(CES502965)

Digital Twins from the Air Down.

Nicole Maier & Connor Tluck

Nearmap

Learning Objectives

- [Introduce users to the concept of a digital twin and the key concepts and data necessary to build a foundational twin.
- Leverage nearmap 2D, 3D, and AI content along with Autodesks suite of tools to build a digital twin of an urban environment.
- Discuss and demonstrate the use cases that the foundational digital twin can support.
- Identify the types and forms of additional data that could be incorporated to further enrich the digital twin.

Description

When reading modern engineering articles about infrastructure and the built environment, it is difficult to find an occurance where Digital Twins are not mentioned. By all accounts, a digital twin of a fixed asset or real-world system is immensely valuable and can be used to support a number of use cases. But, building a digital twin requires a significant amount of data. So, how does one start to build a digital twin? Three-dimensional (3D) basemaps produced from high resolution aerial imagery serve as the foundation and fabric for digital twins. Automated feature extraction from AI uniquely identifies critical infrastructure and can be used to grow an urban digital twin, removes the guess work and shortening the digital twin development time. For engineering professionals interested in exploring the world of digital twins, Nearmap offers a variety of foundational products for getting started.

Speaker(s)

Nicole Maier is a Solutions Engineer at Nearmap, supporting the commercial industries such as architecture, engineering, and construction. Nicole’s professional experience includes civil engineering, environmental modeling for natural hazards, airspace modeling, airport layout plans, and transportation planning and design. She holds a Masters in Applied Geography and Geospatial Sciences and a GISci Certification from University of Colorado, where she also completed her undergraduate degree in Political science and Geography with an emphasis in Quantitative Research Methods.

Connor Tluck is a Solution Architect for Nearmap. He brings a unique skillset derived from a background in civil engineering and a passion for python development and data analytics projects. Connor worked as a civil engineer in the transportation industry for five years prior to joining Nearmap. He was involved in highway design, work zone traffic control, drainage design and rail design for some of the largest design build projects in the country. Applying his experience, he finds innovative solutions for Nearmap clients which integrate well with existing workflows though API access, direct download, and custom tailed integration solutions.

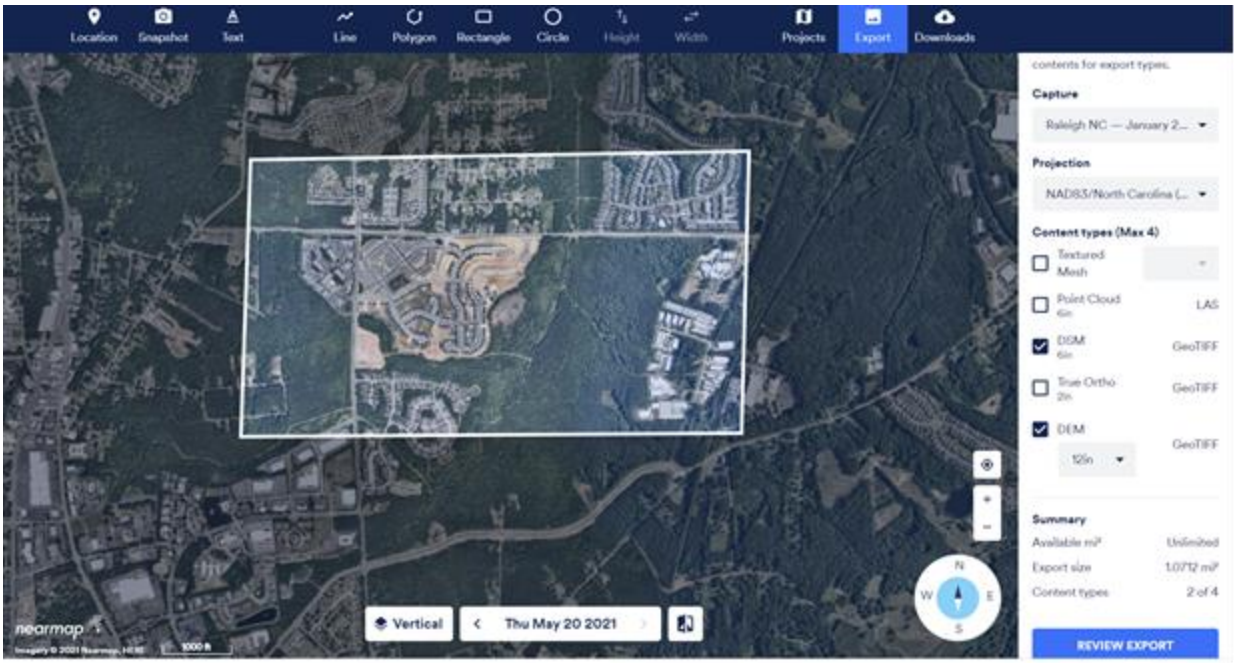
Loading Nearmap 3D Data into Civil 3D to Create Contours

Objective: Load 3D Nearmap Data in civil 3D as a surface for viewing and as a working terrain model to generate contours.

Steps:

1. Download DSM/DTM via Mapbrowser for an Area of Interest.
2. Set Coordinate Workspace in Civil 3D.
3. Create surface in Civil 3D from downloaded Nearmap DEM.
4. Generate contours off of surface for viewing and analysis.

Prestep to Acquire Data – Download Via Mapbrowser



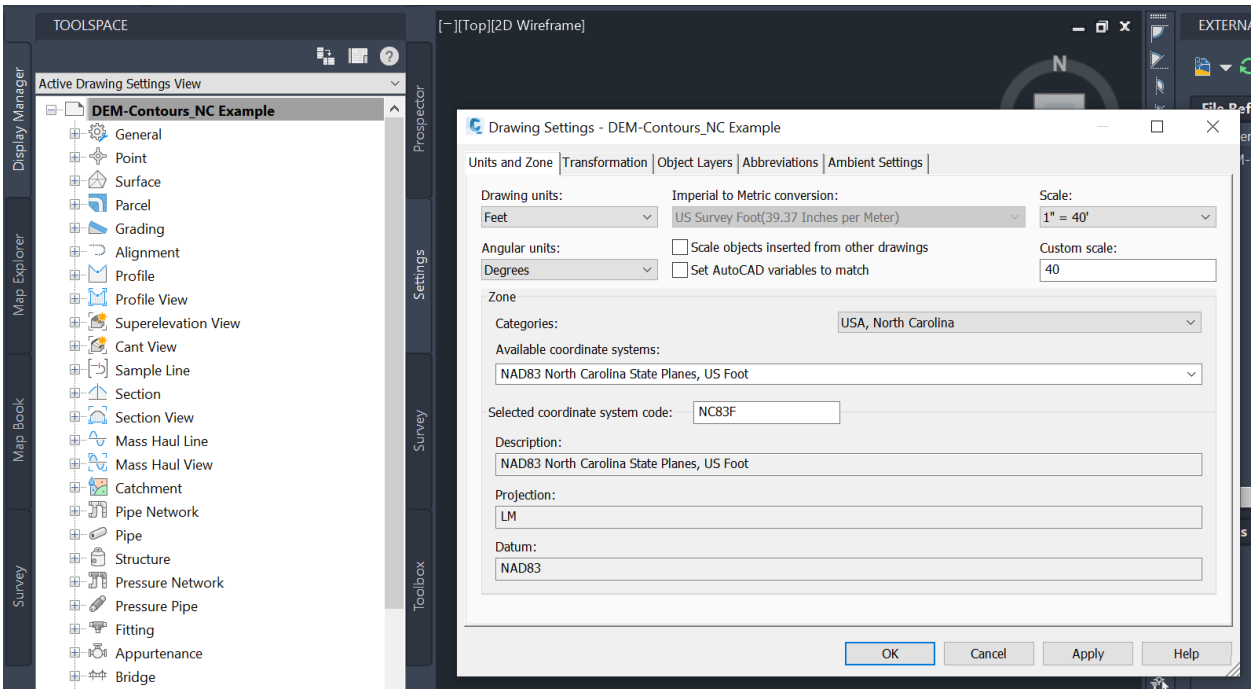
1. Got to map browser to view area of interest, select the export tool.

2. Navigate to 3d export, select capture date and projection, then draw a polygon on the map that defines an area of interest.

