State of Florida Department of Transportation

## FDOTConnect

# **OpenRoads Designer**

for

# Drainage Design & 3D Modeling with

## **Plans Development**

Training Guide 2021 PRODUCTION SUPPORT CADD OFFICE TALLAHASSEE, FLORIDA https://www.fdot.gov/cadd/

### FDOTConnect for OpenRoads Designer

### Drainage Design & 3D Modeling with Plans Development

#### **Description**

This course was developed to introduce the Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition tools for drainage design and modeling on Florida Department of Transportation (FDOT) projects. The curriculum was developed within the FDOTCONNECT Workspace to provide sample exercises for many of the Drainage Tools on a sample project data set. Participants of this course will be introduced to the newest OpenRoads environment and a Workflow for designing two dimensional (2D) Plans, Profiles, and three dimensional (3D) Models for drainage related Construction Deliverables.

#### **Objectives**

- Finding additional learning resources and training materials for OpenRoads Designer CONNECT Edition and the general process using Drainage and Utilities Workflow to design storm drain systems
- Various file types used within the Drainage and Utilities Workflow
- How to create and prepare a drainage file for design
- Navigating the interface for basic drainage tools and FDOT drainage components
- Delivered features and components within the FDOTCONNECT Drainage DGN library
- Laying out a simple network of inlets, pipes, and an outfall
- Tools to evaluate and edit drainage properties
- Creating a custom drainage feature
- Creating and assigning catchments to inlets
- Tools to define drainage design priorities and constraints
- Tools to review and evaluate hydraulic performance
- Producing a NexGen drainage structures sheet
- Producing a NexGen Summary of Drainage report (drainage quantities)
- Editing and exporting flex tables for drainage documentation

#### Audience

**HINT** FDOT Drainage Designers and Engineers

#### **Prerequisites**

Participants need to have a basic understanding of Computer Aided Drafting and Design (CADD) using MicroStation, a basic understanding of OpenRoads Designer CONNECT Edition - OpenRoads Technology tools and a solid understanding of the engineering necessary to design drainage improvements on a Roadway.

#### Duration: 16 Hours

#### Professional Credit Hours: 16 PDHs

*Note* PDH Credits will only be available with Instructor lead or Computer Based Training (CBT) thru Learning Curve.

## **Table of Contents**

T,	ABLE OF CONTENTS	I
F	DOT CONNECT WORKSPACE OVERVIEW	1
	INTRODUCTION	1
	EXPECTATIONS – WHAT THIS COURSE PROVIDES	3
	DOCUMENT STYLE	4
	FILE TYPES	5
	LEARNING RESOURCES	6
	COURSE SUPPORTING FILES	6
	INTRODUCING A NEW WORKSPACE	
	FDOTConnect Function Keys	
	FDOTCONNECT DRAINAGE DESIGN AND 3D MODELING OVERVIEW	
	General Workflow	
	RECOMMENDED MICROSTATION SETTINGS	
	Getting Started	
	Launching FDOTConnect for OpenRoads Designer	
	Menu Docking	
	Create a New DGN File	
	Navigating the Drainage and Utilities Workflow Ribbon	
	Navigating Project Explorer For Drainage	
	Create a New Utility Model	
1	DRAINAGE LIBRARY	1-1
	INTRODUCTION	1_1
	Feature Definitions	
	Symbology	
	Hydraulic Seed Data	
	Catalogs	
	Prototypes	
	Storm Data	
	Exercises	
	Exercise Overview – Existing Features ORD	
	Exercise 1.1 Explore Properties in Feature Definitions	
	Exercise 1.2 Review and Create a New Catchment Prototype	
	Exercise 1.3 Populate the IDF Table with NOAA Atlas 14 Data and Set the Global Storm Event	
2	LAYOUT TOOLS & PROFILE RUNS	2-1
		2.1
	Place Node	
	Place Conduit	
	Place Gutter	
	Place Catchment	
	Profile Runs	
	Exercises	
	Exercise Overview – Layout Tools & Profile Runs	
	Exercise 2.1 Attach References and Set Active Terrain	
	Exercise 2.2 Set View, Display, Window Settings	
	Exercise 2.3 Review Tools to Identify Drainage Patterns	
	Exercise 2.4 Review Civil Accudraw	
	Exercise 2.5 Place Node with Civil Accudraw	
	Exercise 2.6 Place Node (Outfall, no Civil Accudraw) Exercise 2.7 Place Conduit	
	Exercise 2.7 Place Conduit Exercise 2.8 Evaluate Nodes and Conduit in XS and 3D views. Adjust Elevations	
	Exercise 2.0 Place Catchment	

Exercise 2.10	0 Place Gutter	2-36
Exercise 2.1		
Exercise 2.12	2 Create a J-Bottom drainage structure Feature Definition	2-42
3 DESIGN AND ANA	ALYSIS	
	TRAINTS	-
	DS	
SCENARIOS		3-49
Alternatives		3-51
Active Topology	Alternative	3-51
User Data Extens	ions Alternative	3-52
Physical Alternat	ive	3-52
Boundary Condit	ion Alternatives	3-53
Output Alternativ	ves	3-53
	Iternatives	
	tive	
0	/e	
Calculation Option	ns	3-56
CALCULATION AND ANA	LYSIS	3-59
Validate		3-59
Notifications		3-59
•		
•	nary	
•		
•	del	
	ofile	
	g Profile	
	v – Design & Analysis	
Exercise 3.1	Review and Set Default Design Constraints	
Exercise 3.2	Create a new Engineering Standard	
Exercise 3.3	Create a new Analysis Scenario with adjusted Alternatives	
Exercise 3.4	Explore Compute Center, Validate model, resolve Notifications, and Compute Scena	
Exercise 3.5	Review Results in Flex Tables	
Exercise 3.6	Review Results in Analytic Profiles	
4 PLAN DEVELOPM	ENT WORKFLOW FOR DRAINAGE STRUCTURES SHEETS	4-82
INTRODUCTION		
	D SHEET CUTTING	-
	es list box	-
	rs from Named Boundaries	
	nces	
		-
	LING	
Cell		
	1	-
Annotation Grou	ps	
TABLES		4-88
User Data Extensi	ons	4-89
EXERCISES		4-90
Exercise Overview	v – Plan Development	
Exercise 4.1	•	

	Exercise 4.3	Place Drainage Labels in Plan	
	Exercise 4.4	Place Tables	4-101
5	DRAINAGE QUANT	TIES	5-104
	INTRODUCTION		5-104
	ITEM TYPES		5-104
	FDOTProject.xlsm		5-105
	Asset Manager too	۱	5-106
	FDOT QUANTITY TAKEOF	F MANAGER	5-107
	EXERCISES		5-109
	Exercise Overview -	– Drainage Quantities	5-109
	Exercise 5.1	Explore Item Types Manager for Drainage	5-110
	Exercise 5.2	Generate Pay Item Numbers for sample drainage structures	
	Exercise 5.3	Attach Item Types to sample pipes and generate Pay Item Numbers	
	Exercise 5.4	Create a Selection Set	
	Exercise 5.5	Attach alignment information for quantities	
	Exercise 5.6	Use Takeoff Manager to generate Summary of Drainage table	
	Exercise 5.7	Explore Items in Project Explorer and delete strays	
6	DRAINAGE DOCUN	/ENTATION	6-123
	INTRODUCTION		6-123
	HYDRAULIC MODEL PROP	PERTIES	6-124
	REPORTS		6-124
	Hydraulic Model In	ventory:	6-125
	Calculation Summa	זרy:	6-125
	TABLES		6-127
	OpenRoads Tables:		6-127
	FDOT Flex Tables:		6-129
	•		
		rmTab:	
		- Drainage Documentation	
		Complete the Hydraulic Model Properties	
	Exercise 6.2 Exercise 6.3	Compute Center: Review Properties and Run Analysis Scenario (Zone 2 – 3 Year) Export a Hydraulic Model Inventory Report to Excel	
	Exercise 6.4	Copy/Paste Global Storm Events data to Excel	
	Exercise 6.5	Export FDOT Flex Tables to Excel	
	Exercise 6.6	Compute Center: Run 4 in/hr Absolute Intensity (Spread Only) Scenario	
	Exercise 6.7	Export FDOT-Spread Flex Table to Excel	
	Exercise 6.8	Create FDOT storm drain documentation sheet and place labels	
	Exercise 6.9	Place Tables, from Excel, in FDOT Storm Drain Documentation Sheet	6-153
7	ADVANCED TOPICS	S	7-156
	UNDER DEVELOPMENT:		
8	FREQUENTLY ASKE	D QUESTIONS	8-157
	DGNLIB		8-157
	Hydraulic Seed Dat	a	8-157
		·	
	LAYOUT		
	Nodes		8-158

-158
-159
-159
-159
-159
-159
-160
-160
-160
-160

#### [PAGE INTENTIONALLY LEFT BLANK.]

## FDOT CONNECT WORKSPACE OVERVIEW

This course was developed to introduce the Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition tools for drainage design and modeling on Florida Department of Transportation (FDOT) projects. The curriculum was developed within the FDOTCONNECT Workspace to provide sample exercises for many of the Drainage Tools on a sample project data set.

#### INTRODUCTION

OpenRoads Designer CONNECT Edition - Drainage and Utilities Workflow is a comprehensive application 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 Drainage model may contain multiple drainage network and scenarios; each comprised of any number of topologically connected drainage areas, inlets, pipes and ditches. The Drainage and Utilities workflow closely mirrors conventional design processes allowing for the design of the surface collection system (i.e. drainage areas, inlets) and then the design of the subsequent conveyance system (i.e. pipes, ditches).

OpenRoads Drainage & Utilities 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 flex table reports can be generated to provide hard copy outputs.

Roadway alignments and digital terrain models created as part of the design process may be used throughout Drainage & Utilities to provide pertinent information to the drainage design. All drainage components feature interactive graphical placement tools for easy spatial definition of the drainage system. Visualization tools in OpenRoads Drainage & Utilities for networks, drainage components, and computations allow for immediate evaluation of the drainage system.

OpenRoads Drainage & Utilities 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 Federal Highway Administration (FHWA) publication "Drainage of Highway Pavements" as well as the procedures in the American Association of State Highway and Transportation Officials (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. The Department's Intensity-Duration-Frequency curves are included in the Department's DGNLib discussed later in this manual. Drainage area delineation tools allow easy creation of contributing areas and the graphical assignment of these to drainage features.

Inlet design and analysis capabilities include Curb, Slotted Drain, and Grate inlets both on grade and in a sump. The Department's common inlets are included in the Department's DGNLib discussed later in this manual. Inlets may also be designed or analyzed with gutter bypass flows from one inlet to another, including gutter bypass flows between inlets of different networks.

Most standard pipe configurations may be designed and analyzed including box, circular, elliptical and pipe arches. The Department's most common pipe and box culvert shapes and materials are included in the DGNLib, discussed later in this manual. Pipe design selections may be optimized to meet a number of definable constraints. 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.

Participants of this course will be introduced to the newest OpenRoads environment and a Workflow for designing two dimensional (2D) Plans, Profiles, and three dimensional (3D) Models for drainage related Construction Deliverables. At successful completion they will have learned about:

- Finding additional learning resources and training materials for OpenRoads Designer CONNECT Edition and the general process using Drainage and Utilities Workflow to design storm drain systems
- Various file types used within the Drainage and Utilities Workflow

- How to create and prepare a drainage file for design
- Navigating the interface for basic drainage tools and FDOT drainage components
- Delivered features and components within the FDOTCONNECT Drainage DGN library
- Laying out a simple network of inlets, pipes, and an outfall
- Tools to evaluate and edit drainage properties
- Creating a custom drainage feature
- Creating and assigning catchments to inlets
- Tools to define drainage design priorities and constraints
- Tools to review and evaluate hydraulic performance
- Producing a NexGen drainage structures sheet
- Producing a NexGen Summary of Drainage report (drainage quantities)
- Editing and exporting flex tables for drainage documentation

#### **EXPECTATIONS – WHAT THIS COURSE PROVIDES**

This course serves three primary functions. It is a training manual for instructor lead training, a user's manual for designers and technicians, and a technical reference.

The Florida Department of Transportation (FDOT) standards for drainage design are provided in the Drainage Manual. Guidelines for drainage design are provided in the Drainage Design Guide. The FDOT Design Manual and CADD Manual provide the standards for preparing the construction plan sets. Suggestions or preferred approaches for how to best use the Drainage and Utilities Workflow tools to comply with the Department's CADD standards and guidelines are included in this document, where appropriate. Although this course references key tools in the drainage design and plans preparation process for FDOT projects, it does not replace the need for professional engineering judgement or prelude the use of other information.

This course provides a standard workflow for drainage design with Bentley Systems OpenRoads Designer CONNECT Edition – Drainage and Utilities Workflow within the FDOTCONNECT Workspace. While many tools are used throughout, this course does not provide a description of every Bentley Systems OpenRoads Designer CONNECT Edition Drainage and Utilities tool. Where applicable, this guide documents supplemental descriptions of FDOT-specific content, tools, and methodology.

#### **DOCUMENT STYLE**

Item	Convention		Example
Menu names and commands	Bold N (Names separated with > symbol)	•	File > Open File > ComSelect > Design
Dialog box Actions	Bold	•	Click the <b>Apply</b> button. Click the <b>Graphic Select</b> button to the right of the <i>Horizontal Alignment Include</i> box. In the <i>Segment Type</i> list, click <b>Lines</b> .
Dialog box Field Names	Italic	•	Key in <b>Hemfield Road</b> in the <i>Alignment</i> <i>Name</i> field. Click the <b>Graphic Select</b> button to the right of the <i>Horizontal Alignment Include</i> field. In the <i>Segment Type</i> list, click <b>Lines</b> .
Key-ins	Bold	•	Key in <b>Hemfield Road</b> in the <i>Alignment Name</i> field.
File Names	Italic	•	Open the file <i>ALGNRD01.dgn</i> in the C:\WorkSets\FDOT\22049555201\Roadway.
File Paths	Non italic	•	Open the file <i>_Blank.dgn</i> in the C:\WorkSets\FDOT\22049555201
New Terms or Emphasis	Italic	•	The Template Library contains <i>templates,</i> which represent typical sections of the proposed roadway.

Style conventions used throughout the course guide are shown in the following table.

Additionally, a new workflow terminology using the Ribbon is used throughout the course guide. If you see a direction like this:

DRAINAGE AND UTILITIES > LAYOUT > LAYOUT > Place Node

This means we are in the **WorkFlow** of **Drainage and Utilities** which has a **Tab** named **Layout** and has tools that are located in the **Layout Group**. Now that we are in the right workflow, Tab and Group we may need to click on a tool that has more than one option.

#### **FILE TYPES**

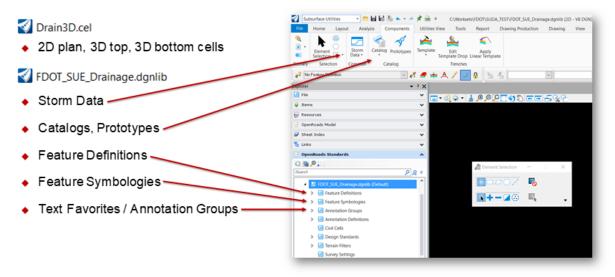
The Bentley Systems OpenRoads drainage design process now uses a single source file type, the MicroStation Design *DGN* file. All pertinent design data is stored in the design file. This information can be viewed through the Project Explorer and reported on through flex tables and other report tools.

The FDOT Connect Workspace is delivered with supporting library files containing the Department's CADD standards and hydraulic seed data: the DGN Library (\*.dgnlib), and the MicroStation Cell Library (\*.cel). Below are brief descriptions of these file types.

File Type Description:

- <u>MicroStation Design File (\*.dgn)</u> This file is utilized for the visualization of the drainage project and definition of certain drainage features using MicroStation graphic elements. When the designer initiates the Drainage & Utilities tools, the DGN Library hydraulic seed data will be referenced by the design file. Subsequently, as drainage components are placed, the. DGN model automatically populates hydraulic properties from the DGN Library and drainage structure geometry from the Cell Library into the design file. All the design data is stored within the design dgn file and database attributes are attached to the 2D graphics. As the designer places components in the 2D model, Drainage & Utilities creates the 3D model elements in the dgn simultaneously.
- <u>DGN Library (\*.dgnlib)</u> The feature definitions, symbology, and hydraulic seed data for drainage design and modeling are stored in DGN libraries. The DGN Library is utilized for numerous projects, as it contains the standards for an entire organization. The DGN Library contains the storm data, hydraulic settings, standard inlet types, standard pipes configurations, spread sections, and land cover tables. These items are used by each project to accommodate standardization and information sharing among projects. The Department provides a DGN Library with the CADD deliverables.
- <u>Drainage Cell Library (\*.cel)</u> Drainage cells are the 2D and 3D views of the Department's drainage structures such as inlets and manholes. The Cell Library contains the commonly used structures. The Nodes used in the DGN Library refer to appropriate cells in the Cell Library. The Department provides a Cell Library with the CADD deliverables.

Currently, there is not a tool to import legacy Select Series GEOPAK Drainage files directly into an OpenRoads drainage model, DGN file from Bentley and FDOT is not developing a utility.



#### **LEARNING RESOURCES**

For optimized use of this manual, it is recommended that new OpenRoads users engage with the Bentley LEARNserver and Online Help as needed to become familiar with the OpenRoads environment and tools.

There are several resources available for learning about the various Bentley Systems OpenRoads Designer CONNECT edition Drainage and Utilities tools. Among them are:

• Bentley Learn:

Bentley Institute site is for registered user and may require a Select Server site license to participate: https://learn.bentley.com

Bentley Product Line: OpenRoads Designer:

09 - OpenRoads Designer - Drainage & Utilities - Fundamentals

10 - OpenRoads Designer - Drainage - Intermediate

• Bentley Product Documentation: Drainage and Utilities CONNECT Edition Help:

https://docs.bentley.com/LiveContent/web/Drainage%20and%20Utilities%20CONNECT%20Edition%20Help-v3/en/GUID-288FAFD8-1107-4FCB-9843-8BECC9099A06.html

Bentley Communities:

https://communities.bentley.com/products/road\_\_\_site\_design/w/road\_and\_site\_design\_\_wiki/38322/drain age-and-utilities

• YouTube Search - Google:

Bentley OpenRoads Drainage returns several sites with videos for learning how to apply the technology on project specific situations.

Production Support Office | CADD (CADD) Website: <u>http://www.fdot.gov/cadd/</u>

Webinar training recordings are available on many of the subjects covered in this manual:

http://www.fdot.gov/cadd/main/FDOTCaddTraining.shtm

http://www.fdot.gov/cadd/downloads/webinars/Posted.shtm#loadSection

https://www.youtube.com/channel/UCqbY8kqZuXp1pyYV6lIQw\_A

#### **COURSE SUPPORTING FILES**

The exercises for each chapter are independent of one another and can be used without having to complete the exercises in previous modules. The exercise files are organized into separate completed Selected zip files for each chapter. All files used in this course are located also at this link:

https://www.fdot.gov/cadd/main/fdotcaddtraining.shtm

#### INTRODUCING A NEW WORKSPACE

The following are some of the FDOTCONNECT workspace settings that will be used during this course. Additional information can be found within the FDOTCONNECT for OpenRoads Designer 2D Design & 3D Modeling with Plans Development Training Guide

#### **FDOTCONNECT FUNCTION KEYS**

F	DOTCONNECT Function Key Assignments
F1	Opens the OpenRoads Designer On-line Help. Ctrl+F1 Closes all Views except View 1
F2	Open View 1 (2D Plan) and View 2 (3D Isometric) and fits both views.
F3	Opens View 3 (2D Plan), closes all View 4, and arranges all Views.
F4	Open View 1 (2D Plan), View 2 (3D Isometric), View 1 (2D Plan), View 1 (2D Plan) & Fits All views
F5	Toggles Dim References ON/OFF
F6 Resets out of any ongoing commands.	
F7	Toggles the Construction view attribute ON/OFF.
F8 Toggles between MicroStation AccuDraw and Civil AccuDraw.	
F9	Toggles (opens or closes) the Reference dialog.
F10	Toggles (opens or closes) the Level Display dialog.
F11	Toggles (opens or closes) the Project Explorer dialog.
F12	Opens the Create Template dialog.

Sunction Keys:\	Preference Seeds\FDOT_ORD_FKEY.mnu	$\times$		
1				
Function Keys				
	<u>l</u> t <u>S</u> hift F1 ▼			
Key: F1 Action: help				
Кеу	Action	^		
F1	help			
F2	vba run [ViewSet] Module1.TwoView3D			
F3 view on 3; view off 4; window arrange				
F4 vba run [ViewSet] Module1.FourView				
F5	vba run [ViewSet] Module1.SetActiveModelToDrawLast			
F6	choose none			
F7	vba run [ViewSet] Module1.ToggleViewConstructions;			
F8	vba run [AccuDraw] Toggle.ToggleOnOff			
F9	dialog reference toggle			
F10	leveldisplay dialog toggle			
F11	dialog explorer toggle			
F12	corridor templatelibrary open	$\mathbf{v}$		
<	>			
	Save Cancel			

#### FDOTCONNECT DRAINAGE DESIGN AND 3D MODELING OVERVIEW

#### **GENERAL WORKFLOW**

The design of a storm drain system is usually an iterative process. Inlets locations and pipe sizes are selected. The designer checks if the system meets the Department's criteria and changes pipe sizes and other items as needed. The need to check if the system meets criteria is not avoided by using OpenRoads Drainage & Utilities. This document describes several ways that designers can use Drainage & Utilities to check and identify where the system need to be changed. The following is a general outline for creating storm drain systems in Drainage & Utilities, detailed in other chapters.

- 1. Start New Project file (.dgn) by using the FDOT Create file tool.
- 2. Select Inlet Locations and Types from Feature Definitions.
- 3. Define Area to each Node.
- 4. Link Inlets Together with Pipe (Conduit) Segments.
- 5. Identify Hydraulic Run of Pipes and Inlets.
- 6. Use Drainage & Utilities to Design System.
- 7. Check Design to meet Criteria.
- 8. Edit System, Re-compute Hydraulics and Check if Criteria are met.
- 9. Add J-structure Bottoms (if appropriate) for Large or Skewed Pipes.

- 10. Print Storm Drain Tabulation Form.
- 11. Prepare Construction Deliverables.

#### **RECOMMENDED MICROSTATION SETTINGS**

Various tools and settings will be used throughout the workshop. Therefore for quick accessibility, several of the dialogs are better docked on the sides the MicroStation view.

#### GETTING STARTED

#### LAUNCHING FDOTCONNECT FOR OPENROADS DESIGNER

FDOTCONNECT can be launched from the FDOT – Roadway and FDOT – ROW icons located in the FDOTCONNECT folder on your desktop. The first time it is launched, it is important to select the FDOT workspace from the workspace dropdown.

1. Find the FDOT Connect launch icons on your desktop or locate the "FDOTCONNECT" folder on your desktop.



2. Launch FDOTCONNECT for OpenRoads Designer by double-clicking one of the FDOT icons. Note that your FDOTCONNECT launch icons will vary depending on which Bentley Connect Edition platforms you have installed. FDOTCONNECT will create an icon for OpenRoads Designer, an icon for MicroStation Connect Edition (MSCE), and an icon for OpenBridge Modeler (OBM) depending on which of these applications is present on your machine during installation of the Workstation or Client.

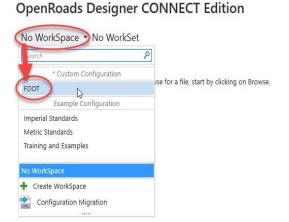


3. In the Workspace/Workset select screen of OpenRoads Designer, select the Workspace selection drop-down menu by clicking on "No Workspace."

#### **OpenRoads Designer CONNECT Edition**

No WorkSpace	• No WorkS	et
Recent Files		
You haven't opened	any files recently.	To browse for a file, start by clicking on Browse.
Browse	New File	

4. Select "FDOT" from the drop-down menu to select the FDOTCONNECT workspace.



5. From here, you can now create a new WorkSet. This is done by selecting the drop-down menu, being sure to select the FDOT's "0\_WORKSET\_TEMPLATE" as the workset template.

P	
start by clicking on I	8rowse
	start by clicking on i

**OpenRoads Designer CONNECT Edition** 

6. Click "OK" after filling in the Create Workset dialog.

Name:	NEW_TEST_WORKSET	
Description:	New Test Workset for Installation Guide Example	
Template:	0_WORKSET_TEMPLATE	Folders Only
Add a Custom Property 🔹		
older locations		
Root Folder:		
Design Files:		
Standard Files:		
Standards Subfolders:		
CONNECTED Project		

- 7. After creating a new project using the FDOT Workset Template, you can create new files using the FDOT Create File tool. This tool is launched from within the FDOTCONNECT workspace, so you must first open a file. The FDOT Workset template includes a blank starting file from which to launch the Create File tool.
- 8. From the OpenRoads Designer file open dialog, select "Browse" to browse the contents of your new workset.

FDOT • NEW_TES	T_WORKSET *	
Recent Files		
You haven't opened any	files recently. To browse for a file, start by clickin	ig on Browse.

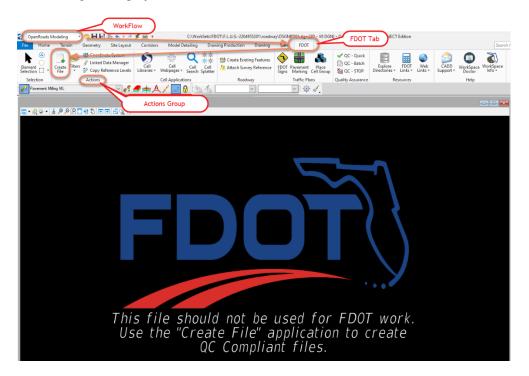
OpenRoads Designer CONNECT Edition

9. Locate "\_Blankfile.dgn" at the root of your workset folder structure. Select this file and then select "OPEN" to open it.

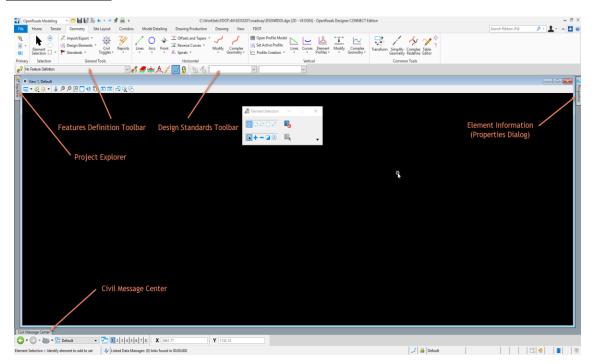
- → · · ↑ 📙 « Worksets → FDOT > NEW_TEST_WC	RKSET > > > > > > > > > > > > > > > > > > >	Q
Organize 👻 New folder		0
Desktop 🖈 ^ Name	Date modified Type	Size
👃 Downloads 🖈 🔤 🧧 Preestim	7/24/2019 3:59 PM File folder	
🖗 Documents 🖈 🔤 roadway	7/24/2019 4:49 PM File folder	
E Pictures 🖈 🔤 rwmap	7/24/2019 3:59 PM File folder	
Configuration	7/24/2019 3:59 PM File folder	
signals	7/24/2019 3:59 PM File folder	
FDOT Microstati signing	7/24/2019 3:59 PM File folder	
roadway specs	7/24/2019 3:59 PM File folder	
👩 Users 🔤 Standards	7/24/2019 3:59 PM File folder	
This PC	7/24/2019 3:59 PM File folder	
survey	7/24/2019 3:59 PM File folder	
I 3D Objects symb	7/24/2019 3:59 PM File folder	
Desktop TrafOps	7/24/2019 3:59 PM File folder	
🗄 Documents	7/24/2019 3:59 PM File folder	
Downloads	7/24/2019 3:59 PM Bentley MicroStati	
Music V		>
File 🔻	Directory -	
File name:BlankFile.dgn	CAD Files (*.dqn;*.dwg;*.dxf)	~

10. When the FDOTCONNECT Workspace opens, you can locate the FDOT ribbon by selecting the "OpenRoads Modeling" workflow from the menu at the top left of the screen. The FDOT

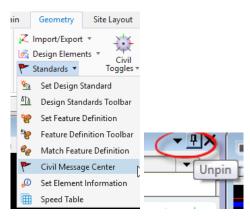
tab is located at the far right of this ribbon. Select "Create File" to launch the Create File tool for creating FDOT project files.



MENU DOCKING



1. Verify that the *Civil Message Center* tool is already docked on the bottom; if not, select it from the *General Geometry Task* group, dock and unpin.



2. Verify that the *Project Explorer* is docked on the left side; if not, from the Ribbon select the Home tab then in the group named primary click on the explorer icon...Or use the F11 function key to toggle ON/OFF the dialog.

☑ OpenRoads Modeling	t 🚊 =	
File Home Terrain Geometry Site Layout	Corridors Model Detailing	
Image: None         ▼         Default         ▼           Image: O         ▼         Image: O         ▼         Image: O         ▼           Image: O         ▼         Image: O         ▼         Image: O         ▼         Image: O         ▼	Explorer Attach Tools *	
Attributes	Primary	Unpin
Group -		

3. Verify that the *Level Display* is docked on the right side; if not, from the FDOT-Function Keys press F10, dock and unpin.



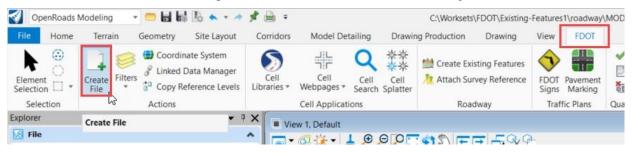
4. Verify that the *Element Information* is docked on the right side; if not, this can be brought up by selecting Ctrl+I, dock and unpin.



*HINT* Many of the dialog settings are stored in user preferences defined in xml data files located in the users data folders, i.e. C:\Users\rd964vd\AppData\Local\Bentley\OpenRoadsDesigner\10.0.0\prefs.

#### CREATE A NEW DGN FILE

- 1. Open FDOTCONNECT, set the Workspace to "FDOT" and select the Workset "22049555201 CE".
- 2. Browse to the "\_BlankFile.dgn" and open.
- 3. On the FDOT Ribbon Tab in the Actions Group, select "Create File."
  - Discipline = "DRAINAGE"
  - File Group = "Drainage Design Files"
  - File Type = "**DRPRRD**"
  - File Sequence # = "01"
  - County = "Wakulla" (State Plane Coordinate System = FL83-NF)
- 4. Click on the "Create Open File" button. Close the Create File Dialogue box.



orkset:	G. WYOINSELS	s\FDOT\22049555201_CE ~
iscipline:	~	
ile Group:	esign Files V	
ile Type:		
Bi	ase Filename	Description
DF	RFLRD	Flood Data Form
DF	ROMRD	Optional Materials Tabulation
DF	RPRRD	Drainage Structures - Proposed
PD	PLRD	Pond Design
TE	XTDR	Text
	ETLRD	Wetlands Delineation
	ETLRD	Wetlands Delineation
W	e:	Wetlands Delineation
Output Fil	e: Base Filenar DRPRRD	Wetlands Delineation The sequence #: Extension:
Output Fil	e: Base Filenar DRPRRD ets\FDOT\2204	Wetlands Delineation          me:       Modifier (Optional)       File       Extension:         01       .dgn         49555201_CE\drainage\DRPRRD01.dgn
Output Fil	e: Base Filenar DRPRRD ets\FDOT\2204 older: [drainage	Wetlands Delineation          me:       Modifier (Optional)       File       Extension:         01       .dgn         49555201_CE\drainage\DRPRRD01.dgn
Output Fil C:\Works Output Fe	e: Base Filenar DRPRRD ets\FDOT\2204 older: [drainage	Wetlands Delineation Wetlands Delineation  Tile Sequence #: D1 dgn 49555201_CE\drainage\DRPRRD01.dgn Browse t\organization-civil\fdot\seed\FDOT-ORD-Seed2D.dgn Browse

#### NAVIGATING THE DRAINAGE AND UTILITIES WORKFLOW RIBBON

When the Drainage and Utilities workflow is activated, there are ten tabs that populate the ribbon. The tabs are organized to help you find the tools you need to complete a task. Upcoming chapters will further describe these tabs and included tools that are commonly used for FDOT drainage design.

🛃 Dra	ainage and l	Jtilities	- 😑 🖥 🖥	i là 🔶 - 🔶 y	i 🗎 =			C:\Wo	orksets\FDOT\	22049555
File	Home	Layout	Analysis	Components	Utilities View	Tools	Report	Drawing Production	Drawing	View

The Home tab has six groups. One of the most useful tools for managing the drainage model is Explorer, located in the Primary Group. The Project Explorer is docked on the left side or use the F11 function key to toggle ON/OFF the dialog.

۲	None	* Default	*	Q			<b>S</b>		-\$-		Z		-	O Subsurface Utilities Help
	0 * 🗟 0	× ⊒0 × 🐚0	т 🛆 о т	Explorer	Attach Tools *	Models	Level Tisplay	Element Selection	Civil Analysis *	Terrain Import *	Import Geometry *	Import Utilities *	Export Utilities *	(i) About Subsurface Utilities
		Attributes			F	rimary		Selection	Model Analysis		Model Imp	ort/Export		Subsurface Help

#### NAVIGATING PROJECT EXPLORER FOR DRAINAGE

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

The Explorer dialog allows you to manage and control project content. It is a single interface that provides browsing function for files, links, items, resources, and sheet indexes.

- File used to browse and manage the file content such as models, references, saved views, levels, styles, templates, and so on.
- Items displays non-graphical business data in a DGN file in hierarchical order.
- *Resources displays resources used in a DGN file in hierarchical order.*
- OpenRoads Model displays content in categories such as alignments, terrain models, etc.
- Sheet Index allows you to manage sheet indexing. A sheet index is an organizes and named collection of sheet models from one or more design files.
- Links tab used to create or view the linked data.
- OpenRoads Standards used to create, edit or review horizontal and vertical geometry design standards, feature information, civil cells, annotation, and graphical filters.

The Drainage and Utilities section of Project Explorer is used to manage conduits, drainage areas, nodes and profile runs in the model.

## *Note* It is a recommended practice to check the Explorer when first opening a drainage DGN file to understand the contents of the file.

A DGN file without an active or referenced drainage model will appear blank:

Explorer 🔻 🖣 🗙
🔞 File 😝 Items 🤤 Resources
🖯 OpenRoads Model 🕼 Sheet Index
😤 Links 🔮 OpenRoads Standards
🕘 Drainage and Utilities Model 📑 Survey
🔇 🧕 🗩 📱
Search 👂 🖉 🗧
Drainage and Utilities Model

However, once a utility model is created, the Drainage and Utilities section of Project Explorer is organized into collapsible lists of elements: nodes, conduits, drainage areas, and profile runs.

#### CREATE A NEW UTILITY MODEL

- 1. In the DRPRRD01.dgn, click on DRAINAGE AND UTILITIES > LAYOUT > LAYOUT > **Place Node.**
- 2. Since this file does not yet contain a utility model, the Place Node tool will not activate. However, the following message will pop up, asking if you wish to proceed creating a utility model. Click **Yes** to this prompt and the next.

You Can	nnot Undo This Action	×
?	This action will create a utility model in the design file. You cannot undo this action. Proceed?	
	Yes No	]
Compact	t Database	$\times$
?	The application is about to compact database, do you want to proceed?	
	Note: You can control how frequently this message is displayed by going to Tools->Project Defaults and configuring the "Compact database after" option.	I
	Yes No	

3. Now, this file is ready to place drainage features in the DGN and/or reference drainage models from other DGNs.

# **1** DRAINAGE LIBRARY

#### INTRODUCTION

The main focus in this chapter will be on: Reviewing the Drainage Library.

This chapter will introduce several important components of the Drainage Library in FDOTCONNECT. They are:

- Feature Definitions
  - o Symbology
    - Levels, cells, materials
    - Element templates
    - Feature Symbology
  - Hydraulic Seed Data
    - Catalog
    - Prototypes
    - o Storm Data

This chapter will also introduce the user to a new workflow terminology using the Ribbon. If you see a direction like this: DRAINAGE AND UTILITIES>COMPONENTS>CATALOG>Catalog>Inlet Catalog, it means we are in the WorkFlow of Drainage and Utilities which has a Tab named Components, and has tools that are located in the Catalog Group. Now that we are in the right workflow, Tab and Group we may need to click on a tool that has more than one option.

#### FEATURE DEFINITIONS

As defined in the Bentley Drainage and Utilities CONNECT Edition help files:

*"Feature Definitions are used to control symbology and define properties of utility elements. There are three types of Feature Definition for support of utility workflow:* 

- Node Feature Definitions A variation on civil Point type. It defines information for Utility Nodes, such as catch basins, manholes, valves and etc.
- Conduit Feature Definitions A variation on the civil Linear type. It defines information for Utility conduits of all types, including drainage pipes, pressure lines, cables and ducts.
- Polygon Feature Definitions Used to denote area features such as catchments (drainage areas).

Feature Definitions developed for the most widely used standard FDOT drainage structures, gutters, and pipes have been included within the *FDOT\_SUE\_Drainage.dgnlib* for the FDOTCONNECT Workspace to be used for most FDOT projects. They can be viewed in the Project Explorer > OpenRoads Standards tab: DRAINAGE AND UTILITIES > HOME > PRIMARY > Explorer > OpenRoads Standards > Standards > Libraries > Feature Definitions. An inventory of available FDOT features is included with the Technical References section of this manual. The Workflow to Create a New Feature Definition will be discussed later in this manual.

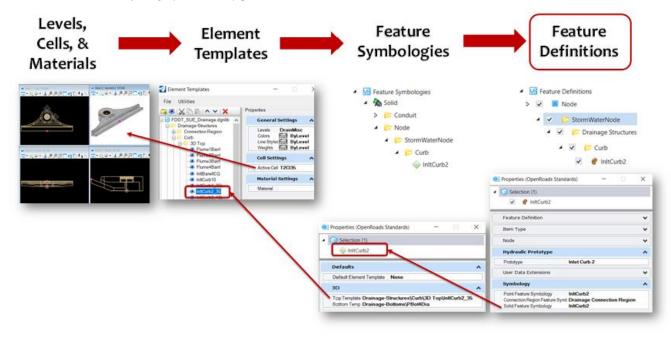
As discussed in the File Types section, all project design and modeling data is stored within the design DGN file. When users choose a drainage feature to place for the first time, the software loads the DGN Library and copies the feature definition and associated properties into the DGN file, both onto the individual drainage feature placed and the design file's OpenRoads Standards.

For purposes of this course guide, components of feature definitions will be separated into two categories: symbology and hydraulic seed data. In the FDOTCONNECT Workspace, both components are stored in the same DGN Library file: FDOT\_SUE\_Drainage.dgnlib.

#### <u>SYMBOLOGY</u>

The 2D and 3D graphical presentations of drainage features in the design file are built from a series of elements defined the DGN library. A description of this series of elements as defined in the Bentley Drainage and Utilities CONNECT Edition help files for utility nodes is below:

- Feature definitions for all node types will link to a series of Feature Symbology's.
- Feature symbologist will link to a series of MicroStation Element Templates for symbology and presentation.
- The plan space template will include a 2D cell of user's design. This cell is placed in plan space for all plans production activities.
- The 3D presentation normally points to two templates. The first defines a 3D cell that models the physical nature of the top of the node. The second defines a 3D cell that models the physical nature of the bottom of the node. The two cells are joined by extruding a slice of the bottom cell upwards to meet the top cell. If the top cell is blank, then no extrusion is done and only the bottom cell is placed.
- The plan, top, and bottom cells will contain various attributed elements to define key points and regions necessary for the creation of the node 3D structure, alignment of the 3 cells, defining connection of conduits, and defining hydraulic key points.



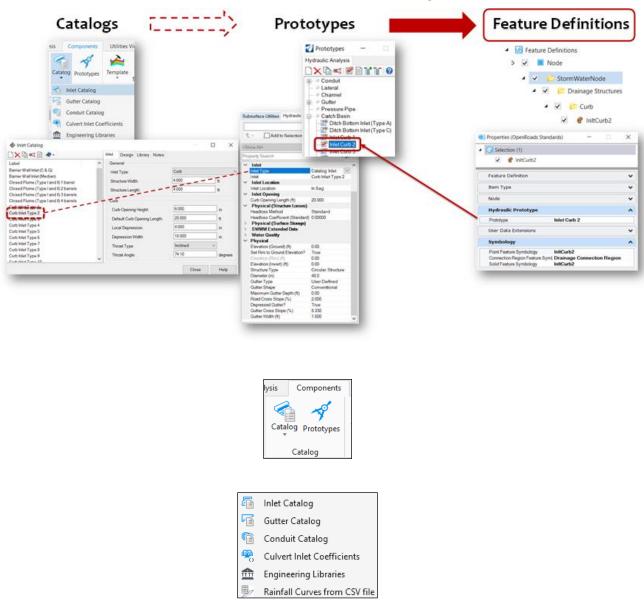
#### HYDRAULIC SEED DATA

In addition to housing drainage symbology information, the FDOT\_SUE\_Drainage.dgnlib is also the repository for the default information and properties necessary for hydraulic modeling. This includes properties assigned to individual drainage features as well as global definitions (e.g. storm data). This information is accessed in various ways within the OpenRoads Designer environment and is described further in the sections below.

