

# **AutoCAD Civil 3D 2016 Productivity Study**

## **A Productivity Comparison between AutoCAD Civil 3D 2010 and AutoCAD Civil 3D 2016**

Commissioned by



Studied By



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Inc.

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The performance results and statistical information reported in this paper were derived from tests commissioned by Autodesk conducted on a standalone system using Autodesk® AutoCAD® Civil 3D 2010 software and Autodesk® AutoCAD® Civil 3D 2016 software. Various workflow tasks were designed to simulate day-to-day production tasks. As with all performance tests, results may vary based on machine, operating system, filters, and even source material. While every effort has been made to make the tests as fair and objective as possible, your results may differ. Product information and specifications are subject to change without notice. Autodesk provides this information “as is,” without warranty of any kind, either express or implied.

## AutoCAD Civil 3D 2016 Productivity Study: A comparison of AutoCAD Civil 3D 2010 and AutoCAD Civil 3D 2016 Workflows

By Jeff Lyons, Landproject Inc.

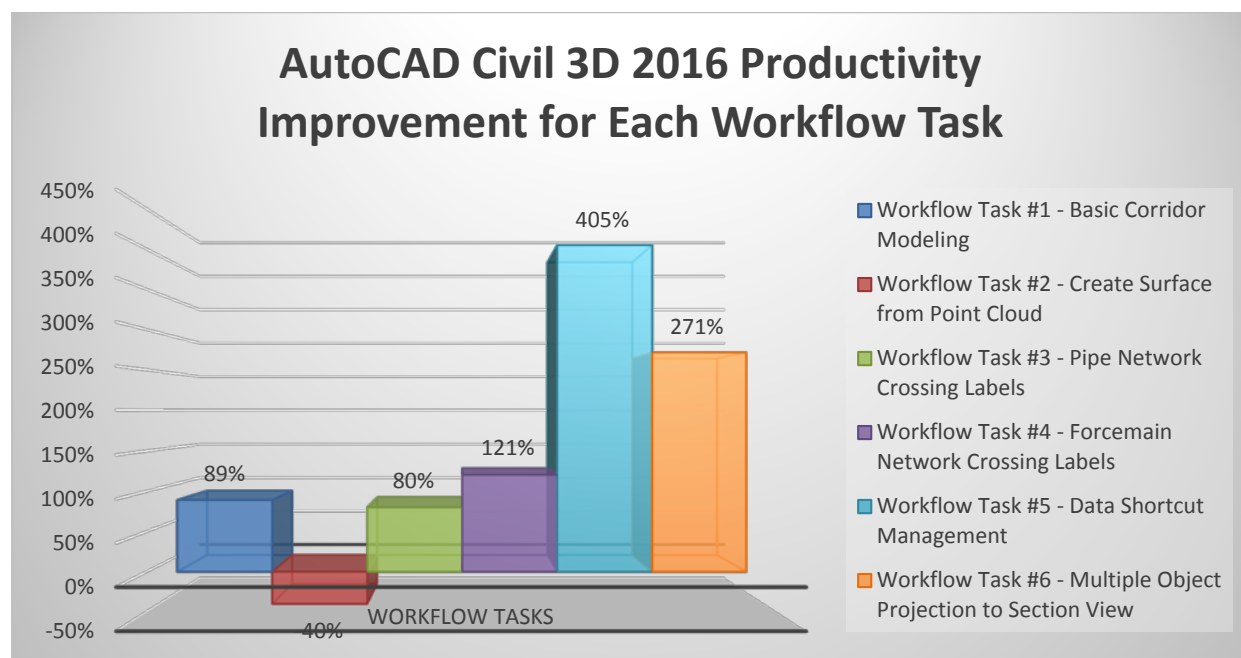
### Executive summary

The following study was developed to look at upgraded and new features of Autodesk® AutoCAD® Civil 3D® 2016 software and compare actual time savings using the same feature or similar workflow in Autodesk® AutoCAD® Civil 3D® 2010 software to produce equivalent results.

In 5 out of the 6 workflow cases we were able to do a direct comparison to more accurately measure the time savings and calculate the Productivity Improvement when comparing to AutoCAD Civil 3D 2010 features or workflow to deliver equivalent results.

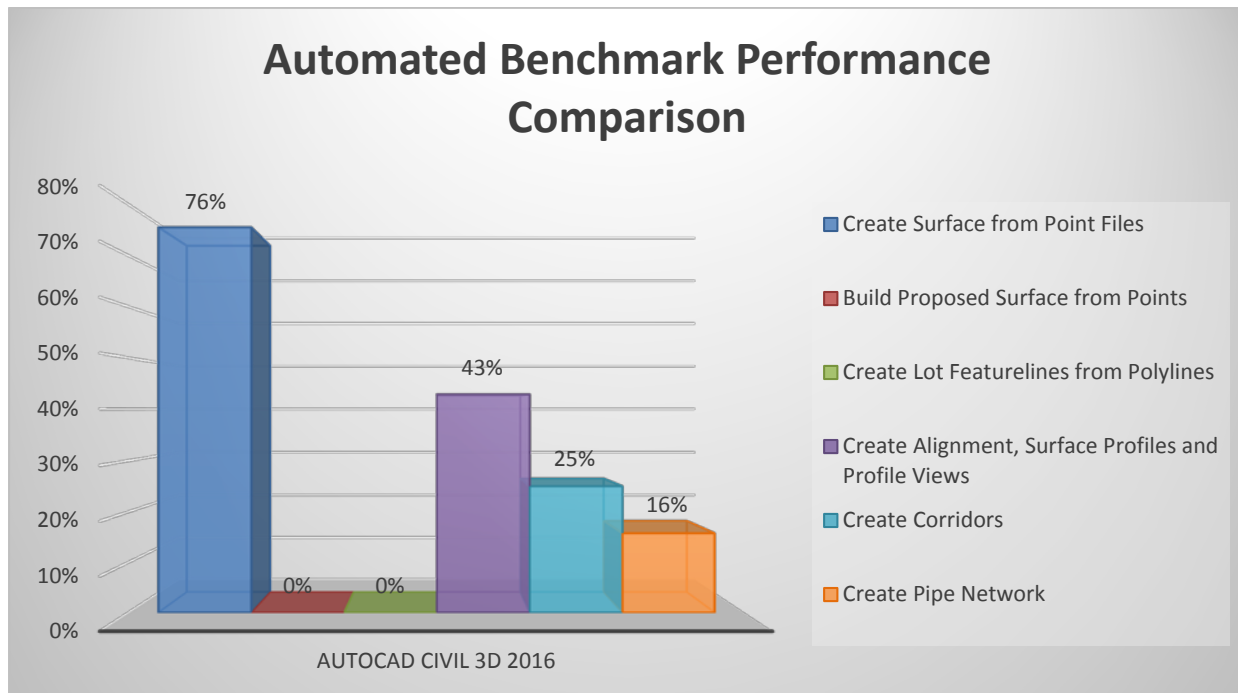
For typical daily tasks like Basic Corridor modeling, Pipe Network Crossing annotation and Force main design, drafting and annotation, the gain was on average a 97% increase in productivity. A significant increase in productivity was found in the workflow to project objects from plan view into multiple sections views automatically. This task was 271% more productive than the feature functionality found in the legacy version of AutoCAD Civil 3D 2010.

When comparing workflows to manage Data Shortcuts for projects where objects needed to be replaced or swapped with updated information, the new Data Shortcuts Manager option proved to be over 405% more productive.



The one workflow task that we could not do direct comparison with was Build Surface from Point Cloud. Instead we compared LiDaR Point Cloud surface building against surface building with standard ASCII point files. This study was added to show that AutoCAD Civil 3D can in fact build surfaces from Points Clouds directly, whereas AutoCAD Civil 3D 2010 had no ability to do this. The metrics show that using Autodesk® ReCap™ 2016 software to index LiDaR files and display them more quickly and easily, without AutoCAD Civil 3D is on its own a big advantage when working with Point Clouds. Once the ReCap files were created, we used AutoCAD Civil 3D 2016 to attach the ReCap file and Build a Surface. This workflow was slightly slower (about 40% less productive) for a surface size of 0.5 million points compared to a typical ASCII Point File attachment to a surface. We know from experience that once the ASCII Point files start to get into the millions, this older workflow to build surfaces from ASCII files becomes significantly slower.

To conclude the study we performed an automated script to build a large dataset and then produce plan and profile sheets using plan production tools, a feature found in each version of AutoCAD Civil 3D. The automated performance improvement overall was on average 50% better when creating the large dataset. The plan production workflow is the same for both and the plotting to DWF™ only slightly faster in AutoCAD Civil 3D 2016 at 18% faster. These metrics could be attributed to better computer hardware used for the AutoCAD Civil 3D 2016 testing.



The main take away from this testing was that using the latest version of AutoCAD Civil 3D means overall better speed and performance compared to AutoCAD Civil 3D 2010 in every case tested.

## Do new features result in increased productivity?

I think that “new features” could be categorized differently depending on the end-user needs and the demands of the extended project team or client. New Features can be categorized in at least 2 ways, “Design Software Updates” and “Industry Trend Changes”.

### Design Software Updates

Typical design software updates can certainly help end-users who have identified productivity “gaps” in current design workflow. Moving to the latest release of software can fill certain gaps with new feature functionality resulting in greater productivity. In most cases, the new feature being introduced is not some random concept thought up during a programmer’s meeting, but an intentional change to the core system, requested by end-users, to help solve a specific issue.

### Industry Trend Changes

Other software updates deal with introducing or addressing specific industry technology trends. An example of an industry trend which needed to be addressed through product update is the main stream adoption of laser scanning technology in almost every design market. Another global trend towards Building Information Modelling (BIM) in the AEC marketplace has required that design software deliverables be more intelligent and compatible with the BIM processes. The reality is that Design and Construction teams looking to do clash detection on sewer, water and utilities could not use the 2D datasets created in AutoCAD® Land Desktop 2009 software.

I think we can all agree that the introduction of AutoCAD Civil 3D in 2005 with its growing list of intelligent objects and annotation in the design production environment was an “industry trend change” that helped Civil Engineers to begin implementing BIM. The continuous improvement of AutoCAD Civil 3D over the last 10 years has helped to revolutionize the way design and drafting is done to deliver projects more efficiently. Since AutoCAD Civil 3D 2010, we have seen the product help address both needs of the industry, our need to constantly improve and deliver, and our need to expand the value of our designs beyond paper and into the world of BIM.

## Developing the study criteria

Keeping in mind that the “new features” can be categorized in at least 2 different ways, we were cautious in this study to select a few meaningful workflows that someone in AutoCAD Civil 3D 2010 would be using on a daily basis. The challenge was to select new feature functionality in AutoCAD Civil 3D 2016 which has a comparative workflow for AutoCAD Civil 3D 2010.

The basic study criteria was to simply perform the task assigned in each product, without bias or interruption and produce the expected results as efficiently as possible in both software releases.

Before beginning the tests, I had no idea what the true “metric” comparison was on the workflows I selected for the study. I didn’t select them because I knew that AutoCAD Civil 3D 2016 would perform better, I selected them based on what I knew AutoCAD Civil 3D 2010 was good at and I wanted to see how AutoCAD Civil 3D 2016 performed in comparison.

In some cases, the test items were selected to show expanded features while others were selected to determine whether the new object or feature was actually better than the “workarounds” used to deliver similar results.

## **Return on the Investment or “Show me the money”**

As a long time user of AutoCAD Civil 3D (on real-world projects), I was equally interested in seeing un-biased results that are clear and measured versus someone’s opinion written about on social media platforms such as blogs. Admittedly, I was an avid AutoCAD Civil 3D 2010 user until AutoCAD Civil 3D 2014 was released. Based on the “changing industry trends” towards BIM, my company identified that AutoCAD Civil 3D 2010 was not a suitable platform to collaborate with stakeholders, specifically addressing the changing DWG formats and DGN translation. We were also compelled to upgrade in order to take advantage of large scale survey point cloud data and associated surfaces provided by surveyors. This is the low-hanging fruit when you need to come up with reasons to justify why you should move to a new release of software. These issues were a real tangible problem that needed action but it’s not necessarily compelling enough if collaboration with others is low on the list when looking at spending money on software upgrades.

Make more money, save more money or Do More with Less are the “metrics” your owner is looking for in making a decision on whether to move to the latest release. For this study, we had to look at the real ROI for each task. After all, the cost of moving to a new release of software is a major corporate decision that is based on real numbers and return on investment year after year. The ultimate decision to update is made by owners, corporate senior managers or IT managers, who in some cases have no idea if an update is “worth the cost and trouble”.

Over the years, “upgrade fatigue” and “if it ain’t broke, why fix it” becomes the standard response from uninformed managers who are looking for the facts before making a decision about internal operating costs. Without studies like this, meeting with decision makers to get upgrades approved based on “it’s really cool” no longer gets you the tools you need to do your job better and deliver projects faster in the current economic environment.

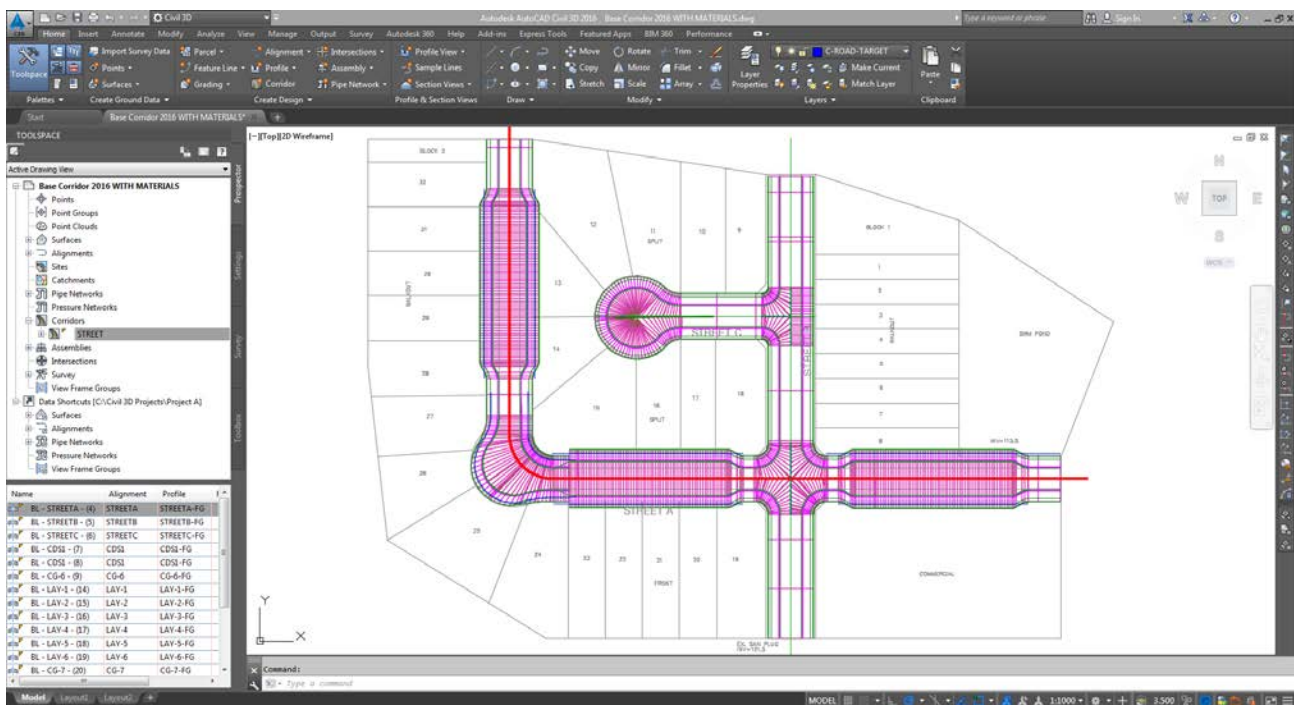
We will review (6) workflows that should make that meeting with decision makers go easier and provide some basis for not just an approval but positive excitement to move from an older version of Civil 3D to Civil 3D 2016.

## The study in detail

The six (6) identified workflow tasks were performed on a small land development sample project consisting of only 3 Streets (35 Lots) with storm, sanitary and watermain. As with most land development projects or road reconstruction projects, repetitive tasks can kill a project budget if the toolset or workflow is not up to the challenge. For each task, if applicable, we expanded the metrics from 3 streets to 30 streets, or a factor of 10x to see the impact for larger projects.

The tasks are as follows:

1. Basic Corridor Modeling – detail a complex land development street network with variable targets and intersections
2. Surface from Point Cloud – compare workflow against building a surface using 500,000 Points
3. Pipe Network Crossing Label in Profile and Section Views – compare a manual process using profile view labels with this new crossing pipe labels annotation feature.
4. Pressure Pipe Network in Profile and Section Views – compare a manual process of creating a watermain using Profile Projection and an Offset Polyline with the new forcemain object.
5. Data Shortcut Management – swapping and replacing data shortcuts mid-project.
6. Multiple Section View Projection – compare the differences in the feature functionality to project multiple object types to the alignment section views



## Workflow Task #1 – Basic Corridor Modelling

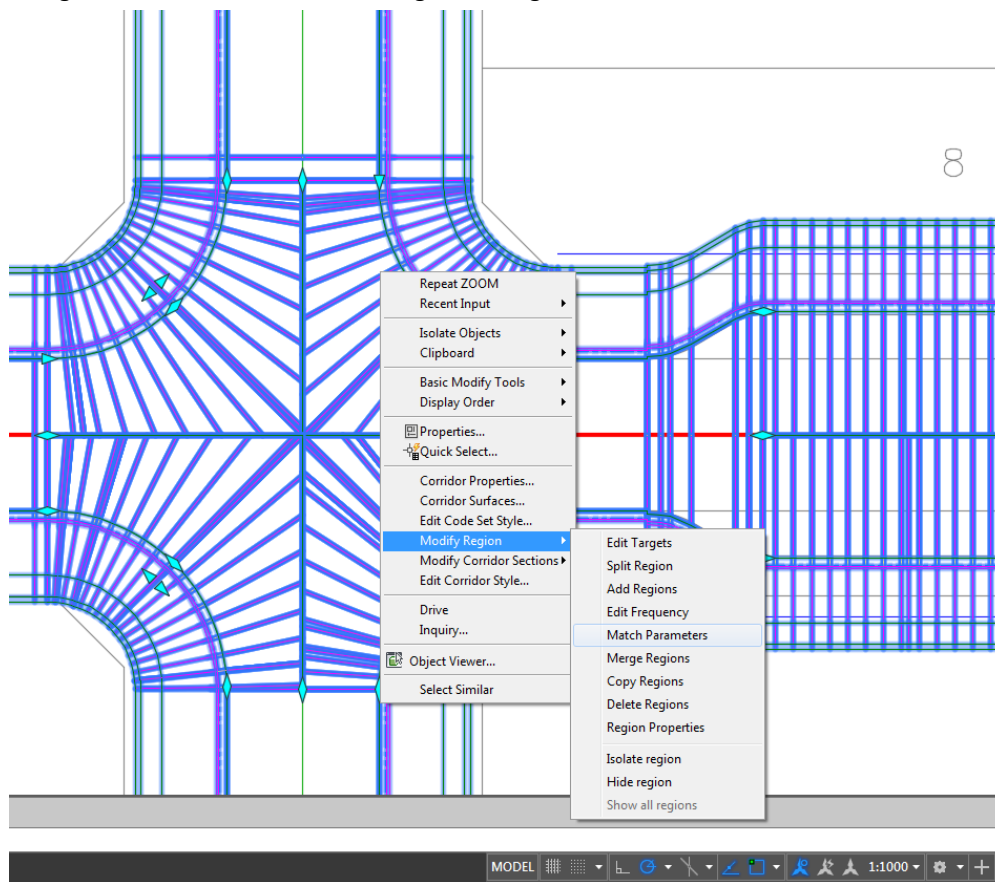
The first task in the study was a fair comparison of basic workflow to create a Street Corridor with Generic Assembly using provided Alignments and Profiles for Streets, Layby curb and intersection curb returns. This is a good example of a “new feature” comparison considered to be in the “Design Software Update” category.

