1. Getting Started

This exercise introduces the GEOPAK Drainage workflow to complete the setup required for a new project. The user will review the project information and set the preferences.

GEOPAK Drainage gives you the best design and analysis based on the input that you enter. Engineering judgment must be used to evaluate the output that the program produces. Refer to the TDOT Roadway Design Division Drainage Manual for additional guidance.

1.1 Project Workflow

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 (DTM) 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.

Each of these components (inlets, areas, and pipes) is composed of two basic types of information:

- Spatial information describing its location, shape and connectivity.
- Hydraulic and Hydrologic information describing its properties, conventions and other associated attributes.

1.2 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**. This information is stored in a *.gdf file – GEOPAK Drainage File.

Nodes: A node (inlets, manholes, etc.) is a point 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.

Profiles: A profile represents a linear feature depicting a path connecting two nodes, it is different than a link in that a path may span multiple links and traverse upstream, downstream, or any combinations. The primary purpose of a profile is to allow visualization of a profile view between any two nodes in a drainage network.

1.3 Directory Information

Class files are located in the directory c:\Projects\Drainage*.*

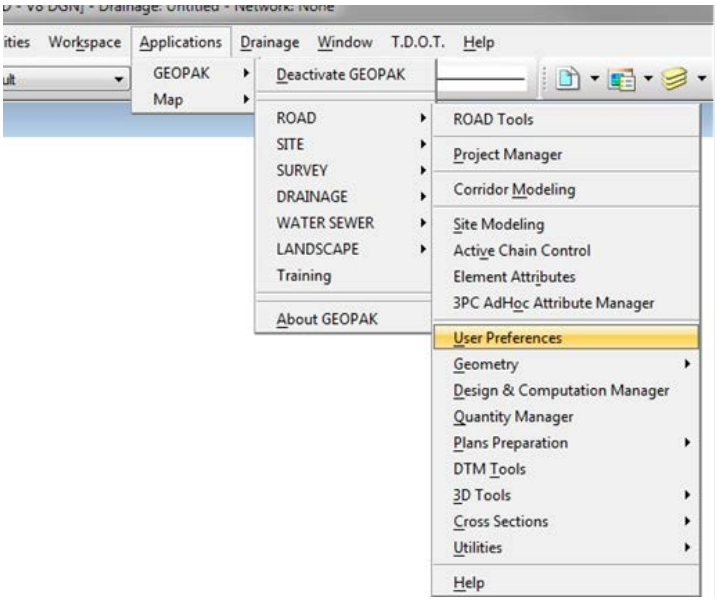
1.4 GEOPAK User Preferences

a) Copy the Geopak Drainage project template file, DrainageProject.gdf from standard directory: C:\Users\Public\Geopak Standards to class project directory: **C:\Projects\Drainage**

NOTE: For your project, the ‘copy to’ location would be your project folder.

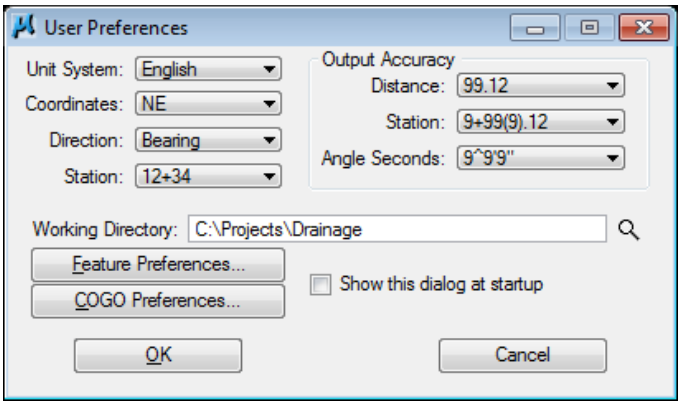
b) Utilizing MicroStation, open DVSR1proposed.dgn using the tdot interface.

c) Activate GEOPAK by going to Applications > GEOPAK > Activate GEOPAK. The GEOPAK User Preferences control the output format of data produced using GEOPAK. Access the **User Preferences** by selecting **Applications > GEOPAK> Road > User Preferences**.



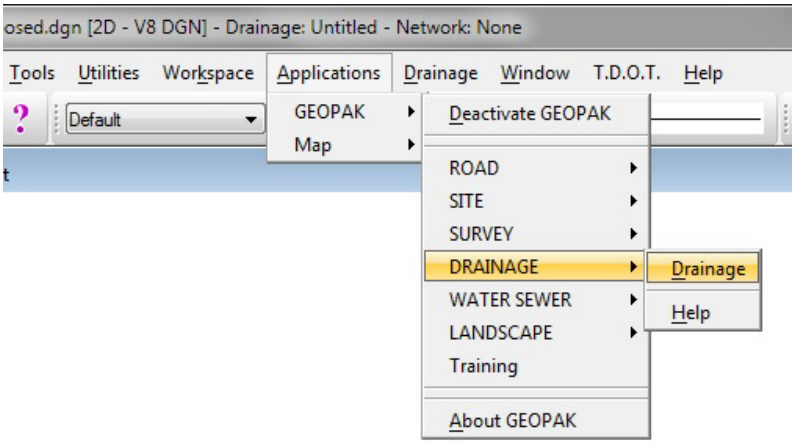
d) Set the Units to **English**, Stationing to **12+34**, and Working Directory to **C:\Projects\Drainage** and click **OK**.

NOTE: For your project, this would be your working directory.

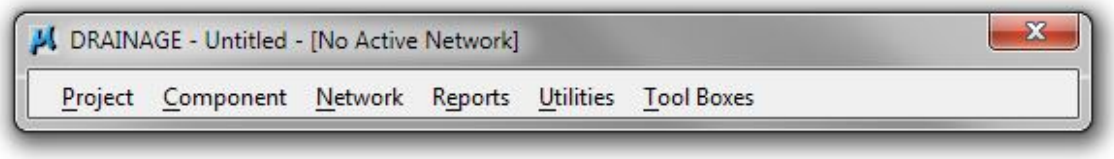


1.5 GEOPAK Drainage Menu

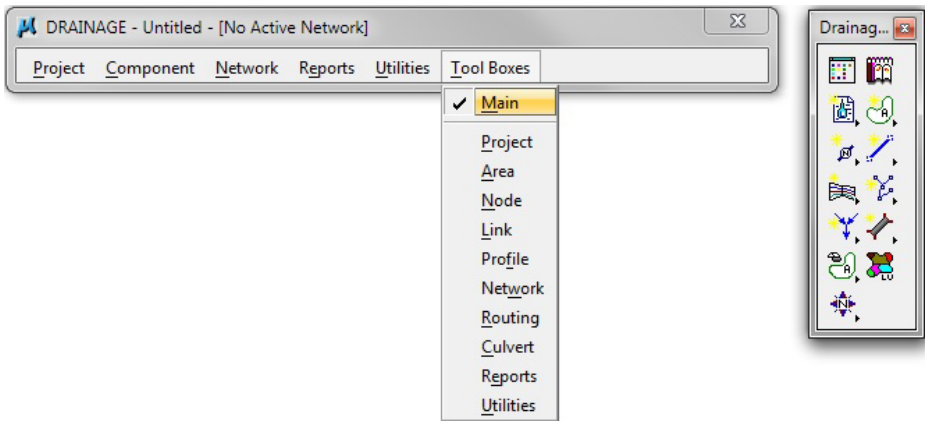
a) Access GEOPAK Drainage from MicroStation's **Applications** menu:



