AUTODESK UNIVERSITY 2014

GIS Interoperability with BIG data in InfraWorks

David Lawrence – URS

CV6703-P

This class will discuss the lessons learned in dealing with a large project area that covered over 27,500 square miles of land within the Navajo Nation for the Navajo Housing Authority (NHA). The NHA is the Navajo Nation's Tribal Designated Housing Entity, pursuant to the requirements of the Native American Assistance and Self-Determination Act (NAHSDA) of 1996, as amended.

NHA is the largest Indian housing authority in the country and manages more than 9,000 homes across the Navajo Nation. A workflow was developed to utilize the NHA's imagery and topographical data which included over 3,225 DEM's and 37 ECW files. URS was asked by the NHA to develop several 3D fly-through educational videos displaying identified flood hazards over this model to show impacts on housing projects.

Data was developed by multiple teams in multiple states using industry standard GIS applications. The data was then integrated into InfraWorks to develop the final product. The project team had originally intended to use 3D Studio Max but transitioned to InfraWorks given its ability to auto project and symbolize the GIS data in 3D. Interoperability was critical in utilizing style rules. This project was a huge success because of the ability of InfraWorks to integrate with native GIS data.

Learning Objectives

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

- Understand the challenges of big data
- Utilize styles and style rules to symbolize GIS data
- Gain a better ability to communicate with GIS staff regarding data needs
- Learn how to use custom projections in InfraWorks

About the Speaker

David first discovered AutoCAD Version 9 in 1987 at the age of 13 when looking for a better way to learn geometry. As the third generation in his family to work in civil design, he has had opportunities to draft by hand and work as a rodman for his father, a licensed surveyor and P.E. Championing more efficient ways to design and communicate complicated design concepts, David has worked for URS Corporation for the past 18 years. He currently serves as leader of the Design Visualization/Multimedia Team in the URS Phoenix office. He is proficient with most products from Autodesk, ESRI, and Adobe, in addition to others. His team has created visual simulations and multimedia products on behalf of Fortune 500 companies and international corporations for presentations to federal, state, and local agencies throughout Alaska, Canada, Mexico, and the western United States.

Contents

Understand the Challenges of Big Data

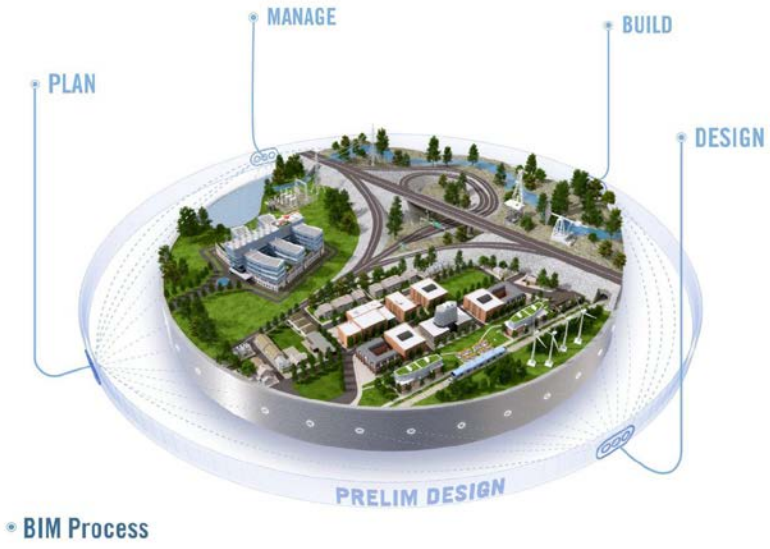
What is BIG Data?

Big data is an simply an all-encompassing term for any collection of data sets so large and complex that it becomes difficult to process using traditional data processing applications.Big data is difficult to work with using most relational database management systems and desktop statistics and visualization packages. Challenges include analysis, capture, curation, search, sharing, storage, transfer, and visualization.

What is considered "big data" varies depending on the capabilities of the organization managing the set, and on the capabilities of the applications that are traditionally used to process and analyze the data set in its domain. Big data is a moving target and what is considered "Big" today will not be so years from now. For some organizations, facing hundreds of gigabytes of data for the first time may trigger a need to reconsider data management options. For others, it may take tens or hundreds of terabytes before data size becomes a significant consideration.

Why Should We Use that Much Data?

Binding Information Management (BIM) is not a software product but a process and a principle that includes looking at all aspects of a project from field to finish by constantly improving the project performance from an understanding that only comes from looking at a project as a whole.



How Much Data are We Talking About?

Prepare to hear and see this often so that you know how you can bribe your IT department.

The project reviewed today covered over 27,500 square miles of land. The terrain consisted of separate surface grids or ADF files that required 6 files to make one of the 3,229 surface grids to cover the project area.

Name	Size	Type	Date modified
dblbnd.adf	1 KB	ADF File	4/23/2012 11:20 AM
hdr.adf	1 KB	ADF File	4/23/2012 11:20 AM
metadata.xml	4 KB	XML Document	4/23/2012 11:20 AM
sta.adf	1 KB	ADF File	4/23/2012 11:20 AM
w001001.adf	1,921 KB	ADF File	4/23/2012 11:20 AM
w001001x.adf	3 KB	ADF File	4/23/2012 11:20 AM

The DEM directory for this project consists of:

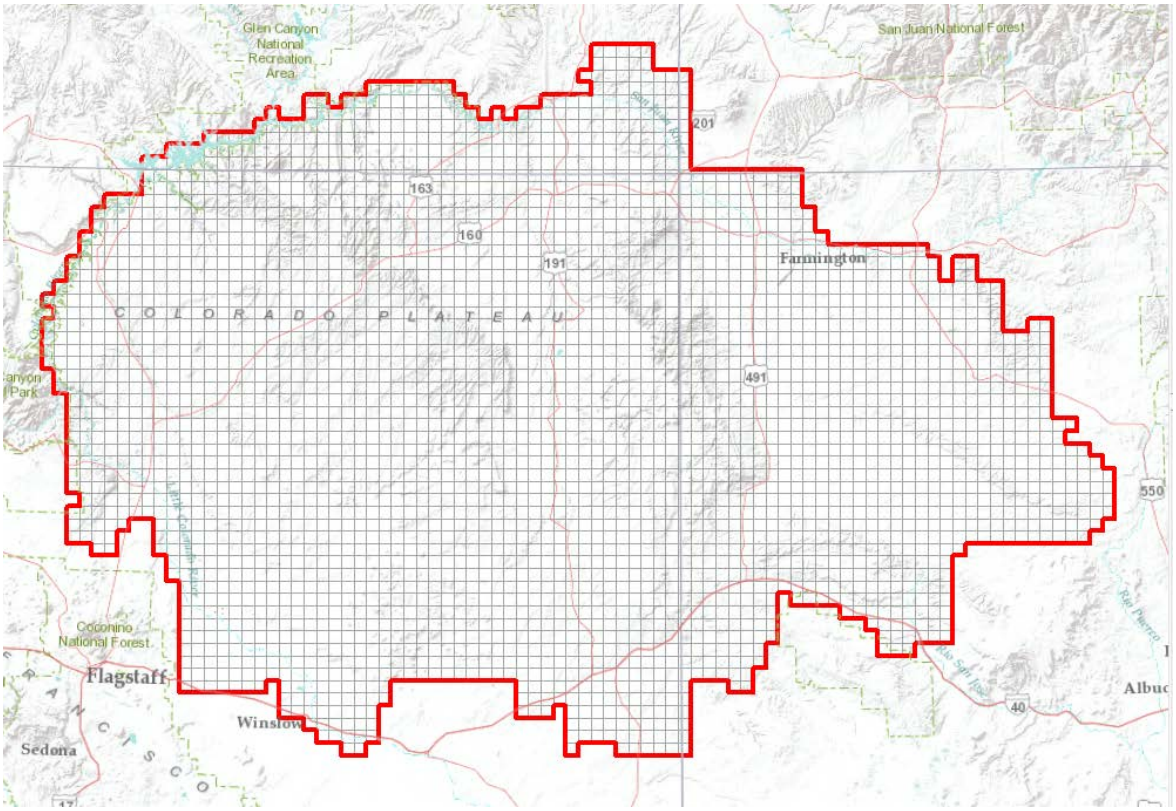
Size:	46.7 GB (50,160,097,564 bytes)
Size on disk:	46.8 GB (50,291,261,440 bytes)
Contains:	41,262 Files, 3,272 Folders

The aerial imagery directory consisted of 3,272 tiff images, and 37 ECW files totaling over 3TB.

