

Drainage and Utilities Feature Definitions – *Overview*

This document is suitable for the **2019 Release 1 (10.07.00.56)** *or later* versions of:

- OpenSite Designer CONNECT Edition
- OpenRoads Designer CONNECT Edition
- OpenRail Designer CONNECT Edition

Document Revision History:

Version	Software Release	Revision Description
01	10.07.00.56	Initial document release

Feature Definitions: Why and What

What we need as designers:

The Ability to *quickly* conform to Standards

A “Quality Mechanism” to **ensure** multi-level conformance to standards (“full stack” compliance)

- Graphical/Physical Clarity
- Spatial Accuracy (as desired)
- BIM-readiness
- Hydraulic Accuracy (for utilities with hydraulics)

How we do it?

Feature Definitions

One fundamental requirement of BIM (and Digital Twins) is the segregation of the design model by objects, not just graphical properties. The Bentley Civil products use the Feature Definition as the BIM-ready datatype.

In simple terms, any Bentley Civil object is a Feature; every Feature has a Feature Definition as a primary attribute. Feature Definitions are Bentley Civil object types that describe the properties and enable the capabilities of Features.

Terminology Notes:

- *Drainage and Utilities* is a software “branding” term.
- **Drainage** refers to Storm and Sanitary systems.
- **Utilities** refers to all other utility types, eg. water, gas, electrical, etc.
- The software performs **hydraulic** analysis and design calculations on drainage systems **only**.

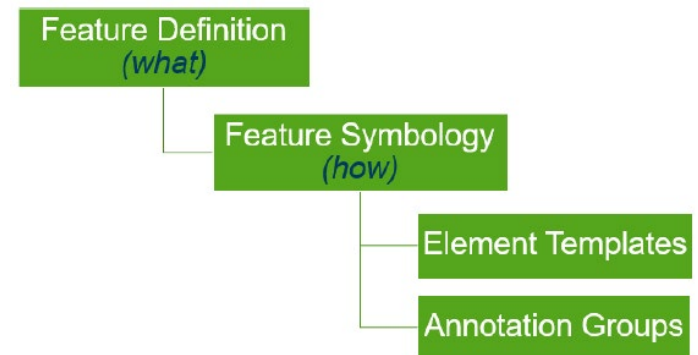
Note: See online Help at [Utility Feature Definitions](#)

Feature Definitions - General

There are many types (and purposes) of Feature Definitions. They are all composed of some common or universal attributes. Differing types of Feature Definitions may also include different additional Type-specific data attributes.

What something is and how it is displayed are separate things.

- *Feature Definition* defines “**what**” an item is.
- *Feature Symbology* defines “**how**” the item is displayed.
- *Element Templates* and *Annotation Groups* define the **detailed display settings**.



The various attributes for feature definitions are organized into groups.

- *Feature Definition* – includes the Feature Definition Name, a Description and a Name Seed for new instances of the Feature Definition.
- *Item Type* – these are extensions to the deliverable data structure. They can be used in quantities, costs, pretty much everything.
- *Point (Symbology)* – the primary way of defining how a feature is displayed is by designating Feature Symbology. This can be multi-faceted as the Feature Definition may include a collection of objects.

An example of a simple Point Feature Definition is shown to the right.

The screenshot shows a software window titled 'Properties (OpenSite Standards)'. It has a tree view on the left with 'Selection (1)' and 'Stop Sign'. The main area displays three expandable sections:

- Feature Definition**:
 - Name: Stop Sign
 - Description: Stop Sign
 - Name Seed: SS
- Item Type**:
 - Item Type: Stop Sign
- Point**:
 - Point Feature Symbology: Stop Sign

Feature Symbolology

Traditionally a Civil Engineering Object might be displayed in three different views: Plan, Profile and Cross Section. They are often displayed differently in one view than another.

Different Feature Types (lines, points, surfaces) display differently in different views.

- A line cut in section is a point
- A terrain or mesh cut in section or profile is a line
- A line in plan may be shown with different symbology (e.g., line weight) in profile
- A profile projected to another object may need to be displayed with a different symbology than on its own profile

Additionally, the industry is shifting to the BIM-centric 3D Model as the primary representation of an object – this is a fourth view and another way to represent an object.

