CV5700-P Integrating Autodesk InfraWorks 360 into Your Daily AutoCAD Civil3D Practice

Jeffrey Lyons, CET, Landproject Inc.

CV5700-P This course details some commonly used workflows that will help the typical AutoCAD Civil 3D software user adopt Autodesk InfraWorks 360 software for daily uses.

You will impress your project managers, partners, and clients with these easy-to-implement workflows that demonstrate the power of InfraWorks 360 software combined with the dynamic AutoCAD Civil 3D software design model.

Autodesk InfraWorks 360 software is a great starting point for civil engineers who are looking to visualize and analyze not only detailed design, but also conceptual proposals—all in the same environment. From geographic information system (GIS) data management to Trimble's SketchUp modeling program, this course is a great introduction for CAD designers looking to expand their skill sets beyond 2D documentation.

Learning Objectives

At the end of this class, you will be able to:

- Learn how to <u>implement</u> commonly used AutoCAD Civil 3D software design practices with Autodesk InfraWorks 360 software
- Learn how to <u>integrate</u> both GIS and AutoCAD Map 3D software into a 3D environment for context visualization
- Learn how to <u>connect</u> concept proposals and detailed design for dynamic updates
- <u>Collaborate</u> with other designers and data providers

About the Speaker

Jeff Lyons received his diploma in mining engineering technology from the Haileybury School of Mines (Northern College), and he received his diploma in geological technology (Geophysics) from Sir Sandford Fleming College. Jeff is the founder of Landproject Inc., a third-party developer for Autodesk, Inc., products and consultant to the infrastructure industry, specifically as it relates to InfraWorks software. From 2010 to 2013, Jeff was the resource manager for land development and the business unit manager for the Building Information Modeling (BIM) Solutions Team at Cole Engineering Group in Markham, Ontario. Prior to joining Cole, Jeff was with Autodesk Canada as the AutoCAD Civil 3D software territory manager, working with the Autodesk Channel and clients to increase AutoCAD Civil 3D product adoption across Ontario. His 18 years of experience in the field includes extensive experience in land development engineering at Stantec Inc. and various surveying/engineering firms in the early 1990s.

In the fall of 2014, Jeff co-founded AEC Solutions Inc., a unique online product suite focused on cloud based solutions connecting the AEC design team with the project management and field inspection teams. Online Project Map registry, Team registry, Field Inspection Reporting and Tender / Bid Management are the primary applications now available at www.aecsolutions.ca .

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Note: This session will provide a supporting ZIP file with completed datasets for the purpose of workflow training vs AutoCAD Civil 3D training.

Implementing Autodesk InfraWorks 360

Getting Started with Autodesk InfraWorks 360

Before we can start to visualize our "design in context of the existing environment" we need to have a Master existing conditions model of the design area. The main components required to show the design area are:

- Digital Elevation Model (DEM) of the surrounding area
- Roadways, Railways
- Creeks and Water Features
- Trees and Forested Areas
- Buildings as Polygons with Height
- Ortho Photography draped to DEM

The quickest way to get started is to use the Autodesk cloud service called "Model Builder". Model builder allows the user to select a design area using an online map location rectangle. A maximum of 150 sq.km is available for each download. Model Builder will query the main components from public datasources. For this demonstration we have zoomed to the design area and selected an area approx. 5km square, the resulting area was ready for download from Autodesk Collaboration within 15 minutes.
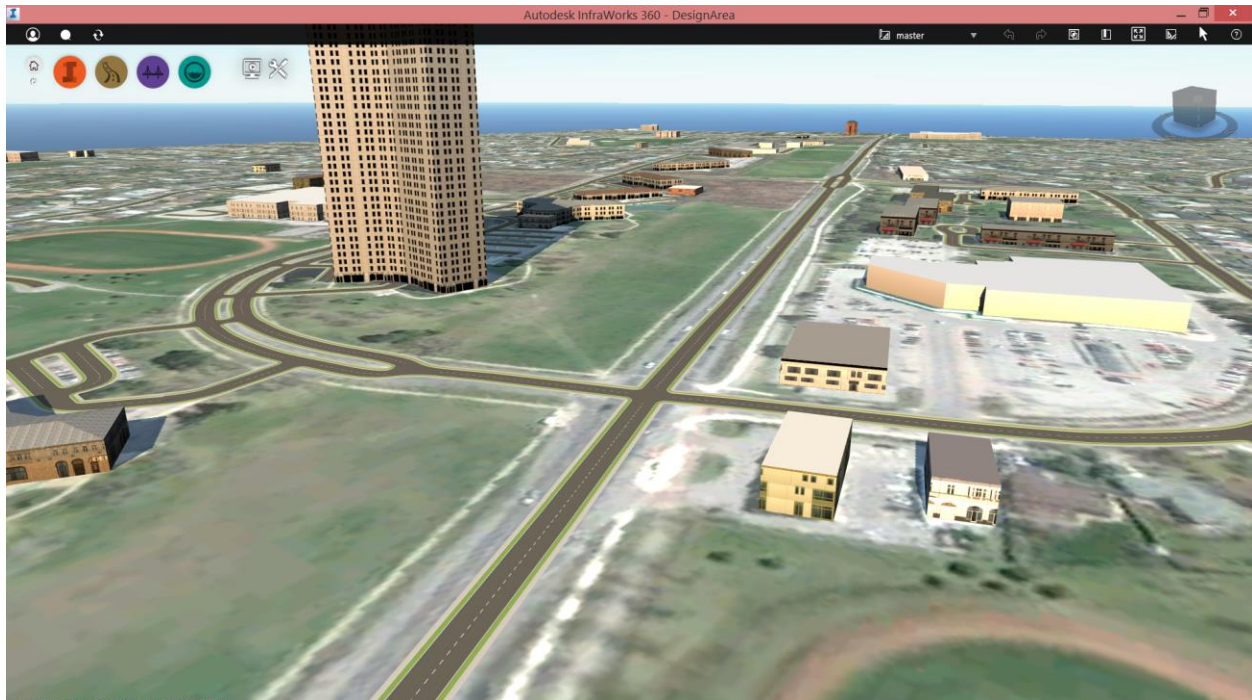
Note: For areas with the USA, the model may contain all or more of the basic master components. For this project in Canada, we have a DEM, Roadways and some commercial buildings.

Augmenting the Master Model DEM Surface

Adding AutoCAD Civil 3D Surfaces

While the model builder may bring in a DEM from online sources, the accuracy of the elevations maybe 1m +/-. This may be suitable for very preliminary concept design but for most engineers, the site area should be more accurate for proper concept design and representation of detailed design. As seasoned AutoCAD Civil 3D users, a typical Topographic Surface object can be used to augment the surrounding DEM imported from Model Builder.

For this project, like many others, a more accurate survey of the area provided by the local mapping service or surveyor. The aerial DEM provided for this area, is within 0.15m +/- vertical and can be used to augment the surface in the specific design area. Review it's contents and verify that the Coordinate system is set to UTM83-17. It's important that for every dataset, the coordinate system be set using the Drawing Setup in prospector.
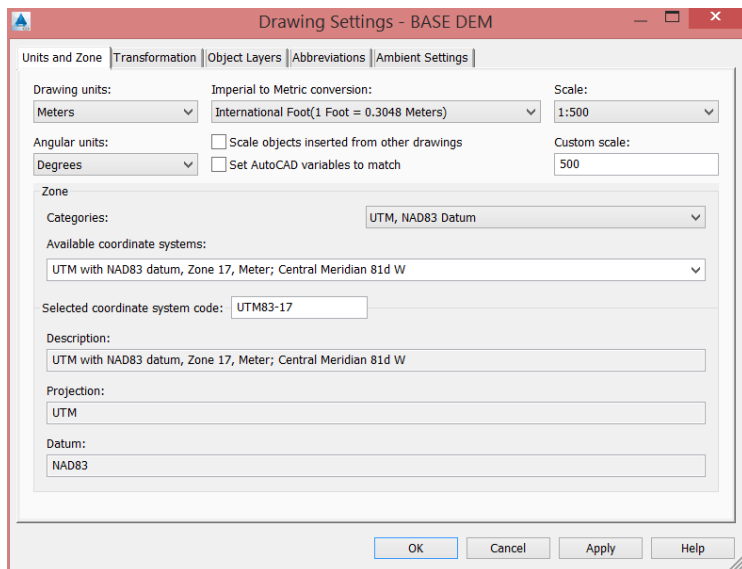
Using the Output tab in AutoCAD Civil 3D, Export the contents of the Drawing to IMX format. The resulting file will be named the same as the drawing - "Base DEM.IMX". This IMX will contain all of the Civil 3D Objects in the drawing which InfraWorks can use, including Alignments, Pipe Networks, Surfaces and Corridors.

Adding your Survey Surface to InfraWorks 360

Back in Autodesk InfraWorks,

- Select the Top Menu Item "Build, Manage and Analyze your Infrastructure Model" option
- Select the first option to "Create and Manage" your model. You will be presented with a sidebar menu with new options
- Select the "Datasources" option
- Select the "Add File Data Source" pull down option and pick the IMX format
- Browse and select your first AutoCAD Civil 3D dataset for the site design model
- Select the "Base DEM" Terrain Datasource then Select the Configure option – verify that the DEM Surface is selected
- Close and Refresh
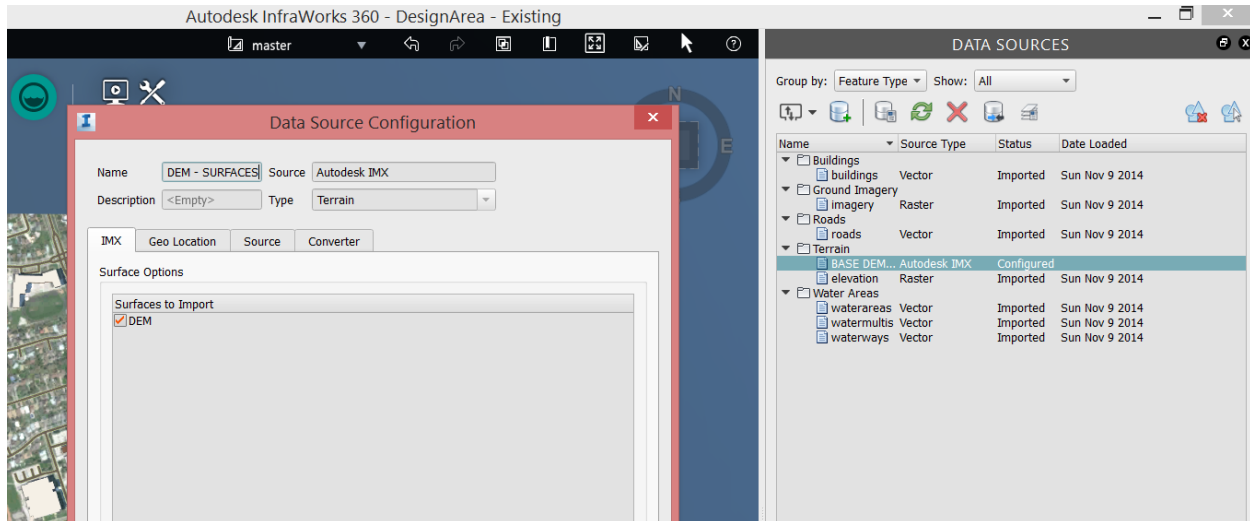
InfraWorks Best Practice: For future topographic surveys and other surfaces you may need to represent the existing conditions, you may want to create a "Composite Topo" drawing and use standard AutoCAD Civil 3D datashortcuts to manage a single, detailed existing surface model, then export the single model to IMX for InfraWorks. When configuring the Composite IMX Surface, you will see all the surfaces in the Civil 3D source drawing. Select only the Composite surface as it is made up of all the others and you only need one.