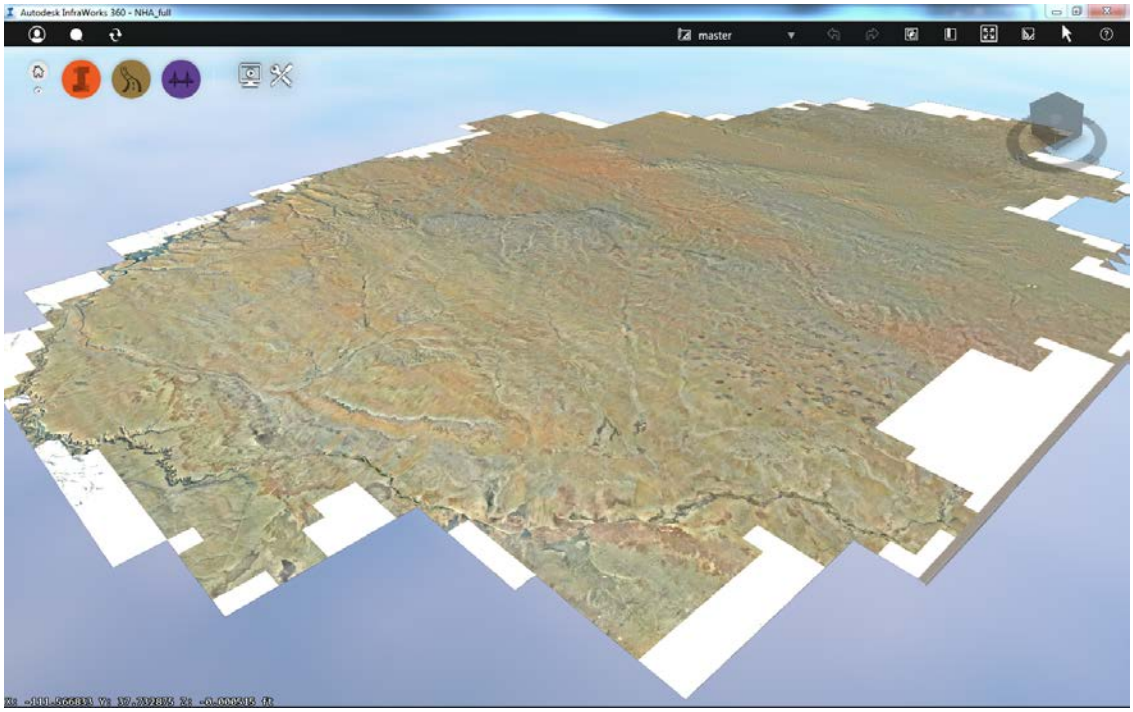
When I started building this model I was very concerned with the sizeable amount of data, but when I relieved that it was only 46.8GB. As I attempted to process the data it became very clear that the problem was not the file size of data, but the number of files.

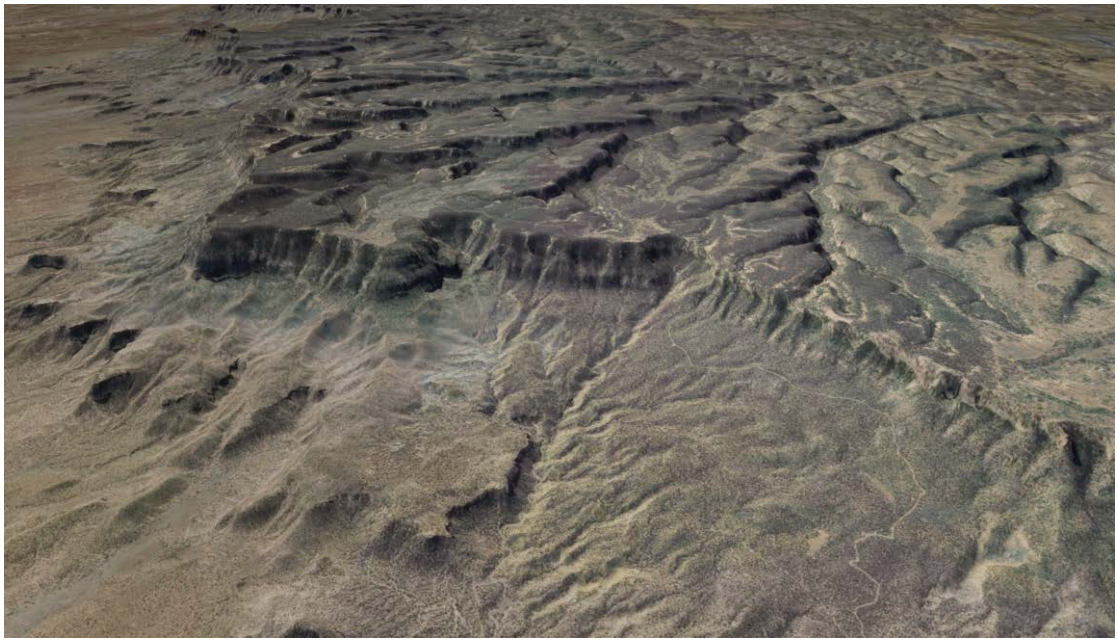
Take a second to think about the largest surface files you have imported into InfraWorks, and then multiply that 3,272 times. This was not going to work.

Working with our GIS team over a few days, the individual tiles were combined into a single master raster dataset.



The Navajo Housing Authority (NHA) Project Area -
Navajo Nation boundary is shown in red with the grid tiles shown

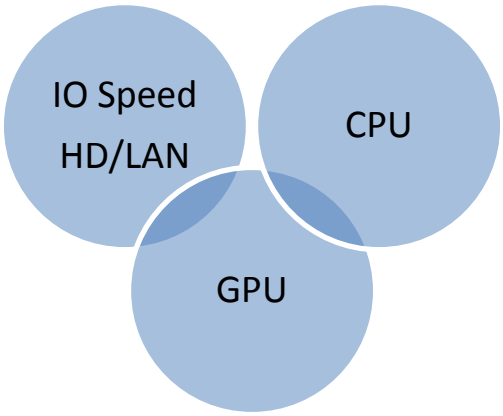




This is how the final surface and imagery looked like after importing data into InfraWorks. This process worked well but not perfectly. After each export our workstations would lock up. More memory was needed and a rebooting was required after each render to clear the cache. We found that this was a hardware limitation and not software as we first had thought.

Can Your Hardware Handle This?

Approach a 3D workstation holistically much like any project; the workstation is only as fast as its slowest part. Balance the hard drives CPU and your Graphics card (GPU) and get as much memory as possible. And don't even think about trying to use a 32-bit workstation.



Workstations

I utilized several workstations throughout the project. At the start of the project I worked on a laptop which did a good job but I started to see limitations from the mobile video card.

- HP Elite book 8760W Laptop, Quad i7, 16GB ram, Mobile Quadra, 7,200 rpm 500GB drive

It sufficed, but when rendering or trying to fly around in the model, the video card was too slow. I then upgraded to a workstation:

- HP Z400 Workstation Intel Xeon 3.06GHz, 16GB ram, NVidia Quadra 4000, 500GB 7200 rpm drive

The HP workstation was more responsive, but still not fast enough for the project sizes we were developing. After much discussion with our Autodesk representatives and focusing on hard drive read/write speeds and testing different computer systems, we decided on these workstations:

- BOXX 4920 XTREME, Intel i7 Six Core Enhanced Performance Processor (4.5 Ghz) 32GB DDR3 1600 (4 DIMMS) NVIDIA Quadro K5000 4GB, 480GB SSD SATA, 6Gb/s 2 x 240GB Raid 0 SSD SATA 6Gb/s

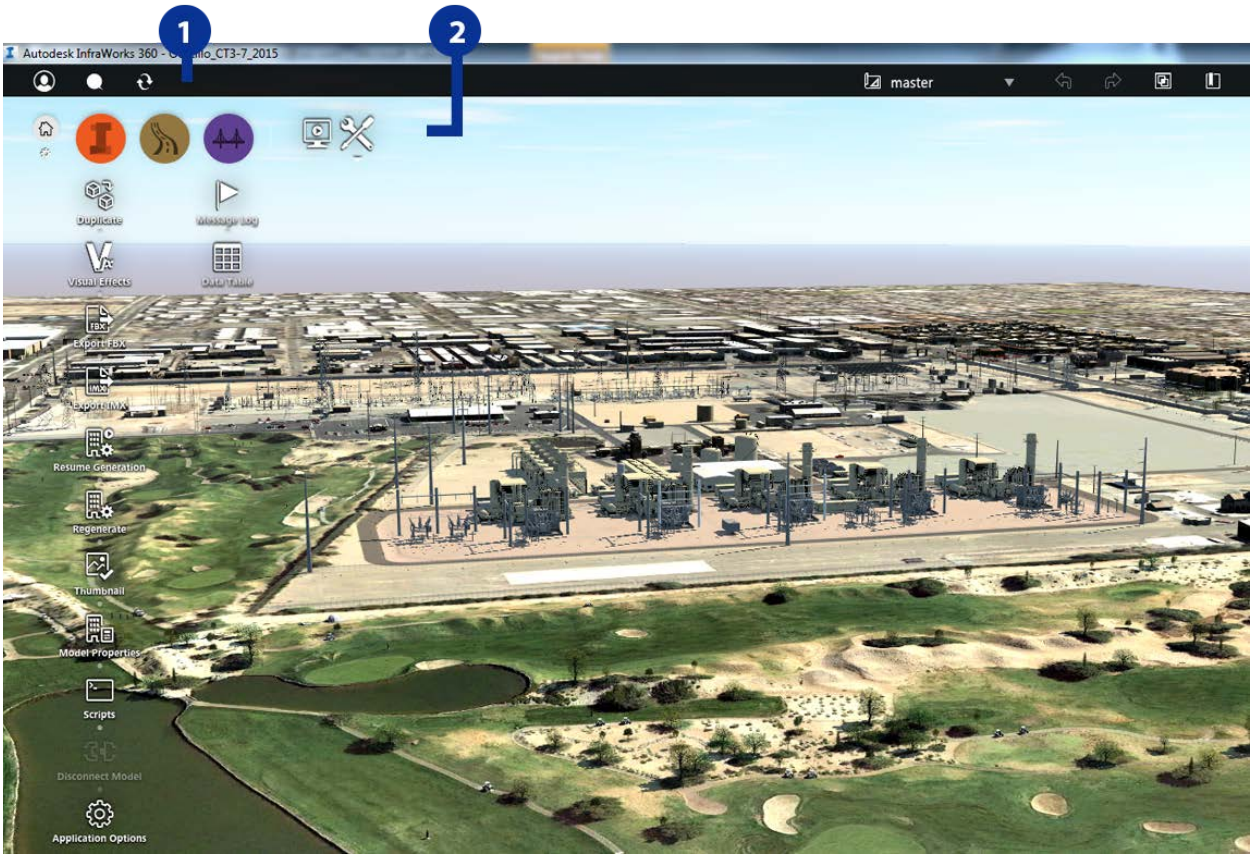
BOXX
THE PROFESSIONAL'S CHOICE

Our current workstations may seem a bit extreme for your situation but with projects this size in InfraWorks, you might need it. Our team uses a wide range of products including Civil 3D, 3D Studio Max Design, Recap, ArcMap, Inroads, Adobe After effects, Photoshop and Premiere.

