AUTODESK **UNIVERSITY** 2015

CI11140-L

It's a Balancing Act: BIM Workflow for Site Design

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Learning Objectives

- Learn how to create conceptual grading plans and parking lots inside InfraWorks 360.
- Learn how to transfer the design to AutoCAD Civil 3D to create the detailed design.
- Learn how to compute quantity takeoffs for the earthworks and material volumes.
- Learn how to communicate the design visually with InfraWorks 360.

Description

Helping the community visualize a project's impact before construction is complete can be very difficult unless you use the right tools for the job. This class explores conceptual site-design options using InfraWorks 360 software to visualize realistic proposed sites. Starting with Model Builder and Revit software models, you will learn how to create realistic and accurate models that support a more informative and productive public-communication model. After clearly demonstrating the conceptual and preliminary design to stakeholders, we take the design into AutoCAD Civil 3D software to run quantity takeoffs and finish the detailed design. The design is then taken back into InfraWorks 360 software to create high-impact visuals to better support public participation and communication. We will perform various types of analysis along the way to validate the design and ensure design parameters are being met.

Your AU Experts

Michelle Rasmussen *has been using AutoCAD since release 9. Starting out in the Civil Engineering Unit of the U.S. Air Force, she has used Softdesk, Land Desktop, Civil 3D, and InfraWorks on infrastructure projects for more than 20 years. She has worked for both consulting engineering firms and municipalities laying out subdivisions, designing roadways, and managing infrastructure projects. Her extensive experience also includes writing training guides and instructing users how to use the Autodesk Infrastructure software product line. As a Senior Instructional Designer at ASCENT, Michelle currently writes courseware for AutoCAD, AutoCAD Civil 3D, AutoCAD Map 3D, Autodesk Infrastructure Design Suite and Autodesk InfraWorks. The training guides she writes are used by Instructors, students, schools and ATC's in over 67 countries.*

Objective 1: Create Conceptual Grading Plans

Create Coverages in a Model

Coverages are used to shape the terrain and change the way the ground displays. Coverages can be used to add ground cover in a landscape design, set the elevation of a building pad, or create a parking lot for a site design. Additionally, Terrain Hole material can be used on a coverage to create openings in a surface with a clean edge. This enables you to display what is going on underground. Whether you want to cut holes in a surface to indicate the station entrances of rail lines or display how utilities are to be laid out, you can use the Terrain Hole material assigned to a coverage. If you just need to reshape the terrain surface without changing how it displays, a transparent material style can be used.

Edit Coverages

Once a coverage has been created, it can be re-shaped using (Control Point Gizmo). The gizmos are displayed at each vertex when the coverage is selected in the model. If you orbit the model more than 45 degrees, (Elevation Gizmo) displays and can be used to adjust the elevation of each corner. As you adjust the elevation of a coverage, the surrounding terrain updates to gradually slope toward the new elevation, as shown in Figure 1.

Figure 1

How gradual the slope is depends on the Smooth Radius value for the coverage, as shown in Figure 2. This value is changed by right-clicking on the coverage and selecting **Properties**. In the Properties palette, change the *Smooth Radius* value and click **Update**.

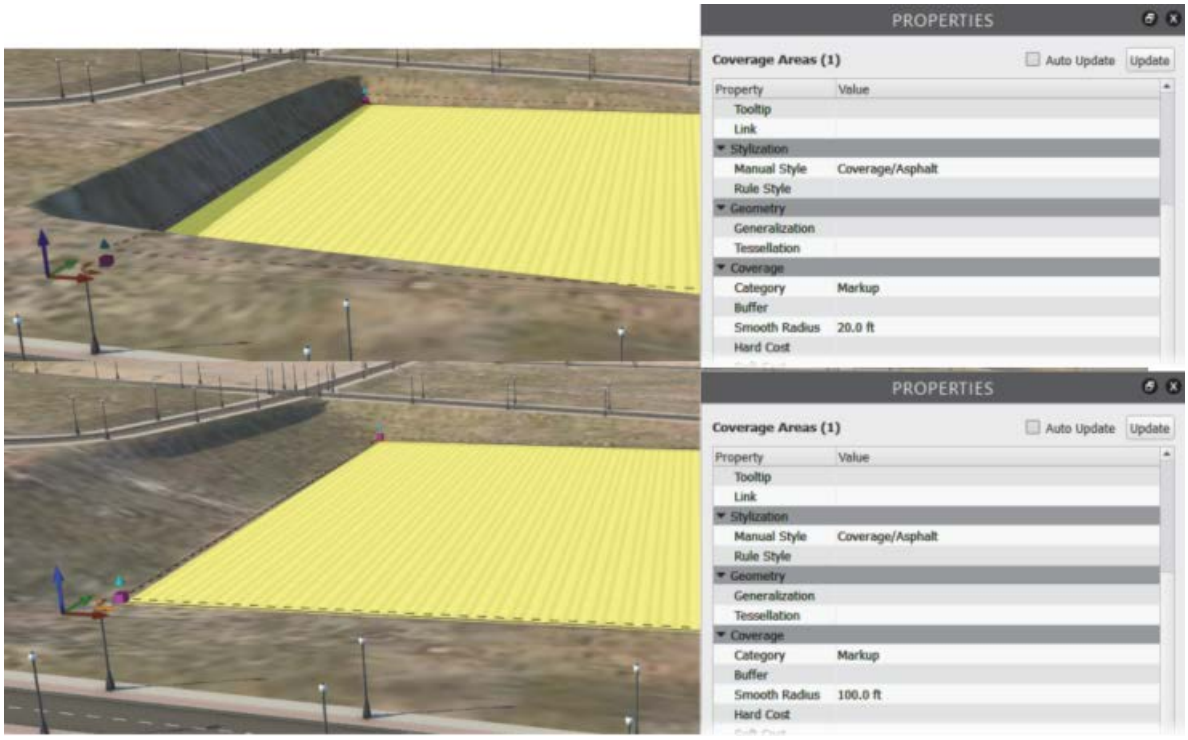

Figure 2

Vertices can be added anywhere along a side to add additional control and elevation points. To add a vertex, select the coverage, right-click on the side that you want to have additional control over, and select **Add Vertex**, as shown in Figure 3.

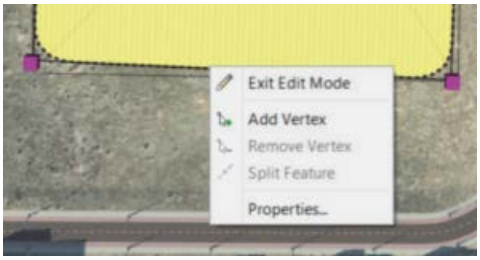

Figure 3

Exercise: Create Coverages in the Model

In this exercise you will shape the ground surface in preparation for a school. You will create a coverage and adjust its elevations.

1. Open the InfraWorks 360 software. If asked for a login, put in the following credentials:
   - Autodesk ID: auexpert2015
   - Password: Passwd123!
2. In the Home Screen, click **Open**.
3. In the *C:\CI11140-L_Grading* folder, select **Grading.sqlite** and then click **Open**.
4. In the Utility Bar, click (Bookmark your current location) and select **School**. Also make sure the current proposal is set to **Coverage**.
5. In the In Canvas Tools, click (Build, manage, and analyze your infrastructure

model)> (Create conceptual design features)> (Coverages).

