Appendix H

Drainage Ditch Design - Lab

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H.1   Ditch Design

H.1.1   Introduction

Objective:	Provide the user with a general understanding of how to design and analyze ditches in GEOPAK Drainage.
Goal:	Create a ditch system using GEOPAK Drainage.

The creation of a ditch system in GEOPAK Drainage is similar to the construction of a storm sewer system, with the difference that instead of specifying a pipe for the link connection, the user needs to select the ditch option.

GEOPAK Drainage allows the user to specify a fixed ditch geometry or a ditch extracted from a reference surface.

H.1.2   Link/Ditch Configuration
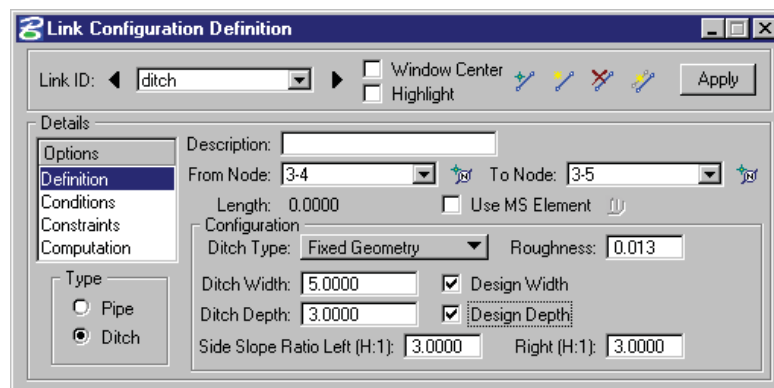
Link options and types are shown in the Option list box on the left side of the dialog. The corresponding fields and items appear on the right. The four options are reviewed below.

|	
Definition	Defines the Link's path, connectivity, shape, material, roughness coefficient, size, and design options.
Conditions	Defines or reviews the elevation condition for the Link including minimum depth, soffit, invert, and slope data. It also includes the profiling options for holding certain values constant.
Constraints	Defines the Link constraints including the minimum and maximum rise (size), slope and velocity used in Link design.
Computation	Reviews the Link hydraulic computation

H.2   Lab 19:   Ditch Design

H.2.1   Introduction

*Lab exercise 19 is an excerpt from the 2011 GEOPAK Drainage VDOT Training Manual*

Step 1.   Execute C:\data\geo\VDOT\drain1\LAB19_V8.EXE.

Step 2.   Open the MicroStation file c:\data\geo\VDOT\drain1\h17682.dgn.

Step 3.   Select Drainage from the Applications > GEOPAK Drainage > Drainage pull down menu.

Step 4.   Access the drainage project h17682.gdf by selecting Project > Open from the GEOPAK Drainage pull down menu.

H.2.2   Design Ditch Node: ditch1

Step 1.   Select from the Drainage Menu: Component > Node > Add.
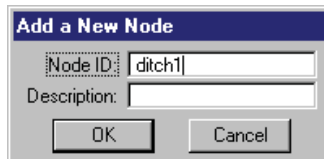
Step 2.   Highlight Properties in the Options group box on the Node Configuration dialog. Select the Node to be used from the Drainage Library and assign its properties as depicted below:
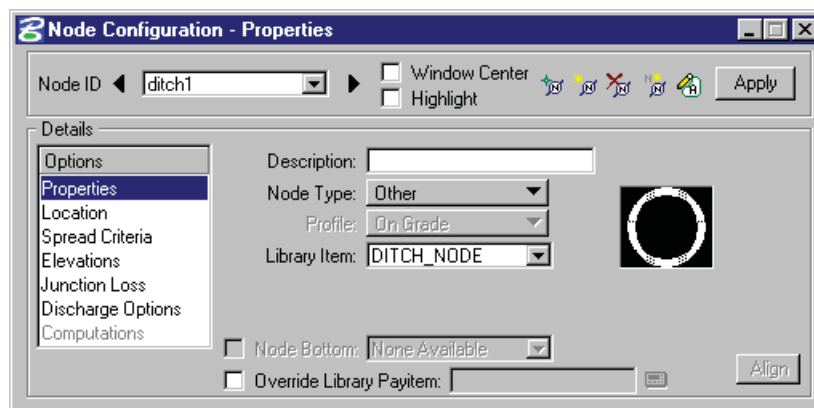
|	
Node ID	Ditch1
Node Type	Other
Library Item	Ditch_Node

