.



Creating the Entrance Road Elements – Applying a Composite Section

1. Select the **Composite Section** tool *(Elements>Composite Section).*



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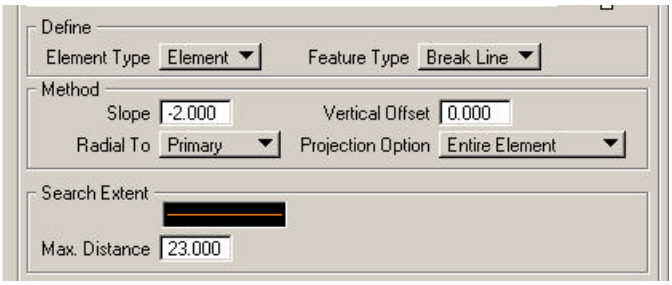
We will focus our attention on the Define, Method, and Search Extent group boxes at the bottom of the dialog. We will set these to find and create the edges of pavement.



2. Complete the **Define** group box.

Element Type:	Element
Feature Type:	Break Line

3. Complete the **Method** group box.

Slope:	-2.00
Vertical Offset:	0.00
Radial To:	Primary
Projection Option:	Entire Element

4. Complete the **Search Extent** group box.

Search Extent Symbology:	Level=level 8, Co=6, Wt=0, Lc=0
Maximum Distance:	23

5. Click **Add List Item** (right side of list box).

Create the Curb and Gutter Section on the Left Side

Now we will create the 6” Curb and Gutter section that will run along the edges of pavement.

1. Complete the **Define** group box.

Element Type:	Section
Feature Type:	Boundary

2. Complete the **Method** group box.

Section By	Table
Side	Left

This will allow us to create a table of offset distances and elevations to define the curb section that will run along the edge of pavement. Keep in mind that the section we create starts at the edge of pavement so all offset values start from that edge and not the centerline of the roadway.

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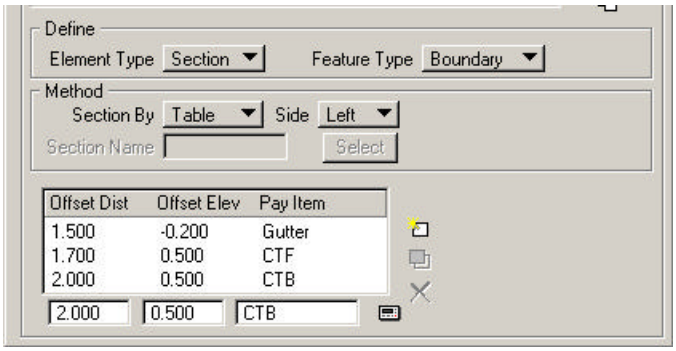
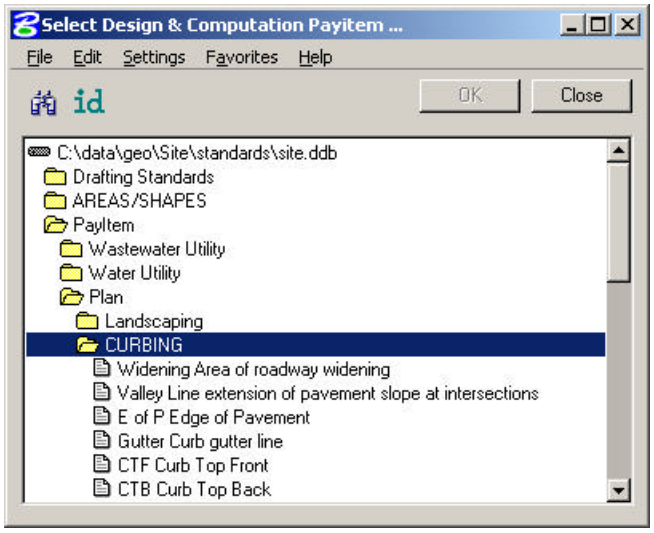
3. Enter the information in the edit boxes along the bottom.



Offset Distance	1.5
Offset Elevation	-0.2

Remember that the distances assume that the edge of pavement element is the origin (0,0).

4. Click **Pay Item** and navigate to PayItem > Plan > Curbing > Gutter Curb gutter line.



5. Select the item and click **OK**.
6. Click **Add List Item** (right of the table).
7. Add two more entries to the table using the same procedure.

OFFSET DISTANCE	DESCRIPTION	PAY ITEM
1.7	0.5	CTF (PayItem > Plan > Curbing)
2	0.5	CTB (PayItem > Plan > Curbing

8. Click the **Add List Item** (next to the Left Side list box) to add the section definition to the Left Side List.

   The left side list is now complete.

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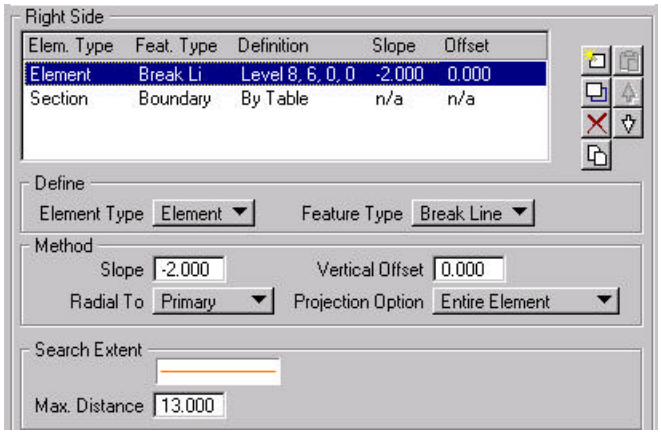
Create the Composite Section for the Right Side

The right side of the roadway is almost the same as the left so we can copy the left side list to the right side. Then we can make the appropriate adjustments to satisfy the slightly different right side conditions.

1. Select all the items in the Left Side list.
2. Click **Copy List Item**.
3. In the Primary Definition group box on the Composite Section dialog, click **Right Side**.
4. Click Paste List Item.

   The Right Side list is now populated and we can make the necessary changes. For example, on the right side of the roadway, the curb and gutter is on the right side of the edge of pavement. Additionally, on the right side of the roadway, in front of the building, the edge of pavement is only 12' away from the centerline.



5. Select the first list item.

   This corresponds to the edge of pavement

6. Change the search distance to 13.
7. Click **Modify List Item**.
8. Select the second list item.

   This corresponds to the curb and gutter section.

9. In the Method group box, change **Side** to Right.
10. Click **Modify List Item**.

    In the intersection of the parking lot and the entrance road are dashed lines representing the extension of pavement edges through the intersection. We will set the composite section up to locate and define these pavement extensions.

11. Complete the **Define** group box.

Element Type:	Feature
Feature Type:	Boundary

12.

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13. Complete the **Method** group box.

Slope:	-2.00
Vertical Offset:	0.00
Radial To:	Primary
Projection Option:	Entire Element

14. Complete the **Search Extent** group box.

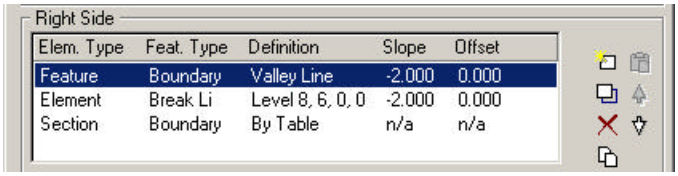
Payitem	Click Select Pay Item, navigate to payitem > plan > curbing > valley line
Max. Distance:	13.00

When utilizing the payitem option, GEOPAK searches for any MicroStation element where the level, weight, color, style, etc. match that of the Valley Line item. This is a slightly alternate method than that used to find the edges of pavement. However the results are the same.

15. Click **Add List Item**.

The item was added to the bottom of the list. We will now move it to the top of the list.

16. Select the item and click **Move Up** until it is the first on in the list.



Applying Completed Composition Section

Our Composite Section is now complete and ready to apply to the centerline.

1. In the Primary Element Definition group box, set to **By Site Element**.
2. Click **ID Element**.
3. Select the entry road centerline element and accept it with a data point.
4. Click **Apply**.

Although the majority of the roadway design is done, both the main road and the entrance road are not yet completed. The intersections between the two still need to be designed. That will be accomplished in a later exercise. At this point we will turn our attention to the parking lot.

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WORKSHOP: CREATING THE PARKING LOT

During the next set of exercises we will design and grade the parking lot. The desired slope across the parking lot is 2%. The parking lot will slope from the back toward the building and entrance road. In order to create this design, we will create a temporary object.

This object will begin at the current edge of pavement, along the entrance road, and slope at 2% toward the Entrance road. This temporary object will encompass the total area of the parking lot layout. Once this temp object is created we will proceed to drape all the elements representing the various Parking Lot edges of pavement onto the temp object. This will create a nice, simple 2% grade across the parking area.

We can then proceed to place curb and gutter where appropriate.

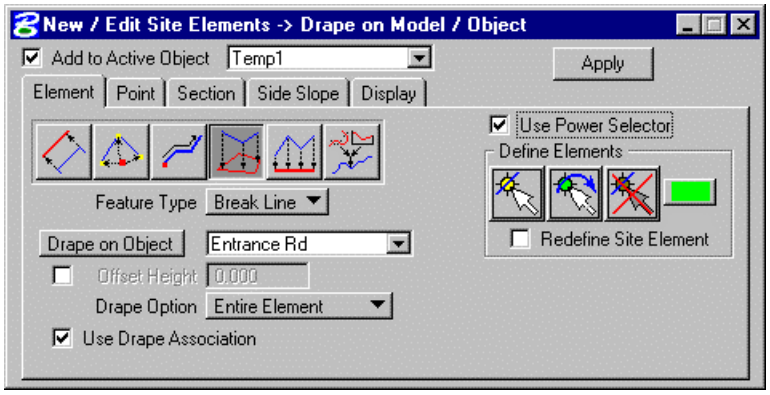
Creating a Temp Object

1. Use the MicroStation **Saved View** Parking.
2. Create a new object with **New Object Type** Parking and **Object Name** Temp1.

Hint Remember to Add to the Active Model.

There are two yellow lines (drawn on level "Level 1") in the DGN file. One line runs along the edge of pavement of the entrance road in front of the building. The other line is outside the back edge of the parking lot and is parallel to the first. These two lines will make up the elements with in the Temp 1 object.

3. Select the **New / Edit Site Element** tool *(Site Modeler menu: Element > New/ Edit).*



4. Click **Drape on Model/Object**.
5. Enter the element information.

Feature Type	Break Line
Drape on Object	Entrance Rd
Drape Option	Entire Element
Use Drape Association	Enable

6. Click **Select Elements** from the Define Elements group box.
7. Select the yellow line that runs along the entrance road edge of pavement.
8. Click **Apply**.

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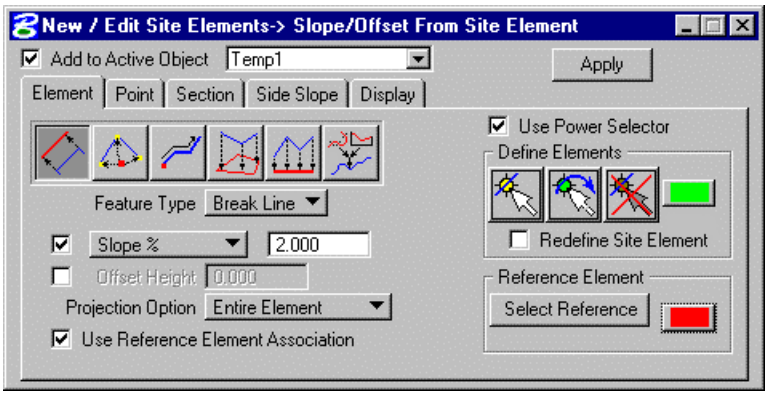
9. Click **Slope/Offset from Site Element**.



10. Enter the element information.

Feature Type	Break Line
Slope %	Enable, +2.00
Projection Option	Entire Element
Use Reference Element Association	Enable

11. Click **Select Elements** from the Define Elements group box.
12. Select the other yellow line located outside the back of the parking lot.
13. Click **Select Reference** from the Reference Element group box.
14. Select and accept the yellow line running along the entrance road edge of pavement.
15. Click **Apply**.

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Creating the Parking Lot Object

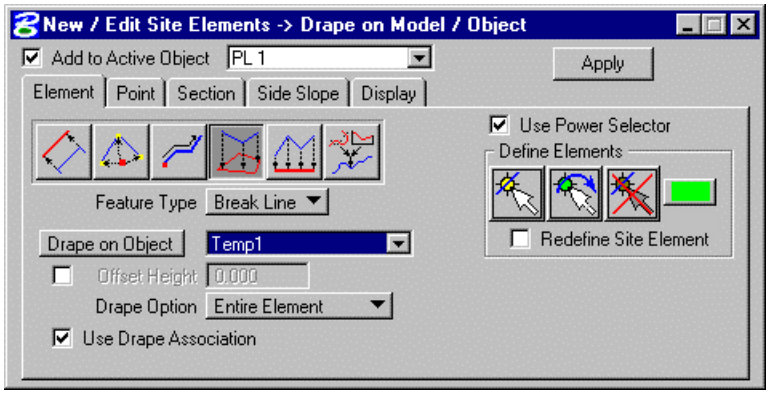
We now have a 2%sloped area *(Object - Temp 1)* which encompasses the entire area of the proposed parking lot. At this point, we can simply select all the parking lot edges of pavement and drape them down onto this temporary object. Thereby effectively and efficiently creating a nice 2%slope from element to element throughout the entire parking lot.

1. Create a new object with **New Object Type** Parking and **Object Name** PL 1.

   The object should be added to the active model.

   We will now create all the edges of pavement elements in the parking lot by draping them onto the Temp 1 object.

2. Select the **New / Edit Site Element** tool. *(Site Modeler menu: Element > New/ Edit)*



3. Click **Drape on Model/Object**.
4. Enter the element information.

Feature Type	Break Line
Drape on Object	Temp 1
Drape Option	Entire Element
Use Drape Association	Enable
Use Power Selector	Enable

5. Click **Select Elements** from the Define Elements group box.
6. Select all the edges of pavement in the parking lot including the curb returns.
7. Click **Apply**.

   At this point we are finished with the Temp 1 object and can remove it from the active model.

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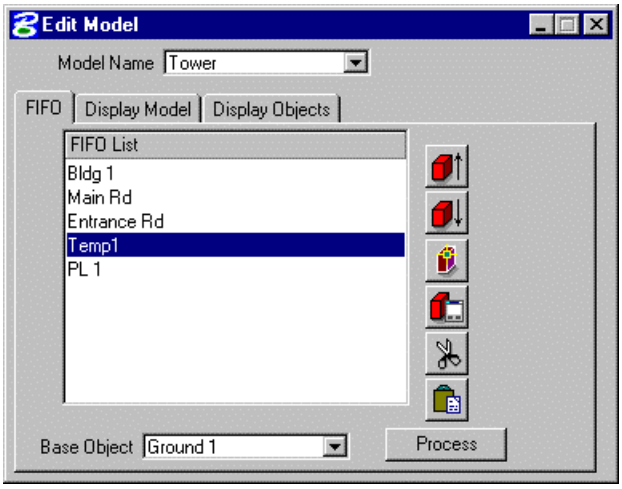
Remove the Temp 1 Object

1. Select the **Edit Model** tool. *(Site Modeler Menu: Model > Edit)*

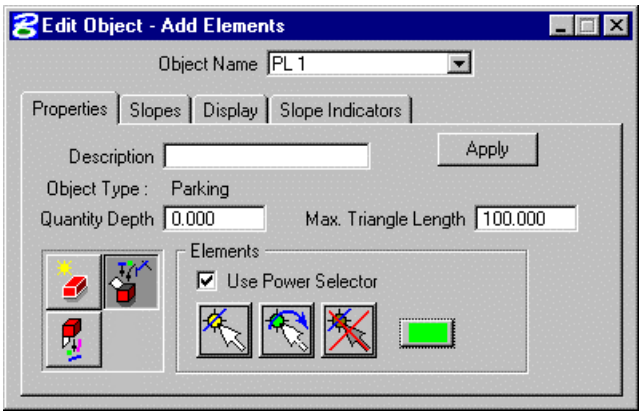


2. Select Temp 1.
3. Click **Remove Object**. *(Scissors)*
4. Click **Process**.

Creating the Parking Lot Elements – Sharing Entrance Road Elements

The Entrance Road elements that are directly adjacent to the parking lot object need to be shared with the parking lot to ensure a direct transition between the two objects.

1. Select the **Edit Object** tool. *(Modeler: Object > Edit.)*
2. Click **Add Elements to Object**.



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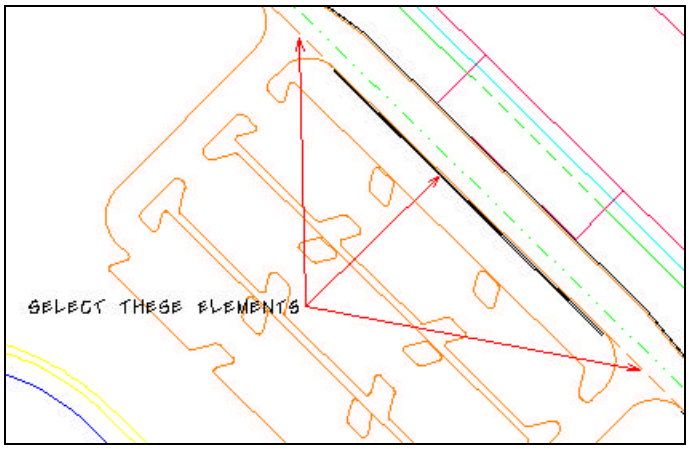
3. Select the dashed join lines and the edge of pavement elements.

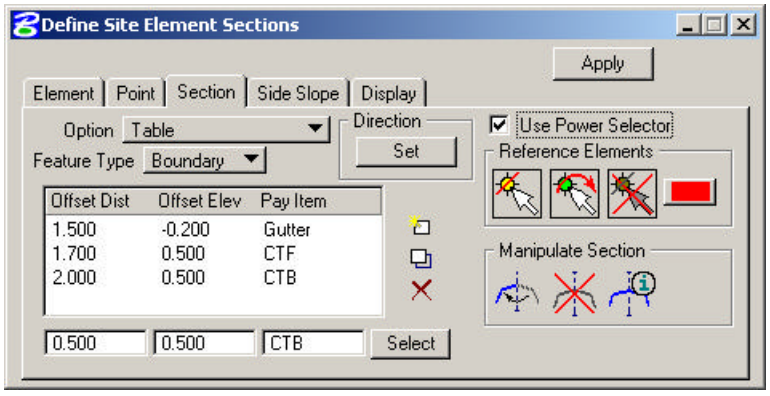


4. Click **Apply**.

Creating the Parking Lot Elements – Adding Curb & Gutter

We will now add the appropriate curb & gutter at the edges of pavement throughout the parking lot. Around the exterior of the lot we will place the same 6" curb & gutter used on the entrance road. In the interior islands we will place a simple 6" curb with no gutter.

1. Select the **Level Display** tool. *(MS: Settings > Level > Level Display)*
2. Turn on Level 9. Close the tool.
3. Select the **New/Edit Site Element** tool. *(Site Modeler menu: Element>New/Edit)*



Note We can import the curb & gutter information into the table from one of the edges of pavement that has the desired curb & gutter attached.

4. Set the **Option** to Table and **Feature Type** to Boundary.
5. Click **Query Section** from the Manipulate Section group box.
6. Select an edge of pavement element along the right side of the roadway. Data point to accept.
7. Click **OK**.

   The table is now populated with the correct offset values and pay item information.
8. Click **Select Reference Elements** from the Reference Elements group box.

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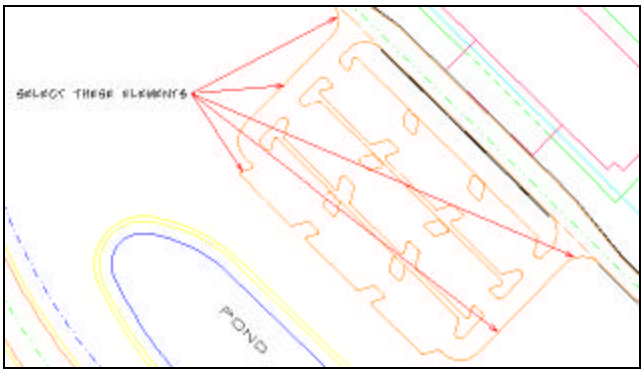
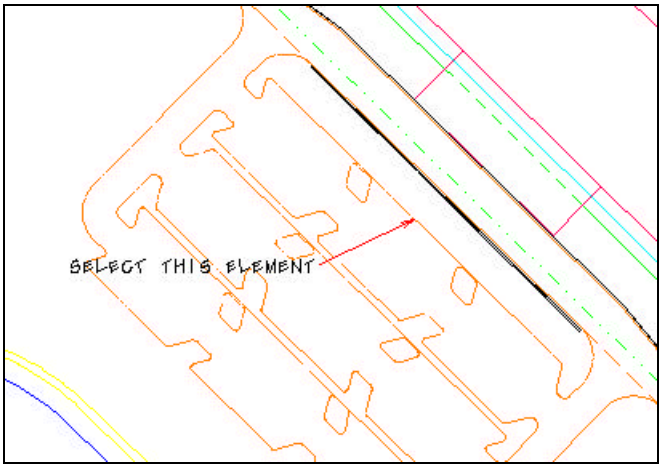
9. Select the parking lot edges of pavement around the outside only.



10. Click **Set** in the Direction group box.
11. Data point to the **outside** of the edge of pavement.
12. Click **Apply**.

    We shall now add the curb and gutter section to the northern most median.

13. Set the **Feature Type** to Breakline.
14. Select the median edge.



15. Click **Set** in the Direction group box.
16. Data point to the **inside** of the median to set the Direction of Section.
17. Click **Apply**.

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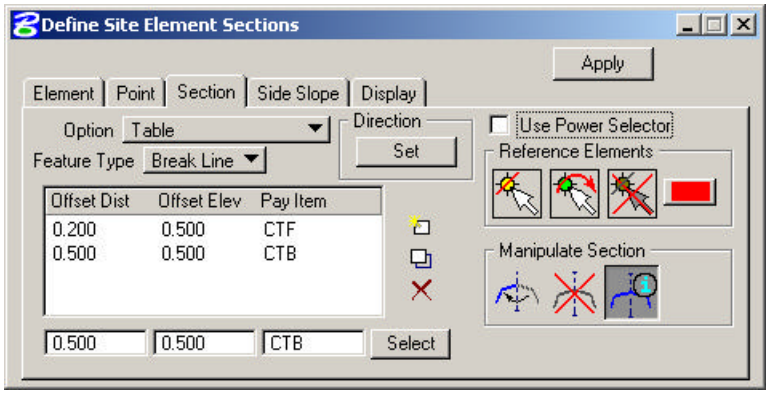
Create Curb on Islands

Next create the curb sections on the interior island edges of pavement. We need to make the necessary changes to the table prior to placing the curb sections.

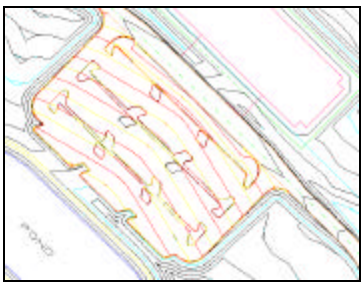
We will remove the gutter item and modify the offset distances and elevations to the top and back of curb items.



1. Select the gutter item and click **Delete List Item**.
2. Select the CTF row.
3. Modify the **Offset Distance** to 0.20 and **Offset Elev** to 0.50.
4. Click **Modify List Item**.
5. Select the CTB row.
6. Modify the **Offset Distance** to 0.50 and **Offset Elev** to 0.50.
7. Click **Modify List Item**.
8. Set the **Feature Type** to Break Line.

Note Each island is done separately. Select the island, set the direction of the section and then apply the section. This process is repeated for each island.

9. Click **Select Reference Element** in the Reference Elements group box.
10. Select one of the islands.
11. Click **Set** in the Direction group box.
12. Data point inside the island to set the Direction of Section.
13. Click **Apply**.
14. Repeat Steps 9 through 13 for each island.



Parking Lot Object

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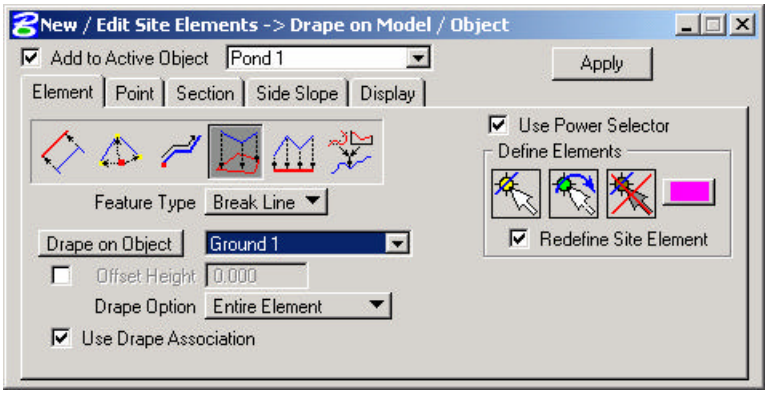
DESIGNING A POND

Creating a Pond Object

In this section we will create a pond object between the roadway and the building. The MicroStation element that represents the pond shape has already been created and we will assign the desired elevation. After the pond is created we will use a few analysis tools to analyze pond volume.

1. Use the MicroStation **Saved View** Pond**.**
2. Create a New Object Pond. Leave the Object name as Pond 1.

   Remember to add the Object to the active Model.
3. Select the **New / Edit Site Element** tool *(Site Modeler menu: Element > New/ Edit).*



4. Click **Drape on Model/Object** on the Elements tab.
5. Enter the Element information.

Feature Type	Break Line
Drape on Object	Ground1
Offset Height	Enable, -4.0
Drape Option	Minimum Elev ation
Use Drape Association	Enable

6. Click **Select Elements** in the Define Elements group box.
7. Select the pond element.
8. Click **Apply**.

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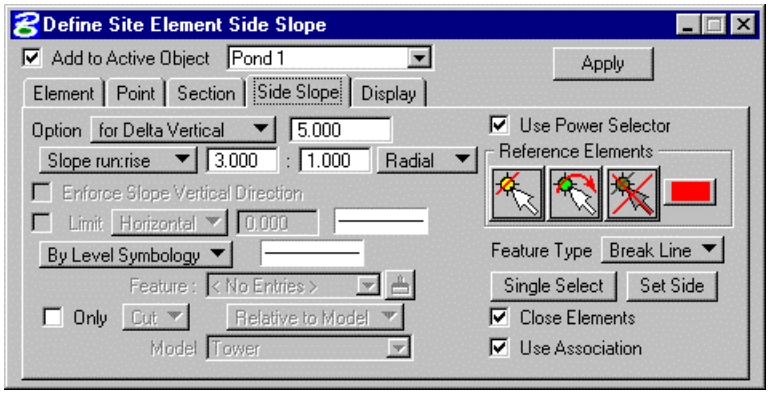
Creating a Pond Object – Adding a Bench

We will now add a bench around the pond approximately 5’ higher than the pond bottom. The bench will be 6’wide and will encompass the entire perimeter of the pond.

1. Click the **Side Slope** tab.



2. Enter the Side Slope information.

Option	For Delta Vertical, 5.00
Slope run:rise	3:1, Radial
Feature Type	Break Line
By Level Symbology	Level 30, color 4, style 0 weight 0.
Close Elements	Enable
Use Association	Enable

3. Click **Select Reference Element** in the Reference Elements group box.
4. Select the previously established pond bottom site element.
5. Click **Set Side**.
6. Data point to the outside of the pond bottom site element to establish the Direction of Slope Element.
7. Click **Apply**.

   The inside edge of the berm is created. Next we will create the outside edge 6’ away.
8. Enter the Side Slope information.

Option:	For Delta Horizontal, 6.00
Slope %:	1.00%
Feature Type:	Break Line
By Level Symbology:	Level 30, color 4, style 0 weight 0
Close Elements:	Enable
Use Association:	Enable

9. Click **Select Reference Element** in the *Reference Elements* group box.
10. Select the side slope element just created *(inside edge of the berm)*.
11. Click **Set Side**.

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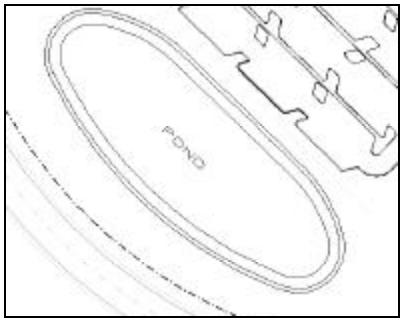
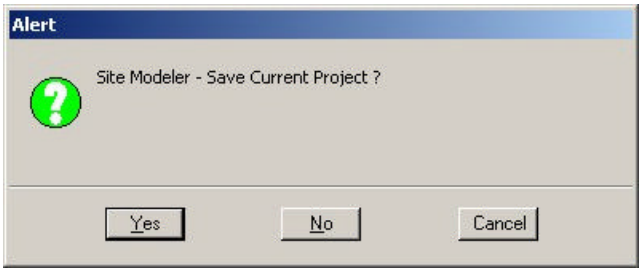
12. Data point to the outside of the side slope element to define the Direction of Slope Element.
13. Click **Apply**.



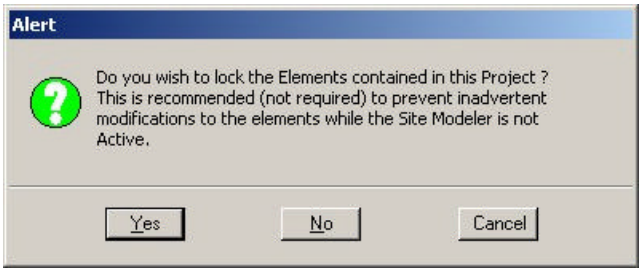
Pond bottom and side slope elements

Saving and Exiting the Project

1. Close GEOPAK Site Modeler *(Modeler: Project > Exit)*.
2. Click **Yes** to save the current project.



3. Click **No** to the Lock Elements alert.



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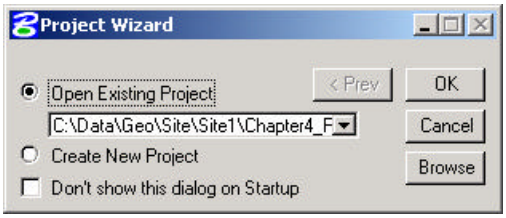
WORKSHOP: DESIGNING THE ROADWAY INTERSECTIONS

During the next few exercises we will follow the necessary steps to design the two intersections between the Main Road and the Entrance Road.

Note To ensure that all students have the same data, we will use an updated dataset.

Change to Updated Dataset

1. Open the file *C:\Data\Geo\Site\Site1\Chapter4\updated_Siteplan2D.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool (*Applications>GEOPAK Site>Site Modeler>Site Modeling*).