Note the Differences in the Terrain Model - Zoom to an Area where the terrain is noticeably interesting, you should see a difference between the aerial DEM and model builder DEM.

Integrate with Datasources

Integrating GIS Datasources to Augment your Master Model

To further add to your existing conditions Master model, we have received ESRI SHP files from the City containing layers for buildings and trees. Review the ESRI Shape files using AutoCAD Map 3D using Data Connect.
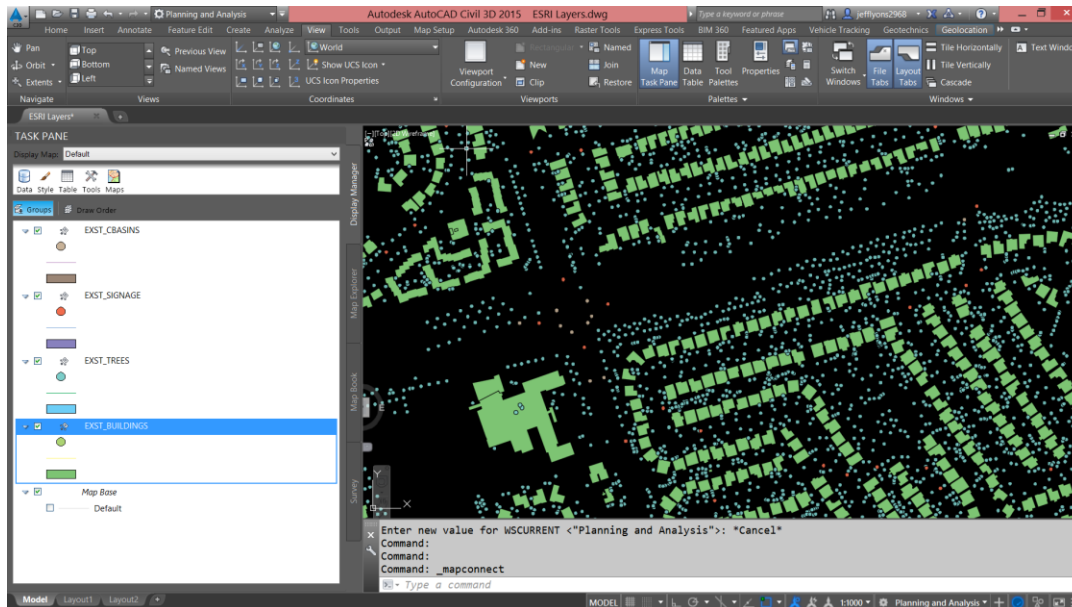
Adding ESRI Datasources to Autodesk InfraWorks

Like every file based datasource, you may simply drag n drop the file into the Autodesk Infraworks environment and configure it. In this case we will look at dropping the buildings from SHP into the master model.

Configuration Details for Buildings - Common & Source Settings
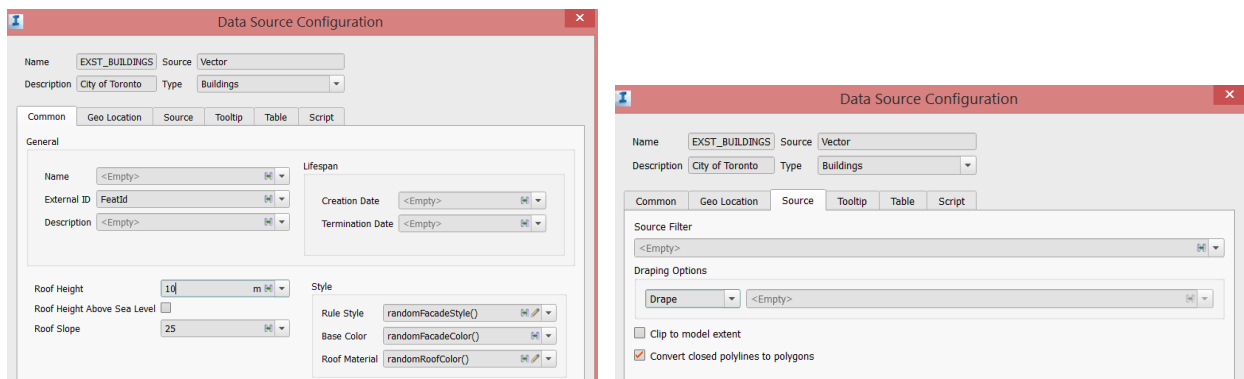
The Results
Some Buildings are duplicates from objects brought in from Model Builder, delete duplicates by manual selection. Some High Rise buildings need to be selected, their properties can be manually adjusted for height and roof slope.
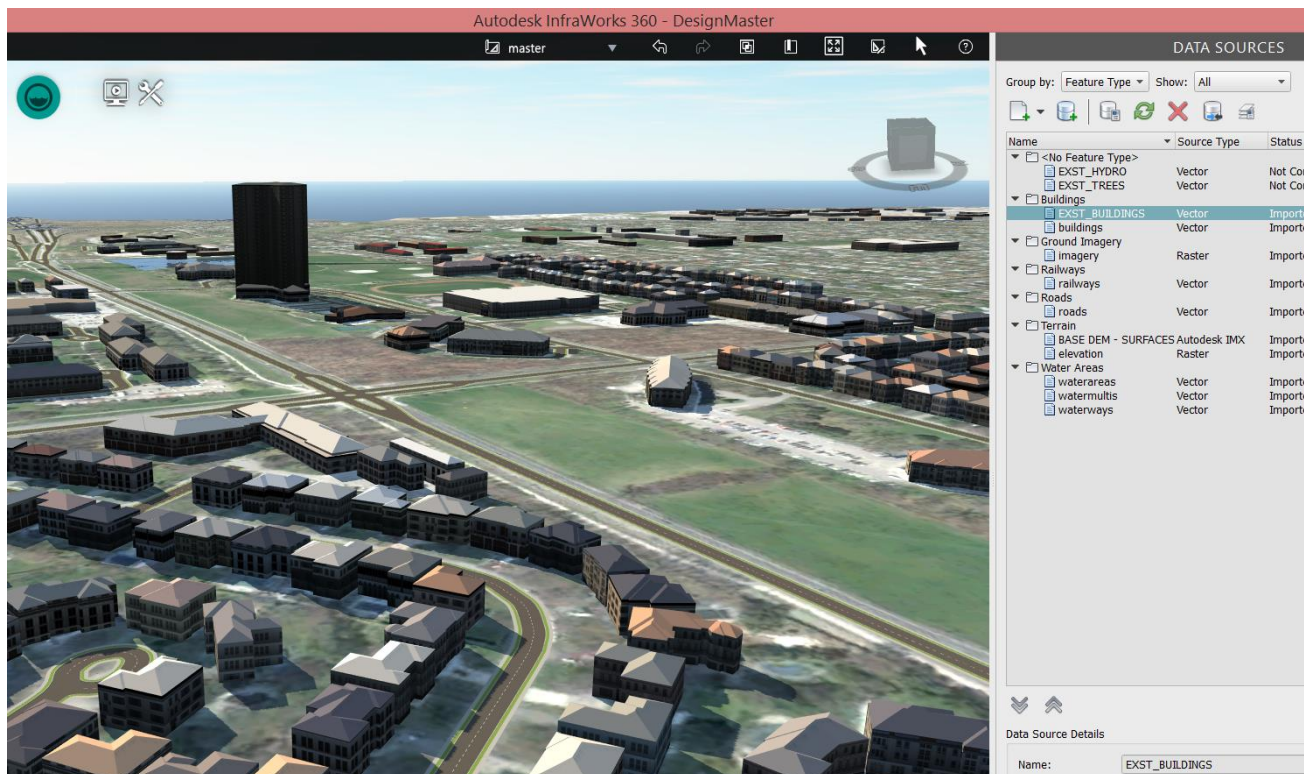
Configuration Details for Trees - Common & Source Settings
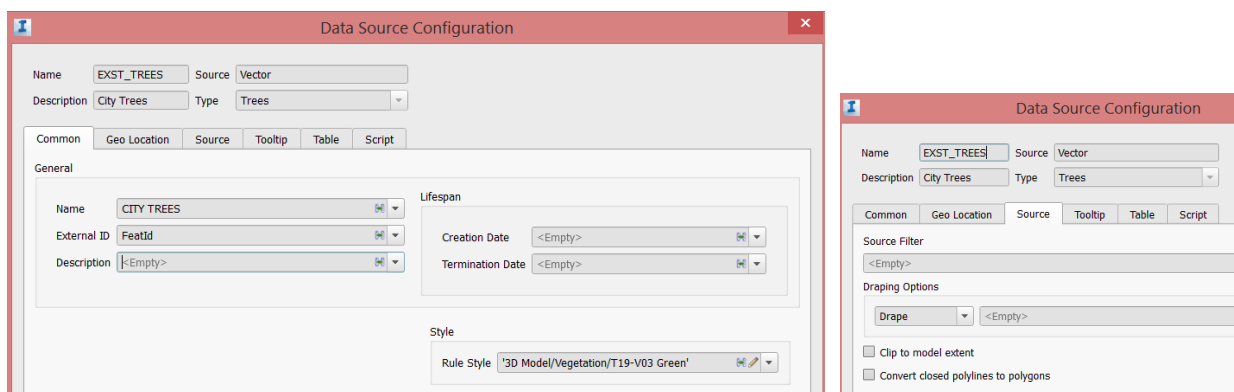
Note: Be sure to add the NAME of the Datasource = CITY TREES, as this is used in the Style Rule (see below)

Apply Style Rule to Randomize Trees

The show the GIS trees with a random style, we will apply a "Style Rule" to the "City Trees" layer.