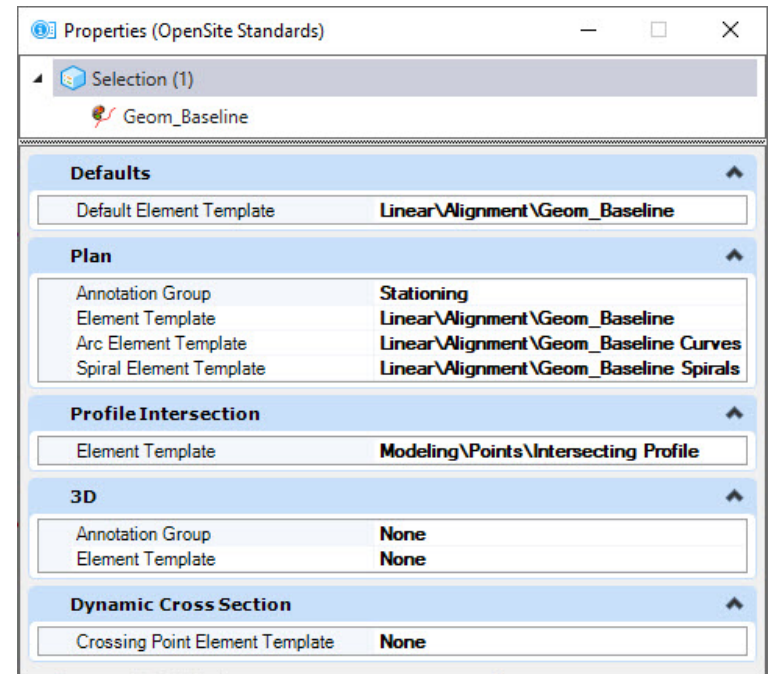
The nature of the industry makes symbolization and annotation of objects rather complex.

A Feature Symbolology is the Bentley Civil data structure to encapsulate the complexities of this multi-modal representation of how an object looks and the space it fills.

A Feature Symbolology:

- Remains relatively simple by essentially being a list of View/Setting pairs.
- Is structured according to type, including Line, Profile, Point, Surface, and others.
- Can call **Element Templates** to define how the feature looks in each presentation – Plan, Profile, 3D, etc.
- Can call **Annotation Groups** (annotation presets) for automatic labeling.

The image to the right shows a Feature Symbolology for an Alignment. Included are pointers to Element Templates for every expected permutation of display as well as pointers to Annotation Groups.



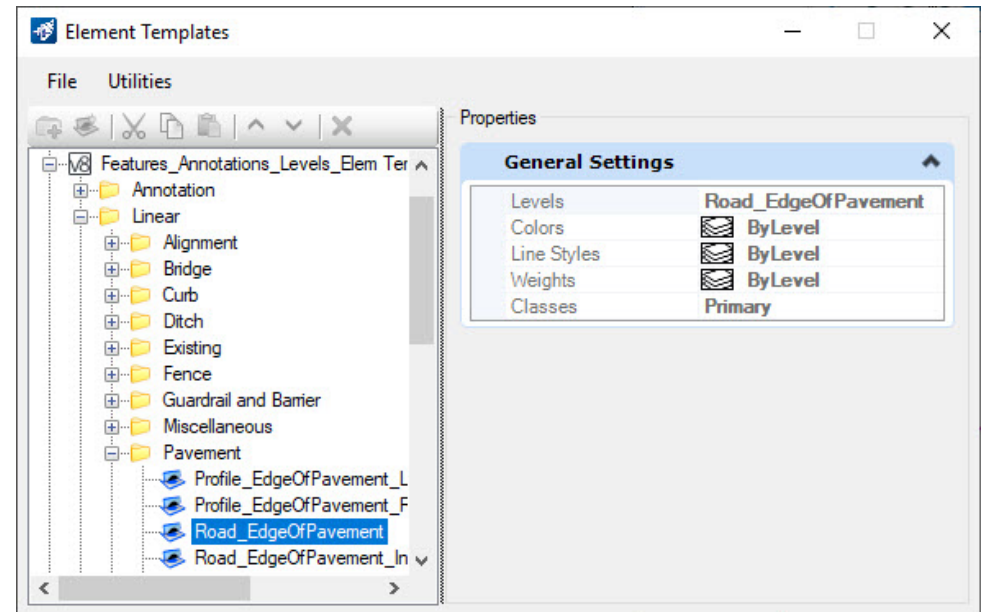
Element Templates

Element Templates are named collections of graphic attributes. By referring to an Element Template rather than a loose collection of properties, it is much easier to adhere to standards.

