CI11073

CIM Workflow with Scan Data

Paul c. Kirkendall
MasterGraphics, Inc.

Kelly John Kaepernick, CM-BIM
MasterGraphics, Inc.

Learning Objectives

- Learn how to capitalize on scan data to validate existing conditions
- Learn how to register, geolocate, and evaluate scan data
- Learn how to import point cloud (scan data) into InfraWorks for further evaluation and proposed design creation
- Learn how to import an InfraWorks model into AutoCAD Civil 3D for further design

Description

In this class you will learn how to capitalize on scan data collected from a scanner to help validate existing-conditions data and provide the basis for your design process. Incorporating scan technology and total station, see how the raw scan data is registered in ReCap software utilizing geolocation control points from the field. We will then evaluate the data and prep it to be passed up to InfraWorks 360 software for further analysis, such as placement of roads, bridges, and surfaces. After completing the analysis, see how you can extract actual design data from the InfraWorks software model to further the design process within AutoCAD Civil 3D software. Finally, see how designers and engineers can begin to capitalize on this data for surfaces, alignments and site planning.

Your AU Experts

***Paul Kirkendall** is an application engineer for MasterGraphics, providing consulting, training, and support for a variety of infrastructure clients. Paul has put together multiple online training videos for WisDOT and Global eTraining. He has presented at the Wisconsin Society of Land Surveyors conference, and Autodesk University 2013 and 2014. Prior to joining MasterGraphics, Paul gained valuable knowledge and experience working with popular Autodesk, Inc., civil design and mapping software. His duties included installation and implementation, creation of company standards, training of staff, and extensive infrastructure design and planning. During this time, Paul also worked closely with surveying departments. He came to understand the interaction of workflow and data collection across projects. Paul is an Autodesk Approved trainer, Autodesk Civil 3D Certified Professional, Autodesk Certified BIM Specialist: Road and Highway Solution, and AutoCAD Certified Professional.*

***Kelly Kaepernick** is a BIM Solutions Consultant with MasterGraphics Inc. where he provides onsite BIM Solutions Consulting for some of the nation's top integrated architecture, engineering and planning firms. He has 20 years of experience in the AEC industry. 15 of which were with a fully integrated healthcare design/build organization. Kelly has supported BIM/VDC Technologies as they relate to Architectural Design, Interior Design, Construction Documentation, MEP and Structural Engineering, as well as Construction.*

Project outline

With project we are going to look at different scenarios for a particular intersection. The city has asked for preliminary design scenarios that will help the flow of traffic during peak hours. This intersection has a newly constructed bike path which includes a bridge that cannot be disturbed. We've decided to take a proof of concept scan of the surrounding area. We will bring it into InfraWorks 360 to layout the different scenerios. Utilizing the scan data, we can efficiently answer a few initial questions.

1. Will adding a lane in each direction conflict with the bridge?
    a. If not, how much space between the bridges abutments is there to add a lane in each direction?
2. Would a Roundabout provide the desired traffic flow?
    a. Is there enough space required for a Roundabout?
    b. If yes what size(s) would meet the current code requirements?

Once these questions are answered through visualizing each scenario in InfraWorks 360, we can take the data from InfraWorks 360 to Civil 3D and further the design. This workflow utilizes the existing conditions that we can easily capture and make use of instead of spending valuable time recreating. Saving time and money on projects is the ultimate goal. Previous methods start from scratch after the project is won.

3D Scan Data

Often referred to by the acronym LiDAR (light image detection and ranging). LiDAR is the umbrella term for detection technologies (aerial, mobile, terrestrial, etc.) that employ the principle of *radar* (pulsed electromagnetic waves) but instead using light, generally from a laser. 3D laser scanning is essentially the swift capture of three-dimensional information reflected from an object or surface to a light sensor. This creates a 3D construct commonly known as a "point cloud" made from multiple scans that have been unified through a process of "registration."

3D laser scanning accurately captures large sets of 3D coordinates. For example, it can detect pavement distresses such as potholes and large-area utility patches.

3D laser scanning is a supplement to, not a replacement for, existing surveying methods. A common method for establishing a control network (Helps link your scans together) is using a Total station.

Civil Engineers get a higher level of accuracy by capturing all data at once, instead of one point at a time. This allows them to focus on forms, the flow and the landscape, rather than simply capturing a large amount of geometry.

Scanning is the easy part. More difficult is the transition to BIM.

Benefits of Scanning

- Allows Designing "In Context"
- High resolution existing conditions
- Confirming as-built documentation
- Reducing time and/or need of physical site visits and inspection
- Assessing structural integrity of assets
- Monitoring and recording construction progress
- Facilitating better information management on projects
- Inspect building facades.
- Detect construction deficiencies and deformations.
- Create accurate as-builts.
- Monitor construction progress.
- Monitor bridge deformation over time.
- Create topographical maps.
- Measure distances, areas, and volumes.
- Map assets and check for clearance.
- Produce navigation models for construction planning and tie-in identification.
- Perform curb and gutter and field-to-finish work in the comfort of the office through virtual surveying.

Types of Scanning:

Phased Based:
Constant waves of varying length are projected, contact an object, and then reflected back to the scanner. The distance from the scanner to the object is accurately measured by measuring the phase shifts in the waves of infrared light.
Ideal Usage: Exterior high accuracy longer range scans (Architectural Reconstruction, Surveying, Engineering, Planning, and Forensics)

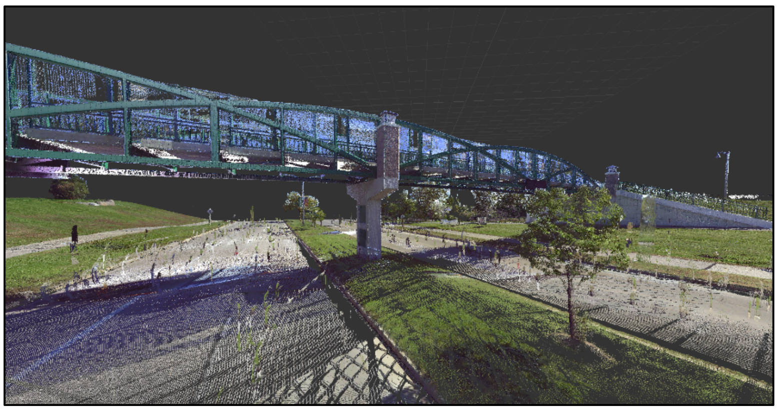

FIGURE 1: PHASED BASED SCAN

Time of Flight:
An active scanner that uses laser light to probe the subject(s) uses a time-of-flight “laser rangefinder”. The laser rangefinder finds the distance of a surface by timing the round-trip time of a pulse of light. A laser is used to emit a pulse of light and the amount of time before the reflected light is seen by a detector, is measured.
Ideal Usage: Interior high density high accuracy scans (MEP, Architectural, Structural, Facilities Management, and Forensics).

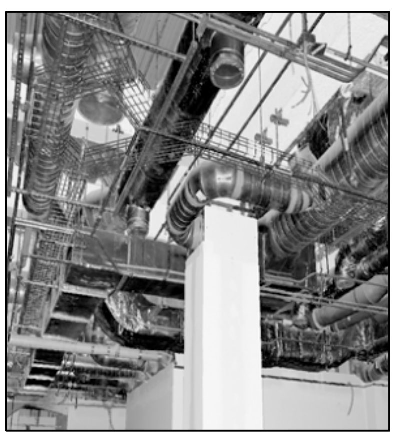

FIGURE 2: TIME OF FLIGHT (TOF) SCAN

Airborne:
High resolution imagery from aerial photography and satellites. Airborne laser scanning is used to data capture the earth surface. It's an important data source for environmental applications, because it is able to map topographic height, the height of surface objects, to high vertical and horizontal accuracy over large areas.

Ideal Usage: Exterior mapping, Corridor, Large scale mapping

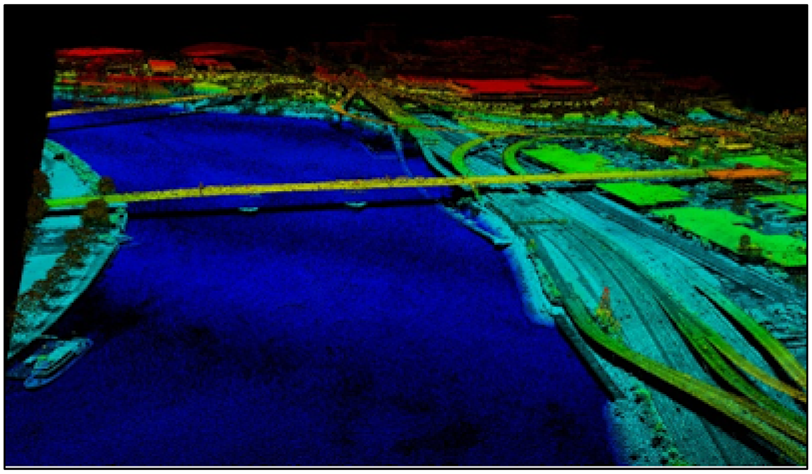

FIGURE 3: AIRBORNE LASER SCAN

Mobile Mapping:
Non-invasive solution that incorporates ground-based LiDAR sensors, cameras, and an inertial measuring units to collect survey-quality point data quickly and accurately.

Ideal Usage: Rapid exterior mapping for corridors with imaging, mapping, Asset Management, Utilities, Planning, Disaster Management, Tunnel, FAA airport design and layout.

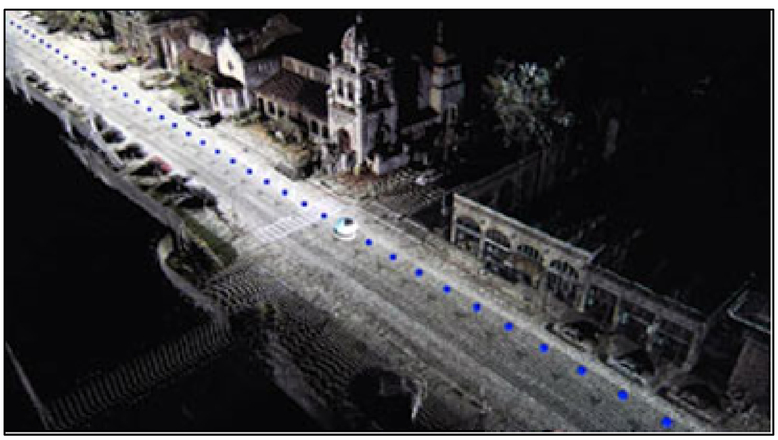

FIGURE 4: MOBILE MAPPING

Scanning Process

Establish the desired end goals and functional requirements
Ultimately dictate the equipment type, strategy, service cost, and what service provider will be used.

- What is the detailed goal that you are trying to achieve?
- What are the budgetary constraints for solving this particular problem?
- What type of deliverable is needed to achieve the goal of the effort?
- What local qualified and experienced service providers can perform this service?
- How will the point cloud data set or other deliverables be used in the future?

Note: The U.S. Institute of Building Documentation (USIBD) currently has it's 3D Imaging Specifications available for free! http://www.usibd.org/usibd_home

Capture Point Data
Point data is first captured using 3D laser scans of existing conditions. In most cases, a survey company provides correctly oriented scans in the native scan format of the manufacturer (Ex. Faro: FLS and FWS Optech: IXF, Riegl: 3DD and RSP, Leica: PTX)

FIGURE 5: PHASE BASED SCANNER CAPTURING POINT CLOUD DATA

Recap 360 Ultimate

Create a project and Import the Raw Scans
In this class we've selected to utilize Autodesk Recap to process the scan data. Full step-by-step instructions, system requirements, etc. can be found at:
https://knowledge.autodesk.com/support/recap/getting-started

Autodesk Recap converts the scan files to a proprietary Reality Capture Scan format (RCS) that can be read by other Autodesk programs. This process, called indexing, involves adjusting your desired settings, importing the raw scan data and saving the indexed scan files into Reality Capture Project file (RCP) that references, but does not contain, the files.

At the beginning of this process, you can adjust the number of points imported by changing settings for noise, distance from the camera, intensity range, and decimation values.