3. Click **Browse**.
4. Navigate to and select the file *…Site1\Chapter4\updated_siteplan.gsf.*
5. Click **OK**.

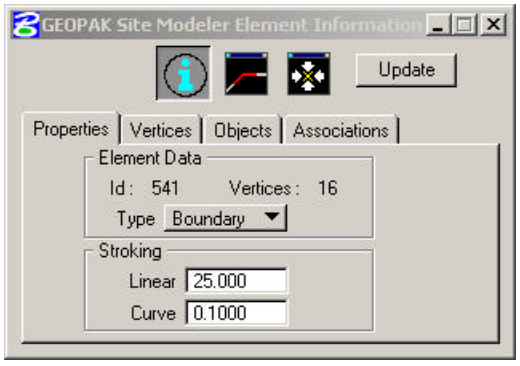
Create the North Intersection for the Roadways

This exercise will focus on the northern intersection of the two roadways. We are going to design the curb returns between the two roads to include the curb & gutter.

1. Use the MicroStation **Saved View** North Intersection.
2. Select the Object Entrance Rd on the **Active Site Object Control** tool frame.

   This makes the object active by selecting it from the Object Pulldown List.

3. Select the **Modeler Element Information** tool. *(Modeler: Element > Information)*



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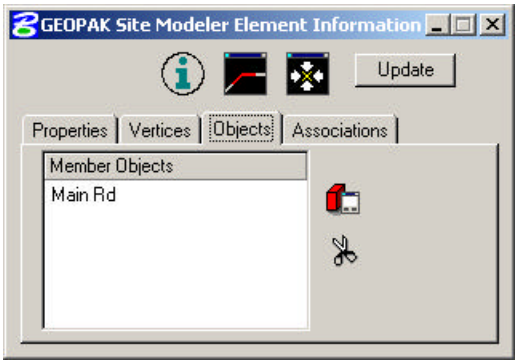
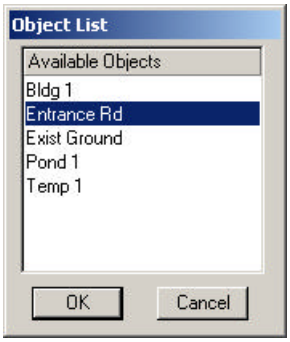
4. Click **Select Element**.
5. Select and accept the dashed line representing the edge of pavement extension through the intersection.

   The Element Data is now populated in the dialog.
6. Click the **Objects** tab.



7. Click **Add Object To List By Name**.
8. Select **Entrance Rd** and click **OK**.



9. Click **Update**.
10. Click **Yes** to save changes to the Site Modeler Element.

Turn Off Element Association

You may notice that it took a while to finish updating the Entrance road object and rebuild the model. By changing the entrance road we are triggering a rebuild of the Temp object, which was used during the creation of the parking lot, which in turn triggers the parking lot to update as well. Element Association is an extremely powerful feature of the software. In this case, and in the interest of time, we want to temporarily disable this feature. The easiest way to do this is to turn off Element Association for the element that runs along the entrance road edge of pavement that in the Temp Object.

1. Open View Window 2. *(Window>Views>2)*
2. Use the MicroStation **Saved View** Parking.

   Set the destination view to 2.

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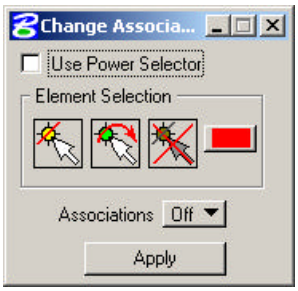
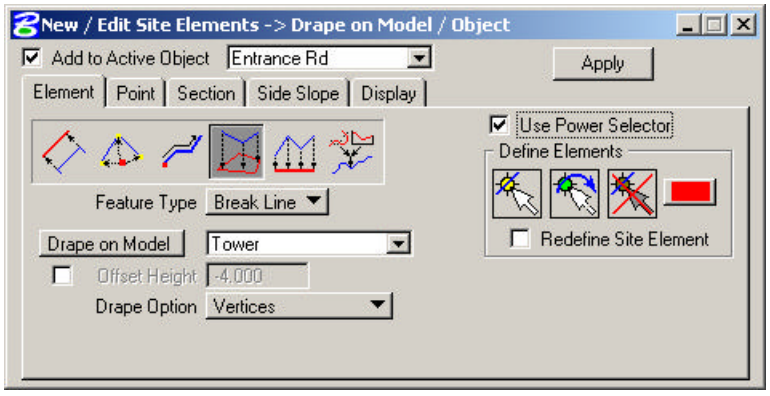
3. Select the **Change Association** tool *(Modeler: Element >Change Association).*



4. Click **Select Reference Element**.
5. Select the yellow line running along the entrance road edge of pavement.
6. Set **Associations** to Off.
7. Click **Apply**.
8. Close View Window 2.

Create the Curb Returns in the Northern Intersection

1. Select the **New/Edit Site Element** tool. *(Modeler: Element > New/Edit)*



2. Click **Drape on Model/Object** on the **Element** tab.
3. Enter the Element information.

Feature Type:	Break Line
Drape on Model:	Tower
Drape Option:	Vertices
Use Power Selector:	Enable

4. Click **Select Elements** in the **Define Elements** group box.
5. Select the two curb return elements in the intersection.
6. Click **Apply**.

   Now we will create the curb & gutter for the two curb returns. The curb & gutter will be the same as that on the rest of the entrance road.

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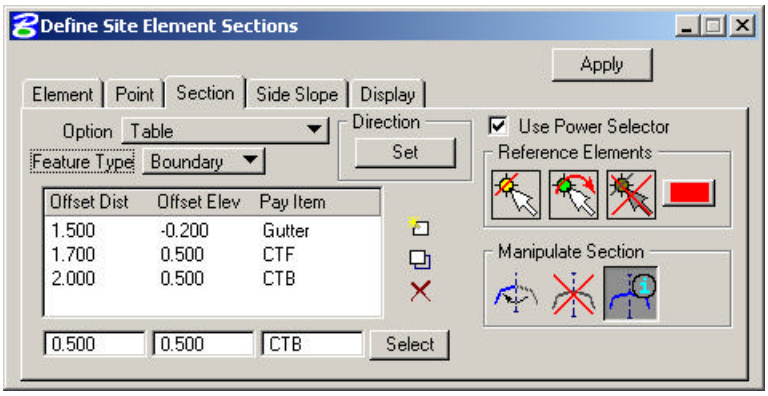
7. Click on the **Section** tab.



8. Set the **Feature Type** to Boundary and the **Option** to Table.
9. Click **Query Section** in the Manipulate Section group box.
10. Select and accept an edge of pavement element along the right side of the Entrance Rd roadway.
11. Click **OK** on the information dialog.

    The table is now populated with the correct offset values and pay item information.
12. Click **Select Reference Elements** from in the Reference Elements group box.
13. Select the two previously created curb return elements.
14. Click **Set** in the Direction group box.
15. Data point to the outside of the curb returns to set the Direction of Section.
16. Click **Apply**.

We will now look at the profile along each curb return to make sure the transition between the two roadways is as smooth as possible.

Drawing the Northern Intersection Curb Return Profiles

1. Open View Window 2. *(MS: Window > Views > 2)*

Note We are going to plot a profile of the edge of pavement along the main road leading into the curb return and continuing through the curb return and onto the entrance road.

2. Select the **Active Site Profile** tool frame. *(Modeler: Elements > Edit Profile)*

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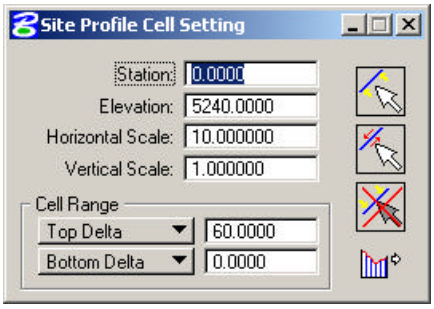
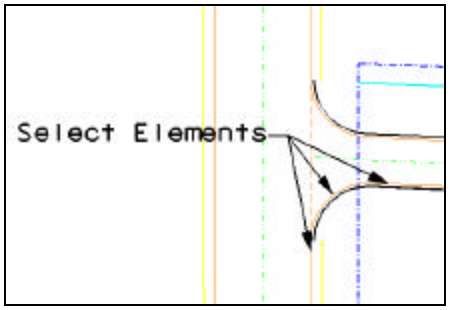
3. Right mouse click on **Profile Cell Status**.
4. Select **Profile Cell Setting**.



5. Fill in the Profile Cell Setting information.

Station:	0.00
Elevation:	5240.00
Horizontal Scale:	10.00
Vertical Scale:	1.00
Top Delta:	60.00
Bottom Delta:	0.00

6. Click **Add Element PCell Chain**.
7. Select and accept the edge of pavement just before the south side curb return in the northern intersection.
8. Select and accept the south side curb return element.
9. Select and accept the adjacent edge of pavement on the entrance road.



Hint Accept each selection with a data point. You should notice arrows pointing to the elements that have been successfully selected.

10. Click **Place Site PCell**.
11. Place the profile cell in the previously opened view window 2.
12. Right click on the View 2 and set it to **Profile** *(Active Profile Control)*.

The profile is now drawn in view window 2. As you slide your cursor along the profile you will notice a cursor locked on the plan view centerline element in view window 1.

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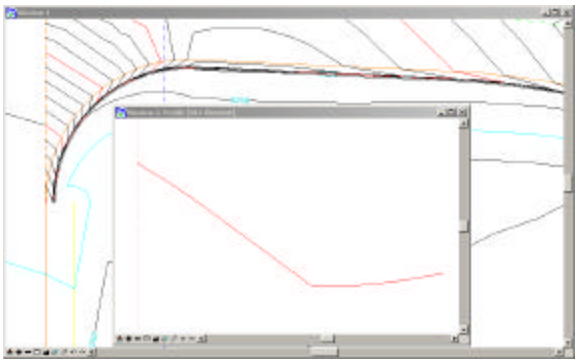


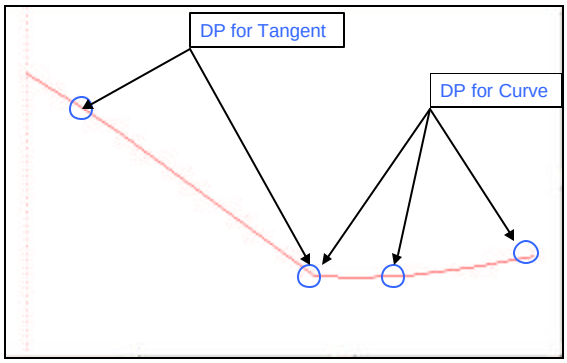
Site Element Profile

Creating the North Intersection Curb Return Design Profiles

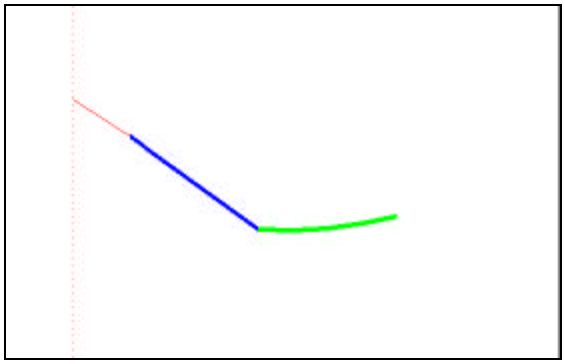
Now that we can visually see the profile, it is time to create the design profile. We will do this right on top of the existing profile.

1. Click **Vertical Component Tools**. *(Active Profile Control).*

2. Click **Place Line By Points**.
3. Data point at the locations shown to create a profile line.



4. Click **Create Profile Curve by 3 Points**.
5. Data point at the locations shown to create a profile curve.



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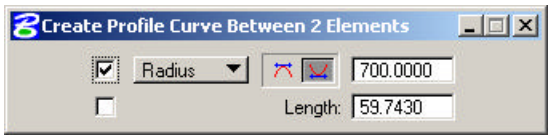
6. Click **Create Profile Curve Between 2 Elements**.



7. Key-in a curve **Radius** of 700.00. Enable the **Radius** lock.
8. Select and accept each of the two profile elements previously created.
9. When prompted to *Enter Way Point*, data point in view window 2.
10. Click **Define Site Element Profile**.
11. Select one of the profile elements drawn in view window 2.
12. Following the tool's prompts, accept the element with a data point.
13. Data point one final time to finish applying the profile to the site element.
14. Repeat the previous exercise steps using the appropriate Vertical Component tools for the curb return on the north side of the intersection between the Main road and the Entrance road

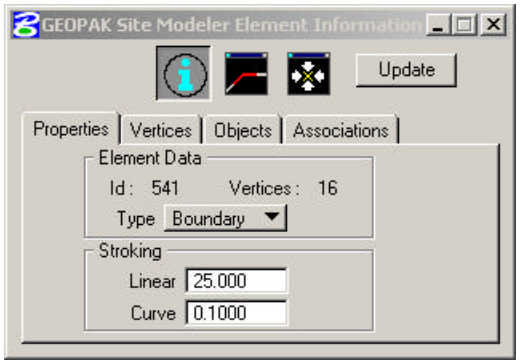
Create the South Intersection for the Roadways

This exercise will focus on the southern intersection of the two roadways. We are going to design the curb returns between the two roads to include the curb & gutter.

Hint	This exercise should be an exact replica of the previous two exercises. Therefore, some of the dialogs and steps may already be completed correctly without any user input. GEOPAK stores RSC (resource) files that contain the dialog settings that were active when the GEOPAK dialog was closed.

1. Use the MicroStation **Saved View** South Intersection.
2. Set the **Object** to Entrance Rd.

3. Select the **Modeler Element Information** tool. *(Modeler: Element > Information)*



4. Click **Select Element**.
5. Select and accept the dashed line representing the edge of pavement extension through the intersection.

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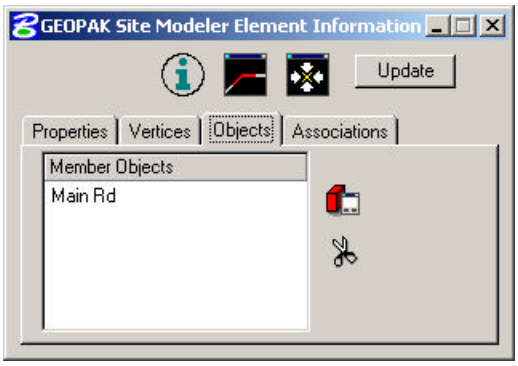
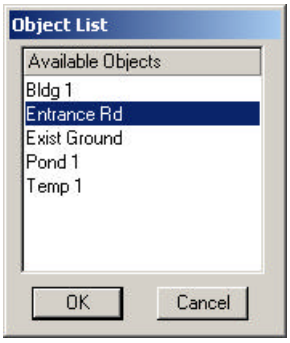
6. Click the **Objects** tab.



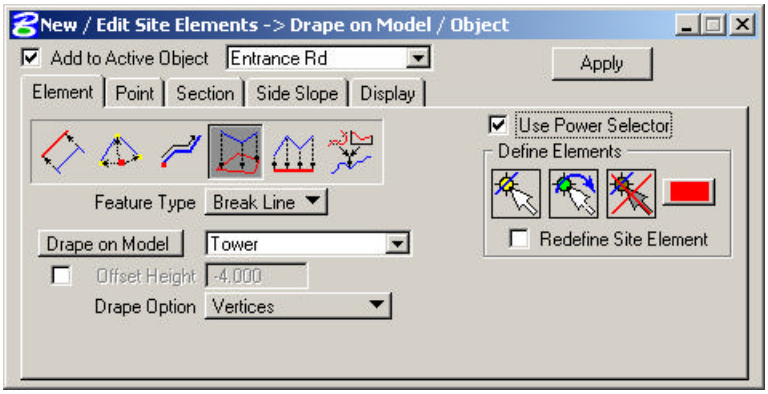
7. Click **Add Object To List By Name**.
8. Select **Entrance Rd** and click **OK**.



9. Click **Update**.
10. Click **Yes** to save changes to the Site Modeler Element.

Create the Curb Returns in the Southern Intersection

1. Select the **New/Edit Site Element** tool. *(Modeler: Element > New/Edit)*



2. Click **Drape on Model/Object** on the *Element tab*.

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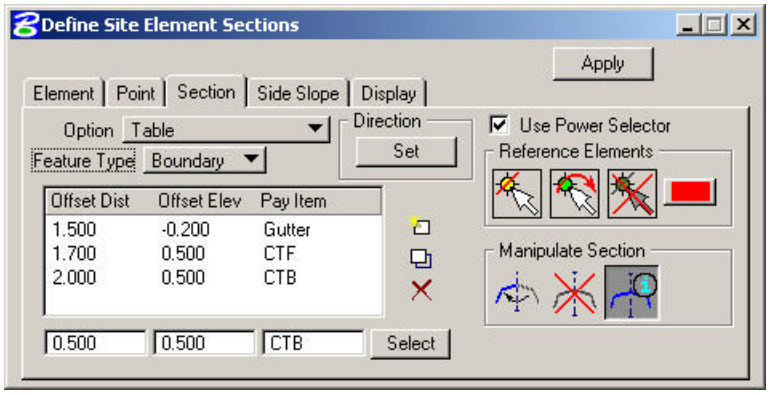
3. Enter the Element information.

Feature Type:	Break Line
Drape on Model:	Tower
Drape Option:	Vertices
Use Power Selector:	Enable

4. Click **Select Elements** in the Define Elements group box.
5. Select the two curb return elements in the intersection.
6. Click **Apply**.

   Now we will create the curb & gutter for the two Curb Returns. The curb & gutter will be the same as that on the rest of the entrance road.

7. Click on the **Section** tab on the New/Edit Site Element dialog.



8. Set the **Feature Type** to Boundary and the **Option** to Table.
9. Click **Query Section** in the Manipulate Section group box.
10. Select and accept an edge of pavement element along the right side of the roadway.
11. Click **OK** on the information dialog.
12. Click **Select Reference Elements** in the Reference Elements group box.
13. Select the two previously created curb return elements.
14. Click **Set** on the Direction group box.
15. Data point to the outside of the curb returns to set the Direction of Section.
16. Click **Apply**.

    We will now look at the profile along each curb return to make sure the transition between the two roadways is as smooth as possible.

Drawing the Southern Intersection Curb Return Profiles

1. Open View Window 2.

   We are going to plot a profile of the edge of pavement along the main road leading into the curb return and continuing through the curb return and onto the entrance road.

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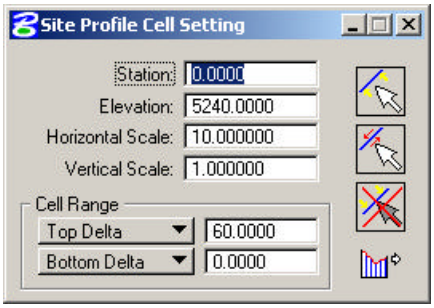
2. Access the **Active Site Profile** tool frame. *(Modeler: Elements > Edit Profile)*

3. Right mouse click on **Profile Cell Status**.

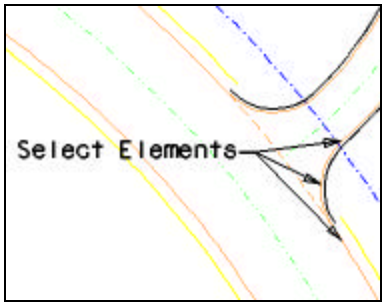
4. Select **Profile Cell Setting**.



5. Populate the Profile Cell Setting information.

Station:	0.00
Elevation:	5240.00
Horizontal Scale:	10.00
Vertical Scale:	1.00
Top Delta:	60.00
Bottom Delta:	0.00

6. Click **Add Element PCell Chain**.
7. Select the edge of pavement just before the south side curb return in the northern intersection.
8. Select the south side curb return element
9. Select the adjacent edge of pavement on the entrance road.



Accept each selection with a data point. You should notice arrows pointing to the elements that have been successfully selected.

10. Click **Place Site PCell**.
11. Place the profile cell in the previously opened view window 2.

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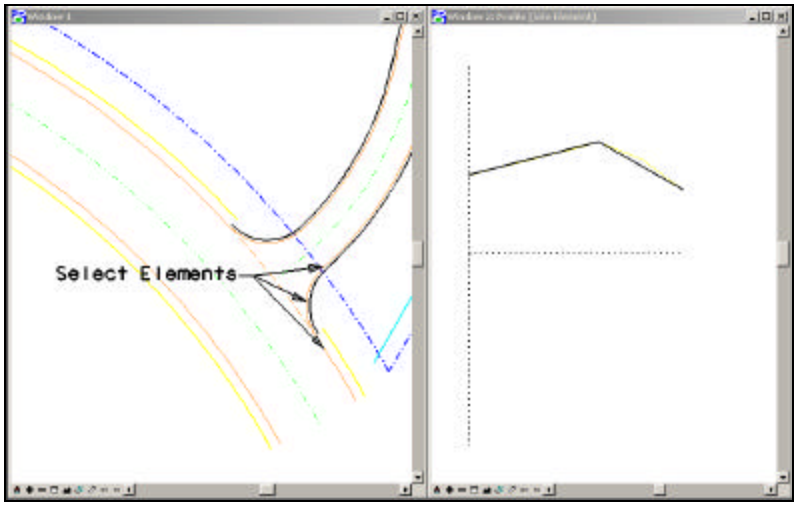
12. Right click on View 2 and set to **Profile**. *(Active Profile Control tool frame).*

    The profile is now drawn in view window 2. As you slide your cursor along the profile you will notice a cursor locked on the plan view centerline element in view window 1.



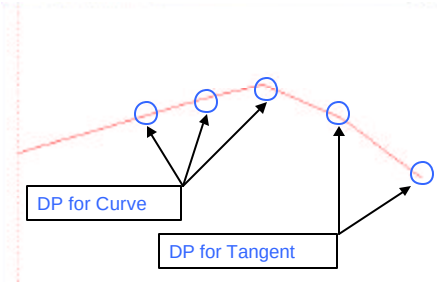
Site Element Profile

Creating the South Intersection Curb Return Design Profiles

Now that we can visually see the profile, it is time to create the design profile. We will do this right on top of the existing profile.

1. Click **Vertical Component Tools**. (Active Profile Control Tool Frame).

2. Click **Place Line By Points.**
3. Data point at the locations shown below to create a profile line.



4. Click **Create Profile Curve by 3 Points**.

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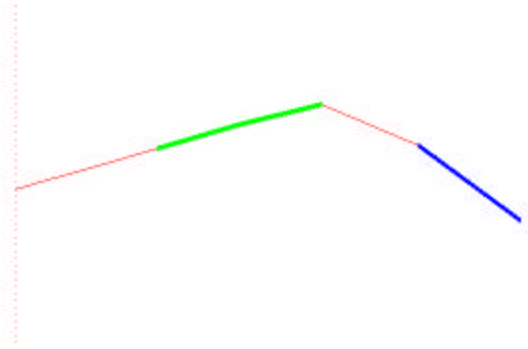
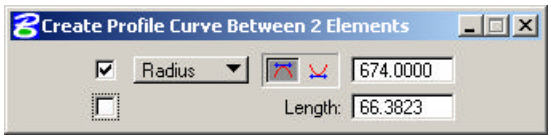
5. Data point at the locations shown to create a profile curve.



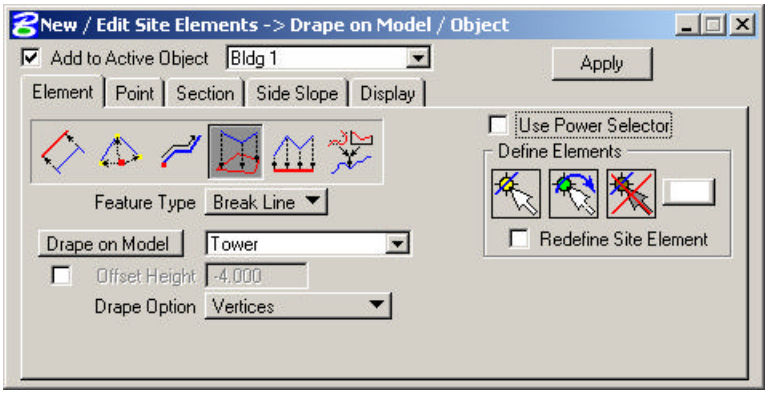
6. Click **Create Profile Curve Between 2 Elements**.



7. Key-in a **Radius** of 674.00.
8. Enable the **Radius** lock.
9. Select and accept each of the two lines previously created.
10. When prompted to *Enter Way Point*, data point in view window 2.
11. Click **Define Site Element Profile**.
12. Select one of the profile elements drawn in view window 2.
13. Following the tool's prompts, accept the element with a data point.
14. Data point one final time to finish applying the profile to the site element.
15. We can now repeat the previous steps for the curb return on the north side of the intersection between the Main road and the Entrance road.

Add A Concrete Walkway to the Building

1. Use the MicroStation Saved View Bldg.
2. Set the **Object** to Bldg 1 in the Active Site Object Control.
3. Select the **New/Edit Site Elements** tool. *(Site Modeler: Element > New/Edit)*



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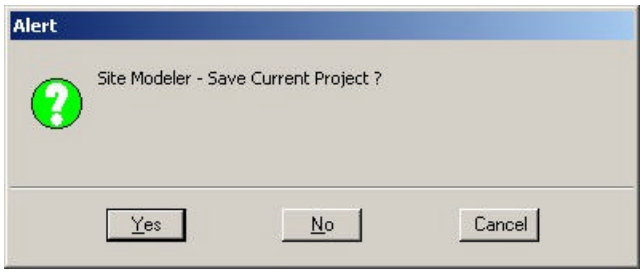
4. Click **Drape on Model/Object**.
5. Enter the Element Information.

Feature Type:	Break Line
Drape on Model:	Tower
Drape Option:	Vertices

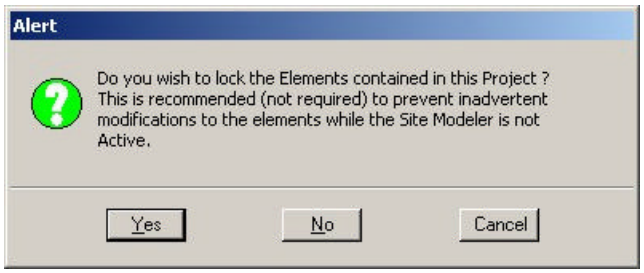
6. Click **Select Elements**.
7. Select the concrete walkway in front of the building.
8. Click **Apply**.

Saving and Exiting the Project

1. Close GEOPAK Site Modeler *(Modeler: Project > Exit)*.
2. Click **Yes** to save the current project.



3. Click **No** to the Lock Elements alert.



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5 Editing With Site Modeler

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- editing a site model.
- modifying a site element or model.
- working with element associations.

INTRODUCTION

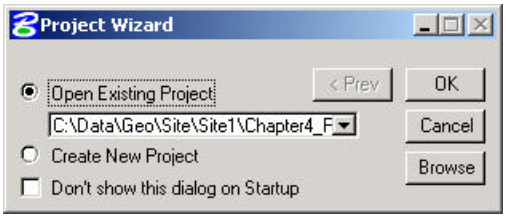
In this section we will use various Site Modeling tools to edit Site Elements and Objects with in the proposed Site Model. Some of the tools are simply MicroStation manipulation tools and others are specific to GEOPAK Site Modeler. However all the tools are very intuitive to use. Explanations of most of the tools were included in the beginning of Section 4.

EDITING WITH SITE MODELER

During this exercise we will learn how to edit several GEOPAK Site Objects previously created including Building 1, Parking Lot 1 and Pond 1. We will explore several GEOPAK Site Modeler tools to aid us in reassigning elevations to elements within each Site Object. After the successful completion of the previous workshop, we will have a GEOPAK Site Model called Tower.

Opening Existing Site Project

1. Open the file *C:\Data\Geo\Site\Site1\Chapter5\Siteplan2D.dgn* (*MicroStation: File>Open*).
2. Select the **Site Modeler** tool (*Applications>GEOPAK Site>Site Modeler>Site Modeling*).



3. Click **Browse**.
4. Navigate to and select the file *…Site1\Chapter5\Siteplan.gsf.*
5. Click **OK**.

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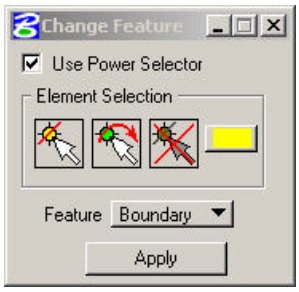
MODIFYING A SITE ELEMENT OR SITE OBJECT

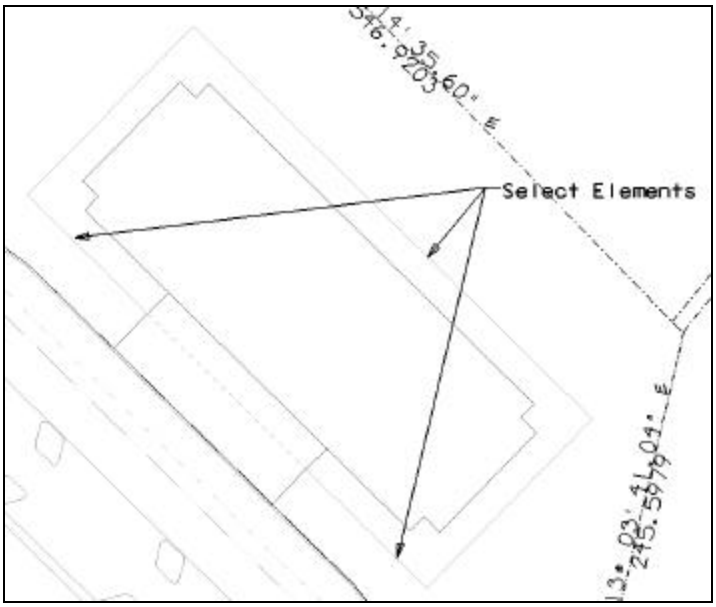
In this section we will modify some of the site elements in our building as well as its position in the overall site model.

Change Site Element Feature Type

1. Use the MicroStation Saved View Bldg.
2. Select the **Change Feature** tool. *(Site Modeler Menu: Elements > Change Feature).*



3. Enable **Use Power Selector**.
4. Set the **Feature** to Boundary.
5. Click **Select Reference Element**.
6. Select the three green MicroStation elements that represent the grass area around the building.