- Select the Top Menu Item "Build, Manage and Analyze your Infrastructure Model" option
- Select the first option to "Create and Manage" your model. You will be presented with a sidebar menu with new options
- Select the "Style Rule" option
- Select the "Trees" tab option, select "Add" and name the new style rule "Random Trees"
- Edit the Expression, Add the Name = 'CITY TREES' to filter the datasource
- Add Tree Styles to the randomization
- Select "Okay"
- Select "Commit" – this will save the style rule
- Select "Run Rules" – this will apply the randomization of styles on trees, you can always "Run Rules" anytime should you have a datasource change and need to refresh it
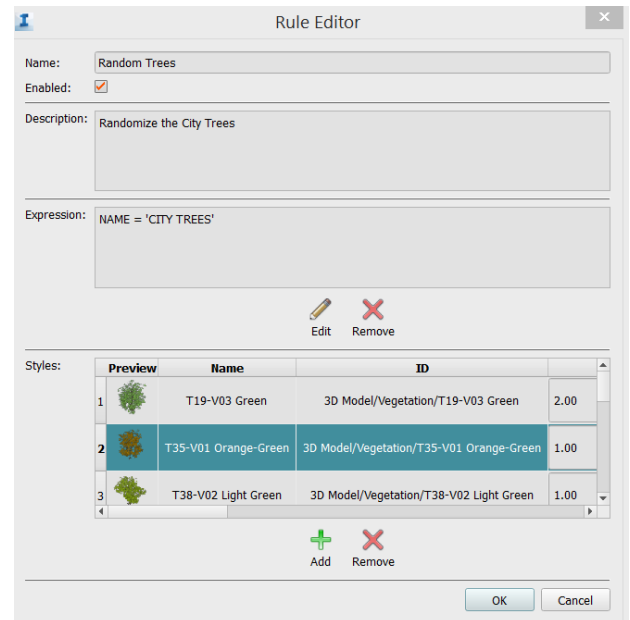
The Results
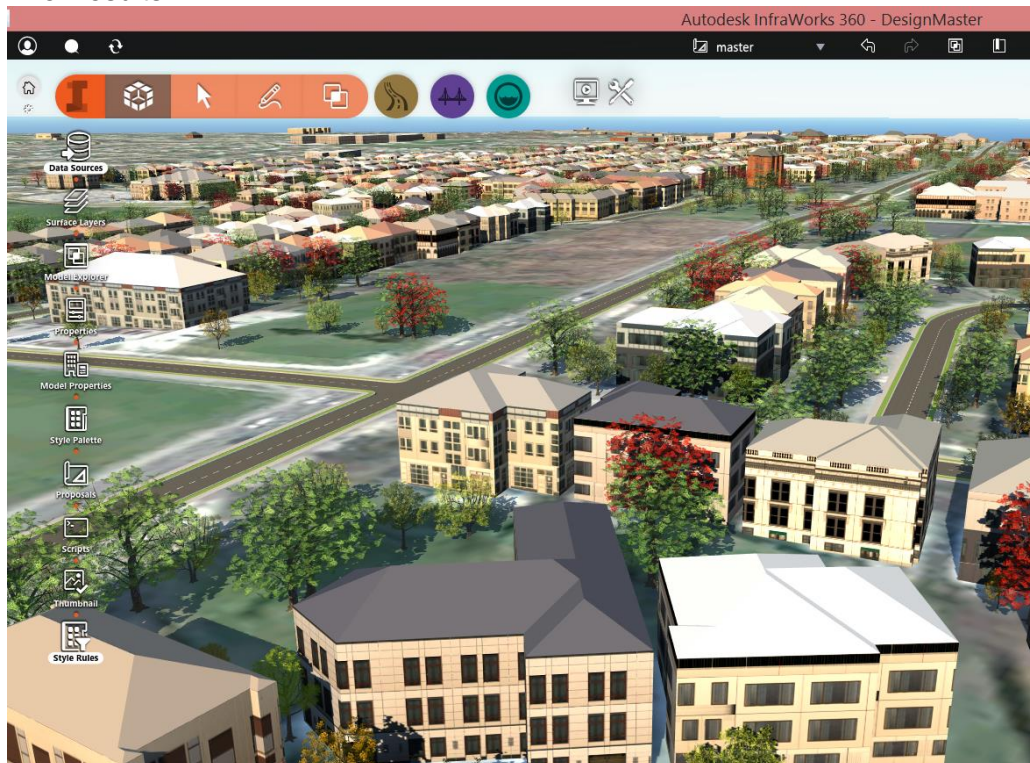
Leveraging AutoCAD Map3D Basic Functionality

We have also received Drawings from the City with layers of street furniture data like signs, poles, traffic signals, catch basins, manholes and hydrants among other things. We can leverage the AutoCAD Map 3D function to successfully apply a coordinate system and export layer objects with a ROTATION attribute. As an example we will use the Hydro Poles found in the drawing.
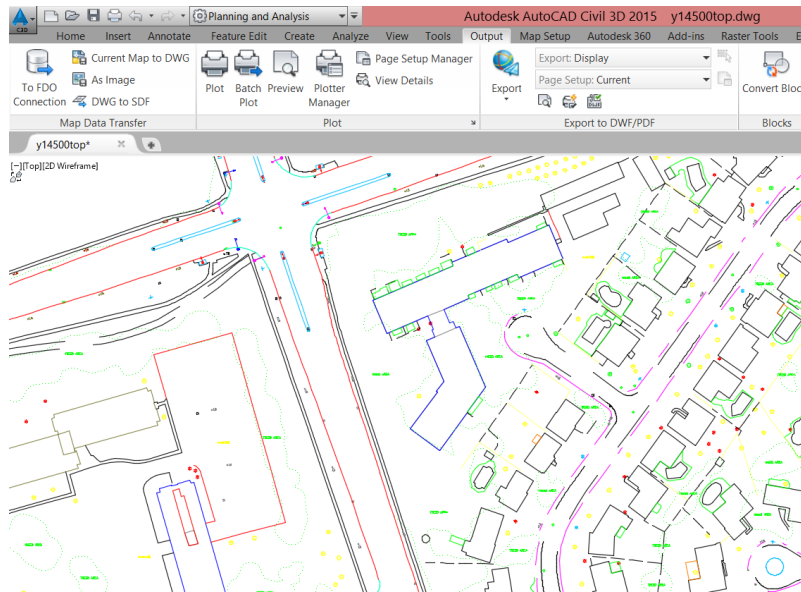
Using AutoCAD Map 3D,

1. Select the Map Setup Tab in the Planning and Analysis ribbon workspace
2. Assign a Coordinate System – type UTM83-17
3. Layer Isolate the data layer
4. Select "Output" tab option
5. Select the "DWGtoSDF" option (command "MapExport")
6. Select the Objects manually or by Layer
7. Select the Feature Class Tab, Select Attributes Option – select any AutoCAD geometry or block attribute to export with the SDF.
8. Select "Ok" – this will export the selected drawing contents to SDF, ready for InfraWorks
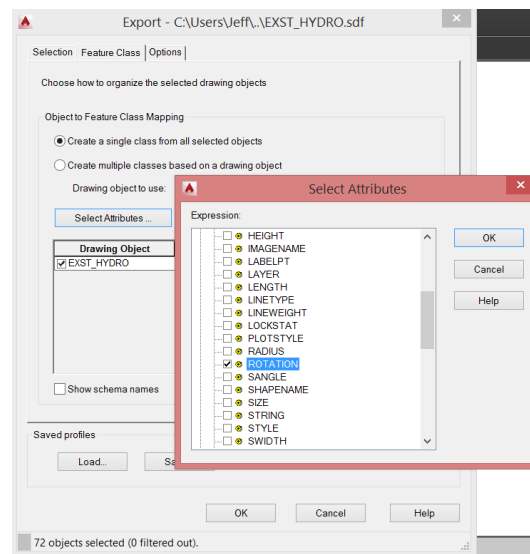
Configuration Details for Hydro Poles in InfraWorks,
Drag n Drop your Hydro Poles.sdf in to the master model. The City Furniture Library consists of a variety of 3D Objects. We can use the "Transmission Pole" for this datasource. You can build your own library using custom models if required.
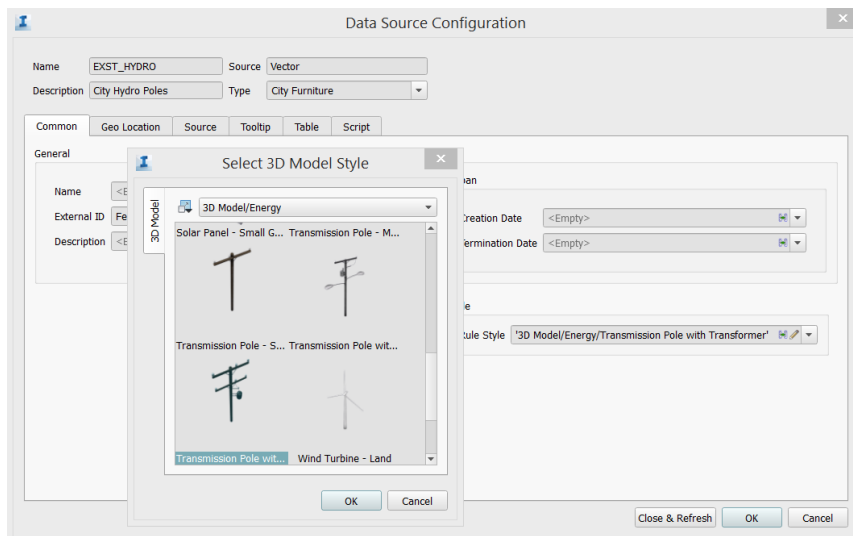
Adjust the Rotation Z using SDF Field Attribute "ROTATION"
Using the rotation variable in the datasource, we can rotate the hydro pole to represent the rotation of the block back in AutoCAD drawing.
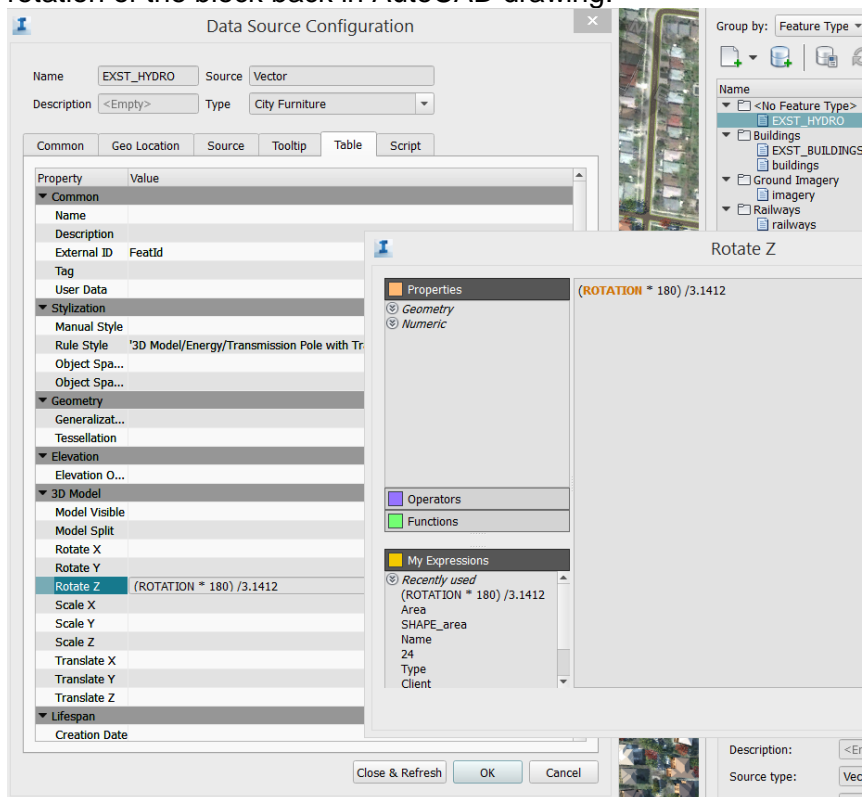
The Results

