



InfoWorks ICM and Civil3D

A Flood Modelers guide to Project Impacts

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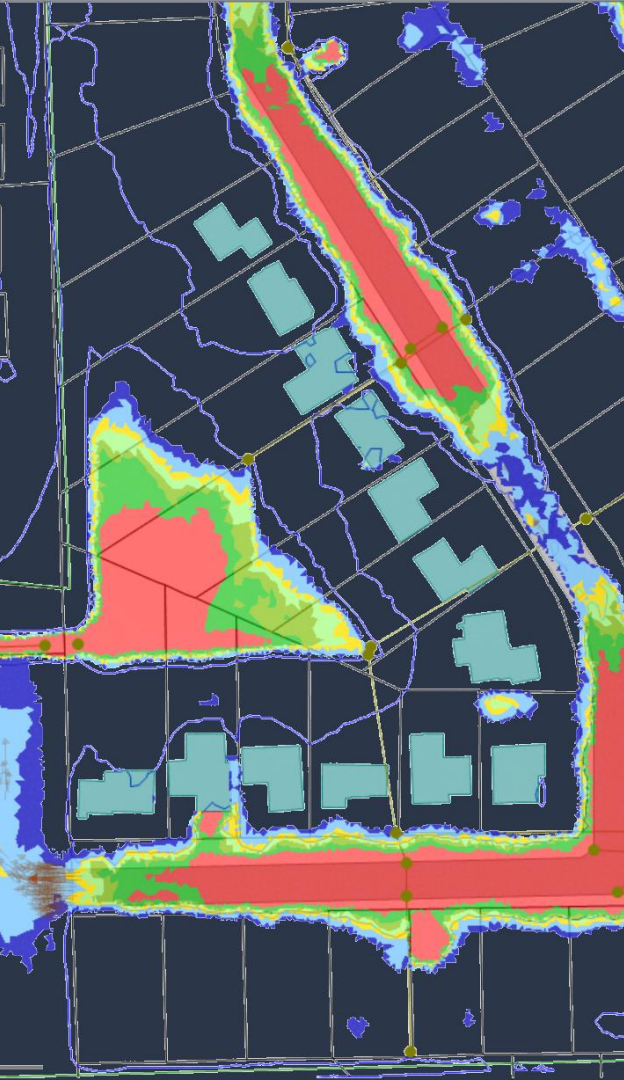
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Course Content

A Flood Modelers guide to Project Impacts

InfoWorks ICM assists engineers and designers in understanding projects impacts on the environment. Extreme events continue to stress local and regional civil infrastructure, and our tools and techniques must change as we design projects in our communities. **InfoWorks ICM** enables team collaboration and empowers engineers to reach beyond single purpose tools to evaluate various options against a multitude of rainfall events within the context of the entire watershed. This technical instruction class will provide users through a number of considerations to preserve **AutoCAD® Civil 3D** designs in evaluation of possible flood damages across the wide range of flood scenarios.



Learning Objectives

1

Data Exchange

AutoCAD® Civil 3D between InfoWorks® ICM models

2

Scenarios

Single network – Many simulations

3

Preserve Design Data

Document overall flood impacts

4

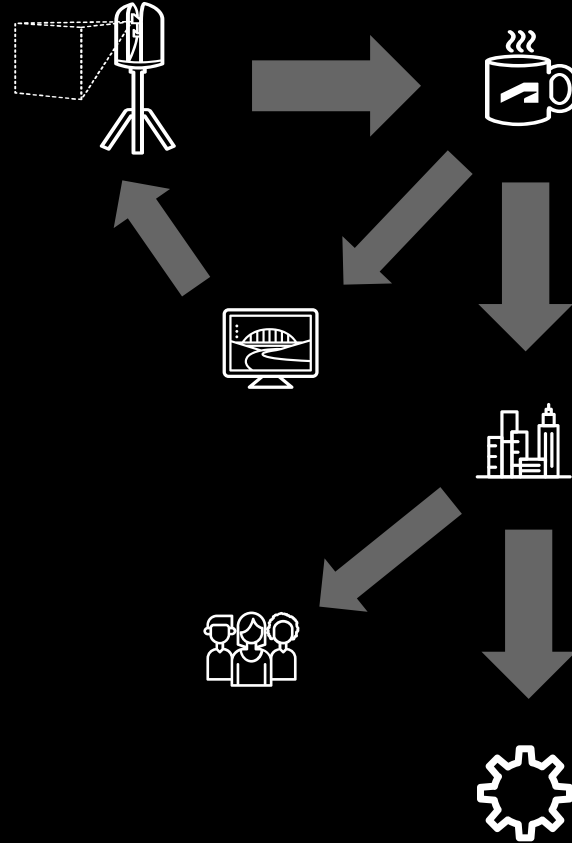
Collaboration

Collaborate with Workgroup Data Server

com•mu•ni•ca•tion

/kəˌmyoʊnəˈkāSH(ə)n/

process by which information is exchanged
(Merriam-Webster)