Importing GIS Data Sources Into Autodesk InfraWorks

Basics of the InfraWorks Interface

This section of the handout is to help familiarize you with the interface and importing GIS data and is similar to the same section in the handout for the other class I am teaching this week CV6703-P GIS Interoperability with BIG data in InfraWorks.



The Utility Bar

- Autodesk 360 Utilities: Sign in so you can share models and proposals using the Cloud. Use Design Feed to include comments with your models, proposals, and published scenarios. Sync to get the changes made by others and to share your changes with others.
- General tools you will use across all phases of your work.

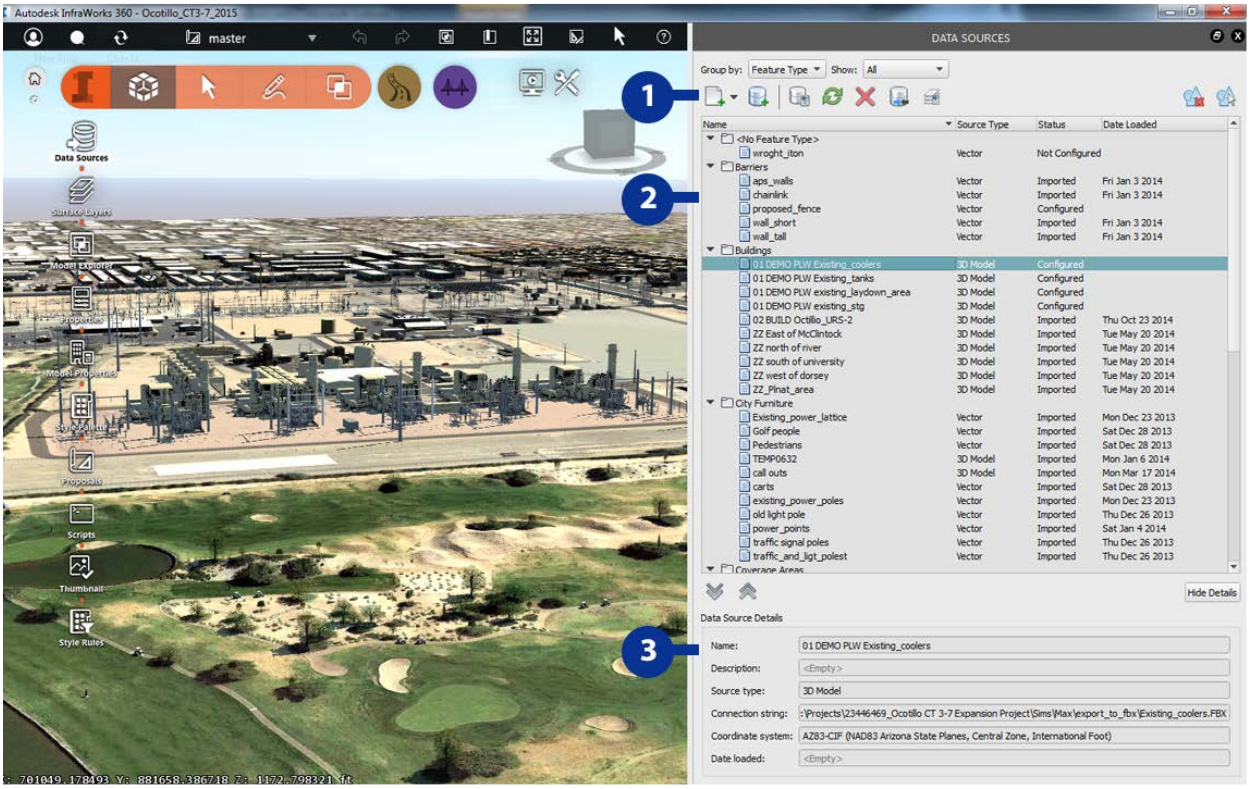
Intelligent Tools

- Tools Grouped by Design task. Basic Design, Roadway Design, Bridge Design, Presentation, and Utilities. Also available but not shown Drainage Design Module.
- Most of your work will be starting in this utility bar.

Data Sources

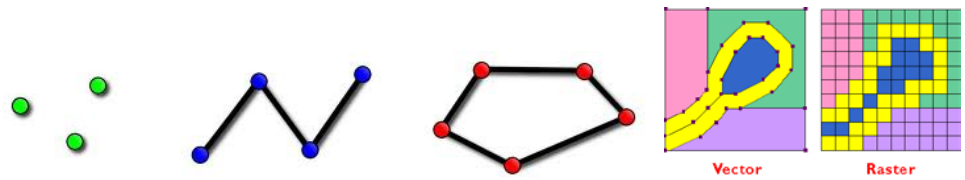
Data import menu is located in the “create and manage” tab in the intelligent tools inside the big orange “I”. Select the Data Sources button to open the Data Sources Panel. There are 3 main sections of this panel that will be used when working all data, and you will need to be familiar with it to import GIS and Civil 3D data.

1. Tool Strip
2. Data Sources List
3. Data Details



Components of GIS Data

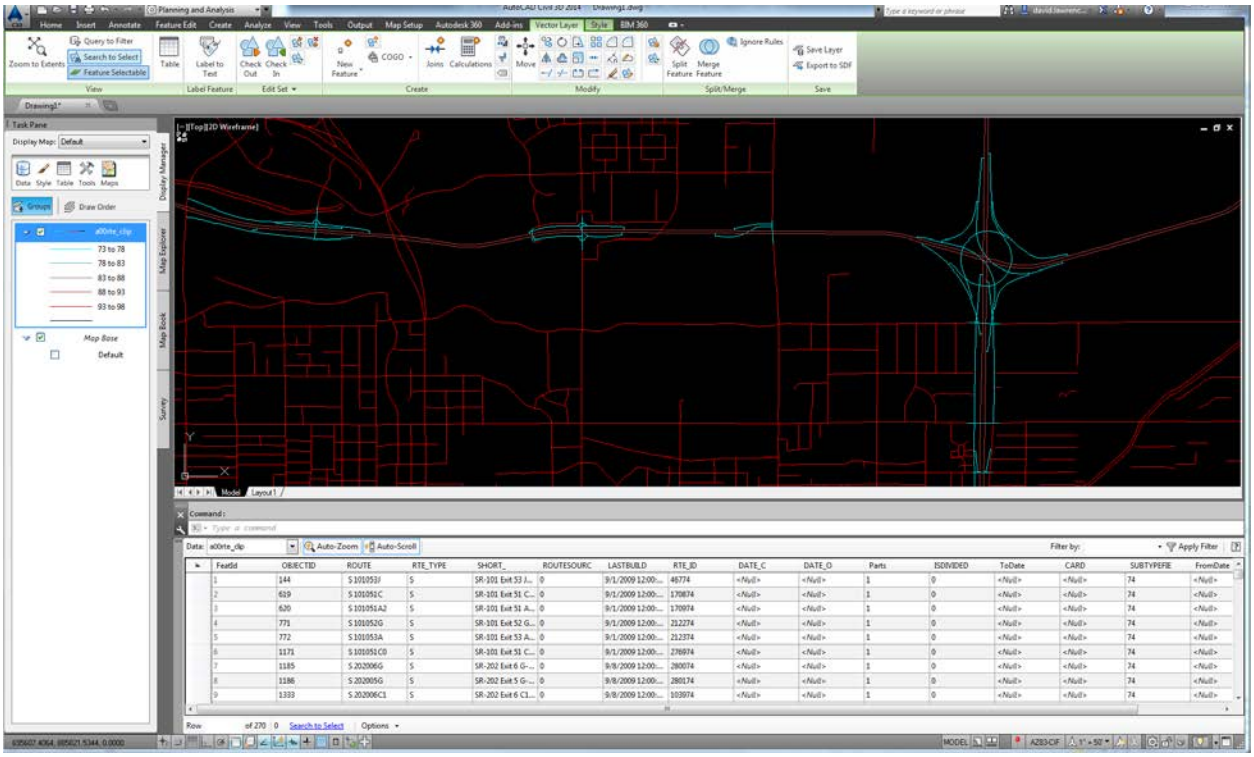
Now that you are familiar with the interface we need to discuss the basics of GIS data. GIS is typically divided into a few classifications: points, lines, polygons, and raster.