7. Click **Apply**.

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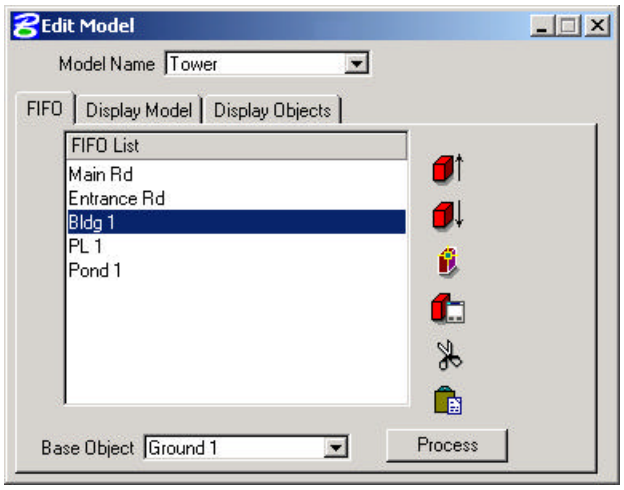
Editing the Model FIFO List

1. Select the **Edit Model** tool *(Site Modeler: Model > Edit)*.

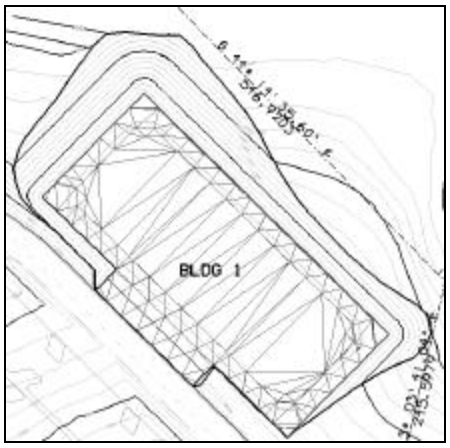


2. Select the **FIFO** tab.

   This FIFO Tab lists all objects currently in the model in the order in which they are merged. Roadway 1 is the first object merged in the model with the Base Object Ground 1. Each subsequent object is merged with Ground 1 as well as the objects above it in the FIFO list.

3. Select Bldg 1 and click **Move Object Down** until Bldg 1 is below Entrance Rd.

4. Click **Process**.



Results of the reordering the FIFO list

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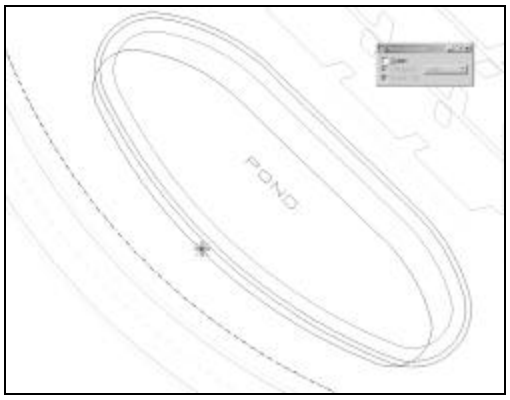
Modifying the Pond Object

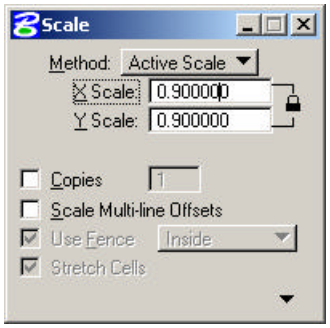
In this exercise, we will move the pond bottom to a new location and then increase the pond area by scaling the pond bottom element. The tools to accomplish this are quite simple and can be applied to any type of object.

1. Use the MicroStation Saved View Pond.
2. Select the MicroStation **Move Element** tool (*MS: Tools > Main > Manipulate).*
3. Select the pond bottom and move it slightly towards the Main roadway.



The inside and outside edges of the berm should also move with the pond bottom since we associated these elements when we created them.

5. Select the MicroStation **Scale** tool. *(MS: Tools > Main > Manipulate)*



6. Scale the pond bottom by 0.9.

   Again the inside and outside edges of the berm will also be scaled appropriately due to the associations.

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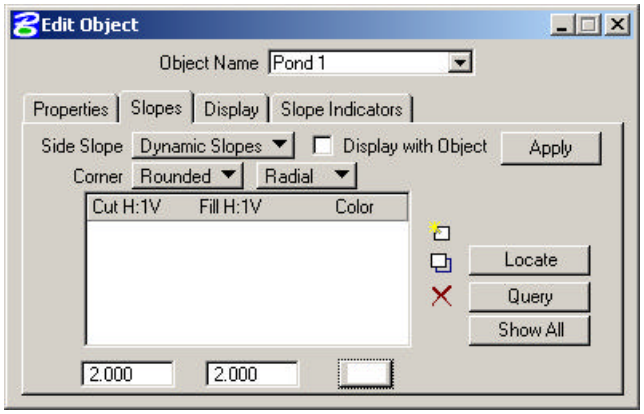
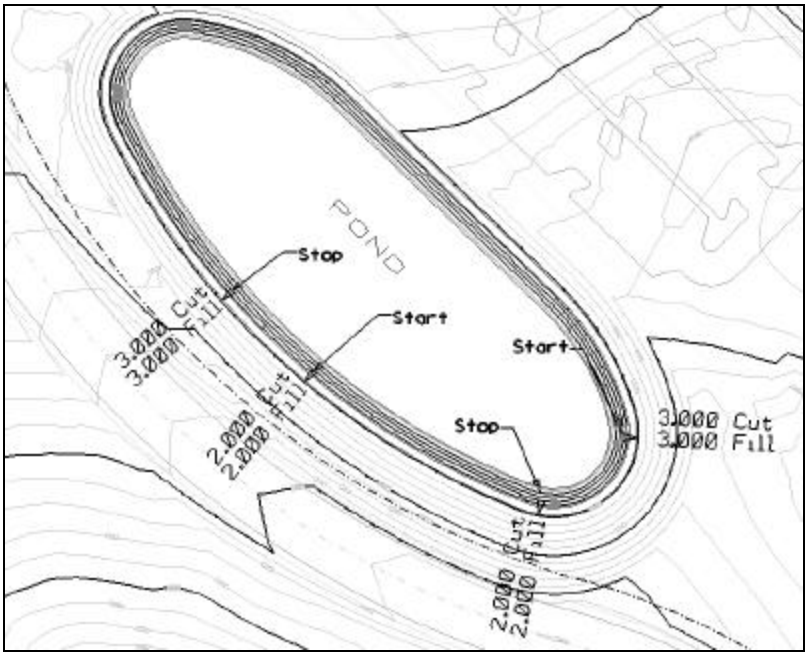
Changing the Pond Object Side Slopes

Moving the Pond closer to the main roadway may cause the slopes coming off of the pond to encroach on the roadway shoulder. There are several ways to address this type of problem. Obviously we could move the pond back from the road until the slopes no longer interfere. We will take a look at modifying the Object side slopes that are adjacent to the roadway. For example we will modify the pond object so that we have 2:1 slopes on the side adjacent to the main road and 3:1 slopes along the side adjacent to the parking lot.

1. Select the **Edit Object** Tool. *(Modeler: Object > Edit)*



2. Click the **Slopes** tab.
3. Set **Side Slope** to Dynamic Slopes.
4. Enter 2.0 in **Cut H:1 V** and **Fill H:1V** in the edit fields at the bottom of the dialog,
5. Click **Locate** and data point for the location to *start* the 2:1 slope.



Locations for Dynamic Slopes

6. Click **Add List Item**.

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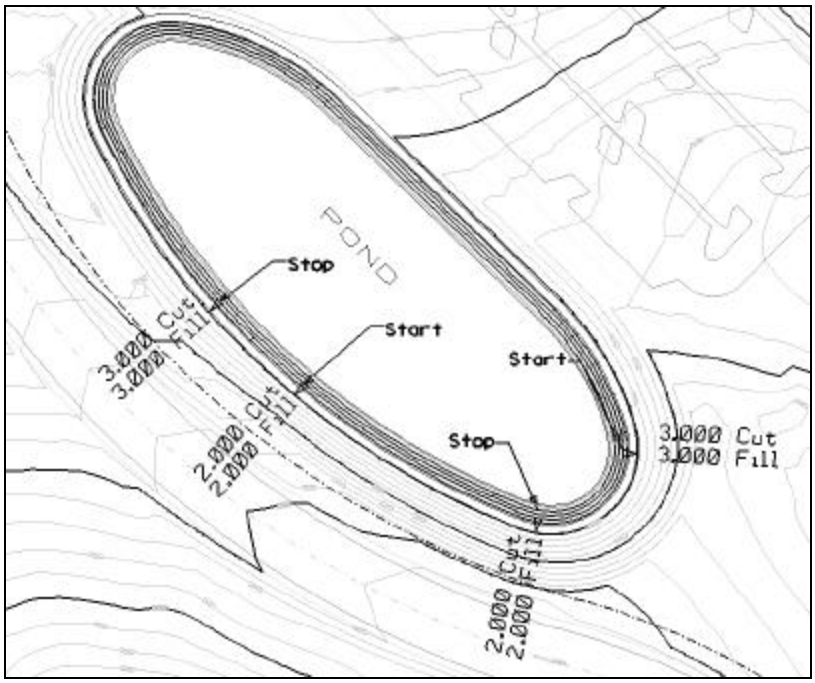
7. Click **Locate.** Data point for the location to *stop* the 2:1 slope.
8. Click **Add List Item**.
9. Enter 3.0 in **Cut H:1V** and **Fill H:1V** in the edit fields at the bottom of the dialog,
10. Click **Locate** and data point for the location to start the 3:1 slope.
11. Click **Add List Item**.
12. Click **Locate** and data point for the location to stop the 3:1 slope.
13. Click **Add List Item**.
14. Click **Apply**.



Pond Contours After Dynamic Slopes Applied

15. Close your site project *(Modeler: File > Close)*.
16. Exit MicroStation.

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6 Drainage Design

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- Drainage components.
- Computation features.
- GEOPAK Drainage (GDF) file.
- Drainage library.
- Navigation tools.
- Labeler.
- Culverts.
- Routing.
- DTM Drainage tools.
- Hydrologic and hydraulic Considerations.
- GEOPAK Road/Site data.
- Design conveyance system.
- Evaluate system.

INTRODUCTION

The GEOPAK Drainage workflow mirrors a conventional design process beginning with the design of the surface collection system (inlets, drainage areas) followed by the design of the conveyance system (subsurface pipes, channels).

Roadway alignments, vertical profiles, and digital terrain models may be used throughout GEOPAK Drainage to provide pertinent information to the drainage design. All drainage components feature interactive *graphical placement tools* for easy definition of the drainage system.

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DRAINAGE COMPONENTS

GEOPAK Drainage organizes the components of a drainage system according to their spatial characteristics. Spatial information is stored as Nodes, Links and Networks.

- Nodes: A node (inlets, manholes, etc.) is a point feature with a user-defined location. The location may be in Cartesian coordinates (x,y) or in curvilinear coordinates (station, offset).
- Links: A Link represents a linear feature depicting a path connecting two nodes, traversing upstream to downstream. The path may be straight line or curvilinear (along a graphic element).
- Networks: A network is a system of interconnected nodes and links that form a system through which water can flow to a single outlet node. A drainage project accommodates any number of Networks.

Other associated components in GEOPAK Drainage include:

- Areas: A drainage area can be represented by a closed boundary or simply keyed-in (acres or hectares). All flows from a single drainage area are tributary to a single Node. There is a *one to one* correspondence between a node and an area. Therefore areas and nodes share the same name (ID). A drainage area may contain multiple subareas representing homogeneous features such as soil types and land uses (“C” values), thereby allowing composite "C" value calculations.
- Profile: A profile represents a path connecting any two or more nodes in a Network. Profiles provide the visualization of pipes, surface tins, crossings, etc, between any two or more nodes in a drainage network.

COMPUTATION FEATURES

Hydrologic and hydraulic capabilities include runoff computations, inlet design and analysis, and pipe and ditch design and analysis. All computations follow recommended methodologies in the FHWA publication "Drainage of Highway Pavements" as well as the procedures in the AASHTO Model Drainage Manual.

Runoff computations are performed using either the Rational or SCS method where rainfall parameters may be specified with common intensity equations, hydrographs, or by tabular intensity-duration data. Drainage area delineation tools allow easy creation of contributing areas and the graphical assignment of these to drainage features. The extremely tedious task of compiling different subareas and runoff coefficients is practically eliminated by GEOPAK Drainage's graphical shape tool, allowing easy creation of drainage areas and land use boundaries. Once the boundaries are defined, the runoff coefficient and associated hydrologic parameters are computed automatically by delineating the land use zones inside of the drainage area. Any subsequent modifications to the boundaries will update the runoff coefficient via a single mouse click.

Inlet design and analysis capabilities include Curb, Slotted Drain, and Grate inlets both on grade and in a sump. Inlet designs may proceed through a user specified library of standard inlet sizes to determine the most suitable design for a given set of user prescribed constraints. Inlets may also be designed or analyzed with by pass flows from one inlet to another, including by pass flows between inlets of different networks.

Most standard pipe configurations may be designed and analyzed including arch, box, circular, elliptical and pipe arches. A library of available sizes in most common materials (Aluminum, Concrete, Steel, and Plastic) is provided for the designer to select sizes or simply specify types for GEOPAK Drainage to select the appropriate size. Pipe design selections may be optimized for either size or depth of cover. Trapezoidal ditches may also be designed or analyzed anywhere within a storm drain network. The pipe and ditch hydraulics include backwater curve computations and junction loss options.

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GEOPAK DRAINAGE FILE (GDF)

The main GEOPAK Drainage File has the extension *.GDF. This binary file contains all the hydraulic and hydrologic information about the drainage system. Each GEOPAK Drainage Project contains Preferences, which includes all computational options, visualization symbologies, and project file references to other commonly used files. Spatial data, connectivity and hydraulic properties for each drainage feature are stored in the GDF. Sufficient data is maintained to rebuild the graphical representation of the Drainage Project with the exception of certain features, which are defined by MicroStation elements (i.e. Drainage Areas).

MICROSTATION DESIGN FILE

This MicroStation dgn graphics file is utilized for the visualization of the drainage project and definition of certain drainage features using MicroStation graphic elements. The only data stored within this file are graphics and their attributes for reference to the GEOPAK Drainage file (.gdf).

DRAINAGE LIBRARY

In contrast to the Drainage File and MicroStation graphics file, the Drainage Library is utilized for numerous projects, as it contains the standards for an entire organization. The Drainage Library contains the rainfall parameters, standard inlet types, standard pipes configurations, spread sections, and land use symbology tables. All of these items are merely referenced by each project to accommodate standardization and information sharing among projects.

NAVIGATOR TOOLS

The Navigator provides an easy method to guide through the components in a GEOPAK Drainage project and affords the following functionality:

- Navigate components of the drainage system.
- Query analysis and design violations based on established parameters.
- Form a list of candidates for investigation or modification based on component query parameters.
- Cross reference components in the GEOPAK Drainage file database with the graphical representation in the design file.
- Shortcuts to add, edit, and delete drainage components.
- Tools to identify and graphically locate drainage components.
- The Global Editor to edit input parameters.
- Update Graphics tool to redisplay any or all of the graphical representations of the drainage components.
- Update Pay Items tool.

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LABELER

The Labeling automates the composition and placement of plan labels onto drawings. This interactive tool permits the creation of very simple to complex labels using many of the following features:

- Numerous Computed Text Inserts permit standardized computed values to be easily incorporated into labels. These standardized computed values are based on the type of element to be labeled and change as different elements are selected by the user. Types of elements available for computed inserts include points, lines, arcs, complex graphic elements, COGO features, and drainage features.
- User Text Inserts facilitate the simple inclusion of user defined text strings into the label. These User Inserts can be customized to include frequently used labeling terms and be saved for continual use.
- Standard shapes can be placed around labels and to accommodate different plan label formats.
- Standard leader lines and leader line terminators can also be utilized to create the desired label formats.
- Frequently utilized labels can be stored as Label Styles for subsequent recall. The complete label, including computed text inserts, user inserts, shapes, and leaders, are all stored within the Style.
- Tools to edit, move, and extract labels are also provided to make manipulation and plan changes easier.
- Enhanced ASCII is supported by use of the (\) symbol.
- Styles are supported, whereby often used labels and associated settings can be saved off and recalled in subsequent sessions.
- Updating options provide for efficient changing as the project dictates changes in the design.

CULVERT

GEOPAK Culvert is a powerful tool for the design and analysis of culvert structures. Located within GEOPAK Drainage, the Culvert tool can leverage data from a coordinate geometry database (GPK), a Site Modeler database file (GSF), the Drainage database file (GDF) or a binary TIN file. This enables the user to utilize roadway and / or storm sewer data, both existing and proposed.

ROUTING

The GEOPAK Routing tool supports the creation and manipulation of runoff hygrograph data in accordance with SCS TR20 methodologies. Runoff Hydrographs can be created, added, and routed through Reaches and Reservoirs.

DTM DRAINAGE TOOLS

Located at the bottom of the Utilities pulldown, the DTM Drainage Tools provide a number of functions to evaluate DTMs for flow patterns, flow paths, drainage area delineation, and other DTM drainage related tools.

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HYDROLOGIC AND HYDRAULIC CONSIDERATIONS

When beginning a GEOPAK Drainage project, certain hydrologic and hydraulic design criteria must be established. Of course, changes can be made throughout the design process, however, sound criteria from the onset of the project lends to a more productive design.

Typical hydrologic and hydraulic criteria to establish at the beginning of a GEOPAK Drainage project include:

- The type of rainfall data, supported by GEOPAK Drainage, to be used in the intensity calculations. This may include intensity-duration-frequency tables, SCS Unit Hydrograph, SCS Cumulative Hydrograph, or intensity equations. Attention should be paid to the units of the project.
- The design and analysis frequencies to be used on the project and the availability of rainfall data for these frequencies.
- Any standard runoff coefficients and land uses applicable to the drainage basins within the contributing project area.
- The types of inlets and other Node structures to be included in the project including all the dimension information and relevant hydraulic properties for each.
- The different shapes, materials, and sizes of pipes to be included in the project along with pertinent pipe hydraulic information.

GEOPAK ROAD/SITE DATA

GEOPAK Drainage is designed to leverage a great deal of GEOPAK Road and DTM design information, if such data exists. While no roadway or DTM data is required to complete a design in GEOPAK Drainage, having this information fully exploits the capabilities of GEOPAK Drainage. The availability and accuracy of such data should be an early consideration in the development of a GEOPAK Drainage project.

Most of the Drainage features referenced to the Roadway and DTM are automatically calculated once the reference to the source of the information is established. These values are automatically updated as features are changed, edited or moved. This leveraging reduces the amount of user derived and computed information and greatly reduces efforts as design features are revised.

Special attention should be given to the purpose, source, and accuracy of DTM data used in GEOPAK Drainage projects. The terrain model typically needs to contain a model of the proposed roadway design. When used for contributing drainage areas, this model may need to be merged with a DTM containing the definition of the surface outside the roadway area to have adequate topographic coverage. DTMs used for evaluation of drainage patterns, and not specific elevation data, could be created to lesser detail since the patterns are the only item of interest. Conversely, DTMs used for specific elevation and profiles must be created with a detail commensurate with the accuracy required for such information. The DTMs for roadways containing superelevation transitions, sag vertical curves, and other profile and elevation anomalies of concern to drainage designers, should be given special consideration in their creation.

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DESIGN SURFACE COLLECTION SYSTEM

The design of the surface collection system (inlets) proceeds in an iterative fashion similar to conventional methods. The roadway or terrain should be evaluated for critical surface drainage points such as low points, zero transverse slope regions, high points etc. These critical points often indicate the initial or required location of inlets. The inlet (Node) is located, the drainage area delineated, the inlet hydraulics are performed and checked for compliance with design criteria (i.e. spread, capacity, by pass flows). If a node meets the design criteria and the location acceptable, it is added to the database and then the next inlet is placed. All the surface collection features may be located, their respective drainage areas delineated, and then hydraulically analyzed for adequacy.

The results of any portion or all of the system can be viewed and reported at any time. Upon successful layout of the surface collection, the conveyance system is ready to be designed.

DESIGN CONVEYANCE SYSTEM

With the inlets (Nodes) located, decisions regarding pipe (Link) alignment, the location of Junctions (Nodes), other confluences and the system outlet completes the initial Node network. Links are defined between the Nodes completing the network connectivity to the outlet. A Network may then be added by defining the outlet Node and the complete Network hydraulic calculations can be computed.

EVALUATE SYSTEM

Once the Network computations have been performed, all the features in the network can be evaluated for adequacy. Many tools are provided to assist in this phase including Reports, querying within the Navigator and drawing profiles. Computation options may be revised in the Preferences or drainage components themselves modified and the Network re-evaluated until a satisfactory design is achieved.

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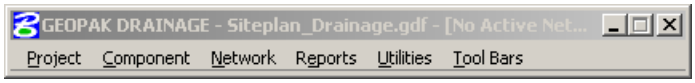
WORKSHOP: DRAINAGE DESIGN

Project Setup

1. Open the MicroStation design file *..\Data\Geo\Site\Site1/Chapter6/Siteplan_Drainage.dgn.*
2. Select the **GEOPAK Drainage** tools *(Applications > GEOPAK DRAINAGE > Drainage).*

   All tools in Drainage can be accessed through this main GEOPAK DRAINAGE Menu Bar. GEOPAK Drainage opens an untitled project file.



3. Open the project file *../Data/Geo/Site/Site1\Chapter6\Siteplan_Drainage.gdf.*

   (Drainage menu: Project > Open).

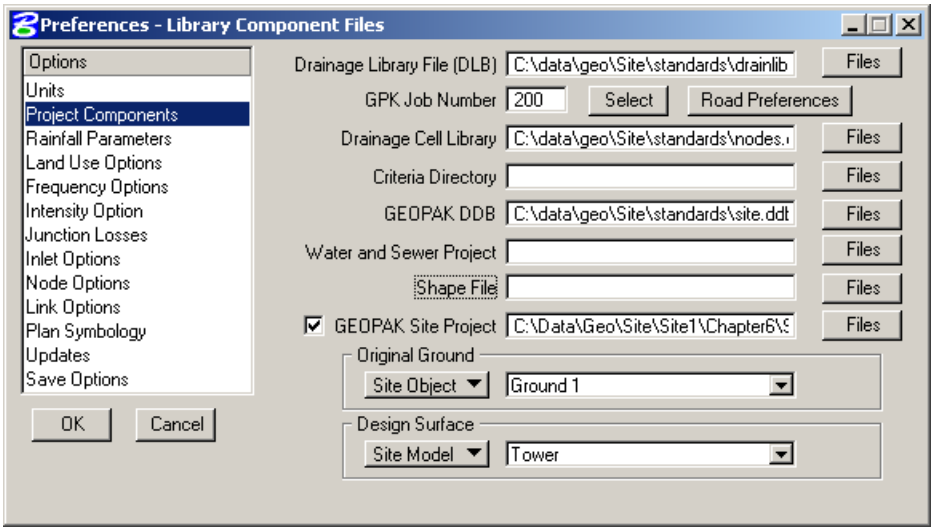
Setting the Drainage Preferences

The Project Preferences control the graphic and computational options of the drainage system. The Project Preferences may be changed at any time and the system can then be redesigned or analyzed utilizing the new preferences.

1. Select the **Preferences** tool *(Drainage menu: Project > Preferences).*
2. Select **Units** and set to **English.**
3. Select **Project Components**.

   These Preferences have already been set for this project. Preferences may be changed at any time during the project, and the network(s) then redesigned to accommodate the new Preferences. Review the other options with your instructor or refer to the *On-Line Help > Drainage > Project Preferences*.

4. Click **OK.**



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5. Enter the following information.

Drainage Library (DLB):	*..\Data\Geo\Site\Standards\drainlib.dlb*
GPK Job Number:	200
Drainage Cell Library:	*..\Data\Geo\Site\Standards\nodes.cel*
GEOPAK DDB:	*..\Data\Geo\Site\Standards\site.ddb*
GEOPAK Site Project:	Enable toggle, *..\Data\Geo\Site\Site1\Chapter6\Siteplan.gsf*
Original Ground:	Site Object; Ground 1
Design Surface:	Site Model; Tower

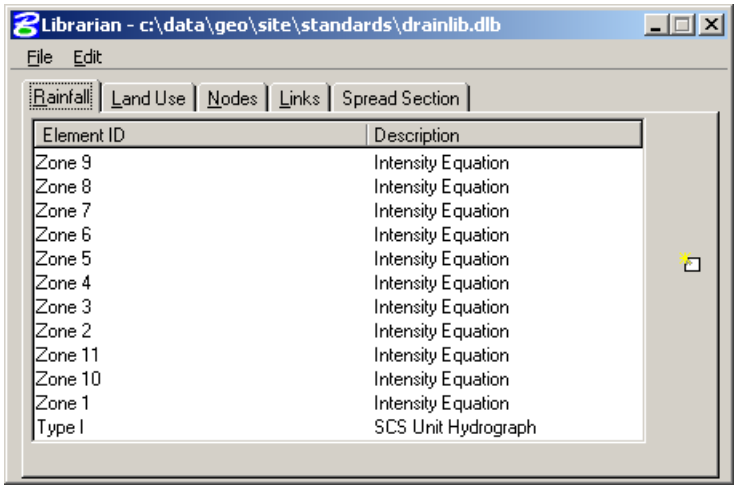
Note These Preferences have already been set for this project. Preferences may be changed at any time during the project, and the network(s) then redesigned to accommodate the new Preferences. Review the other options with your instructor or refer to the *On-Line Help* > *Drainage* > *Project Preferences*.

6. Click **OK.**

Reviewing the Drainage Library

The *Drainage Library* is used to store hydraulic, hydrologic, and construction standards, which may be shared by different projects and designers. Each GEOPAK Drainage project accesses items from the *Drainage Library* for use on any project.

1. Select the **Drainage Library** tool *(Drainage menu: Project > Drainage Library)*.



TAB	DESCRIPTION
Rainfall	Rainfall Data Source
Land Uses	Land Uses and their corresponding “C” values and symbology
Nodes:	Inlets, Junctions, Manholes, Outlets, etc.
Links:	Circular Pipes, Elliptical Pipes, Pipe-Arch pipes, Boxes, etc.
Spread Section:	Inventory of varying Spread Cross Sections

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2. Click the **Rainfall** tab.

   The Rainfall Tab stores the rainfall data information to be used on GEOPAK Drainage Projects. GEOPAK Drainage supports rainfall sources in the form of intensity duration frequency (IDF) tables or as coefficients for intensity-duration-equation formats. Also supported are the HYDRO-35 and TP 40 methods of rainfall.

3. Double-click **Zone 1.**

   Alternately, highlight Zone 1 and click **Modify Library Item** (right of list box).

   Note the various **Data Type** options available in the upper right corner.

4. Click **OK**.

5. Click on the **Land Use** tab.

   The Land Use Tab is used to store runoff coefficients ("C" values) and corresponding graphic symbology for each land use. Land Uses can then be delineated automatically using the selected symbology.

6. Select **Private Land Uses**, and click **Modify Library Item.**

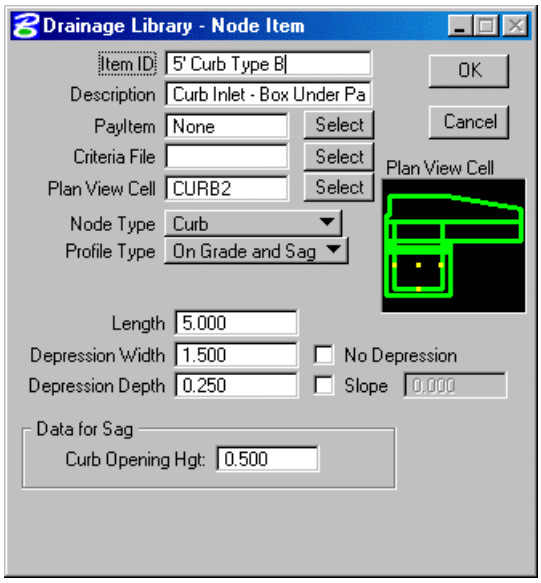
7. Review the various entries.

8. Click **OK**.

9. Click on the **Nodes** tab.

   The Nodes Tab contains standard configurations for Curb, Grate and Slotted Drain inlets as well as Junctions, Outlets and Other Nodes. The description, plan view representation and dimensional information is stored for each node.

10. Double click the first Curb Inlet.



11. Click **Select** to the right of the **Plan View Cell** to open **the Select Cell from Library** dialog.

12. Click **Cancel** to close.

13. Review the various entries in the **Node Item** dialog.

14. Click **OK**.

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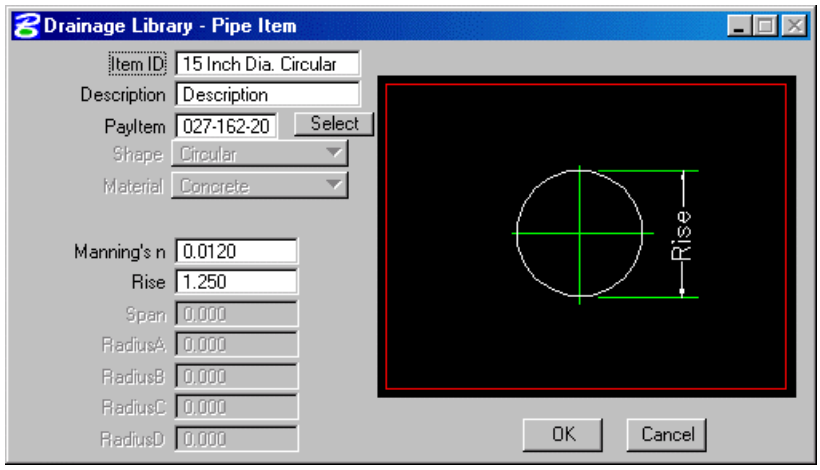
15. Click on the **Links** tab.

    The Links Tab contains all pipes to be used on the Drainage project. Each pipe is categorized by three properties: Shape, Material, and Type (corrugation); and contains information regarding specific pipe geometry, default roughness coefficient, and material combination.

16. Double click on the first Circular Concrete pipe.



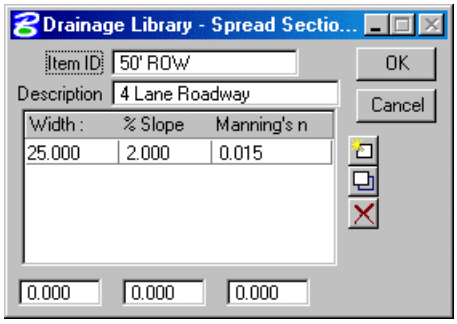
    Note the various geometric input required for the Links.

17. Click **OK**.

18. Click on the **Spread Section** tab.

    The Spread Section stores standard cross sections (for roads, gutters, etc.) to be used on GEOPAK Drainage Projects.

19. Double click on the 50' ROW.



    Note the spread cross-section characteristics for each spread item.

20. Click **OK**.

21. Close the Drainage Library without saving changes *(File > Close)*.

22. Click **No** to saving changes.

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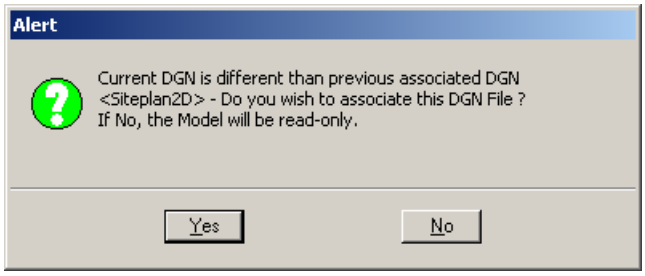
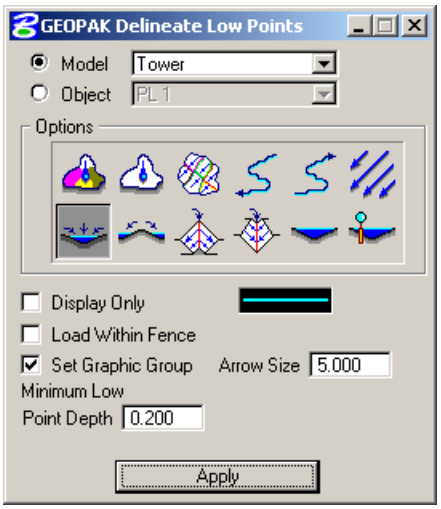
Locate the Low Points

Note The "Siteplan.dgn" file is referenced. This referenced DGN file contains the plan view graphics used for the Site design. We will initially be focusing on the parking lot. Use MS window commands to window in on the parking lot.