AutoCAD[©] Civil 3D
data
InfoWorks[©] ICM models

Data Exchange



Design



Civil 3D

- Terrain Surfaces
- Pipe Networks
- Lines/Points/Polylines
- Rivers/Sections

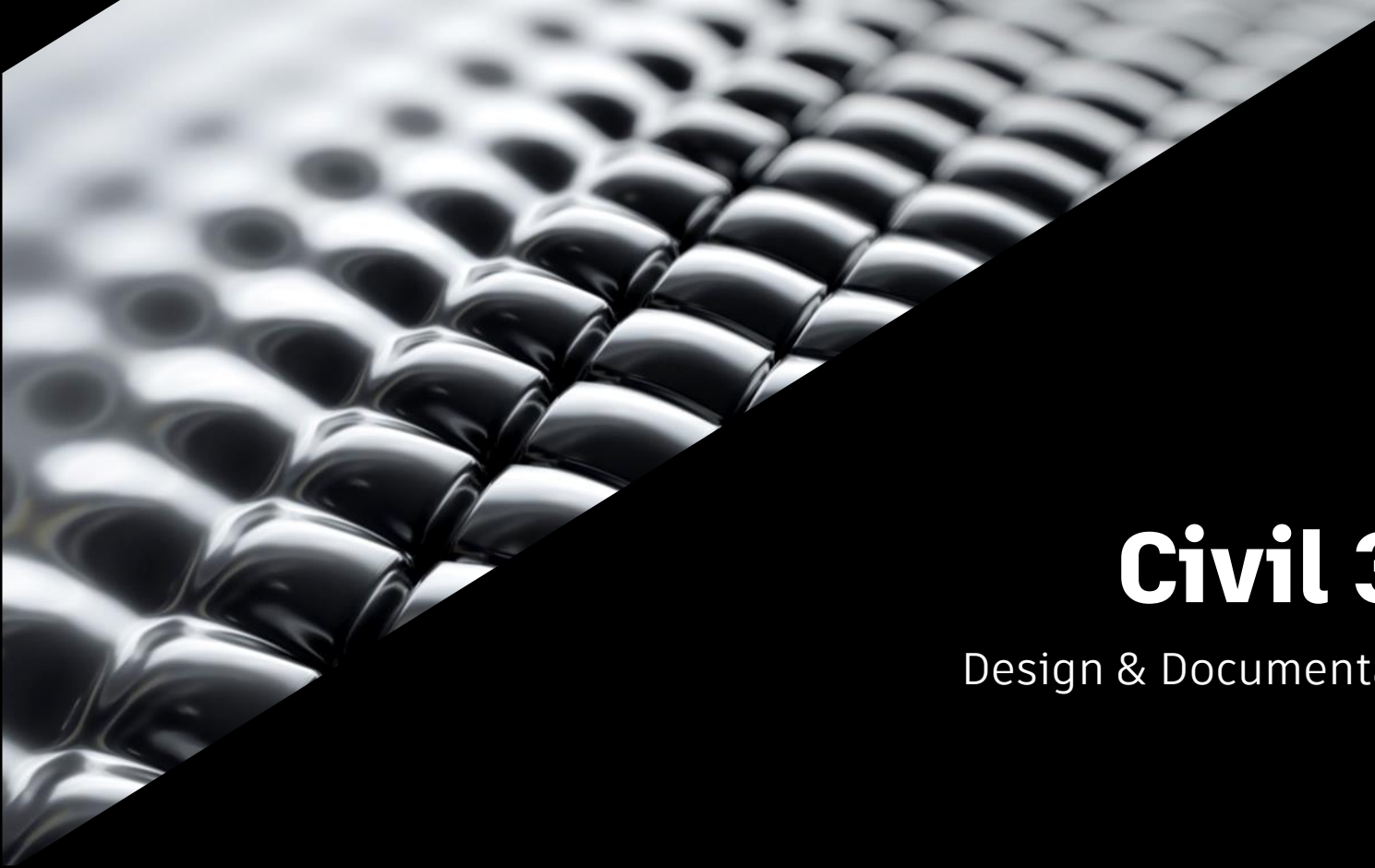


Outcome



InfoWorks ICM

- **Model Inputs**
 - Ground Models
 - 1D Pipe Networks
 - River 1D Networks
 - 2D Mesh Models
- **Model Results**



Civil 3D

Design & Documentation



Civil 3D

Key Questions to ask

Source of
Surface
Data

- Terrestrial
- LiDAR or GIS

Scope of
surface
changes

- ☐ Single
- ☐ Multiple

TIN Surface

Avoid Grid..



A

TIN Surface

Output ► Export ► Export to LandXML

A model or reference?

- **Existing Pipe Networks**
 - Are they flat, CAD-entities – lines and labels?
 - Are they attributed Asset Inventory from GIS?
- **Civil 3D- Pipe Network**
- **Challenges – Be On the Lookout!**
 - *Multiple Barrel Pipes*
 - *Unique Geometric Shapes Pipe & Structures*
 - *Inlet Configurations*