6. In the Select Draw Style asset card, select **Asphalt**.
7. In the model, click to place the corners of the asphalt slab in the field reserved for the school, as shown in Figure 4. Make the measurement **350' x 300'** with the long side running east to west. Double-click on the last corner to place it and end the command.

Figure 4

8. In the Utility Bar, click (Edit).
9. With the new asphalt coverage still selected, orbit the view so that the elevation of the south side is displayed, as shown in Figure 5.

- A box displays indicating orthogonal directions otherwise known as level lines.

The level line in the view can help you to level the pad.

Figure 5

10. Right-click and select **Shape Terrain**.
11. Clcik (Elevation Gizmo) to make change the elevation. In the elevation field, type **4612**, as shown in Figure 6.

- The surrounding ground gradually slopes into the school pad based on the changes in elevation and Smooth Radius value in the Coverage Area Properties.

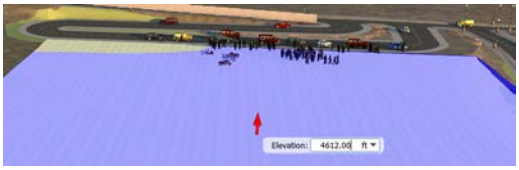

Figure 6

12. With the coverage still selected, right-click and select **Properties**.
13. In the Properties palette, change the Smooth Radius value to **20** and click **Update**.
14. Note the change in the surrounding grade. Then change the Smooth Radius value to **90** and click **Update**. Close the Properties palette.
15. Press <Esc> to clear the selection of the newly created school pad.

Create Land Areas

Similar to coverages, land areas provide a way for you to grade areas and change how the terrain displays. There are two key differences that land areas provide over coverages:

- The top surface of a land area is automatically flattened, as shown in Figure 7. A coverage drapes on the surface until the terrain is manually shaped.
- Land areas enable you to control the display of cut and fill areas separately. Figure 7 shows a land area with a 3:1 grass material for the fill and a 1:1 stone wall material for the cut.

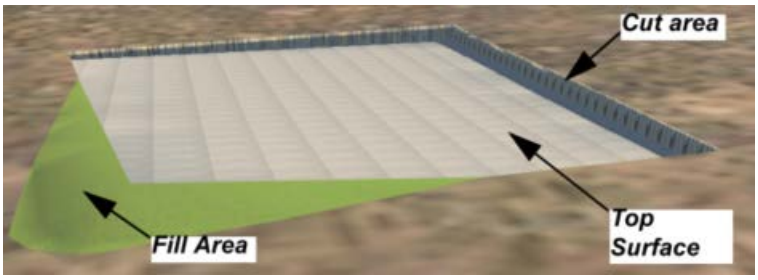

Figure 7

Grading Styles

Grading styles control how the cut and fill slopes display. Several grading styles are provided in the Autodesk InfraWorks software (as shown on the left in Figure 8) and additional styles can be created as required. The thumbnails in the Style palette display a preview of the materials and slopes that are used in each style. If the cut and fill slopes use the same material, only one material is shown in the thumbnail. If the cut and fill slopes use different materials, both materials display in the thumbnail with their slope values, as shown on the right in Figure 8.

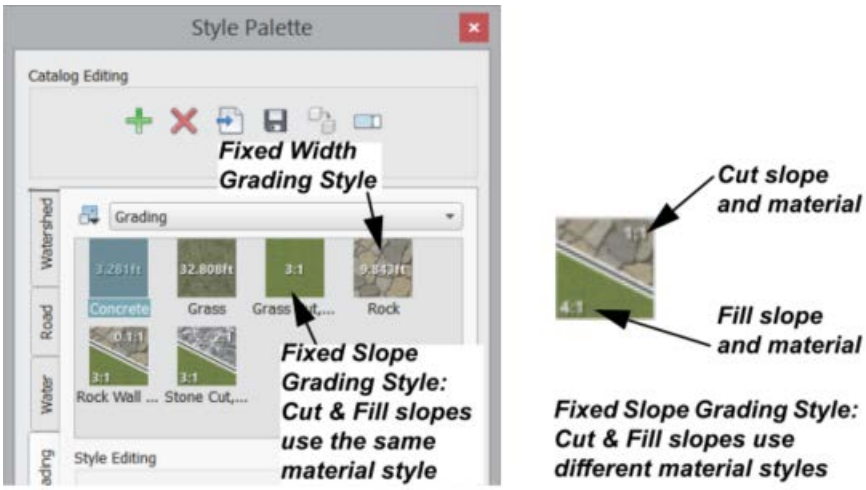

Figure 8

Edit Land Areas

Once a land area has been created, it can be re-shaped using (Control Point Gizmo). The gizmos are displayed at each vertex when the land area is selected in the model. By default, land area top surfaces are flat with all of the footprint vertices sharing the same elevation. If the model is orbited more than 45

degrees, (Elevation Gizmos) display and can be used to adjust the elevation of each vertex independently.

Vertices can be added anywhere along a side to add additional control and elevation points. To add a vertex, select the land area, right-click on the point at which you want to have additional control, and select Add Vertex, as shown in Figure 9.

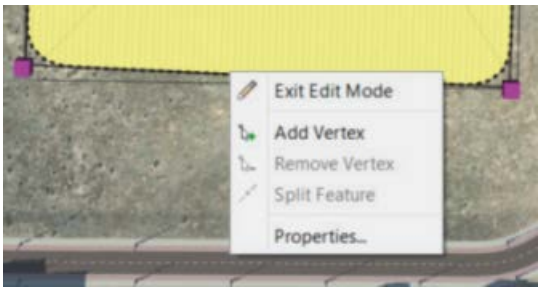

Figure 9

Exercise: Grade a Parking Lot Using a Land Area (Preview)

In this exercise you will use land areas to create a parking lot for the white water park, setting the cut and fill slope displays separately. You will then add another land area with a gradual slope covered in grass for the patrons to access the river.

Task 1: Create a new grading style.

In this task, you will create a new grading style which uses river stone for the cut and grass for the fill of the proposed parking lot.

1. Continue working in the same model. If you closed it, open **Grading.sqlite** in the *C:\CI11140-L_Grading* folder.
2. In the Utility Bar, expand Switch Active Proposal and select **LandAreas**.
3. In Utility Bar, click (Bookmark your current location) and select **River**.
4. Open the Style palette and select the Grading tab.
5. In the Style Editing area at the bottom of the Style palette, click (Add new style to the current catalog above).
6. In the Define New Grading dialog box, set the Grading Method to Fixed Slope.
7. Set the following options, as shown in Figure 10.
   - Cut Slope: **1:1**
   - Fill Slope: **4:1**
   - Clear the checkbox for *Cut and Fill Material use the same Style*.
   - Cut Material: **Select** Material>Land Cover>**Riverstone**.
   - Fill Material: Select Material>Land Cover>**Manicured Grass**.
   - Clear the checkbox for *Set Grading Limit*.
   - Click **OK**.