Step 3.   Highlight Location to describe the inlet's location in the design plane:
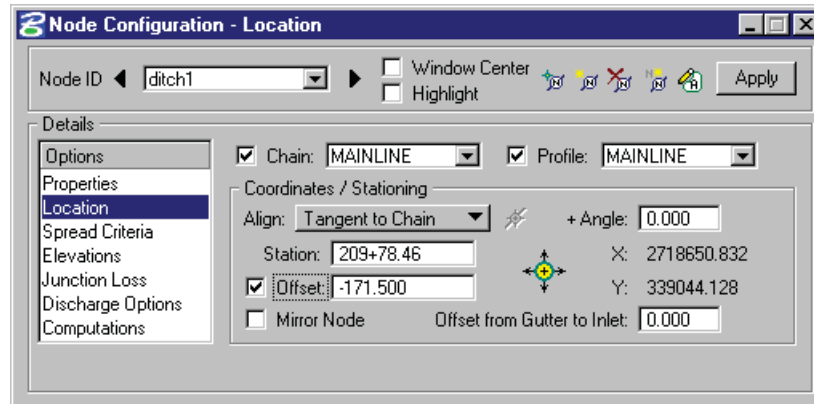
|	
Reference Chain	Select Reference chain: MAINLINE
Reference PGL	Select Reference PGL: MAINLINE
Align	Tangent to Ref. Chain
Station	209+78.46
Offset	-171.50

Press Enter to automatically place the node at the specified location.

Step 4.   Highlight Elevations to assign the node an elevation and vertical alignment of the ditch node.
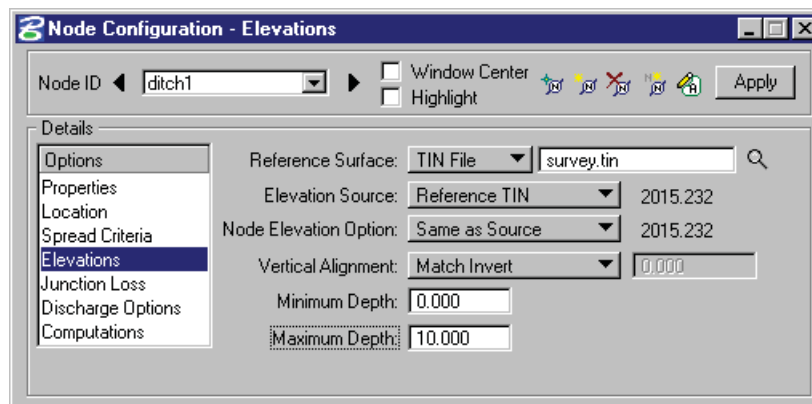
Elevation Source	Reference TIN
Node Elevation Option	Same as Source
Vertical Alignment Preference	Match Invert
Minimum Depth	0 feet
Maximum Depth	10.00 feet