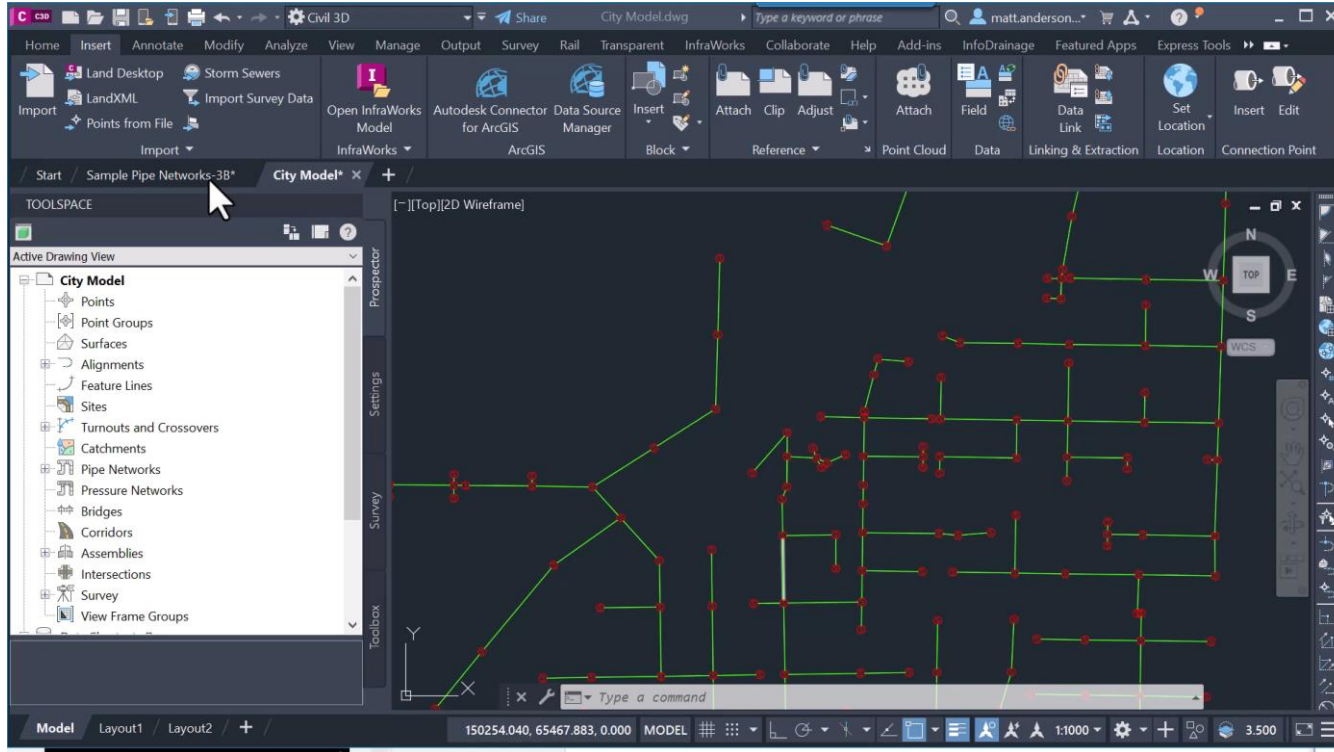
Pipe Network

Output ► Export ► Export to LandXML

Pipe Network

Prospector ► Copy to Clipboard

Pipe Networks



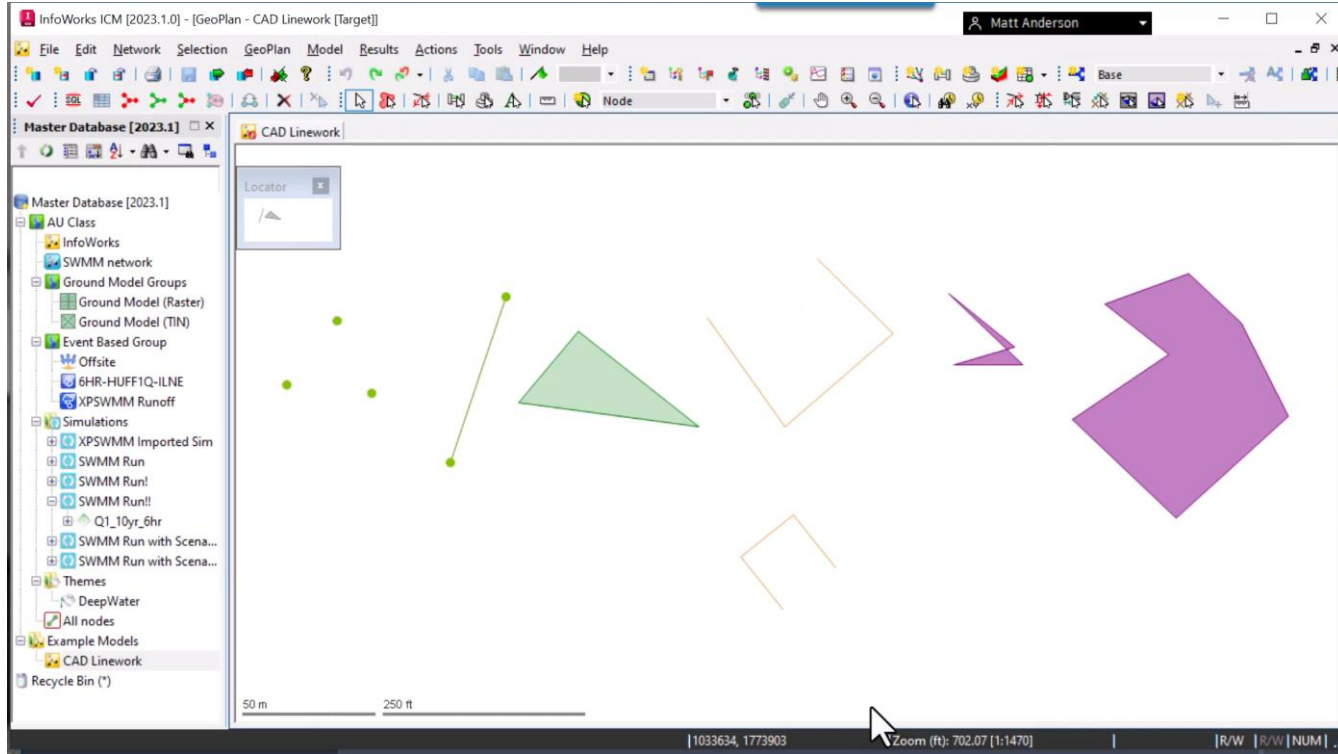
Linework

DWG Lines, Points and Polylines

- AutoCAD Linework to build Hydraulic Model elements
 - Points ► Nodes (Junctions, Outfalls, Storage)
 - Lines ► Linear elements, (River section, conduit, ...)
 - Lines ► Text Elements (General Line & Import Text into)
 - Polylines ► Area elements (Zone, polygon, roughness zone)
 - 2D Polylines ► Area element (One Z elevation)
 - 3D Polylines ► Mesh element (Many Z elevation)



CAD Linework

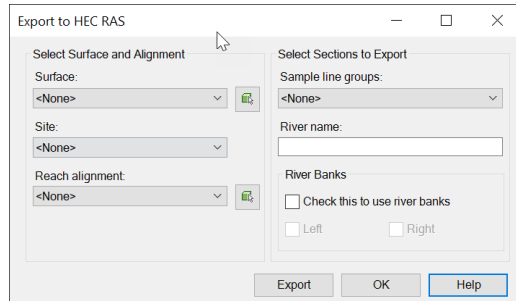


Rivers



2-steps to convert

- Surface (cut cross-sections)
- Alignment
- Sample Line Groups (use polylines)
- Bank Lines (optional)