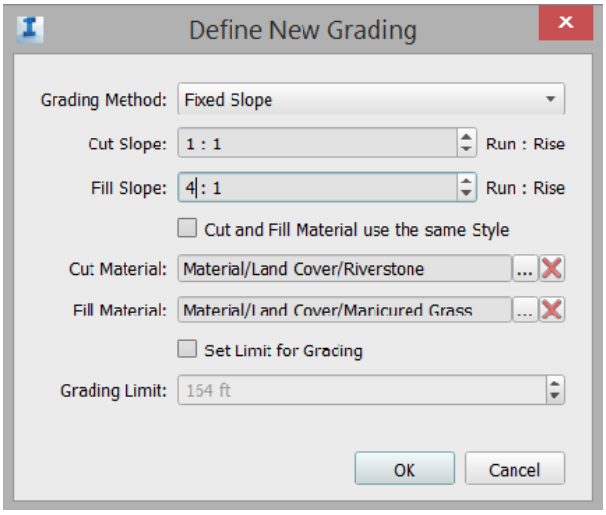

Figure 10

8. Type **Parking** for the name.

Task 2: Create a parking lot and grass area for park patrons.

In this task, you will create a parking lot for the white water park patrons and a grass area which provides a more gradual slope to the river on the south side.

1. Continue working in the same model as the last task. If you did not complete the last task, you can use the **RiverParking** style when called for.
2. In the In Canvas tools, click (Build, manage and analyze your infrastructure model) > (Create conceptual design features) > (Land Areas).
3. In the Select Draw Style asset card that displays, type **PK** and select **PK-Lot**, as shown in Figure 11.

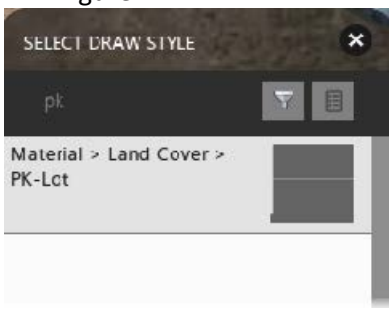

Figure 11

- This style is used for the land area top surface only, not the cut and fill slopes. The cut and fill styles are set later.

4. In the model, click to place the first vertex of the land area footprint, as shown in Figure 12.

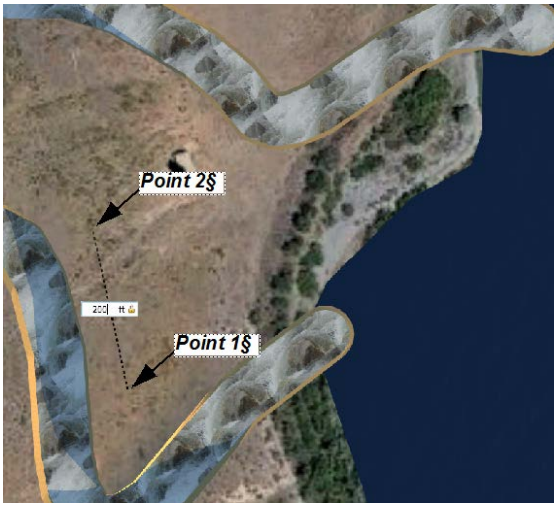

Figure 12

5. Move the cursor in the Northwest direction, type **200**, and then press <Enter> to lock in the distance. Click to place the second vertex, as shown in Figure 12.
6. Move the cursor in the Northeast direction, type **100**, and then press <Enter> to lock in the distance. Click to place the third vertex, as shown in Figure 13.

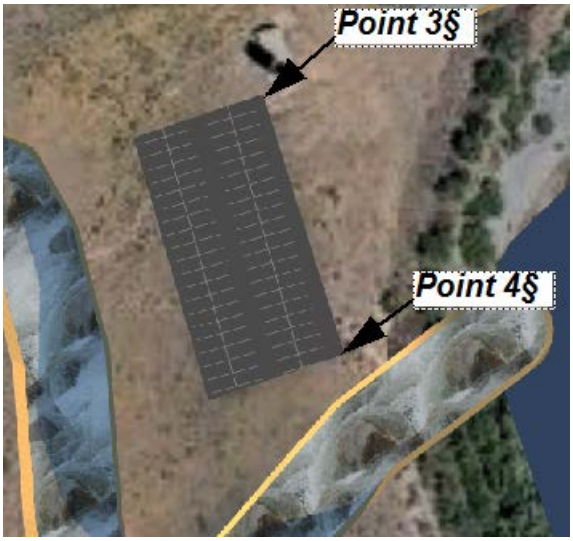

Figure 13

7. Move the cursor in the Southeast direction, type **200**, and then press <Enter> to lock in the distance. Double-click to place the final vertex and end the command, as shown in Figure 13.
8. Restart the Land Area command.
9. Select **ManacuredGrass** for the style.
10. Set the points for the vertices, as shown in Figure 14.

- Ensure that you double-click the last point to end the command.

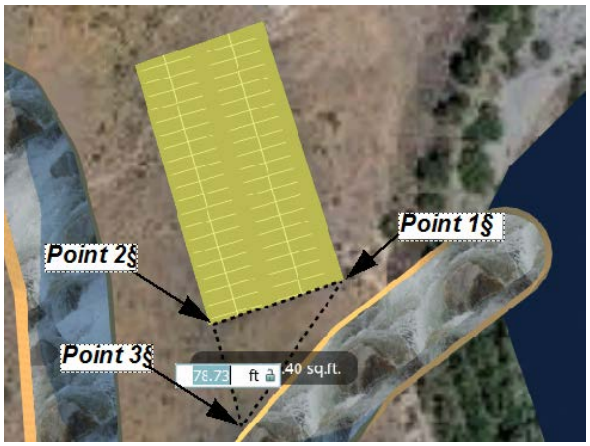

Figure 14

11. Select the Parking lot land area.
12. On the Utility Bar, click (Edit).
13. With the parking lot Land Area still selected, right-click and select **Properties**.
14. In the Properties palette, change the **Rule Grading** style to the new **RiverParking** grading style, as shown in Figure 15. Click **Update**.

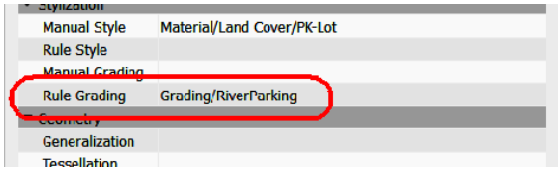

Figure 15

15. Press <Esc> to clear the selection of the parking lot land area.
16. Select the grass land area to the south of the parking lot.
17. Right-click and select **Properties**.
18. In the Properties palette, change the **Rule Grading** style to the **Manicured Grass** grading style. Click **Update**.
19. Press <Esc> to clear the selection of the grass land area.

The results are shown in Figure 16.