#### CATALOGS

In OpenRoads, Catalogs are an efficient way to reuse common physical definitions for inlets, conduits, and gutters. Catalog items can be imported from and exported to engineering libraries. Similar to the symbology series of elements that build feature definitions, there are a series of hydraulic components that ultimately assign the hydraulic properties to the feature definitions for drainage elements in the FDOTCONNECT Workspace. Catalogs are loaded by Prototypes, which are loaded by feature definitions. The FDOTCONNECT Workspace has Catalog items defined locally (not synchronized to a library) for inlets, gutters, and conduits. These can be accessed from the path:

DRAINAGE AND UTILITIES>COMPONENTS>CATALOG>Catalog



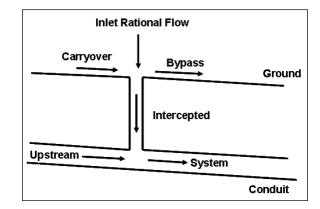
The catalog windows contain several tabs to define input, design parameters, engineering library connections, and notes. Where applicable, notes have been included to clarify input. Though FDOT inlets do not have variable opening lengths subject to design, the conduit catalog is built so that automated design selects from available standard pipe sizes

🚸 Inlet Catalog								×	
D 🗙 🛱 🛋 🖹 🔷 •	Inlet	Design	Library Notes						
Label	Ger	neral							
Barrier Wall Inlet	Inle	et Type:		Curb			$\sim$		
Barrier Wall Inlet (C & G)	Str	ucture Width	r:	4.000		ft			
Barrier Wall Inlet (Median)				4.000		1			
Closed Flume (Type I and II) 1 barrel	Str	ucture Lengt	th:	4.000		ft			
Closed Flume (Type I and II) 2 barrels	Cur	ь							
Closed Flume (Type I and II) 3 barrels		urb Opening	(Lateral)	6.000		in			
Closed Flume (Type I and II) 4 barrels		urb Opening	Height:						
Curb Inlet Type 1	De	efault Curb C	Opening Length:	13.000		ft			
Curb Inlet Type 2 Curb Inlet Type 3	Lo	cal Depress	sion:	5.500		in			
Curb Inlet Type 3	D.	epression W	Caleba	18 000		in			
Curb Inlet Type 5	De	epression w	idin.						
Curb Inlet Type 6	Th	roat Type:		Inclined	~				
Curb Inlet Type 7	Th	roat Angle:		74.10		degrees			
Curb Inlet Type 8		-							
Curb Inlet Type 9			Inlet Desig	n Librarv	Notes				
Curb Inlet Type 10			Notes:	in Dordry					
Ditch Bottom Inlet Type A			The depression		urb and outte	r ara eat ur	a se follo	IND :	
Ditch Bottom Inlet Type B			- Inlet catalog l	ocal depress	sion includes	both gutte	r (1.5" ty	p) and loo	
Ditch Bottom Inlet Type C			(varies). This is						
Ditch Bottom Inlet Type C Mod			- The correspondence - The cor					ross slope	es only, 2%,
Ditch Bottom Inlet Type D			-> Spread is ca	lculated con	nservatively,	based on r	no depre		let or gutter.
Ditch Bottom Inlet Type E			-> Inlet Capacit	y is calculate	ed based on	the full dep	pression	amount.	
Ditch Bottom Inlet Type F			*Note, Subsurf	ace Utilties o	does have fu	inctionality	to separ	ate local o	depression and
Ditch Bottom Inlet Type G			gutter depressi	on along the	e curb & gutte	er. Should u	users ch	oose to m	odel the gutter
			depression for accordingly. The						
			reduction in ca				e a nuet	Copulation	

*Note* These parameters are needed for typical FHWA HEC-12 or HEC-22 calculations. The values provided were determined by the Department's staff and are felt to be conservative. Users should verify values prior to performing inlet and spread calculations with Drainage and Utilities Workflow and OpenRoads Designer CONNECT Edition.

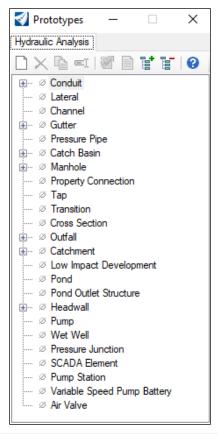
💱 Conduit Catalog					×
	Conduit	Library Notes			
Label Conduit Shape Material		t Shape		Circle	
Box - Concrete       Box       Concrete         Circle - Concrete       Circle       Concrete         Circle - Metal - Helical       Circle       CMP         Circle - Metal - Spiral Rib       Circle       CMP         Circle - PP, Polyethylene-SingleWall       Circle       CMP         Circle - PVC, PP, Polyethylene-DoubleWall       Circle       PVC         Ditch 4Bot 4 Front 4 Back Paved       Trapezoidal Channel       Asphalt ditch         Ditch 4Bot 4 Front 4 Back Sod       Trapezoidal Channel       Asphalt ditch         Ditch 4Bot 6 Front 4 Back Sod       Trapezoidal Channel       Asphalt ditch         Ditch 5Bot 4 Front 4 Back Sod       Trapezoidal Channel       Asphalt ditch         Ditch 5Bot 4 Front 4 Back Sod       Trapezoidal Channel       Flood plain, brush         Ditch 5Bot 4 Front 4 Back Sod       Trapezoidal Channel       Rood plain, brush         Ditch 5Bot 6 Front 4 Back Sod       Trapezoidal Channel       Rood plain, brush         Ditch 5Bot 6 Front 4 Back Sod       Trapezoidal Channel       Rood plain, brush         Ditch 5Bot 6 Front 4 Back Sod       Trapezoidal Channel       Rood plain, brush         Ditch 5Bot 6 Front 4 Back Sod       Trapezoidal Channel       Rood plain, brush         Ditch VBot, 1:6 Paved       Triangular Channel       Rood plain, bru	Cata 1 2 3 4 5 6 7 8 9 10 11	log Conduit Class S Label 12 inch 15 inch 18 inch 24 inch 30 inch 36 inch 42 inch 54 inch 66 inch 66 inch wailability alable For Design?	Available for Design	Circle Inside Diameter (in) 12.0 15.0 18.0 24.0 30.0 36.0 42.0 48.0 54.0 60.0 66.0	Manning's 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

*Note* <u>Conduit vs. Gutter</u>: Conduits model system flow that is intercepted by and passed through nodes. Gutters model bypass flow along the ground surface between nodes. Open channel ditch shapes are included in each catalog with the FDOTCONNECT Workspace.



#### **PROTOTYPES**

In OpenRoads, Prototypes are similar to Catalogs, but contain additional parameters used for design & analysis and are loaded directly by feature definitions. Prototypes are not able to be imported or exported. Where possible, the FDOTCONNECT Workspace Prototypes load the respective Catalog. FDOTCONNECT Prototype items include inlets, manholes, outfalls, headwalls, gutters, conduits, and catchments (drainage areas). These can be accessed from the path: DRAINAGE AND UTILITIES > COMPONENTS >CATALOG>Prototypes.

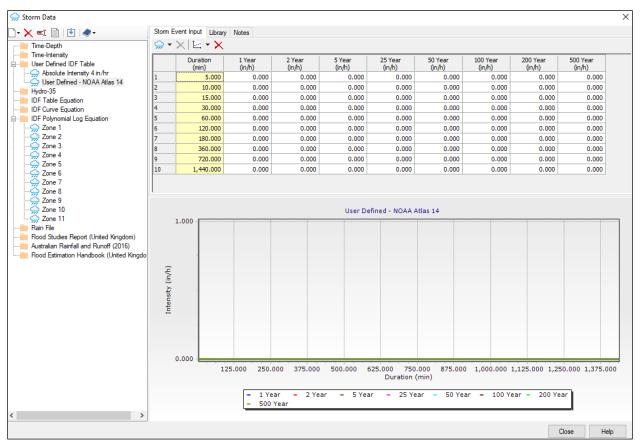


*Note* Changes to the prototypes are not retroactive and will not affect any elements created prior to the change. This also applies to changes in feature definitions; though symbology will change if a feature definition is switched after placement, hydraulic properties are applied automatically only once, during initial placement.

#### STORM DATA

The OpenRoads environment has a variety of options available for assigning wet weather flows to drainage models. Storm data can be accessed from the path: DRAINAGE AND UTILITIES > COMPONENTS > COMMON>Storm Data>Storm Data.

For typical rational method calculations on the Department's projects, the Drainage Manual requires use of National Oceanic and Atmospheric (NOAA) Atlas 14 Rainfall Data. In the FDOTCONNECT Workspace, User Defined IDF Tables are set up with a blank IDF table intended for user input from project-specific NOAA Atlas 14 data.



The Absolute Intensity IDF Table includes a constant 4 in/hr intensity for spread analyses.

For reference only, the Department's 11 Intensity-Duration-Frequency (IDF) curves are included through regression equation constants and coefficients. Each curve is associated with a certain zone of the state. The third-degree polynomial equation provides the best curve fit of the actual data and should not be edited.

There are, for special occasions, several other Storm Types supported in OpenRoads.

*Note* Not all the forms of storm data are compatible with all of the hydrology methods in the model. Refer to Bentley Product Documentation for further information.

#### EXERCISE OVERVIEW – EXISTING FEATURES ORD

- 1.1 Explore Properties in Feature Definitions
- 1.2 Review and Create a New Catchment Prototype
- 1.3 Populate the IDF Table with NOAA Atlas 14 Data and Set the Global Storm Event

#### **Exercise 1.1** Explore Properties in Feature Definitions

In this exercise, the user will open the Properties dialog of a drainage feature definition from the DGN Library and identify the associated symbology and hydraulic properties.

- 1. Open FDOTCONNECT, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "DRPRRD01.dgn".
- 3. Use the Explorer Dialog (Function Key F11) if you do not have it docked. Navigate to the OpenRoads Standards Tab then click on Standards to expand list. The list contains loaded DGN Libraries and the current file you are in.
- 4. Navigate through the following path and right-click to open the properties of the feature definition for a Type 2 Curb Inlet: Libraries > Feature Definitions > Feature Definition (FDOT\_SUE\_Drainage.dgnlib (Default)) > Node > StormWaterNode > Drainage Structures > Curb > InltCurb2.

	<b>4 ×</b>		roperties (OpenRoads Standards)		<b>▼</b> ₽
🛿 File 📦 Items 🗑 Resources 🦉 OpenRoads Model 🕼 Sheet Index 😤 Lin	iks	6	Selection (1)		
OpenRoads Standards 📑 Drainage and Utilities Model 📑 Survey	- 1		🔶 InltCurb2		
	- 1				
Search P	2 ×				
Standards	<b>^</b>				
<ul> <li>Libraries</li> </ul>					
<ul> <li>Feature Definitions</li> </ul>					
Feature Definition (FDOT_Standards_Features.dgnlib (Default))			Feature Definition		
<ul> <li>Feature Definition (FDOT_SUE_Drainage.dgnlib (Default))</li> </ul>			Name	InltCurb2	
A B Node			Description	Curb Inlet Type 2	
CommunicationsNode			Name Seed	S-	
Communications/vode			Item Type		
			Item Type	DrainageInlet	
<ul> <li>Drainage Structures</li> </ul>			Node		
4 📄 Curb					
🔶 Flume1Barrl2			Default Height Use Slope of Surface	4.90' True	
Flume2Barrl2			Structure Type	Inlet Curb Opening	
→ Flume3Barrl2			Network Type	Storm Water Only	
Flume4Barrl2			Hydraulic Prototype		
→ InItBarwIICG			Prototype	Inlet Curb 2	
🔶 InltCurb1L			User Data Extensions		
→ InItCurb1R			User Data Extensions	<collection: 0="" items=""></collection:>	-
✓ InltCurb2					
InitCurb3L			Symbology		•
↓ InitCurb3R			Point Feature Symbology	InltCurb2	
			Connection Region Feature Sy Solid Feature Symbology	mbc Drainage Connection Region InltCurb2	
→ InltCurb4			Solid Feature Symbology	InitGuIDZ	
🔶 InltCurb5L					
InltCurb5R	-				

*HINT* Items in grey are read only.

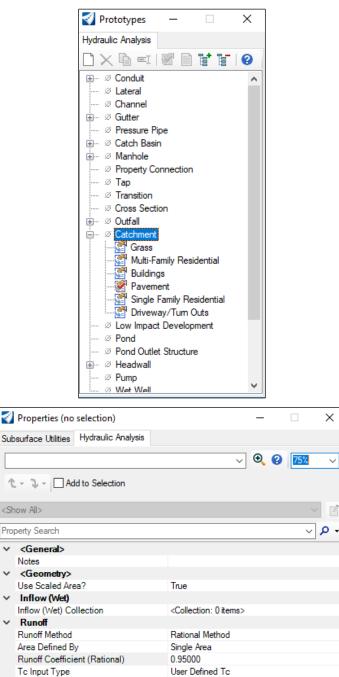
- 5. Reviewing the feature definition properties dialog from top to bottom:
  - a. Feature Definition category includes name, description, and the name seed. When this inlet is placed, the prompts will prefill the name input with 'S-'.

- b. Item Type assigned to this type of structure is 'DrainageInlet'. Item types are used for FDOT quantity reports and will be discussed in more detail later in this course guide.
- c. Node definitions include default height, use slope of surface, structure type, and network type. The default height value controls the minimum distance allowed between the top and structure invert elevations.
- d. The Hydraulic Prototype input indicates that when a Type 2 Curb Inlet is placed, the hydraulic properties will be assigned from the 'Inlet Curb 2' prototype.
- e. User Data Extensions are defined for some FDOTCONNECT drainage features. These are flex tables used in plans and drainage design documentation. Flex Tables and User Data Extensions will be discussed in more detail later in this course guide.
- f. Symbology for nodes include point, connection region, and solid. The point feature symbology controls presentation of the node in plan view and the solid feature symbology controls 3D presentation.

#### **Exercise 1.2** Review and Create a New Catchment Prototype

In this exercise, the user will review available land cover definitions provided with the FDOTCONNECT Workspace and learn how to create a new catchment prototype for project-specific use. Custom prototypes may be useful if project drainage areas have a consistent C value that are not reflected in the predefined land covers.

1. Navigate through the following path to open the list of catchment prototypes and open properties for Pavement: DRAINAGE AND UTILITIES>COMPONENTS>CATALOG>Prototypes>Hydraulic Analysis >Catchment>**Pavement.** 



#### Runoff Coefficient (Rational)

Time of Concentration (min)

The proportion of rainfall which results in surface runoff.

0.000

- 2. Since this is a prototype, settings shown in this **Properties** dialog are applied by default to new catchments with feature definition = Pavement. For Pavement, the assigned C value is 0.95. Time of Concentration is set to user defined, which can be assigned after placement. Close the properties dialog.
- 3. Right click Catchment in the Prototypes dialog and select 'New'. Double click to open the newly created 'Catchment Prototype 1'



- 4. Reviewing from top to bottom, the following are sample settings for a project-specific mixed land cover:
  - a. Change Use Scaled Area to True
  - b. Change Runoff Method to Rational Method
  - c. Change Area Defined by to Multiple Subareas

~	<general></general>	
	Notes	
$\sim$	<geometry></geometry>	
	Use Scaled Area?	True
$\sim$	Inflow (Wet)	
	Inflow (Wet) Collection	<collection: 0="" items=""></collection:>
$\sim$	Runoff	
	Runoff Method	Rational Method
	Area Defined By	Multiple Subareas

- d. On the Subareas line, click on the ellipse to open <Collection: 0 items>.
  - i. Select '**New**' twice to add two lines to the collection table and enter Description and Runoff Coefficient as shown below, or as appropriate for project-specific settings.
  - ii. Click 'OK' to close the dialog. Now, the Subareas line should read <Collection: 2 items>

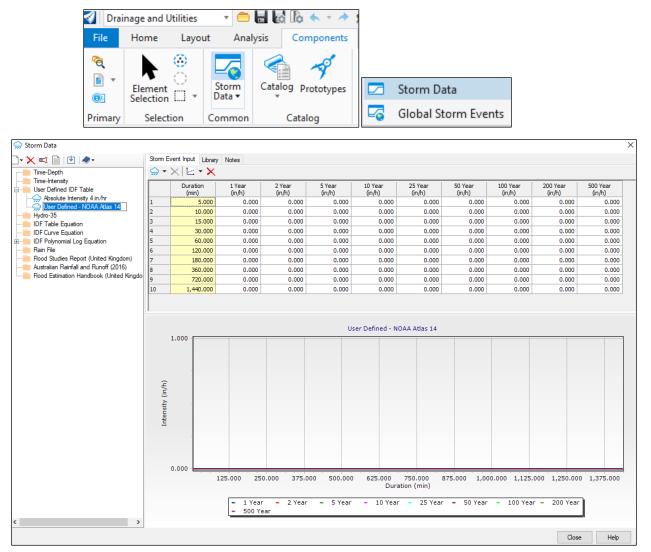
Subare	as - Catchment	(Catchment Prototype - 1)		Х
$\square \times$				
New	Area / Total Area (%)	Surface Description	Runoff Coefficient	
1	0.0	Pavement	0.95000	
2	0.0	Grass	0.25000	
*				
		ОК Са	ancel Help	

- e. Close dialogs.
- *Note* There is currently not a workflow for automated delineation of subareas and computation of composite Rational C Coefficient. Recommended workflows for delineation are discussed later in the next chapter.

## **Exercise 1.3** Populate the IDF Table with NOAA Atlas 14 Data and Set the Global Storm Event

In this exercise, the user will review where to obtain and enter project-specific NOAA Atlas rainfall data and set the global storm event for the Base Rainfall Runoff alternative. Alternatives will be further discussed later in this manual.

1. Navigate through the following path to and select the User Defined – NOAA Atlas 14 IDF Table: DRAINAGE AND UTILITIES>COMPONENTS>COMMON>Storm Data>Storm Data>User Defined IDF Table > User Defined – NOAA Atlas 14.

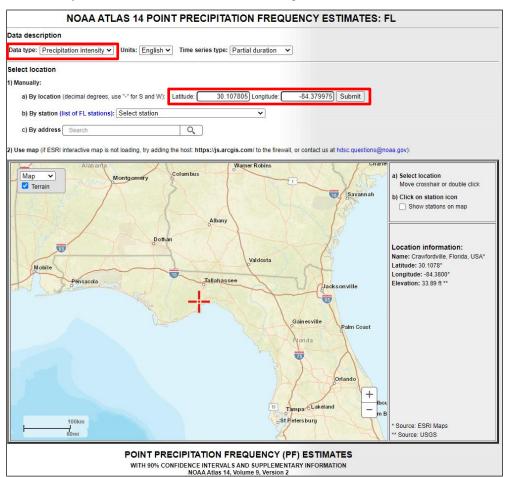


- 2. By default, the table is empty and set up to receive intensity data for durations 5-min to 24-hr and 1 Year to 500 Year storms.
- 3. From the Department's Drainage Manual, Section 1.4, open the hyperlink to the NOAA Atlas 14 Rainfall Data.

Use statistical rainfall depth data for Florida in the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Rainfall Data. This data is available at <a href="http://hdsc.nws.noaa.gov/hdsc/pfds/pfds\_map\_cont.html?bkmrk=fl">http://hdsc.nws.noaa.gov/hdsc/pfds/pfds\_map\_cont.html?bkmrk=fl</a>. Users will find FDOT rainfall distributions in *Appendix E*.

- 4. Enter project location information and make the following selections within the NOAA web page:
  - a. Data type = Precipitation intensity

b. By location = Latitude 30.107805 and Longitude -84.379975 and **Submit**.



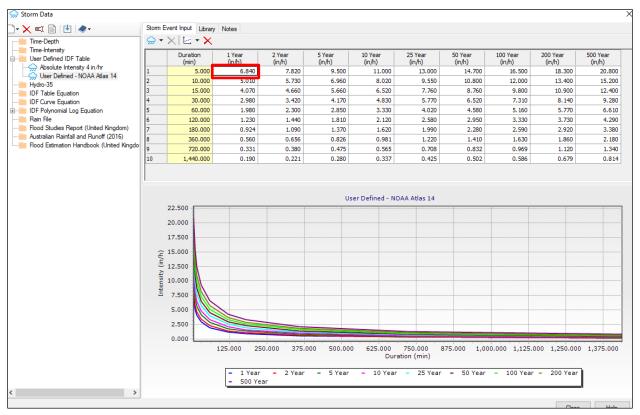
5. At the bottom of the data table, select Submit to generate the CSV file.

60-day	0.013 (0.011-0.015)	0.014 (0.012-0.017)	0.017 (0.014-0.020)	0.019 (0.016-0.022)	<b>0.021</b> (0.017-0.026)	0.023 (0.019-0.028)	0.025 (0.019-0.032)	0.027 (0.020-0.035)	0.029 (0.021-0.039)	0.030 (0.021-0.042)
Numbers recurrence estimates	in parenthesis are	PF estimates at I greater than the up er than currently v	ower and upper bo oper bound (or less alid PMP values.	on frequency analy ounds of the 90% co s than the lower bo	onfidence interval.	The probability th				
Estimates	from the table in	CSV format: Pr	ecipitation frequ	uency estimates	Submit					

#### 6. Open the CSV file and copy the following range of data: 5-min to 24-hr and 1 Year to 500 Year:

13	PRECIPITA	TION FREC	UENCY EST	TIMATES							
14	by duratic	1	2	5	10	25	50	100	200	500	1000
15	5-min:	6.84	7.82	9.5	11	13	14.7	16.5	18.3	20.8	22.8
16	10-min:	5.01	5.73	6.96	8.02	9.55	10.8	12	13.4	15.2	16.7
17	15-min:	4.07	4.66	5.66	6.52	7.76	8.76	9.8	10.9	12.4	13.5
18	30-min:	2.98	3.42	4.17	4.83	5.77	6.52	7.31	8.14	9.28	10.2
19	60-min:	1.98	2.3	2.85	3.33	4.02	4.58	5.16	5.77	6.61	7.27
20	2-hr:	1.23	1.44	1.81	2.12	2.58	2.95	3.33	3.73	4.29	4.72
21	3-hr:	0.924	1.09	1.37	1.62	1.99	2.28	2.59	2.92	3.38	3.74
22	6-hr:	0.56	0.656	0.826	0.981	1.22	1.41	1.63	1.86	2.18	2.45
23	12-hr:	0.331	0.38	0.475	0.565	0.708	0.832	0.969	1.12	1.34	1.52
24	24-hr:	0.19	0.221	0.28	0.337	0.425	0.502	0.586	0.679	0.814	0.924
25	2-day:	0.106	0.128	0.167	0.203	0.257	0.302	0.35	0.402	0.476	0.536

7. Back in OpenRoads, click on the upper left of the table, the cell for 5-min, 1 Year, and Ctrl-V to paste the rainfall data. The completed table is shown below. Close the dialog when finished.



8. Open Global Storm Events, from the path DRAINAGE AND UTILITIES>COMPONENTS> COMMON >Storm Data>Global Storm Events.



 Click the down arrow in the white cell beneath Global Storm Event heading to expand the list of available FDOT storms. Select User Defined – NOAA Atlas 14 – 10 Year, near the bottom of the list, and close the dialog box.

😤 Glo	bal Storm Event	5									×
	Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)	
12: Ba	Base Rainfall	User Defined - NOAA Atlas 1 👻 📖	Orphan (local)	10	0.0	0.000	11.000	0.000	None	0.0	
		Zone 8 - 25 Year           Zone 8 - 50 Year           Zone 9 - 5 Year           Zone 9 - 3 Year           Zone 9 - 5 Year           Zone 10 - 2 Year           Zone 10 - 3 Year           Zone 11 - 40 Year           User Defined - NOAA Atlas 14 - 1 Year           User Defined - NOAA Atlas 14 - 15 Year           User Defined - NOAA Atlas 14 - 25 Year           User Defined - NOAA Atlas 14 - 10 Year           User Defined - NOAA Atlas 14 - 10				-				Close	Help
		User Defined - NOAA Atlas 14 - 100 Ye User Defined - NOAA Atlas 14 - 200 Ye User Defined - NOAA Atlas 14 - 500 Ye	ar								

# **2** LAYOUT TOOLS & PROFILE RUNS

# INTRODUCTION

The main focus in this chapter will be on: Reviewing the Layout Tools.

This chapter will introduce several important tools and features available in the Drainage and Utilities Workflow and FDOTCONNECT Workspace to build a drainage network. They are:

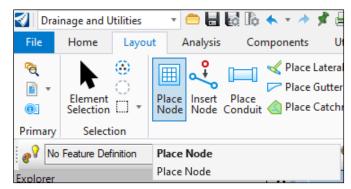
- Place Node
- Place Conduit
- Place Gutter
- Place Catchment
- Profile Runs

This chapter will also introduce the user to a new workflow terminology using the Ribbon. If you see a direction like this: DRAINAGE AND UTILITIES>LAYOUT>Layout>**Place Node**, it means we are in the **WorkFlow** of **Drainage and Utilities** which has a **Tab** named **Layout**, and has tools that are located in the **Layout Group**. Now that we are in the right workflow, Tab and Group we may need to click on a tool that has more than one option.

# PLACE NODE

Nodes are used to define drainage structure points within a drainage network. Nodes include all the Inlets, Junctions, and Outlets in the network and provide for the connectivity of the Conduit system. Nodes are also used to indicate physical changes in Conduit sizes or slopes. Conduits cannot change size or slope, other than at Nodes.

The general workflow includes a series of steps that are prompted by the Place Node tool to define the parameters for elevation, location, and rotation.



Workflows include the following, as defined in Bentley Drainage and Utilities CONNECT Edition Help:

Select Reference Element for Node Elevation. Reset to Type an Elevation - pick the element that you want to use to define the top elevation of the node. This can be a linear element which has an active profile, a mesh, or a terrain model. The elevation normally represents the top of the cover for a chamber. Press Reset if you want to enter an elevation.

**Define Location** - define a point to locate the node (by clicking in the graphics, Civil AccuDraw, or snapped to other graphics). Note that the text of the prompt tells you the type of node being place, such as Place Manhole for example. If you chose a reference element in the previous

prompt, then this prompt lets you define a vertical offset from that element. If you pressed Reset, then this prompt lets you type in an elevation.

*Select Rotation Mode* - choose whether you want to define the rotation of the node using an absolute value, or relative to an alignment (which can be any linear element).

If you choose Absolute, then next prompt is to Select Rotation or Reset to Place again. The rotation is defined as an absolute value, using the settings defined in File > Settings > File > Design File Settings > Angle Readout. If Civil AccuDraw is used the define the location of the node, then the compass will lock to the nearest compass point, which is defined in the Civil AccuDraw Settings. The rotation value is still absolute -it will not update if the element selected in Civil AccuDraw Station and Offset is subsequently modified.

If you choose Relative to alignment, then the next prompt is to Locate Reference Element for Rotation. Select a linear element, from the active design file or a reference. The next prompt is to Select Rotation or Reset to Place again. The rotation value is relative to the selected linear element, and will be updated if the element is subsequently modified.

Feature Definition - Defines the feature definition to be assigned to the new node.

*Name Prefix* - the feature definition provides a default naming prefix, which can be overridden *here*.

Node placement is one of several steps in the FDOT drainage design and modeling process. After placement, nodes may require additional input from the designer within the Element Info and Quick Properties dialogs.

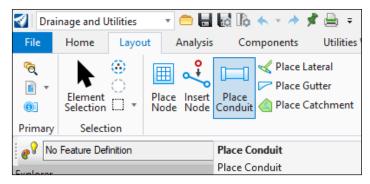
Nodes created in drainage models can be managed through Project Explorer, from the following path: DRAINAGE AND UTILITIES>HOME>PRIMARY> Explorer> Drainage and Utilities Model > (dgn file) > Nodes.

#### PLACE CONDUIT

Conduits connect and convey intercepted runoff from the various Nodes within a network to the Outfall, and may consist of pipes, boxes, or ditches. A multitude of options for sizing, and profiling Conduits are supported.

A Conduit represents a linear feature depicting a path connecting two Nodes. The path may be a straight line, line string, curvilinear, or a combination and series of linear MicroStation elements and should be placed from upstream to downstream.

The tool is accessed from the path: DRAINAGE AND UTILITIES>LAYOUT>Layout>Place Conduit.



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

The characteristics of the Place Conduit command are:

- Utilize a feature definition which defines conduit characteristics
- Will create the conduit to connection points defined in the nodes
- Will model the conduit in 3D

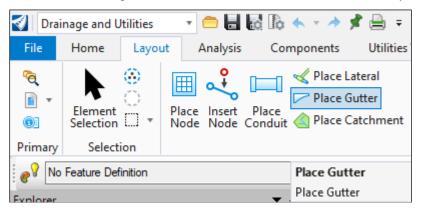
Elevations at the conduit ends are determined as follows:

- The Conduit Feature definition for a utility (non-hydraulic) line contains a minimum depth of cover property, in the conduit table. For a drainage (hydraulic) conduit, the depth of cover is read from the Default Design Constraints, unless this is overridden in the prototype for the Conduit Feature Definition, by changing Set Local Design Constraint to True, then specifying the minimum depth of cover there. The minimum depth of cover will result in an elevation at the end points. If Consider Cover Along Pipe Length is checked on in Default Design Constraints, then the minimum depth of cover will be adhered over the whole length of the pipe - not just at the end points.
- 2. If you enter a slope on second prompt the slope may result in an elevation on the second node which is different than the minimum depth of cover for the conduit or the node cell.
- 3. The nodes will have an invert elevation point defined in the bottom 3D cell. This is the elevation that will be used in absence of other information.

# PLACE GUTTER

Gutters are required to model bypass flow along the surface between nodes. Typical applications of gutters in FDOT designs are Curb & Gutter, median and adjacent barriers, and shoulder gutter. These are included as feature definitions with the FDOTCONNECT Workspace and are available when the Place Gutter tool is activated.

The tool is accessed from the path DRAINAGE AND UTILITIES>LAYOUT>Layout>Place Gutter.



🖃 👘 Conduit		٨			
Ė… 🗊 Storn Water					
🚊 👘 🚺 🖬	tters				
	2 Percent Cross Slope				
	3 Percent Cross Slope				
	5 Percent Shoulder				
	6 Percent Shoulder				
	Ditch 4 Bot 4 Front 4 Back Paved				
	Ditch 4 Bot 4 Front 4 Back Sod				
	Ditch 4 Bot 6 Front 4 Back Paved				
~ 8	Ditch 4 Bot 6 Front 4 Back Sod				
	Ditch 5 Bot 4 Front 4 Back Paved				
	Ditch 5 Bot 4 Front 4 Back Sod				
	Ditch 5 Bot 6 Front 4 Back Paved	¥			

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Place Gutter is used to define the following hydraulic characteristics of a drainage network:

- 1. The path of bypass flow between inlets
- 2. The shape of gutter between inlets.

There is no relationship between the hydraulic definition of a gutter defined with this command and the physical model. The hydraulic and physical characteristics are handled separately and independently.

When the tool is started there is a check made to determine if Analytic View is turned on. It is necessary for analytic view to be toggled on because hydraulic gutter definitions are visible only by way of analytic view

Warning	$\times$
Analytic view is not turned on for this viewport, placed elements will not show up. Would you like to turn it on?	
Yes No	

*Note* In the FDOTCONNECT Workspace, the default Drawing Scale for Drainage Design DGN file is 1" = 50'. When Analytic view is active, the DGN is best viewed at Full Size 1 = 1. The drawing scale can be accessed at the following path: DRAINAGE AND UTILITIES>DRAW>Drawing Scales> Annotation Scale.

Analytic View can be toggled on or off by activating View Attributes and the checkbox for 'Use Analytic Symbology. When toggled on, transient information is displayed for designer information but is not intended for plans production.

View 1, Default		
🛔 🗕 🔅 🚫	🗩 🔎 🎦 🔂 🔁 🖃	6
View Number: 1 - 1	2 🔍	
😚 Presentation		*
점 View Setup		*
🖲 Analytic Symbo	logy	*
Use Analytic Symb	ology	
Select Product:	Hydraulic Analysis 🗸 🗸	
Symbology Definition:	FDOT 🗸	

Both Gutters and Conduits created in drainage models can be managed through Project Explorer, from the following path: DRAINAGE AND UTILITIES>HOME>PRIMARY> Explorer> Drainage and Utilities Model > (dgn file) > Conduits.

9	🖯 Drainage and Utilities Model 📑 Sur					Sur			
0	🔇 🧕 🗩 📑								
Sea	rch								
4	0	Dra	aina	ge	and	l Uti	lities	Mod	lel
	4	$\diamond$	DR	PR	RDO	)1.d	gn , C	Defau	ılt
		⊳	▦	No	ode	s			
		⊳		Co	ond	uits			
		⊳	R	Dr	rain	age	Area		
		⊳	⊞	Pr	ofile	e Ru	ins		

## PLACE CATCHMENT

Catchments (drainage areas) in OpenRoads may be used to compute peak discharges or to attach computed discharge values to Nodes. The physical drainage area boundaries may be delineated using a digital terrain model, simply drawn with MicroStation, or keyed in as a total area value.

The Drainage Library is an integral part of defining and computing discharges for Drainage Areas. With graphical definition of the area boundary, runoff coefficients may be assigned from the available land covers include with Catchment features definitions in the Drainage Library.

Intensity values, for the peak discharge computations, are computed based on the time of concentration (Tc) assigned to catchments and the Department's Intensity-Duration-Frequency curves that are part of the Department's Drainage Library.

The tool is accessed from the path DRAINAGE AND UTILITIES>LAYOUT>Layout>Place Catchment.

引 Drai	nage and Utiliti	es	- 😑 🖬 🖥	d To 🔶 - 🔶 ;	i 🗎 =
File	Home La	ayout	Analysis	Components	Utilities View
<b>60</b> → <b>©</b>	Element Selection		ace Insert I ode Node Co	Place La Place G Place Marce C	utter 🗧 Plac
Primary	Selection				Layou
No Ro	Feature Definitio	n		Place Catc	

As defined in Bentley Drainage and Utilities CONNECT Edition Help the Place Catchment Workflow includes the following:

<u>Method</u> - choose the method to describe the boundary of the area:

- Pick Points lets you pick a series of points (by clicking in the graphics, Civil AccuDraw, or snapped to other graphics)
- Pick shape lets you select a graphic
- Flood Fill lets you pick intersecting graphics

<u>Select Outflow</u> - pick the node that the catchment outflows to, or Reset if this element has not been created.

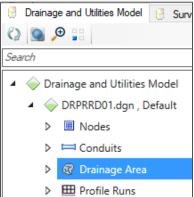
<u>Select reference surface</u> - pick a terrain model if you want a graphic to be created in the 3D model (by draping the catchment boundary over the terrain model) or Reset if you do not want this.

<u>Use Scaled Area</u> - if checked, the enclosed area of the boundary will be used. If unchecked, you can type in the area to use in the Area field.

Feature Definition - Defines the feature definition to be assigned to the new catchment

"Design intent builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. If an element is modified, any related elements will recreate themselves based on these stored relationships.

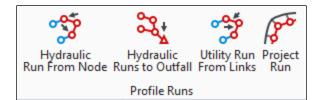
*Note* In OpenRoads, although automatic subarea delineation is not currently available, multiple catchments may be assigned to a single node. For typical FDOT projects, where a combination of impervious and pervious areas is collected by an inlet, there are several workflows available to users including: 1). Place a single shape catchment that represents multiple land covers and input the Percent (%) of each land cover in the catchment properties. 2.) Place multiple shapes and catchments to represent multiple land covers. Use available feature definitions such as grass or pavement. The flood fill method may be useful with this approach.



# **PROFILE RUNS**

A Profile is a path between two nodes, spanning one or more links. This chapter will cover creation of profile runs. Analysis and plans production uses of profile runs for FDOT projects will be discussed in later chapters.

The tools are accessed from the path DRAINAGE AND UTILITIES>LAYOUT>Profile Runs>.



As defined in Bentley Drainage and Utilities CONNECT Edition Help, there are several methods available to create profile runs:

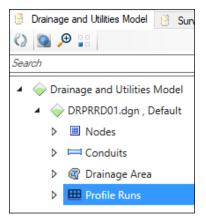
<u>Hydraulic Run From Node</u> - Creates a profile run from a selected node to the outfall, or between two selected nodes. This tool only works on hydraulic (i.e. storm or sanitary) networks.

<u>Hydraulic Runs to Outfall</u> - Creates a profile run for every path, from the most upstream nodes to the outfall. These paths are sometimes known as trunks or branches. This tool only works on hydraulic (i.e. storm or sanitary) systems.

<u>Utility Run From Links</u> - Creates a profile run from selected links, for any type of utility (e.g. storm, communications, electric, etc.) The links must be consecutive, without gaps between them.

*Project Run - Projects a profile run created using the tools above onto a linear element, which could be a road centerline, or another profile run.* 

Profile Runs created in drainage models are managed through Project Explorer, from the following path: DRAINAGE AND UTILITIES>HOME>PRIMARY> Explorer> Drainage and Utilities Model > (DGN file) > **Profile Runs** 



# **EXERCISES**

# EXERCISE OVERVIEW – LAYOUT TOOLS & PROFILE RUNS

In this chapter exercise, users will create a simple drainage network. The existing terrain, proposed Centerline of Construction and SR61 roadway models will be added as references. Display settings will be adjusted to aid identification of drainage patterns. An inlet, a manhole and an outfall will be placed and connected into a drainage network.

- 2.1 Attach references, set active terrain
- 2.2 Set view, display, window settings
- 2.3 Review tools to identify drainage patterns
- 2.4 Review Civil Accudraw
- 2.5 Place Node with Civil Accudraw.
- 2.6 Place Node (Outfall, no Civil Accudraw)

- 2.7 Place Conduit
- 2.8 Evaluate placed nodes and conduit, adjust elevations
- 2.9 Place Catchment
- 2.10 Create Profile Run
- 2.11 Place Gutter
- 2.12 Create a J-Bottom drainage structure Feature Definition

#### Exercise 2.1 Attach References and Set Active Terrain

- 1. Open FDOTCONNECT, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "DRPRRD01.dgn".
- 3. Navigate through the following path to open the References dialog and attach the files listed below: DRAINAGE AND UTILITIES>HOME>PRIMARY>Attach Tools> References>Tools>Attach:

a.	Survey	/ folder: GDTMDR0	1.dgn.			
Attach Refere	ence - C:\Worksets	s\FDOT\22049555201_CE\survey\				×
Look in:	survey	~	G 🤌 📂 🛄 🗸		8 🖲	3D - V8 DGN
Quick access Desktop Libraries This PC	Name eng_data GDTMRD01.d		Date modified 2/10/2020 9:25 AM 4/27/2020 8:47 AM 4/27/2020 8:47 AM	Type File folder Bentley MicroStati Bentley MicroStati	Size 808 KB 4,328 KB	Attachment Method Coincident World
	File name: Files of type:	GDTMRD01.dgn CAD Files (*.dgn;*.dwg;*.dxf)		~	Open Cancel	
	▼	Save Relative Path			Options	

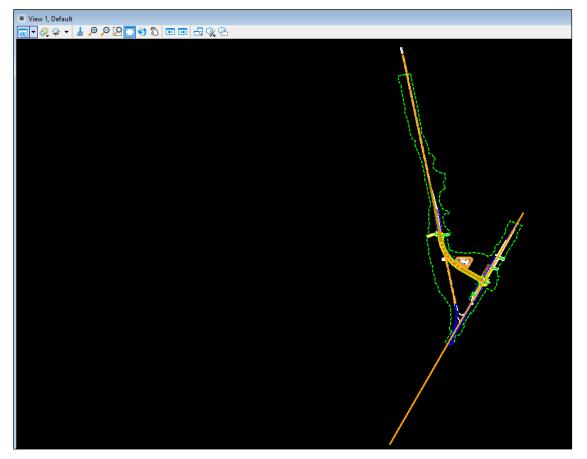


- Drainage folder: PDPLRD01.dgn b.
- Roadway folder: ALGNRD01.dgn, MODLRD\_Mainline\_61.dgn, c. MODLRD\_Details\_61.dgn, DSGNRD01.dgn

Slot	^ 🏴   🖻	) File Name	Model	Description
1		\Roadway\MODLRDMainline61.dgn	Default	Master Model
2		\roadway\ALGNRD01.dgn	Default	Master Model
3		\roadway\DSGNRD01.dgn	Default	Master Model
4		\Roadway\MODLRDDetail61.dgn	Default	Master Model
5		\survey\GDTMRD01.dgn	Default	Master Model
6	$\sim$	DRPRRD00.dgn	Default-3D	
7		\Roadway\PLPRRD_LABELING_01.dgn	Default	Master Model
8		\roadway\RWDTRD01.dgn	Default	Master Model
9		\roadway\Aerials.dgn	Default	Master model
10		PDPLRD01.dgn	Default	Master Model
11	$\sim$	DRPRRD00.dgn	Drainage_Divides	Master Model
12		\survey\SURVRD01.dgn	Default	Master Model
14		\Utilities\UTPRCN01.dgn	Default	Master Model



4. Select Fit View to reset window extents to new references.



- 5. Click on the outer perimeter of the existing terrain in the GDTMRD01.dgn file and hover over the perimeter to activate the pop-up menu.
- 6. Click on the middle icon in the pop up menu to Set as Active Terrain Model.



#### **Exercise 2.2** Set View, Display, Window Settings

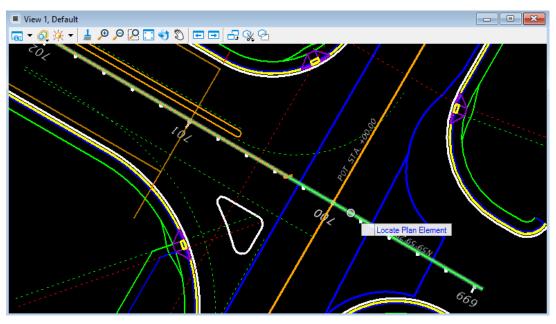
1. Next, move the mouse over to blank space in View 1, hold down the right mouse button to open the quick menu for display, and select View Control > 3 Views Plan/Profile/3D.

	Select All On Level By Element	_		
	View Control			1 View
-7	Сору			2 Views Plan/3D
	Move	6		2 Views Plan/XS
	Scale	6		2 Views Plan/Profile
0	Rotate	6		2 Views Plan/Superelevation
Ĩ.	Mirror	G	٦,	3 Views Plan/Superelevation/XS
R.	Select Links		-	3 Views Plan/Profile/3D
ì		6		3 Views Plan/Profile/XS
6:	View Attributes	5		3 Views Plan/XS/3D
	Model Properties	5		4 Views Plan/Profile/XS/3D
<b>%</b>	Clip Volume	2	þ	Ref Adjust Colors
$\odot$	Select All	5	2	Dynamic XS View
õ	Select None	Œ	Ð	Profile View
r	Select Previous	3	1	Toggle Construction Class
$\overline{\mathbf{v}}$	Cut to Clipboard	-8	3	Levels Off Except Element
o'o B	Copy to Clipboard			Displayset Set
Ê	Paste from Clipboard	>	<	Displayset Clear
	·	-8	8	Arrange Windows
	Turn Level Off by Element	4	•	Rotate View
×	Delete Element		_	Fit View
			1	Illustration View
		1		
				Smooth View
		1		WireFrame View

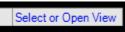
2. The views will automatically orient Plan View in top left, 3D View in top right, and Profile View along the bottom. The 'Open a Dynamic Profile View' window also pops up.