3. Finally select content types DSM/DTM and export to your local machine.

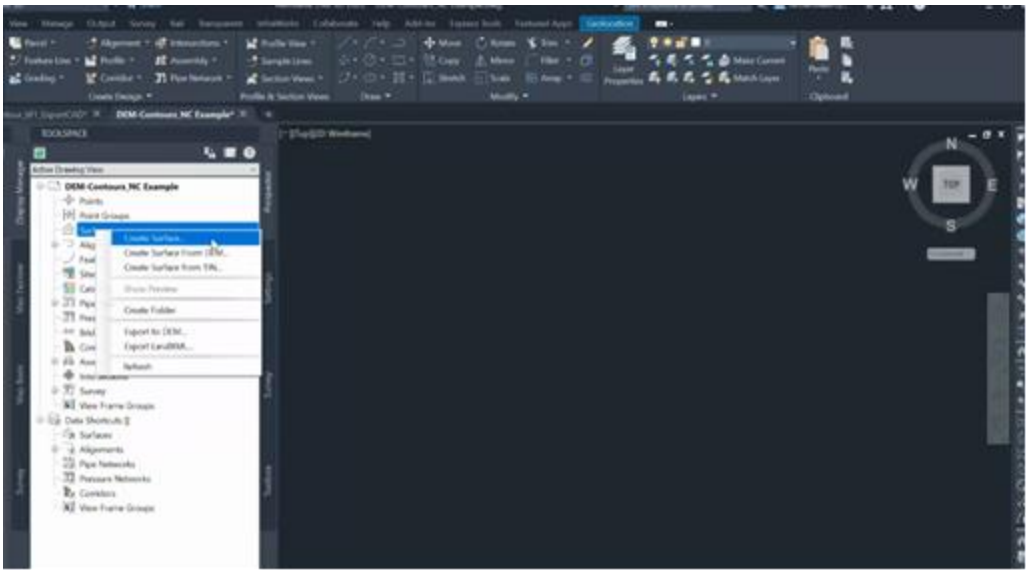
You will see an export summary stating your selections, confirm and your files will be saved to your downloads folder on your local machine.

Autodesk Civil 3D - Set Drawing Coordinate Space

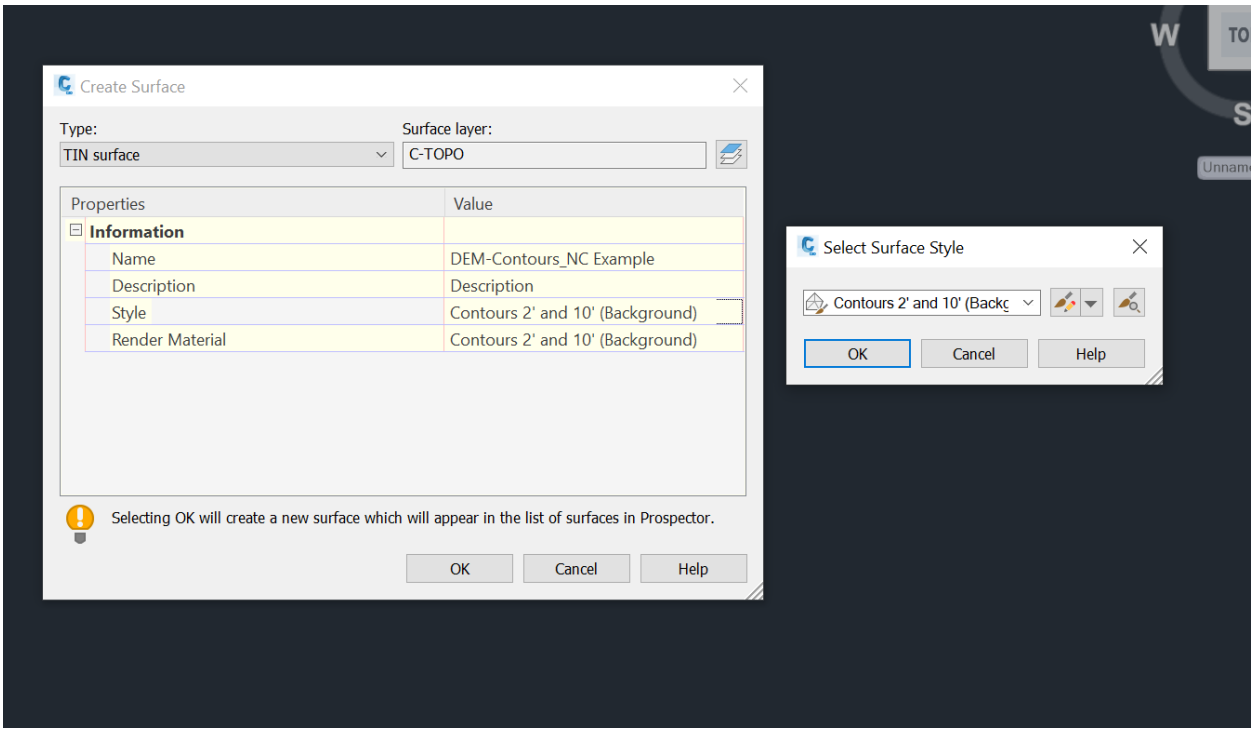


1. From the Settings Tab, Right click on the Drawing name and click edit drawing settings.
2. Select Coordinate system for the drawing

Create a Surface in C3D with downloaded 3d data:

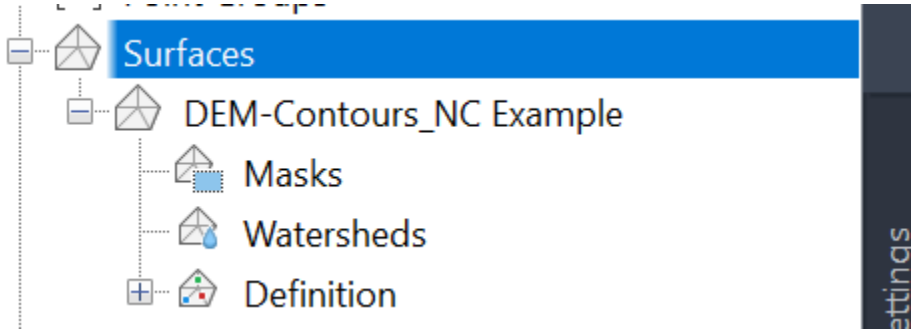


1. In the Prospector tab, Right click surfaces and select ‘Create Surface’

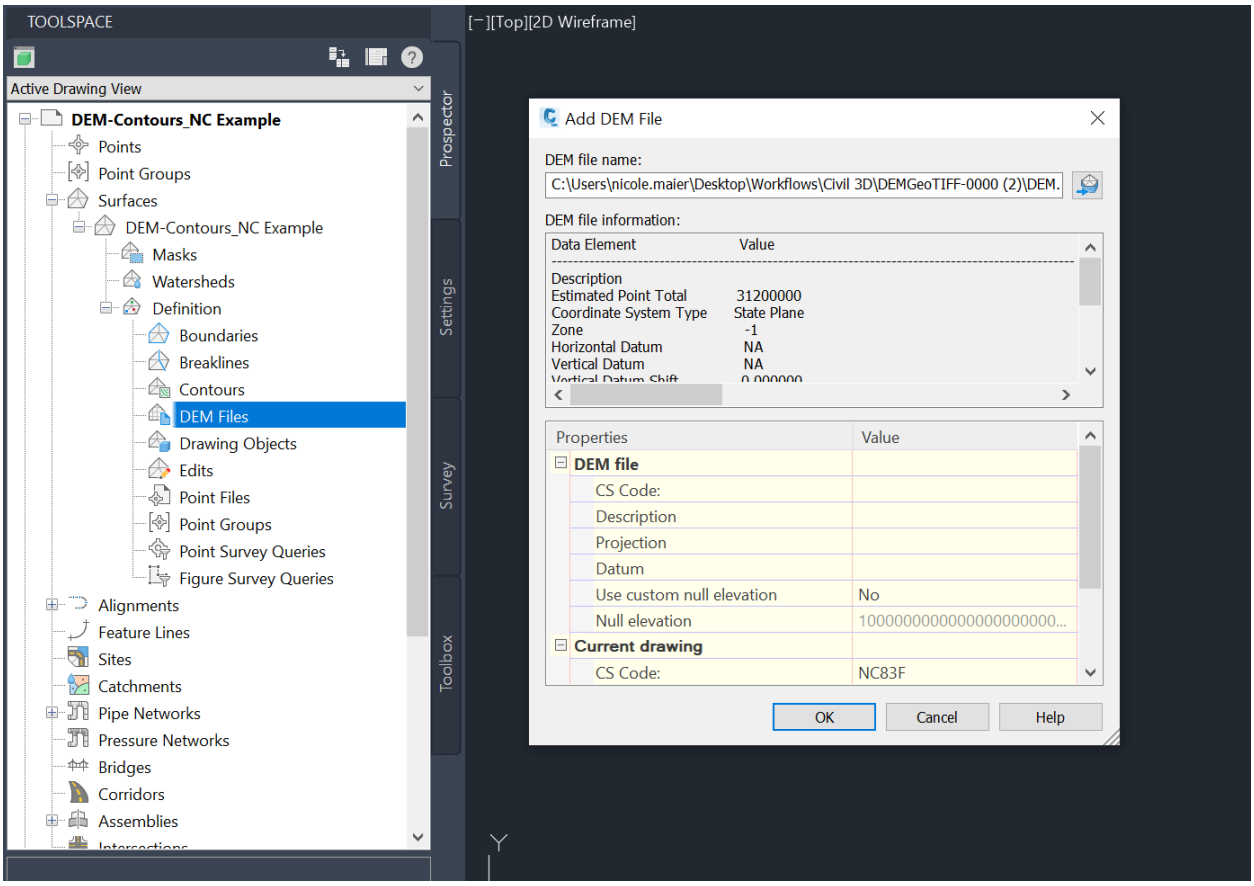


2. For type select ‘TIN surface’

3. Name your surface layer accordingly
4. Click the '…' in the style bar to customize contour preferences
5. Hit 'Ok'



You should now see the shell of the surface that you created in the 'surfaces' drop down



6. In the definition drop down we will bring in our DEM. Right click DEM Files and select ‘add’
7. Navigate to the DEM geoTIFF in your files that was downloaded earlier from MapBrowser
8. Click ‘ok’

9. You can zoom to the layer by right clicking the surface in the prospector tab, and selecting ‘zoom to layer’.
10. You will see the contours generated here as a surface object. Select the object and explode once to create a block reference, and twice for the contours to display as polylines.