### Create a Basic Corridor using AutoCAD Civil 3D 2016 and AutoCAD Civil 3D 2010

AutoCAD Civil 3D 2010 has a solid corridor modeling process that can be replicated in AutoCAD Civil 3D 2016 by any user who does this sort of work on a daily basis. The basic workflow is virtually the same for both versions which means retraining is kept to a minimum. Enhancing the workflow with new feature functionality is the key objective of AutoCAD Civil 3D 2016 since corridor modeling is a very common design task and any improvement can impact the bottom line in a positive way.

To do a more accurate comparison in new feature functionality versus old feature functionality, we looked at not just building the corridor, but editing it and replacing assembly definition after the corridor is created. Creation of the corridor is slightly faster using AutoCAD Civil 3D 2016, but the real advantage is in the on-screen region editing.

**Right-Click Context Menu** – one of the major improvements to Corridor Editing is the ability to select a corridor, right-click on the object and display the expanded list of editing functions. This feature alone, makes editing complex corridors quicker and easier for any user regardless of experience level. The Edit Targets, Split and Match Parameters are the most popular options when editing this sample project corridor and the editing speed is much quicker than using older AutoCAD Civil 3D 2010 region editing features.



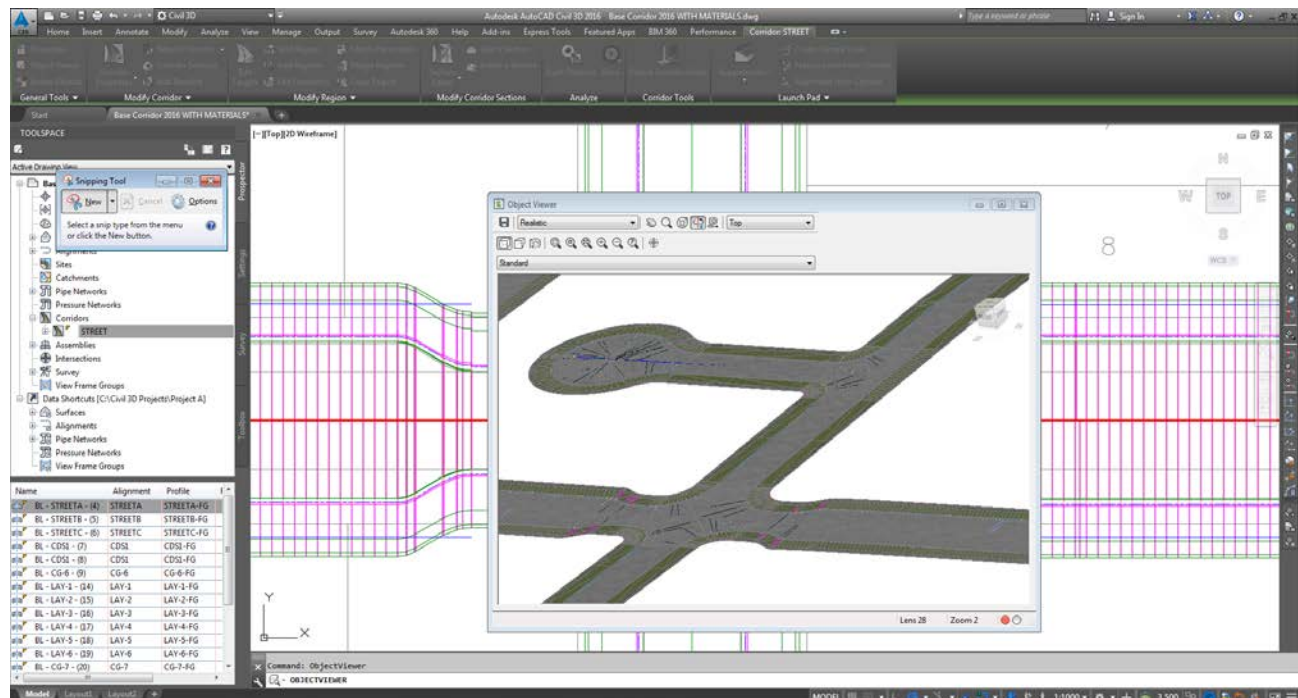


**Assembly Replacement Workflow** – another major improvement in the corridor editing functionality is the ability to “replace” assembly in a selected region and not have to re-target matching sub-assembly targets. In our example, we replaced the curbing type from full size to roll-over in the Layby Curbing baselines in a few seconds. This workflow is a significant improvement over re-doing the targeting for large corridors.

The productivity improvement in AutoCAD Civil 3D 2016 editing and assembly replacement speed is dramatic and important to note. Corridor editing is one of the key tasks in daily workflow that can help support cost savings for any size project.

Corridor Properties - STREET					
Information Parameters Codes Feature Lines Surfaces Boundaries Slope Patterns					
<div> <div> <div></div> <div></div> <div></div> </div> <div> <div></div> <div></div> <div></div> </div> </div> <div>Add Baseline</div> <div>Set all Frequ</div>					
Name	Alignment	Profile	Assembly	Start Station	
BL - STREETA - (4)	STREETA	STREETA-FG		0+000.00m	
RG - ROW - (2)			ROW WITH MATERIALS	0+011.09m	
RG - ROW - (2) [Copy] [...]			ROW WITH MATERIALS	0+094.31m	
RG - ROW - (2) [Copy] [...]			ROW WITH MATERIALS	0+134.25m	
RG - ROW - (9)			ROW WITH MATERIALS	0+209.37m	
RG - ROW - (2) [Copy] [...]			ROW WITH MATERIALS	0+251.71m	
RG - ROW - (2) [Copy] [...]			ROW WITH MATERIALS	0+336.35m	
BL - STREETB - (5)	STREETB	STREETB-FG		0+000.00m	
BL - STREETC - (6)	STREETC	STREETC-FG		0+000.00m	
RI - CDS1 - (7)	CDS1	CDS1-FG		-0+000.00m	

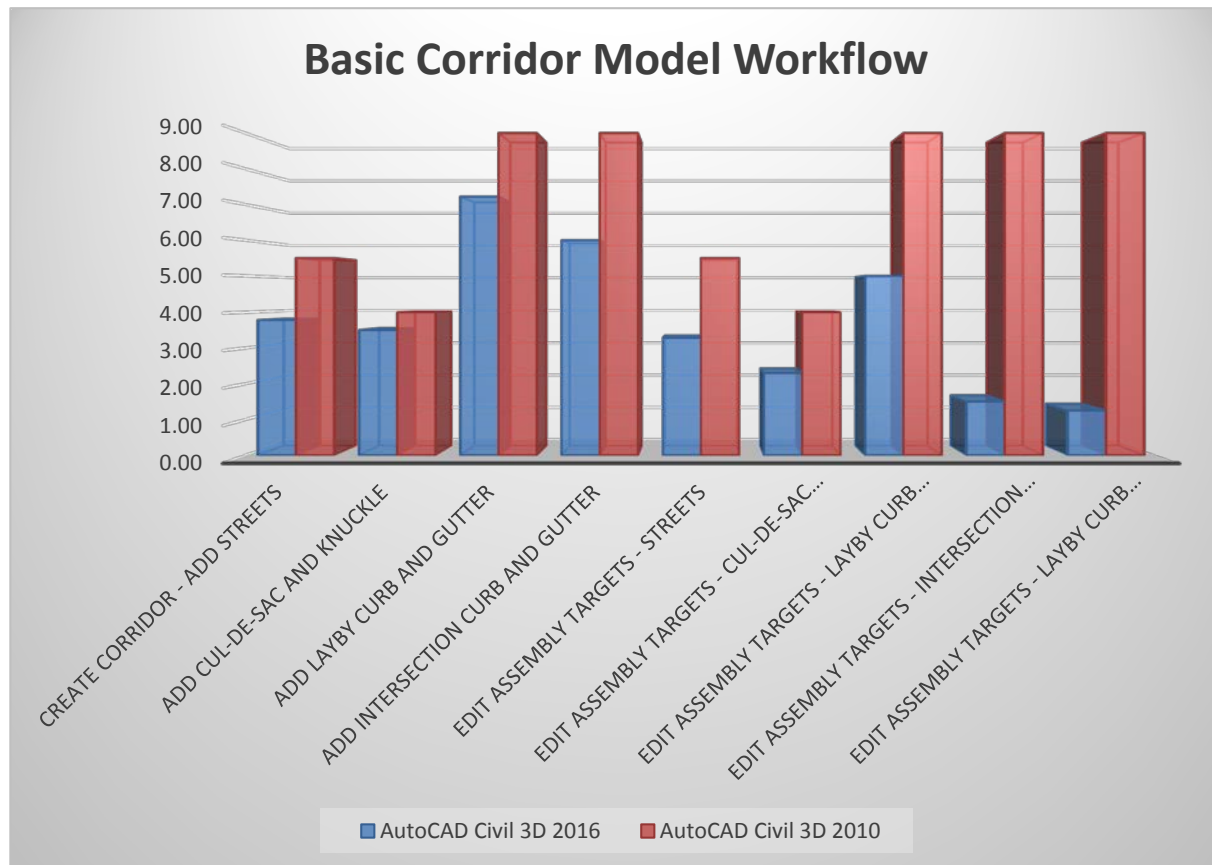
#### Final Results showing the Street Corridor with Materials





## Detailed Workflow #1 Task Completion Metrics

In this set of workflow tasks, AutoCAD Civil 3D 2016 out performs AutoCAD Civil 3D 2010 in every task resulting in a significant performance increase of 89% for this small project. On larger projects with many more streets, intersections, knuckles and cul-de-sacs, along with repetitive design edits to targeting and assembly changes, this performance benefit has the potential to help significantly increase daily productivity.



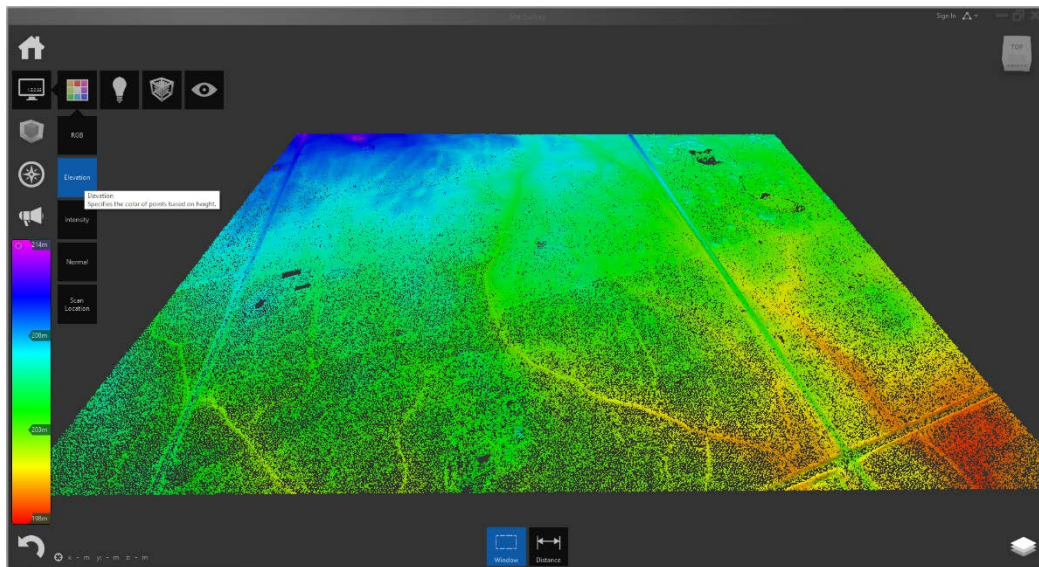
<i>Time to Complete Task</i>	<b>AutoCAD Civil 3D 2016 (Minutes)</b>	<b>AutoCAD Civil 3D 2010 (Minutes)</b>	<b>Time Savings (Minutes)</b>	<b>Performance Increase (Faster)</b>
<i>Overall Summary of Time Savings</i>	33.83	64.00	30.17	89%

## Workflow Task #2 – Surface from Point Cloud

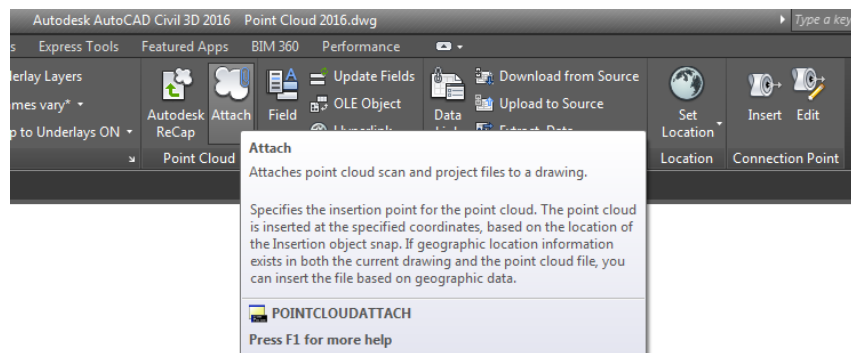
The next workflow task we looked at would be considered more of an “Industry Trend Update” available in AutoCAD Civil 3D 2016 to address the growing popularity of laser scanning and point cloud deliverables. Previous releases of the Point Cloud attachment did not directly create a surface for design. To address the comparison between AutoCAD Civil 3D 2016 and AutoCAD Civil 3D 2010, we looked at two (2) dataset types for the same land development project. We looked at key differences in workflow to achieve the same goal to build an original ground surface ready for design, then compared processing times and performance.

### Create a Surface from Laser Scan Data Workflow using AutoCAD Civil 3D 2016

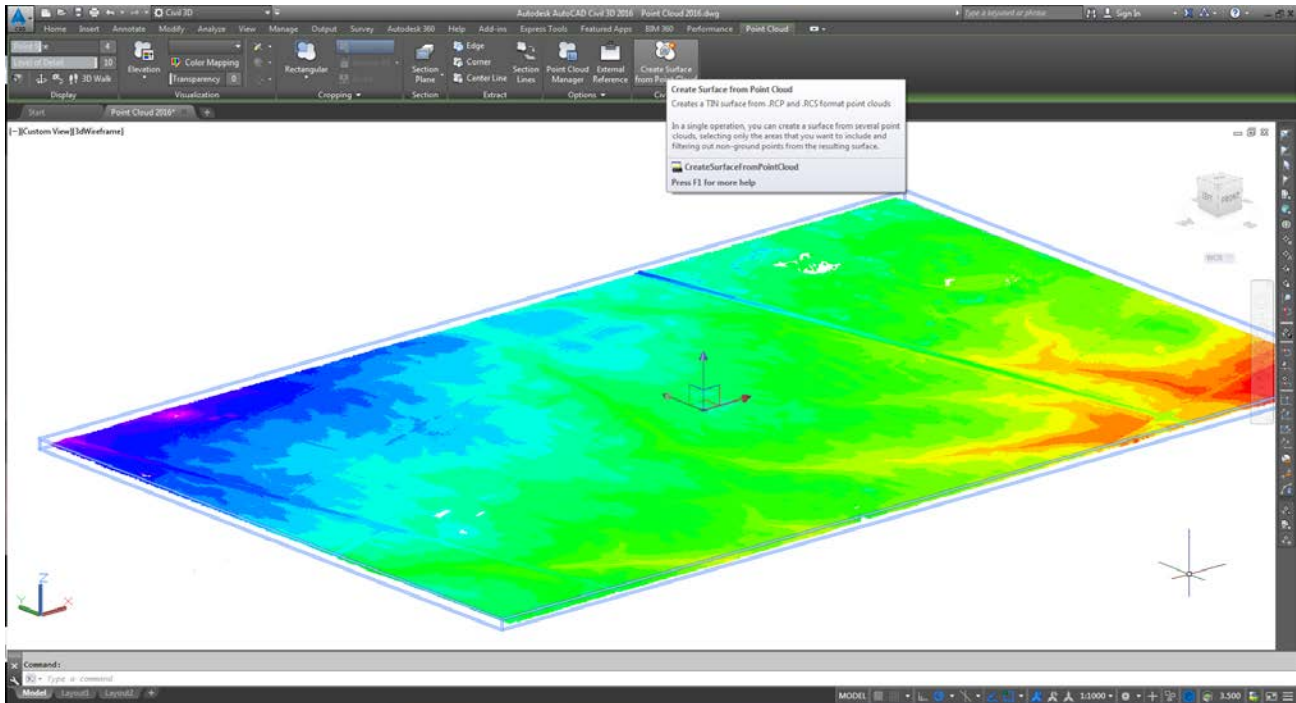
This process required the use of Autodesk® ReCap™ 2016 software to process six (6) LiDaR LAS file formats. The Autodesk ReCap product processed the LAS files within 1 minute, providing a quick viewing and elevation analysis theming of approx. 500,000 points outside the AutoCAD Civil 3D environment. Keep in mind that Autodesk ReCap can handle literally hundreds of millions of LiDaR points in a single project. Using Autodesk ReCap, we saved the indexed LAS files as a single RCP file, ready for AutoCAD Civil 3D attachment.



Our next step in this workflow process was to attach the Point Cloud RCP file to the current AutoCAD Civil 3D Drawing. Using the AutoCAD Civil 3D Import Tab in the User Interface menu, we selected the “Attach” Point Cloud option then selected the RCP file created using Autodesk ReCap.

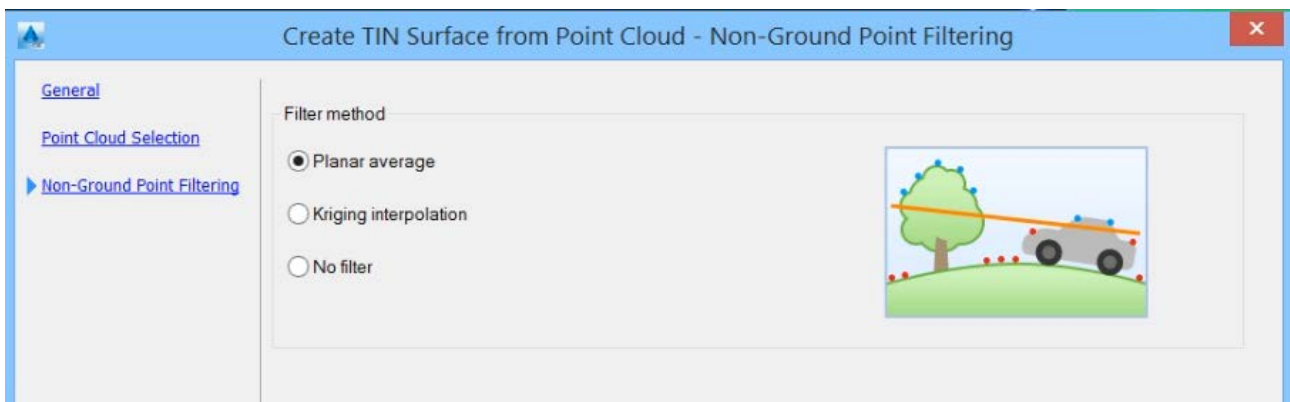


Once the Point Cloud was attached, we were able to select it and review the context user interface menu with various visualization and editing options. Under the Civil 3D Panel in the user interface is the “Create Surface from Point Cloud” option. This means we can attach indexed RCP file and build a Surface ready for design within a few minutes.