Step 5. Highlight Junction Losses to use Defined Equations (defaults to Preference > Junction Loss Settings).
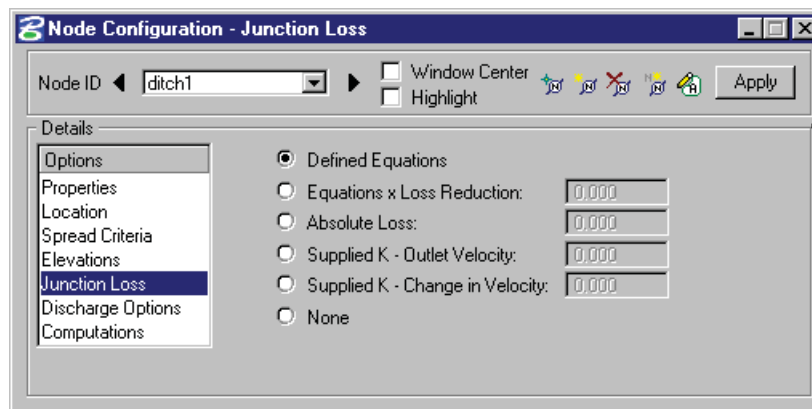
Step 6 Highlight Discharge Options to specify the discharge getting into the ditch. The actual flow was previously calculated. Therefore, keyin 10 cfs at the Supplied Discharge field and activate the toggle.
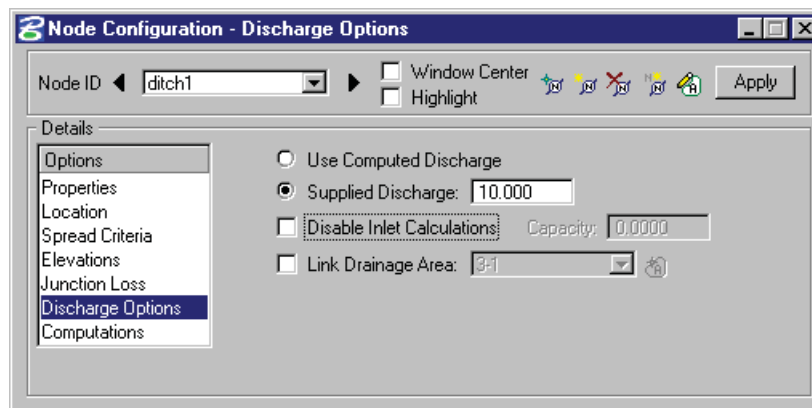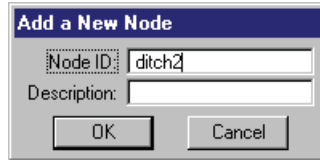

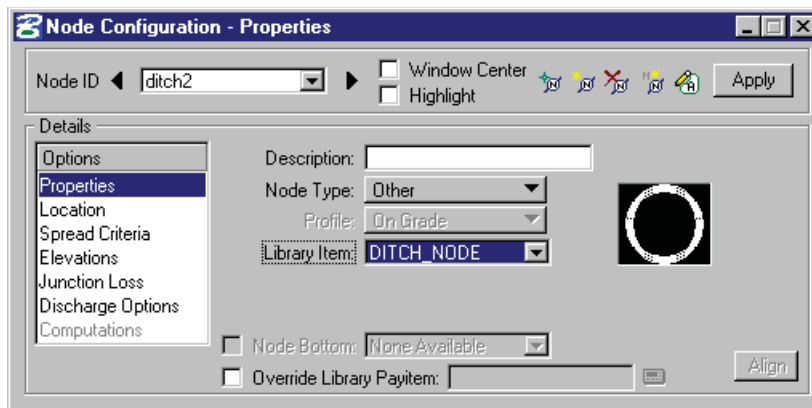Step 7. Click Apply to add this node to the project.

Step 8. Close the Node Configuration dialog.

H.2.3   Design Ditch Node: ditch2

Step 1.   Select from the Drainage Menu: Component > Node > Add.

Add a New Node

Node ID: ditch2
Description:

OK   Cancel

Step 2.   Highlight Properties in the Options group box on the Node Configuration dialog. Select the Node to be used from the Drainage Library and assign its properties as depicted below:

Node Configuration - Properties

Node ID ◀ ditch2 ▼ ▶   □ Window Center   □ Highlight   Apply

Details

Options	Description:
Properties	Node Type: Other
Location	Profile: On Grade
Spread Criteria	Library Item: DITCH_NODE
Elevations	
Junction Loss	
Discharge Options	
Computations	