1. Select the **Site Modeler Tool** *(Applications > GEOPAK Site > Site Modeler > Site Modeling)*.
2. Toggle on **Open Existing Project**.
3. Click **Browse** and select *..\Data\Geo\Site\Site1\Chapter6\Siteplan.gsf.*
4. Click **No** when prompted to associate the design file.



5. Select the **DTM Drainage Tools** tool *(Drainage: Utilities > DTM Drainage Tools).*
6. Select the **Delineate Low Points** tool.



Note We have set the Minimum Low Point Depth to 0.200. This allows the tool to ignore "false" low points in the surface.

7. Double click on sample graphic element and set symbology as desired.
8. Enable **Set Graphic Group**.
9. Set **Arrow Size** to 5.0.
10. Set **Minimum Low Point Depth** to 0.2.

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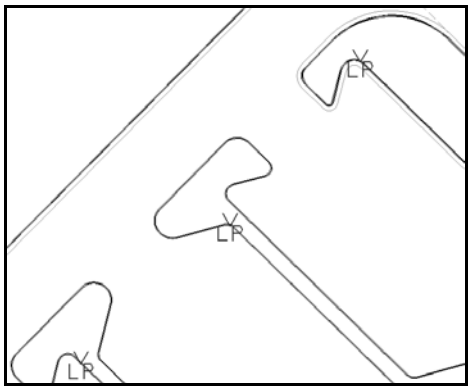
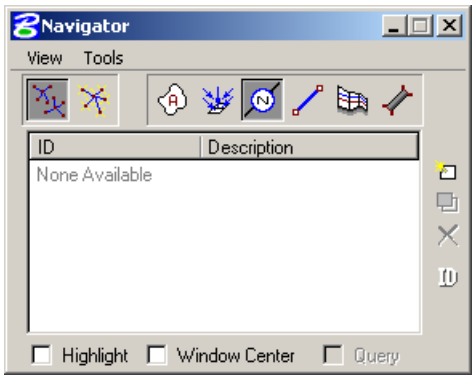
11. Click **Apply**.



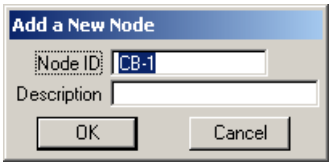
12. Close the DTM Drainage Tools dialog.
13. Close the Site Modeler *(Modeler: Project > Exit)*.

Placing Inlet CB-1

1. Select the **Navigator** tool *(Drainage: Utilities > Navigator)*.



2. Click **Node** from short-cut tools at the top of the Navigator.
3. Click **Add Item** (right side of list box.)



The default Node ID is set to CB-1 per our project preferences.

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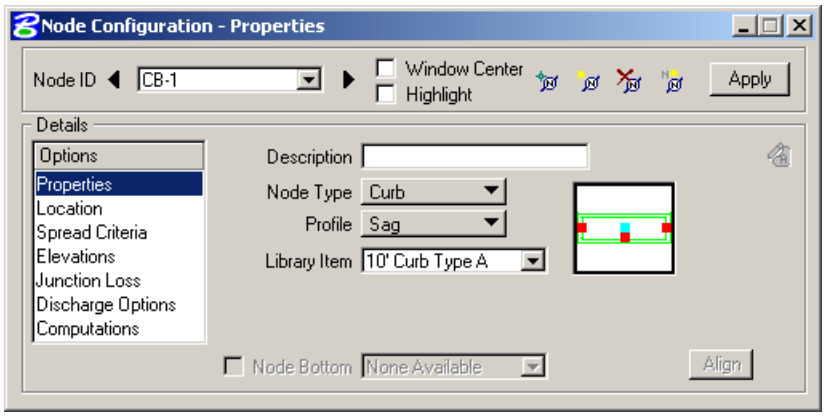
4. Click **OK**.

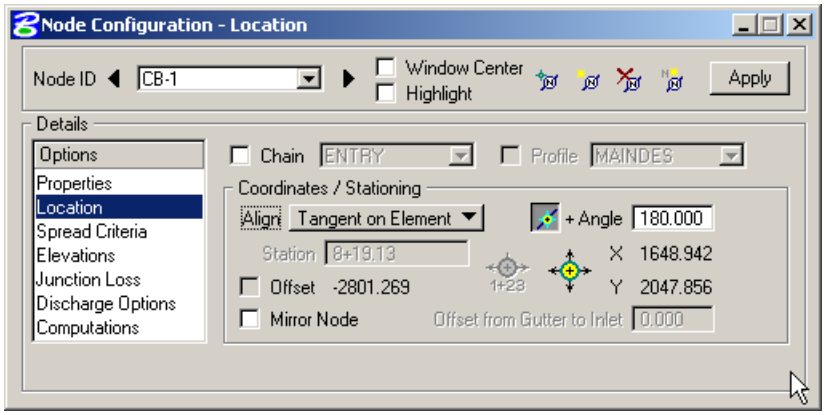


5. Enter the Properties information.

Node Type	Curb
Profile	Sag
Library Item	10' Curb Type A

6. Highlight **Location**.

   This option defines the inlet's location in the design plane.



7. Enter the Location information.

Align:	Tangent on Element
Angle	180

8. Click **Select MS Alignment Element** (right of the Align option).
9. Select and accept the edge of pavement element for the southern most low point.

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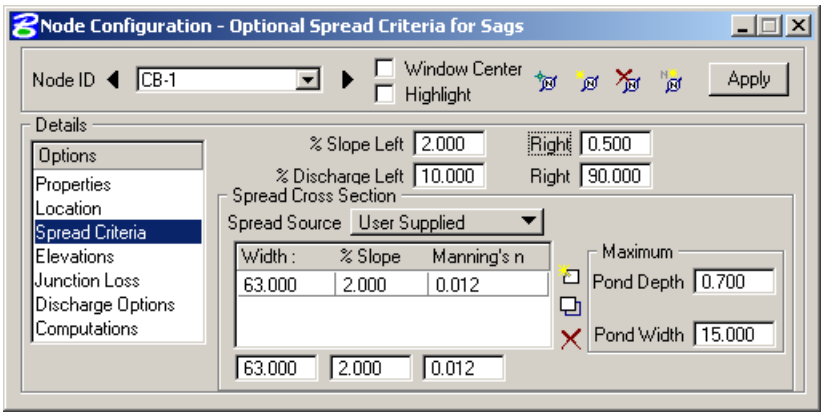
10. Click **Station DP** to dynamically place the inlet.

    The inlet follows your cursor movement.

11. Data point to place the inlet at the low point

12. Highlight **Spread Criteria**.

    Assign the roadway cross sectional characteristic directly in front of the inlet. These values will be utilized to calculate inlet capacity and resulting by-pass flow:



13. Enter the Spread Criteria information

% Slope Left:	2 (Longitudinal slope from the left of the inlet)
% Slope Right:	0.5 (Longitudinal slope from the right of the inlet)
% Discharge Left:	10
% Discharge Right:	90
Spread Source	User Supplied
Spread Source Width:	63.0 (the width of the parking bays and roadway)
Spread Source % Slope:	2.0 (Parking Lot cross slope).
Spread Source Manning's n:	0.012
Maximum Pond Depth	0.70
Pond Width	15.0

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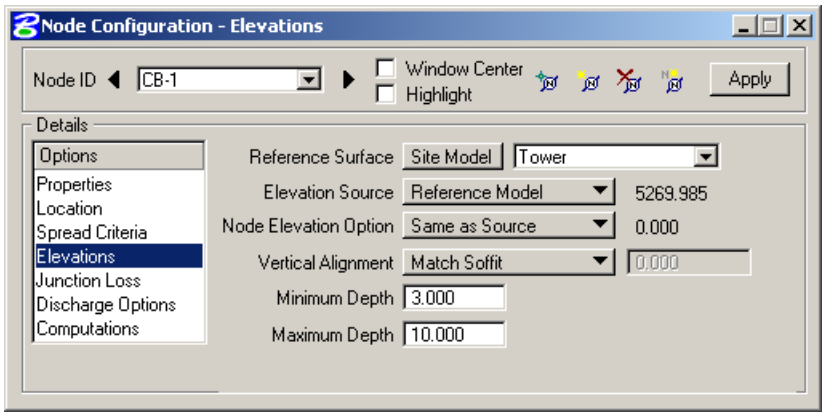
14. Select **Elevations**.



15. Assign the inlet's vertical elevation and vertical pipe alignment preferences.

Reference Surface	Site Model; Tower
Elevation Source	Reference Model
Node Elevation Option	Same as Source
Vertical Alignment	Match Soffit
Minimum Depth	3
Maximum Depth	10

16. Highlight **Junction Loss**.
17. Toggle on **Defined Equations**.
18. Highlight **Discharge Options**.
19. Toggle on **Use Computed Discharge**.
20. Highlight **Computations**.

Note Error Performing Inlet Computations: The Drainage Area for this node won't be added until the next step. Therefore, the Computations for the node can't be completed until a discharge is known (next step).

21. Click **Apply**.
22. Close the Node Configuration dialog.

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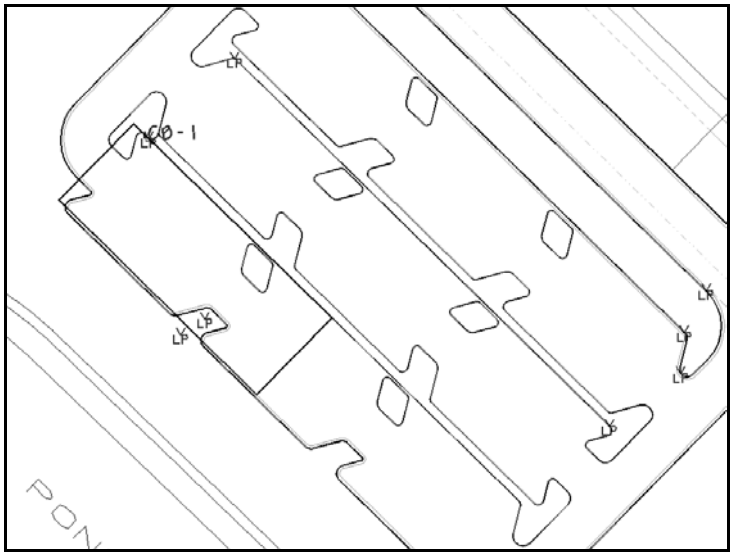
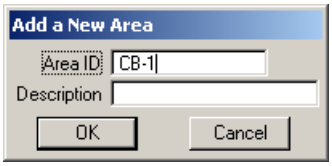
Defining the Drainage Area for CB-1

1. Select the MicroStation Place Shape tool. *(MS: Polygons tool box > Place Shape).*
2. Draw the closed shape similar to the illustration below.

   This closed shape will be selected as the drainage area (next step).



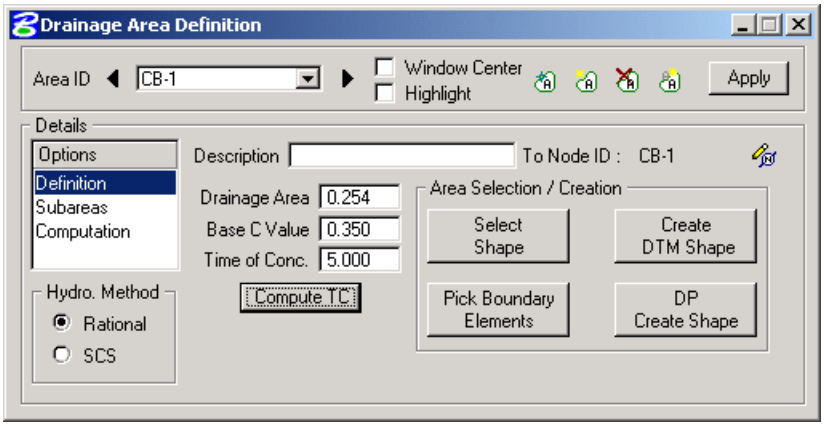
3. Click Area in the Navigator.
4. Click **Add Item**.



   Change the **Area ID** to CB-1.

Note The Area ID and the Node ID should be the same. That establishes the relationship between the two.

5. In the Drainage Area Definition dialog, click **Select Shape**.



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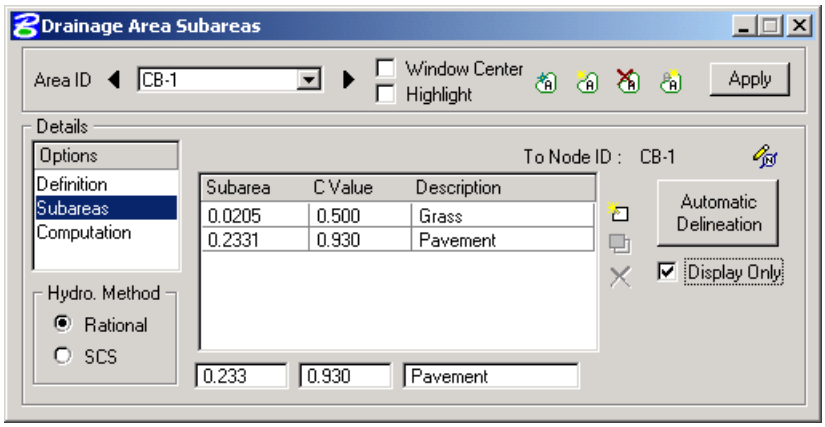
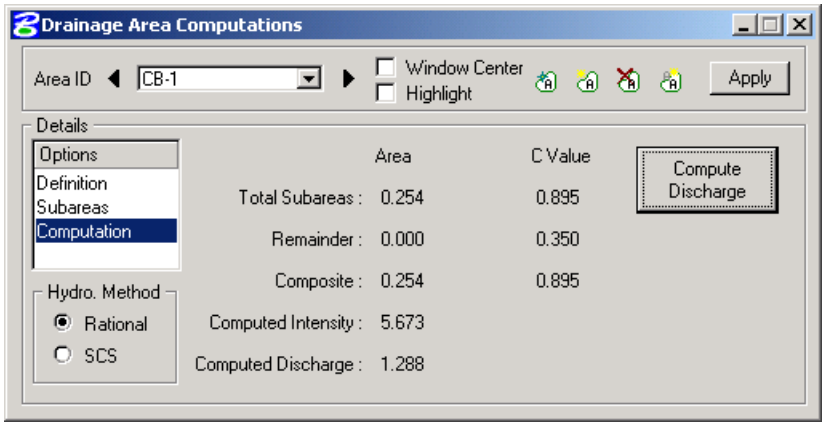
6. Select and accept the shape that was just drawn to represent the drainage area.
7. Set the **Base C Value** to 0.35.
8. Set the **Time of Concentration** to 5.00.
9. Select **Subareas.**
10. Toggle on **Display Only.**
11. Click **Automatic Delineation**.

    The file is scanned for closed shapes matching the Land Use symbology specified in the Drainage Library (Land Use Tab).



12. Select **Computation**.
13. Click **Compute Discharge**.

    Note the Computed Discharge is now displayed.



14. Click **Apply**.

    This applies the land uses (and their "C" values) to the Drainage Area.
15. Use the MicroStation Update View command, if required, to remove the temporary fill.

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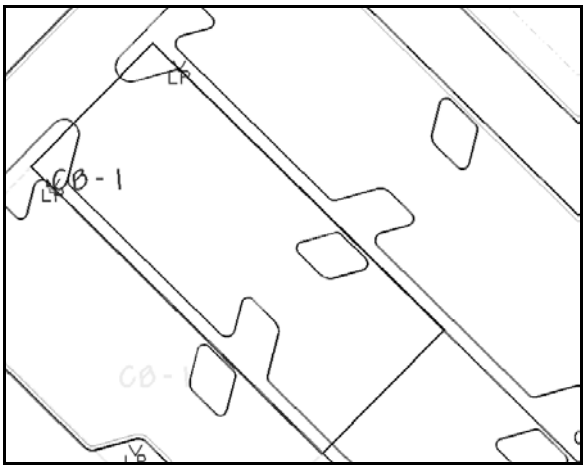
Define Drainage Area for CB-2

1. Place the closed shape similar to the illustration below.



2. Click **Add Area** on the Drainage Area dialog.

   The **Area ID** should be set to CB-2.
3. Select **Definition**.
4. Click **Select Shape**
5. Select and accept the previously placed closed shape.

   The Drainage Area field is populated with the area of the shape.
6. Set the **Base C Value** to 0.93.

   This is for the pavement runoff coefficient (no other land use delineation is necessary).
7. Set the **Time of Concentration** to 5.0 minutes.
8. Select **Computations**.
9. Click **Compute Discharge**.

   We have finalized the Drainage Area computations.
10. Click **Apply**.
11. Select **Definition**.

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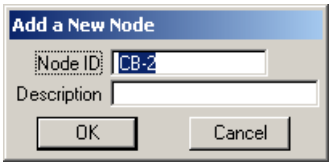
Place Inlet CB-2

1. Click **Edit Node** (located in the top right hand corner of the Details group of the Drainage Area Definition dialog).



   The Node ID should be CB-2.

2. Highlight **Properties**.

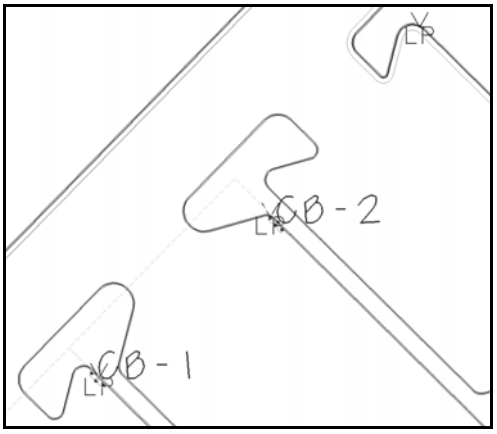
   Note that the dialog box settings are defaulted to the previous setting. No changes are required for this inlet.

3. Highlight **Location**.

   Note again all stored dialog box settings are appropriate for this inlet location.

4. Click **Select MS Alignment Element**. *(right of the align option)*

5. Select and accept the edge of pavement near the low point on the middle curb island.



6. Set the + **Angle** to 0.

7. Click **Station DP** and data point to place the inlet at the low point

   The inlet follows your cursor movement and place the inlet at the low point.

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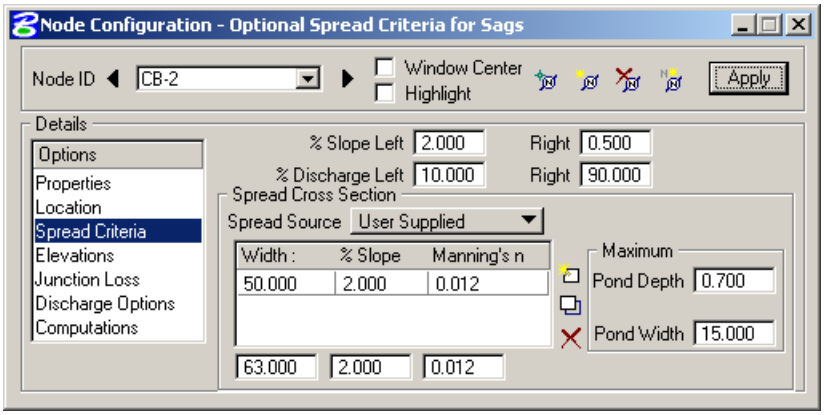
8. Highlight **Spread Criteria**.

   Assign the roadway cross sectional characteristic directly in front of the inlet. These values are utilized to calculate inlet capacity and resulting by-pass flow.



8. Enter the Spread Criteria information.

% Slope Left:	2
% Slope Right:	0.5
% Discharge Left :	10
% Discharge Right:	90
Spread Source:	User Supplied
Spread Source Width:	50
Spread Source % Slope:	3
Spread Source Manning's n:	0.012
Maximum Pond Depth	0.7
Pond Width	15

9. Select **Elevations**.
10. Assign the inlet's vertical elevation and vertical pipe alignment preferences.

Reference Surface	Site Model, Tower
Elevation Source	Reference Model
Node Elevation Option	Same as Source
Vertical Alignment	Match Soffit
Minimum Depth	3
Maximum Depth	10

11. Select **Computations**.

Note *The Junction Loss and Discharge Options should be the same as previously set when creating CB-1.*

12. Click **Apply**.
13. Close the **Node Configuration** dialog.

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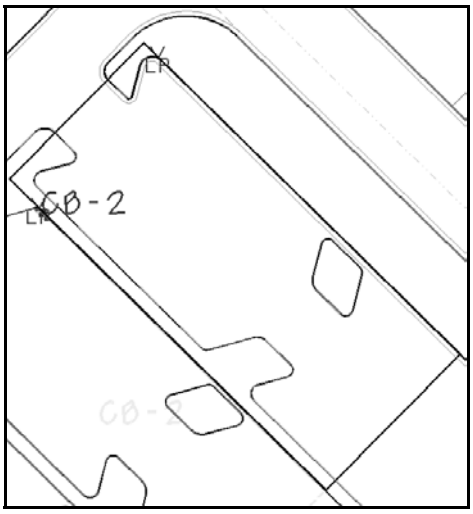
Define Drainage Area for CB-3

1. Place the closed shape similar to the illustration below.



2. Click **Add Area** on the Drainage Area Definition dialog.
3. Set the **Area ID** to CB-3.
4. Highlight **Definition**.
5. Click **Select Shape,** select and accept the previously placed closed shape.
6. Set the **Base C Value** to .93

   This is for the pavement runoff coefficient (no other land use delineation is necessary).
7. Set the **Time of Concentration** to 5.0 minutes.
8. Select **Computations**.
9. Click **Compute Discharge**.
10. Click **Apply**.
11. Highlight **Definition**.

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Place Inlet CB-3

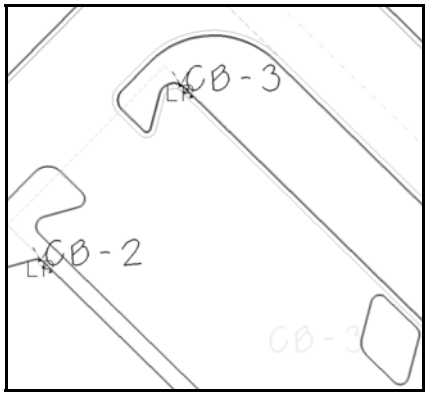
1. Click **Edit Node**.

   The Node ID should be CB-3.

2. Select **Location**.

3. Click **Select MS Alignment Element**.

4. Select and accept the gutter flow line near the low point on the upper curb island.

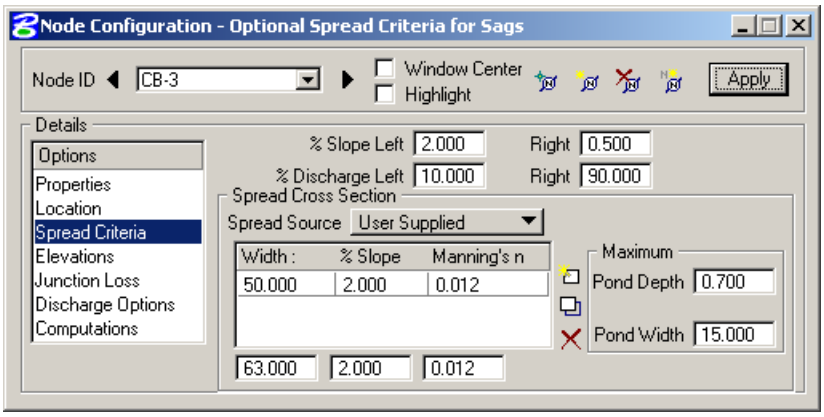


5. Set the + **Angle** to 0.

6. Click **Station DP** to dynamically place the inlet.

7. Data point to place the inlet.

8. Highlight **Spread Criteria**.



9. Enter the Spread Criteria information.

% Slope Left:	2
% Slope Right:	0.5
% Discharge Left :	10
% Discharge Right:	90
Spread Source:	User Supplied
Spread Source Width:	50
Spread Source % Slope:	2

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Spread Source Manning's n:	0.012
Maximum Pond Depth	0.7
Pond Width	15

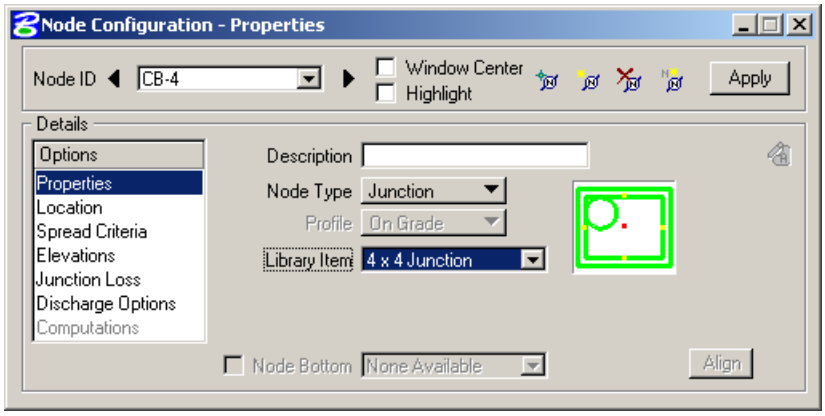
10. Select **Elevations**.
11. Assign the inlet's vertical elevation and vertical pipe alignment preferences.

Reference Surface	Site Model, Tower
Elevation Source	Reference Model
Node Elevation Option	Same as Source
Vertical Alignment	Match Soffit
Minimum Depth	3
Maximum Depth	10

12. Select **Computations**.
13. Click **Apply**.
14. Close the **Node Configuration** dialog.
15. Close the **Drainage Area Definition** dialog.

Placing Inlet CB-4

1. Select the **Add Node** tool and set the **Node ID** to CB-4.
2. Highlight **Properties**.



3. Set **Node Type** to Junction.
4. Set **Library Item** to 4x4 Junction.

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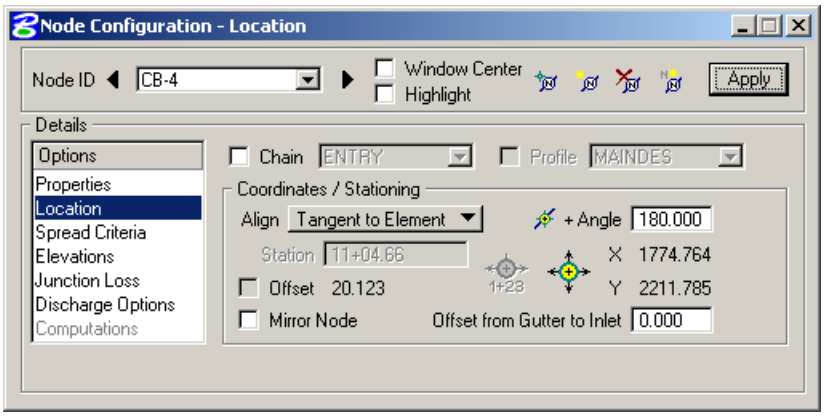
5. Highlight **Location**.



6. Enter the Coordinates / Stationing information.

Align	Tangent to Element
+Angle	180

7. Click **Select MS Alignment Element**.

8. Select and accept the back of curb element on the north side of the entrance road.

9. Data point behind the curb.

   (Ensure the junction is placed in the region between the curb and gutter and the building grassed area).

10. Click **Apply**.

    The inlet is added to the project. No Computations are available for Junctions within this dialog box.

Placing an Outlet

1. Click **Add Node** and set **Node ID** to Outlet.
2. Click **OK**.

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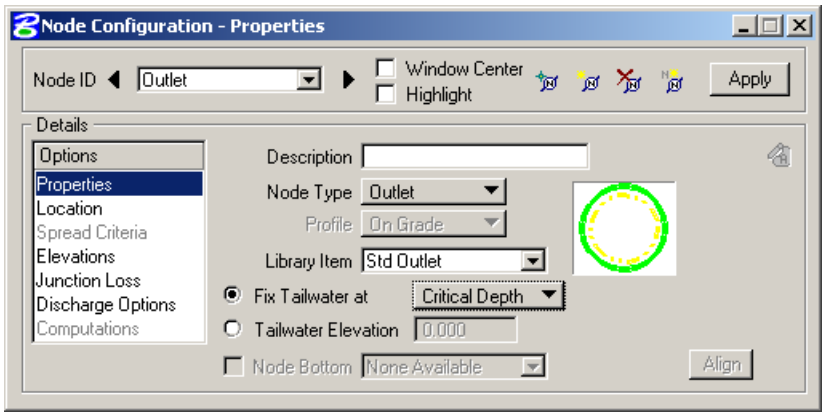
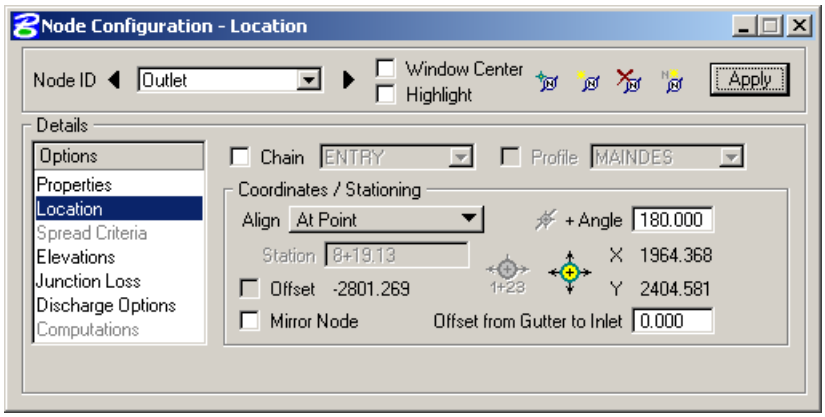
3. Select **Properties**.



4. Set **Node Type** to Outlet.
5. Set the **Library Item** should change to Std. Outlet.
6. Highlight **Location**.



7. Enter the Coordinates / Stationing information.

Align	At Point
+Angle	180

Determine Location of Outlet

To find the location to place the outlet, we shall examine the Site Model.

1. Select the **Site Modeler Tool** and open the existing project *..\Site1\Chapter6\Siteplan.gsf.*
2. Click **No** when prompted to associate the design file.
3. Select the **DTM Drainage Tools** tool *(Drainage: Utilities > DTM Drainage Tools).*

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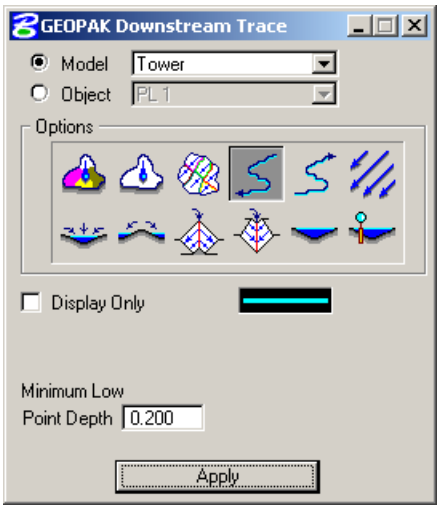
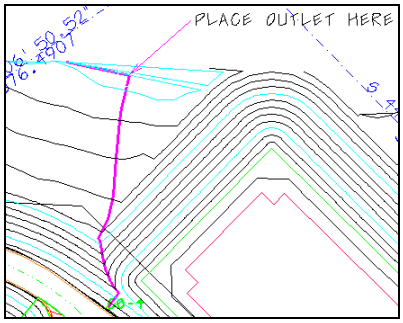
4. Click **Downstream Trace**.