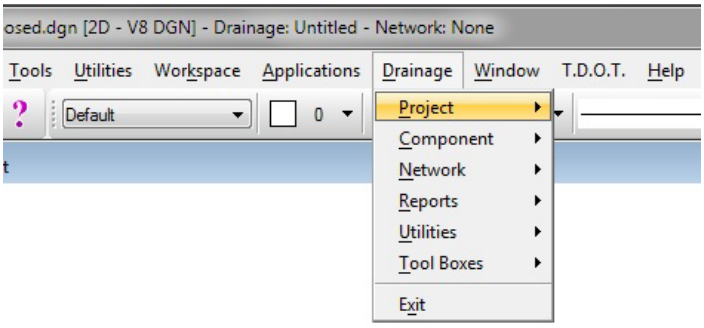
All items in Drainage can be accessed through this main GEOPAK DRAINAGE Menu Bar:



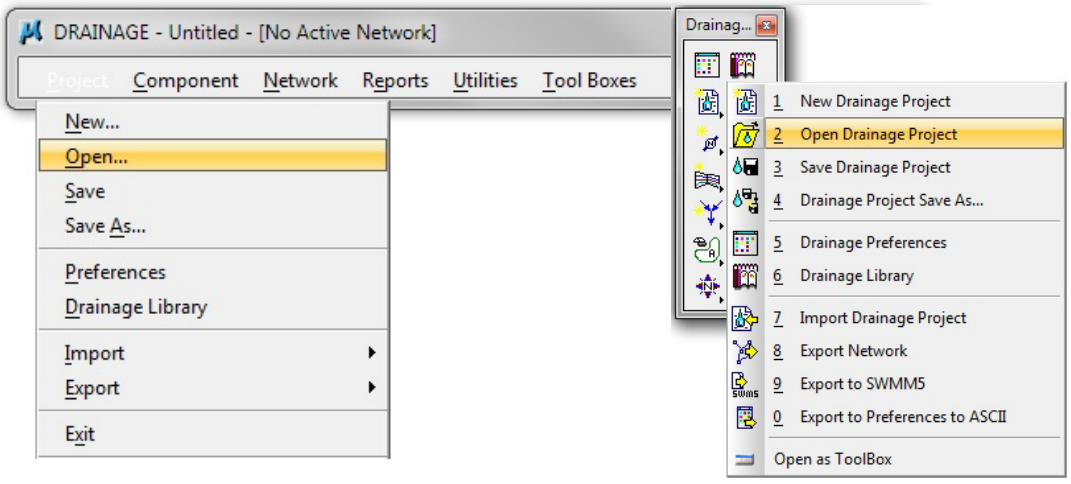
Or by invoking the GEOPAK Drainage **Main Tool Box** from **Tool Boxes>Main**:



Or they can be accessed through the Drainage Menu which has been added to the main menu bar once you load GEOPAK Drainage.



b) Open GEOPAK Drainage project file **DrainageProject.gdf** that was copied into the project directory: **C:\Projects\Drainage\.**

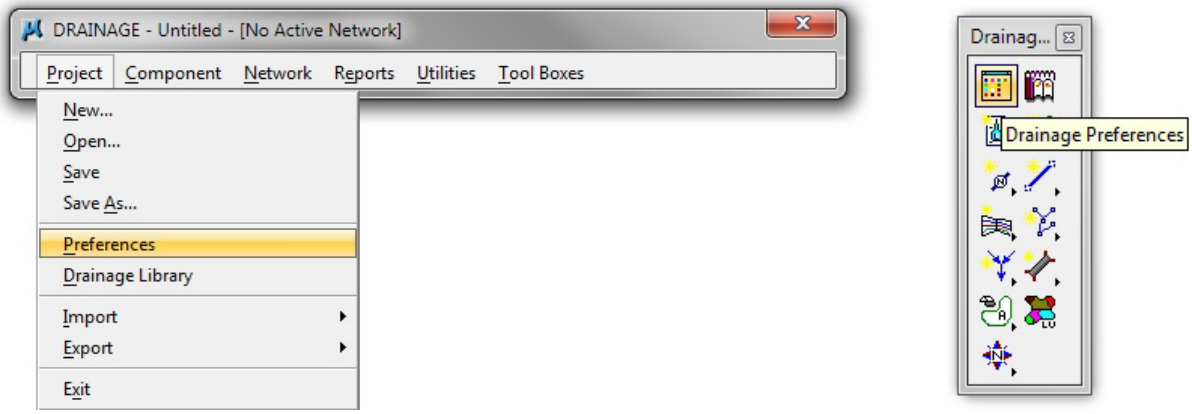


NOTE: Every time that you open GEOPAK Drainage, an untitled project will open. Therefore, you must go to **Project>Open** and select your project .gdf file every time you want to edit or continue working on a project.

1.6 Project 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.

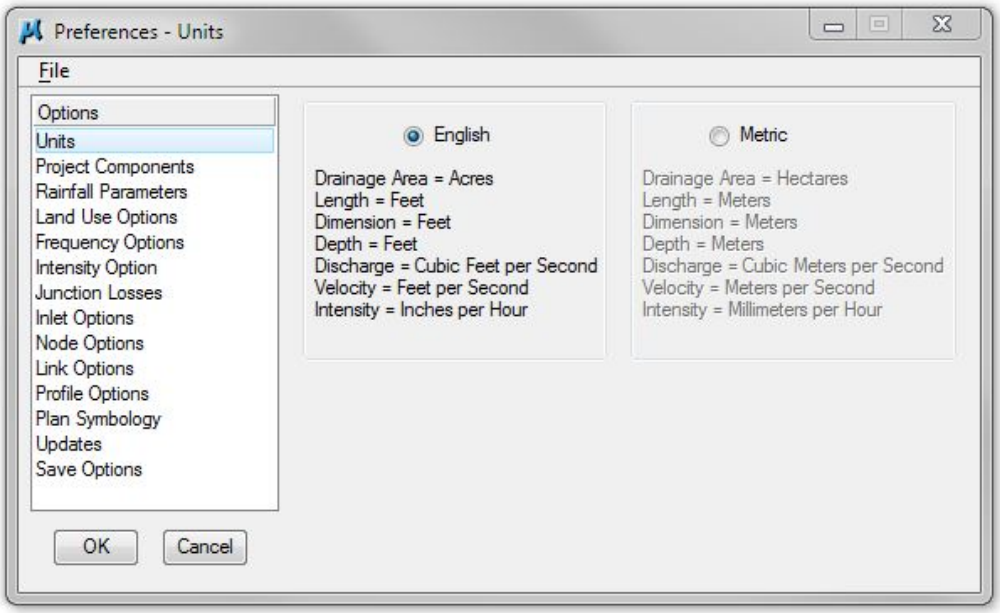
a) Select **Project > Preferences**.