Adding Underground Utility (Assumed depths)
As part of the data collection, we would have received 2D utility layers from the applicable gas, power, cable and telecom companies. These linework drawings, as long as the coordinates are in the UTM can be projected quickly to assumed depths in Autodesk InfraWorks.

Using AutoCAD Map 3D,

1. Select the Map Setup Tab in the Planning and Analysis ribbon workspace
2. Assign a Coordinate System – type UTM83-17
3. Layer Isolate the ultity data layer
4. Select "Output" tab option
5. Select the "DWGtoSDF" option (command "MapExport")
6. Select the Objects manually or by Layer
7. Select "Ok" – this will export the selected drawing contents to SDF, ready for InfraWorks

Configuration of the Existing Utility in InfraWorks,

Drag n Drop your Bell Utlity.sdf into the Master model, configure the utility as a "Pipeline" feature type. Assign a default size and shape to the utility. In the source tab, drape the feature to the surface. In the Table properties set the "elevation offset" to an assumed depth – example -1.3m. This will depict the 2D utility into the model.

The Results

Integrating 3D Warehouse to Augment your Master Model

In some areas of the project you may want to augment your Master Model with more realistic Sketchup models which you create or download from https://3dwarehouse.sketchup.com.
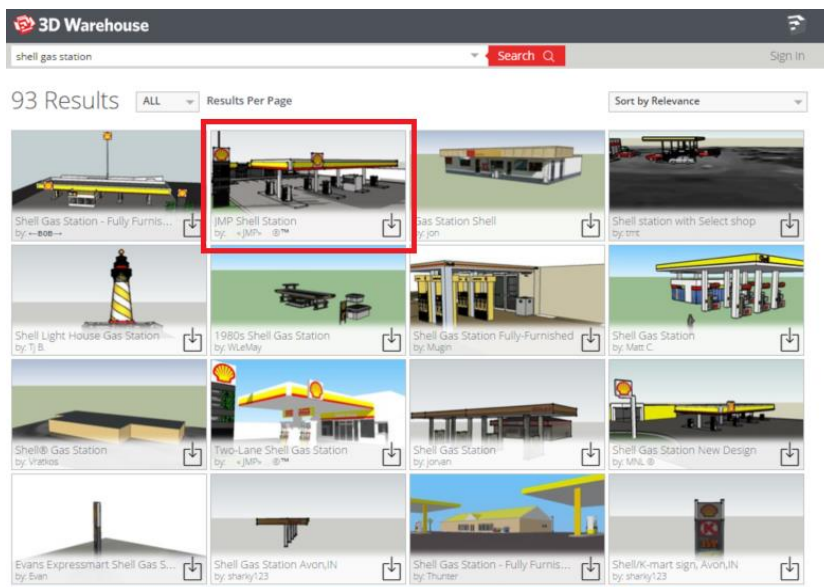
For this example, we will add a gas station to our model.

- Navigate to 3D Warehouse, search for a Gas Station
- Download a Model which closely represents your project requirements, move the model to your project folder or library for other projects
- Open and clean the SKP file if necessary, Export it to FBX format to maintain custom textures
- Drag n drop the FBX file directly into your master model.
- Configure the "Building" and set the Object using "Interactive Pacing"
- Set the Units and Scale Factors if required
- Edit the vertical placement if required
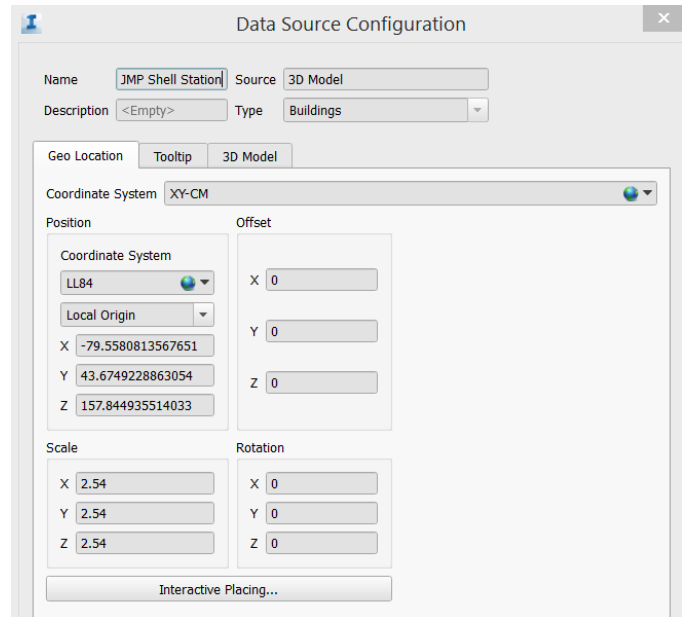
The Results,

Using Basic AutoCAD 3D - Add the Existing Box Culvert for Design

For some projects, you may have AutoCAD Features which are 2D but you wish to make them 3D (Faces, Mesh or Solids) and present them at the right XYZ location. In this example, we will look at a Existing Box Culvert with known elevation.

In AutoCAD,

- Create a Closed Polygon which represents the Box Culvert
- Use the "Region" command to convert the 2D Polygons to a 3D Solid
- Use the "Extrude" command to add a height of the object
- "Move" the object vertically to the elevation. You may decide to change the UCS and Rotate the Object vertically to adjust the exact elevation from start to end of the object.
- Use the "Materials" command to select a material and apply it to the object ie.. concrete
- Use the "FBXExport" command to select and export the object at 0,0,0
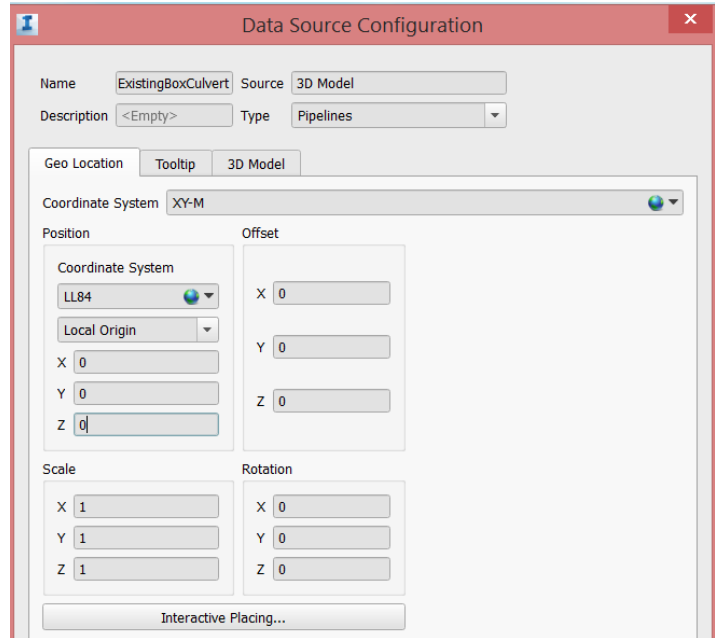
Configure the BoxCulvert in Infraworks,

- Drag n Drop the "ExistingBoxCulvert.FBX" into the Master Model
- Configure the object as "City Furniture" and Apply a XY-M coordinate system and be sure to specific 0,0,0 location
- Review the final location
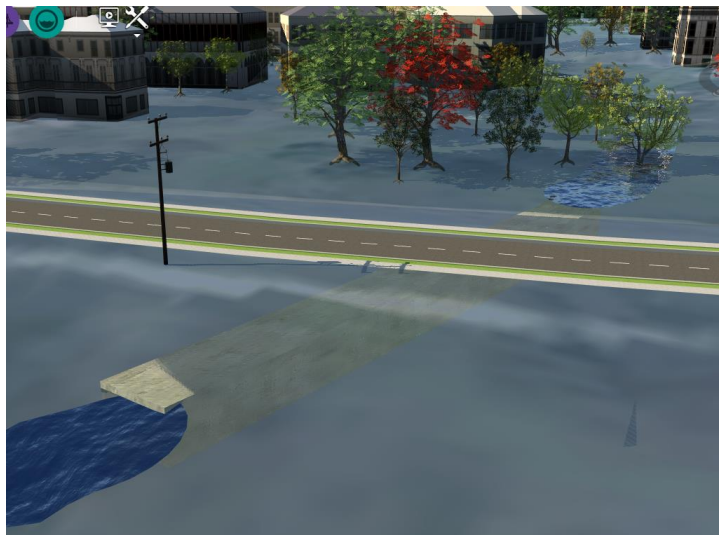
Connect to Detailed Design