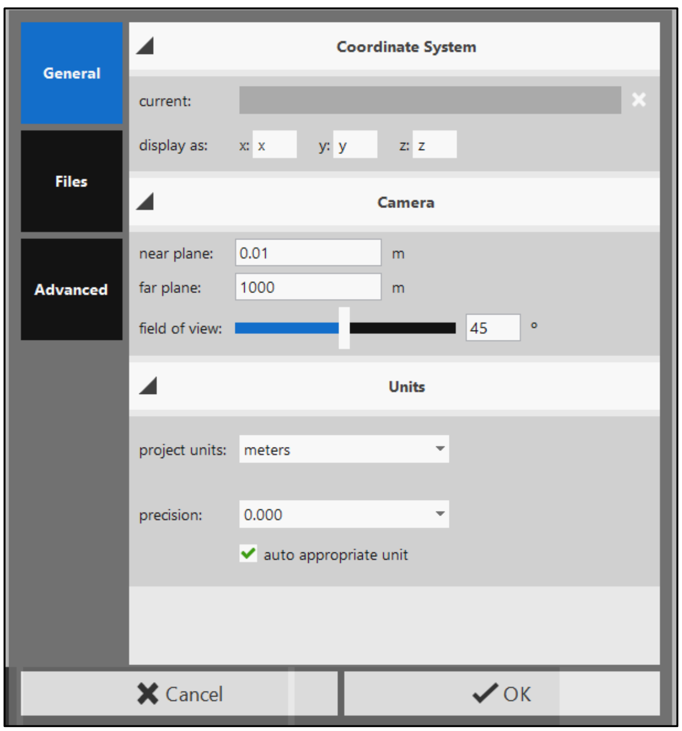

FIGURE 6: SETTINGS

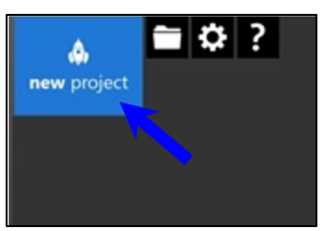

FIGURE 7: NEW PROJECT

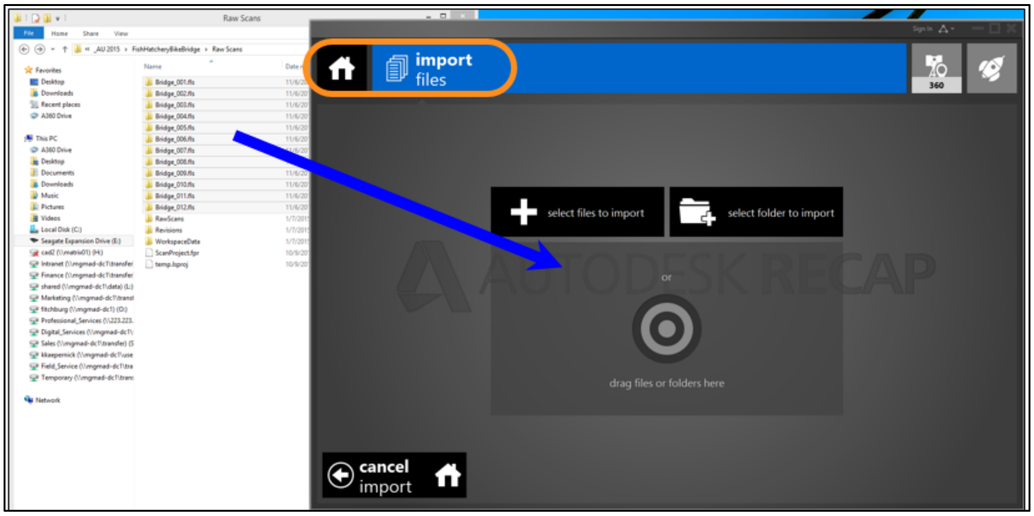

FIGURE 8: IMPORT FILES

FIGURE 9: INDIVIDUAL SCANS

Note: Do not wait for all the scans to import! You can continue with Registration or Indexing while scans import.

Cloud to Cloud Registration

Auto Registration (New in 2016):
Once files have begun importing you have the option to begin the Auto Registration process. Simply click the "register scans" button in the lower right corner of the application to start registering

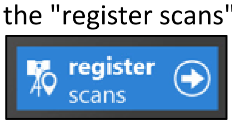

FIGURE 10: REGISTER SCANS BUTTON

Manual registration is still available at any time. Electing to leave the Auto Registration Process will compile any registration already completed and allow you to finish the registration process through the standard manual workflow.
In some instances, auto registration will not be able to find enough matching data to add a scan correctly. In these cases, you will be prompted to manually register the unregistered scans.

FIGURE 10: REGISTRATION WINDOW

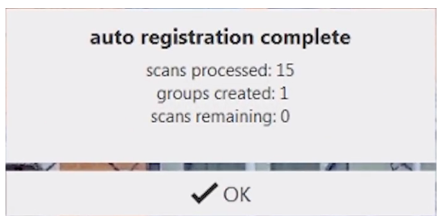

FIGURE 11: REGISTRATION COMPLETION WINDOW

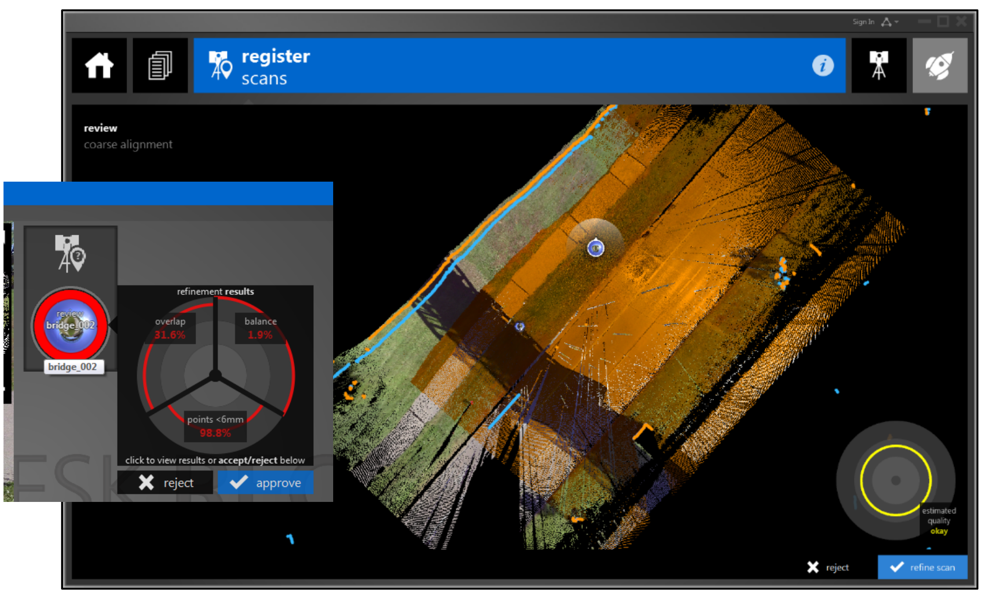

FIGURE 12: REGISTRATION AND REFINEMENT RESULTS

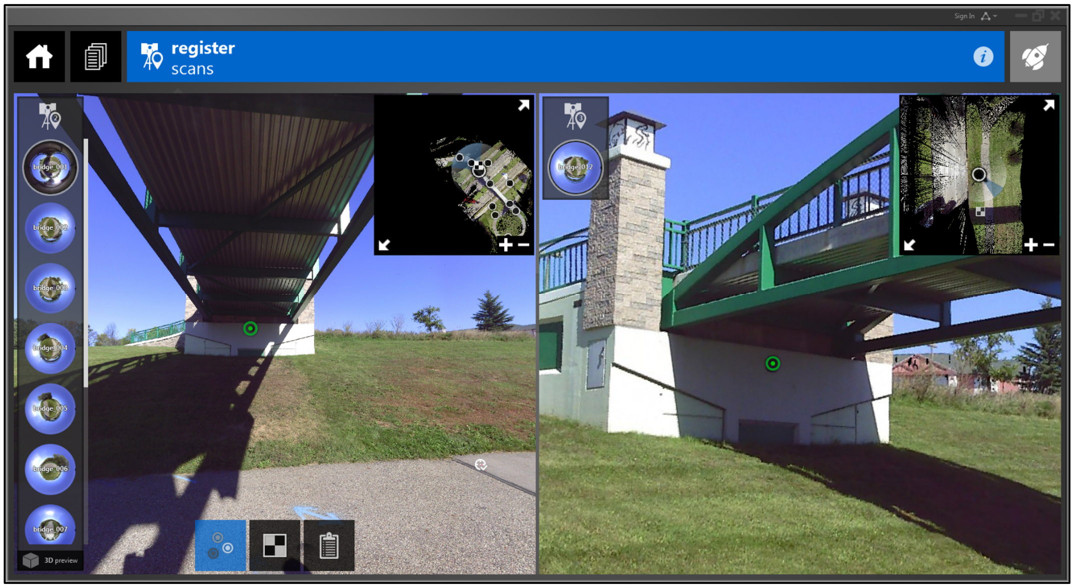

FIGURE 13: TRADITIONAL MANUAL REGISTRATION

Index Scans

Before you can use the data it needs to be converted to a point cloud file. This process is referred to as indexing. You can use Autodesk's ReCap™ product to convert raw scan data to an RCS format. Autodesk ReCap can also save files in an RCP format that serves as a project file that references multiple RCS files. Both formats can be attached to an AutoCAD drawing. You can use AutoCAD® to convert raw scan files to an ISD or PCG format.

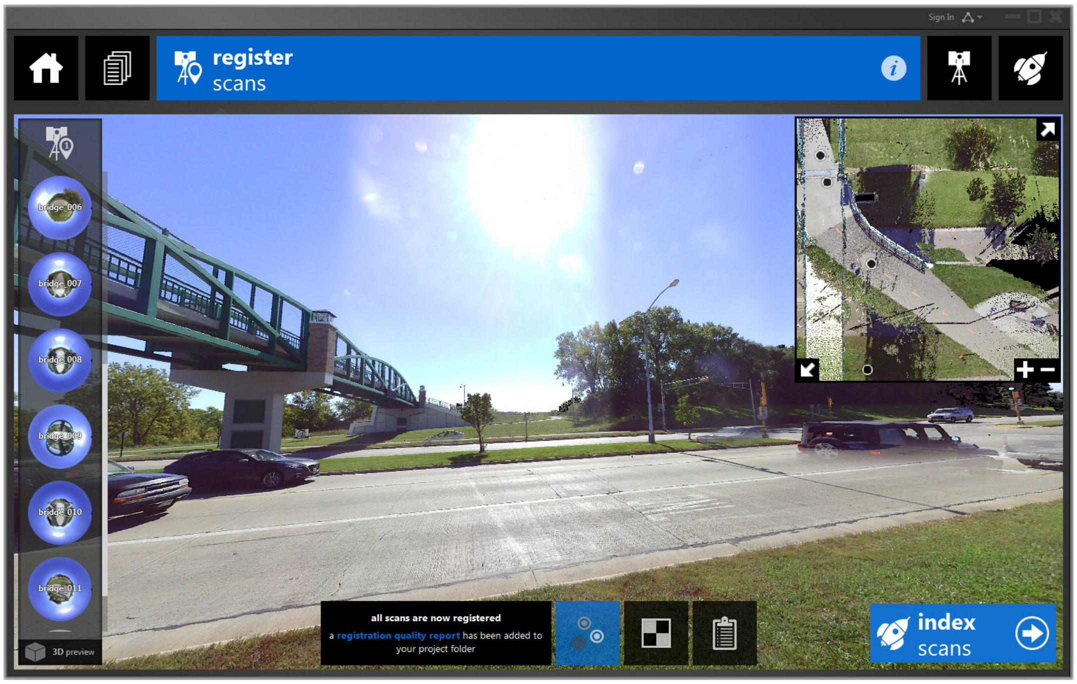

FIGURE 14: TRADITIONAL MANUAL REGISTRATION

Organization, Cleanup, and Analysis

There are a number of methods available to organize the indexed data to remove or hide portions of the point cloud:

Adjust the orientation

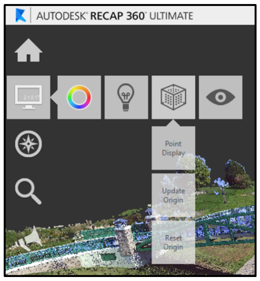

FIGURE 15: POINTS DISPLAY OPTIONS TOOL

Create scan regions of the points that you can turn on and off

FIGURE 16: SCAN REGIONS DIALOG WITH DESIRED POINTS SELECTED

Specify temporary clip regions

FIGURE 17: LIMIT BOX (FORMERLY BOUNDING BOX)

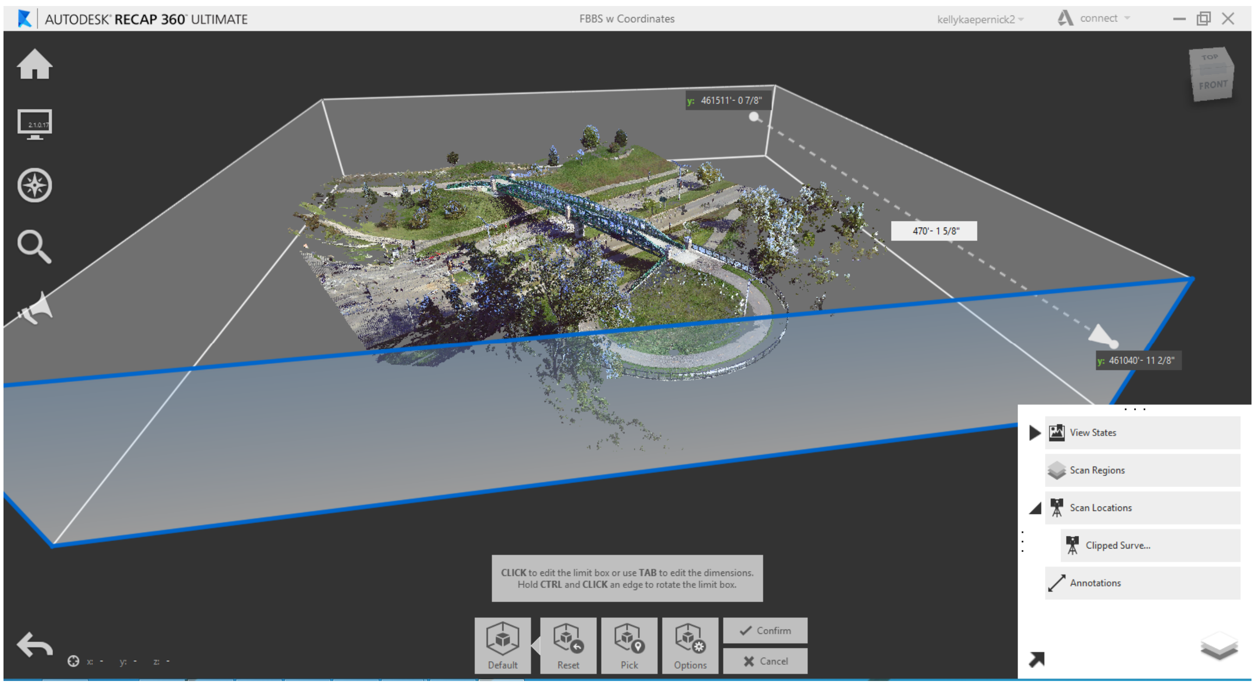

FIGURE 18: LIMIT BOX OPTIONS

Turning off and/or removing scan files

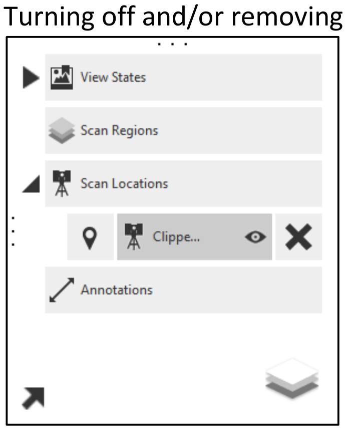

FIGURE 19: SCAN LOCATIONS LIST

Delete unwanted points permanently
Simply use the selection tools and delete

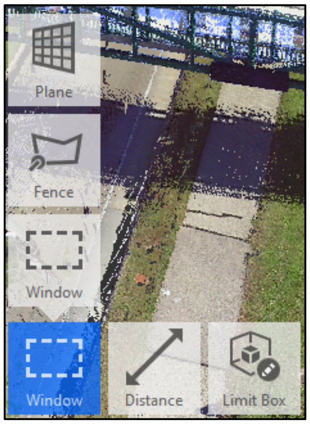

FIGURE 20: SELECTION TOOLS

Note: By viewing the scene using different color modes and lighting, you can gain insight into elevations, normals (which help identify surfaces), and reflectivity.