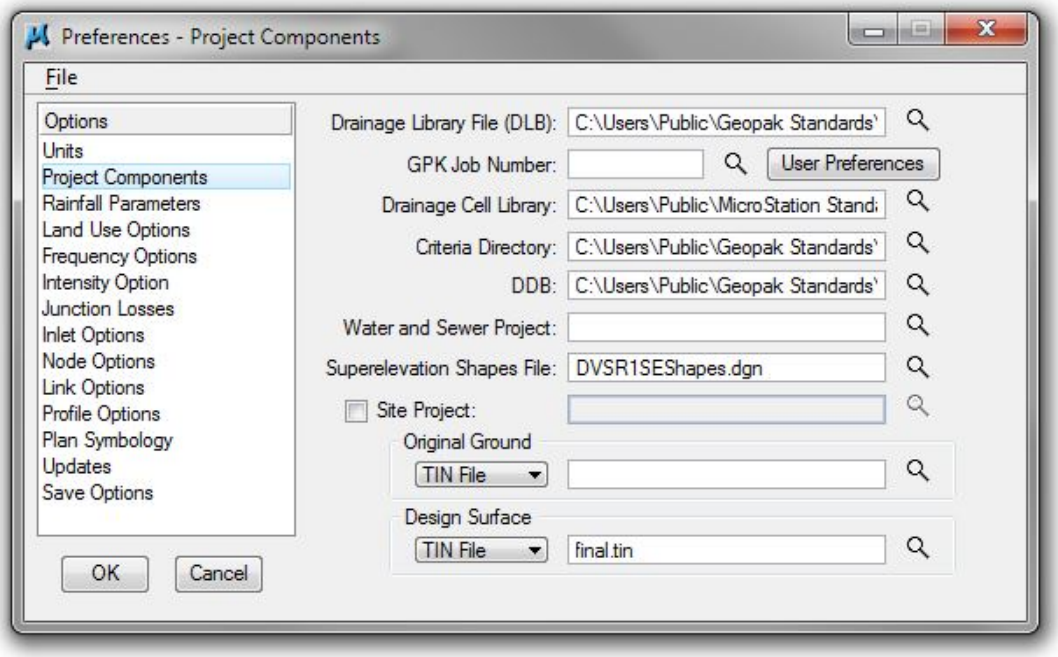
NOTE: Each Drainage Project should begin by copying the file in Step 1 of 1.4 into the project folder. This step automatically imports all needed preferences. If this step is missed, TDOT Standard Preferences may be loaded **after opening** the Preferences window and going to **File > Open** and navigating to the following file: **C:\Users\Public\Geopak Standards\TDOTdrainageprefs.dpf**

Review the Preferences by selecting each option in the column and reviewing the various options.

b) Units:



c) Project Components:



The following items are set to the defaults and NO CHANGES need to be made:

Drainage Library File (DLB) – C:\Users\Public\Geopak Standards\TDOTEnglish.dlb

User Preferences – These settings are already set for you for this exercise.

Drainage Cell Library - C:\Users\Public\MicroStation Standards\cell\STDS.CEL

Criteria Directory - C:\Users\Public\Geopak Standards\Criteria

GEOPAK DDB: C:\Users\Public\Geopak Standards\tdot.ddb

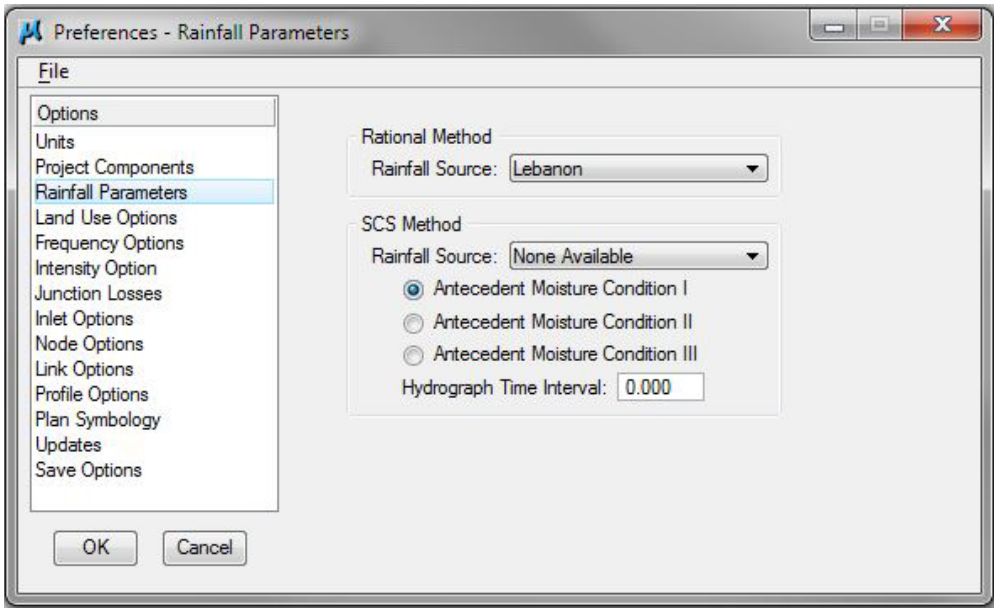
For each Library and Directory file location, select the explorer button and go to the following file locations:

GPK Job Number – Pick the GPK file and it will automatically set the correct number (this only happens if it goes to the correct User Preferences)

Superelevation Shapes File – Choose DVSR1SEShapes.dgn from the project directory

Design Surface – Choose final.tin from the project directory. This final tin is a combination of the proposed tin and existing tin. The final tin includes the proposed areas inside the slopes and the existing area outside the slopes. The tin file has been created for your use in class. Refer to the Geopak Road Course Guide Chapter 22 for instruction on how to create a final tin file for your project.

d) Rainfall Parameters:

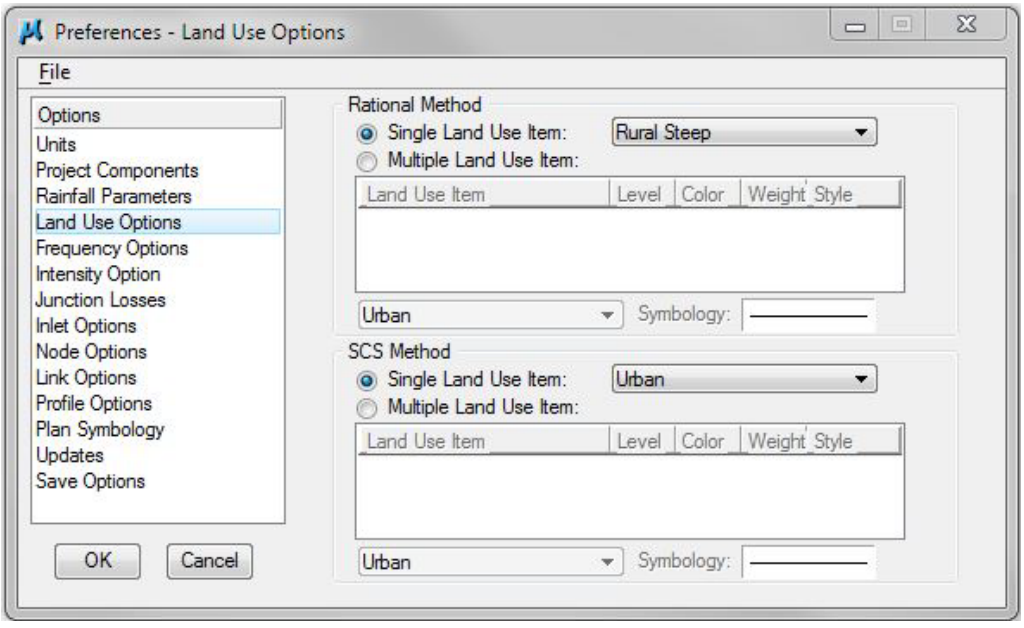


Select the appropriate rainfall source for the city closest to the project site.

See the TDOT Drainage Manual, Chapter 4, Figure 4A-1 or Appendix I.