Nearmap Data Stack in Infraworks for Fast Proposal Decisions.

Objective:
Infraworks is a powerful Autodesk tool which can be used in concept planning and proposal renderings in the engineering space. The infraworks module of the lesson will briefly discuss how to load the full Nearmap Content Stack within Infraworks for concept planning and analysis. Nearmaps high resolution imagery serves at the base ground truth, but when paired with our high resolution terrain data and vector AI content you now have the tools to start doing some real planning. After content stack is loaded I will demonstrate how to run analysis tools for new proposed roadway, view the proposed profile overliad on the existing ground surface created from Nearmap, quantity estimates for earth excavation, and demonstrate the connection between our vector AI and removal cost item generation. I will then also discuss some of the value of a good 3D model and how to create traffic and proposal renderings.

Steps:

1. Download DSM/DTM via Mapbrowser for an Area of Interest.
2. Set Coordinate Workspace in Civil 3D.
3. Create surface in Civil 3D from downloaded Nearmap DEM.
4. Generate contours off of surface for viewing and analysis.

Learning Objective 1: Exporting Nearmap Data.

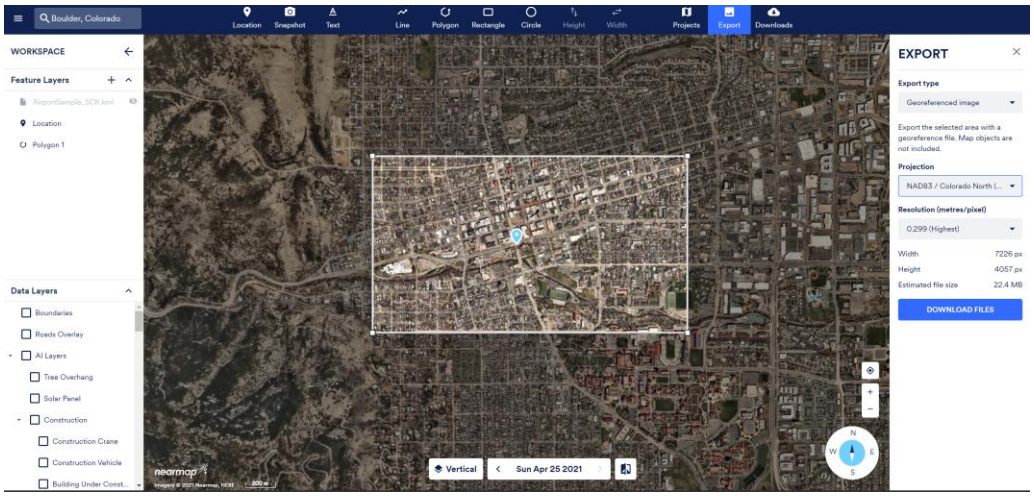
Nearmap prioritizes easy 3rd party integrations by both the file types we produce and how our clients can access them. Our webbrowser application makes it easy to export all the content you need and our APIs assure that work load is scalable across large organizations. Earlier we discussed how to export content for use in civil3d but as a quick refresher the docs will be linked below.

Export Nearmap Vertical Imagery

Nearmap Vertical Imagery can be exported using Mapbrowser export to local machine or a wms server created on the user admin page. For this class we will simply be utilizing local export as this option can then be overlaid on our Infraworks terrain model.

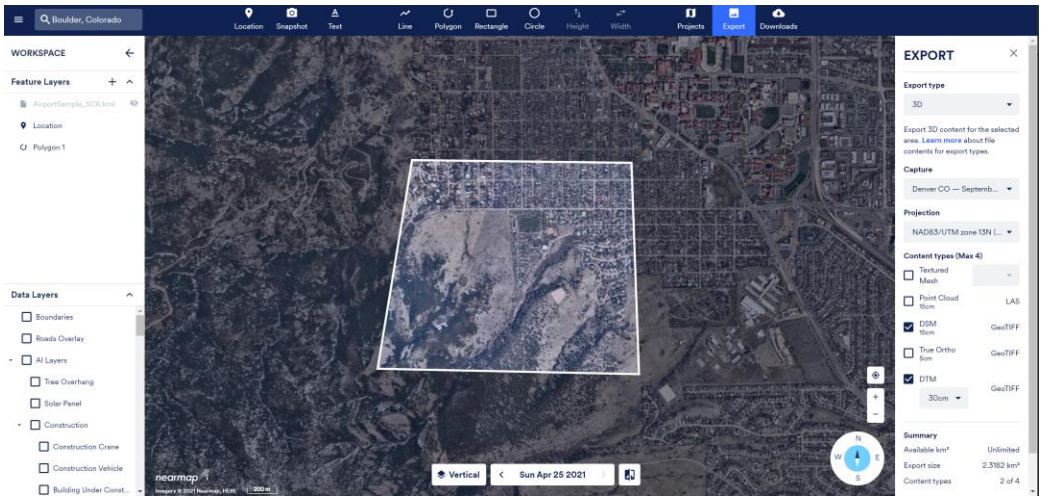
https://docs.nearmap.com/display/ND/NEARMAP+VERTICAL
https://docs.nearmap.com/display/ND/Export+Content+from+MapBrowser
https://docs.nearmap.com/display/ND/WMS+2.0+Integration

In this lesson we will be working in NAD83 Colorado State Plane North (ftUS)
EPSG code is 2231.



Export Nearmap Terrain Data

The second piece of data we need for any concept plan is some good terrain data. To load Nearmap terrain data we can use direct API requests but the best and easiest method is simply logging into mapbrowser and pulling a 3D dataset for our area of interest. Nearmaps Digital Terrain model is our raster formatted image file where pixel values are indicative of terrain, this file is a geotiff and can be read by many CAD and GIS platforms to create terrain through these colorized pixels. Our DTM also removes above ground features like buildings and trees to give a bare earth scenario.



Export Nearmap AI as Infraworks Objects

Our final dataset is our newest product, vectorized AI. This data can be exported from mapbrower but at the moment the newest generation is not available here. Access though the AI Feature API or as an offline delivery is advised. Shapefiles work excellet in Infraworks and are also recommended.

See docs to access:

https://docs.nearmap.com/display/ND/AI+Feature+API

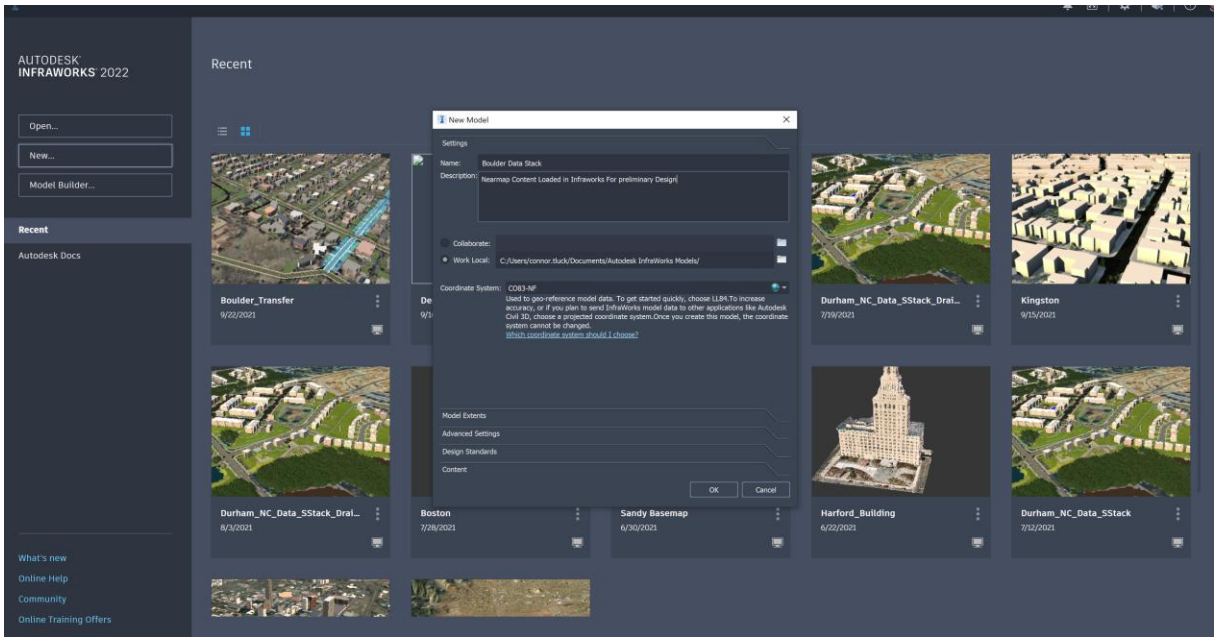
Learning Objective 2: Loading our Data Stack

Now that our content stack has been saved locally we should have our three pieces of data for any concept level design.