### Non-Ground Surface Processing

One of the unique options of building a surface directly from LAS or RCP file formats is the feature functionality to filter point cloud data points above bare ground ie..trees, signs, poles, overhead wires etc. This is an important workflow advantage for the design team when working with LiDaR files which have been provided directly from the field with minimal post-processing.

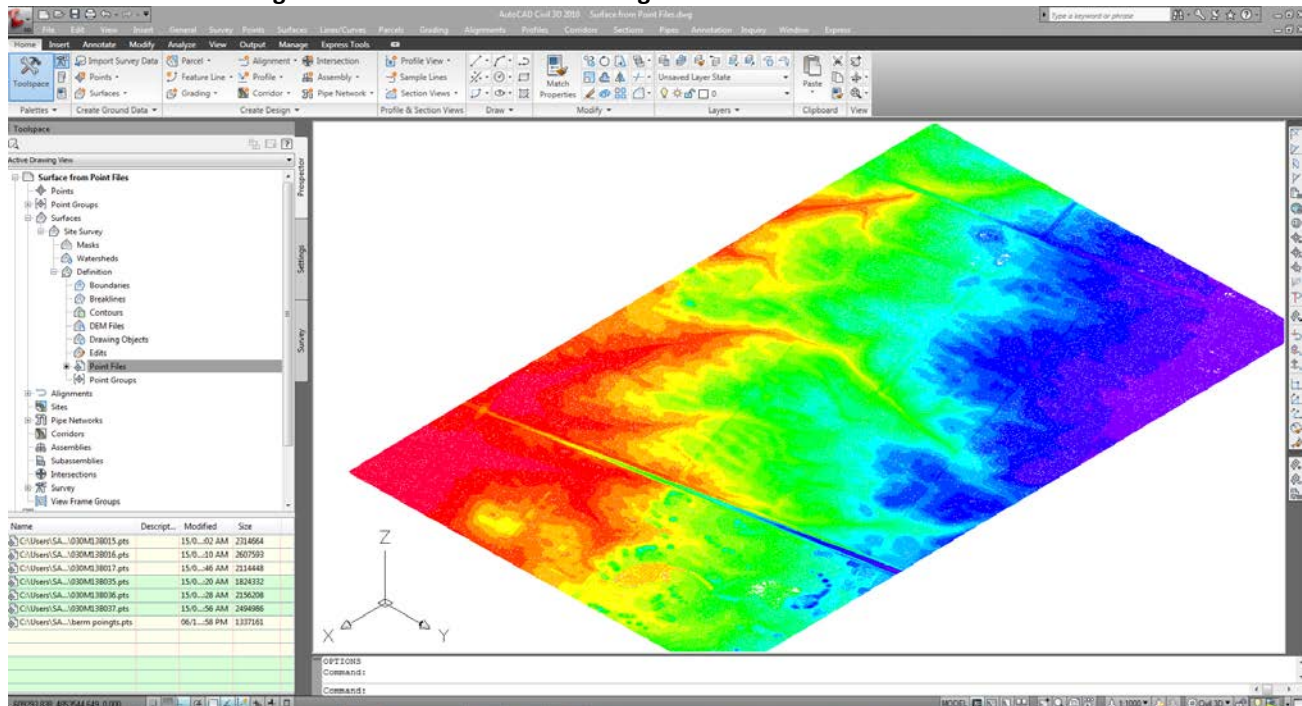


### Create a Surface from ASCII Point Data Workflow using AutoCAD Civil 3D 2010

Since the Point Cloud feature functionality is not available in AutoCAD Civil 3D 2010, we had to look at how a design firm might bring in the Point Cloud datasets without LAS file format support. The only choice available was to have the survey firm provide a clean, post-processed “Key Points” or “Bare Ground” set of ASCII files in XYZ format. This is a typical delivery format for most surveyors providing topographic survey information to engineers. The key workflow difference here is the fact that survey firms would have to do the work to filter the data before it was delivered to the engineer. In AutoCAD Civil 3D 2016 we have seen that the “Non-Ground Surface Processing” filters will perform this task without additional costs and time spent by others. For this report, we did not quantify the hours needed to filter the data on the provided files.

The alternative workflow in AutoCAD Civil 3D 2010 was to simply Create a Surface and Attach the XYZ Comma delimited ASCII files to the surface using traditional surface definition workflow. Warning: Bringing in actual Cogo Points using Point Import is NOT recommended based on the volume of points for this site.

### Final Results of attaching the Point Files to a Surface using AutoCAD Civil 3D 2010



### Surface Level of Detail (LOD) for Large Surfaces

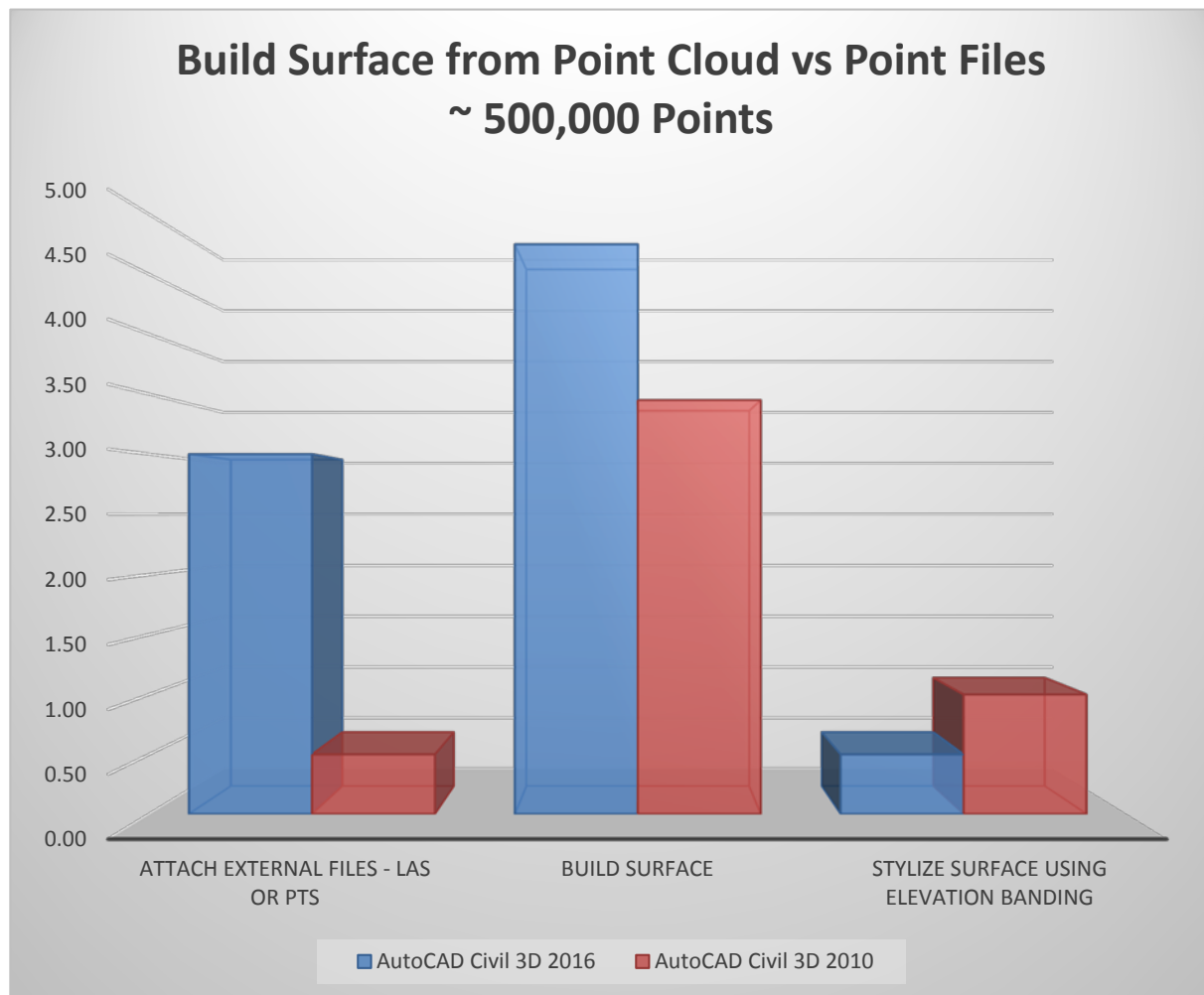
AutoCAD Civil 3D 2010 performed quite well in this task attaching 500,000 points and building a single surface. What about 5 million points, how about 50 million points? Unfortunately, as the number of points increase into the millions, AutoCAD Civil 3D 2010 starts to struggle with Surface Display and overall performance. For larger surfaces, AutoCAD Civil 3D 2016 has functionality to automatically change the surface “Level of Display” to maintain performance on large surfaces with millions of points. This is a critical difference in the 2 releases that cannot be ignored if you are dealing with large surfaces on a daily basis.



### Detailed Workflow #2 Task Completion Metrics

In this set of workflow tasks, AutoCAD Civil 3D 2010 out performs AutoCAD Civil 3D 2016 in the first 2 steps to create the surface. In the third task, using the Level of Detail (LOD) feature to maintain display performance resulted in better regeneration speeds for the surface when elevation banding surface style was used.

Keep in mind that AutoCAD Civil 3D 2016 has the identical ability to use ASCII Point Data in the same way as AutoCAD Civil 3D 2010. On larger projects with many more surface points we expect that the use of AutoCAD Civil 3D 2016 to attach Point Clouds directly, build surfaces and display surfaces at variable resolution will become the norm as it offers a significantly better workflow than traditional methods using ASCII Point file attachment.



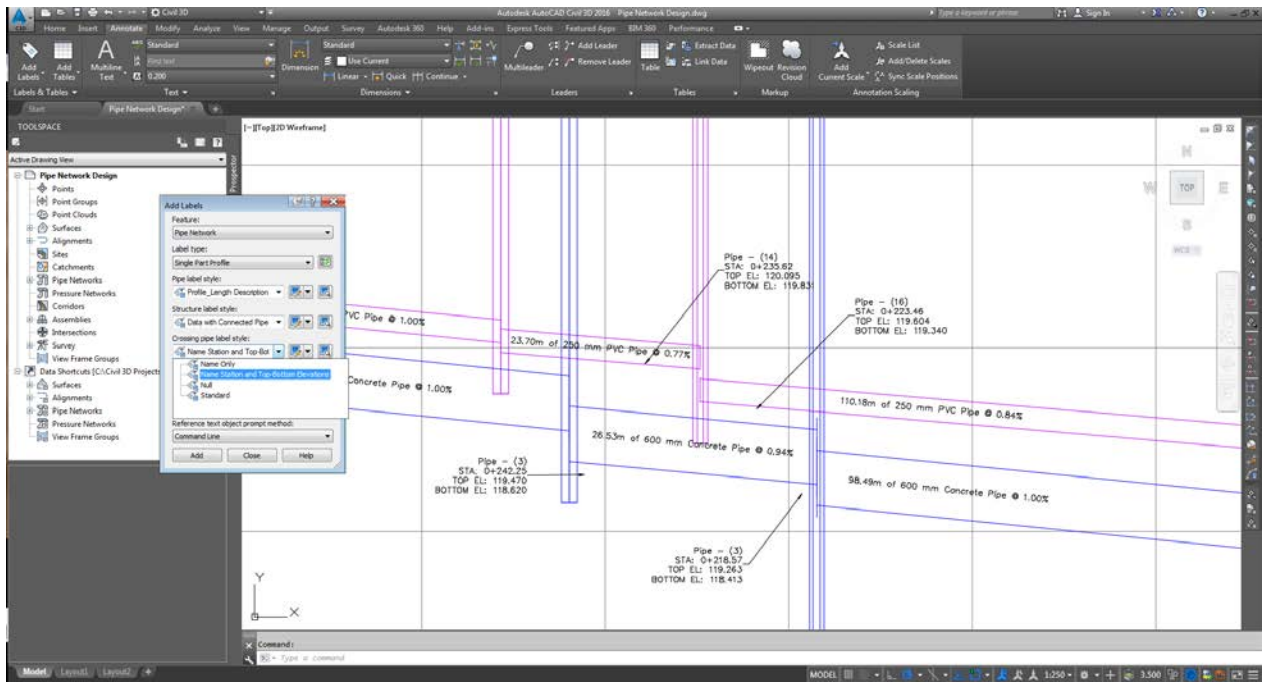
<i>Time to Complete Task</i>	AutoCAD Civil 3D 2016 (Minutes)	AutoCAD Civil 3D 2010 (Minutes)	Time Savings (Minutes)	Performance Increase (Slower)
<i>Overall Summary</i>	8.25	4.95	33.30	40%

### Workflow Task #3 – Pipe Network Crossing Label in Profile and Section Views

Our third workflow task addresses the need to annotate Pipe Network pipe information at the point where they cross the street alignment. The ability to do this has been a long standing request by users. In order to test the use of the “new feature” versus the “old workflow”, we needed to create a Pipe Network for our small sample project. Since we were creating the Pipe Network from scratch, time analysis was done in both cases to see if any changes in workflow existed between 2010 and 2016 versions. Those metrics are shown in the graphic below.

#### Create a Pipe Crossing Annotation using AutoCAD Civil 3D 2016

The new annotation feature for this workflow is found under the Pipe Network Annotation, Single Part Profile, Crossing Pipes label style. We used the out-of-box style to label the Name, Station, Top and Bottom Elevations of Pipe at the alignment crossing point.



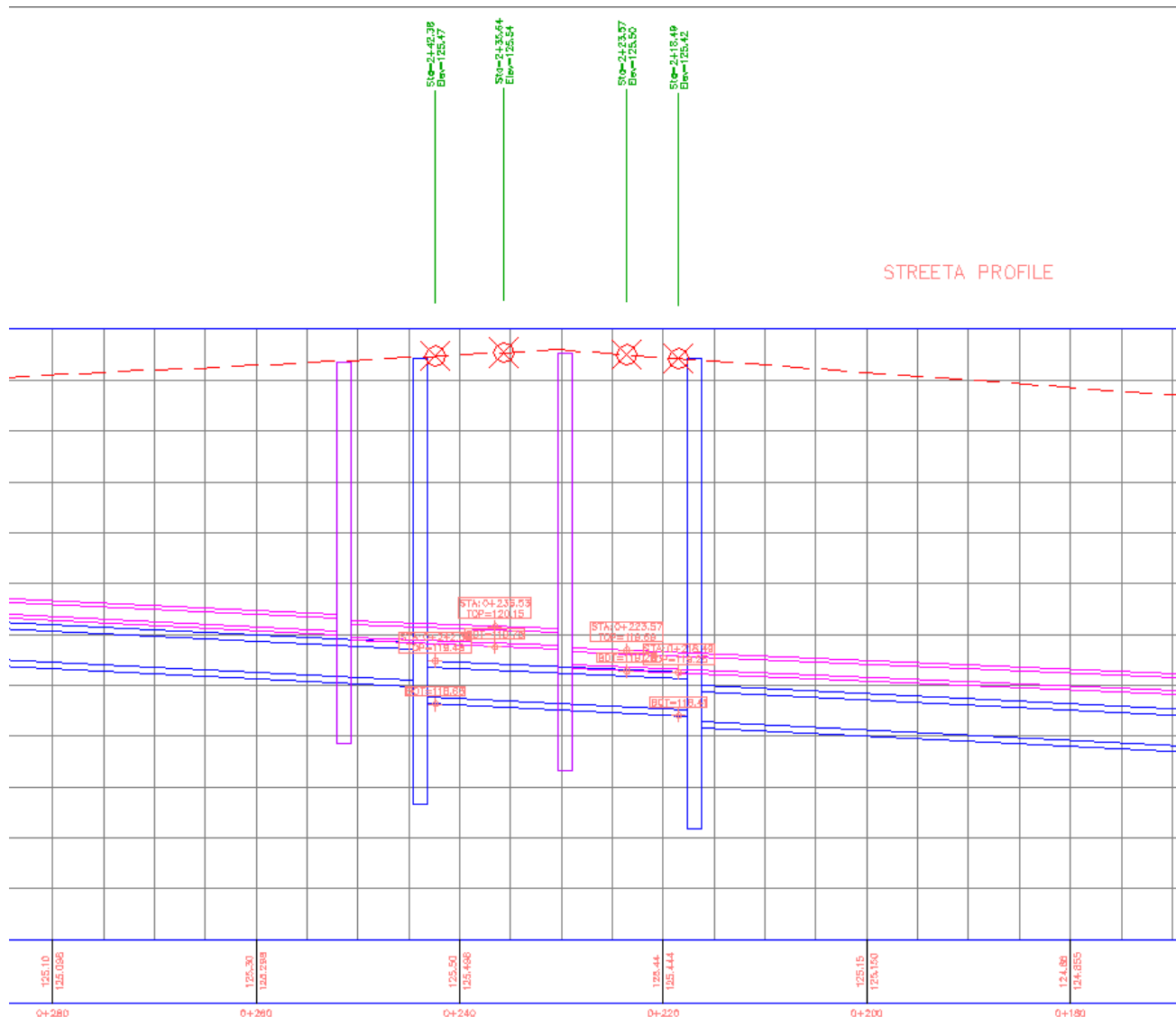
As with any dynamic annotation in AutoCAD Civil 3D, changes to the alignment, pipe design or it's crossing location are dynamically updated in the profile view. Based on the workflow outlined using AutoCAD Civil 3D 2010, this could mean significant savings should the project have many crossing points.

#### Create a Pipe Crossing Annotation using AutoCAD Civil 3D 2010

To easiest method to create the pipe crossing label at points where the pipe object crosses the alignment object in AutoCAD Civil 3D 2010 is to project a placed AutoCAD point to the alignment Profile View and label the Pipe Top and Bottom using standard Profile View spot elevation labels. The first step to accomplishing this is to set AutoCAD Points at every crossing point and do the Profile View projections. This is time consuming depending on the number of crossings. Once projected, the crossing points are shown in profile view. Then using simple profile view labels we can pick the Top and Bottom of the Pipe Object which crosses the alignment.



Should the alignment change, pipe location or elevation change, this would all have to be reviewed and updated for every crossing. The graphic below shows the projected points and associated profile view labels.