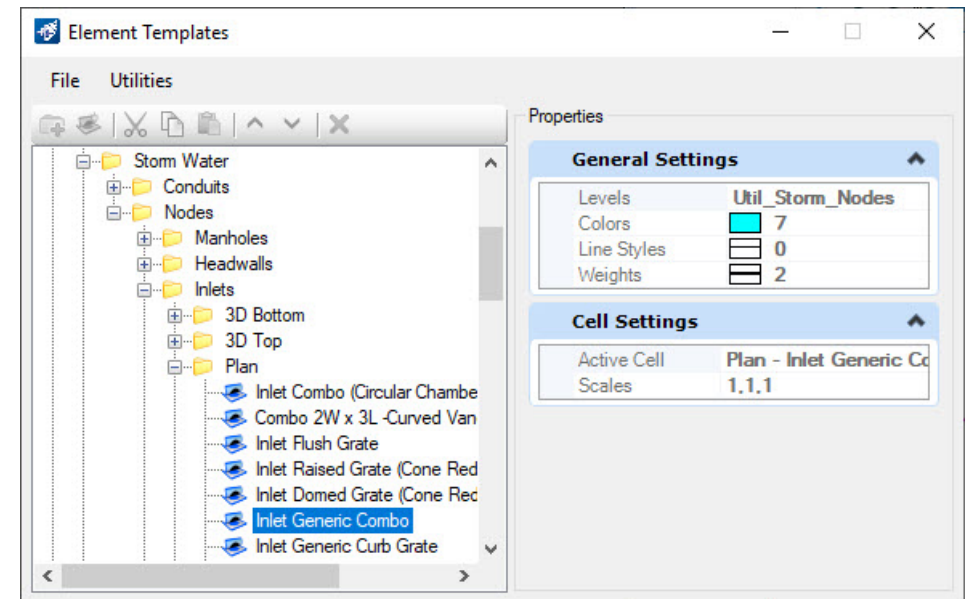
The Element Template Manager is where you can review, edit and create an Element Template and its attributes.

The *Road_EdgeOfPavement* Element Template is a simple Bentley Civil example:

The General Settings group with the four “always” attributes – Level, Color, Line Style and Weight – and Class.

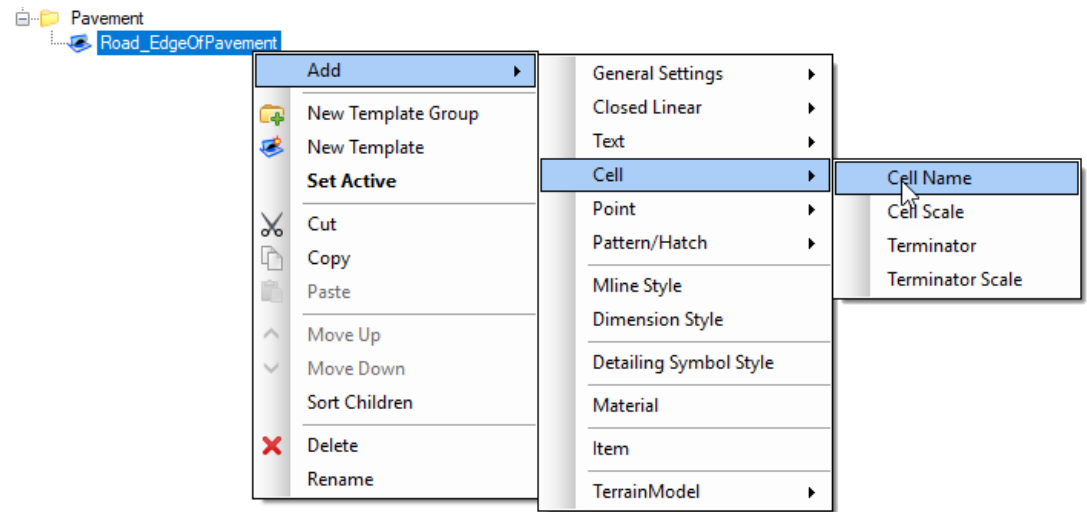


The *Plan Inlet Generic Combo* Element Template, for example, has the “always” attributes with the addition of Cell Settings group attributes – Active Cell and Scales settings.



Properties can be added to an Element Template by right-clicking and clicking *Add*.