Creating a Concept Proposal for Light Rail Transit Corridor

Using Autodesk InfraWorks 360,

- Select the "Proposal" option in the Top Menu area
- Create a Proposal called "Design Concept"
- Select and Delete the current Avenue in the design scope
- Select the "Design, Review and Engineer Roads" on the top menu
- Pick "Design Roadways". Select "Local Roads". Pick the "Sidewalk with Greenspace" option for now
- Digitize the concept centerline of the new design road

The Results
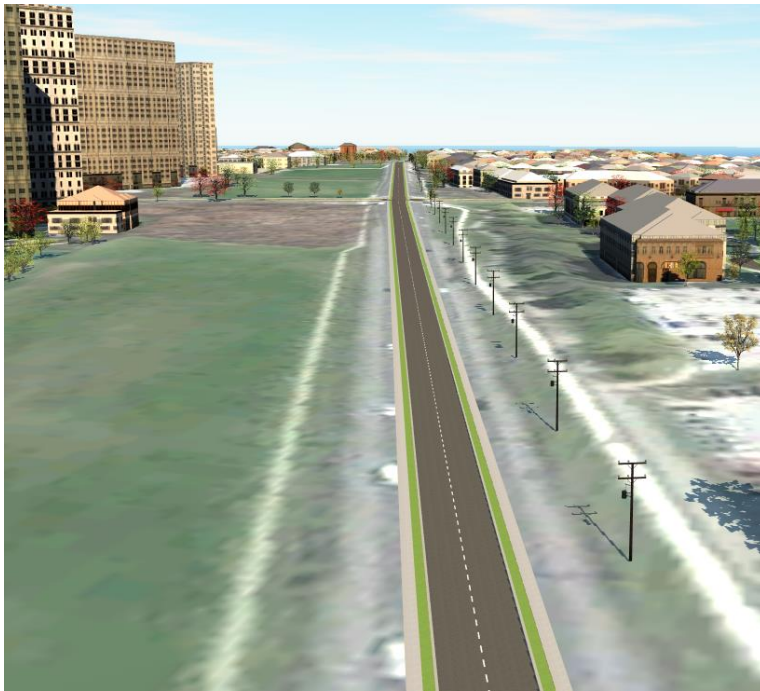
Create a New Road Style for this Roadway

We need to include a LRT and bikepath to the new expanded roadway,

- Select the Top Menu Item "Build, Manage and Analyze your Infrastructure Model" option
- Select the first option to "Create and Manage" your model. You will be presented with a sidebar menu with new options

- Select the "Style Palette" option, select the "Road" tab
- Select the "Sidewalk with Greenspace" style and make a local copy.
- Modify the Name of the Style to be "Concept LRT"
- Edit the Style,
- Add a center median lane for dual LRT, and 2 adjacent lanes with bike path and curb, add a greenspace but no sidewalk
- Drag n Drop the new style onto our concept roadway
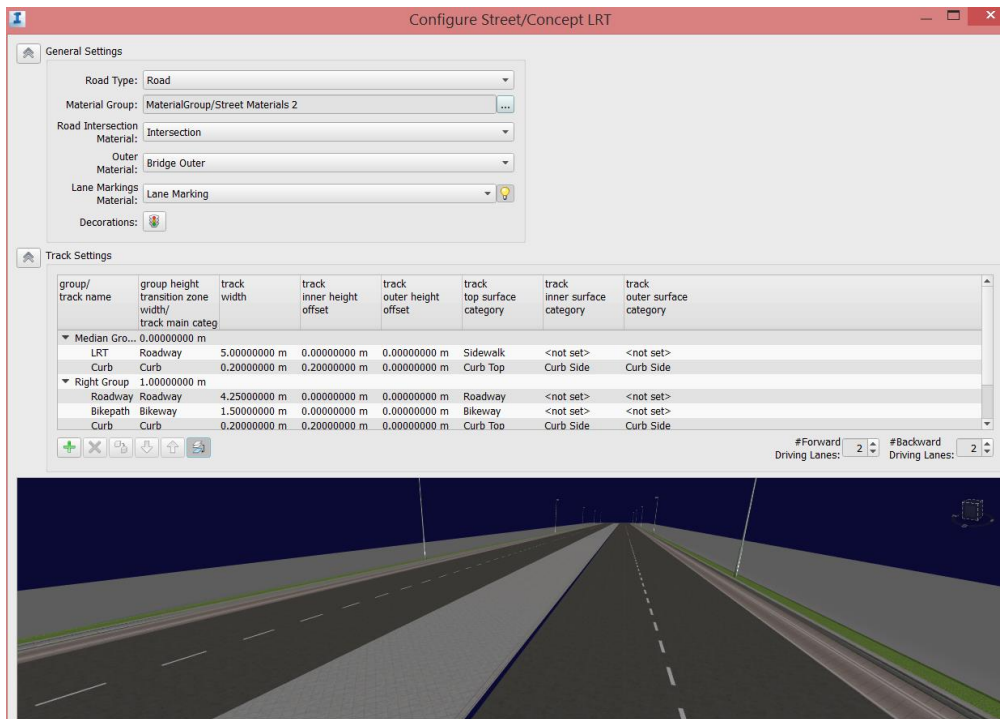
The Results

Edit the Vertical Profile (Manual or Optimize)

Select the "Review and Modify" option under the Roadway Design menu, Select the Vertical profile editor. Edit the profile manually or use Autodesk 360 to "Optimize" the profile based on road design parameters and volume analysis.
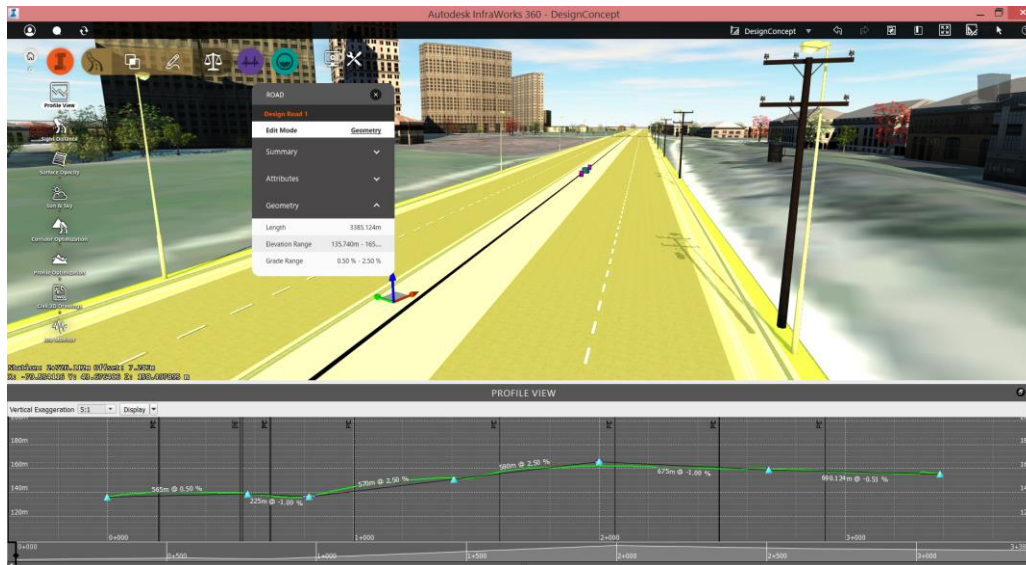
Concept Roadway Intersections

For every intersection, Select the lateral roadway, Right Click and convert the roadway to a Design Road. This will allow you to design the intersections for the concept roadway.
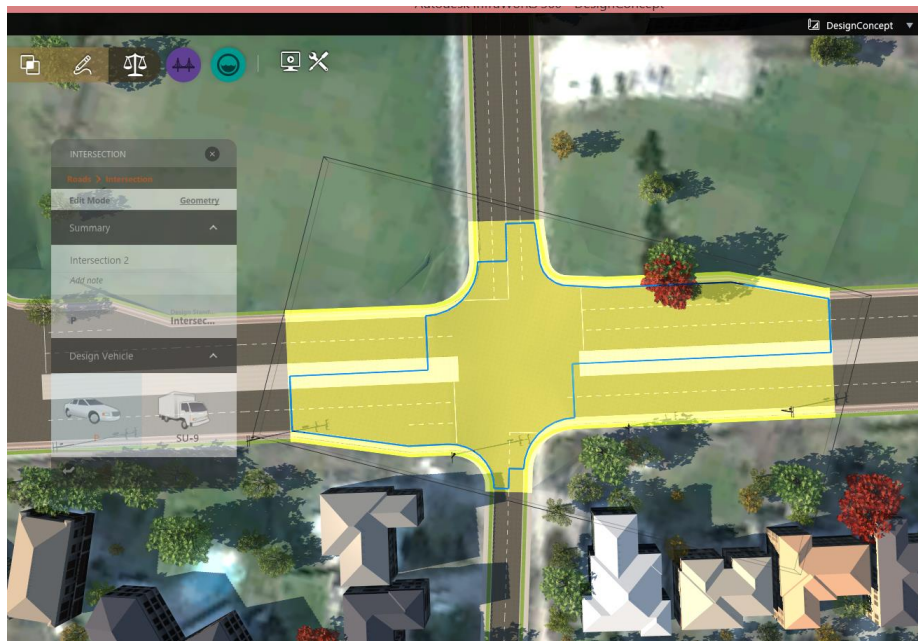
Export the Road Concept Design to AutoCAD Civil 3D

Select the "Review and Modify" option under the Roadway Design menu, Select the "Civil 3D Drawings" option. Create Plan n Profile drawings for the selected design road using the wizard much the same as Civil 3D plan production tools.