- Open HEC-RAS v5 ► Import GIS data

Flooding

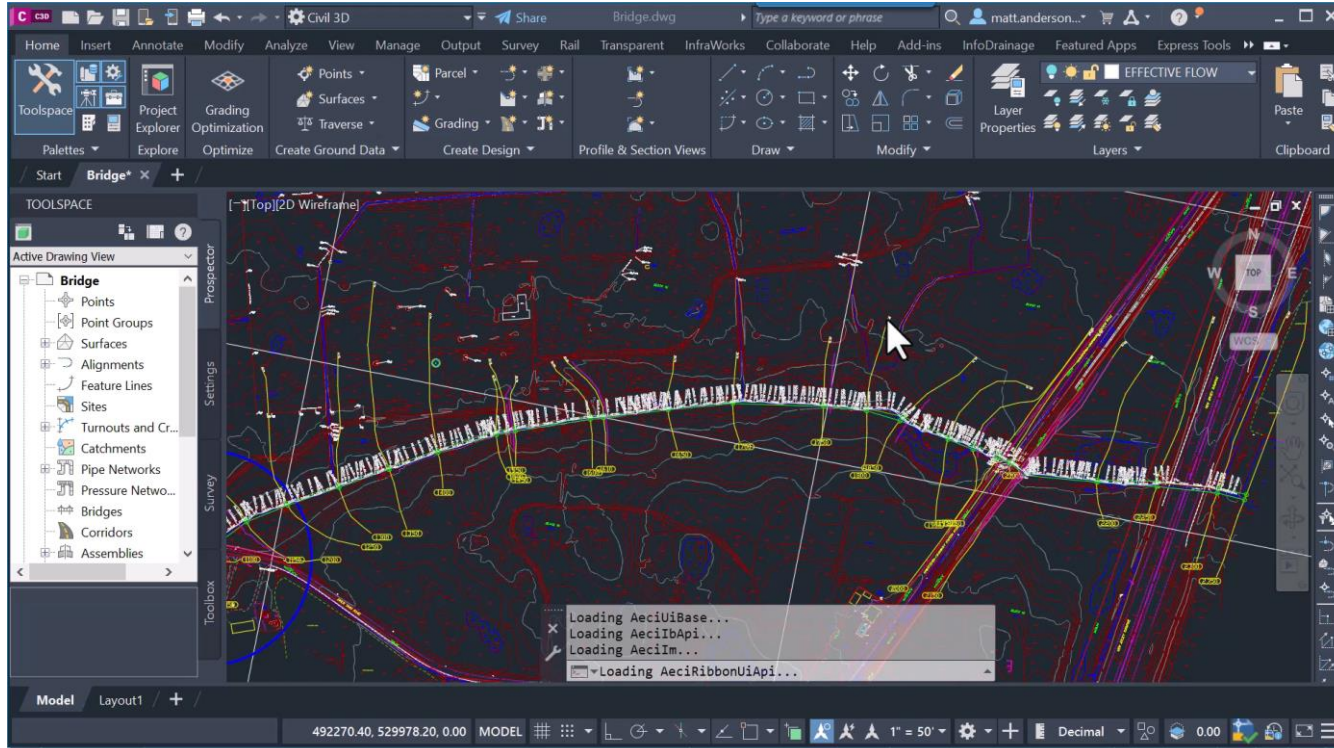
Requires HEC-RAS for conversion

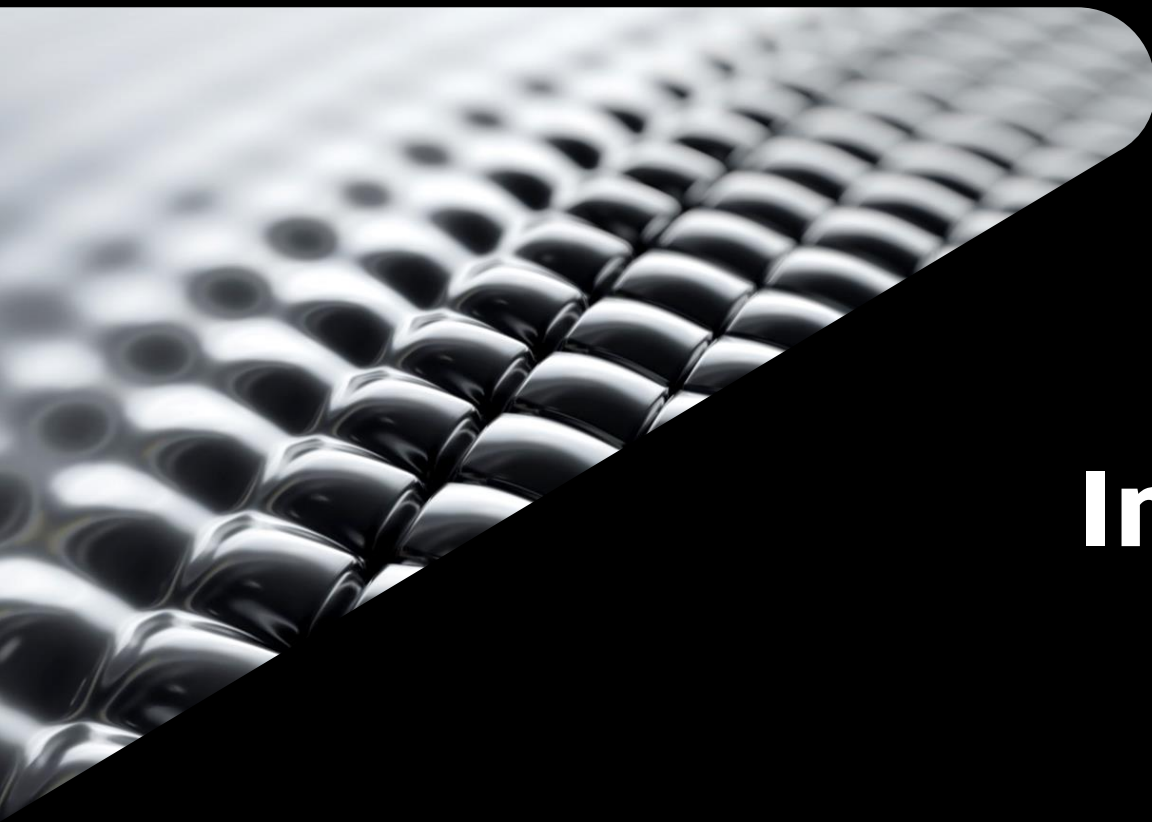


Export Rivers

Output ► Export ► Export to HEC RAS

Export to HEC-RAS





InfoWorks ICM

Import / Export Key Elements

Ground Models

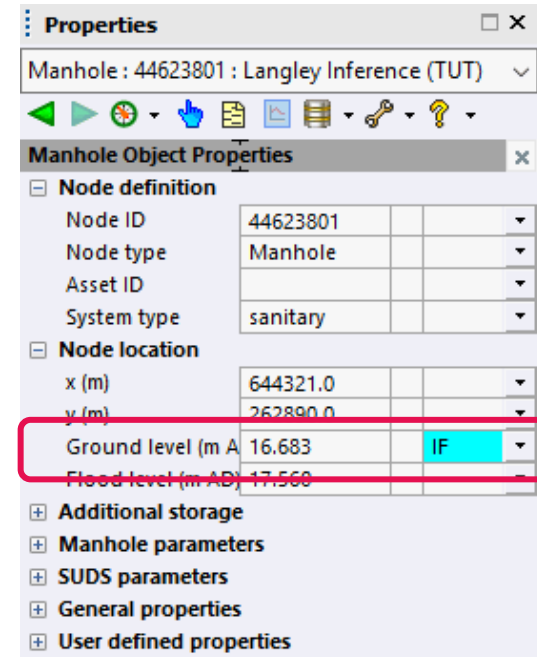
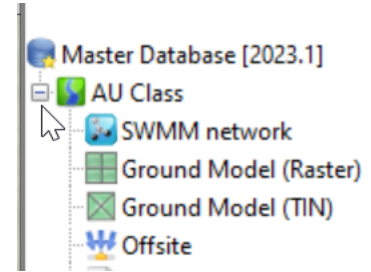
Surfaces from Civil 3D