Open a Dynamic Profile View	$\times$
Select OK to Create a Dynamic Profile View	
OK Cancel	

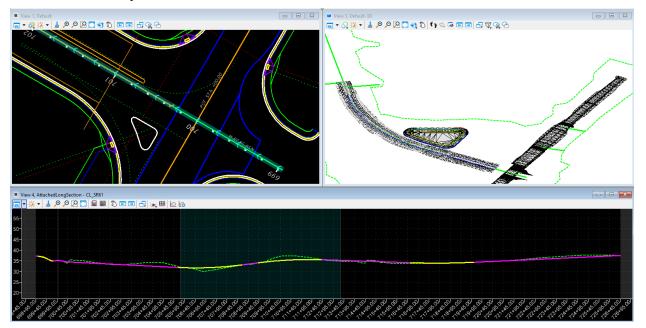
a. Click OK and follow the prompt to Locate Profile Element. Zoom into the plan view and select the alignment for SR 61, as shown below.



b. Next, move cursor to profile view and left click to accept the prompt 'Select or Open View'.



c. As shown below, the proposed profile along SR 61 is populated in the bottom profile window and the corresponding alignment in plan view is highlighted teal with arrows for direction of profile.



#### **Exercise 2.3** Review Tools to Identify Drainage Patterns

In this exercise, the user will review a sample of tools available to designers for use in delineation of drainage areas. Refer to Learning Resources for information on additional tools and OpenRoads features.

#### 1. Profile Reports

a. Click on and hover over the proposed profile, CL\_SR61 to activate the quick menu. Select the **Profile Report** icon from the quick menu.



- b. From the Bentley Civil Report Browser, select VerticalAlignmentReview.xsl from list on the left.
- c. Review this report in the vicinity the SR 61 and US 98 intersection. See VPI at STA 699+99.14 with a high point elevation of 35.24, a vertical high point (VHP) at STA 711+79.56, elevation 35.63, and a vertical low point (VLP) at STA 706+49.68, elevation 31.65. Close the report browser.

#### 2. Terrain Display

a. Another visualization tool is in the 3D view on the terrain itself. Expand the 3D view and click on the down arrow to expand the view attributes tool, located at the top left of the window. Click and turn on Level Overrides. Close the dialog.

Г

View 3,	Default-3D
🔚 🔻 🕗 :	🔆 🛨 📕 🏓
View	Attributes a
View 3, Default-3D	
🗖 🔍 🛃 🗕 🌾 🖓 🗖	2 🖸 🕄 🍕 🕲 🚺 🖓 🖾
View Number: 3 👻 🖳	
😚 Presentation	#≡ *
Display Style: 🔂 Illustration	:Ignore Lighting $\sim$
🔒 ACS Triad	Fast Cells
Background	🖹 Fill
Boundary Display	Grid Grid
📷 Camera	宿 Level Overrides
😴 Clip Back	E Line Styles
😪 Clip Front	Line Weights
😪 Clip Volume	Markers 🔹
Constructions	Patterns
🙀 Default Lighting	Tags
Dimensions	A Text
📼 🚺 Data Fields	1 <sub>+</sub> Text Nodes
🐻 Displayset	Transparency
સ Height Field	
Global Brightness: 🔶 <	> ¢
🫃 View Setup	*
💐 Background Map	*

b. Next, click on and hover over the boundary of the proposed terrain to activate the quick menu.



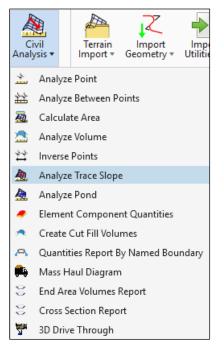
c. From the quick menu scroll down to Calculated Features Display, Source Features Display, and Reference. Note, read only attributes are greyed out.

Calculated Featu	ıres Display
Major Contours	Off
Minor Contours	Off
Triangles	On
Spots	Off
Flow Arrows	Off
Low Points	Off
High Points	Off
Breaklines	Off
Development	0#
Boundary	On
Imported Contours	
Islands	Off
Holes	Off
Voids	Off
Feature Spots	Off
Reference	
Override Symbolog	No

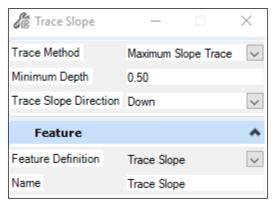
d. Under Reference, change Override Symbology to **Yes**. Attributes from Calculated Features Display and Source Features Display are now available to edit. For example, change Flow Arrows to **On**. Close properties window and review the 3D terrain display.

#### 3. Analyze Trace Slope

a. The final tool review in this exercise is at the following path: DRAINAGE AND UTILITIES>HOME>MODEL ANALYSIS>Civil Analysis> Analyze Trace Slope. Activate the tool.



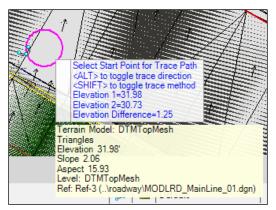
b. For this exercise, select Maximum Slope Trace method, with Minimum Depth set to 0.50 and Trace Slope Direction set to Down. Under Feature, find and select the Trace Slope feature definition. You can enter a name for this feature or use the default.



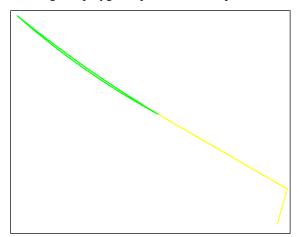
c. Follow the prompt to select the terrain model element. This is done by selecting the boundary of the terrain.



d. Follow the next prompt in the lower corner of the screen, Select a Start Point for Trace Path.



e. The resulting path is the steepest descent from the point selected through the terrain model that terminates at the low point. In the sample shown below, a yellow path originates at the point selected, and the green polygon represent the low point location.



#### **Exercise 2.4** Review Civil Accudraw

- 1. Reset the view controls to 2 Views Plan/3D, (hold down right-click in the plan view, navigate to View Control, select **2 Views Plan/3D**).
- 2. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Toggles> **Civil Accudraw** and click to toggle on. The Civil Accudraw menu can be docked, and when expanded looks like the following:



3. This tool is useful for designers when placing drainage features using precise input. Hover over the icons for descriptions of each. The upcoming exercise will demonstrate use of Accudraw with Station-Offset. Click the Station-Offset icon to activate.



#### **Exercise 2.5** Place Node with Civil Accudraw

The processes followed in this exercise will result in a node location that automatically adjusts to changes in alignment or terrain elevation to maintain the relative horizontal and vertical placement properties.

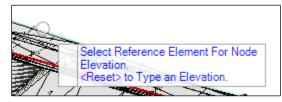
1. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Layout> **Place Node** and click to activate tool. The tool may open by default with the following window and a prompt for 'Select Reference Element for Node Elevation':

S	Place Node	- 🗆	×
	Elevation	0.00	
	Vertical Offset	0.00	
	Rotation		*
	Rotation Mode	Absolute	$\sim$
	Rotation	N90°00'00''E	
	Feature		*
Feat	ture Definition	Existing Comm Man	hole 🗸
Nam	ne Prefix	ECOMMH-	

- 2. Before following plan view prompts, update the dialog with the following:
  - a. Check the Vertical Offset box and enter the value **0.001**. This is a temporary work-around for FDOT structure elevation to properly align with the top mesh surface. Note, the Place Node dialog only displays this value to the hundredth.
  - b. Change rotation mode to **Relative to alignment**.
  - c. Select the FDOT Curb Inlet Type 2 feature definition from the pull-down menu: Node: Stormwater Node: Drainage Structures: Curb: **InltCurb2**. Upon selection, the dialog may expand to show the DrainageInlet Item Type attributes. FDOT Drainage Item Types will be discussed in a later chapter.

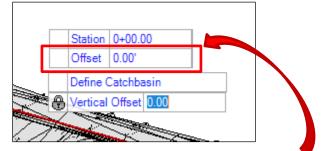
S	Place Node	-	×
	Elevation	0.00	
$\checkmark$	Vertical Offset	0.001	
	Rotation		*
	Rotation Mode	Relative to alignment	$\sim$
	Locate Reference Element for Rotation		$\sim$
	Rotation	N90°00'00''E	
	Feature		*
Feat	ture Definition	InltCurb2	$\sim$
Nam	ne Prefix	S-	
	DrainageInlet		*
Тур	e		$\sim$
Dep	th		$\sim$
Pay	ItemNumber	0425 1	
Des	ignNotes		
Con	structionRemarks		

3. Now that the dialog is set up, follow the prompts to place the curb inlet. The current prompt is Select Reference Element for Node Elevation. With the 3D view open, move the cursor over to the 3D model and left click on the edge of the proposed terrain.

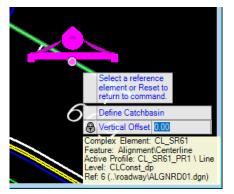


*HINT* If an OpenRoads tool is prompting the user for additional input, the specific prompt can usually be seen both on the cursor and in the messages located in the lower left of the OpenRoads window.

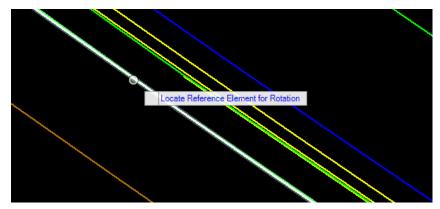
- 4. The next prompt is Define Catchbasin. This exercise will not choose to activate this option, left click to move on to next prompt. There are available workflows within OpenRoads tools to automatically place catchbasins, assign to node, and update based on terrain properties and node locations. Refer to Bentley Product training and online help for further details. The FDOT sample exercises will place the node and catchbasin features separately.
- 5. Since Civil Accudraw Station-Offset was activated when we initiated the place node tool, the cursor prompts now include the following fields for Station and Offset:



6. Use the tab button to cycle through the prompt fields so that Offset is active and type in '**o**' (for 'origin'). The tool prompts change to 'Select a reference element or reset to return to command'. Move cursor back to plan view and select the centerline alignment CL\_SR61.



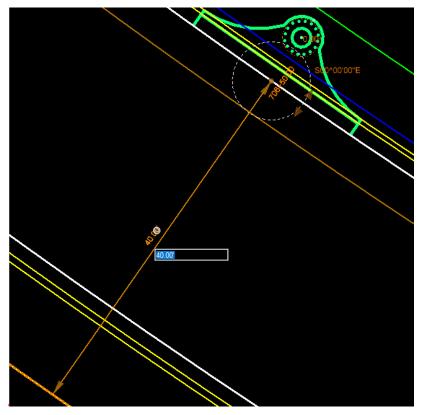
7. Now, the node placement is associated with the project alignment. Moving the cursor dynamically updates the tool display of Station Offset. Use tab to cycle to the Station line and enter **70650.00**. **Tab** to the Offset line and enter **40.0**. This has 'locked in' the location of the curb inlet to STA 706+50, 40' RT.



- 8. The next prompt is Select Rotation Mode. In the earlier setup, we selected Relative to alignment. Left click to accept this mode and the next prompt is to select the element that defines the node rotation. Select the CL\_SR61 alignment from Step 6 and enter **S00°00'00"E** in the Rotation field.
- 9. After accepting settings, the program takes some time to process. This is normal when placing a new node type for the first time. Left click to exit the place node tool. Next we will explore and update properties of the node just placed.
- 10. With the plan view active, open References dialog and turn off the 3D model. This can make it easier to isolate the 2D linework.

Ref	erences (6 of 6 unique, 4 displayed)						_			>	×
<u>T</u> ools	<u>P</u> roperties										
•	🖺 r 🖻 🗇 🔶 🦹 🕈 🖿	) <b>f</b> o (†	🗄 🛈 🗙	<u>H</u> ilite Mode	e: Boundaries 🔻						
Slot	🏴 🛅 File Name ^	Model	Description	Logical	Orientation	Presentation	Visible Edge	٠	\$_	k	P
6	\roadway\ALGNRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	$\checkmark$	×.	$\checkmark$	
4	\roadway\DSGNRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	$\checkmark$	$\sim$	$\checkmark$	
5	\roadway\MODLRD_MainLine_01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	1	$\sim$	1	
2	\survey\GDTMRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Dynamic	$\checkmark$	$\sim$	√_	
1	✓ DRPRRD01.dgn	Default-3D		Ref	Coincident - World	Wireframe	Dynamic		$\checkmark$	1	
3	PDPLRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe		¥.	¥	

11. Select the node. Since this was placed using Civil Accudraw, Station-Offset, the location is locked along these parameters, but may be edited with the orange label and dimension manipulators. For example, click on the 40.00' dimension and type in 100.00 in the text box and enter. The structure location is automatically moved to 100.00' RT offset. Test changing the station to a new location and when done, relocate the node to original STA 706+50, 40' RT location.



12. With the node selected, hover over the node linework and open the center icon from the quick menu, Utility Properties.



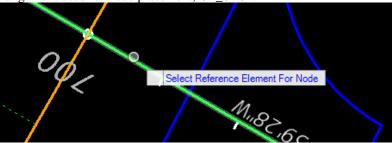
13. The Utility Properties contain two tabs: Subsurface Utilities and Hydraulic Analysis, shown side by side. Most of the properties have been automatically loaded based off the feature definition and prototype.

Prop	ow All>	✓ 🔍 😢 75% 🗸						
Prop	ow All>	· · · · · · · · · · · · · · · · · · ·	S-		~	€ 🧉	3 75%	~
*		✓ [7]	1 - 2 - 🗆 Add	to Selection				
	perty Search	- م ~						
	<general></general>		<show all=""></show>					<b>×</b> 🖪
	ID	14	Property Search				~	<del>،</del> م
	Label	S-	✓ <general></general>					_
	Notes				438			
	GIS-IDs	<collection: 0="" items=""></collection:>	Label		S-			
	Hyperlinks	<collection: 0="" items=""></collection:>	Notes		J-			
	Feature Definition	Node\StormWaterNode\Drainage Structure	GIS-IDs		<collection: 0="" iten<="" td=""><td></td><td></td><td></td></collection:>			
	MicroStation ID	3076	Hyperlinks		<collection: 0="" iten<="" td=""><td></td><td></td><td></td></collection:>			
~	<geometry></geometry>		Feature Definition	_				Character
	X (ft)	2.006.304.90		n	Node\StormWate	rivode \L	vrainage :	Structi
	Y (ft)	403.013.08	Geometry>		0.000.000.00			
	Physical	400,010.00	X (US Survey Ft		2,006,300.89			
	Node Rotation (degrees)	55.12	Y (US Survey Ft		403,012.28			
	Elevation (Top) (ft)	30.85	Station (Calculat		(N/A)			
	Elevation (Invert) (ft)	25.95	<ul> <li>Active Topolog</li> </ul>	Ŋ	_			
	References	20.50	Is Active?		True			
*	Baseline Feature		✓ Design					
		0+00			True			
	Baseline Station (ft)		Pipe Matching?		Crowns			
	Baseline Offset (ft)	0.0	Matchline Offset	(ft)	0.00			
	Elevation Reference	DTMTopMesh	Allow Drop Struc	ture?	True			
~	Utility Data		Use Drop Struct	ure to Minimize Co	True			
	Owner		Minimum Drop E	epth (ft)	1.00			
	Operational Status	In Service	Design Structure	e Elevation?	True			
	Network Type	Storm Water Only	Desired Sump D	epth (ft)	1.00			
	Node Type	Inlet Curb Opening	Freeboard (Reg	uired) (ft)	1.13			
	Utility Footprint		Design Inlet Ope	ening?	False			
	Length (ft)	17.6	Specify Local In	-	False			
	Width (ft)	13.1	✓ Flows					
~	Utility Quality			Subsurface) (cfs)	0.00			
	Quality Level	Undetermined	Flow (Known) (c		0.00			
	Authority	Certified		/	0.00			
	Authority Description		External CA (act		0.000			
	Investigation Level	Land Survey	External Tc (min		0.000			
			<ul> <li>Inflow (Wet)</li> </ul>	v	0.000			
			<ul> <li>Innow (wet)</li> </ul>					~

- *Note* Feature Definition and Prototype properties used for drainage nodes, conduits, and catchments are onetime and one-way. For example, if a prototype is edited after a node is placed, those edits will not be reflected in the node properties. Conversely, if edits are made to a placed node, this has no effect on the prototype or feature definition.
  - 14. In each tab, the References sections, the Baseline, Station, Offset information is either blank or zero. For these location properties to be associated to individual drainage features in the model, there is another workflow that is needed and can be performed individually or with multiple features simultaneously.
    - a. Close the Utility Properties. With the node still selected, open the element properties. Scroll down to the Utility section and see that Station/Offset Reference is 'None'.

Properties	▼ .	ųΧ
▲ 🔏 Elements (1)		
<ul> <li>Node: S-</li> </ul>		
D Items		
O Circle		
/ Line		
/ Line		
/ Line		
( Arc		•
General	*	^
Element Description	Node: S-	
Cell Name	InItCurb2_35	
Cell Type	Graphic	
Class	Primary	
Number of elements		
Annotation Purpose	(None)	
Is Annotation	False	
Geometry	*	
> Origin	2006297.74',403007.77	
Angle	S55°07'09"E	
Scale X	1.00000	
Scale Y	1.00000	
Feature	*	
Utility	*	
Vertical Offset	0.00'	
Ground Elevation	30.85	
Invert Elevation	25.95	
Use Slope of Surfac		
Elevation Reference		
Station/Offset Refer Utility ID	None 14	
Utility Properties	Open Utility Properties	
	open carry repended	
Extended	*	
Model	Default	
Last Modified	8/23/2020 3:10:54 PM	
Modified	Modified Not New	
Locked		5
LUCITOU	onioonou	

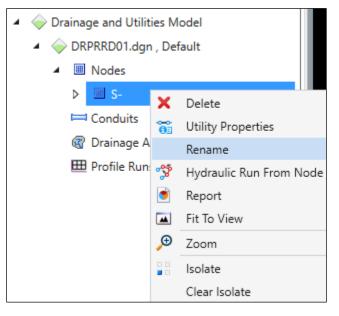
b. Click the ellipse and follow the prompts to define the reference baseline. Select the same alignment used for node placement, CL\_SR61.



c. To verify this has taken effect, unselect & reselect the node. Reopen the utility properties and check the References section. Close the properties dialogs.

~	References	
	Baseline Feature	CL_SR61
	Baseline Station (ft)	706+50
	Baseline Offset (ft)	40.000
	Elevation Reference	DTMTopMesh

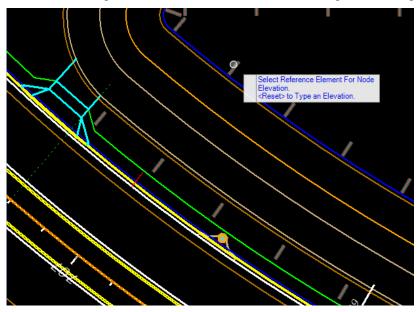
- *Note* If the Station/Offset Reference (alignment file) is turned off or detached, the corresponding Station and Offset fields may not report correctly. If Station / Offsets are reporting 0+00 and 0.00, follow steps 11a. and 11b to reestablish the link. This can also be accomplished with a selection set.
  - 15. Before we move on, let's explore another way to access the node properties. Navigate to this node in Project Explorer: DRAINAGE AND UTILITIES>HOME>Primary > Explorer > Drainage and Utilities Model > DRPRRD01.dgn > Nodes .
  - 16. Right click on the node, 'S-' to expand the tools available for nodes in Project Explorer. Rename this node to S-101. Node names can be set during placement in the place node prompts or renamed subsequently in Project Explorer.



#### **Exercise 2.6** *Place Node (Outfall, no Civil Accudraw)*

In Exercise 2.5, the node was placed with horizontal properties dependent to a roadway alignment. In this exercise, the node location is not dependent on an alignment, and would not change if the roadway alignment were updated. However, the node rotation would update automatically for changes in the pond geometry.

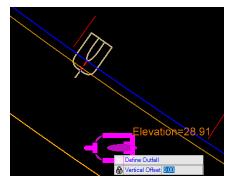
- 1. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Toggles> Civil Accudraw and click to toggle off.
  - JTILITIES>LAYOUT>Layout> Place Node and c
- 2. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Layout> Place Node and click to activate tool. The tool may open by default with the following window and a prompt for 'Select Reference Element for Node Elevation'.
- 3. Before following plan view prompts, update the dialog with the following:
  - a. Check the Vertical Offset box and enter the value **0.001**. This is a temporary work-around for the FDOT structure elevation to properly align with the top mesh surface.
  - b. Change rotation mode to **Relative to alignment**.
  - c. Select the FDOT Cross Drain Mitered End Section (1:4 slope, single 18" pipe) feature definition from the pull-down menu: Node: Stormwater Node: Drainage Structures: Outlet: Mitered End Section (Cross Drain): **MESC18RCP4S.**
  - d. Type in the Name Prefix **S-102**.
- 4. Now that the dialog is set up, we'll follow the prompts to place the outlet. The current prompt is Select Reference Element for Node Elevation. In plan view, move the cursor over to the pond and left click on one of the handles of the pond corridor (the small ticks around the top and bottom perimeter).



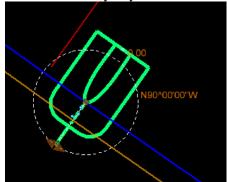
5. With the pond surface selected, moving the cursor along the pond side slopes will dynamically report the elevation of the surface. Find a location along the pond bottom (blue line) approximately aligned with S-101 and left click to select location and advance to the next prompt, rotation.



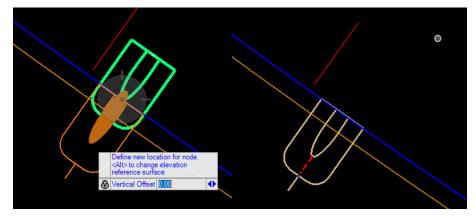
6. Select the pond bottom blue line as reference element for rotation. The Rotation angle or bearing will be about this line, enter N90°00'00"W. Left click to accept and allow the software to process and place the MES. Once complete, right click to exit the tool, which is ready to place the next node.



- 7. The MES is not yet at the desired location. Next we'll explore and use the manipulators available on the node.
  - a. Using Element Selection tool, click on the node. The brown dot & arrows and orange text are all editable when the node is selected. If the node was initially placed at the wrong rotation, overriding the value here is an easy way to fix it.



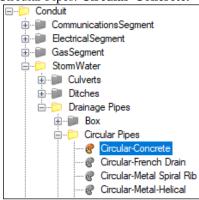
b. Select the dot at the reference location point and move downward so that the end of the MES is aligned with the pond. Left click to accept new location.



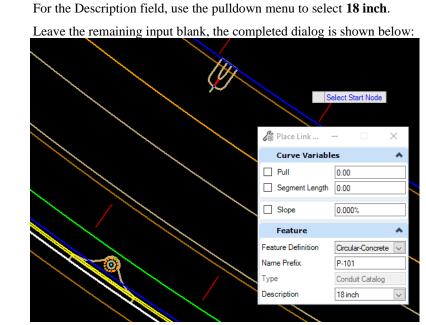
c. Finally, reselect the node and open the element properties. Scroll down to the Utility section and see that Station/Offset Reference is 'None'. Click in this field and the click the adjacent ellipse and zoom out as needed to select CL\_SR61.

#### Exercise 2.7 **Place** Conduit

- 1. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Layout> Place Conduit and click to activate tool. The tool will open by default with the prompt for 'Select Start Node ':
- 2. Before following plan view prompts, update the dialog with the following:
  - Select the Circular-Concrete feature definition from the pull-down menu: Conduit: Stormwater: a. Drainage Pipes: Circular Pipes: Circular-Concrete.

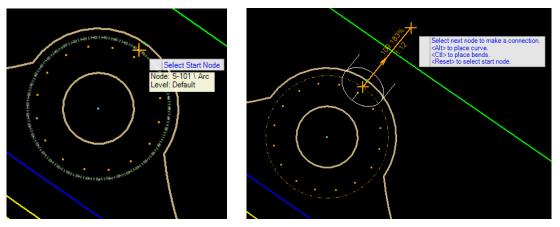


- Since the pipe we intend to place is from S-101 (upstream) to S-102 (downstream), type in the b. Name Prefix P-101.
- c.

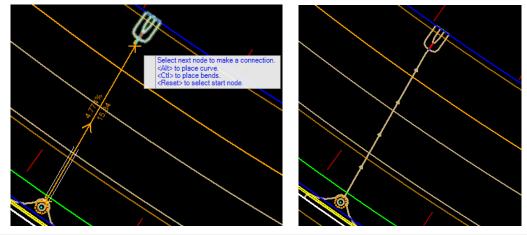


d.

3. Now that the dialog is set up, we'll follow the prompts to place the conduit. The current prompt is Select Start Node. In plan view, zoom towards the curb inlet, S-101 and move the cursor along the connection region, shown in dashed orange. Locate an area that is approximately between the center of the structure and the MES, S-102 and left click to accept the starting point.



4. The next prompt is to Select node to make a connection. Since we intend to place a straight pipe with no curves or bends towards S-102, we will ignore the <Alt> and <Ctrl> options available in the prompt. Move the cursor to the connection region on S-102, left click to accept.



*HINT* In the FDOT CONNECT Workspace, default pipe symbology includes arrows to indicate direction of flow from upstream to downstream.

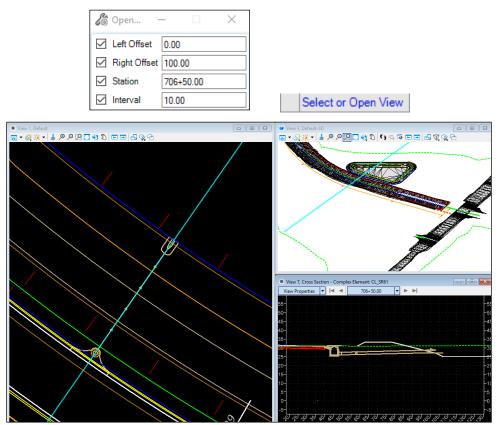
5. For pipes, the manipulators are at the ends and may be used to adjust the start or end of pipe.

#### **Exercise 2.8** Evaluate Nodes and Conduit in XS and 3D views. Adjust Elevations.

1. So far, the place node and conduit exercises have kept the initial default elevation properties. This exercise will show how to view the vertical properties and edit. Activate View Control by holding down the right mouse button and select **3 Views Plan/XS/3D**. The windows will automatically adjust and Select OK to the prompt to Create a Dynamic XS View.

	View Control		1 View
7	Сору		2 Views Plan/3D
	Move	$\bigcirc$	2 Views Plan/XS
 t ; -	Scale	$\bigcirc$	2 Views Plan/Profile
<u></u>	Rotate		2 Views Plan/Superelevation
ĩ۵	Mirror		3 Views Plan/Superelevation/XS
			3 Views Plan/Profile/3D
۳	Select Links		3 Views Plan/Profile/XS
<b>8</b> :	View Attributes		3 Views Plan/XS/3D
	Model Properties		4 Views Plan/Profile/XS/3D
	Open a Dynamic Cros Select OK to Create a OK		
	UK		Cancer

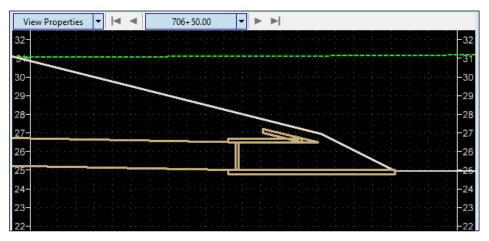
- a. Follow the next prompt to Locate Corridor or Alignment by selecting **CL\_SR61**.
- b. Fill in the dialog with the settings: Left Offset = 0, Right Offset = 100, Station = 706+50, Interval = 10. Left click to accept these settings in the prompts until the Select or Open View prompt is active. Click anywhere within the blank window to automatically load the cross section.



- 2. Since the MES was placed using a 0.00' vertical offset from the pond surface, the initial pipe invert of P-101 defaulted to the elevation of the pond at the node reference point location. However, now that the S-102 outlet structures is linked to P-101, when we override the downstream invert to EL 25.00, the MES invert elevation will follow.
  - a. In plan view, select and open properties for P-101. Type in 25.00 in the Stop Invert field:

~
S-101
S-102
25.95
25.00
1.50'
True
20
Open Utility Properties

b. In cross section view, click in the window to refresh and see updates both to P-101 and S-102 inverts.

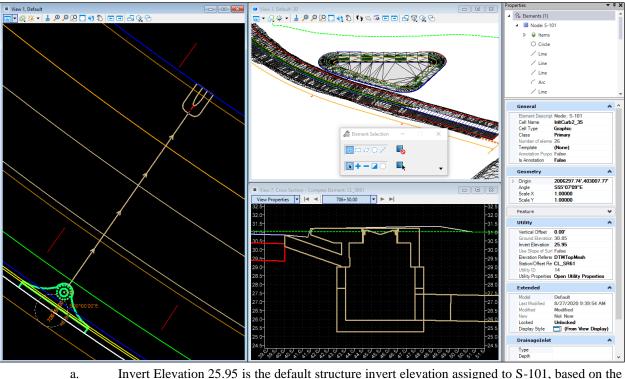




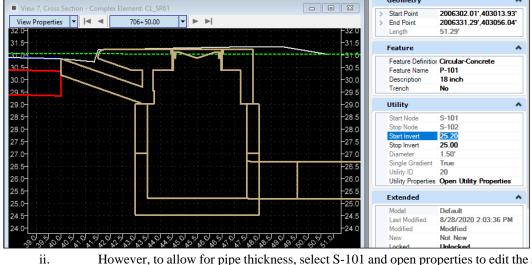
Next, verify the change in S-102 by selecting the node in plan view and open properties.

Utility	*
Vertical Offset	0.00'
Ground Elevation	27.21
Invert Elevation	25.00
Use Slope of Surf	False
Elevation Referer	default
Station/Offset Re	CL_SR61
Utility ID	15
Match Slope of C	False
Utility Properties	Open Utility Properties

3. Finally, in cross section view, zoom in towards the curb inlet, S-101. In plan view, open S-101 properties.

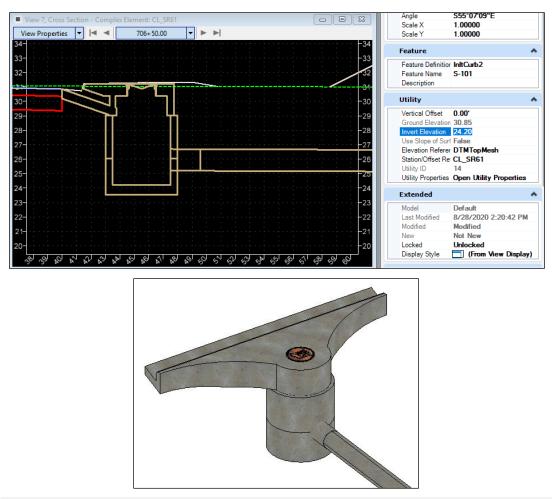


- Invert Elevation 25.95 is the default structure invert elevation assigned to S-101, based on the default height defined in the feature definitions. Similar to the default pipe invert assigned at S-102, the initial P-101 upstream invert matches the structure invert of S-101. The pipe and structures inverts are linked to a point. The steps below will demonstrate this.
  - If the pipe invert is lowered below the structure invert, the structure invert will automatically be lowered to match. Select P-101, open properties, and edit the upstream invert elevation to 25.20.



However, to allow for pipe thickness, select S-101 and open properties to edit the structure invert to 24.20. This time, the P-101 pipe invert, does not follow, but remains at 25.20.

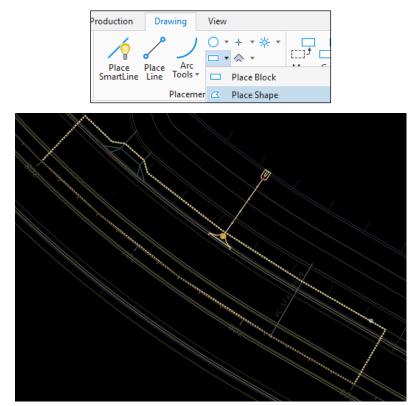
i.



*Note* Refer to Standard Plans Index 425-001 for standard placement of structure bottom relative to pipe.

## **Exercise 2.9** Place Catchment

 Reset view control to plan view and zoom in towards S-101. Use F5 to Toggle Dim References. Navigate to DRAINAGE AND UTILITIES>DRAWING>Placement> Place Shape and click to activate tool. For this exercise, draw a polygon from approximately center of median to back of sidewalk (RT) from Station 705+00 to 708+00. For this exercise, the active level (the level the preliminary shape is drawn) does not matter.



2. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Layout> **Place Catchment** and click to activate tool. The tool and dialog will open by default with the prompt for 'Select Layout Method'.

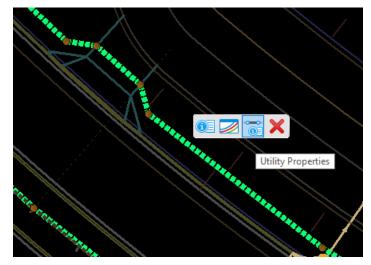
Select L	ayout Method	
Method	Pick Shape 🧹	

- 3. Before following plan view prompts, update the dialog with the following:
  - a. Select the Pavement feature definition from the pull-down menu: Drainage Area: Catchment: Drainage Areas: **Pavement**. By default, this feature will assign a C value of 0.95.
  - b. Since the catchment we intend to place drains to S-101, type in the Name Prefix **DR-101**.

Place	- 🗆	$\times$
Method	Pick Shape	$\sim$
Feature		
reature		•
Feature Definition	Pavement	~

- 4. Follow the plan view prompts, left clicking to accept the settings.
  - a. Pick the shape drawn in step 1.
  - b. Select **S-101** as the outflow.

- c. <Reset> (right click) to continue picking without reference surface and close tool.
- 5. Select the shape and hover over the linework to bring up quick menu. Select Utility Properties.



6. The input used for hydraulic analysis are shown below. Most properties are inherited from the Pavement feature definition, but Time of Concentration needs input. Enter **10.00** (minutes.)

	Properties - Catchment - D	
Sub	surface Utilities Hydraulic Ana	alysis
D	R-101	V 🔍 🕜 75% 🔨
T	Add to Selection	
<sh< td=""><td>now All&gt;</td><td>~</td></sh<>	now All>	~
Prop	perty Search	م ~
~	<general></general>	,
	ID	446
	Label	DR-101
	Notes	
	GIS-IDs	<collection: 0="" items=""></collection:>
	Hyperlinks	<collection: 0="" items=""></collection:>
	Feature Definition	DrainageArea\Catchment\Drainag
~	<geometry></geometry>	
	Geometry	<collection: 13="" items=""></collection:>
	Scaled Area (acres)	0.334
	Use Scaled Area?	True
~	Active Topology	
	Is Active?	True
~	Catchment	
	Outflow Element	S-101
~	Inflow (Wet)	
	Inflow (Wet) Collection	<collection: 0="" items=""></collection:>
~	Runoff	
	Runoff Method	Rational Method
	Area Defined By	Single Area
	Runoff Coefficient (Rational)	
	Tc Input Type	User Defined Tc
	Time of Concentration (min)	
	Time of Concentration (Comp	10.000
~	Results	
	Calculation Messages	<collection: 0="" items=""></collection:>
	Area (Unified) (acres)	0.334
~	Results (Catchment)	
		(N/A)
	Catchment Flow Time (min)	(N/A)
	Catchment Intensity (in/h)	(N/A)
	Catchment Rational Flow (cf	(N/A)

7. There's one more change to DR-101 to better represent the ratio of previous and impervious cover. As an alternative to placing separate shapes for different C values, we're going to edit the properties of DR-101 to calculate the weighted C value. In the Runoff category, select the pulldown for Area Defined By and Select Multiple Subareas.

~	Runoff	
	Runoff Method	Rational Method
	Area Defined By	Single Area 🗸 🗸
	Runoff Coefficient (Rational)	
	Tc Input Type	Single Area
	Time of Concentration (min)	10.000
	Time of Concentration (Comp	10.000

8. In the SubAreas line, click the ellipse next to <Collection: 0 Items>

~	Runoff						
	Runoff Method	Rational Method					
	Area Defined By	Multiple Subareas					
	Subareas	<collection: 0="" items=""></collection:>					
	Tc Input Type	User Defined Tc					
	Time of Concentration (min)	10.000					
	Time of Concentration (Comp	10.000					

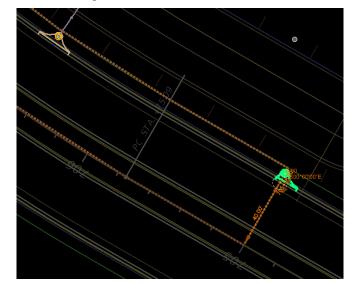
9. Enter the following into the Subareas – Catchment (DR-101) window prompted by the ellipse, select OK to close the dialog. Close utility properties.

Subareas - Catchment (DR-101) X								
$\square \times$								
Area / Total Area Surface Runoff Area (acres) Description Coefficien								
1	80.0	0.267	Pavement	0.95000				
2	20.0	0.067	Grass	0.25000				
*								
		ОК	Cancel	Help				
		UN	Cancer	Theip				

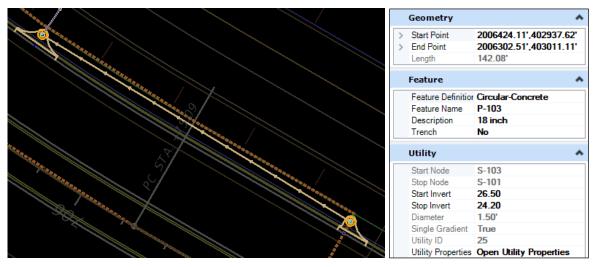
*HINT* In OpenRoads, the Drainage and Utilities tables usually represent calculated values in yellow cells and editable fields in white cells.

# **Exercise 2.10** Place Gutter

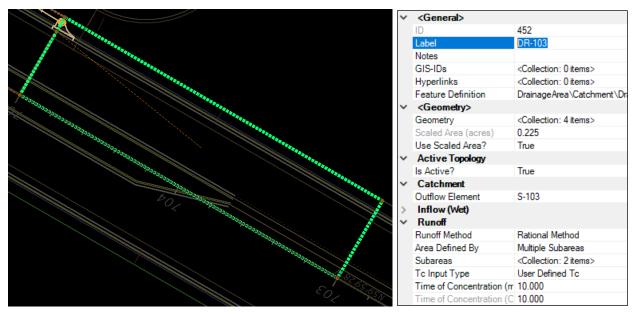
1. Before placing a gutter, use Place Node tool to add S-103, a new curb inlet, Type 1 (RT), at Station 705+00, 40' LT. Refer to steps in Exercise 2.5 as needed.



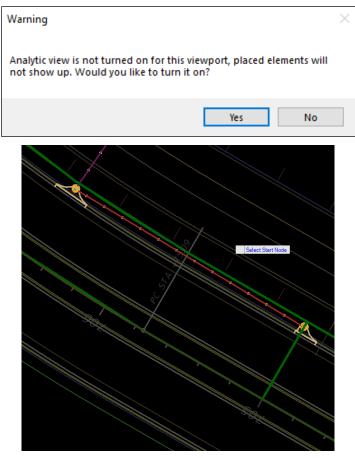
2. Next, use Place Conduit tool to add P-103, a new 18" Circular-Concrete pipe, from S-103 to S-101. Refer to steps in Exercise 2.7 as needed.



3. Also, use Place Catchment tool to add DR-103, a new drainage area, from approximately Station 703+00 to 705+00. Refer to steps in Exercise 2.9 as needed.

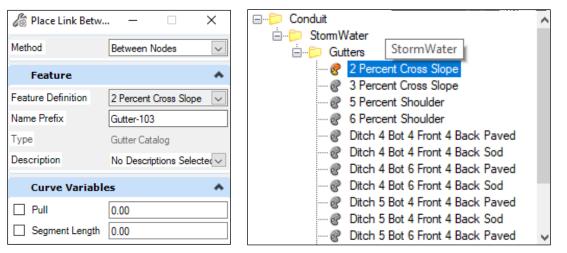


4. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Layout> **Place Gutter** and click to activate tool. After selecting Yes to the warning dialog to turn on Analytic View, the tool will open by default with the prompt for 'Select Start Node' and a change to the view symbology:



- 5. Before following plan view prompts, update the dialog with the following:
  - a. Select the 'Between Nodes' Method

- b. Select the '2 Percent Cross Slope' feature definition from the pull-down menu: Conduit: Stormwater: Gutters:
- c. Since the pipe we intend to place is from S-103 to S-101, type in the Name Prefix Gutter-103.



- 6. Now that the dialog is set up, we'll follow the prompts to place the gutter. Select S-103 as the Start Node and S-101 as the Stop Node.
- 7. Once placed, select the new Gutter-103 and open properties. By default, the inverts of Structures S-103 and S-101 are set as Start and Stop Invert of the gutter. Override these elevations to match the surface, the structure top elevations shown in the corresponding node properties.

Feature	*
Feature Definition Feature Name Trench	2 Percent Cross Slope Gutter-103 No
Utility	*
Start Node	S-103
Stop Node	S-101
Start Invert	31.40
Stop Invert	30.85
Single Gradient	True
Utility ID	453
Utility Properties	Open Utility Properties

8. Close open dialogs. With the gutter placed, the sample network is complete and ready for computations.

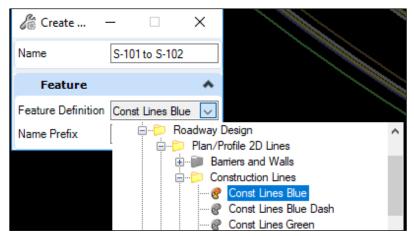
1. Use view control to select **2 Views Plan/Profile**. Select **Cancel** at the Open a Dynamic Profile View prompt.