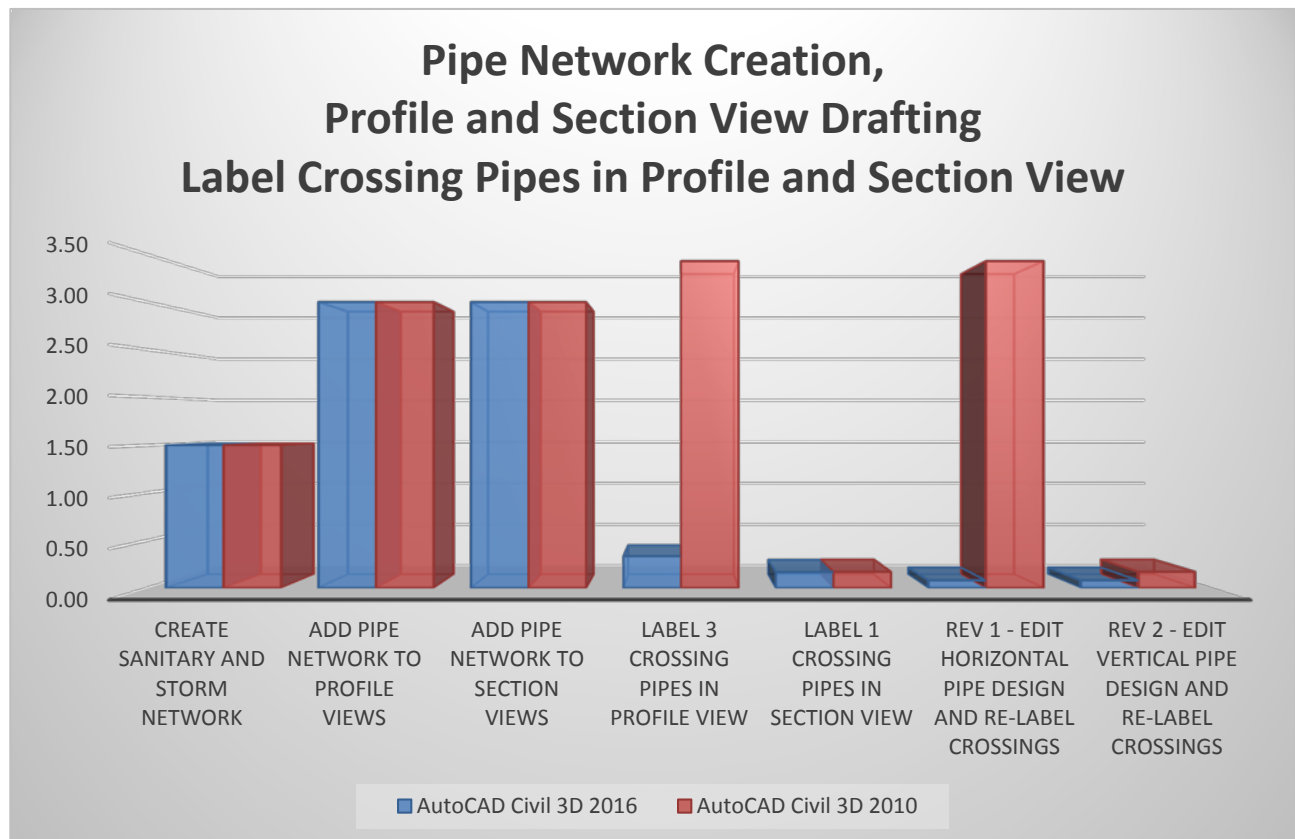
### Nothing beats Annotation that Dynamically Updates

The instant labeling and updating of pipes crossing labels in profile view versus performing the steps required to project points and label pipes without dynamic updating is the ultimate advantage for those who need and use this feature. The metrics shown below illustrate the advantage AutoCAD Civil 3D 2016 has over AutoCAD Civil 3D 2010 in this area.

### Detailed Workflow #3 Task Completion Metrics

The initial workflow to create a Pipe Network, draft the Pipes and Structures in profile views and section views is considered equal to the older version of AutoCAD Civil 3D 2010. If you are not using AutoCAD Civil 3D for Pipe Network design and drafting, please take a second look at these metrics on their own. Basically, the small site sample with 3 streets took less than 10 minutes to create and draft the pipe network with dynamic labels.

Adding the dynamic pipe crossing annotation style in AutoCAD Civil 3D 2016 resulted in huge time savings when labeling even just a few crossings in this sample project. Updating the pipe crossings is dynamic and requires no time versus re-checking them in older versions of AutoCAD Civil 3D.



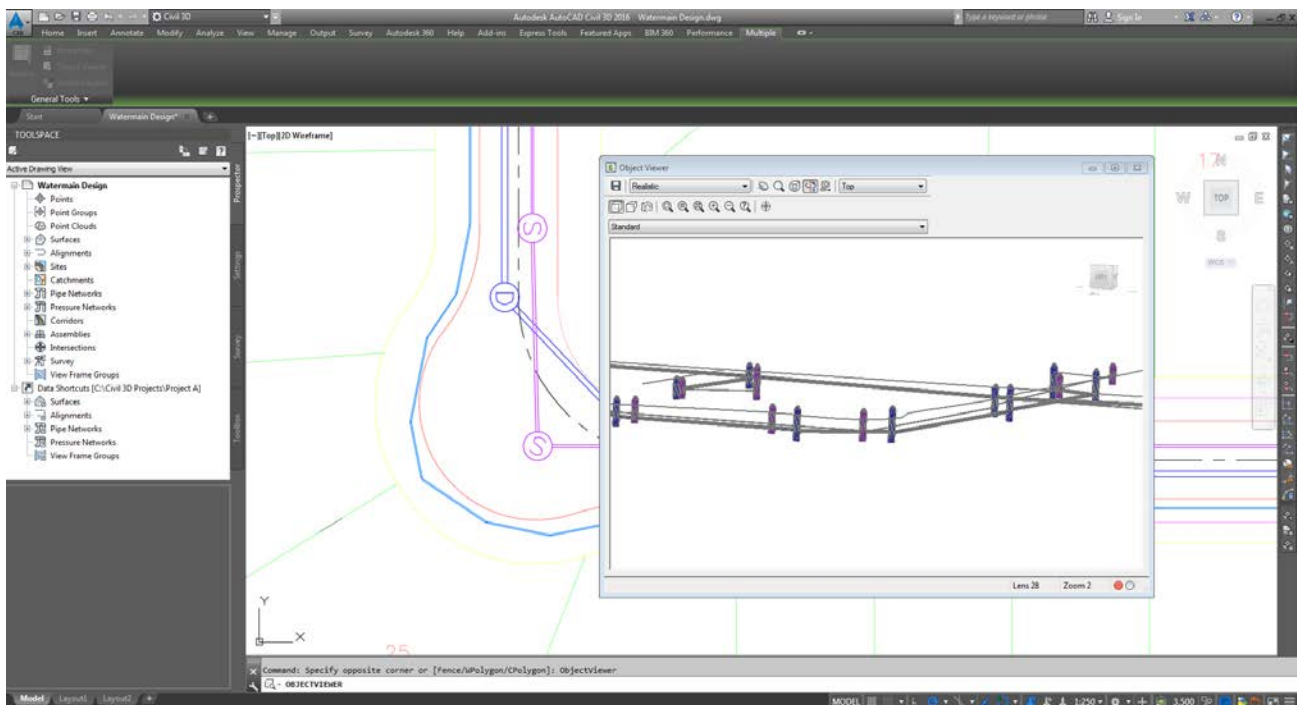
<i>Time to Complete Task</i>	<b>AutoCAD Civil 3D 2016 (Minutes)</b>	<b>AutoCAD Civil 3D 2010 (Minutes)</b>	<b>Time Savings (Minutes)</b>	<b>Performance Increase (Faster)</b>
<i>Overall Summary of Time Savings</i>	8.16	14.70	6.54	56%

## Workflow Task #4 – Pressure Pipe Network in Profile and Section Views

The fourth workflow specifically looked at how pressure pipes were created and drafted using AutoCAD Civil 3D 2016 compared to AutoCAD Civil 3D 2010, which didn't have the pressure pipe network object. This was another long standing feature request.

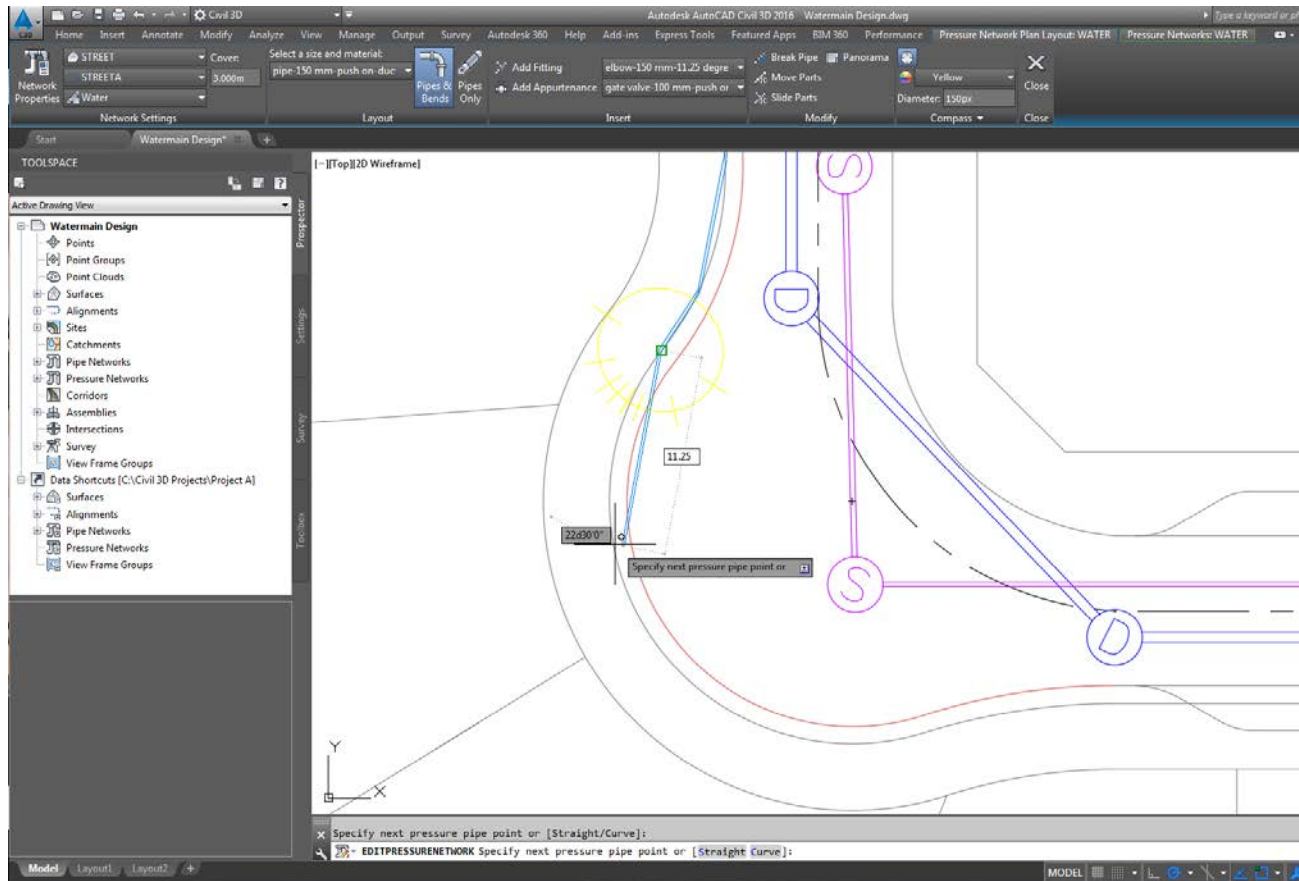
### Create and Draft a Pressure Pipe Network using AutoCAD Civil 3D 2016

Similar to the Pipe Network, the Pressure Pipe Network has parts lists with pipes and connectors. These dynamic objects are digitized in plan view with all the applicable size and material types associated with any pressure pipe. For this sample site, we defined the Pressure Pipe network as a typical watermain (pipes) with bends (connectors) which was set at 1.75m below the corridor surface. The graphic below depicts the Pipe Network for Sanitary, Storm and the Pressure Pipe Network for Watermain, all in the same model with the same feature functionality we have come to expect with respect to dynamic annotation and drafting in plan view, profile view(s) and section(s) views.



### Digitizing Watermain Bends

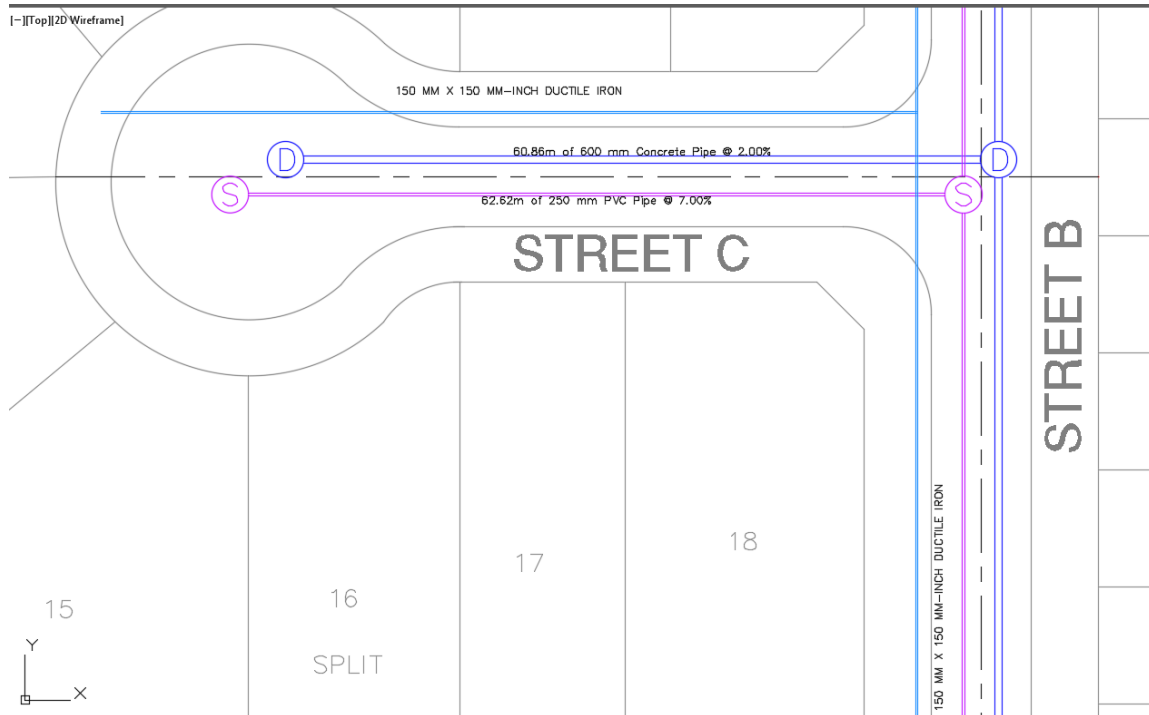
One huge advantage of AutoCAD Civil 3D 2016 forcemain object creation is the feature settings to set bend angles which are required for standardized design. This feature alone makes the creation of the pressure pipe in street knuckles or intersections where bends are required quicker and easier.



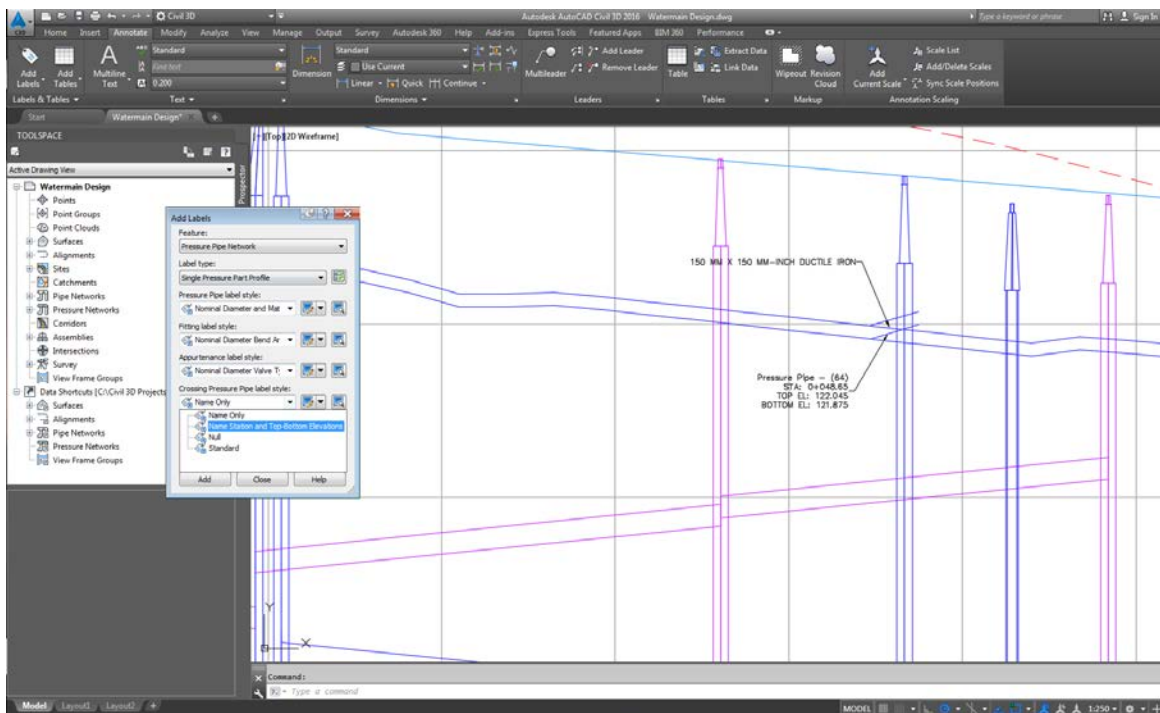
### Forcemain Pipe Crossing Annotation

In AutoCAD Civil 3D 2016, the Pressure Pipe annotation options includes the Pressure Pipe, Single Part Profile View, Pipe Crossing alignment annotation label style. Civil 3D 2016 provides the same feature functionality for pressure pipe crossing that we have in pipe network labeling.