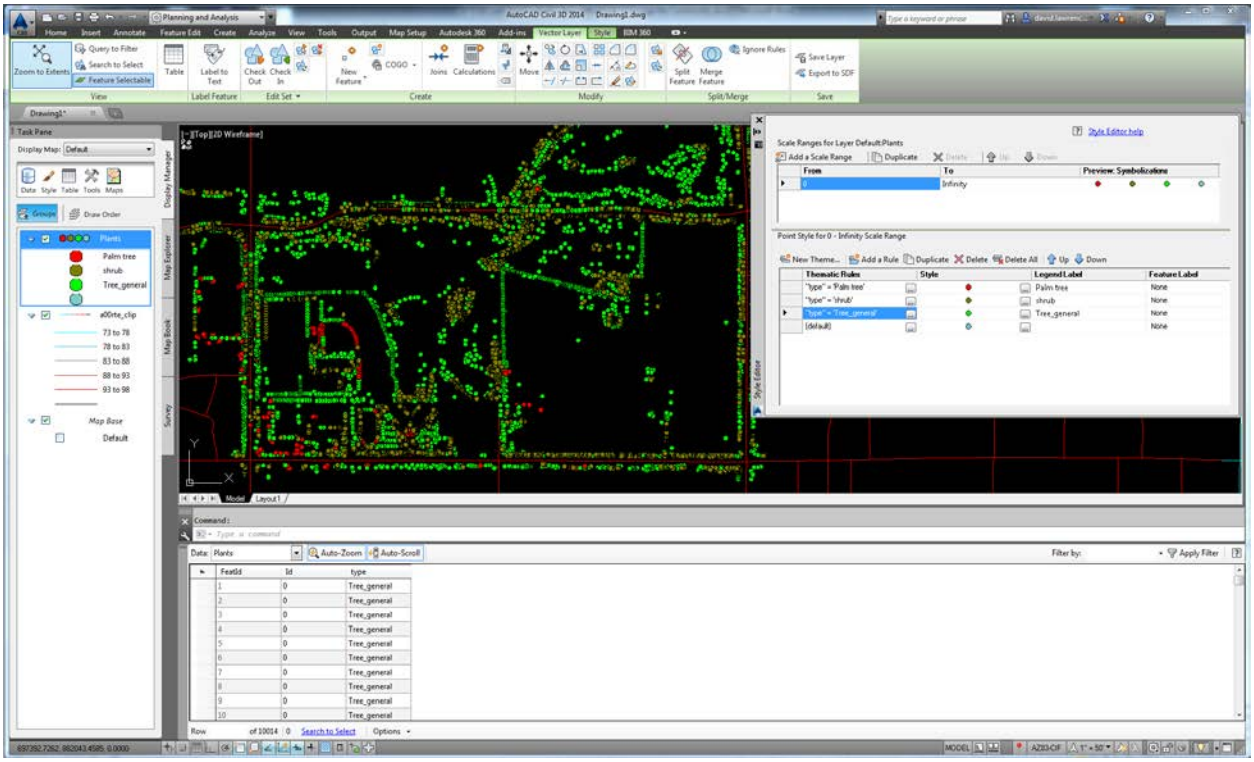
Attributes

More important than the spatial data is the attributed data that is contained in the data fields. The image below shows a very simplistic version of data and the associated data.

Now let's look at a bit more complex data set in Map 3D.

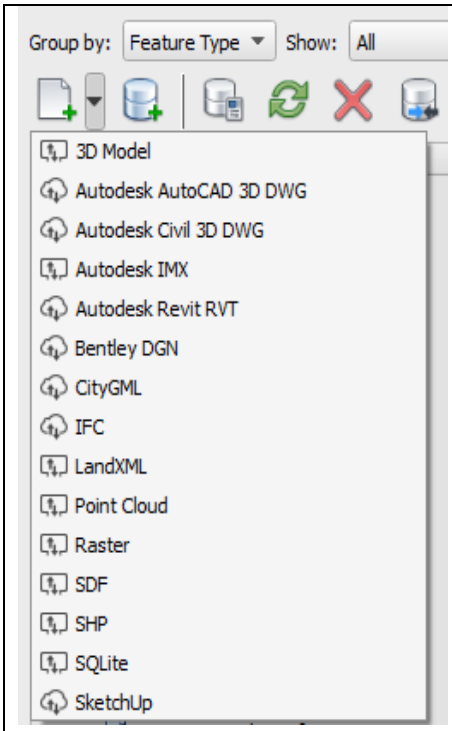


This is a roadway dataset from the Tempe, Arizona area near this project. Each line segment has multiple data attributes including Route type (RTE_TYPE) and subtype (SUBTYPEFIELD) as well as the route name that can be used to query, sort, and symbolize data. As you can see above, the highways are shown in pink, and bridges and ramps are shown in cyan.



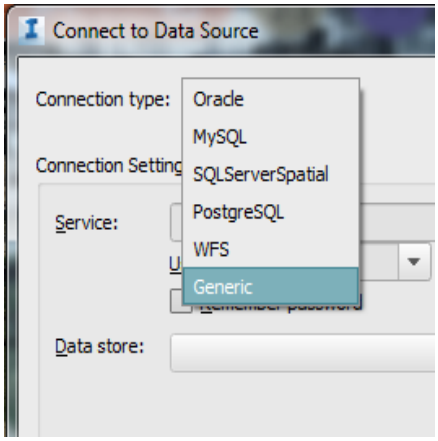
Here is a second smaller dataset for landscape. This table was originally created specifically for a generic visualization so plants were only divided in three groups: palms, trees, and shrubs. All other plant variations were generated using style rules that we will discuss later in this handout.

Add File Data Source and Add Database Data Source

	The Add File Data Source button will allow you to connect to file sources

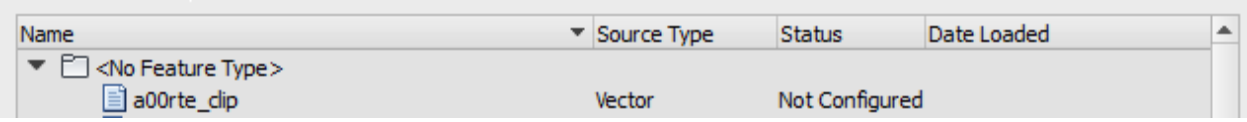
OSGeo.SDF.3.9
OSGeo.SHP.3.9
OSGeo.ArcSDE.3.9
OSGeo.WFS.3.9
OSGeo.MySQL.3.9
OSGeo.PostgreSQL.3.9
OSGeo.OGR.3.9
OSGeo.SQLite.3.9
OSGeo.SQLServerSpatial.3.9
Autodesk.Oracle.3.9
Autodesk.DesignService.3.9
OGR: ESRI Shapefile
OGR: MapInfo File
OGR: UK .NTF
OGR: SDTS
OGR: TIGER
OGR: S57
OGR: VRT
OGR: REC
OGR: Memory
OGR: BNA
OGR: CSV
OGR: NAS
OGR: GML
OGR: GPX
OGR: KML
OGR: GeoJSON
OGR: Interlis 1
OGR: Interlis 2
OGR: GMT
OGR: ODBC
OGR: PGeo
OGR: MSSQLSpatial
OGR: PCIDSK
OGR: XPlane
OGR: AVCBin
OGR: AVCE00

The add Database Data source will provide you with an additional dialog that provides additional abilities. The list of formats is constantly growing.



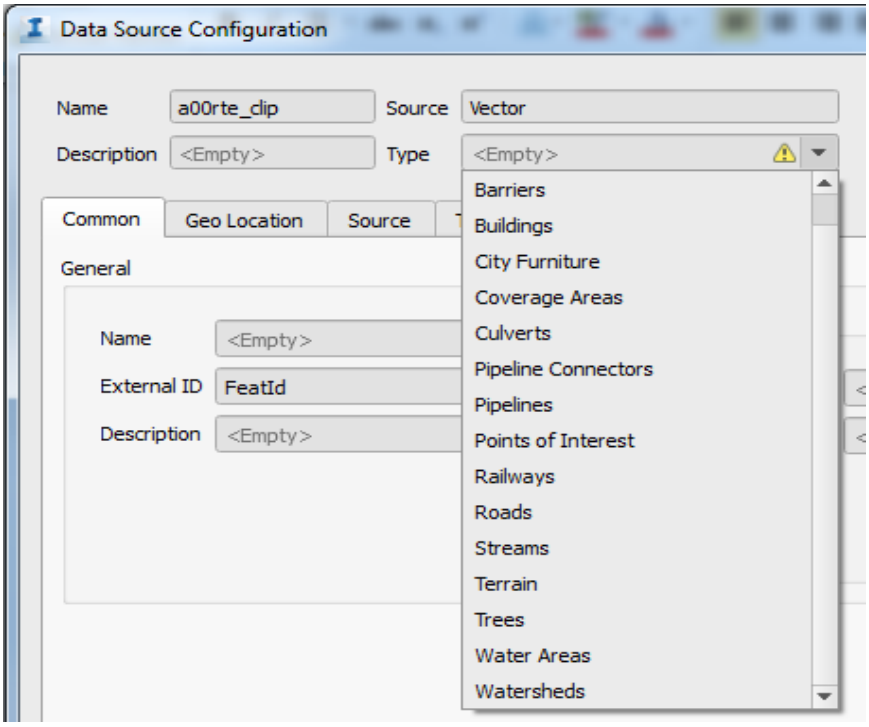
Importing a SHP File

Return to the Data Sources panel and click the File Data Source .
Select SHP.
Select your file.

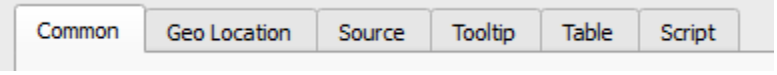


Configuring Your Data

You will notice that the status is not configured; double click on the Data Source or right click and select configure.