1. Source Data

- LiDAR / Remote Sensing / GIS
- Terrestrial Survey
 - Point, Survey Database

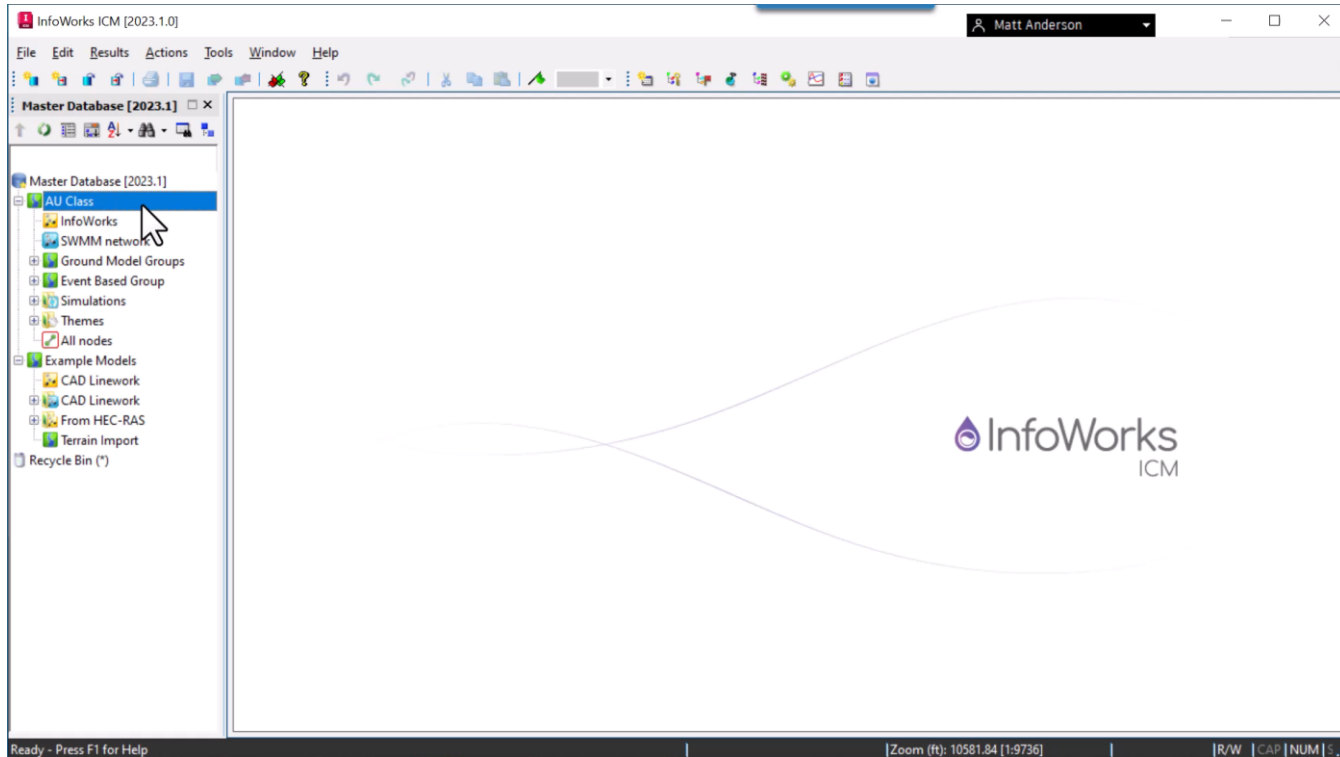


InfoWorks ICM



Ground Models

From GIS or From TIN



Network types



InfoWorks ICM

Properties
Conduit: MH18.1 : InfoWorks

Manhole Object Properties

Node definition

Node ID	MH18
Node type	Manhole
Asset ID	
System type	storm

Node location

x (ft)	1033321.0
y (ft)	1772878.2
Ground level (ft AD)	619.662
Flood level (ft AD)	619.662

Additional storage

Shaft additional storage:	0.0	#D
Shaft additional storage:		
Shaft additional storage:		
Shaft additional storage:	0.0	
Chamber additional storage:	0.0	#D
Chamber additional storage:		
Chamber additional storage:		
Chamber additional storage:	0.0	

Manhole parameters

Chamber roof level (ft AD)	617.485	#D
Chamber floor level (ft AD)	614.985	
Chamber plan area (ft ²)	1.2	
Shaft plan area (ft ²)	1.2	
Flood type		
Benching method	Full Benching	#D

SUDS parameters

	1.17	#D
--	------	----

Properties
Conduit: MH18.1 : InfoWorks

Conduit Object Properties

Link definition

US node ID	MH18
DS node ID	ST19
Link suffix	1
Link type	Cond
Asset ID	S010
Sewer reference	
System type	storm
Branch ID	

Water quality settlement efficiency

US settlement efficiency	0	#D
DS settlement efficiency	0	#D

Conduit definition

Solution model	Full	#D
Minimum computation	5	#D
Critical sewer category		
Taking off reference		
Conduit material	UNKN	#D
Design group		
Site condition	ROAD	#D
Ground condition	SUBURBS	#D
Conduit type		#D

Cross section

Shape ID	CIRC	
Width (in)	30.0	
Height (in)	30.0	#D
Sediment depth (in)	0.0	#D
Number of barrels	1	

Roughness parameters

Roughness type	N	
Bottom roughness	0.014	
Top roughness	0.014	

Long section

Length (ft)	185.2	
Inflow (ft ³ /s)	0.0000	#D
Gradient (%)	0.100	
Full capacity (ft ³ /s)	12.04	
US invert level (ft AD)	614.985	
DS invert level (ft AD)	614.800	
US headloss type	FIXED	

Properties
Node: MH18 : SWMM network

Node Object Properties

Node definition

Node ID	MH18
Node type	Junction

Node location

x (ft)	1033321.0
y (ft)	1772878.2

Node properties

Invert elevation (ft AD)	614.985	
Ground level (ft AD)	619.662	
Max depth (ft)	4.677	#D
Initial water depth (ft)	0.000	
Surcharge depth (ft)	0.000	
Ponded area (ft ²)	0.000	
Treatment		
Sewershed contributing	0.000	#D
Unit hydrograph		
Flood type	2D	
Flooding discharge coeff	0.50	#D

Direct inflows

Baseline inflow (ft ³ /s)	0.00	#D
Inflow scale factor	1.000	#D
Inflow pattern		
Pollutant inflow		

DWF

Base flow (ft ³ /s)	0.00	#D
Base flow pattern 1		
Base flow pattern 2		
Base flow pattern 3		
Base flow pattern 4		

Properties
Conduit: 5010 : SWMM network

Conduit Object Properties

Conduit definition

Link ID	5010
Start node	MH18
End node	ST19
Branch ID	

Conduit properties

Length (ft)	185.230	
Shape	CIRCULAR	
Conduit height (in)	30.0000	
Number of barrels	1	
Upstream elevation (ft AD)	614.985	
Downstream elevation (ft AD)	614.800	
US headloss coefficient	0.000	#D
DS headloss coefficient	0.000	#D
Manning's N	0.014	
Low depth Manning's N	0.010	#D
Depth threshold (in)		
Initial flow (ft ³ /s)	0.00	
Maximum flow (ft ³ /s)	0.00	
Average headloss coefficient	0.000	#D
Seepage rate (in/hr)	0.0000	
Flap valve	<input type="checkbox"/>	#D
Culvert code	0	

General properties

Notes		
Hyperlinks		

User defined properties

A

InfoWorks

B

SWMM

InfoWorks Networks

Open Data Import Center

- Open Data Import Center (GIS)
 - Raw Shape File
 - CSV or Tab
 - Avoid *field ground-level cannot accept value 650.836'*
 - Other GIS formats
- Model Imports
 - Import SWMM Network
- Exchange SWMM into InfoWorks

Open Data Import Centre

Table To Import Data Into: Node

Subtable:

Data Source: Source Type: Raw Shape File

File:

Script File (optional):

Field Mapping Configuration:

Object Fields
Node ID
Node type
System type
Connection type
Asset ID
Ground level
Flood level
Chamber floor level
Chamber roof level
Chamber plan area
Shaft plan area
Flood type

Updating and Delete Options:

☒ Prompt ☐ Merge ☐ Update

☐ Overwrite ☐ Ignore ☐ Only update existing objects

☐ Delete ☐ Don't update geometry

Flag Behaviour:

☐ Import flags from data source

Otherwise, set flag on imported fields to:

Flag when Default Value is used:

Open Data Import Centre

Table To Import Data Into: Conduit

Subtable:

Data Source: Source Type: Tab Separated Data

File:

Script File (optional):

Units Behaviour: User

Field Mapping Configuration:

Object Fields	Import Fields	Default Values
US node ID		
Link suffix		
DS node ID		
Link type		
System type		
Asset ID		
Sewer reference		
Points		
Number of barrels		
Length		
Shape ID		
Width		

Updating and Delete Options:

☒ Prompt ☐ Merge ☐ Update based on asset ID

☐ Overwrite ☐ Ignore ☐ Only update existing objects

☐ Delete missing objects ☐ Don't update geometry

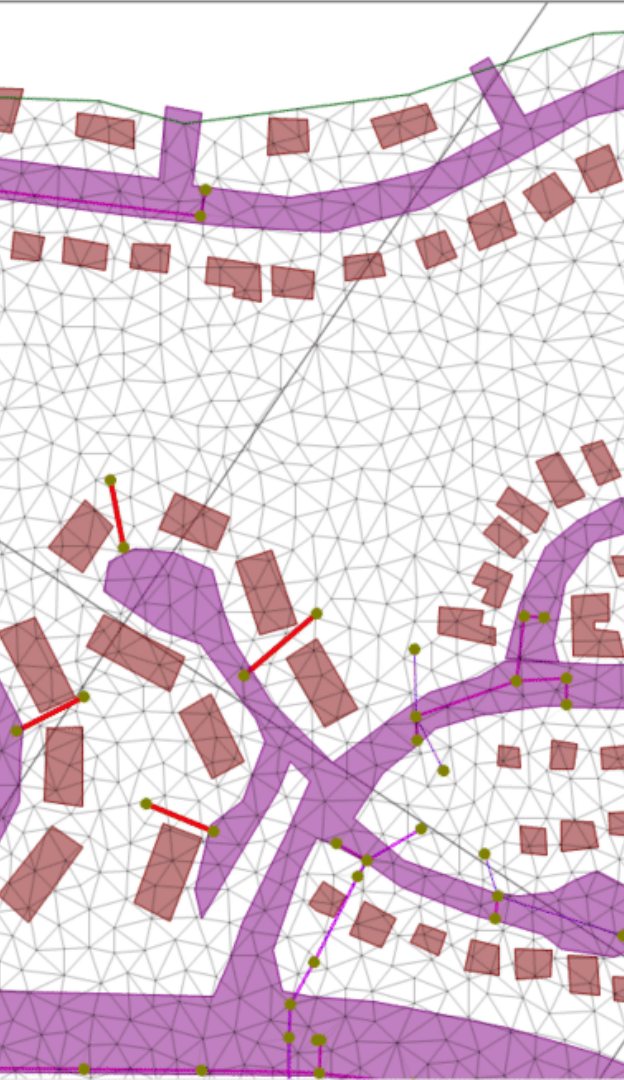
☐ Use auto-name option for generated nodes ☐ Import multi-parts

Import Close

A

SWMM Network

Import SWMM Network ► Import LandXML



SWMM Networks

Open Data Import Center

Open Data Import Centre

Table To Import Data Into
Conduit

Subtable:

Data Source
Source Type: Tab Separated Data
File:

Script File (optional)

Field Mapping Configuration:

Object Fields	Import Fields	Default
Node ID		
Node type		
x		
y		
Route to subcatchment		
Unit hydrograph		
Sewershed contributing area		
Ground level		
Invert elevation		
Max depth		
Surcharge depth		
Initial water depth		

Updating and Delete Options

☒ Prompt ☐ Merge ☐ Update based on asset ID ☐ Only update existing objects ☐ Delete missing objects ☐ Don't update geometry

☐ Overwrite ☐ Ignore

Use auto-name option for generated nodes ☐ Import multi-parts

Import Close

Open Data Import Centre

Table To Import Data Into
Conduit

Subtable:

Data Source
Source Type: Tab Separated Data
File:

Script File (optional)

Field Mapping Configuration:

Object Fields	Import Fields	Default Values
Link ID		
Start node		
End node		
Length		
Points		
Shape		
Horizontal ellipse size code		
Vertical ellipse size code		
Standard size material		
Concrete size code		
Plate 18 size code		
Plate 31 size code		

Updating and Delete Options

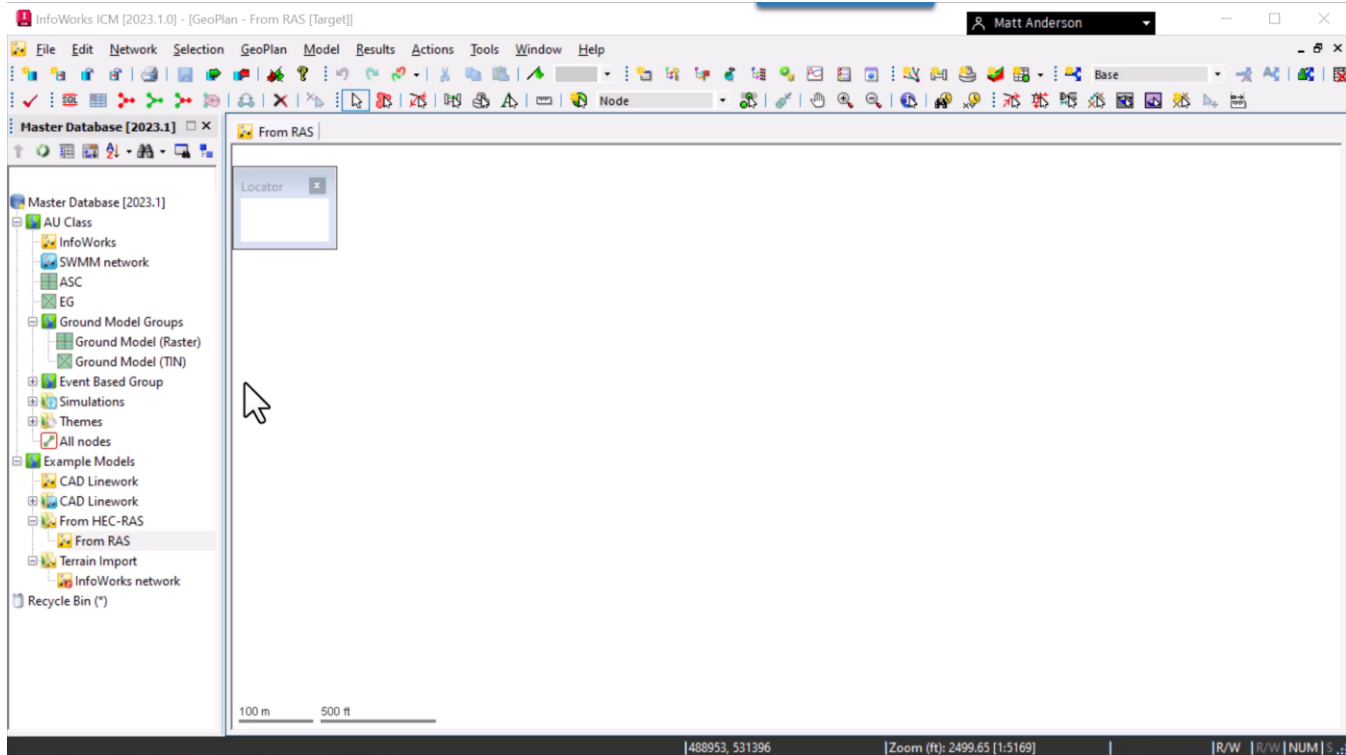
☒ Prompt ☐ Merge ☐ Update based on asset ID ☐ Only update existing objects ☐ Delete missing objects ☐ Don't update geometry