1. High resolution Imagery
2. Terrain Data
3. Vector Linework

Next we will go over how to load this content stack into infraworks.

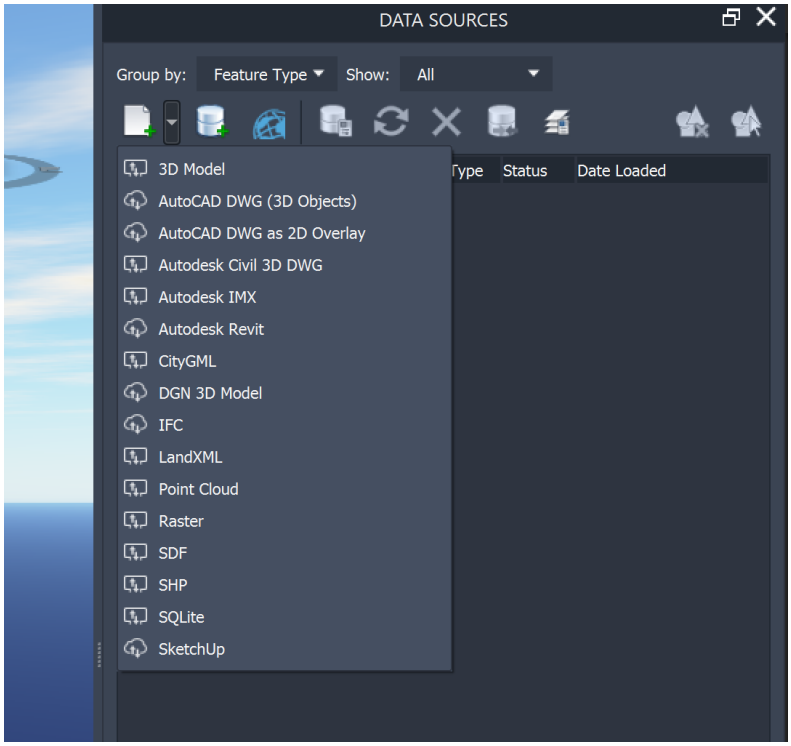
First step before we get started is to set our coordinate space in a new infraworks project, this is critical as all other datasets need to be imported with the same coordinate space to line up correctly.



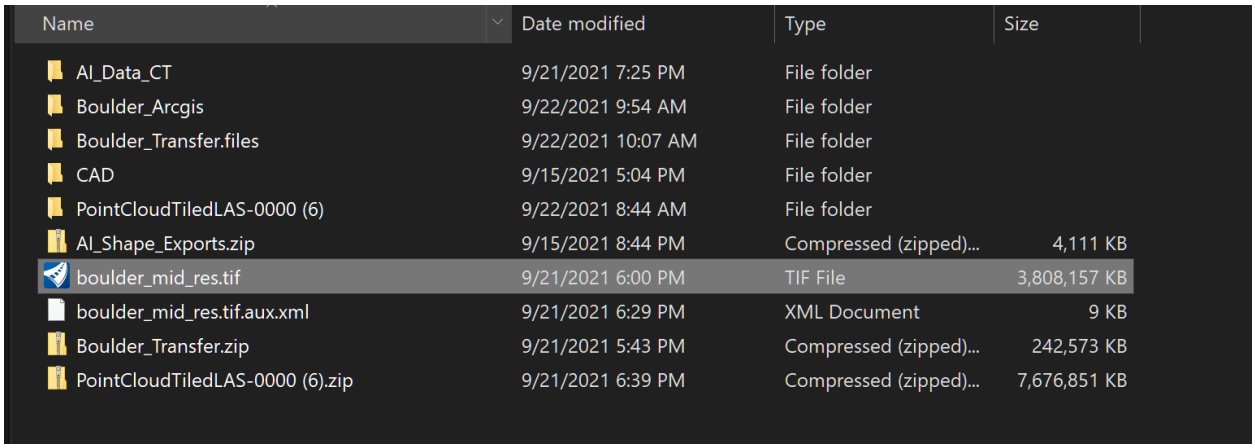
Loading Nearmap Vertical Imagery

First step after setting up our project space is to load our vertical imagery as a raster. Follow the steps.

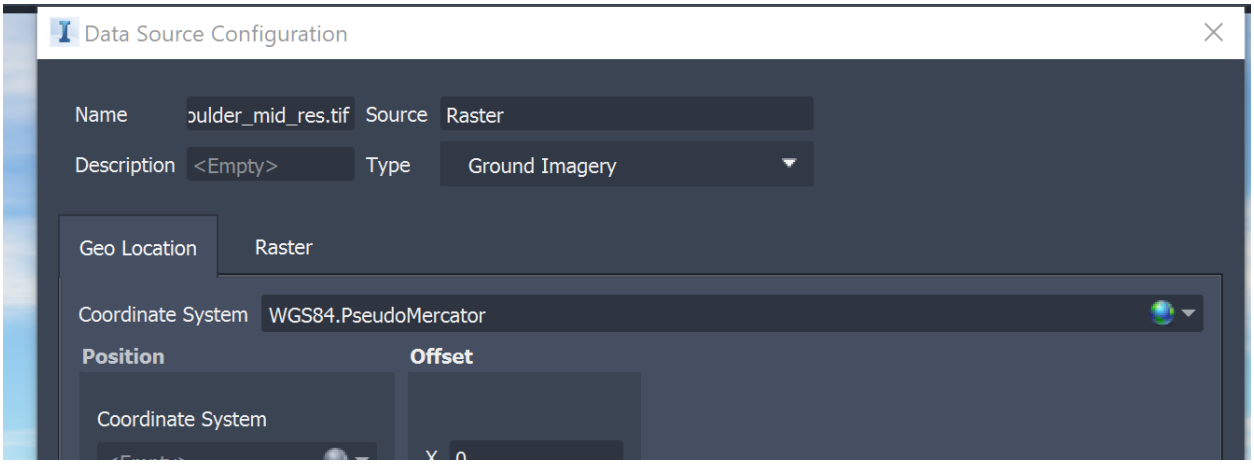
1. Content > Data Sources > Add file data source, Select Raster. Note this will be used for imagery and terrain.

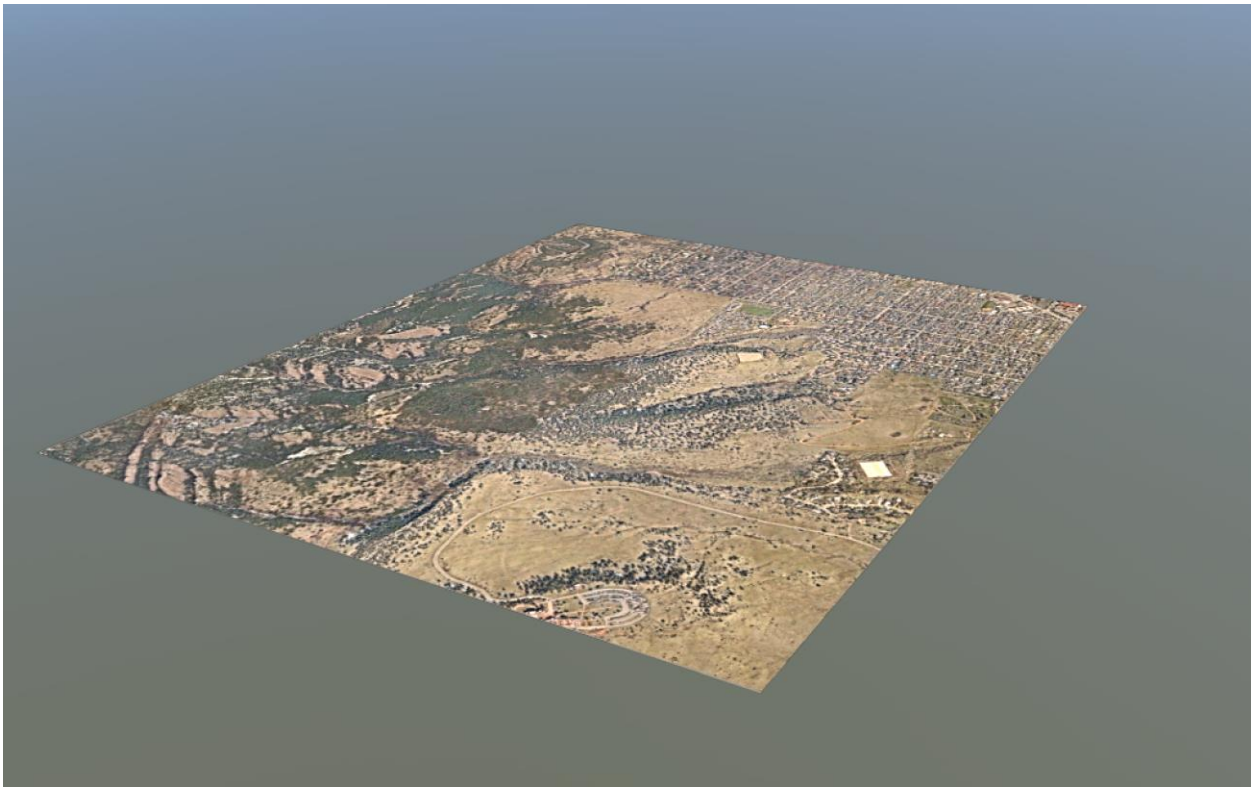


2. Select the Raster we exported off mapbrowser. Here I have it saved as boulder_mid_res.tif. Your file will also be a georeffered .tif file.



