



CONNECT DOCUMENTATION

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Proposed Drainage

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Drainage and Utilities

Creating Proposed Drainage - Node and Link Features

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Introduction

Drainage and Utilities features are created for underground elements that need to be designed and shown on the cross sections. Drainage and Utilities features use both 2D and 3D cells (models) to represent their graphics. The *Default* model of the drawings should be referenced into plan sheets and the *Default-3D* model referenced into the Cross Sections and Drainage Profiles.

Bentley's OpenRoads Designer offers a Product Add-in for design and analysis of Drainage and Subsurface Utilities. At the NHDOT we are not using the design and analysis functionality of this software at this time.

This documentation will cover plotting proposed drainage and utility features, creating Drainage profiles and creating reports of these elements.

Drainage and Utilities

Nodes can be placed onto a surface (or other elements) to get the grate elevation. Follow the documentation for creating the Proposed Terrain model as well as creating a Composite Terrain model to be used by D&U.

Open the *12345-P-Drainage.dgn*, open the *Default* model. *Reference Attach* the *Combined.dgn* with live nesting = 1 if not already attached. *Reference Attach* the *12345-Composite-Terrain.dgn* with no nesting. Attach the Geometry, E-Terrain and any other drawings needed for the Design. Use level display to set up your view as you want it and set the composite terrain model as the active surface. Shut off the display of the existing terrain model so it is not accidentally selected when trying to hit on the composite terrain model.

Project Properties

The first order of business is to create the D&U database for the dgn by selecting from the *Drainage and Utilities WorkFlow > Tools > Project tools > Project > Project Properties*. If this is the first time using D&U in the drawing, it will create the Utility model. Accept. Fill in the Project Properties, then click OK.



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Proposed Drainage - Analyze Surface

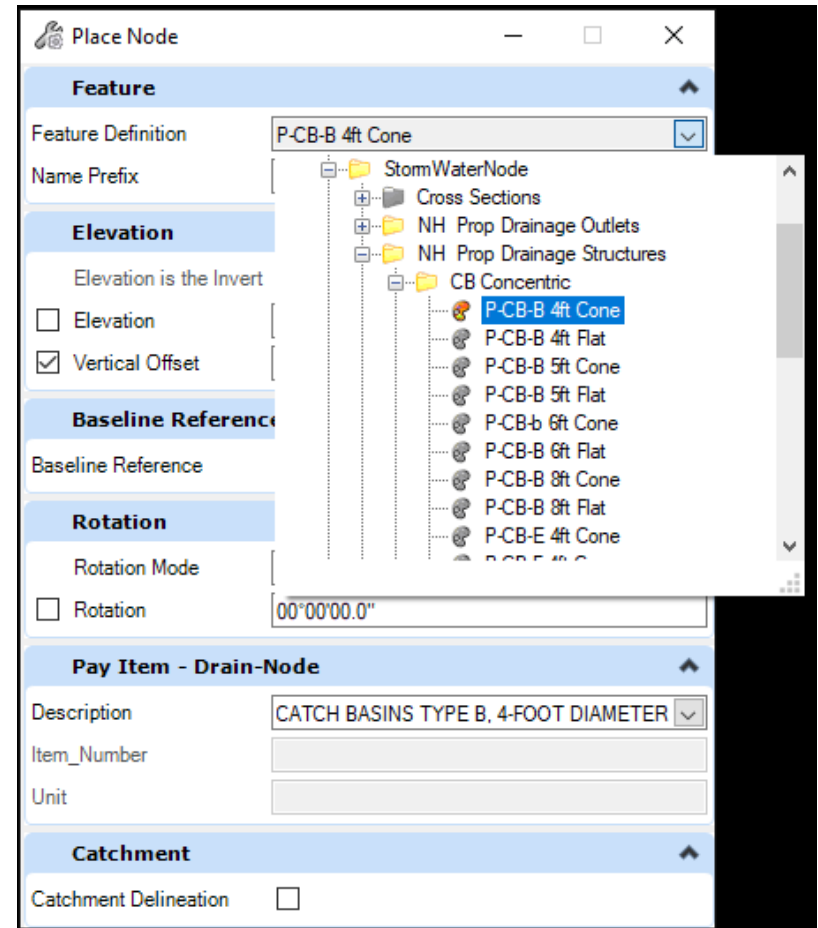
In Terrain Modeling task use the *Analyze Trace Slope* command (both Up and Down) to see where water is flowing. The results should coincide with the displayed Catchment centroids from MX. Turning on the High and Low points as well as the flow arrows from the composite terrain model will also help you determine the location of proposed structures. It is suggested that you work in 3 Views when laying out nodes and pipes.

Place Nodes

Open the *Drainage and Utilities WorkFlow Layout Tab > Place Node* command to place the first node. Select the appropriate proposed node such as **P - CB 4ft Cone** and follow the prompt to select a reference element for elevation by selecting the Composite Terrain model. Accept the Placement Type, *By Minimum Depth*. You can now use a data point on the screen to place the node, or activate Civil Accudraw, Station-Offset, tab to highlight the Offset, then type an **O** (origin) and hit on the alignment as the reference element and then use the station and offset fields to type in a location to place the node. Move the cursor around to define the nodes rotation and accept. When using Civil Accudraw's Station/Offset to place a node, the node will have manipulators for the station and offset to easily move it in the future.