☐ Overwrite ☐ Ignore

Use auto-name option for generated nodes ☐ Import multi-parts

Import Close

Import from HEC-RAS





Scenarios & Collaboration

Start Optioneering

Collaboration

Building a modeling team

Workgroup Server

- Server Installation
- Multi-user version control system that allows concurrent editing of a network.
- User Define Flags

User Defined Flags

	Name	Display Colour	Obsolete	Description
	#A		<input type="checkbox"/>	Asset Data
	#D		<input type="checkbox"/>	System Default
	#G		<input type="checkbox"/>	Data From GeoPlan
	#I		<input type="checkbox"/>	Model Import
	#S		<input type="checkbox"/>	System Calculated
	#V		<input type="checkbox"/>	CSV Import
	AU		<input type="checkbox"/>	Autodesk University Demo
	MCA		<input type="checkbox"/>	Myself
	SOE		<input type="checkbox"/>	Someone else

Open Master Database

☒ Workgroup

Workgroup Data Server

Server name: localhost

Server port: 40000

Status: Success: SuperNumbat 20.0.32 Dec 1 2021

Master database

Group:

Database: New AU Project

☐ Standalone

Commit history - New Project

Version	Branch	Date	User	Changes	Comment
16	0	4/14/2021 11:40:21...		8	only settings changed
15	0	3/31/2021 3:50:11 ...		9	Changed weir coefficient from 2/3 t...
14	0	3/30/2021 9:36:20 ...		5	Added 1.5ft weir scenario
13	0	3/30/2021 6:11:29 ...		10	Added 1ft and 2ft weir proposed sce...
12	0	3/24/2021 3:35:38 ...		7	adjust weir coefficients and losses in...
11	0	3/24/2021 2:28:22 ...		36	Added in mesh level zones
10	0	3/24/2021 1:26:16 ...		23	Changed stored nodes to 2D or sealed
9	0	3/24/2021 12:10:09...		3	Changed 2D zone n-value to 0.025
8	0	3/24/2021 12:09:13...		2	deleted land use surface to get rid of...
7	0	3/24/2021 12:08:43...		11	corrected chamber floor level on 2D ...
6	0	3/24/2021 12:06:12...		23	Added in pond storage curves
5	0	3/23/2021 9:25:21 ...		29	Added 2D zone
4	0	3/23/2021 9:07:03 ...		16	added in ground levels from XPSW...
3	0	3/23/2021 9:03:02 ...		56	Added links and nodes based on XP...
2	0	3/23/2021 6:25:42 ...		25	Input data from XPSWMM
1	0	3/23/2021 6:05:46 ...		41	Created

Close

Show more

Show all

Details

Diff

Open

Branch...

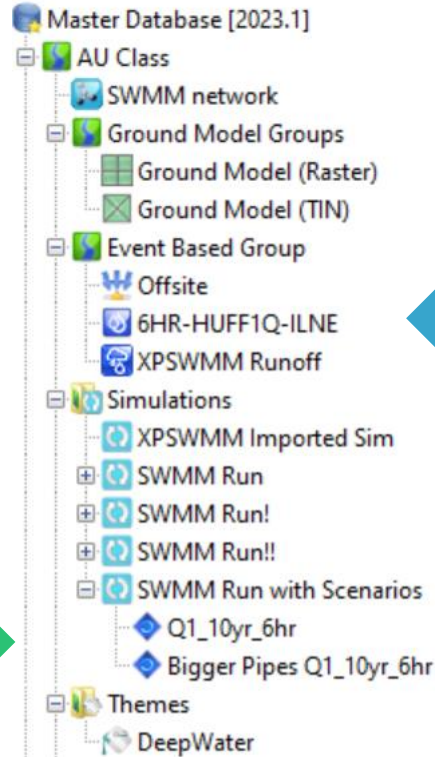
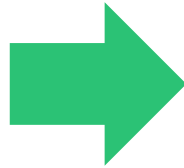
Copy...

Scenarios

Optioneering

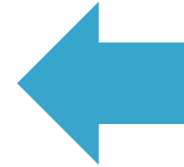
Physical Networks

- How does the system perform with changed physical attributes?
 - Option 1 – Single Pipe – Size X
 - Option 2 – Single Pipe – Size Y
 - Option 3... other options



Range of Events

- Network is separate from Event-based conditions
- Simulations and Results bring events together.



Flood Damages

Pulling results into Civil 3D

Open Data Export Center



InfoWorks ICM

Open Data Export Centre

Table To Export Data From: Node ☐ Selection Only

Time For Results: Choose Time 01/01/2014 13:45:00

Export Data To: SHP

Export Type: CSV

File: C:\Users\matthew.anderson\OneDrive - Autodesk\...

Feature Class:

Feature Dataset:

ArcSDE Keyword:

Script File (optional):

Units Behaviour: User

Field Mapping Configuration:

Export Field Name (blank for default)	Field Type	Precision	Internal Field (or other data)
	Field	Default	node_id
	Field	Default	node_type
	Field	Default	x
	Field	Default	y
	Field	Default	maximum_depth
	Field	Default	sim_max_depth
	Field	Default	flood_type

Updating and Delete Options

☒ Only Update Existing Objects

☐ Delete Missing Objects

☐ Update using changes from a previous version of the network:

☐ Append to existing data

☐ Use report mode for arrays

☐ Create primary key

Export Close

Pick both Physical Attributes to recreate network & Max results

Import GIS Data

Import GIS Data - Pipe Networks - Data Mapping: Structures

Connect to Data

Object Options

Schema and Coordinates

Data Mapping: Pipes

Data Mapping: Structures

Query Options

Clean Up

Imported structure feature class: Civil 3D structure shape

Imported structure feature class: Cylindrical

Imported structure feature class	Civil 3D structure shape
Default:Node	Cylindrical