3. Select your Raster Data source and choose configure. Assure that the type in the Data source configuration menu is set to Ground Imagery and that the projection system is the same as what was exported from mapbrowser. Processing will take a few moments.

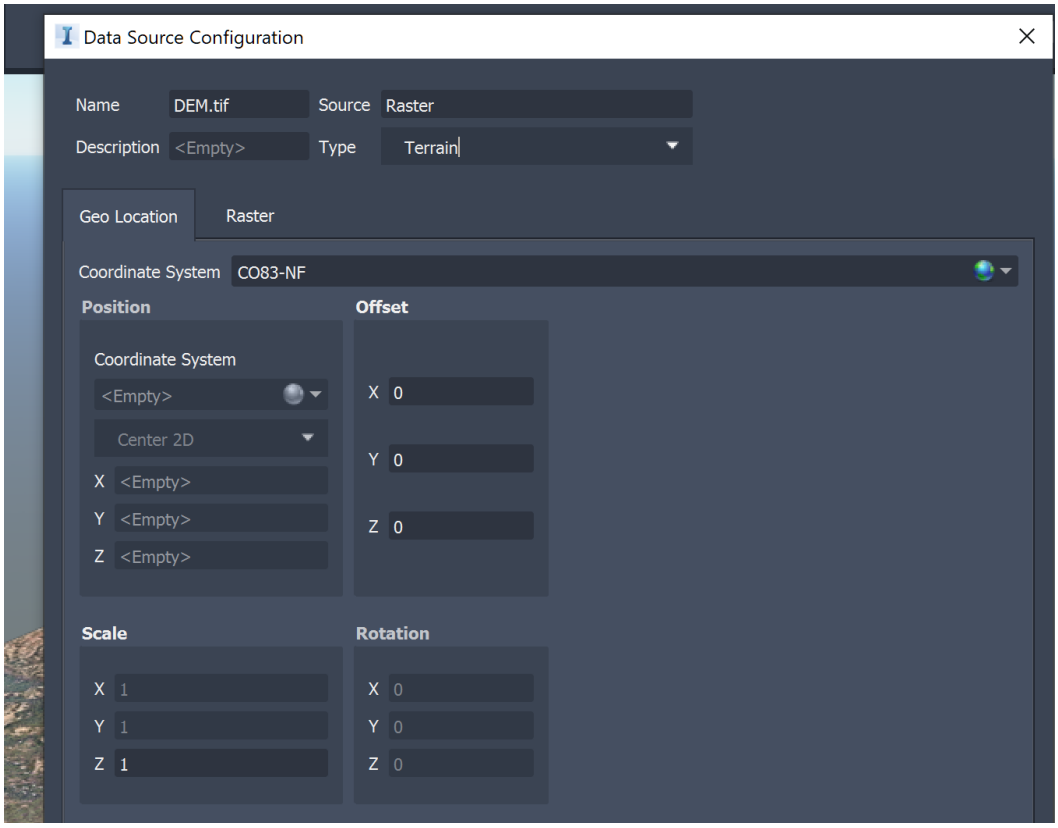




Loading Nearmap Terrain Data

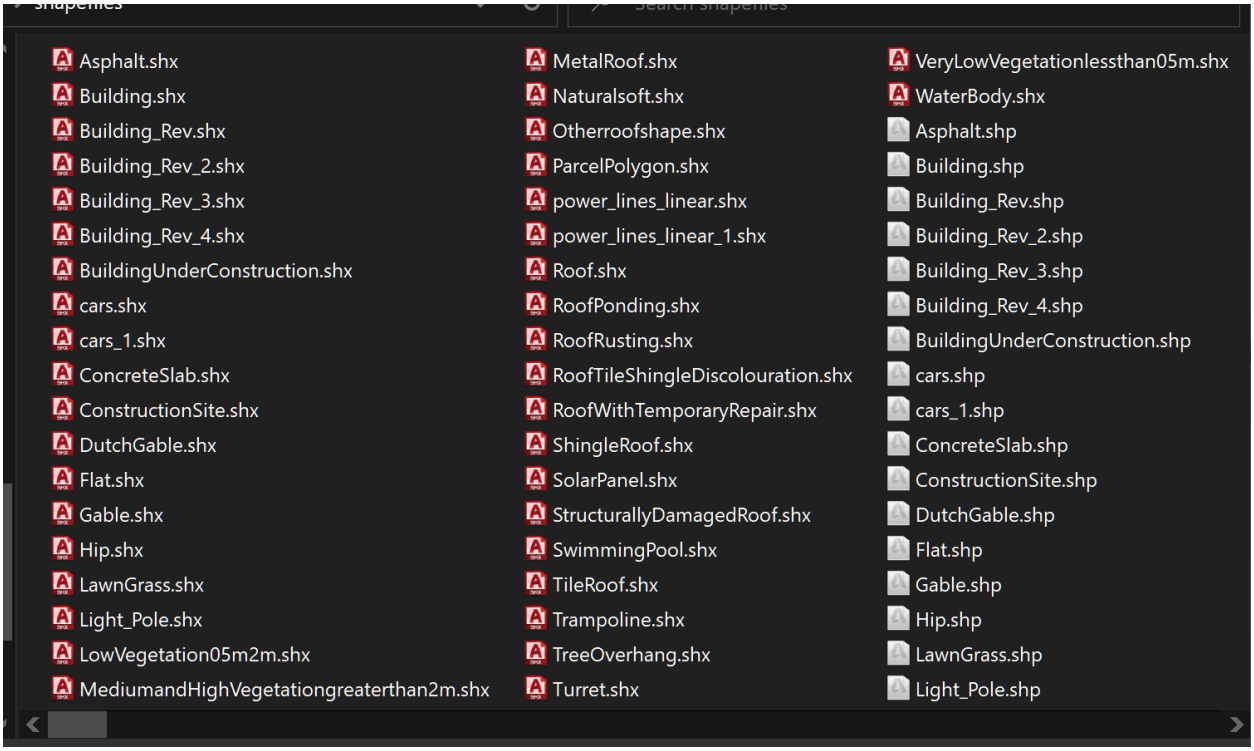
Next we move onto terrain data. This is loaded very similar to the 2D content, but we select terrain now instead of Ground Imagery.

Import your raster datasource and select Terrain this time. This will refresh your model space and project your 2D imagery onto the terrain data.


Data Source Configuration
Name
DEM.tif
Source
Raster
Description
<Empty>
Type
Terrain
Geo Location
Raster
Coordinate System
CO83-NF
Position
Offset
Coordinate System
<Empty>
Center 2D
X
<Empty>
Y
<Empty>
Z
<Empty>
X
0
Y
0
Z
0
Scale
X
1
Y
1
Z
1
Rotation
X
0
Y
0
Z
0