An IMX file is Exported and used as the source design file for the alignment, profile and associated road surfaces.
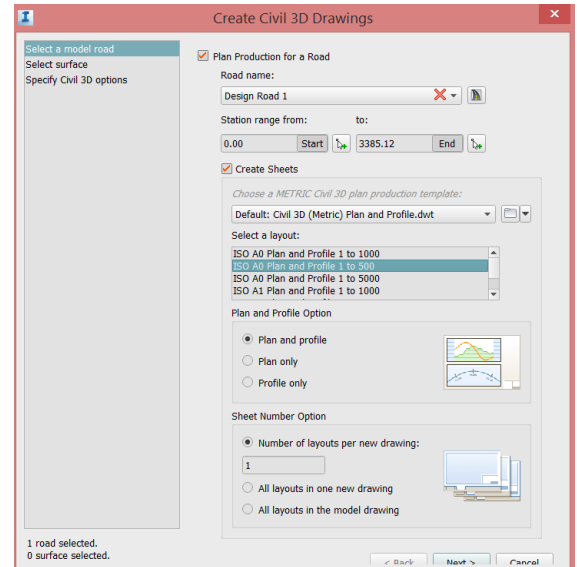
The Results
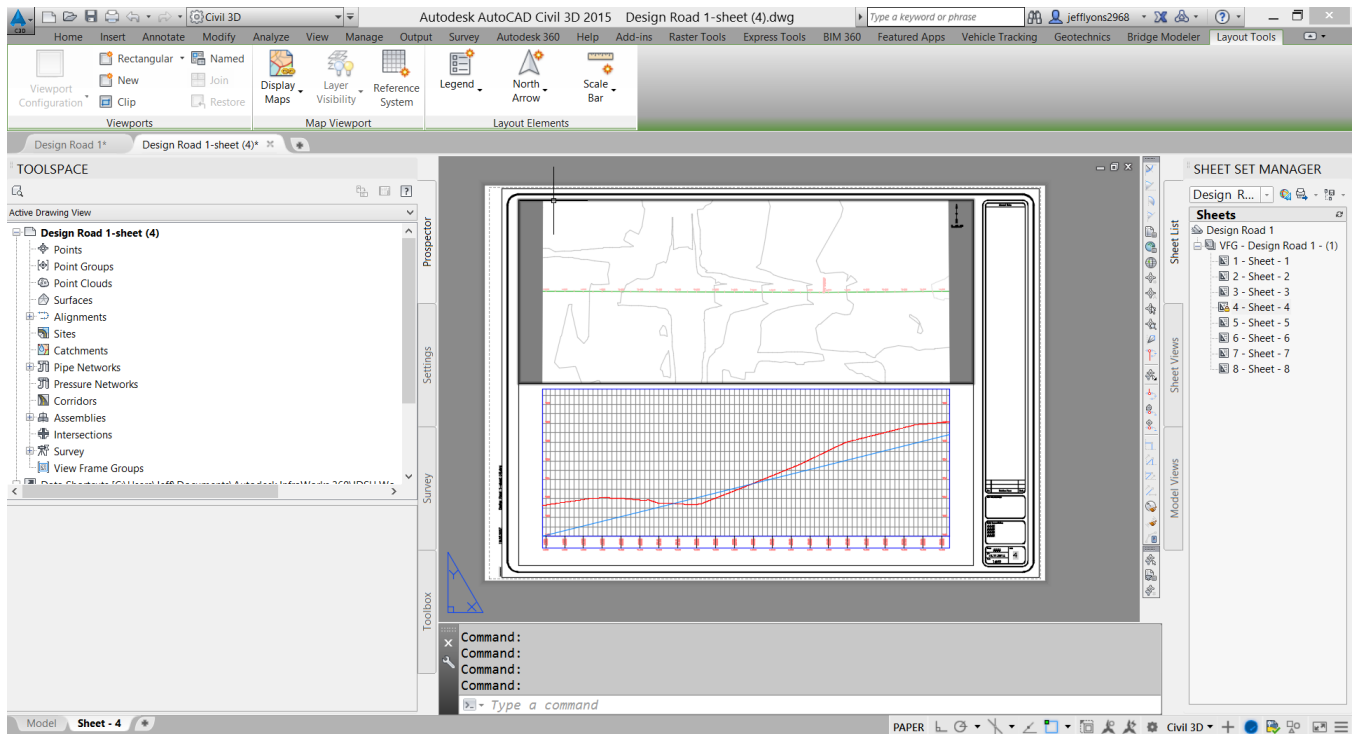
Connecting Detailed Design with Concept Model

Once the concept alignment and profile are exported to AutoCAD Civil 3D, a detailed design process can happen. These are the typical steps in detailed design:

- Data Reference the Topographic Survey or other detailed Surface models used in design
- External Reference to the 2D design plan showing limit of roadway, curbs, island, transitions and paint markings. Also include traffic signals and signage with this AutoCAD Only 2D design layout
- Modify Alignment and Profile as needed
- Create Road Corridor Model with Corridor Surface

Review Design Model Components

Existing Surface, Design Alignment and Profile – Simple Design to demonstrate the connected design in Autodesk InfraWorks.
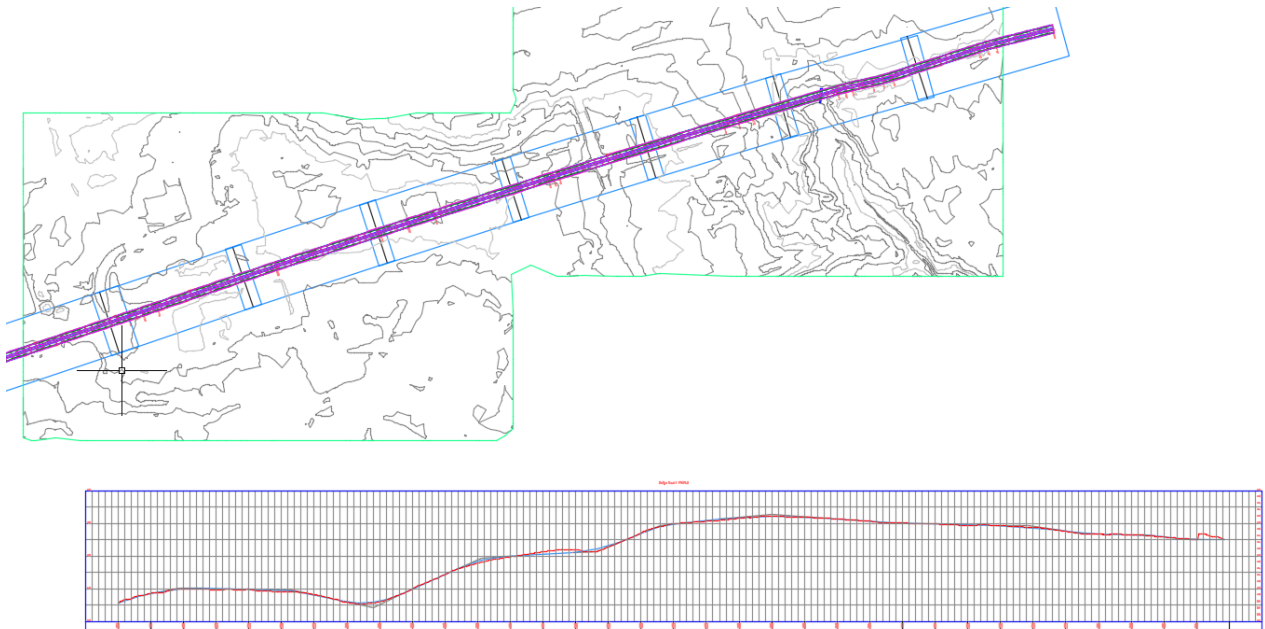
Assembly for LRT Section

Corridor Model

This is a basic Corridor model to show the connected design. For a completed project you would detail daylighting targets and intersection modeling.
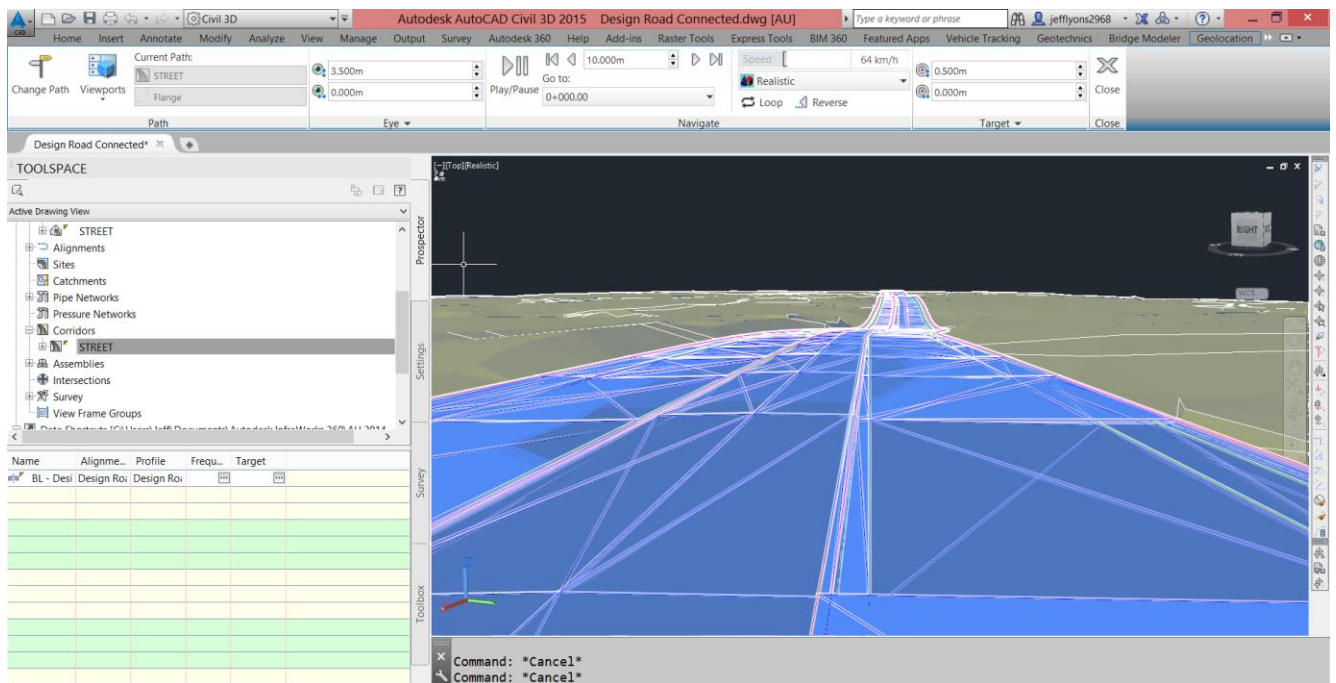
Road Corridor Surfaces

We need to create a composite existing ground surface to manage the surface modeling in InfraWorks easily.