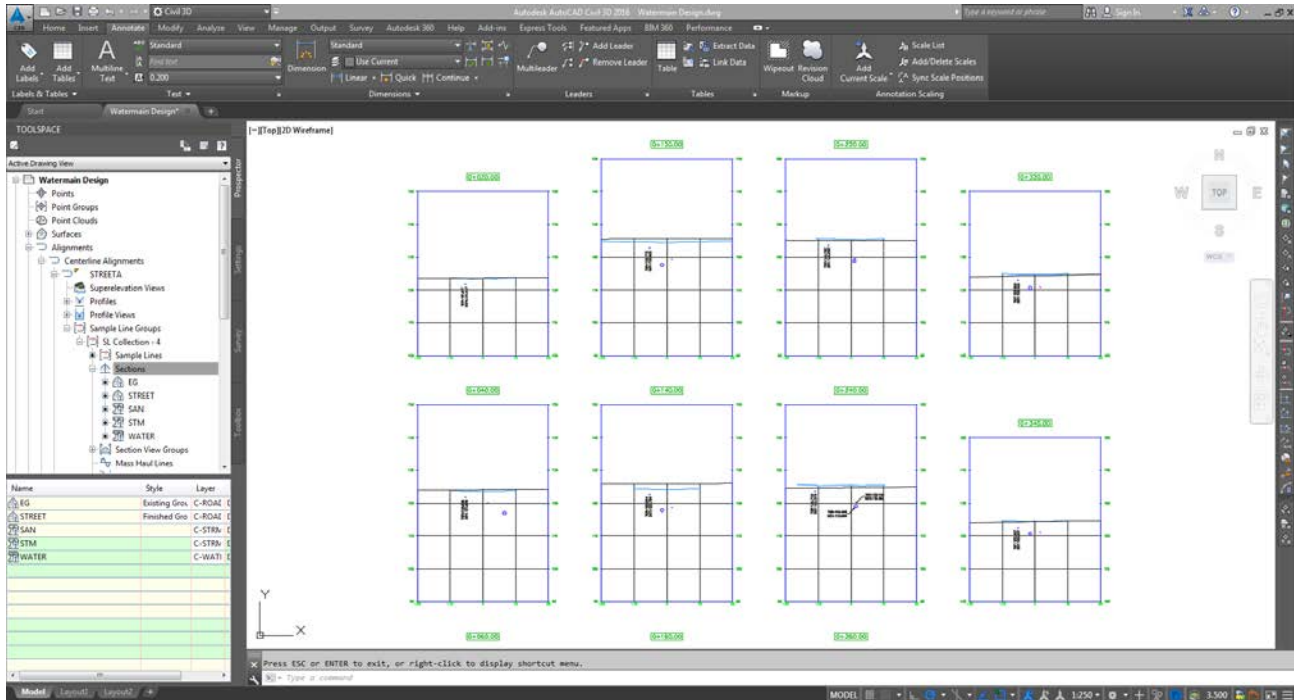
## Typical Plan View Annotation



## Typical Profile View Drafting and Annotation



## Typical Section View Drafting when Watermain is used as a Section Line Sample Datasource



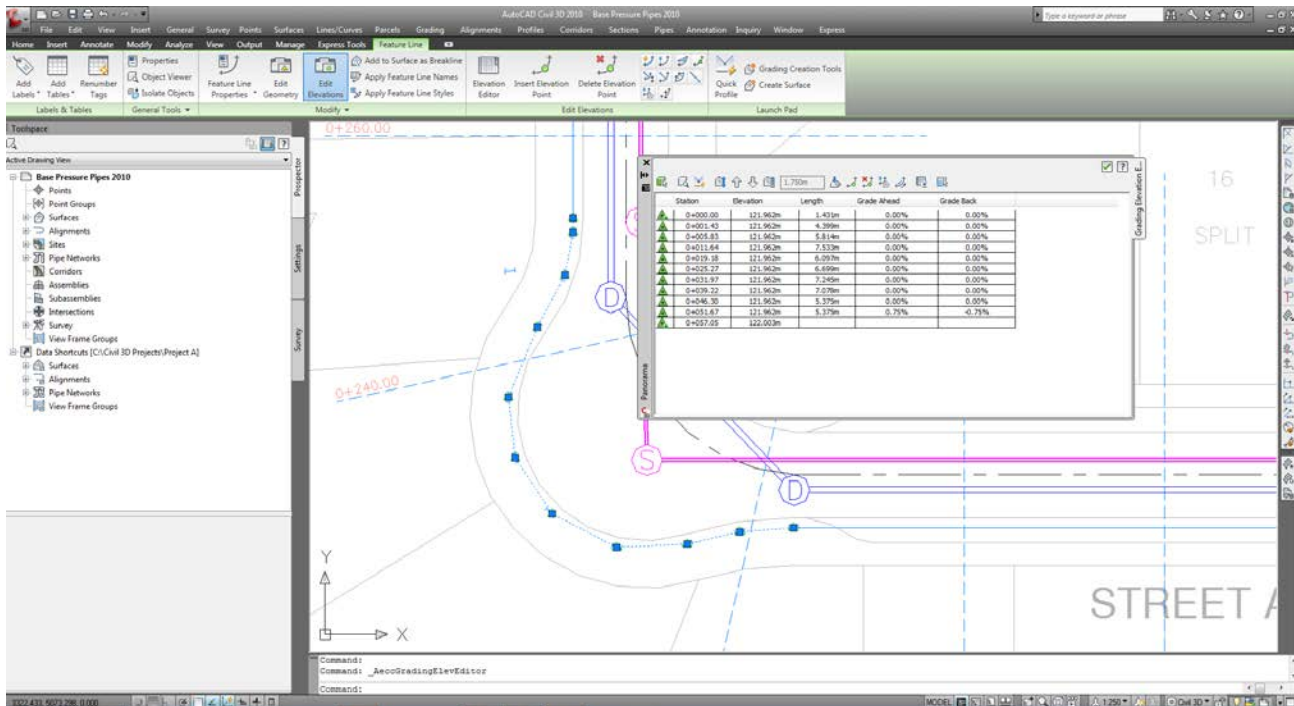
## Create and Draft a Pressure Pipe Network using AutoCAD Civil 3D 2010

To replicate a forcemain or watermain in AutoCAD Civil 3D 2010 we had to use the work-around to project a “Featureline” (aka.. watermain) from Plan View to Profile View and Section View. To start this process, we used a “watermain” Featureline to depict the watermain in plan view, and then draped the Featureline to the street surface at 1.75m below the proposed ground. We then used the Profile View functions to “Project Object to Profile View” which resulted in a dynamic Featureline (obvert of the pipe) shown in Profile View. Once the object is projected, we re-digitized the projected Featureline as a guide and offset it the applicable amount to show the “watermain” in profile view.

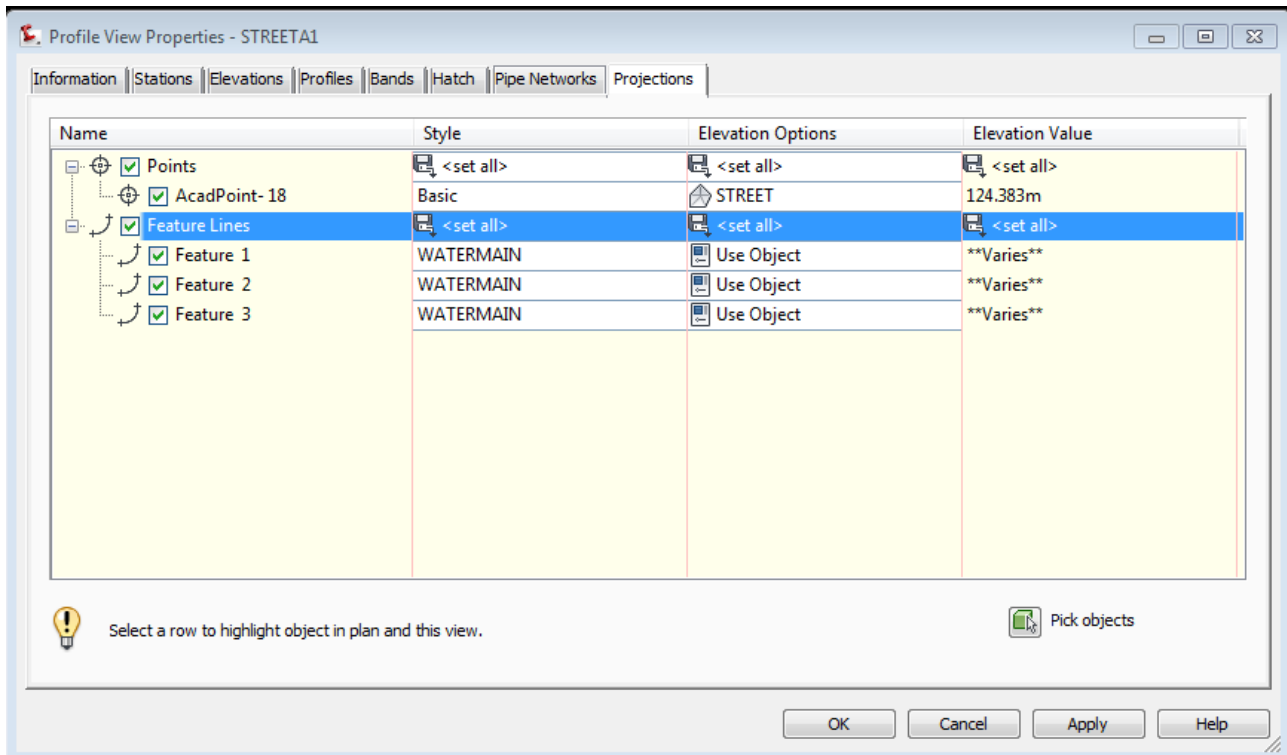
The same projection process was used to show the Featureline position in Section View. Since the AutoCAD Civil 3D 2010 function to project objects in Section View only includes one view at a time, the projection would have to be done for every Section View individually. You can imagine the time required to do hundreds of view on a long stretch of watermain spanning miles.



## Setting the Featureline “Watermain” Elevations using AutoCAD Civil 3D 2010



## Projecting the Featureline “Watermain” into the Profile View using AutoCAD Civil 3D 2010



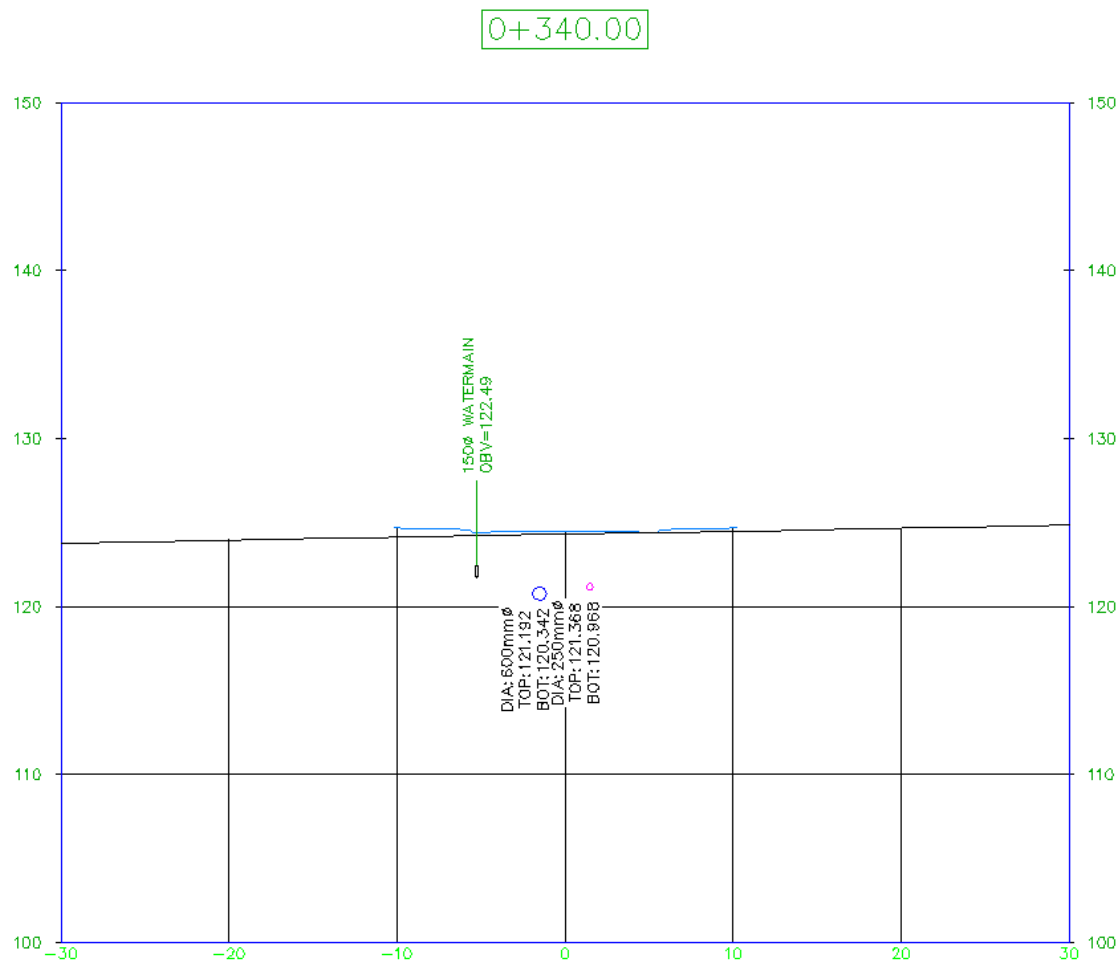
### Projecting the Featureline “Watermain” into Section View using AutoCAD Civil 3D 2010

In Section View, each “Featureline” projected has to have a different style based on diameter to stylize differently in Section Views

Section View Properties - 0+340.00 (17)

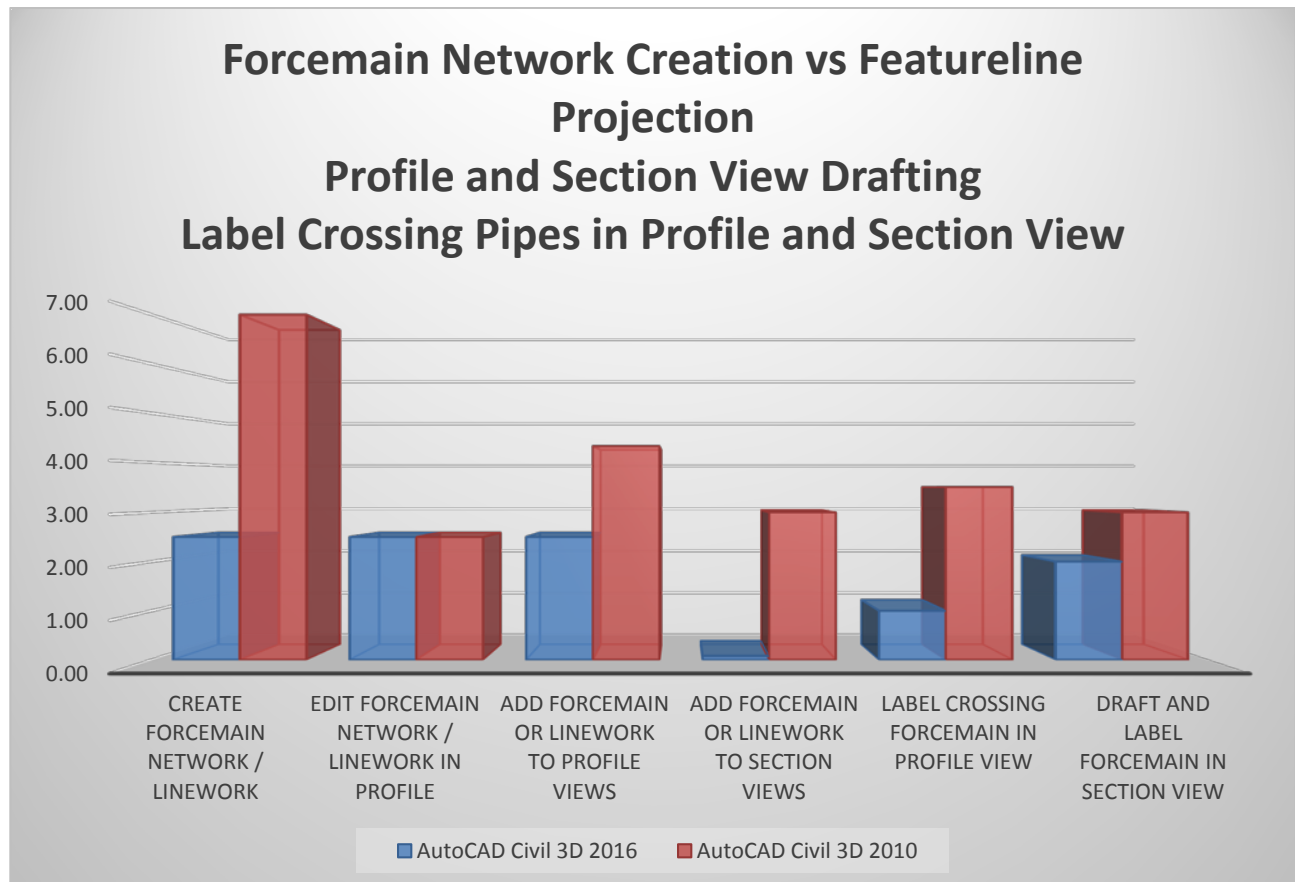
Name	Style	Elevation Options	Elevation Value
<input checked="" type="checkbox"/> Feature Lines	<set all>	<set all>	<set all>
<input checked="" type="checkbox"/> Feature 1	WATERMAIN	Use Object	122.489m

### Resulting Section View Projection of the Featureline



#### Detailed Workflow #4 Task Completion Metrics

Right from the first task, the AutoCAD Civil 3D 2016 workflow to create, draft and label pressure pipe networks outperforms the AutoCAD Civil 3D 2010 work-around workflow. With an overall performance increase of at least 45%, the workflow shows realistic performance gains in every aspect of the tasks required. Specifically in Adding Forcemain to the Profile Views and Section Views, the older work-around cannot compete. For larger projects, the results of this aspect of the study could help significantly influence the planning of resources and budgets for project delivery.

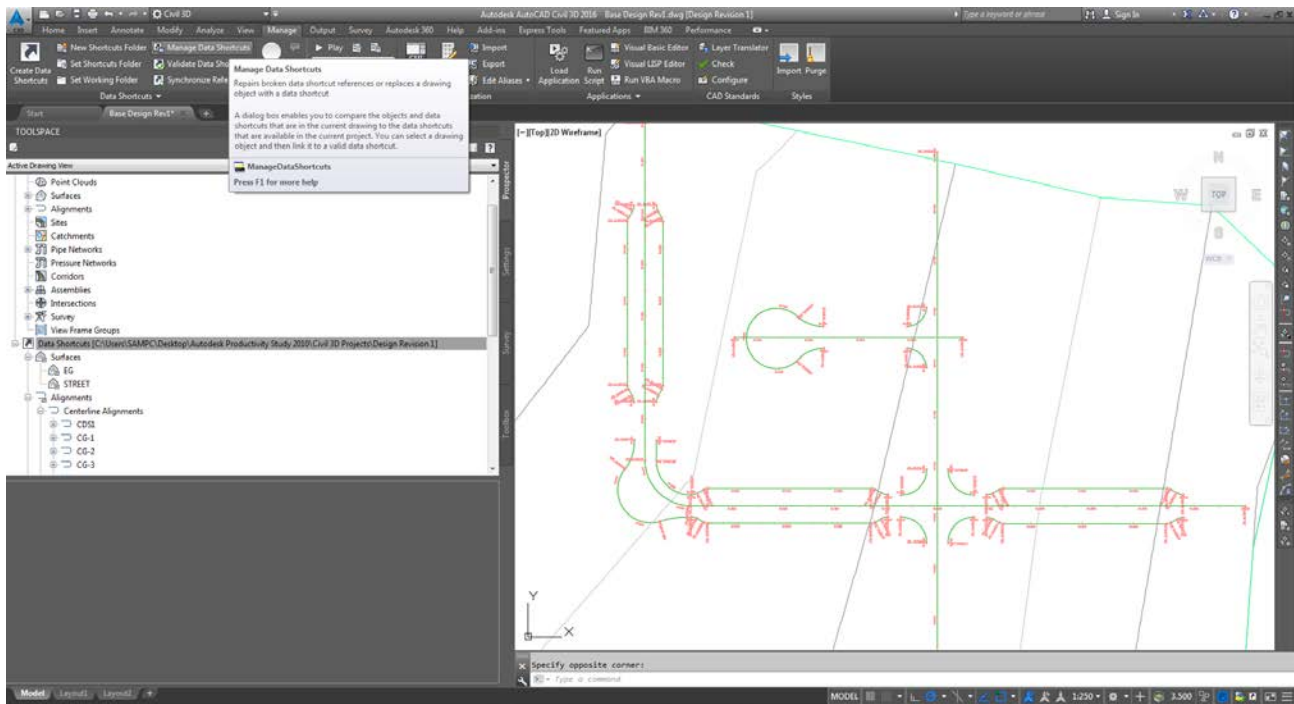


<i>Time to Complete Task</i>	<b>AutoCAD Civil 3D 2016 (Minutes)</b>	<b>AutoCAD Civil 3D 2010 (Minutes)</b>	<b>Time Savings (Minutes)</b>	<b>Performance Increase (Faster)</b>
<i>Overall Summary of Time Savings</i>	10.58	23.33	12.75	45%

## Workflow Task #5 – Project Data Shortcut Management

This workflow task was selected as a “Design Update Feature” based on the need to “swap” core Civil 3D design objects without having to delete, replace and reconnect any associated dependent objects. A good example would be to swap a survey surface with an updated survey surface. Another example would be to swap an alignment and profile from one design concept with another while affecting the connected corridor and corridor surface.