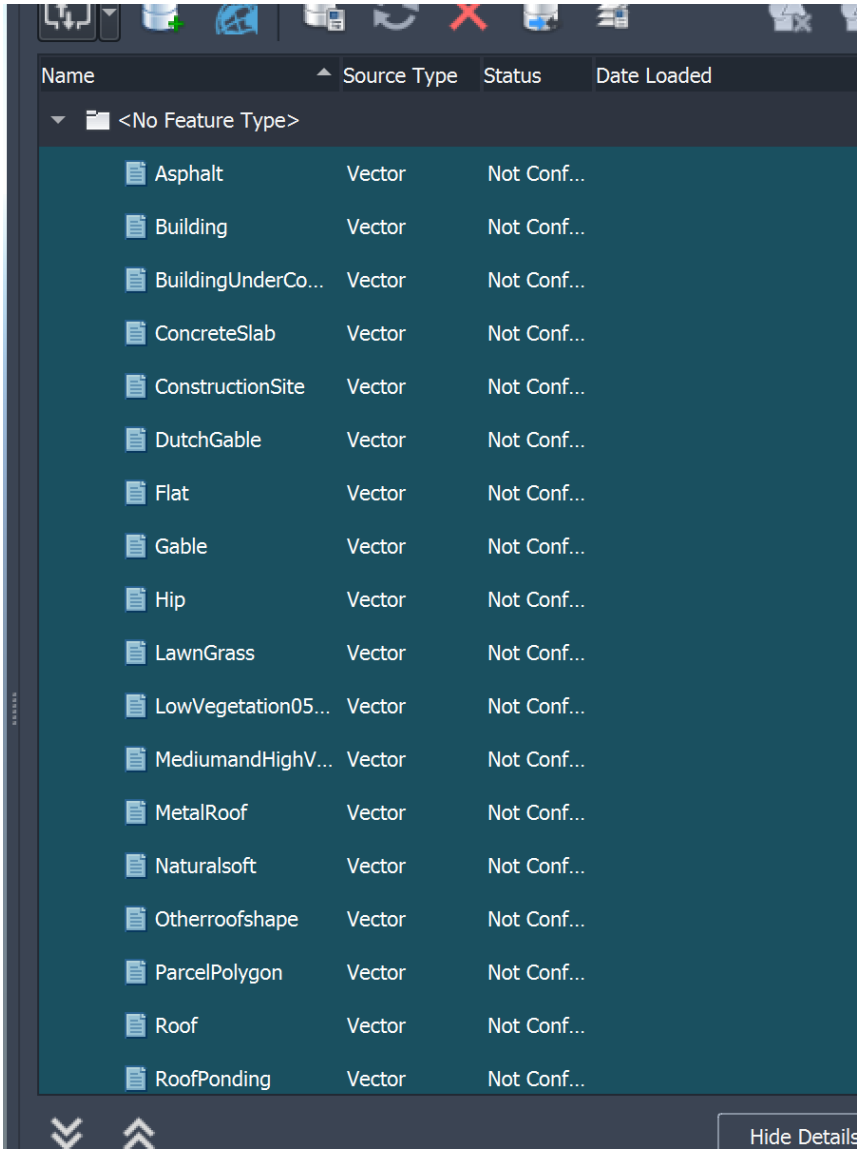
Loading Nearmap AI as Infraworks Objects

This is the fun part and where the real value of Nearmap AI data comes into place. The world of vector data allows us to digitize all of that geolocation insight that our machine learning algorithm has derived. Our AI data format is a list of shape files like so, shape files include a number of other file formats tied to each shape file. We need all of these but be sure to load only the .shp.



Steps:

1. Navigate to Content > Data Sources > Add file data source, Select SHP. Select all the shape files and open. You will see all data sources non featurized.

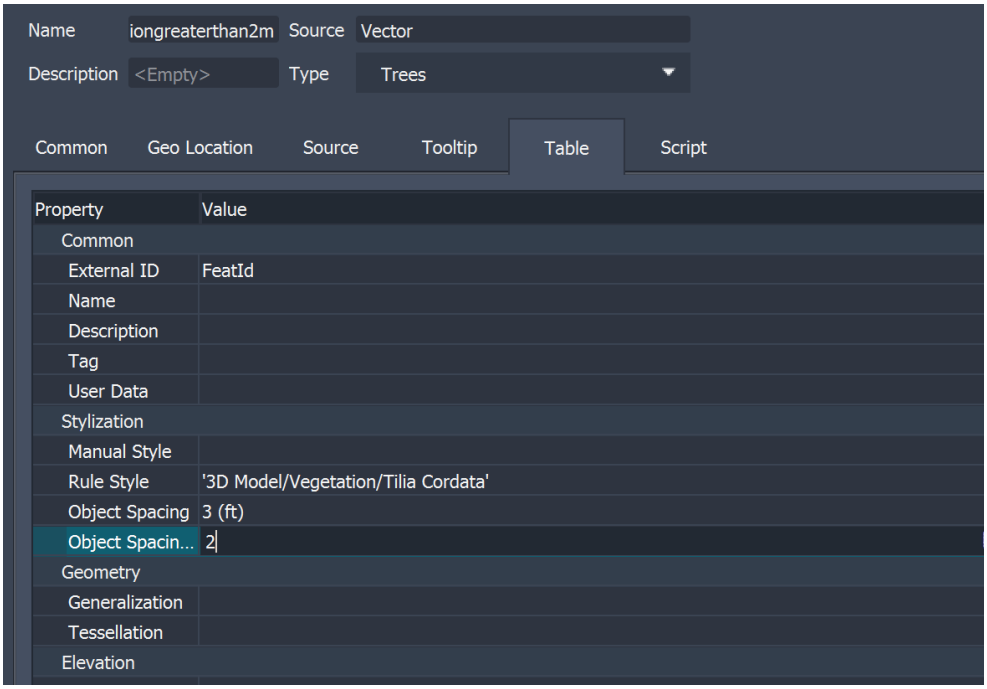


2. Next we need to featurize each one based on what the AI data is showing and how we want to represent that data in our workspace. There is a lot of nuance here but I will run through to examples.

Loading Coverage Area Data

Areas like asphalt, lawn, trees ect are all considered coverage areas and need to be categorized as such. Right click on a data source and click configure.

1. Select Type as Coverage Areas.
2. Select a style that matches the desired style, confirm geolocation data, select the drape option and click close and refresh.

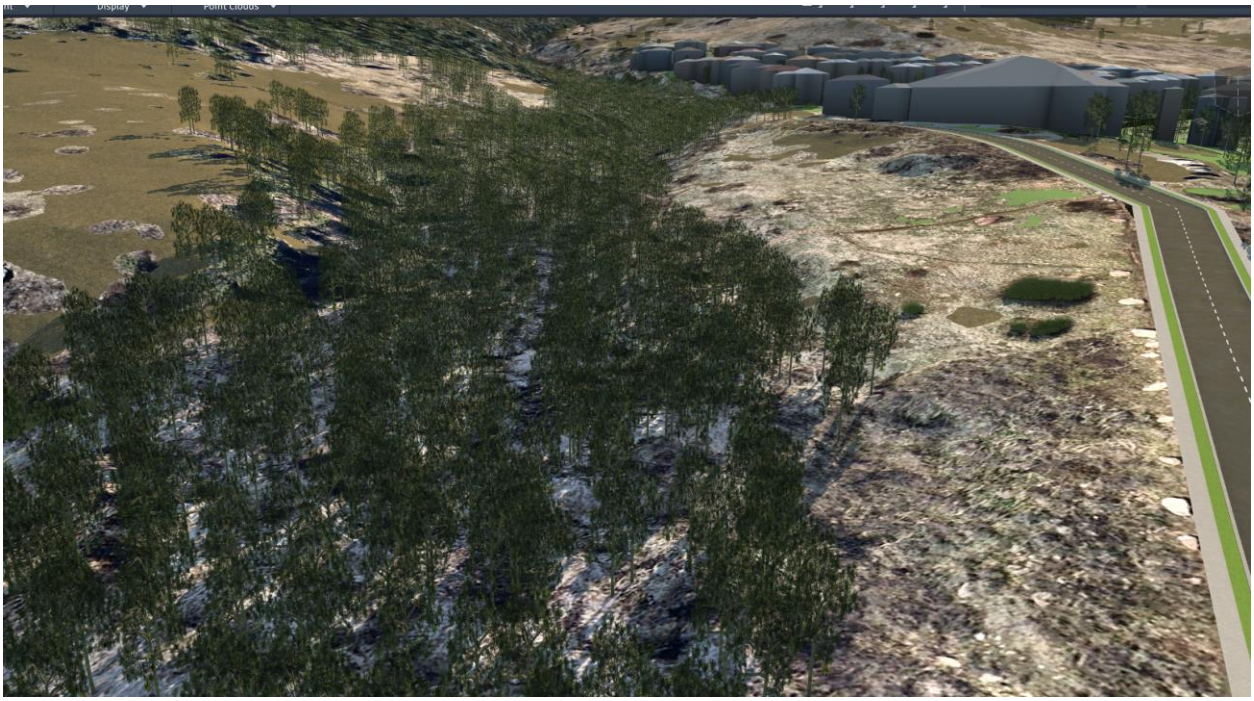


Tree Spacing Settings

Asphalt Pavement Data

Loading Tree Data

For distributed objects like trees, sometimes its advisable to play around in the advanced tools. You an drop tree obects at consistent spacing and then add a random factor to randomly distribute trees with the coverage area of “trees”



Tree Data with Distributed Placement in Vector Area

Loading Building Data

Areas like asphalt, lawn, trees ect are all considered coverage areas and need to be categorized as such. Right click on a data source and click configure.

Buidling Data From AI Vector Data

Loading Point Data

Powerpoles for example need to be loaded as single objects. Luckily the shape file is already formatted this way, simply pick the style that fits best and apply.

Cars Rendered from AI Point Data

Loading Linear Data

Powerlines are Vector Line Data and can be loaded to distribute poles at given intervals along the lines.