- To do this Create 2 Road Corridor Surfaces – Top and Datum.
- Create a Composite Surface called "COMP" - paste the DEM surface then Paste the Datum Surface. This will allow you to "drive" the corridor and ensure that existing surface model does not show through the corridor model.
- Create a Composite Surface called "FINAL" - paste the DEM surface then Paste the TOP Surface. This will allow you to drape the alignment road in InfraWorks when the time comes to connect your design.

Pipe Network Design with Trench
Expand the design to include the pipe network showing the storm sewer pipe and manhole layout.
- Layout a Pipe Network to demonstrate the connected design.
- Create an associated pipe alignment with the pipe network
- Digitize a Pipe Invert Profile.
- Create a Pipe Trench Corridor using the Pipe Alignment and Profile.
- Create a New Pipe Trench Corridor Surface called "Trench".
- Create a new Surface Called "Excavation" and paste the Datum surface and the Trench Surface.

Pipe Design in Profile – Orbit View showing Existing Box Culvert with Pipes
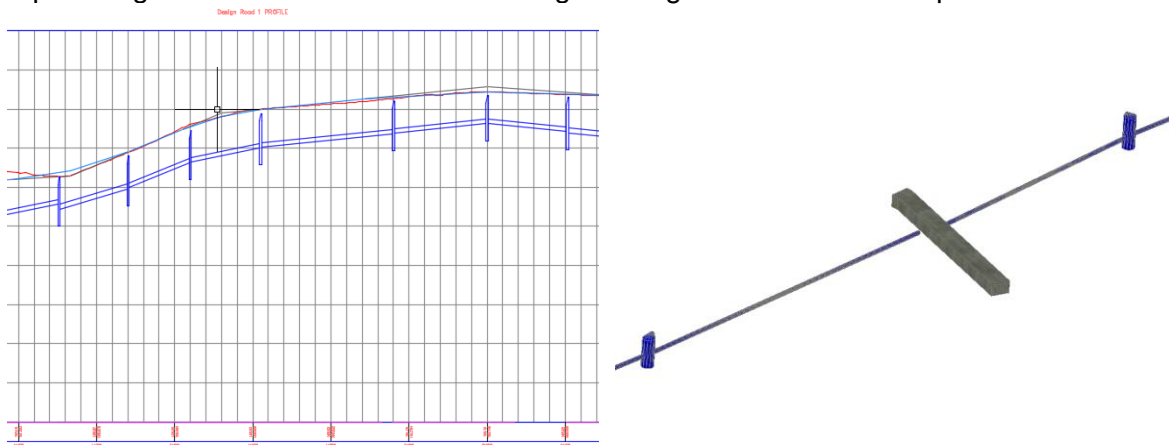
Pipe Trench Model
Create an Alignment along Pipe Centerline, then Create a Pipe Trench Profile along Pipe Invert. Use the alignment, profile and a Pipe Trench Subassembly to build a quick trenching corridor model and surface.

General	
True Color	ByLayer
Layer	C-ROAD-ASSM
Linetype	ByLayer
Linetype scale	1.000
Plot style	ByColor
Lineweight	ByLayer
Hyperlink	
Data	
Code Set Style	All Codes
Default Loop In Layout...	Last
Default Loop Offset In L...	10.000
Geometry Generate Mo...	.NET
.NET Class Name	Subassembly.TrenchPi.
.NET Assembly Name	C:\ProgramData\Auto..
ADVANCED	
Parameters	
Version	R2013
Width	1.500m
Sideslope	0.10:1
Bedding Depth	0.500m
Special Backfill Depth	0.400m
Offset to Bottom	0.900m

Extract Surface Boundary for Material Coverage
- Use the "Extract Objects" tool to extract the boundary of both corridor surfaces.
- Convert the 3D Polyline to 2D Polygon with elevation of Zero.
- Use the "MapExport" command to create an SDF file depicting coverage areas. We will need this later in InfraWorks.
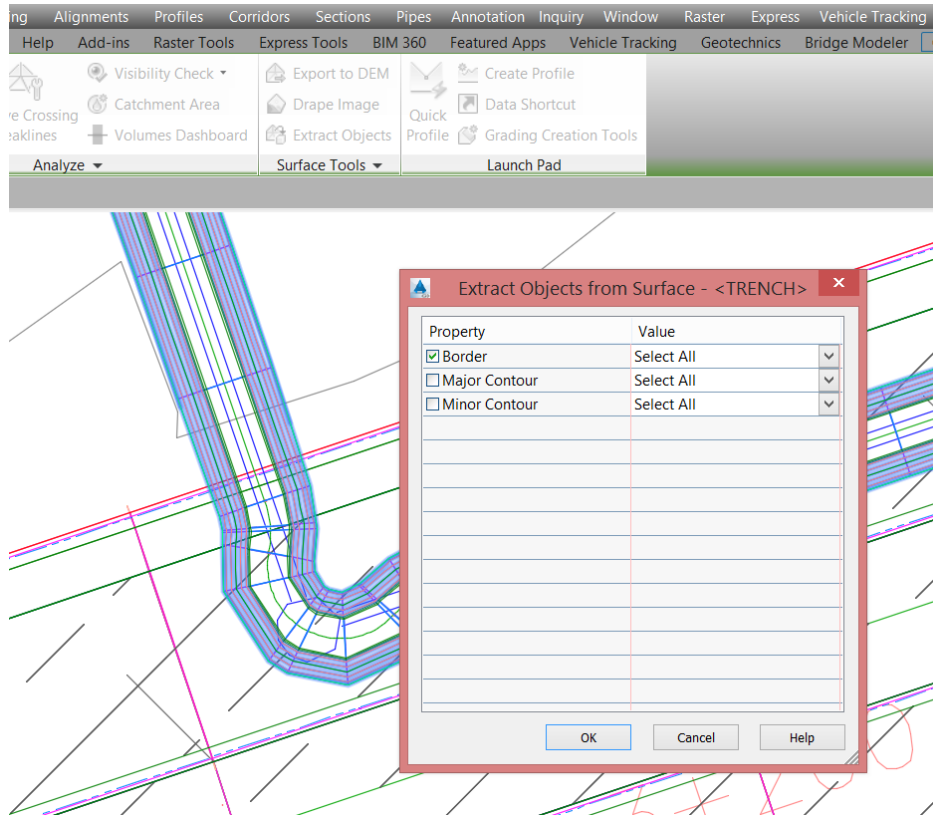
Export Road and Pipe Design to IMX format
Once you have the design completed, Select the Output tab and select the Export IMX function. This will export the alignments, surfaces and corridors to IMX for use in Autodesk InfraWorks 360. We will now connect our detailed design models.

Underground Design Proposal

- Back in the InfraWorks Model, Create a New Proposal Called "UndergroundDesign".
- Select and Delete our Concept LRT Roadway – we want to just view the excavation of the pipe trench and pipe network components
- Drag n Drop the Detailed Design.IMX file into the new proposal
- Configure each component starting with the Pipe Network and Excavation surface. Our intent of this proposal is to review the excavation limits and impact on the existing roadway.

Surface Configuration

Pipe Connector and Pipeline Configuration

The Results

Change the Pipe Network and Trench Design
The huge advantage of a "connected pipe design" means if we change the pipe design or trenching model, we can simply refresh the connected Pipe and Surface IMX datasources and review the updates.

Revision to Pipes from this…   To this…In Seconds

Connecting the Road Design
To connect the Detailed Design Alignment and Top Surface (Profile), we can Create a New Proposal called "RoadDesign".

Surface Configuration – Set the Attached IMX Surface to "FINAL" (Top Surface with DEM)

Road Design – the road from the IMX will drape along the Composite Surface

Make sure you toggle these setting OFF, as we are using a draped Road Style and NOT a Corridor Region model,

The Results,

Change the Road Design – Horizontal and Vertical Notes:

Corridor Surface Changes – the updates to the Corridor in AutoCAD Civil 3D will change the FINAL Surface seamlessly. We can simply Export the detailed design to IMX and overwrite the connected IMX Datasource. Our draped design road will change vertically when the "FINAL" Surface is refreshed.

Alignment Changes – if you have NOT modified the connected detailed design road style or added intersections (ie.. any manual changes to the alignment) then the road object will refresh seamlessly. If you have modified the road object, then you should create a new proposal called "RoadDesign_r2", delete the road object, refresh the datasource and re-stylize the updated road as needed. Based on this workflow, It's best to finalize conceptual Intersections once you are done changing the connected design and ready to create visualization assets.

Create a Site Design Proposal

As in the Master model development, we demonstrated the use of "MapExport" to create SDF files from blocks, polygons and linework. To further enhance the visualization of the project, various design elements can be exported using SDF as a file datasource.

Paint Markings – In the Site Design Layout Drawing, we have a linework representing paint markings within the site coverage area. Apply a 0.15m coverage buffer to see paint appear.

Site Plan Coverages and Buildings – We also have an area outlined with new site plan buildings, parking, grass and interlock brick.