View Control	•	1 View
Сору		2 Views Plan/3D
Move		2 Views Plan/XS
Scale		2 Views Plan/Profile

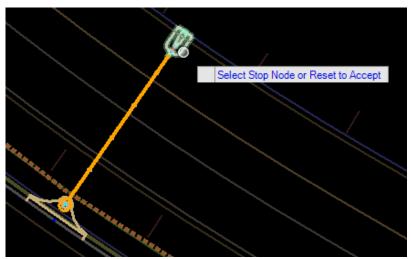
2. Navigate to DRAINAGE AND UTILITIES>LAYOUT>Profile Runs> **Hydraulic Run from Node** and click to activate tool. The tool will open by default with the prompt for 'Select Start Node ':



- 3. Before following plan view prompts, update the dialog with the following:
  - a. Enter 'S-101 to S-102' in the Name field.
  - b. Select the Const. Lines Blue feature definition from the pull-down menu: Linear: Roadway Design: Plan/Profile 2D Lines: Construction Lines: **Const. Lines Blue.**

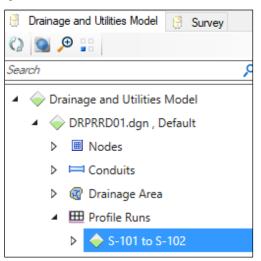


- 4. Follow prompt and select S-101 start node.
- 5. Select S-102 as Stop Node and left click to Accept Profile Run.



2-39

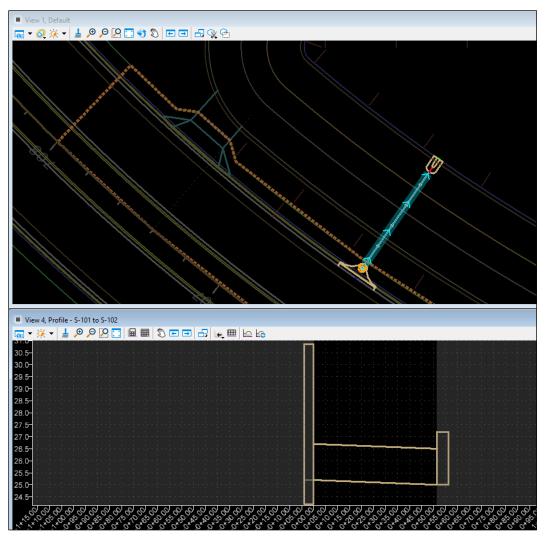
6. If not already docked and open, click F11 to Toggle Project Explorer, or use following path and navigate to profile runs: OpenRoads Standards tab: DRAINAGE AND UTILITIES>HOME>PRIMARY>Explorer>Drainage and Utilities>Drainage and Utilities Model>DRPRRD01.dgn>**Profile Runs**.



7. Right click on S-101 to S-102 to view the tools available to manage this profile from explorer.

🛛 🌐 Profile Rur	ns	
▲ 🔶 S-101 ▷ 토 De	E	Open Profile Model
		Open Analysis Profile
⊨ p	101	Open Engineering Profile
		Rename
	5	Reverse Profile Run
	<b>\$</b>	Regenerate Profile Run
	0	Lock - Deactivate Profile Run Rules
		Fit To View
	×	Delete
	€	Zoom
		Isolate
		Clear Isolate

8. Select Open Profile Model and follow prompt to Select or Open View by clicking anywhere within the blank profile view window below the plan view window.

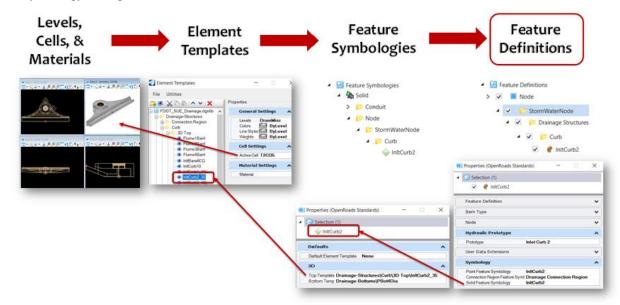


*Note* In OpenRoads, if a profile is active in a view, the related linework in plan, including direction of stationing is shown highlighted in plan view. Stationing in Drainage and Utilities profiles are along the pipe run and always start at 0+00.00.

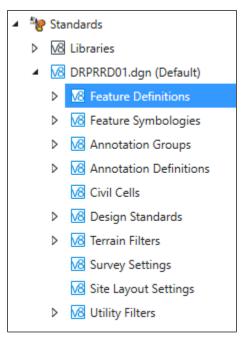
### **Exercise 2.12** Create a J-Bottom drainage structure Feature Definition

There will be cases where a project needs a variation of a drainage structure that is not provided in the default FDOT DGNLib. This exercise shows how to create a new Feature Definition in the DGN design file, by copying a similar structure and editing for changes. A Type 2 Curb Inlet with a 5' diameter J-bottom will be created based off the 'InletCurb2' (P-bottom) definition.

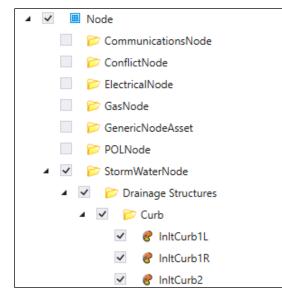
To trace how the Symbology links are made in a Features Definition, this exercise is going to start from the right side of graphic below, at the Feature Definition and work its way left through Feature Symbology's and Element Templates (Steps 1 - 5). Finally, the exercise will work from left to right to re-link connections to the new symbology's (Steps 5-6).



1. While in the Default or Multi-Model Views in DRPRRD00.dgn, use the Explorer Dialog (Function Key F11 if you do not have it docked). Navigate to the OpenRoads Standards Tab then click on Standards to expand list. The list contains loaded DGN Libraries and the current file you are in. Expand DRPRRD00.dgn.



2. Expand Feature Definitions and scroll down to Node: Stormwater Node: Drainage Structures: Curb: to view all the feature definitions that have been brought into this DGN from the default DGNLib through placement of structures.



3. Right click on **InltCurb2** and select **Copy.** This will automatically duplicate the feature definition. For this example, the new feature is for a Type 2 Curb Inlet with a 5' diameter J-bottom; rename **InletCurb2J5Dia**.

	Cut				
	Сору				
	Rename				
	Delete				
61	Properties				
€	Zoom	~	8	InItCurb2	
	lsolate Clear Isolate	$\sim$	8	InltCurb2J5Dia	

4. Right click on **InltCurb2J5Dia** and open properties. Review and see properties copied from the Pbottom definition. It is appropriate for some properties to remain, but some need changes for the Jbottom.

@] Properties (OpenRoads Standards)     -						
🔺 🌍 Selection (1)						
✓ 🔗 InItCurb2J5Dia						
Feature Definition				*		
Name	InItCu	tb2J5Dia				
Description	Curb I	nlet Type 2				
Name Seed	S-					
Item Type				*		
Item Type	Draina	gelnlet				
Node				*		
Default Height	3.90'					
Use Slope of Surface	True					
Structure Type		urb Opening				
Network Type	Storm	Water Only				
Hydraulic Prototype				*		
Prototype	Inlet C	urb 2				
User Data Extensions				*		
User Data Extensions	<colle< td=""><td>ction: 0 Items&gt;</td><td></td><td></td></colle<>	ction: 0 Items>				
Symbology				*		
Point Feature Symbology		nltCurb2				
Connection Region Feature Symb		Drainage Connection Reg	ion			
Solid Feature Symbology		nltCurb2				

- a. Feature Definition: Name, Description, and Name Seed:
  - i. Add to Description: "J-Bottom 5' Dia."
- b. Item Type: no change needed.
- c. Node: no changes needed.
- d. Hydraulic Prototype: no change needed.
- *Note* The Physical properties within the Hydraulic Prototypes include structure bottom sizes and dimensions. For networks that model losses within structures, it may be appropriate to create a new Prototype for Jbottom structures. However, for simple drainage networks, the bottom size does not significantly impact the hydraulic performance.
  - e. User Data Extensions: no change needed.
  - f. Symbology: only the Solid Feature Symbology will need changes (see Step 6), but first a new symbology is required.
  - 5. Close the properties dialog and navigate back through Explorer and right click to make a copy of the InltCurb2 Solid Feature Symbology: OpenRoads Standards: DRPRRD01.dgn: Feature symbology's: Solid: Node: Stormwater Node: Curb: InltCurb2. Name the new symbology to match the new feature definition: InltCurb2J5Dia and right click to open properties.

4	😵 Standards	Properties (OpenRoads Standards)	– 🗆 X
	<ul> <li>Libraries</li> <li>DRPRRD01.dgn (Default)</li> <li>Reature Definitions</li> <li>Feature Symbologies</li> </ul>	<ul> <li>Selection (1)</li> <li>InltCurb2J5Dia</li> </ul>	
	▷ ∕ Linear ▷ ∲ Point	Defaults Default Element Template None	*
	▷ ⚠ Profile ▲ 🌆 Solid ▷ 📂 Conduit	3D	*
	<ul> <li>Conduit</li> <li>Node</li> <li>StormWaterNode</li> <li>Curb</li> <li>InitCurb1L</li> <li>InitCurb1R</li> <li>InitCurb2</li> </ul>	Bottom Template Drainage-Bottoms      Drainage-Bottoms     PBot4Dia     PBot4Dia	S A
	InltCurb2J5Dia	Manage Templates	

- a. The Bottom Template for 3D will need to be updated for a J-bottom structure. Use the pulldown menu to select **JBot5Dia**.
- *Note* Bottom cells and corresponding Element Templates are available for standard J-bottom sizes. If a special structure cell has been added to a cell library, a corresponding Element Template can be created from the **Manage Templates...** dialog. As shown below, Element Templates generally define which cell is used and how it is displayed.

Element Templates			_	Х
File Utilities				
📮 🤞   🔏 🗅 🛍   🔺 🖌 🍃	Properties			
DRPRRD01.dgn	General Settings			*
	Levels Colors	DrainStruct_px		
⊡…⊃ Drainage-Bottoms 	Line Styles	ByLevel		
	Weights	🔛 ByLevel		
	Cell Settings			*
i ⊕ ⊃ Linear v	Active Cell	J5		
< >				

6. Now that the Solid Feature Symbology is set, re-link the symbology properties in Feature Definitions. The feature definition will now be ready to place.

Properties (OpenRoads Standards)	- 🗆 X
<ul> <li>Selection (1)</li> </ul>	
✓ InltCurb2J5Dia	
Feature Definition	~
Name	InItCurb2J5Dia
Description Name Seed	Curb Inlet Type 2 J-Bottom 5' Dia. S-
Name Seed	5-
Item Type	~
Item Type	DrainageInlet
Node	~
Default Height	3.90'
Use Slope of Surface	True
Structure Type Network Type	Inlet Curb Opening Storm Water Only
Network Type	Storm Water Only
Hydraulic Prototype	~
Prototype	Inlet Curb 2
User Data Extensions	~
User Data Extensions	<collection: 0="" items=""></collection:>
Symbology	*
Point Feature Symbology	InItCurb2
Connection Region Feature Symbology	Drainage Connection Region
Solid Feature Symbology	InltCurb2J5Dia
	Flume3Bard2
	····· · · · · · · · · · · · · · · · ·
	······································
	InitCurb 1L
	InitCurb2
	InltCurb2J5Dia
	InitCurb3L

# **3** DESIGN AND ANALYSIS

# INTRODUCTION

The main focus in this chapter will be on: Drainage Design and Analysis.

This chapter will introduce several important tools and features available in the Drainage and Utilities Workflow and FDOTCONNECT Workspace to design, analyze, and view computation results for a drainage network. They are:

- Default Design Constraints
- Engineering Standards
- Scenarios
  - Alternatives
  - o Calculation Options
- Calculation and Analysis
  - o Validation and Notifications
  - Compute Center
  - Calculation Summary
  - o Flex Tables
  - o Analytic Profiles

In OpenRoads Designer CONNECT Edition, the Drainage and Utilities tools include automatic design capabilities including "*size conduits, set node invert elevations and determine the size of inlets to pass a design storm while meeting user-specified constraints.*" For purposes of this chapter, the term 'Design' generally refers to the various automated design functions in OpenRoads.

*Note* 'Design Considerations' from Bentley Drainage and Utilities CONNECT Edition help: "As with any automated design, the program's design is intended only as a preliminary step. It will select pipe sizes and pipe invert elevations based on the input provided, but no computer program can match the skills that an experienced engineer has. The modeler should always review any automated design, and should make any changes required to adjust, improve, and otherwise polish the system."

# **DEFAULT DESIGN CONSTRAINTS**

When Drainage and Utilities is used for 'Automatic Constraint Based Design', the Default Design Constraints allow users to define global constraints that are considered in the design algorithm.

Default Design Constraints is accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Tools > Default **Design Constraints**:

引 Drai	nage and Utilities	- 😑 🔚 🖥	io 🔶 - A 🕏	🚔 =				C:\Worksets\F[	OOT\2204955520
File	Home Layou	ut Analysis	Components	Utilities View	Tools	Report	Drawing Produ	ction Drawir	ng View
<b>~</b> € ■ ▼ ©]	Element Selection	Scenarios	Alternatives Options Compute	<ul> <li>Validate</li> <li>Calculation</li> <li>Notificatio</li> </ul>			ering Standards	Compute C 🛷 Default Desi	enter gn Constraints
Primary	Selection			Calculation				A	analysis Tools

As described in Bentley Drainage and Utilities CONNECT Edition Help:

*Pipe diameters, invert elevations, node structures, and inlets can be all designed with the same set of design constraints. You also have the option to adjust these values individually for each pipe or structure.* 

The Default Design Constraints dialog is divided into the three following tabs:

- Gravity Pipe
- Node
- Inlet

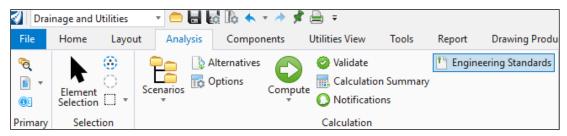
Default Design Constraints			$\times$
Gravity Pipe Node Inlet Default Constraints	tive Stress Simple ~ 2.50 ft/s 15.00 ft/s	Extended Design Part Full Design Is Part Full Design? Percent Full Constraint Type: Simple Percentage Full: 100.0 %	
		Close Search Help	

In the FDOTCONNECT Workspace, default settings have been assigned where applicable to align with FDOT standard practices and criteria. There are also some defaults that will be project-specific, such as Inlet: Maximum Spread.

For additional details on how constraints are evaluated during automated design, see 'Design Priorities' topic in Bentley Drainage and Utilities CONNECT Edition Help.

# **ENGINEERING STANDARDS**

Engineering Standards allow users to assess the model relative to user defined criteria and is accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Engineering Standards:



As described in Bentley Drainage and Utilities CONNECT Edition Help:

Engineering Standards allow you to define custom validation rules that will generate messages pointing to input values in the model that, while they could be computed without causing errors, are not of good engineering judgement.

🖄 En	gineering S	tandards							— C	X I
$\square \times$	Ъ 🗸 I	🛃 🕂								
	Enable	Label	Severity	Element Type	Include Elements	Field	Test Criterion	Value	Min	Max
*										
								ОКС	ancel	Help

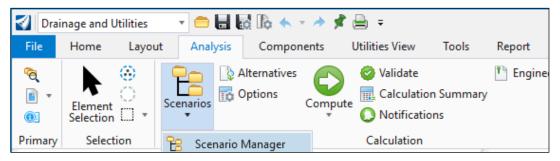
Results of the Engineering Standards validation are reported in the Engineering Standards tab within the User Notifications Manager.

In the FDOTCONNECT Workspace, there are no predefined Engineering Standards. *PLACEHOLDER: It is anticipated this function may be included with typical drainage design documentation to demonstrate various FDOT Drainage Manual Criteria are met.* 

# **S**CENARIOS

In the OpenRoads Designer CONNECT Edition environment, Scenarios are used by the Drainage and Utilities Model to manage all the data, properties, and settings required to perform hydraulic calculations.

The Scenario Manager tool is accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Scenarios > Scenario Manager.



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

A Scenario contains all the input data (in the form of Alternatives), calculation options, results, and notes associated with a set of calculations. Scenarios let you set up an unlimited number of What If? situations for your model, and then modify, compute, and review your system under those conditions.

You can create scenarios that reuse or share data in existing alternatives, submit multiple scenarios for calculation in a batch run, switch between scenarios, and compare scenario results--all with a few mouse clicks. There is no limit to the number of scenarios that you can create.

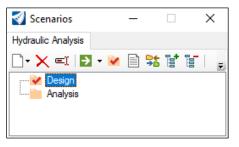
There are two types of scenarios:

- Base Scenarios—Contain all of your working data. When you start a new model, you begin with a default base scenario. As you enter data and calculate your model, you are working with this default base scenario and the alternatives it references.
- Child Scenarios—Inherit data from a base scenario, or other child scenarios. Child scenarios allow you to freely change data for one or more elements in your system. Child scenarios can reflect some or all of the values contained in their parent. This is a very powerful concept, giving you the ability to make changes in a parent scenario that will trickle down through child scenarios, while also giving you the ability to override values for some or all of the elements in child scenarios.

When creating new scenarios, the inherent capabilities can be utilized within Parent-Child scenario relationships to define whether the new scenarios are independent or share data and to help manage variations in global properties. Refer to Bentley Learn Resources, "Managing Multiple Scenarios" for further training.

In the FDOTCONNECT Workspace, there are two base scenarios copied into the DGN file from the Hydraulic Seed File: Design and Analysis. Both base scenarios use the 'Base' Alternatives but differ in Calculation Options.

- An Analysis performs calculations but does NOT change structure properties
- A Design option performs calculations and MAY change structure properties.



*Note* When working in a DGN with multiple scenarios, it is important to know which Scenario is current. This is designated by a red check and dictates what information is active / displayed in the model and available in tables and calculation results.

4	Properties (no selection)	– 🗆 X	刻 Propertie	es - Scenario - Ar	nalysis (1 —	×		
Sul	osurface Utilities Hydraulic A	nalysis	Subsurface U	ilities Hydraulic A	Analysis			
		V 🔍 😯 75% V			✓ 🔍 😮 🛛 75%	$\sim$		
1	Add to Selection		A	Add to Selection	_			
			C + 0 +		11			
<s< th=""><th>now All&gt;</th><th>× 1</th><th><show all=""></show></th><th></th><th>~</th><th>2</th></s<>	now All>	× 1	<show all=""></show>		~	2		
Pro	perty Search	- م ~	Property Sear	:h	~ ~	o -		
~	<general></general>		∽ <gener< th=""><th>als</th><th></th><th></th></gener<>	als				
	ID	1			127			
	Label	Design	Label		Analysis			
	Notes		Notes					
~	Alternatives		✓ Alternati	ves				
	Active Topology	Base Active Topology	Active To	pology	Base Active Topology			
	User Data Extensions	Base User Data Extensions	User Dat	a Extensions	Base User Data Extensions			
	Physical	Base Physical	Physical		Base Physical			
	Boundary Condition	Base Boundary Condition	Boundary	Condition	Base Boundary Condition			
	Initial Settings	Base Initial Settings	Initial Set		Base Initial Settings			
	Hydrology	Base Hydrology	Hydrolog	v	Base Hydrology			
	Output	Base Output	Output		Base Output			
	Infiltration and Inflow	Base Infiltration and Inflow	Infiltratio	and Inflow	Base Infiltration and Inflow			
	Rainfall Runoff	Base Rainfall Runoff	Rainfall F	Runoff	Base Rainfall Runoff			
	Water Quality	Base Water Quality	Water Qu	ality	Base Water Quality			
	Sanitary Loading	Base Sanitary Loading	Sanitary Loading Base Sanitary Loading					
	Headloss	Base Headloss	Headloss		Base Headloss			
	Operational	Base Operational	Operatio	nal	Base Operational			
	Design	Base Design	Design		Base Design			
	System Flows	Base System Flows	System F	lows	Base System Flows			
	SCADA	Base SCADA	SCADA		Base SCADA			
	Energy Cost	Base Energy Cost	Energy C	ost	Base Energy Cost			
~	Calculation Options		✓ Calcula	ion Options				
	Solver Calculation Options	Design	Solver Ca	alculation Options	Analysis			
	<b>bel</b> scriptive label for this elemen	nt.	Label Descriptive la	abel for this eleme	ent.			

By default, the Properties of Design (shown left) and Analysis (shown right) Scenarios have the same 'Base' settings except for Solver Calculation Options.

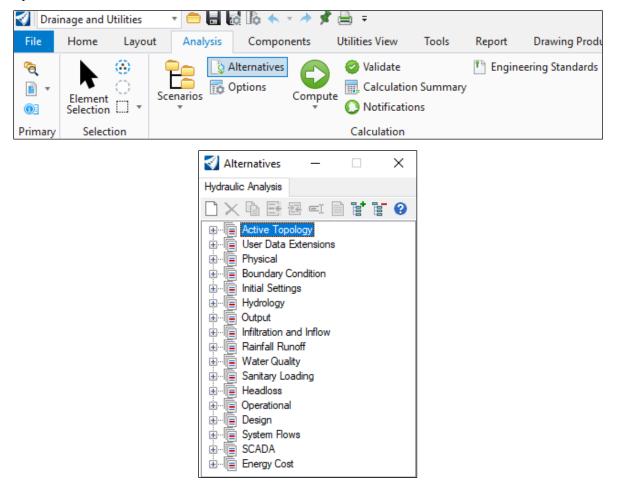
# ALTERNATIVES

As shown in the Design and Analysis scenario properties above, Scenarios do not contain any specific data, but rather reference the various Alternatives.

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Alternatives are the building blocks behind scenarios. They are categorized data sets that create scenarios when placed together. Alternatives hold the input data in the form of records. A record holds the data for a particular element in your system.

Similar to Scenarios, Drainage and Utilities models start with Base Alternatives but allow for creation of child alternatives. Alternatives can be edited and created through the Alternatives Manager tool, accessible from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Alternatives.



Not all types of Alternatives will be used on typical FDOT drainage design projects. Listed below are several types that may be useful for typical FDOT projects.

#### ACTIVE TOPOLOGY ALTERNATIVE

As defined in Bentley Drainage and Utilities CONNECT Edition Help:

The Active Topology Alternative lets you temporarily remove areas of the network from the current analysis.

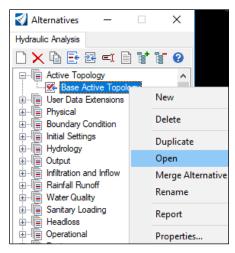
The Active Topology dialog box is divided into tabs for each element type.

For each tab, the same setup applies—the tables are divided into three columns. The first column displays whether the data is Base or Inherited, the second column is the element Label, and the third

column allows you to choose whether or not the corresponding element is Active in the current alternative.

To make an element Inactive in the current alternative, clear the check box in the Is Active. field that corresponds to that element's Label.

The Alternative Editor Dialog Boxes, including the Active Topology Alternative Editor, can be accessed through the Alternatives Tool and right-click: open or double-clicking the specific alternative.



The Alternative Editor dialog boxes are typically organized with tabs for different Drainage and Utility features:

E Active Top	pology : Base	Active Topo	logy (DRPRF	RD01 D	. –		$\times$
(€D) <b>+ 11</b> D <b>+</b>	E 😮						
Conduit	Ø Lateral	Ø Channel	🔲 Gutter	Ø Press	ure Pipe	Catch	E + +
	*	ID	Label	Is Active?			
* 🔽 = Base d	lata	🖌 = Loc	cal data		= Inheri	ted data	

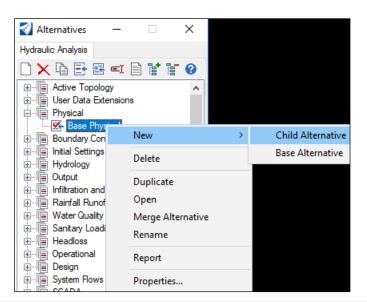
#### USER DATA EXTENSIONS ALTERNATIVE

In the FDOTCONNECT Workspace, there are several User Data Extensions that have been defined for various drainage feature types (Conduit, Catch Basin, Manhole, Outfall, and Headwall). These do not affect hydraulic calculations but are provided to help expedite plans production and drainage documentation. Many are pick lists which can be selected for proposed drainage features within this dialog box, other flex tables, or in Utility Properties. User Data Extensions will be discussed later in this manual.

#### PHYSICAL ALTERNATIVE

A Physical Alternative stores the various physical properties used for hydraulic calculations that are assigned to drainage features, primarily sizes and elevations. The Physical Alternative Editor can be a useful interface to make individual or global edits to the drainage features in the model.

Multiple Physical Alternatives allow for comparison between different variations in design (e.g. pipe sizes, inverts, etc.) without losing older versions that may still be useful during the design process. New Base or Child Physical Alternatives can be created within the Alternative Dialog. Also, Physical Alternatives may be created automatically through prompts when computing a "Design" Scenario.

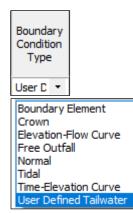


*Note* PLACEHOLDER: are there FDOT deliverable requirements, or any cautionary notes needed when drainage models include multiple versions?

#### **BOUNDARY CONDITION ALTERNATIVES**

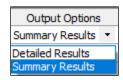
The boundary condition alternative allows users to define boundary condition settings for outfall elements. Generally, 'Crown' or 'User Defined Tailwater' settings are best suited to meet FDOT Drainage Manual requirements.

Multiple boundary condition alternatives are useful when tailwater elevations change for different storm events.



#### **OUTPUT ALTERNATIVES**

The output alternative allows users to define output options for network elements, including conduits and channels.



As described in Bentley Drainage and Utilities CONNECT Edition Help:

When Summary Results is selected, the result attributes are displayed for the start, end, and middle of the conduit. Drainage and Utilities breaks a conduit up into a number of longitudinal sections.

When Detailed Results is selected, the result attributes are displayed for each of the longitudinal sections of the conduit. Only Summary Results are displayed in the graphs and reports for conduits.

In FDOTCONNECT Workspace, Summary Results is the default option selected in the Base Output.

#### RAINFALL RUNOFF ALTERNATIVES

The rainfall runoff alternative allows users to define runoff data for global rainfall or specific drainage elements such as outfalls, catchments and ponds for multiple storm events. By default, there is a single alternative, Base Rainfall Runoff. Users can set this event within the Rainfall Runoff Alternative Editor or the Global Storm Events dialog.

New rainfall runoff alternatives can be added for use in other scenarios, such as the absolute 4 in/hr intensity for spread analysis at curb inlets.

Alternatives	-		×			
Hydraulic Analysis						
🗋 🗙 🖣 📑 🗃	=i 🖹		- <b>0</b>			
Active Topology	nsions ition nflow					
Base Rainfo ⊕… 🕞 Water Quality	all Ru	Nev	v	3		
Sanitary Loadin Headloss Coperational System Flows	g	Delete				
Operational     English		Dup	olicate			
		Оре	en			
		Me	rge Alteri	native		
		Ren	ame			
		Rep	ort			
		Pro	perties			

🔄 Rainfall Runoff : Base Rainfall Runoff (DRPRRD01 Default.stsw) — 🛛 🛛 🗙									
is 🕶 🖏 💌 📄 😮									
Global Rainfall Ø Manhole	Outfall 🛄 Catchment 🖉 Pond 🖉 Wet Well								
Storm Events	Storm Events								
Alternative:	Base Rainfall Runoff								
Global Storm Event:	Zone 2 - 3 Year V								
Source:	Orphan (local)								
Return Event:	3								
Intensity (Average):	(N/A)	in/h							
Depth:	(N/A)	in							
Duration (Modified Rational):	0.000	min							
Maximum Storm Intensity:	7.596	in/h							
Climate Adjustments									
Climate Adjustment Type:	None ~								
Climate Adjustment:	0.0	%							
SWMM Climatology									
* 🔽 = Base data 🔍	= Local data 🔲 = Inherited data								

😤 Glo	🛱 Global Storm Events X										
	Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)	
12: Ba	Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0	
									Close	Help	

#### HEADLOSS ALTERNATIVE

The headloss alternative editor allows users to define headloss properties for manhole, catch basins and conduit elements.

In the FDOTCONNECT Workspace, the Base Headloss alternative default methodology for Minor Losses is the Standard Loss Method. This is consistent with FDOT Drainage Design Guide 6.5.7 and FDOT drainage structure feature definitions are set up for user-defined loss coefficients.

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Standard loss method - a user-defined loss coefficient is used to calculate the head loss based on the velocity head of the exit conduit. The standard method calculates structure headloss based on the exit pipe's velocity. The exit velocity head is multiplied by a user-entered coefficient to determine the loss.

Headloss :	Base Hea	dloss (DRP	RRD01 Defau	lt.stsw)						_		<
€D <b>+ 8</b> D <b>+</b> [	Ì 🕜											
Conduit	🔲 Catch I	Basin Ø	Manhole 🧔 🛛	ransition								
	*	ID	Label	Headloss Method	HEC-22 Benching Method	Absolute Headloss (ft)			Headloss Coefficient (Standard)		ow-Headlos Curve	
438: S-101		438	S-101	Standard					0.00000			
450: S-103		450	S-103	Standard					0.00000			
■ Base data ■ = Local data = Inherited data												
* 🔽 = Base da	ata	✓	= Local data		= innerited	d data						

There are several other head loss methods available, depending on the selected solver. Refer to Bentley Drainage and Utilities CONNECT Edition Help for further information.

Supported Head Loss Methods by Solvers										
	Absolute	Standard	Generic	HEC-22 (2 <sup>nd</sup> )	HEC-22 (3	<sup>rd</sup> ) AASHTO	Flow v	s. Loss	HEC-22	(Minor Loss Eq)
GVF-Convex	Y	Y	Y	Y	Y	Y	Y		Y	
GVF-Rational	Y	Y	Y	Y	Y	Y	Y		Y	
DW	Y	Y	Y	Y (simplified)						
SWMM	Y	Y			Y					
			Sup	ported Hea	d Loss Mo	ode by Solve	ers			
			Absolute	Standard	Generic	HEC-22 (2 <sup>nd</sup> )	HEC-22 (3rd)	AASHT	0	
	G	VF-Convex	HGL/EGL	HGL/EGL	HGL/EGL	HGL/EGL	EGL	HGL/E	GL	
	G	VF-Rational	HGL/EGL	HGL/EGL	HGL/EGL	HGL/EGL	EGL	HGL/E	GL	

HGL

#### **DESIGN ALTERNATIVE**

DW

SWMM

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

HGL

HGL

HGL

HGL

The Design Alternative Editor allows you to edit the pipe, node and inlet constraints governing the design of the system. It also allows you to specify which gravity elements you want designed, and the extent to which you want them designed.

HGL

EGL

The tabbed dialog for each particular type of element follows the same general format. The top of the dialog box contains several fields where the design constraints can be entered. The constraints entered in these fields are applied to every element in the table on the bottom of the dialog, except the elements that are specified to contain local values. This system allows you to rapidly enter the values that govern most of the elements in the table, and then manually override the constraints for those elements that are exceptions to the majority.

By default, the Base Design Alternative applies the global Design Constraints to all drainage gravity pipe, nodes and inlets.

# **CALCULATION OPTIONS**

Calculation Options can be edited and created through the Calculation Options Manager, accessible from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > **Options:** 

剑 🛛 Drai	nage and Utilities	- 😑 🖶 🖡	i lo 🔶 ד 🤌	🖻 🖈 🚔 🗢
File	Home Layo	ut Analysis	Components	Utilities View
	Element Selection		Alternatives Options Cor	validate
Primary	Selection			Calculation
	Calculation			×
	Solver	gn		

As defined in Bentley Drainage and Utilities CONNECT Edition Help,

Calculation options contain attributes that define how your model is calculated in the software. You create calculation options in the Calculation Options Manager. You can create several calculation options with different attributes depending on the requirements of your model.

The software contains a default calculation option called Base Calculation Options. If you do not create additional calculation options, the software will use this default option whenever you calculate your model.

In the FDOTCONNECT Workspace, several defaults defined in the Design and Analysis options have been updated from the default Bentley selections to better align with FDOT standard practices. Additional details are provided in Technical Resources. However, users are responsible to ensure calculations meet design intent and FDOT Drainage Manual criteria.

Note In FDOTCONNECT Workspace, the only difference between the default 'Design' and 'Analysis' options is the Calculation Type selection (Design or Analysis): an Analysis performs calculations but does NOT change structure properties; a Design option performs calculations and MAY change structure properties.

ub	surface Utilities Hydraulic Analysis	
		V 🔍 😮 75% v
¢	→ Add to Selection	
Sh	ow All>	~
rop	perty Search	م ~
~	<general></general>	
	ID	27
	Label	Design
	Notes	
	Active Numerical Solver	GVF-Rational (StormCAD)
	GIS-IDs (Delimited)	
	Calculation Type	Design
	Minimum Time of Concentration (min)	10.000
	Use Minimum Tc as Minimum System Time?	True
~	Gravity Hydraulics	
	Maximum Network Traversals	5
	Flow Convergence Test	0.00100
	Flow Profile Method	Capacity Analysis
	Number of Flow Profile Steps	5
	Hydraulic Grade Convergence Test (ft)	0.00
	Average Velocity Method	Actual Uniform Flow Velocity
	Minimum Structure Headloss (ft)	0.00
	Governing Upstream Pipe Selection Method	Pipe with Maximum QV
	Structure Loss Mode	Hydraulic Grade
	Include Conduit Flow Travel Time in Design	True
	Save Detailed Headloss Data?	False
	Gravity Friction Method	Manning's
		False
	Use Explicit Depth and Slope Equations?	False
	Ignore Pipe Travel Time in Carrier Pipes? Correct for Partial Area Effects?	
	Inlets	True
~		Costs and Costs
	Active Components for Combination Inlets on Grade	Grate and Curb
	Active Components for Combination Inlets In Sag	Grate and Curb
	Neglect Gutter Cross Slope For Side Flow?	True
	Neglect Side Flow?	False
	Grating Parameters (United Kingdom)	<collection: 5="" items=""></collection:>
~	Pressure Hydraulics	144
	Liquid Label	Water at 20C(68F)
	Pressure Friction Method	Manning's
~	Rational Method	<b>F</b> 1
	Use Rational Method Frequency Factors	False
	Allow Runoff Coefficient to Exceed 1.0?	False
	Carryover Modeling Method	As Flow (HEC-22)
>	Headloss (AASHTO)	

*HINT* See the bottom of Properties dialogs for detailed description of the selected field.

# **CALCULATION AND ANALYSIS**

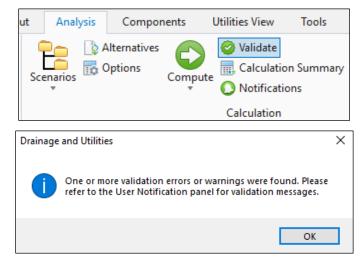
Once default design constraints, scenarios, alternatives and calculation options are set, the model is ready to begin calculating. Computing the model can be initiated directly from the ribbon, from Scenario Manager, and from the Compute Center.

Before computing, there is an optional tool available, Validate, for users to identify any input errors. If 'Compute' is run before validation, the same user notifications will appear.

# VALIDATE

As defined in Bentley Drainage and Utilities CONNECT Edition Help, the Validate tool

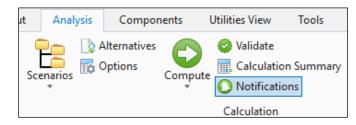
"Runs a diagnostic check on the network data to alert you to possible problems that may be encountered during calculation. This is the manual validation command, and it checks for input data errors."



Results of the validation are reported in the User Notifications Manager.

# **NOTIFICATIONS**

User Notifications are messages about the model and can be accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Notifications:



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

The User Notifications Manager displays warnings and error messages that are turned up by Drainage and Utilities V8i validation routines. If the notification references a particular element, you can zoom straight to that element by either double-clicking the notification, or right-clicking it and selecting the Zoom To command.

Warnings are denoted by an orange icon and do not prevent the model from calculating successfully.

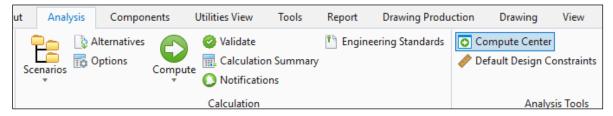
Errors are denoted by a red icon, and the model will not successfully calculate if errors are found.

User Notifi	cations						-			
Hydraulic Analys	is									
User Notifications Engineering Standards										
i 🖥 📑 🖬	è 🔍 🖏 -	0								
Message Id	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source			
44045	Analysis	Catchment	446	DR-101	(N/A)	Time of concentration for	Hydraulic	Results		
9 44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet m	Hydraulic	s Validation		

**HINT** Corresponding warning icons are shown in plan view. The subject drainage element label, Message ID, and Message will display when the mouse hovers over these icons.

# COMPUTE CENTER

The Compute Center is accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Tools > Compute Center:



As defined in Bentley Drainage and Utilities CONNECT Edition Help,

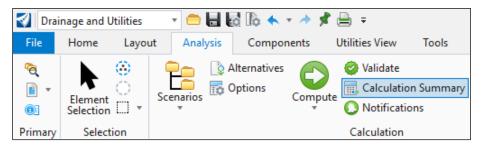
The compute center is a dialog box that enables the user to quickly and easily keep track of and modify high level settings for the current scenario. At a glance, the user can determine what the current scenario is, what the active solver is and what set of calculation options are being used. The user can also change these without getting into the detailed scenario selection and calculation options dialogs.

$\bigtriangledown$	引 Compute Center — 🗆 🗙								
Hydr	aulic Analysis								
e	📑 🎫   🏪 💼   😮								
Sce	nario								
Ana	alysis 🗸 🚽	- 🔽 🚰							
~	Calculation Options								
	Solver Calculation Options	Analysis							
~	<general></general>								
	Active Numerical Solver	GVF-Rational (StormCAD)							
	Calculation Type	Analysis							
	Minimum Time of Concentration (min)	10.000							
~	Gravity Hydraulics								
	Gravity Friction Method	Manning's							
~	Pressure Hydraulics								
	Pressure Friction Method	Manning's							

# **HINT** The Compute Center contains icons to activate most of the tools located in the **Analysis** Tab and **Calculation** Group.

# **CALCULATION SUMMARY**

The Calculation Summary window can be accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Calculation Summary:



As long as the 'Show this dialog after Compute' checkbox is checked, the following Calculation Summary window will open after Compute Scenario has been initiated and completed. A successful compute will include the line "Convergence was achieved" in the Calculation Executive Summary. 'Details...' opens the Calculation Detailed Summary, with more information organized into tabs for each drainage element type.

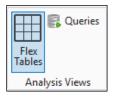
🛂 GVF-Rational Calculation	Summary					>
Scenario						
Label:	Analysis					
Storm Event						
Rainfall Alternative Label:	Base Rainfall Ru	noff				
Global Storm Event:	Zone 2 - 3 Year			1		
Return Event:	3		years			
>>>> Info: Subsurface Analysis i >>>> Info: Convergence was ac						
J I I Show this dialog after C	Compute	Messages	Report	Details	Close	Help

Calculation De	tailed Summary						×
Calculation Options	Catchment Summary	Link Summary	Node Summary	Inlet Summary	Pond Summary		
General					Hydraulics and Hydrology		
Maximum Netwo	rk Traversals:	5			Flow Profile Method:	Backwater Analysis	$\sim$
Flow Convergen	ce Test:	0.00100			Number of Flow Profile Steps:	5	
Inlets					Hydraulic Grade Convergence Test:	0.00 ft	
Neglect Side	Flow?				Average Velocity Method:	Actual Uniform Flow Velocity	$\sim$
Neglect Gutte	r Cross Slope For Side I	Flow?			Minimum Structure Headloss:	0.00 ft	
Active Compone	nts for Combination Inl	ets In Sag:	Grate and Curb	$\sim$	Minimum Time of Concentration:	10.000 min	
Active Compone	nts for Combination Inl	ets on Grade:	Grate and Curb	• ~			
						Report Close	Help

# FLEX TABLES

In addition to the Calculation Summary tables, Flex Tables are used to access information for specific types of elements in the drainage model database. The tabular format allows for easy viewing, sorting, editing, and exporting of model input and calculation results.

The Flex Table Manager can be accessed from the path: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Views > **Flex Tables:** 

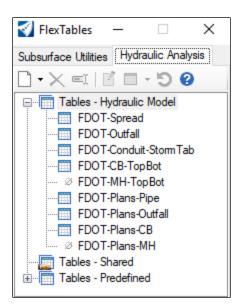


The Flex Table Manager contains two tabs: Subsurface Utilities and Hydraulic Analysis. Each tab includes a section for tables defined in the Hydraulic Model (this DGN), shared (available to multiple DGNs), and predefined (from Bentley).

FlexTables	_		×					
Subsurface Utilities	Hydraulic Analysis							
S C - II II II → X - []								
Tables - Hydraulic Model								
🗄 🖷 Tables - Pre	defined							

In the FDOTCONNECT Workspace, FDOT Flex Tables have been added to the Hydraulic Analysis tab, in the Hydraulic Model section. The FDOT tables are formatted for both plans production and design documentation purposes to follow the FDOT Design Manual and Drainage Manual. Flex Tables for plans production and drainage documentation workflows will be discussed later in this manual.

*Note* Any flex table can be edited to best fit the project. Designers should use the Drainage Manual and Drainage Design Guide to determine the information needed to represent the drainage system.



**HINT** Icons in the Flex Table Manager indicate whether the particular type of drainage element is present in the model. In the graphic above, the Ø icon next to the 'MH' tables indicates this model does not include manholes. The table icon is adjacent to elements that are present, such as catch basins (CB) and outfalls.

# PROFILES

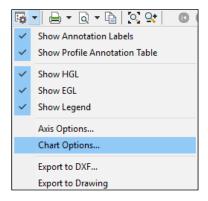
There are several ways to visualize the computation results and evaluate the network performance including three profile visualization tools that can be accessed from the path: DRAINAGE AND UTILITIES>HOME>PRIMARY> Explorer> Drainage and Utilities Model > (dgn file) > **Profile Runs** and right clicking on any profile run. Refer to Chapter 2 of this course guide for creating Profile Runs.