In so many cases, swapping or re-defining the shortcuts to project objects presents another level of complexity that needed to be addressed. The comparison for this workflow study is really simply comparing the new Data Shortcuts Manager versus the task of deleting, replacing and reconnecting objects one by one using first principles.

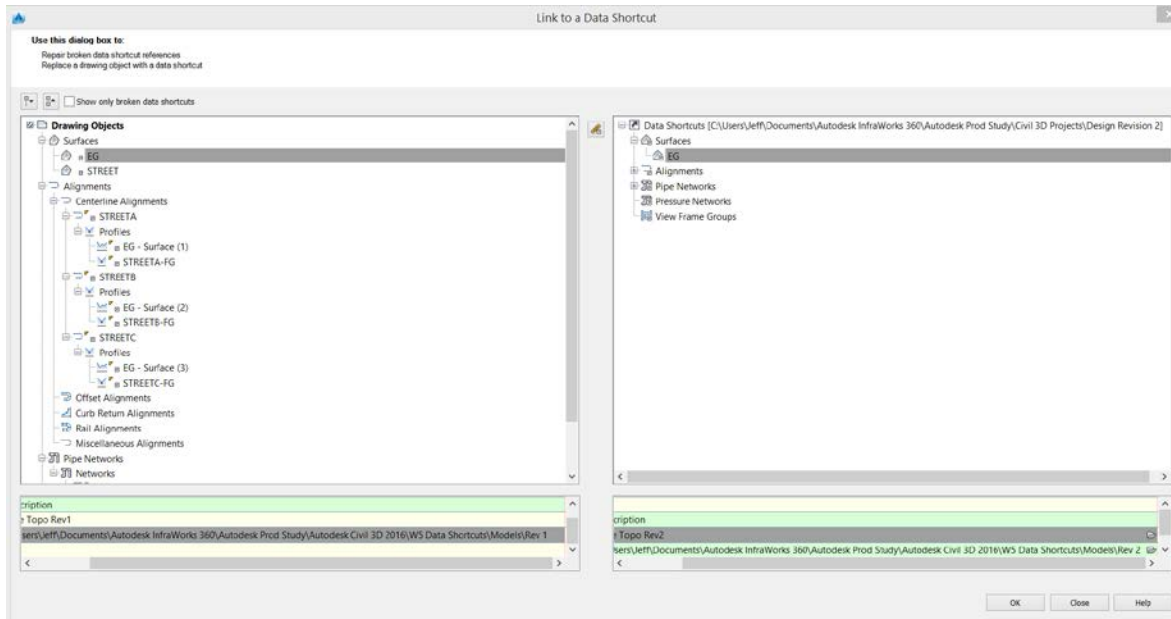


### Swap Critical Design Objects in the middle of a project using AutoCAD Civil 3D 2016

The option to “Manage Data Shortcuts” is found under the modify tab, within the Data Shortcuts panel in AutoCAD Civil 3D 2016. This new feature allows the “swapping” of objects without breaking associated dynamic object dependencies.

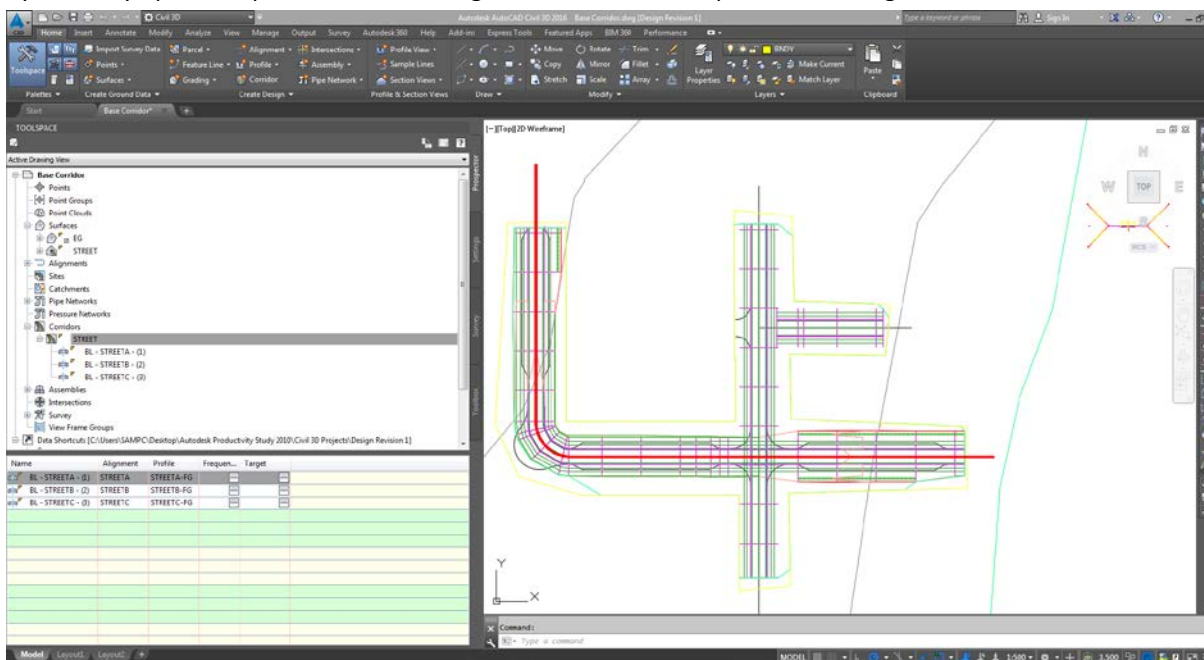
## Swapping Surfaces

Our first example focused on the swapping of the survey surface, which in turn dynamically regenerates the associated existing ground profiles.



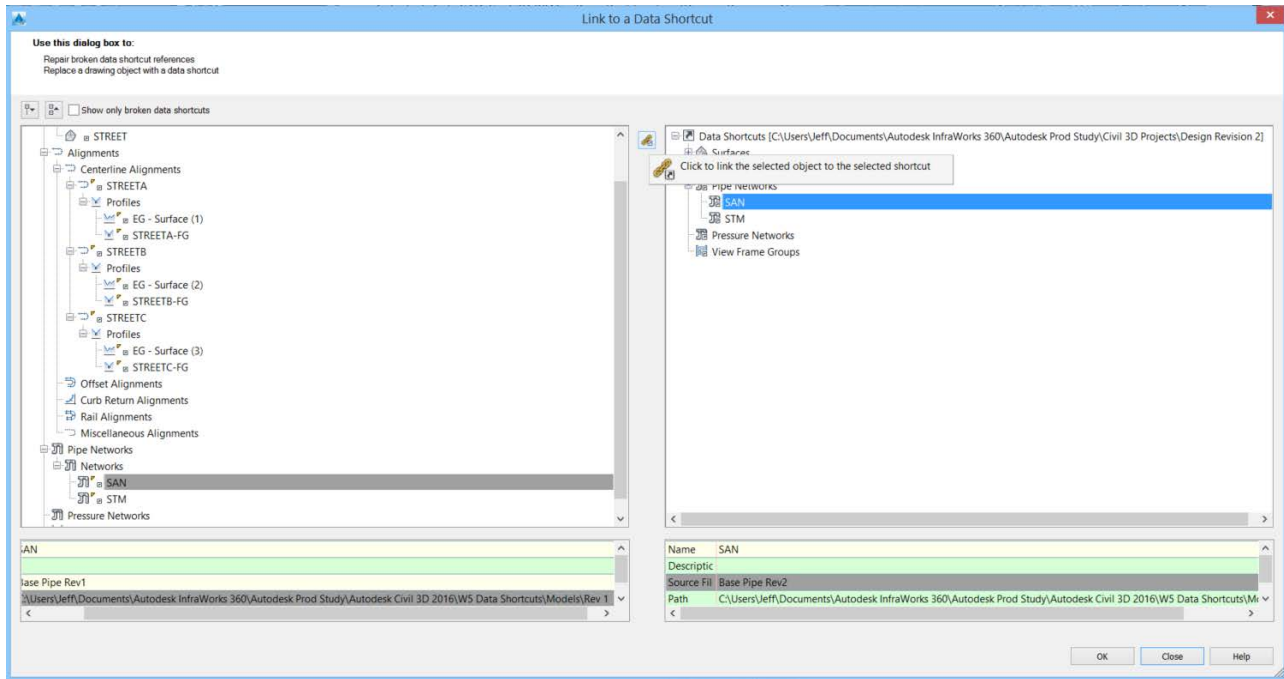
## Swapping Alignments and Profiles

Our second set of swapping included the swapping out of design alignments and dependent profiles, which in turn updated the corridor and any profile views associate with those objects being swapped. Resulting Corridor is dynamically updated upon Rebuild resulting in Corridor Surface Update in Grading Plan.

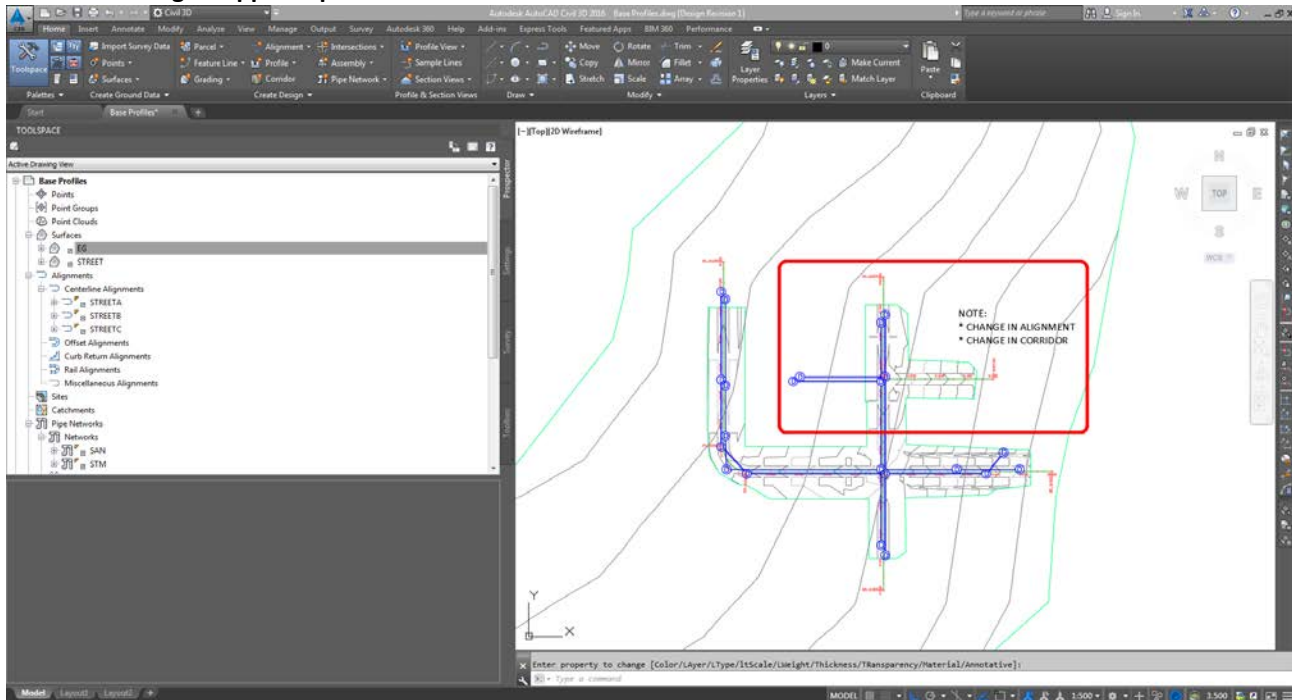


## Swapping Pipe Networks

The Pipe Networks were then swapped out using the Data Shortcuts Manager. One of the disadvantages of swapping the Pipe Network was its limitation to automatically maintain the parts shown in Profile Views.



## Results showing Swapped Pipe Network

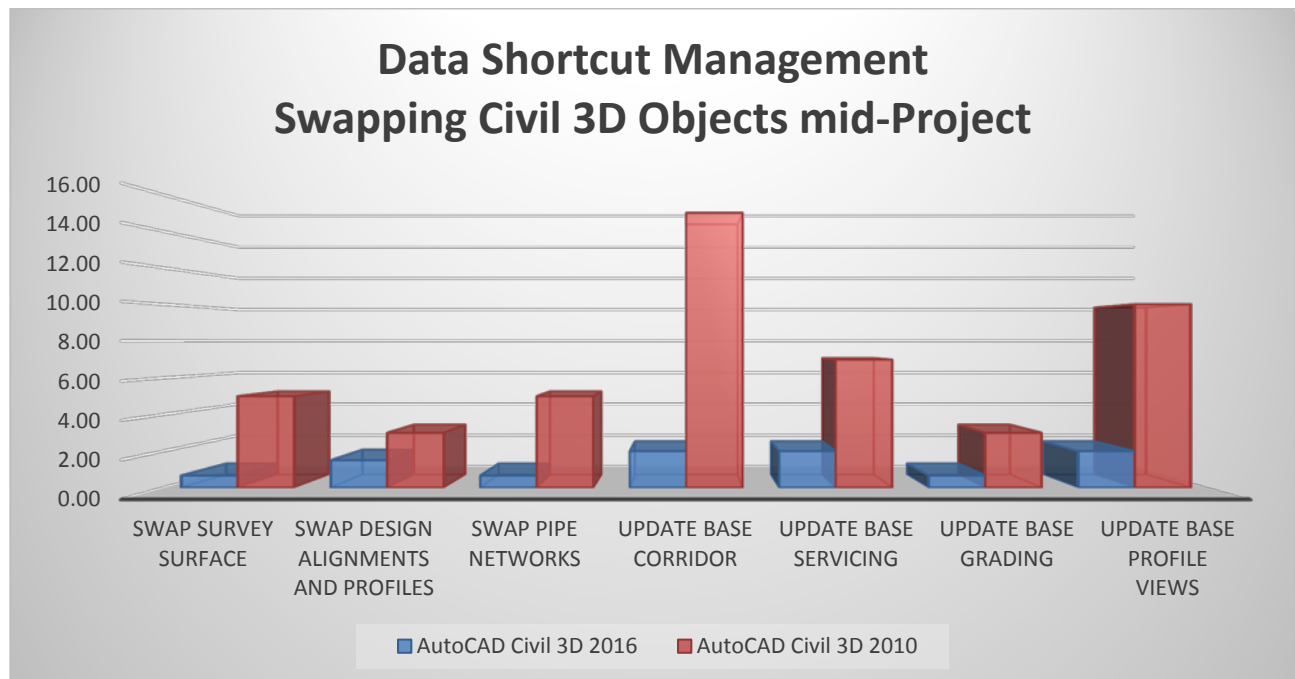




### Detailed Workflow #5 Task Completion Metrics

In this workflow study, we again see the improved workflow advantages of AutoCAD Civil 3D 2016 over the AutoCAD Civil 3D 2010. Over the last few years, the ability to better manage data shortcuts has been a high priority request as users start to leverage the data shortcut strategy to help streamline design production. As users become more experienced with AutoCAD Civil 3D, they want to create conceptual design options and try different strategies to help save the client money. Being able to more quickly, swap out objects with minimal time and effort can be a huge benefit to the project team.

As you can see, the productivity gain when rebuilding the corridor (swapping alignments and profiles) is a huge benefit should a new design concept be adopted mid-project.



<i>Time to Complete Task</i>	<b>AutoCAD Civil 3D 2016 (Minutes)</b>	<b>AutoCAD Civil 3D 2010 (Minutes)</b>	<b>Time Savings (Minutes)</b>	<b>Performance Increase (Faster)</b>
<i>Overall Summary of Time Savings</i>	9.51	48.00	38.49	405%

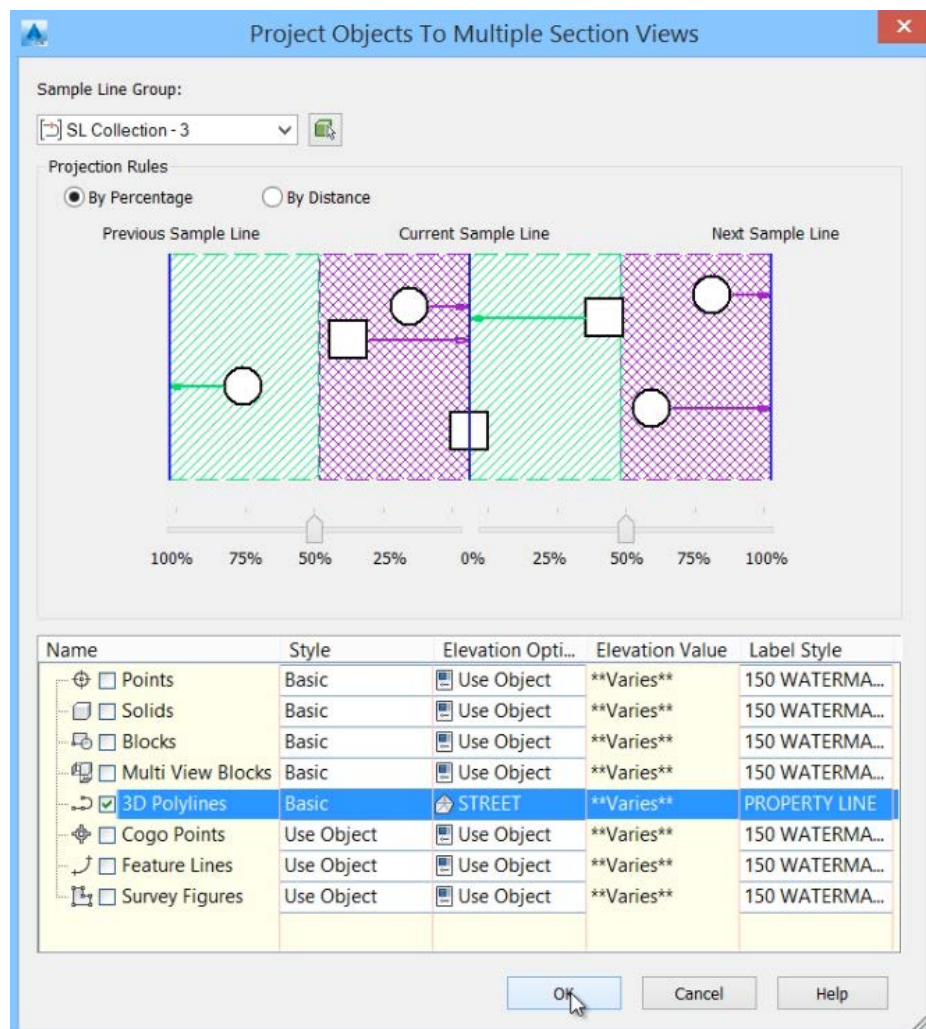
## Workflow Task #6 – Multiple Section View Projection

The last workflow task studied was projecting plan view objects into Section Views. Using Civil 3D 2010, selected objects could only be added to one section view at a time.