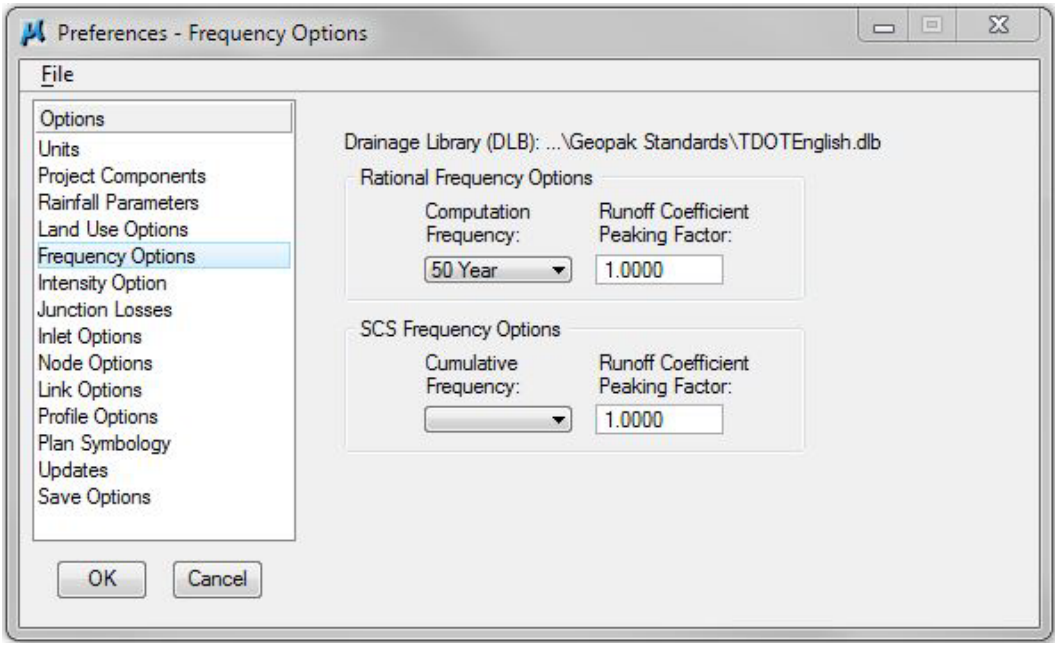
NOTE: The Tennessee Department of Transportation Roadway Design Division uses the Rational Method for drainage design.

e) Land Use Options:

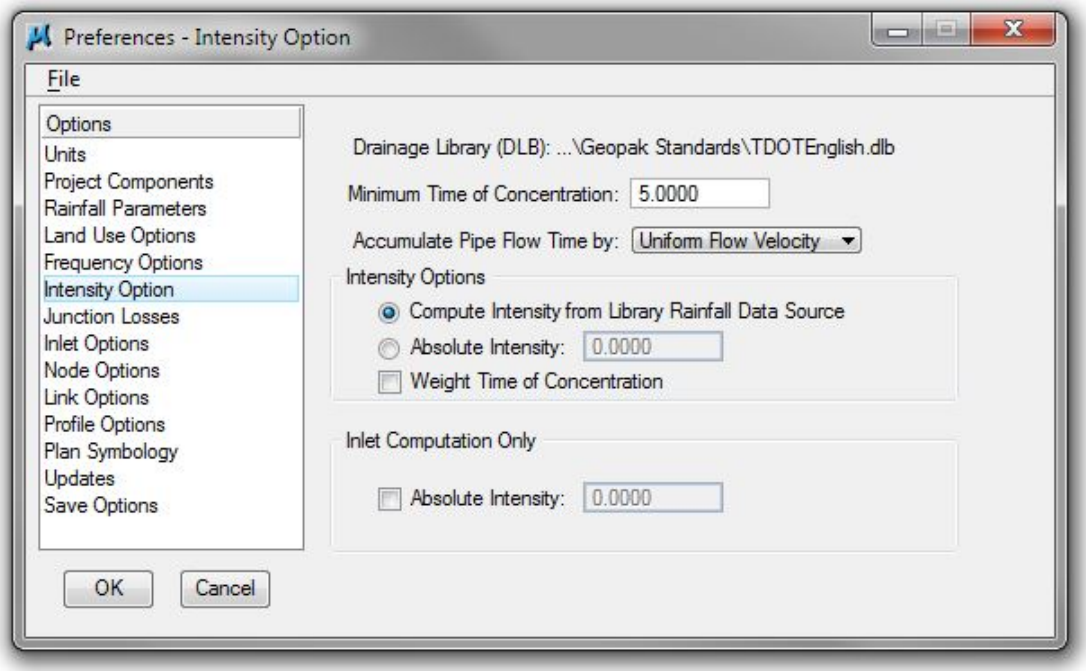


Set the Land Use Option to **Single Land Use Item: Rural Steep** for this class. The Roadway Design Division **does not** use the option for Multiple Land Use Items. All definitions for land use must come from a specific category.

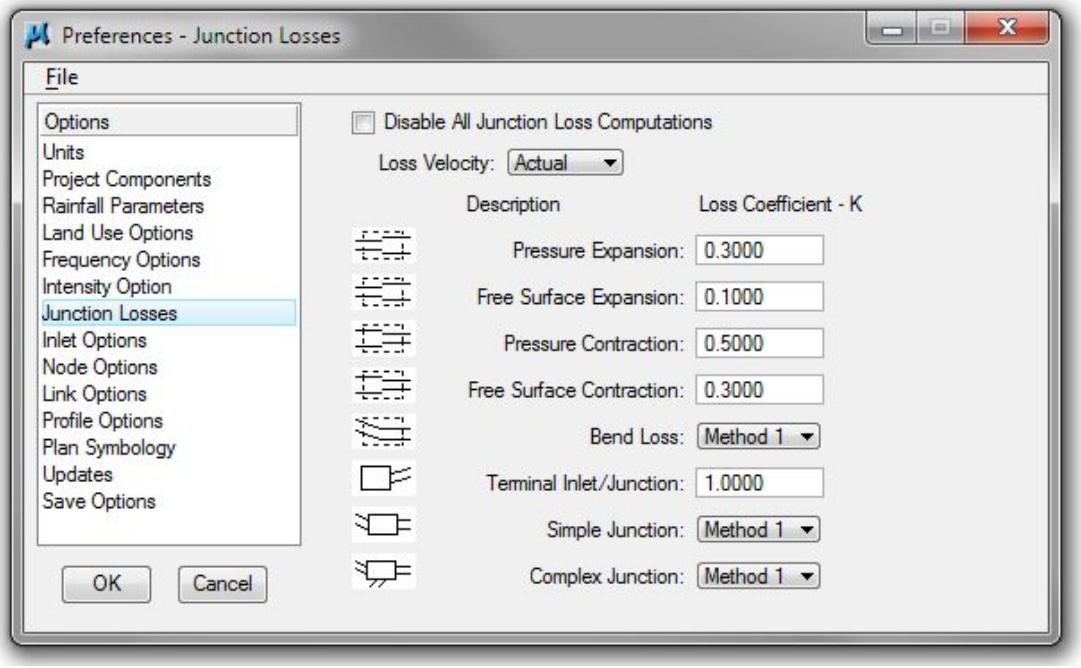
f) Frequency Options:



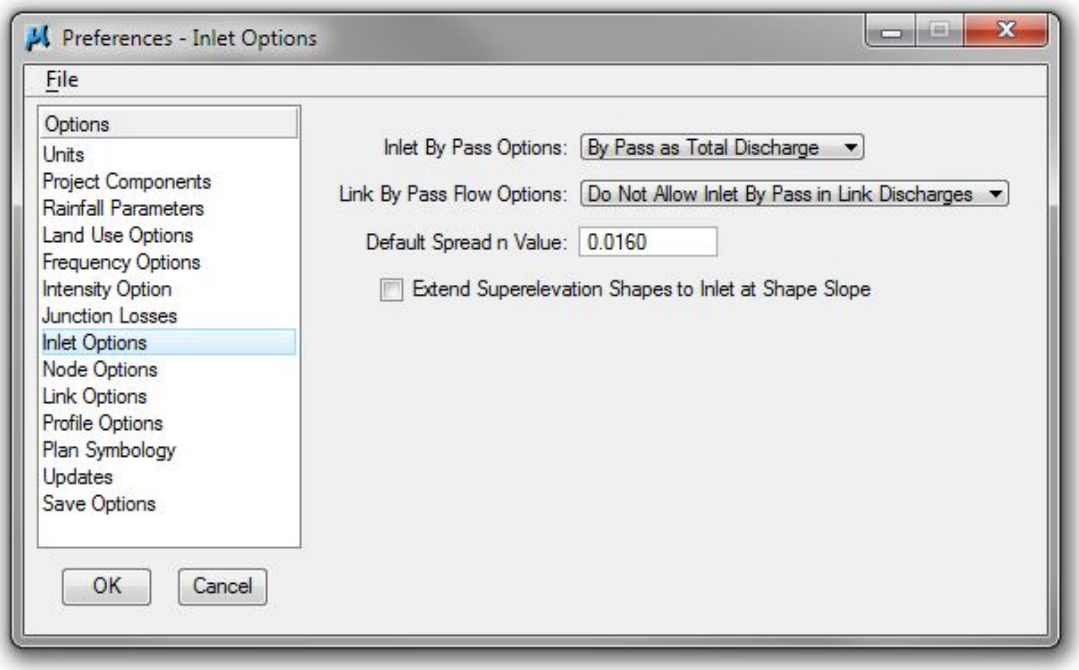
g) Intensity Options:



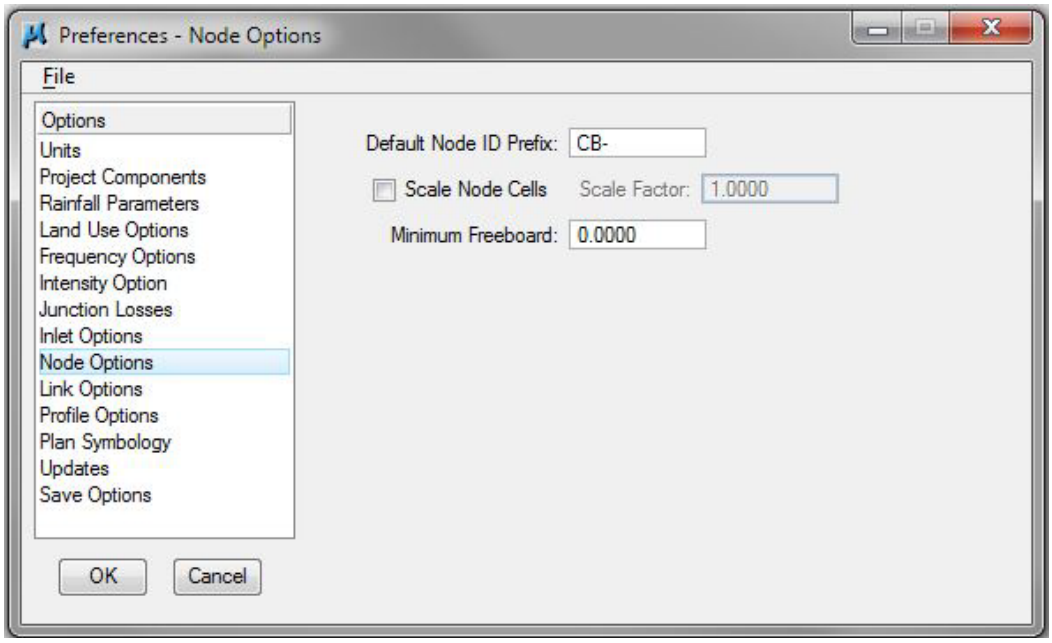
h) Junction Losses Options:



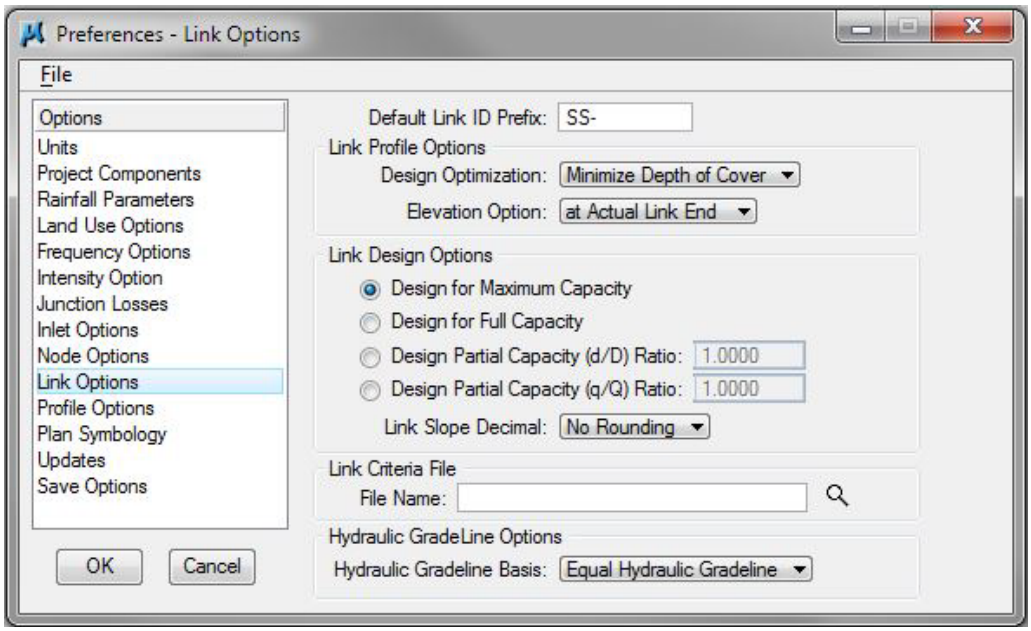
i) Inlet Options:



j) Node Options:



k) Link Options:



NOTE: Do **not** set the **Link Slope Decimal** to rounding. This setting is for control of Pipe Design not annotation. If set it will be impossible to design for minimum depth drainage structures.