5. Click **Apply**.
6. Data point near the previously created junction node.

   A downstream trace (path of overland flow) is drawn from the DP location.

Note We will place the Outlet node near the end of this trace.



8. Close **Downstream Trace**.
9. Exit Site Modeler. (*Modeler: File > Exit*).

   Return the focus to the **Node Configuration** dialog.
10. Click **Dynamic Place**.
11. Place the outlet at the location shown in the figure above.
12. Click **Apply** to add the outlet to the project.
13. Close the Node Configuration dialog.

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STORMWATER CONVEYANCE

This section utilizes tools necessary for connecting the Surface Drainage (areas, inlets) to the Collection System (pipes, ditches, channels).

Placing a Storm Drain Pipe

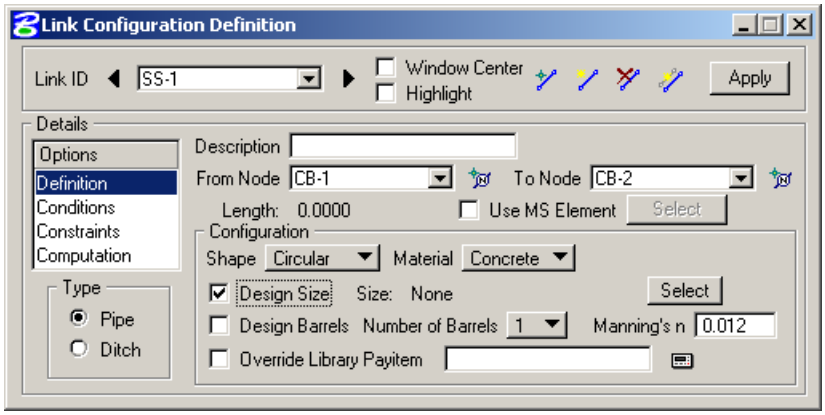
Visually determine the tentative location of the first storm sewer pipe. This link will connect Nodes CB-1 and CB-2. Window in to this area using MS view controls.

1. Select the **Add Links** tool *(Drainage: Component > Link > Add).*

   The Add Link tool can also be accessed from the Drainage Navigator by clicking on Links at the top of the Navigator and clicking **Add Item**.

2. Set the **Link ID** to SS-1.
3. Highlight **Definition**.

   In this dialog, we set the pipe's From Node and To Nodes ID's.



4. Set the **From Node** to CB-1.

   Alternately, click **From Node,** then select and accept the CB-1 plan graphic element.

5. Set the **To Node** to CB-2.

   A temporary graphic element is drawn connecting the two inlets.

6. Set **Shape** to Circular in the Configuration group box.
7. Set **Material** to Concrete.
8. Toggle on **Design Size**.

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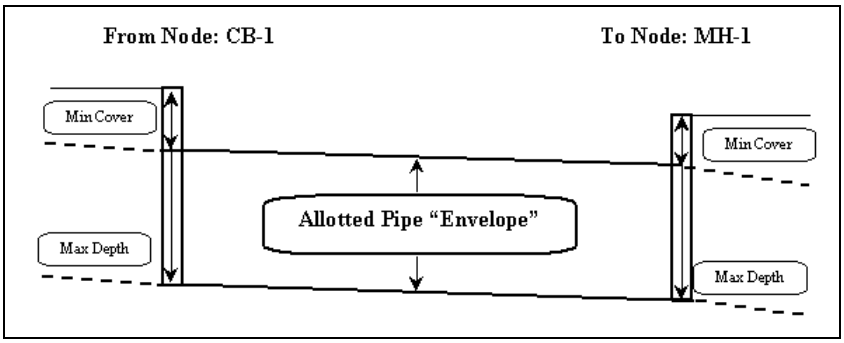
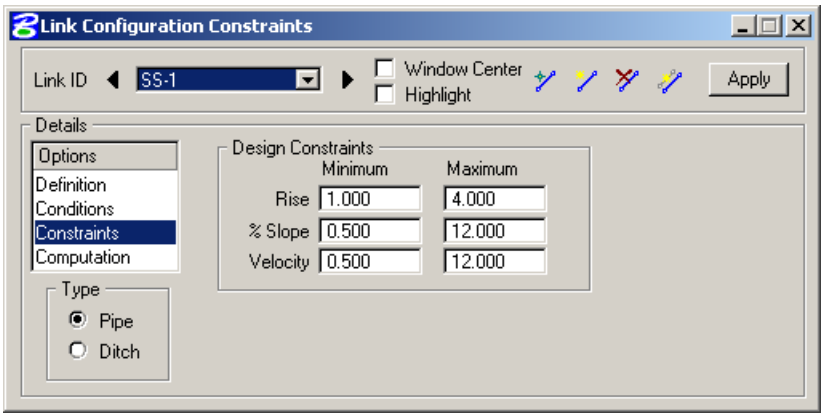
9. Select **Conditions**.

   The elevations shown are based on the From-Node and To-Node elevation minus the min/max depth, as specified in the Node Definition Dialog Box for Nodes *CB-1* and *CB-2* respectively. In this case, no entries are necessary; Drainage will design all the profiles for this project.



10. Select **Constraints**.



11. Establish the min/max design criteria for Links.

Rise - Minimum	1
Rise – Maximum	4
% Slope – Minimum	0.5
% Slope – Maximum	12
Velocity – Minimum	0.5
Velocity - Maximum	12

12. Select **Computations**.

    The computed hydraulic properties of the Link are displayed.

Note Note: Link hydraulics are not available for review until a Network has been established and designed or analyzed (next step) successfully. Check back here for computations after the Network has been added and designed or analyzed.

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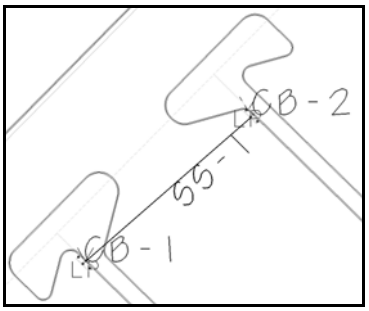
13. Click **Apply**.

    Note that the Link graphic should connect to the inlets properly (i.e. the upstream end of the pipe should connect to the downstream area of the inlet, whereas the downstream end of the pipe should connect to the upstream area of the inlet) as shown below.

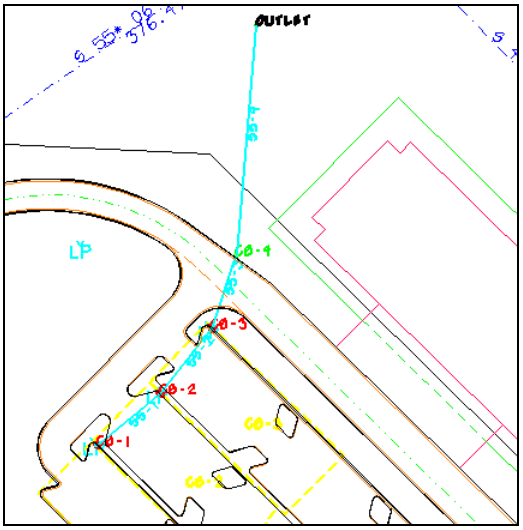


Warning If the pipe did not connect as shown above, simple click the **ID** buttons again and reselect the To and From Nodes (hint: data point closest to the connection point desired).

14. Add Links between all of the following Nodes.

LINK	FROM NODE	TO NODE
SS-2	CB-2	CB-3
SS-3	CB-3	CB-4
SS-4	CB-4	Outlet

    Adding the three links completes the remainder of the link conveyance system. As Links are added, most dialog values default from the previous Link with the exception of the (From and To) Node and elevation information.



15. Close the Link Configuration Definition dialog.
16. Save the Drainage Project. (*Drainage menu bar. Project>Save*).
17. Close GEOPAK Drainage. (*Drainage menu bar. Project>Exit*).

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DESIGNING THE NETWORK

The Network computations serve as the final calculation process in the design or analysis of a storm drain system. A GEOPAK Drainage Network is defined as a series of interconnected Nodes, Links, and Areas, draining to a single outlet. GEOPAK Drainage accommodates multiple Networks in a single project.

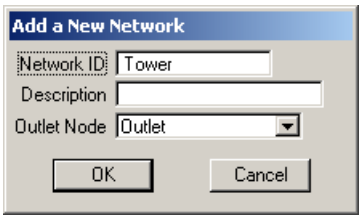
To ensure that all students have the same data, we open a completed design file and drainage project.

Open Updated Dataset

1. Open the MicroStation file *C:\Data\Geo\Site\Site1\Chapter6\updated_drainage.dgn*.
2. Open the Drainage project *C:/Data/Geo/Site/Site1\Chapter6_NetworkDesign\updated_Drainage.gdf. (Drainage menu: Project > Open).*

Create Network - Tower

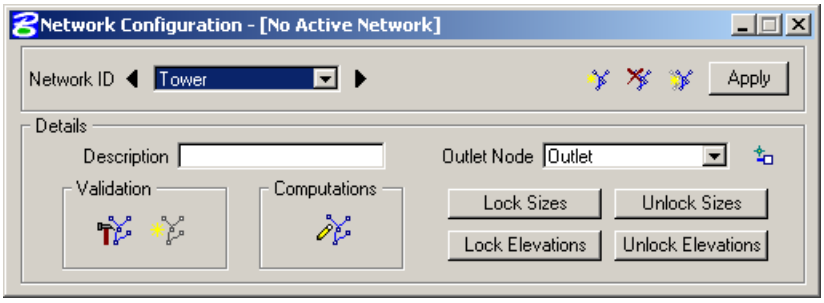
1. Select the **Add Drainage Network** tool *(Drainage menu: Network > Add).*



2. Enter the **Network ID** as Tower.

   Since we only have one outlet in the project, the Outlet Node is already set.

3. Click **OK**.



4. Click **Build Network** in the Validation group box.

   This feature verifies the nodal topology and link connectivity. An Information dialog is displayed indicating whether the network was successfully built. If your network did not build, advise the instructor who will assist you in locating the problem link or node.

   The **Select Network** option highlights all components (areas, inlets, pipes, etc.) connected to the active Network.

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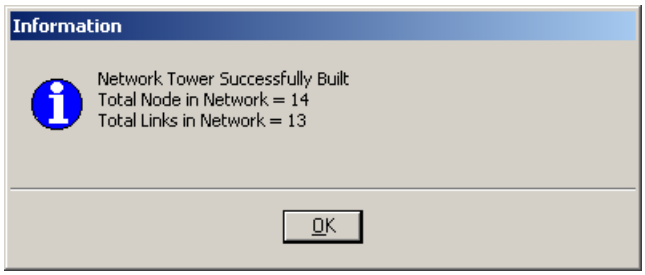
5. Click **OK** on the information dialog.



6. Click **Apply**.

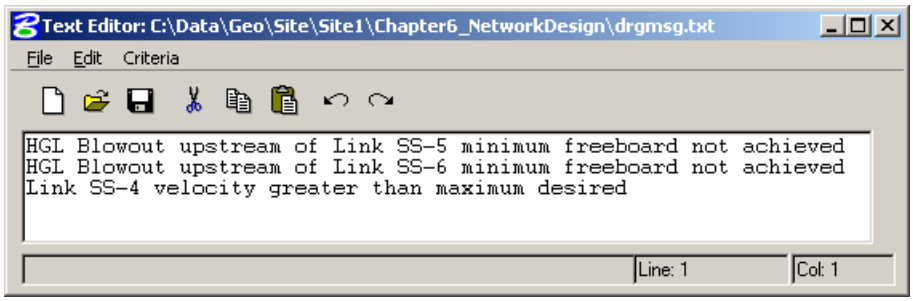
   The Network Tower has been added to the project.

7. Click **Compute Network i**n the Computations group box.

   This command initiates the hydraulic design of the components contained in the Network.

8. Click **OK** on the information dialog.

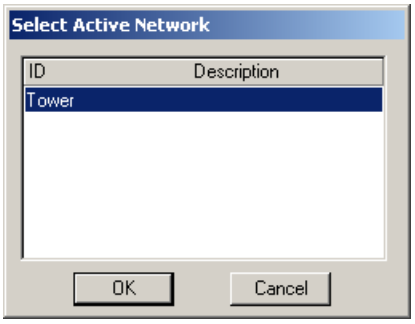
   If the network is computed with warnings, a text file *(..Data/Geo/Site/Site1Chapter6/drgmsg.txt)* is displayed with a list of hydraulic warnings.



9. Close the Text Editor dialog.

Note The Network has now been built and analyzed. We need to make it active.

10. Close the **Network Configuration** dialog.
11. Select the **Active Network** tool *(Drainage menu: Network > Active)*.



12. Highlight **Tower**.
13. Click **OK**.

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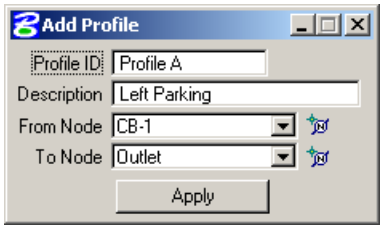
Profile Creation

The Profile tool is utilized to construct customized drainage profiles (including groundline, pipes, depth of cover, hydraulic gradeline, etc. according to the Preferences > Design Symbology > Profile View) along any drainage path.

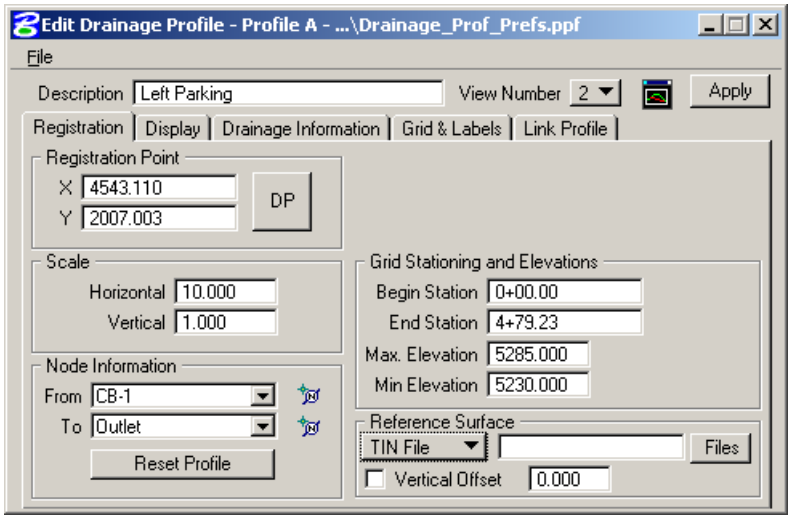
1. Open MicroStation View Window 2. *(MS: Window > View > 2)*
2. Click **MS Fit View**.
3. Click **MS Window Area.** Find an unused portion of the DGN file. We will place our profiles here.
4. Select the **Add Profile** tool *(Component > Profile >Add).*



5. Enter Profile Information.

Profile ID:	Profile A
Description:	Left Parking
From Node:	CB-1
To Node:	Outlet

6. Click **Apply**.



7. Select **File > Open** *..\Data\Geo\Site\Standards\Drainage_Profile_Prefs.ppf.*

   The predefined preferences for drawing profiles are stored in the preferences (ppf) file. By using preferences files, you can develop your own standards to be utilized on numerous projects.

8. Click **DP** and select a data point in MicroStation view window 2 for the bottom left of the profile to be drawn.

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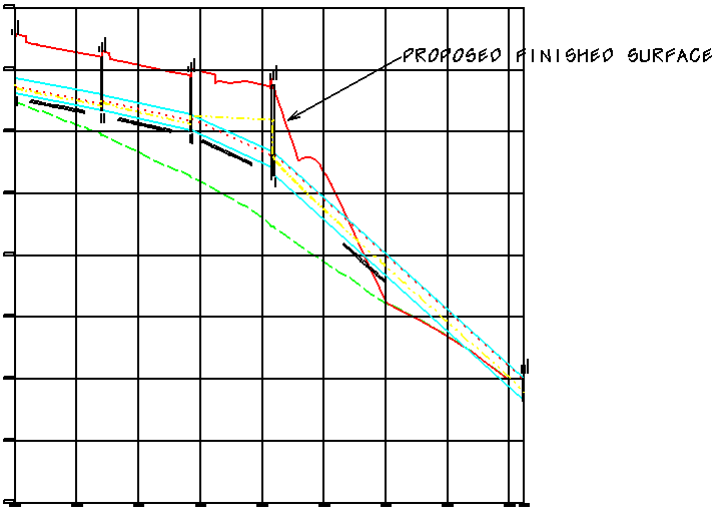
9. Click on the other tabs to review some of the profile drawing options.
10. Click **Apply**.



Profile A From CB-1 through Outlet

Dynamically Editing the Profile

As can be seen from the screen capture of the profile, there is a problem. The proposed drainage system link between CB-4 and Outlet protrudes above the proposed finished surface. This is generally not a desirable outcome. We will look at what steps are required to modify this system to correct the problem.

1. Select the **Link Profile** tab.
2. Click **ID**. (left of the Link List box).
3. Select and accept a component of the problem link (SS-4) from the Profile view.

   This will make the SS-4 Link active.
4. Click **Edit Invert** from the **Downstream Node** group box.
5. Move your mouse cursor into the Profile view.

   There is a circle around the downstream invert at Node CB-4.
6. Move the cursor into the circle and drag the invert down.

   The link SS-4 will dynamically follow your cursor.
7. Data point to define a new invert location in the Profile view.
8. Click **Apply**.
9. Click **No** to the Alert.
10. Close the **Edit Drainage Profile** dialog.

    The link SS-4 now looks good – but the link SS-3 is very steep. The problem is when we dragged the outlet at CB-4 down, the invert at that upstream node was dragged down also. The reason this occurred is the Node has been set to match inverts. We need to reset this Node to allow for a drop manhole.

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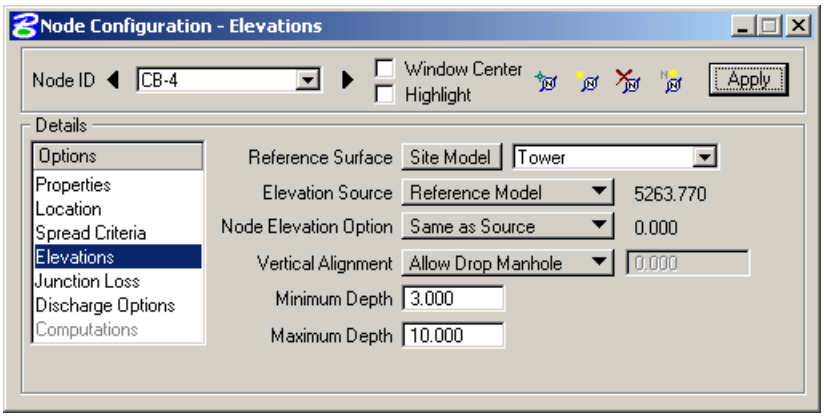
Reset Node to Drop Manhole

1. Select the **Edit Node** tool. (*Component* > *Node* > *Edit*).
2. Select **CB-4** from Node ID.

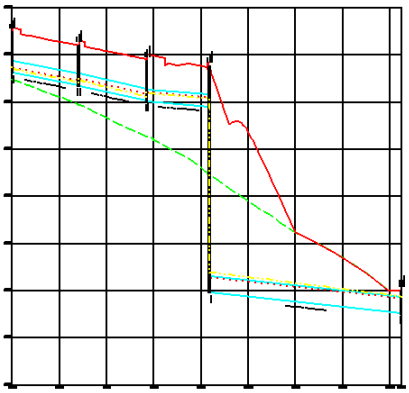


3. Select **Elevations**.
4. Set **Vertical Alignment** to Allow Drop Manhole.
5. Click **Apply**.
6. Close the **Node Configuration** dialog.

   We reset the allowable pipe configuration for this Node, now GEOPAK Drainage needs to redesign the system.

7. Select **Network Compute**.
8. Click **OK**.

   Take note of what happens to the profile.



Note There were no network warnings during this computation. Allowing this node to have drops has allowed GEOPAK Drainage to redesign this system and fix the previous "above maximum velocity" issues.

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Generating Reports

Drainage provides a number of tools to create and generate both standard and customized report files.

1. Select the **Drainage Area Report** tool *(Drainage menu: Reports > Drainage Areas).*
2. Select the **Sag Inlets Report** tool *(Drainage menu: Reports > Inlets >Sag Inlets).*
3. Select the **Sag Inlets Report** tool *(Drainage menu: Reports > Storm Drain /Links >Link Configuration).*

   A customized report via the Report Builder will consist of row and column data as prescribed by the designer; and may be easily imported into other applications that are designed for processing row and column data.

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7 Water and Sewer

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

- water and sewer project components.
- water and sewer line tools.
- water and sewer node tools.
- water and sewer profile tools.
- navigator.
- conflict finder.
- designing a water and sewer system.

INTRODUCTION

GEOPAK Water and Sewer is a comprehensive system for designing Water and Sewer systems. A GEOPAK Water and Sewer project may contain multiple water and sewer runs; each comprised of any number of topologically connected water and sewer nodes and pipes.

GEOPAK Water and Sewer is extremely flexible, in that the designer can create and manipulate elements of the system, while simultaneously seeing the effects. Interactive dialogs and design visualization make the process easy to learn and can efficiently produce results. Manipulations and redesign are accomplished quickly and easily, whether it's moving a single node or developing an entire system. The Conflict finder tool enables the designer to identify potential problems where sewer, water and utilities conflict.

Roadway alignments, vertical profiles, and digital terrain models created as part of the surface design process may be used throughout GEOPAK Water and Sewer to provide pertinent information to water and sewer design. All water and sewer components feature interactive graphical placement tools for easy spatial definition of the water and sewer system.

WATER AND SEWER PROJECT COMPONENTS

GEOPAK Water and Sewer has three major components within each project: the GEOPAK Water and Sewer File (*.GWS), MicroStation design file (*.DGN), and Water and Sewer Preferences (*.WSP).

GEOPAK WATER AND SEWER FILE (*.GWS)

The first component is the GEOPAK Water and Sewer File (*.GWS). This binary file contains all information about the Water and Sewer system. Each GEOPAK Water and Sewer Project contains Preferences, which include visualization symbology, and project file references to the GEOPAK Site Project (.GSF), Design and Computation Manager (.DDB), GEOPAK Drainage project file (.GDF), Water and Sewer Library and GEOPAK coordinate geometry (.GPK) files. Spatial data and connectivity for each Water and Sewer feature are stored in this external file. Sufficient data is maintained to rebuild the graphical representation of the Water and Sewer Project. The main components of the water and sewer system are called nodes and lines.

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- A node is a point feature with a defined location. The location may be in Cartesian coordinates (x,y) or in curvilinear coordinates (station, offset).
- A line represents a linear feature depicting a path connecting two nodes, running from upstream to downstream. The path may be straight line or curvilinear (along any graphics element).

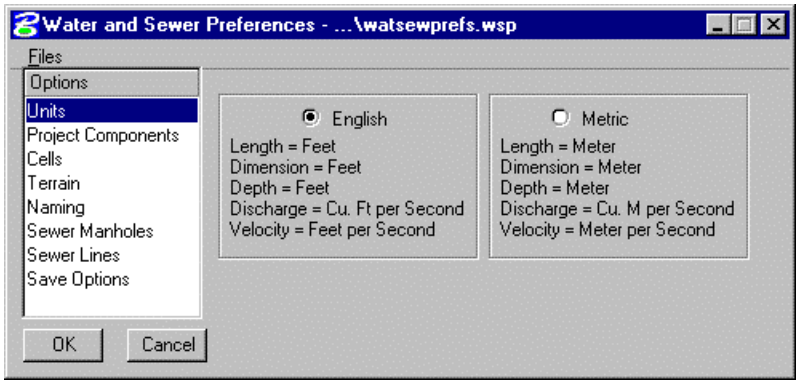
DESIGN FILE

The graphics file is utilized for the visualization of the Water and Sewer project and definition of certain Water and Sewer features using MicroStation graphic elements. The only data stored within this file are attributes attached to the graphics for reference to the GEOPAK Water and Sewer file (.GWS).

WATER AND SEWER PREFERENCES

In contrast to the Water and Sewer File and MicroStation graphics file, the Water and Sewer Preferences file may be utilized for numerous projects, as it contains the standards for an entire organization. The Water and Sewer Preferences includes units option, paths and file names for site and drainage projects, symbology and text parameters for labeling and saving options. At the beginning of a project, the designer may open the standard preferences, then edit the project specific files and paths. In this way, the designer may carry standards from one project to the next, without redundant entering of each parameter. The file is saved off to the project with an .WSP extension.

Computation options in the Preferences may be changed easily and the systems completely redesigned utilizing the new computation options. The Water and Sewer Preferences are invoked via Project > Preferences menu selection or the Project Tools tool box.



GEOPAK Water and Sewer Preferences dialog

The general groupings of Options are displayed in a list box in the left side of the dialog, while the right side displays parameters for the highlighted Option. As different Options are selected in the list box, the right side of the dialog will change dynamically to reflect the parameters for highlighted Option.

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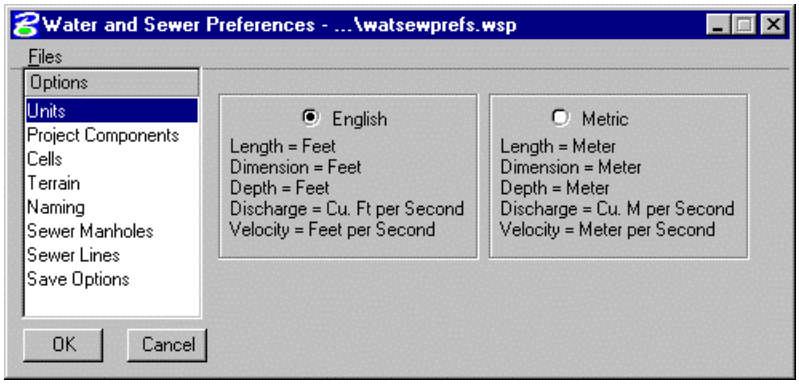
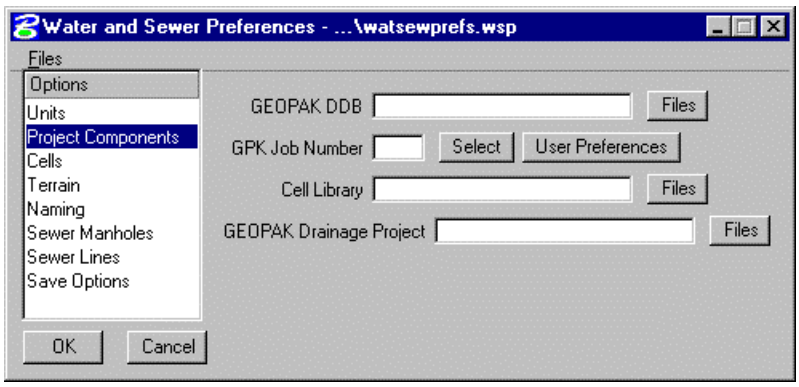
UNITS



The first Preference is Units, which establishes the input and output units for the current project. Two supported options are English and Metric. Within each group box is a listing of the units utilized for GEOPAK Water and Sewer. These are display only and cannot be changed.

Note Projects with mixed units are not supported within GEOPAK. There are no other unit specifications within the project. The data input is expected to be in the proper units (English and Metric). As fields are entered in the dialogs the units required will be displayed in the MicroStation Command Prompt.

PROJECT COMPONENTS



The Project Components option defines the location of GEOPAK files utilized by the water and sewer project.

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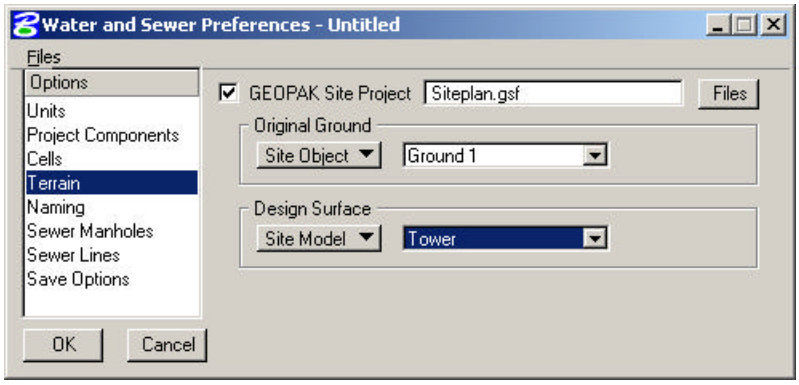
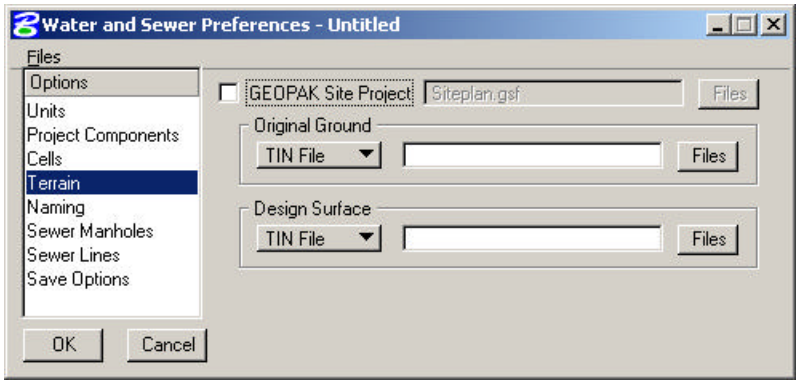
TERRAIN



To leverage data from a GEOPAK Site project, activate the toggle, and then select the directory and GEOPAK Site Project (.GSF) file. The option becomes available to select components from the Site Project (Models or Objects) as the Original Ground and Design surfaces.

Alternately, a TIN file (created with GEOPAK DTM tools) can be used to define existing or original ground.