□ Node Bottom: None Available
□ Override Library Payitem: Align

| Node ID	Ditch2
Node Type	Other
Library Item	Ditch_Node

Step 3.   Highlight Location to describe the inlet's location in the design plane:
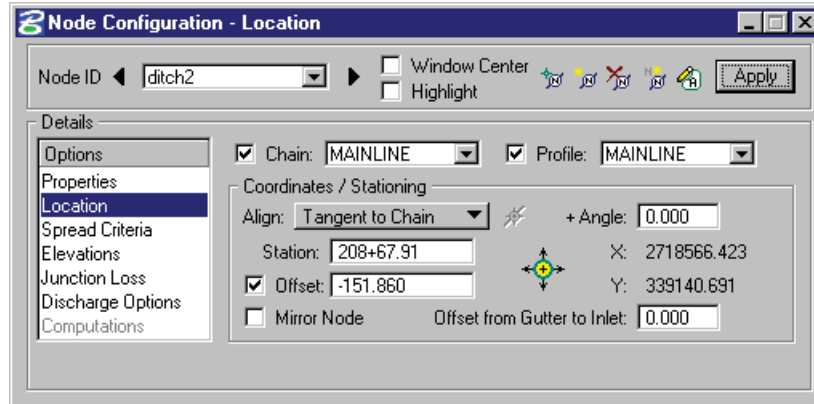
| Reference Chain	Select Reference chain: MAINLINE
Reference PGL	Select Reference PGL: MAINLINE
Align	Tangent to Ref. Chain
Station	208+67.91
Offset	-151.86

Press Enter to automatically place the node at the specified location.

Step 4.   Highlight Elevations to assign the node an elevation and vertical alignment of the ditch node.
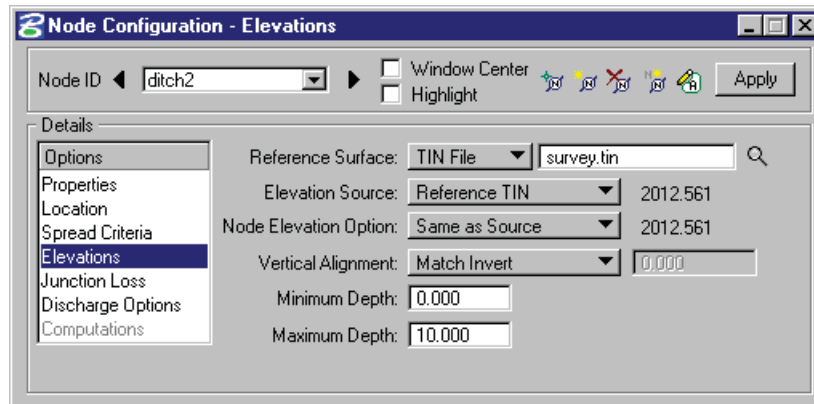

Elevation Source	Reference TIN
Node Elevation Option	Same as Source
Vertical Alignment Preference	Match Invert
Minimum Depth	0 feet
Maximum Depth	10.00 feet

Step 5. Highlight Junction Losses to use Defined Equations
(defaults to Preference > Junction Loss Settings).
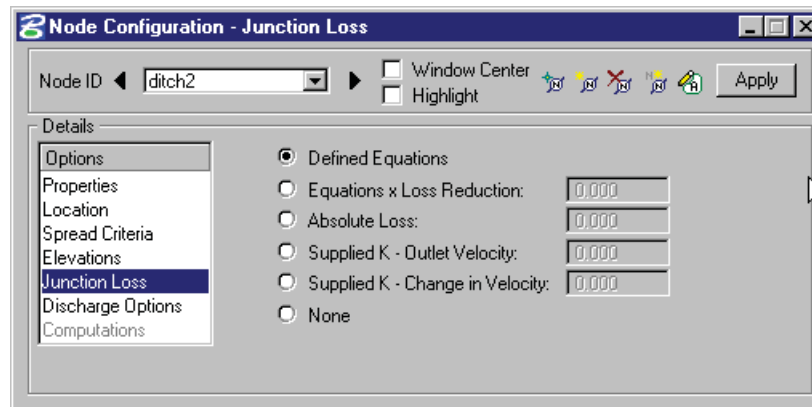
Step 6. Highlight Discharge Options to specify the discharge getting into the
ditch. This node will not receive any direct discharge other than the one
coming from the previous node. Therefore keyin 0 cfs at the Supplied
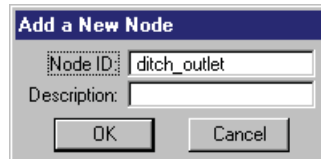Discharge field and activate the toggle.
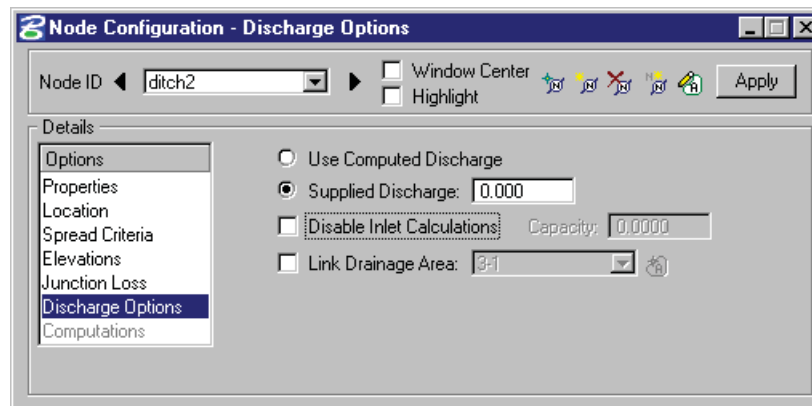
Step 7. Click Apply to add this node to the project.