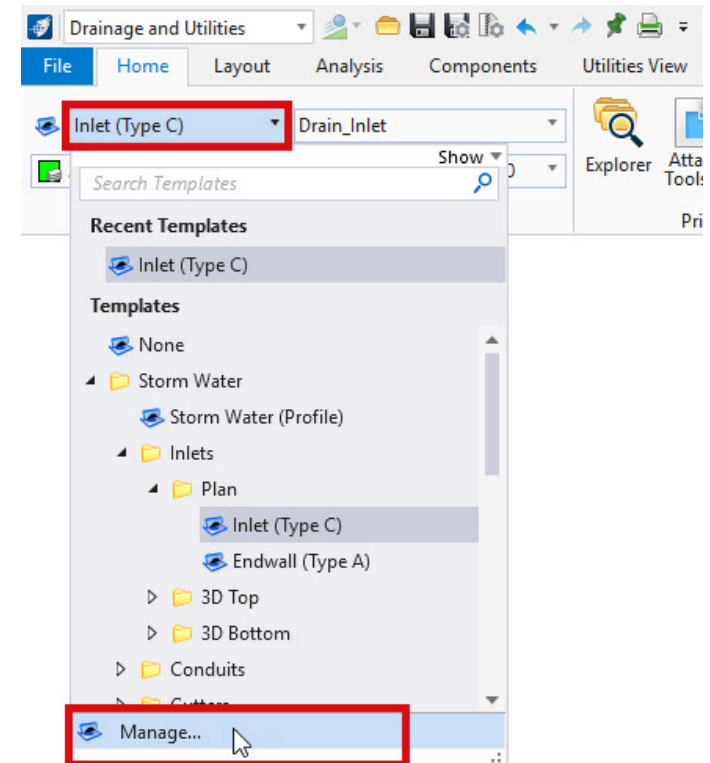
In this way, any combination of graphic attributes, including cells, materials, etc., can be defined in an Element Template for a consistent presentation.



The *Element Templates* dialog is accessed from the Templates selection drop-down menu and clicking “Manage...”.

Note that **only** Element Templates in the *Active File* can be edited.

- In a WorkSpace, Element Templates are stored in DGN Libraries (.dgnlib). This makes it easy to set up standard display configurations that can be deployed and managed across large groups of users.
- When an Element Template is used, it is copied from the .dgnlib to the active design file. This makes the design file “portable” so that the .dgnlib does not need to be included with a data transmittal.
- When administering your WorkSpace, you will typically be working in the .dgnlib file containing the Element Templates. In many instances, this is the same .dgnlib file with the Feature Definitions.



Item Types

The Feature Definition is Bentley Civil's fundamental BIM/Digital Twins Object. As such, its data structure needs to be extensible to support users' varying data needs.

Item Types are Bentley Civil's primary "data extension" technology. Anything needed that is not part of the native data structure of a Feature Definition can be added, tracked and managed through Item Types. Feature Definitions are designed to include them.

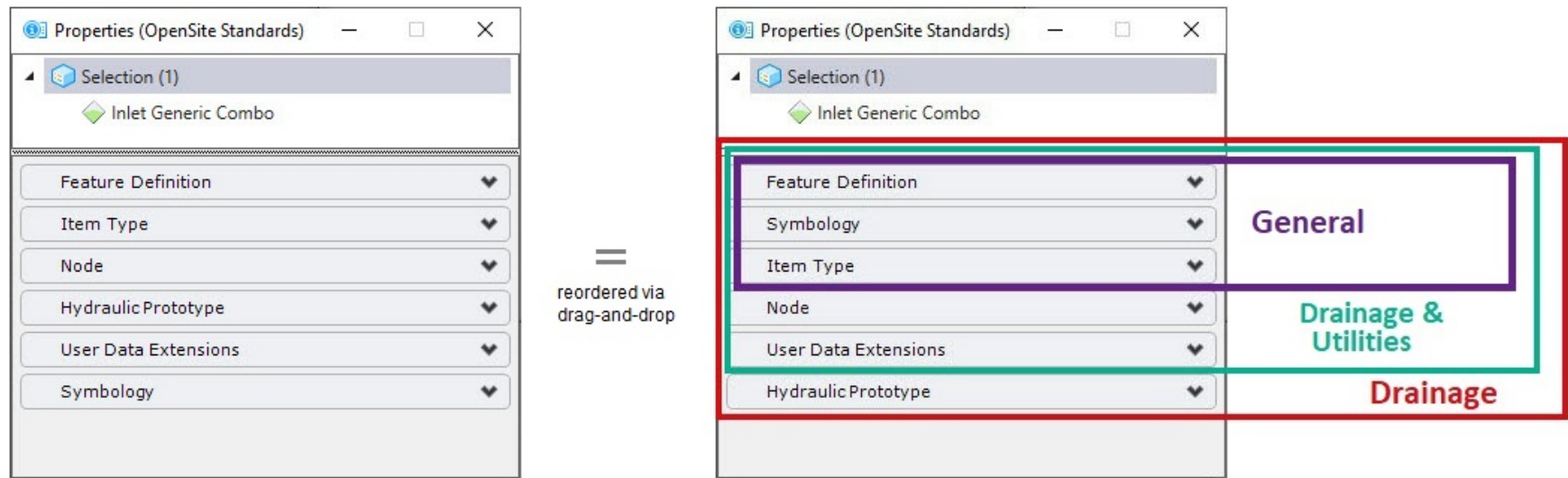
Item Types can include materials, quantities, construction information, pretty much anything.