Geolocate

Use Survey data to Geolocate project

- Set control points
- Survey control points
- Create Survey Markers
- Add the Survey file to Recap
- Assign Survey file to survey markers

FIGURE 21: GEOLOCATION DIALOG

Attach

Indexed scan files and projects can be opened, or *attached*, in another program to provide realistic context for 3D models.

File formats that can be indexed	Formats created by Autodesk ReCap
• **ASC** • **CL3** • **CLR** • **E57** • **FLS** • **FWS** • **ISPROJ** • **LAS** • **PCG** • **PTG** • **PTS** • **PTX** • **RDS** (3D only) • **TXT** • **XYB** • **XYZ** • **ZFS** • **ZFPRJ**	• **RCS**. A single point cloud file that is saved in the Output folder after indexing. Point clouds saved in RCS format use *meter* as the unit of measurement. • **RCP**. A project file that points to the individual RCS files and contains information about them. • **PCG, PTS, E57**. Formats that can be exported.

FIGURE 22: POINT CLOUD FORMATS USED BY AUTODESK RECAP

InfraWorks 360

Retrieving existing conditions data in InfraWorks 360

After opening InfraWorks 360, you will notice thumbnails of projects on the Home screen. If it is your first time opening the software, you will see project samples to be downloaded to your local machine. In this case, we will be using the Model Builder to aggregate existing conditions data from Open Source. On the home page, click on the Model Builder (figure 23).

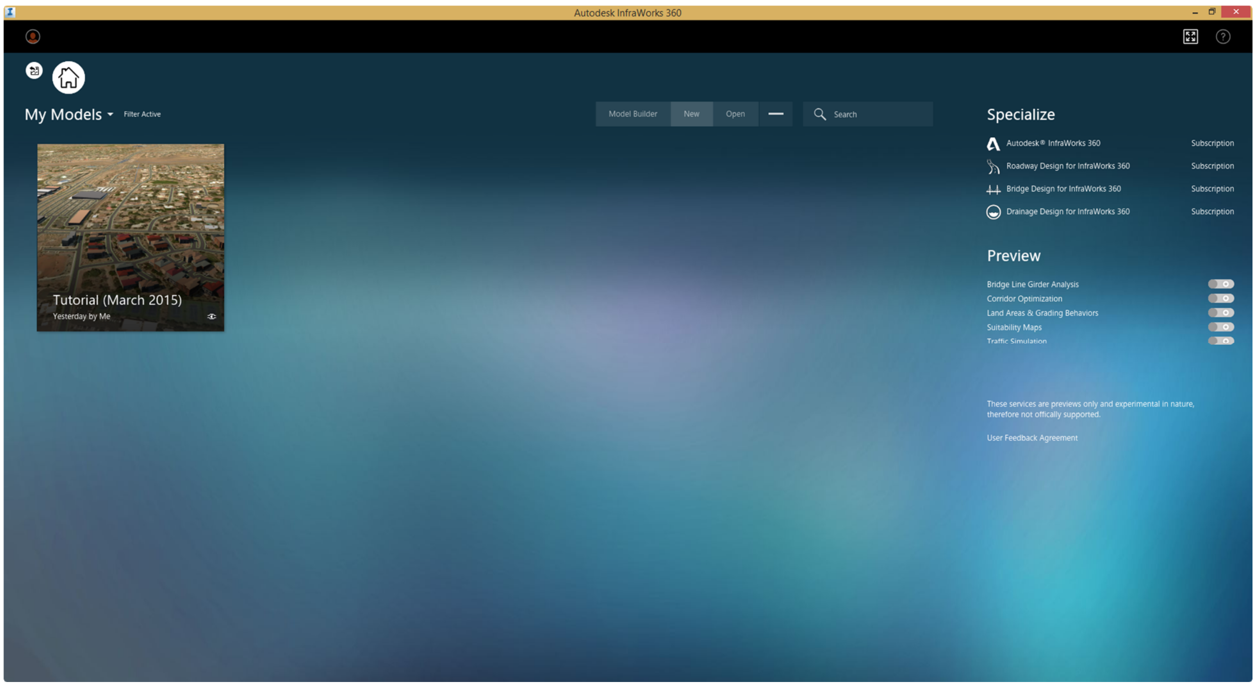

FIGURE 23

Once Model builder opens you will see what looks like a mapping tool. Zoom in or type in the address of your location to get closer to the area of interest (figure 24). There are four ways to select the area of interest: Screen extents, rectangle, polygon or import a polygon. Pick one of those methods to get the area of interest. Now that an area is selected be aware that there is a limit of 200 sq. km. (77.22 sq.mi.) allowed to be processed (figure 24). Next, enter the name of the model in the bottom right corner of the dialog box. Then under the name, select the group to add this model to.

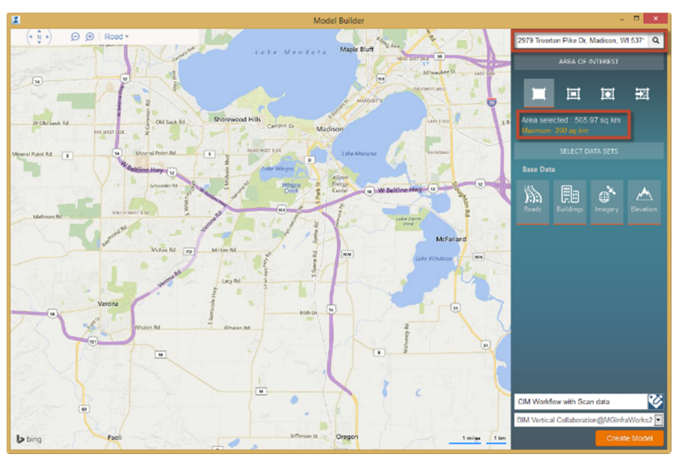

FIGURE 24

Note: Model builder comes with InfraWorks 360 and is not included in InfraWorks 360 LT.

Note: Setting up a new or additional group can be done on the home page. Click on the Home icon>Manage Group Membership icon (figure 26) and add a new group to your account in the Manage Group Membership dialog box (figure 25)

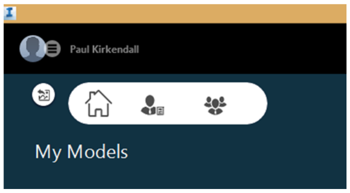

FIGURE 26

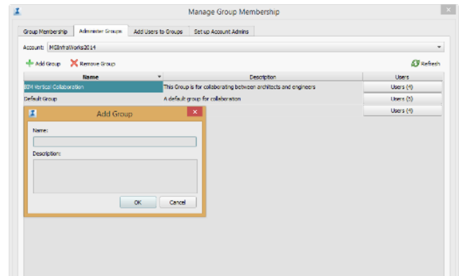

FIGURE 25

Lastly, click Create Model. A message will pop up informing you the model will be processed on the cloud. You will be informed via email upon its completion. InfraWorks 360 processes the data on the cloud, when it is done an email is sent to the user and a thumbnail shows up on the InfraWorks 360 home page (figure 27). The Model must then be downloaded to the user's local machine. Selecting the thumbnail of the model will open the download as dialog box to browse to a save location (figure 28).

Note: Models created in the newest version of InfraWorks 360 can be downloaded to a network location.

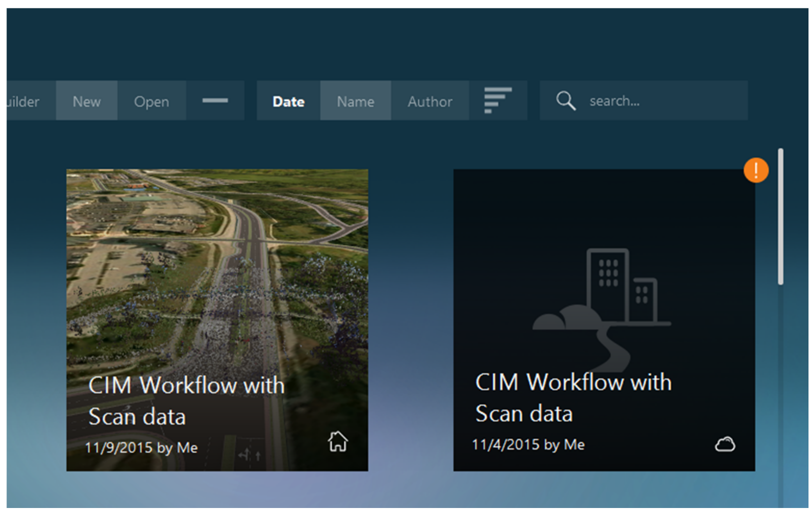

FIGURE 27

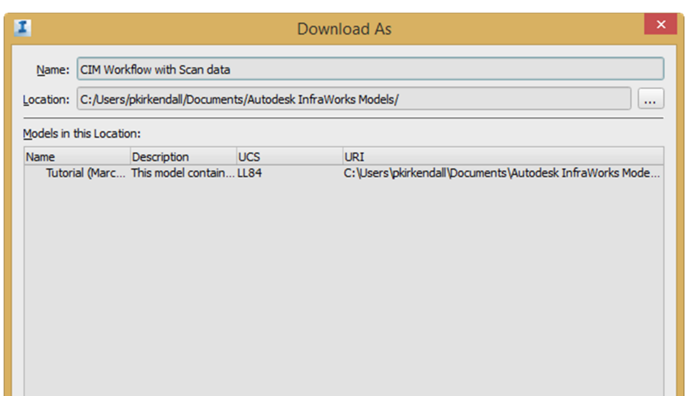

FIGURE 28

After the model is downloaded, the thumb nail will fill in with the model picture and the model will automagically open. Figure 29 shows the model once it's open in InfraWorks 360.

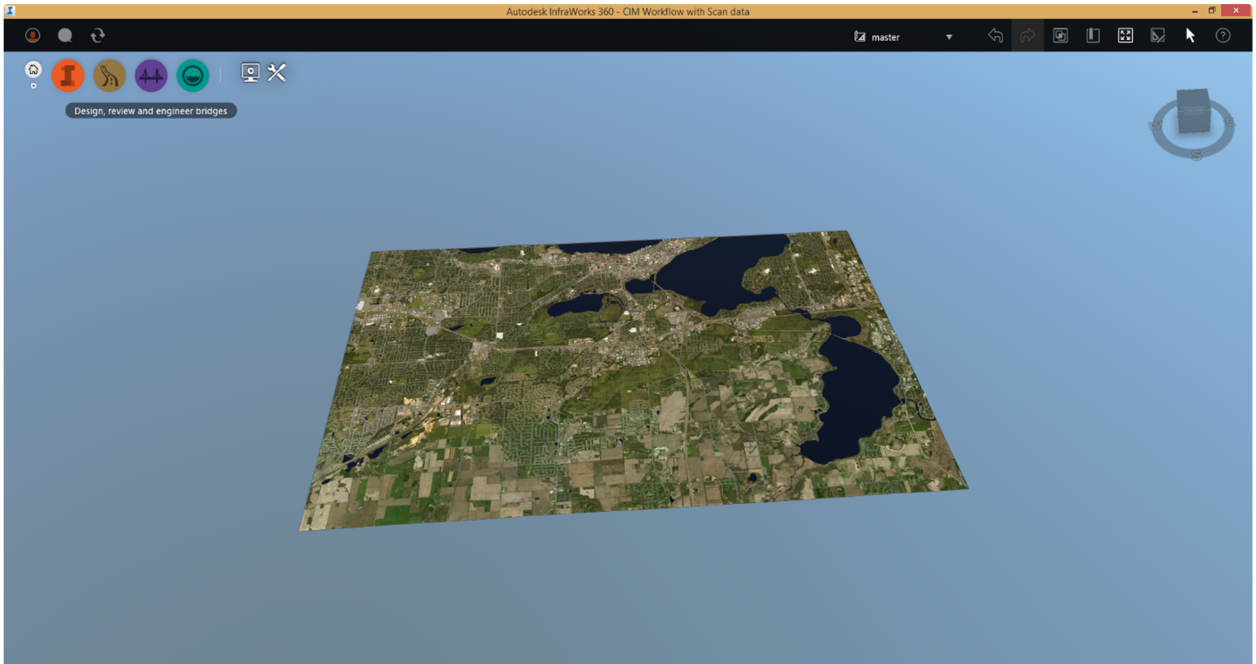

FIGURE 29

Model Builder will supply the user with Terrain data, Imagery, Roads, Rail, Buildings and Waterways. The area will factor in on how much data is available, thus determining how much data is provided to you in your model. Figure 30 shows a zoomed in view of this model with all of the above mentioned represented.