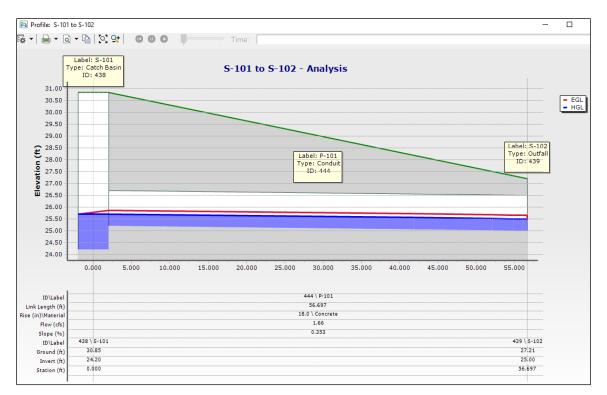
#### **OPEN PROFILE MODEL**

In FDOTCONNECT Workspace, Open Profile Model is a key tool for Plans Production, discussed later in this manual. It is used to generate a View that presents the profile run and enables the Vertical Geometry tools to interact with the features.

#### **OPEN ANALYSIS PROFILE**

This analytic profile displays the profile run with HGL and EGL results. There are multiple options to customize the display.

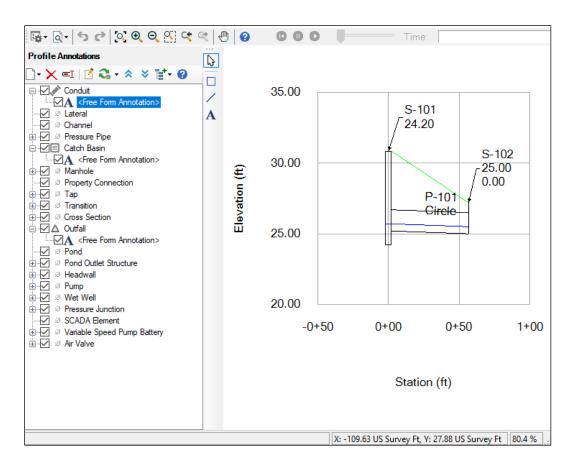




# *Note* Although this Analysis and Engineering profiles can be exported to drawing, it is a snapshot only and would not be automatically updated if the design changes.

#### **OPEN ENGINEERING PROFILE**

Similar to the Analysis Profile, Engineering Profile displays the HGL results, but includes additional customizable label options for the drainage features.



# **E**XERCISES

# EXERCISE OVERVIEW – DESIGN & ANALYSIS

In this exercise, users will select calculation settings, compute a scenario, and analyze results in a variety of methods. The network created in Chapter 2 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- 3.1 Review and Set Default Design Constraints
- 3.2 Create a new Engineering Standard
- 3.3 Create a new Analysis Scenario with adjusted Alternatives
- 3.4 Explore Compute Center, Validate the model, resolve Notifications, and Compute Scenario
- 3.5 Review Results in Flex Tables
- 3.6 Review Results in Analytic Profiles

#### **Exercise 3.1** Review and Set Default Design Constraints

- 1. Open FDOTConnect, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "DRPRRD01.dgn".
- 3. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Analysis Tools> **Default Design Constraints**:



- 4. Review the available input variables that the software will consider if automated design is performed for:
  - a. <u>Gravity Pipe:</u> Velocity, Cover, Slope, Tractive Stress, Part Full Design, Number of Barrels, and Section Size:

Gravity Pipe	Node	e Inlet					
Default Constraints				Extended Design			
Velocity	Cover	Slope	Tractive Stress		 Part Full Design	Number of Barrels	Section Size

b. <u>Node</u>:

Gravity Pipe Node Inlet								
Default Design Constraints								
Pipe Matching:	Crowns	~						
Matchline Offset:	0.00 ft							
Allow Drop Structure?								
Use Drop Structure to Minimize Cover?								
Minimum Drop Depth:	1.00 ft							

c. <u>Inlet</u>: Maximum Spread and Maximum Gutter Depth are project-specific and require user input to compute analysis or design.

Gravity Pipe Node	Inlet							
				Default On Grade Inlet Design Constraints				
Maximum Spread:		0.000	ft	Minimum Efficiency on Grade:	0.0 %			
Maximum Gutter Dep	pth:	0.00	ft					

**HINT** Minimum Efficiency on Grade is used when inlet lengths are adjusted to meet a specified efficiency and is not applicable in FDOTCONNECT Workspace, where all inlet lengths have fixed dimensions based on Standard Plans.

i. For this example, SR 61 has a 45 mph design speed with an 11 ft outside travel lane, 7 ft bike lane and Type F Curb and Gutter. Enter Maximum Spread = 14 ft. Conservatively ignoring the gutter depression, at 0.02 cross slope, enter the corresponding Maximum Gutter Depth = 0.28 ft.

Gravity Pipe Node Inlet	
Maximum Spread:	14.000 ft
Maximum Gutter Depth:	0.28 ft

*Note* Exercise 3.1 set the global Default Design Constraints. However, if a project or network has varying conditions, use Design Alternatives to assign design constraints to individual and/or groups of drainage structures as needed.

### **Exercise 3.2** Create a new Engineering Standard

In this exercise, users will create an Engineering Standard to check that Pipe Size and Length requirements for 18 inch pipes are met in the drainage model, according to FDOT Drainage Manual, 3.10.1.

- 1. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Calculation> Engineering Standards.
- 2. At the top left of the first row, click the checkbox for Enable.

Engineering Standards							
🗋 🔀 🗟   🗗 🛧							
	Enable	Label	Severit				
*							

- 3. Proceed from left to right, completing the columns for the 3.10.1 18" pipe criteria as follows:
  - a. Label = "**3.10.1 18 inch**"
  - b. Severity (select from list: Information, Warning, or Error) = **Error**
  - c. Element Type (select from list) = **Conduit**
  - d. For 'Include Elements', click the ellipse and populate the query with the following statement by double clicking from the field and symbol lists. Enter "**18**" at the end, and check the box for **Validate on OK**. Click **OK**.

💗 Query Builder - Conduit	×
Fields	> C Unique Values
Label         Diameter (n)         Diameter Correction Factor         Diversion rating curve <count>         Diversion Type         Downstream Conduit         Downstream Conduit Flow Type         Downstream Endwall Definition Type         Downstream Structure         Downstream Structure Benching         Downstream Structure Energy Grade         Downstream Structure Energy Grade</count>	
ConduitDiameter <= 18	~
	OK Cancel Help

- e. Field = Length (Construction) (ft)
- f. Test Criterion = "<="
- g. Value = **300.00**

🔁 En	Engineering Standards										
$\square \times$											
	Enable	Label	Severity	Element Type	Include Elements	Field	Test Criterion	Value			
1		3.10.1 18 inch	Error	Conduit	ConduitDiameter <= 18	Length (Construction) (ft)	<=	300.000			

4. Click the Icon for Validate Using Engineering Standards

Engineering Standards								
Enab								
1 🗸	Validate usi	ing Engineering	Standards					

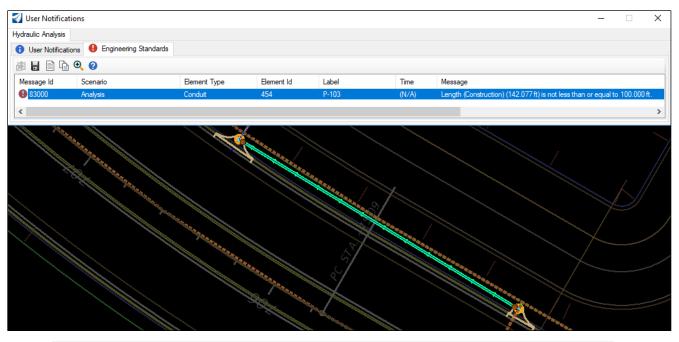
5. The validation will process and automatically close the Engineering Standards Window. Navigate to the following path to open the results DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Notifications.

ł	Vser Notifications -									
1	Hydraulic Analysis									
	User Notifications	Engineering Standards								
	<i>5</i> 1	0								
	Message Id	Scenario	Element Type	Element Id	Label	Time	Message			

- 6. Since there are no pipes that violate this criteria, the Engineering Standards tab in User Notifications is blank.
- 7. To see what happens when a 'Error' level severity Engineering Standard is violated, reopen the Engineering Standards, overwrite the 300.00 with 100.00, and click the icon for Validate using Engineering Standards.

Engineering Standards								
	Enable	Label	Severity	Element Type	Include Elements	Field	Test Criterion	Value
1	$\checkmark$	3.10.1 18 inch	Error	Conduit	ConduitDiameter <= 18	Length (Construction) (ft)	<=	100.000
*								
Drainage and Utilities Problem × One or more Engineering Standards have been violated. Please refer to the Engineering Standards tab for validation messages.								
<						ОК		ОК

8. Click OK to close the error message and Reopen User Notifications. Right click on the error and select **Zoom To**. The conduit that violated the length <= 100.00 ft criteria is now selected.

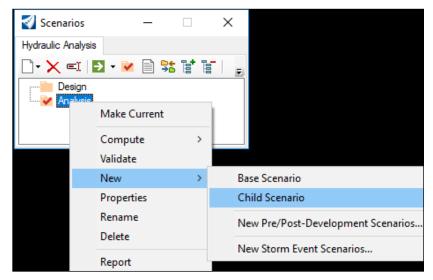


- *HINT* Errors will not allow the model to compute, until the violation is resolved. Users can set Engineering Standards severity based on the level of notification.
- 9. Close User Notifications, reopen Engineering Standards, replace 100 with 300 in the value field, and revalidate.

## **Exercise 3.3** Create a new Analysis Scenario with adjusted Alternatives

In this exercise, users will create a new scenario for a 4 inch/hr intensity event that corresponds to the Drainage Manual 3.9.1 spread criteria.

- 1. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Calculation> Scenarios> Scenario Manager.
- 2. Since we want this scenario to acquire most of the default properties from the base Analysis scenario, right click on Analysis, and select **New: Child Scenario.**



3. Name this scenario "4 in/hr Absolute Intensity (Spread Only)"

Scenarios —		×
Hydraulic Analysis		
🗋 - 🗙 🛋   🖸 - 💌 🗎 🐮 🐮 🖉	Search	0
Analysis	Ø	

4. Double-click this scenario to open the properties. The "<I>" indicates the various Alternatives and Calculation Options that can be acquired.

ubsurface Utilities Hydraulic Analysis	<ul> <li>✓ ④ ② 75% ✓</li> <li>✓ Ø</li> <li>✓ Ø</li> <li>✓ Ø</li> <li>✓ Ø</li> </ul>
Show All> roperty Search CGeneral> ID Label	الا ح ک 456
Show All> roperty Search CGeneral> ID Label	الا ح ک 456
Show All> roperty Search CGeneral> ID Label	
roperty Search	
roperty Search	
General> ID Label	
ID Label	
Label	
	4. 4. 4. 1. 1
Notes	4 in/hr Absolute Intensity (Spread Only)
<ul> <li>Alternatives</li> </ul>	
Active Topology	<l> Base Active Topology</l>
User Data Extensions	<i>&gt; Base User Data Extensions</i>
Physical	<i> Base Physical</i>
Boundary Condition	<i> Base Boundary Condition</i>
Initial Settings	<i> Base Initial Settings</i>
Hydrology	<i> Base Hydrology</i>
Output	<i> Base Output</i>
Infiltration and Inflow	<i>Base Infiltration and Inflow</i>
Rainfall Runoff	<l> Base Rainfall Runoff</l>
Water Quality	<i> Base Water Quality</i>
Sanitary Loading	<1> Base Sanitary Loading
Headloss	<i> Base Headloss</i>
Operational	<l> Base Operational</l>
Design	<l> Base Design</l>
System Flows	<i> Base System Flows</i>
SCADA	<i> Base SCADA</i>
Energy Cost	<i> Base Energy Cost</i>
Calculation Options	
Solver Calculation Options	<i> Analysis</i>

5. Click the pull down list for Rainfall Runoff to view the available Rainfall Runoff Alternatives.

Rainfall Runoff	<l> Base Rainfall Runoff</l>	~
Water Quality	<new></new>	
Sanitary Loading	<l> Base Rainfall Runoff</l>	
Headloss	Base Rainfall Runoff	

6. Select **<New...>.** The Create New Alternative Window appears with a prompt for the new name. By default, the field is populated with a combination of the scenario name and alternative sequence. Select **OK** and close the scenario properties.

Create New Alternative	×
Enter New Alternative Name 4 in/hr Absolute Intensity (Spread Only) - Rainfall Runoff Alternat	]
OK Cancel	

7. Open the Alternatives Manager from the following path: DRAINAGE AND UTILITIES > ANALYSIS > Calculation > Alternatives. Find the new Rainfall Runoff Alternative and double click to open properties.

	off ainfall Runoff /hr Absolute Intensity (Spread Only) - Rainfall Runoff Alternative - 1
E Rainfall Runoff : 4 in/hr Abs	olute Intensity (Spread Only) - Rainfall Runoff Alternative - 1 (DRPRRD01
isi 🕶 🖏 🕶 📄 📀	
Global Rainfall 🖉 Manhole 📗	Outfall Catchment Ø Pond Ø Wet Well
Storm Events	
Alternative:	4 in/hr Absolute Intensity (Spread Only) - Rainfall Runoff Alte
Global Storm Event:	Zone 2 - 3 Year v
Source:	Orphan (local)
* 🖌 = Base data	Elocal data

- 8. For Global Storm Event, use the pull-down menu to select **Absolute Intensity 4 in/hr 0 Year.** Close properties and Alternatives Manager.
  - a. This can also be selected/edited under the Global Storm Events (DRAINAGE AND UTILITIES > COMPONENTS > Common > Storm Data > Global Storm Events.

🛞 Glo	😤 Global Storm Events									
	Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Ba	Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4	4 in/hr Absolute Intensit	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000	None	0.0

## **Exercise 3.4** Explore Compute Center, Validate model, resolve Notifications, and Compute Scenario

In this exercise, users will review the Compute Center settings and compute the Analysis Scenario, for the Zone 2-3 Year event.

1. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Analysis Tools> **Compute Center**.

	Compute Center	- 🗆	Х
Hydr	aulic Analysis		
멶	듣 🎟   🛂 🕫   😮		
Scer	nario		
Des	sign		
Des			
	alysis		
4 in	/hr Absolute Intensity (Spread (	Uniy)	
~	<general></general>		
	Active Numerical Solver	GVF-Rational (StormCAD)	
	Calculation Type	Design	
	Minimum Time of Concentra	10.000	
~	Gravity Hydraulics		
	Gravity Friction Method	Manning's	
~	Pressure Hydraulics		
	Pressure Friction Method	Mannings	

2. The Scenario section includes a pull-down menu to select the 'current scenario'. As this is changed between Design and Analysis type scenarios, the Calculation Type will be updated automatically, based on the Calculation Option.

Progress
Changing Current Scenario

- 3. Select Analysis as the current Scenario.
- 4. Click the  $\boxed{\mathbf{V}}$  icon to Validate the model. Click OK to close the error message.



5. Click the **i** icon to open the User Notifications Manager and review messages:

引 User Notifica	ations						_		×
Hydraulic Analysis									
! User Notifica	tions Engi	neering Standard	s						
	) 🔍 🖏 <del>-</del>	0							
Message Id	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source		
9 44045	Analysis	Catchment	446	DR-101	(N/A)	Time of concentration for catchment is less than the minimum Tc value defined in the calcu	Hydraulic	: Results	
9 44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet minimum cover constraint.	Hydraulic	s Validati	on

- 6. The yellow icons indicate the severity is 'warning' for these notifications and will not prevent the model from computing. Generally, these can be addressed at the designer's discretion.
  - a. In this example, we are not going to address the pipe cover warning, since P-101 is a pipe to the pond bottom, which will not have 1' cover at the MES.
  - b. To resolve the time of concentration warning, right-click the row and select **Zoom To**. This will automatically select the catchment DR-101. Hover the mouse over the drainage area boundary and open Utility Properties from the quick menu.



4	Properties - Catchment - DR-101 (446)	- 🗆 X
Sub	surface Utilities Hydraulic Analysis	
		~ 🔍 😧 75% ~
		V V V
1	👻 🕽 👻 🗌 Add to Selection	
<sh< th=""><th>ow All&gt;</th><th>× [</th></sh<>	ow All>	× [
Pro	perty Search	م ~
~	<general></general>	
	ID	446
	Label	DR-101
	Notes	
	GIS-IDs	<collection: 0="" items=""></collection:>
	Hyperlinks	<collection: 0="" items=""></collection:>
	Feature Definition	DrainageArea\Catchment\Drainage Areas\Paveme
~	<geometry></geometry>	
	Geometry	<collection: 13="" items=""></collection:>
	Scaled Area (acres)	0.334
	Use Scaled Area?	True
~	Active Topology	
	Is Active?	True
~	Catchment	
	Outflow Element	S-101
~	Inflow (Wet)	
	Inflow (Wet) Collection	<collection: 0="" items=""></collection:>
~	Runoff	
	Runoff Method	Rational Method
	Area Defined By	Multiple Subareas
	Subareas	<collection: 2="" items=""></collection:>
	Tc Input Type	User Defined Tc
	Time of Concentration (min)	0.000
	Time of Concentration (Composite) (min)	10.000
×	Results	

- c. Enter **10.00** in the Time of Concentration (min) field and close the properties dialog.
- d. Repeat Steps 4 and 5 to re-validate the model and view user notifications to see that the time of concentration warning has been resolved.
- 7. Click the Compute icon next to the current scenario and select Scenario.

Compute Center		_		×
Hydraulic Analysis				
🎦 📑 📰 🛛 🔁 🗃				
Scenario				
Analysis	~	<b>&gt;</b> - 🔽	3 🚰	
✓ Calculation Options		Sce	enario	
Solver Calculation Options	Analysi	Hie	erarchy	
✓ <general></general>			ildren	
Active Numerical Solver	GVF-R			
Calculation Type	Analysi	Bat	ch Run	

8. Review the Calculation Summary.

GVF-Rational Calculation	Summary					×
Scenario						
Label:	Analysis					
Storm Event						
Rainfall Alternative Label:	Base Rainfall Ru	inoff				
Global Storm Event:	Zone 2 - 3 Year			1		
Return Event:	3		years			
Show this dialog after C	·	Messages	Report	Details	Close	Help

- a. The default view displays the current scenario and rainfall. The executive summary includes "Convergence was achieved" indicating a successful compute.
- b. Open **Messages...** and review warning and information only notifications about the model.

💼 User No	otification D	)etails					-		$\times$
<b>-</b> 🕞 🔍	0								
Message	Scenario	Element Type	Element Id	Label	Time (min)	Message	Source	e	
44036	Analysis	Conduit	444	P-101	(N/A)	Conduit does not meet minimum cover constraint.	Hydrau	ulics Valida	ation
44120	Analysis	Catch Basin	438	S-101	(N/A)	The depth of ponding exceeds the maximum depth constraint for this 'In Sag' inlet.	Hydrau	ulics Valida	ation
6 44131	Analysis	Outfall	439	S-102	(N/A)	User defined tailwater is ignored. Frontwater analysis for a hydraulically steep condition or a minimum tailwater control will govern.	Hydrau	ulic Result	ts.
22019	Analysis	(N/A)	-1	(N/A)	0.000	One or more conduits are operating under pressure at this time step.	Hydrau	ulic Result	ts

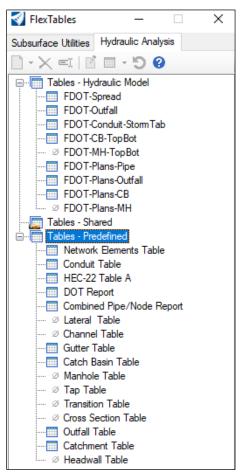
c. Open **Details...** and review the Calculation Detailed Summary with tabs for each type of drainage feature.

					e Summary	Inlet Summa	ry Pond Sum	naiy	
Lat	oel Sect Typ		Subnetwork Outfall	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Depth (In) (ft)	Depth (Out) (ft)
P-10	1 Circle	e 1	S-102	1.66	3.16	25.71	25.48	0.51	0.48
P-10	3 Circle	e 1	S-102	1.12	3.93	26.89	25.71	0.39	0.51

9. Close the open dialogs and Compute Center.

#### **Exercise 3.5** Review Results in Flex Tables

- 1. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Analysis Views> Flex Tables.
- 2. In the Hydraulic Analysis tab, review the available 🗐 Flex Tables in the Hydraulic Model and Predefined groups.



3. Open 'FDOT-Conduit-StormTab', the FDOTCONNECT Workspace equivalent to the Drainage Manual Storm Tabulation format:

FlexTable:	FDOT-C	onduit-9	Storm	Tab (Cu	irrent	Time: (	0.000 m	in) (DR	PRRD	01 C	efault.	stsw)														-	_		×
₫ 🖣 🕇																													
		-Node- pstrear wnstrea	engtr Inifiec		ainag Area	System CA Jacres)	System Flow Time (min)		vsten	dition Flow	ystem ationa Flow (cfs)	ructur		HGL	-FIGL-	-Invert Conduit) pstrear wnstrea	aulos		umbe of arrels	Size )isplay	Rise Inifiec (ft)	Span (ft)	Friction Slope	Slope Iculate			elocit	apacit (Full Flow)	Notes
444: P-101	P-101	S-101	5	0.334		0.452	10	0.299			1.66			5.15	25.71	25.20	0.22	0	1	18	1.50	0	0.356	0.353	0.151	3.16	3.82	6.76	
444: P-101		S-102													25.48	25.00													
454: P-103	P-103	S-103	1	0.225	9,	0.182	10	0.620	6	0.00	1.12	0.00	31.40	4.51	26.89	26.50	1.18	1	1	18	1.50	0	0.858	0.887	0.151	3.93	6.06	10.71	
454: P-103		S-101													25.71	25.20													

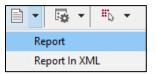
a. Right click in any column header to see the table formatting and sorting options.

=1	Edit Column Label
≜Ļ	Sort •
	Filter •
	Reapply Sort/Filter
	Freeze Column
	Select Column
⊞Ì	Add Column
	Remove Column
	Relabel
	Sort Upstream->Downstream
	Sort Downstream->Upstream
	Sort Dendritic (Upstream->Downstream)

b. Click the Edit icon **I** to view which database properties are used to populate the table.

Table : FDOT-Conduit-StormTab				×
Table Type: Conduit				
Available Columns:       192         Label       -Depth- Upstream Downstream         -EGL- Upstream Downstream         -Ground- Upstream Downstream         -Invert- Upstream Downstream         -X- Upstream Downstream         -Y- Upstream Downstream         Adjusted Headloss Coefficient (H         Allow Multiple Barrels?         Angled Inflow Energy Loss         Area (Flow)         Area (Flow)         Only list fields that apply to the activity	EC	Add > S> Remove <	Selected Columns: 29	~
			OK Cancel He	lp
			*	

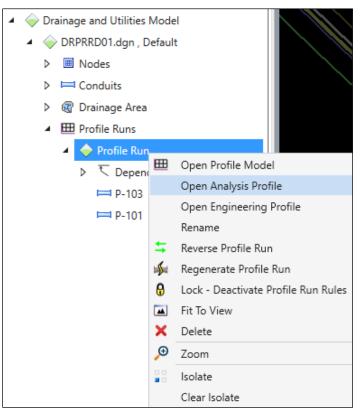
c. Close Edit dialog and Click the Export icon to save the table as a .csv file or the Report icon to open the printable views.



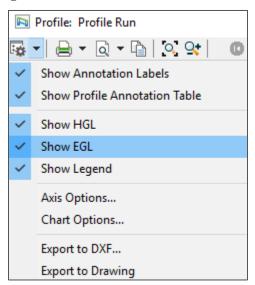
4. Close the open dialogs and Flex Table Manager.

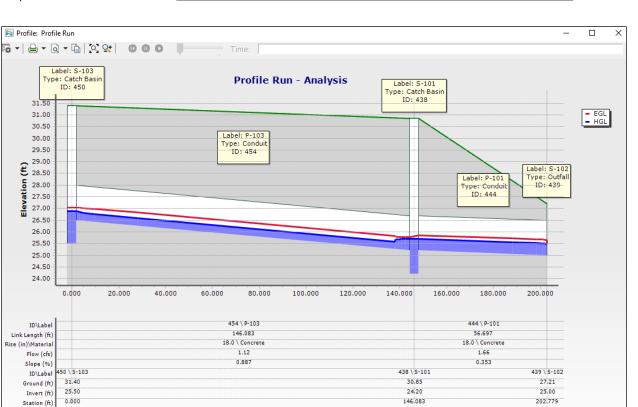
#### **Exercise 3.6** Review Results in Analytic Profiles

1. Navigate through the following path and open: DRAINAGE AND UTILITIES>ANALYSIS>Calculation> Scenarios> Scenario Manager.



2. Click the **Chart Settings** icon to see and turn on available annotation options.





3. Close the open dialogs.

# **4** PLAN DEVELOPMENT WORKFLOW FOR DRAINAGE STRUCTURES SHEETS

## INTRODUCTION

The main focus in this chapter will be on Plan Development Workflow for Drainage Structures Sheets, as described in FDM 916.

The FDOTCONNECT Workspace, includes three default sheet sizes for Drainage Sheets: 11x17, 36x48, and 36x72. Part 3, Chapter 900 series of the FDOT Design Manual (FDM) outlines Florida Department of Transportation (FDOT) NexGen Plans.

This chapter will introduce several important tools and features available in the Drainage and Utilities Workflow and FDOTCONNECT Workspace. They are:

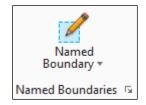
- Named Boundary
- Place Note and Place Label
- Model Annotation
- Tables

This chapter will also introduce the user to a new workflow terminology using the Ribbon. If you see a direction like this: DRAINAGE AND UTILITIES>DRAWING PRODUCTION>NAMED BOUNDARIES>Named Boundary, it means we are in the WorkFlow of Drainage and Utilities which has a Tab named Drawing Production and has tools that are located in the Named Boundaries Group. Now that we are in the right workflow, Tab and Group we may need to click on a tool that has more than one option.

## NAMED BOUNDARY AND SHEET CUTTING

In OpenRoads Designer CONNECT Edition, Named Boundaries are used to define clipping areas for plan and profile. There are several types of boundaries available in the Named Boundary tool; the FDOT Drainage Workflow will typically use Civil Plan and Civil Profile. The Place Named Boundary Civil Plan dialog box is shown below.

The typical FDOT Drainage Workflow is to create a Civil Plan named boundary first with the corresponding sheet(s). Subsequently, when the Civil Profile named boundaries are created, these are not placed on new sheets, but added to the sheet(s) created with the Civil Plan named boundary.



Blace Named Bo	oundary Civil Plan —	×
	P 🗊 🔛 🏈 🖊 🗹 🎞	
Drawing Seed:	(none) 👻	
Detail Scale:	Full Size 1 = 1	
Name:	Plan 1	
Description:		
Group:	(New) 🗸	
Name:	Untitled	
Description:		
Start Location:		◀
Stop Location:		▶
Length:	900.000000	00 Itutui
Left Offset:	-300.000000	oo
Right Offset:	300.000000	00 Itutui
Overlap:	20.00000	00 Inclos
Boundary Chords:	0	
	Create Drawing	
	Show Dialog	

The Drawing Seed selected determines which style sheet is created. In FDOTCONNECT Workspace, the predefined FDOT sheet seeds populate the list:

(none) 🔻
Name
(none)
11x17 Bridge Hydraulic Recommendation - Plan
11x17 Drainage Map - Plan
11x17 Plan Only
11x17 Plan Over Plan
11x17 Plan Over Profile - Plan
36x48 Drainage Plan
36x48 Plan Only
36x48 Plan Over Plan
36x48 Plan Over Profile - Plan
36x48 Triple Plan
36x72 Drainage Detail - Plan

Place Named Boundary Civil Plan > Identify Path Element

Based on the 'Path Element' selected from the prompt, typically the project baseline or centerline, a New Named Boundary Group will be created. The clipping area location and dimensions are defined by the Start and Stop Locations (by station), Length, and Left and Right Offsets. When Create Drawing is checked, the sheet is created automatically.

## NAMED BOUNDARIES LIST BOX

The Named Boundaries list box manages named boundaries and groups in or referenced to the design file and can be opened from the 🕞 icon at the lower right of the Named Boundaries Group.

REC	Name	d Boun	ndaries						_		×
×	2 -	6		ш			1		01	∠ ~=	Ŧ
Nar	ne		٦	r	Descrip	tion	File	Name	Show		
	Plan G	roups									
	Profile	Group	s								
	Cross S	Section	Group	os							
	Other (	Groups	5								

## OTHER FILE CHANGES FROM NAMED BOUNDARIES

Once Named Boundaries and corresponding sheets are created, there are a few changes to the DGN file:

#### Models & References

Models are created for both the Named Boundary View(s) and Sheet(s). The Sheet Model automatically attaches the View Model as a Reference with Live Nesting which can be adjusted (moved or rotated) accordingly.

Models Before:

🗇 Moo	lels					_		×
4	<b>O</b> E	4 🗆 🕤	7 X					
Туре	2D/3D	Name	Description	*	Design File	She	et Numb	er
0 <u>1</u> Ř		Default Default-3D	Master Model		C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn			

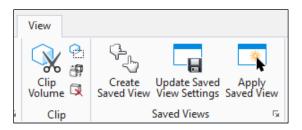
• Models After:

		Models / mer.						
🗇 Mo	dels					-		×
	03	🚰 🔲 🍸 🗙						
Туре	2D/3D	Name	Description	*	Design File	Sheet	Numbe	r
01 6		Default	Master Model	$\checkmark$	C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn			
r 👘		Default-3D		$\checkmark$	C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn			
		Drainage Plan 1		$\checkmark$	C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn			
		Drainage Plan 2		$\checkmark$	C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn			
LA .		Drainage Plan 1 [Sheet]			C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn	Draina	ge Plan	1
Cà		Drainage Plan 2 [Sheet]			C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn	Draina	ge Plan	2

*Note* Like previous versions of MicroStation, References in this workflow use Live Nesting. Display changes, such as turning on or off levels, should only be performed in the Default model.

#### SAVED VIEWS

Saved Views are also created for Named Boundaries and can be managed from the 📮 icon at the following path: DRAINAGE AND UTILITIES>VIEW>SAVED VIEWS



In some cases, special details may be needed to show design intent. For example, these cases may include nonstandard structures or structures with multiple or off-centered pipe connections. If these features are modeled, the Create Saved View tool can be used to add an isometric view from the 3D model to plans.

Method:	From View	•	
View Type:	Detail	•	
<u>N</u> ame:	Untitled		
Description:			
	Create Drawing		
Clip Volume:	(From View)	•	
	Associative		
	()		

## **ANNOTATION AND LABELING**

For Drainage Workflows in the FDOTCONNECT Workspace, predefined dynamic and automated FDOT plans labels have been established for use with the Place Label and Model Annotation tools.

## PLACE LABEL

The Place Label tool is used in the FDOT Drainage Plans Production Workflow to manually add dynamic labels for plan view and can be accessed from the path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Notes > Place Label

Tools	Report	Drawing Production	Drawing	View	
Place Table	A Place Note			Element Annotation *	Model Annotation *
Tables	Notes	Text	Est.	Annota	tions 🖓

As described in Bentley Drainage and Utilities CONNECT Edition Help,

A label is a cell that can maintain association to the element that is being labeled. If the cell definition contains fields, the fields will be updated based on the element being labeled.

Place Label Settings has two type options, Cell and Text Favorite. For the FDOTCONNECT Workspace, all Drainage and Utilities Text Favorites and Cells are named with the prefix "SU"

C Place Label Setting	s —	
Type:	Text Favorite	~
Favorite Name:	Cell	
Dimension Style:	Text Favorite	

Note Labels are placed on the active level. Make sure the correct level is active before using the Place Label tool. It is recommended that drainage structure numbers use the level TextLabel and drainage pipe numbers use the level TextMinor so that other plans that attach the drainage file as a reference can isolate which labels are displayed.

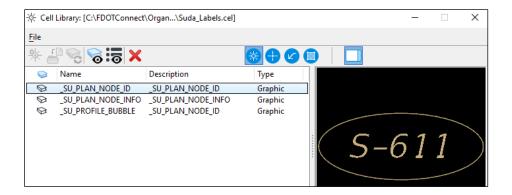
## TEXT FAVORITES

For Drainage Workflows in FDOTCONNECT Workspace, text favorites are used for labeling drainage pipes and drainage areas. The Text Favorites Manager is accessed through the 😼 icon at the following path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Annotations.

Drawing Production	Drawing	View				
	de Text butes A <sup>BC</sup> A <sup>A</sup> A <sup>A</sup> A <sup>A</sup>	Element Annotation *	Model Annotation +	Named Boundary •		1"=50' () ACS I Anno
Text	Fa	Annota	tions 🗔	Named Boundari	es 🗟	Dra
m /m		~		<b>xt Favorite Mana</b> xt Favorite Manage	-	
	> 🕞 Roadwa > 🎅 Structur 4 🎅 SUDA Li	y es	rles_Dimension St	yles.dgnlib		

#### Cell

For Drainage Workflows in FDOTCONNECT Workspace, cells are used for labeling drainage structure numbers. The cell library is named SUDA\_LABELS.cel.



## MODEL ANNOTATION

The Model Annotation tools (Annotate Model and Remove Model Annotations) are used in the FDOT Drainage Plans Production Workflow for automated dynamic labeling of drainage profiles and can be accessed from the path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Annotation > Model Annotation.

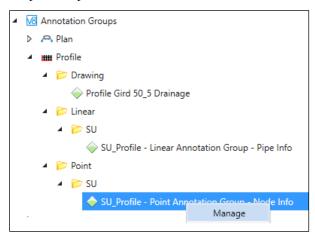
Drawing Production	Drawing	View		
Place Edit Chang	ABC ABC A e Text A A A A A A A A A A A A A A A A A A A	Element Annotation *	Model Annotation •	Named Boundary <del>-</del>
Text	E.	Annotat	😤 Annotate	e Model
STA TOTA		~	🔦 Remove	Model Annotations

In the FDOTCONNECT Workspace, Model Annotation is automatically applied to drainage profiles when Named Boundary Civil Profile is used. The drainage structure and pipe annotation should update automatically if changes are made, such as renaming or relocating. However, Remove / Annotate can be activated to refresh the labels without switching models or views.

The Annotate Model tool uses Annotation Groups included with the FDOTCONNECT Workspace.

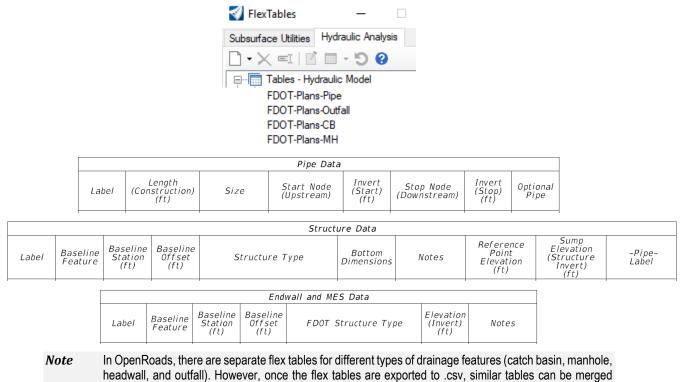
#### ANNOTATION GROUPS

Profile grid, pipe and drainage structure labels are included with the Profile Annotation Groups. They can be managed from the Project Explorer, OpenRoads Standards tab:



## TABLES

In OpenRoads Designer CONNECT Edition, tables are an effective way to organize and report the drainage model database information. In the FDOT Drainage NexGen Plans Production Workflow, most drainage structure and pipe information is shown in plans through tables. Several FDOT flex tables have been developed to follow the Chapter 900 series of the FDOT Design Manual (FDM).



and sorted to complete a single Structure Data table.

The Place Table tool can be used to place flex tables (exported to .csv / .xls files) in plans and is accessed from the path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Tables > **Place Table.** 

Tools	Repo	ort	Dra	awing	Produ	ction
Place Table	<mark>,∕A</mark> Place Note	Place	F	A Place Text	A_ Edit Text	A Chan Attri
Tables	Not	tes				Text
C Place	Table		-	_		×
Seed:       None         Text Style:       ✓ Annotation          Active Angle:       90°00'00"       ↓         File Name:						
	L			s T <u>i</u> tle s Head	коw ler Row	
	6	_		ssocia		

When a placed table is selected, the Table Tools Layout Tab appears with multiple editing and formatting options.

🜍 Drainage and Utilities 🔹 (	📁 🖬 🛃 🕼 🐟 - 🤌 📌	🚔 ÷			Table Tools C:\Worksets\FD	OT\22049555201_CE\drainage\DRPRRD01.dgn [2D - \	/8 DGN] - OpenRoads Designer CONNECT
File Home Layout A	nalysis Components	Utilities View Tools Report Drawi	ing Production	Drawing View	Layout		
	Height: 0.77 Width: 5.36 Lock Aspect Ratio	Delete Delete Insert Insert Insert Column Row Above Below Left Right		☐ Height: 0.26	Distribute Rows	E I I I I I I I I I I I I I I I I I I I	Fill Borders
Table Options	Table Size	Rows / Columns	Merge	Cel	l Size	Alignment	Table Symbology

The FDOT flex tables for plans include some custom fields that allow for FDOT-specific data to be included with the drainage model database. The custom fields are defined and managed within the User Data Extensions Tool.

## **USER DATA EXTENSIONS**

The User Data Extensions tool is accessed from the path: DRAINAGE AND UTILITIES > TOOLS > General Tools > User Data Extensions.

ut	Ana	alysis C	ompone	ents	Utilities View	Т	ools		
UI Co	tilities onflicts	User Data Extensions	Model Builder	🅜 Bra	odate Description anch Labeling t Feature Definitio		Projec Defaul		
			General	Tools					
Selec	Select Data Type For Command								
This	This command needs to know the type of data.								
Avai	ilable Da	ata Types:		raulic Ana			~		
				surface L raulic Ana					

In the FDOTCONNECT Workspace, the User Data Extensions have been defined for use in the FDOT Flex Tables under Hydraulic Analysis Data Type. For most projects, users will not need to make edits to the User Data Extension definitions.

🖡 User Data Extensions [DRPRRD]		- C	)efault.st	tsw]				×		
E. Conduit	~	,	<gener< td=""><td>al&gt;</td><td></td><td></td><td></td><td></td><td></td><td></td></gener<>	al>						
Orientation			Name		FDOT_Top_Na	me				
OptionalPipe			Label		FDOT Top					
HGL Clearance			Category		FDOT Structure	Info				
Physical Velocity			Field Ord	der Index	2					
Fall (Inverts)			Field Des	scription	Select structure	top type from	list			
Minimum Slope			Alternativ	/e	100: User Data	Extensions				
Ø Lateral			Reference		Catch Basin, Ma	anhole, Outfall	, Hea	dwall		
···· ∅ Channel	~		Data Ty							
Gutter			Data Typ		Enumerated					
···· ∅ Pressure Pipe			Default V	/alue	0					
Gatch Basin     Gatch Basin     Gradient HGL Clearance     FDOT Top     FDOT Bot		١.	Enumera	ation Edite	or					×
∅ Manhole ∅ Tap					Label	Enumeratio Value	n			^
Ø Property Connection		Ш	9	CURB INLE	T TYPE 9		9			
···· ∅ Transition		Ш	10	CURB INLE	T TYPE 10		10			
Ø Cross Section			11	CLOSED FI	UME		11			
	D		12		BARRIER		12			
Catchment	T	۲I	13	BARRIER	VALL C&G		13			
I ow Impact Developmen X		Ш			ARRIER, TYPE 1		14			
	-				ARRIER, TYPE 2		15			
					ILET TYPE S		16			
					ILET TYPE V		17			
				DBI TYPE /			18			
				DBI TYPE E			19			~
		ľ	120 1				20			
						ОК	C	ancel	Help	

For the FDOT Drainage Workflow, the user selections for the fields with User Data Extension can be made from the pulldown menus within the FDOT Flex Tables.

<b></b>								
📰 Catch Basin FlexTable: FDOT-CB-TopBot (Current Tim —								
₫   🛱 ▾	<b>B</b>   <b>E</b>	) 🔍 AA 📄 🕶 🐺 🕶	•					
	Label	FDOT Top Name FDOT Bot						
438: S-101	S-101	CURB INLET TYPE P-2 - 4' DIA.						
450: S-103	S-103	CURB INLET TYPE P-6 DBI TYPE A DBI TYPE B DBI TYPE C DBI TYPE C MOD DBI TYPE D DBI TYPE E DBI TYPE F DBI TYPE F DBI TYPE A	^					
2 of 2 elements of	displayed	DBI TYPE J DBI TYPE K FES GUTTER INLET TYPE S GUTTER INLET TYPE V MANHOLE TYPE J-7						

*Note* For catch basins (CB) and manholes (MH) the 'TopBot' FDOT flex tables are where the top and bottom names can be selected. For pipes, headwalls, and outfalls, the User Data Extension selections can be made directly in the respective 'Plans' Flex Tables.

## **EXERCISES**

## EXERCISE OVERVIEW - PLAN DEVELOPMENT

In this chapter exercise, users will create named boundaries, a drainage structure sheet, and add plans information through labels and tables. The network created in Chapter 2 and used in Chapter 3 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- 4.1 Place Named Boundary Civil Plan
- 4.2 Place Named Boundary Civil Profile
- 4.3 Place Drainage Labels in Plan
- 4.4 Place Tables

#### **Exercise 4.1** Place Named Boundary Civil Plan

- 1. Open FDOTConnect, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "DRPRRD01.dgn".
- 3. Navigate through the following path and open: DRAINAGE AND UTILITIES>DRAWING PRODUCTION>Named Boundaries> Named Boundary > Place Named Boundary.