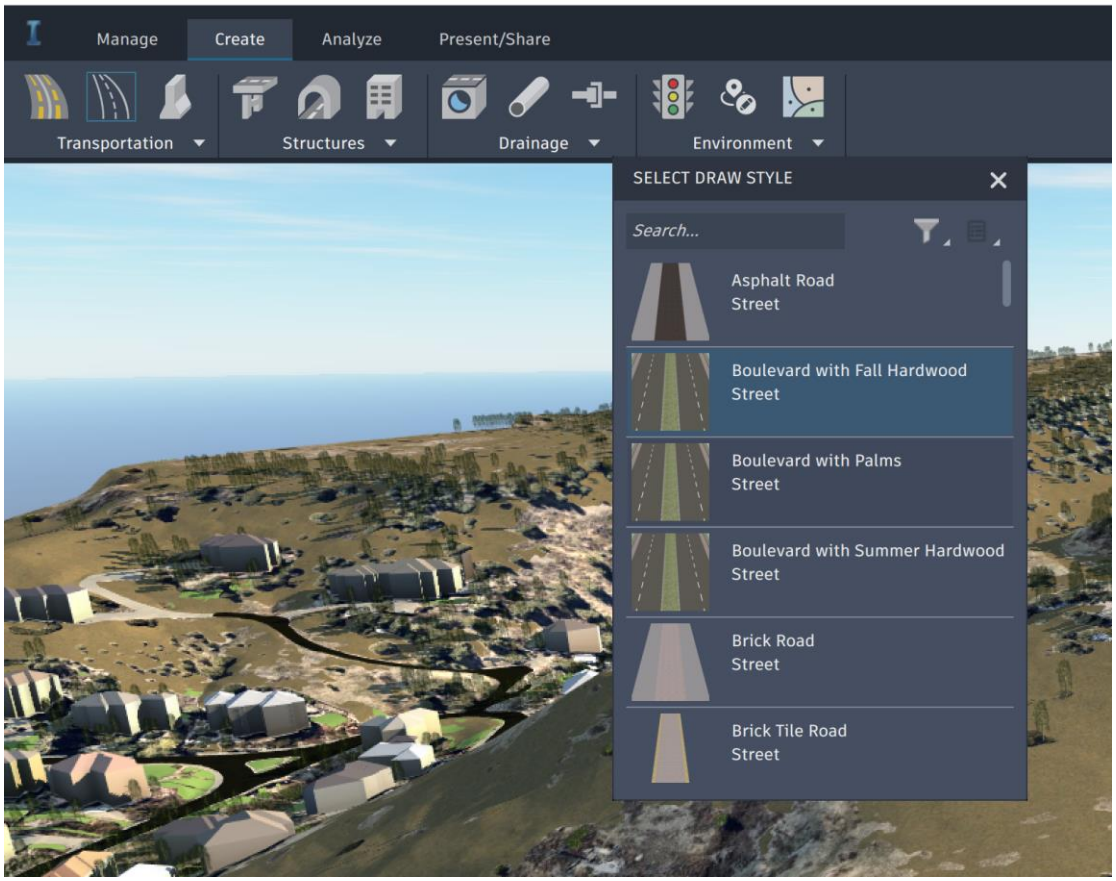
Powerlines Rendered from AI Vector Data

Learning Objective 3: Infraworks Design Decisions – Roadway Design

Loading Nearmaps Data stack into the infraworks workspace is a great way to create an easy visual guide to what is on the ground. Once the model is created though what can we do with it? Lets talk about adding a new proposed roadway, designing the profile and crosssection and then creating a quantity report for earth work and removal items.

Create a component Road

1. Go to Create > Transportation > planning roads

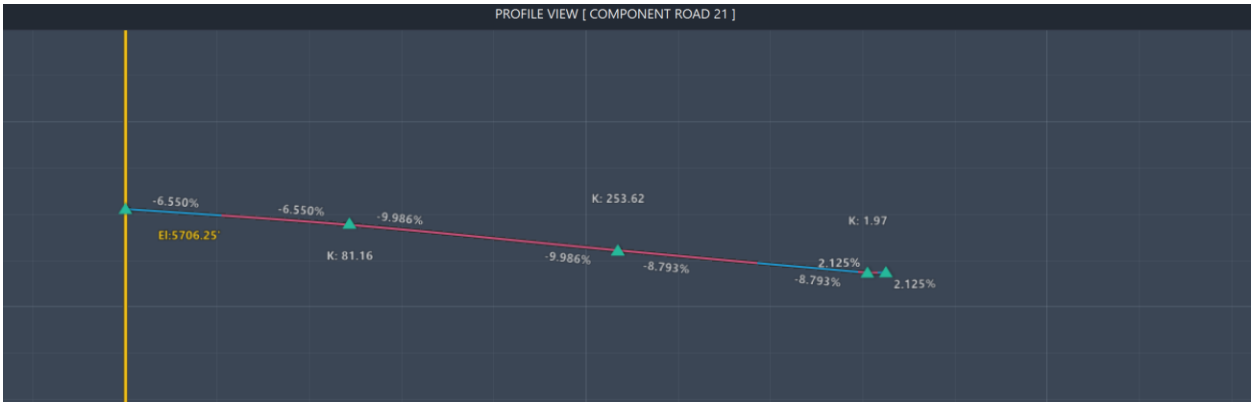


Insert AU caption.

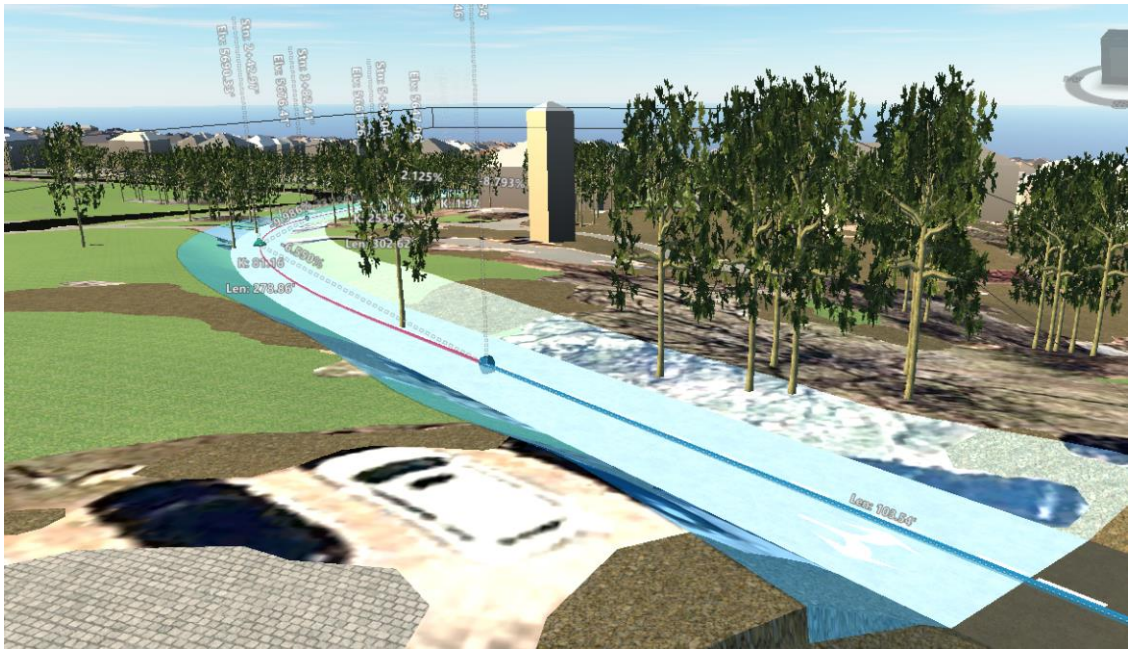
2. Select the road you want and draw where you want to place it. You can connect to existing roads.

3. Convert to component road for full functionality.

4. You know can see profile and stationing.



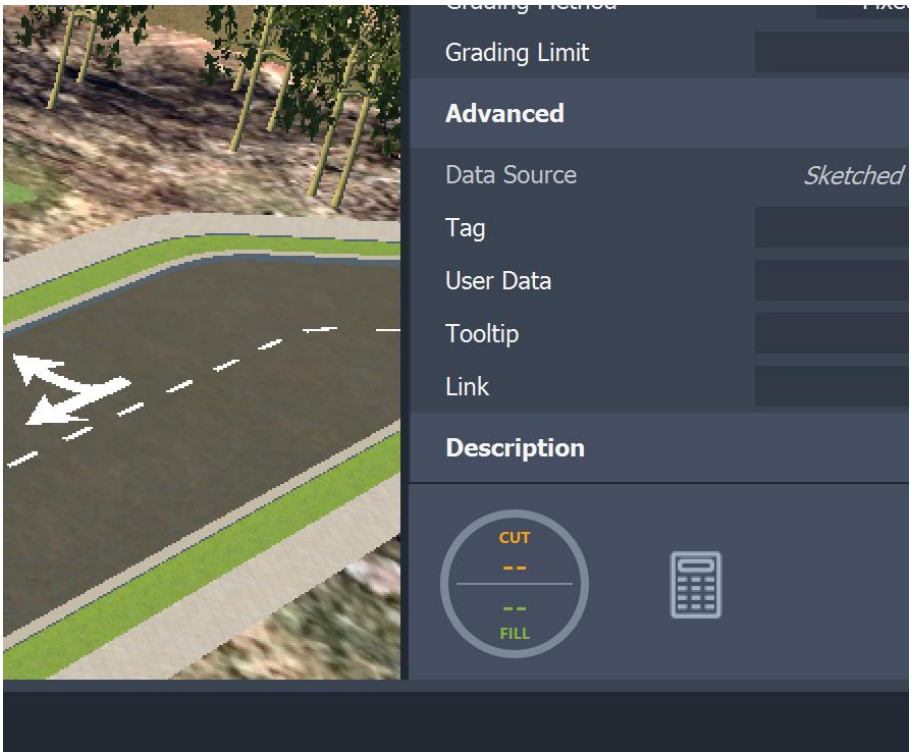
5. Modify Compoenet settings in the properties menu. Here I modified the Grading limits. You also can see that the road is crossing existing features like trees and coverage types. This all will be reflected in the quantity report.