For further information on Item Types, please consult the Civil product documentation.

Note that *Drainage and Utilities* Feature Definitions have a similar technology called [User Data Extensions](#) (UDX). Please see that section later in this manual for differences between Item Types and UDX.

Feature Definitions – Drainage and Utilities

Drainage and Utility Feature Definitions contain the common (general) attributes and include additional attributes as required to meet their object type needs.



In the image above, the attributes have been grouped according to the types of feature definitions they apply to.

- **General** attributes – apply to *all* feature definitions
- **Drainage and Utilities** attributes – apply to *all Drainage and Utilities* feature definitions
- **Drainage** attributes – apply to *Drainage* objects and systems feature definitions

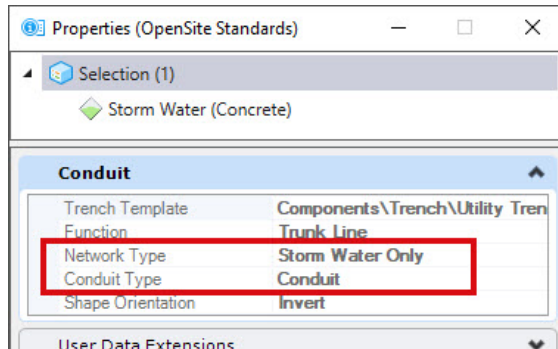
Note: The Node attributes will say 'Node' or 'Conduit' depending on the type of object selected.

Function Attributes – Node or Conduit

In addition to the general Feature Definition attributes, Drainage and Utility Feature Definitions include attributes for the function of the feature. Some attributes common throughout the utilities Feature Definitions answer these questions:

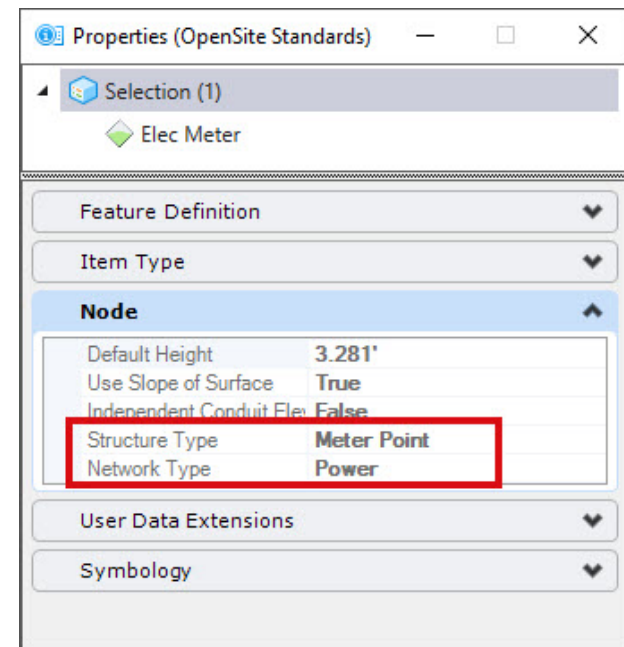
- What type of utility am I? *Water, Gas, etc.*
- What is my function? *Valve, Catch Basin, Manhole, Pull box, etc.*
- What type of network do I belong to? *Potable water, wastewater, etc.*

These include the *Network Type* and *Conduit/Structure Type* attributes.



The Function Attributes for Utilities generally get their own Group in the Feature Definition (Node, Conduit, etc.).