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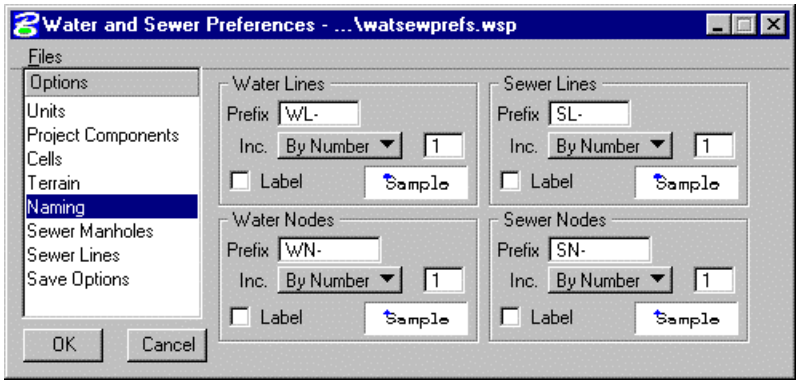
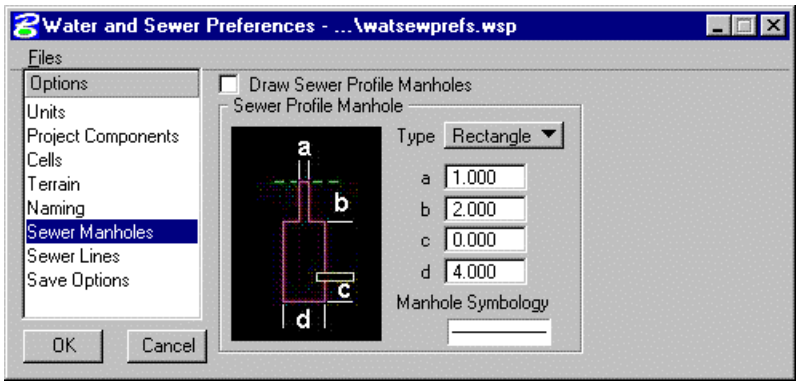
NAMING



The Naming option sets symbology and labeling parameters for water and sewer lines and nodes.

The parameters are utilized for the labels only, as the symbology for the line or node itself is determined from the Item ID within the Design and Computation Manager. This prefix is added to the beginning of the each defined Node or Line label automatically. When By Number is selected, each pipe (or node) added to the system is incremented by the specified number.

SEWER MANHOLES



You can specify dimension, type, and symbology options for sewer manholes drawn into profile. As each of the three types is selected, the dialog dynamically changes to reflect the selection.

SEWER LINES

You can specify the minimum slope and updating options for sewer lines.

SAVE OPTIONS

There are options to create a backup file when the project is opened as well as automatically saving the project at a user specified interval.

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WATER AND SEWER LINE TOOLS

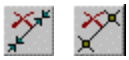
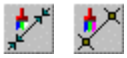
In GEOPAK Water and Sewer, Lines connect the various Nodes within a system. A multitude of options for sizing and profiling Lines are supported.

A Line represents a linear feature depicting a path connecting two or more Nodes. The path may be a straight line, line string, curvilinear, or a combination and series of linear MicroStation elements.

Several options are supported to add, edit, and delete Lines and are invoked via the Lines pull down on the main menu bar.

Alternately, the Line tools are invoked by selecting Tool Bars > Water Lines or Sewer Lines, then identifying the desired tool from the toolbox as depicted below.

The tools for Water and Sewer are functionally identical and are detailed in the table below.

Add 	Utilized to add a water or sewer line to the current GEOPAK Water and Sewer project.
Edit 	Utilized to select and edit any previously defined and stored Line within the current project. Note the Line Edit dialog is identical to the Line Add dialog, however, when the Line is identified, all associated data is displayed.
ID 	Selecting the icon or from the pulldown, GEOPAK prompts the designer to select a previously drawn line. When selected and accepted, GEOPAK opens the Line Edit dialog populated for the selected line.
Delete 	Utilized to select and delete the specified Line and associated data.
Update 	Updates all water or sewer line graphics.

Miscellaneous utilities can be stored within a water and sewer project and checked via the utility conflict tool. Each group of utilities is stored as a group, then the group is referenced for conflicts. Therefore, it is prudent to group by location for subsequent location of conflicts, rather than grouping by utility type. For example, all utilities in an intersection, (i.e., gas, power, cable TV) can be placed within a single group, rather than all gas for an entire subdivision as a group.

Three tools are supported for miscellaneous utilities:

- Add Miscellaneous Utility
- Edit Miscellaneous Utility
- Delete Miscellaneous Utility

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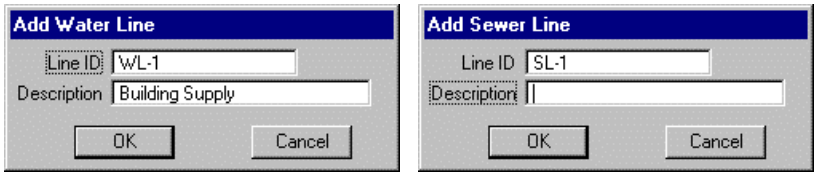
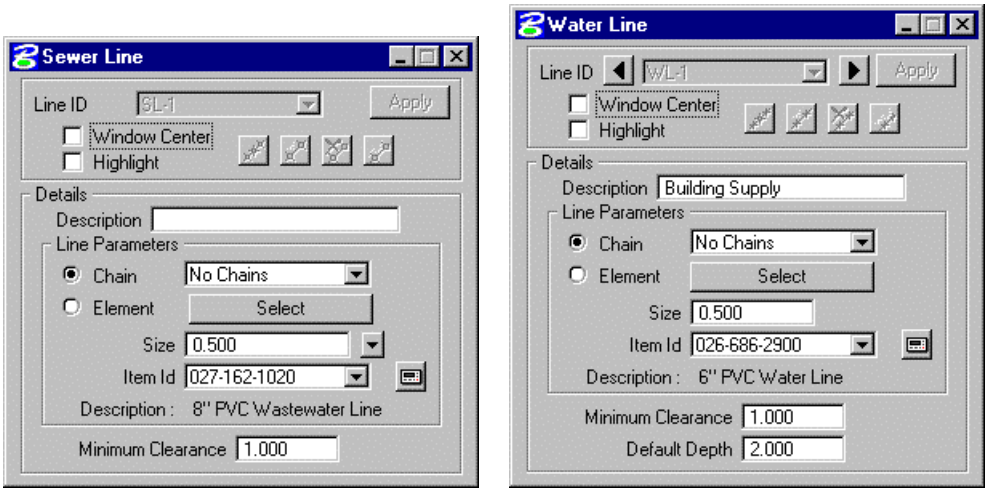
LINES > WATER OR SEWER ADD TOOL



When the Add Water Line or Add Sewer tool is selected, the Line ID prefix is displayed, along with the next water or sewer pipe number. Note the designer may change the Line ID if desired. An optional Description field is supported. When complete, click OK which opens the Water Line or Sewer Line dialog as depicted below. Clicking Cancel closes the Add Water Line or Add Sewer Line dialog with no new line created.



There are options for specifying the water line are within the dialog box. This includes size of the line, whether the element is defined via a GEOPAK chain or MicroStation element, and associated pay item. Additionally you can specify Minimum Clearance in master units (i.e., feet or meters). This value can also be utilized in the utility conflict tool. For Water Lines only, you can specify a default depth to the invert of the line (in master units; i.e., feet or meters).

LINES > WATER OR SEWER EDIT TOOL

When the Edit tool is selected, GEOPAK prompts the designer to identify a previously defined water or sewer line. When the water or sewer line is selected and accepted, the Water Line dialog opens, populated with the data associated with the selected water line.

Modify the desired data, then click Apply to complete the editing procedure. Note the Chain or Element cannot be edited, as they are ghosted. If these change, simply delete the line and add a new line.

LINES > WATER OR SEWER > ID TOOL

Selecting the ID tool, GEOPAK prompts the designer to select a previously drawn water or sewer line. When selected and accepted, GEOPAK opens the Line Edit dialog populated for the selected line.

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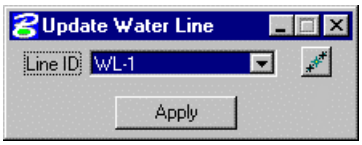
LINES > WATER OR SEWER > DELETE TOOL

The previously stored Water Line may be selected from the Line ID list. Alternately, the ID icon on the right side of the dialog may be clicked, then any Water Line selected graphically. Once the candidate water line has been displayed, click Apply to delete.

LINES > WATER OR SEWER > UPDATE TOOL



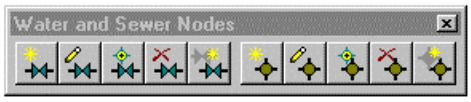
The previously stored Line may be selected from the Line ID list. Alternately, the ID icon on the right side of the dialog may be clicked, then the Water Line selected graphically. Once the candidate water line has been displayed, click Apply to update.

WATER AND SEWER NODE TOOLS

Nodes in GEOPAK Water and Sewer are used to define key points within a sewer or water system. Nodes provide for the connectivity of the Lines. Nodes are also used to indicate physical changes in Line sizes or slopes. Lines cannot change size or slope, other than at Nodes.

Several options are supported to define, edit and delete Nodes and are invoked via the Nodes pull down on the main menu bar.

Alternately, the Node tools are invoked by selecting Tools Bars > Nodes, then selecting the desired tool from the toolbox as depicted below.



Five tools are supported under each of the Node menus as described in the table below.

Add 	Utilized to add a Node to the current GEOPAK Water and Sewer project.
Edit / Modify 	Edit any previously defined and stored Node within the current project by selecting the Node from the Node ID list. Note the Node Edit dialog is identical to the Water / Sewer Node dialog, however, when the Node is identified, all associated data is displayed.
ID 	Utilized to graphically select and edit any previously defined and stored Node within the current project. Note the Node Edit dialog is identical to the Water / Sewer Node dialog, however, when the Node is identified, all associated data is displayed.

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Delete 	Utilized to select and delete the specified Node and associated data. The dialog also supports options to Window Center and Highlight the candidate node.
Rename 	Utilized to rename the specified Node.

WATER AND SEWER PROFILE TOOLS

Water and Sewer profiles can be drawn, edited or deleted via the Profiles toolbox or Profiles menu. Alternately, the Profiles tools are invoked by selecting Tools Bars > Profiles, then identifying the desired tool from the toolbox.

Seven tools supported in the Profile Tools toolbox and are detailed in the table below.

Select Water Line Profile 	Click then select any plan view water line. The Edit Water Line Profile dialog opens, automatically populated with all data associated with the selected profile. Clicking the Center Profile displays the profile if previously drawn.
Select Water Profile Grid 	Click , then select any previously drawn water line grid. The Edit Water Line Profile dialog opens, automatically populated with all data associated with the selected profile.
Water Line Profile List 	Click , then select any previously drawn water line from the list. The Edit Water Line Profile dialog opens, automatically populated with all data associated with the selected profile.
Select Sewer Line Profile 	Click then select any plan view sewer line. The Edit Sewer Line Profile dialog opens, automatically populated with all data associated with the selected profile.
Select Sewer Profile Grid 	Click , then select any previously drawn sewer line grid. The Edit Sewer Line Profile dialog opens, automatically populated with all data associated with the selected profile.
Sewer Line Profile List 	Click , then select any previously drawn sewer line from the list. The Edit Sewer Line Profile dialog opens, automatically populated with all data associated with the selected profile.
Update All Profiles 	Either Water Line Profiles or Sewer Line Profiles or both can be updated. Activate the desired toggle(s), then click Apply .

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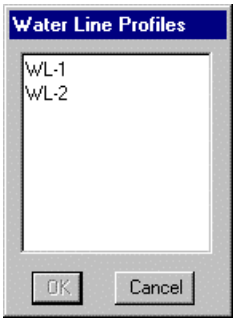
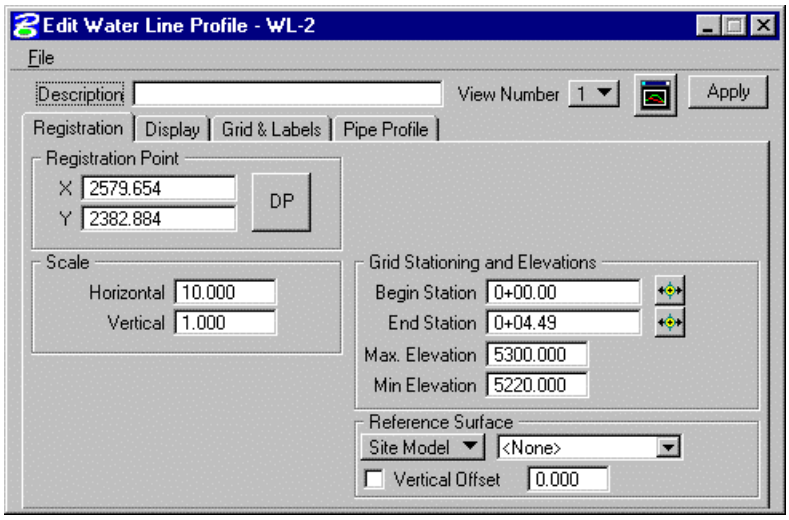
DRAWING WATER OR SEWER LINE PROFILES

The first step to drawing Water or Sewer profiles is defining the line to be profiled. This can be done by selecting the line from the appropriate list via the Water Line Profile List or Sewer Line Profile List.



Highlight the desired line, then click OK, which opens the Edit Water Line Profile or Edit Sewer Line Profile dialog. One sample dialog is depicted below.



Another method of identifying the line to be profiled is graphically. Clicking the Select Water Line Profile or Select Sewer Line Profile tool and graphically identifying a line opens the appropriate Edit Profile dialog automatically populated with the associated Line data.

The profile can be drawn using a myriad of user-defined features to provide maximum flexibility to the designer. These are discussed in detail within each dialog section of the Water and Sewer help.

Once profiles have been drawn, GEOPAK supports tools for editing. The profile can be selected from the Profile List or via the Select Water Line Grid or Select Sewer Line Grid tool. Click, and then select the grid of a previously drawn profile. The Edit Profile dialog opens. It is automatically populated with the data of the selected profile.

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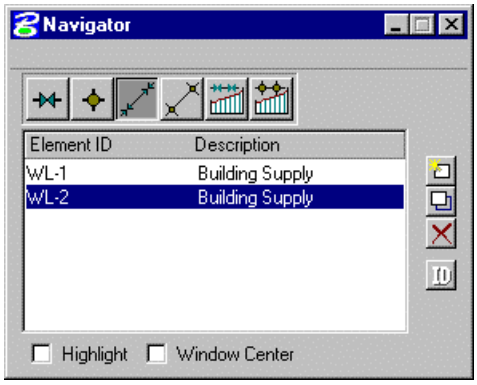
NAVIGATOR

The Navigator tool is an easy method of maneuvering through the components of a GEOPAK Water and Sewer Project. It provides a means to identify, add, edit, and delete the components of the current project. The Navigator also provides graphical maneuvering tools to move through the design file and view the components with highlighting and window centering functions.

The Navigator is accessed via Utilities > Navigator. Alternately, the Navigator tool can be invoked by selecting Tool Bars > Utilities, then identifying the Navigator tool from the Main toolbox. It can also be accessed via the Utilities toolbox.



Six tools are across the top of the dialog and are detailed in the table below. They list all defined elements of the specified Component and their respective descriptions.

Water Node 	When selected, the list box displays all water nodes in the current Water and Sewer project.
Sewer Node 	When selected, the list box displays all sewer nodes in the current Water and Sewer project.
Water Line 	When selected, the list box displays all water lines in the current Water and Sewer project.
Sewer Line 	When selected, the list box displays all sewer lines in the current Water and Sewer project.
Water Line Profile 	When selected, the list box displays all water line profiles in the current Water and Sewer project.
Sewer Line Profile 	When selected, the list box displays all sewer line profiles in the current Water and Sewer project.

When the desired component has been selected, and all current items are displayed, the user can highlight any item within the display box.

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Two action toggles are located at the bottom of the dialog and are detailed in the table below.

Highlight	When activated, the MicroStation highlight color is applied to the selected item in the list box, for easy visual reference. Note: the user must be zoomed in close enough to see the selected item.
Window Center	When activated, it window centers around the selected item in the list box. Note the relative window size is maintained, so the user must be zoomed in close enough to see the selected item.

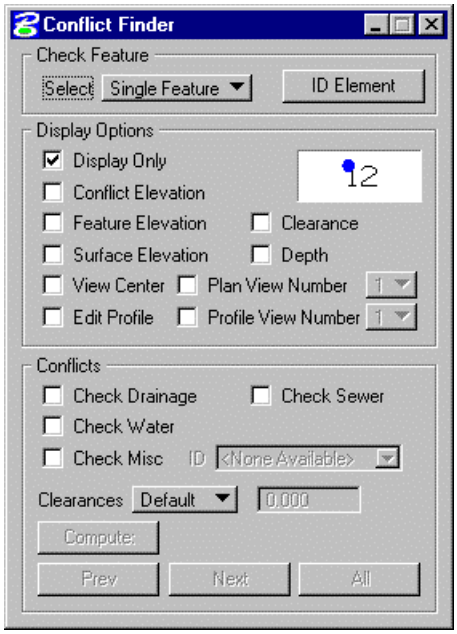
Four action buttons are supported on the right side of the dialog. A component in the list box must be highlighted to unghost the buttons, which are detailed in the table below.

ID 	First, set the component to the desired type. Click ID , and identify the graphic element or label on the screen. GEOPAK reads the label, then highlights the item in the list box.
New / Edit / Delete 	To add another element of the specified type, click Add to invoke the Add dialog for the specified type. To edit an element, highlight the desired element in the list box, then click Edit , invoking the specified type dialog in an update mode. To delete an element, highlight any element in the list box, then click Delete .

CONFLICT FINDER

The Conflict Finder tool is an easy method of locating conflicts between components of a GEOPAK Water and Sewer Project, Drainage project, and miscellaneous utilities. When a conflict is found, a textual label is displayed or drawn in the design file, based on user-defined parameters.

The Conflict Finder is accessed via Utilities > Conflict Finder from the main menu bar. Alternately, the Conflict Finder tool can be invoked by selecting Tool Bars > Utilities, then identifying the Conflict Finder tool from the Main toolbox. It can also be accessed via the Utilities toolbox.



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The dialog is divided into three group boxes:

- Check Feature
- Display Options
- Conflicts

Three types of conflict checking are supported under Check Feature:

- Single Feature
- Water Lines
- Sewer Lines

When Single Feature is utilized, the ID Element is available and used to graphically identify any current Water or Sewer line in the project. Once identified, GEOPAK checks the element against any other elements identified in the Conflicts group box.

A variety of display options are supported, which are found in the Display Options group box and detailed in the table below.

Display Only	The conflicts are labeled with display only, not written into the file. Therefore, they disappear when a View Control or Window command is issued. When not activated, the label is drawn into the design file.
Conflict Elevation	When the toggle is activated, the elevation of the conflicting feature is displayed. Note this corresponds to the feature defined in the Conflicts group box. When the toggle is not activated, no elevation is displayed.
Feature Elevation	When the toggle is activated, the Elevation of the feature is displayed. Note this corresponds to the feature(s) defined in the Check Feature group box. When the toggle is not activated, no elevation is displayed.
Surface Elevation	When the toggle is activated, the Elevation of the Design Surface at the X, Y location of the conflict is displayed. The Design Surface is defined in the Water and Sewer Preferences > Terrain dialog, as depicted below. When the toggle is not activated, no elevation is displayed.
Clearance	When the toggle is activated, the elevation difference (in master units) between the Check Feature and the Conflict Feature is displayed. When the toggle is not activated, no clearance is displayed.
Depth	When the toggle is activated, the elevation difference (in master units) between the Surface Elevation and the Check Feature is displayed. When the toggle is not activated, no depth is displayed.
View Center	When activated, either the plan view or profile view may be centered in the specified view.
Plan View Number	When activated and a conflict is found, and the View Center toggle is activated, the numbered view is utilized to window center about the plan view area of conflict.
Profile View Number	When activated and a conflict is found, and the View Center toggle is activated, the numbered view is utilized to window center about the area of conflict in the profile drawing of the Check Feature.

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WORKSHOP: DESIGNING A WATER AND SEWER SYSTEM

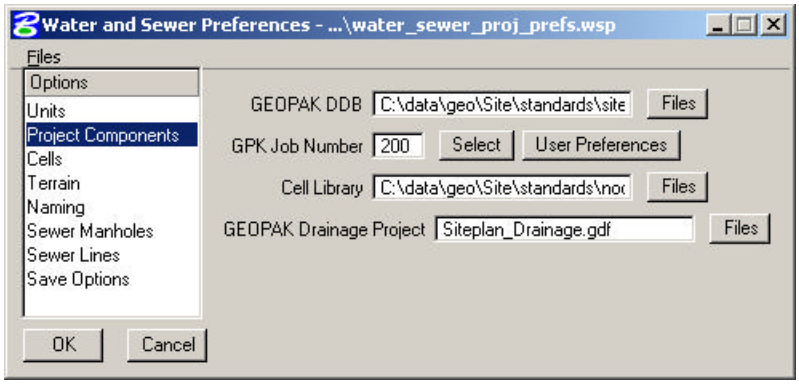
The workflow within GEOPAK Water and Sewer is organized in much the same way conventional Water and Sewer design methods and the technical aspects of Water and Sewer design dictate. A certain amount of information should be obtained in the beginning of a project to properly define all the factors contributing to the Water and Sewer system. Upon obtaining this information, the specific goals of the design, criteria to be used in the design, and features to be used in the design must be established. The design features are then applied to the project within the given criteria and then checked against the goals of the project to determine the adequacy of the design.

Opening the Water and Sewer Project

1. Open the MicroStation file *..\Data\Geo\Site\Site1\Chapter7\Siteplan_WatSew.dgn*.
2. Start the Water and Sewer application. (*Applications > GEOPAK Water Sewer > Water Sewer*).
3. Select **Project > New** and create the project *..\Data\Geo\Site\Site1\Chapter7\Siteplan_WatSew.gws*.

Setting the Project Preferences

1. Select the **Project Preferences** tool *(Water and Sewer menu: Project > Preferences).*
2. Select **Files > Open** and navigate to *..\Data\Geo|Site\standards\water_sewer_proj_prefs.wsp*.
3. Review each of the Preference Options along the left hand side of the dialog.



4. Highlight **Project Components**.
5. Enter the following information.

GEOPAK DDB	*..\data\geo\site1\standards\site.ddb*
GPK Job Number**:**	200
Cell Library	*..\Data\Geo\Site\site1\standards\nodes.cel*
GEOPAK Drainage Project	*..\Data\Geo|Site\Site1\Siteplan_Drainage.gdf*

6. Highlight **Cells**, enable **Scale Node Cell** and set to 10.

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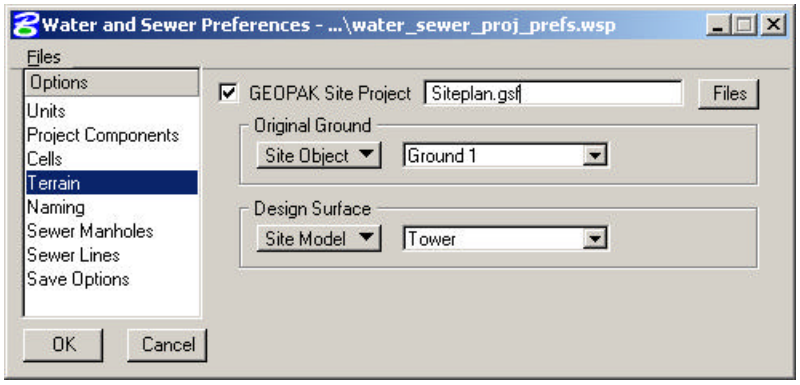
7. Highlight **Terrain**.

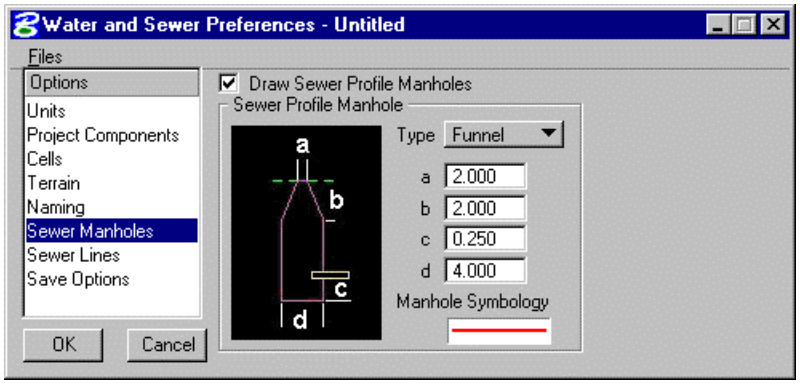


8. Enter the following information.

GEOPAK Site Project	Enable, *..\Data\Geo\Site\Site1\Siteplan.gsf*
Original Ground	Site Object, Ground 1
Design Surface	Site Model, Tower

9. Highlight **Naming** and review the defaults. (No user input required.)

10. Highlight **Sewer Manholes**.



11. Enter the following information.

Type	Funnel
a	2
b	2
c	0.25
d	4.

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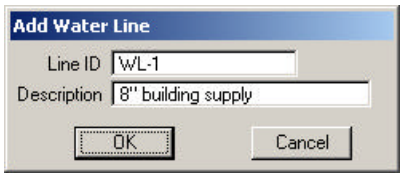
12. Highlight **Sewer Lines** and review the defaults. (No user input required.)
13. Highlight **Save Options** and review the defaults. (No user input required.)
14. Click **OK** to close the dialog.

Adding Water Lines

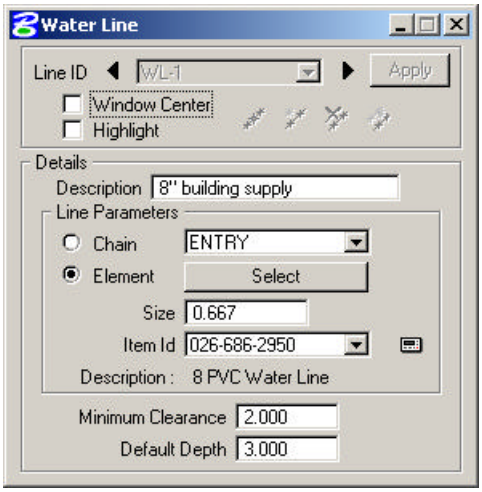
In this exercise, we will create one water line in our project. This water line runs along the entrance road and in front of our building. Water lines consist of MicroStation elements with supplemental data. The supplemental data includes line sizes, pay items information, default clearances, and other variables as required for storing data into a water line. Water line graphics can be selected from the MicroStation design file (Graphic Elements) or from the *.GPK database (Chains).

1. Select the **Add Water Line** tool. *(Water and Sewer Menu: Lines > Water > Add)*



   The Line ID defaults to WL-1. The description is optional.

2. Click **OK**.



3. Enter the required Water Line information.

Size:	0.667
Minimum Clearance:	2
Default Depth:	3

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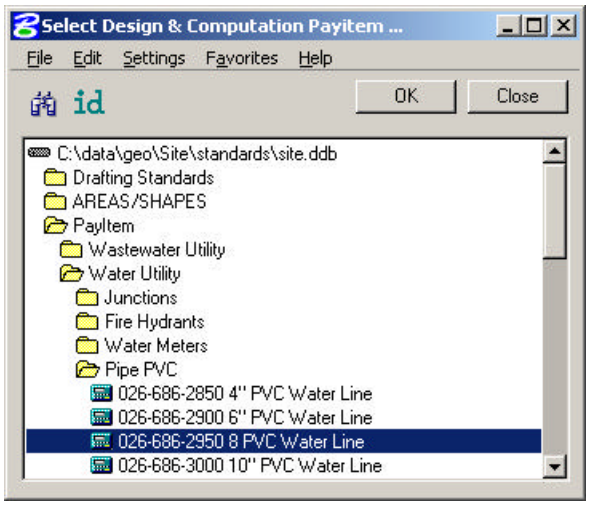
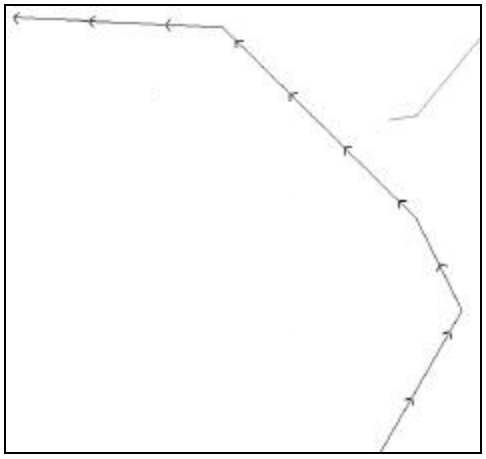
4. Click **Select Pay Item** and navigate to PayItem > Water Utility > Pipe PVC > 026-686-2950 8” PVC Water Line.



5. Highlight the item and click **OK**.
6. Toggle on **Element** and click **Select**.
7. Select and accept the water line. (White line string running along entrance road and in front of building)

   The line string you selected has arrows pointing to the direction of stationing. The arrows are pointing to station zero (0).



Water Line with Flow Arrows

8. Data point to define the elements stationing (downstream/upstream).
9. Click **Apply**.

   Now that all the supplemental data for this water line has been defined, it is added to our project

10. Close the **Water Line** dialog.

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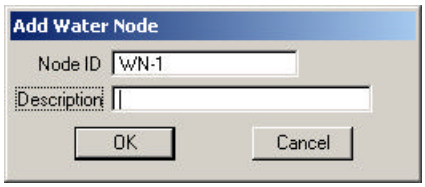
Adding Water Nodes

Now that we have our water lines in the project we will proceed with adding water nodes. These can include gate valves, fire hydrants, water meters, etc. A MicroStation cell representing the node type is placed at the location of each node.

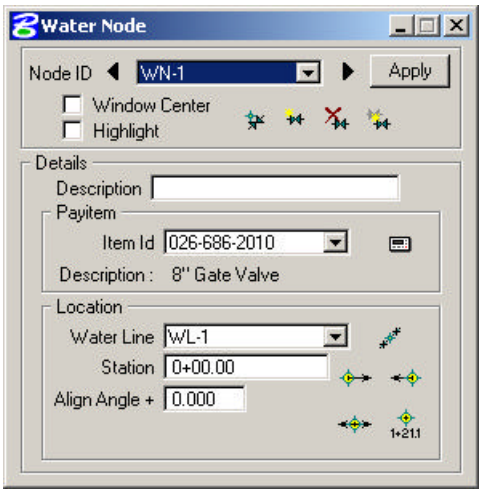
1. Select the **Add Water Node** Tool *(Water and Sewer Menu: Nodes>Water>Add).*



   The Node ID defaults to WL-1. The description is optional.

2. Click **OK**.

   We are going to place 8" Gate Valves in the water line near the southern and northern intersections of the entrance road. We will also locate a fire hydrant near our building.



3. Enter the required Water Node information.

Water Line:	WL-1

4. Click **Select Pay Item** and navigate to Payitem > Water Utility > Gate Valves > 026-686-2010 8" Gate Valve.
5. Highlight the item and click **OK**.
6. Click **End Station**.
7. Click **Apply**.

   The MicroStation cell that represents the Gate Valve is placed and GEOPAK creates a text label with the node number.

Adding Additional Water Nodes

Don't close the *Water Node* dialog just yet. We have a couple of more nodes to add to our project. We will now add a water node at the other end of the water line WL-1.