The command will continue to allow you to place additional nodes. Just select the next feature definition you want to place and continue placing. Reset when done placing nodes. Nodes should be placed for all structures including headwalls and end sections. For links to be placed you must have a node for each pipe end. For outlet ditch links to be placed, use the *Conduit Drainage Node* or *Conduit Drainage Node Outfall* to locate the end of the ditch or channel.

For basins in pavement, the Vertical offset can be set to -0.08333 to achieve an accurate elevation. Recall also that basins on pavement or in ditches are set 1' inside the edge of pavement or CL of ditch respectively. When placing Headwalls and End Sections use the -Pipe





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Diameter for the vertical offset.

Nodes – Name and Base Reference

A node is named from its Feature definition name base. This is incremented for each one placed. After placing all the nodes they should be *Baseline Referenced* to an alignment. In the Drainage and Utilities Model section of the Explorer – expand the Nodes. select all nodes placed along a particular alignment. In the properties box expand the *Utility* pane and click in the *Baseline Reference* box and then select the alignment to associate. The *Station* and *Offset* boxes should populate. Next select each node, one node at a time and update the node name from an incremented value to the station value. (PCB-1... to PCB-207+50). This will help identify nodes when creating reports as well as Profile Runs that are generated.

Place Conduit

Use the *Place Conduit* command to place the pipes or ditches. Select the feature definition (type of pipe) and then the size. Each node has a connection area so when hitting on the node pay attention to where you are hitting on the outside of basins so they connect to the edge of the outside wall closest to the next node. Place a pipe from the upstream node to the downstream node. Continue placing Conduit until all nodes are connected.

Selecting a pipe will allow you to bring up the hydraulic properties by clicking on *Open Utility Properties*. The Drainage properties for links contain all the hydraulic information about the link including the physical as well as the results after analysis/design has been performed. A true/false switch is also available to tell the software if it is a culvert.

Default settings for Proposed pipes have the *Set Invert to Start* and *Set Invert to Stop* set to *True*. This means that when placing a pipe, its inverts will take on the invert of the node they are attaching to which could result in pipe not flowing down hill. This setting can be changed (set to False) on a pipe by pipe basis or it can be changed in the Prototypes for all proposed pipes within the dgn.

After placing pipes, select it and bring up the profile and change the inverts as necessary to get it to flow correctly. A profile of the entire run can be generated from the Layout tab of the Drainage and Utilities workflow. Either from the outlet or by nodes or links. The Drainage Profile run will be shown in the Explorer's Drainage and Utilities Model tab. Right click on it to select it and then Open Profile model. The nodes and pipes should be selectable and editable within the profile view.

Drainage ditches are Conduit links and can be placed from the last outlet structure to a *Pipe End Drainage Node* placed on the surface of the terrain. Bring up the profile and modify as needed. With the pipe selected the Trench can be turned on to create a corridor. Selecting this and drilling down into it allows you to see the Template it is using and change it to what you need. There are several Ditch templates that can be used. Selecting the corridor object tools then the corridor allows you to control all



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aspects of the ditch. The V ditch shapes level **P-Util-Drainage-Conduits-Ditch-3D** can be turned off in the *Default-3D* model leaving only the trench corridor displayed.

Drainage Profile View

A profile of the entire run can be generated from the Layout tab of the Drainage and Utilities workflow. Either from the outlet or by nodes or links. Set the Feature definition to **Geometry Pipe Run**. The Drainage Profile run will be shown in the Explorer's *Drainage and Utilities Model* tab. Right click on it to select it and then Open Profile model. The nodes and pipes should be selectable and editable within the profile view. The pipe run should be renamed to the Start and End Station node values so it is easily identifiable. Update the scale and create a 3D cut to see the referenced 3D model information along the profile. The annotation button (all elements) can be used to show the Pipe and Link annotation. You may need to turn on *Annotation Scale* and set the scale to see it.

Cover or subsidiary excavation depth can be checked from the profile view by either the measure distance command or by the *Profile Creation* tool – *Profile from surface*. The vertical offset from the Existing Ground terrain can be used to create a profile line 4 feet below for cover as well as a second line 9 feet below to check for excavation areas. The line styles and other symbology can be updated for clarity of those lines.

Selecting the Profile run in Explorer allows you to update the *Node Draw Type* to slice if you have it set to something less desirable. Drainage profiles should show the Proposed ground the existing ground as well as all subsurface features from the project. What is globally displayed in the *Default-3D* model is what is displayed in the profiles' 3D cut. (may need to be updated though). To shut off the display of say the corridors select materials, open the Level Manager, (If needed Turn on the column for *Global Display* by Right clicking in the top line of the level view and checking next to *Global Display*.) In the Tree, select the drawings 3D entry to display the levels in that corridor's drawing and Turn off the levels for *XC-CRGR*, *XC-Gravel*, and *XC-Sand* by unchecking them. Save Settings, Save the dgn and it may require reopening the dgn as well as refreshing the 3D profile cut for the view to sync.

See the Cut Sheet documentation to learn about creating sheets of the profiles.