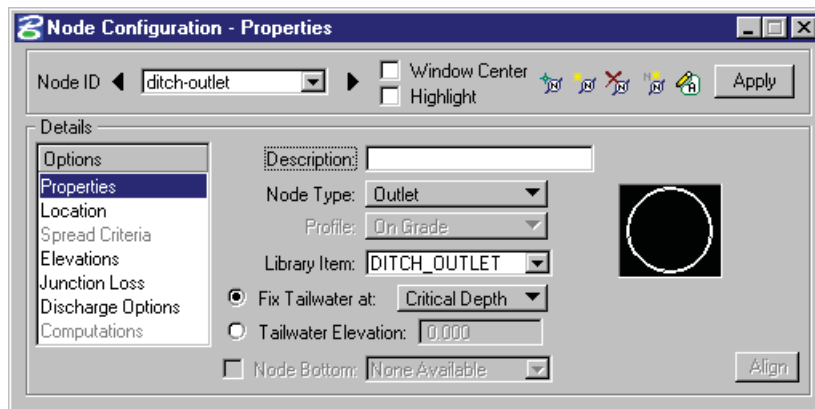Step 8. Close the Node Configuration dialog.

H.2.4   Design Ditch Outlet Node: ditch-outlet

Step 1.   Select from the Drainage Menu: Component > Node > Add.

Step 2.   Highlight Properties in the Options group box on the Node Configuration dialog. Select the Node to be used from the Drainage Library and assign its properties as depicted below:

| Node ID	Ditch_outlet
Node Type	Outlet
Library Item	Ditch_Outlet
Fix Tailwater	Critical Depth

Step 3.   Highlight Location to describe the inlet's location in the design plane:
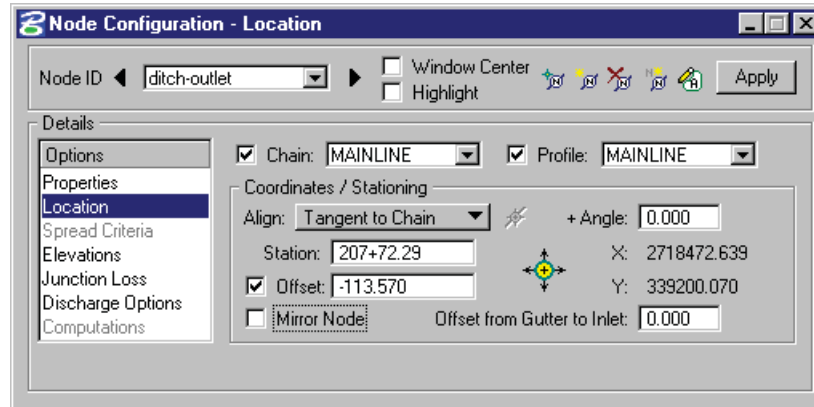
Reference Chain	Select Reference chain: MAINLINE
Reference PGL	Select Reference PGL: MAINLINE
Align	Tangent to Ref. Chain
Station	207+72.29
Offset	-113.57

Press Enter to automatically place the node at the specified location.