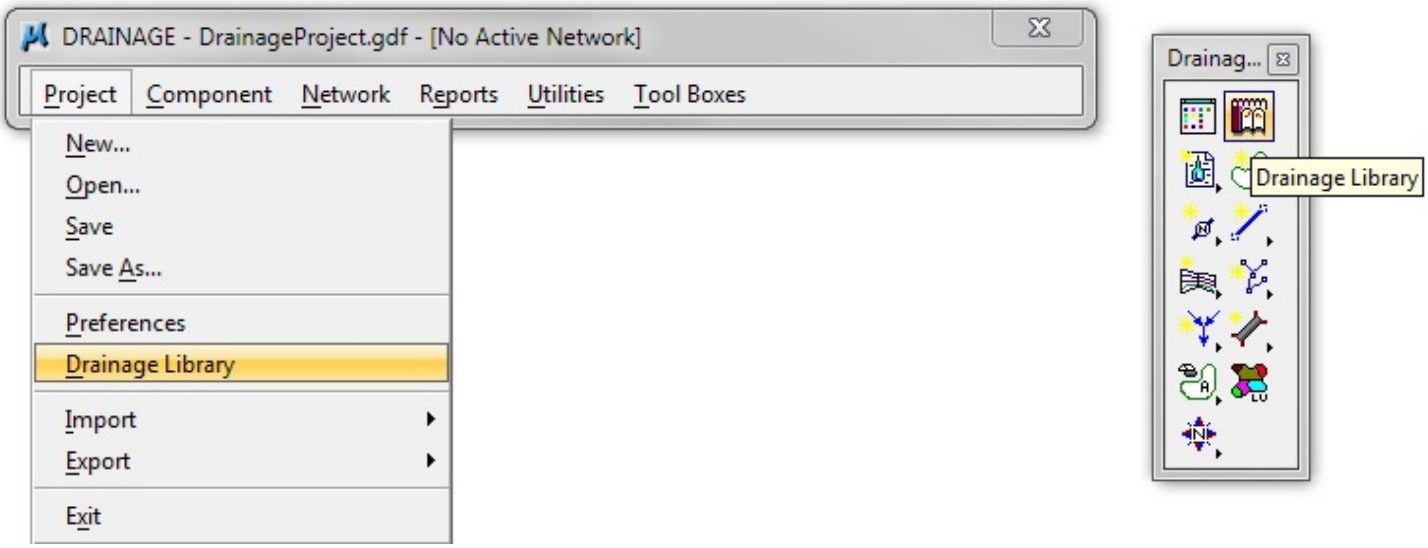
l) Profile Options, Plan Symbology, Updates and Save Options should be kept at the default settings. Do not make any changes.

m) Click **OK** to save changes and dismiss the dialog.

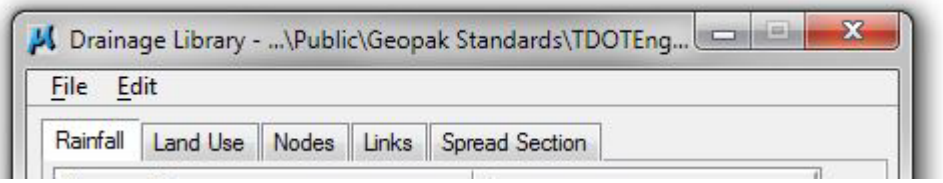
1.7 Drainage Library

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 the specific project.

a) Select **Project > Drainage Library**. The library stored in the Preferences will be opened by default.



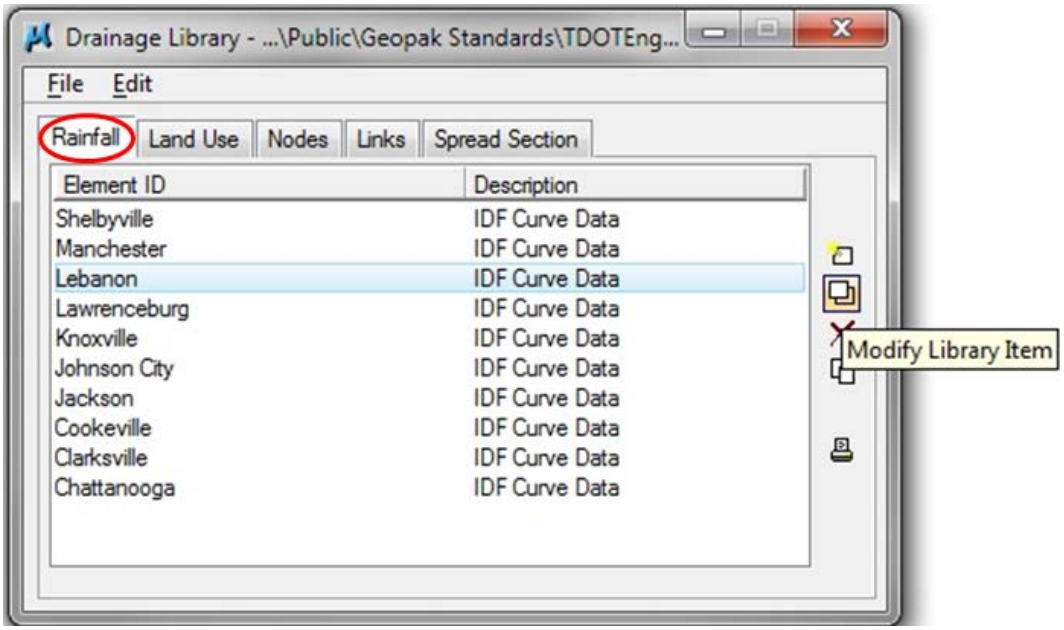
The Drainage Library currently contains five (5) tabs as shown below:



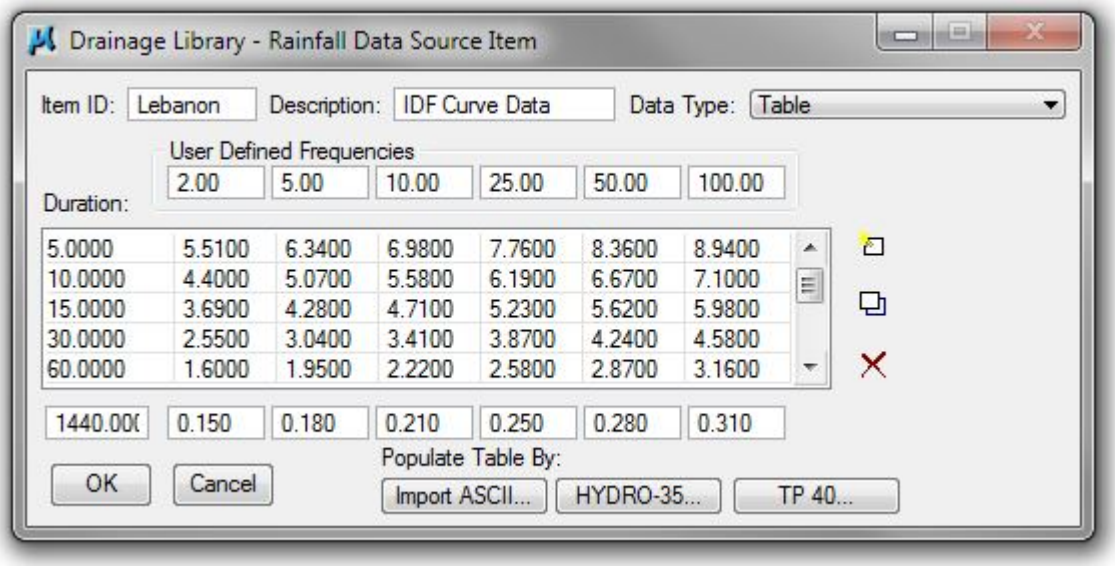
- **Rainfall** .. .. Rainfall Data Source
- **Land Use** ..... Land Uses, their corresponding “C” values and symbology
- **Nodes** ..... Inlets, Junctions, Manholes, Outlets, etc.
- **Links** ..... Circular Pipes, Elliptical Pipes, Pipe-Arch pipes, Boxes, etc.
- **Spread Section** ..... Inventory of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

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.

b) Select the **Rainfall** tab, highlight Lebanon, and select **Modify** to review the various options:



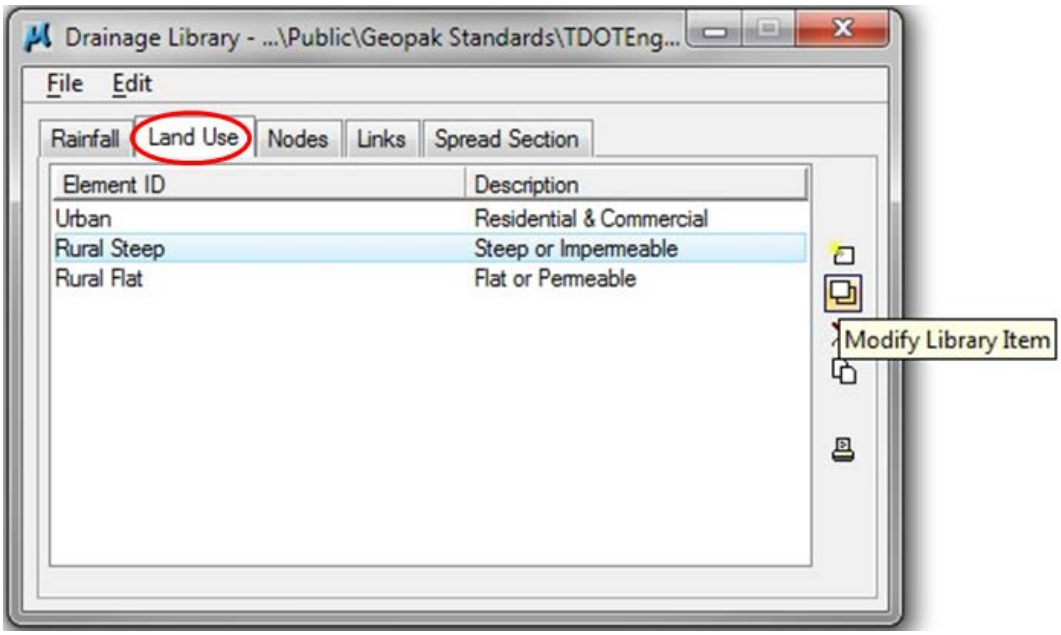
NOTE: See Appendix I for IDF Zone Location Map.

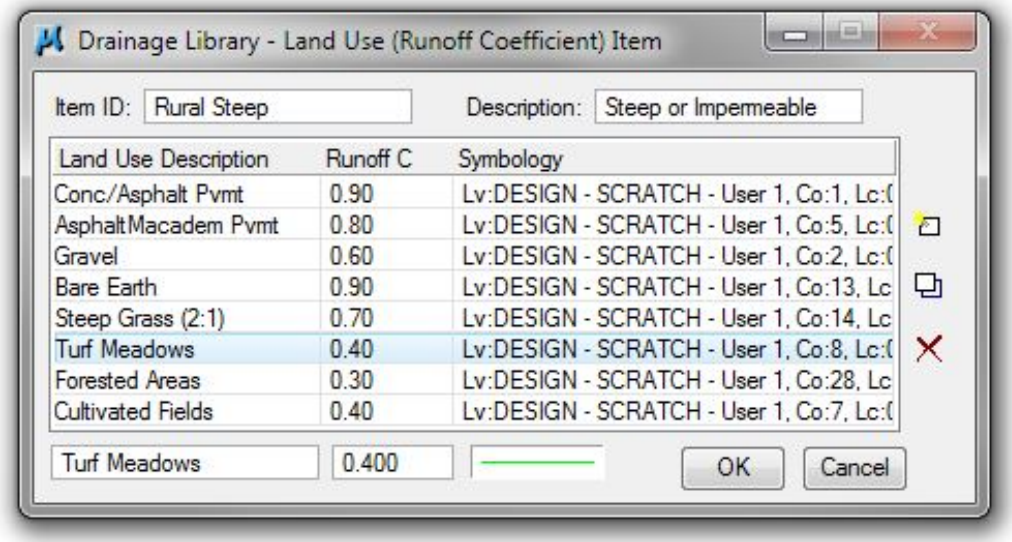


The table contains the Duration-Frequency Table for the Lebanon area.

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.

c) Select the **Land Use** tab, highlight the Rural Steep item and select **Modify** to review the various options:

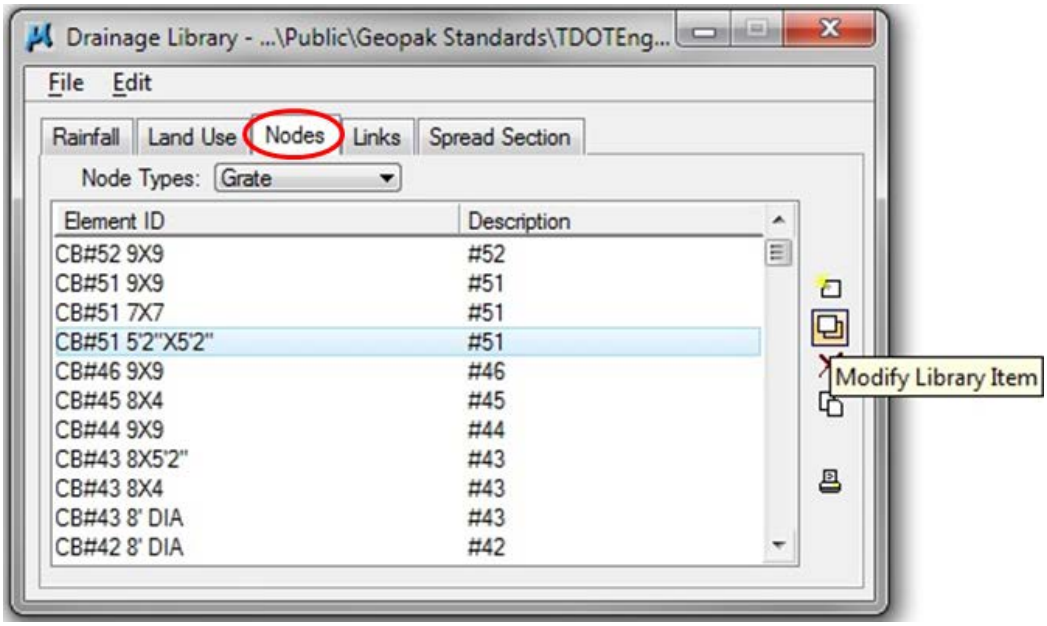


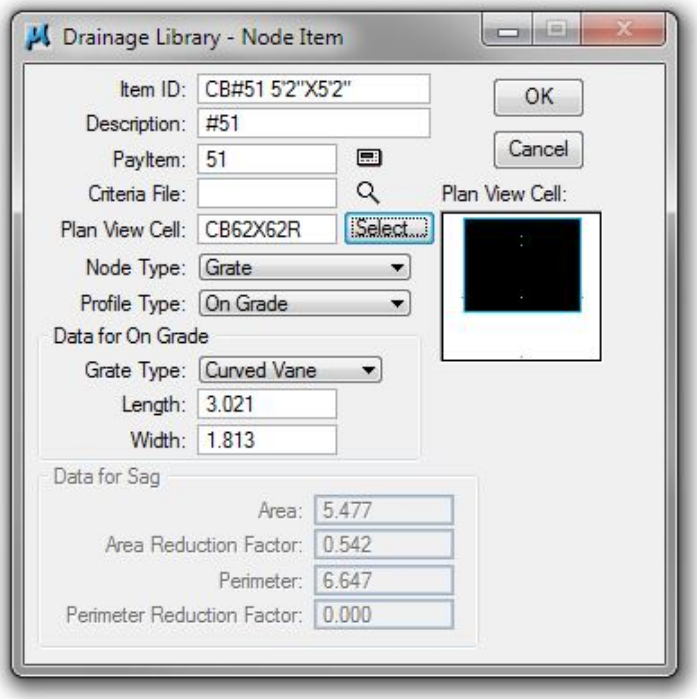


Note the various land uses and their associated symbology. Chapter 2 will discuss how to make a land use file.