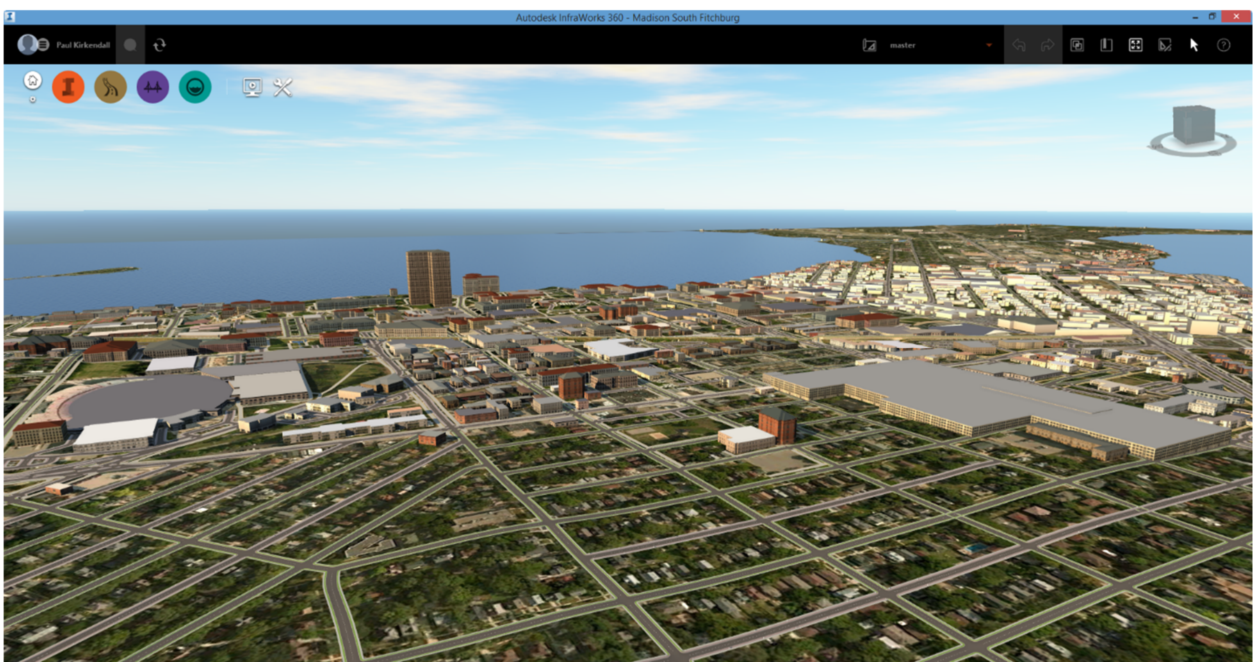

FIGURE 30

Working with the Model in InfraWorks 360

Best practice once you dive into an InfraWorks model is to create a new proposal. Creating a new proposal will allow you to keep the existing conditions in their original state. You can then manipulate the roads, rail, building, etc. to represent the existing conditions more appropriately.

Create a Proposal

On the quick access toolbar, click the dropdown to the right of the word master (Figure 31). Master is the default proposal that is applied to the original data inserted (similar to the 0 layer in AutoCAD). Enter the new proposal name into the dialog box that opens (figure 32). When a new proposal is created, the data that is on the current proposal will then be applied to the new proposal. Any edits to either proposal will not reflect in the other one.

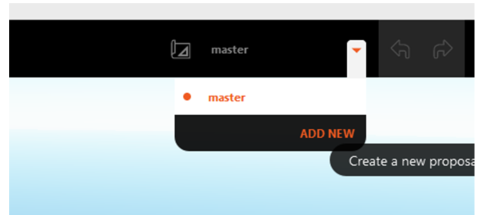

FIGURE 31

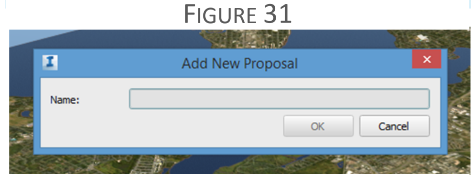

FIGURE 32

Create a Bookmark

InfraWorks opens to the project extents every time it is opened. In order to easily find your project location, you can create a zoomed in view (Bookmark) of that location. Zoom and pan to the location then go to the quick access toolbar. Click the icon that looks like an open book (Figure 33). Enter the name of the new bookmark and click back in the model view to close the bookmark dropdown. Now if you want to get back to this spot, you can go back to the bookmarks and select it.

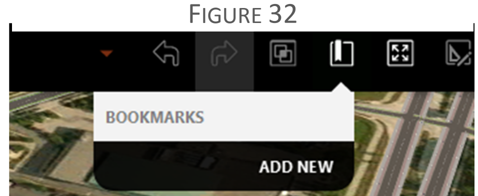

FIGURE 33

Edit existing roadway with Roadway Design module

Note: Roadway Design Module is an additional add-on to the InfraWorks 360 application.

Roads in InfraWorks that are brought in from model builder or created without the roadway design module are called spline roads. Roads created with the roadway design module are called design roads. Design roads use design criteria as they are sketched out in the model. Figure 34 shows the existing intersection as it came from model builder.

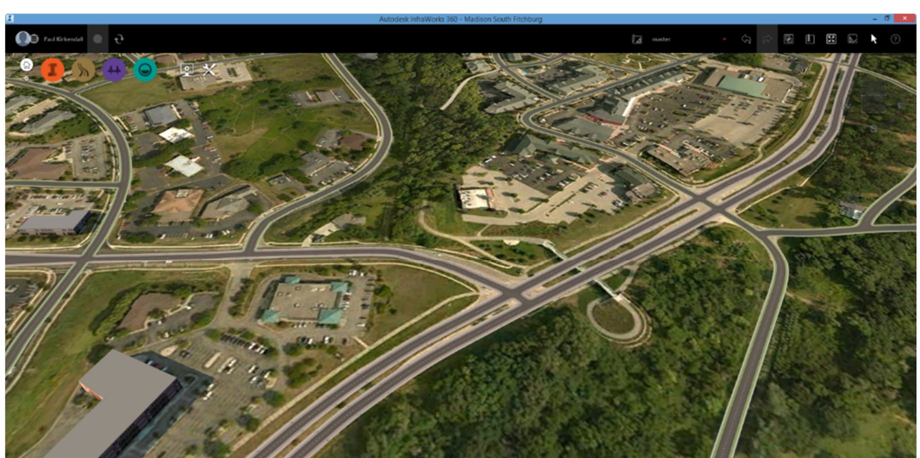

FIGURE 34

Convert existing spline roads to design roads

Since the model came in with roads that have the correct names, profiles, etc., the fastest way to get a design road of the current road is to select it, right click select edit (figure 35), right click select Convert to Design Road (figure 36).

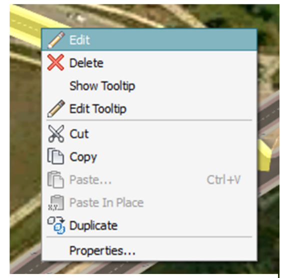

FIGURE 35

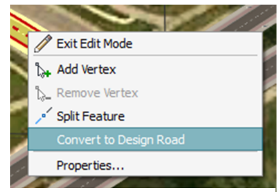

FIGURE 36

Note: By converting roads that intersect, InfraWorks 360 will automagically create an intersection.

Edit an existing Road Style

The existing roadway styles would work for this project. However, I will be showing how to edit the existing road style so it looks even more realistic to the existing conditions. The existing style that I am going to copy and edit has trees in the median and light poles on each side that I will be taking out.

Click the I icon in the top left corner of the screen. On the fly out, click the rubik's cube icon to open the Create and Manage tools. Select style palette icon, the style palette will open on the right of the screen, select the road tab (figure 37). The road tab houses all the current Out of the Box (OOTB) styles. Select the boulevard with palms road style, click the copy button at the bottom of the catalog (make sure to select the copy to current catalog not the copy to another catalog button), change the name of the copied style to boulevard – 2-Lane, click enter, click enter a second time or click the edit pencil button at the bottom of the catalog to open the Configure Style dialog box (figure 38). On the configure style dialog box click the decorations button, on the Decoration Editor (figure 38 inner image), select the decoration target dropdown, select Median Bucket>Median from the Decoration target drop down. Select the red X to remove the tree decoration. Select the right bucket> greenspace (1) and click the red X to remove the light poles. Click close, click ok and drag and drop that style to the existing road to update it.

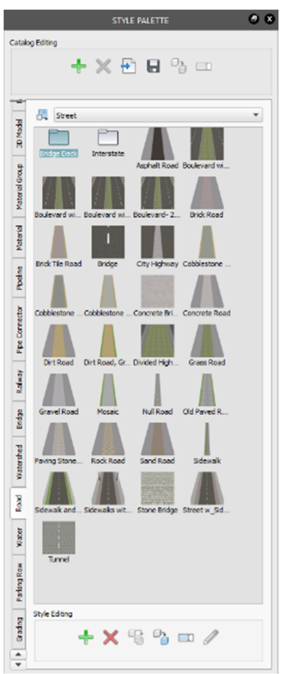

FIGURE 37

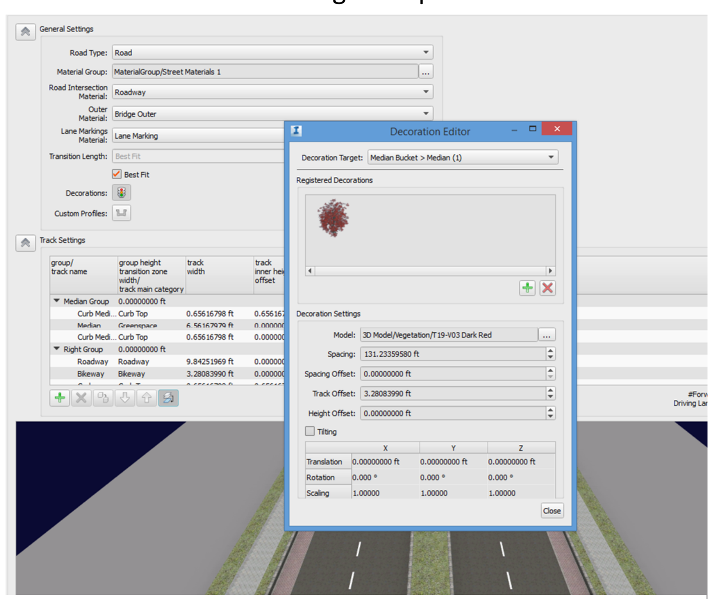

FIGURE 38

Figure 39 shows the new road style after it has been applied. Turn lanes have been added to this model to more closely resemble the existing intersection.