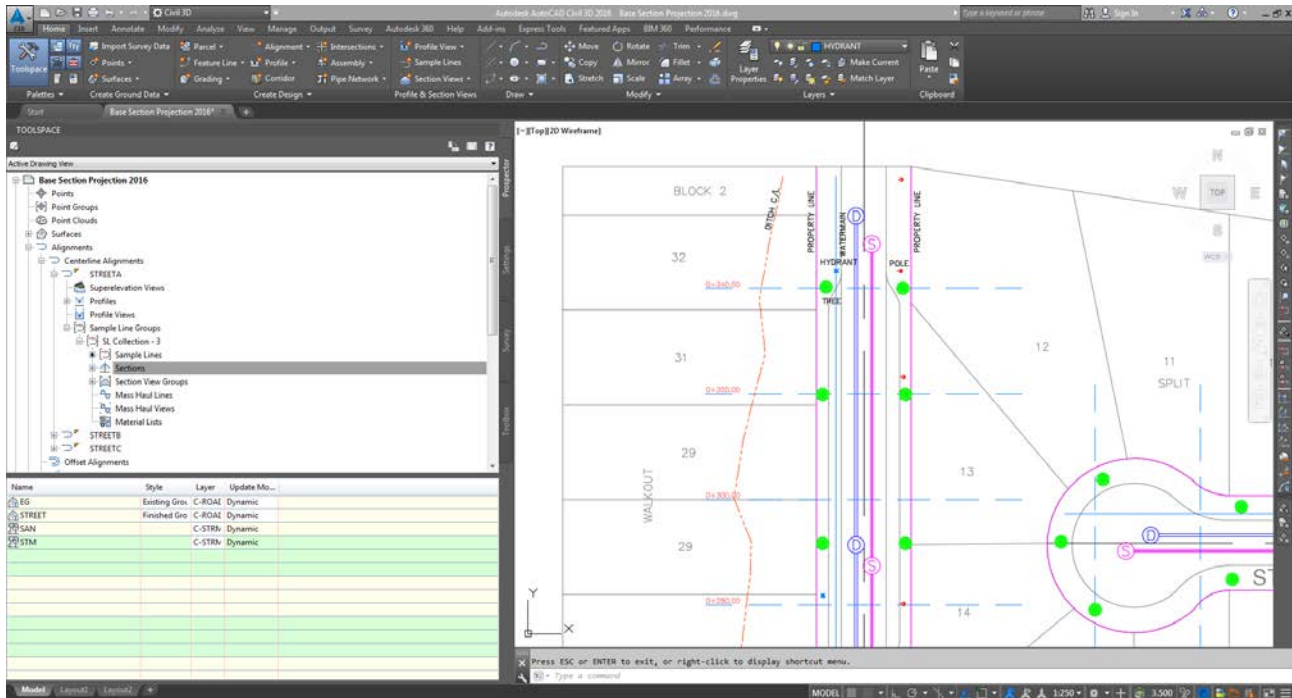
In AutoCAD Civil 3D 2016, this single new feature can have a significant impact on drafting required in Multiple Section Views. Again, this “Design Software Update” was implemented to help address the gap in efficiency prevalent in older versions of AutoCAD Civil 3D.

### Project Objects to Multiple Section Views using AutoCAD Civil 3D 2016

Under the Home tab, Profile and Section Views panel, the Project Objects to Multiple Section Views option is available. This option will project selected objects to the specified Sample Line Group and determine if it should be shown in the section view based on the Project Rules or offset distance/percentage from each section sample line.

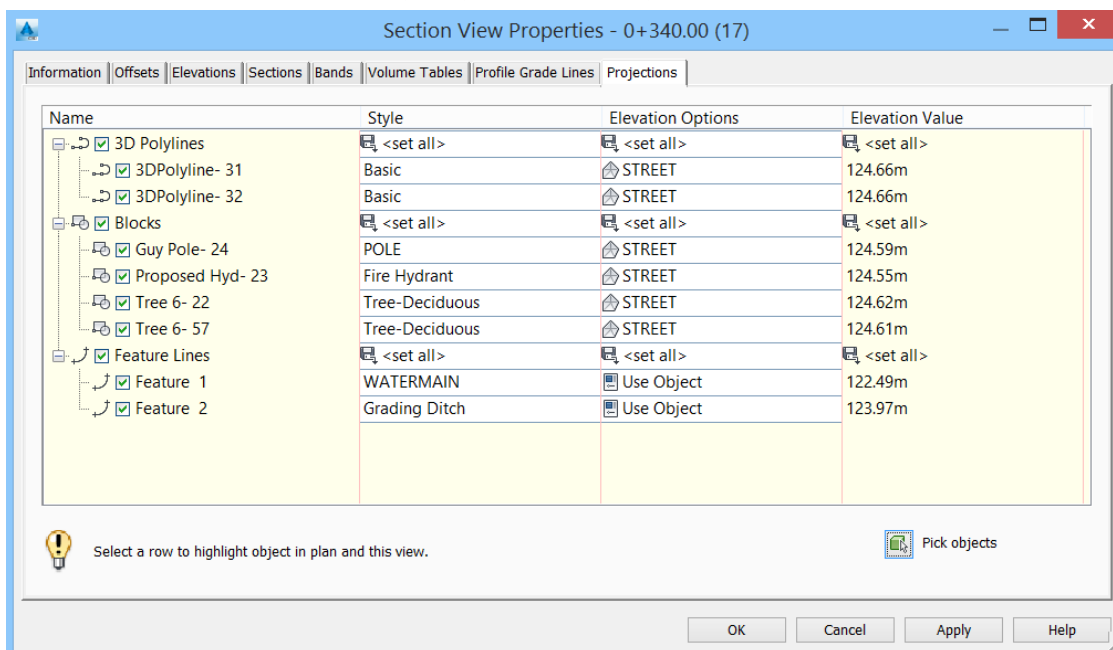


The projected object can be stylized, set on a specific elevation and labeled based on the projection configuration assigned. Once the projection is applied, all applicable Section Views will have the object projected and labeled.

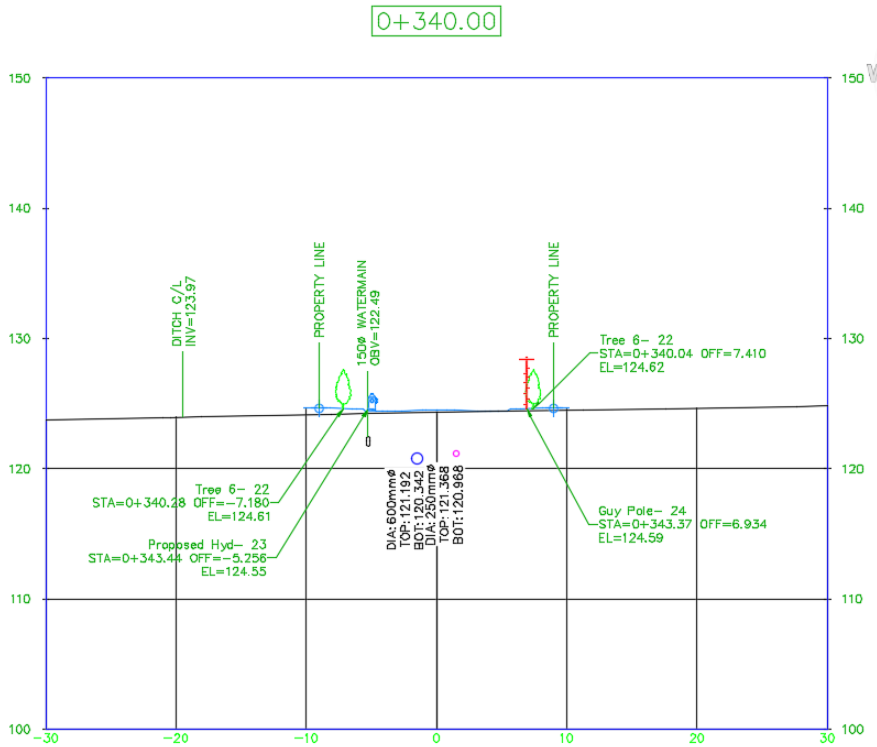


### Section View Projections Configuration

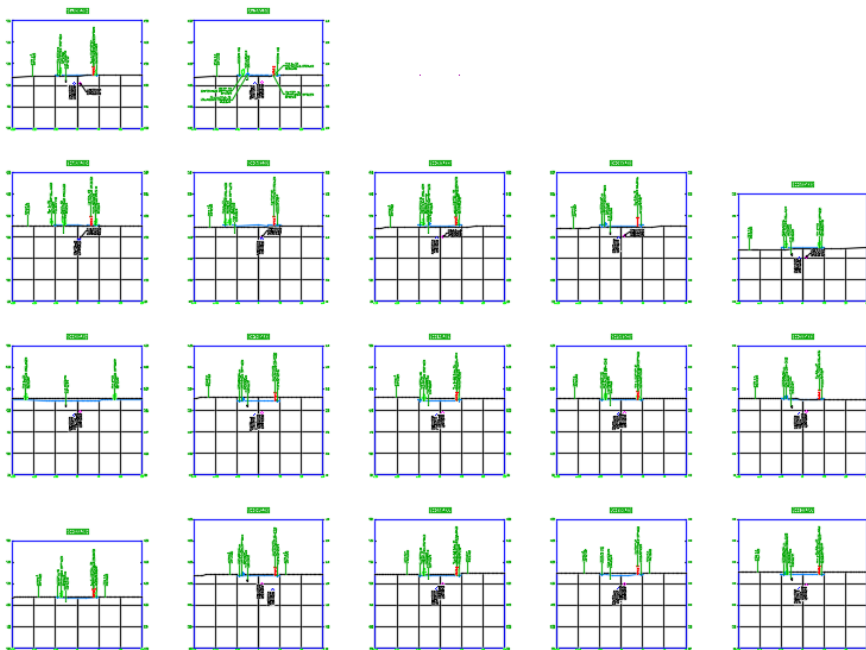
In this sample project we have projected 3D Polylines, Blocks and Feature Lines. Afterwards, selecting any Section View, the user can review and modify the projections at any time.



## Single Section Views showing Multiple Projections

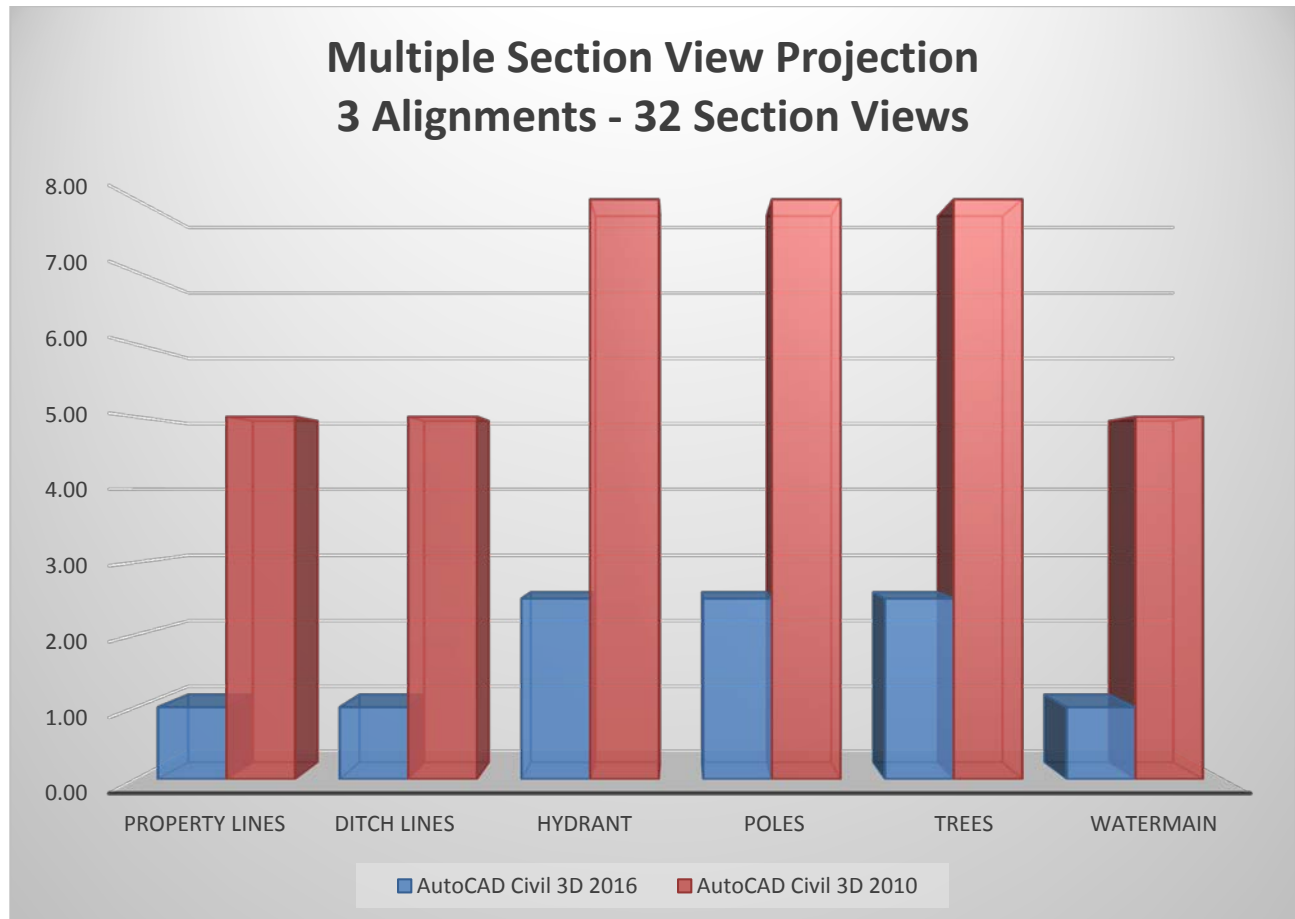


### Multiple Section Views showing Multiple Projections



### Detailed Workflow #6 Task Completion Metrics

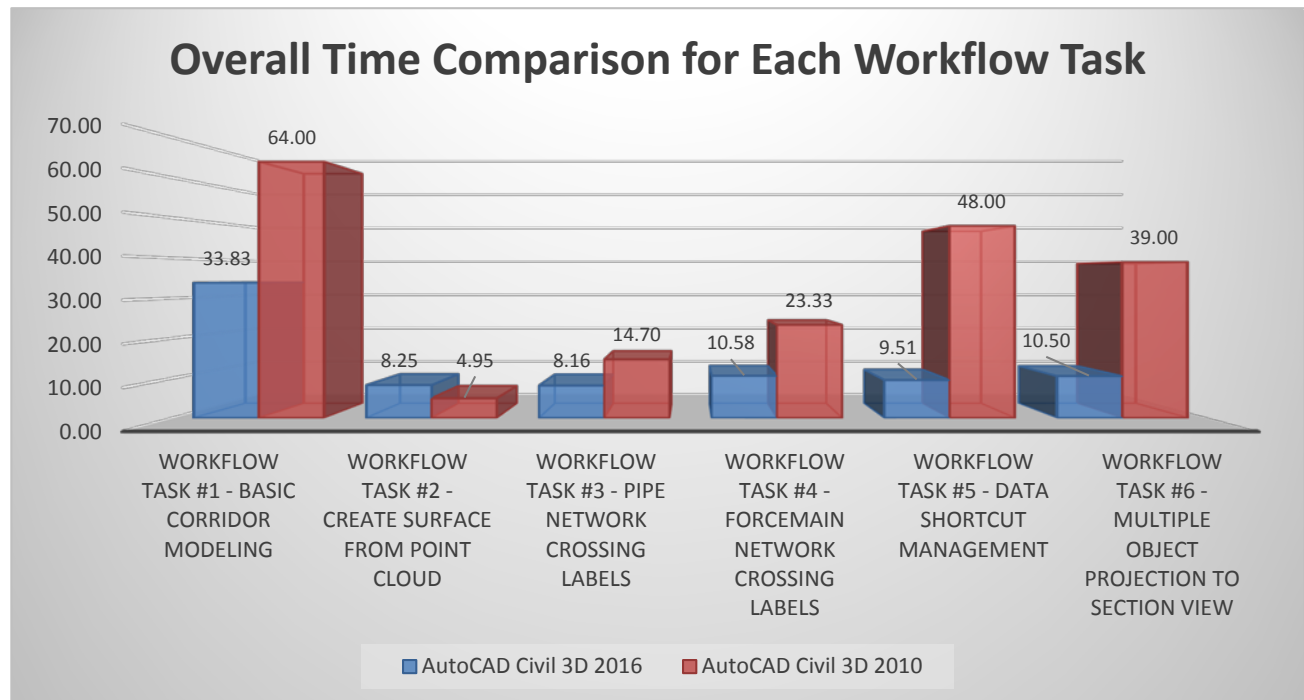
In this final workflow, we see the impact of the new feature on productivity when projecting plan view objects to multiple section views. A 271% performance advantage cannot be ignored when working on section view drafting production. For small projects or large, AutoCAD Civil 3D 2010 cannot compete with AutoCAD Civil 3D 2016 simply cannot compete when performing this task.



<i>Time to Complete Task</i>	AutoCAD Civil 3D 2016 (Minutes)	AutoCAD Civil 3D 2010 (Minutes)	Time Savings (Minutes)	Performance Increase (Faster)
<i>Overall Summary of Time Savings</i>	10.50	39.00	28.50	271%

## Percent Time Saved Summary

For each of the six workflow task scenarios, I measured the time required to complete the task(s) using both AutoCAD Civil 3D 2010 and AutoCAD Civil 3D 2016. The results in the report are then measured in terms of the amount of time spent and saved in minutes.



The time required to complete each workflow task is summarized in the following table.