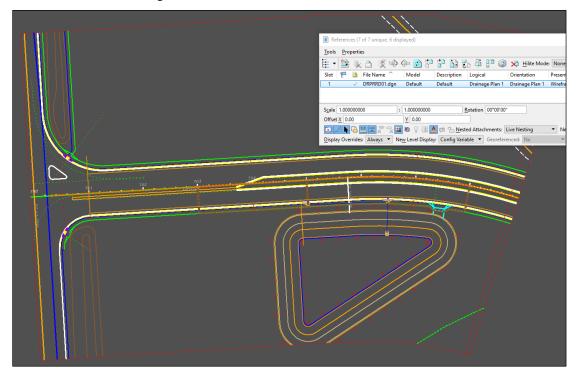
			1	Create Drawing		×
🔏 Place Named Bo	under Civil Plan	×		Mod Nam One Sheet Per Dg	e: Drainage Plan 1	
se Place Named Bo		^		View Type:		
Drawing Seed:	36x48 Drainage Plan 👻			Discipline:	Civil	
Detail Scale:	1"=50' 💌			Purpose:		
Name:	Drainage Plan 1			Seed Model:	Drawing Model 36x48 Drainage Detail Named Boundary.c	
Description:				Filename:		4
Group:	(New) 👻			A	1"=50' <b>•</b>	Lap
Name:	CL_SR61			Annotation Group:	None	
Description:					Sheet Model	
Start Location:	700+00.00	⊲		Seed Model:	36x48 Drainage Detail Named Boundary.c	
Stop Location:	709+00.00	►		Filename:	(Active File)	4
Length:	900.000000			Sheets:	(New) 👻	
Left Offset:	-300,000000			A	Full Size 1 = 1	
		(monor)		Drawing Boundary:	36x48 Drainage Plan 👻	
Right Offset:	300.000000	(Texter)		Detail Scale :	1"=50' 💌	
Overlap:	15.000000				🗌 Add To Sheet Index 🛛 🕼	
Boundary Chords:	5				Make Sheet Coincident	
	Create Drawing				Open Model	
	Show Dialog				<u>O</u> K Cancel	

- a. Select the Civil Plan mode.
- b. Set Drawing Seed to 36x48 Drainage Plan.
- c. In the 2D view, following the 'Identify Path Element' prompt, select the CL\_SR61 alignment along which the plan named boundaries will be created.
- d. Fill out the dialog, as shown.
- e. *Follow the prompts* in the lower left corner. **Left click** to define the named boundaries. *Multiple left clicks may be required*.
- f. Two or three clicks are required to (1) accept the Start Location, (2) accept the Stop Location, and (3) create the Named Boundaries. However, if the Start or Stop Location are selected graphically one or more of these clicks has already been completed. Once completed, the Create Drawing dialog automatically opens.
- g. There is typically no need to revise settings in the *Create Drawing* dialog. With Open Model checked, the sheet model will open automatically after clicking **OK** to create the sheets.
- h. Navigate through the new models to see links between sheets and models.

Slot (P ) File Name ^ Model Description Logical Orientation Prese		
Scale 1.00000000 1 600.0000000 Rotation -146*28*39.1 Offset X 2417.84881018 Y 2408.66716714	References (8 of 8 unique, 7 displayed)	
Slot P File Name ^ Model Description Logical Orientation Press 1		
1       ✓ DRPRRD01.dgn       Drainage Plan 1       Drainage Plan 1       Drainage Plan 1       Wirel		•
<ul> <li>Sgale 1.000000000 ; 600.000000000 <u>Rotation</u> -146°28'39.1</li> <li>Offset ½ 2417.84881018 ¥ 2408.86716714</li> <li>Image 2 R with the state of the state</li></ul>		Presen Virefra
Scale         1.00000000         : 600.00000000         Retation         -146*28'39.1           Offset X         2417.84881018         Y         2408.86716714         ••••••••••••••••••••••••••••••••••••		
Vesting Deg		
		De <u>p</u> t

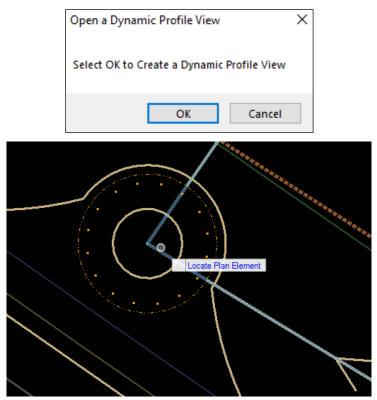
Drainage Plan 1 [Sheet] Views: 0

Drainage Plan 1 Views: 0



## **Exercise 4.2** Place Named Boundary Civil Profile

- 1. Switch to the Multi-Model Views in DRPRRD01.dgn, activate View Control (*hold down the right mouse button to open the quick menu for display, and select View Control*). Select **3 Views Plan/Profile/3D.** 
  - a. Click OK to the prompt below and select the Profile Run line drawn in plan view from S-103 to S-102.



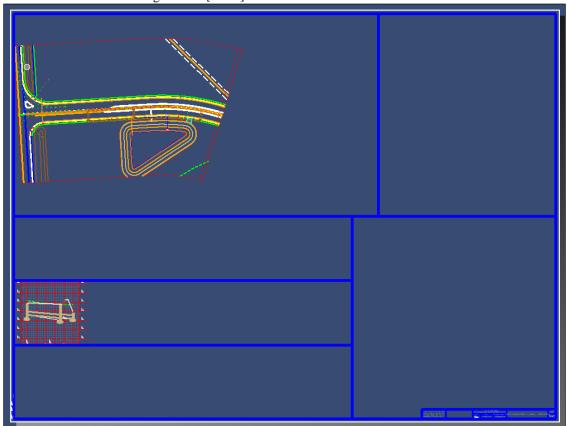
- b. Left click anywhere within the Profile Window to load the Profile Run in profile view.
- 2. Use the 🛰 Quick Profile from Surface Tool to add existing and proposed ground lines from the terrains.
  - a. When the Locate Reference Surface prompt activates, a terrain can be selected from the 3D view. Once selected, the surface will be displayed in the Profile Window.

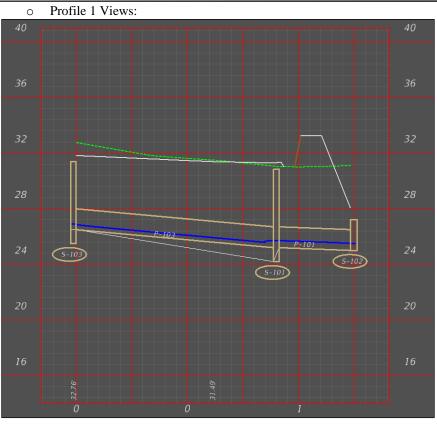


3. Navigate through the following path and open: DRAINAGE AND UTILITIES>DRAWING PRODUCTION>Named Boundaries> Named Boundary > Place Named Boundary.

🔏 Place Named Boundary	Civil Profile —	$\times$	
	A 🖓 🏬 🌒 🖍 💅 🗊 💢		Create Drawing
Drawing Seed:	36x48 Drainage Profile - Middle 🔹 🔻		Mode: Profile
Detail Scale:	1"=50' 👻		Name: Profile 1
Name:	Profile 1		One Sheet Per Dgn:
Description:			Drawing Seed: 36x48 Drainage Profile - Top
Method:	Station Limits 🔹		View Type: Civil Profile
Group:	(New) 👻		Discipline: Civil
Name:	Profile Run		Purpose: Elevation View
Description:			Drawing Model
Start Location:	-0+25.00	◀	Seed Model: 36x48 Drainage Detail Named Boundary.c
Stop Location:	2+25.00	▶	Filename: (Active File)
Length:	250.000000		▲ 1"=50' <b>▼</b>
Vertical Exaggeration:	10.000000	linite.	Annotation Group: Profile Gird 50_5 Drainage
Available Profile Height:	27.00000	<b></b>	Sheet Model
Top Clearance:	0.500000	(testee)	Seed Wodel. Sox46 Drainage Detail Named Boundary.c
	0.500000		Filename: (Active File)
			Sheets: (New)
Elevation Datum Spacing:	2.000000		
Station Datum Spacing:	1.000000		Drawing Boundary: Drainage Plan 1 [Sheet] Detail Scale : Drainage Plan 2 [Sheet]
Profile Shifts:	Datum Stations 🔻		
	Use Terrains		🗌 Add To Sheet Index 🛛 🕼
	Use Active Vertical		Make Sheet Coincident
	Create Drawing		Open Model
	Show Dialog		<u>O</u> K Cancel

- a. Select the **Civil Profile** mode.
- b. Set *Drawing Seed* to **36x48 Drainage Profile Middle.**
- c. Click anywhere in the Profile view.
- d. Fill out the dialog, as shown.
- e. *Follow the prompts* in the lower left corner **left click** to define the named boundaries. *Multiple left clicks may be required*.
- f. Two or three clicks are required to (1) accept the Start Location, (2) accept the Stop Location, and (3) create the Named Boundaries. However, if the Start or Stop Location are selected graphically one or more of these clicks has already been completed.
- g. In the *Create Drawing* dialog, change the Sheet Model Sheets selection to **Drainage Plan 1** [Sheet]. With Open Model checked, the sheet model will open automatically after clicking **OK** to create the sheets.
- h. Navigate between models.



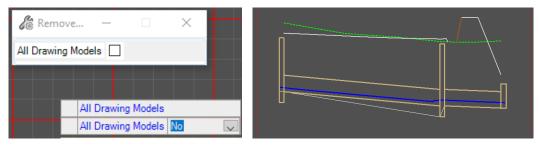


#### • Drainage Plan 1 [Sheet] Views:

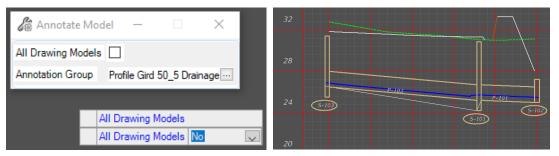
4. In the Profile 1 View, review the characteristics of the Model Annotation. Though this annotation is automated, sometimes it may necessary to Remove Model Annotations and then Annotate Model again. This can help reflect updates to the network and/or fix annotations that did not automatically populate with the Named Boundary process. These tools are available from the path: DRAINAGE AND UTILITIES>DRAWING PRODUCTION>Annotations> Model Annotation.



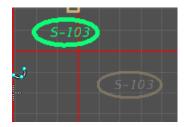
a. Choose Remove Model Annotations and left click through the prompts.



Choose Annotate Model and left click through the prompts.



c. Select one of the labels and move to another position.



- d. Select Annotate Model again and observe the following:
  - i. Annotations can be adjusted, but if re-annotated, the default locations (from the Annotation Group definitions) are used.
  - ii. Annotations can be duplicated.
- e. Change active level to TextLabel and activate Place Note.
  - i. Enter the following in the Text Editor "EXISTING GROUND DIRECTLY ABOVE PIPE".

b.

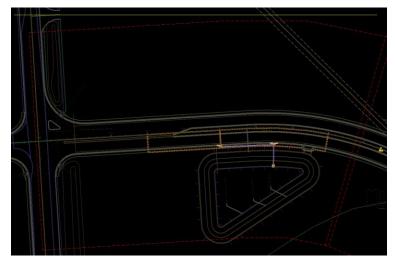
🖓 Place Note	– 🗆 X	🜍 Text Editor	- 🗆 ×
	A A	👽 FDOT (Small) 🗸 🕑 🧩 🐼 🔹 🎋 🕼	FDOT ~
Dimension St	le: T_FDOT_Note-L - 🍞 💩	X · · · · · · · · · · · · · · · · · · ·	
	on: Horizontal 🔻	EXISTING GROUND DIRECTLY ABOVE PIPE	
	on: Automatic 🔻		
	At: Terminator 🔻		
Horizontal Attachme			
		DIRECTLY ABOVE PIPE	
			`

f. Redo steps a. and b. to restore default annotation and see that the placed note remains.

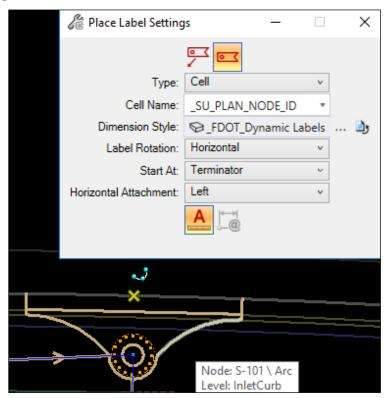
## **Exercise 4.3** Place Drainage Labels in Plan

a.

- 1. For curved alignments and chorded named boundaries, it can be a challenge to find the rotation that matches the sheet. This is one way to set the rotation of the plan view so that the labels placed will be horizontal relative to the sheet.
  - **Notate** View with 2 Points Method along the Named Boundary to match the sheet orientation.



- 2. Set the Level to a TextLabel before placing any notes or Labels.
- 3. Navigate through the following path and activate Place Label tool: DRAINAGE AND UTILITIES> DRAWING PRODUCTION > Notes > Place Label
  - a. Fill out the dialog as shown below, select the curb inlet cell, and left click to accept label placement.



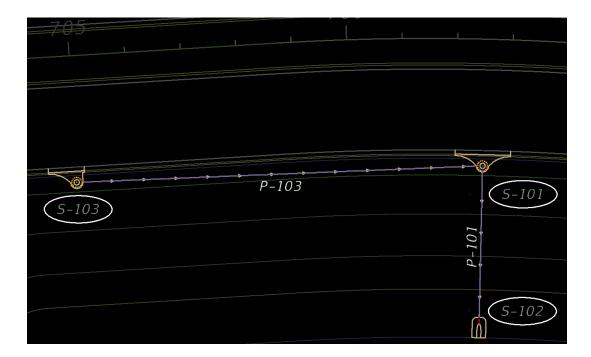
Place labels for S-101, S-102, and S-103:

b.

- 705
  - 4. Navigate through the following path and activate Place Label tool: DRAINAGE AND UTILITIES> DRAWING PRODUCTION > Notes > Place Label
    - a. Fill out the dialog as shown below, select the line for P-103, and left click to accept label placement.

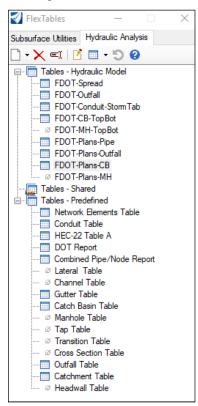
🔏 Place Label Setting	js —		$\times$
Type:	Text Favorite	¥	
Favorite Name:	SU_PLAN_LINK_ID	• •	
Dimension Style:	👽 _FDOT_Dynamic La	bels	D
Label Rotation:	Horizontal	~	
Start At:	Terminator	v	
Horizontal Attachment:	Left	Ŷ	
		_	
	→ <u>×</u> →		
	Link: P-10 Level: Pipe		

b. Place labels for P-101 and P-103, use rotation tools as needed:



## **Exercise 4.4** Place Tables

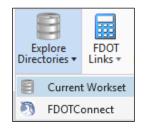
- 1. Switch to the Multi-Model Views in DRPRRD01.dgn and open Flex Tables from the path: DRAINAGE AND UTILITIES>ANALYSIS>Analysis Views> **Flex Tables.**
- 2. From the Hydraulic Analysis tab, open FDOT-Plans-CB.



3. From the upper left of the menu, select **Export to File** and save as .csv in the \drainage\eng data folder.

🛄 Catch Ba	asin FlexTab	le: FDOT-Plans	s-CB (Current	Time: 0.00	00 min) (DRPRRD01 Defau	lt.stsw)			-	- 🗆	×
1 G	- 2	• *	- 🐺 -	• • • • •							
Export to	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe- Label	-
438: S-101	S-101	CL_SR61	706+50	40.000	CURB INLET TYPE P-2	4' DIA.		30.85	24.20		
										(In) P-103	
										(Out) P-101	
450: S-103	S-103	CL_SR61	705+00	40.000	CURB INLET TYPE P-1	4' DIA.		31.40	25.50		
										(Out) P-103	

4. Navigate through the following path to quickly open the workset drainage folder: OPENROADS MODELING>FDOT> Resources > Explore Directories > Current Workset.



- 5. Open the .csv file in Excel and update formatting with the following:
  - a. Select from cells A1 to J6, and add borders (Home: Font: Borders: All Borders).
  - b. Select from cells A1 to J6 and change font to FDOT.
  - c. Delete '<None>' from Cells E3:F4 and E6:F6.
  - d. Adjust units for significant digits and reshape column widths as needed.

Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Structure Type	Bottom Dimensions	Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe- Label
S-101	CL_SR61	706+50	40.00	CURB INLET TYPE P-2	4' DIA.		30.85	24.20	
									(In) P-103
									(Out) P-101
S-103	CL_SR61	705+00	40.00	CURB INLET TYPE P-1	4' DIA.		31.40	25.50	
									(Out) P-103

- e. Save as .xlsx and close.
- 6. In OpenRoads, switch to the Drainage Plan 1 [Sheet] Views Model and navigate through the path to open Place Table Select From File, DRAINAGE AND UTILITIES> DRAWING PRODUCTION>Tables> Place Table.
- 7. Select the ellipse next to File Name, browse to and select the new .xlsx.

🔏 Place Table	- 🗆	×
[	III 💿 🛅	
Seed:	None 🔻	A
Text Style:	👽 FDOT (Small) 🛛 🔻	
Active <u>A</u> ngle:	90°00'00.000"	* *
File Name:		
	Contains Title Row	
	Contains <u>H</u> eader Row	
	Retain Association	

8. Review and click **OK** to accept the default range from A1 to J6.

Select Cells		×
Worksheet:	FDOT-Plans-CB *	
Range:	Automatic *	
From:	A1	]
To:	J6	]
OK	Cancel	

9. Use the cursor to place table in the lower right of the sheet.

Utilities View Too													CONNECT Edition	
	ols	Report	Drav	ving Productio	n Drawin	ig View	Layout							
Delete Column Row Abo				Refresh Table from Data	Merge Sp Cells Ce			Distribute Rows	EE3	HA Text Direction ▼	E = Cell Margins *	Fill Borde	ns 📕 0	* _ * _ *
	Rows /	Columr	IS		Merge		Ce	II Size		Aligni	ment	Table S	mbology	
. 🥖 📥 🖉	2	8	To ton					₩ 4,						
<b>▼</b> ₽ <b>×</b>		-						· · · · ·						
eet Index			-	an 1 [Sheet]										
el 👸 Survey	1 <u>00</u>	<u>_</u>		l 🖸 🛟 🖸 🛛		* 📶 🗕								
× 2ٍ <														
				A	В	с	D	E		F	G	н	I	L L
			1	Label Ba		Baseline Station (ft)	Baseline Offset (ft)	Structure Type		Bottom imensions	, Notes	Reference Point Elevation (ft)	Sump Elevation (Structure Invert) (ft)	-Pipe- Label
			2 4	5-101 CL	SR61 7	06+50	40.00	CURB INLET TYPE F	-2 4	DIA.		30.85	24.20	
			3			00,00	70.00	COND MEET THE T	- 7	L-171		50.05	24,20	(In) P-103
			4											(Out) P-101
			5 9	5-103 CL	SR61 7	05+00	40.00	CURB INLET TYPE F	2-1 4'	DIA.		31.40	25.50	
														(Out) P-103

10. Select the table to activate the Table Tools available for further formatting and editing.

# **5** DRAINAGE QUANTITIES

## INTRODUCTION

The main focus in this chapter will be on the tools to extract quantity information from the drainage design model available in the OpenRoads Designer CONNECT Edition and FDOTCONNECT Workspace including:

- Item Types
- Asset Manager
- Takeoff Manager

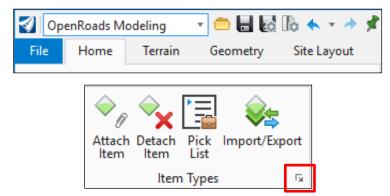
Automated quantity tools are still in development and methodologies are subject to change. Refer to the FDOTCONNECT Automated Quantities Workflow Course Guide for additional information.

The workflows outlined in this chapter will produce a Summary of Drainage table to be included in the Estimated Quantities Report for drainage. As described in Part 3, Chapter 902 of the FDOT Design Manual (FDM), quantities are reported with project documentation but are not included in the Roadway Plans Set.

## **ITEM TYPES**

In the FDOTCONNECT Workspace, Item Types are used to apply Pay Item quantity information to drainage elements.

The Item Types tools can be accessed from the following path: OPENROADS MODELING > HOME > Item Types >.



The FDOT Drainage Item Types are based on FDOT Pay Item Number groupings in Basis of Estimates and can be viewed in the Item Types Manager, by clicking the  $\lceil s \rceil$  icon in the lower right corner of the Item Types Group.

For all drainage structures, the corresponding FDOT Item Type is included with the Feature Definition, and therefore automatically attached when structures are placed. For drainage pipe, Item Types are attached after placement. In each case, the Drainage Item Types provide the framework in the properties dialog for users to select from picklists that generate the appropriate Pay Item Number.

*Note* Since Item Types are added to the drainage element properties (not Utility Properties), Pay Item information is not accessible to Flex Tables.

item T	Types					_	Х
Libraries	Utilities						
8	😪 🖙 🗔 🗙	ñ 🛍 🔨 🤇	<b></b>	) 🕞 🗙			
🔺 🤿 Dr	ainageQuantities		•	Properties			
Þ 🧊	DrainageFES			Item Type			*
🧃	DrainageInlet			Item Name	"Drair	ageInlet"	
	мвс Туре			Use Item Name fo	or Element No		
	ABC Depth						
	PayltemNumber						
	DesignNotes						
	ConstructionRemarks	5					
Þ 🤢	DrainageMES						
Þ 🧊	DrainageMH						
Þ 🧃	DrainagePipe						
Þ 🧃	DrainageSEndwall						
Þ 🧃	DrainageUType						
Þ 🧃	DrainageWinged						
🔺 👽 bo	order		Ţ				
	Γ					]	
		DrainageInlet			*		

DrainageInlet					*
Туре					
Depth					
PayItemNumber	0425	1			
DesignNotes					
ConstructionRemarks					

## **ASSET MANAGER**

In the FDOTCONNECT Workspace, Asset Manager is used to assign Alignment and FPID information to elements for use by FDOT Quantity Takeoff Manager.

Asset Manager can be accessed from the following path: OPENROADS DRAWING PRODUCTION > HOME > Model Analysis and Reporting > Asset Manager.

🛐 🛛 OpenRoads Drawing Pr 🔹 🚍 🛃 🎼 🐟 🔹 🖈 📌	🚔 =		C:\Worksets\FDOT\22049555201_CE\drain
File Home Drawing Production Drawing View	v		
None ConstLines *			🌮 📩 🧟 📚
	Explorer Attach Tools • 👬 • 📰 •	Element Selection	Reports Civil Corridor Asset
Attributes	Primary	Selection	Model Analysis and Reporting

## FDOTPROJECT.XLSM

For FDOTCONNECT Workflows, the first step in the Asset Manager workflow is to define the project alignments and/or FPID as applicable in a pre-formatted spreadsheet named FDOTProject.xlsm. Each project will have to complete the spreadsheet and save in the workset (symb/Symbology folder). The spreadsheet template may be copied from the folder location: C:\FDOTConnect\Organization-Civil\FDOT\Asset Manager\FDOTProject.xlsm.

« FDOTConnect » Organization-Ci	vil > FDOT > Asset Manager
Name	Туре
SummaryReportDefinitions.xml	XML File
AECMERGE.XML	XML File
📳 Asset Management Lookup.xlsx	Microsoft Excel Worksheet
MasterSummaryReport.xlsx	Microsoft Excel Worksheet
DOTProject.xlsm	Microsoft Excel Macro-Enabled
DOTIocations.xlsm	Microsoft Excel Macro-Enabled
🖬 border.xlsm	Microsoft Excel Macro-Enabled
Asset_Lookup_All.xlsx	Microsoft Excel Worksheet
FDOT Sample.xlsm	Microsoft Excel Macro-Enabled
PickListProfessionalofRecord.xlsx	Microsoft Excel Worksheet
🖬 Sheet Borders.xlsm	Microsoft Excel Macro-Enabled
<	

The \_Pick List Definitions tab has the following content:

- Row 1 is preformatted to automatically update as alignment or FPID content is added.
- Row 2 is for users to add alignment(s) from left to right, starting at cell B2.
- Row 3 is for users to add FPID(s) from left to right, starting at cell B3.

	А	В	С
1	Pick List Name	Option 1	
2	Alignment		
3	FPID		
4			
_			

## ASSET MANAGER TOOL

When activated, the two icons at the top of the Asset Manager tool are for the following:

Export empty asset definition template Open Asset Definitions File

Once the FDOTProject.xlsm spreadsheet has been completed for the project and saved to the workset directory, Asset Manager can read the alignment and FPID project information and assign to selected elements.

\left Open /	Asset Definition Excel File			×
$\leftarrow \rightarrow$		nb v Ö	Search symb	Q
Organize	e 🔻 New folder			- 💷 💡
4^	Name	Date modified	Туре	Size
	EDOTProject.xlsm	9/25/2020 11:51 AM	Microsoft Excel M	66 KB
	<			
	File name: FDOTProject.xlsm	~	Excel File (*.xlsm)	~
			Open	Cancel

Asset Manager	– 🗆 X
🗟 😑	-
FDOTProject	Elements
<ul> <li>Alignment</li> <li>FPID</li> </ul>	Element Selection All Elements Selection Set Fence Named Boundary Select (0) Inside Overlap
	Assign Export Assignment Mode Add Replace Remove
	Add Assets

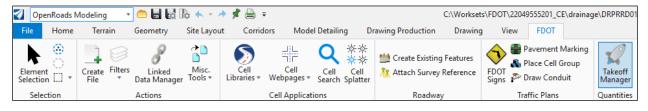
This tool can also be used to replace or remove alignment and FPID information.

# FDOT QUANTITY TAKEOFF MANAGER

In the FDOTCONNECT Workspace, the Takeoff Manager is used to create the Estimated Quantities Report. The tool extracts quantity information from the drainage elements in or referenced to the model and formats the information into an auto-populated, standardized table.

*Note* Quantity reports for all disciplines use the same standardized table, with columns hidden or displayed accordingly.

The Takeoff Manager tool can be accessed from the following path: OPENROADS MODELING > FDOT > Quantities >.



When prompted, the tool opens with a complete list of available reports. The Summary of Drainage report is used for all Drainage Item Types.

Alignment Options Report station and offset relative to: All			
All			
			~
Summary Reports			-
Summary of Box Culverts			î
Summary of Clearing Grubbing and Removal Items			
Summary of Curbs			
Summary of Ditch Pavement			
Summary of Drainage			
Summary of Driveway Base			
Summary of Earthwork	·		
Summary of Erosion Control and Sediment Control	Device	<b>:</b> S	
Summary of Fencing			
Summary of General Items			
Summary of Geotechnical Items			
Summary of Guardrail			
Summary of Intelligent Transportation Systems Ite	ms		
Summary of Landscape Items			
Summary of Lighting Items			
Summary of Litter Removal and Mowing			
Summary of Lump Sum Items			
Summary of Mailboxes			
Summary of Miscellaneous Asphalt			
Summary of Miscellaneous Drainage Items			~
Select All Deselect All Invert Auto	o-Popula	ated Reports	
Output Options			
File Output Location:			
C:\Worksets\FDOT\22049555201_CE\calculations			
Include Referrences			
Output Upper Case			
☑ Open Output File(s)			

By default, the spreadsheet report is saved in the project Workset's calculations subfolder and the PDF report is saved in the project Workset's estimates subfolder. Both locations can be quickly accessed from OpenRoads with following tool: OPENROADS MODELING>FDOT> Resources > Explore Directories > **Current Workset**.



The quantity information reported in the standard table includes several ways to locate the corresponding elements in the DGN model. In addition to the drainage Structure Number and Pipe Numbers (reported in Label column), the Element ID corresponds to a unique value assigned to the properties of each individual element in the DGN.

A	utoSave 🦲		9· (? · ·								Summary of Dra	inage.xlsx - Exce	el			
Fil	e Hon	ne Inser	t Page Layou	ıt Formulas	Data	Review	N V	/iew	Help	ProjectWis	e Acrobat	𝒫 Tell m	e what y	ou want t	o do	
AR	15	• : >	√ fx													
	в	с		D	н	w	х	Y	Z	AG	AH	AI	AL	AM	AN	AO
1								Summ	ary of	Drainage						
2						Quar	ntity	Total C	Quantity		L	ocation				
3	Pay Item Number	Label	Pay Item I	Description	Unit of Measure	Р	F	Р	F	Alignment	Begin Station	End Station	Side	Element ID	Design Notes	Construction Remarks
4																

The Select by Element ID tool can be accessed from the following path: OPENROADS MODELING>FDOT> Actions > Misc. Tools > Select Element by ID.

Misc. Tools 🔻	Cell Cell Libraries Vebpages	×			
6° (	opy Reference Levels				
× c	elete Element by Length		Select Element by ID		×
🖹 P	lace Professional Of Recor				
<b>У</b> Р	otate Text		Element ID:		
💏 S	elect Element by ID			Find	
Đ s	et Coordinate System				

# **EXERCISES**

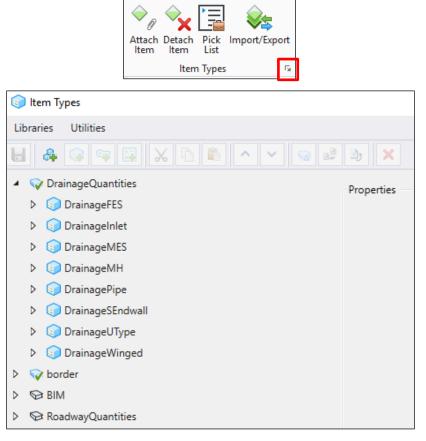
# EXERCISE OVERVIEW – DRAINAGE QUANTITIES

In this chapter exercise, users will create a Summary of Drainage Report for a sample network. The network created in Chapter 2 and used in Chapters 3 & 4 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- 5.1 Explore Item Types Manager
- 5.2 Generate Pay Item Numbers for sample drainage structures
- 5.3 Attach Item Types to sample pipes and generate Pay Item Numbers
- 5.4 Create a Selection Set
- 5.5 Attach alignment information for quantities
- 5.6 Use Takeoff Manager to generate Summary of Drainage table
- 5.7 Explore Items in Project Explorer and delete strays

## **Exercise 5.1** Explore Item Types Manager for Drainage

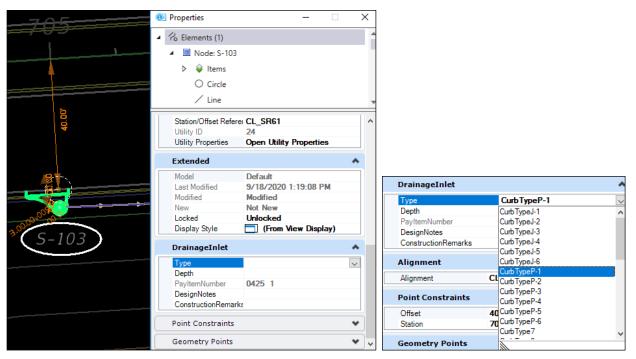
- 1. Open FDOTCONNECT, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "DRPRRD01.dgn".
- 3. Navigate through the following path and open Item Types Manager: OPENROADS MODELING>HOME>Item Types>



- 4. Hover over Drainage Quantities and verify the following message appears: Local resource, matches library
- 5. Close the dialog.
- *Note* When working with Item Types in a DGN file for the first time after its been opened, sometimes the Item Types properties are blank or non-responsive within the element Properties dialog. If that happens, repeat this exercise (open Item Types Manager) to reactivate the properties.

## **Exercise 5.2** Generate Pay Item Numbers for sample drainage structures

- 1. Switch to the Default or Multi-Model Views in DRPRRD01.dgn, activate View Control, and select **1** View and zoom towards S-101, S-102, and S-103.
- 2. Select S-103 and open the element properties <sup>(1)</sup> (from Primary Group in any tab). Scroll down to the DrainageInlet section:
  - a. Click in the field next to Type to access the pulldown picklist and select **CurbTypeP-1** as shown below.
  - b. For Depth, select **LessOrEq10ft** from the picklist.
  - c. The PayItemNumber is not editable, but will automatically be completed based on selections in a and b.
  - d. For DesignNotes, add "Sample notes for S-103" into the text field.
  - e. For ConstructionRemarks, leave this field blank.



DrainageInlet		*
Туре	Curb TypeP-1	
Depth	LessOrEq10Ft	
PayItemNumber	0425 1311	
DesignNotes	Sample notes for S-103	
ConstructionRemarks		

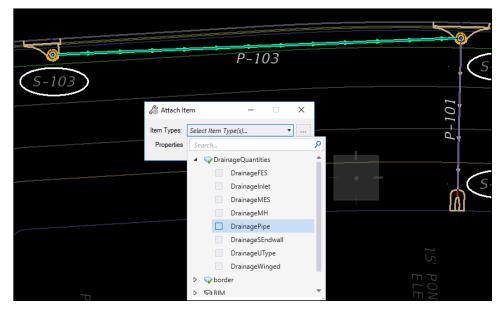
3. Repeat steps for S-101 and S-102 with the data shown below.

DrainageInlet		*	DrainageMES	*
Dramayermet			Application	CrossDrain
Туре	Curb TypeP-2		Shape	Round
Depth	LessOrEq 10Ft		Size	18
PayItemNumber	0425 1321		PayItemNumber	0430982125
DesignNotes Sample notes for S-101			DesignNotes	Sample Notes for S-102
ConstructionRema	rks		ConstructionRemarks	

4. Close properties dialogs.

## **Exercise 5.3** Attach Item Types to sample pipes and generate Pay Item Numbers

- 1. Select P-103, open element properties and review. Note there is not yet a section for Item Types. Close the properties dialog but keep P-103 selected.
- 2. Navigate through the following path and select Attach Item: OPENROADS MODELING>HOME>Item Types>Attach Item.
- 3. For Item Types: select DrainageQuantities:DrainagePipe from the pulldown menu.



- 4. The Item Type property selections can be made in this dialog or later in element properties. Complete the dialog or item types properties with the following information:
  - a. Type = **StormAndCrossDrain**
  - b. Shape = **Round**
  - c. Size = **18**
  - d. PayItemNumber is not editable, but will automatically be completed based on selections in a, b, and c.
  - e. DesignNotes = "Sample notes for P-103"

Item Types: DrainagePipe Properties DrainagePipe Type StormAndCrossDrain Shape Round Size 18 PayItemNumber 0430175118 DesignNotes Sample notes for P-103 ConstructionPagnade	fê	📓 Attach Item 🛛 🗌							
DrainagePipe       Image Pipe         Type       StormAndCrossDrain         Shape       Round         Size       18         PayItemNumber       0430175118         DesignNotes       Sample notes for P-103	Iter	m Types:	DrainagePip	e *					
Type       StormAndCrossDrain         Shape       Round         Size       18         PayltemNumber       0430175118         DesignNotes       Sample notes for P-103	F	roperties							
Shape     Round       Size     18       PayltemNumber     0430175118       DesignNotes     Sample notes for P-103		Drai	nagePipe	*	^				
Size 18 PayltemNumber 0430175118 DesignNotes Sample notes for P-103		Туре	)	StormAndCrossDrain					
PayltemNumber 0430175118 DesignNotes Sample notes for P-103		Shap	e	Round					
DesignNotes Sample notes for P-103		Size		18					
		Paylt	temNumber	0430175118					
ConstructionBounds		Desi	gnNotes	Sample notes for P-103					
ConstructionRemark		Cons	tructionRema	rk	v				

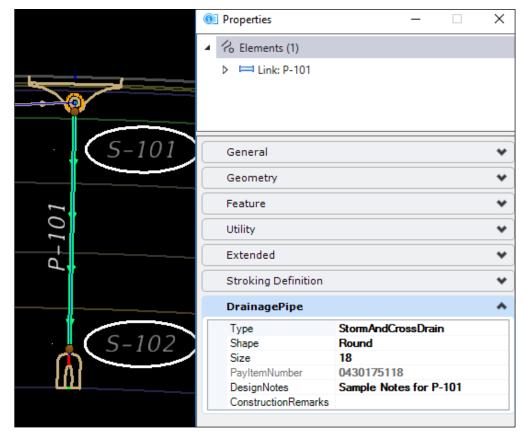
5. Left click to accept the prompt in the lower left, to apply the Attach Item settings.

Attach Item > Accept/Reject Selection

6. Reopen element properties to verify **DrainagePipe** section is complete with the Item Type properties.

OI Properties	_	×
<ul><li>A Elements (1)</li></ul>		
Link: P-103		
General		*
Geometry		*
Feature		*
Utility		*
Extended		*
Alignment		*
Stroking Definition		*
DrainagePipe		*
Туре	StormAndCrossDrain	
Shape	Round	
Size	18	
PayItemNumber	0430175118	
DesignNotes	Sample notes for P-103	
ConstructionRemarks		

7. Close the properties dialog and repeat steps 1 through 6 for P-101.



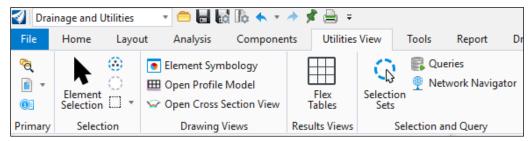


Use level display and selection sets to select and set groups with the same Item Types.

## **Exercise 5.4** Create a Selection Set

Selection sets are useful to quickly select groups of elements for a variety of uses. In the next exercise, the selection set allows properties to be set just once and avoids unnecessary repetition.

1. Navigate through the following path and select Selection Sets: DRAINAGE AND UTILITIES>UTILITIES VIEW>Selection and Query>Selection Sets.



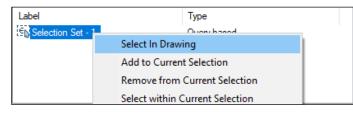
2. Click the New icon and select Create from Query.

Selection Sets		
Subsurface Utilities	Hydraulic Analysis	
	=1 "b + 😮	
Create from	Selection	Туре
Create from		

3. From the list of Available Items, select All Nodes and All Conduits and click Add '>' and click OK to close the dialog.

Selection by Q	uery - Selection	Set - 1						×
Available Items	: (116)			7	Selected Items:	(2)		
Label All Links All Culverts All Channels All Gutters All Pressur All Catch All Catch All Manhol All Transiti All Cross All Outfalls All Catch All Low Im All Low Im All Ponds All Pond	Element Type Link Conduit Channel Gutter Pressure Pipe Catch Basin Manhole Transition Cross Section Outfall Catchment Low Impact Pond Pond Outlet	Query Type Predefined Predefined Predefined Predefined Predefined Predefined Predefined Predefined Predefined Predefined Predefined Predefined		Add > Remove < <	Label All Nodes All Conduits	Element Type Node	Query Type Predefined Predefined	
All Pumps	Pump	Predefined	×					
						ОК	Cancel	Help

4. In the Selection Sets Manager, right click the new 'Selection Set – 1' and click Select in Drawing to verify the 2 pipes and 3 drainage structures are included. Close the dialog.



### **Exercise 5.5** Attach alignment information for quantities

This exercise is going to generate a pick list and item type for the project alignments and assign to drainage features.

- Outside of OpenRoads, navigate through File Explorer to the workset symb/Symbology subfolder: C:\Worksets\FDOT\22049555201\_CE\symb and locate the file FDOTProject.xlsm
- *Note* New projects created through "Create Project" will already have this file copied to the symbology folder. If already in workset folder, skip step 2.
- 2. Navigate through File Explorer to the FDOTConnect Asset Manager resources. Workstation installations typically use the path: C:\FDOTConnect\Organization-Civil\FDOT\Asset Manager:
  - a. Find and copy the file FDOTProject.xlsm
  - b. Paste the file into the workset symb/Symbology subfolder: C:\Worksets\FDOT\22049555201\_CE\symb
- 3. Open the spreadsheet and in the \_Pick List Definitions tab, fill in the following cells:
  - a. Cell  $B2 = CL_SR61$
  - b. Cell B3 = US98

	А	A B		D
1	Pick List Name	Option 1	Option 2	Option 3
2	Alignment	CL_SR61	US98	
3	FPID			
4				
_				

- c. Save and close FDOTProject.xlsm
- 4. Back in OpenRoads, navigate through the following path and open Asset Manager: OPENROADS DRAWING PRODUCTION>HOME>Model Analysis and Reporting> Asset Manager.

<b>1</b>	OpenRo	ads Dra	wing Pr 🔹 😑 🔚 🔝	là 🔶 - A 🎽	🗎 Ŧ				C:\Wo	rksets\FDOT	\220495552(	)1_CE\draina
File	e Ho	ome	Drawing Production	Drawing Viev	v							
	None	<u>a</u> 0	▼ ConstLines ▼ 🗟 0 ▼ 🕥 0	т Т Д 0 т	C Explorer	Attach Tools ¥	□ • ≫ • • 0: • 1 •	Element Selection	W Reports	-∳- Civil Analysis ▼	Corridor Reports *	e Asset Manager
			Attributes			Prima	ry	Selection	M	odel Analysis	s and Repor	ting

5. From Asset Manager, select the 🧮 icon to Open Asset Definitions File and select FDOTProject.xlsm.

🜍 Open Asset Definition Excel File								
$\leftarrow \rightarrow$		b ~ ⊽	Search symb	Q				
Organize	e 🔻 New folder			• • •				
4 ^	Name	Date modified	Туре	Size				
•	DOTProject.xlsm	9/25/2020 11:51 AM	Microsoft Excel M	66 KB				
<b>"</b> ~	٢			>				
	File name: FDOTProject.xlsm	~	Excel File (*.xlsm)	~				
			Open	Cancel				

a. Check the box for Alignment.

🜍 Asset Manager	– 🗆 X
🗟 😑	
FDOTProject Alignment FPID	Elements  Element Selection  All Elements Selection Set Fence Named Boundary Select (0) Inside Overlap  Linear Reference  Assign Export Assignment Mode Add Replace Remove Add Assets

*Note* Typically, FPID should not be attached unless the project has multiple funding sources (sequencing).

- b. In the Elements section of the tool, change setting from All Elements to Selection Set.
- c. From the path, DRAINAGE AND UTILITIES>UTILITIES VIEW>Selection and Query>Selection Sets, open Select Sets Manager, and right click Selection Set 1, and choose Select in Drawing.

_	<del>.705</del>	*****					,
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							40.00
	8		<u>57 A. 172</u>				
	<u>\$-103</u>		. <i>Р-103</i>				\$-101
	Selection Sets			- 🗆	×	P+101	
	Subsurface Utilities						
	D• 🗙 🔓 🧉	=I "b • 😮					5-102
	Label		Туре				
	Selection Set	Select In Drawin	ng				
- ((-		Add to Current	Selection				
l			Current Selection				
		Select within Cu	urrent Selection				
	0	Create from Ou	erv			~ 0	

- d. In the Asset Manager window, under the Assign Tab, click Add Assets.
- e. Verify successful attachment from messages at the bottom of the OpenRoads window.