Step 4.   Highlight Elevations to assign the node an elevation and vertical alignment of the ditch outlet node.
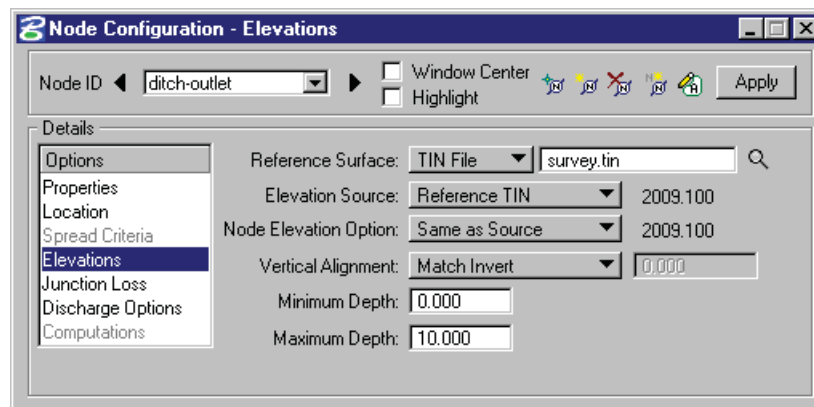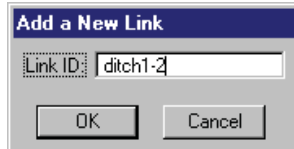

Elevation Source	Reference TIN
Node Elevation Option	Same as Reference
Vertical Alignment Preference	Match Invert
Minimum Depth	0 feet
Maximum Depth	10.00 feet

Step 5.   Click Apply to add this node to the project.

Step 6.   Close the Node Configuration dialog.

H.2.5   Design Ditch Links

Step 1.   Select from the Drainage Menu : Component > Link > Add.

Step 2.   Highlight Definition to Set the ditch spatial characteristics including From and To Nodes ID's, and geometry.

Graphically select the Nodes by clicking the ID button for each and identifying the Nodes. Dtich1-2 traverses From Node ditch1 to Node ditch2
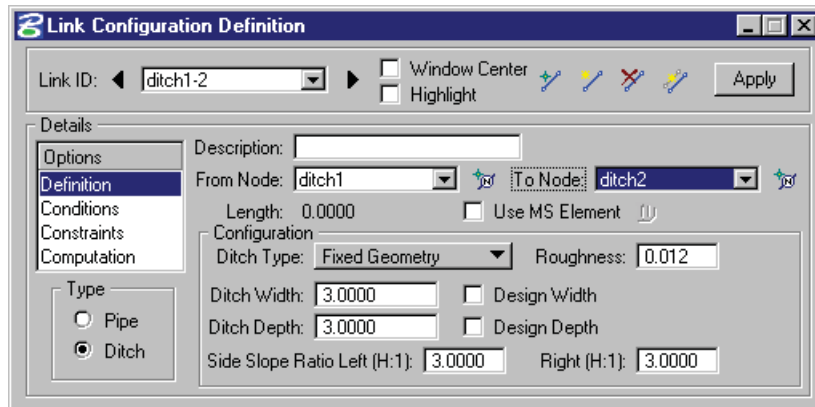

Type	Ditch
Geometry	Fixed Geometry
Manning's n	0.012
Ditch Width	3.00
Design Width	Toggle OFF
Ditch Depth	3.00
Design Depth	Toggle OFF
Side Slope Ratio	3:1 Left and 3:1 Right

Step 3. Highlight 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 ditch1 and ditch2 respectively.