## OVERALL TIME SAVED FOR EACH WORKFLOW

WORKFLOW NAME	AutoCAD C3D 2016	AutoCAD C3D 2010	Time Savings
WORKFLOW TASK #1 - BASIC CORRIDOR MODELING	33.83	64.00	-30.17
WORKFLOW TASK #2 - CREATE SURFACE FROM POINT CLOUD	8.25	4.95	3.30
WORKFLOW TASK #3 - PIPE NETWORK CROSSING LABELS	8.16	14.70	-6.54
WORKFLOW TASK #4 - FORCEMAIN NETWORK CROSSING LABELS	10.58	23.33	-12.75
WORKFLOW TASK #5 - DATA SHORTCUT MANAGEMENT	9.51	48.00	-38.49
WORKFLOW TASK #6 - MULTIPLE OBJECT PROJECTION TO SECTION VIEW	10.50	39.00	-28.50
<b>TOTALS</b>	<b>80.83</b>	<b>193.98</b>	<b>-113.15</b>

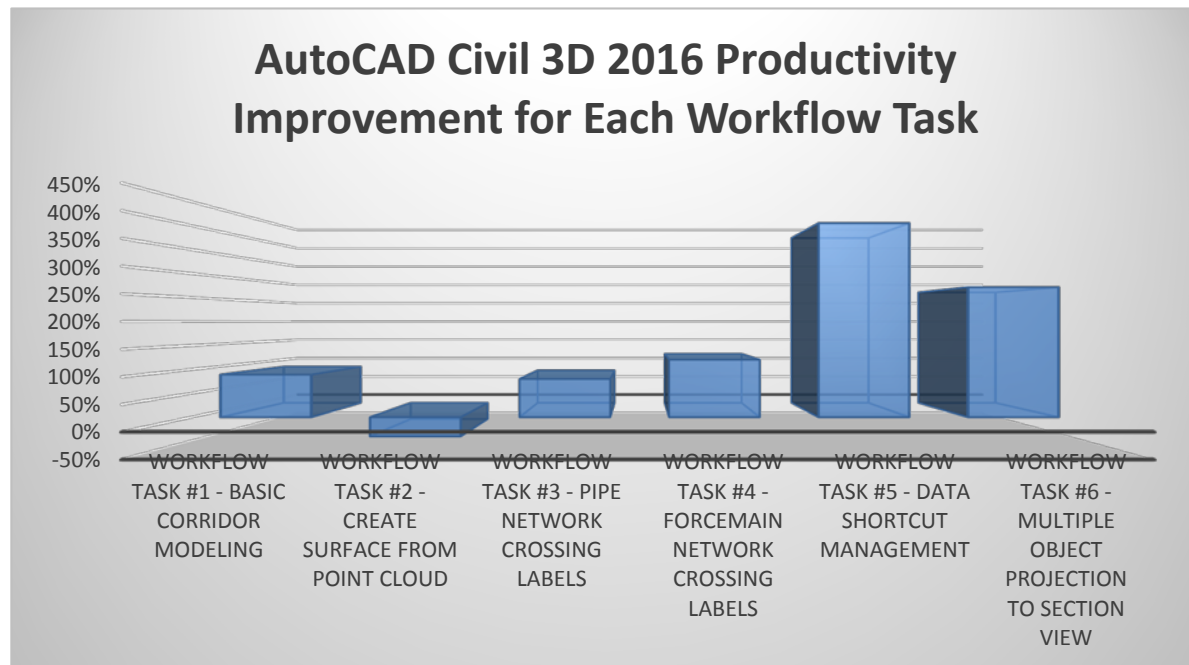
## Productivity improvement



In addition to looking at the results in terms of the time savings, they can also be expressed in terms of productivity or measured output. If we agree that productivity may be calculated by taking the number of items produced multiplied by the standard time required to produce one item and then dividing that by total time spent to produce multiple items, we can use the formulae below to show that a reduction of 20 percent in the amount of time required to complete a task equals a 25 percent improvement in user output for that task.

$$\text{Percent time saved ACAD C3D 2010 to ACAD C3D 2016} = \frac{\text{ACAD C3D 2010 time} - \text{ACAD C3D 2016 time}}{\text{ACAD C3D 2010 time}}$$

$$\text{Productivity improvement ACAD C3D 2010 to ACAD C3D 2016} = \frac{\text{ACAD C3D 2010 time} - \text{ACAD C3D 2016 time}}{\text{ACAD C3D 2016 time}}$$



The respective productivity improvements are summarized in the following table.

WORKFLOW NAME	AUTOCAD C3D 2016	AUTOCAD C3D 2010	PERCENT PRODUCTIVITY IMPROVEMENT
WORKFLOW TASK #1 - BASIC CORRIDOR MODELING	33.83	64.00	89%
WORKFLOW TASK #2 - CREATE SURFACE FROM POINT CLOUD	8.25	4.95	-40%
WORKFLOW TASK #3 - PIPE NETWORK CROSSING LABELS	8.16	14.70	80%
WORKFLOW TASK #4 - FORCEMAIN NETWORK CROSSING LABELS	10.58	23.33	121%
WORKFLOW TASK #5 - DATA SHORTCUT MANAGEMENT	9.51	48.00	405%
WORKFLOW TASK #6 - MULTIPLE OBJECT PROJECTION TO SECTION VIEW	10.50	39.00	271%

<b>TOTALS</b>	<b>80.83</b>	<b>193.98</b>	<b>140%</b>
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## Benchmark Results

In addition to the user productivity analysis performed using the six workflow tasks, I also performed a more traditional quantitative analysis of the software and computer hardware using an automation script written in Visual Basic and the Plan Production feature available in both releases of AutoCAD Civil 3D.

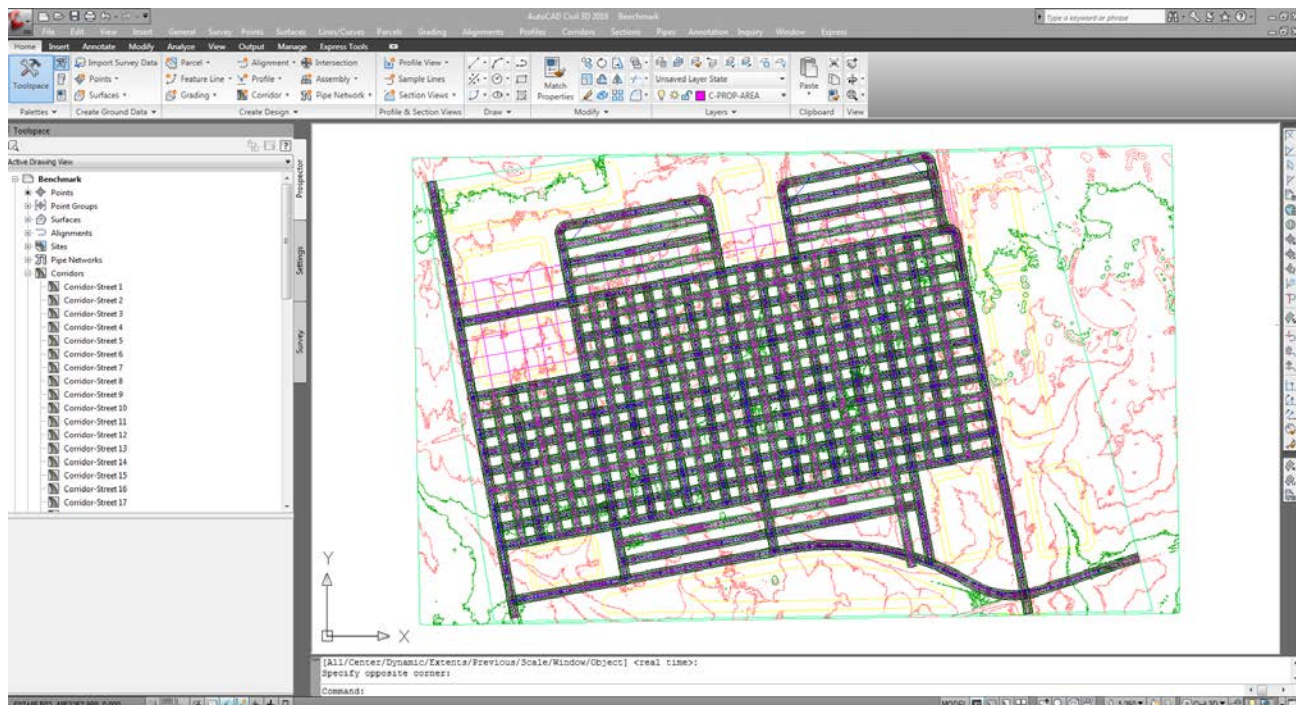
## Automated Script Testing

This study was performed to measure any productivity differences between AutoCAD Civil 3D 2010 running on Windows 7 as compared to AutoCAD Civil 3D 2016 running on Windows 8.1.

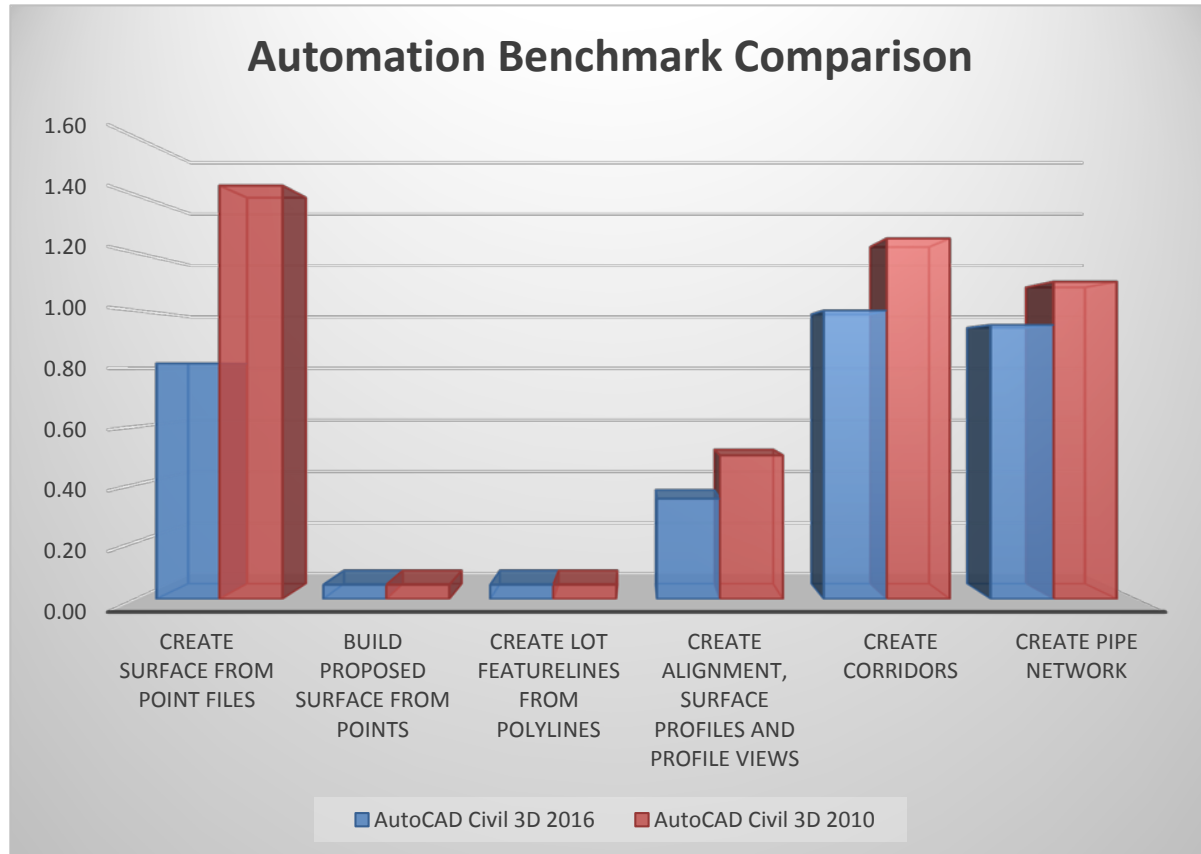
I performed a total of six different benchmark scripts:

1. Create a Large Surface from 500,000 points and changed Style 6 times
2. Build Proposed Surface from Points along Alignment
3. Create 50 Alignments and 100 Surface Profiles, 50 Profile Views
4. Create 500 Feature Lines from Lot Polylines
5. Create 50 Corridors, one for each alignment with a frequency of 5m tangents and 1m on curves
6. Create Pipe Network with Pipes and Structures every 100m along each alignment.

## Resulting Benchmark Drawing after Script showing Surfaces, Alignments, Corridors, Feature lines



## Results of the Automated Script



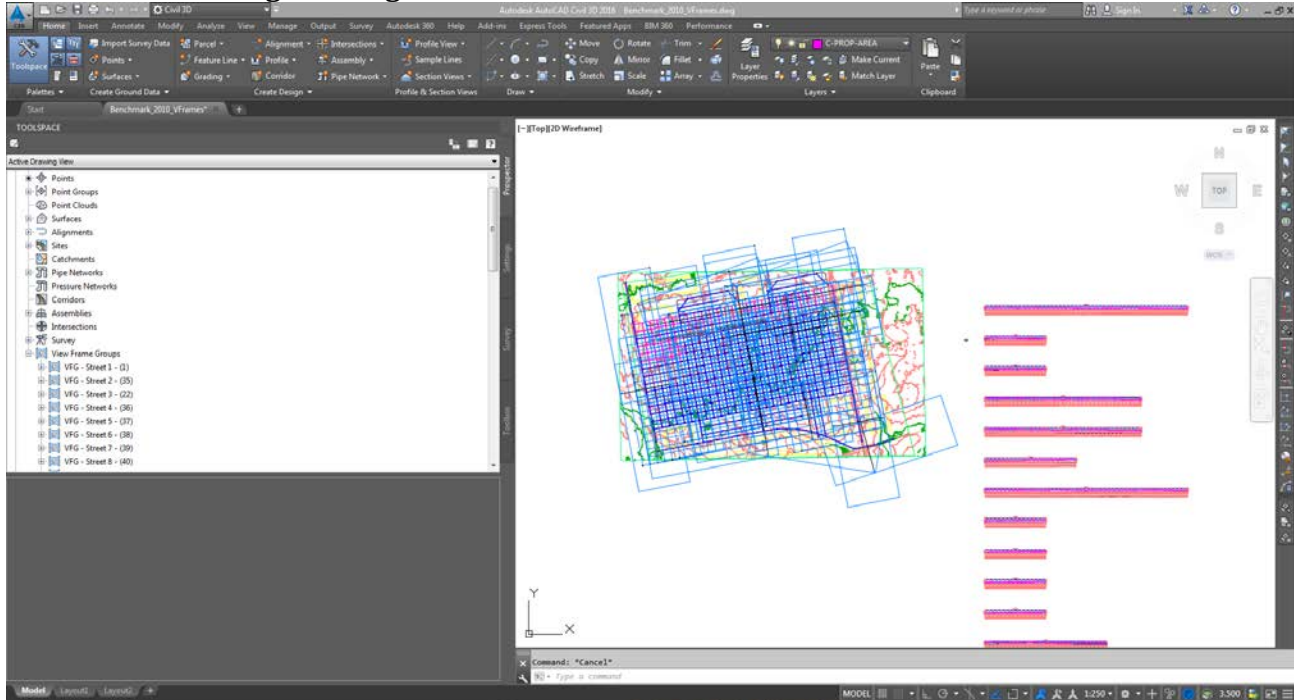
## Observations

Based on the comparisons, minimal differences were noted in the creation of the objects built by the automation script. The main difference was found in the regeneration speeds after the model(s) were created. If anything, this test confirms that AutoCAD Civil 3D 2016 and AutoCAD Civil 3D 2010 perform equally as well on the two different Windows operating systems with similar hardware.

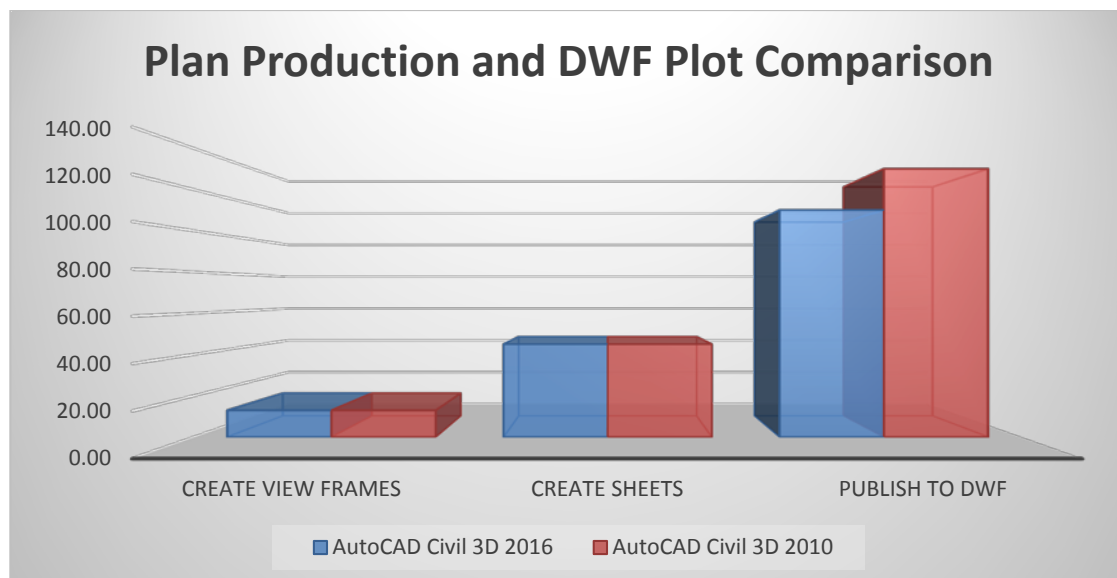
## Plan Production Testing

This study was performed to compare the Plan Production tools in each version. The “Create Viewframes” and “Create Sheets” functions were run in each benchmark drawing to determine performance comparison. A sheet set was created with resulting Plan and Profile Drawings and published to a single DWF™ file.

## Benchmark drawing showing Viewframes



## Results of the Benchmarking



## Observations

Based on the comparisons, minimal differences were noted in the creation of the view frames and sheets. A minor improvement on background plotting to DWF was found. Again, this test confirms that AutoCAD Civil 3D 2016 and AutoCAD Civil 3D 2010 performs equally as well on the two different Windows® operating systems with similar hardware.

## Conclusion

This study looks at real world design and drafting productivity issues that all AutoCAD Civil 3D users face every day. When selecting the workflow tasks, I wanted to select things that I use on a regular basis and see if in fact “the new version” would make the task easier, more efficient and solve challenges related to edits needed when the design changes. It’s important to see that all the tasks selected address the concept that changes happen throughout the project and we need better tools to minimize the need to re-do any work, with specific attention placed on drafting related tasks where budgets get spent if the changes are often and have to be completed quickly to satisfy client demands.

Of course, there are many new features available in the core AutoCAD 2016 product which are inherent with just updating your AutoCAD 2010 platform. Some of those improvements which Civil Engineering firms might appreciate include Windows 8.1 64 bit compatibility, better Bentley® Microstation® DGN Attachment / Translation, Geolocation and Bing® Map Overlay, Autodesk ReCap Point Cloud Attachment and overall drawing size and speed improvements.

As more firms look to “do more with less”, these are the kinds of feature functionality improvements the industry needs to see each year out of Autodesk. As the Industry moves towards Building Information Models and intelligent design beyond paper drawings, AutoCAD Civil 3D 2016 and the associated Autodesk® Infrastructure Design Suite 2016 Premium and Ultimate Editions offer the capabilities to expand the daily deliverable to clients beyond paper submissions and into construction analysis and management.

## About the systems used for testing

### AutoCAD Civil 3D 2016 was tested using this computer hardware.

#### Windows edition

Windows 8.1

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#### System

Processor: Intel(R) Core(TM) i7-4700MQ CPU @ 2.40GHz 2.40 GHz  
 Installed memory (RAM): 16.0 GB (15.8 GB usable)  
 System type: 64-bit Operating System, x64-based processor  
 Pen and Touch: No Pen or Touch Input is available for this Display



### AutoCAD Civil 3D 2010 was tested using this computer hardware.

#### Windows edition


Windows 7 Home Premium

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Service Pack 1

[Get more features with a new edition of Windows 7](#)

#### System

Manufacturer: Samsung Electronics  
 Rating:  [Windows Experience Index](#)  
 Processor: Intel(R) Core(TM) i7-3610QM CPU @ 2.30GHz 2.30 GHz  
 Installed memory (RAM): 8.00 GB (7.90 GB usable)  
 System type: 64-bit Operating System  
 Pen and Touch: No Pen or Touch Input is available for this Display



## About the Author

With over 18 years of experience in the Land Development industry, Jeff specializes in design process and computer aided modeling for municipal infrastructure and land development projects. Jeff was the Resource Manager for the Urbanland Service Sector from 2009 to 2013 at Cole Engineering. In 2012, he created the AEC Solutions Business Unit at Cole Engineering Group to specifically leverage BIM related projects at Cole. Prior to joining Cole, Jeff was with Autodesk Canada as the Architectural Engineering and Construction (AEC) Industry Territory Manager specifically working with private and public sector clients adopting the model based AutoCAD Civil 3D Design and Analysis software across Ontario.



This productivity study was performed at the request of Autodesk which funded this work.



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