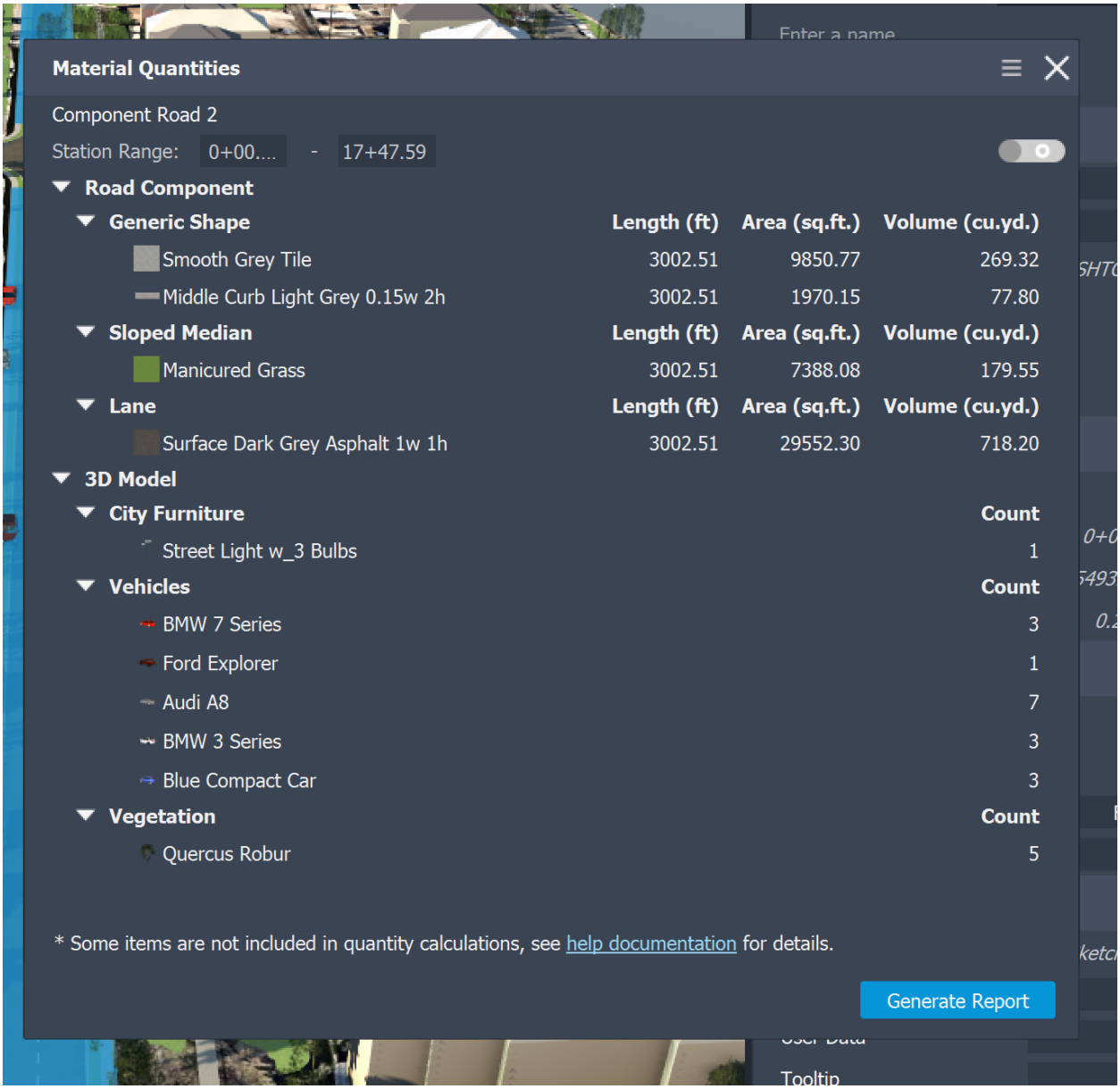


Learning Objective 3: Infraworks Design Decisions – Generate Reports and Quantities

Once a proposed roadway has been created we can generate a cut fill report and quantity take off for removal items based on the AI interesections.

1. Use the Earthwork Quantity button to generate your report once your roadway is selected.


Grading Limit
Advanced
Data Source
Sketched
Tag
User Data
Tooltip
Link
Description
CUT
FILL



2. This can also be exported to a CSV file.

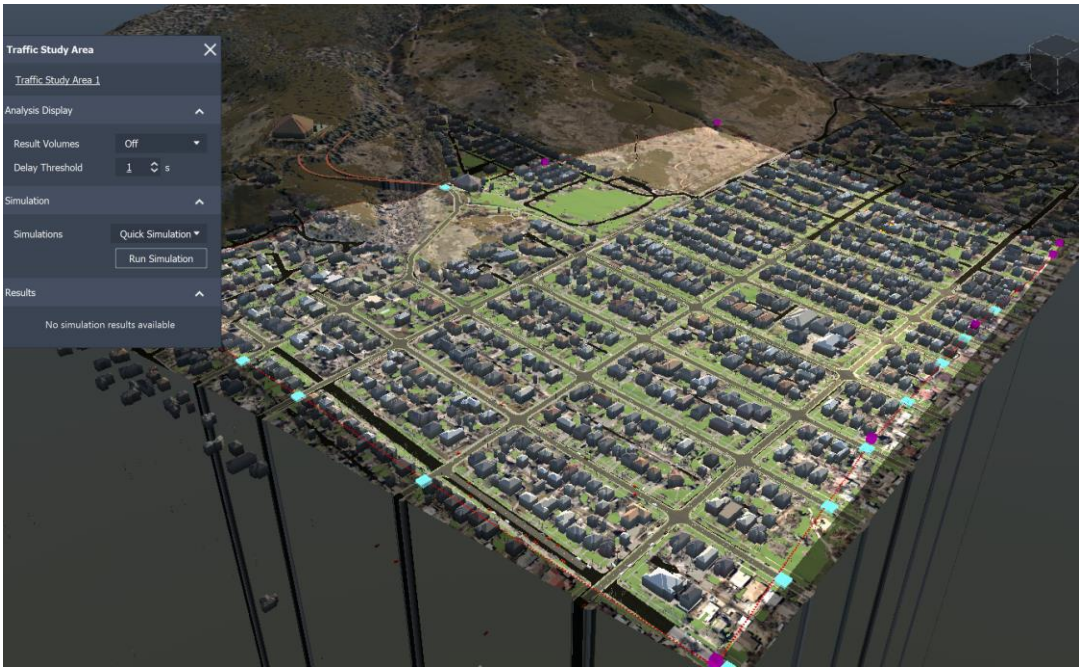
	A	B	C	D	E	F	G	H	I
1	Asset Type	Group	Name	Count	Length (ft)	Area (sq.ft.)	Volume (cu.yd.)		
2	Road Component	Generic Shape	Smooth Grey Tile		3002.51	9850.77	269.32		
3	Road Component	Sloped Median	Manicured Grass		3002.51	7388.08	179.55		
4	Road Component	Generic Shape	Middle Curb Light Grey 0.15w 2h		3002.51	1970.15	77.8		
5	Road Component	Lane	Surface Dark Grey Asphalt 1w 1h		3002.51	29552.3	718.2		
6	3D Model	City Furniture	Street Light w_3 Bulbs	1					
7	3D Model	Vehicles	BMW 7 Series	3					
8	3D Model	Vehicles	Ford Explorer	1					
9	3D Model	Vehicles	Audi A8	7					
10	3D Model	Vehicles	BMW 3 Series	3					
11	3D Model	Vehicles	Blue Compact Car	3					
12	3D Model	Vegetation	Quercus Robur	5					
13									
14									
15									
16									

Learning Objective 4: Infraworks Traffic Rendering

Generating Traffic Analysis is critical for proposed designs and renderings. Infraworks allows this as well.

Genearte Traffic Reports.

1. Navigate to Analayze > Transportation > Traffic Simulation. Select the area you want to run the report on, all roads must be component roads.



2. Additional Settings are in the traffic Analyst Panel. Such as traffic Counts, Volumes, Intersection behavior Ect.