Assets Added to 5 Element(s)
------------------------------

- f. Close the Asset Manager tool.
- 6. With the selection set still active, open properties and set the alignment CL\_SR61 for all elements.

Properties		—		$\times$					
A Elements (5)									
▷ - Cells (3)	▷ ☆ Cells (3)								
▷ / Complex Strings (2)	)								
General				*					
Feature	Feature								
Utility				*					
Extended				*					
DrainageInlet				*					
Alignment				*					
Alignment	CL_SR61			~					
Point Constraints	CL_SR61 US98								
Geometry Points									

## **Exercise 5.6** Use Takeoff Manager to generate Summary of Drainage table

Once Pay Item Numbers are generated and alignments assigned, the Takeoff Manager is ready to run.

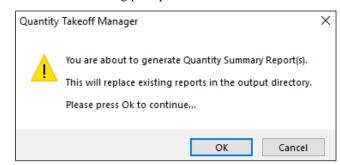
1. Open the FDOT Quantities Takeoff Manager from the path: OPENROADS MODELING > FDOT > Quantities >.



- a. Open the pulldown menu for 'Report station and offset relative to:' and verify the relevant project alignments are recognized. Keep 'All' as the selected option.
- b. Check the boxes for Include References, Output Upper Case, and Open Output File(s).
- c. Click Compute.

FDOT Quantity Takeoff Manag	er	-		×
Alignment Options				
Report station and offset relative to	D:			
All				$\sim$
Common Dana da				
Summary Reports				
Summary of Box Culverts				- 1
Summary of Clearing Grubbing and F	Removal Items			-
Summary of Curbs				-
Summary of Ditch Pavement				
Summary of Drainage				
Summary of Driveway Base				-
Summary of Earthwork				-11
Summary of Erosion Control ar	nd Sediment (	Control Device	s	
Summary of Fencing				
Summary of General Items				
Summary of Geotechnical Items				
Summary of Guardrail				
Summary of Intelligent Transp	ortation Syste	<b>ms Items</b>		
Summary of Landscape Items				
Summary of Lighting Items				
Summary of Litter Removal and Mov	wing			
Summary of Lump Sum Items				
Summary of Mailboxes				
Summary of Miscellaneous As	phalt			
Summary of Miscellaneous Drainage	e Items			- -
Select All Deselect All	Invert	Auto-Popula	ated Repor	ts
	inven			
Output Options File Output Location:				
C:\Worksets\FDOT\22049555201_	CE\calculations	•		
		•		
Include Referrences				
Output Upper Case				
Open Output File(s)				
	Create PDF	Compute	Clos	e

d. Select OK to the following prompts.



*Note* Any previous tables with the same file name and location will be replaced when OK is clicked in the prompt shown above. Ensure no valuable information will be lost by renaming or relocating files as needed.

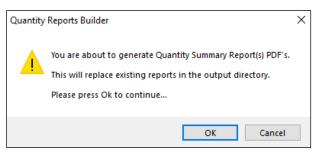


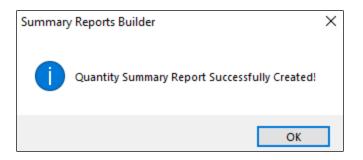
2. Review the new Excel sheet Summary of Drainage.xlsx and close when complete.

	В	С	D	н	W	Х	Y	Z	AG	AH	AI	AL	AM	AN	AO
1	Summary of Drainage														
2					Qua	ntity	Total G	)uantity		L	Location				
3	Pay Item Number	Label	Pay Item Description	Unit of Measure	Р	F	Р	F	Alignment	Begin Station	End Station	Side	Element ID	Design Notes	Construction Remarks
4	0425 1311	5-103	INLETS, CURB, TYPE P-1, <10'	EA	1		1		CL_SR61	705+00.00	705+00.00	RT	4581	SAMPLE NOTES FOR S-103	
5	0425 1321	5-101	INLETS, CURB, TYPE P-2, <10'	EA	1		1		CL_SR61	706+50.00	706+50.00	RT	3046	SAMPLE NOTES FOR S-101	
6	0430175118	P-103	PIPE CULVERT, OPTIONAL MATERIAL, ROUND, 18"S/CD	LF	142.08		193.37		CL_SR61	705+02.00	706+47.89	RT	4992	SAMPLE NOTES FOR P-103	
7		P-101			51.29				CL_SR61	706+50.02	706+50.09	RT	3657	SAMPLE NOTES FOR P-101	
8	0430982125	5-102	MITERED END SECTION, OPTIONAL ROUND, 18" CD	EA	1		1		CL_SR61	706+50.09	706+50.09	RT	3222	SAMPLE NOTES FOR 5-102	

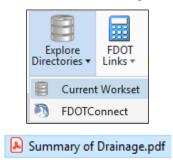
- 3. Back in the FDOT Quantity Takeoff manger Tool, click Create PDF.
- *Note* Summary of Drainage PDFs may be useful for QC purposes, but must be delivered within the complete Estimated Quantity Report generated by the Prime/EOR.
  - 4. In the following prompt, check the box for Summary of Drainage, select Convert and OK to the following prompts:

🖳 Summary Reports Builder	_	×
Spreadsheet Input Directory: C:\Worksets\FDOT\22049555201_CE\calculations		]
PDF Output Directory: C:\Worksets\FDOT\22049555201_CE\estimates		
Excel Summary Report Files		
C:\Worksets\FDOT\22049555201_CE\calculations\Summary of Drainage.xlsx		





5. Navigate through the following path to open the estimates subfolder and the Summary of Drainage pdf: OPENROADS MODELING>FDOT> Resources > Explore Directories > Current Workset.



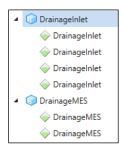
## **Exercise 5.7** Explore Items in Project Explorer and delete strays

FDOT methodologies are subject to change as further Bentley refinements are implemented with OpenRoads updates.

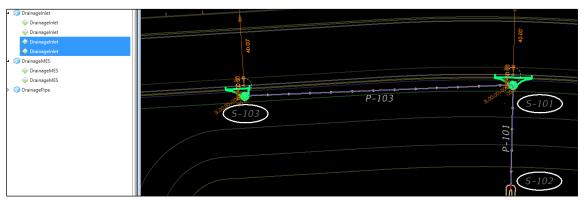
One of the identified limitations in the OpenRoads CONNECT Edition –Version 10.08.01.33 is the duplication of items associated with drainage structure cells. A stray item is added to the drainage structure shapes associated with the connection regions. This example shows how to detect and delete these duplicate drainage structure items. Drainage pipes are not affected by this issue.

*Note* Warning: the process described in this exercise may significantly slow performance and require restart if using Version 10.08.

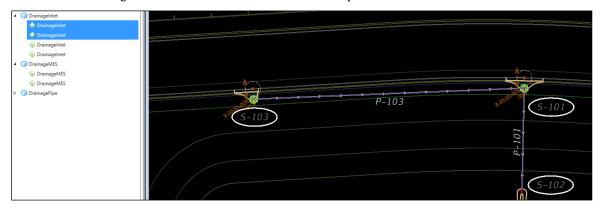
1. If not already docked and open, click F11 to Toggle Project Explorer, or use following path and navigate to Items: DRAINAGE AND UTILITIES>HOME>PRIMARY>Explorer>Items. Expand the sections for DrainageInlet and Drainage MES:



- a. Note the intended total of drainage structures is Drainage Inlets (2: S-101 and S-103) and MES (1: S-102), but the total in the Items sections is double.
- b. Scroll through the list and the corresponding selected element in the DGN will be highlighted.
- c. Find the items corresponding to the Drainage Inlets where the whole structure is highlighted.



d. Find and select the items that do not highlight the entire structure, but just the connection regions. These will be deleted in the next steps.



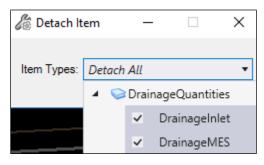
2. Typically, these stray lines are placed on the level Default. Use the level filter in the Element Selection tool to select all the elements on Default. It is OK if more than just the stray items are selected in this process.

🔏 Element Selection	—	×
⊕ ⇔ ≠ ⊖ /	<b>-</b> 0	
<b>≋+-</b> ≥○		•
7a U	چ	۲
	=	
Level	×	^
Default	•	
AccessRamp ep		

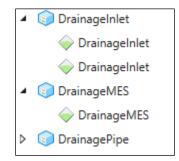
3. Keeping the selection from Step 3, open Detach Item from the path: OPENROADS MODELING>HOME>Item Types> **Detach Item.** 



4. The options of Items attached to the selection are listed. Check boxes for DrainageInlet and DrainageMES.



- a. Left click to accept the prompt in the lower left to attach: Detach Item > Accept/Reject Selection
- b. The message at lower left confirms successful attach: Detached 3 item(s).
- c. Also, to confirm, the Item Tab in Project Explorer now correctly shows 3 item types attached to drainage structures:



# **6** DRAINAGE DOCUMENTATION

# INTRODUCTION

The focus in this chapter will be on the tools available in OpenRoads Designer CONNECT Edition to fulfill FDOT Drainage Manual 3.13.1 drainage documentation requirements. For additional guidance on storm drain calculations and documentation, see FDOT Drainage Design Guide Chapter 6. The Drainage Workflows for FDOTCONNECT aim to provide the required information but are presented in a new format.

In OpenRoads Designer CONNECT Edition, reports and tables are an effective way to organize and convey the drainage model database information and calculations. The FDOT Drainage Workflows for OpenRoads Designer accomplish drainage documentation primarily through a combination of reports and flex tables available in the FDOTCONNECT Workspace.

As discussed in FDM 916, large format sheets can accommodate a combination of multiple model views and tables. For drainage documentation of storm drain networks, the workflows described in this chapter also pair relevant tables with depictions of the storm drain network. For purposes of this course guide, this will be referred to as the FDOT storm drain documentation sheet. The general steps of adding tables to sheets shown in Chapter 4 also apply here: 1) export table to Excel, and 2) place table in sheets.

The drainage documentation tools and features discussed in this chapter are:

- Place Label
- Hydraulic Model Properties
- Reports
  - Hydraulic Model Inventory
  - Calculation Summary
- Tables
  - o OpenRoads Tables
  - o FDOT Flex Tables
- Place Table

# PLACE LABEL

For FDM 903 Drainage Map and/or the FDOT storm drain documentation sheet, the Place Label tool with text favorites can be used to add drainage area information to plan view. For additional guidance on the Place Label tool, see Chapter 4 of this course guide.

The Place Label tool is used in the FDOT Drainage Plans Production Workflow to manually add dynamic labels for plan view and can be accessed from the path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Notes > Place Label.

Tools	Report	Drawing Production	Drawing	View	
Place Table	Place Place Labe	Place Edit Chang	de Text butes A <sup>A</sup> A <sup>A</sup> A <sup>A</sup>	Element Annotation *	Model Annotation *
Tables	Notes	Text	F2	Annota	tions 🕞

*Note* Labels are placed on the active level. Make sure the correct level is active before using the Place Label tool. It is recommended that drainage area labels use the level TextDetails so that other plans that attach the drainage file as a reference can isolate which labels are displayed.

The Favorite Name: '\_SU\_PLAN\_NODE\_ID' also works to add the label for the catchment (drainage area) ID.

🔏 Place Label Setting	Is —		×
Type:	Text Favorite	Ŷ	
Favorite Name:	SU_PLAN_NODE	ID *	
Dimension Style:	👽_FDOT_Dynamic L	abels	D
Label Rotation:	Horizontal	~	
Start At:	Terminator	Ŷ	
Horizontal Attachment:	Auto	Ŷ	

# **HYDRAULIC MODEL PROPERTIES**

In the OpenRoads Designer CONNECT Edition, Hydraulic Model Properties is a tool available to document designer information and model notes. This information can be included in a report, exported to Excel, and placed in the FDOT storm drain documentation sheet.

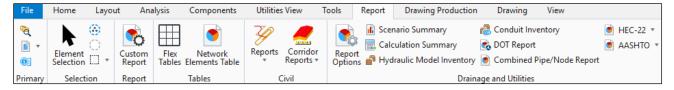
The Hydraulic Model Properties dialog can be accessed from the following path: DRAINAGE AND UTILITIES > TOOLS > Project Tools > Project > **Project Properties.** 

Tools	Report	Drawing Producti	on Drawir	ng N	/iew	
	/ 🙆	📻 Project 🔹	8	Catchr	ment Deline	eation S
Proje	ct i-mod	el 🔐 Project	Properties 🛛 🎙	Gutter	Section Set	tings
	lts Configura		ct Database			
		Proj	ect Tools			
Hyd	raulic Model P	Properties				×
Title						
File	Name:	pData\Local\Tem	p\Bentley\SUDA		RD01 Defau	ult.stsw
Engi	neer:					
Com	pany:					
Date	:	9/ 1/2015				
Notes	3:					
						$\sim$

## REPORTS

In OpenRoads Designer CONNECT Edition, a variety of predefined Reports are included with the installation. Additionally, Custom Report is a tool to build a report based on a variety of model input and results. Reports can be exported to several different formats, including Excel. In the FDOT Drainage Documentation Workflow, some of the required drainage documentation can be accessed from Reports.

Reports can be accessed from the following path: DRAINAGE AND UTILITIES > REPORT > Drainage and Utilities.



Some of the predefined Drainage and Utilities reports open a Flex Table and others open a Report 'Preview'. The Report 'Preview' types cannot be formatted with OpenRoads tools. However, both types may be exported for further formatting as needed.

## HYDRAULIC MODEL INVENTORY:

An example of a predefined Report 'Preview' that can be useful for FDOT drainage documentation is the Hydraulic Model Inventory. The contents include Hydraulic Model Properties, an abbreviated Scenario Summary, and the Network Inventory. The Scenario Summary section shows the type of computation and Alternatives selected.

😥 Preview				_		×
<u>File</u> <u>V</u> iew	<u>B</u> ackground					-
🛛 🙀 Page Se	:t <u>u</u> p	🕞 🖪 🖑 🔍	🔍 100% 💊 🔍 🖛 🔺 🕨 🔛 🗄 🏠 🦛 🖂	- 🙁	-	
· B? Print						~
B Print						
📋 Export I	Document 🕨	PDF File	del Inventory: DRPRRD01 Default.stsw			
🖂 Send vi	a E-Mail 🕨	HTML File	FDOTCONNECT Example Exercise First Last, P.E.			
🔀 Exit		MHT File	Company, Inc.			
	Date	RTF File	9/1/2015			
	Notes		This model represents an example system developed for purposes of			
	Notes	Excel File	navigating through OpenRoads Drainage and Utilities tools.			
	Scenario Sum	CSV File				
	ID	Text File	127			
	Label	Image File	Analysis			
	Notes					
	Active Topolog		Base Active Topology			
	User Data Exte	ensions	Base User Data Extensions Base Physical			
	Physical Boundary Cond	dition	Base Boundary Condition			
	Initial Settings		Base Initial Settings			
	Hydrology		Base Hydrology			
	Output		Base Output			
	Infiltration and		Base Infiltration and Inflow			
	Rainfall Runoff	:	Base Rainfall Runoff			
	Water Quality		Base Water Quality			
	Sanitary Loadir	ng	Base Sanitary Loading			
	Headloss		Base Headloss			
	Operational Design		Base Operational Base Design			
	System Flows		Base System Flows			
	SCADA		Base SCADA			
	Energy Cost		Base Energy Cost			
	Solver Calculat	tion Options	Analysis	_		4
<						>
Page 1 of 2				Zoon	n Factor	: 100%

## CALCULATION SUMMARY:

This report includes a summary of the calculations performed on the model and warning messages. When activated from the menu, or following a computation, the GVF-Rational Calculation Summary Window opens. The 'Report' button at the bottom will generate a Calculation Executive Summary.

GVF-Ration		,					
Scenario					-		
Label:		Analysis					
Storm Event							
Rainfall Alter	native Label:	Base Rainfall	Runoff		]		
Global Storm	Event:	Zone 2 - 3 Ye	ear	~			
Return Event:	:	3		years			
Calculation Exe	ecutive Summary						
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	wergence was ach						
iew	this dialog after Co	ompute	Messages	Report	Details	Close	Help
iew <u>V</u> iew <u>B</u> ackgrou	_		Messages	Report			Help
iew <u>V</u> iew <u>B</u> ackgrou	und					I ▼  🔇 .	Help
iew <u>V</u> iew <u>B</u> ackgrou	und 2 🔒 🗣 🕄   🖑 Scen	🍳   🔍 🛛 100% ario Summary	Calculat			I ▼  🔇 .	Help
iew <u>V</u> iew <u>B</u> ackgrou	und ' 🔒 🧤 🖳 🦓 Scen Labe	्   ् 100% ario Summary	Calculat Analysis			I ▼  🔇 .	Help
iew <u>V</u> iew <u>B</u> ackgrou	und ' 🔒 🧤 🖳 🦓 Scen Labe	🍳   🔍 🛛 100% ario Summary	Calculat Calculat Analysis Summary			I ▼  🔇 .	Help
iew <u>V</u> iew <u>B</u> ackgrou	und Calcu	्   ् 100% ario Summary	Calculat Analysis			I ▼  🔇 .	Help
iew <u>V</u> iew <u>B</u> ackgrou	und	Image: Constraint of the security of the securit	Calculat Calculat Calculat Calculat Subsurface Network Root:S-102 >>>> Info: Subsurface Analysis iterations: 1 >>>> Info: Convergence was achieved.			I ▼  🔇 .	Help
riew <u>V</u> iew <u>B</u> ackgrou	und Calcu Subn Storm	Image: 100%       ario Summary       Image: 100%       Image: 100%    <	Calculat Calculat Calculat Calculat Calculat Calculat Summary Summary Subsurface Analysis iterations: 1 >>>> Info: Subsurface Analysis iterations: 1 >>>> Info: Convergence was achieved.		ve Summ	I ▼  🔇 .	Help

If the 'Details...' button is selected, a second window, 'Calculation Detailed Summary' will open with tabs for various drainage feature types. The 'Report' button generates a Calculation Detailed Summary Report.

Calculation De	tailed Summary									×
Calculation Options	Catchment Summary	Link Summary	Node Sum	mary Ir	nlet Summary	Pond Summary				
General						Hydraulics and Hydrolog	Ŋ			
Maximum Netwo	rk Traversals:	5				Flow Profile Method:		Backwater Analysis	$\sim$	
Flow Convergence	e Test:	0.00100				Number of Flow Profile	e Steps:	5	]	
Inlets						Hydraulic Grade Conv	vergence Test:	0.00	ft	
Neglect Side I	Tow?					Average Velocity Meth	nod:	Actual Uniform Flow Ve	elocity V	
	Cross Slope For Side	Daw 2				Minimum Structure He		0.00	] ft	
			-					10.000	7	
Active Componer	nts for Combination Inl	lets In Sag:	Grate and	d Curb	$\sim$	Minimum Time of Con	centration:	10.000	min	
Active Component	nts for Combination Inl	lets on Grade:	Grate and	d Curb	$\sim$					
									Report Close	e Help
🕼 Preview										
<u>F</u> ile <u>V</u> iew	Background					- 1	1			
#a #A   🍃		y 🛃 🖉	۹   ۹	1009	% ~	🔍 🛛 🖉 🕨	N   🗄 🖑	🔯 🗋 🕶 🛏 🕶	🙁 🚽	
						Calculation	n Detaile	d Summary		
		Eleme	ent Details	6						
		ID				126	Notes			
		Label				Analysis				
		Hydra	ulicSum	mary						
		Flow	Profile Me	thod		Backwater Analysis	Average	Velocity Method	Actual Uniform Flow Velocity	
		Numb	er of Flow	Profil	e Steps	5	Minimum	Structure Headloss	0.00 ft	
		Hydra Test	aulic Grad	e Conv	ergence	0.00 ft	Minimum Concentr		10.000 min	
		Inlets								
			ect Side Flo			False	Combina	omponents for ition Inlets In Sag	Grate and Curb	
			ect Gutter ( de Flow?	Cross S	Slope	True		omponents for ition Inlets on Grade	Grate and Curb	
		1150	DO Enorm		00/60000	d Edition)				

UEC 00 EnergyLeason (Second Edition)

# **TABLES**

Tables are needed to supplement the documentation provided by the OpenRoads predefined reports. Since any table in OpenRoads can be exported or copy/pasted to Excel for documentation purposes, there is a wide variety of tables and information to choose from. Typical applications of both OpenRoads Tables and FDOT Flex Tables are discussed in the following sections.

## **OPENROADS TABLES:**

Although some of the predefined OpenRoads summary reports include a list of which Alternatives were selected for use in the computation settings, designers may choose to document further details as needed.

For example, if minor losses are calculated, the Headloss Alternative table may be exported for a concise summary of methodology and loss coefficients selections.

<b>E</b> € H	leadloss :	Base Head	lloss (DRF	RRD01 Defa	ult.stsw)							_		Х
€D +		i 😮												
~		Catch B	nain (7	<b>M</b> 1 1 77	<b>T</b>									
	duit		asin Ø	Manhole Ø	Transition									
		*	ID	Label	Headloss	HEC-22 Benching	Absolut Headlos			adloss He efficient Co	eadloss efficient	AASHTO Shaping	Flow-Head	
			10	Caber	Method	Method	(ft)			stream) (St		Method	Curve	2
43 : 5	S-101		438	S-101	Standard					(	0.00000			
450: 9	S-103		450	S-103	Standard		Сору			0	0.00000			
								With He	adore I					
*			_		_				auers					
* 🔽	= Base d	ata	✓	= Local data		= Inhe	Paste							
				P	ASE HEADLO	SS. CATCL	I BASIN L		c				-	
				<i>D</i> .	ASL TILADLO	JJ. CAICH	DASIN	ILADLOS.						
				Headlos	HEC-22 s Benchina	Absolute Headloss	Headlos Coefficie		adloss F ficient Co	leadloss	AASHT0 Shaping	Flow- Headlos	c	
		* 1	D La	abel Method	Method	(ft)			stream) (S		Method	Curve	5	
													_	
							or:							
🕼 Pr	eviev												_	
File	View	<u>B</u> ackgroun	d											
-					100%	•	4	ь ы Г	CD As			3		
an.	88   🗁			J 🖑 🔍 🤅	100%	Y 🔨			5 1	🖄   🗋 🕇		✓ -		
						15: Ba	se He	adlos	: <b>G</b>					
					10				_					
F	*	ID	La	bel Head	•	atch B		leadloss	Headlos	s Headlo		ASHTO	Flow-Headlos	26
		10	La	Met				efficient	Coefficie			haping	Curve	
					Meth	od (f	ft) (D	ownstre	(Upstrea	am (Stand	ard) M	1ethod		
H	True	438	S-101	Stand	ard <none< td=""><td></td><td></td><td>am)</td><td>)</td><td>0.00</td><td>000 <n< td=""><td>one&gt; &lt;</td><td><none></none></td><td></td></n<></td></none<>			am)	)	0.00	000 <n< td=""><td>one&gt; &lt;</td><td><none></none></td><td></td></n<>	one> <	<none></none>	
	True	450		Stand						0.00			<none></none>	
							I		1					

Another example of additional supporting details is the Rainfall Runoff Alternative. If the Report icon is selected, a report Preview will generate that includes the maximum (10 minute) storm intensity based on FDOT IDF curves.

📑 Rainfall Runoff : Base Rainfa	ll Runoff (DRPRRD01 Default.sts 🗕 🗌	Х
si + 🖏 + 📄 😮		
Global Rainfall 🧭 Manhole 🛄	Outfall 🔲 Catchment 🖉 Pond 🖉 Wet Well	
Storm Events		
Alternative:	Base Rainfall Runoff	
Global Storm Event:	Zone 2 - 3 Year V	
Source:	Orphan (local)	
Return Event:	3	
Intensity (Average):	(N/A)	in/h
Depth:	(N/A)	in
Duration (Modified Rational):	0.000	min
* 🔽 = Base data 🔍	= Local data 🗌 = Inherited data	

Preview			
le <u>V</u> iew <u>B</u> ackground			
A 🗁 🔚 🔤 🔒	🕞 🛃   🖑 🔍   🔍 🔟	00% 💊 🔍 🖾 🖉 🕨	19 🐴 🔯 🗋
		Base Rainfall Run	off
Global Rainfall			
Global Rainfall Alternative	Base Rainfall Runoff	Depth	(N/A) in
		Depth Duration (Modified Rational)	(N/A) in 0.000 min
Alternative	Runoff Zone 2 - 3		
Alternative Global Storm Event	Runoff Zone 2 - 3 Year Orphan	Duration (Modified Rational)	0.000 min

A different way of summarizing rainfall, if multiple events are used in computations, is from the Global Rain Events table (DRAINAGE AND UTILITIES > COMPONENTS > Common > Global Storm Events

Alternative         Global Storm Event         Source         Event (years)         Deprint (in)         Monal Rational (min)         Source (n,h)         Adverage) (n,h)         Adverage)           12: Ba         Base Rainfall Runoff         Zone 2 - 3 Year         Orphan (local)         3         0.0         0.000         7.596         0.0000         No	Climate Climate
	djustment Adjustment Type (%)
457: 4 4 in/hr Absolute Intensity (Spread Only) Absolute Intensity 4 in/hr - 0 Year Orphan (local) 0 0.0 0.000 4.000 0.000	one 0.0
	Сору
	Copy With Headers
	Paste
GLOBAL STORM EVENTS	🥥
Return (Modified Storm Intensity Climat	e Climate
Alternative Global Storm Event Source (vears) (in) (min) (in/h) (in/h) Type	

0

0

0

0

7.596

4.000

0

0

None

None

0

0

# FDOT FLEX TABLES:

Zone 2 - 3 Year

4 in/hr Absolute Intensity Absolute Intensity 4 in/hr – 0 Year Orphan (local)

Base Rainfall Runoff

Where feasible, FDOT Flex Tables have been developed to resemble familiar documentation formats shown in the FDOT Drainage Manual and FDOT Drainage Design Guide. These tables can be accessed from the Flex Table Manager at the path: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Views > Flex Tables.

0

	📳 Queries
Flex Tables	
Ana	lysis Views

The FDOT drainage documentation flex tables are located in the Hydraulic Analysis Tab:

Orphan (local)

FlexTables	_
Subsurface Utilities	Hydraulic Analysis
🗋 • 🗙 =i   🖻	💷 - 🖸 😮
🖃 🔚 Tables - Hy	draulic Model
FDOT-S	Spread
FDOT-(	Dutfall
FDOT-(	Conduit-StormTab
FDOT-(	Catchment

## FDOT-SPREAD:

The FDOT-Spread flex table is comparable to FDOT Drainage Design Guide Table 6.3-1 and documents to spread and inlet capacity analysis.

Label       Baseline       Baseline       Baseline       Baseline       Inlet       Inlet       Inlet       Total Inlet       Total Inlet       Total Rational       Road       Gutter       Longitudinal       Manning's       Mannin														SPF	EAD	CALCULAT	IONS
Depth (Gutter) (in)Spread / Top WidthMaximum Spread (ft)Capture Inlet LocationIntercepted Efficiency (Calculated)Bypassed Rational FlowAdditional Carryover Flow0(ft)(ft)(ft)(ft)Inlet Location(ft)Capture (Calculated)FlowFlowAdditional Carryover Flow	Label	Baseline	Station	Offset		et Dra	inage rea	Inlet (	Inter	sity	Flow t	o Inlet	Cra Sla	oss Cros ope Slop	ss De	Slope (Inlet)	Manning's
			(Gutte	er) Top W	Vidth	Spread	Inle	Ef Ef	iciency culated)	Rai F	tional Iow	Ration Flow	al '	Additional Carryover Flow	Bypa		

## FDOT-OUTFALL:

The FDOT-Outfall flex table is a supplement to the FDOT-Conduit-StormTab table that documents the tailwater conditions used in the hydraulic calculations.

						OUTFALL	CONDITIO	ONS					
								Elevation (User				System	
		Baseline	Baseline	Elevation	Elevation	Boundary		Defined	System	System	System	Rational	
	Baseline	Station	Offset	(Ground)	(Invert)	Condition	Boundary	Tailwater)	CA	Flow Time	Intensity	Flow	
Label	Feature	(ft)	(ft)	(ft)	(ft)	Туре	Element	(ft)	(acres)	(min)	(in/h)	(cfs)	Notes

## FDOT-CONDUIT-STORMTAB:

The FDOT-Conduit-StormTab flex table is comparable to FDOT Drainage Manual Figure 3-2: Storm Drain Tabulation Form and documents the results of hydrologic and hydraulic calculations for storm drain systems.

													STO	RM DRAIN	I TABUL
Label	-Node- Upstream Downstream	Length (Unified) (ft)	Upstream Inlet Area (acres)	System Drainage Area (acres)	System CA (acres)	Syste Flow Time (min)	(Pipe Flow)	System Intensity (in/h)		System Rational Flow (cfs)	Upstream Structure Headloss (ft)	Ground	d Cleara	nce Ups Down	HGL- tream stream ft)
LATION	FORM											-	-		J 🖣
-Inve (Condu Upstre Downst (ft)	uit)- eam ream (ft)	Fall Inverts (ft)	Number of Barrels	Size (Display)	Rise (Unified) (ft)	Span (ft)	Manning's n	Friction Slope (%)	Slope (Calculated) (%)	Minimum Slope (%)		Physical /elocity (ft/s)	Capacity (Full Flow) (cfs)	Notes	

## FDOT-CATCHMENT:

The FDOT-Catchment flex table is comparable to FDOT Drainage Areas Tabulation form, a previous FDOT GEOPAK Drainage report. This table is useful when multiple subareas define a composite C value.

DRAINAGE AREAS TABULATION							
Label	Area Defined By	Subareas <count></count>	Subareas		Catchment CA (acres)	Composite C	

The individual subareas flex tables can also be accessed and exported to Excel through the ellipses shown in the 'Subareas' column of the FDOT-Catchment flex table.

FlexTable: FDOT-Catchment (Current Time: 0.000 min) (DRPRRD01 Default.stsw)									
₫   🗅 🕶									
	Label	Area Defined By	Subareas <count></count>	Subareas	(Un	rea ified) tres)	Catchment CA (acres)	Composite_C	
446: DR-101	DR-101	Multiple Subareas	2	Collection: 2 items>		0.334	0.270	0.81000	
452: DR-103	DR-103	Multiple Subareas	2	<collection: 2="" items=""></collection:>		0.225	0.182	0.81000	
459: DR-999	DR-999	Single Area	0	<collection: 0="" items=""></collection:>		0.073	0.070	0.95000	
Preview       Image: Constraint of the second									
	Subareas - DR-101 (Catchment)								
	Area /	Total Area Area (%) (acres)	Surface Description	Runoff Coefficient					
		80.0 0.267 20.0 0.067	Pavement Grass	0.95000 0.25000					

# **PLACE TABLES**

Once the appropriate reports and tables have been exported to Excel, the Place Table tool can be used to add these to the FDOT storm drain documentation sheet(s). This tool is accessed from the path: DRAINAGE AND UTILITIES > DRAWING PRODUCTION > Tables > Place Table.

Tools Report			0	Drawing	Produ	ction
Place Table	Place	Place Labe	e	A Place Text	A_ Edit Text	A Chan Attri
Tables	N	otes				Text
C Place	Table			_		×
Seed: None From file						
Active <u>A</u> ngle: 90°00			'00"			-
File	Name:		onta	ins T <u>i</u> tle ins <u>H</u> eac Associa	der Row	

When a placed table is selected, the Table Tools Layout Tab appears with multiple editing and formatting options.

🚺 Drainage and Utilities 🔹	👔 Drainage and Utilities 🔹 🔹 🚍 🔛 🕼 🏡 🔹 🖈 🏓 🖶 🗢					Table Tools C:\Worksets\FDOT\22049555201_CE\drainage\DRPRRD01.dgn [2D - V8 DGN] - OpenRoads Designer CONNEC				
File Home Layout A	Analysis Components	Utilities View Tools Report Drawi	ng Production	Drawing View	Layout					
Title Row First Column Header Row Last Column Footer Row		Delete Delete Insert Insert Insert Right	Merge Split Cells	☐] Height: 0.26 ☐ Width: 1.34	Distribu	ute Rows ute Columns	HA Text Direction ★ = = Cell Margins ★	Fill Borders		
Table Options	Table Size	Rows / Columns	Merge	Ce	II Size		Alignment	Table Symbology		

# **E**XERCISES

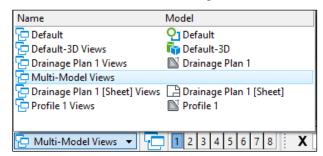
## EXERCISE OVERVIEW – DRAINAGE DOCUMENTATION

In this chapter's exercises, users will locate & export various OpenRoads reports and tables to Excel. A new FDOT storm drain documentation sheet will be created and populated with the exported tables. The scenarios and network set up in Chapter 2 and used in Chapters 3-5 exercises (S-101, S-102, and S-103) will be the starting point for this chapter exercise.

- 6.1 Complete the Hydraulic Model Properties
- 6.2 Compute Center: Review Properties and Run Analysis Scenario (Zone 2 3 Year)
- 6.3 Export a Hydraulic Model Inventory Report to Excel
- 6.4 Copy/Paste Global Storm Events data to Excel
- 6.5 Export FDOT Flex Tables to Excel
- 6.6 Compute Center: Run 4 in/hr Absolute Intensity (Spread Only) Scenario
- 6.7 Export FDOT-Spread Flex Table to Excel
- 6.8 Create FDOT storm drain documentation sheet and place labels
- 6.9 Place Tables, from Excel, in FDOT Storm Drain Documentation Sheet

## **Exercise 6.1** Complete the Hydraulic Model Properties

- 1. Open FDOTCONNECT, set the Workspace to "FDOT" and select the Workset "22049555201\_CE".
- 2. Browse to the drainage folder and open "**DRPRRD01.dgn**" and use Manage View Groups (see lower left of OpenRoads window) to set Active View Groups to Default or Multi-Model Views.



3. Navigate through the following path and select the Project Properties icon: DRAINAGE AND UTILITIES > TOOLS > Project Tools > Project > Project Properties.



- 4. In the Hydraulic Model Properties window, complete the text fields with the following information:
  - a. Title: FDOTCONNECT Example Exercise
  - b. Engineer: First Last, P.E.
  - c. Company: Company, Inc.
  - d. Date: 1/1/2021
  - e. Notes:

This model represents an example system developed for purposes of navigating through OpenRoads Drainage and Utilities tools.

Checked by: ##

Checked date: ##

Hydraulic Model Properties X					
Title:	FDOTCONNECT Example Exercise				
File Name:	$\label{eq:c:Users} \end{tabular} C: \end{tabular} \begin{tabular}{lllllllllllllllllllllllllllllllllll$				
Engineer:	First Last, P.E.				
Company:	Company, Inc.				
Date:	1/ 1/2021				
Notes:					
This model represents an example system developed for purposes of navigating through OpenRoads Drainage and Utilities tools.					
Checked by: ## Checked date: ##					

5. Select **OK** to accept the updates and close the Hydraulic Model Properties window.

# **Exercise 6.2** Compute Center: Review Properties and Run Analysis Scenario (Zone 2 – 3 Year)

This exercise revisits the Compute Center, ways to review the scenario before computation, and rainfall properties to be included in drainage documentation.

1. Navigate through the following path and open the Compute Center: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Tools > Compute Center.

ut	Analysi	s Compon	ients l	Utilities View	Tools	Report	Drawing Produ	ction D	rawing	View
s		Alternatives Options	Compute	<ul> <li>Validate</li> <li>Calculation</li> <li>Notification</li> </ul>	-		ring Standards	<u> </u>	ite Center Design Cor	nstraints
				Calculation					Analysis	Tools

- 2. The active scenario, shown in the pull-down menu, is Analysis.
  - a. To review the Alternatives selections for the Analysis scenario, select the 🛱 Scenarios icon.

4	Compute Center	- 🗆	×
Hydr	aulic Analysis		
멶			
Scer	nario		
Ana	alysis	V D  V D V	
~	Calculation Options		
	Solver Calculation Options	Analysis	
~	<general></general>		
	Active Numerical Solver	GVF-Rational (StormCAD)	
	Calculation Type	Analysis	
	Minimum Time of Concentrat	10.000	
~	Gravity Hydraulics		
	Gravity Friction Method	Manning's	
~	Pressure Hydraulics		
	Pressure Friction Method	Manning's	

b. From the Scenarios Manager window, double-click Analysis to open Properties.

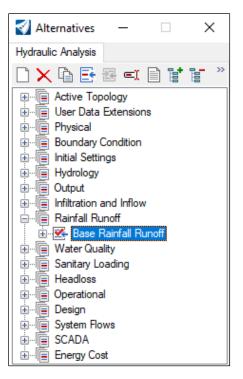


c. In Properties, note the Rainfall Runoff Alternative is set to Base Rainfall Runoff.

Subsurface Utilities Hydraulic Analysis	8
Substitues information fully and	
	V 🔍 😯 75% V
↑ → → → Add to Selection	
Show All>	× [
Property Search	
	× ×
< <general></general>	
ID	127
Label	Analysis
Notes	
<ul> <li>Alternatives</li> </ul>	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	Base Physical
Boundary Condition	Base Boundary Condition
Initial Settings	Base Initial Settings
Hydrology	Base Hydrology
Output	Base Output Base Infiltration and Inflow
Infiltration and Inflow	
Rainfall Runoff Water Quality	Base Rainfall Runoff Base Water Quality
Sanitary Loading	Base Sanitary Loading
Headloss	Base Headloss
Operational	Base Operational
Design	Base Design
System Flows	Base System Flows
SCADA	Base SCADA
Energy Cost	Base Energy Cost
<ul> <li>Calculation Options</li> </ul>	;;
Solver Calculation Options	Analysis
Rainfall Runoff	
	s you to define runoff data for relevant elements.

\_\_\_\_\_

d. To view or edit details of Base Rainfall Runoff, select the EAlternatives icon from Compute Center. The following Alternatives window opens:



e. Double-click Base Rainfall Runoff in the Alternatives window to open the editor shown below. Note, the Global Storm Event selected is Zone 2 – 3 Year.

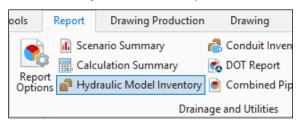
🔄 Rainfall Runoff : Base Rainfall Runoff (DRPRRD01 Default.sts 🛛 🗙							
86 🕶 🐘 🖛 📄 😮							
Global Rainfall 🧭 Manhole 🚦	Outfall 🔲 Catchment 🖉 Pond 🖉 Wet Well						
Storm Events							
Alternative:	Base Rainfall Runoff	]					
Global Storm Event:	Zone 2 - 3 Year v						
Source:	Orphan (local)	]					
Return Event:	3	]					
Intensity (Average):	(N/A)	] in/h					
Depth:	(N/A)	in					
Duration (Modified Rational):	0.000	min					
* 🔽 = Base data	🖌 = Local data 📄 = Inherited data						

f. Close the editor, Alternatives, and Scenario Properties windows. From Compute Center, select the icon to Compute Scenario. After computation is complete, close all open dialogs.

Compute Center	— [
Hydraulic Analysis	
🔁 📑 📰   🚰 💼   😮	
Scenario	
Analysis	✓ 🛃 - I

## **Exercise 6.3** Export a Hydraulic Model Inventory Report to Excel

1. Navigate through the following path and open the Hydraulic Model Inventory report: DRAINAGE AND UTILITIES > REPORT > Drainage and Utilities > Hydraulic Model Inventory.



a. The following window will appear while the report is being generated.

Generating Report	
Generating Report	
	Cancel

b. The Hydraulic Model Inventory information entered in Exercise 6.1 is automatically included in the report preview.

🖗 F	Preview			_	×
<u>F</u> ile	e <u>V</u> iew <u>B</u> ackgr	ound			•
品	8 🗁 🔚 🕯	3' 🗛 🔖 🖳   🖑	100% 🔤 ጫ   ⋈ ଏ 🕨 א   🗄 🐴 🔯   🕼 ▾ 🖂 ▾   😂 ▾		
		-	raulic Model Inventory: DRPRRD01 Default.stsw	 	 ^
		Title Engineer	FDOTCONNECT Example Exercise First Last, P.E.		
		Company Date	Company, Inc. 1/1/2021		
			This model represents an example system developed for purposes of navigating through OpenRoads Drainage and Utilities tools.		
		Notes	Checked by: ## Checked date: ##		
		Scenario Summary			
		10	107		

2. From the Preview menus, select File: Export Document: Excel File.

File	View Backgr	ound		
-	Page Set <u>u</u> p			🗳 🖑 🔍
₽?	Print			
	P <u>r</u> int			Hydraul
۱.	Export Documen	t 🕨	~	PDF File
	Send via E-Mail	. 🕨		HTML File
8	E <u>x</u> it			MHT File
		Note		RTF File
				Excel File
		Scen		CSV File
		ID		Text File
		Labe		Image File

a. Select **OK** to the following prompt:

XLS Export Options					
Show grid lines Export values using their format Export hyperlinks					
Sheet name: Sheet1					
OK Cancel					

b. **Save** the .xls in the example workset folder, drainage: eng\_data subfolder.