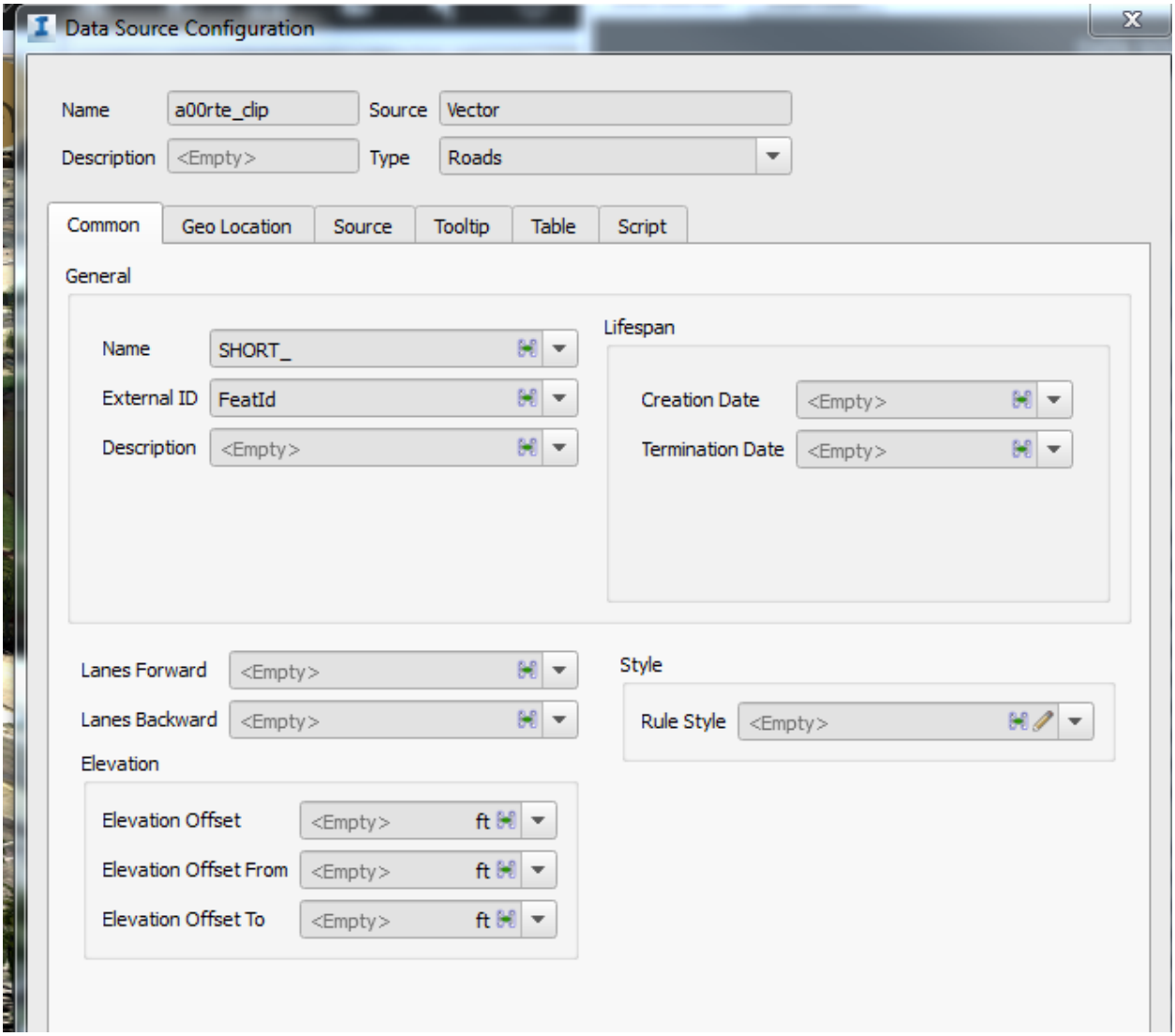


Select how you would like to symbolize the data with the type drop down. By selecting the data type, roads, buildings, pipelines, this selection will configure many of the other menus to help you stylize your data and configurations options. For this example the dataset is a roadway shape file.

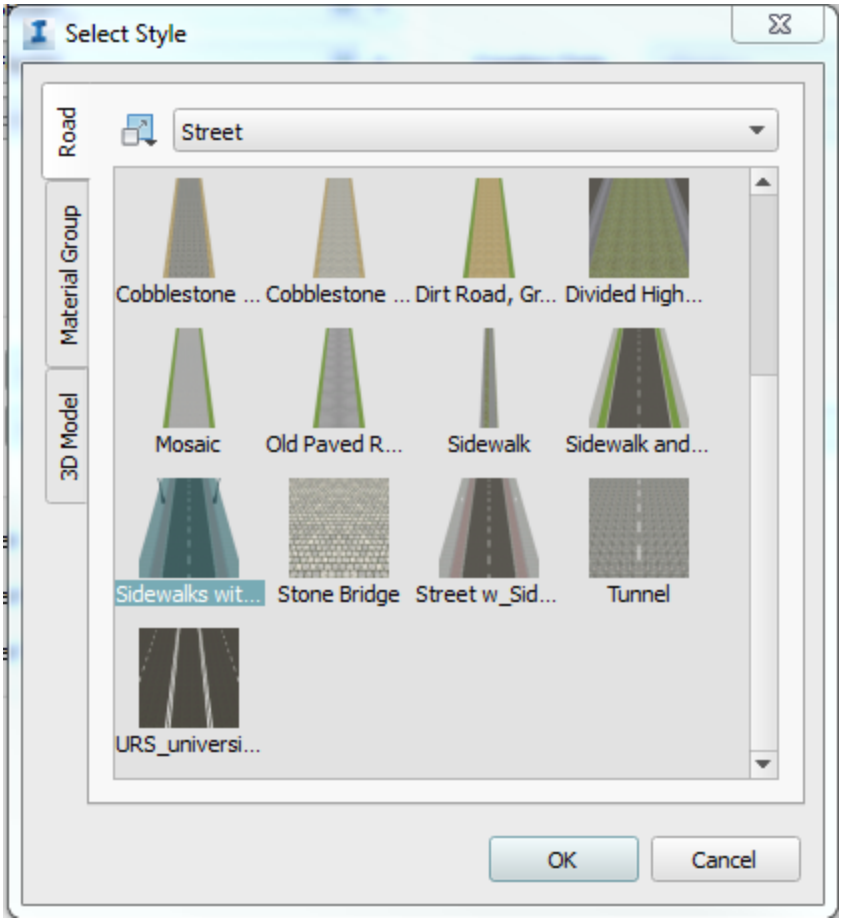


You will notice a set of tabs that allow you to access different tools to stylize the data.

Now the data fields will have options available. Data fields will have a  for each field which provides you access to the attribute data. If you select the drop down you will be able to select the attribute fields. In my dataset the name of the roadway is (SHORT_) so by selecting this field each piece of geometry will be named based on the corresponding GIS attribute.

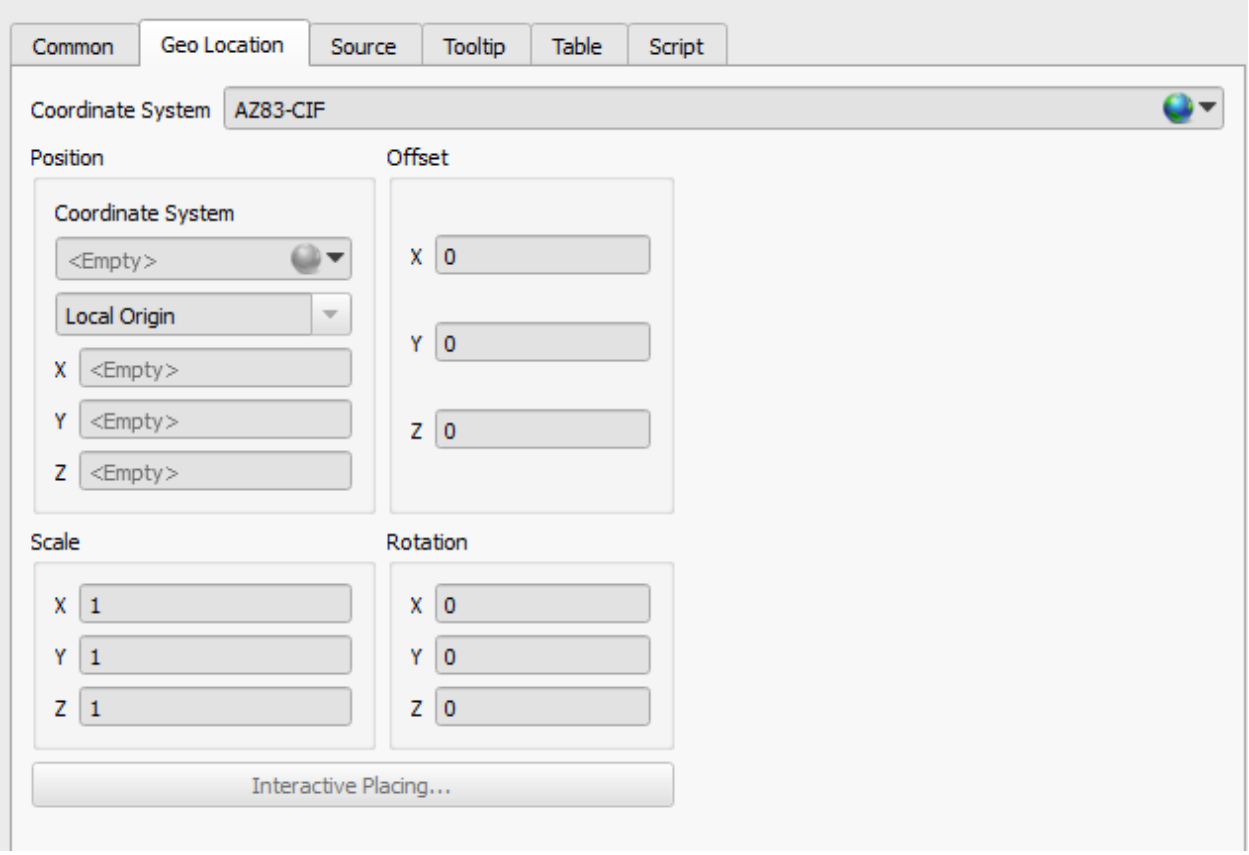


Do not forget to style your data. When you select the pencil you can set the style of the incoming data.