This Group contains additional attributes necessary for the specific type of utility object being defined.

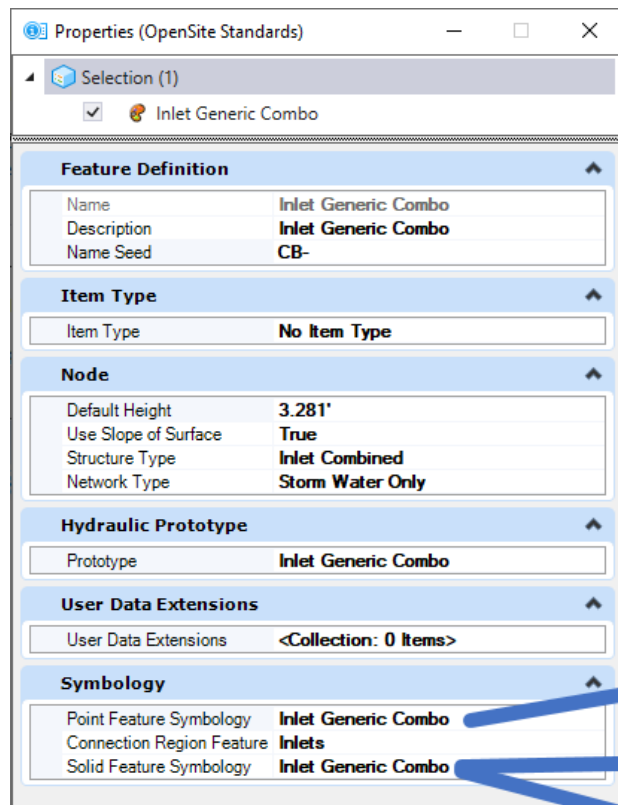


Feature Symbology

Drainage and Utility objects, like corridors and grading, are intrinsically 3D Objects. They have a “legacy” that they tend to be represented by two very different representations in a Plan view versus a 3D view.

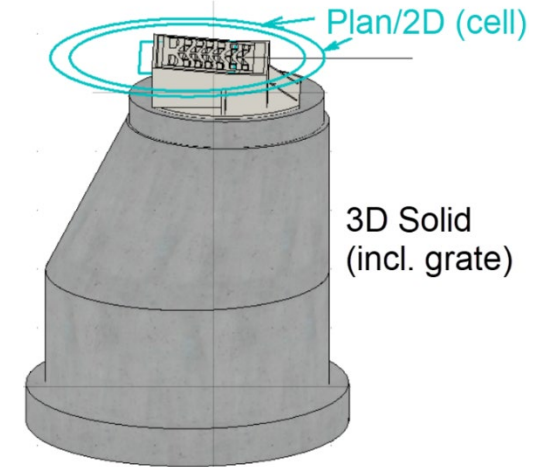
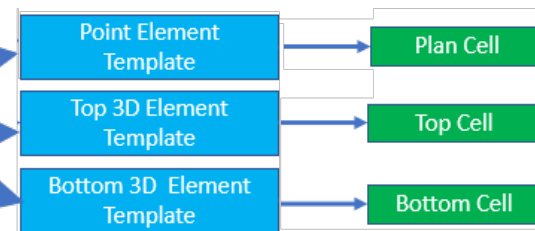
Drainage and Utility Nodes, such as inlets and manholes, generally are represented by a cell in 2D and a Solid in 3D. These are defined in separate Feature Symbologies and corresponding Element Templates:

Feature Definition → Feature Symbology → Element Template → Cell



The cell libraries used by Drainage and Utilities include:

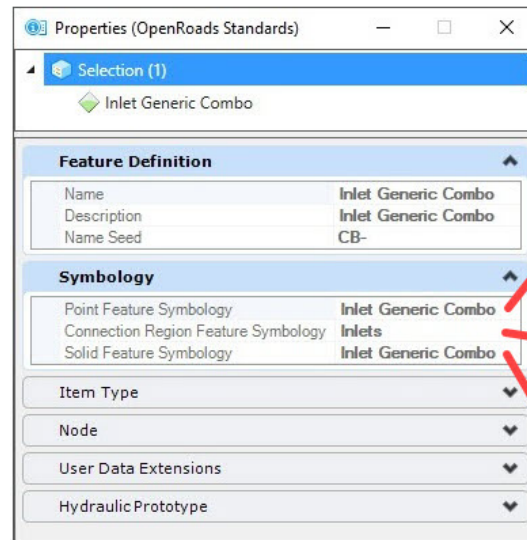
- 2D cells, to represent nodes in plan
- 3D cells, to represent nodes in 3D