🕼 Save As				×
← → ~ ↑ 📙	<< OS (C:) > Worksets > FDOT > 22049555201_CE > drainage > eng_data	ٽ ~	Search eng_data	م
File name:	Doc_Hydraulic_Model_Inventory.xls			~
Save as type:	Excel Document (*.xls)			~
✓ Browse Folders			Save	Cancel

c. Select **Yes** in the following prompt to open the file:

Export	
🕐 Do you wan	t to open this file?
Yes	No

- 3. In Excel, review the report contents. In addition to Hydraulic Model Inventory information, a Scenario Summary, Network Inventory, and Circle Inventory populate the report.
- 4. For the purposes of this example, the only information to be placed into the sample storm drain documentation sheet are the Hydraulic Model Inventory and Scenario Summary.
  - a. Use the tools in Excel to delete rows as shown below:

-	Æ <u>C</u>		O Q
1	Hydraulic I	Nodel Inventory: DRPRRD01 Default.stsw	
2	Title	FDOTCONNECT Example Exercise	
3	Engineer	First Last, P.E.	
4	Company	Company, Inc.	
5	Date	1/1/2021	
		This model represents an example system developed for purposes of	
		navigating through OpenRoads Drainage and Utilities tools.	
	Notes	Charles I have ##	
6		Checked by: ## Checked date: ##	
8	Scenario Summary	CHELNEU UDIE: ##	-
_		K	_
1	ID	127	
2	Label	Analysis	
3	Notes		
4	Active Topology	Base Active Topology	
5	User Data Extensions	Base User Data Extensions	
6	Physical	Base Physical	
17	Boundary Condition	Base Boundary Condition	
8	Initial Settings	Base Initial Settings	
19	Hydrology	Base Hydrology	
20 21	Output Infiltration and Inflow	Base Output Base Infiltration and Inflow	
22	Rainfall Runoff	Base Infiltration and Inflow Base Rainfall Runoff	
23			
23	Water Quality	Base Water Quality	
24 25	Sanitary Loading Headloss	Base Sanitary Loading Base Headloss	
25 26	Operational	Base Operational	
27	Design	Base Design	
28	System Flows	Base System Flows	
29	SCADA	Base SCADA	
0	Energy Cost	Base Energy Cost	
31	Solver Calculation Options	Analysis	
			=
-		Bentley Systems, Inc. Haestad Methods Solution Drainage	and Utilities
35	DRPRRD01 Default.stsw	Center Center	[10.08.01.33]
36	10/29/2020	27 Siemon Company Drive Suite 200 W	Page 1 of 1
38		Watertown, CT 06795 USA +1-203-755-1666	

Save and close the Excel file. b.

## **Exercise 6.4** Copy/Paste Global Storm Events data to Excel

This exercise revisits the Global Storm Events, which can be used for drainage documentation. This table shows all events selected for use by Rainfall Runoff Alternative(s). The model in this exercise contains two rainfall events:

- The Zone 2 3 Year event is selected for the Base Rainfall Runoff Alternative in the Analysis Scenario.
- The 4 in/hr Absolute Intensity 0 Year event is selected for the 4in/hr Absolute Intensity (Spread Only) Rainfall Runoff Alternative in the 4 in/hr Absolute Intensity (Spread Only) Scenario.
- 1. In OpenRoads, navigate through the following path and open Global Storm Events: DRAINAGE AND UTILITIES > COMPONENTS > Common > Storm Data > Global Storm Events.



2. Using the mouse, click and drag from left to right to select the table contents. Left click and select **Copy** with Headers from the prompt that opens, as shown below.

🛞 Glo	bal Storm Events									×
	Alternative	Global Storm Event	Source	Return Event (years)	Depth (in)	Duration (Modified Rational) (min)	Maximum Storm Intensity (in/h)	Intensity (Average) (in/h)	Climate Adjustment Type	Climate Adjustment (%)
12: Ba	Base Rainfall Runoff	Zone 2 - 3 Year	Orphan (local)	3	0.0	0.000	7.596	0.000	None	0.0
457: 4	4 in/hr Absolute Intensity (Spread Only)	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0.0	0.000	4.000	0.000	Сору	
1									Copy W	ith Headers
									Paste	

- 3. Minimize OpenRoads and open Excel.
  - a. Paste the clipboard contents into a new or blank workbook.

	AutoSave 🦲		5.6	~ <del>,</del>					Book2 -	Excel		
F	ile Hor	ne Inse	ert Pag	e Layout	Formula	s Data	Review	/ View	Help	ProjectW	/ise Ac	robat
A	1	• : :	×	<i>f</i> <sub>∞</sub> Alt	ernative							
	Α	В	С	D	E	F	G	Н	1	J	к	L
1	Alternativ	Global Sto	Source	Return Ev	Depth (in)	Duration (	Maximum	Intensity	Climate A	Climate A	djustment	(%)
2	Base Raint	Zone 2 - 3	Orphan (lo	3	0	0	7.596	0	None	0		
З	4 in/hr Ab	Absolute	Orphan (lo	0	0	0	4	0	None	0		

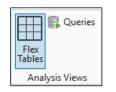
b. Format the table to FDOT font and insert a row at the top for the table title as shown below.

	AutoSave 💽 🗄 り・		Book2 - Excel							
F	ile Home Insert P	age Layout Formulas	5 Data	Review	View	Help	ProjectWise	Acrobat		e what you want
A	A1 👻 : X 🗸 $f_{x}$ GLOBAL STORM EVENTS									
	Α	В	С	D	E	F	G	Н	1	J
1			GLO	BAL STO	DRM EVE	NTS				
				Return Event	Depth	Duration (Modified Rational)	Maximum Storm Intensity	Intensity (Average)	Climate Adjustment	Climate Adjustment
2	Alternative	Global Storm Event	Source	(years)	(in)	(min)	(in/h)	(in/h)	Type	(%)
3	Base Rainfall Runoff	Zone 2 – 3 Year	Orphan (local)	3	0	0	7.596	0	None	0
4	4 in/hr Absolute Intensity (Spread Only)	Absolute Intensity 4 in/hr - 0 Year	Orphan (local)	0	0	0	4	0	None	0

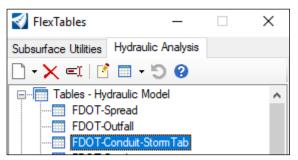
#### Save As 'Global\_Storm\_Events.xlsx' in the example workset folder, drainage: eng\_data c. subfolder.

X Save As	
← → • ↑ <mark> </mark>	« Worksets > FDOT > 22049555201_CE > drainage > eng_data $\checkmark$ 🖑
File name:	Global_Storm_Events.xlsx
Save as type:	Excel Workbook (*.xlsx)

d. Close Excel. 1. In OpenRoads, navigate through the following path and open Flex Tables: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Views > Flex Tables:



2. From the Hydraulic Analysis tab, select the **FDOT-Conduit-StormTab** table and double-click to open.



a. Select the 🖆 Export to File... icon from the upper left of the FlexTable window.

FlexTable:	FDOT-Co	onduit-S	tormT	ab (Cu	rrent Tim	ne: 0.00	)0 min)	(DRPR	RD01 ·	- Defa	ult.sts	N)														-		]	Х
1 là 🔹	6	<u>s</u>   👁	) in		•	• •	"⊳ •	•																					
Export to File	Lapel	-Node-	engtr Inifiec	Inlet Area	Area	System CA acres)		Time (Pipe Flow)	ysten tensit		System ationa Flow		Ground	aran	-HGL- ostreai	Jonduit	:40105	Fall wert	umbe of	Size )isplay	Rise Inifiec		anning	-riction Slope		linimur Slope	PIOCIT	hysica	apac (Ful Flow
		wnstrea	(ft)	acres)	(acres)	acres	(min)	(min)	(in/h)	(cfs)	(cfs)	(ff)	(ft)	(ft)	vnstre	pstrear wnstrea	(ft)	(ft)	arrea		(ft)	(ft)		(%)	(%)	(%)	(ft/s)	(ft/s)	(cfs
444: P-101	P-101	S-101	5	0.334	0.56	0.452	13			0.00	1.66	0.00	30.85	2.84	28.01	25.20	0.01	0	1	18	1.50	0	0.012	0.021	0.353	0.151	0.94	3.82	6.7
444: P-101		S-102													28.00	25.00													
454: P-103	P-103	S-103	1	0.225	0.22	0.182	10	0.402	6	0.00	1.12	0.00	31.40	3.37	28.03	26.50	0.01	1	1	18	1.50	0	0.012	0.010	0.887	0.151	0.63	6.06	10.7
454: P-103		S-101													28.01	25.20													
<																													>
2 of 2 elements di	splayed																												

b. Save as type: Comma Delimited File (\*.csv), with the File Name: FDOT-Conduit-StormTab.csv.

Export to Excel			×
$\leftarrow \rightarrow \cdot \cdot \uparrow$	« Worksets > FDOT > 22049555201_CE > drainage > eng_data	✓ ♂ Search eng_data	م
File name:	FDOT-Conduit-StormTab.csv		~
Save as type:	Comma Delimited File (*.csv)		~
✓ Browse Folders		Save	Cancel

- c. Close the Flex Table.
- 3. Navigate through the following path to quickly open the workset drainage folder: OPENROADS MODELING>FDOT> Resources > Explore Directories > Current Workset.



4. Open the FDOT-Conduit-StormTab.csv file in Excel and update formatting with the following:

			ヨッ・														FDOT-C	onduit-St	ormTab.cs	sv - Excel										
File	Home	In	isert	Page I	Layout	Form	ulas	Data	Review	View	Help	Pro	jectWise	Acr	obat		me what	you wan	t to do											
<b>\1</b>	Ŧ		×	/ fs	La	bel																								
A	В		c	D	E	F	G	н	1.1	J.	к	L	м	N	0	Р	Q	R	s	т	U	v	w	x	Y	z	AA	AB	AC	AD
				ostrea				Time		System Additio	System	e		HGL	-HGL- Upstrea m	m					Rise				Slope				Capacity	
Label	-Node	)	nified m An	ea (	e Area	CA	Flow Time (min)	(Pipe Flow) (min)	Intensit y (in/h)	nal Flow (cfs)	I Flow	Headlos s (ft)		Clearan ce (ft)	eam (ft)		Headlos s (ft)	Inverts	Number	Size (Dis		Span (ft)	Manning	Friction Slope	(Calcula ted) (%)	Minimu m Slope (%)	Velocity (ft/s)		Flow)	Notes
P-101	S-101		56.697	0.334	0.56												0.01			18 inch	1.5		0.012							Notes
	S-102														28															
P-103	S-103 S-101	14	46.083	0.225	0.22	0.182	10	0.402	6.09	0	1.12	0	31.4	3.37	28.03 28.01	26.5 25.2	0.01	1.295	1	18 inch	1.5	(	0.012	0.01	0.887	0.151	0.63	6.06	10.71	

- a. Select from cells A1 to AD5
  - i. Add borders (Home: Font: Borders: All Borders)
  - ii. Change font to FDOT
- b. Adjust units for significant digits and reshape column widths as needed

c.	Add title row and input "STORM DRAIN TABULATION FORM"
----	---

	A	В	с	D	E	F	G	н	1	J	К	L	М	N	0	P
1														STORM	DRAIN TABU	LATION FORM
2	Label	-Node- Upstream Downstream	Length (Unified) (ft)	Upstream Inlet Area (acres)	System Drainage Area (acres)	System CA (acres)	System Flow Time (min)	Time (Pipe Flow) (min)	System Intensity (in/h)	System Additional Flow (cfs)	System Rational Flow (cfs)	Upstream Structure Headloss (ft)		HGL Clearance	-HGL- Upstream Downstream (ft)	-Invert (Conduit)- Upstream Downstream (ft)
З	P-101	S-101	56.70	0.33	0.56	0.45	13.9	0.25	5.39	0.00	1.66	0.00	30.85	2.84	28.01	25.20
4		5-102													28.00	25.00
5	P-103	S-103	146.08	0.23	0.22	0.18	10.0	0.40	6.09	0.00	1.12	0.00	31.40	3.37	28.03	26.50
6		S-101													28.01	25.20

5. Save as .xlsx and close Excel.

#### 6. Repeat Steps 1 through 5 for FDOT-Outfall and FDOT-Catchment Flex Tables.

4	A	В	С	D	E	F	G	н	I	J	K	L	м	N
1							OUTFALL CONDIT	IONS						
2	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Elevation (Ground) (ft)		Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	System CA (acres)	System Flow Time (min)	System Intensity (in/h)	System Rational Flow (cfs)	Notes
3	5-102	CL_SR61	706+50	102.19	27.21	25	User Defined Tailwater	<none></none>	28.00	0.452	14.86	5.25	2.39	

	Α	В	С	D	E	F	G
1			DRAINAG	E AREAS TABULATIO	N		
2	Label	Area Defined By	Subareas <count></count>	Subareas	Area (Unified) (acres)	Catchment CA (acres)	Composite C
з	DR-101	Multiple Subareas	2	<collection: 2="" items=""></collection:>	0.334	0.27	0.81
4	DR-103	Multiple Subareas	2	<collection: 2="" items=""></collection:>	0.225	0.182	0.81

7. In OpenRoads, from the FDOT-Catchment Flex Table, open tables for each Subarea Collection by clicking the ellipse.

FlexTable	FlexTable: FDOT-Catchment (Current Time: 0.000 min) (DRPRRD01 Default.stsw)										
	Label	Area Defined By	Subareas <count></count>	Subareas	Area (Unified) (acres)	Catchment CA (acres)	Composite_C				
446: DR-101	DR-101	Multiple Subareas	2	Collection: 2 items >	0.334	0.270	0.81000				
452: DR-103	DR-103	Multiple Subareas	2	<collection: 2="" items=""></collection:>	0.225	0.182	0.81000				
2 of 2 elements	displayed										

a. Follow methodology from Exercise 6.4 to copy/paste table data and format in Excel.

Subar	eas - Catchment	(DR-101)				
$\square \times$						
	Area / Total Area (%)	Area (acres)	Surface Description	Runof Coefficie		
1	80.0	0.267	Pavement		5000	
2	20.0	0.067	Grass	0.7	F000	
*						Сору
						Copy With Headers
				OK		Paste

b. Save As Subareas\_DR-101.xlsx and SubAreas\_DR-103.xlsx respectively:

ļ		田 ら・ (				Subare	as_DR-101.xlsx -	Saved
Fi	le Home	Insert Pa	ige Layout Fo	rmulas Data	Review	View	Help Proj	ectWis
D7	• • •	× <	fx					
	А		В	с			D	6
1		SU	BAREAS - CA	ATCHMENT (	(DR-101)			
2	Area / Total	Area (%)	Area (acres)	Surface Des	scription	Runoff	Coefficient	
3	80		0.267	Pavem	ent		0.95	
4	20		0.067	Gras	S		0.25	

,	AutoSave 💽 Off 🛛 💾 💆	9- 9	, ±			Subare	as_DR-103.	.xlsx - S	aved	
Fi	ile Home Insert	Pá	age Layout Fo	rmulas Data	Review	View	Help	Proje	ctWis	
E3 • : × ✓ <i>f</i> x										
	А		В	С			D		E	
1		SU	BAREAS - CA	TCHMENT	(DR-103)					
2	Area / Total Area	a (%)	Area (acres)	Surface De	scription	Runoff	Coeffi	cient		
3	80		0.180	Pavem	ent		0.95			
4	20		0.045	Gras		0.25				
<b>E</b>										

8. Save and close all Excel files.

#### **Exercise 6.6** Compute Center: Run 4 in/hr Absolute Intensity (Spread Only) Scenario

- 1. In OpenRoads, navigate through the following path and open the Compute Center: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Tools > Compute Center.
- 2. From the Scenario pull-down, select 4 in/hr Absolute Intensity (Spread Only) and compute.

چ (	Compute Center	- 🗆 X	
Hydra	aulic Analysis		
멶	📑 🎫   🛃 📵   😮		
Scer	nario		
4 in	/hr Absolute Intensity (Spread C	Dni 🗸 🛃 🛨 🔽 🚰	
Des			٦
	/hr Absolute Intensity (Spread C	) <mark>nly) l</mark> ysis	
~	<general></general>		٦
	Active Numerical Solver	GVF-Rational (StormCAD)	
	Calculation Type	Analysis	
	Minimum Time of Concentrat	10.000	
~	Gravity Hydraulics		
	Gravity Friction Method	Manning's	
~	Pressure Hydraulics		
	Pressure Friction Method	Manning's	

3. Once computation is complete, close the Compute Center and Calculation Summary.

#### **Exercise 6.7** Export FDOT-Spread Flex Table to Excel

- 1. In OpenRoads, navigate through the following path and open Flex Tables: DRAINAGE AND UTILITIES > ANALYSIS > Analysis Views > Flex Tables.
- 2. From the Hydraulic Analysis tab, select the FDOT-Conduit-StormTab table and double-click to open.

FlexTables	_	
Subsurface Utilities	Hydraulic Analysis	
🗋 • 🗙 🛋   🙋	🖸 - 🖸 😧	
Tables - Hy	draulic Model Spread	

a. Select the 🗘 Export to File... icon from the upper left of the FlexTable window.

📰 Catch Ba	asin FlexTable: FD	OT-Spread (Curr	ent Time: 0.000	min) (DRPRRD0	)1 Default.stsv	v) —	- 🗆	×	
▲     ▲ </td									
Export to	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Inlet	Inlet Drainage Area (acres)	Inlet C	T	
438: S-101	S-101	CL_SR61	706+50	40.000	Curb Inlet Type	0.334	0.81000		
450: S-103	S-103	CL_SR61	705+00	40.000	Curb Inlet Type	0.225	0.81000		
<								>	
2 of 2 elements	displayed								

b. Save as type: Comma Delimited File (\*.csv), with the File Name: FDOT-Spread.csv.

Export to Excel			×
$\leftarrow \rightarrow \land \uparrow$	« Worksets > FDOT > 22049555201_CE > drainage > eng_data	✓ ♂ Search eng_data	٩
File name:	FDOT-Spread.csv		~
Save as type:	Comma Delimited File (*.csv)		~
✓ Browse Folders		Save	Cancel

- c. Close the Flex Table.
- 3. Navigate through the following path to quickly open the workset drainage folder: OPENROADS MODELING>FDOT> Resources > Explore Directories > Current Workset.



4. Open the FDOT-Spread.csv file in Excel and update formatting with the following:

	AutoSave	• off	] り·	C1 - =												FDOT-Spre	ad.csv - E	ĸcel				
F	ile H	ome Ir	isert	Page Layo	ut For	mulas	Data	Review	View	Help	Project\	Nise A	crobat	, Стеll	me what j	/ou want t	o do					
A:	1	• :	× v	fx	Label																	
	Α	В	с	D	E	F	G	н	1	J	К	L	м	N	0	Р	Q	R	S	Т	U	v
									Total									Capture	Intercept		Bypassed Addition	
			Baseline	Baseline		Inlet Drainage		Total Inlet	Rational Flow to	Road Cross	Gutter Cross	Longitudi nal Slope		Depth	Spread / Top	Maximu		Efficiency (Calculat		Bypassed Rational	al Carryove	
			Station	Offset		Area		Intensity		Slope	Slope	(Inlet)		(Gutter)	Width	m Spread		ed)	Flow		r Flow	
	Label S-101	Baseline F CL_SR61	(ft) 706+50	(ft)	Inlet Curb Inlet	(acres) 0.334	Inlet C 0.81	(in/h) 4	(cfs)	(%)	(%)	(%)	Manning	(in) 6.329		(ft)	Inlet Location	100	(cfs) 1.09		(cfs)	Bypass Targe <none></none>
	S-101 S-103		705+00		Curb Inlet			4	0.73		2	0.502	0.016				On Grade					S-101

- a. Select from cells A1 to V3
  - i. Add borders (Home: Font: Borders: All Borders)
  - ii. Change font to FDOT
- b. Adjust units for significant digits and reshape column widths as needed
- c. Add title row and input "SPREAD CALCULATIONS"

	А	В	С	D	E	F	G	н	1	J	К	L	М	N	0
1	SPREAD CALCULATIONS														
2	Label	Baseline Feature	Baseline Station (ft)	Baseline Offset (ft)	Inlet	Inlet Drainage Area (acres)	Inlet C	Total Inlet Intensity (in/h)	Total Rational Flow to Inlet (cfs)	Road Cross Slope (%)	Gutter Cross Slope (%)	Longitudinal Slope (Inlet) (%)	Manning's n (Inlet)	Depth (Gutter) (in)	Spread / Top Width (ft)
3	S-101	CL_SR61	706+50	40	Curb Inlet Type 2	0.33	0.81	4.0	1.09	2.00				6.3	3.45
4	S-103	CL_SR61	705+00	40	Curb Inlet Type 1	0.23	0.81	4.0	0.73	2.00		0.502	0.016	1.8	7.30
-															

- 5. Save as .xlsx and close Excel.
- 6. Save DRPRRD01.dgn and close OpenRoads.

#### **Exercise 6.8** Create FDOT storm drain documentation sheet and place labels

- 1. Reopen OpenRoads Designer and locate "\_Blankfile.dgn" at the root of the workset folder structure. Select this file and then select "OPEN" to open it.
- 2. Navigate through the path to Create File, OPENROADS MODELING> FDOT > Actions > Create File and complete selections as follows:

Ī	Terrain	Geometry	Site Layou	t Corrido	rs Mode	l Detailing	Drawing Production	Drawing	View	FDOT
Cre Fil	ate Filters	<b>L</b> inked Data Manager	Misc. Tools 🕶	Cell Libraries *	니니 이다 Cell Webpages *	Q 茶茶 Cell Cell Search Splatt	Create Existing Attach Survey			Pavement N Place Cell G Draw Condo
		Actions			Cell Applicati	ons	Roadwa	у	Tra	affic Plans

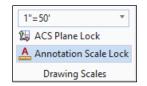
- Discipline = "DRAINAGE"
- File Group = "Drainage Sheet Files"
- File Type = **"DRMPRD"**
- File Sequence # = "01"
- County = "Wakulla" (Coordinate System = FL83-NF)

💎 Cre	ate Fil	e (v 2.0)					×
Works	et:	C:\Worksets\	FDOT\2204	9555201_CE			
Discip	line:	DRAINAGE				~	]
File G	roup:	Drainage She	et Files			~	
File Ty	/pe:						
	Base	e Filename	Descriptio	n			
	BRH	YRD	Bridge Hyd	fraulics Recomm	nenda	tion Sheet (for Box C	ulverts)
	DRD	TRD	Drainage D	Details			
•	DRM	IPRD	Drainage N	Мар			
	DRX	SRD		Cross Sections			
	LDP			ch Plan and Pro			
	LDX:			ch Cross Sectio	ns		
	PDX		Pond Cross				
		DRD		of Drainage Stru			
	SWP	PRD	Storm Wat	er Pollution Pre	ventio	n Plan	
Outp	ut File:						
						File	
		Base Filename	e: N	Aodifier (Option	nal)	Sequence #:	Extension:
		DRMPRD				01	.dgn
C:\W	/orkset	s\FDOT\22049	555201_CE	\drainage\DRM	IPRD	01.dgn	
Outp	out Fold	er: drainage					Browse
Seed	File :	tconnect	organization	n-civil\fdot\seed	I\FDC	T-ORD-Seed2D.dgn	Browse
Cour	nty:	Wakulla	~	Coordinate	Syste	m: FL83-NF V	
Acti	on:						
					C	reate - Open File	Close

- 3. Select Create Open File and Close after the new file is open.
- 4. Navigate through the following path to open the References dialog and attach the files listed below: DRAINAGE AND UTILITIES>HOME>PRIMARY>Attach Tools> References>Tools>Attach
  - a. Survey folder: GDTMDR01.dgn
  - b. Drainage folder: **PDPLRD01.dgn**, **DRPRRD01.dgn**
  - c. Roadway folder: ALGNRD01.dgn, MODLRD\_MainLine01.dgn, DSGNRD01.dgn, Aerials.dgn

📔 Ref	erences (8 of 8 unique, 7 displayed)							-			$\times$
<u>T</u> ools	<u>P</u> roperties										
ŧ∎ •	📴 💺 🗅 🌿 🧇 🧇 🖻 🔭 🖺	🌄 🖗	🗄 🛈 🗙	<u>H</u> ilite Mo	ode: None 🔻						
Slot	🏴 🚺 File Name	Model	Description	Logical	Orientation	Presentation	Visible Edge	٠	\$	k	A
6	\roadway\MODLRD_MainLine_01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe		×.	$\checkmark$	
1	DRPRRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	*	×	1	
2	PDPLRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	√	×.	$\checkmark$	
3	\survey\GDTMRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Dynamic	×	×.	$\checkmark$	
4	\survey\SURVRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Dynamic	$\checkmark$	$\mathbf{v}^{\mathbf{r}}$	$\checkmark$	
5	\roadway\Aerials.dgn	Default	Master model		Coincident - World	Wireframe	Wireframe	$\checkmark$	$\mathbf{v}$	$\checkmark$	
7	\roadway\DSGNRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	$\checkmark$	$\mathbf{v}$	$\checkmark$	
8	\roadway\ALGNRD01.dgn	Default	Master Model		Coincident - World	Wireframe	Wireframe	$\checkmark$	V.	$\checkmark$	
S <u>c</u> ale	1.00000000 : 1.00000000	<u>R</u> otation	00°00'00"	Offset	: <u>X</u> 0.00	<u>Y</u> 0.0	0				
•	1 🗠 🖮 🌄 🖓 🔛 🚳 🚺 🖌 🖓 🛄	lested Attac	hments: No Ne	sting	<ul> <li>Nesting Dept</li> </ul>	h: 0 Disp	lay Overrides:	Nev	er	-	
Ne <u>w</u> L	evel Display: Config Variable 🔻 Georeferenced: No	)	•								

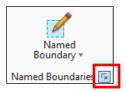
5. Set Annotation Scale to 1" = 50' from the path: DRAINAGE AND UTILITIES>DRAWING>Drawing Scales>.



- 6. Turn off levels from Reference files as needed and save settings.
  - a. Examples of undesired levels include the model handles and labels in the PDPLRD01.dgn.

Level Display - View 1	-= X
🕒 🖹 View Display	•
All Lev - Levels	- 🖂 -
⊡-102 DRMPRD01.dgn	
-108 DRPRRD01.dgn, Default	
-108 PDPLRD01.dgn, Default	
–18\survey\GDTMRD01.dgn	
-13\survey\SURVRD01.dgn	
-18\roadway\Aerials.dgn	
-10\roadway\MODLRD_Mainl	.ine_01.dgn, Default
-M\roadway\DSGNRD01.dgn,	Default
-108\roadway\ALGNRD01.dgn,	Default
Name	Used 🎽

7. The new sheet created in this exercise will use existing named boundaries created in Chapter 4 exercises in the DRPRRD01.dgn file. From the following path, open Named Boundaries Manger: DRAINAGE AND UTILITIES>DRAWING PRODUCTION>Named Boundaries.



8. Expand the Named Boundaries to Plan Groups: CL\_SR61: Drainage Plan 1. Right click on Drainage Plan 1 and select **Create plan drawing**.

REC	Name	d Boun	daries						_		×
×	<b>%</b> -	6	A		~	1			. <	o∕≡	
Nai	me			Ŧ	Description	1	File	Name	Show	,	
4	Plan Gr	oups									
	▲ CL_	SR61					DRP	RRD01.dgn	$\checkmark$		
		Draina	age Pla	an 1			a,	Create plar	n drawi	na	
		Draina	age Pla	an 2			_		i di divi		
⊳	Profile	Group	s				01	Properties			
	Cross S	ection	Grou	ps							
	Other (	Groups									

a. This action creates two new models in this DGN, Drainage Plan 1 Views and [Sheet] Views.

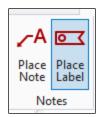
Name	Model
🔁 Default	🔁 Default
🔁 Drainage Plan 1 [Sheet] Views	📑 Drainage Plan 1 [Sheet]
🔁 Drainage Plan 1 Views	📡 Drainage Plan 1
🔁 Drainage Plan 1 [Shŧ 🕶 🔤	1 2 3 4 5 6 7 8



9. Switch back to the Default model and set active level to TextDetails.

File	Home	Layout	Analysis	Components							
😹 No	ne	*	TextDetails	Ŧ							
4	* 30	0 -	2 🔹 💽	0 • 🗛 0 •							
	Attributes										

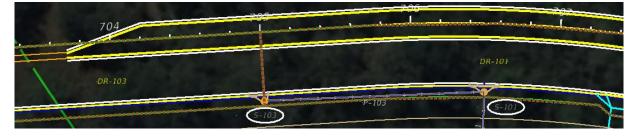
10. Open the Place Label tool from the path: DRAINAGE AND UTILITIES> DRAWING PRODUCTION>Notes> Place Label.



a. Update settings for Text Favorite: \_SU\_PLAN\_NODE\_ID and select one of the drainage areas as shown below:

703	
Polygon: DR-103 Level: DrainDivides04_ep Ref: 1 (DRPRRD01.dgn)	gs — — X
Type:	Text Favorite
Favorite Name: Dimension Style:	SU_PLAN_NODE_ID ▼ ↓ ↓
Label Rotation:	Horizontal v
Start At: Horizontal Attachment:	Terminator ~ Auto ~
and the second	A

b. Left click in the center of the area to accept placement. Repeat for second drainage area:



#### **Exercise 6.9** Place Tables, from Excel, in FDOT Storm Drain Documentation Sheet

This exercise will place the drainage documentation tables generated in Exercises 6.1 through 6.7 into the sheet created in Exercise 6.8.

- 1. In DRMPRD01.dgn, switch to the Drainage Plan 1 [Sheet] Views Model and navigate through the path to open Place Table, DRAINAGE AND UTILITIES> DRAWING PRODUCTION>Tables> Place Table.
  - a. Select the icon for **From file.**

🔏 Place Table	_	×
	×	

b. Select the ellipse next to File Name and locate the drainage/eng\_data folder, where tables were saved in earlier exercises.

裂 Open				Х								
$\leftarrow \  \  \rightarrow$	✓ ↑ ≪ drainage > eng_data	~ Ō	Search eng_data	2								
Organiz	e 🔻 New folder			?								
^	Name			^								
	FDOT-Spread.xlsx											
	Subareas_DR-103.xlsx											
	Subareas_DR-101.xlsx											
	FDOT-Catchment.xlsx											
	FDOT-Outfall.xlsx											
iii	FDOT-Conduit-StormTab.xlsx											
	Global_Storm_Events.xlsx											
	Doc_Hydraulic_Model_Inventory.xls			~								
<b>- *</b>	<			>								
	File 🔻		Directory 💌									
	File name:	~	Excel Workbooks (*.xlsx;*.xls;*.	xl ~								
			Open Cancel	I .								

c. Choose the file **FDOT-Spread.xlsx** and select OK to the prompt shown below:

Select Cells				X
Worksheet:	FDO	T-Spread	*	
Range:	Auto	matic	*	
From:	A1			
To:	V4			
OK		Cance	el	

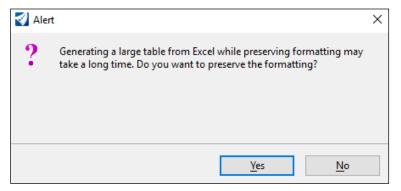
d. The completed settings for the Place Table tool are shown below:

🔏 Place Table	- 🗆	$\times$
	III 💿 🎦	
Seed:	From Excel 🔹	A
Active <u>A</u> ngle:	00°00'00.000"	* *
File Name:	FDOT-Spread.xlsx	
Worksheet:	FDOT-Sprea	
Range:	Automatic	
	Contains Title Row	
	Contains <u>H</u> eader Row	
	Retain Association	

e. Once the table has finished generating, use the cursor to choose the table location. Left click to accept and place.

+ • +	web research	
	AND ADDRESS AND ADDRES	

- 2. Repeat Step 1 for the remaining drainage documentation tables.
  - a. Note, some larger Excel tables may generate the following alert. For this example, select Yes.



- 3. Move tables and organize as needed to best fit the sheet. The following tables are presented on this example:
  - a. STORM DRAIN TABULATION FORM
  - b. OUTFALL CONDITIONS
  - c. SPREAD CALCULATIONS
  - d. DRAINAGE AREA TABULATIONS
  - e. SUBAREA CATCHMENTS
  - f. HYDRAULIC MODEL INVENTORY
  - g. GLOBAL STORM ANALYSIS

Label P=101 P=103	-hode- Upstream Downstream S-101 S-102 S-103 S-101	Length Unified (H) 56.70 146.08	Upstream Infut Are (acres) 0.33 0.23	5ystem Drainage Area (acres) 0.56	System CA (acres) 0.45 0.18	Systen Flow Tirne (mm) 13.9 10.0	Time (Pipe Flow; (ann) 0.25 0.40	System Intensity (in/b) 5.39 6.09	Srəten Additional Flow (15) 0.00	System Rational Flow (cfs) 1.00 1.12	Upstream Structure Headloss (ft) 6.00 6.00	Elen ation Gi ourid (Start) (ft) 30.85 31.40	2.84	-HGL- Upsiteam Domstream (1) 28.03 28.03 28.03 28.03	-fricent (Conduct)- Upsci wani Downstreaam (ft) 25.20 25.00 26.50 25.20	Headloss (fr) 0 DI 0 DI	FaU Inveltan (71) 0.20 1.30	tber of Bar t	18 met	(Unified) (Unified) (II) 1.5	Span (11) 0	Naming's 1 0.012 0.012	Fraction Slope (%) 0.62 0.01	51000 (Calculated) (%) 0.35 0.89	Murauar Slupe (%) 0.15	Volocity (ff/s) 0.94 0.63	Physical Velocity (11/s) 3.87 6.06	Cupatify (Full Flow; (L/2) 6.76	hotes
Calbert	Feature St	setina a(toti (ft) 16+30	(ft)	(fi) (f	11.12	ov Ioundary C User Defin	ondir/	itui <nu< th=""><th>sent Ta</th><th>tion (User lefnied likator) (ft) 28.00 S</th><th>System 5 CA T IALIES 0.452 T</th><th>ninj (70. 4.96 5.</th><th>reality Frances (b) (cfs 25 2.3)</th><th>u Antes</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></nu<>	sent Ta	tion (User lefnied likator) (ft) 28.00 S	System 5 CA T IALIES 0.452 T	ninj (70. 4.96 5.	reality Frances (b) (cfs 25 2.3)	u Antes															
Label 5-101 5-103	CL SR61 70 CL SR61 70	ation 0 (1) 6+50 5+60	seline (fst) 40 Curl 40 Curl	b Inlet Typ	e 1 0.2	age Julet 15) 3 0.8 3 0.8	(ho) 1 4.0 1 4.0	et sity (cts)	al Cruss to Slope	Gutter Cross Stope (%)	Longit di Slope 0.502	_	ming's n Intel (		1dfh Spread (ft) 15 14.0	In Say On Grady	Capture Efficience Calculated (%) 100.0	1.01	3	passod Inal Flow (LTS) 0.00 0.00	Bypassi Additon Carryoy Flow (cts) 0.00	ial Byp er Tai	gat						
Trig Engineeri Lompeny Date Notes Notes Doenerio Bot	many	Final Languer Longuer I/1/2022 This area Checkee Checkee	y, im. Ini represents en s Ini: ## Inio: ## Inio: ##	nenclan manyle system fo	evoluped for part	unan of ravigati	ոլ Ռուլի Սյո	mitanda Usainage	erd Utičkas Louis.					DR-103	Area Definer Multiple Suba Multiple Suba stal Area (%) 80 20	r By Sub. «Co	areas areas 2 < 2 < CATCHM	AREAS TA Collection Collection Collection AENT (DR-b ace Descrite Fas emant Grass	eas <u>2 items&gt;</u> 2 items>	Area (Unifwed) (atres) 0.334 0.225 off Coeffi 0.95 0.25		Campa 7 0.	osite C 81 87						
Label Nation Active Tops Date: Data I Physical Notestary L Institution Hydrol only Datput Institution Reinfall Nations National Nations	rbruins indian is ef beliow all ing	Desce Ac. Person U.S. Desce P.M. Desce D.M. Desce Dr. Desce D.M. Desce D. Desce M. Desce W. Desce W. Desce W. Desce W.	Over Topology or Digit Enternations polarit confloys Loor diffuse for ongo EpiL Enternation of all Record for Calify or Calify or Calify or Calify or direct Sections	X											5 31al Area (%) 80 20	UBAREAS - Ai ea (an es 0.180 0.045	u 💦 fa	IENT (DR-10 are Descrip Pavement Grass	13) tion Burn	0.95 0.25	clent								
Dperational Dasapa Septem Plan SCADA Tenengy Dasi Safara Lako Disference - Lako Disference - Lako	s Sat san Uptions	Perce Sci Perce Sci	sign Jam Plans Alak Hgy Cost					80 1 1 1 1 1 1 1 1 1	This burnship for space of burnship for Software Carpy Instantia Carpy Instant																				
Base Rarit	rriation VI Runoff State fittensity V/	Global Sri Zone 2 Absolute I	8 Year	Au Ti Source (ye	STORM E	Duratio	n Maxma d Stein (n/2) 7 596 4	<ul> <li>Internet;</li> <li>Devrage</li> <li>Gazh)</li> </ul>	Comate Adjustow Type Nane Rane	crimato Adjuato (%) E	(al																		

# ADVANCED TOPICS

# **UNDER DEVELOPMENT:**

Basic workflows for FDOT Storm Drain design are detailed in Chapters 1-6. Advanced topics, such as those listed below are under development to provide additional guidance and considerations for OpenRoads Designer modeling capabilities.

- Culverts and Cross Drain Analysis
- Ditches
- Pond Design (time varying / dynamic conditions)
- Utility Conflicts Matrix
- Show Gutter Flow Tool
- Importing existing Geopak Drainage or ASAD networks.

Submit requests or topic suggestions to <a href="mailto:cadd.support@dot.state.fl.us">cadd.support@dot.state.fl.us</a>

# 8 FREQUENTLY ASKED QUESTIONS

# DGNLIB

HYDRAULIC SEED DATA

Q: What was the basis of hydraulic property input used to populate the FDOT resources?

A: Hydraulic input is comparable to GEOPAK drainage and verified vs. standard plans. Where applicable catalog notes are available to clarify input.

Q: How were the new resources validated? Does the new software run calculations accurately?

A: Validation models were prepared to compare results from OpenRoads with FDOT Drainage Design Guide examples.

#### FEATURE DEFINITIONS

Q: What should I do if I want to change the structure type or Feature Definition?

A: If the Feature Definition is changed from the pulldown menu in the element Properties, the Symbology Properties will automatically update. However, the Hydraulic Properties are automatically assigned only once, at first placement and will not automatically update to the new Feature Definition. However, the Hydraulic Properties can be edited to match the correct structure in the Utility Properties dialog.

Q: All the structures have centered tops and bottoms. What do I need to do to get an eccentric configuration?

A:. Recommendation is to keep models with delivered features. We anticipate future enhancements from Bentley will allow for these configurations to be more easily modified.

Q: If I make a custom Feature Definition for a J-Bottom structure in a design file, can I reuse it for other design files or other projects to avoid?

A:. Create a new DGNLib and copy in the custom Feature Definition(s). Save the new DGNLib in the C:\FDOTConnect\Workspaces\FDOT\Standards\ Dgnlib\Feature Definitions folder.

# DGN

Q: Can more than one person work in a design file at a time?

A: No, however design files with drainage models can be referenced into other DGNs.

# MODEL

Q: Do I need StormCAD activated?

A: No, as long as networks contain less than 100 nodes. Also, separate network(s) can be included in separate dgns.

Q: How are drainage designers notified of model changes that affect drainage placement rules?

A: No apparent software official notification. We recommend having designers provide a quality control on the drainage items.

# LAYOUT

#### NODES

Q: What is the Define Catchment checkbox for, and what should I know before using it?

A: We recommend using other tools available, or other COTS products to assist in delineating boundaries. Note, the Bentley Define Catchment tool appears to increase the amount of information the software needs to process and may increase processing times. Also, since the areas automatically update, any manual edits will not 'hold'. If the terrains are simple and the automatic drainage area does not require further tweaks, this could be an efficient way to set catchments.

#### CONDUIT

Q: Why are there different Feature Definition Categories for pipes, Drainage Pipes and Culverts? What's the difference?

A: The only difference between these two types of conduit is that the 'Is Culvert' property is set to 'True'. This is necessary to run culver or cross drain calculations, especially when overtopping analysis is required.

Q: Is there an option to set barrel spacing?

A: Currently no. This function is pending further enhancement from Bentley in upcoming releases.

DGN

#### CATCHMENTS

Q: Why do the drainage areas not work with curves?

A: This is an observed Bentley defect. If a closed shape includes curved elements, the Place Catchment tool converts the shape into chords.

Q: Why is the automated weighted C value function gone?

A: This has been reported to Bentley, and pending enhancement in a future release.

Q: Is there a recommended work-around to avoid manually calculating percent land cover or weighted C values?

A: Since OpenRoads does handle multiple catchments to a single node, a possible workaround using land cover shapes for grass or pavement, etc. is to break up drainage divides by land cover.

# COMPUTE

#### SCENARIOS

INPUT

#### Q: How do I compute with Minor Losses?

A: The default set up provided in FDOT DGNLib is the Standard loss method where a user-defined loss coefficient is used to calculate the head loss based on the velocity head of the exit conduit. This input is provided at each structure and can be managed either in element properties or Headloss Alternatives. For further reference, see 'Junction Headloss Methods' in Bentley Help.

#### AUTOMATED DESIGN

#### Q: Can I use automated design for drainage networks?

A: Yes, but recommend reviewing the Drainage and Utilities 'Design Priorities'. These may result in a different design than that of following FDOT Drainage Design Guide. For example, "Pipe Capacity Should Be Greater Than the Discharge" could result in larger or deeper pipes than necessary to meet 1' HGL clearance. FDOT recommendation is to design systems using Analysis scenarios.

Q: Surcharging: tracing HGL from downstream to upstream, why does the HGL increase along the pipe – to above the upstream structure elevation, but resets to the upstream structure top for the next upstream pipe?

A: StormCAD solver is not meant for undersized systems, but rather is intended to design systems not to flood. See communities wiki link below: https://communities.bentley.com/products/hydraulics\_\_\_hydrology/w/hydra ulics\_and\_hydrology\_\_wiki/11166/why-is-the-hgl-reset-to-rim-elevation-for-flooded-structures

Q: Can automated design avoid utility conflicts automatically?

A: Not directly, however you can use view utility conflicts with the Conflict Resolution tool.

### **PLANS PREPARATION**

#### ANNOTATION

#### Q: How automated are the labeling and annotation tools?

A: The integrity of dynamic labels using Place Note and Place Label are maintained since they're based on the properties of the labeled element. If properties change, the labels change.

#### PROFILE RUNS

Q: Can I present lateral pipes in profiles and cross sections?

A:.Yes, using the 3D Cut tool, all 3D elements through the model will be shown. The 3D cut elements shown can be turned off by level as needed.

#### DOCUMENTATION

#### Q: Is there a VBA script to run or format the StormTabs?

A: No, the StormTab Flex Table may be exported for use in design documentation. Formatting may be performed within the Bentley Report Tool or in external programs such as Excel.

Under Development

Caution synchronize drawing. Explanation of FDOT design priorities vs. Drainage & Utilities