The **Nodes** tab contains standard configurations for Grates, Curbs and Slotted drain inlets, as well as Junctions, Outlets and Other nodes. The description, plan view representation and dimensional information are stored for each node.

d) Select the **Nodes** tab, highlight a Grate inlet and select **Modify** to review the various options:

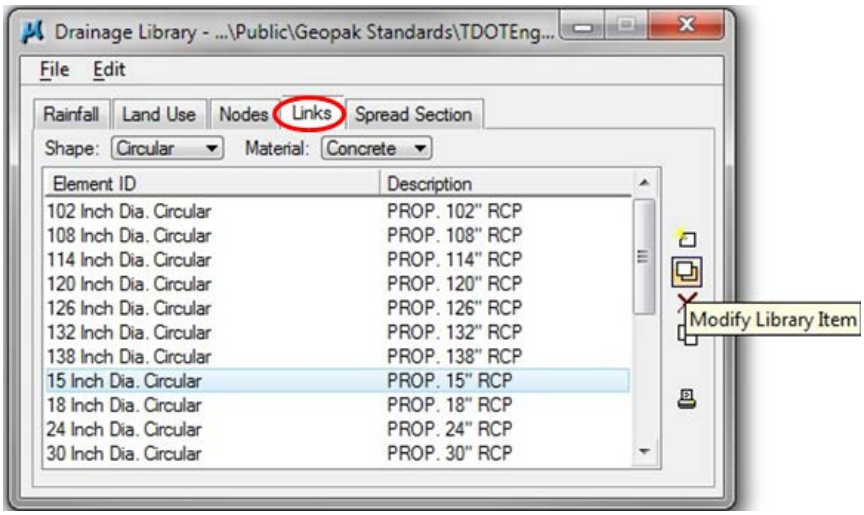


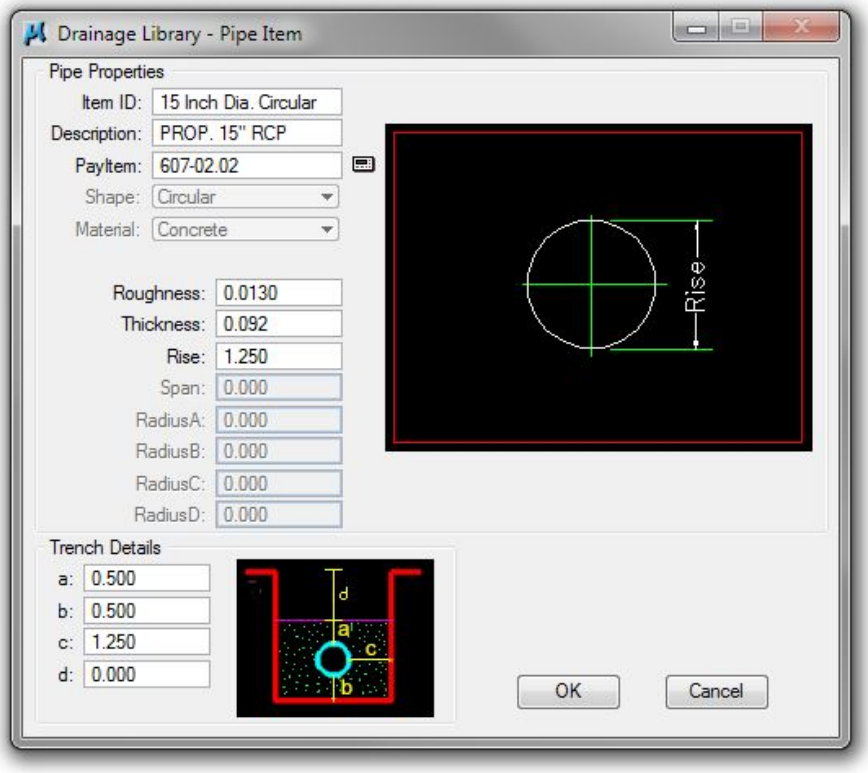


Note the various geometric values required for the nodes.

The **Links** tab contains all culverts to be used on drainage projects. Each link type is categorized by three properties: Shape, Material and Type (for some combinations of Shape & Material); and contains information regarding specific culvert geometry, default roughness coefficient and material combination.

e) Select the **Links** tab, select **Circular** from the Shape dialog box and **Concrete** from the Material dialog box. Highlight the first Circular Concrete pipe, and select **Modify** to review the various options:

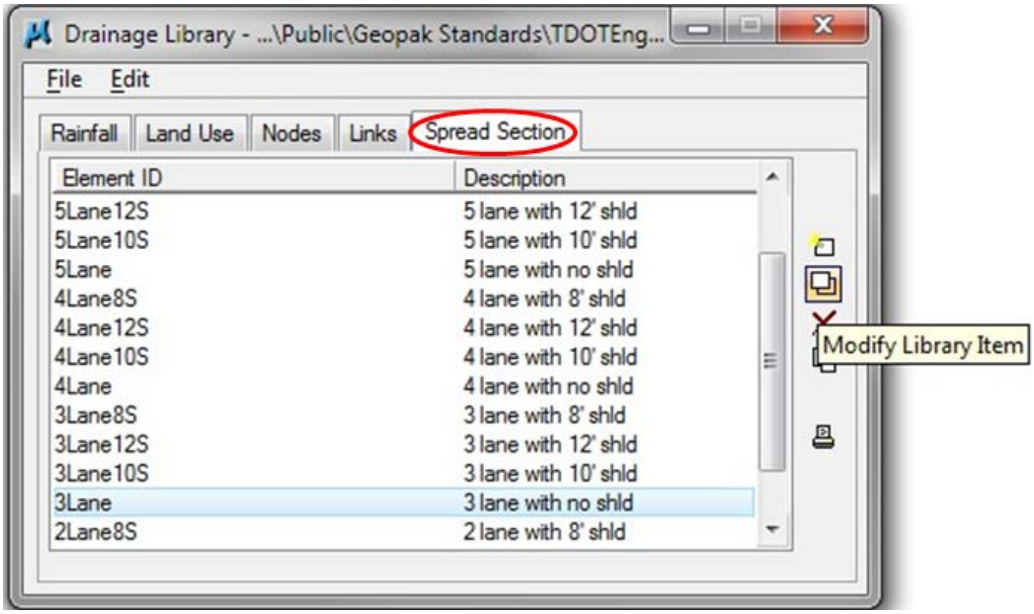


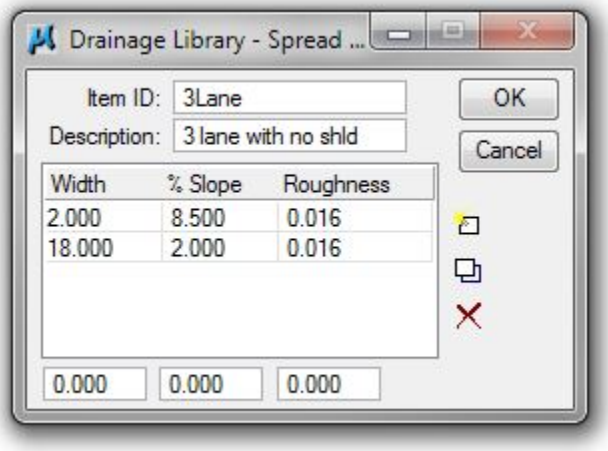


Note the various geometric values required for the links.

The **Spread Section** tab stores standard spread cross sections for roadway, shoulders and gutter that can be used on drainage projects.

f) Select the **Spread Section** tab, highlight any section, and select **Modify** to review the various options:





Note the spread cross section characteristics for the spread item.