Geo Location

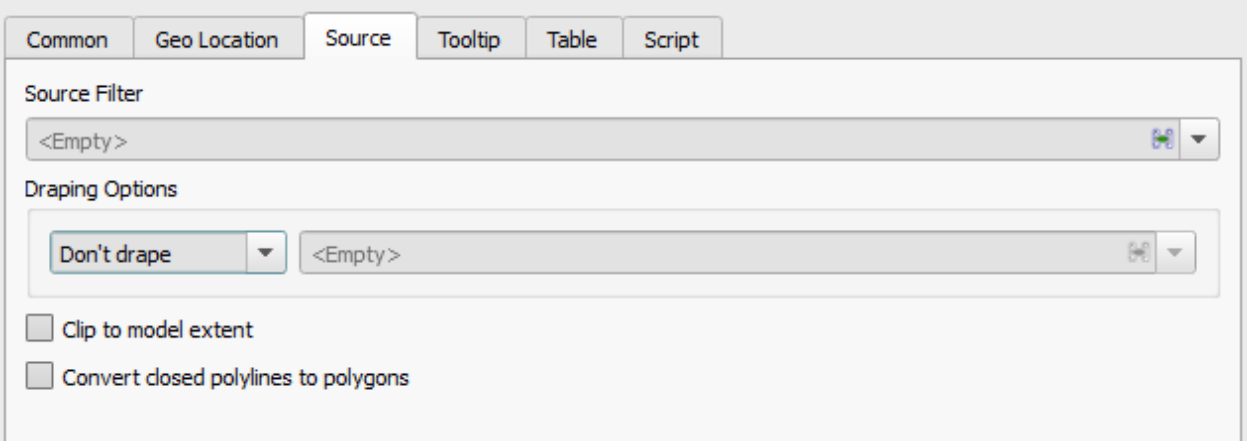
If your data has a PRJ file or a defined projection that is associated with it, InfraWorks will auto populate the coordinate system. My project contains data in NAD83 Arizona State plane central international feet.



If your data does not have a projection or it is using a projection that is not defined in Map 3D or Civil 3D, the coordinate system will show an error. Then you can choose to interactively place the data or manually choose a projection.

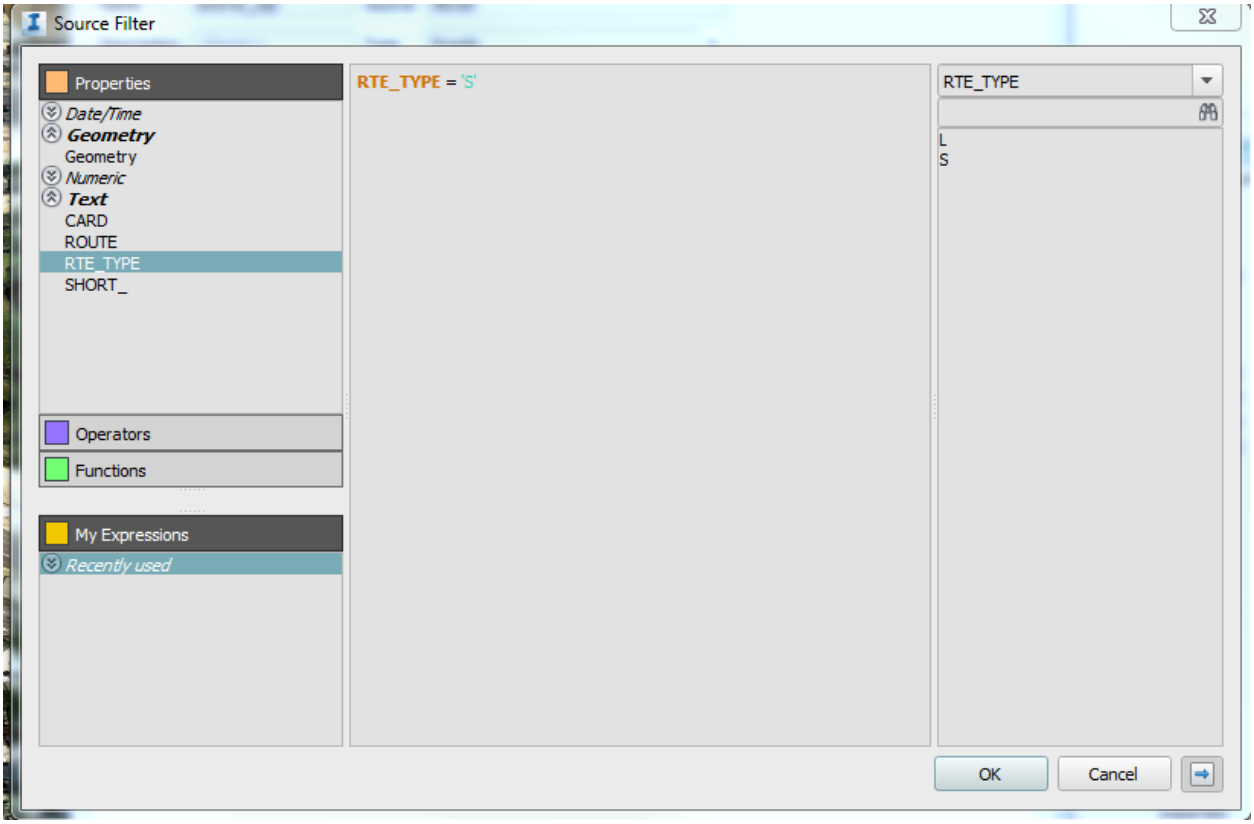
Source

This tab allows you to specify the data you want to load and if you would like to drape it to the loaded surface data.



In the source filter item, leave the field blank for all data or set a filter to only load some data. To filter the data select the  .

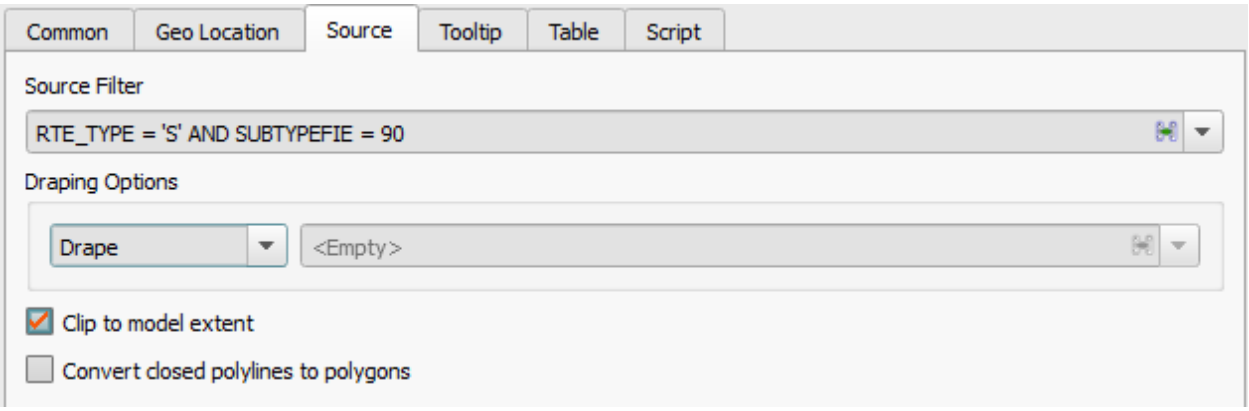
To show only highway data we need to create a filter. In my data the “RTE_TYPE” field is equal to “S” and the line work is associated with a highway. To only show this data, open the spatial filter and select text on the left.



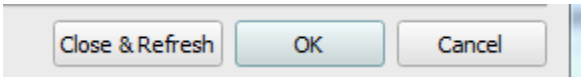
Double click the field on which you want to set a query. In this case it is “RTE_TYPE” and you will see it added to the middle window. We want only the data that is equal to “S”, so type in “a =” in the window or you can choose operators, then math, then “=”. I prefer to just type it. On the right side of the window, select RTE_TYPE in the drop down menu. It will then show you all the options available in that field. In this case we only have two values. The final query looks like this: RTE_TYPE = 'S'

If we would like to further refine the filter to only show mainlines and not ramps we can set a complex filter: RTE_TYPE = 'S' AND SUBTYPEFIE = 90. This will load only data that has a route type of “S” or highways and a subtype of “90” or the mainline. Because my data does not have elevation values, I will set it to drape to the ground.

This is what my source tab looks like when I am done.



Don’t forget to close and refresh.

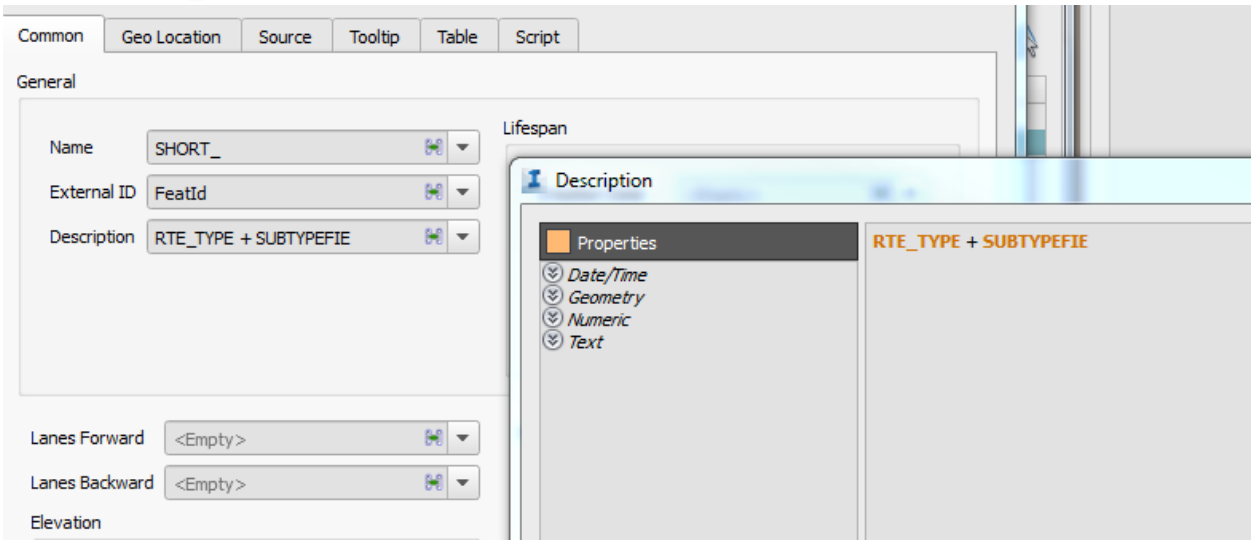


Your model will regenerate and your data will now be visible in your window.