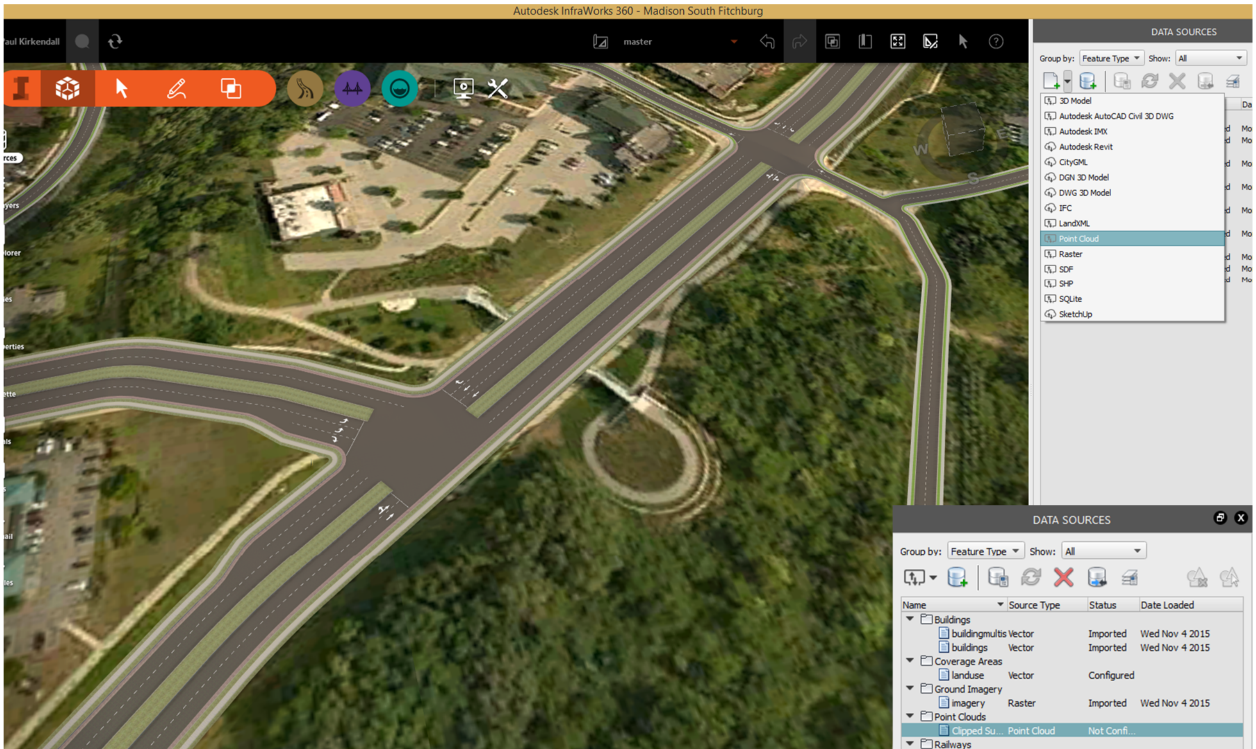

FIGURE 39

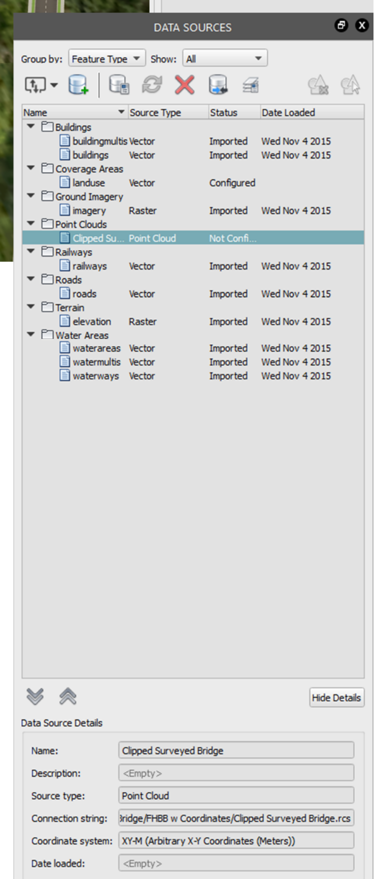

FIGURE 40

Importing the ReCap point cloud into InfraWorks 360

InfraWorks 360 only supports RCS and RCP point cloud files. If you have a LAS point cloud file you can convert it in ReCap to a RCP or RCS file. The file shown in this document has been Geolocated (refer back to page 15 for details) through survey and will be automagically placed in the correct position.

Import a Point Cloud

Click the I icon in the top left corner of the screen. On the fly out click the rubik's cube icon to open the Create and Manage tools. Select the Data sources icon to open the data sources palette, click the Add File Data Source drop down (figure 40), select Point cloud from the drop down. In the select files dialog box navigate to the RCP or RCS file location, select the file and click open.

Configure a Point Cloud

Once the point cloud is imported, you will have to configure it to view it in the model. Double left click or right click on the point cloud file in the data sources palette, select configure to open the data source configuration dialog box (figure 41). The name, source and type will automagically be filled in. Add in a description if its necessary. Again, the RCS file I am using was geolocated in ReCap so I can click on the globe (figure 41) on the coordinate system drop down and assign the correct coordinate system. Once a coordinate system is assigned, the position fields and interactive placing is disabled (figure 42). Click Close & Refresh at the bottom of the dialog box to finish the configuration and have the RCS in the model.

Note: If you click OK instead of the Close & Refresh the Data Source (RCS in this case) will not finish the configuration. You will then have to reopen the Data Source Configuration dialog box and select Close & Refresh for it to finish

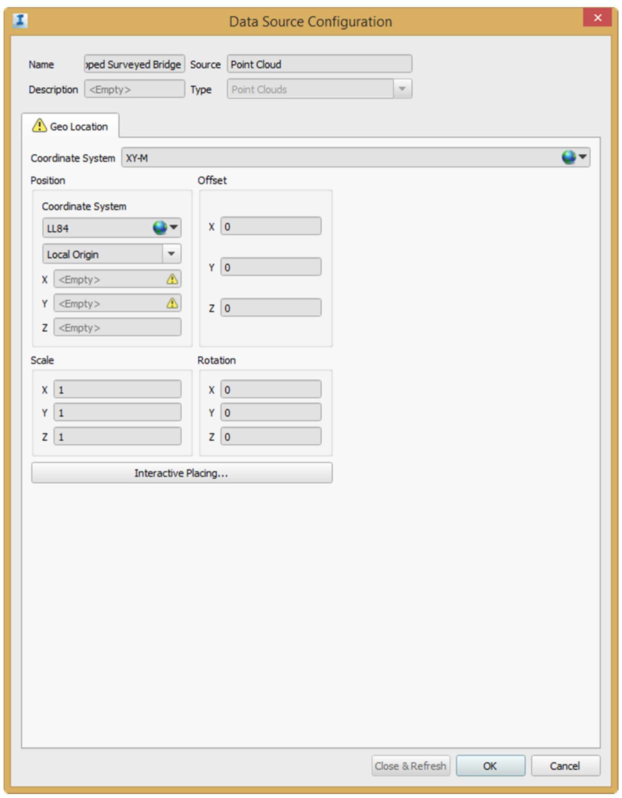

FIGURE 41

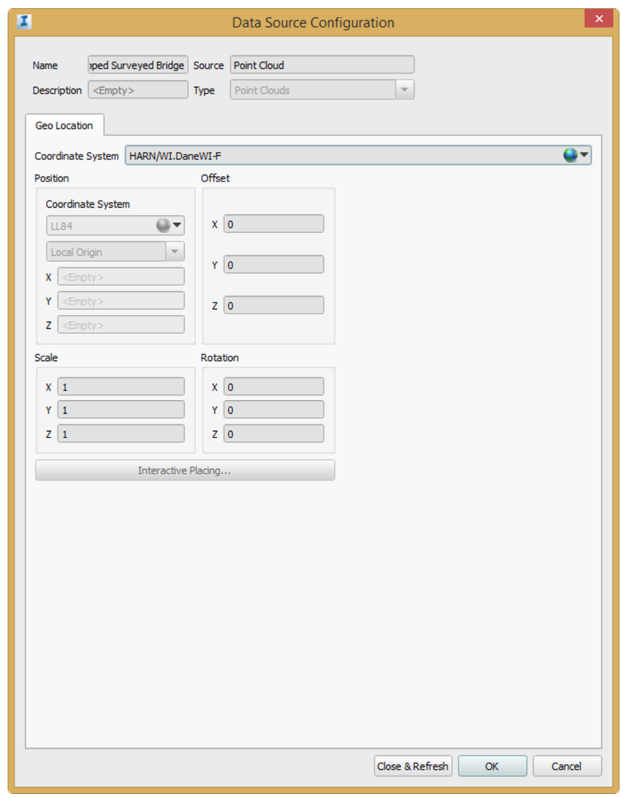

FIGURE42

As you can see in (figure 43), the RCS point cloud was placed at the correct x,y,z. This will help show the available space between the abutments of the bridge, as we bring different options of road and intersection configurations to the client.

FIGURE 43

Adding lanes to Roads

The first option will be to add an additional lane in each direction to the roadway. Select the road, right click select edit, the road asset card will open (figure 44). On the asset card click on the *Geometry* (Edit Mode) and select lanes forward (figure 45) Click on the lanes number to change it. Repeat the last 2 steps, change the edit mode to lanes backward.

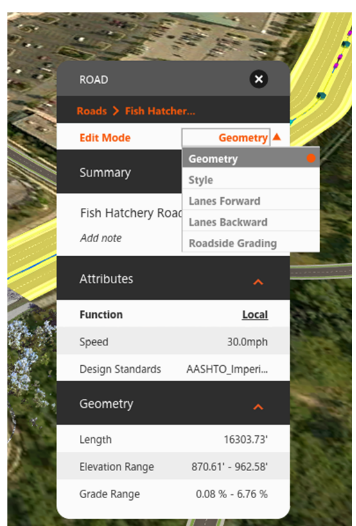

FIGURE 44

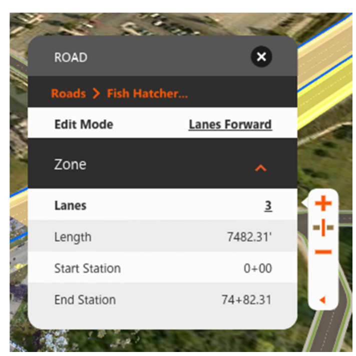

FIGURE 45

Figure 46 shows the additional lane option.

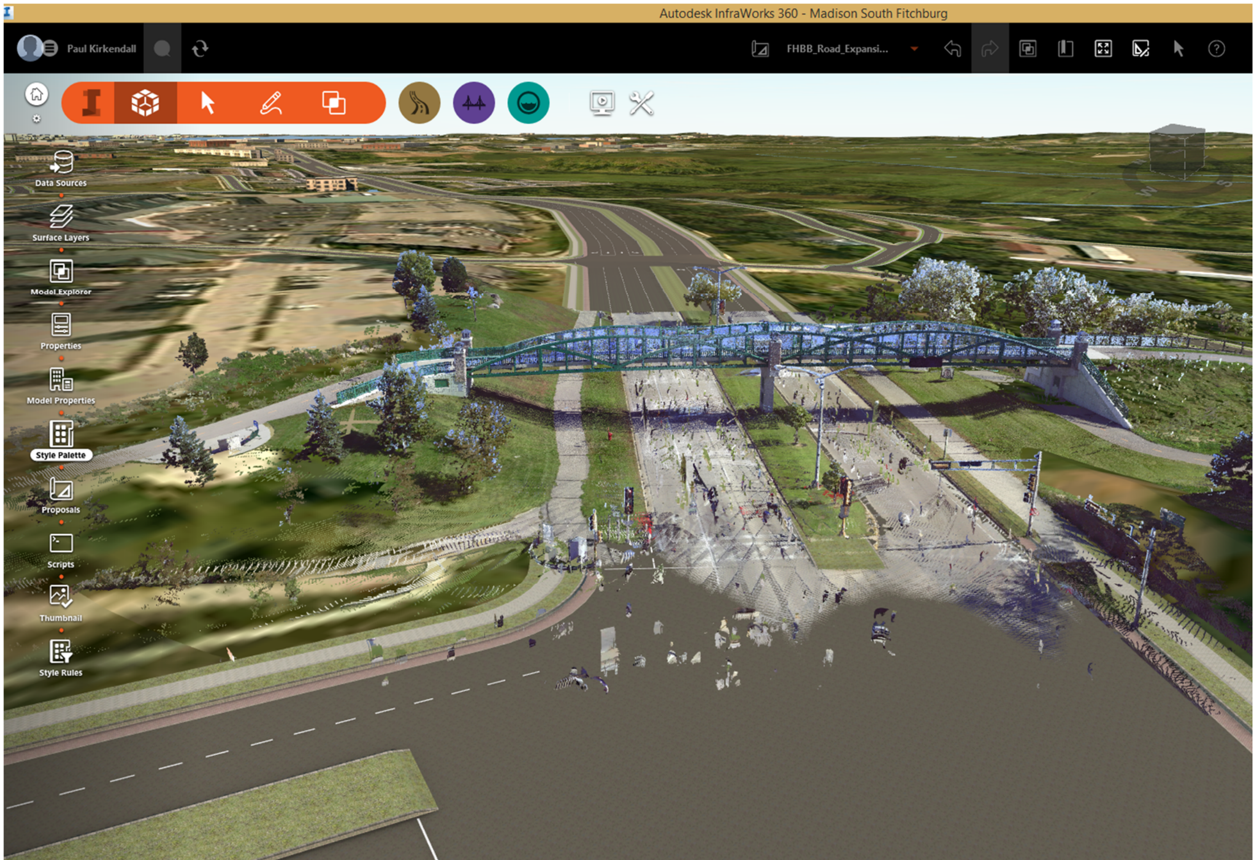

FIGURE 46

Change an Intersection into a Roundabout

Select the intersection, right click and select Convert to Roundabout (figure 47). InfraWorks will automagically convert the intersection to a Roundabout and assign FHWA design criteria based on the lanes forward and backward. Figure 48 shows the roundabout created for this intersection.

FIGURE 47

FIGURE 48

Change the units of an InfraWorks Model

Units assigned in InfraWorks are not editable for the database however the units for the UCS can be changed to reflect the county, state, etc. coordinates you should assign for the model.

Note: Coordinates must be assigned to something other than latitude and longitude in order to bring the model into Civil 3D.

Select the I icon, rubiks cube icon, select model properties. On the Model properties dialog box (figure 49), select in the UCS box and assign the required coordinates, click OK. Now your model is ready for primetime in Civil 3D.

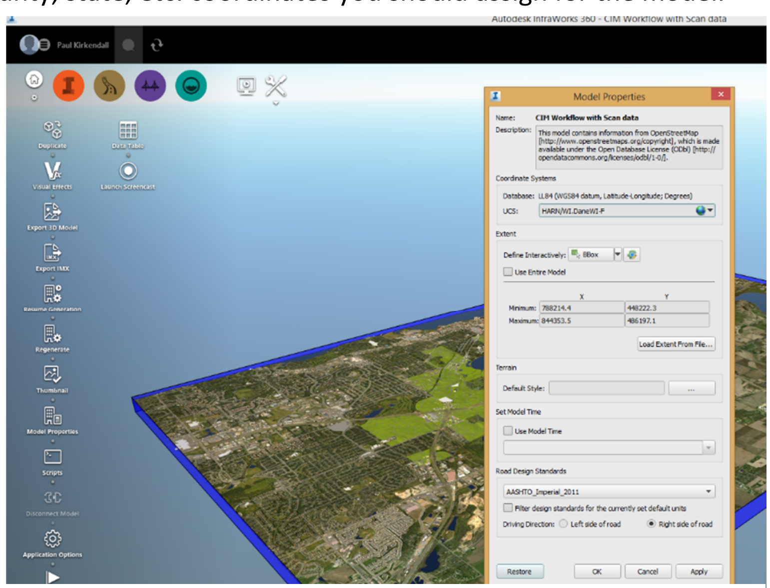

FIGURE 49

Civil 3D 2016

Importing the InfraWorks data into Civil 3D

Infraworks 360 models can be opened in Civil 3D 2016 and the model data will be imported automagically. On the Insert tab of the ribbon click the Infraworks 360 dropdown (figure 50), select Configure Infraworks 360-Civil 3D Exchange Settings to open the dialog box. The Infraworks 360 objects to be imported and the Civil 3D styles and layers can be configured in this dialog box before the import (figure 51). Click OK to save any changes.