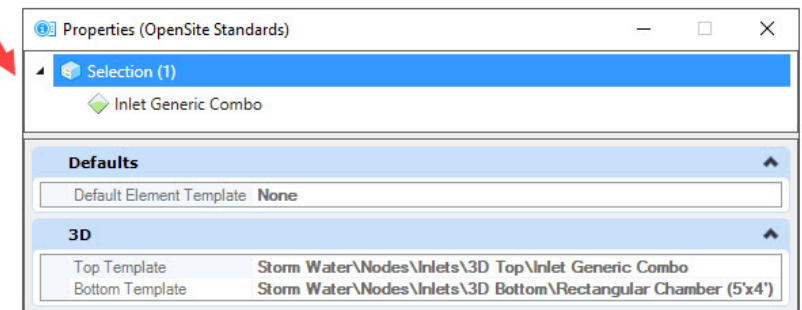
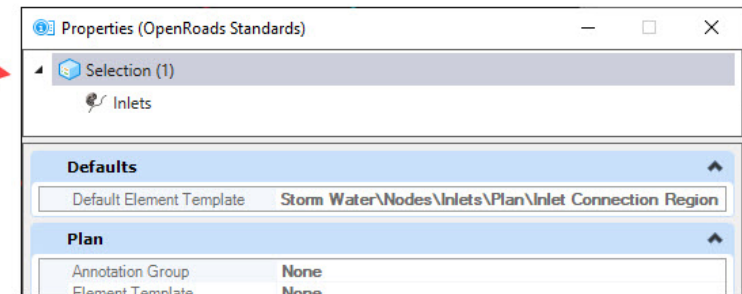
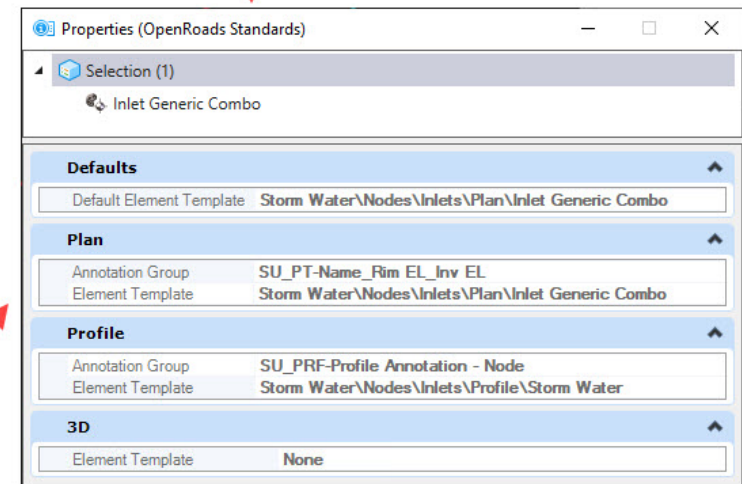
For example, an Inlet has 3 separate entities for display:

- a 2D Point representation (for Plan & Profile, typically a cell)
- a Connection Region
- a Solid (3D) representation

Feature Definition



Feature Symbology



Each entity is defined by a Feature Symbology.

The Feature Symbology points to two different entities:

- Element Templates
- Annotation Groups

Annotation Groups are Bentley Civil annotation definitions that enable automatic/global labeling.

3D objects vary in height and generally are not simple shapes. Consider a Grate Inlet or a Manhole top.