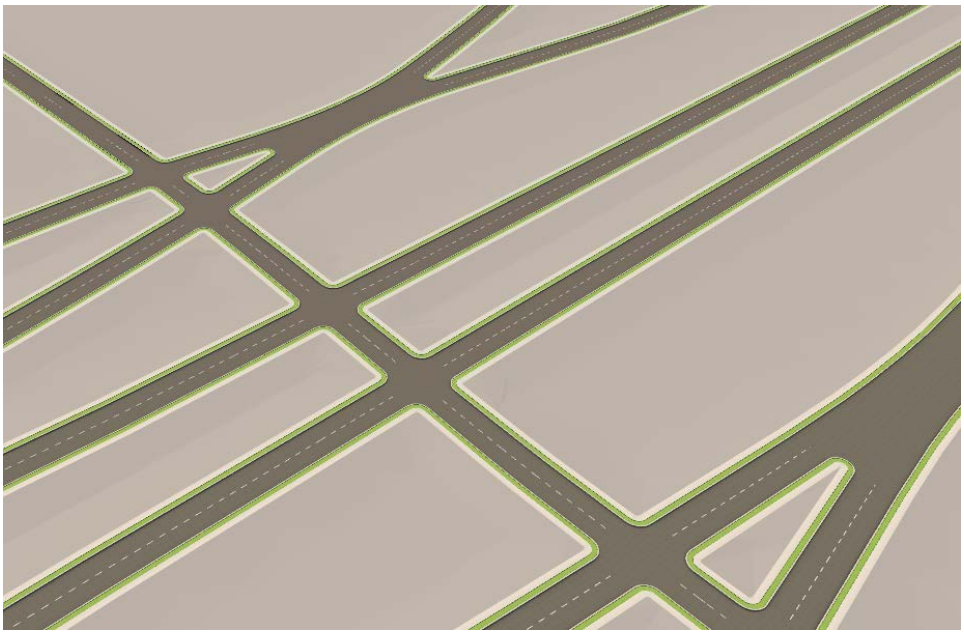
Style Rules Panel

Each of the fields in the data configuration pallet can be accessed to run style rules to style your data based on attributes.

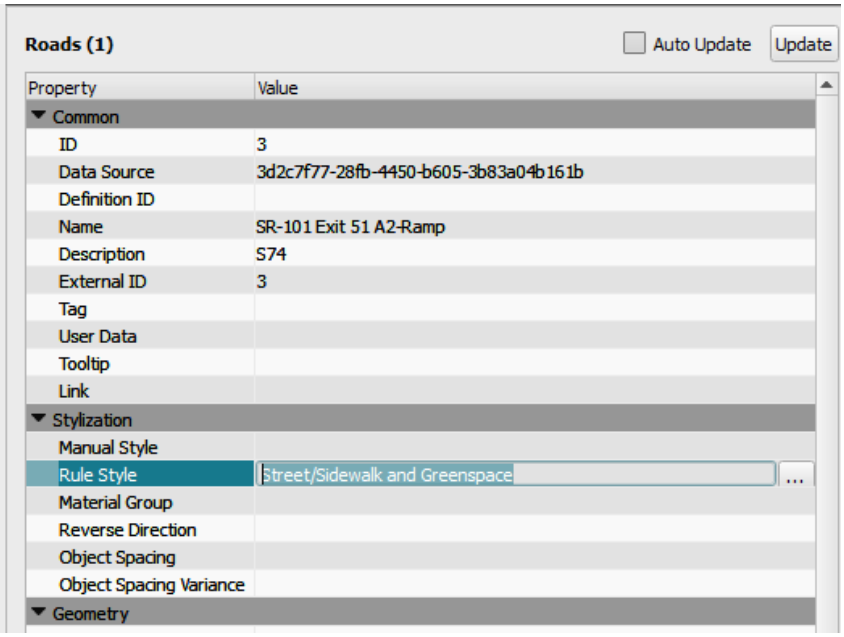
In this example instead of using a source filter as shown above, I will use style rules to symbolize the data. I removed the source filter so I am loading in all data in the file. In the file configuration window, I have selected the **description** field and created a query that combines the fields RTE_TYPE + SUBTYPEFIE.



I set the style for the layer to “Street/Sidewalk and Greenspace” so data imports as shown below. All the roads remained the same.



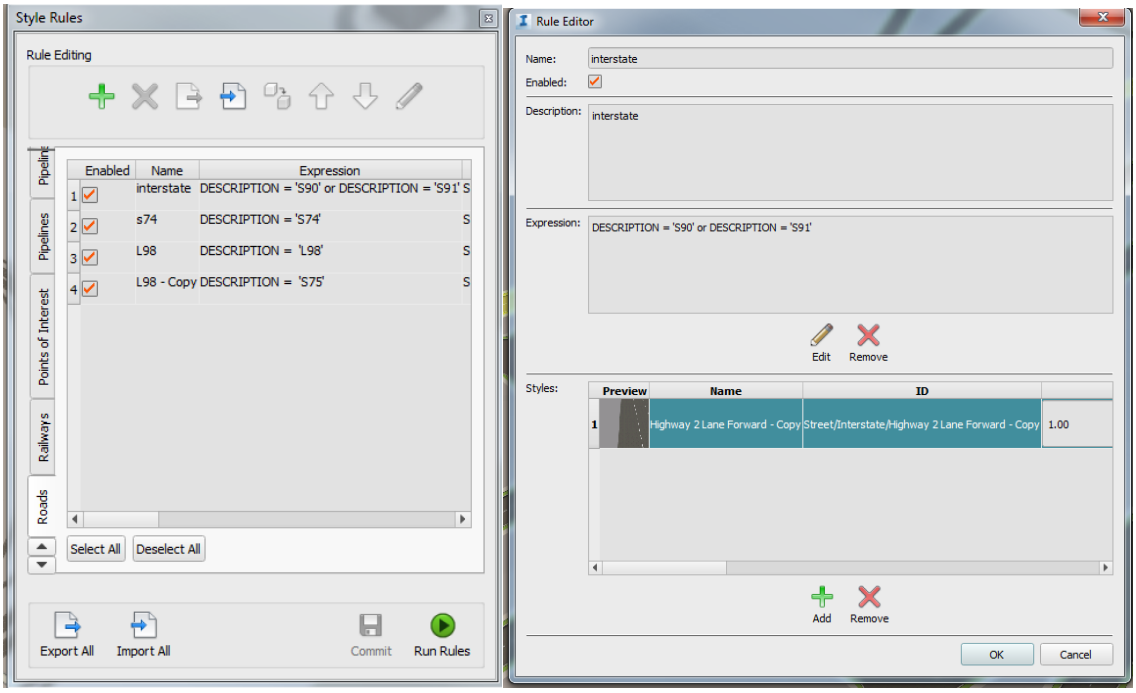
You can see the properties of each line by right clicking, and choosing the properties menu. You will see the description is “S74” (the two values combined) and the name is “SR-101 Exit 51 A2-Ramp”.



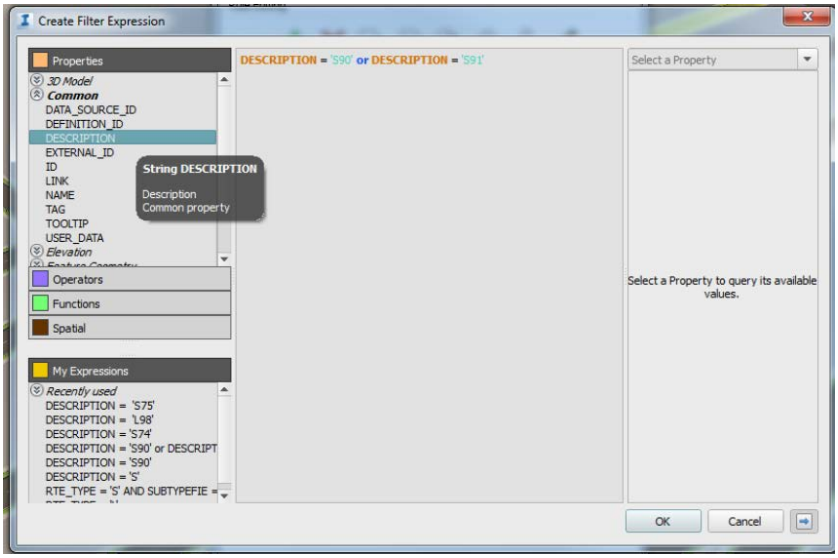
Next Open the Style Panel

For this we will be working the roads tab on the side. Each data type has its own tab for rules and the rules are data type specific. To add new rules to the file select the green plus. Then provide a name for the rule. This will then open the rule editor.

Each rule needs a name, description, expression, and style.



To define an expression you must have data imported first. For this style rule I want to symbolize all roads with a route type of “S” and the subcategory of 90 and 91.



To generate this expression, double-click the description field on the left, pick the operator (in this case it is “=”) and select the values from the description field from the right side. The final query should look like this DESCRIPTION = 'S90' or DESCRIPTION = 'S91'. The expression is set. Goback to the styles portion of the editor add a style for your data. For this example, I chose the highway 2 lane forward style. Click on “ok” and run the style. Below you can see that the style was added only to the interstate. Additional styles can be added for each of the styles you would like in your model. The data below does not have elevation data included,

overlapping roadways are displayed incorrectly because this software does not know what roadway to draw on top.