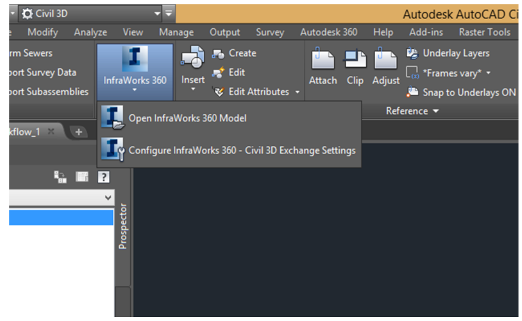

FIGURE 50

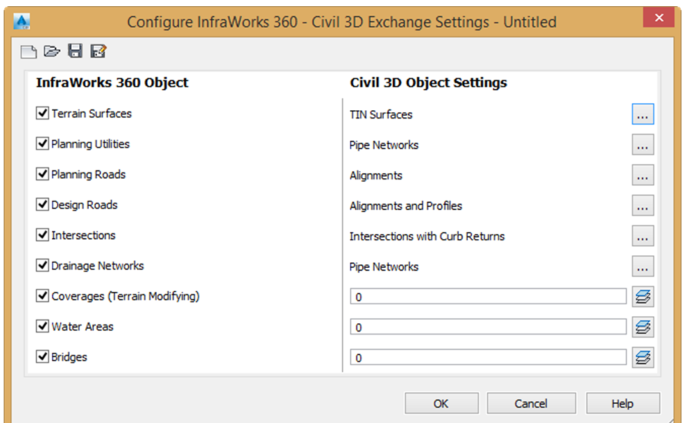

FIGURE 51

On the Insert tab of the ribbon click the InfraWorks 360 dropdown (figure 50), select Open InfraWorks 360 model. The Open InfraWorks 360 model dialog box will open (figure 52). Click the folder icon to navigate to the model, select the model and click open. Click the Set a Coordinate system button, if the coordinate system was assigned in InfraWorks 360 you should receive a "use this coordinate system" message (figure 53), select that coordinate system.

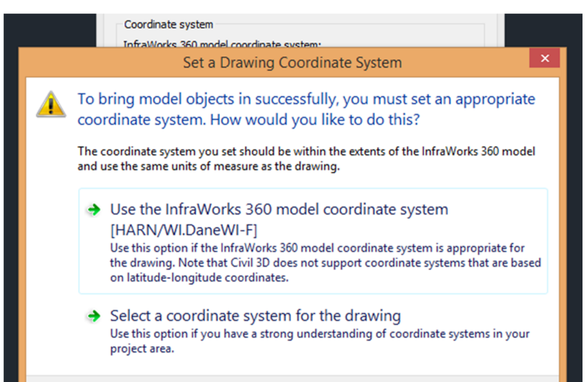

FIGURE 53

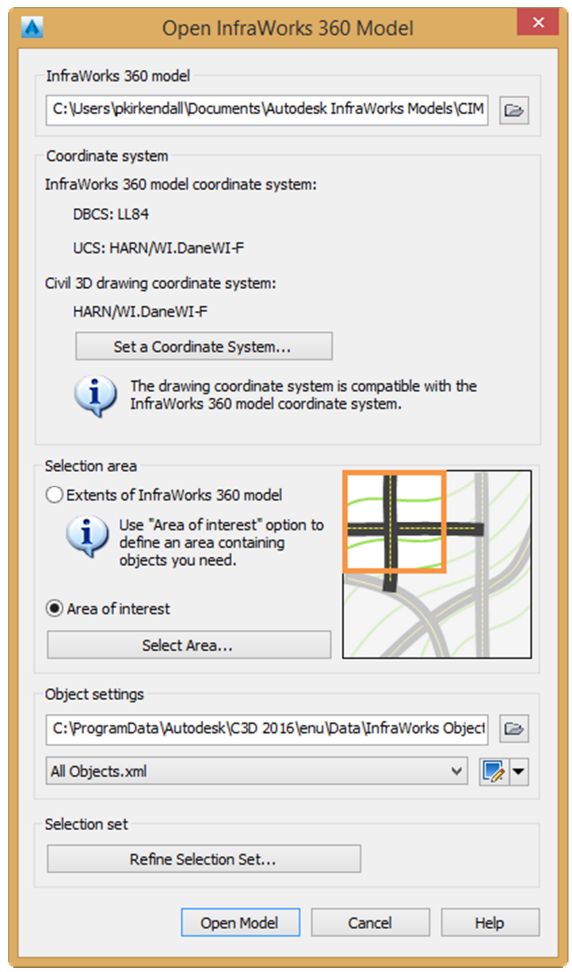

FIGURE 52

In the Selection area you have the choice to import the entire model or select an area of interest. I would recommend selecting an area of interest closer to the size of the project to keep the file size down. Click the Select Area button, an online map data message will pop up (figure 54), select yes, and select a rectangle around the area of interest from left to right (figure 55). Click open model at the bottom of the InfraWorks 360 model dialog box.

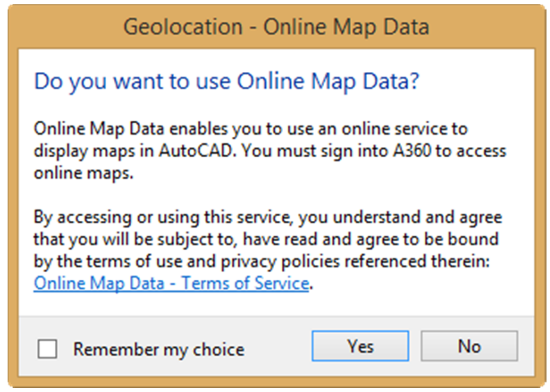

FIGURE 54

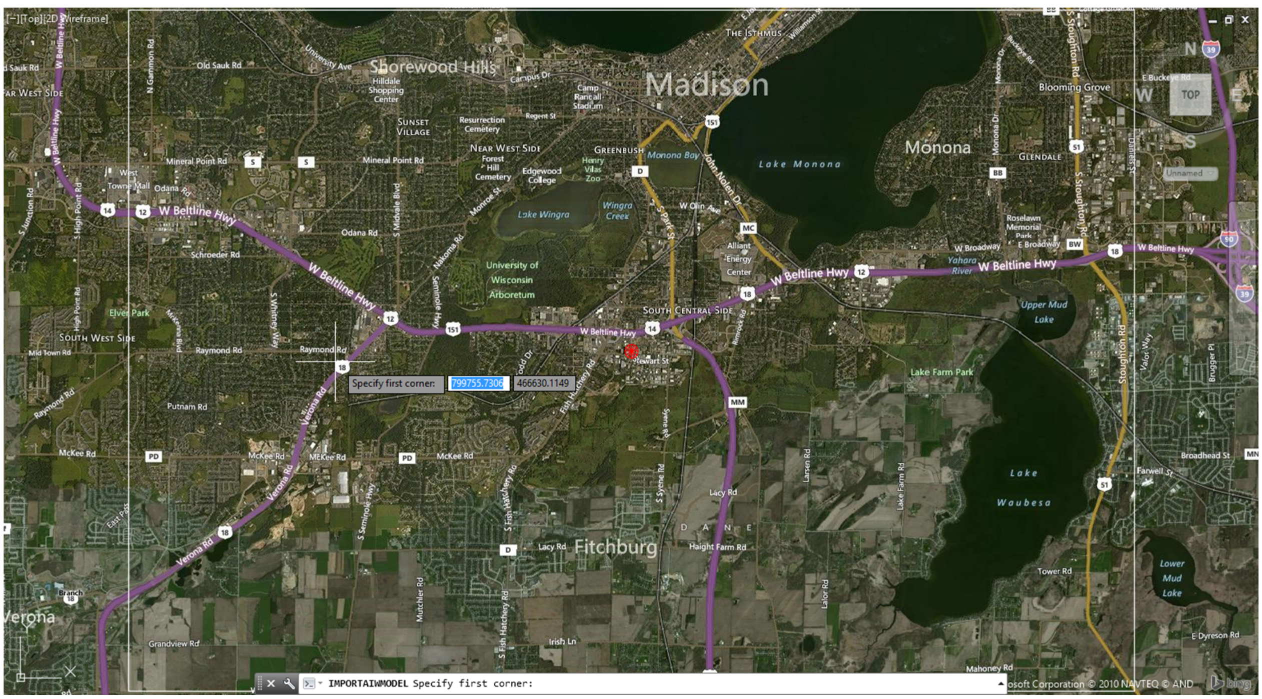

FIGURE 55

Once the model import has processed you will have all the object data selected from the Area of Interest imported into the Civil 3D file (figure 56). Figure 56 and 58 show the surfaces, alignments and profiles that where imported from InfraWorks 360.

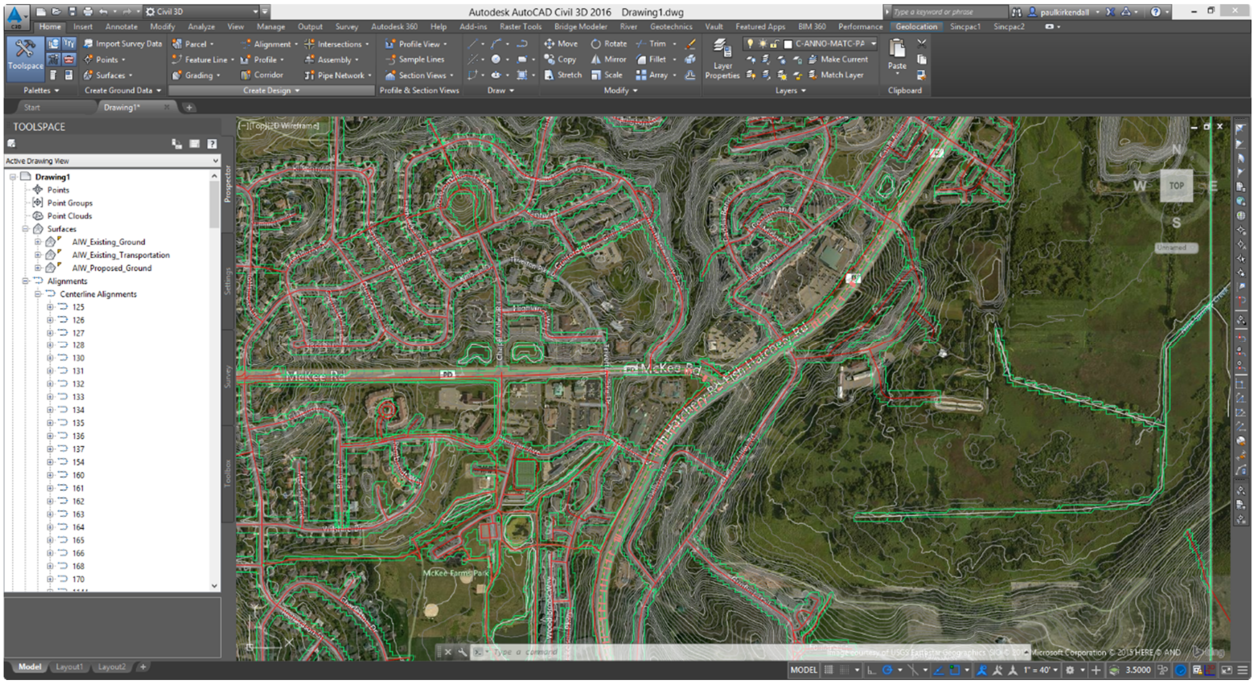

FIGURE 56

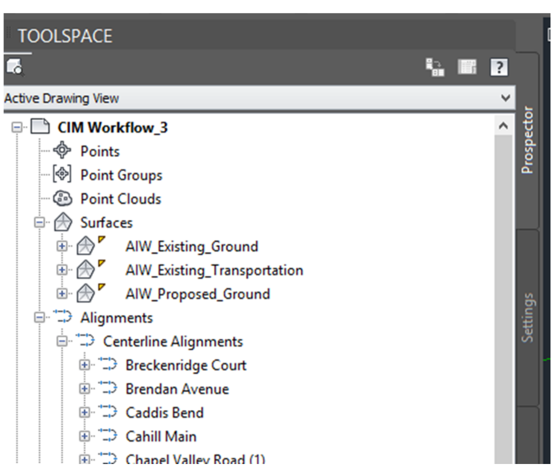

FIGURE 57

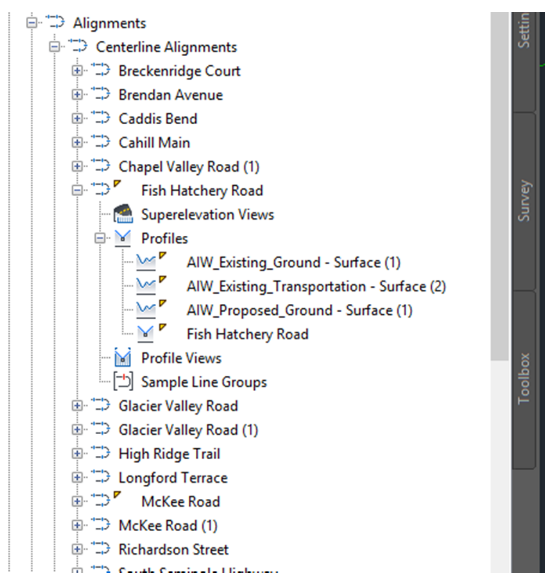

FIGURE 58

Attaching the ReCap file in Civil 3D

On the Insert tab of the ribbon, point cloud panel, select Attach (figure 59).