In this case, no entries are necessary; GEOPAK Drainage will design all the profiles for this project.
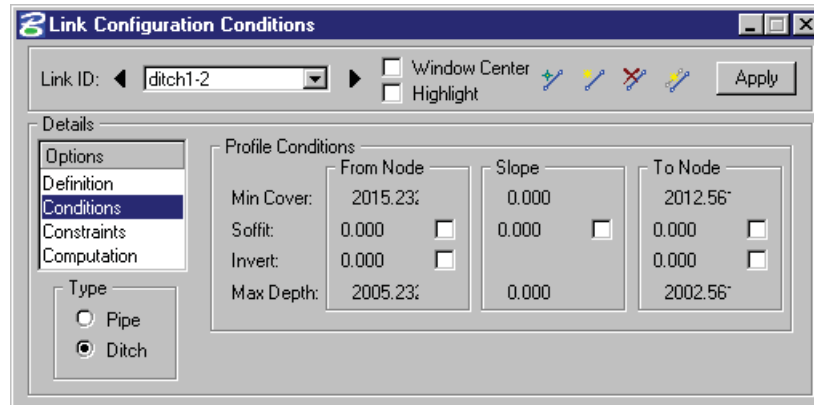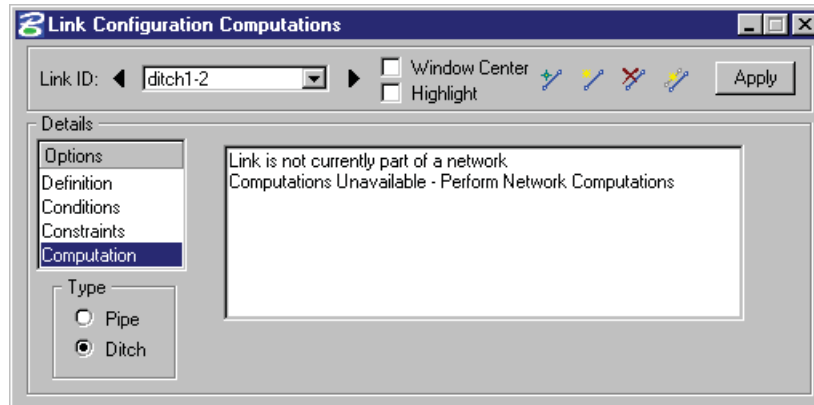

Step 4. Highlight Constraints. Establish the min/max design criteria for Links as follows:
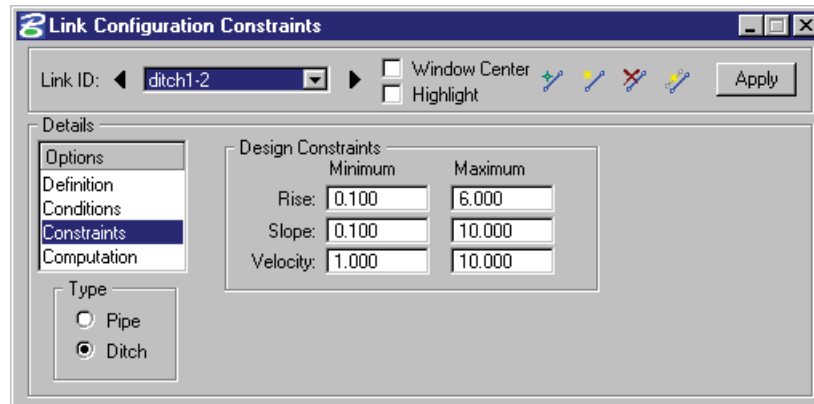
Rise min/max	0.1 / 6.0 (feet)
% Slope min/max	0.10 / 10.00 (%)
Velocity min/max	1.00 / 10.00 (fps)

Step 5.   Highlight Computations to display the computed hydraulic
   properties of the ditch.

Note: Ditch hydraulics are not available for review until a Network has been
established and designed or analyzed successfully. Check back here for
computations after the Network has been added and designed or analyzed.

Step 6.   Press Apply to incorporate the link to the project.

Step 7.   Add the remainder of the ditch system from Node <u>ditch2</u> to Node
           <u>ditch-outlet</u> using the Drainage Menu Component > Link > Add.

Step 8.   After adding the last portion of the ditch, close the Link configuration
           dialog.