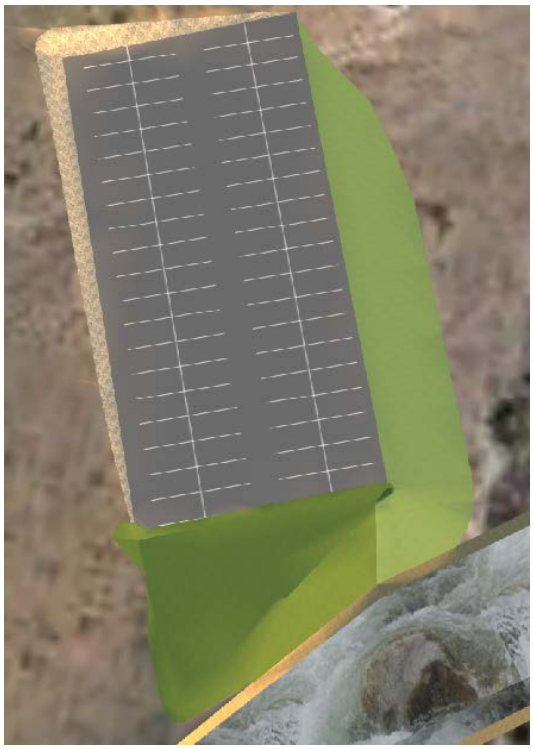

Figure 16

Objective 2: Transfer the Design to Civil 3D

If you have the latest version of AutoCAD Civil 3D, you should be able to open an InfraWorks model directly. If you do not have the latest version of AutoCAD Civil 3D, it will be necessary to export an IMX file from InfraWorks, then import it in AutoCAD Civil 3D. When going the other direction (Civil 3D to InfraWorks) you also have the option to use .IMX files or importing the AutoCAD Civil 3D drawing file directly. Whether opening an InfraWorks model or an IMX file in AutoCAD Civil 3D, the same tools are used. The only change is the file type selection in the Select Model dialog box, as shown in Figure 17.

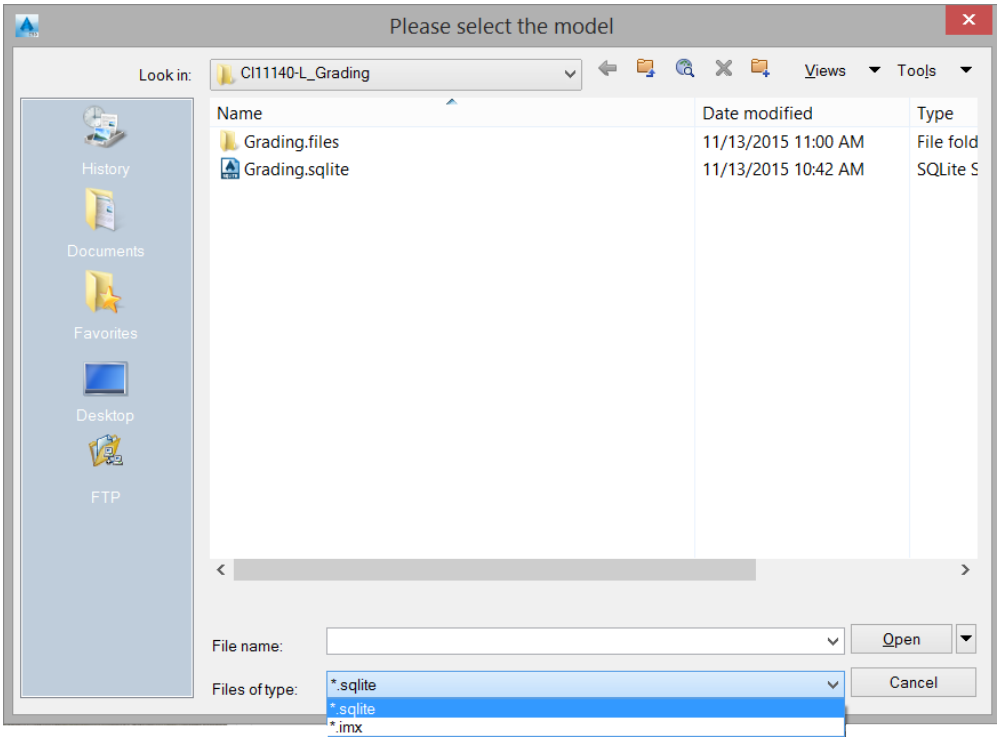

Figure 17

Exercise: Open an InfraWorks model in AutoCAD Civil 3D.

In this exercise you open the existing condition drawing file inside AutoCAD Civil 3D that surveyors created. Then you bring in the proposed design from InfraWorks.

1. Open AutoCAD Civil 3D.
2. Open the **FineGrading.dwg** in the *C:\CI11140-L_Grading* folder.
3. In the *Insert* tab>InfraWorks 360 panel, expand InfraWorks 360 and select  (Open InfraWorks 360 Model).
4. In the Open InfraWorks 360 Model dialog box, browse for **C:\CI11140-L_Grading\Grading.sqlite** and click **Open**.
5. In the *Selection* area, select **Area of interest**, then click **Select Area…**
6. Select the area indicated in Figure 18.

Figure 18

7. In the Object settings area, select **Design Objects.xml**, as shown in Figure 19.

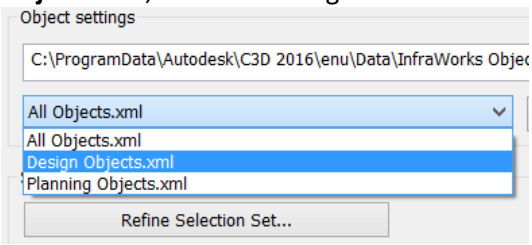

Figure 19

8. Click **Refine Selection Set**. Select the **AIW_Proposed Ground** and review all the other selections, as shown in Figure 20. Click **OK**. Then click **Open Model** to see the results in AutoCAD Civil 3D.

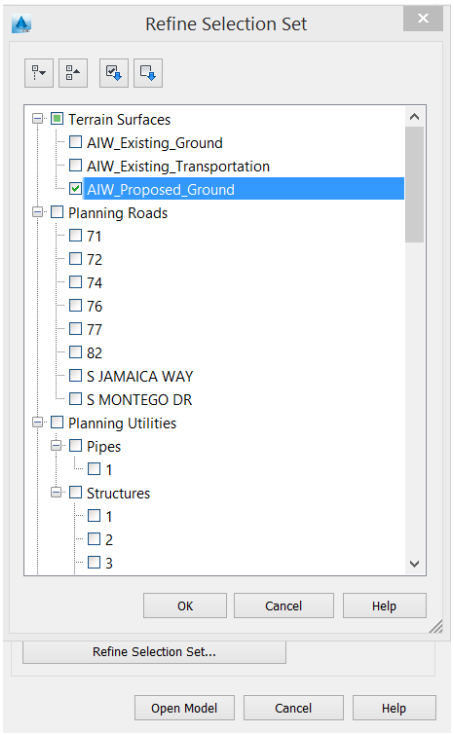

Figure 20

Compute Quantity Takeoffs

Earthwork quantities can be calculated in two ways:

- Create a volume surface.
- Create Sections.

Volume Surface

A volume surface calculates the difference in elevations between two surfaces. When creating a surface, you change the type to a TIN volume surface, then set the Base and Comparison surfaces, as shown in Figure 21. You may find it faster to the Volumes Dashboard tool found in the Analyze tab>Volumes and Materials panel for calculating a quick volume surface.