Gain a Better Ability to Communicate with GIS Staff Regarding Data Needs

Know the Language, Become Bilingual

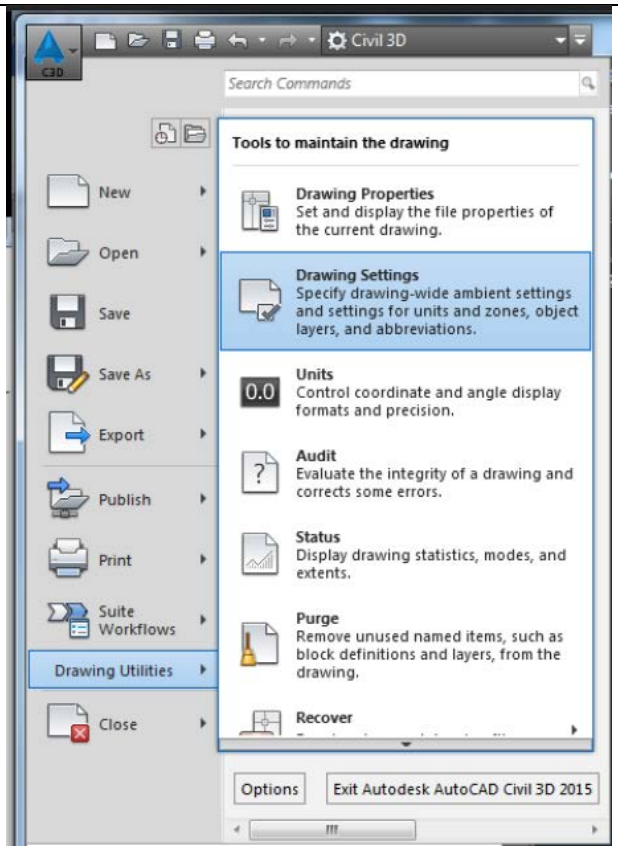
Each software and industry has its own language for the same processes and data types. If you feel that your GIS staff is speaking a different language, don't be embarrassed to ask questions. Just be careful, you might get a longer response than expected. Many of us that work with geospatial data are geeks and get excited that someone has taken interest in how we develop our products.

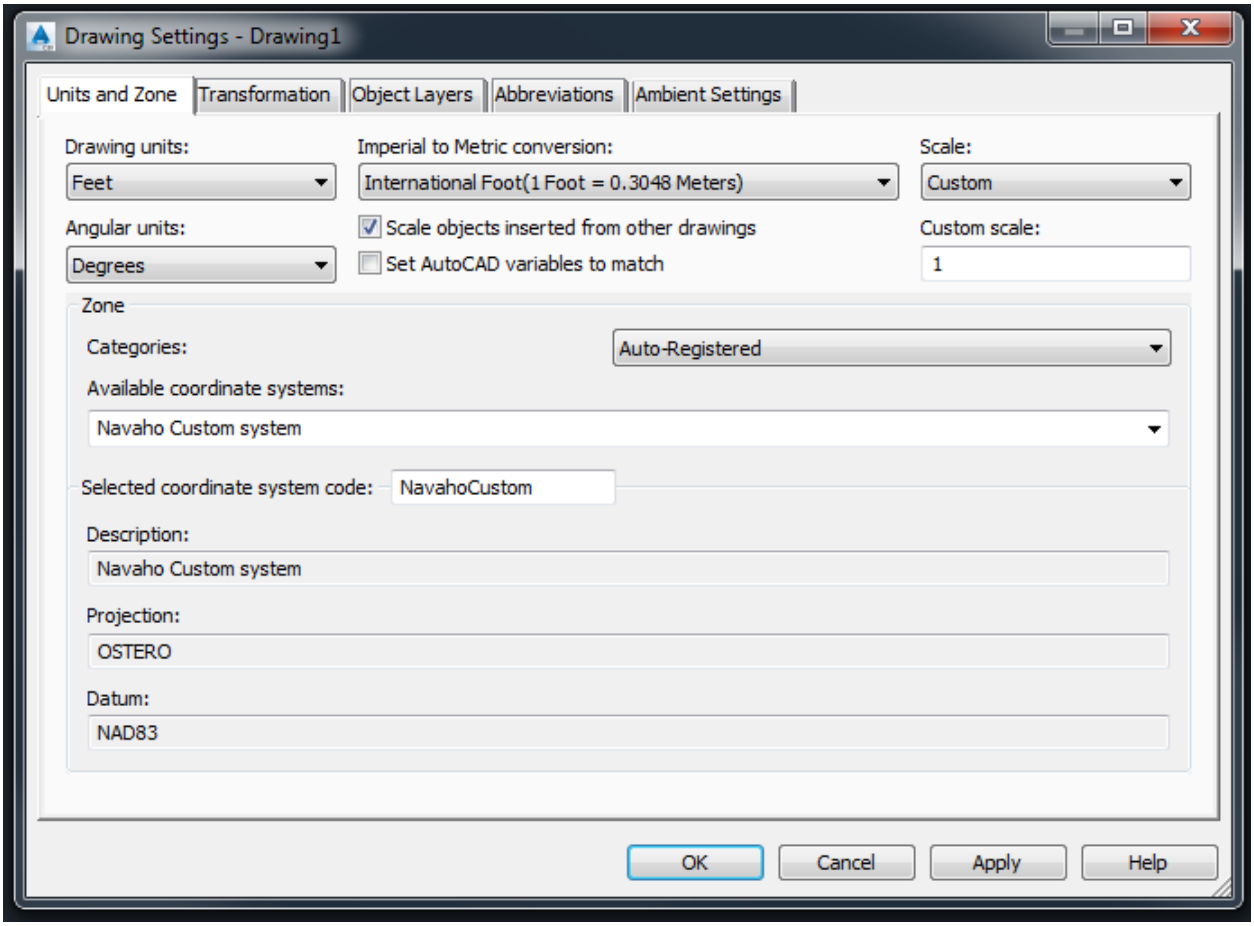
Don't Assume you Know All the Answers

I am often approached with data requests asking for a specific piece of data in a very specific format. This often sets off alarms in my head. This person was told by someone else what to ask for or they have been completing tasks the same way for years and do not want to change their process. This is dangerous if you are the person requesting the data and have not talked to the end user of the data. There may be better processes of transferring data and more efficient formats than you are aware of. You could just possibly link the same data so that as the GIS data changes you only have to reload it, as we did on this project.

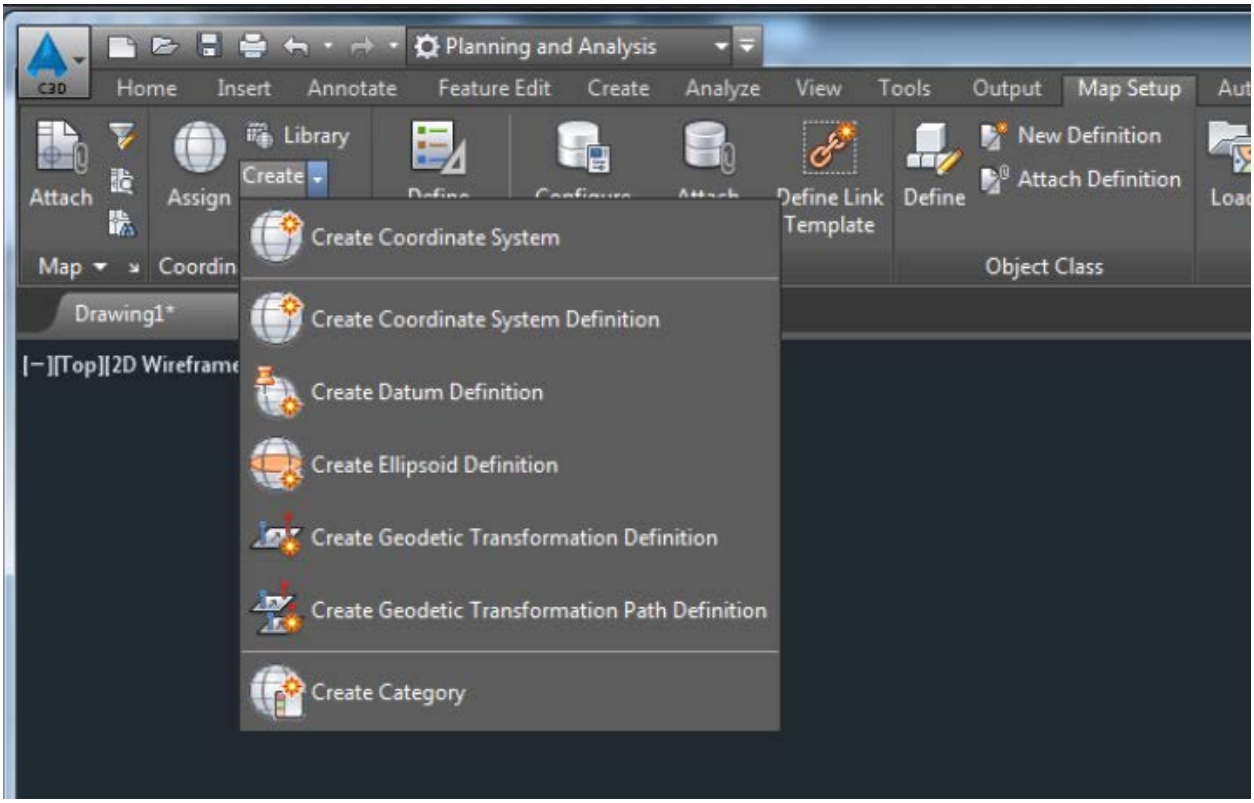
Learn How to Use Custom Projections in InfraWorks

Projections are Controlled Locally in Map 3D/Civil 3D

Projections are assigned in Civil 3D/Map 3D in the Drawings settings menu	



Projection definitions are created in the planning and analysis workspace located in the map setup ribbon of the coordinate systems section.



Transferring Between Workstations

The simplest way to transfer projections between workstations is to save a DWG file with your custom projection defined. When that file is opened on a different workstation without the projection in its library, saving a blank DWG in the project folder with the projection saves time importing projections to a new workstation.

Setting Projections in InfraWorks.

Once you have a projection set in Civil 3D/Map 3D, projections will automatically be converted in InfraWorks.