Cars, Signs, Hydrants – We have a block in the Site Design Layout which represents a city furniture datatype. We can export those quickly and randomize the style as we did with trees.
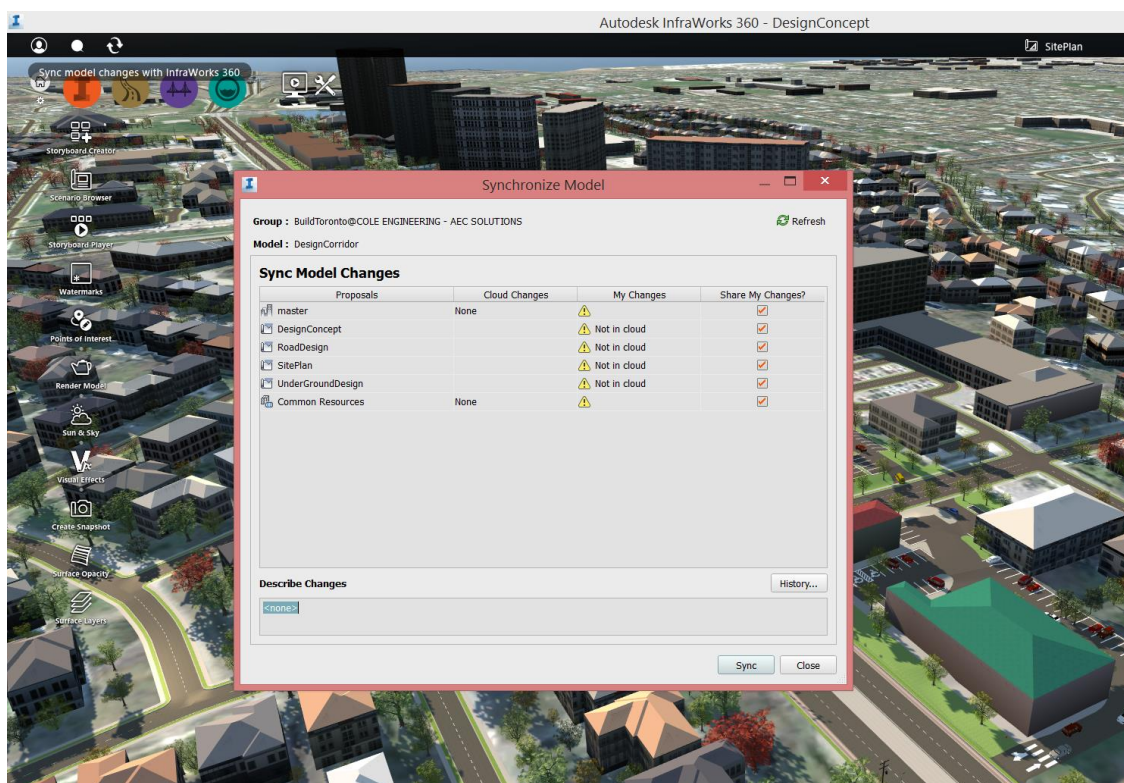
The Results,
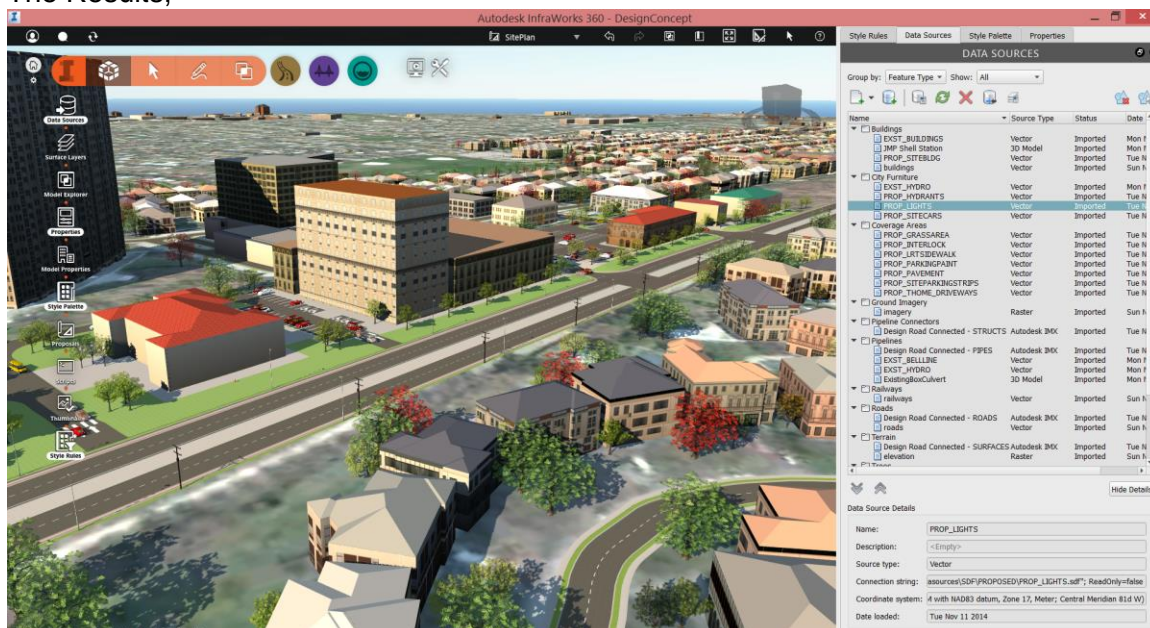
Collaborate and Share

Posting our Model to the Cloud

Collaboration system allows us to upload the entire model and share with others who also use Autodesk InfraWorks 360. Select the "Sync Model changes with InfraWorks 360" option in top left menu bar.

The Model is now available to those who have access to the "Group" specified in the Sync Model Changes dialogue.

Using Autodesk InfraWorks 360, we can publish a "Scenario" of our completed proposals. If you have access to the project group, download the app and login, you should see the model available for viewing. Select the Scenario Browser to create and manage uploaded scenarios.
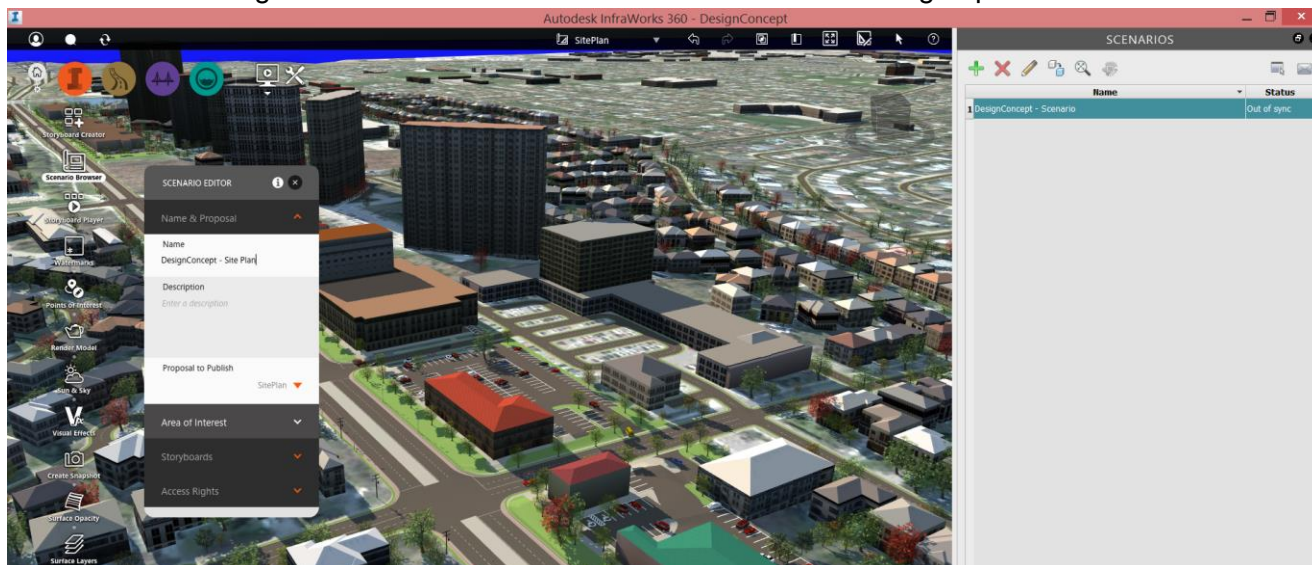
Visualization Assets – Images and Video

Making a storyboard Video for presentations is the next best thing to live navigation. Select the Storyboard Creator, Create a New Storyboard, add some camera locations and let InfraWorks fill in the gaps…

Integrating AEC Solutions Project Sheet with Autodesk InfraWorks Images

Using the Infraworks Image "Create Snapshot" tool, we can create stunning Images within minutes of finishing our proposal.

Once the Images are completed, Login into www.aecsolutions.ca and create an Account. Create a new online project and add marketing details including the 4 images you just captured.
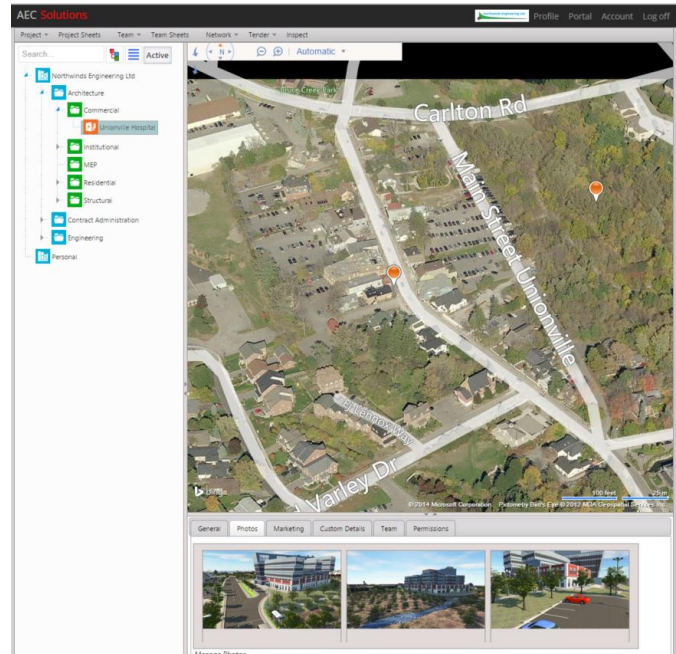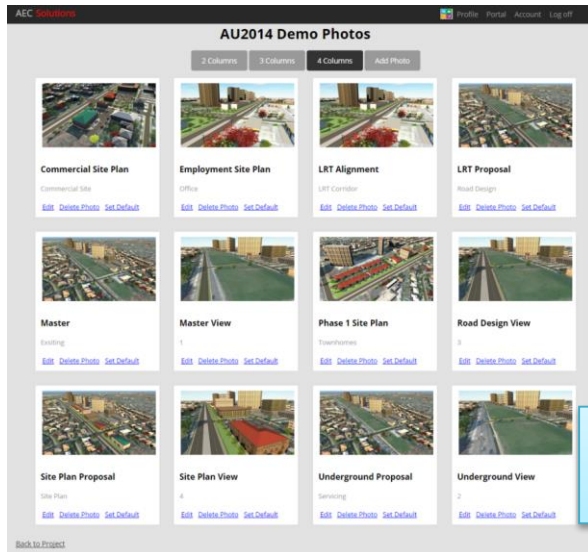
Within seconds you can create a Project Profile Sheet for client meetings and proposals.

AECSolutions.ca has a complete online project registry, team registry, mobile inspection and tender management system ready for any AEC project.

For more Information:

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