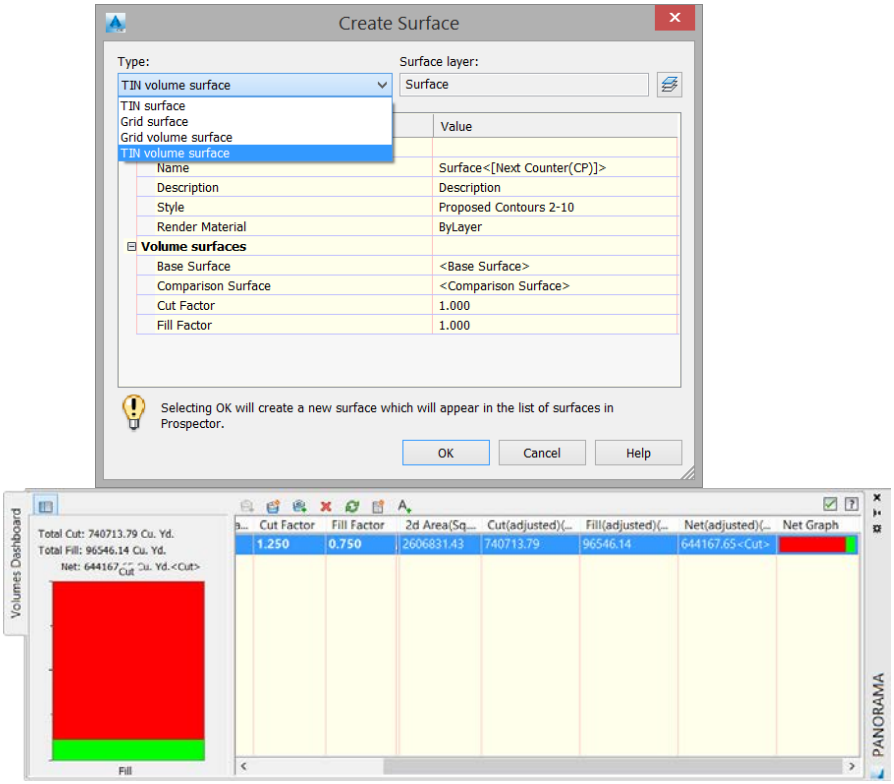

Figure 21

Sections

Two types of quantity takeoffs can be calculated based on sections: earthwork volumes and material volumes. In order to create quantity calculations using this method, an alignment must be created.

- Earthwork volumes represent the amount of cut (existing material above the vertical design) or fill (the vertical design above the existing material).
- Material volumes are the amount of materials needed to build the road. Materials include asphalt pavement, concrete curbing, sub -base materials, and other materials.

Exercise: Create a Volume Surface

1. Continue working in the **FineGrading.dwg**.
2. In the *Analyze* tab>Volumes and Materials panel, click (Volumes Dashboard).
3. In the Panorama, click (Create new volume surface).
4. Type **Total Volume** for the name.
5. Select **Existing** for the Base.
6. Select **AIW_Proposed_Ground** for the Comparison.
7. Click **OK**.
8. In *the Volumes Dashboard, change the Cut Factor* to **1.25** and the *Fill Factor* to **0.75**. Review the volumes.

Communicate the Design Visually

Storyboards

Storyboards are a collection of elements or keyframes that are combined together in a slide show to tell a compelling story about the design. The keyframes in a storyboard are generated from animations. These animations are either Path or Camera animations. Still images can also be incorporated using a Still Motion Camera animation.

Using storyboards, you can simulate driving through the model, get a birds-eye view of the model, or explore the model. Figure 22 shows the Storyboard palette.

- Storyboard Name: Displays the name of the current storyboard and enables you to edit the name as required.
- Timeline: Indicates when specific elements display and how long they remain in the view before changing to the next element.
- Storyboard Tools: Contains tools for creating elements and managing the storyboard.
- Keyframe Settings: Provides settings that can be specified for the active (selected) keyframe element.

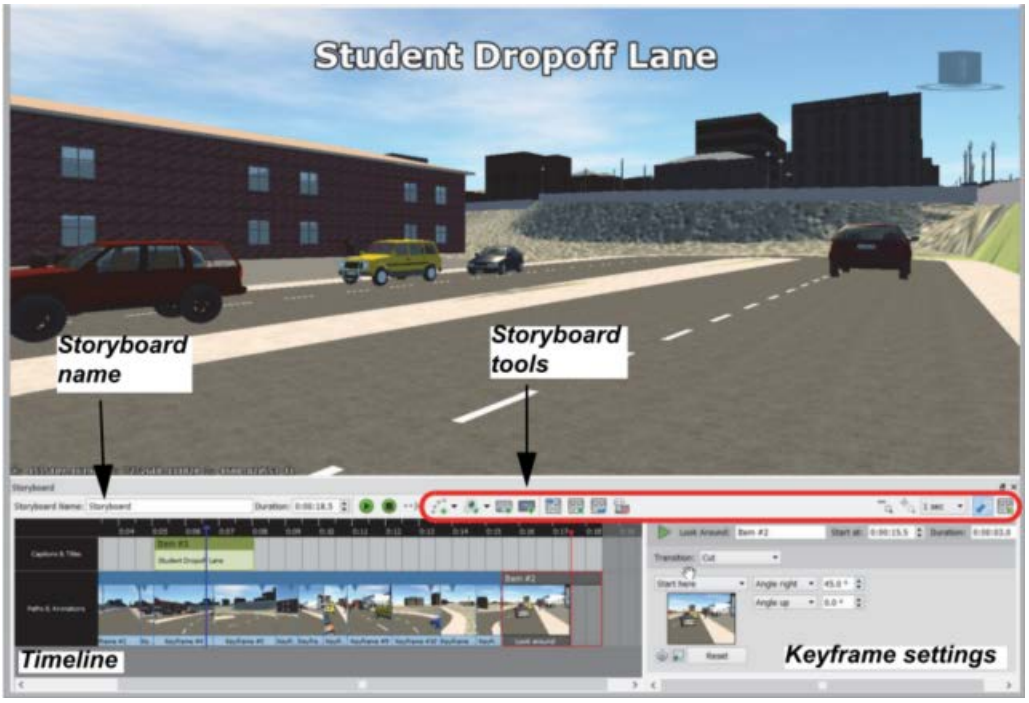

Figure 22

Working with the Timeline

The Timeline identifies the sequence of the keyframes and details approximately how long each keyframe displays in the presentation. Keyframes can be an image, a camera animation, or a path animation.

Figure 23 shows a storyboard timeline and describes its contents. You can drag and drop keyframes to new locations in the timeline to change the order in which they display. You can also drag the right side of a keyframe to change its duration.

- Play Head (blue square and line): Indicates where play stops and resumes during playback. Double-click on the timeline to move the play head to a specific location.
- Duration: Lists the total time (i.e., start to finish) of the storyboard.
- Playback Controls: Starts and stops the presentation at the play head location. It also enables you to control whether the model view follows the storyboard position.
- Captions and Titles: Enables you to label specific views in the model to draw attention to points of interest.
- Camera Paths and Animation Keyframes: Thumbnails used to indicate what is presented at specific times along the timeline. You can drag and drop the thumbnails to change their order or duration.
- Insertion Marker (red triangle and line): Indicates where new elements display in the model when you add them. Click and drag the insertion marker to a location in the timeline to insert the next storyboard feature.