Structure attribute assignment

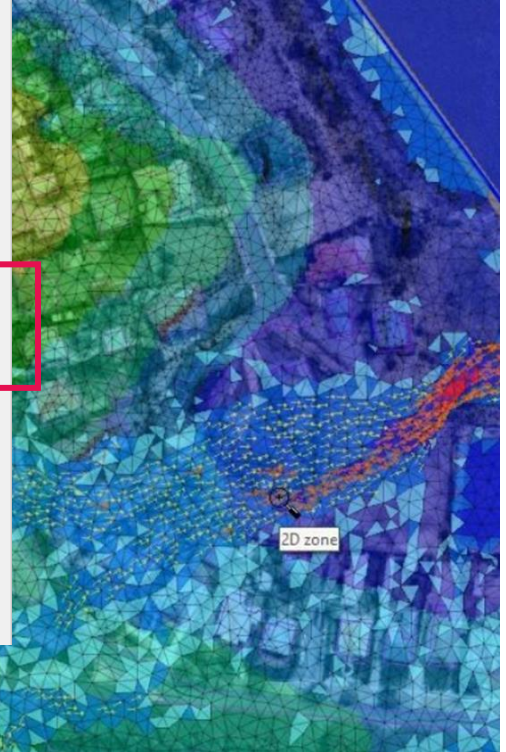
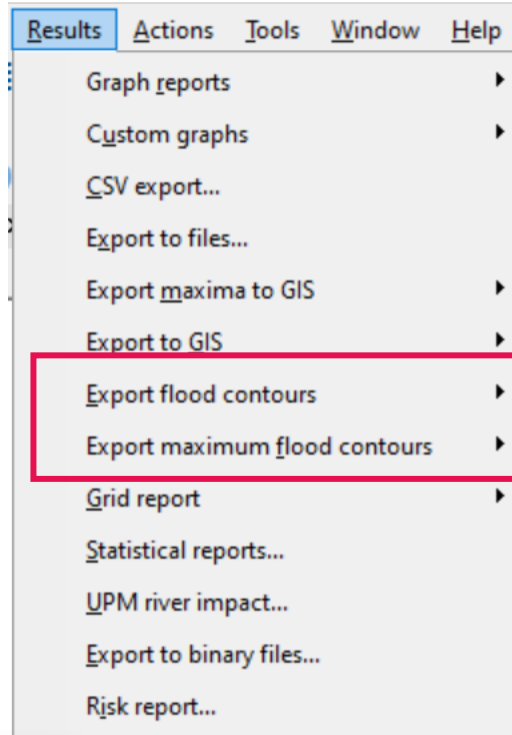
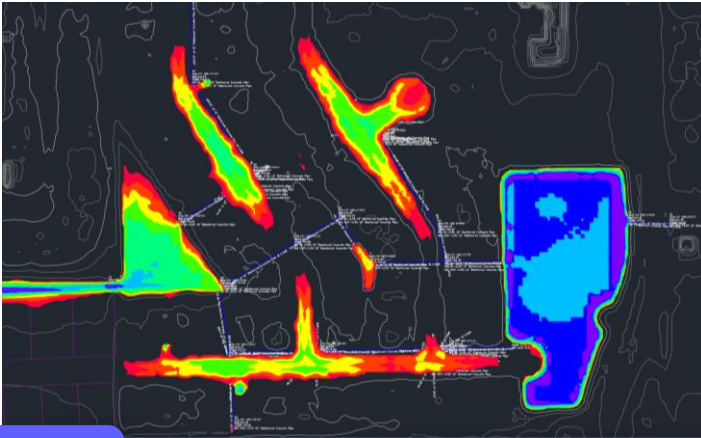
Civil 3D structure property	Imported data field	Imported data unit
Part Data		
Wall Thickness		
Floor Thickness		
Material		
Frame		
Grate		
Cover		
Frame Height		
Frame Diameter		
Frame Length		
Frame Width		

Load data mapping Save data mapping

< Back Next > Finish Cancel Help

Pushing Results Back

- InfoWorks ICM Networks
 - Themes drive values exported
 - Depths looks good – but elevation is needed.



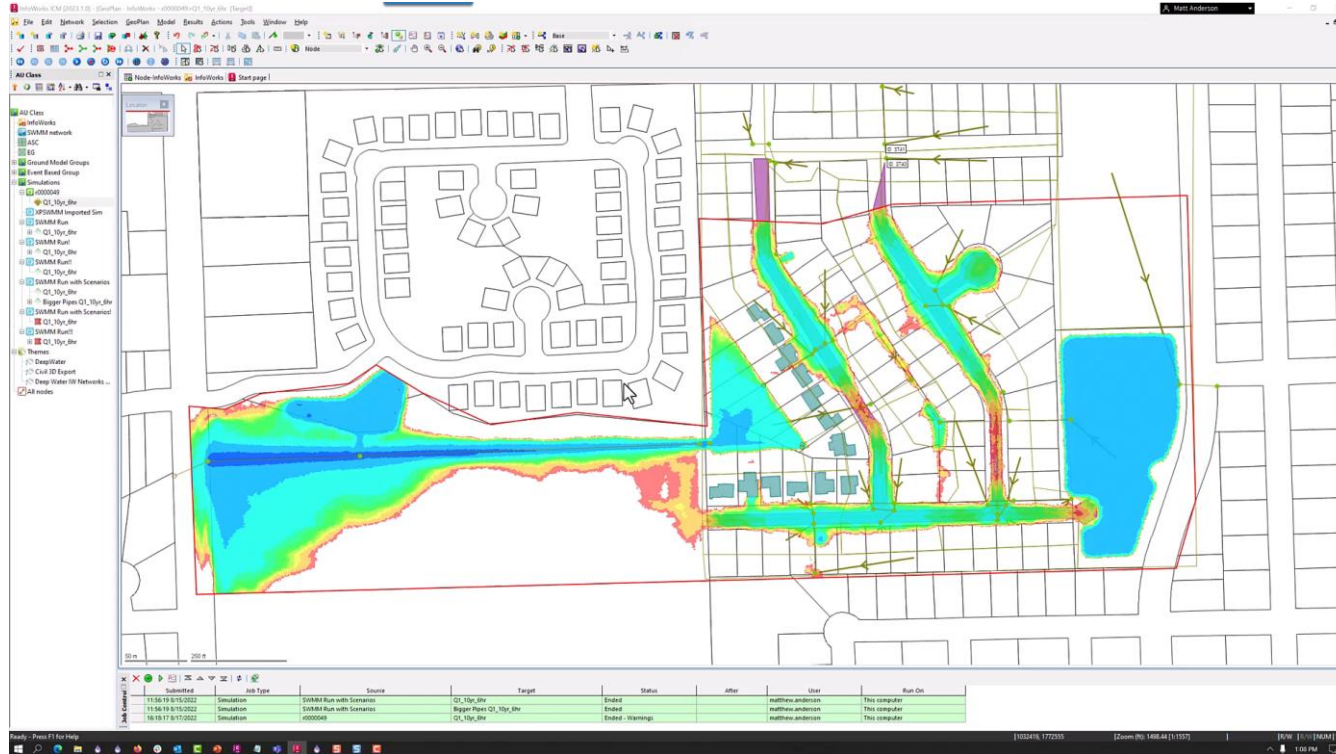
New York



Export maximum flood contours

Surface ► DEM ► Import ► from DEM

Results back to Civil 3D



Data Exchange between C3D and ICM



Know Data

Understand potential scope of data exchange across a project.

Surfaces ► Ground Models

Pipe Networks ► Networks

CAD linework ► Sections...

Results ► C3D Object

Scenarios & Branches

ICM supports groups and multiple networks in one master database – use scenarios and branches to migrate data back and forth.

Test designs fit & performance

Understand Limits

Be on the lookout for those unique situations outside of the commonalities.

- **Unique Structures**
- **Multiple Barrels**
- **Inlet Conditions**
- **Export Themes**

Engage

Let us know what problems you would like to see tackled.

feedback.innovyze.com

[Civil Infrastructure – Public Roadmap - Infrastructure Reimagined \(autodesk.com\)](#)



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