H.2.6   Ditch Network Design

Step 1.   Select Network > Add from the Drainage menu.
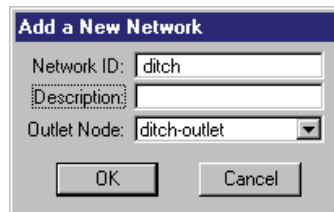
Step 2.   In the Network Configuration dialog, enter the following information:
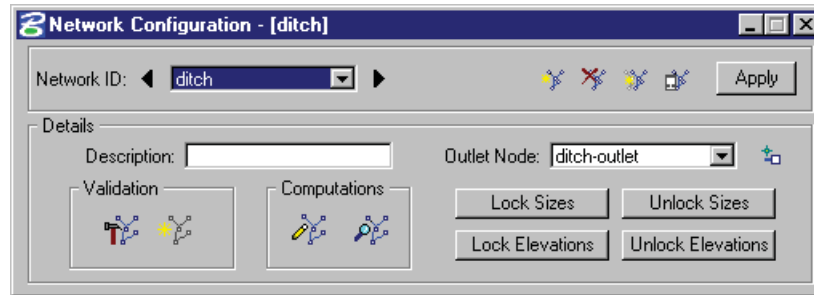
Network ID:	DITCH
Description:	(Optional)
Outlet Node	Click the ID button and select the DITCH- OUTLET node.

Step 3.   Click the Build Network button. This feature verifies the nodal topology and link connectivity. The Highlight Network feature highlights all components (ditch nodes and ditch links) connected to the active Network.
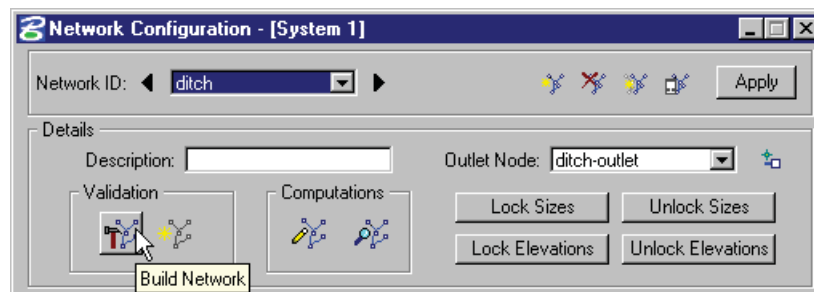
Step 4.   Click the Apply button. Network "DITCH" has been added to the project.

Step 5.   Click the Design button. This command initiates the hydraulic design of the components contained in the Network.

Step 6.   Then GEOPAK will design the network and issue the pertinent Warning messages, if necessary.
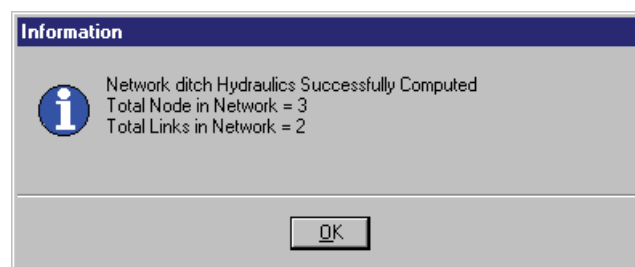
Step 7.   Set the Active Network to Ditch so we can review some of the provided reports.

Step 8.   We can now review some of the GEOPAK provided reports. Drainage > Reports > Storm Drain Links.

Storm Drain Hydraulic Calculation Summary for Network ditch - Errors in Network Calculations

ID	Upstream ID	Downstream ID	Upstream HGL	Downstream HGL	Discharge	Capacity	Slope	Loss	Uniform Velocit	Depth	Actual Velocit	Depth
ditch2-outle	ditch2	ditch-outlet	2010.136	2006.404	10.000	1093.952	3.120	0.000	8.460	0.302	8.410	0.304
ditch1-2	ditch1	ditch2	2012.807	2009.900	10.000	894.122	2.083	0.000	7.360	0.338	7.345	0.339

ASCII File: [   ] 🔍 Edit   ☐ Window Center   ☐ Highlight   Apply

Step 9.   Exit MicroStation.