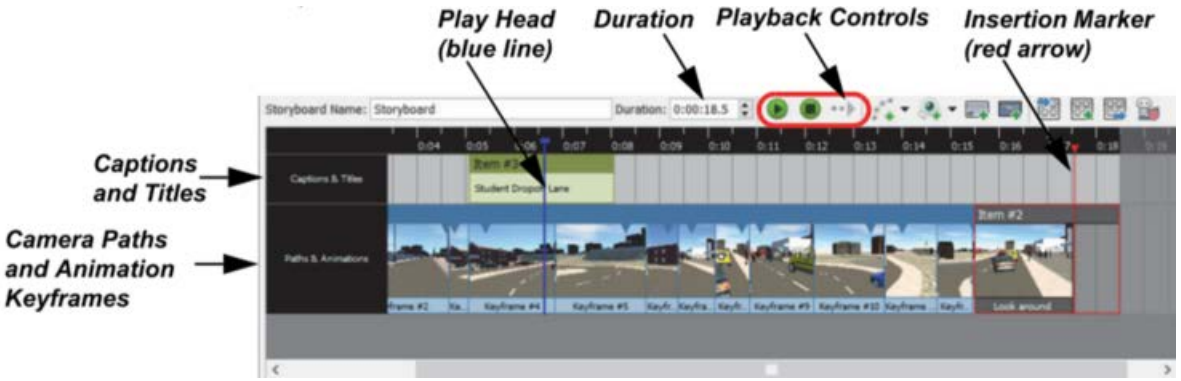

Figure 23

Keyframe Settings

Each keyframe that you add to a storyboard has its own set of properties that can be set to control how the camera moves in the model. Figure 24 shows the settings for a *Look Around Camera Animation* keyframe.

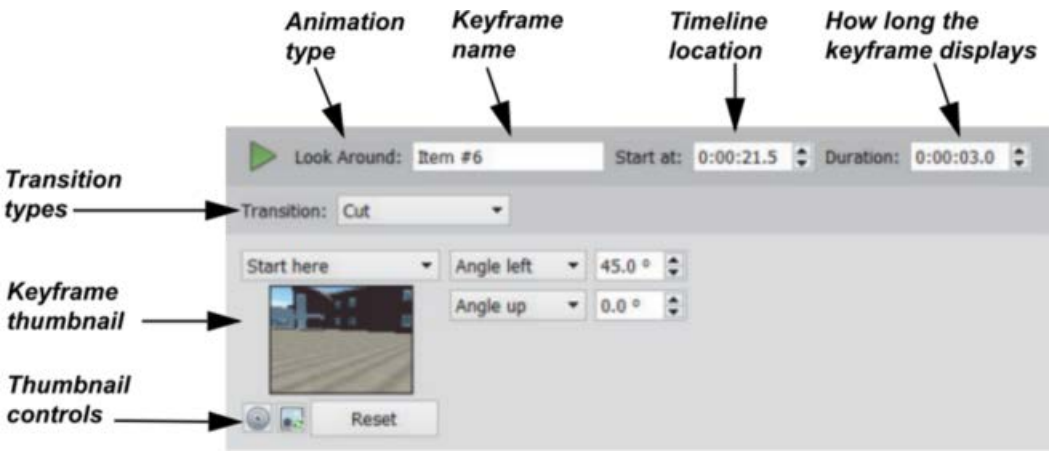

Figure 24

The following are areas of the Keyframe settings that are used in multiple animation types.

- Animation Type: Lists the type of animation that was used to create the keyframe.
- Transition Types: Enables you to set the transition type when entering and exiting the keyframe. There are three transition types:
  - Cut: Moves directly to the current keyframe view.
  - Fade from black: After the previous keyframe, the view displays as black. It then fades into the current keyframe over a duration that you set using the setting to the right of the Transition drop-down list, as shown in Figure 25.

Figure 25

  - Fade from white: After the previous keyframe, the view displays as white. It then fades into the current keyframe over a duration that you set using the setting to the right of the Transition drop-down list.
- Thumbnail Controls: Enables you to change the model view or thumbnail view. The following options are available for all of the animation types.
  - (Go To Location): Quickly sets the model view to be the location of the thumbnail.
  - (Refresh): Refreshes the thumbnail of the keyframe from the current scene content.
  - Reset: Changes the keyframe view to the current model view.

Exercise: Communicating the Design Using a Storyboard

In this exercise you will add path and camera animations to create a storyboard. You will create a presentation to show how parents will use the carpool lane to pick up and drop off students. You will use a camera path animation to simulate driving up to the drop off location. You will then add camera path animations to get a bird's eye view of the school.

1. Continue working in the same model as previously. If you closed it, in the Home Screen click **Open**.

2. In the *C:\CI11140-L_Grading* folder, select **Grading.sqlite** and click **Open**.
3. In the Utility Bar, select **Transfer** for the Proposal.
4. In the In Canvas Tools, click (Create and conduct infrastructure design presentations)> (Storyboard CenterCreator).
5. In the Storyboard palette, click (Add New Storyboard).
6. In the Storyboard palette, rename the new storyboard as **Carpool1**.
7. In the Storyboard palette, expand (Add New Camera Path Animation) and select (Create from Design Road).
8. Select the CarPool Road. Several thumbnails appear in the timeline, as shown in Figure 26.

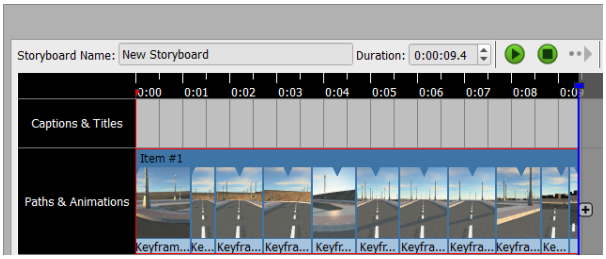

Figure 26

9. Select Keyframe 1. In the Storyboard Keyframe Settings area, change the *Set speed* value to **15 mph**, as shown in Figure 27.

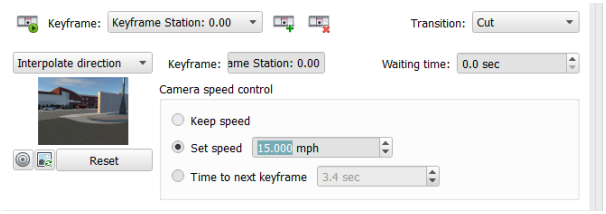

Figure 27

10. Move the Insertion Marker (red line) to the end of the keyframes.
11. In the Storyboard palette, expand the Camera Animations drop-down list and click (Add Pan and Zoom Animation).
12. Ensure that the last keyframe is selected. In the keyframe settings, do the following, as shown in Figure 28
    - For *Duration*, click the up-arrow several times to set it to **10**.
    - Select **Distance Right**, type **1800** for the distance measurement.
    - Select **Distance Up**, type **100** for the distance measurement.
    - Select **Percentage Zoom-out** and set it to **100%**.

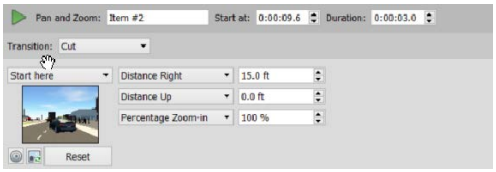

Figure 28

13. In the Storyboard palette, click (Play the current storyboard).
14. Move the Insertion Marker to the end.
15. In the Storyboard palette, expand the Camera Animations drop-down list and click (Add Crane Animation).
16. In the keyframe settings do the following, as shown in Figure 29.
    - In the *Distance Up* field, enter **50**.
    - In the *Distance Back field*, enter **50** again.
    - Clear the **Lock camera on center-of-interest option**.