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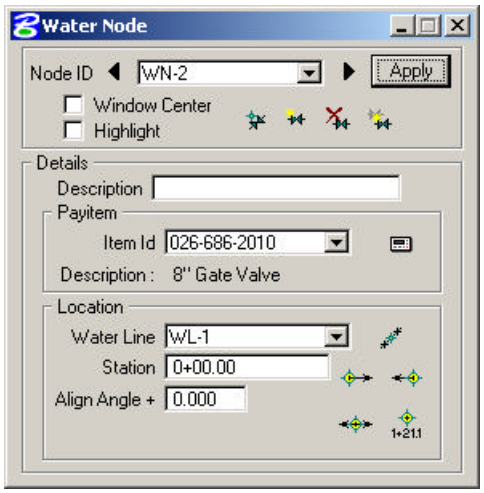
1. Click **Add Water Node.**

   The **Node ID** automatically increments to WN-2.

2. Click **OK**.

3. Click **Begin Station** to set the station to `0+00`.



4. Click **Apply**.

   The water node `WN-2` is added to the project. The MicroStation cell representing the Gate Valve is placed and GEOPAK creates a text label with the Node ID.

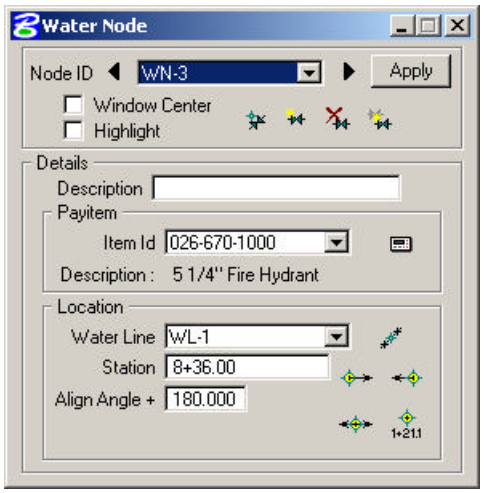
Adding a Fire Hydrant

We will add one more node to our water line `WL-1`. Let's put a fire hydrant at some location along the line.

1. Click **Add Water Node**.

   The **Node ID** automatically increments to WN-3.

2. Click **OK**.



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3. Enter the required Water Node information.

Water Line:	WL-1
Align Angle:	180

4. Click **Select Pay Item** and navigate to Payitem > Water Utility > Fire Hydrants > 026-670-1000 5 ¼" Fire Hydrant .
5. Highlight the item and click **OK**.
6. Click **Dynamic Place.**
7. Data point at a location around Station 8+36.00.
8. Click **Apply**.
9. Close the **Water Node** dialog.

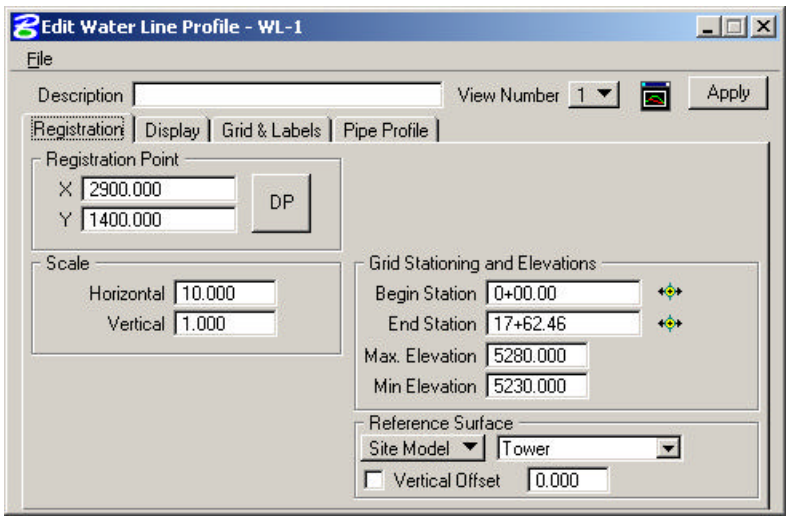
Adding a Water Profile

Having successfully completed adding water line WL-1 with three water nodes WN-1, WN-2**,** and WN-3, we can now create a water line profile.

1. Select the **Water Profiles** tool. *(Profiles > Water > Edit List)*

   The first step to drawing water profiles is defining the water line to be profiled.
2. Select WL-1 and click **OK**.
3. Click **Yes** when prompted to create a new profile.

   The Alert dialog lets us know that the water line profile does not exist.



4. Select **File > Open** and navigate to *C:\Data\Geo\Site\Standards\Site1WaterProfile.ppf.*

   We have a standard preference file that we will open and use for drawing our profiles. This preference file has been set up to display various items such as pipe soffits/inverts, existing and proposed ground, pipe centerline, profile grids, and labels in our company standard symbology.
5. Open MicroStation View Window 2. *(MS: Window > View > 2)*
6. Click **MS Fit View**.

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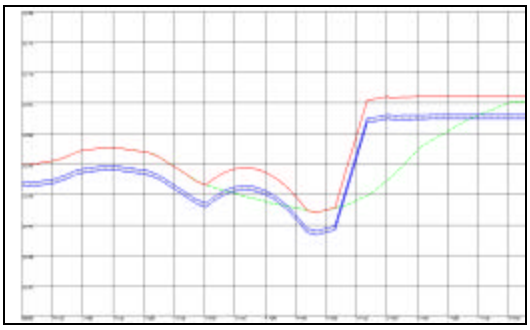
7. Click **MS Window Area**.

   Find an unused portion of the DGN file. We will place our profiles here.

8. Click **DP** and data point in MicroStation View 2.

   This sets the *Registration Point* for our profile by establishing the lower left corner of the profile grid.

9. Click **Apply**.



Sample profile drawn with the Water Profile tool

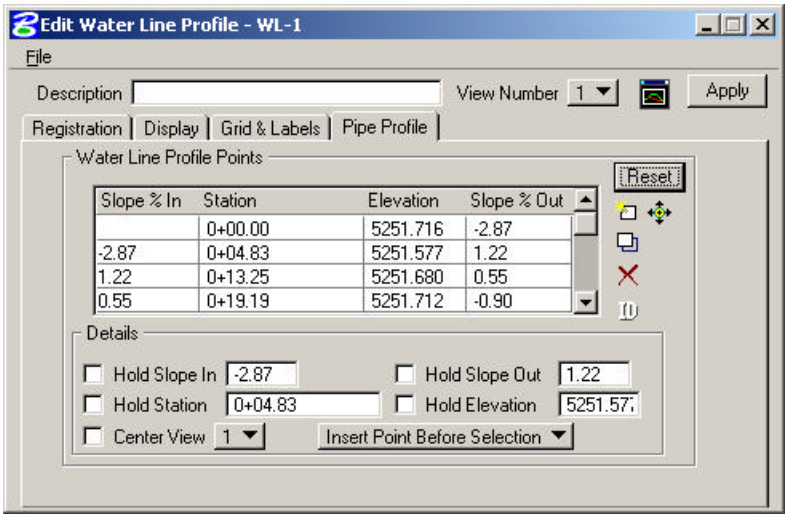
10. Fit the profile to View 2.
11. Click on the **Display** tab and review the settings.

Note You can make a change to any setting. To see that change reflected on the profile, click Apply.

12. Click the **Grid & Labels** Tab and review the settings.

    Again, any changes you make can be seen graphically on the profile by clicking Apply.

13. Click the **Pipe Profile** Tab and review all the Pipe Segments for water line `WL-1`.



14. Highlight each point in the list from station 0+04.83 through Station 5+11.74.
15. Click **Delete Profile Points**.

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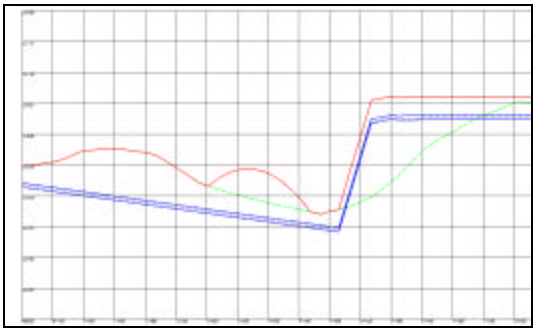
16. Click **Apply**.

    The profile automatically updates to reflect your changes.

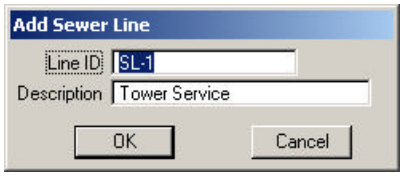


The updated profile illustrates the changes when profile points were deleted.

17. Close the **Edit Water Line Profile** dialog.
18. Save the Water-Sewer project *(Project > Save)*.
19. Close MS Window 2.

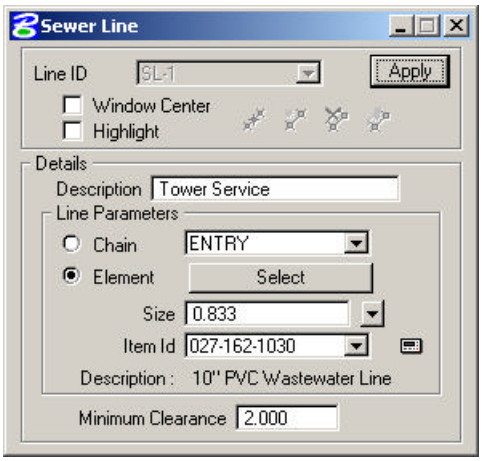
Adding Sewer Lines

1. Select the **Add Sewer Line** tool *(Lines > Sewer > Add)*.



   The default Line ID is SL-1. The description is optional.

2. Click **OK**.



3. Enter the required Sewer Line information.

Size:	0.833
Minimum Clearance:	2.0

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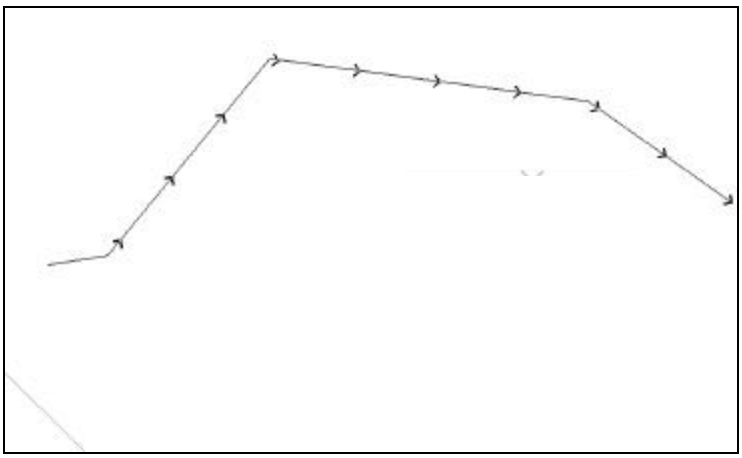
4. Click **Select Pay Item** and navigate to Pay Items > WasteWater Utility > Pipe PVC > 027-162-1030 10" PVC Wastewater Line.
5. Highlight the item and click **OK**.
6. Toggle on **Element** and click **Select**.
7. Select and accept the sewer line.



The line string you selected has arrows pointing to the direction of stationing. The arrows are pointing downstream to station zero (0).

8. Data point to set the flow going away from the building.
9. Click **Apply**.

   Now that all the supplemental data for this sewer line has been defined, it is added to our project.

10. Close the **Sewer Line** dialog.

Adding Sewer Nodes

We will place several wastewater manholes along the newly placed sewer line.

1. Select the **Add Sewer Node** tool (*Nodes > Sewer > Add)*.

   The Node ID is correct. The description is optional.

2. Enable **Auto Locate Sewer Node**.

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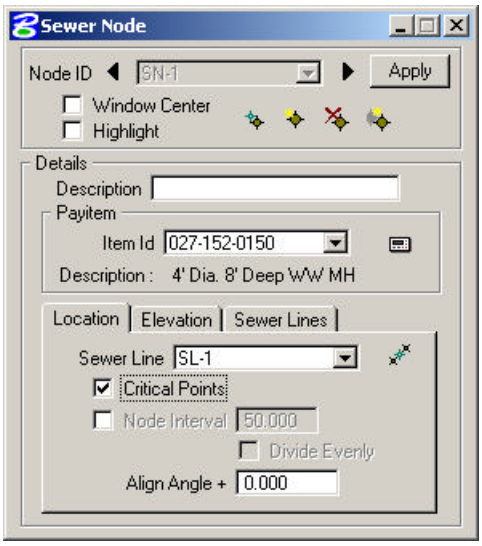
3. Click **OK**.



4. Enter the required Sewer Node information for the **Location** Tab.

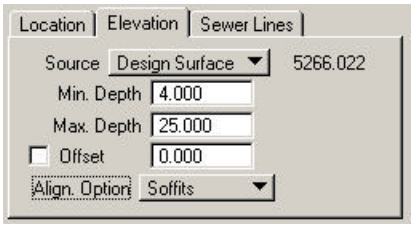
Sewer Line	SL-1
Critical Points.	Enable
Align Angle +	180

Only the MicroStation vertices on the line graphic are considered critical points. GEOPAK applies the selected sewer node payitem to each vertex on the sewer line.

5. Click **Select Pay Item** and navigate to Pay Item > Wastewater Utility > Manholes > 027-152-0150 4' Dia. 8' Deep WW MH.

6. Click **OK**.

7. Click the **Elevation** Tab.



8. Enter the required Sewer Node information for the Elevation Tab.

Source	Design Surface
Min. Depth	4
Max. Depth	25
Align. Option	Soffits

GEOPAK calculates elevations based off of our Site Model (Tower), which we selected in the Water and Sewer project preferences.

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9. Click **Apply**.

   GEOPAK places manholes at each of the sewer line vertices in the symbology on the item selected.

10. Close the **Sewer Node** dialog.

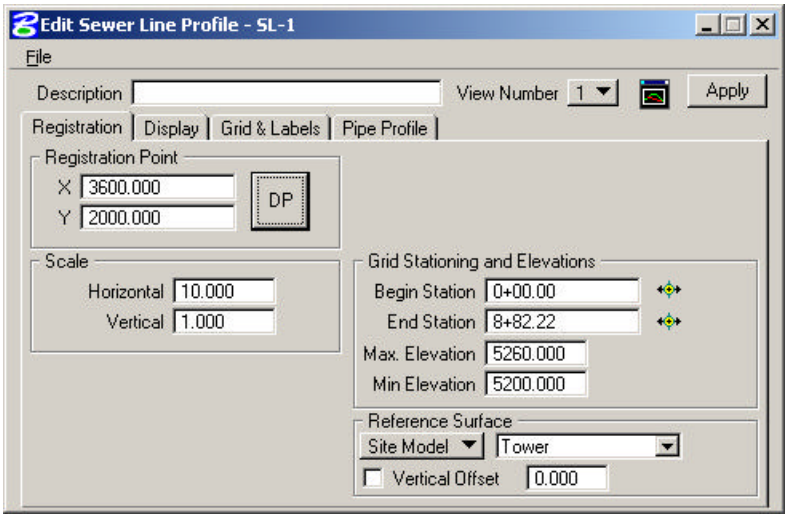
Adding a Sewer Profile

Creating a Sewer Profile is very similar to creating a water line profile.

1. Select the **Sewer Profile** tool *(Water and Sewer Menu: Profiles>Sewer> Edit List)*.

   The first step to drawing sewer profiles is defining the sewer line to be profiled.

2. Highlight SL-1 and click **OK**.
3. Click **Yes** when prompted to create a new profile.
4. Select **File > Open** and navigate to *C:\Data\Geo\Standards\Site1SewerProfile.ppf*.



   We have a standard preference file that we will open and use for drawing our sewer profiles. This preference file has been set up to display various items such as pipe soffits/inverts, existing and proposed ground, pipe centerline, profile grids, and labels in our company standard symbology.

5. Open MicroStation View Window 2. *(MS: Window>View>2)*
6. Click **MS Fit View**.
7. Click **MS Window Area**.

   Find an unused portion of the DGN file. We will place our profiles here.

8. Click **DP** and data point in MicroStation View 2.

   This sets the *Registration Point* for our profile by establishing the lower left corner of the profile grid.

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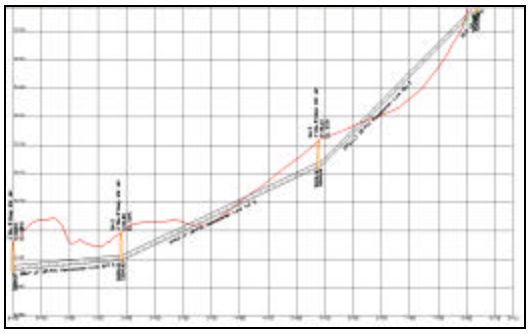
9. Click **Apply**.



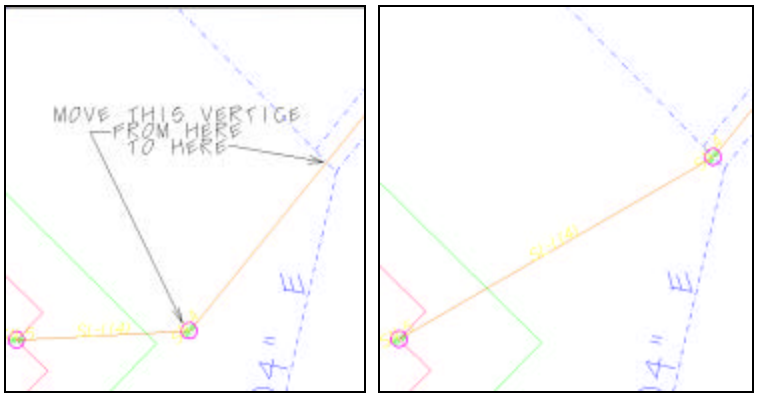
Sample profile drawn with the Sewer Profile tool

Modify Sewer Line and Sewer Profile

1. Select the **Microstation Modify Element** tool. *(MS: Tools > Main > Modify).*

   We are going to move the line vertex closest to sewer node SN-4 further down the slope on the back side of the building toward the property boundary

2. Move the vertex of the sewer line SL-1.



Before and after plan view of modifying vertex.

   The profile automatically updates with the new position and re-labels the pipe.

3. Select the **Sewer Profile** tool. *(Water and Sewer Menu: Profiles>Sewer> ID Grid)*
4. Select and accept a grid line from the sewer profile graphic in Window 2.

Note The Edit Sewer Line Profile tool opens and is populated with the sewer profile SL-1 data.

5. Click the **Pipe Profile** tab.
6. Enlarge Window 2.
7. Click **Center Profile**.

   This centers the profile in Window 2.

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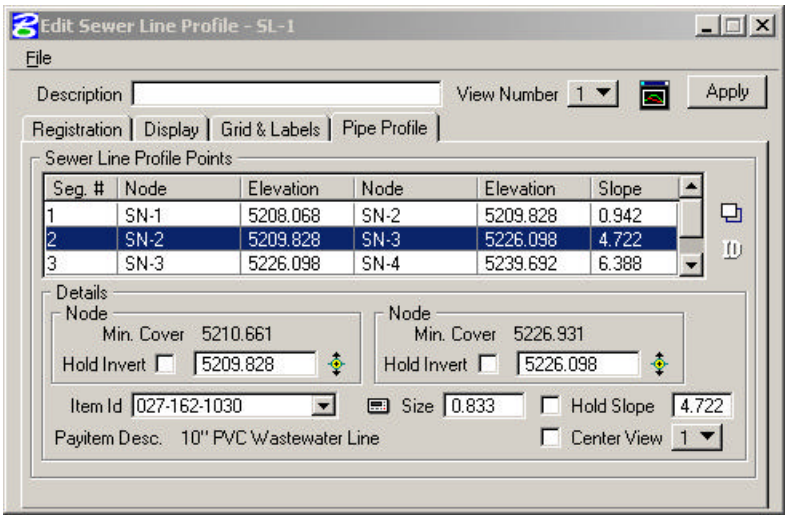
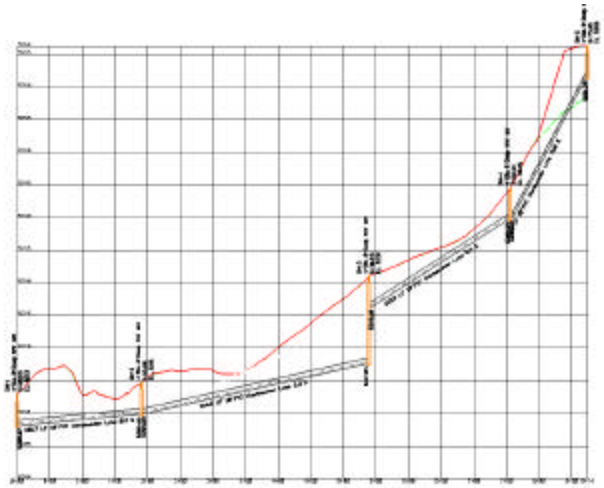
8. Highlight **Seg. # 2**.



9. Click **Edit Invert** in the right Node group box (right of 5226.098).

   This is for the upstream node SN-3.

10. In the profile, move over the invert for *SN-3* until the pipe is attached to your cursor.
11. Data point on the profile to establish the new invert location/depth.
12. Click **Apply**.



Note The profile dynamically updates, extending the MH to the depth required to accept the modified segment invert level.

13. Close the **Edit Sewer Line Profile** dialog.

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8 Plans Preparation

CHAPTER OBJECTIVES

In this chapter, you will learn more about:

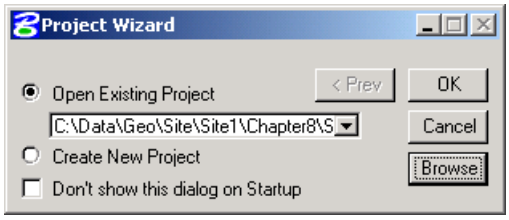
- annotating alignments and profiles.
- labeling.

INTRODUCTION

In this workshop we will explore many of the tools available for generating site plans. We will use tools to draw the existing and proposed contours into MicroStation, label pertinent information with GEOPAK Plan Labeler, and annotate our roadway alignment and profiles with Design and Computation Manager. If time permits we will also perform quantity takeoffs for various features on our project. Let's begin.

Open Existing Site Project

1. Open the design file *..:\Data\Geo\Site\Site1\Chapter8\Siteplan2D.dgn*.
2. Select the Site Modeling tool (*Applications > GEOPAK Site > Site Modeler> Site Modeling)*.



3. Enable the **Open Existing Project** radio button.
4. Click **Browse** and select *..\Data\Geo\Site\Site1\Chapter8\Siteplan.gsf.*

Exporting The Contours To Graphics

In this exercise, we will set up the display to show our model contours only in the areas of proposed construction - ready for export into the MicroStation DGN file.

1. Select the **Edit Model** tool (*Site Modeler menu: Model>Edit*).
2. Click the **Display Model** tab.
3. Set the **Major** contour interval to 5.0 and the **Minor** interval to 1.0.
4. Click **Apply**.

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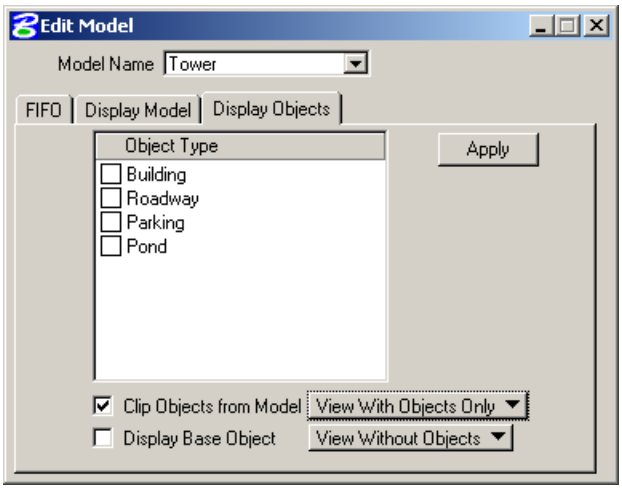
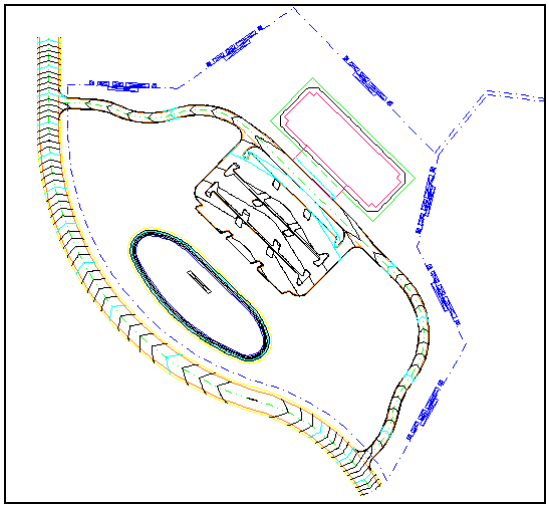
5. Click the **Display Objects** tab.



Clip Objects from Model:	Enable, View With Objects Only

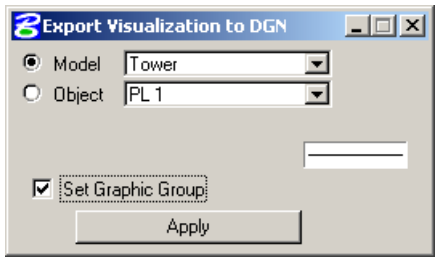
6. Click **Apply**.

   GEOPAK clips the proposed contours in the composite area of the objects.



Hint This shows the contours to the internal boundary of the Objects. If the desired result is to display the contours to the slope toes of the Object, the user would need to toggle ON Display with Object from the Object > Edit > Slopes dialog.

7. Select the **Export Visualization to DGN** tool (*Site Modeler> Project> Export> Visualization to DGN*).



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8. Enter the Export information.

Model	Enable, set to Tower
Set Graphic Group	Enable

9. Click **Apply**.
10. Click **OK** when prompted if you want to proceed.

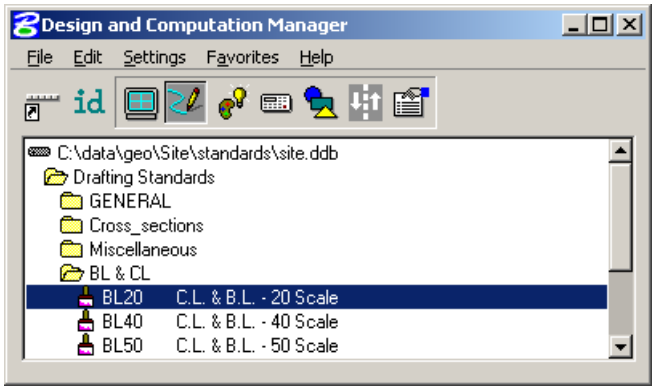
    The graphics are permanently drawn into the MicroStation file.

Hint Turn on the display of the attached *contours.dgn* reference file to see existing contours as well.

Annotate A Roadway Alignment

In this exercise, we will annotate our Main Road centerline. We will place station labels and tick marks along the alignment and then draw and annotate its corresponding profile.

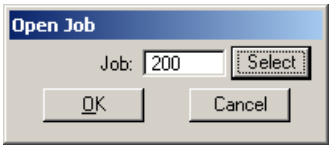
1. Select the **Design and Computation Manager** tool (*Applications> GEOPAK Site> Design and Computation Manager*).
2. Open *site.ddb* located in the *..\Data\Geo\Site\Standards* folder *(File > Open).*
3. Highlight Drafting Standards > BL & CL category > BL20 C.L. & B.L.– 20 Scale.



   This item has all the necessary information set up to label our roadway alignment.

4. Click **Draw Plan & Profile**.

5. Select **Job** 200 and click **OK**.



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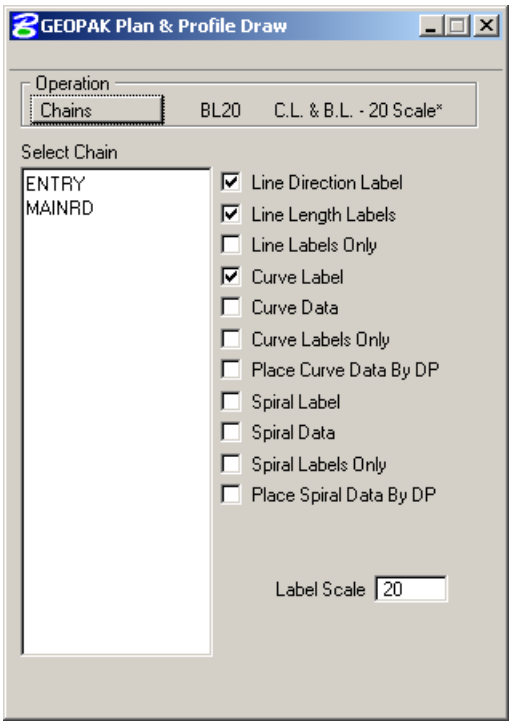
6. Set the **Operation** to Chains.



The Chain Operation draws and labels the centerline of our roadways.

7. Set the **Label Scale** to 20.
8. Enable the label information.

Line Direction Label:	Enable
Line Length Labels:	Enable
Curve Label:	Enable

9. Click on MAINRD.

Clicking on each chain name draws and labels the roadway centerlines. Each time you click on the Chain Name GEOPAK draws the selected information into MicroStation. However, GEOPAK does not erase any old graphical elements and replace them with new elements. It simply draws on top of the existing graphic elements there by creating multiple lines, multiple text labels, etc.

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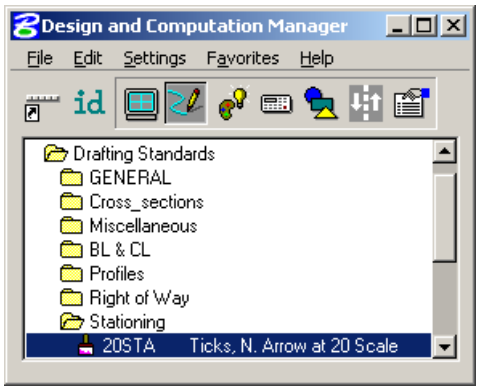
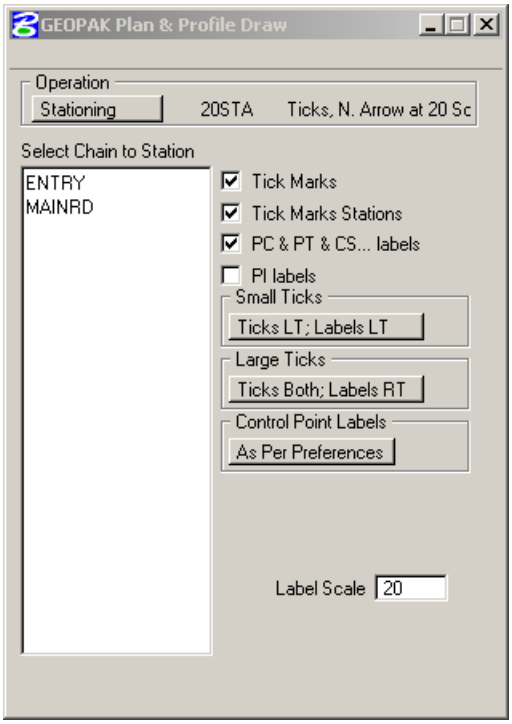
10. Double click Drafting Standards > Stationing category > 20STA Ticks, N. Arrow at 20 Scale.



This item places tick marks along the centerline alignment, station labels and PC & PT labels.