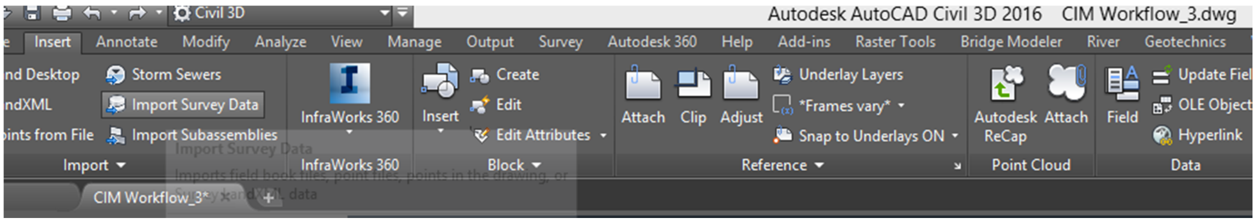

FIGURE 59

Navigate to the RCS or RCP file being used, select it and click open (Figure 60). On the Attach Point Cloud dialog box make sure the only box checked is Zoom to point cloud (figure 61). Click OK. Figures 62 and 63 show the point cloud in plan & 3d model view.

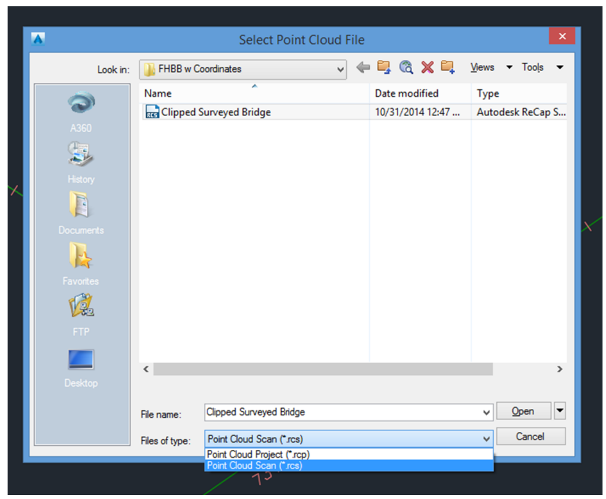

FIGURE 60

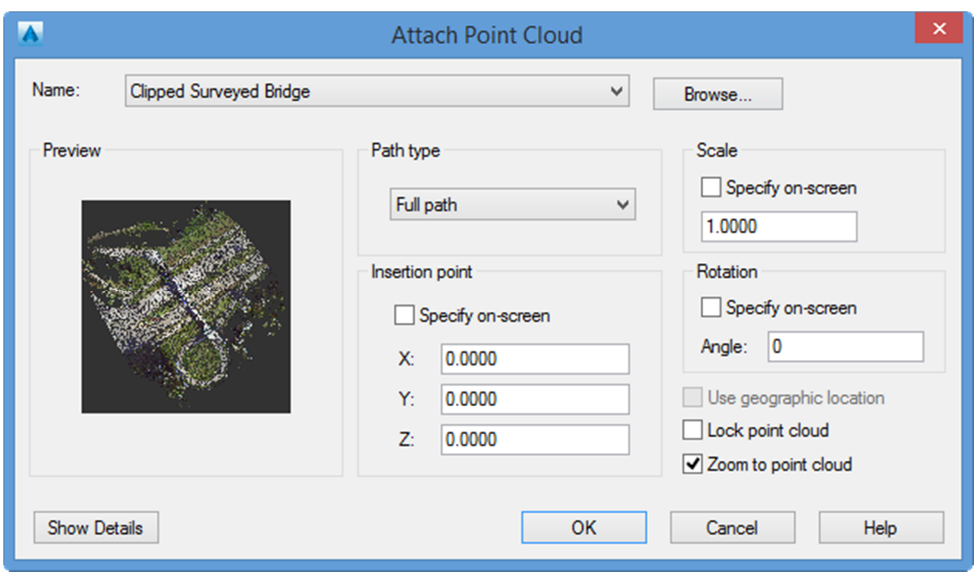

FIGURE 61

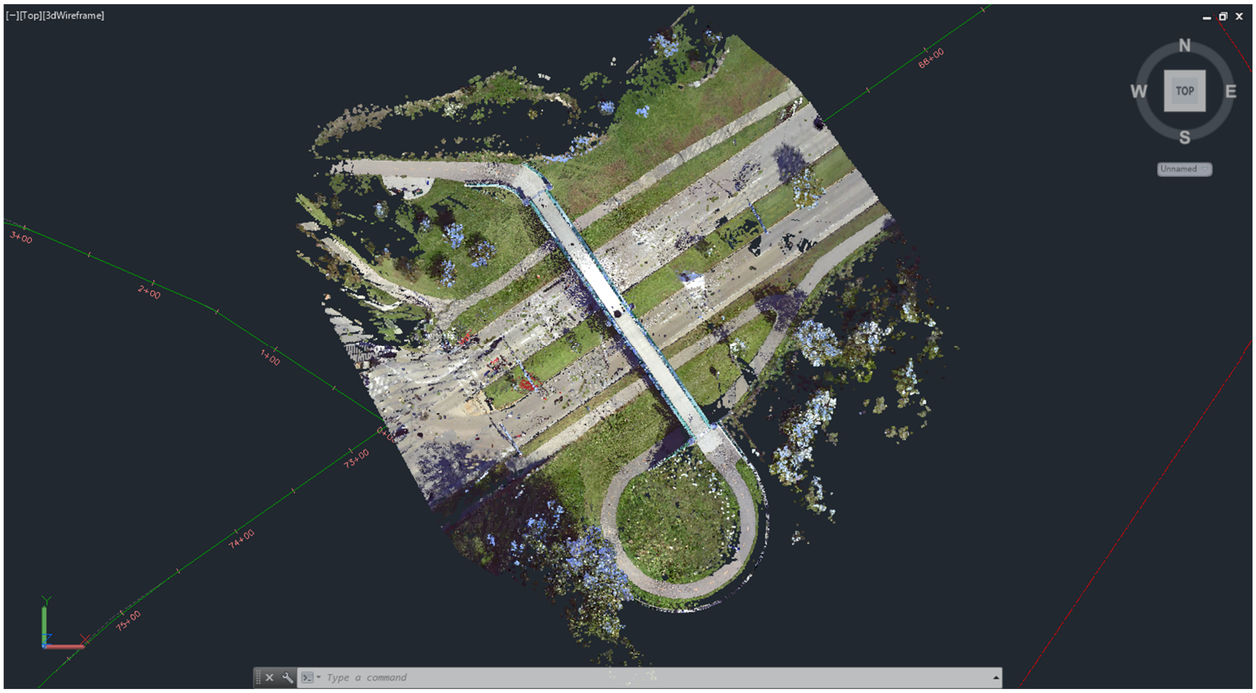

FIGURE 62

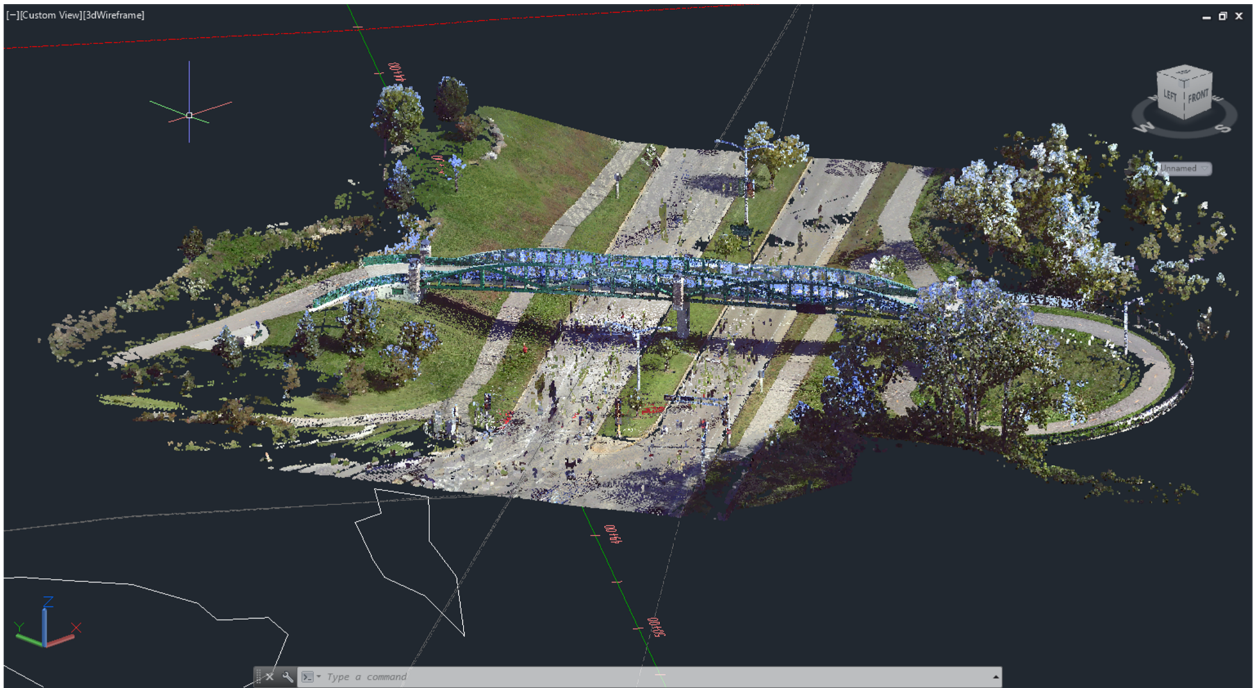

FIGURE 63

Creating a Surface from Point Cloud

On the home tab of the ribbon, create ground data panel, click the surfaces drop down, and select Create Surface from Point Cloud (figure 64). On the Create TIN Surface from Point Cloud dialog box general tab (figure 65), Enter a relevant name for the surface to be created, add a description if it is necessary, select a style for the surface and click next.

On the point Cloud Selection tab (figure 66) an area of the point cloud can be selected or deleted from the surface creation. The Distance between Points can also be changed to help weed out points and help reduce file size. In this project I decided to use 0.5 as the distance between points (figure 67). On the non-ground point filtering tab (figure 68), select kriging interpolation. Click Create surface. Figure 69 and 70 show the messages that pop up to inform you the point cloud will be processed in the background so you can keep working on other things.

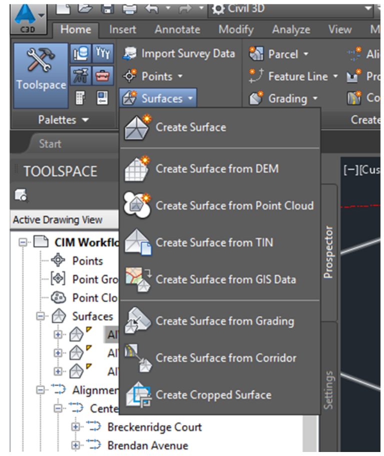

FIGURE 64

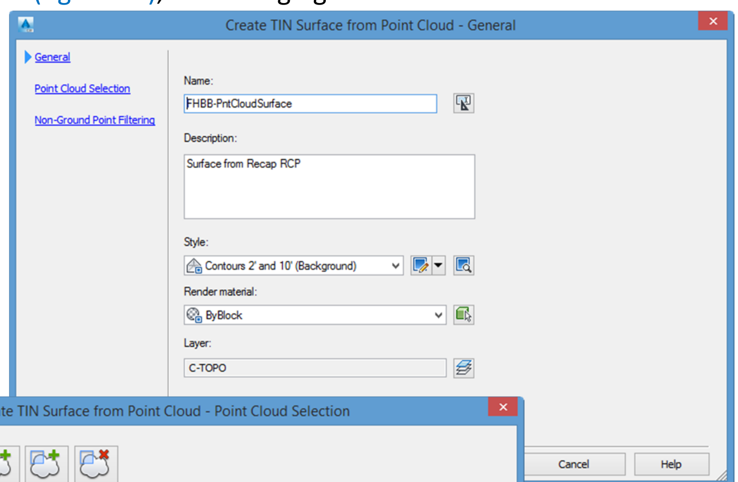

FIGURE 65

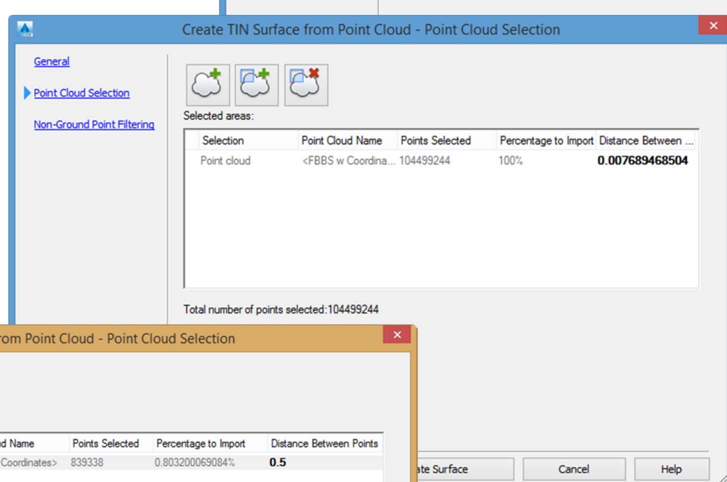

FIGURE 66

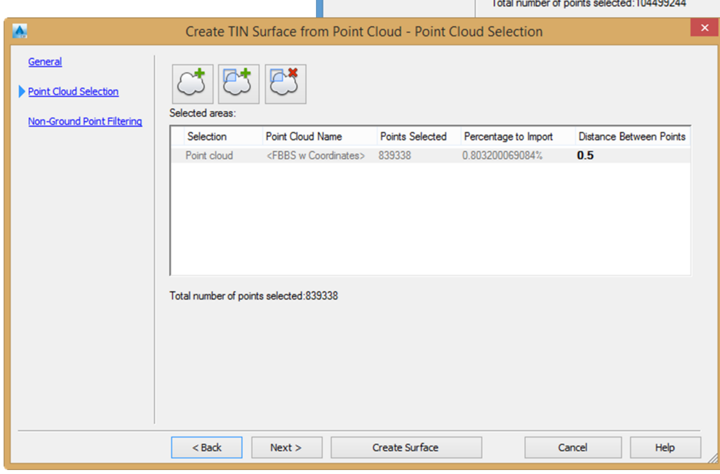

FIGURE 67

Note: the following filter method definitions are taken from the Autodesk help page. Click help (figure 68) to get to them.