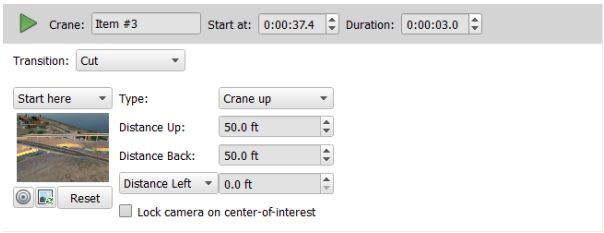

Figure 29

1. Move the Insertion Marker to the end.
2. In the Storyboard palette, expand the Camera Animations drop-down list and click (Add Orbit Animation).

3. In the keyframe settings, do the following, as shown in Figure 30.
    - Select **Angle right** and type **90**, and in the **Angle down** and type **30**.

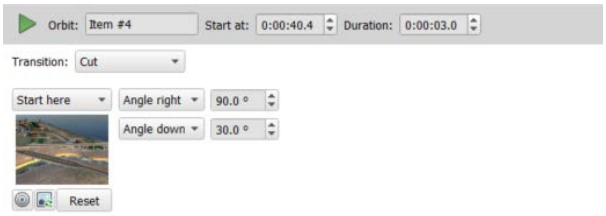

Figure 30

4. In the Storyboard palette, click (Play the current storyboard).

Bonus Material

Exporting .IMX Files

When exporting an .IMX file to be used in the AutoCAD Civil 3D software, you can export the entire Autodesk InfraWorks model or a portion of the model. When you export an .IMX file, everything becomes part of the .IMX, including the existing conditions of features that were imported from other data sources. To reduce the file size and duplication of model elements in the AutoCAD Civil 3D software, it is recommended that you only export a portion of the model by using a bounding box or polyline. In addition to setting how much of the model to include in the .IMX file, you can also set the target coordinate system.

Importing .IMX Files

When importing .IMX files into an Autodesk InfraWorks model, you use the process that would be used to import any other data source. Importing files does not create a link to the file. Therefore, it is recommended that you create a new proposal before importing an .IMX file to ensure that you have a base model to revert to if anything changes. If the detailed design changes in the AutoCAD Civil 3D software, you have to create and import an updated .IMX file.

Only certain AutoCAD Civil 3D elements can be imported into the Autodesk InfraWorks software. These elements include surfaces, alignments and profiles, corridor models, and pipe networks. Each element must be configured separately. When you import an .IMX file with multiple objects, you must select which type of data to include. The Choose Data Sources dialog box enables you to select the data to import, as shown in Figure 31.

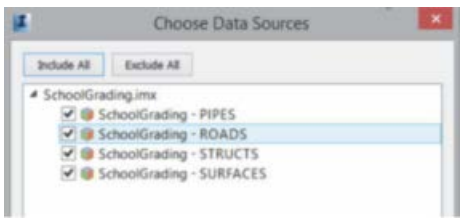

Figure 31

Once imported, each data type becomes its own data source in the Data Sources palette. Before they display in the model, the data source must be configured. The list below describes how each data source is handled and configured in the Autodesk InfraWorks software.

- **Surfaces:** Both existing ground and finish ground surfaces can be imported, becoming terrain surfaces. If a grid surface is imported, it is converted into a TIN surface. Only one surface can be displayed in the model at a time, so you must select which surface to import in the IMX tab, in the Data Source Configuration dialog box, as shown in Figure 32.

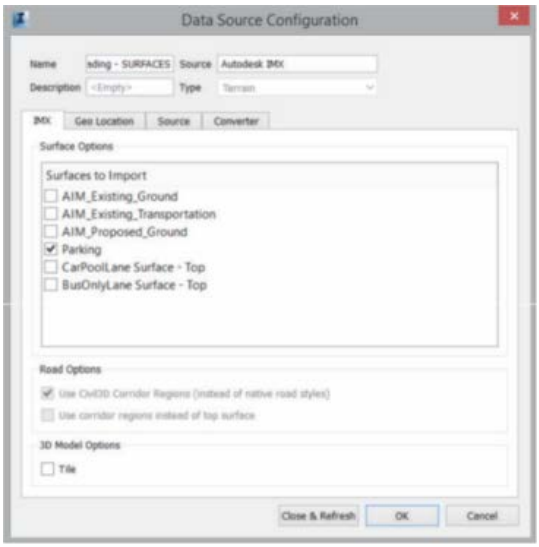

Figure 32

- **Alignments and Profiles:** Alignments and profiles are combined into one road feature. They are assigned a road style in the Data Source Configuration dialog box in the Common tab, in the Style area. Any alignments and profiles that are used to create a corridor model are imported separately. For any alignments that are not associated with a corridor model, you can set the style in the Common tab, in the Data Source Configuration dialog box, as shown in Figure 33.

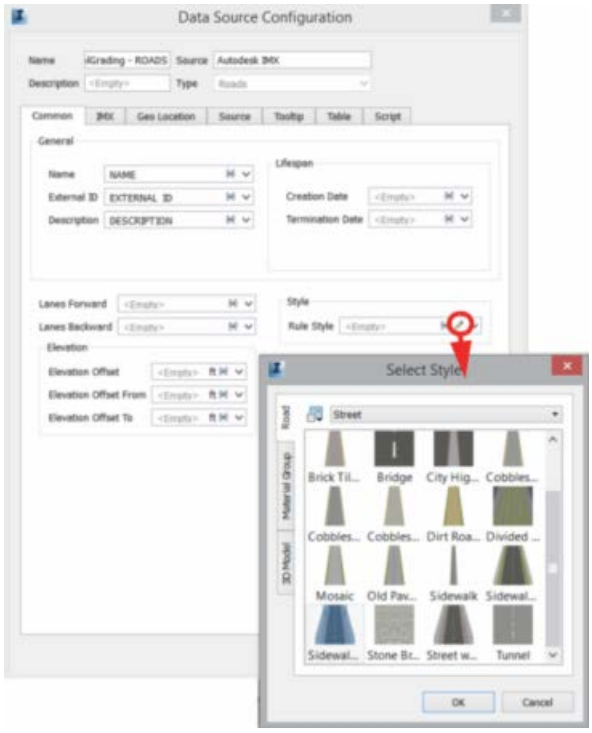

Figure 33

- **Corridors:** Alignments and profiles that have been assigned to a corridor model in the AutoCAD Civil 3D software can be imported into the model in a few different ways. You can use an Autodesk InfraWorks road style, or you can use the AutoCAD Civil 3D corridor surface or regions to display the road design. If the Autodesk InfraWorks styles are used to display the corridor model, only one centerline alignment associated with the corridor is used to stylize the road. All of the other alignments associated with the corridor are ignored. When using the corridor surface or regions to stylize the road, two options are available in the IMX tab in the Data Source Configuration Dialog Box, as shown in Figure 34.

Figure 34

The two Road Options are described as follows:

- Use Civil 3D Corridor Regions (instead of native road styles): If the corridor surface is used to stylize the road, the surface becomes a coverage area rather than a road feature. In Figure 35, the road on the left uses the native road styles and on the right it shows the same road using the Civil3D Corridor Regions setting.