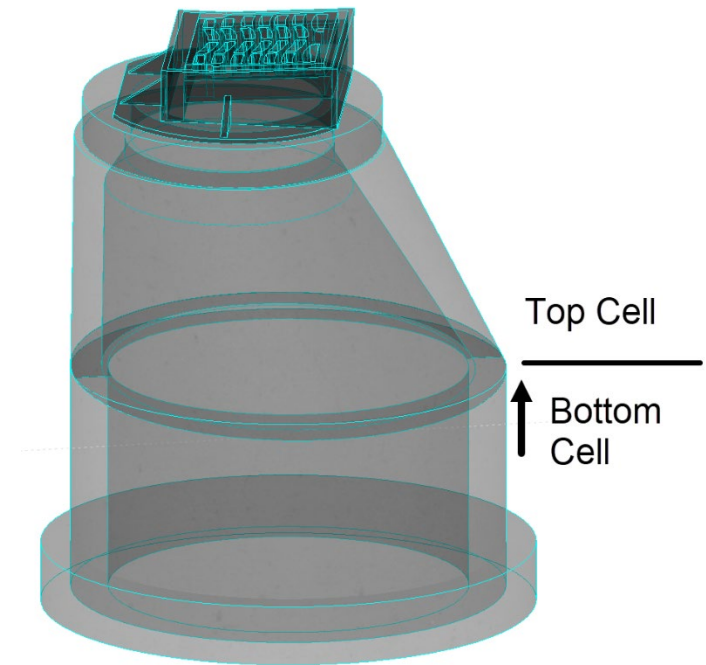
These objects are generally defined with a non-regular Top 3D Cell and a regular Bottom 3D Cell to form a continuous object.

The bottom cell is programmatically extended to the top cell or vice versa.

Typically, the top cell models all the varying geometry and the bottom cell tends to be the regular circular or rectangular vault.

Manhole Solids are built the same way.

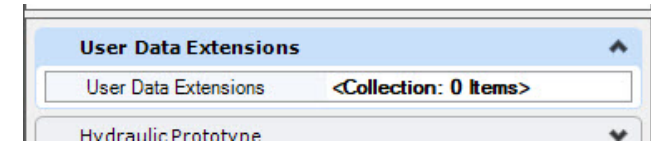
The cells have several “construction elements” that designate invert points, top elevations, cell alignment points, etc. These are covered in the object documentation.



User Data Extensions

Utilities have a consistent set of properties above and beyond the data structure of the “general” Feature Definitions. So many, that files hosting Drainage and Utilities Features require a “database” in the file. This “database” is copied from a Hydraulic Seed File.

Like general Feature Definitions, users may need to augment the data structure of the delivered Utility Database. The mechanism for that is the User Data Extension (UDX) technology.



User Data Extensions fulfill similar needs as Item Types, but UDXs are specific to Drainage and Utilities features.

There are a few differences in their functionality:

- Item Types can be used on any feature type. UDX can only be used on Drainage and Utilities features.
- Item Types include lookup functionality, which you use to get a value from an Excel spreadsheet.
- Item Types cannot be used in UDX – for example you can’t use the value from an Item Type in a UDX Formula.
- Item Types data are not visible to Drainage and Utilities functionality such as FlexTables and Queries.

Note: From version 10.08.00.88 forward, you can retrieve any Drainage and Utilities property, except UDX, in an Item Type.

Feature Definitions - Drainage

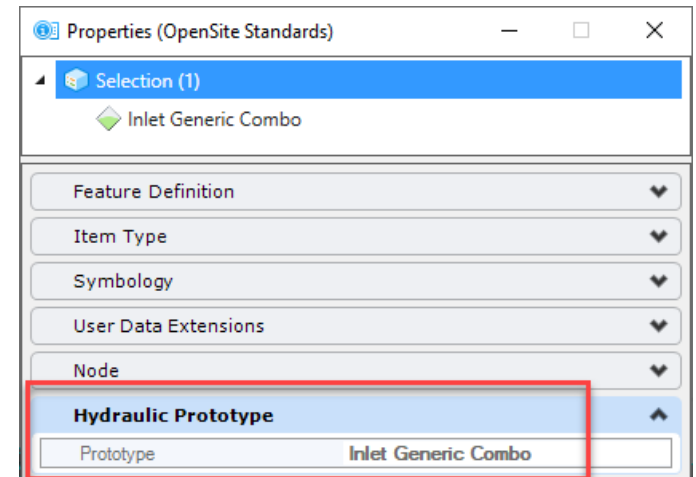
Hydraulic Prototypes

If the Feature Definition is for a Drainage object, it will point to a Hydraulic Prototype. Hydraulic Prototypes are the default settings that are used for hydraulic calculations.

There can be multiple Prototypes for each type, or even each size, of object. Hydraulic Prototypes may also point to Catalogs.

Please refer to object-specific documentation for details on Prototypes and Catalogs.

Note that both Prototypes and Catalogs are identical to the OpenFlows Prototypes and Catalogs. The OpenFlows Bentley Community is a rich resource for information about them.



Note: Please refer to the additional documentation for Drainage and Utility Feature Definitions. There are individual documents for the different object types that contain full details on the Feature Definitions for that particular object type.