11. Change the **Operation** option to Stationing.



12. Enable the labels.

Tick Marks	Enable
Tick Marks Stations:	Enable
PC & PT & CS.. labels:	Enable
Small Ticks	Ticks LT, Labels LT
Large Ticks:	Ticks Both, Labels RT
Label Scale	20

13. Click on MAINRD.
14. Close Design & Computation Manager

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Annotate A Roadway Profile

Now we can annotate the profile for the Main Road. The profile will be drawn in MicroStation View 2. We will use the *Draw Profile* tool to draw and annotate the profile.

1. Open MicroStation View Window 2. *(MS: Window>View>2)*
2. Click **MS Fit View**.
3. Click **MS Window Area**.

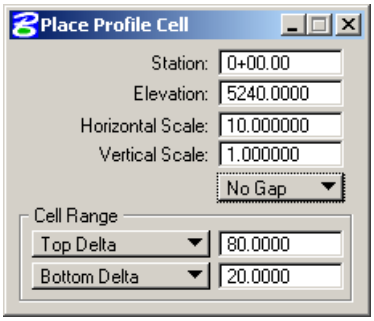
   Find an unused portion of the DGN file. We will place our profiles here.
4. Display all MS levels. (*MS > Settings > Level > Display*).
5. Select the **Draw Profile** tool *(Site Modeler: Object> Draw Profile)*.

6. Enter the Job Number and Chain information.

Job Number	200
Chain	MAINRD

We need to create a profile cell first before we actually draw the profile information. We can do this within the Draw Profile dialog by using the Profile Cell Control tool.

7. Click **Profile Cell Control**.
8. Click **Place Profile Cell** in the Profile Cell Control dialog,



9. Enter the Profile Cell information.

Station:	0+00.00
Elevation:	5240
Horizontal Scale:	10
Vertical Scale:	1
Top Delta:	80
Bottom Delta:	20

10. Data point in MicroStation View 2 to place the profile cell.
11. Close the **Profile Cell Control** dialog.

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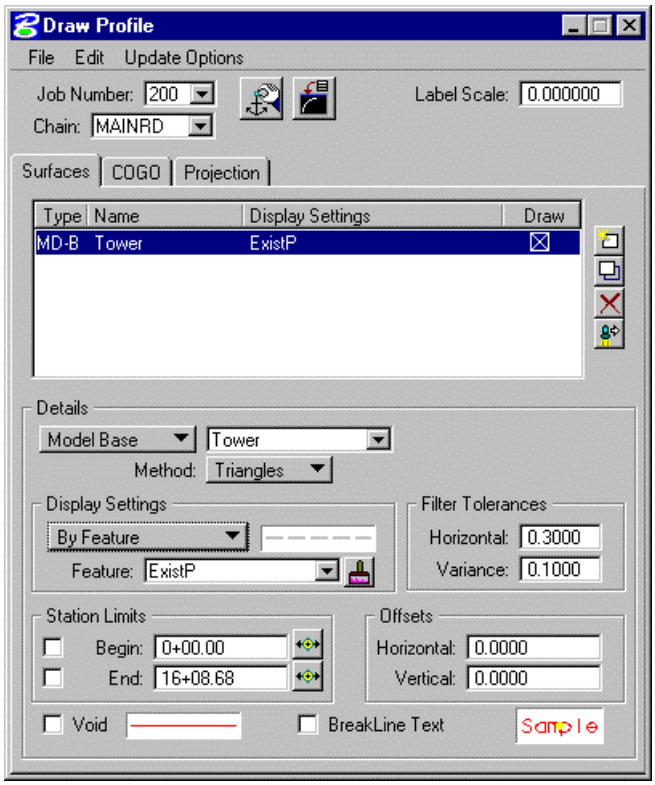
12. Enter the Details group information.



Model Base:	Tower
Method:	Triangles
Display Settings:	By Feature, ExistP

13. Click **Browse Feature** and navigate to Drafting Standards > Profiles > ExistP.
14. Highlight the item and click **OK**.
15. Click **Add Surface Setting**.

    The surface is added in the list box and drawn on the profile cell.
16. Click the **COGO** tab.
13. In the Details group box, set the **Profile Name** to MAINDES and **Vertical Offset** to 0.
14. Set the **Display Settings** to By Feature.
15. Click **Browse Feature** and navigate to Drafting Standards > Profiles > DesignP.
16. Highlight the item and click **OK**.
17. Set the **Label Scale** to 100 (*top right hand corner of Draw Profile dialog*).
18. Click **Add COGO Profile Settings** along the right side of the list box.

    This adds the profile to the list and draws it into the Profile Cell.
19. Close the **Draw Profile** dialog .

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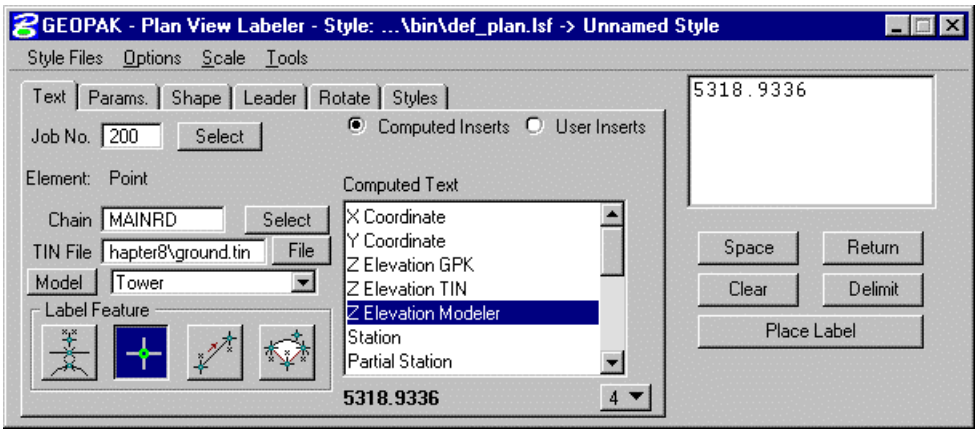
Plan View Labeling

In this section we will use the GEOPAK Plan View Labeler to create a typical Bearing/Distance Label. We will then place the label at various locations along our property line. We will also add this label to a library of other plan view type labels that can then be used on future projects by others. This process of creating and saving the label can be used to create any type of label you may need and aid you in the development of your company standard labels.

1. Select the **Plan View Labeler** tool *(Applications > GEOPAK Site > Plan Preparation > Plan View Labeling)*.



2. Set the project specific information.

Job No.	200
Chain	MAINRD
TIN File	*Ground.tin*
Model	Tower

3. Click **Select GEOPAK or MS Element**, then select and accept one of the property boundary elements.

   Once you have accepted the element to label, GEOPAK puts a circle at the midpoint of the line segment. Now we can construct the text portion of our label. There is a list of computed text in the center of the dialog. To see any particular computed value, simply highlight it in the list.

4. Highlight **Bearing -> DMS** in the Computed Text list box.

   The value of the computed text is displayed below the list box.

5. Double click **Bearing -> DMS** in the Computed Text list box.

   Double clicking on any computed text places the item in our label. This sends the value to the text editor portion of the GEOPAK Plan View Labeler dialog.

6. Click **Return**.

   This moves the cursor to the next line below the bearing.

7. Select Length from the **Computed Text** list.

8. Set the number of decimal places to 2.

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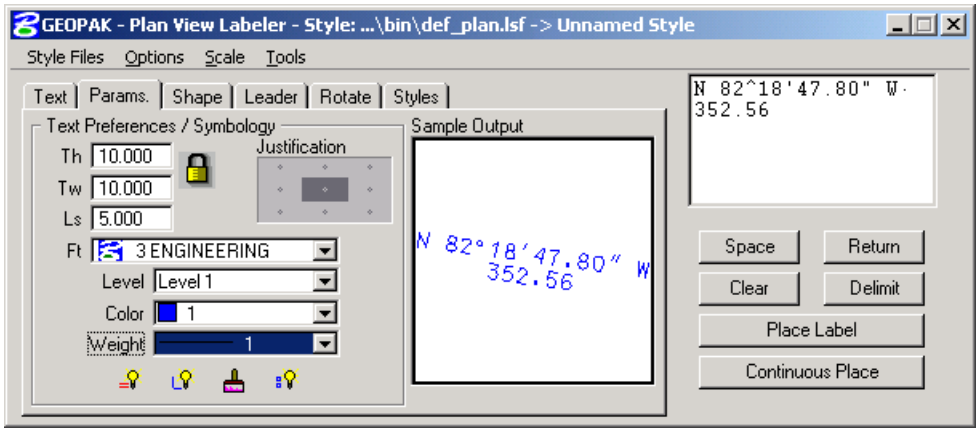
9. Double click on Length to add that information to our label.

Warning Adjust the number of decimal places prior to adding the value to the text editor.

10. Click on the **Params**. Tab and set your parameters as illustrated.

    This is where we set up the text preferences and symbology.



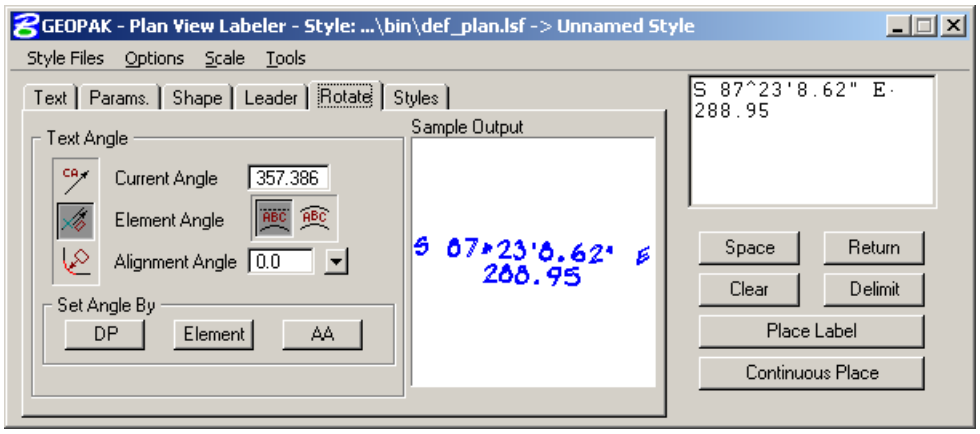
11. Click on the **Shape** Tab and review the options *(no user input required)*.

    We will not put a shape around our label but there are several supported shapes if needed. Just review the options for shape geometry and symbology.

12. Click on the **Leader** tab and review the options.

    Again we will not have a leader on our label but this is where we could select the leader type and symbology. Several leader types are supported with various types of terminators including and Active Terminator from a cell library in MicroStation.

13. Click on the **Rotate** tab.



14. Click **Element Angle** to set the rotation of the text.

15. Click **Place Label**.

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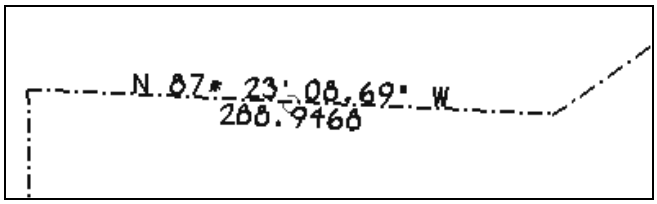
16. Snap to the midpoint of the line to place the label.



Continuous Text Placement

Warning Please read the following steps in their entirety before completing.

1. Click on the **Text** tab.
2. Click **Select GEOPAK or MS Element**.
3. Select and accept another line to label.

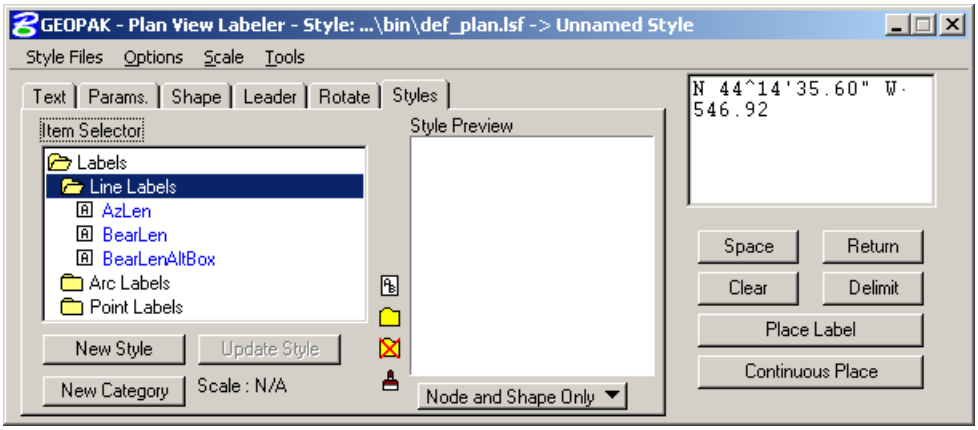
   Notice how the bearing and length values are automatically updated.
4. Click **Continuous Place**.
5. Snap to the midpoint of the line to place the label.
6. Select and accept another line to label.

   The label should have been automatically placed. Continue to label the rest of the property lines in this continuous mode.

Saving a Label Style

In this exercise, we will save the label to a style file which contains all our standard label styles.

1. Click on the **Styles** tab.



2. Double click on **Line Labels**.

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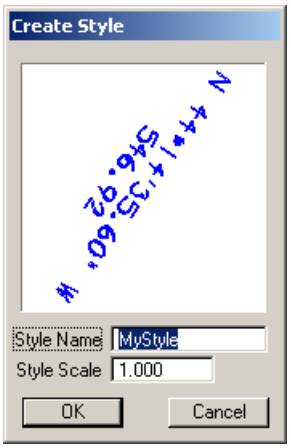
3. Click **New Style**.



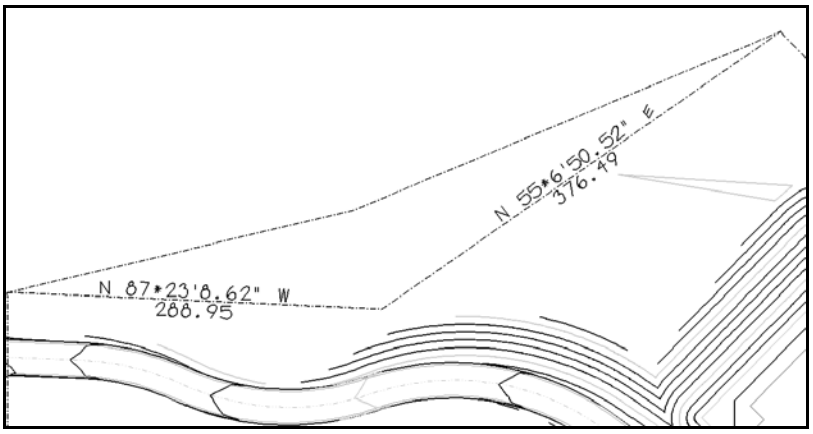
4. Enter the **Style Name** as MyStyle.
5. Click **OK**.

   The style is added to the library.

Updating Labels

We will modify two of the property lines using MicroStation Modify Element tool, then update the labels.

1. Select the **Modify Element** tool *(MS: Modify toolbox > Modify Element)*.
2. Relocate the endpoints of the property lines to a new location in the MicroStation view.



Now that the property lines have been changed, we will have GEOPAK update the labels.

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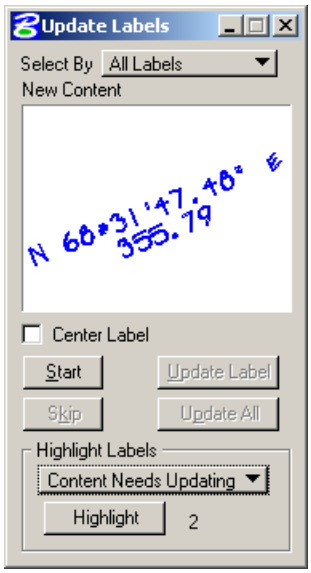
3. Select the **Update Labels** tool *(Plan View Labeler Menu: Tools > Label Updater).*

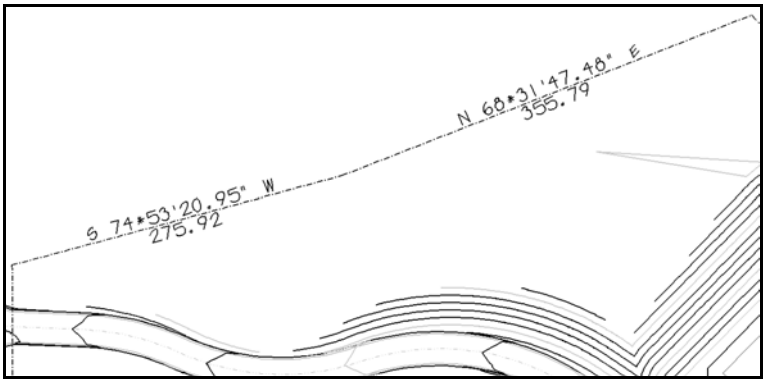


4. Set **Select By** to All Labels.
5. In the Highlight Labels group box, set to **Content Needs Updating.**
6. Click **Highlight**.

   The two labels that need to be changed will highlight.
7. Click **Start**.

   GEOPAK searches through all the labels in the design file and presents you with ones that need to be updated. You will see the new label content in the dialog.
8. Click **Update Label**.

   The label on the line is replaced.
9. Continue until each label has been updated.



10. Close the **Update Labels** dialog.
11. Close the **Plan View Labeler** dialog.
12. Click **Yes** to the alert dialog.

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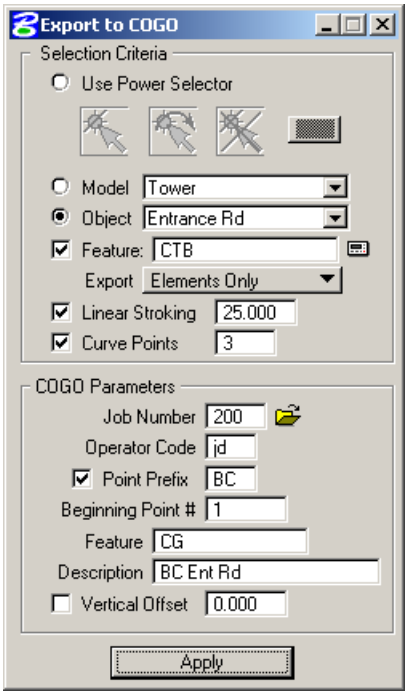
Export Entrance Road Object to Coordinate Geometry

In this section we will export the back of our entrance road curb to coordinate geometry so that later we can upload those points to a data collector for stake out.

1. Select the **Export to COGO** tool *(Site Modeler Menu: Project>Export>To COGO).*



2. Enter the required information.

Object:	Enable, Entrance Rd
Feature:	Enable, CTB (PayItems>Curbing>CTB)
Export:	Elements Only
Linear Stroking:	25
Curve Points:	3
Job Number:	200
Operator Code:	jd
Point Prefix:	Enable, BC
Beginning Point #:	1
Feature:	CG
Description:	BC Ent Rd

3. Click **Apply**.

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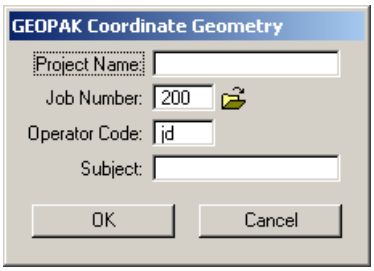
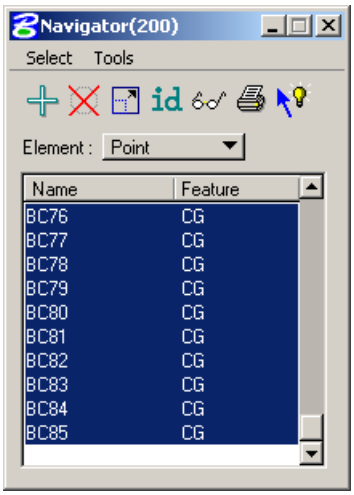
4. Select the **Coordinate Geometry** tool *(Applications > GEOPAK Site > Geometry > Coordinate Geometry)*.



Job Number:	200
Operator Code:	jd

5. Click **OK**.
6. Set Visualization to **Temporary**. *(GEOPAK Coordinate Geometry Menu: User > Preferences > Visualization)*
7. Select the **Navigator** Tool. *(GEOPAK Coordinate Geometry Menu: Tools > Navigator)*



8. Highlight points BC1 through BC85.
9. Click **Visualize Elements** (eyeglasses) .

   The points are displayed in MicroStation until you close coordinate geometry.

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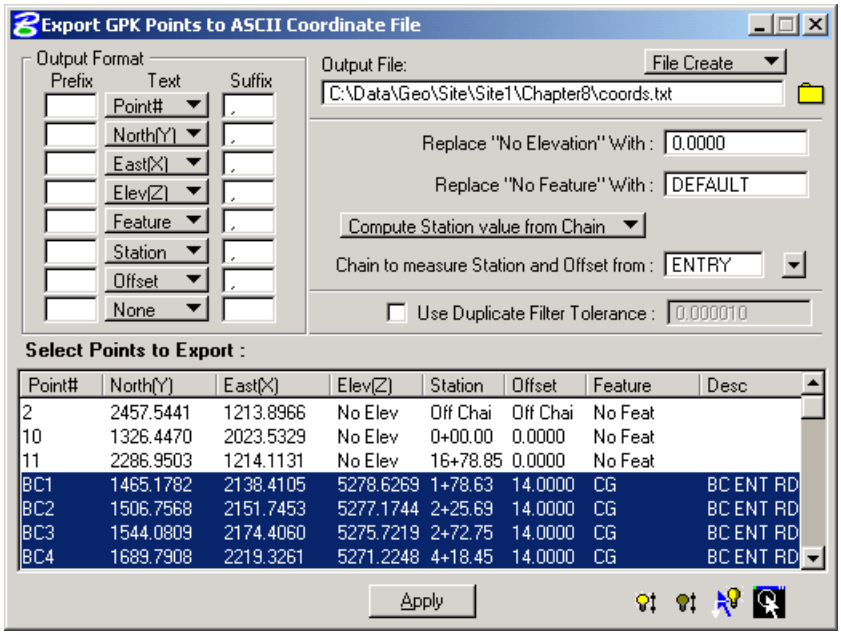
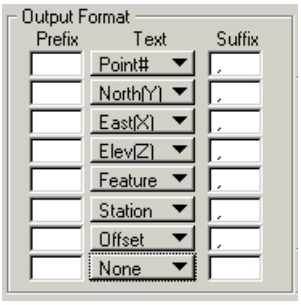
Export Points to ASCII Coordinate File

1. Select the **Export GPK Points to ASCII Coordinate File** tool. *(Coordinate Geometry Menu: File > Export > ASCII Points)*



2. Set the Output Format group box to the following.



3. Set **Compute Station value from Chain**.
4. Set **Chain to measure Station and Offset from** to Entry.
5. Highlight points BC1 through BC85.
6. Click **Apply**.
7. Click **OK** to the dialog informing you of the text file creation.

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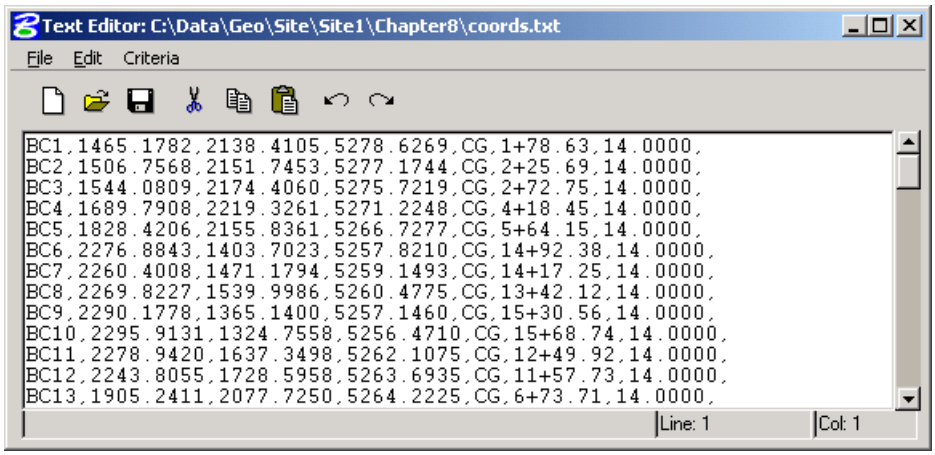
8. Open the file with the GEOPAK Text Editor and review. *(Applications > GEOPAK Site > Text Editor)*



Note	There is a new for V8 GEOPAK tool that works similar to this, but creates a table for you to place into your MS DGN file. This tool is accessible from **Applications > GEOPAK Survey > Plans Production > Coordinate Table**. Used in combination with COGO > Navigator (permanent visualization), COGO points can be mapped to and their associated stake out table created and written to the DGN file very quickly.

9. Close the **Text Editor**.
10. Close **COGO**.

Quantity Takeoffs (Optional)

In this section, we will use GEOPAK Design and Computation Manager to calculate quantities for our project. In our case we will calculate the quantities for all of the elements we have created in the Site Modeler, Drainage and Water/Sewer classes. The same process is used to calculate any type of plan view quantity.

1. Fit the entire site plan into MicroStation View 1.
2. Turn the display **ON** for the referenced Drainage and Water/Sewer DGN files. (*MS: File>Reference*).
3. Select the **Design and Computation Manager** tool *(Applications > GEOPAK Site > Design & Computation Manager).*
4. **File > Open** *C:\Data\Geo\Site\Standards\site.ddb*.
5. Click **Compute** at the top of the dialog.
6. Highlight the **PayItem** Category.

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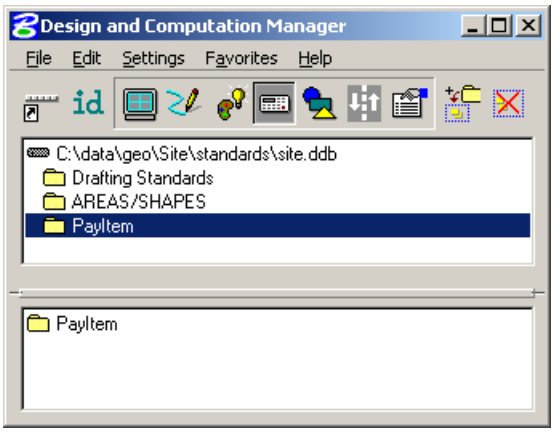
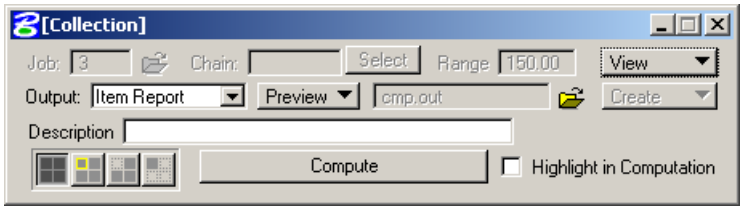
7. Right click and select **Add to Collection**.



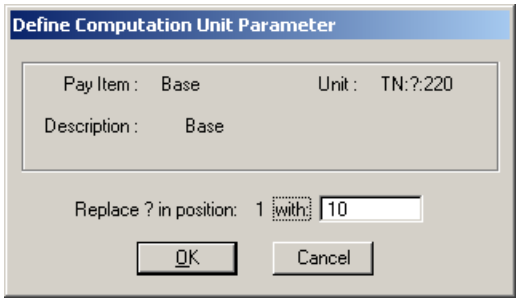
8. On the [Collection] dialog, set the **Output** to Item Report and **Preview**.



9. Click **Compute**.

   GEOPAK searches the view for any element matching an item in the PayItem category.

   A dialog opens prompting you to define a computational unit for Pay Item Base. This means that GEOPAK has found a shape in the view which represents the pavement area for the roadways. In the Design & Computation manager Pay Item category, there is a pavement design item having symbology that matches the symbology of our pavement area shape. This pavement design consists of a layer of Base and a layer of Asphalt.



10. Enter a value of 10.

    The value is in inches and is converted to tonnage by the program.

11. Click **OK**.

12. Click **OK** to continue.

    Next we are prompted for the asphalt layer thickness.

13. Enter a value of 6.

    The value is in inches and will be converted to tonnage by the program.

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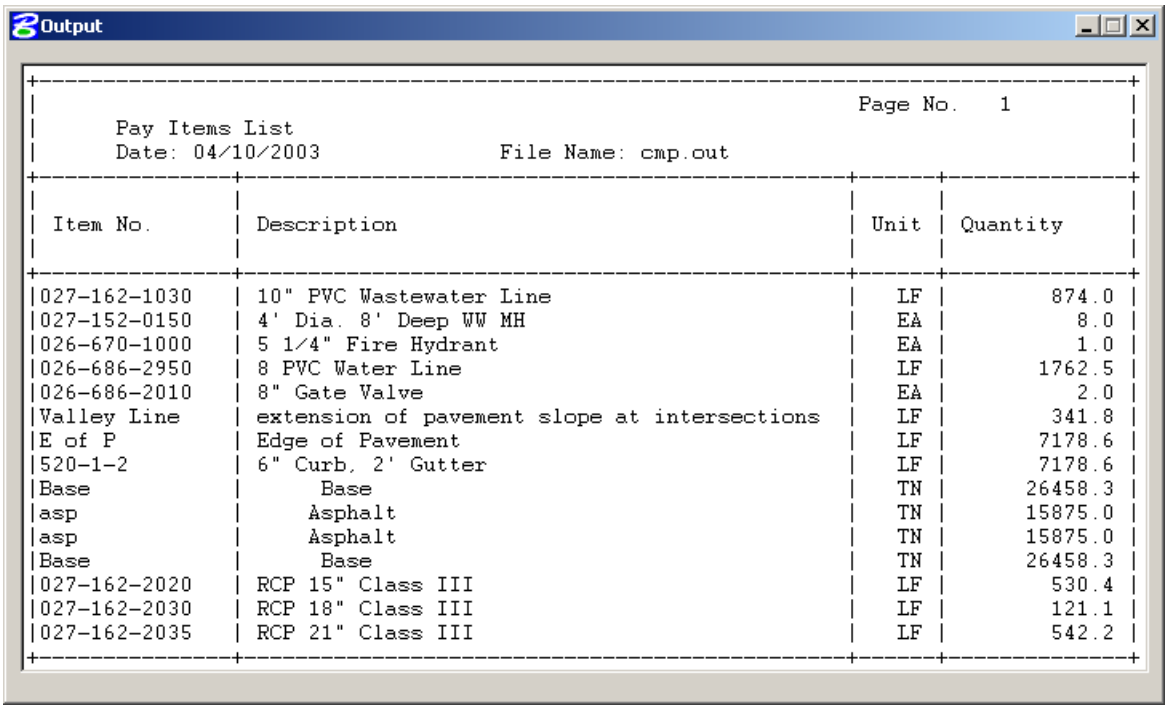
14. Click **OK**.
15. The Alert dialog appears, click **OK** to continue
16. GEOPAK displays the item report in the Output dialog.



Hint This process can be used to calculate a quantity for any Design & Computation Manager item that has an associated computational unit assigned to it. These items have a calculator icon by them in the Design and Computation Manager dialog.

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