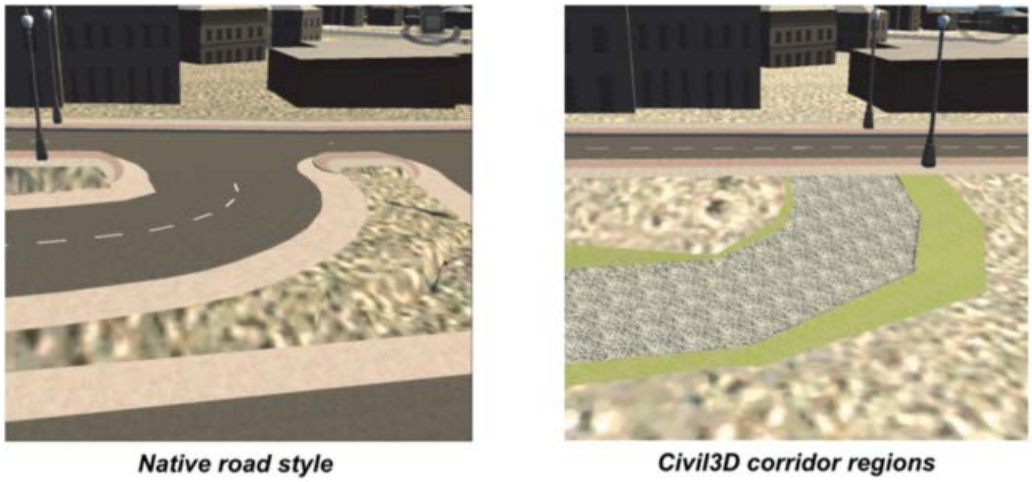

Figure 35

- Use corridor regions instead of top surface: This option creates a more detailed display of the road surface. The detail is sharp enough to display curbs, medians and other raised or lowered areas more clearly. Figure 36 shows the road that is shown on the right in Figure 35, but with both Road Options selected.

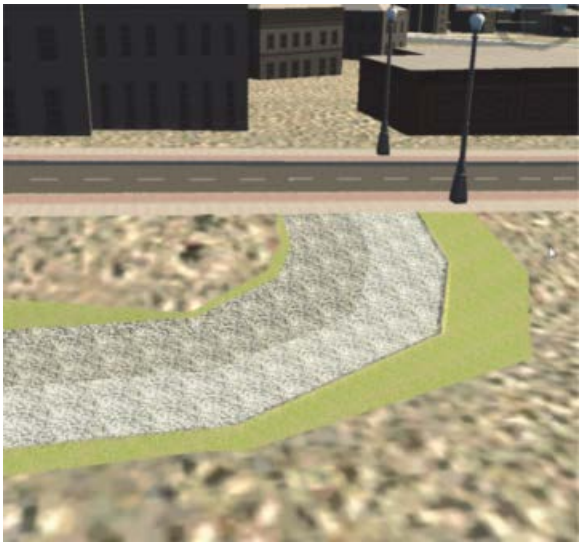

Figure 36

You can take advantage of both corridor regions and native road styles. By configuring the road twice, you can create a more realistic display. For the first time, use the corridor surface and regions. Then, configure it a second time to use a native road style. This causes the road can display the cut/fill slopes from the AutoCAD Civil 3D corridor model, and display the pavement markings and other details that display when using a native road style, as shown in Figure 37.

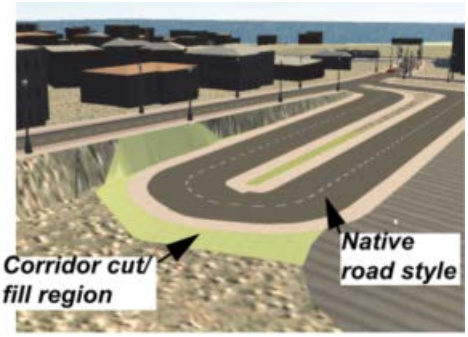

Figure 37

- **Pipe Networks:** Pipes from the AutoCAD Civil 3D software become Pipes in the Autodesk InfraWorks software, while structures become Pipe Connectors. Pipes and Pipe Connectors display separately when a pipe network is imported from the AutoCAD Civil 3D software, as shown in Figure 38. When configuring the pipe networks, set the style in the Common tab, in the Data Configuration dialog box.

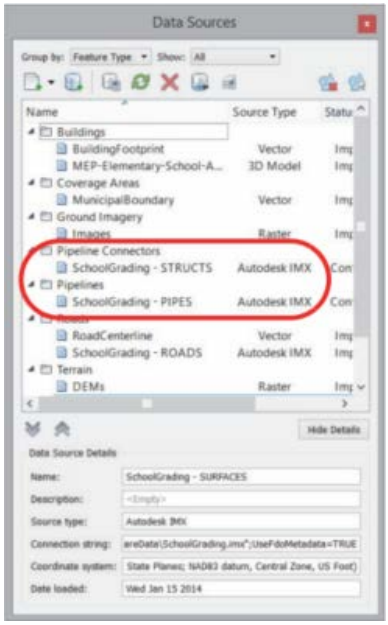

Figure 38

Exercise: Import an .IMX file

1. In the In Canvas Tools, click (Build, manage, and analyze your industry model)> (Create and manage your model)> (Data Sources).
2. In the Data Sources palette, expand (Add file data source) and select **Autodesk IMX**.
3. In the Select Files dialog box, browse to the location of the file, select it, and click **Open**.
4. In the Choose Data Source dialog box (shown in Figure 39) select the AutoCAD Civil 3D objects that you want to import. Click **OK**.

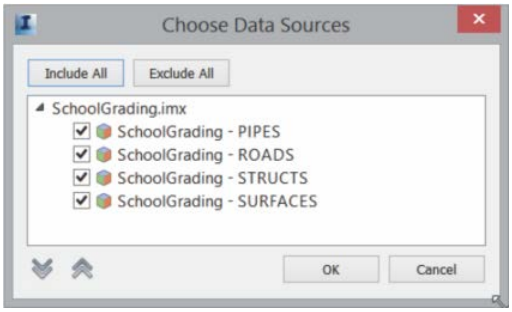

Figure 39

5. In the Data Sources palette, double-click on the .IMX files to configure them.
6. If it is a surface or corridor model, in the *IMX* tab, in the Data Source Configuration dialog box, select the required settings.
7. Click **Close & Refresh** to display the imported data in the model.

Exercise: Create an .IMX file in InfraWorks

1. Continue working in the same model as the last exercise.
2. In the In Canvas Tools, click  (Settings and Utilities)>  (Export IMX).
3. In the Export to IMX dialog box, set the model extents in the Defining Interactively drop-down list by selecting **BBox** or **Polygon** (as shown in Figure 40), or by selecting the **Use Entire Model** option.

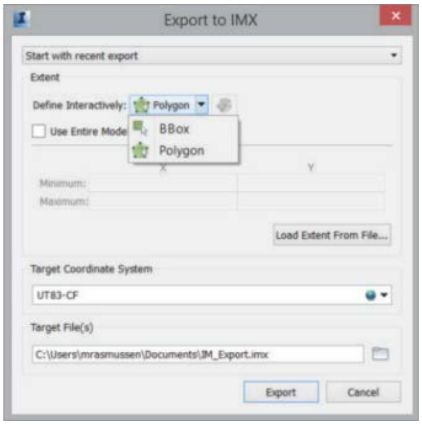

Figure 40

4. In the Export to IMX dialog box, set the target coordinate system and the target's directory and filename.
5. Click **Export**.

Exercise: Create an .IMX file in AutoCAD Civil 3D

1. Open the Civil 3D drawing file.
2. Save the drawing file (even if you just opened it, it requires a save just before exporting.)
3. On the Output tab>Export panel, click  (Export IMX).
4. In the Command Line, select the IMX version required [2.1 or 2.0].