Planar Average

Specifies that the Planar Average method is used to identify which points should be filtered out as non-ground points. This option calculates an average between the elevations of the points and then filters out the points that are at an elevation above the average. In the following illustration, the blue points represent the points that will be filtered out and the red points represent the points that will be included in the surface when this option is selected:

This option is faster than the Kriging Interpolation method, but filters out fewer non-ground points.

Kriging Interpolation

Specifies that the Kriging Interpolation method is used to identify which points should be filtered out as non-ground points. This option interpolates new data points to build curves, and then filters out the points that are at an elevation above the curves. In the following illustration, the blue points represent the points that will be filtered out and the red points represent the points that will be included in the surface when this option is selected:

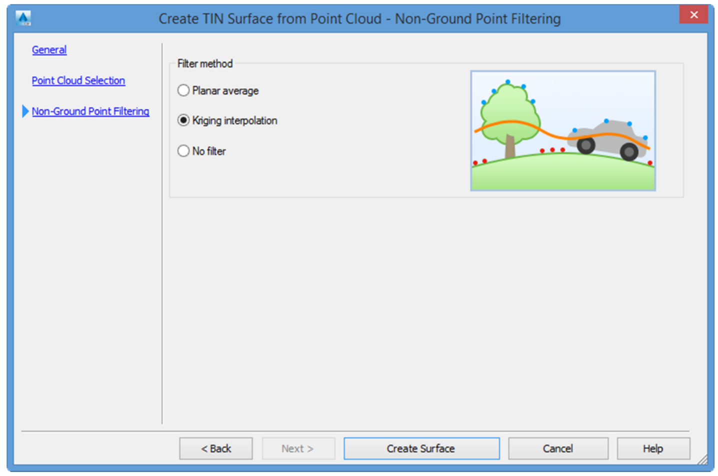

FIGURE 68

This option improves the filtering results but takes more time than the Planar Average method.

No Filter

Does not apply a filter. All points in the selected point cloud areas will be used in the resulting surface. In the following illustration, the red points represent the points that will be included in the surface when this option is selected:

Note: In lamans terms, kriging interpolation will take out the power poles, hydrants, cars, bridges, etc., leaving the important ground points essential for an accurate surface model.

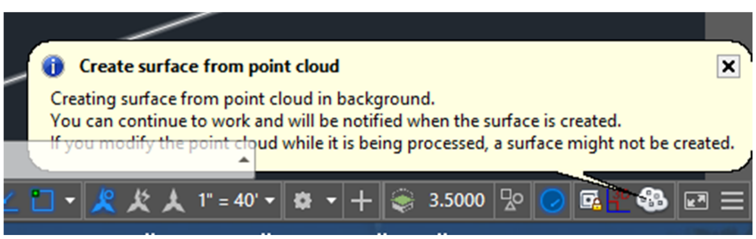

FIGURE 69

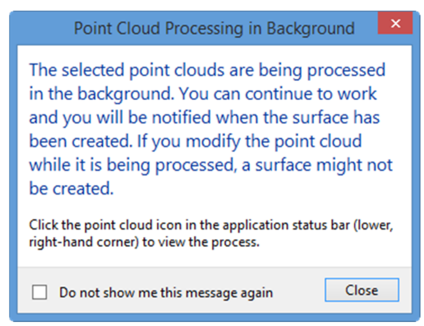

FIGURE 70

Once the surface from Point Cloud has been processed it will show up in your Civil 3D file. Figure 71 shows the surface with the point cloud and figure 72 shows the surface in 2D visual style which point clouds do not display in. Figure 73 is showing the surface in Object Viewer, notice the power poles, cars, trees, and bridge are not built in the surface.

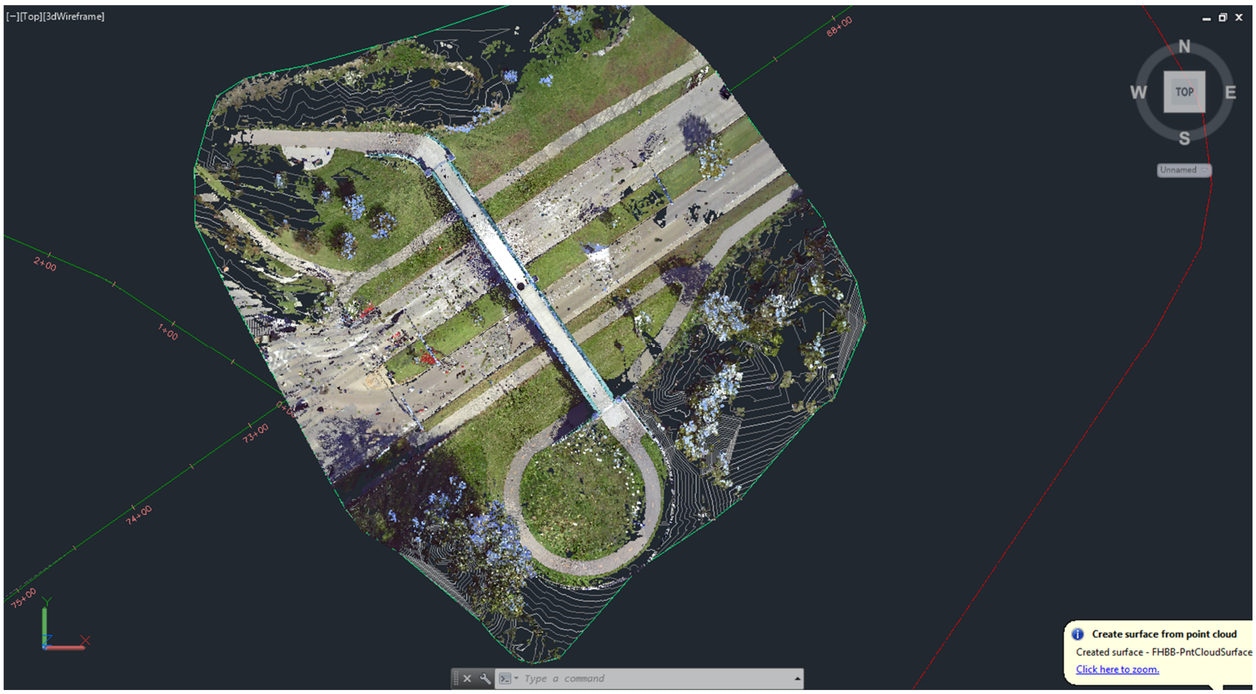

FIGURE 71

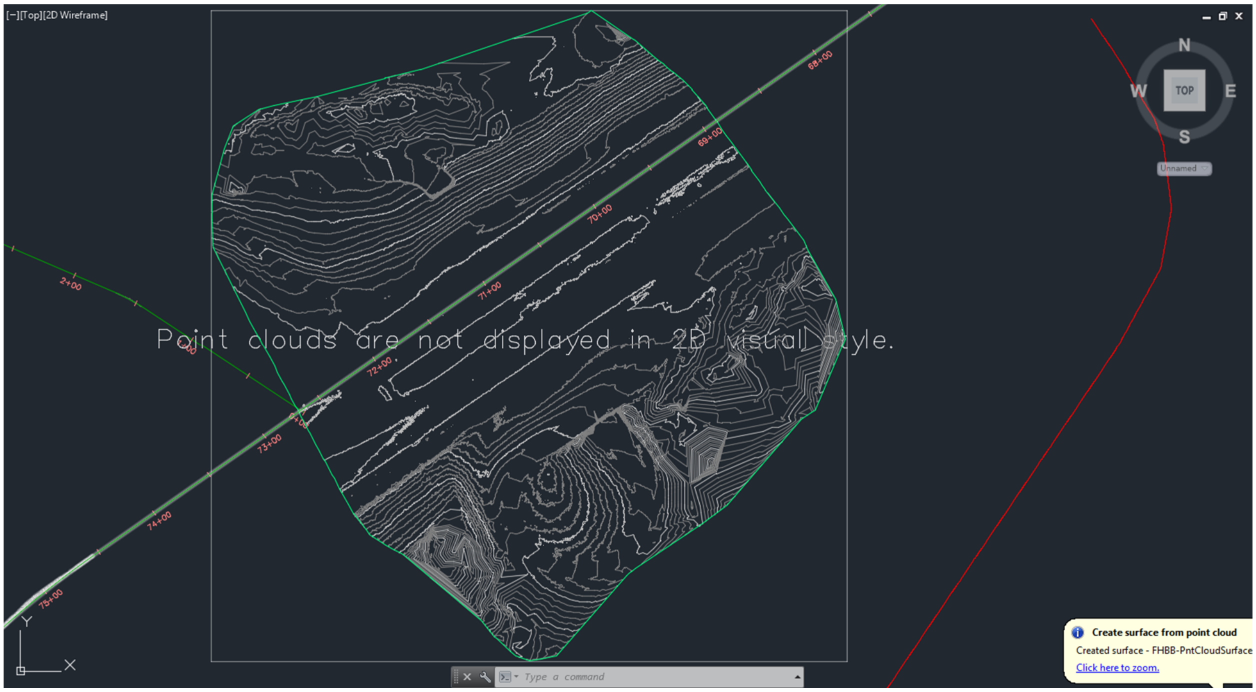

FIGURE 72

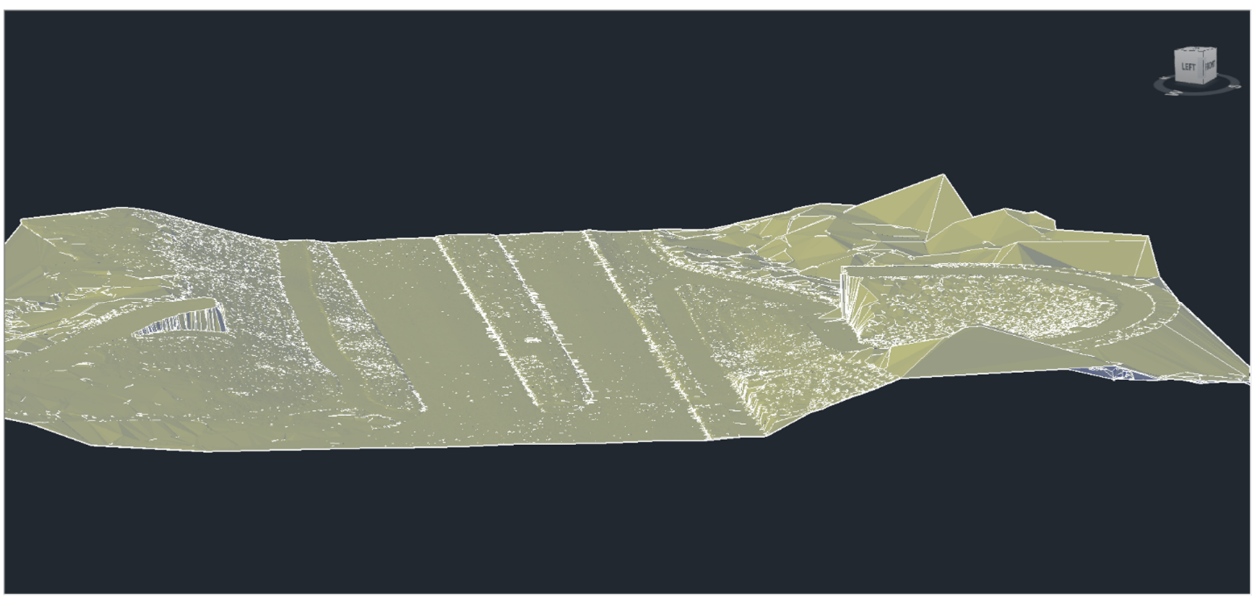

FIGURE 73

In conclusion, the ability to use the data from InfraWorks 360 (alignments, surfaces & profiles) in Civil 3D along with the Point cloud and its surface is a great advantage to minimize rework. In addition, after the corridor is created in Civil 3D, that corridor can be exported to InfraWorks 360 to show/visualize progress and any options to the client as the design process moves along.